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Competence in Test and Measurement, Radiocommunications and Broadcasting

From our Principles

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

Who we are and what we do

Rohde & Schwarz is an internationally active company in the fields of radiocommunications and test and measurement. For more than 60 years the company group has been developing, producing and marketing a wide range of electronic products for the capital goods sector. The company is headquartered in Munich.

With 4400 employees worldwide and subsidiaries and representatives in over 70 countries around the world, the Rohde & Schwarz group achieves an annual turnover of approx. 1.3 billion DM. The company is highly export-oriented: almost 70% of the total turnover is achieved outside Germany. Due to the comprehensive know-how and the innovative strength of its employees, Rohde & Schwarz is among the technological leaders in all of its business fields.

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

- Test and measurement
- Radiocommunications systems
- Broadcasting, paging, broadband communications
- Radiomonitoring and radiolocation
- IT security
- Services

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

Our Business Fields and Products

Test and Measurement

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

- Mobile radio measurements
- EMC measurements
- General-purpose and RF measurements
- Automatic test systems

Radiocommunications Systems

Rohde & Schwarz is one of the leading international suppliers of professional HF, VHF and UHF radio systems for use in stationary and mobile ground stations, on ships and in airplanes. Embassies, authorities and armed forces worldwide use our radio equipment for voice, data and picture transmission.

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

- ATC systems
- Global communication systems
- Avionics
- Naval communications
- Trunked radio systems

Broadcasting, Paging, Broadband Communications

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

In the complex field of paging systems we offer ultramodern solutions including full-coverage installations – based on international standards such as ERMES, POCSAG or FLEX™.

- Sound and TV broadcast transmitters
- Broadband transmission systems
- Measurement and monitoring systems
- Video and broadcast measurements
- Paging systems

Radiomonitoring and Radiolocation

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

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

We are leading in the design and implementation of full-coverage automatic radiomonitoring and frequency management systems. Many years of experience and ultramodern technology are the sound basis of our

- Receivers
- Direction finders
- Signal analyzers
- Antennas

IT Security

SIT Gesellschaft für Systeme der Informationstechnik mbH provides solutions for security in information technology. Key activities are consulting and IT security analyses for industry and authorities as well as the development of crypto products and systems for the protection of information in modern data processing and communication systems.

- Hardware and software crypto products
- Development of customer-specific crypto systems
- Consulting and IT security analyses

Services

Rohde & Schwarz maintains at its Cologne Plant one of Europe's largest service centers for T&M and communications equipment.

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

- Calibration, service and maintenance
- Planning, development, system integration
- Seminars and training courses
- Development of customer-specific systems
- Technical documentation and logistics
- Electronic information systems, multimedia applications

Headquarters Munich (1993) (photo 40802-2)

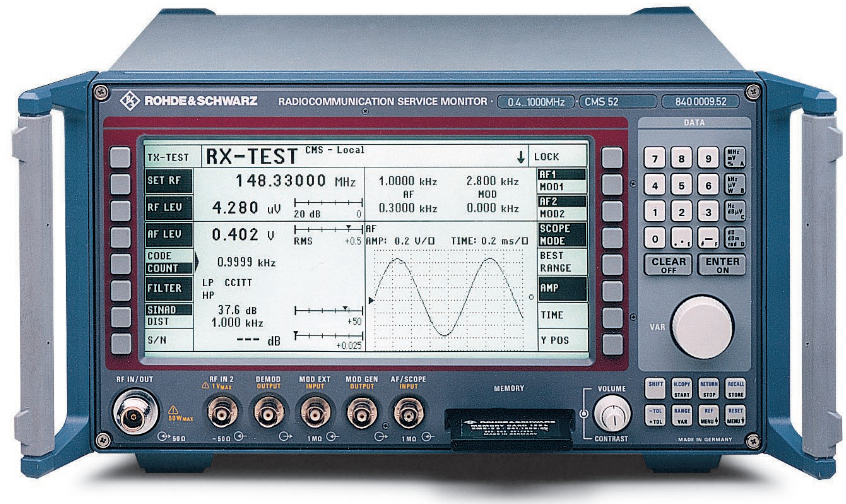
Digital Radio Tester CTS is an extremely compact, modular yet powerful measuring instrument. For testing mobile phones, CTS simulates a GSM900, GSM1800 or GSM1900 base station. (photo 43 115)

Contents of Chapter 1

Radiocommunication Service Monitors of CMS Family

0.4 MHz to 1000 MHz

Radio testers for service, production and development



CMS52 (photo 40077)

Brief description

The family of Radiocommunication Service Monitors CMS comprises four models. These radio testers allow transmitter, receiver and duplex measurements to be performed on mobile radios, base stations or RF modules. The CMS family monitors are ideal radio testers for service, maintenance and test departments.

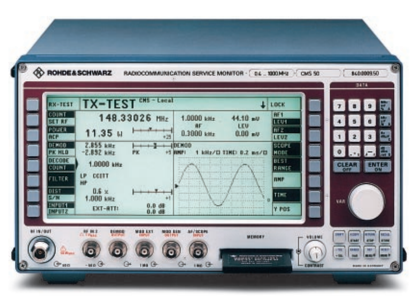
CMS – a test set replacing many individual measuring instruments
Due to the comprehensive standard configuration of the individual models and the optional extensions tailored to specific applications, external measuring instruments in addition to the CMS are not required.

Main features

- AM, FM or φM and SSB
- Analog and digital signalling
- Large, high-contrast LCD
- Operation via softkeys
- Clear menu structure
- Simultaneous and easy-to-read display of settings and results
- Manual and automatic measurements
- Tracking generator
- Cable fault test
- Spectrum monitor
- Optional extensions to cover measurements in related fields
- Stationary and mobile use
- Low weight, compact size
- Extremely sensitive RF frequency counter
- Transient recorder for
  – frequency versus time
  – power versus time

Overview of models

CMS50 – the budget-priced model for service applications
- Transmitter and receiver testing
- Spectrum monitor
- Fully automatic testing
- SSB test
- ERMES coder



CMS50 (photo 40081)

CMS52 – the allround model for service, production, development
- Enhanced capabilities of CMS50 (see specifications in brief)

Basic model additionally with:
- RF spectrum monitor with zero-span to full-span display

CMS54 – the high-end tester for demanding requirements (see page 10)
- Radio measurements and optional extensions same as CMS52

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

CMS57 – the specialist for avionics (see page 12)
- Radio measurements and optional extensions same as CMS52

Basic model additionally with:
- VOR/ILS signal generator

Radiocommunication Service Monitors of CMS Family

Overview of configurations (model-dependent or optional)

Signal sources

- RF synthesizer from 0.4 to 1000 MHz, resolution 10 Hz, with AM, FM, φM and multitone modulation capabilities
- Two independent modulation generators, from 20 Hz to 30 kHz each, resolution 0.1 Hz
- Selective-call encoder to all standards (also user-programmable)
- CDCSS coder
- ERMES coder
- DTMF coder
- 10 MHz reference frequency input/output
- VOR/ILS signal generator
- Signalling units for all main radio networks

Measuring facilities

- RF frequency counter, RF frequency-offset counter
- Power meter from 5 mW to 100 W
- Selective RF power meter down to –100 dBm
- RF spectrum monitor with wide dynamic range and filters which also allow modulation analysis (AM, FM, SSB)
- Tracking generator in frequency range from 400 kHz to 1000 MHz
- Adjacent-channel power meter with standard ETSI filters
- Modulation meter for AM, FM and φM; weighting: +PK, –PK, PK HOLD, ±PK/2, RMS, RMS √2
- Duplex modulation meter for duplex spacings of any size
- AF voltmeter with peak and true RMS weighting
- SINAD meter with variable test frequency
- S/N meter
- Distortion meter with variable test frequency
- AF frequency counter with period and gate-time counting
- Selective-call decoder for all standards (also user-programmable)
- DTMF decoder
- CDCSS decoder
- Oscilloscope
- DC ammeter/voltmeter
- Transient recorder for analysis of power and frequency transients
- Cable fault test

Filters

- CCITT or C-message filters for weighting to relevant standards
- Continuously tunable bandpass filter from 50 Hz to 5 kHz with high skirt selectivity for selective modulation and AF measurement
- Continuously tunable notch filter from 100 Hz to 5 kHz for signal suppression
- Highpass and lowpass filters for band limiting and measurement of subaudio tones

Other facilities

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

Signalling

The CMS features built-in signalling units combining signalling measurements and receiver/transmitter tests on mobile stations as well as partly on base stations. The signalling units support all main radio networks including their country-specific versions:

- Selective call to all international standards
- MPT 1327/1343 (trunked radio)
- POCSAG/Cityruf/Euromessage
- ZVEI digital, VDEW digital
- FMS-BOS
- User-programmable FFSK modem
- ERMES pager test
- ATIS coder/decoder (Rheinfunk)

The following signalling routines are available for cellular networks:

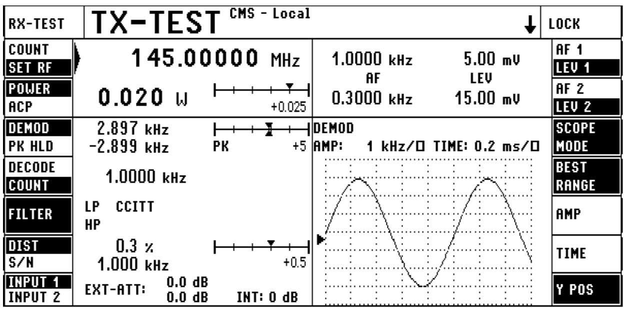
- C Net
- NMT 450 (SIS), NMT 450 I
- NMT 900 (SIS)
- AMPS, E-AMPS, N-AMPS
- TACS, E-TACS, N-TACS, TACS II
- Radiocom 2000
- NMT base station test

No external equipment is required for testing. All signalling routines are permanently available (no loading or reloading of software is required).

Trunked radio as an example

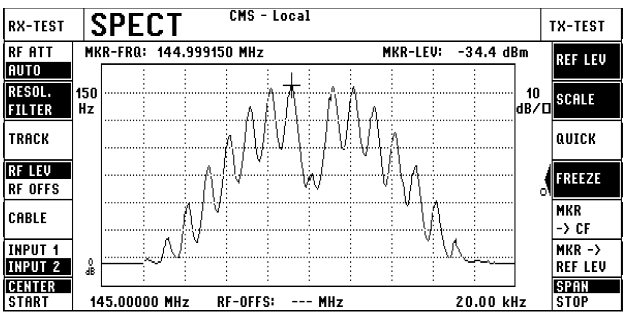
Trunked radio to MPT1327/MPT1343 is an intelligent analog radio system which uses digital signalling to organize a few physical channels for a large number of mobile subscribers and additionally allows user-specific applications. The extremely flexible CMS design fully supports the high versatility of the trunked radio system.

Radiocommunication Service Monitors of CMS Family



CMS user prompting – all settings and test parameters at a glance

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



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

- Additional inputs and outputs allow independent and versatile use of signal sources and test facilities

Automatic tests

Automatic test routines are indispensable for high throughput and reproducible results in service and production: in the learn mode, the Radiocommunication Service Monitor CMS stores all manual settings and measurements and produces from them ready-to-start automatic test routines. The user need not have any programming knowledge or learn equipment-specific command sets.

Tolerances, comments and conditions (loops, jumps, queries and control commands) can additionally be inserted into the test routines. Programs can also be activated directly from the memory card. The test report format may be user-specified and can be clearly structured by transferring control characters to the printer, such as blank line, paragraph and boldface.

Operation

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

Specifications in brief (all CMS models)

Bold-faced values in brackets refer to CMS50

Timebase

Standard	
Temperature effect 0 to 35 °C	$\leq 1 \times 10^{-6}$
Aging	$\leq 2 \times 10^{-6}$/year
Options CMS-B1 and CMS-B2	
Temperature effect 0 to 50 °C	$\leq 1 \times 10^{-7}$
Aging	$\leq 2 \times 10^{-7}$/year (CMS-B2: $\leq 1 \times 10^{-7}$)

Receiver measurements

Signal generator	
Frequency range	0.4 MHz to 1000 MHz
Frequency resolution	10 Hz (**50 Hz**)
Level	
FM, φM, CW	–134 dBm to 0 dBm
AM	–134 dBm to –3 dBm
Level resolution	0.1 dB
Accuracy	±2 dB
Harmonics	≤–25 dBc (≤**–20 dBc**)
Nonharmonics	≤–50 dBc
Phase noise	≤–110 dBc (20 kHz from carrier, referred to 1 Hz test bandwidth)
Modulation	
Frequency range	0.4 to 1000 MHz (2 to 500 MHz)
AM depth	0 to 99%
Mod. frequency range	DC to 20 kHz

Radiocommunication Service Monitors of CMS Family

FM deviation	0 to 100 kHz **(50 Hz to 50 kHz)**
Resolution	1 Hz
Mod. frequency range	20 Hz to 20 kHz
Mod. distortion	≤1%
φM deviation(internal)/resolution	0 to 10 rad/1 mrad
Mod. frequency range	100 Hz to 6 kHz
Mod. distortion	≤1%

AF voltmeter

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

Transmitter measurements

RF power meter

Frequency range	1.5 to 1000 MHz (**2 to 1000 MHz**)
Measurement range	5 mW to 50 W (100 W optional)
Accuracy (P >20 mW, AM=0%)	0.4 dB + resolution
Selective level measurement	in frequency range 1 to 1000 MHz
Level range	–60 to +47 dBm without weighting filter, –80 to +47 dBm with 2 kHz resonance filter

RF frequency counter

Frequency range	0.5 to 1000 MHz

Frequency deviation meter

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

Phase deviation meter

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

AM depth meter

Operating modes	+PK, –PK, ±PK/2, RMS, RMS√2
Measurement range/resolution	0.01 to 99%/0.01%
AF frequency range	50 Hz to 20 kHz (**50 Hz to 10 kHz**)

RF spectrum monitor	1 to 1000 MHz
Display dynamic range	>60 dB
Span	0 (zero span) to 50 MHz
Filter (3 dB bandwidth)	150 Hz, 6/16/50/300 kHz, 1/3 MHz (coupled to span)

Tracking generator (with CMS-B59/-B9)

Frequency range	400 kHz to 1000 MHz
Reference level	–67 to –27 dBm
Display dynamic range	50 dB
Span	0 to 50 MHz (full span for CMS52, CMS54 and CMS57)
Output level	–128 to 0 dBm
Frequency offset	0 to –999 MHz (depending on span and center frequency)

Transmitter measurements at 2nd RF input

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

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

Transmitter and receiver measurements

Modulation generator I and II

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

Distortion meter

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

AF frequency counter

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

Oscilloscope

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

AF filters

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

Selective-call coder/decoder

Tone sequences	ZVEI1/ZVEI2/CCIR/EIA/EEA/EURO/NATEL/CCITT/VDEW/DTMF/VDEW direct dialling/user-defined sequences (DTMF decoding see Control Interfaces CMS-B5 and CMS-B55); CDCSS decoder and ATIS see option CMS-B27

CDCSS coder	entry of 3-digit code number of mobile radio, setting times for turn-off code and RF level drop, setting the data deviation
Audio monitor (loudspeaker)	demodulated signal, AF signal, beat (frequency offset)

General data

Power supply AC	100/120/220/240 V ±10%, 47 to 420 Hz (50 VA)
DC	11 to 32 V
Dimensions (W x H x D)	320 mm x 175 mm x 375 mm
Weight without options	13 kg
with options	15 kg

Ordering information

Radiocommunication Service Monitor	CMS50	0840.0009.50
	CMS52	0840.0009.52
	CMS54	0840.0009.54
	CMS57	0840.0009.57

Radiocommunication Service Monitor CMS54

0.4 MHz to 1000 MHz

New measurement functions for high-end testing in the field of analog mobile ratio

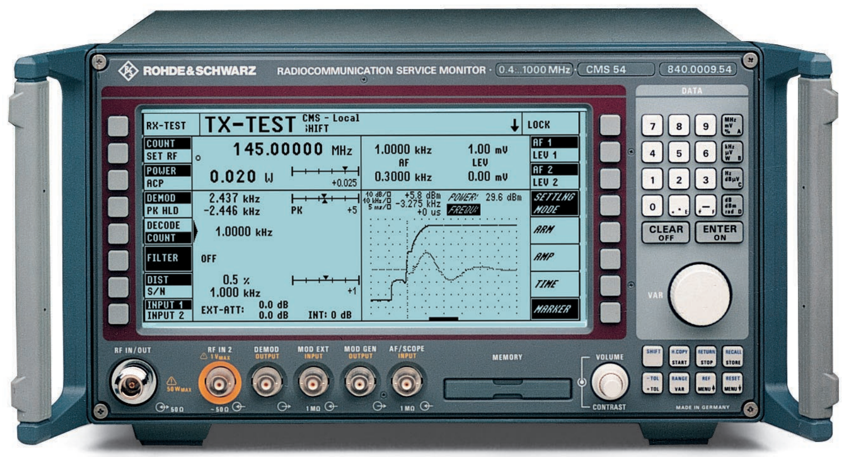


Photo 41410

Brief description

The Radiocommunication Service Monitor CMS54 can alone perform transmitter and receiver testing, measurements on antennas, diplexers, filters and frequency-converting modules as well as modulation spectrum analysis. The signalling unit supports all important mobile radio standards.

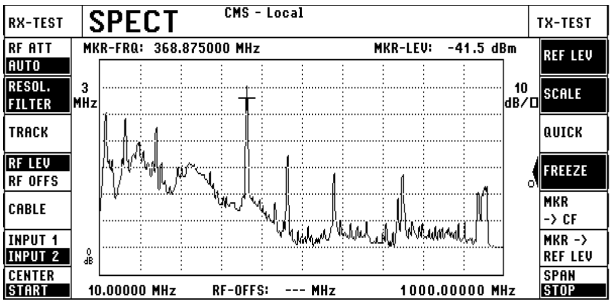
With its full-feature configuration offering enhanced measurement capabilities, this lightweight and compact tester, which is suitable for mobile and stationary use alike, satisfies all requirements of radio measurements:

- High-end service for all fields of radiocommunication
- Base-station testing and monitoring
- Development of RF modules for any application such as
  - radio remote control
  - cordless telephones
  - door-closing systems
- Production and installation of systems with high or low transmitter power, such as
  - high-power transmitters
  - radio telephones, mobile phones
- Measurement of the harmonic suppression of transmitters

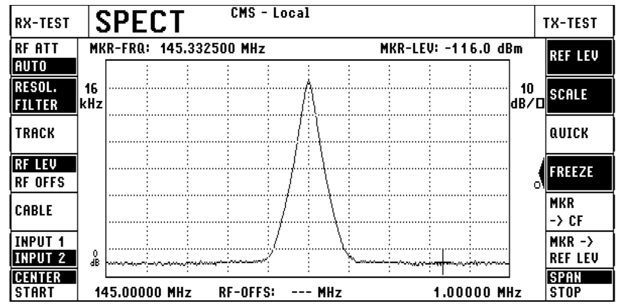
Main features

- Full-span spectrum monitor
  - Display of whole spectrum from 10 to 1000 MHz
  - Dynamic range 80 dB
  - Analysis bandwidths from 150 Hz (modulation spectra AM/FM/SSB) to 3 MHz
  - Ultra-high sensitivity of up to –110 dBm
  - Markers for synthesizer-accurate frequency determination and selective level measurements
  - Storage of spectrum displays as well as demodulation of displayed spectral lines (FREEZE & LISTEN)
  - Built-in tracking generator with selectable level and frequency offset for measurements on filters, modules and antenna systems
  - Quick mode for fast adjustment of RF components
  - Reference markers for determining level and frequency offsets
- Transient frequency and power measurements
  - Display of frequency response when radios are switched on/off or switched over
  - Combined display of power and frequency response
  - Recording of power variations during transmitter switch on and off or of power ramp (TDMA system, data transmission system)
- Adjacent-channel power measurements
  - Direct measurement of adjacent-channel power without external filters being required
  - Filters required for measurements to ETSI are implemented in the CMS
- Harmonics measurements
  - Harmonics up to 1 GHz are measured at a keystroke and results displayed in digital and analog form
- Duplex modulation meter with any frequency offset

Radiocommunication Service Monitor CMS54



Full-span display for fast overview measurements



Display range 80 dB

Special data of CMS54

The specifications of CMS52 apply (see page 6)

RF spectrum monitor (also CMS52/CMS57)

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

Transient recorder (also CMS52/CMS57)

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

Time scale	50 µs/div to 1 s/div, maximum recording time 40 s
Frequency transients	
RF frequency range	1 to 1000 MHz
Measurement range (FM dev.)	0 to ±100 kHz
Scaling	0.5 to 50 kHz/div
Triggering	internal, automatic (frequency changes >8 kHz)
Power transients	
RF frequency range	1 to 1000 MHz
Display dynamic range	60 dB (for 47 dBm at input 1)
Scaling	2/5/10/20 dB/div
Triggering	internal, automatic (power 10%)

RF frequency counter (also CMS52/CMS57)

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

Transmitter measurements at 2nd RF input

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

Harmonic measurements (also CMS52/CMS57 with CMS-B9)

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

Signal generator

Frequency range	0.4 to 1000 MHz (usable from 100 kHz)

Ordering information

see CMS..., page 9

Radiocommunication Service Monitor CMS57

The avionics specialist

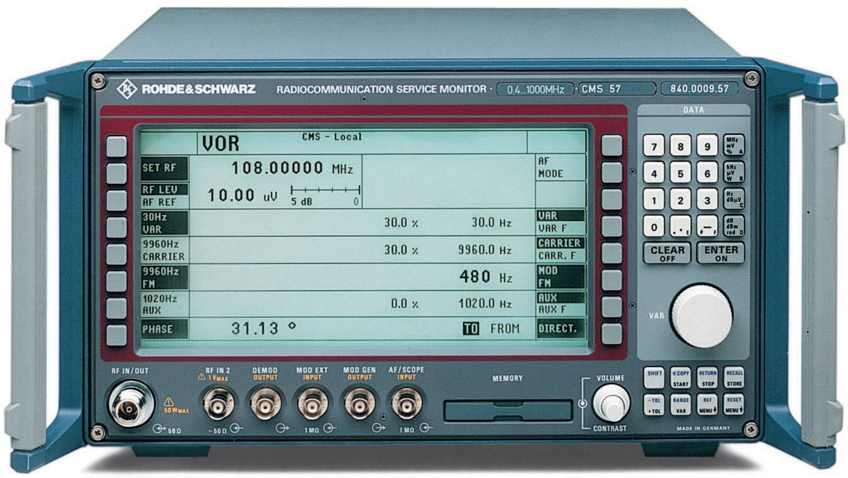
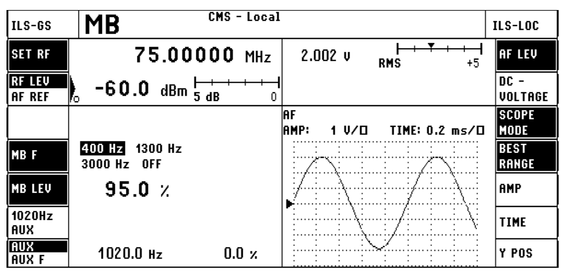


Photo 39832

Brief description

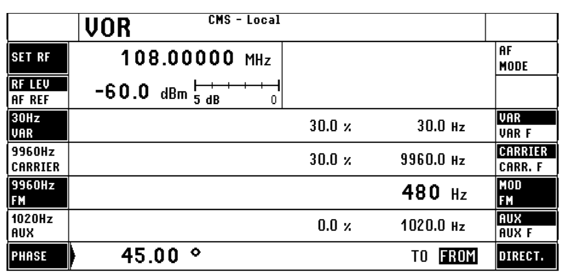
Radiocommunication Service Monitor CMS57 is the ideal radio tester for service and maintenance in the field of avionics. A built-in VOR/ILS signal generator delivers all test signals for

- **VOR** (VHF Omnidirectional Range)
- **ILS** (Instrument Landing System)
- **MB** (Marker Beacon)
- Autopilot



A clear menu is also available for the generation of marker beacons

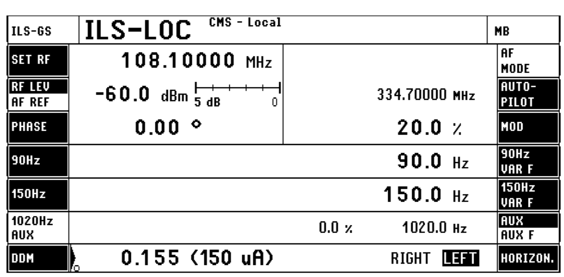
CMS57 features the same characteristics and optional extension facilities as the CMS52 (see page 6).



Frequency and deviation adjustable over a wide range allows receiver testing in line with standard

CMS57 combines conventional radiocommunication and radionavigation measurement facilities in a single unit covering avionics measurements.

Small size, low weight and battery operation enable the CMS57 to be used in the cockpit or for fast go/nogo testing based on off-air measurements (RAMP test).

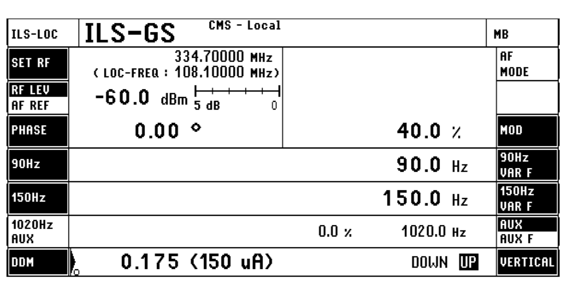


Fine variation of the DDM value in steps of 0.001 DDM for ILS and of the phase in steps of 0.01° for VOR ensure accurate adjustment of the onboard monitor

Main features

The VOR/ILS generator allows for

- Generation of highly accurate signals, ie high measurement accuracy, thanks to digital signal processing
- High resolution of parameters
- High long-term stability and reliability



Radiocommunication Service Monitor CMS57

- Independence from operating temperatures due to automatic self-adjustment

Operation

The operating concept of the CMS57 allows with only a few settings all characteristics of the VOR/ILS receivers to be measured. Signal parameters are defined either by

- direct keyboard entry
- fine variation via spinwheel or recall of preset standard RF frequencies
- fixed coupling of ILS glideslope and localizer frequencies according to specification
- recall of preset test parameters like phase or DDM (Difference in Depth of Modulation)
- recall of standard settings to ARINC 578, 579

Ordering information

see CMS52, page 9

1 Data of VOR/ILS/MB signals in the RF level range (–128 to –9 dBm, fine variation 0 dB) are specified for discrete RF frequencies and for the following continuous ranges:
VOR: 108 to 118 MHz;
ILS localizer: 108 to 112 MHz,
ILS glideslope: 329 to 335 MHz;
Marker beacon: 74 to 76 MHz.

2 **D**ifference in **D**epth of **M**odulation; describes the modulation depth difference between 90 Hz and 150 Hz tone; |DDM| = |(90 Hz modulation in % – 150 Hz modulation in %)|/100%.

Specific data of CMS57

The specifications of CMS52 apply (see page 8)[1]

	Range	Resolution	Accuracy
VOR			
Phase RF output	0 to 360°	0.01°	typ. 0.05°
AF output	0 to 360°	0.01°	0.04°
9960 Hz carrier			
Modulation frequency	7.9 to 12 kHz		
Amplitude modulation			
–128 to –9 dBm	0 to 100%	0.1% AM	typ. 2% at 30% AM
–85 to –45 dBm	0 to 100%	0.1% AM	2% at 30% AM
FM deviation	384 to 576 Hz	1 Hz	1 Hz
30 Hz VAR			
Modulation frequency	24 to 36 Hz		
Amplitude modulation			
–128 to –9 dBm	0 to 100%	0.1% AM	typ. 2% at 30% AM
–85 to –45 dBm	0 to 100%	0.1% AM	2% at 30% AM
1020-Hz AUX			
Modulation frequency	50 Hz to 20 kHz		
Amplitude modulation	0 to 100%	0.1% AM	3%, at 1020 Hz and 10 to 20% AM
ILS			
90 Hz and 150 Hz phase	0 to 180°, referred to 150 Hz	0.01°	1°
90 Hz tone			
Modulation frequency	72 to 108 Hz		
150 Hz tone			
Modulation frequency	120 to 180 Hz		
1020 Hz tone (AUX)			
Modulation frequency	50 Hz to 20 kHz		
Amplitude modulation	0 to 100%	0.1% AM	3%, at 1020 Hz and 10 to 20% AM
ILS localizer			
Amplitude modulation			
–128 to –9 dBm	0 to 50%	0.1% AM	typ. 2% at 20% AM
–85 to –45 dBm	0 to 50%	0.1% AM	2% at 20% AM
DDM[2] RF output	±0 to 0.4 DDM at 20% AM	0.001 DDM	
On-course error, –128 to –9 dBm			0.0004 DDM
Off-course error, –128 to –9 dBm			2% + 0.0004 DDM at |DDM| ≤0.2
DDM AF output	±0 to 0.4 DDM at 20% AM	0.001 DDM	3% + 0.0002 DDM at |DDM| 0.4, AF level 0.5 to 5 V
ILS glideslope			
Amplitude modulation			
–128 to –9 dBm	0 to 50%	0.1% AM	typ. 2% at 40% AM
–85 to –45 dBm	0 to 50%	0.1% AM	2% at 40% AM
DDM RF output	±0 to 0.8 DDM at 40% AM	0.001 DDM	
On-course error, –128 to –9 dBm			0.001 DDM
Off-course error, –128 to –9 dBm			2% + 0.001 DDM at |DDM| ≤0.4
DDM AF output	±0 to 0.8 DDM at 40% AM	0.001 DDM	3% + 0.0002 DDM at |DDM| 0.4, AF level 0.5 to 5 V
Marker beacon (MB)			
Modulation frequency	400, 1300, 3000 Hz		
Amplitude modulation	0 to 100%	0.1% AM	5% at 95% AM
1020 Hz tone (AUX)			
Modulation frequency	50 Hz to 20 kHz		
Amplitude modulation	0 to 100%	0.1% AM	same as CMS52

Options for radio testers of the CMS family

Extensions for basic model	Option	Order No.	Specifications	
OCXO Reference Oscillator For long-term stability	CMS-B1	0840.9406.02	See timebase Aging	2 x 10^{-7}/year
OCXO Reference Oscillator For extremely high long-term stability	CMS-B2	1001.6809.02	Specs same as CMS-B1, except for aging	≤1 x 10^{-7}/year
Duplex Modulation Meter For operation of RF frequency counter and modulation meter independent of RF generator (two-port measurements, also on frequency-converting modules)	CMS-B59	1032.0990.02 (not for CMS54)	Specs same as basic model, except residual FM	≤10 Hz
Duplex Modulation Meter Same as CMS-B59, plus adjacent-channel power meter for measurements on duplex radio, cellular mobile phones and frequency-converting modules	CMS-B9	0840.9506.02 (not for CMS50; standard in CMS54)	Specs same as basic model Adjacent-channel power meter with ETSI filters Channel spacings Dynamic range	10/12.5/20/25 kHz and user-selectable up to 1 MHz ≥70 dB (chan. spacing 25 kHz)
10 MHz Reference Frequency Input/Output External synchronization for measuring systems	CMS-B22	1001.6750.02	Output Input	TTL signal, Z_{out}≈50 Ω, f=10 MHz level >1.5 V (V_{pp}), Z_{in}≈50 Ω, f=10 MHz ±500 Hz
Additional RF Input/Output Two-signal measurements and connection of further measuring instruments (eg spectrum analyzer); bidirectional RF connector for additional measuring instruments	CMS-B31	1001.7005.02 (not for CMS57)	Maximum input power 20 mW Attenuation betw. RF_{in} → RF_{out} 32 dB Measurement sensitivity at input 1 for RF counter/transient recorder and demodulation reduced by 6 dB	
100 W RF Power Meter Measurement of high RF input power	CMS-B32	1001.7905.02	Maximum input power: 100 W for 3 min, then 10 min power off; continuous power: 80 W; max. output level and measurement sensitivity at input 1 reduced by 3 dB; additional error: ≤0.15 dB (P>40 mW, AM=0%)	
13 dBm Output	CMS-B34	1032.1350.02	Additional power output for off-air measurements	
Autopilot Generator for ILS Operation **(CMS57)**	CMS-B38	1065.5003.02 (for CMS57 only)	Second RF output; not in conjunction with CMS-B31 and -B34; level approx. –50 dBm	
IEC/IEEE-Bus Interface	CMS-B54	1032.0748.02 (for CMS50 only)	Use of CMS50 in automatic test systems	

Signalling units for models with Duplex Modulation Meter CMS-B9 or CMS-B59	Option	Order No.	Specifications
Signalling Unit for Cellular Radio NMT 450 (SIS), NMT 450, NMT 900 (SIS), E-AMPS, E-TACS, J-TACS, TACS II, R 2000	CMS-B53 [1)]	1032.0890.02	Simulation of base station for testing cellular mobile phones, eg call setup, call cleardown, channel and power change
Signalling Unit for Cellular Radio Same as CMS-B53, plus C-net signalling	CMS-B13 [1)]	0841.1009.02 (not for CMS50)	Simulation of base station for testing cellular mobile phones, eg call setup, call cleardown, channel and power change
NMT Base Station Test For CMS-B13 in conjunction with CMS-B39	CMS-B25	1032.0490.02 (not for CMS50)	Signalling for setting the base station and RF measurements on air interface
POCSAG, ZVEI/VDEW Digital Signalling For CMS-B13/-B53	CMS-B26	1031.9993.10	Testing of POCSAG radiopaging receivers and ZVEI/VDEW mobile and base stations
MPT 1327/1343 Signalling For CMS-B13/-B53, testing of trunked radio	CMS-B28	1001.7205.02	Additional free programming of signalling sequences via external computer
FMS-BOS Signalling For CMS-B13/-B53	CMS-B29	1032.1550.02	With CMS-B13 and -B39 signalling also at AF

Extensions in conjunction with control interfaces	Option	Order No.	Specifications	
ATIS Coder/Decoder (for CMS-B5)	CMS-B27 [2)]	1032.1250.02	Coder Decoder	– entry of 10-digit ATIS code – sending of ATIS message – decoding and display of 10-digit ATIS message – measurement of data deviation
CDCSS Decoder (for CMS-B5)	CMS-B27 with CMS-B33		Decoding of 3-digit mobile phone code number, measurement of data deviation; CDCSS coder fitted as standard in basic model	

Options for radio testers of the CMS family

Extensions in conjunction with control interfaces	Option	Order No.	Specifications
RS-232-C Interface for CMS-B5	CMS-B30	1001.6909.02	Output and reception of any ASCII strings (max. 33 characters)
300-Hz Lowpass Filter for CMS-B5/-B55; fast frequency and deviation measurement of subaudio tones with simultaneous audio modulation	CMS-B33	1032.0290.02	f_{cutoff} =200 Hz, attenuation >50 dB for frequencies above 300 Hz
VSWR Meter in conjunction with CMS-B5 or -B39	CMS-Z37 3)	1065.4907.02	Connection of Insertion Units NAS-Z1, -Z3, -Z5, -Z6 (GSM900), -Z7 (GSM 1800) with direct reading of VSWR as well as forward and reflected power

Optional control interfaces 4)

Order No.	CMS-B5 0841.0502.10	CMS-B5 0841.0502.12	CMS-B55 1032.0790.02	CMS-B20 0841.1209.02	CMS-B39 1032.0090.02	Specifications	
DTMF Decoder	•	•	•	•	•	Decoding of DTMF dual tones and VDEW direct dialling	
CCITT Filter	•	–	•	•	•		
C-Message Filter	–	•	–	–	–		
Centronics Interface	•	•	•	•	•		
Relays	8	8	–	–	4	With max. 1 W switching power, V_{max}=30 V, I_{max}=0.1 A	
TTL Input/Output	12	12	–	–	8	Outputs: 25 mA	
DC Ammeter/ Voltmeter, floating	–	–	–	•	–	Voltage measurement Range Resolution Error Current measurement Range Resolution Error	 0 to ±30 V 0.1 to 100 mV ±1% + resolution 0 to ±10 A 1 to 100 mA ≤4% ± 3 mA
600 Ω AF Transformers	–	–	–	–	•	Output impedance of AF generator Frequency range Output voltage Max. output current Input impedance of AF voltmeter Frequency range	switchable to 600 Ω ±10% 100 Hz to 6 kHz 10 µV to 2.5 V 4 mA switchable to 600 Ω ± 10% 100 Hz to 6 kHz
ATIS Coder/ Decoder, CDCSS Decoder	CMS-B27	CMS-B27	–	–	–	See option CMS-B27, CDCSS coder fitted as standard in basic model	
RS-232 Interface	CMS-B30	CMS-B30	–	–	–	See option CMS-B30	
300 Hz Lowpass Filter	CMS-B33	CMS-B33	CMS-B33	–	–	See option CMS-B33	
Adapter for VSWR Measurements	CMS-Z37	CMS-Z37	–	–	CMS-Z37	See option CMS-Z37	

1) CMS-B9 or CMS-B59 also required, CMS-B13 and CMS-B53 may be used alternatively. • included

2) CMS-B33 also required for CDCSS. – not included

3) CMS-B5 or -B39 required for Insertion Units NAS-Z1/-Z3/-Z5/-Z6/-Z7.

4) Choice of one option.

2 GHz Radiocommunication Tester CMT55

Broadband modulator/demodulator, for all transmitter and receiver measurements up to 2 GHz

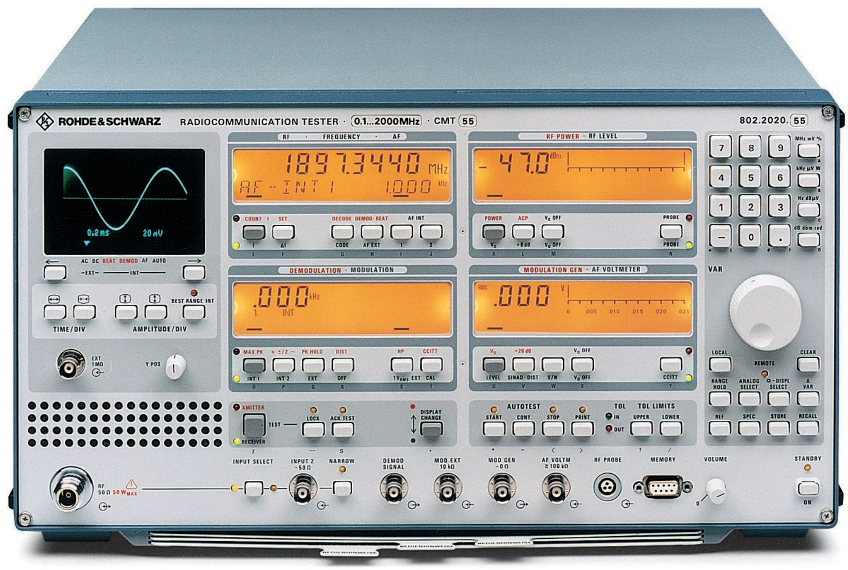


Photo 40547

Brief description

The extension of frequency bands up to 2 GHz in mobile radio places new requirements on radio test equipment. The 2 GHz Radiocommunication Tester CMT55 is a suitable measuring instrument in this field as well as for directional-radio applications.

Main features

- Favourably priced radio tester with all the necessary measurement facilities for AM, FM and φM transceivers
- Full measurement capabilities from 100 kHz to 2 GHz
- Highly sensitive off-air measurements
- High measurement accuracy and wide dynamic range at a high measurement rate
- Integrated oscilloscope
- Integrated broadband modulator and demodulator for broadband radiocommunication measurements
- Wide choice of options for special applications
- Light and compact unit powered from battery or AC supply for mobile and stationary use
- Fully automatic test run including hardcopy test report thanks to integrated memory for comprehensive transceiver tests
- Automatic operation with external process controller via IEC/IEEE bus
- Ergonomic manual operation with measurement data shown on digital and analog displays and on integrated oscilloscope

Overview of equipment and options

Measuring and control facilities contained in CMT55		Receiver test	Transmitter test	Option/add-on
Generator section RF generator with broadband FM	0.1 to 2000 MHz, –137 to +13 dBm	●		
Modulation generator 1	20 dB electronic level fine variation 20 Hz to 30 kHz with 6 additional fixed frequencies	●	●	
Modulation generator 2	20 Hz to 30 kHz	●	●	CMT-B7
Two-tone modulation generator	two-tone generation to DTMF, two-tone modulation with separate setting	●	●	CMT-B7
Selective-call encoder	to standard or programmable	●		

2 GHz Radiocommunication Tester CMT55

Measuring and control facilities contained in CMT55		Receiver test	Transmitter test	Option/add-on
Measurement section				
RF counter	0.4 to 2000 MHz		●	
RF power meter	5 mW to 50 W		●	
Modulation meter (AM, FM, φM)	MAX PK, –PK, +PK, ±PK/2, PK HOLD, RMS, automatic tuning, presettable		●	
Broadband FM demodulator	40 to 2000 MHz		●	
Spurious modulation meter	true rms weighting, automatic tuning, presettable		●	
AF voltmeter	0.1 mV to 30 V, true rms weighting, switchable time constants	●		
Distortion meter	0.1 to 50%	●	●	
SINAD meter	1 to 46 dB	●		
S/N meter	1 to 99 dB	●	●	
AF counter	20 Hz to 500 kHz	●	●	
Frequency offset meter	20 Hz to 20 kHz		●	
Oscilloscope	ext.: AC, DC; int.: AF voltage, demod. signal; beat signal, distortion	●	●	
Selective-call decoder	to standard or programmable		●	
Adjacent-channel power meter	20 to 80 dB		●	CMT-B6
RF millivoltmeter	10 kHz to 2 GHz, 1 mV to 100 V	●	●	CM-B8
Selective RF millivoltmeter			●	CMT-B6
Dual-tone decoder	to DTMF standard		●	CM-B11
Duplex modulation meter	same as main modulation meter		●	CMT-B9
Off-air measurements	sensitivity approx. 5 µV with selectable narrow-band filter		●	
Audible monitoring	demodulated signal, AF voltmeter input signal, beat signal	●	●	
CCITT filter		●	●	
300 Hz highpass filter			●	
DC ammeter	0 to ±10 A	●	●	CMT-Z6
DC voltmeter	0 to ±30 V	●	●	CMT-Z6
Control section		●	●	
IEC/IEEE-bus control interface	to IEC625-1 (IEEE 488) standard, 8 relays			CM-B4
Autorun control/printer interface	20 complex or 100 simple test programs, 3 relays, Centronics parallel interface	●	●	CM-B5

Measurement capabilities

The RF synthesizer, which can be modulated for the receiver test, provides output signals of up to 2 GHz at a maximum level of +13 dBm. A higher maximum frequency deviation (1600 kHz) and a wider modulation frequency range (130 kHz) are available for broadband modulation at high frequencies. The intermodulation distortion of the FM modulator is low regarding the multitone and subcarrier method used in this frequency range. The AM modulation capabilities even apply to the frequency range 1 to 2 GHz, for instance for fading simulation at the receiver input.

2 GHz Radiocommunication Tester CMT55

Two standard FM demodulators are provided:

The first FM demodulator, with modulation frequency and maximum deviation corresponding to that of the 1 GHz models, features low residual FM in the 2 GHz range as well. It is mainly used for testing single-channel radiocommunications (rural links).

The second FM demodulator fitted as standard is a broadband FM demodulator and can also be used for frequencies below 1 GHz (≥40 MHz). It demodulates signals with modulation frequencies of up to 130 kHz and 520 kHz deviation and weights them accordingly to +PK, –PK, ±PK/2, MAX PK and PK Hold or RMS. It is therefore suitable for measurements on multichannel transceivers and radio links and provides sufficient margin regarding deviation and modulation frequency. Even overmodulated 24-channel low-capacity FDM signals (FDM = frequency division multiplex) can thus be weighted.

Especially the RF options Adjacent-Channel Power Meter CMT-B6, Duplex Modulation Meter CM-B9 and RF Millivoltmeter CM-B8 complete the measurement capabilities up to 2 GHz.

Specifications in brief

Reference	
Standard	crystal reference oscillator
Aging	<1 x 10^{-6}/month
Temperature effect	<1 x 10^{-6}/°C
Option CMT-B1	OCXO reference oscillator
Aging	<2 x 10^{-9}/day
Temperature effect	<2 x 10^{-9}/°C

Receiver measurements

Signal generator	
Frequency range	100 kHz to 2000 MHz
Resolution	<200 Hz
Level CW, FM, φM	–137 to +13 dBm
AM	–137 to +7 dBm
Resolution	0.1 dB
Accuracy	2 dB
Spectral purity (up to 1 GHz)	
Harmonics	<–30 dBc (level <10 dBm)
Residual AM (rms) at 0.03 to 20 kHz	<0.02%
Nonharmonics	<–54 dBc
Residual FM (to CCITT)	<24 Hz
Spectral purity (>1 GHz)	
Harmonics and 1/2 f, 3/2 f, etc	typ. –20 dBc
Modulation modes	
Internal/external, AC or DC	AM, FM, φM
Multiple modulation	AM int. with FM/φM ext. FM/φM int. with AM ext.
Amplitude modulation	0 to 95%
Modulation frequency	DC to 30 kHz

Frequency modulation (up to 1 GHz)

Frequency range	0.1 to 31.25	31.25 to 62.5	62.5 to 125	125 to 250	250 to 500	500 to 1000	MHz
Max. deviation	100	50	100	200	400	800	kHz

Modulation frequency range	
FM AC	10 Hz to 100 kHz (internal)
FM DC	DC to 100 kHz
Low Rate FM option (SCM-U1, factory-fitted)	2 Hz to 100 kHz
Frequency modulation (>1 GHz)	
Frequency deviation	up to 1600 kHz
Modulation frequency range	up to 130 kHz (external)
Phase modulation	
up to 1 GHz	0 to 80 rad
>1 GHz	up to 160 rad
Modulation frequency	300 Hz to 6 kHz
AF voltmeter, S/N meter	0 to 35 V
Weighting	rms, +peak, –peak
Frequency range	50 Hz to 20 kHz
AF counter	20 Hz to 500 kHz
Input voltage	
<30 kHz	3 mV to 30 V
≥30 kHz	30 mV to 30 V

Transmitter measurements

Power measurement	
Frequency range	1.5 to 2000 MHz
Measurement range	5 mW to 50 W (usable up to 75 W)
Resolution	0.1 dBm
Accuracy (0% AM)	
P>20 dBm	0.4 dB + resolution (f <1 GHz)
P≥20 dBm	1 dBm (f >1 GHz)
7 dBm<P<20 dBm	typ. 1 dB (f >1 GHz)
VSWR	<1.3 for f≤1 GHz, <1.5 for f>1 GHz
RF frequency measurement	
Frequency range	1 MHz to 2 GHz (usable up to 400 kHz)
Input level range	
up to 1 GHz	5 mW to 50 W
second input	5 to 500 mV
>1 GHz	20 mW to 50 W (10 to 500 mV)
Resolution	10 Hz/1 Hz selectable
Error	timebase error + 100 Hz
Frequency deviation measurement	
Operating modes	+PK, –PK, ±PK/2, PK Hold, MAX PK or RMS
Frequency range	4 to 1000 MHz
Deviation measurement range	1 Hz to 100 kHz
Peak weighting, rms weighting or automatic switchover at 100 Hz deviation	
Demodulation frequency	20 Hz to 20 kHz
Residual FM (to CCITT)	<24 Hz
FM broadband demodulator	
Frequency range	40 to 2000 MHz
Modulation frequency range	up to 130 kHz
Deviation (presettable range limits)	130/260/520 kHz
Residual FM (measured at demodulator output, rms weighting, 130 kHz bandwidth, range limit 130 kHz)	

2 GHz Radiocommunication Tester CMT55

RF<1000 MHz	<120 Hz
RF>1000 MHz	<200 Hz
Accuracy (of reading with peak weighting)	
AF<20 kHz	3% + residual FM + resolution
AF<100 kHz	5% + residual FM + resolution
AF<130 kHz	7% + residual FM + resolution

Phase deviation meter

Operating modes	+PK, –PK, ±PK/2, PK Hold, MAX PK or RMS
Measurement range	0.001 to 25 rad
Demodulation frequency range	300 Hz to 10 kHz

Peak weighting, rms weighting or automatic switchover at 0.1 rad

AM measurement

Operating modes	+PK, –PK, ±PK/2, PK Hold, MAX PK or RMS
Measurement range	0.01 to 99%
Frequency range	1.5 to 2000 MHz

Peak weighting, rms weighting or automatic switchover at 100 Hz deviation

Transmitter and receiver measurements

Weighting filter	to CCITT filter specification, switchable 300 Hz highpass filter

Distortion measurement

Measurement frequency	1 kHz ±1%
Measurement range	0.1 to 50%
Resolution	0.1%
Inherent distortion	≤0.3%
Accuracy	5% of rdg + inherent distortion

SINAD measurement

Measurement frequency	1 kHz ±1%
Measurement range	1 to 46 dB
Resolution	0.1 dB
Accuracy	0.5 dB

Modulation generator

Operating modes	single-tone modulation, two-tone modulation (option CMT-B7)
Frequency range	20 Hz to 25 kHz, usable up to 30 kHz
Resolution; f <1/3/6/10/20 kHz	0.1/0.2/1/2.5/10 Hz
f>20 kHz	20 Hz
Frequency accuracy	0.5 x resolution
Fixed frequencies	8, programmable
Output voltage	10 µV to 5 V
Accuracy (V_0 >1 mV)	3%

Selective-call encoder/decoder

Standard tone sequences	ZVEI1, 2/CCIR/EIA/EEA/EURO/VDEW/CCITT, NATEL plus user-defined sequences
Digits	0 to 9, A to F
Call length	1 to 25 tones
Automatic repeat	can be switched on/off
Encoder	
Frequency offset	adjustable up to ±10%
Tone/interval duration	to standard or programmable
Decoder	tolerance evaluation to standard or programmable with out-of-tolerance indication

Oscilloscope

Displayed signals		external signal (Z_{out} approx. 1 MΩ, AC/DC coupling), AF, demod. signal AM, FM, φM), beat (AC coupling)
Screen size		approx. 6 cm x 4 cm
Vertical deflection		
External		5 mV/div to 10 V/div
AF voltmeter		1 mV/div to 20 V/div
Demod.	AM	0.1%/div to 40%/div
	FM	5 Hz/div to 40 kHz/div
	φM	0.01 to 10 rad/div
Horizontal deflection		0.01 to 20 ms/div
Bandwidth		DC/5 Hz to 100 kHz

RF Millivoltmeter	option CM-B8
Frequency range	10 kHz to 1000 MHz
Measurement range	1 mV to 10 V, 10 mV to 100 V (measurement range and frequency response depending on measuring head)
Readout	in mV, V, W, dBm or dBµV
Resolution (V >100 mV)	1%, 0.1 dBm
Accuracy (+20 to +25°C)	5% + frequency response error

Adjacent-Channel Power Meter	option CMT-B6
Frequency range	4 to 1000 MHz
Channel spacing	10/12.5/20/25 kHz
Dynamic measurement range	typ. 63 dB

General data

IEC/IEEE-Bus Control Interface	option CM-B4 (IEC625/IEEE488)
Control interface	8 relays (max. 28 V, 0.25 A, 3 VA), manual control, programmable
Autorun Control/Printer Interface	option CM-B5
Storage capacity (battery-backed)	approx. 100 simple or 20 complex test programs
DUT control	3 relays (max.28 V, 0.25 A, 3 VA), manual control, programmable, Centronics parallel interface
Power supply	100/120/220/240 V ±10%, 47 to 420 Hz, 100 VA
Battery, CMT	11 to 30 V (80 W)
Dimensions (W x H x D); weight	420 mm x 220 mm x 340 mm; 19 kg

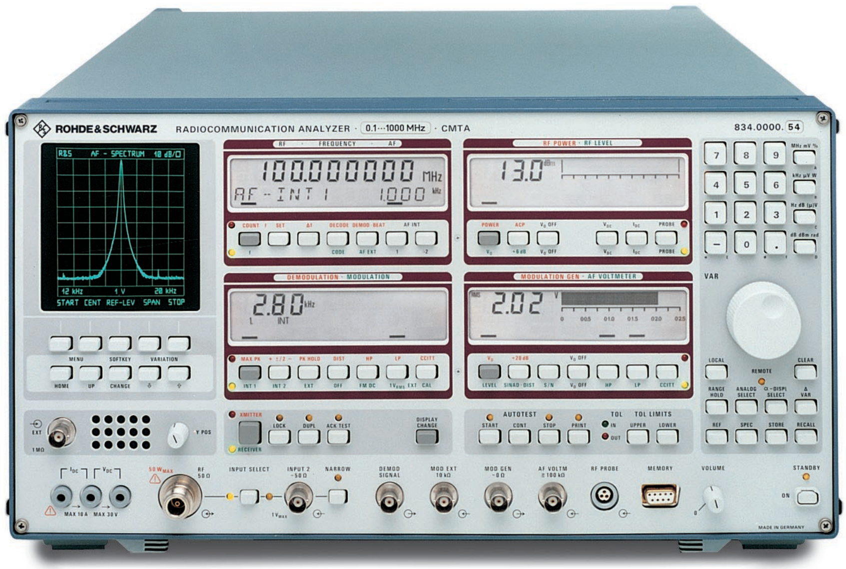
Ordering information

2 GHz Radiocommunication Tester	CMT55	0802.2020.55
Options		
OCXO Reference Oscillator	CMT-B1	0803.8916.02
IEC/IEEE-Bus Control Interface	CM-B4	0803.3914.02
Autorun Control/Printer Interface	CM-B5	0803.3314.02
Adjacent-Channel Power Meter	CMT-B6	0803.7810.02
2nd AF Synthesizer	CMT-B7	0803.2618.02
RF Millivoltmeter	CM-B8	0803.6813.02
Duplex Modulation Meter	CM-B9	0803.5317.02
Extras		
Oscilloscope Probe (100 MHz)	SMFS-Z1	0358.0312.02
Detector Probe (0.1 to 500 MHz)	SMFS-Z2	0358.0412.02

Radiocommunication Analyzers CMTA 54, CMTA 84

100 kHz to 1 GHz

High-tech radiocommunication test equipment in one single unit



CMTA 54 (photo 37322)

Brief description

Radiocommunication Analyzers CMTA 54 and CMTA 84 are universal, top-quality testers equipped with all the necessary signal sources and measuring facilities for complete testing of all types of analog radio equipment. The versatile, independent and high-precision signal sources and measuring facilities make the CMTA particularly suitable for laboratory applications.

Two models are available for different types of application

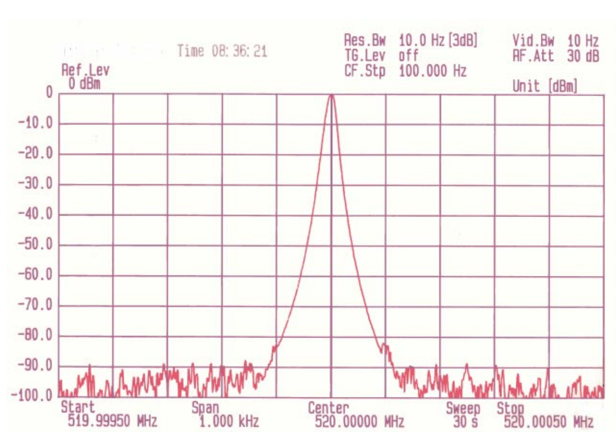
- **CMTA 54:** basic model with spectrum analyzer and storage oscilloscope
- **CMTA 84:** same as CMTA 54 + all cellular-radio simulators

Main features

- Wide frequency ranges, high measurement rates and large dynamic range of all measuring facilities
- Numerous additional facilities such as programmable highpass, lowpass, bandpass and notch filters or continuously tunable distortion/ SINAD meter
- RF synthesizer featuring high spectral purity, fine frequency resolution and universal modulation capabilities

Operation

- Automatic test routines
- Complete device setups
- Program memory for automatic test sequences without external process controller
- IEC/IEEE-bus interface
- Printer connector for data logging or program listings
- Transfer memory for transferring automatic test routines to CMTA testers
- Relay matrix



CMTA RF synthesizer spectrum; extremely high spectral purity over the entire frequency range and excellent stability make the RF synthesizer of the CMTA suitable for all - even extremely narrowband – DUTs

Standard equipment of CMTA 54

RF synthesizer

- Frequency range 0.1 to 1000 MHz, resolution 1 Hz, P_{max}= 16 dBm
- OCXO reference oscillator with little aging and high frequency accuracy
- High spectral purity
- AM, FM and φM by one or two internal modulation generators and/or by external modulation (multiple modulation, multi-tone modulation; separate adjustment)
- FM-DC coupled modulation up to ±100 kHz deviation
- Very short frequency settling
- Wide dynamic range with extremely high level resolution
- Uninterrupted level adjustment over 20 dB

AF synthesizer (encoder functions)

Two independent AF synthesizers as modulation sources for the built-in RF synthesizer or for the DUT

- Frequency range from 20 Hz to 30 kHz, crystal accurate with high frequency resolution
- Dynamic level range from 10 mV to 5 V, with high resolution and excellent S/N ratio (even at low levels)
- Eight presettable fixed frequencies
- Selective-call sequence and two-tone sequence generation (eg DTMF) with standard or programmable frequencies

Decoder functions

Fast testing of encoders for correct codes and observance of frequency tolerances

- Single-tone demodulation to standard frequencies or programmable
- DTMF decoder

RF power meter

- Broadband and wide dynamic range
- Dynamic measurement range can be extended as desired by using input attenuation

RF frequency counter

- Frequency counter operating independently of RF synthesizer
- Resolution 1 or 10 Hz
- Two test inputs with a total dynamic level range of 80 dB
- RF frequency offset measurement

AF frequency counter

- Wide frequency range
- Two operating modes: period meter and gating-time counter

Demodulators

For AM, FM or φM measurements

- Automatic setting to the carrier frequency to be demodulated or presettable
- Measurement functions: +PK, -PK, ±PK/2, PK Hold, RMS
- Low inherent modulation

Distortion/SINAD meter

- User-programmable test frequencies in fine steps (100 Hz to 5 kHz)

S/N meter

Determines the S/N ratio at the AF output of the radio equipment by switching the modulation cyclically on and off. Received pilot tones may be excluded from the switching procedure.

AF voltmeter

- Wide dynamic level range
- Choice of different weighting filters and time constants

DC voltmeter and DC ammeter

Wide dynamic measurement range for checking the power supply and determining the power consumption of the radio equipment; high common-mode rejection and favourable impedance characteristics

IEC/IEEE-bus with relay matrix

Fully automatic measurements through remote-control of analyzer and DUT control by means of relays integrated in the CMTA

Programmable weighting filters

For accurate analysis of AF and demodulation signals. The programmable filters and filter combinations ensure precise band limiting:

- For reducing the noise bandwidth
- For suppressing signal components of no interest
- For signal weighting to various standards
- Programmable highpass filter (107 Hz to 10 kHz)
- Programmable lowpass filter (235 Hz to 20 kHz)
- Programmable bandpass filter (HP+ LP)
- Notch filter (100 Hz to 5 kHz)
- CCITT filter

RF spectrum monitor

- Frequency range 100 kHz to 1GHz
- Two inputs (total dynamic range ≥80 dB + 60 dB display dynamic range)
- Span from 30 kHz to 10 MHz
- Four test filters
- Each point on the frequency axis has synthesizer accuracy

AF spectrum analyzer

For measuring very small spectral components, even when very close to the fundamental; also for identifying very small spurious voltages as may be found on the VCO tuning voltage

- Synthesizer accuracy
- Wide dynamic level range
- Frequency range up to 20 kHz
- Display of wide dynamic range (80 dB)
- Three test-filter bandwidths
- Span, start and stop frequency are user-selectable
- Crystal-accurate at any point on the frequency axis
- Marker function

Additional equipment of CMTA84

Signalling units

- Selective-call encoder/decoder for all standards, programmable
- DTMF encoder/decoder
- Cellular-radio simulator for C Net, Radiocom 2000, NMT450/900, AMPS, E-AMPS, TACS, E-TACS, J-TACS, TACS Issue 4 including
  - Time expansion and compression facility (C Net)
  - Subaudio signalling (Radiocom 2000)
  - Supervisory tone generation (phi tone, SAT)

Radiocommunication Analyzers CMTA54, CMTA84

- Signalling for MPT 1327 (trunked radio), POCSAG, ZVEI/VDEW digital

Options

RF millivoltmeter
For measurements on modules and open transceivers in wide level and frequency ranges

Adjacent-channel power meter
- Frequency range 400 MHz to 1 GHz
- Filters to CEPT/FTZ
- Standard and free channel spacing
- Wide dynamic range for measurements (10 to 85 dB)
- Can be used as a selective voltmeter

Duplex modulation meter
Full duplex operation even during adjacent-channel power measurements

Duplex Modulation Meter CMTA-B9
Separate AM, FM, φM modulation meter for measurements performed independently of the basic synthesizer on relay stations and full-duplex transceivers

Recommended extras

Oscilloscope Probe SMFS-Z1
Division ratio 1:1/10:1/; display of external AC and DC signals on the storage oscilloscope or AF analyzer of CMTA

Detector Probe SMFS-Z2
- Measurement of RF levels in the range 100 kHz to 500 MHz
- Display of frequency response curves during sweep measurements on diplexers, IF filters, resonant circuits and demodulators on the storage oscilloscope of CMTA

19"-Adapter ZZA-95
Integration of CMTA in 19" systems without modifying the equipment (Front Handles ZZG-95 included)

Specifications in brief

Reference — OCXO reference oscillator
Aging — typ. $<2 \times 10^{-7}$/year
Temperature effect — $<2 \times 10^{-9}$/°C

Receiver measurements

Signal generator
Frequency range — 100 kHz to 1000 MHz
  Resolution — 1 Hz
Level CW, FM, φM — –137 to +13 dBm
  AM — –137 to +7 dBm, adjustable up to +16 dBm
Resolution — 0.1 dB
Spurious signals
  Harmonics — <–30 dBc
  Spurious AM (rms), 0.03 to 20 kHz — <0.02%
Wideband noise for CW (>2 MHz from carrier, 1 Hz bandwidth) — –140 dBc
Modulation modes
  Internal/external, AC or DC — AM, FM, φM
  Multiple modulation — AM int. with FM/φM ext. FM/φM int. with AM ext.

Amplitude modulation — 0 to 99%
  Modulation frequency — DC to 50 kHz

Frequency modulation

Frequency range	0.1 to 31.25	31.25 to 62.5	62.5 to 125	125 to 250	250 to 500	500 to 1000	MHz
Max. deviation	200	50	100	200	400	800	kHz

Modulation frequency range
  FM AC — 10 Hz to 100 kHz
  FM DC — DC to 100 kHz

Phase modulation — 0 to 80 rad
Modulation frequency — 300 Hz to 6 kHz

AF voltmeter, S/N meter — 0 to 35 V
Weighting — rms, +peak, –peak
Frequency range — 50 Hz to 20 kHz

AF frequency counter — 20 Hz to 500 kHz
Input voltage
  <30 kHz — 3 mV to 30 V
  ≥30 kHz — 30 mV to 30 V

Transmitter measurements

Power meter — 5 mW to 50 W (usable up to 75 W)
Frequency range — 1.5 to 1000 MHz
Accuracy (0% AM), P>20 dBm — 0.4 dB + resolution
Resolution — 0.1 dBm
Impedance, VSWR — 50 Ω, ≤1.3

RF frequency counter — 1 MHz to 1 GHz (usable from 400 kHz)
  RF input/output — 5 mW to 50 W
  2nd input — 5 to 500 mV
Resolution — 10 Hz/1 Hz selectable

Modulation meter — AM, FM, φM, +PK, –PK, ±PK/2, PK Hold, MAX PK or RMS

Frequency deviation meter — 0 to 100 kHz (peak weighting, rms weighting or automatic switchover at 100 Hz deviation)
Frequency range — 4 to 1000 MHz
Demodulation frequency — 20 Hz to 20 kHz

Phase deviation meter — 0 to 25 rad
Demodulation frequency — 300 Hz to 10 kHz

AM meter — 0 to 99%
Frequency range — 1.5 to 1000 MHz
300 Hz highpass filter — can be switched into demodulation path

Radiocommunication Analyzers CMTA54, CMTA84

Transmitter and receiver measurements

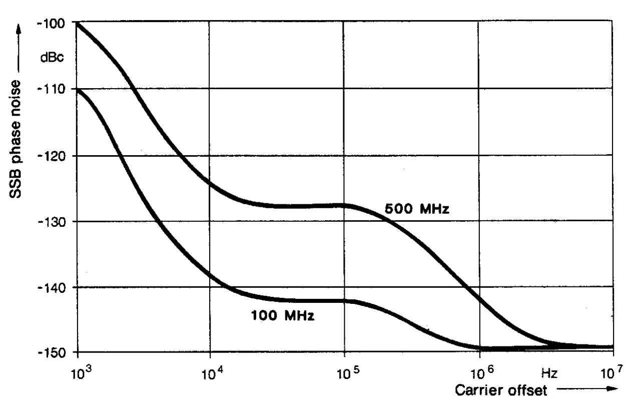
CCITT filter	to CCITT specifications
Notch filter	
Programmable notch frequencies	100 Hz to 5 kHz
Highpass filter	
Programmable passband cutoff frequencies (0.5 dB)	107 Hz to 10.6 kHz, in 60 steps
Lowpass filter	
Programmable passband cutoff frequencies (0.5 dB)	235 Hz to 21 kHz, in 60 steps
Bandpass filter	combination of highpass and lowpass

Distortion measurements on AF or demodulated signals, weighted or unweighted (see filter configuration)

Test frequency	100 Hz to 5 kHz
Measurement range	up to 50%
Minimum input voltage	30 mV

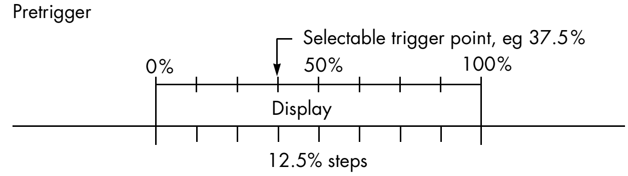
SINAD measurement on AF or demodulated signals, weighted or unweighted (see filter configuration)

Test frequency	1 kHz or 100 Hz to 5 kHz
Measurement range	1 to 50 dB



Single sideband phase noise at 100 and 500 MHz (bandwidth 1 Hz)

Modulation generators	
Operating modes	single-tone modulation, dual-tone modulation with separately adjustable parameters, dual tone having the same level at the modulation generator output
Frequency range	20 Hz to 25 kHz (usable up to 30 kHz)
Output impedance	<3 Ω
Selective-call encoder/decoder	
Standard tone sequences	ZVEI1/ZVEI2/CCIR/EIA/EEA EURO/VDEW/CCITT/NATEL and customer-specific sequences, preselectable
DTMF decoder	DTMF
DC measurement	
Voltage measurement range	0 to ±30 V
Input impedance	10 MΩ
Current measurement range	0 to 10 A, briefly 15 A
Input impedance	50 mΩ
AF spectrum analyzer	
Displayable signals	AF voltmeter input and demodulated signals, beat signal, external signal (Z_{in} approx. 1 MΩ)
Frequency range	up to 20 kHz (crystal-accurate)
Level range (reference level)	
AF	1.6 mV to 35 V (rms)
Demodulated FM	50 Hz to 100 kHz (peak)
AM	0.1 to 100% (peak)
φM	0.1 to 25 rad (peak)
SSB spectrum analyzer	
SSB receiver test	AF analysis via AF input
SSB transmitter test	AF analysis after internal RF/IF conversion
RF frequency range	400 kHz to 1000 MHz
RF spectrum monitor	
Frequency range	400 kHz to 1000 MHz
Dynamic range for input level >13 dBm (RF input/output) or >–27 dBm (2nd input)	>60 dB (for frequencies >0.5 x f_c or <2 x f_c), referred to reference level
Scale	log 10 dB/div, 2 dB/div or linear
Digital storage oscilloscope	
Displayable signals	external signal (Z_{in} approx. 1 MΩ, AC/DC coupling), AF, demod. signal (AM, FM, φM), beat (AC coupling)
Trigger slope	+ or –
Trigger level	full screen height, in 160 steps
Trigger delay	0.1 to 800 ms
Pretrigger	



Single-shot mode	
Recording time	3.2 to 3200 ms
Screen display	1/8 of the recording (15 overlapping ranges)

General data

IEC/IEEE-bus control interface	IEC625/IEEE488
Control interface	8 relays (max. 28 V, 0.25 A, 3 VA), manual control, programmable
Autorun Control/Printer Interface	option CMTA-B5
Storage capacity (battery-backed)	approx. 100 simple or 20 complex test programs
DUT control	3 relays (max. 28 V, 0.25 A, 3 VA), manual control, programmable, Centronics parallel interface
Power supply	88 to 132 V/194 to 264 V, 47 to 420 Hz, 200 VA
Dimensions (W x H x D); weight	420 mm x 220 mm x 460 mm; 26 kg

Ordering information

Radiocommunication Analyzer	CMTA54	0834.0000.54
	CMTA84	0834.0000.84
Options		
Duplex Synthesizer/Modulation Meter	CMTA-B9	0835.3510.02
Extras		
Oscilloscope Probe	SMFS-Z1	0358.0312.02
Detector Probe	SMFS-Z2	0358.0412.02

Overview of models and options for CMS, CMT, CMTA

Equipment features and main differences of analog and analog/digital radio testers

Characteristics ● = standard equipment ❍ = with option or accessory

Characteristics		CMS				CMT	CMTA	
Type		50	52	54	57	55	54	84
Signal sources								
RF signal generator								
Frequency resolution	25/50/100/200 Hz	–	–	–	–	●	–	–
	50 Hz	●	–	–	–	–	–	–
	10 Hz	–	●	●	●	–	–	–
	1 Hz	–	–	–	–	–	●	●
AM (DC), FM (AC), φM		●	●	●	●	●	●	●
FM (DC)		–	–	–	–	–	●	●
Broadband FM		–	–	–	–	●	–	–
Modulation generator 1		●	●	●	●	●	●	●
Modulation generator 2		●	●	●	●	❍	●	●
OCXO reference oscillator		❍	❍	❍	❍	❍	●	●
VOR/ILS generator		–	–	–	●	–	–	–
Autopilot		–	–	–	❍	–	–	–
Measurement facilities								
RF frequency counter		●	●	●	●	●	●	●
RF frequency-offset meter		●	●	●	●	●	●	●
PEP RF power meter		●	●	●	●	–	–	–
RF power meter	50 W	●	●	●	●	●	●	●
	100 W	❍	❍	❍	❍	–	–	–
Selective RF level meter		●	●	●	●	❍	❍	❍
Modulation meter for AM, FM, φM with								
+PK, –PK, ±PK/2, MAX PK, PK HOLD, RMS detectors		●	●	●	●	●	●	●
Duplex modulation meter		❍	❍	●	❍	❍	❍	●
Broadband FM demodulator		–	–	–	–	●	–	–
AF voltmeter with RMS, +PK, –PK detectors		●	●	●	●	●	●	●
Selective modulation and AF level meter		●	●	●	●	–	●	●
Highpass filter	300 Hz	●	●	●	●	●	●	●
	continuously tunable		–	–	–	–	–	●●
Lowpass filter	300 Hz	❍	❍	❍	❍	–	–	–
	3.4 kHz	●	●	●	●	–	●	●
	continuously tunable		–	–	–	–	–	●●
Bandpass filter,	continuously tunable	●	●	●	●	–	●	●
Notch filter,	continuously tunable	●	●	●	●	–	●	●
SINAD meter	1 kHz	●	●	●	●	●	●	●
	continuously tunable	–	●	●	●	–	●	●
CCITT filter		❍	❍	❍	❍	●	●	●
Distortion meter	1 kHz	●	●	●	●	●	●	●
	continuously tunable	●	●	●	●	–	●	●
S/N meter		●	●	●	●	●	●	●
AF frequency meter		●	●	●	●	●	●	●
DC voltmeter		❍	❍	❍	❍	❍	●	●
DC ammeter		❍	❍	❍	❍	❍	●	●
VSWR meter with separate insertion unit		❍	❍	❍	❍	–	–	–

Overview of models and options for CMS, CMT, CMTA

Equipment features and main differences of analog and analog/digital radio testers

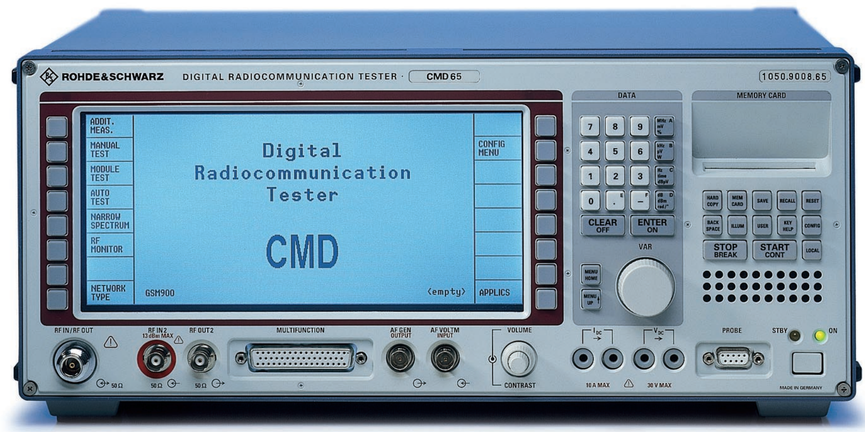
Characteristics ● = standard equipment ❍ = with option or accessory

	CMS				CMT	CMTA	
Type	50	52	54	57	55	54	84
Analyzer/oscilloscope unit							
Oscilloscope	●	●	●	●	●	●	●
Storage oscilloscope	–	–	–	–	–	●	●
RF spectrum monitor	●	●	●	●	–	●	●
Full-span	–	●	●	●	–	–	–
RF tracking operation	❍	❍	●	❍	–	–	–
AF spectrum analyzer	–	–	–	–	–	●	●
SSB spectrum analyzer (digital and screen display)	●	●	●	●	–	●	●
Transient recorder with digital picture memory	–	●	●	●	–	●	●
Signalling units							
Selective-call encoder/decoder for all standards, programmable	●	●	●	●	●	●	●
DTMF encoder	●	●	●	●	❍	●	●
DTMF decoder	❍	❍	❍	❍	❍	●	●
Cellular radio simulator for C Net, Radiocom 2000, NMT 450, NMT 900, AMPS, TACS, E-AMPS, E-/J-TACS, TACS Issue 4	❍[1]	❍	❍	❍	–	❍	●
ERMES coder	❍	❍	❍	❍	❍	❍	❍
CDCSS coder	●	●	●	●	–	–	–
CDCSS decoder	❍	❍	❍	❍	–	–	–
ATIS coder/decoder	❍	❍	❍	❍	–	–	–
Coder/decoder for ZVEI/VDEW digital	❍	❍	❍	❍	–	–	–
Coder for POCSAG (Cityruf)	❍	❍	❍	❍	–	–	–
Coder/decoder for MPT1327/1343 (trunked radio)	❍	❍	❍	❍	–	–	–
Coder/decoder for FMS-BOS	❍	❍	❍	❍	–	–	–
NMT base-station test	–	❍	❍	❍	–	–	–
Control units							
Autorun control	●	●	●	●	❍	❍	❍
IEC/IEEE-bus interface	❍	●	●	●	❍	●	●
Relay matrix	❍	❍	❍	❍	❍	●	●
Programmable control lines	❍	❍	❍	❍	–	–	–
Centronics printer interface	❍	❍	❍	❍	❍	❍	❍
Other equipment							
AF transformers, 600 Ω	❍	❍	❍	❍	–	–	–
10 MHz reference-frequency input and output	❍	❍	❍	❍	●	●	●
3rd RF input/output	❍	❍	❍	❍	●	●	●
13 dBm RF output	❍	❍	❍	❍	●	●	●
Connector for external AF filter	❍	❍	❍	❍	–	–	–
Battery operation	●	●	●	●	●	–	–

1) Without C Net.

Digital Radiocommunication Testers CMD50/52, CMD53/55, CMD65

Multimode compact testers for digital mobile phones to GSM900/1800/1900 and DECT standard



CMD65 (photo 40882-1)

Brief description

CMD 50/52 is a compact unit for testing GSM mobiles. CMD 53/55 is furthermore capable of testing GSM1800 mobile phones. The CMD65 combines the functionality of CMD55 and that of CMD60 (see page 36). CMD53/55 can optional be extended to include the DECT standard. All models can optionally be extended to include the GSM1900 standard.

All models combine small dimensions with high measurement accuracy and speed. The testers' range of capabilities includes all signalling, generator and measurement functions required for verifying the correct operation of the DUT. Thanks to their fast go/nogo tests and accurate analysis using optional extensions, CMD52 and 55 are equally suited for use in service and production.

For use in service and maintenance, models CMD50 and CMD53, which are based on CMD52 and CMD55 but have a reduced number of facilities, are available.

Main differences of CMD52/53 to CMD52/55

– Remote control via RS-232 only (no IEC/IEEE bus)
– No multifunction connector on front panel
– Speech coder/decoder cannot be integrated
– Optional ammeter and voltmeter
– High-sensitivity 2nd RF input available as an option

Operation

Operation of the CMD is extremely user-friendly and requires no detailed GSM knowledge. The high-contrast, backlit LCD provided with softkeys on both sides allows convenient callup of test routines under menu control.

Remote control

- CMD controlled via RS-232 or IEC/IEEE-bus interface uses SCPI-compatible commands
- Designed for fast speed to yield high throughputs in production

Autotest

The autotest function enables complete measurement routines to be started at a keystroke.

Test capabilities

To test mobile phones, the CMD simulates a GSM base station. Two RF synthesizers, one of which delivers a continuous BCCH signal, are available for this purpose. The major test functions are:

- mobile-to-base station synchronization
- location update
- incoming call setup
- outgoing call setup
- mobile power level control
- handover (channel change, time-slot change)
- dual-band handover
- peak power measurement
- SACCH measurement (eg RxLev, RxQual, power level)
- echo test
- call clearing by mobile
- call clearing by network
- DC current/voltage measurement
- phase and frequency error measurement (option CMD-B4)
- measurement of power ramp as a function of time (option CMD-B4)
- bit-error rate (BER) measurement (option CMD-B4)

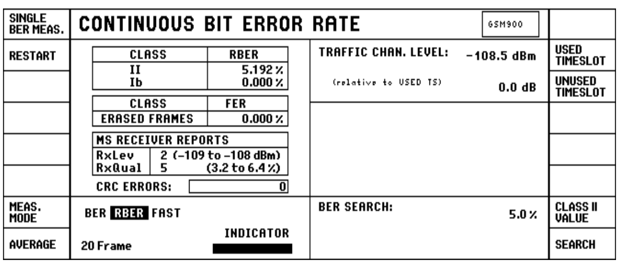
Digital Radiocommunication Testers CMD50/52, CMD53/55, CMD65

Echo test
The echo test allows very rapid go/nogo analysis covering all essential parts of the mobile including microphone and loudspeaker.

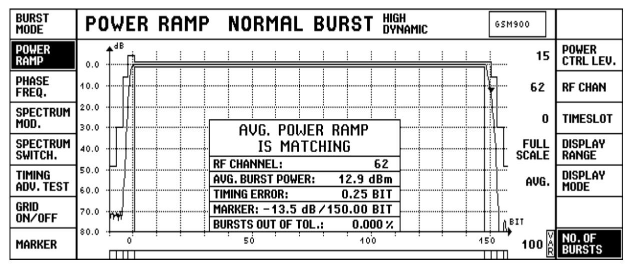
Voltage and power measurements
The DC ammeter/voltmeter designed for pulsed signals allows correct measurement of the power consumption of the mobile phone.

Module test
Fault localization in mobile telephones requires various measurement functions that can also be used without signalling so that defective units can be tested down to module level. The basic model of CMD already provides some of these functions, other functions are available as optional extensions:

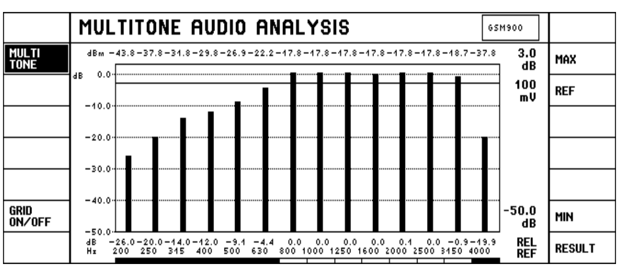
- power measurement
- signal generation
- phase and frequency error measurement
- measurement of power ramp



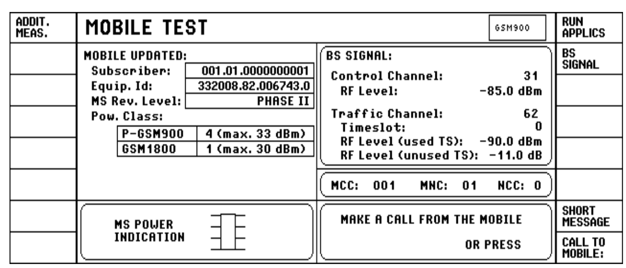
The BER search function allows the absolute sensitivity of a mobile to be determined



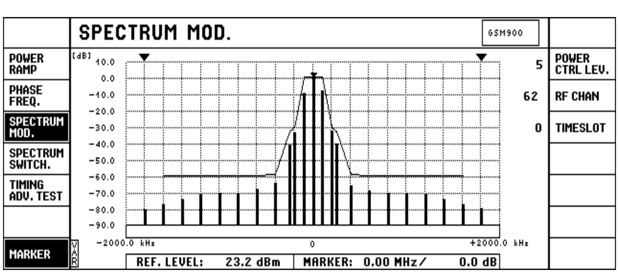
The full dynamic range (>72 dB) of a GSM normal and access burst can be verified with the CMD-B42 option



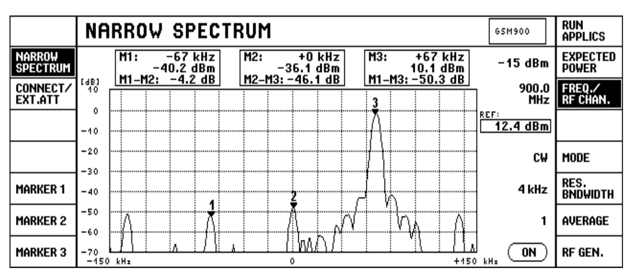
The audio measurement option CMD-B44 is capable of generating and analyzing up to 14 freely configurable tones in about 1 second. Measurements in absolute and relative mode are possible



After location update, it is indicated whether a mobile is a dual-band version. For realistic simulation of the real networks, the CMD-U20 offers the option to have the BCCH present in either band during dual-band simulation



Option CMD-B43 provides measurements of spectrum due to modulation and switching according to GSM recommendations



The narrowband spectrum analyzer option CMD-K43 is used to determine the I/Q modulator balance by measuring the suppressed carrier and sidebands

Digital Radiocommunication Testers CMD50/52, CMD53/55, CMD65

Overview of applications and options

	GSM900	GSM1800	GSM1900	DECT	RS232	IEEE-bus	V/I meas.	Service	Production
CMD50	•	CMD-U1	CMD-U1 CMD-B19	CMD-U1 CMD-U56	•	–	CMD-B20	•	–
CMD52	•	CMD-U1	CMD-U1 CMD-B19	CMD-U1 CMD-U56	•	•	•	•	•
CMD53	•	•	CMD-B19	CMD-U56	•	–	CMD-B20	•	–
CMD55	•	•	CMD-B19	CMD-U56	•	•	•	•	•
CMD65	•	•	CMD-B19	•	•	•	•	•	•

Designation, functions	Option	Order No.
GSM1900 mobile station test (for CMD53/55 and CMD65 only)	CMD-B19	1059.6201.02
OCXO Reference Oscillator: frequency drift $\leq 1 \times 10^{-7}$	CMD-B1	1059.6002.02
Reference Frequency Inputs/Outputs: synchronization to internal or external frequency (2.048, 10, 13.26, 52 MHz) or GSM bit clock (270.8 kHz) 1 to 13 MHz, input signal min. 0 dBm, max. TTL signal	CMD-B3	1051.6202.02
Fast Power Ramp, Phase/Frequency Error and BER Measurement: numeric/graphic display, various BER, RBER, FER test routines; required for fitting CMD-B41 and CMD-B42	CMD-B4	1051.6654.02
AF Measurement Unit with Frequency Counter: comprises AF generator, voltmeter, distortion meter and frequency counter, measurements up to 60 MHz	CMD-B41	1051.6902.02
High-Dynamic Burst Analysis: dynamic range >72 dB (CMD-B4 required)	CMD-B42	1051.7150.02
GSM900/1800/1900-Specific Measurement of spectra due to switching/modulation (CMD-B4 and CMD-B42 required)	CMD-B43	1059.6001.02
Multitone Generator and Analyzer for CMD5x and CMD6x: comprehensive audio tests up to 8460 Hz (CMD-B4 and CMD-B41 required)	CMD-B44	1099.3203.02
Realtime Speech Encoder/Decoder	CMD-B5	1051.8657.02
TDMA Signals ans Adapter for CMD-B6x Options: required for fitting CMD-B61 and CMD-B62	CMD-B6	1051.7409.02
IEC/IEEE-Bus Interface: alternative for RS-232 interface (standard, CMD-B6 required)	CMD-B61	1051.7609.02
Memory Card Interface: archiving of results, etc. (CMD-B6 required)	CMD-B62	1051.8205.02
I/Q Demodulator Output and Trigger Input (BNC connector on the rear panel)	CMD-U5	1059.6901.02
I/Q Demodulator Output and Trigger Input for Fading Simulation	CMD-B17	1099.3003.02
Modification Kit for upgrading CMD50/52 to CMD53/55	CMD-U1	1051.8957.02
DECT Extension for CMD53/55	CMD-U56	1051.8004.02
Narrowband RF Spectrum Analyzer (CMD-B4 required)	CMD-K43	1082.4830.02
Extra Frequency Range for R-GSM, International Railway System (UIC)	CMD-K80	1082.4930.02
Modification Kit for CMD53/65: dual-band handover with BCCH present; for CMD53 only with CMD-U10	CMD-U20	1099.5606.02

Specifications in brief

For CMD65 see also CMD60, page 36

Timebase TCXO standard, 10 MHz

Frequency drift (0 to +35°C)	$\leq 1.5 \times 10^{-6}$
Aging	$\leq 0.5 \times 10^{-6}$/year (at 35 °C)

Timebase OCXO with option CMD-B1, 10 MHz

Nominal frequency	10 MHz
Frequency drift (0 to +50°C)	$\leq 1 \times 10^{-7}$
Aging	$\leq 2 \times 10^{-7}$/year

DC voltmeter 0 to ±30 V

Resolution/accuracy	10 mV/2%

DC ammeter current averaging with GSM-adapted time constant, current peak measurement (positive and negative)

Measurement range	0 to ±10 A
Resolution/accuracy	10 mA/2%

Digital Radiocommunication Testers CMD50/52, CMD53/55, CMD65

Specific data of CMD 52

RF generator 1	
Frequency range	935.2 to 959.8 MHz (GSM channel spacing)
Frequency settling time	≤3 ms for phase error <2°
Output level (RF IN/OUT)	–33 to –120 dBm
Output level (RF OUT 2)	+13 to –77 dBm
Resolution	0.1 dB
Harmonics (RF IN/OUT)	< –30 dBc
Modulation	GMSK, B × T = 0.3
RF generator 2	same as RF generator 1, but
Output level (RF IN/OUT)	–35 dBm (RF OUT 2: +11 dBm)
Peak power meter (RF IN/OUT)	
Frequency range	800 to 1000 MHz
Measurement range/resolution	10 to 47 dBm/0.1 dB
VSWR	≤1.3
GSM phase and frequency error measurement	with option CMD-B4
Frequency range	890.2 to 914.8 MHz (GSM900 band)
Level range (RF IN/OUT	10 to 47 dBm (RF IN 2: –60 to 0 dBm)
GSM burst power measurement	with option CMD-B4
Frequency range	890.2 to 914.8 MHz (GSM900 band)
Reference level range (RF IN/OUT	10 to 47 dBm (RF IN 2: –37 to 0 dBm)
High-dynamic burst analysis	with option CMD-B42
Relative error of individual test sample	≤1.5 dB to 72 dB below peak power
Dynamic range	>72 dB
Measurement limit (RF IN/OUT)	<–36 dBm (RF IN 2: <–83 dBm)

Specific data of CMD 55

RF generator 1		same as CMD52, but
Frequency range	GSM900 band	935.2 to 959.8 MHz
	GSM1800 band	1805.2 to 1879.8 MHz
	GSM1900 band	1930.2 to 1989.8 MHz
Output level	RF IN/OUT	–35 to –120 dBm
	OUT2	+11 to –77 dBm
RF generator 2		same as RF generator 1, but
Max. output level (RF IN/OUT)		–37 dBm (RF OUT 2: +9 dBm)
Peak power meter (RF IN/OUT)		
Frequency range		800 to 1000 MHz
		1700 to 1900 MHz
Measurement range/resolution		
	GSM900 band	0 to 47 dBm/0.1 dB
	GSM1800/1900	0 to 33 dBm/0.1 dB
VSWR		≤1.3
Phase and frequency error measurement		with option CMD-B4
Frequency range	GSM900 band	890.2 to 914.8 MHz
	GSM1800 band	1710.2 to 1784.8 MHz
	GSM1900 band	1850.2 to 1909.8 MHz
Level range		
RF IN/OUT	GSM900 band	0 to 47 dBm
	GSM1800/1900	0 to 33 dBm
RF IN 2		–60 to 0 dBm
Burst power measurement		with option CMD-B4
Frequency range	GSM900 band	890.2 to 914.8 MHz
Frequency range	GSM1800 band	1717.2 to 1784.8 MHz
	GSM1900 band	1850.2 to 1909.8 MHz
Reference level range		
RF IN/OUT	GSM900 band	10 to 47 dBm
	GSM1800/1900	0 to 33 dBm
RF IN 2		–37 to 0 dBm

High-dynamic burst analysis		with option CMD-B42
Dynamic range		>72 dB
Measurement limit		
RF IN/OUT)	GSM900 band	<–36 dBm
	GSM1800/1900	<–48 dBm
RF IN 2	GSM900 band	<–83 dBm
	GSM1800/1900	<–85 dBm

AF Measurement Unit

option CMD-B41

AF generator	
Frequency range/resolution	50 Hz to 10 kHz/0.1 Hz
Frequency drift	same as timebase + half resolution
Voltage range/resolution	10 µV to 5 V/10 µV (1%)
Distortion	≤0.5%
AF voltmeter	
Frequency range	50 Hz to 10 kHz
Measurement range/resolution	0.1 mV to 30 V/100 µV (1%)
Distortion meter	
Frequency range	300 Hz to 3 kHz
Input voltage range/resolution	100 mV to 30 V/0.1%
Inherent distortion	≤0.5%
AF counter	
Frequency range/resolution	20 Hz to 10 kHz/≤1 Hz
Input voltage range	10 mV to 30 V
IF counter	
Frequency range/resolution	10 kHz to 60 MHz/1 Hz
Input signal	min.: 100 mV; max.: TTL signal

Interfaces

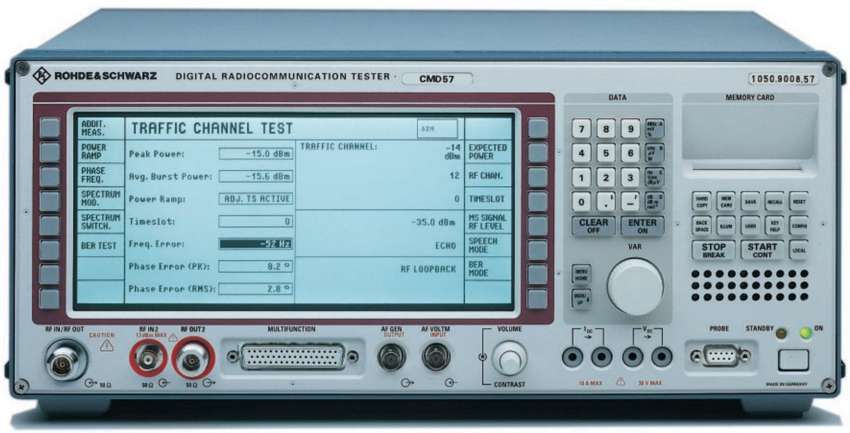
IEC/IEEE-Bus Interface	option CMD-B61 IEC625-1 (IEEE 488), SCPI-compatible
Other interfaces	RS-232-C, Centronics
Reference Frequency Inputs/Outputs	option CMD-B3
Synchronization input	
Frequency (selectable)	GSM bit clock (270.8 kHz), 2xGSM bit clock, 4xGSM bit clock, 16xGSM bit clock, 1 to 13 MHz in 1 MHz steps, 2.048 MHz, 26, 39, 52 MHz
Input signal	min.: 0 dBm; max.: TTL signal
Synchronization output 1	
Frequency	10 MHz with internal reference or frequency at synchronization input with external frequency
Input signal	TTL signal, Z_{out} = 50 Ω
Synchronization output 2	
Frequency (selectable)	GSM bit clock, 2x, 4 x, 16x GSM bit clock, 1, 2, 4 or 13 MHz
Input signal	TTL signal, Z_{out} = 50 Ω

Ordering information

Mobile Station Tester		
GSM900	CMD 50	1050.9008.50
GSM900	CMD 52	1050.9008.52
GSM900 and GSM1800	CMD 53	1050.9008.53
GSM900 and GSM1800	CMD 55	1050.9008.55
GSM900, GSM1800 and DECT	CMD65	1050.9008.65
For all models GSM1900 optional	CMD-B19	1059.6201.02

Digital Radiocommunication Testers CMD54, CMD57, CMD59

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



CMD57

Brief description

Digital Radiocommunication Testers CMD 54/57/59 are advanced top-class instruments for measurements on base stations (BTS) and BTS modules.

CMD 54 is designed for measurements in line with:

- GSM900
- E-GSM
- UIC – European train radiotelephony

CMD 57 additionally covers the following standards:

- GSM1800
- GSM1900 optionally

CMD59 is designed for measurements exclusively in GSM1900 band.

The main applications are:

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

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

These testers combine compact size with high measurement accuracy and speed. They are suitable both for stationary and mobile use and feature great ease of operation and high reliability.

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

The key features at a glance

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

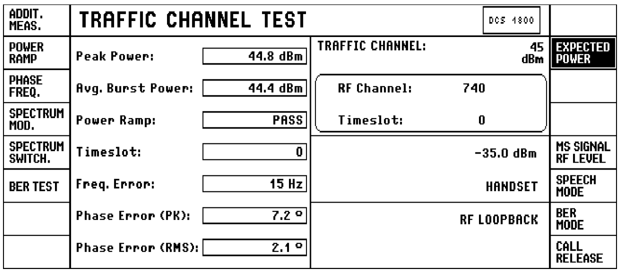
Characteristic/function	Benefit/application
Level error <1dB at –104 dBm	Reproducible and conclusive measurements even at low output levels especially at the sensitivity limits of the receiver
Other measurements	
Echo test	Subjective test of speech quality with call established
Module test	Complete transmitter measurements even without signalling or time synchronization
Multifunction RF generator	Ideal for alignment of receiver modules
DC current and voltage measurement	Optimized for pulsed signals; replaces external measuring instruments
AF measurement facilities and 60-MHz frequency counter (optional)	Replaces external frequency counter; ideal for measuring reference frequencies
RF monitor with bandwidths of 30 kHz, 100 kHz	Replaces external spectrum analyzer
Simulation of fading effects	On request
Flexible use	
Various BTS synchronization facilities as to time and frequency	Easy integration of measuring instrument into operational environment and problem-free adaptation to the specific synchronization signals of a BTS
Remote control via RS-232-C and IEC/IEEE bus	SCPI-compatible for easy generation of user-specific control programs
Low cost of ownership	
Software update via interface	No need to open the instrument; simple download of the latest software version via the RS-232-C interface
3 years of warranty	The optional warranty allows the instruments to be utilized at calculable costs

Overview of options and extras

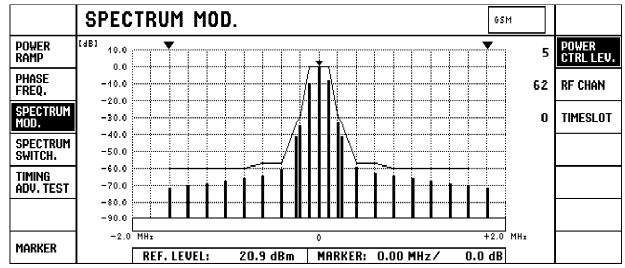
Designation	Brief description, recommendation	Option	Order No.
OCXO Reference Oscillator	For measurements with exacting requirements on frequency stability. Ensures high absolute accuracy, minimum temperature- dependent drift and especially high long-term stability	**CMD-B1**	1059.6002.02
IQ Modulator Output	For BER measurement on BTS receivers under conditions of fading (application note 1MA04_0E available on request). Generator/fading simulator SMIQ can be connected. Not useable with CMD-B8 **and** CMD-B2 together, but with CMD-B8 **or** CMD-B2 (only CMD59)	**CMD-B17**	1099.3003.02
DCS1900 Base Station Test	For testing DCS1900 base stations (only CMD54/57)	**CMD-B19**	1059.6201.02
OCXO Reference Oscillator	For highly demanding requirements on frequency stability. Oven crystal with highest long-term stability. Aging $3.5 \cdot 10^{-8}$	**CMD-B2**	1059.8604.02
DC Voltmeter/Ammeter	Specific voltage and current measurements (only for CMD59)	**CMD-B20**	1059.6401.02
Reference Frequency Inputs/Outputs	For synchronizing DUT and measuring instrument with internal or external frequencies	**CMD-B3**	1051.6202.02
AF Measurement Unit with Frequency Counter	This option includes an AF generator, a voltmeter, a distortion meter and a frequency counter for measurements on the audio interface or on modules. CMD-B41 permits measurements up to 60 MHz as are required for LO alignment	**CMD-B41**	1051.6902.02
Realtime Speech Coder/ Decoder	This option converts digital speech signals into analog signals (and vice versa) (in conjunction with CMD-K1x, CMD-K30 or CMD-B8)	**CMD-B5**	1051.8657.02
Adapter for CMD-B6x Options	Required for operating the options CMD-B61 and CMD-B62	**CMD-B6**	1051.7409.02
IEC/IEEE-Bus Interface	Alternative to standard RS-232-C interface for remote control of CMD	**CMD-B61**	1051.7609.02
Memory Card Interface	Memory cards are a versatile medium for storing instrument settings	**CMD-B62**	1051.8205.02
A_{bis} Interface	For sensitivity measurments; required for A_{bis} control. A_{bis} card for BER measurements at this interface	**CMD-B7**	1051.8357.02

Designation	Brief description, recommendation	Option	Order No.
Test Mobile Functionality	Adds signalling software, SIM card reader and selective filter to the basic model (CMD-B6 required, not usable with CMD-B2 and CMD-B17)	CMD-B8	1059.8204.02
A_{bis} Control Software	Comprises the A_{bis} control software for a certain base station including application program for manual and automatic testing (CMD-B7 required) — ERICSSON RBS200, RBS2000	CMD-K10	1082.2050.02
	NOKIA DE21, DE34, DE45, PRIME SITE	CMD-K11	1082.2150.02
	ITALTEL BS902	CMD-K12	1082.2250.02
	NMC S2000, S4000, S8000	CMD-K13	1082.2350.02
	SIEMENS SBS20, SBS60	CMD-K14	1082.2450.02
	ALCATEL uBTS G2, M1C/M1M, G1 MKII, G2	CMD-K16	1082.2750.02
	LUCENT TECH. BTS2000/2, Cube	CMD-K17	1082.2850.02
Software Upgrade Contract	1 year software upgrade for A_{bis} Control Software CMD-K10	CMDSK10	1082.2950.02
	CMD-K11	CMDSK11	1082.3040.02
	CMD-K12	CMDSK12	1082.3740.02
	CMD-K13	CMDSK13	1082.3140.02
	CMD-K14	CMDSK14	1082.3240.02
	CMD-K16	CMDSK16	1082.3340.02
	CMD-K17	CMDSK17	1082.3440.02
Signalling Software	For signalling purposes eg in test network or in production. Adds call setup functionality to the basic model (functionality is also contained in CMD-B8)	CMD-K30	1082.4530.02
Ciphering Software	Allows encryption according to ETSI Rec. (A5-1/A5-2) (in conjunction with CMD-B8)	CMD-K51 CMD-K52	1082.3540.02 1082.3640.02
UIC European Train Radio	Allows measurements in the UIC frequency range – European train radiotelephony based on GSM-identical signalling (for CMD54/57 only)	CMD-K80	1082.4930.02
Modification Kit High-Level 2nd RF Output (13 dBm)	For off-air measurements. The standard output level range of the second output is approx. –33 dBm to –120 dBm; the level range +9 dBm to –60 dBm is offered alternatively (for CMD54 only)	CMD-U2	1059.6301.02
Modification Kit High-Level 2nd RF Output (9 dBmor 11 dBm)	For off-air measurements. The standard output level range of the second output is approx. –35 dBm to –120 dBm; the level range +9 dBm/+11 dBm to –60 dBm is offered alternatively (for CMD57/59 only, not usable with CMD-U13)	CMD-U3	1059.6501.02
Trigger Inputs/Outputs	The time synchronization signals can additionally be applied to BNC connectors on the rear panel. For monitoring purposes the demodulated I/Q signals are brought out at BNC sockets (rear panel)	CMD-U5	1059.6901.02
Power Meas. Calibration	Power measurement error GSM1800/1900 <0.5 dB (38 dBm to 44 dBm); output level accuracy for BER <1 dB (–95 dBm to –102 dBm)	CMD-U9	1059.7408.02
Modification of RF IN/OUT	Test of micro BTS. Peak power meter measurement range –10 dBm to 37 dBm alternatively to standard range 0 dBm to 47 dBm (not usable with CMD-U3)	CMD-U13	1059.4009.02
Memory Card	Formatted PCMCIA-compatible memory card for storing instrument settings (CMD-B62 required)	CMD-Z1	1059.4809.02
Cable Sets	Cable sets comprise A_{bis} control and monitor cables 75 Ω and 120 Ω, RF connections for A_{bis} control and in-service tests — NMC BTS (US models)	CMD-Z20	1099.3403.02
	ERICSON RBS2000	CMD-Z21	1099.3503.02
	ERICSON RBS200	CMD-Z22	1099.3655.02
	SIEMENS SBS20/60	CMD-Z23	1099.3803.02
	NOKIA DE21/34	CMD-Z24	1099.3955.02
	NOKIA DE45	CMD-Z25	1099.4100.02
Rucksack	Multifunction carrying bag for the instrument	CMD-Z40	1059.7808.02
Handset	Together with CMD-B8 + CMD-B5 allows to talk using CMD in the same way as a mobile	CMD-Z50	1059.4250.02
Message Editor	For analysis of signalling logs on an external PC. Message editor for layer 3 message log	CRPCPH2	1081.6552.02
Transit Case	Robust case for transport CMD with Rucksack CMD-Z40	ZZK-014	1013.9595.00

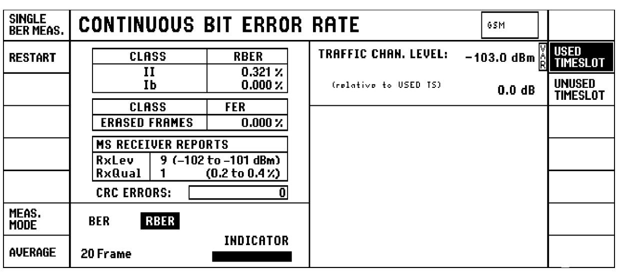
Digital Radiocommunication Testers CMD54, CMD57, CMD59



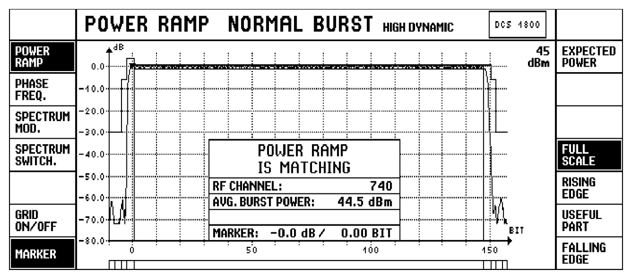
After synchronization to the base station and setting up of a traffic channel, all relevant RF parameters are immediately measured and displayed; this menu also allows a quick change of channel, power and timeslot as well as setting of CMD transmission parameters



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



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



CMD 54 allows the power ramp to be measured with high dynamic range; with graphic display, the zoom function enables application-oriented resolution of parts of the displayed curve

Specifications in brief

Common data of CMD 54/57

Timebase TCXO	standard
Nominal frequency	10 MHz
Frequency drift (0 to 35°C)	$\leq 1.5 \times 10^{-6}$
Aging	$\leq 0.5 \times 10^{-6}$/year (at 35°C)
Timebase OCXO	Option CMD-B1
Nominal frequency	10 MHz
Frequency drift (0 to 50°C)	$\leq 1 \times 10^{-7}$
Aging	$\leq 2 \times 10^{-7}$/year $\leq 5 \times 10^{-9}$/day after 30 days of operation
Timebase OCXO	Option CMD-B2
Nominal frequency	10 MHz
Frequency drift (0 to 50°C) (referred to 25°C)	$\leq 5 \times 10^{-9}$
Aging after 30 days of operation and under constant operat. conditions	$\leq 3.5 \times 10^{-8}$/year $\leq 5 \times 10^{-10}$/day
Warmup time (at 25°C)	approx. 10 min
DC voltmeter	(CMD59: option CMD-B20)
Measurement range	0 V to ±30 V
DC ammeter	(CMD59: option CMD-B20)
Operating modes	current averaging with GSM-adapted time constant, current peak measurement (maximum and minimum)
Measurement range	0 V to ±10 A
Common-mode rejection	±30 V
Resistance	50 mΩ
AF Measurement Unit	Option CMD-B41
AF generator	
Frequency range	50 Hz to 10 kHz
Level range	10 µV to 5 V
Output impedance	<5 Ω
AF voltmeter	
Frequency range	50 Hz to 10 kHz
Measurement range	0.1 mV to 30 V
Input impedance	1 MΩ
Distortion meter	
Frequency range	300 Hz to 3 kHz
Input level range	100 mV to 30 V
AF counter	
Frequency range	20 Hz to 10 kHz
Input level range	10 mV to 30 V
Resolution	≤1 Hz
IF counter	
Frequency range	10 kHz to 60 MHz
Input level range	100 mV rms to TTL
Resolution	1 Hz

Digital Radiocommunication Testers CMD54, CMD57, CMD59

GSM-specific measurement of spectrum

Spectrum due to modulation	
Test method	relative measurement, averaging
Resolution filter bandwidth	30 kHz
Measurement at an offset of	100/200/250/400/600/800/ 1000/1200/1400/1600 and 1800 kHz
Dynamic range	better than specified by GSM
for offset >400 kHz	max. 80 dB
Error	<±1.5 dB
Spectrum due to switching	
Test method	relative measurement, Max Hold over several measurements
Resolution filter bandwidth	30 kHz
Measurement at an offset of	400/600/1200 and 1800 kHz
Dynamic range	better than specified by GSM
for offset >400 kHz	max. 80 dB, with SW correction max. 76 dB, without SW correction
Error	≤1.5 dB (dynamic range <50 dBc) ≤2.5 dB (dynamic range 50 to 80 dBc)

Multi-Reference Frequency Inputs/Outputs Option CMD-B3

Synchronization input:	
Frequency (selectable)	GSM bit clock (270.8 kHz), 2/4/16 times GSM bit clock, 1 to 13 MHz in 1 MHz steps, 2.048/ 16.384/26/39/52 MHz
Impedance	approx. 100 Ω
Level	0 dBm to TTL
Synchronization output 1:	
Frequency	10 MHz with internal reference or frequency at synchronization input with external reference
Level	TTL, R_{out} = 50 Ω
Synchronization output 2:	
Frequency (selectable)	GSM bit clock, 2/4/16 times GSM bit clock, 1/2/4 or 13 MHz
Level	TTL, R_{out} = 50 Ω

A_{bis} Interface	Option CMD-B7
Receive channel (traffic/speech)	75 Ω/high-impedance, unbalanced; 120 Ω/high-impedance, balanced; 16 kbit/s, timeslot selectable
Interfaces	RS-232-C (9-pin), Centronics (25-pin)

Specific data of CMD54 (GSM900)

RF generator	
Frequency range	GSM900: 890.2 to 914.8 MHz E-GSM900: 880.2 to 890.0 MHz
Frequency accuracy	same as timebase
Resolution	GSM channel spacing 200 kHz
Settling time	<3 ms for phase error <2°
Output level (RF IN/OUT)/ (OUTPUT 2)	–33 to –120 dBm
Modulation	GMSK, B x T = 0.3
Phase error	≤4° rms, ≤10° peak
Peak power meter (RF IN/OUT)	
Frequency range	800 to 1000 MHz
Measurement range	10 to 47 dBm
VSWR	≤1.3
Phase and frequency error measurement	
Frequency range	GSM900: 935.2 to 959.8 MHz E-GSM900: 925.2 to 935.0 MHz
Level range	
RF IN/OUT	10 to 47 dBm
RF IN 2	–60 to 0 dBm
Burst power measurement	
Frequency range	GSM900: 935.2 to 959.8 MHz E-GSM900: 925.2 to 935.0 MHz
Reference level for full dynamic range	
RF IN/OUT	10 to 47 dBm
RF IN 2	–37 to 0 dBm
High-dynamic burst analysis	
Relative error of individual test samples	≤1.5 dB to 72 dB below peak power
Dynamic range	>72 dB
Measurement limit RF IN/OUT	<–36 dBm
Measurement limit RF IN 2	<–83 dBm

Specific data of CMD57/59 (GSM900/1800/1900)

RF generator	
Frequency range	GSM900: 890.2 to 914.8 MHz E-GSM900: 880.2 to 890.0 MHz GSM1800: 1710.2 to 1784.8 MHz GSM1900[1)]: 1850.2 to 1909.8 MHz
Frequency accuracy	same as timebase
Resolution	GSM channel spacing 200 kHz
Settling time	<3 ms for phase error <2°
Output level (RF IN/OUT)/(OUTPUT 2)	–35(–37[1)]) to –120 dBm
Modulation	GMSK, B x T = 0.3
Phase error	<4° rms, <10° peak
Peak power meter (RF IN/OUT)	
Frequency range	800 to 1000/1700 to 1900 MHz
Measurement range	0 to 47 dBm
Maximum RF power	47 dBm pulsed 45 dBm CW 47 dBm CW at room temperature
VSWR	≤1.3
Phase and frequency error measurement	
Frequency range	GSM900: 935.2 to 959.8 MHz E-GSM900: 925.2 to 935.0 MHz GSM1800: 1805.2 to 1879.8 MHz GSM1900[1)]: 1930.2 to 1989.8 MHz
Level range	
RF IN/OUT	0 to 47 dBm
RF IN 2	–57(–51[1)]) to 0 dBm
Burst power measurement	
Frequency range	GSM900: 935.2 to 959.8 MHz E-GSM900: 925.2 to 935.0 MHz GSM1800: 1805.2 to 1879.8 MHz GSM1900[1)]: 1930.2 to 1989.8 MHz
Reference level for full dynamic range	
RF IN/OUT	GSM900: 10 to 47 dBm GSM1800/1900: 0 to 47 dBm
RF IN 2	–37(–31[1)]) to 0 dBm
High-dynamic burst analysis	
Relative error of individual test samples	≤1.5 dB to 72 dB below peak power
Dynamic range	>72 dB
Measurement limit RF IN/OUT	GSM900: <–36 dBm GSM1800: <–48 dBm GSM1900: <–42 dBm
Measurement limit RF IN 2	GSM: <–83 dBm GSM1800: <–85 dBm GSM1900: <–79 dBm

Digital Radiocommunication Testers CMD54, CMD57, CMD59

CMD 54/57/59 in multicarrier mode (Option CMD-B8)

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

Typical filter characteristics in multicarrier mode

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

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

Phase and frequency error measurement

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

Measurement of peak power/burst power

Level error ≤1.5 dB

GSM-specific spectrum measurements

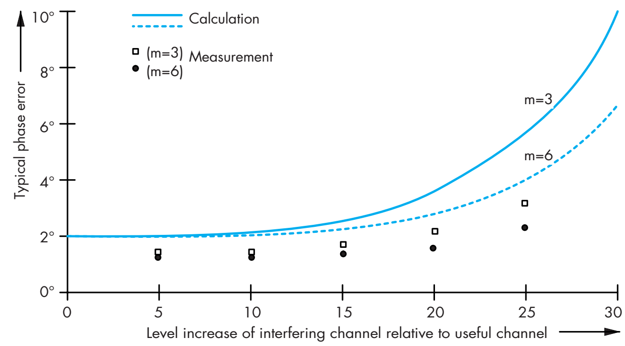
The dynamic range specified for the basic model refers to the sum of all input voltage components. The additional GSM carriers appear as strong spurious emissions in the spectrum measurement and have to be taken into account accordingly when evaluating the tolerances.

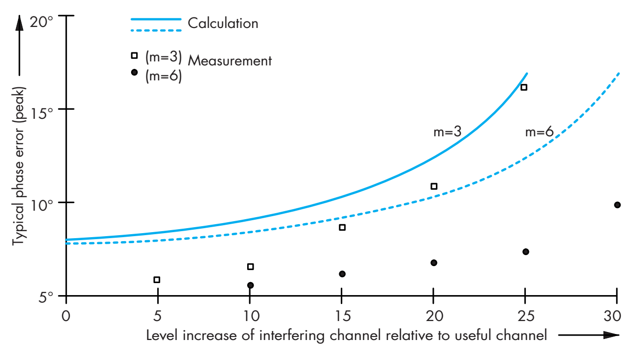
Typical effects of an interferer on power and modulation measurement results (see diagrams on the right). The characteristics of an interferer close to the carrier have the following effect on the measurement error:

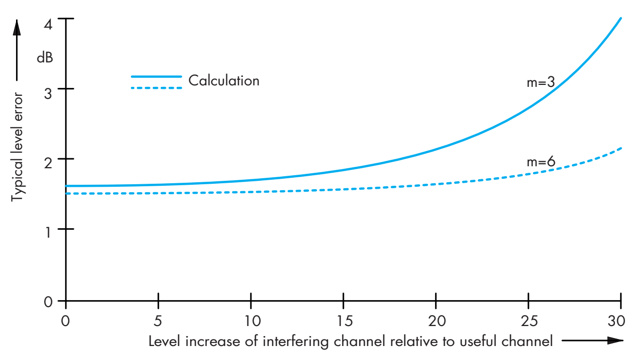
- Power: the lower the power of the interferer, the smaller the measurement error.
- Frequency offset: the larger the frequency offset of the interferer, the smaller the measurement error. In the diagrams on the right an interferer with an offset of m=3 or m=6 GSM channels has been assumed.
- Spectral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

The curves shown in the diagrams have been **calculated** assuming the worst case spectrum as interferer, the guaranteed CMD-B8 specifications for phase and power measurement and a typical IF filter characteristic.

The **measured values** are based on a real GSM spectrum, typical CMD-B8 specifications and typical filter characteristic.







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

General data

Rated temperature range	0 to +45 °C to DIN IEC 68-2-1/2
Storage temperature range	–40 to +60 °C
Power supply	100 to 120 V AC ±10% 200 to 240 V AC ±10% 50 to 400 Hz ±5%
Power consumption (without options)	approx. 85 W
Dimensions (W x H x D)	435 mm x 192 mm x 363 mm
Weight (without options)	approx. 14 kg

Ordering information

Digital Radiocommunication Tester		
for GSM900	CMD54	1050.9008.54
for GSM1800	CMD57	1050.9008.57
for GSM1900n	CMD-B19	1050.9008.59

Accessories supplied power cable, operating manual, fuses

Options see overview of options on page 31

1) In GSM1900 mode with option CMD-B19 fitted.

Digital Radiocommunication Tester CMD60/CMD65

Speedy and cost-effective measurements on DECT communications devices; can be retrofitted for GSM (CMD65 standard), GSM1800 and GSM1900 measurements

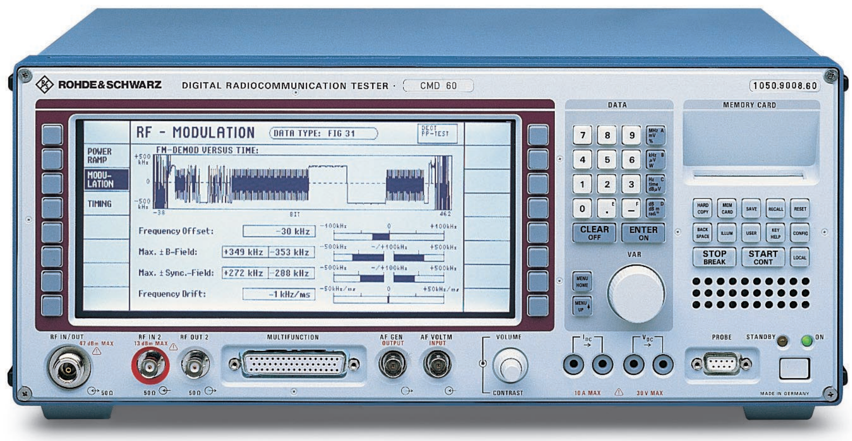


Photo 42198

Brief description

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

In a radiocommunication network such as DECT (Digital European Cordless Telephone) numerous cordless telephones and fixed stations have to share the scarce resources of frequency, time and space. This can only be done by observing stringent rules and specifications.

On the other hand, the DECT system in particular and associated phones are expected to be low-cost units whose complexity and precision are limited. Given these conflicting requirements, it is measurement engineering which has to ensure that the specifications for smoothly working communication are met in spite of less sophisticated technology (compared with other digital cellular systems).The great experience gained with preceding DECT measurement instruments such as signal generators, analyzers, communication testers and DECT type-approval systems as well as cooperative development work with several key end-users have contributed towards creating a well-balanced tester for production and service according to all aspects.

Benefits at a glance

Production

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

Development

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

Servicing

- Relaxed manual operation due to a large bright LCD in conjunction with an extremely simple user interface (requires no DECT-specific knowledge) strictly separated from the

Application overview

	GSM900	GSM1800	GSM1900	DECT	RS232	IEEE-bus	V/I meas.	Service	Production
CMD60	CMD-U65	CMD-U65	CMD-U65 CMD-B19	•	•	•	•	•	•
CMD65	•	•	CMD-B19	•	•	•	•	•	•

Digital Radiocommunication Tester CMD60/CMD65

expert user interface for configurations
- Integrated tools such as a scope display for power and FM demodulation versus time ease troubleshooting

Main features

- For production, service and development
- RF measurements to CTR06
- Comprehensive audio tests
- Extremely fast measurements for high production throughput
- Ergonomic user interface for service applications
- Selfcontained, lightweight, compact tester
- Can be retrofitted for GSM, GSM1800 and GSM1900 measurements

Menu structure

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

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

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

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

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

Interface description

CMD 60 transmitter part
In a very busy DECT environment most DECT frequencies may be in use for communication and therefore influence the measurement in production and development. Besides the channels 0 to 9 the CMD60 enables the use of an extended frequency range for testing. Channels –3, –2, –1 and 10, 11, 12 are outside the normal DECT specification and therefore free for testing.

The DECT standard requires two levels: –83 and –73 dBm. The CMD60 provides an extra level range of up to 30 dB to overcome external coupler and cable attenuation.

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

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

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

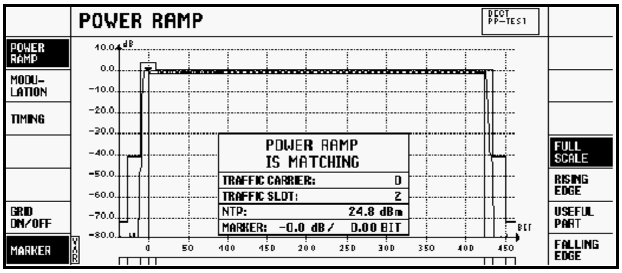
CMD 60 receiver part
It is similar to the transmitter part above: there are 10 DECT frequency channels No. 0 to 9. Additionally, 6 extended DECT frequency channels No. –3, –2, –1 and 10, 11, 12 in DECT channel spacing are provided.

Should the standard DECT output level of 24 dBm be attenuated due to couplers and cable attenuation, the CMD60 provides more than 30 dB measurement range.

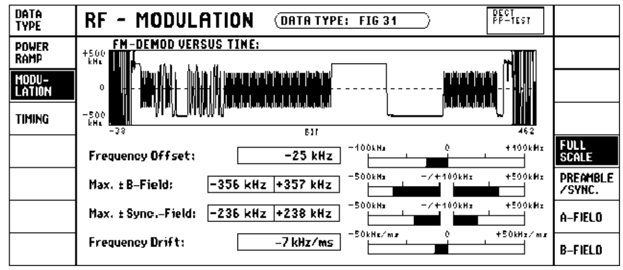
There are two independent receive paths: For DECT signalling and BER a signalling path is incorporated in the CMD60. For TX tests the CMD60 provides a measurement path. The FM and envelope detector are both taken to external connectors and post-processed for power ramp and modulation measurements. The FM and envelope detector output permits monitoring of the DUT transmit signal.

RF input/output
The CMD60 transmitter and receiver are connected to a bidirectional N connector (RF in/out). All mentioned specifications are valid for this connector. Moreover, there is a high-level output for the CMD transmitter (level range like N connector + approx. 40 dB) as well as a high-sensitivity input for the CMD receiver on the front panel.

Digital Radiocommunication Tester CMD60



Power ramp measurement



RF modulation measurement

Demodulator interface
CMD60 provides a linear, analog FM demodulator output (DC-coupled) and a logarithmic analog RF envelope demodulator output (DC-coupled).

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

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

Overview of options

Designation, functions	Option	Order No.
AF Measurement Unit with Frequency Counter (CMD-B4 needed): this option provides an audio measurement unit with AF generator and AF analyzer. The parameters measured are level (peak and rms), frequency, and distortion on selectable frequencies. In addition, the option CMD-B41 incorporates a 60-MHz TTL counter to verify the DUT's reference frequency	CMD-B41	1051.6902.02
Multitone Generator and Analyzer for CMD5x and CMD6x: comprehensive audio tests up to 8460 Hz (CMD-B4 and CMD-B41 required)	CMD-B44	1099.3203.02
Reference Frequency Input/Output, Frequency Syncronization: CMD provides a 10 MHz interface as a common frequency reference.	CMD-B3	1051.6202.02
OCXO Reference Oscillator: this option improves aging and frequency drift of the internal reference source	CMD-B1	1051.6002.02
DSP/Adapter for CMD-B4x options: DSP system carrying out applications for GSM RF and audio tests as well as DECT audio tests. In contrast to GSM, this option is not required for DECT BER measurements	CMD-B4	1051.6654.02
IEC/IEEE-Bus Interface: in addition to the standard RS-232-C interface, the CMD can be fitted with this remote-control interface (CMD-B6 required)	CMD-B61	1051.7609.02
Adapter for CMD-B6x options	CMD-B6	1051.7409.02
Frequency Extension DECT CH +12 to -22 (option only for new instruments) for Latin America and other countries	CMD-K61	1082.3840.02
Same as CMD-K61, but upgrade for instruments with HW version "D"	CMD-U61	1099.5258.02
Extension for GSM900 and GSM1800	CMD-U65	1059.8104.02

Digital Radiocommunication Tester CMD60/CMD65

Specifications in brief

For CMD60/65 see also CMD52/55 on page 26

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

Option CMD-B4 with CMD-B41

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

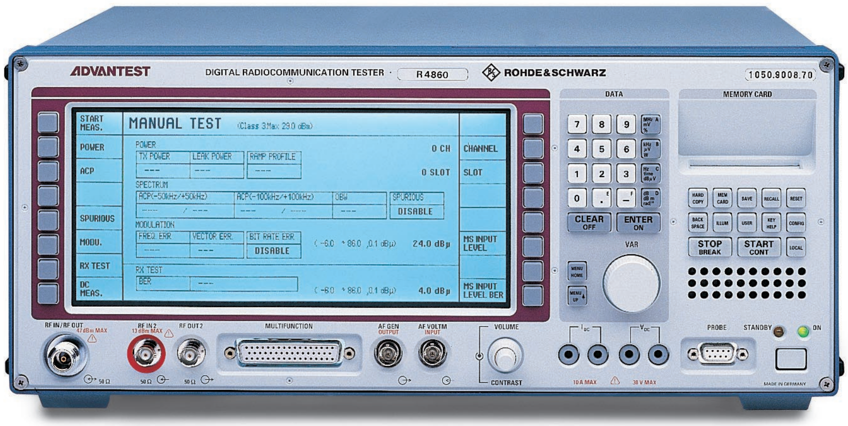
General data

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

Ordering information

Digital Radiocommunication Tester	**CMD60**	**1050.9008.60**
GSM900, GSM1800, DECT	CMD65	1050.9008.65
GSM900 and GSM1800 Extension	CMD-U65	1059.8104.02
Options	see overview of options	

Digital Radiocommunication Tester R4860



Measurement on PDC phones with highest accuracy and speed

Photo 42336

Brief description

Digital Radiocommunication Tester R4860 (joint Product of Rohde& Schwarz and Advantest) is a compact and lightweight measuring instrument. It allows fully automatic, high-speed transmitter and receiver measurements on PDC phones with high accuracy. Operation of the R4860 is extremely user-friendly and requires no detailed PDC knowledge – even complex measurements are carried out at the press of a button. The R4860 is mainly suitable for use in production, maintenance, acceptance testing as well as in all other tests or troubleshooting for PDC phones.

Main features

General advantages

- Measurement to PDC standard STD-27B/C
- Transmitter and receiver measurements with a single unit
- Compact and lightweight (15 kg) unit
- High measurement speed for greater throughput in production

Transmitter measurements

- Frequency error measurement
- Occupied frequency bandwidth
- Output power
- Power leakage with carrier off
- Power measurement with wide dynamic range
- Precision modulation measurement
- Low adjacent-channel leakage power
- Short frequency setting time (1 ms)

Receiver measurements

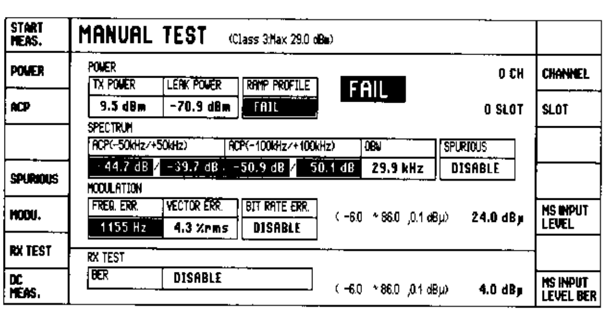
- Receiver sensitivity

DC measurements

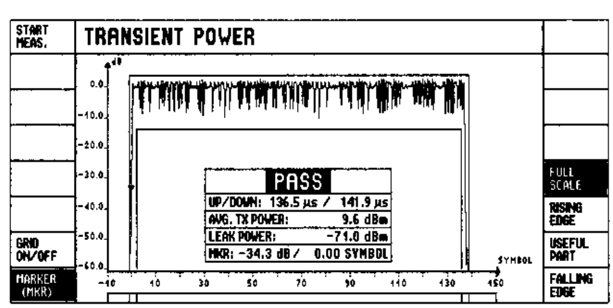
- Measurement of DC current and voltage

Operation

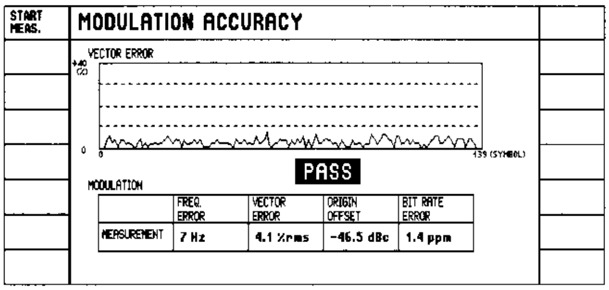
- Simple operation at a keystroke and go/nogo test
- Detailed analysis functions for troubleshooting
- User-specific functions allow setting of any tolerances

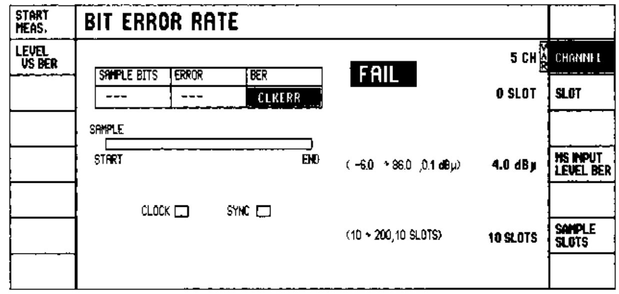


Go/nogo test with pass/fail indication: the radiocommunication tester compares preset or user-defined values with the measured values for each individual measurement



Transient power measurement: the radiocommunication tester allows detailed analysis thanks to the large, easy-to-read display. The transient time (rising and falling edge) is read out by the R4860 as a numerical value based on a built-in measurement algorithm





Measurement of modulation accuracy (frequency, vector error + carrier offset, transmission rate): R4860 displays the relationship between symbol point and vector error with respect to the RF burst modulation of the PDC phone in graphical form. The display allows viewing of the critical burst section. In addition, R4860 can measure the modulation-dependent deviation from the carrier frequency

BER measurement provides information about the sensitivity of the receiver. Provided with two RF outputs, R4860 is able to perform the receiver test based on a calibrated level without using any external switching facilities

Specifications in brief

OCXO reference oscillator

Temperature effect (0 to 45°C)	≤1 x 10^{-7}
Aging (35°C)	≤2 x 10^{-7}/year
DC voltmeter	0 to ±30 V
DC ammeter	0 to ±10 A
Operating modes	current averaging with PDC-adapted time constant, peak current measurement (positive and negative)
Common-mode rejection	±30 V
Resistance	50 mΩ

Receiver measurements

RF generator

Frequency ranges		810 to 826 MHz 860 to 885 MHz 1477 to 1501 MHz
Channel spacing		25 kHz
Resolution		1 Hz
Frequency drift		same as reference frequency
Output level	RF IN/OUT	–119 to –27 dBm
	RF OUT 2	–70 to 0 dBm
Resolution of level setting		0.1 dB
Level accuracy	RF IN/OUT	±1.5 dB
	RF OUT 2	±2 dB
Carrier offset		≤–25 dBc
Vector error		4° rms
Modulation		to RCR-STD27
Signal purity		
Adjacent-channel leakage power (BW = 21 kHz)		≤–50 dB (50 kHz carrier offset) ≤–60 dB (100 kHz carrier offset)
Harmonics		≤–20 dBc

BER measurements

Synchronization range	0 to 10%
Meas. range after synchronization	0 to 25%
Resolution	0.01%
Measured bit length	2240 to 44800
Input transmission rate	≤50 kbit/s

Transmitter measurements

Receive section

Frequency ranges		915 to 956 MHz 1429 to 1453 MHz
Channel spacing		25 kHz
Frequency drift		same as reference frequency
Input level	RF IN/OUT	5 to 37 dBm
	RF IN 2	–20 to –2 dBm
Measurement of adjacent-channel power		
Measurement range (BW = 21 kHz)		≥–53 dB (50 kHz carrier offset) ≥–63 dB (100 kHz carrier offset)
Inherent noise	RF IN/OUT	≤–65 dBm
	RF IN 2	≤–75 dBm
VSWR		≤1.3 (into 50 Ω)
Time-axis measurement		
Resolution		$^1/_4$ symbol (approx. 12 µs)

Modulation measurements

Frequency offset measurement range		±4 kHz
Frequency measurement accuracy		10 Hz + reference frequency drift
Resolution		1 Hz
Modulation accuracy meas. range		0 to 30%
Resolution		0.1%
Accuracy	meas. value ≤2% rms	(1.0 + reading x 3%)% rms
	meas. value >2% rms	(2.0 + reading x 3%)% rms
Inherent offset (at –25 dBc carrier offset)		±2 dB

Measurement of transmission rate

Measurement range	±5 ppm
Resolution	0.1 ppm

Interfaces

Remote control	IEC625-2 (IEEE488)
Printer	Centronics (25-contact)
Data input	BNC, ≤50 kbit/s
External reference input	BNC, TTL (CMOS)
Impedance	100 kΩ

General data

Power supply, AC	100 to 120/200 to 240 V ±10%, 48 to 420 Hz
Power consumption (without options)	145 VA
Dimensions (W x H x D)	435 mm x 192 mm x 363 mm
Weight (without options)	15 kg

Ordering information

Digital Radiocommunication Tester for PDC	R4860

Digital Radiocommunication Tester CMD80

Precise, high-speed CDMA, D-AMPS and analog measurements for production, development, quality control and service

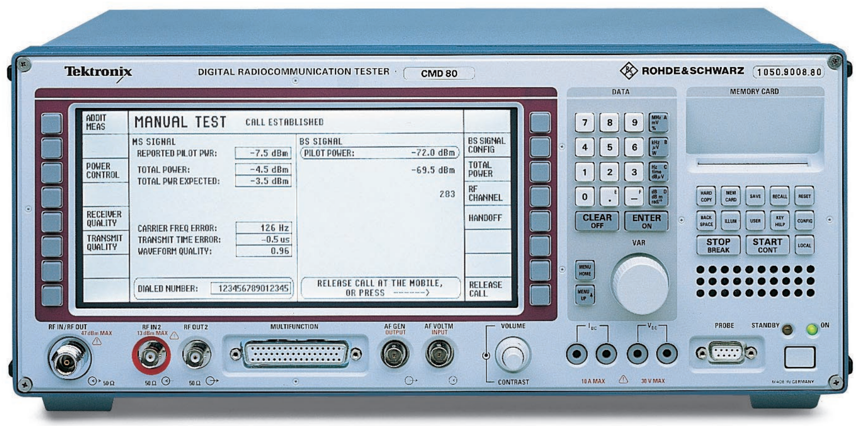


Photo 42164

Brief description

CMD80 is the first compact tester worldwide for CDMA, AMPS, D-AMPS (TDMA) and TACS mobile stations. The mobile's RF parameters are verified under the same conditions as in the real network, ie the tester simulates a tri-mode/dual-band base station, makes a call to the mobile and performs the measurements without any special test mode in the DUT. The following networks and frequency bands are supported:

US Cellular (800 MHz)	CDMA(IS95) D-AMPS/NADC (IS136, IS54) AMPS/N-AMPS (IS95)
Japan Cellular	CDMA (T53, IS95) N-TACS/J-TACS
China Cellular	CDMA (IS95) E-TACS/TACS
US GSM (1900 MHz)	CDMA (UB-IS95, J-STD008) D-AMPS/NADC (IS136, IS54)
Korea GSM (1800 MHz)	CDMA (J-STD008, UB-IS95)

High measurement speed and remote-control capability via IEC/IEEE bus make the tester ideal for use in production. Its high measurement accuracy is indispensable in particular in the development of mobile stations. A user-friendly operating concept and fast functional tests allow cost-effective working in service applications.

Main features

Fast measurements
State-of-the-art digital technology leads to quick and efficient measurements. In remote-control mode via IEC/IEEE bus, the instrument is exceptionally fast and yields high throughput in production.

High flexibility
Almost every signalling and measurement parameter can be modified by the user either dynamically during a test or in advance in the configuration menu. Even the tolerances for the pass/fail limits can be changed to match the requirements of the application. The different configurations can be separately stored and recalled any time at the push of a button.

Easy to use
Operation of the CMD80 is extremely user-friendly and requires no detailed knowledge. The large high-contrast LCD with softkeys on both sides allows convenient menu-guided access to the test routines. A voice loop-back allows quick verification of the performance of a mobile as it is perceived by the user. During a call in data loop-back mode CMD80 checks the basic signalling features and the RF performance.

Test capabilities

Simulation of a base station
Digital Radiocommunication Tester CMD80 simulates a tri-mode/dual-band base station and provides all the signalling necessary for a call (synchronization, registration, incoming/outgoing call origination, tri-mode/dual-band handoffs and echo mode). This also allows checking of all software features that are required for correct operation of the network. This eliminates in many cases the need for expensive customer-specific test beds in development and quality assurance.

Autorun
Custom-tailored autorun applications allow any test routines to be implemented. Complete tests of mobile phones can be performed at the push of a button. Due to the individual configuration, the test time is reduced to a minimum.

Tests
All essential features of a mobile station can be tested with high accuracy. CMD80 not only verifies the RF per-

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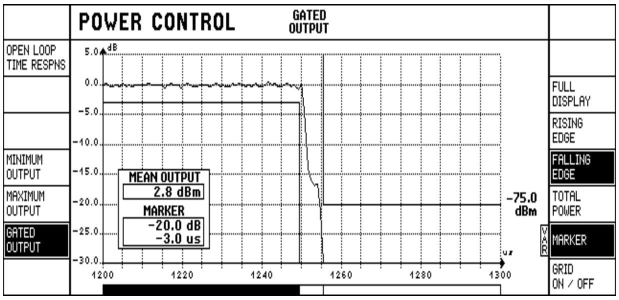
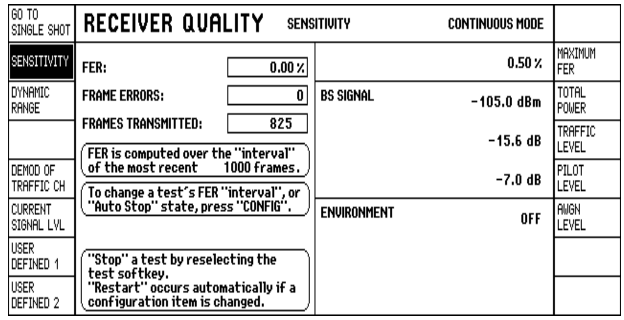
Digital Radiocommunication Tester CMD80



Graphic display of gated output power



Sensitivity test by measuring frame error rate

formance of the mobile station but, but in addition checks all software features that are important for the correct operation of the network.

CMD80 measures for instance the following parameters to IS98/J-STD-18 specification in CDMA:

- Transmitter measurements
  - Magnitude error
  - Phase error
  - Error vector amplitude
  - Signal quality
  - Carrier feedthrough
  - Frequency accuracy
  - Power measurements
- Receiver measurements
  - Transmission error

DC measurements

The DC ammeter/voltmeter for pulsed signals allows accurate measurement of the power consumption of the mobile station.

Measurements at protocol level

The optional Message Monitor (CMD-B83) allows measurements at protocol level. The convenient Windows program clearly displays CDMA forward/reverse link messages and is an indispensable tool especially in the development of mobile units.

Specifications in brief

CDMA

Signal generator

Frequency range,	US Cellular	869 MHz to 894 MHz
	GSM (US)	1930 MHz to 1990 MHz
	GSM (Korea)	1805 MHz to 1870 MHz
Output level,	RF IN/OUT	– 20 dBm to –124 dBm
	RF OUT2	0 dBm to –105 dBm
Modulation		QPSK

Analyzer

Frequency range,	Cellular	824 MHz to 849 MHz
	GSM (US)	1850 MHz to 1910 MHz
	GSM (Korea)	1715 MHz to 1780 MHz
Power measurement (reference level range)		
RF IN/OUT (full scale)		+41 dBm to –28 dBm
RF IN2 (full scale)		0 dBm to –69 dBm
Dynamic range		50 dB below reference level
Demodulator		O-QPSK
Modulation measurements		signal quality (ρ) phase error magnitude error error vector amplitude carrier feedthrough I/Q imbalance carrier frequency error transmission error
DC voltage measurements		
Range		0 V to ±30 V
DC current measurements		
Range		0 A to ±10 A
Signalling		
Digital modes		IS95, UB-IS95, J-STD008, T53

D-AMPS; option CMD-B84

Signal generator

Frequency range,	Cellular	869 MHz to 894 MHz
	GSM	1930 MHz to 1990 MHz
Output level,	RF IN/OUT	–17 dBm to –131 dBm
	RF OUT2	+3 dBm to –112 dBm
Modulation		π/4 DQPSK or unmodulated

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Digital Radiocommunication Tester CMD80

Analyzer

Frequency range, Cellular	824 MHz to 849 MHz
GSM	1850 MHz to 1910 MHz
Power measurement (reference level range)	
RF IN/OUT (full scale)	+39 dBm to – 60 dBm
RF IN2 (full scale)	–2 dBm to –100 dBm
Power ramp	
Adjacent-channel power	
Modulation measurements	phase error magnitude error error vector amplitude carrier feedthrough I/Q imbalance carrier frequency error
Bit error rate measurement	
Signalling	
Digital modes	IS136, IS54

AMPS/TACS; option CMD-B82

RF signal generator

Frequency range	
AMPS	869 MHz to 894 MHz
N-AMPS	869 MHz to 894 MHz
TACS	935 MHz to 960 MHz
J-TACS	860 MHz to 870 MHz
E-TACS	917 MHz to 950 MHz
N-TACS	843 MHz to 846 MHz 863.5 MHz to 867 MHz
Output level	
RF IN/OUT	– 20 dBm to –124 dBm
RF OUT2	0 dBm to –105 dBm
FM modulation	

RF analyzer

Frequency range	
AMPS	824 MHz to 849 MHz
N-AMPS	824 MHz to 849 MHz
TACS	890 MHz to 915 MHz
J-TACS	915 MHz to 925 MHz
E-TACS	872 MHz to 905 MHz
N-TACS	898 MHz to 901 MHz 918.5 MHz to 922 MHz
Reference level range	
RF IN/OUT	+41 dBm to –28 dBm
RF IN2	0 dBm to –69 dBm
RF frequency measurement	
Dynamic range (rel. to ref. level)	>40 dB
RF power measurement	
RF IN/OUT	0 dBm to +41 dBm
RF IN2	0 dBm to –69 dBm
FM demodulation	
Signalling	analog signalling AMPS (IS95), NAMPS, TACS, J/E/N-TACS

Audio source

Frequency	50 Hz to 4 kHz (single tone)
Output voltage	
Range	0.1 mV to 5 V, rms

AF analyzer

Measurements	frequency AC voltage THD SINAD

General data

Rated temperature range	0 °C to 45 °C to DIN IEC 68-2-1/2
Storage temperature range	–40 °C to +60 °C
Power supply	110 V to 120 V/200 V to 240 V (AC) ±10%, 50 Hz to 400 Hz ±5%
Dimensions (W x H x D)	435 mm x 192 mm x 363 mm
Weight (without options)	approx. 15 kg

Ordering information

Digital Radiocommunication Tester	CMD80	1050.9008.84
Options		
IS-95 CDMA 800 MHz Test Functions	CMD-K1	1082.2550.02
GSM1900/1700 MHz Test Functions	CMD-K2	1082.2650.02
OCXO Reference Oscillator	CMD-B1	1051.6002.04
Reference Frequency Inputs/Outputs	CMD-B3	1051.6202.02
Rate Set 2 (13k vocoder support)	CMD-B14	1059.6101.02
I/Q Modulation Outputs	CMD-B17	1099.3003.02
Carrier Board for CMD-B61/B62	CMD-B60	1059.5405.02
IEC/IEEE-Bus Interface	CMD-B61[1]	1051.7609.02
Memory Card Interface	CMD-B62[1]	1051.8205.04
AWGN Generator	CMD-B81	1059.7508.02
AMPS/TACS Option	CMD-B82[1]	1059.4344.12
Message Monitor	CMD-B83	1099.5706.02
IS136 Option	CMD-B84[2]	1099.5806.02
Extras		
Universal Shielded Chamber with Mobile Radio Antenna Coupler	CTD-Z10	1084.0003.02

[1] CMD-B60 required

[2] CMD-B82 required

Brief description

CRTP02 and CRTC02 are extremely powerful tests sets providing all simulation and analysis capabilities from measurement of GSM900/1800 and 1900-specific RF parameters through to detailed checking for errors in the signalling protocol.

Radiocommunication Test Set CRTP02 simulates a base station (BTS, cell) with two independent radio channels in the GSM900 or GSM1800 band. The CRTC02 covers in addition the GSM1900 standard in the US PCS frequency band. With CRTP02 and CTRC02 almost every GSM feature relevant for the communication between mobile and network can be tested.
Besides the standard speech service the instruments optionally support the following services:

- Short message service
- Supplementary services
- Transparent data services
- Non-transparent data services (RLP)
- Ciphering A5-1 and A5-2
- GSM phase II

The sets consist of a digital unit, analog unit, colour monitor and keyboard. Due to their flexible structure the instruments can easily follow the evolution of the GSM standard by software upgrades.

Applications

Development
- Measurements on GMSK-modulated RF signals and receiver testing
- Testing of all signalling functions and validation of data transmission protocols and timing
- Simple generation of customized test procedures

Type-approval preparation and quality assurance
Testing of conformance with GSM Specification 11.10. Phase I and Phase II with respect to
- channel coding
- datalink protocols
- network signalling
- GSM-specific RF parameters

Chip design
Thanks to built-in TTL input/output of bits and an optional I/Q interface at the baseband, the instruments are ideal for use in development and validation of integrated circuits and modules.

Operation

CRTP02 and CRTC02 may be operated in three different ways:

- via convenient menus
- by running ready-to-use test cases selected from a pick list
- by running user-programmed tests

Menu interface
The convenient, menu-guided user interface permits simple and fast call-up of test routines and RF measurements.

Test routines
- Synchronization of mobile
- Location update of mobile

- Incoming/outgoing call setup
- Power level control of mobile
- Bit error in loopback mode
- Channel change
- Call clearing by mobile
- Call clearing by network
- SACCH measurements
- Speech loopback

RF measurements

- Phase error
- Frequency error
- Power level
- Power characteristics versus time

Test routines and measurements are clearly indicated on the screen and activated by simple selection. Test results are displayed in graphical and numerical form.

Ready-to-use programs

About 20 of the ready-to-use test programs complying with GSM Spec. 11.10 GSM 900 and GSM 1800/1900 are delivered with the instrument's basic operating software. Numerous additional test programs are available as software options.

Signalling

The instrument performs all channel coding and layer 2 signalling functions automatically in real time. The detailed signalling sequence is determined by the user-written or ready-to-use C program, defining the order in which layer 3 messages have to be transmitted.

The messages are generated by a special editor which can handle the coding rules of GSM 4.08. The same tool is also used to examine the log memory. In order to test the layer 2 or RLP function, the layer 2 functionality can be modified during the execution of a test. In particular, it is possible to ignore a certain number of layer 2 frames, wait for the arrival of a specific frame or modify the layer 2 status variables V(R), V(S) and V(A). A built-in speech encoder/decoder may be used to test voice transmission. Data traffic may be routed to the display or the COM interface of the instruments.

Protocol analysis

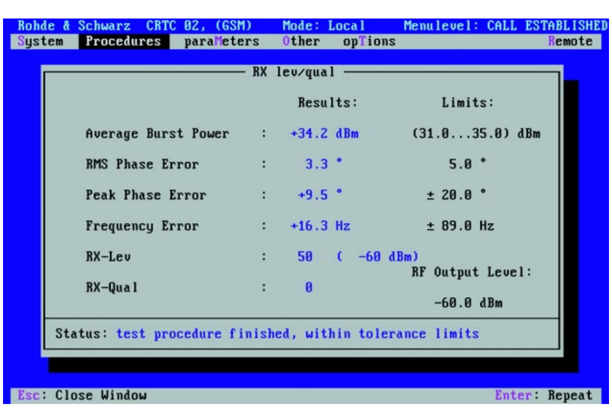
Every transmitted or received layer 3 or layer 2 message, or even the bits of a burst, are marked with a frame number, channel type and recorded in the log memory. The menu-controlled message editor operating in line with the coding rules of GSM 4.08 can be used to navigate through the log memory and to display the recorded sequence at the various layers in mnemonic form. The user may look at the message sequence or in more detail at all the elements of a single layer 3 message. Besides the message type and a frame number the channel type is displayed. The BsChan column allows to distinguish between the two radio channels of the instrument.

Data services

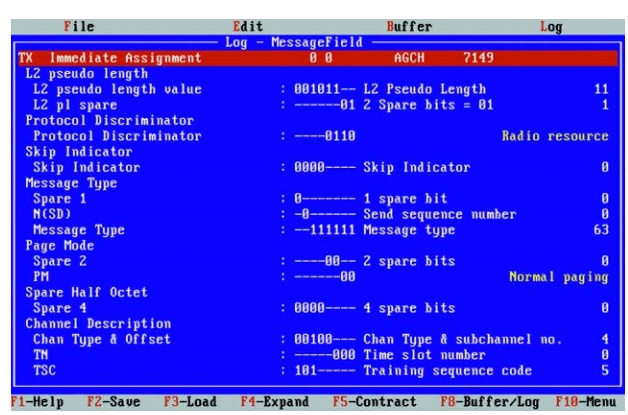
CRTP02 and CRTC02 support the testing of transparent and non-transparent data services. In the transparent, asynchronous case the instrument performs rate adaptation and checks for missing stop bits, wrong parity bits etc. The instrument is also able to generate data streams with over- and underspeed.

Supplementary services

The instrument is able to test supplementary services such as call forwarding, call restriction and call charging by using a set of ready-to-use test programs.

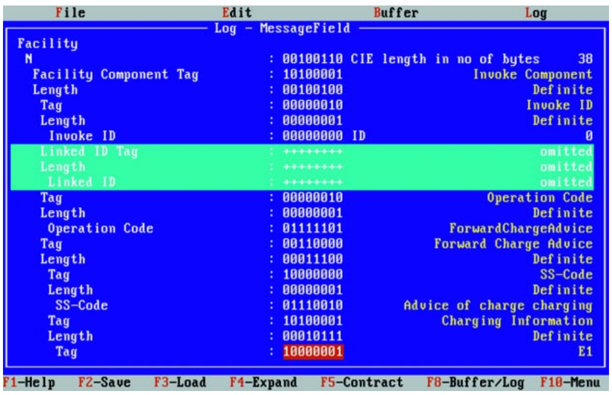


Menu-driven RF measurements

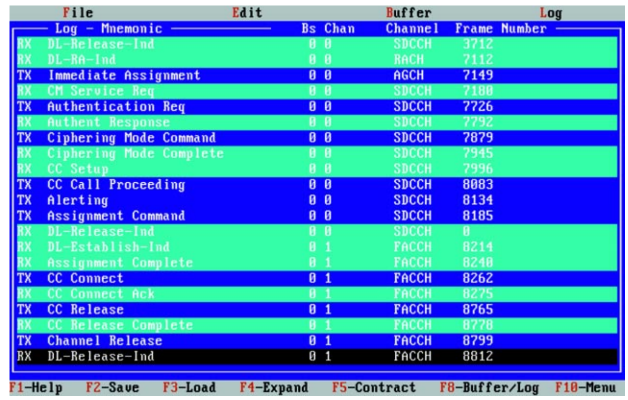


Facility information element for charging supplementary services

Digital Radiocommunication Test Sets CRTP02, CRTC02



Display of detailed content of a layer 3 message



Display of message sequence at layer 3 level

Overview of hardware options

Designation	Type	Order No.	Description
AF Measurement Unit	CRTP-B1	1052.9505.02	A great variety of audio measurements can be performed on the AF section of the mobile under test. The AF generator provides single or double tones. The following measurement facilities are implemented: – AF voltmeter with rms or peak weighting – continuously tunable distortion and SINAD meter – AF frequency counter – DC ammeter/voltmeter
I/Q Inputs/Outputs	CRTP-B7	1052.9257.02	This option provides access to the interface between the modulator and the radio section of the instrument and enables the testing of mobiles at module level.The digital section of a mobile can be examined in the baseband at an early stage when the RF module is not yet available
GSM Test SIM	CRT-Z2	1039.9005.02	A special SIM card with known content enables the testing of authentication and ciphering

Overview of software options

GSM Phase I

Designation	Type	Order No.	Description
GSM900 Test Cases	CRTS-K22 CRTS-K23 CRTS-K24	1034.4286.02 1034.4305.02 1034.4328.02	These three options together contain more than 150 ready-to-use test programs for GSM 900 in accordance with GSM Spec.11.10. The test programs follow the GSM evolution. For detailed content and current version of GSM 11.10. please contact your local sales office
GSM1800/1900 Test Cases	CRTP-K22 CRTP-K23 CRTP-K24	1053.1050.02 1053.1108.02 1053.1150.02	These options are the GSM1800 and GSM1900 version of CRTS-K22 to CRTS-K24
Non-Transparent Data Services/RLP	CRTS-K28	1034.4405.02	Adds non-transparent data services (radio link protocol) capability to the instrument. The option covers both GSM phase I and phase II

Designation	Type	Order No.	Description
Supplementary Services incl. 17 tests	CRTS-K38	1034.4457.02	This option consists of the message editor for supplementary services and ready-to-use test programs. The software can be used for GSM900, GSM1800 and GSM1900
Transparent Data Services/SMS	CRTS-K48	1034.4670.02	This option consists of the message editor support for short message service, ready-to-use test programs for SMS and the basic software for transparent data services. The software can be used for GSM900, GSM1800 and GSM1900

GSM Phase II

Designation	Type	Order No.	Description
GSM-Phase II Basic Software	CR02PH2	1053.0501.02	This option is the GSM phase II operating software for CRTC02 and CRTP02
Transparent Data Services/SMS Phase II	CR48PH2	1057.8157.02	This option consists of the message editor for short message service and the basic software for transparent data services. The software can be used for GSM900, GSM1800 and GSM1900
Non-Transparent Data Services/RLP	CR28PH2	1081.6852.02	Adds non-transparent data services (radio link protocol) capability to the instrument.
GSM900 Test Cases	CRTP-K52 CRTP-K53 CRTP-K54 CRTP-K56	1053.1308.02 1053.1350.02 1053.1408.02 1101.3698.02	These options together contain more than 150 ready-to-use test programs for GSM 900 in accordance with GSM Specification 11.10 phase II. The test programs follow the GSM evolution. For detailed content and current version of GSM 11.10. please contact your local sales office
GSM900 Test Cases Supplementary Services	CRTP-K58	1075.8105.02	This option consists of the message editor support for supplementary services for GSM 900 phase II and a set of ready-to use test programs
GSM900 Test Cases/SMS	CRTP-K59	1075.8357.02	This option consists of a set of ready- to-use test programs for short message services for GSM 900 phase II
GSM Test Cases	CRTPK5A	1101.4607.02	GSM Test Cases for transparent data services (CR48PH2 required).
GSM Test Cases	CRTPK5B	1101.4759.02	GSM Test Cases for non-transparent data services (RLP) (CR28PH2 required)
GSM1800 Test Cases	CRTP-K62 CRTP-K63 CRTP-K64 CRTP-K66	1075.8505.02 1075.8557.02 1075.8605.02 1101.3846.02	These options are the GSM 1800 version of CRTP-K52 to CRTP-K56.
GSM1800 Test Cases	CRTP-K68	1075.8705.02	This is the GSM 1800 version of CRTP-K58
GSM1800 Test Cases	CRTP-K69	1075.8757.02	This is the GSM 1800 version of CRTP-K59
GSM1800/1900 Test Cases	CRTPK6A	1101.4907.02	GSM1800/1900 Test Cases for transparent data services (CR48PH2 required)
GSM1800 Test Cases	CRTPK6B	1101.5055.02	GSM 1800 Test Cases for non-transparente data services (RLP) (CR28PH2 required)
Software GSM1900	CRTPK72 CRTPK73 CRTPK74 CRTPK75 CRTPK76 CRTPK78 CRTPK79	1111.3484.02 1111.3632.02 1111.3784.02 1111.3932.02 1111.4080.02 1111.4239.02 1111.4380.02	Software: GSM1900 , Test Cases Phase II. Software: GSM1900, Test Cases Phase II. Software: GSM1900, Test Cases Phase II. Software. GSM1900, Handover Test Cases Phase II. Software: GSM1900, Test Cases Phase II. Software: GSM1900, Supplementary Services Test Cases Phase II. Software: GSM1900, Short Message Service Test Cases Phase II, (CR48PH2 required)
Software GSM1900	CRTPK7A	1111.4539.02	Software: GSM1900; transparent data services Test Cases Phase II (CR48PH2 required)

Digital Radiocommunication Test Sets CRTP02, CRTC02

Designation	Type	Order No.	Description
Software GSM1900	CRTPK7B	1111.4680.02	Software: GSM1900, non-transparent data services Phase II (CR28PH2 required)
Ciphering A5-1	CRTS-K1	1034.4228.02	Adds A5-1 ciphering to the instrument
Ciphering A5-2	CRTS-K2	1034.4105.02	Adds A5-2 ciphering to the instrument
GSM1800/1900 Handover Test Cases	CRTP-K55 CRTP-K65	1035.1450.02 1075.8657.02	This option contains a set of phase II handover tests for GSM 900 and GSM 1800/1900 mobiles

Specifications in brief

GSM1900 data are only applicable to CRTC02.

Analog unit

Signal generator

Frequency range	GSM 900	935.2 to 959.8 MHz
	GSM1800	1805.2 to 1879.8 MHz
	GSM1900	1930.2 to 1989.8 MHz
Temperature variation		$<2 \times 10^{-9}$/°C
Maximum output level		13 dBm
Static attenuation setting		0 to 135 dB
Resolution		5 dB
Dynamic attenuation		0 to 35 dB (electronic)
Modulation		GMSK, bit rate 270 833 bit/s acc. to GSM Spec. 05.04

Analyzer

Frequency range	GSM 900	890.2 to 914.8 MHz
	GSM1800	1710.2 to 1784.8 MHz
	GSM1900	1930.2 to 1989.8 MHz
Reference level for full dynamic range	GSM900	13 to +47 dBm ($RF_{IN/OUT}$) –17 to +19 dBm (RF_{IN2}),
	GSM1800/1900	9 to +36 dBm ($RF_{IN/OUT}$) –21 to +6 dBm (RF_{IN2})

RF inputs/outputs

Fading simulator	2 N connectors, 50 Ω (output level 8 to 13 dBm)
$RF_{IN/OUT}$ and RF_{IN2}	N connectors, 50 Ω

Digital unit

CPU

Processor	80486 DX
RAM	8 Mbyte
Floppy disk drive	3 ½", 1.44 Mbyte
Hard disk	200 Mbyte
Graphics	VGA
Interfaces	parallel Centronics, RS-232-C
Channels supported	CO channels with FCCH + SCH + BCCH + CCCH + CBCH + SDCCH/4 + SACCH traffic channel (voice and data) with TCH + FACCH + SACCH, SDCCH/8 + SACCH

AF Measurement Unit (CRTP-B1)

AF generator

Signal source	single or dual tone
Frequency range	20 Hz to 20 kHz
Output voltage	10 µV to 5 V_{rms}

AF voltmeter

Operating modes	RMS, +peak, –peak
Frequency range	50 Hz to 5 kHz
Voltage range	0.1 mV to 30 V_{rms}
Weighting filter	CCITT filter, complying with CCITT 0.41

Distortion meter

Frequency range	20 Hz to 20 kHz
Measurement range	0 to 50%

AF frequency counter

Frequency range	50 Hz to 5 kHz
Resolution	0.1 Hz/1 Hz
Input voltage range	10 mV to 30 V (up to 20 kHz)

DC measurements

Voltage/current	0 to ±30 V/0 to ±10 A

I/Q Inputs/Outputs (CRTP-B7)

Input level/output level	±1.5 V_{pp} The option is required separately for each of the two channels of CRTC02/CRTP02

General data

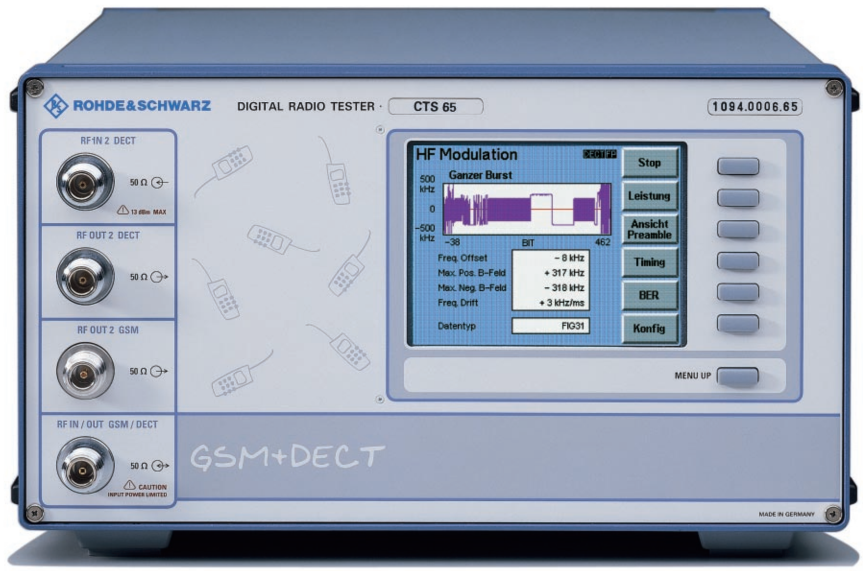
Power supply	110/220 V ±10% 47 to 63 Hz (max. 500 VA)
Dimensions (W x H x D); weight	
Analog unit	435 mm x 236 mm x 570 mm; 27 kg
Digital unit	435 mm x 192 mm x 570 mm; 18 kg

Ordering information

Digital Radiocommunication Test Set	CRTP02	1052.6506.02
	CRTC02	1081.6000.02

Digital Radio Testers CTS50, CTS55, CTS65 for mobile phones

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



CTS65 (photo 43115-1)

Brief description

Digital Radio Tester CTS – a new tester family from Rohde&Schwarz – comes in three models:

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

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

Main features

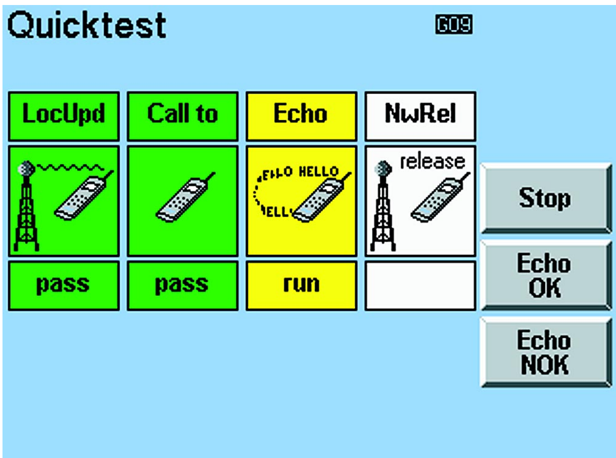
- User-friendly menu-guided control via softkeys
- Logical user prompting without interleaved submenus
- Brilliant TFT colour display: a new dimension in this class of instruments
- Menus in six different languages
- Compact and robust design, low weight
- Eye-strain-free working
- Dynamic range for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

GSM measurement functions

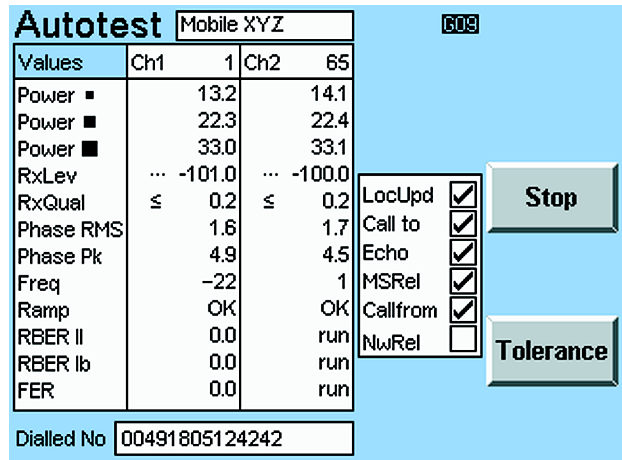
CTS55 simulates a GSM base station for testing mobile phones. The following measurements and tests can performed by automatic test routines or manually.

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

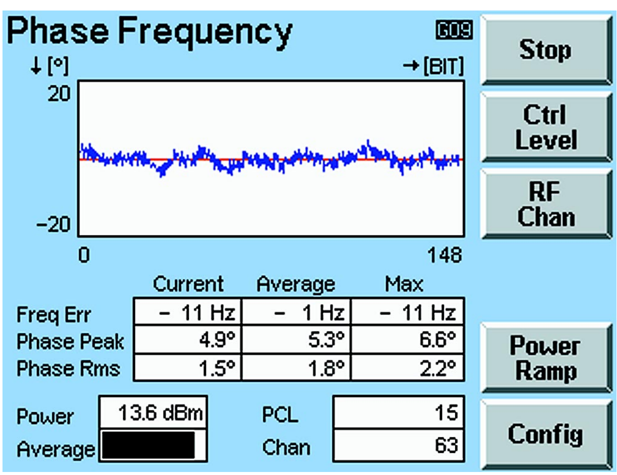
Digital Radio Testers CTS 50, CTS 55, CTS 65 for mobile phones



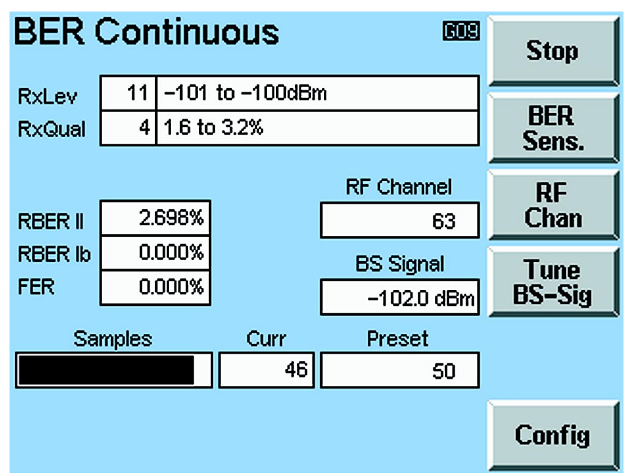
The quick test provides an extremely fast go/nogo information covering all essential parts of the mobile phone. A speech test (echo test) is carried out immediately after the call setup. (GSM)



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



As soon as the training sequence is recognized, the CTS carries out these measurements in accordance with the GSM specifications. The results are displayed graphically and numerically. (GSM)

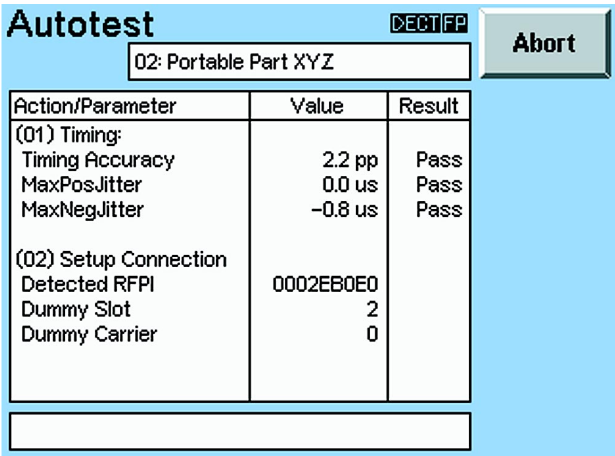


The BER is an essential criterion for evaluating the receiver characteristics of the mobile phone. The CTS measures these characteristics with the aid of various test routines such as RBER (class Ib; II; FER) and BER (class Ib; II). (GSM)

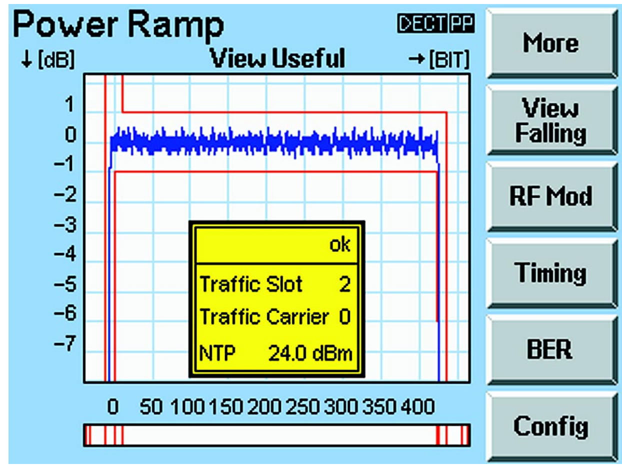
DECT measurement, test and adjustment capabilities

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

Digital Radio Testers CTS 50, CTS 55, CTS 65 for mobile phones



Each individual function, eg call setup or power measurement, is available as a test step. Tolerance limits for the OK/not OK statement are separately stored for each macro and allow an individual configuration. (DECT)



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

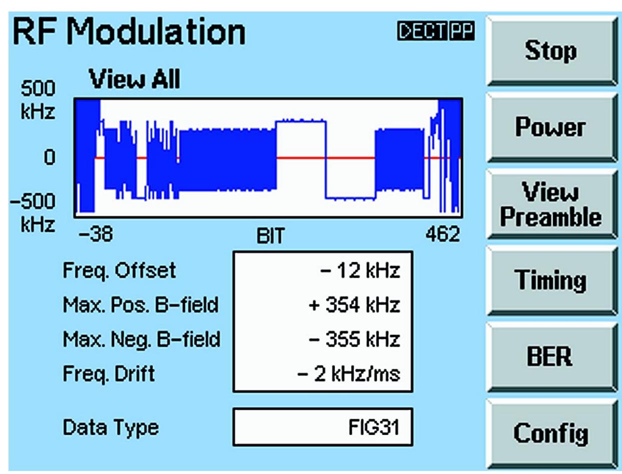
Specifications in brief

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

GSM

GSM signal generator	
Frequency range GSM900 band	935 MHz to 960 MHz
GSM1800 band	1805 MHz to 1880 MHz
GSM1900 band	1930 MHz to 1990 MHz
Resolution	GSM channel spacing 200 kHz
Output level	
RF IN/OUT with 0 dB ext. attenuation	–50 dBm to –110 dBm
RF OUT2 GSM with 0 dB ext. attenuation	–15 dBm to –75 dBm
Level error RF IN/OUT	≤1.5 dB
RF OUT2 GSM	≤2.0 dB
Modulation	GMSK, BxT=0.3
Narrowband Spectrum Monitor Option CTS-B7	
Span	300 kHz
Resolution bandwidth	4/10/20/50/100 kHz
Dynamic range	(P >5 dBm)
Δf = 0 kHz to 30 kHz	typ. 35 dBc
Δf = 30 kHz to 150 kHz	typ. 50 dBc
Markers	3 markers and delta-marker

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



In the RF modulation menu the demodulated signal is graphically displayed in an oscilloscope window in order to allow simple and fast detection of typical data patterns with the aid of various zoom functions. (DECT)

GSM measurement of phase and frequency error	
Frequency range GSM900 band	890 MHz to 915 MHz
GSM1800 band	1710 MHz to 1785 MHz
GSM1900 band	1850 MHz to 1910 MHz
Level range	–15 dBm to 39 dBm (peak values up to 41 dBm)

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

Digital Radio Testers CTS 50, CTS 55, CTS 65 for mobile phones

DECT

DECT signal generator	
Frequency range	1876.608 MHz to 1935.360 MHz and half channels
Frequency drift	same as reference oscillator
Output level	
RF IN/OUT	–100 dBm to –40 dBm
RF OUT2 DECT	–40 dBm to 0 dBm (–20 dBm to 0 dBm if RF IN2 DECT is active) useable up to 5 dBm
Level error	
RF IN/OUT	≤1.5 dB
RF OUT2 DECT	≤2.0 dB
Modulation	GFSK (BxT = 0.5)
DECT analyzer	
Frequency range	same as signal generator
Measurement range	with 0 dB external attenuation
RF IN/OUT	30 dBm to –30 dBm
RF IN2 DECT	–35 dBm to –55 dBm
FM demodulator	
Frequency range	0 kHz to 450 kHz
Resolution	1 kHz
DC offset	<3 kHz
Residual FM	
RF IN/OUT	<15 kHz, peak, 95% confidence (30 dBm to 5 dBm) <5 kHz, peak, 95% confidence (30 dBm to 15 dBm)
RF IN2 DECT	<15 kHz, peak, 95% confidence (–35 dBm to –55 dBm) <5 kHz, peak, 95% confidence (–35 dBm to –40 dBm)
Level meter	
Range	
RF IN/OUT	30 dBm to –30 dBm
RF IN2 DECT	–35 dBm to –55 dBm
Dynamic range	≥60 dB (for P = 24 dBm)
Resolution	0.5 dB
Accuracy	
RF IN/OUT	<1 dB + resolution (30 dBm to 5 dBm) <2 dB + resolution (<5 dBm)
RF IN2 DECT	<2 dB + resolution (–35 dBm to –51 dBm) <2.5 dB + resolution (<–51 dBm)
Audio Interface	
Output	unbalanced
Range	558 mV, 300 Hz to 3 kHz
Output impedance	<10 Ω (R_L >2 kΩ)
S/N + THD	30 dB at max. level
Passband ripple	0.5 dB
Input	unbalanced
Range	80 mV, 300 Hz to 3 kHz
Input impedance	22 kΩ
S/N + THD	35 dB at max. level
Passband ripple	0.5 dB
DECT applications	averaging 10 bursts
Modulation section 1, 2, 4	
Error	approx. 11 kHz with min. (202 kHz) permissible deviation approx. 13 kHz with max. (403 kHz) permissible deviation
Frequency drift	
Error	approx. 1 kHz/ms (over 200 bursts)
Transmit power	
Measurement accuracy	
RF IN/OUT	<1 dB + resolution (30 dBm to 5 dBm) <2 dB + resolution (<5 dBm)
RF IN2 DECT	<2 dB + resolution (–35 dBm to –51 dBm) <2.5 dB + resolution (<–51 dBm)

General data

VSWR at all RF connectors	≤1.5
Rated temperature range	+5 °C to +40 °C
Operating temperature range	+0 °C to +45 °C
Storage temperature range	–25 °C to +60 °C
Electromagnetic compatibility	complies with requirements of European EMC Directives EN 50081-1 and EN 50082-1
Mechanical resistance	
Sine vibration	IEC 68-2-6, IEC 1010-1, VG standard 95332-24-A2, MIL-T-28800 D class 5
Random vibration	DIN 40046, IEC 68-2-34
Shock	MIL-STD-810 D, MIL-T-28800 D classes 3 and 5
Rel. humidity	IEC 68-2-3
Power supply	200 V to 240 V AC ±10%, 100 V to 120 V AC ±10%, 50 Hz to 60 Hz ±5%
Power consumption	approx. 60 W
Electrical safety	ENG 1010-1; IEC 1010-1, VDE 0411 Part 1
Dimensions (W x H x D)	319 mm x 177 mm x 350 mm
Weight CTS55, CTS60	approx. 7.8 kg
CTS65	approx. 8.8 kg

Ordering information

Digital Radio Tester		
(GSM)	CTS 55	1094.0006.55
(DECT)	CTS 60	1094.0006.60
(GSM and DECT)	CTS 65	1094.0006.65
Options		
OCXO Reference Oscillator Aging 0.2 x 10^{-6}/year	CTS-B1	1079.0809.02
GSM Remote Control (with Application Software for Windows)	CTS-K6	1079.2001.01
GSM Module Test [1]	CTS-K7	1079.2501.02
Modification and upgrade kits		
Upgrade CTS55 to CTS65 [1]	CTS-U56	1079.1605.02
Upgrade CTS60 to CTS65	CTS-U65	1079.1705.02
Modification: new front panel with RF OUT2 on front	CTS-U7	1079.1805.02
Extras		
Universal shielded Chamber	CTS-Z12	1079.1605.02
Antenna Coupler for Handheld Phones 900/1800/1900 MHz	CTS-Z10	1079.1240.02
DECT-Antenna with N connector		1086.3116.00
GSM Test SIM	CRT-Z2	1039.9005.02
Compakt keyboard		
German	PSP-Z1	1091.4000.02
US	PSP-Z2	1091.4100.02
Production Calibration	DCV-1	0240.8733.08
Service Manual		1094.3405.24

[1] CTS-U7 is required for units manufactured in May 1998 or before.

Mobile Installation Tester CIT

Fast check for correct installation and reliable troubleshooting solve any installation problem with car telephones

Photo 40765

Brief description

Mobile Installation Tester CIT is a SWR and power meter combined with a multimeter specially designed for pulsed current and power bursts. All measurement functions and features are designed for the everyday maintenance environment.

Versatile

CIT covers a variety of mobile radio applications:

- GSM, D–AMPS
- C Net, NMT, TACS, AMPS, R2000
- Trunked radio
- Private mobile radio (taxi, public transport, police and emergency services)

RF tests

- Antenna test by SWR measurement
- Measurement supported by MIN/MAX HOLD functions
- Transmit power measurements, for instance in power stages dependent on the network selected

AC/DC tests

- Voltage and current measurements on car cabling with mobile phone active or passive: battery power, ignition off/on
- Voltage of ignition sense line
- Continuity test (simplifies fault location)
- Microphone test of hands-free facility via car cabling

Everything is right with the CIT: price, performance, operation and ruggedness. This mobile installation tester will be a real benefit even for small garages.

Construction

The rugged unit is dust-tight and splash-proof. The rubber encasement is shock-absorbing. The CIT is protected against static discharge and tested to the latest CE European standard.

Operation

The CIT is designed to be used by car mechanics, who will be able to handle this compact tester in practically no time. Connection and operation are foolproof. Tests are carried out at the press of a button. The results are easy to read on the combined analog and digital display.

Specifications in brief

Frequency range		100 to 1000 MHz
Power measurement	Range	13 to 43 dBm (20 mW to 20 W)
	Readout	dBm, W or power stage
	Resolution	0.1 dB (20 to 47 dBm)
		0.3 dB (13 to 20 dBm)
SWR measurement	Range	1.0 to 10
	Resolution	0.1
DC current measurement range		0 to 10 A (resolution 10 mA)
DC voltage measurement range		0 to 30 V (resolution 10 mV)
Continuity tester		HI/LOW and beeper, threshold 2 Ω
RF connector		N female
Power supply		4 round cells or rechargeable batteries (AA)
DC/AF connector		banana jacks, sub-D connector for DC/AF Adapter CIT-Z...

Ordering information

Mobile Installation Tester	CIT	1060.5005.52

Universal Shielded Chamber with Antenna Coupler CTD-Z10

Photo 42167

Interference-free testing of mobile telephones of any cellular networks; simple coupling in 900-MHz band

Brief description

Anyone engaged in mobile phone testing is only too familiar with problems such as getting hold of a suitable RF adapter or keeping RFI away which would otherwise falsify the measurement result. CTD-Z10, consisting of a coupler and a shielded chamber, is the solution to these problems. As an alternative to coupling via various manufacturer-specific adapters, the RF connection between mobile phone and test set can be made in the 900 MHz band via a single universal antenna coupler. Moreover, the shielded chamber ensures constant and defined test conditions which without protective measures against external radio fields – eg caused by neighbouring base stations – are usually not given.

With its excellent shielding characteristics both in the 900 MHz band and in all other frequency bands of cellular mobile radio, CTD-Z10 is the ideal accessory not only for the Go/NoGo Tester CTD52, but for all digital and analog radio testers from Rohde & Schwarz.

The shielded chamber of CTD-Z10 provides sufficient space for accommodating all customary analog and digital mobile phones. The antenna of the phone to be tested is connected to the coupler via a spring clamp. To achieve reproducible results, the coupler can be fixed to the chamber base. The radio-specific attenuation factors can be determined through calibration.

As an alternative to the antenna coupler supplied, the mobile phones may also be connected via manufacturer-specific couplers or cables with connectors.

Specifications in brief

Shielded chamber	
Shielding effectiveness in all bands of cellular mobile radio	>50 dB
Material	aluminium, interior lined with foam mats
RF connector	N female (connecting cable supplied)
Dimensions (W x H x D)	4810 mm x 325 mm x 145 mm
Weight	3.4 kg
Antenna coupler	
Frequency range	900 MHz band
Coupling attenuation	typ. 6 dB
Mech. connection phone - coupler	antenna clamp
Dimensions (W x H x D)	170 mm x 80 mm x 60 mm
Weight	0.3 kg

Ordering information

Universal Shielded Chamber with Antenna Coupler for Mobile Radio	CTD-Z10	1084.0003.02
Equipment supplied	shielded chamber, antenna coupler, cable for internal connection between coupler and shielded chamber, cable for external connection between shielded chamber and test set, operating manual	

EMC precertification measurements with EMI Test Receiver ESPC and Near-Field Probe Set HZ-14 (photo 42446-1)

Contents of Chapter 2

Introduction

EMC = EMI + EMS

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

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

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

Conformity mark

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

European CE conformity mark

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

EMI measurements

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

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

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

EMS measurements

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

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

EMC measurement software

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

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

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

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EMC measuring instruments

Rohde & Schwarz not only offers suitable test receivers covering a frequency range from 5 Hz to 26.5 GHz for EMI measurements, but also the necessary accessories. There is an especially wide choice in the range from 9 kHz to 1 GHz, in which the majority of commercial EMI measurements is carried out: seven different types of test receivers of the ESHS, ESVS, ESS, ESCS and ESPC families are available. The frequency range of the ESBI, ESMI and ESI receivers starts at 20 Hz and extends to 5, 7, 26.5 or 40 GHz. There is the right instrument for every application and measurement problem, from the precertification test receiver ESPC for development-accompanying diagnostic measurements through to the high-end ESI.

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

Radiated interference is measured above 30 MHz, with calibrated antennas being required. The Rohde & Schwarz range of products comprises various high-precision antennas, as well as absorbing clamps, which are required for RFI power measurements on household appliances. Remote-controlled antenna positioning masts and turntables for the EUT round off the range of products.

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

EMC test systems

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

EMC seminars

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

EMC legislation and standards

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

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

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

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standards entails compliance with the protection goals.

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

EMC standards

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

Individual EMC standards (as published in the Official Journal 10/97):

Generic standards – emission

- EN50081-1
  Residential, commercial and light industry environment
- EN50081-2
  Industrial environment

Generic standards – immunity

- EN50082-1
  Residential, commercial and light industry environment
- EN50082-2
  Industrial environment

Product family standards and product standards for low-frequency emission

- EN60555-2
  Disturbances in supply systems, harmonics
- EN60555-3
  Disturbances in supply systems, voltage fluctuations
- EN61000-3-2
  EMC Part 2: Limits for harmonics
- EN61000-3-3
  EMC Part 3: Limits for voltage fluctuations and flicker

Product family standards for high-frequency emission

- EN55011
  Radio disturbance suppression of ISM equipment
- EN55013
  Radio disturbance suppression of sound and TV broadcast receivers (incl. amendment A12)
- EN55014
  Radio disturbance suppression of electrical devices and systems (household appliances)
- EN55015
  Radio disturbance suppression of electrical devices and systems (lighting equipment)
- EN55022
  Radio disturbance suppression of information technology equipment

Product standards for immunity

- EN55020
  Immunity of sound and TV broadcast receivers
- EN55104
  EMC: Immunity requirements for household appliances, tools and similar apparatus
- EN61547
  Lighting equipment; EMC immunity requirements

Special standard for disturbance of signals in electrical installations

- EN50065-1
  Signalling on low-voltage electrical installations.
  Part 1: General requirements, frequency bands and electromagnetic disturbances (incl. amendment A1)

Product standards containing EMC requirements:

- EN50083-2
  Cable distribution systems for TV and sound signals, Part 2: EMC for equipment
- EN50091-2
  Uninterruptible power systems (UPS); EMC requirements
- EN50130-4
  Alarm systems, Part 4: EMC immunity requirements
- EN50148
  Electronic taximeters
- EN60521
  Alternating current watt-hour meters for active energy classes 0.5; 1 and 2
- EN60601-1-2
  Medical electrical apparatus, General safety requirements – 2nd collateral standard: EMC requirements and tests
- EN60687
  Alternating current static watt-hour meters for active energy, classes 0.2 S and 0.5 S
- EN60870-2-1
  Telecontrol equipment and systems, Part 2: Operating conditions – Section 1: Power supply and EMC

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- EN60945
  Maritime navigational equipment, General requirements; Methods of testing and required test results
- EN60947-1
  Low-voltage switchgear and control gear; Part 1: General rules
- EN61036
  Alternating current electronic watt-hour meters for active energy classes 1 and 2
- EN61037
  Electronic ripple control receivers for tariff and load control; incl. amendment A1
- EN61038
  Time switches for tariff and load control; incl. amendment A1
- EN61131-2
  Programmable controllers; Part 2: Equipment requirements and tests
- EN61800-3
  Adjustable speed electrical power drive systems, Part 3: EMC product standard

EMC test methods

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

The EMC directive prescribes different test methods, depending on whether the equipment tested is "normal" equipment or radio transmission equipment; in the former case it is also of importance whether complete standards, ie relating to both EMI and EMS, exist for that equipment.

In the simplest possible case, ie if a complete standard is available, the manufacturer or importer in the EEA is authorized to carry out the required tests himself and to label the product with the CE mark without supervision. Incomplete standards, however, require the involvement of a competent body. In case of radio transmission equipment a notified body is required to issue a type-examination certificate before the product is permitted to bear the CE mark.

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

Field-strength measurements

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

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

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

Hardware from Rohde&Schwarz

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

Software from Rohde&Schwarz

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

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		Group of equipment	Industrial, scientific and medical equipment (ISM)	Vehicles with combustion engines, remote/built-in RFI suppression	Sound and TV broadcast receivers	Electrical devices, household appliances and tools	Fluorescent lamps and luminaires	Information technology equipment (ITE)	Military equipment and systems	Generic emission standards	Mains signalling equipment	Cable distribution systems TV/sound	Uninterruptible power systems (UPS)	Professional audio/video equipm.	Electric railways	Medical electrical apparatus	Maritime navigation equipment
Standards		International Europe + Germany Japan USA	CISPR 11 EN 55011 VDE0875 Part 11 EACL Sect. 2 FCC Part 18,	CISPR 12/CISPR25 ECE 10, DIR95/54/EG VDE0879 Part 1, Part 2, 3 JASO D001-82	CISPR 13 EN 55013 VDE0872 Part 13 EACL Sect. 3 & 8	CISPR 14 EN 55014 VDE08725 Part 14 EACL Sect. 5 FCC Part 15,	CISPR 15 EN 55015 VDE 0875 Part 2/ Part 15 EACL Sect. 6 & 7	CISPR22 EN 55022 VDE 0878 Part 22 EACL Sect. 4 FCC Part 15, Subpart B	VG95370, 95373 – MILSTD-461 (CE/RE) DEF-STAN 59-41 (UK)	EN 50 081-1|2	EN 50 065-1	EN 50083-2	EN 50 091-2	prEN 55103-1	prEN 50121	EN 60601-1-2	EN 60945
Frequency range	Test Receivers	Accessories and extras															
from 20 Hz	ESS	Current Probe EZ-17							●								
	ESxI	H-Field Coil HZ-10							●					●			
from 9 kHz		Current Probe EZ-17	○	○	○	○	○	●	●		○	○					
		H-Field Coil HZ-10							● 4)					●			
		Rod Antenna HFH2-Z1		●													
	ESS	Tripod HFU-Z	●						● 5)						●		●
		Loop Antenna HFH2-Z2	●						● 5)						●		●
	ESCS30	Tripod HZ-1							●								
		Rod Antenna HFH2-Z6							●								
	ESHS10	V-Network ESH2-Z5	●		●	●	●	●	● 6)	●	●	●	●	●	●	●	●
		V-Network ESH3-Z5	●		●	●	●	●	● 6)	●	●	●	●	●	●	●	●
	ESHS30	V-Network ENV 4200	●		●	●	●	●	● 6)	●	●	●	●	●	●	●	●
		V-Network ESH3-Z6		●					●								
	ESPC 1)	T-Network ESH3-Z4						○	● 5)								
		T-Network EZ-10						○									
	ESBI	Probe ESH2-Z2	●		●	●	●	●		●	●	●	●	●	●	●	●
		Probe ESH2-Z3	●		●	●	●	●		●	●	●	●	●	●	●	●
		Ant. Imp. Converter EZ-12		●													
	ESMI	Probe Set EZ-11	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
		Probe Set EZ-14	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
		Triple-Loop Ant. HM 020	○				●										○
		RF Cable HZ-3/HZ-4	○		○	○	○	○	○								
from 30 MHz		Current Probe EZ-17	○	○	○		○	○	●	●	○		○				
		Current Probe ESV-Z1	○	○	○		○	○	●	○	○						
	ESS	Absorb. Clamp MDS-21/22	●	●	○	●		○		●	●	●		●			
		Probe Set HZ-11	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	ESCS30	Probe Set HZ-14	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
		Tripod, Mast HFU-Z	●	●	●		●	●		●	●		●	●	●	●	●
	ESVS10	Controller HCC	●	●	●		●	●		●	●	○	●	●	●	●	●
		Mast HCM	●	●	●		●	●		●	●		●	●	●	●	●
	ESVS30	Turntable HCT12	●		●		●	●		●	●		●	●	●	●	●
		Slideway HCA	○		○	●		○			●	○		●	○	○	
	ESPC 1)	Broadband Dipole HUF-Z1	●	●	●		●	●		●	●		●	●	●	●	●
		Log Periodic Ant. HL023A1	●	●			●	●		●	●		●	●	●	●	●
		Biconical Antenna HK116	●	●	●		●	●	●	●	●		●	●	●	●	●
	ESBI	Log Periodic Ant. HL223	●	●	●		●	●	● 7)	●	●		●	●	●	●	●
		Con. Log Spir. Ant. HUF-Z4							● 8)								
	ESMI	Tripod HZ-1							●								
		RF Cable HFU2-Z4/-Z5	●	●	●		●	●		●	●		●	●	●	●	●
		Shielded TEM-Line S-LINE						○		○	○		○	○		○	○
from 1 GHz	ESPC, ESCS30 ESxI	Antennas HL025, AC008	●		●			● 2)				●					
		on request							●								
from 2 GHz	ESBI,	Antennas HL025, AC008	●		●			● 3)				●					
	ESMI	on request							●								
from 5 GHz	ESMI	Antennas HL025, AC008	●					●				●					
		on request							● *								
from 10 GHz	ESMI	Antennas HL025, AC008	●					●				●					
		on request							● **								
from 18 GHz	ESMI +	Accessories							● ***			●					
to 40 GHz	ext. mixer	on request															

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

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Legend

● necessary accessory
❍ recommended extra
*10 GHz = upper freq. limit to GAM-EG 13
**18 GHz = upper freq. limit to CISPR 11, VG standards and DEF-STAN 59-41
***40 GHz = upper frequency limit to ANSI C63.2, C63.4 and MIL-STD-461
Further European standards see page 60

Low-voltage switchgear and controlgear EN 60 947-1	Telecom systems with large dimensions ETS 300 127	Short range devices (SRD) 9 kHz to 25 GHz ETS 300 220, 330 ETS300 440, 683	PMR equipment DECT equipment ETS 300 279 ETS 300 329	Generic EMC standard for radio equipment prETS300339	ERMES paging receivers ETS300340	GSM 900 MHz GSM 1800 MHz ETS300342-1/2	Digital fixed radio links ETS300385	Equipment of public telecom networks ETS300386-1 ETS 300 386-2-2, -3-4	Wireless microphones and similar equipment ETS 300 445	Second generation cordless telephones (CT2) ETS 300 446	VHF FM broadcasting transmitters ETS 300 447	VSAT, SNG and TES equipment ETS 300 673	CB radio and ancillary equipment ETS 300 680-1, -2	On-site paging equipment ETS 300 682	Commercially available amateur radio equipment ETS 300 684	Analog cellular radio comm. equipment ETS 300 717	Wide-area paging equipment ETS 300 741	2.6 GHz wideband transmission and HIPERLAN ETS 300 826	TETRA and ancillary equipment ETS 300 827	VHF maritime mobile radio telephone ETS 300 828	1.5 GHz maritime MES with LBRDC for GMDSS ETS 300 829	1.5 GHz receive-only MES for data comm. ETS 300 830	1.5/2.5 GHz MES for satellite GSM ETS 300 831	<1 GHz MES with LBRDC using LEOs ETS 300 832	
																									Current probe 5 Hz to 2 MHz/20 Hz to 100 MHz
																									Shielded, calibrated field coil 5 Hz to 10 MHz
		●																							Current probe 20 Hz to 100 MHz
																									Shielded, calibrated field coil 5 Hz to 10 MHz
																									Active rod antenna 9 kHz to 30 MHz
		●																		●	●				Tripod for Loop Antenna HFH2-Z2
		●																		●	●				Active loop antenna 9 kHz to 30 MHz
																									Tripod for Rod Antenna HFH2-Z6
																									Active rod antenna 9 kHz to 30 MHz
●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	V-network up to 25 A (70 A), 4-line LISN
●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	V-network up to 10 A (16 A), 2-line LISN
●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	V-network up to 200 A, 4-line LISN
			●	●		●	●		●		●	●		●	●	●	●								V-network up to 150 A (500 A), single-phase LISN
								❍																	2-wire T-network
								❍																	4-wire T-network (eg for ISDN)
●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	Active probe for RFI voltage measurement
●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	Passive probe for RFI voltage measurement
																									Antenna impedance converter 9 kHz to 30 MHz
❍		❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	Near-field probe set 100 kHz to 2 GHz
❍		❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	Near-field probe set 9 kHz to 1 GHz
		❍																		❍	❍				Triple-loop antenna 9 kHz to 30 MHz
																									Low-loss coaxial cables 3 m/10 m
																									Current probe 20 Hz to 100 MHz
																									Current probe 20 to 300 MHz (cal. up to 600 MHz)
																									Absorbing clamp 30 to 1000 MHz
❍		❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	Near-field probe set 100 kHz to 2 GHz
❍		❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	Near-field probe set 9 kHz to 1 GHz
●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	Manually adjustable antenna mast 1 to 5 m
●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	Controller for HCM and HCT12
●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	Antenna mast (1 to 4/6 m) for autom. measurements
●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	EUT turntable dia. 1.2 m for autom. measurements
																									Absorbing Clamp Slideway HCA f. autom. meas.
●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	Broadband dipoles 20 to 80 MHz
●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	Log-periodic antenna 80 to 1300 MHz
●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	Biconical antenna 30 to 300 MHz
●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	Log-periodic antenna 200 to 1300 MHz
																									Conical log spiral antenna 200 to 1000 MHz
																									Tripod for HK116, HL223 and HUF-Z4
●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	RF connecting cable 12 m/7 m, common-mode suppr.
		❍	❍	❍	❍	❍			❍	❍			❍	❍	❍	❍	❍								Shielded TEM-Line, 0.15 to 1000 MHz (2 models)
		●													●										Log-periodic antenna/directional ant. 1 to 18 GHz
																									eg double-ridged waveguide horn antennas
		●													●										Log-periodic antenna/directional ant. 1 to 18 GHz
																									eg double-ridged waveguide horn ant.
		●													●										Log-periodic antenna/directional ant. 1 to 18 GHz
																									eg double-ridged waveguide horn antennas
		●													●										Log-periodic antenna/directional ant.1 to 18 GHz
																									eg double-ridged waveguide horn ant.
		●													●										Double-ridged waveguide horn antenna

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

EMI Test Receiver ESPC

(9) 150 kHz to 1 (2.5) GHz

EMC-compatible development and production

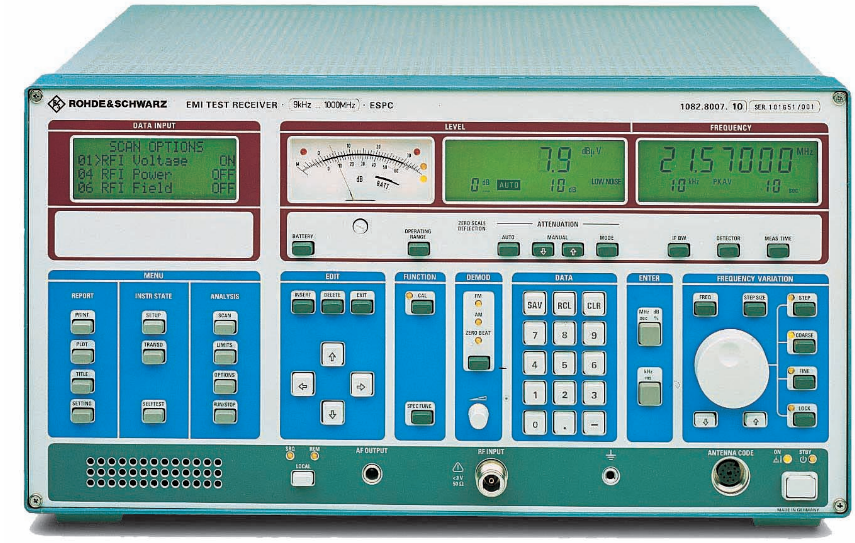


Photo 42092

Brief description

EMI Precertification Test Receiver ESPC has been derived from various Rohde & Schwarz full-compliance receiver models and thus opens up versatile applications in the field of EMI precompliance. It is a budget-priced solution for emission tests at all stages of development and production of electrical products. With a view to obtaining the "CE conformity mark", this test receiver will be used wherever EMI tests become necessary prior to acceptance testing in order to minimize the risks involved and the time taken for full-compliance tests.

Featuring built-in preselection, the ESPC is able to perform accurate interference measurements with pulse repetition frequencies (PRF) to as low as 10 Hz in line with CISPR 16-1.

The ESPC offers a compact and economical solution for

- development-accompanying EMI diagnostic measurements,
- pre- and post-qualification tests,
- production tests

Due to the increasing number and higher frequencies of mobile radio services, useful and interfering emissions up to 2.5 GHz have often to be investigated. The ESPC provides an optional frequency range extension up to 2.5 GHz which can also be retrofitted.

Main features

- Correct interference weighting to CISPR 16-1 down to 10-Hz pulse repetition frequency
- Integrated preselection
- For all commercial EMI standards such as CISPR, EN, ETS, FCC and ANSI C63.4, VCCI as well as VDE
- Parallel detectors for average, peak and quasi-peak reading
- Automatic overload detection
- Automatic level calibration
- Measurement of voltage, field strength, current and pulse spectral density with display of relevant units
- Automatic consideration of frequency-dependent transducer factors
- Easy to use thanks to built-in macro functions
- Power sourcing from internal or external battery
- EMI software under Windows™ supplied as standard

Operation

Users not specialized in EMI can also easily handle and carry out complete test runs. At the press of a button the ESPC starts as a stand-alone unit measurement of

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

A comprehensive test report can be output on a printer or plotter. The report contains comments and description, test receiver settings, graphs and final results.

Enhanced EMI measurement convenience through an external controller
The Windows™ Software ESPC-K1 supplied with the ESPC supports EMI measurements in line with commercial standards. The results are displayed as graphs and lists on the screen of a PC.

Specifications in brief

Frequency range	
Lower limit	150 kHz (optionally 9 kHz, ESPC-B2)
Upper limit	1 GHz (optionally 2.5 GHz, ESPC-B3)
Frequency setting	in 10 Hz, 100 Hz and 100 kHz steps or user-selectable
Automatic scan	for RF analysis
Display	8-digit LCD with backlighting, can be switched off
Resolution	up to 1000 MHz: 10 Hz, from 1000 MHz: 100 Hz
Frequency drift	$<3 \times 10^{-6}$, after 30 min warmup
RF input	Z_{in} = 50 Ω, N female
VSWR, f_{in} <1 GHz	1.5 with ≥10 dB RF attenuation <2 with 0 dB RF attenuation
RF attenuator	0 to 70 dB, 10-dB steps
Preselection	
9 kHz to 1000 MHz	2 fixed-tuned, 6 tracking filters
1000 to 2500 MHz	2 tracking filters
Maximum input level (RF attenuation ≥10 dB)	
Sinewave AC voltage	130 dBμV (corresp. to 1 W)
Max. pulse voltage	150 V
Max. pulse energy (10 ms)	10 mWs
Interference rejection, f <1000 MHz	
Image-frequency rejection, 1st and 2nd IF	70 dB
IF rejection	70 dB

IF bandwidths		
Nominal bandwidth	–3 dB	–6 dB
200 Hz[1] (with option ESPC-B2)	180 Hz	200 Hz
10 kHz[1]	7 kHz	9.5 kHz
120 kHz[1]	90 kHz	120 kHz

Displayed noise floor, average	
9 kHz to 3 MHz, BW=200 Hz	typ. +10 to –28 dBμV
f >3 MHz, BW=200 Hz/10/120 kHz	typ. –28/–12/–2 dBμV
Voltage measurement range	
Lower limit (additional error caused by inherent noise <1 dB)	
Average indication (AV), f >3 MHz BW = 200 Hz/10/120 kHz	typ. –24/–8/+2 dBμV
Upper limits AV, PK, QP	130 dBμV (RF attenuation ≥10 dB)
Level display	
Digital	in dBμV, dBμA, dBm, dB(μV/m), dB(μA/m), dBpW, 3-digit LCD, resolution 0.1 dB
Analog	on moving-coil meter in operating range of IF detector with digital display of lower range limit
Operating ranges	30 dB, 60 dB
Overload indication	by level detectors in RF and IF signal path
Detectors	average (AV), peak (PK), quasi-peak (QP); 2 detectors can be switched on simultaneously
Measurement times	1 ms to 100 s (1/2/5 steps)
Accuracy	
Average indication	
9 kHz to 1000 MHz	≤1.5 dB, typ. 1 dB
1000 to 2500 MHz (optional)	typ. 1 dB
Quasi-peak indication	to CISPR 16, ≥10 Hz pulse repetition frequency
Demodulation modes	AM, FM, A0 (zero beat), internal loudspeaker, headphones connector
Volume	adjustable with rotary knob
Date, time of day	internal clock

1 Tolerances to CISPR 16-1.

Internal memory	
Transducer	22 transducer factors with up to 50 reference values, nonvolatile, can be combined
Limit lines	22 limit lines with up to 50 reference values, nonvolatile
Instrument settings	9 complete setups, nonvolatile
Automatic modes	
Frequency scan	definable start and stop frequency and step size, max. 5 ranges with individual settings
Frequency lists	automatic measurement at max. 400 frequencies
RFI voltage measurements	automatic control of line-impedance stabilization networks, determination of maximum values in up to 400 subranges, checking for out-of-tolerance values
RFI power measurement	interactive mode with MDS absorbing clamps, determination of maximum values in up to 400 subranges, checking for out-of-tolerance values
RFI field-strength measurement	interactive mode with automatic antenna switchover, determination of maximum values in up to 400 subranges, checking for out-of-tolerance values

Connectors and interfaces

Remote control	IEC 625-2 (IEEE 488.2)
Plotter	via IEC/IEEE-bus interface
Printer	Centronics
Front-panel outputs	
Supply and coding connector for antennas etc	12-contact Tuchel connector
AF output	jack JK34, adjustable level
Rear-panel outputs	
IF 10.7 MHz	Z_{out}=50 Ω, BNC connector
User port	25-contact Cannon connector for control of LISNs (phase switching) and antennas
Keyboard connector	5-contact connector for MF2 keyboard
Rear-panel inputs	
Reference input	BNC connector, 10 MHz, >1 V
External battery	3-contact connector
Required voltage	11 to 33 V (switch-on voltage >12 V)

General data

Power supply	
AC supply	100/120/240 V ±10%, 230 V +6/–10%, 47 to 420 Hz (80 VA)
Battery (external)	11 to 33 V
Dimensions (W x H x D); weight	435 mm x 236 mm x 350 mm; 17 kg

Ordering information

EMI Test Receiver	ESPC	1082.8007.10
Accessories supplied	Windows™ Software ESPC-K1, power cable, connector for external battery, operating manual	
PC configuration required for Software ESPC-K1	IBM AT-compatible, 386 or higher	
Options		
Internal Battery with Automatic Charging	ESPC-B1	1082.9503.02
Frequency Extension 9 kHz to 150 kHz and IF bandwidth 200 Hz	ESPC-B2	1082.9555.02
Frequency Extension 1000 to 2500 MHz	ESPC-B3	1082.9603.02

EMI Test Receiver ESCS30

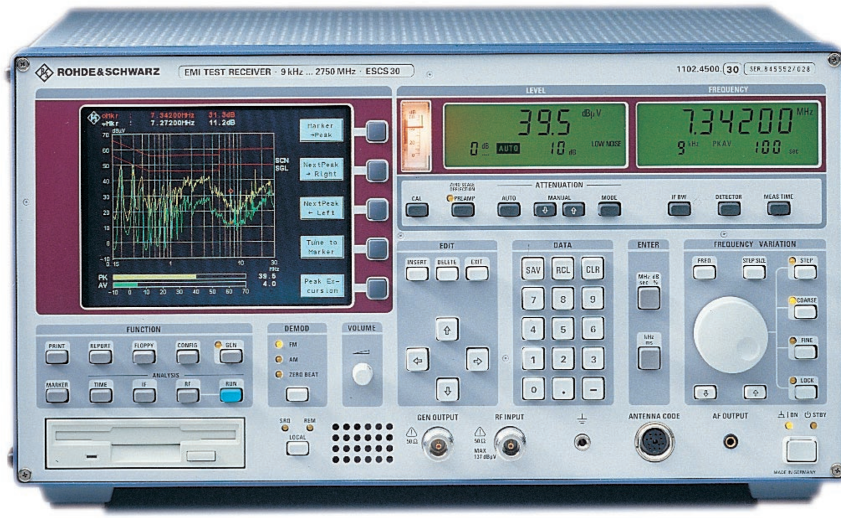


Foto 42987-1

9 kHz to 2.75 GHz

Compact EMI test receiver conforming to all standards

Brief description

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

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

The number of measurements required to ensure electromagnetic compatibility is continuously increasing and is governed by laws in many countries. Thanks to the built-in intelligence of EMI Test Receiver ESCS30, the time required for measurements is reduced considerably. This specialist for EMI measurements supplies the results fast and highly accurately in line with the standards from CISPR, CENELEC, ETSI, FCC, VCCI and VDE.

Complete tests at a keystroke

Using the SPECTRUM OVERVIEW function and the peak detector, the critical ranges of the spectrum can be determined. With the aid of data reduction routines the final measurement is then made accurately at the critical frequencies using quasi-peak and average detectors.

This concept saves valuable measurement time which would otherwise be wasted for ranges with low emission levels.

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

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

Main features

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

High-grade RF circuit design

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

Powerful firmware functions

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

Optimum result display for every application

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

Full storage and logging of results

- Built-in 3½" disk drive
- Storage of test results and test reports as HP-GL file
- Output of results as lists and diagrams including limit lines and user-definable labelling

Specifications in brief

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

Displayed noise level (average)

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

Dynamic range	
Noise figure	typ. 5 dB (<30 MHz, preamplifier on) typ. 9 dB (>30 MHz, preamplifier on)
Intercept point d3	typ. 10 dB (preamplifier off)
Level display	
digital	in dBμV, dBμA, dBm, dBμV/m, dBμA/m, dBpW, dBpT
Display	3½-digit LCD, resolution 0.1 dB
analog	on analog meter in operating range of IF detector with digital display of lower range limit
Bargraph display	horizontal bar; resolution 0.1 dB
Operating range	60 dB
Overdrive indication	for RF and IF signal path
Detectors	AV, PK, QP, can be switched on simultaneously
Measuring times	1 ms to 100 s (1/2/5 steps)
in overview mode	50 μs to 1 s (1/2/5 steps)
Measurement accuracy	
Average indication for S/N >16 dB	
9 kHz to 1000 MHz	<1.0 dB (typ. 0.5 dB)
1000 to 2750 MHz	<1.5 dB
Quasi-peak indication	to CISPR 16-1
RF spectrum analysis	
X axis (frequency)	user-selectable, linear or logarithmic
Y axis (level)	10 dB to 200 dB, 10-dB steps
Marker, traces	2 traces, 2 markers with digital display of frequency/time/level
Display modes	Clr/Write, Max Hold, View
Time domain analysis	
Display range (sweep time)	5 ms to 10,000 s
Minimum resolution (X axis)	100 μs
Level display range (Y axis)	10 to 200 dB, autoscale function
IF spectrum analysis (option ESCS-B4)	
Display range	10 kHz to 10 MHz, 1/2/5 steps
IF input attenuation	0/20 dB (selectable)
Resolution	1/3/10 kHz
Sweep time	50 ms to 10 s, 1/2/5 steps
Level display range	80 dB
Demodulation modes	AM, FM, A0 (zero beat)
Loudspeaker	built-in; headphones connection
Date, time of day	built-in clock module
General data	
Rated temperature range	0 to +50°C
Storage temperature range	–20 to +60°C
Power supply	
AC supply	100/120/230/240 V ±10%, 47 to 420 Hz (60 VA), safety class I to VDE 0411 (IEC348)
Battery (external)	11 to 33 V: 2.5 A/24 V, 4.7 A/12 V
Battery (internal, options -B1, -B2)	13.2 V, Ni-MH
Operating time with options ESCS-B1 and 3 x ESCS-B2	4 h
Dimensions (W x H x D)	435 mm x 236 mm x 350 mm
Weight	18.4 kg
with ESCS-B1 and 3 x ESCS-B2	22.9 kg

Ordering information

EMI Test Receiver	ESCS30	1102.4500.30
Options		
Battery Controller Ni-MH and battery support (without battery packs)	ESCS-B1	1102.6490.02
Battery Pack Ni-MH (max. 3 packs can be inserted, option ESCS-B1 required)	ESCS-B2	1102.6690.02
IF Spectrum Analysis	ESCS-B4	1102.6890.02
Tracking Generator 9 kHz to 2750 MHz	ESCS-B5	1102.7097.02
OCXO Reference Oscillator	ESCS-B6	1102.9397.02
RMS Detector	ESCS-B9	1102.7897.02

EMI Test Receivers ESHS 10, 30, ESVS 10, 30 and ESS

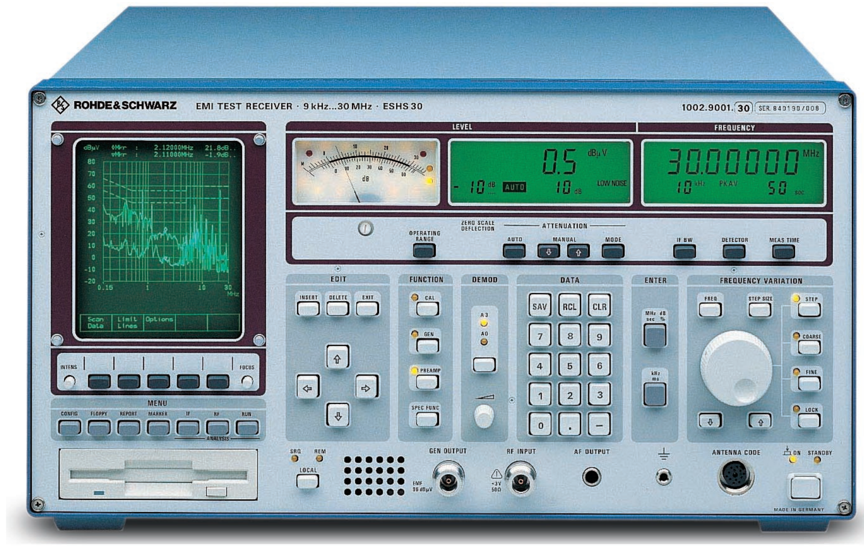
ESHS: 9 kHz to 30 MHz

ESVS: 20 to 1000 MHz

Test receivers for commercial EMI measurements

ESS: 5 Hz to 1000 MHz

Test receiver for commercial and military EMI measurements



ESS (photo 42412)

Brief description

All receivers of the ESxS family are suitable for measuring electromagnetic interference in line with commercial standards.

ESHS, ESVS

- Complying with CISPR 16, VDE 0876 and ANSI C63.2
- Measurements in line with EN 55011 to 55022, ETS, FCC, VCCI and VDE 0871 to 0879 and ANSI C63.4

ESS

- Additionally complying with MIL-STD-462D, DEF-STAN 59-41, GAM-EG 13, VG 95377 Part 11
- Additional measurements to MIL-STD-461, DEF-STAN 59-41, GAM-EG-13, VG 95370 and 95373

A wide choice of different models covers practically all fields of application. ES... models for special applications see Overview of Instruments.

ESHS 10 (photo 42407)

ESHS 10, ESVS 10
Mainly used in routine tests: for example measurements on devices with the same type of interference, like power supply units with permanent broadband interference, which need not be subjected to preliminary measurement.

ESHS 30, ESVS 30
Predominantly used where the type of EUT frequently changes, eg in test houses and quality control departments of large enterprises. The tracking generator allows additional measurement of cable losses, RFI suppression filters and attenuation of field-strength test sites. The built-in IF analyzer enables the interference spectrum to be monitored in manual measurements.

ESS
The continuous frequency range from 5 Hz to 1000 MHz allows all applications of ESHS 10 through to ESVS 30. All measurements to military standards up to 1 GHz are also possible.

Overview of models

The individual models of the EMI test receiver family have different features and frequency ranges. Family members covering the same frequency range have the same RF characteristics as well as measurement and AF demodulators.

- Particularly favourably priced models ESHS 10 for 9 kHz to 30 MHz and ESVS 10 for 20 to 1000 MHz with four-line LCD display
- Enhanced-feature models ESHS 30 and ESVS 30 with screen and floppy-disk drive, plus tracking generator and IF analyzer

EMI Test Receivers ESHS 10, 30, ESVS 10, 30 and ESS

- ESS combines ESHS30 and ESVS30 features in one unit with enhanced frequency range, more bandwidths and RMS indication

All models feature an excellent price/performance ratio, compact design, high measurement speed and great operating convenience.

Main features

Superior circuit design

- High measurement accuracy, typical error 0.5 dB
- Wide dynamic range, typical noise figure 7 dB with preamplifier, third-order intercept point 20 dBm (without preamplifier)
- Calibrated attenuator with high pulse loading capacity, switchable in 10-dB steps from 0 to 120 dB
- Comprehensive preselection filters
- Switchable preamplifier with wide dynamic range
- Crystal-stabilized, fast synthesizer with high resolution and sweep mode for fast frequency scanning
- High-level mixer with high oscillator rejection
- Delay-equalized IF filters

Demodulation

- Parallel detectors for average, peak and quasi-peak indication (ESS: plus RMS indication)
- 60 dB operating range also for quasi-peak and average value indication
- Highly linear envelope detector with more than 70 dB dynamic range
- AM and A0 demodulators (ESVS and ESS also FM)
- Logarithmic amplifier with more than 70 dB dynamic range
- Peak indication with automatic consideration of IF bandwidth correction values for broadband interference measurements
- Automatic overload detection in mixer stages and in test channel by permanently activated peak detectors

Powerful processor system

- Manual operation or internal or external processor control
- Flash EPROMs for convenient and fast firmware update through PC
- Macros for automatic and semi-automatic test runs
- Automatic level calibration
- Automatic consideration of frequency-dependent transducer factors
- All built-in functions fully programmable via IEC/IEE bus
- Fast measurement in external trigger mode; output of up to 5000 values/s via IEC/IEEE bus, up to 400 values/s including frequency change within certain frequency bands
- 12-bit A/D converter with short conversion time, measurement time selectable between 1 ms and 100 s
- High measurement accuracy thanks to automatic total calibration
- Automatic monitoring of all synthesizer loops and supply voltages during operation

Optimum result display and printout

- Measurement of voltage, field strength, current and pulse spectral density with display of relevant units
- Indication of result on analog meter or digital display with 0.1 dB resolution
- Output of results as lists and diagrams on printer or plotter including limit lines and user-defined labelling

Further features

- Digital level indication on LCD and analog level indication on moving-coil meter taking into account transducer factors and their units
- Built-in 3 ½" disk drive with 1.44 Mbyte (models 30 and ESS)
- Numerous interfaces for driving or feeding additional devices
- AC supply as well as battery powering for mobile applications

Operation

RFI field-strength and RFI power measurements

For solving complex EMC problems, manual measurement often is the most efficient way, since the operator can make full use of his experience in identifying interference sources. The receivers feature conventional test receiver operation with tuning knob, indication of results on a meter and built-in loudspeaker.

Nonvolatile storage of 22 limit lines and transducer factors with up to 50 values is possible. By combining the transducer factors, all test configurations occurring in practice can be covered.

Macros for semi-automatic test runs (ANALYSIS OPTIONS) match the test receivers to the specific configuration, device under test and test specification. Being thus prepared, the test receivers perform the following routines:

EMI Test Receivers ESHS 10, 30, ESVS 10, 30 and ESS

- Fast prescan measurement using peak or average detector
- Determination of critical frequencies by means of limit lines with data reduction to shorten the measurement time
- Final measurement at critical frequencies using average and/or peak detector
- Output of results on plotter or printer

The test receivers offer a choice between automatic, semi-automatic and user-controlled test runs. Scan options are available for prescan measurements, data reduction and final measurements.

Data reduction is the main criterion for optimizing the test run. It is the link between prescan interference measurement and correct weighting with test parameter variation (final measurement) to reduce measurement time. There are also scan options taking account of the test configuration, for instance measuring RFI voltage with LISNs, RFI power with an absorbing clamp and RFI field strength with antennas.

Design

The modular design of the test receivers provides excellent RF shielding and great convenience for servicing. An extremely low-noise, temperature-controlled fan ensures low self-heating. The comprehensive selftest functions allow easy identification of a faulty module which can be replaced with a minimum of effort and without affecting the other modules.

Specifications in brief: ESHS

Frequency range	9 kHz to 30 MHz	
Frequency setting	in 10 Hz, 10 kHz steps or user-selectable step size	
Automatic scan	for RF analysis	
Display	7-digit LCD	
Resolution	10 Hz	
Frequency drift	<3 x 10^{-6} +30 Hz	
RF input	N connector, 50 Ω	
VSWR	<1.2 with 10 dB RF attenuation, <2 with 0 dB RF attenuation	
Preamplifier	10 dB, can be connected between preselector and 1st mixer	
Preselector	5 fixed-tuned filters	
Maximum input level (with and without preamplifier, RF attenuation ≥10 dB)		
DC voltage	7 V (corresp. to 1 W)	
Sinewave AC voltage	137 dBμV	
Max. pulse voltage (10 μs)	700 V	
Max. pulse energy (10 μs)	100 mWs	
Interference rejection, nonlinearities		
Image-frequency rejection		
1st IF	>90, typ. 100 dB	
2nd IF	>75 dB	
IF rejection	>90, typ. 100 dB	
Intercept point d3 with $\lvert f_1 - f_2 \rvert$ >100 kHz and 0 dB RF attenuation	preamplifier off	preamplifier on
Level (f_1, f_2) at receiver	2x –10 dBm	2x –20 dBm
f_{in} <2 MHz	typ. 15 dBm	typ. 0 dBm
f_{in} ≥2 MHz	>15 dBm, typ. +20 dBm	>0 dBm, typ. +5 dBm
Intercept point k2	>40 dBm	>20 dBm
RF shielding		
Voltage indication at field strength of 10 V/m with 0 dB RF attenuation ($f \neq f_{in}$)	<–10 dBμV	
Additional error in CISPR indication range at 10 V/m	<1 dB	

IF bandwidth	200 Hz/10 kHz	
Displayed noise floor	preamplifier off	preamplifier on
Average value, BW = 200 Hz		
f_{in} = 9 to 50 kHz	<–24 to <–30 dBμV	<–30 to <–36 dBμV
f_{in} >50 kHz	typ. –35 dBμV	typ. –41 dBμV
Average value, BW = 10 kHz		
f_{in} >50 kHz	typ. –17 dBμV	typ. –25 dBμV
Peak value (typ.increase relative to average value)	+11 dB	+11 dB
Quasi-peak		
Band A 9 to 50 kHz	typ. –24 to –30 dBμV	typ. –30 to –36 dBμV
50 to 150 kHz	typ. –32 dBμV	typ. –38 dBμV
Band B (≥150 kHz)	typ. –13 dBμV	typ. –19 dBμV
PK/MHz (BW_{IF} = 10 kHz)	typ. 34 dB (μV/MHz)	typ. 28 dB (μV/MHz)
Voltage measurement range (f_{in} >50 kHz)		
Lower limit: (additional error caused by inherent noise <1 dB)	preamplifier off	preamplifier on
Average indication (AV)		
BW_{IF} = 200 Hz	typ. –31 dBμV	typ. –37 dBμV
BW_{IF} = 100 kHz	typ. –13 dBμV	typ. –20 dBμV
Peak indication (PK)	+11 dB	+11 dB
BW_{IF} = 200 Hz	typ. –8 dBμV	typ. –14 dBμV
BW_{IF} = 100 kHz	typ. –10 dBμV	typ. +4 dBμV
Quasi-peak indication (QP) to CISPR		
Band A (25 Hz pulse frequency)	typ. –30 dBμV	typ. –36 dBμV
Band B (100 Hz pulse frequency)	typ. –11 dBμV	typ. –17 dBμV
Upper limit:		
AV, PK, QP	137 dBμV (RF attenuation≥10 dB)	
Inherent spurious responses	<–10 dBV (equiv. input voltage)	
Level display		
Digital	3 ½ digits, resolution 0.1 dB in dBμV, dBμA, dBm, dB(μV/m) or dB(μA/m)	
Analog	on moving-coil meter in operating range of IF detector with additional digital display of lower range limit	
Operating ranges	30 dB, 60 dB	

EMI Test Receivers ESHS 10, 30, ESVS 10, 30 and ESS

Screen	5" CRT with digital picture memory, 1024 x 1024 pixels
Display range	
X axis (frequency)	user-selectable, lin/log
Y axis (level)	10 to 200 dB, adjustable
Marker functions	marker, delta marker
Display modes (detectors)	average (AV), peak (PK), spectral density measurement (PK/MHz), quasi-peak (QP)
Averaging, hold and meas. times	1 ms to 100 s (1/2/5 steps)
Measurement accuracy (AV for S/N >16 dB)	
Digital display	<1 dB
Demodulation modes	A0 (zero beat) A3 (for A3E emissions)
IF analysis (ESHS 30 only)	
Display range	10 kHz to 2 MHz (1/2/5 steps)
Nominal bandwidths	1/3/10 kHz
Sweep time	50 ms to 10 s (1/2/5 steps)
Level display range	80 dB
Input attenuation	0/20 dB, selectable
Marker functions	marker, delta marker, marker to maximum, marker to center frequency
Date, time of day	internal clock
Disk drive (ESHS 30 only)	$3^1/_2$", 1.44 MByte formatted
Remote control	to IEC 625-2 (IEEE 488-2)
Plotter language	HP-GL
Front-panel outputs	
Supply and coding connector for antennas, etc	12-contact Tuchel connector
AF output	jack JK34, 10 Ω
Generator output (ESHS 30 only)	N connector, 50 Ω
EMF	96 dBµV ±1 dB

Rear-panel outputs	
IF 74.7 MHz (ESHS 10 only)	BNC connector, 50 Ω
Bandwidth (–3 dB)	2 MHz or bandwidth of preselector
IF 80 kHz	BNC connector, 50 Ω
Video output (envelope demod.)	BNC connector

Interfaces
25-contact Cannon connector, includes 6 control lines for an external device (eg LISN), display voltage with and without meter simulation, input for external triggering, RS-232-C interface for firmware update

Printer connection	parallel interface
Keyboard connection	5-contact connector for MF2 keyboard
Rear-panel inputs	
Ext. reference frequency	BNC connector
Frequency	5/10 MHz
Ext. battery	3-contact connector
Required voltage	11 to 33 V
General data	
AC supply	100/120/220/240 V ±10%, 47 to 440 Hz
Power consumption	
ESHS 10	50 VA
ESHS 30	80 VA
Internal battery (ESHS 10 only)	12 V, 10 Ah
Operating hours	approx. 4 h
External battery	11 to 33 V
Current drain 24 V/12 V	
ESHS 10	1.2 A/2.3 A
ESHS 30	2.1 A/3.9 A
Dimensions (W x H x D)	
ESHS 10	435 mm x 236 mm x 363 mm
ESHS 30	435 mm x 236 mm x 463 mm
Weight	
ESHS 10	18 kg (21 kg with battery)
ESHS 30	28.6 kg

Specifications in brief: ESVS

Data specified below differ from that of ESHS.

Frequency range	20 to 1000 MHz
Frequency setting	
with tuning knob	in 100 Hz, 100 kHz steps or user-selectable step size
numerical	by keyboard entry
in steps	any size selectable
automatic scan	for RF analysis
Display	8-digit LCD
Resolution	100 Hz
Frequency drift	$<3 \times 10^{-6}$
RF input	N connector, 50 Ω
VSWR	<1.2 with ≥10 dB RF attenuation, <2 with 0 dB RF attenuation
Preamplifier	can be switched between preselector and 1st mixer
Gain	10 dB
Preselector	1 fixed-tuned and 5 tracking filters

Maximum input level (with and without preamplifier)	
RF attenuation ≥10 dB	
DC voltage	50 V
Sinewave AC voltage	137 dBµV (corresp. to 1 W)
Max. pulse voltage	150 V
Max. pulse energy (20 µs)	10 mWs
RF attenuation ≥10 dB (option ESVS-B1)	
DC voltage	7 V
Sinewave AC voltage	137 dBµV (corresp. to 1 W)
Max. pulse voltage	1500 V
Max. pulse energy (10 µs)	100 mWs
Interference rejection, nonlinearities	
Image frequency rejection	typ. 100 dB
IF rejection	>90, typ. 100 dB

Intercept point d3	preamplifier off P_{in}=2x (–10 dBm)	preamplifier on P_{in}=2x (–20 dBm)
$\|f_1–f_2\|$≥5 MHz	typ. +20 dBm	typ. +10 dBm
Intercept point k2	>35 dBm	>25 dBm

RF shielding	
Intermediate frequencies	
1st/2nd/3rd IF	1354.7/74.7/10.7 MHz
IF bandwidths	10/120 kHz

EMI Test Receivers ESHS 10, 30, ESVS 10, 30 and ESS

Displayed noise floor	preamplifier off	preamplifier on
Average value, BW=10 kHz	typ. –15 dBµV	typ. –21 dBµV
BW=120 kHz	typ. –4 dBµV	typ. –10 dBµV
Peak value, BW=10 kHz	typ. –4 dBµV	typ. –9 dBµV
BW=120 kHz	typ. +7 dBµV	typ. +1 dBµV
Quasi-peak band C/D	typ. +2 dBµV	typ. –4 dBµV
PK/MHz (spectral density measurement, BW_{IF}=120 kHz)	typ. 25 dB (µV/MHz)	typ. 21 dB (µV/MHz)

Voltage measurement range	
Lower limit (additional error caused by inherent noise <1 dB):	
Average indication (AV)	values 4 dB higher than displayed noise (AV)
Peak indication (PK)	values 27 dB higher than displayed noise (PK)
Quasi-peak indication(QP)	
CISPR band C/D	
(100 Hz pulse frequency)	
Preamplifier off	<10, typ. 6 dBµV
on	<4, typ. 0 dBµV
Upper limit:	
AV, PK, QP	137 dBµV (RF attenuation ≥10 dB)
Inherent spurious responses	<0 dBµV (equivalent input voltage)
Level display	
Digital	3 ½ digits, resolution 0.1 dB in dBµV, dBµA, dBm, dB(µV/m), dB(µA/m) or dBpW
Analog	on moving-coil meter in operating range of IF detector with additional display of lower range limit
Screen	
(RF analysis, ESVS 30 only)	5" CRT with digital picture memory, 1024 x 1024 pixels
Display modes (detectors)	average (AV), peak (PK), spectral density measurement (PK/MHz), quasi-peak (QP)
Measurement accuracy (AV for S/N >16 dB)	
Digital display (0 to 55 °C)	≤1 dB
Demodulation modes	A0, A3, F3
IF analysis (ESVS 30 only)	
Display range	10 kHz to 2 MHz (1/2/5 steps)
Nominal bandwidth	1/3/10 kHz
Sweep time	50 ms to 10 s (1/2/5 steps)
Level display range	80 dB
Input attenuation	0/20 dB, selectable
Marker functions	marker, delta marker, marker to maximum, marker to center frequency

Date, time of day	internal clock
Disk drive	
(ESVS 30 only)	3½", 1.44 MByte formatted
Remote control	to IEC 625-2 (IEEE 488-2)
Front-panel outputs	
Supply and coding connector for antennas, etc	12-contact Tuchel connector
AF output	jack JK34, 10 Ω
Generator output (ESHS 30 only)	N connector, 50 Ω
EMF	96 dBµV ±1 dB
Rear-panel outputs	
IF 74.7 MHz (ESVS 10 only)	BNC connector, 50 Ω
IF 10.7 MHz	BNC connector, 50 Ω
IF 80 kHz	BNC connector
Video output	BNC connector

Interfaces
25-contact Cannon connector, includes 6 control lines for an external device (eg LISN), display voltage with and without meter simulation, input for external triggering, RS-232-C interface for firmware update

Printer connection	parallel interface
Keyboard connection	5-contact connector for MF2 keyboard
Rear-panel inputs	
Ext. reference frequency	BNC connector
Frequency	5/10 MHz
Ext. battery	3-contact connector
Required voltage	11 to 33 V
General data	
AC supply	100/120/220/240 V ±10%, 47 to 440 Hz
Power consumption	
ESVS 10	60 VA
ESVS 30	90 VA
Internal battery (ESVS 10 only)	12 V, 10 Ah
Operating hours	approx. 2.5 h
External battery	11 to 33 V
Current drain 24 V/12V	
ESVS 10	1.9 A/3.3 A
ESVS 30	2.6 A/4.8 A
Dimensions (W x H x D)	
ESVS 10	435 mm x 236 mm x 363 mm
ESVS 30	435 mm x 236 mm x 463 mm
Weight	
ESVS 10	20.4 kg (23.7 kg with battery)
ESVS 30	26.4 kg

Specifications in brief: ESS

Data specified below differ from that of ESHS and ESVS.

Frequency range	5 Hz to 1000 MHz, subdivided into
Range I	5 Hz to 50 kHz
Range II	9 kHz to 30 MHz
Range III	20 to 1000 MHz

Automatic range selection, depending on IF bandwidth and RF input (balanced/unbalanced)

Frequency setting	fine or coarse increments or user-definable step size
Automatic scan	for RF analysis
Display	8-digit LCD
Resolution of ranges I/II/III	0.1/10/100 Hz
Frequency drift	$<3 \times 10^{-6}$
with option ESS-B1	1×10^{-7}

RF input		
5 Hz to 50 kHz, balanced	Twinax connector, 50 Ω	
Preselector		
Range I	1 fixed bandpass filter	
Range II	5 fixed bandpass filters	
Range III	1 fixed bandpass filter, 5 tracking bandpass filters	
Maximum input level (with and without preamplifier)		
RF attenuation ≥10 dB		
Ranges I and II		
DC voltage	7 V (corresp. to 1 W)	
Sinewave AC voltage	137 dBµV	
Max. pulse voltage	700 V	
Max. pulse energy (10 µs)	100 mWs	
Range III		
DC voltage	7 V (corresp. to 1 W)	
Sinewave AC voltage	137 dBµV	
Max. pulse voltage (20 µs)	150 V	
Max. pulse energy (10 µs)	10 mWs	
Interference rejection, nonlinearities		
Image-frequency rejection	>90, typ. 100 dB	
IF rejection	>90, typ. 100 dB	
Intercept point d3	preamplifier off P_{in}=–10 dBm	preamplifier on P_{in}=–20 dBm
Range I ($\lvert f_1–f_2 \rvert$ ≥5 kHz)	20 dBm	10 dBm
Range II ($\lvert f_1–f_2 \rvert$ ≥2 kHz)	≥15, typ. 20 dBm	≥0, typ. 5 dBm
Range III ($\lvert f_1–f_2 \rvert$ ≥7 kHz)	≥15, typ. 20 dBm	≥5, typ. 10 dBm
Intercept point k2	≥35 dBm	≥25 dBm
Intermediate frequencies		
Range I, 1st IF	80 kHz	
Range II, 1st/2nd/3rd IF	74.7/10.7 MHz/80 kHz	
Range III, st/2nd/3rd/4th IF	1354.7/74.7/10.7 MHz/80 kHz	
IF bandwidths	2/5/10/20/50/100/200/500 Hz/ 1/10/100/120 kHz/1 MHz	
Displayed noise floor	preamplifier off	preamplifier on
Average value, range I		
BW=2 Hz, f_{in}=5 to 30 Hz	typ. –38 to –48 dBµV	typ. –38 to –52 dBµV
BW=10 Hz, f_{in} >30 Hz	typ. –44 dBµV	typ. –48 dBµV
Average, range II, BW=200 Hz		
f_{in}=9 to 50 Hz	<–24 to –30 dBµV	<–30 to –36 dBµV
f_{in} ≥50 Hz	typ. –35 dBµV	typ. –41 dBµV
Average, range II, BW=10 kHz		
f_{in} ≥50 kHz	typ. –17 dBµV	typ. –25 dBµV
Average, range III		
BW=120 kHz	typ. –6 dBµV	typ. –10 dBµV
RMS, typ. increase relative to average value	+1 dB	+1 dB
Peak (PK), typ. increase relative to average value	+11 dB	+11 dB
Quasi-peak, band A, 9 to 50 kHz	–27 dBµV	–30 dBµV
50 to 150 kHz	–32 dBµV	–38 dBµV
Band B	–13 dBµV	–19 dBµV
Band C/D	+2 dBµV	–4 dBµV
PK/MHz, range II, BW_{IF}=10 kHz	34 dB(µV/MHz)	28 dB(µV/MHz)
Range III, BW_{IF}=1 MHz	16 dB(µV/MHz)	12 dB(µV/MHz)
Voltage measurement range		
Lower limit (additional error caused by internal noise ≤1 dB):		
Average (AV)	4 dB above displayed noise	
RMS	5 dB above displayed noise	
Peak (PK)	15 dB above displayed noise	
Quasi-peak (QP) (25/100 Hz pulse repetition frequency)	3 dB above displayed noise	
Upper limit:		
AV, RMS, PK, QP	137 dBµV (RF attenuation≥10 dB)	
Inherent spurious responses (equivalent input voltage)		
5 Hz to 30 MHz	<–10 dBµV	
30 to 1000 MHz	<0 dBµV	
Display modes (detectors)	average (AV), peak (PK), spectral density measurement (PK/MHz), quasi-peak (QP), RMS	

Measurement accuracy	
Digital display (0 to 55 °C)	<1 dB
Demodulation modes	A0, A3, F3
IF analysis (ranges II and III)	
Display range	10 kHz to 2 MHz (1/2/5 steps)
Nominal bandwidths	1/3/10 kHz
Sweep time	50 ms to 10 s (1/2/5 steps)
Level display range	80 dB
Input attenuation	0/20 dB, selectable
Marker functions	marker, delta marker, marker to maximum, marker to center frequency
Date, time of day	internal clock
Level display	
Digital	3 ¹/₂ digits, resolution 0.1 dB in dBµV, dBµA, dBm, dB(µV/m), dB(µA/m), dBpW and dBpT
Analog	on moving-coil meter in operating range of IF detector with additional display of lower range limit
Screen (RF analysis)	5" CRT with digital picture memory, 1024 x 1024 pixels
RF shielding	
Voltage indication at a field strength of 10 V/m with 0 dB RF attenuation	<0 dBµV
Additional error in CISPR display range at 10 V/m	<1 dB
Connectors and interfaces	
Remote control	to IEC 625-2 (IEEE 488-2)
Front-panel outputs	
Supply and coding connector for antennas, etc	12-contact Tuchel connector
AF output	jack JK34, 10 Ω
Generator output (ESHS30 only)	N connector, 50 Ω
EMF	96 dBµV ±1 dB
Rear-panel outputs	
IF 10.7 MHz	BNC connector, 50 Ω
IF 80 kHz	BNC connector
Video output (envelope demod.)	BNC connector

Interfaces

25-contact Cannon connector, includes 6 control lines for an external device (eg LISN), display voltage with and without meter simulation, input for external triggering, RS-232-C interface for firmware update

Printer connection	parallel interface
Keyboard connection	5-contact connector for MF2 keyboard
Rear-panel inputs	
Ext. reference frequency	BNC connector
Frequency	5/10 MHz
Ext. battery	3-contact connector
Required voltage	11 to 33 V
General data	
AC supply	100/120/220/240 V ±10%, 47 to 440 Hz (110 VA)
Battery	11 to 33 V; 3 A/24 V, 5.5 A/12 V
Dimensions (W x H x D); weight	435 mm x 236 mm x 572 mm; 37 kg

Ordering information

EMI Test Receiver	ESHS10	1004.0401.10
	ESHS30	1002.9001.30
	ESVS10	1011.2006.10
	ESVS30	1010.5001.30
	ESS	1011.4509.30
Options		
Reference Oscillator OCXO for ESS	ESS-B1	1026.7520.02
Pulse Power Attenuator for ESVS and ESS	ESVS-B1	0816.1815.02

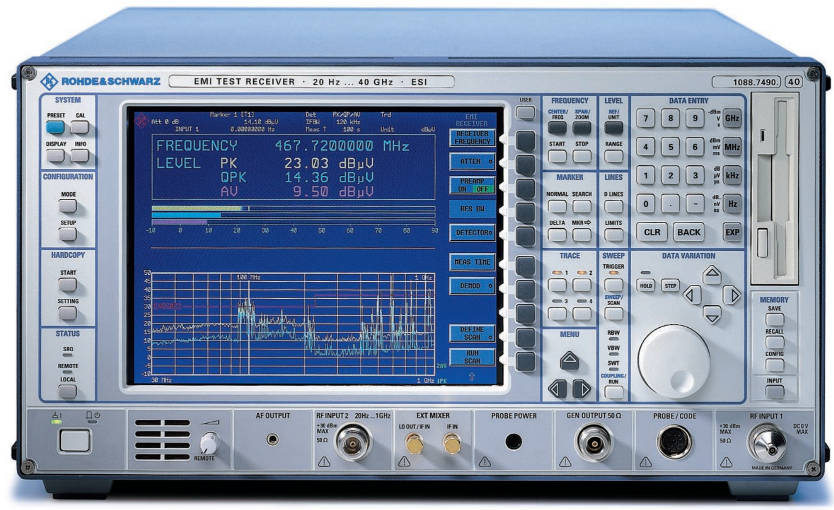
EMI Test Receiver ESI

ESI7: 20 Hz to 7 GHz

ESI26: 20 Hz to 26.5 GHz

ESI40: 20 Hz to 40 GHz

EMI test receiver and spectrum analyzer all in one



ESI40 (photo 43176)

Brief description

EMI Test Receivers ESI are based on the worldwide successful Spectrum Analyzer Family FSE (page 152) and combine the versatility and speed of spectrum analyzer measurements with the required top-class specifications of EMI measurements. These test receivers feature in particular

- high sensitivity
- wide dynamic range
- high overload capability
- high measurement accuracy
- fast prescan measurements

Measurements to current standards

- Correct interference measurements to CISPR 16-1 and VDE 0876
- Measurements to all commercial and military standards such as CISPR, VDE, ANSI, FCC, EN, VCCI, MIL-STD, VG, DEF-STAN, BS, DO 160, GAM EG 13

Thanks to the integrated measurement and analysis functions, measurements to relevant industrial and military standards are facilitated and carried out reliably and quickly. EMI Test Receivers ESI contain all the detectors required by the relevant standards and satisfy the exacting requirements of CISPR 16-1 and VDE 0876 standards up to 1 GHz and above without any restrictions.

EMI measurements – innovative and convincing

Interference measurements with weighting to CISPR place extremely high demands on test receivers. Integrated preselection filters which can be switched into circuit in analyzer mode feature high overload immunity and ensure reliable protection even against broadband signals with high levels. A low-noise preamplifier (20 dB) can optionally be switched between the preselector and 1st mixer to achieve sufficient sensitivity at low signal levels or to improve the S/N ratio. Depending on the frequency range, sensitivity can thus be improved by up to 6 dB.

Documentation

The EMI test receivers support a wide variety of commercial monochrome and colour printers for output of the measurement results in form of screenshots. Comprehensive test reports can be generated with the aid of the Rohde & Schwarz EMI Software ES-K1.

Use in automatic test systems

Fast processing of results makes ESI ideal for use in automatic test systems. The IEC/IEEE-bus command set (IEC 625-2/IEEE488) is conforming to SCPI (1994.0).

With an internal computer kernel and a second commercial IEC/IEEE-bus card, ESI can be used as a controller for complete test systems. EMI Software ES-K1 (with numerous drivers for external accessories such as mast, turntable, etc) is an ideal tool for this purpose.

Low overall costs

In the design of the ESI models, special emphasis was placed on keeping operating costs to a minimum:

- Temperature-controlled fans
- Calibration interval up to 2 years
- Built-in calibration routines
- Numerous selftest routines
- Modular design allowing easy replacement of faulty modules

Specifications in brief

Frequency

Frequency range	
Input 1 ESI7	20 Hz to 7 GHz
ESI26	20 Hz to 26.5 GHz
ESI40	20 Hz to 40 GHz
Input 2	20 Hz to 1 GHz
Frequency resolution	0.01 Hz
Internal reference frequency	
Total frequency drift (per year)	2.5 x 10^{-7}
Preamplifier (9 kHz to 7 GHz)	can be switched between preselector and 1st mixer, gain 20 dB

Level

Level display range	noise floor to 137 dBmV
Maximum input level	
Input 1 (20 Hz to max. frequency) RF attenuation ≥10 dB, DC voltage 0 V	
CW RF power	137 dBµV (= 1 W)
Max. pulse voltage	150 V (ESI7) 50 V (ESI26, 40)
Max. pulse energy (10 µs)	1 mWs (ESI7) 0.5 mWs (ESI26, 40)
Input 2 (20 Hz to 1 GHz) RF attenuation ≥10 dB	
CW RF power	137 dBµV (= 1 W)
Max. pulse voltage	1500 V (ESI7) 150 V (ESI26, 40)
Max. pulse energy (10 µs)	100 mWs (ESI7) 10 mWs (ESI26, 40)
1 dB compression of input mixer (0 dB RF attenuation) w/o preselector, w/o preamplifier	+10 dBm nominal
Level measurement accuracy (0 to –50 dB, S/N >15 dB, receiver mode or span/RBW <100)	
<1 GHz	<1.0 dB (ESI7/26/40)
1 to 7 GHz	<1.5 dB (ESI7/26/40)
7 to 18 GHz	<2.5 dB (ESI26/40)
18 to 26.5 GHz	<3.0 dB[1]) (ESI26/40)
26.5 to 40 GHz	<3.5 dB[1]) (ESI40)

Audio demodulation

Modulation modes	AM and FM
Audio output	loudspeaker and phones output

Receiver mode

Frequency display	numeric display
Resolution	0.1 Hz
Frequency sweep	scan with max. 10 subranges with different settings
Measurement time per frequency	100 µs to 1000 s
IF bandwidths (6 dB bandwidths)	10, 100, 200 Hz, 1, 9, 10, 100, 120 kHz, 1 MHz, 10 MHz
Level display	
digital	numeric, 0.1 dB resolution
analog	bargraph display, for each detector separately
Spectrum	
Level axis	10 to 200 dB in 10 dB steps
Frequency axis	user-defined, linear or logarithmic
Units of level display	dBµV, dBµA, dBm, dBpW, dBpT, dB (µV/m) or dB (µA/m)

Analyzer mode

Frequency display	with marker
Resolution	0.1 Hz to 10 kHz (dependent on span)
Frequency counter	measures marker frequency
Resolution	0.1 Hz to 10 kHz (selectable)
Display range for frequency axis	0 Hz, 10 Hz to full span
Sweep time	
Display range	
0 Hz (zero span)	1 µs to 16000 s, 5% steps
≥10 Hz	5 ms to 1000 s, ≤10% steps
Picture refresh rate (span ≤7 GHz)	>20 updates/s with 1 trace >15 updates/s with 2 traces
Sampling rate	50 ns (20 MHz A/D converter)
Sweep trigger	free run, single, line, video, gated, delayed, external
Zero span	additionally pretrigger, posttrigger, trigger delay

Resolution bandwidths

3 dB bandwidth	1 Hz to 10 MHz, in 1/2/3/5 steps
Shape factor 60:3 dB	
< 1 kHz	< 6
1 kHz to 2 MHz	< 12
> 2 MHz	< 7
Video bandwidths	1 Hz to 10 MHz, in 1/2/3/5 steps

FFT filter

Resolution bandwidths (RBW)	
3 dB bandwidths	1 Hz to 1 kHz, in 1/2/3/5 steps
Shape factor 60:3 dB, nom.	2.5
Display range of frequency axis	
Min. span	25 x RBW
Max. span	100000 x RBW

Level display

Display of measurement result	500 x 400 pixels (per diagram), max. 2 diagrams with independent settings
Log level display range	10 to 200 dB in 10 dB steps
Lin level display range	10% of reference level per division (10 divisions) or logarithmic scaling
Traces	max. 4 per diagram (max. 2 per diagram with display of 2 diagrams); quasi-analog display of all results
Trace detectors	max peak, min peak, auto peak (normal), sample, rms, average
Trace functions	clear/write, max/min hold, average
Max. dynamic range(1 Hz BW) Displayed noise floor to 1 dB compression	162 dB (ESI26, ESI40: 160 dB)
Max. intermodulation- free range 150 MHz to 7/26.5 GHz (nominal)	115 dB (ESI26, ESI40: 112 dB)

General data

Display	9.5" LC TFT colour display, VGA
Mass memory	3 ½" FDD, 1.44 Mbyte, hard disk
Rated temperature range	+5 to +40°C
Limit temperature range	+0 to +50°C
Storage temperature range	–40 to +70°C
Power supply	100/120/230/240 V ±10%, 47 to 440 Hz (195 to 230 VA)
Dimensions (W x H x D)	435 mm x 236 mm x 570 mm
Weight	25.1 to 27 kg (depending on model)

Ordering information

EMI Test Receiver

20 Hz to 7 GHz	ESI 7	1088.7490.07
20 Hz to 26.5 GHz	ESI26	1088.7490.26
20 Hz to 40 GHz	ESI40	1088.7490.40

Options

Tracking Generator 9 kHz to 7 GHz	FSE-B10	1066.4769.02
Tracking Generator 9 kHz to 7 GHz with I/Q Modulator	FSE-B11	1066.4917.02
Switchable Attenuator for Tracking Generator 0 to 70 dB	FSE-B12	1066.5065.02
External Mixer Output	FSE-B21	1084.7243.02
TV Demodulator, line and frame trigger, standards B/G, D/K, I, L, M	FSE-B3	1073.5244.02
Vector Signal Analyzer	FSE-B7	1066.4317.02

Extras

EMI Software for R&S EMI Test Receivers and accessories	ES-K1	1026.6790.02
Driver for EMI Software ES-K1 for ESI	ES-K16	1108.0288.02

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

EMI Test Receivers ESBI and ESMI

ESBI: 20 Hz to 5 GHz

ESMI: 20 Hz to 26.5 GHz

EMI test receiver and spectrum analyzer all in one

ESMI (photo 39551)

Brief description

EMI Test Receivers ESBI and ESMI combine the top-class specifications of Rohde&Schwarz EMI test receivers with the speed of Rohde& Schwarz spectrum analyzers. The integral measurement and analysis functions simplify and speed up all measurements to the relevant commercial and military standards such as CISPR, VDE, FCC, EN, VCCI, MIL-STD, VG, DEF-STAN, BS, DO 160, GAM-EG13.

All these test receivers satisfy the exacting requirements of CISPR standard 16-1 (08.93) and VDE standard 0876. They are thus highly suitable for all compliance tests in line with commercial standards.

ESBI and ESMI provide excellent characteristics for EMI measurements. They can however also be used as top-class spectrum analyzers for general laboratory applications (further typical characteristics see data sheets PD 756.4808/.8384 and .7120).

Main features

- RF attenuation switchable in wide range and small steps
- Refined preselection
- Very large frequency range for EMI measurements
- Low-noise preamplifier with wide dynamic range
- High-level mixer for IF conversion
- Additional filters ahead of IF preamplifier to avoid overloading due to broadband interference in IF section
- Highly linear envelope detector with dynamic range of 70 dB in addition to 110 dB logarithmic converter in analyzer path
- Five parallel detectors for peak, minimum, quasi-peak, average and RMS weighting
- DC logarithmic converter with dynamic range of 70 dB
- Overload detectors at the mixers and in the test channel to avoid incorrect measurements

EMI Test Receivers ESBI and ESMI

Measurement capabilities

RF dynamic range
The EMI test receivers feature a large dynamic range and high sensitivity.

Moreover, the test receiver settings completely conform to CISPR requirements, ie the dynamic range is large enough in all CISPR ranges to allow correct weighting of single pulses.

Refined preselection filtering provides the required large dynamic range for wideband signals. A low-noise preamplifier, which can be switched after the preselector, is used to increase sensitivity. To measure high-energy pulses, a second input is provided which can handle pulses in the frequency range from 20 Hz to 200 MHz. An automatic overload detector checks sensitive points in the signal path.

Signal analysis
EMI test receivers have a variety of maximum, minimum, average, rms and quasi-peak detectors for simultaneous signal analysis. Built-in AM/FM demodulators allow audio monitoring of interference signals.

A pulse calibration source for checking the CISPR weighting curves is provided in addition to the built-in sine calibration source, thus ensuring extremely high measuring accuracy. A tracking generator for all kinds of EMC measurements is also provided.

Operation

OVERVIEW mode
In this mode, the whole interference spectrum is displayed on the screen of the test receiver. The IF resolution bandwidths can be adjusted to CISPR standards; the IF selectivity has also a quasi-analog setting mode to optimize the sweep time. The interference spectrum can be displayed on the screen using a linear or logarithmic frequency scale. A maximum of eight different limit lines can be displayed on the screen. Out-of-limit values are automatically detected and displayed.

Fast, flexible scan
In the SCAN mode, ESBI and ESMI are directly comparable with a conventional test receiver:

- In addition to measurements at the selected frequency, a scan can be started
- Measurements are made automatically between start and stop frequency and at a selectable step size
- Manual adjustments while the scan is in progress and repeat measurements over selectable subranges reduce the time required for measurements

To conform to relevant standards, measurements over various frequency ranges and bandwidths have to be made. For this purpose, the user can define a variety of frequency ranges in a configuration table. Measurements are then made over these subranges using the selected bandwidth, measurement time, step size, etc.

Split-screen display
The results are output in two windows obtained by splitting the screen display horizontally. Different trace memories, and so the results from different detectors, can be displayed in the upper and the lower window. The split-screen display is ideal for showing narrowband and broadband signals separately.

Automatic compensation for transducers
The test results are always displayed with correct units. The transducers designed for the Rohde & Schwarz test receivers are, of course, suitable for use with ESBI or ESMI. Correction factors entered in a transducer table are used to automatically compensate for the frequency dependence of the transducer factor. A maximum of four such tables are available and can also be combined.

Documentation on printers and plotters
A wide range of commercially available monochrome and colour hardcopy devices including laser printers is supported.

EMI Test Receivers ESBI and ESMI

Specifications in brief

Frequency

Frequency ranges	
ESBI	20 Hz to 5 GHz
ESMI	20 Hz to 26.5 GHz, up to110 GHz with external mixers
Frequency setting	with spinwheel or keys
Resolution	1 Hz
Reference frequency drift	<1 x 10^{-7}
Frequency axis	LIN or LOG selectable
Frequency display	
Accuracy (for span >5 MHz, sweep time <100 ms)	<8 x 10^{-3} x span
Frequency span	10 Hz to 2/5.2/26.5 GHz
Frequency counter	
Scan mode	<1000 x resolution bandwidth
Resolution	0.1 Hz to 10 kHz
Accuracy	reading x 10^{-7} ±2 x resolution
Spurious responses at discrete frequencies	
n x mains frequency	>70 dBc
m x line frequency (29.4 kHz)	>80 dBc
100 kHz (span ≤5 MHz)	>90 dBc
–10.7 MHz	>90 dBc
Other for Δf >1 MHz	>75 dBc

Filters

RF preselector	
Selectable filters	(except YIG filter in ESMI), automatically switched
All models	1 lowpass, 9 fixed bandpasses, 4 tunable bandpasses
ESBI	plus 1 additional bandpass
ESMI	plus 2 additional fixed bandpasses and 1 YIG filter
IF filters	
Overview mode	
3 dB bandwidths	from <10 Hz (typ. 6 Hz) to 3 MHz in 5% steps (except in range 30 to 80 kHz)
EMI receiver mode	
6 dB bandwidths	10 Hz, 100 Hz, 200 Hz, 1 kHz, 9 kHz, 10 kHz, 100 kHz, 120 kHz, 1 MHz
Video filter	1st order RC lowpass after IF rectifier
Bandwidths (–3 dB)	1 Hz to 3 MHz in 1/3/10 steps

Amplitude

Maximum input signals	
DC voltage	
DC-coupled	0 V
AC-coupled	20 V
AC voltage (sinewave)	
RF attenuation 0 dB	20 dBm (100 mW; 127 dBµV)
RF attenuation ≥10 dB	30 dBm (1 W; 137 dBµV)
Pulse spectral density with RF attenuation 0 dB	
RF preselector on	
Frequency setting <150 kHz	130 dB(µV/MHz)
for 150 kHz to 1 GHz	90 dB(µV/MHz)
Frequency setting ≥1 GHz	61 dB(µV/MHz)
RF preselector off	61 dB(µV/MHz)
Maximum pulse voltage (RF attenuation ≥10 dB)	
Input 1	150 V
Input 2	50 V

Maximum pulse energy (t=10 µs), RF attenuation ≥10 dB

	ESBI	ESMI
Input 1	<1 mWs (100 W/10 µs)	<10 mWs (1 kW/10 µs)
Input 2	<1 mWs (100 W/10 µs)	<1 mWs (100 W/10 µs)

Level compression
Pulse spectral density for 1 dB compression (RF attenuation 0 dB, RF preselector on, RF preamplifier off)

Frequency	1 dB compression at
<150 kHz	ESBI, ESMI: >110 dB(µV/MHz)
0.15 to 5 MHz	ESBI, ESMI: >86 dB(µV/MHz)
5 to 30 MHz	ESBI, ESMI: >80 dB(µV/MHz)
30 to 300 MHz	ESBI, ESMI: >76 dB(µV/MHz)
300 to 1000 MHz	ESBI, ESMI: >75 dB(µV/MHz)
>1000 MHz	ESBI, ESMI: >50 dB(µV/MHz)

Maximum displayed noise floor in CISPR bands
RF preamplifier off, RF attenuation 0 dB, discrete spurious excepted

Frequency range	CISPR band/ bandwidth	Model	Display mode (in dBmV)		
			Average	Quasi-peak	Peak
9 to 150 kHz	A/200 Hz	ESBI, ESMI	–7	–5	+4
0.15 to 5 MHz	B/9 kHz	ESBI, ESMI	0	+3	+11
5 to 30 MHz	B/9 kHz	ESBI, ESMI	–5	–2	+6
30 to 300 MHz	C/120 kHz	ESBI, ESMI	+5	+9	+16
0.3 to 1 GHz	D/120 kHz	ESBI, ESMI	+8	+12	+19

In the frequency range from 20 Hz to 1 MHz a limited temperature range from 15 to 35°C applies to the displayed noise; outside this temperature range the specified values may vary by max.10 dB. The guaranteed sensitivity in the CISPR bands is improved by 9 dB with the preamplifier on.

Spectral sensitivity

Resolution bandwidth1 MHz, f >30 MHz, peak detector

	preamplifier: 0 dB	preamplifier: 10 dB
ESBI	<30 dBµV	<21 dBµV
ESMI (<18 GHz)	<32 dBµV	<23 dBµV

Level measurement error after internal calibration	
Sum error in display range and in temperature range 15 to 35°C	<1.5 dB (f=9 kHz to 1 GHz)
IF rejection and image-frequency rejection	
IF rejection	>100 dB, typ. >110 dB
applies to all intermediate frequencies used, with the following exception: ESMI: 221.4 MHz	>90 dB, typ. 110 dB
Image-frequency rejection	
ESBI, ESMI: f +10.8428 GHz	>80 dB, typ. 90 dB
ESBI: f +442.8 MHz	>100 dB, typ. 115 dB
ESMI: f +442.8 MHz	>85 dB, typ. 100 dB
All models at f +42.8 MHz	>100 dB, typ. 115 dB
All models at f +8.388 MHz	>100 dB, typ. 115 dB

Sweep

	Frequency span >0 Hz		Frequency span=0 Hz (sampling rate: 1/8.9 µs)	
Sweep time	Step size	Error	Step size	Error
0.2 to 10 ms	–	–	1/2/4/8/10	<2%
20 ms to 2 s	20 ms	10^{-3}	20 ms	10^{-3}
2 to 20 s	200 ms	10^{-3}	200 ms	10^{-3}
20 to 1980 s	2 s	10^{-3}	2 s	10^{-3}

Trigger modes: free run, line, video, external

Scalar network analysis

Tracking generator frequencies and levels

	Output frequency		Output level		
	min.	max.	min.	max.	Steps
ESBI	100 Hz	5 GHz	26 dBµV	107 dBµV	0.1 dB
ESMI	100 Hz	5 GHz	32 dBµV	107 dBµV	5 dB
ESMI + ESMI-B1	100 Hz	26.5 GHz	32 dBµV	107 dBµV	5 dB

Measurement ranges for gain and attenuation

	Measurement range		Frequency offset
	Gain	Attenuation	
ESBI	110 dB	110 dB	0 to ±1 GHz
ESMI (up to 5 GHz)	105 dB	110 dB	0 to ±1 GHz
ESMI + ESMI-B1	105 dB	5 to 18 GHz: 105 dB 18 to 26.5 GHz: 100 dB	not possible

Demodulation	AM and FM
Modulation analysis	measurement of modulation depth and frequency deviation
Monitoring	built-in loudspeaker, headphones output

VDU

Screen	9" in-line colour CRT, 1024 x 512
Display mode	full display height or 2 x ½ display height (split screen)
Number of picture memories	4
Output on plotter/printer	HP-GL, pinwriter (24-pin), laser printer
Functions	curve arithmetic (swap, subtract), comparison with tolerance curves, averaging, peak hold

Inputs and outputs

Front panel, RF section

Input 1 (all models)	BNC connector, 50 Ω
DC coupling	20 Hz to 200 MHz (AC from 9 kHz)
VSWR with RF attenuation ≥10 dB	<1.2
Protection	fuse, surge arrester
Input 2 (DC coupling only)	N connector, 50 Ω
VSWR with RF attenuation ≥10 dB	<1.2 (f <1 GHz) <1.5 (f=1 to 1.8 GHz)
ESBI	20 Hz to 5 GHz <1.2 (f <1 GHz) <1.5 (f=1 to 2.7 GHz) <1.8 (f= 2.7 to 4.8 GHz)
ESMI	20 Hz to 26.5 GHz, adaptable to 3.5 mm SMA connector <1.2 (f <1 GHz) <1.5 (f=1 to 2.7 GHz) <1.8 (f= 2.7 to 4.8 GHz) <2 (f= 4.8 to 26.5 GHz, RF attenuation ≥20 dB)

Selectable preamplifier	
ESBI, ESMI	10 dB
Input attenuator	
ESBI	0 to 120 dB in 2 dB steps
ESMI	0 to 75 dB in 5 dB steps
Calibration output	BNC connector, 50 Ω
Coding and supply connector	Tuchel connector, 12-contact
Supply voltages	+10 V, –10 V, max. 100 mA each
Front panel, display section	
Headphones connector	jack JK-34
Keyboard connector	jack JK-34
Rear panel, RF section	
IF OUTPUT 21.4 MHz	BNC connector, 50 Ω, VSWR ≤2
10-MHz reference	BNC connector
EXT ALC	BNC connector, 0 to –1 V (V_{input})
SWEEP OUTPUT	BNC connector, 0 to 5 V (V_{output})
START-SWEEP-STOP	BNC connector
Function	positive TTL signal (t=1.4 µs) occurring at sweep start or stop
Rear panel, display section	
IF OUTPUT 21.4 MHz (narrow)	BNC connector, 50 Ω, VSWR ≤2
EXT. SWEEP TRG	BNC connector
VIDEO-OUTPUT	BNC connector
EXTERNAL MONITOR	BNC connectors for RED, GREEN, BLUE, COMP VIDEO; V SYNC; H SYNC
Line frequency/sync pulses	29.4 kHz/2 µs
EXT FLOPPY	Cannon D connector, 37-contact for PZ-11
RS-232-C	Cannon D connector, 25-contact
PARALLEL INTERFACE (Centronics)	Amphenol connector, 36-contact
USER PORT	Cannon D connector, 25-contact
PHONES	jack JK-34, 30 Ω
IEC625-Bus (IEEE488)	24-contact Amphenol connector

General data

Power supply	100/120/220/240 V ±10%, 45 to 66 Hz
Dimensions (W x H x D); weight	
ESBI	435 mm x 413 mm x 590 mm; 64 kg
ESMI	435 mm x 457 mm x 590 mm; 68 kg
ESMI with ESMI-B1	435 mm x 457 mm x 590 mm; 72 kg

Ordering information

EMI Test Receiver	ESBI	1005.4000.52
	ESMI	1032.5510.53
Optional Tracking Generator for ESMI (5 to 26.5 GHz)	ESMI-B1	1033.3240.52
Extras		
Service Kit	FS-Z1	811.0010.02
Connecting Cable Set (for servicing, 1 m)	FS-Z2	811.0304.02
Microwave Cable and Interchangeable Adapter Set (DC to 26.5 GHz)	FS-Z15	1046.2002.02

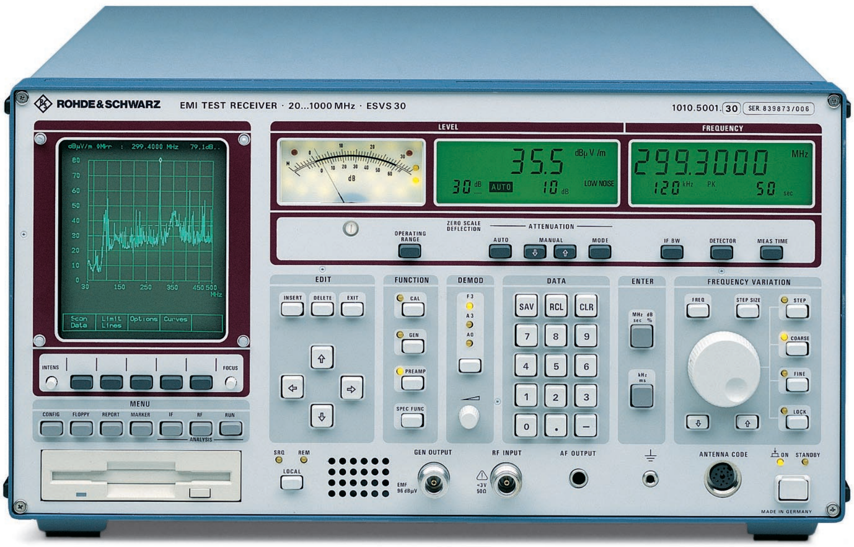
Test Receivers ESN, ESVN20, 30, 40

ESN: 9 kHz to 2050 MHz

ESVN20, 30: 20 to 1000 MHz

ESVN40: 9 kHz to 2750 MHz

Useful and interfering signal measurements



ESN (photo 42422)

Brief description

Test Receivers ESN and ESVN are used to measure and demodulate both amplitude-modulated (DSB, SSB, pulse) and frequency-modulated signals as well as narrowband and broadband interference. Their high overload capability, wide dynamic range, high measurement rate and versatile analysis functions make the test receivers ideal tools for

- all applications in useful field-strength measurements (eg radio surveillance measurements, radio network planning and radiomonitoring),
- commercial RFI measurements in line with all relevant standards,
- selective voltage and two-port measurements in manual and automatic operation.

ESN and ESVN are based on the ESxS models (page 68).

Main features

- 13 fixed-tuned, 5 tracking preselection filters up to 2.75 GHz
- Crystal-stabilized synthesizer as 1st LO, variable in 10 Hz/100 Hz steps, sweep mode
- IF filters for all analog radio services with bandwidths between 1 kHz and 250 kHz; 9 kHz and 120 kHz filters with low delay distortion for quasi-peak and average value measurements to CISPR 16
- Peak, average, rms and quasi-peak detectors
- Demodulators for FM, AM, SSB (LSB and USB), zero beat and 1 kHz beat; loudspeaker, headphones connector; squelch; demodulation using signal processors
- Tracking generator for attenuation and gain measurements with ESN (up to1000 MHz) and ESVN30
- Frequency and frequency-offset measurements with built-in counter
- Demodulators for measuring modulation depth and frequency and phase deviation
- IF analysis with resolution bandwidth 1, 3 and 10 kHz; span 0.01 to 10 MHz; runs in parallel with level measurement
- Detection of faulty modules by self-test function

Manual operation

The test receivers measure at a fixed frequency with the desired bandwidth, attenuation, measurement time and mode of indication. The following measurements are carried out simultaneously:

- level measurement,
- modulation and deviation measurement,
- frequency and frequency-offset measurement.

Thanks to simultaneous measurements, the parameters of the receive signal can be determined comprehensively in a single test cycle. The level is indicated on a digital LCD display and an analog meter, which is ideal for alignments or determination of maximum signal strength. The results of modulation and frequency measurements are digitally displayed on the screen.

IF analysis

While measurements are being performed, the IF analysis function allows the spectrum about the receive frequency to be analyzed. Measurement of level, modulation and frequency as well as signal assessment using the built-in loudspeaker are made at the center frequency displayed on the screen.

Two test curves can simultaneously be displayed in different modes:

- Max Hold: to detect pulse-shaped or short-time signals
- Max/Min: to detect CW signals, eg in TV channels
- Average: to suppress broadband signals and thus highlight narrowband signals

These display modes allow fast identification and measurement of useful and interference signals in a signal spectrum. Marker functions support precise evaluation and measurement of the signals identified.

Automatic operation

RF analysis
The receive frequency range is scanned and the result displayed as a spectrum on the screen. Single-shot or repetitive scanning can be selected. Two test traces can be displayed at a time. For comparison measurements waveforms can also be loaded from a floppy.

Three different modes are provided for frequency scanning:

- **Overview:** scanning over the desired frequency range is at maximum speed and with constant attenuation.
- **Scan:** scanning is quasi-continuous with selectable step size and measurement time. Thanks to automatic attenuation control, an extremely wide dynamic range is available at full measurement accuracy.
- **Channel:** the receivers perform a scan over a frequency table with up to 400 different values. The measurement can be triggered at a specific frequency by an adjustable threshold with defined dwell time which in turn switches a carrier-operated relay (COR). The results can be output automatically together with the time of the day as lists on a printer. ESN and ESVN can thus be used without an external controller for unattended useful field-strength measurements over long periods of time.

Use in radiomonitoring

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

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

Use in computer-controlled systems

Full benefit of the high measurement rate of the test receivers is obtained only in the remote mode using a high-speed controller. For the determination of field-strength profiles, the test receivers can furnish up to 5000 measured values per second after being triggered by a positioning system or a timebase. 3000 measured values with a dynamic range of up to 100 dB can be attained if the IF autorange function is activated. The field strength can be determined at different frequencies within a particular frequency band at a rate of 2.5 ms per measured value. With cellular networks it is thus possible to measure for instance the field strength of several base stations according to Lee's statistical method using a single receiver at the normal speed of the test vehicle.

For radiomonitoring, up to 10,000 frequencies can be stored and combined to give a maximum of 100 segments. A set of 20 different receiver setups at the most can be assigned to each segment. The modulation limit values can be defined separately for each segment. The measurement results are output to the controller either in blocks, continuously or depending on a limit-value violation detected by the receiver. Automatic user-port control with programmable wait time supports even complex test sequences involving several antennas.

- 10.7 MHz IF output, switchable between regulated and unregulated IF voltage for connection to a direction finder (external access to control voltage possible) or analysis of the IF signal (eg using an oscilloscope)
- CCVS output for connection to a TV monitor, switchable between positive and negative video polarity, measurement of vision carrier or one sound carrier selectable with simultaneous picture display on the monitor through access to the internal LO
- Inphase and quadrature outputs for most general type of demodulation, eg connection to A/D converters and external further processing

Specifications in brief

Frequency range 9 kHz to 2750 MHz, subdivided into

	Range I	Range II	Range III	Range IV
ESVN20, 30	–	20 to 1000 MHz	–	–
ESN	9 kHz to 30 MHz	30 to 1000 MHz	–	–
ESN with option ESN-B1	9 kHz to 30 MHz	30 to 1000 MHz	1000 to 2050 MHz	–
ESVN40	–	20 to 1000 MHz	1000 to 2050 MHz	–
ESVN40 with options ESVN-B1 and ESVN-B2	9 kHz to 30 MHz	30 to 1000 MHz	1000 to 2050 MHz	2050 to 2750 MHz

Frequency setting

with tuning knob	in fine, coarse or user-selectable steps
Automatic scan	for RF analysis
Display	8-digit LCD
Frequency drift	
ESVN20, 30	3×10^{-6}
ESN, ESVN40, ESVN20, 30 with option ESS-B1	$<1 \times 10^{-7}$ (after 30 min warmup)

RF input N connector, 50 Ω

RF attenuator	0 to 120 dB, switchable in 10 dB steps
VSWR	
9 kHz to 1000 MHz	<1.2 with 10 dB RF attenuation <2 with 0 dB RF attenuation
1000 to 2750 MHz	<1.35 with 10 dB RF attenuation <2 with 0 dB RF attenuation
Preselector	
Range I	5 fixed-tuned bandpass filters
Range II	1 fixed-tuned and 5 tracking bandpass filters
Range III	4 fixed-tuned bandpass filters
Range IV	3 fixed-tuned bandpass filters

Preamplifier can be connected between preselector and 1st mixer

Gain 10 dB

Interference rejection, nonlinearities

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

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

Maximum input signals (RF attenuation >0 dB)

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

RF shielding

Voltage indication at field strength of 10 V/m with 0 dB RF attenuation ($f \neq f_{in}$) <0 dBµV

Additional error in CISPR indication range (10 V/m) <1 dB

Intermediate frequencies

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

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

*) Complying with tolerances to CISPR 16.

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

Customer-specific bandwidths available on request.

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

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

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

Level measurement range

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

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

Level display

Digital	3 digits, in dBµV, dBµA, dBm, dB(µV/m), dB(µA/m), dBpW
Resolution	0.1 dB
Analog	on moving-coil meter in operating range of IF detector with additional digital display of lower range limit
Operating ranges	30 dB, 60 dB

Screen 5" CRT with digital memory

Resolution 1024 x 1024 pixels

RF analysis

Display range	
X axis (frequency)	selectable, linear or logarithmic
Y axis (level)	10 to 200 dB, adjustable in 10-dB steps
Test curves	max. 2 traces
Display modes	Clr/Write, Max Hold, View
Frequency scan modes	
Overview	scan with fixed attenuation and step size at maximum speed
Scan	scan with automatic attenuation setting and selectable step size
Channel	scan at up to 400 predefinable frequency values
Marker	2 markers with digital display of frequency and level
Marker functions	normal marker, delta marker, marker to peak,marker to receiver frequency

Measurement accuracy (digital display, average value for S/N >16 dB)

Range I, II	1 dB
Ranges III, IV	2 dB

Frequency drift digital display in kHz

Measurement range/resolution	0.5 x IF bandwidth/0.1 to 100 Hz
Measurement time	1 ms to 100 s (1/2/5 steps)

Frequency deviation	digital display in kHz
Measurement range	deviation + f_{mod} <0.5 x IF bandwidth
Resolution	0.1/0.01 kHz
Modulation frequency f_{mod}	<100 kHz
Phase deviation	
(bandwidths 1/3/9/15 kHz)	digital display in rad
Measurement range/resolution	0.1 to 8 rad/0.1 rad
Modulation frequency	300 Hz to 5 kHz
Amplitude modulation depth	digital display in %
Measurement range/resolution	1 to 99%/0.1%
Modulation frequency f_{mod}	<100 kHz
IF analysis	
Frequency display	
Range I	10 kHz to 2 MHz, 1/2/5 steps
Ranges II, III and IV	10 kHz to 10 MHz, 1/2/5 steps
Level display range	80 dB
Resolution bandwidths (–3 dB)	1/3/10 kHz
Sweep time	50 ms to 10 s, 1/2/5 steps
Test curves, markers	same as for RF analysis
AF demodulation modes	zero beat, 1 kHz beat, AM, USB and LSB, FM
Squelch	adjustable
Trigger functions	
External	TTL levels, pos. or neg. edge
Internal	controlled by RF level, threshold adjustable
Date, time of day	internal clock

Connectors and interfaces

Remote control	interface to IEC 625-2 (IEEE 488)
Plotter	via IEC/IEEE bus
Plotter language	HP-GL
Printer	parallel interface
Keyboard	5-contact connector for MF2 keyboard
Floppy disk drive	3½", 1.44 MByte (formatted)
Front-panel outputs	
Supply and coding connector for antennas, etc	12-contact Tuchel connector
AF output	jack JK34, 10 Ω
Generator output (tracking generator)	N connector, 50 Ω
ESN	9 kHz to 1000 MHz
ESVN30	20 to 1000 MHz
Frequency	receiver frequency
EMF	96 dBμV ±1 dB
Rear-panel outputs	
IF 10.7 MHz	BNC connector, 50 Ω, switchable between regulated and unregulated IF voltage
AM/FM	output for demodulated AF voltage
I/Q demodulator outputs (not available for ESVN20, 30, included in ESN with option ESN-B1 and in ESVN40)	1 BNC connector each, 50 Ω
CCVS output	BNC connector for CCVS TV monitor, video polarity and vision/sound carrier offset selectable for all TV standards
Reference output	BNC connector, can be switched to input for external reference, 10 MHz
User port	25-contact Cannon connector, includes 6 TTL control lines for an external device (eg controlled by RF level), analog voltage indication, input for external trigger, input for IF control, RS-232-C interface for firmware update
Rear-panel inputs	
External battery	3-contact connector
Reference input	BNC connector, can be switched to reference output

General data

Power supply	
AC supply	100/120/240 V ±10%, 230 V +6/–10%, 47 to 420 Hz
Power consumption	
ESN, ESVN40	155 VA
ESVN20, 30	125 VA
Battery (external)	11 to 33 V (switch-on voltage >12 V)
ESN, ESVN40	4.4 A at 24 V/8 A at 12 V
ESVN20, 30	3.7 A at 24 V/6.8 A at 12 V
Dimensions (W x H x D)	
ESN, ESVN40	435 mm x 236 mm x 572 mm
ESVN20, 30	435 mm x 236 mm x 460 mm
Weight	
ESN	32 kg (35 kg with ESN-B1)
ESVN40	32 kg (35 kg with ESVN-B1 and -B2)
ESVN20, 30	29 kg

Ordering information

Test Receiver	ESN	1027.3007.30
Test Receiver		
without tracking generator	ESVN20	1056.8990.20
with tracking generator	ESVN30	1051.9001.30
Test Receiver	ESVN40	1056.9497.40
Options		
Frequency Extension 1000 to 2050 MHz and I/Q Demodulator for ESN	ESN-B1	1052.0508.02
Frequency Extension 9 kHz to 20 MHz for ESVN40	ESVN-B1	1070.4501.02
Frequency Extension 2050 to 2750 MHz for ESVN40	ESVN-B2	1070.4001.02
Reference Oscillator OCXO for ESVN20, 30 (included in ESN ESVN40)	ESS-B1	1026.7250.03
Balanced 600 Ω Audio Output for ESN and ESVN	ESN-B3	1056.9422.02

Function Frequency range	ESN	ESVN20	ESVN30	ESVN40
9kHz to 20 MHz	x	-	-	ESVN-B1
20 to 1000 MHz	x	x	x	x
1000 to 2050 MHz	ESN-B1	-	-	x
2050 to 2750 MHz	-	-	-	ESVN-B2
Ref. Oscillator OCXO	x	ESS-B1	ESS-B1	x
Tracking Generator	x 9 kHz to 1000 MHz	-	x	-
Balanced Audio Output 600 Ω	ESN-B3	ESN-B3	ESN-B3	ESN-B3
I/Q Demodulator Outputs	ESN-B1	-	-	x

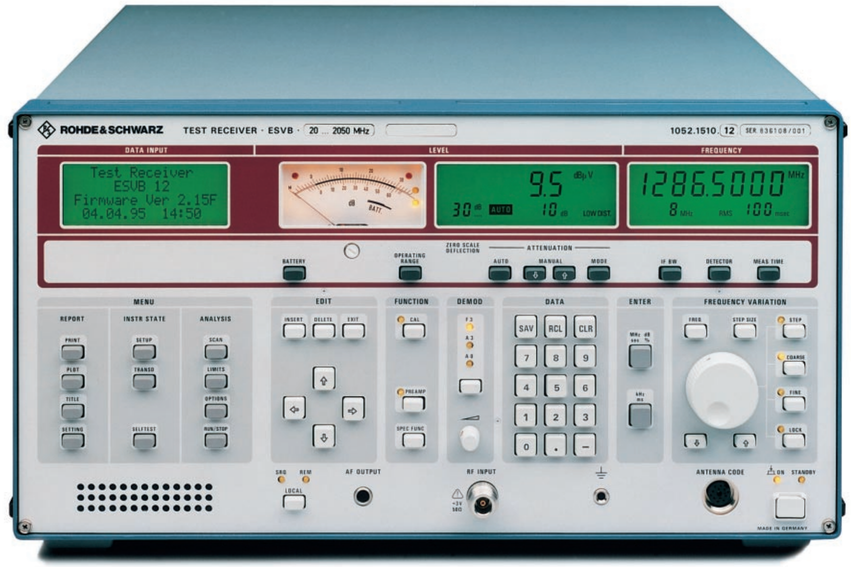
Legend: x = included
- = function not included, cannot be retrofitted
ESx-Bx = option ESx-Bx to be ordered

Test Receivers ESVB

20 MHz to 1 (2.05) GHz

Coverage measurements in digital audio and video broadcast networks

DAB, DVB-T



ESVB (photo 42081)

Brief description

For planning and operation of sound and TV broadcast networks it is essential to know the propagation conditions in the area to be covered. Test Receiver ESVB features the bandwidths and signal weighting facilities required for terrestrial digital video (DVB-T) as well as for digital audio broadcasting (DAB). In conjunction with its high measurement rate it is ideal for use in mobile and stationary coverage measurements.

Being a triple-heterodyne receiver, the ESVB is equally suitable for measuring signal and interfering field strengths; it includes all functions of EMI Test Receiver ESVS10 (page 68).

ESVB can be upgraded for measurements in digital mobile radio networks (GSM) (with optional I/Q Demodulator ESN-B1). This option also allows the frequency range to be extended to 2050 MHz.

Main features

- Large display range, 60 dB even for quasi-peak and average indication; 70 dB for DAB/DVB signal measurements without changing input attenuation
- 1 fixed-tuned and 5 tracking preselection filters, optionally 4 additional fixed-tuned filters
- Crystal-stabilized synthesizer as 1st local oscillator, variable in 100 Hz steps, sweep mode for fast frequency scanning; frequency accuracy complying with GSM recommendations
- IF filters (10 kHz,120 kHz, 300 kHz) with optimized group delay in the third IF stage; additional 1.5 MHz and 8 MHz channel filters for DAB/DVB
- I/Q demodulator (1.5/4 MHz bandwidth per demodulated channel); I/Q demodulator for narrowband IF filters included in ESN-B1 (bandwidth = 1/2 IF bandwidth)

Field-strength measurements in digital sound and TV broadcast networks

With a bandwidth of 1.5 MHz and 8 MHz matching the DAB/DVB-T channel, ESVB is able to cover the entire COFDM spectrum.

The power of the total spectrum at the receiver input is the measure of DAB/DVB-T coverage. Due to the addition of very many carriers with pseudo-random phases, the DAB/DVB-T signal behaves like white noise within the transmission bandwidth, so that only the RMS measurement method is suitable for determining the power. A thermal power meter is inadequate for mobile measurements because of the speed. Therefore, the ESVB features an RMS detector allowing the power at the receiver input to be indicated very quickly and over a wide range.

Specifications in brief

Frequency range	20 to 1000 MHz	
with option ESN-B1	20 to 2050 MHz	
Frequency setting steps	100 Hz/100 kHz/user-selectable	
Automatic scan	for RF analysis	
Frequency display	8-digit LCD	
Resolution	100 Hz	
Frequency drift (after 30 min)	$<1 \times 10^{-7}$	
RF input	N connector, 50 Ω	
VSWR		
20 to 1000 MHz	<1.2 at ≥10 dB RF attenuation	
1000 kHz to 2050 MHz	<1.35 at ≥10 dB RF attenuation	
Preamplifier	can be connected between preselector and 1st mixer	
Gain	10 dB	
Maximum input signals (RF attenuation ≥10 dB, with and w/o preamplifier)		
DC voltage	7 V	
Sinewave AC voltage	137 dBµV (=1 W)	
Max. pulse voltage	150 V	
Max. pulse energy (10 µs)	1 mWs	
Interference rejection, nonlinearities		
Image-frequency rejection 1st IF	typ. 100 dB (1900 to 2050 MHz, typ. 90 dB)	
2nd IF	typ. 100 dB	
IF rejection	typ. 100 dB	
Intercept point d3 ($\lvert f_1 - f_2 \rvert$ ≥10 MHz)	preamplifier off	preamplifier on
Level (f_1, f_2) at receiver	–10 dBm	–20 dBm
20 to 50 MHz	typ. 15 dBm	typ. 5 dBm
50 to 1000 MHz	typ. 20 dBm	typ. 10 dBm
1000 to 2050 MHz	typ. 18 dBm	typ. 8 dBm
Intercept point k2		
20 to 1000 MHz	>35 dBm	>25 dBm
1000 to 2050 MHz	>50 dBm	>40 dBm
Preselector		
20 to 1000 MHz	1 fixed-tuned, 5 tracking filters	
1000 to 2050 MHz	4 fixed-tuned filters	
Intermediate frequencies		
1st IF 20 to 1000 MHz	1354.7 MHz	
1000 to 2050 MHz	394.7 MHz	
2nd/3rd IF	74.7/10.7 MHz	
IF bandwidths	10/120/300 kHz; 1.5 MHz; 8 MHz	
Displayed noise floor		
20 to 1000 MHz	preamplifier off	preamplifier on
Average indication (AV)		
BW=10 kHz	typ. –15 dBµV	typ. –21 dBµV
BW=120 kHz	typ. –5 dBµV	typ. –9 dBµV
BW=300 kHz	typ. 0 dBµV	typ. –4 dBµV
BW=1.5 MHz	typ. 12 dBµV	typ. 5 dBµV
BW=8 MHz	typ. 18 dBµV	typ. 11 dBµV
RMS indication	1 dB above AV values	
Level measurement range		
Lower limit:		
Additional error (inherent noise)	<1 dB	
20 to 1000 MHz	preamplifier off	preamplifier on
Average indication (AV)		
BW=10 kHz	typ. –12 dBµV	typ. –16 dBµV
Other bandwidths	4 dB above displayed noise floor, 20 to 1000 MHz, AV	
Peak indication (PK)		
BW=10 kHz	typ. –14 dBµV	typ. 10 dBµV
BW=120 kHz	30 dB above displayed noise floor,	
BW=300 kHz	20 to 1000 MHz, AV	
RMS indication	3 dB above AV values	
Quasi-peak indication (QP), CISPR bands C/D		
30 to 1000 MHz	typ. 4 dBµV	typ. 0 dBµV
1000 to 2050 MHz	2 dB above values for 20 to 1000 MHz	same values as for 20 to 1000 MHz

Upper limit: AV, PK, QP, RMS as above	137 dBµV (≥10 dB RF attenuation)
Inherent spurious responses	<0 dBµV (equivalent input voltage)
Level display	
Digital	3½ digits, resolution 0.1 dB, in dBµV, dBµA, dBm, dB(µV/m), dB(µA/m), dBpW
Analog	on moving-coil meter in operating range of IF detector with additional digital display of lower range limit
Operating ranges	30 dB (for ≤1.5 MHz IF bandwidth), 60 dB
Display modes	AV, RMS (for all IF bandwidths), PK, QP, Pk/MHz (not for 1.5 and 8 MHz IF bandwidths)
Measurement times, steps	1 ms to 100 s, 1/2/5
Measurement accuracy (AV for S/N >16 dB, RMS for S/N >20 dB, IF BW ≤1.5 MHz)	
20 to 1000 MHz (0 to +55 °C)	≤1 dB (digital display)
1000 to 2050 MHz	≤2 dB (digital display),
20 to 2050 MHz	≤2 dB (IF BW = 8 MHz)
Demodulation modes	A0, A3, F3
Date, time of day	internal clock
Remote control	interface to IEC625-2 (IEEE 488)
Plotter connection	via IEC/IEEE-bus interface
Plotter language	HP-GL
Printer connection	parallel interface (15-contact Cannon connector)
Front-panel outputs	
Supply and coding connector	12-contact Tuchel connector
AF output	Z_{out}=10 Ω, jack JK34
Rear-panel connectors	
IF 74.7 MHz	Z_{out}=50 Ω, BNC connector
IF 10.7 MHz	Z_{out}=50 Ω, BNC connector (not 8 MHz IF BW)
Envelope demodulator output	BNC connector
Inphase and quadrature signal outputs	1 BNC connector each, 50 Ω
Reference output	BNC connector
User port	25-contact Cannon connector
Keyboard connector	5-contact DIN connector
Rear-panel input	
External battery	3-contact connector; 11 V to 33 V
Ext. reference frequency	BNC connector; 5/10 MHz
General data	
Power supply	
AC supply	100/120/240 V ±10%, 230 V +6/–10%, 47 to 420 Hz (70 VA)
Battery	
internal	12 V, 10 Ah (operating time approx.2 h)
external	11 to 33 V (switch-on voltage >12 V), 2.1 A at 24 V, 3.9 A at 12 V
Dimensions (W x H x D)	435 mm x 236 mm x 460 mm
Weight	26/23 kg with/without int. battery

Ordering information

Test Receiver (20 to 1000 MHz) for DAB and DVB-T applications	ESVB	1052.1510.22
Options		
UHF Frontend 1000 to 2050 MHz (incl. I/Q demodulator ≤150 kHz)	ESN-B1	1052.0508.02
Extras		
Service Kit	EZ-8	1052.0508.02
6 V Lead Storage Battery 10 Ah (2 required)		0338.4012.00

Test Receiver ESVD

20 MHz to 1 (2.05) GHz

Field-strength measurements for planning and operation of mobile radio networks (GSM)

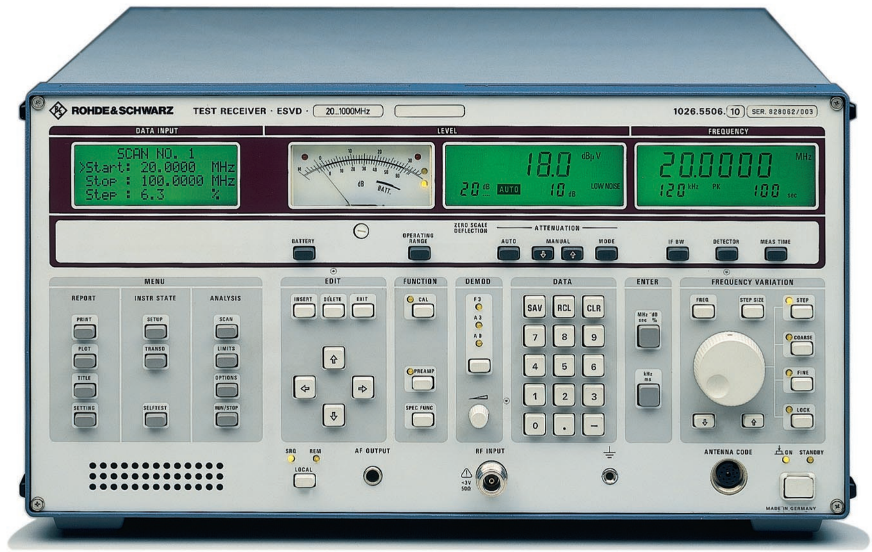


Photo 42427

Brief description

For planning and operation of mobile radio networks it is essential to know the propagation conditions in the area to be covered. Test Receiver ESVD features optimal bandwidths for mobile radio services as well as a high measurement rate so that it is ideal for fixed and mobile coverage measurements.

The ESVD is equally suitable for measuring useful and interfering signals; it partly also covers the application range of EMI Test Receiver ESVS (page 68).

Main features

- Frequency accuracy to GSM specifications
- Filter bandwidths to allow coverage measurements in cellular radio networks
- Frequency range can be extended to 2.05 GHz using option ESVD-B2 (GSM1800 network)
- IF filters with optimized group delay for distortion-free demodulation of digitally modulated signals
- Inphase and quadrature signal outputs for evaluating any modulated signals (option ESVD-B1)
- Output for internal crystal reference frequency (10 MHz)

Field-strength measurements in mobile radio networks
The ESVD is ideal for propagation measurements in mobile radio networks thanks to its level display accuracy, excellent frequency resolution and precision, high sensitivity as well as the 300 kHz bandwidth specially optimized for the GSM1800 network.

The user-friendly operating concept and the easy-to-read LCDs for settings and test results make the ESVD a highly practical test instrument for manual operation. The internal or external battery – 11 to 33 V – makes it suitable for mobile use. Thanks to its high measurement rate, the ESVD is for instance able to supply a value every 2.5 ms in the determination of field-strength profiles with the test receiver being triggered by a positioning system.

This high measurement rate is even achieved when changing frequencies within a mobile radio band. The field strength of several transmitter stations in the GSM band can thus be determined with a single receiver at normal speed of the test vehicle.

I/Q demodulator (option ESVD-B1)
This option allows an additional evaluation of the signal received. This most general type of demodulation enables any kind of modulated signals to be further processed.

Frequency range extension up to 2.05 GHz (option ESVD-B2)
The frequency range of mobile radio networks in the range up to 1.8 GHz can be covered by retrofitting the frequency range extension to 2 GHz. This option contains another four filters with fixed tuning.

Specifications in brief

Frequency range	20 to 1000 MHz	
with option ESVD-B2	20 to 2050 MHz	
Frequency setting		
with tuning knob	in 100 Hz, 100 kHz steps or user-selectable step size	
numerical	by keyboard entry	
in steps	of any selectable size	
automatic scan	for RF analysis	
Frequency display	8-digit LCD	
Resolution	100 Hz	
Frequency drift (30 min warmup)	$<1 \times 10^{-7}$	
RF input	N connector, 50 Ω	
VSWR		
20 to 1000 MHz	<1.2 with ≥10 dB RF attenuation	
1000 to 2050 MHz	<1.35 with ≥10 dB RF attenuation	
Preamplifier	can be connected between preselector and 1st mixer	
Gain	10 dB	
Maximum input signals (with and without preamplifier, RF attenuation ≥10 dB)		
DC voltage	7 V	
Sinewave AC voltage	137 dBμV (corresp. to 1 W)	
Max. pulse voltage	150 V	
Max. pulse energy (10 μs)	1 mWs	
Interference rejection, nonlinearities		
Image-frequency rejection		
1st IF	100 dB (1900 to 2050 MHz, typ. 90 dB)	
2nd IF	100 dB	
IF rejection	typ. 100 dB	
Intercept point d3 ($\lvert f_1-f_2 \rvert$>5 MHz)	preamplifier off	preamplifier on
Level (f_1, f_2) at receiver	–10 dBm	–20 dBm
20 to 1000 MHz	typ. 20 dBm	typ. 10 dBm
1000 to 2050 MHz	typ. 18 dBm	typ. 8 dBm
Intercept point k2		
20 to 1000 MHz	>35 dBm	>25 dBm
1000 to 2050 MHz	>50 dBm	>40 dBm
Preselector		
20 to 1000 MHz	1 fixed-tuned, 5 tracking filters	
1000 to 2050 MHz	4 fixed-tuned filters	
Intermediate frequencies		
1st IF 20 to 1000 MHz	1354.7 MHz	
1000 to 2050 MHz	394.7 MHz	
2ns/3rd IF	74.7 MHz/10.7 MHz	
IF bandwidths	10/120/300 kHz; 1 MHz	
Displayed noise floor	preamplifier off	preamplifier on
20 to 1000 MHz, average (AV)		
BW=10 kHz	typ. –15 dBμV	typ. –21 dBμV
BW=120 kHz	typ. –5 dBμV	typ. –9 dBμV
BW=300 kHz	typ. 0 dBμV	typ. –4 dBμV
BW=1 MHz	typ. 4 dBμV	typ. 0 dBμV
Level measurement range		
Lower limit:		
Additional error (internal noise)	<1 dB	
20 to 1000 MHz	preamplifier off	preamplifier on
Average indication (AV)		
BW=10 kHz	typ. –12 dBμV	typ. –16 dBμV
Other bandwidths	4 dB above displayed noise floor, 20 to 1000 MHz, AV	
Peak indication (PK)		
BW=10 kHz	typ. –14 dBμV	typ. 10 dBμV
BW=120 kHz	30 dB above displayed noise floor, 20 to 1000 MHz, AV	
BW=300 kHz		
Quasi-peak indication (QP), CISPR bands C/D		
30 to 1000 MHz	typ. 4 dBμV	typ. 0 dBμV
1000 to 2050 MHz	2 dB above values for 20 to 1000 MHz	same values as for 20 to 1000 MHz

Upper limit:	
AV, PK, QP as above	137 dBμV (≥10 dB RF attenuation)
Inherent spurious responses	<0 dBμV (equivalent input voltage)
Level display	
Digital	3 ½ digits, resolution 0.1 dB, in dBμV, dBμA, dBm, dB(μV/m), dB(μA/m) or dBpW
Analog	on moving-coil meter in operating range of IF detector with additional digital display of lower range limit
Measurement accuracy (average indication for S/N >16 dB)	
20 to 1000 MHz	
0 to 55°C	≤1 dB (digital display)
1000 to 2050 MHz	≤2 dB (digital display)
Level calibration	sinewave and harmonics generator
Demodulation modes	A0, A3, F3
Date, time of day	internal clock
Remote control	interface to IEC 625-2 (IEEE 488)
Plotter connection	via IEC/IEEE-bus interface
Plotter language	HP-GL
Printer connection	parallel interface (15-contact Cannon connector
Front-panel outputs	
Supply and coding connector	12-contact Tuchel connector
AF output	Z_{out}=10 Ω, jack JK34
Rear-panel outputs	
IF 74.7 MHz	BNC connector, 50 Ω
IF 10.7 MHz	BNC connector, 50 Ω
Envelope demodulator output	BNC connector
Inphase/quadrature signal outputs (option ESVD-B1)	1 BNC connector each, 50 Ω, can be loaded with >200 Ω
Reference output	BNC connector
User port	25-contact Cannon connector
Keyboard connector	5-contact DIN connector
Rear-panel inputs	
Ext. reference frequency	BNC connector; 5/10 MHz
Ext. battery	3-contact connector; 11 to 33 V
General data	
Power supply	
AC supply	100/120/240 V ±10%, 230 V +6/–10%, 47 to 420 Hz (70 VA)
Battery	
internal	12 V, 10 Ah (operating time approx. 2 h)
external	11 to 33 V (switch-on voltage >12 V), 2.1 A at 24 V, 3.9 A at 12 V
Dimensions (W x H x D)	435 mm x 236 mm x 460 mm
Weight (without options)	26 kg/23 kg with/without battery

Ordering information

Test Receiver	ESVD	1026.5506.10
Options		
I/Q Demodulator	ESVD-B1	1026.9001.02
UHF Frontend 1000 to 2050 MHz (only in conjunction with ESVD-B1)	ESVD-B2	1026.9501.02
Extras		
Service Kit	EZ-8	0816.1067.02
6 V Lead Storage Battery 10 Ah (2 required)		0338.4012.00

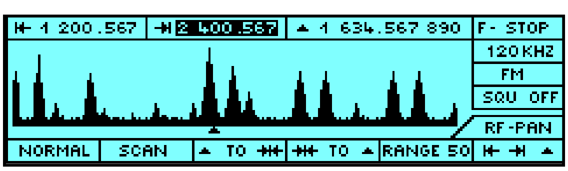
Brief description

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

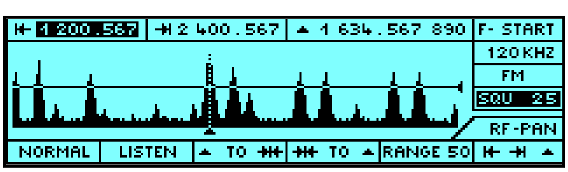
Its small dimensions – ½19″ in size corresponds to two height units – and low weight as well as a sturdy, pickup-proof die-cast aluminium housing with well-protected integrated operating elements make the EB200 ideal for use in places which cannot be reached with a vehicle. Its low power consumption permits battery operation typically of four hours. The EB200 battery pack is easily accessible and can be exchanged quickly. In case of power supply interruption, all the data are stored. Operation can thus be resumed immediately after the power supply is restored.

EB200 fulfils the following tasks:

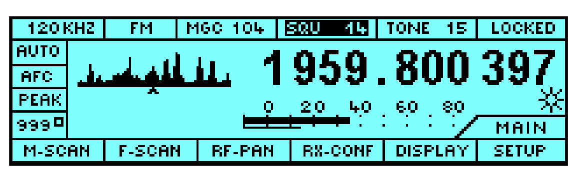
- Monitoring of given frequencies, eg storage of 1 to 1000 frequencies, squelch setting, constant monitoring of one frequency or cyclical scanning of several frequencies
- Searching in a frequency range with freely selectable start and stop frequency and step widths of 1 kHz to 9.999 MHz
- Location of close-range to medium-range targets with the aid of Hand-held Directional Antenna HE200
- Detection of undesired emissions including pulsed emissions
- Detection of unlicensed transmitters communicating illegally or interfering with licensed transmission



DIGI-Scan:

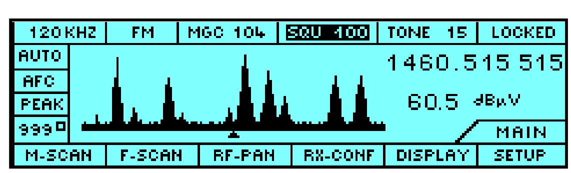


Listen mode



Overview

Differential mode



IF panorama

- Protection against tapping by detecting miniature spy transmitters (bugs)
- Monitoring of one's own radio exercises in a service band
- Monitoring of selected transmissions
- Remote-controlled operation via modem and PC in coverage measurement and monitoring systems

Main features

- Ergonomic design for on-body operation
- Continuous frequency range 10 kHz to 3 GHz
- Digital IF section with 12 bandwidths (150 Hz to 150 kHz)
- Fast, accurate level indication across 110 dB dynamic range
- Scanning modes
  - Frequency scanning
  - Memory scanning
  - Frequency spectrum
- Remote-controllable via RS232 PPP or LAN (Ethernet 10 Base-T, option)

Specifications in brief

Frequency range	10 kHz to 3 GHz
Frequency setting via keypad or rollkey	1 kHz, 100 Hz, 10 Hz, 1 Hz or in selectable increments
Frequency accuracy	≤1.5 x 10^{-6} (–10 to + 55 °C)
Aging	≤0.5 x 10^{-6} /year
Synthesizer setting time	≤3 ms
Oscillator phase noise	≤–100 dBc/Hz at 10 kHz offset
Antenna input	N female, 50 Ω, VSWR ≤3, SMA connector on rear panel for rack mounting
Oscillator reradiation	≤–107 dBm
Input attenuation	manual or automatic
Input selection	
100 kHz to 20 MHz	highpass/lowpass
20 MHz to 1.5 GHz	tracking preselection
1.5 GHz to 3 GHz	highpass/lowpass
Interference rejection, nonlinearities	
Image frequency rejection	≥70 dB, typ. 80 dB
IF rejection	≥70 dB, typ. 80 dB
2nd order intercept point	typ. 40 dBm
3rd order intercept point	typ. 2 dBm
Internal spurious signals	≤–107 dBm
Sensitivity	
Overall noise figure	typ. 12 dB
Demodulation	AM, FM, USB, LSB, CW
IF bandwidths	12 (150/300/600 Hz/1.5/2.5/6/9/15/30/50/120/150 kHz)
IF bandwidths for level and deviation indication	15 (150 Hz to 1 MHz) only with IF Panoramic Unit EB200SU
Squelch	signal-controlled, can be set from –10 to 100 dBμV
Gain control	AGC, MGC
AFC	digital retuning for frequency-unstable signals
Deviation indication	graphical with tuning label
Signal level indication	graphical as level line or numerical from –10 to 100 dBμV, acoustic indication by level tone
IF panorama (option SU)	internal module, ranges 25, 50, 100, 200, 500, 1000 kHz
Scan characteristics	
Automatic memory scan	1000 definable memory locations to each of which a complete data set can be allocated
Frequency scan	START/STOP/STEP definition with receiving data set
Inputs/outputs	
Digital IF output	serial data (clock, data, frame) up to 256 ksps
I/Q output (digital)	AF signal, 16 bit
IF 10.7 MHz, wideband	±5 MHz uncontrolled for external panoramic display
AF output, balanced	600 Ω, 0 dBm
Loudspeaker output	8 Ω, 500 mW
Headphones output	via volume control
Output log. signal level	0 to +4.5 V
BITE	monitoring of test signals by means of loop test
Data interface	RS232C 9-pin, PPP
option	LAN (Ethernet 10 Base-T)
General data	
Operating temperature range	–10 to +55 °C
Rated temperature range	0 to +50 °C
Storage temperature range	–40 to +70 °C
Power supply	AC 110/230 V, 50/60 Hz battery pack (typ. 4 h operation) or DC 10 V to 30 V (max. 22 W)
Dimensions (W x H x D)	210 mm x 88 mm x 270 mm ½19" x 2 HU
Weight (without battery pack)	4 kg
Battery pack	1.5 kg

Brief specifications of HE200

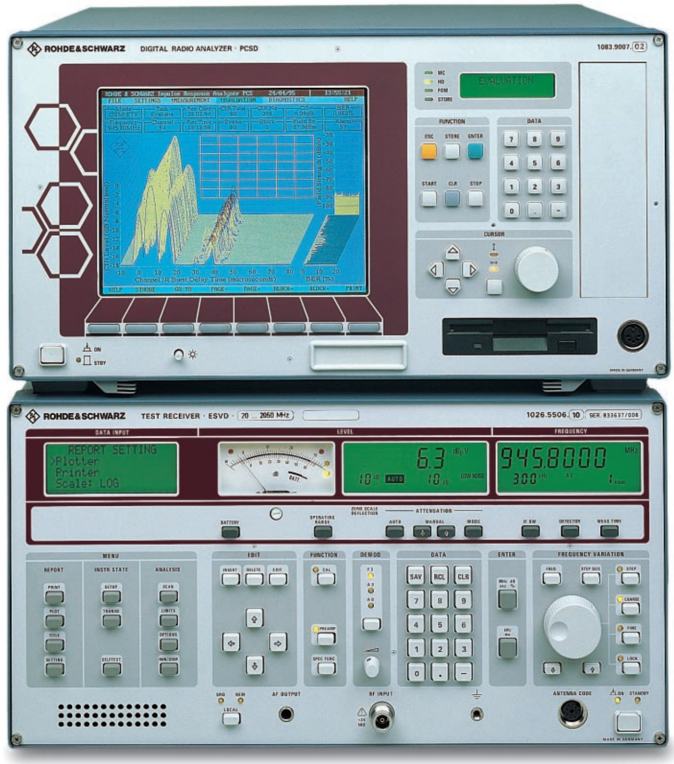
Frequency range	20 to 3000 MHz with 3 RF modules
HF module	10 kHz to 20 MHz as an option
RF connector	N, male, 50 Ω
Length of connecting cable	0.9 m
General data	
Operating temperature range	–10 to +55 °C
Rated temperature range	0 to +50 °C
Storage temperature range	–30 to +60 °C
Power supply	in handle, 4 x 1.5 V mignon cell R6
Dimensions (W x H x D)	470 mm x 360 mm x 180 mm (in transport case)
Weight (without battery)	4.5 kg including transport case

Ordering information

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

Digital Radio Analyzer PCSD

Detects and analyzes all potential interferers in digital radio networks; see also Interference Measurement System TS9952, page 287



PCSD
in conjunction with
Test Receiver ESVD
(photo 42152)

Brief description

In conjunction with a test receiver (ESVB, ESVD – see pages 84 and 86) and appropriate measurement software Digital Radio Analyzer PCSD detects and analyzes practically all interference parameters in operational radio networks such as

- GSM900/1800/1900
- ERMES
- DAB

Its compact, shockproof design and the option of DC powering make the PCSD ideal for use in vehicles. It is an important tool for

- network optimization and expansion
- frequency planning
- service
- quality monitoring
- troubleshooting
- base-station site planning

Basic unit

Thanks to a RISC processor, the PCSD provides realtime measurement and display of the interference parameters as well as comprehensive data management. The measurement results are output on a built-in colour TFT display or on an external monitor. Results are stored on the built-in hard disk, a PC card exchangeable disk or on a floppy to allow further analysis. They can easily be transferred to other programs.

Software options

Channel impulse response (CIR) analysis (channel sounder)
The channel sounder displays the power spectrum of all reflections, thus supporting the user in finding the cause of the interference and selecting suitable remedies.

- Measurements in operational GSM900/1800/1900 networks (PCSD-K2)
- Measurements in operational DAB (Digital Audio Broadcast) networks in mode 1, 2, 3 (PCSD-K3)
- General measurements in other or future networks (PCSD-K4)

Interference analysis – carrier-to-interference measurement
Interference on the transmission channel can often be observed at the boundaries of the individual radio network cells and may cause a complete failure of the coverage in some areas. With the C/I measurement (option PCSD-K1/-K6) the PCSD determines all potential interferers such as:

- co-channel/adjacent-channel interference
- noise
- multipath propagation, reflection
- extraneous interference (built-in spectrum analyzer

Synchronization measurements in ERMES single-frequency networks
The transmission quality of ERMES signals depends on the total receive power and also largely on the delay and power differences of the received signal components. In areas where RF signals of similar high power levels are received, delay differences of more than 50 µs will cause noticeable reception impairment.

To optimize coverage in pager networks, these delay differences can be minimized by matching the transmission time, power or radiation characteristics of the transmitters of a network.

For the startup, optimization and maintenance of the network, the synchronization measuring system with PCSD-K5 provides information on the power, delay difference and frequency offset of up to five signal components of a composite signal.

Signal composition is also of interest where the ERMES sum signal causes disturbance in problem areas. By allocating the signal power to the interfering transmitter the disturbance can be eliminated.

Specifications in brief

Basic unit

Graphics

Built-in display	8" colour TFT LCD, VGA standard: 640 x 480 pixels
For external monitors	max. 1024 x 768 pixels

Mass storage

Internal hard disk	>250 Mbyte
PC card exchangeable disk	>100 Mbyte
Disk drive	3 ½", 1.44 Mbyte

Interfaces

Serial	3 x RS-232-C (eg mouse, GPS)
Parallel	2 x LPT (eg printer, external trigger)
PC card	release 2.0, Type III
Keyboard	2 x 5-contact connector for MF2 keyboard

General data

Power supply AC	100 to 120 V ±10%, 47 to 440 Hz, max. 4 A and 220 to 240 V ±10%, 47 to 63 Hz, max. 1.3 A
DC	10 to 28 V
Dimensions (W x H x D); weight	427 mm x 236 mm x 460 mm; 15 kg

Channel impulse response analysis (CIR)

GSM900/1800/1900 (option PCSD-K2)

Synchronization	C0 carrier, BCCH, extended training sequence
Measurement rate	approx. 46 ms
Max. delay time	80 µs
Max. dynamic range	18 dB, automatic noise suppression
Resolution	1 µs
Bandwidth	120 kHz, 300 kHz

DAB (option PCSD-K3)

Synchronization	run-in symbol
Measurement rate, mode 1/2/3	96/24/24 ms
Max. delay time, mode 1/2/3	500/130/65 µs
Max. dynamic range	35 dB, automatic noise suppression
Resolution	1 µs
Bandwidth	1.5 MHz

General measurements with special sequences (option PCSD-K4)

Synchronization	special sequence
Measurement rate	approx. 100 ms
Max. delay time	460 to 60 µs, depending on bandwidth
Max. dynamic range	35 dB, automatic noise suppression
Resolution	0.1 to 3 µs, depending on bandwidth
Bandwidths	8/1.08 MHz/541/362/271 kHz; other bandwidths on request

Interference analysis (option PCSD-K1)

BCCH measurements

Min. power of BCCH for display	–140 dBm
Number of measurable BCCHs per channel	5

Probability of determining a BCCH with power C in a composite signal with power I as a function of the number of dummy bursts (DB) per TDMA frame. (The composite signal may consist of noise, adjacent and co-channels of a TCH or BCCH, reflections and CW interferers):

Number of DBs	C/I (dB)				
per TDMA frame	–40 to –30	–30 to –20	–20 to –10	–10 to 0	>0
4 to 8	65%	80%	98%	99.9%	100%
3 to 4	50%	76%	97%	99.7%	100%
2	30%	73%	96%	99.2%	100%
1	20%	70%	95%	99.0%	100%

BCC determination	definitive determination of a BCC (base-station colour code) in 97% of all measurements (otherwise probability distribution)
Noise power measurement	>–30 dB (P_{noise}/P_{signal})
Spectrum (display of spectrum)	±200 kHz
Reflection measurement	max. 25 dB (C/I reflection)
Measurement rate	5 to 10 s per channel, depending on number of BCCHs

Ordering information

A = CIR for GSM900/1800/1900
B = CIR for DAB
C = CIR for general measurements
D = interference analysis for GSM900/1800/1900

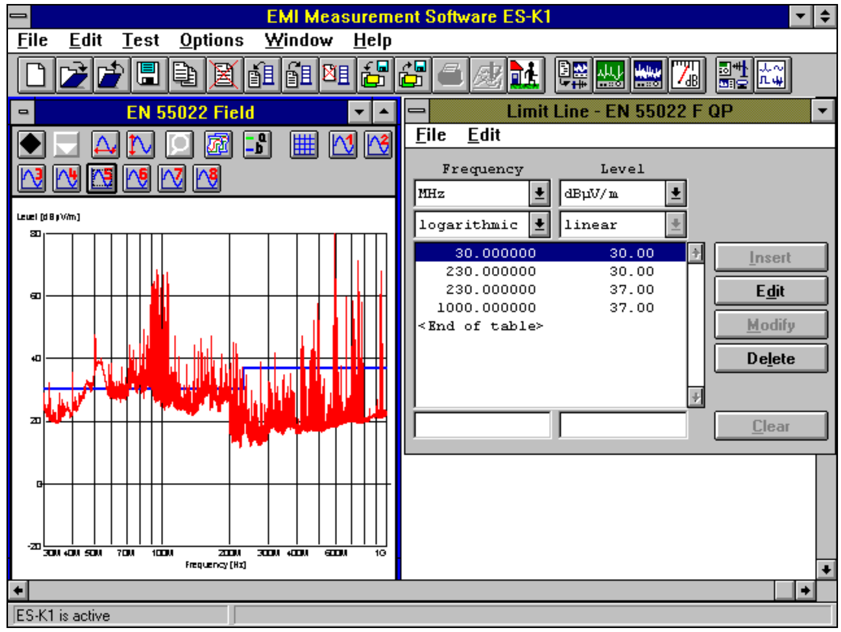
Type, Order No.	Designation	A	B	C	D
PCSD 1083.9007.02	Basic unit	X	X	X	X
PCSD-K1 1083.1841.02	Option C/I measurement, interference analysis				X
PCSD-K2 1062.3000.02	Option CIR for GSM900/1800/1900	X			
PCSD-K3 1062.3100.02	Option CIR for DAB		X		
PCSD-K4 1062.3200.02	Option CIR for general measurements			X	
ESVD 1026.5506.10	Test Receiver 20 to 1000 MHz, max. bandwidth 1 MHz	X			X
ESVD-B1 1026.9001.02	I/Q Demodulator for ESVD and ESVB	X	X	X	X
ESVD-B2 1026.9501.02	Frequency Extension 1000 to 2050 MHz	X*	X	X	X*
ESVB 10 1026.5506.10	Test Receiver 20 to 1000 MHz, max. bandwidth 1.5 MHz		X		
ESVB 12 1026.5506.12	Test Receiver 20 to 1000 MHz, max. bandwidth 8 MHz			X	
PCSD-K5 1090.1108.02	Option Synchronization Measurement in ERMES single-frequency networks				

* Only required for GSM1800/GSM1900.

Extras

Additional PC card disk	PSM-B9	1064.5700.02

EMI Software ES-K1



Automation of EMI measurements with R&S instruments:

Test Receiver Families

ESCS, ESS, ESHS, ESVS, ECPC

Analyzer Families

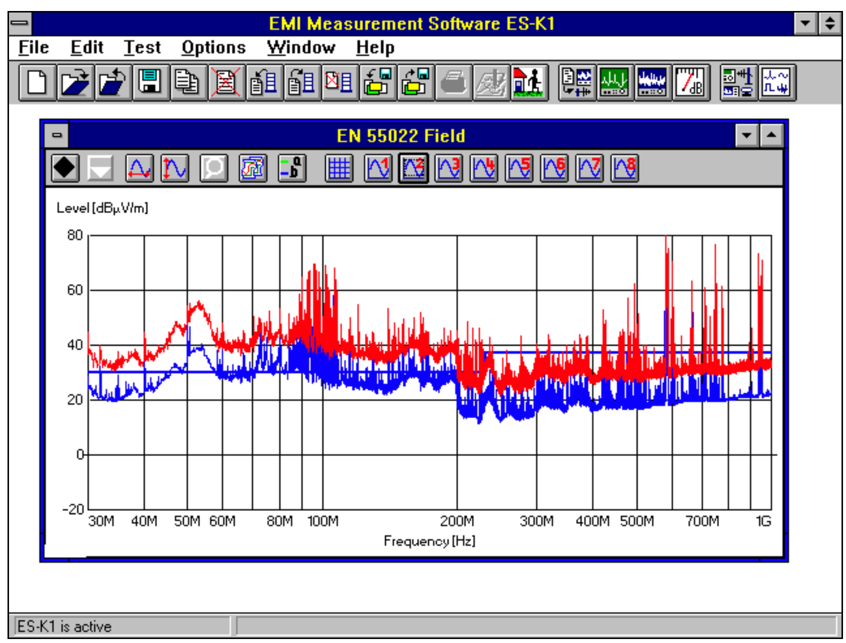
ESI7, ESI26, ESI40

ESAI, ESBI, ESMI

Family ESH3, ESVP, EZM

Brief description

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



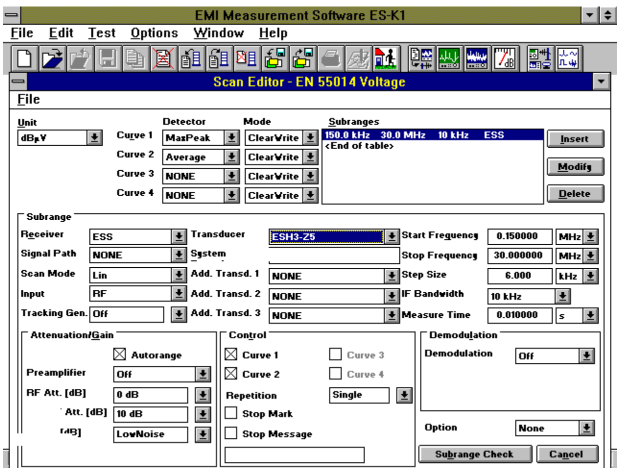
Offering various drivers, the software not only supports EMI test receivers and EMI spectrum analyzers from Rohde&Schwarz, but also a large variety of accessories:

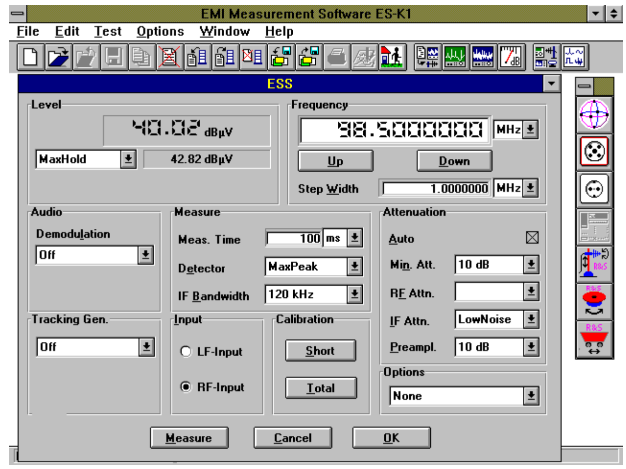
- Mast and turntable system for measurement of RFI field strength
- Artificial mains networks and absorbing clamp slideways for measurement of conducted emissions
- Matrix for switching over antennas and transducers

Main features

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

EMI Software ES-K1





- Universal data storage
- Hardlock key (dongle) for authentication
- Network-compatible

Test runs

Depending on the application and use of the software, control of the test runs is either fully automatic or interactive. By loading automatic test routines defined in the form scripts, measurements can be started simply at the press of a button without any time-consuming entries. The scripts control the test run, evaluate the results and generate the necessary test reports. In addition to standard scripts, user-specific scripts can be generated and existing scripts modified (option ES-K2).

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

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

A zoom function allows enlargement of any parts of the result display.

Report generation

The script run generates a user-configured report which combines the test results in an informative documentation. Another way of generating the reports is by automatic data exchange between the Windows programs, the DDE function implemented in ES-K1 allowing both graphs and texts to be exported from ES-K1 and copied into the user-generated test report wherever desired. For the hardcopy of the test reports all printers and plotters supported by Windows are suitable.

Hardware requirements

PC fully compatible with Windows 3.x/95/98/NT with a minimum of 8-MByte RAM; minimum memory capacity on hard disk 8 Mbyte; IEC/IEEE-bus interface with Windows driver (DLL), compatible with National Instruments IEEE-Bus Interface. Recommended: Process Controller PSM

Ordering information

EMI Software	ES-K1	1026.6790.02
(Windows program with driver for Artificial Mains Networks ESH2-Z5, ESH3-Z5 and Relay Matrixes PSU, RSU and PSN)		
Script Development Kit	ES-K2	1026.6890.02

Drivers for Test Receivers and Spectrum Analyzers		
ESHS, ESVS, ESVD, ESCS, ESPC	ES-K10	1026.6948.02
ESS	ES-K11	1026.7096.02
ESAI, ESBI, ESMI	ES-K12	1026.7144.02
ESH3, ESVP	ES-K13	1062.3497.02
ESH3, ESVP, EZM	ES-K14	1062.3597.02
ESI7, 26, 40	ES-K16	1108.0288.02

Drivers for accessories		
Mast HCM and Turntable HCT	ES-K30	1026.7196.02
Absorbing Clamp Slideway HCA	ES-K31	1026.7921.02
EMCO Controller/Mast/Turntable 1050/1060/1090/2090	ES-K32	1062.3697.02
User specific IEC/IEEE-Bus Driver	ES-K50	1057.2496.02
Multi-User Licence	ES-K100	1057.0741.02

EMI Software ESxS-K1

User-friendly EMI test software under Windows

Can be used for all Test Receivers of ESS, ESHS, ESVS, ESPC, ESCS, ESVN, ESN, ESVD, ESVB, ESAI, ESBI, ESMI Families

Photo 42219

Brief description

EMI Software ESxS-K1 combines the main features of commercial EMI measurement requirements in one complete, easy-to-use application including: setup definition and storage, scan data capture and display with automatic data reduction, peak search with acceptance margin and subrange selection, final measurement with worst case selection, report generation and measured data storage.

ESxS-K1 provides for all test receiver and EMI test receiver families (except ESBI, ESMI) a low-cost Windows based remote-control display and result storage solution.

All the benefits of Windows are available including: keyboard and mouse operation, report printout on any printer/plotter supported by Windows, and dynamic data exchange (DDE). Online help explains all software functions, so no user manual is required.

Main features

- Full on-screen setup entry and storage to disk, including limit lines and transducer factors
- Colour graphic display of scan data, with automatic data reduction
- Marker function, including Marker to Peak and Tune Receiver to Marker Frequency
- Automatic Peak Search with user-definable acceptance margin and subrange/peak value count
- Peak List Edit function for automatic, semi-automatic or manual measurements
- Find Worst Case function: to find max hold level
- Zoom function: expands frequency axis to display a part of the scan in greater detail
- Report generation compatible with ESxS receiver family using any printer or plotter supported by Windows
- Report data export to other applications (WinWord, Excel)

Hardware requirements

Runs under Windows 3.1 and higher on any IBM-compatible machine with an 80386 processor or higher and a hard disk; requires an IEEE–bus interface card for receiver control, eg PS-B4 (model 04) from Rohde & Schwarz, or PCII/IIA, AT-GBIP from National Instruments.

Ordering information

EMI Software	ESxS-K1	1082.9678.02

Mast and Turntable System HCC, HCM, HCT12; Absorbing Clamp Slideway HCA

Positioning facilities for antenna and EUT for RFI field-strength measurements and for absorbing clamp for RFI power measurements

HCT12 with EUTs (left), HCM with antenna and HCC on top of test receiver (photo 40407-5)

Brief description

Commercial RFI field-strength measurements are carried out in line with international standards (CISPR, EN, ANSI, VCCI, VDE) above reflecting ground.

To measure the maximum RFI field strength, the antenna height must therefore be varied. Moreover the equipment under test must be turned to capture the maximum radiated interference. For measuring the RFI power using an absorbing clamp, the latter has to be positioned where maximum RFI power is picked up.

The following facilities are available:

- Antenna Positioning Mast HCM
- Turntable HCT12
- Positioning Controller HCC
- Absorbing Clamp Slideway HCA

Main features

- Fully electrical operation (without compressed air) from AC supply or battery (24 V)
- Polarization variable by means of double toothed belt, which is also for safety
- Smooth startup and braking, nine speeds selectable
- High positioning accuracy
- Antenna carrier tiltable
- Control via fiberoptic cables
- Weatherproof material
- Sufficient mast height for underfloor mounting of the drive unit
- Turntables for carrying loads up to 500 kg, wooden or metallic models available (with slip-ring system to ground plane)

HCA (left) with absorbing clamp slideway (photo 41352)

Operation

- Handheld control unit for convenient manual control
- Automatic calibration routines for final positions (different routines for horizontal and vertical polarization)
- Various command sets (SCPI conformity or EMCO command set)
- One controller for two devices, eg turntable and mast

Specifications in brief

Positioning Controller HCC

Positioning	atenna, turntable, absorbing clamp
direct	numerical entry on basic unit
interactive	quasi-analog entry by means of 4 keys per peripheral unit on handheld control unit
stepwise	in steps of 1 to 99 cm or degrees, triggered by handheld control unit
Speed	selectable in 9 steps for each peripheral unit
Indication of actual position	on LCD (4 x 20 characters), 3 digits for each peripheral unit
Resolution	1 cm or 1 degree
Control of peripherals	2 connectors for fiberoptic cables (max. length 50 m), RS-232 protocol, duplex operation
General data	
Remote control	to IEC 625-1/2; IEEE 488-1/2; SCPI
Dimensions (W x H x D); weight	435 mm x 103 mm x 350 mm; 4.5 kg
AC power supply	100/120/230/240 V ±10%, 47 to 63 Hz (15 VA)

EUT Turntable HCT12

Turning range	
with mechanical stops	0 to 360° and 0 to 705°, selectable
without mechanical stops	0 to 359° endless
Electronic limit values	user-definable
Selfcalibration; any reference angle	
Continuous mode	alternating clockwise/counterclockwise rotation within electronic limits
Angular resolution	1°
Positioning accuracy, absolute	±0.5°
Repeat accuracy	±0.5°
Drive (speed-controlled)	electronically commutated permanent-magnet motor
Transmission	worm gear and toothed belts
Rotational speed	2 to 30°/s in 9 steps
Torque	approx. 100 Nm at plate edge
General data	
Remote control	same as Controller
Load carrying capacity	max. 500 kg
Tabletop diameter	1200 mm
Height to upper edge of tabletop	
Metallic/wooden turntable	198.5 mm/800 mm
Weight (without accessories)	
Metallic/wooden turntable	73 kg/73 kg
Power supply: AC	100/120/230/240 V (max. 300 VA)
Battery	23 to 30 V (max. 10 A)

Antenna Positioning Mast HCM

Minimum height of antenna carrier above	
ground plane of mobile mast	850 mm
foundation of fixed mast	740 mm
Maximum height of antenna carrier above upper edge of drive unit	4000 mm or 6000 mm
Setting range of antenna	3470 mm or 5470 mm
Tilt of antenna carrier referred to ground plane	0 to 15°, continuously adjustable
Antenna polarization	0°/45°/90°
Antenna flange projection from center of mast tube	160 to 850 mm, continuously adjustable
Load carrying capacity	
Distance between mast tube center and antenna center of gravity 1200 mm	8 kg
500 mm	12 kg
Drive	
Vertical drive/polarization adjustment (speed-controlled)	electronically commutated permanent-magnet motor
Lifting speed	1 to 15 cm/s in 9 steps
Transmission	twin toothed belt drive
General data	
Remote control	same as Controller
Overall height	4670 mm or 6670 mm
Weight (basic mast)	
without mast base	66 kg (4 m); 75 kg (6 m)
Fixed/mobile mast base	13 kg/30 kg
Mast extension to 6 m	9 kg
Power supply	
AC supply	100/120/230/240 V (max. 350 VA)
Battery	23 to 27 V (max. 10 A)

Absorbing Clamp Slideway HCA

Max. slideway with	MDS 21: 5 m MDS 22: 5.3m
Nonlinearity	≤15 mm
Reproducibility error	≤5
Height of slideway above ground	80 cm
Drive (speed-controlled, 1:15)	electrical using an electronically commutated permanent-magnet motor
Speed	3 to 40 cm/s in 9 steps
Transmission	by toothed belt
Materials	
Supporting tube (slideway)	glassfiber-reinforced epoxy tube 110 x 110 mm/5 mm
Toothed belt	polychloroprene, glassfiber tension rope
General data	
Remote control	via fiberoptic cables; RS-232 protocol, duplex operation
Overall height/length	910 mm/5700 mm
Width (drive unit)	980 mm
Weight	59 kg
Power supply (AC only)	100/120/230 V +10/–15% (max. 350 VA)

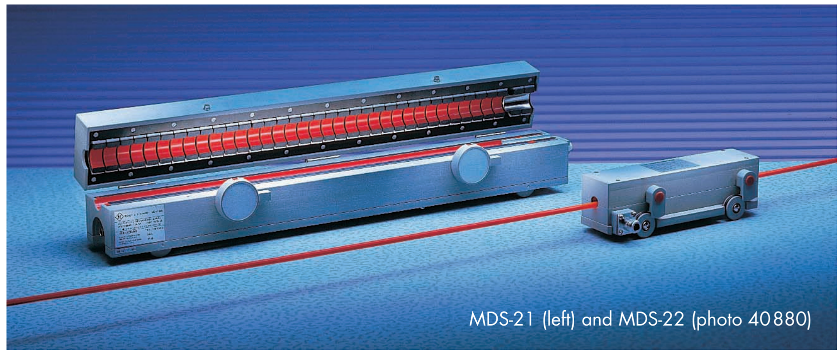
Ordering information

Positioning Controller	HCC	1008.8207.02
Accessories for Controller		
Control Cable (fiberoptic), xx m	HZ-16	1026.8028.xx
(xx = length in m, max. 50 m; a 40 m cable is supplied with HCT12, a 20 m cable with HCM)		
EUT Turntables		
Metallic Turntable	HCT12	1008.8307.02
Wooden Turntable	HCT12	1008.8307.03
Other turntable model		
Non-metallic table adjustable in height (on request)		
Accessories for turntables		
Metal-free table, dia. =1.2 m, height 0.8 m (for use with metallic turntable)	HZ-17	1026.8040.02
Protective cover for wooden turntable	HZ-18	1026.8057.02
Antenna Positioning Mast		
Mast height 4 m, fixed	HCM	1008.8059.04
4 m, mobile	HCM	1008.8107.04
Mast height 6 m, fixed	HCM	1008.8059.06
6 m, mobile	HCM	1008.8107.06
Accessories for antenna masts		
Mast extension from 4 to 6 m	HCM-B1	1026.8086.02
Mobile mast base (for fixed mast)	HCM-B2	1026.8092.02
Fixed mast base (for mobile mast)	HCM-B3	1026.8070.02
Protective cover for mast drive and antenna carrier	HZ-19	1026.8063.02
Absorbing Clamp Slideway		
incl. 10 m fiberoptic control cable	HCA	1008.8420.02

Absorbing Clamps MDS-21 and MDS-22

MDS-21: 30 to 1000 MHz

MDS-22: 300 to 2500 MHz



MDS-21 (left) and MDS-22 (photo 40880)

Brief description

Absorbing Clamps MDS can be used in conjunction with EMI test receivers to measure RFI power on lines to CISPR 14, EN55014, EN50083-2 and VDE 0875 Part 14 and in conjunction with two-port measurement devices to measure the shielding effectiveness of lines to IEC96-1, DIN47250 Part 6, EN50083-2 and DIN VDE0855 Part 10. The clamps are also used for testing the effectiveness of RFI suppression devices for high-voltage ignition systems in line with VDE0879 Part 4.

Main features

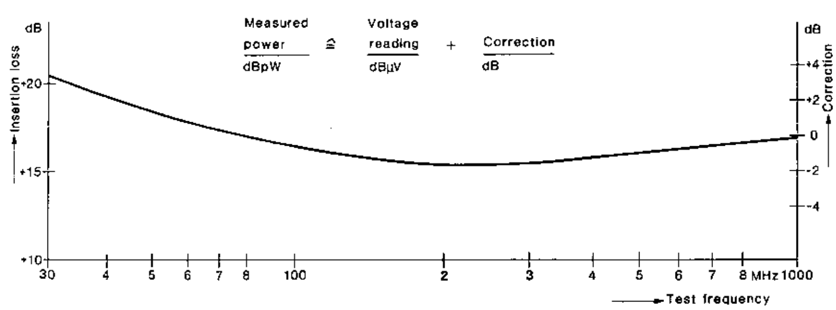
- Calibrated to CISPR 16-1
- Ball-bearing rollers for continuous use in automatic measurements
- Can easily be opened to take up the line to be tested
- Line diameter: for MDS-21 up to 20 mm, for MDS-22 up to 12 mm

RFI power measurement
The current flowing into the absorber is measured with an EMI test receiver at the absorber input via a current transducer. The absorbing clamp is slid along the line for maximum current.

Shielding effectiveness measurement
The shielded cable is terminated with its nominal impedance. Interfering effects caused by standing waves are reduced by the ferrite absorber of the clamp.

Design
The absorbing clamps are accommodated in a plastic case made up of two hinged parts, each part containing a set of ferrite ring halves. The latter are held in sprung plastic holders to form a channel for the EUT cable to be inserted. By closing the two parts of the case the magnetic loop around the cable is completed.

Automatic measurements
For automatic measurement of RFI power and shielding effectiveness, the Absorbing Clamp Slideway HCA with Positioning Controller HCC is available (page 95).



Typical calibration curve of Absorbing Clamp MDS-21

Specifications in brief

	MDS-21	MDS-22
Frequency range	30 to 1000 MHz	300 to 2500 MHz
Insertion loss (CISPR 16-1)	17 ±4 dB	17 +4/–2 dB
Connector	BNC female	N female
Receiver input impedance	50 Ω	50 Ω
Permissible DC current or peak AC current	30 A	50 A
Max. RF input power for susceptibility measurement	5 W	5 W
Max. cable diameter	20 mm	12 mm
Rollers	ball bearing, dust-protected	
Dimensions (W x H x D)	610 x 115 x 80 mm	230 x 70 x 70 mm
Weight	6.3 kg	1.25 kg

Ordering information

Absorbing Clamp	MDS-21	0194.0100.50
	MDS-22	1052.3507.02
Extras		
Absorbing Clamp Slideway	HCA	1008.8420.02

Triple-Loop Antenna HM020

9 kHz to 30 MHz

van Veen/Bergervoet system: more sensitive, faster and cheaper than previous test methods to CISPR Publication 16

New standards: CISPR 15, CISPR 16-1 Amd 1, CISPR 11/12.97

Normal setup (photo 39533-7)

Test setup with reduced height (photo 39533-6)

Brief description

Test method to CISPR16-1 Amd 1 for electric lighting equipment to CISPR 15 and for induction sources to CISPR11

- Fully automatic measurement of the magnetic field strength in the X, Y and Z planes of a centrally placed EUT

Main features

- Automatic control with Software ES-K1 from test receivers or manual remote control from optional Control Unit BG020
- Loop system suitable for mobile use; can be folded in one plane
- Wooden pedestals (100 kg load capacity) for various installation heights available
- Neither EUT nor loop need to be turned during the measurement
- The effect of the shielded room on the test result is considerably reduced
- Ambient interference is strongly suppressed in open-area measurements
- The antenna is factory-calibrated with the Calibration Dipole HM020Z3 placed at the antenna center, which is available to the user for recalibration

Specifications in brief

Frequency range	9 kHz to 30 MHz
Loops	switchable between X, Y and Z planes
Transducer factor of current probe	0 dB, referred to 1 S
RF connector	N female, 50 Ω
Dimensions (W x H x D); weight	
Loops set up, normal mode	2.49 m x 2.57 m x 2.07 m; 45 kg
Loops set up, reduced height	2.49 m x 2.09 m x 2.07 m
Transport crate	2.68 m x 2.32 m x 0.57 m
Basic Pedestal HM020Z1	0.9 m x 1 m x 0.9 m; 40 kg
Adapter Pedestal HM020Z2	0.9 m x max. 0.5 m x 0.9 m; 30 kg

Ordering information

Triple-Loop Antenna	HM020	4023.4508.02
Extras		
Control Unit	BG020	4024.1002.02
Basic Pedestal	HM020Z1	4023.5504.02
Adapter Pedestal	HM020Z2	4023.5604.02
Calibration Dipole	HM020Z3	4023.5704.02
Control Cable	EZ-14 (included)	1026.5341.05

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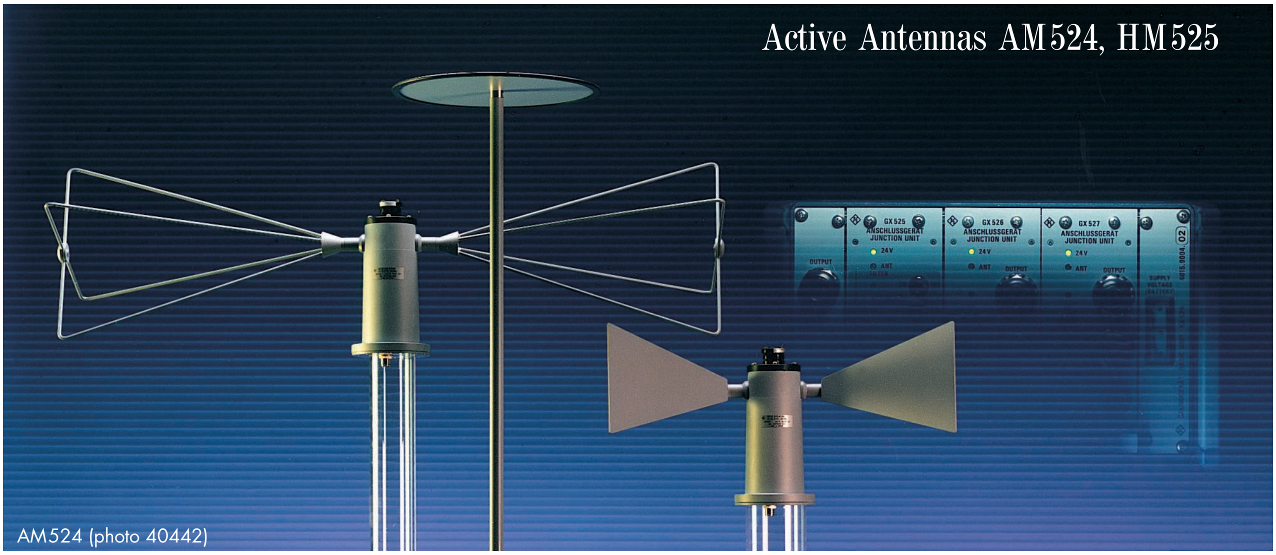

Active Antennas AM524, HM525

AM524 (photo 40442)

Active Antenna System AM524: 100 Hz to 1 GHz

Active H-Field Test Antenna HM525: 100 Hz to 30 MHz

HM525 (photo 41322)

Brief description

For measuring unwanted, compromising emissions, antennas are required which allow detection of extremely low-level signals.

Active Antennas AM524 and HM525 are able to measure signals with a level 10 to 20 dB lower than that of signals that can be measured with conventional EMC test antennas. Therefore they are mainly used in anechoic chambers.

Equipment supplied

AM524 consists of three antennas (HE525, HE526 and HE527) with the appropriate junction units, a basic unit with power supply, transit case and support. HM525 requires the same peripheral devices as AM524.

Specifications in brief

	Sensitivity at 1 Hz bandwidth			
Frequency	HE525	HE526	HE527	HM525
100 Hz	0 dB(µV/m)			18 dB(µA/m)
1 kHz	–18 dB(µV/m)			–22 dB(µA/m)
10 kHz	–35 dB(µV/m)			–50 dB(µA/m)
100 kHz	–43 dB(µV/m)			–68 dB(µA/m)
1 MHz	–48 dB(µV/m)			–88 dB(µA/m)
10 MHz	–49 dB(µV/m)			–93 dB(µA/m)
30 MHz	–51 dB(µV/m)	–49 dB(µV/m)		–92 dB(µA/m)
100 MHz		–54 dB(µV/m)		
200 MHz		–48 dB(µV/m)	–49 dB(µV/m)	
300 MHz			–54 dB(µV/m)	
400 MHz			–48 dB(µV/m)	
500 MHz			–49 dB(µV/m)	
1000 MHz			–54 dB(µV/m)	

Ordering information

Active Antenna System	AM524	4015.7001.02
consisting of		
Active Rod Antenna	HE525	4015.7101.02
Active Dipole Antenna	HE526	4015.7501.02
Active Dipole Antenna	HE527	4015.8008.02
Junction Unit for HE525	GX525	4015.9256.02
HE526	GX526	4015.9504.02
HE527	GX527	4015.9756.02
Basic Unit with power supply	KK524	4015.9004.02
Transit Case	ZR524K	4015.8508.02
Support for HE526 and HE527	AM524-Z1	4036.0506.02
Active H-Field Test Antenna	HM525	4031.0508.02
Support for H-Field Test Antenna	HM525-Z1	4036.1402.02
Control Unit	GS525	4035.5004.02

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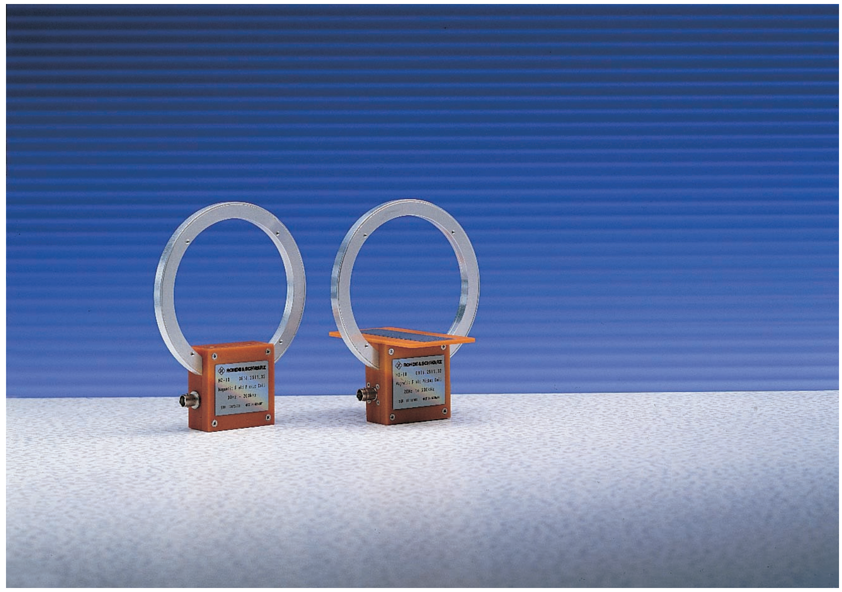
Shielded, Calibrated Magnetic Field Pickup Coil HZ-10

5 Hz to 10 MHz

Measurement of magnetic field strengths to relevant standards



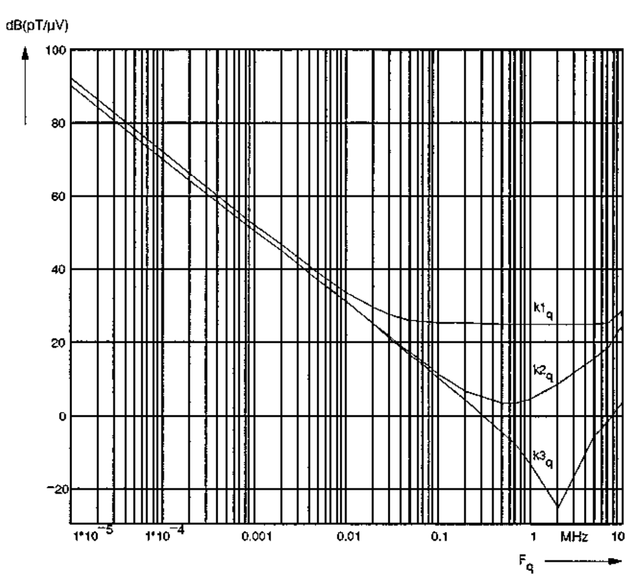
HZ-10 with (right) and without (left) spacing plate (photo 40877)

Brief description

The shielded and individually calibrated Magnetic Field Pickup Coil HZ-10 allows magnetic field strengths in the frequency range from 20 Hz to 200 kHz to be measured in line with commercial and military standards MIL-STD-461/462, DEF STAN59-61, GAM-EG13, VG 95377 Part 13 and EN55103-1. These standards give limits for the magnetic flux density in the frequency range from 30 Hz to 50 kHz or 200 kHz and prescribe an electrostatically shielded coil with a defined number of turns for measuring the magnetic flux density. The coil comes with a calibration certificate for the range from 5 Hz to 10 MHz.

Main features

- Built to MIL-STD-461A and 462D
- Individually calibrated
- Shielded twin-wire connection
- Spacing plate 7 cm (MIL-STD-461, DEF-STAN59-41) and 5 cm (VG standard)
- Isolated coil with shielded twin-wire connection to avoid galvanic surface currents induced in the shielding
- ¼" thread for mounting on a camera tripod



Antenna factors in dB(pT/µV) measured and calculated by calibration: antenna factor k1 with 50 Ω, k2 with 600 Ω and k3 with 1 MΩ; k2 and k3 valid up to 100 kHz (above 100 kHz approximate values only)

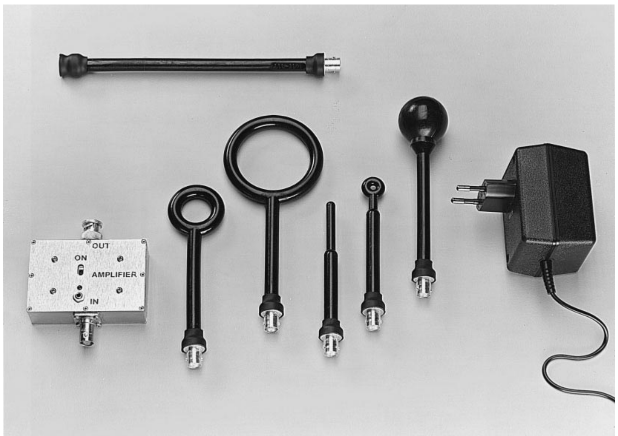
Specifications in brief

Frequency range	5 Hz to 10 MHz
Antenna factor	see diagram (calibration certificate supplied with coil)
Coil	
Diameter	133 mm
Number of turns	36
Type of wire	7-41, litz wire
Resistance	10 Ω
Inductance	415 µH
Connector	Twinax female
Dimensions (W x H x D); weight	142 mm x 178 mm x 29 mm; 260 g

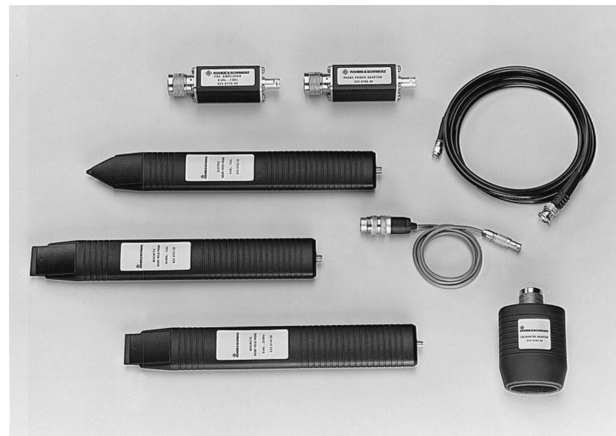
Ordering information

Shielded, Calibrated Magnetic Field Pickup Coil	HZ-10	0816.2511.02
Extras		
RF Connecting Cable balanced, 1.5 m, Twinax connector	EZ-15	1052.2500.02
balanced/unbalanced, 0.2 m, Twinax/BNC connector	EZ-19	1052.2630.02

E and H Near-Field Probe Sets HZ-11, HZ-14



HZ-11 (photo 40623-2)



HZ-14 (photo 40625-2)

HZ-11: 100 kHz to 2 GHz

HZ-14: 9 kHz to 1 GHz

Diagnostic tools for solving EMC problems

Brief description

The near-field probe sets can be used in conjunction with test receivers, spectrum analyzers or oscilloscopes to determine electromagnetic emissions of any type. Their main applications is in the diagnosis of emissions from printed circuit boards, cables and leakage spots in shielded enclosures. The passive probes can be used for a local susceptibility test.

Probe Set HZ-11 is for a qualitative, Probe Set HZ-14 for a quantitative analysis.

The probe sets come in a handy transit case.

Equipment supplied, characteristics

Probe Set HZ-11 comprises:
- three passive H-field probes
- two passive E-field probes
- one probe extension and
- one preamplifier with built-in battery and battery charger

The H-field probes are small (diameter of 1, 3 and 6 cm) electrically shielded loop antennas with directional pattern; the E-field probes, shaped as rod and spherical probes, are for omnidirectional reception of the interference source.

Probe Set HZ-14 comprises:
- two passive H-field probes (9 kHz to 30 MHz and 30 MHz to 1 GHz)
- one active E-field probe (9 kHz to 1 GHz)
- one 30 dB preamplifier for the H-field probe (can be powered from all Rohde & Schwarz test receivers and spectrum analyzers)
- a test jig for testing the H-field probes and simplified normalization of H-field measurements with the aid of a tracking generator and normalization functions provided in spectrum analyzers

Specifications in brief

HZ-11	operating range: 100 kHz to 2.3 GHz
Preamplifier	
Bandwidth (3 dB)	300 Hz to 600 MHz
Battery operating time	typ. 20 h
HZ-14	9 kHz to 1 GHz
H-field probe, max. input power	≤30 MHz: 0.5 W >30 MHz: 0.25 W
VSWR (f >30 MHz)	<2
E-field probe	
Frequency response	3 dB
Sensitivity	13 mV/V
Connectors	SMA female
Preamplifier	9 kHz to 1 GHz
Gain	30 ±2 dB (typ. 1 dB)
Input/output	BNC female/N male
Impedance, VSWR	50 Ω, <2
Powering	10 V ±0.1 V, <100 mA
DC connector	LEMO

Ordering information

E and H Near-Field Probe Set		
with battery charger 220 V	HZ-11	0816.2770.02
with battery charger 110 V	HZ-11	0816.2770.03
E and H Near-Field Probe Set	HZ-14	1026.7744.02

Precision Halfwave Dipole Sets HZ-12, HZ-13

HZ-13 (Photo 40784)

HZ-12 (Photo 40786)

HZ-12: 30 to 300 MHz

HZ-13: 300 to 1000 MHz

Test standards for antenna calibration and test-site attenuation measurements

Brief description

Antenna calibration

Tunable halfwave dipoles are used for the calibration of VHF-UHF broadband antennas, which have their advantages in practical use but whose characteristics cannot be strictly calculated.

Test-site attenuation measurements

Halfwave dipoles are the only tool for checking reference sites used for antenna calibration to ANSI C63.5. They are also used for checking anechoic chamber test sites.

Characteristics

The dipoles contain balance-to-unbalance transformers and attenuators. The attenuation between the dipole connectors and the 50 Ω connector is about 10 dB. Two closely linked dipoles provide an attenuation of about 20 dB. This value can be very accurately measured with a network analyzer. The sum of the two antenna factors $2k_e$ (it is only the sum that is of significance for the test-site validation) can thus be precisely calculated:

$2\,k_e$ = 20 dB + 2 x 1.64 dB
+ 2 x 20 log (2 π/λ) dB
1.64 dB = voltage transformation
2 π/λ = antenna factor of λ/2 dipole

Equipment supplied

Each dipole set comes in a transit case to protect the dipole rods. The dipole supports are fitted with flanges suitable for mounting on Rohde&Schwarz antenna masts. The manual supplied with the dipole sets contains the attenuation values of the dipole set and a table for height-dependent correction of the antenna factors above a conductive ground plane.

Specifications in brief

Frequency range	
HZ-12	30 to 300 MHz
HZ-13	300 to 1000 MHz
Power attenuation of dipole pair (closely coupled)	20 dB (calibration curve supplied with set)
Antenna factor	
HZ-12	7.5 to 27.6 dB (proportional to f)
HZ-13	27.4 to 38 dB (proportional to f)

Ordering information

Precision Halfwave Dipole Set	HZ-12	0816.2870.02
	HZ-13	0816.2940.02

Active Receiving Dipoles HE202, HE302

HE202 (photo 32573-1)

HE302 (photo 32573-1)

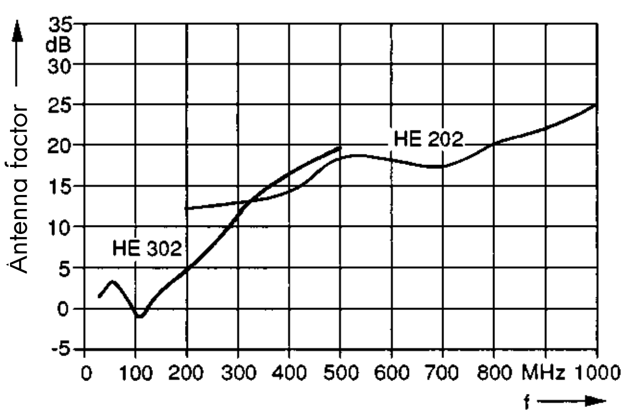
Brief description

Despite their extremely large bandwidth, HE202 and HE302 feature a field-strength sensitivity that is in the entire frequency range comparable to that of antennas with smaller bandwidth and considerably larger dimensions.

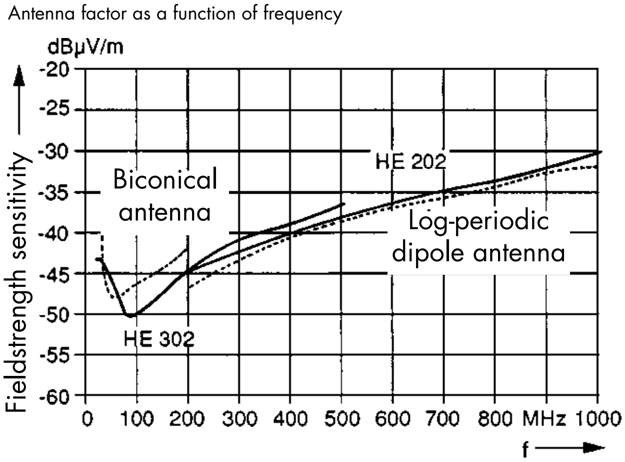
The degree of nonlinear distortion in the test system is important for signal field strength and interference field-strength measurements in shielded rooms. With 1-dB compression, for example, the Active Receiving Dipole HE 302 is in the linear range for field strengths up to 5 V/m at 20 MHz and up to 8 V/m at 500 MHz. At frequencies below 20 MHz the maximum field strength increases by 40 dB per decade thanks to the reactive components in the input circuit.

Main features

- Extremely small size
- High sensitivity
- Wide frequency range
- High immunity to nonlinear distortion, comparable to passive antennas in conjunction with high-grade preamplifier
- High immunity to nearby lightning strikes
- Shock- and vibration-resistant



Antenna factor as a function of frequency



Specifications in brief

	HE202	HE302
Frequency range	200 to 1000 MHz	20 to 500 MHz
Polarization	linear	linear
Connector	N female, 50 Ω	N female, 50 Ω
VSWR	<2.5	<2.5
Electronic gain	5 to 9 dB	–11 to +8 dB
Practical gain	7 to 11 dB	–9 to +10 dB
Directivity	2 dB average	2 dB average
Antenna factor and field-strength sensitivity	see diagrams	see diagrams
Noise figure	200 MHz: 6 dB 1000 MHz: 7 dB	20 MHz: 28 dB 500 MHz: 9 dB
Intercept point		
2nd order	>55 dBm	>60 dBm
3rd order	>30 dBm	>30 dBm
Power supply (from Power Supply Unit IN115), DC voltage	18 to 30 V, via RF cable 200 mA	 170 mA
Dimensions (L x H)	512 mm x 238 mm	1 m x 240 mm
Weight	2.1 kg	2.5 kg

Ordering information

Active Receiving Dipoles	**HE202**	**0630.0310.0x**
	HE302	0644.1114.0x

(x = 2: for monitoring; x = 3: calibrated to ANSI C63.5)

Extras		
Mast Adapter	HE202 Z1	0649.7510.02
RF Cable	HE202 Z2	0649.7785.02
Antenna Adapter	AM524Z2	4036.0658.02
Calibration at Delivery	HE202, HE302	0758.3109.23

Left: field-strength sensitivity of Active Receiving Dipoles HE 202, HE 302 compared to that of passive antennas with a receiver noise figure of 10 dB

HF Antennas

Rod Antenna HFH 2-Z1

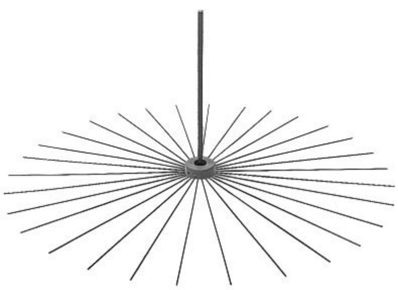


Photo 28081-3

Broadband active rod antenna for use as a general-purpose receiving antenna and for measuring the electrical field-strength components, preferably for open-area measurements.

Loop Antenna HFH 2-Z2

Broadband active loop antenna for measuring the magnetic field-strength components.

Photo 28024

Inductive Probe HFH 2-Z4

Inductive probe for the assessment of the magnetic field-strength components.

Photo 28826

Rod Antenna HFH 2-Z6

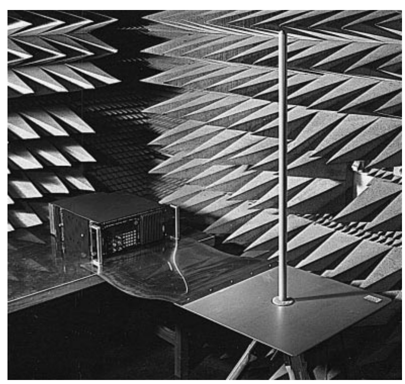


Photo 36487-1

Broadband active rod antenna for measuring the electrical component of emitted EMI in test setups to MIL-STD-461/462 and similar MIL standards.

Power Supply HZ-9

Photo 38647

Power supply for feeding the active Antennas HFH2-Z1/Z2/Z6 if these antennas cannot be powered from the test receiver.

Specifications in brief: HZ-9

Output voltages	±10 V ±0.5 %
Min. current load	100 mA
DC connector	12-contact Tuchel female
AC supply	100 to 240 V, –15/+10%
Dimensions (W x H x D)	125 mm x 70 mm x 188 mm
Weight	1.5 kg

Ordering information HZ-9

Power Supply for Active Antennas HZ-9	0816.1015.02

Specifications in brief

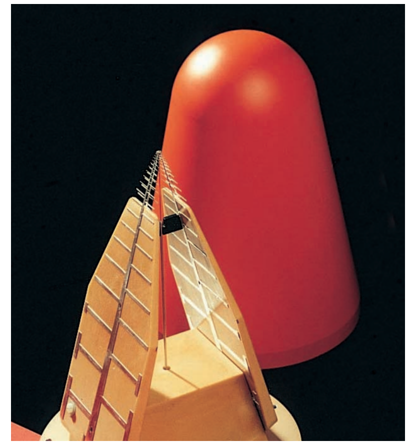
	Rod Antenna HFH 2-Z1	**Loop Antenna HFH 2-Z2**	**Inductive Probe HFH 2-Z4**	**Rod Antenna HFH 2-Z6**
Frequency range	9 kHz to 30 MHz	9 kHz to 30 MHz	100 kHz to 30 MHz	9 kHz to 30 MHz
Antenna factor k, referred to 1/m	10/20 dB, selectable	20 dB (E field)	80 dB (E field)	10/20 dB, selectable
Accuracy	1 dB	1 dB	6 dB	1 dB
Measurement range (IF bandw. 200 Hz, AV ind.)				
Lower limit, frequency-dependent	+15 to –10 dB(μV/m)	9 kHz to 1 MHz: +40 to +10 dB(μV/m) 1 to 30 MHz: +10 to +5 dB(μV/m)	50 dB(μV/m) (≈0 dB(μA/m))	+15 to –18 dB(μV/m)
Upper limit	140 dB(μV/m) 130 dB(μV/m) (k=10 dB)	140 dB(μV/m)	>190 dB(μV/m) (≈140 dB(μA/m))	140 dB(μV/m) 130 dB(μV/m) (k=10 dB)
Connectors				
RF	BNC female, 50 Ω	BNC female, 50 Ω	BNC male, 50 Ω	BNC female, 50 Ω
Supply and coding (antenna factor)	12-contact Tuchel female	12-contact Tuchel female	12-contact Tuchel male	12-contact Tuchel female
Length of connecting cables	10 m	10 m	1 m	10 m
Current drain (±10 V)	<40 mA	<40 mA	–	<45 mA
Dimensions	ground net dia.: 2510 mm rod height: 1092 mm	loop dia.: 590 mm	outer dia.: 50 mm height: 20 mm	base: 60 x 60 mm rod height: 1000 mm
Weight	in transit case, without cable: 8 kg	in transit case, without cable: 12 kg	with cable: 0.3 kg	without cable: 5 kg
Order No.	0335.3215.52	0335.4711.52	0338.3016.52	0837.1866.54

VHF, UHF and SHF Antennas

Biconical Antenna HK116, Log Periodic Antennas HL223, HL023A1, HL025 and HL040, Conical Log Spiral Antenna HUF-Z4

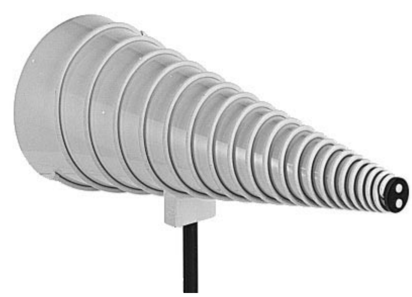
These linearly polarized antennas are used for EMI and EMS measurements in line with commercial and military standards. Depending on frequency and type of antenna, maximum field-strength values between 10 V/m and 300 V/m can be achieved. The use of Conical Log Spiral Antenna HUF-Z4 with circular polarization is limited to measurements in line with MIL-STD-461 A to C.

HK116 (photo 38843)



HL025 (photo 39273)

HL223 (photo HL023A1on page 106)
(photo 38841)



HUF-Z4 (photo 36512)

Specifications in brief

	HK116	HL223	HUF-Z4	HL023 A1	HL040	HL025
Frequency range	20 to 300 MHz	0.2 to 1.3 GHz	0.2 to 1 GHz	0.08 to 1.3 GHz	0.4 to 3 GHz	1 to 18 GHz
Antenna factor k	21 to 8 dB	10 to 26 dB	17.5 to 27 dB	4 to 25 dB	17 to 33 dB	22 to 47 dB
Power-handling capacity	70 W	1500 to 600 W	5 W	700 to 230 W	50 W	5 W
Max. field strength	10 to 40 V/m	300 V/m	10 to 50 V/m	150 to 200 V/m	50 to 100 V/m	40 V/m
VSWR	typ. 2.5	typ. 1.6 (<2)	<2.5	typ. 2 (<2.5)	typ. 2 (<2.5)	<2.5
Connector/nominal impedance	N female/50 Ω	N female/50 Ω	N female/50 Ω	N female/50 Ω	N female/50 Ω	SMA female
Weight	3 kg	2 kg	7.7 kg	5 kg	2.8 kg	0.7 kg
Order No.	4000.7752.02	4001.5501.02	0807.2210.02	0577.8017.02	4035.8755.02	0671.5317.02

RF Probe HFV-Z

This inductive probe is used for locating RFI sources. It permits measurement of RFI from leakage spots in shielded enclosures as well as from RF-carrying parts such as ignition systems in motor vehicles.

Specifications in brief

Frequency range	20 to 1000 MHz
Connector	BNC female
Nominal impedance	50 Ω
Antenna factor k	58 ±10 dB
Weight with connecting cable supplied	120 g
Order No.	0204.1010.02

HFV-Z (photo 33389)

Broadband Dipole HUF-Z1

The antenna complies with CISPR16-1. The antenna factor k is nearly constant in the range 25 to 80 MHz; a factor of 15 dB or 20 dB can be selected.

Specifications in brief

Frequency range	20 to 80 MHz
Connector	N female
Nominal impedance	50 Ω
VSWR	
for k = 15 dB	<2
for k = 20 dB	<1.3
Antenna factor k	
for k = 15 dB	
20 to 25 MHz	22.5 to 15 dB
25 to 80 MHz	15 dB
for k = 20 dB	
20 to 25 MHz	27.5 to 20 dB
25 to 80 MHz	20 dB
Dipole length	1.77 m
Folded size	0.9 m x 0.13 m dia.
Weight	2.5 kg
Order No.	0358.0512.52

HUF-Z1 (photo 33925-1)

Mast and Tripod HFU-Z

Brief description

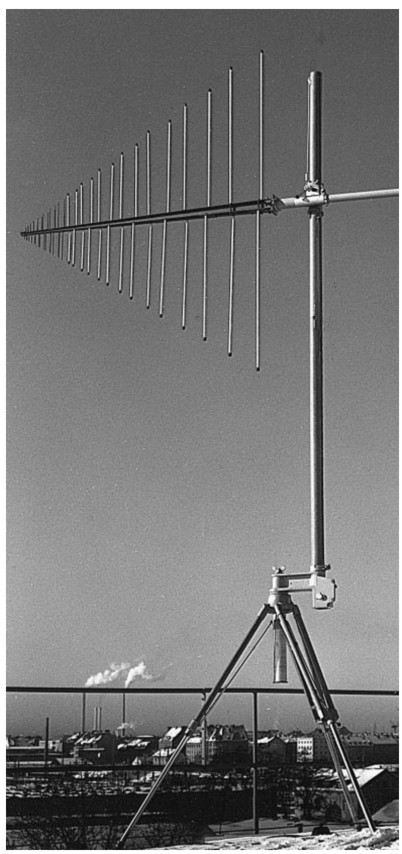
The mast consists of three epoxy glass laminate tubes, a swivel arm holder and an antenna carrier. Guy ropes and pegs are supplied with the mast. The receiving antenna can be positioned at a height between 1 m and 5 m. Azimuth and polarization plane can be chosen as desired; the elevation angle can be varied by a maximum of ±30°.

Specifications in brief

Dimensions (folded)	
Mast	length: 1.65 m
Tripod	length: 0.9 m dia.: 0.22 m
Transport weight	
Mast	36 kg (with crate)
Tripod	9 kg

Ordering information

Mast	HFU-Z	0100.1120.02
Tripod	HFU-Z	0100.1114.02



Mast and Tripod HFU-Z with Antenna HL023A1 (photo 29359-1)

Wooden Tripod HZ-1

Brief description

This tripod supports the Antennas HFH2-Z6, HK116, HL223 and HUF-Z4.

- Light-metal universal ball joint tiltable all round up to 25°; lockable in any position
- Antenna holder with captive 1/4" screw
- Each two-section tripod leg extensible between 830 and 1360 mm

Specifications in brief

Length, collapsed	910 mm
Weight	6.5 kg

Ordering information

Wooden Tripod HZ-1	0837.2310.02

V-Networks ESH2-Z5, ESH3-Z5, ESH3-Z6

Interference measurements on AC-powered loads

Models -Z5 for remote-control via R&S EMI test receivers

Insertion loss calibrated to ANSI C63.4

Main features

- AC voltage supply to EUT
- Isolation of test circuit from line interference
- Standardized load impedance
- Defined feed of interference voltage produced by EUT to EMI test receiver

Brief description of ESH2-Z5

Four-line V-network (50 µH + 5 Ω) shunted by 50 Ω in line with VDE0876 and CISPR16-1. It uses air-core inductances and contains an artificial hand as well as a PE simulating network that can be bypassed. A built-in fan with its own AC supply provides automatically controlled or permanent cooling, as required.

ESH2-Z5 (photo 35326)

Brief description of ESH3-Z5

Two-line V-network (50 µH + 5 Ω) shunted by 50 Ω in line with VDE0876 and CISPR16-1. It uses air-core inductances and contains an artificial hand as well as a PE simulating network that can be bypassed. The compact design and low weight make the ESH 3-Z5 an ideal choice for frequently varying applications.

ESH3-Z5 (photo 35760)

Brief description of ESH3-Z6

ESH3-Z6 is a single-phase V-network (5 µH + 1 Ω) shunted by 50 Ω complying with the requirements of VDE 0876 Part 1 (onboard power supply systems), CISPR Publ. 16 (low-impedance power supplies) as well as MIL-STD-462 Notice 3, MIL-I-6181D, MIL-I-16910C, MIL-E-55301, DEF-STAN 59-41 and DO 160 in the frequency range 100 kHz to 200 MHz.

ESH3-Z6 (Foto 35913)

Specifications in brief

	ESH2-Z5	ESH3-Z5	ESH3-Z6
Frequency range	9 kHz to 30 MHz	9 kHz to 30 MHz	0.1 to 200 MHz
Impedance accuracy	±20%	±20%	±20%
Continuous current	4 x 25 A	2 x 10 A	100 A (150 A to T_{amb}=35°C)
Max. short-time current	4 x 50 A (2 min)	2 x 16 A (30 min)	500 A (30 s)
Max. AC supply voltage	250 V rms	250 V rms	250 V rms; 600 V DC
Max. AC supply frequency	63 Hz	63 Hz	440 Hz
AC supply input connector	4 x 32 A (Cekon male) European male for fan	earthing-contact type male with 1.8-m cable	screw terminal M8
AC supply connector for EUT	4 x 32 A (Cekon female) 2 x 16 A (earthing-contact type female)	earthing-contact type female	screw terminal M8, reference ground to metallic ground plate
RF output to test receiver	BNC female	BNC female	N male
Remote-control input from test receiver	50-contact Amphenol female	9-contact Cannon female	–
Input for artificial hand	two 4 mm jacks	4 mm jack	–
Dimensions (H x B x T)	492 mm x 294 mm x 603 mm	219 mm x 147 mm x 350 mm	122 mm x 128 mm x 322 mm
Weight	26 kg	5.5 kg	1.9 kg

Ordering information

V-Network	0338.5219.53	0831.5518.52	0836.5016.52
Control cable to test receiver	EZ-5, 0816.0625.02	EZ-4, 0816.0560.02 (3 m) or EZ-6, 0816.0683.02 (10 m)	–

200-A Four-Line V-Network ENV4200

150 kHz to 30 MHz

For RFI voltage measurements at high currents

Photo 42 885

Brief description

Four-Line V-Network ENV4200 is used for measuring RFI voltages on AC supply connections of EUTs carrying very high currents.

It uses air-core inductances and contains an artificial hand. ENV4200 satisfies the requirements of CISPR 16-1, VDE 0876 and ANSI C 63.4 for V-networks with an impedance of 50 µH || 50 Ω in the frequency range 150 kHz to 30 MHz.

CISPR 16-1 specifies two types of V-networks for the frequency range 150 kHz to 30 MHz: one with an impedance of 50 µH || 50 W and another with an impedance of (50 µH + 5 W) || 50 W. V-Network ENV4200 corresponds to type 1.

The maximum attainable current of the V-network is limited by the voltage drop at the standardized inductances (CISPR 16-1 prescribes the voltage drop at 5% of the AC supply voltage) and by unavoidable heat losses.

Main features

- V-network to CISPR, EN, VDE, ANSI
- Impedance 50 µH || 50 Ω
- Artificial hand
- Continuous current up to 4 x 200 A
- Air-core design
- Remote control with TTL levels
- Calibrated to CISPR/A/201/CDV and ANSI C63.4

Specifications in brief

Frequency range	150 kHz to 30 MHz
Impedance characteristic of V-network	50 µH || 50 Ω
Error limits (to CISPR 16-1)	±20%
Test path (to EUT)	
Max. permissible continuous current	4 x 100 A with fans switched off 4 x 200 A with fans switched on
Operating time derated	at higher currents
DC resistance per path	6.7 mΩ (typ.)
AC supply frequency range	0 to 63 Hz
Max. permissible AC supply voltage	260 V/450 V
Test path (to test receiver)	
Pulse limiter	to 150 dBµV (built-in)
Voltage attenuation between EUT and test receiver	10 dB (built-in attenuator pad)
Cooling	with 4 built-in fans
Connectors	
EUT connectors	knob for 15 mm terminals
Ground	screw terminal M8
Reference ground	uninsulated busbars
RF connector	BNC female
Remote control	25-pin Cannon female
General data	
Rated temperature range	+5 to +40°C
Storage temperature range	–30 to +70°C
Dimensions (W x H x D); weight	450 mm x 315 mm x 670 mm; 43 kg

Ordering information

Four-Line V-Network	ENV4200	1107.2387.02
Recommended extras		
25-wire remote control cable for control by Test Receivers of		
ESxS Series: control cable 3 m	EZ-21	1107.2087.03
control cable 10 m	EZ-21	1107.2087.10
2 required for shielded room		
EBxl Series: control cable 3 m (Combination with EZ-21 required for shielded chamber)	EZ-22	1107.2235.03

T-Networks ESH3-Z4, EZ-10

Artificial mains networks for symmetrical interfaces

ESH3-Z4: 9 kHz to 150 MHz

EZ-10

Model 02: 9 kHz to 150 MHz

Model 03: 0.15 to 150 MHz

Photo 39362

Brief description

T-networks are used to measure asymmetrical RFI voltage of devices with symmetrically driven communication, data, audio frequency and control lines and they are also employed as coupling networks to measure the susceptibility of such devices to conducted asymmetrical RFI voltages. Both networks comply with IEC1000-4-6 and FTZ Regulation 12TR1.

ESH3-Z4

Two-wire T-Network ESH3-Z4 complies with the following standards:

VDE0878 Part 1 (12/86),
VDE0878 Part 2 (draft 12/86),
VDE0878 Part 200 (12/92),
IEC Draft IEC 1000-4-6 and
VG95377 Part 14 (12/84).

EZ-10

Four-wire T-Network EZ-10 is used for EMC measurements on devices and systems with two pairs of symmetrical lines with and without phantom powering, eg ISDN communications equipment with S0-bus interface. Model 03 is also suitable for EMC measurements on high-impedance interfaces.

Main features

- High unbalance rejection
- High isolation
- Low capacitance
- High RF power-handling capability

Specifications in brief

	ESH3-Z4	**EZ-10, model 02**	**EZ-10, model 03**
Frequency range of asymmetrical RFI voltage	9 kHz to 150 MHz	9 kHz to 150 MHz	150 kHz to 150 MHz
Load impedance for asymmetrical RFI voltage	150 Ω ±20%	150 Ω ±20%	150 Ω ±20%
Voltage attenuation in measurement circuit	10 ±1 dB	9 kHz to 100 MHz: 10 ±1 dB 100 to 150 MHz: <13 dB	150 kHz to 100 MHz: 10 ±1 dB 100 to 150 MHz: <13 dB
Passband (BW_{6dB}; Z_{bal} = 100 Ω)	>10 MHz	>10 MHz	>10 MHz
Unbalance rejection	>80 dB (10 kHz) >25 dB (150 MHz)	>80 dB (10 kHz) >25 dB (150 MHz)	>53 dB (1 MHz) >25 dB (150 MHz)
Isolation	>20 dB (10 kHz) >70 dB (150 MHz)	>20 dB (10 kHz) >60 dB (150 MHz)	>37 dB (150 kHz) >60 dB (150 MHz)
Max. RF input voltage (asymm.)	17 V rms	17 V rms	17 V rms
Max. DC/AF AC between line and ground	100 V	200 V	200 V
Max. DC current (phantom current, forward and return)	150 mA on one line pair	150 mA on one or different line pairs	
Input/output for test receiver/signal generator	BNC female connectors	BNC female connectors	BNC female connectors
Connectors for EUT and line	4 mm jacks	4 mm jacks	4 mm jacks
Dimensions (W x H x D)	147 mm x 41 mm x 93 mm	196 mm x 115 mm x 41 mm	196 mm x 115 mm x 41 mm
Weight	500 g	1 kg	1 kg

Ordering information

T-Network	0800.1510.52	0800.1215.02	0800.1215.03

Antenna Impedance Converter EZ-12

Photo 39305-2

EZ-12 is a broadband matching unit for test receivers and spectrum analyzers with low-impedance inputs. It is used for high-impedance measurements of interference voltage at the feedpoint of a vehicle-mounted antenna in the long-, medium- and shortwave bands to VDE0879 Part 2 and CISPR25.

Main features

- Flat frequency response
- High sensitivity
- High overload capability
- Calibration input
- Rugged metal case

The EZ-12 can be directly powered from Rohde & Schwarz test receivers or spectrum analyzers. Should this not be possible, it is recommended to use Power Supply HZ-9 (see page 104). A calibration input with a circuit simulating a vehicle antenna to DIN IEC 315 Part 1 is used to check performance and frequency response in conjunction with a tracking generator.

Specifications in brief

Frequency range	9 kHz to 30 MHz
RF input connector	to DIN41585
Input impedance	approx. 350 kΩ, 10 pF (at 1 MHz)
Gain factor	
for direct input to antenna connector	0 ±1 dB
for input via antenna simulator (CAL input)	–14 dB
RF output	BNC female, 50 Ω
VSWR	<2
Noise voltage at output (input terminated with antenna simulator; average detector, BW = 10 kHz, f >100 kHz)	typ. –10 dBµV
1 dB compression point	>107 dBµV
Calibration input	BNC female, 50 Ω
Power supply	12-contact Tuchel connector
Supply voltages	±10 V ±0.1 V
Current drain	50 mA (max.) each
Dimensions (W x H x D (mm))	125 x 110 x 40
Weight	0.6 kg

Ordering information

Antenna Impedance Converter	EZ-12	1026.4800.02

Current Probe EZ-17

Photo 39784-2

Model 02 with its extremely flat frequency response is optimal for current measurements as well as for measuring shielding effectiveness. Due to its high load capacity, model 03 is recommended for EMS measurements (bulk current injection). Thanks to their high magnetic overload capacity, these two models can be employed on power lines with currents up to 300 A without having an adverse effect on the measurement results. Due to its high sensitivity in the range below 100 kHz, model 04 is especially recommended for measurements to military standards.

Current Probes EZ-17 comply with the following standards:

- CISPR16-1 and VDE0876 Part 1 for measurement of RFI currents
- MIL-STD-461 CE 01 and CE 03
- VG95373 Part 20, VG95377 Part 14
- DEF-STAN59-41 DCE 01 and 02
- RTCA/DO-160 C

Main features

- High sensitivity and overload capability
- Wide frequency range
- High load capacity for DC and AC current (300 A)
- Small dimensions in spite of large inner diameter (30 mm)
- Simple clamping thanks to spring-loaded mechanism

Specifications in brief

	Model 02	Model 03	Model 04
Frequency range	20 Hz to 100 MHz	20 Hz to 100 MHz	5 Hz to 2 MHz
Range with constant transducer factor (–3 dB)	1 to 100 MHz	2 to 100 MHz	1 kHz...2 MHz
Transducer factor reduced by 20 dB/decade in range	20 Hz to 1 MHz	20 Hz to 2 MHz	1 Hz...1 kHz
RF connector	N female	N female	Twinax female
Source impedance	≤0.8 Ω	≤1 Ω	≤0.1 Ω
Transfer impedance Z_T in range with constant transducer factor	3.16 Ω	7.1 Ω	0.1.27 Ω
Transducer factor k in range with flat frequency response	–10 dB	–17 dB	+15 dB
Load capacity (RF current measurement)			
Max. DC current or peak AC current	300 A (f <1 kHz)	300 A (f <1 kHz)	300 A (f <100 Hz)
Max. RF current (rms)	2 A (f >1 MHz)	1 A (f >1 MHz)	20 A (f >1 kHz)
Load capacity (EMS measurement)			
Max. power at RF connector	–	10 W (f >1 MHz)	10 W (f >10 kHz), 50 W for ≤15 min

Ordering information

Current Probe	EZ-17	0816.2063.02	0816.2063.03	0816.2063.04

VHF Current Probe ESV-Z1

Photo 28825

Brief description

Current Probe ESV-Z1is used for selective or broadband measurement of very small as well as of very large RF currents in electric lines. They are shielded against electrostatic effects and comply with CISPR16-1 and VDE0876.

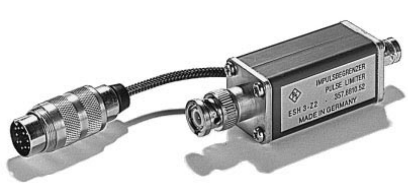
Specifications in brief

Frequency range	20 to 300 MHz
Measurement range (average indication)	–33 to +117 dBµA (IF bandwidth 7.5 kHz)
Transfer admittance $Y_t = I_{in}/V_{out}$	0.1 S
Transducer factor k = 20 log (Y_t/s)	–20 dB
Max. current (superimposed on RF current or peak AC current)	50 A
Max. diameter of conductor	13.5 mm
RF connector	N male, 50 Ω, 1 m
Coding connector (transducer factor)	12-contact Tuchel
Dimensions (dia./height)	55 mm/20 mm
Weight	130 g

Ordering information

VHF Current Probe ESV-Z1	0353.7019.02

Pulse Limiter ESH3-Z2, Attenuator ESH 2-Z11



ESH3-Z2 (photo 32934)

For limiting and reducing the interference level to protect the receiver input.

Specifications in brief

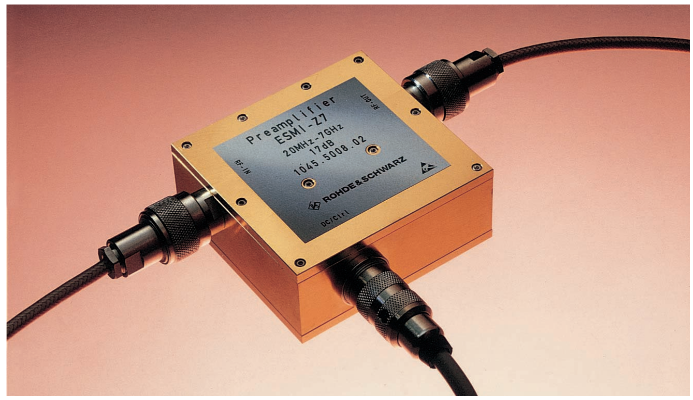
	ESH3-Z2	**ESH 2-Z11**
Frequency range	0 to 30 MHz	0 to 1500 MHz
Insertion loss	10 ±0.3 dB	20 ±0.5 dB (f ≤1GHz)
Input/output VSWR	≤1.06/≤1.25	—
Power-handling capacity in continuous mode	1 W	10 W
Pulse power-handling capacity	E=0.1 Ws (6 µs)	P=750 W (3 µs)
RF connector, 50 Ω	BNC (female/male)	BNC (female/male)
Dimensions (L x W x H or L x dia.)	94 mm x 25 mm x 25 mm	97 mm x 42 mm
Weight	120 g	150 g

Ordering information

Pulse Limiter or Attenuator	0357.8810.52	0349.7518.52

Preamplifiers ESH3-Z3, ESV-Z3, ESMI-Z7

ESV-Z3 (photo 34762-1)



ESMI-Z7 (photo 42373-1)

Brief description

Through the use of an external preamplifier the noise figure of a Rohde&Schwarz test receiver is reduced while at the same time its sensitivity is improved. Coding lines for transducers used for correcting the level and unit display of the rest receiver are looped through.

The preamplifiers can also be used for other receivers. Power Supply HZ-9 (see page 104) is recommended for feeding ESH3-Z3 and ESV-Z3 if they cannot be powered from the test receiver. ESMI-Z7 is available with power supply 115 V and 230 V.

Main features

ESH3-Z3
- Noise figure typ. 5 dB
- Noise indication typ. –37 dBµV for average value and IF bandwidth 200 Hz

ESV-Z3
- Noise figure typ. 4 dB
- Noise indication typ. –20 dBµV for average value and IF bandwidth 7.5 kHz

ESMI-Z7
- Noise figure <8 dB
- Noise indication typ. 0 dBµV for QP with Test Receiver ESxI at 1 GHz.

Specifications in brief

	ESH3-Z3	ESV-Z3	ESMI-Z7
Frequency range	9 kHz to 30 MHz	20 to 1000 MHz	20 MHz to 7 GHz
Gain	10 dB	10 dB	17 dB
Input VSWR with test receiver	typ. 1.25	typ. 1.5 60 MHz to 7 GHz: <1.8	20 to 60 MHz: <2.2,
Noise figure	<6 dB, typ. 5 dB	<6 dB, typ. 4 dB	typ. <8 dB
1 dB compression point	typ. +13 dBm (output level)	typ. +13 dBm (output level) otherwise >+7 dBm guaranteed	typ. >+9 dBm
Intercept point d3	typ. +27 dBm (output level)	typ. +27 dBm (output level)	–
Connectors			
RF input	BNC female, 50 Ω	N female, 50 Ω	N female, 50 Ω
RF output	BNC female, 50 Ω	N male, 50 Ω	N female, 50 Ω
Coding/power supply	12-contact Tuchel male to receiver,	12-contact Tuchel female for amplifier input	
Dimensions (W x H x D)	160 mm x 29 mm x 110 mm	160 mm x 29 mm x 110 mm	80 mm x 33 mm x 76 mm
Weight	0.4 kg	0.4 kg	0.4 kg

Ordering information

	ESH3-Z3	ESV-Z3	ESMI-Z7
Order No.	0827.8016.52	0397.7014.52	with power supply 230 V: 1045.5008.02 with power supply 115 V: 1045.5008.03

Probes ESH2-Z2, ESH2-Z3

ESH2-Z3 (photo 34981)

Active Probe ESH2-Z2
The active probe is used for measuring AC voltages on lines that do not carry AC supply voltage.

Passive Probe ESH2-Z3
The passive probe is suitable for measuring RFI voltages (on AC supply lines) to CISPR16-1 and VDE0876.

Attenuator ESH2Z31
For checking the interference source impedance to VDE 0877, Part 1 and CISPR16-2.

Specifications in brief

	ESH2-Z2	ESH2-Z3
Frequency range	9 kHz to 30 MHz	9 kHz to 30 MHz
Measurement range (average indication, IF bandwidth 200 Hz with Rohde&Schwarz Test Receivers)	–20 dBµV to +120 dBµV	+10 dBµV to +150 dBµV
Attenuation/error	10 dB/<1 dB	30 dB/–1 to +5 dB
Input impedance	118 kΩ ±5% ||8 pF	1.5 kΩ ±2% ||9 pF
Max. input voltage f <63 Hz	100 V	250 V
f <500 Hz	5 V	250 V
9 kHz to 30 MHz	3 V	30 V

Ordering information

Active or Passive Probe ESH2-Zx	0299.7210.52	0299.7810.52
Attenuator ESH2Z31	0827.6513.02	0827.6513.02
BNC Adapter URV-Z	0241.1110.02	0241.1110.02

RF Connecting Cables HFU2-Z4, HFU2-Z5

Low-loss cables for connecting antennas to test receivers. With this type of cable the outer sheath is filled with a special ferrite to reduce sheath currents.

Ordering information

RF Connecting Cable		
12 m	HFU2-Z4	0252.0090.56
7 m	HFU2-Z5	0252.0055.56

Feeder Cables HZ-3, HZ-4

Connecting cables with 12-contact Tuchel male/female connectors for remote feeding of active antennas from the test receiver or from Power Supply HZ-9, page 104. The correction factor for automatic correction of unit and level display on the test receiver is also transmitted.

Ordering information

Feeder Cable		
3 m	HZ-3	0837.3469.02
10 m	HZ-4	0816.0519.02

Digital Video Component Analyzer VCA for analysis of digital studio signals (photo 42246-1)

Contents of Chapter 3

MPEG2 Measurement Generator DVG

Digital TV test signals at a keystroke

Large choice of signals (525- and 625-line standard)

Endless MPEG2 sequence loop thanks to realtime updating of all time stamps

Note: With R&S label available in Europe, Middle East and Japan only; in all other areas available as model MTG200 by Tektronix (photo 42480)

Brief description

MPEG2 Measurement Generator DVG is a universal generator for digital TV signals in the form of transport streams in line with the MPEG2 standard. The structure of these streams and the data reduction methods employed were developed and standardized by the Moving Picture Experts Group (MPEG) and the Digital Video Broadcasting (DVB) project. A main feature of the transport stream is that it contains several programs, each consisting of several substreams carrying video, audio and data signals.

DVG generates in an endless loop a large variety of selectable MPEG2 transport streams with combined video, audio and data sequences as contents and is thus a favourably priced and compact alternative to expensive MPEG2 encoders with multiplexer and external standard generators.

Complementary to DVG, MPEG2 Measurement Decoder DVMD (page 120) is offered for realtime monitoring, analyzing and decoding of MPEG2 transport streams.

Main features

- Endless MPEG2 sequence loop: all the required time information is continuously updated during playback of the transport stream, and the signal is available without any interruption.
- The output data rate can be varied as desired and thus adapted to the specifications of the transmission link or devices under test.
- Thanks to the settable PID of the program elements, DVG is ideal for use as a substitution signal source.
- A built-in PCR (program clock reference) jitter generator is available for stress testing of decoder PLLs.

The optional Stream Combiner™ software can be used to configure any new transport streams from the supplied or customer-specific elementary streams (ES) in addition to stored transport streams.

A PC card interface on the front panel allows the exchange of user-defined transport streams via a small exchangeable hard disk.

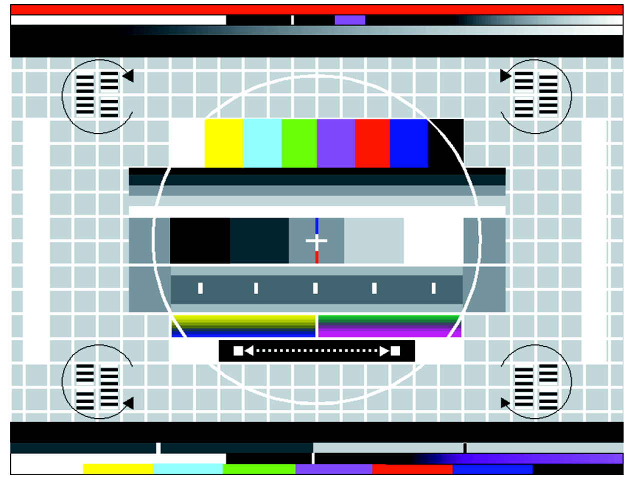
Applications

The digital data streams generated by DVG are used as test signals for a variety of equipment employed on digital TV transmission links – from the studio to the domestic receiver. One field of application of DVG therefore is in the development, production, quality management and servicing of equipment processing MPEG2-coded signals.

Further applications are in the field of signal distribution and transmission (eg cable headends), where the generator can be used as a substitution signal source.

Test signals

DVG offers a variety of predefined MPEG2 transport streams which can be called at a keystroke. Video data streams of different contents and data rates are available. The set of signals stored comprises moving picture sequences as well as stationary test patterns. For fast testing of set-top boxes, ie integrated receiver decoders (IRT), DVG provides the Rohde & Schwarz codec test pattern (see right). Thanks to integrated test signals in the upper and lower picture area and using a suitable video analyzer such as VSA (page 142), analog interfaces can be tested out within a few seconds. In addition, moving elements at the corners and in the center of the picture allow visual checking of the decoder functions. Audio data streams, which are also available at different data rates, comprise the sound component accompanying the video sequences as well as special audio test signals.



Rohde&Schwarz codec test pattern

Choice of test signals (625-line standard)

Moving pictures for general video and audio function test

Video contents	**Audio contents**
Automatic insertion machine	Classical music
Flower garden	Classical music
Table tennis	Applause
Neuschwanstein Castle	Classical music
Encoder test sequence DVTS	Classical music

Dynamic test signals

Video contents	**Audio contents**
Alternating all-black and all-white picture	L+R: 1-kHz sine burst only during all-white picture
Rohde&Schwarz CODEC test pattern (16:9), monitor test pattern with moving elements	L+R: sine burst 20 ms, 9.5 kHz, 6 dBr, synchronized with moving picture elements
Rohde&Schwarz CODEC test pattern (4:3), monitor test pattern with moving elements	L+R: sine burst 1 s, 1 kHz, 0 dBr, synchronized with moving picture elements
Moving zone plate	L+R: noise white/incoherent

Static test signals

Video contents	**Audio contents**
Colour bars to ITU-R-801 (100/0/100/0)	L: sine burst 15 kHz, 4 dBr R: silence
Colour bars to ITU-R-801 (100/0/75/0)	L: silence R: sine burst 15 kHz, 4 dBr
CCIR17 test signal in frame	L+R: sine burst 1 kHz, 0 dBr
H-SWEEP test signal in frame	L+R: sine burst 40 Hz, –20 dBr
Ramps in RGB signal	L+R: sine burst 12 kHz, –20 dBr
Ramps in all components in frame	L+R: sine burst 9.5 kHz, –20 dBr
Sweep in RGB signal	L+R: sine burst 14 kHz, –20 dBr
Sine x/x test signal in frame	L+R: sine burst 18 kHz, –20 dBr
All-white window	L: sine burst 7 kHz, –6 dBr R: sine burst 11 kHz, –6 dBr

Transport streams with several programs

Number of programs	**Contents**
Max. 6	various test signals (frame) and audio measurement signals

Coding of audio level: 0 dBr (+6 dBu or 1.55 V, DIN 45406) with a headroom of 6 dB

Specifications in brief

Output signals (see left)	transport stream to ISO/IEC 1-13818
Data rate (incl. null packets)	0.6 to 160 Mbit/s (settable in 1 Hz steps)
Data rate for video/audio contents	up to 24 Mbit/s
Data quantity of video/audio contents	up to 200 Mbit
MPEG2 sequence length	endless loop
Video/audio sequence length	typ. 192 video frames, depending on data rate for video/audio contents
Length of transport stream packets	188/204 bytes (settable)
Error of data rate	±3 ppm (calibration interval: 1 year), without calibration additional error of ±0.5 ppm per year
Signal outputs	
Synchronous parallel MPEG2 data stream (SPI), LVDS (to DVB-A010)	25-pin female connector on front panel, 410 mV pp, 1.25 V DC, 100 Ω
Synchronous parallel MPEG2 data stream (SPI), RS422	25-pin connector on rear panel, 0 V (lo) and 4 V (hi) with ext. clock input
Asynchronous serial MPEG2 transport stream (ASI), 270 Mbit/s (to DVB-A010)	BNC (front and rear panel), 800 mV pp, 75 Ω
Interfaces of integrated PC	1 connector for PC keyboard, 1 connector for VGA monitor, 2 serial RS-232-C interfaces, 1 parallel printer interface, 1 PC card interface
Remote control	via RS-232-C interface
Special features	PID of elementary streams in instrument user-definable; PCR jitter settable in 0.1 µs steps from 0 to 10 ms
General data	
Rated temperature range	+5 to +40°C
Storage temperature range	–40 to +70°C
Power supply	88 to 264 V, 47 to 63 Hz (50 VA)
Dimensions (W x H x D); weight	434 mm x 43 mm x 460 mm; 5 kg

Ordering information

MPEG2 Measurement Generator	DVG	2068.8600.03
Extras		
Stream Combiner™ Software	DVG-B1	2068.9835.02
Calibration Data Documentation	DVG-DCV	2082.0490.14
19" Adapter (1HU)	ZZA-91	0396.4870.00
Service Manual		2069.0354.24

Stream Combiner™ DVG-B1

Generating user-specific MPEG2 transport streams with the PC

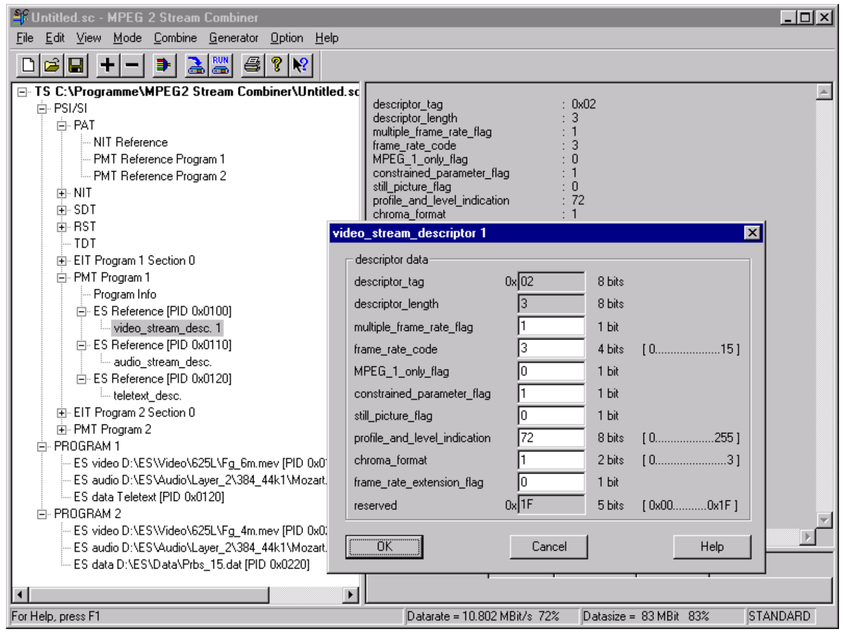


Fig. 1: Display of transport stream structure with information on individual elements

Brief description

Stream Combiner™ Software DVG-B1 in conjunction with MPEG2 Generator DVG (see page 116) allows user-specific transport streams to be generated. The software runs under Windows 95 or Windows NT on any PC or laptop. The data are loaded into the DVG via a parallel interface or a PC card hard disk. The user-friendly operating concept with integrated help function ensures fast and efficient working right from the start without any special knowledge of MPEG2 or DVB being required.

Main features

- Generation of user-specific transport streams
- Elementary stream library
- Insertion of external elementary stream files
- Editing PSI and SI tables as required
- Setting of defined nonconformal states
- Windows 95/NT operating system

Defining a user-specific transport stream

A new transport stream can be defined very easily step by step with the Stream Combiner™. In the lefthand part of the program window (Fig. 1), all elements of the transport stream that have already been defined are represented as a tree structure. In the righthand part of the window, detailed information on the individual elements is displayed. The elements can be selected by means of a mouse-click.

Adding programs

In the first step, the user adds the desired number of programs (max. 6) to the transport stream. Stream Combiner™ automatically generates the required PSI tables, eg PAT and PMT, and represents these tables immediately in the tree structure. The tables contain predefined default settings which can be changed as required.

Adding elementary streams

In the second step the desired elementary streams such as video, audio or data are added to the programs. Each program may contain up to 6 elementary streams. The software comes with a comprehensive elementary stream library from which the user can configure his specific transport stream. Stream Combiner ™ automatically updates the relevant PSI tables every time a new elementary stream is added.

Adding service information

In the third step, further SI and PSI tables (PAT, PMT, CAT, NIT, BAT, SDT, EIT, RST, TDT, TOT, ST, SIT, DIT) can be added to the transport stream. Each of these tables can be fully edited; the repetition rates can be set independently for each table.

Generating the transport stream data file for the DVG

As a final step, Stream Combiner™ generates a transport stream data file for the MPEG2 Generator DVG. The file can be transferred to the DVG directly via cable. Alternatively, a PC card hard disk can be used. This is expedient if the generated transport stream is to be installed in several generators. DVG generates the new transport stream in the same way as the preconfigured stored signals as an endless MPEG2 sequence with all time stamps being continuously updated.

Inserting external elementary streams (data files)

Besides the elementary streams from the library supplied, Stream Combiner™ allows external elementary streams (binary files to ISO/IEC13818, MP@ML) to be inserted. Such files are offered by various suppliers on the Internet or on CD-ROMs (MPG, VID, M2V, MP2, AUD, M2A file extensions). Stream Combiner™ first checks whether the external file is suitable for integration, and then processes the file so that it can be inserted into the new transport stream. Thus it is always ensured that the DVG plays back the new transport stream as an endless MPEG2 loop.

Editing a user-specific transport stream

All transport streams generated with the Stream Combiner™ can subsequently be modified. This is possible for the elementary streams and for all tables of a transport stream. Editing can be performed after the respective file has been opened. The Stream Combiner™ operates in the same mode as for generating a new transport stream, ie the tree structure and the contents of the tables are displayed. Any desired element can be modified, deleted from or added to the transport stream.

Generating defined nonconformal states

Stream Combiner™ offers various possibilities of integrating nonconformal states into a transport stream:

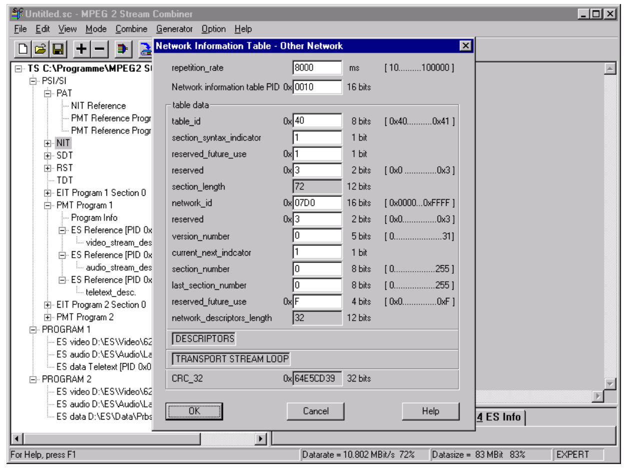


Fig. 2: Editing individual tables using the Network Information Table (NIT) as an example

- Insertion of descriptors into tables for which they are not intended
- Insertion of wrong information into tables and descriptors
- Changing the repetition rate of tables
- Removing specific tables
- Introducing an offset between elementary stream clock (PTS, DTS) and PCR
- Switching off PCR, PTS and DTS updating at the end of a video/ audio sequence

Specifications in brief

Contents of elementary stream library
All video and audio sequences contained in the preconfigured stored transport streams of DVG
Further moving picture sequences ("Table Tennis" and "Flower Garden" with 2/4/6 Mbit/s)
Additional audio sequences of different data rates and sampling frequencies
Teletext sequences
Other sequences on request

Transport stream

Sum of elementary data stream rates	max. 24 Mbit/s 1)
Total data volume of all elementary streams	max. 200 Mbit 1)
Output data rate at DVG (attained by adding null packets)	max. 160 Mbit/s
Number of programs	max. 6
Number of elementary streams per program	max. 6
Sequence length of contents	max.200 Mbit/sum of elementary stream 1) data rates
MPEG2 sequence length	endless

System requirements
PC or laptop with Pentium processor (recommended clock frequency min. 100 MHz), Windows 95 or Windows NT operating system, min. 16 MByte RAM (Windows NT: 32 Mbyte), required space on hard disk approx. 20 Mbyte, 1 free parallel printer interface, 1 free RS-232 interface, CD-ROM drive

Ordering information

Stream Combiner™	DVG-B1	2068.9835.02

1) Depending on Generator DVG used.

MPEG2 Measurement Decoder DVMD

19 realtime measurements at a time, analyzer and decoder in one unit, analysis of data rates, integrated long-term report, on-screen display on video monitor

Note: With R&S label available in Europe, Middle East and Japan only; in all other areas available as model MTD200 by Tektronix (photo 42482)

Brief description

MPEG2 Measurement Decoder DVMD monitors and analyzes the MPEG2 transport stream. It indicates the contents and provides comprehensive information on the quality of the transport stream.

The combination of decoder and analyzer in one unit with conventional operating concept (no PC system) makes DVMD the waveform monitor of digital television. It is suitable for use wherever MPEG2 signals have to be checked.

Realtime measurements and simultaneous in-depth analysis yield extremely fast results. This makes DVMD an indispensable tool in development, in troubleshooting as well as in quality management and production.

Another important application is in the final inspection of MPEG2 signals before they leave the studio. While DVMD checks the video and audio signals at the output, error information is inserted directly into the decoded program (on-screen display).

Remote control capability allows integration into automatic monitoring networks. DVMD is thus ideal for network operators.

Complementary to Decoder DVMD, MPEG2 Measurement Generator DVG (page 116) is offered for providing continuous MPEG2 transport streams made up of video, audio and data sequences in an endless loop.

Analyzer

The analyzer functions of DVMD comprise a protocol analysis of the measured MPEG2 transport stream in realtime. All measurements are in compliance with the measurement guidelines for DVB systems (ETR 290) of the European DVB project, which define possible error conditions in terms of three different priorities.

Any error occurring is directly indicated by front-panel LEDs. DVMD also detects sporadic errors. Moreover it provides error statistics showing how often a particular type of error has occurred within a specified time interval. A list (REPORT; see lower figure on righthand page) giving detailed information on the errors occurred including date and time can be obtained. The list contains up to 1000 entries and may be edited to cover exclusively a single type of error.

An integrated monitoring facility allows upper/lower limit checking of individual data rates which are mainly used in statistical multiplexing. If there is an error, the trigger/capture facilities of DVMD can be used to freeze part of the transport stream affected by the error (approx. 2 Mbit) and output it, analyzed down to bit level, via the RS232 interface.

In addition to in-depth analysis, the optional Stream Explorer™ software (see page 122) allows further online masurements with graphic display on the screen (eg data rates, PCR jitter, etc).

Decoder

An MPEG2 transport stream usually consists of a number of programs which may contain video, audio and data streams (elementary streams). DVMD decodes a video and an audio stream from the selected program. The decoded video signal is simultaneously output in CCVS, analog Y/C and digital serial ITU-R601 formats.

Audio signals are output as analog stereo signals and as digital AES/EBU signals.

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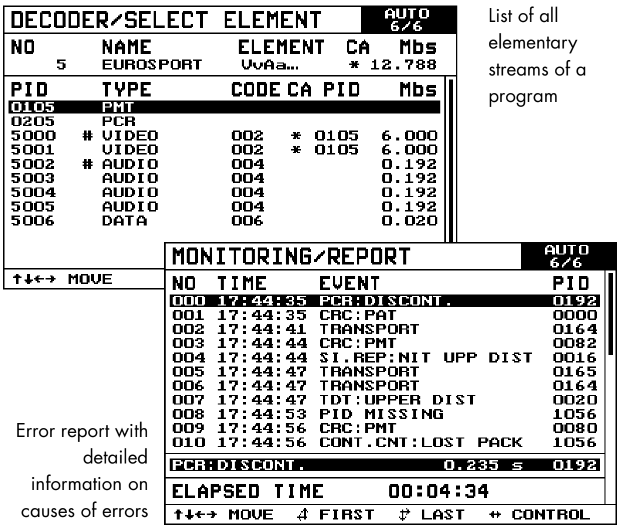
Optional alarm lines and parallel printer interface
In addition to a second parallel printer interface, 12 alarm lines for signalling errors detected in the transport stream are available. Each alarm line can be allocated to one or several (ORed) types of errors. The contacts close to ground and in case of an error they can be chosen to close or open.



List of all elementary streams of a program

Error report with detailed information on causes of errors

Realtime measurement functions

Simultaneous monitoring of all signals in transport stream

Measurement	Priority (ETR290)	Error No. (ETR290)
TS_sync_loss	1	1.1
Sync_byte_error	1	1.2
PAT_error	1	1.3
Continuity_count_error *)	1	1.4
PMT_error *)	1	1.5
PID_error *)	1	1.6
Transport_error	2	2.1
CRC_error *)	2	2.2
PCR_error *)	2	2.3
PCR_accuracy_error *)	2	2.4
PTS_error *)	2	2.5
CAT_error	2	2.6
SI_repetition_error	3	3.2
NIT_error	3	3.1
SDT_error	3	3.5
EIT_error	3	3.6
RST_error	3	3.7
TDT_error	3	3.8
Unreferenced_PID *)	3	3.4

*) Simultaneously for up to 64 programs and 10 different PMT PIDs

Specifications in brief

Input signals	
Transport stream	to ISO/IEC 1-13818
Data rate of transport stream	up to 54 Mbit/s
Length of data packets	188/204 bytes
Signal inputs	
Synchronous parallel MPEG2 transport stream (SPI), LVDS to DVB-A010	25-pin female connector on front panel, 100 mV to 2 V pp, 100 Ω
Asynchronous serial MPEG2 transport stream, 270 Mbit/s (ASI, to DVB-A010)	BNC connector on front and rear panel, 200 mV to 1 V pp, 75 Ω
Signal outputs	
Video CCVS (PAL, SECAM, NTSC)	BNC connector on front and rear panel, 1 V pp ±1%, 75 Ω
Video luminance (Y)	BNC connector on rear panel, 1 V pp ±1%, 75 Ω
Video chrominance (C)	BNC connector on rear panel, 0.7 V pp ±1%, 75 Ω
C/L gain	±2%
C/L delay	±30 ns
Return loss (0 to 6 MHz)	34 dB, CCVS on front panel: 30 dB
Audio	
Level (full scale)	6/9/12/15 dBu ±0.5 dB
Freq. response (40 Hz to 15 kHz)	±0.5 dB relative to 1 kHz
S/N ratio	>70 dB, unweighted
THD	>70 dB
Video serial digital (ITU-R 601)	BNC connector on rear panel, 800 mV pp, 75 Ω
Audio left, audio right	LEMO Triax connector on front and rear panel, <50 Ω
Audio serial digital (AES/EBU)	LEMO Triax connector on rear panel, 4 V pp, 110 Ω
Interfaces	1 serial RS-232-C interface (remote control or printer), 1 PC card slot (common interface) for descrambling card in unit
General data	
Rated temperature range	+5°C to +40°C
Storage temperature range	–40°C to +70°C
Power supply	88 to 264 V, 47 to 63 Hz (50 VA)
Dimensions (W x H x D)	434 mm x 43 mm x 460 mm
Weight	4.9 kg

Ordering information

MPEG2 Measurement Decoder	DVMD	2068.8597.02
Accessories supplied	power cable, operating manual, audio adapter (LEMO Triax to XLR)	
Options		
Stream Explorer™ Software	DVMD-B1	2068.8597.02
Alarm Lines + Parallel Printer Interface	DVMD-B5	2068.9158.02
Calibration Data Documentation	DVMD-DCV	2082.0490.15
Extras		
19" Adapter (1HU)	ZZA-91	0396.4870.00
Service Manual		2069.0348.24

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Stream Explorer™ DVMD-B1

Enhanced MPEG2 analysis with MPEG2 Measurement Decoder DVMD

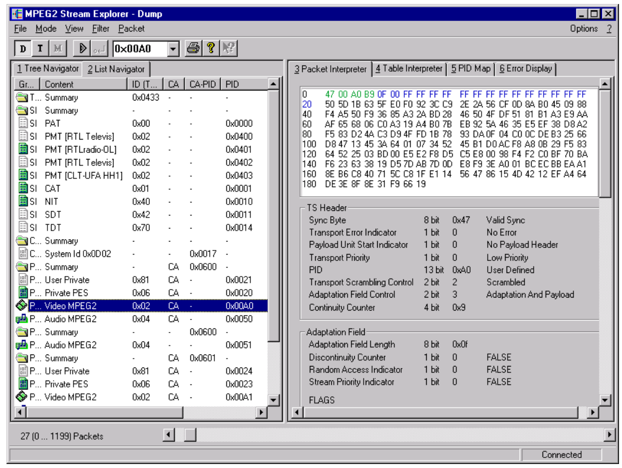


Fig. 1: All transport stream details under control with List Navigator and Packet Interpreter

Brief description

Stream Explorer™ Software DVMD-B1 enhances the MPEG2 Measurement Decoder DVMD (page 120) from Rohde & Schwarz to form a universal analysis system for MPEG2 transport streams. The software runs under Windows95 or WindowsNT on any PC or laptop connected to the DVMD via a serial interface. The easy-to-operate software and the clear presentation of test results ensure efficient working right from the start.

DVMD can buffer a transport stream of up to 2 Mbit and transfer it on request via the serial interface to the Stream Explorer™. DVMD uses several data or event filters (TRIGGER), which can be activated via the Stream Explorer™. The investigated data quantity of the transport stream can thus be considerably increased if required. Moreover, the software can activate realtime analyses in the DVMD and output the results as moving graphic representations. The realtime measurement functions of DVMD are thus considerably enhanced.

Four operating modes

- **DUMP** for comprehensive analysis of transport stream contents
- **TRIGGER** for detailed investigation of errors in transport streams
- **MEASURE** for graphic display of transport stream parameters in realtime
- **MONITORING** for remote control

DUMP

This operating mode allows detailed analysis of the contents of transport streams (TS). The transport stream contents is represented by Stream Explorer™ in hexadecimal format as well as in an interpreted form. This makes it very easy for the user to recognize any irregularities that may occur.

The analyzed transport stream data can be filtered as follows:

- only TS packets with a specific PID
- only TS packets with adaptation field
- only TS packets with start of a PES packet (payload unit start indicator set)

Combinations of the above selection criteria are also possible. Irrespective of the filter settings, Stream Explorer™ additionally determines the complete contents structure of the transport stream.

Display modes

- **TS NAVIGATOR:** Display of transport stream contents as a tree structure (Fig. 2, left) or in tabular form (Fig. 1, left) with general information about elementary streams such as PID, stream ID, data rate and information about scrambling. This display mode is always available together with a second display mode.
- **PACKET INTERPRETER:** (Fig. 1, right) Display of a TS packet in hexadecimal format and at the same time as an interpreted list of all elements contained in the transport stream. A colour code for the various parts of the packet (header, adaptation field, payload, etc) makes for a clear representation. The packets are selected either via the TS NAVIGATOR or via a software slide switch allowing all buffered packets to be addressed in their original sequence.
- **TABLE INTERPRETER:** (Fig. 2, right) Lists all elements of a selected table and interprets the contents. The following tables can be selected: PAT, PMT, CAT, NIT, BAT, SDT, EIT, RST, TDT, TOT, ST, SIT, DIT.

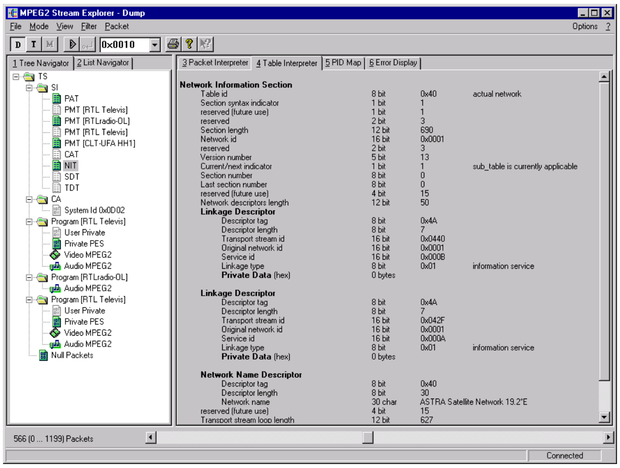


Fig. 2: Clear representation of transport stream structure with Tree Navigator and of individual tables with Table Interpreter

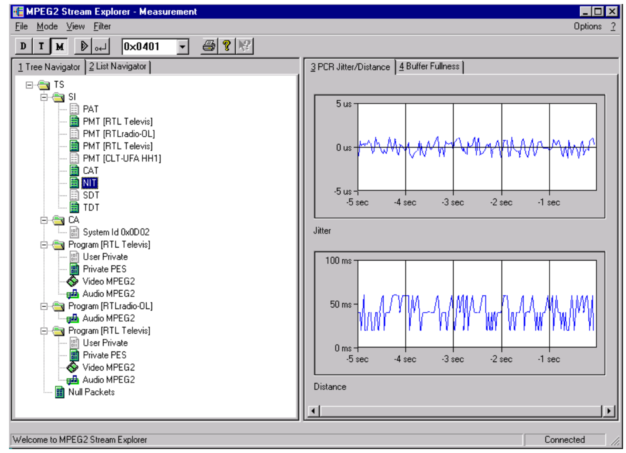


Fig. 3: Realtime measurement of PCR jitter and PCR spacings

- **PID MAP:** Gives an overview of the distribution of elementary stream packets within the transport stream. The headers of a selected elementary stream are highlighted.

TRIGGER

If an error occurs in the transport stream applied to DVMD, the data in the region of the error are stored in the DVMD and made available to Stream Explorer™ for evaluation. The cause of the error can thus reliably be detected and displayed in detail.

ERROR DISPLAY: This display mode is additionally available for error investigation. It shows the structure elements in which the error occurred. Faulty data are shown in red. The type of error is explained in addition.

MEASURE

This operating mode allows realtime analysis of several transport stream parameters and graphic display in the form of bargraphs or traces:

- PCR jitter (Fig. 3)
- Spacing of PCR values in transport stream (Fig. 3)
- Spacing of elementary-stream-related PTS values
- PTS/PCR difference
- Spacing of PSI and SI tables
- Data rates of elementary streams
- Buffer fill states in MPEG2 system target decoder

MONITORING

Full remote control of the DVMD is integrated in this operating mode, including display, filtering and storage of the monitoring report.

Other features

By switching to offline mode, the current contents of the transport stream can be stored in all operating modes for subsequent analysis.

Stream Explorer™ supports the software interface COM/DCOM (**D**istributed **C**omponent **O**bject **M**odule) which allows data and commands to be exchanged between Windows programs. In networked monitoring systems the Stream Explorer™ can be remote-controlled as an OLE automation server by application software packages.

System requirements

PC or laptop with Pentium processor (recommended clock frequency min. 100 MHz), Windows 95 or Windows NT operating system, min. 16 Mbyte RAM (Windows NT: 32 Mbyte), required space on hard disk approx.10 Mbyte, 1 free RS-232 interface (recommended data rate: 115 kbit/s), 1 parallel printer interface, 3.5″ disk drive

Ordering information

Stream Explorer™	DVMD-B1	2068.9406.02
Equipment supplied	3.5″ floppy disks with setup program; cable for connecting the DVMD to the PC, manual and dongle for connection to the parallel printer output of the PC	

TV Test Receiver Family EFA

Test receivers and demodulators for analog and digital (DVB-C) TV signals

Note: EFA model 20 with Rohde & Schwarz label available in Europe, Middle East and Japan only; in all other areas available as model DDS200 by Tektronix (photo 42462)

Brief description

TV Test Receiver and Demodulator Family EFA is a new equipment generation with outstanding performance features and excellent transmission characteristics. The TV test receivers and demodulators are able to receive and demodulate both conventional AM vestigial sideband signals and quadrature-amplitude-modulated DVB signals with high precision, measure a variety of transmission parameters and are ideal for measurement and monitoring applications in cable networks and TV transmitter stations.

The family members:

- Model 12
  Analog TV test receiver,
  tunable, selective, standard B/G
- Model 20
  Digital (QAM) TV test receiver
  (DVB-C), tunable, selective
- Model 23
  Digital (QAM) TV demodulator
  (DVB-C), broadband
- Model 33
  Analog TV demodulator,
  broadband, standard B/G
- Model 72
  Analog TV test receiver,
  tunable, selective, standard M
- Model 78
  Analog TV test receiver,
  tunable, selective, standards D/K, I
- Model 83
  Analog TV demodulator,
  broadband, standard M
- Model 89
  Analog TV demodulator,
  broadband, standards D/K, I

Applications

TV Test Receiver Family EFA from Rohde&Schwarz is a versatile and high-performance TV test receiver and demodulator platform that is able to keep pace with the rapid development in television.

A QAM demodulator is available for digital video broadcasting in cable networks (DVB-C), allowing all necessary measurements to be made on digital channels.

The EFA family also comprises an analog TV test receiver for monitoring all other TV channels.

QAM demodulator and analog receiver can be combined in a compact unit which can be expanded by adding further options, eg an MPEG2 decoder (EFA-B4) or NICAM decoder (EFA-B2). In particular the Preselection Option EFA-B3 adds excellent selectivity characteristics to the demodulator models.

Features

TV test receiver models 12, 72 and 78

- Selective test receiver, frequency or channel entry
- Measurement functions for
  – input power/level
  – vision carrier offset frequency
  – vision/sound carrier spacing (level and frequency)
  – FM sound carrier and pilot deviation
- Upgradable to dual-mode instrument, ie analog and digital (DVB-C) receiver in one compact unit (option EFA-B1)
- Group-delay correction can be switched off
- Models 12, 78: NICAM Demodulator EFA-B2

QAM test receiver model 20 and QAM demodulator model 23

- World's first test receiver for DVB-C signals
- 4QAM to 256QAM selectable
- Constellation diagram with automatic result analysis
- Integrated noise generator for measurement of noise margin
- IF filters of various bandwidth specially developed for DVB (standard 8 MHz, optional 6 MHz)

- Self-adapting equalizer for in-depth signal analysis in transmission channel:
  - echo measurement
  - amplitude and phase response
- Alarm register with 1000 memory locations for the following errors:
  - signal level (threshold adjustable)
  - synchronization
  - bit error rate (threshold adjustable)
  - non-corrected MPEG errors
- MPEG2 Decoder EFA-B4 (option) can be integrated
- Preselection (model 23 only)

TV demodulator models 33, 83 and 89

- Nyquist demodulator, broadband RF input
- Retrofittable RF Preselection EFA-B3 (option), the broadband input remains usable
- Same measurement functions as test receiver
- Group-delay correction can be switched off
- Models 33, 89: NICAM Demodulator EFA-B2

All EFA models

- Simple, user-friendly hardkey and softkey control
- IEC/IEEE bus, RS-232 interface
- Compact unit (3 height units)
- Frequency range 47 to 862 MHz; demodulator models 23, 33, 83 and 89 with RF Preselection EFA-B3, lower cutoff frequency 5 MHz (return-channel-compatible)
- Modular design
  - easy retrofitting of options
- Comprehensive measurement and monitoring functions
- Excellent price/performance ratio
- Platform for new digital technologies

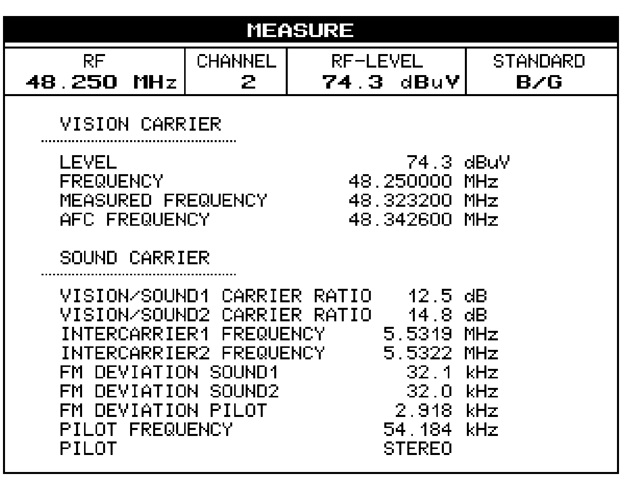
Family concept

With its modular design the extremely compact, only three units high TV Test Receiver EFA is made for easy upgrading and high versatility. One of the EFA family members is the analog TV test receiver with selective receiver section. The measurement menu of the analog TV test receiver is shown below left.

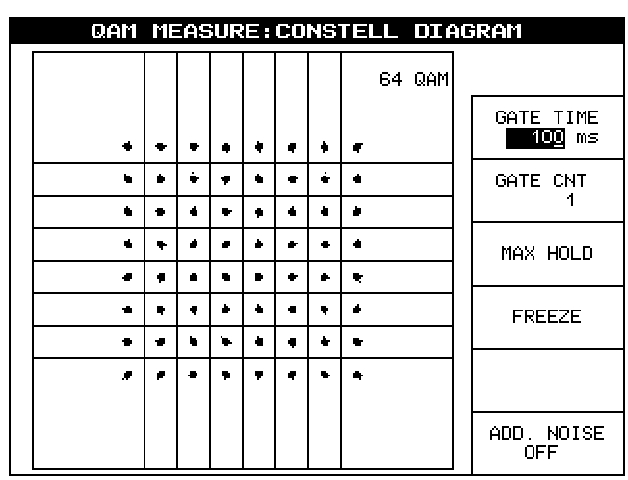
Another family member is the DVB test receiver with QAM demodulator. A QAM demodulator is used for processing the TV channel converted to IF. The most important measurement tool for QAM signals is the constellation diagram (see below right).

A further family member is the analog demodulator. In addition to the selective receiver section there is also a broadband receiver section, which with measurements directly at the source and single-channel occupancy (TV transmitter) provides results of highest precision. A high-grade preselection module can be connected ahead of this broadband converter module.

An MPEG2 decoder for video and audio processing and evaluation of the transport stream generated by the QAM demodulator can be integrated for comprehensive measurements on the FM sound carriers of analog TV. Furthermore, a NICAM sound demodulator is available.



Measurement menu in analog TV test receiver mode



Constellation diagram in QAM demodulator mode

TV Test Receiver Family EFA

Specifications in brief

Analog TV test receiver and TV demodulator
RF/IF characteristics

	Test receiver	Demodulator
Frequency (vision carrier)		
Frequency range	45 to 860 MHz	45 to 900 MHz
with optional RF Preselection EFA-B3		5 to 900 MHz
Intermediate frequency	38.9 MHz	38.9 MHz
Frequency setting	channel number (+ special channels), vision carrier frequency or memory location number (00 to 99)	
Resolution	1 Hz	1 Hz
Frequency accuracy	$<\pm 3\times 10^{-6}$x receive frequency	
Image-frequency rejection		
VHF	≥70 dB	
UHF	≥50 dB	
Adjacent-channel rejection	≥48 dB (std. B/G)	≥48 dB (std. B/G)

RF input	selective	broadband
Connector	on front panel (BNC female) or rear panel: 50 Ω: N or 75 Ω: BNC fem.	N female, on rear panel
Impedance (model-dependent)	50 Ω or 75 Ω	50 Ω
Level range	100 µV to 1 V[1] (40 to 120 dBµV)[1]	10 mV to 2.5 V[1]
with 10 dB preamplifier	30 µV to 1 mV [1] (30 to 60 dBµV)[1]	
Return loss	50 Ω: ≥14 dB 75 Ω: ≥12 dB	≥30 dB

IF input	BNC female, on rear panel, 50 Ω	
Level range	20 to 200 mV[1] (86 to 106 dBµV)[1]	50 to 350 mV[1] (94 to 111 dBµV)[1]
Return loss (33 to 40 MHz)	≥20 dB	≥30 dB
Crosstalk attenuation RF/IF	≥70 dB	≥70 dB

IF output	BNC female, on rear panel, 50 Ω	
Level	100 mV [1]) (100 dBµV)[1])	
Return loss (33 to 40 MHz)	≥20 dB	≥20 dB

Video characteristics

Video outputs	BNC female on front/rear panel, 75 Ω	
with optional Video Distributor EFA-B6		2x as above
Level of CVS 0-signal with zero reference pulse, inphase signal	1.12 V pp ±2%	1.12 V pp ±2%
Setting range	±3 dB	±3 dB
DC offset with zero carrier	0 ±20 mV	0 ±20 mV
with optional Video Distributor EFA-B6		can be switched to 0 V for blanking value
Return loss (0 to 6 MHz)	≥26 dB	≥26 dB
Decoupling of outputs (level variation at terminated output when switching at the other outputs between short circuit and open circuit)	≤1%	≤1%

Quadrature signal output	BNC female, on rear panel, 75 Ω	
with optional Video Distributor EFA-B6		additional BNC female on front panel
Gain difference, referred to nominal video output level	≤0.5 dB	≤0.5 dB
Return loss (0 to 6 MHz)	≥20 dB	≥20 dB

Input of external zero reference pulse	BNC female, on rear panel, 75 Ω	
Input level	>+1 V	>+1 V
Delay of zero reference pulse, referred to control pulse	3 µs	3 µs

Synchronous demodulation	continuous or clamped to back porch, selectable	
Time constant of sync demodulator, selectable		
for continuous control	fast, normal, slow	fast, normal, slow
for sampled control	normal, slow	ormal, slow

Signal/noise ratio		
Unweighted ,V_{in} >200 mV		≥60 dB
Weighted to CCIR Rec. 567		
V_{in} >200 mV		≥67 dB
50 Ω; input attenuation 0 dB:		
V_{in}=3 mV (70 dBµV)	≥56 dB	
1 mV (60 dBµV), with preampl.	≥52 dB	
Periodic noise (peak measurement)		
up to 1 kHz		≥52 dB
1 kHz to 5 MHz		≥60 dB
5 to 6 MHz		≥50 dB

Linear distortion		
Amplitude frequency response		
Standard B/G, 0 to 4.5 MHz	±0.5 dB	±0.25 dB
4.8 MHz	–3/+0.5 dB	–3/+0.25 dB
D/K, 0 to 5.5 MHz	±0.5 dB	±0.25 dB
I, 0 to 4.5 MHz	±0.5 dB	±0.25 dB
Group-delay response (0 to 4.8 MHz); standard B/G		
Group-delay correction	fully equalized, can be switched off	
without group-delay correction	<±20 ns	<±12 ns
with group-delay correction		
0 to 3.7 MHz	<±20 ns	<±12 ns
4.43 MHz	<±20 ns	<±20 ns
4.8 MHz	<±50 ns	<±50 ns
Additional group delay ripple caused by SAW filter	<±20 ns	<±20 ns

Transient response		
2T pulse amplitude		<±2%
2T k factor	≤1%	≤1%
20T pulse amplitude		<±3%
Chrominance/luminance gain		<±3%
Chrominance/luminance delay		
without group-delay correction	<±20 ns	<±12 ns
with group-delay correction	<±20 ns	<±20 ns

Nonlinear distortion		
Luminance nonlinearity (8 to 100%)	<2%	<2%
Differential gain (10 to 90%)	<±2%	<±2%
Differential phase (10 to 90%)	<±2°	<±1°
Intermodulation		
Low-distortion mode (vision carrier: –8/sound carrier: –10/SB: –16 dB)	≥72 dB[2])	
(sound carrier: –10 dB/SB: 10 to 90%, –0.85 to +5 MHz)		≥55 dB[3])

Q signal		
Phase error of switching carrier	≤±1°	≤±1°
Bandwidth (–3 dB)	approx. 1.5 MHz	approx. 1.5 MHz

Audio characteristics

Audio outputs	Lemo-Triax female, in pairs; front panel: unbalanced, rear panel: balanced, floating, <35 Ω	
Additional connectors with optional Split-Carrier Demodulator EFA-B5		broadband output on front panel (unbalanced) and pilot output on rear panel (BNC female)
Signals	mono, left/right sound 1/sound 2	
Level (±30 kHz deviation,f_{mod} =500 Hz)	+6 dBm ±0.2 dB into 600 Ω	

Audio parameters
(Intercarrier demodulator; improved values are obtained with optional Split-Carrier Demodulator EFA-B5)

Stereo/dual-sound method	A2 (IRT)	A2 (IRT)
Frequency response	≤0.5 dB	≤0.5 dB
Deemphasis, can be switched off	50 µs	50 µs
Distortion at ±50 kHz deviation	<0.5%	<0.5%
Stereo crosstalk attenuation	≥40 dB	≥40 dB
Channel crosstalk attenuation with ±30 kHz spurious FM	≥74 dB	≥74 dB
Intercarrier S/N ratio (weighted to CCIR 468-3)		
All-black picture	≥55 dB	≥55 dB
FuBK test pattern	≥48 dB	≥48 dB
Sinewave modulation (receiver 10 to 75%, demodulator 0 to 75%)		
0 to 5 MHz	≥46 dB	≥46 dB
242 ±15 kHz	≥42 dB	≥42 dB
Split-carrier S/N ratio, measured at IF output (weighted to CCIR 468-3, deemphasis 50 µs)	≥50 dB	≥62 dB

[1]) The levels are RMS values of the sync pulse.
[2]) Referred to sync pulse.
[3]) Referred to b/w transition.

Test parameters

	Resolution	Accuracy
Vision carrier power/level in μV/mV, dBμV, dBm, dBpW	0.1 dB	±3 dB (demodulator ±2 dB)
Vision carrier frequency	20 Hz	$\pm 3 \times 10^{-6}$ x receive frequency
Vision/sound carrier level ratio	0.1 dB	±2 dB
Vision/sound carrier frequency spacing	100 Hz	±200 Hz (with unmodulated sound carrier)
FM sound carrier deviation	100 Hz	$\pm 3 \times 10^{-2}$ x Δf ±200 Hz
FM pilot deviation	10 Hz	±200 Hz
FM pilot frequency	1 Hz	±10 Hz

DVB test receiver (QAM)

The test receiver complies with DVB specifications ETS 300429 and ETR 290.

RF IF characteristics (further data same as analog TV test receiver)

Frequency range	47 to 862 MHz
Level range of input signal	100 μV to 700 mV (40 to 117 dBμV)
Input impedance (model-dependent)	50 Ω or 75 Ω
Channel bandwidth	8 MHz (2/4/6 MHz optional), selectable
IF input	36 MHz; BNC female on rear panel
Impedance	50 Ω
Level range	10 to 100 mV (80 to 100 dBμV)
IF output	36 MHz; BNC female on rear panel
Impedance	50 Ω
Level	45 mV (93 dBμV)

Demodulator characteristics

Modulation mode	4, 16, 32, 64, 128 and 256QAM
Roll-off factor	0.13; 0.15; 0.20; 0.25; 0.30; selectable
Insertion loss	≤1.5 dB (64QAM)
Symbol rate	1.5 to 7 Mbaud
Equalizer	self-adapting, selectable
Reed-Solomon decoder	204, 188, 8; selectable
Bit error rate measurement range	1.0 E-3 to 0.1 E-9
Interleaving	interleaver (Forney), L = 12
Energy dispersal	ESS 309 to DVB specification
Internal noise generator (on/off)	
C/N ratio	12 to 62 dB
Setting	in steps of 0.1 dB
Filters	automatic conversion and correct setting of C/N ratio if optional filters (2, 4 or 6 MHz) are fitted
Outputs	parallel MPEG data stream to LVDS standard (188.204 bytes), serial MPEG data stream (ASI), serial data stream before Reed-Solomon decoder
MPEG decoder	available as option EFA-B4
Screen	LCD with 240 x 320 pixels
Sync information on	symbol rate, carrier recovery, equalizer, MPEG2 frame

Test parameters (at 64QAM)

	Range	Tolerance
Level	–60 to +10 dBm	≤±3 dB, typ. ±1 dB
MER	24 to 30 dB	≤±0.3 dB
	30 to 35 dB	≤±0.7 dB
	35 to 40 dB	≤±1.5 dB
SNR	24 to 30 dB	≤±0.4 dB
	30 to 35 dB	≤±0.8 dB
	35 to 40 dB	≤±1.8 dB
Carrier suppression	25 to 40 dB	≤±1 dB
	40 to 50 dB	≤±1.5 dB
	50 to 60 dB	≤±3 dB
I/Q amplitude imbalance	0 to 5%	≤±0.02%
I/Q phase error	0 to 5°	≤±0.02°
Frequency offset	±100 kHz	≤±3 kHz
BER	2E–4 to 1E–3	<5% ±2 digits
	0E–9 to 2E–4	<1% ±2 digits
Symbol rate (auto search mode)	1.5 to 6.99 Msymb/s	≤±0.003 Msymb/s

General data

Display	monochrome LCD (320 x 240) with backlighting
Interfaces	IEC625-2/IEEE488 bus RS-232 printer (Centronics)
Rated temperature range	+5 to +45°C
Operating temperature range	0 to +50°C
Storage temperature range	–40 to +70°C
Power supply	100 to 120/220 to 240 V +10/–15% (automatic voltage selection), 50 to 60 Hz
Dimensions (W x H x D)	450 mm x 147 mm x 460 mm
Weight	12 kg

Ordering information

TV Test Receiver *)		
Standard B/G, stereo/dual sound IF 38.9 MHz, RF 45 to 860 MHz, IEC/IEEE bus	EFA	2067.3004.12
Standard M/N IF 45.75 MHz, RF 55 to 890 MHz, IEC/IEEE bus	EFA	2067.3004.72
Standard D/K, stereo/dual sound or standard I, mono IF 38.9 MHz, RF 45 to 860 MHz, IEC/IEEE bus	EFA	2067.3004.78
TV Demodulator *)		
Standard B/G, stereo/dual sound IF 38.9 MHz, RF 45 to 900 MHz, IEC/IEEE bus	EFA	2067.3004.33
Standard M/N IF 45.75 MHz, RF 55 to 900 MHz, IEC/IEEE bus	EFA	2067.3004.83
Standard D/K, stereo/dual sound or standard I, mono IF 38.9 MHz, RF 45 to 900 MHz, IEC/IEEE bus	EFA	2067.3004.89
DVB-C Test Receiver, selective *) 4/16/32/64/128/256QAM, Output MPEG data stream, constellation diagram	EFA	2067.3004.20
DVB-C Test Receiver, broadband *) 4/16/32/64/128/256QAM, Output MPEG data stream, constellation diagram	EFA	2067.3004.23
Accessories supplied		
Adapter Lemo-Triax to XLR (stereo), power cable		
Options		
QAM Demodulator (for analog units)	EFA-B1	2067.3604.02
NICAM Demodulator Standard B/G	EFA-B2	2067.3610.02
Standard I	EFA-B2	2067.3610.04
RF Preselection (for TV demodulator)	EFA-B3	2067.3627.02
MPEG2 Decoder	EFA-B4	2067.3633.02
Video Distributor	EFA-B6	2067.3656.02
Residual Picture Carrier Measurement	EFA-B8	2067.3727.02
6 MHz SAW Filter	EFA-B11	2067.3691.02
Extras		
EFA Calibration Data Documentation	EFA-DCV	2082.0490.09
19" Adapter	ZZA-931	0396.4892.00
Lemo-Triax connector (mono) with connecting cable		2067.7451.00
Sevice Manual		2068.0950.24

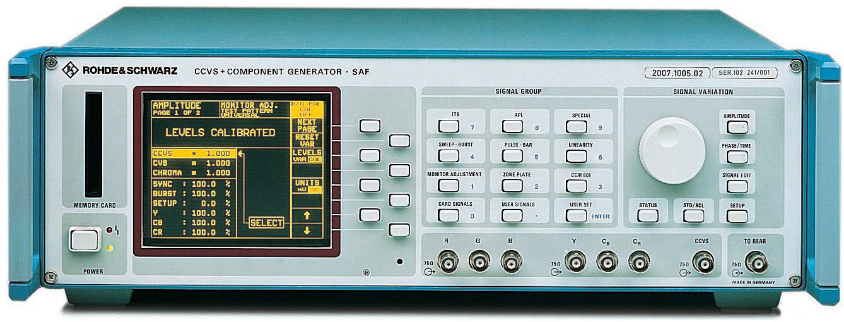
*) Test receivers are available with 50 Ω or 75 Ω impedance, demodulators with 50 Ω only; please enclose filled-in Configuration Sheet (available from your local Rohde & Schwarz representative) with your order.

CCVS+Component Generator SAF, CCVS Generator SFF

SAF: CCVS, YC_BC_R, RGB, S-VHS

SFF: CCVS

Multi-standard generators for all TV applications; optionally PALplus and ITU-R601



SAF (photo 40328-1)

Brief description

TV Generators SAF and SFF are two multistandard instruments (B G/PAL, M/NTSC, M/PAL, N/PAL) suitable for all applications in the field of television. CCVS+Component Generator SAF supplies all test signals and patterns required for video measurements in CCVS, YC_BC_R, RGB and S-VHS formats, for test patterns an aspect ratio of 4:3 or 16:9 being selectable. Where only the CCVS format is required, CCVS Generator SFF can be used.

SAF and SFF also generate all test signals to CCIR Rec. 801, a number of common pathological test signals, and shallow ramps with a resolution of 10 bits. The PALplus test pattern option provides all PALplus reference signals and the bits required for wide screen signalling (WSS).

Both generators afford extensive signal variations via softkey-controlled menus. Such amplitude and phase adjustments of signal components enable testing of gain controls, white-level limiting circuits and video analyzers over the whole range of the devices. User-specific signals can be defined by front-panel entry and stored in the generator or on a memory card.

Function

The generator section is of digital design. A transputer – a high-speed RISC processor – calculates the three components Y, C_B and C_R of all test signals which in CCVS+Component Generator SAF are applied to three D/A converters. An analog matrix converts the three components into the RGB format. Therefore the RGB signals are made available simultaneously with the YC_BC_R components. The digital CCVS in SAF and SFF is determined from the YC_BC_R components in realtime with the aid of two LSI gate arrays.

Digital Video Interface SAF-Z1

The optional Digital Video Interface SAF-Z1 upgrades the SAF and SFF for use in digital TV studios. In addition to the analog video signals, a parallel and two serial digital video signals are thus simultaneously available.

Main features

- Clear menu-guided operation on large-size EL display
- 12 signal groups with up to 8 signal menu pages each; each page may contain 7 signals
- Superposition of hum, sweep, noise or other signals with different clamping modes
- APL and bounce signals with preselectable parameters
- Insertion of external test signals such as teletext or data lines
- Free programming of test-line coding and monitoring
- Entry of texts as source identification or scrolling text
- Program monitoring + substitution pattern
- System compatibility and full remote control capability (IEC-625/IEEE-488 bus)
- Definition of customer-specific signals by "Signal Edit" via the front panel
- Zone-plate signals, 8 coefficients freely selectable

Specifications in brief

Inputs/outputs	BNC female connectors, 75 Ω
Return loss	≥34 dB (up to 6 MHz)
Sync output	2 V into 75 Ω
SC (colour subcarrier)	1 V pp into 75 Ω
Bounce trigger (input)	TTL level, Z_{in} approx. 10 kΩ, for external triggering of bounce function
Bypass	0/5 V for controlling bypass circuit in junction panel, Z_{out} approx. 20 Ω
EXT inputs	2, BNC, 75 Ω
Gain	0 ±0.1 dB
Differential gain	≤0.3%
Differential phase	≤0.3°
Clamping modes	– gated clamping to back porch – clamping to negative signal peak (EXT2 only) – AC-coupled signal (EXT2 only)
Superposition (EXT2 only)	– anywhere – in active picture range

Amplitude adjustment
variable in the range 0 to 140% (CCVS max. 1.6 V pp): signal components CCVS, CVS, chroma, sync pulse, burst, setup and components Y, C_B, C_R

Phase/time adjustment

H_{EXT} - H_{INT}	±9 µs
SC_{EXT} - SC_{INT}	0° to 360°
SC/H phase	–180° to +180°
H frequency	±5% (burst switched off from +1.5%)
Colour subcarrier frequency	100 Hz to 6 MHz
Burst timing reference, burst duration and rise time, as well as sync duration and rise time	setting range of each parameter dependent on settings of the other parameters
Option CCIR 601 (parallel interface)	shifting the reference clock by ±10 ns relative to data

Program path

Input/output	BNC, 75 Ω
Amplitude-frequency response	±0.1 dB (up to 6 MHz)
Group-delay error	≤5 ns (up to 5.5 MHz)
Differential gain	≤0.2%
Differential phase	≤0.2°
S/N ratio (rms, weighted, 0.2 to 5 MHz)	≥78 dB
Test signal insertion	
Level	same as generator signal – CAL (normal mode) – variation up to CVS x V_{pp} = 1.2 V

		B G/PAL, N/PAL	M/NTSC, M/PAL
Insertion range	in 1st field	lines 6 to 22	lines 10 to 22
	in 2nd field	lines 319 to 335	lines 10 to 22

Teletext signals	5 pages and teletext test line	eyetest pattern and teletext test line
Amplitude (V_{pp})	462 ±5 mV	500 ±5 mV
Eye height	≥96%	≥96%
Clock	6.9375 MHz	5.72727 MHz

Data lines

	4 sequences
Amplitude (V_{pp})	500 ±5 mV
Coding	biphase
Clock	5 MHz

Option CCIR 601	test sequences to CCIR 801, pathological signals, shallow ramps, in addition all other signals digitally
Signal output	
25-pin Cannon connector	9+1 bit parallel, clock rate 27 MHz
75-Ω BNC connector	serial, 270 Mbit/s
Remote-control interface	to IEC625-2 (IEEE488)

CCVS

Level tolerances

Standard	B G/PAL, N/PAL	M/NTSC, M/PAL
Nominal luminance level (cal.)	700 ±4 mV	714 ±4 mV
Nominal chrominance level (cal.)	700 ±7 mV	714 ±7 mV
Departure		
at nominal 500 to 700 mV	±1%	±1%
<500 mV	±5 mV	±5 mV
Squarewave pulses, staircase and sawtooth signals	nominal ±4 mV	nominal ±4 mV
2T pulse	nominal ±5 mV	nominal ±5 mV
10T and 20T pulses	nominal ±7 mV	nominal ±7 mV
12.5T pulse		nominal ±7 mV

Amplitude-frequency response

Multipulse, multiburst, sweep signals	
up to 5.5 MHz	±0.1 dB
>5.5 to 6 MHz	±0.15 dB

Group delay

10T and 20T pulses (modulated with frequencies ≤5 MHz)	≤5 ns

Rise times (10 to 90%) and half-amplitude duration
(also for YC_BC_R signals)

Sync rise time		200 ±5 ns (PAL, 625 lines) 140 ±5 ns (NTSC, 525 lines)
Luminance	rise times	125 to 2000 ns
	tolerances	125 to 249 ±5 ns
		250 to 999 ±10 ns
		1000 to 2000 ±30 ns
Chrominance	rise times	150 to 2000 ns
	tolerances	150 to 299 ±5 ns
		300 to 999 ±10 ns
		1000 to 2000 ±30 ns

Line-time nonlinearity

5-step staircase	≤0.8%

Chrominance phase

Phase between R-Y and B-Y axes	90° ±1°
Maximum departure of chrominance phase from nominal	±2°

S/N ratio

rms, weighted, 0.2 to 5 MHz	
on all-black picture	≥78 dB
on sawtooth signal	≥70 dB

Sync frame	PAL	NTSC
	sync frame and burst phase to CCIR Rec. 624-3	coupled with stable SC/H phase (to RS-170A)
SC/H phase, calibrated	0 to ±5°	0 to ±5°
V component	can be disabled for special measurements	

The tolerances in S-VHS format (SAF only) correspond to those of CCVS

Component signals

YC_BC_R (SAF only)

(for 525/625 lines)	Y signal	C_B, C_R signal
Squarewave, staircase signals	nominal ±4 mV	nominal ±7 mV
Sawtooth signals	nominal ±7 mV	nominal ±7 mV
2 to 20T pulses	nominal ±7 mV	–
3 to 20T pulses	–	nominal ±7 mV
Sweep, multiburst signals		
0 to 5.5 MHz	nominal ±7 mV	nominal ±7 mV
>5.5 to 6 MHz	nominal ±10 mV	nominal ±10 mV

RGB (SAF only)	each component can be disabled separately; the rise times are determined by those of the YC_BC_R signals
Amplitude error	same as YC_BC_R signal components
Matrixing error	±1%
Matrixing frequency response	±0.2 dB (up to 6 MHz)
Sync pulse (can be disabled)	300 ±7 mV (can be added to each component or removed from it)

General data

Remote control interface	to IEC 625-2 (IEEE 488)
Power supply	100/120/230/240 V +10/–15%, 47 to 63 Hz (SAF: 100 VA, SFF: 80 VA)
Dimensions (W x H x D); weight	435 mm x 147 mm x 460 mm; 17 kg

Ordering information

CCVS+Component Generator	SAF	2007.1005.02
CCVS Generator	SFF	2007.1057.02
Options		
Digital Video Interface	SAF-Z1	2007.1063.02
	SFF-Z1	2007.1063.03
PALplus Test Pattern for SAF and SFF	SAF-B20	2007.1011.02
Calibration Data Documentation	SAF-DCV	2082.0490.02
	SAF-DCV	2082.0490.03
Extras		
32 kbyte Memory Card	ZZM-32	2005.4394.02
512 kbyte Memory Card	ZZM-512	2005.4388.02
Service Kit	SAF-Z	2007.1111.00
	SFF-Z	2007.1105.00

TV Test Transmitter SFM

5 MHz to 1000 MHz

Vision and sound signals

to all common TV standards

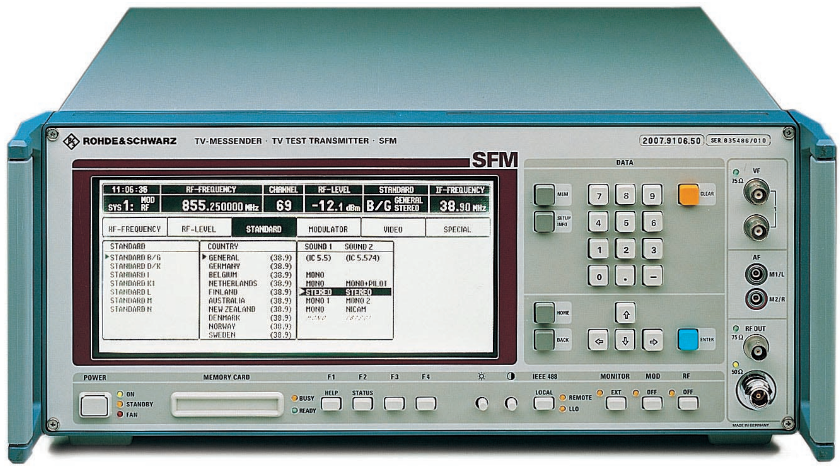


Photo 41846

Brief description

TV Test Transmitter SFM from Rohde & Schwarz supplies vision and sound signals to all common TV standards for the IF (32 MHz to 46 MHz) and RF ranges (5 MHz to 1000 MHz).

Thanks to a very flexible modular concept based on plug-ins, SFM is the compact solution for all analog applications in development, production and servicing. Each SFM frame can accommodate up to ten plug-ins so that standards B/G, D/K, I, L/L', M and N can be implemented in a single SFM.

SFM is ideal for use in EMC measurements: In Europe, EMC requirements are set down in special regulations and laws. Full compliance with prescribed limits is a prerequisite for certification with the European conformity mark CE.

For the American BTSC method, a multiplex signal with a frequency of up to 120 kHz can be applied. The frequency deviation and output level of the sound carriers are also set automatically as per standard.

Many parameters for the vision, NICAM and sound modulators can be set to non-standard values. The display outputs a warning that non-standard parameters are being used; however, compliance with the appropriate standard can be restored with a single keystroke.

Main features

- Generation of TV signals to standards B/G, D/K, I, L/L', M and N, including stereo/dual sound and digital sound (NICAM)
- Double-sideband test modulator for all IFs between 32 MHz and 46 MHz
- Internal audio generator, stereo-coder and NICAM generator
- High frequency resolution of 1 Hz for precision offset
- Frequency locking for all oscillators

Operation

SFM outputs all information on a large LCD graphics display; if required an external monitor can be connected. The display is divided into different areas. The currently valid key setting parameters are displayed in the top half, these being frequency, TV channel, output level and the selected standard with the associated vision IF. Below there is the main selection line with menus such as frequency, level and standard. A special menu enables intermodulation measurements and sweep mode to be selected.

SFM is equipped with an IEC/IEEE-bus interface to SCPI and also has an RS-232-C interface. Thanks to a PC card interface, complete setups can be loaded from or to a memory card. Software updates can be carried out via the serial interface or memory-card interface.

Specifications in brief

Modulator

Vision modulator

Video inputs	3 x 75 Ω; 1x front panel; 2 x rear panel
Vision carrier IF	adjustable from 32 to 46 MHz stepwidth 10 kHz
Modulation characteristics	
Type of modulation	C3F, negative (B/G, D/K, I, M, N) C3F, positive (L/L’)
Mode of operation	double sideband, vestigial sideband with SAW filter, with or without group-delay correction filter
Level control	
Clamping	to back porch (hard/soft switchover)
Average value	for symmetrical modulation

Transmission characteristics

Transmission range (IF)	±10 MHz (referred to vision carrier)
Vestigial-sideband filter	SAW filter for adjacent-channel operation (B/G, D/K, I, L/L’, M, N)
Amplitude response	
Double-sideband operation	<±0.2 dB
Vestigial-sideband operation	depending on SAW filter
Group-delay response	
Double-sideband operation	<10 ns
Vestigial-sideband operation	depending on SAW filter
Signal-to-noise ratio	
0.2 to 5 MHz	>60 dB rms (weighted)
0 to 1 kHz	>60 dB pp (unweighted)
Hum suppression	
in clamped mode (hard)	>57 dB (with 30% superimposed hum)

Sound modulator 1, sound modulator 2

AF signal input	+6 dBm for 0 to ±100 kHz deviation, floating, Z_{in} >5 kΩ, switchable internal/external
Sound carrier IF	$\lvert f_{vision\ carrier} - f_{sound} \rvert$ ≤7 MHz
Modulation characteristics for standards B/G, D/K, I, M, N	
Type of modulation	F3 with preemphasis option: 50 µs or 75 µs
Signal-to-noise ratio	>70 dB (referred to 30 kHz deviation)
Modulation characteristics for standard L/L’	
Type of modulation	A3 without preemphasis
AF input	+6 dBm for m = 0 to 100%
Signal-to-noise ratio	>70 dB, weighted and unweighted (m = 100%)
Internal AF generator (DSP)	30 Hz to 15 kHz

TV stereo/dual-sound coder

AF input signals	L/R or AF_1/AF_2
Signal level	+6 dBm for ±30 kHz deviation
AF output signals	
Coding	IRT or Korea standard M
Crosstalk	
Dual sound	>70 dB
Stereo	>46 dB
Pilot carrier	in sound channel 2
Pilot frequency	
IRT	54.6875 kHz = 3.5 f_H
Korea	55.06994 kHz

NICAM sound modulator

Standards	B/G, I, L (switchable)
Type of modulation	differential QPSK
Data rate	728 kbit/s according to NICAM
Pulse shaping	digital
cos roll-off	
Standards B/G + L	40%
Standard I	100%
Resolution	8 bit

Intermodulation measurement

(Level in dB)	Vision carrier	Sound carrier 1	Sideband
Intermodulation IM	0	–10	off
IM/K	–8	–10	–16.5
IM/B	–5.5	–11.5	–11.5
Linearity LIN1	–2.5/–8	–10	–32
Linearity LIN2	–2.5/–20	–10	–32

(Linearity measurement with vision-carrier switching every two seconds)

Upconverter

Frequency

Input frequency range	32 to 46 MHz ±8 MHz for double-sideband operation (vision carrier)
Output frequency range	5 to 1000 MHz, step width 1 Hz
RF tuning	numeric frequency entry via keyboard in MHz or channel entry according to country table
RF sideband (selectable)	upper sideband (normal) or lower sideband

Level

IF input level range	0 to –7 dBm into 50 Ω
RF output level (max. level)	
LOW NOISE	+10 to –99 dBm
NORMAL	+6 to –99 dBm
LOW DISTORTION	0 to –99 dBm
RF level resolution	0.1 dB
Total RF level error	<±1.5 dB
RF frequency response in TV channel	<0.5 dB (typ. 0.2 dB, channel-dependent)

Total transmission characteristics

(Spurious signals with vision/sound ratio of 10:1, LOW DISTORTION mode)

Spurious emissions	≥66 dB
Vision carrier –5.5 and 11 MHz	≥60 dB
Intermodulation products	>76 dB
Harmonics	≥50 dB
Video signal-to-noise ratio (referred to black-to-white transition)	
0.2 to 5 MHz (noise)	≥67 dB rms, weighted
10 Hz to 1 kHz (hum)	≥60 dB pp, unweighted
Audio signal-to-noise ratio up to 15 kHz (with pre- and deemphasis)	≥66 dB (30 kHz deviation)

General data

Rated temperature range	+5 to +45°C
Operating temperature range	0 to +45°C
Power supply	100/120/220/240 V +15/–10%, 47 to 63 Hz, 150 VA
Dimensions (W x H x D); weight	435 mm x 192 mm x 460 mm; 19 kg

Ordering information

TV Test Transmitter

Basic unit with vision modulator and FM modulator sound 1, without upconverter	SFM	2007.9106.10
Basic unit with vision modulator and FM modulator sound 1, with upconverter 5 to 1000 MHz, 50 Ω	SFM	2007.9106.50
Basic unit with upconverter 5 to 1000 MHz, 50 Ω, without vision/sound modulator	SFM	2007.9106.90

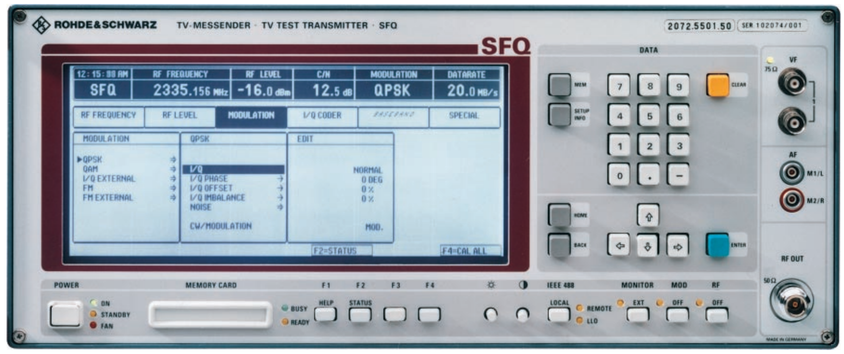
Options

Multistandard plug-in	SFM-B7	2008.0248.02
Sound modulator 2 (switchable FM/AM), including dual-sound coder (IRT)	SFM-B9	2008.0183.02
QPSK sound modulator for NICAM728 with internal NICAM generator	SFM-B10	2008.0302.02
RF output 75 Ω (switchable)	SFM-B16	2007.9212.02

TV Test Transmitter SFQ

0.3 MHz to 3.3 GHz

Generation of DVB signals for satellite and cable and of analog broadband FM signals and noise signals



Note: SFQ model 10 with R&S label available in Europe, Middle East and Japan only; in all other areas available as model DVT200 by Tektronix (photo 42591)

Brief description

TV Test Transmitter SFQ supplies all signals used in satellite transmission: analog frequency-modulated vision and sound signals as well as QPSK signals (DVB-S) for satellite links and QAM signals (DVB-C) for cable systems in compliance with ETSI Specifications (ETS300421 and ETS300429). SFQ is capable of generating both analog FM sound subcarriers and digitally modulated ADR (Astra Digital Radio) sound subcarriers. Its continuously tunable wide RF output range caters for future extensions of the satellite IF and covers the back channel bands.

Main features

- Digital modulation to ETSI
  - QPSK for DVB-S
  - 16QAM to 256QAM (selectable) for DVB-C

Noise generator option (for digital modulation only

- Broadband white noise
- High stability

Input interface option

- ASI input
- Synthesizer for precise data clock
- Selectable symbol rate

Broadband FM modulator option

- Broadband FM modulation
- Two FM sound subcarriers (further sound subcarriers optionally available), continuously tunable from 5 MHz to 9 MHz
- Noise generator

ADR sound subcarrier option

- Two ADR sound subcarriers (further modules available as options)
- Continuously tunable from 5 MHz to 9 MHz

Further features

- Input data rate selectable between 2 and 62.25 Mbit/s
- Switch-selected energy dispersal, Reed-Solomon coder and interleaver
- Variable rolloff factor for pulse shaping
- Data, random sequence (PRBS) and null transport stream packet selectable as modulation signal
- Serial and parallel MPEG2 interface
- Input for I/Q signals
- Selectable puncturing rate for QPSK
- PAL, NTSC or SECAM selectable
- Internal generation of max. 6 FM and max. 12 ADR sound subcarriers
- Noise generator
- PRBS generator
- Output level: –99 to +4 dBm (CW: +13 dBm)
- Error simulation in I/Q modulation by defined signal distortion

Specifications in brief

Frequency of main carrier	
Range	0.3 MHz to 3.3 GHz
Resolution	1 Hz
Aging (after 30 days of operation)	1×10^{-6}/year
Temperature effect (0 to 55 °C)	2×10^{-6}
Output for internal reference freq.	10 MHz; 1 V rms EMF, sinewave
Input for external reference freq.	5 or 10 MHz ($\pm 3 \times 10^{-6}$); 0.1 to 2 V rms, 200 Ω
Spectral purity	
Harmonics	<–30 dBc
Nonharmonics, CW	<–70 dBc
Nonharmonics, I/Q	<–56 dBc
SSB phase noise (at 20 kHz carrier offset, 1 Hz bandwidth)	<–108 dBc
Spurious FM rms	<8 Hz (f = 1 GHz, 0.3 to 3 kHz, CCITT)
Level	
Range CW	–99.9 to +13 dBm (resolution 0.1 dB)
I/Q, digital modulation	–99.9 to +4 dBm (resolution 0.1 dB)
Total level error	<±1.5 dB
Frequency response at 0 dBm	<1 dB, typ. <0.5 dB
Characteristic impedance	50 Ω
VSWR RF level –99 to 0 dBm	<1.4
RF level 0 to +13 dBm	<2
RF output	with DC block (max. 50 V)
Interruption-free level setting	0 to –15 dB
Overvoltage protection	protects instrument against externally fed RF power (50 Ω source)

I/Q modulation	
Modulation inputs for external I and Q signals	
Input impedance	50 Ω
VSWR (up to 30 MHz)	<1.4
V_{in} for full modulation	$\sqrt{(I^2+Q^2)}$ = 0.5 V (1 V EMF, 50 Ω)

Digital modulation with I/Q coder	
Internally predefined modulation	QPSK, QAM
Input data rate (selectable)	2 to 62.25 Mbit/s
QPSK symbol rate	2 to 45 Msymb/s
QAM symbol rate	1.5 to 7 Msymb/s
Modes (QPSK and QAM)	DATA
	AUTO (automatic switchover to PRBS in case of input data loss)
	NULL TS PACKET (null transport stream packets according to definition in Measurement Guidelines)
	PRBS (2^{23-1} to CCIT REC.O.151)

Data input	transport stream (synchronous parallel, LVDS), serial with option SFQ-B6
Modulation frequency response	
DC to 3.5 MHz, RF 0.3 to 1000 MHz	<±0.2 dB (DVB-C: up to 7 Msymb/s)
DC to 17.5 MHz, RF 0.3 to 3300 MHz	<±0.8 dB (DVB-S: up to 35 Msymb/s)
DC to 22.5 MHz, RF 0.3 to 3300 MHz	<±1 dB (DVB-S: up to 45 Msymb/s)
S/N ratio	>35 dB (QAM, 6.9 Msymb/s, rolloff = 0.15, measured with EFA from R&S)
Residual carrier at 0 V input voltage, referred to full modulation	< –50 dBc (after calibration)
Carrier suppression (residual carrier)	0 to 50% (selectable, resolution 0.1 dB)
I /Q amplitude imbalance	
Setting range, resolution	– 25 to + 25%; 0.1%
Quadrature offset (phase error)	
Setting range, resolution	–10 to +10 °; 0.1°

QPSK encoder	to ETSI 300421
Energy dispersal	switchable
Sync inversion	to standard
Reed-Solomon encoder	switchable (204, 188, t = 8)
Convolutional interleaver	switchable
Convolutional encoder	to standard
Puncturing rate (selectable)	1/2, 2/3, 3/4, 5/6, 7/8
Pulse filtering	0.25/0.3/0.35/0.4/0.45 rolloff

QAM encoder	to ETSI 300429
Energy dispersal, sync inversion, Reed-Solomon encoder, convolutional interleaver	same as QPSK encoder
Mapping (selectable)	16, 32, 64, 128, 256QAM
Differential encoding	to standard
Pulse filtering	0.1/0.13/0.15/0.175/0.2 rolloff

Broadband FM modulator	**option SFQ-B2**
Video transmission characteristics	
Modulation type	FM (F3)
TV standard (selectable)	PAL, SECAM, NTSC
Nominal input level	1 V pp
Video frequency dev. (selectable)	10 to 40 MHz (resolution 0.1 MHz)
Hum suppression (with level clamping on)	>40 dB
Linear distortion	
Freq. response 0 to 5 MHz (ref. to 1.5 MHz and 25 MHz (pp) dev.)	<±0.5 dB, with preemphasis and LP filter
Group delay 0 to 5 MHz	<±20 ns, with lowpass filter
Transients (streaking) with 200 ns rise and fall time	<±2%
Nonlinear distortion	measured with standard video signal and pre- and deemphasis switched on
Differential gain	<1.5% (25 MHz deviation)
Differential phase	<1.5° (25 MHz deviation)
Video-frequency S/N ratio ref. to 22.5 MHz deviation with pre- and deemphasis 100 kHz to 5 MHz	>70 dB rms weighted acc. to CCIR

Energy dispersal signal	
Signal type	25 Hz or 30 Hz triangular signal, coupled to frame frequency
Deviation (selectable)	0 to 5 MHz (automatically doubled if video or baseband signal is switched off)
Resolution	0.1 MHz

FM sound subcarrier	**option SFQ-B3** (1x included in SFQ-B2)
Number of subcarriers per module	2
Frequency range (selectable)	5 to 9 MHz (resolution 10 kHz)
Frequency deviation of IF carrier caused by FM sound subc. (selectable)	1 to 4 MHz (pp) (resolution 10 kHz)
Audio signal input	>5 kΩ (balanced); Lemo Triax female
Frequency range	30 Hz to 15 kHz (100 kHz)
Nominal input level	+9 dBm (600 Ω)
Internal modulation generator (DSP)	
Frequency range	30 Hz to 15 kHz (resolution 100 Hz)
Audio deviation(selectable)	0 to 600 kHz (pp)
Preemphasis	50 µs, 75 µs, J17 or off
Modulation distortion	<0.5%

ADR sound subcarrier	**option SFQ-B4**
Number of subcarriers per module	2
Frequency range (selectable)	5 to 9 MHz
Frequency deviation of IF carrier caused by ADR subcarrier (selectable)	1 to 4 MHz (pp)
Modulation type	DQPSK
Source data	internal, external, PRBS
Data rate	192 kbit/s
Channel coding, FEC	to ADR specification
Transmission data rate	256 kbit/s
DQPSK test	4 patterns selectable; I/Q interchange
Bit error generator	10^{-2} to 10^{-6} (BER only)
External data input	only for one of the two subcarriers
Type	clock (invertible) and data
Level	to RS-422
Data rate	192 kbit/s
PRBS generator	pseudo random binary sequence as source data
MUSICAM generators (internal)	2 (acc. to ISO/IEC 11172-3 Layer II), independent of each other
Audio generator	20 Hz to 20 kHz; 1 Hz steps
Amplitude range	100 dB; 0.1 dB steps
MUSICAM modes	single, dual, stereo, joint stereo
Preemphasis (switchable)	50 µs/15 µs
Additional data (selectable)	1 of 4 data records (memory card)

Noise generator	**option SFQ-B5 (included in SFQ-B2)**
Receiver bandwidth (selectable)	5 to 60 MHz
C/N variation range	0 to 60 dB
Minimum C/N	depending on bandwidth and modulation
Resolution	0.1 dB
C/N inaccuracy	<1 dB (level range depending on modulation mode)
at +23 ±3 °C C/N inaccuracy/C/N drift	≤0.5 dB/≤0.2 dB

Input interface	**option SFQ-B6**
Connector	BNC female, 75 Ω
Input level	200 to 800 mV pp
Asynchronous serial interface (ASI) for MPEG2 data stream	to DVB-A010
Stuffing bytes	single byte and block mode
Symbol rate	selectable
Error	<±1 x 10^{-4}
Transport stream	NULL PRBS PACKET (PRBS corresponds to 2^{23}–1 to CCITT Rec. O.151)

Ordering information

TV Test Transmitter (DVB-C and DVB-S)SFQ		2072.5501.10
Options		
Broadband FM Modulator for baseband PAL, SECAM, NTSC and FM sound (2 subcarriers)	SFQ-B2	2072.6108.02
FM Sound Subcarrier	SFQ-B3	2072.7379.02
ADR Sound Subcarrier	SFQ-B4	2072.7479.02
Noise Generator	SFQ-B5	2072.7579.02
Input Interface	SFQ-B6	2072.7679.02
I/Q Output	SFQ-B14	2072.6266.02
Extras		
4 Mbyte flash memory card		0008.5499.00
Lemo Triax female cable connector		0231.9182.00
Audio cable (2 x Lemo Triax/ 1 x 5-pin DIN 41524)		2020.6636.00
19" Adapter (4 HU) for rackmounting	ZZA-94	0396.9471.00

TV Generators SGPF, SGSF, SGMF

Photo 43165

Brief description

With its TV Generators SG.F for all traditional colour standards, Rohde & Schwarz has the right unit for any production, studio and service requirement.

Main features

- More than 30 baseband signals
- General-purpose test pattern with optional text insertion for source identification
- Signal output on the front and rear panel
- Remote control of all generator functions via IEC/IEE bus
- Insertion test signals included in every signal
- Insertion of external test signals into the field blanking interval or application of sweep signals to the active picture area
- Use as test signal inserter with the genlock option fitted

Digital picture generation

With the PAL generator, the three components Y, C_B and C_R are stored for digital generation of the realtime composite colour video signal (CCVS). For generation of the test signals to NTSC and SECAM, about 1000 different video lines are stored digitally and can be combined to obtain the desired pattern under program control.

Test signals

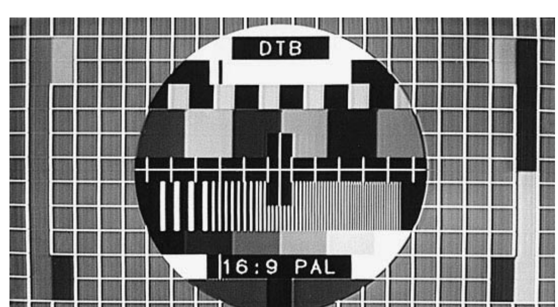
For all three generators the assignment of a test signal to a specific line can be programmed via DIP switches. Eight complete test signal configurations can be stored and recalled enabling the user to tackle any measurement task.

Output signal

The signal amplitude can be set via the IEC/IEEE bus or manually by a potentiometer. On all models separate amplifiers ensure excellent decoupling between the front and the rear outputs.

Options

For options see ordering information. Some options cannot be retrofitted.



SGPF: Optional is a general-purpose test pattern of 16:9 (see photo) or 4:3 aspect ratio or an FuBK test pattern (photo 39583-2)

With the genlock option for test signal insertion fitted, switchover to the selected substitution pattern is ensured in the case of program failure.

Ordering information

TV Generator for		
PAL	SGPF	2016.4049.03
SECAM	SGSF	2016.7048.03
NTSC	SGMF	2016.0943.03
Options		
(some options cannot be retrofitted)		
Source Identification	SG.F-B1	2016.1004.02
Test Signal Insertion	SGPF-B2	2016.4278.02
	SGSF-B2	2016.7190.02
	SGMF-B2	2016.1185.02
FuBK Test Pattern	SGPF-B3	2016.4284.02
French FrenchFront-panel Labelling	SGSF-B3	2016.7225.02
General-purpose Test Pattern of 16:9 aspect ratio	SGPF-B4	2016.4290.02
Extras		
Junction Panel with bypass	SG.F-Z	2016.1679.02
19" Adapter	ZZA-91	0396.4870.00
Calibration Data Documentation	SG.-DCV	2082.0490.04

Specifications in brief

TV Generators	SGPF (PAL)	SGSF (SECAM)	SGMF (NTSC)
Level tolerances			
Nominal luminance level (cal.)	700 ±4 mV	700 ±4 mV	714 ±4 mV
Nominal chrominance level (cal.)	700 ±7 mV	–	714 ±7 mV
Departure at			
nominal <500 mV	±5 mV	±5 mV	±5 mV
≥500 mV	±1%	±1%	±1%
Squarewave, staircase and sawtooth signals	nominal ±4 mV	nominal ±4 mV	nominal ±4 mV
2T pulse	nominal ±5 mV	nominal ±5 mV	nominal ±5 mV
10T and 20T pulses	nominal ±7 mV	nominal ±7 mV	–
12.5T pulse	–	–	nominal ±7 mV
Amplitude/frequency response			
Multipulse, sweep signals	±0.1 dB (up to 5.5 MHz)	±0.1 dB (up to 5.5 MHz)	±0.1 dB (up to 5.5 MHz)
Multiburst	±0.1 dB (up to 5.8 MHz)	±0.1 dB (up to 5.8 MHz)	±0.1 dB (up to 5.5 MHz)
Group delay			
10T and 20T pulses (f_{mod} ≤5 MHz)	≤5 ns	≤5 ns	≤5 ns
12.5T pulse	–	–	5 ns
Rise time (10 to 90%) and half-amplitude duration			
Sync rise time	200 ±5 ns	200 ±5 ns	140 ±5 ns
Luminance rise time	200 ±5 ns, 231 ±5 ns	200 ±5 ns, 231 ±5 ns	125 ±5 ns, 250 ±5 ns
Half-amplitude duration 2T pulse	200 ±5 ns	200 ±5 ns	250 ±5 ns
10T pulse	1000 ±15 ns	1000 ±15 ns	-
12.5T pulse	-	-	1570 ±5 ns
20T pulse	2000 ±30 ns	2000 ±30 ns	-
Chrominance rise time	300 ±10 ns, 1000 ±15 ns	–	300 ±10 ns, 1000 ±10 ns
Rise time of 4.43 MHz components	–	300 ±10 ns, 1000 ±15 ns	–
Line-time nonlinearity			
5-step staircase	≤0.8%	≤0.8%	≤0.8%
Chrominance phase			
Phase between R-Y and B-Y axes	90 ±1°	–	90 ±1°
Maximum departure of chrominance phase from nominal	±2°	–	±2°
SECAM colour coding			
Tolerance of colour-difference signal preemphasis	–	±0.2 dB	–
Tolerance of subcarrier preemphasis	–	±0.15 dB	–
S/N ratio			
measured on all-black picture	≥74 dB rms, weighted, 0.2 to 5 MHz	≥74 dB rms, weighted, 0.2 to 5 MHz	≥74 dB rms, weighted, 0.2 to 4.2 MHz
measured on sawtooth signal	≥70 dB rms, weighted, 0.2 to 5 MHz	≥70 dB rms, weighted, 0.2 to 5 MHz	≥70 dB rms, weighted, 0.2 to 4.2 MHz
Clock frame			
SC/H phase	0 ±5°	–	0 ±5°
V component	can be disabled	can be disabled	can be disabled

Inputs/outputs	BNC, 75 Ω
Return loss	≥34 dB (up to 6 MHz)
Sync pulse output	2 V into 75 Ω
EXT-VITS input	
Gain	0 ±0.1 dB
Amplitude/frequency response	±0.1 dB (up to 6 MHz)
Differential gain	≤0.3%
Differential phase	≤0.3°
Genlock option with test signal insertion	
Input/output	BNC, 75 Ω
Return loss	≥34 dB (up to 6 MHz)
Amplitude/frequency response	±0.1 dB (up to 6 MHz)
Group delay error	<5 ns (up to 5.5 MHz)
Differential gain	≤0.3%
Differential phase	≤0.3°

S/N ratio (rms, weighted, 0.2 to 5/4.2 MHz)	≥74 dB	
Test signal insertion		
Level (same as generator signal)	CAL (normal operation) or variable between –50 and +40% of CAL	
Insertion range		
PAL	1st field	lines 6 to 22
	2nd field	lines 319 to 335
SECAM	1st field	lines 6 and 16 to 22
	2nd field	lines 319 and 329 to 335
Identification signals of applied CCVS	in lines 7 to 15 and 320 to 328, can be replaced by all-black line or other signal	
NTSC, both fields	lines 10 to 21	

TV Network Analyzers SWKF, SOKF

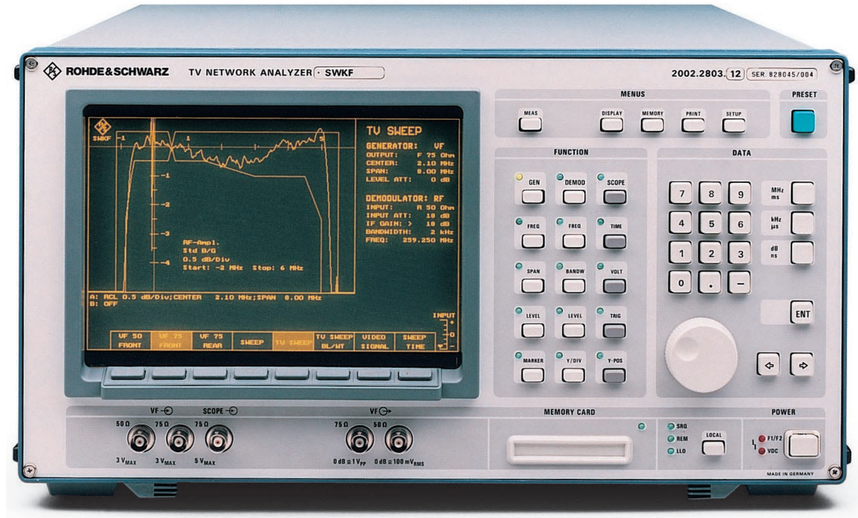
SWKF, SOKF:

0.01 (0.02) to 55 MHz

IF/45 to 960 MHz

SOKF: 0 to 9 MHz (oscilloscope)

TV sweep technology with application-specific high measuring convenience



SWKF (photo 41539)

Brief description

TV Network Analyzers SWKF and SOKF are general-purpose sweepers for determining the transmission characteristics of TV transmitters, both for terrestrial application and broadband communication. They are suitable for use in development, production, acceptance testing, on-site maintenance and servicing in all fields of TV technology. SOKF is setting new standards in the field of TV transmitter measurements. Due to the integration of a digital TV oscilloscope with video analyzer functions, comprehensive measurements of linear and nonlinear transmission characteristics both in the time and in the frequency domain can be performed by a single unit. Depending on the transmission parameter to be determined, measurement either in the frequency or in the time domain may be more advantageous and these two methods are ideally combined in SOKF.

Main features

- Measurement of amplitude-frequency and group-delay response in the video and IF/RF ranges, with and without sync pulses
- Additional insertion of video test signals into the field-blanking interval during full-field sweeping
- Test signal insertion into specific lines of the field, with variable grey level
- Frequency markers and level line
- Intermodulation analysis with suppressed line spectrum
- Spectrum analysis in the video and IF/RF ranges
- Display and measurement of waveforms as well as analysis of selected video parameters such as DG, DPH, ICPM (SOKF only)
- Special filters for selective measurement and analysis of certain signal components such as colour subcarrier, luminance, step size of staircase, hum, etc (SOKF only)
- Printer interface, IEC/IEEE bus, RS-232

Functional groups

- Sweep generator
- Selective receiver (analyzer)
- Video test signal generator producing various full-field test signals
- Group-delay meter
- Processor for device control and digital signal processing
- EL display
- TV oscilloscope (SOKF)

Measuring capabilities

Measurements in the frequency domain

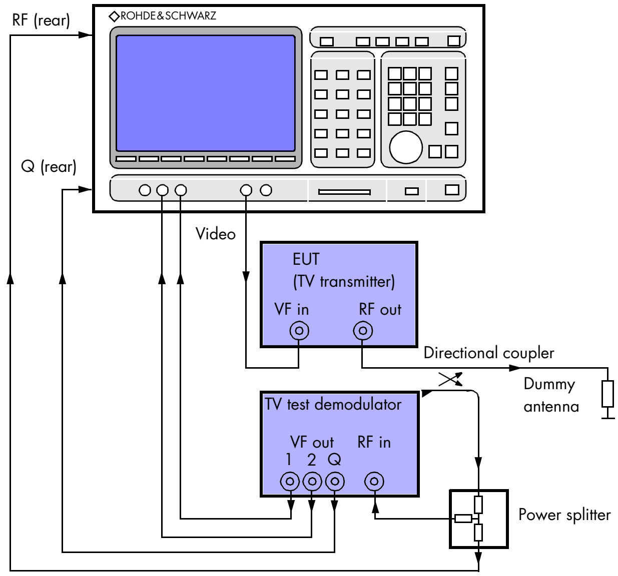
These are performed by the network and spectrum analyzer of the SOKF. Thanks to its wide dynamic range and frequency range, it is particularly suitable for continuous measurement of the linear transmission characteristics inside and outside the transmission channel (amplitude-frequency and group-delay response, filter quality and spurious emissions of TV transmitters) as well as of some nonlinear transmission characteristics (luminance-dependent amplitude frequency response, intermodulation products).

Measurements in the time domain

These are performed using the oscilloscope function of the SOKF which features high time resolution, fine quantization with high linearity and short measurement times. In conjunction with the built-in video generator (also in SWKF) and – for TV transmitter measurements – an external test demodulator (eg EFA, page 124), the oscillator function enables in particular the measurement of TV-specific nonlinear distortion, low-frequency linear distortion and interference, as well as signal monitoring during the ongoing program (see illustration).

The oscilloscope section of the SOKF is specially designed for video measurements. In addition to the pure waveform display it also provides analysis of selected video parameters. Built-in special filters enable selective measurements on signal components (colour subcarrier, luminance, step size of staircase, hum). Moreover, waveforms can be measured easily and with high accuracy using the cursor functions.

The user is thus provided with a highly compact, value-for-money solution for his measurement problems. What makes the SOKF different from the SWKF is the built-in oscilloscope. Otherwise the two instruments have the same features, eg a large, high-contrast ELD with a wide viewing angle (useful for TV transmitter alignment) and a variety of interfaces (IEC/IEEE bus, RS-232-C, Centronics, VGA monitor port).



Test setup with SOKF

Specifications in brief

VDU	
Screen	electroluminescent
Display	amplitude and group-delay response, data, text, softkey menus
Resolution (Y axis)	0.5; 1; 5; 10 dB/div, 10; 20; 100; 200 ns/div
Sweep generator	
Frequency range	0.01 to 55 MHz
with sync pulses	0.01 to 30 MHz
Modulation	
H (line-repetitive)	modulation from black to white, 20% modulation for black or white and for variable grey
H + V (field-repetitive)	with additional CCIR signals in field blanking interval
Span	100 kHz to 55 MHz
Frequency markers	3
Output level	100 mV rms/50 Ω
Output attenuator	0 to 31 dB
for group-delay measurement	0 to 26 dB
Video generator	
Signals	
H (line-repetitive)	2T pulse; 50 Hz, 15 kHz, 250 kHz squarewave; 10-step staircase with/without superposition, variable grey signal; sin x/x; sinewave 50 kHz to 7 MHz; CCIR 17, 18, 330, 331
H + V (field-repetitive)	with additional CCIR signals in field blanking interval
External signal input	0.05 to 100 kHz; +6 dBm/600 Ω for full modulation from black to white
Output level	1 V pp/75 Ω ±10%, adjustable
Sync pulse height	150 to 300 to 600 mV, adjustable (line-repetitive)
Selective receiver section	
Video demodulator input	
Frequency range	0.02 to 55 MHz
Nominal input level	100 mV rms/50 Ω, 1 V_{pp}/75 Ω
IF/RF demodulator input	
Frequency range	32.7; 38.0; 38.9; 45 to 960 MHz
Nominal input level	100 mV rms/50 Ω
Resolution bandwidth	300/100/20/2 kHz
Dynamic range	>80 dB

Sweep generator/receiver section	
Amplitude-frequency response	
0.02 to 0.1 MHz	<±0.3 dB
0.1 to 10 MHz	<±0.2 dB
10 to 55 MHz	<±1 dB
45 to 960 MHz	<±0.2 dB/10 MHz (down to 0.5 MHz)
Group-delay response	<5 ns/10 MHz
TV oscilloscope (SOKF)	
Signal bandwidth	0 to 9 MHz
Sampling frequency	40 MHz
Quantization	10 bits
Frequency response	<1%, <5 ns up to 5 MHz
Input sensitivity	50, 100, 200 mV/div
Timebase	5 ms/div to 100 ns/div
Inputs	front, rear, Q (all 75 Ω)
Coupling	AC, DC, GND
Clamping	hard, soft
Trigger	int., ext., mains coupling: direct or via PLL, any line selectable
Special filters	spike, colour, 1 MHz LP, 1 kHz LP
Video analysis	DG, DPH, ICPM
Interfaces	IEC/IEEE bus, RS-232, Centronics, memory card, keyboard, VGA monitor
General data	
Power supply	100/120/230/240 V ±10%, 47 to 63 Hz, 250 VA
Dimensions (W x H x D); weight	435 mm x 236 mm x 570 mm; 25 kg

Ordering information

TV Network Analyzer	SWKF	2002.2803.12
	SOKF	2002.2826.02
Option		
TV Oscilloscope Function for SWKF (to obtain SOKF)	SWKF-B1	2002.3797.00
Extras		
Memory card, 256 Kbytes		0008.5547.00

Video Analyzer UAF

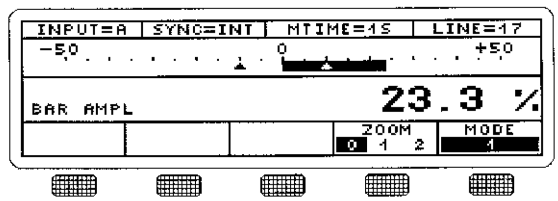
Standards B/G, D/K, I, M

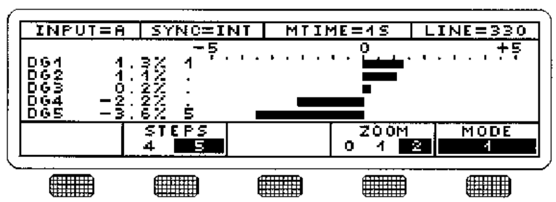
Perfection in video analysis: fast, precise, reliable

Photo 39139

Brief description

Thanks to its outstanding characteristics, Video Analyzer UAF from Rohde&Schwarz meets all requirements as regards high measurement accuracy for the studio and fast measurements down to a few seconds. User-friendly operation and a clear display with graphics support afford straightforward measurements.





The test results are displayed either in the form of numeric values or as a bar

Main features

- 3 signal inputs
- 29 video parameters
- Limit monitoring
- Full-field measurements
- Freely selectable test signal
- Memory card, printer interface

The core of the digital section is a microprocessor plus an arithmetic coprocessor. The signal analysis comprises 29 video and test line parameters and covers all important levels as well as linear and nonlinear distortion such as 2T K rating, frequency response and hum. Optionally 50 Hz tilt, 200 ns overshoot, NICAM and dual-sound intermodulation can be measured. The position of the test lines can be freely selected over the entire picture area and in the field blanking interval; storage of up to eight test configurations is possible.

Thanks to its variable integration time, the UAF can be adapted to all test conditions. Using the shortest integration time of less than 1 s, the UAF is ideal for all alignments. In the case of very noisy signals, stable results can be obtained by increasing the integration time to 2.5, 5 or 10 s.

For use in quality and production control of video recorders, the UAF also handles the S-VHS component signals Y/C. Distorted test signals do not affect the operation of the UAF.

Using a plug-in memory card, customer-defined test programs can be loaded and test results stored on the card. Moreover, the memory card permits storage of complete instrument setups.

Operation

The logical arrangement of the UAF front-panel controls offers a clear overview of its functions and ensures ease of operation. Each parameter is assigned its own key. The associated LED above the key blinks if the limit values are exceeded.

The keypad to the left of the display permits the setup menus of the UAF to be selected directly. Such a menu is inserted as a window above the normal result display. Thus it is possible to use the softkeys for changing general settings such as the input, synchronization, printer mode, etc.

The "option" function allows further test parameters, eg an external level or future extensions, to be called up.

Special modes are the difference and the reference measurement modes with which signal errors at the input of the device under test can be eliminated. The AUTORUN menu permits test sequences to be programmed on the UAF front panel; these sequences are executed automatically and can be repeated cyclically.

Specifications in brief (standard B/G)

Signal inputs	3; 75 Ω loopthrough filters, 3 x CCVS or 1 x Y/C and 1 x CCVS, adjustable
Level	1 V pp ±6 dB
Return loss up to 10 MHz	≥40 dB
Decoupling of inputs up to 10 MHz	≥85 dB
Synchronization	
Internal	optionally from one of the three inputs
Sync pulse level	300 mV ±6 dB
External	loopthrough filter
Nominal level	2 V/4 V into 75 Ω (V_{pp})
SIS	permissible

Test parameter	Measurement range	Error limits at nominal
Luminance bar amplitude	–100 to +100%	±0.3%
Black level distortion	–20 to +40%	±0.3%
Tilt of luminance bar	–40 to +40%	±0.3%
2T pulse amplitude	–50 to +50%	±0.5%
2T K factor	0 to +10%	±0.7%
Luminance nonlinearity	0 to +50%	±0.5%
Residual picture carrier	0 to +30%	±0.3%
Sync pulse amplitude		
Reference signal	–50 to +50%	±0.5%
Reference nominal	–80 to +100%	±0.5%
Colour subcarrier gain		
CCIR 331	–50 to +50%	±1%
CCIR 17	–50 to +50%	±1%
Chrominance/luminance intermodulation		
CCIR 331	–50 to +50%	±0.3%
CCIR 17	–50 to +50%	±1%
Chrominance/luminance delay	–500 to +500 ns	±5 ns
Differential gain		
positive/negative	–50 to +50%	±0.3%
peak-to-peak	0 to +100%	±0.5%
Differential phase		
positive/negative	–50 to +50°	±0.3°
peak-to-peak	0 to +100°	±0.5°
Nonlinearity of colour subcarrier amplitude		
positive/negative	–50 to +50%	±0.7%
peak-to-peak	0 to +100%	±1%
Nonlinearity of colour subcarrier phase		
positive/negative	–50 to +50°	±0.7°
peak-to-peak	0 to +100°	±1°
Burst amplitude		
Reference signal	–50 to +50%	±1%
Reference nominal	–80 to +80%	±1%
Multiburst amplitude	–80 to +50%	±1%
Luminance signal/noise ratio	25 to 80 dB	±1 dB
Intermodulation between colour subcarrier and sound carrier	30 to 70 dB	±1 dB
Hum	6 to 60 dB	±1 dB
DC measurement	–5 to +5 V	±10 mV
Incidental phase modulation of vision carrier (ICPM)	–7 to +45°	±1°
Video data amplitude	–50 to +50%	±1%
50 Hz tilt (optional)	0 to 40%	±0.5%
200 ns overshoot (optional)	–20 to +40%	±0.3%

Noise voltage	
Measurement mode	rms
Filter	200 kHz highpass and video filter integrated, weighting filter and colour subcarrier trap can be connected
Inherent S/N ratio	>83 dB
Reference	luminance bar or 700 mV nominal, can be selected
Differential gain/phase	
Evaluation	4 or 5 steps (can be selected)
Hum	
Measurement mode	peak-to-peak
Filter	1 kHz lowpass integrated
Reference	luminance bar or 700 mV nominal, selectable
Special functions	
SETUP	for basic settings
MEAS TIME	measurement time 1/2.5/5/10 s
MEAS HOLD	measured values of all parameters are simultaneously frozen
PRINT	measured value output via printer
MONITORING	limit monitoring of single parameters, parameter groups or all parameters
AUTORUN	entry and recall of user-defined test routine
Difference measurement	selectable between two inputs
Reference measurement	one test cycle stored as reference
Indication	LC display
Display mode (selectable)	numeric, 1 parameter, 3 parameters supported by analog bar display
Language	German, English, French or Italian
Interfaces and outputs	
IEC/IEEE bus	interface to IEC 625-2/IEEE 488-2
Printer	Centronics interface
Memory card	storage of measured values, device setups, test routines, etc.
Monitor output	clamped test signal, (input signal ±1%, 75 Ω)
Zero reference control	2.5 V pp ±10% into 75 Ω, position and duration adjustable
General data	
Power supply	100/120/220/240 V ±10%, 47 to 63 Hz, 115 VA
Rated temperature range	0 to +50°C
Dimensions (W x H x D); weight	435 mm x 103 mm x 460 mm; 10 kg

Ordering information

Video Analyzer	Standard B/G	UAF	2013.0807.02
	Standard D/K	UAF	2028.5780.02
	Standard M	UAF	2028.5774.02
	Standard I	UAF	2028.5768.05
	Other standards		on request
Accessories supplied		four 75 Ω Terminations RMF2, 32 Kbyte memory card	
Options			
50 Hz tilt, 200 ns overshoot		UAF-B1	2028.6406.02
S/N extension			
552 kHz (NICAM)		UAF-B2	2028.6412.02
242 kHz (dual sound)		UAF-B3	2028.6429.02
Calibration Data Documentation		UAF-DCV	2082.0490.05
Extras			
Memory card 32 Kbyte		ZZM-32	2005.4394.02
512 Kbyte		ZZM-512	2005.4388.02
Service Manual			2013.1684.24

Digital Video Component Analyzer VCA, DTL Analysis VCA-B11

VCA: combined waveform monitor and analyzer
With VCA-B11: additional jitter analysis and spectral measurements

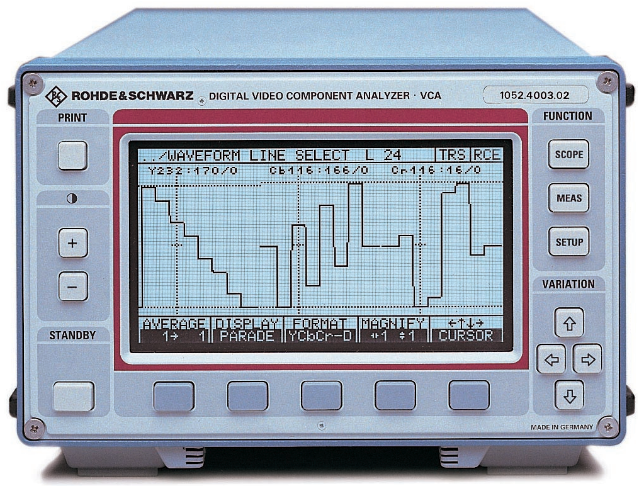


Photo 41575

Brief description

Digital Video Component Analyzer VCA is designed to solve measurement problems in the digital studio, in operation and servicing as well as in the development of digital studio equipment. Combining the characteristics of a waveform monitor and an analyzer and including all conventional display modes, the VCA is suitable for a great variety of measurements and so makes working with digital video signals easy. An optional remote control unit permits the VCA to be readily integrated into large measuring systems for comprehensive monitoring in the studio.

Main features

- To standards ITU-R601/656, SMPTE125M/259M, 8 bits, 10 bits, 625/525 lines
- Waveform display
- Numeric output of video data
- Analysis of data frame/contents
- Timing and level measurements
- Hardcopy of screen via external printer
- DTL analysis (optional)
- Remote control (optional)

Equipped with a digital-parallel and a digital-serial video input as well as SCOPE and MEASURE functions, VCA is capable of monitoring the digital video signal at all the transfer points of a digital TV studio. Measurement results are clearly displayed on a large-size monitor. Compared to the purely visual information obtained from an oscilloscope, VCA reads out precise measurement values. A graphic display facilitates evaluation of the results.

SCOPE functions
These functions allow waveforms and numerical values of the digital video signal to be analyzed.

MEASURE functions
These functions are used for monitoring and measuring live signals and for measuring special test signals. In the SCOPE mode, too, two monitoring functions are active in the background for checking the sync frame. The results of measurements on live signals are shown on the ERROR RATE display or on a new type of HISTORY display.

DTL analysis option (VCA-B11)

The DTL analysis option (digital transport layer) allows to search for the physical causes of data errors in serial-digital video signals, with signal jitter playing an important role in this respect. VCA performs jitter measurements according to the demodulator method and also supports measurements to the clock extractor method.

Specifications in brief

Waveform monitor (SCOPE)
WAVEFORM LINE SELECT
Display of digitized video signal:
Y, C_B, C_R as original digital data,
Y, C_B, C_R and G, B, R analog simulation
Display modes: parade, overlay or single; cursor measurement with position and value of sample; average function; magnify function; line selection

WAVEFORM
Same as WAVEFORM LINE SELECT with overlay of active video lines
NUMERIC DUMP
Binary, decimal and hexadecimal display of all data words with sample numbering and data type designation (Y, C_B, C_R, EAV, SAV or ANC); quick view of data at cursor, SAV, EAV and EDH; line selection

Additional functions with option VCA-B11

AMPLITUDE SPECTRUM
Measurement of frequency-dependent signal level; 3 measurement speeds, normalize function, magnify function, cursor measurements, consideration of cable lengths

Frequency range	5 to 800 MHz (RBW = 4 MHz)
Measurement range	–50 to +5 dB (referred to nominal level of serial signal)
Amplitude-frequency response (referred to 50 MHz)	5 to 300 MHz: ±2.5 dB 300 to 800 MHz: ±4 dB
Linearity	±1.5 dB

RETURN LOSS
Measurement of return loss (external SWR bridge required); 3 measurement speeds, normalize and magnify functions, cursor measurements

Frequency range	5 to 800 MHz (RBW = 4 MHz)
Attenuation measurement range	up to –30 dB (referred to broadband noise of –10 dBm)

Analyzer (MEASURE)

TRS ERROR
Sync word monitoring with respect to preamble, frame sync flag, line sync flag, field blanking flag, ERROR RATE and HISTORY display; background monitoring with adjustable limit values and insertion of warning (TRS) in other displays
VIDEO RANGE ERROR
Data word monitoring in active video range for checking data range (standard level), separately for Y, C_B, C_R; ERROR RATE and HISTORY display
RESERVED CODE ERROR
Data word monitoring with respect to TRS preamble (#FF, #00) in active video, ERROR RATE and HISTORY display; background monitoring with adjustable limit values and insertion of warning (RCE) in other displays
CRC ERROR
Monitoring of all data bits in a field by means of cyclic redundancy check, single bit and data word analysis; CRC WORD and HISTORY display
C/L GAIN/DELAY ERROR

Luminance/nominal level diff.	display in 0.1% steps, resolution 1 LSB
Luminance/nominal delay diff.	measurement range: –2.5 to +2.5 µs, resolution 0.1 ns
Chrom./lum. level diff.	display in 0.1% steps, resolution 1 LSB
Chrom./lum. delay diff.	measurement range: –1 to +1 µs, resolution 0.1 ns, test signals: 100% and 75% colour bar, average function, magnify function

Additional functions with option VCA-B11

SIGNAL DELAY
Measurement of delay difference between two serial-digital signals

Measurement range	±1 field with standard signal, ± 16 fields with test signal sequence
Resolution	1 sample (37 ns)

JITTER TIME/JITTER SPECTRUM
Jitter measurement either in time or in frequency domain; 3 time or frequency windows, average function, magnify function, cursor measurements

Meas. range (discrete jitter freq.)	10 Hz to 200 kHz: 0.01 to 8 UI_{pp}[1]) 200 kHz to 8 MHz: 0.01 to 8 UI_{pp}[1]) x (0.2 MHz/jitter frequency [MHz])

CLOCK EXTRACT
Clock extraction with selectable division factor 1/1 or 1/4; trigger signal with same division factor; extractor band limits: 10 Hz, 1 kHz
SIGNAL HEADROOM
Adjustable superimposed noise of signal from input B to output SUP IMP

[1]) Measured in unit intervals (UI); one UI corresponds to the bit period = 3.7 ns.

Signal inputs	
Serial (270 Mbit x 1)	to SMPTE 259M
Return loss	>25 dB (20 kHz to 270 MHz) into 75 Ω
Parallel (27 Mbit x 10)	to CCIR 601/656 and SMPTE 125M
Signal inputs with option VCA-B11	
Serial A and serial B (270 Mbit x 1)	to SMPTE 259M
Parallel (27 Mbit x 10)	to CCIR 601/656 and SMPTE 125M
Signal outputs	
Serial (270 Mbit x 1), signal of serial input with RECLOCKING	to SMPTE 259M
Return loss	>17 dB (20 kHz to 270 MHz) into 75 Ω
Parallel (27 Mbit x 10), signal of selected input with RECLOCKING	to CCIR 601/656 and SMPTE 125M
Signal outputs with option VCA-B11	
Serial A (270 Mbit x 1)	signal of serial input A to SMPTE 259M with reclocking
Serial B (270 Mbit x 1)	signal of serial input B to SMPTE 259M with reslicing
Parallel (27 Mbit x 10)	signal of selected input to CCIR 601/656 and SMPTE 125M with reclocking
MONITOR (270 Mbit x 1)	signal of input to SMPTE 259M selected for measurement
SUP IMP (270 Mbit x 1)	signal of input B to SMPTE 259M with superimposed noise
EYE MON (270 Mbit x 1)	signal of input B after cable equalization or after digitization (reslicing); V_{pp} = approx. 700 mV into 75 Ω
SER CLK	clock of signal input B (270 MHz or 67.5 MHz) with jitter bandwidth <8 MHz; V_{pp} = approx. 800 mV into 75 Ω
TRIG	clock of signal input B (270 MHz or 67.5 MHz) with jitter bandwidth <10 Hz; V_{pp} = approx. 800 mV into 75 Ω
NOISE	broadband noise of typ. –90 dBm/Hz (5 MHz to 1 GHz)
Signal standards	selectable video standards: 525 lines/60 Hz and 625 lines/50 Hz, 8 and 10 bits
Display (134 mm x 76 mm)	LC, illuminated, 240 x 128 pixels, intensity and contrast adjustable
Instrument setups (SETUP)	
SAVE/RECALL CONFIGURATION	storage and recall of 9 instrument setups
PRINTER	suitable printers: Epson RX80/FX80, HP DeskJet/LaserJet, R&S PUD3 and PDN
Printout	hardcopy of screen via RS-232/RS-422
General data	
Rated (operating) temperature range	+5 to +40°C, (0 to +50°C)
Power supply	100/230 V, –10/+15%, 120/220 V, –15/+10%, 47 to 63 Hz (60 VA, with VCA-B11: 140 VA)
Dimensions (W x H x D)	220 mm x 148 mm x 461 mm
Weight	6.4 kg, with VCA-B11: 7.7 kg

Ordering information

Digital Video Component Analyzer	VCA	1052.4003.02
Options		
Remote Control (RS-232/RS-422)	VCA-B1	1052.5600.02
DTL Analysis	VCA-B11	1052.5800.02
SWR Bridge 5 to 850 MHz	VCA-Z1	1052.5900.02
Calibration Data Documentation	VCA-DCV	2082.0490.06
Same for VCA-B11	VCA-DCV	2082.0490.07

Video Measurement System VSA

0 MHz to 9 MHz

Compact platform for video signal analysis: measurements of all relevant video parameters in the baseband, graphic and numeric result display, vector and waveform display

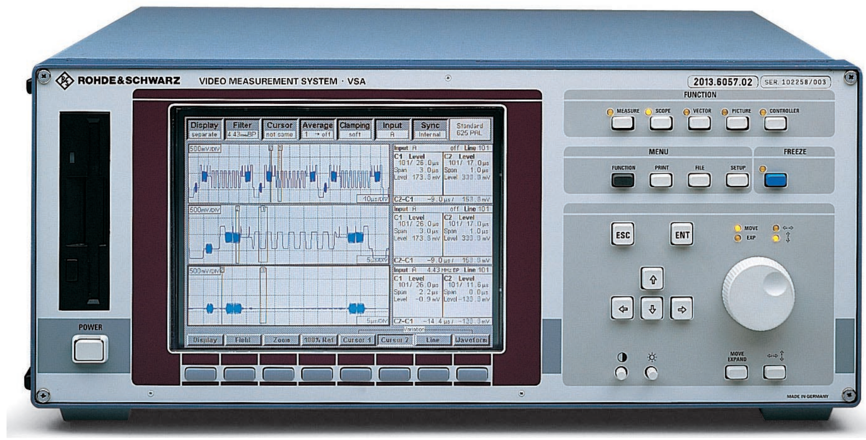


Photo 41802

Brief description

Video Measurement System VSA from Rohde&Schwarz combines the functions of a video analyzer, vectorscope, oscilloscope, monitor and controller (PC) in a 19" desktop.

Fields of applications are

- laboratory and service
- automatic test and monitoring systems
- production and quality assurance

The instrument features convenient operation as well as high measurement accuracy and speed. The compact design makes it also suitable for mobile applications. Thanks to the great number of integrated functions and system interfaces the VSA is an essential tool for measurements and system applications in all fields of video.

In addition to the versatile measurement capabilities provided, the modular software and hardware configuration offers sufficient capacity for future expansions.

Main features

- Four loopthrough video signal inputs with analog 9 MHz bandwidth
- DOS- and Windows-compatible PC with IEC/IEEE-bus controller
- Multitasking operating system
- Connectors for external keyboard and colour monitor
- Monochrome graphic LCD display with 640 x 480 pixels or colour LCD
- Two serial interfaces
- SCPI remote control via IEC/IEEE or serial interface
- Printer interface
- 3.5" floppy disk drive (DOS format) for result transfer and software options
- Hard disk
- Modular design with hardware and software options

Five instruments in one

Video and FFT analyzer

- Simultaneous computation of up to **150 different signal parameters**
- Automatic limit monitoring
- Automatic overall measurement of all parameters
- Individual measurements using extended test capabilities
- Test-signal and test-location display
- Standard or reference measurement for each parameter separately

3-channel oscilloscope

- Simultaneous display of up to three video signals in separate displays
- Separate test input for each part display (eg components, RGB, YC_BC_R)
- Simultaneous display of the same signal with different time scales in up to three separate windows
- Displayed signal section variable in the x and y direction from approx. 200 ns to 20 ms
- Digital filters for simulating signal manipulations, eg all CCIR filters for insertion signal measurements
- Scale automatically matched to the display
- Two cursors for each window: LEVEL, PEAK, SLOPE and PULSE functions allow analysis of complete signal elements

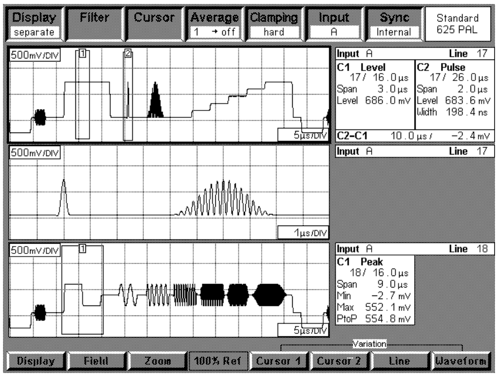


Fig. 1: With a single sin x/x measurement the result display is divided, one part showing the amplitude frequency response and the other the group delay. An info and a cursor window are assigned to each spectrum.

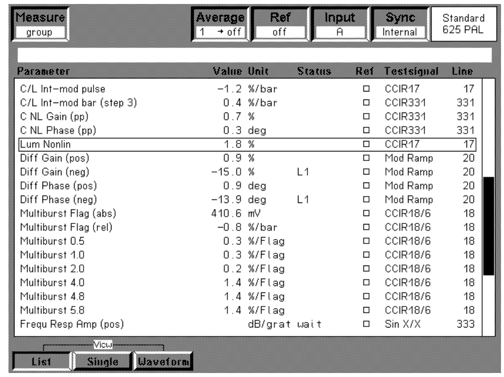


Fig. 2: In the list mode, selected video parameters and their measured values are displayed in the form of a list.

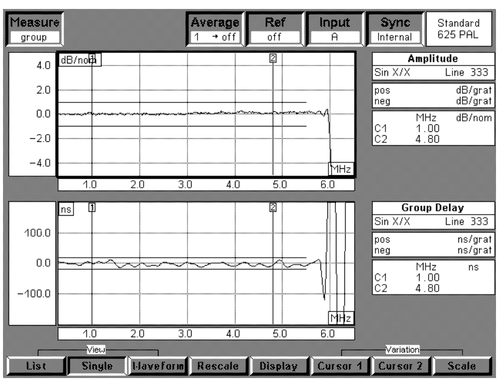


Fig. 3: In the SCOPE mode the screen is divided in a signal, an info and a cursor window. The waveform of one video signal can be displayed simultaneously in up to three windows with continuously variable time and amplitude scaling.

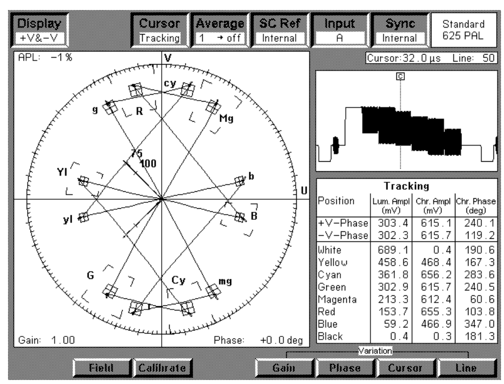
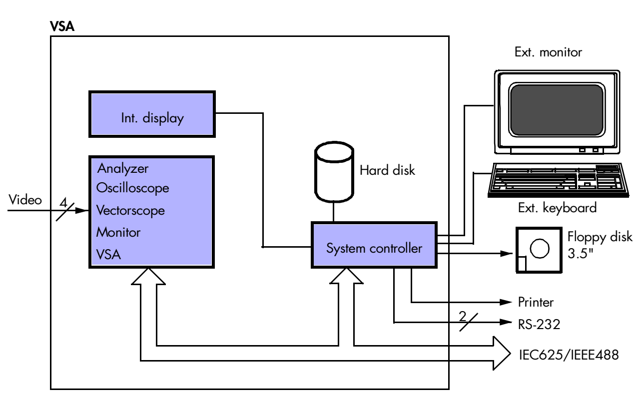


Fig. 4: In the vectorscope function the magnitude and phase of all colour parameters of a video line are shown in a graphics display; the line is also displayed in the waveform window. A cursor line in the waveform display of the video line marks the measurement time for colour subcarrier amplitude and phase. The cursor corresponds to one or two markers in the vector diagram. When the cursor line is shifted, the markers track the vector curve.

Vectorscope

- Graphic display of all colour parameters of a video line in magnitude and phase
- Accurate measurement of phase difference of two colour signal subcarriers by alternate suppression of colour subcarrier reference
- Permanent waveform display of video line
- Automatic computation and display of all colour subcarrier amplitudes and phases when a standard colour bar signal is applied



Monitor

- Easy identification of selected video signal
- Display of a video signal as monochrome TV picture with eight grey levels
- Simultaneous display of any rollkey-selected video line of the TV picture

System controller

- Comprehensive automatic test system
- Control of external devices via IEC/IEEE bus or serial interface
- Complete PC (DOS + Windows) with integrated IEC/IEEE-bus card
- Computing and measurement functions independent of each other
- Simple switchover between measurement display and DOS display
- VGA colour monitor and external keyboard available as accessories

Specifications in brief

Frequency range	0 to 9 MHz
Standard	B/G, I, D, K PAL
Signal inputs	
Video inputs	75-Ω loopthrough 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	2.5 V ±10%
Line position and duration	adjustable
Interfaces	
Remote control	IEC 625-2/IEEE 448-2, 2x RS-232-C (9-pin)
Printer	parallel interface (Centronics)
External monitor	VGA colour monitor, 640 x 480 pixels
External keyboard	PC AT keyboard
Display	colour or monochrome, max. pixel error 0.017‰

Measurement parameters

Amplitude & delay	Unit	Range	Res.	Max. error
Luminance bar amplitude (abs)	mV	0 to 1400	0.1	±2.0
Luminance bar amplitude (nom)	%	–100 to +100	0.1	±0.3
Sync amplitude (abs)	mV	60 to 600	0.1	±2.0
Sync amplitude (nom)	%	–80 to +100	0.1	±0.5
Sync amplitude (bar)	%	–50 to +50	0.1	±0.5
Burst amplitude (abs)	mV	60 to 600	0.1	±3.0
Burst amplitude (nom)	%	–80 to +100	0.1	±1.0
Burst amplitude (bar)	%	–50 to +50	0.1	±1.0
C/L gain (modulated pulse)	%	–50 to +50	0.1	±1.0
C/L delay (modulated pulse)	ns	–500 to +500	1	±5
C/L gain (modulated bar)	%	–50 to +50	0.1	±1.0
Average picture level (bar)	%	0 to 200	0.1	±3.0
DC level X_1	mV	–2000 to +2000	0.1	±3.0
Residual picture carrier	%	0 to +30	0.1	±0.3
Residual picture black level	%	50 to 90	0.1	±0.3
Linear distortion				
Baseline distortion (bar)	%	–40 to +40	0.1	±0.3
2T pulse amplitude (bar)	%	–50 to +50	0.1	±0.5
2T k factor	%	0 to 10	0.1	±0.5
2T half-amplitude duration	ns	100 to 400	1.0	±3
Tilt	%	–40 to +40	0.1	±0.3
Short/field-time distortion	%	–40 to +40	0.1	±0.3
Non-linear distortion				
C/L intermodulation (modulated pulse)	%	–50 to +50	0.1	±1.0
C/L intermod. (modulated bar), 1/2/3 steps	%	–50 to +50	0.1	±0.3
C NL gain, pos/neg	%	0 to +50/–50	0.1	±0.7
C NL gain, pp	%	0 to 100	0.1	±1.0
C NL phase, pos/neg	deg	0 to +50/–50	0.1	±0.7
C NL phase, pp	deg	0 to 100	0.1	±1.0
Lum NL	%	0 to 50	0.1	±0.5
Lum NL, 1/2/3/4/5 steps	%	50 to 100	0.1	±0.5
Diff. gain, ref (bar)	%	–50 to +50	0.1	±0.3
Diff. gain, pos/neg	%	0 to +50/–50	0.1	±0.3
Diff. gain, pp	%	0 to 100	0.1	±0.5
Diff. gain, 1/2/3/4/5 steps	%	–50 to +50	0.1	±0.3
Diff. phase, pos/neg	deg	0 to +50/–50	0.1	±0.3
Diff. phase, pp	deg	0 to 100	0.1	±0.5
Diff. phase, 1/2/3/4/5 steps	deg	–50 to +50	0.1	±0.3

	Unit	Range	Res.	Max. error
Frequency response				
Multiburst flag (abs)	mV	0 to 1000	0.1	±2.0
Multiburst flag (nom)	%	–100 to +50	0.1	±0.3
Multiburst flag (bar)	%	–100 to +50	0.1	±0.3
Multiburst 0.5/1/2/4/4.8/5.8	%	–100 to +50	0.1	±1.0
Multiburst 0.5/1/2/4/4.8/5.8	dB	–40 to +6	0.01	±0.1
Multiburst (national) flag (abs)	mV	0 to 1000	0.1	±2.0
Multiburst (nat) flag (nom/bar)	%	–100 to +50	0.1	±0.3
Multiburst (nat) flag 0.5/1.5/3.0/4.4	%	–100 to +50	0.1	±1.0
Multiburst (nat) flag 0.5/1.5/3.0/4.4	dB	–40 to +6	0.01	±0.1
Sin x/x amplitude, pos/neg	dB	–100 to +100	0.01	±0.3
Sin x/x group delay, pos/neg	ns	–1000 to +1000	1.0	±20
Spectrum, pos/neg	dB	–100 to +100	0.01	±0.3
Noise measurements				
Lum noise, unw (abs)	mV	0 to 50	0.1	±1.0
Lum noise, unw (nom/bar)	dB	25 to 75	0.1	±1.0
Lum noise, lumw (abs)	mV	0 to 50	0.1	±1.0
Lum noise, lumw (nom/bar)	dB	25 to 80	0.1	±1.0
Lum noise, chrw (abs)	mV	0 to 50	0.1	±1.0
Lum noise, chrw (nom/bar)	dB	25 to 80	0.1	±1.0
Hum (abs.)	mV	0 to 700	1	±5
Hum (nom/bar)	dB	0 to 55	0.1	±1.0
C/SND intermodulation (abs)	mV	0 to 50	0.1	±1.0
C/SND intermod. (nom/bar)	dB	30 to 70	0.1	±1.0
SND/SND intermod. (abs)	mV	0 to 50	0.1	±1.0
SND/SND intermod. (nom/bar)	dB	30 to 70	0.1	±1.0
Chroma noise AM	dB	0 to –80	0.1	±1.0
Chroma noise PM	dB	–25 to –70	0.1	±1.0
Timing measurements				
Field period, first/sec. field	µs	20 000 ±30	0.001	±0.005
Equalizing pulse duration	µs	1.35 to 3.35	0.001	±0.005
Serration pulse duration	µs	2.70 to 6.70	0.001	±0.005
Line period	µs	60 to 68	0.001	±0.005
Line blanking (nom/bar)	µs	7 to 65	0.001	±0.05
Sync duration	µs	2.7 to 6.7	0.001	±0.005
Sync slope, neg/pos	µs	70 to 1000	1	±5
Burst position	µs	4.7 to 6.0	0.001	±0.01
Burst duration	µs	1.5 to 3.0	0.001	±0.01
SC/H, line/average	deg	–90 to +90	1	±4
SC/H, pos p/neg p/pp	deg	–90 to +90	1	±4
PAL phase, line/average	deg	0 to 180	1	±4
PAL phase, pos p/neg p/pp	deg	0 to 180	1	±4
SC frequency	Hz	4433 618 ±100	0.05	±1
Jitter measurements				
Field jitter, pos p/neg p/pp	µs	0 to 30	0.001	±0.005
Field jitter, std. deviation	µs	0 to 30	0.001	±0.005
Line jitter, pos p/neg p/pp	ns	0 to 4000	1	±5
Line jitter, std. deviation	ns	0 to 4000	1	±5
Teletext measurements				
Basic amplitude (abs)	mV	0 to 1400	1	±10
Basic amplitude (nom/bar)	%	–100 to +100	0.1	±2.0
Decoding/timing margin	%	0 to 100	0.1	±2.0
Run-in bits	–	6 to 24	–	–
Data timing	µs	10 to 14	0.001	±0.01

General data

Rated temperature range	0 to +50°C
Power supply	100/230 V –10/+15% 120/240 V –15/+10%, 47 to 63 Hz (310 VA)
Dimensions (W x H x D); weight	435 mm x 192 mm x 460 mm; 17.7 kg

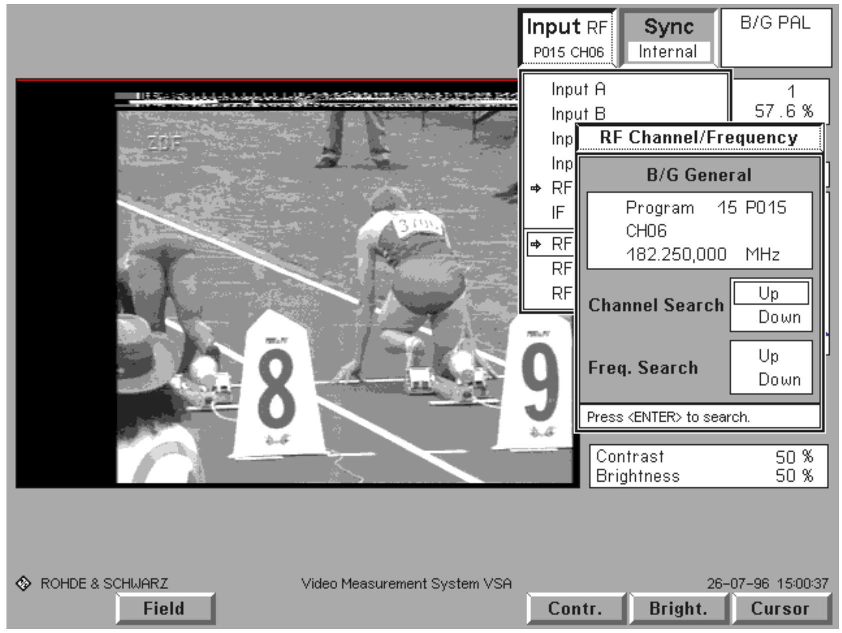
Ordering information

Video Measurement System		
with monochrome display	VSA	2013.6057.02
with colour display	VSA	2013.6057.03
Option		
Calibration Data Documentation	VSA-DCV	2082.0490.08

TV Test Receiver Option VSA-B10

47 MHz to 862 MHz

RF parameter measurement and monitoring with Video Measurement System VSA



VSA screen with channel setting of Test Receiver Option VSA-B10

Brief description

TV Test Receiver Option VSA-B10 enhances the **Video Measurement System VSA** (page 142) for the reception and analysis of RF and IF TV signals. The system allows all important RF and VF quality parameters to be analyzed **in a single unit**. VSA-B10 can easily be retrofitted – even on site – without calibration and level adjustment and with no problems regarding interfaces or cabling.

VSA with Option VSA-B10 provides the following functions:

- TV test receiver for standards B/G, I, D/K, K1
- Video and FFT analyzer
- 3-channel oscilloscope
- Vectorscope
- Monitor
- System controller

Features of VSA with Option VSA-B10

- RF/video analysis in a single unit
- Measurement of all relevant RF and VF quality parameters
- High-speed analysis
- No external cabling
- Easy to transport
- Little space required
- Uniform user interface for all measurement functions
- RF test parameters displayed in parameter list of VSA
- Display of test receiver configuration on VSA screen

VSA-B10 allows measurement of the following additional parameters:

- Incidental carrier phase modulation (ICPM) of vision carrier
- Vision and sound carrier level and frequency
- Modulation depth of vision carrier (residual carrier) and sound carrier (FM deviation)
- Pilot deviation and frequency
- Pilot decoding

Features of TV test receiver

- Models with 50 Ω or 75 Ω input
- IF input and IF output
- Video and audio outputs
- Dynamic range 40 to 120 dBμV
- Low-noise and low-distortion mode
- Low-noise preamplifier can be switched on to improve noise figure of receiver
- Video S/N ratio (weighted at 66 dBμV) >56 dB
- Intercarrier S/N ratio (weighted) >46 dB
- Program, channel and frequency entry
- Channel and frequency search
- Synthesizer with low phase noise and high frequency resolution (1 Hz)
- Digital frequency control
- Manual and automatic gain control
- Integrated zero clamping for defining vision modulation depth
- Selectable synchronous detector mode with sampled or continuous phase control as well as selectable time constants
- Sound demodulation and decoding according to IRT dual-sound carrier method
- Linear distortion of video frequency response <0.5 dB (luminance/chrominance error <±20 ns)
- Video group-delay correction of receiver and sound deemphasis can be switched off
- Sound monitoring via loudspeaker of basic unit
- Very easy installation in VSA

Specifications in brief of VSA-B10

Specifications of Video Measurement System VSA see page 142.

Inputs and outputs

RF input	rear panel, N connector
Frequency range	47 to 862 MHz
Level range	0.1 to 1000 mV (40 to 120 dBμV) [1])
Level range with 10 dB preamplifier	0.03 to 1 mV (30 to 60 dBμV) [1])
Impedance	50 Ω or 75 Ω (depending on model)
Return loss (attenuation ≥10 dB)	>14 dB (VSWR <1.5)
IF input	rear panel, BNC connector
Frequency (vision carrier)	38.9 MHz (for all standards)
Level range	20 to 200 mV (86 to 106 dBμV) [1])
Impedance	50 Ω
Return loss	>20 dB (VSWR <1.2)
IF output	rear panel, BNC connector
Frequency (vision carrier)	38.9 MHz
Level	100 mV, controlled (100 dBμV) [1])
Impedance	50 Ω
Return loss	>20 dB (VSWR <1.2)
Video output	rear panel, BNC connector
Level	1 V pp CVS with video modulation to standard
Impedance	75 Ω
Return loss	>26 dB (VSWR <1.1)
Audio outputs	2 x BNC connector on rear panel, unbalanced
Level for ±30 kHz deviation and f_{mod}=500 Hz	+ 6 dBm ±0.2 dB into 600 Ω
Impedance	<25 Ω
Signals	mono, right and left (stereo), mono 1 and mono 2 (dual sound)

RF/IF characteristics

Frequency resolution	1 Hz
Frequency accuracy	<±2x10^{-6} x receive frequency
Image-frequency rejection	
VHF	>70 dB
UHF	>50 dB
Adjacent-channel suppression	>48 dB

Video parameters

Synchronous demodulation		
Phase control	continuous or sampled (switch-selectable)	
Time constants for		
continuous phase control	fast, normal, slow	
sampled phase control	normal, slow	
Switching carrier phase error	<1°, typ. <0.5°	
Quadrature signal	for measuring the incidental carrier phase modulation (ICPM)	
S/N ratio		
weighted to CCIR Rec. 567, V_{RF}=3 mV (70 dBμV) [1]); attenuation 0 dB	>56 dB	
Linear distortion		
Amplitude response		
Standard B/G, 0 to 4.5 MHz	±0.5 dB	
D/K, 0 to 5.5 MHz	±0.5 dB	
I, 0 to 5 MHz	±0.5 dB	
Group-delay response	group-delay correction	
0 to 4.43 MHz	off	on
via IF input	<±10 ns	<±15 ns
via RF input	<±15 ns	<±20 ns
Additional ripple due to SAW filter	<±20 ns	
Group-delay correction	flat plus one standard-specific curve	
2T k factor	<1%	
15 kHz tilt	<1%	
Nonlinear distortion		
Luminance nonlinearity	<3%	
Differential gain	<3%	
Differential phase	<2°	
Intermodulation in low-distortion mode (vision carrier: –8/sound carrier:–10/SB: –16 dB)	<72 dB	

Audio parameters

Stereo/dual-sound mode	A2 (IRT)
Frequency response, 40 Hz to 15 kHz	<0.5 dB
Deemphasis	50 μs and off
Distortion for ±50 kHz deviation	<0.5% [2])
Stereo crosstalk	>40 dB
Channel crosstalk with spurious FM	
±30 kHz	>80 dB
±55 kHz	>70 dB
Intercarrier S/N ratio (weighted to CCIR 468-3)	
All-black picture	>55 dB
FuBK test pattern	>48 dB
Sinewave modulation (10 to 75%)	
0 to 5 MHz	>46 dB
242 ±15 kHz	>42 dB
Split-carrier S/N ratio, measured at IF output (weighted to CCIR 468-3)	>56 dB

Test parameters

	Resolution	Deviation
Vision carrier power/level in dBμV, dBm, dBpW	0.1 dB	±3 dB
Vision carrier offset frequency	100 Hz	±2x10^{-6} x receive frequency
Residual carrier	0.1%	±1%
Vision/sound carrier level ratio	0.1 dB	±2 dB
Vision/sound carrier freq. spacing	0.1 kHz	±0.2 kHz [3])
FM deviation of sound carrier	0.1 kHz	±5x10^{-2}x $\Delta f_{carrier}$ ±500 Hz
Pilot deviation	10 Hz	±200 Hz
Pilot carrier frequency	1 Hz	±10 Hz
Incidental carrier phase modulation	0.1°	±1°

Ordering information

TV Test Receiver Option			
Standard B/G Europe, dual sound, IF 38.9 MHz + 33.4/33.158 MHz	50 Ω 75 Ω	VSA-B10 VSA-B10	2014.0000.02 2014.0000.03
Standard B/G Europe, mono sound, IF 38.9 MHz + 33.4 MHz	50 Ω 75 Ω	VSA-B10 VSA-B10	2014.0000.06 2014.0000.07
Standard B/G Australia, dual sound, IF 38.9 MHz + 33.4/33.158 MHz	50 Ω 75 Ω	VSA-B10 VSA-B10	2014.0000.10 2014.0000.11
Standard D/K CCIR, dual sound, IF 38.9 MHz + 32.4/32.642 MHz	50 Ω 75 Ω	VSA-B10 VSA-B10	2014.0000.40 2014.0000.41
Standard D/K CCIR, dual sound, IF 38.9 MHz + 32.4/32.158 MHz	50 Ω 75 Ω	VSA-B10 VSA-B10	2014.0000.42 2014.0000.43
Standard D/K NICAM, IF 32.4 MHz	50 Ω	VSA-B10	2014.0000.44
Standard I UK, mono sound, IF 38.9 MHz + 32.9 MHz	50 Ω 75 Ω	VSA-B10 VSA-B10	2014.0000.70 2014.0000.71
Standard I SABC, mono sound, IF 38.9 MHz + 32.9 MHz	50 Ω 75 Ω	VSA-B10 VSA-B10	2014.0000.72 2014.0000.73

Other standards on request.

Option		
Calibration Data Documentation	VSA-DCV	2082.0490.10

Noise Generator SUF2

20 Hz to 50 MHz

White, pink, triangular and program substitution noise

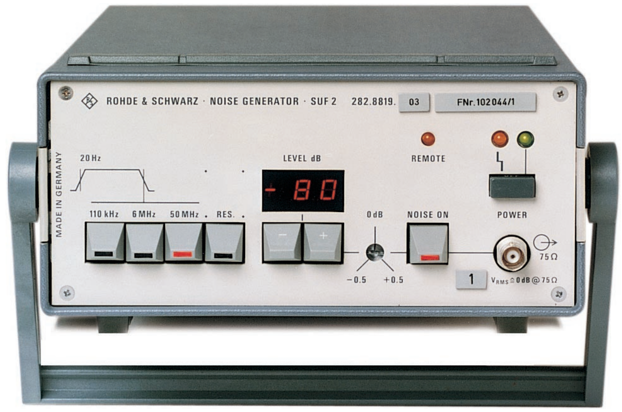


Photo 28461-1

Brief description

The basic model of Noise Generator SUF 2 delivers a noise spectrum with a constant mean energy which is uniformly distributed over all frequencies (white noise). A variety of options permits the SUF 2 to be easily adapted for virtually all applications in audio and video noise-voltage and distortion measurements (including digital systems); it can be remote-controlled for use in automatic test systems.

Fields of application

- Video engineering: measurement of interference effects on all the components of transmission systems
- Radio engineering: measurement of nonlinear crosstalk and intermodulation using noise to substitute a sound program signal
- Architectural acoustics: measurements using noise (similar to speech/music) are advantageous over fixed-frequency test methods
- Frequency response measurement: pink noise permits fast and reproducible measurements
- Control engineering: simulation of noise sources in system control and general control circuits
- Research: analysis of stochastic processes

Basic configuration

- White noise: 20 Hz to 110 kHz/6 MHz/50 MHz

Optional weighting filters

- Pink noise: 20 Hz to 16 kHz, spectral components decreasing by 3 dB/octave
- Triangular noise: 20 Hz to 6 MHz
- Weighting filter to CCIR Rec. 559 for "modern dance music" substitution signal
- Weighting filter to CCIR Rec. 571 (for "conventional program" substitution signal)

Specifications in brief

Noise spectrum	20 Hz to 50 MHz
Noise level (max., link-selected)	1 V rms into 75 Ω, BNC (standard) 0.775 V rms into 75 Ω (audio) 0.7 V rms into 75 Ω (video)
Level setting	1 dB steps (±0.5 dB fine adjustment) 0 to –80 dB (20 Hz to 50 MHz) 0 to –100 dB (other ranges)
Frequency response, level error	<1 dB
Remote control (standard)	parallel TTL, BCD code
IEC-625 bus interface option	functions AH1, L1, RL1
CCIR Rec. 571 Program option	
Mode	periodic, programmable
Level values	two levels and noise off plus type of filter link-selectable

General data

Power supply	115/125/220/235 V +10/–15%, 47 to 63 Hz, 20 VA
Dimensions (W x H x D); weight	210 mm x 110 mm x 347 mm; 4 kg

Ordering information

Noise Generator	SUF 2	0282.8819.03
Options		
IEC-625 Bus Interface	SUF 2-Z1	0282.9915.00
Triangular Noise Filter	SUF 2-Z2	0282.9715.00
Pink Noise Filter	SUF 2-Z3	0282.9815.00
CCIR Rec. 559 Filter	SUF 2-Z4	0282.9615.00
CCIR Rec. 571 Filter	SUF 2-Z5	0282.9644.00
CCIR Rec. 571 Program	SUF2-Z6	0282.9673.00
CCIR Rec. G227 Filter	SUF2-Z7	0282.8860.00
ISDN Filter	SUF2-Z8	0218.3526.02

Video Analyzer VTA71

25 Hz to 10 MHz

General-purpose video analyzer with oscilloscope and vectorscope function (PAL)

Photo 41081

Brief description

Video Analyzer VTA71 sets new standards for the combination of video analyzer, oscilloscope and vectorscope that comes in one compact cabinet $^{1}/_{2}$19" wide and 3 units high. It is ideal for all TV applications:

- Monitoring of multiple video signals
- Ideal for studios – eg setting up of TV cameras, measurement and broadcasting vehicles, monitoring of broadband communications equipment, research and development labs, TV set and video recorder production, service centers
- VTA 71 is an ideal complement to the Rohde & Schwarz Video Analyzer UAF

A variety of inputs and a large choice of measurement functions provide high monitoring flexibility for

– differential phase
– differential gain
– lowpass and chroma filters

The innovative combination of analog and digital signal processing provides the fidelity of analog resolution with the unequalled accuracy of digital measurements.

Main features

- Four CCVS loopthrough inputs
- Analog signal display as waveform parade, nine signals simultaneously, overlays
- SC/H phase display (patent)
- Digital line selector
- On-screen digital readouts
- Four cursors
- Two operating levels
- Great ease of operation
- 3D display (patent)
- Storage of 20 instrument settings
- Remote control: RS-232-C/RS-422

Specifications in brief

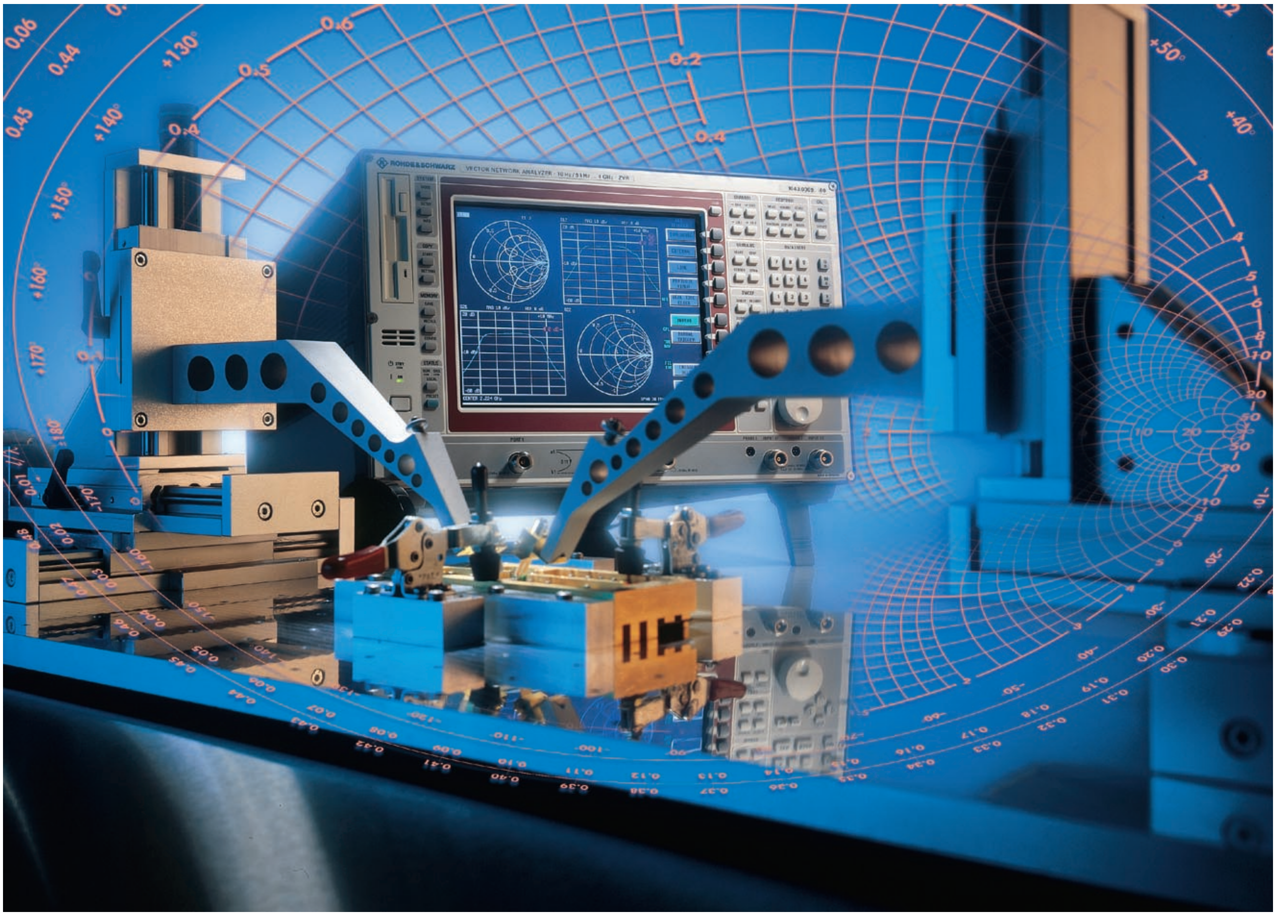
Vertical deflection	
Frequency response	
25 Hz to 10 MHz	±0.1 dB referred to 50 kHz
14 MHz	±1 dB
Lowpass filter (luminance)	<1% FLAT
Attenuation at f_{SC}	40 dB
Line selector bandwidth	9 MHz (–3 dB)
Level variation at 4.43 MHz	max. 1% between FLAT and chroma
Transient response	<1° in FLAT mode and using sin² pulse-and-bar signal
Pulse-to-bar-ratio	0.99:1 to 1.01:1
Tilt with field rate squarewave or window signal or 25 µs pulse signal	≤1%
Max. absolute input level	±3.5 V (DC + AC peak)
Input impedance	100 kΩ ll <10 pF (unterminated)
Return loss (75 Ω)	>40 dB, DC to 6 MHz
Variable gain range	–6 to +14 dB
Horizontal deflection	
Vertical sweep magnification	x1, x5, x10, x50
Horizontal sweep magnification	x1, x5, x10, x50
Line select	3 independent, each capable of displaying: any line of any single field, or all odd or even fields, or all fields
DC restoration	back porch
Video output (monitoring output)	
Frequency response	±3 dB, DC to 10 MHz
Differential gain	2% at 50% APL with 1 V display
Differential phase	3° at 50% APL with 1 V display
Amplitude	1 V ±10% for 1 V input
Return loss	>40 dB, DC to 5 MHz
Synchronization	
Internal reference	composite video or black burst with sync and burst amplitudes of 286 mV ±6 dB
Vector mode	composite video or black burst with sync and burst amplitudes of 286 mV ±6 dB
Input impedance	100 kΩ ll <10 pF (unterminated)
Vector mode	
Chrominance bandwidth (3 dB), lower/upper limit frequency	3.88 MHz/4.98 MHz ±150 kHz
Phase control range	infinite
Vector tolerance	≤1°
Differential gain	≤1%
Differential phase	≤1°
Variable gain range	–6 to +14 dB
Gain instability (0 to 50°C)	<2% (for ±5% variation of nominal AC supply voltage)
Subcarrier regenerator	phase-locked to subcarrier with burst signal as reference
Nominal frequency	4.433619 MHz
Pull-in range	±50 Hz
Measurement accuracy in multiple display mode	
Waveform overlays (x10), relative (referred to 700 mV)	±100 ns, ±1%
Vector overlays, relative (referred to 700 mV)	±1°, ±1%
CRT	8 cm x 10 cm, internally etched graticule with variable scale illumination; scales for waveform and vector display

General data

Power supply	110/120 V (90 to 132 V) or 220/230 V (180 to 264 V); jumper-selectable, 48 to 66 Hz (125 VA)
Rated temperature range	0 to +50°C
Dimensions (W x H x D); weight	216 mm x 134 mm x 451 mm; 8.2 kg

Ordering information

Video Analyzer (PAL)	VTA71	1062.5090.02
Extras		
Portable case with handle and sunshield	VTA-Z1	1062.5390.00
Double adapter with one blank panel for mounting in 19" racks	VTA-Z2	1062.5419.00



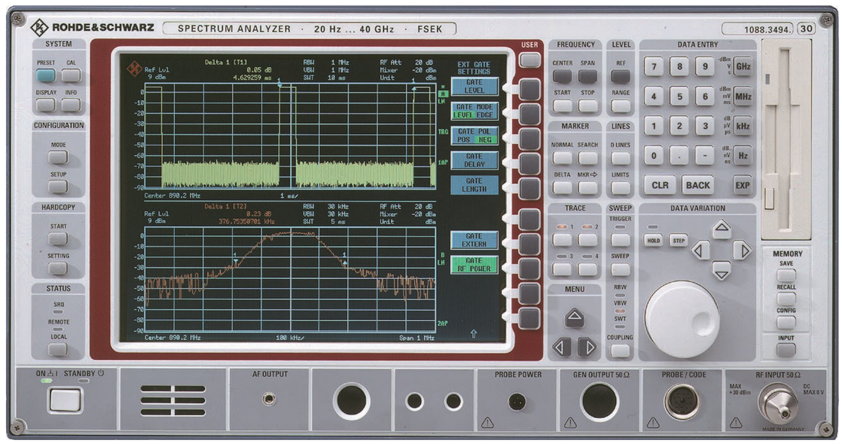
Vector Network Analyzer ZVR (photo 43117)

Contents of Chapter 4

Spectrum Analyzers FSEA, FSEB, FSEM, FSEK

20 Hz to 40 GHz

High-performance analyzers for digital mobile radio and universal applications



FSEK30 (photo 42756)

Brief description

FSEA, FSEB, FSEM and FSEK are advanced, high-speed and high-performance analyzers tailored to the requirements of modern digital communication systems. They can also be used as general-purpose analyzers for many applications. High measurement speed, modular design and excellent technical features make for an excellent price/performance ratio.

In addition to measurement functions for digital communication systems, such as 2 µs sweep time in ZERO SPAN mode, pretrigger and trigger delay, gated sweep and adjacent-channel power measurement, these spectrum analyzers feature a wide dynamic range, a very low measurement uncertainty of 1 dB and a low-noise synthesizer.

FSE analyzers have low inherent noise and a wide dynamic range, so that for instance measurement of GSM power ramps is no problem.

An extremely wide intermodulation-free dynamic range of 110 dB (with 10 Hz resolution bandwidth) ensures reliable measurements on highly linear amplifiers as well as correct analysis of broadband complex signals.

From the available frequency ranges, the basic models 20 and the high-performance models 30 the right instrument can be chosen for every application. Models 20 can easily be upgraded to give the full range of functions of models 30.

To ensure correct measurement of time variants or pulse-modulated signals, the FSE features digital resolution filters (10 Hz to 1 kHz) with a response corresponding to that of analog filters. It additionally provides FFT bandwidths down to 1 Hz (models 30).

Main features

- Resolution bandwidths 1 Hz (up to 10 MHz), adjustable in steps of 1/2/3/5/10
- Displayed noise floor down to –160 dBm (FSEA)
- 3rd-order intercept point >+15 dBm
- 1 dB compression point of RF input >+10 dBm
- Phase noise at 20 kHz from carrier: down to –123 dBc (FSEA)
- Intermodulation-free dynamic range 110 dB
- Measurement uncertainty up to 1 GHz: 1 dB
- Headphones connector and built-in loudspeaker for AM/FM
- Internal RF trigger for GATED SWEEP measurements
- Speed records:
  - Shortest FULL SPAN sweep time is 5 ms (for 3.5 and 7 GHz span) with a fully synchronized sweep – added speed is not at the expense of frequency accuracy but even enhances it
  - Shortest ZERO SPAN sweep time is 1 µs (100 ns/div) – ideal for high-resolution measurements on pulse edges
  - More than 20 sweeps/s – an optimal prerequisite for fast alignments or applications in production

Spectrum Analyzers FSEA, FSEB, FSEM, FSEK

From AF to microwave

FSEM/K21/31 (corresponding to FSEM/K20/30 with option FSE-B21) allow **frequency range extension by means of external mixers**. Continuous automatic signal identification, which is used to suppress unwanted image frequency bands and mixture products, ensures fast and easy measurements. Due to the built-in diplexer, three-port as well as two-port mixers can be used.

The external mixer measurement function features great ease of operation:

- Definition of frequency range and harmonics by selection of a waveguide band
- Definition of all important parameters for each waveguide band separately
- Frequency-dependent consideration of mixer conversion loss
- Storage of parameters on hard disk

Measurement functions

- Up to 8 markers
- Marker functions for the direct measurement of
  – phase noise and phase power density
  – NEXT MIN/PEAK, NEXT MIN/PEAK RIGHT, NEXT MIN/PEAK LEFT
- Frequency counter with selectable resolution
- LOW NOISE, NORMAL and LOW DISTORTION modes to cater for low-intermodulation and low-noise operation
- Plotting or printout in background operation or file saving in standard graphic format
- Simultaneous display of four traces
- Selectable colour setup
- Numerous level and frequency lines
- Split-screen display with independent windows
- Quasi-analog display
- Frequency zoom
- Limit lines
- User-configurable menu and keyboard macros
- Adjacent-channel power measurement for up to 7 channels
- RMS detector

Operation

A combination of hardkeys and softkeys makes for extremely fast and easy operation. The operating convenience based on a wide variety of evaluation routines and marker functions can be accessed via the menus. Complicated tree structures could be avoided by using menus of lateral structure and fixed control keys. Complete setups and traces, limit lines as well as macros can be stored on the hard disk or on floppy disks.

Overview of configurations and options

The analyzers of the FSE family are of modular design throughout. In the table below the right solution tailored to the needs of the various applications can be found. Except for the Colour Display FSE-B1 all options can easily be retrofitted ([1] Cannot be retrofitted, factory-fitted only).
Note: max. two of the options -B4, -B7 can be fitted in FSEM20

Designation, characteristics (hardware)	Type	Order No.	FSEA 20	FSEA 30	FSEB 20	FSEB 30	FSEM 20	FSEM 21	FSEM 30	FSEM 31	FSEK 20	FSEK 21	FSEK 30	FSEK 31
Colour Display	FSE-B1[1)]	1073.4990.02	❍	●	❍	●	❍	❍	●	●	❍	❍	●	●
7 GHz Frequency Extension	FSE-B2	1073.5040.02	❍	❍	●	●	–	–	–	–	–	–	–	–
TV Demodulator Frame frequency and line trigger, trigger delay and gap sweep allow convenient selection and analysis of individual lines	FSE-B3[1)]	1073.5244.02	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍

Spectrum Analyzers FSEA, FSEB, FSEM, FSEK

Designation, characteristics (hardware)	Type	Order No.	FSEA 20	FSEA 30	FSEB 20	FSEB 30	FSEM 20	FSEM 21	FSEM 30	FSEM 31	FSEK 20	FSEK 21	FSEK 30	FSEK 31
Low Phase Noise and OCXO Typ. phase noise only –125 dBc (BW = 1 Hz, at 10 kHz from carrier), ideal for measuring phase noise of oscillators or adjacent-channel power of radio equipment	FSE-B4	1073.5396.02	❍	●	❍	●	❍	❍	●	●	❍	❍	●	●
FFT Filter (1 Hz to 1 kHz)	FSE-B5	1073.5544.02	❍	●	❍	●	❍	❍	●	●	❍	❍	●	●
Vector Signal Analyzer Demodulation of digitally modulated signals	FSE-B7	1066.4317.02	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Tracking Generator (9 kHz to 3.5 GHz)	FSE-B8	1066.4469.02	❍	❍	–	–	–	–	–	–	–	–	–	–
Tracking Generator with I/Q Modulator (9 kHz to 3.5 GHz)	FSE-B9	1066.4617.02	❍	❍	–	–	–	–	–	–	–	–	–	–
Tracking Generator (9 kHz to 7 GHz)	FSE-B10	1066.4769.02	–	–	❍	❍	❍	–	❍	❍	❍	–	❍	❍
Tracking Generator with I/Q Modulator (9 kHz to 7 GHz)	FSE-B11	1066.4917.02	–	–	❍	❍	❍	–	❍	❍	❍	–	❍	❍
Switchable Attenuator for Tracking Generators FSE-B8/9/10/11 (0 to 70 dB)	FSE-B12	1066.5065.02	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Computer Function Additional use of 486 processor for DOS or Windows applications	FSE-B15	1073.5696.02	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Ethernet Interface LAN integration for use in production	FSE-B16	1073.5973.02	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
2nd IEC/IEEE-Bus Interface	FSE-B17	1066.4017.02	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
External Mixer	FSE-B21	1084.7243.02	–	–	–	–	❍	●	❍	●	❍	●	❍	●
Increased Level Accuracy up to 2 GHz	FSE-B22[1)]	1073.5544.02	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍

1) Factory-fitted only

Designation, characteristics (software)	Type	Order No.	FSEA 20	FSEA 30	FSEB 20	FSEB 30	FSEM 20	FSEM 21	FSEM 30	FSEM 31	FSEK 20	FSEK 21	FSEK 30	FSEK 31
Application Firmware for mobile radio transmitter measurements to GSM900 specs 11.20 (mobiles), GSM1800 and GSM1900	FSE-K10	1057.3092.02	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Application firmware for mobile radio transmitter measurements to GSM900 specs 11.20 (BTS), GSM1800 and GSM1900	FSE-K11	1057.3392.02	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Noise Measurement Software Noise figure or noise temperature measurement (Y-factor method) from 100 kHz, 2nd-stage correction, measurements on frequency converters, editor for ENR tables, consideration of isolator/cable attenuation	FSE-K3	1057.2996.02	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍

● Fitted in basic model ❍ Option

Spectrum Analyzers FSEA, FSEB, FSEM, FSEK

Model-dependent specifications in brief

Frequency	FSEA20	FSEA30	FSEB20	FSEB30	FSEM20/21	FSEM30/31	FSEK20/21	FSEK30/31
Frequency range	9 kHz to 3.5 GHz	20 Hz to 3.5 GHz	9 kHz to 7 GHz	20 Hz to 7 GHz	9 kHz to 26.5 GHz	20 Hz to 26.5 GHz	9 kHz to 40 GHz	20 Hz to 40 GHz
Refer. frequency (aging)	1 x 10^{-6}/year	2 x 10^{-7}/year	1 x 10^{-6}/year	2 x 10^{-7}/year	1 x 10^{-6}/year	2 x 10^{-7}/year	1 x 10^{-6}/year	2 x 10^{-7}/year
With option FSE-B4	2 x 10^{-7}/year	—	2 x 10^{-7}/year	—	2 x 10^{-7}/year	—	2 x 10^{-7}/year	—
Spectral purity								
SSB phase noise, referred to 1 Hz bandwidth, f ≤500 MHz								
100 Hz[1)]	—	<–87 dBc	—	<–81 dBc	—	<–81 dBc	—	<–81 dBc
1 kHz[1)]	<–85 dBc	<–107 dBc	<–79 dBc	<–100 dBc	<–79 dBc	<–100 dBc	<–79 dBc	<–100 dBc
10 kHz[1)]	<–96 dBc	<–120 dBc	<–90 dBc	<–114 dBc	<–90 dBc	<–114 dBc	<–90 dBc	<–114 dBc
100 kHz[2)]	<–119 dBc	<–117 dBc	<–113 dBc	<–111 dBc	<–113 dBc	<–111 dBc	<–113 dBc	<–111 dBc
1 MHz[1)]	<–135 dBc	<–135 dBc	<–129 dBc	<–129 dBc	<–129 dBc	<–129 dBc	<–129 dBc	<–129 dBc
Resolution bandwidths								
3 dB bandwidths	10 Hz to 10 MHz	1 Hz to 10 MHz	10 Hz to 10 MHz	1 Hz to 10 MHz	10 Hz to 10 MHz	1 Hz to 10 MHz	10 Hz to 10 MHz	1 Hz to 10 MHz
Steps	1/2/3/5	1/2/3/5/10	1/2/3/5	1/2/3/5/10	1/2/3/5	1/2/3/5	1/2/3/5	1/2/3/5
Shape factor 60 : 3 dB (1 kHz to 2 MHz)	<15	<12	<15	<12	<15	<12	<15	<12
Video bandwidths	1 Hz to 10 MHz	1 Hz to 10 MHz	1 Hz to 10 MHz	1 Hz to 10 MHz	1 Hz to 10 MHz	1 Hz to 10 MHz	1 Hz to 10 MHz	1 Hz to 10 MHz
Steps	1/2/3/5	1/2/3/5	1/2/3/5	1/2/3/5	1/2/3/5	1/2/3/5	1/2/3/5	1/2/3/5

Level

Displayed noise floor, average level in dBm (10 Hz bandwidth, 0 dB RF attenuation, VBW = 1 Hz, no signal at RF input)

	FSEA20	FSEA30	FSEB20	FSEB30	FSEM20/21	FSEM30/31	FSEK20/21	FSEK30/31
20 Hz	—	–80	—	–74	—	<–74	—	<–74
1 kHz	—	–110	—	–104	—	<–104	—	<–104
10 kHz	–90	–125	–84	–119	<–84	<–119	<–84	<–119
100 kHz	–110	–135	–104	–129	<–104	<–129	<–104	<–129
1 MHz	<–125, typ.–130	<–145, typ. –150	<–119, typ. –124	<–142	<–124, typ. –129	<–142, typ. –145	<–124, typ. –129	<–142, typ. –145
10 MHz to 3.5/6 GHz	<–140, typ. –145	<–145, typ. –150	<–142, typ. –147	<–142, typ. –147	<–138, typ. –140	<–138, typ. –140	<–138, typ. –140	<–138, typ. –140
6 GHz to 7 GHz	—	—	<–139	<–139	<–135, typ. –138	<–135, typ. –138	<–135, typ. –138	<–135, typ. –138
7 GHzto 18 GHz	—	—	—	—	<–138, typ. –140	<–138, typ. –140	<–138, typ. –140	<–138, typ. –140
18 GHz to 26.5 GHz	—	—	—	—	<–135, typ. –138	<–135, typ. –138	<–135, typ. –138	<–135, typ. –138
26.5 GHz to 30 GHz	—	—	—	—	—	—	<–120, typ. –125	<–120, typ. –125
30 GHz to 40 GHz	—	—	—	—	—	—	<–116, typ. –122	<–116, typ. –122
Max. dynamic range	10 Hz bandwidth	1 Hz bandwidth	10 Hz bandwidth	1 Hz bandwidth	10 Hz bandwidth	1 Hz bandwidth	10 Hz bandwidth	1 Hz bandwidth
Displayed noise floor at 1 dB compression	155 dB	165 dB	152 dB	162 dB	150 dB	160 dB	150 dB	160 dB
Max. intermodulation-free range								
50 MHz to 3.5/7 GHz	105 dB	115 dB	—	—	—	—	—	—
100 MHz to 26.5 GHz	—	—	105 dB	115 dB	103 dB	112 dB	103 dB	112 dB

1) Valid at ≤10 kHz for average control loop bandwidth; automatic setting of this bandwidth at span ≤50 kHz and resolution filter <1 kHz; other bandwidths can be switched manually to "medium". Value at 10 kHz valid for span/sweep time <0.4 MHz/ms with FSEB/M/K20/21.

2) Valid for span >100 kHz.

Spectrum Analyzers FSEA, FSEB, FSEM, FSEK

Common specifications in brief

Frequency	
Frequency display	with marker
Resolution	0.1 Hz to 10 kHz (depending on span)
Frequency counter	measures the marker frequency
Resolution	0.1 Hz to 10 kHz (selectable)
Display range of frequency axis	0 Hz, 10 Hz to full span
Sweep time	
Display range	0 Hz 1 µs to 1000 s ≥10 Hz 5 ms to 1000 s
Picture refresh rate	>20 updates/s with 1 trace >15 updates/s with 2 traces
Sampling rate	50 ns (20 MHz A/D converter)
Sweep trigger	free run, single, line, video, gated, delayed, external
Zero span	additionally pretrigger, posttrigger, trigger delay

Level	
Display range	noise floor displayed to 30 dBm
Max. input level	
RF attenuation 0 dB/≥10 dB	
DC voltage	0 V
CW RF power	20 dBm (= 0.1 W)/30 dBm (= 1 W)
Pulse spectral density	97 dB (µV/MHz)
Max. pulse energy (10 µs)	1 mWs/FSEM: 0.5 mWs (RF attenuation ≥10 dB)
Max. pulse voltage	150 V (RF attenuation ≥10 dB)
1 dB compression of input mixer (0 dB RF attenuation)	+10 dBm
Max. harmonics suppression	90 dB (f >50 MHz)
3rd-order intercept point	
IP3, Δf >5 × resolution bandwidth or >10 kHz, f >50MHz	>12 dBm (typ. 15 dBm)
Intercept point k2	30 dBm for f <50 MHz >45 (typ. >50) dBm for f >50 MHz
FSEM	>25 dBm for f <150 MHz >40 dBm for f >150 MHz
Level display	
Screen	10 × 10 subdivisions
Trace	500 × 400 pixels (one diagram)
Log level axis	10 to 200 dB in 10 dB steps
FSEM	0 to 200 dB in 10 dB steps
Linear level axis	10% of reference level per level division, 10 divisions
Setting range of reference level	
Log level display	–130 to +30 dBm in 0.1 dB steps
FSEM	–120 to +30 dBm in 0.1 dB steps
Linear level display	7 nV to 7.07 V in 1% steps
FSEM	70 nV to 7.07 V in 1% steps
Units of level axis	dBm, dBµV, dBµA, dBpW (log level display); mV, µV, mA, µA, pW, nW (linear level display)
Measurement accuracy (0 to –50 dB)	1 dB (f <1 GHz), 1.5 dB (f >1 GHz)
FSEM	2 dB (f <18 GHz), 2.5 dB (f >26.5 GHz)
Pulse amplitude accuracy (single pulses)	
Bandwidth <1 MHz	0.5 dB
>1 MHz	2 dB

Trigger function	
Trigger	free run, line, video, RF, external
Delayed sweep	
Trigger source	free run, line, external, video
Delay time	100 ns to 10 s, 1 µs
Delayed sweep time	2 µs to 1000 s
Gated sweep	
Trigger source	external
Gate position	1 µs to 100 s
Gate length	1 µs to 100 s, resolution 1 µs

Demodulation	
Modulation modes	AM and FM
Audio output	loudspeaker and headphones output
Marker stop time	100 ms to 60 s
Squelch	adjustable by means of level line

External Mixer FSE-B21 (standard in models 21/31)	
LO output/IF input (front panel)	SMA female, 50 Ω
LO signal	7.5 GHz to 15.2 GHz
Amplitude	+15.5 dBm ±3 dB
IF signal	741.4 MHz
Max. reference level	–20 dBm
IF input (front panel)	SMA female, 50 Ω
Frequency	741.4 MHz
Max. reference level	–20 dBm

Inputs and outputs (front panel)	
RF input	N female, 50 Ω
VSWR (RF attenuation >0 dB), f <3.5 GHz	<1.5
Attenuator	0 to 70 dB, selectable in 10 dB steps
Probe power	+15 V/–12.6 V (DC) and ground, ≥150 mA
Power supply and coding connector for antennas etc (antenna code)	12-contact Tuchel connector
Supply voltages	±10 V, max. 100 mA, ground
AF output	jack, adjustable up to 1.5 V (Z_{in} = 10 Ω)

Inputs and outputs (rear panel)	
IF 21.4 MHz	BNC female 50 Ω, bandwidth >1 kHz or resolution bandwidth
Level	0 dBm at reference level, mixer level >–60 dBm
Video output	BNC female 50 Ω, 0 to 1 V (open-circuit voltage)
Reference frequency	
Output, usable as input	BNC female 10 MHz, 7 dBm
Input	1/.../16 MHz, >0 dBm into 50 Ω
Sweep output	BNC female, 0 to 10 V, proportional to displayed frequency
Noise source connector	BNC female, 0/28 V, switch-selected
Ext. trigger/gate input	BNC, TTL signal –5/+5 V
FSEM	BNC, >10 kΩ, –5 to +5 V selectable
IEC/IEEE-bus control	interface to IEC625-2 (IEEE488.2), Command set SCPI 1994.0
Serial interface	RS-232 interface (COM1 and COM2), 9-contact female connectors
Mouse interface	PS/2-compatible
Plotter	via IEC/IEEE bus or RS-232-C, HP-GL
Printer interface	parallel (Centronics) or serial (RS-232-C)
Keyboard connector	5-contact female for MF2 keyboard
User interface	25-contact Cannon female
Connector for external monitor (VGA)	15-contact female

General data	
Display (640 × 480)	
Models 20	24 cm LCD (9.5")
30	24 cm colour LCD (9.5")
Mass memory	3½", 1.44 MByte; hard disk
Power supply, AC	100/120/230/240 V ±10%, 47 to 440 Hz (170 to 230 VA)
Power consumption	170 to 230 VA (depending on model)
Dimensions (W × H × D; 5 HU))	427 mm × 236 mm × 460 mm
FSEM20	435 mm × 236 mm × 460 mm
FSEM30	435 mm × 236 mm × 570 mm
Weight	21.5 to 29 kg (depending on model)

Spectrum Analyzers FSEA, FSEB, FSEM, FSEK

Ordering information

Spectrum Analyzer	FSEA20	1065.6000.20
	FSEA30	1065.6000.30
	FSEB20	1066.3010.20
	FSEB30	1066.3010.30
	FSEM20	1080.1505.20
	FSEM21	1080.1505.21
	FSEM30	1079.8500.30
	FSEM31	1079.8500.31
	FSEK20	1088.1491.20
	FSEK21	1088.1491.21
	FSEK30	1088.3494.30
	FSEK31	1088.3494.31

Options

7 GHz Frequency Extension for FSEA	FSE-B2	1073.5044.02
TV Demodulator	FSE-B3	1073.5244.02
Low Phase Noise and OCXO (for models 20)	FSE-B4	1073.5396.02
FFT Filter 1 Hz to 1 kHz (for models .20)	FSE-B5	1073.5544.02
Vector Signal Analyzer	FSE-B7	1066.4317.02
Tracking Generator 3.5 GHz	FSE-B8	1066.4469.02
Tracking Generator 3.5 GHz with I/Q Modulator	FSE-B9	1066.4617.02
Tracking Generator 7 GHz	FSE-B10	1066.4769.02
Tracking Generator 7 GHz with I/Q Modulator	FSE-B11	1066.4917.02
Switchable Attenuator for Tracking Generator	FSE-B12	1066.5065.02
Controller for FSE (mouse and keyboard included) German	FSE-B15	1073.5696.02
English	FSE-B15	1073.5696.03
Ethernet Interface 15-contact AUI connector	FSE-B16 [1]	1073.5973.02
Thin-wire BNC connector	FSE-B16 [1]	1073.5973.03
2nd IEC/IEEE-Bus Interface for FSE	FSE-B17 [1]	1066.4017.02
Removable Hard Disk	FSE-B18 [2]	1088.6993.02
Second Hard Disk for FSE-B18 (firmware included)	FSE-B19	1088.7248.02
External Mixer	FSE-B21 [2]	1084.7243.02
Increased Level Accuracy up to 2 GHz	FSE-B22 [2]	1106.3480.02
Broadband Output 741.4 MHz	FSE-B23 [2]	1088.7348.02

Software

Noise Measurement Software, Windows	FSE-K3	1057.2996.02
Phase Noise Measurement Software, Windows	FSE-K4	1108.0088.02
GSM Application Firmware, Mobile	FSE-K10	1057.3092.02
GSM Application Firmware, BTS	FSE-K11	1057.3392.02

Recommended extras

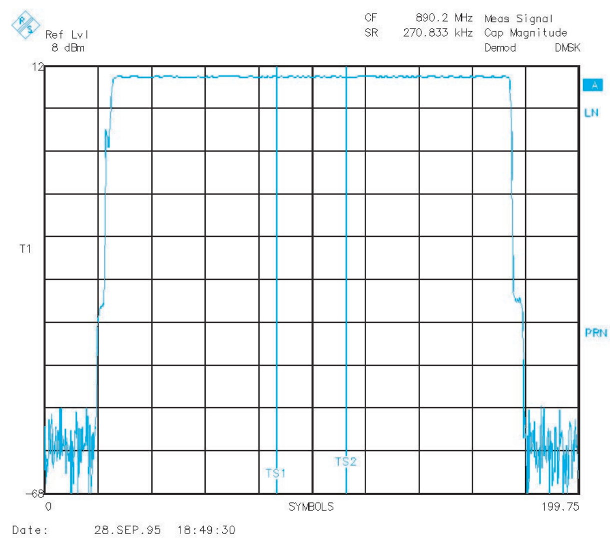
Service Kit	FSE-Z1	1066.3862.02
DC Block, 5 to 7000 MHz (Type N)	FSE-Z3	4010.3895.00
DC Block, 10 kHz to 18 GHz, Type N	FSE-Z4	1084.7443.02
Microwave Measurement Cable and Adapter Set for FSEM	FS-Z15	1046.2002.02
Service Manual	–	1065.6016.24
Headphones	–	0708.9010.00
German Keyboard	PSA-Z2	1007.3001.31
American Keyboard	PSA-Z2	1007.3001.02
PS/2 Mouse	FSE-Z2	1084.7043.02
Colour Monitor, 15", 230 V	PMC3	1082.6004.02
Printer, 24-pin printer head	PDN	0351.4512.04
IEC/IEEE-Bus Cable, 1 m	PCK	0292.2013.10
IEC/IEEE-Bus Cable, 2 m	PCK	0292.2013.20
19" Rack Adapter with front handles	ZZA-95	0396.4911.00
without front handles	ZZA-951	0396.9488.00
Set of Front Handles	ZZG-95	0396.5176.00
Transit Case	ZZK-954	1013.9395.00
Transit Case (FSEM 30 and FSEK 30 only)	ZZK-955	1013.9408.00
Trolley	ZZK-1	1014.0510.00
Matching Pads, 75 Ω L section	RAM	0358.5414.02
Series resistor, 25 Ω	RAZ	0358.5714.02
Accessories for current, voltage and field-strength measurement	see accessories for Test Receiver ESS, data sheet PD 756.9768	
SWR Bridge, 5 MHz to 3000 MHz	ZRB2	0373.9017.52
SWR Bridge, 40 kHz to 4 GHz	ZRC	1039.9492.52
High-Power Attenuators, 100 W, 3/6/10/20/30 dB	RBU 100	1073.8820.xx (xx=03/06/10/20/30)
High-Power Attenuators, 50 W 3/6/10/20/30 dB	RBU 50	1073.8895.xx (xx=03/06/10/20/30)
Preamplifier, 9 kHz to 30 MHz	ESH3-Z3	0827.8016.52
Preamplifier, 20 MHz to 1000 MHz	ESV-Z3	0397.7014.52
For FSEM only: Test-Port Adapter, N (male)	–	1021.0541.00
3.5 mm (male)	–	1021.0529.00
For FSEK only: Test-Port Adapter, N (male)	–	1036.4783.00
K (male)	–	1036.4802.00

[1] Options FSE-B16 and FSE-B17 require option FSE-B15.

[2] Cannot be retrofitted, factory-fitted only.

Vector Signal Analyzer Option FSE-B7 for Spectrum Analyzers FSE

Universal demodulation, analysis and documentation of digital and analog mobile radio signals



Measurement of GSM power ramps to standard with high-precision time reference through synchronization to midamble

Brief description

The vector signal analyzer option upgrades the high-quality Spectrum Analyzers FSE, adding universal demodulation and analysis capability down to bit stream level for digital mobile radio signals. The option supports all common mobile radio communication standards. Analyzers FSE in conjunction with option FSE-B7 replace several individual instruments:

– high-grade spectrum analyzer
– vector demodulator
– constellation analyzer
– or process controller

Main features

Standards
GSM900/1800/1900, NADC, TETRA, PDC, PHS, DECT, QCDMA (IS-95)

Modulation modes
BPSK, QPSK, π/4DQPSK, 8PSK, 8DPSK, (G)MSK, (G)FSK, 4FSK, 16QAM, AM/FM/φM

Optimum representation of results

- In-phase and quadrature signal
- Magnitude, phase
- Eye and trellis diagrams
- Vector diagram
- Constellation diagram
- Table with modulation errors
- Demodulated bit stream

Benefits at a glance

- Measurement and analysis of analog modulation signals
- Versatile applications in the lab
- Efficient in production
- All mobile radio standards at a keystroke
- Multi-measurement functions in a single unit

Principle of vector signal analysis

The IF signal is digitized by means of a fast A/D converter, allowing purely digital processing of all subsequent analysis steps, thus making them practically error-free and providing high long-term and temperature stability. After A/D conversion, the signal is digitally mixed into the baseband and split into a real and an imaginary component. The complete signal information is thus available for further analysis. The signal is demodulated down to bit level by several DSPs. From the data stream thus obtained, an ideal signal is calculated. This reference signal is compared with the test signal. The resulting difference signal contains all modulation errors. The sampling rate of the A/D converter is always set to an integer multiple of the symbol rate, which speeds up analysis and contributes towards the high rate of 5 measurements/s.

- Phase error measurements on GSM mobile phones or base stations
- Modulation error measurements on π/4DQPSK signals
- Convenient analysis with constellation diagram
- Frequency response of GSM signal
- Measurements on frequency-modulated signals
- Measurement of AM/φM conversion or synchronous phase modulation
- Measurement of transmitter frequency transients

Specifications in brief

Specifications are guaranteed subject to the following conditions:
30 minutes warmup at ambient temperature, specified environmental conditions met, calibration cycle adhered to and total calibration performed. Data without tolerances are typical values. Data designated "nominal" apply to design parameters and have not been checked.

Measurement of digital modulation signals

Signal types	continuous signals, TDMA signals
Modulation modes	BPSK, QPSK, Offset QPSK, DQPSK, π/4DQPSK, 8PSK, D8PSK, 16QAM, MSK/GMSK, 2(G)FSK, 4(G)FSK
Standards	GSM900/1800/1900, NADC, TETRA, PDC, PHS, CDPD, DECT, WCPE, CT2, ERMES, FLEX, MODACOM, TFTS, QCDMA (IS-95)
Filters	
Filter types	raised cosine, square root raised cosine, Gaussian
Setting range α/B x T	0.2 to 3 in steps of 0.01
Filters to specific standards	
FLEX	Bessel B × T = 1.22 and 2.44
ERMES	Bessel B × T = 1.25
QCDMA	forward and reverse channel (IS-95)

Measurements (except FSK)
I and Q signals (filtered, synchronized to frequency and symbol clock)
I and Q reference signals (calculated from demodulated bits)
I and Q error (magnitude and phase)
Vector error
Bit stream/modulation error (bits demodulated at ideal decision points and table of all modulation errors)

Measurements with FSK
Frequency-demodulated signal (filtered, synchronized to symbol clock)
FSK reference signal (calculated from demodulated data)
FSK error signal
Data/bit stream/modulation error (symbols demodulated at ideal decision points and table of all modulation errors)

Display modes (except FSK)
Polar diagram: constellation diagram, vector diagram
Time domain: in-phase and/or quadrature signal, magnitude (level), phase, eye diagram, trellis diagram
Error display in time domain: error vector magnitude (EVM) in %, phase/frequency error, in-phase and quadrature signals
Numerical error readout (* rms and peak value): error vector magnitude*, magnitude error*, phase error*, frequency error, I/Q offset, I/Q imbalance, amplitude droop, ρ-factor

Display modes with FSK
Time domain: magnitude (level), frequency deviation, eye diagram (frequency signal)
Error display in time domain: frequency deviation error, magnitude error
Numerical error readout (* rms and peak value): deviation error*, magnitude error, FSK frequency deviation, frequency error, FSK reference deviation

Modulation measurement range	
Symbol rate	320 Hz to 2.133 MHz
Testpoints/symbol	
Symbol rate ≤200 kHz	1, 2, 4, 8, 16
200 to ≤400 kHz	1, 2, 4, 8
>400 kHz	1, 2, 4
Memory size	
Symbol rate ≤1 MHz	max. 16000 samples
>1 MHz	max. 3200 points
Number of demodulated symbols	
Symbol rate ≤1 MHz	max. 1600 symbols (with 4 points/symbol), max. 800 symbols (with 8 points/symbol), max. 400 symbols (with 16 points/symbol)
>1 MHz	max. 600 symbols
Synchronization	**internal symbol clock and frequency/ phase**
Trigger	free run, external, video
Trigger offset	pre- or posttrigger
Synchronization on bit sequences	definable bit sequences, max. 32 symbols, TDMA bursts
Synchronization offset	selectable, positive or negative

Measurement of analog modulation signals

Demodulation mode	offline demodulation
Demodulation bandwidth	5 kHz to 2 MHz (typ. 5 MHz)
Realtime demodulation	5 to 200 kHz bandwidth in steps of 1, 2, 3, 5
Offline demodulation	5 kHz to 2 MHz (5 MHz) bandwidth in steps of 1, 2, 3, 5
Demodulation length (max. sweep time)	(5000 × 0.7)/(bandwidth/Hz) [s]
Display	AF signal, carrier power (AM AF signal DC-coupled) or modulation summary (table)
Numerical display of	– peak or rms values of modulation depth or deviation of main demodulation – SINAD 1 kHz (only with REAL TIME ON) – AF frequency – carrier power – peak values of supplementary modulations

Level measurements

Peak power	–60 to +30 dBm

Dynamic range for burst measurement
(mean power, ref level ≥–10 dBm,
peak power = ref level +1 dB,
low-noise mode, points/symbol ≤4) 80 dBc – 4 x log(symbol rate/kHz)

Absolute level error	
Average power (0 to –10 dB below reference level)	
f ≤1 GHz	<1 dB
f >1 GHz	see data sheet FSE (total measurement uncertainty)
Relative level error	
Mean power, level	
0 to –10 dB below reference level	0.2 dB
–10 to –50 dB below reference level	(0.0325/dB – 0.125)dB
Time reference (nominal)	
without clock synchronization	<1/(2 x symbol rate x points/symbol) for MSK/GMSK modulation, <1/(2 x symbol rate) for PSK/QAM/ FSK modulation
with clock synchronization	<0.001 x 1/(symbol rate)

Measurement times
Readout of detected symbols and numerical modulation errors, synchronized

GSM900/1800/1900, PHS	330 ms/measurement
NADC, TETRA, PDC	600 ms/measurement

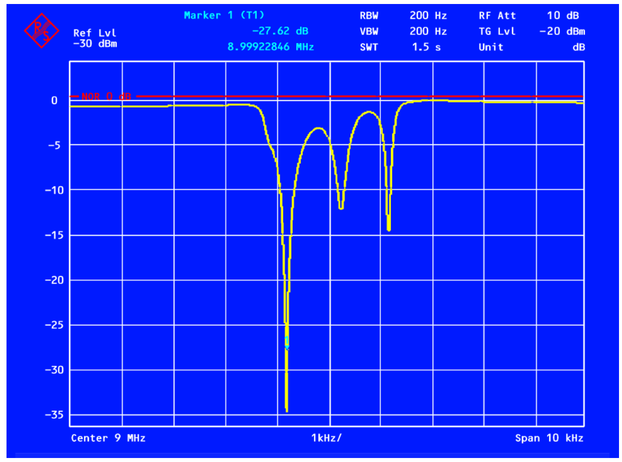
Ordering information

Vector Signal Analyzer	FSE-B7	1066.4317.02
Option for FSE		
Low Phase Noise and OCXO (for models 20)	FSE-B4	1073.5396.02

Tracking Generators FSE-B8 to -B11

Scalar network analysis with Spectrum Analyzers FSE

9 kHz to 3.5/7 GHz



Measuring the passband and stopband attenuation of a filter (1)

Main features

- Attenuation measurement range >90 dB, typ. 120 dB
- I/Q modulator in FSE-B9/-B11 for generating any phase or amplitude modulation modes
- Output level 0 to –20 dBm, optionally 0 to –90 dBm
- Frequency offset up to ± 200 MHz

Brief description

The optional Tracking Generators FSE-B8, FSE-B9, FSE-B10 and FSE-B11 enhance the Spectrum Analyzers FSE for selective scalar network analysis. They allow gain, frequency response, ripple, insertion and return loss (with additional SWR bridge) to be measured in a wide dynamic range. In contrast to measurements with broadband scalar network analyzers, the selective measurement method ensures that harmonics and spurious responses of the generator or device under test have no effect on the measurement.

Spectrum Analyzers FSE with built-in tracking generators feature a very low noise floor and hence an extremely wide dynamic range for attenuation measurements. They are thus ideal for instance for measuring shielding effectiveness.

Description

Generator	Designation	Order No.	Frequency Range	FSEA 20	FSEA 30	FSEB 20	FSEB 30	FSEM 20	FSEM 30	FSEK 20	FSEK 30
FSE-B8	Tracking Generator	1066.4469.02	9 kHz to 3.5 GHz	•	•	–	–	–	–	–	–
FSE-B9	Tracking Generator	1066.4617.02	9 kHz to 3.5 GHz	•	•	–	–	–	–	–	–
FSE-B10	Tracking Generator	1066.4769.02	9 kHz to 7 GHz	–	–	•	•	–	•	–	•
FSE-B11	Tracking Generator	1066.4917.02	9 kHz to 7 GHz	–	–	•	•	–	•	–	•
FSE-B12	Switchable Attenuator	1066.5065.02	9 kHz to 7 GHz	•	•	•	•	–	•	–	•

Permissible combinations of tracking generators and optional switchable attenuator with Spectrum Analyzers FSE
• Permissible combination – Cannot be installed

Versatile measurement functions

- Easy to operate normalization with interpolation
- Normalization for reflection measurements with open or short, or both
- Automatic bandwidth measurement ("n dB down" function)
- Shape factor 60/6 or 60/3 dB
- Tolerance limits with PASS/FAIL evaluation
- Level range display up to 200 dB for compensation of frequency responses of even large amplitude variation
- Frequency range settable down to 3 kHz with reduced output level

Specifications in brief

Frequency

Frequency range	
FSE-B8, FSE-B9	9 kHz to 3.5 GHz
FSE-B10, FSE-B11	9 kHz to 7 GHz
Min. start frequency	typ. 3 kHz
Frequency offset	±200 MHz
Spurious responses	
Harmonics (f >50 MHz)	25 dB
Other	30 dB

Level

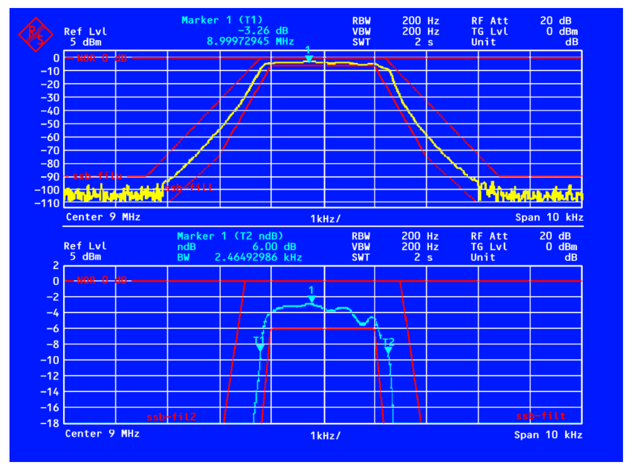
Output level	–20 to 0 dBm
with option FSE-B12 (can be set in 0.1 dB steps)	–90 to 0 dBm
Level accuracy	
Frequency response referred to 120 MHz, for sweep time >100 ms and start frequency >2 × RBW and start frequency >SPAN/1000	
Absolute error at 120 MHz, 0 dBm	<1 dB
Without FSE-B12:	
9 kHz to 1 GHz	<2.0 dB
1 to 3.5 GHz	<3.0 dB
3.5 to 7 GHz	typ. <3 dB
Additional frequency response with option FSE-B12:	
9 kHz to 3.5/7 GHz	<1.0 dB

Dynamic and measurement range

Gain measurement range	
Without option FSE-B12	50 dB
With option FSE-B12	120 dB
Attenuation measurement range	
f >10 MHz, RBW = 1 kHz	>90 dB, typ. 120 dB

Modulation

Modulation modes	AM, FM, I/Q (cannot be used simultaneously)
Start frequency	>200 kHz
Amplitude modulation	
Operating mode	EXTERN AM
Modulation depth	0 to 80%
Modulation frequency range	1 to 20 kHz
Frequency modulation	
Operating mode	EXTERN FM
Deviation	max. 1 MHz
Modulation frequency range	1 to 100 kHz with modulation index $<2\pi \times 75$



Measuring the return loss of a filter (2)

I/Q modulation (with FSE-B9 and -B11 only)

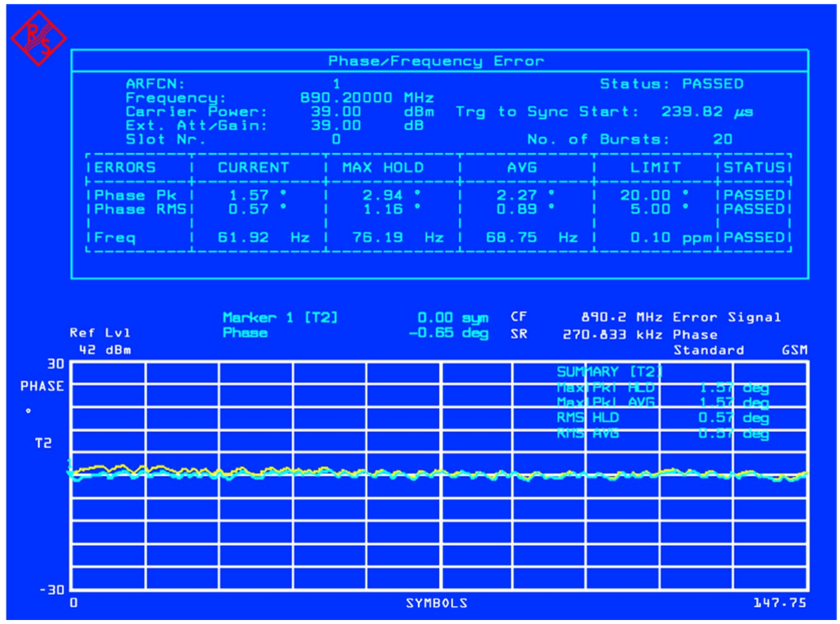
Modulation inputs I and Q	
VSWR	typ. <1.4
Input voltage for 100% modulation	±0.5V
Modulation frequency response	
f_{mod} = DC to 5 MHz	<1dB
f_{mod} = DC to 10 MHz	typ. <1dB

Ordering information

Tracking Generator		
9 kHz to 3.5 GHz	FSE-B8	1066.4469.02
9 kHz to 3.5 GHz, with I/Q Modulator	FSE-B9	1066.4617.02
9 kHz to 7 GHz	FSE-B10	1066.4769.02
9 kHz to 7 GHz, with I/Q Modulator	FSE-B11	1066.4917.02
Switchable Attenuator for Tracking Generators	FSE-B12	1066.5065.02
Extras		
SWR Bridge 40 kHz to 4 GHz	ZRC	1032.9492.52/55
SWR Bridge 50 to 3000 MHz	ZRB2	0373.9017.5x
N Calibration Kit, 0 to 3 GHz, termination, short/open	ZCAN	0800.8515.52/72
Matching Pad 75 Ω, L-section	RAM	358.5414.02
Matching Pad 75 Ω, series resistor 25 Ω	RAZ	0358.5714.02
Extras for I/Q modulation		
Dual Arbitrary Waveform Generator	ADS	1012.4002.02
Software for generation of I/Q signals in conjunction with ADS	IQSIM-K	1013.1642.02

Application Firmware FSE-K10/FSE-K11

GSM transmitter measurements conforming to standards:
FSE-K10 for mobile phones
FSE-K11 for base stations



Measurement of phase/frequency error

Brief description

Spectrum Analyzers FSE with their wide dynamic range and high accuracy, together with optional Vector Signal Analyzer FSE-B7, are ideal for GSM transmitter measurements in development and production. Application Firmware Modules FSE-K10 and FSE-K11 now further simplify operation: complex measurements can be performed exactly in line with standards at a keystroke. The modules take into account all requirements and settings for GSM900, GSM1800 (phase I and phase II) and GSM1900. Operation follows the sequence of measurements as specified in the standards.

Fitted with the application firmware, Spectrum Analyzer FSE automatically sets the frequency limits, measurement bandwidths, sweep times and detectors required for a given standard and the associated measurements. FSE compares results with specified limit values and verifies their compliance.

FSEM covers the frequency range up to 27 GHz, which allows the measurement of spurious through to 12.75 GHz.

Covered standards

Standards	FSE-K11 (for base stations)	FSE-K10 (for mobile phones)
GSM900, Phase I	ETS300067/GSM 11.20	GSM 11.10
GSM1800	GSM 11.20	I-ETS300020-3/GSM 11.10
GSM900 Phase II und E-GSM	ETS300069-1/GSM 11.21	ETS300067-1/GSM 11.10-1
GSM1900	J-STD-007 Air Interface	J-STD-007 Air Interface

Main features

- Measurement of RF parameters for GSM900, GSM1800 and GSM1900 in line with:
  - GSM 11.10
  - GSM 11.10-1
  - GSM 11.20
  - GSM 11.21
  - J-STD 007 Air Interface
- Firmware modules FSE-K10 and FSE-K11 can be fitted to all models of the FSE family (also both modules at the same time)

Measurement functions and trigger sources

Measurements	with FSE-B7	without FSE-B7	Trigger mode FSE-K10	Trigger mode FSE-K11	Synchronization to midamble
Phase/frequency error	✓	–	External, video, RF power, free run	External	Yes
Mean carrier power versus time			External, video, RF power	External	Yes/No
with synchronization to midamble	✓	–			
without synchronization to midamble	✓	✓			
Transmitted power versus time (burst timing)			External, video, RF power	External	Yes/No
with synchronization to midamble	✓	–			
without synchronization to midamble	✓	✓			
Spectrum due to modulation	✓	✓	External, RF power	External	–
Spectrum due to transients	✓	✓	External, RF power, free run	External, free run	–
Spurious emissions	✓	✓	External, RF power, free run	External, free run	–

Specifications in brief

Measurements with	FSEA30	FSEB30, FSEM30, FSEK30
and with options FSE-B7 and FSE-K10 or FSE-K11		

Values in [ ] apply to FSE with optional Increased Level Accuracy FSE-B22 fitted.

Phase measurement error rms value	≤0.5°	≤0.7°
peak value	≤1.5°	≤2.1°
Frequency measurement error	1.45 Hz + error of reference frequency relative to carrier	
Mean carrier power versus time		
Measurement error absolute	<0.9 dB [<0.6 dB]	
relative	<0.55 dB [<0.3 dB]	
Transmitted power versus time		
Error of 0 dB reference level	<0.9 dB [<0.6 dB]	
Relative error of reference level, relative to reference level	<0.3 dB (0 to –50 dB), <0.5 dB (–50 to –70 dB)	
Trigger error (with synchronization to midamble)	±0.25 µs [±1/16 bit]	
Dynamic range (resolution bandwidth 300 kHz)	75 dB	73 dB
Spectrum due to modulation		
Level measurement error absolute, relative to reference level	<0.9 dB [<0.6 dB] (0 to –50 dB) <1 dB (–50 to –70 dB) <1.4 dB (–70 to –95 dB)	
Level measurement error relative		
Δf ≤0.1 MHz	<0.3 dB	<0.3 dB
0.1 MHz ≤Δf ≤1.8 MHz, level difference <50 dB	<0.45 dB	<0.45 dB
1.8 MHz ≤Δf ≤6 MHz, level difference ≥50 dB	<1.3 dB	<1.3 dB
Δf ≥6 MHz	<1.3 dB	<1.3 dB
Dynamic range (carrier power 46 dBm)		
Frequency offset		
200 kHz	78 dB	72 dB
250 kHz	78 dB	72 dB
400 kHz	82 dB	76 dB
600 kHz	87 dB	81 dB
1200 kHz	93 dB	87 dB
1800 kHz	94 dB	88 dB
1800 to 6000 kHz (resolution bandwidth 100 kHz)	90 dB	84 dB
>6 MHz (resolution bandwidth 100 kHz), transmit band	91 dB	87 dB
Spectrum due to transients		
Level measurement error absolute	<0.9 dB [<0.6 dB]	
relative, level difference <50 dB	<0.45 dB	<0.45 dB
≥50 dB	<1.2 dB	<1.2 dB
Dynamic range (carrier power 46 dBm)		
400 kHz	76 dB	70 dB
600 kHz	81 dB	75 dB
1200 kHz	87 dB	81 dB
1800 kHz	91 dB	85 dB
Spurious emissions		
In transmit band:		
Level measurement error	<1.75 dB [<1.3 dB]	
Noise floor (peak value) (resolution bandwidth 100 kHz, 46 dBm transmit power)	–40 dBm	–38 dBm
Outside transmit and receive band:		
Level measurement error f ≤2 GHz	<1.75 dB [<1.3 dB]	
2 GHz <f ≤4 GHz	<1.75 dB (up to 3.5 GHz)	<2.15 dB (up to 7 GHz)
f >4 GHz (up to 12.75 GHz with FSEM/FSEK)	–	<2.2 dB
Noise floor (peak value) (resolution bandwidth 3 MHz, 46 dBm transmit power)	–37 dBm	–35 dBm
In receive band (carrier suppression >25 dB):		
Level measurement error	<1.5 dB	<1.5 dB
Sensitivity (noise indication averaged over 200 sweeps)	–107 dBm	–105 dBm

Ordering information

Application Firmware		
for tests on		
GSM mobile phones	FSE-K10	1057.3092.02
GSM base stations	FSE-K11	1057.3392.02

The 5-pole resolution filters stipulated by standards are included in all .30 FSE models; .20 models are equipped with 4-pole resolution filters.

Options		
Increased Level Accuracy up to 2 GHz for FSE (factory-fitted)	FSE-B22	1106.3480.02
Vector Signal Analyzer	FSE-B7	1066.4317.02

Signal Analyzer FSIQ

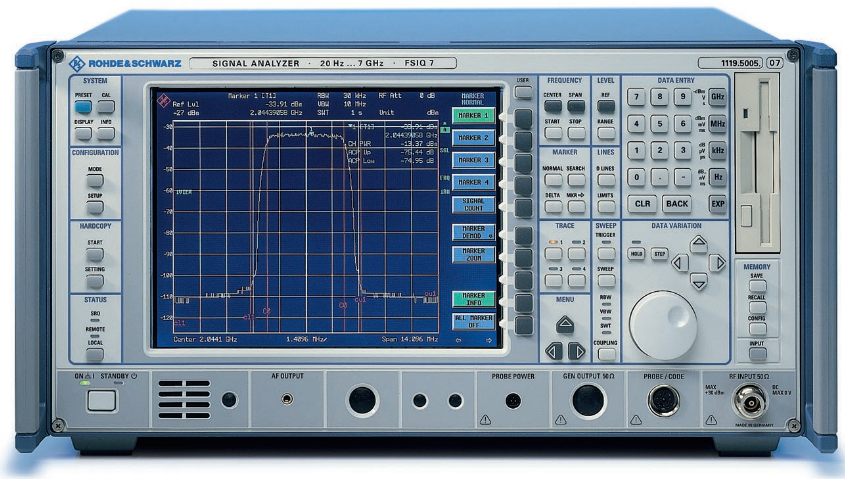


Foto 43185-3

FSIQ3: 20 Hz to 3.5 GHz

FSIQ7: 20 Hz to 7 GHz

FSIQ26: 20 Hz to 26 GHz

75 dB ACPR for W-CDMA

The one box solution in signal analysis

Brief description

FSIQ provides in a single unit comprehensive and easy-to-use measurement functions in the frequency time and modulation domain.

Frequency domain

In the frequency domain, FSIQ measures intermodulation and harmonics with great accuracy. The high 3rd-order intercept point in conjunction with the extremely low noise floor yields an intermodulation-free dynamic range of >110 dB and ensures reliable performance of even sophisticated measurements.
The excellent dynamic range and the optimized phase noise values make the FSIQ an ideal tool for ACPR (adjacent channel power ratio) measurements in all mobile radio systems and in particular for W-CDMA. The maximum ACPR value for W-CDMA in 4.096 MHz bandwidth is 75 dB and is already attained at –12 dBm input level.

The RMS detector available for all bandwidths up to 10 MHz is the ideal tool for precise power measurements whatever the waveform. Channel power and adjacent-channel power can accurately be measured and displayed irrespective of any signal statistics. Typical measurement problems such as the high and uncertain crest factor in CDMA systems can thus be eliminated and the true RMS value be displayed.

Time domain

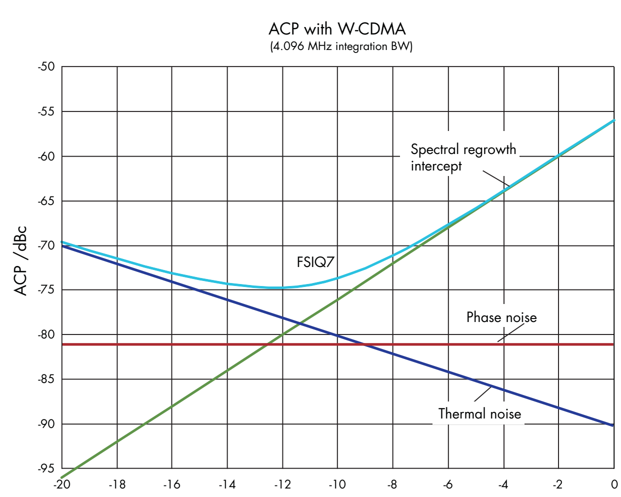
In the time domain, FSIQ features all modern capabilities of burst analysis in TDMA systems; gate functions, trigger delay and integrated RF trigger in conjunction with a short sweep time of 1 μs ensure precise measurement of the timing characteristics of all main mobile radio systems.

Thanks to the wide range of bandwidths available up to 10 MHz the effect of the measuring instrument becomes negligible, in particular in the case of measurements on broadband systems.

Various marker functions in conjunction with editable gated sweeps allow RMS, average and peak measurements to be carried out over any selectable time.

Modulation domain

In the modulation domain, the integrated vector signal analyzer provides diverse measurements on signals with digital or analog modulation. The variety of settings that can be called simply at a keystroke covers 18 mobile radio standards from GSM, NADC, IS-95 through to W-CDMA. These convenient presettings make it superfluous for the user to spend valuable time in looking up specifications and go towards enhancing the measurement reliability.



Display of the results caters to practically each and every need: in addition to vector and constellation diagrams, I/Q signal and eye/trellis diagrams, tables with modulation errors including the demodulated bit sequence are particularly useful. EVM (error vector magnitude), phase and frequency error,waveform factor and I/Q offset are output as numeric values, with RMS and peak value being shown separately.
Besides the mobile radio standards, FSIQ can also be used as a general-purpose measurement demodulator for non-standard modulation methods. The list of the 14 digital demodulators available ranges from BPSK, QPSK and (G)MSK through to 16QAM. With a symbol rate selectable up to 6.4 Msymbol/s and cosine and root-cosine filters adjustable in 0.01 step width, configuration of customized systems is no problem.

Main features

Spectrum analysis

- Spectrum analysis with ultra-wide dynamic range for sophisticated ACPR measurements: NF = 15 dB/ TOI = +20 dBm; Figure of merit (NF - TOI) = +5 dBm
- 75 dB ACPR dynamic range for W-CDMA (4.096 MHz integration bandwidth)
- 82 dB ACPR in 4.096 MHz integration bandwidth for alternate channel
- Total measurement uncertainty <1 dB up to 2.2 GHz, <1.5 dB up to 7 GHz
- Resolution bandwidth 1 Hz to 10 MHz in 1/2/3/5 steps
- 5-pole resolution filters with high selectivity
- FFT filter with 1 Hz to 1 kHz RBW for fast measurements
- Displayed average noise floor typ. –150 dBm in 10 Hz bandwidth

Vector signal analysis

- Integrated vector signal analyzer for universal analysis of digital and analog modulated signals BPSK to 16QAM, (G)MSK, AM, FM, PM
- Vector signal analyzer for W-CDMA
- Symbol rate up to 6.4 Msymbol/s

General-purpose signal analysis

- High-speed synthesizer with 5 ms sweep time for FULL SPAN (FSIQ3/7)
- Fast time domain analysis with 1 µs zero span sweep time
- True RMS detector for precise and repeatable measurements of any signal type
- High display update rate up to 25 sweeps/s
- Large colour display with high resolution (24 cm/9.5" TFT)

Specifications in brief

Common data

Aging per day	$1 \cdot 10^{-9}$
Aging per year[1)]	$2 \cdot 10^{-7}$
Marker resolution	0.1 Hz to 10 kHz (dependent on span)
Frequency counter resolution	0.1 Hz to 10 kHz (selectable)
Display range for frequency axis	0 Hz, 10 Hz to full span
Display range with digital demodulation	
Number of displayed symbols	
Symbol rate ≤1 MHz	max. 1600 symbols (4 points per symbol)
Symbol rate >1 MHz to <3.2 MHz	½ x symbol rate / MHz x 1000 symbols in steps of 100 symbols
Symbol rate ≥3.2 MHz	max. 1600 symbols (4 points per symbol)
Display range with analog demodulation	(3500/demodulation bandwith/Hz) s
Sweep	
Display range 0 Hz	1 µs to 2500 s in 5% steps
Display range ≥10 Hz	5 ms to 16 000 s in steps ≤10%
Sampling rate	50 ns (20 MHz A/D converter)
Number of pixels(x axis)	500
Resolution bandwidths with spectrum display	
Analog filter	
3 dB bandwidths	1 Hz to 10 MHz in 1/2/3/5 steps
Shape factor 60:3 dB	
<1 kHz	<6
1 kHz ... 2 MHz	<12
>2 MHz	<7
Video bandwidths	1 Hz to 10 MHz in 1/2/3/5 steps
FFT filter	
3 dB bandwidths	1 Hz to 1kHz in 1/2/3/5 steps
Shape factor 60:3 dB	2.5 nominal
Max. display range	100 dB
Inherent spurious response	<–100 dBm
Level	
Display range	noise floor displayed to 30 dBm
Maximum input level	
RF attenuation 0 dB	
DC voltage	0 V
CW RF power	20 dBm (=0.3 W)
Pulse spectral density	97 dBµV/MHz
RF attenuation ≥10 dB	
DC voltage	0 V
CW RF power	30 dBm (=1W)
Max. pulse voltage	150 V
Max. pulse energy (10 µs)	1mWs; 0.5 mWs
1 dB compression of input mixer (0 dB RF attenuation)	+10 dBm nominal
Intermodulation	
Second harmonic intercept point (SHI)	>25 dBm, typ. >35 dBm at f<150 MHz >40 dBm, typ. >45 dBm at f>150 MHz
Level display	
Screen	500 x 400 pixel (one diagram), max. 2 diagrams with independent settings
Log level axis	10 to 200 dB, in steps of 10 dB
Linear level axis	10% of reference level per level division, 10 divisions or logarithmic scaling
Trace	max. 4 (with two diagrams on screen, max. 2 per diagram); quasi-analog display of all results

Trace detector	Max Peak, Min Peak, Auto Peak (Normal), Sample, RMS, Average
Trace functions	Clear/Write, Max Hold, Min Hold, Average

Setting range of reference level

Logarithmic level display	–130 dBm to 30 dBm, in steps of 0.1 dB
Linear level display	7.0 nV to 7.07 V in steps of 1%
Units of level axis	dBm, dBµV, dBmV, dBpW (log level display) V, A, W, dBµA (linear level display)

Total measurement error (0 to –50 dB, S/N >15 dB, span/RBW <100) (95% confidence level)

< 2.2 GHz	<1 dB
2.2 GHz to 3.5/7 GHz	<1.5 dB
7 GHz to 18 GHz	<2.5 dB
18 GHz to 26.5 GHz	<3 dB

Measurement of digital modulation signals

Modulation formats
BPSK, QPSK, Offset QPSK, DQPSK, π/4DQPSK, 8PSK, D8PSK, 16 QAM, MSK, GMSK, 2FSK, 2GFSK, 4FSK, 4GFSK

Selectable Standards
W-CDMA, Q-CDMA (IS-95) forward/reverse, GSM, NADC, TETRA, PDC, PHS,CDPD, DECT, PWT, APCO25, CT2, ERMES, FLEX, MODACOM,TFTS

Filters

Filtering	raised cosine,square root raised cosine, Gaussian
Setting range α/B x T	0.2 to 3 in steps of 0.01
Filters to specific standards	
FLEX	Bessel B x T = 1.22 and 2.44
ERMES	Bessel B x T = 1.25
CDMA (IS 95)	forward and reverse channel
APCO 25 FM	

Symbol rate

Symbol rate	320 Hz to 6.4 MHz (symbol rate x (1+ α)) < 8 MHz
Samples/symbol	
Symbol rate ≤200 kHz	1, 2, 4, 8, 16
200 kHz < Symbol rate ≤400 kHz	1, 2, 4, 8
Symbol rate >400 kHz	1, 2, 4
Synchronization	internal to symbol clock and frequency/phase

Level measurements with digital demodulation

Peak power range	–60 dBm to +30 dBm
Absolute level error	
Mean power(0 dB to –10 dB below reference level)	
f ≤ 2.2 GHz	1 dB
2.2 GHz to 7 GHz	1.5 dB
7 GHz to 18 GHz	2.5 dB (FSIQ7/26)
18 GHz to 26.5 GHz	3 dB (FSIQ7/26)

Dynamic range for burst measurement

(mean power, ref. level ≥10 dBm, power = ref. level +1 dB, low-noise mode, points/symbol <4, nominal values

	W-CDMA	60 dB
	GSM	74 dB
	NADC	78 dB
	TETRA	79 dB

Time reference (nominal)

without clock synchronization	
MSK/GMSK modulation,	<1/(2 x symbol rate · points/symbol)
PSK/QAM/FSK modulation	<1/(2 x symbol rate)
with clock synchronization	<0.001 x 1/(symbol rate)

Residual error in modulation measurements

(data valid for level from reference level to reference level – 6 dB, S/N >60 dB, α/BT = 0.3 to 0.7, number of demodulated symbols >100, averaging ≥10, analog bandwidth >10 x symbol rate, input frequency >15 x symbol rate, local suppression at 0 Hz input frequecy adjusted), symbol rate (1+α) ≤ 8 MHz

Frequency error	± (symbol rate × 5 × 10^{-6} + 0.1 Hz + reference error × carrier frequency)
I/Q offset error	0.2% (–54 dB)

Error with modulation standard

GSM900/1800/1900	phase error ≤0.5° rms, typ. <1.5° peak
NADC, CDPD	EVM ≤0.5% rms, typ. <1.5% peak
TETRA, PDC, PHS	EVM ≤0.7% rms, typ, <2% peak
PWT	EVM ≤1% rms, typ. <3% peak
IS-95 CDMA,	forward/reverse channel ρ factor ≥ 0.9995
W-CDMA	EVM ≤1.8% rms, typ. <5% peak

Measurement of analog modulation signals

Demodulation bandwidth	
Realtime demodulation	5 kHz to 200 kHz in steps of 1,2,3,5
Offline demodulation	5 kHz to 5 MHz in steps of 1,2,3,5
Demodulation length (max. sweep time)	3500/(demod. bandwith/Hz) s

Readout
Trace with AF signal, carrier power (AM DC-coupled), or modulation summary (table) with numerical display of: peak and rms values of modulation depths or deviations of main demodulation;
SINAD value 1 kHz (only with realtime demodulation); AF frequency; carrier power; peak values of incidental modulation

The following specifications are valid for demodulation bandwidth ≤2 MHz, resolution bandwidth ≥5 x demodulation bandwidth, RF input level ≤–10 dBm, reference level setting = peak input level + 0 to +6 dB.

Amplitude demodulation

Range	up to 100%
AF	
Offline demodulation	0.001 to 0.2 x demod. BW
Realtime demodulation	30 Hz to 0.2 x demod. BW, max. 20 kHz

Frequency demodulation

Deviation range	max. 0.4 x demod. BW
AF	
Offline demodulation	DC/0.001to 0.2 x demod. BW
Realtime demodulation	DC/30 Hz to 0.2 x demod. BW, max. 20 kHz

Phase demodulation

Deviation range	up to 10 rad
AF	
Offline demodulation	DC/0.001 to 0.1 x demod. BW <(0.4 x demod. BW)/(phase deviation/rad)
Realtime demodulation	200 Hz to 0.1 x demod. BW, max. 15 kHz < (0.4 x demod. BW)/(phase deviation/rad), smaller limit values apply

Measurement of unmodulated carrier power

Measurement error, (ref. level to ref. level –30 dB)	1.5 dB

SINAD measurements

Realtime demodulation, AF = 1 kHz ± 4 x 10^{-4} x demod. BW	
Error with 6 to 54 dB SINAD	±1 dB + error due to demodulator SINAD

Display of AF frequencies

Range	
Offline demodulation	0.001 to 0.3 x demod. BW
Realtime demodulation	30 Hz to 0.3 x demod. BW, max. 20 kHz
Resolution	1 mHz to 1 Hz
Error (S/N ≥40 dB)	1 · 10^{-6} x demod.BW + error of reference frequency +1 mHz ±1 digit

AF filters

Realtime demodulation	
Lowpass	3 kHz, 15 kHz (Butterworth, 12 dB/oct.)
Highpass	30 Hz, 300 Hz (6 dB/oct.))
Weighting filters	CCITT P.53, C message
Offline demodulation	
Lowpass	5%, 10%, 25% of demod.BW, (12 dB/oct.)

Audio demodulation

Modulation modes	AM and FM
Audio output	speaker and phone jack
Marker stop time in spectrum mode	100 ms to 60 s
Squelch	adjustable with level line

Trigger functions

Trigger	Span ≥10 Hz	free run, line, video, RF level, external
	Span = 0 Hz	plus pretrigger, posttrigger, trigger delay
with digital demodulation		plus burst trigger and synchronization to bit sequence (max. 32 symbols)
with analog demodulation		plus trigger to demodulated AF
Gated sweep, trigger source		external, RF level
Gate delay		1 µs to 100 s
Gate length		1 µs to 100 s, resolution min. 1 µs or 1% of gate length
Error of gate length		±(1 µs + (0.05% x gate length))

Inputs and outputs (front panel)

RF input	N female, 50 Ω
FSIQ26 only	adapter system, 50 Ω, N/3.5 mm male and female
VSWR (RF attenuation >0 dB)	<1.5 (f <3.5 GHz)
Attenuator	0 dB to 70 dB, switchable in 10 dB steps
Probe power supply	+15/–12.6 V DC, max. 150 mA
Supply and coding connector for antennas, etc)	±10 V, max. 100 mA, ground
AF output	Z_{out} = 10 Ω, JK34 jack
Reference frequency	
Output, usable as input	BNC female, 10 MHz, 10 dBm nom.
Input	1 MHz to 16 MHz, >0 dBm from 50 Ω
Sweep output	BNC female, 0 V to +10 V, proportional to displayed frequency
Power supply for noise source	BNC female, 0 V and 28 V, switched
External trigger/gate input	BNC female, >10 kΩ –5 V to +5 V, adjustable
IEC/IEEE bus remote control	IEC 625-2 (IEEE 488.2), SCPI 1994.0
Serial interface	RS-232-C (COM1 and COM2)
Mouse interface	PS/2 compatible
Printer interface	parallel (Centronics compatible) or serial (RS-232-C)
Keyboard connector	5-pin DIN female for MF2 keyboard
User interface	25-pin Canon female
Connector for external monitor (VGA)	15-pin female

Model-dependent data

3rd-order intermodulation

Intermodulation-free dynamic range, level 2 x –20 dBm, Δf >5 x RBW or 10 kHz, whichever is the greater value

FSIQ3	>64 dBc for f >100 MHz (TOI >12 dBm, typ. 18 dBm)
FSIQ7	>70 dBc for f >150 MHz (TOI >15 dBm, typ. 20 dBm)
FSIQ26	>74 dBc for f >150 MHz (TOI >17 dBm, typ. 22 dBm) >60 dBc for f >7 GHz (TOI >10 dBm)

Displayed average noise level (DANL)

(0 dB RF attenuation, RBW10 Hz, VBW = 1 Hz, 20 averages, trace average, span 0 Hz, termination 50 Ω)

Frequency	**FSIQ3**	**FSIQ7**	**FSIQ26**
20 Hz	<–80 dBm	<–74 dBm	<–74 dBm
1 kHz	<–110 dBm	<–104 dBm	<–104 dBm
10 kHz	<–125 dBm	<–119 dBm	<–119 dBm
100 kHz	<–135 dBm	<–135 dBm	<–135 dBm
1 MHz	<–145 dB, typ. –150 dBm	<–142 dBm, typ. –145 dBm	<–142 dBm, typ. –145 dBm
10 MHz to 6 GHz	<–145 dBm, typ. –150 dBm	<142 dBm, typ. –147 dBm	<–138 dBm, typ. –140 dBm
6 GHz to 7 GHz	–	<–139 dBm	<–135 dBm typ. –138 dBm
7 GHz to 18 GHz	–	–	<–138 dBm typ.–140 dBm
18 GHz to 26.5 GHz	–	–	<–135 dBm, typ. –138 dBm

Maximum dynamic range

	FSIQ3	FSIQ7	FSIQ26
1 dB compression to DANL (1 Hz)	170 dB	165 dB	165 dB

Inherent error on modulation measurements

General modulation modes (except FSK)

Error vector magnitude (EVM) and magnitude error (f < 1 GHz) [1]

Symbol rate [1]	**FSIQ3**	**FSIQ7**	**FSIQ26**
≤30 kHz	0.5% rms	0.7% rms	0.7% rms
30 kHz to 300 kHz	1% rms	1.4% rms	1.4% rms
300 kHz to 1 MHz	2% rms	2.8% rms	2.8% rms
1 MHz to 4.2 MHz	2% rms	2% rms	2% rms
4.2 MHz to 6.4 MHz	2.4% rms	2.4% rms	2.4% rms

Phase error (f<1 GHz) [2]

Symbol rate			
≤30 kHz	0.3° rms	0.4° rms	0.4° rms
30 kHz to 300 kHz	0.5% rms	0.7% rms	0.7% rms
300 kHz to 1 MHz	1.5% rms	2% rms	2% rms
1 MHz to 4.2 MHz	1.5% rms	2% rms	2% rms
4.2 MHz to 6.4 MHz	2% rms	2.8% rms	2.8% rms

General data

Display	24 cm colour display TFT (9.5")
Resolution	640 x 480 pixels (VGA resolution)
Mass memory	1.44 Mbyte 3½" FDD, hard disk
Rated temperature range	+5°C to +40°C
Power supply	
AC supply	200 V to 240 V: 50 Hz to 60 Hz, 100 V to 120 V: 50 Hz to 400 Hz,
Power consumption	195 VA to 245 VA (depending on model)
Dimensions (W x H x D)	
FSIQ3/7	435 mm x 236 mm x 460 mm
FSIQ26	435 mm x 236 mm x 570 mm
Weight	24 kg to 26.5 kg (depending on model)

Ordering information

Signal Analyzer		
20 Hz to 3.5 GHz	FSIQ3	1119.5005.03
20 Hz to 7 GHz	FSIQ7	1119.5005.07
20 Hz to 26.5 GHz	FSIQ26	1119.6001.26
Accessories supplied		
FSIQ3/7/26	keyboard, mouse, power cable, operating manual, fuses, Windows NT 4.0	
FSIQ26		
Testport adapter 3.5 mm female		1021.0512.00
Testport adapter N female		1021.0535.00
Options		
7 GHz Frequency Extension for FSIQ3	FSE-B2	1073.5044.02
Tracking Generator 3.5 GHz	FSE-B8	1066.4469.02
Tracking Generator 3.5 GHz with I/Q modulator	FSE-B9	1066.4617.02
Tracking Generator 7 GHz	FSE-B10	1066.4769.02
Tracking Generator 7 GHz witht I/Q modulator	FSE-B11	1066.4917.02
Switchable Attenuator for Tracking Generator	FSE-B12	1066.5065.02
Ethernet Interface 15-contact AUI connector	FSE-B16	1073.5973.02
Thin-wire BNC connector	FSE-B16	1073.5973.03
2nd IEC/IEEE Bus Interface	FSE-B17	1066.4017.02
External Mixer Input/Output for FSIQ 26 [3]	FSE-B21 [3]	1084.7243.02
Increased Level Accuracy up to 2 GHz [3]	FSE-B22 [3]	1106.3480.02
GSM Test Software, Mobile	FSE-K10	1057.3092.02
GSM Test Software, BTS	FSE-K11	1057.3392.02

[1] For frequencies >1 GHz the specified values have to be multiplied by $10^{0.552 \times \lg (f/GHz\ /\ 1\ GHz)}$.

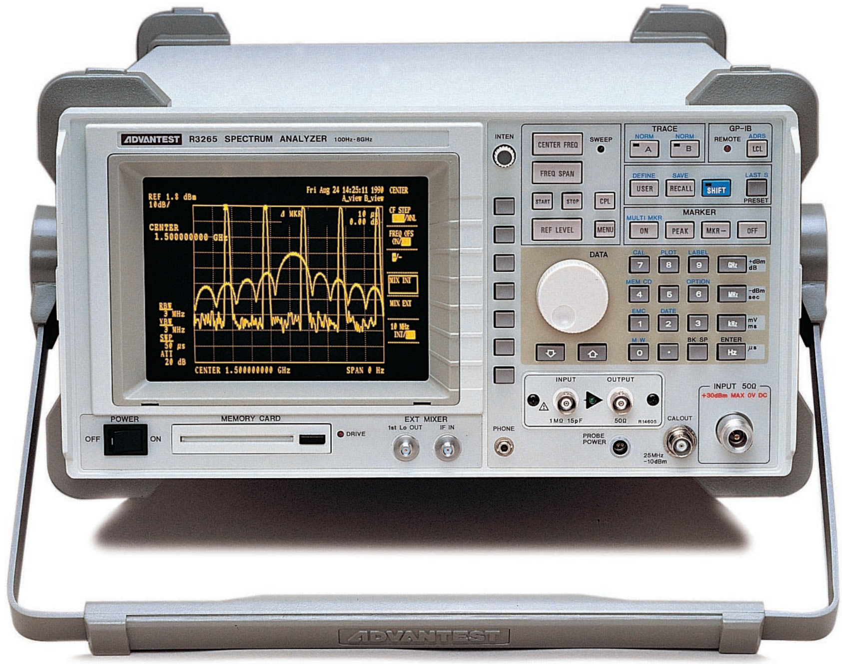
[2] For frequencies >1 GHz the specified values have to be multiplied by $10^{0.354 \times \lg (f/GHz\ /\ 1\ GHz)}$.

[3] Can not be retrofitted, factory fitted only.

Spectrum Analyzers R3265A, R3271A, R3365A, R3371A

100 Hz to 26.5 (31.8) GHz

Portable microwave analyzers of high sensitivity



R3265

Brief description

Spectrum Analyzers R3x65A and R3x71A (Advantest) provide synthesizer operation with high frequency accuracy and stability, 10 Hz resolution and –145 dBm sensitivity. High signal purity and wide dynamic range with low noise floor are further outstanding features of these analyzers.

R3x71A is designed for applications in the microwave range up to 26.5 GHz, with external mixer up to 325 GHz.

Digital IF filters provide excellent selectivity and extremely high sweep speed. A built-in frequency counter allows frequency measurements with an uncertainty of as low as 750 Hz for 7.5 GHz, for instance, and can also be used for burst signals. As a fixed-tuned receiver in zero-span mode it allows sweep times of 50 µs (14 MHz bandwidth) to be selected for measurements on broadband signals such as TV video or TDMA pulses.

For specified setting conditions the measurement uncertainty is <1 dB up to 3.5 GHz. Antenna correction factors and two limit lines (time, frequency) can be entered via the front-panel keys. A window function allows faster sweep times to be defined in a given display range. A demodulated AM/FM audio signal can be monitored at the marker position via the built-in loudspeaker without having to switch to zero span mode.

Operation

User-defined parameters can be entered via the numeric keypad. Softkey-controlled menus reduce the number of function keys and avoid double assignment of keys. The user can configure application-specific softkey menus. The analyzers have a built-in controller allowing simple programming in a language similar to BASIC. Programs for automatic measurement of the RF parameters of the radio interface for (GSM) base stations are available as an extra for this controller. A memory card of credit card size allows user-defined program sequences and waveforms to be stored and recalled.

Overview of models

R3265A: 100 Hz to 8.3 GHz

R3271A: 100 Hz to 26.5 GHz (31.8 GHz enhanced range, up to 325 GHz with external mixers)

R3365A: same as R3265A, but with built-in tracking generator, 100 kHz to 3.6 GHz

R3371A: same as R3271A, but with built-in tracking generator, 100 kHz to 3.6 GHz

Spectrum Analyzers R3265A, R3271A, R3365A, R3371A

Specifications in brief

Model-dependent data

	R3265A, R3365A	R3271A, R3371A
Frequency range	100 Hz to 8.3 GHz	100 Hz to 26.5 GHz (31.8 GHz), with ext. mixer up to 325 GHz
Harmonics	1	N = 1 to 4
Frequency span/division	20 Hz to 830 MHz	20 Hz to 3.18 GHz
	zero span, log display up to 1 GHz, start/stop	
IM-free dynamic range	75 dB	75 dB
Meas. sensitivity (<3.6 GHz)	–145 dBm	–135 dBm
RF input	N	N, SMA

Tracking generator

Included in R3365A and R3371A

Frequency range	100 kHz to 3.6 GHz
Output level	–3 to –30 dBm (1 dB steps)
Level sweep range	30 dB

Common data

Preselector	>3.5 GHz
Resolution bandwidths	10 Hz to 3 MHz, QP 200 Hz/9 kHz/120 kHz, digital 10/30/100 Hz
Shape factor (60:3 dB)	15 : 1, digital 5 : 1
Frequency resolution	1 Hz
Residual FM	<3 Hz (V_{pp}) x N/0.1 s (span <2 MHz)
Reference frequency accuracy	±2 x 10^{-8}/day, ±1 x 10^{-7}/year
Max. input level	+30 dBm/0 V (DC)
3rd-order intermodulation distortion	<–90 dBc at –40 dBm
Phase noise at 10 kHz	–110 dBc (1 Hz) (<2.6 GHz) –100 dBc (1 Hz) (20 GHz)
Frequency response	±1 dB
Reference level	–140 to +60 dBm
Level units	dBm, dBµV, V, dB(µV/m), dBmV, dBpW, W
Level resolution	log 10/5/2/1/0.5/0.2/0.1/dB, lin x1/x2/x5/x10
RF attenuator	0 to 70 dB, 10 dB
Video filter	1 Hz to 3 MHz in 1 to 10 sequence
Sweep time	20 ms to 1000 s, manual, automatic, up to 50 µs with zero span
Interfaces	2 x IEC/IEEE bus, RS-232, video
Evaluation functions	average, max hold, default offset, 2 display memories, marker peak search, delta marker, x dB down, marker next peak, signal track, frequency counter with 1 Hz resolution, dBc(Hz), dBm(Hz), display line, multimarker, OBW, ACP, gated sweep, delayed sweep, TV trigger (PAL, NTSC), etc

General data

Power supply, AC	90 to 250 V (400 VA)
Dimensions (W x H x D)	353 mm x 177 mm x 450 mm
Weight	22 kg

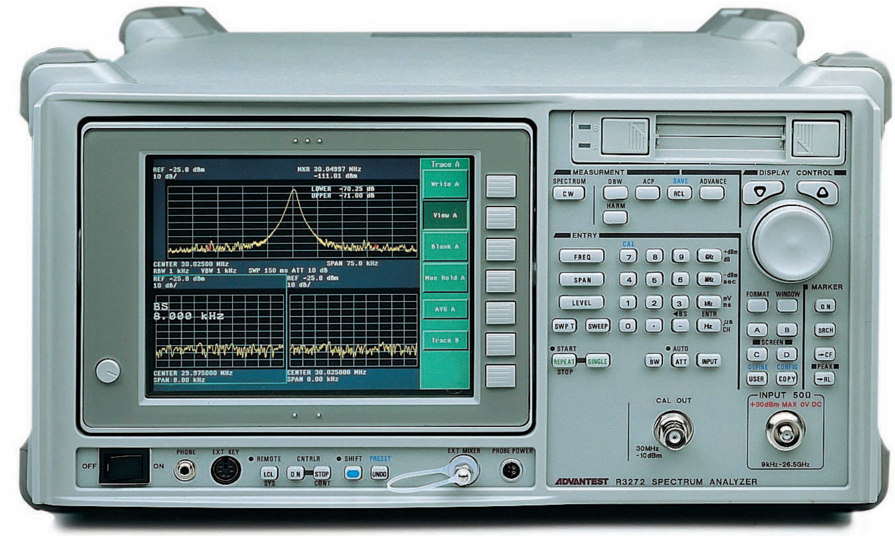
Ordering information

Spectrum Analyzer	
100 Hz to 8.3 GHz	R3265A, R3271A
100 Hz to 26.5 GHz	R3365A, R3371A
Option	
Timebase 5 x 10^{-9}/day	21
Extras	
IEC/IEEE-Bus Cable 1 m/2 m	408JE-101/102
19" Adapter 5 HU	A02459
Memory Card 32 k (standard)	A09505-1
Memory Card 128 k	A09506-1
DOS Software for program-controlled EMC precertification	EPS9980
External EMC Preselector	AUP9211A
DOS Software for PC control of analyzer	SPECTRA
Pulse Limiter 9 kHz to 30 MHz	CFL9206
Memory Card with DECT Test Software	PR326506-IC
Memory Card with GSM MS Test Software	PR326503-IC
Memory Card with GSM BS Test Software	PR326513-IC
Memory Cards with GSM MS and BS Test Software	PR326543-IC
Preamplifier	R14601
Impedance Converter 1 MΩ	R14602
Aluminium Transit Case	R16059

Spectrum Analyzers R3263, R3465, R3272

9 kHz to 26.5 (325) GHz

Ideal for all measurements in digital communications systems



R3272

Brief description

Spectrum Analyzers of the R3263, R3465 and R3272 Series (Advantest) provide synthesizer operation with high frequency accuracy and stability plus a measurement sensitivity of up to –120 dBm. R3465 (R3263: optionally) features additional digital modulation analysis functions. R3272 is designed for applications in the microwave range up to 26.5 GHz, with external mixers up to 325 GHz.

The large, inclinable 6.5-inch TFT colour LCD display makes for easy reading and also for the low weight of the instruments – the 26.5 GHz model R3272 for instance weighs 15 kg only.

Analysis of TDMA signals
Due to their special menu structure, Spectrum Analyzers R3263 and R3465 provide optimum support in the analysis of pulse-shaped signals, eg in GSM systems. The analyzers are able to measure the power ramp versus time, the modulation or switching spectrum and the spurious responses at a single keystroke. A high-precision power measurement routine and an easy-to-operate configuration menu are included. Ready-to-use programs for GSM and DECT are available for the optional controller. These programs allow measurement of the RF parameters of the radio interface in line with the relevant standards. The sweep accuracy was improved to <1% by means of DDS (direct digital synthesis). Delayed sweep, gated sweep and an extremely short sweep time of 50 µs in zero span mode enable detailed display of the burst edges of TDMA signals.

Modulation analysis
R3465 provides modulation analysis as standard, R3263 as an option. The IQ signal is digitally demodulated and the phase and frequency error are determined. Another option that can be retrofitted measures the phase error of the individual bits, provides a FFT or displays the demodulated result.

Operation

Measurement of harmonics, spurious responses, adjacent-channel leakage power (ACP) and occupied bandwidth (OBW) at the touch of a single key make operation extremely easy and speed up measurements. A wide variety of marker functions is also provided. The integrated controller (option) allows the generation of test programs.

Instrument settings, programs and measurement curves can be saved on the PCMCIA memory cards inserted into the two slots. Results can be output either on a plotter (IEC/IEEE bus), printer (Centronics interface) or as a bitmap file. A monitor interface with VGA-compatible signals allows display on a PC screen.

Overview of models

- **R3263:** 9 kHz to 3 GHz, optional digital modulation analysis
- **R3465:** 9 kHz to 8 GHz and digital modulation analysis
- **R3272:** 9 kHz to 26.5 GHz (with external mixer up to 325 GHz)

Spectrum Analyzers R3263, R3465, R3272

R3465 Options

Option/Model	R3465	R3465 +51	R3465 +52	R3465 +56	R3465 +57	R3465 +58	R3465 +61	R3465 +56+61	R3465 +57+61
PDC/PHS/NADC Tx Analysis	✔	✔	✔	–	–	–	v	–	–
PDC/PHS/NADC Constellation (Option 75)	☞	☞	☞	–	–	–	☞	–	–
PDC/PHS/NADC Graphics (Option 76)	☞	☞	☞	–	–	–	☞	–	–
Rx Control for R3560 (Option 8)	☞	☞	☞	–	–	–	☞	–	–
GSM900/1800/1900 Tx Analysis (Opt. 51, 56, 58)	–	✔	–	✔	–	✔	–	✔	–
GSM900/1800/1900 Graphics (Option 77)	–	☞	–	☞	–	☞	–	☞	–
DECT Tx Analysis (Option 52, 57, 58)	–	–	✔	–	✔	✔	–	–	✔
CDMA Tx Analysis (Option 61)	–	–	–	–	–	–	✔	✔	✔
CDMA Source Control for R3561L (Option 9)	–	–	–	–	–	–	☞	☞	☞
FM Deviation (Option 73)	☞	☞	☞	☞	☞	☞	☞	☞	☞
Program Loader (Option 15)	☞	☞	☞	☞	☞	☞	☞	☞	☞

✔ Fitted as standard
☞ Selectable option
– Combination not possible

Option 51 = GSM additionally
Option 52 = DECT additionally
Option 61 = CDMA additionally

Option 56 = GSM only
Option 57 = DECT only
Option 58 = GSM and DECT

GSM900/1800/1900 Tx Analysis
Predefined measurement functions for analysis of GSM signals. Measured parameters:

- Power versus time
- Power measurement
- Frequency error, phase error
- Spectrum due to modulation and switching
- Spurious emissions

GSM Graphics
- Bit/frequency display
- Phase error
- FFT of phase error
- Trellis diagram
- Display of demodulated bits

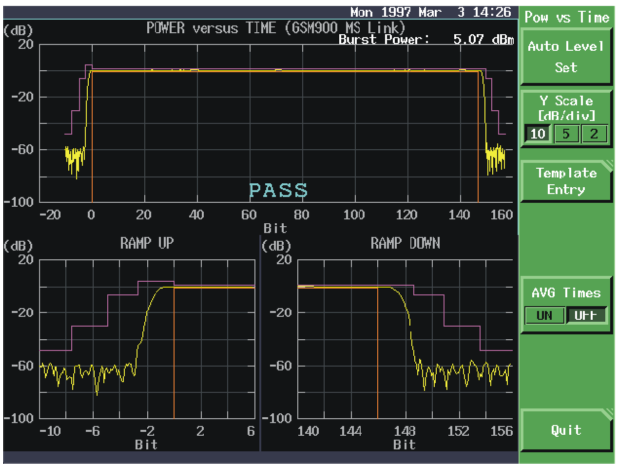
DECT Tx Analysis
This option allows measurements on various pulse packets for RFP (radio fixed part) and PP (portable part).

- Power versus time
- Power measurement
- FM deviation and carrier frequency offset
- Spectrum due to modulation and switching
- Timing jitter between PP/RFP and RFP/PP
- Spurious emissions
- Various graphic representations, eg eye diagrams

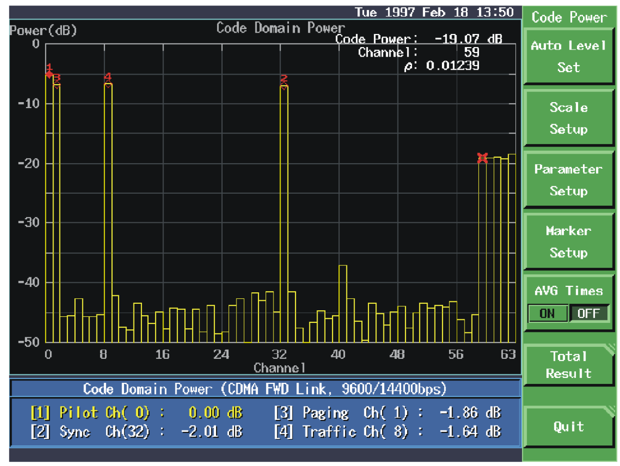
CDMA Tx Analysis
Based on the IS-95 standard, this option allows in-depth analysis of RF parameters, modulation and modulation contents, in particular:

- Power versus time
- Various power measurements
- Occupied bandwidth (OBW) measurement
- Measurement of rho, tau and other key parameters
- Code domain power over all 64 Walsh codes
- Spurious emissions
- Various graphic representations, eg eye diagrams

Spectrum Analyzers R3263, R3465, R3272



Pulse analysis referred to midamble



Code domain power measurement

R3263 Options

The basic model of R3263 provides the following measurement functions for TDMA signals such as GSM:

- Analysis of pulse characteristic with gated sweep and delayed sweep
- Display of spectrum due to modulation and switching
- Measurement of spurious emissions
- Power measurement

GSM Tx Plus, Option 55, 58
This option enhances the basic functionality of the analyzer by:

- Frequency and phase error measurement
- Measurement of power and of power versus time referred to midamble

GSM Graphics, Option 77 (only in conjunction with Option 55 or 58)
This option provides the following graphic representations:

- Bit/frequency
- Phase error
- FFT of phase error
- Trellis diagram
- Demodulated data

DECT, Option 52, 58
This option allows measurements on various pulse packets for RFP (radio fixed part) and PP (portable part).

- Power versus time
- Power measurement
- FM deviation and carrier frequency offset
- Spectrum due to modulation and switching
- Timing jitter between PP/RFP and RFP/PP
- Spurious emissions
- Various graphic representations, eg eye diagrams

Add-on units

R3561L, CDMA Test Source Unit
Controlled from R3465 (Option 9 required), the CDMA Test Source Unit allows receiver sensitivity measurements in line with the IS-95 standard.

- Output frequency 50 MHz to 2 GHz
- Resolution 1 Hz
- Output level –125 dBm to 0 dBm
- Resolution 0.1 dB
- Signal purity ≤–45 dBc (BW = 30 kHz, 900 kHz offset, 0 dBm)
- Rho ≥0.96
- OQPSK or QPSK modulation
- Traffic or pilot channel
- Data rate1200 to 9600 bps, 1800 to 14400 bps
- PN offset 0 to 511 (x64 chip)

External mixers
External mixers from 40 GHz to 325 GHz are available to extend the frequency range of the R3272 beyond 26.5 GHz.

Specifications in brief

	R3263	R3465	R3272
Frequency range	9 kHz to 3 GHz	9 kHz to 8 GHz	9 kHz to 26.5 GHz
Harmonics	—	N = 0, 1, 2	N = 0, 1, 2, 3, 4
Preselector	—	>1.7/>3 GHz	>3 GHz
Resolution bandwidths	300 Hz to 3 MHz, 5 MHz (1, 3, 10 steps)	300 Hz to 3 MHz, 5 MHz (1, 3, 10 steps)	300 Hz to 3 MHz, 5 MHz (1, 3, 10 steps)
Shape factor (60:3 dB)	15 : 1	15 : 1	15 : 1
Phase noise	<–100 dBc (1 Hz) at 10 kHz	<–100 dBc (1 Hz) at 10 kHz	<–100 dBc (1 Hz) at 10 kHz
Frequency span/division	200 Hz to 300 MHz zero span, start/stop	200 Hz to 800 MHz zero span, start/stop	200 Hz to 2.65 GHz zero span, start/stop
Residual FM	3 Hz/0.1 s (zero span)	3 Hz/0.1 s (zero span)	3 Hz/0.1 s (zero span)
Reference frequence (aging)	$\pm 2 \times 10^{-8}$/day, $\pm 1 \times 10^{-7}$/year	$\pm 2 \times 10^{-8}$/day, $\pm 1 \times 10^{-7}$/year	$\pm 2 \times 10^{-8}$/day, $\pm 1 \times 10^{-7}$/year
with Option 21	—	$\pm 5 \times 10^{-9}$/day	—
Input level	–120 to +30 dBm	–120 to +30 dBm	–120 to +30 dBm
Max. dynamic range	115 dB	115 dB	115 dB
Sensitivity	at 1 GHz: –114 dBm	at 1 GHz: –115 dBm	at 1 GHz: –114 dBm
Displayed noise floor (1 kHz BW)		at 7 GHz: –115 dBm	at 7 GHz: –110 dBm at 20 GHz: –96 dBm
Intermodulation (3rd order)	<–75 dBc (–30 dBm)	<–75 dBc (–30 dBm)	<–75 dBc (–30 dBm)
Frequency response	±1 to ±1.5 dB	±1 to ±1.5 dB	9 kHz to 7.5 GHz: ±1.5 dB 7.4 to 15.4 GHz: ±3.5 dB 15.4 to 26.5 GHz: ±4 dB
Reference level	–105 to +60 dBm (0.1 dB steps)	–105 to +60 dBm (0.1 dB steps)	–105 to +60 dBm (0.1 dB steps)
Level units	dBm, dBµV, V, dB(µV/m), dBmV, dBpW, W	dBm, dBµV, V, dB(µV/m), dBmV, dBpW, W	dBm, dBµV, V, dB(µV/m), dBmV, dBpW, W
Level resolution	0.1 dB	0.1 dB	0.1 dB
RF step attenuator	0 to 70 dB, 10 dB steps	0 to 70 dB, 10 dB steps	0 to 70 dB, 10 dB steps
Video filter	1 kHz to 3 MHz, 5 MHz (1, 3, 10 steps)	1 kHz to 3 MHz, 5 MHz (1, 3, 10 steps)	1 kHz to 3 MHz, 5 MHz (1, 3, 10 steps)
Sweep time	50 ms to 1000 s, 50 µs (transient mode)	50 ms to 1000 s, 50 µs (transient mode)	50 ms to 1000 s —
Evaluation functions	average, max hold, default offset, 2 display memories, marker peak search, delta marker, x dB down, marker next peak, signal track, frequency counter (1 Hz resolution), dBc(Hz), dBm(Hz), display line, multimarker, harmonics, OBW (not R3263), ACP (not R3263), gated sweep, delayed sweep (not R3272), limit value curves, etc		
Modulation analysis	**Option 55**	**Standard**	**—**
Modulation method	GMSK	GMSK	
on request		π/4 DQPSK, DECT, CDMA	
Transmitter output power	measurement range: –30 to +30 dBm	measurement range: –30 to +30 dBm	
Accuracy	±0.8 dB	±0.8 dB	
Time resolution	¼ bit rate	¼ bit rate	
Modulation spectrum	offset 200 to 1800 kHz; measurement range 65 dB	offset 200 to 1800 kHz; measurement range 65 dB	
Switching spectrum	offset 400 to 1800 kHz; measurement range 65 dB	offset 400 to 1800 kHz; measurement range 65 dB	
Carrier frequency	measurement range 20 kHz; error: $<1 \times 10^{-8}$ Hz x [carrier freq., Hz] ±5 Hz	measurement range 20 kHz; error: $<1 \cdot 10^{-8}$ Hz x [carrier freq., Hz] ±5 Hz	
Phase	measurement range 0 to 30° (peak)	measurement range 0 to 30° (peak)	
Accuracy	±5° (peak), ±1° (RMS)	±5° (peak), ±1° (RMS)	
Phase error	1° (rms)	1° (rms)	—

R3561L with R3465

General data

RF input	N, N/SMA (R3272)
Interfaces	IEC/IEEE bus, Centronics, RGB, RS232
Power supply, AC	100 to 240 V (300 VA)
Dimensions (W x H x D)	350 mm x 177 mm x 420 mm
Weight	15 kg

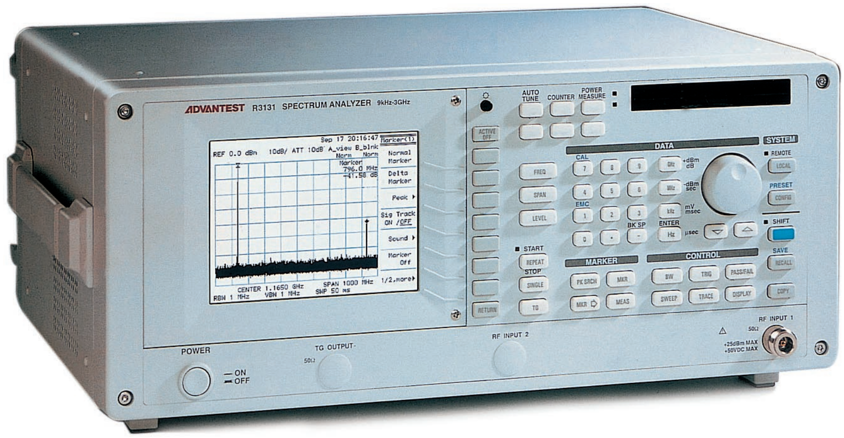
Ordering information

Spectrum Analyzers		R3263, R3465, R3272
Extras		
IEC/IEEE-Bus Cable 1 m		408JE-101
IEC/IEEE-Bus Cable 2 m		408JE-102
Memory Card		
	256 k	A09508
	2 M	A09509
Transit Case		R16074
Carrying Case		R16219
Front Cover		A02807
19" Adapter		A02467

Spectrum Analyzer R3131

9 kHz to 3 GHz

General-purpose analyzer for use in development, production, testshop, service and training. Thanks to special filters also suitable for EMC precertification measurements



Brief description

Spectrum Analyzer R3131 features the performance of a medium-class analyzer but at lower costs. With its wide frequency range from 9 kHz to 3 GHz it is suitable for many applications. Thanks to a highly stable synthesizer-controlled LO it satisfies exacting requirements in lab and system use. Its 19" size makes it particularly suitable for use in systems.

Operation, functions

Clear arrangement of the control elements and keys predominantly without multiple assignment make for great ease of operation. The basic model provides a large variety of measurement and marker functions as well as a built-in frequency counter. It also features the 6 dB bandwidth of 9 kHz and 120 kHz and a QP detector for EMC measurements.

Disk drive, printer support, RS232 and IEEE488 interfaces are standard. An optional tracking generator allows scalar network analysis.

Specifications in brief

Frequency range	9 kHz to 3 GHz
Reference oscillator	
Frequency drift 0 to 50°C	>±5x10^{-6}
Aging	>±2x10^{-6}/year
Resolution bandwidths	1 kHz to 1 MHz/auto, (6 dB) 9/120 kHz
Shape factor	15 : 1
Frequency span	5 kHz to 300 MHz, zero span
Residual FM	<100 Hz/0.1 s (zero span)
Input level	+20 dBm to displayed average noise level/±50 V (DC)
Displayed average noise level	–113 +2f[GHz] dBm (1 kHz) (>1 MHz)
Intermodulation	<–70 dBc at –30 dBm (>10 MHz)
Spurious responses	–100 dBm (>1 MHz)
Phase noise	–100 dBc (1 Hz) at 20 kHz
Frequency response	<±0.5 dB (>100 kHz)
Reference level	–64 to +40 dBm/1 dB steps
Amplitude display units	dBm, dBmV, dBµV, Watt, Volt
Level resolution	10, 5, 2, 1 dB/div, linear
RF attenuator	0 to 50 dB in 10 dB steps
Video filter	10 Hz to 1 MHz, 1 to 10 steps
Sweep time	50 ms to 500 s, zero span
Frequency counter resolution	1 Hz to 1 kHz

General data

Remote control interface	IEEE488, RS232
Dimensions (W x H x D)	424 mm x 177 mm x 300 mm
Weight	12 kg

Ordering information

Spectrum Analyzer	R3131
Extras	
IEC/IEEE-Bus Cable 1 m	408JE-101
IEC/IEEE-Bus Cable 2 m	408JE-102

BasePak - for all measurements on antenna installations

Complete hardware and software for full qualification measurements on antennas

Brief description

BasePak is an ideal tool for measuring transmit and receive signals and for qualification measurements on antennas of analog and digital transmission systems. BasePak is a combination of spectrum analyzer, Windows software, SWR bridge and further accessories. It allows measurement and monitoring of the receive spectrum, measurement of SWR and transmission characteristics as well as detection of cable faults using FDR (frequency domain reflectometry).

BasePak is available in two versions

- BasePak with Advantest Spectrum Analyzer U4342 (see page 178)
- BasePak+ with Advantest Spectrum Analyzer U3641 and tracking generator (see page 176)

Measurement capabilities

- Spectrum
- Transmission
- SWR
- Faults in cables
- Optional burst analysis

All measurements are carried out using a small-size and lightweight spectrum analyzer controlled from a notebook. Results can be stored in the notebook and recalled later. This allows fast comparisons to be made and changes recognized immediately. Through the use of Microsoft Windows the data can be output on all commercial-type printers and even be integrated in other programs.

Ordering information

BasePak consisting of:		
Advantest Spectrum Analyzer	U4342	
Battery	U4000-B5	
Battery Charger	U4000-C4	
Accessory case with		
RSWinTDR Software		
SWR Bridge	ZRB2	0373.9017.5x
Coupler		
Calibration kit		
Cables		
BasePak+ consisting of:		
Advantest Spectrum Analyzer	U3641, U3641-74	
Battery	U4000-B5	
Battery Charger	U4000-C4	
Accessory case with		
RSWinTDR Software		
SWR Bridge	ZRB2	0373.9017.5x
Coupler		
Calibration kit		
Cables		

Options (for U3641)		
Internal controller	15	
Improved reference frequency	20	
100/300 Hz resolution bandwidths	26	
TV demodulator including option 78	72	
Broadband FM demodulator	73	
Tracking generator	74	
Channel input	78	
Extras (for U3641)		
Battery 60 Wh	U4000-B5	
Charger for 2 batteries B5	U4000-C4	
Charger for 4 batteries B5	U4000-C5	
Charger for 4 batteries B5 and diagnostic module	U4000-C6	
Memory Card 256 k	A09508	
GSM MS Application Program for Internal Controller	PU36410300-IC	
GSM/PCN BS application Program for Internal Controller	PU36410310-IC	
Display Hood	R16601	
DC Connecting Cable	A01434	
SWR Bridge	ZRB2	0373.9017.5x
Transit Case	R16072	
Carrying Case	R16216	
Front Cover	A02806	

Spectrum Analyzers U3641, U3661

U3641: 9 kHz to 3 GHz

U3661: 9 kHz to 26.5 GHz

Lightweight, portable analyzers with synthesizer accuracy for mobile use

Photo 42744

Brief description

Spectrum Analyzers U3641 and U3661 (Advantest) feature exceptional characteristics such as:

- Size and weight: only 148 mm x 291 mm x 330 mm and 6.5 kg/ 8.3 kg (without battery or power supply unit)
- Three types of power supply possible: AC supply, battery (up to 1.5 h/1 h) or direct DC supply
- 15.2 cm (6 inch) colour LCD
- Integrated preamplifier with a gain of >25 dB
- Full dynamic range, eg for GSM pulse measurements
- Two memory card drives to PCMCIA standard for saving measurement results and instrument settings

The main technical features at a glance

- Optional OCXO reference oscillator with aging of 2 x 10^{-8}/day
- Operation independent of AC supply

Measurements on mobile radio base stations

- Dynamic range >70 dB for measuring the power ramp of GSM base stations
- SWR measurements on antennas in conjunction with tracking generator and SWR Bridge ZRB2 (see page 194)
- With BasePak hardware and software package (see page 175): SWR measurements and detection of cable faults using FDR (frequency domain reflectometry)
- Precision measurement of pulse power with the aid of various power measurement functions
- Different power measurement functions (only U3661)
- Gated sweep for display of spectrum due to modulation or switching
- GSM application software for optional controller (only U3641)

Radiomonitoring

- High sensitivity through built-in preamplifier up to 3 GHz for measurements down to –135 dBm with 1 kHz resolution bandwidth
- Input of antenna correction factors and limit curves
- Output of all results also in dBµV
- Ideal combination with Rohde & Schwarz antennas

Modularity through retrofittable options

Options and their functions	Option
Internal controller	15 (only U3641)
Improved reference frequency	20 (not usable with option 73)
100 Hz, 300 Hz RBW additionally	26
CDMA measurements at a key stroke	60 (only U3641, not usable with option 72)
TV demodulator including screen display	72
FM deviation measurements	73 (not usable with option 20)
Tracking generator 100 kHz to 2.2 GHz	74
Channel input	78

Spectrum Analyzer U3641, U3661

Specifications in brief

Internal reference oscillator	standard
Frequency drift in temperature range 0 to +50°C	≥± 1 x 10^{-5}
Aging	≥± 2 x 10^{-6}
OCXO reference oscillator	option 20
Frequency drift in temperature range 0 to +50°C	≥± 1 x 10^{-7}
Aging	≥± 2 x 10^{-8}
Frequency	
Frequency range	
U3641	9 kHz to 3 GHz
U3661	9 kHz to 26.5 GHz
Resolution bandwidths	1 kHz to 3 MHz, wide (5 MHz)/auto
option 26	100 Hz, 300 Hz
Shape factor	15 : 1
Frequency span	1 kHz to 3.2 GHz/zero span
Residual FM	≤60 Hz pp/100 ms
Max. input level	
Preamplifier off	≥±27 dBm
Preamplifier on	≥±13 dBm
Sweep time	50 ms to 1000 s 50 µs to 100 s Zero Span
Tracking generator	option 74
Frequency range	100 kHz to 2.2 GHz
Output level	0 to –31 dBm in 1 dB steps
Level accuracy	≤±0.5 dB at 30 MHz
Frequency response	≤±0.7 dB up to 1 GHz ≤±1.5 dB from 100 kHz to 2.2 GHz
General data	
Operating temperature range	0 to 50°C
Storage temperature range	–20 to +60°C
EMC	complies with the requirements of the European EMC Directives EN 50081-1 and EN 50082-1
Permissible humidity	<85% non-condensing
Power supply	200 to 240 V AC ±10 %, 48 to 66 Hz 100 to 120 V AC ±10 %, 48 to 66 Hz 10 to 16 V DC at XLR connector
Power consumption	approx. 60 W
Dimensions (W x H x D)	148 mm x 291 mm x 330 mm
Weight	approx. 6.9 kg without battery, without power supply

Ordering information

Spectrum Analyzer		
50 Ω	U3641	
75 Ω	U3641N	
50 Ω	U3661	
Options		
Internal controller	15 (only for U3641)	
Improved reference frequency	20	
100/300 Hz resolution bandwidths	26	
CDMA measurements	60 (only for U3641)	
TV demodulator including option 78	72	
Broadband FM demodulator	73	
Tracking generator	74	
Channel input	78	
Extras		
Battery 60 Wh	U4000-B5	
Charger for 2 batteries B5	U4000-C4	
Charger for 4 batteries B5	U4000-C5	
Charger for 4 batteries B5 and diagnostic module	U4000-C6	
Memory card 256 k	A09508	
GSM MS application		
Program for Internal Controller	PU36410300-IC	
GSM BS application		
Program for Internal Controller	PU36410310-IC	
Display Hood	R16601	
DC Connecting Cable	A01434	
SWR Bridge	ZRB2	0373.9017.5x
Transit Case	R16072	
Carrying Case	R16216	
Front Cover	A02806	

Distortion signals, frequency response	**U3641**	**U3661 band 0 (N = 1)**	**U3661 band 1 (N = 1)**	**U3661 band 2 (N = 2)**	**U3661 band 4 (N = 4)**
Frequency range	9 kHz to 3 GHz	9 kHz to 3.2 GHz	3.0 GHz to 7.1 GHz	6.7 GHz to 14.5 GHz	13.7 GHz to 26.5 GHz
Noise floor RBW 1 kHz, ATT 0 dB, VBW 10 Hz	Preamplifier off: ≤–117 dBm + 2.7 f[GHz]dB Preamplifier on: ≤–135 dBm + 4.3 f[GHz]dB	–118 dBm + 2f [GHz] >1 MHz	–115 dBm	–110 dBm	–105 dBm
Intermodulation	Preamplifier off: ≤–70 dBc Preamplifier on: ≤–70 dBc	–70 dBc <1.7 GHz –80 dBc >1.7 GHz	–100 dBc	–100 dBc	–100 dBc
Internal distortion signals	Preamplifier off: ≤–100 dB Preamplifier on: ≤–105 dB	–100 dBm >1 MHz	–90 dBm	–90 dBm	–90 dBm
Phase noise	≤–100 dBc/Hz (10 kHz carrier offset)	≤–100 dBc/Hz + 20 logN	≤–100 dBc/Hz + 20 logN	≤–100 dBc/Hz + 20 logN	≤–100 dBc/Hz + 20 logN
Frequency response	Preamplifier off: ≤±1.0 dB (100 kHz to 2.7 GHz) ≤±2.0 dB (9 kHz to 3 GHz) Preamplifier on: ≤±1.0 dB (100 kHz to 2.7 GHz) ≤±2.0 dB (9 kHz to 3 GHz)	±2 dB	±1.5 dB	±3.5 dB	±4 dB

Spectrum Analyzers U4941, U4341, U4342

9 kHz to 2.2 GHz

Lightweight portable analyzers

– mobile use (battery-powered)

Brief description

Spectrum Analyzers of the ULIS Family (Advantest) feature exceptional characteristics such as:

- Weight and size: only about 148 mm x 291 mm x 330 mm and 6.5 kg (without power supply unit or battery)
- Three types of power supply possible: AC powering from different supply voltages, battery powering or direct DC supply. With battery powering, the analyzer can operate up to 1.5 h
- 15.2 cm (6 inch) colour LCD with 100 dB display range
- Integrated preamplifier with a gain of >25 dB in full frequency range for measurements up to –135 dBm
- Two memory cards in line with PCMCIA 2.0 or JEIDA 4.1 standard can be used simultaneously for saving measurement results or instrument settings

Operation

AM- or FM-modulated audio signals can easily be monitored via built-in loudspeaker or external headphones. The displayed signal is available as a composite video signal at a rear-panel output.

The analyzer can be remote-controlled via IEC/IEEE bus or a serial RS-232 interface and can thus easily be integrated into measurement systems.

Overview of models

U4941: basic model

U4342: basic model with tracking generator

U4341: basic model with video demodulator

U4941N, U4341N, U4342N: models with 75 Ω adapters

Spectrum Analyzers U4941, U4341, U4342

Specifications in brief

Frequency	
Frequency range	9 kHz to 2.2 GHz
Resolution bandwidths	1 kHz to 3 MHz/auto, QP (6 dB): 9/120 kHz (not U4941DECT, U4341)
Shape factor	15 : 1
Frequency span/division	50 kHz to 2.4 GHz, zero span
Center frequency accuracy	±5%
Frequency stability	<10 kHz, zero span locked with f_{ref}
Residual FM	<3 kHz (V pp)
Reference frequency drift	±2 x 10^{-6}/year
Input level	
Preamplifier off	+27 dBm (ATT 10 dB), ±50 V (DC) max.
Preamplifier on	+13 dBm, ±50 V (DC) max.
Dynamic range	
Inherent noise	
Preamplifier off	(–117 + 2.7 f/GHz) dBm (RBW 1 kHz; VBW 10 Hz; ATT 0 dB; frequency >1 MHz)
Preamplifier on	(–132 + 3.3 f/GHz) dBm (RBW 1 kHz; VBW 10 Hz; ATT 0 dB; frequency >1 MHz)
Intermodulation distortion	
Preamplifier off:	
2nd-order harmonics	≤–70 dB, –30 dBm input (ATT 0 dB, frequency >10 MHz)
3rd-order harmonics	≤–70 dB, –30 dBm input (ATT 0 dB, frequency >10 MHz)
Preamplifier on:	
2nd-order harmonics	≤–70 dB, –60 dBm input (ATT 0 dB, frequency >10 MHz)
3rd-order harmonics	≤–70 dB, –60 dBm input (ATT 0 dB, frequency >10 MHz)
Residual responses	
Preamplifier off	≤–100 dBm (ATT 0 dB, input terminated with 50 Ω, frequency >1 MHz)
Preamplifier on	≤–115 dBm (ATT 0 dB, input terminated with 50 Ω, frequency >1 MHz)
Phase noise	–100 dBc(Hz) at 20 kHz
Frequency response	±1.0 dB (100 kHz to 2 GHz) ±2.0 dB (9 kHz to 2.2 GHz) (ATT 0 dB; 20°C to 30°C; ref. to 30 MHz and after automatic calibration)
Reference level	–64 to +40 dBm (without preamplifier)
Level units	dBm/dBmV/dBV/dBµV/dBpW
Level resolution	10, 5, 2, 1 dB
RF attenuator	0 to 50 dB/10 dB
Video filter	10 Hz to 3 MHz
Built-in tracking generator (U4342 only)	
Frequency range	100 kHz to 2.2 GHz
Output level	0 to –30 dBm
Sweep time	4.5 ms to 1000 s, zero span
U4941	50 µs to 1000 s, zero span
Interfaces	IEC625 Bus (IEEE488), RS-232-C

General data	
Dimensions (W x H x D)	291 mm x 148 mm x 330 mm
Weight	6.5 kg without power supply, 8.5 kg with power supply or battery

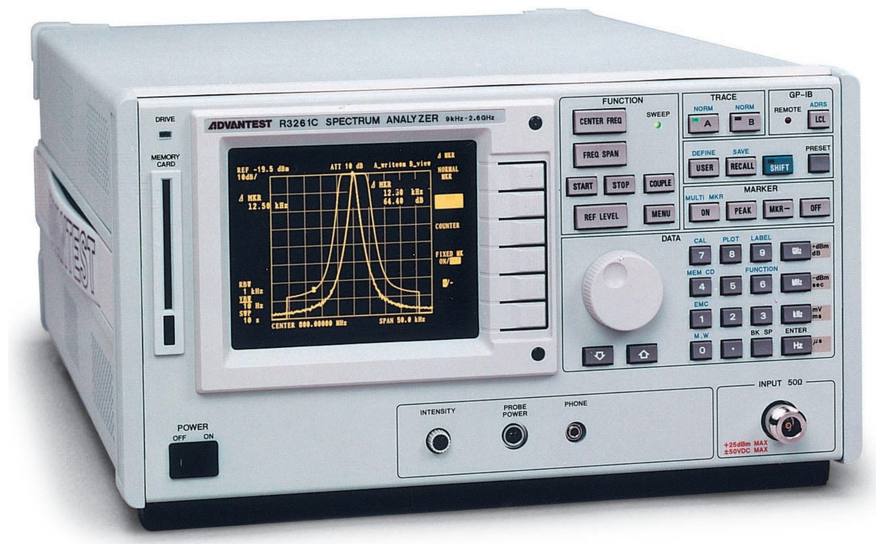
Ordering information

Spectrum Analyzers	U4941, U4341, U4342
Extras	
IEC/IEEE-Bus Cable 1 m/2 m	408JE-101/102
19" Adapter 4 HU	A02405
Front Cover	A02806
Memory Card 256 k/2 M	508/509
Transit Case	R16072
Carrying Case	R16276
TDR Measurement Software (Windows)	RSWinTDR
DOS Software for PC control of analyzer	SPECTRA
Battery for approx. 1.6 h operation	U4000-B5
Charger for	
4 batt. B2-B5 LED indication, 1 h charging time	U4000-C2
4 batt. B2-B5 µP control, 1 h charging time	U4000-C3
2 batt. B3 or 1 batt. B2/B5, 4 to 8 h charging time	U4000-C4
Adapter 50/75 Ω, N, 10 MHz to 2 GHz, 1 dB, St/B	ZT301

Spectrum Analyzers R3261, R3361

(100 Hz) 9 kHz to 3.6 GHz

General applications in development, production, testshop and service as well as EMC precertification



R3261C

Brief description

Spectrum Analyzers of the 3261 and 3361 Series (Advantest) provide synthesizer operation with high frequency accuracy and stability, 30 Hz resolution bandwidth and –130 dBm sensitivity. For specified setting conditions the total level accuracy is <1 dB. The digital functions provide great ease of operation and signal processing capabilities like top-class instruments.

Operation

User-defined parameters can be entered via the numeric keypad. Softkey-controlled menus reduce the number of function keys and avoid keys being assigned double functions. The user can configure application-specific softkey menus. A memory card of credit card size and the built-in memories allow program sequences, instrument settings and waveforms to be stored and recalled. Antenna correction factors and limit lines can be entered via the front-panel keys. A window function allows a faster sweep time in defined display ranges.

Overview of models

R3261C: 9 kHz to 2.6 GHz

R3261D: 9 kHz to 3.6 GHz

R3361C: same as R3261C but with built-in tracking generator, 9 kHz to 2.6 GHz

R3361D: same as R3261D but with built-in tracking generator, 9 kHz to 3.6 GHz

R3261CN, R3361CN: models with 75 Ω adapter

Spectrum Analyzers R3261, R3361

Specifications in brief

Frequency range	
R3261C	9 kHz to 2.6 GHz
R3261D	9 kHz to 3.6 GHz
Resolution bandwidths	30 Hz to 1 MHz, auto, QP (6 dB): 200 Hz/9 kHz/120 kHz
Shape factor	15 : 1
Frequency span/division	1 kHz to 2.6 GHz/zero span, log display 1 to 3 decades, start/stop
Frequency stability	<300 Hz/min
Residual FM	<20 Hz (V_{pp})/0.1 s (span <2 MHz)
IM-free input level	–131 to +25 dBm/±50 V (DC)
Dynamic range	>70 dB
Inherent noise (1 kHz)	(–121 dBm +1.5 x f/GHz) dBm
Residual responses	–100 dBm (>500 kHz)
Phase noise	–105 dBc(Hz) at 20 kHz
Frequency response	±0.5 dB (<2 GHz)
Reference level	–109 to +40 dBm/0.1 dB
Level units	dBm, dBµV, V, dB(µV/m), dBmV, dBpW
Level resolution	log 10/5/2/1/0.5/0.2/0.1 dB, lin x1/x2/x4/x8
RF attenuator	0 to 50 dB/10 dB
Video filter	1 Hz to 1 MHz in 1 to 10 sequence
Sweep time	30 ms to 1000 s, manual, automatic
Evaluation functions	average, max hold, default offset, 2 display memories, marker peak search, delta marker, x dB down, marker next peak, signal track, frequency counter with 1 Hz resolution, bandwidth measurement, dBc(Hz), dBm(Hz), display line, multimarker, etc

Internal tracking generator

Frequency range R3361C	9 kHz to 2.6 GHz
R3361D	9 kHz to 3.6 GHz
Output level	0 to –59 dBm in 1 dB steps
Frequency response	±0.7 dB (<1 GHz)
Output impedance	50 Ω, VSWR <1.5:1 (<2 GHz); models CN, DN: 75 Ω

General data

Interfaces	IEC625 bus (IEEE488)
Dimensions (W x H x D)	330 mm x 132 mm x 450 mm
Weight	15 kg

Ordering information

Spectrum Analyzer

9 kHz to 2.6 GHz	R3261C
9 kHz to 3.6 GHz	R3361D

Options

RS-232 I/O Interface, Gated Sweep	80
Integrated BASIC Controller, RS-232 I/O Interface, 2nd IEEE Bus, Gated Sweep	81
Frequency Range Extension 100 Hz	91

Extras

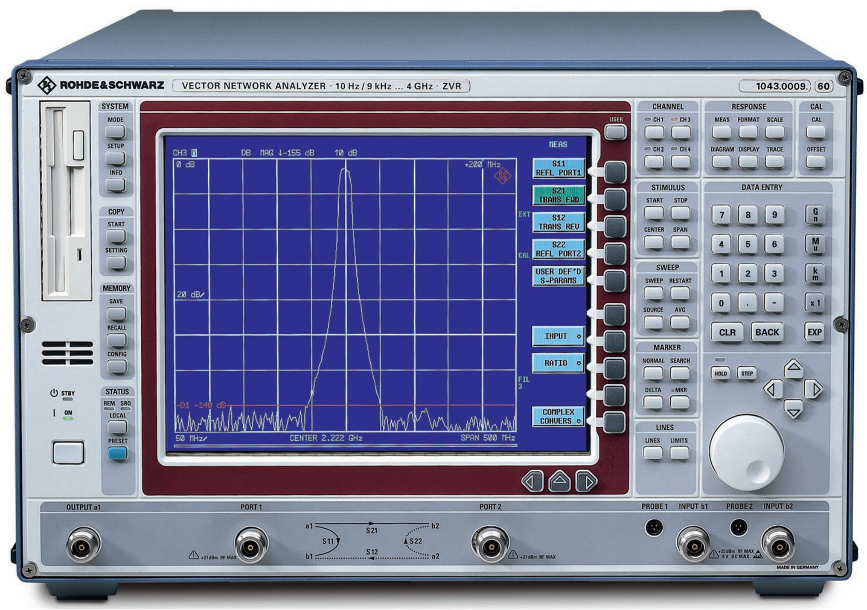
IEC/IEEE-Bus Cable 1 m/2 m	408JE-101/102
19" Adapter 4 HU	A02455
Front Cover	A02804
Memory Card 32 k (standard)	A09505-1
Memory Card128 k	A09506-1
DOS Software for program-controlled EMC precertification	EPS9980
External EMC Preselector	AUP9211A
Pulse Limiter 9 kHz to 30 MHz	CFL9206
Preamplifier	R14601
Impedance Converter 1 M	R14602
Aluminium Transit Case	R16056A
Carrying Case	R16211
DOS Software for PC control of analyzer	SPECTRA
TDR Measurement Software (Windows)	RSWinTDR

Vector Network Analyzers ZVC, ZVCE, ZVR, ZVRE, ZVRL

ZVRx: (10 Hz) 9 kHz to 4 GHz

ZVCx: 20 kHz to 8 GHz

Extremely fast, high-precision and versatile vector network analyzers



ZVR (photo 43086-11)

Brief description

The family comprises the five Vector Network Analyzers ZVRL, ZVRE and ZVR as well as ZVCE and ZVC which extend the frequency range to 8 GHz. All models are compact instruments with integrated generator, test set and receiver, each tailored to a different field of application. All analyzers can be subsequently upgraded to the higher-class models.

ZVRL – the lean model
ZVRL comprises a test set with **one SWR bridge**, two measurement channels and a reference channel for measuring the magnitude and phase of the forward S-parameters S_{11} and S_{21}.

ZVRE and ZVCE – the economy models
The test set of these models comprises **two SWR bridges (ZVRE) or directional couplers (ZVCE),** an RF switch, two measurement channels and one reference channel. They measure the magnitude and phase of all four S-parameters of a DUT, allow a full two-port calibration (TOSM) and have an exceptionally high accuracy and wide dynamic range.

ZVR and ZVC – the universal models
ZVR and ZVC comprise a test set with **two SWR bridges (ZVR) or directional couplers (ZVC),** an RF switch, two measurement channels and – unlike ZVRE and ZVCE – **two reference channels**. With this configuration a variety of novel calibration procedures, eg TNA, can be performed, which considerably improve the accuracy particularly in non-coaxial applications. ZVR and ZVC are the allrounders of the family and suitable for applications in R&D and production no matter how sophisticated.

Main features

- High measurement speed (in fast mode <125 µs/testpoint)
- Low inherent noise (–130 dBm)
- Wide dynamic range (>130 dB)
- Fast IEC/IEEE bus(<15 ms)
- High frequency resolution (10 µHz)
- Short calibration times (<20 s)
- Active colour LCD (26 cm)

Dynamic range >130 dB
Thanks to fundamental mixing, the useful dynamic range of the R&S network analyzers is more than 25 dB better than that achieved by conventional sampling techniques. Because of the low-noise front end, the ZVR models attain a dynamic range of >130 dB, so transmission measurements on DUTs with extremely high stopband attenuation can be performed at high speed – even at low input levels.

High sweep rate
The high measurement speed allows more than 25 sweeps/s with 200 points. This gives a real analog feeling for tuning sensitive DUTs in real time. The short measurement time of <125 µs per point considerably increases the throughput in automatic test systems.

Fast IEC/IEEE bus
Reading out a single marker value via the IEC/IEEE bus takes only 15 ms, reading out complete trace data (200 values) less than 30 ms, which speeds up complex, computer-controlled measurements.

Vector Network Analyzers ZVC, ZVCE, ZVR, ZVRE, ZVRL

Wide frequency range

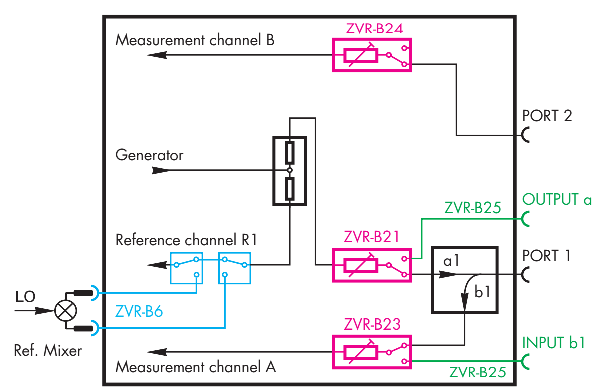
Short calibration times
With the new R&S calibration method *AutoKal* a simple through-connection of the test ports is sufficient to perform automatic full two-port calibration. This calibration takes only some seconds (including computation of error parameters) and cuts time and operating errors to a minimum.

Innovative calibration techniques
ZVR and ZVC provide an additional number of modern calibration methods (TOM, TRM, TRL, TNA). Unlike classic TOSM (12-term), they require only three different standards which may be partly unknown. This opens new application fields.

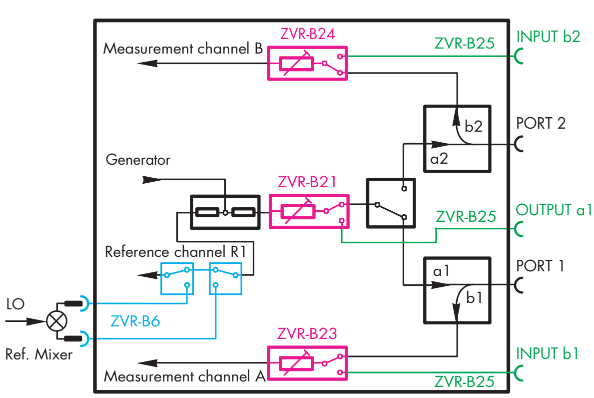
Mixer and amplifier measurements
Due to the use of two independent synthesizers for generator and receiver and the ability to control two external generators, a variety of measurements can be performed at full dynamic range (up to 140 dB) and speed on frequency-converting DUTs, eg mixing losts or intermodulation products of mixers. Thanks to the special receiver principle used by Rohde & Schwarz analyzers, add-ons like filters are not required for the suppression of spurious.

Integrated in the world of PC
The analyzers of the ZVR family can be configured like a PC and networked with measuring instruments and PCs. Data exchange is also possible via the built-in PC-compatible disk drive. The analyzers ensure full compatibility with CAE tools, eg Super Compact or Touchstone.

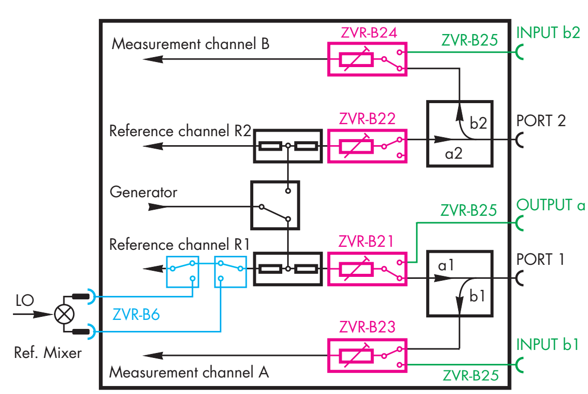
System configuration



Test set ZVRL



Test set ZVRE



Test set ZVR

Vector Network Analyzers ZVC, ZVCE, ZVR, ZVRE, ZVRL

Brief specifications

Data only for 50 Ω test sets. For 75 Ω test sets and further details please refer to data sheet PD 757.1802.23. Unless otherwise stated, specifications apply to test ports PORT 1 and PORT2, a nominal source power of –10 dBm at the test port and an IF bandwidth ≤10 kHz.

The arrow marks important data.

Frequency range, measurement speed, dynamic range

Frequency range

Without *External Measurements* option	
ZVRL, ZVRE, ZVR	
with passive test set 50 Ω or 75 Ω	9 kHz to 4 GHz
with active test set 50 Ω or 75 Ω	300 kHz to 4 GHz
ZVCE, ZVC	
with active test set 50 Ω	20 kHz to 8 GHz
With *External Measurements* option	
ZVRL, ZVRE, ZVR	10 Hz to 4 GHz
ZVCE, ZVC	20 kHz to 8 GHz
Relative frequency deviation	$<2 \times 10^{-6} + 1 \times 10^{-6}$/a
Resolution	10 µHz

Measurement speed (above 2 MHz)

Number of points: 1 to 2001 (selectable)

Measurement time per point	IF bandwidth (IFBW) 3 kHz	10 kHz	26 kHz
with system error correction	<1050 µs	<460 µs	<330 µs
normalized	<530 µs	<230 µs	<190 µs
Fast Mode			
with system error correction	–	–	<240 µs
normalized	–	–	<125 µs

Dynamic range (without system error correction)
ZVRL, ZVRE, ZVR
(models ZVRL and ZVRE: at IF bandwidth 10 Hz values are reduced by 5 dB)

	IF bandwidth 10 Hz	3 kHz	10 kHz
With passive test set 50 Ω			
20 kHz to 200 kHz	>65 dB, typ. >110 dB	–	–
200 kHz to 20 MHz	>110 dB	>90 dB	>85 dB
20 MHz to 3 GHz	>120 dB	>100 dB	>95 dB
3 GHz to 4 GHz	>110 dB	>90 dB	>85 dB
With active test set 50 Ω			
300 kHz to 1 MHz	>107 dB	>87 dB	>82 dB
1 MHz to 20 MHz	>110 dB	>90 dB	>85 dB
20 MHz to 3 GHz	>120 dB	>100 dB	>95 dB
3 GHz to 4 GHz	>110 dB	>90 dB	>85 dB
With *External Measurements* option			
50 Hz to 200 kHz	>75 dB	–	–
200 kHz to 20 MHz	>110 dB	>95 dB	>90 dB
20 MHz to 1 GHz	>130 dB	>110 dB	>105 dB
1 GHz to 3 GHz	>120 dB	>100 dB	>95 dB
3 GHz to 4 GHz	>110 dB	>95 dB	>90 dB

ZVCE, ZVC
(model ZVCE: at IF bandwidth 10 Hz values are reduced by 5 dB)

	10 Hz	3 kHz	10 kHz
With active test set 50 Ω			
20 kHz to 200 kHz	>60 dB, typ. >90 dB	–	–
200 kHz to 20 MHz	>100 dB	>80 dB	>75 dB
20 MHz to 3 GHz	>120 dB	>100 dB	>95 dB
3 GHz to 4 GHz	>110 dB	>90 dB	>85 dB
4 GHz to 6 GHz	>105 dB	>85 dB	>80 dB
6 GHz to 8 GHz	>100 dB	>80 dB	>75 dB
With *External Measurements* option			
20 kHz to 200 kHz	>75 dB	–	–
200 kHz to 20 MHz	>110 dB	>95 dB	>90 dB
20 MHz to 1 GHz	>130 dB	>110 dB	>105 dB
1 GHz to 3 GHz	>120 dB	>100 dB	>95 dB
3 GHz to 4 GHz	>110 dB	>95 dB	>90 dB
4 GHz to 6 GHz	>105 dB	>90 dB	>85 dB
6 GHz to 8 GHz	>100 dB	>85 dB	>80 dB

Stability of measurement trace

per degree temperature variation	
ZVRL, ZVRE, ZVR	<0.05 dB or 0.4°
ZVCE, ZVC	<0.1 dB or 1°

Measurement bandwidth

(IF bandwidth IFBW)	1 Hz to 10 kHz (half-decade steps) and 26 kHz (full)

Measurement accuracy

The following data are valid between 20°C and 30°C provided the instrument has reached thermal equilibrium (about 1 h after switch-on) and the temperature has not varied by more than 1 degree after calibration.

ZVRE and ZVR (bidirectional network analyzers)

Accuracy of transmission measurements after full two-port system error correction (TOSM)
Specifications are based on a matched DUT and refer to a nominal source power of –10 dBm at the test port.

With test set 50 Ω

300 kHz to 4 GHz

at IF bandwidth 10 Hz	
for +10 dB to +3 dB	<1 dB or 6°
for +3 dB to –5 dB	<0.2 dB or 1°
for –5 dB to –60 dB (passive)	<0.05 dB or 0.4°
for –5 dB to –60 dB (active)	<0.2 dB or 1°
for +3 dB to –40 dB	typ. <0.025 dB
for –60 dB to –70 dB	<0.2 dB or 1°
for –70 dB to –80 dB (ZVRE)	<1 dB or 6°
for –70 dB to –85 dB (ZVR)	<1 dB or 6°

Accuracy of reflection measurements after system error correction (TOSM or full one-port)
Specifications are based on an isolating DUT and refer to a nominal source power of –10 dBm at the test port.

With test set 50 Ω
It is assumed that the return loss of the match used for calibration is >46 dB (effective system data: directivity D_{eff} >46 dB, test port match S_{eff} >30 dB).
20 kHz to 4 GHz (passive test set),
300 kHz to 4 GHz (active test set)

for +10 dB to +3 dB	<1 dB or 6°
for +3 dB to –15 dB	<0.4 dB + 0.04 dB/GHz, <3° + 0.4°/GHz
for –15 dB to –25 dB	<1 dB or 6°
for –25 dB to –35 dB	<3 dB or 20°

ZVCE and ZVC (bidirectional network analyzers)

Accuracy of transmission measurements after full two-port system error correction (TOSM)
Specifications are based on a matched DUT and refer to a nominal source power of **–20 dBm** at the test port.

10 MHz to 4 GHz

at IF bandwidth 10 Hz	
for +10 dB to +3 dB	<1 dB or 6°
for +3 dB to –50 dB	<0.2 dB or 1°
for +3 dB to –40 dB	typ. <0.025 dB
for –50 dB to –60 dB	<0.5 dB or 4°
for –60 dB to –70 dB (ZVCE)	<1 dB or 6°
for –60 dB to –75 dB (ZVC)	<1 dB or 6°

4 GHz to 8 GHz

at IF bandwidth 10 Hz	
for +10 dB to +3 dB	<1 dB or 6°
for +3 dB to –45 dB	<0.2 dB or 2°
for +3 dB to –40 dB	typ. <0.025 dB
for –45 dB to –55 dB (ZVCE)	<1 dB or 6°
for –45 dB to –60 dB (ZVC)	<1 dB or 6°

Accuracy of reflection measurements
after system error correction (TOSM or full one-port)
Specifications are based on an isolating DUT and refer to a nominal source power of **–20 dBm** at the test port.
It is assumed that the return loss of the match used for calibration is >40 dB (effective system data: directivity D_{eff} >40 dB, test port match S_{eff} >30 dB).

20 kHz to 8 GHz

for +10 dB to +3 dB	<1 dB or 6°
for +3 dB to –10 dB	<0.4 dB + 0.04 dB/GHz, <3° + 0.4°/GHz
for –10 dB to –20 dB	<1 dB or 6°
for –20 dB to –30 dB	<3 dB or 20°

ZVRL (unidirectional network analyzer)

Accuracy of transmission measurements
after system error correction (one-path two-port)
Specifications are based on a matched DUT and refer to a nominal source power of –10 dBm at the test port.
With test set 50 Ω (only passive test set available)
20 kHz to 300 kHz
at IF bandwidth 10 Hz
for +10 to –45 dB (typ. –80 dB) <1 dB or 6°

300 kHz to 4 GHz
at IF bandwidth 10 Hz

for +10 dB to +3 dB	<1 dB or 6°
for +3 dB to –75 dB	<0.2 dB or 1°

ZVRL – Accuracy of reflection measurements
after system error correction (full one-port or one-path two-port)
Specifications are based on an isolating DUT and refer to a nominal source power of –10 dBm at the test port.

With test set 50 Ω
It is assumed that the return loss of the match used for calibration is >46 dB (effective system data: directivity D_{eff} >46 dB, test port match S_{eff} >30 dB).

20 kHz to 4 GHz

for +10 dB to +3 dB	<1 dB or 6°
for +3 dB to –15 dB	<0.4 dB + 0.04 dB/GHz, <3° + 0.4°/GHz
for –15 dB to –25 dB	<1 dB or 6°
for –25 dB to –35 dB	<3 dB or 20°

Effective system characteristics (above 200 kHz)

These data are valid between 20°C and 30°C provided the instrument has reached thermal equilibrium (about 1 h after switch-on) and the temperature variation is not more than 1 degree after calibration.

ZVRE, ZVR, ZVCE, ZVC (bidirectional network analyzers)

After full two-port system error correction (TOSM)

	ZVRE, ZVR	**ZVCE, ZVC**
Directivity	>46 dB [1)]	>40 dB [2)]
Source match	>40 dB [3)]	>36 dB [4)]
Load match	>46 dB [1)]	>40 dB [2)]
Transmission tracking	<0.04 dB	<0.06 dB
Reflection tracking	<0.04 dB	<0.06 dB

ZVRL (unidirectional network analyzer)

After system error correction (one-path two-port)

Directivity	>46 dB [1)]
Source match (PORT 1)	>30 dB
Load match (PORT 2)	>18 dB
Transmission tracking	<0.2 dB
Reflection tracking	<0.06 dB

[1)] Return loss of matched load >46 dB.
[2)] Return loss of matched load >40 dB.
[3)] Phase deviation of open standard <1°.
[4)] Phase deviation of open standard <1.6°.

Output power

Power range (without options)

ZVRL, ZVRE, ZVR with test set 50 Ω	–25 dBm to 0 dBm
ZVRL, ZVRE, ZVR with test set 75 Ω	–27 dBm to –6 dBm
ZVCE, ZVC	
20 kHz to 6 GHz	–25 dBm to 0 dBm
6 GHz to 8 GHz	–25 dBm to –3 dBm

Deviation (at –10 dBm)
These data are valid between 20°C and 30°C.

up to 2 MHz	<1 dB
above 2 MHz	<0.5 dB

Linearity (referred to –10 dBm)

0 dBm to –25 dBm (up to 20 kHz)	<0.8 dB
0 dBm to –15 dBm (above 20 kHz)	<0.4 dB
–15 dBm to –25 dBm	<0.6 dB

Resolution 0.1 dB

Spectral purity

Harmonics	ZVRL, ZVRE, ZVR	ZVCE, ZVC
At maximum source power		
40 kHz to 400 MHz	<–25 dBc	<–25 dBc
above 400 MHz	<–30 dBc	<–25 dBc
At –10 dBm source power		
up to 600 MHz	<–35 dBc	<–35 dBc
above 600 MHz	<–40 dBc	<–35 dBc

Spurious <–40 dBc

SSB phase noise
1 Hz bandwidth, 10 kHz from carrier

up to 10 MHz	<–110 dBc
10 MHz to 150 MHz	<–100 dBc
150 MHz to 1 GHz	<–90 dBc
above 1 GHz	<–90 dBc +20·log(f/GHz) (<–78 dBc at 4 GHz, <–72 dBc at 8 GHz)

Residual FM
RMS weighting from 10 Hz to 3 kHz

up to 10 MHz	<1 Hz
10 MHz to 150 MHz	<2 Hz
150 MHz to 1 GHz	<5 Hz
1 GHz to 2 GHz	<10 Hz
2 GHz to 4 GHz	<20 Hz
above 4 GHz	<40 Hz

Input level

Maximum nominal input level	**Receiver step attenuator** **0 dB**	**≥30 dB**
Without options	0 dBm	–
With *Receiver Step Attenuator* option	0 dBm	+27 dBm
Damage level		
Without options	+27 dBm	–
With *Receiver Step Attenuator* option	+27 dBm	+30 dBm

Damage DC current/voltage

With passive test set (internal DC short R_{in} <0.1 Ω)	0.5 A
With active test set	0.5 A or 30 V

RMS noise level (50 Ω, without options)
With 75 Ω models the noise level is higher by 6 dB

Frequency range	IF bandwidth	Noise level
9 kHz to 50 kHz	1 kHz	<–75 dBm
50 kHz to 200 kHz	3 kHz	<–70 dBm
200 kHz to 20 MHz	3 kHz	<–90 dBm
20 MHz to 3 GHz	3 kHz	<–100 dBm
3 GHz to 4 GHz	3 kHz	<–90 dBm
4 GHz to 8 GHz	3 kHz	<–80 dBm

Vector Network Analyzers ZVC, ZVCE, ZVR, ZVRE, ZVRL

System error correction techniques

All analyzer models offer simple normalizations for reflection and transmission measurements, one-path two-port calibration and a full one-port calibration (3-term). Full two-port calibration TOSM (12-term) can be carried out with models ZVRE and ZVCE. ZVR and ZVC offer the greatest variety of modern system error correction methods. Apart from the techniques already mentioned, the following full two-port procedures are available: TOM, TRM, TRL, TNA, TOM-X (15-term). The names indicate the standards used for calibration.

- T = Through
- O = Open
- S = Short
- M = Match
- R = Reflect
- L = Line
- N = Network
- A = Attenuator

TOM-X (X = crosstalk) is an extension of the TOM method. It considers all possible crosstalk between the four receiver channels (full model). Since an exact model and no approximations are used, the result is a perfect elimination of crosstalk and thus the effective dynamic range of the system is dramatically increased. On the other hand, this method needs a higher effort. The lowest possible effort offers the new automatic calibration procedure *AutoKal* that is available as an option for ZVRE, ZVR, ZVCE and ZVC.

General data

Nominal temperature range	+5 °C to +40 °C
Operating temperature range	0 to +50 °C
Storage temperature range	–40 °C to +70 °C
Power supply	90 V to 132 V (AC), 47 Hz to 440 Hz or 180 V to 264 V (AC), 47 Hz to 66 Hz; safety class I to VDE 411
Power consumption	max. 400 VA (standby: 10 W)
Certification	CE mark
Dimensions (W x H x D)	435 mm x 281 mm x 584 mm
Weight	30 kg

Benefits at a glance

Features	Benefits	Option
Comprehensive measurement functions		
Patented automatic two-port calibration AutoKal	Saves time, prevents operating errors	ZVR-B1
New TOM calibration method	Only three standards needed	ZVR, ZVC
Plausibility test during calibration	No calibration errors	ZVR/E/L
Power calibration	Accurate source power and receiver levels	ZVR-B7
Independent measurement of 4 parameters	Combined capabilities of 4 analyzers	✔
Segmented diagram axes	Increased measurement speed	✔
Zoom function even in Smith diagram	Improved reading accuracy	✔
High-resolution, 26 cm colour display	Clear readout, effortless operation	✔
Independent computation of markers	More information at a glance	✔
Scales with min/max values	Clear curve display	✔
Creation of individual logos	Professional documentation	✔
Versatile instrument		
Universal measurements on frequency-converting DUTs	Harmonics and mixer measurements	ZVR-B4
External reference channel ports	Group-delay measurements on frequency-converting DUTs	ZVR-B4 + ZVR-B6
Multiport measurements	Real-time adjustment of three-port and four-port devices	ZVR-B8, ZVR-B14
Automatic determination of filter characteristics	Filter parameters set with a single keystroke	✔
User-defined aperture for group-delay measurements	Independent of test frequencies	✔
Triggered measurements (point/sweep)	For measuring pulsed signals	✔
Phase unwrap	Phase measurement beyond 360°	✔
Marker tracking function	Speeds up alignment	✔
Automatic generation of equivalent circuit	Saves conversion of results	✔
Versatility for automatic test systems		
Use of external generators	Convenient mixer and IP_3 measurements	ZVR-B4
External Measurements option	Flexible configuration of an external test set	ZVR-B25
IEC/IEEE bus	SCPI standard	✔
Networking capabilities/LAN	Networking with other measuring instruments and computers	ZVR-B15 + FSE-B16
Links to the PC world		
Use as a PC and measuring instrument	Measurement, remote control and calculation in one unit	ZVR-B15 + FSE-B17
Compatible to Super Compact® and Touchstone®	Simple data exchange	✔
Four PC slots available	Configurable like a PC	ZVR-B15

Ordering information

Order designation	Type	Frequency range	Order No.
Vector Network Analyzers (test sets included)			
3-channel, unidirectional, 50 Ω, passive	ZVRL	9 kHz to 4 GHz	1043.0009.41
3-channel, bidirectional, 50 Ω, passive	ZVRE	9 kHz to 4 GHz	1043.0009.51
3-channel, bidirectional, 50 Ω, active	ZVRE	300 kHz to 4 GHz	1043.0009.52
4-channel, bidirectional, 50 Ω, passive	ZVR	9 kHz to 4 GHz	1043.0009.61
4-channel, bidirectional, 50 Ω, active	ZVR	300 kHz to 4 GHz	1043.0009.62
3-channel, bidirectional, 50 Ω, active	ZVCE	20 kHz to 8 GHz	1106.9020.50
4-channel, bidirectional 50 Ω, active	ZVC	20 kHz to 8 GHz	1106.9020.60
Alternative test sets Active test sets, in contrast to passive test sets, comprise internal bias networks, eg to supply DUTs.			
75 Ω SWR Bridge for ZVRL (instead of SWR bridge, 50 Ω, passive) [a]			
75 Ω, passive	ZVR-A71	9 kHz to 4 GHz	1043.7690.18
75 Ω Bridge Pairs for ZVRE and ZVR (instead of bridge pairs, 50 Ω) [1)]			
75 Ω, passive	ZVR-A75	9 kHz to 4 GHz	1043.7755.28
75 Ω, active	ZVR-A76	300 kHz to 4 GHz	1043.7755.29
Options			
AutoKal	ZVR-B1	0 to 8 GHz	1044.0625.02
Mixer Measurements [b]	ZVR-B4	same as analyzer	1044.1215.02
Reference Channel Ports	ZVR-B6	same as analyzer	1044.1415.02
Power Calibration [c]	ZVR-B7	same as analyzer	1044.1544.02
3-Port Adapter	ZVR-B8	0 to 4 GHz	1086.0000.02
Virtual Embedding Networks [d]	ZVR-K9	–	1106.8830.02
4-Port Adapter (2 x SPDT)	ZVR-B14	0 to 4 GHz	1106.7510.02
4-Port Adapter (SP3T)	ZVR-B14	0 to 4 GHz	1106.7510.03
Controller (German) [e]	ZVR-B15	–	1044.0290.02
Controller (English) [5)]	ZVR-B15	–	1044.0290.03
Ethernet BNC for ZVR-B15	FSE-B16	–	1073.5973.02
Ethernet AUI for ZVR-B15	FSE-B16	–	1073.5973.03
IEC/IEEE-Bus Interface for ZVR-B15	FSE-B17	–	1066.4017.02
Generator Step Attenuator PORT 1	ZVR-B21	same as analyzer	1044.0025.11
Generator Step Attenuator PORT 2 [f]	ZVR-B22	same as analyzer	1044.0025.21
Receiver Step Attenuator PORT 1	ZVR-B23	same as analyzer	1044.0025.12
Receiver Step Attenuator PORT 2	ZVR-B24	same as analyzer	1044.0025.22
External Measurements, 50 Ω [g]	ZVR-B25	10 Hz to 4 GHz (ZVR/E/L) 20 kHz to 8 GHz (ZVC/E)	1044.0460.02
Upgr. Kit ZVRL → ZVRE [h]	ZVR-U1	–	1085.6005.02
Upgrade Kit ZVRE → ZVR [8)]	ZVR-U2	–	1085.6092.02
Upgrade Kit ZVRL → ZVR [8)]	ZVR-U3	–	1085.6170.02
Service Kit [8)]	ZVR-Z1	–	1044.1650.02

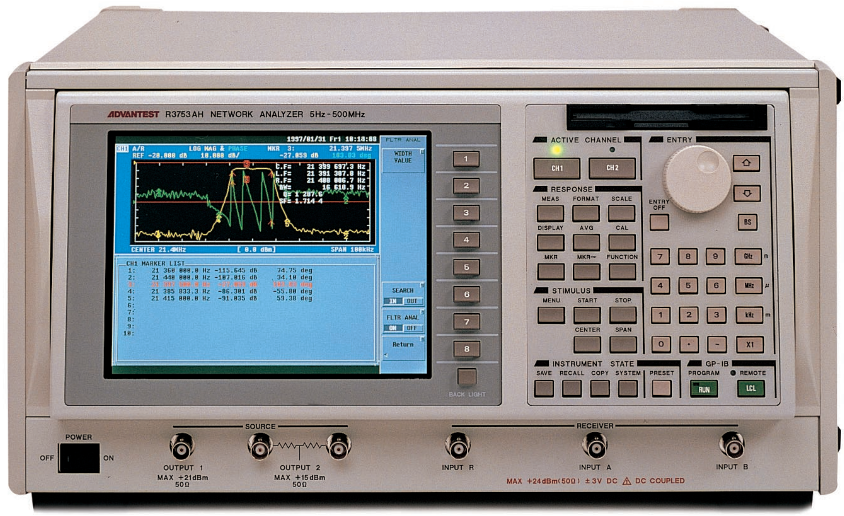
Order designation	Type	Frequency range	Order No.
Extras			
Test Cables (pairs)			
N, 50 Ω, male	ZV-Z11	0 to 18 GHz	1085.6505.02
N, 75 Ω, male	ZV-Z12	0 to 18 GHz	1085.6570.02
Calibration Kits			
N, 50 Ω	ZV-Z21	0 to 18 GHz	1085.7099.02
N, 50 Ω	ZCAN	0 to 3 GHz	0800.8515.52
N, 75 Ω	ZCAN	0 to 3 GHz	0800.8515.72
PC 3.5	ZV-Z23	0 to 26.5 GHz	1085.7247.02
F, male, 75 Ω	ZV-Z24	0 to 3 GHz	1085.7001.02
TRL Suppl. Kit, N, 50 Ω	ZV-Z26	0.4 to 18 GHz	1085.7318.02
TRL Suppl. Kit, PC 3.5	ZV-Z27	0.4 to 26.5 GHz	1085.7401.02
TOM-X Suppl. Kit, N, 50 Ω	ZV-Z28	0 to 18 GHz	1085.7499.02
TOM-X Suppl. Kit, PC 3.5	ZV-Z29	0 to 26.5 GHz	1085.7647.02
Sliding Loads			
N, 50 Ω, male	ZV-Z41	1.7 to 18 GHz	1085.8095.02
N, 50 Ω, female	ZV-Z41	1.7 to 18 GHz	1085.8095.03
PC 3.5, male	ZV-Z43	1.7 to 26.5 GHz	1085.8195.02
PC 3.5, female	ZV-Z43	1.7 to 26.5 GHz	1085.8195.03
Adapters for Test Cable ZV-Z11			
N, 50 Ω, male	ZV-Z51	0 to 18 GHz	1085.8295.02
N, 50 Ω, female	ZV-Z51	0 to 18 GHz	1085.8295.03
PC 3.5, male	ZV-Z53	0 to 26.5 GHz	1085.8408.02
PC 3.5, female	ZV-Z53	0 to 26.5 GHz	1085.8408.03
Adapters for Test Cable ZV-Z12			
F, male	ZV-Z54	0 to 3 GHz	1085.8514.02
F, female	ZV-Z54	0 to 3 GHz	1085.8514.03
Attenuators, N 50 Ω			
1 W	DNF	0 to 12.4 GHz	0272.4X10.50
50 W [8)]	RBU50	0 to 2 GHz	1073.8695.XX
100 W [8)]	RBU100	0 to 2 GHz	1073.8495.XX
Matching Pads, 50 Ω → 75 Ω			
Series resistor	RAZ	0 to 2.7 GHz	0358.5714.02
L-section	RAM	0 to 2.7 GHz	0358.5414.02
Bias Network/DC Block			
Bias Network	ZV-Z61	2 MHz to 4 GHz	1106.8130.02
DC Block	FSE-Z3	5 MHz to 7 GHz	4010.3895.00
Power Splitter			
2 x 50 Ω	RVZ	0 to 2.7 GHz	0800.6612.52
External SWR Bridges			
50 Ω	ZRA	40 kHz to 150 MHz	1052.3607.52
50 Ω	ZRB 2	5 MHz to 3 GHz	0373.9017.52
75 Ω	ZRB 2	5 MHz to 2 GHz	0802.1018.73
50 Ω	ZRC	40 kHz to 4 GHz	1039.9492.52
75 Ω	ZRC	40 kHz to 2.5 GHz	1039.9492.72
Miscellaneous			
Transit Case	ZZK-965	–	1013.9437.00
19" Rack Adapter with front handles	ZZA-96	–	396.4928.00

a. To be ordered together with the analyzer.
b. Harmonics measurements included.
c. Power meter and sensor required.
d. Only for ZVR or ZVC with ZVR-B15.
e. DOS, Windows 3.11, keyboard and mouse included.
f. For ZVR or ZVC only.
g. Attenuators required.
h. On request.

Vector Network Analyzers R3752, R3753

5 Hz to 500 MHz

Application-oriented vector network analyzers



R3753

Brief description

Vector Network Analyzers R3752 and R3753 (Advantest) are designed for a wide variety of applications up to 500 MHz, in particular where high throughput and wide dynamic range are required. Measurements can be carried out on two DUTs at a time with up to four traces being simultaneously displayed on the analyzers. In addition to the normal sweep mode, a programmable sweep allows the user to define resolution bandwidth, power and measurement time for each individual testpoint – in combination with selected frequency segments the measurement time can be considerably reduced.

Main features

- Stand-alone or system unit
- High measurement speed 0.1 ms/ testpoint with 10 kHz resolution and full calibration
- 2 channels, 4 traces
- 115 dB dynamic range
- Built-in process controller

R3752 Series

The analyzers of this series have especially been developed for system applications and have an alphanumeric fluorescent display. They have one to three channels and a BASIC controller is provided as standard. The internal programs allow for instance simple user prompts to be displayed as well as a go/nogo decision for the test result. The low weight of 12 kg makes the analyzer also suitable for mobile applications. In conjunction with a portable PC with control software, a full-featured screen can be obtained. A RAM ensures reliable storage of the results even under harsh conditions of use.

R3752

R3753 Series

The analyzers of this series have a TFT colour LC display and are designed as stand-alone units. They have one to three channels and a BASIC controller is provided as standard like in the R3752 Series. Detailed user prompts can for instance be displayed on the screen in addition to the test results.

Overview of models

	R3752 Series			R3753 Series		
Model	R3752A H	R3752B H	R3752E H	R3753A H	R3753B H	R3753E H
Design	System unit			Stand-alone unit		
Display	Alphanum. fluorescent display			TFT colour LC display		
Outputs	Direct or power splitter		Direct	Direct or power splitter		Direct
Inputs	R, A, B	R, A	A	R, A, B	R, A	A
Frequency range	5 Hz to 500 MHz, 0.1 Hz steps					
Connection to S-parameter test set	No	No	No	Yes	No	No

Test programs and instrument settings can be saved on floppy disk. Frequently recurring test routines can easily be executed thanks to menu-guided control; an external controller is usually not required. All models of this series are fitted with an IEC/IEEE bus for external control. The command language is SCPI-compatible. A serial interface (RS-232) for the connection of a printer or barcode reader is available in addition. Analysis of test results is facilitated by entry of limit lines. A user-definable parallel interface allows direct connection of component feeders. All R3753 models have a RAM and are highly suitable for mobile measurements thanks to their low weight.

Specifications in brief

Measurement functions

Number of measurement channels	max. 2 channels/4 traces

Measurement settings

R3752A/R3753AH	A/R, B/R, A/B, R, A, B
R3752E/R3753EH	A
R3752B/R3753BH	A/R, R, A

Display formats

R3752 Series
Log/linear amplitude, phase, group delay, real and imaginary part, |Z|, R, X, |Y|, G, B

R3753 Series
Log/linear amplitude, phase, group delay, real and imaginary part,|Z|, R, X, |Y|, G, B; Smith chart: marker display for log/linear amplitude, phase, real and imaginary part, R + jX, G + jB; polar coordinates: marker display for log/linear amplitude, phase, real and imaginary part

Signal characteristics

Frequency range; resolution	5 Hz to 500 MHz; 0.1 Hz
Reference oscillator (aging)	±5 x 10^{-6}/day (25 ±5°C)
	±20 ppm (25 ±5°C)
with Option 20	±2 x 10^{-8}/day
Output level	+21 to –63 dBm (output 1)
Resolution	0.1 dB
Accuracy	0.5 dB (0 dBm, 50 MHz, 25 ±5°C)
Linearity (25 ±5°C)	
+21 to –35 dB	±0.5 dB
–35 to –63 dB	±1.5 dB
Frequency responses (25 ±5°C)	
5 Hz to 100 kHz	±4 dB
100 kHz to 1 MHz	±2.0 dB
1 to 300 MHz	±1.5 dB
300 to 500 MHz	±2.0 dB
Impedance	50 Ω (output 1)

Signal purity

Harmonic distortion	<–20 dBc
Nonharmonic distortion	<–30 dBc or –70 dBm (the higher value applies)

Sweep characteristics

Parameters	frequency, level
Range	5 Hz to 500 MHz, +21 to –43dBm
Sweep mode	linear frequency or level sweep; user-defined
Sweep time	0.1 ms/testpoint (10 kHz resolution)
Testpoints	3, 6, 11, 21, 51, 101, 201, 301, 401, 601, 801, 1201
Trigger	continuous, single, external
Output	direct or via power splitter (R3752E, R3753E direct only)
	BNC connector, 50 Ω
Power splitter (R3752A/B, R3753A/B only)	
Insertion loss	6 dB
Gain error	<0.1 dB, at >100 MHz <0.2 dB
Phase error	typ. 1°

Receiver characteristics

Input impedance	50 Ω or 1 MΩ ‖20 pF
Maximum input level	
50 Ω	0 dBm (Att=0 dB: –20 dBm)
1 MΩ	224 mV (Att=0 dB: 22.4 mV)
Noise level	
500 kHz to 300 MHz	–115 dBm at RBW ≤1 kHz
300 to 500 MHz	–110 dBm at RBW ≤3 kHz
Resolution bandwidth	3 Hz to 10 kHz in 1 to 3 steps
Amplitude ratio measurement (R3752/53/A/B)	
Range	0 ±120 dB (RBW 1 kHz)
Resolution	0.001 dB
Amplitude response	±0.05 dB (–10 to –60 dBm)
Phase ratio measurement (R3752/53/A/B)	
Range	±180°
Resolution	0.01°
Accuracy	50 MHz,
Frequency response (25 ±5°C)	5°pp (up to 100 MHz)
	10°pp (up to 300 MHz)
	20°pp (up to 500 MHz)
Amplitude response	±0.3° (–10 to –50 dBm)
Group-delay measurement	1 ps to 250 s
Resolution	1 ps
Aperture frequency	0.01 to 50% of frequency span

Display

R3752 Series	alphanumeric fluorescent display, 256 x 64 dots (32 x 8 characters)
R3753 Series	7.8" TFT colour LC display, 640 x 480 dots
Markers	up to 10 independent markers + delta marker with the option of showing all markers in a list
Automatic search function	min, max, bandwidth, etc
	SWR, filter parameters

Data transfer

Built-in BASIC controller	provided as standard, high-speed evaluation functions for essential trace points through direct data access; control of external devices via IEC/IEEE bus
Disk drive	3.5", 720 Kbyte (DD), 1.44 Mbyte (HD)
External interfaces	15-pin VGA
	IEC bus (IEEE 488.2, SCPI)
	RS-232 (for BASIC controller only)
Parallel interface	TTL 8-bit output, 4-bit input/output for BASIC applications; Keyboard: PS2 connector for US keyboard
External reference frequency	1, 2, 5, 10 MHz, >0 dBm

General data

Power supply, AC	100 to 240 V, 48 to 66 Hz, max. 350 VA
Dimensions (W x H x D); weight	
R3752 Series	424 mm x 132 mm x 400 mm; 15 kg
R3753 Series	424 mm x 220 mm x 400 mm; 20 kg

Ordering information

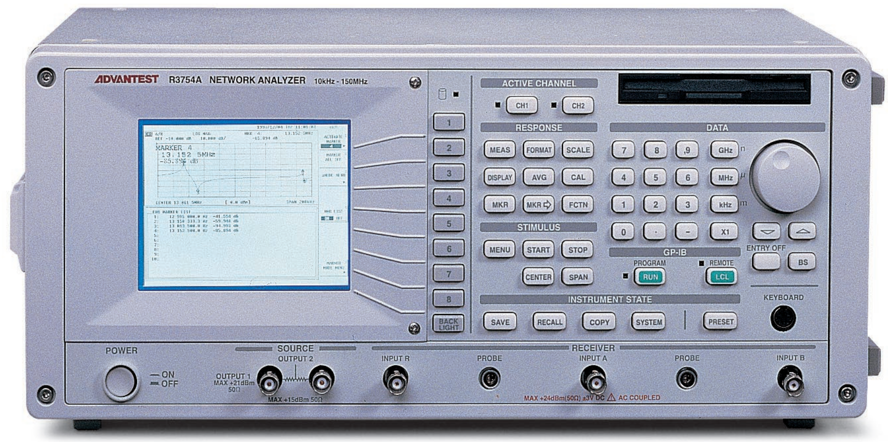
Vector Network Analyzer

Alphanum. fluorescent display	R3752A, R3752B, R3752E
TFT colour LC display	R3753A, R3753B, R3753E

Vector Network Analyzer R3754

10 kHz to 150 MHz

High-performance vector network analyzer mainly for use in applications with high throughput and wide dynamic range



Brief description

Vector Network Analyzer R3754 up to 150 MHz (Advantest) is designed as a fast measuring instrument predominantly for use in applications with high throughput and wide dynamic range, eg for measurements on crystal oscillators and filters.

The analyzer is available as a single-channel, 2-channel or 3-channel model, with monochrome or colour display. A 15 kHz resolution filter allows sweep speeds down to 50 µs per point. The measurement uncertainty in the warmup phase of the instrument as well as the effect of the average noise level on the measurement accuracy were substantially reduced with this analyzer model.

Main features

- Monochrome or TFT colour LCD
- High sweep speed of 50 µs/point with 15 kHz resolution
- 1 or 2 measurement channels, 1 reference channel
- 130 dB dynamic range
- Built-in process controller

Design features

Model R3754A features a high contrast monochrome LC display, whereas model R3754B has a TFT colour display but otherwise the same performance features.

All models of the R3754 Series are fitted with a built-in BASIC controller as standard. Detailed user prompts can be displayed on the screen in addition to the measurement results. Test routines and instrument settings can be stored on floppy disk.

Options

The basic model comes with one measurement channel, a reference channel and a second measurement channel being available as an option.

Further options include a programmable parallel interface as well as a measurement function for determining the dependence of the measurement parameters on the drive level of the device under test (DLD = drive level dependence).

- Option 01: parallel I/O interface
- Option 10: 2-channel option (A,R)
- Option 11: 3-channel option (A,B,R)
- Option 71: DLD function

Specifications in brief

Receiver section (23°C ±5° C)	
Frequency range	10 kHz to 150 MHz
Impedance	50 Ω
Return loss (ATT 0 dB)	≥20 dB
Max. input level	
ATT 25 dB, AMP 0 dB	+8 dBm
ATT 0 dB, AMP 0 dB	–20 dBm
ATT 0 dB, AMP 16 dB	–36 dBm
Input destruction level	+24 dBm, +3 V DC
Input crosstalk	
10 kHz to 500 kHz	105 dB
Average noise level	
RBW 10 kHz	200 kHz to 500 kHz: –102 dBm 500 kHz to 150 MHz: –112 dBm
RBW 3 kHz	60 kHz to 500 kHz: –107 dBm 500 kHz to 150 MHz: –117 dBm
RBW 1 kHz	20 kHz to 500 kHz: –112 dBm 500 kHz to 150 MHz: –122 dBm
RBW 300 Hz	10 kHz to 500 kHz: –117 dBm 500 kHz to 150 MHz: –127 dBm

Vector Network Analyzer R3754

Measurement format

Input channel	1 channel, 2 channels (option 10), 3 channels (option 11)
Measurement channel	2 channels (4-trace display)
Measurement parameter	R A/R R A (option 10) A/R BiR, A/B, R, A, B (Option 11)
AC/DC display	logarithmic/linear amplitude, phase, group delay, real and imaginary parts of complex number parameters Z, R, X (impedance conversion measurement) Y, G, B (admittance conversion measurement) phase extension display
Smith chart	logarithmic/linear amplitude and phase for marker reading, real and imaginary, R+jX, G+jB
Polar coordinates display	logarithmic/linear amplitude and phase for marker reading, real and imaginary parts

Signal source (23°C ±5° C)

Frequency	
Range	10 kHz to 150 MHz
Resolution	0.1 Hz
Accuracy	+5 ppm (typ.)
Output	
Level range	+21 dBm to –43 dBm
Resolution	0.1 dB
Accuracy	+0.5 dB (0 dBm, 10 MHz)
Linearity (50 MHz)	
+21 dBm to –35 dBm	+0.5 dB
–35 dBm to –43 dBm	+1.5 dB
Flatness (at 0 dBm)	
10 kHz to 300 kHz	+ 2.0 dB
300 kHz to 150 MHz	+ 1.5 dB
Impedance (output port 1)	50 Ω
Return loss (at 0 dBm)	≥13 dB (typ.)
Signal purity	
Harmonic wave distortion	<–15 dBc
Nonharmonic wave spurious	<–20 dBc or –60 dBm, whichever is larger
Phase noise	<–95 dBc/Hz (10 kHz offset)

Sweep characteristics

Sweep parameter	frequency, signal level
Range	same as the frequency sweep frequency
Range setting	start/stop or center/span
Sweep type	linear/logarithmic frequency sweep, level sweep, sweep of a user-defined segment
Sweep time	max. 0.05 ms/point (RBW 15 kHz)
Measurement point	3, 6, 11, 21, 51, 101, 201, 301, 401, 501, 601, or 1201 points
Sweep trigger	continuous, single, external
Sweep mode	dual sweep (2-channel sweep in the same frequency range)

Marker functions

- 10 individual markers can be set for each channel
- Any of the10 markers can be specified as the reference marker enabling delta value measurements between markers
- Markers of each channel can be set in coupled or independent form
- Marker search possible for a section specified by the delta marker
- MAX search, MIN search, NEXT search
- Search is performed for each sweep
- It is possible to calculate the bandwidth, center frequency, Q at the X dB down point. It is also possible to search the phase 0° frequency value and the ±X° frequency width
- Limit line function, direct analysis function, resonator analysis, etc

Save register	allows storing of set conditions and CAL data in battery-backed internal memory
Data save/recall	allows storing/loading data to/from FDD programming functions
BASIC control function	standard control function allows control of the main unit as well as other measurement equipment with GPIB interface

Error correction functions

Normalization	corrects frequency response (amplitude, phase) during transfer measurement
1-port calibration	corrects bridge directivity, frequency response and source matching error; error correction requires short, open and load
Data averaging	averages data (vector values) for each sweep; averaging count can be set from 2 to 999
Transfer full calibration	high-accuracy measurement possible using transfer normalization in transfer measurement; error correction requires short and load

Interfaces

External display signal output	15-pin D-sub connector (VGA)
GPIB data output and remote control	conforming to IEEE 486
Printer port	25-pin D-sub
Serial port	based on RS-232
Keyboard	IBM PC/AT-compatible
External reference frequency input	
Parallel I/O interface	TTL level, 8-bit output (2 ports), 4-bit I/O (2 ports) (option 01)
Probe power	(option 10, option 11)
External trigger signal input	BNC connector (female)

Display

R3754A	5" STN monochrome LCD
R3754B	6.5" TFT colour LCD, 640 x 640 pixel
Backlighting	ON/OFF, no adjustment for R3754A
Contrast	contrast control provided for R3754A

General data

With FDD	
Operating temperature range	+5°C to +40°C
Humidity	80% max. (no condensation)
Without FDD	
Operating temperature range	0 to +50°C
Storage temperature range	–20°C to +60°C
Humidity	80% or less (no condensation)
Power supply	100 V to 120 V AC, 220 V to 240 V AC, 48 Hz to 66 Hz, autosetting to AC supply
Power consumption	200 VA max.
Dimensions (W x H x D)	424 mm x 177 mm x 300 mm
Weight	12 kg or less

Ordering information

Vector Network Analyzer	R3754

Vector Network Analyzers R3765, R3767

40 MHz to 3.8 (8) GHz

High-speed network analyzers

for the microwave range

Model R3767

Brief description

Network Analyzers R3765 and R3767 (Advantest) measure amplitude, phase and group delay. Thanks to high-speed signal processing, the analyzers can perform measurements at a high rate of 0.15 ms per testpoint.
Models have a TFT colour LCD allowing simultaneous display of up to four diagrams and eight traces. A programmable sweep function is provided in all models and allows the user to define the resolution bandwidth, power level and measurement time for each individual testpoint. An electronic attenuator supports high-speed measurement of the performance characteristics of crystals or compression points of amplifiers.

Main features

- Measurement speed: 0.15 ms/testpoint
- 1 Hz steps
- Dynamic range up to 100 dB
- Built-in process controller
- 3-Port test sets

Overview of models

- The **A models** have a built-in power splitter and two test inputs so that two DUTs can be measured simultaneously or for instance a three-port multiplexer in a single sweep.
- The **B models** have a built-in SWR bridge for simultaneous measurement of reflection and transmission
- The **C models** incorporate a full-featured S-parameter test set, thus allowing simultaneous measurement of the forward and reflected characteristics of any DUTs.

Operation

The analyzers of this Series are provided with a built-in BASIC controller. Frequently recurring test routines can easily be executed thanks to programmable menu-guided control; an external controller is usually not required. Detailed user prompts can be displayed on the screen in addition to the test results. Limit lines facilitate evaluation of the test results. The required programs and instrument settings can be saved on floppy disk. All models are fitted with an IEC/IEEE bus for external control, the command language is SCPI-compatible. A serial

Frequency range	Model		
40 MHz to 3.8 GHz	R3765AH	R3765BH	R3765CH
40 MHz to 8 GHz	R3767AH	R3767BH	
Design	Stand-alone unit		
Display	TFT colour LC display (640 x 480 dots)		
Outputs	Direct	Direct	Port 1
Inputs	A, B	Transmission, reflection	Port 2
Output level	+17 to	+7 to	+10 to
40 MHz to 3.8 GHz	–8 dBm	–18 dBm	–15 dBm
>3.8 GHz	–3 dBm	–16 dBm	–13 dBm

interface (RS-232) for the connection of a printer or barcode reader is available in addition; a user-definable parallel interface allows direct connection of component feeders.

Extras

- **Option 10:** output attenuator up to 70 dB
- **Option 20M:** frequency range extension up to 20 MHz
- **Option 70:** time domain analysis

3-port test sets (R396x series) facilitate measurements on 3-port devices, eg duplexers, without having to change the cabling. Software for various applications is available for automatic test routines, eg for duplexers, filters, TDR measurements on coaxial cables for finding faults and for the use of customer-specific calibration sets.

Application Software TDANT
Software for measurement of VSWR, gain, horizontal and vertical patterns of antennas with the aid of a rotary mast or turntable.

Specifications in brief

Measurement functions	
Number of measurement channels	models A/B: 2 channels/4 traces model C: 4 channels/8 traces
Measurement settings	
AH models	A/R, B/R, A/B, A, B
BH models	transmission, reflection
CH models	S11, S12, S21, S22, S11&S21, S22&S12
Display formats	log/lin amplitude, phase, group delay, real and imaginary part, |Z|, R,X, |Y|, G, B
Smith chart	marker display for log/lin amplitude, phase, real and imaginary part, R + jX, G + jB,
Polar coordinates	marker display for log/lin amplitude, phase, real and imaginary part
Signal characteristics	
Frequency range, resolution	40 MHz to 3.8 (8) GHz, 1 Hz
with option 20	up to 20 MHz
Accuracy (25 ±5°C)	±20 ppm
Output level	see overview of models
Resolution	0.01 dB
Accuracy (50 MHz, 25 ±5° C)	0.5 dB
Frequency response (25 ±5°C)	2 dB (V_{pp})
Impedance	50 Ω
Signal purity	
Harmonic distortion	<–20 dBc (40 MHz to 3.8 GHz, max. output power)
Nonharmonic distortion	<–25 dBc (40 MHz to 3.8 GHz, max. output power)
Phase noise (10 kHz offset, 1 kHz RBW)	(–85 dBc +20 log (f/40 MHz)) dBc
Sweep characteristics	
Parameters	frequency, level
Range	full frequency range or full level range depending on model
Sweep mode	linear frequency or level sweep; user-defined
Sweep time	0.15 ms/testpoint with normalization 0.25 ms/testpoint with 2-port calibration
Testpoints	3, 6, 11, 21, 51, 101, 201, 301, 601, 801, 1201
Trigger	continuous, single, external
Receiver characteristics	
Input	N connector, 50 Ω
Maximum input level	0 dBm (models A/B) +15 dBm (model C)
Noise level	with maximum input signal –90 dBc at RBW=3 kHz –100 dBc at RBW=10 kHz
Resolution bandwidth	10 Hz to 10 kHz in 1 to 3 steps
Input crosstalk	
R3765 (<3.8 GHz)	–90 dB
Model C (2.6 to 3.8 GHz)	–85 dB
R3767 (<5 GHz)	–80 dB (model C: –70 dBm)
R3767 (<8 GHz)	–70 dB (model C: –60 dBm)
Directivity	
<2.6 GHz	–30 dB
<3.8 GHz	–26 dB
<8 GHz	–22 dB
Amplitude measurement	
Resolution	0.001 dB
Accuracy	
–10 dBm, 50 MHz, 25 ±5°C	±0.5 dB
Amplitude response	max. input level –20 dB
–10 to –60 dBm	±0.05 dB
Phase measurement	±180°
Resolution	0.01°
Frequency response	±5°
–10 to –50 dB	±0.3°
Group-delay measurement	1 ps to 250 s
Resolution	1 ps
Display	see overview of models
Markers	up to 10 independent markers + delta marker with the option of showing all markers in a list
Automatic search function	min, max, bandwidth, etc. SWR, filter parameters
Data transfer	
Built-in BASIC controller	provided as standard, high-speed evaluation functions for essential trace points through direct data access; control of external devices via IEC/IEEE bus
Disk drive	3.5", 720 Kbyte (DD), 1.44 Mbyte (HD)
External interfaces	15-pin VGA IEC bus (IEEE 488.2, SCPI) RS-232 (for BASIC controller only)
Parallel interface	24 bit, 2 x TTL 8-bit output, 2 x 4-bit input/output for BASIC applications; PS2 connector for US keyboard
External reference frequency	1, 2, 5, 10 MHz, >0 dBm
General data	
Power supply, AC	100 to 240 V, 48 to 66 Hz, max. 300 VA
Dimensions (W x H x D)	424 mm x 220 mm x 400 mm
Weight	16 kg

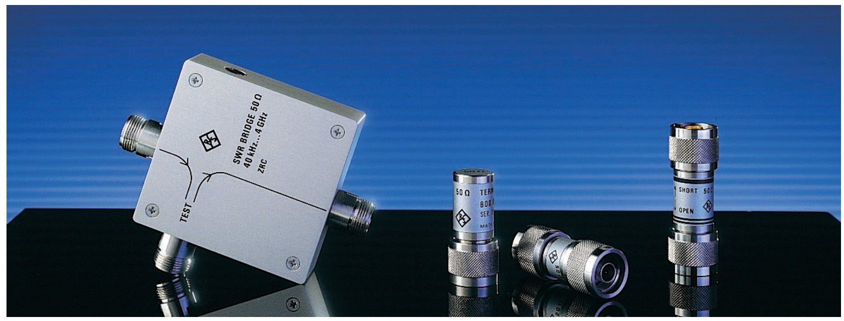
Ordering information

Vector Network Analyzers	R3765, R3767

SWR Bridges ZRA, ZRB2, ZRC, VCA-Z1

Measurement of reflection coefficient of RF circuits and components

ZRA	**40 kHz to 150 MHz**
ZRB2	**5 MHz to 3 GHz**
ZRC	**40 kHz to 4 GHz**
VCA-Z1	**5 MHz to 850 MHz**



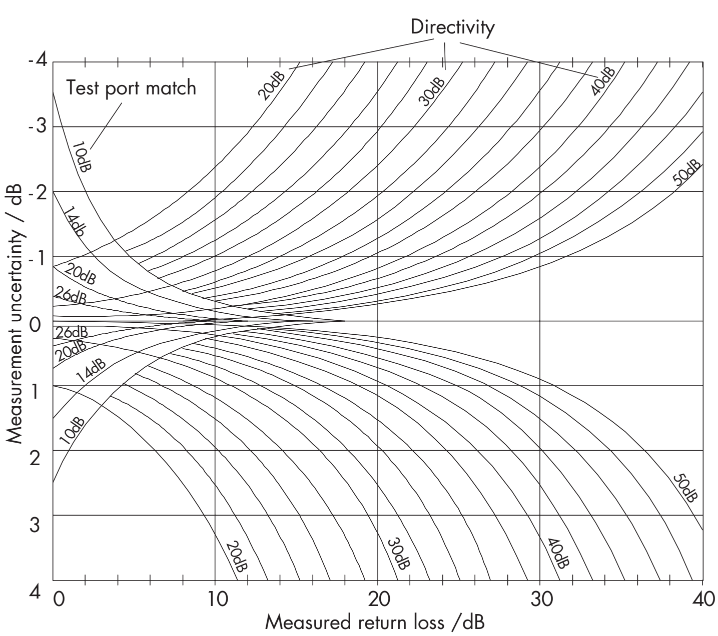
SWR Bridge ZRB2 with calibration standards (Photo 40527)

Brief description

SWR briges are used for measuring the reflection coefficient of RF circuits and components. The output signal from the signal generator, eg the tracking generator of Spectrum Analyzer FSE or Scalar Network Analyzer ZWOB is applied to the device under test via the SWR bridge. Depending on the reflection coefficient of the device under test, part of the signal is reflected to the bridge and then routed to the receiver, eg to the test input of FSE or measuring head of ZWOB, where it is detected and displayed.

Measurement accuracy
The accuracy of the bridge is limited by its directivity as well as by the SWR of the bridge at the test port. The measurement of small reflection coefficients is affected by the finite directivity. Reflection coefficients that are smaller than the directivity cannot be measured directly. In measurements of large reflection coefficients, the accuracy depends primarily on the matching at the test port.

The diagram shown allows a quantitative evaluation of the measurement error.



Maximum measurement error as a function of directivity and test port matching of the bridge

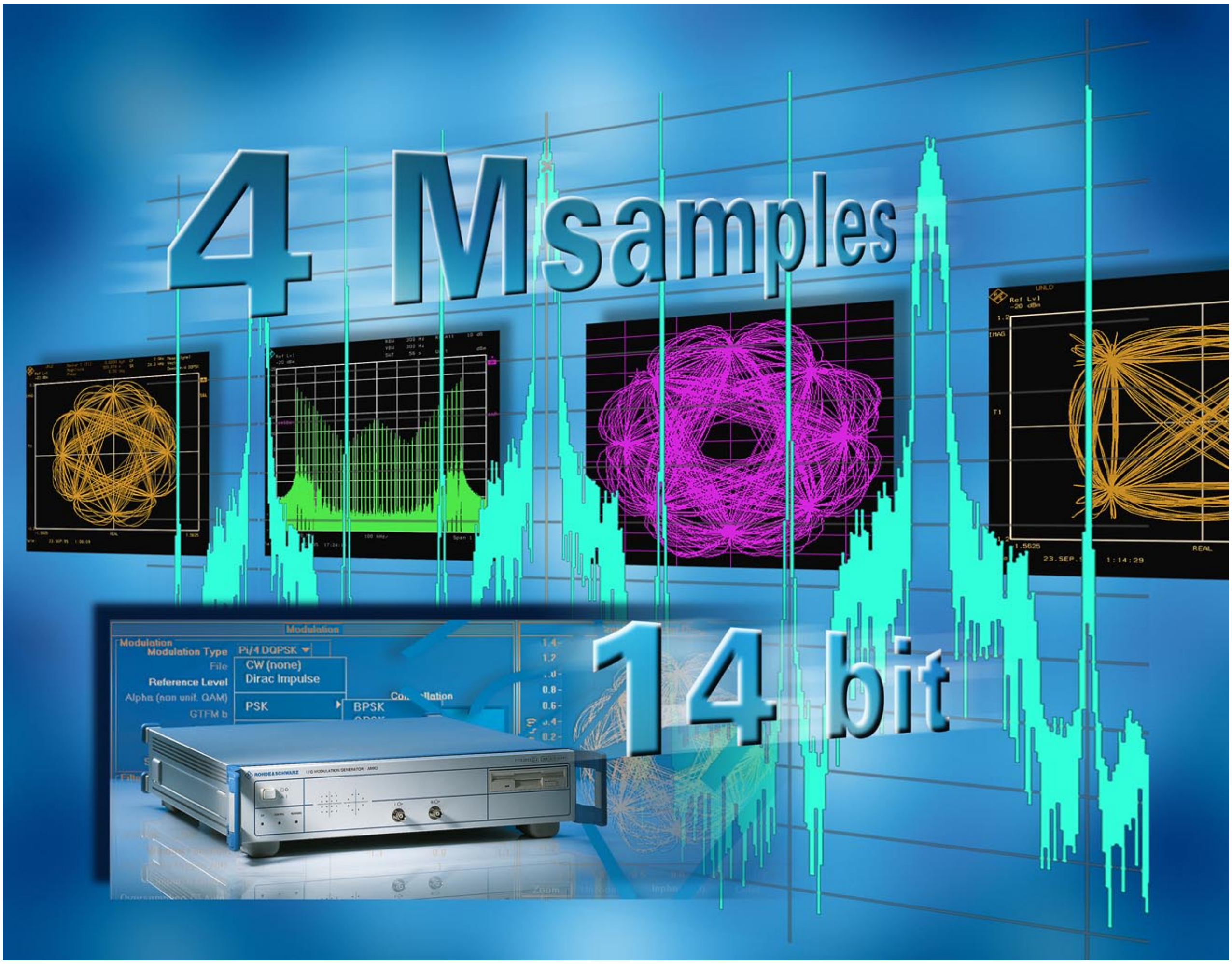
SWR Bridges ZRA, ZRB2, ZRC, VCA-Z1

Specifications in brief, ordering information

Designation	ZRA	ZRB2	ZRB2 (precision)	ZRB2
Impedance	50 Ω	50 Ω	50 Ω	75 Ω
Frequency range	40 kHz to150 MHz	5 MHz to 2.5 GHz	5 MHz to 3 GHz	5 MHz to 2 GHz
Directivity	≥45 dB (up to 1 MHz) ≥40 dB (up to 150 MHz)	≥40 dB	≥46 dB (up to 2 GHz) ≥40 dB (up to 2.5 GHz) ≥34 dB (up to 3 GHz)	≥40 dB
Test port matching	≥20 dB (up to 200 kHz) ≥30 dB (0.2 to 50 MHz) ≥20 dB (up to 150 MHz)	≥23 dB	≥26 dB (up to 2.5 GHz) ≥22dB (up to3 GHz)	≥20 dB (up to1.5 GHz)
Insertion loss[1]	7.5 dB + 6 dB	7 dB + 6 dB	7 dB + 6 dB	8 dB + 6 dB
Power-handling capacity	0.5 W	0.5 W	0.5 W	0.5 W
Test port connector	N female	N female N male	N female N male	N female N male
Accessories supplied	—	—	—	—
Rated temperature	0 to +50°C	0 to +50°C	0 to +50°C	0 to +50°C
Storage temperatúre	–40 to +70°C	–40 to +70°C	–40 to +70°C	–40 to +70°C
Connectors [2]	N female	N female	N female	N female
Weight	190 g	240 g	240 g	250 g
Dimensions [3]	52 x 52 x 41	72 x 57 x 20	72 x 57 x 20	72 x 57 x 22
Order numbers	1052.3607.52	373.9017.52 373.9017.55	373.9017.53 373.9017.56	802.1018.73 802.1018.76

Designation	ZRC	ZRC	VCA-Z1
Impedance	50 Ω	75 Ω	75 Ω
Frequency range	40 kHz to 4 GHz	40 kHz to 2.5 GHz	5 MHz to 2.5 GHz
Directivity	≥40 dB (up to 3 GHz)	≥40 dB	≥40 dB (up to 300 MHz) ≥34 dB (up to 850 MHz)
Test port matching	≥12 dB + 11dB log (f/40 kHz) (up to 400 kHz) ≥23 dB (up to 3 GHz) ≥20 dB (3 GHz to 4 GHz)	≥8 dB + 12 dB log ≥20 dB (0.4 GHz to 2.5 GHz)	≥20 dB (f/40 kHz) (up to 400 kHz)
Insertion loss[1]	7 dB + 6 dB	7 dB + 6 dB	8 dB + 5 dB
Power-handling capacity	0.5 W	0.5 W	0.5 W
Test port connector	N female N male	N female N male	BNC male
Accessories supplied	short/open termination/connector adapter	short/open termination/connector adapter	–
Rated temperature	0 to +50°C	0 to +50°C	0 to +50°C
Storage temperature	–40 to +70°C	–40 to +70°C	–40 to +70°C
Connectors [2]	N female	N female	BNC female
Weight	340 g	340 g	250 g
Dimensions [3]	72 x 77 x 24	72 x 77 x 24	72 x 57 x 22
Order numbers	1039.9492.52 1039.9492.55	1039.9492.72 1039.9492.75	1052.5900.02

[1] Input attenuation —> test port + test port –> output; [2] input, output; [3] in mm without connectors



New approaches in generation of complex I/Q Signals with Vector Signal Generator AMIQ (photo 43160)

Contents of Chapter 5

Designation	Type	Description	Page
RF Signal Generators			
0.1 to 2160 MHz	SMGU	High-performance generator for all analog in-channel and out-of-channel measurements and LO applications, reference for noise measurements; highest spectral purity, short frequency setting time	204
0.1 to 4320 MHz	SMHU	Same as SMGU, but enhanced frequency range; for selectivity and spurious measurements to CEPT up to 4 GHz	204
0.1 to 4320 MHz	SMHU58	Same as SMHU; plus I/Q, broadband AM and FM modulators; generation of complex test signals for modern communications/radar/EW applications; can be retrofitted for network-specific digital modulation	206
9 kHz to 1040 MHz	SMY01	Economy-class instrument for analog receiver and component measurements; high signal quality, full-featured model for versatile modulation and signal generation modes	208
9 kHz to 2080 MHz	SMY02	Same as SMY01, but enhanced frequency range	
0.1 to 1 GHz	SMG	General-purpose instrument for communications, EMS and radar measurements; very high spectral purity	210
0.1 to 2 GHz	SMH	Same as SMG, but enhanced frequency range	
9 kHz to 1 GHz	SMGL	Same as SMG, but enhanced frequency range and maximum output power +30 (+36) dB for EMS applications	
Microwave Signal Generators			
0.01/2 to 20 GHz	SMP02	High spectral purity, excellent pulse modulation characteristics for radar applications; extensions for specific or universal use in EMC measurements, material testing, R&D	212
0.01/2 to 20 GHz	SMP22	Same as SMP02, but output level of +22 dBm	
0.01/2 to 27 GHz	SMP03	Same as SMP02, but enhanced frequency range	
0.01/2 to 40 GHz	SMP04	Same as SMP02, but enhanced frequency range	
Function and ARB Generators			
14 bit, 4 Msamples	AMIQ	Dual-channel I/Q modulation generator for I/Q signals; 14-bit resolution, 100 MHz sample rate, 4 Msamples memory depth	214
10 mHz to 20 MHz	AFG	Universal function generator for analog and digital techniques, control engineering, acoustics, material testing; standard waveforms, versatile operating and modulation modes	216
1 µHz to 20 (50) MHz	AFGU	Same as AFG, but synthesizer-accurate frequency; ARB mode with software for arbitrary waveforms	216
Clock up to 33 MHz	ADS	Dual-channel ARB waveform generator for independently programmable signals for communications, navigation, audio, video, car and medical electronics, 320 Kbyte memory, 64 Kbyte waveform memory, 12-bit amplitude resolution; sequence mode for long signal periods, software for generating I/Q signals for digital methods and COFDM signals	218
AF Signal Generators			
1 Hz to 260 kHz	APN04	Test set like APN06 in laboratory and service for hifi, radiotelephony and transmission measurements; digital voltmeter for RMS measurements	220
Software	AWD-K1	Generation of user-programmed waveforms with Generator AFGU or ADS	221
	IQSIM-K	For simulation of I/Q signals with any digital modulation mode with Generator ADS and SMHU58	221
	DAB-K1	Generation of COFDM signals for digital audio broadcasting (DAB) and digital video broadcasting (DVB) with Generator ADS and SMHU58	222
	SME-K2	Generation of communication signals with Signal Generator SME	223

Signal Generator SMT

SMT02: 5 kHz to 1.5 GHz

SMT03: 5 kHz to 3 GHz

SMT06: 5 kHz to 6 GHz

For receiver and EMS measurements

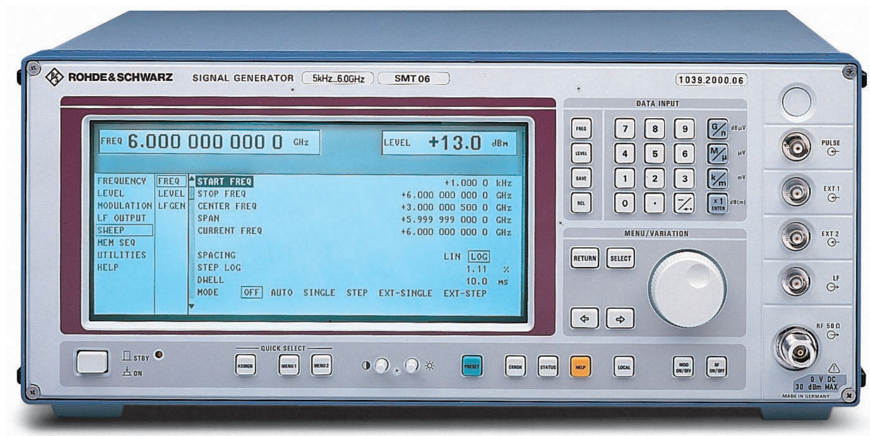


Photo 42353

Brief description

Signal Generator SMT covers the complete range of conventional analog receiver measurements. It provides an exceptionally high signal quality for a generator in this price category, as well as outstanding level accuracy, a wide variety of modulation and signal generation modes, customized configuration, and great ease of operation. Features such as programmable RF, LF and level sweeps as well as the correction of external frequency response make the SMT an ideal source for EMS measurements.

Main features

- Ideal EMS signal source with specified frequency range from 5 kHz
- AM, FM, φM, pulse modulation
- FM DC with high carrier frequency accuracy
- Broadband FM from DC to 8 MHz, broadband φM from DC to 2 MHz
- Convenient RF/LF/level sweep
- Programmable level correction (compensation of external frequency response)
- VOR/ILS generator (option SM-B6)
  – phase resolution 0.01°
  – DDM resolution 0.0001
- Stereo generator (option SM-B6) for measurements on FM sound broadcast transmitters and receivers
- Large, backlit LCD for clear display of all relevant settings
- Minimum RF leakage due to special shielding measures
- Calibration interval of three years

Overview of options

Designation, functions	Option
Reference Oscillator OCXO: aging <1 x 10^{-9}/day	SM-B1
LF Generator: supplies sinewave, noise 0.1 Hz to 500 kHz, triangular, squarewave 0.1 Hz to 50 kHz signals	SM-B2
Pulse Modulator: on/off ratio >80 dB, rise/fall time <10 ns — SMT02: / SMT03: / SMT06:	SM-B3 / SM-B8 / SM-B9
Pulse Generator: only in conjunction with SM-B3/SM-B8/SM-B9; provides single, delayed and double pulses	SM-B4
Multifunction Generator: produces stereo multiplex and VOR/ILS signals as well as sinewave, noise 0.1 Hz to 1 MHz, triangular, sawtooth, squarewave 0.1 Hz to 50 kHz signals	SM-B6
Rear Connectors for RF and LF: to replace front-panel connectors	SMT-B19

Specifications in brief

Frequency		
Range	SMT02	5 kHz to 1.5 GHz
	SMT03	5 kHz to 3 GHz
	SMT06	5 kHz to 6 GHz
Resolution		0.1 Hz
Phase offset		adjustable in 1° steps

Reference frequency	standard	option SM-B1
Aging (after 30 days of operation)	1 x 10^{-6}/year	<1 x 10^{-9}/day
Temperature effect (0 to 55°C)	2 x 10^{-6}	<5 x 10^{-8}

Signal Generator SMT

Spectral purity	
Spurious signals	
Harmonics	<–30 dBc, with SM-B8/-B9: <–26 dBc
Nonharmonics	
f <1.5 GHz	<–80 dBc
f >1.5 GHz	<–74 dBc
f >3 GHz	<–68 dBc
SSB phase noise at 20 kHz from carrier, 1 Hz bandwidth	
<67.5 MHz	<–120 dBc
125 MHz	<–134 dBc
250 MHz	<–128 dBc
500 MHz	<–122 dBc
1000 MHz	<–116 dBc
2000 MHz	<–110 dBc
3000 MHz	<–109 dBc
6000 MHz	<–103 dBc
Residual FM, rms (f=1 GHz)	
0.3 to 3 kHz (CCITT)	<8 Hz
0.03 to 20 kHz	<20 Hz
Level	–144 to +13 dBm
Resolution	0.1 dB
Accuracy for levels >–127dBm	
f <1.5 GHz	±1 dB
f >1.5 GHz	±1.5 dB
f >3 GHz	±2 dB
Level frequency response at 0 dBm	1 dB, typ. 0.3 dB
Overload protection	protects the unit from externally applied RF power (50 Ω source) and DC voltages, SMT02 and 03: ≤50 W/ 35 V, SMT06: ≤1 W/0 V
Simultaneous modulation	any combination of AM, FM (φM) and pulse modulation
Amplitude modulation	internal, external AC/DC
Modulation depth/resolution	0 to 100%/0.1%
Setting error at 1 kHz (m <80%)	<4% of reading ±1%
AM distortion at 1 kHz	
m=30%	<1%
m=80%	<2%
Modulation frequency range	DC to 100 kHz
Frequency modulation	internal, external AC/DC, two-tone with two separate channels FM1 and FM2
Maximum deviation	depending on carrier frequency: 5 MHz (at f_c <130 MHz) to 40 MHz (at f_c 6 GHz)
Setting error at AF=1 kHz (FM AC)	<(3% of reading + 20 Hz)
FM distortion at AF=1 kHz and 50% of max. deviation	<0.2%, typ. 0.1%
Modulation frequency response	
FM1/2: 20 Hz (DC) to 100 kHz	0.5 dB
FM2: 20 Hz (DC) to 8 MHz	3 dB
Stereo modulation	
Crosstalk attenuation	>50 dB
Unweighted S/N ratio	>76 dB
Carrier frequency offset (FM DC)	<0.1% of deviation
Phase modulation	internal, external AC/DC, two-tone with two separate channels broadband φM or narrowband φM (broadband φM only possible with φM2)
Maximum deviation	depending on carrier frequency
φM range 1: DC to 100 kHz	12.5 to 400 rad
φM range 2: DC to 2 MHz	0.625 to 20 rad
Pulse modulation	with option SM-B3, SM-B8, SM-B9
Operating modes	external; internal with optional Pulse Generator SM-B4
On/off ratio	>80 dB
Rise/fall time (10/90%)	<10 ns
Internal modulation generator	0.4/1/3/15 kHz ±3%
Level (EMF) at LF socket	1 V ±1% (R_{out}=10 Ω, R_L >200 Ω)
LF generator	option SM-B2
Sinewave, noise	0.1 Hz to 500 kHz
Triangular, squarewave	0.1 Hz to 50 kHz
Distortion (20 Hz to 100 kHz)	<0.1% (level >0.5 V)
Level (EMF) at LF socket	1 mV to 4 V (R_{out}=10 Ω, R_L >200 Ω)
Multifunction generator	option SM-B6
Modulation signals	sinewave, triangular, sawtooth, squarewave, noise, stereo MPX, VOR/ILS
Sinewave, noise	0.1 Hz to 1 MHz
Triangular, sawtooth, squarewave	0.1 Hz to 50 kHz
Distortion (20 Hz to 100 kHz)	<0.1% (level >0.5 V)
Level (EMF) at LF socket	1 mV to 4 V (R_{out}=10 Ω, R_L >200 Ω)
Stereo multiplex signal	with option SM-B6
Stereo operating modes	R, L, R=L, R=–L, ARI (pilot tone or MPX signal can be connected to LF socket)
Frequency range of L, R signal	0.1 Hz to 15 kHz
Preemphasis	50 µs, 75 µs
Pilot-tone frequency	19 kHz ±1 Hz
Pilot phase/resolution	0 to 360°/0.1°
VOR modulation signal	with option SM-B6
Settings	30 Hz (VAR, REF)/ 9.96 kHz FM carrier, FM deviation, COM/ID tone
Phase/phase resolution	0 to 360°/0.01°
Bearing error (RF output, 108 to 118 MHz)	<0.05°
ILS modulation signal	with option SM-B6
Settings	90 Hz, 150 Hz tone, COM/ID tone, marker beacon
DDM setting range/resolution	0 to ±0.8/0.0001
DDM error (RF output)	
Localizer (108 to 112 MHz)	<0.0004 + 1% of DDM reading
Glideslope (329 to 335 MHz)	<0.0008 + 1% of DDM reading
Pulse generator	option SM-B4
Operating modes	single, delayed and double pulse
Pulse repetition period	100 ns to 85 s
Pulse width	20 ns to 1 s
Pulse delay	40 ns to 1 s
Double pulse	60 ns to 1 s
Sweep	digital sweep in discrete steps for RF, level and LF LF sweep with option SM-B2 or SM-B6
Remote control	IEC 625 (IEEE 488)
Command set	SCPI 1993.0
General data	
Power supply	90 to 132/180 to 265 V, 47 to 440 Hz (300 VA)
Dimensions (W x H x D)	435 mm x 192 mm x 350 mm
Weight	20 kg for fully equipped unit

Ordering information

Signal Generator	SMT02	1039.2000.02
	SMT03	1039.2000.03
	SMT06	1039.2000.06
Options		
Reference Oscillator OCXO	SM-B1	1036.7599.02
LF Generator	SM-B2	1036.7947.02
Pulse Modulator		
for SMT02	SM-B3	1036.6340.02
for SMT03	SM-B8	1036.6805.02
for SMT06	SM-B9	1039.5100.02
Pulse Generator (only in combination with SM-B3, SM-B8 or SM-B9)	SM-B4	1036.9310.02
Multifunction Generator	SM-B6	1036.7760.02
Rear Connectors for RF and LF	SMT-B19	1039.4003.02

Signal Generator SME

SME02: 5 kHz to 1.5 GHz

SME03: 5 kHz to 3 GHz

SME03E: 5 kHz to 2.2 GHz

SME06: 5 kHz to 6 GHz

For digital communication with all types of modulation of mobile radio

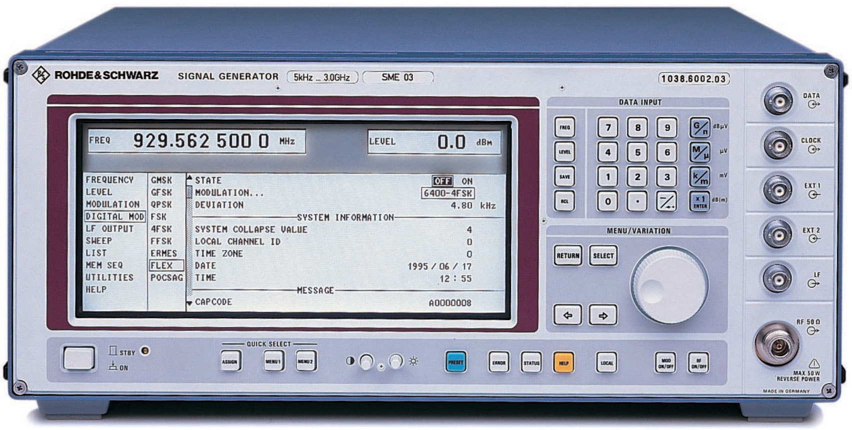


Photo 42212

Brief description

The SME supplies the complex signals required for the development and testing of digital mobile radio receivers. It is capable of generating all signals used in the main digital radio networks in line with relevant standards regarding the type of modulation, data format, TDMA structure and frequency hop patterns. The SME is completely at home also in the analog signal world of conventional signal generators.

SME02, SME03 and SME06 are identical except for the frequency range. Economy Signal Generator SME03E has been designed as an especially economical solution for applications involving digitally modulated signals. The large variety of options available allows the SME to be tailored to the specific needs of the user.

Main features

- All common digital modulation modes provided in one unit
- Great ease of operation thanks to a novel menu concept
- No external modulation and data sources required
- User-programmable data sequences and TDMA structure
- RF, LF and level sweep
- Ultra-low RF leakage for measurements on highly sensitive pagers
- List mode: programmable measurement sequence for up to 4096 frequency and level combinations, setting time <0.5 ms (not SME03E)

Overview of options

Designation, functions		Option
Reference Oscillator OCXO: aging <1 x10^{-9}/day		SM-B1
LF Generator: supplies sinewave, noise 0.1 Hz to 500 kHz, triangular, squarewave 0.1 Hz to 50 kHz signals		SM-B2
Pulse Modulator: on/off ratio >80 dB, rise/fall time <10 ns	SME02: SME03E,SME03: SME06	SM-B3 SM-B8 SM-B9
Pulse Generator: only in conjunction with SM-B3/SM-B8/SM-B9; provides single, delayed and double pulses		SM-B4
FM/φM Modulator: FM DC to 2 MHz, φM DC to 100 kHz		SM-B5
Multifunction Generator: produces stereo multiplex and VOR/ILS signals, as well as sinewave, noise 0.1 Hz to 1 MHz, triangular, sawtooth, squarewave 0.1 Hz to 50 kHz signals		SM-B6
DM Coder: generates FSK, FFSK, 4FSK, GFSK, GMSK, QPSK, π/4 QPSK, π/4 DQPSK, O-QPSK; user-programmable data sequences and PRBS		SME-B11*
DM Memory Extension 8 Mbit: expands the 8-kbit memory of the DM Coders to 8 Mbit (data only); required for fitting SME-B41 and SME-B42		SME-B12
FLEX Protocol: generates call signals to FLEX standard for testing pagers		SME-B41
POCSAG Protocol: generates call signals to POCSAG standard for testing pagers		SME-B42
Rear Connectors for RF and LF: to replace front-panel connectors		SMT-B19

* Already included in basic model of SME03E

Specifications in brief

Frequency		
Range SME02/03	5 kHz to 1.5/3 GHz	
SME03E/06	5 KHz to 2.2/6 GHz	
Resolution	0.1 Hz	
Setting time		
after IEC/IEEE-bus delimiter	<10 ms	
after trigger pulse in list mode	<500 µs	
Phase offset	adjustable in steps of 1°	
Reference frequency	standard	option SM-B1
Aging (after 30 days of operation	1 x 10^{-6}/year	<1 x10^{-9}/day
Temperature effect (0 to 55°C)	2 x 10^{-6}	<5 x10^{-8}
Spectral purity		
Spurious signals		
Harmonics	<–30 dBc, <–26 dBc with SM-B3/-B8/-B9	
Nonharmonics at		
>5 kHz from carrier, f <1.5 GHz	<–80 dBc	

SSB phase noise at 20 kHz from carrier, 1 Hz bandwidth, FM/φM deviation <5% of max. deviation

<93.75	125	250 MHz	0.5	1	2	3	6 GHz
<–129	<–140	<–137	<–132	<–126	<–120	<–116	<–116 dBc

Residual FM, rms (f=1 GHz)	
0.3 to 3 kHz (CCITT)	<1 Hz
0.03 to 20 kHz	<4 Hz
Level	–144 to +13 dBm
Resolution	0.1 dB
Accuracy for levels >–127dBm	
f <1.5 GHz	±1 dB
f >1.5 GHz	±1.5 dB
f >3 GHz	±2 dB
Level frequency response at 0 dBm	1 dB, typ. 0.3 dB
Overload protection	protects the unit from externally applied RF power (50 Ω source) and DC voltage, SME02 and 03: ≤50 W/ 35 V; SME06: ≤1 W/0 V
Simultaneous modulation	any combination of AM, FM (φM), pulse modulation and DM (DM = FSK, 4FSK, FFSK, GFSK, GMSK or QPSK)
Frequency modulation	with option SM-B5
Operating modes	internal, external AC/DC, two-tone with two separate channels FM1 and FM2
Maximum deviation	depending on carrier frequency: 500 kHz (<130 MHz) to 4 MHz (6 GHz)
Setting error at AF=1 kHz	<3% of reading + 20 Hz
FM distortion at AF=1 kHz and 50% of max. deviation	<0.5%, typ. 0.05%
Modulation frequency range	
for maximum deviation	DC to 500 kHz
for <25% of max. deviation	DC to 2 MHz
Carrier frequency offset with FM	depending on carrier frequency: <50 Hz (f_c <93.75 MHz) to <100/200 Hz (f_c 1.5/3 GHz) +1% of deviation
Phase modulation	with option SM-B5
Operating modes	internal, external AC/DC, two-tone with two separate channels φM1 and φM2
Maximum deviation	depending on carrier frequency: 5 rad (f_c <130 MHz) to 40 rad (f_c 6 GHz)
Setting error at AF=1 kHz	<3% of reading + 0.01 rad
Distortion at AF=1 kHz and 50% of max. deviation	<1%
Modulation frequency range	DC to 100 kHz
Digital modulation	with option SME-B11, standard in SME03E
Modulation modes	FSK, 4FSK, FFSK, GFSK, GMSK, QPSK, π/4 DQPSK
Operating modes	internal, external
Internal data generator	programming of data, level switching and burst output
Storage capacity	3 x 8192 bit
Frequency accuracy	same as reference frequency
PRBS (pseudo-random bit sequence)	selectable lengths: 2^9–1, 2^{15}–1, 2^{20}–1, 2^{21}–1 or 2^{23}–1
FSK	to Cityruf, POCSAG, FLEX specs
Shift, filtered	4/4.5/4.8 kHz
unfiltered	0.01 to 400 kHz, maximum shift depending on carrier frequency
Data rate, filtered	0.05 to 90 kbit/s
unfiltered	0.05 to 1900 kbit/s
FFSK	to Cityruf, POCSAG specifications
Shift	1.5/2/3/3.5/4/4.5 kHz
Data rate	0.05 to 90 kbit/s
4FSK	to APCO25, ERMES, FLEX, MODACOM specifications
Shift	0.01 to 400 kHz, maximum shift depending on carrier frequency
Data rate	1 to 24.3/27 to 48.6 kbit/s
GFSK	to CT2, CT3, DECT specifications
Shift	18/160/288 kHz as well as non-standard shifts
Data rate	10 to 585/640 to 1170 kbit/s
GMSK	to CDPD, GSM1800, DSRR, GSM, MC9, MD24 to MD192, MOBITEX8000 specifications
Data rate	2.4/3.6/4/4.8/6/8/9.6/10/12/ 16/19.2/270.833/1000 kbit/s
QPSK, π/4 DQPSK	to APCO25, MSAT, NADC, PDC, TETRA, TFTS specifications
for f >3 GHz	not specified
Data rate	1 to 24.3/27 to 48.6 kbit/s
Filter	√cos0.35/0.4/0.5/0.6 cos0.2/0.35/0.4/0.5/0.6

Amplitude modulation, pulse modulation, internal modulation generator, LF generator, multifunction generator, stereo multiplex signal, VOR modulation signal, ILS modulation signal, pulse generator and sweep see SMT, page 198

List mode (not SME03E)	automatic, single-shot, manual, externally triggered
Max. number of channels	2000
Step time	1 ms to 1 s
Remote control	IEC 625 (IEEE 488)
Command set	SCPI 1992.0
General data	
Power supply	90 to 132/180 to 265 V, 47 to 440 Hz, autosetting to AC voltage, max. 300 VA
Dimensions (W x H x D)	435 mm x 192 mm x 460 mm
Weight	25 kg for fully equipped unit

Ordering information

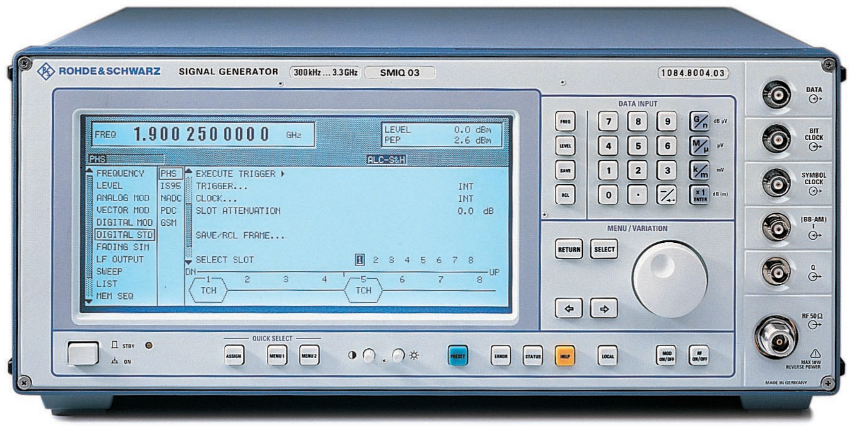
Signal Generator	SME02	1038.6002.02
	SME03	1038.6002.03
	SME03E	1038.6002.13
	SME06	1038.6002.06
Options		
Reference Oscillator OCXO	SM-B1	1036.7599.02
LF Generator	SM-B2	1036.7947.02
Pulse Modulator for SME02	SM-B3	1036.6340.02
for SME03	SM-B8	1036.6805.02
for SME06	SM-B9	1039.5100.02
Pulse Generator (only in combination with SM-B3, SM-B8 or SM-B9)	SM-B4	1036.9310.02
FM/φM Modulator	SM-B5	1036.8489.02
Multifunction Generator	SM-B6	1036.7760.02
DM Coder	SME-B11	1036.8720.02
DM Memory Extension (8 Mbit)	SME-B12	1039.4090.02
FLEX Protocol	SME-B41	1039.5645.02
POCSAG Protocol	SME-B42	1039.5745.02
Rear Connectors for RF and LF	SME-B19	1039.3907.02

Vector Signal Generator SMIQ

SMIQ02/02E: 0.3 to 2.2 GHz

SMIQ03/03E: 0.3 to 3.3 GHz

Digital signals of your choice



SMIQ03 (photo 42807)

Brief description

The Rohde&Schwarz signal generators of the SMIQ family feature both analog and digital modulation to keep pace with the present-day and future rapid development in the field of digital modulation.

The signal generator family comprises four models which differ in their frequency range and main fields of application.

SMIQ02 and SMIQ03 feature a hitherto unrivalled versatility regarding signal generation and signal quality and are therefore ideal for use in development and type-approval testing.

The economy models SMIQ02E and SMIQ03E have especially been designed for the needs in production environments and satisfy the requirement for an economically attractive solution with an outstanding price/performance ratio.

Applications, options

Application	Required option	SMIQ02E	SMIQ03E	SMIQ02	SMIQ03
Digital modulation					
GFSK	**SMIQB10**	●	●	●	●
GMSK	**SMIQB10**	●	●	●	●
π/4 DQPSK	**SMIQB10**	●	●	●	●
All other digital modulation modes	**SMIQB10**	–	–	●	●
Internal data generator incl. 4 Mbit memory	**SMIQB11**	●	●	●	●
Digital mobile radio standards					
PHS	**SMIQB10 + -B11**	●	●	●	●
NADC	**SMIQB10 + -B11**	●	●	●	●
PDC	**SMIQB10 + -B11**	●	●	●	●
GSM	**SMIQB10 + -B11**	●	●	●	●
IS-95 CDMA	**SMIQB10 + -B11 + -B42**	❍	❍	❍	❍
Fading simulation					
1 channel/6 paths	**SMIQB14**	–	–	●	●
1 channel/12 paths	**SMIQB14 + -B15**	–	–	●	●
2 channels/6 paths each (with second SMIQ)	**SMIQB14 + -B15**	–	–	●	●

● Included in option   ❍ Can be retrofitted   – Not available

Main features

- Versatile and broadband generation of digitally modulated signals up to 7 Msymbol/s
- Analog and digital modulation capabilities
- Generation of TDMA and CDMA signals to all main mobile radio standards
- Broadband I/Q modulator with outstanding vector accuracy
- Optional internal fading simulator to test specifications of mobile radio standards
- Three-year calibration cycle

Option/function/software	Designation	SMIQ02E	SMIQ03E	SMIQ02	SMIQ03	Order No.
Frequency range up to 3.3 GHz		❍	●	❍	●	
Reference Oscillator OCXO	**SM-B1**	❍	❍	❍	❍	1036.7599.02
FM/φM Modulator	**SM-B5**	●	●	❍	❍	1036.8489.02
Modulation Coder	**SMIQB10**	❍*	❍*	❍	❍	1085.5009.02
Data Generator (incl. 4 Mbit memory)	**SMIQB11**	❍	❍	❍	❍	1085.4502.02
Memory Extension 8 Mbit	**SMIQB12**	❍	❍	❍	❍	1085.2800.02
Fading Simulator (6 paths)	**SMIQB14**	–	–	❍	❍	1085.4002.02
Fading Simulator (with 6 additional paths)	**SMIQB15**	–	–	❍	❍	1085.4402.02
IS-95 CDMA (Digital Standard)	**SMIQB42**	❍	❍	❍	❍	1104.7936.02
Fast CPU	**SM-B50**	–	–	❍	❍	1104.8410.02
Low ACP for W-CDMA chip rate 4096 MHz		❍	❍	❍	❍	1105.0006.02
Rear Connectors	**SMIQB19**	❍	❍	❍	❍	1085.2997.02

● Included in basic model ❍ Can be retrofitted – Not available * Limited functionality

Specifications in brief

Frequency		
Range SMIQ02/SMIQ02E	300 kHz to 2.2 GHz	
SMIQ03/SMIQ03E	300 kHz to 3.3 GHz	
Resolution	0.1 Hz	
Reference frequency	Standard	Option SM-B1
Aging (after 30 days of operation)	1×10^{-6}/year	$<1\times10^{-9}$/day
Temperature effect (0 to 50°C)	2×10^{-6}	$<5\times10^{-8}$
Spectral purity		
Harmonics at level ≤10 dBm	<–30 dBc	
SSB phase noise at 1 GHz, carrier offset 20 kHz, 1 Hz bandwidth	CW	Vector modulation
SMIQ02/SMIQ03	<–126 dBc	<–123 dBc
SMIQ02E/SMIQ03E	<–116 dBc	<–113 dBc
Level	–140 to +13 dBm (PEP) [1]	
Resolution	0.1 dB	
Total uncertainty for levels >–127 dBm: f <2 GHz/f >2 GHz	<±1 dB/<±1.5 dB	
Frequency response at 0 dBm	<1 dB, typ. <0.3 dB	

Modulation	
Internal modulation generator	0.1 Hz to 1 MHz, resolution 0.1 Hz
Amplitude modulation	internal, external AC/DC
Modulation depth	0 to 100%
Modulation frequency range	DC to 50 kHz (RF >5 MHz)
Broadband amplitude modulation	external DC
Modulation frequency range	DC to 30 MHz
Vector modulation	external DC
Modulation frequency range	30 MHz (–3 dB)
Envelope control	RF level can be controlled with an analog voltage of 0 to 1 V via the POWER RAMP input

Digital modulation with optional Modulation Coder SMIQB10	int., ext. serial, ext.l parallel
Internal PRBS	selectable lengths: 2^9–1, 2^{15}–1, 2^{16}–1, 2^{20}–1, 2^{21}–1 and 2^{23}–1
Envelope control	external or external
Function range	1 ksymbol/s to 2.5 Msymbol/s
Modulation modes SMIQ02/03	2FSK, 4FSK, GFSK, GMSK, BPSK, QPSK, OQPSK, π/4 DQPSK, π/4 QPSK, 8PSK, 16QAM, 32QAM, 64QAM, 256QAM
Symbol rate FSK, GMSK	1 ksymbol/s to 2.5 Msymbol/s
PSK, QAM	1 ksymbol/s to 7 Msymbol/s
Baseband filter	√cos, cos, Gauss and Bessel
Modulation modes SMIQ02E/03E	GFSK, GMSK, π/4 DQPSK
Symbol rate	1 ksymbol/s to 1.3 Msymbol/s

Data generator (option SMIQB11)
Programmable data memory for modulation data, envelope-control and trigger signals. The data generator can be operated only in conjunction with the optional modulation coder.

Memory capacity	4 Mbit, up to 20 Mbit with SMIQB12
Modes	automatically repeating, single shot, manually or externally triggered
Digital standards with options SMIQB10 and SMIQB11	GSM, NADC, PDC, PHS, CDMA, IS-95

Fading simulation with SMIQ02/SMIQ03 with options SMIQB14, SMIQB15	
RF bandwidth (–3 dB)	>14 MHz
Number of paths and channels	
with option SMIQB14	6 paths, 1 channel
with options SMIQB14 and -B15	12 paths, 1 channel, or 6 + 6 paths, 2 channels with second SMIQ
Path attenuation	0 to 50 dB
Path delay	0 to 1600 µs
Doppler shift	0.1 to 1600 Hz

Modulation with SMIQ02/SMIQ03 with option SM-B5	
Frequency/phase modulation	internal, external AC/DC, two-tone with two modulation channels
Max. deviation	depending on carrier frequency
FM/φM	500 kHz to 2 MHz/5 to 20 rad
Modulation frequency range FM/φM	DC to 2 MHz/DC to 100 kHz

Modulation with SMIQ02E/SMIQ03E	
Frequency/phase modulation	internal, external AC/DC, two-tone with two modulation channels; with PM: bandwidth 2 MHz only for channel 2
Max. deviation	depending on carrier frequency
FM	5 to 20 MHz
φM, bandwidth 100 kHz/2 MHz	50 to 200 rad/2.5 to10 rad
Modulation frequency range FM	DC to 8 MHz

General data	
Remote control	IEC 625 (IEEE 488)
Command set	SCPI 1993.0
Power supply	90 to 132 V/180 to 265 V (autosetting), 47 to 440 Hz (max. 300 VA)
Dimensions (W x H x D)	435 mm x 192 mm x 460 mm
Weight	25 kg when fully equipped

Ordering information

Vector Signal Generator	0.3 to 2.2 GHz	SMIQ02	1084.8004.02
	0.3 to 3.3 GHz	SMIQ03	1084.8004.03
	0.3 to 2.2 GHz	SMIQ02E	1106.1506.02
	0.3 to 3.3 GHz	SMIQ03E	1106.1506.03
	0,3 to 3.3 GHz	SMIQ03A[2]	1084.8004.53
Options	see above		
Extras			
Service Kit		SM-Z3	1085.2500.02
Service Manual SMIQ			1085.2445.24

[1] PEP = peak envelope power.

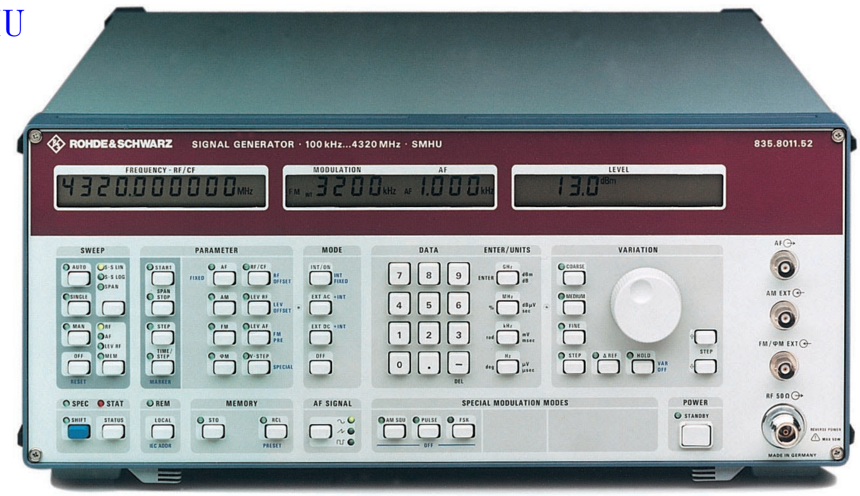
[2] SMIQ03 including Option SM-B50.

Signal Generators SMGU, SMHU

SMGU: 100 kHz to 2160 MHz

SMHU: 100 kHz to 4320 MHz

High-performance generators with excellent features over a wide frequency range



SMHU (photo 37926)

Brief description

SMGU and SMHU are ideal for applications which the majority of signal generators cannot handle. In addition to out-of-channel measurements, they are for instance able to determine the spurious rejection of radiotelephone equipment up to 4 GHz as laid down by CEPT.

Main features

- Extremely high spectral purity
- Frequency setting time <1 ms
- Frequency resolution 0.1 Hz
- RF, AF, level and memory sweeps
- Broadband FM from DC to 1 MHz
- Frequency-accurate and drift-free FM DC for FSK applications
- OCXO as a reference
- Pulse modulator

Characteristics

Frequency

The frequency can be set with a resolution of 0.1 Hz over the entire range, and this is sufficient even for measurements on extremely narrowband DUTs. Both instruments supply frequencies down to 1 kHz.

The frequency setting time is below 10 ms. In the fast mode up to 200 user-defined frequencies can be handled by means of a trigger signal or by memory sweep in less than 1 ms per setting.

Spectral purity

SMGU/SMHU fulfill requirements for selectivity measurements on top-class receivers. Signals of extremely high spectral purity afford critical adjacent-channel, in-channel and out-of-channel measurements with a wide tolerance margin.

Phase noise remains low right up to the carrier. SMGU and SMHU are therefore ideal for LO applications or as a low-noise reference in noise measurement systems.

Frequency modulation

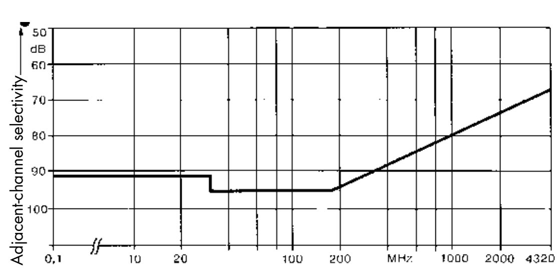
The FM modulation frequency range extends from DC to 1 MHz. In FM DC mode a high carrier-frequency accuracy is attained. The frequency offset occurring with FM DC selected is extremely small.

Amplitude modulation

The whole of the modulation frequency range can be used down to carrier frequencies of less than 100 kHz. The minimal phase shift at 30 Hz (AM DC) and a flat frequency response make for the precision amplitude modulation that is required for testing VOR/ILS navigation receivers.

Pulse modulation

Rise/fall times of 20 ns (typ. <10 ns for frequencies >200 MHz) and an on/off ratio of 80 dB open up a wide range of possibilities for testing telemetry, microwave link, radar and satellite communications systems.



Dynamic adjacent-channel selectivity can be measured with an uncertainty of <1 dB (modulation for RT applications, channel spacing 20 Hz, AF bandwidth 3 kHz)

Digital and analog sweep

In addition to the digital, step-by-step sweep with presettable start and stop frequency, span, step width and step time, an analog frequency and level sweep is also provided.

Phase offset

The phase of the RF output signal can be varied in steps of 1° using keyboard entry or the spinwheel. This makes it easier to adjust for phase quadrature during noise measurements and to investigate phase-critical components.

Specifications in brief

Frequency

Range	
SMGU	100 kHz to 2160 MHz
SMHU	100 kHz to 4320 MHz
Underrange without guarantee of specs	down to 1 kHz
Resolution	0.1 Hz
Stability	same as reference frequency
Setting time	<10 ms, <1 ms in fast mode
Reference frequency, aging	<1 x 10^{-9}/day after 30 days of operation
Temperature effect	<2 x 10^{-9}/°C
Reference frequency input/output	5 or 10 MHz, selectable

Level

Range	–140 to +13 dBm
Overrange without guarantee of specs	up to 16 dBm (SMGU) up to 19 dBm (SMHU)
Frequency response at 0 dBm f ≤2160 MHz	1 dB
Characteristic impedance	50 Ω
VSWR	<1.5 for levels ≤0 dBm (SMGU) <1.8 for f ≤3000 MHz (SMHU)
Setting time	<25 ms (<10 ms with non-interrupting level setting)
Non-interrupting level setting	0 to –20 dB
Overload protection (maximum permissible RF power)	50 W (SMGU)/30 W (SMHU)

Spectral purity

Spurious signals	
Harmonics	<–30 dBc
Subharmonics	
f <2160 MHz	none
f >2160 MHz	<–60 dBc
Nonharmonic spurious signals at >10 kHz from carrier	see line a in table below
Residual FM, rms, 0.3 to 3 kHz (CCITT)	see line b in table below
SSB phase noise at 20 kHz from carrier, 1 Hz bandwidth (FM/φM deviation <2% of max. deviation), typical	see line c in table below

f <	15.6	125	250	500	1000	2000	4000	MHz
a <	–100	–100	–100	–100	–94	–94	–88	dBc
b <	0.5	0.5	0.5	0.5	1	2	4	Hz
c	–145	–150	–145	–137	–134	–128	–121	dBc

Amplitude modulation

Modes	INT, EXT AC, EXT DC, two-tone
Modulation depth	0 to 100%
AM distortion at 1 kHz and m = 60%	<2%
Modulation frequency (3 dB bandwidth)	
AM EXT AC (DC)	10 Hz (DC) to 50 kHz
AM INT	1 Hz to 50 kHz

AM square (AM-SQU)

Dynamic range	typ. 30 dB
Rise/fall time	typ. 2 µs
Modulation signal (AM EXT)	logic signal

Frequency modulation

Modes	INT, EXT AC, EXT DC, two-tone, preemphasis

Max. deviation (without preemphasis)

f<	15.625	31.25	62.5	125	250	500	1000	2160	4320	MHz
	200	25	50/800*	100	200	400	800	1600	3200	kHz

*) With special function "heterodyne band 0.1 to 125 MHz"

FM distortion at 1 kHz and 50% of max. deviation	<0.2% (<1% with preemphasis)
Modulation frequency	
FM INT	10 Hz to 100 kHz
FM EXT AC (DC)	10 Hz (DC) to 100 kHz, 10 Hz (DC) to 1 MHz (with deviation <10% of max. deviation)
Preemphasis	50 µs, 75 µs

FSK modulation

Rise/fall time	10 µs
Modulation signal (FM/φM EXT)	logic signal

Phase modulation

Modes	INT, EXT AC, two-tone

Maximum deviation

f<	15.625	31.25	62.5	125	250	500	1000	2160	4320	MHz
	20	2.5	5/80*	10	20	40	80	160	320	rad

*) With special function "heterodyne band 125 MHz"

φM distortion at f = 1 kHz and 50% of max. deviation	<0.5%
Modulation frequency	10 Hz to 10 kHz

Pulse modulation external

On/off ratio	>80 dB
Rise/fall time	<20 ns (f >125 MHz)

Sweep

Modes	automatic, single-shot or manual

	RF sweep	AF sweep	RF level sweep	Memory sweep
Sweep range	user-selectable	user-selectable	0.1 to 20 dB	user-selectable
Step size (lin)	user-selectable	user-selectable	–	1
Step time	10 ms to 1s	10 ms to 1s	10 ms to 1s	50 ms to 60 s 1 ms to 60 s*)

*) In fast mode

General data

Remote control	IEC625-1 (IEEE488)
Power supply	100/120/220/240 V ±10%, 47 to 63 Hz, max. 270 VA
Dimensions (W x H x D)	435 mm x 192 mm x 460 mm
Weight	26 kg for fully equipped unit

Ordering information

Signal Generator	SMGU	0819.0010.52
	SMHU	0835.0011.52

Signal Generator SMHU58

0.1 to 4320 MHz

RF signal generator with I/Q modulator and coder options for generating modulation signals for digital radio networks to relevant standards; basic model SMHU page 204

Photo 39080

Brief description

Signal Generator SMHU58 is identical with SMHU apart from an additional extremely broadband I/Q modulator making for high versatility.

Any digital modulations can be generated with the aid of Software IQSIM-K (page 221) for computing user-programmable waveforms of Generator ADS (page 218). This is a particularly invaluable feature in view of new modulation standards.
The coder options (see overview) provide modulation signals in line with the relevant standards.

Main features

- I/Q modulator 1 MHz to 2 GHz, modulation bandwidth DC to 200 MHz
- Second, coherent carrier for simple I/Q demodulation
- Broadband amplitude modulation for TV applications
- Broadband frequency modulation for satellite communications, radar and video applications
- Coders for generating modulation signals for digital radio networks to relevant standards
- Frequency hopping – 4800 stored frequency and level settings; setting time <1 ms
- Extremely high spectral purity for out-of-channel measurements and LO applications
- High output power (+19 dBm)
- Fast AM DC for generating level bursts
- RF, AF, level and memory sweeps for automatic test runs, built-in AF generator

Level, modulation

Level
The I/Q modulator provides very fast level control:

Level control via the I/Q inputs
In the input voltage range from 0 to 0.5 V there is a linear level control over 60 dB from the minimum value to the set nominal output level. The input frequency range is from DC to 200 MHz.

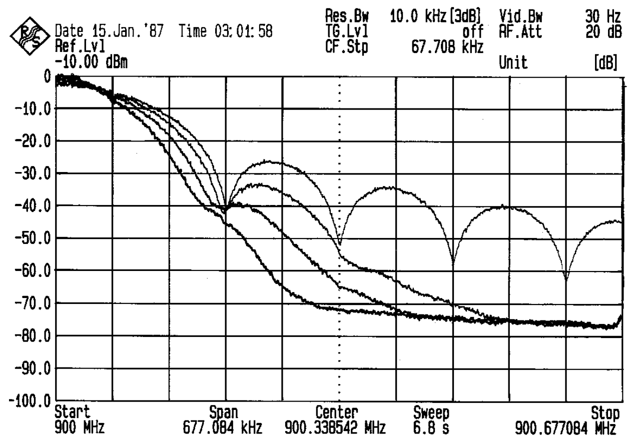
I/Q modulator
The I/Q modulator is adjusted for minimum amplitude and phase error in an automatic calibration routine. The settings can also be varied to simulate a non-ideal behaviour of the modulator. With the aid of selectable defined modulation distortion, effects on bit error rates can be determined and demodulator maladjustments corrected.

Overview of options

Designation, functions	Option
GMSK Coder	SMHU-B2
DECT Coder	SMHU-B3
NADC/PDC Coder	SMHU-B4
PHS Coder	SMHU-B5
Qualcomm CDMA Coder	SMHU-B6
TETRA25 Coder	SMHU-B7

External I/Q modulation

The Arbitrary Waveform Generator ADS (page 218) is a versatile I/Q modulation signal source and ideal supplement to the SMHU58. It can be used to generate various types of digital modulation; modulation mode, data sequence, filter characteristics as well as power burst can be defined by the user.



GMSK modulation spectra for B x T = 0.2/0.3/0.5/∞

Specifications in brief

Valid for I/Q modulation, GMSK, GFSK, π/4 DQPSK, BB-FM and BB-AM, supplementary data to specifications of basic model SMHU, page 205

Frequency

Range	10 to 1900 MHz
Overrange without guarantee of specs	1 to 2000 MHz
Setting time for frequency change	<4 ms in fast mode

Spectral purity

Spurious signals		
Harmonics		<–30 dBc
Nonharmonics at >10 kHz from carrier		<–74 dBc
SSB phase noise with I/Q modulation, GMSK and BB-AM, 1 Hz bandwidth		
Carrier offset	1 kHz	<–94 dBc
	20 kHz	<–98 dBc
	100 kHz	<–112 dBc

2nd RF output (RF 2)

Unmodulated coherent carrier with I/Q, GMSK and BB-AM; the output level is unregulated.

Broadband AM (BB-AM)

Operating mode	EXT DC
Level range	up to +7 dBm (overrange up to +13 dBm)
Modulation frequency response at 140 MHz and m = 60% (DC to 50 MHz)	3 dB

Broadband FM (BB-FM)

Operating modes	INT, EXT AC
Deviation range	50 kHz to 50 MHz, adjustable from 1 kHz
Modulation frequency	
BB-FM, INT	20 Hz to 100 kHz
BB-FM, EXT AC	20 Hz to 20 MHz

I/Q modulation

Vector DC accuracy, referred to full-scale I input, fed from 50 Ω source, input voltage range $\sqrt{I^2 + Q^2} \leq 0.5$ V

Carrier frequency 140 MHz	<1.5%
10 to 1900 MHz	typ. <1.5%

Residual carrier at 0 V input voltage, fed from 50 Ω source (I and Q), referred to full-scale input

Carrier frequency 140 MHz	<0.3%
10 to 1900 MHz	typ. <0.3%
I/Q imbalance, setting ranges	
Carrier leakage	0 to 50%
I not equal to Q	–12 to +12%
Quadrature offset	–9.9 to +9.9
Modulation inputs I and Q	
Input impedance	50 Ω
VSWR (DC to 200 MHz)	<1.4

Ordering information

Signal Generator	SMHU58	0835.8011.58
Options		
GMSK Coder	SMHU-B2	0820.4350.02
DECT Coder	SMHU-B3	0836.4010.02
NADC/PDC Coder	SMHU-B4	0836.4161.02
PHS Coder	SMHU-B5	0836.4410.02
Qualcomm CDMA Coder	SMHU-B6	0836.4661.02
TETRA25 Coder	SMHU-B7	0836.3788.02

Signal Generator SMY

SMY01: 9 kHz to 1040 MHz

SMY02: 9 kHz to 2080 MHz

Low-cost, ideal for receiver testing and component measurements

Photo 43026-3

Brief description

Signal Generator SMY from Rohde&Schwarz is a cost-effective instrument for testing AM, FM and φM receivers and for component measurements. Designed exclusively for the main applications of signal generators by cutting out the unnecessaries, the SMY features an outstanding price/performance ratio. Thanks to its comprehensive basic features and excellent signal characteristics, it is an economical solution for universal use in lab, production and service environments.

Main features

- Level range –140 dBm to +19 dBm (25 dBm overrange with option SMY-B40), sufficient even for receivers of highest sensitivity
- High level accuracy and low RF leakage allowing accurate and undegraded sensitivity measurements
- FM-DC with high accuracy of carrier frequency for testing pagers and receivers fitted with digital squelches
- Low SSB phase noise and high spurious rejection for all in-channel and blocking measurements
- Low residual FM affording ample of margin for S/N measurements
- Modulation generator 1 Hz to 500 kHz for modulation frequency response measurements
- Stereo channel separation of 50 dB and low harmonic distortion for testing FM stereo receivers
- Non-interrupting level setting over a range of 20 dB for reproducible measurement of squelch hysteresis
- Frequency resolution 1 Hz, suitable also for narrowband DUTs
- FM-DC, deviation up to 20 MHz for VCO simulation
- FM bandwidth 2 MHz for fast FSK and telemetry applications
- AF synthesizer 1 Hz to 500 kHz, separate use as AF signal source for external applications possible, eg recording of AF frequency response
- Remote-control interface IEC625/IEEE488 for use in automatic test systems
- RF sweep
- Sequence function and SEQ input for semi-automatic use

Characteristics

Cost-saving synthesis concept
Single-loop synthesis is a concept that makes for simple and cost-effective circuit design without losing out on high frequency resolution and short setting time. The fractional N-technique uses a fractional frequency division ratio, ie a frequency resolution of 1 Hz is obtained in spite of the high reference frequency. High reliability and light weight thanks to VLSI components are further advantages of this technique.

Uncomplicated operation
The panel controls are ergonomically arranged. The patented, magnetically locking spinwheel is easy to turn, nevertheless the user can exactly feel each setting step. Fast tuning and programming of the step width are also possible. Frequently used settings can be stored and recalled any time. The memory saves up to 100 complete instrument setups.

Reliability of operation, ease of maintenance
The built-in selftest facility monitors continuously the signal generator status. If there are any malfunctions, these are immediately detected and indicated. The user thus has an effective protection against invalid measurements, should the generator ever fail. The SMY requires particularly little maintenance: aging and drift are compensated for by control loops. Due to the few reference components, which are designed for maximum stability, calibration is required at intervals of 3 years only.

Specifications in brief

Frequency	
Range SMY01/SMY02	9 kHz to 1.04 GHz/9 kHz to 2.08 GHz
Underranging	down to 5 kHz (without guarantee of specs)
Resolution	1 Hz
Setting time (to within $<1 \times 10^{-7}$ for f >65 MHz or <70 Hz for f <65 MHz)	<60 ms

Reference frequency	**standard**	**option SMY-B1**
Aging (after 30 days of operation)	1×10^{-6}/year	$<1 \times 10^{-9}$/day
Temperature effect (0 to 55°C)		2×10^{-6} $<5 \times 10^{-8}$
Warmup time	–	10 min
Output for internal reference		
Frequency	10 MHz	
Level V_{rms} (EMF, sinewave)	1 V at 50 Ω	
Input for external reference	5 or 10 MHz $\pm 5 \times 10^{-6}$	
Input level (V rms)	0.2 to 2 V at 200 Ω	

Spectral purity	
Spurious signals	
Harmonics	<–30 dBc for levels <10 dBm <–25 dBc for levels <16 dBm[1]
Subharmonics	none (f >1.04 GHz: <–40 dBc)
Nonharmonics at >5 kHz from carrier	<–70 dBc (f >1.04 GHz: <–64 dBc)
Broadband noise with CW, carrier offset >1 MHz, 1 Hz bandwidth, f=>65 MHz	<–140 dBc
SSB phase noise at 20 kHz from carrier, 1 Hz bandwidth,	
CW f <65 MHz	<–114 dBc
100 MHz/500 MHz	<–132 dBc/<–120 dBc
1 GHz/2GHz	<–114 dBc/<–108 dBc
Residual FM, rms, <1% of max. deviation, f=1 GHz, 0.3 to 3 kHz (CCITT)	<10 Hz (0.03 to 20 kHz: <20 Hz)
Residual AM, rms (0.03 to 20 kHz)	<0.02%

Level	
Range	–140 to +13 dBm; –134 to +19 dBm[1]
Overranging (without guarantee of specs)	up to +19 dBm; –140 to +25 dBm[1]
Resolution	0.1 dB
Accuracy for levels >–127dBm	±1 dB (f >1.04 GHz: ±1.5 dB)
Frequency response at 0 dBm	1 dB, typ. 0.3 dB
Characteristic impedance	50 Ω
VSWR	<1.5 (f >1.04 GHz: <1.8)
Setting time (IEC/IEEE bus)	<25 ms (<10 ms with electronic level setting)
Non-interrupting level setting	0 to –20 dB

Overload protection	protects the instrument against externally applied RF power and DC voltage (50 Ω source)
Max. permissible RF power	30 W (SMY 02: 50 W)
Max. permissible DC voltage	35 V
Max. pulse load (pulse width <10 µs)	1 mWs or 150 V (peak)

Simultaneous modulation	any combination of AM, FM (φM) and pulse modulation

Amplitude modulation	internal, external AC/DC
Modulation depth	0 to 100%
Resolution	0.1%
Setting error at 1 kHz (m <80%)	<4% of reading ±1%
AM distortion at 1 kHz	
m=30%	<1%; 3%[1]
m=80%	<2%; 5%[1]
Modulation frequency response (m=60%)	
30 Hz (DC) to 10 kHz	0.4 dB
10 Hz (DC) to 50 kHz	3 dB
Incidental φM at AM (30%), AF=1 kHz	<0.2 rad <0.4 rad at f >1.04 GHz (SMY 02)

Frequency modulation	internal, external AC/DC
Max. deviation for carrier frequency	
<65 MHz	10 MHz
65 to 130 MHz	1.25 MHz
130 to 260 MHz	2.5 MHz
260 to 520 MHz	5 MHz
520 to 1040 MHz	10 MHz
1040 to 2080 MHz	20 MHz
Resolution	<1%, min. 10 Hz
Setting error at AF=1 kHz	<3% of reading + 20 Hz
FM distortion at AF=1 kHz and 3% of max. deviation	<0.3%, typ. 0.1%
Modulation frequency response 10 Hz (DC) to 2 MHz	3 dB, typ. 1 dB
Incidental AM at AF=1 kHz, f >1 MHz, 40 kHz deviation	<0.1%
Stereo modulation at 40 kHz deviation, AF=1 kHz	
Crosstalk attenuation	>50 dB
S/N ratio	
unweighted	>76 dB
weighted	>70 dB
Distortion	typ. 0.1%
Carrier frequency offset with FM-DC	<1 Hz + 0.1% of deviation

Phase modulation	internal, external AC
Max. deviation for carrier frequency	
<65 MHz	200 rad
65 to 130 MHz	25 rad
130 to 260 MHz	50 rad
260 to 520 MHz	100 rad
520 to 1040 MHz	200 rad
1040 to 2080 MHz	400 rad
Resolution	<1%, min. 0.01 rad
Setting error at AF=1 kHz	<5% of reading + 0.02 rad
Distortion at AF=1 kHz and 50% of max. deviation	<0.5% (typ. 0.2%)
Modulation frequency response 20 Hz to 20 kHz	<3 dB (typ. 1 dB)

Pulse modulation	external
On/off ratio	>80 dB; >70 dB at 70 MHz[1]
Rise/fall time (10/90%)	typ. 4 µs; <20 ns[1]
Pulse delay	typ. 2.5 µs; <200 ns[1]
Modulation input	TTL/HC logic signal, polarity selectable
Input impedance	10 kΩ

Internal modulation generator	
Frequency range/resolution	1 Hz to 500 kHz/0.1 Hz
Display	7 digits, floating point
Frequency drift	$<5 \times 10^{-5}$
Frequency response up to 50 kHz	0.2 dB (up to 100 kHz: <0.3 dB)
Distortion (20 Hz to 100 kHz)	<0.1%
Output voltage (peak)	1 V ±1% (R_{out} <10 Ω, R_L >200 Ω)

RF Sweep	digital sweep in discrete steps
Mode	automatic, linear
Sweep range and step width	user-selected
Step duration	10 ms to 5 s
Resolution	1 ms

General data

Remote control	IEC 625 (IEEE 488)
Memory	non-volatile, for 100 instrument setups
Power supply	100 V/230 V (AC) –10 to +15%, 120 V/220 V (AC) –12.5 to +10%, 47 to 440 Hz, max. 120 VA
Dimensions (W x H x D)	
SMY01	435 mm x 147 mm x 350 mm
SMY02	435 mm x 147 mm x 460 mm
Weight for fully equipped unit	12 kg (SMY01), 13 kg (SMY02)

Ordering information

Signal Generator	SMY 01	1062.5502.11
	SMY 02	1062.5502.12
Options, extras		
Reference Oscillator OCXO	SMY-B1	1062.7505.02
Rear Connectors for RF and LF	SMY-B10	1062.8001.02
High Output Power	SMY-B40[2]	1062.9008.02
Service Kit	SMY-Z2	1062.7805.02
Service Manual		1062.5583.24

[1] with option SMY-B40

[2] To be retrofitted by authorized service centers only.

Signal Generators SMG, SMH, Power Signal Generator SMGL

SMG: 0.1 to 1 GHz

SMH: 0.1 to 2 GHz

SMGL: 9 kHz to 1 GHz

High-end general-purpose generators, SMGL with output level up to +36 dBm

SMGL (photo 39736)

Brief description of SMG, SMH

SMG and SMH are fast, high-resolution synthesizers featuring great ease of operation as well as versatile modulation and sweep capabilities. High spectral purity and short setting times make the SMG and SMH ideal signal generators for communications systems, EMC/EMS measuring systems, IF components of satellite transmission as well as radar, avionics and navigation equipment.

Brief description of SMGL

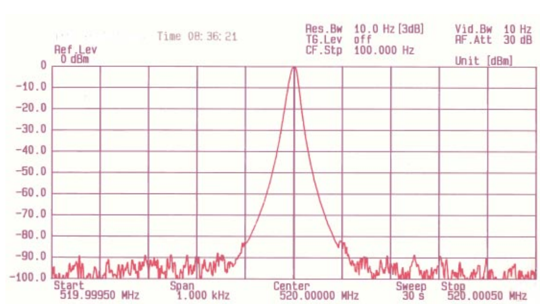
SMGL is a versatile power signal generator with built-in broadband power amplifier and ideal for driving power stages, frequency multipliers, power semiconductors and high-level mixers.

Typical measurement applications

- Antenna patterns
- Overload capabilities of receivers
- Intermodulation, crossmodulation
- Electromagnetic compatibility
- Linearity of amplifiers
- Shielding effectiveness

Main features

- Short frequency setting time of 15 ms, fast sweep, high measurement rate in automatic test systems
- RF and AF sweep without level transients; phase-continuous frequency steps
- Spectral purity, excellent weighted and unweighted S/N ratio, low spurious FM
- Excellent RF shielding allowing accurate measurements even on the smallest of signal levels
- Non-interrupting level variation within a range of 20 dB
- Modulation generator with 8 fixed frequencies
- AM, FM AC and FM DC, phase and pulse modulation; two-tone modulation possible
- Great ease of operation: nonvolatile storage of 50 instrument setups, memory sequence, level and frequency offset adjustable



Signal quality close to carrier at 520 MHz, 10 dB and 100 Hz/division

Overview of options

Designation, functions	Option
OCXO Reference Oscillator: aging <1 x10^{-9}/day	SMG-B1
AF Synthesizer: frequency range 10 Hz to 100 kHz	SMG-B2
X Output: for control of oscilloscopes and recorders	SMG-B3

Specifications in brief

Frequency

Range		
SMG	100 kHz to 1000 MHz	
SMH	100 kHz to 2000 MHz	
SMGL	9 kHz to 1000 MHz	
Resolution	1 Hz	
Setting time	<15 ms	
Frequency drift f ≥31.25 MHz	$<0.5 \times 10^{-9}$ + error of reference	
Reference frequency	standard	OCXO oscillator
Aging (after 30 days of operation)	2×10^{-6}/year	$<1 \times 10^{-9}$/day
Temperature effect	2.5×10^{-6}/ 0 to 50°C	$<2 \times 10^{-9}$/°C
Input/output for external/ internal reference frequency	5 or10 MHz, selectable	

Level

Range	–140 to +13 dBm (SMG, SMH) –118 to +30 dBm (SMGL)
Underrange and overrange without guarantee of specs	–140 to +16 dBm (SMG, SMH) –130 to +36 dBm (SMGL)
Accuracy for levels >–127 dBm (SMG, SMH) >–118 dBm (SMGL)	±1.5 dB
Frequency response at 0 dBm output level	1 dB (typ. 0.3 dB)
Characteristic impedance	50 Ω
VSWR	<1.5 for level ≤0 dBm (SMG, SMH) <1.5 for level ≤16 dBm (SMGL)
Setting time	<25 ms
Non-interrupting level setting	0 to 20 dB
Overload protection (maximum permissible RF power)	50 W

Spectral purity

Spurious signals	
Harmonics	<–30 dBc (SMGL: level ≤27 dBm)
Subharmonics	
SMG, SMGL	none
SMH	<–40 dBc (f ≥1 GHz)
Residual AM, rms (0.03 to 20 kHz)	<0.02%
Nonharmonic spurious signals at >5 kHz from carrier	see line a in table below
Residual FM, rms 0.3 to 3 kHz (CCITT)	see line b in table below
SSB phase noise, carrier offset 20 kHz, 1 Hz bandwidth, typical	see line c in table below

f <	31.25	62.5	125	250	500	1000	2000	MHz
a <	–70	–80	–80	–80	–76	–70	–64	dBc
b <	2	1	1	1	2	4	8	Hz
c	–139	–148	–142	–136	–130	–124	–118	dBc

Amplitude modulation

Modes	INT, EXT AC, EXT DC, two-tone
Modulation depth	0 to 99%
AM distortion at 1 kHz, 0 to 30% AM	<1%
Modulation frequency	
AM EXT AC (DC)	10 Hz (DC) to 50 kHz
AM INT	40/150/300/400 Hz/ 1/3/6/15 kHz ±3%
AM INT with option SMG-B2	10 Hz to 100 kHz (SMG, SMH) 10 Hz to 50 kHz (SMGL)

Frequency modulation

Modes: INT, EXT AC, EXT DC, two-tone

f <	31.25	62.5	125	250	500	1000	2000	MHz
Max. dev.	200	50	100	200	400	800	1600	kHz

FM distortion at 1 kHz and 50% of maximum deviation	<0.5% (typ. 0.1%)
Modulation frequency	
FM EXT AC (DC)	10 Hz (DC) to100 kHz
FM INT	40/150/300/400 Hz/ 1/3/6/15 kHz ±3%
FM INT with option SMG-B2	10 Hz to 100 kHz
Frequency drift with FM DC, carrier frequency offset when switching on FM DC for $f_{carrier}$ ≥31.25 MHz	1% of deviation + $1 \times 10^{-6} \times f_{carrier}$

Phase modulation

Modulation: INT, EXT AC, two-tone

f <	31.25	62.5	125	250	500	1000	2000	MHz
Max. dev.	20	5	10	20	40	80	160	rad

Phase modulation distortion at 1 kHz and 50% of max. deviation	<0.5% (typ. 0.1%)
Modulation frequency	
φM EXT	10 Hz to 10 kHz
φM INT	40/150/300/400 Hz/ 1/3/6 kHz ±3%
φM INT with option SMG-B2	10 Hz to 10 kHz

Pulse modulation

Mode	external
On/off ratio	>70 dB (typ. >80 dB)
Rise/fall time (10/90%) f_c> 200 MHz	typ. 20 ns
Pulse repetition frequency	0 to10 MHz
Modulation signal	TTL levels

AF Synthesizer (option SMG-B2)

Frequency	10 Hz to 100 kHz
Readout	3 digits
Frequency drift	$<4 \times 10^{-5}$
Level error at 1 kHz	<3% (typ. 1%)
Distortion	<0.1% (typ. 0.03%)
Phase-continuous frequency change, response time between setting command and frequency change	<10 ms

RF sweep, AF sweep

(AF sweep with option SMG-B2)	digital start-stop sweep in discrete steps
Modes	automatic following ramp function, single-shot, manual control via spin-wheel, linear or logarithmic
Sweep range	user-selectable over entire frequency range
Step size	user-selectable
Time per step	10 ms to10 s

X output (with option SMG-B3)

X output	0 to10 V staircase ramp, max. 1000 steps

Remote control IEC625-1 (IEEE488)

General data

Power supply	100/120/220/240 V ±10% 47 to 440 Hz
Power consumption	max. 130 VA (SMG, SMH) max. 250 VA (SMGL)
Dimensions (W x H x D)	
SMG, SMH	435 mm x 147 mm x 460 mm
SMGL	435 mm x 147 mm x 570 mm
Weight for fully equipped unit	17 kg (SMG, SMH), 22 kg (SMGL)

Ordering information

Signal Generator	SMG	0801.0001.52
	SMH	0845.4002.52
Power Signal Generator	SMGL	1020.2005.52
Options		
Reference Oscillator OCXO	SMG-B1	0802.0005.02
AF Synthesizer	SMG-B2	0802.0405.02
X Output	SMG-B3	0801.9609.02

Microwave Signal Generator SMP

SMP02, 22: 0.01/2 to 20 GHz

SMP03: 0.01/2 to 27 GHz

SMP04: 0.01/2 to 40 GHz

Excellent signal characteristics and high output power up to 40 GHz

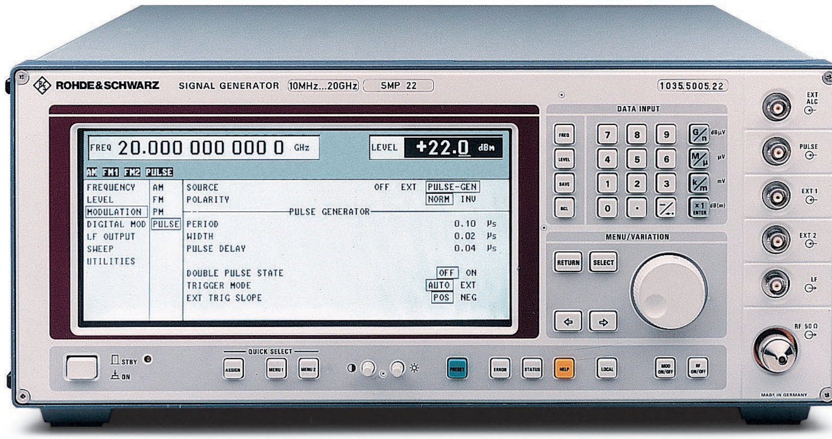


Photo 41 154

Brief description

SMP is a reliable, high-precision signal source featuring high output power, high spectral purity and excellent pulse modulation. It is able to supply signals for any measurements on radar and communications receivers. A wide range of extensions ensures universal use in R&D, production, EMC and environmental measurements as well as in material testing.

Main features

- High spectral purity
- Stable output frequency
- High output level:
  SMP02 SMP22 SMP03 SMP04
  >11.5 >20 >13 >10 dBm
  at 20 20 27 40 GHz
- Fast settling after a frequency change
- AM, FM, φM, pulse modulation
- Scan modulation
- RF, AF and level sweep
- Large choice of options for user-specific configuration
- Great ease of operation through modern menu concept

Overview of options

Designation, functions	Option
Reference Oscillator OCXO: aging <1 x10^{-9}/day	SM-B1
LF Generator: supplies sinewave, noise 0.1 Hz to 500 kHz, triangular, squarewave 0.1 Hz to 50 kHz signals	SM-B2
FM/φM Modulator: FM DC to 1 MHz, φM DC to 100 kHz, precision FM DC	SM-B5
Frequency Extension 0.01 to 2 GHz[1]**:** extends the lower frequency limit to 10 MHz	SMP-B11
Pulse Modulator 2 to 20 GHz[1]**:** on/off ratio >80 dB, rise/fall time <10 ns; for SMP02 and SMP22 only	SMP-B12, model 02
Pulse Modulator 2 to 27 GHz[1]**:** on/off ratio >80 dB, rise/fall time <10 ns; for SMP03 only	SMP-B12, model 03
Pulse Modulator 2 to 40 GHz[1]**:** on/off ratio >80 dB, rise/fall time <10 ns; for SMP04 only	SMP-B12, model 04
Pulse Modulator 0.01 to 2 GHz[1]**:** on/off ratio >80 dB, rise/fall time <10 ns	SMP-B13
Pulse Generator: provides single, delayed and double pulses	SMP-B14
RF Attenuator 27 GHz[1]**:** allows level setting down to –130 dBm; for SMP02, SMP22 and SMP03 only	SMP-B15
RF Attenuator 40 GHz[1]**:** allows level setting down to –130 dBm; for SMP04 only	SMP-B17
Auxiliary Interface: V/GHz output, Z output for scalar network analyzers	SMP-B18
Rear Connectors for RF and AF[1]**:** to replace front-panel connectors; for SMP02, SMP22 and SMP03 only	SMP-B19
Rear Connectors for RF and AF[1]**:** to replace front-panel connectors; for SMP04 only	SMP-B20
[1] Factory-fitted option.	

Specifications in brief

Frequency

	standard	with option SMP-B11
Range		
SMP02, SMP22	2 to 20 GHz	10 MHz to 20 GHz
SMP03	2 to 27 GHz	10 MHz to 27 GHz
SMP04	2 to 40 GHz	10 MHz to 40 GHz
Resolution	0.1 Hz	
Setting time (to within $<1 \times 10^{-6}$) after IEC/IEEE-bus delimiter	<(11 ms + 5 ms/GHz)	

Reference frequency	**standard**	**option SM-B1**
Aging (after 30 days of operation)	1×10^{-6}/year	$<1 \times 10^{-9}$/day
Temperature effect (0 to 55°C)	2×10^{-6}	$<5 \times 10^{-8}$

Spectral purity

Spurious signals	**SMP02**	**SMP22**	**SMP03**	**SMP04**
Harmonics:				
f <1.8 GHz	<–30 dBc (<+8 dBm)	<–25 dBc (<+8 dBm)	<–30 dBc (<+3 dBm)	<–30 dBc (<±0 dBm)
f ≥1.8 GHz	<–40 dBc (<+10 dBm)	<–25 dBc (<+15 dBm)	<–40 dBc (<+3 dBm)	<–40 dBc (<±0 dBm)
Harmonics with options SMP-B12, -B13 (pulse modulation on):				
f <1.8 GHz	<–25 dBc (<+8 dBm)	<–25 dBc (<+8 dBm)	<–25 dBc (<+3 dBm)	<–25 dBc (<±0 dBm)
f ≥1.8 GHz	<–25 dBc (<+11 dBm)	<–25 dBc (<+11 dBm)	<–25 dBc (<+3 dBm)	<–25 dBc (<±0 dBm)
Subharmonics:				
f ≤20 GHz	none	none	none	none
f >20 GHz	–	–	<–40 dBc	<–30 dBc
Nonharmonics at >10 kHz from carrier:				
f <2 GHz	typ. <–60 dBc	typ. <–60 dBc	typ. <–60 dBc	typ. <–60 dBc
2 to 20 GHz	<–60 dBc	<–60 dBc	<–60 dBc	<–60 dBc
f >20 GHz	–	–	<–54 dBc	<–54 dBc

SSB phase noise, 1 Hz bandwidth, FM off:

		offset from carrier		
Frequency range	100 Hz	1 kHz	10 kHz	100 kHz
10 MHz to <2 GHz	<–64 dBc	<–92 dBc	<–98 dBc	<–101 dBc
2 to 10 GHz	<–64 dBc	<–92 dBc	<–98 dBc	<–101 dBc
>10 to 20 GHz	<–58 dBc	<–86 dBc	<–92 dBc	<–95 dBc
>20 to 27/40 GHz	<–54 dBc	<–80 dBc	<–86 dBc	<–92 dBc

Level

Maximum level SMP02, SMP22:

Frequency range	SMP02, option SMP-B15 w/o	with	SMP22, option SMP-B15 w/o	with
10 MHz to <2 GHz	>+17 dBm	>+17 dBm	>+17 dBm	>+17 dBm
2 to 20 GHz	>+11.5 dBm	>+10 dBm	>+20 dBm	>+18.5 dBm

Maximum level SMP03, SMP04:

Frequency range	SMP03, option SMP-B15 w/o	with	SMP04, option SMP-B17 w/o	with
10 MHz to <2 GHz	>+12 dBm	>+12 dBm	>+12 dBm	>+12 dBm
2 to <18 GHz	>+10 dBm	>+8.5 dBm	>+10 dBm	>+8.5 dBm
18 to 20 GHz	>+6 dBm	>+4.5 dBm	>+6 dBm	>+4.5 dBm
>20 to 27/33 GHz	>+13 dBm	>+11 dBm	>+12 dBm	>+10 dBm
>33 to 40 GHz	–	–	>+10 dBm	>+8 dBm

Modulation	any combination of AM scan, FM (φM) and pulse modulation
Amplitude modulation	internal, external AC/DC
Modulation depth/resolution	0 to 90%/0.1%
AM distortion at AF=1 kHz (m=60%), f >50 MHz	<1%, typ. <0.5%
Modulation frequency range	DC to 100 kHz
Frequency modulation	int., ext. AC/DC, locked/unlocked, two-tone with two separate channels FM1 and FM2
Standard frequency modulation	without option SM-B5
Maximum deviation	f ≤20 GHz: 10 MHz f >20 GHz: 20 MHz
FM distortion at AF=50 kHz and 500 kHz deviation	<0.5%, typ. 0.05%
Modulation frequency range	
Locked mode	10 kHz to 5 MHz
Unlocked mode	DC to 5 MHz
FM with option SM-B5	standard FM available
Maximum deviation/resolution	
f ≤20 GHz	1 MHz/<1%, min. 10 Hz
f >20 GHz	2 MHz/<1%, min. 20 Hz
FM distortion at AF=1 kHz and 500 kHz deviation	<0.5%, typ. 0.05%
Modulation frequency range	DC to 1 MHz
Phase modulation	with option SM-B5; int., ext. AC/DC, two-tone with two separate channels φM1 and φM2
Maximum deviation/resolution	
f ≤20 GHz	10 rad/<1%, min. 0.001 rad
f >20 GHz	20 rad/<1%, min. 0.002 rad
φM distortion at AF=1 kHz and 5 rad deviation	<1%
Modulation frequency range	DC to 100 kHz
ASK modulation	external
Max. modulation depth/resolution	90%/0.1%
Data rate	0 to 200 kHz
FSK modulation	external

Maximum shift	standard FM	with option SM-B5	Resolution
f ≤20 GHz	10 MHz	1 MHz	<1%, min. 10 Hz
f >20 GHz	20 MHz	2 MHz	<1%, min. 20 Hz

Data rate (standard FM)	
Locked mode	20 kHz to 2 MHz
Unlocked mode	0 to 2 MHz
Data rate with option SM-B5	0 to 2 MHz
Pulse modulation	ext., int. with option SMP-B14

	w/o option SMP–B12, -B13	with option SMP–B12, -B13
Frequency range	≥2 GHz	-B13:10 MHz to 2 GHz -B12: ≥2 GHz
On/off ratio	>50 dB (level >0 dBm)	>80 dB
Rise/fall time (10/90%)	<500 ns	<10 ns
Minimum pulse width	1 µs	20 ns
Pulse repetition frequency	0 to 500 kHz	0 to 10 MHz
Pulse delay	typ. 100 ns	typ. 50 ns
Video feedthrough	<15 mV (peak value)	<15 mV (peak value)

Further data

Internal modulation generator	see SMT, page 198
LF generator (option SM-B2)	see SMT, page198
Pulse generator (option SMP-B14)	see SMT (option SM-B4), page 198
2nd RF output	2 to 20 GHz, 0 dBm
Sweep	see SMT, page 198
Auxiliary interface	with option SMP-B18
V/GHz output	output voltage proportional to frequency, 0.5 or 1 V/GHz selectable
Remote control	IEC 625 (IEEE 488); SCPI 1993.0
Power supply	90 to 132/180 to 265 V, 47 to 440 Hz, max. 400 VA
Dimensions (W x H x D)	435 mm x 192 mm x 570 mm
Weight	27 kg for fully equipped unit

Ordering information

Signal Generator	SMP02	1035.5005.02
	SMP22	1035.5005.22
	SMP03	1035.5005.03
	SMP04	1035.5005.04
Options		
Frequency Extension 0.01 to 2 GHz[1]	SMP-B11	1036.6240.02
Pulse Modulator [1]		
2 to 20 GHz (SMP02, SMP22)	SMP-B12	1036.5750.02
2 to 27 GHz (SMP03)	SMP-B12	1036.5750.03
2 to 40 GHz (SMP04)	SMP-B12	1036.5750.04
Pulse Modulator 0.01 to 2 GHz[1]	SMP-B13	1036.7147.02
Pulse Generator	SMP-B14	1036.7347.02
RF Attenuator 27 GHz[1]	SMP-B15	1036.5250.02
40 GHz[1]	SMP-B17	1036.5550.02
Auxiliary Interface	SMP-B18	1036.8920.02
Rear Connectors for AF, RF[1]		
up to 27 GHz	SMP-B19	1039.4303.02
up to 40 GHz	SMP-B20	1039.4503.02
Reference Oscillator OCXO	SM-B1	1036.7599.02
LF Generator	SM-B2	1036.7947.02
FM/φM Modulator	SM-B5	1036.8489.02

[1] Factory-fitted option.

I/Q Modulation Generator AMIQ/Simulation Software WinIQSIM

New approaches in the generation of complex I/Q signals

Brief description

I/Q Modulation Generator AMIQ and Simulation Software WinIQSIM open up new dimensions for the generation of I/Q signals. AMIQ is a dual-channel modulation generator that has consequently been designed for use as an I/Q source. It is programmed and set with Software WinIQSIM. Alternatively, AMIQ can be operated from a Vector Signal Generator SMIQ.

Each channel can store 4000000 samples. Even at high symbol rates sequences of sufficient length can thus be generated. With clock frequencies of up to 100 Msample/s and a high amplitude resolution of 14 bits, AMIQ is the ideal source for any signal in the world of digital modulation.

An automatic amplitude/offset alignment as well as fine adjustment of the skew provide excellent symmetry of the two channels which previously was extremely difficult to attain with dual-channel ARB generators. The error vector can thus be minimized.

A typical application of AMIQ and WinIQSIM is not only to drive the I/Q inputs of a vector signal generator. This combination is also ideal for direct applications in the baseband, eg for testing I/Q modulators/demodulators.

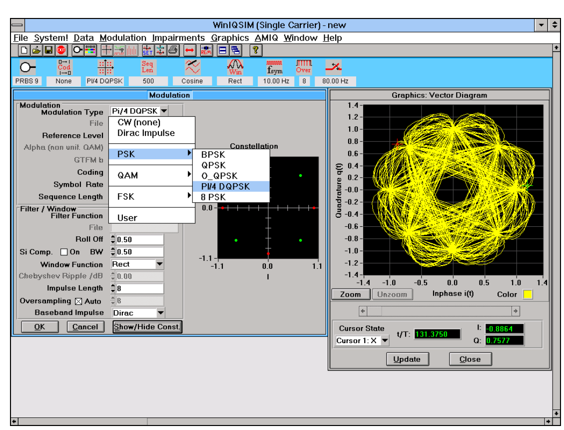
Main features

AMIQ
- 14-bit resolution
- 4000000 samples memory depth
- 100 MHz sample rate
- Integrated hard disk and floppy disk drive
- Optional BER measurement

WinIQSIM
- Calculation of digitally modulated I/Q and IF signals
- Single-carrier, multicarrier and CDMA signals
- Versatile data editor
- Superposition/simulation of impairments
- Graphic display

I/Q simulation software

Modulation methods like GMSK or π/4DQPSK are used in mobile communication systems such as GSM (Global System for Mobile Communications) or NADC (North American Digital Cellular). These complex modulation modes are usually generated with the aid of an I/Q or vector modulator. The calculation and generation of the required baseband signals is of course quite complex.



WinIQSIM, successor of the well-proven IQSIM, is a Windows software allowing calculation of I and Q baseband signals. Its capabilities range from single-carrier modulation, generation of multicarrier, CDMA and W-CDMA signals through to TDMA frame configurations with the help of a convenient data editor. All modulation parameters and impairments can be simulated for single-carrier and multicarrier as well as for CDMA signals. To put it in a nutshell: WinIQSIM is an indispensable tool for anyone engaged in modern digital modulation.

Specifications in brief

AMIQ

Output memory	
Waveform length (data and markers)	
Clock rate mode 1 (10 Hz to 4 MHz)	24 to 4000000 samples in steps of one
Clock rate mode 2 (2 to100 MHz)	24 to 4000000 samples in steps of four
Amplitude resolution	14 bits
Marker outputs	4
Clock generation	
Clock rate	
Mode 1 (slow)	10 Hz to 4 MHz
Mode 2 (fast)	2 MHz to 100 MHz
Setting range	10 Hz to 105 MHz [a]
Resolution	1×10^{-7}

a. Specs not guaranteed for clock >100 MHz, max. ambient temperature 35 °C

Reference frequency	
Internal reference output	
Frequency	10 MHz
Aging (after 30 days of operation)	1×10^{-5}/year
Temperature effect (0°C to 45°C)	$<2 \times 10^{-6}$/°C
Signal output	
Number of outputs	2 (I and Q)
Output impedance	50 Ω
Output voltage (V_p into 50 Ω)	
Fix mode	0.5 V, same for both channels
Variable mode	0 mV to 1 V, separately adjustable for each channel
Skew between I and Q channel (filter off, clock rate 10 MHz, fix mode)	
Fine variation	typ. ±1 ns
Resolution	<10 ps
Effective bits (sinewave 5 MHz, clock frequency 50 MHz, fix mode)	typ. 11
Filters	
Operating modes	off (no filter), ext. filter, int. filter
Internal filters	
25 MHz, elliptic, 7th order + delay equalizer	
Freq. response: Amplitude	typ. 0.15 dB up to 25 MHz
Group delay	typ. 500 ps up to 20 MHz
2.5 MHz, elliptic, 7th order + delay equalizer	
Freq. response: Amplitude	typ. 0.15 dB up to 2.5 MHz
Group delay	typ. 5 ns up to 2 MHz
Trigger	
CONT mode	repetitive output of loaded waveform after occurrence of trigger
SINGLE mode	single output of loaded waveform after occurrence of trigger
GATED mode	start of (repetitive) waveform output after occurrence of trigger until end of trigger event
Trigger signal	via remote control or trigger input
Trigger input	BNC connector, selectable polarity
Input level	TTL
Marker outputs	4, BNC connectors

BER (option AMIQ-B1)
Data supplied by the DUT can be compared with a nominal random bit sequence; the results are transferred to the host computer (via the currently used remote control)

Pseudo random bit sequences	2^9-1, $2^{11}-1$, $2^{15}-1$, $2^{20}-1$, $2^{23}-1$

Remote control and memory via IEC 625-2 (IEEE 488) and RS232

Command set	SCPI 1996.0 with extensions
Mass memory	floppy disk drive (3.5", 1.44 MB), built-in hard disk 1 GB
General data	
Rated temperature range	0°C to +45°C; to IEC68-2-1 and IEC68-2-2
Storage temperature range	–40°C to +70°C
Power supply	90 V to 132 V (AC), 47 Hz to 63 Hz, 180 V to 264 V (AC), 47 Hz to 63 Hz, autoranging of AC supply, 150 VA
Dimensions (W x H x D)	427 mm x 88 mm x 450 mm
Weight	8.4 kg

WinIQSIM

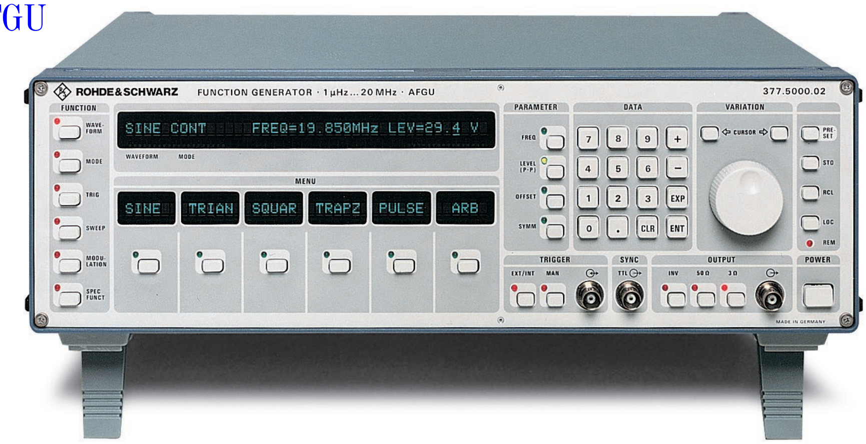
User interface	Windows interface with context-sensitive help
Systems	single-carrier, IF signals up to 25 MHz, multicarrier, up to 512 carriers with or without modulation, with variable power, W-CDMA
Modulation modes	
PSK	BPSK, QPSK, offset QPSK, π/4DQPSK, 8PSK; parameter: reference level
QAM	16/32/64/256QAM; parameter: reference level
FSK	MSK, 2FSK, 4FSK, GTFM; parameter: modulation index 0.1 to 12; GTFM b 0 to 1
User-specific modulation	
Data editor	definition of TDMA data structures with power-time templates
Sequence length	1 to max. 4 M symbols
Simulation of impairments and transfer characteristics	I/Q impairments, phase, bandpass, amplifier models, power ramping, multipath propagation, offset, additive interferers, receiver filters, quantization, smoothing
Graphic output	user-selectable scaling, zoom function, delta marker; display modes: i(t), q(t), r(t), phi(t), r(t), f(t), eye I, eye Q, eye F, vector diagram, constellation diagram, magnitude/ phase/group delay spectrum
Remote control of AMIQ	download and starting of waveforms, hardware configuration, alignment and fine adjustment, file management

Ordering information

I/Q Modulation Generator	AMIQ	1110.2003.02
Accessories supplied	WinIQSIM, version für Windows 3.x and Windows 95/NT on 3.5"disks; manual, dongle; power cable, operating manual	
Options		
BER Measurement	AMIQ-B1	1110.3500.02
Rear I/Q Outputs	AMIQ-B19 [1)]	1110.3400.02
Recommended extras		
19" Rack Adapter	ZZA-211	1096.3260.00

1) Marker outputs 3 and 4 not provided if this option is fitted

Function Generators AFG, AFGU



AFG: 10 mHz to 20 MHz

AFGU: 1 µHz to 20 MHz

Generation of standard waveforms, versatile operating and modulation modes

AFGU (photo 35 573)

Brief description

AFG and AFGU provide practically all signals that are required in electronics, electroacoustics, vibration measurements, material testing and control engineering. Modulation modes include AM, FM, PM (pulse), FSK (frequency shift keying) and VCO operation. FSK and PM can be triggered internally or externally. AM and FM can be produced with the aid of external modulation signals.

Typical applications

- Analog and digital techniques
- All broadband applications such as frequency response/filter measurements
- Acoustic measurements
- Frequency divider and multiplier (AFGU)
- Waveform regeneration, transformation
- On/off ratio variation, level shift keying
- Stimulating source in test systems
- Tests on sonar equipment
- Control engineering
- Triggering of pressure, tension and torsion testing machines in material testing
- Triggering of test equipment for vibration testing and operational load simulation

Main features

- Ramp and sine^2 pulse through variation of symmetry, start/stop phase and DC offset
- Single pulses, pulse trains – internally /externally triggered, adjustable edges
- Linear/logarithmic sweep (phase-continuous steps)
- AM, FM, VCO, pulse modulation and frequency shift keying

Additional features of AFGU

- Synthesizer-accurate signals
- Arbitrary (ARB) waveforms
- Use of special ARB software (AWD-K1; page 221) on a PC
- F/N and FxN mode
- Arbitrary (ARB) sweep
- Enhanced level range, selectable source impedance 5/50 Ω

Operating modes

Continuous

Low-distortion sine, linear triangle and precise squarewave signals with adjustable symmetry.

Arbitrary waveform ARB (AFGU)

Any user-specific waveforms; for the definition of such waveforms a memory providing a resolution of 4096 x 1024 points is available.

Pulse

Pulses up to 20 MHz with rise/fall times of 10 ns and minimum pulse widths of 25 ns. In the BURST MODE, single pulses, double pulses or pulse trains can be generated.

Burst

Preselected number of full cycles, internally or externally triggered. The BURST MODE can be selected for sine, triangle and square waveforms – even with variable symmetry.

1/2-CYCLE BURST MODE

Half cycles of the selected waveform.

GATE MODE

Signal switched on for the duration of the internal or external GATE signal.

SWEEP MODE

Periodic sweep, single-shot sweep and externally triggered sweep; the sweep can take the form of a ramp, triangle or trapeze, with linear or logarithmic frequency steps. AFGU additionally provides a digital, arbitrary sweep (the arbitrary sweep trace is defined by the ARB waveform).

FxN MODE and F/N MODE (AFGU)
Output signal synchronized to internal or external trigger signal; the ratio of output signal (sine, triangle and square) to trigger signal is determined by the factor N or 1/N.

Modulation

Amplitude modulation
Level control and level keying are possible through DC coupling of the AM input.

Frequency modulation/VCO mode
The maximum deviation depends on the carrier frequency selected. The VCO mode is suitable for analog sweep applications.

Pulse modulation
Allows internally or externally triggered signal blanking.

FSK modulation
The two frequencies may have any relative values up to a ratio of 1:10 (switchover by internal or external triggering).

Option, software

50 MHz frequency extension
Frequency range extension from 20 to 50 MHz for the sync output (TTL/HCMOS) of the AFGU.

Arbitrary Waveform Designer AWD-K1
Software for generating complex waveforms.

Specifications in brief: AFG

Frequency	
Sine, triangle, square	10 mHz to 20 MHz (symm. 50%)
	2 Hz to 2 MHz (symm. 5 to 95%)
Trapeze	666 µHz to 500 kHz
Pulse/sin^2 pulse	666 µHz to 1 MHz
Ramp	2 Hz to 2 MHz
Resolution	3.5 digits
Signal output	
Output voltage (AC)	can be set independently of DC offset
Range	0 to 10 V pp into 50 Ω
DC offset voltage	can be set independently of AC
Range	+5 to –5 V into 50 Ω
SYNC output	TTL, 50 Ω, symmetry and frequency same as signal output
Waveforms	
Standard functions	sine, triangle, square, trapeze, pulse
Derived functions	ramp, sin^2 pulse by symmetry setting
Symmetry setting	for sine, triangle, square
Range	5 to 95% (of cycle)
Operating modes	(sine, triangle, square)
CONT	
BURST	
$^1/_2$ -CYCLE BURST	
GATE	
SWEEP	
Modes	periodic, single-shot, externally triggered, manually triggered sweeps
Functions	lin/log, ramp up/down, triangle, trapeze
Trigger input/output	
Modes	internal, external
Internal	TTL/HCMOS, 1 kΩ
External	Z_{out} =1 kΩ, DC to 20 MHz
Modulation	
Modes	AM, FM, VCO external, PM internal/external, FSK internal/external
Carrier frequency	10 mHz to 20 MHz
General data	
Remote control	IEC 625-1/IEEE 488
Power supply	100/120/220/240 V ±10%, 47 to 63 Hz, 65 VA

Specifications in brief: AFGU

Data differing from that of Function Generator AFG

Frequency	
Sine, triangle, square, pulse	1 µHz to 20 MHz
Ramp, trapeze	1 µHz to 2 MHz
Signal sync output:	
Square (TTL/HCMOS)	1 µHz to 20 MHz
with option AFGU-B1	1 µHz to 50 MHz
Frequency resolution	6-digit, min. 1 µHz (continuous)
	3.5-digit, min. 1 µHz (burst, gate)
Frequency error in synthesizer mode	setting error + error of reference
Setting error (2 kHz to 20 MHz)	±6 x 10^{-7}
Signal output	
Output impedance	50 Ω/<5 Ω selectable (f = 10 kHz)
Output voltage (AC)	
Range (V pp), EMF	0 to 30 V (I_{max} = 200 mA)
	0 to 15 V (into 50 Ω with Z_s = 50 Ω)
DC offset voltage (Z_s = 50 Ω)	
Range	$\lvert V_{offset}\rvert$ ≤10 V–0.5 V pp
Waveforms	same as AFG, plus arbitrary waveforms
Operating modes	same as AFG, plus:
F/N and FxN	
DIGITAL SWEEP	
Optional 50 MHz TTL/CMOS Output AFGU-B1	
Frequency range	1 µHz to 50 MHz
Output signal	TTL, HCMOS into 50 Ω
General data	
Power supply	100/120/220/240 V ±10%, 47 to 63 Hz, 120 VA
Dimensions (W x H x D)	435 mm x 147 mm x 350 mm
Weight for fully equipped unit	10.5 kg (AFG), 14 kg (AFGU)

Ordering information

Function Generator	AFG	0377.2100.02
	AFGU	0377.5000.02
Extras		
Optional 50 MHz Frequency Extension, TTL/CMOS Output for AFGU	AFGU-B1	0351.8018.02
Service Kit	AZ-1	0377.4810.02
Arbitrary Waveform Designer (application software for AFGU)	AWD-K1	1026.4500.03

Dual Arbitrary Waveform Generator ADS

Signal source of virtually unlimited flexibility, see also Application Software AWD-K1, IQSIM-K, DAB-K1

Photo 39395

Brief description

ADS is provided with two independently programmable synthesis channels. Thanks to its simple channel synchronization facility and precise phase setting, the ADS is ideal for generating complex signals.

ARB generators are essential tools for

- digital modulation,
- communications,
- navigation,
- automatic test equipment,
- component testing,
- audio and acoustics measurements,
- material testing,
- ultrasound measurements,
- filter design,
- video applications, control engineering,
- sensors and
- automotive engineering.

Complex modulation signals

The ADS is a high-precision signal source for driving I/Q modulators to produce digital modulation; it is particularly suitable for driving the I/Q modulator of Signal Generator SMHU58 (page 206).

Main features

- Convenient editor functions for creating user-programmable waveforms, ARB sequences and ARB sweeps
- 12-bit amplitude resolution
- 64-Kpoints waveform memory per channel
- Sine synthesis with high spectral purity (0.1 Hz to 5 MHz)
- Generation of triangular waves with high linearity (0.1 Hz to 100 kHz)
- User-programmable frequency sweep
- ARB sequence mode for generating signals with extremely long periods
- Nonvolatile memory for storing 20 instrument setups as well as up to 99 ARB signals, ARB sequences and ARB sweeps
- Memory card for waveform libraries

Spectral purity

The low distortion (typically –70 dB) and a frequency response of typically 0.1 dB allow precise audio measurements. The high spectral purity close to the carrier throughout the entire sinewave frequency range enables testing of fast, high-resolution A/D converters.

Overview of options and software

Designation, functions	Type
Clock Generator: resolution improved by a factor of 4000 to further enhance the accuracy of setting the period of ARB signals	ADS-B1
Software: for generating complex waveforms (page 221)	AWD-K1
Software: for generating I/Q signals for any digital modulation modes (page221)	IQSIM-K
Software: for generating COFDM signals (page 222)	DAB-K1

Trigger functions
A variety of trigger functions (SINGLE, GATE, RESET, HOLD and HOLD/ RESET in ARB mode, SINGLE and STEP in sequence mode) is provided for control of signal generation. In the sine mode, the modulation modes FSK (frequency shift keying), PSK (phase shift keying) and PM (pulse modulation) can be selected in addition to the trigger functions HOLD and HOLD/ RESET. Triggering can be carried out with the internal trigger generator, through an external source or manually.

Operation

Waveform editor
This is a highly convenient tool for synthesis and modification of any waveform or application-specific sweep. The complete waveform library stored by the user in the internal memory can be accessed and is available for editing.

Sequence mode
In this mode, ARB signals can be joined up to a continuous programmed sequence. By assigning a repetition rate to any element in the sequence, it is possible to create sequences that use a fraction of the memory capacity required for conventional ARB synthesis. Each element in the sequence can be assigned an individual read clock frequency; in this way, expanded ARB signals can be included in the sequence. The SEQ editor which is similar to the ARB editor is used for programming and modifying ARB sequences.

Specifications in brief

Specifications apply to both synthesis channels of ADS

Signal output	
Output voltage (AC), EMF	0 to 20 V pp, I_{max} = ±100 mA, 0 to 10 V into 50 Ω
DC offset setting range	–5 to +5 V into 50 Ω
Sine	0.1 Hz to 5 MHz
Triangle	0.1 Hz to 100 kHz
Phase setting range	CH1/CH2 –180° to +180°
Trigger modes	
Frequency shift keying (FSK)	phase-continuous
Phase shift keying (PSK)	setting range –180 ° to +180 °
Pulse modulation (PM)	
Reset (RESET)	triggered phase reset to 0°
Hold	triggered stop
Hold/Reset (HD/RS)	triggered stop and reset
Sweep mode	
Digital, user-programmable frequency and phase sweeps, triggered internally, externally or manually	
User-programmable waveforms	
Length	2 to 65536 points, composite ARB sequences
Amplitude resolution	12 bits
Clock source (CLK) internal	400 Hz to 25 MHz
with ADS-B1	200 Hz to 33 MHz
external	DC to 33 MHz
Filters	(DC) 400 Hz to 33.33 MHz
3rd-order Bessel filters, modified	10 kHz, 100 kHz, 1 MHz, 2.5 MHz
7th-order Chebychev filters, modified	500 kHz, 5 MHz
ARB sequences	
Sequence length	2 to 8192 ARB curves
Repetition rate for single curves	1 to 65535, programmable
Expansion factor	(1 to 65535) x clock period, programmable for each ARB curve
Operating modes	
Continuous mode	CONT
Trigger modes	SINGLE, STEP
Trigger mode	trigger source internal, external, manual
Internal triggering	HCT/TTL-compatible, 50 Ω
Trigger period	1 µs to 2000 s
On/off ratio	adjustable, 1:6500 to 6500:1
Resolution, ON/OFF time	min. 500 ns
External triggering	
Input impedance	50 Ω/600 Ω, selectable
Trigger threshold	0.2 V/2.0 V, selectable
Trigger edge	up/down selectable
Trigger state	active LOW/HIGH selectable
Frequency	DC to 25 MHz
Memory	320 Kbyte, nonvolatile
Memory card	128 Kbyte
Clock generator (option ADS-B1)	
Read frequency	200 points/s to 33.33 Mpoints/s
Resolution	0.01%, min. 10 ps
Reference frequency	
Input/output frequency	5 or 10 MHz, selectable
Remote control	IEC bus (IEEE 488.2), in line with SCPI
General data	
Power supply	100/230 V –10/+15%, 120/220 V –15/+10%, 47 to 420 Hz, 150 VA
Dimensions (W x H x D)	435 mm x 192 mm x 350 mm
Weight	14 kg for fully equipped unit

Ordering information

Dual Arbitrary Waveform Generator	ADS	1012.4002.02
Option		
Clock Generator	ADS-B1	1013.5748.02
Extras		
Memory Card	CMS-Z2	0841.1509.02
Software for ARB Signals	AWD-K1	1026.4500.03
for I/Q Signals	IQSIM-K	1013.1642.02
for COFDM Signals	DAB-K1	1013.4649.02
Service Kit	ADS-Z2	1013.1494.02

Generators APN04, APN06

1 Hz to 260 kHz

Versatile, high-precision

AF signal sources

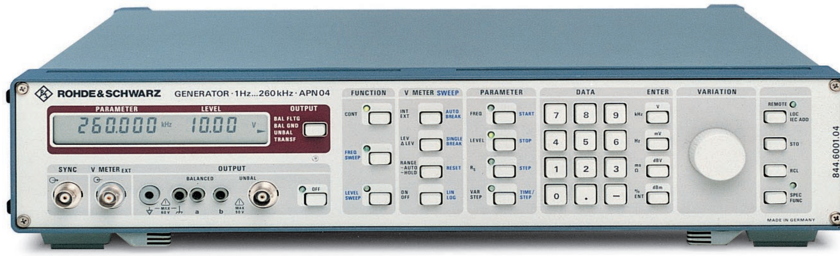


Photo 37171-2

Brief description

AF Generator APN is a high-precision signal source with a large variety of outstanding features and functions. APN04 is a complete AF test set with voltmeter.

Main features

- Synthesizer resolution 1 Hz (up to 20 kHz: 0.1 Hz)
- Reference frequency input/output for external synchronization: signal proportional to frequency or level (option APN-B1)
- Phase-continuous frequency change without transients
- Frequency sweep: fast, phase-continuous, with synthesizer accuracy
- Output voltage 50 µV to 20 V, balanced and unbalanced
- Level sweep, non-interrupting over 20 dB
- Floating, balanced output with two identical signal branches eliminating the disadvantages of a transformer
- Source impedance selectable
- Low distortion, high signal symmetry
- Triangular, squarewave and ramp signals up to 20 kHz
- APN04: signal source and voltmeter
- APN06: squarewave signal (instead of voltmeter) 1 Hz to 260 kHz, V_{pp} = 0 to 10 V, rise/fall times <100 ns

Overview of options

Designation, functions	Option
Reference Frequency Input/Output: 5 or 10 MHz; X output	APN-B1
Transformer 1:3	APN-B2

Specifications in brief

Frequency	1 Hz to 260 kHz
Resolution	1 Hz, 0.1 Hz (0.1 Hz to 20 kHz)
Frequency drift	<4 x 10^{-5} + error due to aging
Aging	<10^{-5}/year
Signal output	
Impedance	keyboard entry
balanced, floating	10 to 640 Ω in 5 Ω steps
balanced, grounded	2 x (5 to 320 Ω) in 2.5 Ω steps
unbalanced	10 to 640 Ω in 5 Ω steps
Impedance error	≤2 Ω
Output voltage (EMF)	resolution 10 µV or 0.1 dB
balanced, floating	100 µV to 20 V, I_{max} = 200 mA (10 V into 50 Ω)
balanced, grounded	2 x (50 µV to 10 V), I_{max} = 200 mA (2 x 5 V into 25 Ω)
unbalanced	100 µV to 20 V, I_{max} = 200 mA (10 V into 50 Ω)
Accuracy	±0.5 dB

SINAD (typ.)

Signal level	1 V	100 µV bal.	100 µV unbal.
broadband 22 Hz to 22 kHz	80 dB	40 dB	30 dB
weighted to CCITT	84 dB	50 dB	40 dB

Spectral purity	
THD 10 Hz to 100 kHz	<–60 dBc (<0.1%, typ. –70 dBc)
Sum of 2nd to 9th harmonic 10 Hz to 20 kHz	typ. –80 dBc
Harmonics and nonharmonics 100 to 260 kHz	<–46 dBc (typ. <–55 dBc)
Sweep (frequency, level)	
Digital start-stop sweep	automatic, single-shot, manual, linear, logarithmic
Level sweep range	selectable, max. 20 dB
Voltmeter (model 04)	digital display, INT/EXT, difference measurement (V, dB), trend display
Measurement range (V_{rms})	50 µV to 50 V
Readout; resolution	3.5 digits; 10 µV
General data	
Remote control	IEC625 (IEEE488)
Power supply	100/120/220/240 V ±10%, 47 to 440 Hz, max. 60 VA
Dimensions (W x H x D)	435 mm x 103 mm x 350 mm
Weight	7.5 kg for fully equipped unit

Ordering information

Generator	APN04	0844.6001.04
	APN06	0844.6001.06
Options		
Reference Frequency Input/Output	APN-B1	0844.8340.02
Transformer 1:3	APN-B2	0844.9700.02
Transformer 1:1	APN-B2	0844.9700.04

Arbitrary Waveform Designer AWD-K1

Professional generation of complex waveforms for ARB generators

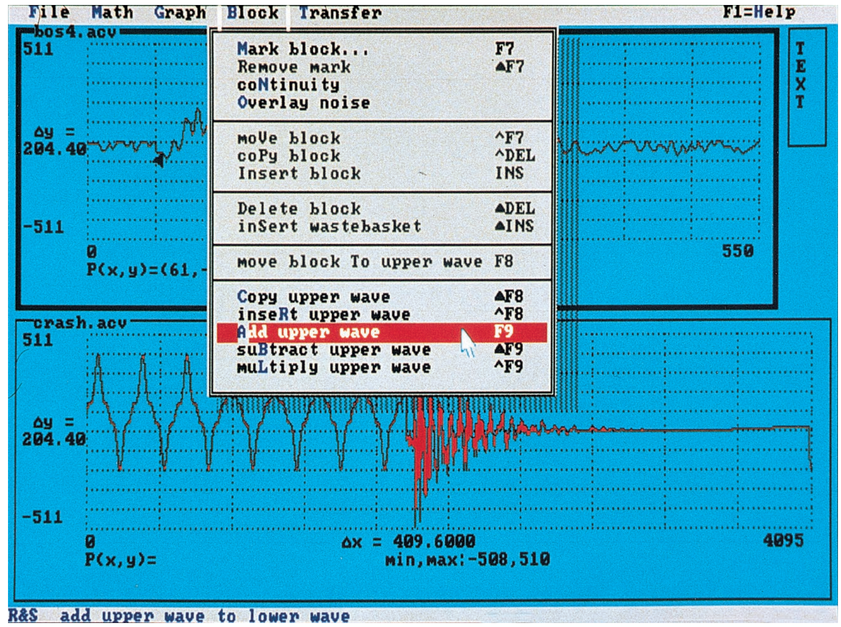


Photo 38829-5

Main features

- Entry of formulas
- Freehand design using the mouse
- Drawing of line segments
- Loading of signals from digital storage oscilloscopes
- Combining existing waveforms or parts thereof
- Compression or expansion of curves in X and Y directions
- Addition, subtraction and multiplication of two waveforms
- Superimposed noise with adjustable amplitude
- Any combination of these methods

I/Q Simulation Software IQSIM-K

Generation of I/Q signals for any type of digital modulation

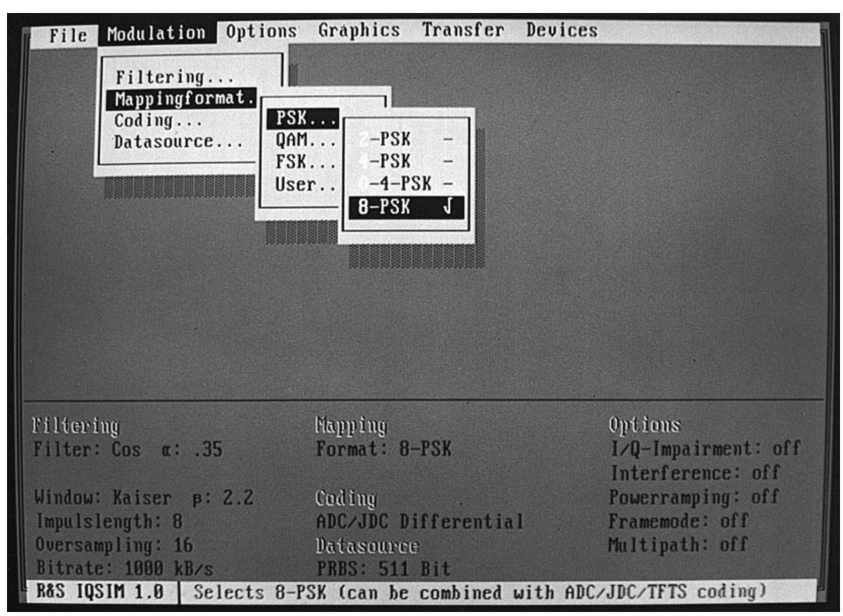


Photo 40588-1

Main features

IQSIM-K computes according to user-specific requirements:

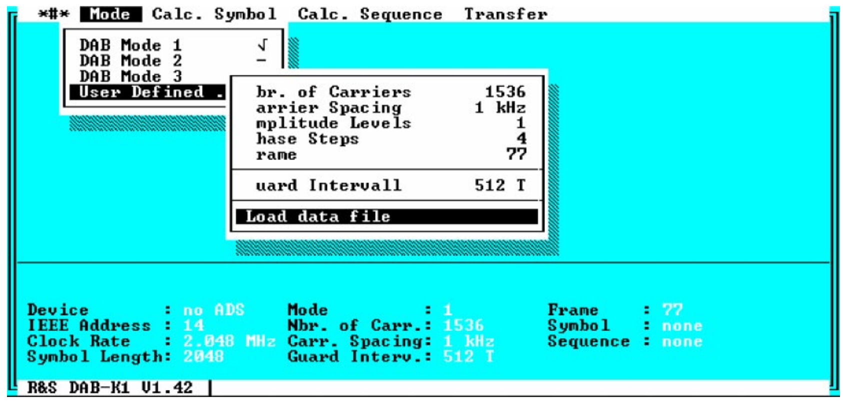
- Type of modulation
- Coding
- Baseband filtering
- Bit sequence

Additional features:

- Superpositioning/simulation of interference sources
- Power ramping
- Data transfer to ARB generator

COFDM Software DAB-K1

Generation of COFDM signals (coded orthogonal frequency division multiplex) for DAB and DVB



Main features

- Simulation of DAB and DVB signals with COFDM modulation
- All DAB modes (1, 2, 3) selectable
- Inclusion of guard intervals of selectable length
- Simulation of a DAB frame made up of 77 or 144 symbols, number of symbols also user-selectable
- Calculation of other multicarrier signals with user-selectable number of carriers (up to 8190) and frequency spacing of carriers selectable from 1 Hz to 1 MHz
- Simulation of signal interference such as spurious amplitude and phase
- Simulation of fading
- Conversion of COFDM-modulated signals into the frequency range of the SMHU58 (5 MHz to 2 GHz)
- Bandwidth of modulated signals 1.5 MHz for DAB modes and up to 20 MHz for user-defined COFDM signals
- User-selectable D/A converter resolution from 1 to 12 bits
- Selectable clipping of maximum peak power

Hardware required for Software AWD-K1, IQSIM-K and DAB-K1

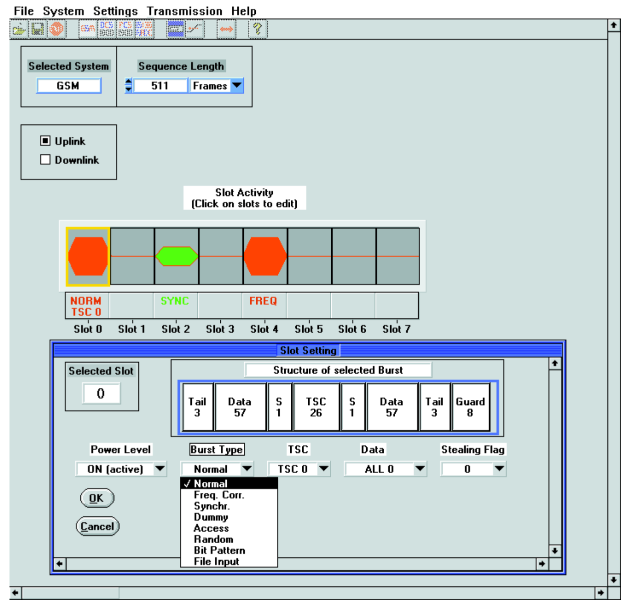
	AWD-K1	IQSIM-K	DAB-K1
Controller	PSA controller family or AT-compatiblem PC to industry standard (min. 80386/20)		
Operating system	MS-DOS 3.0 or higher	MS-DOS 3.0 or higher	MS-DOS 3.3 or higher
Main memory	min. 420 Kbyte RAM; recommended: 1 Mbyte extended memory with XMS driver (versions 2.0 or higher) and RAM disk	min. 350 Kbyte RAM	min. 400 Kbyte RAM
Graphic card	Hercules, EGA or VGA		
Monitor	monochrome or colour monitor		
Drives	hard disk drive with min. 2 Mbyte storage capacity, $5^1/_4$" disk drive for high-density floppies		
IEC-bus card (IEEE 488)	Rohde&Schwarz IEC/IEEE-bus card (fitted in PSA) or National Instruments PCIIA card		
IEC/IEEE-bus driver	Rohde&Schwarz IEC/IEEE-bus driver PS-K2, National Instruments GPIB PC software		
Mouse	PS-B11 from Rohde&Schwarz, serial Microsoft mouse		
Generators	AFGU, 0377.5000.02, page 216 ADS, 1012.4002.02, page 218	SMHU58, 0835.8011.58, page 206 ADS, 1012.4002.02, page 218 ADS-B1, 1013.5748.92, page 218	SMHU58, 0835.8011.58, page 206 ADS, 1012.4002.02, page 218 ADS-B1, 1013.5748.92, page 218

Ordering information

Arbitrary Waveform Designer	I/Q Simulation Software	COFDM Software
AWD-K1, 1026.4500.03	IQSIM-K, 1013.1642.02	DAB-K1, 1029.4649.02

Software SME-K2

Generating communication signals with Signal Generator SME



Brief description

As regards the development and production of base stations, cellular phones and chip sets Software SME-K2 facilitates the setting of the universal Signal Generator SME to the different signals required and greatly enhances its usability.

Main fatures

- Easy generation of TDMA bursts with graphical display
- Predefined burst structures according to communication standards GSM900/1800/1900, IS-136 (NADC), DECT, PDC
- Automatic setting of signal generator (frequency, level, modulation, burst control)
- Synchronization words according to communication standards or user definition
- PRBS data sequences (2^9–1 or 2^{15}–1), continued in same time slot from frame to frame
- User-defined modulation data
- Signal generator control via IEC/IEEE bus or RS232-C interface

Modulation data selection of all bursts

- All 0, all 1
- PRBS 2^9–1, PRBS 2^{15}–1 in data section of burst
- Bit pattern (length of pattern up to max. number of bits in timeslot)
- File input

Specifications

Available bursts/physical channels (according to system specifications):
GSM900/1800/1900
Normal (TSC0 to TSC7, user-defined), frequency correction, synchronization, dummy, access burst
IS-136 (NADC)
Downlink (synchronization words S1 to S6), uplink (synchronization words S1 to S6), shortened uplink, all eight combinations of full-rate and half-rate channels possible
DECT
Short PCH R00, basic PCH R32, low-rate PCH R0j (L=0/L=1), high-capacity PCH R80, optionally with Z field
PDC
Downlink and uplink: traffic PCH, control PCH, synchronization burst, all eight combinations of full-rate and half-rate channels possible, slot at head of superframe
Additional
Random (PRBS 2^9–1 or PRBS 2^{15}–1), file input, bit pattern

Hardware requirements

Controller	PSP/PSA controller family or AT-compatible PC to industry standard (CPU 386 + mathematical coprocessor or better)
Operating system	Windows 3.1x or Windows 95
Main memory	min. 8 Mbyte RAM
RS232-C interface	null modem cable (1050.0346.00)
IEC/IEEE-bus card (IEEE 488.2)	R&S PS-B4 (1006.6207.04) or National Instruments AT-GPIB card, Windows driver installed
Mouse	R&S PS-B11, serial Microsoft mouse or compatibles

Supported generators

Signal Generator SME02	5 kHz to 1.5 GHz	1038.6002.02
SME03	5 kHz to 3 GHz	1038.6002.03
SME06	5 kHz to 6 GHz	1038.6002.06
with option (mandatory) DM Coder for SME02/03/06	SME-B11	1036.8720.02
Signal Generator SME03E (DM coder included)	5 kHz to 2.2 GHz	1038.6002.13

Supported options

8-Mbyte Memory Extension	SME-B12	1039.4090.02
Pulse Modulator for SME02	SM-B3	1036.6340.02
SME03/03E	SM-B8	1036.6805.02
SME06	SM-B9	1036.5100.02
Pulse Generator for SME	SM-B4	1036.6340.02

Ordering information

Software	SME-K2	1104.7736.02

Fast and precise measurement of all audio parameters at analog and digital interfaces: Audio Analyzer UPD (photo 42402)

Contents of Chapter 6

Audio Analyzer UPA

10 Hz to 100 kHz

System-compatible analyzer for generating and measuring analog audio signals

Photo 37920

Brief description

Audio Analyzer UPA is a compact instrument allowing all essential audio parameters to be measured at balanced and unbalanced analog audio interfaces.

Due to its large variety of options (see overview on the right) it can be optimally adapted to the specific application. The great number of filters available makes the UPA suitable for numerous audio measurements.

Model UPA3 is a cost-effective test set with a generator and distortion meter.

Due to its remote-control capability (IEC 625/IEEE 488) and high measurement speed, a major application of UPA is in automated testing of audio components in series production.

Main features

- Psophometric measurements to DIN, CCIR, CCITT
- Broadband level meter with true RMS reading or quasi-peak reading
- Simultaneous measurement of level and frequency
- DC voltage measurements
- Combined digital and analog displays for all functions
- Synthesizer generator with low distortion and floating outputs (option)
- Switch-selectable generator output impedance
- Fully automatic distortion meter for measurement of total and selective harmonic distortion or SINAD (option)
- Wow and flutter meter to DIN, CCIR, IEC, NAB, JIS with amplitude variation meter (option)
- Frequency counter and phase meter
- Nonvolatile memory for 50 instrument setups

Overview of options

Designation, functions	Option
Generator: provides level- and crystal-accurate sinewave signals with low distortion and excellent S/N ratio; high frequency and level resolution	UPA-B6
Distortion Meter: measures total harmonic distortion (THD/ THD+N), selective harmonic distortion up to 9th order, sum of all even/odd distortion factors, SINAD	UPA-B8
Wow and Flutter Meter: measures wow and flutter to DIN-IEC, NAB, JIS as well as amplitude variations	UPA-B9
Special Filter: contains a large variety of customary audio filters (see specifications); selected filter is switched into the signal path	UPA-B2
Filter Circuit Board, partly fitted: plug-in filter board with control section fitted; allows configuration of customized filters	UPA-B3
Customized Filter: on request, customized filters (also several filters on one PC board) will be devised and manufactured by Rohde & Schwarz	UPA-B4
Harmonics Filter: comprises AC-supply adapter and PC program disk; allows measurement of harmonic currents of the AC supply in line with European standard EN 60555 part 2	UPA-B4, model 17
CD Filter: filter board for measurements on CD players and DAT recorders using the test CD; comprises PC program disk for complete automatic measurements	UPA-B4, model 04
Audio Test Disc: signal source for testing CD players, DAT recorders, sound broadcast links, tape recorders, etc	UPA-CD
DC Output: allows XY representation of the selected measurement functions, eg on a recorder	UPA-B1

Audio Analyzer UPA

Specifications in brief

Basic unit

AF level meter	
Voltage measurement range	10 µV to 300 V, unbalanced 10 µV to 35 V, balanced
Frequency range	10 Hz to 100 kHz
Filters	22.4 Hz and 300 Hz highpass filters, 22.4 Hz and 100 kHz lowpass filters, CCIR, CCITT
Other filters	contained in option UPA-B2
Test inputs	floating
Balanced	two 3-contact female connectors, switchable R/L channel, 600 Ω/20 kΩ
Unbalance rejection	>110 dB at 50 Hz
Unbalanced	two BNC female connectors, switchable R/L channel, 1 MΩ
Crosstalk attenuation R/L	>80 dB at 20 kHz
Detector	RMS-responding rectifier, quasi-peak responding rectifier
Level indication	5 digits in mV, V, dBm, mW or W, relative indication in % or dB
Accuracy RMS (sinewave)	±1% ±1 digit (30 Hz to 20 kHz)
Inherent noise CCIR, weighted (QPK)	<10 µV (unbalanced, 600 Ω) <20 µV (balanced, 600 Ω)
S/N ratio measurement (with Generator Option UPA-B6)	
Signal frequency range	30 Hz to 100 kHz
Display range	0 to 120 dB
Accuracy (S/N ≤60 dB)	±1 dB
Inherent S/N ratio	>85 dB or <20 µV
DC voltage measurement	0 to ±300 V
Test inputs	see AF level meter, but unbalanced only
Accuracy	±1% ±1 digit
Frequency counter	
Frequency measurement range	8 Hz to 250 kHz
Required input voltage	>10 mV (S/N ratio >20 dB)
Accuracy	±0.005% ±1 digit
Phase measurement	
Display range	0 to 180°
Resolution	0.1°

Options

Generator (option UPA-B6, standard in UPA3)	
Frequency range	10 Hz to 100 (110) kHz
Accuracy	±0.01%
Outputs	like test inputs of AF level meter
Unbalance rejection	>80 dB at 1 kHz (bal., V_{out} >1 V)
Crosstalk attenuation L/R	>80 dB at 20 kHz
Output impedance	30 Ω/200 Ω/600 Ω, selectable
Output voltage, no load	0.1 mV to 12.4 V
Load impedance, max. load	>200 Ω/54 mA
Output circuit	short-circuit-proof, switched off in case of external feeding
Inherent distortion (V_{out} >300 mV)	<–80 dB (30 Hz to 20 kHz)
Frequency response (ref. to 1 kHz)	±0.5% (10 Hz to 20 kHz)
Distortion meter (option UPA-B8, standard in UPA3)	
Frequency range, fundamental	10 Hz to 100 kHz
Frequency adjustment	automatic or by frequency preselection
Display modes	total harmonic distortion THD, selective distortion d_2 to d_9, SINAD, level
Display range	–120 to 0 dB (distortion)
Accuracy THD or SINAD, 20 Hz to 20 kHz	±1 dB (harmonics up to 100 kHz)
Wow and flutter meter (option UPA-B9)	
Wow and flutter meter	
Measurement method	IEC, NAB, JIS, 2-sigma
Measurement range	0.003 to 5%
Accuracy	±10%
Amplitude variation meter	
Frequency range	2 to 20 kHz
Variation range	
Level	0 to 20 dB
Frequency	0.1 to 300 Hz
Accuracy	±0.25 dB (0 to 3 dB)
Special filter (option UPA-B2)	
A-filter	to DIN IEC 651
Bandstop filters	pilot-tone trap with15 kHz lowpass filter, line-frequency trap with 13 kHz LP (both filters can be combined with A-filter)
Bandpass filters	standard frequencies 315 Hz/1/3.15/6.3/10/12.5 kHz; additionally adjustable fixed center frequencies of 8/9/10/11/12/13/14/15/15.5/16/17/18/19/20/25 kHz; adjustable passband frequencies from 23 Hz to 25 kHz; telephone bandpass filter 320 Hz to 3.4 kHz; bandpass filter 2 to 10 kHz
Lowpass filter	350 Hz/1.04/3.5/7/10.4/15 kHz

General data

Remote control	IEC 625-1 (IEEE 488), control of all instrument functions

Ordering information

Audio Analyzer		
Basic model	UPA	0372.6014.02
with generator and distortion meter	UPA3	0372.6014.03
Options		
Generator (standard in UPA3)	UPA-B6	0373.0010.02
Distortion Meter (standard in UPA3)	UPA-B8	0373.1616.02
Wow and Flutter Meter	UPA-B9	0373.2612.02
Special Filter	UPA-B2	0373.1216.02
Filter Circuit Board, partly fitted	UPA-B3	0373.1545.02
Customized Filter	UPA-B4	1002.1200.xx
DC Output	UPA-B1	0373.2512.02
Audio Test Disc	UPA-CD	0852.8400.02

Audio Analyzer UPL

DC to 110 kHz

Compact instrument for audio measurements at analog and digital interfaces

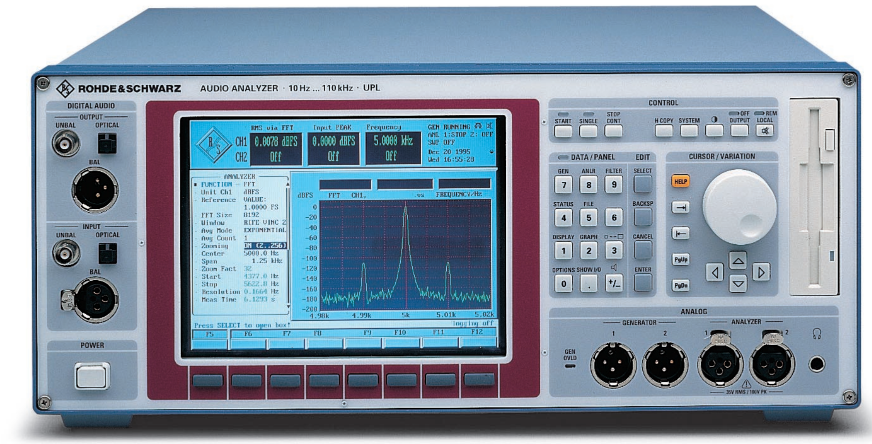


Photo 42374-1

Brief description

Audio Analyzer UPL comprises analyzers and generators for dual-channel measurements and generation of a wide variety of analog and digital audio signals. Its measurement functions and signals are available at all interfaces so that all input-output combinations (AA, AD, DA, DD) are possible. An option allows comprehensive tests of the physical parameters of the audio interfaces, including jitter amplitude and spectrum, pulse amplitude, difference and delay with respect to a reference input.

UPL is thus suitable for all types of audio measurement. Particular emphasis was placed on high measurement speed, which is a must in automatic testing in production.

Main features

- Compact instrument with integrated PC and colour or monochrome LC display
- Wide variety of test functions and numerous test signals for performing virtually all measurement tasks
- Versatile analysis thanks to internal FFT analyzer of wide dynamic range and high frequency resolution
- Future-proof: new test functions can be loaded from diskette
- Any number of digital filters, also for analog measurements
- Maximum dynamic range for the analysis of high-grade components
- Intelligent operator guidance and context-sensitive help system (German and English)
- Mnemonic analysis and generation of channel status data of digital audio interfaces
- Measurement/generation of protocol errors at digital interfaces
- Variety of sweep functions
- More than 10 weighting filters
  - highpass, lowpass, bandpass filters

Overview of options

Designation, functions	Option
Low Distortion Generator: analog sinewave generator offering lower inherent distortion and wider frequency range than built-in standard generator	UPL-B1
Digital Audio I/O: contains the balanced, unbalanced and optical digital audio interfaces	UPL-B2
Extended Analysis Functions: coherence and transfer functions, rub & buzz measurement, third-octave analysis	UPL-B6
Digital Audio Protocol: with Digital Audio I/O UPL-B2 fitted, this option allows the generation and analysis of additional digital data such as channel status and user data, validity bits and the evaluation of parity bits	UPL-B21
Jitter and Interface Test: with Digital Audio I/O UPL-B2 fitted, this option enables the physical parameters of digital audio interfaces to be examined	UPL-B22
Remote Control: enables remote control via the RS-232-C interface or the IEC/IEEE-bus interface (IEC 625/IEEE 488)	UPL-B4
Audio Monitor: adds a headphones output and a built-in loudspeaker to UPL	UPL-B5
Hearing Aids Test Accessories	UPL-B7
Universal Sequence Controller: enables measurement sequences to be generated and executed with the aid of a built-in program generator	UPL-B10
Automatic Audio Line Measurement: enables measurement of broadcast links according to CCITT 0.33 recommendations (UPL-B10 required)	UPL-B33

Specifications in brief

All inherent distortion values refer to the frequency range 20 Hz to 22 kHz.

Analyzers

Analog inputs	
Balanced, floating	2 channels, 300 Ω/600 Ω/200 kΩ
Voltage measurement range	0.1 µV to 110 V rms
Common-mode rejection	>100 dB (50 Hz)
Frequency range	DC to 110 kHz
Frequency response	±0.03 dB, 20 Hz to 22 kHz
Digital inputs	
Digital Audio I/O option	
Balanced input	XLR connector, 110 Ω
Unbalanced input	BNC connector, 75 Ω
Optical input	Toslink system
Clock rate	27 to 55 kHz
Frequency range	10 Hz to 45.7% of clock rate

Measurement functions of analog analyzers; digital analyzers in *italics*

AF level	
Noise (600 Ω)	1.6 µV (CCIR unweight.); *–180 dBFS*
Weighting	RMS, peak[2]), quasi-peak (CCIR 468)[2])
Accuracy	±0.05 dB (V_{rms}, 1 kHz)
Filters	weighting filter; HP, LP, BP; user-configurable in terms of cutoff frequency/attenuation; max. 3 filters can be combined
Selective level	
Center frequency	selectable/swept/coupled to generator or input frequency
Bandwidth (0.1 dB)	1%/3%/third octave/$^1/_{12}$ octave/ selectable
Total harmonic distortion (THD)	
Fundamental	10 Hz to 22 kHz
Inherent distortion (Σ 2nd to 9th order)	–120 dB[1]); *–130 dB[1])*
SINAD and THD+N	
Fundamental	20 Hz to 22 kHz
Inherent distortion	–110 dB[1]); *–126 dB[1])*
Filters	HP, LP + weighting filter
Modulation distortion	2nd plus 3rd order
Measurement method	selective to DIN IEC 268-3
Inherent distortion	–100 dB; *–123 dB[1])*
Difference-frequency distortion	2nd or 3rd order
Measurement method	selective to DIN IEC 268-3
Inherent distortion d2	–120 dB; *–130 dB[1])*
d3	–100 dB[1]); *–130 dB[1])*
Wow and flutter[2]), meas. method	DIN IEC/NAB/JIS/2-sigma
Frequency	10 Hz to 110 kHz 20 Hz to 20 kHz
Accuracy (S/N >80 dB)	±0.005%
Phase, group delay	20 Hz to 20 kHz
Accuracy (phase)	±0.5°
Polarity test	
DC voltage	0 to ±110 V; *0 to ±FS*
Waveform (2-channel)	memory depth 7424 points
FFT analyzer	
Frequency range	DC to 110 kHz; *DC to 45.7% of clock rate*
FFT size/resolution	16 k points/0.023 Hz
Window functions	rectangular/Hann/Blackman-Harris/ Rife-Vincent 1 to 3/Hamming/ flat-top/Kaiser
Averaging	max. 256-fold, exp. + linear
Noise floor	–140 dB; *–160 dB*

Generators

Analog outputs	
Balanced, floating	2 channels,10 Ω/200 Ω/600 Ω
Output voltage	0.1 mV to 20 V rms (no load)
Unbalanced, floating	2 channels, 5 Ω
Output voltage	0.1 mV to 10 V rms (no load)
Frequency range	2 Hz to 21.75 kHz, sine up to 110 kHz[3])
Frequency response	±0.05 dB, 20 Hz to 20 kHz
Inherent distortion[3])	–120 dB
Digital outputs	same as digital inputs

Generator functions of analog generators; digital generators in *italics*

Sinewave	
Inherent THD	–120 dB[3]); *–130 dB*
Inherent THD+N	–110 dB[1]); *–126 dB[1])*
Signal for modulation distortion analysis, selectable	signal/interf. freq., amplitude ratio
Inherent distortion	–100 dB; *–123 dB[1])*
Difference-frequency signal, select.	center frequency and frequency offset
Inherent distortion d2	–120 dB; *–130 dB[1])*
d3	–100 dB[1]); *–130 dB[1])*
Multisine, selectable	amplitude/frequency; max. 17 freq.
Sine-burst, $sine^2$ burst	level ratio and duty cycle selectable
Noise	flat/Gaussian/triangular distribution
Multifrequency noise	band-limited/white/pink/user-defined
Arbitrary waveform	any waveform from file
Max. number of points	16 k
Polarity test signal[2])	
Sweeps	frequency, amplitude, burst interval, burst duration, time

Interfaces

Result logging	2 x RS-232-C, Centronics
Option UPL-B4	IEC 625/IEEE 488
Remote control (option UPL-B4)	IEC 625-2/IEEE 488 and RS-232-C, most commands in conformity with SCPI

Jitter and interface test

with option UPL-B22

Generator	
Jitter injection	0 to 5 UI, 10 Hz to 21.75 kHz
Common mode signal	0 to 20 V pp, 20 Hz to 21.75 kHz
Phase (output to reference)	0 to ±64 UI, selectable
Cable simulator	100 m audio cable
Analyzer	
Input signal	amplitude, sampling rate
Jitter measurement	amplitude, frequency, spectrum, reclocking
Common mode test	amplitude, frequency, spectrum
Phase (input to reference)	0 to ±64 UI
Delay (input to output)	100 µs to 500 ms

Ordering information

Audio Analyzer		
with colour LCD	UPL06	1078.2008.06
without display and keyboard	UPL66	1078.2008.66
GSM model	UPL16	1078.2008.16
Options		
Low Distortion Generator	UPL-B1	1078.4400.02
Digital Audio I/O	UPL-B2	1078.4000.02
Remote Control	UPL-B4	1078.3804.02
Audio Monitor	UPL-B5	1078.4600.02
Extended Analysis Functions	UPL-B6	1078.4500.02
Hearing Aids Test Accessories	UPL-B7	1090.2704.02
Universal Sequence Controller	UPL-B10	1078.3904.02
Digital Audio Protocol	UPL-B21	1078.3856.02
Jitter and Interface Test	UPL-B22	1078.3956.02
Automatic Audio Line Measurement according to CCITT 0.33	UPL-B33	1078.4852.02
150 Ω Modification	UPL-U3	1078.4900.02
XLR/BNC Adapter Set	UPL-Z1	1078.3704.02

1) Total inherent distortion of generator and analyzer.

2) Not in whole frequency range.

3) Only with built-in Low Distortion Generator UPL-B1.

Audio Analyzer UPD

2 Hz to 300 kHz

Versatile instrument for measuring the full range of audio parameters at analog and digital interfaces

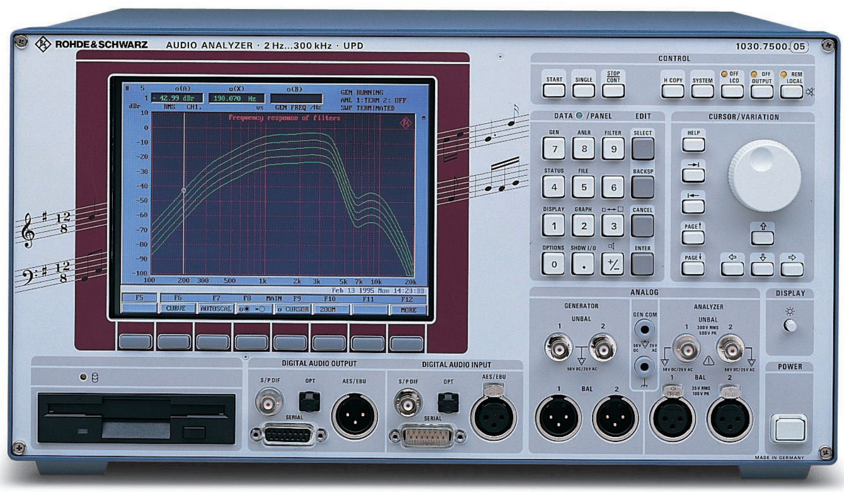


Photo 41956

Brief description

Audio Analyzer UPD is largely identical with UPL (see page 228). UPD has a wider frequency and level range and more interfaces. Moreover, free slots are available in the processor section for commercial plug-in boards.

Features differing from UPL

- Additional BNC sockets for connecting unbalanced DUTs
- Extended level measurement range up to 300 V at unbalanced interfaces
- Extended frequency range from 2 Hz to 300 kHz

Additional measurements

User-programmable digital interfaces enable measurements on modules and audio chips that have no standardized audio interfaces. In the development of A/D and D/A converters, Audio Analyzer UPD can thus be adapted to virtually any data format via its serial or parallel lines. Clock rates are selectable between 100 Hz and 1 MHz, which covers both slow rates for telephone applications and fast rates for oversampling modules.

- UPD can generate squarewave and FM-modulated signals
- UPD also provides less common measurements like dynamic intermodulation
- Besides the generation and analysis of channel status data, UPD generates protocol errors (eg CRC, parity, sequence errors) at digital interfaces for testing input circuits.

Overview of options

Designation, functions	Option
Low Distortion Generator: analog sinewave generator with inherent distortion lower than that of built-in standard generator	UPD-B1
AES/EBU Interface: contains the AES/EBU and the S/P DIF interface as well as optical interfaces	UPD-B2
Jitter and Interface Test: in conjunction with AES/EBU Interface UPD-B2, this option allows testing of the physical parameters of digital audio interfaces	UPD-B22
High-Speed Extension: further increases the measurement speed through parallel digital signal processing	UPD-B3
IEC-625/IEEE-488-Bus Interface: allows remote control of UPD and in conjunction with option UPD-K1 remote control of external devices	UPD-B4
Monitoring Output: provides the UPD with a headphones output and a built-in loudspeaker for monitoring the signals to be measured	UPD-B5
Universal Sequence Controller: enables test sequences to be generated and executed; with built-in program generator	UPD-K1
Arbitrary Waveform Designer: DOS program that can be run on UPD for arithmetical and graphical design of waveforms	UPD-K2
Automatic Audio Line Measurement: for measurement of broadcast links in line with CCITT O.33 recommendations (UPD-K1 required)	UPD-K33

Audio Analyzer UPD

Specifications in brief

All inherent distortion values refer to the frequency range 20 Hz to 22 kHz.

Analyzers

Analog inputs	
Balanced, floating	2 channels, 300 Ω/600 Ω/20 kΩ
Voltage measurement range	0.1 µV to 35 V rms
Common-mode rejection	>110 dB (50 Hz)
Unbalanced, floating	2 channels, 1 MΩ
Level measurement range	0.1 µV to 300 V rms
Frequency range	2 Hz to 300 kHz
Frequency response	±0.03 dB, 20 Hz to 22 kHz
Digital inputs	
AES/EBU option	
AES/EBU input	XLR connector, 110 Ω and 10 kΩ
S/P DIF input	BNC connector, *75 Ω*
Optical input	Toslink system
Clock rates	32/44.1/48 kHz
Serial	1- and 2-channel
Parallel	28-bit parallel, 1- and 2-channel
Clock rates (serial, parallel)	32/44.1/48 kHz/multiples thereof up to 768 kHz and adjustable
Frequency range	2 Hz to 45.7% of clock rate

Measurement functions of analog analyzers; digital analyzers in *italics*

AF level	
Noise (600 Ω)	1.6 µV (CCIR unweight.); *–180 dBFS*
Weighting	RMS, peak[2]), quasi-peak (CCIR 468)[2])
Accuracy	±0.05 dB (V_{rms}, 1 kHz)
Filters	weighting filter; HP, LP, BP, NOTCH; user-configurable in terms of cutoff frequency/attenuation; max. 4 filters can be combined
Selective level	
Center frequency	selectable/swept/coupled to generator or input frequency
Bandwidth (0.1 dB)	1%/3%/third octave/$^1/_{12}$ octave/selectable
Total harmonic distortion (THD)	
Fundamental	6 Hz to 110 kHz
Inherent distortion (Σ 2nd to 9th order)	–115 dB[1]); *–130 dB[1])*
SINAD and THD+N	
Fundamental	20 Hz to 110 kHz
Inherent distortion	–110 dB[1]); *–126 dB[1])*
Filters	HP, LP + weighting filter
Modulation distortion	2nd plus 3rd order
Measurement method	selective to DIN IEC 268-3
Inherent distortion	–103 dB; *–123 dB[1])*
Difference-frequency distortion	2nd or 3rd order
Measurement method	selective to DIN IEC 268-3
Inherent distortion d2	–125 dB; *–130 dB[1])*
d3	–105 dB[1]); *–130 dB[1])*
Dynamic intermodulation distortion[2])	
Measurement method	selective to DIN IEC 268-3
Inherent distortion	–90 dB[1]); *–125 dB[1])*
Wow and flutter[2]), meas. method	DIN IEC/NAB/JIS/2-sigma
Frequency	2 Hz to 300 kHz
Accuracy (S/N >80 dB)	±0.005%
Phase	2 Hz to 110 kHz; *20 Hz to 20 kHz*
Accuracy	±0.1° (1 kHz)
Polarity test	
DC voltage	0 to ±35 V balanced, 0 to ±300 V unbalanced; *not possible*
Waveform	memory depth *7424* points
FFT analyzer	
Frequency range	2 Hz to 300 kHz; *2 Hz to 45.7% of clock rate*
FFT size/resolution	16k points/0.023 Hz
Window functions	rectangular/Hann/Blackman-Harris/Rife-Vincent 1 to 3/Hamming/flat-top/Kaiser
Averaging	max. 256-fold, exp. + linear
Noise floor	–140 dB; *–160 dB*

Generators

Analog outputs	
Balanced, floating	2 channels,10/30/200/600 Ω
Output voltage	0.1 mV to 24 V rms (no load)
Unbalanced, floating	2 channels, 5 Ω/15 Ω
Output voltage	0.1 mV to 12 V rms (no load)
Frequency range	2 Hz to 110 kHz
Frequency response	±0.05 dB, 20 Hz to 20 kHz
Inherent distortion[3])	–115 dB
Digital outputs	same as digital inputs

Generator functions of analog generators; digital generators in *italics*

Sinewave	
Inherent THD	–115 dB[3]); *–130 dB*
Inherent THD+N	–110 dB[1]); *–126 dB[1])*
Signal for modulation distortion analysis, selectable	signal/interf. freq., amplitude ratio
Inherent distortion	–103 dB[3]); *–123 dB[1])*
Difference-frequency signal, select.	center frequency and frequency offset
Inherent distortion d2	–125 dB[3]); *–130 dB[1])*
d3	–105 dB[1]); *–130 dB[1])*
Signal for DIM analysis[2])[3])	
Inherent distortion	–90 dB[1]); *–125 dB*
Multisine, selectable	amplitude/frequency; max. 17 freq.
Sine burst, sine^2 burst	level ratio and duty cycle selectable
Rectangular wave	max. 10 kHz
Noise	flat/Gaussian/triangular distribution
Multifrequency noise	band-limited, white/pink/user-defined
Arbitrary waveform	any waveform from file
Max. number of points	16384
Polarity test signal[2])	
Sweeps	frequency, amplitude, burst interval, burst duration, time

Interfaces

Result logging	2 x RS-232-C, Centronics
Option UPD-B4	IEC 625/IEEE 488
Remote control (option UPD-B4)	to IEC 625-2/IEEE 488, most commands in conformity with SCPI

Ordering information

Audio Analyzer		
with colour LCD	UPD	1030.7500.05
Options		
Low Distortion Generator	UPD-B1	1031.2601.02
AES/EBU Interface	UPD-B2	1031.2301.02
Jitter and Interface Test	UPD-B22	1078.6503.02
High-Speed Extension	UPD-B3	1031.2001.02
IEC-625/IEEE-488-Bus Interface	UPD-B4	1031.2901.02
Monitoring Output	UPD-B5	1031.5300.02
Universal Sequence Controller	UPD-K1	1031.4204.02
Automatic Audio Line Measurement	UPD-K33	1031.5500.02
Arbitrary Waveform Designer	UPD-K2	1031.4404.02

1 Total inherent distortion of low distortion generator and analyzer.

2 Not in whole frequency range.

3 Only with built-in Low Distortion Generator UPD-B1.

VOR/ILS Receiver/Analyzer EVS200

Monitoring terrestrial radio-navigation equipment at airports and field stations

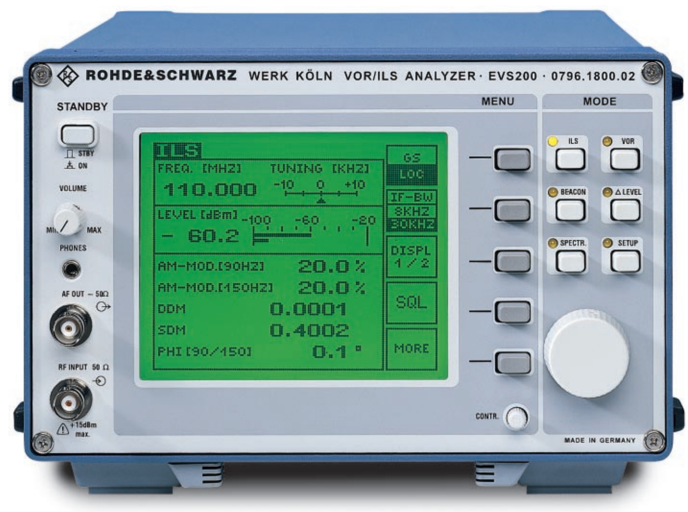


Foto 43151-1

Brief description

VOR/ILS Analyzer EVS200 is a portable combinational measuring instrument for monitoring terrestrial radio-navigation equipment at airports and field stations. It provides high-precision signal analysis of ILS localizers and glidepath transmitters as well as of VOR systems including marker beacon.

Thanks to its high measurement accuracy and fast data output, EVS200 is ideal for dynamic, computer-aided measurement of runway characteristics. The wide input level range and optimal shielding of the modules allow measurements to be carried out close to antennas.

Measurement applications

- Dynamic runway measurements
- Measurement of DDM/SDM on antenna array and runway
- Clearance & glidepath (joint analysis of parameters without switching off transmitter system)
- Qualification of test signals at field testpoints and checking of bearing indication of VOR/DVOR transmitters
- Difference level measurement with dynamic range up to 110 dB
- Measurement of marker beacon signal parameters
- Point-by-point far-field measurement
- Measurement of transmitting antenna characteristic using delta level mode
- Functional monitoring of VOR/ILS transmitter systems in the field including remote data transmission
- Use in flight inspection systems
- Further analysis of received signals via multifunctional output (DSP OUT) and audio output
- Analysis of external audio signals via audio input

Main features

- VOR/ILS signal analysis with digital signal processor (DSP)
- High measurement accuracy and wide dynamic range
- High long-term stability
- High measurement speed, 90 measurements/s in ILS mode
- Minimum susceptibility to interference through special shielding, operational even at high levels up to +15 dBm
- 120 memory channels for DDM/SDM values
- Built-in test equipment (BITE)
- RF spectrum display
- RS-232 interface for remote control of all functions and result output
- Large, illuminated LCD with clear display of results
- Simultaneous indication of parameters on display
- AC-supply-independent operation with built-in battery
- Operation in vehicles from12 V on-board supply
- Operation from AC supply voltages 87 to 265 V at 47 to 63 Hz
- High mechanical resistance to MIL-810D and DIN-IEC 68

VOR/ILS Receiver/Analyzer EVS200

Specifications

Receiver section

Frequency range	74.7 MHz to 75.3 MHz, 107 MHz to 119 MHz, 319 MHz to 341 MHz
Accuracy	≤2 ppm
Resolution	5 kHz
Input voltage	15 dBm max. into 50 Ω
VSWR	<1.5
RF input	BNC (optional N)
Sensitivity	–96 dBm ≥18 dB (IF bandwidth 8 kHz)

IF bandwidth

Standard	min. ±15 kHz (–3 dB), max. ±40 kHz (–60 dB)
	min. ±4 kHz (–3 dB), max. ±12 kHz (–60 dB)
optionally:	min. ±19 kHz (–6 dB), max. ±38 kHz (–60 dB)
	min. ±8 kHz (–6 dB), max. ±20 kHz (–60 dB)
Demodulation	AM

Absolute level

Display range	–96 dBm to +10 dBm
Accuracy	≤±2 dB

Difference level

Bargraph (quasi-analog)	±12 dB (rel. to reference level)
Resolution	0.1 dB
Accuracy	≤±1 dB

ILS signal analysis

RF level	–70 dBm to –30 dBm
Frequency range	108 MHz to 118 MHz, 328 MHz to 336 MHz

Modulation depth (10% to 80%)

90 Hz/150 Hz ±2%	accuracy 0.5%
300 Hz to 4 kHz (identifiable)	≤1.2% of reading

Phase angle 90 Hz/150 Hz

Measurement range	±60°
Measurement accuracy	≤0.2°
Resolution	0.1°

DDM measurement (≥30 kHz IF bandwidth)

Localizer mode, measurement accuracy at	
15% to 25% modulation	≤±0.0004 DDM, ±0.1% of reading
10% to 30% modulation	≥±0.0004 DDM, ±0.2% of reading

Glideslope mode (≥30 kHz IF bandwidth)

Measurement accuracy at	
30% to 50% modulation	≤±0.0008 DDM, ±0.1% of reading
Resolution (LOC/GS)	0.0001 DDM
Analog DDM output	
Localizer	0 to1 V in 4 subranges
Glideslope	0 to1 V in 4 subranges
SDM measurement	
SDM 10% to 80%	accuracy ±1% absolute
Resolution	0.0001 SDM

VOR signal analysis

Azimuth

Accuracy	±0.1°
Resolution	0.05° / 0.01° (setup)

AM modulation depth 30 Hz and 9.96 kHz

Accuracy	≤1%
Resolution	0.1%

FM deviation

Accuracy	0.5%, ±0.1 Hz
Resolution	0.1 Hz

General data

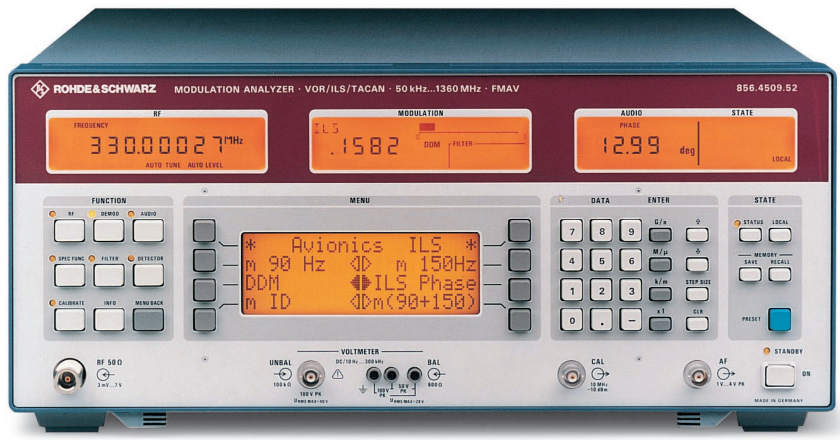
RS-232 interface	8N1
Selectable baud rate	1200, 2400, 4800, 9600, 19200
Operating temperature range	–5°C to +45°C
Storage temperature range	–20°C to +60°C
Power supply	
AC	87 to 265 V, 47 to 63 Hz (440 Hz optional), built-in battery charger
External DC	9 to 15 V DC (typ. 12 V DC, 1.4 A)
Battery (optional)	12V / 3.2 Ah
Charging	during AC-supply operation
Operating time	>100 min with average brightness of display
Mechanical resistance	shock-tested to MIL-810D
Vibration test	to DIN-IEC 68-2-36 and 68-2-6
EMC	
RF leakage	to EN 50081-1
RF pickup	to EN 50082-1
Dimensions (W x H x D)	219 mm x 147 mm x 350 mm
Weight	4.9 kg/6.5 kg without/with battery

Ordering information

VOR/ILS Analyzer	EVS200	0796.1800.02
Options		
Battery (optional)	EVS200-B1	0796.2012.00
Remote-Control Software	EVS200-SWF	0798.4358.00
Application Software for analysis and display of results	EVS200-SWA	0798.4287.00
Software for additional analyses	on request	
Weatherproof case with 2 straps	EVS200-T	0798.4264.00

Modulation Analyzers FMA, FMAB, FMAV, FMB; Selective Modulation Analyzer FMAS

FMA: 50 kHz to 1360 MHz
FMAB: FMA with built-in FM stereo decoder
FMAS: FMA with receiver and FM stereo decoder
FMAV: analysis for air navigation systems
FMB: extended frequency range up to 5.2 GHz



FMAV (photo 40299-1)

Overview of options

● Standard   FMA-B.. Option

Functions of individual models, options	FMA	FMAB	FMAS	FMAV	FMB
AM/FM/φM	●	●	●	●	●
Weighting filters (CCITT, CCIR), special filter	FMA-B1	●	●	FMA-B1	FMA-B1
SINAD/distortion meter 10 Hz to 100 kHz	FMA-B2	●	FMA-B2	FMA-B2	FMA-B2
Stereo decoder	FMA-B3	●	●	–	FMA-B3
Calibrator with AF and MPX generator	FMA-B4	FMA-B4	FMA-B4	–	FMA-B4
Calibrator with AF and VOR/ILS generator	–	–	–	FMA-B4	–
VOR/ILS measurements	–	–	–	●	–
ILS distortion meter	–	–	–	●	–
Selective AF analysis up to 45 kHz	–	–	–	●	–
Selective AF analysis up to 150 kHz	FMA-B8	FMA-B8	●	–	FMA-B8
RF/IF selection 5 to 1000 (400) MHz	FMA-B9	FMA-B9	●	(FMA-B9.57)	–
Reference oscillator (1 x 10^{-7}/year)	FMA-B10	FMA-B10	FMA-B10	●	FMA-B10
Frequency range up to 5 GHz	FMA-B12	FMA-B12	–	–	●

Designation and further functions of options	Option
Filter: lowpass filter 5 Hz, 4.2 kHz (high skirt selectivity), 30 kHz, 120 kHz (Bessel), special φM filter	FMA-B1
DIST/SINAD Meter: distortion measurable down to typically <0.005%	FMA-B2
Stereo Decoder: precision instrument, built-in RDS demodulator with external evaluation facility	FMA-B3
AM/FM Calibrator/AF Generator: high-precision level calibration, FMA performance test, complete modulation test set for transmitters and transposers, VOR/ILS baseband signal generation/analysis	FMA-B4
AF Analyzer/DSP Unit: digital AF analyzer, true THD measurement, measurement of intermodulation products	FMA-B8
RF/IF Selection: can be switched on when required; tracking 4-section preselection, selectable IF filters	FMA-B9
RF/IF Selection: high-precision off-air measurement of VOR/ILS signals directly at the antenna (eg flight inspection systems)	FMA-B9.57
5.2 GHz Frequency Extension: enhanced power measurement accuracy	FMA-B12

Brief description

Modulation Analyzer FMA
FMA combines the functions of several measuring instruments all in one unit. It allows fast and accurate analysis of all parameters of modulated signals. Thanks to its versatility, it can also be used as an RF counter, power meter, voltmeter, psophometer, distortion meter and as an FM stereo decoder. FMA is suitable for measurements in the field of broadcasting (eg on AM and FM transmitters) as well as radiotelephony and in the calibration of signal generators. It can be upgraded for many other measurement tasks.

Modulation Analyzer FMAB
FMAB has been especially designed for the analysis of FM stereo broadcast signals. Its measurement tasks include comprehensive analysis of VHF transmitters, channel transposers and VHF/baseband converters. The built-in stereo decoder with all its analysis functions can be separately used via the rear-panel input so that measurements on FM receivers and stereo coders are also possible.

Selective Modulation Analyzer FMAS
FMAS combines the characteristics of a universal modulation analyzer with those of an FM stereo/TV dual-sound receiver:

- RF/IF selection for 5 to 1000 MHz can be switched on when required
- Selective audio analyzer

Modulation Analyzer FMAV
FMAV features the versatile measurement functions of the basic model and special functions for the needs of air-traffic control authorities, airport operators as well as manufacturers of air-navigation airborne and test systems. It measures with utmost precision all modulation parameters relevant in VOR and ILS air navigation systems. With its extremely low measurement error achieved by means of digital signal processing, FMAV meets the stringent requirements placed on measuring instruments for ILS systems of category III.

Its high accuracy makes FMAV also ideal for use as a calibrator for VOR and ILS signal generators like Radiocommunication Service Monitor CMS 57 (page 12). With CMS 57 as a signal generator used in conjunction with FMAV as a demodulator, Rohde & Schwarz offers a complete, state-of-the-art test system for aeronautical radio.

Modulation Analyzer FMB
FMB enables modulation analysis right into the lower microwave range. Its fields of application are especially in outside broadcasting, radio relay links as well as testing and calibration of microwave generators. The outstanding characteristics of the basic model are fully maintained in the extended frequency range up to 5.2 GHz. The power meter function of FMB differs from that of FMA in that it is individually calibrated as a function of frequency and level.

Main features

- Fast, automatic frequency adjustment by direct frequency measurement
- Low-noise synthesizer with high frequency resolution
- Separate +PK and –PK detectors with extremely short response time
- True RMS detector
- Extremely high accuracy
- High-precision power measurement (typ. error of FMA <0.5 dB, even smaller for FMB)

Additional features of FMAS:

- Excellent static and dynamic selectivity and high sensitivity for direct measurements at the antenna
- Excellent transmission quality
- High overload capability to interfering signals
- Selective RF level measurement
- Low distortion due to phase-linear IF filters

High measurement speed

- Two independent frequency counters for simultaneous RF and AF frequency measurements
- All measurement times can be adapted to the specific measurement problem, eg lowest measurement frequency or required counter resolution
- Measurement functions that are not required can be switched off
- FM demodulator with high bandwidth for analysis of digital modulators (eg mobile radio)

Operation

- Menu-guided operation with softkeys
- Nonvolatile storage of up to 20 complete instrument setups
- Three displays for simultaneous readout of measurement results and indication of all important instrument settings
- Quasi-analog indication of high resolution with absolute or selective as well as MIN-MAX display
- IEC/IEEE-bus remote control to IEEE 488.2

Modulation Analyzers FMA, FMAB, FMAV, FMB; Selective Modulation Analyzer FMAS

Specifications in brief

Frequency		
Frequency range		
FMA, FMAB, FMAV	50 kHz to 1.36 GHz	
FMAS	5 to 1000 (1360) MHz	
FMB as well as FMA and FMAB with option FMA-B12	50 kHz to 5.2 GHz	
Frequency tuning	automatic or manual	
Display	10-digit readout	
Resolution	0.1/1/10/100 Hz selectable	
Reference oscillator	standard	option FMA-B10
Aging	2×10^{-6}/year	1×10^{-7}/year
after 30 days of operation	–	1×10^{-9}/day
Warmup time	15 min	15 min
External reference input/output	manual or remote-controlled	

RF input	N connector, 50 Ω
Overload protection	up to 5 W (15 V rms)
Maximum peak voltage	25 V (including DC)
VSWR (f_{in} up to 1.36 GHz, attenuation ≥20 dB)	≤1.2

RF power measurement with calibration (FMA models)	
Power measurement range	0.18 µW to 1 W (–37.5 to +30 dBm)
Accuracy (P ≥0.1 mW)	±1 dB (typ. ±0.5 dB)

RF power measurement (FMB)	
Measurement range	0.18 µW to 1 W (–37.5 to +30 dBm)
Accuracy (input level –10 to +5 dBm, f_{in}=50 kHz to 1.36 GHz)	±0.3 dB

Amplitude modulation measurement	
Modulation frequency range	10 Hz to 200 kHz
Resolution	0.1% of reading
Accuracy	±1%
Residual AM (f_{in} up to 1.36 GHz, CCITT)	≤0.01%
Incidental AM in FM mode	≤0.1%
AF distortion	≤0.2%

Frequency modulation measurement			
Modulation frequency range	10 Hz to 200 kHz		
Max. measurable deviation for f_{in}	50 to 300 kHz	0.3 to 10 MHz	≥10 MHz
	f_{in}/10	150 kHz	700 kHz
Accuracy	±1%		
Resolution	better than 0.1% of reading		
Residual FM for f_{in} ≤1.36 GHz, CCITT, RMS	≤1 Hz		
Stereo S/N ratio, weighted	≥76 dB		
Stereo crosstalk attenuation	≥56 dB (f_{mod}=1 kHz)		
AF distortion	≤0.05%		
Incidental FM	≤10 Hz		
Deemphasis	50/75/750 µs selectable		

Phase modulation measurement	
Modulation frequency range	200 Hz to 200 kHz
Max. measurable deviation	
300 kHz to 10 MHz	150 rad
≥10 MHz	700 rad
Accuracy	±2%
Residual φM (f_{in} up to 1.36 GHz, CCITT)	≤0.004 rad
Resolution	<0.1% (minimum 0.0001 rad)
AF distortion	≤0.1%

AF voltmeter	
DC voltage measurement range	±10 µV to 20 V
Resolution	<0.1%
Accuracy	±0.5%
AC voltage measurement range	30 µV to 20 V
Frequency range	10 Hz to 300 kHz
Resolution	0.1% of reading
Accuracy (RMS, 30 Hz to 20 kHz)	±1%

All AF measuring facilities such as detectors, filters, frequency counter and distortion meter can also be used in voltage measurements for weighting.

Inputs	
unbalanced	BNC, R_{in}=100 kΩ ‖80 pF
balanced	R_{in}= 600 Ω, 3-contact connectors, DIN 41628

AF detector	
Peak detector	positive or negative peak or their arithmetic mean
RMS detector	readout as RMS value or converted to peak for sinewave
Quasi-peak detector (with Filter option FMA-B1)	detector to CCIR Rec. 468-4

Weighting filters	
Highpass filters (2nd/3rd/2nd order)	10/20/300 Hz
Lowpass filters	3/23 kHz (4th order), combined with 20 Hz highpass filter meets CCIR 468-4, unweighted; 100 kHz (4th order)
Filter option FMA-B1	CCIR 468-4 (weighted), CCITT P53, 5 Hz lowpass, 30 kHz and 120 kHz Bessel lowpass of 4th order, 4.2 kHz Cauer lowpass, special φM filter

AF frequency display	5 digits
Frequency range	10 Hz to 300 kHz
Resolution	1 mHz to 10 Hz
Accuracy	±0.005% ±3 mHz ±1 digit

Distortion measurement (option FMA-B2)	
Readout	in % or SINAD in dB
Automatic adjustment	for S/N ≥20 dB
Measurement range	10 Hz to 100 kHz
Display range	
THD	0.005 to 50%
SINAD	6 to 86 dB
Accuracy (20 Hz to 20 kHz)	±1 dB ±0.015% THD

Stereo decoder (option FMA-B3)	
Crosstalk attenuation	≥60 dB (30 Hz to 15 kHz)
Frequency response	±0.1 dB (30 Hz to 15 kHz)
Level difference between L and R	≤0.1 dB
Nonlinear distortion	≤0.1% (THD, 30 Hz to 15 kHz)
Difference-frequency distortion (DIN 45403)	d_2 ≤0.05%, d_3 ≤0.1%
S/N ratio (CCIR, weighted, unweighted)	≥80 dB
Deemphasis	50 or 75 µs, selectable
External decoder input	bal., 3-cont. connector (DIN 41628)
Common-mode rejection	≥50 dB (1 kHz < f ≤15 kHz)
Input level range	–12 to +12.5 dBm into 600 Ω, Z_{in} ≥40 kΩ
Resolution of level setting	≤0.2 dB
Stereo decoder outputs	
L, R, M	bal., 3-cont. connectors (DIN 41628), +6 dBm, Z_{out} ≤30 Ω, Z_L ≥300 Ω
S	unbalanced, BNC, Z_L ≥600 Ω
RDS decoder outputs	9-contact Cannon connector
Signals available	data, clock, quality signal, TP information, 57 kHz carrier (TTL)

Measurement time	typ. 1 s
Fast modulation measurement	≤120 ms

Outputs	
IF output	max. 200 mV into 50 Ω
AM output	max. 1 V into 600 Ω (can be DC-coupled)
FM/φM output	+6 dBm (1.545 V) at 40 kHz deviation/40 rad into 600 Ω (DC-coupled)
Distortion measurement output (with option FMA-B2)	max. 1 V into 600 Ω
AF output	1 to 4 V into 600 Ω

Remote control	IEC 625-1/625-2 (IEEE 488.1/.2)

AM/FM Calibrator/AF Generator (option FMA-B4)

The data are tested at 23 °C (73.4 °F) and guaranteed by design in the range 23 ± 5°C (73.4 ± 9° F).

AF (single-tone and two-tone signals)	10 Hz to 100 kHz
Resolution	1 mHz
Accuracy	1 mHz + reference frequency drift
Level	1 mV to 7 V (max. 10 V pp)
Accuracy at 1 kHz	≤0.1% ±10 µV
Level resolution	0.02% (min. 10 µV)
Frequency response (at Z_{in} = 20 Ω, C_L ≤200 pF), 10 Hz to 50 kHz	≤±0.1%
THD + N (level ≤6 V) 10 Hz to 20 kHz	≤0.02%
Difference-frequency distortion (two-tone signals, peak voltage ≤8 V)	≥74 dB (10 Hz to 20 kHz)

Stereo MPX

Data determined by design, not tested individually. Generation of stereo multiplex signals L, R, R=L, R=–L including 19 kHz pilot tone (disconnectible) or 19 kHz pilot tone + 57 kHz subcarrier (without mutiplex signal)

Linear distortion	
Preemphasis	50/75 µs, selectable
Frequency response (10 Hz to 53 kHz)	≤0.1%
Crosstalk attenuation	≥65 dB (30 Hz to 15 kHz)
Non-linear distortion and difference-frequency distortion	≥70 dB
Unweighted and weighted S/N ratio to CCIR 468-4	≥80 dB
Pilot tone	
Nominal frequency	19 kHz ±1 mHz + reference frequency drift
Phase versus carrier	≤0.1°
Setting range	±10°
57 kHz subcarrier (only possible with multiplex signal switched off)	
Nominal frequency	57 kHz ±1 mHz + reference frequency drift
Phase versus pilot tone	≤0.1°
Setting range	±30°

VOR/ILS/TACAN (FMAV only)

Data determined by design, not tested individually.

VOR	
Deviation accuracy at 9.96 kHz subcarrier	≤±0.1% ±1 Hz
Setting range	0 to 700 Hz
Phase accuracy 30 Hz	≤±0.005°
ILS	
Frequency response 90 Hz/150 Hz	≤±0.02%
Additional gain difference error	≤0.1% x amplitude difference
Phase accuracy 90 Hz/150 Hz	≤±0.05°
TACAN	
Phase accuracy 15 Hz/135 Hz	≤±0,1°

Outputs	2 BNC female connectors on rear panel, unbalanced, same signal at both outputs (can be individually switched off) or 1 x balanced
Output impedance	20 Ω, 200 Ω, 600 Ω selectable
Tolerance	±1% ±2 Ω

AM

Carrier frequency	10 MHz
Level	–10 dBm
Modulation depth	adjustable from 0 to 99%
Accuracy at f_{mod}=1 kHz, 80% AM	≤0.1% of reading
Additional linearity error	≤0.1% (m=10 to 95%)
Modulation frequency response	≤0.1% (15 Hz to 10 kHz)
Modulation distortion (THD + N, m = 80%)	≤0.1% (10 Hz to 20 kHz)
Incidental φM, m ≤80%	≤0.01 rad
Residual AM	typ. ≤0.02% (20 Hz to 23 kHz, RMS)

AM VOR/ILS (FMAV only)

ILS	
DDM accuracy	
m=18 to 22%	≤±0.00005 DDM ±0.001 x (DDM)
m=32 to 48%	≤±0.0001 DDM ±0.001 x (DDM)
Phase accuracy 90 Hz/150 Hz	≤0.1°
VOR	
Deviation accuracy at 9.96 kHz subcarrier	≤±0.1% ±1 Hz
Setting range	0 to 700 Hz
Phase accuracy 30 Hz	≤0.01°
TACAN	
Phase accuracy 15 Hz/135 Hz	≤±0.25°

FM

Carrier frequency	10 MHz
Level	–10 dBm
Deviation (f_{mod}=1 kHz, squarewave)	100 kHz
Accuracy	≤0.1%
Additional sinewave modulation	f_{mod}=10 Hz to 100 kHz, deviation =1 to 100 kHz
Residual FM (BW=23 kHz, RMS)	≤10 Hz
Accuracy for 100 kHz deviation, f_{mod}=1 kHz	≤0.2% + residual FM
Additional linearity error for f_{mod}=1 kHz, dev. =10 to 100 kHz	≤0.1%
Modulation frequency response	≤0.5% (10 Hz to 100 kHz)
Modulation distortion for 100 kHz deviation	≤0.1% (f_{mod}=10 Hz to 20 kHz)
Incidental AM for 50 kHz deviation	typ. ≤0.05% (f_{mod} = 1 kHz, BW = 3 kHz)

Level

Carrier frequency	10 MHz
Accuracy	same as reference frequency
Level range	–50 to –4 dBm
Accuracy	
–10 dBm	≤0.1 dB at
–40 dBm to –4 dBm	≤0.2 dB ±6 nW (
Output	BNC female on front panel (CAL), can be internally switched to RF input
VSWR at 10 MHz	≤1.05

Specs in brief: FMAS receive mode

Instead of the optional DIST/SINAD Meter FMA-B2, the optional AF Analyzer/DSP Unit FMA-B8 is fitted in the FMAS.

RF/IF Selection (option FMA-B9)

Frequency

Frequency range	5 to 1000 MHz	
	FM wide	FM narrow/TV 2-sound
IF bandwidth (–3 dB)	350 kHz	150 kHz
Shape factor (–3/–60 dB)	3.4	3.7

RF level

RF input level range	–87 to +30 dBm (10 µV to 7 V)
Overload protection	up to 5 W (15 V RMS), max. peak voltage 25 V
VSWR	≤2.7 (without attenuation) ≤1.4 (with ≥10 dB attenuation)
Selective level measurement	peak measurement
Measurement accuracy[1)]	
5 to 500 MHz	±2 dB ± 3 µV
500 to 1000 MHz	±3 dB ± 3 µV

1) In temperature range 15 to 35 °C; error doubles outside this range.

Modulation Analyzers FMA, FMAB, FMAV, FMB; Selective Modulation Analyzer FMAS

FM stereo

Selectivity

Ratio of wanted to unwanted signal for a weighted S/N ratio of ≥54 dB, referred to a wanted signal of Δf=40 kHz, f_{mod}=500 Hz.
Stereo measurements with 50 µs deemphasis in stereo decoder. Specifications apply to input levels ≥200 µV (–61 dBm) for mono, ≥2 mV (–41 dBm) for stereo.

Nearby selectivity, unwanted sig. modulated, f_{mod} = 500 Hz, Δf = 75 kHz

Frequency difference	stereo FM wide	mono FM narrow	FM wide	FM narrow
±100 kHz	≤64 dB	≤ 61 dB	≤ 7 dB	≤ 4 dB
±200 kHz	≤25 dB	≤ 11 dB	≤ 7 dB	≤ 0 dB
±300 kHz	≤ 5 dB	≤–15 dB	≤ 4 dB	≤–16 dB
±600 kHz	–	–	≤–26 dB	≤–46 dB

Far-off selectivity, unwanted signal modulated, f_{mod}=500 Hz, Δf=75 kHz,
Frequency difference ≥1.2 MHz (except for image frequency and 1st IF)

87.5 to 108 MHz	–	–	≤–54 dB	≤–54 dB
rest of range	–	–	≤–40 dB	≤–40 dB

Linear distortion

Amplitude-frequency response, measured at MPX signal output, Δf=40 kHz, reference frequency 500 Hz

	FM wide	FM narrow
40 Hz to 43 kHz	±0.1 dB	±0.1 dB
43 to 53 kHz	±0.1 dB	±0.3 dB
53 to 61 kHz	±0.2 dB	±1 dB
61 to 70 kHz	±0.5 dB	±3 dB
70 to 75 kHz	±1.5 dB	±5 dB

Stereo crosstalk L↔R, measured via stereo decoder, without deemphasis

40 Hz to 5 kHz	–50 dB	–37 dB
5 to 15 kHz	–44 dB	–31 dB

Nonlinear distortion

THD measured at MPX signal output (mono)

FM	Δf=75 kHz wide	narrow	Δf=100 kHz wide	narrow
40 Hz to 5 kHz	–	≤0.5%	–	≤1%
40 Hz to 15 kHz	≤0.25%	–	≤0.5%	–

Measured via stereo decoder

FM	stereo wide	narrow	mono wide	narrow
40 Hz to 5 kHz				
Δf=75 kHz	≤0.3%	≤0.8%	≤0.25%	≤0.5%
Δf=100 kHz	≤0.6%	≤1.6%	≤0.5%	≤1%

S/N ratio

To CCIR 468-4, deemphasis 50 µs, referred to Δf=40 kHz, f_{mod}=500 Hz
S/N ratio (CCIR 468-4, weighted)
LOW NOISE[1]) mode

f_{in}/MHz:	5 to 130	stereo 130 to 470	470 to 1000	5 to 130	mono 130 to 470	470 to 1000
Input voltage						
≥200 µV	–	–	–	≥58 dB	≥58 dB	≥58 dB
≥2 mV	≥58 dB	≥58 dB	≥56 dB	≥76 dB	≥76 dB	≥74 dB
≥20 mV	≥70 dB	≥63 dB	≥60 dB	≥76 dB	≥76 dB	≥74 dB

TV dual sound

Input signal	TV dual-sound signal, standard B/G, at IF or in bands I, II and IV, V with and without modulated vision carrier
Deviation measurement accuracy 30 Hz to 15 kHz, Δf ≤70 kHz	±1% + residual FM
Difference accuracy with successive dev. measurement sound 1/sound 2, 30 Hz to 15 kHz	±0.3% + residual FM

Nonlinear distortion	Δf=50 kHz	Δf=70 kHz
Distortion		
f_{mod}=30 Hz to 5 kHz	≤0.3%	0.5%
f_{mod}=5 to 15 kHz	≤0.5%	1%

S/N ratio
Quasi-peak measurement to CCIR 468-4,weighted and unweighted; deemphasis 50 µs, ref. to wanted signal of Δf=30 kHz and f_{mod}=500 Hz

Input level (selective)	unweighted	weighted
≥200 µV	≥53 dB	≥53 dB
≥2 mV	≥73 dB	≥73 dB

Channel crosstalk, referred to Δf=30 kHz, f_{mod}=500 Hz, selective measurements, deemphasis 50 µs, other sound carrier modulated with frequencies from 30 Hz to15 kHz, Δf=55 kHz.
Level (selective) ≥5 mV ≥80 dB

AF Analyzer/DSP Unit (FMA-B8)

Selective distortion measurement

Readout	in % or dB
Display range	0.001 to 20%, –100 to –14 dB

Measurement of individual distortion d_i (i=2, 3, …10)

Meas. acc.	10 Hz ≤ f_1 ≤14 kHz, f_{di} ≤ 42 kHz ±5% of rdg ±0.02% absolute	f_1 ≤50 kHz f_{di} ≤150 kHz ±5% of rdg ±0,05% absolute

THD measurement
Measurement of harmonic i = n (n = 2 to 10 selectable)

Meas. acc.	10 Hz ≤ f_1 ≤14 kHz f_{dn} ≤42 kHz ±5% of rdg ±0.03% absolute	f_1 ≤50 kHz f_{dn} ≤150 kHz ±5% of rdg ±0.1% absolute

Intermodulation measurement

Difference frequency distortion d_2, d_3 to IEC 268-3

Readout	in % oder dB
Display range	0.001 to 20%, –100 to –14 dB

Meas. acc. (f_2–f_1 ≥30 Hz)

2 x f_2–f_1 ≤42 kHz ±5% of rdg ±0.02% absolute	42 kHz < 2 x f_2–f_1 ≤150 kHz ±5% of rdg ±0.05% absolute

Selective modulation and voltage measurement

using special bandpass filter, in voltmeter, AM, FM and φM mode
Bandwidth (BW_{-3dB}) at center frequency f_c

f_c	10 Hz to ≤1 kHz	1 kHz to ≤20 kHz	20 kHz to ≤150 kHz
B_{-3dB}	2.3 Hz	6.8 Hz	68 Hz

Shape factor 3 dB/80 dB	<4
Far-off selectivity	80 dB
Display range	corresponding to display range of selected operating mode

Measurement uncertainty[1])
with meas. frequency deviation from center frequency <BW_{-3dB}/4

at center frequency f_c	10 Hz to 100 kHz	100 kHz to 150 kHz
	≤2%	≤5%

Rear-panel outputs

Deflection for external oscilloscope

DSP1	Y deflection, 0 to 4 V, BNC female
DSP2	X deflection, 0 to 4 V, BNC female
Scale markers	
Vertical	13 markers, 10 dB/div
Horizontal	10 markers, scaling can be called up via the information menu

1) Error of selective measurement in addition to error specified for selected voltmeter, AM, FM or φM mode.

Specs in brief: FMAV, VOR/ILS measurement

VOR/ILS/TACAN
Data are guaranteed within the frequency ranges specified (f_{in}).
They are typical values for all frequencies ≥10 MHz.

VOR (f_{in} = 10 MHz; 108 to 120 MHz)	
Amplitude modulation measurement	accuracy for m = 10 to 90%:
f_{mod} = 30 Hz/9.96 kHz	±0.8% of reading
f_{mod} = 300 Hz to 4 kHz	±1.2% of reading
Frequency modulation measurement	9.96 kHz carrier
Max. measurable deviation	700 Hz
Accuracy (f_{mod} = 30 Hz ±1%)	±0.5% ±0.1 Hz
Phase difference measurement at 30 Hz	
Measurement range	0 to 360°
Measurement accuracy	±0.03°
Resolution	≤0.01°

ILS (f_{in} = 10 MHz; 108 to 120 MHz; 328 to 336 MHz)	
Amplitude modulation measurement	m = 10 to 90%
Measurement accuracy	
90/150 Hz ±2%	±0.5% of reading
300 Hz to 4 kHz (identifier)	±1.2% of reading
DDM measurement	
Measurement range	0 to ±0.2 DDM
f_{mod}	90/150 Hz ±1%
Measurement accuracy	
m = 18 to 22%	±0.0002 DDM ±0.1% of reading
m = 32 to 48%	±0.0005 DDM ±0.1% of reading
Resolution	≤0.0001 DDM
Measurement of phase angle between 90 Hz and 150 Hz signals	
Measurement range	±60°
Measurement accuracy	±0.2°
Resolution	≤0.01°

TACAN (f_{in} = 10 MHz; 950 to 1250 MHz)	
Amplitude modulation measurement	m = 10 to 90%
Measurement accuracy at	
f_{mod} = 15/135 Hz ±2%	±0.5% of reading
Measurement of phase angle between 15 Hz and 135 Hz signals	
Measurement range	±180° (135 Hz)
Measurement accuracy	±0.5°
Resolution	≤0.01°
AF outputs DSP1, DSP2	max. 4 V into 600 Ω
DC offset	≤3 mV

RF/IF Selection (option FMA-B9.57)

Additional data of FMAV in receive mode

Input frequency range	5 to 400 MHz
RF level	
Input level range	–87 to +30 dBm (10 µV to 7 V)
Overload protection	up to 5 W (15 V RMS), max. peak voltage 25 V
VSWR	≤2.7 (without attenuation)
	≤1.4 (with ≥10 dB attenuation)
Selective level measurement (peak measurement)	
Measurement accuracy [1]	±2 dB ± 3 µV
Selectivity	
IF bandwidth (–3 dB)	17 kHz
Static selectivity	≤–60 dB in ±50 kHz
Far-off selectivity	≤–60 dB [2]
Intermodulation distortion (d_3)	≤–60 dB [2]

VOR/ILS-specific data
Unless stated otherwise, the specifications of FMAV are valid. Data differing from FMAV specs can be calibrated to FMAV accuracy using option FMA-B4.

VOR	
Accuracy of amplitude modulation measurement (% of reading) at f_{mod}	
30 Hz ± 1%	±0.8% [3]
1.02 kHz ± 2%	±2% [3]
9.96 kHz with Δf=480 Hz, f_{mod} = 30 Hz (all tolerances ±1%)	±2% [4]
Accuracy [1] of phase difference measurement at 30 Hz	±0.05°
ILS	
Amplitude modulation measurement	
Measurement accuracy [3] (% of reading) at f_{mod}	
90 Hz ± 2%	±0.5%
150 Hz ± 2%	±0.5%
1.02 kHz ± 2%	±2%

Ordering information

Modulation Analyzer	FMA	0852.8500.52
	FMAB	0856.4750.52
	FMAV	0856.4509.52
	FMB	0856.5005.52
Selective Modulation Analyzer	FMAS	0856.6001.52
Options (possible configurations see pages 234)		
Filter	FMA-B1	0855.2002.52
DIST/SINAD Meter	FMA-B2	0855.0000.52
Stereo Decoder	FMA-B3	0856.0003.52
AM/FM Calibrator/AF Generator	FMA-B4	0855.6008.52
AF Analyzer/DSP Unit	FMA-B8	0855.9007.55
RF/IF Selection 5 to 1000 MHz	FMA-B9	0856.6501.52
RF/IF Selection for FMAV	FMA-B9	0856.6501.57
Reference Oscillator	FMA-B10	0856.3502.52
5.2 GHz Frequency Extension	FMA-B12	0855.8500.52
Extras		
Service Kit	FMA-Z1	0856.4009.52
For FMAV:		
Log-Periodic Antenna	HL023A1	0577.8017.02
	HL023A2	0624.2815.02
High-Power Attenuator 20 dB/50 W	RDL 50	1035.1700.52

1) In temperature range 20 to 30°C; error doubles in full temperature range.

2) Guaranteed data for frequencies from 108 to 120 MHz and 328 to 336 MHz, typical values for all other frequencies.

3) In temperature range 20 to 30°C, additional error ±0.3% in full temperature range.

4) In temperature range 20 to 30°C.

Light beam measurement with optical spectrum analyzer

Contents of Chapter 7

Introduction to Optical Measurements

Ever since printing was invented by Gutenberg in the middle of the 15th century, the printed word has become the basis for passing on knowledge. The invention of the printing technology was however also the basis for the development of modern technologies on the way to the communications age. Today, computers play an important part in the generation, processing and filing of information and have replaced in many cases printing as a storage and transmission medium. Magnetic and semiconductor memories can save a gigantic quantity of data on a minimum of space. Computers are nowadays practically an indispensable tool in the generation of print and online media. High-speed worldwide data transmission is playing an important role as well.

Four centuries after the Gutenberg invention a new medium is having a revolutionary effect on the recording and imparting of human knowledge – the optical transmission. Semiconductors, laser and optical fibers are the main elements in this new transmission technology. Optoelectronic circuits and systems gain information from the light by analyzing its intensity, wavelength and polarization. This light in turn is also produced by optoelectronic devices and information added to it. Research, development and further refinement of such optoelectronic circuits makes an accurate measurement of the optical parameters necessary.

Optical power meters and light sources

Optical power meters are indispensable tools in the development of optical technologies. With their aid it is possible to determine basic parameters and thus increase the efficiency of a transmission system or components thereof. The measurement method is based either on a conversion of the light intensity into a proportional current or the light power is directly converted into thermal energy. While the latter method is frequently used for laboratory standards, the optoelectric conversion using semiconductor sensors is preferred for the industrial field. These sensors respond faster to intensity variations and nowadays also ensure stable measurement results.

A disadvantage however is the strong wavelength dependence of the semiconductor materials. To cover a range from 400 nm to 1750 nm, silicon sensors are generally used today up to about 1000 nm; for longer wavelengths, germanium or indium-gallium-arsenide (InGaAs) materials are suitable. With modern power meters, the wavelength dependence of the sensor material in its operating range is compensated with the aid of a correction table. The user merely needs to enter the wavelength of the light to be measured and the corrected result is displayed. To ensure correct measurement, the wavelength has to be precisely known. This is also important when using light sources, which in turn should be of tight tolerances within the wavelength spectrum.

The higher the power of a light source, the greater the dynamic range that is available. Since the power meter is calibrated to a light source eg for measurement of the transmission loss of an optical fiber, it is important that the power of the source remains stable. It is therefore imperative for the light sources to be power-regulated. For LEDs, current regulation with temperature signalling is sufficient, whereas for laser diodes (LDs) the power has to be directly measured via a monitor sensor.

Spectral analysis

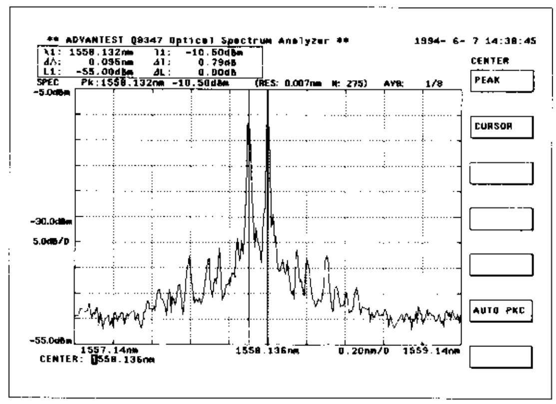
Spectral investigation of light began with the light of the sun. The human eye can perceive a wavelength range from about 400 nm to 800 nm. The short wavelength end of this range is the transition to the ultraviolet and appears to the eye in blue/violet; the long wavelengths produce deep red and are the transition to heat radiation (infrared). Within this range the different wavelengths appear as colours. Wavelengths from 850 nm to 1550 nm are used in optical communications. This "light" is invisible to the human eye so that a direct assessment is not possible. For scientific wavelength analysis socalled spectroscopes are used; in communications they are called optical spectrum analyzers. Methods for wavelength measurements are for instance:

- Diffraction of light using a diffraction grating (dispersive spectroscopy)
- Measurement of spatial intensity distribution
- Analysis of light eg with a Michelson interferometer (Fourier spectroscopy), using Fourier transform to retrieve a spectral signal from a temporal signal.

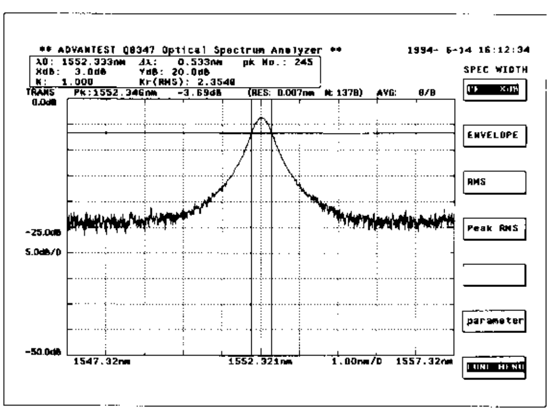
Dispersive methods are used in the majority, since they allow a high measurement sensitivity. Interferometer methods are often superior in terms of measurement accuracy and resolution. Wavelength Meter TQ8325 for instance achieves with this method a resolution of 1 pm with a measurement uncertainty of as low as 5 ppm. Other methods like Fabry-Perot or Macht-Zehnder interferometers are less frequently used in practice, but they also allow reliable wavelength analysis.

Measurement examples,

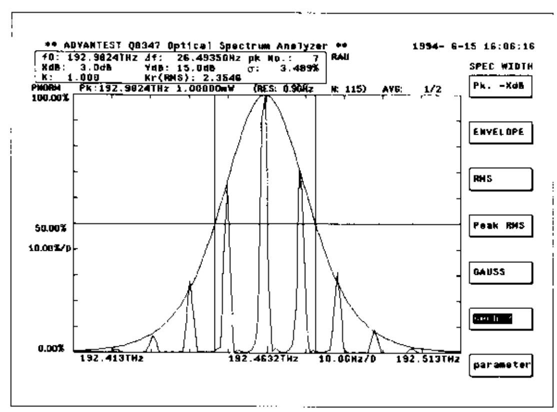
carried out with Optical Spectrum Analyzer Q8347 (page 248).



High-resolution measurement of two optical sources with 0.1 nm resolution



Measurement of transmission characteristic of optical filters with an accuracy of 0.01 nm



Spectral measurement of ultrashort light pulses in frequency display mode

About the following pages

This chapter on optical measurements describes important measuring instruments of the two types described above for use in R&D, industry and professional training. Our line of products is continuously updated to keep pace with the latest developments in this complex field of measurements.

You can find out about our current range of products, especially about newly developed and special models, by contacting:

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Munich
Telephone: +49 89 4129-3711
Telefax: +49 89 4129-3723

Cologne
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Automatic OTDR OFR14

850 to 1550 nm

Precise optical time domain reflectometer for measurement of all characteristic parameters of fiberoptic links

OFR14 with power supply modules (photo 42602)

Brief description

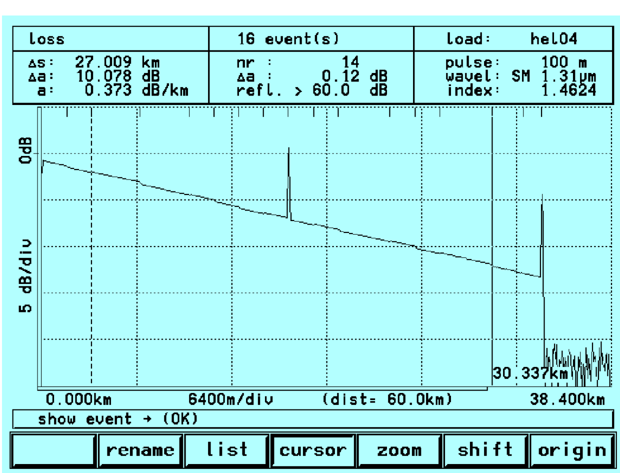
Automatic OTDR OFR14 (Advantest) is a compact optical time domain reflectometer featuring convenient automatic and manual measurements for portable and stationary use.

The modular concept allows the mainframe to be configured according to the user's requirements with

– power supply modules for operation from mains or internal/external battery (see specifications),
– optical modules, depending on wavelength, type of fiber and application (see data table).

Main features

- Fully automated measurements; manual parameter entry and evaluation also possible
- Selectable automatic functions for connector test, distance/pulse width adjustment and event analysis
- Measurement of attenuation and reflection of front-end connector
- Distance ranges from 200 m to 240 km, one-point resolution up to 6 cm, with minimum dead zone
- Easy to carry
- Easy to operate through menu guidance via softkeys, bright 7" LCD and versatile automatic functions
- Single and dual wavelength modules available, easy to exchange
- User-definable softkeys
- Average and realtime mode
- Reference traceability
- Nonvolatile storage of max. 8000 traces (200 m range) with full resolution
- Built-in disk drive for data storage and transfer
- Serial interface
- Parallel interface
- Convenient trace management
- Software for enhanced trace analysis with a PC
- Multilingual user prompting



Main screen with backscatter trace and attenuation values, events and trace parameters (top) as well as event marking (bottom). Information about attenuation range, 0 dB reference level and scaling (dB/div) can be read from vertical axis; information about distance range, cursor and marker position as well as scaling (m/div) is displayed below horizontal axis. Softkeys can be defined by user.

Measurement capabilities

Selectable automatic functions:

– connector test,
– search distance,
– event detector.

Only 3 steps to obtain precise results:

– power up,
– connect fiber,
– press START.

Specifications in brief

Mainframe OFR 14

Operating modes	backscatter, reflection
Measurement	accumulated average, realtime
Pulse widths[1]	1/2/6/24/100/400/1000 m
Data points	max. 65000
Display	LCD, 147 mm x 110 mm; VGA, 640 x 480 pixel, trace: 600 x 300 pixel
Refractive index	1.3700 to 1.6600
Averaging time	10 s to 59 min, step width: 1 s
Realtime mode	≥1 measurement/s

Automatic functions (selectable)	attenuation	reflection
Event detector	0.05 to 5 dB	10 to 50 dB
Connector test	0.05 to 5 dB	10 to 50 dB
Distance search	all ranges	

Horizontal distance ranges

Ranges (km)	0.2/0.4/0.8/1.8/3.6/7.5/ 15/30/60/120/240
Zoom ranges (m)	37.5/75/150/300/600/1200/ 2400/4800/9600/19200/ 38400/76800/153600
Max. distance resolution	6.25 cm to 4 m
Distance error[2]	±2 m/±3 x 10^{-5} x distance/ ±cursor resolution

Vertical attenuation ranges

Ranges	45/30/15/6/3/1.5/0.6 dB
Zoom ranges	30/15/6/3/1.5/0.6 dB
Scaling	0.1 to 7.5 dB/div
Resolution	0.002 to 0.1 dB/pixel
Linearity (backscatter)	≤0.05 dB/dB

Data transfer and storage

Interfaces	serial (RS-232-C), parallel (Centronics)
Data memory	HDD (170 Mbyte), FDD (1.44 Mbyte)
Memory on HDD	more than 500 traces (3.5 to 240 km), max. 8000 (200 m)

1) A pulse width of 1 m corresponds to10 ns.
2) Better accuracy available on request.

Optical modules

Specs and order designations see table below

Power supply modules

Mains modules	
Input voltage	85 to 132 V or 170 to 265 V (please specify in order)
Battery module	
Type	Ni-MH, 6 V (5 Ah)
Operating hours	typ. 4 h under normal conditions
Module for connection of an external battery	
Input voltage (DC)	10 to 30 V

General data

Dimensions of mainframe (W x H x D)	290 mm x 66 mm x 199 mm
Power supply modules	80 mm x 35 mm x 190 mm
Weight of mainframe	2.5 kg
Power supply modules	0.5 to 1.3 kg
Classification	laser: class 1/IEC 1010-1/ EN 60825-1 tested for: CE conformity

Ordering information

Automatic OTDR	OFR14
Additionally required: 1 optical module and 1 power supply module	

Optical modules see table below

Power supply modules	
Battery modules (comprising two batteries, one charger)	OFR14/Batt
Mains module	OFR14/Mains
DC module (for external battery)	OFR14/DC

Extras	
Softcase for OFR 14	OFR14/Softc
Hardcase for OFR 14, optical module, power supply module	OFR14/Hardc
Software for OFR 14	OFR14/SW

Optical modules

Type	Single-mode module			Multi-mode module		
	OFR14/ 1310SM	OFR14/ 1550SM	OFR14/1315SM	OFR14/85MM	OFR14/1310MM	OFR14/8513MM
Wavelength (µm)	1.31 ±0.03	1.55 ±0.03	1.31 ±0.03/1.55 ±0.03	0.85 ±0.03	1.31 ±0.03	0.85 ±0.03/1.31 ±0.03
Dynamic[a] min. pulse width 1 m	16 dB	14 dB	16/14 dB	24 dB	19 dB	24/19 dB
max. pulse width 1000 m	31 dB[b]	29 dB[2]	31/29 dB[2]	29 dB (max. 10 m)	28 dB (max. 100 m)	29/28 dB
Dynamic/reflection mode	30 dB, minus backscatter attenuation					
Dead zone/resolution						
Event dead zone[c] Reflection mode	3 m			3 m	3 m	3
Backscatter mode	6 m			6 m	6 m	6
Backscatter dead zone[d]	8 m			10 m	15 m	10/15
Spatial resolution[e]	6.5 m					
Connector[f]	FC-PC (straight polishing), FC-APC (slant polishing); ST, SC, DIN and RADIALL on request					

a. In backscatter mode, one-way dynamic at S/N = 1, 3 min averaging in full span.
b. Noise reduction ON for pulse width of 1000 m.
c. Event dead zone: 1.5 dB below non-saturated peak.
d. Reflection attenuation >50 dB (single-mode module), >35 dB (multi-mode module): distance between event location and 0.5 dB deviation of linear backscatter trace.
e. Spatial resolution in backscatter mode (1 m pulse width, non-reflective attenuation <1 dB): distance between event location and 0.1 dB deviation of linear backscatter trace.
f. Please specify in order: PC (straight polishing) or APC (slant polishing). Other connectors on request.

Optical Wavelength Meter TQ8325

600 nm to 1.6 µm

Digital optical wavelength meter of highest precision

Brief description

TQ8325 is a digital optical wavelength meter (Advantest) featuring high resolution of the central wavelength. It is suitable for laser diodes, LEDs and other narrowband light sources. Its high measurement accuracy and resolution are ensured over an extremely long period of time by the built-in HeNe reference laser. The light is coupled in by means of optical fiber. An analog level meter is provided to facilitate alignment of the optical axis, if the light has to be fed into the optical fiber first.

Thanks to its high accuracy, TQ8325 can be used as a calibration standard for spectroscopes; it allows tuning of dye lasers. It can also be used for investigating the wavelength characteristics of semiconductor components.

The high resolution allows for instance accurate measurement of the temperature and chirp response of laser diodes in case of modulation.

The instrument always displays the measured wavelength as a value in a vacuum, thus eliminating measurement errors due to the variable refraction index of the air. With 5 measurements per second, the instrument allows realtime observation of wavelength fluctuations. Intensity-modulated light can be accurately measured with a modulation frequency of 3 MHz or higher.

Main features

- Measurement uncertainty 5 ppm only
- Resolution 0.001 nm
- Wavelength and frequency display

Operation

TQ8325 can be switched to frequency display with a resolution of 100 MHz. The resolution is automatically set to the maximum value, the spectral width of the light source to be measured having a limiting effect and the attainable measurement accuracy being reduced by wideband sources. The display can be reset in the frequency and in the wavelength mode, so that only the frequency or wavelength variations will be displayed. This function is particularly useful for monitoring the long-term stability of sources.

An optional 19" rack adapter is available for integration into systems. Measurement errors due to the use of connectors or fibers different from the standard types are excluded.

Specifications in brief

Wavelength ranges	600 nm to 1 µm 1 µm to 1.6 µm
Input sensitivity	–23 to +3 dBm (600 nm to 1.0 µm) –20 to +3 dBm (1.0 to 1.4 µm) –15 to +3 dBm (1.4 to 1.6 µm)
Display	10 digits, wavelength or frequency
Resolution	1/0.1/0.01/0.001 nm or 100/10/1 GHz/100 MHz, automatic optimization
Measurement accuracy (25 ±5°C)	±(0.05 x half-value width of source) ±5 ppm ±resolution
Stability	±resolution for averaging
Averaging	moving average value (of last 10 measurements)
Measurement rate	5 measurements per second
Optical connector	FC/PC with internal 50/125 µm graded-index fiber, connector adaptable
Analog output	D/A conversion from 0 to 1 V for last three digits of display
Remote control	IEC625 (IEEE488)
Power supply	180 to 250 V, 50/60 Hz (52 VA)
Dimensions (W x H x D)	300 mm x 132 mm x 450 mm
Weight	12 kg

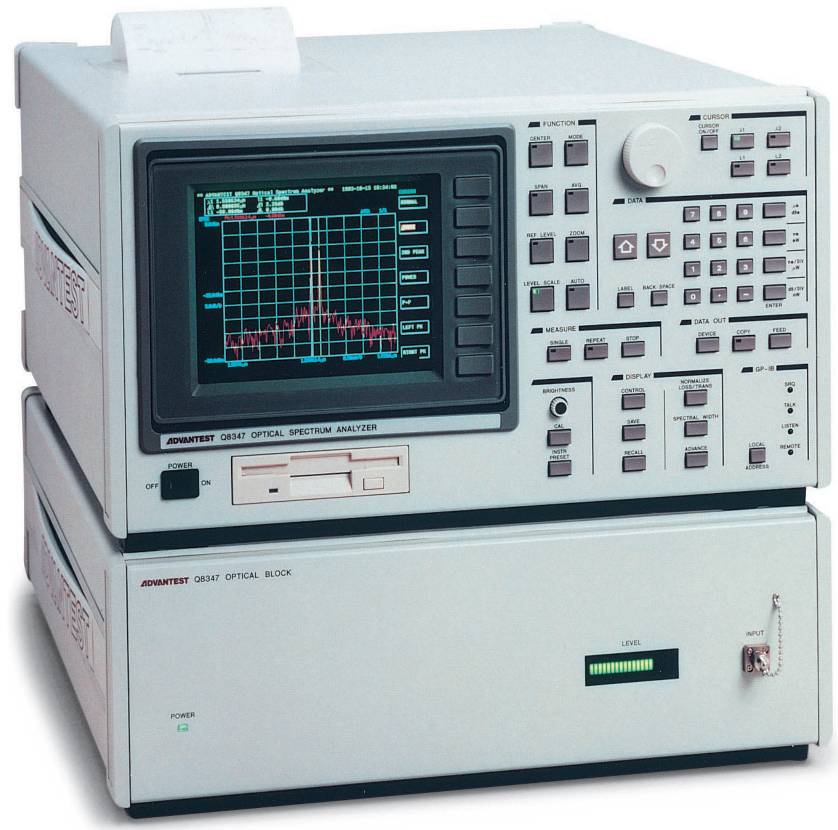
Ordering information

Optical Wavelength Meter	**TQ8325**
Extras	
Adaptation of optical input to DIN	TQ8325-DIN
19" Rack Adapter	A02617
Fiber Collimator with Selfoc Lens	OPCL-5H-100/FC

Optical Spectrum Analyzer Q8347

350 to 1750 nm

Top-class, high-resolution optical analyzer



Brief description

Optical Spectrum Analyzer Q8347 (Advantest) uses a Michelson interferometer. The larger mechanical configuration of the interferometer allows max. resolutions of 1 pm or 1 GHz in the frequency mode. This resolution as well as a measurement accuracy of ±0.001 nm for interferometers of this size cannot be attained with monochromators. At 1550 nm the resolution is still as high as 0.007 nm, thus allowing accurate measurement of high-grade optical wavelength division multiplexers (WDM). This resolution enables chirps from modulated LDs as well as from Soliton transmission to be analyzed. The highest resolution of 0.001 nm is attained at a wavelength of about 500 nm and is particularly useful for the analysis of blue laser diodes. The indicated wavelength is always the value in a vacuum.

In addition to the wavelength display mode, frequency display can also be selected, with deviations being read out in GHz. The use of the Fourier spectroscopy enables true measurement of the coherence length. Q8347 allows a value of up to 165 mm to be analyzed. The evaluation itself is made automatically at a keystroke. In the spectral range a curve fitting function can be used. It directly shows the electroluminescence characteristic by fitting a Gaussian distribution into the emission spectrum – a valuable aid in the measurement of erbium-doped fiber amplifiers (EDFA), LDs and Soliton transmission systems.

Main features

- Max. resolution 0.001 nm (at 500 nm)
- Measurement accuracy 0.01 nm
- Coherence measurement

Operation

Alternatively to spectrum display, the instantaneous optical power can be directly read like on a power meter. The display shows the power versus time in graphical form. Versatile display modes such as

– overlay display,
– comparison with memory contents, display of two separate diagrams (split screen),
– use of several markers,
– normalization and direct readout of transmission loss as well as
– automatic bandwidth analysis (eg half-value width measurement to RMS and envelope method),
– curve fitting

and many other features facilitate operation of the analyzer and simplify analysis via IEC/IEEE bus.
The standard built-in 3 ½" disk drive is used as a storage medium. The stored binary data can be further processed under MS-Windows. The high-speed built-in thermal printer provides a hardcopy of the measurement results with all setting parameters within 8 seconds.

Specifications in brief

Spectral values	
Wavelength	350 to 1750 nm
Resolution (spacing between two testpoints)	0.001 nm at 500 nm 0.01 nm at 1550 nm
Measurement accuracy	±0.01 nm, the wavelength in a vacuum is indicated
Measurement principle	Michelson interferometer with HeNe reference laser
Span	0.1 to 1400 nm
Level	
Sensitivity	
700 to 1600 nm	–65 dBm
450 to 1700 nm	–52 dBm
350 to 1750 nm	–42 dBm
Max. input level	+10 dBm
Measurement accuracy	±2 dB
Polarization dependence	±0.8 dB
Linearity	±0.5 dB/10 dB ±1.0 dB/25 dB
Scale	0.2 to 10 dB/division, 1/2/5 steps, linear
Processing	
Measurement time	1 to 3.5 seconds per measurement depending on setting
Memory	16 curves, 10 instrument setups, 3 ½" disk drive
Analysis	coherence to 165 mm, X dB bandwidth, peak wavelength, curve fitting, etc
Interfaces	
Optical connector	FC/PC with internal 50/125 µm graded-index fiber, connector adaptable
Remote control	IEC625 (IEEE488)
Printer	built-in printer (standard) or output to plotter via IEC/IEEE bus
General data	
Power supply	220 to 240 V, 48/66 Hz, 260 VA
Dimensions (W x H x D)	424 mm x 335 mm*) x 500 mm *) total height of both parts
Weight	36 kg in total

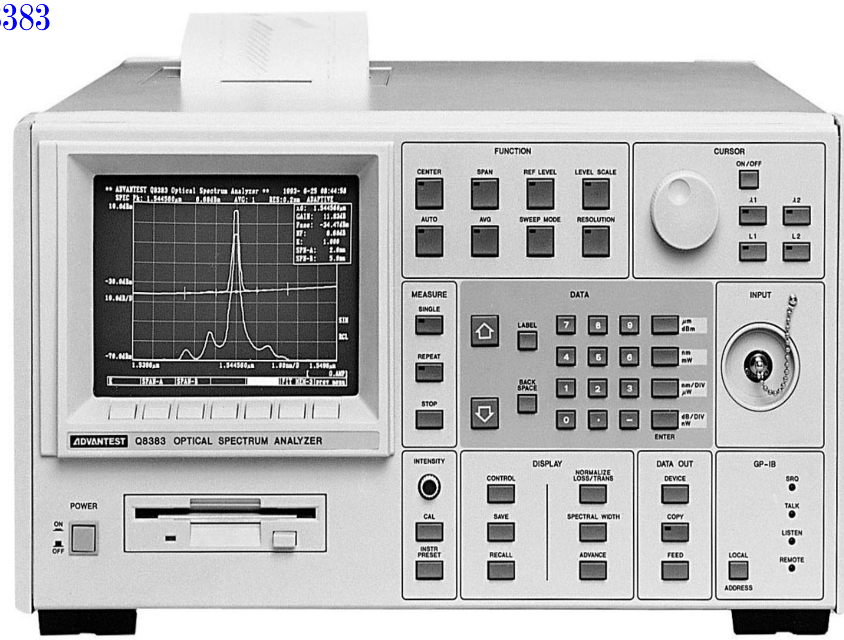
Ordering information

Optical Spectrum Analyzer	Q8347
Extras	
5 rolls of printer paper	A09075
Adaptation of optical input to DIN	Q8347-DIN
19" Rack Adapter (please order both numbers)	A02728 and A02732

Optical Spectrum Analyzer Q8383

550 to 1750 nm

Optical spectrum analyzer with low polarization dependence for optical amplifiers



Brief description

Q8383 is a high-grade spectrum analyzer (Advantest) with double-pass monochromator and extremely low polarization dependence. Thanks to a special method used, a value of ±0.05 dB can be guaranteed, the typical value is as low as 0.02 dB. Together with the high accuracy of the resolution bandwidth, the Q8383 can be used to perform accurate power measurements.
All these features make the Q8383 an ideal measuring instrument for erbium-doped fiber amplifiers (EDFA). A special measurement function allows determination of noise figure, gain and spontaneous emission by simple comparison of the signal at the amplifier input with the signal at the amplifier output. All these features are of course also of great advantage for the measurement of laser diodes, LEDs and other light sources. A curve fitting function directly shows the electroluminescence characteristic by fitting a Gaussian distribution into the emission spectrum. This is a valuable aid in the measurement of erbium- doped fiber amplifiers (EDFA) and LDs. Special functions for pulsed light allow measurements of fiber rings and Soliton transmission systems. Internal or external triggering is possible.

The measurement time is 0.8 second for a span of 200 nm and varies as a function of the span. The highest sensitivity is attained for wideband sources with a resolution of 5 nm, while narrowband sources (laser) can reliably be analyzed down to the noise level even with narrow resolution bandwidths. A normalization function in conjunction with a white light source enables direct measurement of the transmission and loss characteristics of optical filters and fibers.

Main features

- Sensitivity –92 dBm
- Polarization dependence ±0.05 dB
- Accuracy of resolution bandwidth ±2%
- Power measurement
- Pulse light measurement

Operation

In addition to the amplifier analysis, the versatile display modes such as
- overlay display,
- comparison with memory contents,
- display of two separate diagrams (split screen),
- power meter function,
- use of several markers,
- normalization and direct readout of transmission loss as well as
- automatic bandwidth analysis (eg half-value width measurement to RMS and envelope method),
- curve fitting

and many other features facilitate operation of the analyzer and simplify analysis via IEC/IEEE bus.

The standard built-in disk drive is used as a storage medium. The stored binary data can be analyzed with an appropriate program under MS-Windows, copied into documents and printed. The high-speed built-in thermal printer provides a hardcopy of the measurement results with all setting parameters within 8 seconds.

Optical Spectrum Analyzer Q8383

Specifications in brief

Spectral values	
Wavelength	550 to 1750 nm
Resolution (half-value width)	0.1 to 5 nm, 1/2/5 steps
Measurement accuracy	±0.2 nm
Measurement principle	polarization-compensated double-pass monochromator
Span	1 to 1200 nm, 0 nm
Level	
Sensitivity	
1200 to 1650 nm	–92 dBm
550 to 1750 nm	–55 dBm
Max. input level	+20 dBm
Measurement accuracy	±0.4 dB
Polarization dependence	±0.05 dB
Linearity	±0.05 dB/–10 to –50 dBm
Dynamic range	55 dB at ±0.5 nm 65 dB at ±1 nm
Scale	0.2 to 10 dB/division, 1/2/5 steps, linear
Pulse light	in pulse mode or with external trigger, pulse >10 ns; Max Hold mode
Processing	
Measurement time	0.8 second for 200 nm span
Memory	32 curves, 10 instrument setups, 3 ½" disk drive
Analysis of amplifiers (EDFA)	noise figure, spontaneous emission, power, gain; X dB bandwidth, peak wavelength, etc
Interfaces	
Optical connector	FC without contact in fiber
Remote control	IEC625 (IEEE488)
Printer	built-in printer (standard) or output to plotter via IEC/IEEE bus

General data

Power supply	90 to 250 V, 48/66 Hz, 180 VA
Dimensions (W x H x D); weight	424 mm x 221 mm x 450 mm; 29 kg

Ordering information

Optical Spectrum Analyzer	Q8383
Extras	
5 rolls of printer paper	A09075
19" Rack Adapter with handles	A02712
19" Rack Adapter without handles	A02722

Handheld Optical Power Meter Q8210

400 to 1650 nm; versatile, handy optical power meter

Brief description

Q8210 (Advantest) is a versatile optical power meter. In conjunction with various optical sensors it covers a wavelength range from 400 nm to 1650 nm. Thanks to stringent calibration throughout, the power meter can be used in the entire wavelength range. Depending on the type of sensor, the optical power in optical fibers or in the light beam can be determined. An extremely flat sensor (TQ82017) facilitates measurements in tight spaces, eg of optical disks (CD).

The sensitivity is as good as –60 dBm even at 1550 nm. At low levels an averaging function with up to 20 average values ensures reliable measurement. The necessary zero adjustment is made automatically with the sensor darkened. A Max Hold function allows accurate power measurement even of test setups that are difficult to adjust and highly instable. An analog output is provided for recording the measurements.

Main features

- Continuous wavelength sensitivity compensation
- Backlit 4 ½-digit display
- Up to 13 hours of operation independent of AC power (built-in battery)
- Analog output

Operation

The instrument automatically identifies the sensor connected and recalls the appropriate correction values for the set wavelength, which remains indicated during the measurement. Backlighting of the display can be switched on for measurements in dark rooms.

Handheld Optical Power Meter Q8210

Specifications in brief

Basic unit	
Display	4 ½-digit LCD with selectable back-lighting
Resolution	0.01 dB (measurement in dBm) 0.005 to 0.1 W (measurement in W)
Measurement rate	2 measurements/second
Measurement functions	power measurement, dBr (relative), Max Hold (for measurements in W)
Averaging	2 to 20 values, moving average value
Offset and zero adjustment	automatic upon keystroke
Analog output	0 to 2 V, impedance <10 Ω
Power supply	200 to 245 V (with AC adapter); built-in NiCd battery, max. 13 hours of operation (10 hours with LCD back-lighting on)
Dimensions (W x H x D)	80 mm x 180 mm x 35 mm
Weight	400 g

Ordering information

Handheld Optical Power Meter	Q8210
Extras	
Optical Sensor	TQ82014 TQ82015 TQ82017 Q82018A
Charging Adapter 200 to 245 V	A08019 (standard accessory)

Adapters for connectors

Connector/Sensor	TQ82014/15	Q82018A
FC/PC	A08012	A08081 (standard)
SC	A08090	A08082
ST	A08096	A08083
Biconical	A08025	—
D4	A08013	A08087
DIN	A08029	A08084
SMA (⅛")	A08028	—

Optical sensors

	TQ82014	TQ82015	TQ82017	Q82018A
Wavelength range	400 to 1100 nm	800 to 1600 nm	400 to 1100 nm	800 to 1650 nm
Field of application	measurement on optical fibers (adapter for connector to be ordered separately) or light beam	measurement on optical fibers (adapter for connector to be ordered separately) or light beam	light beam measurements also in very narrow spaces (eg in CD drives)	power measurement in optical fibers, FC/PC adapter supplied as standard
Sensor material	silicon	germanium	silicon	InGaAs PIN
Power measurement range	–60 ±17 dBm, 1 nW to 50 mW	–40 ±10 dBm, 100 nW to 10 mW	–60 ±17 dBm, 1 nW to 50 mW	–60 ±17 dBm
Photoreceptor area	approx. 8 mm dia.	approx. 5 mm dia.	approx. 10 mm x 10 mm square	–
Measurement ranges	8 ranges in 10 dB steps	5 ranges in 10 dB steps	8 ranges in 10 dB steps	8 ranges in 10 dB steps
Accuracy	±5% at 850 nm, –20 dBm	±5% at 1300 nm, –20 dBm	±5% at 850 nm, –20 dBm	±5% at 1300 nm, –20 dBm

Benchtop Optical Power Meter Q8221

400 to 1750 nm

Benchtop optical power meter

of high measurement accuracy

Brief description

Optical Power Meter Q8221 (Advantest) provides two plug-in slots and can be fitted with five different optical sensors or nine different sources. The optical sensors cover the wavelength range from 400 nm to 1750 nm and the power range from –93 dBm to +27 dBm. A continuous wavelength sensitivity compensation allows the sensors not only to be used at specific wavelengths, but throughout the specified range. Compensation is made automatically following selection of the wavelength by the user.

LEDs and LDs are the sources for all three optical windows. The high measurement accuracy and the extremely low polarization dependence make the Q8221 an ideal tool for demanding measurement tasks. A special adapter allows a return loss of at least 45 dB to be obtained even with PC polished FC connectors.

Thanks to its high speed of 20 measurements per second, Q8221 is suitable for a large variety of applications. Whether it is used as a two-channel power meter or as a combined power meter/source, its high measurement accuracy and source stability always ensure reliable measurement results.

Main features

- Two independent channels
- High measurement accuracy of 2.5% (with Q82208)
- Versatile measurement capabilities through various sensors and plug-in light sources

Specifications in brief (basic unit)

Basic unit	
Display	2 x 5 ½-digit
Resolution	0.001 dB (measurement in dBm)
Measurement rate	20 measurements/second
Measurement functions	power measurement in W and dBm, dBr (relative), etc
Averaging	2 to 256 values, moving average value
Offset and zero adjustment	automatic upon keystroke
Remote control	IEC 625 (IEEE 488)
Power supply	100 to 240 V, 48 to 66 Hz, 50 VA
Dimensions (W x H x D); weight	212 mm x 88 mm x 360 mm; 4 kg

Optical sensors

Optical Sensor	Q82214	Q82215	Q82216	Q82227	Q82208	Q82232/Q82233 1)
Wavelength	400 to 1100 nm	800 to 1750 nm	800 to 1750 nm	800 to 1750 nm	800 to 1700 nm	900 to 1650 nm
Level	–80 to +17 dBm	–60 to +10 dBm	–77 to +10 dBm	–80 to +27 dBm	–94 to +10 dBm	–94 to +10 dBm
Sensor material	Si, 8 mm dia.	Ge, 8 mm dia.	Ge, 5 mm dia., cooled	InGaAs, cooled	InGaAs, cooled	InGaAs, cooled
Measurement accuracy (with pulsed light)	±3% (±4%) 780 nm, 0 dBm	±3% (±4%) 1300 nm, 0 dBm	±2.5% (±3.5%) 1300 nm, 0 dBm	±2.5% (±3.5%) 1550 nm, 0 dBm	±2.5% (±3.5%) 1300 nm, 0 dBm	±2.5% (±3.5%) 1550 nm, 0 dBm
Polarization	–	typ. 0.03 dB (pp)	typ. 0.03 dB (pp)	typ. 0.05 dB (pp)	typ. 0.015 dB (pp)	0.003 dB (pp)/ 0.005 dB (pp)
Adapter for connection of sensors (additionally required)	Q82202	Q82202	Q82202	Q82203	–	Q82203

Extras
Adapter Q82202 for connection of sensors, 19" Rack Adapter A02463

Adapters for connectors

	Q82202	Q82202	Q82202	Q82203	–	Q82203
FC	A08012	A08012	A08012	Standard	Standard	A08161
SC	A08090	A08090	A08090	–	–	A08161
ST	A08096	A08096	A08096	–	–	A08162
D4	A08013	A08013	A08013	–	–	A08163
SMA 1/8"	A08028	A08028	A08028	–	–	–
DIN	A08029	A08029	A08029	–	–	–
FC >45 dB ORL	–	–	–	A08328	A08328	–

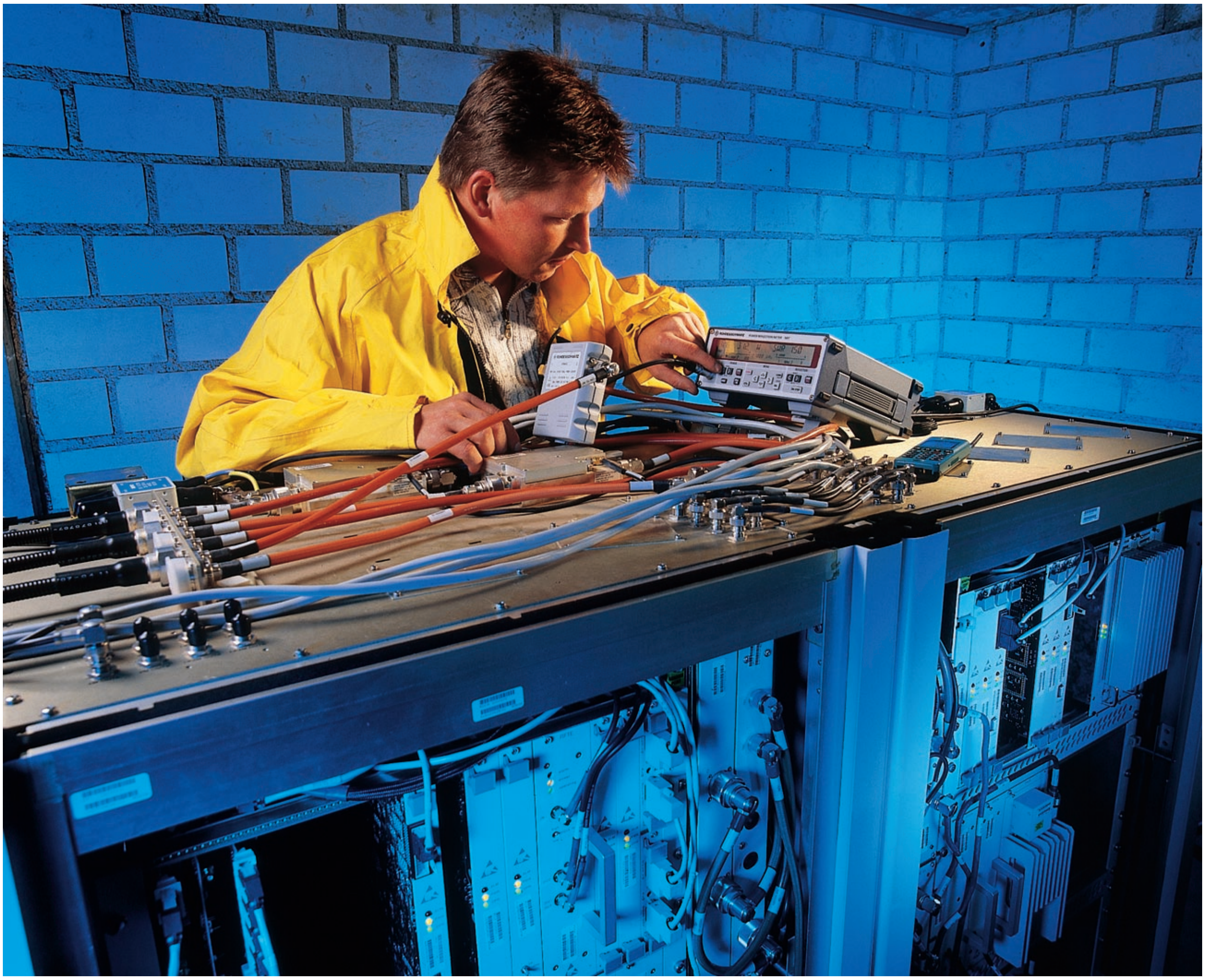
Plug-in light sources

Light Source	Q81201	Q81202	Q81203	Q81204	Q81205
Type	LED	LED	LED	LED	LED
Wavelength	850 ±25 nm	1310 ±40 nm	1550 ±30 nm	1310 ±10 nm	1550 ±10 nm
Half-value width	55 nm	160 nm	210 nm	20 ±5 nm	20 ±5 nm
Level	–15 ±1 dBm	–20 ±1 dBm	–43 ±1 dBm 1)	–35 ±1 dBm	–53 ±1 dBm 2)
Drift 1 h/8 h	0.02 dB/0.2 dB	0.02 dB/0.2 dB	0.04 dB/0.2 dB	0.02 dB/0.2 dB	0.04 dB/0.2 dB
Modulation		270 Hz, 2 kHz, 4 kHz, ±0.1% each; duty cycle 2 (±10%; 270 Hz: ±5%)			
Type of connector	FC	FC	FC	FC	FC

Light Source	Q81206	Q81207	Q81211	Q81212
Type	LED	LED	FP-LD	FP-LD
Wavelength	1300 ±30 nm	1550 ±30 nm	1310 ±10 nm	1550 ±20 nm
Half-value width	100 nm	140 nm	5 nm	10 nm
Level	–14 ±1 dBm 1)	–27 ±1 dBm 1)	0 ±1 dBm 1)	0 ±1 dBm 1)
Drift 1 h/8 h	0.02 dB/0.2 dB	0.02 dB/0.2 dB	0.05 dB/1 dB	0.05 dB/1 dB
Modulation		270 Hz, 2 kHz, 4 kHz, ±0.1% each; duty cycle 2 (±10%; 270 Hz: ±5%)		
Type of connector	FC	FC	FC	FC

1) ORL ≥45dB

2) At SM 10/125 µm, otherwise GI 50/125 µm.



Installing a mobile radio base station with NRT (photo 42667)

Contents of Chapter 8

Level Meter URV35

DC to 3/40 GHz

200 µV to 1000 V

100 pW to 30 W

Power and voltage measurement with a unique analog/digital display

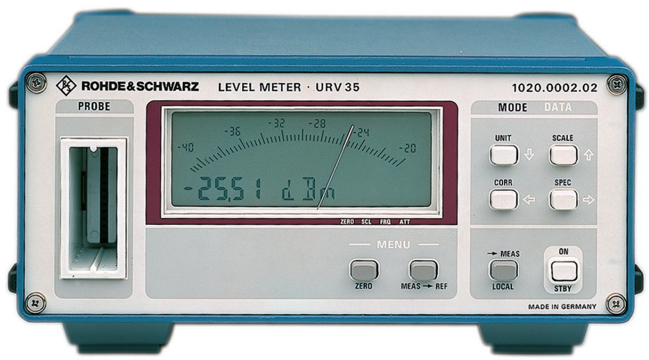


Photo 40278

Brief description

URV35 is a voltmeter and power meter for versatile applications in service and production as well as for precision measurements in RF and microwave labs. A large variety of probes and sensors allows voltage measurements up to 3 GHz and power measurements up to 40 GHz.

Main features

- Compact, handy and mobile
- Voltmeter and power meter in one unit
- Rugged design
- Combined (true) analog and digital display
- Menu-guided operation
- AC-supply or battery operation
- Large choice of probes and sensors
- DC frequency input for tracking frequency-response correction
- Analog output for YT recorder
- RS-232-C interface
- Test generator for checking the probe or sensor (optional)

Specifications in brief; voltage probes page 262, power sensors page 266

Probes and sensors	all URV5 probes and NRV sensors
Display	backlit LCD, moving-coil meter with short response time
Absolute readout	dBm, dBµV, V or W
Relative readout	dB, referred to stored reference value
Resolution of digital display	4½ digits: 19999 steps; 0.001 dB 3½ digits: 1999 steps; 0.01 dB
Analog display	steps of 1-2.5-5 for V, W and dB, 5 (10) dB for dBm and dBµV with windows of 10 (20) dB
Entry of scaling	left- and right-hand scale limits
Display filtering	level-dependent digital averaging filter
Accuracy (18 to 28°C)	
Digital display	±0.02 dB ±1 digit
Moving-coil meter	1.5% of full scale
Zero adjustment	via interface or manually, approx. 4 s
Hold function	for displayed measurement result
Measurement rate	5 readouts/s in manual mode
Frequency-response correction (selectable)	sensor-specific calibration data taken into account
Attenuation compensation (selectable)	external attenuation or gain taken into account, range ±199.99 dB
Entry of reference value	measured value on keystroke, or value entered via interface or keypad
Reference impedance	50 Ω/75 Ω, automatic/selectable
Sensor check source (option NRVS-B1)	
Output	50 MHz/1 mW ±0.7%; N connector
VSWR	1.05
Interfaces	
Remote control	serial interface (V.24, RS-232-C)
DC frequency input	BNC, R_{in} = 9 MΩ
Input voltage range	±12 V, linear with selectable scale
DC voltage output	BNC, R_{out} = 1 kΩ, EMF proportional to pointer deflection
Left-/right-hand scale limit	corresponding to 0/+3 V
Additional settling time	250 ms
Accuracy	±5 mV
General data	
Model 02 power supply	
Battery, standard	5 x 1.5 V alkaline-manganese LR20
Operating time	125 h
Rechargeable battery, retrofittable	5 x 1.2 V NiCd IEC KR35/62
Operating/charging time	60 h/24 h
AC supply with UZ-35, European version	230 V ±10%, 47 to 63 Hz
AC supply with UZ-35, US version	120 V ±10%, 57 to 63 Hz
Model 03	115 V +15%/−22%, 47 to 440 Hz 230 V +15%/−22%, 47 to 63 Hz (switch-selectable); 6 VA
Dimensions (W x H x D)	220 mm x 100 mm x 240 mm
Weight model 02	3.1 kg/2.3 kg with/without batteries
model 03	2.4 kg

Ordering information

Level Meter battery-operated	URV35	1020.0002.02
AC-supply model	URV35	1020.0002.03
Options		
Sensor Check Source	NRVS-B1	1029.2908.02
Power Supply/Charger (for model 02)1)	UZ-35	1020.1709.02
Power Supply/Charger (for model 02)2)	UZ-35	1020.1709.04
Service Kit	URV35-S1	1029.2608.02

1) European power supply
2) US power supply

Millivoltmeter URV5

DC, 9 kHz to 3/26.5 GHz

200 µV to 1000 V

Voltage, level, power measurements; trend indication

Photo 33034

Brief description

Millivoltmeter URV5 is a broadband voltage, level and power meter of high accuracy and sensitivity. It is suitable both for manual operation and for use in systems. A wide choice of individually calibrated probes and sensors allows URV5 to be used for a great variety of measurements:

- With RF probe and DC probe for no-load AC and DC voltage measurements
- Voltage (and power) measurements in coaxial 50 Ω and 75 Ω systems using low-reflection and low-loss insertion units
- Power measurements up to 26.5 GHz using Power Sensors NRV-Z1 to -Z6

Main features

- Two test inputs
- High accuracy through µP-controlled error correction: ±1%
- Dynamic range >94 dB
- IEC/IEEE-bus interface
- Readout in all standard units with selectable reference impedance; relative measurements
- Optional DC output
- PEP measurement

Specifications in brief; voltage probes page 262, power sensors page 266

Probes and sensors	all URV5 probes and NRV sensors, except NRV-Z3x and NRV-Z5x, -Z15
Test channels	2 (A and B)
Absolute measurement	A, B
Relative measurement	A/REF_A, B/REF_B, A/B, B/A
Absolute readout	V, W, dBm, dBV
Relative readout	ΔV, ΔW, Δ%, ΔdB, X/REF
Resolution	0.01% or 0.01 dB
Accuracy of voltage readout in V (18 to 28 °C)	±0.15% of rdg per channel
Filter	to reduce display noise in 6 steps (F0 to F5), selectable
Zero adjustment	via keyboard or remote control
Measurement rate (manual)	approx. 1 measurement/s with filter F0, up to 30 measurements/s with filter F5
Measurement time (IEC/IEEE bus)	approx. 0.05 s with filter F5, up to 20 s with filter F0
PEP measurement	
Pulse width	approx. 200 µs to CW
Min. pulse repetition frequency	

Filter	F0	F1	F2	F3	F4	F5
f_{min}/Hz	0.05	0.25	1	5	25	100

Frequency-response correction (selectable)	sensor-specific frequency response after entry of test frequency
Attenuation compensation (selectable)	one attenuation value per channel can be entered (–199.99 to +199.99 dB)
Reference value for relative measurements	one value per channel
Optional DC Output URV5-B2	
Output voltage range (EMKF)	–1.999 to +1.999 V, R_{out} = 1 kΩ
Resolution; error	1 mV (10 digit); ±2 mV
General data	
Remote control	IEC 625-1 (IEEE 488) for control of all instrument functions
Interface functions	SH1, AH1, T5, L4, SR1, RL1, DC1, DT1, PP1
Power supply	100/120/220/240 V ±10% 47 to 63 Hz, 400 Hz, 30 VA
Dimensions (W x H x D); weight	241 mm x 110 mm x 340 mm; 4.4 kg

Ordering information

Millivoltmeter	URV5	0394.8010.02
Options		
DC Output	URV5-B2	0079.0631.00
Service Kit for Calibration	UZ-8	0394.9968.02

Millivoltmeter URV 55

DC to 3/40 GHz

200 µV to 1000 V

100 pW to 30 W

RF/DC voltage, level and power measurements

Photo 40 113

Brief description

Millivoltmeter URV 55 is suitable for voltage measurements up to 3 GHz as well as for power and level measurements up to 40 GHz. Thanks to probes with calibration data memory and temperature sensors, which make adjustments by the user superfluous, URV 55 provides at all times high-precision measurements free of operator's errors.

Main features

- Voltage, level and power measurements
- Large choice of intelligent probes and sensors (URV 5-Z, NRV-Z)
- IEC/IEEE-bus interface
- DC frequency input for tracking frequency-response correction
- Analog output for YT recorder
- Menu-guided operation with softkeys
- Storage of 20 complete instrument setups
- 13 digital filters for noise suppression, automatic or manual filter selection
- Sensor check source (optional)

Measuring heads

The range of measuring heads includes high-impedance probes with plug-on dividers and adapters (URV 5-Z7, -Z1) as well as insertion units for voltage measurements on coaxial lines (URV 5-Z2, -Z4). All power sensors of the NRV-Z series can be used without any restrictions.

Specifications in brief: URV55, NRVS, NRVD; voltage probes page 262, power sensors page 266

Additional NRVD-specific features in bold

Measurement functions	average power, pulse power, peak envelope power **AM, reflection**, DC voltage (depending on sensor)
Frequency and level range	DC to 40 GHz, 100 pW to 30 W 9 kHz to 3 GHz, 200 µV to 1000 V (depending on sensor)
Probes and sensors	all NRV sensors and URV5 probes
Display	LCD for digits, units, menu-guided operation and analog display, **adjustable backlighting**
Display of results	single-channel (with optional display of correction frequency) or **dual-channel**
Absolute readout	W, dBm, V, dBµV, **dBV**
Relative readout NRVS, URV55	dB, %W or %V relative to a stored reference value
Relative readout NRVD	**dB, difference, percent and ratio, relative to a stored reference value or to the second measurement channel; VSWR, reflection coefficient, return loss in dB, AM modulation depth**
Analog display	automatic or with selectable scale
Digital display and resolution	max. 4½ digits, resolution selectable (0.1/0.01/0.001 dB)
Display filtering	averaging over 1 to 512 readings to reduce display noise; manual or automatic setting depending on measurement range and resolution
Display noise	see sensors from page 262/266
Measurement rate	see table below
Accuracy of URV55 (without sensor)	
18 to 28 °C	±0.02 dB ±1 digit
10 to 40 °C	±0.04 dB ±1 digit
0 to 50 °C	±0.06 dB ±1 digit
Accuracy of power readout in W (NRVS/D without sensors)	0.4% **(0.3%)** +1 digit (18 to 28°C) 0.9% **(0.8%)** +1 digit (10 to 40°C) 1.4% **(1.3%)** +1 digit (0 to 50°C)
Zero adjustment	manual or via IEC/IEEE bus, duration approx. 4 s
Frequency response correction	sensor-specific calibration data taken into account; numerical entry of test frequency (keyboard or via IEC/IEEE bus) or by frequency-proportional DC voltage
Attenuation compensation	external attenuation or gain taken into account; data entry via keyboard or IEC/IEEE bus, range ±200 dB
Entry of reference value	measured value on keystroke or numerical entry via keypad or IEC/IEEE bus
Reference impedance	for conversion between voltage and power, automatic readout of reference impedance from sensor data memory or numerical entry via keyboard or IEC/IEEE bus (for RF probe)
Remote control	IEC 625 (IEEE 488), **SCPI**, control of all instrument functions
Interface functions	SH1, AH1, T6, L4, SR1, RL1, DC1, DT1, PP0, **PP1**
DC frequency input	
URV55, NRVS	standard
NRVD	option NRVD-B2
Connector	BNC
Input voltage range	±12 V, linear with selectable scale
DC output	
URV55, NRVS	standard
NRVD	option NRVD-B2
Connector	BNC, R_{out} = 1 kΩ, EMF proportional to analog display
Left-/right-hand full-scale value	corresponding to 0/+3 V
Accuracy	±5 mV
Channels	1, 2
Input/Output Option NRVD-B2	**2 simultaneous DC voltage outputs, DC frequency input, trigger input (TTL, active low), ready output (TTL, active high)**
Sensor check source	
URV55, NRVS	option NRVS-B1
NRVD	standard
Output power	1 mW ±0.7%
Frequency	50 MHz
VSWR	1.05, ≤**1.03**
RF connector	N female
General data	
Power supply	115 V +15/–22% (–15%) 47 to 63 (440) Hz; 230 V +15/–22%, 47 to 63 Hz, 13 VA **100/120/220 V ±10%, 230 V –6/+15%; 47 to 400 Hz (25 VA)**
Dimensions (W x H x D); weight	219 mm x 103 mm x 350 mm; 3.2 kg **219 mm x 147 mm x 350 mm; 4.5 kg**

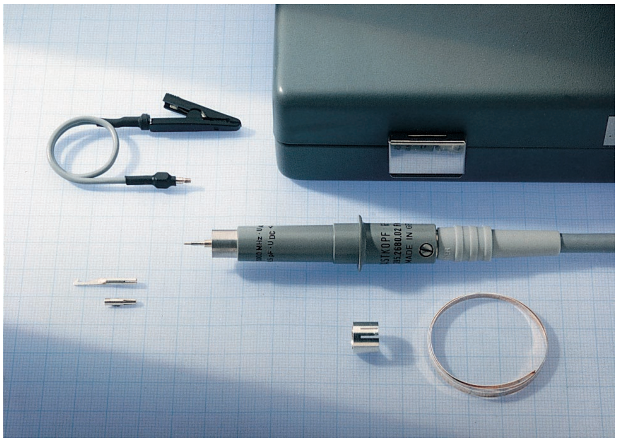
Ordering information

Millivoltmeter	URV55	1029.1701.02
Power Meter	NRVS	1020.1809.02
Dual-Channel Power Meter	NRVD	0857.8008.02
Options		
Input/Output Option for NRVD	NRVD-B2	0857.8908.02
Sensor Check Source for NRVS	NRVS-B1	1029.2908.02
Extras		
Service Kit for NRVS	NRVS-S1	1029.2708.02
for NRVD	NRVD-S1	1029.2808.02

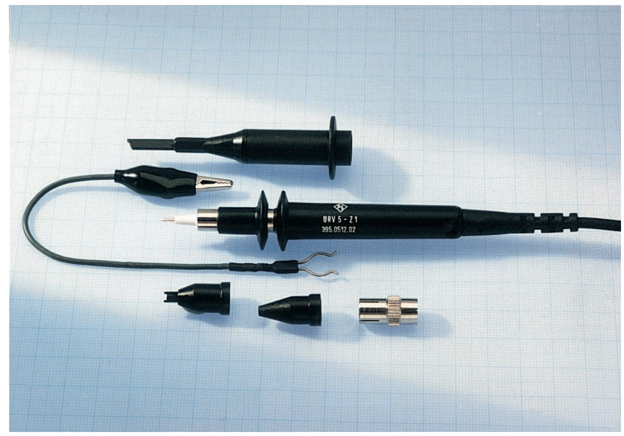
Measurement time in seconds (from trigger to output of first byte) depending on filter setting

Resolution	Filter number 0	1	2	3	4	5	6	7	8	9	10	11	12
NRV-Z1 to -Z15	0.045	0.05	0.06	0.08	0.15	0.27	0.49	0.95	1.85	3.6	7.2	14.5	28.5
NRV-Z31 mod. 02	1.04	1.04	1.05	1.07	1.13	1.24	1.44	1.84	2.7	4.3	7.5	14	27
NRV-Z31 to -Z33 mod. 03, 04	0.135	0.14	0.15	0.17	0.23	0.34	0.54	0.94	1.77	3.4	6.6	13	26
NVR-Z32 mod. 05	0.435	0.44	0.45	0.47	0.53	0.64	0.84	1.24	2.07	3.7	6.9	14	27
NRV-Z51 to -Z55	0.115	0.12	0.13	0.15	0.21	0.32	0.52	0.92	1.75	3.4	6.6	13	26
URV 5-Z2, -Z4, -Z7	0.065	0.07	0.08	0.1	0.2	0.38	0.72	1.45	2.8	5.5	11	22	44

Probes and Insertion Units URV5-Z1, -Z2, -Z4, -Z7, -Z9 for voltage and level measurement



RF Probe URV5-Z7 (photo 40621-11)



DC Probe URV5-Z1 (photo 40621-10)

Brief description

URV5-Z probes and insertion units are indispensable tools for RF and microwave labs, test departments and service. They cover the frequency range from 9 kHz to 3 GHz and thus fill the gap between low-frequency voltage measurement at one end and microwave power measurement at the other end.

All corrections of the rectifier such as linearization, temperature compensation or frequency-response correction are made numerically. Each probe or insertion unit has a built-in calibration data memory with its individual data which are continuously read by the meter.

All AC probes read out the RMS value for unmodulated sinewave voltages.

RF Probe URV5-Z7
A versatile tool for measuring high-frequency voltages. Thanks to its low input capacitance of 2.5 pF ideal for practically no-load measurements on non-coaxial circuits up to about 500 MHz (with accessories up to 1 GHz). Measurement range with plug-on dividers 1000 V (input capacitance 0.5 pF).

Accessory Set URV-Z6
- Plug-on divider 20 dB and 40 dB for extending the measurement range and reducing the input capacitance to100 V/1 pF or 1000 V/0.5 pF.
- BNC adapter for level measurements on coaxial 50 Ω lines (see also Insertion Units URV5-Z2, -Z4).

Adapters
URV-Z50 (50 Ω), URV-Z3 (75 Ω)
With integrated termination for power measurements on matched sources.

Dual Direction Coupler URV5-Z9
Suitable for power and SWR measurements at higher powers in conjunction with two RF probes for forward and reflected power.

DC Probe URV5-Z1
Due to its low input capacitance ideal for DC voltage measurements on high-frequency modules.

Insertion Units URV5-Z2 (50 Ω), URV5-Z4 (50 Ω and 75 Ω)
Insertion units are used for non-interrupting level measurements between source and load and for power measurements with wide dynamic range. They are made up of a short, reflection-free and low-loss line section with voltage tap and rectifier in the middle of the line.

With a well-matched load, the transmitted power P can be calculated for the measured voltage V_{rms} and the characteristic impedance Z_0 according to the formula $P = V_{rms}^2/Z_0$.

Specifications in brief

The indicated measurement uncertainties are valid in the temperature range 18°C to 28°C. Influences of the basic unit, meter noise, zero error, mismatch and temperature effects (beyond the indicated range) must also be taken into account.

1) With BNC adapter (URV-Z6); maximum power is limited by power loss of the adapter.

2) 1 mV to 100 V

3) 100 V to 400 V

Model	Frequency range Impedance	Voltage measurement range Max. load	Power measurement range Level meas. range	Max. VSWR (reflection coefficient)		Meas. uncertainty in dB (% of voltage)		RF connector
RF Probe URV5-Z7	20 kHz to 500 MHz 2.5 pF/80 kΩ	200 µV to 10 V 15 V (RMS) 22 V (PK) 400 V (DC)	1 nW to 2 W –60/+33 dBm	–	–	0.07 to 1.1	(0.8 to 12)	BNC female/ female[1]
with 20 dB divider (URV-Z6)	1 to 500 MHz 1 pF/1 MΩ	2 mV to 100 V 150 V (RMS) 220 V (PK) 1000 V (DC)	100 nW to 20 W –40/+43 dBm	–	–	1.1 to 1.9	(12 to 20)	BNC female/ female[1]
with 40 dB divider (URV-Z6)	0.5 to 500 MHz 0.5 pF/10 MΩ	20 mV to 1000 V 1050 V (RMS) 1500 V (PK) 1000 V (DC)	10 µW to 20 W –20/+43 dBm	–	–	0.63 to 1.9	(7.3 to 20)	BNC female/ female[1]
with 50 Ω Adapter URV-Z50	20 kHz to 1 GHz 50 Ω	200 µV to 10 V 10 V (RMS) 22 V (PK)	1 nW to 2 W –60/+33 dBm	20 to 50 kHz >0.05 to 50 MHz >50 to 100 MHz >100 to 500 MHz >500 to 700 MHz >0.7 to 1 GHz	1.03 (0.015) 1.03 (0.015) 1.06 (0.030) 1.11 (0.050) 1.22 (0.10) 1.44 (0.18)	0.90 0.12 to 0.20 0.20 0.30 to 0.63 1.0 to 1.4 1.0 to 1.4	(10) (1.3 to 2.3) (2.3) (3.3 to 7.3) (11 to 18) (11 to 18)	BNC female (male)
with 75 Ω Adapter URV-Z3	20 kHz to 500 MHz 75 Ω	200 µV to 10 V 12 V (RMS) 22 V (PK)	500 pW to 1.3 W –62/+31 dBm	20 to 50 kHz >0.05 to 100 MHz >100 to 200 MHz >200 to 500 MHz	1.03 (0.015) 1.03 (0.015) 1.06 (0.03) 1.22 (0.10)	0.90 0.12 to 0.20 0.38 1.10	(10) (1.3 to 2.3) (4.3) (12)	BNC male 2.5/6 male 1.6/5.6 male
with Dual Directional Coupler URV5-Z9	100 kHz to 80 MHz 50 Ω	Max. load see data sheet	10 µW to 2 kW –20/+63 dBm	0.1 to 30 MHz >30 to 80 MHz	1.02 (0.01) 1.03 (0.015)	0.10 to 0.20 0.15 to 0.20	(1.2 to 2.3) (1.7 to 2.3)	N female/ male
DC Probe URV5-Z1	3 pF/9 MΩ	1 mV to 100 V 400 V (PK)	–	–	–	0.013 dB 0.030 dB	(0.15%)[2] (0.35%)[3]	BNC male
10 V Insertion Unit URV5-Z2	9 kHz to 3 GHz 50 Ω	200 µV to 10 V 15 V (RMS) 22 V (PK) 50 V (DC)	1 nW to 2 W –60/+33 dBm	9 to 20 kHz >20 to 50 kHz >50 kHz to 200 MHz >200 to 500 MHz >500 MHz to 1 GHz >1.0 to 2.0 GHz >2.0 to 3.0 GHz	1.04 (0.02) 1.04 (0.02) 1.04 (0.02) 1.10 (0.048) 1.22 (0.10) 1.35 (0.15) 1.35 (0.15)	0.20 to 0.35 0.17 to 0.20 0.13 to 0.17 0.20 to 0.25 0.25 to 0.30 0.30 to 0.50 0.40 to 0.75	(2.3 to 4) (2.0 to 2.3) (1.5 to 2.0) (2.3 to 2.8) (2.8 to 3.4) (3.4 to 5.6) (4.5 to 8.3)	N female/ male
100 V Insertion Unit URV5-Z4	100 kHz to 3 GHz 50 Ω	2 mV to 100 V 150 V (RMS) 220 V (PK) 1000 V (DC)	100 nW to 200 W –40/+53 dBm	100 to 200 kHz >200 to 500 kHz >0.5 to 3 MHz >3 to 200 MHz >200 to 500 MHz >0.5 to 1 GHz >1 to 2 GHz >2 to 3 GHz	1.04 (0.02) 1.04 (0.02) 1.04 (0.02) 1.04 (0.02) 1.04 (0.02) 1.07 (0.035) 1.07 (0.035) 1.10 (0.048)	0.50 to 1.50 0.25 to 0.60 0.13 to 0.20 0.13 0.17 to 0.20 0.20 to 0.25 0.30 to 0.50 0.45 to 1.05	(5.6 to 16) (2.8 to 6.7) (1.5 to 2.3) (1.5) (2.0 to 2.3) (2.3 to 2.8) (3.4 to 5.6) (5.0 to 11.4)	N female/ male
100 V Insertion Unit URV5-Z4	100 kHz to 2 GHz 75 Ω	2 mV to 100 V 150 V (RMS) 220 V (PK) 1000 V (DC)	50 nW to 130 W –42/+51 dBm	0.1 to 0.5 MHz >0.5 to 200 MHz >200 to 500 MHz >0.5 to 1 GHz >1 to 2 GHz	1.03 (0.015) 1.03 (0.015) 1.04 (0.02) 1.06 (0.03) 1.11 (0.05)	0.7 to 1.9 0.12 to 0.2 0.25 0.47 0.63 to 1.2	(8 to 20) (1.3 to 2.3) (2.8) (5.3) (7.3 to 15)	N female/ male

Ordering information

DC Probe with ground cable, clip tip and BNC adapter	URV5-Z1	0395.0512.02
10 V Insertion Unit (50 Ω, 3 GHz)	URV5-Z2	0395.1019.02
100-V Insertion Unit		
50 Ω, 2 GHz	URV5-Z4	0395.1619.02
75 Ω, 2 GHz	URV5-Z4	0395.1619.75
RF Probe with case, ground cable, ground sleeve and tape, hook and solder tip	URV5-Z7	0395.2615.02
Accessory Set for RF Probe Plug-on divider 20 dB and 40 dB, BNC adapter 50 Ω, reducing sleeve for divider, ground sleeves and ground tape	URV-Z6	0292.5364.02
50 Ω Terminating Adapter BNC female connector, with adapter to BNC male	URV-Z50	0394.9816.50
75 Ω Terminating Adapter with adapters to BNC, 2.5/6 and 1.6/5.6 connectors	URV-Z3	0243.9118.70

Power Meter NRVS

DC to 40 GHz

100 pW to 30 W

Power (average, pulse, PEP), level and DC voltage measurements

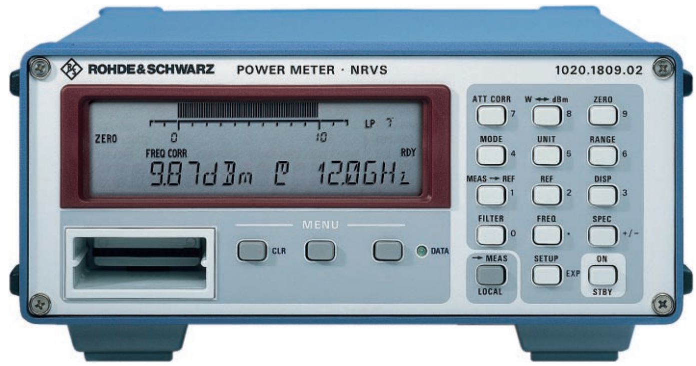


Photo 43225

Brief description

Power Meter NRVS is an ideal instrument for a great variety of power measurement applications in labs and systems. Thanks to its intelligent sensors with calibration data memory and thermocouple sensors, which make adjustments by the user superfluous, NRVS provides at all times high-precision measurements free of operator's errors.

Main features

- Fast power, level and voltage measurements
- Intelligent NRV-Z probes and URV5-Z sensors: plug and play
- IEC/IEEE-bus interface
- DC frequency input for tracking frequency-response correction
- Analog output
- Menu-guided operation with softkeys
- Storage of 20 complete instrument setups
- 13 digital filters for noise suppression, automatic or manual filter selection
- Sensor check source (optional)

Characteristics

Display
Measurement results, units and various items of information are displayed on a large easy-to-read $4^1/_2$-digit LC display in three selectable steps of resolution.

Pulse power
If pulse-modulated RF signals are measured, NRVS calculates the pulse peak power from the measured average power and the entered pulse duty factor, and reads out the result directly. The use of Peak Power Sensors NRV-Z31 and -Z33 for measuring the peak envelope power (PEP) is highly recommended.

Measurement rate
The attainable measurement rate not only depends on the type of sensor used but also on the setting of the averaging filter. NRVS automatically makes the appropriate settings by determining the optimum averaging time required for a steady readout as a function of level and selected resolution. This automatic selection can be switched off.

Measuring heads

The range of measuring heads includes thermocouple power sensors as well as highly sensitive diode power sensors, peak power sensors (from page 266), probes and insertion units for voltage measurement (from page 262). NRVS therefore covers a frequency range from DC to 40 GHz and a power span from 100 pW to 30 W (2 kW in shortwave range).

The power sensors are not specifically designed for NRVS and can therefore be freely used with any of the Rohde&Schwarz power meters and voltmeters.

Specifications in brief page 261,
voltage probes page 262,
power sensors page 266

Dual-Channel Power Meter NRVD

DC to 40 GHz

100 pW to 30 W

Power, level and voltage measurements; attenuation and reflection measurements: precise, versatile, convenient

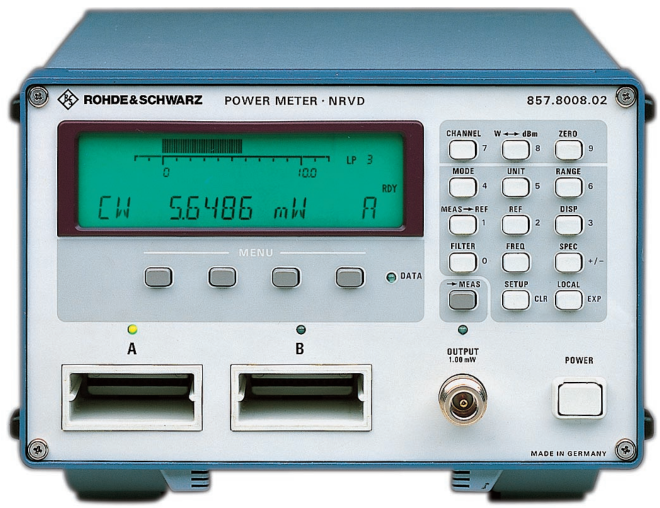


Photo 40095

Brief description

NRVD functions like two independent NRVS power meters in one enclosure performing simultaneous measurements and exchanging data with each other. The two channels can be set separately so that two completely different measurements can be carried out at the same time. The two measured values can also be related to each other for readout of reflection coefficient, SWR or return loss, for instance.

Main features

- Two independent channels performing simultaneous measurements
- LC display with variable backlighting, separate digital readout for each channel, bargraph indicator
- Menu-guided operation with softkeys
- IEC/IEEE-bus interface (optionally SCPI or compatible with URV5)
- Entry of reference values for level and attenuation
  13 digital filters for noise suppression, automatic or manual filter selection
- Storage of 20 complete instrument setups
- Input/output option with DC frequency input, analog outputs, trigger input, ready output
- Large variety of intelligent sensors: plug and play
- Rear connectors for sensors
- Sensor check source

Characteristics

Display
Measurement results are displayed with selectable resolution on a five-digit LCD with adjustable backlighting. The values measured in the two channels or one measured value plus an additional item of information are displayed.

The NRVD measures pulse-modulated RF signals like the NRVS. Additionally, the modulation depth of amplitude-modulated signals can be determined from the power variation. After entering the source matching, the expected uncertainty for thermocouple power sensors can be displayed.

Measurement rate
See NRVS, page 264.

Sensor check source
It supplies a highly accurate, low-distortion 50 MHz signal of 1 mW (0 dBm) power for checking the sensors.

Input/Output Option NRVD-B2
Each measurement channel has an analog output wiht selectable scaling for connection of a recorder or for control purposes. Simple automatic test routines can be implemented with the aid of the trigger input and the ready output. Another input serves for taking up the frequency-proportional DC voltage from a sweep generator for tracking frequency-response correction.

Specifications in brief page 261, voltage probes page 262, power sensors page 266

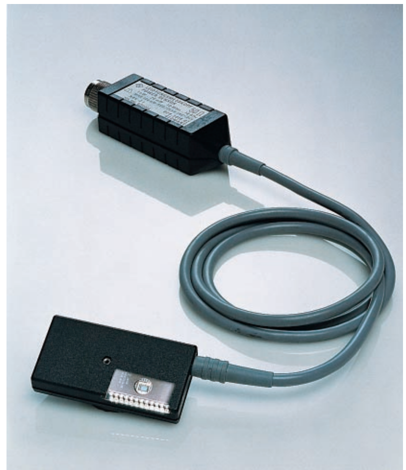
Power Sensors NRV-Z

Brief description

For all power measurements with instruments from the URV/NRV families, 15 power sensors in all cover the frequency range from DC to 40 GHz. Three classes of sensitivity allow direct measurement of any power between 100 pW and 30 W. A 75-Ω sensor is available for TV and video applications.

The calibration data memory integrated in the sensor contains all the relevant information. With the sensor plugged in, a fully calibrated meter is ready for measurements. The calibration of all sensors can be traced to the relevant standards of the Federal German Bureau of Standards.

For calculating the total measurement uncertainty of the source power delivered to Z_0 load the following factors have to be taken into account: mismatch uncertainty, calibration uncertainty, linearity error, meter noise, zero error, temperature effect, pulse measurement uncertainty (peak power sensors only) and measurement uncertainty of basic unit.



Calibration data for each sensor are stored in an EPROM in the sensor's connector (photo 37902)

Overview of models

High-Sensitivity Sensors NRV-Z1, -Z3, -Z4, -Z6, -Z15
These sensors measure the true RMS power from about 100 pW to 10 µW and can be used in this level range for signals with harmonic contents, noisy or modulated signals. For sinewave signals, the measurement range extends to 20 mW (13 mW into 75 Ω).

Medium-Sensitivity Sensors NRV-Z2, -Z5
Based on diode detectors with 20 dB attenuator, these sensors provide true RMS power measurement in the range from 10 nW to1 mW and up to 500 mW for sinewave signals. Compared to thermocouple sensors, shorter measurement times can be attained with these sensors.

Thermocouple Power Sensors NRV-Z51 to -Z55
They measure the average power irrespective of the waveform and therefore are also suitable for spread spectrum, IS-95 CDMA and W-CDMA measurements, irrespective of the peak-to-average power ratio of the waveform concerned. Being individually calibrated, these sensors feature an unrivalled linearity over the entire dynamic range.

Peak Power Sensors NRV-Z31 to -Z33
These sensors measure the peak envelope power (PEP) of modulated or pulsed signals. The TDMA models 04 of the sensors allow fast and precise measurement of the transmitter power of mobile stations in GSM900/1800/1900 networks. Models 03 are suitable for measuring the sync pulse power of TV transmitters. Model 02 with a minimum pulse repetition frequency of 10 Hz is designed for general applications. Model 05 of NRV-Z32 enables measurement of the power peak value of mobile stations to NADC and PDC standard.

Specifications in brief

Model	Frequency range Min. pulse width Min. PRF	Power range Max. power	Max. SWR (reflection coefficient)	Zero error (±)	Meter noise	Linearity uncertainty in dB	Calibration uncertainty in dB
NRV-Z1 N; 50 Ω	10 MHz to 18 GHz	200 pW to 20 mW 100 mW (AVG) 100 mW (PK)	0.01 to 1 GHz: 1.06 (0.03) >1 to 2 GHz: 1.13 (0.06) >2 to 4 GHz: 1.27 (0.12) >4 to 18 GHz: 1.41 (0.17)	100 pW	40 pW	0.03	0.07 0.07 0.08 0.08 to 0.15
NRV-Z2 N; 50 Ω	10 MHz to 18 GHz	20 nW to 500 mW 2 W (AVG) 10 W (PK)	0.01 to 4 GHz: 1.05 (0.024) >4 to 8 GHz: 1.1 (0.048) >8 to 12.4 GHz: 1.15 (0.07) >12.4 to 18 GHz: 1.2 (0.09)	10 nW	4 nW	0.03	0.07 0.07 0.07 0.09 to 0.13
NRV-Z3 N; 75 Ω	1 MHz to 2.5 GHz	100 pW to 13 mW 70 mW (AVG) 70 mW (PK)	1 to 100 MHz: 1.11 (0.05) >0.1 to 1 GHz: 1.11 (0.05) >1 to 2.5 GHz: 1.2 (0.09)	40 pW	16 pW	0.03	0.06 0.07 0.07

Specifications in brief

Model	Frequency range Min. pulse width Min. PRF	Power range Max. power	Max. SWR (reflection coefficient)	Zero error (±)	Meter noise	Linearity uncertainty in dB	Calibration uncertainty in dB
NRV-Z4 N; 50 Ω	100 kHz to 6 GHz	100 pW to 20 mW 100 mW (AVG) 100 mW (PK)	0.1 to 100 MHz: 1.05 (0.024) >0.1 to 2 GHz: 1.1 (0.048) >2 to 4 GHz: 1.2 (0.09) >4 to 6 GHz: 1.35 (0.15)	50 pW	20 pW	0.03	0.05 to 0.06 0.06 0.06 0.07
NRV-Z5 N; 50 Ω	100 kHz to 6 GHz	10 nW to 500 mW 2 W (AVG), 10 W (PK)	100 kHz to 4 GHz: 1.05 (0.024) >4 to 6 GHz: 1.1 (0.048)	5 nW	2 nW	0.03	0.05 to 0.06 1.7 to 1.9
NRV-Z6 PC 3.5; 50 Ω	50 MHz to 26.5 GHz	400 pW to 20 mW 100 mW (AVG) 100 mW (PK)	0.05 to 0.1 GHz: 1.3 (0.13) >0.1 to 18 GHz: 1.2 (0.09) >18 to 26.5 GHz: 1.4 (0.165)	200 pW	80 pW	0.03	0.06 0.06 to 0.13 0.09
NRV-Z15	50 MHz to 40 GHz	400 pW to 20 mW 100 mW (AVG) 100 mW (PK)	50 MHz to 4 GHz: 1.15 (0.7) >4 to 18 GHz: 1.37 (0.157) >18 to 40 GHz: 1.37 to 0.157)	200 pW	80 pW	0.03	0.05 to 0.06 0.07 to 0.15 0.08 to 0.1
NRV-Z31 N; 50 Ω	30 MHz to 6 GHz 2 µs (mod. 02/03), 200 µs (mod. 04) 10 Hz (mod. 02), 100 Hz (mod. 03/04)	1 µW to 20 mW 100 mW (AVG) 100 mW (PK)	0.03 to 0.1 GHz: 1.05 (0.024) >0.1 to 2 GHz: 1.1 (0.048) >2 to 4 GHz: 1.2 (0.09) >4 to 6 GHz: 1.35 (0.15)	30 nW	3 nW	included in calibration uncertainty	0.06 0.07 0.11 to 0.15 0.12 to 0.16
NRV-Z32 N; 50 Ω	30 MHz to 6 GHz 200/2 µs (mod. 04/05) 100/25 Hz (mod 04/05)	100 µW to 2 W 1 W (AVG) 8 W (PK, 1 µs)	0.03 to 2 GHz: 1.11 (0.052) >2 to 4 GHz: 1.11 (0.052) >4 to 6 GHz: 1.22 (0.099)	3 µW	0.3 µW	includ. in calibration uncertainty	0.08 to 0.10 0.13 to 0.25 0.18 to 0.27
NRV-Z33 N; 50 Ω	30 MHz to 6 GHz 2 µs (mod. 03), 200 µs (mod. 04) 100 Hz (mod. 03/04)	1 mW to 20 W 12 to 18 W (AVG) 80 W (PK)	0.03 to 2 GHz: 1.11 (0.052) >2 to 4 GHz: 1.22 (0.099) >4 to 6 GHz: 1.22 (0.099)	30 µW	3 µW	includ. in calibration uncertainty	0.08 to 0.10 0.15 to 0.18 0.18 to 0.20
NRV-Z51 N; 50 Ω	DC to 18 GHz	1 µW to 100 mW 300 mW (AVG) 10 W (PK, 1 µs)	DC to 2 GHz: 1.1 (0.048) >2 to 12.4 GHz: 1.15 (0.07) >12.4 to 18 GHz: 1.2 (0.09)	60 nW	22 nW	0.02	0.05 0.05 to 0.07 0.09 to 0.12
NRV-Z52 PC 3.5; 50 Ω	DC to 26.5 GHz	1 µW to 100 mW 300 mW (AVG) 10 W (PK, 1 µs)	DC to 2 GHz: 1.1 (0.048) >2 to 12.4 GHz: 1.15 (0.07) >12.4 to 18 GHz: 1.2 (0.09) >18 to 26.5 GHz: 1.25 (0.11)	60 nW	22 nW	0.02	0.05 to 0.06 0.06 to 0.08 0.10 to 0.13 0.08 to 0.09
NRV-Z53 N; 50 Ω	DC to 18 GHz	100 µW to 10 W 12 to 18 W (AVG) 1 kW (PK, 1 µs)	0.05 to 2 GHz: 1.11 (0.052) >2 to 8 GHz: 1.22 (0.099) >8 to 12.4 GHz: 1.27 (0.119) >12.4 to 18 GHz: 1.37 (0.157)	6 µW	2.2 µW	0.03 + 0.01 P/W	0.07 0.10 0.12 to 0.13 0.14 to 0.18
NRV-Z54 N; 50 Ω	DC to 18 GHz	300 µW to 30 W 24 to 36 W (AVG) 1 kW (PK, 3 µs)	0.05 to 2 GHz: 1.11 (0.052) >2 to 8 GHz: 1.22 (0.099) >8 to 12.4 GHz: 1.27 (0.119) >12.4 to 18 GHz: 1.37 (0.157)	20 µW	7 µW	0.03 + 0.007 P/W	0.08 0.10 to 0.11 0.12 to 0.13 0.14 to 0.18
NRV-Z55 K; 50 Ω	DC to 40 GHz	1 µW to 100 mW 300 mW (AVG) 10 W (PK, 1 µs)	DC to 2 GHz: 1.1 (0.048) >2 to 12.4 GHz: 1.15 (0.07) >12.4 to 18 GHz: 1.2 (0.08) >18 to 26.5 GHz: 1.25 (0.11) >26.5 to 40 GHz: 1.30 (0.13)	60 nW	22 nW	0.02	0.05 0.06 to 0.08 0.10 to 0.13 0.08 to 0.09 0.10 to 0.11

Dimensions and weight

NRV-Z1 to -Z15, -Z31, -Z51, -Z52	120 mm x 37 mm x 31 mm; 0.35 kg
NRV-Z32	190 mm x 54 mm x 60 mm; 0.42 kg
NRV-Z33, -Z53	240 mm x 54 mm x 60 mm; 0.53 kg
NRV-Z54	298 mm x 54 mm x 60 mm; 0.68 kg
Length of connecting cable	approx. 1.3 m; other lengths on request

Ordering information

Power Sensors

20 mW, 50 Ω, 18 GHz	NRV-Z1	0828.3018.02
500 mW, 50 Ω, 18 GHz	NRV-Z2	0828.3218.02
13 mW, 75 Ω, 2.5 GHz	NRV-Z3	0828.3418.02
20 mW, 50 Ω, 6 GHz	NRV-Z4	0828.3618.02
500 mW, 50 Ω, 6 GHz	NRV-Z5	0828.3818.02
20 mW, 50 Ω, 26.5 GHz	NRV-Z6	0828.5010.02
20 mW, 50 Ω, 40 GHz	NRV-Z15	1081.2305.02
100 mW, 50 Ω, 18 GHz	NRV-Z51	0857.9004.02
100 mW, 50 Ω, 26.5 GHz	NRV-Z52	0857.9204.02
10 W, 50 Ω, 18 GHz	NRV-Z53	0858.0500.02
30 W, 50 Ω, 18 GHz	NRV-Z54	0858.0800.02
100 W, 50 Ω, 40 GHz	NRV-Z55	1081.2005.02

Peak Power Sensors

50 Ω, 6 GHz	NRV-Z31, 20 mW	NRV-Z32, 2 W	NRV-Z33, 20 W
Standard model	0857.9604.02	–	–
High-speed model	0857.9604.03	–	1031.6507.03
TDMA model	0857.9604.04	1031.6807.04	1031.6507.04
General-purpose model	–	1031.6807.05	–

Power Reflection Meter NRT

200 kHz to 4 GHz

0.3 mW to 2000 W

Power and reflection measurements under operational conditions

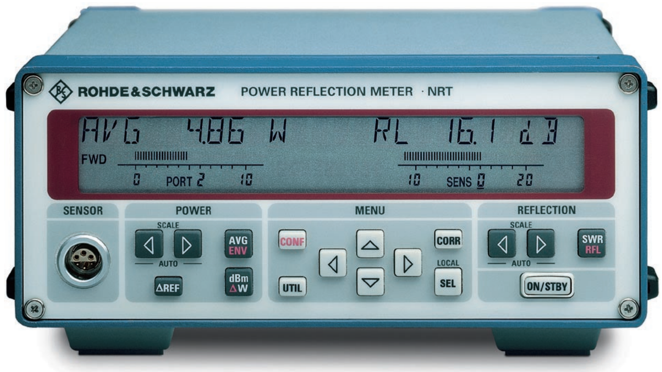


Photo 42661

Brief description

Directional power meters are used to measure power and reflection under operational conditions. Typical applications are in installation, maintenance and monitoring of transmitters, antennas and RF generators in industrial and medical fields. Power Reflection Meter NRT is the right choice: rugged, accurate and compact. Due to the large variety of measurement functions and high accuracy it is suitable for classic applications in mobile use as well as for use in research, development, production and quality management.

Power Sensors NRT-Z43 and -Z44 for use in radiocommunications
The wide frequency range from 200 (400) MHz to 4 GHz covers all relevant frequency bands, the measurement method is compatible with all common analog and in particular digital modulation standards: GSM 900/1800/1900, DECT, PHS, NADC, PDC, DAB, DVB, IS-95-CDMA, W-CDMA and many more.

Power Sensors NAP-Z
The complete range of power sensors of the predecessor model NAP is available for the customary frequency ranges, eg shortwave, and can be connected via an option. The sensors cover all the main frequency bands, from the maritime radio frequencies in the range of 200 kHz through to the digital GSM900 network. The power measurement range extends from 0.3 mW to 2 kW. The NAP sensors are able to measure the average power irrespective of the modulation mode and some of them even the peak envelope power (PEP). All NAP sensors up to 1 GHz have a directivity of at least 30 dB and thus allow very precise reflection and power measurements.

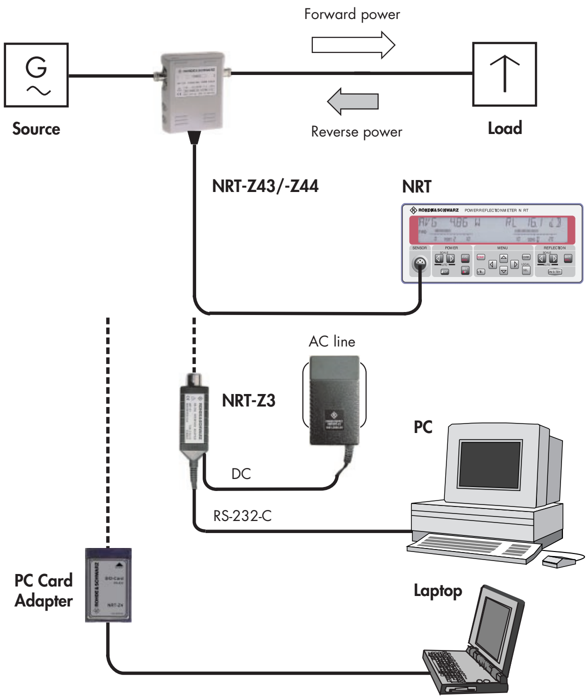
Measurement directly on PC
The sensors of the NRT family are self-contained measuring instruments which are able to communicate with the basic unit or with a PC via a standard serial data interface. Interface Adapter NRT-Z3 allows connection to the serial RS-232 standard interface of PCs (COMx), PC Card Interface Adapter NRT-Z4 operation at the PC card connector of laptops and notebooks. A program running under Windows (V-NRT) is available for operation of the sensor and display of the measurement results.

Direct power monitoring on PC

Operation, measurement functions

Thanks to menu control, a manageable number of keys and a large display, operation of the NRT is extremely easy. Switchover between the main functions is made at a keystroke:

- Choice between average power, average burst power, peak envelope power (PEP) and peak-to-average power ratio (crest factor)
- Switchover between forward power and absorbed power
- Measurement of power differences in dB or %
- Choice between return loss, SWR or reflection coefficient in reflection measurements
- Acoustic SWR monitoring
- Indication of maximum and minimum values
- Quasi-analog bargraph display
- Choice between measurement at the source or at the load



Power and reflection measurement with NRT-Z43/-Z44: readout of results either on basic unit or directly on PC

Options

The NRT basic unit comes with an IEC-bus (IEEE488) and RS-232 interface, both to SCPI standard. Three options allow the NRT to be adapted to different applications:

- Test input for connection of NAP sensors
- Two additional test inputs for NRT sensors for simultaneous monitoring of up to three testpoints (NRT-B2)
- Battery and built-in charger for mobile use (NRT-B3)

Specifications in brief: power sensors

General data	**NRT-Z43**	**NRT-Z44**
Power measurement range[1)]	0.0007 to 30 W (average)/75 W (peak)	0.003 to 120 W (average)/300 W (peak)
Frequency range	400 MHz to 4 GHz	200 MHz to 4 GHz
SWR (referred to 50 Ω)	1.07 max. from 0.4 to 3 GHz 1.12 max. from 3 to 4 GHz	1.07 max. from 0.2 to 3 GHz 1.12 max. from 3 to 4 GHz
Insertion loss	0.06 dB max. from 0.4 to 1.5 GHz 0.09 dB max. from >1.5 to 4 GHz	0.06 dB max. from 0.2 to 1.5 GHz 0.09 dB max. from >1.5 to 4 GHz
Directivity	30 dB min. from 0.4 to 3 GHz 26 dB min. from >3 to 4 GHz	30 dB min. from 0.2 to 3 GHz 26 dB min. from >3 to 4 GHz
Average power measurement[2)]		
Definition	mean value of carrier power, averaged over several modulation cycles (thermal equivalent, true rms value in case of voltage measurement)	
Power measurement range CF: peak-to-average power ratio (crest factor)	0.007 [0.0007] to 75 W (CW, FM, φM, FSK, GMSK or equivalent) to 30 [3] W (CDMA, W-CDMA, DAB, DVB) to 75 [7.5] W/CF (other modulation)	0.03 [0.003] to 300 W (CW, FM, φM, FSK, GMSK or equivalent)) to 120 [12] W (CDMA, W-CDMA, DAB, DVB) to 300 [30] W/CF (other modulation)
Modulation	for all kinds of analog and digital modulation; lowest frequency component of signal envelope should exceed 7 Hz for steady indication	
Measurement uncertainty at 18 to 28 °C	unmodulated RF (CW): 4% of rdg (0.17 dB)	
Burst average power measurement[2)]		
Definition	average on-power of periodic carrier bursts, based on the measurement of average power under consideration of burst width t and repetition rate 1/T: burst average power = average power x T/t	
Power measurement range	0.007 [0.0007] W x $\frac{T}{t}$	0.03 [0.003] W x $\frac{T}{t}$
	up to specified upper limit of average power measurement	
Burst width (t)	0.2 μs to 150 ms	
Repetition rate (1/T)	7/s min.	
Measurement of peak-to-average power ratio (crest factor)		
Definition	ratio of peak envelope power to average power in dB (only with 1 → 2 forward direction)	
Power measurement range	see average power and peak envelope power specifications	
Measurement of peak envelope power (PEP)		
Definition	peak value of carrier power (only with 1 → 2 forward direction)	
Power measurement range Burst signals (repetition rate min. 20/s)	0.1(1)* to 75 W (* lower measurement limit depending on modulation)	0.4 (4)* to 300 W (* lower measurement limit depending on modulation)

Measurement of complementary cumulative distribution function (CCDF)	NRT-Z43	NRT-Z44
Definition	probability in % of forward power envelope exceeding a given threshold (only with 1 → 2 forward direction)	
Measurement range	0.1 to 100%	
Threshold level range	0.25 to 75 W	1 to 300 W
Reflection measurement 2) (values in { }: 3 to 4 GHz)		
Definition	measurement of load match in terms of SWR, return loss or reflection coefficient	
Reflection measurement range Return loss/SWR/reflection coefficient	0 to 23 {20} dB / 1.15 {1.22} to ∞ / 0.07 {0.10} to 1	
Min. forward power	0.007 [0.07] W (specs met from 0.05 [0.5] W)	0.03 [0.3] W (specs met from 0.2 [2] W)
Measurement uncertainty	see diagram	

General data	**NAP-Z3**	**NAP-Z4**	**NAP-Z5**	**NAP-Z6**	**NAP-Z7**	**NAP-Z8**
Power measurement range1)	0.01 to 35 W	0.03 to 110 W	0.1 to 350 W	0.3 to 1100 W	0.05 to 200 W	0.5 to 2000 W
Frequency range	25 MHz to 1 GHz				0.4 to 80 MHz	0.2 to 80 MHz
SWR (referred to 50 Ω)	1.03 max.			1.05 max.	1.03 max. (1.02 max. from 1.5 to 30 MHz)	
Insertion loss up to 0.3 GHz up to 0.5 GHz total frequency range	0.10 dB max. 0.25 dB max. 0.75 dB max.	0.08 dB max. 0.15 dB max. 0.35 dB max.	0.08 dB max. 0.15 dB max. 0.20 dB max.	0.05 dB max. 0.10 dB max. 0.15 dB max.	– – 0.015 dB max.	
Directivity	30 dB min. (30 MHz to 1 GHz), 26 dB min. (25 to 30 MHz)				35 dB min. (1.5 to 30 MHz)	
Average power measurement						
Measurement range	0.01 to 35 W	0.03 to 110 W	0.1 to 350 W	0.3 to 1100 W	0.05 to 200 W	0.5 to 2000 W
Measurement uncertainty at 20 to 25°C	6% of reading				6 [4] % of reading (1.5 to 30 MHz) value in brackets: sensor-specific calibration factors taken into account	
Measurement of peak envelope power						
Measurement range	not possible				0.5 to 200 W	5 to 2000 W
AM Burst width t Repetition rate 1/T					30 Hz to 10 kHz 20 µs min. 30/s min.	
Reflection measurement						
Measurement range for return loss/SWR/ reflection coefficient	0 to 23 dB / 1.15 to ∞ / 0.07 to 1 (30 MHz to 1 GHz)				0 to 28 dB / 1.08 to ∞ / 0.04 to 1 (1.5 to 30 MHz)	
Minimum forward power	0.1 (0.6) W	0.3 (2) W	1 (6) W	3 (20) W	0.5 (10) W	5 (100) W
	specs met with power values in ( )					

General data	**NAP-Z9**	**NAP-Z10 (model 02)**	**NAP-Z11 (model 02)**	**NAP-Z10 (model 04)**	**NAP-Z11 (model 04)**
Power measurement range1)	0.3 mW to 1.1 W	0.005 to 20 W	0.05 to 200 W	0.005 to 20 W	0.05 to 200 W
Frequency range	0.1 to 1 GHz	35 MHz to 1 GHz		890 to 960 MHz	
SWR (referred to 50 Ω)	max. 1.03	max. 1.03		max. 1.03	
Insertion loss up to 0.3 GHz up to 0.5 GHz total frequency range	0.10 dB max. 0.25 dB max. 0.75 dB max.	0.10 dB max. 0.25 dB max. 0.75 dB max.	0.08 dB max. 0.15 dB max. 0.20 dB max.	– – 0.20 dB max.	
Directivity	30 dB min. from 170 MHz (else 26 dB min.)	30 dB min. from 40 MHz to 1 GHz 26 dB min. from 35 to 40 GHz		30 dB min.	
Average power measurement					
Measurement range	0.3 mW to 1.1 W	0.005 to 20 W	0.05 to 200 W	0.005 to 20 W	0.05 to 200 W
Measurement uncertainty at 20 to 25°C	6% of reading	6.5% of reading		4.5% of reading	
Measurement of peak envelope power					
Measurement range	not possible	0.05 to 20 W	0.5 to 200 W	0.02 to 20 W	0.2 to 200 W
AM Burst width t Repetition rate 1/T		50 Hz to 100 kHz min. 4,5 µs min. 50/s		– 577 µs 216.7/s	
Reflection measurement					
Measurement range Return loss/SWR Reflection coefficient	0 to 23 dB/1.15 to ∞ 0.07 to 1 (0.17 to 1 GHz)	0 to 23 dB/1.15 to ∞ 0.07 to 1 (40 MHz to 1 GHz)		0 to 23 dB/1.15 to ∞ 0.07 to 1	
Minimum forward power	3 (20) mW	0.05 (0.35) W	0.5 (3.5) W	0.05 (0.35) W	0.5 (3.5) W
	specs met with power values in ( )				
Measurement time	equal to measurement time of selected power measurement function, shortest with average power measurement				

Specifications in brief: NRT basic unit

Frequency range	200 kHz to 4 GHz 3)
Power measurement range	0.3 mW to 2 kW 3)
Test inputs	1 to 3 (4), one active
for NRT-Z sensors	one input on front panel, two additional inputs on rear panel (option NRT-B2)
for NAP-Z sensors	one input on rear panel (option NRT-B1)
Measurement functions	
Power	forward power and power absorbed by the load in W, dBm, dB or % (dB and % referred to measured value or reference value)
Power parameters3)	average, burst average, envelope peak, peak-to-average ratio (crest factor) and complementary cumulative distribution function (CCDF)
Reflection	SWR, return loss, reflection coefficient and reverse power
Frequency response correction	upon input of RF frequency, the stored correction factors of the power sensor being taken into account; for NAP sensors the NRT basic unit offers memory for 3 sets of calibration factors
Display	LCD
Digital	simultaneous indication of power, reflection and frequency
Resolution	HIGH: 4½ digits (0.001 dB) LOW: 3½ digits (0.01 dB)
Analog	two 50-element bargraphs for indication of power and reflection with selectable or predefined scale-end values
Averaging	automatic, depending on selected resolution and sensor characteristics
Max/Min.	indication of current maximum, minimum or max-min value for the selected measurement functions
Remote control	to SCPI-1995.0 command set
IEC/IEEE bus	to IEC 625 (IEEE 488)
Serial interface	9-pin sub-D connector to EIA-232E; 1200, 2400, 4800 and 9600 baud
AUX connector	BNC connector as signalling output or trigger input (TTL)
General data	
Power supply	
AC supply	100 to 240 V, 50 to 60 Hz or 100 to 120 V, 400 Hz; 35 VA, max. 0.4 A
Battery	with option NRT-B3, operating time approx. 8 h with one NRT-Z power sensor and option NRT-B1; recharging within 2 hours in quick-charge mode
Dimensions	219 mm × 103 mm × 240 mm
Weight	3.5 kg with all options

Power Sensors NRT-Z43/-Z44

Measurement channels	2 (for forward and reverse power)
Forward dir. 1 → 2	standard for all measurement functions
2 → 1	only for measurement of average and burst average power (at low levels)
Measurement functions	forward power and reflection
Power parameters	average, burst average, envelope peak, peak-to-average ratio and complementary cumulative distribution function (CCDF)
Reflection	return loss, SWR, reflection coefficient, reverse power
Range selection	automatic
Video bandwidth	4 kHz, 200 kHz, 4 MHz and spread-spectrum setting available for all power parameters except average power measurement
Frequency response correction	upon input of RF frequency, the stored correction factors of both measurement channels being taken into account
RF connectors	N (female) on both ends
Remote control	via serial RS-422 interface, 6-pin LEMOSA connector

General data

Power supply	6.5 to 28 V, approx. 1.5 W
Length of connecting cable	1.5 m
Length of extension cable	max. 500 m with 12 V supply voltage (via NRT-Z3, NRT-Z4 or line-operated NRT) max. 30 m with 7 V supply voltage (battery-operated NRT)
Dimensions (W x H x D)	120 mm x 95 mm x 39 mm
Weight	0.65 kg

Power measurement with NAP power sensors and option NRT-B1

Measurement channels	2 identical channels (for forward and reverse power)
Range selection	automatic
Frequency response correction	with NAP-Z7, -Z8 and -Z42 under consideration of calibration factors
Zero adjustment	with RF level switched off, duration approx. 5 s
RF connectors	N male/N female (NAP-Z6: 7/16 male, 7/16 female)
Length of connecting cable	1.5 m

Environmental conditions for NRT and Power Sensors NRT-Z and NAP-Z

Temperature range	specifications to IEC 68-2-1, IEC 68-2-2 and MIL-T-28800D, class 5
Operating	-10 to +55°C
Specifications met	0 to 50°C (unless otherwise stated)
Storage	-40 to +70°C
Climatic load	+25/40°C cyclic at 95% rel.humidity (non-condensing) to IEC 68-2-30

Ordering information

Power Reflection Meter	NRT	1080.9506.02
Power Sensors NRT (incl. V-NRT software)		
30 (75) W, 0.4 to 4 GHz	NRT-Z43	1081.2905.02
120 (300) W, 0.2 to 4 GHz	NRT-Z44	1081.1309.02
Power Sensors NAP		
35 W, 25 to 1000 MHz	NAP-Z3	0392.6610.55
110 W, 25 to 1000 MHz	NAP-Z4	0392.6910.55
350 W, 25 to 1000 MHz	NAP-Z5	0392.7116.55
1100 W, 25 to 1000 MHz	NAP-Z6	0392.7316.56
200 W, 0.4 to 80 MHz	NAP-Z7	0350.8214.02
2000 W, 0.2 to 80 MHz	NAP-Z8	0350.4619.02
1.1 W, 100 to 1000 MHz	NAP-Z9	0392.5513.55
20 W, 35 to 1000 MHz	NAP-Z10	0858.0000.02
20 W, 890 to 960 MHz	NAP-Z10	0858.0000.04
200 W, 35 to 1000 MHz	NAP-Z11	0852.6707.02
200 W, 890 to 960 MHz	NAP-Z11	0852.6707.04
Options		
Interface for NAP-Z Power Sensors	NRT-B1	1081.0902.02
2 rear inputs for NRT-Z Power Sensors	NRT-B2	1081.0702.02
Battery supply with built-in charger and NiMH battery	NRT-B3	1081.0502.02
Extras		
NiMH Battery	NRT-Z1	1081.1209.02
Extension Cable		
for NRT-Z Power Sensors 10 m	NRT-Z2	1081.2505.10
30 m	NRT-Z2	1081.2505.30
for NAP-Z Power Sensors 25 m	NAP-Z2	0392.5813.02
RS-232 Interface Adapter for NRT-Z Power Sensors including AC Power Supply	NRT-Z3	1081.2705.02
PC Card Interface Adapter for NRT-Z Power Sensors	NRT-Z4	1120.5005.02
Carrying Bag with Straps and Pocket of Accessories	ZZT-222	1001.0500.00
19" Rack Adapter	ZZA-97	0827.4527.00

1) Dependent on measurement function.

2) Values in []: 2→1 forward direction (if different from 1→2 forward direction).

3) Sensor-dependent.

Directional Power Meter NAS

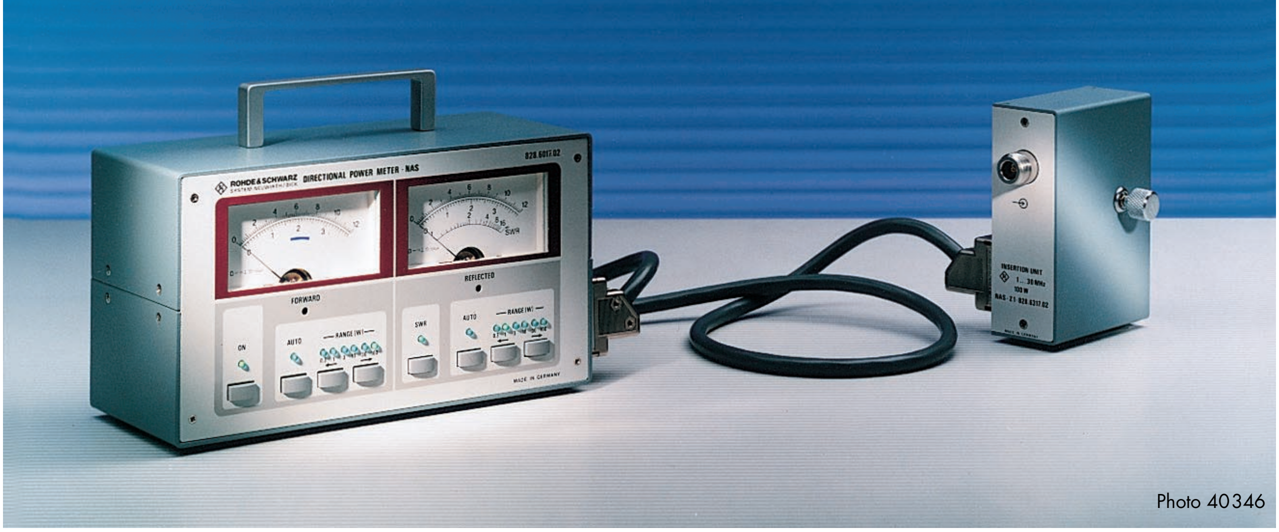


Photo 40346

1 to 1990 MHz

10 mW to 1200 W

Convenient and precise power and SWR measurements in the entire field of radiotelephony

Brief description

Directional Power Meter NAS is the ideal servicing unit wherever power and SWR of all kinds of radio equipment have to be measured. Insertion units for the whole field of mobile radio – including GSM applications – make the NAS a versatile unit and an investment for the future.

Main features

- Two moving-coil meters
- Autoranging
- Battery operation
- Automatic switchoff
- High EMI immunity
- Excellent price/performance ratio

Operation
Operation of the NAS is extremely simple and reliable thanks to microprocessor control. Forward and reflected power or forward power and SWR are simultaneously indicated on two large meters. Indication of SWR does away with the cumbersome use of tables.

Insertion units

Insertion units are either plugged to the side of the NAS or connected via a 1.5 m long cable for measurements at test points that are difficult to reach. Each insertion unit contains its individual calibration data which are read by the NAS and considered in the measurement results.

GSM900/1800/1900 applications
Insertion Units NAS-Z6 and -Z7 measure the peak envelope power (PEP) of the clocked signal with due consideration of the timing laid down in the GSM specifications. The insertion units are ideal for measurements on mobile stations which according to definition are sending signals in only one of the eight timeslots. Transient overshoots of the signal bursts are eliminated by a signal-controlled circuit so that the forward and reflected power as well as the SWR can be correctly measured and indicated.

Standard applications
The standard Insertion Unit NAS-Z5 with its wide frequency range is suitable for almost any application and practically covers all commercial analog RT services including air navigation.

Shortwave applications
Insertion Units NAS-Z1 and -Z2 have been especially designed for the frequency range up to 30 MHz. NAS-Z2 is for powers up to 1200 W for use in long-range shortwave communication systems.

Terminated power measurements
For measurements on transmitters, a Termination NAZ10 or NAZ30 acting as a dummy antenna is connected to the output of the insertion unit.

Directional Power Meter NAS

Specifications in brief: basic unit

Display	two moving-coil meters for forward and reflected power, plus SWR indication
Range selection	automatic or manual, separate for forward and reflected power
Accuracy (18 to 28 °C)	±1.5% of selected range + error of power sensor
Additional error at temperatures >28 and <18 °C	≤0.25% of rdg/°C
Automatic switchoff	approx. 1 h after last keystroke
General data	
Power supply	5 dry batteries IEC R20, service life >150 h (alkaline-manganese batteries)
Dimensions (W x H x D); weight	210 mm x 145 mm x 90 mm; 2 kg

Ordering information

Directional Power Meter	NAS	0828.6017.02
Insertion Unit	NAS-Z1	0828.6317.02
	NAS-Z2	0828.6417.02
	NAS-Z3	0828.6517.02
	NAS-Z5	0828.6717.03
for GSM900	NAS-Z6	0828.6723.02
for GSM 900/1800/1900	NAS-Z7	0828.6746.02
Extras		
Connecting Cable (1.5 m) for detached operation of insertion units	NAS-Z9	0828.6969.02
Carrying Bag	NAS-Z10	0828.6917.02
Termination	NAZ10	NAZ30
Power-handling capacity (for 1 min)	10 W (15 W)	30 W (50 W)
Frequency range	0 to 2 GHz	0 to 4 GHz
VSWR	≤1.15	≤1.1 to 2 GHz
Connector, impedance	N male, 50 Ω	N male, 50 Ω
Order number	1029.2408.02	1029.2508.02

Specifications in brief: Insertion Units NAS-Z

Model	**NAS-Z1**	**NAS-Z2**	**NAS-Z3**	**NAS-Z5**	**NAS-Z6**	**NAS-Z7**
Frequency range	1 to 30 MHz	1 to 30 MHz	25 to 200 MHz	70 to 1000 MHz	890 to 960 MHz[1])	890 to 960 MHz[1]) and 1710 to 1990 MHz
Power measurement range	0.01 to 120 W	0.1 to 1200 W	0.01 to 120 W	0.01 to 120 W	0.01 to 120 W	0.01 to 30 W[6])
Accuracy (of rdg)	±4.5%	±6.5%	±5.5%	±6.5%[2])	±5.5%	±6/8.5% (≤20 W)[5]), ±7/9.5% (<30 W)[5])
SWR	<1.07	<1.07	<1.07	<1.07[3])	<1.1	<1.15
Directivity	>30 dB	>30 dB	>30 dB	>30 dB[4])	>26 dB	>26 dB

Connector, characteristic impedance	N female, 50 Ω
Dimensions (W x H x D); weight	55 mm x 120 mm x 90 mm; 0.7 kg

1) Useful frequency range: 100 to 1000 MHz for NAS-Z6, 850 to 2000 MHz for NAS-Z7 (with wider error tolerances).

2) 100 to 1000 MHz; 75 to 100 MHz: –11 to +5.5% of rdg; 70 to 75 MHz: –15 to –5.5% of rdg

3) f <500 MHz; at f ≥500 MHz: <1.1.

4) f <500 MHz; at f ≥500 MHz: >26 dB.

5) Wider error tolerances are valid within a frequency range of 1880 to 1990 MHz.

6) Up to 100 W with wider error tolerances.

RMS Voltmeter URE2, RMS/Peak Voltmeter URE3

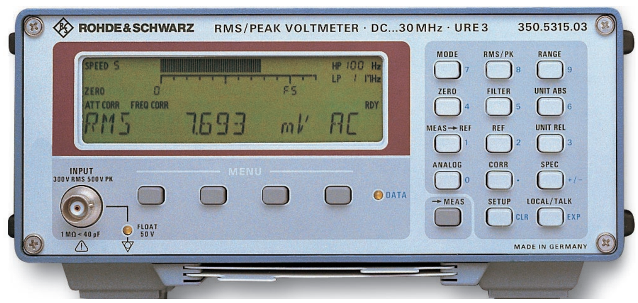
URE2: DC, 10 Hz to 25 MHz

URE3: DC, 20 mHz to 30 MHz

URE2 and URE3:

50 µV to 300 V (AC)

0 to 300 V (DC)



URE3 (photo 38122)

Brief description

URE2 is a broadband RMS voltmeter featuring extremely high accuracy and speed. A patented rectifier circuit allows measurement of signals with a crest factor of up to 7 and frequencies of up to 25 MHz.

RMS/Peak Voltmeter URE3 further enhances the range of applications due to its greater frequency range and higher accuracy, built-in frequency counter and additional peak-responding rectifier.

Fields of application

- Level measurements in audio range
- Interference measurements on switch-mode power supplies
- Measurement of extremely fast dialling signals and detection of simultaneously transmitted supply voltages in radiotelephony
- Automatic quality control of audio and video tapes
- High-frequency measurements in digital magnetic storage and optical data storage
- Peak weighting in video measurements (sync signals)
- Secondary calibration standard

Main features

- True RMS weighting for AC and AC + DC
- More than 30 measurements/s
- $4^{1}/_{2}$-digit display and analog display with selectable scale
- Very high measurement accuracy
- Highpass and lowpass filters
- Relative measurement, maxima/minima
- Convenient menu-guided operation
- Use of commercial probes, taking into account their division factor in the displayed result
- IEC bus (IEEE488)

Additional features of URE3

- Peak-value measurement (positive, negative, peak-to-peak) without tilts and overshoots
- Fast RMS measurement even of very low-frequency signals
- Frequency measurement up to 30 MHz
- Ultrahigh measurement accuracy through automatic frequency response correction
- In/out option:
  dual-channel analog output, ready output, trigger input, TTL frequency counter input

Characteristics

Measurement accuracy
A patented rectifier circuit with microprocessor-controlled autocalibration makes for the outstanding measurement characteristics of URE2 and URE3. In order to further enhance the accuracy, correction factors are determined for each instrument and measurement range and stored in a nonvolatile memory.

A zero function allows noise voltages and the inherent noise to be compensated for, the measurement accuracy being thus increased in particular at low levels.

The measured frequency value is used by URE3 for an internal frequency response correction. This method increases the accuracy mainly at the higher frequencies. Distortion-free measurement of signals is ensured by:

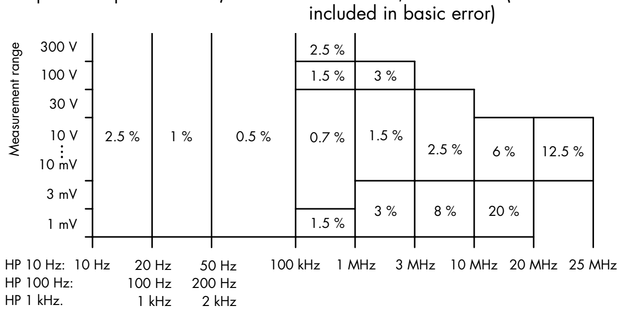
– high input impedance
– low input capacitance
– highpass and lowpass filters that can be switched in to suppress hum or high-frequency noise voltages

Specifications in brief: URE2

Measurement functions	RMS value, DC voltage
Range selection	automatic or manual
Input	BNC connector, floating
Input impedance	1 MΩ|| 40 pF
Display	LCD, $4^1/_2$-digit readout, digital and analog in V, W, dBV, dBm, dBμV or dBu; difference, deviation in % or dB and ratio to a reference value
Remote control	to IEC625-2

RMS measurement

Voltage measurement range	50 μV to 300 V
Ranges	1 mV to 300 V, 10 dB steps
Maximum reading	3800 or 12000 counts
Frequency range AC coupling	10 Hz to 25 MHz
AC + DC	DC, 10 Hz to 25 MHz
Selectable lowpass filters	20 kHz, 100 kHz Butterworth (3 dB cutoff freq., 40 dB/decade)
Selectable highpass filters	10 Hz, 100 Hz, 1 kHz (lower meas. limit, AC component in AC + DC)
Time of triggered measurement	32 ms to 1.3 s (selectable; shortest meas. time with 1 kHz highpass only)
Maximum crest factor (S)	7 for nominal range
Measurement uncertainty for non-sinusoidal voltages (spectral components up to 25 MHz)	S <5: <1%, S <7: <3% (for S <3: included in basic error)



Accuracy of RMS measurement (T_{amb} = 23 ±5°C), plus 10 counts for DC coupling (inherent noise taken into account by zero function)

DC voltage measurement, general data same as URE3

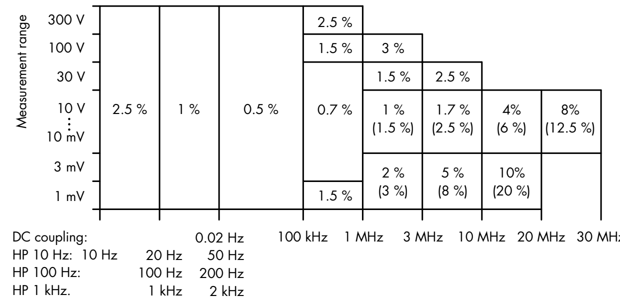
DC voltage measurement	see URE3
General data	see URE3

Specifications in brief: URE3

Measurement functions	RMS value, peak value, DC voltage, frequency
Range selection	automatic or manual
Input	BNC connector, either floating or grounded, switch-selectable
Input impedance	1 MΩ|| 40 pF
Display	backlit LCD, $4^1/_2$-digit level and 5-digit frequency indication, digital and analog in V, W, dBV, dBm, dBμV, dBu or Hz; difference, deviation in % or dB and ratio to a reference value
In/out option	two simultaneous analog outputs (level and frequency), frequency input, trigger input, ready output
Remote control	to IEC 625-2

RMS measurement

Voltage measurement range	50 μV to 300 V
Ranges	1 mV to 300 V, 10 dB steps
Maximum reading	3800 or 12000 counts
Frequency range AC coupling	0.02/10/100/1000 Hz to 30 MHz
AC + DC	same as AC coupling, plus DC component
Selectable lowpass filters	same as URE2, plus 1 MHz Bessel
Selectable highpass filters	same as URE2
Time of triggered measurement	32 ms to 60 s (selectable; shortest meas. time with 1 kHz highpass only)
Maximum crest factor (S)	7 for nominal range

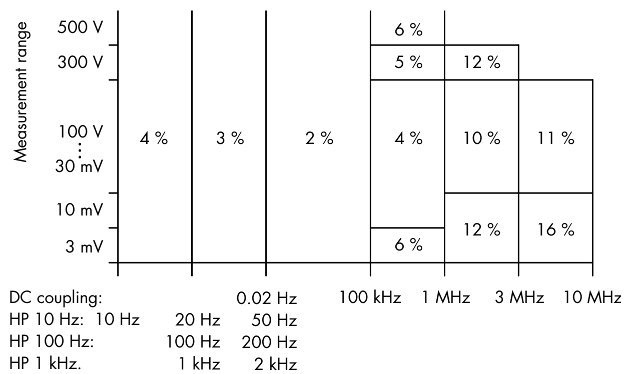


Accuracy of RMS measurement (T_{amb} = 23 ±5°C), plus 10 counts for DC coupling (inherent noise taken into account by zero functions); values in parentheses without frequency response correction

Measurement uncertainty for non-sinusoidal voltages same as URE2

Peak measurement

Voltage measurement range	0.1 mV to 500 V
Ranges and resolution	3 mV to 1000 V, 10 dB steps
Maximum reading	1200 or 3800 counts
Frequency range AC coupling	10/100/1000 Hz to 10 MHz
AC + DC	DC, 0.02 Hz to 10 MHz
Selectable highpass/lowpass filters	same as RMS measurement
Time of triggered measurement	65 ms to 60 s (selectable; shortest measurement time with 1 kHz high-pass or DC coupling only)



Accuracy of peak measurement (T_{amb} = 23 ±5°C), sinewave signal

Frequency measurement

Frequency range	0.02 Hz to 30 MHz
Display	5 digits
Time of triggered measurement	75 ms to 60 s (selectable)
Sensitivity	min.10 dB below nominal range

DC voltage measurement

Voltage measurement range	0 to ±300 V
Ranges	10 mV to 1000 V, 20 dB steps
Maximum reading	12000 counts
Time of triggered measurement	32 ms to 60 s (selectable)
Accuracy	±(0.1% of rdg +10 counts)

General data

Power supply	100/120/240 V ±10%, 230 V –10%/+6% 47 to 440 Hz (25 VA)
Dimensions (W x H x D); weight	219 mm x 103 mm x 350 mm; 4.5 kg

Ordering information

RMS Voltmeter	URE2	0350.5315.02
RMS/Peak Voltmeter	URE3	0350.5315.03
Input/Output Option	URE3-B2	0351.1513.02

Digital Multimeter R6552

High-speed and

high-resolution true

RMS digital multimeter

Brief description

R6552 is a high-speed and high-resolution true RMS digital multimeter which can be used for instance for measuring the current consumption of mobile phones. The product is ideal for integration into test systems and its various measurement modes allow reliable determination of current consumption of mobile phones in different operating modes.

Main features

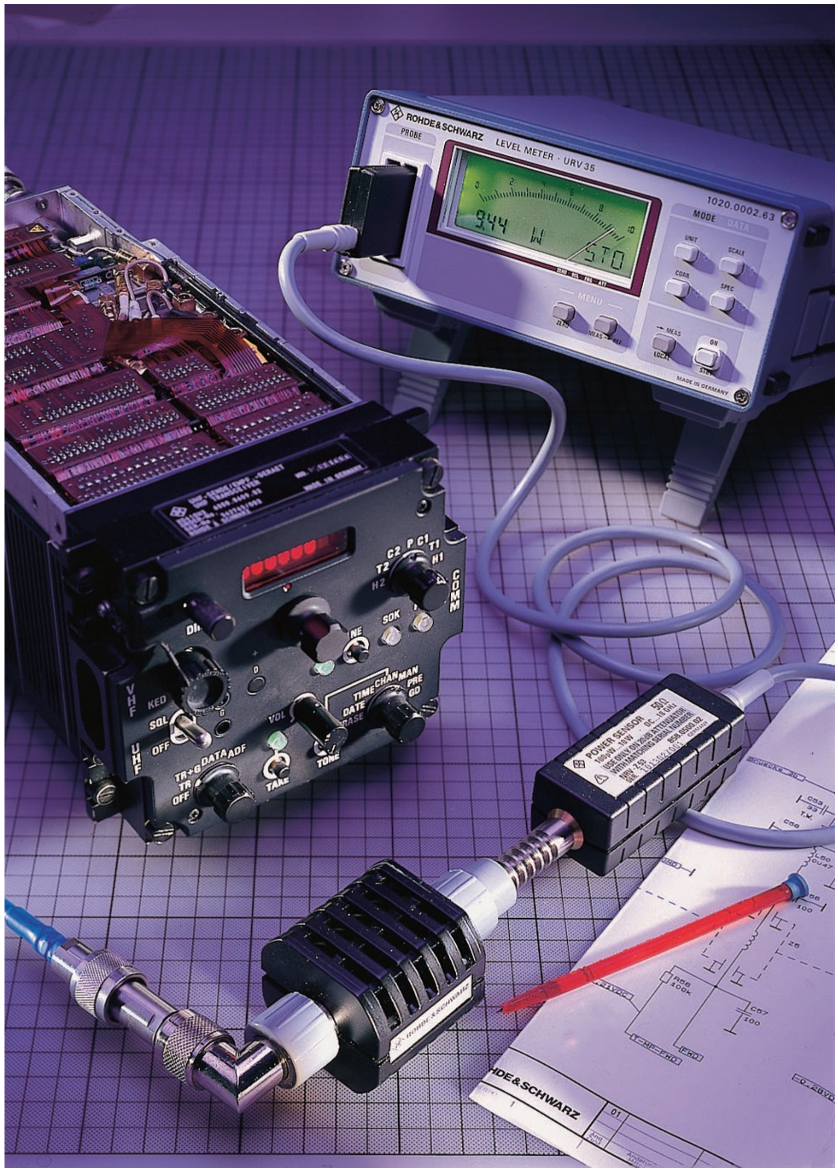
- Display range up to 319999 (5½ digits)
- Full remote-control capability via IEC/IEEE bus and RS232
- 12 different settings for mesurement of DC voltage/current, AC voltage/current, 4- and 2-wire resistance, frequency and diodes
- Resolution of 0.1 μV or 100 μΩ for resistance measurements
- True RMS measurement of AC voltage/current even of distorted waveforms
- Measurement of DC component of AC+DC currents or voltages
- Max. sampling rate 1000 samples/second
- FAST, MED and SLOW setting modes
- BURST and LONG-IT modes for measurement of standby current of PDC, PHS and other mobile phones
- External trigger input, end-of-measurement signal output
- NULL adjustment, smoothing, range selection, dB/dBm display, comparator function and MAX/MIN functions
- High-speed autoranging
- High-intensity fluorescent display

Specifications in brief

Max. display range	319999 (5½ digits)
Resolution for DC voltage measurement	0.1 μV
Resolution for resistance measurement	100 μΩ
Max. sampling rate	1000 samples/s (for BURST measurement)
Accuracy	
DC voltage	±0.01% of reading
AC voltage	±0.06% of reading
DC current	±0.05% of reading
Integration time for averaging repetitive signals	can be set in steps of 10 ms between 100 ms and 60 s
GPIB and RS-232C interfaces	standard
Data memory	for up to 10 000 measured values
Memory	for four instrument settings

Ordering information

Digital Multimeter	R6552



Output power measurement of a UHF transceiver with NRV-Z53 and URV35 (photo 41057)

"System integration with the aid of software and engineering efforts will be given more emphasis than ever before – and the development of powerful and convenient system solutions take on importance."

Contents of Chapter 9

The future lies with systems

Customer-specific solutions are implemented to an increasing extent by integrating measuring instruments and specially developed devices into overall systems. This is proven by the valuable experience made with turnkey EMC test centers, type-approval test systems for mobile phones of digital radio networks, mobile test systems for coverage measurements and mobile phone production lines.

System applications

In numerous branches of industry measurements and tests often have to be carried out repeatedly on a series of DUTs, eg in

- incoming inspection: component or module tests
- production: automatic alignment
- quality assurance: testing at the various stages of production and final testing
- research & development: series measurements on prototypes
- service: long-time measurements (such as temperature) at defined test intervals

The quantity of devices under test required to make investments and software development worthwhile depends on the complexity of the measurement task. The necessary expenditure may even be justified for a few DUTs if a measurement is to be continuously repeated, eg at many different frequencies (intermodulation measurement of antenna amplifiers), or if a parameter is to be monitored as a function of time (long-term drift).

Project handling by 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 make for the high performance and availability of a system.

System design at Rohde & Schwarz ensures full utilization of a large variety of measuring instruments of advanced technology and highest precision both of Rohde & Schwarz and other make. System responsibility lies always with Rohde & Schwarz, irrespective of the origin of the measuring equipment and individual system components.

Rohde & Schwarz has experienced and optimally trained staff to implement a project from initial planning through to the operational system.

Our range of test systems

- Production test systems, board testers
- Type-approval test systems for mobile phones
- Coverage measurement systems for all modern radio networks
- EMC test systems and test centers

Production test systems, board testers – a strong concept
A development and production chain is only as strong as its weakest links which used to be highly complex measurement systems and time-consuming final testing. Market launch of the products was thus held up. Today, production test systems and type-approval systems from Rohde & Schwarz can be used wherever electronic equipment is produced. Efficient solutions in this field range from precompliance test equipment through to complete production lines. In addition to the classical method of board testing, there are also completely new methods such as optical checking. The unique modular hardware and software concept of Rohde & Schwarz allows a large variety of test combinations with respect to alignment, RF test, optical check, board test, etc.

Our production test systems are tailored to the needs of the customers and provide overall solutions: measurements with DUT adaptation up to 2 GHz via test prods; with conveyor belts; networking within user-specific computer network; logistics; consulting and advice in the selection of suitable tests for optimization of measurement times and test depth.

Type-approval test systems for mobile phones of analog and digital radio networks

Test systems from Rohde & Schwarz, especially for type-approval testing, are at the leading edge in their field.

Our customers are benefiting from this high innovation potential. Specialists at Rohde & Schwarz have implemented well in-time the latest requirements for type-approval measurements in the appropriate test systems and were able to use ultramodern measuring equipment off our production. This synergy of available equipment and new system applications brings about optimum results.

Thus it is for instance possible to achieve maximum test depth while ensuring the highest degree of ergonomics and operational reliability. And another great advantage is self-calibration. This means a whole bundle of benefits which the customer can utilize to make his products fit both for the future and present-day market.

Coverage measurement systems for all modern radio networks

Test systems from Rohde & Schwarz are not only used where electronics is produced but also where it is made to "work": in mobile radio networks for instance. Our range of mobile coverage measurement systems ensures full monitoring of analog and digital radio networks as well as smooth and best possible operation.

EMC test systems and test centers

Rohde & Schwarz supplies complete EMC test systems covering all aspects of this complex field. The manufacturer need no longer combine individual instruments – systems will do it. Whole EMC test chambers? No problem for Rohde & Schwarz: after handing over the turnkey system, all your staff trained by us has to do is to switch on the DUT and the test will be carried out fully automatically. This is to the benefit of test houses as well as manufacturers performing comprehensive EMI and EMS measurements themselves. The test systems from Rohde & Schwarz check for full compliance with all relevant standards.

Future-oriented design

Measurement and test systems from Rohde & Schwarz feature extremely flexible hardware and software concepts allowing adaptation to modified requirements any time.

Support

Test stations from Rohde & Schwarz are powerful instruments for increasing productivity in automated production. Rohde & Schwarz products include a complete service package, which allows the full performance of the system to be utilized from the very first day. This package includes training, application support, maintenance, fixture design, 24-hours spare parts service and a telephone hotline.

References

Measurement and test systems from Rohde & Schwarz are used to success all over the world: tailored to the needs of the customers, the test systems can be found at renowned industrial companies, test houses and government institutes – the impressive list of references can be supplied on request.

Service for systems

First-hand service

Rohde & Schwarz systems combine the latest achievements in hardware and software with the knowhow and experience gained over many decades. According to the Rohde & Schwarz system philosophy, the high level of competence does not stop with system development but is maintained during the operational life of the systems in terms of the services offered.

Hotline support, continuous updating of system software, fast replacement and repair of equipment and modules in case of a fault are essential prerequisites for high availability of an operational system.

Rohde & Schwarz offers complete packages and solutions for servicing the systems. The service concept is of modular structure and consists of unit blocks providing a whole series of services for hardware and software. Thus the user will be able to adapt the service to his specific system and needs.

Services available

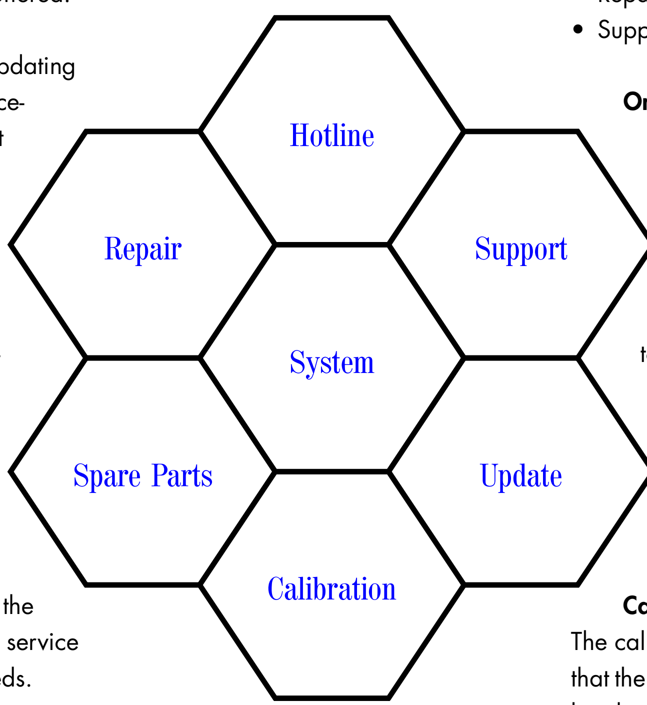
During warranty period

- Rohde & Schwarz warranty (included in price of system)
- Enhanced warranty service
  - Option: express support
  - Option: extended service time
- Startup service
- Calibration service

After warranty period

- After warranty service
  - Option: express support
  - Option: extended service time
  - Option: guaranteed availability (in conjunction with express support and calibration service)
- Calibration service

Service blocks



Enhanced warranty service

The enhanced warranty service supplements the standard warranty services of Rohde & Schwarz to satisfy already during the warranty period the high demands placed on system availability and offers a service time of eight hours and defined response time.

- Database-supported information system with direct customer access
- Hotline service
- Access to a pool of spare modules
- On-site repair, if necessary
- Escalation procedure

After warranty service

The after warranty service contains all the unit blocks of the enhanced warranty service plus the following:

- Repair of faults
- Supply of software updates

On-site startup service

The on-site startup service will give you the on-site support of an experienced system engineer during the critical phase of starting up your system. This support is to assure smooth transition to an efficient use of your system.

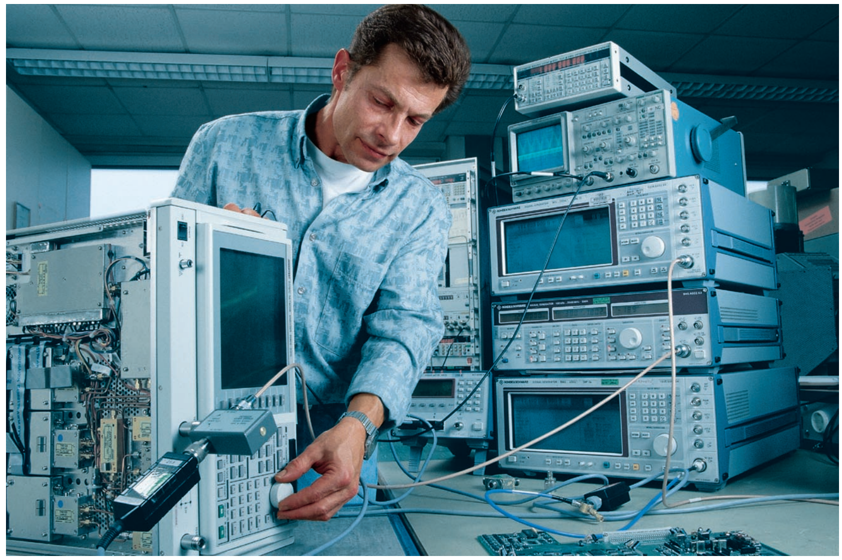
- Support in system handling
- Application support

Calibration service

The calibration service assures you that the parameters of your system will be checked at regular intervals and corrected if necessary.

- Calibration at specified calibration intervals in line with DIN ISO 9001/EN 21001
- Traceability of calibration to national or international standards
- Calibration reports and certificates
- On-site calibration possible

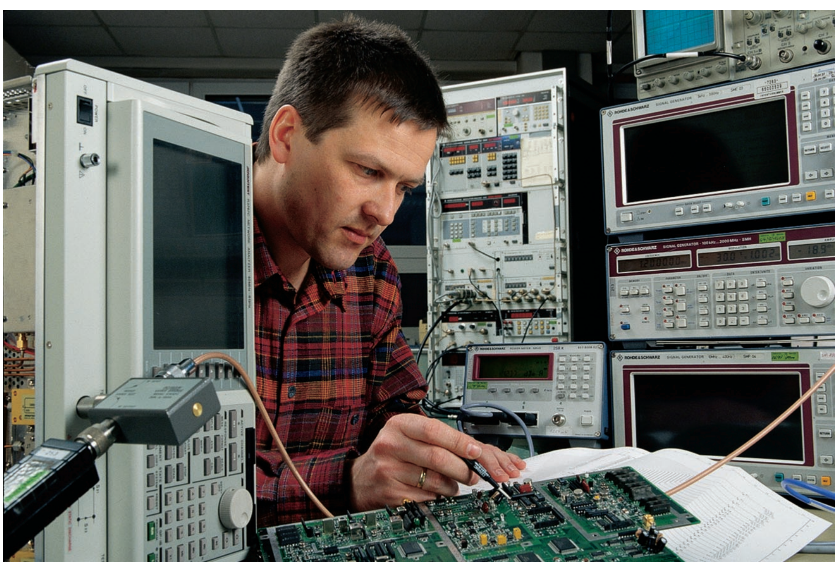
Service options



Express support

The express support is the ideal supplement both to the enhanced warranty service and the after warranty service. It ensures that any downtimes of your system will be kept to a minimum:

- Hotline service with a response time of 24 hours
- Enhanced equipment pool with express dispatch
- Express repair
- Quick on-site support



Guaranteed availability

This option in conjunction with the calibration service and the express support will assure you a system availability of more than 85% after expiry of the warranty.

Extended service time

If your working day lasts longer than eight hours, we can extend the service for your system up to 16 hours per day.

Hotline

Test systems (without board testers)

Telephone: +4989 4129-3607
Telefax: +4989 4129-3441

Production test systems (board testers)

Telefax: +498331 108225

Production Test Systems – Contents

Quality is measurable, quality is testable

Quality management

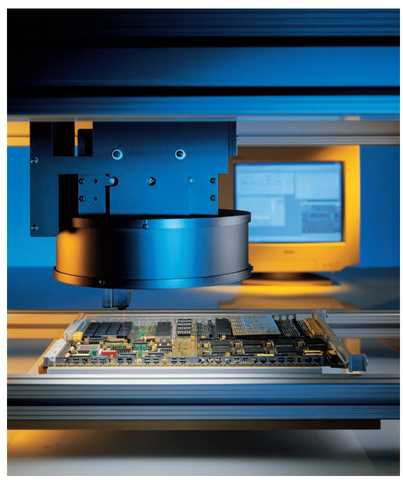
Quality management is one of the central aspects of modern electronics production. Whatever the size of the company, the quality of the products depends on the electronic components functioning perfectly. The introduction of lean production methods has placed new and greater demands on automatic testing techniques.

Economy

Product quality, product liability

Today, excellent product quality is not only important in giving the edge in international competition but also saves cost. Our test systems help to eliminate defects early in production, thus preventing the high costs involved in the removal of defects in the final stages of production or after delivery to the customer.

In-depth testing is possible due to the wide range of precise measuring facilities provided by the workstations and test stations from Rohde & Schwarz, so faults can be detected early in production and their cause removed immediately.



Optical Inspection System LaserVision TS-LV2 (photo 42852)

Start small – upgrade later

Test stations from Rohde & Schwarz are more than simply autonomous testers – they have specifically been designed for integration into development, production and service.

Fixtures and programs can be exchanged directly between the testers. The systems can thus be used to maximum effect: all test stations can be utilized optimally at all times; if the unit under test is large, subsequent upgrading to larger systems is no problem; fixtures can be adopted for servicing at any time.

Due to the modular design of the Rohde & Schwarz test stations, investment decisions can be made to satisfy the requirements of today, and, at the same time, options be left open for expanding capacity or testing new products as well as for incorporating future test strategies or supplementary test facilities at a later date. Investments, costs of adaptation and running costs of the test stations can be optimized for different products and production methods.

Low follow-up costs

Budget-priced fixture sets can be offered thanks to a standardized fixture interface. CAD postprocessors provide data for automatic program generation and fixture production.

Thus costs of adaptation are low, which is of major importance for products manufactured in small quantities only. The reliable and easy-to-service concept ensures high availability, so running costs are reduced to a minimum.

Test strategies

Electrical in-circuit test

Strategy

The electrical in-circuit test for a board checks all connections and the individual components independent of their environment.

This tried-and-tested method is an extremely reliable means of detecting and diagnosing the majority of typical manufacturing defects, such as shorts, opens, soldering and insertion defects. The influence of neighbouring components can be eliminated to a large extent, and a high degree of precision achieved, by means of 2-, 3-, 4- or 6-wire measurements, guarding and in-phase quadrature measurements. The measured values are stabilized, even under unfavourable conditions, by averaging, autocalibration and autodelay technique. The depth of testing is far superior to that of conventional prescreeners.

The electrical in-circuit test checks the following:

- Contact
- Shorts and opens
- Resistances, inductances and capacitances
- Impedances by magnitude and phase
- Diodes, Zener diodes, LEDs
- Transistors (current amplification)
- IC contacting with vectorless procedure
  - ICC (measurement of diodes)
  - CoCheck (inductive sensors)
- Multipole components such as potentiometers, relays, operational amplifiers, optocouplers

Hybrid in-circuit test

Strategy

This test serves for checking digital and hybrid (mixed analog/digital) boards from simple to complex VLSI boards. The digital tests check the functions of each digital IC and the correctness of insertion. The influence of neighbouring components is eliminated by means of controlled backdriving, digital guarding and disabling.

Procedure

Functional and digital in-circuit tests, wide-ranging patterns with high clock rate of up to 10 MHz, test voltage up to ±15 V or 0 to 30 V, algorithmic patterns with loops, subroutines and conditional branches.

- All the procedures of analog in-circuit test
- Bus test and automatic diagnosis in the event of bus conflicts
- Signature analysis (CRC) for RAMs, PROMs
- Cluster test

Vectorless IC test

Analog and digital ICs, for which a test model is not available in the library (customer-specific circuits, FPGAs, etc), are tested by measurement using analog vectorless methods. The aim of this test is to verify that all component pins are soldered and that it is the correct IC with the correct orientation.

IC check method

Node impedance measurement: measurement of the ohmic resistance of each pin to GND and VCC. If all parallel circuits are relatively high impedance with respect to the pin, a significant difference is shown if the pin is not soldered or the IC twisted.

- Very fast method
- Does not work with bus nodes
- Free of charge (standard test function)

CoCheck method

Contact-free method: a capacitive or inductive sensor positioned above the IC detects the current flowing through the IC. The capacitive method is mainly used for testing the polarity of electrolytic capacitors.

CoCheck measures with the aid of inductive sensors the magnitude and direction of the current flowing through the IC, the reliability of the test being thus increased (current measurement with the aid of the magnetic field is strongly dependent on the position of the sensor).

- Also works with bus nodes
- Problems in case of parasitic currents in tracks below the ICs

Combined IC check and CoCheck

- First all "simple" nodes are checked with the aid of the IC check method (minimum debug effort, no additional mechanical parts)
- All other nodes are tested by CoCheck

Optical in-circuit test

Strategy:

Presence and correct orientation (accurate to a few µm) are checked with the aid of cameras and laser height measurement. Even solder joints on 2- and 3-pin SMDs, mechanical components and short circuits –

also of fine-pitch ICs – can be checked.

Same as with the electrical in-circuit test, the aim of this optical test is to detect considerably more than 90% of the faults and to ensure also an excellent diagnostic depth, thus contributing to a substantial reduction of repair costs.

Moreover, practically all faults in production can be detected at the earliest possible time and reported to the automatic component insertion and solder machines. If this method is employed prior to the soldering process, the time required to eliminate the fault can be reduced even further. At this time it is also possible to make a manual correction of the components on the solder paste without need for a repair.

Procedure:
The CCD camera picture (black and white) taken by vertically arranged cameras of different focal lengths is analyzed. Analysis is made adaptively using neural network technology. To minimize pseudo faults, an automatic position correction is made within the defined area of inspection (that is the component is so to say searched before it is tested). Inspection covers the presence, position (displacement), orientation and polarity and the solder joints of the components.

An optional OCR (optical character recognition) unit for reading the labelling of IC components allows verification of the component type. Programs can very easily be generated with the aid of the CAD converter and preconfigured test routines that can be learnt intuitively. Costs for fixtures are not incurred.

Analog functional test

Strategy
Defined analog input signals are applied to the unit under test and the output signals are measured. This test checks all functions of the UUT and the interaction of its components.

Procedure
Rohde & Schwarz test stations provide all standard signals and measurement functions via appropriate stimulus and measurement modules. The signals are accessible either via very short paths at special fixed pins, or via the signal bus and the switch module at any pin.

The modules are equipped to trigger and synchronize with each other, the UUT, or external instruments. External IEC/IEEE-bus instruments can be connected to the test stations.

Digital functional test

Strategy
The digital functional test checks all functions of a digital circuit as close as possible to operating conditions.

It covers all technologies from SSI to VLSI, microprocessors, ASICs and SMDs. Digital input patterns are applied, and the output signals are measured and compared with the reference patterns. Due to the varying complexity – from simple to complex VLSI boards – and the widely differing timing requirements, the user is given the opportunity of choosing the most economical of the various testing procedures available. The type of fixture can thus also be varied via the connectors of the UUT, the bed-of-nails (including 2-stage fixture), a clip or probe.

Procedure
Overall functional test with reference patterns: digital patterns (vectors) are applied to the connections of the UUT in realtime mode and with a high clock rate; the response is then measured and compared with the reference values. The patterns can be generated algorithmically with loops, subroutines and conditional branches, whereby the program flow is determined by the UUT.

- The cluster test checks the functions of associated parts of a circuit. Subdividing the circuit into several different parts makes the tests simpler and more transparent. The clusters are isolated by means of backdriving
- Signature analysis is used to measure complex patterns and check them in reduced form
- Logic-state display performs the function of a logic analyzer during debugging and when unknown signals are recorded

Combinational test

The combinational test unifies various test strategies in a single tester with one program and one fixture, eliminating the handling time for separate testers. The user can select a combination which is specially tailored to his needs. This concept allows the peculiarities of customer-specific requirements to be taken into account, for instance the production environment, production quality, test strategy, complexity of UUT and special factors such as stipulated or impermissible test procedures, inaccessible nodes or varnished boards.

Super combinational test
Using the optical inspection in addition to the combinational test described above not only increases the test depth but also further reduces the time required for testing.

The optional inspection systems from Rohde & Schwarz are designed for use in combination with an electrical test system. The tests of the optical system can thus be parallelized with those of the electrical system. By adopting this procedure a smooth transition from the electrical to the optical in-circuit test can be achieved which becomes evident by the steadily de-creasing number of accessible nodes.

Production Test Systems – Overview of TSA System Family

Common test functions
- In-circuit test
- Analog IC check (ICC)
- Analog functional test

Common options
- Contact-free IC test method (CoCheck)
- Integration into CAD
- LaserVision system extension
- IBX interface extension for special signals such as high current/high voltage, coaxial/RF
- Oracle database QUOTIS with paperless repair and quality management

Analog Prescreener (MDA) and Analog Functional Tester TSAC

Additional test capabilities and features
- Static digital test
- Max. 1216 pins
- Max. data rate 50 kHz

Analog Prescreener (MDA) and Analog Functional and Performance Tester TSACP

Additional test capabilities and features
- Static digital test
- Power test
- High-voltage test up to the kV range
- High-power switch module
- Max. 1152 pins
- Max. data rate 50 kHz

Additional options
- HV/HC stimulus and measurement modules
- Loads
- High-voltage-protected adaptation

Combinational Tester TSA

Additional test capabilities and features
- Digital in-circuit test
- Dynamic digital functional test
- Hybrid in-circuit and functional test
- Boundary scan (option)

Power Test Station TSAP

Additional test capabilities and features
- Power test
- Digital in-circuit test
- Dynamic digital functional test
- Hybrid in-circuit and functional test
- High-voltage test up to the kV range
- High-power switch module
- Max. 1024 pins
- Max. data rate 10 MHz (sensor resolution 10 ns)

Additional options
- HV/HC stimulus and measurement modules
- Loads
- High-voltage-protected adaptation
- Boundary scan

Test Workstation TSA

TSA – extremely compact board test system, adaptable to complexity of units under test and test requirements

Photo 40413-1

Brief description

Test Workstations from the TSA Family are powerful benchtop test systems for testing loaded printed circuit boards and modules in production and service. The test workstations meet the test requirements of industrial and consumer electronics sectors, such as communications, measurements, control engineering, automobile and accessories industry. TSA systems are suitable both for small-batch production entailing boards of many different types, and mass production.

Main features

- In-circuit, functional or combinational tests
- Low initial investment making for excellent price/performance ratio
- Low costs of adaptation due to automatic program generation
- Low repair costs of UUTs thanks to automatic fault diagnosis
- Paperless repair and quality management
- High throughput
- In-depth testing and fault location
- Easy integration into systems thanks to 19" design
- Networking with CIM
- Compatible with Rohde & Schwarz tester family TSU
- Fast amortization

Design

Test unit

The test unit is the core of the system; it has 23 slots for accommodating the stimulus and measurement modules, a fixture interface with support plate and a UUT and system power supply.
Extremely short signal paths ensure high-quality signal transmission between UUT and measurement modules. Due to its VLSI design, the 19" unit features on a minimum of space a maximum of measurement capabilities that were previously not possible. Moreover, the TSA is ergonomically designed and satisfies even the most stringent requirements regarding operating convenience.

Fixture concept (pylon system)

The proven fixture system transfers the signals between measurement modules and UUT. User-specific connectors can be plugged into three free ports of the fixture interface. The type of fixture is determined by the selected test strategy and the UUT. Two vacuum connectors with built-in valves allow single-chamber, double-chamber or two-stage fixtures with bed-of-nails to be used.

Pneumatic, mechanical or double-sided SMD fixtures are also available. When fixtures are used that make contact with the UUT via the connectors, in-depth measurements can be made within the circuit via clips and a probe.

Modules

The modules inserted into the 23 slots determine the measurement functions. The control module performs general transfer and control tasks. The remaining 22 slots can be filled up from a selection of 24 analog stimulus and measurement modules, digital modules, switch and application modules so that practically any requirement can be fulfilled. Distributed intelligence achieved by integrated processors on different modules makes for high measurement speed.

Expansions

For special applications, external devices can be controlled via the IEC/IEEE bus which is fitted as standard. The signals are connected via various switch modules (DC, AC, video and power up to the line-voltage range) and routed to the fixture and UUT via suitable contacts. The user can integrate special circuits into the test workstation using a universal application module.

DC source	up to 10 V/200 mA, 4-quadrant operation
Voltage sources	up to 10 V/5 mA (2 ea.)
High-voltage buffer	up to –100 V to +100 V (200 V pp)/10 mA/10 kHz
Isolation amplifier	±10 V/5 mA/10 kHz
Voltage/current measurement unit	up to 100 V DC/AC max. 1 A
Voltage measurement unit	up to 500 V DC/AC
Arbitrary waveform generator	up to 20 V pp/16.8 M samples/sec, 2 channels (with high-voltage buffer and isolation amplifier up to 200 V pp floating)
Waveform analyzer	max. 500 V pp/10 MHz sampling rate 2 channels with timing measurement unit
Integrated switch matrix	12 analog busses, 8 trigger busses

Measurement configuration

Explorer configuration (can be retrofitted in existing systems)

All systems of the TSA family are equipped with the multifunction module AMV (TSS 5.0 or higher required). In addition to a complete high-speed in-circuit measurement unit the AMV features comprehensive functional test capabilities in the DC/AF range covering practically any requirements (see table). An intelligent trigger concept allows extensive test sequences to be executed in absolute realtime. The unique search and analysis functions of the dual-channel waveform analyzer that are included in the module's firmware are top features and outperform many an oscilloscope.

Stimulus and measurement modules are inserted into the rear of TSA (photo 38860)

AMV completely fits into the existing range of modules. It can be used instead of the VMM/CMM/DCS modules to replace the in-circuit measurement unit (existing in-circuit test programs can still be used with minor modifications) or used in addition, allowing practically any combination with the simultaneous use of up to four AMV modules in a system. The in-circuit measurement unit made up of the VMM/CMM/DCS modules or of the AMV covers three or two slots in the front.

With this range of comprehensive measurement functions implemented for the first time in the AMV and downloading of the complete operating firmware, AMV is setting new standards in terms of functionality, compact size and future-proof design.

Analog in-circuit test

- Voltage and current measurement modules VMM, CMM for DC voltage measurement from 80 μV to 100 V and DC current measurement from 8 nA to 256 mA
- Alternatively: AMV (see explorer configuration)
- DC stimulus module DCS as a four-quadrant current/voltage source up to 25.6 V and 200 mA (can also be used in addition to AMV)

Hybrid in-circuit test

- Analog in-circuit measuring unit (VMM, CMM, DCS or AMV)
- Timing and address modules (TIM, ADM) for realtime control of timing and sequences of dynamic digital test (see digital functional test)
- Driver/sensor/switch modules

Analog functional test

- Analog multifunction module AMV (see explorer configuration)
- Timer/counter module (TCM): measures frequency, period, pulse width, time interval or frequency ratio between two input signals up to 10 MHz and counts the events (32 bits). Trigger threshold and hysteresis are programmable. A separate 50 Ω input allows frequency measurements up to 200 MHz
- Voltage source module (VSM): provides four floating programmable sources up to 10 V. Two of them can be used for programming the programmable power module (PPM)
- DC stimulus module (DCS)
- Fixed voltages 5 V/8 A, 2 x 12 to 15 V/2 A (resistance programming)
- Programmable power module (PPM) 2 x 4.5 to 30 V/1 A (with VSM)

- External power supply units up to 100 V/10 A
- Secondary matrix module (SMM) for universal pins
- Instrument multiplexer module (IMM) for connection of external devices to hybrid switch equipment
- Input/output module (IOM) for switching and control tasks with input/output ports and assignable relays
- Application module (APM) for switching AC supply modules and user-specific expansion. Additional circuits can be fitted on this module or external devices be driven via opto-decoupled inputs/outputs
- Application relay module (ARM) with 32 assignable relays for analog and digital signals as well as four relays for AC voltage

Digital functional test

- Timing module (TIM), vector rate up to 10 MHz, resolution up to 10 ns, 2 clocks, external synchronization up to 50 MHz
- Address module with subroutines, loops, branches, conditional branches for almost unlimited pattern lengths; synchronization with external events
- Driver/sensor modules DSF, DSB, DSG and DSH for two logic families; pin memory 4 K (5 bits), signature analysis, start/trigger/clock, pull-up/down, programmable slew rate, format selection, pin-by-pin logic analysis
- DSD for level –2.5 to +30 V/ 10 MHz

Maximum configuration for analog in-circuit test

Switch modules	Pins/module	Slots/ module	No. of modules	Maximum No. of pins
SMH	64	1	max. 19	1184

Maximum configuration for hybrid in-circuit test

Module	Test rate	Test voltage	Multiplex	Pins/module	Max. config.
Driver/sensor/ switch module DSG (2 slots)	5 MHz	±5 V	1 : 8	64 hybrid pins	512 hybrid pins
Driver/sensor module DSF Driver/sensor module DSB	5 MHz 10 MHz	±5 V ±15 V	1 : 4 1 : 4	32 digital pins each	320 digital and 320 analog pins
Switch module SMM	–	–	without	48 analog pins	912 pins
Driver/sensor/ switch module DSH	10 MHz	±5 V	1 : 4	64 hybrid pins	1088 hybrid pins

Overview of driver and sensor modules

Driver/sensor module	Max. test rate	Max. level	Channels/ module	Max. No. of modules	Max. No. of channels
DSF	5 MHz	±5 V	8	17	136
DSB	10 MHz	±15 V	8	8	64
DSG	5 MHz	±5 V	8	8	64
DSC	10 MHz	TTL	32	16	512
DSD	10 MHz	–2.5 to 30 V	32	16	512
DSS	50 kHz	±30 V	32	16	512
DSH	10 MHz	±5 V	16	17	272
DSH	10 MHz	±5 V	16	17	272

Operation

Data entry, programming and debugging are made via the alphanumeric keyboard of the computer and the mouse. In the series test mode, the control panel is used to start programs, answer queries or control the vacuum.

The program is selected automatically via barcode or using the fixture codes, so that even untrained personnel will be able to operate the testers after a brief training.

Power Test Station TSAP

Complements Test System Family TSA through adding tests for power supplies and other electronic power circuits

Photo 40959

Brief description

Power Test Station TSAP complements Test System Family TSA through the testing of power supplies and other electronic power circuits. As a full-featured in-circuit and combinational tester TSAP localizes all defects down to component level with extremely high accuracy, as a full-featured power tester it measures all data under full load and with all these capabilities combined it provides complete fault coverage in a single test run.

Power test generator

The interactive power test generator cuts down on learning and programming time. With the aid of self-explanatory forms, the user can immediately concentrate on the test problem without having to learn the programming language or handle IEC/IEEE-bus commands. The tests can be carried out and modified interactively and the software generates commands with the correct syntax in the test language.

Power test

- Output voltage (with and without load)
- Power consumption, load current
- Input power (active/reactive/ apparent power), efficiency
- Load regulation, line regulation
- Cross regulation
- Ripple and noise measurement
- Frequency and pulse width of switching regulators
- Load transient recovery time
- Current limiting
- Short-circuit behaviour
- Overvoltage protection, shutdown
- Power-fail function
- Automatic alignment

Main features

- In-circuit, functional and power-supply test in one step, hence considerable savings in test costs
- Maximum test depth
- 100% compatible with TSA fixtures and programs
- Interactive power test generator
- Measurement of all quality data to ISO9000 during testing
- Modular concept ensuring customized solutions for every application

Fixtures

- Combined standard and power interface: pylon (TSA-compatible), similar to DIN 41612 for power signals
- Bed-of-nails fixture (vacuum, pneumatic or mechanical system)
- Two-stage and double-chamber fixture
- Functional-test fixture or connection via cables

Universal Test System TSU

Versatile solutions for automated testing

Photo 42319

Brief description

Universal Test System TSU is an extremely versatile solution for automated testing. With the aid of a large variety of modules, the basic unit consisting of a module mainframe and a power supply can optimally be configured for any test application. The system features comprehensive test strategies such as functional test, combinational test, emulation, boundary scan, testing of power supplies, electronic power circuits, ISDN products through to the classical in-circuit test. A novel feature is that all test strategies can be combined with RF measurements (up to 4 GHz via a standard fixture). Due to its compact design and high modularity, the TSU is also ideal for use as a basic unit for application- or branch-specific test systems.

Design

Universal Test System TSU consists of a mainframe (for max. 13 modules), a system power supply, a 5 V/5 A UUT power supply and an optional low-power UUT power supply as well as an optional vacuum valve for use with exchangeable vacuum fixtures.

A customer-specific connector panel for the connection of signal lines to external IEEE-bus devices is located in the upper section of the mainframe.

The necessary wiring to the functional test modules and the switching modules which are located in the lower section of the mainframe is implemented in the fixture.

The functional test and switching modules are plugged into the mainframe. All modules are now controlled by the central processing unit (control module TS-CTE) in the TSU. The control module coordinates all modules and also provides the interface to the IEC/IEEE bus. The internal data transfer in the TSU takes place via the multibus.

Software and hardware concept

The modular concept and open system architecture of the TSU allows almost all modules of the related test system family TSA to be used. This applies in particular to the explorer configuration with AMV (page 289) which in TSU makes the special signals directly available at the fixture interface. Like TSA, TSU can also be retrofitted with up to four AMV modules. Simple interface cards (TS-INK) are required for other modules.

In addition, the uniform software concept TSSwindows (see page 296) employed in all the above test system families ensures full transparency throughout an entire test system installation.

Through the use of multibus interface modules (TS-MBI), not only the relay modules TS-RELx but also customer-specific applications can be integrated into the system, ensuring an open system architecture also for the hardware.

The compatibility of all test systems also includes the options, so that the TSU system can any time be upgraded or expanded to include boundary scan, power test, LaserVision, etc.

Overview of TSU System Family

Common test functions
- Analog in-circuit test
- Analog functional test
- Switching facilities from DC to 4 GHz and for power
- Use as a universal test system core

Common options
- LaserVision system extension
- Oracle database QUOTIS with paperless repair and quality management

Analog Prescreener (MDA) and Universal Analog Functional Tester TSUC

Test functions and features
- Analog in-circuit test
- Analog IC check (ICC)
- Static digital test (max. data rate 50 kHz)
- Max. 576 pins
- Max. data rate 50 kHz

Options
- Integration into CAD
- CoCheck pin contacting test
- Boundary scan

Universal Functional Tester TSU

Test functions and features
- Analog functional test
- Dynamic digital functional test
- Hybrid functional test
- Max. 512 pins
- Max. data rate 10 MHz (sensor resolution 10 ns)

Options
- CoCheck pin contacting test
- Boundary scan

Universal Combinational Tester TSUM

Test functions and features
- Analog in-circuit test
- Analog functional test
- Analog IC check (ICC)
- Dynamic digital functional test
- Hybrid functional test
- Max. 384 pins
- Max. data rate 10 MHz (sensor resolution10 ns)

Options
- Integration into CAD
- CoCheck pin contacting test
- Boundary scan

LaserVision TS-LV1, -LV2

Optical inspection of electronic components

Brief description

We see a printed circuit board in three dimensions and evaluate it accordingly. Conventional optical test systems try to do the same, with a large number of cameras being installed at different angles and provided with a complex lighting unit to allow the device under test to be inspected under different angles of view. LaserVision does not need such complex and expensive test setups. According to the principle of laser triangulation a laser beam is focussed on the device under test. The distance is measured by evaluating the diffusely reflected light with a position-sensitive detector (PSD). The presence and the position of components can thus be checked with the aid of a difference measurement.

This method can be used to advantage in particular where contrasts are inadequate for an image analysis, eg for checking the orientation or coplanarity of ICs. Normally, the only way to determine the orientation of ICs is with the aid of the notch in the IC housing.

Main features

- Very low pseudo fault rate through adaptive position correction
- No extensive libraries
- Extremely low test generation costs (1 program per day)
- No fixture costs
- Checking polarity and coplanarity of components
- SMD insertion test (before or after soldering) including checking of the X/Y position (accurate to a few µm) and angle (accurate to 0.1°) (TS-LV2 only)
- Checking of solder joints at 2- or 3-pin SMDs including verification of paste quantity
- Short-circuit test of ICs (including fine-pitch ICs)
- Optional, novel and extremely reliable optical character recognition system. For reading component labelling (even miniature labelling on 2- or 3-pin SMDs)
- Testing of mechanical components
- Checking of display elements
- Testing of all wired components
- Very simple in-line integration

Windows NT interface

- Intuitive operation (few days of training only)
- Integrated camera picture
- Graphical positioning of camera

Two basic models in use

LaserVision 1 (LV1)
is the entry-level model and mainly used as a complementary system to electrical test systems. For this application a high-speed function is not required, since only those components and parameters are checked which cannot be covered by an electrical test.

LaserVision 2 (LV2)
is ideal for use as a stand-alone system after component insertion and/or soldering even where an in-circuit test is not possible.

Modular concept

LaserVision consists of a basic module and a model-dependent control module which can easily be expanded by further modules to meet the specific requirements of the user.

Due to this system architecture, an upgrade (eg from LV1 to LV2) can very quickly and easily be made without having to remove the system from its place of use or without shutdown for a longer period of time.

The **basic module** comprises the following components:

- Anti-vibration benchtop cabinet
- x/y positioning unit
- 2 CCD cameras with lenses of different focal length
- Laser triangulation sensor
- Switchable high-frequency annular lighting (per camera)
- Calibration and selftest fixture

The basic module is driven by a control module designed to suit the model.

The **control module** comprises the following integral parts:

- 19" benchtop cabinet
- Motor control unit
- Laser control and analysis unit
- Shielded image processing computer
- Operating software (LV 1 or LV 2)
- Documentation

Specifications in brief

Hardware

Camera system	2 CCD cameras with different resolution, 740 x 576 pixels
Picture area camera 1	approx. 51 mm x 40 mm
camera 2	approx. 15 mm x 12 mm
Resolution camera 1	approx. 65 µm
camera 2	approx. 22 µm
Test rate (components/s)	LV1: 2 to 3
	LV2 (with 4 cameras): >12 (18)
Laser	depending on insertion density
Protection class 2, red	675 nm
Operating area I	0 to 20 mm
Resolution	±20 µm depending on surface contour
Operating area II	0 to 100 mm
Resolution	±100 µm depending on surface contour
Measurement method	triangulation
x/y positioning unit	
Working area	520 mm x 420 mm
Moving speed	approx. 120 mm/s
Positioning accuracy	±12 µm
Axial system	"T", maintenance-free
Fixture/calibration	standard fixture + calibration chart
Computer	minimum requirement: PC-AT
Monitor	17"

Software

Operation	
Operating system	Windows NT 4.0 required
Standard test routines for image processing	
Axial/radial capacitors	polarity
Component marking	orientation
Light/dark transition	insertion
Calculation/correction of component drift	model search
Testing of indicators and displays	LED, LCD, dot matrix
SMD insertion test	presence
LV2 only: SMD insertion test	x/y position, angle
Solder-joint verification, short-circuit test (of ICs)	reflection
Standard test routines for laser triangulation	
Measurement of component height difference	presence
Component level measurement	coplanarity
Reference point measurement	0-point calibration
Height profile measurement of an area	various criteria (LV2 only)
Program generation	
Inputs, modifications	menu-guided
Adaptation to production tolerances	tolerance windows
Panel board test program derived from master program	automatic
Input aid for identical test steps	array test
Automatic test route optimization	model LV2 only
Generation of user-specific test routines with the aid of learning software	model LV2 only

Program run
branching to insertion alternatives, test alternatives for component versions, inversion of test result (eg test failed), comments for user prompting

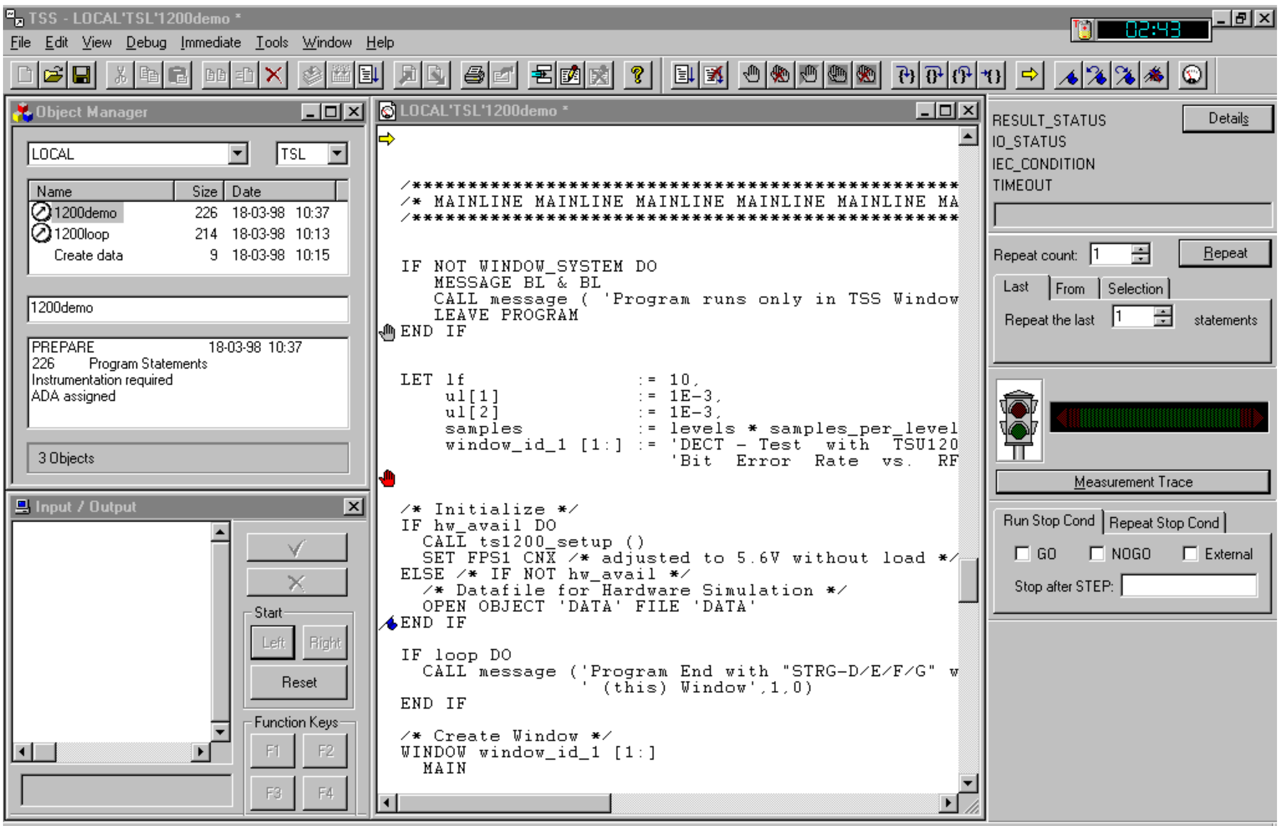
Program documentation
conversion to source text program, test data storage or transfer to superordinate quality management system, storage of program generation/modification date, software version

General data	
Operating temperature	+15° C to +40° C
Power supply	110 V/4 A, 220 V/2 A
Certification	CE; VDE
Dimensions (W x H x D); weight	
Basic module	105 cm x 72 cm x 80 cm; 140 kg
Control module	19"/10 HU
	555 mm x 489 mm x 600 mm; 49 kg

Ordering information

Optical Inspection System LaserVision	TS-LV1	0382.6030.02
	TS-LV2	0382.9000.02
Options		
Light curtain to prevent manipulation during operation	TS-LVLC	1072.9017.02
IEC/IEEE-bus interface for remote control in combinational systems (incl. software)	TS-LVIE	1072.9023.02
z axis with support for cocheck sensors, trimmers and other tools	TS-LVXZ	1072.9046.02
Upgrade by one further camera	TS-LV4C	1072.9052.02
Offline programming module	TS-LVPR	1072.9069.02
Graphical process monitoring software	TS-LVQR	1072.9075.02
Statistics module for test data	TS-LVST	1072.9081.02
Software for optical character recognition (OCR)	TS-LVOC	1072.9098.02
LED flash + additional camera for OCR (laser labelling)	TS-LVOX	1121.6011.02
Display test software (LCD, LED)	TS-LVDS	1121.6005.02
Configurable CAD data converter	TS-LVDC	1072.9117.02
Upgrade kit for LaserVision1 to LaserVision2	TS-LVU1	1072.9123.02
Hardware expansion for LaserVision/TSAx combinational systems (benchtop model)	TS-LVKT	0382.6130.03
Hardware expansion for LaserVision/TSAx combinational systems (rack model)	TS-LVKR	0382.6130.05
Detached control panel for TSA	TS-ETF	0386.6218.02
Extras		
Drawer for component feed	TS-LVDR	1121.6028.02
Barcode reader	TS-BCR	1072.7988.02
Anti-vibration table 160 cm x 100 cm for stand-alone systems and combinational rack systems	TS-LVT1	0382.6130.90
Anti-vibration table 160 cm x 160 cm for TSAx/TSUx LaserVision combinational systems	TS-LVT2	0382.6130.91
Anti-vibration table 200 cm x 100 cm with lateral shifting mechanism for combinational systems with detached or parallel operation	TS-LVT3	0382.6130.92
Spare parts for brief maintenance	TS-LVP1	1072.9130.02
Spare parts for full maintenance	TS-LVP2	1072.9146.02

Production Test System Software TSS 5.0



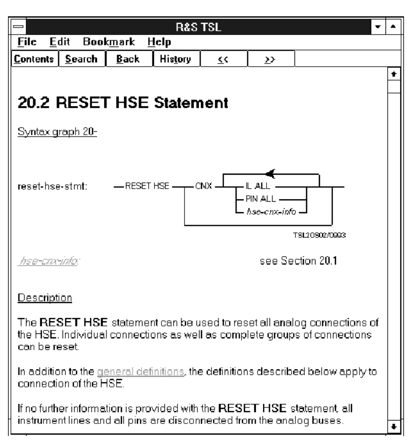
Testing under Windows NT on PCs

Brief description

TSS 5.0 is an extremely powerful system software under Windows NT which can be used on PCs. This software features a menu-controlled user interface designed for ease of use. Since the menus only contain those functions which can really be performed in a particular mode, even the inexperienced user will soon be able to operate the system. The menu options can be selected using softkeys or the mouse, so ensuring fast and error-free operation. Entries can be made on forms containing default data derived from the current operating environment.

Windows help function

The programmer's manual for the test language TSL is contained in the Windows help function. Clear graphics, references displayed at a keystroke, search and index functions help the user get to the sought information quickly and without having to go through the manual.

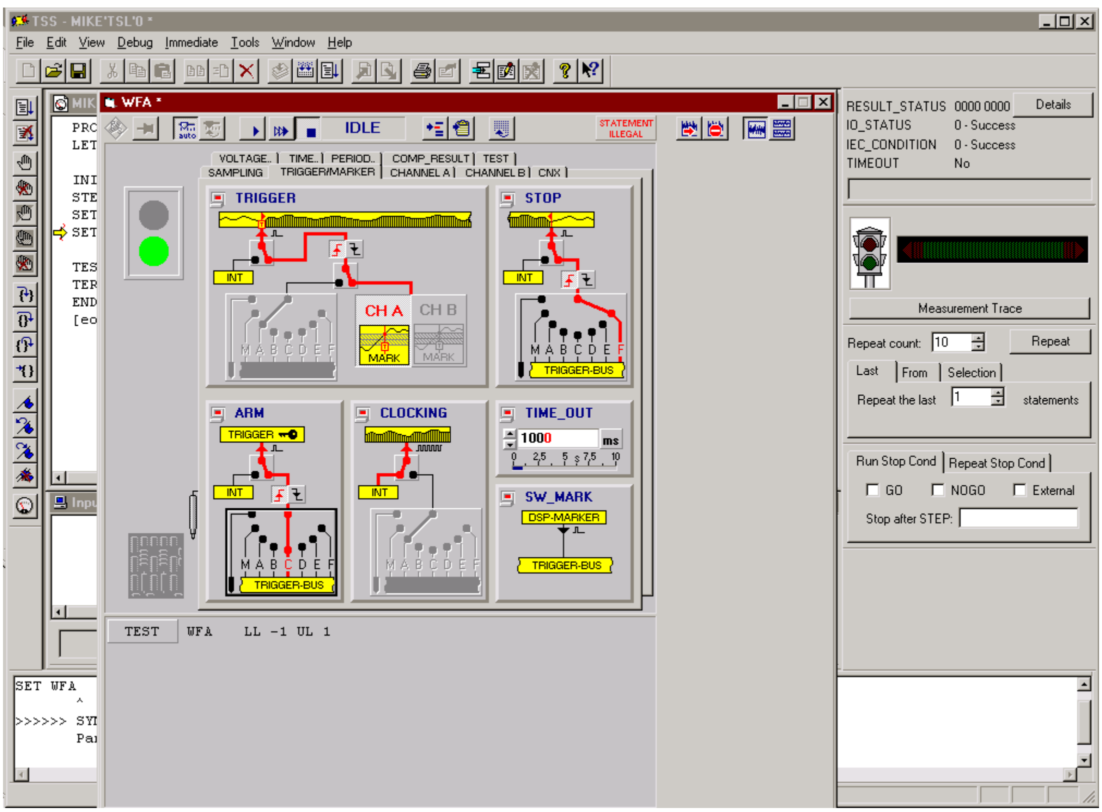


Convenient help function

High-level test language

The test language TSL is a high-level language for in-circuit and functional testing. Standard terms make it easy to follow the tests that have to be performed during program generation and updating. Node and signal names make the test program independent of the fixture, so that any changes to the wiring do not have to be subsequently entered into the test program. The digital realtime test is fully integrated in the test programs and enables clear display of analog and digital tests especially when testing hybrid components.

User-friendly program structures are achieved with the aid of IF, CASE, FOR and WHILE constructs as well as modular technique. The test language makes user dialogs based on a form technique simple to implement so that the user will encounter a standard user interface.



Logic state display

The programming status of the digital test unit can be called up by a keystroke. The logic state display with pin functions, timing sets and command sequence allows even very complex digital tests to be analyzed.

Short modification procedure

The whole software system TSS 5.0 has been optimized for highly effective operation in particular with a view to the test language TSL and the editor/debugger to achieve fast program generation. The program is displayed on the screen throughout the debugging process and can be modified any time.

Modifications are directly imported into the program and can immediately be implemented without need for any time-consuming compiling. This is made possible by the "compreter" concept of TSS where due to the use of a special segmenting method only the modified part of the program is compiled. This is done automatically and immediately after each modification and goes unnoticed by the user. Operation is thus similar like with an interpreter language (eg BASIC) without having to do without the benefits of a compiler language. A novel feature of TSS 5.0 are the interactive virtual device control panels embedded in TSS per OLE (object linking and embedding) standard. These control panels enable purely graphical control of individual devices within the TSA/TSU system families. An important feature is that the interactively generated device settings can be imported into the current program at the press of a button. If the control panels are called up from the debugger, the current hardware settings are automatically used in the control panel.

IEC/IEEE-bus compatible devices

Convenient language constructs are provided for controlling external instruments via the IEC/IEEE bus. The configuration-dependent settings such as bus addresses and end characters are stored outside the program in the resource management system; this relieves the workload on the programmer and facilitates clearer programming based on the instrument names.

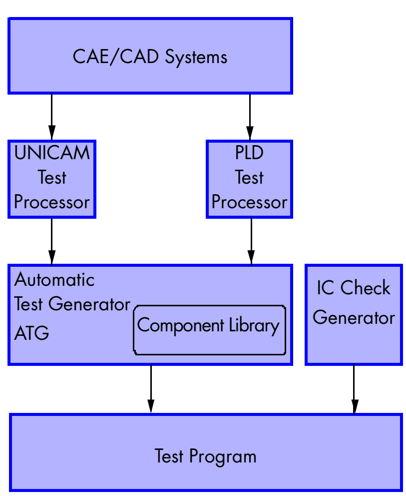
Open architecture

Any Windows applications can be called up from a test program. This, for instance, allows test data to be processed in MS Excel and graphically displayed. Programs for PC plug-in cards can also be included in the test run. A fully compatible DDE interface is available for this purpose.

Test methods

Hybrid in-circuit test

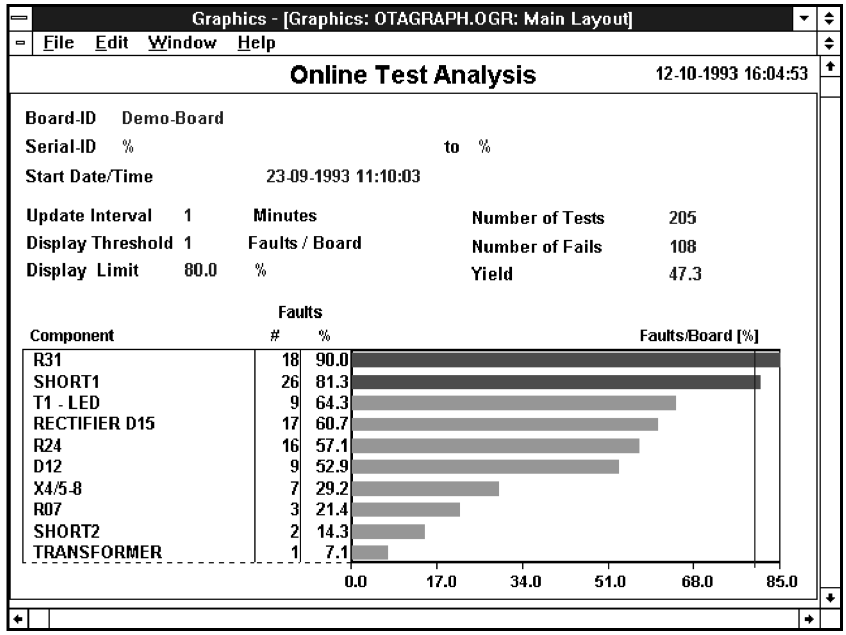
- The CAD test processor UNICAM converts CAD output lists in Edif-II code to the board description format of Test Workstation TSA
- The PLD test processor generates tests for programmable logic components. Clock, force and disable sequences are generated using the standardized JEDEC format
- The automatic test generator ATG generates an in-circuit/cluster test program on the basis of the board description
- The IC check generator is used to generate pin contacting tests for ICs by means of analog test facilities. In the case of a fault, an automatic diagnostic algorithm analyzes and evaluates the test results



Automatic in-circuit test generation with CAE/CAD data

Boundary scan test

The boundary scan method considerably simplifies testing of complex digital boards. A test pattern generator provides test patterns for checking the connections between the individual ICs. The boundary scan test can be combined with the in-circuit and the functional test.



Online test analyses for detection of weak spots in production process

Quality management and paperless repair

Relational database Oracle

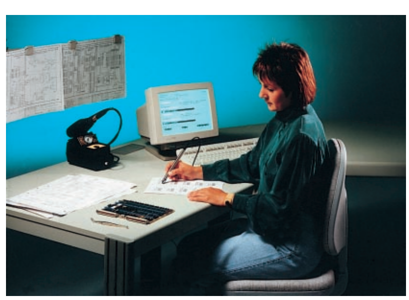
After each test, the relevant data are directly entered into the Oracle database and so are immediately available for repairs and quality reports. Via an ASCII or DDE interface test and repair data can be loaded from other systems or transferred to other PCs. The database may also be incorporated in networked computers running under different operating systems (eg UNIX, VMS, OS/2). Quality analysis and paperless repair are carried out using the TSA computer or a networked PC.

Quality reports

Online analyses with summary, detailed and trend reports including graphics permit weak spots in the manufacturing process to be analyzed and immediately eradicated. Alarm indications during the production test enable defects to be localized at an early stage and further defects to be avoided. An SQL interface provides access to the data stock.

Paperless repair

The test data of the boards to be repaired can be retrieved from the database in paperless form after the boards have been identified using a barcode reader. For every board unsuccessfully repaired, a test and repair report can be displayed by



pressing a key. For each fault a list of the most frequent repairs carried out for this type of fault can be displayed at a keystroke. Experience made in the past can thus be used to benefit which is a great advantage in particular where personnel frequently changes.

Windows NT – the modern platform

Windows NT from Microsoft is a high-end operating system with 32-bit architecture and preemptive multitasking. The user interface, which is basically the same as Windows 95, is very convenient and easy to learn.

Protection

The memory protection provides high system stability. The operating system and the applications have their own address ranges to prevent overwriting. The various user resources (programs, data, memories) are protected by the entry of a name/password.

Type-Approval Systems for Mobile Radio

A complete range of systems for type-approval tests to GSM, DECT and analog standards

International benchmark for mobile radio test technology

Before being allowed onto the market, each and every mobile phone has to undergo a comprehensive series of checks which is referred to as the full type-approval test (FTA). This approval test can only be carried out on a specially designed and officially approved system simulator. Rohde & Schwarz is the sole provider of simulators of this kind for the world's most successful digital mobile radio systems.

System solutions for all significant mobile radio systems

We provide a whole range of integrated systems and components for full type-approval tests on mobiles. The approach we offer is technically innovative, practice-oriented and gives optimal performance and user-friendliness.

Type	Designation	Applications	Page
TS8915A TS8915B TS8916B	GSM Simulator GSM900/1800/1900 Simulators	Type testing, QA and development of GSM900/1800/1900 mobile phones	301
TS8510	Base Station Test System	Type testing, QA and development of GSM1800/1900 base stations	302
TS8930B TS8930F	DECT Type-Approval Test System	Type testing of DECT cordless phones to CTR06	303
TS1210	DECT Type-Approval Test System	Type testing of DECT cordless phones to CTR10	304
TS1220	DECT Protocol Tester	Type testing of DECT fixed and portable parts to TBR 22	305
TS8410	Type-Approval Test System	Type testing of AM/FM/φM/SSB transceivers	306
Other systems on request, eg Tetra, ICO			

We set the standards – you enjoy the benefits

With our type-approval systems, you are guaranteed a high level of standard conformity and result reproducibility. This is why they have been accepted as standard test tools by test houses and accredited testing organizations all over the world. Mobile radio manufacturers know that equipment that has been developed using our systems will have no problems with official acceptance tests. You can be sure of the successful outcome of approval procedures without any bother.

Future-proof thanks to high flexibility

The most striking features of the test and measurement systems from Rohde & Schwarz are the highly flexible hardware and software concepts which can be adapted to any changes in standards and any new technical requirements. Service packages tailored to your individual requirements secure your investment in equipment and keep your equipment at the leading edge of technology.

GSM900/1800/100 Simulators TS8915A, TS8915B and TS8916B

Type testing, QA and development of GSM900/1800/1900 mobile phones

Test System TS8915B with audio option for all GSM standards (photo 42284)

Brief description

Simulators TS 8915A (GSM900), TS8915B (GSM900/1800/1900) and TS8916B have been designed for development and QA requirements. Thanks to their extraordinarily powerful hardware and software, drastic reductions in test and development times are possible. TS8915B is a type-approval system for GSM1800 and GSM1900 and can be used for precompliance testing in GSM900. The TS8916B is based on the TS8915B and has been extended to meet the full type-approval requirements in all three GSM bands. These systems enable mobile phone manufacturers to apply the severity level and the test depth of accredited test houses already at the development stage.

Main features

- RF transceiver tests, analysis of spurious emissions
- RF transmitter tests, eg quality of the RF output spectrum
- RF receiver tests, immunity to interference
- Link management tests (synchronization characteristics)
- Layer-2 and layer-3 signalling tests
- Audio tests
- Test of supplementary services
- Short familiarization thanks to easy-to-use software (test cases and maintenance menu)
- Development of user-specific test programs in the standardized programming language C under MS-DOS

Tests to ETS 300 607-1

Thanks to Simulators TS8915 and TS8916, you can test GSM900, GSM1800 as well as dual-band GSM900/1800 mobiles to ETS300607-1, the ETSI standard. GSM1900 mobiles can be tested to GTS Spec. PCS1900 11.10-1 Edition 3. There are about 190 system test cases for each band, offered in functional groups. Besides these all test case packages for the Digital Radiocommunication Test Set CRTC can be run on the systems TS8915A/B and TS8916B. Furthermore we also offer a dedicated research and development tool which allows in-depth analysis of RF performance beyond the limits of predefined test cases.

The test systems are therefore ideal
- verification tools for development environments (prescreening)
- QA test systems
- simulators for type-approval tests

GSM900/1800/1900 Multicarrier Tester TS8913

Multicarrier Tester TS8913 closes the performance gap between the Digital Radiocommunication Test Set CRTC02 as a phase 2 stand-alone tester and Type-Approval Systems TS8915A/B and TS8916B. It has been designed for running merely signalling tests requiring up to 9 carriers for precompliance testing.

TS8913 comes as a double-rack system which can be upgraded to a TS8916 any time.

GSM1800/1900 Base Station Test System TS8510

Type testing, QA and development of GSM1800/1900 base stations

Photo 41750

Brief description

The trend towards smaller and smaller cell structures in mobile radio networks is causing a marked increase in the demand for base stations. In a modern radio network, it is not uncommon to find thousands of stations of this kind sharing the scarce resources of frequency, time and space. It is, therefore, essential that all requirements are rigorously observed.

The test equipment used must therefore meet very tight specifications. Base Station Test System TS 8510 from Rohde & Schwarz is an essential tool for use in type testing, quality assurance and development of GSM1800/1900 base stations. This system is already able to perform tests to GSM phase 2.

Main features

- RF parameter measurements (frequency, phase, spurious emissions) at the air interface for transmitter tests
- Provides the required wanted and interference signals for measuring the bit error rate during receiver tests (signals received via A_{bis} interface)
- Tests to detect spurious emissions from the base station between 100 kHz and 12.75 GHz
- Analysis of the base station's RFI immunity
- Implementation of any user-specific channel model in addition to GSM Spec. 05.05
- High measurement accuracy due to RF path compensation
- Automatic system selftest
- Short familiarization thanks to easy-to-use software (test cases and maintenance menu)
- Development of user-specific test programs in the standardized high-level programming language C under MS-DOS

Tests to ETSI/GSM Spec. 11.2x

GSM Spec. 11.2x is a comprehensive set of regulations dealing with the testing of GSM base stations that has been issued by the European Telecommunications Standards Institute (ETSI). These specifications form the basis for approval regulation BAPT 222 ZV6 in Germany and for MPT 1378 in Great Britain.

TS8510 has specially been designed to perform measurements to the comprehensive GSM Spec. 11.21 and so completely satisfies not only the German BAPT and the British MPT regulations but also can provide more extensive and searching tests. Tests to GSM Spec. 11.23 are also supported.

DECT Type-Approval Test Systems TS8930B, TS8930F

Type testing of DECT cordless phones to CTR06

Photo 41583

Brief description

DECT (Digital European Cordless Telecommunications) is a flexible communication technology with a wide range of applications in the commercial and private sector and, what is more, is a rapidly growing segment of the mobile communications market.

The test requirements for DECT products are stipulated in a number of standards. This is also reflected by the wide range of test systems that are available. The TS 8930 systems handle tests at the air interface to CTR06, TS1210 covers acoustic tests to CTR10 (see page 304) and TS1220 is for protocol analysis to TBR22 (see page 305).

TS 8930B gives DECT phone developers indispensable information while development is actually taking place. This means that their products will clear the type-approval hurdle at the first attempt, resulting in time-saving and marketing benefits.

TS8930F gives test houses a system that can rapidly and comprehensively check a pan-European standard for cordless phones on the RF side complying with all relevant regulations. TS8930 B can be upgraded at a later date to give the full functionality of TS8930F.

Main features

Transmitter measurements
- Accuracy and stability of RF carriers
- Timing jitter
- Referenced timing accuracy
- Transmission bursts
- TX power
- RF carrier modulation
- Emissions due to modulation, transients and intermodulation
- In-channel spurious emissions

Receiver measurements
- Sensitivity
- RFI immunity
- Intermodulation
- Blocking
- Out-of-channel spurious emissions

Other features
- High measurement accuracy due to RF path compensation
- Automatic system selftest
- Flexible concept for easy adaptation to changes in standards at any time
- Short familiarization thanks to easy-to-use software
- Development of user-specific test programs in a standardized high-level programming language

DECT Type-Approval Test System TS 1210

Type testing of DECT cordless phones to CTR 10

Foto 42274

Brief description

The DECT guideline CTR10 describes the acoustic measurements as part of the type-approval procedure for DECT phones. The guideline specifies measurements that have to be performed on the complete DECT system comprising the fixed and portable components on the one hand and test routines separately for the portable and fixed parts on the other. With the TS 1210 system, you can do both. The system generates and measures all the RF and data signals that are needed to communicate with the test items. As the hardware and software have been designed for maximum flexibility, you will be able to handle any changes in the DECT standard that the future may bring. Easy adaptation to amended standards, such as modifications of the test signals or test method, is guaranteed by this flexible approach.

The user-friendly system software, which features programming in a high-level language, and the wide-ranging debugging facilities guarantee short learning times.

Main features

Tests on portable parts
- Frequency response
- Loudness rating
- Sidetone mask rating
- Terminal coupling loss
- Acoustic stability
- Distortion
- Out-of-band signals
- Idle noise level
- Sampling noise
- DECT-specific delays
- Variation of gain

Tests on fixed parts
- Artificial echo loss
- Fixed part echo suppression
- Echo suppression on network side
- DECT-specific delays

Other features
- Two-channel audio measurement system
- ISDN interface
- Analog a/b interface
- Easy adaptation to changes in standards
- High measurement accuracy thanks to internal calibration

DECT Protocol Tester TS 1220

Type testing of DECT fixed and portable parts to TBR 22

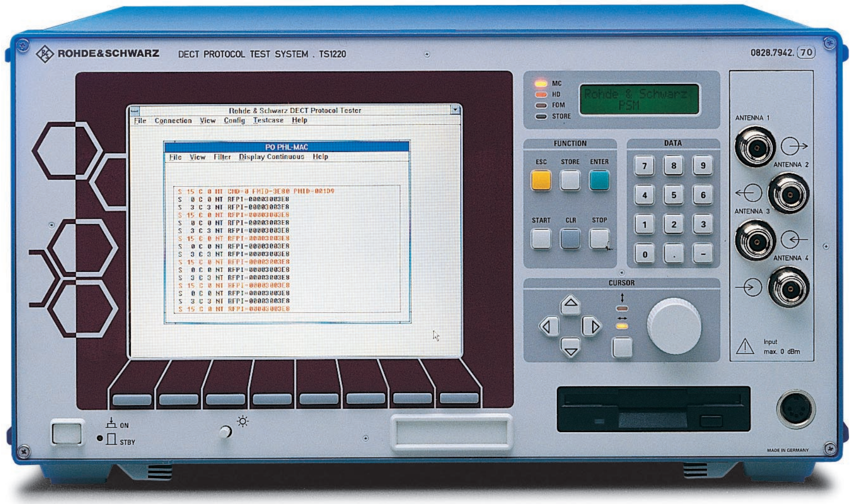


Photo 42044

Brief description

Classic PBXs which connect mobile stations to each other or to the PSTN by means of one or more base stations as well as PABX (private automatic branch exchange) systems are changing over to DECT, the European standard for digital, cordless information exchange.

The main objective of the European Telecommunications Standards Institute (ETSI) introducing the new DECT access profile GAP (Generic Access Profile) was to achieve product compatibility on the market. If manufacturers want to test their products for compliance with the new DECT access profile, they need a universal and versatile test system that can easily handle a variety of technologies - this system is the DECT Protocol Tester TS1220.

The Generic Access Profile (GAP) only applies to the DECT voice service, ie to those sections of the standard concerned with voice transmission. This means that only part of the standard which defines a general transit system (LAN, pager applications, etc, too) is binding for telephone applications. Protocol Tester TS1220 from Rohde & Schwarz is a test system for developing and type testing DECT phones whose software performs all the necessary analysis and interpretation of data and timing sequences. Simple software updates therefore ensure that the test system can handle any future changes to the standard or any new requirements.

Main features

- Full DECT-GAP implementation
- Ready-to-run TTCN test cases to TBR 22
- Any implementation for DECT transit systems thanks to open concept
- Can be used for mobile applications as it operates on 10 V DC and 30 V DC
- Straightforward software updates to handle changes in standards and new requirements

Type-Approval Test System TS 8410

Type testing of analog AM/FM/φM/SSB transceivers

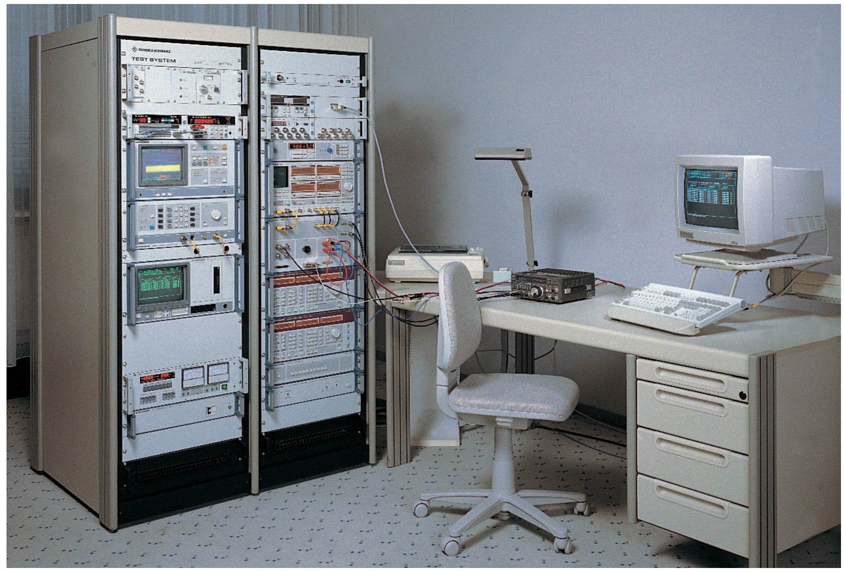


Photo 40887-2

Brief description

Type-Approval Test System TS 8410 has been specially designed for checking mobile radio equipment that uses analog modulation techniques (ie AM, FM, φM or SSB transceivers) to CEPT TR-24 or ETS 300 296. The range of DUTs that can be covered extends from portable, miniature mobile phones with an output power of only a few milliwatts through public and private radiotelephones to large SSB transceivers with transmission powers of, perhaps, a thousand Watts.

To perform measurements with the TS8410 all you need to do is press a button as you can create any automatic test sequence by choosing a number of basic tests. All the results, including graphics, are stored and can be called whenever you want. This means that it is possible to document longterm changes.

The modular software can be expanded, for example, to handle AMPS, TACS and NMT signalling. Modularity also makes it easy to set up the right power supply for the DUT - whether it's 50 Hz, 400 Hz or DC, a fixed or variable voltage, no problem for the TS 8410. The way the software has been designed also makes for simple connection of extra test equipment such as testpoint scanners or high-precision digital voltmeters.

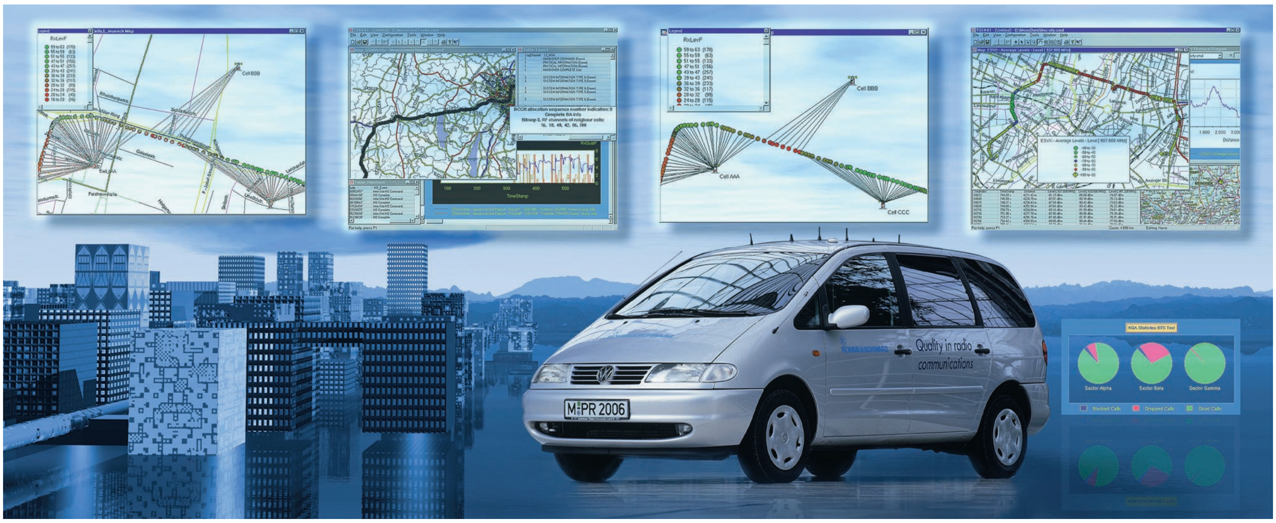
Main features

Receiver tests
- Sensitivity
- AF output power
- AF distortion
- AF frequency response
- SINAD
- Receiver bandwidth
- Noise blocking level with hysteresis
- Adjacent-channel selectivity
- Co-channel suppression
- Image-frequency rejection
- IF rejection
- Limiter response
- Quieting
- Out-of-band suppression
- Intermodulation
- Blocking
- Oscillator reradiation
- Current drain

Transmitter tests
- RF power
- Frequency offset
- RF harmonics
- Spurious emissions
- Adjacent-channel power
- Modulation sensitivity
- Spurious modulation
- Modulation limiting
- Modulation-frequency response
- Modulation distortion
- S/N ratio
- Current drain

General tests
- AF frequency
- AF level
- AF distortion
- AC voltage/current
- DC voltage/current

Coverage Measurement Systems (Mobile Radio or DAB) – Overview



Successful know-how transfer: innovative ideas for coverage measurements

In the field of radio coverage measurements too, the name of Rohde & Schwarz has over the years become worldwide synonymous with top quality. As the only manufacturer of a complete range of high-performance and practice-oriented system solutions, Rohde & Schwarz is setting standards in this field.

Customer satisfaction is your capital – and your dividends

Our systems are unrivalled regarding fast and high-precision field-strength measurements wherever the location may be, detailed analysis of the receiving conditions for digital radio signals and absolute reliability of the measured data, eg through compliance with the Lee criterion. They thus create the basis for interference-free network operation as well as for the economic success of your network.

Only a satisfied customer will be a faithful customer too. Therefore your aim should be lasting customer satisfaction which will pay out dividends over and over again.

The optimized network – minimum investment returning maximum performance

Whether in densely built-up areas or in the mountains: the patented interference measurement equipment of Rohde & Schwarz will show you how many base stations are in fact required and where it is best to install them. You benefit twofold: low investment costs in the network installation phase and maximum reliability in the operational phase. Your customers will appreciate it.

Digital mobile radio systems – a new challenge to measurement technology

Multipath reflection, scatter, diffraction and interference mean a new challenge to every operator in the digital radio network business. Digital mobile radio systems are far more complex than their analog counterparts. Field-strength measurements alone often prove to be inadequate to evaluate the radio coverage in difficult areas. The unique, patented interference measurement system from Rohde & Schwarz analyzes the multipath propagation of a signal as well as noise or co-channel and adjacent-channel interference - and it detects extraneous signals. There is no potential interference factor whatsoever that is not taken into account. This means that with the measuring systems from Rohde & Schwarz you are always on the safe side and optimally equipped for future digital communication.

Reliable planning through practice-oriented measurement

The dilemma in this context is that only practical experience will furnish useful data about the functioning of a network. This knowledge is required

Coverage Measurement Systems (Mobile Radio or DAB) – Overview

early in the planning phase to optimize the network prior to its commissioning. The solution is in operational measurements using test transmitters. The point of the Rohde & Schwarz solution is that our test transmitters are not only suitable for calibrating the planning software, but can be switched to signalling mode. This allows testing under realistic conditions with exactly the same signals that are later used by the network.

This stage will show whether the theoretically determined transmitter sites are suitable and the realistic receiving conditions are sound. It's no longer a matter of hope ("will it run smoothly?"). You can put your radio network installed with the aid of Rohde & Schwarz test equipment into operation and be sure that you provide the customer with a fully developed and tested infrastructure.

From a single source

Efforts involved in building up a radio network are enormous: carrying out market research, procuring the licence, ensuring financing, planning the sites, determining the mobile radio method, choosing the service and sales partners, setting up the administration network, installing the network, testing, optimizing and maintaining it. Therefore it is good to have reliable partners providing competent support in important areas of the implementation and ensuring that the project remains calculable both in time and in money. To live up to all this we supply a complete range of ideally matched measuring systems and components embedded in a consistent software environment. Whether you decide for budget-priced portable test mobile systems or fully equipped test vehicles, whether you wish to make field-strength measurements or signalling measurements - the solutions offered by us are technically innovative, proven in practice and feature maximum performance and ease of use. Numerous network operators – including all providers of full-coverage digital radio networks in Germany – rely on Rohde & Schwarz systems. Our range of cost-optimized network measurement tools certainly includes the right solution for your specific requirements.

Overview of systems

Type	Designation	Description	Application	Page
TS9955	High-Performance Coverage Measurement System	High-performance measurement system for all coverage measurements; basic model for CW measurements; can be upgraded for signalling and interference measurements, Measurement Software "ROMES"	Field-strength measurement Signalling measurement Interference measurement Network optimization Quality monitoring Network planning and installation	309
TS9951 Outdoor	Portable Coverage Measurement System	Compact case system with 1 to 4 test mobiles for network-specific measurements as well as network comparison measurements	Signalling measurement Network optimization Quality monitoring Network installation	310
TS9951 Indoor	Handheld Coverage Measurement System	Special solutions for - signalling measurements with 1 test mobile - CW and signalling with 1 or 2 test mobiles	Field-strength measurement Signalling measurement Network optimization Quality monitoring Network installation	310
TS9953	Test Transmitter System	System for emitting network-specific digital or CW signals	Signalling measurement Interference measurement Network planning and installation	312
TS9954 "ROSEVAL"	Evaluation Software	Evaluation software for all Rohde & Schwarz coverage measurement systems	Field-strength measurement Signalling measurement Data analysis Network optimization Network planning and installation	313

Coverage Measurement System TS9955 (Mobile Radio or DAB)

Highly accurate and fast coverage measurements in mobile radio or DAB networks

Foto 43125-2

Brief description

TS9955 is a high-performance system for measurements carried out in the planning, installation, optimization and quality monitoring of mobile radio or DAB networks. This system is not only suitable for high-precision and fast field-strength measurements, but in an upgraded configuration (see following pages) also for a comprehensive interference analysis which in this unique form is offered by Rohde & Schwarz only.

TS9955 means an investment in a highly efficient equipment providing extremely fast and reliable measurements. It is basic configuration for field-strength measurements, the system is able to measure four GSM900 channels simultaneously at a speed of up to 90 km/h (63 mph) and with the Lee criterion being adhered to, ie a distance of a few centimeters between the measurements. Preparing field-strength profiles and detecting any field-strength gaps is thus speeded up considerably so that accurate data required for calibrating the planning tools are quickly available.

Main features

- Measurement of field strength; up to four GSM channels at a time at speeds of up to 90 km/h and the LEE criterion being complied with
- Frequency hopping over 124 channels
- All filters required for GSM900/ 1800/1900 and analog systems or DAB
- Integrated test mobiles for various standards
- Acquisition of RxQual, RxLev and layer-3 information via test mobile in GSM900/1800/1900 networks
- Acquisition of signalling data for other mobile communication standards such as ETACS, D-AMPS and CDMA
- Acquisition of field-strength and signalling data in DAB and DVB-T networks
- Collection of positioning data via GPS (Global Positioning System)
- Removable hard disk for easy data handling (PC card)
- Realtime graphics
- Ten user-definable event keys, various system events with freely definable thresholds
- User-friendly measurement software for controlling all system components
- Comprehensive evaluation software

System configuration

The complete measurement equipment can be accommodated in a car. The system installed in the car mainly consists of test receiver, navigation systems, test mobiles, process controller and software. The core of the system is the powerful Test Receiver ESVD (ESVB for DAB, DVB-T and CDMA) which is not only extremely fast but also provides maximum level accuracy and frequency stability. Unlike conventional controllers, the robust Coverage Analyzer PCSP features excellent electromagnetic shielding so that it is absolutely neutral to the highly sensitive measuring equipment.

Software

Measurement Software ROMES integrates and administrates all system components and is ideally supplemented by the Software Package ROSEVAL (see page 313) for drafting and evaluating the test tours.

Coverage Measurement System TS9951 (Mobile Radio or DAB)

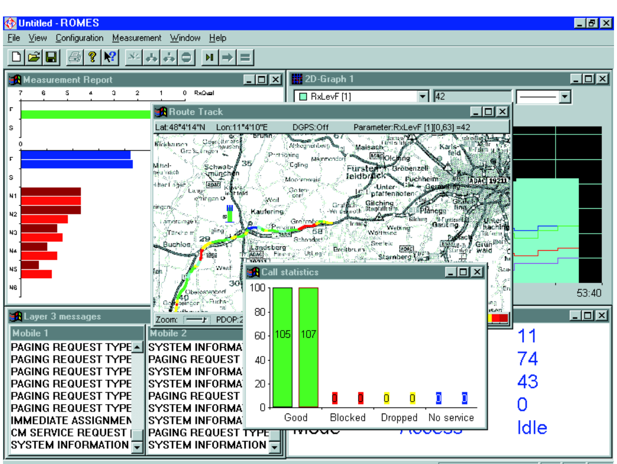
Compact case system with 1 to 4 test mobiles for network-specific measurements and network comparison measurements

Photo 43094

Brief description

Out and about with compact systems
System TS9951 is a budget-priced compact solution for network-specific quality parameter measurements during network installation, but mainly for quality monitoring during regular network operations. Through the integration of the main system components in a robust transit case, the systems are ready for use at any time and easy to transport. They can optionally be fitted with GSM900/1800/1900 test mobiles, as well as ETACS or CDMA test mobiles.

Simultaneous measurement of different networks to save time
TS9951 with up to four (maximum of three GSM) test mobiles allow mobiles of different standards to be used at the same time to carry out simultaneous measurements on several networks available at a site, or various antenna models or antenna positions on the vehicle to be tested. The test mobiles can readily be exchanged in no time. This flexibility is a great advantage in particular for service enterprises that have to carry out measurements on different networks on behalf of their customers often under an enormous pressure of time.



Coverage Measurement Software ROMES

The right system for every application

Different requirements call for different solution:

- TS9951 for outdoor application with one to four test mobiles for measurements in operational network or for use in conjunction with Test Transmitter System TS 9953 (GSM technology)
- TS9951 for indoor measurements

Main features

- Compact case system with built-in GPS receiver and with IBM-compatible laptop
- Test mobiles available for GSM900/1800/1900 (other standards such as CDMA or ETACS on request)

- One, two, three or four test mobiles
- Test mobiles can be calibrated
- Basic measurement in passive idle mode – no call setup required
- Camp mode for determining the cell boundaries
- Recording of signalling and analysis of OSI layer-3 information
- Realtime graphical display of test report
- Realtime alphanumeric display for presenting signalling information
- Realtime presentation of selected parameters on underlaid road maps
- Automatic or manual measurement mode
- Outdoor positioning with the aid of GPS navigation
- GSM Network Quality Analysis (NQA) Software running under Excel 5.0 or 8.0 for statistical evaluation of network availability, quality of connection, time required for call setup, call hold time, etc
- DC (12 V) or AC supply
- Indoor navigation modes

System configuration

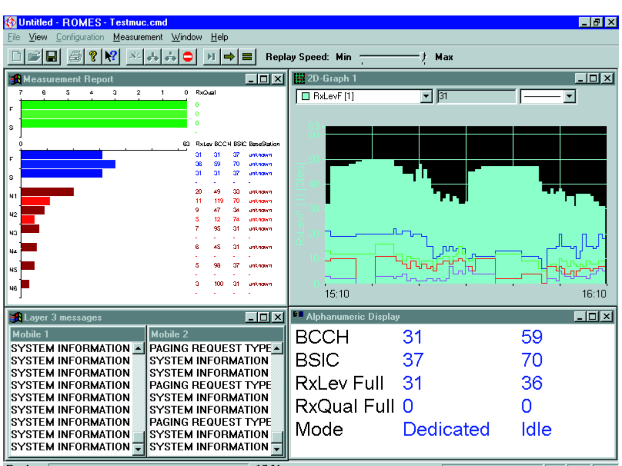
The systems use the intelligence of the radio telephones, ie they automatically find the operating frequencies of the radio service. The measurements are not only carried out in the dedicated mode, but also in the RxQual idle mode of the mobile. The great advantage of these systems is that quality measurements can be made in conjunction with a digital test transmitter such as the TS9953 (see page 289) so that a full-featured base station is not required.

The test mobiles used are modified exclusively for Rohde & Schwarz by adding new vital measurement functions. They also allow measurements on cell boundaries to be readily performed (camp mode). Moreover, the mobiles can be calibrated for high measuring accuracy. The built-in GPS receiver can be supplemented by a Travelpilot or sensor system to handle situations in which GPS reception via satellite is not possible, for instance in road tunnels.

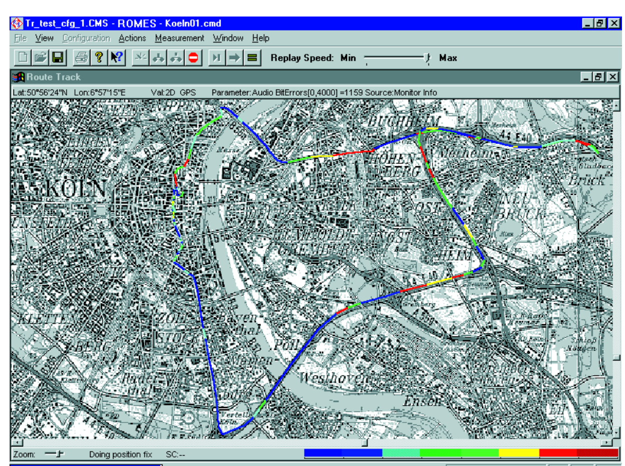
TS9951 for indoor measurements

Software

TS9951 not only features an extraordinary hardware but also a very special software providing far more than the usual capabilities. In addition to the display of standard parameters such as RxQual, RxLev or SSI, this system also allows graphical processing of data and presentation on underlaid road maps.



Four typical windows in replay mode



Full-screen display of Route Track window with a complete DAB test tour

Test Transmitter System TS9953

System for emitting network-specific digital or CW signals

Photo 42658-1

Brief description

Planning needs data
The best theoretical wave propagation model in your prediction tool can be no more than a rough approximation of the realistic conditions at the site. Experience has shown that the calculated sites of the transmitters as furnished by prediction tools are quite useful as a basis to start with, but that in digital networks such calculations do not guarantee the proper functioning of the network. Test transmitters therefore are the solution for "fine tuning" of the transmitter sites, and in particular those test transmitters that are able to master the digital signalling of the network to address the mobile phones.

Main features

- Models for GSM900/1800/1900 (each including CW)
- Generates all GSM signals required for the measurement of
  - field strength
  - RxLev
  - RxQual
  - CIR (channel impulse response)
- Can be used in parallel with an operational network
- ERP (effective radiated power) selectable between 1 W and 100 W
- Antenna can be installed up to 50 m away from power supply
- Available as a pure CW transmitter for various frequency ranges

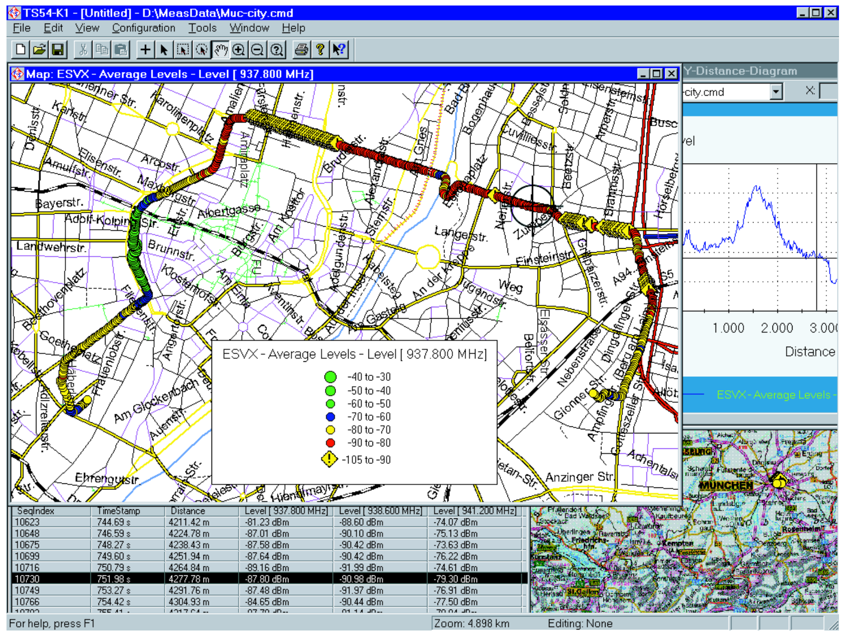
System configuration

Test Transmitter TS9953 is based on the multistandard Signal Generator SME. At the push of a button (or IEC/IEEE-bus command) the SME provides all the signalling data in the network-specific modulation mode required for the quality parameter measurements with a test mobile system. Due to its flexibility and in conjunction with the system TS9955 or TS9951, the SME is able to send the test signals that are required for in-depth analysis of problems on hand.
Usually, a 20 W amplifier connected to the SME is sufficient for the coverage measurements. Where higher RF power is required, other external amplifiers (up to 100 W available from Rohde & Schwarz) can simply be connected.

Built into a lightweight aluminium frame, the SME and a suitable RF amplifier can easily be transported and connected to the antenna practically in no time to be ready for operation. Accessories such as protective tent and antenna guying ensure that the test transmission can take place right in line with your time schedule and is not dictated by the uncertainties of the weather.

Evaluation Software ROSEVAL

High-performance evaluation software for field-strength analysis



Graphical representation of RxLev and RxQual along a route

Brief description

The high-performance Evaluation Software TS9954 "Roseval" (**Ro**hde & **S**chwarz **eval**uation software) is an excellent tool for analyzing all measurement data from data collection systems (Rohde & Schwarz Systems TS9951 or TS9955) by means of different methods.

With the aid of this software the user can ensure high network quality during the installation, optimization, service and maintenance of his network. As a Windows application it can easily be handled and installed on a standard PC. The concept is modular and adaptable to the most familiar digital networks like GSM, ETACS, CDMA.

As a subunit the well-known GIS software MAPINFO is used for geographical evaluations. The full power of this embedded software is open for designing new customer-specific layers.

Main features

- Generation of structured meta files
- Highly effective evaluation through the use of filtered and selected data
- Efficient file management of measurement data (central server)
- Fast access to all local temporary data
- Freely definable legends and comments
- Selection and evaluation of multiple measurement files in database only limited by system resources
- Exact reference of measured points to the measurement device they originate from
- Statistical evaluation and area data mapping
- Wide range of attributes assignable to each signal (colour, icons, pattern, ranges) to get the most efficient visualization of parameters
- SQL (structured query language) data selection and evaluation
- User-definable derived signals
- Global data selection (interactive and SQL)
- No special expensive hardware is needed (PC/486, recommended Pentium class 166 MHz or better)

Available technologies

The most important digital network technologies and Rohde & Schwarz Test Receivers ESVx are supported.

- CW, Field-Strength Test Receiver ESVx
- GSM900/1800/1900 test mobiles, signalling
- ETACS test mobile, signalling
- CDMA test mobile, signalling
- CIR (channel impulse response) analysis
- C/I (carrier/interference ratio)
- AMP5/NAMP5

EMC Test Systems – Overview

Turnkey EMC test centers, customized solutions for test houses, electrical and car industry, etc

EMC Test Systems and Projects from Rohde&Schwarz

Standard EMC test systems for...

...EMI measurements

TS9975

...EMS measurements...

...on sound and TV receivers

TS9980

...on other equipment...

...conducted

TS9986

...radiated...

TS9981 (up to 1 GHz)

TS9983 (1 to 18 GHz)

EMI Test System TS 9975


Photo 40816-1

Brief description

EMI Test System TS 9975 is used for all EMI measurements of conducted and radiated interference.

Commercial standards

- CISPR 11–22
- EN55011–55022
- VDE 0872–0879
- ANSI-C63.4
- FCC 15, 18
- EACL 1–8

Military standards

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

Customer-specific adaptations to other standards or different regulations can be integrated into Test System TS 9975 without any problems.

System configuration

The system features a highly modular hardware and software concept. Customized systems can be configured from a variety of instruments and software options. The system is a complete package of hardware and user-friendly software as well as system services so that the user will be familiar with the system within the shortest possible time.

Hardware

Process Controller PSM is the core of the system; it controls the complete measurement system via its IEC/IEEE-bus interface. Depending on the frequency range to be covered and the special test requirements, measurements are carried out by one or several test receivers.

Hardware expansions

- Artificial Mains Networks ESH 2-Z5 and ESH 3-Z5
- Absorbing Clamp Slideway HCA for measurement of conducted interference
- Remote-controlled Mast and Turntable System HCM and HCT for measurement of interfering field strengths
- Relay Matrixes PSU and PSN for switching antennas and transducers
- Rohde & Schwarz test antennas

Moreover, Rohde & Schwarz can offer the integration of products from other manufacturers into Test System TS 9975, if required.

Software concept

EMI Software ES-K1 from Rohde & Schwarz (page 92) is used in EMI Test System TS 9975.

EMS Test System TS9980

EMS measurements on sound and TV receivers (photo 42327-1)

Automatic measurement of electromagnetic susceptibility of sound and TV receivers as well as of video recorders to EN55020, EN55013, CISPR20 and CISPR13 standards

Brief description

Test System TS9980 is used for automatic EMS measurement on sound and TV receivers to EN55020 and CISPR20. It covers the following measurements:

- immunity to input interference (S1)
- immunity to RFI voltages (S2a)
- immunity to RFI currents (S2b)
- immunity to radiated interference (S3)
- screening effectiveness (S4)

Main features

Automatic measurements to
- EN55020
- EN55013
- CISPR20
- CISPR13

Three basic systems
- audio
- audio and video multistandard
- multistandard, DVB

Optimized system software for
- efficient test routines
- user-friendly operation
- high reproducibility

Measurement technology

The growth in telecommunications via radio and the scarcity of cable-network bandwidth for sound and TV broadcasting can have a very detrimental effect on reception quality. Comprehensive EMS tests are used to verify the capability of receivers to operate properly even in adverse electromagnetic environments. As the tests are highly complex and involve a large number of single measurements, it is best to use an automatic test system.

Test System TS9980 is available in three versions for different applications:

Audio, basic version
This system is used for testing receivers, tuners, amplifiers, equalizers and car radios.

Audio and video, multistandard
The second system is for measurements on sound and TV receivers. All common standards as in AV/multistandard are available. PAL, SECAM and NTSC

video generators are available for these standards.

Multistandard, DVB

The hardware of this version can generate up to five TV standards. The anlog standards available are the same as for the audio and video multistandard system. In addition, the digital TV standards DVB-C, DVB-S and DVB-T are covered.

Software

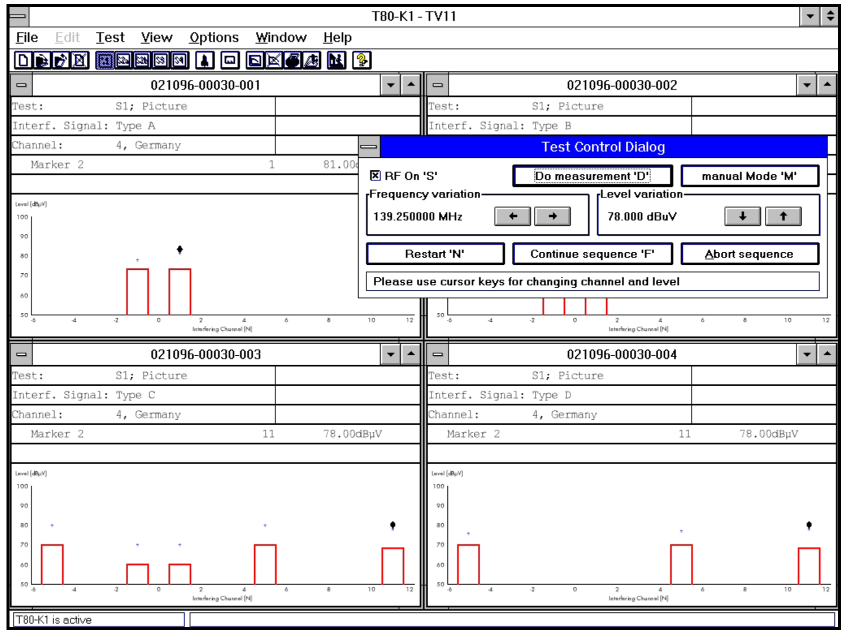
The system software for TS9980 is supplied on 3½" floppy disks and is fully documented. The graphical user interface allows the user to immediately and intuitively work with the program. All functions of Windows can be used to advantage, including operation via keyboard and mouse, printout of test reports on any printer/plotter supported by Windows or DDE (dynamic data exchange) for communication with other Windows applications. All software functions are explained in online help texts. TV channels and the relevant frequencies can be entered with the aid of the keyboard and DUT editor:

Standards B/G

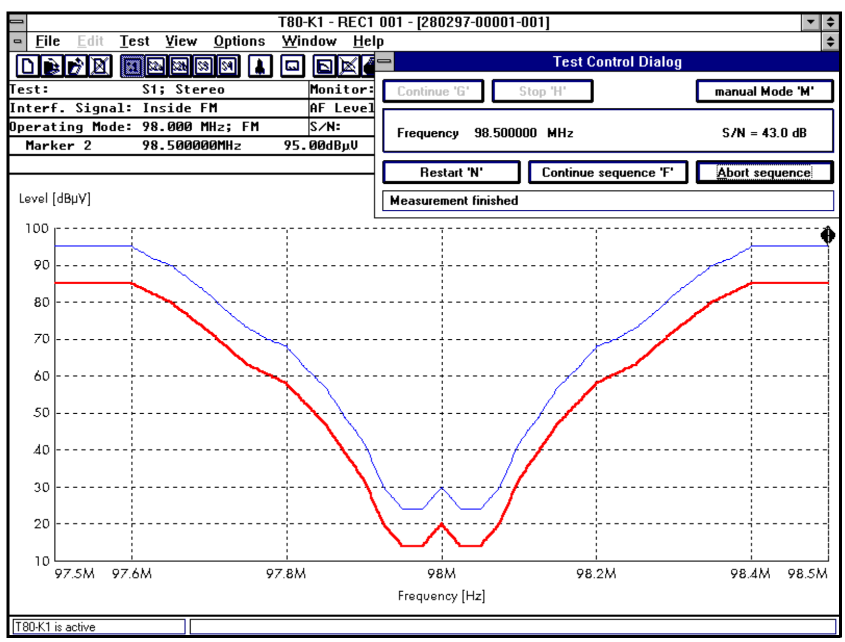
- Cable channels S1 to S20
- Hyperband channels S21 to S38
- Terrestrial channels E2 to K69

Standard M

- Korea/Japan 1 to 62
- USA 1 to 64, 82, 83



S1 measurement on TV receiver



S1 measurement on tuner, receiver

EMS measurements to IEC801-3/IEC1000-4-3/EN61000-4-3

Brief description

With the new European standards for electromagnetic compatibility and the relevant national EMC laws that came into effect, EMS tests on electrical and electronic equipment are required in all areas of the civilian sector.

The test procedure for determining susceptibility to electromagnetic fields is described in the international standard IEC 1000-4-3. In Germany, standard VDE0843, Part 3 was derived from this standard. Product-specific European standards (EN61000-3-4) based on valid national and international standards have been established. Test System TS9981 from Rohde & Schwarz is for automatic EMS testing to IEC1000-4-3 and EN61000-3-4 with field strengths of ≥10 V/m in the frequency range 80 MHz to 1 GHz. It is an efficient and reliable tool both for tests in development and acceptance tests.

Main features

Automatic measurement of susceptibility to electromagnetic fields to IEC-1000-4-3, EN61000-3-4 and other standards

- Measurements at all severity levels with test field strengths ≥10 V/m
- High accuracy and reproducibility of results
- Short preparation and test times with powerful software under MS-Windows95/NT4.0
- Automatic generation of detailed test reports
- Efficient test routines
- User-friendly operation

System configuration

System TS9981 includes an EMS control unit, an amplifier, a transmitting antenna and a field probe. The system is fully computer-controlled (PC). This makes for reproducible and largely automatic test sequences.

The EMS control unit comprises a signal generator, a field strength meter, a power meter, and a directional coupler unit. The broadband power amplifier used in the system covers the whole frequency range from 80 MHz to 1 GHz.

To generate electromagnetic fields, one log-periodic antenna is used for the whole frequency range from 80 MHz to 1 GHz. EMS tests can be performed without changing the antenna, thus avoiding time-consuming interruptions.

Operation

Test System TS9981 includes the Rohde & Schwarz System Software EMS-K1 for Windows. The software makes it possible to perform automatic EMS measurements in line with all relevant standards. EMS-K1 is a convenient, cost-effective and reliable tool, enabling fast and easy system operation and high throughput. The test and configuration capabilities ensure high reproducibility of results.

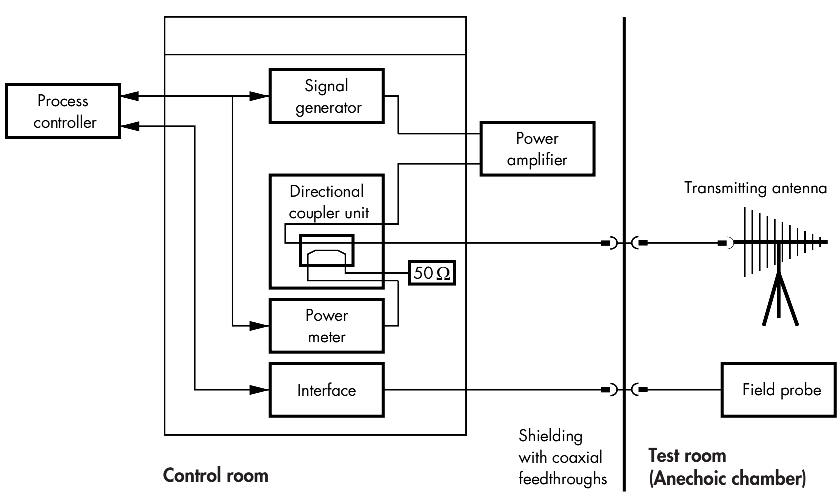
Expandability

Test System TS9981 is of modular design and can be extended by options. Various configuration levels allow for further automation of the test system, so giving an even higher throughput. Optional components include:

- EUT Monitoring System TS9981M (see page 322)
- Components and accessories for remote-controlled amplifier in separate room
- Shielded anechoic chambers
- TEM/G-TEM cells

Overview of models

Model	Main applications	Technical features	Power output
TS9981A	Favourably priced test system for development labs, EMC labs and test houses; compliance tests with field strengths according to selected amplifier output power	Generator SMY01, Power Meter NRVS for measurement of forward power; EMS control unit designed as a 19" desktop; amplifier 25/100/200/500 W	25 W 100 W 200 W 500 W
TS9981B	Expandable test system for EMC labs (quality management) and test houses	Same as TS9981A, but with EMS control unit designed as a 19" rack; measurement of forward and reflected power with NRVD	25 W 100 W 200 W 500 W



Block diagram TS9981

EMS Test System TS9986

Photo 41942-1

EMS measurements to IEC801-6/IEC1000-4-6

Brief description

With the new European standards for electromagnetic compatibility and the relevant national EMC laws that came into effect, EMS tests on electrical and electronic equipment are required in all areas of the civilian sector. The test procedure for determining susceptibility to conducted RFI is described in the international standard IEC1000-4-6. In Europe, a corresponding EN standard was derived from this standard (EN61000-4-6).

Test System TS9986 enables automatic EMS testing to IEC1000-4-6 with severity levels of up to 10 V/m in the extended frequency range 150 kHz to 230 MHz. It is an efficient and reliable tool both for tests in development and acceptance tests.

Main features

- Automatic measurement of susceptibility to conducted interference to IEC 1000-4-6 and other standards
- High accuracy and reproducibility of results
- Short preparation and test times with powerful software under MS-Windows
- Efficient test routines
- Automatic generation of detailed test reports
- User-friendly operation

System configuration

System TS9986 includes a signal generator, a 25 W power amplifier and a power meter. The system is fully computer-controlled (eg PSM, page 368) via the IEC/IEEE bus. This makes for reproducible and largely automatic test routines.

Operation

Test System TS9986 comes with the Rohde & Schwarz System Software EMS-K1 for Windows (see page 326). The software makes it possible to carry out automatic EMS measurements to all relevant standards. EMS-K1 is a convenient, cost-effective and reliable tool, enabling fast and easy system operation and high throughput. The extended test and configuration capabilities ensure high reproducibility of results.

Expandability

Test System TS9986 comes in three configuration stages plus an option for automatic EUT monitoring. One or several different coupling/decoupling networks may be required in addition to the TS9986 basic system configuration depending on the type and number of connections to the EUT. Further accessories including a computer desk, a wooden test bench with a copper surface, and feedthroughs for shielded walls are available to yield a system tailor-made to customer's requirements.

Overview of models

Model	Main applications	Technical features	Order No.
TS9986A	Budget-priced basic system for development labs, EMC labs and test houses; compliance tests already possible	25 W amplifier, EMS control unit designed as a 19" desktop	1076.6993
TS9986B	Expandable basic system for EMC labs (quality management) and test houses	25 W amplifier, EMS control unit designed as a 19" rack	1076.7090
TS9986D	Universal, high-performance expandable system; for test houses and EMC labs	150 W amplifier, EM clamp with decoupling network, EMS control unit designed as a 19" rack	1076.7290

EMS Test System TS9982

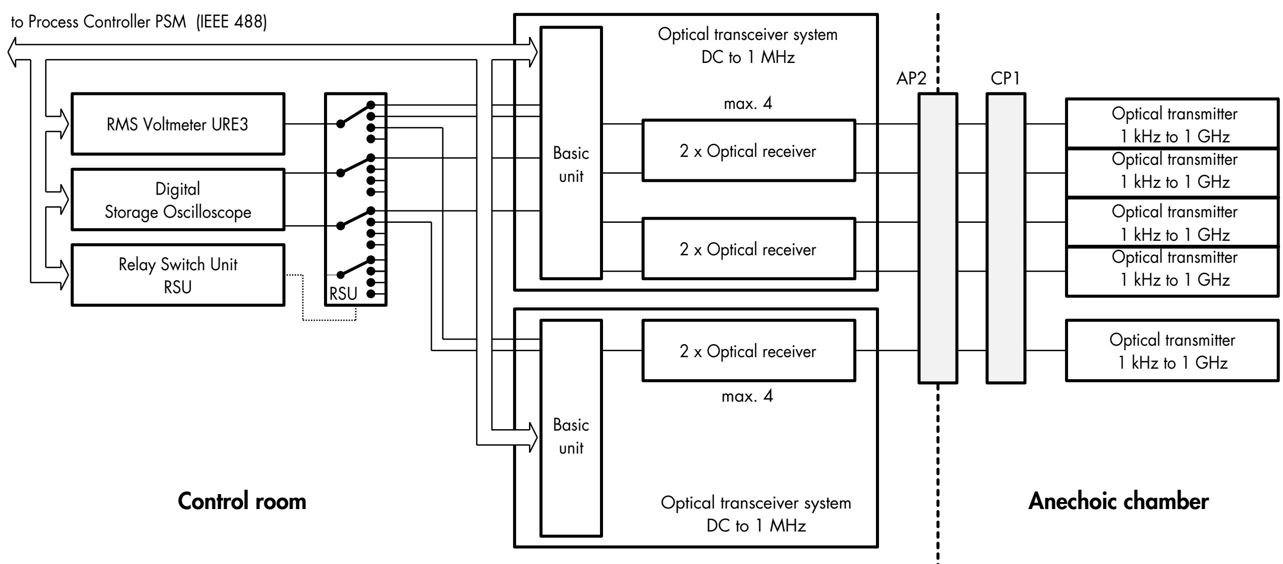
Photo 40127

EMS measurements to IEC801-3, 6/IEC1000-4-3, 6

Brief description

This system is a combination of Test Systems TS9981 and TS9986, allowing EMS measurements in line with IEC1000-4-3 and IEC1000-4-6. It is a favourably priced alternative for users performing measurements in line with both standards.

EUT Monitoring Systems TS998xM



EUT monitoring for Test Systems TS9981 and TS9986

Brief description

EUT (Equipment under Test) Monitoring System TS998xM is used for automatic monitoring of the equipment under test for proper functioning during EMS measurements.

If the EUT does not function properly during the measurement, the field strength is reduced until the EUT resumes correct operation. The field strength is then increased until the EUT shows signs of malfunctioning or the nominal field strength is reached.

System configuration

The system functions are shown in the above diagram. The EUT Monitoring System is an option for the EMS Test Systems and can be divided into two main sections:

- measurement section and
- switching section

Measurement section

A data acquisition unit (option 1) is used for collecting analog and digital data signals. The instrument has 8 analog inputs and 16 digital input/output channels. It is mainly used for go/nogo testing of the EUT.

For accurate evaluation, eg for measuring signals of different shapes or levels, a digital storage oscilloscope and an RMS/peak voltmeter, eg URE3 (see page 274), can be used (option 2).

Switching section

The different EUT signals are switched to the Voltmeter URE3 or storage oscilloscope by means of the RF Relay Matrix PSU. All instruments feature remote control via the IEC/IEEE bus as well as manual control.

System configuration

The fully configured system takes up a 19" rack in the control room. If only the data acquisition unit is used for measurements, it will be accommodated in the 19" rack of the EMS control unit.

Software concept

The software (monitoring module) for the TS998xM is part of EMS System Software EMS-K1 (see page 326). Up to 10 independent channels can be monitored simultaneously and a maximum of four displayed at a time, selection being possible during the measurement.

The measurements required for EUT monitoring are performed fully automatically. The results are compared with the malfunction criteria and thus control the field strength. With switch-off criteria clearly defined, the EUT is optimally protected.

EMS Test System TS9983

1 to 18 GHz (40 GHz option)

Automatic measurement of susceptibility to electromagnetic fields

Photo42577-1

Brief description

The test procedure for determining susceptibility to electromagnetic fields in the frequency range 1 GHz to 18 GHz (40 GHz) is described in various national and international standards. EMS Test System TS9983 allows automatic EMS measurements in line with these standards with a minimum field strength of 20 V/m (distance of 2 m between antenna and EUT) over the total frequency range. It is an efficient and reliable tool both for tests in development and acceptance tests.

Main features

- Minimum field-strength level of 20 V/m over the total frequency range and EUT at a distance of 2 m
- High accuracy and reproducibility of results
- Short preparation and test times with powerful software under MS-Windows
- Automatic generation of detailed test reports
- Efficient test routines
- User-friendly operation

System configuration

The test system is made up of six functional components:

- control module
- generator module
- switching module
- amplifier module
- antenna module
- measurement module

To minimize the losses between generator, power amplifier and antennas, these system components are integrated in a rack which is accommodated in the anechoic chamber and controlled from the control room by the system controller via an IEEE-bus fiberoptic converter. The field strength is set and monitored with the aid of a power meter and field probes.

Operation

Test System TS9983 includes the Rohde & Schwarz System Software EMS-K1 for Windows (see page 326). The software makes it possible to perform automatic EMS measurements in line with all relevant standards. EMS-K1 is a convenient, cost-effective and reliable tool, enabling fast and easy system operation and high throughput. The test and configuration capabilities ensure high reproducibility of results.

Expandability

Test System TS9983 is of modular design and can be extended by options. Various configuration levels allow for further automation of the test system, so giving an even higher throughput. Optional components include:

- EUT Monitoring System TS998xM
- Components and accessories for remote-controlled antenna positioning
- Combination with EMI and other EMS test systems
- Shielded anechoic chambers

S-LINE

Shielded TEM cell

for measurement of electromagnetic susceptibility

Photo 43101-2

Brief description

S-LINE from Rohde & Schwarz is a favourably priced test cell for measuring the susceptibility to electromagnetic fields (EMS) and electromagnetic interference (EMI) in the frequency range 150 kHz to 1 GHz.

S-LINE comes in two different sizes. The larger model with dimensions of 1.5 m x 1 m x 1 m offers a test volume comparable to that of compact anechoic chambers. Compared with conventional precompliance cells, S-LINE has clear advantages regarding the radio frequency characteristics. The enclosure prevents radiation of electromagnetic fields into the surroundings. It is fitted with a shielded door which provides easy access to the cell. A shielded window in the door as well as illumination inside the cell allow visual monitoring of the EUT.

Main features

- In-development measurement of electromagnetic interference (EMI), eg to EN 55022
- Precompliance measurement of electromagnetic susceptibility (EMS), eg to EN 61000-4-3
- Low space requirement due to compact design
- High field strengths and field uniformity
- Concept for EMC testing in production
- Ideal for use with Rohde & Schwarz EMS instrument families and test systems

Available models

S-LINE comes in two models of different size. The choice of the model depends on the maximum size of the EUT. Both models can be get through doors with an opening of 800 mm. The large-size cell can be disassembled for transport.

Extensions

For electrical monitoring, standard filtered feedthroughs are provided as well as screw-on access panels which allow customized feedthroughs to be configured. A new model designated S-LINE P has especially been developed for use in production environments.

EMS line application package

- Automatic measurement of susceptibility to radiated and conducted interference to EN61000-4-3/-6 and other standards
- TEM cell with excellent radio frequency characteristics
- Interfering signal generation (see TS9982)
- Software EMS-K1
- Compact design for versatile use in the lab

EMI line application package

- Correct interference weighting to CISPR 16-1 down to 10 Hz pulse repetition frequency
- For all commercial EMI standards such as CISPR, EN, ETS, FCC and ANSI-C63.4, VCCI
- TEM cell with excellent radio frequency characteristics
- EMI Test Receiver ESPC
- Software ESXS-K1

Specifications in brief

Electrical data

Frequency range	150 kHz to 1 GHz
Max. RF input power	100 W CW at 40°C 150 W CW at 25°C, max. 5 min 245 W PEP at 80% AM and 40°C
Input impedance	50 Ω
Size of uniform area	
S-LINE 700	350 mm x 350 mm
S-LINE 1000	500 mm x 500 mm
RF input power for 10 V/m to EN 61000-4-3, 8/97	
S-LINE 700	33 dBm typ.
S-LINE 1000	36 dBm typ.
Shielding effectiveness	≥75 dB (up to 500 MHz) ≥60 dB (above 500 MHz)

Mechanical data

Dimensions (W x H x D)	
S-LINE 700	1062 mm x 815 mm x 790 mm
S-LINE 1000	1512 mm x 1192 mm x 1121 mm [1)]
Door opening (W x H)	
S-LINE 700	598 mm x 442 mm
S-LINE 1000	1100 mm x 650 mm
Inner dimensions of test cell (W x H x D)	
S-LINE 700	525 mm x 445 mm x 695 mm
S-LINE 1000	950 mm x 704 mm x 982 mm
RF connector	N female
Weight (basic equipment)	
S-LINE 700	≤80 kg
S-LINE 1000	≤210 kg

EUT

Max. EUT dimensions (W x H x D)	
S-LINE 700	350 mm x 350 mm x 350 mm
S-LINE 1000	500 mm x 500 mm x 500 mm

General data

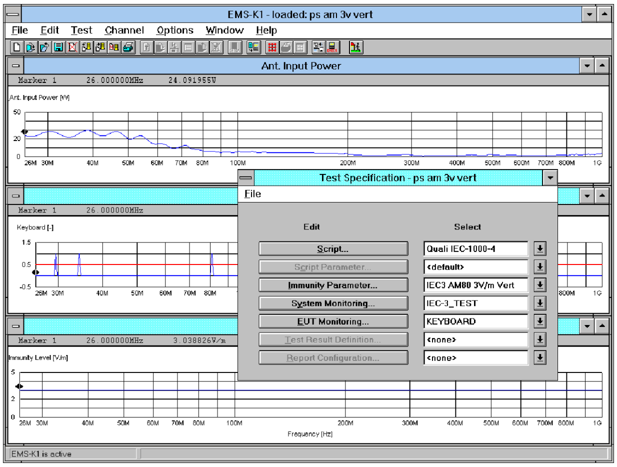
Operating temperature range	+5°C to +40°C
Storage temperature	–40°C to +40°C
Temperature rise inside test cell	
S-LINE 700	15°C after 2 h with 200 W dissipated power
S-LINE 1000	15°C after 2 h with 500 W dissipated power
Mechanical load	
Sine vibration	5 Hz to 55 Hz, max. 2g
Relative humidity (without condensation)	95% at 40°C

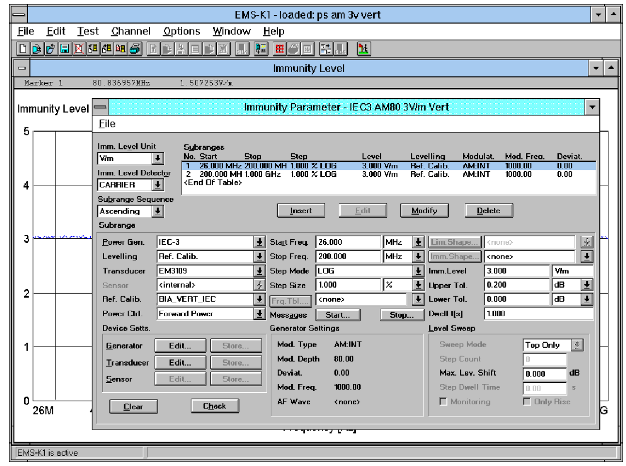
Ordering information

	S-LINE 700	S-LINE 1000	S-LINE P
Order No.	1095.2990.02	1089.9296.02	1095.2990.04
US version	1095.3980.02	1089.9596.02	1095.3980.04

1) The test cell can be disassembled for getting it through doors with an opening of less than 1.2 m. Disassembly and reassembly of the test cell shall only be carried out by trained staff.

EMS Software EMS-K1





Automatic measurement of electromagnetic susceptibility

Brief description

The powerful Software Package EMS-K1 forms the basis for the automatic control and monitoring of EMS test systems and also for the acquisition and analysis of the measurement data. The advantages of automation are:

- high reproducibility and accuracy of results
- automatic generation of detailed test reports
- permanent system control
- automatic calibration and correction of frequency-dependent parameters

The software is extremely user-friendly and has been optimized both for tests in development and acceptance tests. Predefined automatic test sequences and procedures as well as high flexibility for easy adaptation to new EMC standards and test methods are further outstanding features.

The three basic functions of the EMS-K1 are:

- Automatic generation of test signals (field strength, current, voltage)
- Automatic monitoring of the EUT for malfunctions
- Determination of the immunity threshold at which an EUT malfunction occurs

The complete software package can be run on a PC or a PC-compatible industrial controller, eg Process Controller PSM (see page 368). The measurement devices are controlled via the IEC/IEEE bus using an integrated interface card.

Main features

- Automatic measurement of electromagnetic susceptibility in line with all commercial and military standards, eg
  - EN61000 -4-3,-6
  - IEC 1000-4-3,6
  - ENV 50140/50141
  - ISO 11451/11452/10600
  - VDE 0843
  - DIN 40839
  - VG 95373, part 10,13
  - RTCA/DO-160C
- Running under Windows 3.1/95/NT4.0
- Open and modular system software concept
- High flexibility
- Programmable user interface
- Three types of user level:
  - normal
  - advanced
  - system manager
- Customer-specific test scripts
- Interface to other Windows programs
- Supports all EMS test systems from Rohde & Schwarz (TS9981/82/83/86)

Automatic generation of immunity parameters

EMS-K1 is a universal EMS software package that can be used for just

EMS Software EMS-K1

about any measurement method and test system:

- measurement of immunity to radiated electromagnetic fields using an antenna, stripline, TEM or GTEM cell
- measurement of immunity to conducted interference using coupling/decoupling networks or current clamps
- measurement of immunity to magnetic fields

Three operating modes are available for setting the immunity level:

- Transducer: the immunity test level is set by means of a specified transducer correction factor (constant or frequency-dependent) for the amplifier or generator output power
- Reference calibration: based on calibration data from a reference measurement, the immunity test level is set using the frequency-dependent amplifier power values derived from the calibration measurement
- Sensor: the test level is set to the required value using the actual level measured with a sensor

EUT monitoring

EMS-K1 provides logical monitor channels which can handle analog or digital data. A practically unlimited number of channels can be defined; the crucial limiting factor is processor power and the time required for monitoring. Depending on the graphics resolution, any number of channels can be displayed as on-screen diagrams during a measurement. The operator can change the selection of displayed channels while the measurement is running.

If there is a nogo condition, ie malfunction of the EUT, a variety of responses can be adopted:

- store the frequency and the EUT measurement value and continue the measurement automatically
- stop the program run to enter operator comments or
- branch to a user application routine, for instance to re-initialize the EUT

It is also possible to combine the above responses in a number of ways. A flexible control concept is implemented in the EMS-K1 by means of scripts.

Measurement sequence control

The measurement sequence control in EMS-K1 software is encoded in scripts. The scripts are accessible to the user who can adapt them to his requirements. Scripts provide a high level of flexibility and are easy to modify.

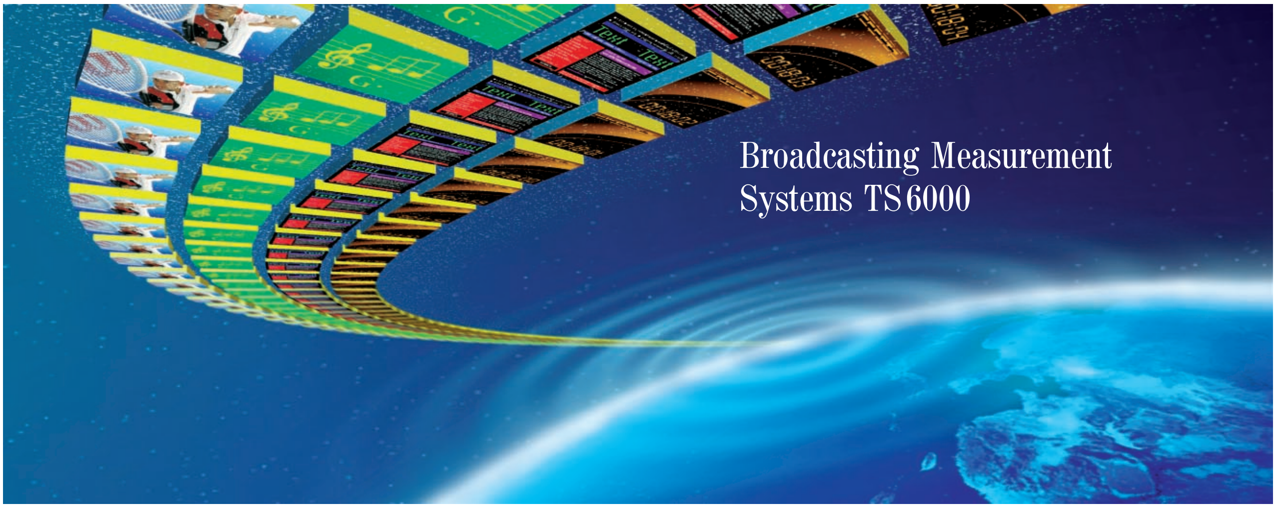
The EMS measurement sequence is implemented by two standard scripts, the qualification mode and the susceptibility mode.

In the qualification mode the selected parameter profile (limits as a function of frequency) is run automatically and the responses of the EUT are recorded. If there is no malfunction detected, the EUT passes the test and fulfills the specified immunity limits. The measurement is thus completed. Only if there is a malfunction is the frequency in question noted automatically.

In the susceptibility mode the immunity threshold is automatically determined when a malfunction occurs. Level and frequency are recorded in the test report; the susceptibility profile of the EUT can then be displayed in the form of graphs or tables.

Ordering information

Basic package		
System Software for Rohde & Schwarz EMS test systems (EMS-K2 or EMS-K8 additionally required)	EMS-K1	1084.3548
Standard device driver package for EMS-K1	EMS-K2	1084.3748
Extensions		
Software extension for EMS-K1 (script development kit)	EMS-K3	1084.3790
Standard device driver package for EMS-K1 for EMS test systems 1 to 18 GHz (eg TS9983)	EMS-K8	1084.3890
Complete package EMS-K1, -K2, -K3, -K4 and -K20	EMS-K9	1084.3948
EUT monitoring		
Software extension for EMS-K1; basic device driver package	EMS-K20	1084.4196
Software extension for EMS-K1; EUT monitoring with additional PC	EMS-K21	1084.4244



The digital broadcasting age is coming. We are ready for it: BMS from Rohde & Schwarz

Digital broadcasting: the ultimate challenge for test & measurement

- Planning and monitoring conditions are more complex than with analog technology
- Network availability of >99% must be guaranteed
- Monitoring the complete transmission link from the studio to the receiver is an absolute must
- Different types of transmission links (satellite, cable, microwave, terrestrial broadcasting) must be mastered
- More advanced quality control in production
- New demands on type-approval testing

Everything under control– with Rohde & Schwarz

- Leading supplier of measurement and operational equipment for the complete analog and digital transmission link
- Special test equipment for use in the production of transmitter systems and consumer units
- Know-how transfer as early as in the project planning phase
- Competent partner in international DAB/DVB projects
- Training: fundamentals and on-the-job

The complete test & measurement equipment for the digital broadcasting revolution

Product family TS6100 for monitoring the complete transmission link. Maximum network availability and transmission reliability

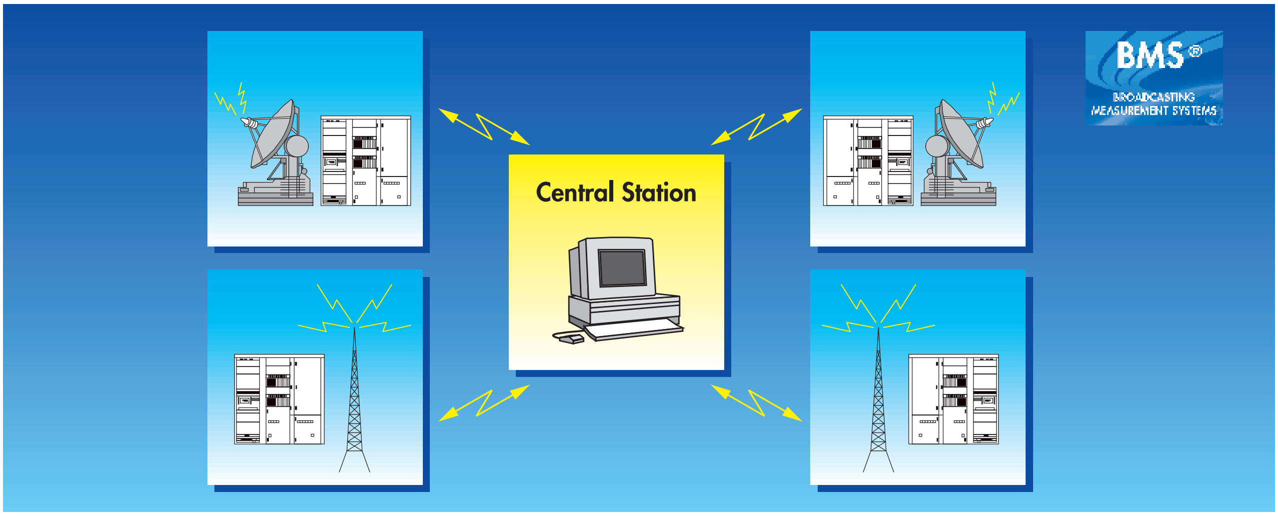
Product family TS6200 for mobile and stationary coverage measurements (field strength, bit error rate, channel impulse response, etc)

Product family TS6300*) for component testing of broadcasting equipment. Ideal for use in product design and quality management

Product family TS6400*) for functional testing at the factory. The solution for use in the production of consumer and professional units

*) For up-to-date information please contact your local Rohde & Schwarz representative.

Broadcasting Measurement and Monitoring Systems TS6100 (System Family)



Monitoring means continuous checking of one or several physical parameters

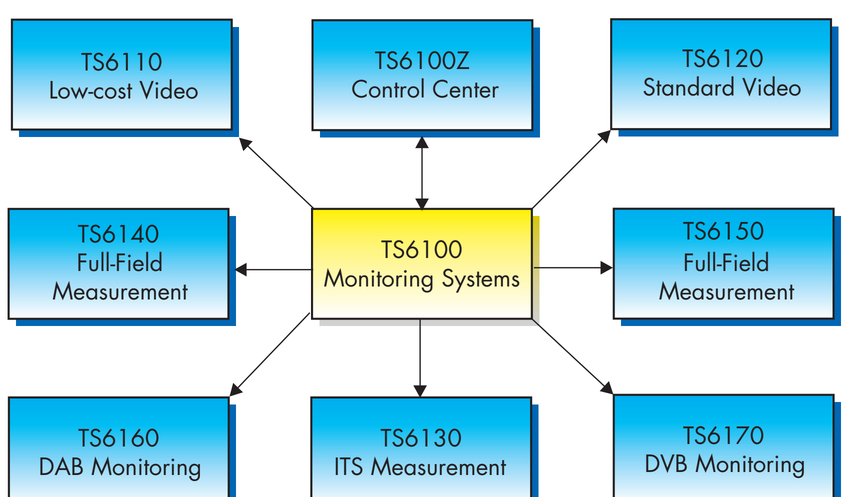
Introduction

Broadcasters need a special monitoring and test concept to sustain the high transmission quality standards over the ever increasing program times (24 hours a day). System Family TS6100 from Rohde&Schwarz is the ideal solution for these tasks.

Main features

- Modularity
- Use of standard hardware and software components
- System concept allowing a minimal solution as well as a solution for in-depth measurements
- Upgradable in individual stages

TV monitoring involves on-air checking of the most important video and audio parameters of attended and unattended transmitter stations, studios and interfaces. The measurement results are presented in EXCEL graphs or tables. Using a commercially available modem or LAN/WAN connection, data can automatically be sent to the main control center or downloaded from the main control center to the transmitter station. These systems can also be used for remote control of the transmitters and monitoring of the station buildings.
In addition to on-air monitoring of broadcast transmissions, Rohde&Schwarz offers systems for comprehensive measurements of transmission parameters outside the official program times. A full-field test system is available for this task, which features computer-aided test programs as well as manual measurements (according to specifications). Thanks to intuitive user prompting, operator errors and erroneous measurements are practically excluded.



Control Center TS6100Z

Brief description

The central monitoring station supervises the various monitoring sites
The status of all monitored sites is clearly indicated by graphic displays. The user has a complete overview of all transmitting and receiving stations and can see at a glance where a problem has occurred.

Alarm and status messages are automatically sent from the individual monitoring sites to the control center. These messages indicate the reason for the alarm/status, the time and the identification of the monitored station. The alarms are colour-coded and can easily be recognized on the screen. Green colour means that the test station parameters are within the tolerances, yellow is a prewarning (inner tolerances exceeded) and red signals serious faults that require immediate action.

The monitoring stations can be accessed at any time and more precise measurements be made for a thorough investigation of the fault that has occurred. The user can then determine the precise cause of the fault and pass on this information to the responsible personnel (eg for repairs, replacement, etc).

A database is used to follow up long-term changes of a parameter and to recognize trends. Windows applications (eg Excel) can be used to display and analyze the results.

System hardware

The hardware components are of modular design so that options can be added to the system at any time – as well as customer's own equipment. Each system component is tried and tested by Rohde & Schwarz under operational conditions. Only upon successful completion of this trial period will the complete system be installed at the respective site and commissioned either by trained personnel of the customer or by Rohde & Schwarz.

Process controller
All measuring instruments are software-controlled via IEC/IEEE bus or RS-232-C interface. An Industrial Controller PSM or PSP (page 363) is used to run the monitoring software. The controllers are compatible with the industry standard and operate without any degradation in performance in the presence of strong electromagnetic fields (as are typically encountered at TV stations). An already existing controller may be used. The software runs under Windows 3.1 and higher. The controller comes with 17" colour monitor and keyboard.

CCVS Generator SFF
The multistandard CCVS Generator SFF (page 128) produces a standardized video signal. In addition to the FuBK test pattern and the standard ITS signals, a large number of other video signals (eg with 100 ns rise time to standard specifications; or sin x/x) is thus available. The TV transmitter can for instance be aligned during operation (ICPM measurement). User-defined test signals may also be used.

Video Measurement System VSA
The digital Video Measurement System VSA (page 142) is very fast and features high measurement accuracy plus FFT analysis function. In contrast to previous measurement methods, which were mainly concerned with the time domain characteristics of the video channel, digital signal processing methods open up entirely new types of measurements which provide an exact description of the characteristics in the frequency domain.

Spectrum Analyzer FSEA20
FSEA20 (page 152) is used to determine the transmission characteristics (eg amplitude frequency response) of TV transmitters. The analyzer is also suitable for measuring the spectral distribution of signals, and it allows checking the frequency accuracy of oscillators.

TV Test Receiver/TV Demodulator
For monitoring and quality control of the RF signals, a TV Test Receiver/Demodulator, eg Video Measurement System VSA (page 142) with TV Test Receiver Option VSA-B10 (page 145) or TV Test Receiver/Demodulator EFA (page 124) are used, allowing measurement of RF parameters such as vision and sound level, frequency and residual carrier.

Control Center TS6100Z

TV Network Analyzer SOKF
Classic measurements on TV transmitters are based on the use of a TV network analyzer. TV Network Analyzer SOKF or SWKF (page 136) allows the amplitude and group-delay frequency response to be measured at the video frequency and at the IF/RF. A video signal generator is integrated in SOKF and SWKF. SOKF also has a built-in oscilloscope function for evaluating the video signals in the time domain.

Test Pattern Generator SGPF
Since a video generator for TV transmitter measurements to standard specifications (rise time100 ns) is already integrated in TV Network Analyzers SOKF and SWKF, TV Generator SGPF (PAL, rise time 200 ns, page 134) is only used to generate a standardized CCVS with FuBK test pattern.

Audio Monitoring System AMON
Generator AMON-G (page 354) is used in the TV studio to measure the audio signal with an FFT analyzer and send the measured values on a 14.85 kHz subcarrier to Receiver AMON-E in the monitoring system. Receiver AMON-E also measures the audio signal and compares the results with those received from AMON-G. The final results give the audio characteristics of the transmission link or of the transmitter.

Signal Selector MFA703/ Control Panel MFA801
This switching unit is integrated into the system for processor-controlled switching of RF, audio and video signals. The connections between test system and transmitter are established via special RF, audio and video cables connected to the rear of the 19" system rack via a junction panel. The signal selector also compensates for frequency response of the VF test cables.

19" system racks
All units are accommodated in 19" system racks of 36 height units which also include the required cabling (IEC/IEEE bus, RF, audio and video). The racks are castered and have fans and EMI line filters.

Hardware system extensions

Some of the optional extensions are described in the following – customer-specific configurations are available on request

PC, clock
To ease for instance the workload of the CPU of Video Measurement System VSA in larger transmitter stations, an additional computer can be used for program control. To record the time of the error messages, a GPS receiver or a DCF77 clock in the form of a PC card can be integrated into the computer.

Modem
The modem is used to transmit control data from the control center to the transmitter station as well as measured values and alarm signals from the transmitter stations to the control center. Monitoring networks can be implemented with the aid of modem links.

GPS receiver
Time synchronization is necessary in DAB or DVB networks. This option uses the time signal from GPS satellites.

Printer
A HP DeskJet colour printer is used for the output of test reports.

RF combiner
An RF combiner is used to connect the signals from several transmitters to the monitoring system.

Video/audio switch
The video audio switch allows VF and AF signals from different testpoints to be connected to the monitoring system. The switch has 10 video and 10 stereo inputs, each with one video and one stereo output, and can be cascaded.

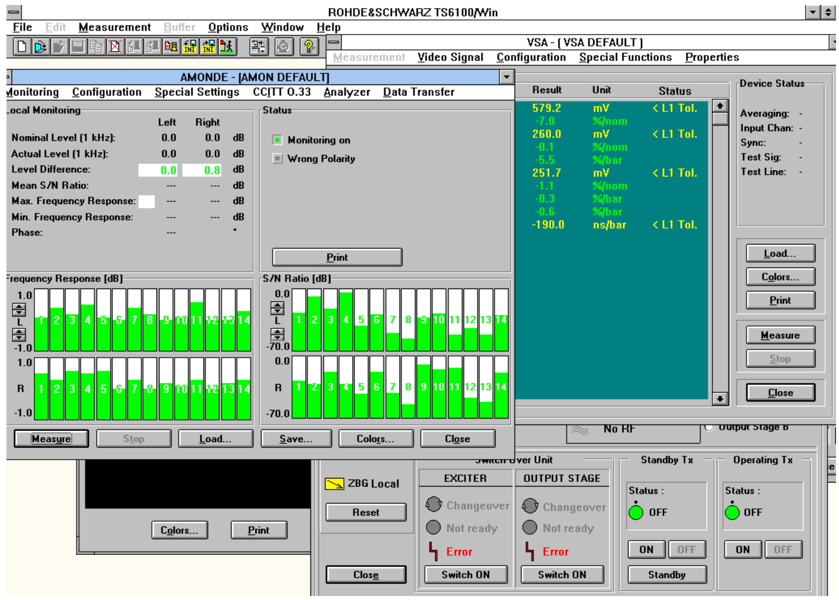
Audio measurements
Audio Monitoring System AMON generates and analyzes AF signals. A universal audio analyzer (eg UPL from Rohde& Schwarz, page 228) can be used alternatively.

Spectrum Analyzer, Option T61-B44
A spectrum analyzer (eg Advantest R3131, page 174) is provided for measuring the spectral distribution of signals.

Station building monitoring
Monitoring the infrastructure of the transmitter station via the infrastructure of the monitoring system. Monitoring is to be configured individually.

System Software TS6100/Win

Complex measurement functions and monitoring tasks in interactive and automatic mode



Simultaneous monitoring of audio and video parameters

System Software TS6100/Win

TS6100/Win is a software package used to continuously monitor different types of transmission signals. It can be used to control instruments which measure signals for analog (VHF radio, PAL TV) and digital broadcasting (DAB, DVB), satellite communications, GSM and other transmission applications.

TS6100/Win has all the performance features required for monitoring systems

- Configuration of measurement sequence
- Generation of alarm signals via modem, TTL, relay contacts
- Password protection
- Automatic restart after power failure
- Statistical tables and graphs for measurement results
- Intuitive user interface

The entire monitoring and test system is controlled via IEEE bus or RS232 using an IBM-compatible controller. The software can be run under Windows 3.1 or higher. Complex measurement routines and monitoring tasks can easily be performed. In the manual mode (direct measurement mode) specific measurements can be carried out with individual instruments. The results are time-stamped and stored for further processing.

System requirements

TS6100/Win can be used on any PC meeting the following requirements:

- Min. 486 processor (recommended: 586 processor or higher)
- Fully compatible with Microsoft Windows 3.1 and higher
- 8 MB RAM (recommended: 16 MB RAM)
- At least10 MB storage capacity on hard disk
- Super VGA graphics adapter (or better)
- IEEE-bus interface compatible with National Instruments AT-GPIB/TNT interface with Windows device driver (DLL)

Graphical user interface

This interface enables the user to immediately and intuitively work with the program. The options menu is used to define the device configuration (name, address, driver, mode, etc). New devices can easily be integrated using the appropriate drivers from Rohde&Schwarz (see software extensions), the installation being similar to that of a printer under Windows. The user list including passwords and the test station are also specified in this menu.

Automatic or interactive control of measurement routines

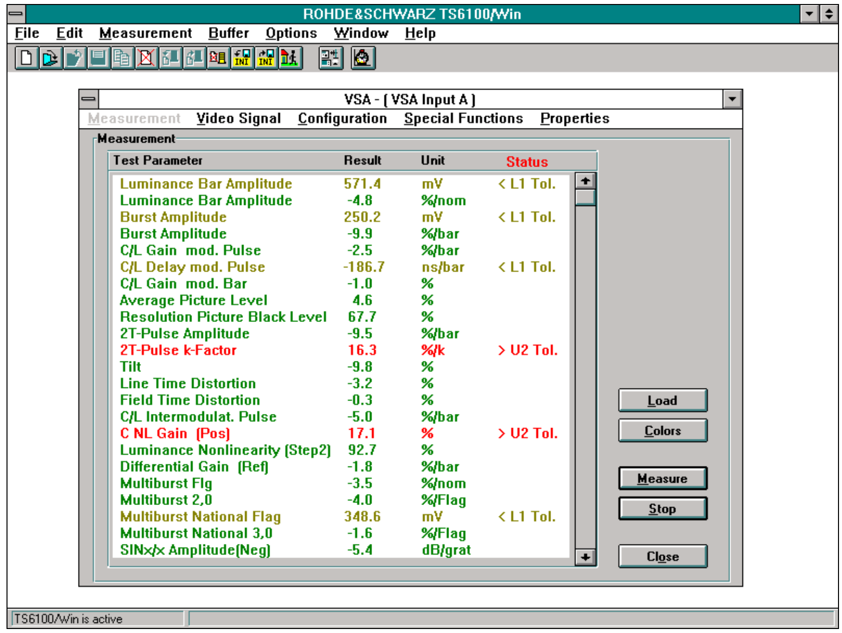
In the interactive mode, each device can be controlled from its own window. All other functions – for instance the measurement and analysis functions – can also be controlled interactively. In this mode it is possible to start and abort measurements, to change device settings with immediate effect and to restart measurements.

System Software TS6100/Win

Automatic measurements are controlled by means of scripts – a macro language – and relieve the user from routine work.

Documentation of results

Measurement results, limit lines and correction factors can be displayed as tables or graphs. Commercially available programs like MS-Excel can be used for this purpose. Rohde & Schwarz supplies a basic evaluation software which can be extended by the customer and adapted to the specific needs. The measurement results are compiled in a user-configurable report to provide an informative piece of documentation.

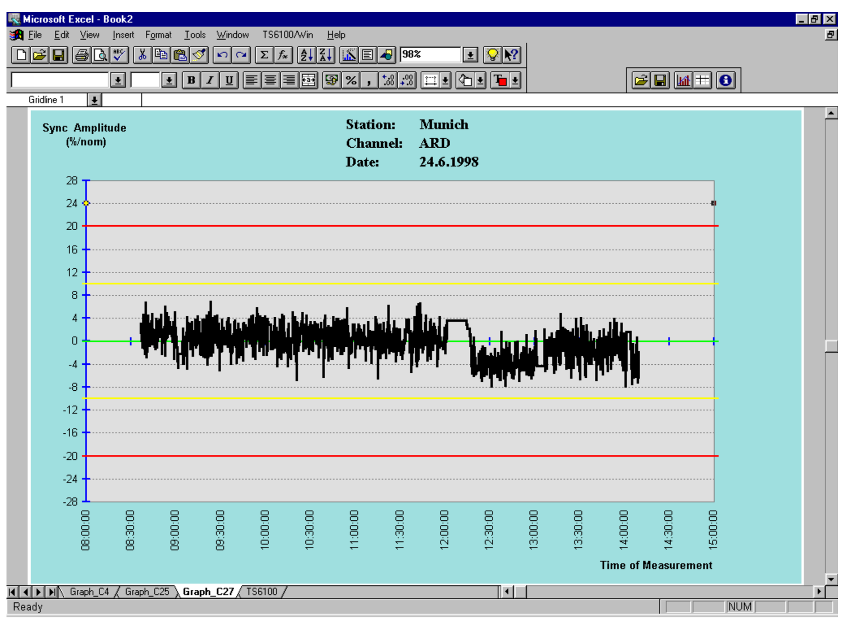


Menu for selecting test parameters for single measurement

Software extensions

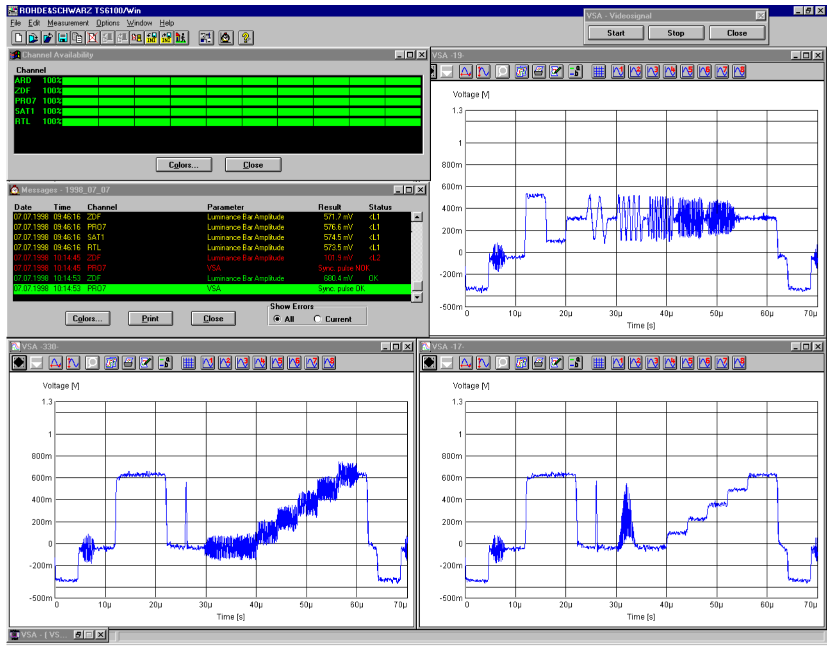
The modular structure of System Software TS6100/Win allows easy integration of options and future upgrading. The required device drivers can be added to the existing software kernel with little programming effort (either by the customer or by Rohde & Schwarz). This concept allows the software to be adapted to the specific needs of the customers.

The basic software not only supports Video Measurement System VSA but also other Rohde & Schwarz measurement equipment, as for instance video generators, test demodulators, spectrum analyzers as well as VF/AF/RF junction panels. Products from other manufacturers can also be integrated into the monitoring system using appropriate drivers (please enquire).



Graphical display of measurement result

System Software TS6100/Win



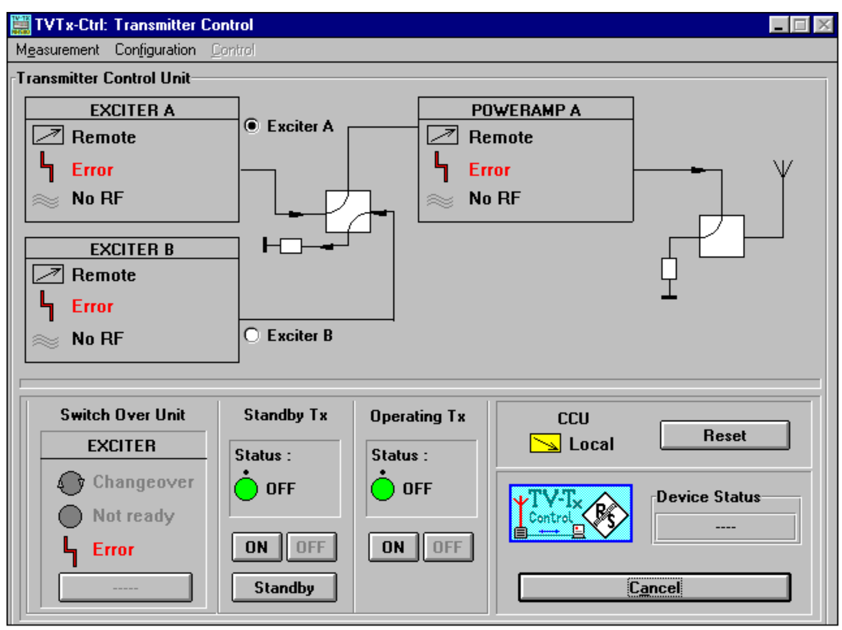
The software informs the user anytime whether the transmitter is fully functional

Transmitter control

Software package for remote control of the transmitter functions via the infrastructure of the monitoring system. The user can make all important settings via the PC directly at the transmitter site or from the control center. The software allows monitoring of the transmitter and supplies important information about its current operating status.

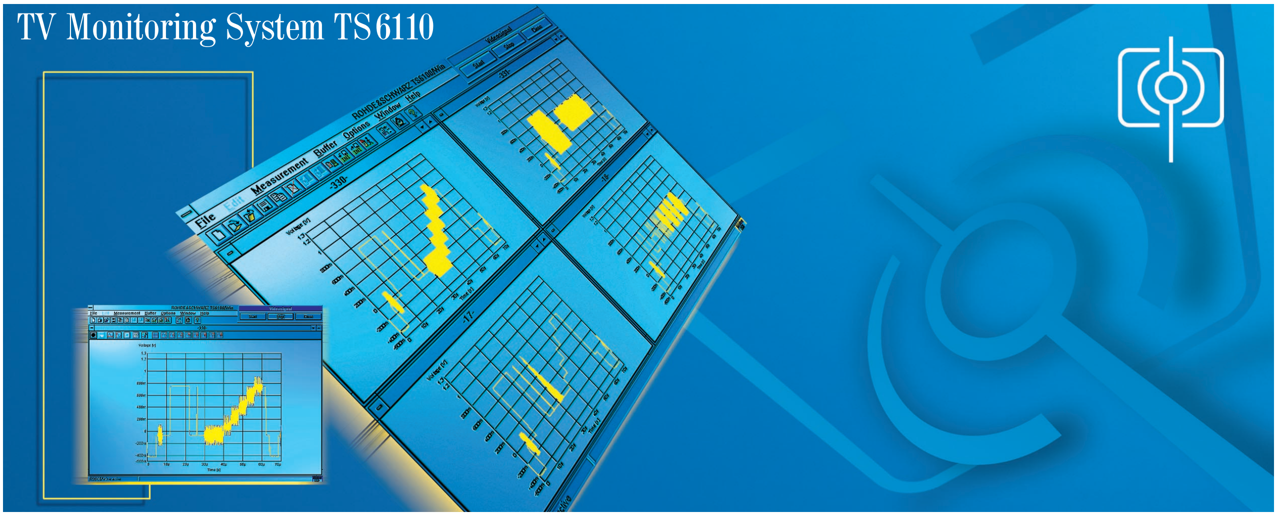
Even if the transmitter generates proper RF output signals, it may be possible that errors in the transmitter go undetected for some time. The software informs the user whether the transmitter is fully functional.

Further options as well as customized configurations will be offered individually on request



All important settings can be (remotely) controlled via PC

TV Monitoring System TS6110



Upgradable low-cost monitoring system with Video PC Card VPC1000 (page 358)

Brief description

TV Monitoring System TS6110 is ideal for low-cost quality monitoring of VF, AF and RF signals in small attended and unattended transmitter stations and at transfer points. The station controller contains the Video PC Card VPC1000 and Monitoring Software T61-K1 for video monitoring. The system can optionally be upgraded to meet specific requirements of the customers.

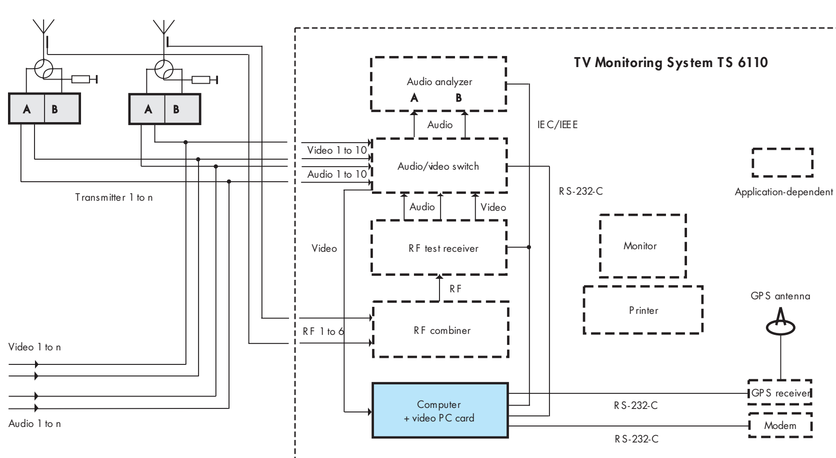
The video analyzer is the measurement core of the monitoring system. It is in the form of a plug-in card (video PC card) in the station controller and is controlled by Software TS6100/Win (page 332).

Specifications

Function	continuous, automatic TV signal monitoring
Measurement core	video PC card, specs see page 358

Ordering information

TV Monitoring System		
Bench model for integration in station controller	TS6110	2066.6000.02
19" rackmount system (36 HU)	TS6110	2066.6000.03



TV Monitoring System TS6110 with transmitter; the basic system configuration – including customer-furnished equipment – is shown in blue

TV Monitoring System TS6120

Basic configuration with Video Measurement System VSA (page 142) for monitoring over 80 video parameters

Photo 43102

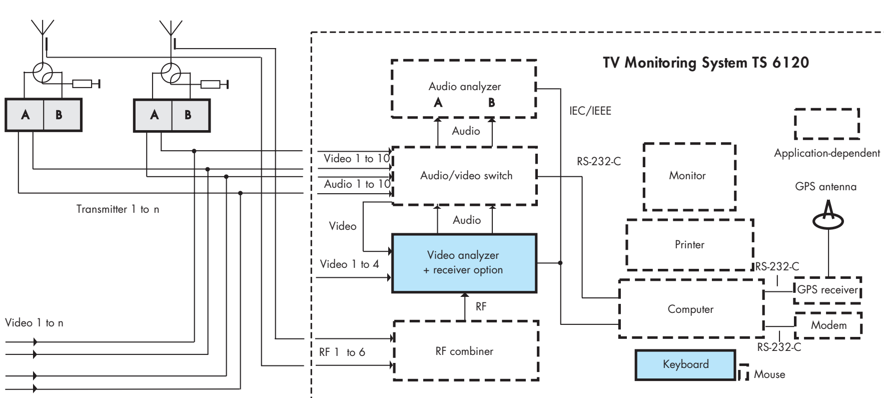
Brief description

TV Monitoring System TS6120 measures and evaluates the TV signal applied (video, audio, RF). Video Measurement System VSA is the main component in this basic system configuration. More than 80 video parameters can be monitored. Monitoring Software T61-K1 runs under Windows on the processor of the VSA. A keyboard with trackball is included. Two serial interfaces are provided for connection of a modem and a GPS receiver (for time synchronization) and a parallel interface for connection of a printer. This is the minimum system configuration.

TV Monitoring System TS6120 is ideal for VF, AF and RF signal monitoring in medium- to large-size attended and unattended transmitter stations and at transfer points. The system can optionally be upgraded to meet specific requirements of the customers.

Ordering information

TV Monitoring System		
Bench model for integration into station controller	TS6120	2066.6251.02
Equipment supplied: Video Measurement System VSA System Software TS6100/Win (page 332) Keyboard with trackball Software licence for operating system Documentation		
19" rackmount system (36 HU)	TS6120	2066.6251.03
Equipment supplied same as above		



TV Monitoring System TS6120 with transmitter; the basic system configuration – including customer-furnished equipment – is shown in blue

TV Transmitter Test and Monitoring System TS6130

Continuous ITS measurements as well as transmitter alignment during program times with Video Measurement System VSA (page 142) and CCVS Generator SFF (page 128)

Brief description

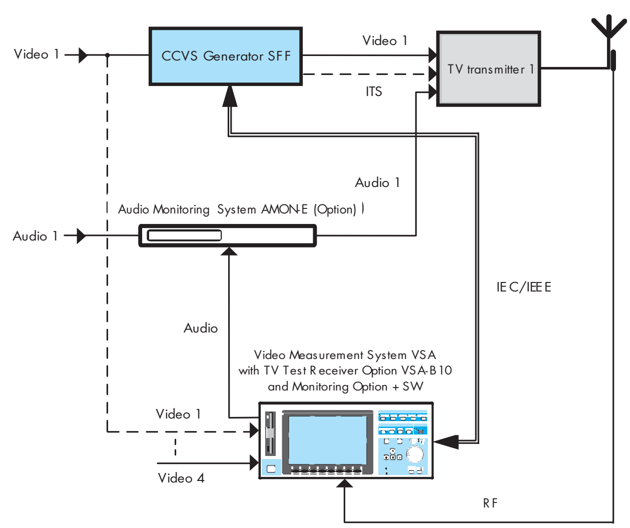
In addition to the monitoring functions of the basic system TS6120, TV Transmitter Test and Monitoring System TS6130 offers the possibility of measuring and aligning the transmitter while it is on air. The additional measurement and control units required for this purpose are either accommodated in the available racks (eg TV transmitter input or monitoring assembly) or in a separate 19" system rack.

BMS BROADCASTING MEASUREMENT SYSTEMS

MONITOR

ITS measurements
Test signals are inserted into the non-visible part of the video signals, measured at various points and evaluated. Evaluation of the test signals to CCIR (eg lines 17, 18, 330, 331) and weighting of the signal/noise ratio are especially conclusive. If certain parameters are out-of-tolerance, more specific measurements can be made to pinpoint the fault.

Transmitter alignment during program times
In addition to the FuBK test pattern and the standard ITS signals, CCVS Generator SFF provides a large number of other video signals (eg with 100 ns rise time to standard specifications; or sin x/x). The TV transmitter can thus for instance be aligned during operation (ICPM measurement). User-defined test signals may also be used.



Block diagram of TV Transmitter Test and Monitoring System TS6130 (audio path optional) with TV transmitter

Ordering information

TV Transmitter Test and Monitoring System (rackmount system)	TS6130	2066.6500.02

Equipment supplied
CCVS Generator SFF
Video Measurement System VSA with TV Test Receiver Option VSA-B10
System Software TS6100/Win
Keyboard with trackball and rack drawer
Software licence for operating system
System cabling
19" rackmount kits
Documentation

TV Transmitter Test System TS6140

Full-field measurements with Spectrum Analyzer FSEA20

(see also page 152)

Example of a TV Transmitter Test System TS6140

(photo 42486)

Brief description

Appropriate measurement facilities are required for acceptance testing and periodical checking of TV transmitters for compliance with standard specifications. In addition to ITS system for on-air monitoring of TV transmitters, Rohde & Schwarz offers systems for comprehensive off-air measurements of the transmission characteristics.

BMS BROADCASTING MEASUREMENT SYSTEMS

MONITOR

TV Transmitter Test System TS6140 is a full-field measurement system which in addition to manual measurements also provides computer-controlled test routines (standard specifications), thus excluding operating errors and erroneous measurements.

TS6140 measures the amplitude frequency response using Spectrum Analyzer FSEA20 and the group delay using a combination of video generator and video analyzer. The tracking generator in the spectrum analyzer is set to a frequency offset of 38.9 MHz. An external mixer (oscillator frequency from transmitter) mixes the RF signal in the video range. Via the video generator the signal is taken to the transmitter for measuring the amplitude frequency response. The output of the transmitter or a testpoint inbetween is directly connected to the input of the spectrum analyzer.

The spectrum analyzer is also used for measuring harmonics (spectral distribution of signals) and frequency (IF/RF). Group delay is measured with the aid of the video analyzer using the sin x/x signal of the video generator.

Ordering information

TV Transmitter Test System TS6140 2066.8002.02

Equipment supplied:
Spectrum Analyzer FSEA20 with Tracking Generator FSE-B8
CCVS Generator SFF
Video Measurement System VSA
TV Demodulator EFA
System Software TS6100/Win (for extended measurements)
System Panel (Signal Selector MFA703 with Control Panel MFA801)
Industrial Controller PSM2
Industrial Monitor (15") PMC4
DeskJet colour printer
System rack with system cabling
19" rackmount kits
Documentation

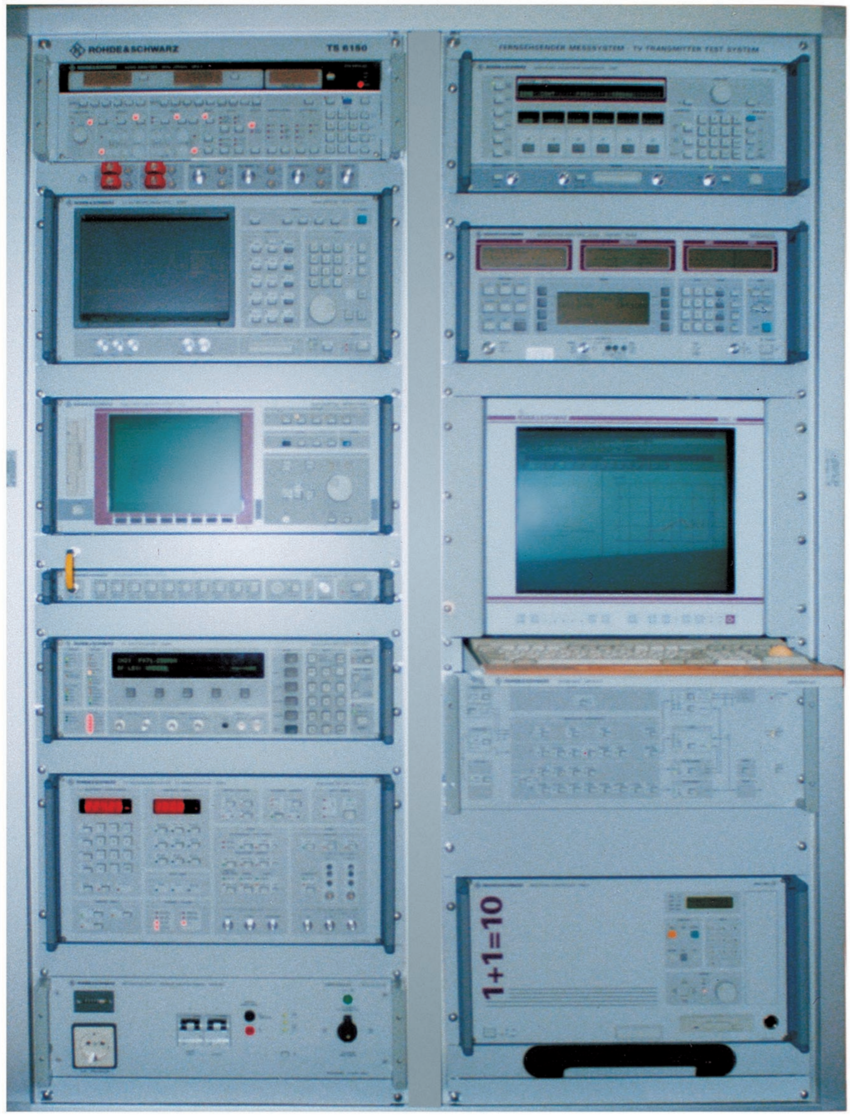
TV Transmitter Test System TS6150

Full-field measurements with TV Network Analyzer SWKF or SOKF (page 136)

Brief description

Similar to Test System TS6140, TV Transmitter Test System TS6150 is used for measurements outside program times – eg for automatic and manual quality measurements of TV transmitters and checking for compliance with standard specifications. Instead of a spectrum analyzer the system uses TV Network Analyzer SOKF or SWKF.

Classic measurements on TV transmitters are based on the use of a TV network analyzer. TV Network Analyzer SOKF or SWKF allows the amplitude and group-delay frequency response to be measured at the video frequency and at the IF/RF. A video signal generator is integrated in SOKF and SWKF. SOKF also has built-in oscilloscope function for evaluating the video signals in the time domain.



- A video generator can be used to provide a standard FuBK test pattern

Options

- A spectrum analyzer for harmonics measurements (spectral distribution of the signals) can be used in addition
- Frequency counters for measuring the frequency accuracy and power meters for the transmitter output power can be added

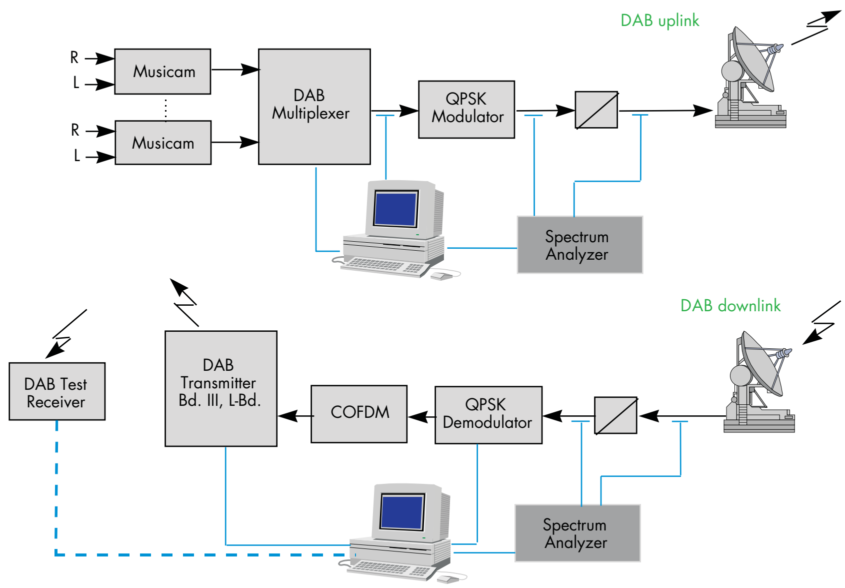
Ordering information

TV Transmitter Test System	TS6150	2066.8254.02

Equipment supplied:
TV Network Analyzer SOKF
TV Demodulator EFA
System Software TS6100/Win (for extended measurements), page 332
System Panel (Signal Selector MFA703 with Control Panel MFA801)
Industrial Controller PSM2
Industrial Monitor (15") PMC4
DeskJet colour printer
System rack with system cabling
19" rackmount kits
Documentation

DAB Monitoring System TS6160

Continuous measurement of DAB signal quality



Brief description

DAB Monitoring System TS6160 continuously measures the quality of the DAB signal. The status of the ETI and DAB signals is graphically displayed on the screen. Alarm and status messages are automatically passed from the monitoring system to the central monitoring station. The messages indicate the reason for the alarm/status information, the time and the identification of the monitored station.

System configuration

Frame Decoder/ETI Analyzer FD1000
ETI Transport Frame Decoder FD1000 analyzes the bit stream in DAB networks at the multiplexer output and transmitter input. It measures the ensemble transport interface (ETI) to ETS 300 799. Further details see page 360.

DAB Multiplexer Software Driver T61-KMU (option)
This software package allows the user to integrate the DAB multiplexer into the automatic TS6100/Win monitoring routines. The multiplexer configuration software can be installed on the same computer.

DAB RF Demodulator Software Driver T61-KDD (option)
This software package allows the user to integrate an RF demodulator/(QPSK) analyzer into the automatic TS6100/Win monitoring routines. The user can also control the demodulator directly from the PC keyboard.

DAB Transmitter Driver T61-K21 (option)
Most DAB transmitters allow direct monitoring and control. The user can perform these functions via the PC directly at the transmitter site or from the central monitoring station. Transmitter settings and error messages are displayed on the screen of the PC so that the user is informed about the status of the DAB transmission chain any time.

The software allows monitoring of the DAB transmitter and provides important information about its current operating status. Even if the transmitter generates proper RF output signals it may be possible that errors in the transmitter go undetected for some time. The software informs the user whether the transmitter is fully functional.

DAB Receiver Philips 752 (option)
A commercial DAB receiver can be used for off-air monitoring of the DAB signal quality. Monitoring can be made directly at the transmitter site or any other site within the network.

DAB Commercial Receiver Software Driver T61-KP7 (option)
This software allows the user to integrate the DAB Receiver Philips 752 into the automatic TS6100/Win monitoring routines. The user can also control the DAB receiver directly from the PC keyboard.

Further hardware and software options see TS6100 overview (page 329) and TS6100/Win (page 332).

Monitoring concept

Various types of disturbances may occur in the DAB transmission chain, anything from a slight interference to a complete transmission breakdown. The newly developed monitoring concept from Rohde & Schwarz enables the operator to choose the extent of monitoring required for his DAB network.

Uplink

The uplink of the satellite transmission path (including the multiplexer) is the most critical point in the DAB transmission chain since several programs are combined in a multiplexer to form a DAB ensemble, which is then transmitted to the satellite (eg DFS Copernicus). If the multiplexer fails or an error occurs in the ETI (ensemble transport interface) signal, the whole network will be affected.

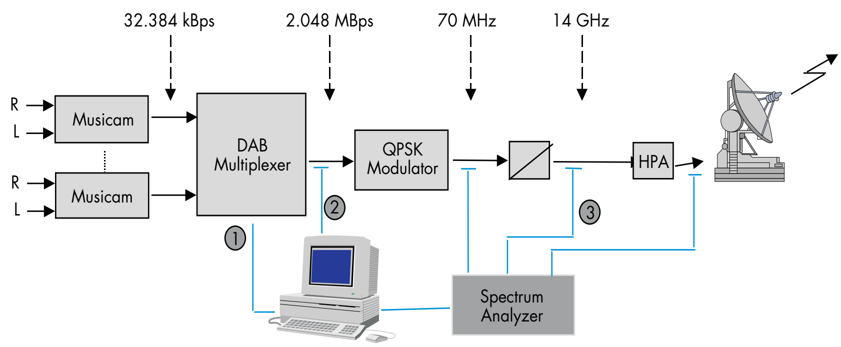
In order to avoid such failures, which can be very costly for the operator, the ETI signal output by the multiplexer is continuously monitored by a decoder and switched to a standby multiplexer whenever necessary. This ensures that an error-free ETI signal will be sent to the satellite. In addition, the RF signal on the uplink can be monitored by a spectrum analyzer containing all the relevant information.

Downlink

The DAB transmitters for terrestrial broadcasting of the satellite signal to the DAB receivers are located at the ground stations. The satellite signal received via the downlink and the terrestrial signal transmitted by the DAB transmitter must be monitored in these stations. The transmission quality of the satellite link can be determined from the various parameters of the satellite receiver which is used to demodulate and decode the received signal. The signal output of the terrestrial transmitter is continuously monitored by a DAB monitoring receiver which allows a comprehensive analysis of the DAB signal. Any error occurring in the DAB transmission chain will be detected by the monitoring receiver and localized with the aid of additional system components. The monitoring receiver is suitable for mobile use as well as for use directly at the transmitter site.

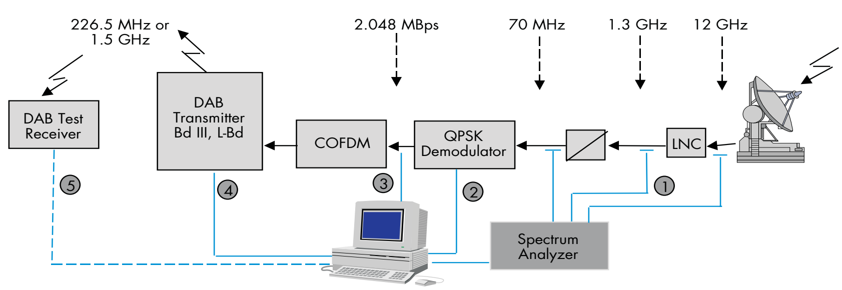
COFDM modulator

A further device for monitoring the transmission chain is the COFDM (coded orthogonal frequency division multiplex) modulator, which provides operational status information (see Sound and TV Broadcasting Catalog).



① Monitoring and configuration of the multiplexer
② Monitoring of the ETI transport stream using Frame Decoder (integrated inside PC).
③ Monitoring of the RF signal using spectrum analyser

DAB uplink

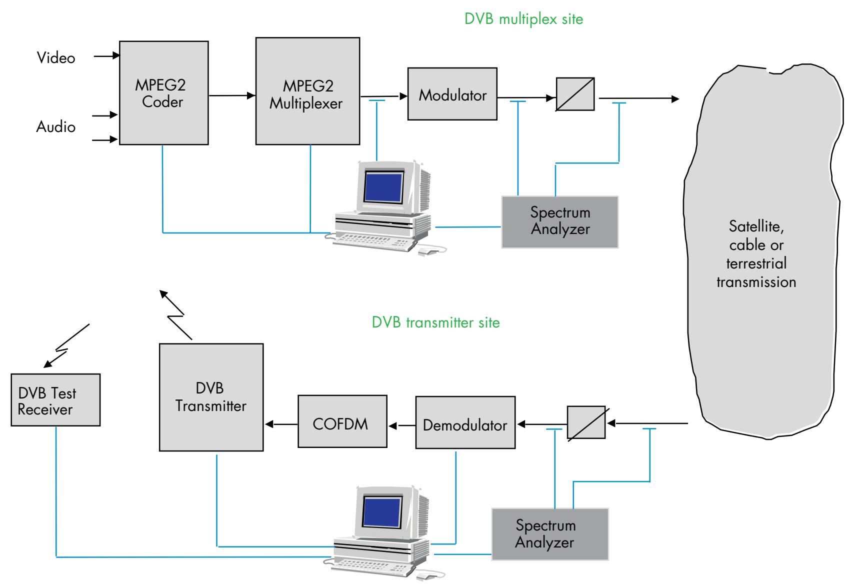


① Monitoring of the RF signal using a spectrum analyzer
② Monitoring of the Eb/N0 signal
③ Monitoring of the ETI transport stream using Frame Decoder (built inside PC)
④ Monitoring and control of the DAB transmitter
⑤ Monitoring of the transmitted DAB signal

DAB downlink

DVB Monitoring System TS6170

Continuous measurement of DVB signal quality



Brief description

DVB Monitoring System TS6170 continuously measures the quality of the DVB signal. The status of the TS and DVB signals is graphically displayed on the screen. Alarm and status messages are automatically passed from the monitoring system to the central monitoring station. The messages indicate the reason for the alarm/status information, the time and the identification of the monitored station.

System kernel

MPEG2 Measurement Decoder/Transport Stream Analyzer DVMD (page 120)
MPEG2 Measurement Decoder DVMD is used to analyze the MPEG2 transport streams in DVB networks. DVMD performs 19 realtime measurements at a time, indicates the contents and provides comprehensive information on the quality of the transport stream. A video and audio output is available for connection of an external monitor.

Options

DVMD Software Driver T61-70
This software package allows the MPEG2 Measurement Decoder DVMD to be integrated into the automatic TS6100/Win monitoring routines or controlled directly from the PC keyboard.

Audio Monitoring System AMON
An AMON generator is used in the TV studio to measure the audio signal with a FFT analyzer and to send the measured values on a 14.85 kHz carrier to the AMON receiver in the monitoring system. The AMON receiver measures the audio signal once more and compares the results with that of the AMON generator. The final results give the audio characteristics of the transmission link.

DVB Satellite Demodulator CT050 (see Sound and TV Broadcasting Catalog)
CT050 is a budget-priced satellite demodulator for demodulation of the DVB QPSK signal. The MPEG2 transport stream available at its output is taken to MPEG2 Measurement Decoder DVMD for analysis.

Software Driver T61-K64 for CT050
This software package allows the user to integrate an IF satellite demodulator (QPSK) into the automatic TS6100/Win monitoring routines. The user can also control the demodulator directly from the PC keyboard.

MPEG2 Switch Matrix Philips BDS300A
With the aid of this hardware option several MPEG2 transport streams can be switched to Measurement Decoder/Transport Stream Analyzer DVMD. This unit has 24 inputs and 8 outputs. Other configurations are also possible.

Software Driver T61-51 for BDS300A
This software package allows the user to integrate Switch Matrix BDS300A into the automatic TS6100/Win monitoring routines. The user can also control the BDS300A directly from the PC keyboard.

Further hardware and software options see TS6100 overview (page 330) and TS6100/Win (page 332).

DVB Monitoring System TS 6170

Monitoring concept

Various types of disturbances may occur in the DVB transmission chain, anything from a slight interference to a complete transmission breakdown.

Uplink

The MPEG uplink via satellite, microwave link or cable is one of the most critical points in the DVB chain since several programs are combined in a multiplexer to form a TS signal. If the multiplexer fails or an error occurs in the MPEG transport stream of the multiplexer, the whole network will be affected and may even break down.

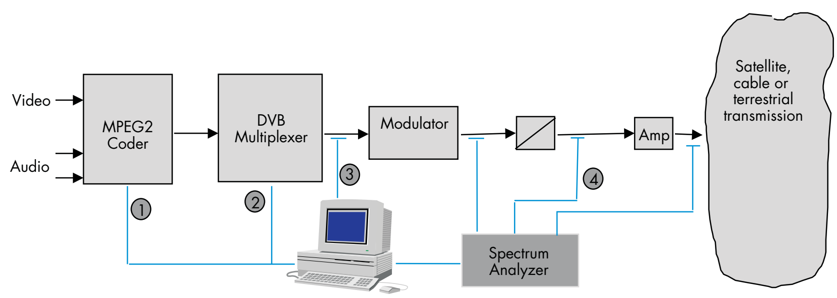
In order to avoid such failures, which can be very costly for the operator, the MPEG transport stream generated by the multiplexer is continuously monitored and switched to a redundant multiplexer whenever necessary. This ensures that an error-free MPEG transport stream will be transmitted on the uplink. In addition, the RF signal on the uplink can be monitored by a spectrum analyzer.

Downlink

DVB transmitters for terrestrial broadcasting to the set-top boxes are located at the ground stations. The signal received (eg from satellite) and the terrestrial signal transmitted by the DVB transmitter must be monitored in these stations. The transmission quality of the satellite link can be determined with the aid of various parameters of the satellite receiver used for demodulating and decoding the received signal. The signal output of the terrestrial transmitter is continuously monitored by a DVB monitoring receiver which allows a comprehensive analysis of the DVB signal. Any error occurring in the DVB transmission chain will be detected by the monitoring receiver and localized with the aid of additional system components. The monitoring receiver is suitable for mobile use as well as for use directly at the transmitter site.

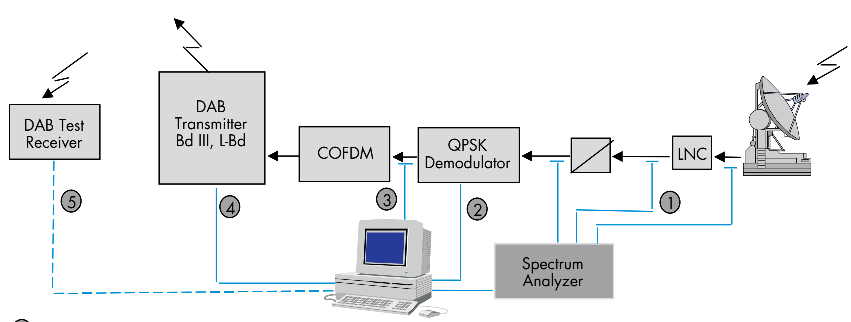
COFDM modulator

A further device for monitoring the transmission chain is the COFDM (coded orthogonal frequency division multiplex) modulator, which provides operational status information (see Sound and TV Broadcasting Catalog).



1 Monitoring of MPEG2 coder
2 Monitoring and configuration of multiplexer
3 Monitoring of MPEG2 transport stream
4 Monitoring of RF signal using spectrum analyzer

DVB uplink

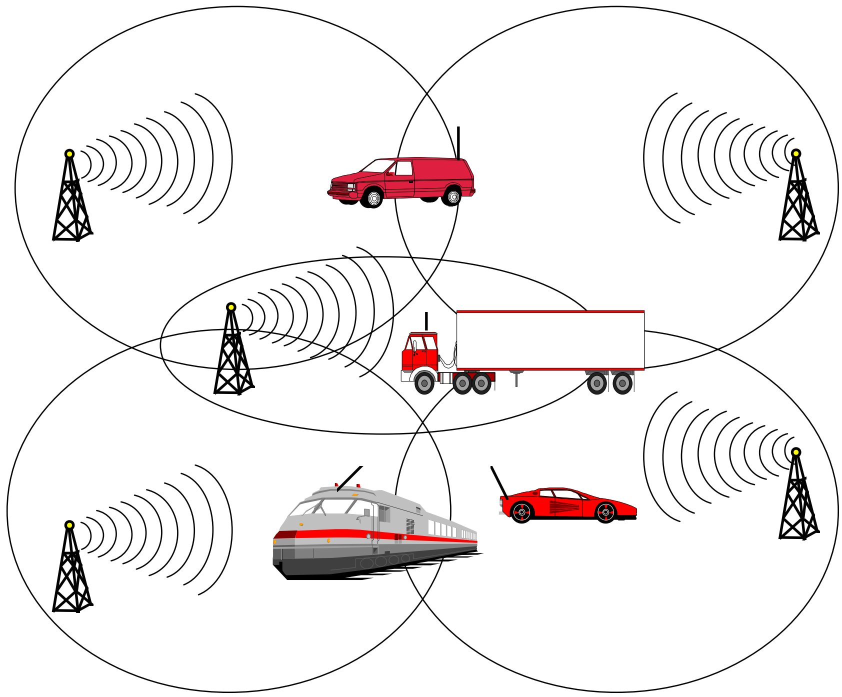


1 Monitoring of RF signal using spectrum analyzer
2 Monitoring of Eb/N0 signal
3 Monitoring of MPEG2 transport stream
4 Monitoring and control of DVB transmitter
5 Monitoring of transmitted DAB signal

DVB downlink

Broadcasting Coverage Measurement Systems TS6200

Mobile and stationary coverage measurements (field strength, bit error rate, channel impulse response, etc)



Possible scenario in a single-frequency network

Introduction

Broadcasting coverage measurements are fast, highly accurate, mobile or stationary measurements of receiver parameters (eg field strength, bit error rate) at a defined location and time during the test phase or operational phase of a transmitter or a complete broadcasting network.

A special measurement concept is required allowing the network operator (among others) to verify reception quality at any time and at any location in the network.

This requirement is valid both during the installation and the operation of a network. Operation must not be interrupted by measurements.

Because of the high network availability required, it is necessary especially during operation for any errors and deviations from nominal to be measured and confirmed very quickly and with high accuracy so that the cause of error can be eliminated.

If for instance the reception of broadcast signals is not possible with a commercial receiver at a given location and time (go/nogo test), the cause of error can be detected with the BMS COVER.

To cover all possible causes of error, it must be possible to measure specific physical parameters in the network. A suitable measurement is required for this purpose. BMS COVER is a coverage measurement system that includes all the equipment and software needed to meet these requirements.

Principle of operation

In a broadcasting network it should be ensured that the programs broadcast by a terrestrial transmitter can be received by commercial receivers without any problems irrespective of location and time.

For this, the terrestrial transmitter must emit a defined, correct signal conforming to specifications to produce sufficiently high field strength levels in the network at low bit error rate.

In single-frequency networks the situation is aggravated by the fact that all

Broadcasting Coverage Measurement Systems TS6200

transmitters broadcast the same information at the same frequency and at the same time (synchronization of information, time and frequency).

To ensure proper reception for a given receiver, it must be possible to measure its primary and secondary parameters both during the installation phase of the network and during operation. Network operation must not be interrupted by measurements.

Measurements during network installation and operation involve different requirements as to

- number of physical parameters
- measurement speed
- measurement accuracy.

Applications

The measurement system must be able to simulate the type of reception (mobile, stationary). For this reason, coverage measurement systems are preferably integrated as mobile systems in test vehicles. Subsystems can of course be implemented in different forms to cater for special applications.

Stationary measurements

The receive quality is measured at a specific point (geographical position) of the network. To this effect, the measurement system is set up at a defined place, the location described, the directional antenna aligned to the transmitter in question by means of the antenna mast and the desired parameters are measured.

The field strength (dBµV/m) is usually the main parameter of interest. Even at sufficiently high field-strength levels the receiver may not be able to detect a given signal so the system must be capable of measuring the BER (channel bit error rate, bit error rate following the Viterbi decoder).

Another important parameter in the single-frequency network is the channel impulse response which among others provides information on the network synchronization.

Furthermore the system should be able to analyze the (digital) data stream of the receiver to provide information on any errors in the program configuration, etc.

The received transmitter spectrum (direct receive path) already allows a first analysis of the expected receive quality.

Mobile measurements

The receive quality is measured along a defined route within the network. Field strength and bit error rate are usually the parameters of interest, with the Lee criterion playing a special role.

According to the Lee criterion, the field strength is to be obtained by averaging over a defined number of measured values along a defined route in order to obtain conclusive information about the field strength conditions. The following has proven itself in practice: 50 measurements/40 wavelengths λ.

For DAB (f = 225 MHz) this means 26 measurements/sec at a speed of 100 km/h, for DAB (f = 1.5 GHz) 167 measurements/sec and for DVB (f = 600 MHz) 70 measurements/sec.

The measurement system must be capable of performing these measurements.

In mobile measurements it is important that a maximum number of measurements is obtained along each route section so that averaged results are available for each parameter.

Portable measurements

Portable measurements are hybrid (mobile and stationary) measurements.

COVER Family

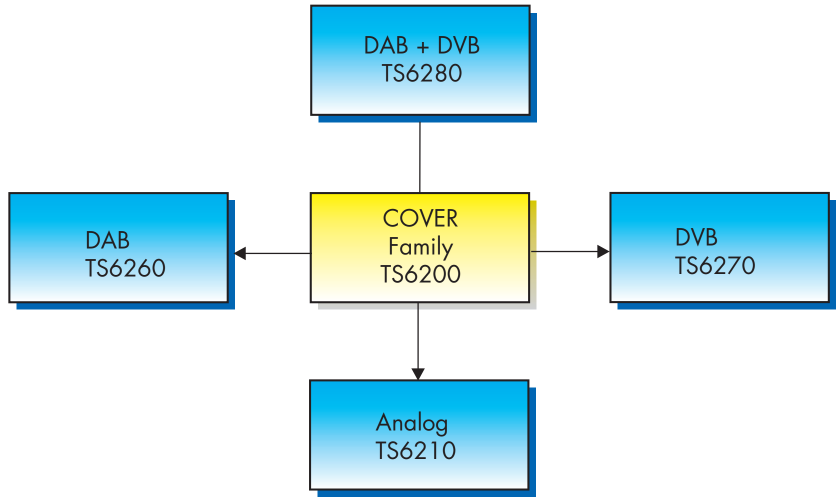
Rohde&Schwarz has developed the TS6200 Cover Family for coverage measurements in broadcasting networks. This system family measures the propagation parameters in digital (DAB, DVB) and analog (VHF and PAL) broadcasting networks. Hybrid measurements (DAB/VHF and PAL/DVB) can also be performed.

Characteristics

The BMS COVER family is made up of subfamilies and optional modules so that the user can choose a cost-optimized, high-precision measurement system tailored to his specific needs and satisfying all requirements for fast and highly accurate quality assessment of a broadcasting network.

Broadcasting Coverage Measurement Systems TS 6200

All system versions feature processor-controlled measurement sequences and storage of results for the purpose of documentation. Parameters measured by BMS COVER systems and the equipment required are listed in the table below.



COVER measurement parameters

Parameter	Significance	Brief description
Field strength	Mobile and stationary measurement of field strength	The field strength provides information about electromagnetic coverage in a network (receiver sensitivity)
Bit error rate	Measurement of bit error rate (before/after Viterbi decoder) in receiver, determination of channel bit error rate by channel estimation	The bit error rate is a measure of the receive quality in the DAB/DVB test receiver
Spectrum	Measurement of transmitter spectrum (receive spectrum)	Checking of required mask
Channel impulse response	For DAB and DVB for checking network synchronization, etc	Non-synchronized transmitters are potential interferers in single-frequency networks
DAB frame	Analysis of ETI frame	Checking of received multiplexer signal
DVB frame	Analysis of transport stream (MPEG2 data stream)	Checking of received multiplexer signal
Go/nogo test	For DAB/DVB, mobile and stationary	Simple checking of reception using a commercial receiver
Position of test vehicle	At the time of measurement	Correlation between current measurement position and current measured value
Climatic parameters	During stationary measurements; before/after mobile measurements	Determination of current atmospheric conditions relevant for measurements
Transmitter monitoring	Correlation of parameters measured in network to parameters emitted by terrestrial transmitter	Determination of transmitter effects on current measured values

Equipment required for parameter measurement (DAB/DVB)

Equipment	Description, type	Test parameter
DAB receiver	Commercial receiver for go/nogo test (GRUNDIG)	Acoustic check of reception
DAB receiver	Test receiver with system interface (Philips 752)	Measurement of bit error rate before/after Viterbi decoder, decoding of digital data stream
DAB test receiver	I/Q output, IF = 10.7 MHz, BW = 1.5 MHz (ESVB, page 84)	Stationary and mobile field-strength measurements for DAB, reception of signals for determination of channel impulse response for DAB
DVB receiver	Commercial receiver for go/nogo test	Acoustic and visual checking of reception
DVB receiver	EFA, page 124	Test receiver with system interface
Video monitor	17" monitor (SONY)	Display of decoded DVB video signal

Equipment	Description, type	Test parameter
DVB test receiver	I/Q output, IF = 10.7 MHz, BW = 8 MHz (ESVB22, page 84)	Stationary and mobile field-strength measurements for DVB, reception of signals for determination of channel impulse response for DVB
GPS receiver	Suitable for mobile use, connected to PC (Garmin, Trimble)	Determination of current measurement position, derivation of GPS time for synchronization tasks in measurement system
Audio monitor	Audio Monitoring System AMON (page 354)	Display of decoded DAB audio signal
Video analysis		Analysis of decoded DVB video signal
Spectrum analyzer	IEC/IEEE bus; screen print (FSEA or Advantest, page 151)	Measurement, display and plotting of received spectrum
ETI analyzer	PC card FD1000 (page 360)	Analysis of digital ETI signal (DAB)
MPEG2 decoder	DVMD (page 120)	Analysis of digital TS signal (DVB)
CIR analyzer	Stand-alone possible	Measurement and display of channel impulse response for DAB/DVB in conjunction with ESVB test receiver
Climatic analysis	Climatic sensors Reinhardt MWS9	Measurement and storage of current climatic conditions, eg temperature, etc, before/after mobile or during stationary measurements
Directional antenna	Mounted on antenna mast (R&S)	Stationary DAB/DVB measurements
Dipole antenna	Optimized for DAB and DVB (ALGOL)	Use in mobile measurements
Antenna mast	Integrated telescopic mast, max. height = 10 m (HSRG), continuously tiltable and retractable, processor-controlled	Implementation of stationary measurement at a height of 10 m in line with EBU Recommendations, data are stored
Switching matrix	Low-loss RF switching matrix (Novotronik)	Switchover between stationary and mobile antenna, switching of receive signal to various instruments
PC	586, 32 MB, 133 MHz, 2 GB hard disk	Control of measuring instruments, collection of measured values, measurement sequence, analysis, data export
Software	Operating software, Windows NT user interface	Control of measuring instruments (setting of measurement status, COVER software), recall of data, on-site display of results
Monitoring system	TS6100, notebook, GSM mobile phone, software	Checking the parameters of any terrestrial transmitter in the network

System software

The software based on Windows NT fulfills the following tasks:

- User interface
- Control of individual instruments
- Storage of measurement results
- Display of results in various display modes (mathematical functions)
- Support of various accessory functions (climatic parameters, compass, etc)

The system operator (who sets the basic parameters) or the user logs in per password.

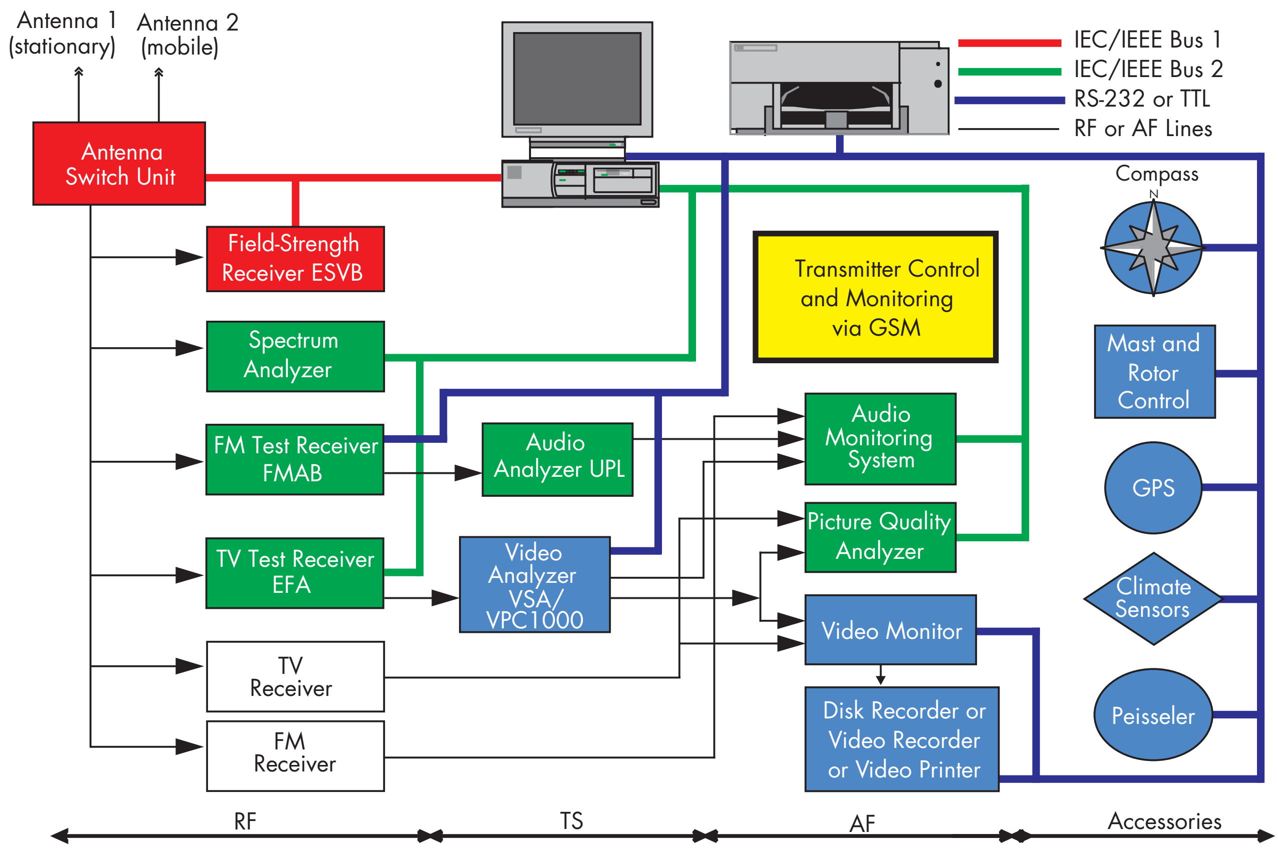
Measurements can completely be predefined and started automatically or manually as a function of time, place or event.

A new measurement can be defined on the basis of a previous one (important for comparison) and started or defined completely new. A Wizzard guides the user through all available definitions. Thanks to the straightforward menu concept, the user is provided with an overview during the definition phase so that erroneous definitions are practically excluded.

Measurements can be carried out by operator and driver or by the driver only. The current overall system status (system error, error present but not relevant for measurement, system o.k., etc) is displayed at all times in the back of the car. During the test tour the driver can enter via preprogrammed keys specific events into the ongoing measurement supported by time and location. The stored results can be evaluated in the lab.

The software has been defined for broad, flexible broadcasting and can be upgraded any time for future tasks.

Analog Coverage Measurement System TS6210



Analog coverage measurements, reception with VHF or PAL receiver

Brief description

With the basic version of TS6210 go/nogo tests can be performed in the network in mobile or stationary reception using a VHF or PAL receiver and the associated position of the test vehicle be determined with the aid of a GPS receiver.

The receivers and the GPS system are computer-controlled so the date and location of the measurements can be documented.

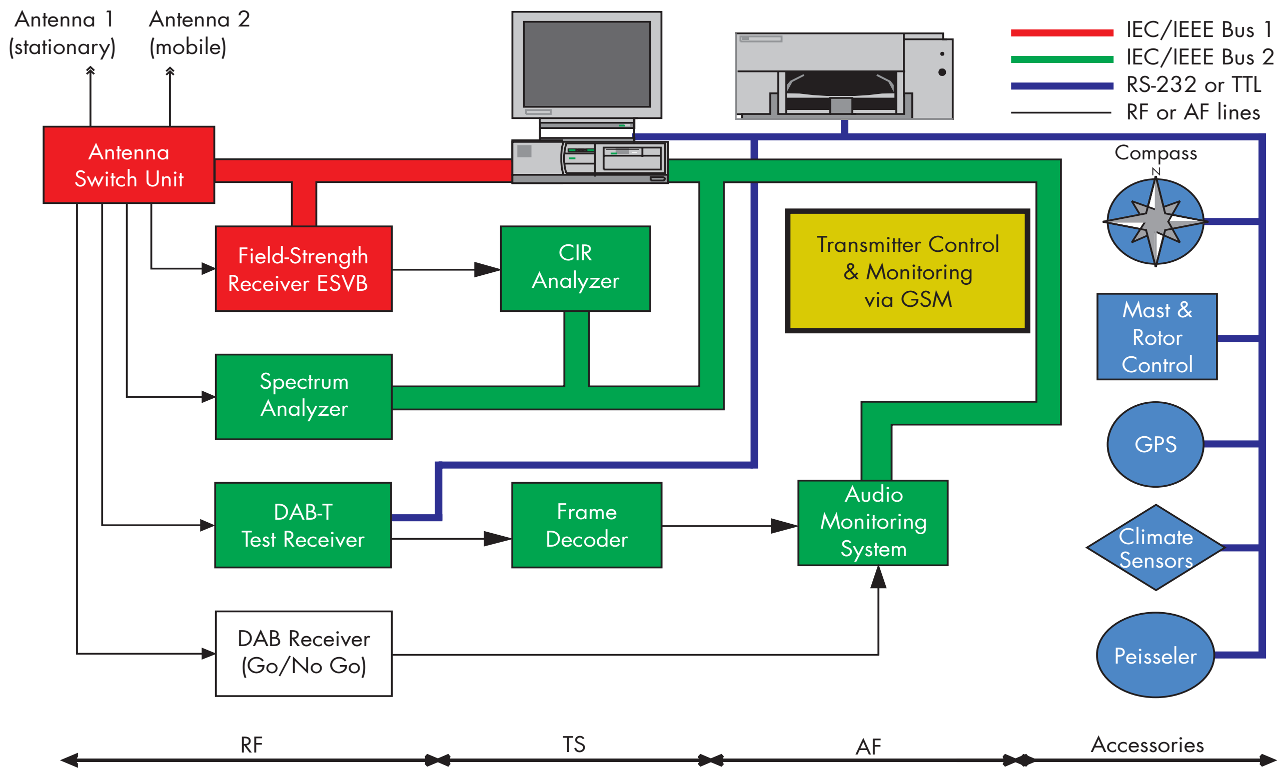
Equipment

- VHF receiver
- PAL receiver
- GPS receiver
- PC
- Software

Options

A large variety of options is available for customized upgrading of the basic version.

DAB Coverage Measurement System TS6260



BMS version for digital radio (Digital Audio Broadcasting DAB-T)

Brief description

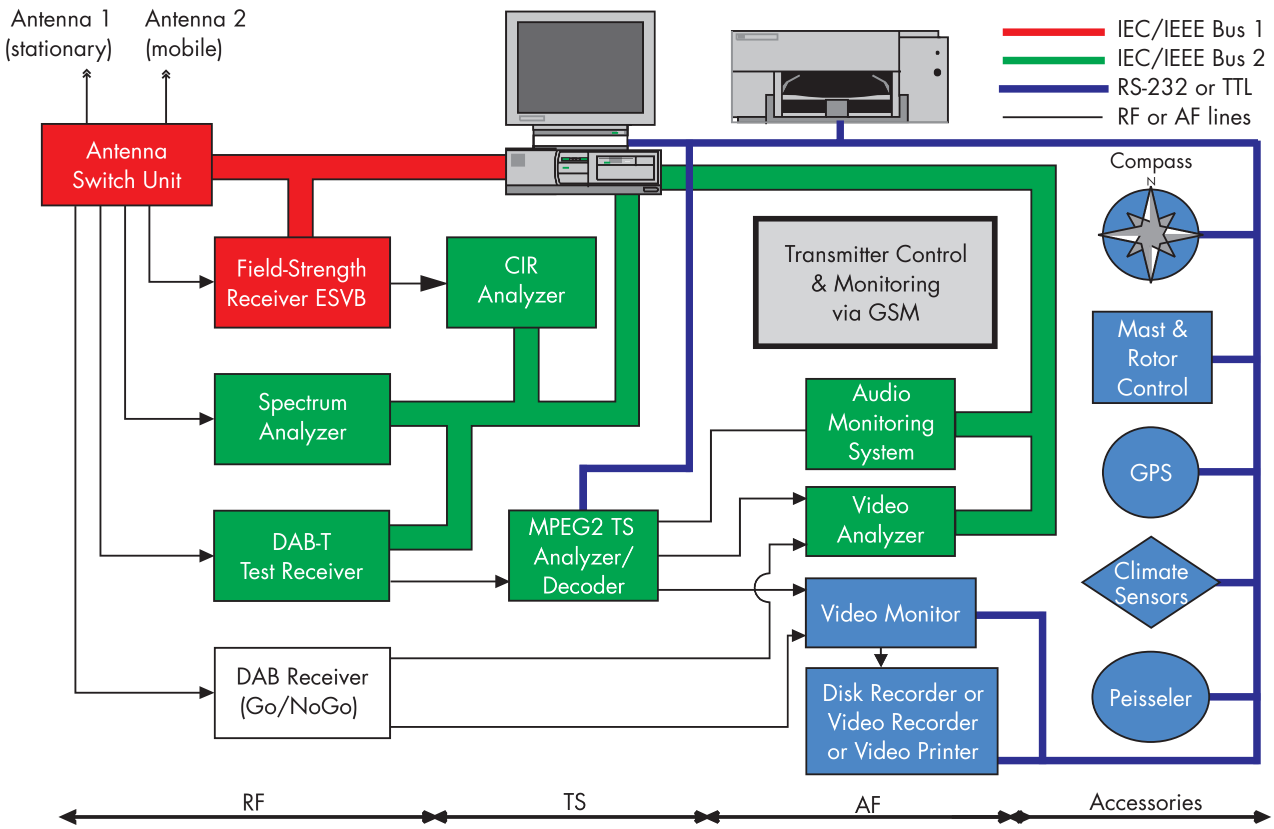
With the basic version of TS6260 go/nogo tests can be performed in the network in mobile or stationary reception using a DAB receiver and the associated position of the test vehicle be determined with the aid of a GPS receiver. Receiver and GPS system are computer-controlled so the date and location of the measurements can be documented.

Equipment
- DAB receiver
- GPS receivers
- PC (586, 32 MB, 200 MHz, 2 GB, D drive, etc)
- Software

Options

The following options are available for upgrading the basic version:
- DAB test receiver
- Field-Strength Test Receiver ESVB (BW = 1.5 MHz)
- Spectrum analyzer
- ETI analyzer
- CIR analyzer
- Climatic analysis
- Antenna mast (height 10 m, telescopic)
- Directional antenna, (dipole) antenna, antenna switch
- Monitoring system (notebook, GSM mobile phone, software)
- Peisseler plate

DVB Coverage Measurement System TS6270



BMS version for digital TV (Digital Video Broadcasting DVB-T)

Brief description

With the basic version of TS6270 go/nogo tests can be performed in the network in mobile or stationary reception using a DVB receiver and the associated position of the test vehicle be determined with the aid of a GPS receiver.

Receiver and GPS system are computer-controlled so the date and location of the measurements can be documented.

Equipment

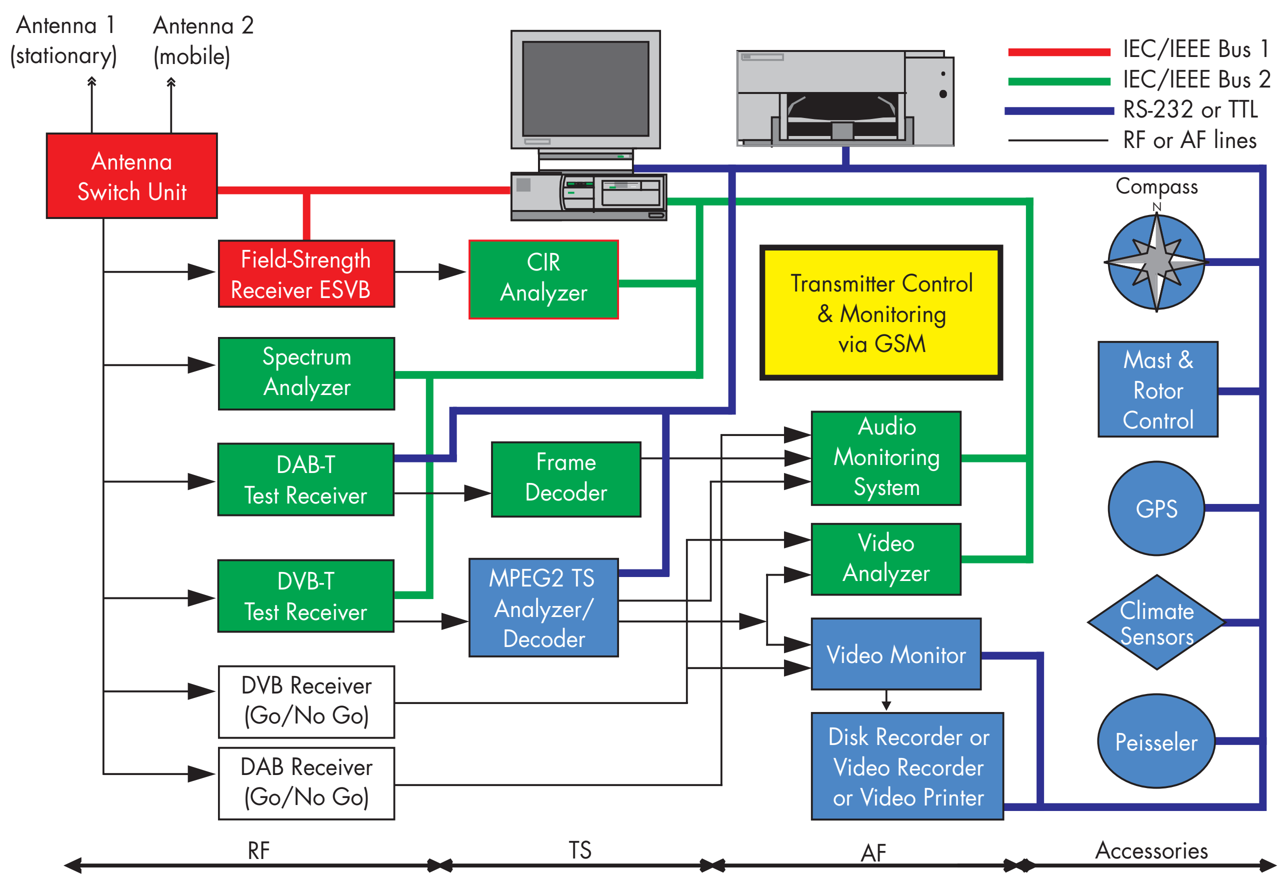
- DVB receiver
- GPS receiver
- PC
- Software

Options

The following options are available for upgrading the basic version:

- DVB test receiver
- Field-Strength Test Receiver ESVB (BW = 8 MHz)
- Spectrum analyzer
- MPEG2 decoder
- CIR analyzer
- Climatic analysis
- Antenna mast (height 10 m, telescopic)
- Directional antenna, (dipole) antenna, antenna switch
- Monitoring system (notebook, GSM mobile phone, software)
- Peisseler plate
- Video monitor

DVB Coverage Measurement System TS6270

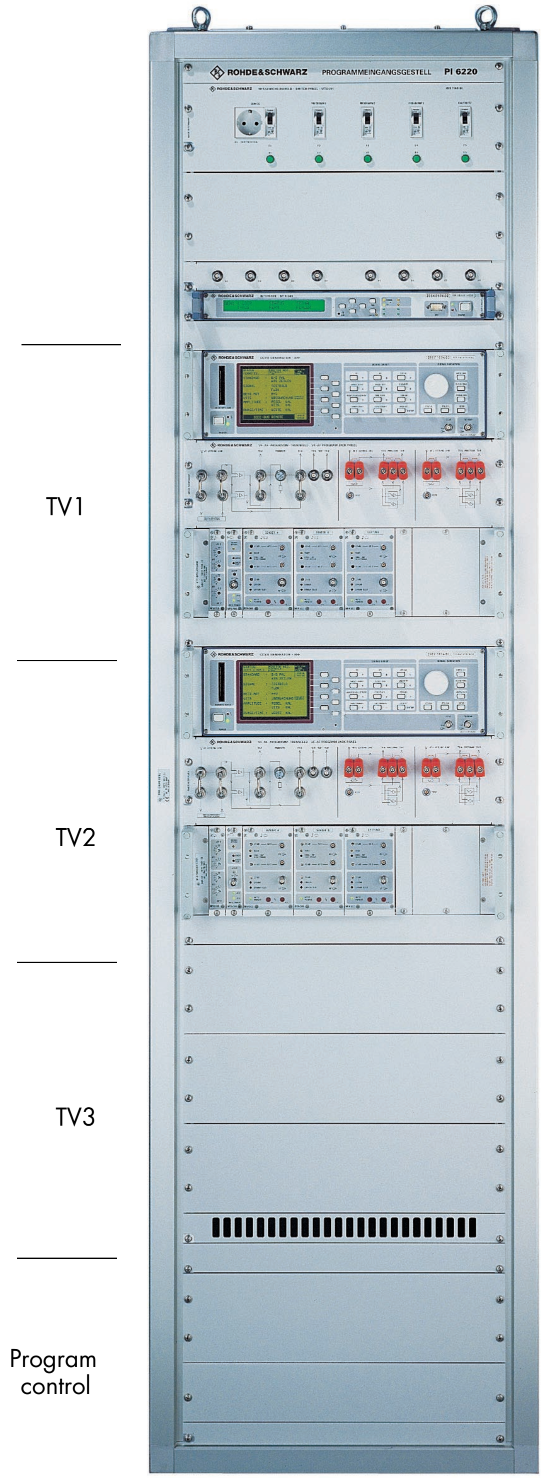


Combination of Measurement Systems TS6260 (DAB) and TS6270 (DAB)

Program Input Racks with Monitoring Function

Program signal processing for dual and single transmitters

Ideal monitoring concept in conjunction with TV Monitoring System TS 61.. (page 329)



Brief description

Program input racks have been designed for coupling the video and audio signals to TV dual transmitters in passive standby with modern exciters as well as to single transmitters. Video and audio monitoring functions can be integrated. The exciters can be equipped with an optional test signal inserter and an audio coder.

Program input racks are used for program signal processing for the transmitters and provide the interfaces for TV monitoring and broadcasting measurement systems (eg System Family TS6100, page 329).

Main features

- Program signal distribution to exciters, signal check and monitoring
- Level matching
- Cable equalization for video program signal
- Test signal insertion
- Demodulation of signal at transmitting or dummy antenna and routing to monitoring systems (eg TS6100)
- Video and audio monitoring for subjective quality assessment
- Checkpoint selection for AF, VF, IF and RF signals

Characteristics

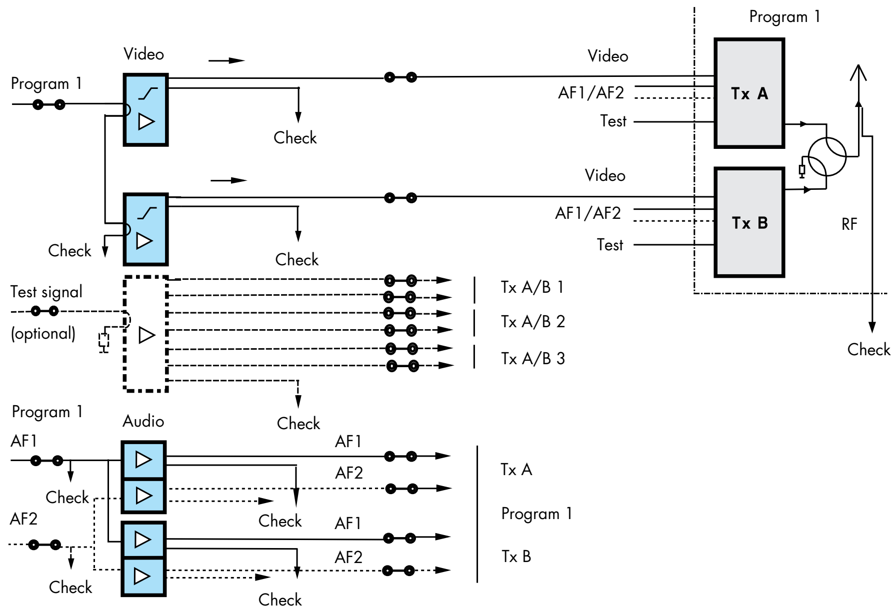
The TV program can be switched to up to three TV transmitters via the built-in video and audio distribution amplifiers and monitored.

The input signal levels can be adjusted and signal distortion corrected by a cable equalizer. The video audio switch allows various backup circuits to be implemented. Signal outputs are available for connection of external measurement devices.

Signal paths

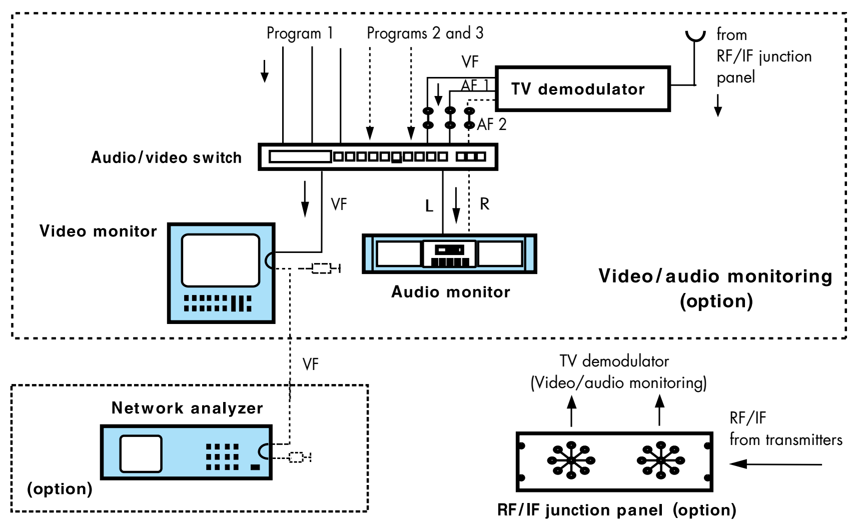
The video signal is passed through the distribution amplifier. The built-in video control and cable equalizer allow the signal to be adjusted to nominal level. A level matching circuit is provided at the audio signal input for adjusting the nominal level for the transmitter input.

VF and AF junction panels allow connection of additional devices and of a TV monitoring system.



Program input rack connected to dual transmitter (video and audio distribution amplifiers with setting facilities shown in blue; optional test signal insertion shown for three dual transmitters

Optional monitoring facilities allow program and test signal monitoring from the rack inputs through to the antenna



Specifications in brief

Signal paths	**RF**	**IF**	**VF**	**AF**
Impedance	50 Ω	50 Ω	75 Ω	>30 kΩ, bal.
Connectors	N	SMA	BNC/Musa	Triax/XLR
Frequency range	40 MHz to 960 MHz	26 MHz to 47 MHz	0 MHz to 6 MHz	10 Hz to 15 kHz
Number of checkpoints	6	3	7	7 x dual-channel

Video signal path

VF input impedance	75 Ω
Return loss up to 6 MHz	
Inputs	≥34 dB
Outputs	≥26 dB
Crosstalk attenuation (between lines with different signals) up to 6 MHz	≥60 dB
S/N ratio (weighted, rms without hum)	≥60 dB, ref. to 0.7 V picture signal
Gain of program lines	0 dB (nominal value)
Setting range for level control	1 V pp ±6 dB

Audio signal path

AF input impedance	600 Ω
Gain of program lines	±6 to ±33 dB, adjustable
Crosstalk attenuation (between lines with different signals) up to 6 MHz	≥75 dB
S/N ratio (weighted)	≥66 dB, referred to +6 dBm

General data

Cooling	none
Power supply	230 V
Power consumption (fully equipped)	850 VA
Dimensions (W x H x D)	540 mm x approx. 2000 mm x 1000 mm (adaptable to transmitter depth)
Weight (fully equipped)	approx. 200 kg

Audio Monitoring System AMON

Link measurements without program interruption

Photo 42927

Brief description

Audio Monitoring System AMON serves for the monitoring of audio transmission equipment. The actual program signal is used as the test signal so that the transmission link quality can be monitored during program time.

Measurements

Measurements are carried out at the source and sink simultaneously. Synchronization is via the data signal.

Remote control

For remote-control applications a serial (RS232) and a parallel (8-bit data word) interface are provided for each channel.

Operation

The audio signal is divided up into 14 frequencies and the rms value of each of them is measured and transmitted to the receiver. The receiver analyzes the incoming signal and compares the results with the data of the source analysis. The differences between the two characterize the transmission link quality.

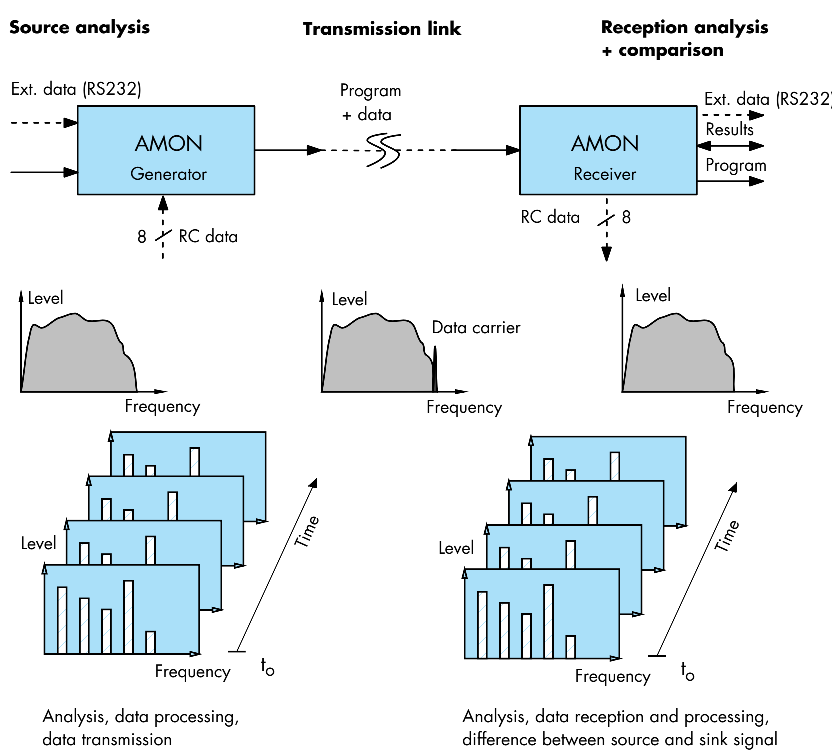
Data are inserted into the program signal at the upper end of the audio band at 14.85 kHz. The bit rate is 400 bit/s per channel.

Each measurement yields 15 test values per sound channel, which allows the determination of the following transmission link parameters depending on the program signal used:

- level accuracy
- frequency response
- S/N ratio
- polarity (phase L/R)
- channel and program assignment

Option AMON-F1

A sound generator in the AMON decoder enables complete sound measurement (frequencies). Automatic measurements according to CCITT0.33 are also possible. This option enables the measurement of audio transmission equipment during program intervals. It may be used with both the AMON generator and the AMON receiver, thus allowing measurements on the transmission link and the audio transmitter to be performed separately.



Principle of operation

Audio Monitoring System AMON

Monitoring
The AMON decoder has an extra stereo test input for monitoring transmission equipment at the site. The signal received at this input is compared directly with the program input, which yields information on the quality of the sound broadcast transmitter. The results obtained are compared with integrated tolerance tables.

Digital links
If a data channel with a defined delay to the program signal is available, the system can also be used for digitally coded audio links with compressed data. The signals are compared in the analog domain.

Interface
For use within a system the test results are available at the IEEE488.2 (IEC625-2) interface. AMON can also be integrated into Monitoring Systems TS6100 (page 329) using Software Driver T61-K40.

Specifications

Data transmission of modulator	
Type of modulation	4DPSK
Pulse shaping	square root of cosine
Roll-off factor	40%
Bit rate	approx. 400 bit/s per channel (L, R)
Bandwidth	±140 Hz
Carrier frequency	14.85 kHz
Carrier amplitude	–50 to –35 dB (selectable)
Residual carrier (40 Hz to 14.5 kHz)	<–90 dB
Data transmission of demodulator	
Coherent 4DPSK demodulator	
Residual carrier (program output)	<–90dB
Audio filter	
Frequency response 40 Hz to 14.5 kHz (reference 1 kHz)	<+0.1/–0.2 dB
Group delay (1 kHz)	<2 ms
Phase linearity (40 Hz to 13 kHz)	±2°
Phase difference L/R (40 Hz to 13 kHz)	<4°
Stopband attenuation above 14.71 kHz	>70 dB
Distortion	
at 1 kHz/6 dBu	<0.05%
40 Hz to 14.5 kHz	<0.15%
Unweighted S/N ratio (referred to maximum volume)	>78 dB (CCIR 468)
Weighted S/N ratio (referred to maximum volume)	>72 dB (CCIR 468)
Crosstalk (L/R)	<–85 dB
Monitoring	
Resolution	0.1 dB
Measurement range	approx. 100 dB
Measurement time	approx. 200 ms
Measurement speed	approx. 1 measurement/4 s
Test report	start code, program identification, 14 selective test values, two broadband test values, checksum, 8-bit remote-control data
Parameters	level error, frequency response, S/N ratio, polarity (phase L/R), channel assignment, program assignment
Measurement functions (optional)	
Generator sequence	CCITT 0.33, program No. 01
Start	1650 Hz/1850 Hz (FSK)
Level	1020 Hz/0 dB
Frequency response	13 frequencies /–12 dB
Distortion	60 Hz/1020 Hz/+9 dB
Crosstalk	2040 Hz/–12 dB
Analyzer measurement range	
Level range	+12 to –85 dB
Measurement accuracy	±0.2 dB (+6 to –20 dB)
Frequency response	+0.1/–0.2 dB (40 Hz to 14.5 kHz)
Distortion	0.1 to 100%
Crosstalk	>70 dB
Unweighted S/N ratio	–70 dB (CCIR 468)
Weighted S/N ratio	–65 dB (CCIR 468)
Interfaces	
AF program inputs	female connector (similar to DIN41524)
Balanced/floating	transformer
Nominal level	0 to 12 dBu (selectable)
Headroom	9 dB
Input impedance	600 Ω/22 kΩ (can be coded)
AF auxiliary inputs	female connector (similar to DIN41524)
Balanced/floating	transformer
Nominal level	0 to 12 dBu (selectable)
Headroom	9 dB
Input impedance	600 Ω/22 kΩ (can be coded)
AF program outputs	male connector (similar to DIN41524)
Balanced/floating	transformer
Nominal level	0 to 12 dBu (selectable)
Headroom	9 dB
Output impedance	<40 Ω
External data (serial)	2 x sub-D 9-contact RS232 DTE
External data (parallel)	2 x sub-D 25-contact (floating)
Bypass	bypasses program inputs and outputs in case of failure
Messages	bypass ON, alarm and loss of synchronization via contacts
Measurement values/messages	IEEE488.2 (IEC625-2)
Front-panel display	LCD, 2 x 40 characters, alphanumeric
General data	
Rated temperature range	+5 to +45°C
Power supply	100 to 240 V, 50 to 60 Hz (50 VA)
Dimensions (W x H x D)	427 mm x 44 mm x 460 mm
Weight	approx. 4.2 kg

Ordering information

Generator	AMON-G	2067.1001.02
Receiver	AMON-E	2067.1001.03
Accessories supplied	power cable, mating connector	
Options		
19" Adapter	ZZA-91	0396.4870.00
Measurement to CCITT 0.33 for Generator/Receiver	AMON-F1	2067.1501.02
Adapter Cable Set (3-contact male and female connectors to XLR, similar to DIN 41524)	AMON-Z	2067.1476.00
Software Driver for integration into Monitoring Systems TS6100	T61-K40	2066.6800.00

Audio Data Transmission System ADAS

Transmission of data within the program signal

Photo 42923

Brief description

Audio Data System ADAS serves for the transmission of data from the studio to the transmitter via standard program feed lines. The system hardware is a 19" rackmount of 1 height unit. The simplest way of using it is to connect a terminal to the RS232 interface in the studio and at the transmitter end (see illustration). This arrangement allows data transmission between studio and transmitter.

A more complex application is the transmission of dynamic RDS data (see illustration). In this case data are processed in a PC with the aid of the PROFI software (supplied with RDS Codec DMC01). The serial data are recovered at the transmitter and fed to DMC01, where they are processed and become available as a 57 kHz RDS signal. If the stereo coder does not have an RDS input, DMC01 can modulate the MPX signal as required by means of the RDS signal (see DMC01 data sheet PD757.0435).

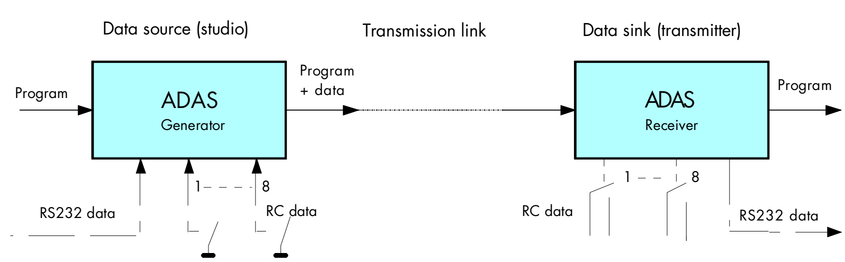
This enables the user to set up a country-wide RDS network without dedicated data feed lines.

Of course, ADAS may also be used to transmit all other RDS functions.

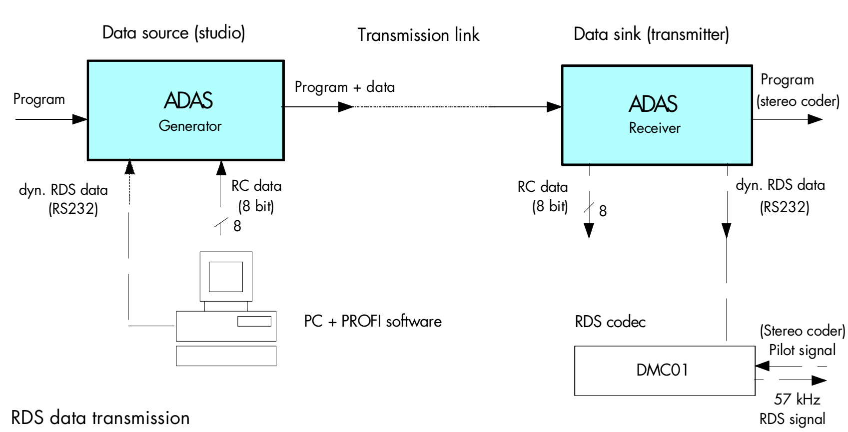
In addition to the data transmitted via the serial interface, an 8-bit data word for remote-control applications (RC data) is also available. The inputs at the studio are floating (optocoupler) and the outputs are floating relay contacts. Thus the stereo coder can be switched from mono to stereo and vice versa. Remote control of the transmitter is also possible.

Main features

- Data transmission from studio to transmitter during program time
- Transmission via 34 Mbit/s paths, ADR or ISDN possible
- Remote control of transmitters
- Utilization of existing audio lines
- RDS data transmission
- Program identification
- Serial and parallel inputs (2 x RS232C, 2 x 8 bits parallel)



Block diagram of data flow



RDS data transmission

Audio Data Transmission System ADAS

- Transmission rate 2 x 400 bit/s
- Carrier frequency 14.85 kHz
- Carrier amplitude –50 to –35 dB

Operation

Data are inserted into the program signal at the upper end of the audio band at 14.85 kHz. The maximum transmission rate is 400 bit/s per channel. Data are output via the serial RS232 and/or the parallel 8-bit RC interface. The remote-control data are polled in the studio once per second and then transmitted. Transmission of serial data is continuous. A large number of addressing levels (256 main addresses, 16 subaddresses) allow the access to individual receivers or receiver groups.

Specifications

Data transmission of modulator	
Type of modulation	4DPSK
Pulse shaping	square root of cosine
Roll-off factor	40%
Bit rate	approx. 400 bit/s per channel (L, R)
Bandwidth	±140 Hz
Carrier frequency	14.85 kHz
Carrier amplitude	–50 to –35 dB (selectable)
Residual carrier (40 Hz to 14.5 kHz)	<–90 dB
Data transmission of demodulator	
Coherent 4DPSK demodulator	
Residual carrier (program output)	<–90 dB
Audio filter	
Frequency response 40 Hz to 14.5 kHz (reference 1 kHz)	<+0.1/–0.2 dB
Group delay (1 kHz)	<2 ms
Phase linearity (40 Hz to 13 kHz)	±2°
Phase difference L/R (40 Hz to 13 kHz)	<4°
Stopband attenuation above 14.71 kHz	>70 dB
Distortion	
at 1 kHz/6 dBu	<0.05%
40 Hz to 14.5 kHz	<0.15%
Unweighted S/N ratio (referred to maximum volume)	>78 dB (CCIR 468)
Weighted S/N ratio (referred to maximum volume)	>72 dB (CCIR 468)
Crosstalk (L/R)	<–85 dB
Interfaces	
AF inputs	female connector (similar to DIN41524)
Balanced/floating	transformer
Level	0 to 12 dBu (selectable)
Headroom	9 dB
Input impedance	600 Ω/22 kΩ (can be coded)
AF outputs	male connector (similar to DIN41524)
Balanced/floating	transformer
Level	0 to 12 dBu (selectable)
Headroom	9 dB
Output impedance	<40 Ω
External data (serial)	2x sub-D 9-contact RS232 DTE
External data (parallel)	2x sub-D 25-contact (floating)
Bypass	bypasses AF inputs and outputs in case of failure
Messages	bypass ON and loss of synchronization via contacts

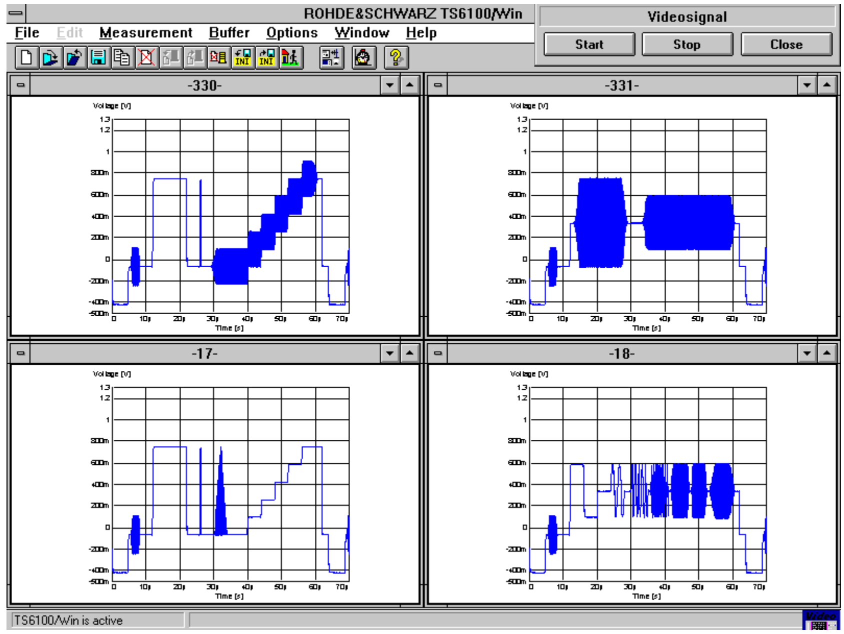
General data	
Rated temperature range	+5 to +45°C (operation class 1)
Storage temperature range	–40 to +70°C
Power supply	100 to 240 V, 50 to 60 Hz (50 VA)
Dimensions (W x H x D)	427 mm x 44 mm x 460 mm
Weight	approx. 4.2 kg

Ordering information

ADAS Generator	ADAS-G	2067.2008.02
ADAS Receiver	ADAS-E	2067.2008.03
Accessories supplied	power cable, mating connector	
Extras		
Adapter Cable Set (3-contact male and female connectors)	AMON-Z	2067.1476.00
19" Adapter	ZZA-91	0396.4870.00

Video PC Card VPC1000

High-quality and cost-effective video measurements using a PC



Brief description

Operators of TV broadcasting stations are required to provide highest quality and maximum transmission reliability (99.9%/year) while reducing operating costs. Video monitoring systems are used to increase transmission quality. Video monitoring provides continuous, unattended measurement of picture quality and signalizes any degradation of transmission. This kind of preventive maintenance substantially cuts down on operating costs.

Video PC Card VPC1000 meets the requirements for unattended, cost-effective video monitoring in broadcast and cable television. It is a high-quality, low-cost monitoring solution for manned and unmanned television stations, relay stations and studios.

Applications

VPC1000 is a standard PC card for use with an IBM-compatible computer and is controlled by a measurement program. Several cards can be installed in a PC, which allows several video signals to be measured simultaneously. VPC1000 can be inserted, for example, in the Portable Industrial Controller PSP7 from Rohde&Schwarz (battery-operated!), which yields a small, compact video measurement system for field use.

VPC1000 provides measurement of teletext and data lines using eye height and eye width as well as display of the data in ASCII format. By evaluating the data line it is ensured that the signal transmitted is identical with the signal measured.

Software

VPC1000 comes with a Windows driver (DLL). With the aid of a standard program such as LabWindows, user-specific measurement and monitoring routines can be created.

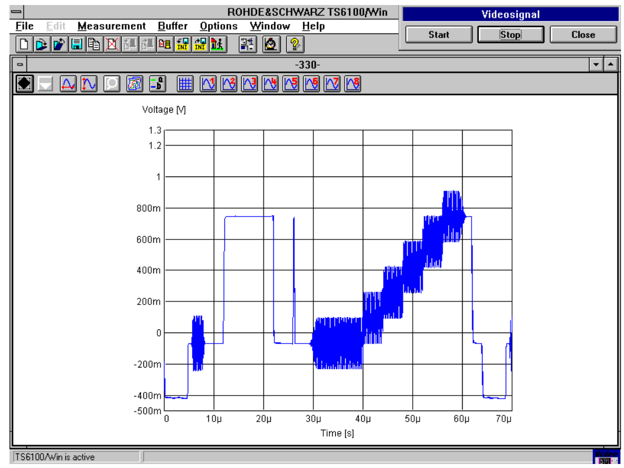
Rohde & Schwarz also offers software packages for automatic monitoring systems, eg TS6100/Win. This software package makes it easy to define and store measurement results and tolerances. Any alarm messages that may be generated (eg tolerance limits exceeded) can be sent to a control center. The software package allows the integration of further measuring and monitoring equipment (eg Audio Monitoring System AMON).

Video PC Card VPC1000

Specifications in brief

Video signals	
Video standards	PAL and NTSC
Test signals	CCIR17, CCIR18/6, CCIR18/4, CCIR330, CCIR331, UK-ITS1, UK-ITS2 and NTC7
Test lines	6 to 622 (selectable)
Data line decoder	standard
Teletext decoder	standard
Video inputs	
Number	2 x BNC terminated with 75 Ω
Level	1 V pp ±3 dB
Offset	±1 V
Input attenuation	>34 dB
Isolation of inputs	>60 dB
A/D converter	10 bit, clock frequency >20 MHz

Measurement parameters	Unit	Range	Max. error
Amplitude & delay			
Luminance bar amplitude (nom)	%/nom	–0 to +50	±2
Sync level (nom)	%/nom	50 to +50	±2
Burst level (nom)	%/nom	50 to +50	±3
C/L gain (20T pulse)	%/bar	–25 to +25	±3
C/L delay (20T pulse)	ns	–300 to +300	±20
Residual carrier	%	0 to +30	±1
Linear distortion			
Baseline distortion	%/bar	–20 to +20	±1
2T pulse amplitude	%/bar	–20 to +20	±3
2T k rating	%	0 to 10	±0.8
Tilt	%	–20 to +20	±1
Nonlinear distortion			
Luminance nonlinearity, step 1/2/3/4/5	%	50 to 100	±4
Differential gain, step 1/2/3/4/5	%	–25 to +25	±3
Differential phase, step 1/2/3/4/5	degrees	–25 to +25	±3
Frequency response			
Multiburst flag (nom)	%	–50 to +50	±3
Multiburst 0.5/1/2/4/4.8/5.8	%	–50 to +50	±3
Multiburst nat flag (nom)	%	–50 to +50	±3
Multiburst nat 0.5/1.5/3.0/4.4	%	–50 to +50	±3
Noise			
Luminance S/N ratio, unweighted (nom)	dB	35 to 60	±2
Luminance S/N ratio, weighted (nom)	dB	35 to 65	±2
Data line			
Reading of words	word	1 to 15	–
Start position	μs	12.5	±2
Basic amplitude (nom/bar)	%	6 to 150	±5
Decoding margin	%	100 to 0	–
Decoding margin, w/ref bar	%	150 to 0	–
Eye height	%	150 to 20/ 20 to 0	±2/ ±4
Eye width	%	100 to 20/ 20 to 0	±2/ ±4
Run-in bits	–	6 to 24	–
Data timing	μs	10 to 14	±0.1
Teletext			
Basic amplitude (nom/bar)	%	6 to 150	±5
Decoding margin	%	100 to 0	–
Decoding margin, w/ref bar	%	150 to 0	–
Eye height	%	150 to 20/ 20 to 0	±2/ ±4
Eye width	%	100 to 20/ 20 to 0	±2/ ±4
Run-in bits	–	6 to 24	–
Data timing	μs	10 to 14	±0.1

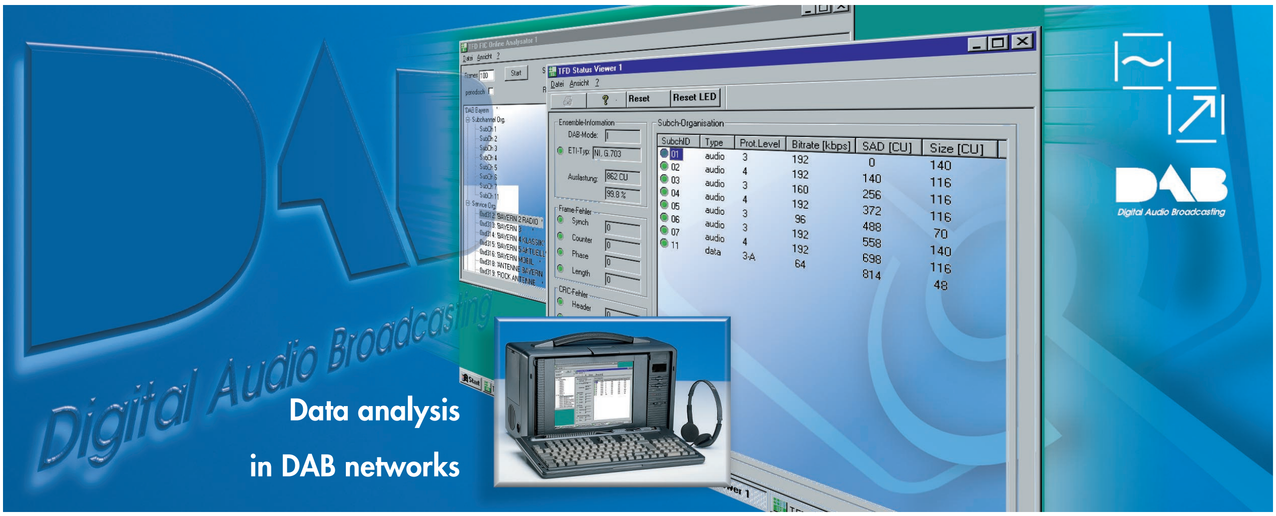


General data	
Bus interface	AT (8-bit ISA bus)
Base address	0000 hex to 03E0 hex in steps of 20 hex
Interrupts	IRQ3 to 8
DMA channels	5, 6, 7, none
Dimensions	169 mm x 107 mm
Operating temperature range	0°C to +70°C
Storage temperature range	–20°C to +70°C
Rel. humidity	5% to 90%, non-condensing
Power consumption	max. 700 mA/+5 V

Ordering information

Video PC Card	VPC1000	1110.4887.02

ETI/STI Transport Frame Decoder FD 1000



Brief description

Operators of broadcast stations are required to ensure highest quality and maximum transmission reliability (99.9%/year) while reducing operating costs. A transport stream analyzer is used to increase the quality of digital audio broadcasting. This analyzer allows continuous measurement of the transport stream and signalizes any degradation of the transmission. The use of this monitoring equipment ensuring easy and quick location of transport stream errors substantially cuts down on operating costs.

Main features

- Monitoring, decoding, recording and protocolling the ensemble transport interface (ETI) and the service transport interface (STI)
- Used after the ensemble multiplexer and/or before the COFDM
- ETI decoding according to the ETI format in ETS 300799
- STI decoding according to the STI format in ETS 300797

Functions

FD 1000 offers the following functions:

ETI

- Online analysis of the fast information channel (FIC) while showing the complete subchannel and service organizations
- Display and monitoring of all subchannels within the ETI transport stream
- Display of subchannel parameters
  - audio, stream or packet data
  - bit rate, protection level
  - status information
- Display of CRC errors in the header, mainstream as well as in the FIBs of the FIC
- Display and protocolling of dynamic reconfigurations
- Monitoring and testing of ISO-CRC and SCF-CRC in the audio subchannels
- Selection of a subchannel and output via the SP-DIF interface; with optional DA converter: audio monitoring via headphones
- Protocolling of status information and events including time stamps and event filter
- Realtime recording of complete ETI transport stream, single subchannels or FIC
- Output of FIC and MSC via a full-rate RDI interface to control a data terminal for MOT data analysis

STI

- Online analysis of control files and FIC streams
- Display and monitoring of all audio, data and packet streams contained in the STI transport stream
- Display of audio, stream or packet data stream parameters
  - bit rate
  - CRC protection level
- Display of synchronization, transport frame and data file errors
- Display and protocolling of dynamic reconfigurations

ETI/STI Transport Frame Decoder FD 1000

- Selection of an audio stream with output via SP-DIF interface and audio monitoring via headphones (with optional DA converter)
- Protocolling of status information and events including time stamps and event filter
- Realtime recording of complete STI transport stream, single streams or control files

FD 1000 has a convenient graphical user interface using Windows NT. All functions can easily be controlled via the keyboard and mouse.

Components

ETI/STI Transport Stream Decoder FD1000 contains the following components:

- PC card for ISA bus (format: 333 mm x 114 mm)
- PC software, for Windows NT
- PC-FAN (fast information channel analyzer)
  - FIC search
  - reconfiguration display
  - statistics

Options
- Portable Pentium PC
- External digital audio converter, controlled via SP-DIF, for audio monitoring output

Electrical interfaces

- G.703 input (ETI): HDB3-coded, BNC female, 75 Ω
- RS-422 interface, input/output, V.11 level, 25-pin sub-D connector
- Digital output, SP-DIF, RCA female connector
- Optical output (Toslink)

Ordering information

ETI/STI Transport Frame Decoder (including SW user interface)	FD 1000	1110.4506.02
Options		
External Digital Audio Converter (for headphones)	FD 1000W	1110.4606.00
Software Driver (for integration in TS61.. Systems)	TS61-K91	1110.4658.00

Perfection in mobile measurements and control: Portable Industrial Controller PSP7 (photo 42681-6)

Contents of Chapter 10

Measurement software is described in connection with its specific applications in the individual chapters of the catalog.

Contents Overview | Chapter Overview | Type Index | R&S Addresses

Portable Industrial Controller PSP

Mobile measurements and their control made to perfection

Photo 42674

Brief description

At long last Portable Industrial Controller makes measurements and their control mobile. Thanks to its compact size and rechargeable batteries, the built-in test and measure- ment facilities of PSP can be used at any location and in any situation. The principle of "switch on and go" was consistently applied to the development of the PSP as with all of Rohde & Schwarz's previous process controllers. Everything one is likely to need is included as standard. Low emission and highly effective shielding are as much part of the PSP as shock and vibration resistance.

Operation
The front-panel keypad comprises a numeric block, programmable function keys and a cursor block with a spinwheel. The softkeys are fully integrated into Windows. The keypad includes as many keys as are needed to operate programs effectively under Windows, and few enough to avoid input errors. This is especially important for applications in the field of production. Whenever necessary, a keyboard and a monitor can be connected and run parallel to the front-panel keypad and the built-in display.

Fully independent powering
Through the DC input connector PSP can be powered by a solar panel. PSP also accepts DC voltages from cars, ships or aeroplanes. With the aid of cascadeable internal or external batteries the PSP can be kept in operation for several hours. The power management function informs the user on how long the PSP can operate with the remaining battery charge, and thus optimizes the available capacity and extends battery life.

Powerful hardware and software components
PSP comes with an IEC/IEEE bus fitted as standard. Software drivers for almost any programming language are included so that the time-consuming task of installing hardware and software becomes unnecessary. Moreover PSP with LabWindows/CVI comprises a highly specialized tool for software development.

LabWindows/CVI
National Instruments' LabWindows/CVI (C for Virtual Instrumentation) is an interactive base for the programming of virtual instruments on the PSP and is regarded by most as today's industry standard. The software is delivered with a selection of drivers and extensive analysis func-tions. With LabWindows/CVI a C source code can be generated in next to no time, allowing communication with measuring instruments via IEC/IEEE bus or serial interface.

Interfaces
Numerous interfaces like 2 x serial, 1 x parallel, IEC/IEEE bus, PC card are the links to communication between the controller and the controlled devices. Again, extensive software libraries are included to simplify data input and output and to shorten software development time.

Modular expansion
Despite its small size, PSP incorporates everything one needs for standard measurement tasks. And in the case that expansions should be necessary for unusual tasks, PSP can accommodate up to four additional long-size measuring cards.

Best of EMC characteristics
PSP was developed and imple-mented along existing EMC guidelines. Extensive filtering measures for the electric components paired with effective shielding and a novel design of the casing led to an industrial controller that can safely be employed even in the vicinity of highly sensitive receivers without impairing the measurement results.

Fit for the future

All of the components used in the PSP were developed and selected with long-term availability in mind so that the PSP will be able to be serviced or extended even in many years' time. An advantage that especially production engineers and system planners value.

Specifications in brief

Processor	AMD X5 (586), 133 MHz other processors on request
RAM	16 Mbyte, expandable with PSP-B2 to 32 Mbyte
Display	
PSP2	none
PSP7	LCD colour, 8.4"
Screen	anti-glare
Mass storage	
Hard disk	1 Gbyte minimum
Disk drive	1.44 Mbyte, 3 ½"
Interfaces	
-internal-	
Available ISA-bus interfaces (other bus systems on request)	4 x 16 bits, dimensions (L x H): 330 mm x 140 mm 330 mm x 140 mm 312 mm x 140 mm 312 mm x 140 mm
-external-	
IEEE	IEEE488.2, compatible with NI NAT
Serial	2 x RS-232-C
Printer	Centronics LPT1
PC card	release 2.0, type III, connector
Keyboard	5-contact DIN, 5-contact PS/2 for mouse & keyboard
Software	
Operating system	MS-Windows from version 3.1 and MS-DOS from version 6.2
Test & measurement software	LabWindows/CVI, Rohde & Schwarz BASIC
Graphics	
With integrated LCD	VGA standard: 640 x 480 pixels
For external monitors	1024 x 768, 800 x 600, 640 x 480 pixels
General data	
Rated temperature range	+5°C to +45°C
Operating temperature range	0°C to +50°C
Storage temperature range	–25°C to +60°C
Temperature load	
Standards complied with	DIN IEC 68-2-1 and 68-2-2 as well as MIL-T-2800D class 5
Rel. humidity	95% at +40°C
Standards complied with	DIN IEC 68-2-3
Mechanical load	
Sinusoidal vibrations	5 to 150 Hz, max. 2 g at 55 Hz, 0.5 g for 55 to150 Hz
Standards complied with	DIN IEC 68-2-6 and EN 61010-1/ DIN IEC1010-1 as well as MIL-T-28800D class 5
Random vibration	10 to 300 Hz, 1.2 g rms
Standards complied with	DIN IEC 68-2-36 and DIN 40046 T24
Shock	40 g, shock spectrum
Standards complied with	DIN IEC 68-2-27, MIL-STD-810D, method 516.3, and MIL-T-28800D classes 3 and 5
Safety	in compliance with low-voltage directive of EU
Standards complied with	EN 61010-1: 1993
EMC	in compliance with EMC directive of EU
Standards complied with	EN 55022: 1994, class B EN 61000-3-2: 1995 EN 50081-2: 1992 EN 50082-1: 1992
Quality standard	development and manufacture in compliance with ISO 9001
Power supply	
AC supply	100 V to 120 V ±10%, 50 Hz to 400 Hz ±5% 220 V to 240 V ±10%, 50 Hz to 60 Hz ±5%
DC supply	DC, 10 V to 32 V
Dimensions (W x H x D)	412 mm x 198 mm x 380 mm
Weight PSP2/PSP7	7.5 kg/8 kg

Ordering information

Portable Industrial Controller		PSP2	1099.6002.20
		PSP7	1099.6002.70
Accessories supplied		pocket guide, manuals and disks for MS-DOS/Windows, LabWindows/CVI for Rohde&Schwarz, power cable, connector for external DC operation	
Options			
Interfaces			
2nd IEC/IEEE Bus (AT GPIB, 488.2)		PS-B4	1006.6207.04
TTL I/O Interface, 40 I/O ports, 8 relays, 8 optocouplers, 3 timer		PS-B11	1006.7303.02
TTL I/O Interface without relays, optocouplers, timers		PS-B11	1006.7303.04
Analog I/O Interface		PS-B13	1006.6859.03
SCSI Host Adapter		PS-B27	1064.5500.02
4COM, 4 x RS-232		GR2-B4	6084.3040.02
Memory			
PC Card Exchangeable Hard Disk 260 Mbyte (minimum)		PSM-B9	1064.5700.02
16 Mbyte Memory Expansion		PSP-B2	1091.3640.02
Compact keyboards with integrated trackball (37 cm x 13.8 cm x 1.9 cm)			
German, without swivel frame		PSP-Z1	1091.4000.02
English, without swivel frame		PSP-Z2	1091.4100.02
German, with swivel frame		PSP-Z3	1091.4200.02
English, with swivel frame		PSP-Z4	1091.4300.02
(other keyboards on request)			
Mouse, Microsoft-compatible		PS-B1	1006.6359.02
Battery operation Set of Batteries, 24 V, 2.4 Ah, Power Management, operating time per set approx. 2 h, 2 pcs can be inserted into 3 ISA slots		PSP-B3	1091.3740.02
Industrial Monitor 15" (38 cm)		PMC4	1034.8000.03
Rack Adapter 19" (48.3 cm)		PMC4-Z1	1034.8100.02
Printer, 24 pins, colour graphics RS-232 and Centronics interface		PDN	0351.4512.04
IEC/IEEE-Bus Cable	0.5 m	PCK	0292.2013.05
	1 m	PCK	0292.2013.10
	2 m	PCK	0292.2013.20
	4 m	PCK	0292.2013.40

Industrial Controller PSM

Switch on and go ...

PSM has it all: a great variety of interfaces, comprehensive software and an interactive documentation system

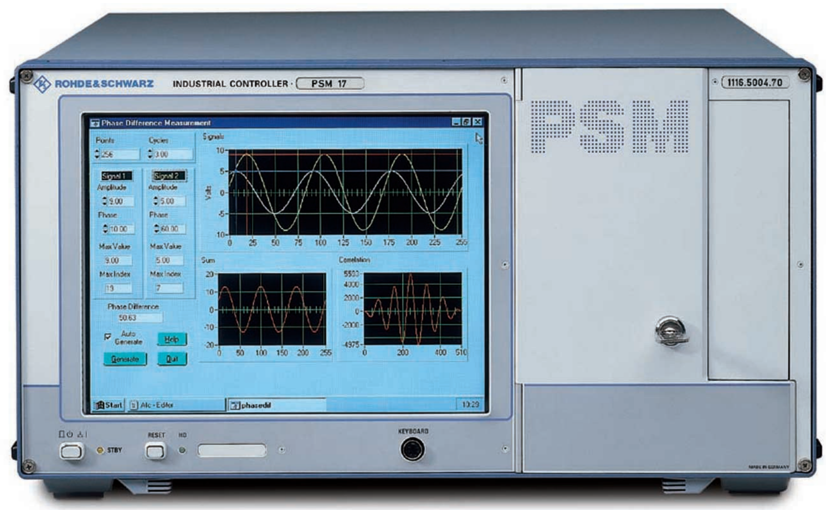


Photo 43088-3

Brief description

Especially when it comes to professional measurements, the controller should not be the weakest member of a system but rather be able to meet special requirements: shock and vibration resistance, particularly when used in vehicles or industrial environment, ultra-low temperature effect, high immunity to interference even in strong electromagnetic fields as well as low self-generated emission so that measurements will not be impaired by fields produced by the controller. Commercial PCs do not fulfill these requirements.

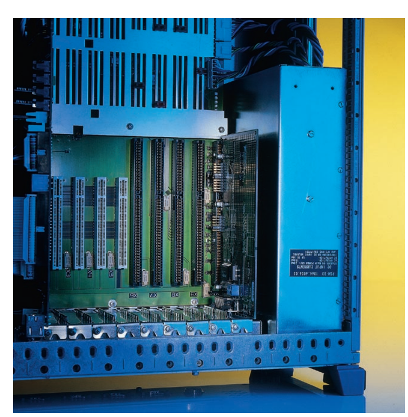
PSM offers ideal characteristics for all key applications: shock resistance in mobile applications, rackability, built-in measurement facilities for use in production and high EM shielding. For mobile applications, a DC input is provided for powering PSM from on-board supplies. The lockable cover of PSM protects the CD ROM drive, floppy disk drive and PC CARD interface against contamination and unauthorized access.

Main features

- Extremely high immunity to interference
- High shock resistance for mobile use
- Wide variety of interfaces: Ethernet, ultra/ultrawide SCSI, 16-bit GPIB, PC CARD
- Brilliant colour TFT display
- CD ROM drive
- Factory user port
- Windows user interface
- Safe investment through modular concept

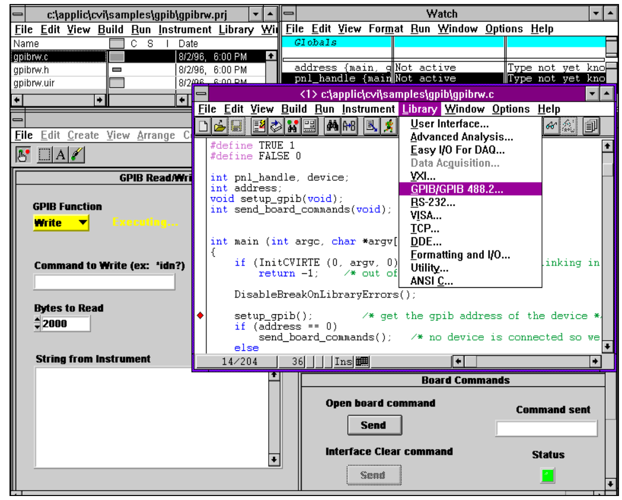
Comprehensive basic configuration

When purchasing a controller, the customer frequently has to buy hardware, software and interfaces from different manufacturers and integrate them into his system. This is not the case with PSM, which has been configured to cater for any demand. All key components are included in the basic unit: the built-in Ethernet interface makes it extremely easy to connect PSM eg to a company network. The state-of-the-art ultra/ultra wide SCSI interface allows adding internal and external SCSI standard components, eg streamers. The 16-bit GPIB interface as well as a large number of serial and parallel ports have always been the standard in PSM, likewise the Factory User Port (FUP), which provides a variety of extra functions (analog input, digital I/O, relays, optocouplers, pulse width modulator) required in automated test procedures. The fast CD ROM drive makes software installations a pleasure.



PSM has a well organized interior and, while featuring comprehensive basic configuration, offers plenty of space for extensions

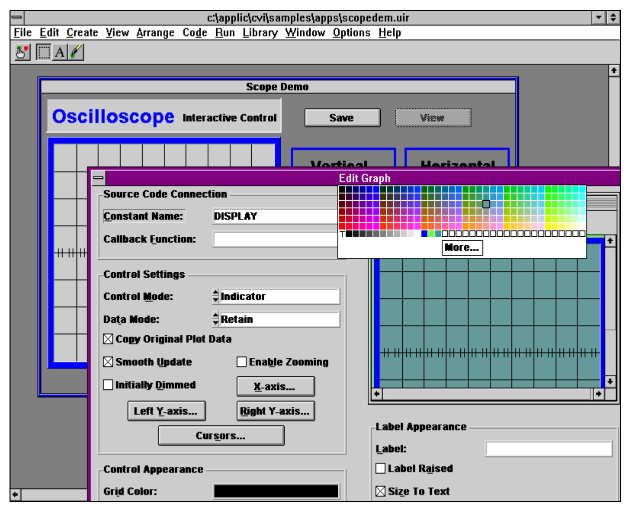
Industrial Controller PSM



Interactive development and rapid testing of test software is a salient feature of LabWindows/CVI

High flexibility

PSM can be tailored to suit specific needs: 4 free 16-bit ISA slots and 3 free PCI slots or alternatively 3 free 16-bit ISA slots and 4 free PCI slots leave ample space for expansion. Additionally, 2 PC CARD slots in the basic unit can be used for further extensions.



LabWindows/CVI simplifies the creation of displays, ie virtual instruments. The displayed data come from either a measuring card in the PSM or from an external measuring instrument that is communicated with via the IEC/IEEE bus

Unlimited memory expansion

Expandability of memories is of particular importance. The standard 32 Mbyte RAM can be expanded to 256 Mbyte. Mass storage can be expanded to practically any size; a modern EIDE hard disk is installed as standard. The integrated SCSI interface allows any kind of SCSI peripherals, eg streamer drives, to be controlled.

Versatile auxiliary functions

For automating test procedures, control lines are needed which are not available in standard PCs. The digital I/O interfaces, partly isolated via optocouplers, allow external processes to be controlled or analog voltages to be measured without an IEC/IEEE-bus-compatible voltmeter being needed. These interfaces are available as standard in PSM via the factory user port (FUP).

R&S system software

A powerful computer requires a powerful software. The system software not only contains the operating system but also the professional LabWindows/CVI measurement software. It goes without saying that the software is installed on the hard disk and tailored to the PSM hardware configuration. A CD ROM with all drivers, LabWindows/CVI and utility programs is supplied as a backup.

LabWindows/CVI

National Instruments' LabWindows/CVI (C for Virtual Instrumentation) is an interactive base for the programming of virtual instruments on the PSM and is regarded by most as today's industry standard.

The visual instruments for creating graphic user interfaces are an integral component of the C development environment allowing EXE programs and DLL files to be generated.

Industrial Controller PSM

Options

TTL I/O Interface PS-B11
The interface extends the control inputs/outputs of the factory user port. PS-B11 offers 40 digital I/O lines, eight single-pole switching relays and four two-pole optocoupler inputs/outputs each that can be read or set just like the FUP by means of the supplied driver software. Eight of these 40 lines can be configured to detect interrupt events.

Analog I/O Interface PS-B13
The interface provides eight differential or 16 unipolar analog inputs as well as two analog outputs, each with a resolution of 16 bits. Signals applied to the inputs can be sampled up to 100,000 times a second, thus covering the entire audio frequency range.

PS-B11 and PS-B13 are supplied with drivers for numerous programming languages such as R&S BASIC, QuickBASIC, MS-C or VisualBASIC for DOS and Windows. Interfaces are addressed by means of simple instructions.

PC CARD Exchangeable Hard Disk PSM-B9
Exchangeable hard disks simplify data logging and software installation. The handy hard disk is operated via the PC CARD connector on the front of PSM. Thanks to a compact design, the hard disk is particularly shock-proof and therefore ideal for mobile applications.

Your sensitive data under lock and key

Data security through the use of power-up passwords is a matter of course today. PSM takes it even further and "hides" all drives (CD ROM, floppy, PC CARD) behind a lockable cover. This not only enhances passive security but improves electromagnetic compatibility of PSM.

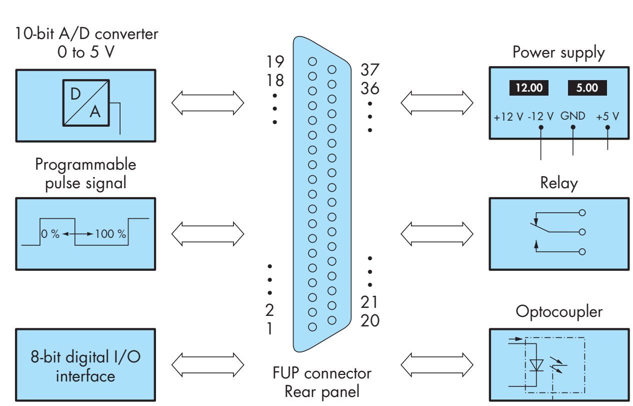
Safe investment thanks to modular concept

The high innovation rate in the computer industry results in short product lives. What is state-of-the-art today, will be at the bottom of the scale tomorrow. The possibility of boosting computer power is therefore of particular importance. This is one of the strong points of PSM. Modules like the CPU and graphics are accommodated on a separate card which can easily be replaced when greater performance is required.

This is important especially for industrial controllers, where the cost of integrated computer functionality makes up only a minor part of total costs, the principal share being attributable to measures taken for compliance with requirements relating to shock and vibration resistance, thermal loading capacity and electromagnetic compatibility.

A variety of interfaces are included in the basic unit: eg Ethernet, ultra/ultrawide SCSI, 16-bit GPIB. The factory user port adds versatile auxiliary functions

The factory user port (FUP) offers a variety of versatile auxiliary functions



Industrial Controller PSM

Specifications in brief

Processor	CPU slot, CPU performance: min. AMD-K6-2, 333 MHz; 32 Mbyte RAM (expandable to max. 256 Mbyte)
Display	
PSM 12	none
PSM 17	LCD colour, 10.4"
Mass storage	
Hard disk	1 Gbyte or more
Disk drive	1.44 Mbyte, 3 ½"
CD ROM drive	24 times or faster
Interfaces	
IEEE	IEEE 488.2, compatible with NI NAT
FUP (factory user port)	8 digital inputs/outputs 4 analog inputs: 0 to 5 V, 10-bit resolution 1 analog output: 0 to 5 V, 8-bit output via pulse width modulator optocouplers: 1 input, 1 output relays: 2 switches, SPS driving
Serial	RS-232, COM1, 2, 3, 4 (16550-compatible)
Parallel	Centronics LPT1 (ECP, EPP), LPT2
PC CARD	release 2.1, type III (slot 1), type II (slot 2)
SCSI	ultra, ultrawide (internal)
Ethernet	10 base T (10 Mbit/s)
Keyboard connector	5-pin DIN connector (on the rear) PS/2 connector (on the front)
Software	
Operating system	MS Windows from version 95 (free-of-charge option) MS Windows NT/3.1x on request
Measurement software	LabWindows/CVI
Graphics	
Video memory	2 Mbyte
Resolution with integrated LCD	VGA standard: 640 x 480 pixels
Resolution for external monitors	max. 1280 x 1024 pixels

General data

Rated temperature range	+5 to +45°C
Operating temperature range	0 to +50°C
Storage temperature range	–20 to +60°C
Temperature loading capacity	to DIN IEC 68-2-1and 68-2-2 as well as MIL-T-28800D class 5
Relative humidity	95% at +40°C, to DIN IEC 68-2-3
Mechanical loading	
Sinusoidal vibration	5 to 150 Hz, max. 2 g at 55 Hz, 0.5 g for 55 to 150 Hz, to DIN IEC 68-2-6, EN61010-1/ DIN IEC 1010-1 as well as MIL-T-28800D class 5
Random vibration	10 to 300 Hz, 1.2 g rms, to DIN IEC 68-2-36 and DIN 40046 T24
Shock	40 g shock spectrum, to DIN IEC 68-2-27, MIL-STD-810D, method 516.3 and MIL-T-28800D class 3 and 5
Electromagnetic compatibility	complies with EMC directive of EU
Standards complied with	EN 55022: 1994, class B EN 61000-3-2: 1995 EN 50081-1: 1992 EN 50082-2: 1992
Safety	safety class 1 to DIN VDE 106 and safety class 1 to IEC 536
Standards complied with	low-voltage directive of EU EN 61010-1/IEC1010-1: 1993 EN 60950/VDE 805/IEC950: 1992
Quality standard	designed and manufactured to ISO 9001
Power supply	
AC	100 to 120 V ±10%, 50 to 400 Hz ±5%, max. 4 A, 200 to 240 V ±10%, 50 to 60 Hz ±5%, max. 2 A
DC	10 to 28 V
Dimensions (W x H x D)	435 mm x 236 mm x 460 mm
Weight PSM12/PSM17	approx. 13 kg/14 kg

Ordering information

Industrial Controller	PSM12	1116.5004.20
	PSM17	1116.5004.70

Please state desired option PSM-K10 in your order.

Accessories supplied	pocket guide, power cable, LabWindows/CVI for Rohde&Schwarz

Options		
Interfaces		
2nd IEC/IEEE Bus (AT-GPIB, 488.2)	PS-B4	1006.6207.04
TTL I/O Interface	PS-B11	
40 I/O ports, 8 relays, 8 optocouplers, 3 timers		1006.7303.02
without relays, optocouplers, timers		1006.7303.04
Analog I/O Interface	PS-B13	1006.6859.02
Memories		
PC CARD Exchangeable Hard Disk 260 Mbyte (minimum)	PSM-B9	1064.5700.02
32 Mbyte Memory Expansion	PSM-B2	1064.5880.04
Software (free-of-charge option)		
R&S System Software, Windows 95, German	PSM-K10 *)	1116.7507.31
R&S System Software, Windows 95, English	PSM-K10 *)	1116.7507.32
Keyboards		
Rack-attachable Special Keyboard (English) with rollkey	PSA-Z1	1009.5001.32
Standard Keyboard (English)	PSA-Z2	1007.3001.32
Mouse	PS-B1	1006.6359.02
Pinwriter (24 pins, with graphics capabilities)	PDN	0351.4512.04
Monochrome Ribbon	PDN-Z2	0399.0917.03
Colour Ribbon	PDN-Z3	0399.1013.03
14" Colour Monitor	PMC1	1008.3005.03
17" Colour Monitor	PMC3	1082.6004.03
15" Industrial Monitor	PMC4	1034.8000.03
IEC/IEEE-Bus Cable	PCK	
0.5 m		0292.2013.05
1 m		0292.2013.10
2 m		0292.2013.20
4 m		0292.2013.40
Others		
19" Adapter	ZZA-95	0396.4911.00
Transit Case	ZZK-954	1013.9395.00

*) Factory-installed only

Industrial Monitor PMC4

15" colour monitor, especially for use in vehicles and industry

Photo 41661

Main features

- Multisync technology with automatic adaptation of display resolution
- All controls on front panel, membrane keypad
- Low emissions, tested to Swedish directives MPRII
- 23 nonvolatile memories for picture geometry and positioning
- Demagnetization automatically or manually upon keystroke
- Black-level adjustment via front-panel keys
- Sturdy aluminium casing, dust- and splashproof
- 19" adapter for rackmounting

Specifications in brief

CRT	15" flat-face CRT, active display area 262 mm x 196 mm, medium persistence (phosphor P22), anti-glare, anti-static coating, internal implosion protection
Deflection/dot pitch	90°/0.38 mm
Input signal	
Video	composite RGB, analog, positive, 1 V pp, negative sync on green; non-composite RGB, analog, positive, 0.7 V pp, with external sync
Impedance	75 Ω
Video bandwidth	80 MHz
Synchronization	
Horizontal	30 to 62 kHz (automatic)
Vertical	48 to 400 Hz (automatic)
Resolution (non-interlaced)	640 x 350 bis 1024 x 768 pixels
Colours	unlimited number, depending on graphics card
Convergence error	<0.4 mm in center of screen
Geometric distortion	within a 2 mm x 2 mm window
Luminance	≥80 NIT, screen center, full white field
General data	
Power supply	
AC	90 to 265 V, 45 to 65 Hz, 0.6 to 1.2 A
DC	20 to 32 V, 2.5 to 5 A
Dimensions (W x H x D)	376 mm x 405 mm x 316 mm
Weight	19.4 kg

Ordering information

15" Industrial Monitor	PMC4	1034.8000.02
Extra		
19" Monitor Adapter	PMC4-Z1	1034.8100.00

Pinwriter PDN

High-resolution dot matrix printer with graphics capability and 24-pin printer head

Photo 42311

Brief description

PDN is suitable both for printing program listings, for which speed is the main consideration, and for printing documents in letter quality.

PDN is also suitable for graphic result output, up to seven colours being available for visual processing.

Specifications in brief

Printing technique	24-pin dot matrix/colour print
Resolution	
Letter quality	360 x 180 dots/inch
Draft quality	180 x 180 dots/inch
High-speed draft quality	90 or 120 x 180 dots/inch
Graphics	max. 360 x 360 dots/inch
Printing speed	
Letter quality	120 characters/s (12 cpi)
Draft quality	240 characters/s (12 cpi)
High-speed draft (Hi-Draft)	400 characters/s (12 cpi)
Throughput to ECMA-132	
Letter quality	154 pages/h
High-speed draft	299 pages/h
Graphics	90 pages/h
Line feed speed	60 ms for simple feed (6 lpi)
Paper feed speed	5.6 inches/s
Command language	Fujitsu DPL24C+
Emulations	IBM Proprinter XL24E, Epson ESC/P2
Fonts	
Letter quality (bit map)	Courier 10, Prestige Elite 12, Pica 10, OCR-B, Boldface PS
Letter quality (scalable)	Courier, Timeless, Nimbus Sans (Outline)
Draft quality	Compressed/Draft, Hi-Draft (high-speed draft)
Typeface	underline, raised, lowered, bold, shaded, italics, multiple raise (up to 16 times), broad (16 times), barcode
Character sets	IBM PC.sets 1/2, IBM PS/2 ch. sets (code page 437, 850, 852, 855, 860, 863, 865, 866), Fujitsu character set with 357 characters, ISO 8859-1/ECMA 94, 37 national character sets, code page 852/866/8859-9, Slovenia, Croatia, Turkey, Hungary, Czech Republic, Slovak Republic, etc
Print line (print span)	80 columns with 10 cpi (345.4 mm)
Cut sheet width	102 to 267 mm
Paper feed	manual single-sheet feed and bidirectional paper movement, fanfold paper feed from bottom or rear, paper parking function, paper width measurement, auto-load function, auto-tear-off function
Carbon copies	max. 5 incl. original
Memory	max. 128 Kbyte
Interfaces	dual (Centronics parallel and RS-232-C serial)
Weight	7 kg
Noise level	max. 49 dB(A) in line with ECMA-74
Power supply	220/240 V ±6%
Dimensions (W x H x D)	434 mm x 133 mm x 330 mm
Service life of colour ribbon	
Black	5 million characters
4-colour	0.3 milllion characters per colour
Print head	300 million impacts per pin
MTBF	8000 hours with 25% duty cycle

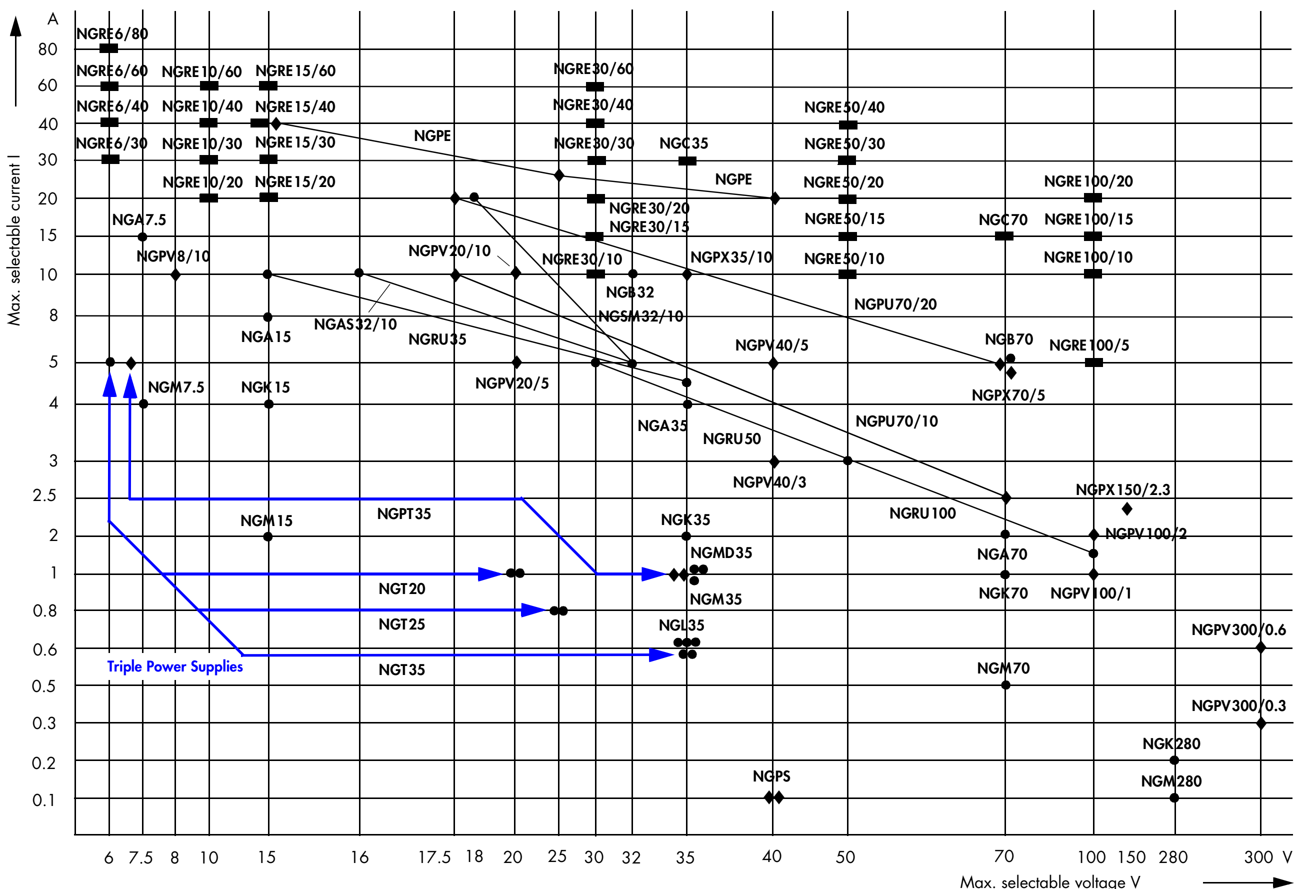
Ordering information

Pinwriter	PDN	0351.4512.04
Accessories supplied Power cable, connecting cable for IBM-compatible printer connection, colour ribbon	PDN-Z2	0399.0917.02

Precision Triple Power Supply NGPT35 of high stability for optimal testing of a mixed configuration of analog and digital modules (photo 40647)

Contents of Chapter 11

Range of Products, Introduction



- • Compact bench model
- •• Dual power supply (dual tracking)
- ••• Triple power supply
- ▬ 19" model
- ♦ Programmable power supply (IEC 625-1/IEEE 488), 19" model
- ♦♦ Two-channel programmable voltage source, 19" model

Power supplies

- Selection guide to available line of power supplies (see above diagram)
- Overview of power supplies (page 376) with units classified according to
  - – maximum output voltage,
  - – maximum output current

The symbols in the above diagram provide information on the kind of unit: whether it is a bench model in the form of a single, dual or triple power supply, or a 19" unit (single or dual output), as well as information on programmability.

The model nearest to the coordinates of the desired maximum voltage/current values will meet your requirements or even surpass them.

For more information on the unit of your choice please refer to the overview of power supplies.

The wide variety of Rohde&Schwarz power supplies falls into three main groups: bench models with output powers up to 350 W – ten type series with a total of 27 basic models; 19" models with up to 2000 W output power – two type series with 29 basic models; system units/programmable power supplies with IEC625-1/IEEE488 bus – five type series with 25 basic models.

Beyond these, a programmable voltage source for IEC/IEEE bus systems is available. It has two independent outputs and its output voltages can be controlled manually or by a controller.

General technical features
All power supplies from Rohde&Schwarz are designed to offer essentially the same features: floating outputs, permissible voltage of the outputs with reference to chassis or ground – or with multiple output power supplies to one another – 1000 V.

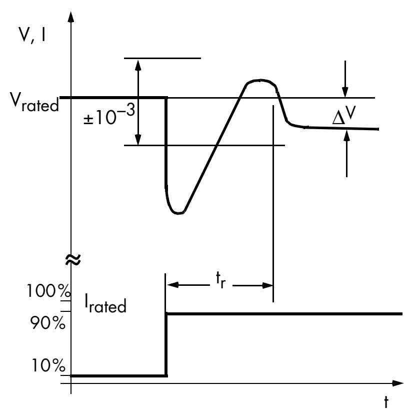
Setting of voltage and current
Settings start from a threshold near zero. The rated values specified for current and voltage are the maximally settable levels. Almost all types of the available power supplies are constant-voltage/constant-current units, which means that they can also be used as current regulators. Pilot lamps or LEDs indicate whether the unit is operating in the constant-voltage/constant-current mode or in the current limiting mode. All power supply units feature current limiting which can be continuously adjusted to any value between zero and the rated current. The current limiting of NGAS models can be set to 1.5 times the rated current.

Parallel and series connection
If higher currents or voltages are required, all power supplies can be parallel- or series-connected. Protective circuits prevent the connected load or the power supply unit from being damaged.

The parallel connection capability is restricted for instruments with fast down programming (NGPV, NGPX, NGPE, NGSM).

Output impedance Z_{out}
The output impedance is specified in the tables to describe the effect of load variations on the output quantity. For instance, with constant-current operation of a 100 V/1 A unit, a specified output impedance of Z_{out}=30 kΩ means that a load variation between 0 and 100 Ω at a nominal current of 1 A will cause a current deviation of 3 mA corresponding to 0.3%.

Transient recovery time t_r
The value specified refers to a step change from 10% to 90% of the rated current in constant-voltage mode. After t_r the output voltage is again within tolerance. In constant-current mode t_r strongly depends on the load (<100 µs to 1 s).



Transient recovery time t_r following step change in load

Remote sensing
With models of >70 W output power, the voltage drop on the supply lead, which varies with the load current, can be corrected, if separate sensor leads are connected to the terminals of the load. A variation of 0.5 to 1 V on the positive and negative leads can be compensated for.

Remote control
NGRE power supplies can be equipped for remote control on request. NGRU models can be remote-controlled through external analog voltages.

Programming
Power Supplies NGPT, NGPS, NGPV, NGPX, NGSM (with option), NGPU and NGPE are suitable both for manual operation and for control via IEC/IEEE bus, ie for use in automatic test systems.

Cooling
The power supplies cannot be damaged by thermal overloading. The models of the NGM, NGK, NGMD, NGT, NGL and NGRU series have rear-mounted convectional heatsinks. Models of higher output power rating use a two-stage (NGPT, NGSM, NGPX: continously variable) thermostat-controlled cooling fan. At low demands the fan is running at a speed that is hardly noticeable; only when high output is required is it switched to full power. The fans are driven by quiet, maintenance-free motors.

Overload protection
To provide protection against undesirably high voltages caused by maloperation or faults, the power supplies are fitted with independent crowbar circuits with an adjustable response threshold (exceptions see table). An external overvoltage protection is also available:

- Overvoltage Protection NG-Z, 4.5 to 100 V/10 A, Order No. 0100.5103.02

Output capacitor
The output capacitor can be switch-selected to match the load: small capacitance with little energy content for sensitive semiconductor circuits, large capacitance for dynamic loads.

Overview of Power Supplies

Type	Designation/Uses	Order No.	V_{max}/V	I_{max}/A	P_{max}/VA	RS	OPV	RC_{DC}	IEC	Page
NGM7.5	Universal	117.7110.12	7.5	4	30	–	●	–	–	378
NGM15	constant-current	117.7110.13	15	2	30	–	●	–	–	378
NGM35	and constant	117.7110.14	35	1	35	–	●	–	–	378
NGM70	voltage sources	117.7110.15	70	0.5	35	–	●	–	–	378
NGM280		117.7110.06	280	0.1	28	–	–	–	–	378
NGMD35	Dual power supply	117.7127.02	2 × 35	2 × 1	70	–	●	–	–	379
NGK15	Same as NGM,	192.0003.02	15	4	60	●	●	–	–	378
NGK35	but	192.0003.03	35	2	70	●	●	–	–	378
NGK70	double	192.0003.04	70	1	70	●	●	–	–	378
NGK280	output current	192.0003.05	280	0.2	56	●	–	–	–	378
NGA7.5	Constant-voltage-	192.0010.02	7.5	15	112	●	❍	–	–	378
NGA15	sources with	192.0010.03	15	8	120	●	❍	–	–	378
NGA35	adjustable	192.0010.04	35	4	120	●	❍	–	–	378
NGA70	current limiting	192.0010.05	70	2	120	●	❍	–	–	378
NGAS32/10	Same as NGA, high surge capability	192.0803.04	16/32	10 (15)	160	●	❍	–	–	378
NGB32	Same as NGA, high	117.7210.90	32	10	320	●	●	–	–	378
NGB70	surge capability	117.7227.90	70	5	350	●	●	–	–	378
NGL35		192.0026.02	3 × 35	3 × 0.6	63	–	❍	–	–	379
NGT20		117.7133.02	20/20/6	1/1/5	70	–	● (6 V)	–	–	380
NGT25	Triple	192.0503.02	25/25/6	0.8/0.8/5	70	–	● (6 V)	–	–	380
NGT35	power supplies	191.2019.02	35/35/6	0.6/0.6/5	72	–	● (6 V)	–	–	380
NGPT35		192.0510.31	35/35/7	1/1/5	105	●	●	–	●	392
NGPT18		192.0510.21	18/18/7	2/2/5	105	●	●	–	●	392
NGPT7		192.0510.71	7/7/18	5/5/2	105	●	●	–	●	392
NGRU 35	Precision	192.0210.03	35	10	150	●	●	●	–	381
NGRU 50	laboratory	192.0210.05	50	5	150	●	●	●	–	381
NGRU 100	power supplies	192.0210.08	100	3	150	●	●	●	–	381
NGC 35	Universal	192.0032.02	35	30	1050	●	❍	–	–	382
NGC 70	high-output	192.0032.03	70	15	1050	●	❍	–	–	382
NGRE 6 to 100	power supplies	100.8xxx.xx	6 to 100	5 to 80	180 to 2000	●	❍	❍	–	383

RS = remote sensing
OVP= overvoltage protection
RC_{DC} = remote control with DC voltage
* =fast on/off switching via TTL-compatible signal
IEC = IEC 625-2 bus (IEEE 488)
● = standard
❍ = option

Type	Designation/Uses	Order No.	V_{max}/V	I_{max}/A	P_{max}/VA	RS	OPV	RC_{DC}	IEC	Page
NGPS	Programmable voltage sources	192.0061.02	±16.3835 ±40	±0.1	8	●	–	–	●	385
NGPU 70/10	Programmable	192.0049.92	70	10	175	●	●	–	●	386
NGPU 70/20	power supplies	192.0055.92	70	20	350	●	●	–	●	386
NGPV 8/10		192.0310.8x	7.99	9.99	80	●	●	–	●	387
NGPV 20/5		192.0310.2x	19.99	4.99	100	●	●	–	●	387
NGPV 20/10		192.0326.2x	19.99	9.99	200	●	●	–	●	387
NGPV 40/3		192.0310.4x	39.99	2.99	120	●	●	–	●	387
NGPV 40/5		192.0326.4x	39.99	4.99	200	●	●	–	●	387
NGPV 100/1	Programmable	192.0310.1x	99.99	0.99	100	●	●	–	●	387
NGPV 100/2	precision	192.0326.1x	99.99	1.99	200	●	●	–	●	387
NGPV 300/ 0.3	laboratory power supplies	192.0310.3x	299.99	0.299	90	●	●	–	●	387
NGPV 300/ 0.6		192.0326.3x	299.99	0.599	180	●	●	–	●	387
NGPE 40/40		192.0332.41	39.99	39.9	800	●	●	–	●	391
NGPT35		192.0510.31	35/35/7	1/1/5	105	●	●	–	●	392
NGPT18		192.0510.21	18/18/7	2/2/5	105	●	●	–	●	392
NGPT7		192.0510.71	7/7/18	5/5/2	105	●	●	–	●	392
NGPX35/10		192.0610.31	35	10	350	●	●	●*	●	389
NGPX70/5		192.0610.71	70	5	350	●	●	●*	●	389
NGPX150/2.3		192.0610.11	150	2.33	350	●	●	●*	●	389
NGSM32/10	Progr. lab. model, arbitrary functions	192.0810.31	18/32	20/10	180	●	–	–	❍	394

RS = remote sensing
OVP= overvoltage protection

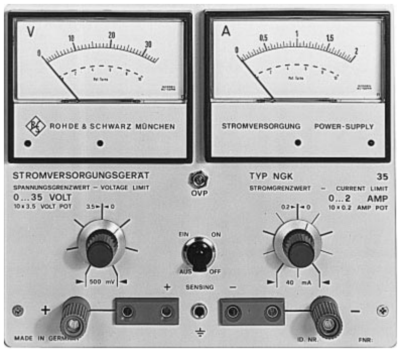
RC_{DC} = remote control with DC voltage
* =fast on/off switching via TTL-compatible signal

IEC = IEC 625-2 bus (IEEE 488)

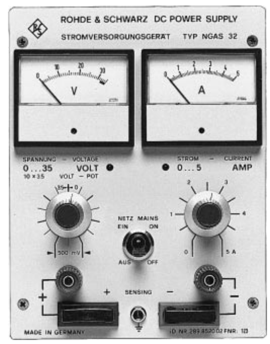
● = standard
❍ = option

Single Power Supplies

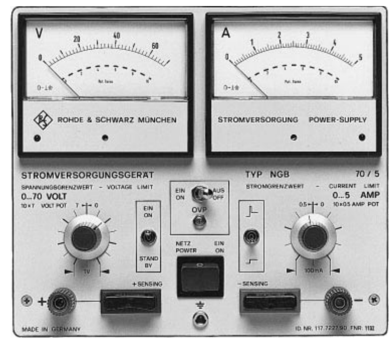
NGM (photo 24541)



NGK (photo 24544)



NGAS (photo 29831-1)



NGB (photo 29832-1)

NGM, NGK: 30/70 W lab models

- Compact bench models
- High-resolution ten-turn potentiometer for voltage and current
- Single switchable meter on NGM, separate meters on NGK

The power supplies of the NGM series can be used either as constant-voltage or as constant-current sources, eg in the laboratory.

The power supplies of the NGK series provide twice the output current of the otherwise identical NGM models and are provided with remote-sensing sockets to compensate for voltage drops in the load leads.

NGA – 120 W compact models

- High-resolution ten-turn potentiometer for voltage
- Separate meters, remote-sensing sockets

The power supplies of the NGA series are constant-voltage sources with adjustable current limiting. They are mainly used for the supply of modules and systems in testshops and labs.

NGAS: 160 W compact model

- High surge capability, twice the rated current can be drawn for short periods
- Use as battery eliminators
- Separate meters for voltage and current

NGAS is suitable both for general lab applications and for the supply of loads with high surge or pulse-type current demands, eg test systems for car electronics or transceivers with switching power supplies.

Thanks to its compact design, NGAS is suitable for mobile use. It is insensitive to RF voltages radiated by other equipment or a nearby antenna.

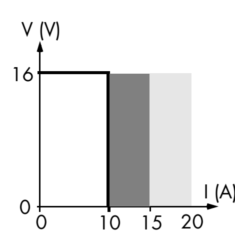
The current limiting threshold can be set to 1.5 times the rated current which may be drawn for up to 5 minutes. Due to the delayed response of current limiting, twice the rated current may be drawn for several milliseconds. The output voltage range can be set to 16 V or 32 V.

NGB: 350 W bench models

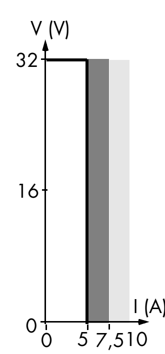
- High-resolution ten-turn potentiometer for voltage and current
- Surge current capability – several times the rated current may be drawn for short periods

Suitable for use as constant-voltage/constant-current sources with automatic regulation of voltage-to-current transition (LED indication) and as battery eliminator with switch-selected delay for current regulation (higher surge current), eg for incandescent lamps, blinkers, voltage converters. Other features: large panel meters for voltage and current, voltage compensation on leads up to 1 V, adjustable overvoltage protection.

a) Continous
b) Short-term (5 min)
c) Pulse



NGAS: 16 V range



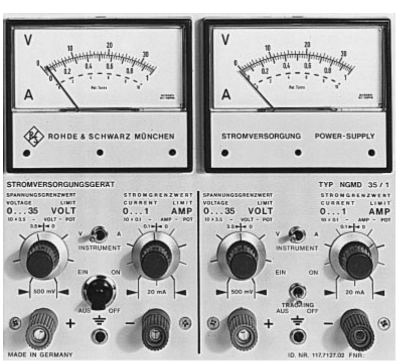
NGAS: 32 V range

Current drain of NGAS as a function of selected output voltage

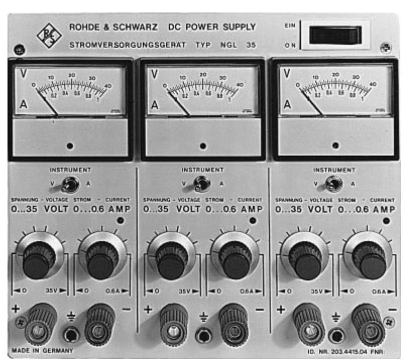
Specifications in brief of Single Power Supplies

Type	Order No.	Setting ranges Voltage V	Setting ranges Current A	Resolution V %	Resolution I %	Max. deviation of output for ΔV AC supply ±10% V(%)	Max. deviation of output for ΔV AC supply ±10% I(%)	Δtamb −10 to +40 ×C V(%/×C)	Δtamb −10 to +40 ×C I(%)	Z_{out} for V mΩ	Z_{out} for I kΩ	t_r for V µs	Max. PARD V_{rms} mV	Max. PARD I_{rms} mA	Remote sensing S	OV protec. O	Dimens. WxHxD Weight mm (kg)
NGA 7.5	192.0010.02	0.01 to 7.5	0.2 to 15	0.02	0.5	0.01	0.2	0.01	0.1	0.25	0.25	75	0.15	–	S	–	129/172/ 330 (8)
15	192.0010.03	0.01 to 15	0.1 to 8	0.02	0.5	0.01	0.2	0.01	0.1	0.375	1	75	0.3	–	S	–	
35	192.0010.04	0.01 to 35	0.05 to 4	0.02	0.5	0.01	0.2	0.01	0.1	0.875	4.4	75	0.6	–	S	–	
70	192.0010.05	0.01 to 70	0.025 to 2	0.01	0.5	0.01	0.2	0.01	0.1	3.5	17.5	75	1	–	S	–	
NGAS 32/10	192.0803.04	0.01 to 32 0.01 to 16	0.1 to 10 (15)	0.02	0.5	0.01	0.2	0.01	0.1	0.16	1	75	0.6	–	S	–	129/172/ 330 (8)
NGB 32	117.7210.90	0.01 to 35	0.02 to 10	0.02	0.02	0.001	0.002	0.01	0.01	0.35	17.5	50	0.2	10	S	O	190/172/ 330 (10)
70	117.7227.90	0.01 to 70	0.01 to 5	0.02	0.02	0.001	0.002	0.01	0.01	1.4	70	50	0.5	5	S	O	
NGK 15	192.0003.02	0.01 to 15	0.01 to 4	0.02	0.02	0.001	0.002	0.01	0.01	0.75	37.5	50	0.2	0.1	S	O	190/172/ 278 (8)
35	192.0003.03	0.01 to 35	0.01 to 2	0.01	0.02	0.001	0.002	0.01	0.01	1.75	175	50	0.4	0.05	S	O	
70	192.0003.04	0.01 to 70	0.01 to 1	0.01	0.02	0.001	0.002	0.01	0.01	7	700	50	0.8	0.015	S	O	
280	192.0003.05	0.01 to 280	0.002 to 0.2	0.01	0.02	0.001	0.002	0.01	0.01	140	700	50	3	0.005	S	–	
NGM 7.5	117.7110.12	0.01 to 7.5	0.01 to 4	0.02	0.02	0.001	0.002	0.01	0.01	0.75	10	50	0.2	0.1	–	O	95/172/ 278 (4)
15	117.7110.13	0.01 to 15	0.01 to 2	0.02	0.02	0.001	0.002	0.01	0.01	1.5	40	50	0.2	0.05	–	O	
35	117.7110.14	0.01 to 35	0.01 to 1	0.02	0.02	0.001	0.002	0.01	0.01	3.5	175	50	0.4	0.02	–	O	
70	117.7110.15	0.01 to 70	0.01 to 0.5	0.01	0.02	0.001	0.002	0.01	0.01	14	700	50	0.8	0.001	–	O	
280	117.7110.06	0.01 to 280	0.002 to 0.1	0.01	0.02	0.001	0.002	0.01	0.01	280	1400	50	3	0.002	–	–	

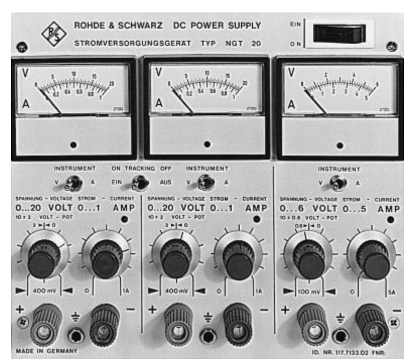
Dual and Triple Power Supplies



NGMD 35 (photo 24543)



NGL35 (photo 24547)



NGT20 (photo 24545)

NGMD 35 – 2 x 0 to 35 V/1 A

- Independent or tracking operation
- Isolated floating outputs, permanently shortcircuit-proof

Two NGM 35 power supplies are accommodated in one cabinet and can be used either separately or in tracking mode. In the tracking mode, unit II follows unit I. Relative to a common reference point, NGMD supplies a positive and a negative voltage of 0 to 35 V, which are concurrently and equally variable by a percentage of the voltage. The current limits can be set independently of each other.

NGL 35 – 3 x 0 to 35 V/0.6 A

- Three voltages at a time, series or parallel connection
- Thermal overload protection, automatic power-up

NGL 35 has three equal, separate and floating outputs. The voltages can be independently adjusted between 0 and 35 V and the current limiting

Dual and Triple Power Supplies

threshold between 0 and 0.6 A. Voltage or current ratings can be tripled by parallel or series connection. A switchable panel meter is provided for each output.

NGT – 2 x 0 to 20/25/35 V 1/0.8/0.6 A; 1 x 0 to 6 V/5 A

- Independent or tracking operation of 20/25/35 V outputs
- Shortcircuit-proof, adjustable overvoltage protection (6 V output)

NGT models combine three independent voltage sources in one unit. A switchable panel meter is provided for each output. The 20 V, 25 V, 35 V outputs can be used separately, in series or parallel connection or in tracking mode. The independent 6 V output with its load rating of 5 A is especially designed for the supply of digital integrated circuits; overvoltage protection is adjustable.

Specifications in brief of Dual and Triple Power Supplies

Type	Order No.	Setting ranges Voltage V	 Current A	Resolution V %	 I %	Max. deviation of output for ΔV AC supply ±10% V(%)	 I(%)	 Δt_{amb} −10 to +40 °C V(%/°C)	 I(%)	Zout for V mΩ	 I kΩ	tr for V µs	Max. PARD V_{rms} mV	 I_{rms} mA	Over-voltage pro-tection	Dimen-sions WxHxD Weight mm (kg)
Dual Power Supplies																
NGMD35	117.7127.02	0.01 to 35 (2 x)	0.01 to 1	0.02	0.02	0.001	0.001	0.01	0.01	3.5	175	50	0.4	0.02	●	190/172/ 278 (8)
Triple Power Supplies																
NGL35	192.0026.02	0.01 to 35 (3 x)	0.01 to 0.6	contin.	1	0.01	0.2	0.1	0.1	3.5	15	75	0.2	–	–	190/172/ 278 (7)
NGT20	117.7133.02	0.01 to 20 (2 x) 0.01 to 6 (1 x)	0.01 to 1 0.01 to 5	0.02	1	0.01	0.2	0.01	0.1	2 1	9 0.4	75 75	0.15 0.2	–	– ●	190/172/ 278 (7)
NGT25	192.0503.02	0.01 to 25 (2 x) 0.01 to 6 (1 x)	0.01 to 0.8 0.01 to 5	0.02	1	0.01	0.2	0.01	0.1	2.5 1	10 0.4	75 75	0.2 0.2	– –	– ●	190/172/ 278 (7)
NGT35	191.2019.02	0.01 to 35 (2 x) 0.01 to 6 (1 x)	0.01 to 0.6 0.01 to 5	0.02	1	0.01	0.2	0.01	0.1	3.3 1	15 0.4	75 75	0.25 0.2	– –	– ●	190/172/ 278 (7)

Power Supplies NGRU

NGRU35: 0 to 35 V/0 to 10 A

NGRU50: 0 to 50 V/0 to 5 A

NGRU100: 0 to 100 V/0 to 3 A

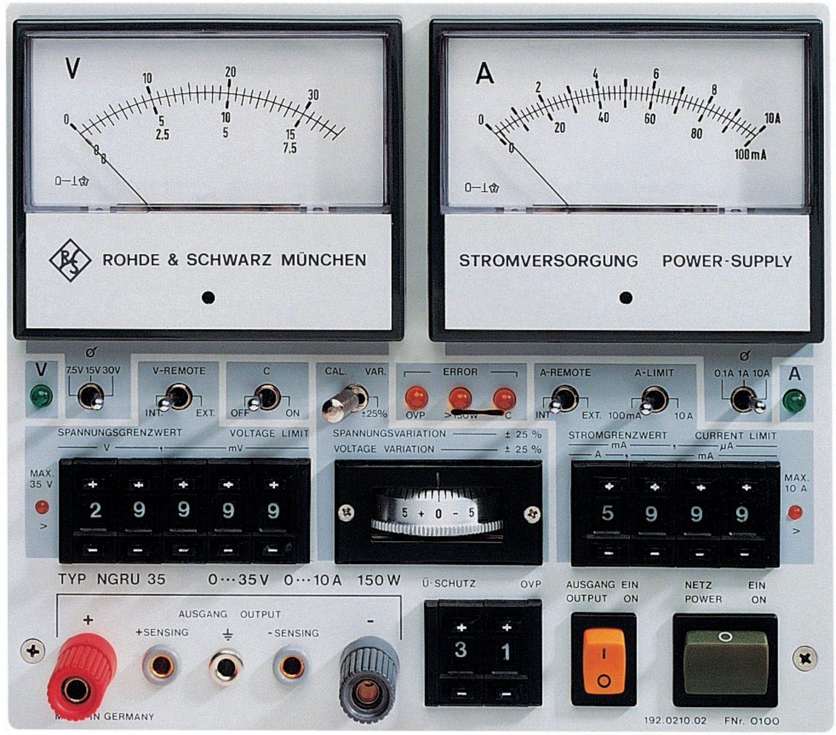


Photo 31460

Brief description

Power Supplies of the NGRU series are precision laboratory units providing high accuracy and repeatability of voltage and current settings via digital potentiometers.

The power supplies can be used as constant-voltage or constant-current sources. The maximum output power is 150 W and remains constant over a wide voltage range. The current loadability depends on the output voltage.

Main features

- Compact bench models
- High resolution and reproducibility through digital potentiometers
- Output voltage continuously variable with calibrated potentiometer
- Automatic power matching ensuring full power over wide output voltage range
- Digitally settable overvoltage protection
- Output voltage can be modulated – simulation of interference factors
- Remote programming of voltage and current
- Panel meter for voltage and current indication in three ranges
- Large LED indicators for overload, overtemperature, overvoltage protection and selected operating mode
- Switch-selectable output capacitor
- Remote sensing

Operation

The voltage can be set in five digits and continuously varied by ±25% with a calibrated potentiometer.

The current can be set in four digits within two ranges. The low range is 100 mA for all NGRU models so that even currents in the µA range can be reliably regulated.

The overvoltage protection is also set via digital potentiometer. In addition to manual operation, remote programming of voltage and current is possible by means of analog control signals.

Specifications in brief

Voltage setting in 5 digits	**NGRU 35**	**NGRU 50**	**NGRU 100**
	<1 mV to 35 V	<1 mV to 50 V	<1 mV to 100 V
Resolution	1 mV	1 mV	1 mV
Max. error at 20°C	$\pm 10^{-4}$ of set value ±20 mV		
analog (continuously)	±25% with ±0.5% setting error of scale		
Resolution	0.25%	0.25%	0.25%

Current setting (2 ranges in 4 digits)	**NGRU 35**	**NGRU 50**	**NGRU 100**
High range	<1 mA to 10 A	<1 mA to 5 A	>12 mA to 3 A
Resolution	1 mA	1 mA	1 mA
Max. error at 20°C	$\pm 2 \times 10^{-3}$ of set value ±10 mA		
Low range	<10 µA to 100 mA		
Resolution	10 µA	10 µA	10 µA
Max. error at 20°C	$\pm 2 \times 10^{-3}$ of set value ±0.2 mA		

Max. constant current (150 W)	**NGRU 35**	**NGRU 50**	**NGRU 100**
	up to 15 V: 10 A	up to 30 V: 5 A	up to 50 V: 3 A
	20 V: 7.5 A	40 V: 3.8 A	75 V: 2 A
	35 V: 4.3 A	50 V: 3 A	100 V: 1.5 A

Constant-voltage source

Deviation of output voltage with			
±10% AC supply variation		$<\pm10^{-5}$	
between 0 and 40°C		$<\pm10^{-4}$/K	
with 10 to 90% load		$<10^{-4}$	
PARD (V_{rms})	<0.3 mV	<0.5 mV	<1 mV
Transient recovery time	<75 µs	<75 µs	<75 µs

Constant-current source

Deviation of output current with			
±10% AC supply variation		$<\pm2\times10^{-5}$	
between 0 and 40°C		$<\pm2\times10^{-4}$/K	
from 10 to 90% load		$<2\times10^{-4}$	
PARD			
in high range (I_{rms})	<2 mA	<1 mA	<0.3 mA
in low range (I_{rms})	<20 µA	<20 µA	<20 µA
Sensing sockets			
Max. voltage compens.	<0.5 V	<1 V	<1.5 V

Common data

Modulation of output voltage (BNC female, floating)	V_{pp} = 10 V for 10 V modulation, 50 Hz to 1 kHz ±3 dB
Input impedance	approx. 3.5 kΩ

Overvoltage protection	
Setting range	1 to 99 V (response threshold approx. 5% higher)

Programming (external, analog)

for output voltage 0 to 100%´	0 to 10 V
for output current 0 to 100%	0 to 10 V
Setting time	<3 ms (to within ±1%)
Connector	5-contact Tuchel female
Input impedance	approx. 10 kΩ
Reference potential	positive terminal

General data

Meter accuracy	±2.5% of full scale
AC supply	110/120/220/240 V ±10%, 47 to 63 Hz,
Dimensions (W x H x D); weight	190 mm x 180 mm x 330 mm; 9 kg

Ordering information

Power Supply	NGRU 35	0192.0210.03
	NGRU 50	0192.0210.05
	NGRU 100	0192.0210.08

1000 W Power Supplies NGC

NGC35:

0 to 35 V; 0.05 to 30 A

NGC70:

0 to 70 V; 0.025 to 15 A

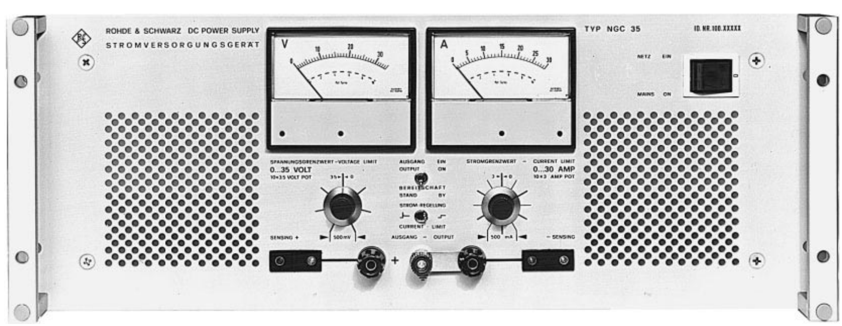


Photo 24536

Brief description

- Surge current capability – several times the rated current can be drawn for short periods
- High efficiency, 19" cabinet

The high efficiency of Power Supplies NGC is achieved through continuous preregulation. A series-pass regulator ensures for excellent static and dynamic characteristics. Special constructional measures allow use in RF systems.

Specifications in brief

	NGC 35	NGC 70
Voltage	<10 mV to 35 V	<10 mV to 70 V
Current	<50 mA to 30 A	<25 mA to 15 A
Resolution	<0.02%	<0.02%
Deviation of voltage		
with ±10% AC supply variation	$<\pm10^{-5}$	
between 0 and 40°C	$<\pm10^{-4}$/K	
from 10 to 90% current	$<10^{-4}$	
Deviation of current		
with ±10% AC supply variation	$<\pm10^{-4}$	
between 0 and 40°C	$<\pm10^{-3}$/K	
from 10 to 90% voltage	$<10^{-3}$	
PARD		
Voltage V_{rms}	<1 mV	<2 mV
Current I_{rms}	<20 mA	<20 mA
Transient recovery time (10 to 90% load)	<60 µs	
Sensing sockets		
Surge current for 1 ms/0.2 s	80/60 A	40/30 A
Max. voltage compensation	0.5 V per lead	

General data

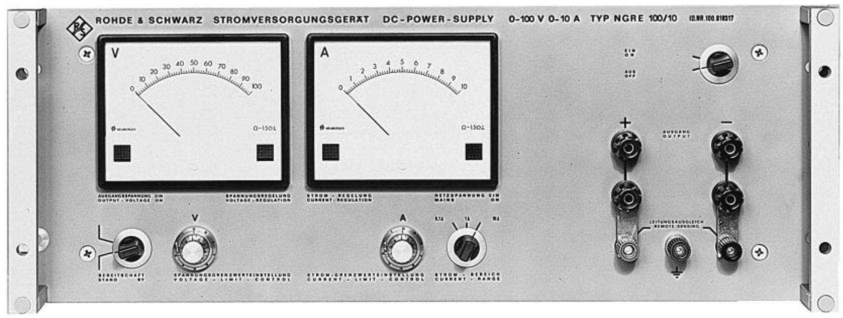
Rated temperature range	0 to +40°C
Meter accuracy	2.5 % of full scale
AC supply	220 V ±10%, 50 Hz, 2.4 kVA (other values on request)
Dimensions (W x H x D); Weight	484 mm x 194 mm x 509 mm; 40 kg

Ordering information

1000 W 19" Power Supply	NGC 35	0192.0032.02
	NGC 70	0192.0032.03

Power Supplies NGRE

19" models – from about 200 to 2000 W



NGRE in design A and B: cabinet model or rackmount, design B without operating controls (photo 24537)

Brief description

Power Supplies NGRE provide high output power (from about 200 W). This type series is extremely versatile due to the use of standardized modules.

There are 27 basic versions (see table on next page), most of which come in five models. The basic versions only differ in the obtainable maximum voltage and current values and in the output impedance.

Each of these basic versions is equipped differently regarding meters, operating controls, connectors and available as a cabinet model or rackmount.

Power Supplies of the NGRE series are designed for operation from 220 V AC supply. The power supplies can be adapted to other voltages upon request and at no extra cost.

Main features

- Sustained shortcircuit-proof, thermal overload protection
- Series and parallel connection of several units possible
- Built-in overvoltage protection (optional)

Operation

Voltage and current are set by means of high-resolution ten-turn potentiometers and indicated on separate panel meters. The power supplies are fitted with remote sensing sockets to compensate for voltage drops in the load leads. The two-stage cooling fan is thermostat-controlled and very quiet.

Setting the current ranges
NGRE models 16 and 17 for currents up to 30 A are available on request with decade current ranges, eg a 10 A unit can be set to 0.1/1/10 A.

Remote control
The following functions of models 12, 13, 16, 17 can be modified for remote control: output voltage, output current, power switch on/off/standby and control of power regulating element. Power supplies which have been modified for remote control may be operated in master-slave mode (optional). This mode, in which the output quantity is controlled by only one of the supplies involved, is especially recommended for equally splitting up the load current at high powers.

Surge current capability
Two to three times the rated current may be drawn from the NGRE Power Supplies. An external or internal (model code number …19) switch is provided for this purpose.

Dimensions of different designs

	Cabinet model mm	Rackmount mm	Seated depth mm
Design A	484 x 194 x 436	483 x 177 x 425	347
Design B	484 x 194 x 509	483 x 177 x 498	420
Design C	608 x 394 x 284	–	–

Specifications in brief and Order Numbers

Setting ranges **Voltage** V	 **Current** A	**Order number**	**Max. deviation of output for** ΔV AC supply ±10% V, I (%)	 Δt_{amb} −10 to +40 °C V, I (%)	**Z_{out} for** V mΩ	 (I) (kΩ)	**t_r for** V µs	**Max. PARD** V_{rms} µV	 I_{rms} mA	**Power consumption** at 220 V/50 Hz kVA	**Available design**	**Weight** incl. case kg
0 to 6	0 to 30	100.8402.xx	±0.001	0.01	1	(1)	<50	300	9	0.9	A, C	22
	0 to 40	100.8419.xx	±0.001	0.01	0.1	(1)	<50	300	12	0.9	A, C	22
	0 to 60	100.8425.xx	±0.001	0.01	0.1	(1)	<50	300	18	0.9	A, C	28
	0 to 80	100.8431.xx	±0.001	0.01	0.1	(1)	<50	300	24	1.8	B, C	29
0 to 10	0 to 20	100.8354.xx	±0.001	0.01	1	(2)	<50	300	6	0.9	A, C	19
	0 to 30	100.8360.xx	±0.001	0.01	1	(2)	<50	300	9	0.9	A, C	28
	0 to 40	100.8377.xx	±0.001	0.01	0.1	(2)	<50	300	12	1.8	A, C	28
	0 to 60	100.8383.xx	±0.001	0.01	0.1	(1)	<50	300	18	1.8	A, C	37
0 to 15	0 to 20	100.8319.xx	±0.001	0.01	1	(2)	<50	300	6	0.9	B, C	28
	0 to 30	100.8325.xx	±0.001	0.01	1	(2)	<50	300	9	1.8	A, C	28
	0 to 40	100.8331.xx	±0.001	0.01	0.1	(2)	<50	300	12	1.8	A, C	37
	0 to 60	100.8348.xx	±0.001	0.01	0.1	(1)	<50	300	18	2.5	B, C	39
0 to 30	0 to 10	100.8254.xx	±0.001	0.01	1	(5)	<50	300	3	0.9	A, C	19
	0 to 15	100.8260.xx	±0.001	0.01	1	(5)	<50	300	4.5	0.9	A, C	28
	0 to 20	100.8277.xx	±0.001	0.01	1	(3)	<50	300	6	1.8	A, C	28
	0 to 30	100.8283.xx	±0.001	0.01	1	(2)	<50	300	9	1.8	A, C	37
	0 to 40	100.8290.xx	±0.001	0.01	0.1	(2)	<50	300	12	2.5	B, C	39
	0 to 60	100.8460.xx	±0.001	0.01	0.1	(2)	<50	300	18	3.5	C	50
0 to 50	0 to 10	100.8219.xx	±0.001	0.01	1	(5)	<50	300	3	0.9	A, C	28
	0 to 15	100.8225.xx	±0.001	0.01	1	(5)	<50	300	4.5	1.4	A, C	28
	0 to 20	100.8231.xx	±0.001	0.01	1	(5)	<50	300	6	1.8	A, C	37
	0 to 30	100.8248.xx	±0.001	0.01	1	(3)	<50	300	9	2.5	B, C	39
	0 to 40	100.8454.xx	±0.001	0.01	0.1	(2)	<50	300	12	3.5	C	50
0 to 100	0 to 5	100.8160.xx	±0.001	0.01	1	(10)	<50	500	1.5	0.9	A, C	28
	0 to 10	100.8183.xx	±0.001	0.01	1	(10)	<50	500	3	1.8	A, C	37
	0 to 15	100.8190.xx	±0.001	0.01	1	(5)	<50	500	4.5	2.5	A, C	39
	0 to 20	100.8448.xx	±0.001	0.01	1	(5)	<50	500	6	3.5	C	50

Completion of Order Numbers

Model code number (last two digits of Order No.)	Design	Voltage and current setting Precision potentiometer on front panel	 Screwdriver adjustment on rear panel	Current range in three decades (up to 30 A) at extra cost	Four additional fixed voltages, pushbutton-selected	Large meters for voltage and current
13	19" cabinet		●			
17		●		●		●
12	19" rackmount		●			
16		●		●		●
19	Aluminium case	●			●	●

Programmable Voltage Source NGPS

For IEC/IEEE-bus systems

2 × ±40 V/±16.38 V,

max. 100 mA

Photo 27335

Brief description

Programmable Voltage Source NGPS has two independent outputs, the output voltages being programmable manually or by a controller. The two outputs can be combined as desired.

Main features

- Maximum current drain 100 mA: any value in excess of this limit will be signalled as a malfunction of the analog section
- Six-digit display for visual monitoring of programmed test runs
- In combined mode (programmed and manual) a digitally set voltage can be varied manually
- Two separate bipolar voltage sources with 0.5 mV or 2 mV resolution
  – 65,536 steps in low range
  – 40,000 in high range
- Programming via IEC/IEEE bus or manual control
- Shortcircuit-proof outputs
- Remote sensing to compensate for voltage drops of up to 0.5 V per lead

Operation

A trigger facility allows fast on/off switching of preset voltages and thus defined timing of test runs. By programming an automatic voltage sweep, the output voltage changes upon a trigger command between a start and a stop value.

Step size (n × count) and duration (n × 700 µs) can be preset. Depending on the trigger command, single-shot or current sweeping or different step size/duration for forward and return sweep can be programmed.

Specifications in brief

Outputs (A and B)	2 separate, floating channels, in parallel with rear outputs
Output voltage per channel	
Low range	–16.3835 to +16.3835 V
High range	–40.00 to +40.00 V
Setting	keypad; variation in steps or continuously within one range or programmed
Resolution (low/high range)	0.5 mV/2 mV
Deviation of fs (low/high range)	±2 mV/±4 mV
Display (with polarity sign)	6 digits for one channel
Output current	max. 100 mA, limiting threshold at approx. 130 mA
Stability, PARD	
Voltage deviation	
with ±10% AC supply variation	$<10^{-5}$
with temperature variation	$<10^{-5}$/K +100 µV/K
with load variation	$<10^{-5}$
Instability (low/high range)	<4 x 10^{-6}/h/<8 x 10^{-6}/h
Capacitive load	≤0.1 µF (80 V step)
PARD at 20 Hz and 1 MHz (low/high range)	<500 µV/<1 mV; V_{rms}
Nonlinearity (low/high range)	<700 µV/<3 mV
Remote control	
Interface	IEC 625-1 (IEEE 488) for ranges and voltage
Functions	SH1, AH1, T2, TE2, L1, LE1, SR1, RL0, PP1, C0, DC1, DT1
Programming response time	<1 µs
Data rate	max. 42 Kbyte/s
Programming time	>183 µs
Transient recovery time	<700 µs (<100 µs for smallest programming step)
Remote sensing	compensation for 0.5 V per lead
General data	
AC supply	110/220 V ±10%, 50 to 60 Hz, 120 VA
Dimensions (W x H x D); weight	492 mm x 116 mm x 392 mm; 6.2 kg

Ordering information

Programmable Voltage Source	NGPS	0192.0061.02

Programmable Power Supplies NGPU

NGPU 70/10: 175 W

(70 V/max. 10 A)

NGPU 70/20: 350 W

(70 V/max. 20 A)

Photo 26310

Brief description

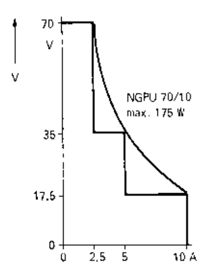
NGPU Power Supplies are constant voltage or constant-current sources, which can be programmed via IEC/IEEE bus or operated manually. Three selectable current ranges and one floating test output which can be switched between voltage and current make the NGPU ideal for use in IEC/IEEE-bus test systems.

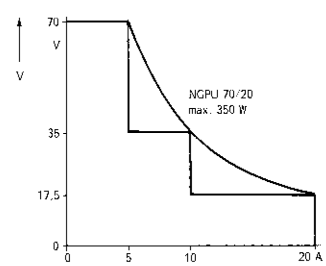
Main features

- Programming via IEC/IEEE bus or manual operation
- Three-digit programming of voltage and current (1000 steps), resolution: 10 to 100 mV, 10 to 20 mA
- Output current in three decade ranges

Graduated current loadability

Since the current drain of many loads – for instance of transceivers – is inversely proportional to the supply voltage, a graduated current loadability is fully compatible with practical requirements. The maximum continuous current drain for the selected output voltage is indicated on a scale of the panel voltmeter. Brief current surges exceeding this load limit are tolerable. If above 15 V a current exceeding this limit is permanently drawn, the power supply is disconnected from the AC supply via the built-in temperature monitor.





Current loadability is graduated as a function of the output voltage. Full output current can be derived over almost 80% of the voltage range. As the figure shows, the characteristic practically combines the curves, ie the performance, of three individual supplies.

Specifications in brief

Output quantities	adjustable via ten-turn potentiometer or IEC/IEEE bus	
Resolution		
Manual control	0.02%	
IEC/IEEE bus	1000 steps/range; for voltage adjustable 10 to 100 mV/step	
Voltage	<10 mV to 70 V	
Current	**NPGU 70/10**	**NPGU 70/20**
3 ranges	0.1/1/10 A	0.2/2/20 A
Deviation of output voltage/current		
with ±10% AC supply variation	$<10^{-5}$/$<5 \times 10^{-5}$	
between 0 and 40°C	$<(10^{-4}$/K+100 µV)/ $<(10^{-4}$/K+100 µA)	
with 10 to 90% load	$<10^{-4}$/$<5 \times 10^{-4}$	
PARD		
Voltage, V_{rms}	<1.5 mV	<1.5 mV
Current, I_{rms}	<5 mA	<10 mA
Transient recovery time (10 to 90% load)	<60 µs	<60 µs

Remote control	IEC 625-1 (IEEE 488)
Remote sensing	compens. for 0.5 V per lead
Test output	
for voltage	100 mV ±1% at 70 V
for current	100 mV ±2% for full scale
Overvoltage protection	adjustable from 4.5 to 80 V

General data

AC supply	110/220 V ±10%, 50 to 60 Hz	
Power consumption	600 VA	1250 VA
Dimensions (W x H x D) in mm	492 x 161 x 514	492 x 205 x 514
Weight	14 kg	19 kg

Ordering information

Programmable Power Supply

NGPU 70/10	0192.0049.92
NGPU 70/20	0192.0055.92

Programmable Power Supplies NGPV

Photo 431316-1

Brief description

Power Supplies of the NGPV series are suitable for use in test systems and for general laboratory applications.

Nine different models are available
NGPV 8/100 to 8 V/0 to 10 A
NGPV 20/50 to 20 V/0 to 5 A
NGPV 20/100 to 20 V/0 to 10 A
NGPV 40/30 to 40 V/0 to 3 A
NGPV 40/50 to 40 V/0 to 5 A
NGPV 100/10 to 100 V/0 to 1 A
NGPV 100/20 to 100 V/0 to 2 A
NGPV 300/0.30 to 300 V/0 to 0.3A
NGPV 300/0.60 to 300 V/0 to 0.6A

Each model comes in two versions
The version for use in systems and labs can be programmed via IEC/IEEE bus or operated manually. These power supplies are provided with the necessary operating controls, a digital LED display for indication of all input data including IEC/IEEE-bus commands, and analog meters for indication of actual voltage and current values. The system version is without operating controls so that models for use in systems are lower-priced.

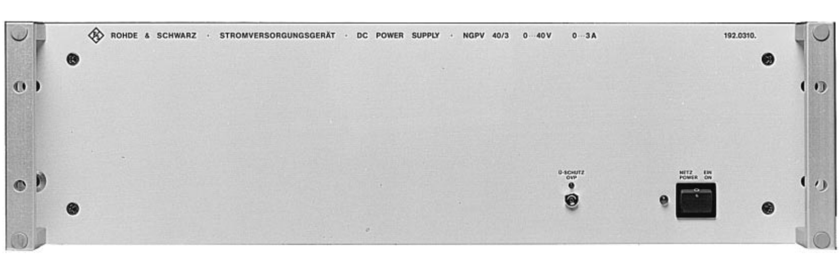
Main features

- Digital setting, high resolution
- No discrete output capacitance, true current source
- Programmable via IEC/IEEE bus and manual control
- Short setting time for down programming thanks to current sinking
- Two current ranges - high-resolution current monitoring output
- Display of operating status and faults
- Thermostat-controlled cooling fan
- 19" design

System use
Power Supplies NGPV are ideal for use in systems because of the short setting time of 2 ms which applies both to the rise time and thanks to controlled current sinking also to the fall time.

The NGPV models have no discrete output capacitance so that they can be used for regulating extremely low currents. Relay contacts will not be damaged by switching of current paths. A larger output capacitor can be switched into circuit manually or via the program.

Remote sensing
Remote sensing is a particularly system-friendly mode since it is set automatically with no sensing links involved. In the sensing mode, the maximum output voltage of the power supply exceeds the specified nominal voltage only by the amount of the voltage drop in the leads. The load is thus fully protected, even in the presence of a shortcircuit, wrong polarity or interruption of the sensing leads.



Power Supply NGPV for use in systems (photo 31924)

Specifications in brief

Type	NGPV 8/10	NGPV 20/5	NGPV 20/10	NGPV 40/3	NGPV 40/5	NGPV 100/1	NGPV 100/2	NGPV 300/0.3	NGPV 300/0.6
A1	0 to 7.99 V	0 to 19.99 V		0 to 39.99		0 to 99.9 V		0 to 299.9 V	
A2	10 mV/800	10 mV/2000		10 mV/4000		100 mV/1000		100 mV/300	
A3	$<10^{-3}$	$<10^{-3}$		$<10^{-3}$		$<10^{-3}$		$<10^{-3}$	
B1	0 to 9.99 A	0 to 4.99 A	0 to 9.99 A	0 to 2.99 A	0 to 4.99 A	0 to 0.999 A	0 to 1.99 A	0 to 0.299 A	0 to 0.599 A
B2	10 mA/1000	10 mA/500	10 mA/1000	10 mA/300	10 mA/500	1 mA/1000	10 mA/200	1 mA/300	1 mA/600
B3	$<10^{-3}$	$<2 \times 10^{-3}$	$<10^{-3}$	$<3 \times 10^{-3}$	$<2 \times 10^{-3}$	$<10^{-3}$	$<4 \times 10^{-3}$	$<3 \times 10^{-3}$	$<2 \times 10^{-3}$
B11	0 to 999 mA	0 to 999 mA		0 to 999 mA		0 to 99.9 mA		0 to 99.9 mA	
B12	1 mA	1 mA		1 mA		0.1 mA		0.1 mA	
B13	$<10^{-3}$	$<10^{-3}$		$<10^{-3}$		$<2 \times 10^{-3}$		$<2 \times 10^{-3}$	
C	<200 µV	<250 µV		<400 µV		<600 µV		<900 µV	
D	500 pF/220 µF	500 pF/100 µF	750 pF/220 µF	500 pF/47 µF	750 pF/100 µF	500 pF/22 µF	750 pF/47 µF	500 pF/10 µF	750 pF/22 µF
E	4.5 to 15 V	4.5 to 25 V		4.5 to 50 V		5 to 110 V		5 to 330 V	

Output voltage
A1: setting
A2: resolution (mV/steps)
A3: deviation (of fs)

Output current (A range)
B1: setting
B2: resolution (mA/steps)
B3: deviation (of fs)

Output current (mA range)
B11: setting
B12: resolution (1000 steps)
B13: deviation (of fs)

C: PARD, V_{rms}

D: output C (OFF/ON)

E: overvoltage protection (OVP)

Common data

Constant-voltage source

Deviation of output voltage	
with ±10% AC supply variation	$<10^{-5}$
between 0 and 50°C	$<2 \times 10^{-5}$/K
with 10 to 90% load	$<10^{-4}$
Transient recovery time (10 to 90%/90 to 10%)	<75 µs (to within $\pm 10^{-3}$)

Constant-current source

Deviation of output current	
with ±10% AC supply variation	$<10^{-5}$
between 0 and 50°C	$<5 \times 10^{-5}$/K
with 10 to 90% load	$<10^{-4}$
Transient recovery time, output C OFF/ON	<50 µs/<2 ms
PARD, I_{rms}	
in mA range	10 µA
in A range	100 µA/A

Remote control	IEC 625-1 (IEEE 488)	
Interface functions	SH0, AH1, T0, TE0, L1, LE0, SR0, RL1, PP1, DC1, DT1, C0	
Setting time (0 to 100%/100 to 0%)	<2 ms (to within $\pm 2 \times 10^{-3}$)	
Remote sensing	compensation for 1 V per lead	
Current monitoring output		
mA range	100 mV ±1% for full scale	
A range	10 mV ±1%/A	
General data		
Meter accuracy	±2.5% of fs	
AC supply	110/120/220/240 V ±10%, 47 to 63 Hz	
Order No.	192.0310...	192.0326...
Power consumption	approx. 250 VA	approx. 500 VA
Dimensions (W x H x D) in mm	492 x 161 x 392	492 x 161 x 420
Weight	12 kg	19 kg

Ordering information

Type	NGPV 8/10	NGPV 20/5	NGPV 20/10	NGPV 40/3	NGPV 40/5	NGPV 100/1	NGPV 100/2	NGPV 300/0.3	NGPV 300/ 0.6
F1	192.0310.80	192.0310.20	192.0326.20	192.0310.40	192.0326.40	192.0310.10	192.0326.10	192.0310.30	192.0326.30
F2	192.0310.81	192.0310.21	192.0326.21	192.0310.41	192.0326.41	192.0310.11	192.0326.11	192.0310.31	192.0326.31

F1: system version

F2: system and lab version

Programmable Power Supplies NGPX

NGPX 35/10:

0 to 35 V/0 to 10 A

NGPX 70/5:

0 to 70 V/0 to 5 A

NGPX 150/2.3:

0 to 150 V/0 to 2.3 A

High-speed power supply for power ramp simulation and high test throughput

Photo 42846

Brief description

Power Supplies NGPX are high-performance programmable laboratory units (350 W) using linear regulation. With their excellent regulation characteristics these 19" units are ideal for use in development labs. Thanks to convenient manual operation and IEC/IEEE-bus control they can readily be integrated into production test systems. A rear trigger input allows fast on/off switching of the output voltage to support current-saving applications.

Main features

- 350 W output power
- Low PARD thanks to linear regulation
- Accurate return signalling of voltage and current values, also via IEC/IEEE bus
- Effective current measurement with dynamic loads
- Fast up and down programming (typ. 10 µs for NGPX35/10)
- Large alphanumeric LCD display for output of nominal and actual values as well as status information
- Nominal value input via numeric keypad; increment and decrement key
- Rear, isolated trigger input
- Rear isolating and polarity reversal relay (optional)
- Current monitor in 3rd current range with 25 µA resolution (optional)
- Nonvolatile storage of 10 complete instrument setups
- Selectable foldback function
- Temperature-controlled cooling fan
- Soft limits for current and voltage
- Hardware overvoltage protection
- Remote sensing
- 19" system unit with IEEE488.2

Specifications in brief

Constant-voltage source	35/10	70/5	150/2.3
Voltage setting	0 to 35.00 V	0 to 70.00 V	0 to 150.00 V
Resolution (mV/steps)	10/3500	20/3500	50/3000
Deviation			
from nominal value (±1 LSB)	<25 mV	<50 mV	<125 mV
with ±10% AC supply variation	<±0.35 mV	<±0.7 mV	<±1.5 mV
with load variation (10 to 90% of fs)	<±1 mV	<±2 mV	<±3.5 mV
Transient recovery time with load variation (10 to 90% of fs) to ±0.15%	<75 µs	<75 µs	<75 µs
Rise/fall time of output voltage (fast mode)	typ. <10 µs	typ. <20 µs	typ. <20 µs
PARD, V_{rms} (C_{ON}/C_{OFF})	<0.25/<0.5 mV	<0.5/<1.0 mV	<1/<2 mV
Voltage measurement	0 to 40.95 V	0 to 81.9 V	0 to 204.75 V
Resolution (mV/steps)	10/4095	20/4095	50/4095
Deviation from measured value (±2 LSB)	<±35 mV	<±70 mV	<±150 mV
Constant-current source			
Current setting	0 to 10.00 A	0 to 5.00 A	0 to 2.30 A
Resolution (mA/steps)	2.5/4000	1.25/4000	1/2300
Deviation from nominal value[1]	<±10 mA±1 LSB	<±10 mA±1 LSB	<±5 mA±1 LSB
with ±10% AC supply variation	<±0.2 mA	<±0.2 mA	<±0.2 mA
with load variation (10 to 90% of fs)	<±1 mA	<±1 mA	<±0.5 mA
PARD, I_{rms} (C_{ON}/C_{OFF})	<0.2/<0.6 mA	<0.1/<0.3 mA	<0.05/0.15 mA
Current measurement in range 1	0 to 10.2375 A	0 to 5.1188 A	0 to 4.095 A
Resolution (mA/steps)	2.5[1]/4095	1.25[1]/4095	1/4095
Deviation from measured value ±2 LSB)	<±20 mA	<±10 mA	<±5 mA
Current measurement in range 2	0 to 1.02375 A	0 to 511.88 mA	0 to 409.5 mA
Resolution (µA/steps)	250/4095	125[2]/4095	100/4095
Deviation from measured value ±2 LSB)	<±2 mA	<±1 mA	<±0.5 mA
Current measurement in range 3 (option)		0 to 102.375 mA	
Resolution (µA/steps)	25[3]/4095	25[3]/4095	25[3]/4095
Deviation from measured value (±2 LSB)	<±30 µA[3]	<±30 µA[3]	<±30 µA[3]
Overvoltage protection			
Operating range	4 to 99.95 V	4 to 99.95 V	4 to 200 V
Resolution	50 mV	50 mV	100 mV
Response accuracy	±4 V	±4 V	±4 V

General data	
Refresh rate of display	3 updates per second
Refresh rate of measured value	update on each query
Setting time (incl. command processing)	typ. 4ms (NGPX mode)
Outputs	floating, max. 250 V DC
AC supply	100/120/220/240 V; 47 to 63 Hz; 1400 VA
Dimensions (WxHxD); Weight	492 mm x 161 mm x 513 mm; 23 kg
Programming	IEC625-2/IEEE488.2

Ordering information

Programmable Power Supply	NGPX35/10	0192.0610.31
	NGPX70/5	0192.0610.71
	NGPX150/2.3	0192.0610.11
Options		
Rear isolating and polarity reversal relay for	NGPX 35/10	0192.0610.32
	NGPX 70/5	0192.0610.72
	NGPX 150/2.3	0192.0610.12
Current monitor in current range 3 for	NGPX 35/10	0192.0610.33
	NGPX 70/5	0192.0610.73
	NGPX 150/2.3	0192.0610.13

1) Readout rounded to full mA

2) Readout rounded to full 100 µA

3) Readout rounded to full 10 µA

Programmable Power Supply NGPE 40/40

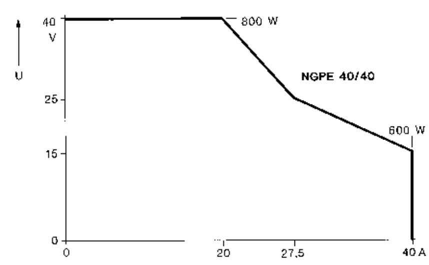
Brief description

Programmable Power Supply NGPE is suitable for use in test systems and for general laboratory applications. The relatively small output capacitance, the short setting time even for down programming (thanks to built-in current sinking) as well as the voltage and current monitoring outputs are significant benefits in system use.

Photo 43554

Main features

- 0 to 40 V/0 to max. 40 A
- Primary-switched regulator with high efficiency and low heat dissipation
- Low PARD, excellent EMC, RFI suppression grade B
- Good regulation characteristics even with partial loading thanks to push-push converter configuration using power FETs
- Wide AC supply regulation range: 190 to 265 V/95 to 135 V
- Manual setting or via IEC/IEEE bus
- Clear front-panel layout and LED display for voltage and current as well as IEC/IEEE-bus commands
- Separate panel meters for voltage and current, each with two switch-selected ranges
- High resolution and reproducibility due to decade setting
- High setting speed (for up programming independent of preset current limit, for down programming due to current sinking)
- Current monitoring output (two ranges)
- Voltage monitoring output
- Overvoltage protection (OVP)
- Thermostat-controlled cooling fan
- Remote sensing similar to NGPV
- 19" system unit



The autoranging output characteristic shows that higher currents are available at lower voltages. At 15 V and 40 A the output power is still 600 W

Specifications in brief

Voltage setting, in 4 digits	0 to 39.99 V	
Resolution	10 mV (4000 steps)	
Deviation	$<10^{-3}$ of full scale	
Current setting, in 3 digits	0 to 39.9 A	
Resolution	100 mA (400 steps)	
Deviation	$<2 \times 10^{-3}$ of full scale	
Constant-voltage source		
Deviation of output voltage		
with ±10% AC supply variation	$<10^{-4}$	
between 0 and 45°C	$<2 \times 10^{-5}$/°C	
with 10 to 90% nominal current	$<10^{-4}$	
Transient recovery time at 40 V,		
from 2 to 18 A or conversely	2.0 ms (to 150 mV)	
from 2 to 4 A or conversely	0.2 ms (to 50 mV)	
from 16 to 18 A or conversely	0.2 ms (to 50 mV)	
Setting time	without load	with load
from 0 to 39 V	50 ms	60 ms
from 39 to 0.4 V	100 ms	30 ms
from 39 to 0.1 V	120 ms	40 ms
PARD, V_{rms}/V_p	2 mV/20 mV	
Constant-current source		
Deviation of output current		
with ±10% AC supply variation	$<10^{-4}$	
between 0 and 45°C	$<10^{-4}$/°C	
with 10 to 90% nominal current	$<10^{-4}$	
PARD, I_{rms}	<40 mA	
Remote control	**IEC 625-1 (IEEE 488)**	
Functions	SH0, AH1, T0, TE0, L1, LE0, SR0, RL1, PP1, DC1, DT1, C0	
Remote sensing	compensation for 0.5 V per lead	
Panel meters		
Voltmeter (2 ranges)	10/40 V ±2.5% of full scale	
Ammeter (2 ranges)	4/40 A ±2.5% of full scale	
Monitoring output		
for current	400 mV corresp. to 4 A, 2% of fs 400 mV corresp. to 40 A, 0.2% of fs	
for voltage	0 to 40 V, 0.2% of fs	
Overvoltage protection (OVP)	4.5 to 50 V	
General data		
AC supply, selectable	95 to 135 V or 190 to 265 V, 47 to 63 Hz, 1600 VA	
Dimensions (W x H x D); weight	492 mm x 161 mm x 420 mm; 14 kg	

Ordering information

Programmable Power Supply	NGPE 40/40	0192.0332.41

Triple Power Supply NGPT

NGPT35:

2 × 35 V/1 A and 1 × 7 V/5 A

NGPT18:

2 × 18 V/2 A and 1 × 7 V/5 A

NGPT7:

2 × 7 V/5 A and 1 × 18 V/2 A

Photo 40649

Main features

- Insensitive to RF voltages radiated by device under test or nearby antenna
- Very low PARD (periodic and random deviation) due to linear regulation
- 14 bit resolution
- Precise and stable over wide temperature range
- Simultaneous readout of nominal and actual values of all channels
- Output voltage of all channels simultaneously variable by a percentage value
- Nonvolatile storage of up to six complete setups
- Software calibration via IEC/IEEE bus without potentiometer adjustment
- Coupled protection mode for DUTs which should not be supplied from an asymmetrical voltage source
- Floating outputs, max. 120 V DC
- Remote sensing (0.5 V per lead)
- Soft limits for defined voltage and current limiting
- Hardware overvoltage protection
- Quiet, temperature-controlled fan
- 19" system unit, full system capability via IEC/IEEE bus interface (IEC625-1/IEEE488-2)

Operation

Setting and display

Three displays are provided for indication of the nominal and actual values. A separate display is provided for status information and menu-guided operation.

Variable by percentage

For module testing, NGPT35 provides the possibility of varying the output voltage of all three channels simultaneously in percent. After selection of the channels to be included in this operating mode, the desired variation can either be set via the numeric keypad or in steps of 0.1, 1 or 10% using the increment/decrement keys.

Triple Power Supply NGPT

Specifications in brief

Constant-voltage source	35 V	18 V	7 V
Voltage range	0 to 35 V	0 to 35 V	0 to 7 V
Resolution	2.5 mV	2.5 mV	0.5 mV
Deviation of full scale	<0.01%	<0.01%	<0.01%
with ±10% AC supply variation	<0.001%	<0.001%	<0.001%
from 0 to 45°C	<0.005%/°C	<0.005%/°C	<0.005%/°C
with 10 to 90% rated current	0.01%	0.01%	0.01%
Transient recovery time			
following load variation	75 µs	75 µs	150 µs
Programming time	35 ms	35 ms	35 ms
PARD (V_{rms})	200 µV	200 µV	100 µV
Constant-current source			
Current range	0 to 1 A	0 to 2 A	0 to 5 A
Resolution	0.1 mA	0.2 mA	0.5 mA
Deviation of full scale	<0.02%	<0.02%	<0.02%
with ±10% AC supply variation	<0.002%	<0.002%	<0.002%
from 0 to 45°C	<0.01%/°C	<0.01%/°C	<0.01%/°C
with 10 to 90% rated voltage	0.02%	0.02%	0.02%
Transient recovery time			
following load variation	10 ms	10 ms	5 ms
Programming time	60 ms	60 ms	60 ms
PARD (I_{rms})	20 µA	20 µA	1 µA
Display			
Voltage measurement	0 to 40 V	0 to 32.7660 V	0 to 8 V
Resolution	2.5 mV	2.5 mV	0.5 mV
Deviation of full scale	<0.01%	<0.01%	<0.01%
from 0 to 45°C	<0.005%/°C	<0.005%/°C	<0.005%/°C
Measurement rate	2 per s	2 per s	2 per s
Current measurement	0 to 1 A	0 to 3,2766 A	0 to 5 A
Resolution	0.1 mA	0.1 mA	0.5 mA
Deviation of full scale	0.02%	0.02%	0.02%
from 0 to 45°C	<0.01%/°C	<0.01%/°C	<0.01%/°C
Measurement rate	2 per s	2 per s	2 per s
Soft limits			
Voltage range	0 to 35 V	0 to 18 V	0 to 7 V
Resolution	2.5 mV	2.0 mV	0.5 mV
Current range	0 to 1 A	0 to 2 A	0 to 5 A
Resolution	0.1 mA	0.2 mA	0.5 mA
Overvoltage protection			
Voltage range	1.5 to 40 V	1.5 to 25,55 V	1 to 10 V
Resolution	100 mV	50 mV	20 mV
Deviation of full scale	<2%	<2%	<2%
Response time	50 µs	50 µs	50 µs
Voltage variation			
Resolution	0.1%	0.1%	0.1%
Range	0 to 35 V	0 to 18 V	0 to 7 V
General data			
AC supply	100/120/220/40 V ±10%, 50 to 60 Hz, 350 VA		
Dimensions (W x H x D); weight	492 mm x 161 mm x 514 mm; 16 kg		

Ordering information

Triple Power Supply	NGPT35	0192.0510.31
	NGPT18	0192.0510.21
	NGPT7	0192.0510.71

DC Power Supply NGSM32/10

0 to 18 V/10 A (20 A)

0 to 32 V/5 A (10 A)

Designed for car electronics applications in service, laboratory and production

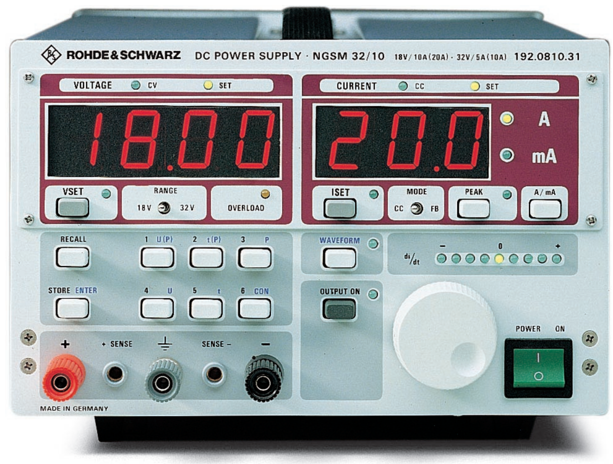


Photo 42945

Brief description

DC Power Supply NGSM is a versatile supply and measuring unit for testing electronic car components by simulating real operating conditions. In addition to a wide field of car electronics, it can be used in mobile radio and car hifi applications. Due to its compact design, the unit takes up only one half 19" width. A 19" adapter is available for mounting the NGSM into test racks.

Main features

- Excellent RF shielding, accurate standby current measurement – ideal for mobile radio applications
- Trend indication for current measurements
- Car electronics testing by simulating motor startup
- Currents up to 20 A for car hifi applications
- Storage of up to 12 device setups for short tests
- DUT protected against erroneous settings by ON/OFF output key
- IEC/IEEE-bus or RS-232-C interface for use in production environments (optional)
- Acoustic signal upon changeover from voltage to current regulation – ideal for long-time testing
- Great ease of operation despite numerous functions

Application-specific characteristics

Car electronics

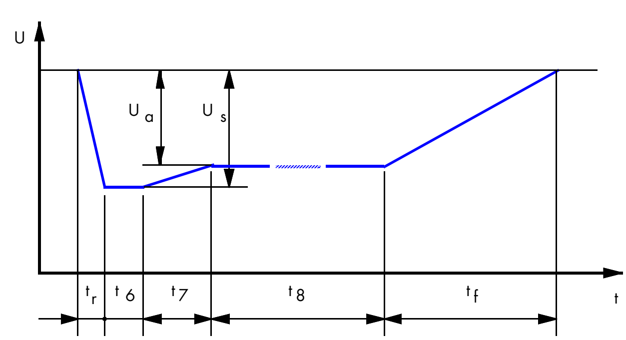
NGSM is a precise and, thanks to its versatility, an extremely economical tool for use in the production of electronics. With the aid of an IEC/IEEE-bus or RS-232-C interface (optional), the power supply can readily be integrated into in-line production systems. The startup curve in line with DIN40839 can be adapted to other factory standards by reprogramming it. High surge currents typically occur in applications such as central locking or ABS, but with a pulse current of up to 30 A, NGSM is ideally prepared for these applications.

Mobile radio systems

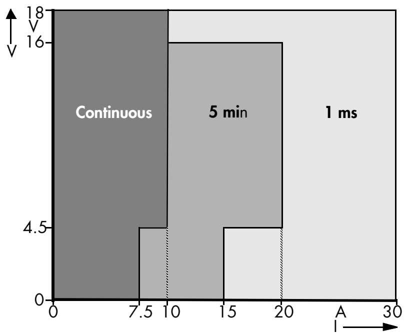
Mobile phones are either operated from theit own battery or from the car supply, thus placing specific requirements on the power supply:

- Ready status should be very long in standby and in transmit/receive mode
- Reliable functioning, even in case of typical onboard supply fluctuations

The high resolution for current measurements allows the maximum operating time of a mobile phone to be accurately predicted; typical voltage drops during the startup of a car can be simulated. DC Power Supply NGSM is insensitive to the RF voltage conducted from a device under test or radiated from a nearby antenna.



Startup curve to DIN40839



Current loadability in 18 V range

Current loadability in 32 V range

The trend indication of current can be used to check the transmit function of a mobile very simply. The experienced technician will for instance immediately recognize whether a Net-C phone has registered. The peak current measurement allows the achieved transmit power to be indirectly estimated and to detect any malfunctions of the mobile from the ratio of peak current to average value. The high power reserve of NGSM also covers the current required by additional peripherals.

Car hifi

With a short-term load current of 20 A, even boosters can be reliably supplied. Equipment for 12 V and for 24 V onboard supplies can be operated; peak current measurements allow the power loading of devices to be predicted. Simulation of the startup curve to DIN 40839 is also very useful in car hifi applications, eg to spot problems due to unexpected data loss of theft-proof car radios with security code.

Simple arbitrary generator

NGSM can also be used as a simple arbitrary generator – but with the high output power of a power supply unit. Up to 60 reference values are available per voltage range which have to be programmed at intervals of 1 to 4 ms. NGSM automatically interpolates between two values.

Operation

DC Power Supply NGSM features a large-size, extremely easy-to-read display and simple operation despite its versatile functions. It always stores the last instrument setting used. Up to six settings as well as the data of the arbitrary generator can be stored for each voltage range and recalled whenever required. Any faults occurring during operation are immediately displayed and signalled by an acoustic alarm; for protection of the DUT in the event of a fault, the user can choose between the constant-current mode or automatic switch-off. The sensing lines are provided with an integrated protection against wrong polarity for added safety.

Specifications in brief

Voltage range	**0 to 18 V**	**0 to 32 V**
Constant-voltage source		
Voltage setting	0 to 18 V	0 to 32 V
Resolution	10 mV	10 mV
Deviation of full scale	<0.4%	<0.2%
with ±10% AC supply variation	<0.01%	<0.01%
between 0 and 45°C	<0.02%/°C	<0.02%/°C
with 10 to 90% nom. current	0.01%	0.01%
Transient recovery time after load variation	0.1 ms	0.1 ms
PARD, V_{rms}	1 mV	1 mV
Constant-current source		
Current setting	0 to 20 A	0 to 10 A
Resolution 0 to 9.99 A	10 mA	10 mA
10 to 20 A	100 mA	100 mA
Deviation of full scale	<0.5%	<1.5%
with ±10% AC supply variation	<0.02%	<0.02%
between 0 and 45°C	<0.05%/°C	<0.05%/°C
with 10 to 90% nom. voltage	0.2%	0.2%
PARD, I_{rms}	20 mA	20 mA
Current loadability		
Continuous current	0 to 10 A*	0 to 5 A
Surge current (max. 5 min)	0 to 20 A*	0 to 10 A
Impulse current (max. 1 ms)	0 to 30 A*	0 to 20 A
	*reduced output currents at V ≤4.5 V	
Display		
Voltage measurement	0 to 40 V	0 to 40 V
Resolution	10 mV	10 mV
Deviation of full scale	<0.2%	<0.1%
between 0 and 45°C	<0.02%/°C	<0.02%/°C
Measurement rate	6/s	6/s
Current measurement in mA range	0 to 199 mA	0 to 199 mA
Resolution 0 to 99.9 mA	0.1 mA	0.1 mA
100 to 199 mA	1 mA	1 mA
Current measurement in A range	0 to 40 A	0 to 40 A
Resolution 0 to 9.99 A	10 mA	10 mA
10 to 40 A	100 mA	100 mA
Deviation of current meas. (mA, A)	<0.5% ±1 LS of rdg	<0.5% ±1 LS of rdg
between 0 and 45°C	<0.1%/°C	<0.1%/°C
Peak current measurement	0 to 40 A	0 to 40 A
Resolution	100 mA	100 mA
Deviation of peak current meas.	<2% of fs	<2% of fs
between 0 and 45°C	<0.2%/°C	<0.2%/°C

General data

Outputs	max. 120 V DC, floating
Voltage compensation	0.5 V per lead (remote sensing)
AC supply	100/120/220/240 V ±10%, 50 to 60 Hz, 690 VA
Dimensions (W x H x D); weight	211 mm x 150 mm x 350 mm; 8 kg

Ordering information

DC Power Supply	NGSM32/10	0192.0810.31
Options		
IEC-625/IEEE-488 Interface (listener/talker)	NGSM-B2	0192.0810.02
RS-232-C Interface	NGSM-B1	0192.0810.01
19" Adapter (3 HU, 2.8 kg)	NGSM-B0	0192.0810.00

RF Step Attenuator RSP up to 2.7 GHz (photo 37354)

Contents of Chapter 12

RF Step Attenuators RSP, RSG

RSP: DC to 2.7 GHz

0 to 139.9 dB

0.1 dB steps

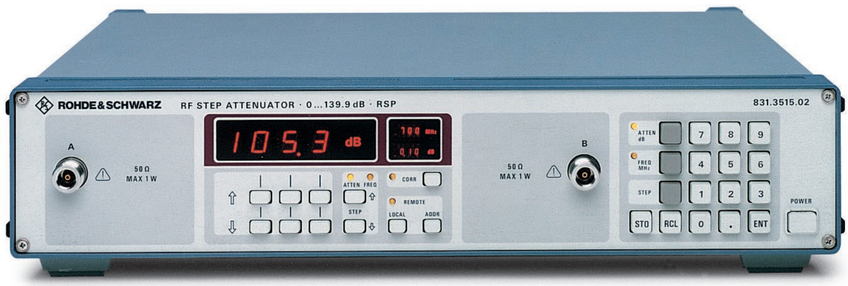


Photo 36277

RSG: DC to 5.2 GHz

0 to 139 dB

0.1 dB steps

Photo 38502

Brief description

Attenuator sets are two-port networks providing adjustable attenuation and the same constant characteristic impedance at the input and output.

Switching characteristics
During the switch-on routine the attenuators are set to DC and an attenuation of 40 dB. During switchover between two attenuation values it is ensured that there will be no reduction to lower attenuation values. During switching off the maximum attenuation value is always obtained.

Design
RSP and RSG are accommodated in compact 19" cases. The connectors can be refitted from the front to the rear panel. Since the attenuator module is electrically isolated from the unit itself, the attenuator pads have no ground or AC supply connections.

Main features

RSP, RSG

- Lifetime >5 x 10^6 switching operations per step
- Low input and output reflection coefficient
- Connectors electrically isolated from chassis ground
- High setting accuracy and switching reliability
- Short setting time of 20 ms
- Residual attenuation taken into account
- Frequency-dependent attenuation correction (RSP)
- Programmable via IEC/IEEE bus

RSP
Precision Attenuator RSP provides attenuation values between 0 and 139.9 dB in the frequency range 0 to 2.7 GHz. Above 1 dB, the smallest step is 0.1 dB. RSP can be used as an attenuator pad from 1 dB to 139.9 dB.

RSG
Attenuation can be set in 1 dB steps from 0 to 139 dB. The low residual attenuation with 0 dB setting can be determined by means of a special function. The attenuation accuracy can be improved by taking into account the correction values which are displayed on the front panel and can be recalled via IEC/IEEE bus.

RF Step Attenuators RSH, DPSP, DPS

RSH: DC to 5.2 GHz
0 to 139 dB
1 dB steps

DPSP: DC to 2.7 GHz
0 to 139 dB
1 dB steps

Photo 26970

DPS: DC to 2.7 GHz
0 to 139 dB
1 dB steps
Independent of
power supply

Photo 26972

Brief description

Attenuator sets are two-port networks providing adjustable attenuation and the same constant characteristic impedance at the input and output.

RSH
The attenuation of RSH can be set manually from 0 to 139 dB in 10 dB and 1 dB steps. Operation of RSH is purely mechanical and the model is fully independent of any power supply.

DPSP
RF Step Attenuator DPSP allows manual settings with two rotary switches, the carry being executed automatically. For remote control, DPSP has an IEC/IEEE-bus interface and can be used in automatic test systems.

DPSP can be mounted into 19" racks using an adapter. The connectors can be refitted from the front to the rear panel with no change of cables being involved.

DPS
RF Step Attenuator DPS features manual operation and the same electrical characteristics as the programmable DPSP. The desired attenuation is set with decade switches.

Built-in batteries, which are charged during AC supply operation, make DPS ideal for all applications where a power cable would be troublesome, eg in servicing and in outdoor measurements.

Specs in brief

Specs in brief	RSH		RSG		RSP		DPSP, DPS	
Frequency range	DC to 5.2 GHz		0 to 5.2 GHz		0 to 2.7 GHz		0 to 2.7 GHz	
Attenuation range	0 to 139 dB		0 to 139 dB		0 to 139.9 dB		0 to 139 dB	
Smallest step	1 dB		1 dB		0.1 dB (from 1 dB)		1 dB	
Residual attenuation (0 dB position)	DC	≤0.1 dB	DC	≤0.1 (typ. 0.05) dB	DC	≤0.12 (typ. 0.08) dB	≤200 MHz	≤0.4 dB
	≤1 GHz	≤0.7 dB	≤1 GHz	≤0.8 (typ. 0.5) dB	≤1 GHz	≤1.2 (typ. 0.8) dB	≤1 GHz	≤0.8 dB
	≤2.7 GHz	≤1 dB	≤3 GHz	≤1.2 (typ. 0.8) dB	≤2.7 GHz	≤1.8 (typ. 1.4) dB	≤2.7 GHz	≤1.2 dB
	≤5.2 GHz	≤1.6 dB	≤5.2 GHz	≤1.6 (typ. 1.3) dB				
Maximum attenuation error (in dB + % of attenuation value)	≤1 GHz	±(0.2 dB + 1%)	≤1 GHz	±(0.2 dB + 1%)	≤1 GHz	±(0.2 dB+ 1%)	±(0.2 dB + 1.3%), max. 1 dB	
	≤2.7 GHz	±(0.4 dB + 1%)	≤3 GHz	±(0.4 dB + 1%)	≤2 GHz	±(0.3 dB+ 1%)	typical: ±(0.1 dB + 0.6%),	
	≤5.2 GHz	±(0.6 dB + 1.3%)	≤5.2 GHz	±(0.6 dB + 1.3%)	≤2.7 GHz	±(0.4 dB+ 1%)	max. 0.5 dB	
Maximum attenuation error with correction	–				≤0.5 GHz	±(0.05 dB + 0.5%)	–	
					≤1 GHz	±(0.1 dB + 0.5%)		
					≤2 GHz	±(0.15 dB + 1%)		
Correction data stored for each attenuation setting	–		at 50 MHz intervals		at 50 MHz intervals		–	
VSWR	≤3.5 GHz	≤1.1 + 0.2 f/GHz	≤3.5 GHz	≤1.1 + 0.2 f/GHz	≤2 GHz	≤1.2 + 0.1 f/GHz	≤1.5 GHz	≤1.1 + 0.2 f/GHz
	≤5.2 GHz	≤1.8	≤2.7 GHz	≤1.8	≤2.7 GHz	≤1.4	≤2.7 GHz	≤1.4
Power-handling capacity								
Continuous	1 W		1 W		1 W		1 W	
Pulse	200 W/10 µs, max. 150 V		200 W/10 µs, max. 150 V		200 W/10 µs, max. 150 V		200 W/10 µs, max. 150 V	
Duty cycle								
Life	>1 x 106 switching operations		>5 x 10^6 switching operations/step		>5 x 10^6 switching operations/step		>5 x 10^6 switching operations/step	
Switching time	–		≤20 ms (atten. not corrected)		≤20 ms (atten. not corrected)		≤20 ms	
Selftest	–		checking of correction values		checking of correction values			
Power supply	–		100/120/220/240 V ±10%, 47 to 440 Hz		100/120/220/240 V ±10%, 47 to 440 Hz		115/125/220/235 V ±10 %, 47 to 440 Hz	
Dimensions (W x H x D)	248 mm x 135 mm x 76 mm		435 mm x 103 mm x 359 mm		435 mm x 103 mm x 359 mm		241 mm x 110 mm x 234 mm	
Weight	1.2 kg		5.5 kg		5.5 kg		3 kg	

Ordering information

	RSH	RSG	RSP	DPSP, DPS
RF Step Attenuator	1060.6518.02	1009.4505.02	0831.3515.02	DPSP: 0334.6010.02 DPS: 0334.7217.02

Extras

RSM, RSH	1046.2002.02	(microwave cable and adapter set (DC to 26.5 GHz), 1 m, adapter for N male connector)
	0358.5414.02	(matching Pad RAM (50/75 Ω))
RSM,		(adapter for 3.5-mm PC connector, male)
		(adapter for N connector, male)

Relay Matrix PSN, RF Relay Matrix PSU

PSN: DC and AF Relay Matrix for IEC/IEEE-bus programming

Photo 25290

Main features

- Six action reed relays and two power relays
- AF and control applications, high loadability
- Easy to operate, LED indication
- Remotely controllable via IEC/IEEE bus
- Fully isolated

Specifications in brief

	Relays 1 to 6	Relays 7 to 8
Connectors	telephone jacks on rear panel	
Contact/insulation resistance	150 mΩ/10^8 Ω	25 mΩ/10^8 Ω
Max. power-handling capacity	30 VA; 20 W (1 A, 110 V)	1 kVA; 100 W (5 A, 250 V)
Switching time	<1 ms	<5 ms

General data

Lifetime	>1000000 switching operations
Power supply	115/125/220/235 V ±10%, 47 to 420 Hz; max. 20 VA
Dimensions (W x H x D); weight	211 mm x 112 mm x 346 mm; 4 kg

Ordering information

Relay Matrix	PSN	0290.9210.02

PSU: DC to 6 GHz RF Relay Matrix for IEC/IEEE-bus programming

Photo 25289

Main features

- Six independent 50 Ω coaxial relays:
  - three with N connector up to 6 GHz,
  - three with BNC connector up to 500 MHz
- RF and pulse applications
- Easy to operate, LED indication
- Remotely controllable via IEC/IEEE bus

Specifications in brief

	Relays 1 to 3	Relays 4 to 6
Connectors	50 Ω N female on front panel	50 Ω BNC female on rear panel
Frequency range	DC to 6 GHz	DC to 500 MHz
VSWR	<1.22 to 1 GHz	<1.1 to 100 MHz
Insertion loss	0.3 dB to 1 GHz	0.2 dB to 100 MHz
Crosstalk attenuation	>80 dB to 1 GH	>40 dB to 100 MHz
Max. power-handling capacity	100 W at 0.1 GHz; 50 W at 1 GHz	1 A at 28 V
Switching time	<25 ms	<7.5 ms

General data

Lifetime	>1000000 switching operations
Power supply	115/125/220/235 V ±10%, 47 to 420 Hz; max. 25 VA
Dimensions (W x H x D); weight	211 mm x 112 mm x 346 mm; 4.8 kg

Ordering information

RF Relay Matrix	PSU	0290.8014.02

Matching Pads, Attenuators, Terminations

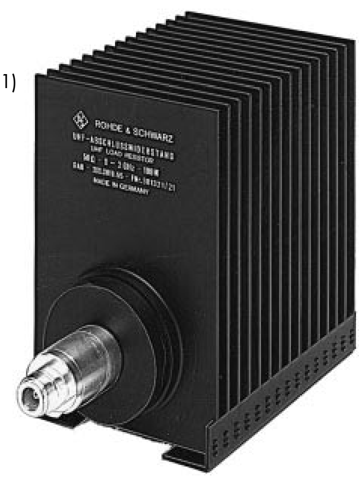
DNF (photo 36389)

RBS 1000 (photo 31777)

RDL50 (photo 39853-1)

RNB (photo 27202)

RNA (photo 36390-1)



RAU, 100W (photo 33901)

RAD (RAD50, RAD600), photo 29356

RAM (RAZ), photo 34891-1

Brief description

Attenuators
Attenuators are ideal for use in test setups in which the attenuation values do not have to be frequently changed. Their compact design and ease of handling (easy to replace) makes them also highly suitable for use in mobile test setups.

High-power attenuators
These are used as dummy loads for transmitter and power amplifiers. They have a test output with exactly defined attenuation for the connection of a measuring instrument such as power meter, analyzer or counter.

Terminations
They provide reflection-free termination of instruments and cables and can also be used as a reference impedance for VSWR measurements. In contrast to high-power attenuators, terminations do not have a test output.

Matching pads, feedthrough terminations
Matching pads are used to provide the necessary matching between measuring instruments and transmission lines of different characteristic impedances or as feedthrough terminations for matching 50 Ω lines to measuring instruments of high input impedance.

◀ Contents Overview | Chapter Overview | Type Index | R&S Addresses ▶

Specifications in brief / Ordering information for attenuators, terminations, matching pads

Designation	Type Order No.	Characteristic impedance	Power rating	Nominal insertion loss	Frequency range	VSWR	Accuracy of insertion loss	Max. peak pulse voltage	Connectors	Dimensions, weight
Attenuators	**DNF** 0272.4010.50	50 Ω	2 W[a]	3 dB	0 to 12.4 GHz	≤1.1 (up to 4 GHz) ≤1.2 (up to 10 GHz) ≤1.25 (up to 12.4 GHz)	±0.3 dB up to 8 GHz[b] ±0.5 dB up to 12.4 GHz[2]		N male, N female	20.5 mm dia. x 55 mm, 69 g
	DNF 0272.4110.50			6 dB						
	DNF 0272.4210.50		1 W[1]	10 dB			±0.3 dB up to 8 GHz[2] ±0.6 dB up to 12.4 GHz[2]			
	DNF 0272.4310.50			20 dB			±0.5 dB up to 4 GHz[2] ±0.6 dB up to 8 GHz[2] ±0.8 dB up to 12.4 GHz[2]			
	DNF 0272.4410.50			30 dB			±1 dB up to 12.4 GHz[2]			
High-Power Attenuators	**RBU 50** 1073.8695.03	50 Ω	50 W[c]	3 dB	0 to 2 GHz	≤1.1	±0.5 dB up to 1.5 GHz ±0.75 dB up to 2 GHz	5 kW (1 µs, 1%)	N male, N female, to MIL-C39012	180 mm x 77 mm x 90 mm, 0.8 kg
	RBU 50 1073.8695.06			6 dB			±0.5 dB up to 1.5 GHz ±0.75 dB up to 2 GHz			
	RBU 50 1073.8695.10			10 dB			±1 dB up to 1.5 GHz ±1 dB up to 2 GHz			
	RBU 50 1073.8695.20			20 dB			±1 dB up to 1.5 GHz ±1 dB up to 2 GHz			
	RBU 50 1073.8695.30			30 dB			±1 dB up to 1.5 GHz ±1 dB up to 2 GHz			
	RBU 100 1073.8820.03	50 Ω	100 W[3]	3 dB	0 to 2 GHz	≤1.1	±0.5 dB up to 1.5 GHz ±0.75 dB up to 2 GHz	5 kW (1 µs, 1%)	N male, N female, to MIL-C39012	236 mm x 140 mm x 141 mm, 2.8 kg
	RBU 100 1073.8495.06			6 dB			±0.5 dB up to 1.5 GHz ±0.75 dB up to 2 GHz			
	RBU 100 1073.8495.10			10 dB			±1 dB up to 1.5 GHz ±1 dB up to 2 GHz			
	RBU 100 1073.8495.20			20 dB			±1 dB up to 1.5 GHz ±1 dB up to 2 GHz			
	RBU 100 1073.8495.30			30 dB			±1 dB up to 1.5 GHz ±1 dB up to 2 GHz			
	RDL50 1035.1700.52	50 Ω	50 W (input), 10 W (output)	20 dB	0 to 6 GHz	≤1.15 (up to 2 GHz)	±0.5 dB	2 kW/5 µs	N male, N female	114 mm x 89 mm x 500 mm, 0.5 kg
	RBS 1000 0207.4010.55	50 Ω	≤1000 W (≤600 W)	40 dB	0 to 0.4 GHz (1 GHz)	≤1.2 input	± 1 dB[d]	10kW/1 µs	N female	500 mm x 285 mm x 152 mm, 12 kg

◀ Contents Overview | Chapter Overview | Type Index | R&S Addresses ▶

Designation	**Type** Order No.	Characteristic impedance	Power rating	Nominal insertion loss	Frequency range	VSWR	Accuracy of insertion loss	Max. peak pulse voltage	Connectors	Dimensions, weight
Terminations	**RNA** 0272.4510.50	50 Ω ±1%	1 W[1)]		0 to18 GHz	≤1.02 (up to 1 GHz) ≤1.02 + 0.004 x f [GHz]			N male	21 mm dia. x 46 mm, 36 g
	RNA 1028.4994.72	75 Ω	1 W[1)]		0 to 3 GHz	≤1.02			N male	21 mm dia. x 46 mm, 65 g
	RNB 0272.4910.50	50 Ω	1 W[1)], 2 W peak		0 to 4 GHz	≤1.05 (up to 1 GHz) ≤1.1 (up to 2 GHz) ≤1.2 (up to 4 GHz)			N male	20.5 mm dia. x 35 mm, 36 g
	RAU 0200.0019.55	50 Ω	100 W[e)]		0 to 2 GHz	≤1.05 (up to 1 GHz) ≤1.1 (up to 1.5 GHz) ≤1.4 (up to 2 GHz)		2 kV	N female	95 mm x 152 mm x 235 mm, 2 kg
Feedthrough terminations	**RAD** 0289.8966.00	50 Ω	500 mW[f)]		0 to 1 GHz	≤1.05 (up to 0.1 GHz)[g)] ≤1.1 (up to 0.5 GHz) ≤1.2 (up to 1 GHz)			BNC male, BNC female	14.5 mm dia. x 50.5 mm, 22 g
	RAD50 0844.9352.02	50 Ω	2 W		0 to 500 MHz	≤1.1 (up to 200 MHz) ≤1.25 (up to 500 MHz)			BNC male, BNC female	15.3 mm dia. x 50.5 mm, 22 g
	RAD600 0844.9452.02	600 Ω			0 to 10 MHz					
Matching pads	**RAM** 0358.5414.02	50 Ω → 75 Ω	2 W[h)]	5.72 dB	0 to 2.7 GHz	≤1.06 (up to 2 GHz) ≤1.2 (up to 2.7 GHz), both terminals	+ 0.15/–0.05 dB		N male, N female on 75 Ω end	21 mm dia. x 73 mm, 105 g
	RAZ 0358.5714.02			1.76 dB		≤1.06 (up to 2 GHz) ≤1.2 (up to 2.7 GHz), at 75 Ω terminal	± 0.2 dB			

a. At a max. ambient temperature of 30 °C; decreasing linearly to 0 W at 130 °C.
b. Attenuation change at a temperature change of 1 K: ≤0.0001 dB/dB. At a load change of 1 W: ≤0.001 dB/dB.
c. Continuous load up to a max. ambient temperature of 20 °C, decreasing linearly to 0 W at 125 °C; power-handling capacity at output up to 20 W.
d. The frequency response of the insertion loss is specified on a label on RBS1000 as 0.1 dB measurement error.
e. Overload capacity 100% (max. 5 s).
f. Continuous load up to a max. ambient temperature of 70 °C; decreasing linearly to 0 W at 130 °C.
g. Measured with open-circuit output.
h. Ambient temperature 25 °C.

Junction Boxes/Power Splitters

Photo 27807

Photo 27603

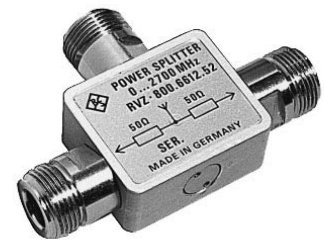


Photo 35789

Power Splitter/Combiner DVS

- Distribution or combination of signals
- High isolation between inputs
- Low insertion loss

Specifications in brief

Frequency range	0.1 to 400 MHz
Characteristic impedance	50 Ω
VSWR	typ. 1.2 dB
Insertion loss	typ. 3 dB
Isolation between inputs	20 to 40 dB
Max. continuous load	1 W = 7 V into 50 Ω
Dimensions	57 mm x 36 mm x 41 mm

Ordering information

Power Splitter/ Combiner	DVS	0342.1014.50

Four-Port Junction Box DVU4

- Four-port junction box for splitting up into or combining three channels with correct impedance matching
- For use eg in 3-signal measurements on radiotelephone equipment

Specifications in brief

Frequency range	0 to 1500 MHz
Characteristic impedance	50 Ω
VSWR	<1.1 (up to 1 GHz) typ. 1.2 (up to 1.5 GHz)
Insertion loss	9.5 dB
Max. load per connector	0.25 W
Max. permissible voltage spikes	300 V
Connectors	N female
Dimensions	120 mm x 120 mm x 35 mm

Ordering information

Four-Port Junction Box	DVU4	0201.4018.03

Power Splitter RVZ

- Power distribution to signal paths of exactly the same waves
- Measurement of correct transmission factor (reference: forward wave)

Specifications in brief

Frequency range	0 to 2700 MHz
Characteristic impedance	50 Ω
VSWR	≤1.1
Level deviation of outputs	≤0.1 dB
Phase deviation of outputs	≤2°
Insertion loss from input to each output	6 dB –0.1/+0.5 dB
Power-handling capacity	1 W
Connectors	N female
Dimensions	47 mm x 70 mm x 16 mm

Ordering information

Power Splitter	RVZ	0800.6612.52

Adapters for RF Connectors

All RF connectors can be adapted for use in other systems by means of screw-in connectors, see table on the right. The maximum power values for frequencies other than 1000 MHz are obtained by means of the following formula:

$$P_{max} = P_{(1\ GHz)}/\sqrt{f_{(GHz)}}$$

Conversion to	Male connector	Female connector	Max. power at 1000 MHz
N	017.7532.00	017.5398.00	0.6 kW
BNC	017.7832.00	017.5730.00	0.4 kW
4.1/9.5	017.9106.00	017.8516.00	0.8 kW
7/16	017.9258.00	017.8739.00	1.0 kW
Dezifix B	018.2486.00	018.2486.00	1.3 kW

Coaxial Components

Brief description

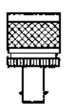
Measuring instruments from Rohde&Schwarz are fitted with internationally used standard connectors. Depending on the requirements (frequency range, power rating, reflection characteristics, etc), connector systems N, PC-3.5 or BNC are used.

The following overview also shows the most frequently required couplings, angle junctions and T connectors.

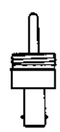
Note
Order numbers are bold-faced.

Adapters to systems of other make

50 Ω
N female/
BNC male
0541.8030.00



50 Ω
N male/
BNC female
0118.2812.00

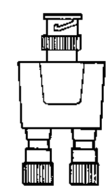


Screw-in connector
4/13 male/
BNC female
0017.5975.00

4/13 female/
BNC male
0408.4509.00

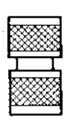
4/13 male/
BNC female
0408.4480.00

BNC male/
knurled terminal
0541.8030.00



BNC male/
dual knurled
terminal
0017.6742.00

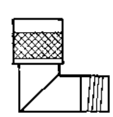
Couplings, angle junctions and T connectors, 50 Ω



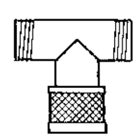
N
male/
male
0092.6581.00

N
female/
female
0092.6700.00

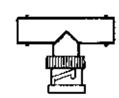
BNC
female/
female
0017.6559.00



N
male/
female
0018.4495.00

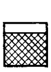


N
female-female/
male
0018.4537.00

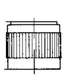


BNC
female-female/
male
0017.6588.00

Shortcircuits

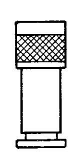


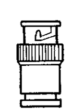
N connector
(male)
0017.8080.00



N connector
(female)
0017.8145.00

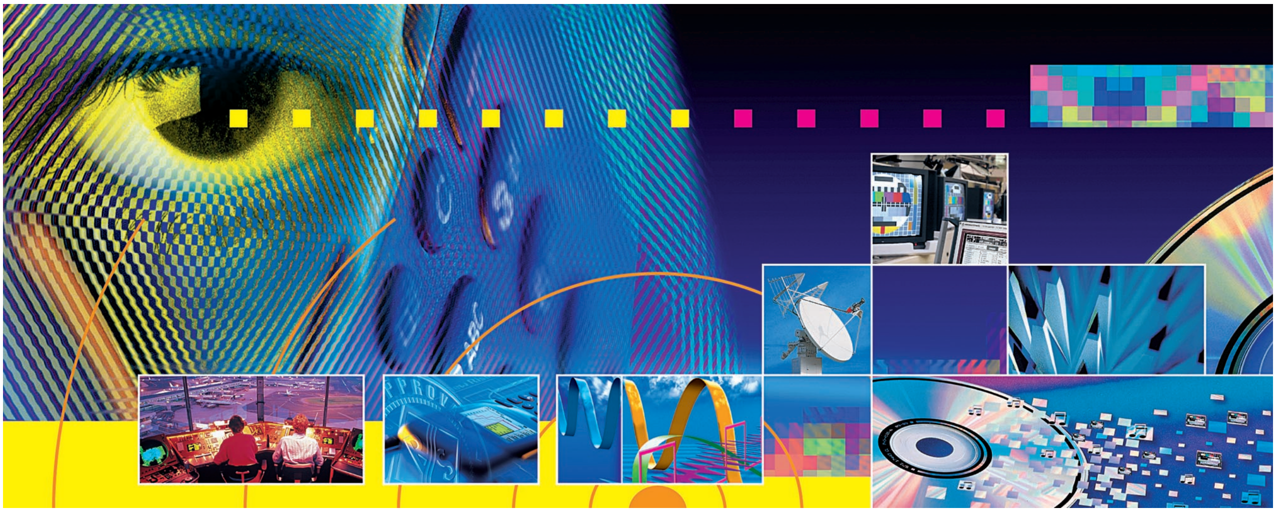
Cable-mounting connectors (male)





For cable	N, 50 Ω	BNC, 50 Ω
RG 58 C/U	**0472.9714.00**	**0017.6536.00**
RG 8/213/214U	**0415.9502.00**	**0017.6442.00**

Rohde & Schwarz Customer Service



Contents of Annex

Documentation – medium between man and technology

Technical documentation from Rohde & Schwarz prepared to customer's order - also for non-R&S products

- Review and appraisal of existing documentation for compliance with standards and guidelines
- Operating instructions and user's guides
- Maintenance instructions
- Service and calibration instructions
- Repair instructions
- Fault diagnosis instructions
- Leaflets
- Brochures
- Data sheets
- Materials management concepts
- Technical manuals
- Design drawings with 2D and 3D illustrations
- Spare parts catalogs and illustrated spare parts lists
- Program-controlled input and print-out of modular documents
- Training documentation

Keeping pace with new requirements

Laws, standards and directives place high demands on technical documentation. We guarantee that the documentation prepared by us conforms to all relevant standards, directives, regulations and laws, including for instance the

- EU directives for
  - machinery
  - low voltage
  - EMC
- medical products law
- EN, ISO and VDI specifications
- DIN specifications
- product liability law
- product safety law
- multimedia law

New tools for your technical documentation

Your documentation will be tailored to your specific needs. We undertake the complete project handling through to the finished data medium.

More than just a translation

Our translations cover all fields of activity of our company. Technical documentation is translated into any desired language mainly by native speakers. The texts are translated technically correctly and edited. The result is a comprehensible, reliable and accurate match of your original documentation.

Drawing on qualified sources

Our staff at the Cologne Plant has a solid background of experience and know-how. This is the result of close cooperation with headquarters ranking among the market leaders worldwide in the fields of communications and test and measurement, as well as of numerous projects handled for other branches of industry. Benefits are also gained from the broad range of services provided by the Cologne Plant, including maintenance and repair, calibration, generation of special software, training and over 30 years of experience in documentation. We are always technically up to date. This is ensured by our participation in standardization bodies and joint ventures with leading international companies, by our intensive R&D work as well as by holding or attending lectures at universities and institutes of technology.

This up-to-date technical know-how is of course also a benefit for product documentation where our staff can provide valuable information and recommendations.

Documentation just in time

Market success is also determined by the "time to market". This means: if development and documentation take place simultaneously, time to market can be reduced substantially. Therefore we can make available on request an expert or whole team to support you on site in generating optimized documentation just in time in close cooperation with your specialists.

Documentation as you like it

You choose the hardware and software to be used for generating, storing and duplicating your documentation. The technical documentation furnished by us can easily be revised or completed – of course also by your staff. The documentation you receive is your individual solution: a manual, an illustrated catalog, detailed operating instructions – as a hardcopy, disk, tape, microfiche or CD-ROM.

Further support provided by Rohde & Schwarz

- Logistics concepts
- Material maintenance concepts
- Repair concepts
- Spare parts stockkeeping concepts
- Equipment layout diagrams
- Integrated logistics support
- Illustrated spare parts catalog (complying with B007, C-1-4, SPEC 2000, ATA DMKL, NATO guidelines)
- Electronic spare parts management, spare parts catalogs, materials lists
- Electronic information systems
- 3D illustrations, exploded views
- Generation of circuit diagrams, block diagrams to standard

- Design drawings to DIN
- Generation of home pages for Internet
- Generation of documentation in SMGL or HTML format
- Online documentation
- Database programming and design
- Multimedia productions eg for maintenance, service, marketing and sales
- Multimedia product presentations including trainer or simulator
- Storage on CD-ROMs

Get in touch with us

Call us and put our competence to the test. We shall be glad to provide you with any further information.

Rohde & Schwarz Cologne Plant
Telephone: +492203 49-246
Telefax: +492203 49-364

Training

Committed cultivation of market and customer as well as the continuous training of your staff will ensure competitiveness of your company in the present and in the future

Photo 40829-1

Welcome to our training courses

Electronics as a basic technology calls for highly qualified staff. Rohde& Schwarz offers basic training, seminars, retraining, and training on instruments and systems in line with customer's requirements.

We provide our customers with what will be increasingly important in the future: practical training, transfer of know-how, helping you to help yourself. Our seminars are constantly being adapted to meet these objectives and to offer up-to-date solutions to your measurement problems.

Small groups for optimum results
The number of participants is limited for all seminars. This makes for enhanced receptivity and allows an intensive dialog between the trainees and the trainer. Thus, knowledge can be passed on at greater depth, and individual problems can be dealt with in greater detail. In most seminars, the emphasis is on practical exercises performed on modern test equipment, since this is the most efficient way of learning.

Photo 40829-3

Our training staff

Our communications, electrical and software engineers and physicists provide you with the knowledge you actually require. Having the latest know-how and many years of experience is one thing, being able to pass this on in an interesting and comprehensible way is another.

We therefore attach utmost importance to the qualified didactic training of our engineers picked to be your lecturers and trainers. Where appropriate and necessary, we call in lecturers from universities, authorities and from among users. We want to make sure that our customers have the best trainer available.

Training courses kept up to date

All seminars are constantly reviewed and improved and new knowledge and relevant changes taken into account immediately. This guarantees that the technical know-how as well as the regulations and standard specifications presented to you are always up to date.

Rohde & Schwarz standard seminars

In our seminars your measurement problems, and not the Rohde & Schwarz test assemblies, are given top priority. Our training programs are structured so that both newcomers and specialists will find a seminar suiting their requirements.

Customer-specific seminars

We offer customized seminars for training tasks to be performed at your company. This starts with an analysis of the learning objectives and target group in the conceptual phase, which is followed by a proven methodical approach. This ensures an optimum benefit/cost ratio and avoids burdening the courses with unnecessary information. Within the framework of these seminars, we also offer special user and application courses for Rohde & Schwarz instruments to allow an even more time-saving and efficient use.

Training sites

Training courses are held at Rohde & Schwarz headquarters in Munich, at the Cologne Plant, our branch offices and representatives and at the customer's.

Training at Rohde & Schwarz

Highly qualified personnel and a complete range of measuring instruments and teaching aids make each seminar a success. Here you can get acquainted with state-of-the-art measurement and communications technology from Rohde & Schwarz.

Seminars at the customer's

You want to train several staff members at a time? To put learned matter into practice immediately? To solve specific problems within your own organization? To leave travelling to us? In this case we hold seminars at your company. These may be standard Rohde & Schwarz or customized seminars.

Ask for information on our seminars

Training Center Munich

Our brochure provides detailed information on the contents, dates, prices and other terms of our seminars.

Telephone: +4989 4129-3051
Telefax: +4989 4129-3335

Training Center Cologne

Our training brochure gives you an overview of the seminars held at the Cologne Plant.

Telephone: +492203 49-271
Telefax: +492203 49-285

For information on seminars held in other cities or at the customer's or seminars held in English please contact our sales offices (see address list on page 422).

Repair

We check, overhaul and repair electronic equipment from R&S and other manufacturers

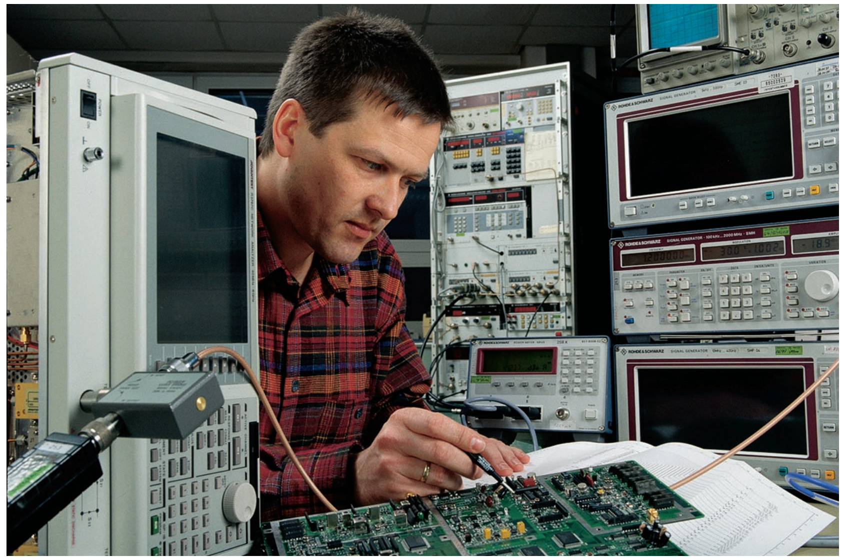


Photo 39001

Service centers of international standard

Maintenance and repair are central to our integrated support

- Our service labs are equipped with state-of-the-art computerized test stations
- All instruments can be tested under simulated environmental conditions of extreme temperatures and humidity
- The mobile service from Rohde & Schwarz provides rapid, reliable on-site support

With its testing labs, workshops and maintenance vehicles worldwide, Rohde & Schwarz is perfectly equipped to provide comprehensive, short-term and reliable service. This covers measuring instruments and systems, automatic test systems, data processing systems, communications engineering, radiomonitoring/radiolocation, sound and TV broadcasting, avionics, telemetry and radar and sonar equipment testing.

Customer-oriented service

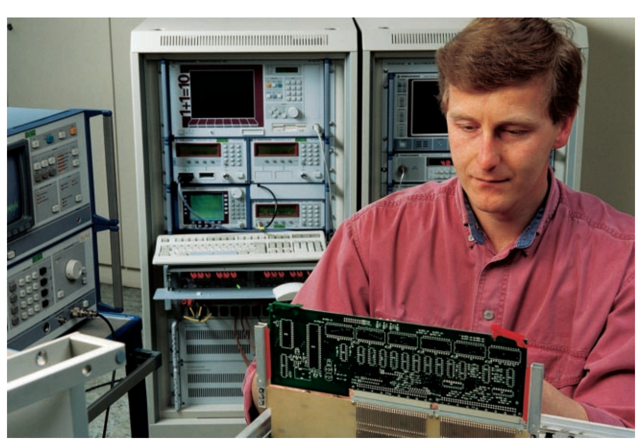
Where appropriate, we have set up independent service centers, for example the Rohde & Schwarz Emirates LLC in Abu Dhabi. Already shortly after its foundation, this service center developed into a strong partner of regional customers as well as European manufacturers, providing an on-site service base for the latter.

Spare parts procurement also for older components and PCBs

We work out reasonably priced alternatives if the original components or assemblies you need are no longer available. Our technical documentation is constantly updated to comply with current developments. Documentation is modified in accordance with requirements and supplied with the equipment. A well-thought-out logistics concept guarantees availability of PCBs and assemblies produced by Rohde & Schwarz even after many years.

Our range of services

- Worldwide service
- Service at the operational facilities of our customers
- Mobile calibration/repair labs
- Express service
- Repair of measuring and communications equipment from Rohde & Schwarz, OEM (**O**riginal **E**quipment **M**anufacturer) products and equipment of other make
- Service training
- Spare parts procurement



Calibration

Rohde & Schwarz has been calibrating measuring equipment and systems from domestic and foreign manufacturers since the 60s. In 1977, our Cologne Plant was appointed the first accredited calibration center of the German Calibration Service (DKD) for electrical parameters

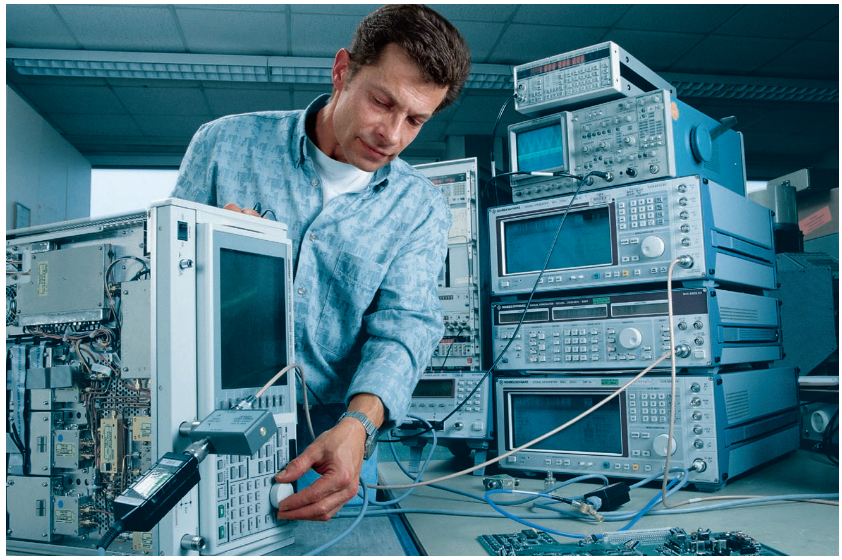


Photo 39002

Definitions

Calibration

- Upon calibration, the deviation of measured values from rated specifications of the device under test (DUT) is determined (difference between nominal and actual value or nominal and actual reading)
- Each calibration is based on relevant test instructions
- Results are recorded in a test report
- The measurement uncertainty of the calibration equipment must be known
- No technical modifications are made on the DUT

Official calibration

- Same scope of services as for calibration
- Testing by calibration authority in line with calibration standards
- Stamped label affixed to DUT
- Measuring instruments subject to official calibration and those exempt from official calibration are governed by legal provisions

Testing

- Same scope of services as for calibration, but without test report
- Verification of compliance with predefined conditions (eg specifications)

Adjustment (alignment)

Adjustment involves manipulation, which usually results in a permanent modification of the DUT. The DUT is adjusted to ensure minimum departure from rated specifications or departure that is so low that the DUT fully complies with specifications (measurement uncertainty to be taken into account!). The adjustment is made with the aid of variable components or via computer control (eg new correction factors in EEPROM or RAM).

Product calibration certificate

More and more companies are endeavouring to obtain certification or already have a certification to ISO 9000. Calibration must be traceable for instruments intended for use in quality-related processes, eg R&D, incoming goods inspection, testing, final inspection, quality control, etc. We offer a special factory calibration package for you to furnish evidence that your equipment has been calibrated by Rohde&Schwarz. You can order the factory calibration package against a small charge when buying an instrument. This package provides you with a qualified, written evidence that the instrument has undergone calibration. This evidence includes a calibration certificate, a label affixed to the instrument and a test report.

Calibration in service

This type of service is becoming more and more important in view of the obligation to furnish evidence under product liability but also with respect to increasing demands being made on precision in all fields of electronics. Rohde & Schwarz provides high-precision calibration for the electrical instruments and fields of measurement approved by the Federal German Bureau of Standards (PTB), which is the national metrological institute of the Federal Republic of Germany.

Calibration

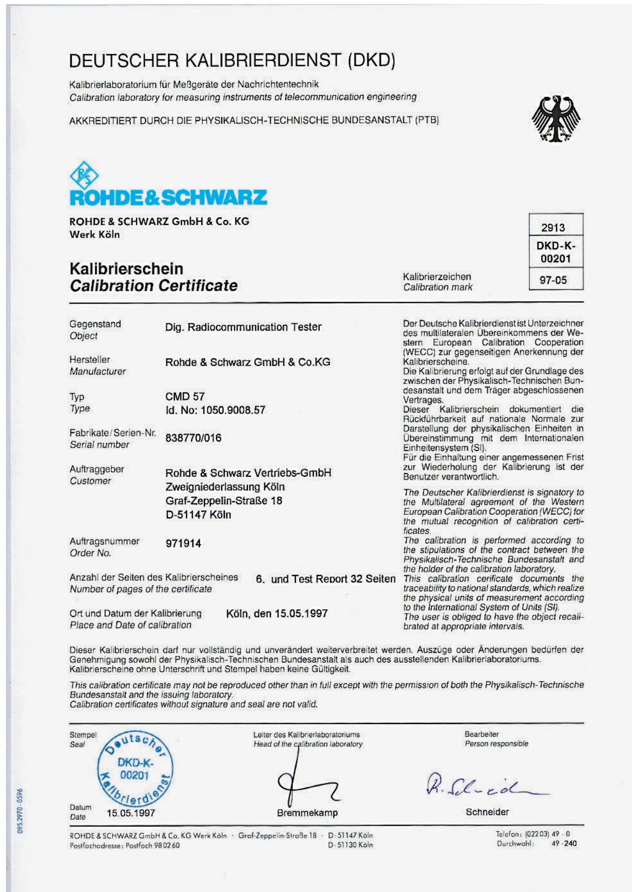
The test antennas from Rohde & Schwarz are calibrated in compliance with relevant standards, eg ANSI, C63.5, SAE, ARP958, DIN45003 and IEC597-2. Prior to the calibration of loop antennas, a patented attenuation measurement is performed.

Calibration to DIN ISO9000

- Inspection and documentation of status of DUT upon receipt, if DUT data are out of specified tolerances (ISO 9001 4.11g)
- Remark on cover sheet of test report/calibration certificate
- Testing and recording of results according to performance test/ calibration instructions
- Readjustments
- Minor repairs
- Detailed test report
- Calibration certificate
- Calibration label affixed to DUT
- Archiving of results for 5 years
- Electrical safety inspection (VBG 4)

DKD calibration (at R&S Cologne only)

- Measurement of basic parameters accredited by PTB Braunschweig
- Measurements at specific points
- Scope of measurements to be specified by customer
- Recording of nominal and actual values
- Verification of measurement uncertainty
- With a sufficient number of measurement points, a certificate of conformity with manufacturer's specifications can be issued
- DKD label on DUT
- Calibration certificate and test report



DEUTSCHER KALIBRIERDIENST (DKD)

Kalibrierlaboratorium für Meßgeräte der Nachrichtentechnik
Calibration laboratory for measuring instruments of telecommunication engineering

AKKREDITIERT DURCH DIE PHYSIKALISCH-TECHNISCHE BUNDESANSTALT (PTB)

ROHDE&SCHWARZ

ROHDE & SCHWARZ GmbH & Co. KG
Werk Köln

Kalibrierschein
Calibration Certificate

Kalibrierzeichen / *Calibration mark*: 2913 DKD-K-00201 97-05

Gegenstand / *Object*	Dig. Radiocommunication Tester
Hersteller / *Manufacturer*	Rohde & Schwarz GmbH & Co.KG
Typ / *Type*	CMD 57 Id. No: 1050.9008.57
Fabrikate/Serien-Nr. / *Serial number*	838770/016
Auftraggeber / *Customer*	Rohde & Schwarz Vertriebs-GmbH Zweigniederlassung Köln Graf-Zeppelin-Straße 18 D-51147 Köln
Auftragsnummer / *Order No.*	971914
Anzahl der Seiten des Kalibrierscheines / *Number of pages of the certificate*	6. und Test Report 32 Seiten
Ort und Datum der Kalibrierung / *Place and Date of calibration*	Köln, den 15.05.1997

Der Deutsche Kalibrierdienst ist Unterzeichner des multilateralen Übereinkommens der Western European Calibration Cooperation (WECC) zur gegenseitigen Anerkennung der Kalibrierscheine.
Die Kalibrierung erfolgt auf der Grundlage des zwischen der Physikalisch-Technischen Bundesanstalt und dem Träger abgeschlossenen Vertrages.
Dieser Kalibrierschein dokumentiert die Rückführbarkeit auf nationale Normale zur Darstellung der physikalischen Einheiten in Übereinstimmung mit dem Internationalen Einheitensystem (SI).
Für die Einhaltung einer angemessenen Frist zur Wiederholung der Kalibrierung ist der Benutzer verantwortlich.

*The Deutscher Kalibrierdienst is signatory to the Multilateral agreement of the Western European Calibration Cooperation (WECC) for the mutual recognition of calibration certificates.
The calibration is performed according to the stipulations of the contract between the Physikalisch-Technische Bundesanstalt and the holder of the calibration laboratory.
This calibration cerificate documents the traceability to national standards, which realize the physical units of measurement according to the International System of Units (SI).
The user is obliged to have the object recalibrated at appropriate intervals.*

Dieser Kalibrierschein darf nur vollständig und unverändert weiterverbreitet werden. Auszüge oder Änderungen bedürfen der Genehmigung sowohl der Physikalisch-Technischen Bundesanstalt als auch des ausstellenden Kalibrierlaboratoriums.
Kalibrierscheine ohne Unterschrift und Stempel haben keine Gültigkeit.

*This calibration certificate may not be reproduced other than in full except with the permission of both the Physikalisch-Technische Bundesanstalt and the issuing laboratory.
Calibration certificates without signature and seal are not valid.*

Stempel / *Seal*: Deutscher Kalibrierdienst DKD-K-00201

Leiter des Kalibrierlaboratoriums / *Head of the calibration laboratory*: Bremmekamp

Bearbeiter / *Person responsible*: R. Schneider — Schneider

Datum / *Date*: 15.05.1997

ROHDE & SCHWARZ GmbH & Co. KG Werk Köln · Graf-Zeppelin-Straße 18 · D-51147 Köln
Postfachadresse: Postfach 98 02 60 D-51130 Köln
Telefon: (02203) 49 - 0
Durchwahl: 49 -240

095.2970-0596

Our air-conditioned calibration labs are equipped with state-of-the art technology allowing a wide variety of electrical parameters to be measured over wide frequency ranges. If a measuring instrument is found defective or out of tolerance in calibration, and the defect or deviation cannot be eliminated by adjustment, the instrument can be repaired right in the lab.

Calibration interval

The calibration interval is the maximum period of time between two calibrations. It is proposed by the manufacturer or by the calibration center. Recalibration is performed by the Rohde&Schwarz Central Service Department in Munich.

The calibration interval proposed by Rohde&Schwarz for new types of equipment is 12 to 36 months unless otherwise specified in the data sheet. In the case of harsh environmental conditions, stringent requirements placed on safety (eg in medicine or air traffic control) or great financial loss in the event of erroneous measurements, the calibration interval should be shortened. The interval can be prolonged however where for instance the requirements placed on measurement accuracy are less stringent than specifications or if the financial losses resulting from erroneous measurements would be minimal.

Tolerance analysis

Tolerance analysis is an integral part of any test instructions. It is used to determine the measurement uncertainties of a test setup/measuring system and to take into account errors that cannot be specified in the data sheet. Such errors may for instance occur in power measurements if both the power meter and the source are mismatched and may become as large as the specified errors.

A correct error specification must contain two aspects:

- the error limits and
- the confidence level, ie how many results from a large number of measurements do not exceed the error limits

For the maximum error the confidence level is 100%. In practice the maximum error occurs very rarely only. If the total error is made up of a large variety of individual errors resulting from independent sources (which is typical of individual errors) it is according to the laws of statistics very rarely encountered that in a single measurement all individual errors do occur with their maximum value and the same polarity.

In measurements it has therefore become expedient to specify the practice-oriented RSS error (RSS = root sum of squares), which is the square root of the sum of the squares of the individual RSS errors. The RSS error of a sum of individual errors is an error that will not be exceeded in 95% of all measurement results.

Traceability

According to the quality system DIN ISO 9001 (4.11.b), test equipment must be calibrated against certified equipment having a known valid relationship to nationally recognized standards. This relationship is defined in a calibration pyramid (see below).

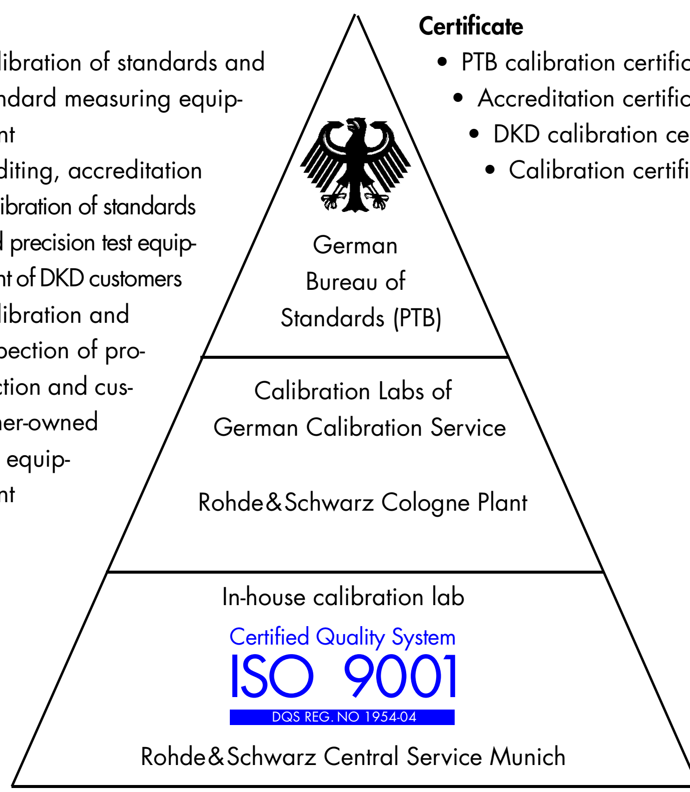
Parameters that are not included in the list of accredited measured quantities (voltage, current, attenuation, mechanical length, etc) such as amplitude and frequency modulation can be traced to the basic parameters via approved measurement and computational methods. For example, FM can be traced to the mathematical Bessel function, which in turn can be described in terms of amplitude and frequency.

How do we do it?

Our technical competence is the result of six decades of experience in developing and producing electronic measuring instruments and communications equipment and providing customized solutions for a wide variety of applications.
Rohde & Schwarz stands for uncompromising quality and competence in the industry, as well as among authorities and institutions.
Our certified quality management system meets the requirements of the international DIN ISO 9001 standard – "Quality systems - Model for quality assurance in design/development, production, installation and servicing". The confirmation system for the measuring equipment used meets the requirements of DIN ISO 10012 Part 1 – "Quality assurance requirements for measuring equipment".

Task

- Calibration of standards and standard measuring equipment
- Auditing, accreditation
- Calibration of standards and precision test equipment of DKD customers
- Calibration and inspection of production and customer-owned test equipment



Certificate

- PTB calibration certificate
- Accreditation certificate
- DKD calibration certificate
- Calibration certificate

Repair, Calibration

Hotline

Your contact partner for servicing is your nearest Rohde & Schwarz agency, which as a rule has a service lab of its own. This guarantees fast availability of equipment. For addresses, telephone and fax information please refer to our list of addresses on page 422.

Central Service Munich, Spare Parts:
Telephone: +4989 4129-2860 or 2465
Telefax: +4989 4129-3306

Service Hotline, T&M Equipment
Telephone: +4989 4129-3774
Telefax: +4989 4129-3777

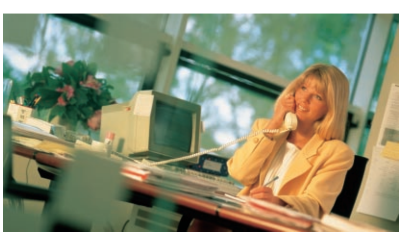
Technical Inquiries
Telefax: +4989 41 29-3275

Rohde&Schwarz Cologne Plant
Telephone: +492203 49-205
Telefax: +492203 49-308

Integrated customer support at Rohde&Schwarz

Financing

Rohde & Schwarz offers a variety of financing schemes based on rental and leasing contracts that allow the acquisition of test & measurement equipment at the time it is needed. Required T&M products are thus available fast and easily without any strain being placed on your liquidity.



Rental agreement with purchase option
You need an instrument only temporarily? Or you are not sure if an instrument is to be purchased at a later date? Or you have to bridge a momentary financial bottleneck? In such cases a rental agreement with purchase option is an ideal solution: you can rent an instrument for a period between six and 36 months, and buy the instrument after min. three and max. 30 months after the beginning of the rental agreement. If you buy the instrument, 75% of the paid rent will be credited against the price.

Leasing
Leasing is common practice in today's business transactions especially as far as medium-term investments are concerned. The lease of instruments expands your financial scope for implementing other, long-term investments, for instance a planned extension of your plant.

We are cooperating with well-established companies and can offer you a broad spectrum of leasing schemes. You can profit from state-of-the-art measuring equipment and systems from Rohde&Schwarz without binding your finances. This makes it possible to realize necessary investments immediately if budgets are tight and acquisitions would normally have to be postponed to the next fiscal period.

And, another important point: leasing is an interesting alternative also in terms of taxation since leasing payments are immediately and fully tax-deductible for example in Germany.

Service contracts

Repair service contract
Admittedly, not even equipment from Rohde&Schwarz is completely safe from failure. We therefore offer a repair service contract which you can conclude already at the time of purchasing your instrument so as to profit from this Rohde & Schwarz service right from the start and on the most favourable terms. The repair service contract extends the standard warranty period to three years. The contract price covers all services necessary to restore the instrument to proper operating condition.

Calibration and maintenance contract
In addition to the repair service contract for new equipment, Rohde & Schwarz offers a calibration and maintenance contract for the most common instruments and test antennas. Please direct your inquiry to:

Central Service Munich
Telefax: +4989 4129-3275

Application notes

Free-of-charge publications
Measuring instruments from Rohde& Schwarz are small, highly complex systems in themselves. They can be used for a variety of applications. The data sheets only cover a small selection of possible applications. Our application engineers are constantly working out solutions to new measurement problems and describing them in application notes. These notes are available to you free of charge. For some applications, we also offer a special software at a small nominal charge. Please contact your local Rohde & Schwarz representative.

Demo units

Rohde & Schwarz offers demo units at very favourable prices. These units have been in use very little, if at all, and are in an excellent condition. As a matter of course, the instruments are checked through before leaving our factory, and Rohde & Schwarz gives full warranty. Your local Rohde & Schwarz representative will be glad to inform you of available instruments.

Support center

Whatever your problem, our support center is there to help you. Your question will be dealt with fast and in detail, or a competent partner will be found for your problem. The staff of our support center is optimally trained to assist you in solving your problems.

- You are looking for a special type of instrument?

Our hotline team (photo 42385)

- You need competent support in the implementation of remote control concepts for test equipment for use in production?
- You have a question regarding the operation of equipment?
- Or you just want to find your local sales partner in order to take a look at our equipment?
- And so on ...

Just call our support center, and we will be glad to assist you. You can get in touch with us in the following ways:

Telephone
+49180 512 4242

Fax
+4989 4129-3777

E-mail
customersupport@rsd.de

The support center can work out a solution together with you for any aspect relating to the operation, programming and also applications of T&M equipment from Rohde & Schwarz or Advantest. You can rely on the technical expertise of our personnel.

In cases where an immediate answer is not possible, your time will not be wasted with unnecessary calls but the support center will record your problem and find a competent partner to get back to you.

Try us
Our support center can certainly help you. It is your hotline.

+49180 512 4242

Your local partner remains
If you are already in contact with Rohde&Schwarz, your local sales office will of course remain the first partner to get in touch with as it is more familiarized with your specific requirements and applications than the support center, and will know right away how to give you the fastest support.

Cabinets, designs

Dimensions

The dimensions of Rohde&Schwarz instruments are specified as follows:

Overall width x height x depth in mm, looking onto the front panel (this also holds for pocket-size instruments). Dimensions generally refer to bench models.

Cabinet designs

Cabinet design must meet all the criteria that mature electronic packaging has to fulfill. Changing requirements regarding technology and environment call for new cabinet designs and systems.

Rohde & Schwarz uses the following two design forms for its products:

- design 2000 (BW2000)
- compact design 90 (KB90)

Rackmounting

Rohde & Schwarz instruments in the above cabinet design can be mounted into 19" racks with the aid of appropriate adapters. It may be necessary to retrofit the racks accordingly.

Design 2000 (BW2000)

Design 2000 is a standardized cabinet system suitable for bench models, for mobile use and for mounting in 19" racks. With only a few basic elements, a variety of cabinets can be implemented from one to five height units and in different widths and depths.

Design 2000 (Photo 42980-3)

With the

- iF Product Design Award 1998

and

- iF Ecology Design Award 1998

received from Industrie Forum Design Hanover, design 2000 has been attested excellent design that takes account of all environmental and recycling criteria for product design.

Construction

The sturdy construction of design 2000 essentially consists of a chassis, an enclosure, feet and front handles.

The chassis is made up of an aluminium-cast front frame and a sheet-metal module support including rear panel. To enclose the instrument, the enclosure is slid over the chassis from the rear and fixed by means of rear-panel feet with elastic pads. The bottom feet with antislide protection are screwed to the enclosure and serve at the same time as a locking device for stacking units.

Compared to previous designs, design 2000 features further improved shielding. The few interfaces between the cabinet parts can be sealed with braided cords and spring strips where required.

Options

The cabinets can optionally be fitted with side handles for use with carrying strap and tilt feet. Special shock-absorbing parts for the front and rear panel as well as a swivel carrying handle that can also be used as a stand are available for mobile use.

Cabinets, designs

19" adapters for rackmounting design 2000

Cabinet (all depths)	19" adapter Type	Order No.
2HU 1/2	ZZA-212	1096.3477.00
3HU 1/2	ZZA-312	1096.3483.00
4HU 7/8	ZZA-478	1096.3248.00
1HU 1/1	ZZA-111	1096.3254.00
2HU 1/1	ZZA-211	1096.3260.00
3HU 1/1	ZZA-311	1096.3277.00
4HU 1/1	ZZA-411	1096.3283.00
5HU 1/1	ZZA-511	1096.3290.00

Adapters for mounting on telescopic rails (only in conjunction with19" adapter of design 2000)

Cabinet Height	Depth	Adapters for telescopic rails Type	Order number
1HU	350	ZZA-T13	1109.3739.00
	450	ZZA-T14	1109.3745.00
2HU to 5HU	250	ZZA-T25	1109.3751.00
	350	ZZA-T35	1109.3768.00
	450	ZZA-T45	1109.3774.00
	550	ZZA-T55	1109.3780.00

Accessories

A wide range of accessories enhances the versatile applications of design 2000. Suitable adapters are available for all cabinet sizes for mounting in 19" racks. Cabinets of 4 height units can be equipped with a special swivel keyboard. Sturdy transit cases can be supplied for all cabinet sizes to ensure safe transport. Padded carrying bags with an accessory pocket make for greater convenience in mobile measurements.

The compact cabinets of design 90 can be stacked not only with one another but also with19" cabinets of the preceding cabinet designs (Foto 35053-4)

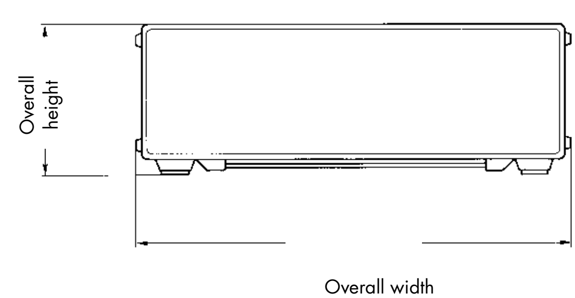
Compact design 90 (KB 90)

Construction

The design 90 cabinet consists of a self-supporting aluminium-cast frame with front and rear panels and top and bottom covers which make up the panelling.

The panelling is fixed and the instrument thus enclosed by screwing two feet (4 screws) to the rear panel. The cabinet is completed by attaching feet at the bottom and on the sides. Depending on the type of equipment, one or two carrying straps fixed on the sides make for portability of the instruments.

Front view of compact design 90



Compact design 90 meets shielding requirements that are becoming more and more stringent. By laying braided cords into special grooves, the instruments can be adapted to specific shielding requirements.

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The tilt stands at the bottom allow the instrument to be set up in a position for convenient operation. The tilt stands on the rear panel enable the instrument to be operated in an upright position (except instruments of one or two height units). Bench models can be provided with additional front handles.

System compatibility

The compact units of design 90 can be stacked with each other as well as with 19" units of previous designs. The bottom feet serve for stacking the units to form a system.

For mounting into 19" racks to DIN41494 all that is required is to remove the side and bottom feet and to fix the 19" adapter brackets including front handles.

The 19" adapter comes with mounting instructions and two self-adhesive slides for protecting the underside when sliding the unit in or out of the rack. Adapters are also available for mounting on telescopic rails.

Cabinet dimensions, rackmounting accessories (compact design 90)

Dimensions in mm					Rackmounting			Adapters for mounting on telescopic rails (only in conjunction with 19" adapter			
Width in 19" system	over-all (mm)	Height in units	Height overall (mm)/rack-mount	Depth overall (without controls) (mm)	19" adapters Type	19" adapters Order No.	DIN adapters Order No.	Height (in units)	Depth	Type	Order No.
$^1/_2$	219	2	103/87.6	240/350/460	ZZA-97[1]	0827.4527.00	–	1	350	ZZA-913	0396.5430.00
		3	147/132.1	350/460	ZZA-98[1]	0827.4533.00	–		460	ZZA-914	0396.5460.00
$^3/_4$	327	4	192/176.5	350 460	ZZA-99	0839.5775.00	– –	2 to 6	350	ZZA-923	0396.5476.00
$^1/_1$	435	1	59/43.2	350 460	ZZA-91	0396.4870.00	0396.8569.00		460	ZZA-924	0396.5482.00
		2	103/87.6	350 460/570	ZZA-92	0396.4886.00	0396.8575.00		570	ZZA-925	0396.5499.00
		3	147/132.1	350 460 570	ZZA-93	0396.4892.00	0396.8581.00				
		4	192/176.5	350 460 570	ZZA-94	0396.4905.00	0396.8598.00				
		5	236/221	350 460 570	ZZA-95	0396.4911.00	0396.8600.00				
		6	280/265.4	350/460/570	ZZA-96	0396.4928.00	–				

[1]) The 19" adapters for half-width 19" instruments are suitable for mounting 1 or 2 units. For two units of half width and different height (2HU und 3HU) use 19" adapter ZZA-98.

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Transit Cases ZZK-9x

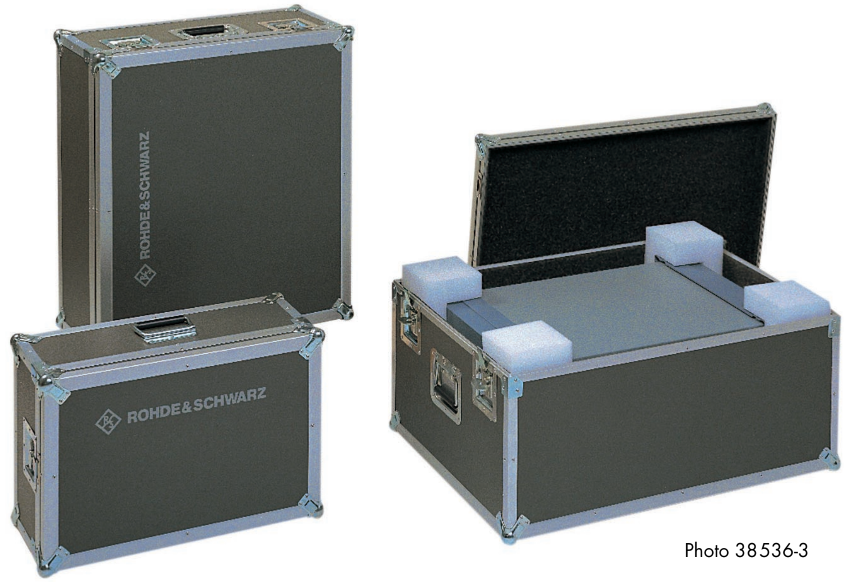

Photo 38536-3

Transit cases made of an aluminium composite material are available for all cabinet sizes. Reinforced rounded corners and edges ensure high stability and protection against knocks. Locks and handles are recessed for safety. The cases are dust-proof and splash-proof to DIN 40050 with IP54 type of protection.

Their suitability for airfreight and express freight has been proven in free-fall tests from a height of 80 cm with a 30 kg instrument inside.

The interior is lined with anthracite-grey foam mats. Foam inserts adhered to the corners ensure tight fit and protection of the instruments. The protective covers supplied with the instruments must be used for packing. A protective cover supplied with the cases allows the instruments to be transported with front handles mounted.

Dimensions, ordering information

Instrument size (H, W, D)	Inner dimensions of case (mm) Height	Width	Depth	Weight (kg)	Type	Order No.
2HU, 1/2, 350	211	329	507	7.3	ZZK-973	1013.9143.00
2HU, 1/2, 460	211	329	619	8.5	ZZK-974	1013.9150.00
3HU, 1/2, 350	256	329	507	8.0	ZZK-983	1013.9172.00
3HU, 1/2, 460	256	329	619	9.3	ZZK-984	1013.9189.00
4HU, 3/4, 350	300	438	507	10.0	ZZK-993	1013.9237.00
4HU, 3/4, 460	300	438	619	11.6	ZZK-994	1013.9243.00
1HU, 1/1, 350	166	546	507	8.5	ZZK-913	1013.9266.00
1HU, 1/1, 460	166	546	619	9.8	ZZK-914	1013.9272.00
2HU, 1/1, 350	211	546	507	9.2	ZZK-923	1013.9295.00
2HU, 1/1, 460	211	546	619	10.7	ZZK-924	1013.9308.00
2HU, 1/1, 570	211	546	731	12.0	ZZK-925	1013.9314.00
3HU, 1/1, 350	255	546	507	10.0	ZZK-933	1013.9320.00
3HU, 1/1, 460	255	546	619	12.0	ZZK-934	1013.9337.00
3HU, 1/1, 570	255	546	731	13.0	ZZK-935	1013.9343.00
4HU, 1/1, 350	299	549	507	10.8	ZZK-943	1013.9350.00
4HU, 1/1, 460	299	549	619	12.4	ZZK-944	1013.9366.00
4HU, 1/1, 570	299	549	731	14.0	ZZK-945	1013.9372.00
5HU, 1/1, 350	343	549	507	11.6	ZZK-953	1013.9389.00
5HU, 1/1, 460	343	549	619	13.3	ZZK-954	1013.9395.00
5HU, 1/1, 570	343	549	731	14.5	ZZK-955	1013.9408.00
6HU, 1/1, 350	392	558	507	12.4	ZZK-963	1013.8682.00
6HU, 1/1, 460	392	558	619	14.2	ZZK-964	1013.8682.00
6HU, 1/1, 570	392	558	731	15.5	ZZK-965	1013.8682.00

Rohde & Schwarz Addresses

FIRMENSITZ/HEADQUARTERS	Telefon/Phone Telefax E-mail
ROHDE & SCHWARZ GmbH & Co. KG	
Mühldorfstraße 15 · D-81671 München	+49 89 41 29-0
Postfach 801469 · D-81614 München	+49 89 41 29-21 64
Internet: http://www.rsd.de	–

WERKE/PLANTS

ROHDE & SCHWARZ Meßgerätebau GmbH	+49 83 31 1 08-0
Riedbachstraße 58 · D-87700 Memmingen	+49 83 31 1 08-1 24
Postfach 16 52 · D-87686 Memmingen	–
ROHDE & SCHWARZ GmbH & Co. KG	
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Kaikenrieder Straße 27 · D-94244 Teisnach	+49 99 23 8 50-1 74
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