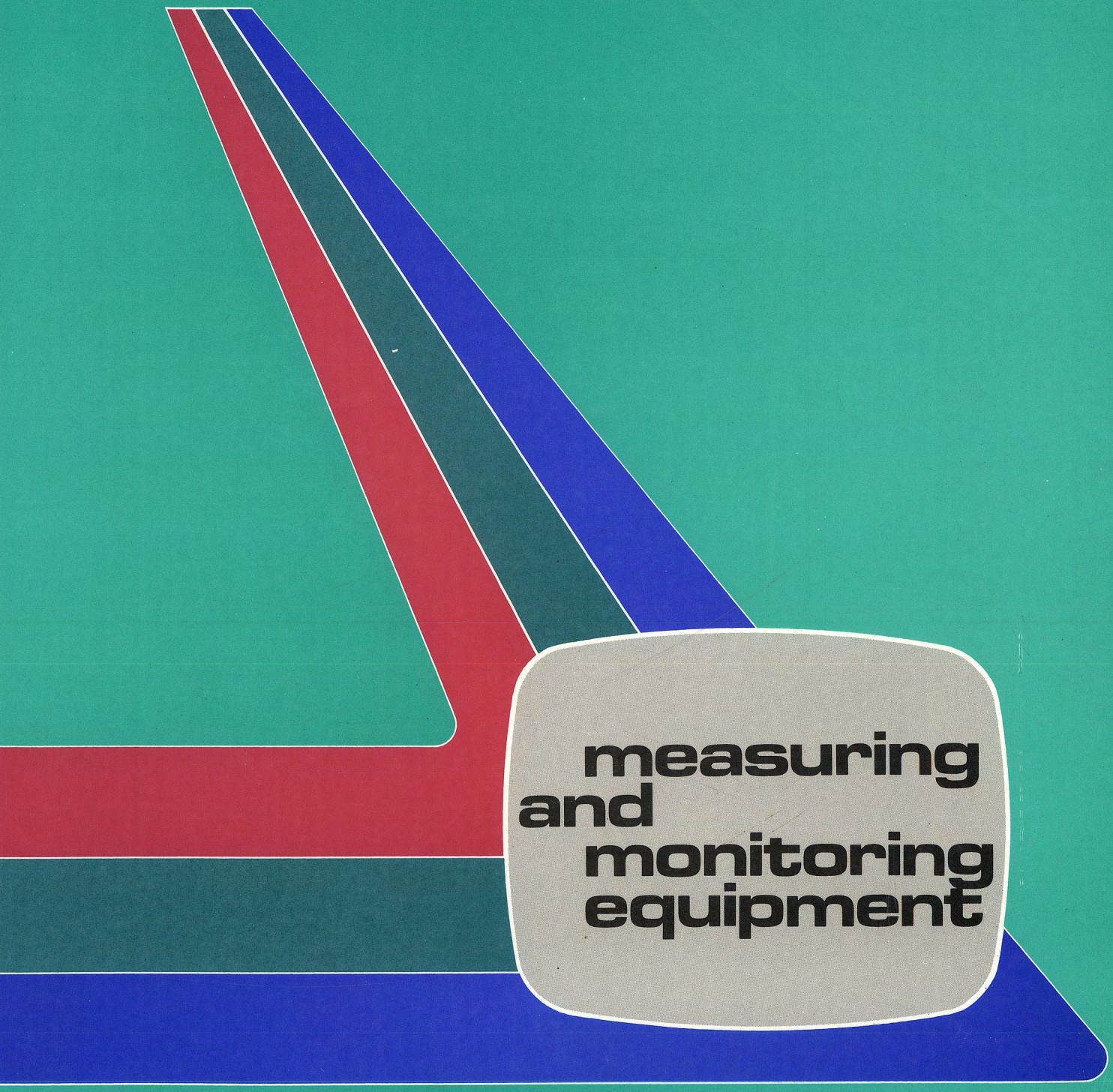
ROHDE & SCHWARZ

SOUND and TV BROADCASTING



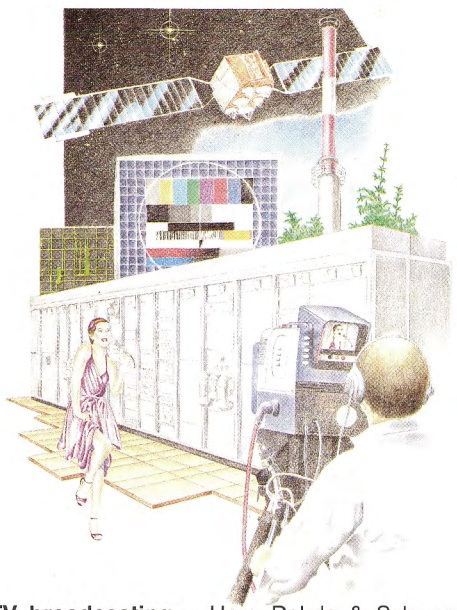
measuring and monitoring equipment

ROHDE&SCHWARZ

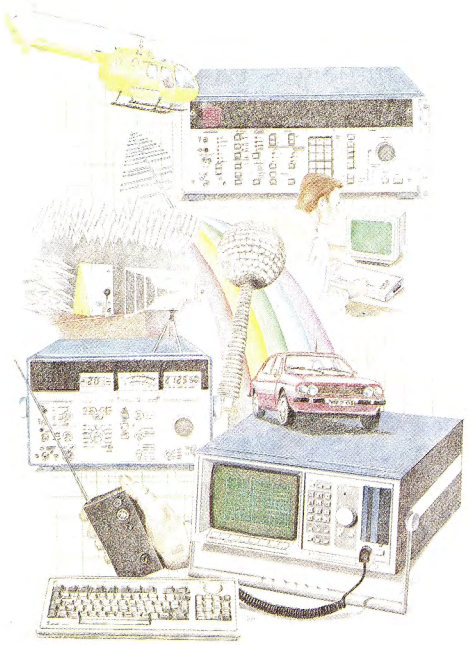
Rohde & Schwarz develops, manufactures and sells measuring and communications equipment, all bearing the stamp of **electronic precision.** The independent concern grew out of a development laboratory, founded by the physicists Dr. Lothar Rohde and Dr. Hermann Schwarz in Munich in 1933. Dipl.-Ing. Friedrich Schwarz joined the executive in 1971.

Rohde & Schwarz employs 5000 persons worldwide and is represented in 80 countries. There are manufacturing plants in Munich and Memmingen, Cologne and Teisnach as well as in Italy, the USA and Canada. The company group has an annual turnover of more than 800 million DM, exports accounting for 50%.

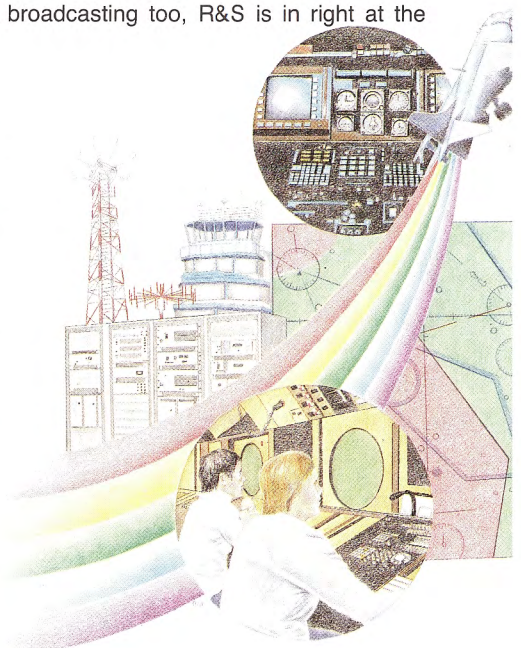
The company operates with **four divisions:** measuring instruments and systems, sound and TV broadcasting, radiomonitoring/radiolocation, radiocommunications. The R&S quality-assurance system is approved by industry and government. After-sales service covers field installation, staff training, maintenance and repair plus calibration to international standards. In Cologne Rohde & Schwarz runs West Germany's largest industrial service centre for electronic measuring and communications equipment.

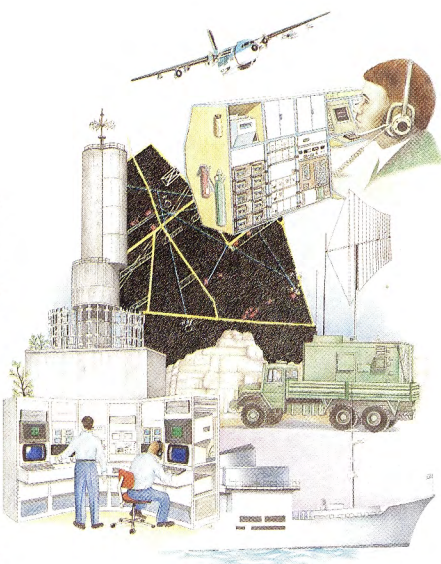


Sound and TV broadcasting – Here Rohde & Schwarz offers everything from a single source: from a low-power VHF transmitter through to a turnkey 40-kW TV transmitting system. Plus test and in-service equipment for broadband communication (satellite reception) and the entire measuring and monitoring equipment needed for maintaining AF, VF and RF quality. R&S delivered Europe's first VHF sound-broadcast transmitter in 1949, the first automatic TV measuring system of the Deutsche Bundespost in 1978 and the first dual-carrier/dual-sound TV adaptation in 1980. With VPS, RDS and digital sound broadcasting too, R&S is in right at the start.



Radiomonitoring/radiolocation – Rohde & Schwarz meets the needs of PTT radiomonitoring, of communications and electronic intelligence, of security services and of traffic control. Microprocessorized receivers, direction finders and antennas are combined with project software to form computer-assised systems that can cover whole countries with their outlying sensors, mobile units and central stations. Four decades of experience make R&S leading in DF.





Measuring instruments and systems established the company's reputation fifty years ago. The first portable crystal clock was produced in 1938, Europe's first high-impedancei, general-purpose voltmeter in 1952, and the first intelligent, systemcompatible radio test set in 1974. The major product lines of this division are now: signal generators for AF through to microwaves, test receivers for field strength and EMC, radio test assemblies, logic, frequency and network analyzers, voltmeters and power meters plus automatic testers (in-circuit and functional) for electronic modules and complete units of equipment.

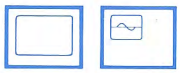
Radiocommunications from R&S, that means a comprehensive line of products for HF, VHF and UHF communication, complete radio systems for vehicles, ships and aircraft, for airtraffic control and stationary networks. The equipment is engineered to meet operational needs with economy in use. Modern methods of transmission create secured and protected links: the ALIS processor finds undisturbed or unjammed channels automatically, message handling simplifies operating procedures.

contents

VHF sound and television measurements 14 to 33

1 In-service, monitoring and measuring equipment for sound and TV broadcasting 34 to 145

2 In-service and measuring equipment for broadband and satellite communications 146 to 165

3 Monitoring and measuring assemblies (assemblies)  166 to 195

4 Automatic measuring and monitoring systems

196 to 219

Appendix

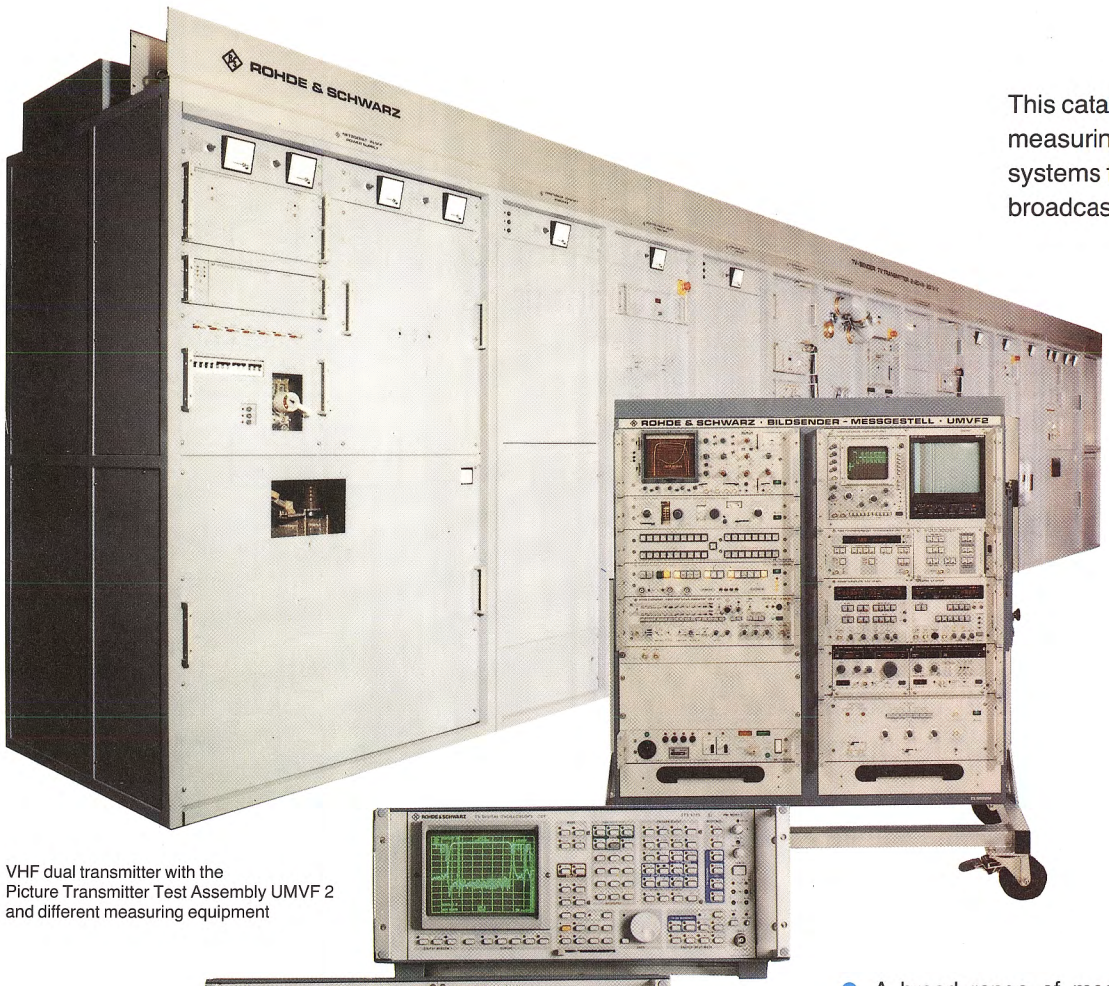
A1 Supplementary equipment from the measuring instruments and systems division 220 to 289

A2 Cabinets, addresses, type index 290 to 304

Publisher: Rohde & Schwarz GmbH & Co. KG, Dept. 5ZW
Editor: Heinz-Hermann Schulz
Printed in the Federal Republic of Germany

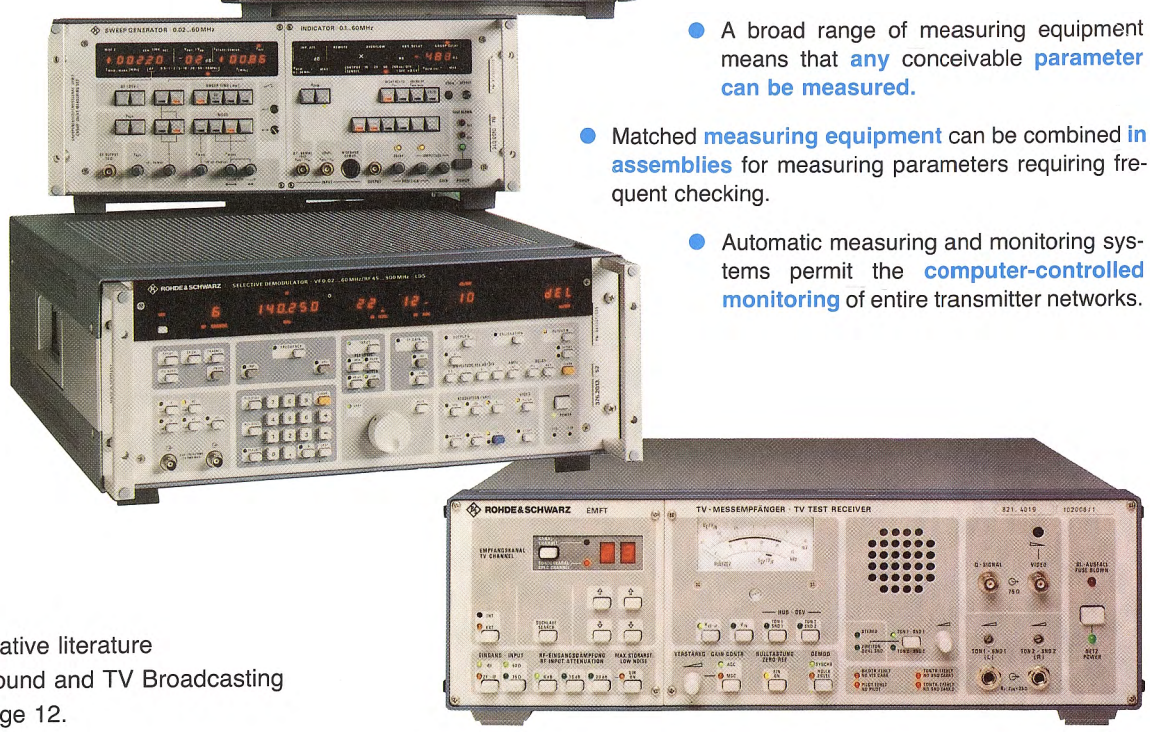
From a single source: in-service systems, measuring and monitoring systems

This catalog contains measuring and monitoring systems for sound and TV broadcasting.



VHF dual transmitter with the Picture Transmitter Test Assembly UMVF 2 and different measuring equipment

- A broad range of measuring equipment means that **any** conceivable **parameter can be measured.**
- Matched **measuring equipment** can be combined **in assemblies** for measuring parameters requiring frequent checking.
- Automatic measuring and monitoring systems permit the **computer-controlled monitoring** of entire transmitter networks.



Further informative literature for the field Sound and TV Broadcasting is given on page 12.

Rohde & Schwarz – suppliers of quality from studio equipment to home receivers

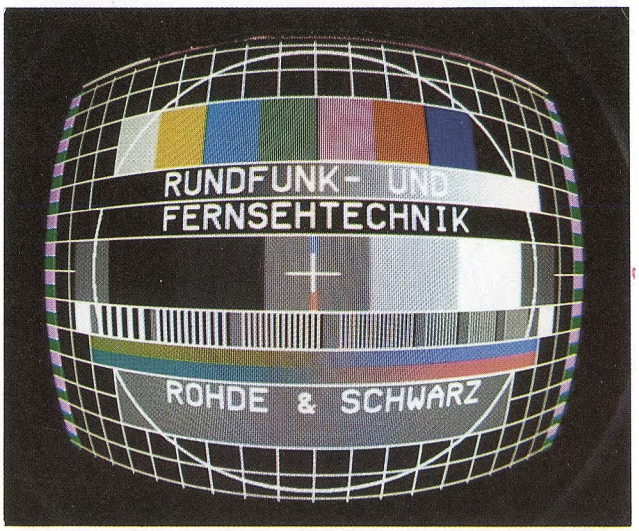
The origins of both the company and the **Sound and TV Broadcasting Division** can be traced back to RF measurement systems.

Today, the R&S sound and TV broadcasting division is the **only manufacturer in the world** producing the entire range of equipment for

- in-service TV and FM radio systems and
- measuring and monitoring systems for sound broadcasting and television

Thanks to many years of experience and success, Rohde & Schwarz continue to be suppliers for

- public and private sound and TV broadcasters and distributors
- manufacturers of home electronics equipment such as radios, TV sets and video recorders
- research institutes and appliance testing centres
- universities and technical colleges
- national and international organizations



Test pattern generated by the Video Test & Pattern Generator SVDF

Multi-channel TV test system in receiver production

Quality is an in-built feature . . .

The main **areas of sound and TV broadcasting** are

measuring systems and **in-service systems**

Audio Coder DCA for digital sound data transmission

In the field of **in-service systems,** Rohde & Schwarz has developed a complete product range comprising:

- VHF/FM radio and European radiopaging transmitters up to 20 kW
- TV transmission equipment up to 40 kW including different amplifier designs, such as models fitted with tetrodes and klystrons
- broadband communications and satellite signal receiver systems
- converters, relay receivers and diplexers for sound broadcasting and television

In the field of **measuring systems,** Rohde & Schwarz supplies the complete range of monitoring and quality control equipment for all transmission equipment in the AF, VF and RF bands.

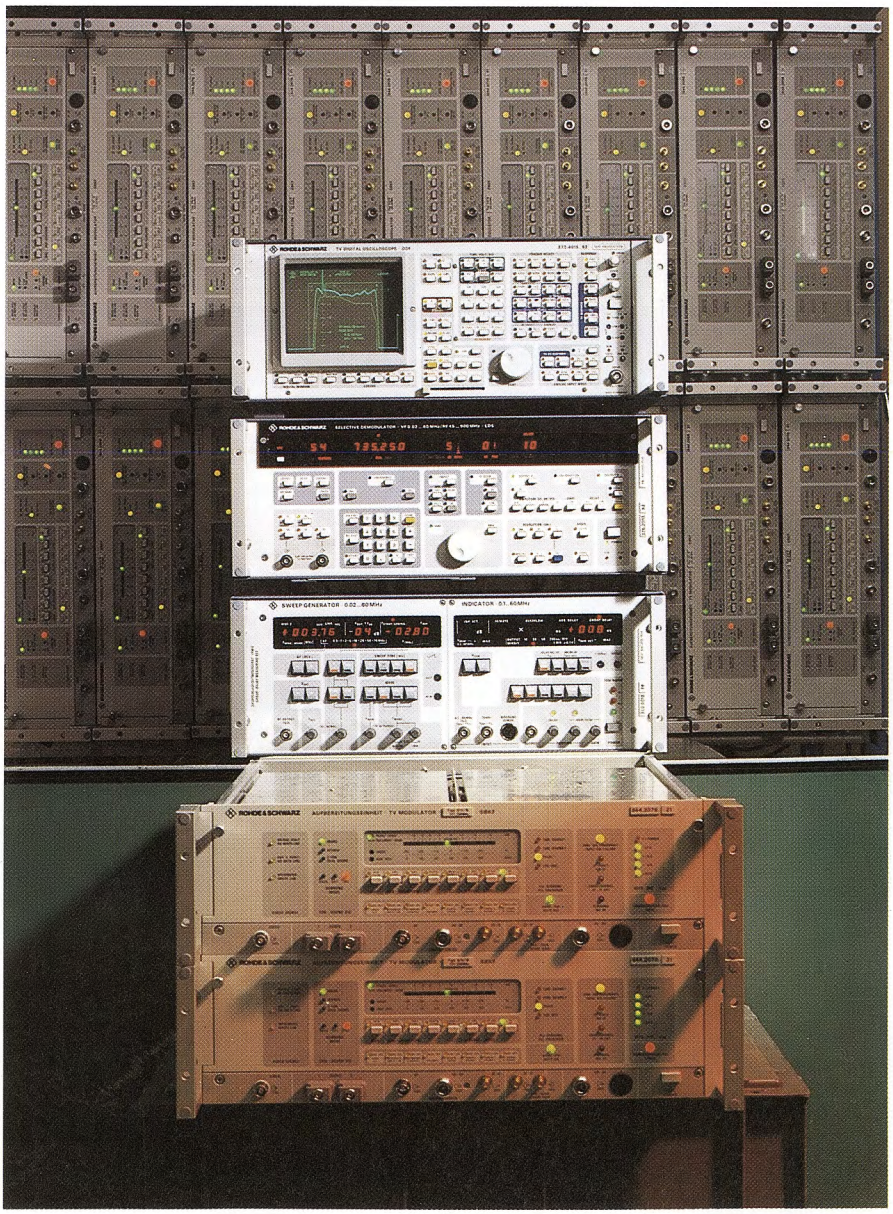
Rohde & Schwarz offers **complete solutions** for the following fields:

- **TV signal monitoring**
  Equipment in the following ranges are mostly used for measuring and monitoring TV signal paths
  – in **baseband,** such as video signal generators and analyzers, and
  – in **RF,** such as modulators, demodulators, receivers and visual monitors
  This equipment can be combined to form complete software-controlled systems for special applications.
- **Monitoring systems**
  These systems consist of standard equipment and integrated hardware and software for the manual or fully automatic monitoring of
  – FM radio transmitters and FM transmission links, eg using the FM Input Assembly MST 01, and
  – TV transmitter systems and TV transmission links, eg using the TV Transmitter Operating Assembly USTF, Input Assembly UELF, Sound and ITS Monitoring Assembly TOPAS and TV Automatic Monitoring System FAMOS.

for the eye and the ear

- **Data transmission**
  There is an increase in data transmission superimposed on the program signal, both in FM radio and TV. This data is used to supply the public or distributors with information. One example is information broadcasting in the Radio Data System (RDS) with transmitter identification for car radio listeners. Rohde & Schwarz supplies FM data coders and decoders for car radios.
- **Signal distribution and monitoring**
  An audio/video cassette system is available – also as separate components – for distribution and particularly for monitoring picture and sound signals.
- **Satellite communications**
  Ever since it was first attempted to send TV and sound broadcasts via satellites, Rohde & Schwarz has been successful in this field and in the field of coding and decoding as well as program signal measurement and monitoring.

  Rohde & Schwarz was the first company to supply a complete range of equipment for the measurement and in-service monitoring of TV satellite links within the European TV satellite program.
- **Digital audio**
  Progress is being made in digitizing video and audio program signals which were previously broadcast as analog signals. Rohde & Schwarz supplies audio coders, decoders and modulators for studio applications.



Testing the TV Modulator SBKF which is in use in large numbers at CATV head stations. Here are the instruments belonging to the Sweep Tester WMP: the ODF, LFM 2 and LDS.

See the following pages for **new products in these fields.**

Signals must be monitored . . .

New products for TV signal monitoring

in baseband (VF)

ATF
page 128

Digital Teletext Analyzer for automatic quality control of teletext and test line signals

SCDF
page 76

Component Generator for PAL/CCVS signals, YC_BC_R and RGB components simultaneously at separate outputs

in RF

EMFD
page 48

TV Test Demodulator for AFC and fixed-frequency crystal operation in the VHF, UHF and IF ranges

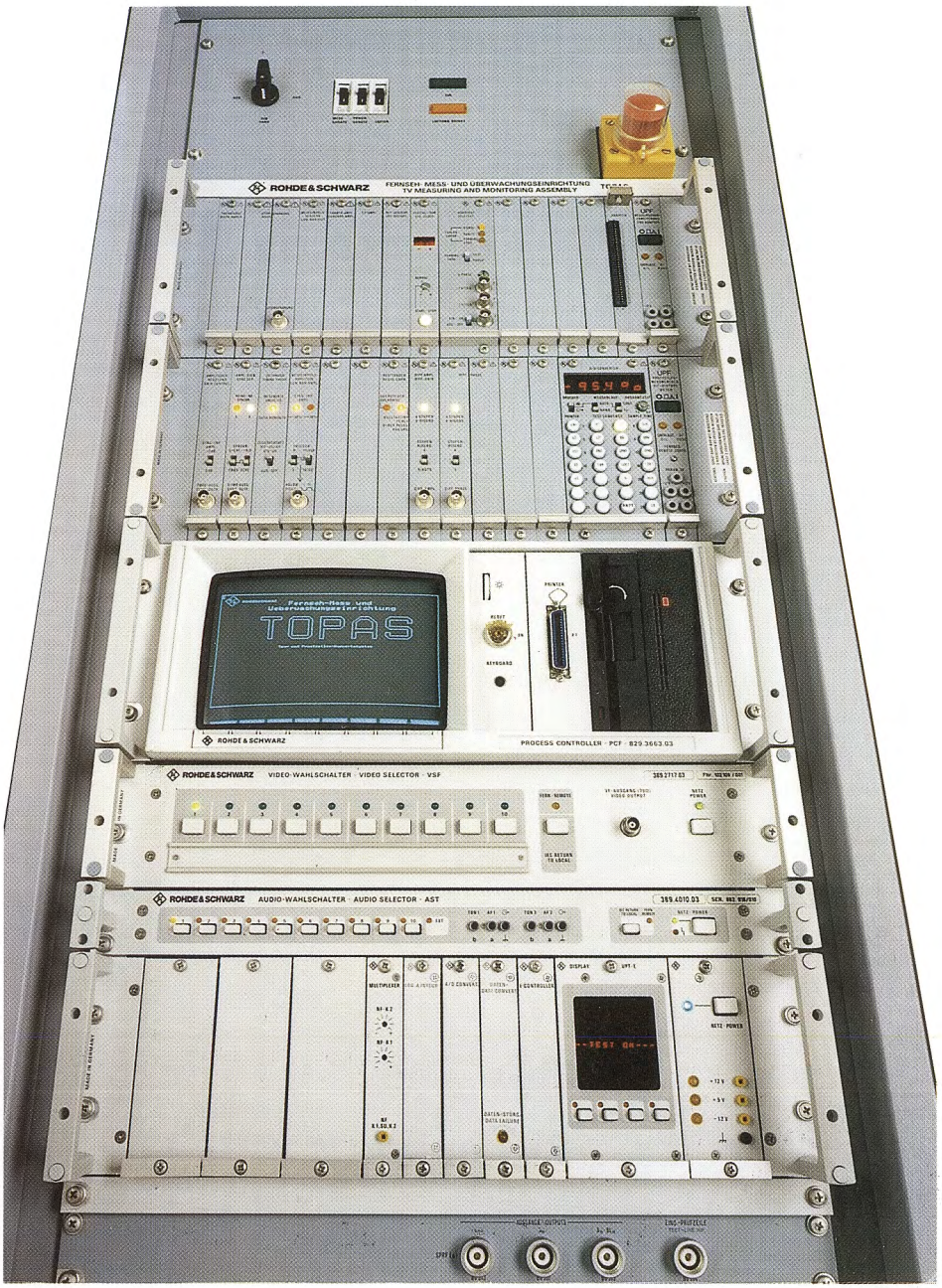
EMFT
page 48

TV Test Receiver, continuously tunable in all ranges including special channels up to 470 MHz

TV Test Receiver EMFT is continuously tunable in all ranges and in special channels up to 470 MHz

manually and automatically

New products for monitoring systems



Sound and ITS Monitoring Assembly TOPAS in the TV transmitter

Equipment for VF and RF measurements is combined to form systems for special applications or adapted to customer requirements using hardware and software expansions.

The tried and tested monitoring systems for television picture transmission have been supplemented by the following equipment:

USTF page 186 — **TV Transmitter Operating Assembly** for generating substitute signals in the event of a power failure and for checking input and output signals

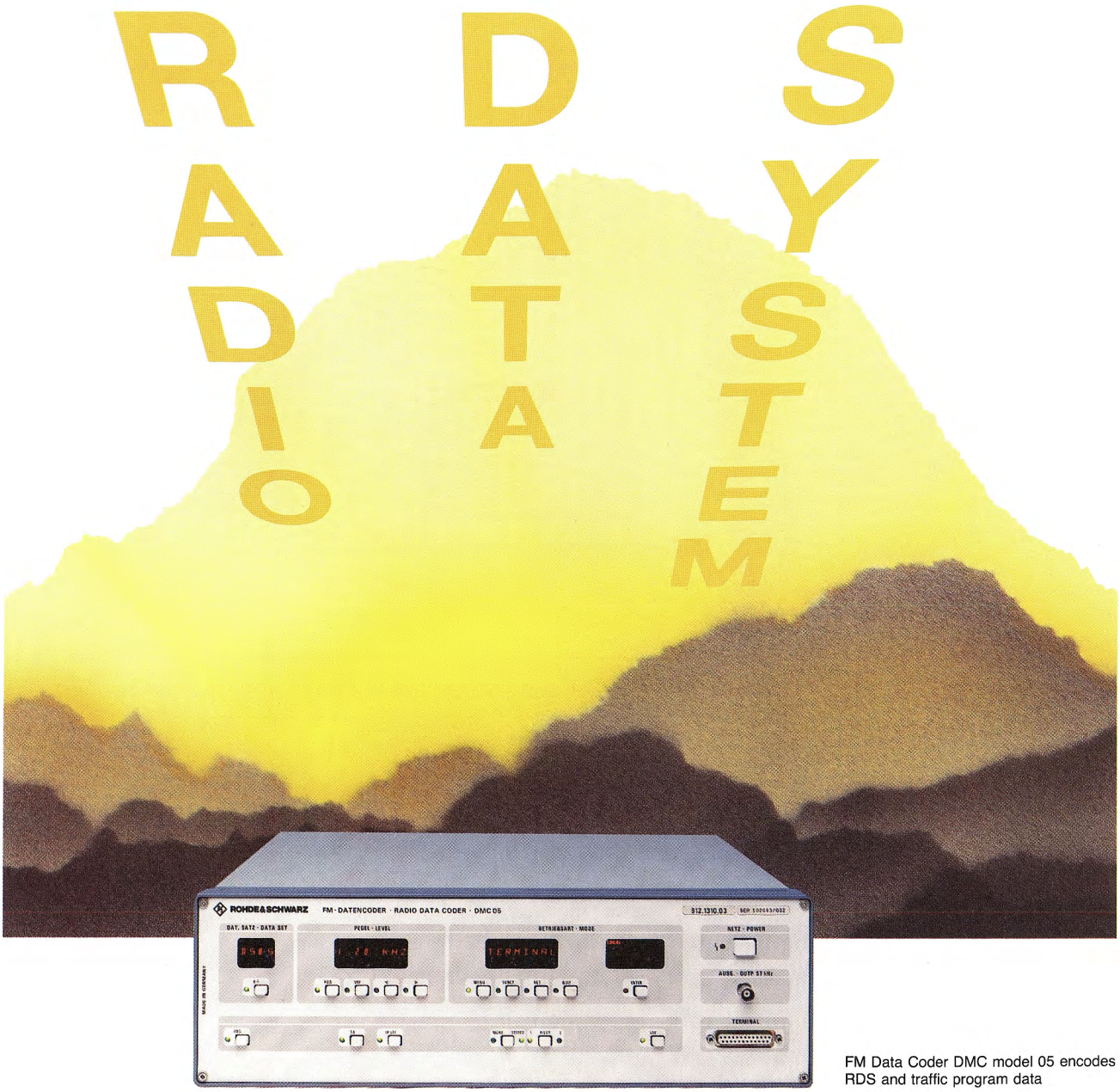
UELF page 184 — **TV Transmitter Input Assembly** for switching video/audio program signals to in-service and stand-by transmitters, test line insertion, circuit and data line monitoring

TOPAS page 206 — **Sound and ITS Monitoring Assembly** for fully automatic evaluation and logging of all audio and video parameters on program circuits

A new product has been developed for monitoring VHF sound broadcasting signals:

MST 01 page 172 — **FM Input Assembly** for monitoring the input signals and demodulated RF signals of FM radio transmitters

Additional products for sound broadcast listeners: Data transmission



FM Data Coder DMC model 05 encodes RDS and traffic program data

New: Data transmission using the Radio Data System

RDS data coders and decoders have been developed in compliance with EBU specifications for data transmission over FM radio.

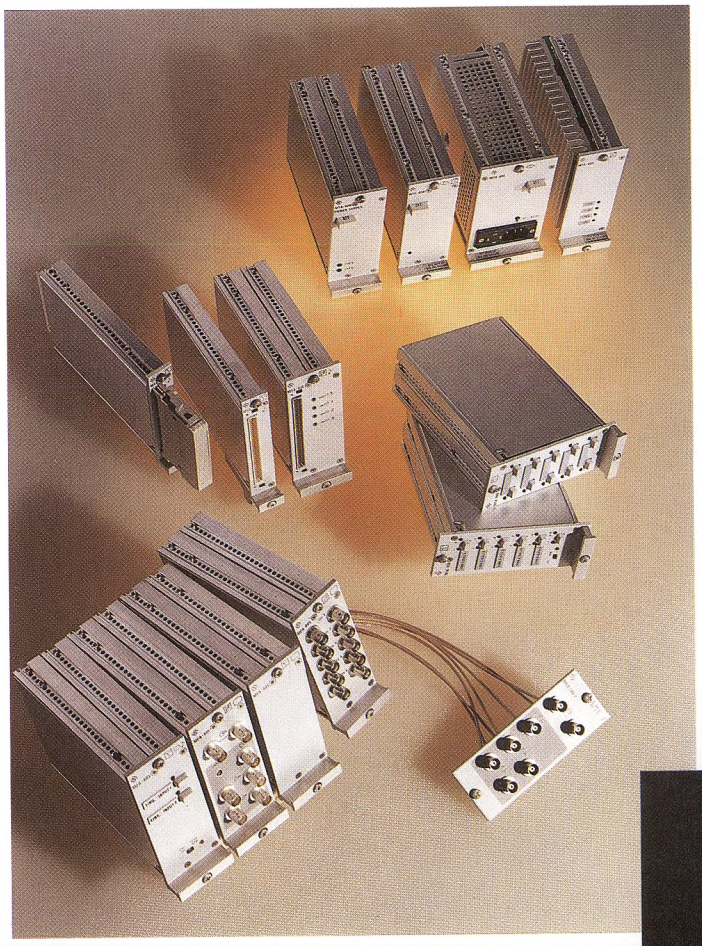
DMC models 05, 09
page 40

Radio Data Coders for encoding RDS and traffic program data in compliance with EBU specifications

DMDC models 05, 09
page 42

Radio Data Decoders for demodulating and decoding additional signals such as RDS or traffic program data in compliance with EBU specifications

Information wherever you are:
Signal distribution

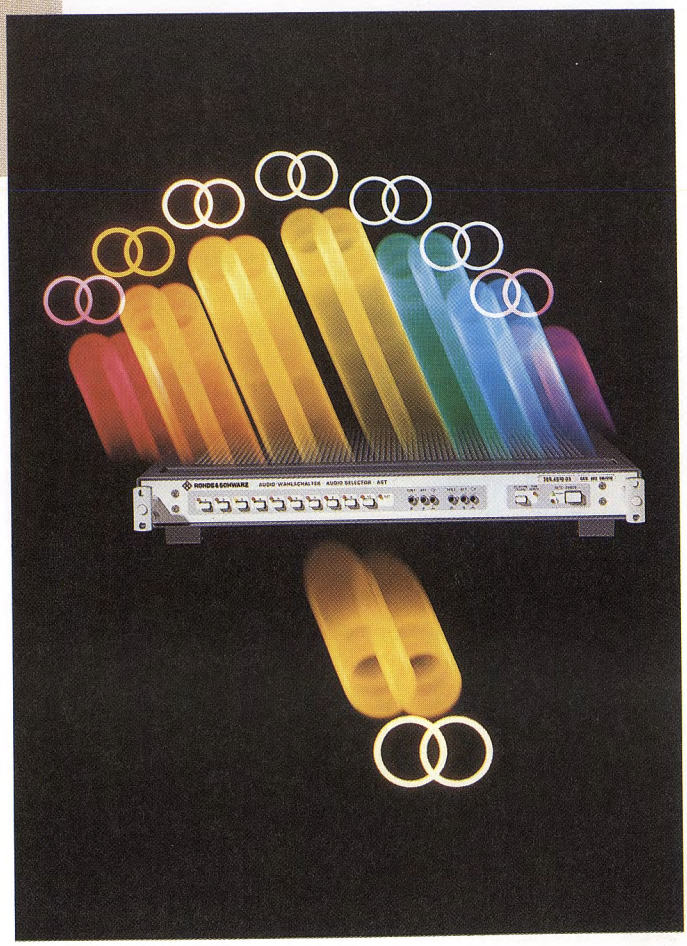


New products for signal distribution and monitoring

MTA/MFA
page 174

Audio/Video Cassette System for matching, distributing and isolating signals in automatic in-service and measuring systems

Components of the
Audio/Video Cassette System MTA/MFA



Audio Selector AST
for ten program circuits

VSF
page 69

Video Selector, for remote control, for ten program circuits or checkpoints with signals of up to 10 MHz

AST
page 46

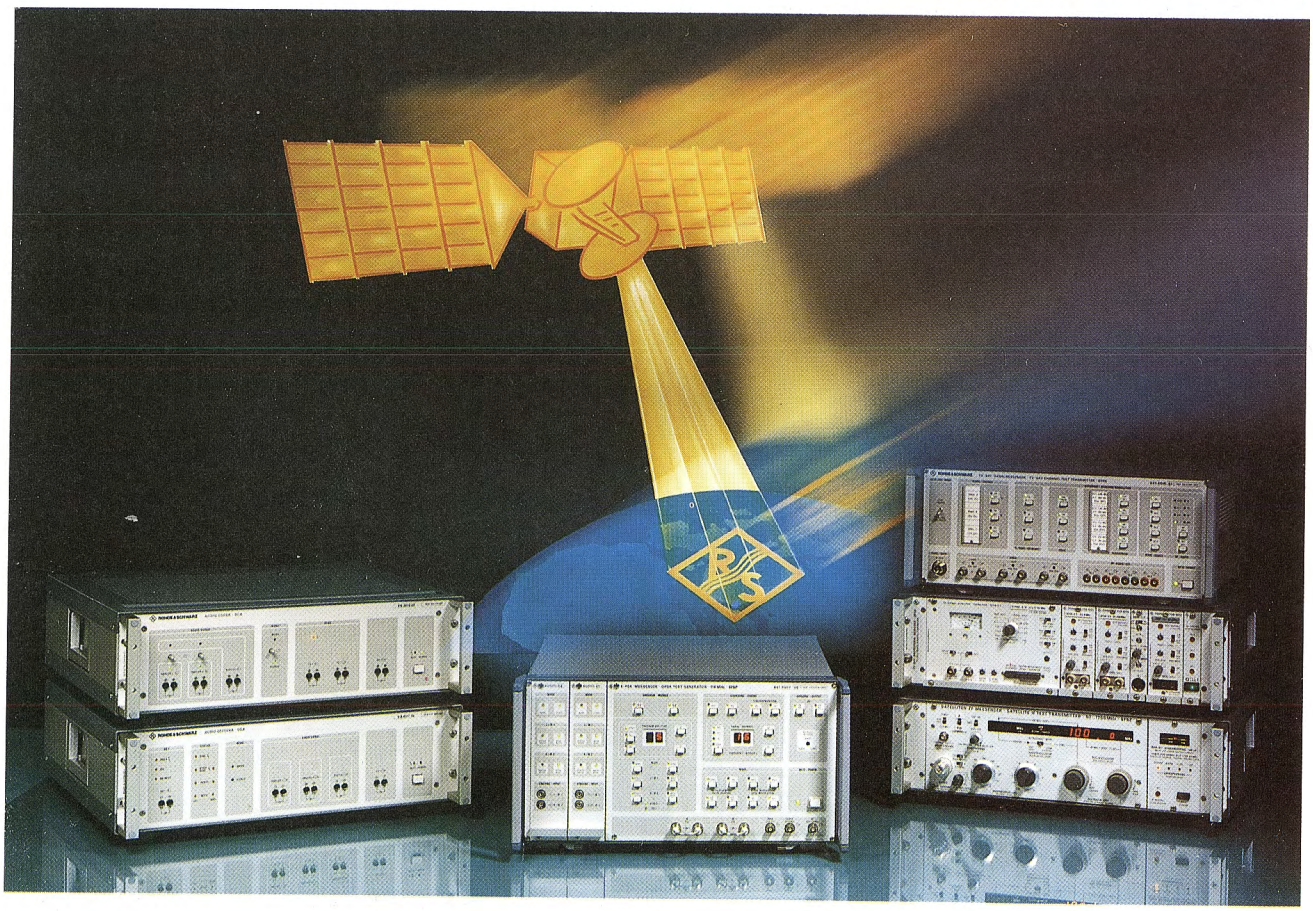
Audio Selector, for remote control, for ten program circuits or checkpoints with signals of 20 Hz to 100 kHz

Large coverage area – Satellite communications

New products for satellite communications

Radio and TV programs broadcast via satellite and the introduction of the new television standard D2-MAC/Packet have lead to the development of modulators and test transmitters to enable the full measurement and monitoring of signal paths.

A selection from the range of TV satellite measuring and in-service equipment produced by Rohde & Schwarz



SFSK
page 164

TV Satellite Channel Test Transmitter generates three carrier signals modulated with one video signal and a maximum of four sound subcarrier signals, in the 900 to 1800 MHz band

SYNCER
page 126

TV Syncer identifies the TV standard and colour transmission system and supplies a standardized sync signal for evaluating D2-MAC/Packet signals using standard measuring equipment

SBKE
page 159

D2-MAC Substitute Signal IF Modulator modulates a D2-MAC video/data signal on a 38.9 MHz IF carrier

Audible signal purity: Digital audio

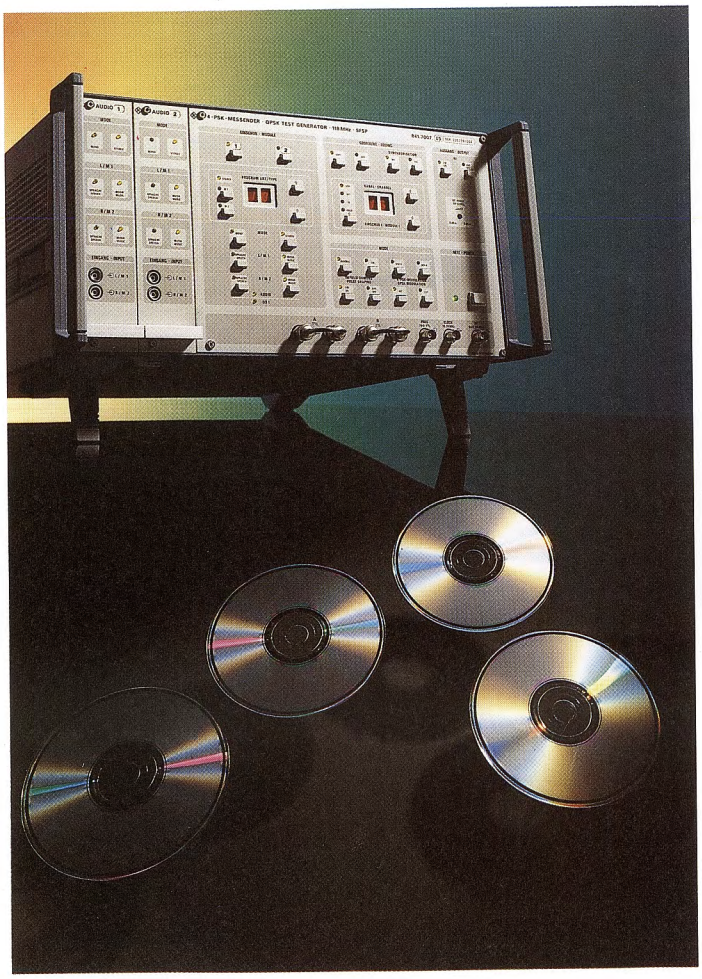
New: Digital sound broadcasting and television dual sound

Our product range features the following new products for generating, encoding, measuring and monitoring digital audio signals in TV program signal paths:

DCA page 44 — **Audio Coder** converts two analog audio signals with additional information, eg program type identification, to a serial data stream in compliance with DS1 specifications

R&S compact disc with SOFTWARE for high-precision "New Age" sound

4 PSK Test Transmitter SFSP for generating a maximum of 16 digital stereo channels



DDA page 45 — **Audio Decoder** processes a serial data stream to DS1 specifications and is provided with two output channels for analog and digital audio signals

SFSP page 165 — **4 PSK Test Transmitter** modulates up to 16 stereo or 32 mono analog or digital audio channels on a 118 MHz carrier (DSR standard)

Rohde & Schwarz has also developed the following basic equipment for the TV dual-sound system NICAM (Near Instantaneously Companded Audio Multiplex):

SBUF-E page 94 — **NICAM Generator** for integration in the Modulator Unit SBUF/SBTF 2 with a sine-wave and random generator; supplies test frequencies for mono, stereo, mono/data transmission and data transmission operating modes, etc.

SBUF-E page 94 — **NICAM Modulator** for standard B/G or I for integration in the Modulator Unit SBUF/SBTF 2

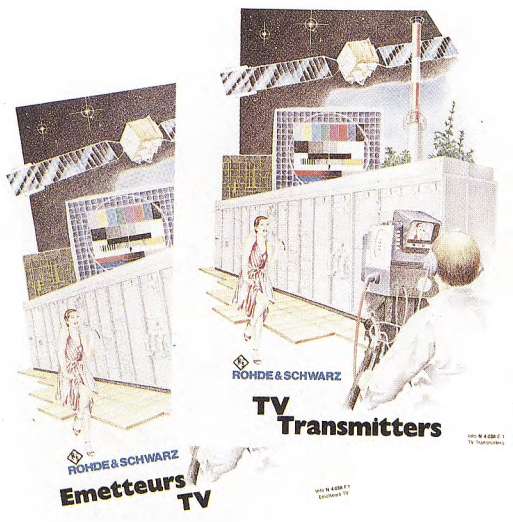
NDZ page 97 — **NICAM Demodulator** for standard B/G or I as an additional unit for the TV Test Receiver EMFT

Information for all applications . .

There are several publications available on the products of the Rohde & Schwarz Sound and TV Broadcasting Division and their applications:

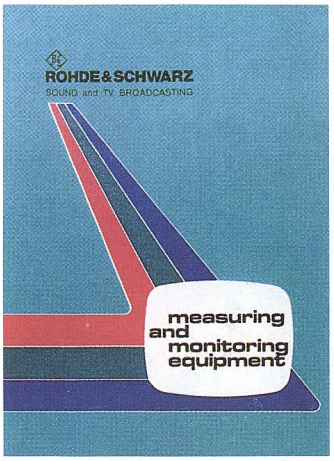
The publication **"Sound transmitter systems"** presents VHF-FM transmitters ranging from 1 W to 20 kW (including the corresponding European AM radiopaging transmitter family) and converters, relay receivers, diplexers and antennas through to complete transmitter systems (PD 756.6198 in German, English or French).

The publication **"TV transmitter systems"** presents the TV transmitter family for Band I at 10 kW, Band III at 5 W to 20 kW and Band IV/V at 2 W to 40 kW (tetrode/klystron) and the corresponding converter models. This publication also includes cooling systems, diplexers and antennas in addition to information on planning TV transmitter stations (PD 756.6552 in German, English or French).



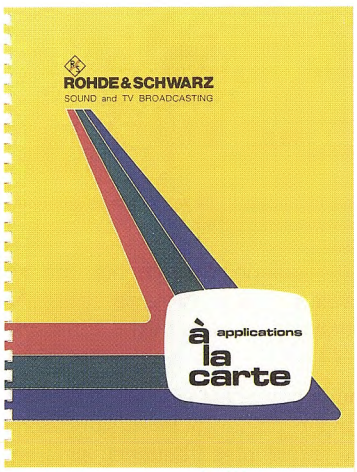
An overview of the complete range of TV transmitter systems is provided in the publication **"TV transmitters"** (756.6869 in English or French).

in sound broadcasting and television

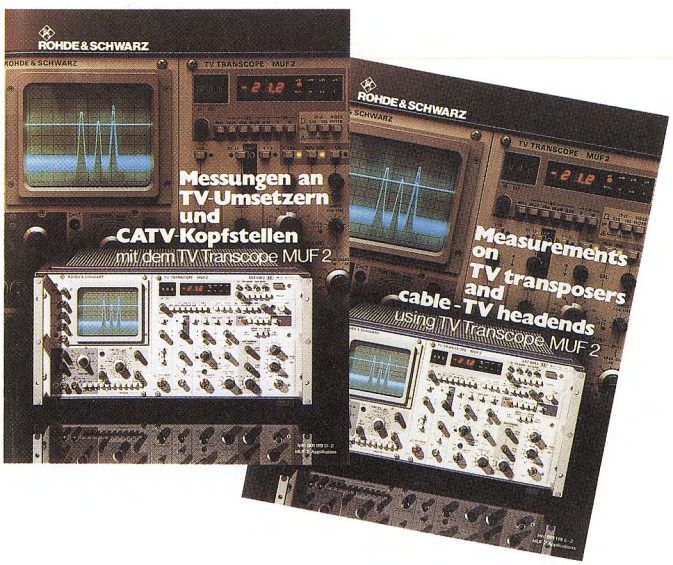


The catalogue **"Measuring and monitoring equipment"** (PD 756.7294 in German, English or French – this catalog) provides the complete range of measuring, monitoring and small in-service equipment and system combinations.

"Rigs and Recipes", Suggestions for measuring and monitoring sound broadcasting and television transmission systems are published in a 224-page publication (PD 756.6475 in German or English).

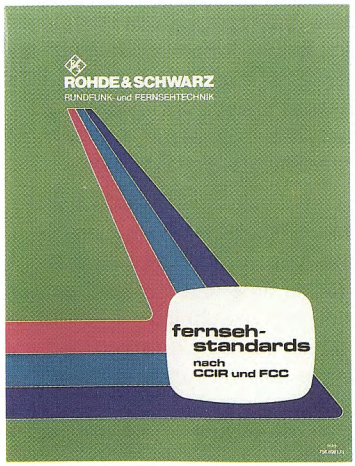


The application-data publication **"à la carte"** (in English) contains important and interesting applications, not only for measuring and monitoring systems but also for TV transmitter systems and TV satellite measuring and transmission systems.



Further special publications are available for special applications and measuring systems:

The publication **"Measurements on TV converters and CATV head stations"** describes measurements using the TV Transcope MUF 2 (PD 756.3618 in German or English).



Professor Rudolf Mäusl's review **"Television technology"** provides a detailed overview of current television engineering (in German or English).

International television standards and the different national television standards are compiled in the publication **"CCIR and FCC television standards"** (PD 756.6981 in German or English).

VHF sound and TV measurements

Since the first VHF sound broadcasting transmitter was produced, the Rohde & Schwarz' highlights include a wide range of measuring equipment for VHF sound broadcasting and television.

1953 First TV measuring instruments: broadband oscilloscope, signal generators

1954 First TV Nyquist-slope demodulator

First vision-sound channel signal generator with IF modulation

1955 to 1956 Test signal generators, mixers etc.

1958 First complete picture-transmitter test assembly

1960 First TV group-delay measuring set

1965 First video noise meter

1972 Insertion-line test system for TV applications

1974 Audiodat test system for quality control in VHF sound broadcasting applications

1975 First computer-controlled remote TV monitoring centre

1978 First automatic TV measuring system (test line) for the TV line and transmitter network of the Federal German Posts and Telecommunications Administration

1980 First digital video test signal generator (SPF 2)

1981 First TV stereo/dual-sound transmission system in Europe; developed, manufactured and installed by R&S

1984 First portable high-speed video analyzer (UVF)

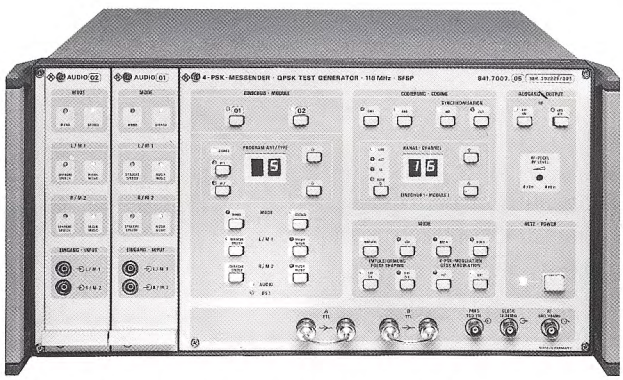
1985 First TV satellite measuring and in-service equipment in the GHz band

1986 First digital TV oscilloscope
The Radio Data Coder DMC marked the introduction of the Radio Data System for sound broadcasting in West Germany

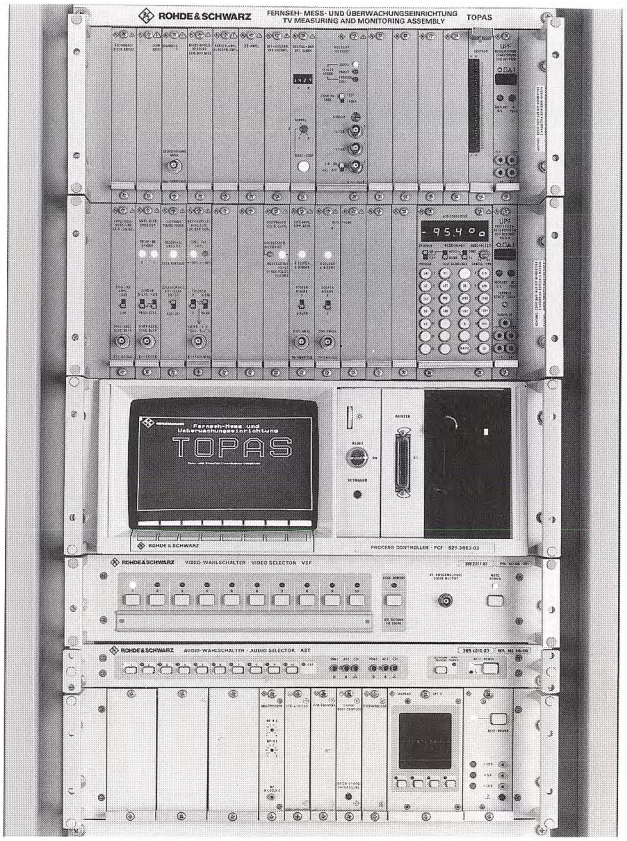
1987 First digital sound broadcast transmission in West Germany using the Audio Coder DCA

1988 First digital sound test transmitter using the 4 PSK modulation system for digital satellite sound broadcasting

The production of the first VHF sound broadcasting transmitter by Rohde & Schwarz was necessarily accompanied by the development of related measuring instruments. The first TV measuring equipment was already available before the company turned to the development of its own TV transmitters.



4 PSK Test Transmitter SFSP for max. 16 channels for digital satellite sound broadcasting to DSR recommendations



State-of-the-art automatic TV measuring system, not for test lines but for AF signals: Sound and ITS Monitoring Assembly TOPAS

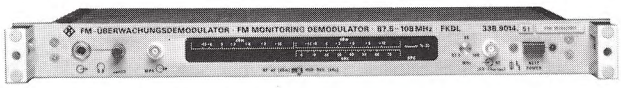
Unlike the signals of a sound broadcast system, which may at all times occupy points in a hypothetical three-dimensional information space with the coordinates frequency, time and amplitude and thus, in principle, do not allow the possibility of using this information for any auxiliary signals, the **signal in a television system,** as generated, for example, by a camera, is **digitized from the start** because of the need for scanning.

The result is that the time function of the TV signal exhibits gaps and the spectrum of the signal shows unused ranges which may be occupied with information unrelated to the picture signal. The insertion test lines are an example of using "time sharing" for the introduction of extra information, and the technique of including the chrominance information in colour TV systems illustrates the "frequency-sharing" approach. The sharing principle is even used in the third available dimension, the amplitude, since the first 30% of the dynamic range is occupied by the sync signal and only the remaining 70% is used for the picture signal proper.

The generation and processing of a colour television signal in the studio is thus much more complex than the generation of a sound signal. This is also true of the transmission and distribution of the signals to the final receiver, and applies equally to the measurement and monitoring of the signal quality during the transmission. Measuring equipment for FM sound broadcasting and for the sound channel of the television signal is relatively simple, whereas the equipment needed for measurements on the picture signal is complex and expensive.

VHF sound measurements

For performance checking during ongoing program and for measurements involved in maintenance **FM/AM demodulators** and **deviation meters** (modulation-depth meters for European AM radiopaging service) are mainly required. Simply listening to the broadcast signal is infeasible in multiprogram working. To enable this performance checking, Rohde & Schwarz developed the **automatic monitoring system Audiodat**. The system uses frequency sharing to transmit measured parameters of the signal along with the program, thereby making it possible to compare the input and output signals of a test object such as a transmission link. The Audiodat System also permits remote-control commands to be signalled to the transmitter, with acknowledgements, if required, being sent to the control centre over the radiated output signal of the transmitter.



FM Monitoring Demodulator FKDL for measurements on and monitoring of frequency-modulated VHF sound broadcast transmitters

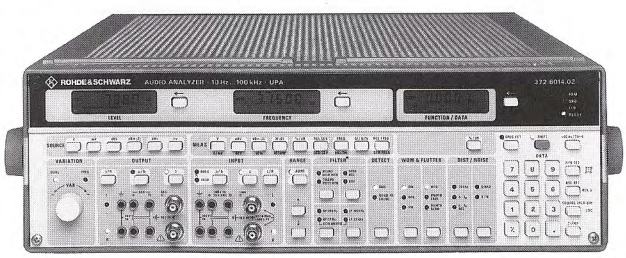
The Rohde & Schwarz range of **VHF sound measuring and monitoring equipment** covers

- **Modulation Analyzer FAM** for measurements and indication of total frequency deviation,
- **FM Monitoring Demodulator FKDL** (photo above) with separate indication of channels in stereo mode,
- **Audio Analyzer UPA** (photo below) for 10 Hz to 100 kHz as a broadband level meter and psophometer and with an integrated frequency counter,
- **AF Transmission Measuring Set SUN 2** for 10 Hz to 100 kHz, made up of AF Generator SUN 2/S and Level Meter SUN 2/U with switch-selected filters,
- **Precision Stereocoder MSC 2** and **Precision Stereodecoder MSDC 2,**
- **Audiodat System SPT/UPT,**

and from the range of general-purpose measuring instruments

- **Microwave Power Meter NRS** or **Directional Power Meters NAUS 3 to 6** for measurement of transmitter power with a dummy antenna,
- **Test Receiver ESV and ESVP** for 20 MHz to 1.3 GHz, for measurement of harmonics and spurious responses.

The measuring instruments are often combined in sound transmitter test assemblies or used in conjunction with transmitter input assemblies. The assemblies can be fitted with different equipment to meet the customers's requirements.



The Audio Analyzer UPA which can be expanded to form the complete audio tester performs fully automatical calculations and also records without a control computer

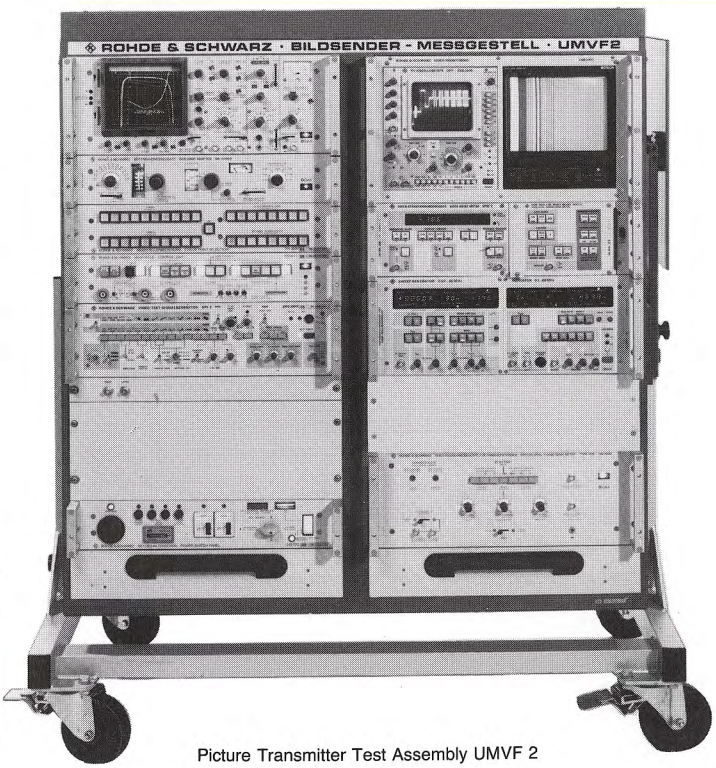
TV measurements

It is the purpose of TV measurements to ensure the required **transmission quality** between TV camera and the home receiver by continuous monitoring. To this end, camera monitors and test equipment at the central distribution point as well as monitoring and test assemblies are employed (photo below). Beyond that, the **field strength** must be checked according to the transmitter network plans by propagation measurements.

Although the TV viewer has no measuring or monitoring equipment for his TV set, reliable performance of his antenna, antenna cable and TV receiver is guaranteed by the **prior** use of specific television measuring equipment during development and manufacture of these products by the electronics industry.

Modern television engineering covers the **frequency range** from slowly varying DC (mean picture brightness) to 18 GHz (upper limit of satellite transmission bands) as well as the range of light waves. This wide spectrum (1:10^{14}) has created the following operational areas in television measurements:

1. Baseband	video (0) 1 Hz to 5 MHz	(—)
2. IF of transmitters and receivers	IF_{rec} 30 to 50 MHz	(VHF)
3. IF of radio-relay links	70 ±20 MHz 140 ±20 MHz	(VHF)
4. Carrier frequency, band I	47 to 68 MHz	(VHF)
5. Carrier frequency, band III	174 to 230 MHz	(VHF)
6. Carrier frequency, CATV	47 to 300 MHz	(VHF)
7. Carrier frequency, band IV/V	470 to 790/860/960 MHz	(UHF)
8. Carrier frequency, radio-relay links	2/4/6/7 GHz	(SHF)
9. Carrier frequency, satellites	10.95 to 12.5/18 GHz	(SHF)
10. Carrier frequency, fibreglass network (at 1 µ wavelength)	3× 10^{14} Hz	(light)



Picture Transmitter Test Assembly UMVF 2

VHF SOUND and TV MEASUREMENTS

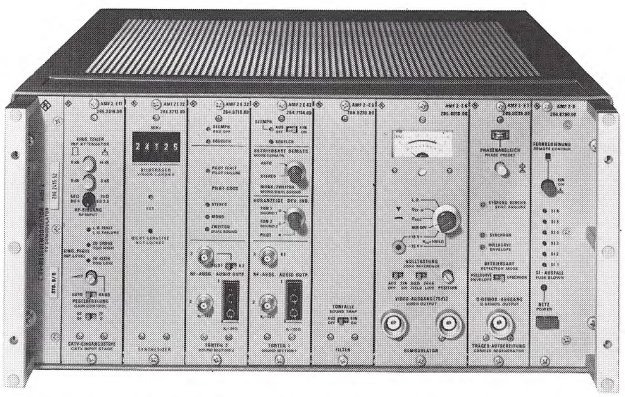
Owing to the fact that a television signal is composed of time-varying levels of brightness interrupted by periodic sync signals, two different measurement techniques have evolved since the inception of television:

- **Time-domain** measurement based on the waveform, and:
- **Frequency-domain** measurement based on the frequency responses of amplitude and phase (group delay).

Although both methods are identical in a mathematical and a physical sense, as confirmed by Fourier analysis and Laplace transformation, great differences do exist in practical applications and significance of the results. Since its start in the television measurements field, Rohde & Schwarz has contributed instruments that reflect the state of the art in both techniques.

As in any other communication system using radio links, the well-known, fundamental measuring tasks also occur in television engineering.

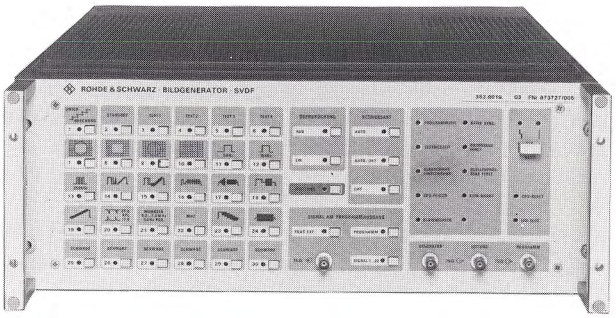
Level measurement For checking the level within the video range, highly stable oscilloscopes with provisions for calibration, such as the ODFand OPF, are employed almost exclusively. For recalibration, the Video Test Signal Generator SPF 2 is used. In the same way, the optimum modulation level of TV transmitters is observed by inserting a TV Demodulator AMF 2. Among the most important level criteria are the blanking level, the white level and the residual carrier in television transmitters. The rated power is measured as rms voltage at sync level using attenuators, which are also known as dummy antennas.



TV Demodulator AMF 2 for envelope and synchronous detection; model shown with high-selectivity CATV input stage, synthesizer and dual-sound units

The high-selectivity CATV Input Stage AMF 2-E11 and the Synthesizer AMF 2-E22 may be fitted in the TV Demodulator AMF 2 (photo above) instead of the broadband input module and the crystal-referenced channel oscillator.

AF modulation (deviation) and centre-frequency error of the TV sound transmitters in single-tone operation can be measured by means of the FM/AM Demodulator FAB, but only ahead of the TV diplexer; the measurements cannot be carried out on transmitters with common vision-sound amplification and on transposers. In these cases the new TV Dual Sound Demodulator FATF has to be used. This is a precision measuring instrument operating according to the parallel-sound method with indication of the deviation difference between the two sound channels; it gains full capability when the vision carrier with video modulation is switched on.



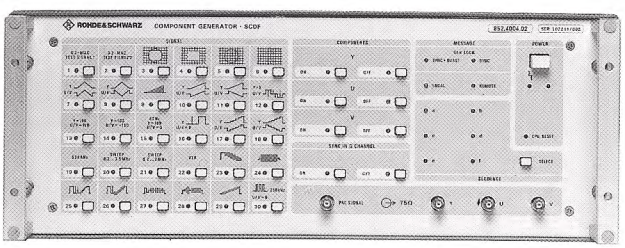
Video Test & Pattern Generator SVDF for TV transmission and measurements also generates FuBK test patterns

Linear distortion In **time-domain** measurements the distortion of a high-precision bar or pulse-and-bar-signal derived from test signal generators, such as the new Component Generator SDCF, the Video Test & Pattern Generator SVDF (photos top and bottom) and the proven Video Test Signal Generator SPF 2, is determined with high-precision video oscilloscopes and other evaluation equipment. Due to the digital test signal generation, the SCDF, SVDF and SPF 2 feature a great variety of different signals, including the internationally standardized insertion test signals, which can be inserted not only into the composite colour video signals produced by the instrument itself, but also into incoming program signals without requiring any special insertion unit (this applies also to teletext and other external data signals).

The Video Test & Pattern Generator SVDF also generates electronic test patterns (such as the FuBK test pattern with and without circle) and programmable character fields (such as station names or information for the viewers).

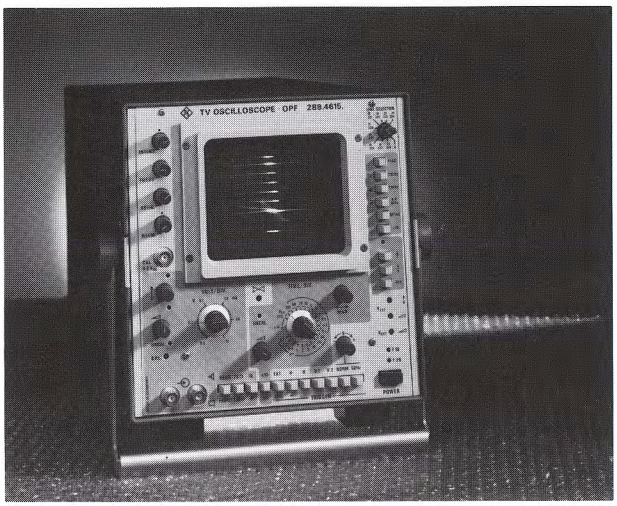
A special test signal and six test pages for teletext and data lines for VPS operation extend the range of applications of this generator family. Serial or parallel remote control is possible for both instruments, the SVDF can also be controlled via data lines (16 and/or 329). Automatic substitution of the program signal in case of program failure is particularly valuable for an instrument used in transmission.

The Component Generator SCDF can supply three signal shapes (CCVS-PAL, YC_BC_R and RGB) at separate outputs.



The digital Component Generator SCDF supplies not only YC_BC_R, RGB and CCVS signals at separate outputs but also generates teletext pages, data lines and the new MAC test pattern

In the group of oscilloscopes used for evaluation the TV Oscilloscope OPF (photo below) is particularly used for measuring the incidental vision carrier phase, an essential criterion for the more stringent quality requirements on the TV sound. In the OPF, the video signals to be investigated are processed in analog form through to screen display, whereas in the ODF the video signals to be measured are processed in digitized form.



TV Oscilloscope OPF permitting measurement of the vision carrier phase

The TV Digital Oscilloscope ODF (photo below) evaluates TV test signals with a 10-bit analog/digital converter affording a resolution of 1/1024 of the display height, stores them and enables a physiologically optimized readout independent of the repetition frequency of the measurement. Tolerance masks and other reference systems can be electronically inserted, so that the measured values will be free from geometric distortion and parallax reading errors. Test signals with superimposed random noise can be much better evaluated on the screen due to signal averaging in an intermediate memory. Adjustments are greatly facilitated by display of the difference between the measured and stored reference signals. An internal error correction is possible in a similar way.

The ODF is IEC-bus-compatible and can be integrated in computer-controlled test systems.

The low operating speed of highly selective instruments such as the Selective Demodulator LDS is irrelevant for spectral analysis and group-delay measurement when using the ODF, since the readout speed can be increased independently.

Advantage of these measurements: simple signals that enable amplitude and group-delay errors to be evaluated simultaneously. Consequently, this has become the standard test procedure in TV measurements. In precision measurements, e.g. in acceptance testing, etc., no inherent errors, such as distortion in single-sideband modulation systems and nonlinearities should influence the result.

In **frequency-domain** measurements, linear distortion is measured as the frequency response of gain and phase or of group delay, using the system's TV Analyzer/Sweep Tester WMP (photo below), consisting of the Group-Delay Measuring Set LFM 2, Selective Demodulator LDS and TV Digital Oscilloscope ODF.

Group-delay measurements are imperative for checking group-delay equalization networks of TV receivers and in transmission systems for teletext, since the error rate is mainly determined by the group-delay equalization at the upper end of the video band.

The Selective Demodulator LDS for use with the LFM 2 also permits tracking selective measurement, but not only of the amplitude (vestigial sideband characteristic) but also of the group-delay response.

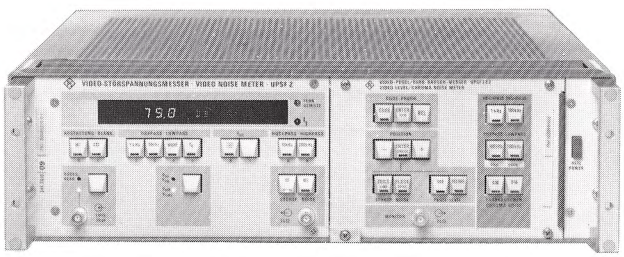
The TV Analyzer/Sweep Tester WMP comprising the Group-Delay Measuring Set LFM 2 for tracking selective measurements with the LFM 2 and microprocessor-controlled TV Digital Oscilloscope ODF are controlled by processor controllers (eg PCA 5 from R&S)

Nonlinear distortion The nonlinearity of a monochrome television signal (CVS) or of the luminance component of a composite colour video signal (CCVS) is measured with staircase or saw-tooth signals, 10% superimposed with a test voltage from generators, such as the SPF 2.

The signals are evaluated in the oscilloscope mostly in conjunction with a filter rejecting the superimposed voltage or with filters differentiating between the step heights of the staircase (spike method). In contrast to the greyscale errors in monochrome television nonlinearities in the colour component (chrominance signal) of a composite colour video signal cause degradations of the hue in the affected parts of the picture (differential phase) or change the degree of colour saturation (differential gain). Although the PAL system largely eliminates the influence of the former, careful measurements with a distortion meter, e.g. with the PVF are necessary, especially on radio links which might be overloaded due to the preemphasis in the chrominance signal range, and on TV transmitters and transposers.

For the intended improvement of the sound quality in the intercarrier method the incidental phase modulation of the vision carrier in the vestigial sideband should be as low as possible if there are modulation components at sound frequency in the video signal. The Q component at the output of a synchronous detector like the AMF 2 forms the criterion. It can be evaluated accurately to ±0.5° in a special test circuit of the TV Oscilloscope OPF.

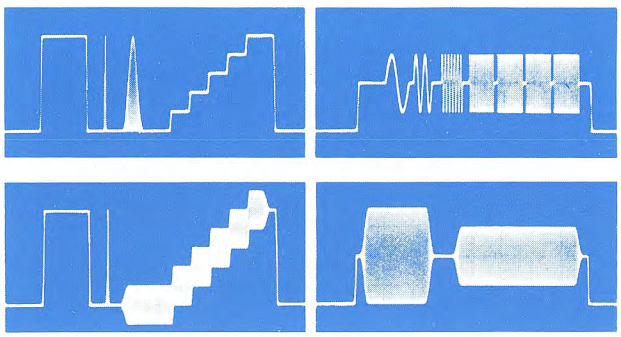
Interference voltage As a makeshift measure, interference voltages in the video range can be subjectively estimated (with an accuracy of ±3 dB) with the aid of an overload-proof oscilloscope by observing the continually varying peak values. However, the objective method has now found general acceptance which permits the rms value to be read off a meter with an accuracy of ±0.5 dB, as with the Video Noise Meter UPSF 2 (photo below), and the use of weighting filters, e.g. according to CCIR Rec. 567, and of special filters to IEC-SC 60 B for measuring the chroma noise in magnetic tape recording.



Video Noise Meter UPSF 2 for luminance and chrominance noise measurements, system-compatible due to IEC-bus interface

Reflection coefficient Careful measurements for matching purposes are required on long video cables, and on TV transmitting and receiving antennas and their cable connections, since the TV screen – being a sensitive oscilloscope – also displays any spurious superimposed voltages. A suitable measuring instrument is the ZPV in conjunction with SWR Bridge ZRB 2.

Field strength/propagation The high investments made by postal authorities and broadcasting services in procuring main and gap-filling transmitters and transposers in order to provide unimpaired TV coverage require exact field-strength measurements. The Field-strength Meter HUF for 20 to 1000 MHz, for instance, is suitable for this purpose. Field-strength indicators can be used where a general survey is required.



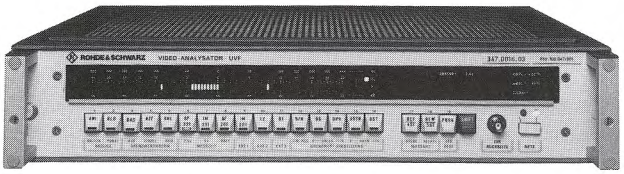
Oscillograms of the four international standard test lines (CCIR Rec. 473-2, Annex 1)

VIT technique Extended program hours and increasing use of unattended transmitter stations demand drastic reduction of test periods. The VIT technique permits constant performance monitoring during program time as required for automatic measuring and monitoring systems.

Internationally agreed test signals (CCIR Rec. 473-2; illustration above) are inserted into the program during the vertical blanking intervals which are devoid of picture information. For this purpose the Video Test & Pattern Generator SVDF, the Component Generator SCDF, the Video Test Signal Generator SPF 2 and the VITS Generator & Inserter SKF (the latter generates insertion test signals only) are available as generators and inserters. The signals can be evaluated with the aid of oscilloscopes featuring selectable test line display, such as ODF and OPF, or automatically using the Video Distortion Analyzer UPF (photo on page 23), Video Analyzer UVF or Digital Teletext Analyzer ATF (next page).

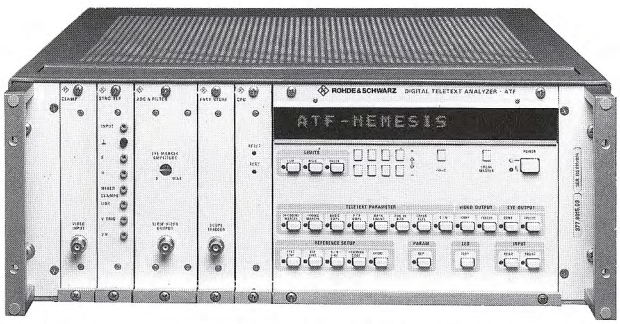
Oscilloscopes with test line selection permit the test parameters to be evaluated in real time on the screen. The Video Distortion Analyzer UPF outputs the values of a maximum of 28 parameters on a numerical display either successively upon selection or cyclically. Since the final result produced by the UPF for each parameter is formed by the integration of 250 individual measurements over a period of 10 seconds, it was possible to improve the accuracy by about one order of magnitude and to reduce the minimum acceptable signal-to-noise ratio by about 20 dB relative to visual measurements on the screen of the oscilloscope. The measured values can be monitored by limit monitors or, after data transmission, processed by computers.

The Video Analyzer UVF (photo right) has been developed in line with CCIR Recommendation 569-1 and some EBU/UER specifications for measurement of the 16 most important test line parameters. 64 individual measurements are integrated over a period of 2.56 seconds. The UVF features a quasi-analog display in form of a LED bar made up of 81 LEDs; it can be remote-controlled via the IEC-bus interface and is fully systemcompatible.



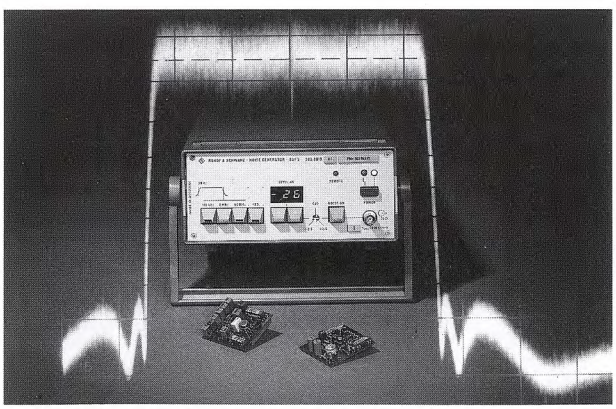
Video Analyzer UVF for automatic measurement of a maximum of 16 fixed test line parameters

Teletext The Digital Teletext Analyzer ATF (photo below) is used to evaluate, measure and monitor test lines and primarily teletext signals. The ATF contains a digital line memory which sends the scanning values of each TV line to a 16-bit microprocessor for testing and evaluation. The line to be measured and the test parameter are selected using permanently assigned keys. The test result is shown on an alphanumeric display.



The Digital Teletext Analyzer ATF for teletext and test lines can be used in a very wide range of applications for automatic quality and limit value control with data recording in systems and for manual operation in the laboratory

Measurement with noise signals Noise signals can be used in practically all video noise voltage and distortion measurements as well as in audio measurements. The Noise Generator SUF 2 with its filter options delivers noise spectra for various measurements and can be used in test systems.

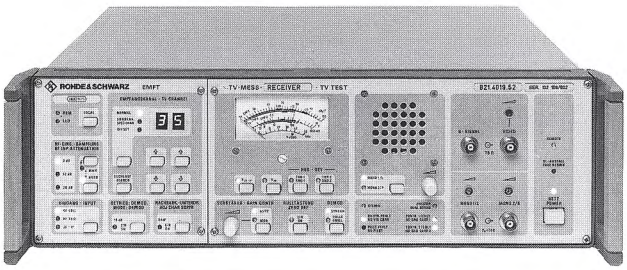


The Noise Generator SUF 2 is system-compatible and supplies white noise up to 50 MHz and coloured noise for any measurements

Measurements on broadband communication systems The adjacent-channel operation in broadband communication system necessitates a reduction of the out-of-band radiation of each TV channel far beyond the 20 dB usual for terrestrial transmitters. The envelope delay distortion linked up with the steep filter edges is reduced in the TV Modulator SBKF (photo on page 5) by the use of SAW filters.

The TV Test Receiver EMFT can be used as a measuring receiver in broadband communication systems. It is continuously tunable in all TV bands – including the special channel band up to 470 MHz. The switchable SAW filter on the front panel ensures optimum measurement results, even when the adjacent channel is occupied.

Measurements for satellite sound broadcasting see page 26, for data transmission page 29.



The remote-control TV Test Receiver EMFT from the EMF family can be continuously tuned through to the hyperband and is intended for adjacent channel measurements in conjunction with the switch-on SAW filter; it is also multitone-compatible (including NICAM system)

Dual-sound TV

Television sound, for a long time the "poor relation" of the picture, has undergone a **major technical improvement** in the Federal Republic of Germany thus giving television a greater appeal. In a joint effort involving the ZDF, the Federal German PTT Administration, the ARD (Association of German Broadcasting Corporations), the IRT (Institute for Broadcasting Technology) and the German electronics industry a new **dual-sound system** has been developed. Rohde & Schwarz has furnished the equipment required for retrofitting the transmitters supplying manufacturers of receivers.

With dual sound, the most significant innovation since the introduction of colour television, it is now possible to hear the television sound in **stereo** and in a **quality** equivalent to that **of VHF sound broadcasting.** The capacity to transmit two separate AF signals opens up a number of further possibilities: foreign-language films can be transmitted **simultaneously in the original language and with dubbing into the local language,** or the proceedings of conferences can be transmitted in the local language together with simultaneous translation. In countries, where different languages are spoken in different regions, two different languages can be transmitted over two separate sound channels.

VHF SOUND and TV MEASUREMENTS

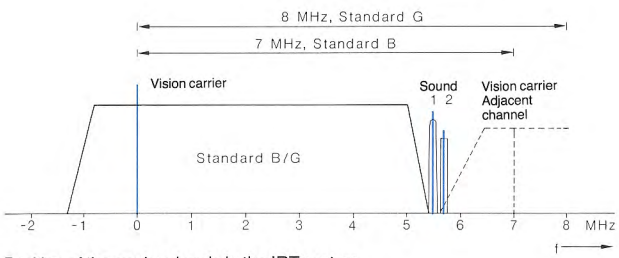
Rohde & Schwarz has had considerable experience in the field of dual-sound technology in Europe. The TV transmitter in the Olympia tower in Munich was equipped for dual-sound as early as November 1980. In 1988, Rohde & Schwarz also presented the basic equipment for the **NICAM system** developed by the BBC/IBA.

IRT system

The **essential criteria** of dual-sound technology are high crosstalk attenuation with two independent sound signals and **equal phase delays** with stereo sound signals.

System parameters (for standards B/G)

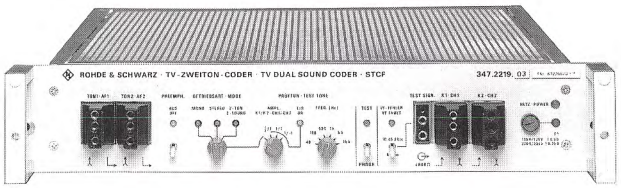
	Channel 1	Channel 2
RF sound carrier		
Frequency	f_{vision} +5.5 MHz (±500 Hz), eqvt. to 352 f_H	f_{vision} +5.7421875 MHz (±500 Hz), eqvt. to 367.5 f_H
Vision/sound power ratio	13 dB	20 dB
Modulation	FM	FM
Frequency deviation	≤±50 Hz	≤±50 kHz
Preemphasis	50 µs	50 µs
AF bandwidth	40 to 15 000 Hz	40 to 15 000 Hz
Sound modulation		
Mono	mono 1	mono 1
Stereo	$\frac{L+R}{2}=M$	R
Dual sound	mono 1	mono 2
Identification		
Pilot carrier frequency	–	54.6875 kHz (±5 Hz), eqvt. to 3.5 f_H
Modulation	–	AM (with identification frequency)
Modulation degree	–	50%
Identification frequency		
mono	–	none
stereo	–	117.5 Hz eqvt to f_H/133
dual sound	–	274.1 Hz eqvt to f_H/57
Frequency deviation of transmitter carrier (due to pilot tone)	–	±(2.5 kHz ±0.5 kHz)
Synchronization	–	pilot carrier and identification frequencies phase-locked with f_H



Position of the carrier signals in the IRT system

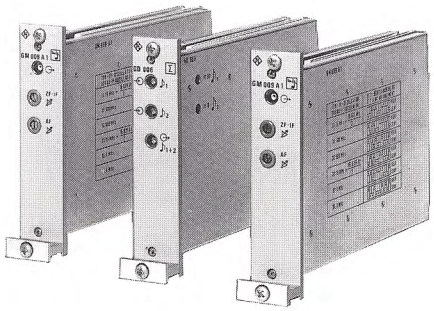
The two sound channels are taken via radio link with 15 kHz bandwidth to the transmitter, where they are matrixed: channel 1=(L+R)/2, channel 2 = R. In an additional sound modulator the second sound carrier is frequency-modulated with the second sound channel 5.74 MHz above the vision carrier. The second channel contains the information which identifies to the domestic TV set the sound mode being used.

R&S dual-sound equipment



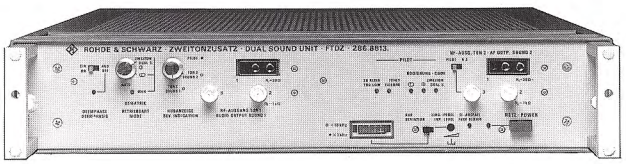
STCF

The **TV Dual Sound Coder STCF** is used for processing sound modulation signals (40 Hz to 15 kHz). From two AF signals the STCF produces, under remote control, the coded channel signals 1 and 2 (including a modulated pilot-tone signal).



GM 009 A1 GD 006 A1 GM 009 A1

Two **Sound Modulators GM 009 A1** generate and modulate the intermediate frequencies of 33.4 MHz and 33.158 MHz. The IF signals are combined by the **Diplexer GD 006 A1.**



FTDZ

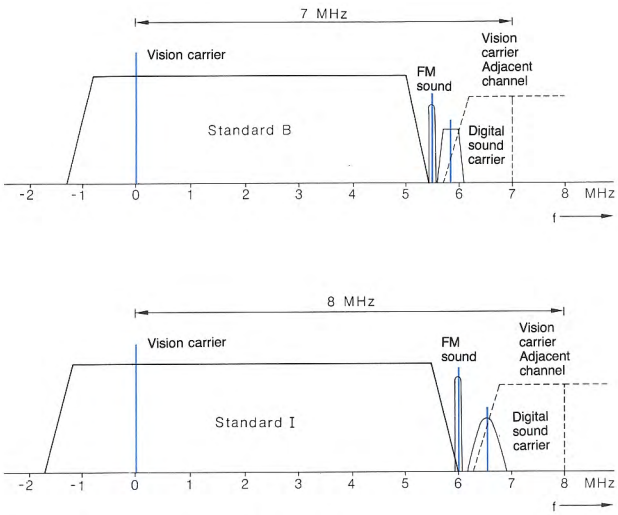
The **Dual Sound Unit FTDZ** for R&S relay and monitoring receivers is used for checking and monitoring. The R&S Receivers EB 001 and EKF 2 can be readily retrofitted with the new sound sections for dual sound of the TV Demodulator AMF 2.

NICAM system

The BBC/IBA have defined the specifications for the NICAM system (Near Instantaneously Companded Audio Multiplex) for Great Britain. This digital TV sound transmission system is based on the EBU specifications for C-MAC/Packet (Doc. SPB 284). It has also been introduced in Scandinavia. With the NICAM system, the digital sound signals provided with scale factors are compensated – ie only 10 bits per sample – and transmitted modulated on another sound carrier.

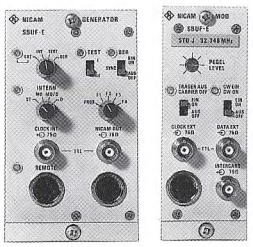
System parameters

	Standard B/G	Standard I
Digital sound carrier	5.85 MHz	6.552 MHz
Shape of curve	40% cos	100 % cos
Level, vision carrier	0 dB	0 dB
sound carrier	13 dB	10 dB
digital sound carrier	20 dB	20 dB
Modulation	4 PSK	4 PSK
Transfer rate	728 kbit/s	728 kbit/s



Position of carrier signals in NICAM system

R&S in-service equipment



2 × SBUF-E

In conjunction with the **NICAM Modulator SBUF-E,** the **NICAM Generator SBUF-E** generates a 4 PSK-modulated carrier signal at the intercarrier level. These modules supplement the SBUF/SBTF 2 test transmitter family for developing, manufacturing, monitoring and servicing TV receivers.

NDZ

The **NICAM Demodulator NDZ** is used to measure and monitor 4 PSK-modulated IF signals.

Test assemblies

In many cases it is necessary to measure more than just a few parameters. Instead, as during commissioning or major readjustment of a transmitter, it is often required to measure a vast number of different parameters.

For such purposes the individual instruments are combined into test assemblies operated from a **central control unit** such as a signal switching panel, control panel, checkpoint selector or connection panel. The use of modern circuit techniques and relay components has made it possible to **select** checkpoints at all frequencies up to 1000 MHz using only **DC signals,** while achieving very high return loss and crosstalk attenuation. Such control functions are essential to permit the integration of measuring equipment into remote measuring and control systems, the first step towards complete automation.

The following **types of test assembly** have been formed:

- **Picture Transmitter Test Assembly UMVF 2,** in the fourth generation (photo on page 15), is indispensable for measurements on TV systems and for maintenance and repair. Manual or automatic (remotely controlled) selection of checkpoints.
- **TV Transmitter Monitoring Assembly UKFZ 2** is used for quality control during the ongoing program. In combination with the transmitter, the TV Demodulator AMF 2 forms a "modem" for monitoring the video input and IF output signals of modern IF-modulated TV transmitters. The sound transmitter is monitored by a TV Dual Sound Demodulator FATF in the same rack.
- **FM Transmitter Input and Monitoring Assembly UMT-5** for measurement and to a certain extent also monitoring tasks. Consists of the AF Transmission Measuring Set SUN 2 for level, distortion and noise-voltage measurements; precision stereocoder (MSC 2) and decoder (MSDC 2); and accurate FM/AM Demodulator FAB for reliable measurements in the audio baseband between transmitter input and demodulator output in both mono and stereo operation.
- **TV Monitoring Console MSF** contains the main controls for transmitter operation and program selection, the Vision Monitors and Audio Monitor MTA 702, the AF and VF Switching Equipment MTA/MFA and the TV Monitoring Receiver EKF 2 for checking the quality of the radiated signal or for use as a relay receiver in the event of feeder breakdown.
- **Vision Transmitter Input Equipment UERF** is connected between the modulation feed line and the TV transmitter. It has the following functions:

  division of the main program line to feed main and standby transmitters,

  automatic level control with white-level limiting, subcarrier control and sync-pulse regeneration,

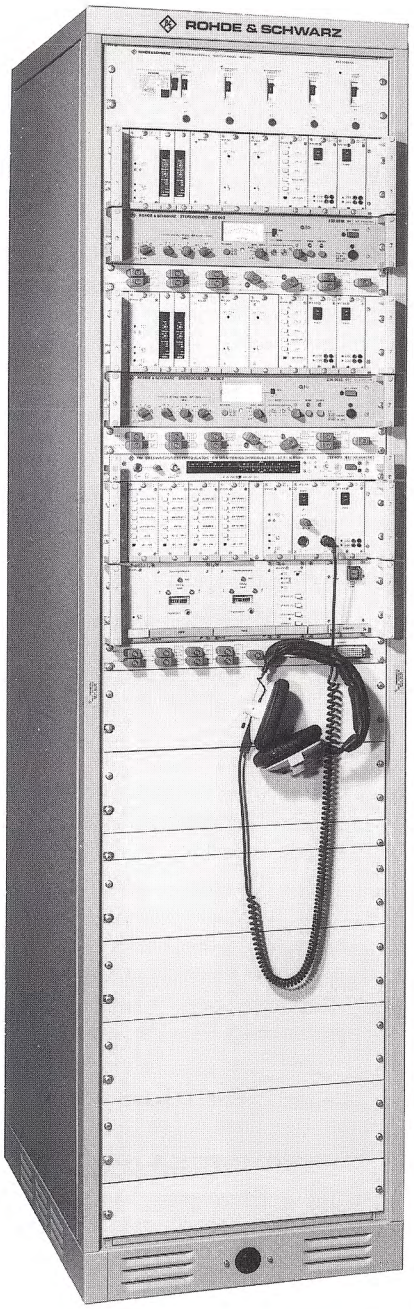
  interface to vision transmitter test and monitoring assemblies.

- The **FM Input Assembly MST 01** (photo below) has both an input and a monitoring function. Its functions are as follows:

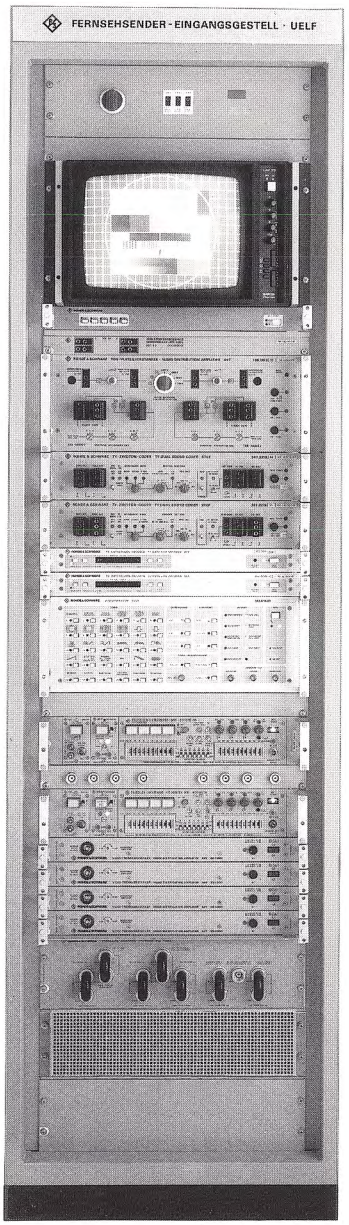
  Monitoring measurements on FM mono and stereo transmitters

  Signal distribution, AF signal level adjustment and in-service monitoring of a dual transmitter

  Internal and external switchover control



The FM Input Assembly MST 01 is used for signal distribution, in-service monitoring of mono and stereo transmitters and switchover control



The TV Transmitter Input Assembly UELF sends vision and sound broadcasting signals to dual transmitters

- The **TV Transmitter Input Assembly UELF** (photo above) functions only as an input assembly and is used to send vision/sound broadcasting signals to dual transmitters. It features:

  Transmission of vision and sound broadcasting signals to in-service and standby transmitters

  Automatic substitute vision signal transmission with text insertion

  VIT insertion in program and substitute signals

  VF monitor for monitoring incoming or radiated signals

  Dual sound signal processing

  Data line monitoring

- The **TV Transmitter In-service Assembly USTF** also has a dual function. It sends sound broadcasting signals to TV dual transmitters and monitors vision broadcasting signals. Its different functions are as follows:

  Transmission of sound broadcasting signals to in-service and standby transmitters

  Dual sound signal processing

  VF monitor for monitoring incoming or radiated signals

  Automatic substitute vision signal transmission with text insertion

  Data line monitoring

- The **Sound and ITS Monitoring System TOPAS** (photo below) with the Video Distortion Analyzer UPF automatically monitors the in-service and quality parameters of the modulation feeders and TV dual transmitters for operation with several programs at a station. It also enables data processing (linked to the transmitter centre via four-wire lines).

  The free programmability of the Process Controller PCF contained in the system means it can be matched to any existing TV monitoring system and its specifications.

  When setting up a TOPAS system, existing system components can be integrated into the TOPAS system and are therefore reusable.

  The TOPAS system is housed in a mini-rackmount which is suitable for both bench-top operation and integration in a vision transmitter input assembly.

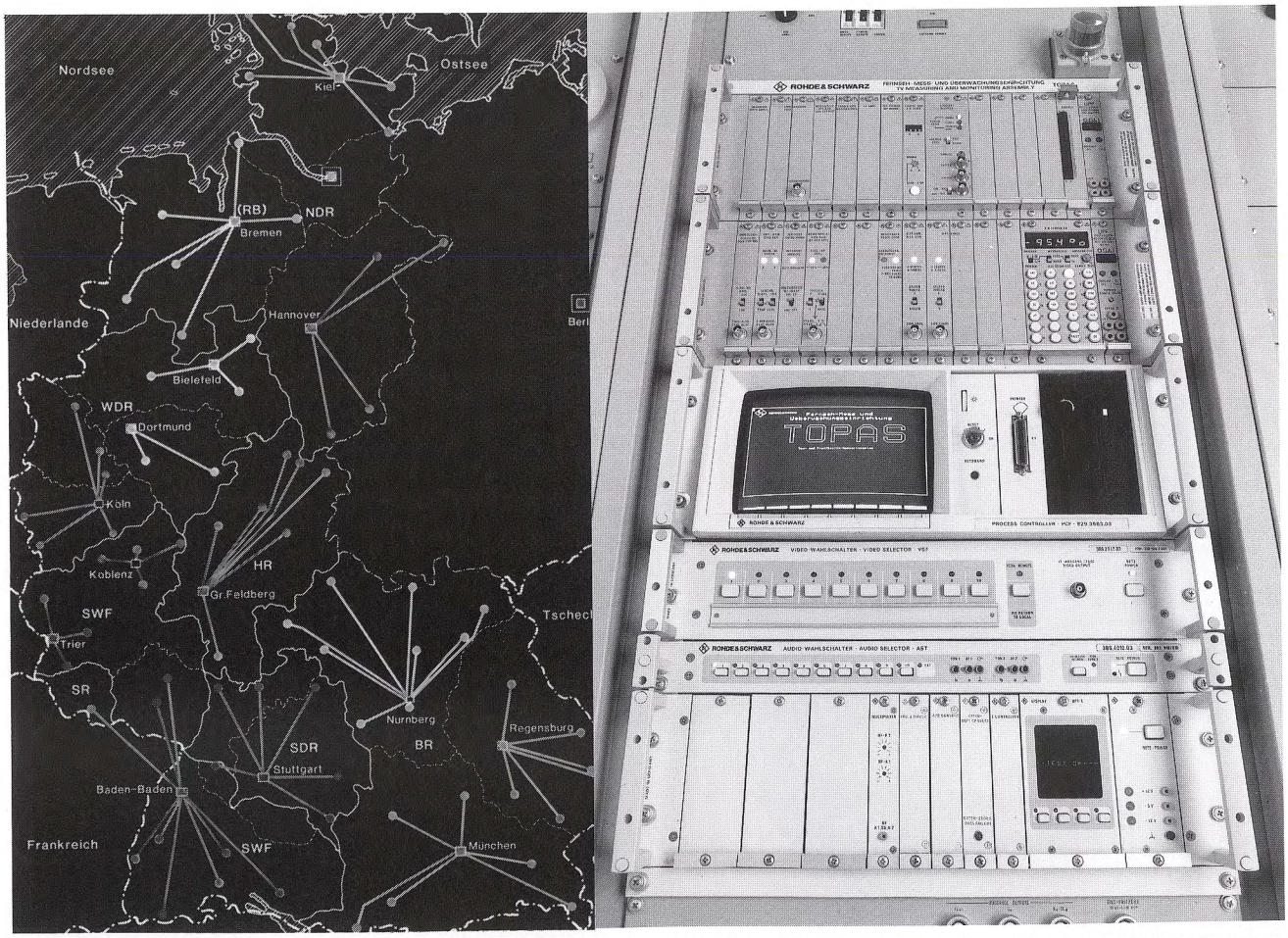
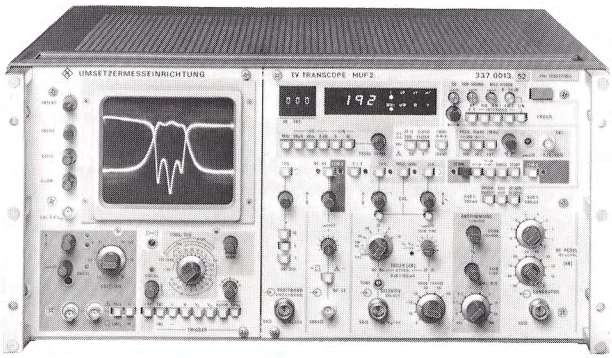


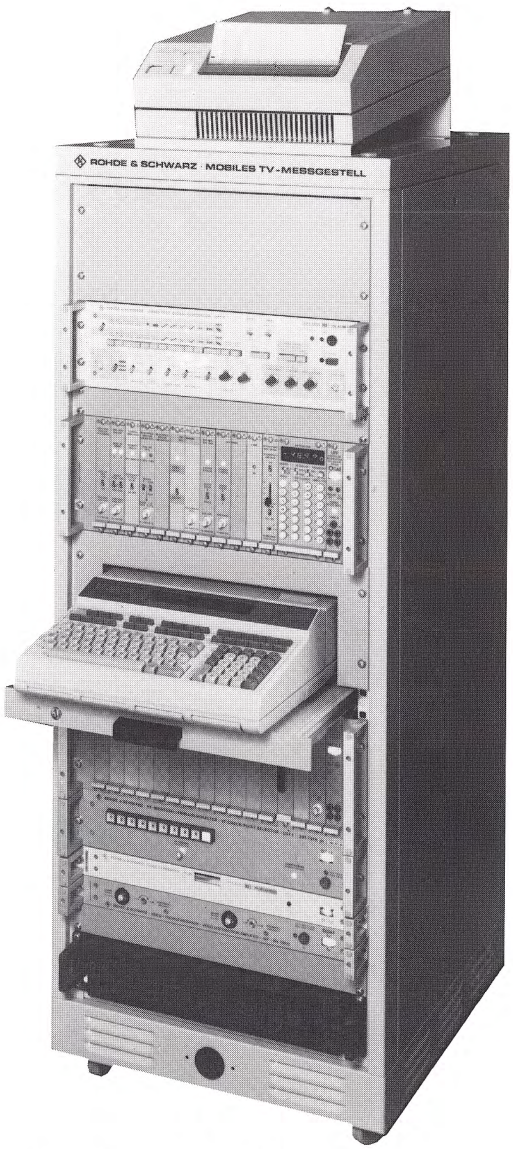
Photo left: Decentralized TV transmitter monitoring system with monitoring equipment in the unattended transmitter stations of the Federal German Posts and Telecommunications Administration and with computer control and remote-control facilities in the attended regional transmitter centres; right: Sound and ITS Monitoring System TOPAS with Video Distortion Analyzer UPF

VHF SOUND and TV MEASUREMENTS

- **Operational test system for picture and sound studio** (photo below). Picture sources (cameras) and storage devices (film, magnetic tape, video disk, slide) are selected in the studio according to the program using crossbar selector panels. The correctness and the quality of the video signal path can be checked by the insertion of identification and test-line signals immediately after the source or storage unit and the evaluation of these signals at the far end of the signal path, even during the ongoing program. This simultaneous approach is not possible for the audio signal path. In this case a short 10-s test program must be sent along the path after it has been connected up and before applying the program material. In normal practice both these checks on the signal paths are coordinated to give a clearance criterion for the occupancy of the channels.



TV Transcope MUF 2 for practically all measurements on TV transposers



Operational test system in form of a video test mobile

Only with the introduction of the Audiodat system did it become possible to make simultaneous comparison measurements between the input and output signals of a section to be monitored (e.g. transmitter or link). The measured information is carried as binary signals in a very narrow band (25 bits/s) at the top end of the audio baseband. It is possible to measure the following parameters with the Audiodat:

signal level,
noise level,
linearity of transmission system,
polarity of stereo signal,
level of stereo components,
amplitude/frequency response in three subranges,
identification of source and/or signal path.

The Audiodat remote-control system with 60-kHz carrier frequency and a higher transmission rate of 200 bits/s operates according to the same principle and is used in FM sound channels above the AF spectra of mono or stereo signals.

- **Automatic video test system with video test signal generator** and programmable computer control and evaluation via IEC bus is used in extensive video transmission systems (studios) and in final testing of batch-produced professional video equipment. The Process Controller PUC, PCA or a similar computer is used as control unit.
- **Automatic video test system without video test signal generator** is only suitable for acceptance and evaluation of inserted test signals. The Video Analyzer UVF used in this system is IEC-bus-compatible. The Process Controller PUC or the faster Process Controller PCA 5 can be used as IEC-bus-compatible controller.
- **Transposer test assemblies** Although predominantly designed for low powers (1 to 10 W), TV transposers make exacting requirements on TV measurements: the receiver section must be checked in line with the requirements for sensitive, highly stable receivers, ie noise, selectivity, crossmodulation and overdrive capability (in addition to the transmission quality in terms of frequency response and group delay), whereas the transmitter section must have the characteristics of a TV transmitter with

common vision/sound output stage. Parameters of particular importance are low intermodulation and cross-modulation distortion, linearity of the transmission characteristics, low spurious responses and harmonic content, frequency stability (especially in offset mode) as well as small variations in amplitude and group delay frequency responses. Therefore, transposer test assemblies comprise almost the full range of TV measuring instruments, including Nyquist test demodulators.

The TV Transcope MUF 2 (photo left page) makes it possible to carry out almost all the measurements mentioned above and is particularly suitable for use in field maintenance.

The TV Transcope is also ideal for measurements on TV transmitters due to its compact design.

- **Central TV vision and sound monitoring system "off air"** with central receiving unit for all obtainable regional transmitters; channel receivers, including IF, followed by high-accuracy TV Demodulator AMF 2 with synchronous detection and cyclic connection to each channel; automatic quality analysis using received insertion test lines with optional computer back-up. An extended version of the system converts the received quality and status information to remote-control commands for the monitored transmitters in order to optimize operation within the technical limits of the equipment.

- **Cable TV monitoring systems** on CCIR test line basis consisting of
  TV Demodulator AMF 2 with
  CATV Input Stage AMF 2-E11,
  Video Analyzer UVF and
  Process Controller PCA 5.

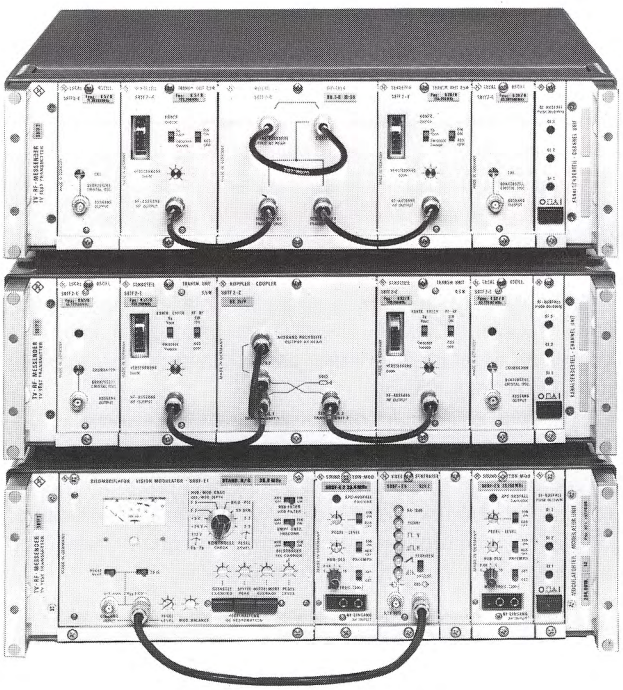
  A V.24/RS 232 C interface for a modem permits data transmission in a telephone channel.

- **Systems with TV-channel signal generators** (SBUF and SBTF 2, photos below) for the simulation of complete, standardized TV-channel signals of high accuracy for virtually all TV standards (B, G, D, K, I, M, N, E). Generated signals comply with norms in parameters such as: vision-sound carrier spacing, vision-sound carrier power ratio, type of modulation FM sound, vestigial-sideband characteristic, group-delay precorrection, linearity, differential gain and differential phase.

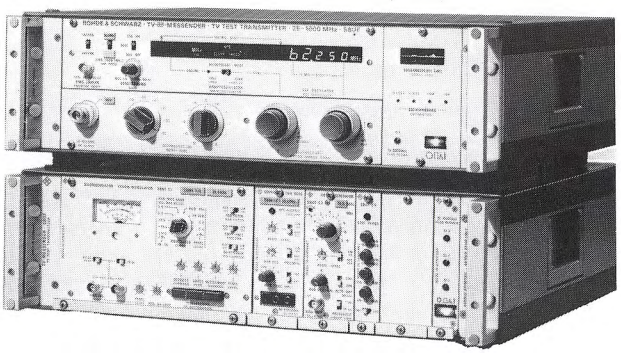
  Basic components: Video signal generators,
  IF modulators,
  channel-frequency transposers,
  power amplifiers.

  Main applications: Used in the development and final testing of domestic TV receivers. Measurements in all channels and in special channels for CATV receivers. Signals fed to test stations via high-quality cable networks and low-reflection distribution systems.

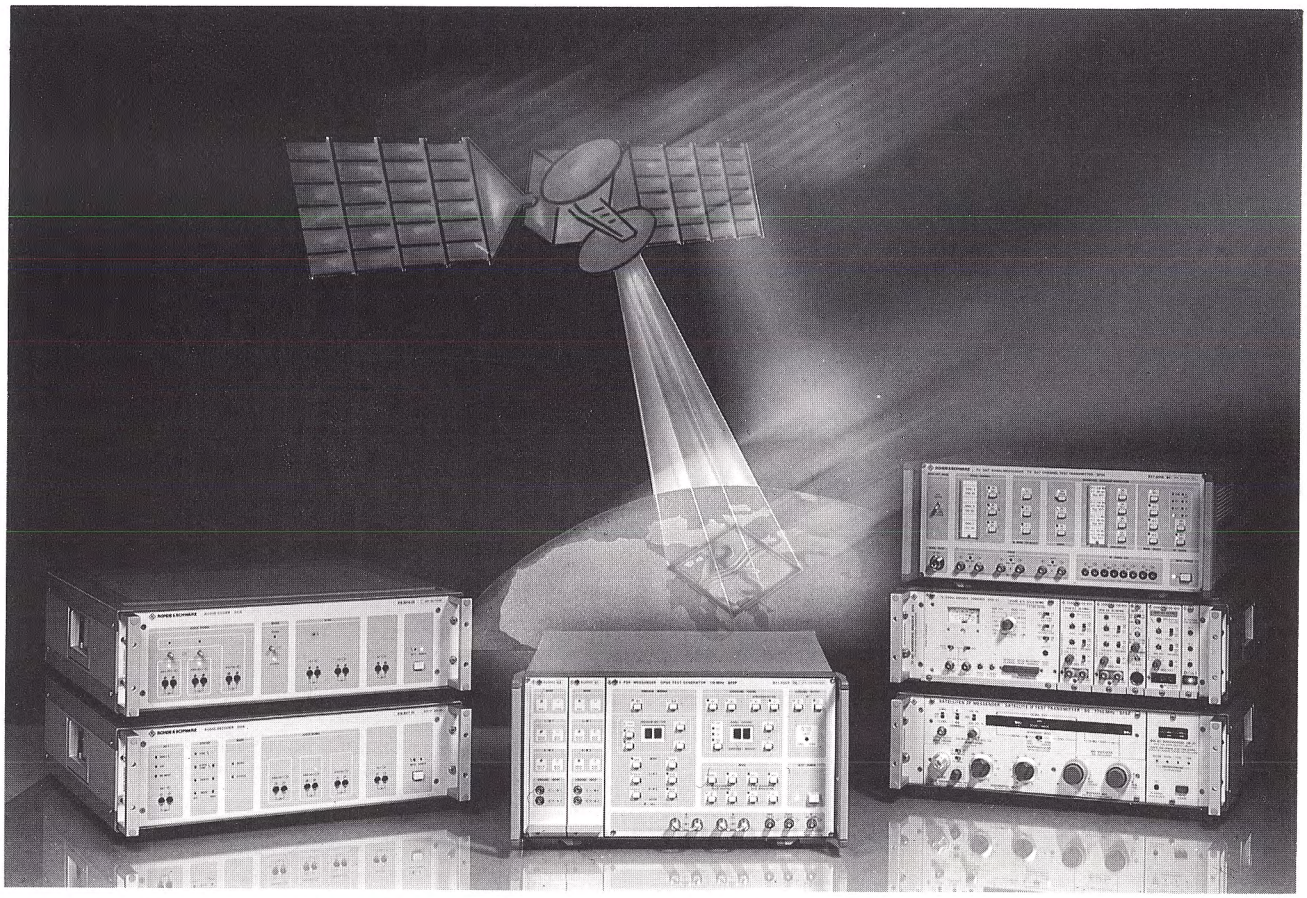
  The TV Modulator SBKF (photo page 5) is available for broadband communication systems with adjacent-channel operation.



Universal TV Test Transmitter SBUF (below) providing wide range of high-precision RF output signals; slightly modified version available as SBTF 2 for system applications, with modules specially designed for this application (left)



The test assemblies described above are the result of the many years of **cooperation between the broadcasting services** using the equipment **and Rohde & Schwarz.** They offer an optimized solution to the measurement tasks in the various fields of application. In addition, **customized** assemblies can be designed and manufactured and optimally integrated into existing systems.



Equipment for digital audio transmission DCA and DDA (left) and TV satellite measuring and in-service equipment SFSP, SFSK, SFSA and SFSZ

Transmission and measurement techniques for satellite radio broadcasting

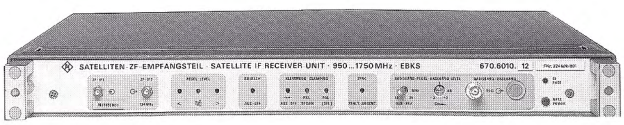
Transmission links Three different modes are possible:

- Point-to-point communication for transmission of a TV program similar to a directional radio link, established for the first time with "Telstar" on 10th July 1962; 2 W ERP downlink with 4.2 GHz, aperture of receiving antenna 335 m^2 and gain 60 dB.
- Program distribution similar to starpoint with directional radio network or headend (receiving) stations in broadband networks, eg "Eutelsat 1 – F1": 12 transponders of 20 W each and transmitting antennas with 32 dB gain for downlink radiation between 10.95 and 11.7 GHz; receiving antennas of 3.7 m diameter (10.8 m^2) and a gain of 50 dB yield in conjunction with the SHF/UHF receiving converter a system quality gain/temperature of 25 dB/K.
- Direct television via satellites with individual program transmission to the viewers via individual parabolic receiving antennas with a minimum diameter of 0.9 m, planned for 1989 with "TV-Sat", "TDF" or "Astra", with, for example, 5 channels of 150 W RF power each and 40 dB antenna gain for downlink radiation between 11.7 and 12.5 GHz; the receiving antenna with 2° aperture and a gain of 37 dB yields in conjunction with the SHF/UHF receiving converter a system quality G/T of 6 dB/K.

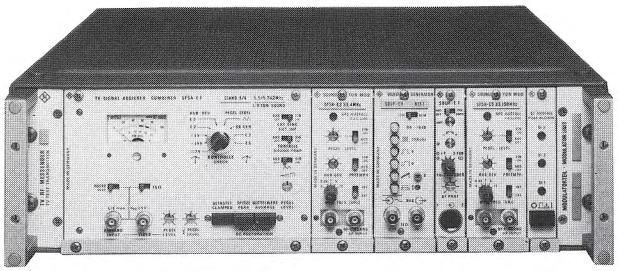
Transmitter end Measurements on a satellite communication link are carried out at the transmitter end (uplink) in the form of a quality check of the emission with the aid of test and insertion test signals in the earth station similar to the testing of terrestrial TV transmitters. Direct access to the satellite is not possible.

Receiving system The high-grade Satellite Communications Receiving System RS 002 allows evaluation of the quality of the total system after demodulation of the received satellite test signals.

The RS 002 can also be used as a communications system for distribution satellites, which feeds in the programs received from satellites in the headend of a broadband communication network. For this purpose a Satellite IF Receiver Unit EBKS (one required for each program, photo below) and a Satellite IF Distributor ABKS are used.



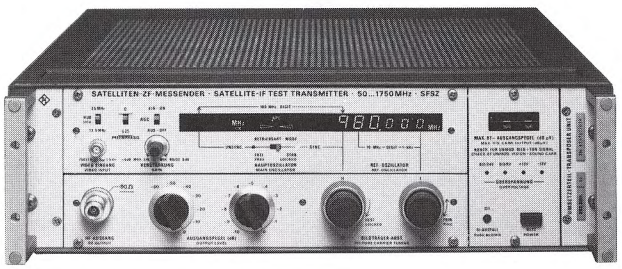
Satellite IF Receiver Unit EBKS



TV-Sat Base Signal Combiner SFSA

Test transmitter For the successful development and maintenance of communications systems and also of home receivers for satellite television it is necessary to simulate the complete uplink and downlink signal paths. The new R&S test transmitter for satellite communications consists of a TV-Sat Base Signal Combiner SFSA (photo above) for the video signal and a maximum of two associated audio signals, which are frequency-modulated to 5.5 MHz and 5.74 MHz.

This mixture signal is frequency-modulated in the Satellite IF Test Transmitter SFSZ (photo below) and directly converted into the range up to 1750 MHz, eg for driving a 18-GHz uplink transmitter or as test signal for a satellite-signal receiver.

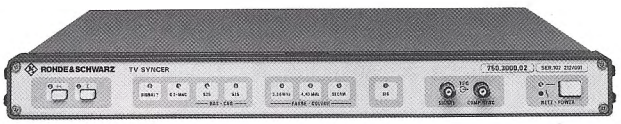


Satellite IF Test Transmitter SFSZ

TV Transmission System D2-MAC/Packet The D2-MAC/Packet system represents a completely new transmission system in central Europe which is about to be introduced, initially in France and in West Germany. In this system, the brightness and colour components are transmitted separately in time. The digital sound, data and sync signals are also contained as packet components in the header of a line.

Digital sound broadcasting A new era in sound broadcasting programs has also started and the corresponding channels have been assigned; CD-quality sound broadcasts will be received on the air.

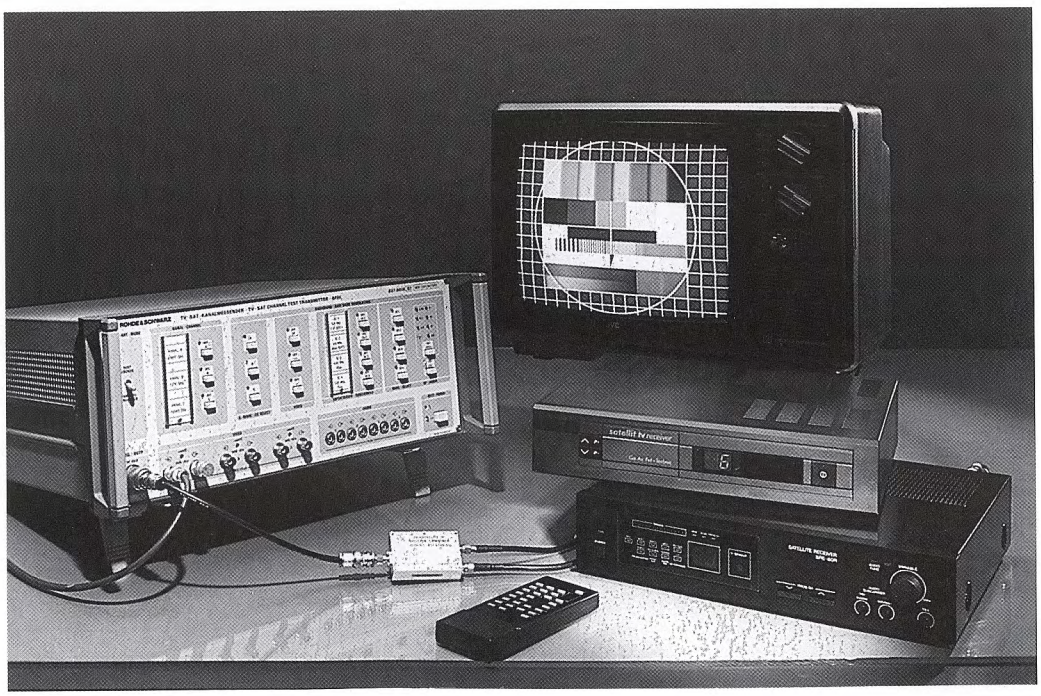
Complete in-service and measuring equipment for program transmission in compliance with the new D2-MAC television standard and for digital sound broadcasting via TV satellites, such as "TV-Sat", "TDF" and "Astra", have also been included in the Rohde & Schwarz product range prior to the introduction of this new standard. The main new products for use in the receiver industry and for broadcasters and distributors are featured below.



TV Syncer

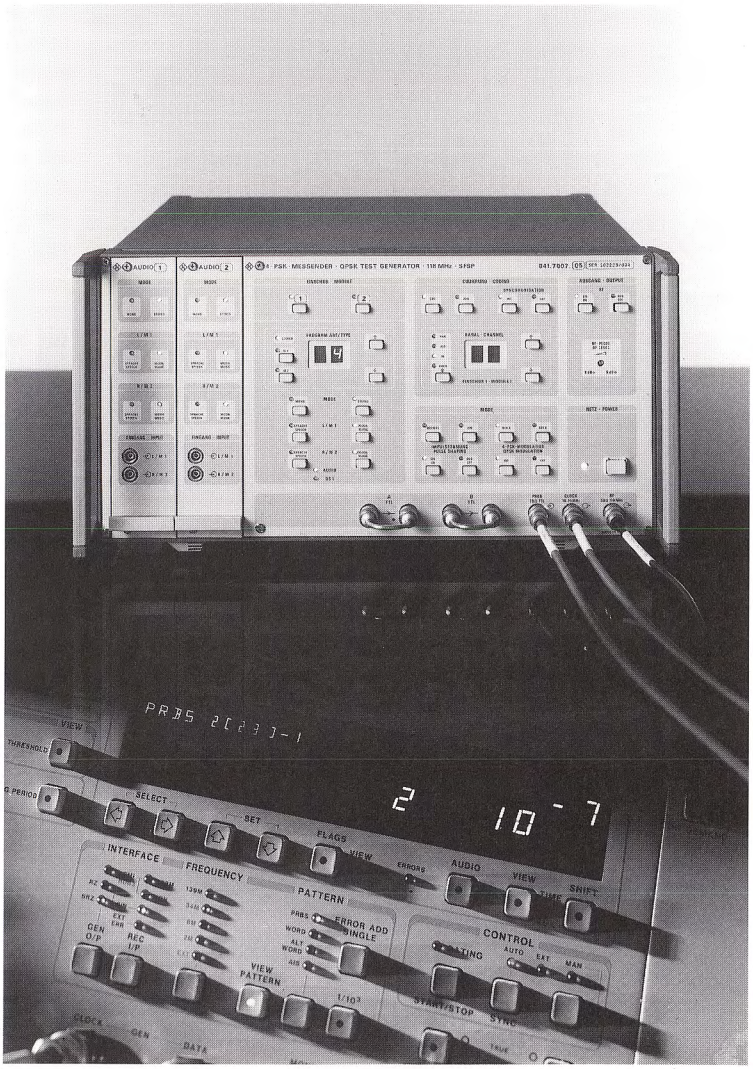
The TV Syncer (photo above) identifies the television standard of each received television signal, ie either the CCVS or the D2-MAC standard. The TV Syncer supplies a standardized sync signal for further processing by conventional measuring and monitoring equipment.

The TV Satellite Channel Test Transmitter SFSK (photo below) generates three carrier signals in the frequency range of 900 to 1800 MHz. Each carrier can then be modulated with one video signal and a maximum of four sound subcarrier signals.



TV Satellite
Channel Test Transmitter SFSK

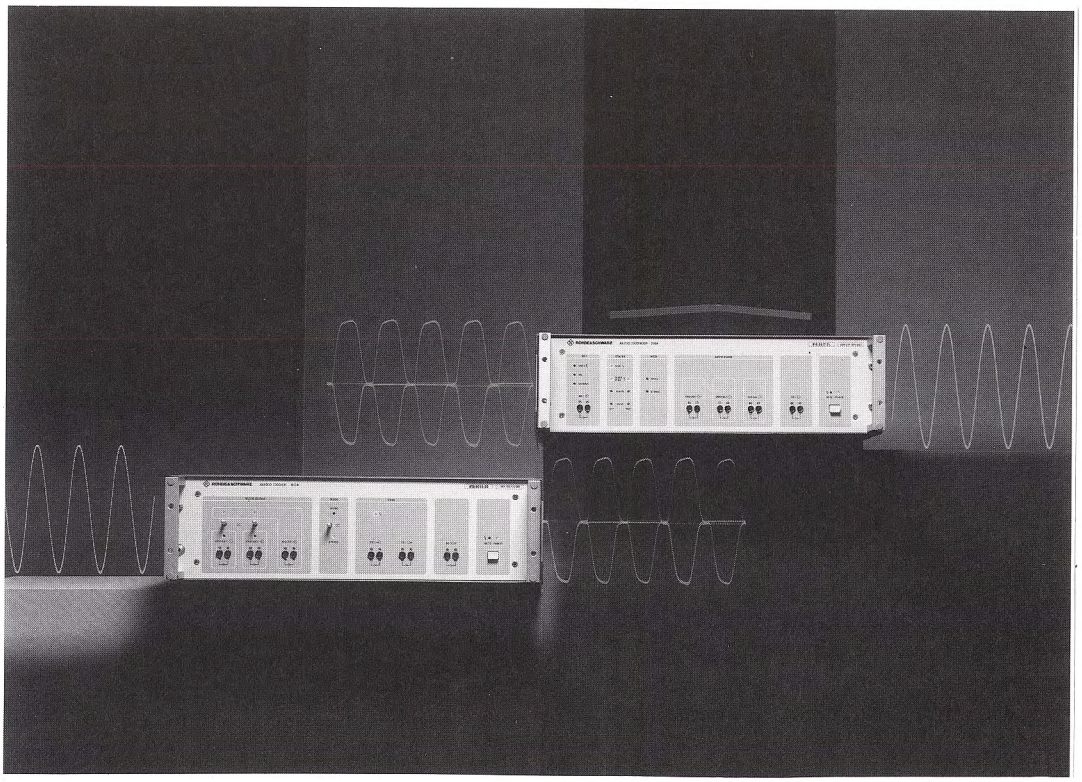
4 PSK Test Transmitter SFSP



The 4 PSK Test Transmitter SFSP (photo right) modulates a maximum of 16 stereo or 32 mono analog or digital sound channels on a 118 MHz carrier.

The Audio Decoder DDA (photo below) processes a serial data stream in compliance with DS1 specifications and supplies analog and digital information from the two audio channels (2 × 16 bits parallel) and also additional information and status reports as output signals.

Audio Decoder DDA (right) and Audio Coder DCA



Transmission and measurement techniques for data transmission

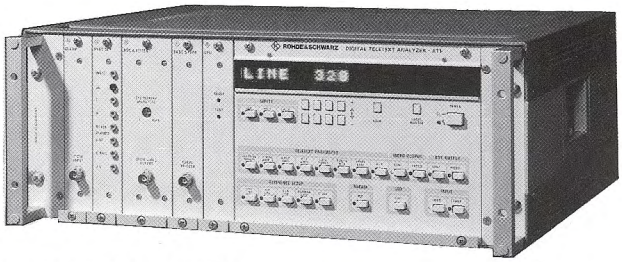
Transmission channels The use of conventional FM sound broadcasting and TV channels for transmitting information in addition to the program proper was initiated by the test line patent No. 949350 of H. Fröling of 4th October 1953, which is based on the time sharing principle. The test lines were followed by data, instructions, information, TV sound, teletext etc.

In AM sound transmission there is no possibility whatsoever of inserting non-program-related information, whereas this is possible in FM systems. According to the frequency sharing principle additional information can be inserted either immediately below the limit frequency of the 15-kHz sound channel or above the frequency band of a stereo multiplex signal. It is especially the latter possibility which brought about the traffic broadcasting system ARI as well as system-internal data transmission of quality parameters and complex control and monitoring information.

More and more customers are showing interest in increasing the efficient utilization of existing television and sound broadcasting channels by transmitting data at the same time as the program. The information sent may be destined for consumers or for the operating centres of CATV distributors, or data can be transmitted for the remote control of terminal equipment.

Measuring instruments The Digital Teletext Analyzer ATF (photo above) is used as a special measuring instrument for TV data transmission in the blanking interval of the television picture. The ATF can be used as a telemetry and recording system to analyze teletext parameters in the automatic mode via the IEC bus interface or RS-232-C interface. Two ATFs operate in master-slave operation via an RS-232-C interface (eg via telephone modems) with remote-control functions.

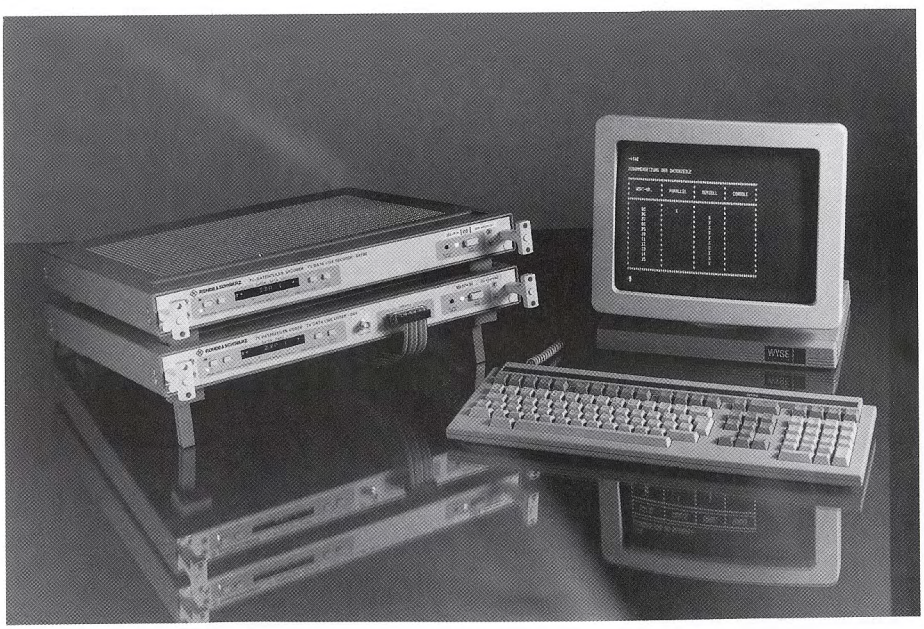
Transmission equipment The following R&S equipment is available for data transmission:



Digital Teletext Analyzer ATF

The TV Data Line Decoder DEF (photo below) decodes the data signals transmitted in biphase coding in line 16 (standard position) for control and monitoring of TV transmission systems. In addition, a program identification as to source and type (speech, classical or light music) is possible as well as program and time control of home video recorders for recording of preselected programs according to the new video program system VPS. The bit error rate is continuously monitored at the same time. Up to 13 different useful data can be output in parallel form.

The TV Data Line Coder DGF converts the input data into the data-line format. Two serial input channels are provided for the dialog with a terminal, while ten parallel input channels and a third serial channel process the useful data from peripheral equipment. The data line signals suitably processed for the system ($\cos^2$ pulses with 200 ns half-amplitude duration) are available either as picture signal for a video test signal inserter or as data line already inserted into a composite colour video signal passing through the DGF. A front-panel display permits monitoring of the input data and indication of messages.



Data link with TV Data Line Decoder DEF model 03 and TV Data Line Coder DGF with console

R·D·S
RADIO DATA SYSTEM

The new service in radio broadcasting

Radio Data System

The new radio broadcasting service, Radio Data System (RDS), transfers the following inaudible information in the stereo multiplex signal:

- Additional information for VHF radio receivers, this contributes to the car radio listener's convenience

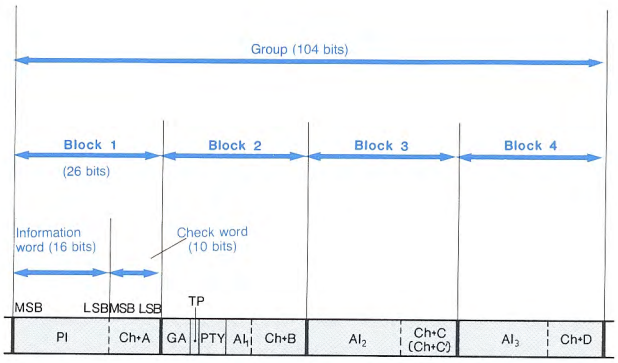
  and

- Transmitter and program identification, information accompanying a program and messages primarily intended for transmitter operation.

Specifications The EBU (European Broadcasting Union) has proposed the Radio Data System RDS as a **standard European system** for broadcasting transmitter and program identification, various control data, radio broadcasts and various messages at the same time as the regular radio program. The relevant specifications are defined in the EBU Report Tech. Doc. 3244-E and based on the following **principal conditions:**

- the additional data must not affect the transmission quality of the radio program;
- there should be no interference of existing data transmission systems, such as traffic programs or remote-control systems;
- there must be no increase in adjacent channel interference;
- the coverage area for additional information should, if possible, be greater than that for receiving mono radio programs.

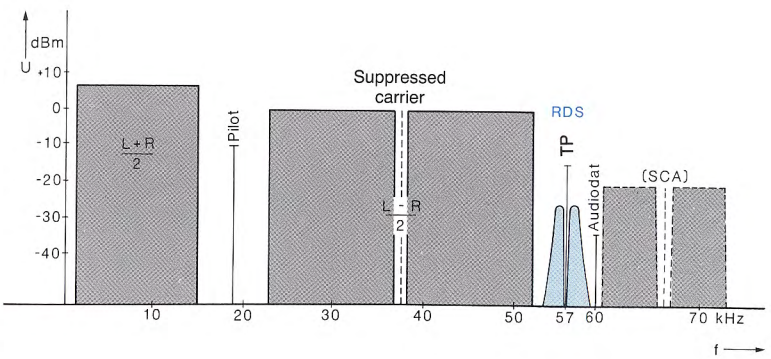
RDS data structure RDS data is transmitted in the form of a continuous binary data stream at 1.1875 kbit/s. The data organization provides for 104-bit long data groups (see figure below) each consisting of four 26-bit blocks. Each block comprises a 16-bit information word and a 10-bit check word. The check word contains an offset word and is therefore used for block and group synchronization and for detecting and correcting certain transmission errors.



Structure of RDS data coding (CH: check word; A to D: offset words; AI_1 to AI_3: addressed information, 37 bits)

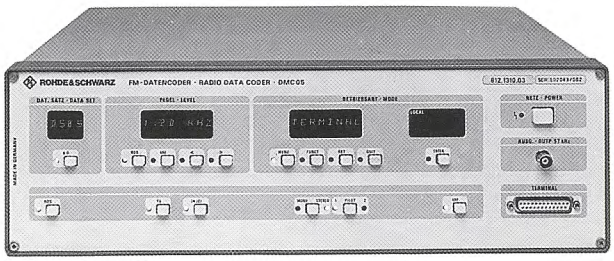
Modulation mode When selecting the modulation carrier and type of modulation for the RDS signal (see figure below), the existing organization in the stereo multiplex baseband also had to be considered. The traffic program (TP) carrier is transmitted at **57 kHz** for certain programs in West Germany and a number of other European countries. It is amplitude-modulated with the area identification frequency at 23.75 to 53.98 Hz for regions A to F (60% AM) and additionally at 125 Hz for traffic announcements (30% AM).

A modulation mode with carrier suppression – **double-sideband modulation** – was selected for the RDS for reasons of compatibility. The phase angle between the (suppressed) RDS carrier and the TP carrier is 90° in order to avoid mutual interference.



Stereo multiplex baseband with RDS and TP signal

The generation of both signals in one unit is particularly advantageous, as in the DMC.05 model (photo below), since no undesired phase shifts may occur across the common 57 kHz bandpass.

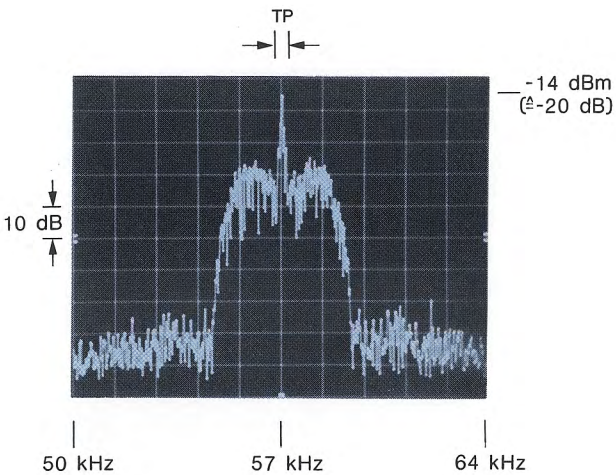


Radio Data Coder DMC.05

Only a **slight AM component** is obtained from the traffic program carrier due to the quadrature position of the RDS carrier. This means that no announcement identification is simulated by RDS signals in TP decoders with envelope demodulators.

The binary TP data stream is **differentially encoded,** ie the output of the differential encoder maintains its level at the next pulse edge when logic 0 is applied to the input, and the logic value at the output is changed when logic 1 is applied to the input. This is followed by **biphase coding** with an impulse pair for each data bit. Before modulation, the differentially and biphase-encoded data signal is evaluated for the purpose of band-limiting using a cosine-shaped lowpass characteristic.

Due to the optimum data conditioning of the binary RDS signal prior to conversion to 57 kHz, the RDS spectrum only features minimum components in the range of 57 kHz ±125 kHz. The bandwidth is ±2.4 kHz (photo below).



RDS-TP spectral distribution: combination signal of RDS component (random logic 0/logic 1 distribution) and TP components (area identification F, announcement identification ON)

RDS information

Tuning aids

PI **Program identification**
Contains identification for the country, area, program service, broadcasting corporation, program number, etc.

PS **Program service name**
The tuned program is indicated by 8 ASCII characters at the RDS radio receiver.

PTY **Program type**
Identification bits for programs such as news, sport, light or classical music, etc.

TP **Traffic program identification**
Identifies transmitters broadcasting traffic information (equivalent to the 57 kHz in the TP).

AF **Alternative frequencies**
Lists of frequencies of adjacent transmitters broadcasting the same program.

Switching signals

TA **Traffic announcement identification**
Equivalent to announcement identification in the TP.

DI **Decoder identification**
For mode selection, mono, stereo (equivalent to the 19 kHz pilot), dummy head, compander, etc.

MS **Music/speech identification**
Identification of speech or music broadcasts.

PIN **Program item number**
Transmission of information for automatically switching on the receiver or for program-synchronous recording.

RT **Radiotext**
Transmission of information accompanying a program (music, name of interpreter, program change, etc.) in the form of texts with 32 or 64 ASCII characters for display on receivers.

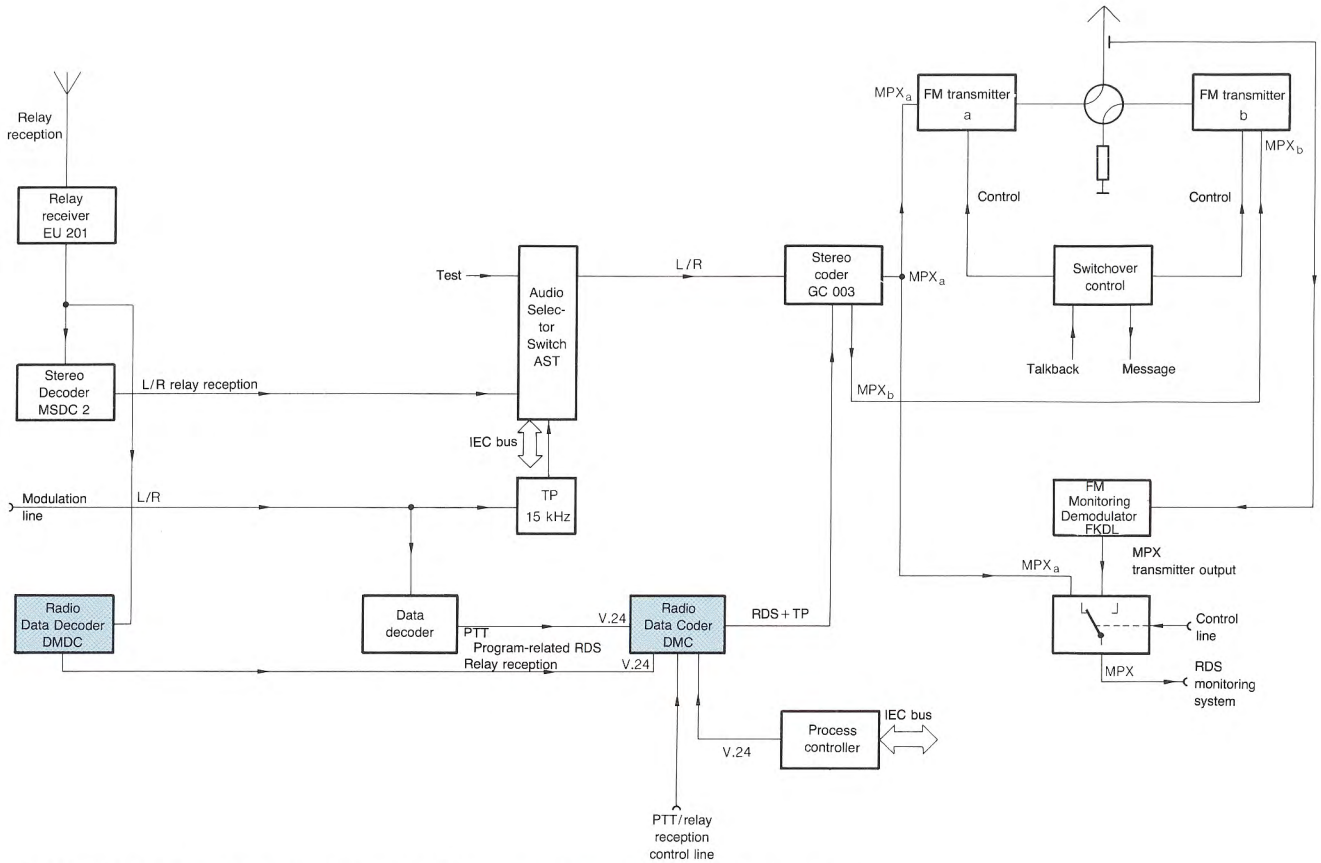
Further applications

ON **Other networks**
Transmission of identification signals for up to eight other program services with PI, PIN, TP, PTY, TA and AF.

TDC **Transparent data channel**
Up to 32 data channels can be transmitted with one channel number.

IH **In-house applications**
Exclusive transmission of in-house information, such as identification of program origins, transmitter-related switching signals, sound test signals (Audiodat system SPT/UPT), radiopaging calls, etc.

CT **Clock time**
Transmission of clock time as Coordinated Universal Time (UTC) with hour, minute and local offset, and of the date according to the Modified Julian Day (MJD) with the days counted from March 1, 1900; conversion to local time and current date takes place in the RDS decoder of the radio receiver.



Overview of RDS, data and monitoring system at the FM transmitter (blue: special data transfer equipment)

TMC **Traffic message channel**
Transmission channel or digital traffic programs with identification for validity range, region, street number, etc.

RP **Radiopaging**
Data transmission for regional or nationwide radiopaging services

Further applications (eg warning broadcasting information system) are in preparation.

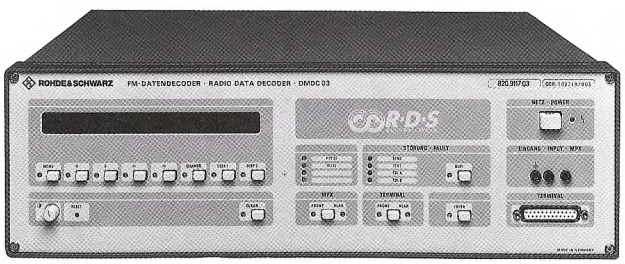
There is still a wide range of future possible RDS applications. This is not only because of capacity reserves in the Radio Data System but also due to system introduction and utilization which are mainly restricted to certain RDS information.

RDS data transmission

After definition of RDS specifications, the supply of RDS information to the transmitter location is also gaining in significance for the practical introduction of the system (see also block diagram above).

The existing **modulation lines** between studio and transmitter and the existing **relay reception links** can also be used to transmit these data.

With **relay reception** of the radio programs followed by modification of the RDS data contents, the received multiplex signal must then be converted to baseband via a Precision Stereo Decoder MSDC 2 and reprocessed in the stereo coder GC 003 contained in the transmitter. The RDS signal is decoded by the Radio Data Decoder DMDC (photo below) and sent as a serial data stream to a downstream Radio Data Coder DMC via a data link.



Radio Data Decoder DMDC.03

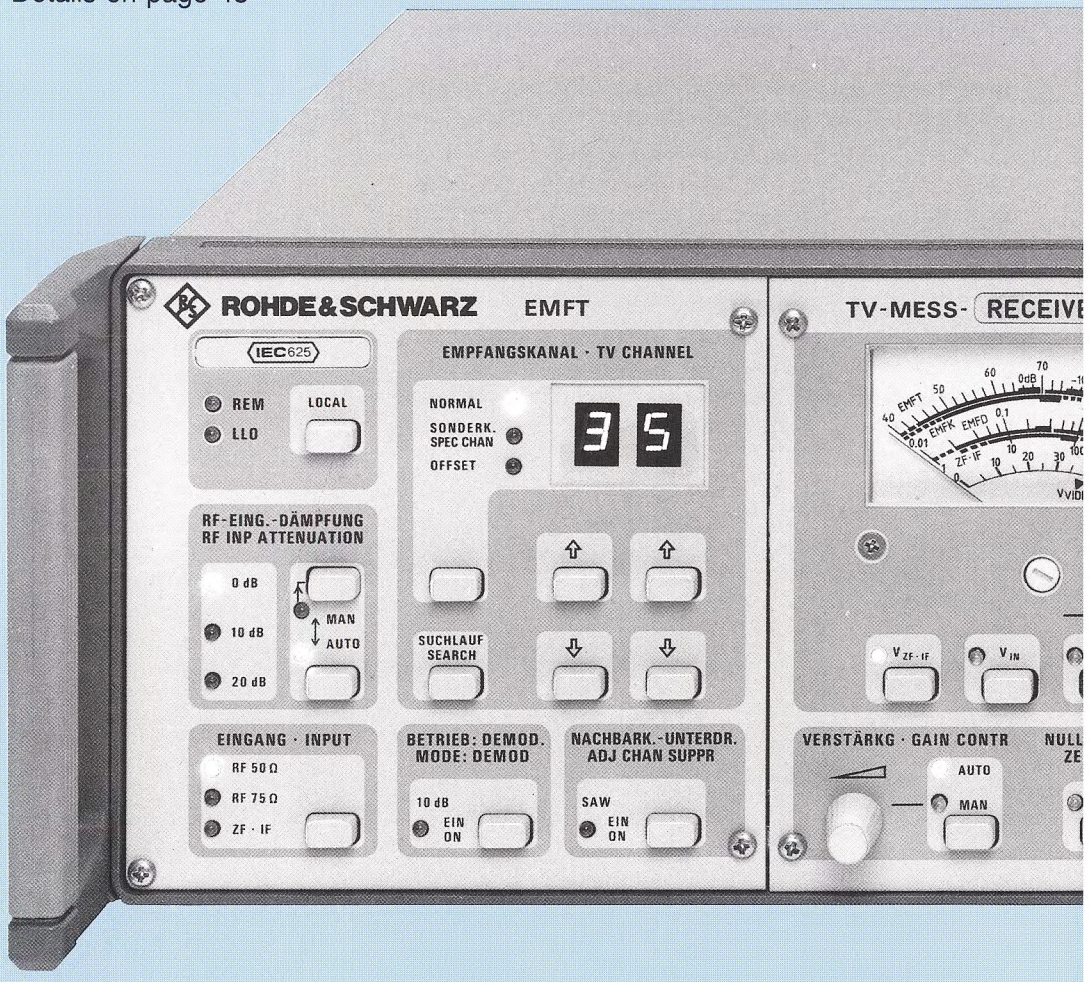
A high-precision **RDS filter** with extremely steep cut-off characteristic and minimum phase shift can be used to extract the 57 kHz carrier from the multiplex signal so that the amount of signal-processing equipment can be reduced. The stereo decoder and stereo coder can then be dispensed with. An RDS filter which includes all system-specific conditions is currently in development at R&S.

The Audiodat system SPT/UPT (see catalog Section 4) already provides a means of transmitting RDS data over **modulation lines.** This means that information can be inaudibly transmitted simply and reliably at 15 kHz. This not only allows **remote-control functions,** such as switching the announcement identification function on and off, but also level errors, frequency response deviations and incorrect signal formats (depending on the expansion level) can be **measured** and **transmitted.** A minimum rate of 200 bit/s is required both for transmitting RDS data as in the Audiodat system at 60 kHz, although 15 kHz is also possible with suitable modulation in the AF band.

Based on experience gained with the Audiodat system, **modulation modes** can be found for realizing the required transfer rates. The data coder and decoder based on these modes are currently being developed. This means that a complete design for supplying, processing and monitoring programs and data can be implemented at the transmitter site.

Rohde & Schwarz aims to provide a full product and application range for this new radio service through to a complete **customized network configuration including software** (further information available on request).

TV measuring receiver EMFT
for all TV bands, IF and
special channels up to 470 MHz;
Details on page 48



broadcast in-service, measuring and monitoring equipment

In-service equipment ensures correct signal transmission in accordance with specific standards.

Receivers perform continuous monitoring of the broadcast program or, in the case of relay receivers, rebroadcast programs.

Special measuring instruments are required to measure transmission parameters and quality criteria in radio broadcasting and in particular in TV engineering (for broadband communications, see catalog Section 2).

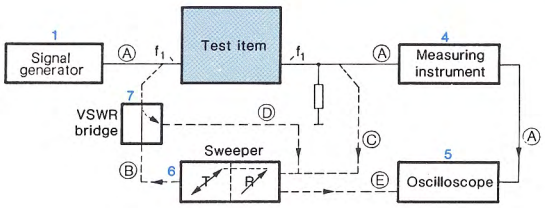
In addition, instruments for general (RF) measurements are necessary; see catalog Appendix A1 and the Rohde & Schwarz measuring equipment catalog.

Measurement examples

By way of some general examples, block diagrams and tables on the following pages illustrate the use of the equipment for frequent measurements on passive and active modules as well as on transmitters.

Under the heading "Measurement", instruments with analog or digital readout of the measured value are listed whereas the column "Display" contains equipment affording screen display of the curve and thus determination of the measured value.

Measurements on passive and active modules, eg filters and amplifiers



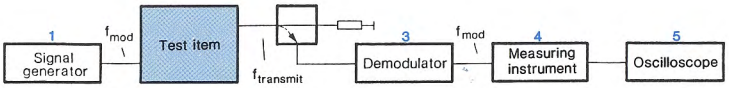
input frequency = output frequency

(T = transmitter section, R = receiver section)

Task		Signal generation	Measurement	Display
Measurement with discrete frequencies (connections Ⓐ)				
AF 20 Hz to 100 kHz	Amplitude/frequency response, also attenuation/gain Distortion Noise voltage	1 AF Generator SUN 2/S page 71	4 Level Meter (with filters) SUN 2/U page 110	
VF 0 (0.1) Hz to 5 MHz	Signal distortions Transient response 2T/20T pulse Lum. and chrom. nonlinearity	1 Video Test Signal Generator SPF 2 or Insertion Signal Generator SPZF pages 72/78	4 Video Dist. Analyzer UPF or Video Analyzer UVF page 118/123	5 TV Oscilloscope OPF or ODF page 142/144
	Diff. phase and gain		4 Diff. Phase/Gain Meter PVF p. 117	
	Noise voltage		4 Video Noise Meter UPSF 2 p. 114	
Swept-frequency measurement				
VF 0.1 to 20 MHz	Amplitude/frequency response, also attenuation/gain (connections Ⓑ and Ⓒ)	6 Videoskop SWOF 3 page 130		
	Input matching, starting at 5 MHz (connections Ⓑ and Ⓓ)	6 Videoskop SWOF 3 page 130 + 7 VSWR Bridge ZRB 2		
	Amplitude/frequency response, also attenuation/gain Group/delay/frequency response (connections Ⓑ and Ⓒ)	6 Group-delay Measuring Set LFM 2 page 133		5 TV Oscilloscope same as above (connection Ⓔ)
HF 100 kHz to 1 GHz	Amplitude/frequency response, also attenuation/gain (connections Ⓑ and Ⓒ)	6 TV Transcope MUF 2 (page 138) or Polyskop SWOB 5 (page 242)		
	Input matching, starting at 5 MHz (connections Ⓑ and Ⓓ)	6 TV Transcope MUF 2 (page 138) or Polyskop SWOB 5 (page 242) + 7 VSWR Bridge ZRB 2		

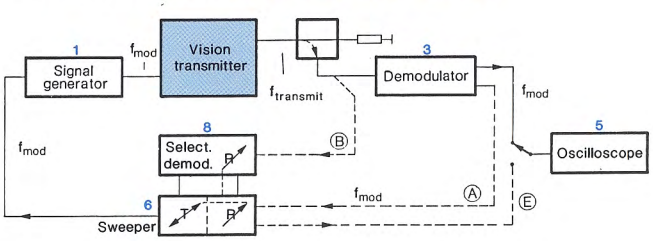
Measurement examples

Measurements on FM sound-broadcast and TV transmitters



Task			Signal generation	Demodulation	Measurement	Display
Measurement with discrete frequencies						
AF FM-sound broadcasting	Mono	Amplitude/frequency response Harmonic distortion Spurious AM	1 AF Generator SUN 2/S page 71	3 FM/AM/ Demodulator FAB or Modulation Analyzer FAM	4 Level Meter (with filters) SUN 2/U page 110	5 AF oscilloscope
	Stereo	Stereo crosstalk			4 + Stereodecoder MSDC 2 page 113	
AF TV sound	Single sound	Amplitude/frequency response Harmonic distortion Spurious modulation		3 TV Dual Sound Demodulator FATF page 106	4 Level Meter (with filters) SUN 2/U page 110	
	Dual sound	Stereo crosstalk	1 + TV Dual Sound Coder STCF p. 56			
VF TV vision		Level stability Transient response 2T/20T pulse Lum. and chrom. nonlinearity	1 Video Test Signal generator SPF 2 or Insertion Signal Generator SPZF pages 72/78	3 TV Demodulator AMF 2 page 100	4 Video Dist. Analyzer UPF or Video Analyzer UVF page 118/123	5 TV Oscilloscope OPF or ODF pages 142/144
		Diff. phase and gain			4 Diff. Phase/Gain Meter PVF p. 117	
		Spurious modulation			4 Video Noise Meter UPSF 2 page 114	

Measurements on TV vision transmitters



The TV signal generator combines sync and burst waveforms with the external test signals coming from the sweepers and permits (even simultaneous) measurement of different picture contents (for instance black and white).

Task			Demodulation	Signal generation	Measurement	Display
Swept-frequency measurement						
Modulation monitoring			3 TV Demodulator AMF 2 page 100	1 Video Test Signal Generator SPF 2 or Insertion Signal Generator SPZF pages 72/78		5 TV oscilloscope
VF (connection Ⓐ)		Amplitude/frequency response			+ 6 Videoskop SWOF 3 page 130	
		Amplitude/frequency response Group-delay/frequency response			+ 6 Group-delay Measuring Set LFM 2 p. 133	5 TV oscilloscope (connection Ⓔ)
RF (connection Ⓑ)		Amplitude/frequency response (sideband spectrum) Intermodulation products	8 Demodulator SWOF 3-Z p. 131		+ 6 Videoskop SWOF 3 page 130	
		Group-delay/frequency response	8 Selective Demodulator LDS p. 135		+ 6 Group-delay Measuring Set LFM 2 p. 133	5 TV oscilloscope (connection Ⓔ)

EU 200
EU 201

VHF FM Relay Receivers EU 200 and EU 201 ♦ 87.5 to 108 MHz

- Stereo/mono receivers to ARD standard specifications, with automatic switchover through 19-kHz pilot
- EU 200: continuously tunable
  EU 201: single-channel receiver
- High overload capability

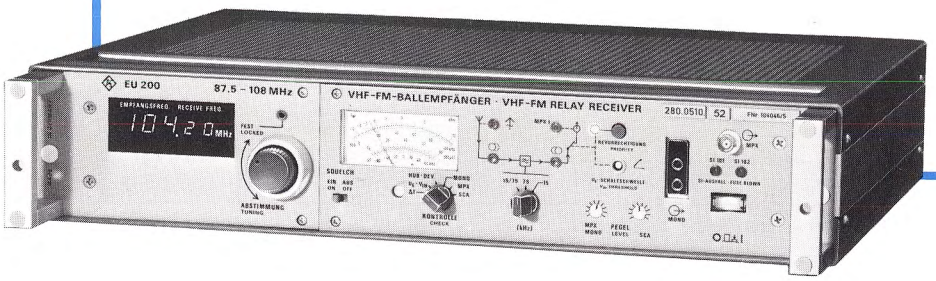


Photo: EU 200

The **VHF FM Relay Receivers EU 200 and EU 201** are designed in accordance with the CCIR standards for the 19-kHz pilot-tone method. They can receive **stereo-modulated and mono sound broadcasts** (automatic switchover) and can modulate slave transmitters with level-matched signals. They can also be used for retransmission of road traffic, SCA and auxiliary channels. The operating status is indicated by LEDs; floating contacts are provided for remote signalling.

The EU 200 and the EU 201 only differ in the RF sections:

EU 200: quasi-continuous frequency setting in **crystal-referenced 10-kHz steps,** frequency memory, 5-digit LED display,

EU 201: crystal-referenced channel receiver for fixed-frequency-reception (channel can be changed).

Outputs The relay receivers have two MPX outputs suitable for traffic radio broadcasts and two mono signal outputs (with an additional output of each type on the front panel) with common level setting plus a broadband SCA signal output (level adjustable). With mono broadcasts the mono signal is switched via a 15-kHz lowpass filter to one of the MPX signal outputs. A **squelch** circuit with adjustable threshold level suppresses the noise.

Automatic switchover Each receiver contains an automatic switchover circuit, which can be turned off for operation in passive standby mode (the receivers can be set to act as main or standby).

Specifications of EU 200 and EU 201

Frequency range	87.5 to 108 MHz (EU 200 variable, EU 201 single-channel)
RF input	50 Ω; BNC female connector
Noise figure EU 200/EU 201	≤10 dB/≤9 dB
Required EMF for constant V_{out} (mono) EU 200/EU 201	V_{rms} ≥10 µV/≥6 µV
Frequency drift	≤±2 kHz (+5 to +40 °C)
Oscillator reradiation at input EU 200/EU 201	≤10 µV/≤3 µV
AF outputs	2 MPX (unbalanced, isolated) and mono (balanced, isolated), one parallel output of each type on front panel
Source impedance	≤30 Ω; Z_{out} ≥600 Ω (MPX), ≥300 Ω (mono)
Output level (deviation ±40 kHz, f_{mod} 500 Hz); adjustable	+6 dBm into 600/300 Ω; ±3 dB
Stopband attenuation at 19/100 kHz	≥50 dB/20 dB
Deemphasis (mono)	50/75 µs (disconnectible)
Squelch	response threshold at 20 µV EMF
Broadband output 40 Hz to 100 kHz (SCA signal)	unbalanced
Source impedance	≤50 Ω at Z_{out} ≥600 Ω
Output level (deviation ±40 kHz, f_{mod} 500 Hz); adjustable	+6 dBm into 600 Ω; ±3 dB
Linear distortion (deviation ±40 kHz, referred to 500 Hz)	
Frequency response for	
40 Hz to 15 kHz	≤±0.5 dB (mono, with deemphasis)
40 Hz to 43/53/61/70/75 kHz	≤±0.1/0.3/0.5/1/3 dB (stereo)
Phase response for 40 Hz to 43/53/58/61 kHz	≤±1°/3°/5°/10° (stereo)
Stereo crosstalk (measured via decoder) for 40 Hz to 0.1/5/15 kHz	≥40/46/43 dB down (without deemphasis)
Non-linear distortion	
Distortion for 40 Hz to 5 kHz with ±75 kHz/±100 kHz deviation	≤0.5%/≤1%
Intermodulation distortion (to DIN 45 403), f_{diff} 1 kHz	5 to 15 kHz / 15 to 53 kHz
±75 kHz deviation	d_2 ≤0.25% / d_2 ≤0.5%
	d_3 ≤0.37% / d_3 ≤0.75%
±100 kHz deviation	d_2 ≤0.5% / d_2 ≤1%
	d_3 ≤0.74% / d_3 ≤1.5%
S/N ratios (measured to CCIR Rec. 468-2); referred to: ±40 kHz deviation, f_{mod} 500 Hz; useful EMF: mono ≥200 µV, stereo ≥2 mV	
unweighted	≥60 dB (typ. ≥65 dB)
weighted	≥60 dB (typ. ≥65 dB)

Selectivity		MPX	Mono	
Adjacent-channel selectivity (ratio of interfering to wanted signal)	±100 kHz	≥61 dB	≥4 dB	±75 kHz deviation, f_{mod} 500 Hz
	±200 kHz	≥11 dB	≥0 dB	
	±300 kHz	≥−15 dB	≥−16 dB	
	±600 kHz	—	≥−46 dB	
	±1.2 MHz	—	≥−54 dB	
Common-channel selectivity				
Unmodulated interfering signal		≥49 dB	≥49 dB	
f_{mod} 500 Hz, ±40 kHz deviation		≥63 dB	≥44 dB	
Image-frequency rejection		EU 200: ≤20 mV; EU 201: ≤1 V (mono: ≤0.1 V)		interfering EMF for f_{image} and f_{IF} ±6 kHz
IF rejection		≤2 V		

Automatic switchover (with signalling contacts)	response level 20 µV to 5 mV EMF
General data	
Panel meter	for V_{in}, centre-frequency error, frequency deviation and all output levels
Rated temperature range	+5 to +40 °C
Power supply	115/125/220/235 V, 47 to 63 Hz; 30 VA (EU 200), 20 VA (EU 201)
Dimensions, 19″ rackmount	483 mm×88 mm×384 mm
19″ bench model (design 80)	492 mm×116 mm×392 mm
Weight rackmount/bench model	8 kg/10 kg

Ordering information

Order designation ▶ VHF FM Relay Receiver	19″ bench model	19″ rackmount
EU 200 (continuously tunable)	264.2012.52	264.2012.51
EU 201 (please specify frequency)	280.0510.52	280.0510.51

Recommended extras	
BNC connector (RF input and MPX outputs)	497.7144.00
3-contact male connector (mono output on front panel)	019.0458.00
3-contact male connector (mono, MPX output on rear panel)	018.5340.00
Adapter rail for 19″ rack	264.3854.00

Stereocoders GC 001 and GC 003

♦ 40/30 Hz to 15 kHz

GC 001, GC 003

- High-quality stereocoders complying with ARD specifications 5/3.2
- Built-in 1-kHz test oscillator
- SCA option retrofittable
- GC 001 for AC-supply and battery operation (with automatic switchover)

Photos: top GC 001, bottom GC 003

The **Stereocoder GC 001** combines the signals of the left and right channels to form the **coded stereo** (multiplex) **signal** according to the pilot-tone method (CCIR Recommendation 450, Section 2). It complies with the standard specifications 5/3.2 of ARD. **Mono** operation can be selected locally or by remote control. A 1-kHz **test oscillator** is incorporated. **Uses:** For valve FM transmitters of 5 to 20 kW; alternative operation from a battery allows use in conjunction with **OB transmitters;** transmission of traffic-radio and SCA signals.

The **Stereocoder GC 003** uses a new method to form the standard multiplex signal with **high precision.** Its performance far exceeds the requirements of ARD standard specification 5/3.2. **Mono** operation can be selected locally or by remote control. Built-in **test oscillator;** peak voltmeter for performance check. **Uses:** In transistorized FM transmitters and systems, transmission of traffic-radio and SCA signals. The GC 003 can be interfaced with the Radio Data Coder DMC (see next page).

Specifications

	GC 001	**GC 003**
Inputs for L and R channels	40 Hz to 15 kHz; balanced, Z_{in} ≥2 kΩ	30 Hz to 15 kHz; balanced, Z_{in} ≥4 kΩ
Attenuation (f ≥19 kHz)	≥50 dB	≥54 dB
Input level at 1 kHz for output level of +6 dBm of M signal or of S signal modulated onto subcarrier	−8 to +12 dBm	−4 to +8 dBm
Preemphasis	50 µs/75 µs/off	50 µs/75 µs/off
Auxiliary-signal inputs	2; ≥5 kΩ, unbal.; 53 to 75 kHz	2; ≥2 kΩ, unbal.; 53 to 100 kHz
Pilot-tone frequency	19 kHz (subcarrier 38 kHz)	19 kHz (subcarrier 38 kHz)
Multiplex-signal outputs	2 (free of DC), Z_{out} ≤12 Ω	2 (free of DC), Z_{out} ≤20 Ω
Output level	+6 dBm (stereo or mono) −9.5 dBm (pilot tone)	+6 dBm (stereo or mono) −9.5 dBm (pilot tone)
M-signal output	+6 dBm, bal.; Z_{out} = 30 Ω	+6 dBm, bal.; Z_{out} ≤20 Ω
Pilot-frequency output	1 V_{pp} at Z_{load} ≥1 kΩ, squarewave	1 V_{pp} (Z_{out} ≤100 Ω), squarewave
Frequency response flatness (ref. 500 Hz) measured after decoder		
40/30 Hz to 15 kHz	≤±0.5 dB	≤±0.15 dB
53 to 75 kHz	≤±0.5 dB	≤±0.1 dB (up to 100 kHz)
Crosstalk M/S	≥40 dB down (40 Hz to 15 kHz)	≥46 dB down (30 Hz to 15 kHz)
L/R	≥50 dB down (100 Hz to 5 kHz)	≥60 dB down (100 Hz to 5 kHz) ≥58 dB down (30 Hz to 15 kHz)
Signal/THD ratio at output levels up to +12.5 dBm	≥50 dB (40 Hz to 5 kHz)	≥54 dB (30 Hz to 15 kHz)
Unweighted S/N ratio	≥60 dB, peak	≥80 dB, peak
Weighted S/N ratio (CCIR 468-2)	≥67 dB, peak	≥76 dB, peak
Power supply	220 V +10/−15%, 47 to 63 Hz (20 VA) or 24 V +6/−2 V (0.5 A)	115/125/220/235 V +10/−15%, 47 to 63 Hz (10 VA)
Dimensions, weight		
19″ bench model	484 mm×105 mm×336 mm, 8.5 kg	492 mm×116 mm×392 mm, 6.9 kg
19″ rackmount	483 mm×88 mm×326 mm, 5.5 kg	483 mm×88 mm×384 mm, 4.7 kg
Order designation	▶ Stereocoder GC 001	▶ Stereocoder GC 003
19″ bench model	410.0013.03	(with Panelling 085.1313.00) 230.8518.03
19″ rackmount	410.0013.02	230.9014.00
SCA-Modulator	—	

FM ADDITIONAL SIGNAL CODING

new

DMC

Radio Data Coder DMC

♦ Carrier 57 kHz

- Coder for Radio Data System (RDS) and Traffic Program (TP) signals to EBU and ARD specifications
- 16-bit RDS data processor
- 8 + 1 RDS data records

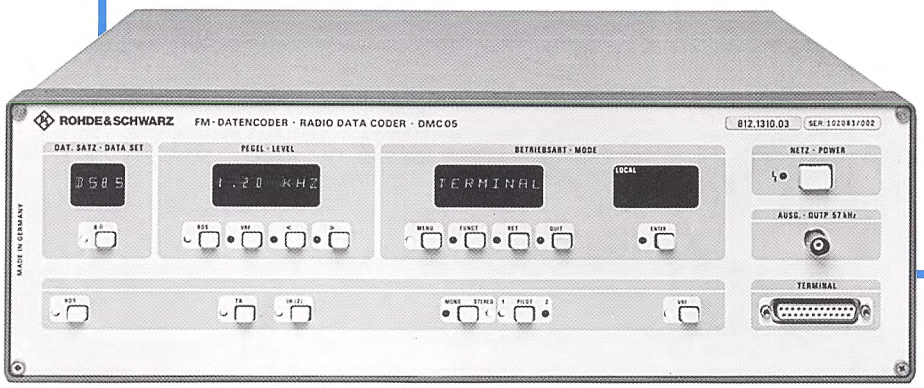


Photo: DMC.05

The **Radio Data Coder DMC** supplies the 75 kHz auxiliary carrier which is modulated with the traffic program (TP) signals and the additional digital signals of the Radio Data System (RDS). This instrument is supplied in two models:

- **DMC.05** generates the auxiliary carrier and modulates it with the generated TP and RDS signals
- **DMC.09** operates as an RDS Coder only, with the additional digital information of the RDS system.

The features of the particularly easy-to-operate and easy-to-service DMC.05 and DMC.09 models were selected based on experience with the DMC developed specially for operational tests to study the compatibility, the error and correction techniques for data transmission and the acceptance of RDS technology.

Characteristics of the DMC

- RDS signal coding to EBU Specifications Tech 3244-E and to ARD Specifications 5/3.8 and 5/1.0
- TP signal coding to ARD Specifications 5/3.6 and 5/1.0
- Modular design with microcomputer-controlled operation and signal generation
- Interface for 5 RDS input interfaces, remote control and acknowledgement signals
- Integrated 16-bit microcomputer for 8 + 1 complete RDS data records
- Digital RDS and TP signal modulator with time functions for precise signal characteristics stored in EPROMs
- Precise and stable 0°/90° phase relation between RDS and TP carriers
- Calibratable level display and separate phase adjustment for each pilot signal input
- Only one 57 kHz bandpass filter required; this prevents mutual phase shifts between the RDS and TP signals
- Alphanumeric displays for data records, level, operating modes and messages
- Non-volatile storage of operating parameters and RDS information
- Two independent 19 kHz pilot signal inputs (internally adjustable to MPX signal) with three separate 57 kHz outputs
- Prepared for hardware and software expansions for future RDS services

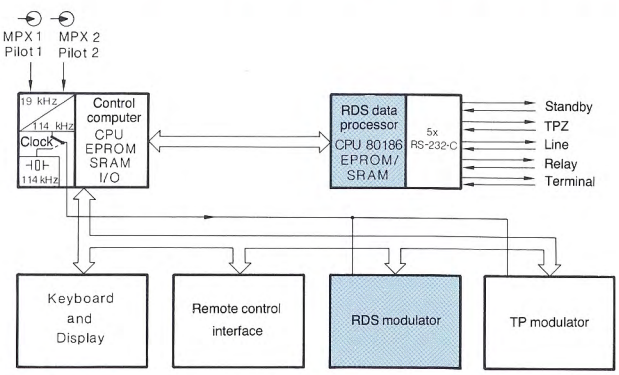
Operation The DMC has three operating modes:

- manual operation on the front panel with status display
- remote control with acknowledgement signals
- dialog mode via terminal (RS-232-C interfaces) and operation in ASCII-encoded form (relay, line, TPZ, standby)

Using the **pushbuttons on the front panel,** all the switching functions, the level adjustment and level indication are controlled. The menu functions are presented on alphanumeric displays and LEDs. An LED indicator panel provides information on special settings and alarm messages.

Remote control is over switched lines and is separate for on and off states. Floating relay contacts are used for the acknowledgement signals.

If the instrument is **operated using the five RS-232-C interfaces,** RDS data are stored in max. eight data records, each data record being capable of storing all current fixed RDS information. A separate data record is provided for



Block diagram of Radio Data Coder DMC.05

specific RDS data for putting the coder into operation or for long downtimes in the network or in data transmission. Transmission data are copied into a buffer from which they are read by a microprocessor.

Design The Radio Data Coder DMC is designed using digital and microprocessor technology, except for the 57 kHz bandpass filter and the output stages for the RDS/TP signals. The control computer/clock subassembly contains a **complete microcomputer** and controls the front panel, remote control interface and modulators. A special clock circuit generates the clock signal. A separate **RDS data processor** serves the RS-232-C interfaces and manages the RDS data.

The DMC is particularly easy to service through its **modular concept** using functional blocks. Each of the fold-down subassemblies can be checked and measured in service. Subassemblies can be quickly replaced through the use of motherboard technology with multiple cables. This also applies to the front panel pushbuttons, the displays and the power supply module, including the transformer and power switch.

All RFI-critical components and their cable terminals are **shielded.** Low-heat dissipation electronic components were selected to allow the use of a particularly efficient side ventilation with no louvres between the instruments despite high packing density.

Specifications

RDS signal	to EBU Tech 3244-E and ARD Specifications 5/3.8 and 5/1.0
Shape	differential coding, biphase
Modulation	double sideband modulation (DSB) with suppressed carrier, 90° reference phase to the 57 kHz TP carrier (can be switched to 0°)
Centre frequency	57 kHz
Bandwidth	±2.4 kHz (−80 dB)
Suppression of carrier and spurious responses (at +6 dBu)	≥80 dB)
Level (V_{pp})	55 to 437 mV into ≥300 Ω || 5 nF
Phase	adjustable and switch-over between 90°/0° (referred to 19 kHz pilot signal)
TP signals (DMC.05)	to ARD specifications 5/3.6 and 5/1.0
Level (unmodulated carrier), V_{pp}	219 to 490 mV into ≥300 Ω || 5 nF
Modulation factor	
Area identification A to F	60% ±5%
Announcement identification	30% ±5%
Synchronization	
External	to 19 kHz pilot signal of selected input (if pilot signal supplied from stereo coder)
Phase position of 57 kHzsignal	separately adjustable for the two pilot inputs
Internal (quartz crystal oscillator)	automatic switch-over if external pilot tone fails
Frequency	19 kHz ±2 Hz
Linear distortion	<0.5 dB between upper and lower sidebands
Spectual purity (referred to +6 dBu)	
up to 53 kHz	>90 dB
over 53 kHz	>80 dB
Inputs (can be switched over)	2 × for 19 kHz pilot signal/MPX signal
Input resistance	≥5 kΩ
Input signal	1 V ±0.1 V; square-wave, unbalanced, internal switch-over for MPX signal
Outputs	RDS (and TP) signal, 57 kHz
Rear panel (floating)	2 × balanced
Front panel (floating)	1 × unbalanced
Remote control	32 circuits, low active, separate for on/off functions, TTL level
Acknowledgement signals	32 floating relay contacts, separate for on/off functions
Data interfaces	
Line, relay, TPZ, standby	4 × RS-232-C interfaces on the rear panel, asynchronous
Input of RDS data	in ASCII-encoded form, switched as DCE
Connector	25-contact (Cannon socket, subminiature)
Data transfer rate	75 to 9600 Baud
Format	1 stop bit, no parity, 8 data bits
Terminal	RS-232-C interface on front panel, asynchronous
Input of RDS data	in dialog form, switched as DCE
Connector	25-contact (Cannon socket, subminiature)
Data transfer rate	75 to 9600 Baud
Format	1 stop bit, even parity, 7 data bits
RDS data processor	separate 16-bit microprocessor 80186
RDS data management	8 + 1 software-defined data records in non-volatile memory
Control processor	for instrument control (front panel, modulators, remote control), non-volatile storage of instrument status
Front panel	software-driven menu functions for instrument setting, operating mode selection, level, data records
Displays	alphanumeric LED displays for data record, level and operating mode; LED indicator panels for alarm signals; RDS, TP or composite signal level in mV (V_{pp}), deviation (kHz) or dBu, level indicator can be calibrated
General Data	
Rated temperature range	+5 to +45 °C
Operating temperature range	0 to + 55 °C
Storage temperature range	−40 to +70 °C
Power supply	100/120/220/240 V + 10/−15% 47 to 63 Hz (45 VA)
Dimensions (W × H× D), weight	
Bench model	435 mm × 147 mm × 460 mm, 14 kg
19″ rackmount	483 mm × 132 mm × 510 mm, 14 kg

Ordering Information

Order designations

DMC for RDS and TP signals	▶ Radio Data Coder DMC.05
Bench model	812.1310.03
DMC for RDS signal	▶ Radio Data Coder DMC.09
Bench model	812.1610.03

Recommended extras

Junction panel for self-engaging connection for rackmounting	DMC-Z	833.6963.03
Mounting kit (for 19″ rackmounting) for DMC and DMC-Z	DMC-Z	812.1656.03
for DMC (including 2 × 72-contact connectors)	DMC-T	812.1640.00
19″ adapter with front handles (for rackmounting), 3U	ZZA-93	396.4892.00
Set of front handles, 3U	ZZG-93	396.5153.00
RDS coder load and operating software		on request

new

DMDC

Radio Data Decoder DMDC ♦ Carrier 57 kHz

- RDS and traffic program decoder to EBU and ARD standard specifications
- In-service monitoring and fault signalling
- Error correction for RDS data

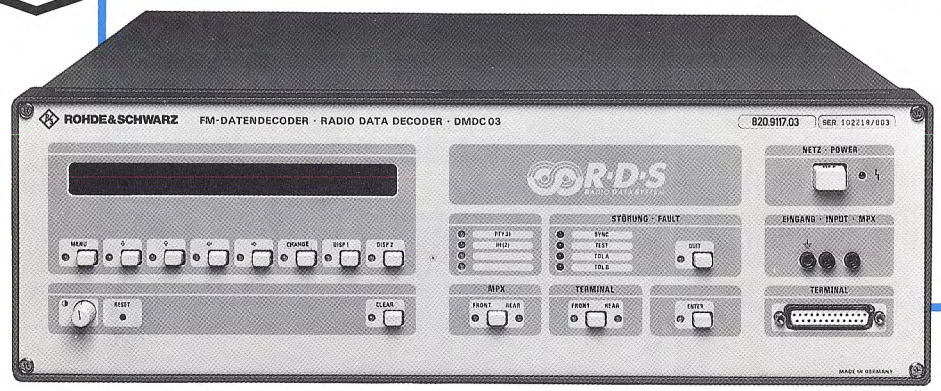


Photo: DMDC model 03

The **radio data decoder DMDC** is used to recover the traffic program and radio data system (RDS) signals. It is available in two models:

- The **DMDC model 05** is both a measuring and an in-service instrument for traffic program and RDS signals in compliance with ARD standard specifications 5/3.7 and EBU specifications Doc. Tech 3244-E.
- The **DMDC model 03** is an RDS test decoder for monitoring and evaluating additional digital RDS information in compliance with EBU specifications Doc. Tech 3244-E.

The information transmitted to the RDS specifications are decoded, buffered, continuously updated, alphanumerically displayed and outputted via interfaces. This means that the main functions and information can be monitored.

The DMDC can also be used as a **data link** in conjunction with the radio data coder DMC, eg for transmitting RDS data in relay reception.

In-service monitoring The DMDC monitors the following parameters and functions and signals faults:

- RDS level (DMDC model 05)
- RDS phase (DMDC model 05)
- RDS/traffic program phase (DMDC model 05)
- Transmission link
- Source
- Information modification
- RDS decoder (test)
- Mains voltage

Deviations from the **reference** level (V_{pp} = 131 mV≙−24.5 dBu≙±1.2 kHz frequency deviation) of the RDS input signals can be corrected in the range of −3 to +6 dB (DMDC model 05).

The auxiliary carrier (57 kHz ±6 Hz) is phase-locked to the pilot in stereo transmission. **Phase deviations** of the received signal in the range of ±10° can be compensated (DMDC model 05).

Internal and external limit values can be set for **fault reports.** The response delays for alarm signals are selectable.

The decoder operates in either the error detection or error correction **modes.**

Display The DMDC is fitted with an alphanumeric display with two lines, each consisting of 40 characters.

The following **RDS information** can be displayed:

PI	Program identification
PS	Program service name
DI	Decoder identification
AF	Alternative frequencies (storage of 40 AF lists with 25 frequencies each)
CT	Clock time
PIN	Program item number
PTY	Program type (alarm)
RT	Radiotext (2 texts with 64 characters each)
TDC	Transparent data channel
IH	In-house application
GR	Group sequence (max. 36 groups)
QU	Source monitoring (PI, PS and TP)
TP	Traffic program identification
TA	Traffic announcement identification
MS	Music/speech identification
SYN	Synchronziation error
ON	Information on other networks

The following measurement values can be displayed:

RDS level (with correction factor) (DMDC model 05)
RDS phase (with correction factor) (DMDC model 05)
RDS/traffic program phase (DMDC model 05)
Block error rate
Synchronization errors

Source monitoring If source monitoring is activated for PI, PS and TP, the received information is compared with one of eight reference memories and an alarm is generated if there are deviations.

MPX signal input: one balanced-to-ground connector on the front and rear panels (switch-selected).

Inputs and outputs for data and measured values

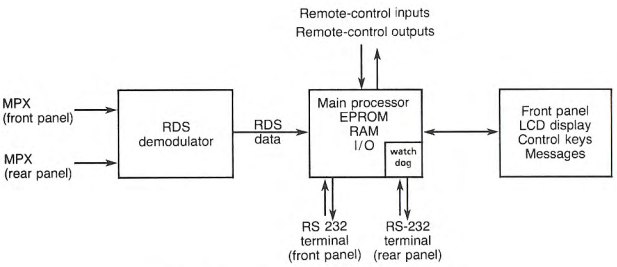
V.24/V.28 interfaces on the front and rear panel for terminal
Three V.24/V.28 interfaces on the rear panel (DMDC model 05) for the radio data coder DMC (for setting up a data link), sound test signal evaluation (eg Audiodat system), IH evaluator

Additional signal outputs (DMDC model 05)

RDS clock: unbalanced output with TTL level on the front panel
"Test start" signal: negative pulse with the duration of an RDS clock starts TPZ evaluation (rear panel)
RDS data (serial): unbalanced output with TTL levels (rear panel)

Operation

The functions of the DMDC and local/remote switchover can be set via a menu and protected against unintentional adjustment. Diagnostic programs support functional tests and error detection.



Block diagram of the Radio Data Decoder DMDC model 03

Specifications

RDS signal evaluation

DMDC model 03	to EBU Doc. Tech 3244-E
DMDC model 05	to EBU Doc. Tech 3244-E and ARD standard specifications 5/3.8 and 5/1.0
Shape	differential coding, biphase
Modulation	double-sideband modulation (DSB) with suppressed carrier
Centre frequency	57 kHz
Bandwidth	±2.4 kHz
Reference level (V_{pp})	131 mV ≙ −24.5 dBu ≙ ±1.2 kHz frequency deviation
Level setting	−3 to +6 dBm (DMDC model 05)
Phase deviation (ref. to 19 kHz pilot sound carrier)	can be corrected by ±10° (DMDC model 05)

Traffic program signals

(DMDC model 05)	evaluation to ARD standard specifications 5/3.7 and 5/1.0

Inputs (switch-selected)	2 × for MPX signal (front/rear panel)
Input resistance	>5 kΩ (40 Hz to 76 kHz)
Input level (DMDC model 05)	≤12.5 dBu (without pilot sound carrier and without additional signals)

Outputs (DMDC model 05)

RDS data	serial, unbalanced (TTL level), rear panel
RDS clock	TPZ interface, pin 9, and BNC female connector, unbalanced (TTL level), rear panel
Test start	TPZ interface, pin 10, rear panel
Remote control	switched lines, low/active, TTL level, back signals via floating relay contacts, with DMDC model 05 separate for ON/OFF functions

Data interfaces

RDS coder, TPZ, IH (DMDC model 05)	3 × RS-232-C interfaces on rear panel, asynchronous
Input	in ASCII code form, switched as DTE
Connector	25-contact (Cannon female, sub-miniature)
Transfer rate	75 to 9600 Baud
Format	1 stop bit, no parity, 8 data bits
Terminal	RS-232-C interface on front and rear panel, asynchronous
Input	in dialog form, switched as DCE
Connector	25-contact (Cannon female, sub-miniature)
Transfer rate	75 to 9600 Baud
Format	1 stop bit, even parity, 7 data bits
Front panel	software-driven menu functions for setting unit
Display	alphanumeric displays for data record contents and block error rate; LEDs for alarm signals, with DMDC model 05 display also for level and phase

General Data

Rated temperature range	+5 to +45 °C
Operating temperature range	0 to +50 °C
Storage temperature range	−40 to +70 °C
Power supply	100/120/220/240 V +10/−15%, 47 to 63 Hz (45 VA)
Dimensions (W×H×D), weight	
Bench model	435 mm×147 mm×460 mm, 14 kg
19″ rackmount	483 mm×132 mm×510 mm, 14 kg

Ordering information

Order designations

DMDC for RDS and traffic program signal	▶ Radio Data Decoder DMDC.05	
Bench model	820.6618.03	
DMDC for RDS signal	▶ Radio Data Coder DMDC.03	
Bench model	820.6618.03	

Recommended extras

Junction panel for automatic rack insertion	DMDC-Z	820.8779.03
Set of insertion components (for 19″ rackmounts)		
for DMDC and DMDC-Z	DMC-T	812.1656.03
for DMDC with trailing cable	DMC-T	812.1640.00
19″ adapter with front handles (for rackmounts), 3 U	ZZA-93	396.4892.00
Set of front handles, 3 U	ZZG-93	396.5153.00

new

DCA

Audio Coder DCA ♦ 1.024 Mbit/s (DS1)

- Digital sound transmission to studios, program distribution points and satellite ground stations

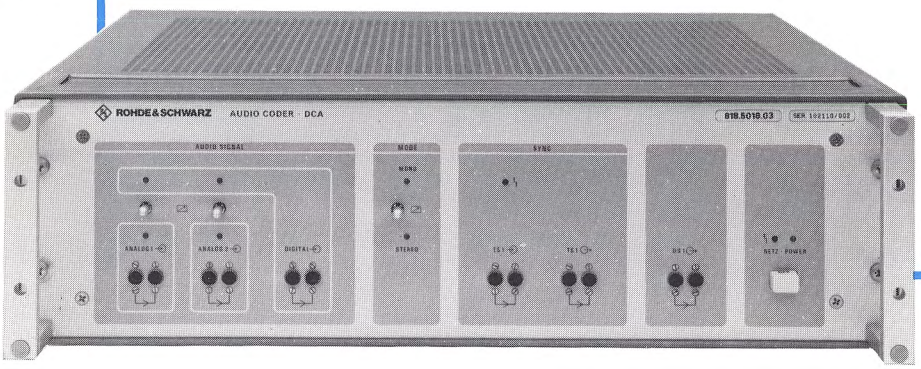


Photo: DCA (below) with DCA-B

Digital sound broadcasting via satellite offers the listener essential improvements:

- Stereo programs with the quality known from CDs
- Auxiliary information for identifying the program type

The **Audio Coder DCA** converts a stereo signal (two audio signals) and the associated auxiliary information into a serial 1.024 Mbit/s data stream in accordance with DS1 Specifications. A sampling rate converter for the digital studio interface (16-bit resolution, 48 kHz sampling frequency, 3.072 Mbit/s data stream) can be retrofitted.

In addition to applications in digital satellite radio broadcasting, the DCA can also be used for digital sound transmission to radio studios and program distribution points.

The **Auxiliary Data Coder** used with the Audio Coder DCA is used for feeding auxiliary information in the digital sound signal. The following program-type information can be encoded and transmitted:

Program-type information	Code
No program type indicated	0000
News	0001
Comments, features	0010
Magazines	0011
Sport	0100
Education	0101
For children	0110
For young people	0111
Religious	1000
Radio plays	1001
Pop and rock music	1010
Light music	1011
Serious music (eg operas, symphonies)	1100
Jazz	1101
Folk music	1110
Miscellaneous (eg quizzes, telephone games)	1111

Specifications

Inputs

Analog signal (L/R)	+6 dBu nominal, 4 to 12 dB, adjustable in 1 dB steps, Z_{in} = 600 Ω/15 kΩ, balanced, floating
Digital signal	2 × 16 bit parallel, 32 kHz sampling rate
Auxiliary data	2 (stereo) or 4 (mono) data channels, serial, 10 mA
CL1	binary signal 1.024 MHz, 3 V_{pp}, Z_{in} = 120 Ω, balanced, floating

Outputs

DS1	pseudo-ternary HDB3 signal, bit repetition frequency 1.024 MHz, 6 V_{pp}, Z_{out} = 120 Ω, balanced, floating
Auxiliary data	32 kHz clock signal, gate signals for 4 info channels, output current 10 mA

Other data

A/D converter	16/14-bit floating-point format, 32 kHz sampling rate
S/N ratio of unoccupied channels (to DIN 45405)	>76 dB
Quantization S/N ratio (60-Hz method)	
15 dB below max. signal level	>76 dB
9 dB below max. signal level	>73 dB
3 dB below max. signal level	>71 dB
Crosstalk L/R	>90 dB
THD ratio for input signal 40 Hz/17 dBu	>46 dB

General data

Rated temperature range	+5 to +45 °C
Operating temperature range	0 to +55 °C
Storage temperature range	−40 to +70 °C
Power supply	100/120/220/240 V +10/−15%, 47 to 63 Hz (30 VA)
Dimensions, weight	
19″ rackmount	483 mm×132 mm×506 mm, 12 kg
Colour of front panel	grey, RAL 7035

Ordering information

Order designation	▶ Audio Coder DCA	
19″ rackmount	818.5018.03	
19″ bench model	818.5018.04	

Accessories supplied: power cable, links, spare fuses

Recommended extras

Junction panel with bypass circuit (TS1), for 19″ rackmounts	DCA-Z	818.8100.03
or		
set of mating connectors	DCA-T	818.7104.00

Three 72-contact connectors (DIN 41622), consisting of 3 male connectors 246.0834.00, 3 hand guards 082.6408.00, 6 female sensor connectors 043.5627.00

Connectors: four 2-contact connectors 818.8881.00, two 3-contact connectors 590.9907.00

Panelling (3U) 085.3668.00

Additional information generator and AES/EBU studio interface on request

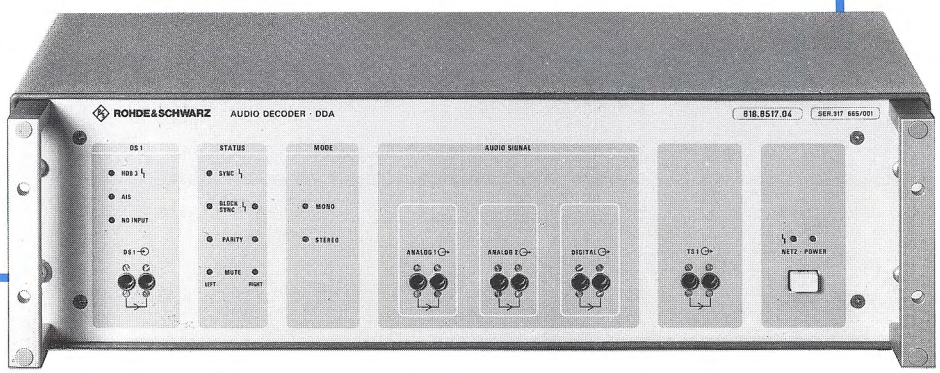
Audio Decoder DDA

♦ 1.024 Mbit/s (DS1)

DDA

new

- DS1 receiver for digital sound transmission
- 2 × 16-bit resolution
- Crosstalk attenuation >90 DB
- Auxiliary information transmission



The **Audio Decoder DDA** handles DS1 serial bit streams. Two audio channels in both analog and digital form (2 × 16 bits, parallel), the auxiliary information and status and error messages are available as output signals.

Operation In the decoder, the DS1 frame is disassembled, the 14-bit data words are expanded to 16 bits by using a scale factor, and, if necessary, errors are encrypted. In addition to the two audio signals, the decoder also supplies information on parity violations and errored frame alignment words in the form of 16-bit data words.

The digital audio signals are processed by the two analog subassemblies or by the future "digital studio interface" (see below). The analog subassemblies contain the digital/analog converters and the 15 kHz band limiters.

DS1 interface The standard for 1.024 Mbit/s data transfer rate ensures **high-quality audio transmissions** over digital radio links. Two DS1 signals can therefore be transmitted in 2.048 Mbit/s radio-relay channels. The frequency of the DS1 system clock is a multiple of the 32 kHz scanning frequency for audio signals. The system clock can easily be recovered using the HDB3 code. Space is provided for the auxiliary information and sensitivity is improved by reducing the linear scanning data quantized at 16-bits to a floating point expression with a 14-bit mantissa and a 3-bit exponent.

Studio interface The optional studio interface converts the 2 × 16-bit audio signals into a 3.072 Mbit/s data stream in accordance with EBU Specification Doc. Tech 3250-E.

Status displays The following status messages are displayed on the front panel:

HDB3	HDB3 code violation
AIS	AIS received
NO INPUT	no input signal
SYNC	frame alignment word errored
MONO	mono transmission
STEREO	stereo transmission
BLOCK SYNC	block alignment word errored
PARITY	parity error
MUTE	mute

Specifications

Input

DS1 . . . . . pseudo-ternary HDB3 signal (High Density Bipolar, max. 3 consecutive logic 0's), bit rate 1.024 MHz, 6 V_{pp}, Z_{in} = 120 Ω, balanced, floating

Outputs

Analog signal (L/R) . . . . . +6 dBu nominal level, headroom 4 to 12 dB (1 dB steps), Z_{out} <35 Ω, balanced, floating

Digital signal (L/R) . . . . . 2 × 16 bit parallel, sampling frequency 32 kHz

Additional information . . . . . gate signal for the 2 (stereo) or the 4 (mono) additional information channels, 10 mA: 2 or 4 data signals, serial, 10 mA; clock signal 32 kHz, 10 mA

TS1 . . . . . binary signal 1.024 MHz, 3 V_{pp}, Z_{out} = 120 Ω, balanced, floating

Counter outputs (parity error) . . . . . 10 µs rectangular pulse, TTL levels, 50 Ω (BNC connector)

Messages . . . . . 4 relay outputs, selection with DIP switch

Other data

D/A conversion . . . . . 14/16-bit floating point, sampling rate 32 kHz

Idle channel S/N ratio . . . . . >76 dB (to DIN 45405)

Quantizing noise referred to clipping limit (60 Hz method) drive

15 dB below headroom	>76 dB	applies to Audio Coder DCA/ Audio Decoder DDA combination
9 dB below headroom	>73 dB	
3 dB below headroom	>71 dB	
Crosstalk attenuation (L/R)	>90 dB	
Harmonic distortion at 40 Hz/17 dBu Input signal	>46 dB	

General data

Rated temperature range . . . . . +5 to +45 °C

Operating temperature range . . . . . 0 to +55 °C

Storage temperature range . . . . . −40 to +70 °C

Power supply . . . . . 100/120/220/240 V +10/−15%, 47 to 63 Hz (30 VA)

Dimensions, weight 19″ rackmount . 483 mm×132 mm×506 mm, 12 kg

Front-panel colour . . . . . grey, RAL 7035

Ordering information

Order designation . . . . . ▶ Audio Decoder DDA

Accessories supplied: power cord, links, spare fuses

19″ rackmount 818.8517.03

19″ bench model 818.8517.04

Junction panel for 19″ rackmounts . . DDA-Z 818.9259.03

or

set of mating connectors . . . . . DDA-T 818.9607.00

Three 72-contact connectors (DIN 41622), consisting of 3 male connectors 246.0811.00, see p. 44 for hand guards and female sensor connectors

Connector: (three 2-contact and two 3-contact), see p. 44 for panelling

Additional information generator and AES/EBU studio interface on request

new

AST

Audio Selector AST ♦ 20 Hz to 100 kHz

- 10 × 2 inputs – cascaded up to 100 × 2 inputs
- Crosstalk attenuation >100 dB
- Frequency response ≤±0.1 dB

IEC625Bus

The **Audio Selector AST** selects a stereo signal from 10 program lines or checkpoints via FET switches. The stereo signal is then switched to an output on the front panel (for aural monitoring and measurements) and to an output on the rear panel. The number of inputs can be increased to a maximum of 100 by cascading.

The applications of the AST extend beyond audio to MPX signals and signals up to 100 kHz. One example of this extended field of application is its use in the Sound and ITS Monitoring Assembly TOPAS (Catalog Section 4).

Serial data Data channel inputs, data output, error data channel inputs and error data output are used for the transmission of serial data, eg program analysis in the dataline, and serial error data, eg "No dataline" signal.

Cascading The AF output of one selector is connected to the AF input EXT of the next selector (this also applies to the outputs and inputs for data and error signals). This means 100 stereo inputs can be realized using only ten ASTs.

Operation The AST can be addressed by selecting front-panel keys (provided with LED indicators) or via the standard IEC/IEEE-bus interface. Signal part interrogation and local operation disable can be performed over the IEC/IEEE-bus. The key "IEC Return To Local" switches the instrument back to local operation.

Specifications

Switching devices

Operating modes	Local (front/panel keys), remote (IEC/IEEE bus)
Switch over to remote operation	automatically for IEC/IEEE mode
Signalling of remote operating mode	REMOTE LED on front panel
Signalling of switched path	LEDs next to keys; query on IEC/IEEE bus
Cascading	max. 10 AST units (100 inputs)

AF signal inputs

Number	10 × 2 (sound signal) 1 × 2 (cascading/test signals)
Type	left/right (channel 1/2), balanced
Input level	max. +18 dBm
Overdrive protection	up to $V_{max.}$ = 100 V_{rms}, limiting at approx. +22 dBm by diodes
Input impedance	Z_i ≥20 kΩ or 600 Ω ±5%
Common-mode rejection	≥40 dB (20 Hz to 100 kHz)

AF signal outputs

Number and type	1 × 2, left/right (channel 1/2), balanced, on front and rear
Output level into 600 Ω	max. +18 dBm
Output impedance	Z_o ≤30 Ω
Common-mode rejection	≥40 dB (20 Hz to 100 kHz)

Transmission characteristics

Frequency range	20 Hz to 100 kHz
Gain (1 kHz into 600 Ω)	0 dB ±0.1 dB
Polarity of output signal	as input signal
Isolation of outputs	>40 dB (20 Hz to 100 kHz)
Frequency response (referred to 1 kHz), 20 Hz to 100 kHz, at 12/18 dBm	≤±0.1 dB/≤±0.2 dB
Distortion factor	
20 Hz to 100 kHz, at 12/18 dBm	≤0.1%/≤0.3%
20 Hz to 70 kHz, at 16 dBm	≤0.1%
Phase response	<2° (20 Hz to 100 kHz)
Waited S/N ratio (CCIR 468-3, DIN 45405), peak value	
weighted	≤−80 dBm
unweighted	≤−80 dBm
Common mode output (at 100 kHz, f_{mod} 2 kHz, input level 18 dBm)	V_{pp}≤32 V
Crosstalk attenuation 20 Hz to 100 kHz	
left/right (channel 1/2)	>100 dB
inputs not switched through, referred to the selected Input (with identical signals to these inputs)	>100 dB
all inputs off	>100 dB

General data

Rated temperature range	+5 to +45 °C
Storage temperature range	−20 to +75 °C
Power supply	100/120/220/240 V +10/−15%, 47 to 63 Hz (10 VA)
Safety regulations	comply with VDE 0411 part 1/10.73 and IEC 348, VDE 0804 Ln/02.80, radiated RFI VDE 0871/0875
Connectors	
AF connectors and control lines	72-contact female connectors
IEC/IEEE bus	24-contact standard connectors
Front-panel output	Relkli-sockets
Dimensions (W×H×D)	
19″ rackmount	483 mm×43 mm×506 mm
19″ bench model	492 mm×71 mm×514 mm
Weight	
19″ rackmount	5 kg
19″ bench model	6.5 kg
Colour of front panel	grey, RAL 7035

Ordering information

Order designation	▶ Audio Selector AST
19″ rackmount	389.4010.03

Accessories supplied

Power cable, spare fuses, manual

Recommended extras

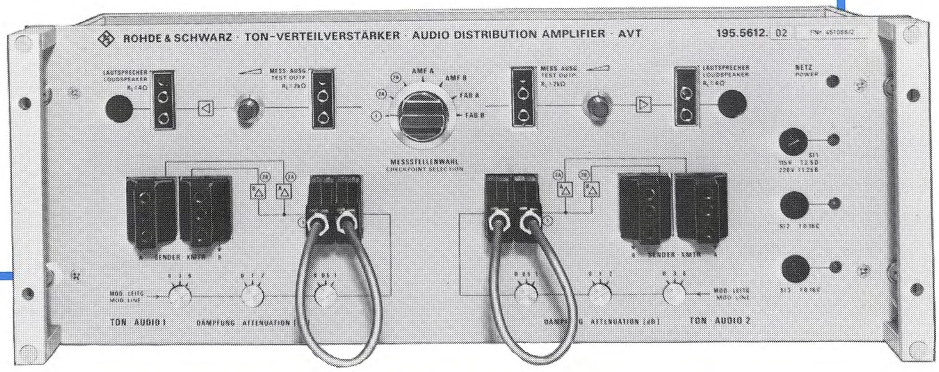
Connecting Rail AST-Z for 19″ rackmounting	389.4332.03
or	
two 72-contact connectors (DIN 41622), each comprising:	
72-contact connector strip	246.0834.00
handguard	528.6966.00
receptacle (2)	548.1660.00
Two 3-pin plugs (9 REL STP 6AC)	019.0458.00
IEC-IEEE-bus cable PCK, 0.5 m	292.2013.05
1 m	292.2013.10
2 m	292.2013.20
4 m	292.2013.40
Panelling	462.9410.00

Audio Distribution Amplifier AVT

AVT

♦ 40 Hz to 15 kHz

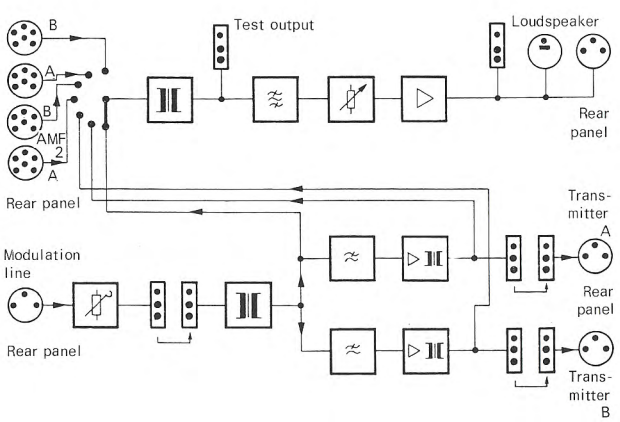
- Distribution of up to two mono programs or one stereo program to two transmitters
- Facilities for checking modulation signal and (via an external demodulator) transmitted program
- Loudspeaker outputs (female) provided for three different connector systems



The **Audio Distribution Amplifier AVT** for TV transmitters simultaneously constitutes an AF distributor, a buffer amplifier, a checkpoint selector and an AF monitoring amplifier; depending on the transmitter configuration, it can be supplied with two identical sound channels. The single-channel model can be easily retrofitted for use with two channels. A modulation and a monitoring path are provided for each sound channel. If there is a power failure, the modulation circuit is automatically switched to both outputs.

In the **modulation section,** the program signal is taken from the input attenuator via two buffer amplifiers to two outputs. If a buffer amplifier fails, it can be bypassed with the aid of front-panel links.

In the **monitoring section,** the incoming modulation signal, the amplified signals and, after detection in the AMF 2 or FATB, the AF signals of the transmitted program can be checked via test and loudspeaker outputs. The checkpoint selector permits simultaneous switchover of the two monitoring paths.



Block diagram for one sound channel in the AVT (top: monitoring section, bottom: modulation section)

Specifications

Modulation section

Frequency	40 Hz to 15 kHz
Input impedance	600 Ω, bal.; floating
Return loss	≥26 dB
Nominal input level	+6 dBm
Attenuator (0.5-dB steps)	0 to 9 dB ±≤0.15 dB
Gain	0 ±0.1 dB/6 ±0.1 dB (link-selected)
Frequency response flatness (0.04 to 15 kHz)	≤±0.2 dB, referred to 1 kHz
Nominal output level	+6/+12 dBm (into 600 Ω)
Output impedance	≤35 Ω, bal.; floating
THD at V_{out} = +12 dBm into 600 Ω (0.04 to 15 kHz)	≤0.2%
Unweighted S/N ratio	≥76 dB, referred to +6 dBm
Weighted S/N ratio (CCIR Rec. 468-2)	≥70 dB, referred to +6 dBm
Crosstalk between the channels (0.04 to 15 kHz)	≥80 dB down

Monitoring section

Output power into 4 Ω at 1 kHz	≥8 W (d = 4%) ≥5 W (d = 1%)
Frequency response flatness (0.08 to 10 kHz)	≤±0.5 dB
Gain roll-off beyond 0.08 to 10 kHz	≥3 dB/octave
Weighted S/N ratio (in accordance with CCIR Rec. 468-2)	≥70 dB, referred to P = 5 W
Input voltage requirement	+6 dBm for P = 8 W ±5%
Input impedance	≥20 kΩ
Test output	Z_{load} ≥2 kΩ

General data

Rated temperature range	+5 to +45 °C
Connectors, front panel	to DIN 41 628, loudspeaker outputs additionally to DIN 41 529
rear panel	3-contact and 6-contact female chassis connectors similar to DIN 41 524 (lockable)
Power supply	110/220 V ±10% 47 to 63 Hz (max. 60 VA)
Dimensions, weight	483 mm×177 mm×426 mm, 10 kg

Ordering information

Order designation (19″ rackmount) equipped for 2 sound channels ... ▶ Audio Distribution Amplifier AVT 2002.1707.03

Accessories supplied for each sound channel:
1 AF connecting cable, 2 AF connectors

Recommended extras

Sound circuit patch panel	AVT-Z2	244.3765.03
Attenuator (600 Ω/6 dB)	AVT-Z3	249.0312.06

TV MONITORING RECEIVERS

new

EMFT
EMFD
EMFK

TV Test Receiver
TV Test Demodulator
TV Channel Receiver

EMFT ♦ for all TV bands
EMFD ♦ for VHF, UHF and IF
EMFT ♦ for VHF, UHF and IF

- Standard B/G, D/K, I, M
- Real synchronous detection with quadrature signal output for measuring incidental phase modulation of vision carrier
- Multitone capability in line with dual-carrier technique
- RF input voltage indication
- Tunable in all TV bands including hyperband from 330 to 470 MHz (EMFT)

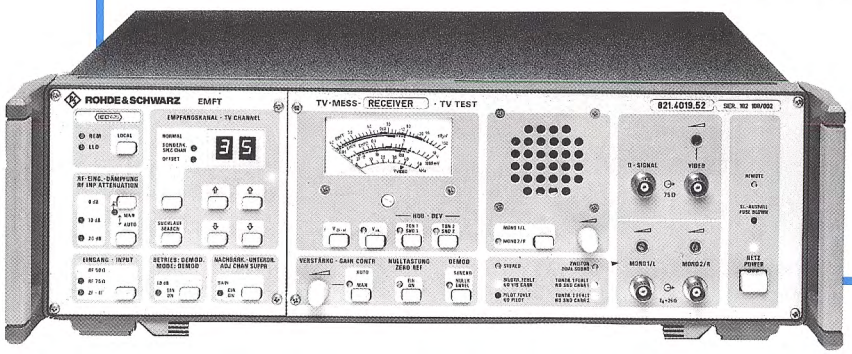


Photo: TV Test Receiver EMFT

EMFT: Option IEC 625 Bus

Characteristics, uses

The EMF family is capable of solving all problems in the field of TV reception and demodulation. State-of-the art techniques such as synthesizer, double conversion, SAW filter afford great operating convenience and outstanding transmission quality.

There are three units available for the different measurement tasks and transmission requirements:

- EMFT – continuously tunable test receiver and demodulator
- EMFD – TV test demodulator with AFC and crystal-controlled operation
- EMFK – selective, crystal-controlled channel receiver and demodulator

All units of the EMF family are provided with two isolated video outputs and two outputs for the Q signal. These outputs permit the measurement of the incidental phase modulation of the vision carrier which determines the intercarrier S/N ratio of the sound channel. In addition, the adjustment of linearity and phase equalizing circuits in transmitters is facilitated through the use of the Q signal.

The complex sound processing circuitry employs state-of-the-art ICs taking full account of present-day quality requirements. The deviation of the two sound demodulators can thus be guaranteed to be equal – which is the prerequisite for low stereo crosstalk.

Switchover from synchronous detection to envelope detection is possible. The input voltage and the frequency deviation of the sound carriers are indicated on the analog meter. The sound level is monitored by means of a built-in loudspeaker.

Special features

TV Test Receiver EMFT

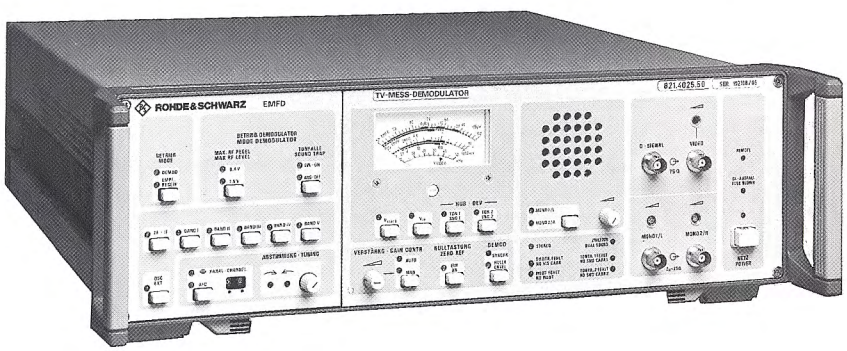
- Channel selection with digital entry of channel number either in manual or in remote mode
- Automatic control of frequency offset up to ±100 kHz
- Continuously tunable in all TV bands, also in special channels up to 470 MHz
- SAW filter switch-selected on front panel for adjacent-channel suppression
- Optional IEC/IEEE-bus control (IEC 625-1/IEEE 488); channel selection also possible by entering the vision carrier frequency
- Reduction of IF gain allowing operation at high input levels (demodulator mode) and thus providing increased video S/N ratio

TV Test Demodulator EMFD

- Test demodulator for VHF, UHF and IF
- Crystal-controlled operation at a fixed frequency, switch-over to continuously tuned AFC possible
- Sound trap can be switched off
- Selectable input sensitivity

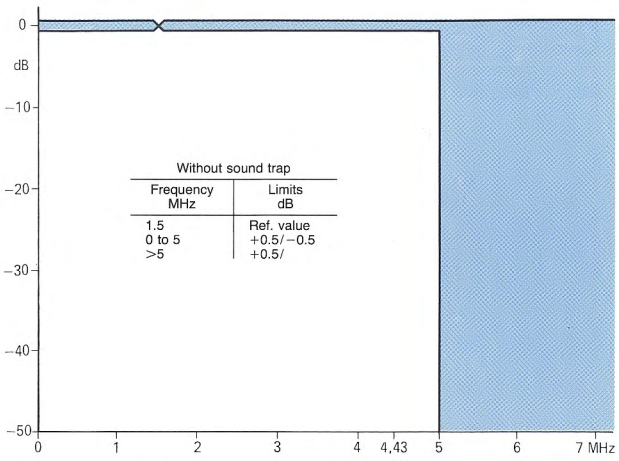
TV Channel Receiver EMFK

- Suitable as relay receiver for transmission and measurements
- Continuously tunable demodulator same as EMFD, however, with additional input via selective filter and preamplifier

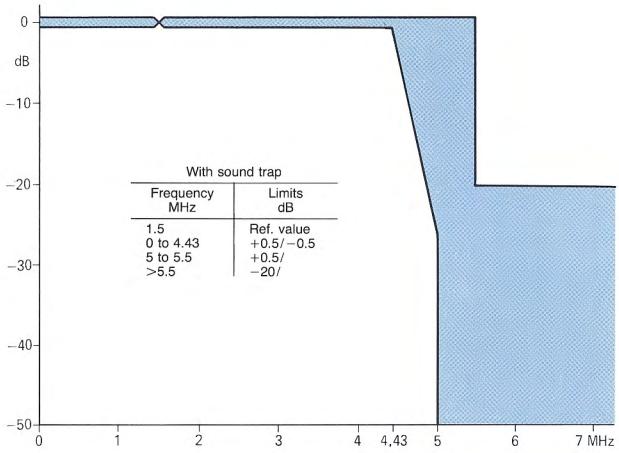


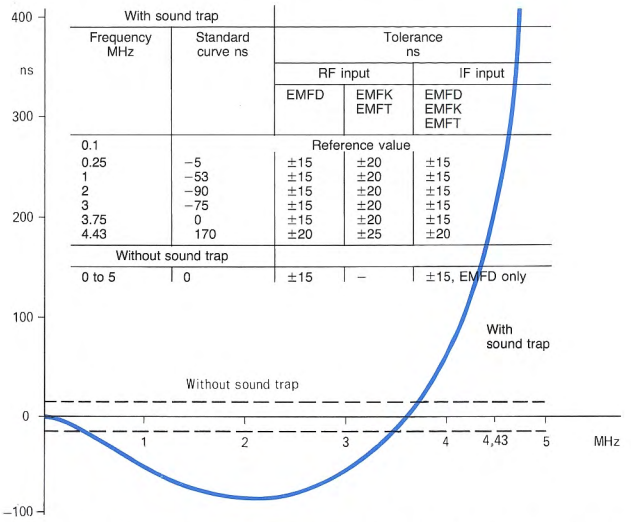
TV Test Demodulator EMFD

Tolerance masks



Tolerance of overall amplitude characteristic (RF, IF, VF) without sound trap

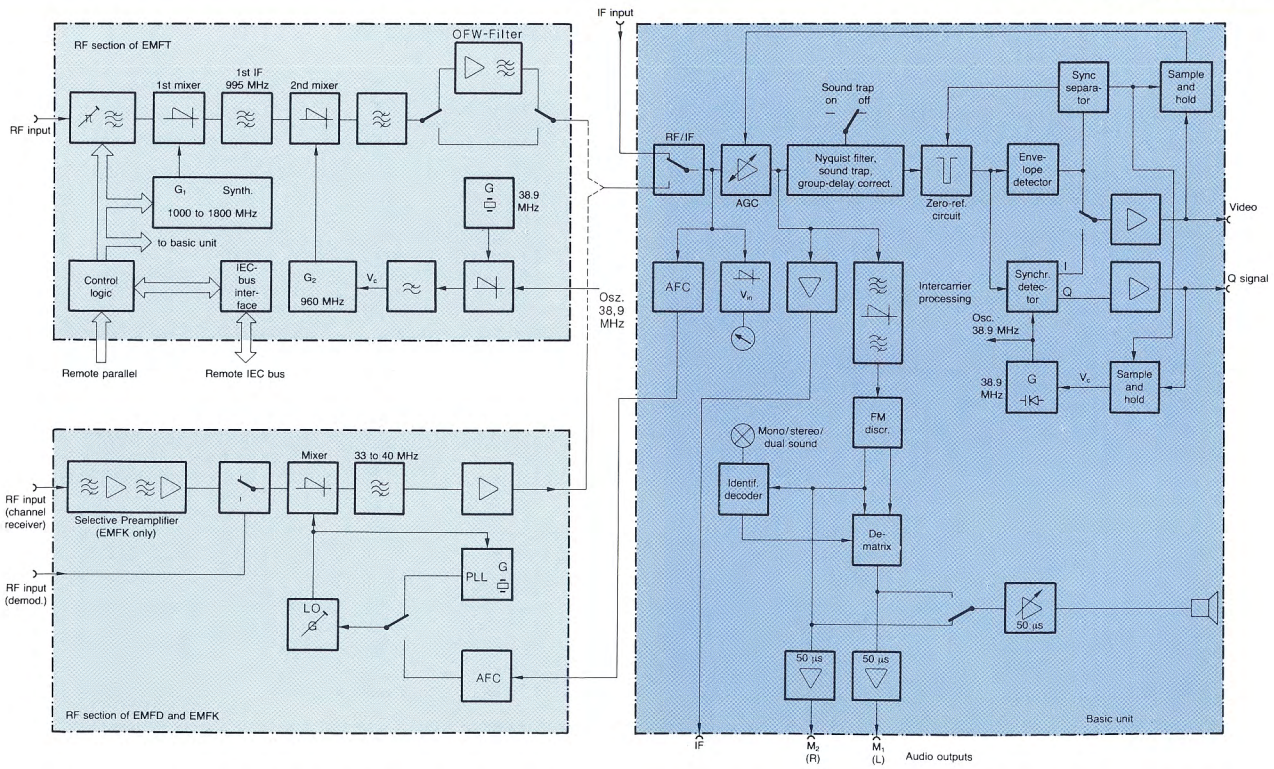




Group-delay characteristic of EMF family: curve with sound trap, dashed line for operation without sound trap
EMFT only: Additional ripple with SAW filter ≤±30 ns

Tolerance of overall amplitude characteristic (RF, IF, VF) with sound trap
EMFT only: Additional ripple with SAW filter ≤±0.3 dB

Functional diagram of EMF system



EMF

Specifications for Standard B/G

	TV Test Receiver EMFT	TV Test Demodulator EMFD	TV Channel Receiver EMFK
Frequency ranges	bands I, II, III, IV/V, special channels up to 470 MHz and IF 38.9 MHz	bands I, II, III, IV/V and IF 38.9 MHz	bands I, II, III, IV/V and IF 38.9 MHz
Channel selection	entry of channel number, automatic search or via IEC bus (option)	fixed-channel operation and tunable with AFC	fixed-channel operation, also AFC when used as demodulator
Frequency processing	by synthesizer	crystal and AFC	crystal and AFC
Frequency error	≤±2.5 kHz	≤±10 kHz (crystal) ≤±30 kHz (AFC)	≤±10 kHz (crystal) ≤±30 kHz (AFC)
Inputs			
RF inputs	BNC female (50 and 75 Ω)	BNC female (50 Ω)	N (50 Ω, RX) and BNC female (50 Ω, demod.)
IF input	BNC female	BNC female	BNC female
Input voltage range[1])			
RF switchable	0.15 to 30 mV 0.5 to 100 mV	20 to 400 mV 80 to 1.6 mV	250 µV to 5 mV 2.5 to 50 mV
IF	5 to 100 mV	5 to 100 mV	5 to 100 mV
Return loss			
IF	≥20 dB	≥20 dB	≥20 dB
RF, 50 Ω	<300 MHz: ≥12 dB >300 MHz: ≥10 dB	≥20 dB	≥16 dB
RF, 75 Ω	≥8 dB		
RF input attenuation	0/10/20 dB automatic or manual adjustment	17/29 dB	0/20 dB (internal link)
Noise figure	VHF: ≤9 dB, UHF: ≤12 dB (with RF input attenuation 0 dB)	–	typ. 8 dB
Video S/N ratio, rms measurement, CCIR-weighted, HP 10 kHz, ref. to black-to-white transition	≥58 dB (input level 3 mV) ≥62 dB (input level 10 mV and reduced IF gain)	VHF: ≥67 dB UHF: ≥64 dB (input level 400 mV/1.5 V)	≥62 dB (input level 5 mV)

Common specifications of equipment family EMF

Transmission characteristics in video channel

Amplitude/frequency response (RF + IF + video, SAW filter switched off in case of EMFT)	see page 49
Group-delay characteristic (SAW filter switched off in case of EMFT)	see page 49
Video S/N ratio	see above
Nonlinearity with modulation depth 10 to 75% (synchronous detection)	
Differential gain	≤3%
Differential phase	≤±2°
Tilt (50 Hz)	≤0.5%
Gain control	automatic or manual
Dynamic range	≥34 dB (typ. 40 dB) additionally 2× 10 dB input attenuation for EMFT

Transmission characteristics in audio channel

Intercarrier frequency	5.5/5.742 MHz
Frequency response flatness, referred to deemphasis 50 µs (cannot be disabled)	≤±0.5 dB
Harmonic distortion at ±50 kHz deviation and f_{mod} = 5 kHz	≤1%, typ. 0.5%
Stereo crosstalk (L→R or R→L)	down ≥36 dB
Channel crosstalk, selective measurement ($M_1 \rightarrow M_2 \rightarrow M_1$)	down ≥70 dB
Intercarrier S/N ratio, measured to DIN 45405 (quasi-peak) with sinusoidal vision modulation (0 to 5 MHz), referred to nominal output level, weighted to	
CCIR 468-3	≥46 dB (typ. 50 dB)
with all-black picture	≥54 dB

Outputs

Video outputs	
In-phase signal	2; 75 Ω, BNC (front/rear panel)
Quadrature signal	2; 75 Ω, BNC (front/rear panel)
Output level	
In-phase video output	1 V_{pp}, CVS with standard modulation
Quadrature output	corresponding to 1 V_{pp} with standard modulation and internal phase shift of switching carrier by 90°
IF output	1; 50 Ω, BNC (rear panel)
Output level (AGC)	200 mV_{rms} ±3 dB
Frequency response flatness in range 33 to 40 MHz, referred to 38.9 MHz	≤0.5 dB
Audio outputs	
Signal depending on pilot coding mono or R and L or M, and M_2	
Front panel	2; BNC, unbalanced, Z_{out} <25 Ω
Rear panel	37-contact connector
Output level with ±30 kHz deviation and f_{mod} = 500 Hz	+6 dBm ±0.5 dB

Indication

Analog meter for	a) input level with marking of optimal input level range b) deviation of sound 1 and sound 2 (fsd 50 kHz) c) marker for correct video output level
LED indication for	selected channel, "no vision carrier", "no sound carrier 1", "no sound carrier 2", "no pilot", "stereo", "dual sound"

Miscellaneous

Zero-reference pulse	for checking of residual carrier, field-repetitive, can be enabled in lines 15 and 328 (factory-set) of field blanking interval or triggered by external pulse
Error referred to CVS in case of synchronous detection	≤1.5%
Loudspeaker with volume control	can be connected to both sound channels

General data

Rated temperature range	+5 to +45 °C
Operating temperature range	0 to +45 °C
Storage temperature range	−40 to +70 °C
Power supply	110/120/220/240 V ±10%, 47 to 63 Hz (110 VA)
Dimensions (W×H×D), weight	
19″ bench model	450 mm×147 mm×525 mm, 16 kg

Ordering information

Order designation (standard B/G)

Test receiver	TV Test Receiver EMFT 821.4019.50
Test demodulator	TV Test Demodulator EMFD 821.4025.50
Channel receiver	TV Channel Receiver EMFK
Band I	821.4283.50
Band III	821.4283.53
Bands IV/V	821.4283.54
Other standards	on request

[1]) Additionally 6 dB beyond lower and upper limits of control range

TV Monitoring Receiver	EKF 2
TV Demodulator	EKF 2 D
TV Measuring Receiver	EKF 2 K
TV IF Demodulator	EKF 2 ZF

EKF 2
Family

- ♦ Bands I, III, IV/V IF range, CATV bands (EKF 2)
- Synchronous and envelope detection
- Switch-selected zero-reference pulse
- IF input and output

See next page for family overview

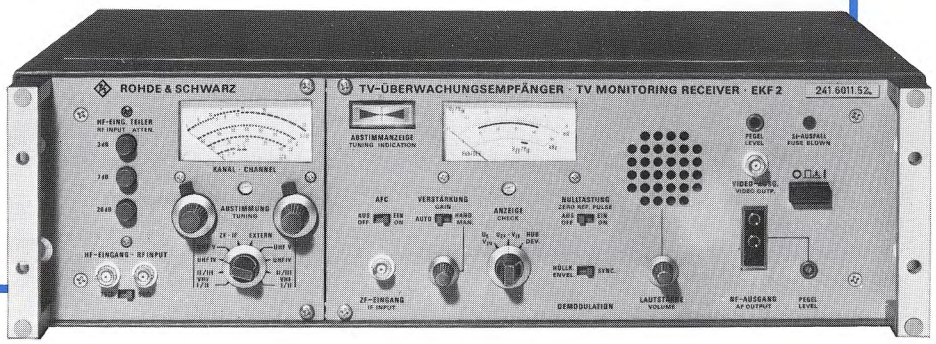


Photo top: EKF 2

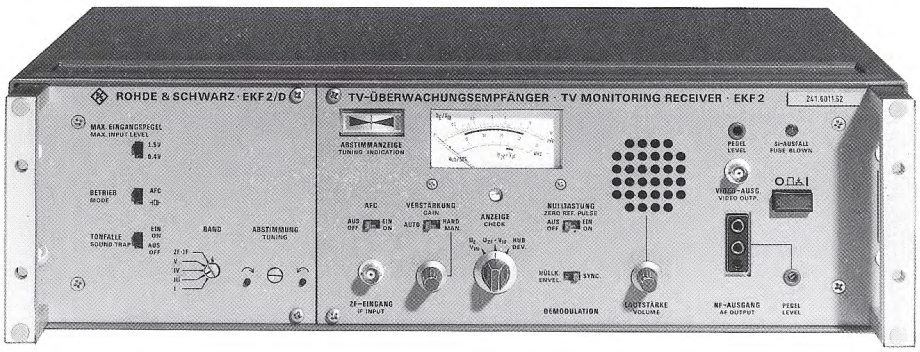


Photo bottom: EKF 2 D

The EKF 2 Family

The **EKF 2 family** comprises four units and provides a high-performance, tried and tested system of measuring receivers and demodulators for **analyzing, checking and monitoring** TV signals. They are capable of precisely recovering information modulated on video and audio carriers and presenting them for further applications.

The family is derived from a common basic unit which is optimally matched to the specific application by **changing the receiving unit.** Thus, precise and reliable measurements can be made in all frequency ranges, in the near-field and far-field and at IF (see family overview on the next page).

Applications for the EKF 2 include the monitoring of TV transmitters and translators in the far-field, and the checking of broadband communication systems.

EKF 2 D – The Demodulator

The EKF 2 D is a **precision demodulator** with a broadband RF input unit which is **tunable** in the I, III and IV/V bands. It has **input level ranges** of 20 to 400 mV and 80 mV to 1.5 V. It is frequency-stabilized either by means of a crystal-referenced PLL in the input unit or by AFC in the demodulator unit.

This instrument is **used** for measurements on TV transmitters, translators and measuring equipment.

EKF 2 – The Monitoring Receiver

The EKF 2 **basic unit** is a measuring receiver which can be **continuously tuned** through all TV bands, including the special CATV channels. To perform a rapid frequency change, **two channels** in any band can be **preselected.**

The **input sensitivity** is between 0.25 and 5 mV at in input impedance of 50 Ω (switchable to 75 Ω). In the RF input there are three attenuators rated at 3, 7 and 20 dB. They can be combined for level matching, thus expanding the input voltage range up to 150 mV.

EKF 2 K – The Channel Receiver

The EKF 2 K is derived from the EKF 2 D model. It has a selective RF preamplifier **permanently set** by two two-section filters **to one channel** in the I, III or IV/V bands. **Sensitivity** is high as for the EKF 2.

The **applications** of the instrument are mainly in TV remote monitoring and relay reception (ie transmitter modulation with the received program). It can also be used as a tunable demodulator EKF 2 D.

EKF 2 Family

EKF 2 ZF – The IF Demodulator

The EKF 2 ZF is similar to the EKF 2 D but has no RF receiver unit and is therefore only designed for measurements in the **IF.**

Its **applications** are mainly linked to specific receiver units.

General

All four units are equipped with an **IF input** for signals ranging from 5 to 100 mV. The demodulated video and audio signals are presented for further processing to **two video outputs** and one **audio output,** each with adjustable levels.

The video output level is held constant by automatic or manual **gain control.** Modulation can be controlled either by a **zero-reference pulse** superimposed on the video signal at field rate or externally triggered. A front-panel switch permits selection of **synchronous detection or envelope detection** (the switching carrier phase for the synchronous detector is stabilized with a control loop).

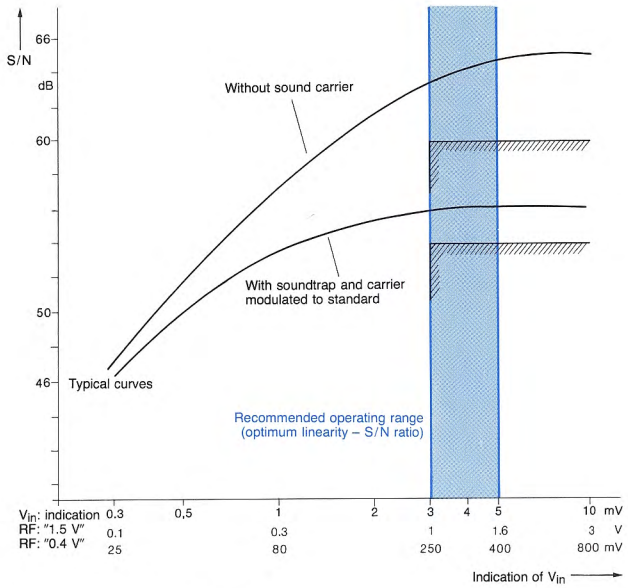
The **sound trap** of the demodulator can be switched off in the EKF 2 D, EKF 2 K and the EKF 2 ZF.

A **meter** indicates the RF input level, the IF voltage demodulator or the sound carrier deviation.

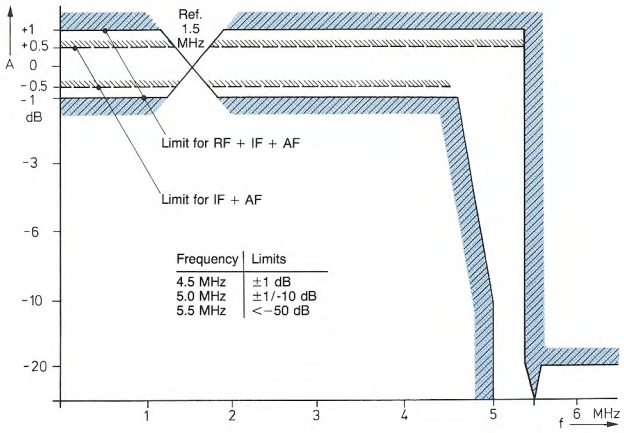
Family overview

Model	Typical application	Input circuit	Input frequency range (Std. B/G)	Channel selection	Oscillator stabilization	Sound trap	Common features
EKF 2 TV monitoring receiver	Monitoring and checking of transmitters in near- and far-fields and of measuring and CATV systems	Continuously tunable selective highly sensitive	RF bands I, III, IV/V CATV special channels S1 to S20 IF	Continuous in band selected 2 preselectable channels	AFC	Cannot be switched off	Envelope/synchronous detection (to avoid quadrature distortion) Zero-reference pulse to check video modulation can be switched on (at field rate or externally triggered)
EKF 2 D TV demodulator	Quality measurement and monitoring (RF and IF)	Continuously tunable broadband less sensitive	RF bands I, III, IV/V IF	Continuous in band selected	AFC or channel crystal	Can be switched off	Instrument for input voltage/sound transmitter deviation 2 isolated video outputs (adjustable level)
EKF 2 K TV measuring receiver	Transmitter remote monitoring relay reception (fixed channel)	Continuously tunable selective highly sensitive		Crystal change and retuning (oscillator and input filter)			Automatic/manual IF gain control (range ≥40 dB) Audio output (adjustable level), monitoring loudspeaker (adjustable volume)
EKF 2 ZF TV IF demodulator	Quality measurement and monitoring (IF)	For IF	IF	–	–		IF output (controlled level) Recorder output to log input voltage

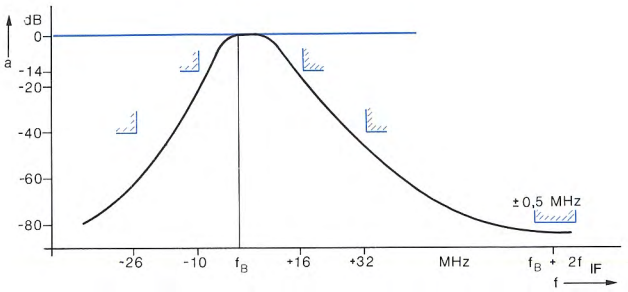
Tolerance masks

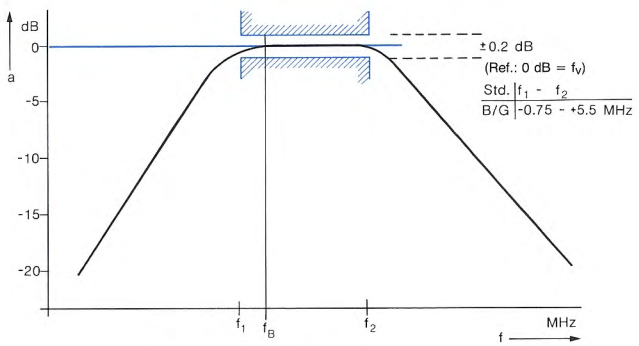


Video S/N ratio for the EKF 2 D

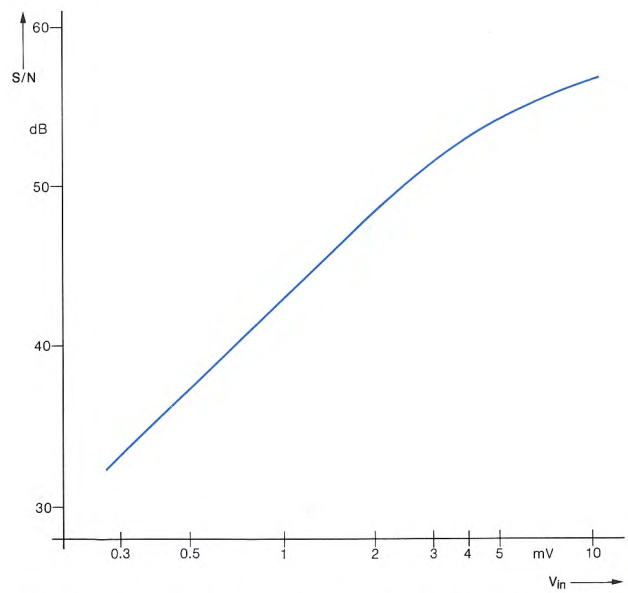


Tolerance for EKF 2 for the overall amplitude characteristic (RF, IF, AF) and Standard B/G





Static selection of preamplifier in EKF 2 K
(f_v = video carrier frequency
f_{IF} = intermediate frequency)



Video S/N ratio (typ.) of the EKF 2 K with sound carrier modulated to standard (RMS measurement, unweighted)

EKF 2 family

Specifications for Standard B/G

	EKF 2	EKF 2 D	EKF 2 K	EKF 2 ZF
Frequency	TV bands I to V and IF	TV bands I, III and IV/V and IF		only IF
Band I/II	47 to 80 MHz channels 2 to 4, S			
Band II/III	104 to 300 MHz channels S1 to S10 5 to 12 S11 to S20			
Band IV	470 to 628 MHz channels 21 to 40			
Band V	628 to 860 MHz channels 40 to 69			
Band I		47 to 68 MHz channels 2 to 4		
Band III		174 to 230 MHz channels 5 to 12		
Band IV/V		470 to 830 MHz channels 21 to 65		
Stabilization of oscillator frequency	AFC	Channel crystal or AFC, selectable on front panel		–
Video/audio IF		38.9 MHz/33.4 MHz		
Channel selection	Continuous in selected band, any 2 preselectable channels (remote control possible)	Crystal mode: by changing crystal and retuning oscillator AFC mode: continuous in band	Crystal mode: by changing crystal and retuning oscillator and input filter AFC mode: by retuning selective input filter	–
RF input	Front-panel BNC fem. connector (on rear panel after internal cable port)	Rear-panel BNC female connector	Rear-panel BNC female connector	–
Input resistance	50 or 75 Ω (switchable)	50 Ω	50 Ω	–
Selective preamplifier	–	–		–
Gain			24 dB ±1 dB	
Limit sensitivity			≤8 kTo	
Conditional amplitude frequency response			≤ ±0.2 dB	
Image frequency stability			typ. 80 dB	
Input voltage[1])	without / with input divider	Range 0.4 V / Range 1.5 V	without / with pre-attenuation	–
Nom. range (V_{in} indication in black scale range)	0.25 to 5 mV / to 150 mV	20 to 400 mV / 80 mV to 1.5 V	0.25 to 5 mV / 2.5 to 50 mV	
Working range (typ.)		8 to 800 mV / 30 mV to 3 V	0.1 to 10 mV / 1 to 100 mV	
Optimum operating range		250 to 400 mV / 1 to 1,5 V	3 to 5 mV / 30 to 50 mV	
Input divider	0/3/7/10/20/23/27/30 dB (3 pushbuttons 3/7/20 dB)	2 switch-selectable level ranges (Δ = 12 dB)	2 level ranges selectable by inserting links (Δ = 20 dB)	–
Gain control		Manual or automatic; DC restoration		
AGC offset in working range		≤0.3%/dB		

Common data

IF input	front-panel BNC female connector (internally reconnectable, with rear panel cable)
Input impedance	50 Ω
Return loss	≥20 dB
VSWR	<1.2
Input voltage[1])	
Rated range (V_{IF} indication in black scale range)	5 to 100 mV
Working range	2 to 200 mV
Optimum operating range	60 to 100 mV
Zero-ref. pulse (to check video modulation)	at field rate during field blanking interval or triggered by external pulse
External zero-reference level	V_{pp} ≥1 V into 75 Ω

Transmission characteristics in video channel

Non-linearity of demodulator (modulation range 10 to 70%)	
EKF 2	≤5%
EKF 2 D, EKF 2 K, EKF 2 IF	≤3%
Differential amplitude EKF 2	≤5%
EKF 2 D, EKF 2 K, EKF 2 IF	≤3%
Differential phase	≤±2°
50 Hz squarewave tilt	≤0.5%
Video S/N ratio EKF 2	≥50 dB rms (referred to black/white transition; V_{in} = 5 mV)
EKF 2 D	see diagram on previous page
EKF 2 K	see diagram on previous page

Transmission characteristics in audio channel

Intercarrier frequency	5.5 MHz
Frequency response	≤±1 dB, referred to deemphasis 50µs (not switchable)
Intercarrier S/N ratio, measured to CCIR 486-2 (peak value), meas. referred to +6 dBm, sinusoidal video modulation 0 to 5 MHz	≥43 dB, typ. 50 dB

Outputs

Video output (isolated)	BNC female connector (front/rear panel)
Internal resistance	75 Ω
Output voltage with standard CVS 0 signal	V_{pp} = 1.11 V (variable by ±1.5 dB)
Return loss up to 5 MHz	≥20 dB
Level control (only IF)	Manual or automatic, black level sampled
Control range	>34 dB, typ. 40 dB

[1]) Specified and indicated values are RMS values at synchronous peak.

Group delay characteristics

	Standard	B/G general	B/G Australia	B/G New Zealand	B/G Denmark	Receivers EKF 2	EKF 2 D	EKF 2 K	EKF 2 ZF
	Frequency MHz	Rated value ns	ns	ns	ns	Tolerance ns (RF)	ns (RF)	ns (RF)	ns (IF)
With sound trap	0	0	0	0	0	Reference	Reference	Reference	Reference
	0.25	−5	–	–	−5				
	0.5	–	−7	–	–				
	1.0	−53	−20	–	−53				
	2.0	−90	−56	–	−75		±15, Austr.: ±20	±15, Austr.: ±20	±15, Austr.: ±20
	2.25	–	−60	−60	–				
	3.0	−75	−40	−60	−75	±50			
	3.5	–	0	–	–				
	3.6	–	–	–	–				
	3.75	0	–	0	0				
	4.0	–	+90	–	–				
	4.43	+170	+170	+170	+170		±20[1])	±20[1])	±20[1])
Without sound trap	0.1 to 5.0	0	0	0	0	–	±15	±15	±15

[1]) Australia ±30 ns.

Audio output	balanced, floating; all outputs parallel
EKF 2	three-contact female connector (front panel), 30-contact connector (rear panel)
EKF 2 D, EKF 2 K, EKF 2 ZF	3-control coaxial port and 3-contact female connector 9RelKli6a (front panel) 30-contact connector (rear panel)
Output level at ±30 kHz deviation (f_{mod} = 500 Hz)	+6 dBm into 600 Ω (var. ±3 dB)
Distortion at ±30 kHz deviation	≤1.5%
Max. output level	+12 dBm
Internal resistance	≤25 Ω (40 Hz to 15 kHz)
Monitoring loudspeaker	continuously variable volume
Squelch	to suppress noise when audio carrier not present
Recorder output (for V_{in})	30-contact connector (rear panel), Z_{in} = 2 kΩ
Output voltage	about 0.5 V at V_{in} = 1 mV
IF output	BNC female connector (rear panel)
Internal impedance	50 Ω
Output voltage	V_{rms} approx. 200 mV (controlled)
Return loss	≥20 dB
Frequency response 33 to 40 MHz	≤±1 dB
Output 5.5 MHz signal	internal socket

General data

Rated temperature range	+5 to +35 °C
Operating temperature range	0 to +45 °C
Storage temperature range	−20 to +70 °C

Power supply	115/125/220/235 V +10/−15%, 47 to 63 Hz 50 VA (EKF 2: 40 VA)
Overall dimensions (W × H × D)	
19″ rackmount	483 mm × 132 mm × 384 mm
19″ bench model	492 mm × 161 mm × 392 mm
Weight	
19″ rackmount	8.2 kg
19″ bench model	10.7 kg
Colour	front panel: grey RAL 7001
Lettering	German/English
Accessories supplied	Power cable 025.2365.00 Description

Recommended accessories

30-contact female socket strip 063.9770.00 with connector housing (AF, 12 V DC; for recorder connection)
Front panel adapter 034.1074.00 and adapter bars 034.0410.00 to adapt 19″ rackmount to DIN 41 490 (520 mm) dimensions

Converting an EKF 2 D into an EKF 2 K

To convert a TV demodulator EKF 2 D into a TV measuring receiver EKF 2 K, the following are required:

Basic converter kit (for selective preamplifier)	EKF 2 K-U	288.2064.00
also one of the following preamplifiers, optional:		
Selective preamplifier	EKF 2 K-Z	
with filter for band I		288.2029.00
with filter for band III		288.2035.00
with filter for band IV/V		288.2041.00

Ordering information

Order designation ▶ TV Monitoring Receiver EKF 2, Bands I, III, IV/V, IF; CATV channels S1 to S20

	19″ rackmount	19″ bench model
Standard B/G	241.8914.51	241.8914.52
B/G, Australia	241.8914.83	241.8914.84
B/G, New Zealand	241.8914.81	241.8914.82
D/K, China 38 MHz	241.8914.33	241.8914.34
D/K, OIRT 38.9 MHz	241.8914.41	241.8914.42
I	241.8914.21	241.8914.22
K1	241.8914.11	241.8914.12
M, 38.9 MHz	241.8914.91	241.8914.92
M, 45.75 MHz	241.8914.93	241.8914.94

▶ TV Demodulator EKF 2 D, Bands I, III, IV/V, IF

19″ rackmount	19″ bench model
288.3019.51	288.3019.52
288.3019.83	288.3019.84
288.3019.81	288.3019.82
288.3019.39	288.3019.40
288.3019.41	288.3019.42
288.3019.21	288.3019.22
288.3019.11	288.3019.12
288.3919.91	288.3919.92
288.3919.51	288.3919.52

▶ TV IF Demodulator EKF 2 ZF, IF

19″ rackmount	19″ bench model
288.7814.51	288.7814.52
288.7814.83	288.7814.84
288.7814.81	288.7814.82
288.7814.33	288.7814.34
288.7814.41	288.7814.42
288.7814.21	288.7814.22
288.7814.11	288.7814.12
288.7814.91	288.7814.92
288.7814.93	288.7814.94

Order designation ▶ TV Measuring Receiver EKF 2 K

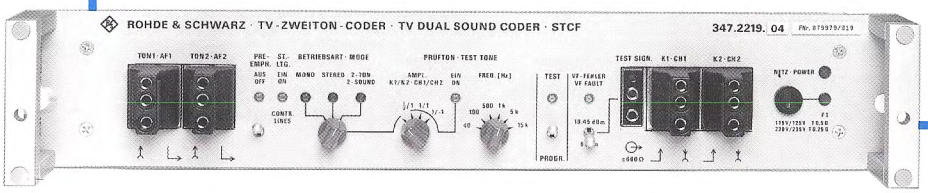
	Band I and IF 19″ rackmount	Band I and IF 19″ bench model	Band III and IF 19″ rackmount	Band III and IF 19″ bench model	Band IV/V and IF 19″ rackmount	Band IV/V and IF 19″ bench model
Standard B/G	288.3019.53	288.3019.54	288.3019.55	288.3019.56	288.3019.57	288.3019.58
B/G, Australia	288.3019.91	288.3019.92	288.3019.93	288.3019.94	288.3019.95	288.3019.96
B/G, New Zealand	288.3019.85	288.3019.86	288.3019.87	288.3019.88	288.3019.89	288.3019.90
D/K, China 38 MHz	on request	on request	on request	on request	on request	on request
D/K, OIRT 38.9 MHz	288.3019.43	288.3019.44	288.3019.45	288.3019.46	288.3019.47	288.3019.48
I	288.3019.23	288.3019.24	288.3019.25	288.3019.26	288.3019.27	288.3019.28
K1	288.3019.13	288.3019.14	288.3019.15	288.3019.16	288.3019.17	288.3019.18
M, 38.9 MHz	288.3919.93	288.3919.94	288.3919.95	288.3919.96	288.3919.97	288.3919.98
M, 45.75 MHz	288.3919.53	288.3919.54	288.3919.55	288.3919.56	288.3919.57	288.3919.58

TV DUAL-SOUND CODING

STCF

TV Dual Sound Coder STCF ♦ 40 Hz to 15 kHz

- Dual-sound/stereo/mono coder for dual-sound TV transmitters
- Automatic switchover by decoding data line
- Built-in test oscillator

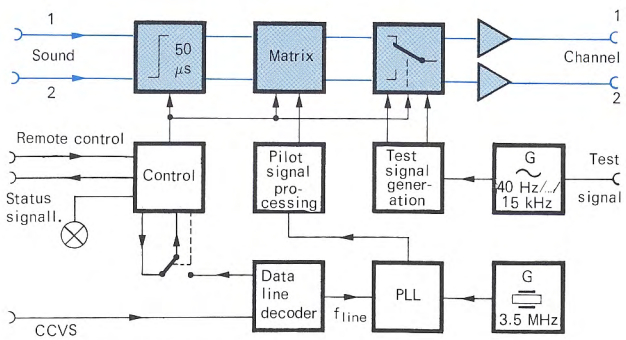


The **TV Dual Sound Coder STCF** is used for processing sound modulation signals for dual-sound TV transmitters. Based on two AF input signals, the STCF produces, under remote control, the coded channel signals 1 and 2 (including a modulated pilot-tone signal) for dual-sound, stereo or mono operation.

Identification, pilot frequency For mode identification, a 54.6875-kHz crystal-controlled pilot signal produced in the STCF is amplitude-modulated with the identification frequency of 274.1 Hz for dual-sound or 117.5 Hz for stereo operation (unmodulated in the mono mode). The pilot-tone and the identification frequencies are locked to the line frequency. The pilot signal is transmitted in channel 2.

Mode switchover The required mode (dual-sound/stereo/mono) can be selected via remote-control lines, automatically by the program signal or manually on the set. For switchover by the program signal, the STCF contains a data line decoder with a nonvolatile memory which maintains the current operating mode in the event of a data line failure. Switchover via the remote-control lines is possible also in this case. The mode of operation is signalled by front-panel indicators or via relay contacts.

Test signal generation For program simulation and measuring purposes, the STCF includes an AF generator whose output signal can be connected to channels 1 and 2 and, in the different modes of operation, permits measurement of crosstalk attenuation, deviation stability, amplitude and phase equality, or harmonic distortion.



Block diagram of STCF, blue: signal path

Specifications

AF inputs (sound 1 and sound 2)

Frequency range	40 Hz to 15 kHz
Input impedance (set by links)	≥3 kΩ or 600 Ω (bal.)
Nominal input level	+6 dBm
Preemphasis	50 µs (can be disabled in test mode)

Channel outputs 1 and 2 (coded)

Frequency range	40 Hz to 15 kHz
Channel 2, additionally	pilot subcarrier with AM
Output impedance (unbal.)	≤15 Ω
Level (input level +6 dBm)	+6 dBm ±0.2 dB

Data line decoder input

Input impedance	75 Ω
Required input voltage	1 V_{pp} CCVS ±3 dB
Permissible frequency deviation from f_{line}	$\leq 1 \times 10^{-4}$

Pilot signal

Frequency	54.6875 kHz ±5 Hz (3.5 times f_{line})
Modulation	AM, 50% (40 to 60%)
Identification frequencies	dual sound: 274.1 Hz (f_{line}/57) stereo: 117.5 Hz (f_{line}/133) mono: unmodulated
Output voltage (in channel 2)	−15.6 dBm ±2 dB
Monitoring output	provided

Distortions

Unweighted S/N ratio	≥70 dB } preemphasis: 50 µs;
Weighted S/N ratio (CCIR 468-2)	≥75 dB } reference: +6 dBm
Total harmonic distortion	
40 Hz to 5 kHz	≤0.2% (V_{out} +6 dBm)
60 Hz to 5 kHz	≤0.2% (V_{out} +12.5 dBm)
Intermodulation d_2	≤0.1% } 5 to 15 kHz;
d_3	≤0.2% } V_{out} +12.5 dBm
Frequency response flatness, 40 Hz to 15 kHz, without preemphasis	≤0.2 dB, reference: 500 Hz
Crosstalk	dual sound: ≥80 dB } 40 Hz to stereo: ≥50 dB } 15 kHz

Test signals

Frequencies (switch-selected)	40/100/500 Hz/1/5/15 kHz ±3%
Harmonic distortion	≤0.3%
Operating modes (selectable)	channel 1/channel 2 0 dBm/+6 dBm +6 dBm/+6 dBm (in phase) +6 dBm/+6 dBm (anti-phase)

Dual-sound/stereo/mono switchover

remote-controlled (selected by links)	control lines/data line
on STCF	by front-panel switch
Mode signalling	indicators and relay contacts

General data

Rated temperature range	+5 to +45 °C
Power supply	115/125/220/235 V +10/−15%, 47 to 63 Hz (30 VA)
Dimensions, weight (19″ rackmount)	483 mm×88 mm×506 mm, 5 kg

Ordering information

Order designation

(19″ rackmount) ▶ TV Dual Sound Coder STCF 347.2219.04

Accessories supplied

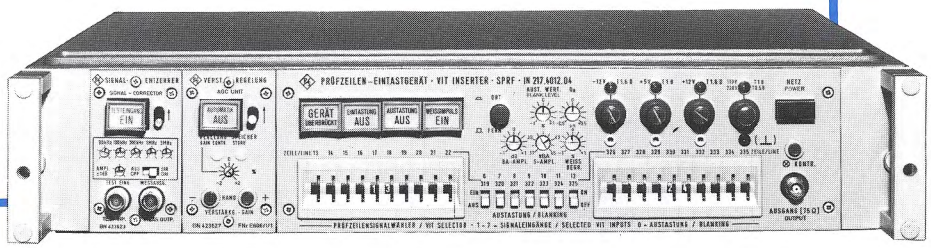
Power cable, spare lamps, spare fuses

Mating connector kit STCF-Z2	347.2791.02
Mating connector kit STCF-Z2 with DIN adapter	347.2791.03
Three-contact connector (9 REL STP 6 AC)	019.0458.00

VIT Inserter SPRF

- Insertion and erasure of test and data signal lines, max. seven gate circuits
- White-level limiting and sync-pulse regeneration
- Automatic through-connection between input and output in the case of a failure
- Plug-ins for automatic gain and frequency-response correction

SPRF



The **VIT Inserter SPRF** inserts test signals from a signal generator into an **ongoing program** signal. Prior to signal insertion, the SPRF provides for heavy attenuation of any incoming test lines. The insertion channels can be assigned as required to any one or to several test lines and erasure of other test lines can be set by means of a selector switch on the front panel. The normal SPRF version comes with four test-line gate circuits. Please specify different requirements (maximum **seven gate circuits**) when ordering.

The signal source can be either a generator which provides all the insertion test signals on one line (eg Video Test Signal Generator SPF 2 or VITS Generator & Inserter SKF) or a device which has a separate line for each signal (Insertion Signal Generator SPZF). Application of special test signals is possible via the additional gate circuits. Thanks to additional plug-ins, the SPRF features automatic correction facilities which make it especially suitable for use as an in-service device ahead of the transmitter input. This is the advantage of the SPFR over the SPF 2 and SKF which are also capable of test signal insertion.

The SPRF contains a **sync-pulse regenerator** and a **white-level limiter.** Thus it can be used for applications which, in addition to test signal insertion and/or erasure, require a constant sync-pulse amplitude and do not allow the picture component to exceed the nominal white level even briefly.

Plug-ins for extension The SPRF is fully operational without plug-ins. However, for gain and frequency-response correction, the **AGC Unit** and **the Automatic Colour Control (ACC) Plug-in** are available (see page 59).

The **AGC Unit** should be included in every SPRF since, in conjunction with the white-level limiter and the sync-pulse regenerator, it ensures that – at the outputs of the basic unit –

- the luminance component of the program signal never exceeds 0.7 V_{pp} picture signal,
- the full luminance information is available after control of a gain variation, and
- the standard ratio of luminance bar (program signal) to sync pulse is maintained.

Level variations are brought back to the nominal value slowly and unnoticed by TV viewers. When DC voltage jumps with amplitudes of up to ±3 V occur, the SPRF delivers a standard signal again after a maximum of five lines.

The **ACC Plug-in** corrects frequency-response errors and thus restores the correct amplitude of the colour subcarrier.

The SPRF is not affected by equalizing pulses; however, due to the sync-pulse regeneration, it does not process any signals including SIS pulses. **Faulty synchronization** does not affect the program signal but test-line insertion is stopped until regular conditions are restored.

Signal insertion/erasure

Insertion/erasure:	lines 13 to 22 (1st field) and lines 326 to 335 (2nd field)
Erasure:	lines 6 to 12 and lines 319 to 325 (e.g. for noise voltage measurement)
Luminance bar:	can be inserted into lines 17 and 330

Program-signal input, automatic bypassing The instrument has a program input on the rear panel which, in the case of failure, is automatically connected to the main output. Bypassing as well as all other important instrument functions can be selected by remote control or from the front panel.

Pulse outputs for line-frequency synchronization For compatibility with other types of signal generators, various pulses are available at rear outputs.

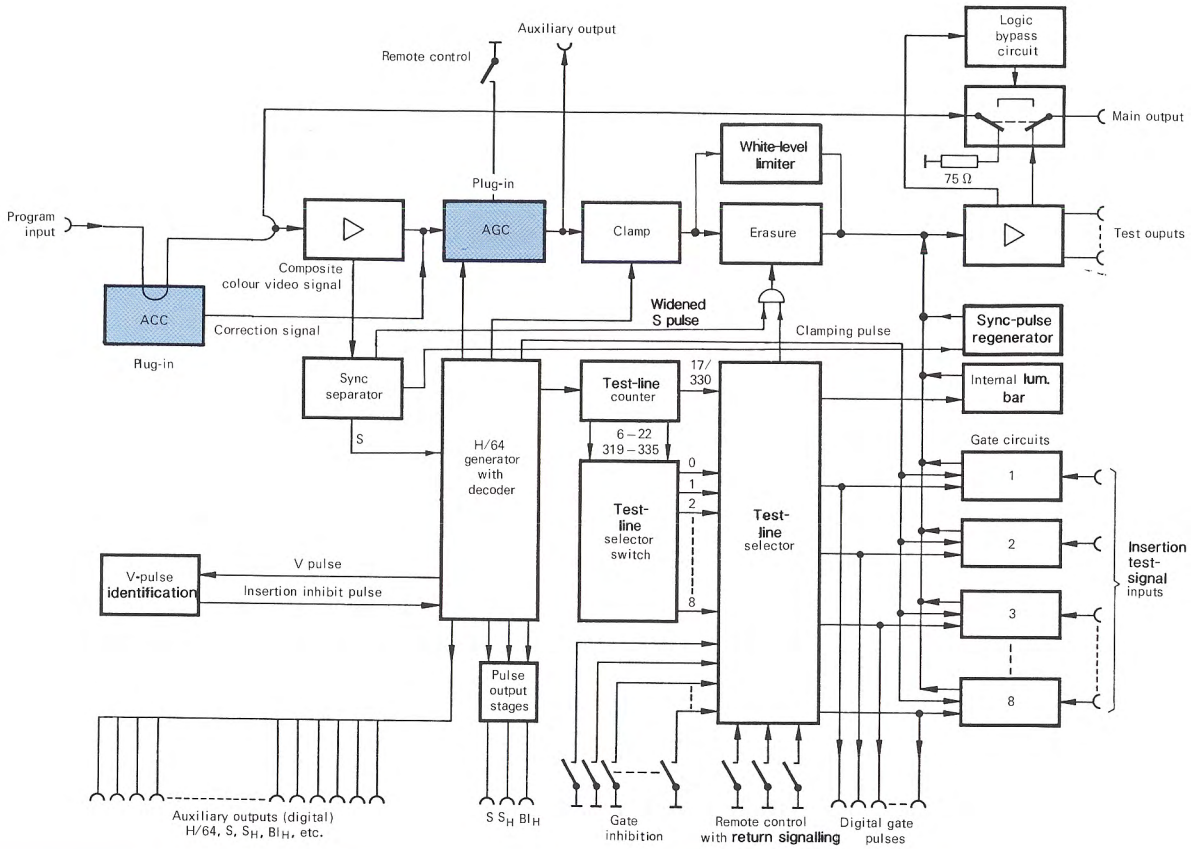
All **transmission characteristics** of the SPRF comply at least with the following specifications:

EBU: Performance specification of equipment for EBU insertion signals (Tech. 3209, June 1974), Com. T. (M) V.14
CCIR: Rec. 473-3, Geneva 1982
ARD: Standard specifications 8/13.2.1: VIT inserter (October 29, 1969)
FTZ: Draft of standard specifications FTZ 155 Pfl. 3 of October 1968

Additional characteristics The flexible logic circuitry for control and monitoring meets the diversified operating requirements encountered in the studio, program link and transmitter station.

In addition to test signals, the SPRF permits insertion of any other line-repetitive or preprogrammed signals. These include, for example, **data signals** (e.g. identification signals for type and origin of program, test results or control commands).

TEST SIGNAL INSERTION



Specifications

(for plug-ins see next page)

Inputs

Program input . . . . . 75-Ω input (through-connected in bypass mode)

Test line inputs (each followed by separate gate circuit) . . . . . up to seven 75-Ω inputs for line-repetitive signals or previously erased test line signals

Outputs

Output of program input . . . . . 75-Ω termination (normal)

Auxiliary output . . . . . 75-Ω output; input signal (after AGC if required) available for synchronization of a colour-subcarrier oscillator in the SPZF using the burst of the program signal

Main output . . . . . program output containing the newly inserted test-line signals; in the by-pass mode connected to the program input

CVS outputs . . . . . four 75-Ω outputs on rear panel and one on the front delivering the signal of the main output

Pulse outputs . . . . . 75-Ω outputs, 4 V_{pp}, rise time ≈230 ns

- Sync signal . . . . . sync component separated from program signal
- Horizontal sync signal . . . . . line-repetitive sync signal of 4.7-µs half-amplitude duration
- Horizontal blanking signal . . . . . line-repetitive blanking signal of 12-µs half-amplitude duration

Digital outputs . . . . . in +5-V TTL for special purposes

Remote control . . . . . by earthing of a control line

Status outputs . . . . . floating make contacts (can be individually changed to break contact)

Transmission characteristics

Input signal . . . . . CVS, 1 V_{pp} (if desired 0.7 V); sync component 30%, picture component 70%

Return loss of all inputs and outputs . . . . . ≥34 dB (up to 10 MHz)

Sync-pulse regeneration . . . . . amplitude and rise time; amplitude can be set on front panel

White-level limiting . . . . . luminance component limited to 0.7 V (variable by ±1%)

Frequency-response flatness, referred to 200 kHz . . . . . <±0.15 dB (up to 5 MHz)
0 to −1 dB (up to 10 MHz)

20T pulse distortion . . . . . amplitude <0.1 dB, delay <±5 ns ≙ k_{20T} <0.25%

2T pulse-to-bar ratio . . . . . 100% ±0.5% ≙ $k_{2T/B}$ <0.15%

15-kHz tilt . . . . . <0.25% ≙ k_B <0.15%

Differential gain
- at standard level . . . . . <0.2%
- 3 dB above standard level . . . . . <0.4%

Differential phase
- at standard level . . . . . <0.15°
- 3 dB above standard level . . . . . <0.3°

(APL between 10 and 90%)

S/N ratio (weighted) . . . . . >75 dB (rms, without hum)

Hum suppression . . . . . >60 dB (peak value)

Internal luminance bar . . . . . from 12/64 H to 22/64 H

Rise/fall time . . . . . 200 ns +0/−10 ns

Overshoot, tilt, rounding . . . . . <0.5%

Amplitude (main output) . . . . . 0.7 V ±0.5%

SP.F-E Plug-ins see next page

General data

Rated temperature range . . . . . 0 to +45 °C

Power supply . . . . . 115/125/220/235 V +10/−15%, 47 to 63 Hz (60 VA)

Dimensions, weight
- 19″ bench model . . . . . 484 mm×105 mm×509 mm, 15 kg
- 19″ rackmount . . . . . 483 mm×88 mm×498 mm, 11.5 kg

Ordering information

Order designation (with four gate circuits) . . . . . ▶ VIT Inserter SPRF

19″ bench model 217.4012.04

19″ rackmount 217.4012.03

Further gate circuits 128.4999.02

Accessories supplied

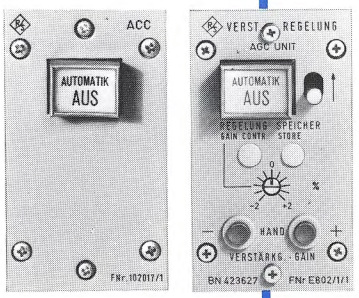
Termination RMF (75 Ω), power cord, adapters for operation of individual circuit cards outside the set

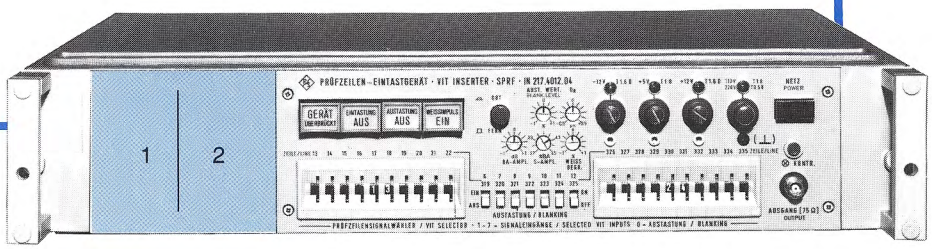
Plug-ins SP.F-E for VIT Inserter SPRF

SP.F-E

- Automatic gain control
- Automatic frequency-response correction

1 2





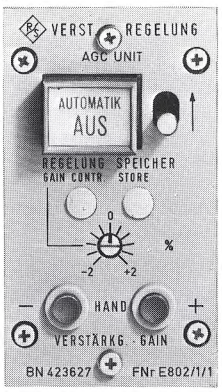
1

The **Automatic Colour Control (ACC) Plug-in** is used for automatic correction of frequency-response errors frequently caused in practice by under- or over-equalization in video cables (roll-off frequency response).

Elimination of deviations at the subcarrier simultaneously removes errors on the 2T pulse, streaking and tilt.

The ACC Plug-in can be switched to linear operation by a button on the front panel.

2



The **AGC Unit** automatically controls the incoming program signal to a constant amplitude of 0.7 V_{pp} picture signal. If the luminance bar, the test line or the power supply fails, the last existing gain is stored. The gain can also be varied manually. In conjunction with the sync-pulse regenerator and the white-level limiter of the SPRF, the AGC Unit prevents transmitter overmodulation and is thus particularly suitable for use ahead of TV transmitter inputs.

Specifications

Input level range	±3 dB about nominal level (basic unit)
Control range	+4 to −2 dB
Error limits	±2%
Residual error on 2T pulse and streaking at range limits	≤±2% (for pure cable error)
Frequency-response error with no test line or with correction switched off	≤±2%
Nonlinear distortions	≤0.2°, ≤0.2%
Control speed	approx. 0.1 dB/s (for small errors) to 0.3 dB/s (for large errors)
Disabling	by front panel pushbutton with lamp lighting to indicate disabled control (no remote control)
Order designation	▶ Automatic Colour Control (ACC) Plug-in SP.F-E 213.5714.03

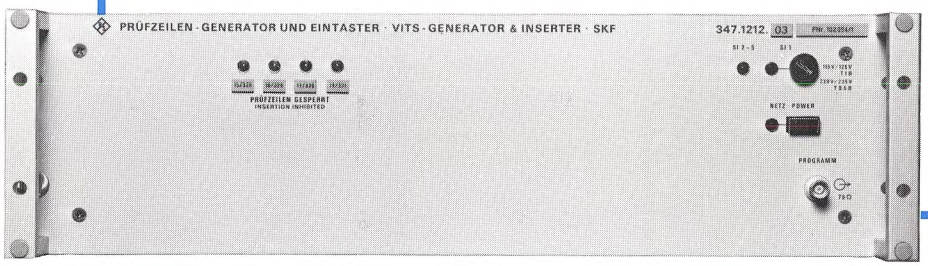
Specifications

Input signal of basic unit	CVS, 1 V_{pp} ±3 dB (can be modified to 0.7 V ±3 dB)
Luminance-bar control	electronic, with magnetic storage of gain
Control range	±3 dB
AGC reference level	luminance-bar amplitude 0.7 V_{pp} ±0.5% (variable by ±2%)
Control speed	0.2 to 0.5 dB/s
Switchover to manual operation	by pushbutton or remote control
Manual control (AGC off)	by pushbuttons + and − on front panel or by remote control
Order designation	▶ AGC Unit SP.F-E 111.3165.02

TEST SIGNAL INSERTION

SKF

VITS Generator & Inserter SKF



♦ Standards B, D, G, H, K, L

- Digital signal generation and test signal insertion
- Remote-controlled test line inhibition
- Test line detector for program monitoring
- Automatic program path bypassing and switchover to substitution signal possible

The **VITS Generator & Inserter SKF** produces all the video signals required for insertion signal measurements (in accordance with the individual standards) and inserts test line signals into the program signal. The SKF is ideal for **in-service use;** it combines a number of separate instrument functions:

- test signal generator
- test signal inserter
- substitution signal generator

Models To cover the wide range of applications, several SKF models fitted with different additional modules are available (see below).

Test signal generator Waveforms complying with different TV standards and national requirements are stored in the memory of the SKF to ensure general-purpose application of the generator. Thus not all the signals generated can be used for one specific standard (e.g. Federal Republic of Germany: signals 1 to 5, 15 and 16 only).

Substitution program In the event of a program signal failure, automatic switchover of all SKF models to an internal or external substitution signal is possible. For this purpose the recommended junction panel which contains the switchover facility must be fitted. The factory-set substitution program is the black-burst signal with test lines but any other signal produced by the SKF can also be coded for use as the replacement signal. The external substitution signal is applied to the junction panel.

Bypassing The recommended junction panel includes another switchover facility which through-connects the signal path if the SKF fails, is disconnected or withdrawn from the rack.

Test signal insertion Internal coding permits the produced test signals to be inserted into any line, even into several lines at the same time. Thus any test lines included in the incoming program signal can be replaced by inserting new, undistorted signals, be erased by black lines or can pass unaffected. The insertion can be inhibited by remote control for four preset line pairs.

SKF model Application:	**04** Studio input	**06** Teletext test line insertion	**66** Production plants	**07** OB vans	**08** Studio output
Additional modules					
Signal inputs	1	2	2	1	3
Test line detector				●	●
Data line detector					●
Teletext test line		●	●		
Teletext pages			2		
Generator outputs	1	1	1	2	1

Test line detector (models 07 and 08) The luminance bar and staircase amplitudes are evaluated in internally preset lines for monitoring the incoming test line signals. If the amplitude of at least one component is smaller than 50% of nominal value, erasure of the incoming and insertion of new test signals is enabled (internally also codable for additional lines).

Data line detector (model 08) The data line detector is used to check whether data are transmitted in certain preset lines. If so, the insertion of new data signals is inhibited.

Teletext test line (model 06) This SKF model delivers a teletext test signal for line 328 to monitor all transmission characteristics for the teletext service.

Teletext pages (model 66) For special use in production, this SKF model is fitted with an internal memory storing two complete teletext pages with an interlaced teletext test signal.

Specifications

Generator

Available signals:	1	flat field (black line)
	2	CCIR-331 signal, multi-pedestal, PAL
	2 special	CCIR-331 signal, single-pedestal, PAL
	3	CCIR-18 signal, multiburst (Bundespost)
	4	CCIR-330 signal, PAL
	4 special	CCIR-330 signal, PAL (4 steps)
	5	CCIR-17 signal
	6	test signal 20/333, standard I
	7	test signal 19/332, standard I
	8	red area signal, 75/0/75/0
	9	2T sequence
	10	100% luminance signal
	11	barra rossa (RAI)
	12	250-kHz squarewave
	13	100/0/75/0 colour bar (EBU)
	14	50% luminance signal
	15	2T pulse at mid-line
	16	EXT 1 (option: EXT 2)
Signals 6 to 15 can be used only with specific SKF models.		
Signal level (calibrated)		700 mV ±1%
Program substitution signal		black burst signal with insertion test signals (factory-set; other signals codable)
S pulse output signal		$-4\ V_{pp}$ into 75 Ω
External video signals		for instance insertion test, data, teletext signals
Input impedance		75 Ω
Input voltage		700 mV_{pp}
Gain		0 dB ±0.1 dB (up to 6 MHz)
Clamping		gated black level clamping

Program path, test signal insertion and erasure

Impedance	75 Ω
Clamping	gated black level clamping
Frequency response flatness (referred to 200 kHz)	±0.1 dB (up to 6 MHz)
Differential gain	≤±0.2%
Differential phase	≤±0.2°
Group delay error	≤5 ns (at 4.43 MHz)
S/N ratio (200 kHz to 5 MHz, weighted)	
Program signal path	≥75 dB (rms)
Erased/inserted test signals	≥72 dB (rms)
Test signal insertion	into the program signal and into the internal program substitution signal
Disabling of test signal insertion	via four control lines
Signals inserted	in accordance with CCIR Rec. 473-3 and all signals generated
Program blanking	in all lines into which a new or a black signal is inserted
Test line allocation	by internal coding
Line region	8 to 22/321 to 335
Teletext test signal (mod. 06 only)	line 328 (others codable)
Test line detector	monitoring of incoming test lines 8 to 22/321 to 335 (factory-set to 17 and 330)
Signal elements monitored	luminance bar and staircase
Status signal "test line absent"	in the case of <50% signal amplitude for at least one signal element
Data line detector (model 08 only)	monitoring of one incoming data line (factory-set to 16/329)
Monitored criteria	frequency and duration of run-in sequence
Enabling of external substitution data line	in the case of data line absence
Line and field synchronization	
when applying a program signal	within 2 s
after phase discontinuity	during one field
Colour subcarrier and PAL switching phase synchronization	within 3 s

Control of external bypassing device

Status signals (on rear female connector)	
"set switched on"	-12 V, Z_{out} = 33 Ω
"program sync pulse present"	-12 V, Z_{out} = 68 Ω

General data

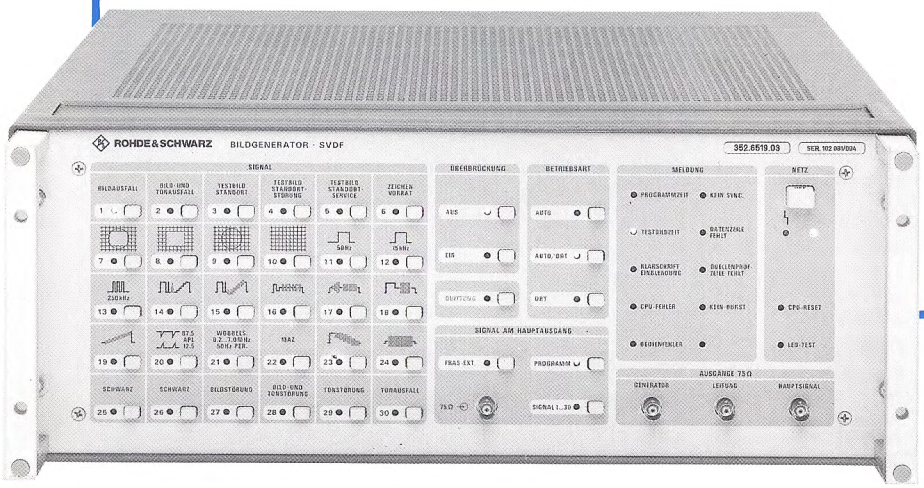
Rated temperature range	+5 to +45 °C
Connectors	BNC, 75 Ω; return loss (up to 6 MHz) ≥34 dB
Program input, video input, substitution program output	rear panel
Program output	front and rear panels
Power supply	110/125/220/235 V +10/−15%, 47 to 63 Hz (50 VA)
Dimensions, weight	
19″ rackmount	483 mm×132 mm×506 mm, 8.6 kg

Ordering information

Order designation	▶ VITS Generator & Inserter SKF
19″ rackmounts	Stds B, D, G, H, K, L
Basic model	347.1212.04
Model with teletext test line	347.1212.06
with two teletext test pages	347.1212.66
for OB van	347.1212.07
with test line and data line detector	347.1212.08
Please enquire for signal EXT2	
Junction panel (with bypass circuit) for 19″ and DIN racks	283.2814.13

SVDF

Video Test & Pattern Generator SVDF ♦ Standards B/G, H



- Digital generation of test-pattern, text and test signals
- Automatic connection of substitution program and through-connection of program path
- Test signal insertion into program and substitution signals
- Text insertion
- Remote control in parallel or serial mode or by way of data line

See also under generators on page 80.

IEC 625 Bus

The **Video Test & Pattern Generator SVDF** is a general-purpose **video signal generator** which, thanks to its specific characteristics, is suitable for **in-service use** in TV transmitter stations and at TV junction points as well as in TV studios and TV production plants.

Generator The generator digitally produces 30 full-field signals with programmed texts as well as test patterns and signals. User-specific programming of six full-field signals is possible. The test pattern or test signal which can be selected on the front panel is always present at the generator output.

Substitution program In the event of program signal failure, a clock-synchronous pulse frame (sync pulse plus burst) is immediately available and a preset substitution signal is delivered after an adjustable wait time. The substitution signals provided are the FuBK test charts to German standard (with and without circle and with inserted transmitter identification) and different text pages furnishing information to the viewers in the case of a disturbance.

Test signal and text insertion Test signals can be inserted into all the signals and into the program signal applied. Text insertion is possible both for the substitution and the program signal.

External signals such as teletext and data signals can be applied via three inputs. In addition, variable text can be entered by way of the data lines and via the serial interface (see below) and inserted into a substitution signal or the ongoing program.

Operation is possible via four hierarchical interfaces with the local mode as the highest priority:

- **Local operation** permitting selection of individual signals and operating modes from the front panel
- **Bit-parallel** remote-controlled interface with floating return signalling of operating state
- **Serial** interface (RS 232 C/V.24) for control via a station computer
- **IEC/IEEE bus interface** (IEEE 488) for control via a station computer
- Built-in **data line decoder** for data lines 329 and/or 16

Data line In accordance with the address capability of the data line, the information included in the data line can be limited to individual sites, regional groups or supra-regional areas. The same holds for systematic selection of the programmed generator signals and for information to the viewers (e.g. trade and commerce).

Junction panel The associated junction panel contains an adjustable **cable equalizer** (3 dB basic attenuation) and a passive **bypass circuit** which can be selected and responds automatically in the case of device failure.

Specifications

See also page 80

Generator

Available full-field signals	text pages for vision and/or sound failure or vision and/or sound disturbance, FuBK test charts to German standard with and without circle and with inserted transmitter identification, FuBK test charts to German standard announcing short-term or long-term interruption for technical reasons; 50-Hz, 15-kHz and 250-kHz square-wave signals; CCIR insertion test signals; calibration signal (standard video level 1 V); sawtooth signals with and without automatic switchover of APL; video sweep signal 0.2 to 7 MHz; VTR test signal; 100/0/75/0 colour bar; red area signal, 75% saturation; unprogrammed (all-black picture), for user-specific signals
Additional insertion test signals	2T reflection signal, national insertion test signal variants and optionally teletext insertion test signal or 4 teletext test pages
Signal level (calibrated)	700 mV ±1%
Substitution program signal	local or remote-controlled selection
Signals	FuBK test chart with transmitter identification or text pages
Wait time, int. (adjustable)	approx. 1 to 10 s

Specifications of SVDF, continued

Video signal inputs for teletext, test line and data signals ..... 3 BNC female connectors
Input voltage ..... 700 mV_{PP}
Input impedance ..... 75 Ω
Return loss ..... >34 dB (up to 6 MHz)
Gain ..... 0 dB ±0.1 dB (up to 6 MHz)
Clamping ..... gated black level clamping
Variable texts ..... via serial interface or by way of data line

Modes

Auto ..... automatic switchover to substitution signal in the event of program failure; text insertion and selection of substitution signal via one of the remote-controlled interfaces
Local ..... signal selection and program/substitution signal switchover on front panel
Auto/local ..... same as auto; in addition, signal selection for generator output on front panel as long as no substitution signal or text insertion is used

Program path, test signal insertion and erasure

Impedance ..... 75 Ω
Clamping ..... gated black level clamping
Frequency response flatness (referred to 200 kHz) ..... ±0.1 dB (up to 6 MHz)
Differential gain ..... ≤±0.2%
Differential phase ..... ≤±0.2°
Group delay error ..... ≤ 5 ns (at 4.43 MHz)
S/N ratio (200 kHz to 5 MHz, weighted)
Program signal path ..... ≥ 75 dB (rms)
Erased/inserted test signals ..... ≥ 72 dB (rms)
Test signal insertion ..... into the program signal and into the internally produced full-field signal
Signals inserted ..... test signals in accordance with CCIR Rec. 473-3, 2T reflection signal, teletext test signal, three external signals
Program blanking ..... in all lines into which a new or a black signal is inserted
Test line allocation ..... by internal coding
Line region ..... 6 to 22/319 to 335
Test line detector ..... monitoring of incoming test lines 8 to 22/321 to 335 (factory-set to 17 and 330)
Signal elements monitored ..... luminance bar and staircase
Status signal "test line absent" ... in the case of signal amplitude < 50% for at least one signal element

General data

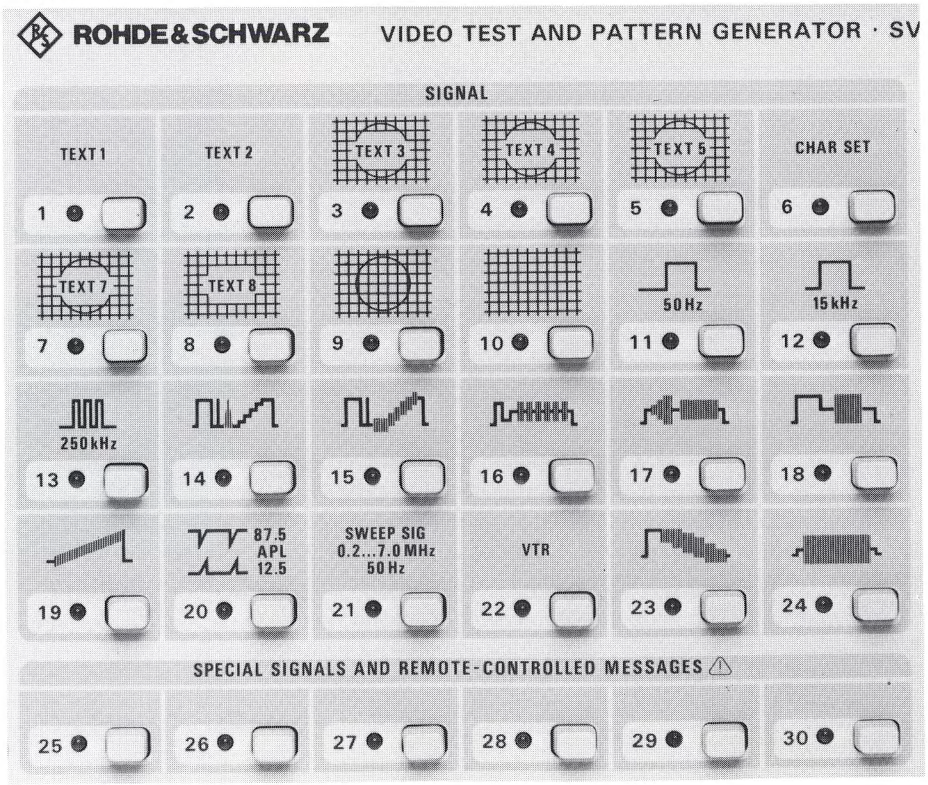
Rated temperature range ..... +5 to +45 °C
Connectors ..... BNC, 75 Ω
Return loss ..... ≥34 dB (up to 6 MHz)

	front panel	rear panel
Program signal input		1
CCVS input	1	
Video signal inputs		3
Program signal outputs		3
Generator outputs	1	1
Colour subcarrier output		1
Sync pulse output		1
Program test output	1	
Line test output	1	

AC supply ..... 110/125/220/235 V +10/−15%, 47 to 63 Hz (150 VA)
Dimensions, weight
19″ rackmount ..... 483 mm × 177 mm × 509 mm, 12 kg

Ordering information

Order designation ..... ▶ Video Test & Pattern Generator SVDF
19″ rackmount, Stds B/G, H 352.6019.03
Junction panel (with cable equalizer and bypass circuit) 352.6219.03



The signals for test, measurement and program modes are selectable using the keyboard on the left-hand half on the SVDF front panel

TV DATA LINE CODING

DGF

TV Data Line Coder DGF

- Picture and CCV signals
- Serial and parallel data entry
- Alphanumeric display

The **TV Data Line Coder DGF** converts **operational information** to be transmitted with the TV signal and data of the **video program system** (VPS) into the data line format. For general-purpose use it is fitted with different input and output channels.

Data line The data line (standard lines 16 and 329, used lines 10 to 22/323 to 335) was originally used for TV in-service monitoring and control. Since the introduction of the video program system, it also provides viewers with important information. It is used for transmitting:

- program source codes
- audio data, such as the TV dual-sound operating mode
- audio measured values of the Audiodat system
- signal-specific data
- OCR transmissions in ASCII
- VPS labels, and
- messages and commands

The additional VPS information enables the viewer to record programs on video recorder automatically and in synchronism with the broadcast.

DGF features The DGF offers a range of excellent features for data conversion:

- data input via 11 parallel and 2 serial interfaces
- programmable DZ start code for NAT or EBU standard or user definition
- control via keys or console
- alphanumeric LED display of transmitted data values (8 characters) with number and display code
- VPS message clearly displayed in plain text
- LED display of programmed TV field
- insertion of data line into the program signal and output as a CCVS signal
- output of data line as a video signal for insertion into the program signal by the test line insertion unit

Data link The serial input channel enables a **data link to** be set up **together with the TV data line decoder (DEF).** The combination of DGF and DEF enables modifications to the information of individual data words or takeover of the entire contents of the DEF data line.

Output signals The information converted into data line format by the DGF is available at separate outputs as a data line without sync components for transmission to a test signal inserter and in the form of a data line already inserted in the CCVS.

Specifications

Video input

Input signal	CCVS signal
Input	75 Ω bridge-type filter
Return loss up to 7 MHz	>36 dB
Input voltage V_{pp}	1 V (±6 dB functional range)
Permitted CCVS signal features	
2T pulse-amplitude error	±15% (ref: white pulse) or
S/N ratio of input signal (unweighted) up to 5 MHz)	≥29 dB or
Hum superposition	50% (ref.: picture signal)
SIS and TV-PCM2	permitted

Data inputs

Parallel input channels	11 × 8 bits (TTL-compatible)
Serial input channel	CCIR V.24/EIA RS-232-C
Transmission rate	50 to 19,200 Baud
Serial console interface	2 CCIR V.24/EIA RS-232-C
Transmission rate	50 to 2400 Baud

Data outputs

Output signal	2 CCVS with inserted data line 1 picture signal data line
Outputs	2; 75 Ω
Return loss up to 7 MHz	>34 dB
Gain	0 dB ±0.2 dB
Frequency response up to 7 MHz	<±0.3 dB (ref.: 15 kHz)
Bar tilt 50 Hz/15 kHz	<0.5%
Differential amplitude (1 V CCVS)	<0.3%
Differential phase (1 V CCVS)	<0.3°
S/N ratio (weighted)	>65 dB_{rms}
Data signal level	0.5 V ±5%
Signal shape	cosine-square pulse
Half-amplitude duration	200 ns ±10 ns
Overshoot and undershoot	≤4%
Start of data line signal referred to S pulse leading edge	11.6 µs + 0.5/−0.3 µs

Display

Display for	start code, data words
Start code (for selectable)	NAT/EBU standard/user
Data word readout (selectable)	8 digits (ASCII)
Code (selectable)	binary octal, decimal, hexadecimal, ASCII, interpretation
Word and field selection	by pushbuttons

General data

Rated temperature range	+5 to +45 °C
Operating temperature range	0 to +55 °C
Storage temperature range	−40 to +70 °C
AC supply	100/120/220/240 V +10/−15%, 47 to 63 Hz (30 VA)
Dimensions, weight	
19″ rackmount	483 mm×44 mm×506 mm, 5.2 kg
Colour of front panel	grey, RAL 7035

Ordering information

Order designation	▶ TV Data Line Coder DGF
19″ rackmount	812.0714.03

Accessories supplied

Power cables, terminating resistor RMF 2 (75 Ω), spare fuses

Recommended extras

Guide rail with bridging unit for 19″ racks ... DGF-Z	812.1110.03
or	
BNC connector and two 72-contact connectors (DIN 41 622), consisting of:	
72-contact female connector, 2 required	246.0834.00
Handguard, 2 required	528.6966.00
Feeler sockets, 4 required	548.1660.00
Panelling	462.9410.00

TV Data Line Decoder DEF ♦ Lines 10/323 to 22/335 DEF

- Parallel and serial data word output
- Data word display or text insertion depending on model
- Measurement of bit error rate

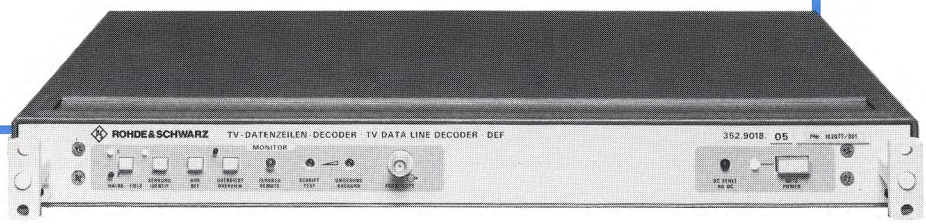


Photo: DEF model 05 for text insertion

The **TV Data Line Decoder DEF** permits microcomputer-aided evaluation of the data line pair transmitted with the TV signal. To this effect, it can be coded for lines 10/323 to 22/335 (standard data lines: 16 for source and 329 for section) and switched to the first or the second field. Output and display of the 13 data words available per line are dependent on the model:

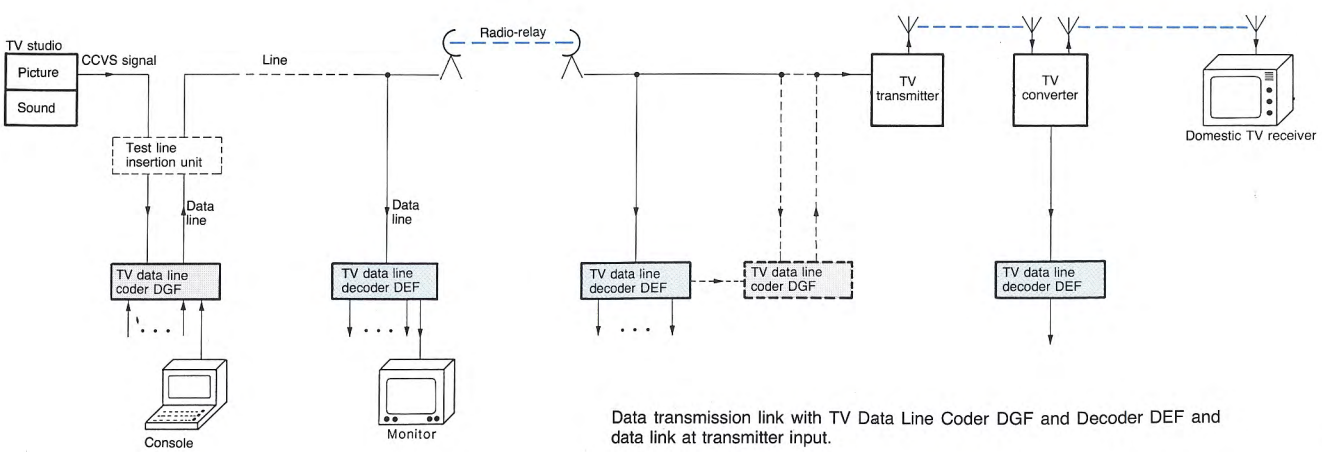
Model	**02**	**03**	**05**
Data output: parallel serial (V.24/RS 232-C)	1 word codable	13 words (1 word or entire data line)	1 word
Data word display	in words on display	in words on display	listed on monitor

Data line The data line is particularly used to identify its CCVS signal: through the source data line in the first field and the section data line in the second field. The following is also possible: transmission of audio data for identifying the operating mode in the TV dual sound system, audio measured values of the Audiodat system and signal content data (eg first, second or third channel, test chart/program, news/sport) and OCR transmissions in ASCII, addressed transmission of messages and commands (eg remote control of transmitters, slide control with information for the viewer), etc. The required broadcast can be recorded automatically and simultaneously due to additional information for the video program system (VPS), after evaluation in the viewer's video recorder.

Basic unit – DEF model 05 The contents of the data words, messages and measurement results are read out on an eight-character alphanumeric display. The keyboard can be used to select any wanted word (words 3 to 15) from a data line for display in binary, octal, decimal, hexadecimal or as ASCII characters. The display mode and the number of the selected word are read off on the right and left in the alphanumeric display. The field can also be selected using pushbuttons. An additional measurement function of the data line decoder enables the bit error rate to be determined during data transmission.

Output The data line decoder is provided with both a parallel interface with an acknowledgment signal and a serial output channel (RS 232-C) for transmitting wanted data to peripheral equipment. The parameters (field and word number) of the data word to be read out can be set on the keyboard for both interfaces.

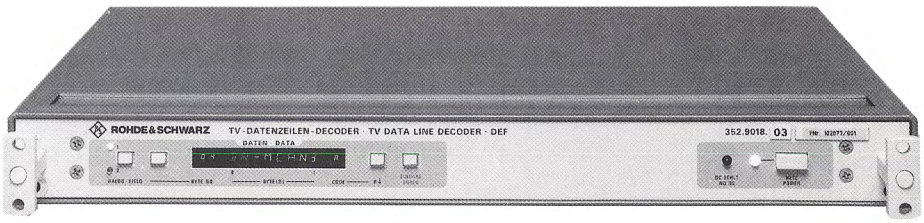
A reference identification which may be used for comparison with constant source or section identification can also be selected in the same way. If identification is incorrect and if a limit value of the 10^{-3} bit error rate is exceeded with data transmission in the video signal, error signals are set at an internal message output.



Data transmission link with TV Data Line Coder DGF and Decoder DEF and data link at transmitter input.

TV DATA LINE DECODING

DEF – TV data line decoder



DEF model 03 with alphanumeric display

Data line numbers The number of the data line (standard at 16/329) of lines 10/323 to 22/335 can be set using internal coding switches. This avoids a simulation of the data line start code by videotext or video information.

Start code In addition to the permanently set data line start code in compliance with German standards, the DEF model also detects another start code which is selectable via coding switches in accordance with EBU standards or user definition.

Parallel output – DEF model 03 To expand the DEF model 02, the DEF model 03 (illustrated above) is equipped with twelve additional parallel output channels. This enables the parallel output of all 13 wanted words in the section data line.

Text insertion – DEF model 05 In contrast to the DEF model 02, the data line information in the DEF model 05 (start code, data word contents, messages, measurement results) is inserted into the television picture as a main menu on a monitor. The main menu on the monitor can be reduced by pressing keys to OCR identification insertion with audio status. Alternatively it can be completely switched off. All the functions on the front panel keypad can be switched by remote control.

Specifications

Input

Signal	CCVS with data lines
Data words (selectable)	3 to 15, from 1st or 2nd field
Input	75-Ω loop-through filter
Return loss	>36 dB up to 6 MHz
Input voltage	0.5 to 2 V_{pp}
Permissible CCVS characteristics within level range of ±3 dB	
2T-pulse amplitude error	±15% (referred to luminance bar) or
S/N (unweighted)	≥26 dB up to 5 MHz or
Superimposed ripple	100% (referred to pict. signal)
SIS and TV-PCM2	permissible

Data evaluation

Start code	national and EBU standards codable
Data-line window	lines 10/323 to 22/335 (codable)
Identification with subdefinition (word 3)	4 × 4 bits + 1st or 2nd field (codable)

Data outputs

	Models **02** and **05**	Model **03**
Parallel outputs	1	13
Signal		8 bits + "data valid"
Level		TTL 1-compatible
Word coding	words 3 to 15, 1st/2nd field	
Message outputs	no sync pulse, no data line, identification incorrect, bit error rate ≥10^{-3}	
Serial output	CCIR V.24/EIA RS 232 C	
Transmission rate	50 to 19,200 Baud	
Word coding	words 3 to 15, 1st/2nd field	

Display (not with DEF model 05)

Display for	start code, bit error rate, fault
Start-code display	NAT/EBU/user
Data-word display	8 characters (ASCII)
Code (selectable)	ASCII, hexadecimal, binary, octal, decimal
Word and field selection	key-selected
Display range of bit error rate	10^{-1} to 10^{-5}
Fault display	e.g. no data line

Text insertion (only with DEF model 05)

Output signal for display on monitor	CCVS with inserted text
Modes	overview (start code, content of data words, messages, test results)/identification/text off; 1st/2nd field
Switchover	key-selected/7 control lines
Outputs	2; 75 Ω
Return loss	>34 dB
Gain	0 dB ±0.2 dB
Frequency response flatness	<±0.3 dB up 6 MHz
Tilt at 50 Hz/15 kHz	<0.5%/<0.5%
Differential gain	<0.5% with 1-V CCVS
Differential phase	<0.5° with 1-V CCVS
S/N (weighted)	≥65 dB_{rms}
Background brightness (adjustable)	−6 to −20 dB (referred to pict. sig.)
Text brightness (adjustable)	350 to 700 mV

General data

Rated temperature range	+5 to +45 °C
Operating temperature range	0 to +55 °C
Storage temperature range	−40 to +70 °C
AC supply	100/120/220/240 V +10/−15%, 47 to 63 Hz (30 VA)
Dimensions, weight	
19″ rackmount	483 mm×44 mm×506 mm, 5 kg
Colour of front panel	grey, RAL 7035

Ordering information

Order designation	▶ TV Data Line Decoder DEF 19″ rackmount
Model with serial output and 1 parallel output and display	DEF.02 . . . 353.0014.03
13 parallel outputs and display	DEF.03 . . . 353.0314.03
1 parallel output and text insertion	DEF.05 . . . 353.0514.03

Accessories supplied

Power cables, terminating resistor RMF 2 (75 Ω), spare fuses

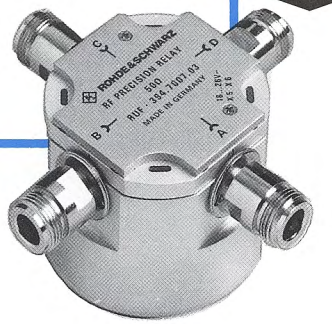
Recommended extras

Guide rail for 19″ racks	DEF-Z . . . 352.9847.03
or	
BNC connectors and 72-contact connectors (DIN 41 622), consisting of:	
72-contact female connector (2 required for DEF.02/.03, 1 for DEF.05)	246.0811.00
Handguard (2 for DEF.02/.03, 1 for DEF.05)	528.6966.00
Feeler sockets (4 for DEF.02/.03, 2 for DEF.05)	548.1660.00
Panelling	462.9410.00

RF precision relay RUF
♦ DC to 2 GHz

- Self-adjusting disc-operated actuator
- LED switch status display
- Crosstalk attenuation up to 1 GHz ≥86 dB
- Return loss up to 1 GHz ≥40 dB

new



The **RF precision relay RUF** is a 50 Ω motor-driven **two-way switch.** Four LEDs display the switch settings.

Application The RUF is used in transmitter control systems for checkpoint selection wherever signals of up to 2 GHz have to be switched over with small or medium power levels or to be routed in two-route operation (eg measurement and monitoring installations for converters and broadband communications, in-service and measurement systems of satellite signal receiver installations).

Design The RF terminals are designed as adaptable N female precision connectors. A special feature is the self-adjusting, gold-plated disc-operated actuator with rhodium contacts.

Specifications

		up to 1 GHz	>1 to 2 GHz
Return loss	for RUF	≥40 dB	≥28 dB
Reflection	equipped with	≤1%	≤4%
VSWR	4 N female connectors	≤1.02	≤1.08
Crosstalk attenuation		≥86 dB	≥70 dB
Transmission loss		≤0.1 dB	≤0.2 dB
Transmitted power (not switched under load)		max. 100 W	max. 35 W
Operating voltage		+18 to +26 V/−18 to −26 V	
RMS current/holding current (24 V)		<500 mA/50 to 100 mA	
Switchover time (at 24 V)		<30 ms	
Lifetime in switching operations		≥0.5·10^6	
Switch status display		4 LEDs	
Connectors		N female connectors (adaptable)	
for switching voltage		soldering terminals	
Nominal temperature range		+5 to +45 °C	
Dimensions (D×H), weight		100 mm×53 mm, 0.4 kg	

Order designation ▶ RF Precision Relay RUF 394.7007.03

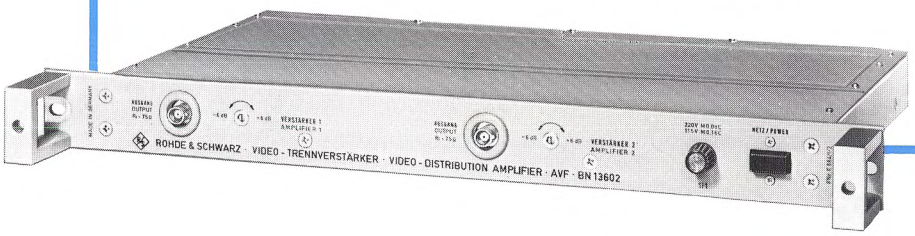
Recommended extras

Termination RNB, 50 Ω, 1 W, N female connector	272.4910.50
Built-in precision termination, 50 Ω	124.1143.00
4.1/9.5 built-in socket, 50 Ω	076.6780.00

AVF

Video Distribution Amplifier AVF

- Amplification and distribution of video signals without circuit loading
- Equally suitable for monochrome and colour TV signals (NTSC, PAL or SECAM)



The **Video Distribution Amplifier AVF** is in the form of a flat 19″ rackmount (an adapter permits incorporation into DIN racks). Two models are available, one with a single amplifier and the other with two independent amplifier sections. Each amplifier section is provided with one loop-through input and five mutually isolated outputs. The characteristics of the incoming and outgoing signals are identical. The differential phase at 1 V_{pp} is ≤ 0.1°, differential gain is ≤ 0.5%. Within certain limits the amplification is adjustable. The amplifier processes the colour subcarrier (up to 2 V), the colour picture signals, composite colour video signals and composite colour video signals with insertion signals (up to 1.5 V). The signal frequency range is 1 Hz to 20 MHz. All connections for operation are at the rear of the unit, the test output is on the front panel.

Specifications

Signal inputs
Characteristic impedance 75 Ω
Return loss ≥40 dB (up to 6 MHz)

Signal outputs
Source impedance 75 Ω
Return loss ≥40 dB (up to 6 MHz)
Isolation of outputs up to 1/5/10 MHz ≥50/40/35 dB
Signal gain, adjustable 0 to ±≥6 dB

General data

AC supply . . . . . 115/125/220/235 V +10/−15%, 47 to 63 Hz (13 or 16 VA)
Dimensions, weight . . . . . 483 mm×44 mm×331 mm, 2.5 kg
(totally enclosed 19″ plug-in; may be used as a separate unit; cabinet available if required)

Order designation . . . . . ▶ Video Distribution Amplifier AVF
Model with 1×5 outputs 100.0901.91
Model with 2×5 outputs 100.0953.91

Recommended extras: 2 Terminations RMF 2, 265.6863.00 (75 Ω, BNC); RF connecting cable 100.6980.20 or 100.6980.10 (200 or 100 cm, 75 Ω, BNC), cabinet 134.3003.00

Video Selector VSF
for 10 program lines

- Broadband signals up to 10 MHz
- Remote-control capability

VSF

new

IEC 625 Bus

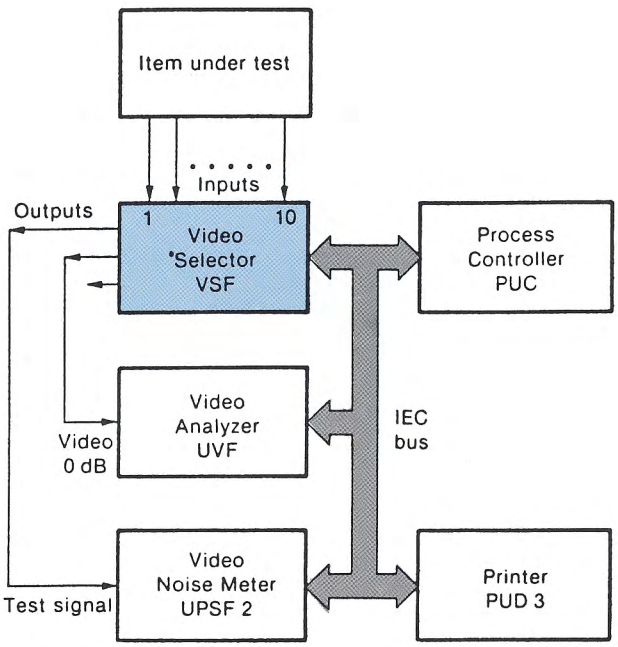
Characteristics and uses

The **Video Selector VSF** allows a signal to be selected from a total of 10 program lines or checkpoints. Beyond the **video range,** the field of application of the VSF covers the transmission of all **broadband signals up to 10 MHz.** A special model of the VSF is available with a bandwidth of 20 MHz but a slightly greater amplitude tolerance. The number of inputs can be increased to 100 by cascading several selector units (max. 10).

The Video Selector VSF is suitable for **use** in TV studios, TV transmitter stations, test departments and development laboratories.

Operation

In the **local mode,** the input to be through-connected is selected by one of the ten keys on the front panel. The associated LED lights up to signal the selected input. A paper strip below the row of keys allows user-specific labelling of the signal paths.



Test setup for video signal monitoring using Video Selector VSF

Remote control is possible either via the IEC bus (IEC 625-1/IEEE 488) or via a 1-out-of-10 parallel interface (internally selected). In the IEC-bus mode, local operation can be inhibited by the LLO command whereas it is automatically blocked in the 1-out-of-10 mode. Backsignalling of the through-connected signal path can be performed simultaneously via the IEC bus and floating contacts. The same applies to local operation.

Description

The VSF is provided with 10 inputs six of which are of the loop-through type and four are internally terminated with 75 Ω. At any given time, one input can be connected through to four parallel, decoupled outputs. One of these outputs is provided on the front panel for monitoring. Transistor switches are employed for through-connection of inputs. With remote control selected, it is also possible to cut off the ten inputs from the outputs so that no signal will be through-connected. The values of the output impedances are not changed in this case.

Example of application

In conjunction with the Video Analyzer UVF, the VSF can be used for **video signal monitoring.** Thus it is possible to monitor several checkpoints (up to 10 per VSF) for instance on a dual TV transmitter. To complete the test setup, the Process Controller PUC or PCA 5 is used as the control computer and the Printer PUD 3 is connected for logging the test results.

As shown to the left, the test setup can be extended by the Video Noise Meter UPFS 2 permitting then in addition noise voltage parameters to be determined, for instance when checking and aligning video recorders.

Ordering information

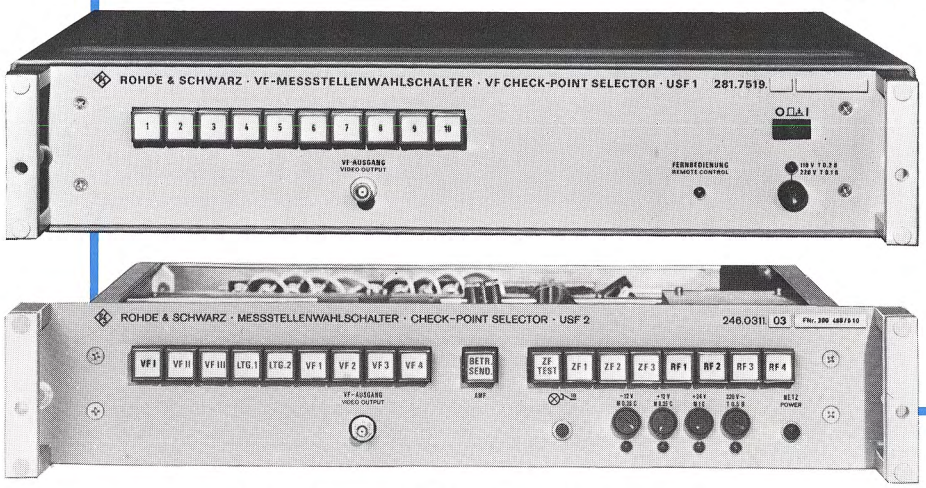
Order designation	▶ Video Selector VSF
19" bench model	389.2717.03
Special model with 20-MHz bandwidth (19" bench model)	378.0818.03

Accessories supplied

Shorting female connector (for St 506/507/508 and St 509/510/511)	342.1895.00 (for coding single-wire remote control)
Coding female connector (for St 514)	641.8547.00 (two-row connector; coding for memory operation)
72-contact female connector for parallel remote control	246.0811.00

USF 1
USF 2

Checkpoint Selectors USF 1 and USF 2



- ♦ 1 Hz to 10 (20) MHz
- Selection of 10 lines with USF 1, 18 checkpoints with USF 2, 4 outputs on each selector, can be cascaded
- Manual and remote-controlled operation, floating return signalling
- High crosstalk attenuation between inputs and excellent output decoupling

The **Checkpoint Selectors USF 1 and USF 2** permit centralized selection of program lines and checkpoints on video transmission equipment; to increase the number of checkpoints (max. 100 lines with USF 1), parallel and series connection of the selectors is possible. The USF 1 is a general-purpose video selector (also for program switchover) whereas the USF 2 enables selection of video, IF and RF checkpoints on TV transmitters. For use with dual transmitters, two USF 2 can be operated in parallel, mutual resetting being provided.

Operation, indication **Manual operation** by means of pushbuttons and **remote control** with the aid of external pulses are possible. The checkpoint connected is indicated by a lamp in the corresponding pushbutton and signalled via floating contacts.

Inputs and outputs

USF 1 10 inputs for **10 video lines** (6 of which can be looped through and 4 are internally terminated),

4 parallel video outputs (1 on front panel).

USF 2 9 inputs for **9 video checkpoints** (6 of which can be looped through and 3 are internally terminated).
1 video input (internally terminated) for **9 IF and RF checkpoints** which the USF 2 connects to a test demodulator via external RF switches (video output of demodulator connected to input of USF 2).

4 parallel video outputs (1 on front panel),
1 reset-signal output for second checkpoint selector (with dual transmitters),

24-V output for external loads.

Logic control circuitry USF 1 The logic control circuitry of the USF 1 is made up of low-speed, high-noise-immunity components. Bistable multivibrators store the switching state (connected line). A control line is used for switchover between local (front-panel) and remote control; by internal links this line can be permanently earthed or the state can be stored by a bistable relay in the set.

Cascading inputs and outputs permits several checkpoint selectors to be interconnected, a reset line ensuring fault-free operation. A coding connector enables interruption of the normal video channel/control channel path so that one video channel can be used by several control channels.

Logic control circuitry USF 2 The logic control circuitry of the USF 2 uses bipolar relays, permitting the switching state to remain stored even in the event of loss of AC power.

Specifications (USF 1 and USF 2)

Signal inputs	number see text	
Characteristic impedance	75 Ω	
Return loss	≥36 dB (up to 10 MHz)	
Crosstalk	≥66 dB down (up to 10 MHz)	
Permissible input voltage	≤1.5 V_{pp} (≤1.2 V_{pp} for 3-dB version)	
Signal outputs	number see text	
Source impedance	75 Ω	
Return loss	≥34 dB (up to 10 MHz)	
Decoupling	≥36 dB (up to 6 MHz)	
Maximum output voltage	≤1.5 V_{pp} into 75 Ω	
Transmission characteristics		
Gain at 15 kHz	0 dB ±0.1 dB (can be modified to +3 dB)	
Frequency range	1 Hz to 10 MHz (can be extended to 20 MHz)	
Group delay (20T pulse)	≤±5 ns	
Pulse response		
15-kHz squarewave (CCIR test signal No. 2 or luminance bar)		
Overshoot	≤1% (for rise times ≥60 ns)	
Tilt	≤1%	
50-Hz squarewave		
Tilt	≤1%	
Linearity in the whole range of the composite colour video signal	1 V_{pp}	1.5 V_{pp}
from 10 kHz to 5 MHz	≥0.99	≥0.98
at colour subcarrier	≥0.999	≥0.998
Permissible differential phase at colour subcarrier frequency in the level range from 8 to 85%	≤0.1°	≤0.2°
General data		
Rated temperature range	+10 to +35 °C	
Connectors, video	BNC	
Connectors, control lines	72-contact female connector	
AC supply	115/125/220/235 V +10/−15%, 47 to 63 Hz	
Consumption	USF 1: 18 VA, USF 2: max. 35 VA	
Dimensions, weight: USF 1	483 mm×88 mm×325 mm, 5.5 kg	
USF 2	483 mm×88 mm×420 mm, 7.5 kg	

Ordering information

Order designation
(19″ rackmount)
- ▶ Checkpoint Selector USF 1 281.7519.03
- ▶ Checkpoint Selector USF 2 246.0311.03

Recommended extras
Panelling for USF 1 085.1313.00

AF Generator SUN 2/S

♦ 10 Hz to 100 kHz

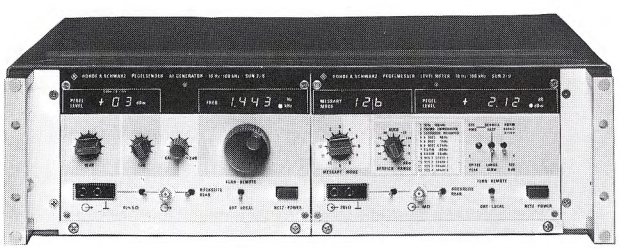
- Single-range tuning
- Frequency synthesis
- Output level −20 to +12 dBm

For AF Transmission Measuring Set see page 110.

SUN 2/S

In conjunction with the Level Meter SUN 2/U, the **AF Generator SUN 2/S** constitutes the AF Transmission Measuring Set SUN 2 (see page 110 and photo below); however, the two units can be supplied and used separately.

The SUN 2/S permits single-knob tuning over the entire frequency range. It is a precision AF generator with digital frequency setting and large LED digits for frequency and level indication. The SUN 2/S uses frequency synthesis, the crystal-controlled frequency being displayed with a resolution of about 0.3%. The output voltage which features high amplitude stability can be set in steps of 1 dB and continuously over about 3 dB and is available at a balanced or unbalanced output.



AF Transmission Measuring Set SUN 2 for measurement of level, voltage, noise and distortion on VHF sound-broadcast and TV transmitters

Specifications

Frequency	10 Hz to 100 kHz, tunable
Indication	4 digits, floating point; Hz, kHz
Indication error	$\leq 1 \times 10^{-3} \pm 1$ digit
Resolution	0.25 to 0.5%
Output level	
Range	−20 to +12 dBm (0 dBm = 0.775 V)
Setting in range −20 to +9 dBm	least step 1 dB
Additional fine adjustment	0 to +3 dB (±0.1 dB)
Indication	−20 to +9 dBm; 2 digits, polarity sign
Setting error (1000 Hz)	≤±0.1 dB
Source impedance	approx. 5 Ω; $Z_{load} \geq 600\ \Omega \parallel \leq 4.7$ nF
Frequency response flatness referred to 1000 Hz	30 Hz to 70 kHz: ≤±0.1 dB other frequencies: ≤±0.3 dB
Harmonics	≥65 dB down (30 Hz to 30 kHz) ≥60 dB down (30 to 100 kHz) ≥40 dB down (10 to 30 Hz)
DC component	≤±1 mV
Outputs	
Front panel (switch-selected)	unbalanced; BNC female connector balanced: 3-contact connector (Rel Kli 6a)
Rear panel (instead of front-panel output)	3-contact female chassis connector (similar to DIN 41 524), lockable; in parallel with 30-contact male connector (DIN 41 622)
General data	
Rated temperature range	+5 to +45 °C
Storage temperature range	−20 to +70 °C
AC supply	110/125/220/235 V +10/−15%, 47 to 63 Hz (30 VA)
Dimensions, weight ½ 19″ rackmount	245 mm × 154 mm × 347 mm, 4.9 kg

Ordering information

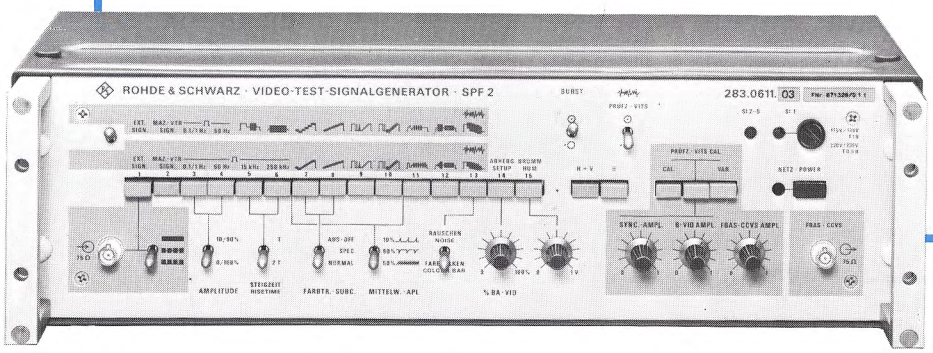
Order designation	▶ AF Generator SUN 2/S
½ 19″ rackmount in cabinet	282.2010.03
Accessories supplied	
Power cord, manual, adapter board	
Recommended extra	
Panelling SUN 2-Z to convert ½ 19″ rackmount for use as bench model	085.6421.00

For **AF Transmission Measuring Set SUN 2** consisting of AF Generator SUN 2/S and Level Meter SUN 2/U **see page 110.**

SPF 2

Video Test Signal Generator SPF 2 ♦ Standards B/G, D, H, I, M and N (PAL)

- Video test signal and noise generator plus test signal inserter combined in one unit
- 32 different test signals (to standard or with special waveforms)
- Digital signal processing
- Light weight – suitable for mobile operation



With option: IEC 625 Bus

The **Video Test Signal Generator SPF 2** produces all the video signals in accordance with the individual standards or with special waveforms and amplitudes as required for TV engineering – including the insertion signal technique – and inserts these as test lines into the program signal. The SPF 2 combines a number of separate instrument functions:

- video signal generator
- test signal generator
- noise generator
- VTR test signal generator
- test signal inserter

Its ease of operation, light weight and low power consumption make the SPF 2 ideal for **mobile use.**

All the signal information is stored in MOS read-only memories. Thus even special signal waveforms can be implemented by simply changing the memory contents.

Models To cover the wide range of applications, different models of the SPF 2 are available (for details see under ordering information):

SPF 2	Standard	**Model**
for laboratory and servicing	B/G	**03**
	M (NTSC)	**13**
	M (PAL)	**23**
for studios	B/G	**08**
with full-field signal generation and additional signals	B/G	**09*)**
with teletext test line	B/G	**56**
with 2 teletext test pages	B/G	**66**
with FuBK test chart to German standard	B/G	**59*)**
with user-specific signals		**"special"**

*) Remote control via IEC-625 Interface UPIF.

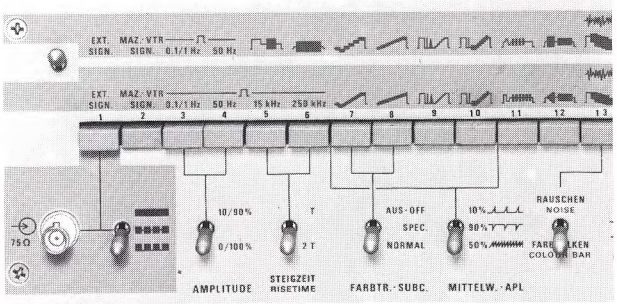
Video signal The composite colour video signal (CCVS) for full-field measurements can have standard levels, or the amplitudes of the individual signal components, such as sync pulse, picture component and (colour) video component, can be adjusted. Moreover, an insertion signal at the calibrated level of 700 mV with adjustable sync and video components is available. The picture contents can be selected from a total of 32 signals and signal variants (including test signals) available as standard.

Test signal and test-signal insertion The test signals produced in accordance with CCIR are inserted into the generator signal and automatically into the program signal as well if such a signal is applied. By changing internal links the test signals can be inserted into any line, even into several lines at the same time. Thus any test lines included in the incoming program signal can be replaced by inserting new, undistorted signals, be erased by black lines or can pass through unaffected. Except for the setup and the calibrated signal of the SPF 2, all the other signals can be inserted into test lines. Bypassing the program path in the SPF 2 is possible by means of an external bypassing device with the aid of status signals.

Noise signal The digitally produced white noise signal (about 50 Hz to 5 MHz) can be used both as the picture and a test line signal.

VTR test signal A signal for which the test line configuration is repeated four times with a spacing of 16 lines is available at the generator output (not the program output). Moreover, the CCIR-330 signal is included in the first half and a colour bar signal in the second half of the remaining picture. This signal permits – via the four heads of helical-scan video tape recorders or the two heads of machines for the 1″ SMPTE-B or -C formats – automatic and manual measurements as well as checkouts with an oscilloscope on the equalizers used for VTR reproduction; it is also used as the leader reference signal for adjusting the recorders.

External video signal Test signals, superimposed signals or for instance teletext can be applied via a front-panel input and used as picture component or test line signal with different modes of clamping and blanking.



Panel controls for picture content selection

Specifications

Signal processing

Pulse generator

Modes . . . . . H+V/H (switch-selected)
Synchronization, internal . . . . . by standard coupling with internal colour subcarrier
external . . . . . by external CCVS

Signal generation (the following specifications are applicable for the switch position CAL. and for the test line signals at the program output)

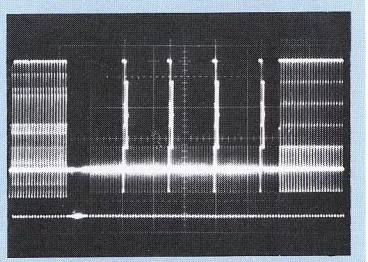
Test signals . . . . . 28, not counting the switchable rise time, amplitude superimposed and APL

Luminance signals
White level . . . . . 700 mV ±0.5%
Sync pulse . . . . . 300 mV ±1%
Chrominance signals
Amplitude (with full modulation) 700 mV_{pp} ±1%
Error of 90° phase . . . . . ≤±1°; (B-Y)/(R-Y) axis

Individual signals

External signal . . . . . eg superimposed signal for frequency-response measurement, test line, data, teletext signals
Frequency range . . . . . 10 Hz to 6 MHz
Frequency response flatness (ref. 200 kHz)
for 10 Hz to 6 MHz . . . . . ±0.1 dB (at 10 MHz 0/−3 dB)
Gain (at 15 kHz) . . . . . 0 dB ±0.1 dB
Input voltage . . . . . ≤1 V_{pp}
Crosstalk with button EXT not pressed . . . . . ≥50 dB down (up to 10 MHz)
≥60 dB (at colour subcarrier)
Clamping and blanking . . . . . switch-selected:
a) without clamping, without blanking
b) with line- and field-repetitive blanking, without clamping
c) with line- and field-repetitive blanking, clamping to negative potential (internally adjustable to gated black-level clamping)

VTR test signal



For automatic and manual measurements on VTR equipment and as leader reference signal

Signal sequence . . . . . test line configuration repeated four times (spacing 16 lines)
Occupation of other lines . . . . . both fields: half with CCIR-330 signal and half with colour bar

0.1- to 1-Hz squarewave . . . . . for transient-response measurement on amplifier chains and transmission links at low frequencies
Period . . . . . 1 to 10 s, internally adjustable (factory-set to 4 s)
Mark-to-space ratio 1:1
Picture level (switch-selected) . . . . . 0%/100% or 10%/90%

50-Hz squarewave

(CCIR test signal No. 1) . . . . . for measurement of black-level modulation, low-frequency tilt and frequency response at black and white
Time interval for white level . . . . . middle of line 154 to beginning of field blanking interval
Picture levels (switch-selected) . . . . 0%/100% or 10%/90%
Tilt . . . . . ≤0.5%

15-kHz squarewave

(CCIR test signal No. 2) . . . . . for measurement of pulse transmission response
Amplitude . . . . . 700 mV
Tilt/overshoot . . . . . ≤1%/≤1%
Rise times (switch-selected) . . . . . 200/100 ns
Duration . . . . . 32/64 to 57/64 H

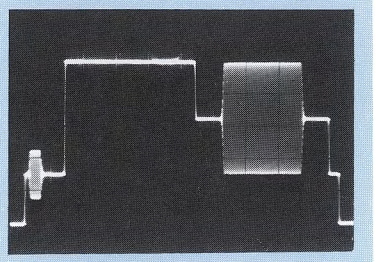
250-kHz squarewave . . . . . for measurement of pulse transmission response
Duration . . . . . 2/64 H (beginning: 12/64 H)
Other data . . . . . same as for 15-kHz squarewave

Hum signal . . . . . for checking clamping circuits
Frequency . . . . . 50 Hz (±0.5 Hz)
Amplitude . . . . . 0 to 1 V_{pp}, adjustable

Burst signal (can be switched off)

Amplitude . . . . . 300 mV
Rise time . . . . . 300 ns
Phase switchover . . . . . to PAL standard
Phase error . . . . . ≤1°, ref. to 90°

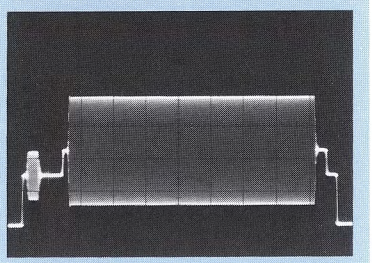
Video standard level signal



For level adjustment of luminance and chrominance channels

Duration of luminance bar . . . . . 12/64 to 37/64 H
Duration of grey pedestal . . . . . 37/64 to 62/64 H
Colour subcarrier burst . . . . . 42/64 to 57/64 H
Phase . . . . . 180°, referred to (B-Y) axis

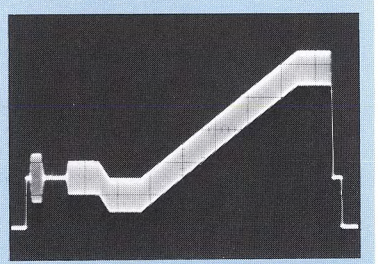
Red area signal



For measurement of phase and amplitude noise in the chrominance channel (VTR), intermodulation (colour subcarrier/sound carrier), colour purity

Amplitude, phase, rise times . . . . . same as for red colour bar (see colour bar signal 100/0/75/0 below)
Duration of grey pedestal . . . . . 12/64 to 62/64 H
Duration of chrominance signal . . . . 13/64 to 60/64 H
For the time being, models 09 and 59 only
Duration of grey pedestal . . . . . 11/64 to 62/64 H
Duration of chrominance signal . . . . 11/64 to 62/64 H

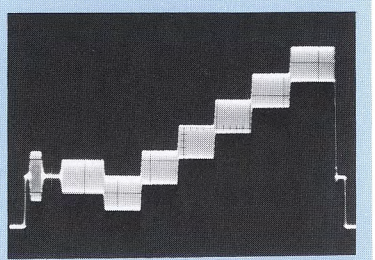
Blacker-than-black sawtooth



For measurement of differential phase and gain

Luminance signal
Black level duration . . . . . as far as 18/64 H
−100 mV . . . . . 20/64 to 26/64 H
700 mV . . . . . 56/64 to 62/64 H
Chrominance signal . . . . . normal/special/off
Amplitude . . . . . NORMAL: 100 mV; SPEC.: 200 mV
Phase . . . . . 180°, ref.: (B-Y) axis
Duration . . . . . 12/64 to 62/64 H

Blacker-than-black staircase signal

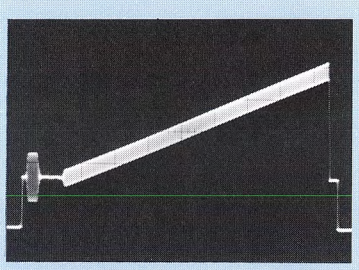


For measurement of differential phase and gain, determination of linearity errors

Luminance signal
Level . . . . black level −100 mV +60 mV
Duration . . as far as
19/64 H 19/64 to 26/64 H 26/64 to 33/64 H
+220 mV +380 mV +540 mV +700 mV
33/64 to 40/64 H 40/64 to 47/64 H 47/64 to 54/64 H 54/64 to 62/64 H
Chrominance signal . . . . . same as with blacker-than-black sawtooth

VIDEO SIGNAL GENERATION

Sawtooth
(CCIR test signals No. 3, 3a and 3b)

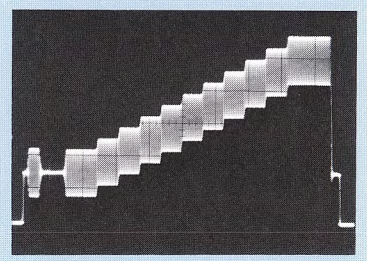


For measurement of differential phase and gain

Luminance signal
- Amplitude . . . . . 700 mV
- Duration . . . . . 12/64 to 62/64 H

Chrominance signal . . . . . normal/special/off
- Amplitude . . . . . 100 mV
- Phase . . . . . 180°, ref.: (B-Y) axis
- Duration . . . . . NORMAL: 12/64 to 62/64 H
  SPEC.: 15/64 to 59/64 H

Staircase signal



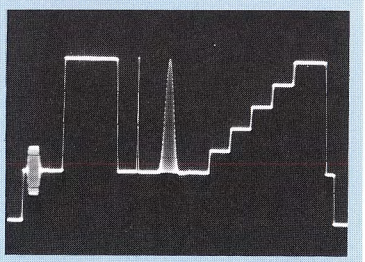
For measurement of differential phase and gain, determination of linearity errors

- Amplitude . . . . . 700 mV
- Riser height . . . . . 70 mV
- Chrominance signal . . . . . normal/special/off
  - Amplitude . . . . . NORMAL: 140 mV; SPEC.: 280 mV
  - Phase . . . . . 180°, ref.: (B-Y) axis
  - Duration . . . . . 12/64 to 62/64 H

Test signals (CCIR Rec. 473-2) and **colour bar signals** in accordance with EBU. Deviations are listed.

Several of these signals are produced in two variants which can be switch-selected (front-panel switch "up" or "down").

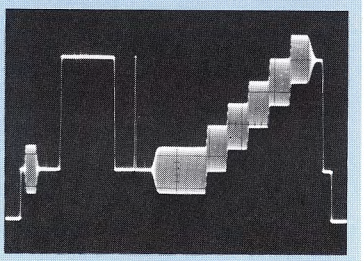
CCIR-17 test signal



For measurement of pulse response, group delay, intermodulation, frequency responce, reflection (suitable in particular for automatic measurements)

Line-time nonlinearity . . . . . ≤1.5%

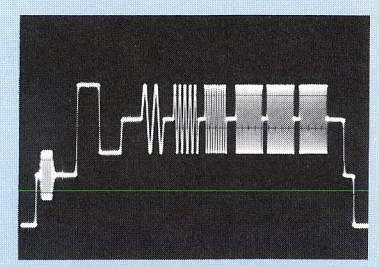
CCIR-330 test signal
Photo: variant with switch "down"



For measurement of pulse response, differential phase and gain, linearity error, reflection (suitable in particular for automatic measurements)

- Line-time nonlinearity . . . . . ≤1.5% (staircase)
- Colour subcarrier superimposed on staircase . . . . . 5 steps (internally adjustable to 4 steps)
- Signal variant with switch "up" . . . . . chrominance signal phase 60°, ref.: (B-Y) axis
- Signal variant with switch "down" . . . standard PAL signal

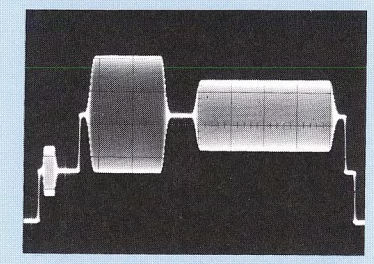
CCIR-18 test signal
Photo: variant with switch "down"



For frequency response measurement

- Signal variant with switch "up" . . . . . reference 200 kHz instead of squarewave to CCIR
- Further frequency bursts . . . . . 0.5/1.5/3/4.43/0/0 MHz
- Signal variant with switch "down" . . . to CCIR Rec. 473-2

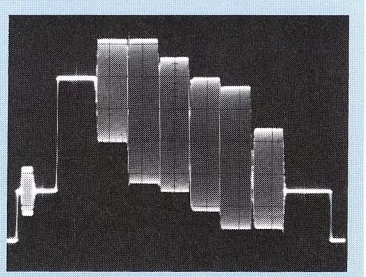
CCIR-331 test signal
Photo: variant with switch "up"



For measurement of intermodulation and amplitude errors in the chrominance channel

- Signal variant with switch "up" . . . . . single-pedestal variant
  - Chrominance signal phase . . . . . 60°, ref.: (B-Y) axis
- Signal variant with switch "down" . . . to CCIR Rec. 473-2 (in picture region: standard in accordance with PAL)

Colour bar signals in accordance with EBU
Photo: variant with switch "up"

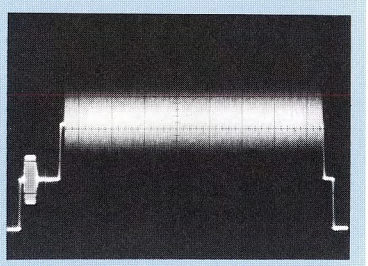


For checking monitors and PAL decoders

- Signal variant with switch "up" 100/0/100/0
- Signal variant with switch "down" . . . 100/0/75/0
- Level and phase . . . . . in accordance with EBU recommendations

(designation in accordance with CCIR Rec. 471)

Noise signal



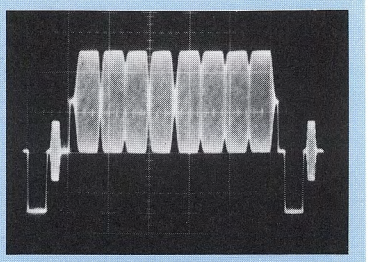
Signal applied to radio links carrying no wanted signal; for rapid checking of noise meters

- Amplitude distribution . . . . . white noise
- Frequency range . . . . . <50 Hz to >5 MHz
- Frequency response flatness . . . . . <2 dB
- Output voltage . . . . . approx. 700 mV_{pp}
  - V_{rms} (after 200 kHz to 5 MHz bandpass filter) . . . . . 25 dB (0 dB ≙ 700 mV)

Setup (grey pedestal) . . . . . for frequency response measurement over the entire modulation range; noise voltage measurement at various modulation depths

Level range . . . . . 0 to 700 mV, adjustable

Calibration signal



For self-testing of generator and checking of vectorscopes

Signal waveform . . . . . eight colour subcarrier bursts with the same amplitude
Phase . . . . . 0°/45°/ ... /360°, ref.: (B-Y) axis

Additional characteristics

APL switchover for linearity test signals

Effect . . . . . on sawtooth and staircase signals, CCIR-17 and CCIR-330 test signals

Amplitude setting

Calibrated
- Output amplitude . . . . . 1 V_{pp} ±1%
- Sync pulse component 30%

Test line calibrated, picture and sync amplitudes adjustable (CCVS panel control without effect)
- Test line amplitude . . . . . 700 mV_{pp}
- Picture component . . . . . 0.1 to 1 V_{pp}
- Sync pulse component . . . . . 0 to 450 mV_{pp}

Variable
- Test line amplitude and picture component . . . . . 0.1 to 1 V_{pp}
- Sync pulse component . . . . . 0 to 450 mV_{pp}
- CVS amplitude . . . . . 0.1 to 1.5 V_{pp}
- CCVS amplitude . . . . . 0.1 to 2 V_{pp}

Test line coding

Line range . . . . . 8 to 22/321 to 335 (any of the signals can be inserted into any line, even into several lines at the same time)
Internally codable signals . . . . . all line-repetitive signals selectable on the front panel except for the setup and the calibration signal;
external signal;
2T pulse at line-mid;
noise signal
(can also be coded such that selection between noise signal and black level is possible on the front panel)

Program path, test signal insertion and erasure

Characteristic impedance . . . . . 75 Ω
Clamping . . . . . gated black-level clamping
Frequency response flatness (up to 6 MHz) . . . . . ±0.1 dB, referred to 200 kHz
Differential gain (measured with CCIR-330 signal) . . . ≤±0.2%
Differential phase (measured with CCIR-330 signal) . . . ≤±0.2°
Group delay error at 4.43 MHz . . . . . ≤5 ns
S/N ratio (200 kHz to 5 MHz) . . . . . ≥75 dB (weighted rms value)
Test signal insertion . . . . . all signals programmed for the generator can be inserted; the test lines are not repeated within an interval of 16 lines
Program blanking . . . . . in all lines into which a black or any other signal is inserted
Disabling . . . . . internal
Synchronization
- Line and field synchronization when applying a program signal . . . . . within 2 s
- after phase discontinuity . . . . . during one field
- Colour and PAL switching phase synchronization . . . . . within 3 s

Control signals for external bypassing

Connectors . . . . . BNC, on rear panel
Signalling
- "set switched on" . . . . . −12 V, Z_{out} = 33 Ω
- "program sync pulse present" . . . . −12 V, Z_{out} = 68 Ω

General data

Rated temperature range . . . . . +5 to +45 °C
Warmup time . . . . . 15 min
Connectors . . . . . BNC, 75 Ω; return loss (up to 6 MHz): ≥34 dB
- Generator output . . . . . on front and on rear panel
- Input for external signal . . . . . on front panel
- Program input, program output, outputs for pulses and status signals . . . . . on rear panel

AC supply . . . . . 110/125/220/235 V +10/−15%, 47 to 63 Hz (50 VA)
Dimensions, weight
- 19″ bench model (design 80) . . . . . 492 mm×161 mm×514 mm, 10.6 kg
- 19″ rackmount . . . . . 483 mm×132 mm×506 mm, 8.6 kg

Ordering information

Order designation . . . . . ▶ Video Test Signal Generator SPF 2
Model for **laboratories and service centres,** Standard B/G 283.0611.03
- Standard M (NTSC) 283.0611.13
- Standard M (PAL) 283.0611.23

Model for **studios,** Standard B/G . . . 283.0611.08
In addition to S pulse output, provided with outputs for V, H, BL and PAL signals (instead of H or PAL, the burst flag pulse can be coded), colour subcarrier output, adjustable H delay (0 to ±5 µs) and colour subcarrier phase (0 to 360°)

Model for **remote-controlled signal selection and full-field signal generation,** Standard B/G 283.0611.09
Signals selectable via remote control (also via IEC bus with IEC-625 Interface UPIF): vertical grey scale, test pattern (simplified, without circle), crosshatch pattern (and intersection points), video recorder test signal (for all techniques), additional 25 signals and signal variants. Control: 5 bits (binary), 1 bit for local/remote switchover

Model with **teletext test line option,** Standard B/G 283.0611.56
Contains teletext test signal in line 328, second signal input, eg for teletext program signal or data line

Model with **two teletext test pages** and interlaced teletext test signal, Standard B/G 283.0611.66

Model for **FuBK test chart generation to German standard,** Standard B/G 283.0611.59
Remote-controlled signal selection: 5 bits (binary), 1 bit for local/remote switchover (also via IEC bus with IEC-625 Interface UPIF), further 29 signals and signal variants can be selected in addition to FuBK test chart

"Special" model furnishing **signals to customer's requirements** . . . . . please enquire
Implementation (by software or hardware modification) for instance of 10T pulse (instead of 20T pulse) in CCIR-17 test line, 5-step staircase (instead of 10 steps), national insertion test signals, such as barra rossa (Italy), pulse-and-bar signal (instead of 15-kHz squarewave), automatic switchover between black and white lines for linearity measurements, cyan colour area (instead of red signal), special full-field signals (such as adjustment signal for optical test patterns or test signal for gamma correction on cameras)

Accessories supplied

Power cable 025.2365.00

Recommended extras

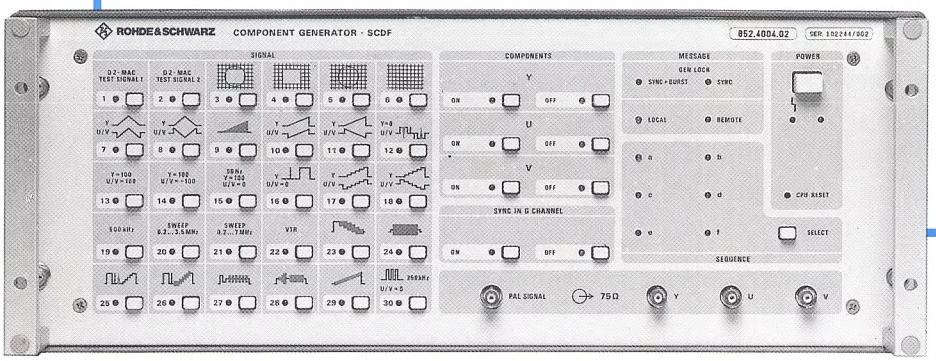
Junction panel including bypass circuit and cover:
- for incorporation into 19″ racks 283.2814.13

Video-frequency connecting cable (75 Ω, BNC, 2 m long) 100.6980.20
Termination RMF 2 (75 Ω, ±0.1%, 250 mW, BNC) 265.6863.00
For models 09 and 59:
- IEC-625 Interface UPIF 231.2813.03
- Connecting cable SPF 2-UPIF 212.9180.03

new

SCDF

Component Generator SCDF ♦ YC_BC_R- and RGB components CCVS signal (PAL)



- Separate outputs for YC_BC_R, RGB and CCVS
- Generation and insertion of teletext and data line
- Redefined MAC test chart
- Synchronization with external signals

IEC 625 Bus

The **Component Generator SCDF** generates **picture signals with superimposed text.** In addition to the familiar test signals, it supplies the redefined **MAC test chart,** six **teletext pages** and **data lines** with test information for checking VPS operation.

Signal components The picture signals are generated as digital Y, C_B- and C_R- components and converted into R, G and B signals via an analog matrix. The green signal is sent either with or without a synchronous signal. All the components are simultaneously available. The Y, C_B- and C_R- components are used to operate a CCVS or MAC coder.

CCVS signal The test charts can be extracted at a separate output as CCVS signals in compliance with PAL standards. This means that the quality of the coding and decoding processes for component processing can be very easily checked visually as opposed to the PAL method. This also simplifies the location of system-related phenomena as opposed to actual errors.

Signals Due to their significance for testing, signals are divided into PAL signals and component signals.

PAL signals

- Test lines CCIR 17, CCIR 18, CCIR 330, CCIR 331
- Saw-tooth signal
- 50 Hz square-wave signal
- 250 kHz square-wave signal
- Signal for red area
- EBU colour bar signal (Fig. 1)
- VTR test signal
- FuBK test chart (to German standards) with and without circle
- Grid test chart with and without circle
- MAC test chart, redefined (Fig. 2)

Component signals

- Triangular signals with positive/negative polarity (eg Fig. 4)
- Split-level signal (Fig. 3)
- Ramp signals with positive/negative polarity
- Pulse-and-bar signals (eg Fig. 5)
- Signals with constant levels (±100%)
- Staircase signals with positive/negative polarity (eg Fig. 6)
- 500 kHz sinusoidal signal (Fig. 7)
- Sweep signals 0.2 to 3.5 MHz/0.2 to 7 MHz

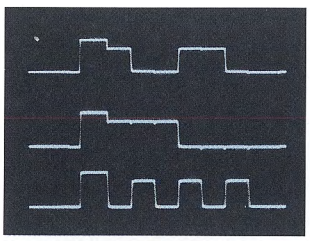


Fig. 1a EBU colour bar (RGB)

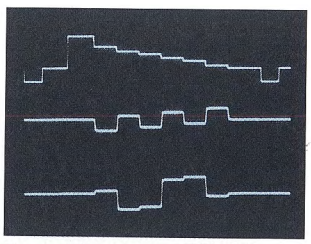


Fig. 1b EBU colour bar (YC_BC_R)

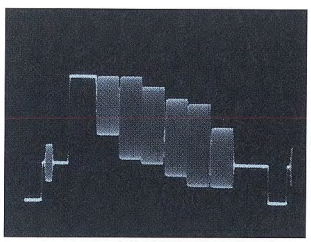


Fig. 1c EBU colour bar (CCVS)

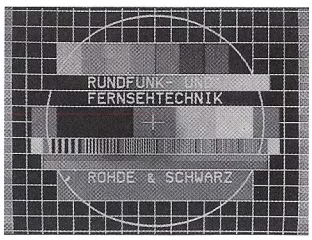


Fig. 2 MAC test chart

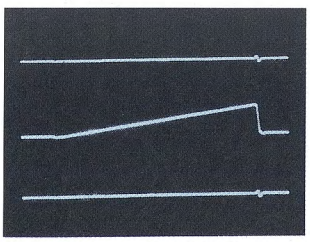


Fig. 3a Split-level signal (RGB)

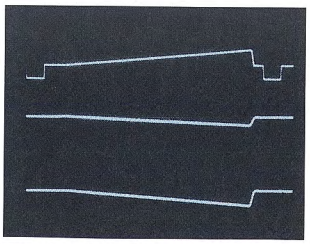


Fig. 3b Split-level signal (YC_BC_R)

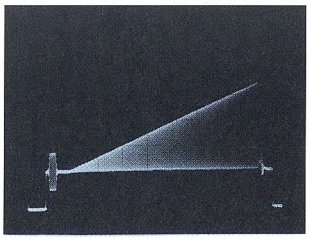


Fig. 3c Split-level signal (CCVS)

MAC test chart Text lines, eg for information on the transmitted sound configuration, can be inserted into the MAC test chart in D2-MAC operation.

Teletext pages Six different teletext pages can be inserted into the CCVS or Y signal. In D2-MAC operation, a teletext page, for example, may contain information about the satellite, its geostationary position, the channel and polarization.

Signal combinations The SCDF can be synchronized by external CCVS and black burst signals. The signal combination is displayed and acknowledged on the front panel.

In addition to the internally generated signals, combined signals, such as test lines, teletext and data line signals, can also be inserted via two inputs into the test line area of the Y channel.

Remote control The functions of the SCDF can be remote-controlled via the following interfaces:

- IEC 625-1/IEEE 488
- EIA V.24/RS-232-C
- Parallel interface (TTL)

These interfaces can be used to select the test signals, switch the signal components on and off, and insert text. The first two also allow unit status requests.

Specifications

Inputs/outputs (all)	BNC, 75 Ω
return loss	≥34 dB (up to 6 MHz)
Sync input	for CCVS signal (PAL)
Signal inputs EXT 1, EXT 2	Z_{out} = 75 Ω, V_{pp} = 700 mV picture signal (sync component allowed)
Sync pulse output	2 V into 75 Ω
Colour subcarrier output	2 V into 75 Ω

Signal tolerances

Y-, C_B-, C_R-signals

	Y signal	C_B-, C_R-signals
Pulses, staircases, saw teeth	ref. value ±4 mV	ref. value ±7 mV
2T, 20T pulse	ref. value ±7 mV	–
3T, 5.8T-, 20T pulse	–	ref. value ±10 mV
Sweep, multi-burst amplitude	ref. value ±10 mV	ref. value ±10 mV
Sweep, multi-burst frequencies	ref. value ±2.5%	ref. value ±2.5%
Text/graphics	700 mV ±3%	–

R, G, B components

The rise times are determined by those of the Y-, C_B- and C_R-signals.

Amplitude error	like YC_BC_R signal components
Matrixing error	±1%
Matrixing frequency response	±0.2 dB (up to 6 MHz)
Sync pulse in G channel (can be switched off)	300 ±2%

CCVS signal

	Luminance	Chrominance
Amplitudes		
Pulses, staircases, saw teeth	ref. value ±4 mV	ref. value ±7 mV
2T, 20T pulse	ref. value ±7 mV	–
3T, 5.8T, 20T pulse	–	ref. value ±7 mV
Signal rise time	100 ±10 ns	300 ±30 ns
	200 ±15 ns	1 µs ±40 ns
	500 ±30 ns	2 µs ±60 ns
	2 µs ±60 ns	
Differential amplitude	≤0.2%	
Differential phase	≤0.2°	

Inputs EXT 1, EXT 2

Differential amplitude	≤0.3%
Differential phase	≤0.3°

Teletext pages	6 (to specifications)
Position	inserted into the test line area of the Y channel
Amplitude	V_{pp} = 462 mV ±2%
Eye level	≥95% } measured in 0 to 6 MHz
Eye width	≥90% } frequency range

Data lines	8 encodable sequences
Position	inserted into the test line area of the Y channel
Amplitude	V_{pp} = 500 ±1.5%

General data

Rated temperature range	+5 to +45 °C
Operating temperature range	0 to +50 °C
Power supply	110/120/220/240 V +10/ −15%, 47 to 63 Hz (160 VA)
Dimensions, weight bench model	483 mm×177 mm×506 mm, 12 kg

Ordering information

Order designation	▶ Component Generator SCDF
Bench model	852.4004.03
19″ rackmount	852.4004.02

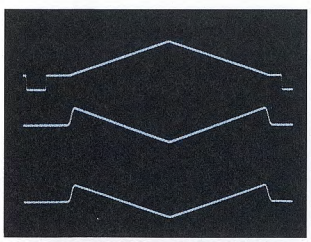


Fig. 4a Inverted triangular signal (YC_BC_R)

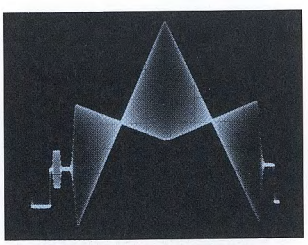


Fig. 4b Inverted triangular signal (CCVS)

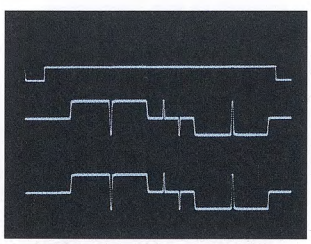


Fig. 5a Pulse-and-bar signal (YC_BC_R)

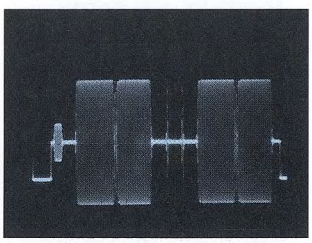


Fig. 5b Pulse-and-bar signal (CCVS)

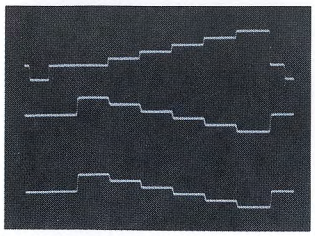


Fig. 6a Inverted staircase signal (YC_BC_R)

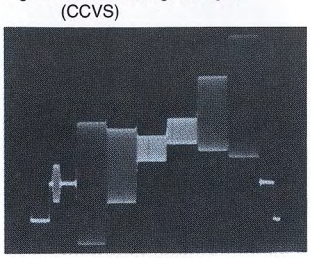


Fig. 6b Inverted staircase signal (CCVS)

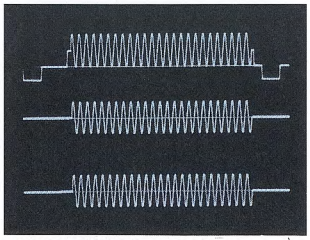


Fig. 7a 500 kHz sinusoidal signal (YC_BC_R)

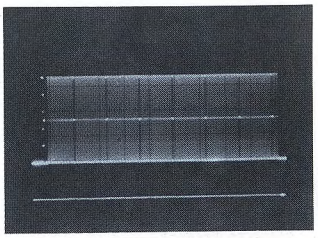
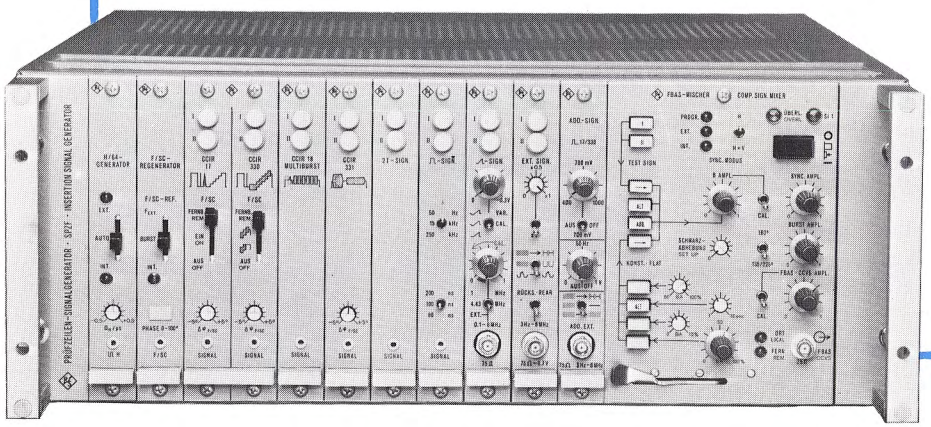


Fig. 7b 500 kHz sinusoidal signal (CCVS)

SPZF

Insertion Signal Generator SPZF



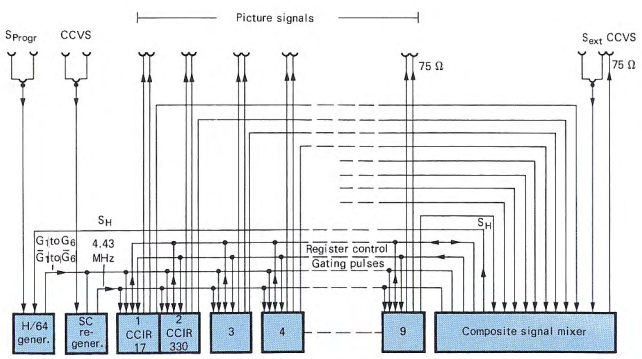
- Up to nine video and insertion signals (each signal being available at two 75-Ω outputs) for full-field measurement
- Built-in colour-subcarrier regenerator providing burst-synchronized insertion test signals
- Standard level or adjustable signal components available from Composite Signal Mixer
- Versatile due to modular design
- Main functions can be remote-controlled

With a full complement of cassettes including the Composite Signal Mixer, the **Insertion Signal Generator SPZF** produces nine video and test signals for checking all sections of a TV transmission path from the studio camera right through to the domestic receiver. At present cassettes for a total of ten different test signals are available. The Basic Unit, Composite Signal Mixer, Colour Subcarrier Regenerator and H/64 Generator constitute a **sync signal assembly.**

The SPZF is an **independent program-signal source** delivering a standard composite colour video signal (CCVS) with PAL or NTSC burst and freely selectable picture content. It complies with the specifications of the Federal German Post Office for TV test equipment FTZ 176 Pfl. 8, ARD Standard Spec. 5/4, EBU Performance Spec. Techn. 3209 and CCIR Recommendation 473-2, Appendix 1 (625-line system).

The SPZF is of modular **design** and consists of:

- **Basic Unit** comprising the cassette adapter with a central power supply and fitted with the H/64 Generator and the SC Regenerator (photo, left-hand side). The remaining compartments accommodate any desired selection and combination of test-signal plug-ins and the Composite Signal Mixer.
- **Test-signal plug-ins:** each test signal is produced in a separate cassette and made available at two isolated 75-Ω outputs. The signals are also applied to the Composite Signal Mixer. All modes of operation can be selected on the front panel or by remote control.



Simplified block diagram of SPZF

- **Composite Signal Mixer** (photo, right-hand side). This adds the sync pulses and the burst to the test signals to form a standard CCVS. It consists of the following four functional groups: timing program, sync signal generation, signal mixing and mode selection.

Specifications

CCIR 17/CCIR 330 Cassette

Luminance bar

Amplitude	0.7 V ±0.5%
Overshoot, tilt and rounding	<0.5%
Rise time	200 ns +0/−10 ns

2T pulse

Amplitude instability	<0.5% of luminance-bar amplitude
Half-amplitude duration	200 ns ±5 ns

20T pulse

Amplitude instability	<0.5% of luminance-bar amplitude
Half-amplitude duration	2 µs ±60 ns
Baseline distortion	<0.5%, <5 ns
Colour-subcarrier phase	60° ±5° (referred to positive [B-Y] axis)

Staircase

Amplitude instability	<±0.5% of luminance-bar amplitude
Riser height	1/5 of luminance-bar amplitude
Line-time nonlinearity	<0.5%
Rise time	approx. 230 ns

Superimposed signal

Amplitude	0.28 V_{pp} ±2%
Differential phase	<0.2°
Differential gain	<0.2%
Colour-subcarrier phase	60° ±5° (referred to positive [B-Y] axis)
Rise time	1 µs

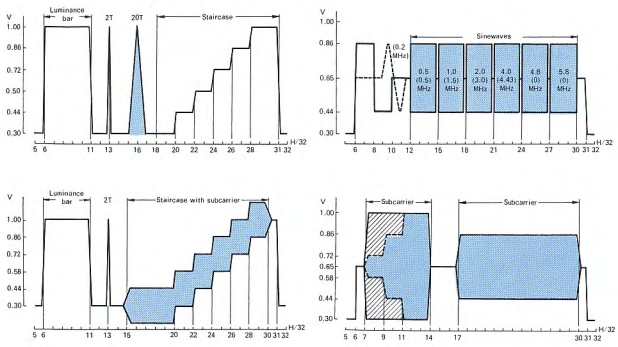
CCIR 18 (Multiburst) Cassette

Frequencies according to FTZ (standard)	0.2[2])/0.5/1.5/3.0/4.43/4.8[3])/5.8[3]) MHz ±2.5%
according to CCIR 486[1])	squarewave/0.5/1.0/2.0/4.0/4.8/5.8 MHz ±2.5%
Amplitude	0.42 V_{pp} ±1% (referred to 3/5 of luminance-bar amplitude)

CCIR 331 Cassette (colour subcarrier reference bursts)

Rise time and phase	same as for superimposed signal
Amplitude of first burst	three levels: 0.14/0.42/0.7 V_{pp} one level: 0.7 V_{pp}
Amplitude of second burst	0.42 V_{pp} ±1% (referred to luminance-bar amplitude)

[1]) Please indicate when ordering (specifying also special requirements).
[2]) By changing the position of coding links in the cassette, the sinewave burst can be replaced by a squarewave signal.
[3]) The cassette is supplied with these two bursts disabled. They can be inserted by unsoldering the corresponding links.



Test signals CCIR 17, 18 (in parentheses: frequencies of standard version), 330 and 331

2T Cassette

Amplitude . . . . . 0.7 V
Repetition frequency . . . . . 15 625 Hz (line frequency)
Half-amplitude duration . . . . . 200 ns ±5 ns
Position . . . . . at mid-line, can be coded in 1-µs steps
Use . . . . . reflection and propagation measurements (multipath reception)

Squarewave Signal Cassette

Amplitude . . . . . 0.7 V ±0.5%
Repetition frequency . . . . . 50 Hz and 15 625 Hz (CCIR test signals Nos. 1 and 2), 250 kHz
Rise/fall time . . . . . switch-selected: 60/100/200 ns (100 ns and 200 ns can be set by remote control)

Sawtooth Signal Cassette

Amplitude of luminance component . . . . . 0.65 V (can be set to 0.7 V)
Repetition frequency . . . . . 15 625 Hz (line frequency)
Signal direction . . . . . black-to-white transition
Signal shapes . . . . . a) CCIR test-signal No. 3
b) signal with blacker-than-black component
c) signal as under b) with variable blacker-than-black component
Superimposed signal, int. . . . . 1 MHz or 4.43361875 MHz, crystal-controlled
ext. . . . . 0.1 to 6 MHz
Amplitude of superimposed signal calibrated: 10% CVS
variable: 0 to 100% CVS

External Signal Cassette

Input signal . . . . . picture signal, 3 Hz to 6 MHz
Clamping (switch-selected) . . . . . to negative peak (normal), to mean value (no clamping), to black level (gated, only with external picture signal)
Gain . . . . . calibrated: A = 1
variable: A = 0 to 1

Addition Signals Cassette

Luminance bar . . . . . calibrated: 0.7 V ±0.5%
variable: 0.4 to 1 V
External superimposed signal . . . . . 3 Hz to 6 MHz, blanked or unblanked (gain ≈ 1)
50-Hz sinewave . . . . . 0 to 1 V_{pp} (can be turned off)

The above addition signals are **not** picture components since they are added to the CCVS only at the output of the Composite Signal Mixer.

Sweep Generator

Frequency range (sweep signal) . . . 100 kHz to 7.2 MHz
Step size . . . . . 50 kHz (every 2 lines)
Period . . . . . 20 ms (one field)
Frequency range (sinewave) . . . . . 100 kHz to 7.9 MHz
Step size . . . . . 100 kHz
Test-line sweeping . . . . . lines 6 to 22 (both fields)
Step size . . . . . 50 kHz every 40 ms (internally adjustable to 20 ms)
Range switchover (sweep and sinewave signal) . . . . . ×0.1/×0.01
Frequency error . . . . . ≤3%
for frequencies below the first frequency marker . . . . . ≤3% of marker frequency

Picture-signal output . . . . . blanked at line frequency
Amplitude . . . . . 0.7 V_{pp} ±1%
Harmonic distortion . . . . . ≤2%
Duration (referred to S leading edge) . . . . . 13 to 61 µs
Pedestal . . . . . 0.35 V ±2%
Duration (referred to S leading edge) . . . . . 12 to 62 µs
Frequency markers (sweep mode only) . . . . . spaced 1 MHz (100 kHz, 10 kHz)
Signal buildup (time referred to S leading edge) . . . . . white 0.7 V ±1% from 12 to 22 µs, black from 22 to 40 µs, grey 0.35 V ±2% from 40 to 62 µs

Sinewave output . . . . . without frequency markers
Amplitude . . . . . 1 V_{pp} ±5%

Composite Signal Mixer

Signal inputs . . . . . 9, one for each compartment
Switchover . . . . . input of one compartment (addition signals) recodable
Input impedance . . . . . 75 Ω

Signal outputs (cassette adapter) . . 2, one on the front and the other on the rear panel
Output voltage of CCVS . . . . . 0.1 to 1.5 V into 75 Ω (variable), 1 V ±1% into 75 Ω (calibrated or with remote control)
Return loss . . . . . ≥34 dB up to 6 MHz
Decoupling . . . . . variation of output voltage between 75-Ω termination and no load on second output <1%

Transmission characteristics . . . . for picture component inputs and addition signals input
Frequency-response flatness (picture component range 0 dB ±3 dB, referred to 200 kHz) . . . . . ±0.05 dB (10 Hz to 4.43 MHz), ±0.1 dB (10 Hz to 6 MHz), attenuation <3 dB at 10 MHz
Tilt (50-Hz and 15-kHz squarewaves) . . . . . <0.5%
Group-delay error . . . . . <5 ns (at 4.43 MHz)
Nonlinearity . . . . . <1% (1 to 4.43 MHz)
Differential gain . . . . . <0.3% } in range
Differential phase . . . . . <0.2° } 15 to 100% C(C)VS
S/N ratio
Hum (<1 kHz) . . . . . ≥56 dB (peak-value measurement)
Noise (10 kHz to 5 MHz) . . . . . ≥75 dB (weighted rms-value measurement)
Periodic noise (1 kHz to 5 MHz) . . ≥65 dB (peak-value measurement)

General data

Rated temperature range . . . . . 0 to +45 °C
AC supply . . . . . 98 to 127/187 to 250 V, 47 to 63 Hz (110 VA, when equipped for delivering four test line signals)
Dimensions, weight (fully equipped)
19″ bench model . . . . . 484 mm×194 mm×509 mm, 27 kg
19″ rackmount . . . . . 483 mm×177 mm×499 mm, 23 kg

Ordering information

Order designation . . . . . ▶ Insertion Signal Generator SPZF

Subassembly or cassette	Type	Order No.
Basic Unit; cassette adapter plus power supply; 19″ rackmount[1])	SPZF	208.0518.71
H/64 Generator[1])	SPZF-E1	208.8019.03
SC Regenerator[1])	SPZF-E2	209.0011.03
CCIR 17/CCIR 330 Cassette	SPZF-E3	209.2014.03 (double plug-in)
CCIR 18 (Multiburst) Cassette	SPZF-E4	209.8012.03
CCIR 331 Cassette	SPZF-E5	209.6010.03
2T Signal Cassette	SPZF-E6	209.4617.03
Squarewave Signal Cassette	SPZF-E7	267.0010.03
Sawtooth Signal Cassette	SPZF-E8	267.0510.03
External Signal Cassette	SPZF-E9	267.1317.03
Addition Signals Cassette	SPZF-K1	267.0910.03
Sweep Generator	SPZF-K2	230.5419.03
Composite Signal Mixer (Standards B, G)	SPZF-E0	230.0517.03
19″ cabinet	UPF-Z	103.8510.00
Self-engaging Connector Strip, BNC; for 19″ rack	SPZF-Z	208.6916.02
Plug-in Adapter[2]) for SPZF-E1	SPZF-Z	208.7212.02
Plug-in Adapter[2]) (two required)	SPZF-Z	208.7412.02
Cable, 30-way	SPZF-Z	208.5049.02
Blank panel for cassette adapter width 1″	SPZF-Z	208.7712.02
width 5″	SPZF-Z	208.7912.02

[1]) Basic equipment [2]) For servicing and repair

Accessories supplied

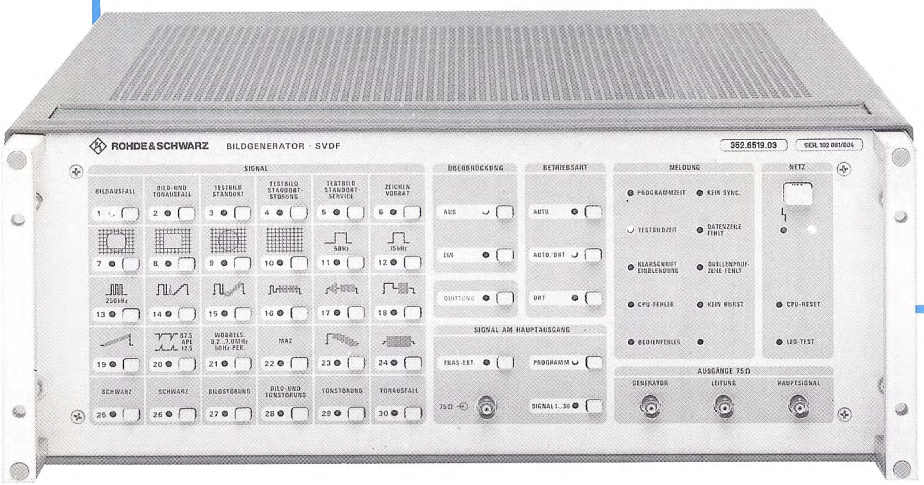
2 Terminations RMF 2, cassette extractor, power cord

SVDF

Video Test & Pattern Generator SVDF

♦ Standards B/G, H

- Digital generation of test, insertion and test pattern signals
- TV test signal generator
- Test signal insertion into program signal
- Remote control via serial or parallel interface



For the description of the SVDF, see page 62 – in-service equipment.

The **Video Test & Pattern Generator SVDF** and its capability for **in-service use** as well as for application as a **video signal generator** in TV measurements are described on page 62. Below only the signals available for testing are listed.

Signal generator In addition to signals for in-service use such as text pages for operational failure, the FuBK test charts (to German standard) for program interruption and with inserted transmitter identification, the SVDF delivers the following test signals for the laboratory, for development and production:

Full-field signals (see page 62)
FuBK test charts to German standard with and without circle
50-Hz, 15-kHz and 250-kHz squarewave signals
CCIR insertion test signals
calibration signal (standard video level 1 V)
sawtooth signals with and without automatic switchover of APL
video-frequency sweep signal 0.2 to 7 MHz
VTR test signal
100/0/75/0 colour bar
red area signal, 75% saturation

Additional test signals (internal link selection)
2T reflection signal
national insertion test signals variants (customer-specific) and optionally either
teletext insertion test signal or
4 teletext test pages

The complete set of signals is also available at the generator output when the SVDF is used in service as long as no substitution signal (in the event of program signal failure) is required.

Specifications – Signal processing SVDF

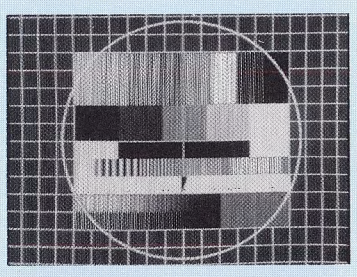
Pulse generator

Mode	H + V
Synchronization, internal	by standard coupling with internal colour subcarrier
external	by external CCVS

Test signals (see text)	30 full-field signals (+6 programmable signals) see below; 4 test signals (internally link-selected)
Luminance signals	
White level	700 mV ±0.5%
Sync pulse	300 mV ±1%
Chrominance signals	
Amplitude (with full modulation)	700 mV_{pp} ±1%
Error of 90° phase	≤±1° (B-Y)/(R-Y) axis
External signals	3 inputs (see page 62) eg for test signals, data, teletext (internally link-selected)
Frequency range	10 Hz to 6 MHz
Frequency response flatness (ref. 200 kHz)	
for 10 Hz to 6 MHz	±0.1 dB (at 10 MHz 0/−3 dB)
Gain (at 15 kHz)	0 dB ±0.1 dB
Input voltage	≤1 V_{pp}
Clamping	gated black level clamping

Internal full-field signals

FuBK test charts
to German standard
(with and without circle)



In accordance with ARD specifications 8.13.1 (Nov. 1973)

50-Hz squarewave

(CCIR test signal No. 1)	for measurement of black-level modulation, low-frequency tilt and frequency response at black and white
Time interval for white level	middle of line 154 to beginning of field blanking interval
Tilt	≤0.5%

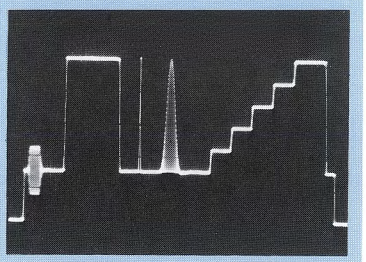
15-kHz squarewave

(CCIR test signal No. 2)	for measurement of pulse transmission response
Amplitude	700 mV
Tilt/overshoot	≤1%/≤1%
Rise time	200 ns
Duration	32/64 to 57/64 H

250-kHz squarewave	for measurement of pulse transmission response
Duration	2/64 H (beginning: 12/64 H)
Other data	same as for 15-kHz squarewave

Test signals (CCIR Rec. 473-2)

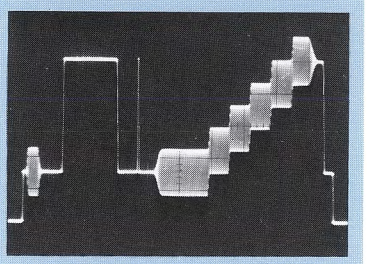
CCIR-17 test signal



For measurement of pulse response, group delay, intermodulation, frequency response, reflection (suitable in particular for automatic measurements)

Line-time nonlinearity . . . . . ≤1.5%
Full-field signal (to standard, PAL)

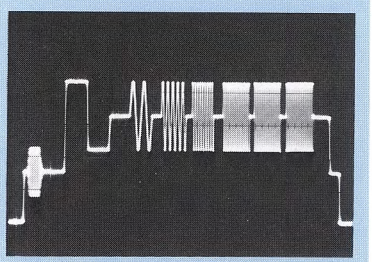
CCIR-330 test signal



For measurement of pulse response, differential phase and gain, linearity error, reflection (in particular for automatic measurements)

Line-time nonlinearity . . . . . ≤1.5% (staircase)
Colour subcarrier superimposed on staircase . . . . . 5 steps (internally adjustable to 4 steps)
Full-field signal (to standard, PAL)

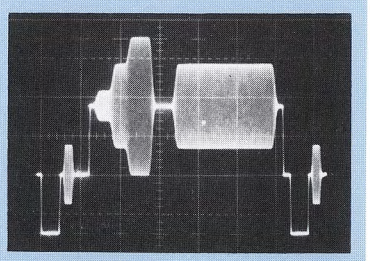
CCIR-18 test signal



For frequency response measurement

Full-field signal (to standard, PAL)

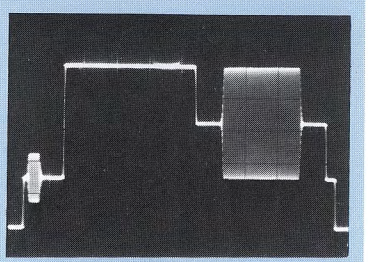
CCIR-331 test signal



For measurement of intermodulation and amplitude errors in the chrominance channel

Full-field signal (to standard, PAL)

Video standard level signal

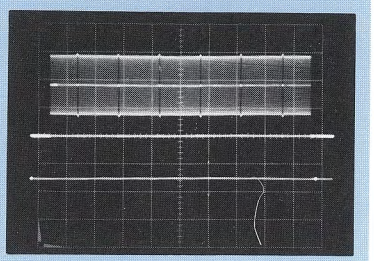


For level adjustment of luminance and chrominance channels

Duration of luminance bar . . . . . 12/64 to 37/64 H
Duration of grey pedestal . . . . . 37/64 to 62/64 H
Colour subcarrier burst . . . . . 42/64 to 57/64 H
Phase . . . . . 180°, referred to (B-Y) axis

Sawtooth signal (CCIR test signals Nos 3, 3a and 3b repeated automatically) . . . . . for measurement of differential phase and gain
Luminance signal: Amplitude . . . . . 700 mV
Duration . . . . . 12/64 to 62/64 H
Chrominance signal: Amplitude . . . . . 100 mV
Phase . . . . . 180°, ref.: (B-Y) axis
Duration . . . . . 12/64 to 62/64 H
Automatic switchover of average picture level (APL) . . . . . between 12.5 and 87.5%

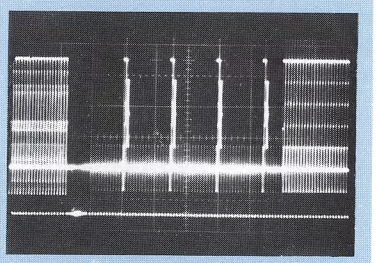
Video-frequency sweep signal



For measurement of video frequency response during one field

Luminance signal . . . . . 350 mV ±1%
Amplitude of superimposed signal . . . 700 mV_{pp}
Superimposed frequency . . . . . 0.2 to 7 MHz
Sweep time . . . . . same as field
Frequency markers . . . . . spaced 1 MHz
Amplitude reference . . . . . black, 50% and white level in frequency marker line

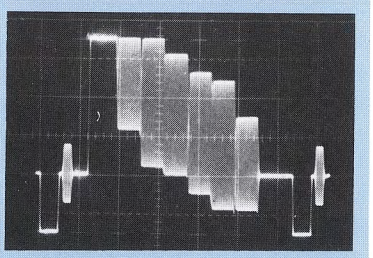
VTR test signal



For automatic and manual measurements on VTR equipment and as leader reference signal

Signal sequence . . . . . test line configuration repeated four times in both fields (spacing 16 lines)
Occupation of other lines . . . . . both fields: half with CCIR-330 signal and half with colour bar

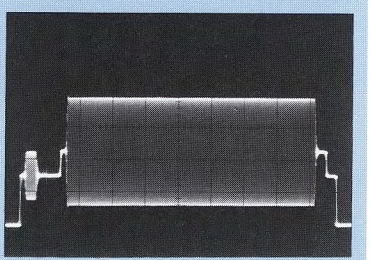
EBU colour bar 100/0/75/0



For checking monitors and PAL decoders

Level and phase . . . . . in accordance with EBU recommendation
(designation in accordance with CCIR Rec. 471)

Red area signal

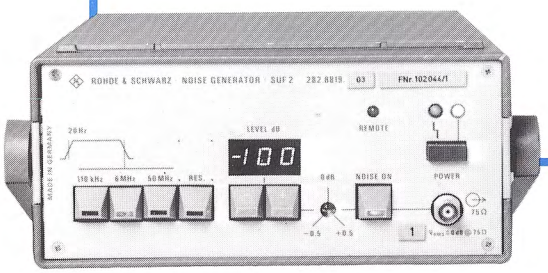


For measurement of phase and amplitude noise in the chrominance channel (VTR), intermodulation (colour subcarrier/sound carrier), colour purity

Amplitude, phase, rise times . . . . . same as for red colour bar in EBU colour bar, see above
Duration of grey pedestal . . . . . 10.5/64 to 62.5/64 H ±0.3 µs
Duration of chrominance signal . . . . . 10.5/64 to 61.5/64 H ±0.3 µs

For **general data** and **order designation** see page 63

SUF 2 **Noise Generator SUF 2** ♦ **20 Hz to 50 MHz**



- Noise level 0 to −100 dB (−80 dB up to 50 MHz); reference level 0 dB = 1 V/0.775 V/0.7 V into 75 Ω
- White noise in three frequency ranges up to 50 MHz
- Coloured noise with plug-in filters for internationally recommended test methods
- Can be remote-controlled for use in automatic test systems

IEC 625 Bus

The basic version of the **Noise Generator SUF 2** delivers a noise spectrum with a constant mean energy content which is uniformly distributed over all frequencies (white noise).

The noise power can be reduced down to the µV range with the aid of the built-in attenuator. A three-digit readout displays the selected level value in dB relative to the internally link-selected reference value (1 V/0.775 V/0.7 V).

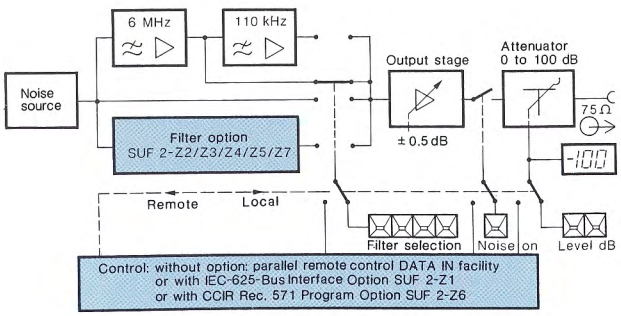
Frequency ranges The three frequency ranges for **white noise** (20 Hz to 110 kHz/6 MHz/50 MHz) and a fourth range covered by a plug-in (optional) filter board (see page 83) producing the noise spectrum for **pink noise, triangular noise** or **sound-program noise** permit virtually any noise measurement to be performed.

Audio engineering Here, noise signals are required for simulating speech/music. Compared with single-frequency measurements, the noise-signal method yields more meaningful values; however, selective voltmeters or analyzers must be used. Moreover, suitably shaped noise spectra are indispensable as program substitution signals for internationally recommended test methods in accordance with CCIR and CCITT.

Frequency-division multiplex systems The noise signals can be used to closely mimic the program signal on one or several adjacent channels.

Video engineering In video engineering, the measurement of the noise rejection in circuit components, such as sync separators or clamping circuits, is of interest; in digital TV systems, it is particularly the bit error rate of the different types of coding which is tested.

RF engineering often requires rapid, approximate measurements on IF filters in TV and FM-sound modules or radio equipment up to 50 MHz.

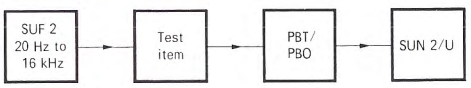


Functional diagram SUF 2

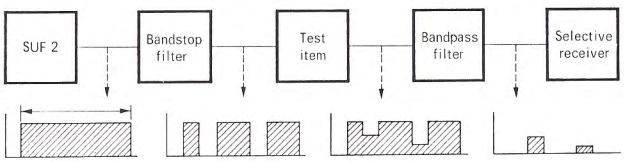
Control The different ways to control all the instrument functions, such as the parallel remote control of the basic model, programming via an **IEC-625 bus interface** (option) or periodic level switching with link-selected time and level values (option) extend the instrument's application range to automatic test systems.

CCIR Rec. 571 Program Option SUF 2-Z6 This option periodically switches between two programmable levels and the "noise off" status. The filters and the time intervals can be selected as well. The instrument is factory-set for intermodulation measurements in accordance with CCIR Rec. 571, the noise spectrum being shaped with the aid of the associated Filter SUF 2-Z5.

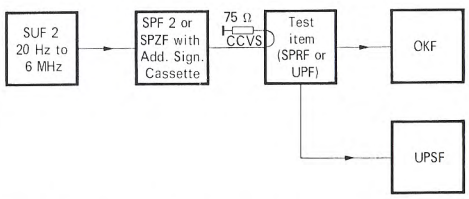
Measurement examples



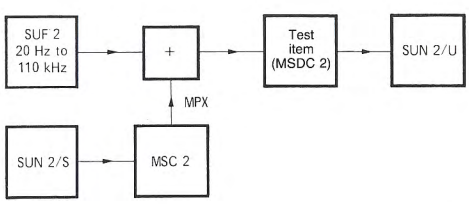
Rapid AF frequency response measurement with pink noise using one-third-octave or octave filter and level meter



Harmonic distortion measurement in a crowded frequency band with simulated gaps



Measurement of noise rejection in video circuitry (amplifiers, sync separators, clamping circuits, test equipment)

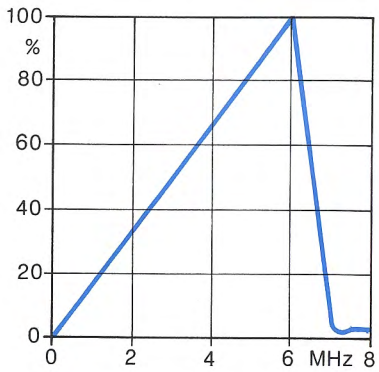


Measurements on stereo systems and analog frequency-multiplex and telephony transmission systems (60 to 108 kHz, international)

Filter options

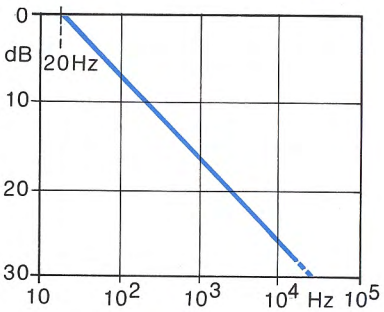
Triangular Noise Option SUF 2-Z2

Used for:
measurements on video equipment when simulating FM transmission systems, radio links and satellite communication equipment



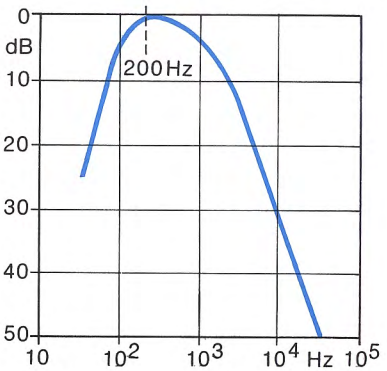
Pink Noise Option SUF 2-Z3

Used for:
rapid frequency response measurements using one-third-octave and octave filters



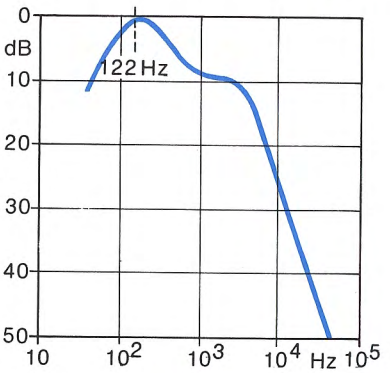
CCIR Rec. 559 Filter Option SUF 2-Z4

Used for:
"modern dance music" substitution signal for long, medium and short wave systems (9-kHz channel spacing, AM)



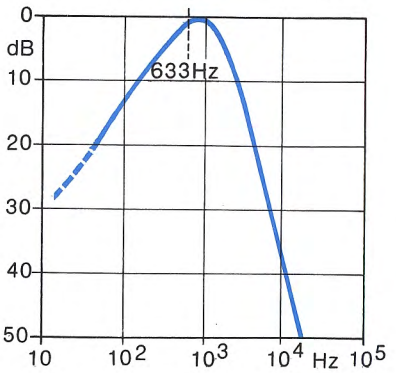
CCIR Rec. 571 Filter Option SUF 2-Z5

Used for:
"conventional program" substitution signal for frequency-division multiplex systems (FM)



CCITT Rec. G. 227 Filter Option SUF 2-Z7

Used for:
speech substitution signal for telephony



Specifications

Noise spectrum

Filter bandwidth, switch-selected	20 Hz to 110 kHz 20 Hz to 6 MHz 20 Hz to 50 MHz spare for filter option
Filter options	one only can be inserted

Noise level

Maximum level, link-selected	1 V_{rms} into 75 Ω (standard) 0.775 V_{rms} into 75 Ω (audio) 0.7 V_{rms} into 75 Ω (video)
Setting range	1-dB steps; 0 to −80 dB (20 Hz to 50 MHz) 0 to −100 dB (remaining ranges)
Fine adjustment	approx. ±0.5 dB (cannot be remote-controlled)
Frequency response flatness	<1 dB (ripple)
Level error	<1 dB
Clock period for level variation	approx. 0.3 s per 1-dB step (approx. 30 ms/dB with the button held down)
Output	BNC female connector

Operation

Manual	by means of buttons on front panel
Remote-controlled (standard)	parallel TTL control signals; level: BCD code + transfer pulse filter: binary code + transfer pulse noise: on/off
Remote-control options	one only can be inserted

Filter Options SUF 2-Z2/-Z3/-Z4/-Z5/-Z7 (these specifications in common)

Construction	plug-in PCB
Gain	full gain compensation, exchangeable without calibration
Frequency response	see diagrams

IEC-625-Bus Interface Option SUF 2-Z1

Interface standard	IEC 625-1 (IEEE-488)
Connector	24-contact, Amphenol
Interface functions	AH 1: acceptor handshake L1: listener RL1: remote/local
Local operation in system configuration	with "rtl" (return-to-local) switch
Character standard	ISO 7-bit code (ASCII)
Timing	approx. 0.2 ms for addressing approx. 0.2 ms for data transfer

CCIR Rec. 571 Program Option SUF 2-Z6

Cycle run	automatic, programmable
Level values	two levels and "noise off" plus the filter type can be link-selected
Standard timing	4 s: −7 dB 2 s: 0 dB 2 s: noise off cycle duration: 8 s
Nominal 0-dB level	if the audio reference output level has been set, the recommended test level of +3 dBm into 600 Ω can be obtained by a series resistor of 173 Ω

General data

Rated temperature range	+5 to +45 °C
Storage temperature range	−20 to +75 °C
AC supply	115/125/220/235 V +10/−15%, 47 to 63 Hz (20 VA)
Overall dimensions (without stand; W × H × D) and weight	210 mm×110 mm×347 mm, 4 kg

Ordering information

Order designation ▶ Noise Generator SUF 2 282.8819.03

Accessories supplied power cord, manual

Recommended extras (order separately)

Filter options:

Triangular Noise	SUF 2-Z2	282.9715.00
Pink Noise	SUF 2-Z3	282.9815.00
CCIR Rec. 559 Filter	SUF 2-Z4	282.9615.00
CCIR Rec. 571 Filter	SUF 2-Z5	282.9644.00
CCITT Rec. G. 227 Filter	SUF 2-Z7	282.8860.00

Remote-control options:

IEC-625-Bus Interface	SUF 2-Z1	282.9915.00
CCIR Rec. 571 Program	SUF 2-Z6	282.9673.00

SBUF

TV Test Transmitter SBUF ♦ 25 to 1000 MHz

- Modular construction of modulator section for adaptation to different TV standards
- Transposer section with digital vision carrier indication to an accuracy of ±1 kHz
- Programmed pushbutton selection of vision, sound and sideband levels; programmable for use in systems
- Measurement of intermodulation, spurious responses and line-time nonlinearity using sinusoidal sideband signals
- Full field signals to 525- and 625-line standards
- Dual-sound coding and modulation

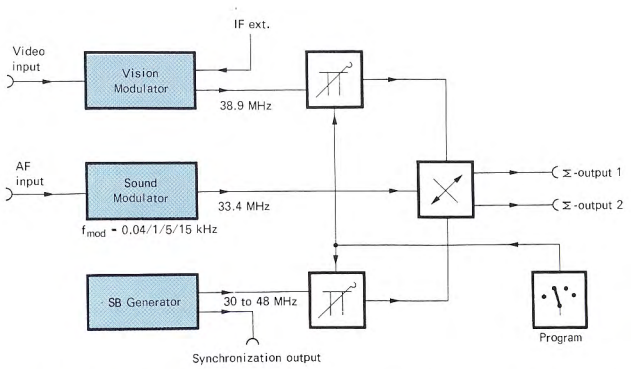
Photo: Transposer Unit SBUF (top) and Modulator Unit SBUF/SBTF 2 with second sound modulator

The **TV Test Transmitter SBUF** offers a variety and quality of high frequency TV test signals that have until now not been attained by any other test transmitter with continuously variable tuning. These attributes open up a wide field of applications in the development, testing and maintenance of TV receivers, amplifiers and transposers, as well as their modules and in cable TV systems. Together with ancillary equipment it is also suitable for instance for use with automatic test systems in research and production (as SBTF 2; see following pages and Section 3). It consists of two self-contained functional units, the Modulator Unit SBUF/SBTF 2 and the Transposer Unit SBUF, which are available as separate items of equipment, each with its own power supply.

Modulator Unit SBUF/SBTF 2

Thanks to its modular design, the Modulator Unit can be adapted to a full range of measurement tasks. The basic equipment comprises the Vision Modulator and the Sound Modulator (for FM or AM depending on the standard) which are accommodated in a Modulator Frame SBUF-B (19″; with power supply). The following configurations are possible:

Plug-in	SBUF-	Combinations			
Vision Modulator	–E1	×	×	×	×
Sond Modulator 1 (FM/AM)	–E2	×	×	×	×
SB Generator	–E3	×			
Program Selector	–E4	×			
Sound Modulator 2 (FM)	–E5		×		
Video Generator	–E6	×	×		
TV Dual-sound Coder	–E7		×		
Local Oscillator SBTF 2-E	page 91			×	
Transmitter Unit SBTF 2-E	page 91			×	
NICAM Generator	page 94 –E				×
NICAM Modulator	page 94 –E				×

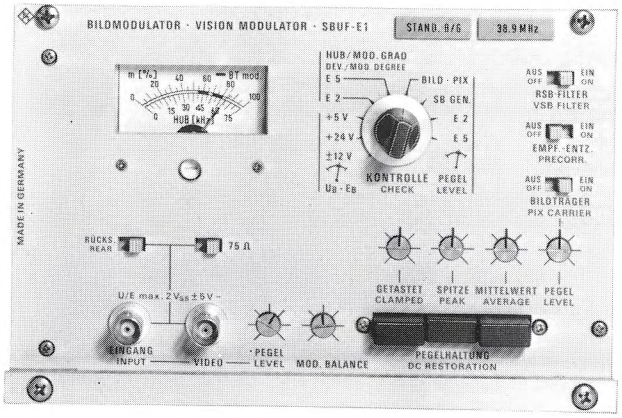


Block diagram of Modulator Unit of TV Test Transmitters SBUF and SBTF 2

The Modulator Unit (block diagram to the left) generates IF carrier signals modulated with vision and sound components in accordance with the standard involved. For the measurement of intermodulation distortion, a static or swept sideband can be added to this signal.

Vision Modulator SBUF-E1 The video signal can be applied at switch-selected loop-through inputs on the front or the rear panel. The receiver precorrection filter can be disabled. The balanced modulator uses one of the following modes of clamping:

1. clamping to the sampled value of the back porch
2. peak-value clamping to sync pulse level
3. mean-value clamping for symmetrical modulation signals

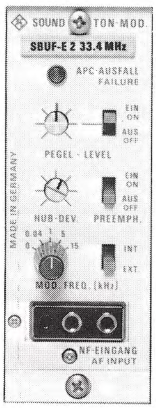


The carrier frequency is supplied by an internal crystal oscillator or an external signal source. A switch is fitted for **double-sideband modulation** (1-dB bandwidth ± 8 MHz) or – via a group-delay-equalized filter – **vestigial-sideband operation.**

The check meter indicates either supply voltages, deviation (or modulation depth) or output level of the vision, sideband or sound carrier.

For the **cable TV mode** using adjacent TV channels Vision Modulators with increased selectivity (surface wave filters) are available for Standards B/G and M.

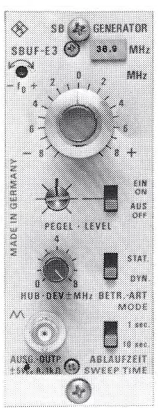
FM Sound Modulator SBUF-E2 The Sound Modulator is suitable both for mono transmission and for **modulation with stereo signals** (VHF). A low-distortion signal from an internal sinewave generator which can be set to 0.04/1/5/15 kHz or an external signal (two parallel balanced inputs) is used for frequency modulation. The preemphasis can be disconnected. The centre frequency is stabilized by **frequency and phase control loops.** The FM deviation can be continuously adjusted.



AM Sound Modulator SBUF-E2 (for Standards C, L, L') The AM Sound Modulator can be used instead of the FM Sound Modulator. It is also suitable for internal and external modulation; the modulation depth is continuously adjustable.

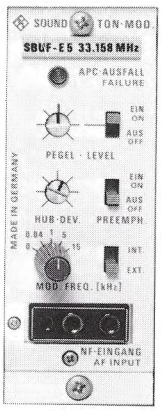
SB Generator SBUF-E3 The frequency of the voltage-controlled oscillator (30 to 48 MHz) can be set by hand or swept at one of two speeds over a continuously adjustable sweep width. The triangular sweep signal is level-controlled and available at a front-panel output.

The SB Generator enables simple **determination of the intermodulation products and the linearity** of amplifiers – in particular of TV transposers.

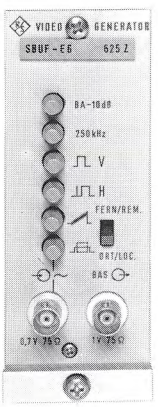


Program Selector SBUF-E4 Five static programs (no modulation; see specifications) and the dynamic program (normal mode) can be pushbutton-selected. In the dynamic mode, the modulated vision and sound carrier signals are available at the sum outputs in the ratio 10:1. **External program selection** is possible by applying TTL levels.

FM Sound Modulator SBUF-E5 for TV dual-sound or stereo measurements (the specifications are the same as those of Sound Modulator E2). The TV Dual-sound Coder E7 is required for operation (see below).



Video Generator SBUF-E6 The SBUF-E6 delivers a standard composite video signal (625 or 525 lines) with a selectable test signal for rapid checking and measuring of the transmission characteristics of TV transmission systems, in particular receivers and transposers. It makes the SBUF or SBTF 2 into a complete TV test transmitter. The five test signals can be selected either by pushbuttons or by external TTL levels. A mean grey pedestal can be connected for application of external signals (e.g. a sweep signal). Can be used instead of SBUF-E3 (external control possible) or SBUF-E5.

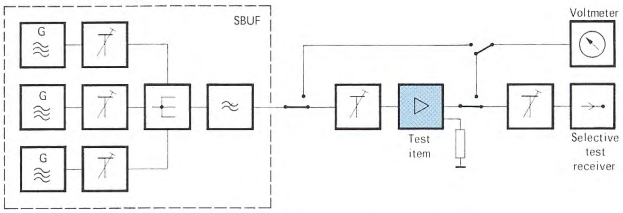


TV Dual-sound Coder SBUF-E7 The plug-in permits encoding of the AF signals for the FM Sound Modulators E2 and E5 and adjustment of amplitude and phase of the two sound channels. The E7 also delivers the frequencies for mode identification (for pilot modulation) and the pilot frequency.

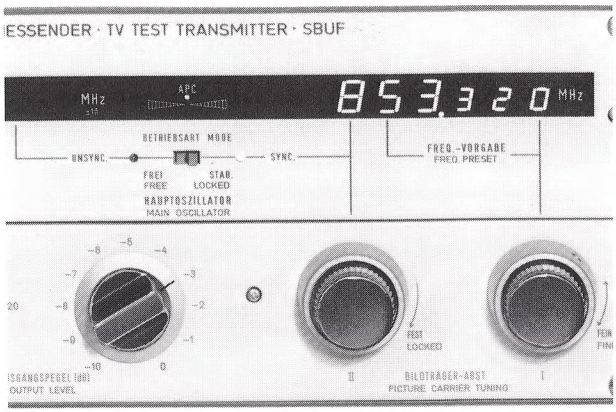
TV Test Transmitter SBUF (continued)

Output signal The combined signals from the Vision Modulator, Sound Modulator 1, Sideband Generator and Sound Modulator 2 are brought out at two sum outputs for frequency conversion in the Transposer Unit. The levels of the signal components are determined by attenuators in accordance with the selected program. Adjustment by a further ±3 dB is also possible on each component, or the components can be switched off.

The nonlinear distortion of the device under test can be efficiently measured with the aid of these signals by evaluation with an analyzer or selective receiver. The expense of three continuously variable signal generators with calibrated attenuators and decoupling networks, the separate tuning to three frequencies and the setting of three levels can thus be eliminated (see diagram below).



Test setup for moiré measurement on a channel amplifier



Frequency setting (bottom right) and readout (top) on Transposer Unit SBUF

Transposer Unit SBUF

In the transposer section the sum IF signal from the modulator section is up-converted and down-converted to obtain a carrier frequency anywhere in the range 25 to 1000 MHz. Unwanted spurious emissions are suppressed by fixed bandpass filters and a lowpass filter.

Frequency setting The frequency can be set in one of two ways:

"Unsync." mode Adjustment with tuning knob II only; frequency indication calibrated in MHz (error ≤±10 MHz), 3½ digits.

"Sync." mode Additional setting with tuning knob I; frequency indication calibrated for 0 to 100 MHz to an accuracy of ±1 kHz via a counter, locking however every 10 kHz. The channel frequency is set without the 100-MHz decade. The latter is derived from the adjustment of tuning knob II after phase locking.

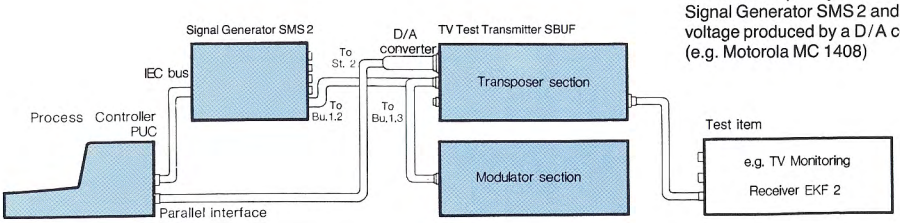
It is thus possible to set and read off the desired channel frequency without an IF signal being applied at the input of the transposer.

By way of a **counter input** with a 10:1 prescaler the reference-frequency input can be used for measuring external frequencies in the range **25 to 300 MHz.**

Second intermediate frequency The Transposer Unit is also available with a second input IF, for instance 45.75 MHz in addition to 38.9 MHz (switch-selected on the front panel). Moreover, the model is available with an IF of 32.7 MHz (Standard L/L') for the lower sideband. Another application is the conversion of the nominal IF into a second IF.

Output level The levelled output signal can be continuously adjusted by varying the overall gain and is indicated by a row of LEDs. A **calibrated attenuator** further allows the output level to be set in smallest steps of 1 dB.

Remote-controlled operation Channel setting is also possible by an external frequency for tuning I and by an external voltage for tuning II (see diagram below). A signal is delivered in the case of synchronization. The overall gain is selected by way of TTL levels.



Block diagram of computer-controlled test assembly for rapid channel change, the reference frequency is delivered by the Signal Generator SMS 2 and the tuning voltage produced by a D/A converter (e.g. Motorola MC 1408)

Specifications Modulator Unit SBUF/SBTF 2

Vision Modulator SBUF-E1

Video input signal

Signal level ..... 0.5 to 2 V_{pp} (CCVS)
DC offset ..... max. ±5 V
Input (switch-selected) ..... loop-through filter, BNC connectors; high-impedance or 75-Ω termination; front or rear panel
Return loss (0 to 8 MHz)
Front-panel input ..... ≥34 dB, external termination
≥26 dB, internal termination[1])
Rear-panel input ..... ≥20 dB, internal termination

IF output signal

Vision carrier ..... 38.9 MHz (B/G, D/K, I, M)
38.0 MHz (D/K)
32.7 MHz (L)
45.75 MHz (M-cable TV)
Frequency error ..... $\leq \pm 1 \times 10^{-5}$
Output level[2]) ..... 200 mV_{rms}, sync peak (white level with standard L)
Setting range ..... approx. ±3 dB, carrier can be disabled

Modulation characteristics

Type of modulation ..... C3F (A5C), negative (B/G, D/K, I, M)
C3F (A5C), positive (L)
Modes of operation ..... double sideband, vestigial sideband, with or without receiver group-delay correction filter
Clamping (pushbutton-selected)
Sampled ..... to back porch
Peak ..... peak clamping to sync level
Mean value ..... for symmetrical modulation

Transmission characteristics

Transmission range (IF) ..... ±8 MHz, ref.: vision carrier
Amplitude response
Double-sideband operation ..... <±0.2 dB, ±10 Hz to ±6 MHz
<±0.5 dB, ±6 Hz to ±8 MHz
Vestigial-sideband filter ..... see bottom left
Receiver group-delay correction ..... additional amplitude response:
Standard B/G ..... ±0.2 dB, 10 Hz to 4.8 MHz
D/K ..... ±0.2 dB, 10 Hz to 5.5 MHz
I (South Africa) ..... ±0.2 dB, 10 Hz to 4.8 MHz
L and I (Great Britain) ..... 0 (no correction)
M ..... ±0.2 dB, 10 Hz to 3.8 MHz
Group-delay response
Double-sideband operation ..... <10 ns, ±10 Hz to ±6 MHz
Vestigial-sideband operation .... additional ripple (peak-to-peak value):
Standard B/G ..... ≤40 ns, −4.8 to +0.5 MHz
B/G – cable TV ..... ≤70 ns, −4.8 to +0.5 MHz
D/K ..... ≤40 ns, −5.5 to +0.5 MHz
I ..... ≤30 ns, −5.2 to +1.0 MHz
L ..... ≤40 ns, −1.25 to +6.0 MHz
M ..... ≤40 ns, −4.0 to +0.5 MHz
M – cable TV ..... ≤70 ns, −4.0 to +0.5 MHz
Receiver group-delay correction .. see bottom right

Nonlinearity of modulation characteristic ..... ≤3%, 8 to 100% modulation
Differential gain at colour subcarrier frequency ..... ≤2%, 10 to 85% modulation
Differential phase at colour subcarrier frequency ..... ≤2°, 10 to 85% modulation
S/N ratio[3])
for 0.1 to 5 MHz ..... ≥64 dB (rms)
for 0 to 1 kHz ..... ≥60 dB (peak-to-peak)
Hum suppression[3]) in clamped mode ..... ≥57 dB (with 30% superimposed hum)

Check meter ..... for carrier level, modulation and supply voltages

Monitoring connector

(vision carrier) ..... test output: approx. 0.5 V into 50 Ω
oscillator input: 1 to 3 V

Sound Modulator 1 SBUF-E2 and Sound Modulator 2 SBUF-E5

AF input signal

Signal level ..... +6 dBm for 0 to ±80 kHz deviation, continuously adjustable
Frequency range ..... 40 Hz to 75 kHz
Input ..... floating, Z_{in} approx. 5 kΩ, switchable external/internal
Connector ..... front panel: 3-contact female
rear panel: 30-contact male

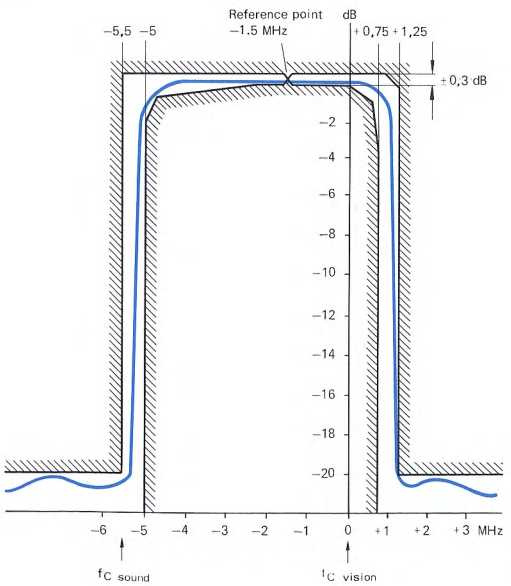
Internal AF generator

Frequency, switchable to ..... 0.04/1/5/15 kHz and "off"
Amplitude response ..... <±0.3 dB, ref. to 1 kHz
Harmonic distortion ..... <0.3%

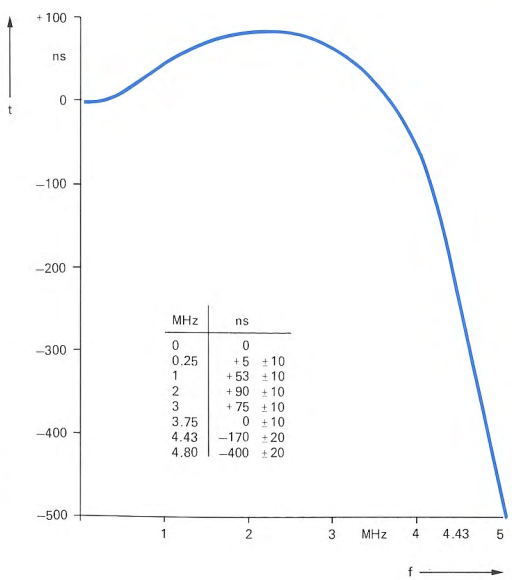
IF output signal

Sound carrier frequency[4])
Standard B/G ..... 33.4 MHz (sound 2: 33.158 MHz)
D/K ..... 32.4 MHz
I ..... 32.9 MHz
M ..... 34.4 MHz (cable TV: 41.25 MHz)
Frequency error ..... <±500 Hz
Centre frequency stabilization .... frequency and phase control; ref.: vision carrier
Output level[2]) SBUF-E2 ..... ≤45 to ≥90 mV_{rms} } carrier can
SBUF-E5 ..... ≤14 to ≥28 mV_{rms} } be disabled
Nominal level for single sound ... 45/63/90 mV, corresponding to vision/sound power ratio 20:1/10:1/5:1
dual sound .... 45 mV (20:1) for sound 1, 20 mV (100:1) for sound 2

[1]) Applies only if no cable is used.
[2]) Level at rear-panel IF summing outputs.
[3]) Measured via TV Demodulator AMF 2; ref.: black-to-white transition.
[4]) Please enquire for different frequencies.



Left:
Tolerance mask for frequency response of IF sideband spectrum (standard B/G)



Right:
Group-delay/frequency response of receiver group-delay correction (standard B/G)

TV Test Transmitter SBUF (continued)

Modulation characteristics for standards B/G, D/K, I, M

Type of modulation	F3E (F3), with preemphasis
Modulation frequency response flatness	<±0.3 dB, 40 Hz to 53 kHz <±0.5 dB, 53 to 75 kHz ref.: 1 kHz, preemphasis disabled
Preemphasis (switched)	50 µs ±5% (M: 75 µs)
Modulation distortion	≤0.5%, 40 Hz to 15 kHz, deviation ±75 kHz (preemphasis disabled)
Stereo crosstalk	>40 dB down, 0.1 to 5 kHz (measured with coder and decoder)
S/N ratio	>70 dB (mono), >66 dB (stereo), weighted and unweighted; ref.: ±40 kHz deviation
Synchronous AM	>40 dB down; for f_{mod} 1 kHz and deviation ±40 kHz; ref.: 100% modulation

Modulation characteristics for standard L (differing characteristics)

Type of modulation	A3E (A3), without preemphasis
AF input signal, level	+12 dBm for 0 to 100% modulation, continuously adjustable
Frequency range	30 Hz to 15 kHz
IF output signal	
Sound carrier frequency	39.2[1]) MHz ±500 Hz, crystal-controlled
Output level[2])	≤50 to ≥100 mV_{rms}, unmodulated
Modulation frequency response flatness	<±0.5 dB, 30 Hz to 15 kHz; ref.: 1 kHz
Modulation distortion	≤1% (up to 90% modulation)
S/N ratio	>70 dB, weighted and unweighted; ref.: 100% modulation

SB Generator SBUF-E3

Frequency range	30 to 48 MHz
Frequency setting	manual or swept
Sweep width	0 to ±8 MHz; ref.: 38.9 MHz
Sweep time, switch-selected	1 or 10 s (triangular)
Nominal output level	−16.5 dB (approx. 30 mV); ref.: vision carrier at summing output
Setting range	approx. ±3 dB, carrier can be disabled; can be controlled from SBUF-E4
Frequency response flatness	≤2% (automatic control)
Harmonics	≥40 dB down
Output for triangular signal	±5 V ±5%; Z_{out} approx. 1 kΩ

Program Selector SBUF-E4

Coupling network for vision, sound and SB signals	passive, attenuators selected with program buttons or externally
Program types	5 static programs plus normal operation, see text

Levels for the different programs

Program	Vision carrier	Sound carrier	Sideband
IM	0 dB	−10 dB	off
IM/K	−8 dB	−10 dB	−16.5 dB
IM/B	−5.5 dB	−11.5 dB	−11.5 dB
LIN 1	−2.5/−8 dB*)	−10 dB	−32 dB
LIN 2	−2.5/−20 dB*)	−10 dB	−32 dB
DYN	0 dB	−10 dB**)	off

*) alternating every 2 s **) with AM sound, carrier not modulated

External program selection .. by TTL level: 0 = active

Sound Modulator SBUF-E5 same as E2

Video Generator SBUF-E6

Pulse generator	mode H+V	
System	**625 lines**	**525 lines**
Line frequency	15.625 kHz ±0.1%	15.750 kHz ±0.1%
Field frequency	50 Hz	60 Hz
Colour subcarrier frequency	4.433618 MHz ±10 Hz	3.579545 MHz ±10 Hz

CV output signal (data common to the signals listed below)

Picture component, switch-selected	0.7/0.22 V (0/−10 dB)
S component, fixed	0.3 V
Output (front panel)	75 Ω; A_r ≥34 dB (up to 10 MHz); BNC
S/N ratio	>50 dB (peak measurement at grey pedestal, ref. to 0.7 V)
Rise and fall times	200 ns −10/+20 ns

[1]) Please enquire for other frequencies.
[2]) Separate IF outputs for vision and sound carriers if separate Channel Unit SBTF 2 is used; IF summing output for Transposer Unit SBUF.

250-kHz squarewave

Tilt	≤1%
Synchronization	H signal

V squarewave

Tilt	≤1%

H squarewave and 2T pulse

Squarewave (duration)	approx. 17 or 52 µs
Tilt/overshoot	≤1%/≤2%
2T pulse, switch-selected	normal/inverted position

Sawtooth with superimposed RF (CCIR signal No. 3)

Sawtooth signal (duration)	approx. 12 to 64 µs after S leading edge
Superimposed colour subcarrier	100 mV/32 mV ±10% (corresponding to picture component 0/−10 dB)
Diff. gain/phase	≤0.2%/≤0.3°

Pedestal plus external signal

Input signal	0.7 V for 10 to 70% superimposed RF
Frequency response flatness	<±0.1 dB (50 Hz to 6 MHz)
Input (front panel)	75 Ω; A_r ≥34 dB (up to 10 MHz); BNC
Blanking	3 µs before to 12 µs after S leading edge
Grey pedestal, adjustable	30 to 100% picture component
Signal selection	by pushbuttons or external signal (TTL level when inserted in compartment 3)
Accessories supplied	75-Ω cable, BNC, 0.5 m long

TV Dual-sound Coder SBUF-E7

AF input signals	L/R or AF 1/AF 2
(Nominal) signal level	+6 dBm for ±30 kHz deviation
Maximum input level	+12.5 dBm
Preemphasis, can be disabled	50 µs ±5%
Input (front panel)	Z_{in} approx. 5 kΩ; 6-contact

AF output signals (coded)

(Nominal) signal level	+6 dBm	
Frequency response flatness	<±0.5 dB (40 Hz to 15 kHz)	
Signal type	sound channel 1	sound channel 2
Mono without pilot	M 1	M 1
Mono with pilot	M 1	M 1 + pilot
Dual sound	M 1	M 2 + pilot
Stereo	M = 0.5 (L+R)	R + pilot
Crosstalk dual sound/stereo	<70 dB/<50 dB	
Setting of deviation symmetry	level approx. ±0.5 dB phase approx. ±3° (at 15 kHz)	
Pilot carrier	in sound channel 2	
Pilot level	−15.6 dBm, ±6 dB adjustable (corresponding to deviation ±2.5 kHz)	
Pilot frequency	54.6875 kHz (≙ 3.5 f_H)	
Frequency stabilization		
with vision modulation	synchronized with line frequency f_H	
without vision modulation	error ≤±5 Hz	
Operating mode identification	pilot carrier amplitude-modulated with identification frequency	
Identification frequencies	mono:	without (unmodulated)
	dual sound:	274.1 Hz (= f_H/57)
	stereo:	117.5 Hz (= f_H/133)
Modulation depth	adjustable from 40 to 60%	
Accessories supplied	connecting cable to Sound Modulators	

Specifications Transposer Unit SBUF

Frequency and level

Input frequency range	38.0 MHz ±7 MHz 38.9 MHz ±7 MHz 45.75 MHz ±6 MHz 32.7 MHz ±7 MHz (combinations possible, see ordering information) — for standard, see Modulator Unit
Nominal input level	200 mV ±0.5 dB
Input	BNC female connector on rear panel, Z_{in} = 50 Ω, return loss ≥20 dB
Output frequency f_{out} with f_{in} = IF_{vision}	25 to 1000 MHz continuous tuning range
Frequency stabilization	APC with indicator, switched
Output frequency indication	1. with APC via counter, accurate to 10 kHz ±1 kHz 2. without APC via A/D converter and digital voltmeter, error <±10 MHz
Gain from input to output	adjustable from −6 to 0 dB
Frequency-response flatness of gain	≤2 dB with AGC ≤6 dB with manual setting
within f_{out} ±7 MHz	≤±0.5 dB, ±0.2 dB typ., channel-dependent

Output level	30 µV to 200 mV into 50 Ω (106 dBµV max.), may be reduced in steps of 1 and 10 dB by calibrated attenuator
Ext. switchover 100/106 dBµV	by way of TTL levels
Error of output attenuator	fine ≤±0.2 dB coarse ≤±0.5 dB
Output	N female connector, adaptable; Z_{out} = 50 Ω, return loss ≥6 dB with output attenuator set to 0 dB, or BNC female connector; Z_{out} = 75 Ω (with matching pad)
Monitoring outputs for local oscillators	approx. 0.1 V into 50 Ω, BNC female connectors on rear panel
Nominal frequency of first LO	70.366833 MHz
Nominal frequency of second LO and timebase	100.00000 MHz
Oscillator-frequency adjustment	≥5 ×10^{-6} with rear-panel potentiometers
Effect of crystal aging	≤2 ×10^{-8}/day (manufacturer's data)
Output-level monitoring	row of LEDs
Input for tuning signal I	150 to 250 MHz, 0.5 to 1 V_{rms}
Input for tuning signal II	0 to 5 V for 0 to 1000 MHz
Connectors	BNC female (rear panel)

Transmission characteristics

Spurious signals with vision/sound ratio of 10:1 (gain −6 dB)	
Spurious emissions	≥66 dB down, 70 dB typ., channel-dependent
Vision carrier −5.5 MHz and +11 MHz	≥56 dB down, 60 dB typ., channel-dependent
Intermodulation products	≥70 dB down
Harmonics	≥40 dB down
Spurious signals outside tuning range	≥40 dB down
Video S/N ratio at 0 dB gain, referred to black-to-white transition	
0.1 to 5 MHz (noise)	≥60 dB (rms)
0 to 1 kHz (hum)	≥56 dB (peak-to-peak)
Audio S/N ratio up to 15 kHz (with pre- and deemphasis)	≥66 dB, referred to 40-kHz deviation

Frequency counter

Frequency counter for measurement of output frequency	switched external/internal
Frequency range for ext. mode	25 to 300 MHz
Input voltage	50 mV_{rms} to 1 V_{rms} into 50 Ω
Input	50 Ω, BNC female connector (front panel)
Frequency of timebase	100 MHz ±5 ×10^{-7}

General data

Rated temperature range	+5 to +35 °C
Operating temperature range	+5 to +45 °C
Storage temperature range	−20 to +70 °C
Connectors on Modulator Unit (rear panel)	
IF summing output (BNC)	2 for modulator configuration 1 for channel transmitter configuration
Return loss	≥18 dB, 30 to 48 MHz
Monitoring output	for vision carrier, 50 Ω, BNC
Video input	loop-through filter, BNC; see SBUF-E1
AF/control/status lines	30-contact male connector to DIN 41 622
AC supply	110/125/220/235 V +10/−15%, 47 to 63 Hz
Power consumption Modulator Unit	70 VA for Vision and Sound Modulators, 125 VA for fully equipped frame
Transposer Unit	130 VA
Overall dimensions (W×H×D)	
19″ bench model	492 mm×161 mm×514 mm
19″ rackmount	483 mm×132 mm×506 mm
Weight of Modulator Unit	
19″ bench model	17 kg fitted with Vision and Sound Modulators, 21 kg fully equipped
19″ rackmount	15 kg fitted with Vision and Sound Modulators, 19 kg fully equipped
Weight of Transposer Unit	25 kg

Ordering information

Modulator Unit SBUF/SBTF 2

The basic version comprises the Modulator Frame SBUF-B plus the power supply, fitted with the Vision Modulator SBUF-E1 and the Sound Modulator SBUF-E2 (sound 1).

Order designations

Modulator ▶ Modulator Unit SBUF/SBTF 2	19″ rackmount	19″ bench model
Standard		
B/G – general	341.0014.11	341.0014.12
B/G – general – cable TV	341.0014.41	341.0014.42
B/G – Australia	341.0014.87	341.0014.88
B/G – New Zealand	341.0014.89	341.0014.90
D/K – CCIR Rep. 308	341.0214.11	341.0214.12
D/K – Czechoslovakia/Hungary	341.0214.15	341.0214.16
D/K – 38.0 MHz	341.0214.19	341.0214.20
I – United Kingdom	341.0414.11	341.0414.02
I – South Africa	341.0414.13	341.0414.14
L – France	341.0814.11	341.0814.12
M – 38.9 MHz	341.0614.11	341.0614.12
M – 45.75 MHz – cable TV	341.0614.41	341.0614.42

Accessories supplied termination 124.0324.00, power cord 025.2365.00

Recommended extras

SB Generator SBUF-E3	294.6416.00
Program Selector SBUF-E4	294.7012.00
Sound Modulator (sound 2) SBUF-E5 for standard	
B/G (33.158 MHz)	294.7312.00
For other standards please specify sound carrier frequency.	
Video Generator SBUF-E6	
625-line standard (CCIR)	340.8211.76
525-line standard (FCC)	340.8211.75
TV Dual-sound Coder SBUF-E7	241.3812.00
Adapters for servicing	
13-contact plug-in	294.0260.13
21-way cable	294.1420.00
50-Ω cable	341.5245.00 (2 cables recommended)

Transposer Unit SBUF

Order designations ▶ Transposer Unit SBUF

Transposer section (one IF only):

IF_{vision} MHz	38.9[1]	38.9[2]	45.75	32.7[2]
19″ bench model				
50 Ω	292.8011.52	292.8011.58	293.8215.52	293.8415.56
75 Ω	292.8011.72	292.8011.78	293.8215.72	293.8415.76

Transposer section, two-standard version (IF switch-selected):

$IF_{vision\ 1}/IF_{vision\ 2}$ MHz	38.9/38.0	38.9/45.75	38.9/32.7	45.75/32.7
19″ bench model				
50 Ω	292.8011.14	292.8011.54	292.8011.56	293.8215.56
75 Ω	292.8011.24	292.8011.74	292.8011.76	293.8215.76

[1]) Please enquire for IF_{vision} = 38.0 MHz.
[2]) Can be switch-selected to lower or upper sideband.

Please enquire for further standards and special versions.

Accessories supplied connecting cable (50 Ω) 292.8970.00, power cord 025.2365.00

SBTF 2

TV Test Transmitter SBTF 2 ♦ Bands I/II, III, IV/V and cable TV bands

- Compact design with couplers or diplexers integrated into the system
- Up to 8 transmitter units can be operated simultaneously from one modulator
- Video signal generation and dual-sound modulation after adding the appropriate plug-ins
- Available for different standards
- Channel change within a band possible by exchanging the crystal

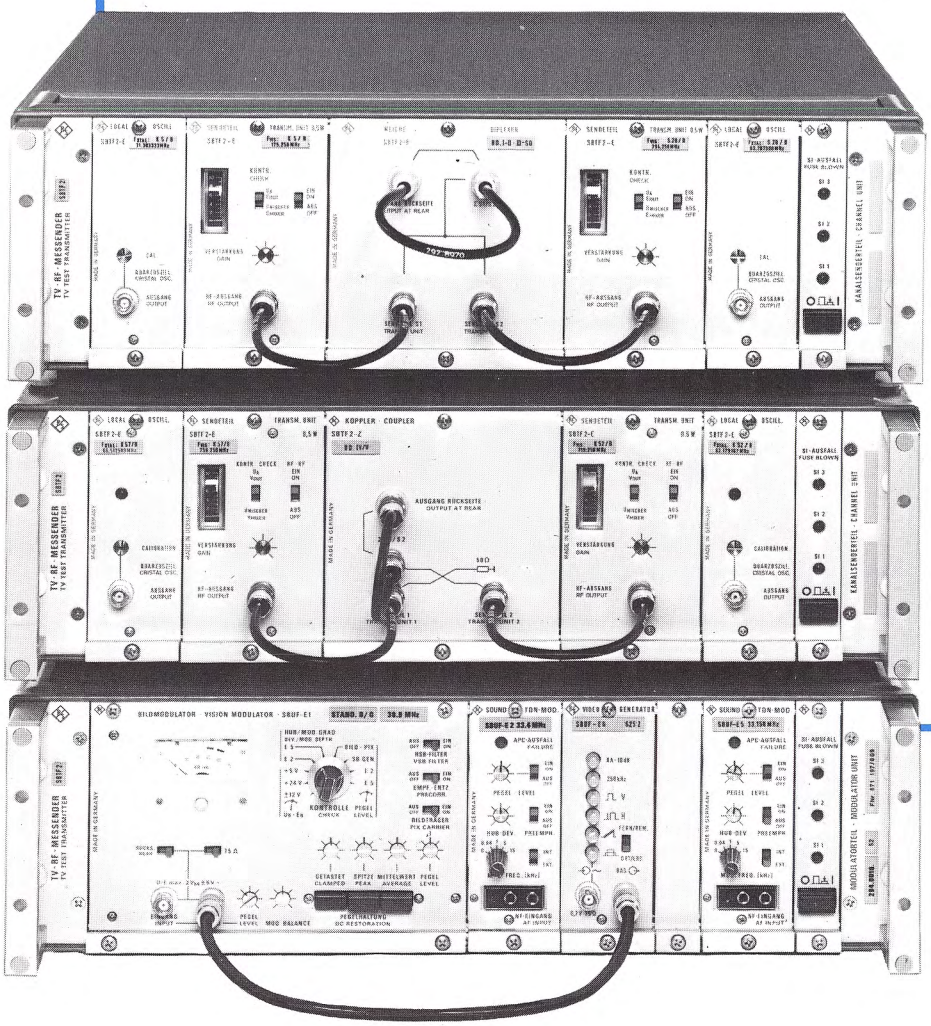


Photo: Four-channel model of SBTF 2 with expanded Modulator Unit SBUF/SBTF 2. Bottom: Dual-sound Modulator and Video Generator; top: Channel Unit (two 19″ frames, each fitted with two Local Oscillators and two Transmitter Units, one using a Diplexer and the other a Coupler)

The **TV Test Transmitter SBTF 2** is a general-purpose TV channel test transmitter for measurements and checkouts in research and development labs, TV receiver and VTR manufacturing, cable TV systems, and for mobile use **both in the TV and the VHF ranges.**

The SBTF 2 uses the Modulator Unit SBUF/SBTF 2 of the TV Test Transmitter SBUF developed in accordance with state-of-the-art technology, operating nevertheless with fixed channel frequencies. Thanks to its modular design, the SBTF 2 system is extremely **flexible and easy to expand.** The rated output power is **0.5 W per channel.**

Frequency range In addition to the TV and VHF ranges, the frequency range also covers the lower (channels S1 to S10) and upper (channels S11 to S20) cable TV bands as well as the hyperband up to channel S38.

Configuration The SBTF 2 consists of the Modulator Unit and the Channel Unit which, depending on the number of channel frequencies desired, includes up to eight Transmitter Units plus their Local Oscillators and the Diplexers or Couplers as required. It can be expanded with the options Numerics Inserter IF (subassembly) or Numerics Inserter Video (19″ unit).

Modulator Unit SBUF/SBTF 2

The Modulator Unit SBUF/SBTF 2 (see previous pages) is used making it possible to connect up to 8 Transmitter Units plus their Local Oscillators.

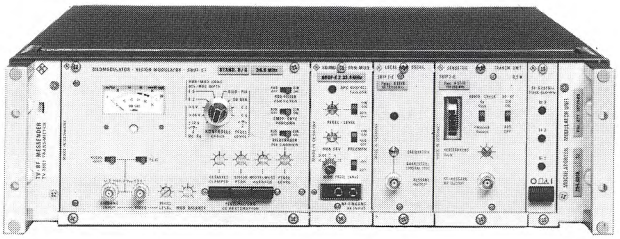
Channel Unit

The Channel Unit converts the IF sum signal modulated to standard in the Modulator Unit to the corresponding channel frequencies.

Each channel requires a
Local Oscillator SBTF 2-E and a
Transmitter Unit SBTF 2-E (0.5 W).

The Local Oscillator and the Transmitter Unit determine the channel and thus the band. A channel change within the band is possible by exchanging the crystal and subsequent adjustment. Four different 0.5-W Transmitter Units and the associated Local Oscillators cover bands I to V.

Channel Unit Frame SBTF 2-B with power supply A Channel Unit Frame accommodates two channel transmitters (Local Oscillator plus 0.5-W Transmitter Unit), an output coupling network and the Numerics Inserter (IF). The two transmitter units can be driven separately via two IF inputs or together via the power divider fitted as standard. An additional power divider (option) permits use of a second Channel Unit fitted with two channel transmitters.



Complete SBTF 2 for a single channel (comprising Vision Modulator, Sound Modulator, Local Oscillator and Transmitter Unit)

Local Oscillator SBTF 2-E The Local Oscillator produces the conversion frequency for the Transmitter Unit. In the bands up to 300 MHz, it is obtained by multiplying the frequency of a crystal oscillator whereas, in the band from 470 to 890 MHz, it is delivered by a free-running oscillator stabilized to crystal accuracy by way of a PLL.

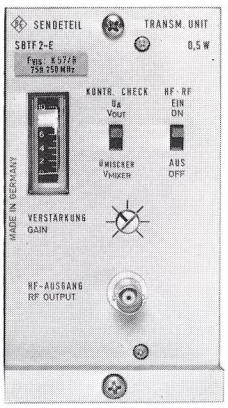
Coupling networks

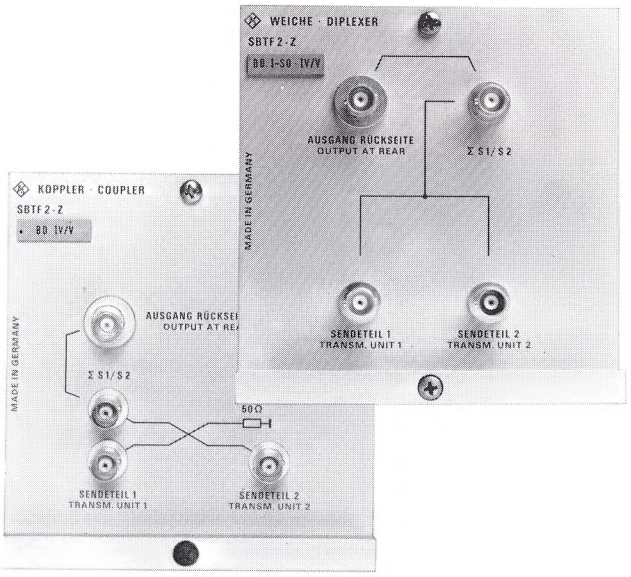
The Channel Unit Frame accommodates one Coupler or Diplexer. Each individual signal as well as the sum signal is accessible at RF from the front panel. If only one Transmitter Unit is fitted in the frame, the access is through the junction panel (if used).

Freely cabled, additional couplers and diplexers permit several Channel Units to be connected to one common line. In general, the characteristic impedance of the coupling networks is 50 Ω. BNC connectors are used throughout.

Couplers SBTF 2-Z The two models for 25 to 300 MHz and 470 to 890 MHz combine two RF signals of the same frequency range.

0.5-W Transmitter Unit SBTF 2-E This plug-in converts the modulated IF sum signal to the RF. Bandpass filters tuned to the channel frequency suppress spurious components. The output level is continuously adjustable over about 10 dB and is indicated on a panel check meter. The RF signal is available at the front-panel output but can also be routed to the rear-panel output on the 50-Ω model. The connector which is not used as the power output can be employed for monitoring purposes.





Transmitter Unit for Standard L With this standard, the vision and the sound carriers are amplitude-modulated and must be separately converted to avoid the critical intermodulation. Therefore, a fully equipped Channel Unit Frame fitted with a Diplexer or Coupler is required for each channel.

Channel transmitter The basic version of the Modulator Unit (with Vision and Sound Modulators) can be fitted with the 0.5-W Transmitter Unit plus its Local Oscillator (see photo right-hand column top) to form a TV channel transmitter. This smallest component of the SBTF 2 system is available for any channel between 47 and 890 MHz.

Diplexers SBTF 2-Z Diplexers apply two RF signals of different frequency ranges to a common load. Three models are required corresponding to the different possibilities of combination. The transmitter unit using the lower frequency must be inserted to the left of the diplexer.

Impedance Transformers SBTF 2-Z The transformers permit the transition to a characteristic impedance of 60 Ω or 75 Ω.

System configuration

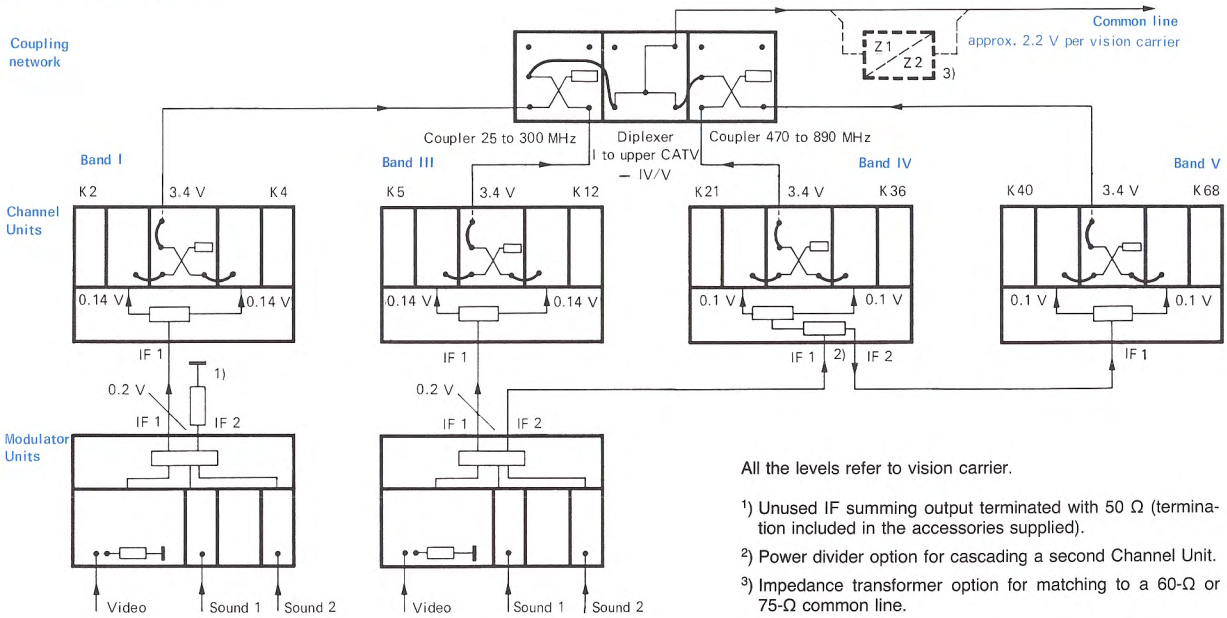
Thanks to its great flexibility, the SBUF/SBTF 2 system is ideal for setting up test assemblies required for instance in the production of TV receivers and VTRs (see Section 3).

Smaller systems (example see below) can be configured by inserting the plug-ins into the Modulator and Channel Unit Frames (see photo on title page). Larger systems and any other instruments can be accommodated in 19″ racks.

Channel-identification numbers In particular in large test assemblies, it has proved useful to insert program- and channel-identification numbers and a background with the aid of the Numerics Inserter (Video) coming as a 19″ unit or, without background insertion, using the Numerics Inserter (IF) fitted on a circuit board.

Numerics Inserter (Video) SBTF 2-Z (19″ rackmount)

Example of a small system



All the levels refer to vision carrier.

[1]) Unused IF summing output terminated with 50 Ω (termination included in the accessories supplied).

[2]) Power divider option for cascading a second Channel Unit.

[3]) Impedance transformer option for matching to a 60-Ω or 75-Ω common line.

Specifications

Modulator Unit . . . . . see SBUF

Channel Unit

0.5-W Transmitter Unit SBTF 2-E

Frequency range (depending on model)

Band I/II	47 to 108 MHz
Lower CATV band/band III	104 to 230 MHz
Upper CATV band	230 to 300 MHz
Hyperband	300 to 450 MHz
Band IV/V	470 to 890 MHz
Channel change within one band	by exchanging the crystal and subsequent adjustment

The special lower (S1 to S10) and upper (S11 to S20) CATV channels are used in cable TV networks.

IF input signal

Standard	B/G	D/K	I	L	M
Vision carrier, f_{IF} (MHz)	38.9	38.9	38.9	32.7	38.9
Sound carrier (MHz)	33.4	32.4	32.9	39.2	34.4
	(M-CATV: 45.75/41.25 MHz)				

Other intermediate frequencies (38.0/39.5/37.0 MHz, etc.) on request.

Vision carrier level	100 to 200 mV
Sound carrier level	corresponding to vision/sound power ratio (20:1 to 5:1)
Connector (rear panel)	50 Ω, BNC; A_r ≥20 dB

IF output signal (for cascading a second Channel Unit)

Output level	140 mV (with power divider option)
Connector (rear panel)	50 Ω, BNC

RF output signal

Nominal output power	0.5 W; 1 W (with some loss in performance) (ref.: sync peak, white level for standard L)
Output impedance	50 Ω (60 or 75 Ω possible at front-panel output)
Permissible termination	nominal value ±5% for guaranteed performance data, otherwise not limited
Level error	≤±0.5 dB
Spurious RF levels (referred to vision carrier level)	
Spurious signals	≥60 dB down (bands I/II/lower CATV/III/upper CATV) ≥40 dB down (bands IV/V)
Intermodulation products	≥60 dB down (within one channel)
Video S/N ratio (referred to black-to-white transition)	
0.1 to 5 MHz (noise)	≥60 dB (rms)
0 to 1 kHz (hum)	≥54 dB (peak-to-peak)
Connector (BNC)	50 Ω, front or rear panel 60 Ω/75 Ω, front panel only
RF monitoring output	0.1 to 0.8 V into 50 Ω, BNC
Connector	unused output on front or rear panel
Checking	panel meter; oscillator and output voltages

Transmission characteristics

Gain	28 dB; 22 to 35 dB adjustable
Frequency response flatness	≤±0.5 dB; −0.75 to +5.5 MHz; ref.: vision carrier for Standard B/G (for other standards, from beginning of vestigial sideband to sound carrier)
Group-delay error	≤50 ns; −0.75 to +5 MHz; ref.: vision carrier for Standard B/G (for other standards, up to 0.5 MHz below sound carrier)
Sync crushing	≤2%; ref. to complete signal

Local Oscillator SBTF 2-E

Conversion frequency ..... $f_{OSC} = f_{vision} + f_{IF}$ (standard L, band I: $f_{vision} - f_{IF}$)

Crystal oscillator frequency (f_{xtal}) ... band I/II: $1/2\ f_{osc}$
lower CATV band/band III: $1/3\ f_{osc}$
upper CATV band: $1/4\ f_{osc}$
band IV/V: $1/12\ f_{osc}$

Frequency error ..... $\leq \pm 1 \times 10^{-6}\ f_{xtal}$
Aging ..... $\leq 2 \times 10^{-8}\ f_{xtal}$/day
Pull-in-range ..... approx. $5 \times 10^{-6}\ f_{xtal}$

Level transferred
to transmitter unit ..... approx. 1 V (band I to upper CATV band),
approx. 0.3 V (band IV/V)

General data

(Channel Unit Frame with Transmitter Unit plus Local Oscillator)

Rated temperature range ..... +5 to +35 °C
Operating temperature range ..... +5 to +45 °C
Storage temperature range ..... −20 to +70 °C
Connectors on Channel Unit Frame (rear panel)
RF outputs ..... 1 per transmitter unit and 1 summing output with coupler/diplexer
IF inputs ..... 1 with common, 2 with separate driving
IF output ..... 1 for second Channel Unit; enabled only with power divider option
Status outputs ..... 30-contact male connector DIN 41622
AC supply ..... 110/125/220/235 V +10/−15%, 47 to 63 Hz (55 VA for each transmitter unit)
Overall dimensions (W×H×D)
19″ bench model ..... 492 mm×161 mm×514 mm
Weight with 1 transmitter unit .. 12 kg (2 transmitter units: 18 kg)
19″ rackmount ..... 483 mm×132 mm×506 mm
Weight with 1 transmitter unit .. 10 kg (2 transmitter units: 16 kg)

Coupler SBTF 2-Z

Frequency range (depending on model)
Bands I/II/lower CATV/III/upper CATV ..... 25 to 300 MHz
Bands IV/V ..... 470 to 890 MHz
Power handling capacity ..... 1 W per input
Insertion loss ..... 3.3 dB ±0.5 dB
Characteristic impedance ..... 50 Ω
Return loss ..... ≥20 dB
Isolation of inputs ..... ≥30 dB, 25 to 300 MHz
≥20 dB, 470 to 890 MHz
for vision/sound, Std L ..... ≥30 dB, 470 to 890 MHz
Connectors ..... BNC

Accessories supplied ..... cable set (BNC, 50 Ω)

Please enquire for couplers of the same construction with two RF summing outputs (different models for bands I/II, lower CATV/III, upper CATV and IV/V)

Diplexer SBTF 2-Z

Frequency range (depending on model)

	lowpass filter (S1)	highpass filter (S2)
Bands I/II and III/upper CATV ...	45 to 111 MHz	168 to 300 MHz
Bands I to lower CATV and upper CATV	45 to 181 MHz	224 to 300 MHz
Bands I to upper CATV and IV/V	45 to 300 MHz	470 to 890 MHz

Power handling capacity ..... 1 W per input
Insertion loss ..... ≤0.5 dB
Characteristic impedance ..... 50 Ω
Return loss ..... ≥20 dB
Isolation of inputs ..... ≥30 dB
Connectors ..... BNC

Accessories supplied ..... cable set (BNC, 50 Ω)

Impedance Transformer SBTF 2-Z

Impedance transformation ..... 50/60 Ω, 50/75 Ω oder 60/75 Ω
Frequency range ..... 25 to 1000 MHz
Return loss ..... ≥18 dB
Insertion loss at 100 MHz ..... <0.2 dB
500 MHz ..... <0.5 dB
1000 MHz ..... <0.8 dB
Power handling capacity ..... max. 2.5 W
Connectors ..... BNC

Numerics Inserter SBTF 2-Z

Channel number ..... video: 1 to 4, IF: 1 or 2
Background (only for video) ..... selectable with/without
Program/channel number ..... 1 to 16/00 to 99
Height of numerics/background .... 20 lines/32 lines
AC supply, video ..... 100/120/220/240 V (15 VA)
IF ..... from basic unit
Weight, video ..... 19″ rackmount: 3 kg } height: 19″ bench model: 5 kg } 1 unit
IF (circuit board) ..... 1 kg

Ordering information

Modulator Unit ..... see SBUF

Channel Unit

One Channel Unit Frame SBTF 2-B including the power supply accepts a maximum of two 0.5-W Transmitter Units SBTF 2-E plus the associated Local Oscillators SBTF 2-E, a Numerics Inserter (IF) and a coupling network. The output impedance of the transmitter units must be 50 Ω to permit combination via the Coupler or Diplexer SBTF 2-Z.

Please order the Local Oscillator together with the Transmitter Unit, indicating the channel frequency (vision carrier) and the TV standard. The Transmitter Units are also available with a 60-Ω or 75-Ω front-panel output. Then the last two figures of the order number read .60 for 60 Ω and .75 for 75 Ω.

Systems using an amplitude-modulated sound carrier require separate Transmitter Units plus the associated Local Oscillators for vision and sound to permit signal conversion to the RF. A Coupler with 30-dB coupling attenuation is used for vision/sound diplexing.

Order designation

Frame	▶ Channel Unit Frame SBTF 2-B
19″ rackmount	341.5016.51
19″ bench model	341.5016.52
Oscillator	▶ Local Oscillator SBTF 2-E
Band I/II	341.1010.50
Lower CATV band/band III	341.1510.50
Upper CATV band	341.1810.50
Hyperband	831.9520.50
Band IV/V	341.2117.50
Transmitter Unit	▶ 0.5-W Transmitter Unit SBTF 2-E
Band I/II	341.2517.50
Lower CATV band/band III	341.3313.50
Hyperband	831.9720.50
Upper CATV band	341.3813.50
Band IV/V	341.4310.50
Coupler	▶ Coupler SBTF 2-Z
25 to 300 MHz	341.5816.53[1]
470 to 890 MHz	341.5816.57
with two summing outputs	please enquire
Diplexer	▶ Diplexer SBTF 2-Z
Bands I/II and III/upper CATV ...	341.6412.50
Band I to lower CATV and upper CATV	341.6429.50
Bands I to upper CATV and IV/V	341.6435.50

Accessories supplied ..... power cord 025.2365.00

Recommended extras (order separately)

Impedance Transformer SBTF 2-Z	
50/60 Ω	341.6935.56
50/75 Ω	341.6935.57
60/75 Ω	341.6935.67
Numerics Inserter (Video) SBTF 2-Z	
	19″ rackmount
1 channel	357.8010.11
2 channels	357.8010.21
3 channels	357.8010.31
4 channels	357.8010.41
Numerics Inserter (IF) SBTF 2-Z	
1 channel	289.7701.11
2 channels	289.7701.21
Adapter cables for servicing	same as for Modulator Unit (see SBUF)

[1]) Vision/sound diplexer for AM sound.

System configuration

19″ racks of the R&S series KCJ are recommended for setting up larger systems. The following accessories are available for mounting:

Junction Panel SBTF 2-Z for self-engaging connection for all frames	294.0153.00
Guide rails	
for R&S Racks KCJ	281.3742.00 (1 pair, with boreholes)
for general use either on left or right side (without boreholes, length 740 mm)	281.3759.00 (1 unit)
Bracket for fixing a junction panel on the guide rails	281.3771.00 (mounting set)

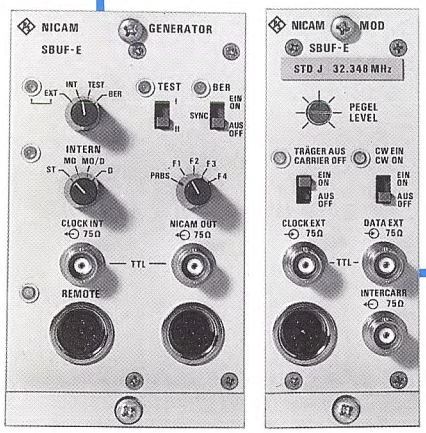
new

SBUF-E

NICAM Generator SBUF-E
NICAM Modulator SBUF-E

- 5.85/6.552 MHz IF range

- 4 PSK modulator with intercarrier and IF carrier output
- Digital pulse shaping
- CW operation
- Digitally generated AF test signals
- Defined bit error
- Remote-control AF test signals and carrier level switch-off



The **NICAM generator SBUF-E and NICAM modulator SBUF-E** for the TV RF test transmitters SBUF and SBTF 2 generate a 4-PSK modulated carrier signal at the intercarrier frequency (IF) in compliance with the dual-sound standard NICAM-728 (Nearly Instantaneously Companded Audio Multiplex). In conjunction with the integrated sound modulator, the test transmitter equipped with these rackmounts supplies **IF and RF test signals** in development, production and maintenance **for TV equipment with NICAM sound demodulators,** such as TV home receivers, test receivers and transmission equipment.

The following can be measured:

- Frequency response
- Distortion
- Channel crosstalk
- S/N ratio

The following is also possible:

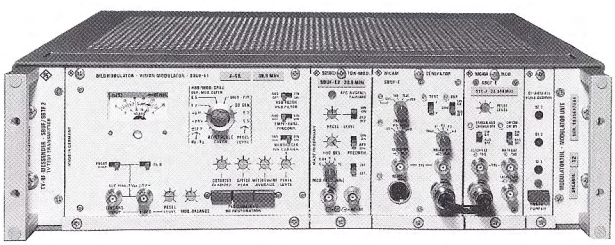
- Testing the switchover functions depending on the control bits for stereo, mono, mono/data and data
- Response of switchover equipment NICAM sound/FM sound if there is an excessive number of bit errors.

The NICAM generator and NICAM modulator are simply plugged in the modulator section SBUF/SBTF 2 like the other system modules.

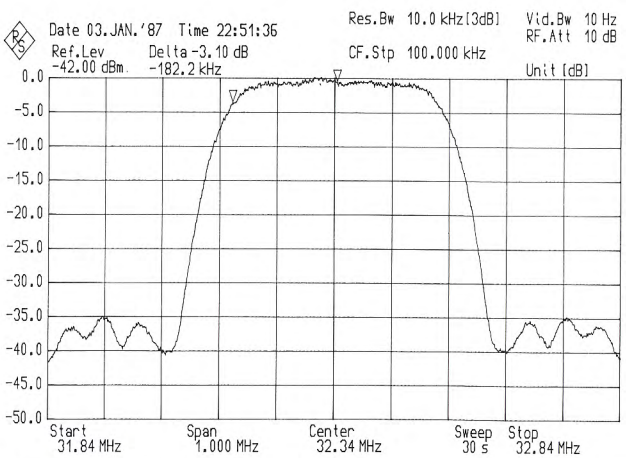
The **NICAM generator SBUF-E** generates a complete 728 kbit serial data stream with a frame alignment word, check and additional data bits, and a digital AF sinusoidal signal (see the spectral distribution diagrams below). The main functions of the generator and IF carrier level switch-off can be **remote-controlled** via a TTL interface.

A maximum of four signal combinations with different frequencies and a pseudo-random bit sequence (PRBS) can be selected as data content in the INTERNAL operating modes ST (stereo), MO (mono) and MO/D (mono/data), whereas only data and the PRBS can be selected in the operating mode D (data). A frame alignment word can be inserted into the injected PRBS signal for bit error measurements using digital transmission analyzers. The 728 kHz synchronizing clock output is interrupted during the transmission of the frame alignment word.

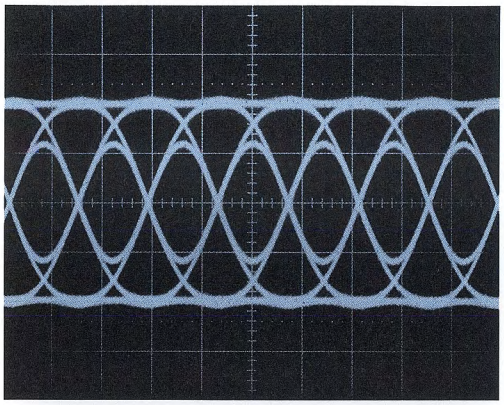
In the TEST operating mode, two different, internally adjustable 16 bit test sequences can be supplied to both the I and Q modulators at a clock frequency of 364 kHz. In this way, the modulators can be operated with a data pulse change of 91 kHz at a phase shift of 90° in order to tune 4 PSK demodulators. When the I and Q components of the receivers are displayed as X/Y coordinates on an oscilloscope, the 90° phase shift of the demodulators can be easily checked (see figures opposite top).



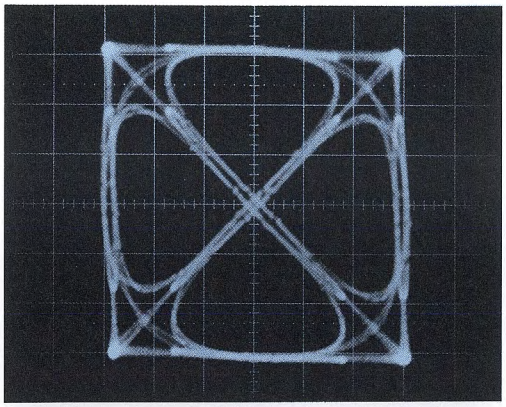
Modulator section for the TV Test Transmitter SBUF or SBTF 2 with rackmounts for generating NICAM sound carrier signals



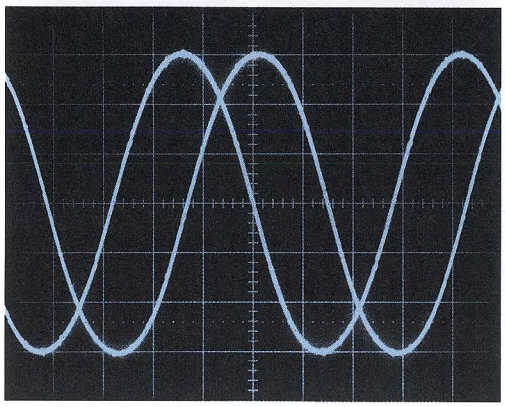
Spectral distribution, Standard B/G



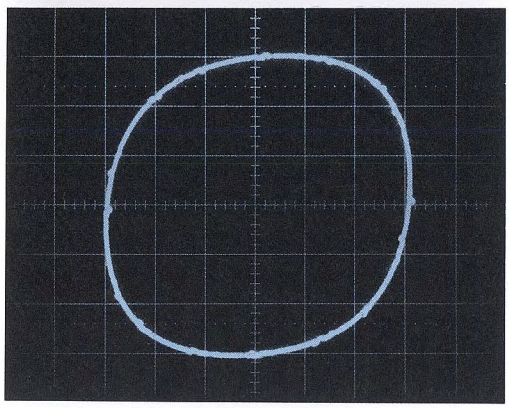
I signal,
pseudo-random
bit sequence



X/Y trace consisting
of I and Q signals



Test operating mode,
I signal 11001100,
Q signal 01100110



X/Y trace in test
operating mode

The **NICAM modulator SBUF-E** contains the entire frequency processing module and the modulation stage for the carrier. The clock frequency of 728 kHz and the NICAM intercarrier frequency (5.85 MHz for Standard B/G, 6.552 MHz for Standard I) are phase-linked to an internally generated, highly stable reference frequency. The internal clock frequency can be phase-locked to an external 728 kHz clock frequency.

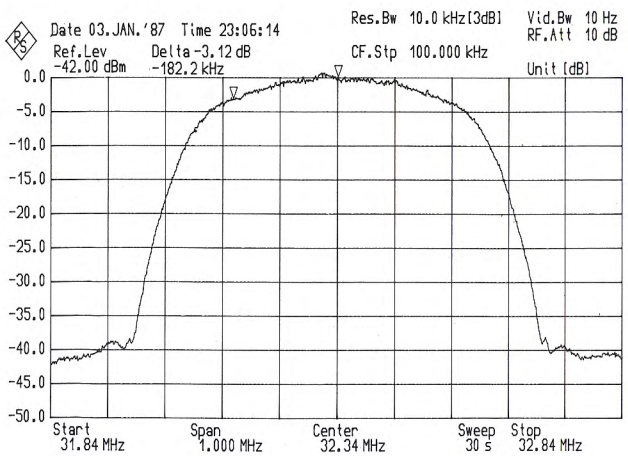
A mixer stage converts the intercarrier signal with the unmodulated IF vision carrier of the vision modulator to the NICAM intermediate frequency in compliance with the selected standard (see figure below).

Specifications

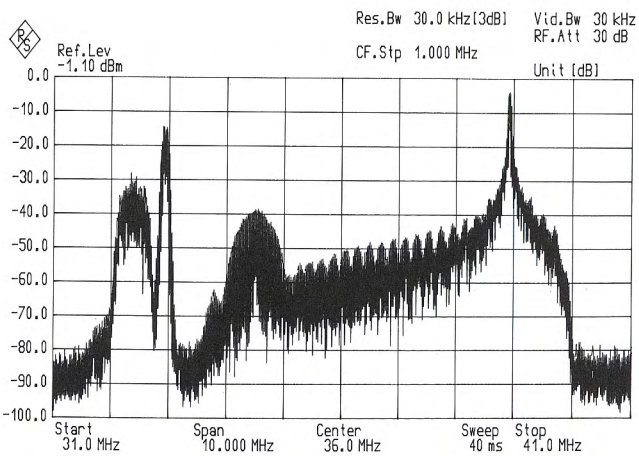
Standard . . . . . NICAM 728 method (728 kbit/s)

NICAM Generator SBUF-E

Operating modes . . . . . external/internal/test/BER
EXTERNAL
Modulation signal . . . . . serial data stream from modulator SBUF-E
Clock synchronization . . . . . from modulator



IF output signal, Standard B/G, modulated



Spectral distribution, Standard I

SBUF-E – Specifications

INTERNAL
- Modulation signal: internally generated serial data stream
- ADDITIONAL DATA: internally adjustable additional information
- Data content signals: see table below
- Preemphasis: to CCITT Rec. J17
- NICAM operating modes: stereo, mono, mono/data, data
- Level at MO (M1): 6 dB at full modulation at 15 kHz
- ST, MO (M2), MO/D: full modulation at 15 kHz

TEST
- Modulation signal: 2 internally adjustable 16-bit data sequences for I and Q each
- Selection: on front panel
- Clock frequency: 364 kHz

BER (bit error rate): for bit error measurement with digital transmission analyzers
- Input for data stream: on modulator SBUF-E
- Clock synchronization of analyzer: used internal clock
- Synchronization ON: FAW (Frame Alignment Word) is inserted into the data stream (clock signal is interrupted)
- OFF: data stream from digital transmission analyzer is directly taken over

Outputs

Internal clock
- Level: TTL
- Output restistance: 75 Ω
- Frequency: 728 kHz
- Connector: BNC

NICAM signal: applied independently of operating mode switch
- Level: TTL
- Output resistance: 75 Ω
- Transfer rate: 728 kbit/s
- Connectors: BNC

Output signals at remote-control female connector
- FSP signal (Frame Sync Pulse): TTL during FAW
- FFB pulse (Frame Flag Bit C_o): square-wave, all 16 ms

Remote control

Functions
- Remote-control switch-on: ON/OFF
- Scrambler clock and data: clock and serial data for loading system scrambler with external initialization word
- Operating modes: external/internal/test/BER
- NICAM operating modes: ST/MO, MO/D, D
- Frequencies: PRBS, F1 to F4
- IF carrier level (in modulator)
  - Front panel setting: ON/OFF
  - Internal potentiometer: level can be reduced for test purposes
- Connector: 12-contact, round (Tuchel)

NICAM Modulator SBUF-E

Modulation
- Modulation mode: 4-PSK
- Transfer rate: 728 kbit/s (in compliance with standard NICAM 728)
- Curve shape for standard B/G: 40% cos roll-off
- I: 100% cos roll-off
- Referenze frequency: 2.912 MHz $\pm 2 \cdot 10^{-6}$ for +25 °C
- Temperature drift: $\leq \pm 6 \cdot 10^{-6}$ (+5 to +45 °C)
- Aging: $\leq \pm 2 \cdot 10^{-6}$/year

Switching functions
- IF carrier: ON/OFF, for remote control via generator
- CW (Continuous Wave): ON/OFF

Inputs

Clock
- Frequency: 728 kHz
- Level: TTL
- Input impedance: 75 Ω
- Connector: BNC

Data
- Data format: to NICAM 728
- Transfer rate: 728 kbit/s
- Level: TTL
- Input impedance: 75 Ω
- Connector: BNC

Vision carrier (unmodulated)
- Level: V_{rms}, approx 250 mV
- Input impedance: 75 Ω
- Connector: SMC

Outputs

Intercarrier
- Frequency for standard B/G: 5.85 MHz
- I: 6.552 MHz
- Stability: phase-locked to reference frequency
- Level: V_{rms}, approx 100 mV
- Return loss: ≥26 dB
- Output impedance: 75 Ω
- Connector: BNC

IF
- Frequency: vision carrier frequency minus intercarrier frequency
- Level: –2 dBm
- Setting range: 0 to –8 dBm, for remote control via generator
- Connector: SMC

General Data

- Rated temperature range: +5 to +45 °C
- Storage temperature range: –40 to +70 °C

Power supply (from SBUF/SBTF 2)
- Generator: +5 ±0.3 V, 300 mA
- Modulator: +5 ±0.3 V, 220 mA; +12 ±0.4 V, 300 mA; –12 ±0.4 V, 22 mA

Dimensions (W×H×D), weight
- Generator: 75 mm × 132 mm × 320 mm, 1.2 kg
- Modulator: 50 mm × 132 mm × 320 mm, 1.2 kg

Ordering information

Order designation
- Generator: ▶ NICAM Generator SBUF-E 0831.8417.02
- Modulator: ▶ NICAM Modulator SBUF-E
  - Standard B/G (f_{vision} 38.9 MHz): 0831.8917.02
  - Standard I (f_{vision} 38.9 MHz): 0831.8917.03
  - Standard I (f_{vision} 39.5 MHz): 0831.8917.05
  - Standard L (f_{vision} 32.7 MHz, f_{IC} 5.85 MHz): 0831.8917.04

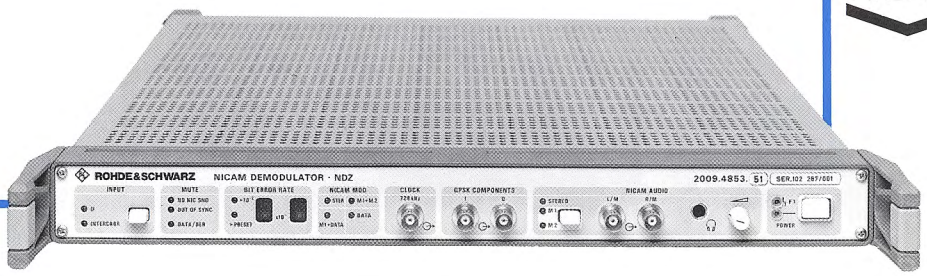
Data contents (internally generated data stream for NICAM operating modes)

Operating mode	PRBS [1]	Frequency F1 L/M1	Frequency F1 R/M2	Frequency F2 L/M1	Frequency F2 R/M2	Frequency F3 L/M1	Frequency F3 R/M2	Frequency F4 L/M1	Frequency F4 R/M2
ST	PRBS	31 Hz	15 kHz	2 kHz	5 kHz	5 kHz	2 kHz	15 kHz	31 Hz
MO	PRBS	406 Hz	94 Hz	2 kHz	1 kHz	10 kHz	7.5 kHz	14 kHz	13 kHz
MO/D	PRBS	500 Hz [2]		500 Hz [3]		500 Hz [4]			
D	PRBS	Data		Data		Data		Data	

[1]) Pseudo-random bit sequence.
[2]) Bit error rate (BER): $3 \cdot 10^{-4}$ (1 error in 500 parity bits).
[3]) Bit error rate (BER): $7 \cdot 10^{-4}$ (1 error in 200 parity bits).
[4]) Bit error rate (BER): $3 \cdot 10^{-3}$ (1 error in 100 parity bits).

NICAM Demodulator NDZ

- 5.85/6.552 MHz
  30 to 40 MHz
- Demodulation and decoding of 4 PSK IF signals to NICAM 728
- Digital display of bit error rate
- I and Q component outputs



The **NICAM Demodulator NDZ** is used for high-quality demodulation and decoding of 4 PSK IF signals in compliance with NICAM 728 standards. It can be connected to TV test receivers and TV test demodulators with IF outputs.

While the program is being transmitted, the parity bits in the AF data range are evaluated for continuous measurement of the bit error rate.

Inputs The inputs for the IF signal or for the NICAM intercarrier can be switch-selected on the front panel.

Displays The bit error rate is shown as a digital display (with overflow indicator). LEDs indicate the type of modulation content, muting, synchronization error and loss of carrier.

Outputs In addition to the AF signals, various output signals (such as the I and Q components for eye level measurement and for setting the phase symmetry of modulators) are available for evaluating the NICAM sound signal.

Specifications

Standard ..... NICAM 728 system

Inputs ..... for TV IF signal and intercarrier signal
Switch selection ..... on front panel (LED display)
IF input
- Frequency range ..... 30 to 40 MHz
- Level (vision carrier) ..... V_{rms} = 15 to 150 mV
- Vision-to-sound carrier spacing .. 20 ±3 dB
- Input impedance ..... 50 Ω
- Connector ..... BNC female (rear panel)

Intercarrier input
- Frequency standard B/G ..... 5.85 MHz
- I ..... 6.552 MHz
- Input level ..... V_{rms} = 20 to 150 mV
- Impedance ..... 50 Ω
- Connector ..... BNC female (rear panel)

Outputs

Output, 728 kbit data stream
- Level ..... TTL
- Load rating ..... 50 Ω
- Connector ..... BNC female (rear panel)

Output, 728 kHz clock
- Level ..... TTL
- Load rating ..... 50 Ω
- Connector ..... BNC female (front panel)

Outputs, I and Q components
- Level ..... V_{pp} = 0.8 V ±3 dB, floating
- Load rating ..... 1 kΩ
- Connectors ..... 1 BNC female each (front panel)

Outputs, audio signal
- Signal ..... floating, unbalanced
- Level at full signal level ..... V_{pp} = 0.7 V
- Internal resistance ..... 20 Ω
- Load rating ..... ≥100 Ω
- Deemphasis ..... J17 (fixed)
- Signals in stereo mode ..... L/R
  - M1+M2 mode ..... M1 or M2 (switch-selected) at both outputs
  - M1+data mode ..... M1 at both outputs
- Connectors ..... 2 BNC females (front panel)

Headphone output ..... stereo, adjustable volume
- Internal resistance ..... 300 Ω
- Connector ..... 6.3 mm jack, front panel

Displays

Bit error rate display
- Evaluation range of parity bits .... AF data range
- Digital display range ..... $1 \cdot 10^{-7}$ to $9 \cdot 10^{-3}$
- Overflow indicator ..... at $>10^{-2}$

Modulation contents display ..... LEDs for stereo/M1+M2/M1+data/data

Muting display (AF outputs switched off)
- No input signal ..... NO NICAM SND
- Frame alignment signal is not detected ..... OUT OF SYNC
- Transfer of only data or when bit error rate is too large ..... DATA/BER

General data

- Rated temperature range ..... +5 to +45 °C
- Operating temperature range ..... 0 to +45 °C
- Storage temperature range ..... −40 to +70 °C
- Power suppy ..... 110/120/220/240 V ±20%, 47 to 63 Hz (25 VA)

Dimensions (W×H×D)
- Bench model ..... 450 mm × 60 mm × 525 mm
- Rackmount ..... 435 mm × 59 mm × 460 mm

Weight ..... 4.5 kg

Ordering information

Order designation ..... ▶ NICAMDemodulator NDZ
Standard B/G 2009.4853.52
I 2009.4853.51

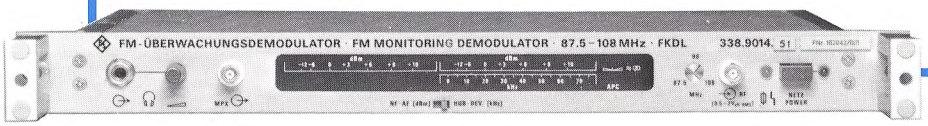
Recommended extras

19″ adapter ..... ZZA-91 ... 396.4870.00

FKDL

FM Monitoring Demodulator FKD/FKDL ♦ 87.5 to 108 MHz

- Outputs for multiplex, L, R and mono signals; headphones output
- L and R signal-level or peak deviation indication



The continuously tunable **FM Monitoring Demodulator FKDL** is used for monitoring carrier signals modulated with mono or stereo signals in accordance with the relevant CCIR recommendation. It is connected to the transmitter output via directional couplers or voltage dividers and deliver demodulated mono, multiplex, L and R signals for checking the performance of FM transmitters.

The FM Monitoring Demodulator FKDL consists only of one demodulator in the form of a 19″ rackmount and is provided for incorporation into transmitters; it is also available for FM Europaging transmitters.

Indication Analog display of the **AF voltages** of the L and R channels is provided by two LED arrays (32 diodes). The 80-mm scale can be read even from a distance of several meters. One LED array can be switched over at the front panel to indicate the **frequency deviation** of the transmitter. Two additional LEDs signal that the stereo mode is selected and that the RF input voltage is sufficient.

Outputs A low-impedance output on the rear panel delivers the **mono signal** for monitoring and measuring purposes. The **multiplex signal** is available at two parallel, low-impedance outputs on the front and rear panels. A **headphones output** with adjustable level for the **L and R signals** is fitted on the front panel.

The FM Monitoring Demodulator FKDL comes as a 44-mm high 19″ rackmount with a power supply of its own and is fitted with connectors on the front and rear panels.

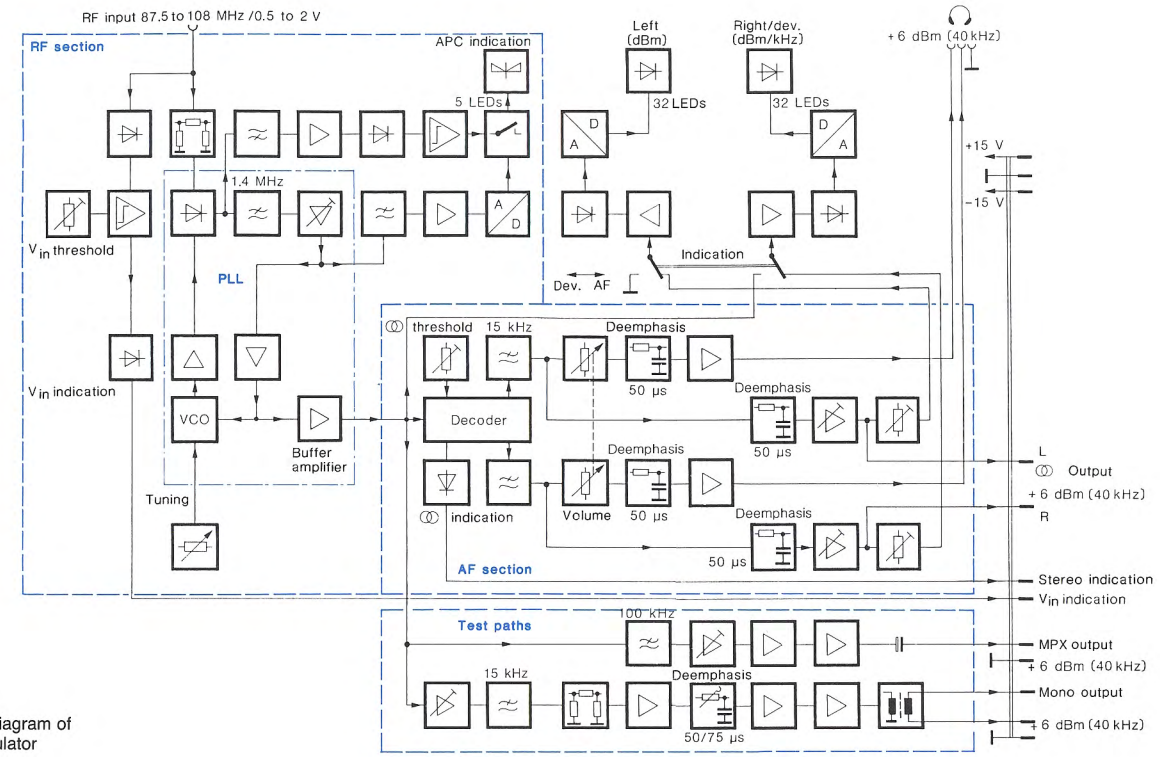
Operation The RF section of the FM Monitoring Demodulator includes a variable-frequency oscillator whose frequency can be modulated and which is synchronized via a PLL to the frequency of the transmitter to be measured. A five-LED array indicates the tuning with respect to carrier midpoint. The AC component of the correction voltage is used after peak-rectification for indication of the FM deviation. The stereo decoder module, working on the time-division-multiplex principle, automatically switches over to mono operation if the pilot is absent.

Connection to transmitter The RF signal is coupled out either from a test output or from the transmitter output with the aid of a probe. If several transmitters are connected to one antenna, the RF signals can be monitored after the combining filter. After bringing the signals out at the antenna feeder, 3-dB couplers and filters are used to isolate the signals. Single-section filters such as the **Bandpass Filter FKD-B** are suitable for this purpose, the frequencies being as follows:

frequency spacing of transmitters >1.2 MHz, eg $\Delta f_{1\ 2}$,
difference of frequency spacings ≥300 kHz, eg
$|\Delta_{1\ 2} - \Delta_{2\ 3}|$
(1, 2 and 3 are the transmitter frequencies)

Specifications

Frequency range	87.5 to 108 MHz (tunable)
Input voltage	1 V_{rms} ±3 dB
Input impedance	50 Ω (unbalanced)
Return loss	≥20 dB
Tuning	manual
Spurious signals (Δf ≥ ±1 MHz off carrier frequency)	≥30 dB down referred to carrier (see also last paragraph above)
AF outputs	
Multiplex signal output	≤30 Ω, unbalanced, BNC female connector (front panel) in parallel with 30-contact female connector (rear panel)
Output level at ±40 kHz deviation	+6 dBm ±0.5 dB into 600 Ω
Frequency response flatness	
30 Hz to 53 kHz	≤±0.3 dB
53 to 100 kHz	≤±1 dB
Harmonic distortion at ±75 kHz deviation[2]	≤0.5%, typ. 0.3% (30 Hz to 15 kHz)
S/N ratio, weighted[2][3]	≥64 dB, typ. 68 dB
S/N ratio, unweighted[2][3]	≥66 dB, typ. 70 dB
Crosstalk[3], however without deemphasis	100 Hz to 15 kHz: ≥46 dB down 40 to 100 Hz: ≥40 dB down



Block diagram of demodulator

Mono signal output[1]	≤30 Ω (balanced), free of DC, 30-contact female connector (rear panel)
Output level at ±40 kHz deviation, f_{mod} = 500 Hz	+6 dBm ±0.5 dB into 600 Ω
Frequency-response flatness, referred to 50 µs deemphasis	≤±0.5 dB
Harmonic distortion at ±75 kHz deviation	≤0.3% (40 Hz to 5 kHz)
S/N ratio, weighted[2][3]	≥68 dB, typ. 72 dB
S/N ratio, unweighted[2][3]	≥68 dB, typ. 72 dB
Pilot suppression	≥72 dB
Monitoring outputs	
Stereodecoder outputs	for L and R signals: ≤30 Ω (unbalanced), free of DC, 30-contact female connector (rear panel)
Output level at ±40 kHz deviation, f_{mod} = 500 Hz	+6 dBm ±1 dB into 600 Ω
Crosstalk between L/R channels	typ. 40 dB down (100 Hz to 5 kHz)
Frequency response flatness, 40 Hz to 15 kHz	≤±1.5 dB (deemphasis 50 µs)
Harmonic distortion at ±75 kHz deviation, f_{mod} = 40 Hz to 5 kHz	≤0.25%
S/N ratio, weighted[2][3]	≥66 dB, typ. 68 dB
S/N ratio, unweighted[2][3]	≥64 dB, typ. 70 dB
Pilot suppression	typ. 60 dB (ref. nominal level)
Headphones output	max. +12 dBm (adjustable); front panel; Z_{out} ≤30 Ω
Other data	same as for stereodecoder outputs
AF level indication	−12 to +12 dBm
Indicator	LED array (2 × 32 LEDs, scale length 80 mm)
Deviation indication	0 to 77.5 kHz (peak voltage)
Resolution	2.5 kHz (32 LEDs)
Indication error[1]	≤±5% of fsd (f_{mod} = 40 Hz to 60 kHz)
Additional indicators (LEDs)	RF input level, stereo mode, tuning to carrier centre frequency
Filter FKD-B	to derive max. four carrier signals
Insertion loss	6 dB per filter circuit
Selectivity	typ. 13 dB ±1.5 MHz off carrier

[1]) Additional error after change of channel, without recalibration (on front panel) max. ±0.3 dB or ±3%.
[2]) Measured to DIN 45 405 via stereodecoder, eg MSDC 2.
[3]) Referred to nominal output level; with deemphasis.

General data

Rated temperature range	+5 to +40 °C
Operating temperature range	0 to +45 °C
Power supply	110/120/220/240 V +10/−15%, 47 to 63 Hz (16 VA)
Dimensions	
19″ rackmount	483 mm×44 mm×384 mm
19″ bench model	492 mm×74 mm×392 mm
Weight	
19″ rackmount	3.3 kg
19″ bench model	5 kg
Connectors	
RF inputs	BNC female (on front and rear panels)
L, R, MPX, mono outputs	30-contact male connector
Status signals for RF carrier and pilot monitoring	30-contact male connector
Headphones	jack
Colour of front panel	light grey, RAL 7035

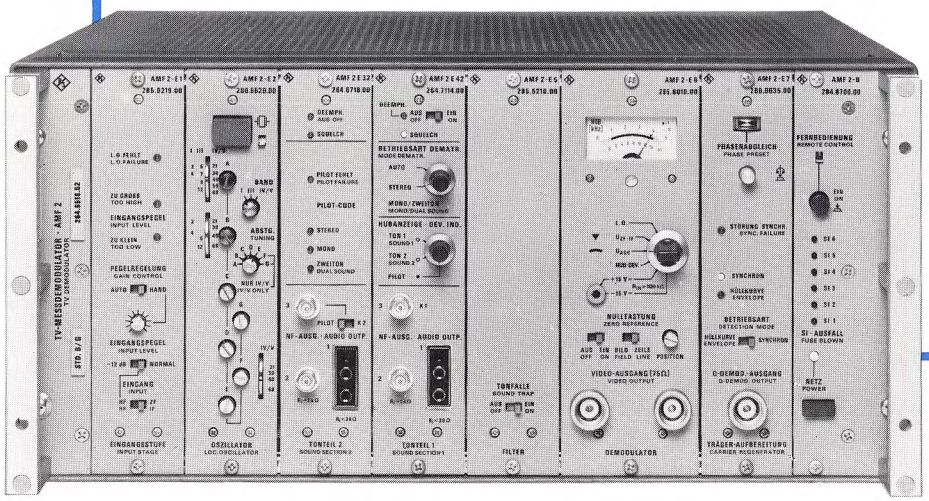
Ordering information

Order designation	▶ FM Monitoring Demodulator FKDL
19″ rackmount	338.9014.51
19″ bench model	338.9014.52
Recommended extras	
Filter FKD-B for 4 transmitter frequencies	343.3210.50
Junction panel FKDL-Z for rack insertion	338.9614.00

AMF 2

TV Demodulator AMF 2 ♦ Bands I, III, IV/V, CATV

- Precision test demodulator with Nyquist slope for vision and sound TV signals
- Switch-selected envelope or synchronous detection
- Automatic control of video output level – zero-reference pulse
- Dual-sound/stereo/mono demodulation selected by automatic switchover



The **TV Demodulator AMF 2** is used to convert the RF signal of a TV transmitter or transposer into the video and sound signals. Analysis or comparison with the original video and sound signals permits distortions to be recognized and faults to be found based on the type and amount of distortion.

Thanks to its negligible inherent error, the AMF 2 is ideal for the acceptance and initial adjustment of transmitters and transposers as well as for their development, alignment and continuous performance monitoring. Moreover, some parameters can be measured only with the aid of the special facilities provided in the TV Demodulator. The AMF 2 is therefore fitted with envelope and synchronous detection, switch-off sound trap, Q signal output and zero reference pulse.

Uses

The applications of the AMF 2 cover measurements at the RF and IF, eg

measurements on the vision transmitter (picture quality)

- display of the transient response
- measurement of the video frequency response, phase and group delay and grey-scale distortion
- checking the residual-carrier level of the transmitter and monitoring the picture quality

measurements on the sound transmitter (sound quality)

- measurement of the audio frequency response, modulation distortion and intercarrier S/N ratio (vision in sound) as well as of channel crosstalk in the case of dual-sound models
- monitoring the sound quality during transmission

For **demodulation** of the vision signal, the AMF 2 contains an **envelope detector** and a **synchronous detector.** The demodulation mode can be selected on the front panel or by means of an external switch.

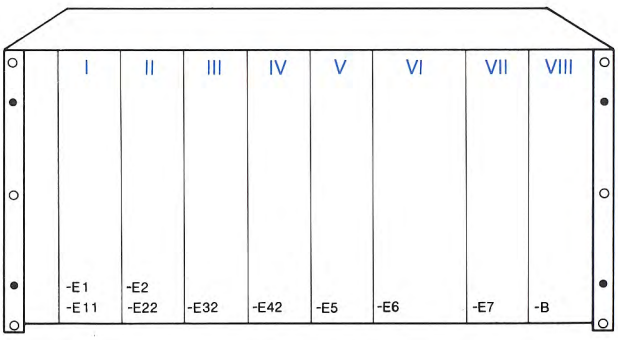
Accurate **measurements in the colour subcarrier region** and near the sound edge are possible after **switching off** the internal **sound carrier trap.**

A **vision carrier zero reference** is provided for **modulation depth measurements.** The zero reference pulses can be either field-repetitive, line-repetitive or externally controlled.

In conjunction with the TV Oscilloscope OPF the AMF 2 permits the Q component of the transmitted video signal to be determined. This quadrature component is a **measure of the phase angle variation** of the carrier dependent on the modulation level.

Configuration

Depending on the field of application, the TV Demodulator is adjusted in accordance with the standard used, fitted with a crystal oscillator or synthesizer, with the plug-ins for single-sound, stereo or dual-sound operation or, for broadband communication systems, supplied with a sensitive input stage featuring adjacent-channel rejection.



I Input Stage AMF 2-E1
II Loc. Oscillator AMF 2-E2 or Synthesizer AMF 2-E22
III Sound Section 2 AMF 2-E32
IV Sound Section 1 AMF 2-E42
V Filter AMF 2-E5 (standard-dependent)
VI Demodulator AMF 2-E6 or Demodulator AMF 2-E62
VII Carrier Regenerator AMF 2-E7
VIII Mainframe AMF 2-B

Input section

Broadband Input Stage AMF 2-E1 When the AMF 2 is used for measuring and monitoring TV transmitters, the wanted signal at the directional coupler of the transmitter output is available with a sufficiently high level and does not contain any spurious components. For these applications, the low-sensitivity Input Stage AMF 2-E1 is provided.

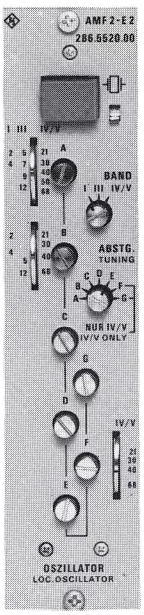
Oscillator section

Local Oscillator AMF 2-E2 Like the Input Stage AMF 2-E1, the Local Oscillator AMF 2-E2 is generally used for measuring and monitoring TV transmitters. The crystal oscillator covers all TV frequency bands and, after exchanging the crystal, can be easily adjusted to different channels. The AMF 2-E2 should be used in particular if a TV Dual-Sound Demodulator FATF is to be connected to the AMF 2.

Synthesizer AMF 2-E22 This plug-in is provided for mobile use or frequent channel switchover. The continuous frequency range from 45 to about 900 MHz also covers the broadband communication bands. The channel is set by entering the vision carrier frequency with BCD coding switches (external setting in the BCD code also possible).

Broadband Input Stage AMF 2-E1

Local Oscillator AMF 2-E2



Synthesizer AMF 2-E22

AMF 2 – TV Test Demodulator

Sound section

Sound Section 1 AMF 2-E42 (for **single sound**) This plug-in is prepared for stereo and uses the intercarrier method. The AF signals are available on the **front and rear panels** of the AMF 2.

Sound Section 2 AMF 2-E32 is required for the second sound signal in **dual-sound operation.** Like the AMF 2-E42, it uses the intercarrier method and provides the **AF signals on the front and rear panels.** Moreover, the AMF 2-E32 evaluates the pilot signal to produce the switchover commands for mono/stereo/dual-sound dematrixing in the Sound Section 1 AMF 2-E42.

TV Demodulators AMF 2 which have not yet been modified for dual-sound operation can be fitted in the factory with the Sound Sections AMF 2-E42 and AMF 2-E32. However, without any internal modification of the basic unit, decoded AF signals can also be produced by connecting a Dual Sound Unit FTDZ to a mono-mode AMF 2.

Filter, demodulator

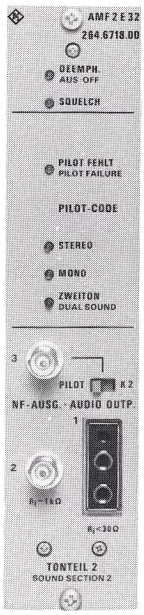
Filter AMF 2-E5 The filter plug-in is adjusted in the factory for the TV standard concerned. It contains the switch-selected sound trap, the Nyquist filter and allpass filters for group delay correction.

Demodulator AMF 2-E6 In this plug-in, the IF signal is applied to an envelope or a synchronous detector, the latter cutting out the quadrature distortion produced by the vestigial sideband system. The AMF 2-E6 also contains the zero reference mode selectors and the switch-selected panel meter of the AMF 2. **Outputs on the front and rear panels** are provided for the video signal.

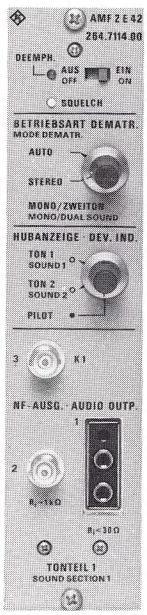
Demodulator AMF 2-E62 This demodulator is intended for television transmitters fitted with a klystron and operating in ABC (annular beam control). The sync pulse is then applied separately. It can be used to compensate group-delay differences between different checkpoints in the time domain.

Carrier Regenerator AMF 2-E7 For synchronous detection, the AMF 2-E7 produces a switching carrier which is phase-locked to the signal carrier and does not exhibit any amplitude or phase modulation. A VCO operating at the IF carrier frequency is synchronized to the signal carrier in a PLL and automatically brought to the nominal phase using a quadrature demodulator and a controllable allpass filter. The circuit is designed for optimum reliability.

Sound Section (2) AMF 2-E32

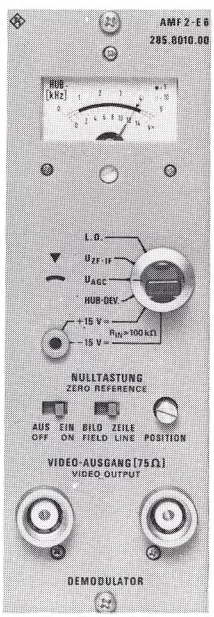


Sound Section (1) AMF 2-E42



Filter AMF 2-E5

Demodulator AMF 2-E6



Carrier Regenerator AMF 2-E7

Specifications

RF and IF characteristics

Frequency ranges

AMF 2 with **Loc. Oscillator AMF 2-E2** (crystal)

Standard, country	Band I (II) MHz	Band III MHz	Bands IV, V MHz
B/G, Europe	48.25 to 62.25	175.25 to 224.25	471.25 to 847.25
B/G, Australia	46.25 to 138.25	175.25 to 216.25	471.25 to 847.25
B/G, New Zealand	45.25 to 62.25	175.25 to 217.25	471.25 to 847.25
B/G, Morocco	—	163.25 to 211.25	471.25 to 847.25
B/G, Italy	53.75 to 82.25	175.25 to 224.25	471.25 to 847.25
D/K, CCIR	49.75 to 93.75	175.25 to 223.25	471.25 to 847.25
D/K, China	49.75 to 85.25	168.25 to 216.25	471.25 to 693.25
K1, French Overseas P & T	—	175.25 to 215.25	471.25 to 847.25
I, Ireland	45.75 to 61.75	175.25 to 215.25	471.25 to 847.25
I, South Africa	—	175.25 to 247.43	471.25 to 847.25
M, USA	55.25 to 83.25	175.25 to 211.25	471.25 to 885.25
M, Japan	91.25 to 103.25	171.25 to 217.25	471.25 to 765.25
N, South America	55.25 to 83.25	175.25 to 211.25	471.25 to 885.25

Change of channel within range ..... change of crystal, retuning

Crystal frequencies

- Band I (II) ..... ½ (f_{vision} + 38.9 MHz)
- Band III ..... ⅓ (f_{vision} + 38.9 MHz)
- Bands IV, V ..... 1/12 (f_{vision} + 38.9 MHz)

Frequency error (when using the crystal supplied) ..... <10 kHz (adjustable)

Incidental phase modulation ..... typ. 30 Hz

AMF 2 with **Synthesizer AMF 2-E22** 45 to 900 MHz

Frequency setting ..... with coding switches

Resolution ..... 10 kHz

Frequency error ..... <2.5 kHz

Incidental phase modulation ..... typ. 150 Hz

Remote control ..... BCD, parallel (rear panel)

Vision IF ..... 38.9 MHz

Intercarrier frequency	sound 1	sound 2
Standard B/G	5.5 MHz	5.724 MHz
Standard D/K/K1	6.5 MHz	not yet fixed
Standard I	6 MHz	not yet fixed
Standard M/N	4.5 MHz	not yet fixed

RF and IF inputs

RF/IF switchover ..... on front panel and by remote control

Isolation of inputs ..... >60 dB

RF input (with AMF 2-E1)

- Connector ..... Dezifix B (adaptable), 50 Ω
- Input requirement at sync level (V_{rms}) ..... switch-selected on front panel
  - Range 1 ..... 0.2 to 0.7 V
  - Range 2 ..... 0.7 to 2.2 V
- Return loss
  - Range 1 ..... ≥26 dB
  - Range 2 ..... ≥30 dB

IF input

- Connector ..... Dezifix B (adaptable), 50 Ω
- Input requirement (V_{rms}) ..... 0.12 to 0.6 V at sync level
- Return loss (30 to 40 MHz) ..... ≥32 dB

Input voltage indication ..... vision carrier peak voltage on meter of demodulator plug-in

AGC offset ..... <0.3% per dB

Input for external oscillator ..... 0.3 to 1 V (50 Ω); BNC (rear panel)

IF output

Connector ..... BNC

Output level ..... approx. 100 mV

Gain control ..... can be switched over, manual/automatic

Control range ..... 14 dB

Control error of AGC in control range ..... ≤±0.15 dB

Control range display ..... on instrument (bar)

Display when input level range is undershot/overshot ..... by LED

Noise figure ..... ≤10 dB
typ. 7.5 dB (47 to 230 MHz)
typ. 8.5 dB (230 to 300 MHz)

Suppression for input signals in frequency range f_{vision} +2 × 38.9 MHz ..... ≥80 dB

Reradiated oscillator voltage at RF input (680 to 980 MHz) ..... ≤30 µV

Amplitude frequency response in 47 to 300 MHz receive range (without Band II) ..... ≤±1.5 dB

S/N ratio at input of 2 mV and standard modulated sound carriers at S/N ratio of −13 dB and −20 dB to vision carrier with no adjacent channel

Noise 100 kHz to 5 MHz

- unweighted ..... ≥49 dB } rms
- weighted ..... ≥56 dB } measurement

Sinusoidal and pulse-shaped interference

- up to 1 kHz ..... ≥50 dB
- 5 MHz to 6 MHz ..... ≥50 dB
- with adjacent channel
- 1 kHz to 5 MHz ..... ≥43 dB

} peak measurement

Video signal characteristics

Video outputs

- Connectors, rear panel ..... 2 × BNC female
- front panel ..... 2 × RF, female 4/13 (DIN 47284)

Output voltage ..... 1.11 V_{pp} (composite video signal with zero reference pulse)

Output impedance ..... 75 Ω

Return loss ..... ≥26 dB (up to 6 MHz)

Level variation at terminated output ..... <0.2 dB (between open circuit and termination of the remaining outputs)

Amplitude characteristic ..... } in accordance

Group delay response ..... } with standard

Nonlinearity of demodulation characteristic	envelope detection	synchronous detection
Modulation range 10 to 75%	<3%	<2%
Modulation range 8 to 100%	<5%	<3%

Differential phase

- Modulation range 8 to 90% ..... ±1°

Tilt (50 Hz) ..... <0.5%

Noise suppression with sound trap and sound carrier modulated by standard signal or without sound trap and sound carrier

Noise (100 kHz to 5 MHz)

- without weighting ..... >60 dB down, typ. 63 dB } rms measurement
- with weighting to CCIR Rec. 567 (Vol. XII, 1978, Kyoto) ..... >67 dB down, typ. 70 dB } rms measurement

Periodical interferences

- up to 1 kHz ..... >52 dB down, typ. 60 dB
- 1 kHz to 5 MHz (D/K/K1: up to 6 MHz) ..... >60 dB down
- 5 to 6 MHz (D/K/K1: 6 to 7 MHz) ..... >50 dB down

} peak measurement

Zero reference

- line-repetitive ..... pulse of about 4 µs length, shiftable over first third of line
- field-repetitive ..... pulse of about 10 µs length in lines 15 and 328
- external ..... for the duration of an externally applied pulse, delay about 3 µs with respect to trigger pulse

Error of residual carrier indication referred to composite video signal with zero reference pulse (CVS0) ... <1% (synchronous detection)
<2% (envelope detection)

Q signal outputs

Connectors

- Front panel ..... BNC female
- Rear panel ..... BNC female

Output level ..... adjusted such that a CVS0 of 1.11 V_{pp} would result at a 90° phase shift of the switching carrier

Bandwidth (−3 dB) ..... approx. 500 kHz

Phase error of switching carrier ..... <1°

Residual LO voltage

- with Loc. Oscillator AMF 2-E2 ..... typ. 30 mV_{pp}
- with Synthesizer AMF 2-E22 ..... typ. 75 mV_{pp}

AMF 2 – TV Test Demodulator

Specifications of Sound Sections AMF 2-E42 and AMF 2-E32

	Sound section 1			Sound section 2			
	Output 1	Output 2	Output 3	Output 1	Output 2	Output 3 K2 + pilot[1]	Output 3 Pilot[1]
Output impedance	≤25 Ω	≈1 kΩ	≤25 Ω	≤25 Ω	≈1 kΩ	≤25 Ω	≤25 Ω
Output level[2]	+6 dBm ±0.2 dB	+6 dBm ±0.35 dB	+6 dBm ±0.2 dB	+6 dBm ±0.2 dB	+6 dBm ±0.35 dB	+6 dBm ±0.2 dB	−15.6 dBm ±0.5 dB
Frequence response without deemphasis[3]							
40 Hz to 15 kHz	≤±0.2 dB	≤±0.3 dB	≤±0.3 dB	≤±0.2 dB	≤±0.3 dB	≤±0.2 dB	selective
15 to 60 kHz	—	—	≤±1 dB	—	—	≤±1 dB	54.6875 kHz
Frequence response with deemphasis[4]							
40 Hz to 15 kHz	≤±0.3 dB	≤±0.4 dB	—	≤±0.3 dB	≤±0.4 dB	—	—
Harmonic distortion[5]							
Deviation 50 kHz	≤0.5%	≤0.5%	≤0.5%	≤0.5%	≤0.5%	≤0.5%	—
Deviation 70 kHz	≤1%	≤1%	≤1%	≤1%	≤1%	≤1%	—
S/N ratio[6], vision modulation							
a) black	≥60 dB	≥60 dB	—	≥60 dB	≥60 dB	—	—
b) FuBK test chart to German standard	≥55 dB	≥55 dB	—	≥55 dB	≥55 dB	—	—
c) sinewave, without 250 kHz	≥50 dB	≥50 dB	—	≥50 dB	≥50 dB	—	—
d) sinewave, 250 kHz	≥50 dB	≥50 dB	—	≥50 dB	≥48 dB	—	—
Stereo crosstalk attenuation[7]	≥40 dB	≥40 dB	—	≥40 dB	≥40 dB	—	—
Channel crosstalk attenuation[8]	≥80 dB	≥80 dB	≥80 dB	≥80 dB	≥80 dB	≥80 dB	≥80 dB

AF output 1 . . . . . 3, balanced, floating
Connectors
- Front panel of sound section . . . . . 3-contact female conn. (9 Rel. kli)
- Rear panel of AMF 2 . . . . . 5-contact miniature receptacle (T3363), 30-contact connector (T2070)

Deemphasis . . . . . common switch selection on sound section 1
Dematrixing . . . . . automatic (pilot) or manual, switch-selected (mono/stereo/dual sound)

Output signal	sound section 1	sound section 2
Mono	M1 (mono)	M1 (mono)
Stereo	L (left)	R (right)
Dual sound	M1 (channel 1)	M2 (channel 2)

AF output 2 . . . . . 2, unbalanced
Connectors
- Front panel of sound section . . . . . BNC female
- Rear panel of AMF 2 . . . . . 30-contact connector (T2070)

Characteristics . . . . . same as AF output 1

AF output 3 . . . . . 2, unbalanced
Connectors
- Front panel of sound section . . . . . BNC female
- Rear panel of AMF 2 . . . . . 30-contact connector (T2070)

Deemphasis . . . . . disconnectible (internal links)

Output signal	sound section 1	sound section 2, switch-selected	
Mono	M1	M1 + P	P (unmod.)
Stereo	0,5 (R + L)	R + P	P (117.5 Hz)
Dual sound	M1	M2 + P	P (274.1 Hz)

Permissible load

AF outputs 1 and 3	≥300 Ω	≤5000 pF
AF output 2	≥100 kΩ	≤100 pF

[1]) Switch-selected on front panel.

[2]) For 600 Ω-load at outputs 1 and 3 and for ≥100 kΩ at output 2. Deviation = ±30 kHz and f_{mod} = 500 Hz for all measurements except for output 3 "pilot"; latter case: $f_{mod} = f_{pilot}$ and deviation = ±2.5 kHz.

[3]) With the deemphasis disconnected, a 19-kHz lowpass filter becomes effective at outputs 1 and 2.

[4]) The specified tolerances refer to the deemphasis of 50 µs (75 µs for Standard M) which can be connected into outputs 1 and 2.

[5]) f_{mod} = 40 Hz to 15 kHz.

[6]) Referred to the output level at a deviation = ±30 kHz and f_{mod} = 500 Hz. Measurement to DIN 45 405 with deemphasis connected and weighting to CCIR 468-3. The channel which is not measured carries no signal.
a) Vision modulation = all-black picture
b) Vision modulation = FuBK colour test chart to German standard
c) Vision modulation = sinewave with frequencies from 0 to 5 MHz excluding the range 230 to 255 kHz, modulation depth 10 to 75% of vision carrier
d) Vision modulation same as c) however, for range 230 to 255 kHz

[7]) Reference level +6 dBm; deemphasis connected; transmitter input (without TV dual sound coder); deviation for channel 1 ±15 kHz, for channel 2 ±30 kHz, both modulated with the same frequency in the range 40 Hz to 15 kHz.

[8]) Reference level +6 dBm; selective measurement with deemphasis connected. Signal in interfering channel: f_{mod} = 40 Hz to 15 kHz and deviation = ±55 kHz.
At output 3, frequency-dependent reduction of S/N ratio corresponding to a time constant of 50 µs.

General data

Rated temperature range . . . . . +5 to +40 °C
Operating temperature range . . . . . 0 to +45 °C
Storage temperature range . . . . . −20 to +70 °C
Power supply . . . . . 100/120/220/240 V +10/−15%, 47 to 63 Hz (150 VA)
Overall dimensions (W×H×D) and weight
- 19″ rackmount . . . . . 483 mm×221 mm×506 mm, 26.5 kg
- 19″ bench model (design 80) . . . . . 492 mm×250 mm×514 mm, 29 kg

Colour of front panel . . . . . grey RAL 7001
Inscription . . . . . German/English

Ordering information

Order designation . . . . . ▶ TV Demodulator AMF 2
For order no. see below

Accessories supplied

Crystal AMF 2-Z (for Loc. Oscillator AMF 2-E2; please specify vision carrier frequency when ordering) 089.6010.00 (common order no. for all crystals), power cord 025.2365.00, manual

Recommended extras

30-contact female connector
(with shell) . . . . . 063.9770.00 (for St 2, rear panel)
3-contact AF cord plug . . . . . 019.0458.00 (for front panel)
5-contact AF miniature connector . . . 018.5356.00 (for Bu 7, rear panel)

Order nos. for instruments with broadband Input Stage AMF 2-E1 (all TV bands); RF input level 0.2 to 2.2 V

Please enquire for standards not listed or for special models

Sound section	Oscillator section	19″ rackmount	Standard (IF 38.9 MHz) B/G	B/G Australia	D/K	K1	I	M
Single sound (Sound Section AMF 2-E42)	Local Oscillator AMF 2-E2	a	264.7514.51	264.7514.55	286.4018.51	286.2415.81	286.2415.51	264.4015.51
		b	264.7514.52	264.7514.56	286.4018.52	286.2415.82	286.2415.52	264.4015.52
		c	264.7514.53	—	286.4018.53	286.2415.83	286.2415.53	264.4015.53
	Synthesizer AMF 2-E22	a	286.8013.51	286.8013.55	286.4130.51	—	287.0216.51	264.4109.51
		b	286.8013.52	286.8013.56	286.4130.52	—	287.0216.52	264.4109.52
		c	286.8013.53	—	286.4130.53	—	287.0216.53	264.4109.53
Dual sound (Sound Sections AMF 2-E32 and AMF 2-E42)	Local Oscillator AMF 2-E2	a	264.6518.51	264.6518.55				
		b	264.6518.52	264.6518.56				
		c	264.6518.53	—				
	Synthesizer AMF 2-E22	a	287.0016.51					
		b	287.0016.52					
		c	287.0016.53					

a = 19″ rackmount
b = 19″ rackmount with panelling (bench model)
c = 19″ rackmount with self-engaging connector for RF and IF inputs

FATF

TV Dual-Sound Demodulator FATF ♦ 33.4 MHz/33.158 MHz

- Separation of sound carriers by high-quality filter circuits
- Suppression of vision carrier, therefore measurement also possible with vision transmitter switched on
- Permanent deviation indication for both channels, multiple signal evaluation

The **TV Dual-Sound Demodulator FATF** is used for measuring and checking TV dual-sound signals transmitted according to the dual-carrier method of the Institute for Broadcasting Technology IRT.

With this method, the two sound signals are emitted with two separate, frequency-modulated carriers. The two carrier frequencies are spaced 242 kHz apart and differ by 7 dB in their power. The carrier frequency 2 (with the lower power) is additionally modulated with a pilot frequency, which causes automatic switchover between mono/stereo/dual sound in the receiver.

The FATF does not decode the channels in the stereo mode, since it is a pure measuring instrument which does not need a decoder.

Special features of FATF

Input filters Other than the conventional FM demodulators, as for instance the FAB, the FATF uses highly selective filters for **suppression of the vision carrier** and for separation of the two sound carrier frequencies. This enables measurements to be carried out on the sound transmitter (with one or two sound channels) with the vision transmitter being switched on.

Displays/signal evaluation The frequency deviations of both channels are permanently displayed by two rows of LEDs. Exceeding of the respective deviation is indicated by separate LEDs. Further LEDs are provided for indication of the "mono", "stereo" or "dual sound" information contained in the pilot frequency.

The demodulated signal of the selected channel (K1 or K2) is available at the test output. The corresponding values (FM deviation or AM modulation depth) are displayed on the screen. The pilot voltage (55 kHz) of channel 2 can be separately evaluated in the same way and thus the frequency deviation of the pilot frequency and the modulation frequencies contained therein be investigated.

Measurement of deviation difference With equal modulation of the two sound channels this measurement is particularly important, since the value measured provides information on the equality of the two sound channels which is an essential parameter for stereo operation.

Description

The basic model of the FATF is designed for connection to the IF output of a TV demodulator (e.g. AMF 2 or EKF 2). An optional RF section ist available for connection of the FATF to the RF output of a transmitter.

Three frequencies are available at the IF input:

Vision carrier	38.9 MHz	0 dB (sync peak)
Sound carrier 1	33.4 MHz	−13 dB carrier level
Sound carrier 2	33.158 MHz	−20 dB carrier level

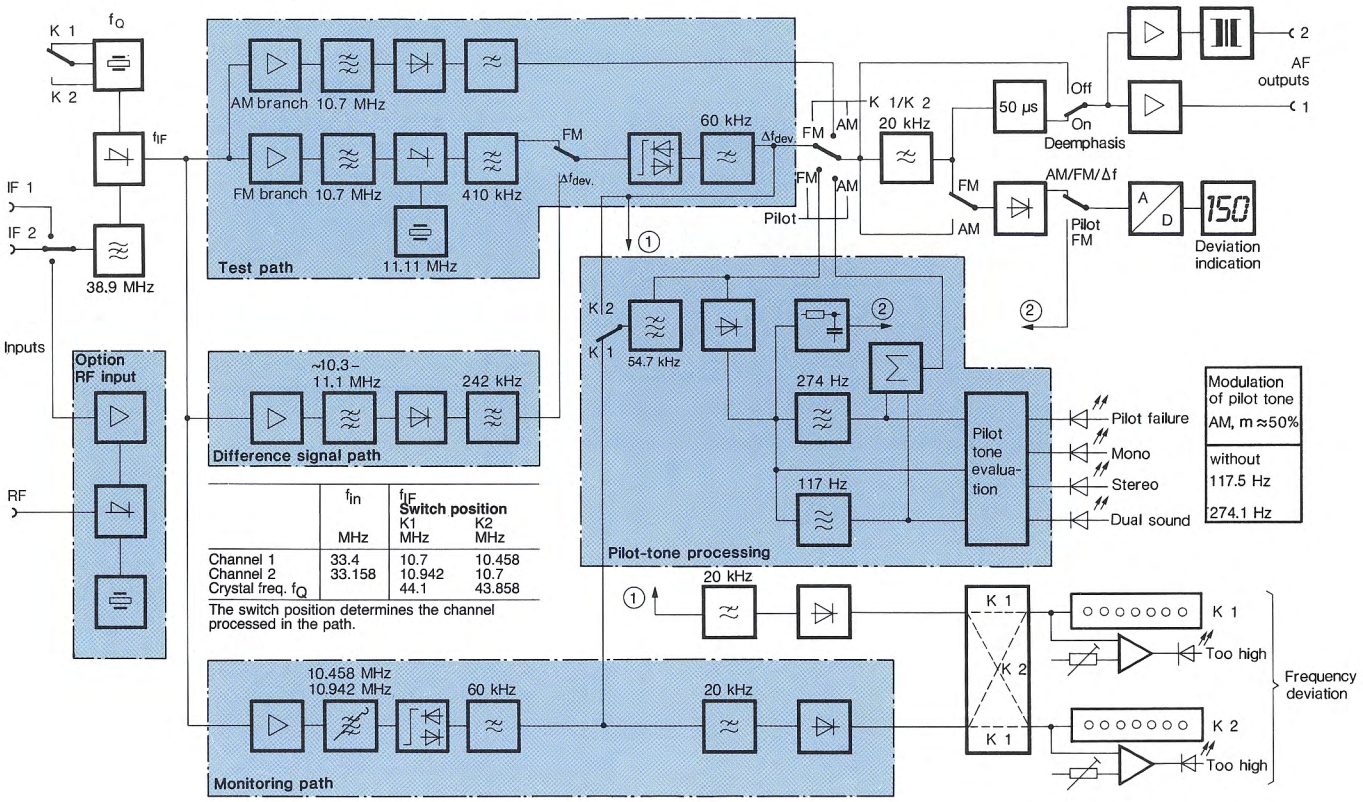
The vision carrier frequency is first suppressed by a very effective filter (trap). Then both sound carriers are converted to the same frequency of 10.7 MHz, see block diagram. Further processing is then effected in four different ways:

1. The **test path** (10.7 MHz) contains a branch each for FM and AM; demodulation in the AM branch is effected at 10.7 MHz. In the FM branch the signal is converted to 410 kHz (main selectivity and group-delay correction); the signal is then taken to the AF outputs 1 and 2 and to the digital display. The FM branch controls the LED row for the deviation indication.

2. The **difference signal path** (≈10.3 to 11.1 MHz) handles the two converted frequencies of the sound channels. The difference frequency of 242 kHz resulting after the AM demodulation is constant if frequency deviation and phase position are equal; if they are unequal, there will be a deviation difference, which as FM will also affect the 242 kHz. This signal path is then routed to the digital display and to the test output.

3. The **monitoring path** (10.46 or 10.94 MHz) always processes the frequency of the channel that is not demodulated in the test path and controls the second LED row for the deviation indication.

4. The **pilot-tone processing** circuit (55 kHz) is automatically switched to channel 2 which contains the pilot tone. The pilot tone is filtered out and taken to the test output. The **pilot signal is evaluated** (via rectifier and bandpass filters) for the modulation frequencies 274 and 117 Hz. The derived average value of the pilot tone is a measure for the frequency deviation and digitally displayed.



	f_{in} MHz	f_{IF} Switch position K1 MHz	K2 MHz
Channel 1	33.4	10.7	10.458
Channel 2	33.158	10.942	10.7
Crystal freq. f_Q		44.1	43.858

The switch position determines the channel processed in the path.

Block diagram of TV Dual-Sound Demodulator FATF

Specifications

Input signal . . . . . TV dual-sound signal at IF (RF section available as an option) with or without modulated vision carrier

Input level

RF input 1 . . . . . matched to AMF 2 and EKF 2D
Vision carrier (sync level) . . . . . 89 to 112 mV ≙ 0 ±1 dB
Sound carrier 1 . . . . . approx. 22 mV ≙ −(13 ±2) dB
Sound carrier 2 . . . . . approx. 10 mV ≙ −(20 ±2) dB
IF input 2 . . . . . matched to sound IF test point of R&S transmitter input stages
Sound carrier 1/sound carrier 2 . . 35 mV/15 mV
Input impedance . . . . . 50 Ω
Return loss (33 to 33.8 MHz) . . . . . ≥20 dB

AF outputs

Output 1 . . . . . unbalanced (free of DC); $Z_s \leq 10\ \Omega$, $Z_{out} \geq 300\ \Omega \parallel \leq 5$ nF
Connector . . . . . BNC female (front panel)
Output 2 . . . . . balanced, floating; $Z_s \leq 30\ \Omega$, $Z_{out} \geq 300\ \Omega \parallel \leq 5$ nF
Connector . . . . . 3-contact female RelKli 6a (front panel)
Signals (both outputs) . . . . . according to operating mode (FM/AM and PILOT/K1/K2/ΔDEVIATION)

AF output signals for FM measurements

Output level
K1/K2, f_{mod} = 500 Hz, deviation ±30 kHz . . . . . +6 dBm ±0.25 dB
PILOT, f_{mod} = 54.7 kHz, deviation ±2.5 kHz . . . . . −15.6 dBm ±0.25 dB
Frequency response flatness, 40 Hz to 15 kHz, referred to 500 Hz
without deemphasis . . . . . ≤±0.1 dB
with deemphasis . . . . . ≤±0.2 dB
Distortion
40 Hz to 5 kHz } deviation 50/70 kHz ≤0.3%/≤0.5%
5 to 15 kHz ≤0.5%/≤1%
S/N ratio (to CCIR Rec. 468-2) with deemphasis, referred to f_{mod} = 500 Hz, deviation ±30 kHz, unweighted and weighted . . . . . ≥74 dB
Channel crosstalk with deemphasis, selective measurement (ref. to f_{mod} = 500 Hz, deviation ±30 kHz) . . . . . ≥80 dB down

AF output signal for AM measurements
(modulation in second sound channel switched off)

Output level
10% AM (f_{mod} = 500 Hz) . . . . . −14 dBm ±0.25 dB (corresp. to 100% AM = +6 dBm)
Frequency response flatness (ref. to f_{mod} = 500 Hz)
40 Hz to 30 kHz . . . . . ≤±0.5 dB
30 to 60 kHz . . . . . ≤±3 dB
S/N ratio (to CCIR Rec. 468-2) with any standard vision modulation; referred to 100% AM
Useful carrier unmodulated . . . . . ≥56 dB
Useful carrier with FM (f_{mod} = 500 Hz, dev. ±50 kHz) . . . ≥40 dB
PILOT AM measurement
AM modulation of pilot tone:
Mono . . . . . –
Stereo . . . . . 117 Hz
Dual sound . . . . . 274 Hz
Output level
Pilot deviation ±1.5 to ±3.5 kHz, 50% AM . . . . 0 dBm ±0.5 dB

Indicators

FM deviation/AM mod. depth . . . . . 3½ digits, 2½ digits
Deviation indication for both sound channels . . . . . two rows of LEDs (simultaneous display)
Error . . . . . ≤2% of reading
Deviation overdrive indication . . . . . threshold adjustable
Pilot coding . . . . . indication for mono/stereo/dual sound

General data

Rated temperature range . . . . . +5 to +40 °C
Operating temperature range . . . . . 0 to +45 °C
Storage temperature range . . . . . −20 to +70 °C
Power supply . . . . . 100/120/220/240 V, +10/−15%, 47 to 63 Hz (80 VA)

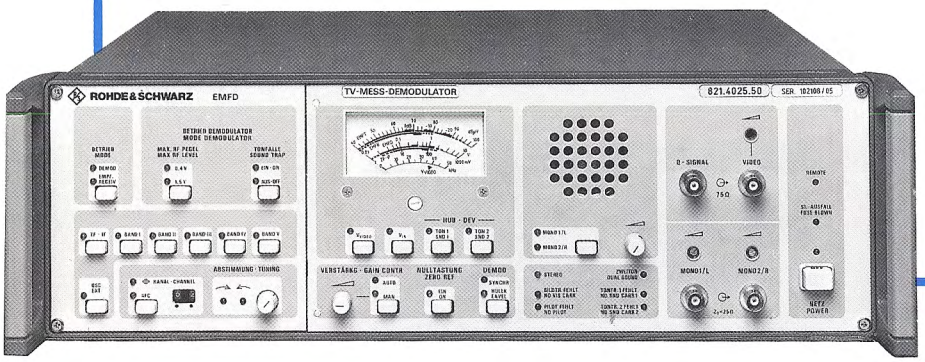
Dimensions, weight
19″ bench model . . . . . 492 mm×161 mm×392 mm, 12.5 kg
19″ rackmount . . . . . 483 mm×132 mm×384 mm, 10.0 kg

Ordering information

Order designation . . . . . ▶ TV Dual-Sound Demodulator FATF
19″ bench model 392.1018.54
19″ rackmount 392.1018.53
Option: RF Section FATF-B 392.3210.02

EMFD

TV Test Demodulator EMFD ♦ Bands I, III, IV/V, IF range



- Synchronous detection with (quadrature signal output) and envelope curve detector
- Multitone capability (dual-carrier technique)
- Selectable input sensitivity
- IF input

For EMF equipment family see page 48.

The **TV test demodulator EMFD** for crystal-controlled operation at a fixed frequency and continuously tunable AFC operation is a member of the EMF family whose features are described on page 48. The EMFD sound trap can be switched off.

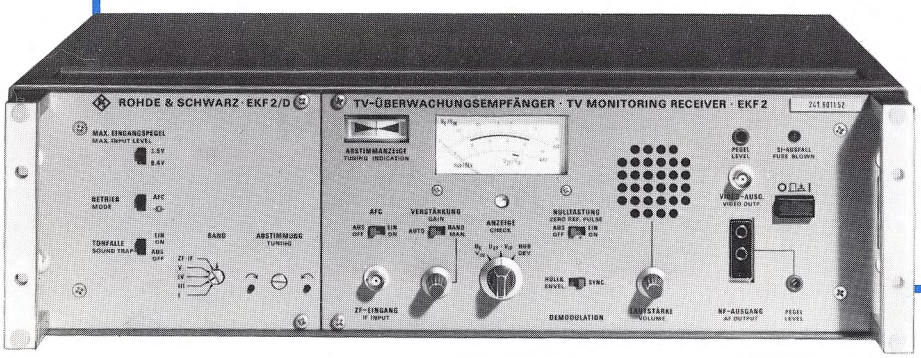
Brief data for Standard B/G

Frequency bands	I, III, IV/V, IF
Channel selection	fixed-frequency operation and continuously tunable (with AFC)
RF input impedance	50 Ω (N) and 75 Ω (BNC)
Input voltage range	
RF 1	20 to 400 mV
RF 2	80 mV to 1.6 V
IF	5 to 100 mV
Video outputs (isolated)	2; 75 Ω, BNC (front/rear panel)
Sound outputs (unbalanced)	2; ≤25 Ω, BNC (front panel)
See page 48 for further data	
Order designation	▶ TV Test Demodulator EMFD 821.4025.50

EKF 2 D
EKF 2 ZF

TV Demodulator EKF 2 D
TV IF Demodulator EKF 2 ZF

♦ Bands I, III, IV/V, IF range



- EKF 2 D: broadband RF input for all bands and IF input
  RF input voltage range
  20 mV to 1.6 V
- EKF 2 ZF: IF input
  IF input voltage range
  5 to 100 mV

For EKF 2 family see page 51.

Photo: TV Demodulator EKF 2 D

The **TV Demodulator EKF 2 D** and the **TV IF Demodulator EKF 2 ZF** are used for the demodulation of TV signals in the voltage range of transmitters and transposers. These demodulators are part of the EKF 2 family and are described together with the EKF 2 receivers on page 51.

- The **TV Demodulator EKF 2 D** has a broadband RF input and is used for monitoring TV transmitters.
- The **TV IF Demodulator EKF 2 ZF** is similar to the EKF 2 D but includes no RF/IF conversion and is used for testing in the IF range or after receiver units provided with an IF output.

Brief data for Standard B/G

	EKF 2 D	EKF 2 ZF
Frequency bands	I, III, IV/V, IF	IF
Frequency stabilization	crystal or AFC	–
Input impedance	50 Ω	50 Ω
Input voltage range		
RF 1	20 to 400 mV	–
RF 2	80 mV to 1.6 V	–
IF	5 to 100 mV	5 to 100 mV
Video outputs (isolated)	2; 75 Ω, BNC (front/rear panel)	
Sound outputs (balanced)	2	

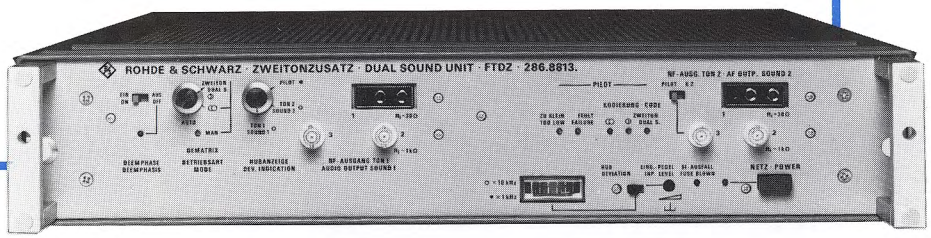
For detailed specifications and **ordering information** see page 51.

Dual Sound Unit FTDZ

♦ 33.4 MHz/33.158 MHz

FTDZ

- Intercarrier demodulator
- Dematrixing for stereo operation
- Identification-signal decoding with automatic mode switchover
- Pilot-signal monitoring



The **Dual Sound Unit FTDZ** demodulates dual-sound TV signals if used in conjunction with receivers having an IF output. The output level must be equal to or greater than 200 mV. The TV Monitoring Receiver EKF 2, TV Demodulator EKF 2 D and TV Demodulator AMF 2 from Rohde & Schwarz would be suitable instruments. The main subassemblies of the FTDZ are the intercarrier demodulators for sound 1 and sound 2.

Operating modes The mono, stereo or dual-sound modes can be selected automatically by means of the pilot-signal identification or manually. They are indicated by LEDs on the front panel and signalled by floating contacts.

Outputs Depending on the operating mode (mono, stereo, dual sound) the AF signals of the two sound channels are available at the AF outputs 1 and 2 directly or in dematrixed form as left-hand or right-hand information (see below). The non-decoded broadband AF signals and the filtered-out pilot signal are available at the auxiliary AF outputs 3.

Deviation indication The deviation of the two channels as well as the pilot deviation are indicated in analog form.

Specifications

IF input and output	BNC female connectors (rear panel); 50 Ω
Frequency	33.4 MHz/33.158 MHz
Input voltage	0.17 to 1.5 V_{rms} (sync level)
Return loss (one connector terminated)	≥15 dB
Insertion loss	approx. 4 dB
Operating modes	mono/stereo/dual sound
Switchover	automatic by pilot signal or on front panel
Sound channel outputs	each output available for channel 1 and channel 2
AF output 1	3 (parallel); balanced, floating; Z_s ≤25 Ω, Z_{out} ≥600 Ω
Connectors front panel	3-contact female RelKli 6a
rear panel	5-contact female, 30-contact male
AF output 2	unbalanced; Z_s approx. 1 kΩ, Z_{out} ≥100 kΩ|| 100 pF
Connector front panel	BNC female
AF output 3 (auxiliary)	2 (isolated); unbalanced; Z_s ≤25 Ω, Z_{out} ≥600 Ω
Connectors front panel	BNC female
rear panel	30-contact male
Deviation indication	analog
Range for sound 1 and 2	50 kHz (pilot: 5 kHz)
General data	
Rated temperature range	+5 to +40 °C
Operating temperature range	0 to +45 °C
Power supply	100/120/220/240 V +10/−15%; 47 to 63 Hz (40 VA)
Dimensions, weight	
19″ bench model	492 mm×116 mm×514 mm, 10 kg
19″ rackmount	483 mm×88 mm×506 mm, 7.5 kg
Order designation	▶ Dual Sound Unit FTDZ
19″ bench model	286.8813.52
19″ rackmount	286.8813.51

Sound channel outputs of FTDZ

	Sound channel 1			Sound channel 2			
	Output 1	Output 2	Output 3	Output 1	Output 2	Output 3 R + Pilot[1]	Output 3 Pilot[1]
Signal in							
stereo mode			$\frac{R+L}{2}$		R	R + Pilot	P (117.5 Hz)
mono mode		M1			M1	M1 + P	P (0 Hz)
dual-sound mode		M1			M2	M2 + P	P (274.1 Hz)
Output level (f_{mod} = 500 Hz, deviation ±30 kHz)		+6 dBm			+6 dBm		−15.6 dBm
	±0.25 dB	±0.35 dB	±0.25 dB	±0.25 dB	±0.35 dB	±0.25 dB	±0.25 dB
Frequency response (ref. to 500 Hz)							
40 Hz to 15 kHz	≤±0.2 dB	≤±0.3 dB	≤±0.2 dB	≤±0.2 dB	≤±0.3 dB	≤±0.2 dB	selective
40 Hz to 55 kHz			≤±1 dB				54.6875 kHz
Deemphasis[2]	50 µs ±2%			50 µs ±2%			
Distortion (without deemphasis), deviation ±50 kHz							
40 Hz to 15 kHz	≤0.5%[3]		≤0.75%	≤0.5%[3]		≤0.75%	
S/N ratio (all-black picture), weighted to CCIR 468-2	≥60 dB			≥60 dB			
Stereo crosstalk							
40 Hz to 5 kHz	≥38 dB down			≥38 dB down			
Channel crosstalk	≥76 dB down			≥76 dB down			

[1]) Can be switch-selected on front panel. [2]) Can be jointly switched off for output 1 and 2 on front panel (with status signalling), for output 3 internally by means of plug-in link. [3]) With internal 19-kHz lowpass filter.

AF LEVEL MEASUREMENT

SUN 2/U Level Meter SUN 2/U
SUN 2 AF Transmission Measuring Set SUN 2

- ♦ 10 Hz to 100 kHz
- Digital readout and autoranging
- Built-in filters for measuring harmonic distortion and weighted and unweighted S/N ratio
- Balanced and unbalanced test inputs

The Level Meter SUN 2/U and AF Generator SUN 2/S (see page 71 and specifications) constitute the AF Transmission Measuring Set SUN 2 (photo below).

Photo: Level Meter SUN 2/U

The **Level Meter SUN 2/U** is a precision AF voltmeter with digital indication. It has an unbalanced and a transformer-isolated balanced input. Range selection is automatic; switchover to manual operation with 10-dB steps is possible.

A quasi-rms-responding rectifier in line with DIN 45 633 produces an rms-proportional voltage from signals up to a crest factor of 5. Quasi-peak-responding rectification complying with DIN 45 405 can be switch-selected for weighted noise measurements.

The DC voltage proportional to the measured value is digitized and converted into dB by a microprocessor for display and further processing.

Readout characteristics are specified in existing standards for **psophometric measurements.** Conventional psophometers implement the required characteristics through the rectifier and meter time constants.

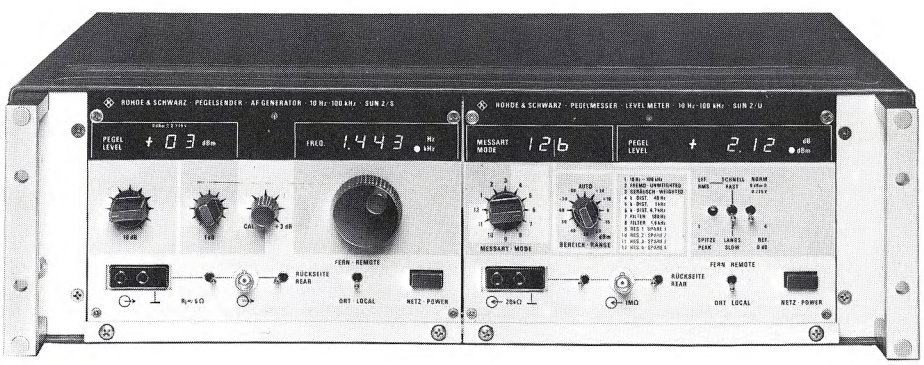
The Level Meter SUN 2/U simulates the characteristics of a moving-coil meter electrically, the digital display indicating the mean rms value or the maximum peak value during the display time.

Filters can be inserted in the amplifier path for measuring unweighted and weighted S/N ratio and **harmonic distortion.** The Level Meter then operates in the difference mode: it measures and stores the reference quantity, then measures the unknown via the filters and subtracts one from the other.

Linear **DC and AC outputs** permit connection of analog processing equipment such as recorders.

The **AF Transmission Measuring Set SUN 2** (photo below) is used for in-service measurements on sound broadcast and TV sound transmitters as well as for routine measurements on AF studio equipment and in laboratories. Thanks to the instrument's high accuracy, **single-knob tuning** over the entire frequency range on the AF Generator and **autoranging** for all modes of the Level Meter enable rapid, convenient and accurate measurements in AF engineering.

The **AF Generator** (see page 71 and specifications) and the **Level Meter** can be used **separately;** combined they yield a **test assembly** permitting weighted and unweighted S/N ratio as well as harmonic distortion to be measured. In addition, the feature of being able to select a reference level enables level variations to be determined.



AF Transmission Measuring Set SUN 2 with AF Generator SUN 2/S (left) and Level Meter SUN 2/U (right) as a 19″ bench model

Specifications

AF Generator SUN 2/S

Frequency	10 Hz to 100 kHz, tunable
Indication	4 digits, floating point; Hz, kHz
Indication error	$\leq 1 \times 10^{-3} \pm 1$ digit
Resolution	0.25 to 0.5%
Output level	
Range	−20 to +12 dBm (0 dBm = 0.775 V)
Setting in range −20 to +9 dBm	min. step 1 dB
Additional fine adjustment	0 to +3 dB (±0.1 dB)
Indication	−20 to +9 dBm; 2 digits, polarity sign
Setting error (1000 Hz)	≤±0.1 dB
Source impedance	approx. 5 Ω; $Z_{load} \geq 600\ \Omega \parallel \leq 4.7$ nF
Frequency response flatness, referred to 1000 Hz	30 Hz to 70 kHz: ≤±0.1 dB other frequencies: ≤±0.3 dB
Harmonics	≥65 dB down (30 Hz to 30 kHz) ≥60 dB down (30 to 100 kHz) ≥40 dB down (10 to 30 Hz)
DC component	≤±1 mV
Outputs	
Front panel (switch-selected)	unbalanced; BNC female connector balanced: 3-contact connector Rel Kli 6a
Rear panel (instead of front-panel output)	3-contact female chassis connector (similar to DIN 41 524), lockable; in parallel with 30-contact male connector (DIN 41 622)

Level Meter SUN 2/U

Frequency range	10 Hz to 100 kHz
Operation with filter inserted	see under "filter"
Level measurement range	−84 to +32 dBm (0 dBm = 0.775 V)
Range stepping	10-dB steps (−80 to +20 dBm)
Individual range	approx. −10 to +12 dBm about mid range
Range selection	automatic or manual
Indication	4 digits, polarity sign; dBm, dB; readout blinking in the case of over-ranging and underranging
Resolution	0.02 dB
Error limits of indication (inherent noise level not taken into account)	
Error with sinusoidal voltages and rms-value indication (1000 Hz)	≤±0.1 dB
Frequency response flatness with rms-value indication (referred to 1000 Hz)	30 Hz to 70 kHz: ≤±0.1 dB; other frequencies: ≤±0.2 dB
Weighting error of rms-responding rectifier	up to crest factor 3: ≤±0.5 dB up to crest factor 5: ≤±1 dB (in accordance with DIN 45 633 and IEC 179)
Error limits and dynamic range with quasi-peak-responsive indication	in accordance with DIN 45 405 (1983) and CCIR Rec. 468-2
Inherent noise level (rms)	≤ −90 dBm ($Z_s \leq 20$ kΩ)
Meter detectors	
rms mode	quasi-rms-responding rectifier in accordance with DIN 45 633, sheet 2, and IEC 179
Integration time	FAST: 35 ms SLOW: 145 ms
Measured value indication	mean value of detector voltage during integration time (145 ms)
Peak mode	quasi-peak-responding rectifier in accordance with DIN 45 405 (1983) and CCIR Rec. 468-2
Measured value indication	maximum value of detector voltage during integration time (35 ms)
Distortion measurement	L_2 subtracted from L_1 automatically
Reference measurement	±dB variation from any selected reference value
Inputs	
Front panel (switch-selected)	unbalanced: 1 MΩ ∥ ≈50 pF, BNC female connector; balanced: ≥20 kΩ, 3-contact connector Rel Kli 6a
Rear panel	balanced: ≥20 kΩ, 30-contact male connector (DIN 41 622), in parallel with 3-contact female chassis connector (similar to DIN 41 524), lockable
Common-mode rejection and ratio of balanced voltage to voltage between centre tap and earth	≥125 dB (50 Hz) ≥85 dB (1 kHz) ≥60 dB (16 kHz)
Permissible DC voltage at unbalanced input	max. ±100 V
Outputs	telephone jacks on rear panel
DC voltage	+0.1 to +1 V, proportional to V_{in}
Source impedance, load	$R_{out} \approx 10\ \Omega$, $R_{load} \geq 1$ kΩ
AC voltage	max. ≥0 dBm, proportional to V_{in}
Source impedance, load	$Z_{out} \approx 10\ \Omega$, $Z_{load} \geq 1$ kΩ
Useful dynamic range (instrument used as amplifier)	≥60 dB
Filters	
Unweighted	bandpass filter 31.5 Hz to 16 kHz in accordance with DIN 45 405 (1983) and CCIR Rec. 468-2
Weighted	psophometric filter in accordance with DIN 45 405 (1983) and CCIR Rec. 468-2 (exchangeable plug-in board)
Distortion (d)	highpass filter 80 Hz (for $d_{(40\ Hz)}$), highpass filter 2 kHz (for $d_{(1\ kHz)}$), highpass filter 9.4 kHz (for $d_{(4.7\ kHz)}$)
Distortion (separately for d_2 and d_3)	bandpass filter 180 Hz for $d_{3\ (60\ Hz)}$ and $d_{2\ (90\ Hz)}$, bandpass filter 1.6 kHz for $d_{3\ (533\ Hz)}$ and $d_{2\ (800\ Hz)}$
Highpass filters (f_o = frequency of fundamental)	
Passband attenuation between 2 f_o and 45 kHz	≤±0.3 dB
Stopband attenuation at f_o	≥65 dB
Bandpass filters (f_p = passband frequency)	
Passband attenuation at f_p	≤±0.3 dB
Stopband attenuation at 0.33 f_p and 0.5 f_p	≥65 dB
Stopband attenuation at ≥1.33 f_p to 45 kHz	≥40 dB
Special filters	space and four switch positions provided for special filters
Inherent noise indication with distortion measurement	≥65 dB (≥60 dB for $d_{(40\ Hz)}$ and balanced input)

General data

Rated temperature range	+5 to +45 °C
Storage temperature range	−20 to +70 °C
AC supply	110/125/220/235 V +10/−15%, 47 to 63 Hz
Power consumption	AF Generator: 30 VA Level Meter: 25 VA
Dimensions	
19″ bench model	492 mm×161 mm×392 mm
19″ rackmount	483 mm×132 mm×384 mm
½ 19″ rackmount SUN 2/S or SUN 2/U	245 mm×154 mm×347 mm
Weight	
19″ bench model	10.2 kg
19″ rackmount	8.6 kg
½ 19″ rackmount SUN 2/S	4.9 kg } in cabinet
SUN 2/U	5.1 kg }

Ordering information

Order designations

Test assembly comprising SUN 2/S and SUN 2/U	▶ AF Transmission Measuring Set SUN 2
19″ bench model	190.2750.02
19″ rackmount	190.2744.02
Rackmount SUN 2/S in cabinet	▶ AF Generator SUN 2/S 282.2010.03
Rackmount SUN 2/U in cabinet	▶ Level Meter SUN 2/U 282.4213.03

Accessories supplied

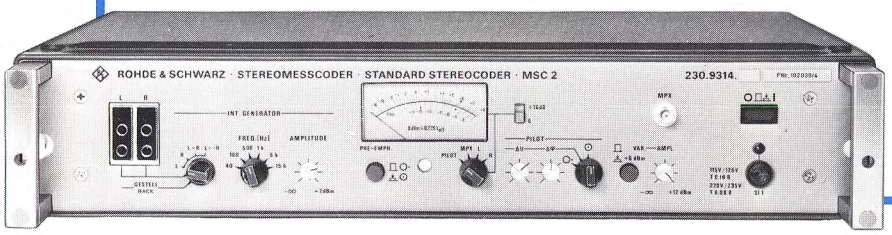
Power cord, manual, adapter board; one of each of these for the AF Generator and for the Level Meter

Recommended extras

Panelling SUN 2-Z to convert ½ 19″ rackmount for use as bench model	085.6421.00
Cassette Adapter SUN 2-Z for any two plug-ins of the SUN 2 system	282.5910.03
Panelling SUN 2-Z to convert Cassette Adapter for use as bench model	085.1459.00

MSC 2

Precision Stereocoder MSC 2 ♦ 30 Hz to 15 kHz



- High-quality stereocoder complying with CCIR, EBU and FCC standards
- Excellent S/N ratio
- Channel crosstalk >60 dB down
- Harmonic distortion <0.1%
- AF generator with 6 fixed frequencies
- SCA option retrofittable

The **Precision Stereocoder MSC 2** produces the standard stereo multiplex signal with **high precision.** Extremely high crosstalk attenuation, very low harmonic and linear distortions and a high S/N ratio are the results of a coding method which replaces "hard switching" at 38 kHz by graded switching in 14 steps. The channel separation (measured in conjunction with the Precision Stereodecoder MSDC 2) is shown on page 113. The MSC 2 can be interfaced with the Radio Data Coder DMC.

AF inputs The AF inputs are fitted with differential amplifiers to reliably suppress common-mode voltages caused by hum pickup for example. Subsequent lowpass filters remove all frequencies above 18.5 kHz so that a perfect multiplex signal is generated independently of the input voltages. The **amplitudes** of the AF and multiplex signals are **adjustable** over a wide range. A built-in peak voltmeter indicates the modulation of the coder.

Additional signals At two additional inputs, extra signals in the frequency range 53 kHz to about 100 kHz, for instance traffic radio or SCA channels, can be added without affecting the rest of the multiplex signal. For this purpose an **SCA modulator** is available as an **option** (SCA = Subsidiary Communications Authorization = background program of lower quality for commercial use).

AF generator For its use as a measuring instrument, the stereocoder is fitted with an AF generator producing six fixed frequencies with high amplitude stability and low distortion, with the result that an external generator will not be required in most cases. The internal generator is used for the modulation modes:

L
R
L = R (mono signal)
L = −R (difference signal)

Pilot The phase and amplitude of the pilot (19 kHz) are adjustable with front-panel controls so that the characteristics of the decoder under test can be measured under any operating conditions.

Specifications

Inputs for L and R channels	30 Hz to 15 kHz; bal./unbal., Z_{in} ≥30/20 kΩ
Attenuation (f ≥19 kHz)	≥54 dB
Input level at 1 kHz for output level of +6 dBm of M signal or S signal modulated onto carrier	+6 dBm (nominal input level)
Overload capability	≥6.5 dB
Common-mode suppression for	
F <150 Hz	≥66 dB
150 Hz <f <15 kHz	≥44 dB
Preemphasis	50 µs/75 µs/off
Inputs for additional signals	2; ≥2 kΩ, unbal.; 53 to 100 kHz
Multiplex signal outputs	2 (shortcircuit-proof), Z_{out} ≤20 Ω
Output level	+6 dBm/−∞ to +12 dBm (without pilot)
Frequency response flatness (ref. 500 Hz), measured after decoder	≤±0.15 dB
Signal characteristics	
Harmonic distortion (level +6 or +12 dBm)	≤0.1% (measured after decoder)
Intermodulation distortion to DIN 45403 at +12.5 dBm	d_2 ≤0.05%, d_3 ≤0.1% (measured after decoder)
Crosstalk M/S	≥46 dB down (30 Hz to 15 kHz)
L/R	≥60 dB down (100 Hz to 5 kHz), ≥58 dB down (30 Hz to 15 kHz)
Signal/THD ratio at output levels up to +12.5 dBm	≥60 dB
Unweighted S/N ratio	≥80 dB
Weighted S/N ratio	≥76 dB (CCIR 468-2)
Pilot	
Pilot frequency	19 kHz ±1 Hz (38-kHz carrier)
Pilot fixed, amplitude	−9.5 dBm ±0.2 dB
Phase (referred to 38-kHz carrier)	0° ±0.3°
Adjustable pilot, amplitude	−16 to −5 dBm
Phase	±5°
Pilot frequency output	1 V_{pp} (Z_{out} ≤100 Ω), squarewave
AF generator	
Fixed frequencies	40/100/500 Hz/1/5/15 kHz ±2.5%
Harmonic distortion	≤0.1%
Level at sync output	+7 dBm (Z_{out} ≤12 kΩ)
SCA modulator option	
Input signal	−10 to +12 dBm
Frequency response flatness	±0.5 dB (30 Hz to 7.5 kHz)
FM deviation	±2 to ±8 kHz
Centre frequency, crystal-controlled	60 to 74 kHz (codable)
Harmonic distortion (deviation ≤7.5 kHz)	≤1% (30 Hz to 7.5 kHz)
Output level	−20 to 0 dBm
General data	
AC supply	115/125/220/235 V +10/−15%, 47 to 63 Hz (10 VA)
Dimensions, weight	
19″ bench model	492 mm×116 mm×392 mm, 6.7 kg
19″ rackmount	483 mm×88 mm×384 mm, 4.5 kg
Connectors	
Multiplex signal output	BNC female
AF inputs for L and R signals	to DIN 41628
Rear inputs and outputs	30-contact male, to DIN 41622

Ordering information

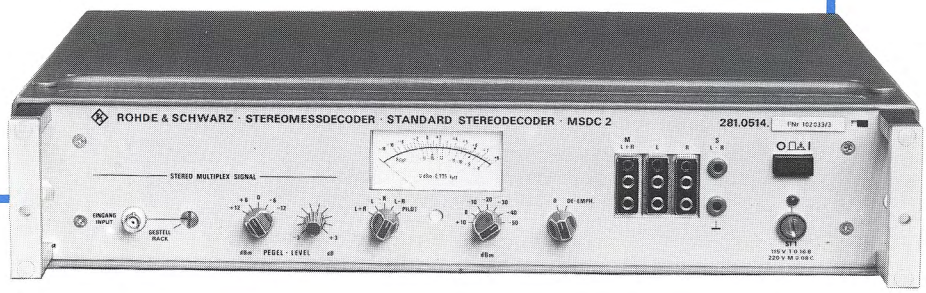
Order designation	▶ Precision Stereocoder MSC 2
19″ bench model	230.9314.04
19″ rackmount	230.9314.03
SCA modulator	230.9014.00

Precision Stereodecoder MSDC 2

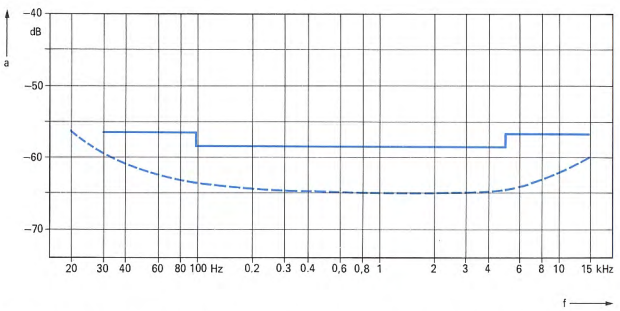
♦ 30 Hz to 75 kHz

MSDC 2

- High-grade decoding of multiplex signals
- Very high channel separation: typically 64 dB
- Extremely low intrinsic distortion



The **Precision Stereodecoder MSDC 2** is used to measure and monitor stereo multiplex signals. Its performance far exceeds the requirements set by ARD in all significant points. Thus the MSDC 2 can be employed as a reference standard in the development and production of stereo coders and decoders, as well as in transmitter networks to ensure high transmission quality.



Stereo separation of the Precision Stereodecoder MSDC 2 between the right and left channels; full line: guaranteed values; dashed line: typical values

Input The input of the MSDC 2 is balanced; common-mode rejection exceeds 60 dB for the lower frequencies. The input amplifier handles frequencies from about 0.1 Hz to 1 MHz without introducing distortion. Amplitude and phase errors thus remain so small that high channel separation is obtained (see diagram above and specifications).

The **decoder** uses a time-division-multiplex decoding technique. The stereo signal is connected alternately at a rate of 38 kHz to the right and left channels. This circuit arrangement provides a carrier suppression of more than 40 dB.

To obtain the specified channel separation, it is essential that switching is in exact synchronism with the pilot. For frequency deviations up to ±2 Hz and level variations up to +6/–12 dB the time shift of the squarewave switching voltage referred to the 19-kHz pilot must not exceed 50 ns.

Outputs The signals of the left and right channels, the centre signal M = (L+R)/2 and the side information S = (L–R)/2 are delivered with extremely low distortion at separate outputs. Apart from the S-signal output they are balanced. Toroidal core transformers are used, giving distortion of less than 0.1%, even at a frequency of 30 Hz and a signal level 6 dB above nominal.

Indication A selector switch allows the levels of the output signals and of the pilot to be indicated on the panel meter. The measurement range for the output signals (–66 to +18 dBm) is large enough to permit even the intrinsic error of the MSDC 2 or a coder working directly into the MSDC 2 to be measured. The pilot voltage can be measured over a range of –7.5 to –17 dB relative to the setting of the input attenuator. This permits exact level adjustment, even with an unknown stereo multiplex signal.

Specifications

Stereo multiplex input

Frequency range	30 Hz to 75 kHz
Input impedance	≥40 kΩ bal., ≥20 kΩ unbal.
Common-mode rejection	≥58 dB at <150 Hz ≥46 dB at 150 Hz to <15 kHz ≥36 dB at 15 to <100 kHz
Input level	–12 to +12 dBm (0 dBm ≙ 0.775 V into 600 Ω)
Setting	6-dB steps, ±3 dB continuous
Overload capability	≥6.5 dB

AF outputs

L, R, M signal outputs (balanced)	+6 dBm, Z_s ≤20 Ω, Z_L ≥200 Ω
S signal output (unbalanced)	+6 dBm, Z_s ≤500 Ω

Linear distortions

Frequency response flatness at the outputs, relative to 500 Hz	≤±0.15 dB for 30 Hz to 15 kHz
Deemphasis	50 µs ±2%/75 µs ±2%/off

Linear crosstalk

M/S channels	≥46 dB down (typ. 50 dB)
L/R channels, 100 Hz to 5 kHz	≥60 dB down (typ. 64 dB)
30 Hz to 15 kHz	≥58 dB down (typ. 60 dB)

Nonlinear distortions

Harmonic distortion at 6 and 12.5 dBm	≤0.1%
Intermodulation distortion to DIN 45 403 at 12.5 dBm	d_2 ≤0.05%, d_3 ≤0.1%

S/N ratio

(with 50-µs deemphasis) relative to +6 dBm at 1 kHz	
unweighted	≥80 dB, rms (30 Hz to 100 kHz)
weighted	≥78 dB (peak value to CCIR)
Pilot suppression	≥90 dB
SCA suppression (SCA level –16 dB relative to multiplex signal)	≥76 dB (56 to 96 kHz)

Meter indication	L, R, M, S or pilot level
Indicating error	≤0.2 dB of rdg +1.5% of fsd
Pilot indication	–7.5 to –17 dB
AF indication (10-dB steps)	+18 to –66 dBm

General data

Rated temperature range	+5 to +45 °C
Rear connectors	30-contact male
AC supply	115/125/220/235 V +10/–15%, 47 to 63 Hz (12 VA)
Dimensions, weight	
19″ bench model	492 mm×116 mm×392 mm, 6.7 kg
19″ rackmount	483 mm×88 mm×384 mm, 4.5 kg

Ordering information

Order designation (19″ rackmount)	▶ Precision Stereodecoder MSDC 2 281.0514.03
Panelling	085.1313.00

VIDEO NOISE MEASUREMENT

UPSF 2

Video Noise Meter UPSF 2 ♦ 40 Hz to 10 MHz

- Weighted and unweighted measurement of noise voltages occurring in 625-line and 525-line systems
- Full-field, spot and line measurement
- Chroma noise measurement (AM and φM components)

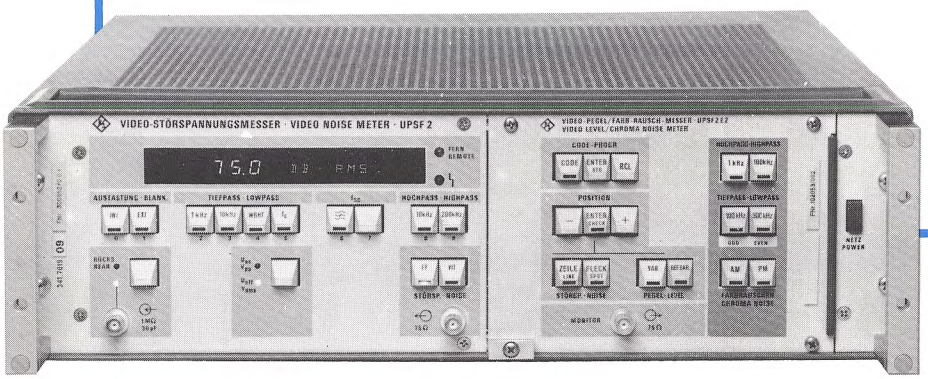


Photo: UPSF 2 with plug-in for chroma noise measurement

IEC 625 Bus

The **Video Noise Meter UPSF 2** measures noise voltages occurring in transmission systems either in the unweighted mode from 40 Hz to 10 MHz or in the weighted mode with the appropriate filters incorporated. The **Video Level/Chroma Noise Meter UPSF2E2** (see page 115) affords further measuring possibilities. The relevant IEC and CCIR specifications are satisfied.

Special features of basic unit:

- Automatic switchover to 625-line or 525-line systems (dual-standard unit)
- Free choice of test point:
  full field or
  any test line
- Measurement of true rms and peak values
- Autoranging over 80 dB
- Alphanumeric readout of measured value and operation status (see below)
- System-compatible thanks to IEC-bus interface (option)

The UPSF 2 functions both in 625-line and 525-line systems. Switchover is automatic, including the standard-dependent filters.

Filters The basic unit includes the following filters:

Band-limiting filters (lowpass filters to CCIR Rec. 567) preventing measurement errors due to noise voltages above the upper video cutoff frequency. The filters with a cutoff frequency of 4.2 and 5 MHz are selected automatically.

Noise-weighting filter (to CCIR Rec. 567) Unified weighting network for noise voltage weighting in accordance with the response of the eye to noise.

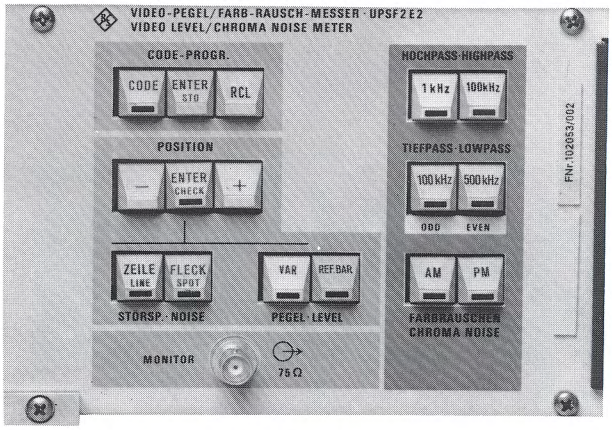
1-kHz lowpass filter for measuring hum voltages superimposed on a line-repetitive signal.

200-kHz highpass filter (to CCIR Rec. 567) for measurement without low-frequency components, always connected into circuit for test line and spot measurements; please enquire for 100-kHz highpass filter.

Wave trap for attenuating any residual colour subcarrier components by at least 26 dB. The colour subcarrier frequency of 4.43 or 3.58 MHz is selected automatically.

10-kHz highpass/lowpass filter (to CCIR Rec. 567) for measurement below or above 10 kHz.

Readout section on UPSF 2; left: 7-segment readout for numerical value of test result, cutoff frequency, line number, etc.; right: alphanumeric 16-segment readout for parameter designation (unit), mode, reference and operating error messages
The second functions of the keys are used for entering the test point coordinates, line numbers, etc.



Video Level/Chroma Noise Meter UPSF2E2

Video Level/Chroma Noise Meter UPSF2E2 This plug-in which is to be ordered separately for a colour subcarrier frequency of either 4.43 or 3.58 MHz adds the following measurement capability to the basic unit:

- Chroma-noise measurement on magnetic tapes and VTRs in the range from 100 Hz to 1 MHz,

  measurement in line with the IEC standard currently being prepared for chroma-noise,

  separate measurement of amplitude and phase,

  automatic correction of differences in the colour subcarrier amplitudes; the lower and upper cutoff frequencies can be switch-selected for assessment,

  lower f_c: 100 Hz, 1 kHz, 10 kHz, 100 kHz, 200 kHz,

  upper f_c: 10 kHz, 100 kHz, 500 kHz, 1 MHz, WGHT
- Luminance measurements (referred to the measured luminance bar) with free selection of test point:

  – any line or

  – spot at any point
- Level measurement:

  – measurement of luminance bar amplitude

  – level difference measurement (sample-and-hold technique) between any two points
- Greater measuring convenience thanks to (code) programs available. Examples from the code table:

  – noise-voltage output in mV

  – pulse-level output in mV, % or IRE units

  – disabling luminance-bar reference

  – determination of gain range

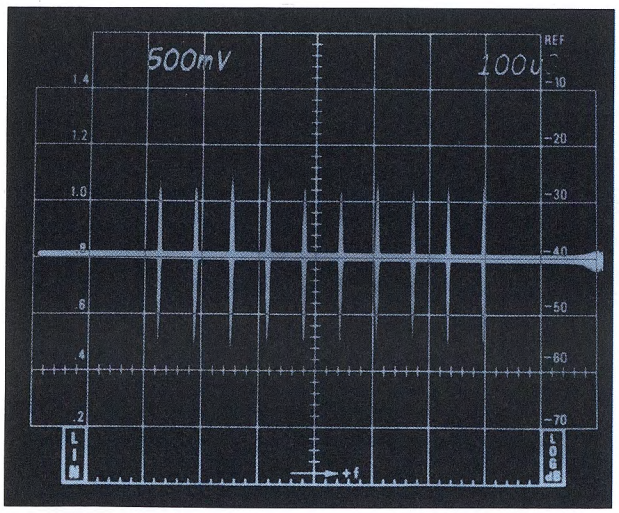
Operation The UPSF 2 is fast and easy to use:

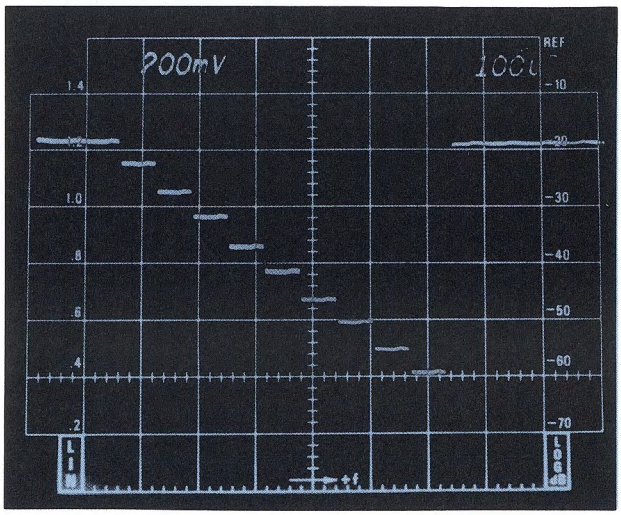
Instrument wiring

- Test signal (picture or composite video signal) at front input or at the loop-through filter on the rear panel
- Frame alignment signal S or H (only required with picture signal) at the loop-through filter S/H on the rear panel

Settings

- Selection of the input for the test signal (front or rear panel)
- Selection of synchronization of internal, external or no blanking
- Selection of filters
  Lowpass filters: 1 kHz, 10 kHz, evaluator, band limiter, colour subcarrier trap: f_{sc}
  Highpass filters: 10 kHz, 200 kHz (100 kHz)
- Selection of operating mode
  FF (Full Field) = measurement throughout video range; ie in all lines for the duration of 40 µs. If the V signal is present, there is no measurement in the V interval or VIT (Vertical Insertion Test line) = measurement in the test line. The line number is changed by activating another key.
- Selection of operating mode
  V_{rms} = true rms measurement or
  V_{pp} = peak responsive measurement





Spot measurement (luminance noise) using the video noise meter UPSF 2;
left: oscillogram at the noise voltage output;
right: oscillogram showing voltage integration of more than 10 × 4 µs with interruption of integration during the remaining time and integrator discharged after the measurement period

UPSF 2 – Operation

Operator guidance

- Permitted settings are performed and signalled by permanent LEDs
- Incorrect operations are not performed; LEDs flash until a correct operation is carried out or the entry is cancelled
- The test range is automatically selected in steps of 10 dB between 0 and −80 dB (autoranging)
- The standard (525 or 625 lines) is obtained from the CVS or S signal, and the appropriate filters and 0 dB reference are automatically assigned correctly.

Display

- The data of the self test after switch-on
- Test value in dB and test mode "RMS" or "PP"
- Status display such as: number of lines, selected test line, video cutoff frequency used and colour subcarrier trap frequency.

Specifications

Basic unit

Frequency range	40 Hz to 10 MHz (with frequency response flat within ±0.25 dB)
Test signal	picture or composite video signal with and without test lines
Standard	625 or 525 lines (automatic switch-over)
Modes of operation	full field and test line
Synchronization	internal or external
Measurement range	0 to −80 dB
Range switchover	automatic
Reference	0 dB corresponding to 714 mV or 700 mV (automatic switchover)
Types of rectification	true rms- or peak-responsive measurement
Readout	digital (mV, V, dB, %)
Error	±1 dB
Inherent S/N ratio (limited)	≥80 dB_{rms}
Filters used	see text
Test input on front panel	1 MΩ ‖ 30 pF
on rear panel	75-Ω loop-through filter
Return loss	≥40 dB (up to 6 MHz)
Synchronization input	75-Ω loop-through filter (on rear panel)
Return loss	≥36 dB (up to 6 MHz)
Sync amplitude	−4 V ±1 V
Noise-voltage output (test signal blanked)	on front panel
Output impedance	75 Ω
Return loss	≥36 dB (up to 6 MHz)
Remote control (option)	interface to IEC 625-1 (IEEE 488)

Basic unit plus plug-in

Chroma-noise measurement	AM and φM components
Colour subcarrier	4.43 or 3.58 MHz (depending on model)
Measurement range	−25 to −70 dB
TV standard	PAL and NTSC
Filters used	see text
Luminance-noise voltage measurement	
Reference	current luminance bar in test line
Modes of operation	
Line	measurement time 40 µs
Line number	freely selectable
Spot	4 µs, 10 lines
Test point	freely selectable
Level measurement	
Measurement range	0 to ±1500 mV
Tolerance range	±0.5% ±3 mV
Luminance bar	to CCIR Rec. 569
Video signals	test points can be selected in 1-µs steps
Level-difference measurement	
Sampling-pulse duration	1 µs
Sampling points	freely selectable
Monitor output	on front panel (unblanking of test-point coordinates)

General data

Rated temperature range	+5 to +45 °C
AC supply	115/125/220/235 V +10/−15%, 47 to 63 Hz (65 VA)
Dimensions, weight	
19″ bench model	492 mm×161 mm×514 mm, 18 kg
19″ rackmount	483 mm×132 mm×506 mm, 14.5 kg

Ordering information

Order designations

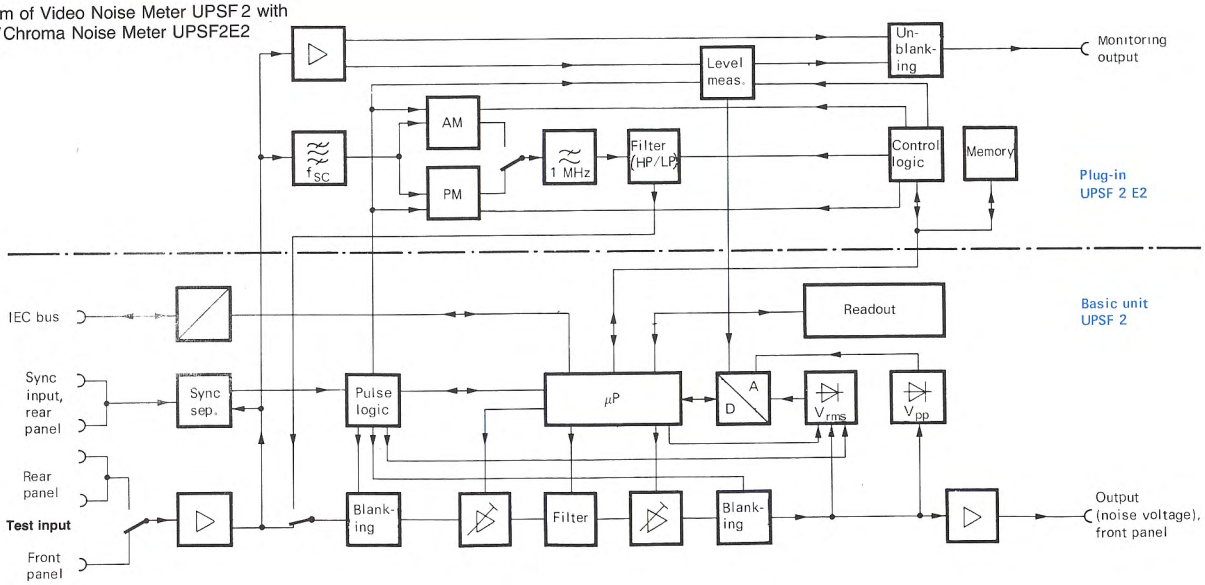
Basic unit (without plug-in) for 625 and 525 lines	▶ Video Noise Meter UPSF 2
19″ bench model	341.7019.09
19″ rackmount	341.7019.08
Plug-in	▶ Video Level/Chroma Noise Meter UPSF2E2
for colour subcarrier	
4.43361875 MHz	342.0018.03
3.579545 MHz	342.0018.13

Accessories supplied
Termination (75 Ω), power cord

Option

IEC Bus UPSF2-Z	341.8238.02

Block diagram of Video Noise Meter UPSF 2 with Video Level/Chroma Noise Meter UPSF2E2



Differential Phase/Gain Meter PVF

PVF

- For differential phase and gain measurements on television transmission systems
- For open- and closed-circuit measurements on studio equipment
- Permits display on simple laboratory oscilloscopes
- Switch-selected scale calibration signals
- Remote control via parallel interface

The **Differential Phase/Gain Meter PVF** measures the non-linear distortions in colour TV transmission systems. The test item is driven by a line-frequency sawtooth or staircase voltage, on which an RF signal at the frequency of the colour subcarrier is superimposed (e.g. CCIR test signal No. 3 or CCIR test line 330). An electronic switch permits **simultaneous observation of differential phase and gain.** The reference voltage for the phase demodulator is produced by the set itself, so the test-signal source and the PVF can be set up in different locations. The relatively large measuring range (differential phase 0.1° to 60°; differential gain 0.5 to 50%) covers all cases which are likely to occur in practice.

Calibration lines for 1° and 10° or 1% and 10% can be inserted into the screen of the VDU used.

Signal processing The PVF adjusts automatically and within wide limits to the test-item output level (inadmissible deviations of the input voltage are signalled). Any burst present in the test signal does not affect the performance; it has no effect even if its phase alternates at line frequency (PAL method). Likewise, field-repetitive sync and blanking pulses as well as any insertion test signals included do not affect the measurement. The PVF also handles test signals with blanked colour subcarrier or signals in which the test sawtooth appears only in every fourth line in order to give the required average picture level.

Specifications

Input signal	CVS with line-repetitive sawtooth or staircase with superimposed colour subcarrier
Amplitude of CVS	0.3 to 2 V_{pp}
Amplitude of colour subcarrier	20 to 300 mV_{pp}
Standards (depending on model)	see ordering information
Inputs	
Test input	2 loop-through filters, switch-selected front/rear panel
Input impedance	75 Ω (female BNC connectors)
Return loss	≥34 dB (up to 6 MHz)
H pulse input (external synchronization)	loop-through filter (rear panel)
Input impedance	75 Ω (female BNC connectors)
Return loss	≥34 dB (up to 6 MHz)
Outputs	
Test output for oscilloscope (display)	75 Ω (female BNC connectors; front and rear panels)
Maximum sensitivity	
Differential phase	1 V_{pp}/1°
Differential gain	0.4 V_{pp}/1%
Sawtooth output for oscilloscope	BNC (front panel)
Output voltage	10 V_{pp}, Z_{out} = 600 Ω ±10%
Indication of measured value	on oscilloscope
Evaluation	voltage comparison with calibration lines
Measurement ranges	
Differential phase	0.1 to 60°
Resolution	≤0.1°
Calibration lines	1° and 10°
Differential gain	0.5 to 50%
Resolution	≤0.5%
Calibration lines	1% and 10%
General data	
Rated temperature range	+5 to +35 °C
AC supply	115/125/220/235 V ±10%, 47 to 63 Hz (40 VA)
Dimensions, weight	
19″ bench model	492 mm×207 mm×507 mm, 15 kg
19″ rackmount	483 mm×177 mm×498 mm, 11 kg

Ordering information

Order designation	▶ Differential Phase/Gain Meter PVF	
	19″ bench model	19″ rackmount
Standards B, G, H, I	0676.7118.04	0676.7118.03
D, K, L	100.2362.04	100.2362.05
M	100.2362.07	100.2362.08
M (PAL)	100.2362.75	—

Accessories supplied

Termination RMF (75 Ω), power cord

Recommended extras

2 RF patch cords (200 cm, 75 Ω, 2 BNC) 100.6980.20
RF patch cord (100 cm, 75 Ω, 2 BNC) 100.6980.10

UPF

Video Distortion Analyzer UPF

- Automatic in-service monitoring of TV transmisson equipment
- Simplification of measurements in production, test and final-inspection departments
- Optical signalling of faults; analog and digital output of results
- Immunity to interference and noise on the signal
- Flexibility to meet different requirements, e.g. measurements in the picture interval or separate measurements on VCR heads

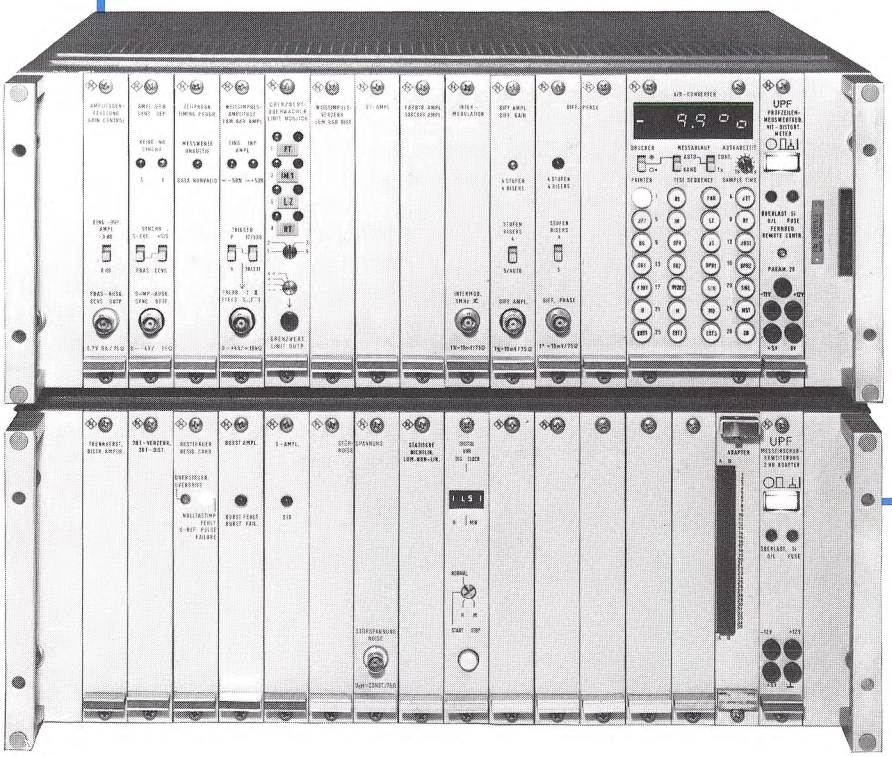


Photo: UPF basic unit (top) plus second cassette adapter

With option: IEC 625 Bus

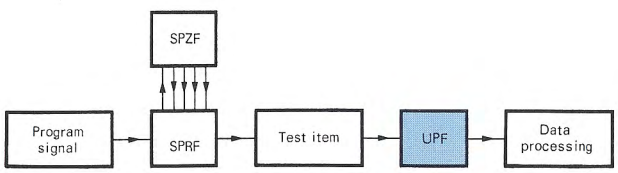
The **Video Distortion Analyzer UPF** is designed for automatic evaluation of the international CCIR test signals inserted in lines 17, 18, 330 and 331 of the television picture.

By changing the positions of internal links it is possible to take measurements anywhere within the field-blanking interval and the first few lines of the picture up to line 32. Special versions permit measurement in the full field.

The measured values are generated as proportional DC voltages, which can be read singly or in a cyclic scan and digitally displayed or output. Abnormal conditions or values which exceed predetermined limits are signalled by LEDs on the UPF and by outgoing status lines. Conditions so indicated include:

missing sync signal,
missing field-sync component,
luminance bar too small (= missing),
signal amplitude exceeds control range.

Since the sampling points can be selected as desired by changing the required links, it is possible to perform many measurements other than test-line analysis; eg signals in the picture interval or other test signals can be examined. Operating parameters such as the sync and burst amplitudes or the hum level can also be measured.



Block diagram showing use of UPF in a video distortion measurement system

Construction The UPF is of modular construction and is composed of the following functional groups:

- basic unit
- test-parameter cassettes
- limit monitors
- display unit
- second cassette adapter

The **basic unit** (cassette adapter) includes the power supply section with the mains switching panel plus a coding board for establishing the relationship between the various measured values in the form of DC voltages and the 28 available parameter numbers. All interconnections, including signal distribution, are carried on a motherboard in the cassette adapter.

The **basic cassettes** (Gain Control, Sync Separator and Timing Program Cassettes) plus the **Luminance-bar Amplitude Cassette** provide essential signal processing and thereby minimize the complexity of the remaining test-parameter cassettes.

Test-parameter cassettes Each test-parameter cassette derives its own nominal and reference values and is thus independent of the other test-parameter cassettes. The outputs of the cassettes are DC voltages proportional to the measured parameters. Along with external DC measured values, these proportional voltages may be monitored in limit monitors to check whether preset tolerances are maintained. Indication and output are also possible via the display unit.

Normally each test-parameter cassette is associated with one measured value. The user can freely determine the parameter cassette complement. The maximum delay between application of the video signal and appearance of the

measured result is 10 s (special version with 5 s available). Each parameter is output in the form of a proportional DC voltage with 100 mV corresponding to 1%, 1°, 1 dB or 10 ns. With the exception of some operating parameters and the group delay, the results are given as deviations from the nominal value in percent, degrees, nanoseconds or decibels.

Limit monitors Each cassette simultaneously monitors four parameters, checking their compliance with both an inner and an outer tolerance. For stations where different tolerances apply to the incoming and outgoing signals (eg a cable link and a transmitter), an extended limit monitor is available. It provides a total of eight adjustable limit values for each parameter, monitored in one of two groups of four limits. The groups may be remotely switched over.

Display unit The plug-in includes an A/D converter for digital data output and handles a total of 28 internal and/or external parameters. A parity generator may be added. The DC parameter selector switch enables the measured values to be periodically sampled, displayed and output in two different forms:

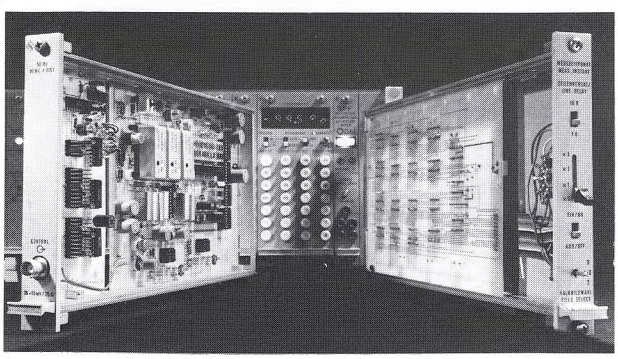
- BCD parallel output for printer, separate display unit or computer; the data format comprises parameter number, measured value and limit symbols
- ASCII output (serial) for teletype or computer, providing measured-value and limit information

The A/D Converter receives the hours and minutes information from the **Digital Clock** for insertion into the test report. The Digital Clock is powered from a buffered NiCd accumulator and is thus in continuous operation. The clock has a four-digit display.

Second cassette adapter For larger systems, the basic unit can be extended by adding a second cassette adapter with its own power supply. It is connected by a number of cables (on the rear) to the basic unit and can accommodate up to 14 further test-parameter cassettes.

Uses in laboratory and production

Besides automatic monitoring of TV transmission equipment of all kinds, the UPF can be used in laboratories, production facilities, and test and final-inspection departments to simplify measuring procedures. For this purpose, some test-parameter cassettes and a number of modified standard cassettes are available.



On all the UPF cassettes, the integration time of 10 s can be reduced to 5 s (even to 3 s with a suitable test line configuration). This affects the measurement accuracy only in the case of a very poor S/N ratio. The short transient response is a decisive criterion for automated test runs (for example when using the TV Data Processor UPCF, Process Controller PUC, Tektronix Desktop Computers 4051 and 4052 or HP 9826 and 9836) as well as for alignment procedures.

Cassettes

Programmable measurement instant This cassette permits separate measurement of the video heads on four- or two-head video recording systems. Another application is the measurement of VCR equipment that records a complete field with each head. The cassette permits programmed line delay over the entire field from 0 to about 288 and contains two completely separate functional groups for the different requirements:

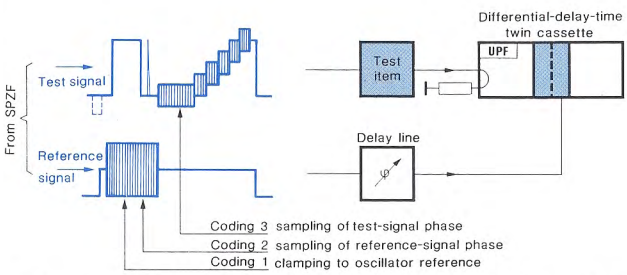
1. **Selection of the measurement instant** by setting the line delay relative to the normal test line. The usual values can be set on the front panel, while remote control permits flexibility of choice.

2. **Selection of the field** in which the measurement is to be made. If this circuit is to be used, a complete and identical group of test line signals must be present in the corresponding lines in both fields and all UPF test-parameter cassettes coded for measurement in the first field. Then it is possible to select with the front-panel switch or by remote control

measurement in the 1st field only,
measurement in the 2nd field only
or measurement in both fields,

and to make separate or joint measurements on the two heads of VCR systems.

Differential delay time This cassette permits the determination of the smallest delay differences between two video signals, such as the relative phase difference of a signal at different outputs of an amplifier or video-signal selector or the phase variation at the output of a video-signal selector when applying the same signal to different inputs (see diagram). It determines the phase difference between a reference signal and a test signal. Both signals must be obtained from the same, appropriately modified signal generator (e.g. SPZF). The measurement range is about ±10° with a resolution of 0.1° (indication range ±50°).

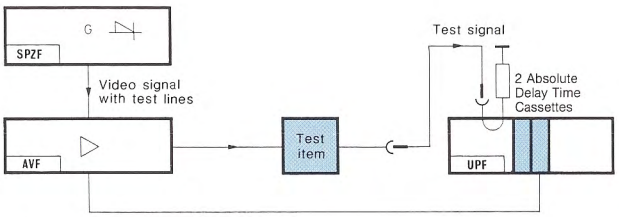


Measurement of differential delay time using Video Distortion Analyzer UPF (CCIR-330 test signal)

Differential phase 3/5, differential gain 3/5 During normal measurement of differential phase and gain, two maximum and minimum detectors determine the largest positive and negative deviation of the test result for all five treads in

line 330. Even with a distortion-free signal there is an indication of 1 to 2 digits through superimposed noise or slight differences in alignment. This indication can mask a real distortion of the same magnitude so that the difference between measurement with test item and measurement without test item does not yield a correct result. For this reason the modified cassettes evaluate only the third and fifth treads of line 330 relative to the baseline. When small distortions are measured, the relative error is only 1 digit.

Absolute delay time In widely branched studio signal paths it is important that all signals at the input of a switching device exhibit exactly the same basic delay time. To measure this delay (see diagram), the shift of the 20T pulse (LF or RF component) with respect to a reference signal is determined, this reference signal being applied to the UPF via a separate input. For this purpose, the UPF is fitted with the Absolute Delay Time Cassettes 1 and 2, permitting also measurement of the 20T colour subcarrier amplitude, 20T intermodulation and 20T group delay.



Block diagram of absolute delay-time measurement using Insertion Signal Generator SPZF (with Composite Signal Mixer), Video Distribution Amplifier AVF and Video Distortion Analyzer UPF with two Absolute Delay Time Cassettes

2T overshoot/undershoot Errors in the amplitude and group-delay response of a test item become apparent mainly through a change in the first undershoot or overshoot after the 2T pulse. Often the tolerances for these undershoots/overshoots are so narrow that peak-value measurement is not possible because of the superimposed noise interference. The cassette employing the sampling technique is primarily used in the laboratory for measuring small distortions according to the difference method (with and without item under test).

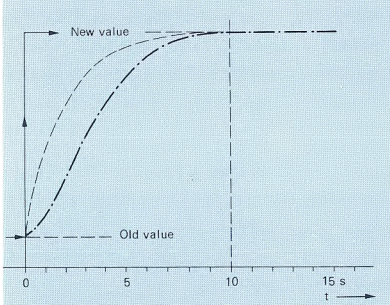
Noise voltage/residual subcarrier 4.43 MHz This twin cassette primarily measures the crosstalk between the non-selected inputs of a video crossbar distributor or a video signal selector into the output. A subcarrier signal of 700 mV_{pp}, for instance, must be present at the non-selected inputs.

50-Hz tilt Measurement of the 50-Hz tilt is the rule for practically all video equipment. Even as a "non-test-line parameter", this distortion can now be determined automatically and accurately to within 0.2% if the picture content consists of a 50-Hz squarewave containing white level from line 155 (467) to the end of the particular field. The tilt from the beginning (line 158 or 471) to the middle (232 or 545) and from the middle to the end (306 or 619) of the white region is evaluated and read out separately. Coding to different lines is possible.

For **further cassettes** see under ordering information.

Specifications

Input	75-Ω loop-through filter followed by differential amplifier	
Return loss	≥40 dB (up to 6 MHz)	
Common-mode rejection	≥50 dB (for hum of up to 6 V_{pp})	
Nominal input level	1 V_{pp} CVS ≙ 0 dB or 0.707 V_{pp} CVS ≙ −3 dB (local or remote switchover)	
Superimposed direct voltage	≤±6 V	
Input level range	V_{nom} ±6 dB (automatic control)	
Additional effect for	V_{nom} ±50%	+100/−50%
on 2T amplitude	<±0.3%	<±0.5%
on colour subcarrier amplitude	<±0.5%	<±1%
Synchronization	by sync component (also from line-repetitive signals)	
Modes	with/without SIS/external	
Min. sync pulse amplitudes for	V_{nom}: 0 dB	−3 dB
SIS off	≥100 mV	≥70 mV
SIS on (present or not)	≥150 mV	≥100 mV
Absence or presence of isolated sync pulses	no effect	
Permissible superimposed noise voltage (50 Hz, V_{nom} 0 dB, standard sync component)	≤100% of nominal picture-signal amplitude	
White noise	rms (unweighted) ≙	peak-to-peak
SIS off	27 dB	10 dB
SIS on (present or not)	30 dB	13 dB
Permissible noise voltages with external synchronization	much greater than above (however, with higher residual statistical fluctuations – see next column); upper limit depending on parameter	
Integration time	10 s	
Residual error after 10 s	max. 0.5% of magnitude of change	
Noise suppression	approx. 4 dB better than with RC integration	

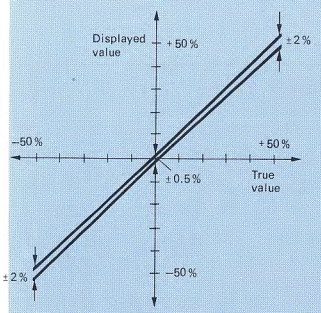


Transient response characteristic of UPF following a sudden change in the measured quantity (t = 0). With practically the same residual error (t = 10), the noise suppression of the UPF is about 4 dB better than with pure RC integration due to the horizontal shape at the beginning of the response characteristic

Special version with much shorter transient response time (for laboratory measurements)	5 s (3 s)
External DC measured values	
(eg for transmitter power, coolant temperature)	can be connected to all free parameter lines (max. 28)
Outputs	
Output for regulated video signal	test output (front panel)
Monitoring outputs	for oscilloscope; on the following cassettes: Intermodulation, Differential Gain, Differential Phase, Noise Voltage
Sync-pulse outputs	one on front and one on rear panel (Z_{out} = 75 Ω)
Trigger output	for oscilloscopes with no TV-sync facility (Z_{out} = 1 kΩ)
Trigger signal	25-Hz squarewave with field identification
Zero-reference trigger pulse output	for Nyquist demodulator
Output level	0 to +4 V into 75 Ω (or 0 to −4/0 to +1/0 to −1 V)
Digital outputs providing the signals (when equipped accordingly)	sum of limits – lower and upper limits, measured values not valid, no sync pulse or no field-sync component in sync signal, subcarrier on only four treads in line 330, CCVS carries SIS, burst missing, zero-reference pulse missing
Fan-out	min. 4 standard TTL loads or 10 LS TTL loads

Measurement accuracy of test-parameter cassettes

Parameter	Measurement range (display range)	Max. error ±1 digit At zero[1]	At end of range[2]	Noise suppression, mean-value shift and standard deviation[3] [4]
Luminance-bar amplitude	±50% (+100/−50%)	±0.25%	±0.5%	±0.2%
Tilt, streaking, rounding, baseline distortion	±25%	±0.35%	±2%	±0.3%
2T amplitude	±50%	±0.5%	±2%	+0.4 ±0.4%
Subcarrier 331	±50%	±1%	±2%	±0.35%
Intermodulation 331	±25%	±0.25%	±0.5%	±0.25%
Subcarrier 20T	±50%	±1%	±2%	−0.35 ±0.35%
Intermodulation 20T	±50%	±1%	±2%	−0.7 ±0.3%
Group delay 20T	±500 ns (±800 ns)	±5 ns	±10 ns	±4 ns
Differential gain	±50%	±0.35%	±3%	
DG 1				+1.2 ±1%[5]
DG 2				−1.2 ±1%
Max. (DG 1/2)				+1.8 ±0.7%
DG 1 − DG 2				+2 ±0.7%
Differential phase	±50°	±0.5°	±2°	
DPH 1				+0.4° ±0.3°[5]
DPH 2				−0.4° ±0.3°
Max. (DPH 1/2)				+0.7° ±0.3°
DPH 1 − DPH 2				+0.8° ±0.2°
Residual carrier	+5 to +15% −30 to +40%	±0.5% sign uncertain in range −5 to +5%	±0.5% ±2%	±0.25% ±0.25%
Luminance nonlinearity	50%	±1.5%	±3%	+1.2 ±0.8%[5]
Noise voltage	10 to 80 dB, inherent noise ≥78 dB down (rms weighted)	±1 dB (limited by inherent noise)		±0.1 dB (constant within range)
Sync-pulse amplitude	−50 to +90%	±0.5%	±2 to ±3%	±0.3%
Burst amplitude	−50 to +90%	±1%	±2 to ±3%	±0.1%; mean value shift ≤ ±1%
Hum	−6 to −60 dB (limited by inherent tilt)	±1 dB		±0.2 dB



Definition of tolerance for parameter Δ2T (2T amplitude)

[1]) The given error is valid over the entire temperature range with a moderate signal-to-noise ratio. The stability of the measured results is generally better than 1 digit over several measurement cycles. Additional statistical variations caused by a poor signal-to-noise ratio are given in the right-hand column of the table.

[2]) The measurement accuracy is fully defined by the maximum error at zero and at the range ends. The linear extension of the tolerance band throughout the entire range is illustrated by the diagram above.

[3]) The statistical residual variation refers to white noise and a signal-to-noise ratio of 27 dB (see left-hand column).

[4]) Mean-value shift and statistical variations reduce by a factor of approximately 2 for each 6-dB improvement in the signal-to-noise ratio.

[5]) Mean-value shifts which are due to large superimposed noise components in maximum or minimum value extractor circuits become insignificant when a true distortion of the same amount is present in the parameter being measured.

Measured-value output

DC voltage outputs . . . . . for each measured value (Z_{out} <100 Ω)
Output voltage . . . . . 100 mV ≙ 1%/1°/1 dB/10 ns
Digital outputs (BCD) . . . . . parameter number, measured value, out-of-tolerance signal; TTL levels
Digital output (ASCII, serial) . . . . . TTL levels or 20-mA loop (RS-232-C/V. 24 with cable 195.4551.02)
Transmission speed . . . . . 110 Baud (different values on request)
Output control . . . . . ext./low level (for cycle start)/computer

General data

Rated temperature range . . . . . 0 to +45 °C
AC supply . . . . . 98 to 127/187 to 250 V, 47 to 63 Hz (approx. 5 VA per cassette)
Dimensions, weight (1 cassette adapter, fully equipped)
19″ bench model . . . . . 484 mm×194 mm×509 mm, 23 kg
19″ rackmount . . . . . 483 mm×177 mm×499 mm, 19 kg

Ordering information

Order designation . . . . . ▶ Video Distortion Analyzer UPF

Subassembly or cassette	Type	Order No.	Remarks
Basic Unit; 19″ rackmount[1])	UPF	265.6511.04	
Gain Control[1])	UPF-E	266.0617.04	
Sync Separator[1])	UPF-E	266.1313.04	
Timing Program[1]) [2])	UPF-E	280.7315.02	
Luminance-bar Amplitude[1])	UPF-E	266.2310.04	
Luminance-bar Distortions	UPF-E	266.2810.02	
2T Amplitude	UPF-E	266.3316.02	
Subcarrier Amplitude	UPF-E	266.3816.02	
Intermodulation	UPF-E	266.4812.04	
20T Distortions	UPF-E	266.8818.02	
Differential Gain	UPF-E	266.5319.04	
Differential Phase	UPF-E	266.5819.04	double plug-in
Residual Carrier	UPF-E	266.6815.02	
Luminance Nonlinearity	UPF-E	281.0014.02	
Noise Voltage	UPF-E	266.8318.04	double plug-in
Sync Amplitude	UPF-E	280.7015.02	+int. timing program
Burst Amplitude	UPF-E	266.9614.02	
Digital Clock	UPF-E	280.9518.02	
Limit Monitor	UPF-E		
2×4 or 1×6 limits		266.4312.07	
Display Unit (A/D Convert.)	UPF-E	266.7311.02	
Second Cassette Adapter (extension)	UPF-Z	280.6019.04	
plus Distribution Amplifier[1])	UPF-E	280.9018.02	

[1]) Necessary basic equipment. [2]) With VIT delay switch.

New or modified cassettes

1.07-MHz Intermodulation	UPF-E	190.2638.02	
Absolute Delay Time 1	UPF-E	190.2650.02	
Absolute Delay Time 2	UPF-E	190.2573.02	
Noise Voltage/Crosstalk	UPF-E	190.3128.02	double plug-in
50-Hz Tilt	UPF-E	190.3134.02	
DC Measurement	UPF-E	190.3140.02	
Noise Voltage (measurement via external filters)	UPF-E	190.3686.02	double plug-in
Moiré	UPF-E	190.3992.02	double plug-in
2T Overshoot/Undershoot	UPF-E	190.4082.02	
Noise (with filter switchover and setup capability)	UPF-E	190.4160.02	
PM Noise	UPF-E	190.5843.02	for chroma noise measurement
AM Noise	UPF-E	190.5850.02	for chroma noise measurement
PM Demodulator	UPF-E	190.5866.02	for chroma noise measurement
AM Demodulator	UPF-E	190.6872.02	for chroma noise measurement
Differential Delay Time	UPF-E	195.4480.02	double plug-in
Frequency Response 0.2 MHz	UPF-E	195.5929.02	
Frequency Response 1 MHz	UPF-E	195.4500.02	
Frequency Response 1.5 MHz	UPF-E	193.0707.02	
Frequency Response 2 MHz	UPF-E	195.4516.02	
Frequency Response 3 MHz	UPF-E	193.0120.02	
Frequency Response 4 MHz	UPF-E	195.4522.02	
Frequency Response 4.8 MHz	UPF-E	195.5058.02	
Frequency Response 5.8 MHz	UPF-E	195.5064.02	
Differential Phase 3/5	UPF-E	195.5558.02	
Differential Gain 3/5	UPF-E	195.5564.02	
Hum	UPF-E	280.7615.04	
Programmable Measurement Instant	UPF-E	280.7915.02	
Videotext	UPF-E	394.7613.02	

Accessories supplied

2 Terminations RMF 2, adapter (for servicing and repair), power cord; four additional connecting cables for the second cassette adapter

Recommended extras

Distortion Network UPF-Z 230.5119.00 (for UPF performance checking)
19″ Cabinet UPF-Z 103.8510.02
IEC-625 Interface UPIF 231.2813.03

UPIF

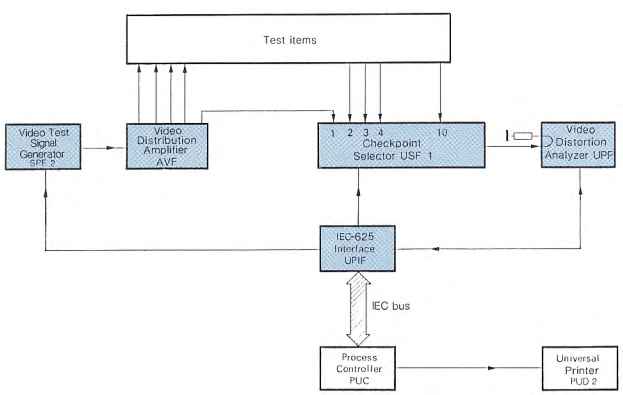
IEC-625 Interface UPIF ♦ for UPF, USF 1 and SPF 2

- Local/remote switchover of measuring instruments
- UPF:
  Mode selection (eg filter, test line shift, ext. synchronization)
  Parameter selection
  Callup of status and measured values
- USF 1:
  Checkpoint selection
- SPF 2:
  Signal selection

Photo: UPIF (centre) with Process Controller PUC

IEC 625 Bus

The **IEC-625 Interface UPIF** permits the Video Distortion Analyzer UPF to be used in conjunction with the Checkpoint Selector USF 1 and model 09 or 59 of the Video Test Signal Generator SPF 2 in an IEC-bus-controlled test system (interface to IEC 625-1 and IEEE 488). When using computers, the corresponding basic software makes it easy to write the required test program (see Section 4).



Block diagram of test setup using UPIF for automatic device testing

Basic software is available for the following computers:
Process Controller PUC (see R&S measuring equipment catalog)
4051 and 4052 from Tektronix
9835 and 9826/9836 from HP

Specifications

Interface	to IEC 625-1 and IEEE 488
Data inputs/outputs	40 lines each (eg 10×4 bits each)
Additional control lines	10 each
Levels	TTL (+2.4 to +5 V/0 to −0.5 V)
Connectors	
IEC bus	Amphenol 57-20240 (24-contact)
Data inputs/outputs	1 Amphenol 57-20500 (50-contact) each

General data

Rated temperature range	+5 to +45 °C
Operating temperature range	0 to +50 °C
Storage temperature range	−20 to +70 °C
Power supply	115/230 V ±10%, 47 to 63 Hz (40 VA)
Dimensions, weight	
½ of 19″ unit	216 mm×88 mm×286 mm, 2.7 kg
in 19″ cabinet	484 mm×105 mm×336 mm, 5.3 kg

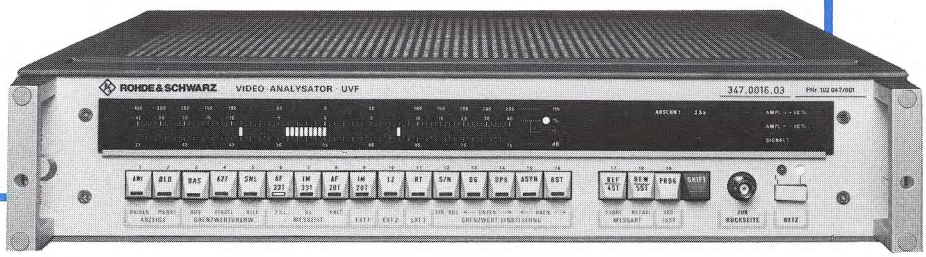
Ordering information

Order designation	▶ IEC-625 Interface UPIF 231.2813.02
Panelling	231.3032.03
Connecting cables	
for UPF/USF 1/SPF 2 . UPF-Z ...	265.7630.03
for UPF/USF 1 . . . . . UPF-Z ...	265.7430.03
for SPF 2 . . . . . SPF 2-Z ...	212.9180.03
IEC-bus Cable PCK, 0.5 m	292.2013.05
1 m	292.2013.10
2 m	292.2013.20
4 m	292.2013.40
Basic software for	
PUC from R&S	231.4022.03
4051/4052 from Tektronix	231.4028.03
9835/9826/9836 from HP	231.4034.03

Video Analyzer UVF ♦ 16 parameters

UVF

- Input level: 1 V (standard level) or 0.707 V
- 81-LED bar
- Integration time: 2.5 or 5 s
- Limit value monitoring
- 4 sampling programs
- Standard B/G, M



IEC 625 Bus

The **Video Analyzer UVF** is used for automatic evaluation of insertion test signals and thus for monitoring TV distribution and transmission equipment through to complete transmitter networks. For system use it is fitted with an IEC-bus interface (IEC 625-1/IEEE 488) permitting **remote control of all functions.**

In contrast to the high-precision Video Distortion Analyzer UPF (see preceding pages) which, due to its modular design, is adaptable to any measurement task, the UVF has **16 fixed test parameters.** This feature combined with operating convenience, the possibility of limit value monitoring and an easy-to-read novel LED bar display make it an ideal tool for video measurements.

Test line parameters The following key-selected test parameters complying with CCIR Rec. 569-1 and EBU Specifications D34-1982, D35-1982 and Tech 3216 can be measured (list below corresponds to key layout):

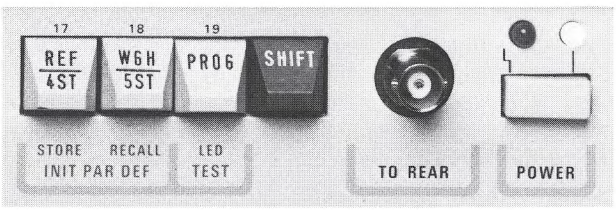
luminance bar amplitude
base line distortion
tilt
2T amplitude
line-time (staircase)
nonlinearity
colour subcarrier 331
intermodulation 331
colour subcarrier, 20T pulse
intermodulation, 20T pulse
chrominance-luminance delay
residual picture carrier
noise voltage
differential gain
differential phase
sync pulse amplitude
burst amplitude

In addition, three inputs are provided for external DC voltages (parameters).

Parameters, such as the 2T undershoot and 1.07 MHz intermodulation can be measured using additional UVF models (see ordering information).

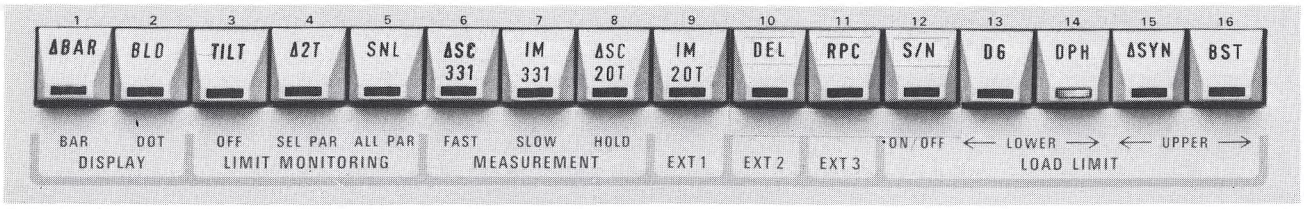
Measurement of nonlinear distortion Either 4 or 5 steps of the staircase signal can be evaluated for measuring the differential gain and phase. Simultaneous display of the positive and negative deviations facilitates limit monitoring and permits assessment of amplitude and phase characteristics. Moreover, it is possible to read the values as peak or peak-to-peak deviation.

Reference value The reference for the measurement of noise voltage, sync pulse amplitude and burst amplitude can be switch-selected between the nominal value and the actual signal level (luminance bar). It is possible to separately define the setting of each of the three parameters just like the insertion of the S/N weighting filter.



Keys for selecting the sampling programs and parameter-dependent additional functions (called up with SHIFT key); the socket can be connected to a rear-panel input or output

Operation The operation of the UVF is simple and clear. Each parameter is selected by a key of its own provided with an acknowledgment LED (photo below). This affords optimal operating convenience. Messages applicable to specific parameters light up only if they are required. Alarm LEDs indicate signal absence or wrong test lines. Thus all the important information is available at a glance. The second functions of the parameter keys (measurement mode, limit setting, external and selective/all limit monitoring) are enabled after using the SHIFT key (see above). This makes operation easy and helps to avoid operational errors.



Keys for selecting 16 fixed parameters and parameter-independent additional functions

Video Analyzer UVF (continued)

Sampling programs A choice of four customer-specific sampling programs is available determining in which line and at which point each of the selected parameters is to be measured. A specific set of limit values is associated with each sampling program. This permits measurements on source and sectional test lines (CCIR signals and national signal variants) or with different timing (10T instead of 20T pulse) or in the full field (e.g. measurement of video heads in VTRs). For examples see the specifications.

Inputs and outputs The UVF has two 75-Ω test inputs. One input is provided for a standard level of 0 dB and the other for test points whose level is reduced by 3 dB, such as after passive cable equalizers. A monitoring output permits the measured video signal to be observed on an oscilloscope. One of these rear-panel ports can be connected to a socket on the front panel.

Filters and demodulators to CCIR Rec. 567-1 are included in the UVF. The luminance parameters are measured with the aid of a 300-ns Thomson lowpass filter, all chroma parameters by way of a subcarrier filter and rectifier. The noise voltage is determined via a 5-MHz lowpass filter and a colour subcarrier trap; a CCIR filter can be switched in. The 2T amplitude is measured via a peak-responding rectifier and the differential phase by way of a phase demodulator.

Integration time An important advantage is the short filter integration time: 2.5 s after application of the test signal, all the results are steady. A switch-selected integration time of 5 s causes the fluctuations of the luminous bar to be dampened if the video signals are extremely noisy. In the case of intermittent disturbances, the instantaneous state of all parameters measured can be frozen in the hold mode.

Display The measured value is displayed along an 81-LED bar (see photo below) whose scaling is nonlinear offering the following advantages:

- **Simultaneous display of positive and negative measured values** in the case of differential phase and gain
- Constant relative accuracy along the entire scale with **higher resolution about zero** due to expansion
- **Insertion** of limit value markers
- Easy recognition of **tendencies and variations** of the measured value (important for alignment)
- **Reading accuracy** same as for a digital readout

Switchover from bar to dot display is possible.

Tolerance monitoring All the measured values can be checked for selectable upper and lower tolerance limits which are displayed along the LED bar together with the measured value. Specific limit values can be set for each sampling program. These values are stored in EEPROMS and thus protected in the case of loss of power.

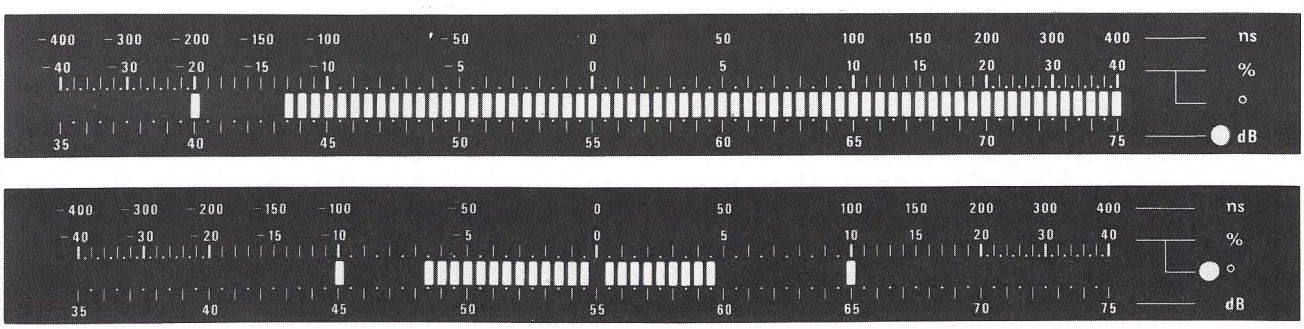
While one parameter is being displayed, all the other parameters can be checked for adherence to the set tolerances. If one of these parameters goes out of tolerance, the LED in the associated parameter key starts to blink.

Grounding To ensure DC isolation of the video and IEC-bus grounds, the analog section and the microprocessor are connected by way of optocouplers. Normally these two grounds are taken to the safety earth contact by links on the rear panel of the instrument. When these links are removed – while duly observing the safety regulations – it is possible to perform measurements at different system ground levels without producing hum pickup.

Principle of operation The measured values are obtained by sequential sampling of the video signal at the points which are required for calculating the individual parameters (in contrast to the UPF with sample-and-hold circuits for each test point). A **microprocessor** is used for control.

A track-and-hold amplifier performs the actual **sampling** of the video signal. The sampling procedure is controlled by the sampling program, the position and sequence of the sampling points being stored in two EPROMs. By exchanging the two chips, the sampling program can be adapted to specific measuring tasks. The execution of the sampling program is synchronized by the sync separator which features high immunity to noise voltages and also handles video signals with SIS or TV-PCM2 sound pulses.

All the points required for calculating the whole set of parameters are sampled within a cycle which consists of two frames. From the individual values found during 64 consecutive frames the processor determines all the **measured values,** which are **continuously updated.** With the frame duration of 40 ms, the resulting integration time is 2.56 s. Since all the measured values are continuously available, no additional time is required for integration when changing over to a different parameter.



Display of noise voltage (top) and differential phase (bottom) with limit values

A high-speed **arithmetic processor,** whose functions are driven by the main processor, is used to perform the mathematical calculations. This multiprocessor system makes possible the short measuring times in spite of digital signal processing and thus affords the great operating convenience of the UVF.

Specifications

Input signal

Nominal level 0 dB . . . . . 1 V_{pp} } CCVS into 75 Ω
−3 dB . . . . . 0.707 V_{pp} }
Level range . . . . . nominal ±50%
Permissible S pulse deviation . . . . . +100/−50% from nominal
SIS and TV PCM2 . . . . . permissible

Measurement accuracy, ranges

Parameter	Key label	Measurement range	Max. measurement error ±½ digit at zero	at range limits
Luminance bar amplitude	ΔBAR	±40%	<±0.8%	<±1%
Base line distortion	BLD	±40%	<±1%	<±1.5%
Tilt	TILT	±40%	<±1%	<±1.5%
2T amplitude	Δ2T	±40%	<±1%	<±2%
Line-time (staircase) nonlinearity	SNL	±40%	<±1.5%	<±3%
Colour subcarrier 331	ΔSC 331	±40%	<±1%	<±2%
Intermodulation 331	IM 331	±40%	<±1%	<±1.5%
Colour subcarrier 20T	ΔSC20T	±40%	<±1.5%	<±2.5%
Intermodulation 20T	IM20T	±40%	<±1%	<±1.5%
Delay	DEL	±400 ns	<±10 ns	<±15 ns
Residual picture carrier[1])	RPC	±40%	<±0.8%	<±1.5%
Noise voltage	S/N	35 to 75 dB	<±1.5 dB[3])	<±1.5 dB[3])
Differential gain[2])	DG	±40%	<±3%	<±3%
Differential phase[2])	DPH	±40°	<±1°	<±3°
S-pulse amplitude	ΔSYN	±40%	<±1%	<±1.5%
Burst amplitude	BST	±40%	<±3%	<±5%

Residual picture carrier
Error at nominal +10% . . . . . <±0.8%
Noise voltage
Measurement mode . . . . . rms
Filters . . . . . 200-kHz highpass filter and video f_{outoff} lowpass filter, built in
Weighting filter . . . . . disconnectable
Colour subcarrier trap . . . . . can be connected internally
Reference value (switch-selected) . . . . . 700 mV (NOM) luminance bar (SIG)
Inherent S/N ratio (unweighted) . . >74 dB
Differential gain
Evaluation (switch-selected) . . . . . 5 or 4 steps
Differential phase
Evaluation (switch-selected) . . . . . 5 or 4 steps
S-pulse amplitude
Reference value (switch-selected) . . . . . 300 mV or 3/7 of luminance bar
Burst amplitude
Reference value (switch-selected) . . . . . 300 mV or 3/7 of luminance bar

Parameter selection

16 parameters . . . . . by keys with acknowledgment LEDs
3 external parameters (DC measured values) . . . . . by keys, second functions after SHIFT

Output of measured values

Display . . . . . 81-LED row
Resolution
Range 0 to ±10%/° . . . . . 0.5%/0.5°
±10 to ±20%/° . . . . . 1%/1°
±20 to ±40%/° . . . . . 2%/2°
0 to ±100 ns . . . . . 5 ns
±100 to ±200 ns . . . . . 10 ns
±200 to ±400 ns . . . . . 20 ns
over entire dB range . . . . . 0.5 dB
Reading error . . . . . ±½ digit

Sampling programs[4])

Number . . . . . 4, with separate setting of limit values and mode for parameters S/N, DG, DPH, ΔSYN and ΔBST
Selection . . . . . by PROGR key
CCIR/LIM 1 . . . . . eg source test line, line tolerances or inner limits
CCIR/LIM 2 . . . . . eg source test line, transmitter tolerances or outer limits
CCIR/LIM 3 . . . . . eg source test line, tolerances for international transmissions
CCIR/LIM 4 . . . . . eg source test line, studio tolerances

Special functions

Selection . . . . . by way of second functions
Display mode . . . . . bar, dot
Limit value monitoring . . . . . OFF/SEL PAR/ALL PAR
SEL PAR . . . . . indication for selected parameter
ALL PAR . . . . . indication for selected parameter, monitoring of all other parameters, LED blinks in the out-of-tolerance parameter key
Measuring time
FAST . . . . . approx. 2.5 s
SLOW . . . . . approx. 5 s
HOLD . . . . . updating of measured values interrupted; all the measured values from the preceding test cycle can be selected as often as required
Limit value setting . . . . . the LOWER and the UPPER limit values can be varied separately for each parameter in each sampling program
Monitoring output . . . . . for video signal

Messages

WAIT . . . . . wait period until first the sampling cycle is terminated, eg after HOLD or new sampling program
REM, SRQ, LIS, TAL . . . . . IEC bus status messages
SIGNAL? . . . . . no CCVS available for evaluation
AMPL >+50% and AMPL <−50% . . . . . the input signal is not within the measurement range; the figures refer to the ΔBAR readout (departure from nominal)
L_I . . . . . interruption (failure) of the low voltage supply, e.g. blown fuse or shortcircuit

IEC bus . . . . . interface to IEC 625-1 (IEEE 488), connector: 24-contact Amphenol, functions: SH1, AH1, T6, L4, SR1, RL1, DC1, DT1

General data

Rated temperature range . . . . . +5 to +45 °C
Power supply . . . . . 220 V ±10%, 47 to 63 Hz (70 VA), safety class I
Connectors . . . . . BNC; the front-panel port can be used as input or monitoring output
Dimensions, weight
19″ bench model . . . . . 492 mm×116 mm×514 mm, 9.4 kg
19″ rackmount . . . . . 483 mm×88 mm×506 mm, 7 kg

Ordering information

Order designation . . . . . ▶ Video Analyzer UVF

Model	Sampling program	19″ bench model
B/G (front panel)	Standard (German)	347.0016.03
B/G (front panel)	CCIR (English)	347.0016.04
B/G	Custom-tailored	822.2026.XX
1.07 MHz intermodulation	Custom-tailored	822.2032.XX
2T undershoot	Custom-tailored	822.2049.XX
D/K	Custom-tailored	822.2055.XX
M	Custom-tailored	822.2255.XX
M (NTSC)	4 × NTC-7	824.9511.04

Accessories supplied

Power cord, 9-contact female connector with hand guard and locking device, 75-Ω connecting cable, spare fuses

Recommended extras

IEC-bus Cable PCK (2 m) 292.2013.20

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[1]) Measurement possible only in the presence of a zero reference pulse whose timing corresponds to the programming of the UVF.
[2]) The maximum positive and negative deviations are simultaneously displayed along the LED bar. This facilitates limit value monitoring and approximation of the amplitude and phase characteristics. It is possible to read the values as the positive, negative, peak and peak-to-peak deviation without any switchover.
[3]) Constant over the entire display range.
[4]) The sampling programs are given as examples. National and custom-tailored sampling programs are possible.

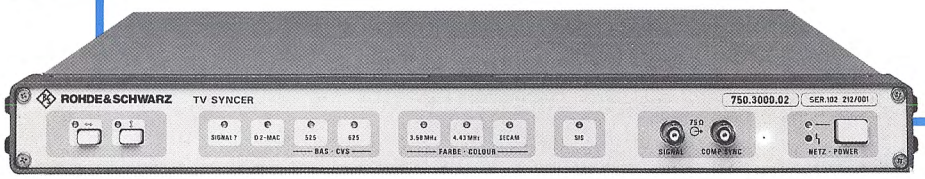
TV SIGNAL IDENTIFICATION

new

SYNCER

TV Syncer ♦ D2-MAC/CCVS signals

- Identification of TV standard
- Sync pulse generation from the input signal for display on monitors



The **TV syncer** for signals to D2-MAC PACKET standards (ie without sync pulses) and for (C)CVS signals identifies both the **television standards** of the incoming signal and the **colour transmission system** and supplies a standardized sync signal for driving monitors and oscilloscopes. It is also used for monitoring and synchronization in day-to-day operation and for all kinds of laboratory applications.

Display The TV syncer uses LEDs on the front panel to indicate the detected television standard and, in the case of CCVS signals, the colour transmission system in use, PAL, SECAM or NTSC. It also provides information whether there are SIS (sound in sync) sound pulses. All information on display is presented to a **parallel data interface** on the rear panel.

Synchronization The TV syncer supplies a **standardized sync signal** with both a D2-MAC signal and a CCVS signal of 625 or 525 lines. This means that a television still frame can be displayed on a monitor. The signal can then be passed on to the monitor via the loop-through filter input of the TV syncer. The still frame is also applied clamped to the **signal output.**

Monitors without sync inputs can be driven by the **monitor output** of the TV syncer. The output signal contains the sync pulses with front and back porch which are inserted into the D2-MAC signal. This means that the monitor can clamp the black level correctly so that no brightness fluctuations caused by the picture contents can occur.

Two keys are used to **shift** the generated **sync signal** by half a line and half a frame with respect to the television signal. On the monitor, the horizontal and vertical blanking intervals are then seen with CCVS signals, whereas the data burst and the data line 625 can be seen for D2-MAC signals.

In addition to the complete sync signal, the video- and line-frequency sync pulses are available separately for **triggering the oscilloscope.**

Specifications

Input	loop-through filter (rear panel)
Return loss (up to 8.5 MHz)	≥34 dB
Input signal	video signal of 625 or 525 lines or D2-MAC signal
Level	V_{pp} = 1 V ±50%
Colour system with CCVS signal	PAL or SECAM with 625 lines NTSC with 525 lines
Sync level with CCVS signal	300 mV +100/–50%
Sound in sync	permitted with CCVS

Signal outputs	one each for CCVS and D2-MAC signal on front and rear panel; 75 Ω	
Level	input signal level ±0.3 dB	
Clamping for CCVS	sync level = –300 mV	
D2-MAC	nominal black level = –300 mV	
Frequency response 0 to 5 MHz	±0.2 dB	
>5 to 10 MHz	±0.5 dB	
Stat. non-linearity	≤1.5%	
Differential phase	≤±0.5°	
Monitor output	rear panel; 75 Ω	
Output signal	input signal with inserted blanking and sync pulses	
Level		
CCVS (without sync pulse shift)	as for input signal level	
D2-MAC or CCVS with sync pulse shift	0.7 × input signal level	
Blanking	using a blanking signal matching the composite sync signal in time	
Sync pulse level	0.3 V	
Time position	as for composite sync signal	
Sync pulse outputs	3	
Composite sync signal	with CCVS and D2-MAC	
Level	V_{pp} = –2 V at 75 Ω	
Position with D2-MAC		
Sync leading edge	1.3 µs after first data burst bit	
V leading edge	start at line 1	
Shift	composite sync signal can be shifted with regard to input signal	
ΔH with CCVS	0.5 lines	
D2-MAC	19 µs	
ΔV with CCVS	0.5 V periods	
D2-MAC	156 lines	
H trigger signal	square-wave pulse	
Period length	1 line	
Level	V_{pp} approx. 2.5 V	
	neg. edge	pos. edge
Position at CCVS	line start	line centre
D2-MAC	0.5 µs before first data burst bit	0.3 µs before start of clamping period
V trigger signal	square-wave pulse	
Period length	1 frame	
Level	V_{pp} approx. 2.5 V across 75 Ω	
	neg. edge	pos. edge
Position (line start)		
with 625 lines	line 623	line 311
525 lines	line 1	line 263
D2-MAC	line 623	line 311
Signalling outputs	for D2-MAC, 625 lines, 525 lines, 4.43 MHz, 3.58 MHz, SECAM, SIS, signal error	
Level	TTL, open collector, active low	

General data

Nominal temperature range	+5 to +45 °C
Operating temperature range	0 to +50 °C
Power supply	100/120/220/240 V ±10%, 47 to 63 Hz (30 VA)
Dimensions (W×H×D) and weight	435 mm× 59 mm× 460 mm, 5.5 kg

Ordering information

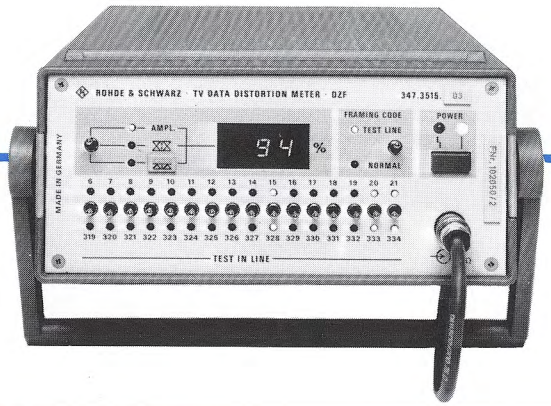
Order designation	▶ TV Syncer 750.3000.02

TV Data Distortion Meter DZF

DZF

♦ 25 to 100% eye height

- Measurement of eye height, half-eye height and amplitude of teletext signals
- Measurement in up to 16 switch-selected lines per field
- Outputs for display of eye pattern and for connection of printer



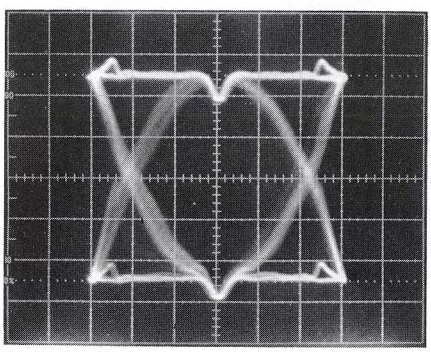
The **TV Distortion Meter DZF** measures the so-called eye height and the amplitude of **teletext signals.** Thus, for the first time, unambiguous quality criteria for teletext signals can be determined by objective and repeatable measurements. This is of special importance for instance at transfer points between systems run by the broadcasting corporations and those of the postal authorities as well as for final inspection in decoder module production.

Eye height If, with the appropriate expansion of the time axis, digital signals are overlaid in an oscillogram such that a high and low level are displayed at the same point, an "eye" is produced. The eye height is a measure of the transmission reliability of a digital data stream; it decreases with increasing signal distortions. It is defined as the difference between the lowest of all high levels and the highest of all low levels.

Eye height measurement The DZF measures the eye height in the middle of the teletext bits within an accurately defined window and indicates the result in %. Compared with normal display on an oscilloscope, meaningful assessment of the distortions is possible thanks to the special processing of the eye pattern. To recognize limiting effects in the data signals, half the eye height can be measured (between half the data signal amplitude and the high or low level).

Amplitude measurement In this mode, the DZF measures the amplitude of the teletext signal referred to the nominal value of 66% picture signal.

Test procedure The teletext signal is controlled to 2 V_{pp}, the reference being the mean DC value of the clock run-in signal and the third of at least five consecutive low levels. The test window is synchronized with the teletext signal after some high-low level alternations. The measurement starts as soon as the framing code has been recognized in the teletext signal and ends after further 333 bits or if more than 14 consecutive 1s or 0s are detected.



Eye pattern (eye height 100%)

Specifications

valid for 625-line systems with 6.9375 MHz clock frequency

Input level range	66% picture signal = 462 mV (teletext nominal level) +6/−3 dB
Input impedance	75 Ω
Return loss	≥40 dB up to 10 MHz
Measurement modes	eye height/half eye height/amplitude
Eye height measurement range	25 to 100%
Measurement error for indication ≥60%	1% ±1 digit
<60%	2% ±1 digit
Half-eye height measurement range	15 to 50%
Measurement error for indication ≥35%	1% ±1 digit
<35%	2% ±1 digit
Test window	14.4 ns
Amplitude measurement range	64 to 190% (up to 210% as indicator)
Resolution	2%
Measurement error in range 64 to 86%	2% ±2 digits
86 to 120%	1% ±2 digits
120 to 190%	2% ±2 digits
Indication for teletext signal being too small	Err
for signals >190%	Err/measured value/Err/ ... (alternating)
Change of mode	display is dark or signals Err or Err is blinking
Test signal	
Line selection	measurement in up to 16 lines per field possible simultaneously
Selectable lines	1st field: 6 to 21 2nd field: 319 to 334
Framing code (switch-selected)	
for test line	1111 1111 (fixed)
for normal teletext lines	free coding (factory-set to 1110 0100)
Measurable signals	Teletext, Ceefax, Oracle, Antiope, Telidon; data line
Outputs	
Eye pattern display	BNC
Y output	1 V into 75 Ω; measured teletext signal with identification of measurement timing
X output	1 V into 75 Ω; sine voltage with ¼ f_{clock}
Z output (unblanked)	TTL levels
Teletext signal	TTL levels; 15-contact female connector
Measured value	BCD (with data-valid pulse); 15-contact female connector
General data	
Rated temperature range	+5 to +45 °C
Storage temperature range	−20 to +70 °C
AC supply	110/120/220/240 V +10%/−15%, 47 to 63 Hz (30 VA), safety class 1 (VDE 0411 or IEC 348)
Overall dimensions (without stand), weight	210 mm×110 mm×349 mm, 4 kg

for the measurement of one line per full field

Ordering information

Order designation	▶ TV Data Distortion Meter DZF
625 lines, 6.9375 MHz	347.3515.03
525 lines, 5.727272 MHz	347.3515.13
Model for Antiope/Didon	347.3515.04

Recommended extras

VITS Generator and Inserter SKF 347.1212.06

TELETEXT MEASUREMENT/INSERTION SIGNAL TESTING

ATF

Digial Teletext Analyzer ATF

Seven teletext parameters

- Measurement of any TV line
- 16-bit microprocessor
- Frozen or continuous signal display
- IEC-bus or RS-232-C interface
- Limit value monitoring
- Nonvolatile storage of operating states
- Remote measurement and data transmission via telephone network

IEC 625 Bus

The **Digital Teletext Analyzer ATF** is an extremely versatile instrument designed to assess, measure and monitor teletext and test signals. The ATF may be manually operated with a fast response time for use in laboratory and servicing applications and is suitable in its automatic mode for quality monitoring and data logging. Its digital line memory means that it can test and analyze each of the 625 teletext lines using a 16-bit microprocessor.

A special kind of video sampling also allows an expanded **continuous or frozen display** of the selected TV line or a linear eye diagram on a simple oscilloscope.

Remote measurement and result logging are possible in the automatic mode via an IEC-bus or RS-232-C interface (master-slave operation via the IEC bus).

Application The Digital Teletext Analyzer ATF can be used wherever the teletext clock frequency is 6.9375 MHz. Models for systems with different clock frequencies are being prepared. The Digital Teletext Analyzer ATF is based on the NEMESIS development (Numerical Eye Measuring Equipment for Surveillance of Insertion Signals).

Operation Permanently assigned keys are used for parameter and line selection. The activated keys are displayed by pilot lamps on the keypad module. All functions can be remote-controlled.

Display The test results are shown on an alphanumeric display (7 × 5 point matrix) for the selected line (see illustrations on page 129). Not only measured values but also messages can be displayed. Error and status reports are shown as a fluorescent display.

Input and outputs The ATF is fitted with two switch-selected 75 Ω signal inputs for the video signal to be measured. An oscilloscope can be connected to the 75 Ω slow video signal output for an expanded display of the signal and eye diagram. An output on the front panel is used for triggering.

Measurement possibilities of the ATF:

- decoding margin (eye height)
- timing margin (eye width)
- basic amplitude (teletext amplitude)
- peak-to-peak amplitude
- data timing (start of data code)
- number of run-in bits
- parity error rate
- signal-to-noise ratio and
- ITS bar amplitude.

Reference values The ATF accepts four different framing codes (start code in a teletext line) which are freely selectable.

Reference level The white level is used as a reference level for measuring the teletext and peak-to-peak amplitude. Other reference levels can be set.

Basic setting The position of the teletext, test and noise voltage test lines in addition to the four requested framing codes are stored power-failure-proof.

Noise voltage measurements are possible in any line for coarse-checking the noise influence on the teletext parameters. The white level or nominal value of 700 mV forms the reference value.

Limit value monitoring All test parameters can be monitored with any selectable lower and upper limit values. The limit values can be stored power-failure-proof. When the limit values of all parameters are monitored, the ATF sequentially measures all parameters, checks the limit values and sends the corresponding alarm signals.

Expanded continuous or frozen displays can be shown from any line on an oscilloscope (slow video expansion factor: 256).

Video function: analog-reproduced 8 bit signal (including sync pulse and burst); the level of precision is sufficient for in-service measurements, and the possibility of remote signal transmission via the telephone line makes this function particularly attractive.

Eye function: bright eye diagram with markers which can be inserted at the centre of the data bits.

TELETEXT MEASUREMENT/INSERTION SIGNAL TESTING

Specifications

Inputs and outputs

Test inputs
- Number: 1, front/rear panel, switch-selected
- Input impedance: 75 Ω
- Input level: CCVS, 1 V ±10% for full-measuring accuracy, 1 V +15/−40% with half the measuring accuracy (S/N >50 dB)
- Sync pulse level: 300 mV, +50/−30%

Slow video outputs
- Number: 2, front/rear panel
- Waveform: video signal slowed down by a factor of 256 for eye pattern display
- Display: continuous or frozen
- Level: input level ±2%
- Output impedance: 75 Ω

Trigger outputs
- Number: 2, front/rear panel
- Waveform: positive-going pulse, approx. 10 µs for video signal; 27 kHz for eye pattern
- Level: TTL
- Output impedance: approx. 1 kΩ

Test outputs
- Number: 7 (input signal, sync pulse, clamping pulses)

Parameters

Number of selectable parameters: 9 (7 teletext parameters, S/N ratio, ITS bar amplitude)

Selection: direct, from keyboard

Decoding margin (eye height)
- Measurement range: 100 to 0%
- Referred to nominal level or bar amplitude: 150 to 0%
- Error: ±2% from 150 to 20%, ±4% from 20 to 0%

Timing margin (eye width)
- Measurement range: 100 to 0%
- Error: ±2% from 100 to 20%, ±4% from 20 to 0%

Basic amplitude
- Measurement range: 60 to 150%
- Error: ±5%

Peak-to-peak amplitude
- Measurement range: 0 to 200%
- Error: ±5%

Data timing (start of data code)
- Measurement range: 10.0 to 14.0 µs
- Error: ±0.1 µs

Number of run-in bits
- Measurement range: 6 to 24 bits

Error rate
- Measurement range: −30 to −70 dB corresponding to a parity error rate of 1×10^{-3} to 1×10^{-7}

S/N ratio
- Measurement mode: rms, unweighted
- Measurement range: 24 to 50 dB
- Error: ±1 dB

ITS bar amplitude: additional parameter, limit monitoring not possible
- Measurement range: 60 to 115%; underranging or overranging causes NO ITS message to appear and sync pulse amplitude to be displayed
- Error: ±2%

Error of indication: ±1 digit

Test conditions

Reference value (selectable):
a) ITS bar amplitude. When no ITS pulse is available, line sync pulse amplitude is used as the reference, index I = ITS
b) nominal signal level (462 mV for teletext signal, 700 mV for noise voltage), index N = nominal
c) teletext level (for decoding margin and peak-to-peak amplitude only), corresponds to basic amplitude, index T = teletext

Test lines: lines for teletext signal, noise voltage measurement and reference test line can be selected

Framingcode (start code in a teletext line): 4 different framing codes can be selected

Limit value monitoring: for each specific parameter or all 8 parameters; disconnecable; limit monitoring not possible for additional parameter "ITS bar amplitude"
- Alarm: for specific parameter by limit LED, otherwise by blinking of parameter LED

Limit value setting: an upper and a lower can be set separately for each parameter

Data interfaces

IEC bus: interface to IEC 625-1 (IEEE 488)
- Connector: 24-contact, Amphenol

RS-232-C
- Baud rate: 150, 300, 600, 1200, 2400, 4800, 9600
- Mode: synchronous/asynchronous, selectable
- Connector: 25-contact, Cannon

General data

Rated temperature range: +5 to +45 °C

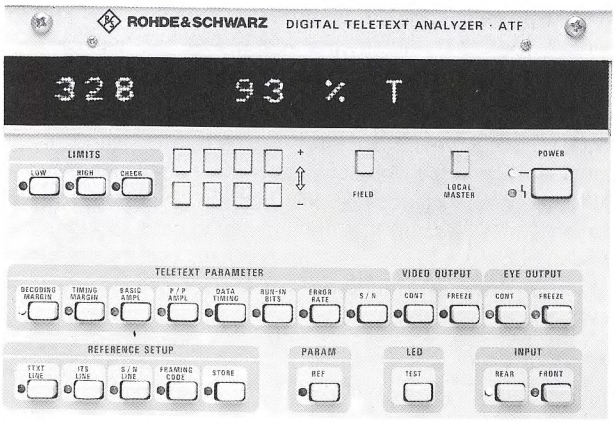
Operating temperature range: 0 to +50 °C

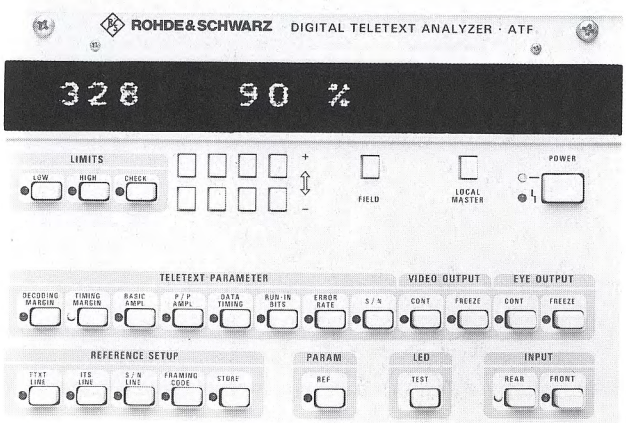
AC supply: 100/120/220/240 V ±10%, 47 to 63 Hz (approx. 95 VA)

Dimensions, weight
- 19″ bench model: 483 mm×177 mm×506 mm, 19 kg
- 19″ bench rackmount: 492 mm×205 mm×514 mm, 17 kg

Ordering information

Order designation	▶ Digital Teletext Analyzer ATF 19″ bench model
ATF basic unit with ADC rackmount	0377.8015.04
ADC rackmounth ATF-E for	
British Teletext and RAI Teletext	0842.5508.04
NABTS, WST and Japan Teletext	0842.5508.05
Antiope, Didon	0842.5508.06
Standard B/G, data line	0842.5508.07



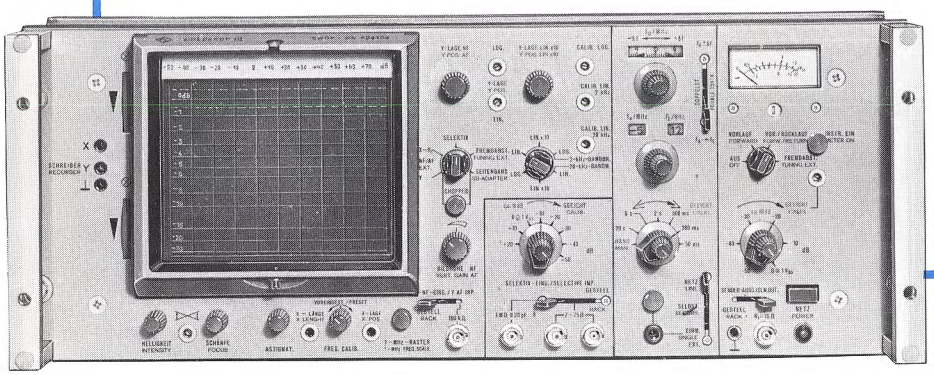


ATF displays when measuring the decoding margin (eye height, left) with the teletext level as the reference value (index T) and the timing margin (eye width, right) in TV line 328

SWOF 3

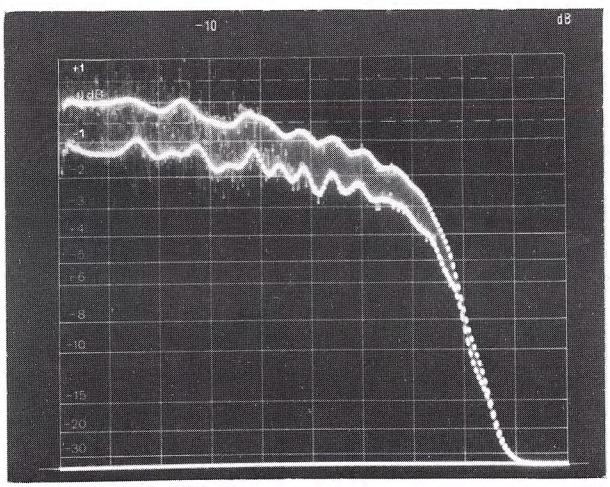
Videoskop SWOF 3 ♦ 10 kHz to 20 MHz

- Fully transistorized combination of video sweep generator, selective receiver and display unit
- Signals down to 10 μV_{pp} (or −100 dB) can be measured
- Double sweep control and chopper circuit for simultaneous display of two input signals



The **Videoskop SWOF 3** is the main unit of test setups measuring amplitude-frequency response and gain of four-terminal networks, the evaluation of voltages down to 10 μV_{pp} being possible. The sweep generator together with the receiver permits **swept-frequency measurements** with selective or broadband display and **point-by-point measurements** with manual sweep. The receiver can be used on its own as a **wave analyzer** or as a **selective microvoltmeter.** With selective display of the test signal, accurate measurements are possible even with dense spurious spectra, for example, on test items requiring auxiliary pulses or particular frequencies for operation.

The frequency ranges and the resolution of the SWOF 3 receiver are specifically adapted to television measurements. A swept signal of at least 1% of the composite video signal can, for instance, be used to measure the frequency response as a function of the setup interval. Simultaneous display of the amplitude-frequency response at black and white level is possible by switching with a 50-Hz squarewave (see photo below). The same measurement can be made, for example, at 60% or 70% of the composite video signal amplitude. The test signal is perfectly discriminated by the receiver and displayed between the spectral lines.



Simultaneous display of level-dependent amplitude-frequency responses of a TV test item at white and black level, obtained by alternating the test signal in the composite video signal with 50 Hz

The **sweep generator** produces the swept test signal. The amplitude is adjustable in five 10-dB steps and continuously from 1.2 V_{pp} to 1 mV_{pp} meter reading.

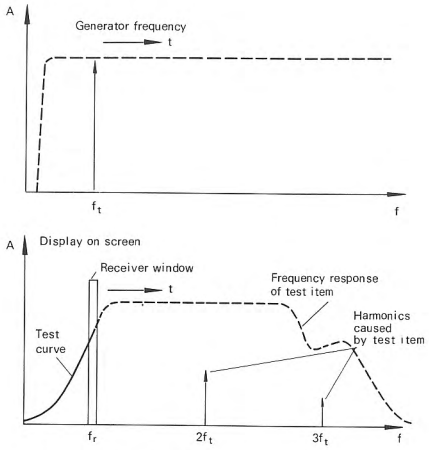
The sweep range is adjusted in the **oscillator.** It is set by fixing the start and stop frequencies in 1-MHz steps or selected between ±0.1 and ±1 MHz with continuously adjustable centre frequency ($f_0 \pm \Delta f$ mode). Double sweep control using the two above adjustments permits the investigation of steep amplitude-frequency responses or of interference spectra with slowed-down sweep throughout the subrange defined by the $f_0 \pm \Delta f$ adjustment while the overall sweep rate is high. Since the sweep time can be adjusted between 50 ms and 80 s with a fixed forward-to-return ratio of 4:1, slow plotting of the result by means of a recorder is possible. Switchover from automatic sweep to manual tuning is provided.

The **receiver and display unit** also contains an attenuator with 10-dB steps. A linear range from +1 to −30 dB with magnification by 20 dB and a logarithmic range from 0 to −50 dB are available for readoff from the screen. The overall coverage is +20 to −100 dB (0 dB ≙ 1 V_{pp}). A chopper is incorporated for simultaneous display of VF and AF input signals.

With a dynamic range of 50 dB, 3 mV are sufficient to produce a full-height picture; when measurements are carried out on video signals, this enables a 0.5% picture component in a composite signal to be measured.

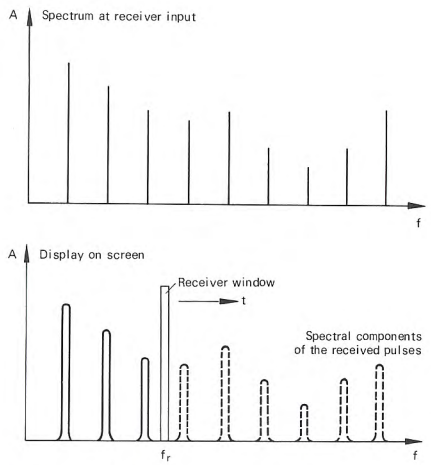
A 1-MHz marker generator permits checking the sweep range. The 75-Ω inputs and outputs of the set can be switched over to sockets on the rear panel (rack operation).

Swept-frequency measurements (see diagram on next page, top of left-hand column) Errors due to harmonics of the test frequency which simulate a wavy amplitude characteristic do not occur since the narrow window (2-kHz IF bandwidth) allows only the fundamental to pass through. The sweep generator-to-receiver characteristic can thus be used as an unambiguous reference, increasing the accuracy of evaluation.



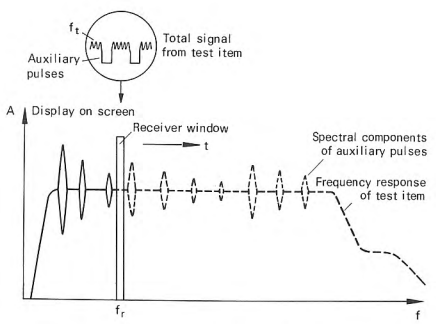
Principle of selective sweep measurement

Analysis (see diagram below) Due to its narrow bandwidth (2 kHz) the receiver resolves pulses at a repetition frequency of more than 7 kHz into their spectral components. The lines of the pulse spectrum appearing on the screen correspond in shape to the response curve of the receiver. The generator is switched off during analysis.



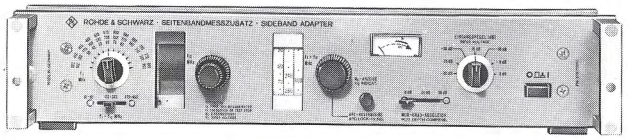
Principle of spectral analysis

Sweeping and analyzing (see diagram below) In the combination of swept-frequency operation with analysis the pattern is hardly affected by spurious signals (eg auxiliary pulses or any discrete frequencies). The spectral lines of the spurious signals are additionally displayed on the screen. The test signal can easily be observed and measured between spectral lines.



Simultaneous presentation of sweep and analysis displays

SWOF 3-Z



Sideband Adapter SWOF 3-Z

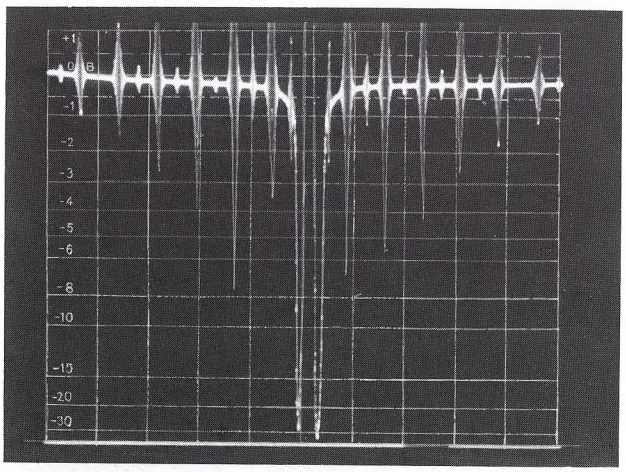
Sideband Adapter SWOF 3-Z for Videoskop

♦ 30 to 860 (1070) MHz

- Measurement as near as 10 kHz from the carrier
- High measuring accuracy due to high stability of oscillator frequency

In conjunction with the **Sideband Adapter SWOF 3-Z,** the Videoskop permits direct **display of the sideband characteristics** of TV vision transmitters in bands I, III, IV/V and at the IF of 38.9 MHz as well as spectral analysis in these bands. The Sideband Adapter is designed for continuous tuning.

Since the full selectivity and accuracy of the Videoskop are maintained, the successively displayed sidebands are perfectly separated even at low modulation frequencies and if blanking and sync pulses are contained in the modulation signal. Accurate measurements as near as to 10 kHz from the carrier are ensured.



Sideband characteristic close to vision carrier

Specifications and ordering information for SWOF 3 and SWOF 3-Z see **next page.**

Specifications and ordering information for SWOF 3+SWOF 3-Z

Videoskop SWOF 3

Generator section

Frequency range	10 kHz to 20 MHz
Tuning	a) swept by sweep oscillator b) manual via sweep oscillator
Generator output	1 mV_{pp} to 1.3 V_{pp} (calibrated), adjustable in steps and continuously, Z_{out} = 75 Ω
Output attenuator	0 to −50 dB in 10-dB steps
Attenuator error	<±0.2 dB referred to frequency response at 0 dB
Frequency-response flatness	≤±0.2 dB (20 kHz to 20 MHz) ≤±0.3 dB (10 to 20 kHz)
Distortion products	>34 dB down

Sweep circuit

Sweep control	by time-linear sawtooth, internal or external triggering
Sweep time	50 ms to 80 s, in steps and continuous, plus manual tuning
Forward/return sweep ratio	4:1

Sweep oscillator

Frequency range	63.08 to 93.08 MHz
Tuning	controlled by sweep circuit
Oscillator output	for Sideband Adapter
Connector for external oscillator	Z_{in} = 50 Ω, 150 mV_{rms}

Receiver and display unit

Receiver frequency range	10 kHz to 20 MHz
Tuning	same as for generator section
Intermediate frequencies	83.08/24.92/2.08/0.08 MHz
3-dB bandwidth	approx. 2 kHz (plus 20 kHz)
Selectivity (about the IF)	>110 dB for ±9 kHz (B = 2 kHz) >60 dB for ±100 kHz (B = 20 kHz)
Image-frequency rejection	>50 dB
IF rejection	>60 dB
Receiver inputs for selective measurements	
Video filter input	75 Ω
High-impedance video input	1 MΩ || 20 pF
Max. input voltage	10 V_{pp} (without probe)
Input attenuator	−50 to +20 dB
Frequency-response flatness (B = 2 kHz)	
20 kHz to 20 MHz	≤±0.2 dB (referred to 0.2 MHz)
10 kHz to 20 kHz	±0.5 dB
50 kHz to 20 MHz (B = 20 kHz)	≤±0.2 dB (referred to 0.2 MHz)
IF input 24.92 MHz	for Sideband Adapter
IF output 24.92 MHz	for narrowband analysis using accessory units
AF input	for broadband measurement and for connection of accessory units
Input frequency range	0 to 10 kHz
Input voltage	1 to 100 V_{pp} for full display height
Display	CRT, useful area 125 mm×100 mm
Display modes	signal presentation (forward sweep) and zero line (return sweep) or AF input (forward), return blanked or normal signal display alternated with AF input (forward sweep) at 25 kHz
Display width	117 mm
Total level range (lin. and log. displays)	−100 to +20 dB, the difference between the attenuator settings of generator and receiver is shown above the CRT (0 dB ≙ 1 V_{pp})
Sensitivity for full display height	3 mV_{pp} (at −50-dB input attenuator setting)
Smallest readable voltage	10 μV_{pp} (log scale), B = 2 kHz
Frequency markers (int.)	1-MHz spacing
Recorder outputs	for X and Y directions

General data

Rated temperature range	+10 to +35 °C
AC supply	115/125/220/235 V ±10%, 47 to 63 Hz (100 VA)
Dimensions, weight	
19″ bench model	484 mm×194 mm×509 mm, 27 kg
19″ rackmount	483 mm×177 mm×498 mm, 24 kg

Ordering information

Order designation	▶ Videoskop SWOF 3
19″ bench model	110.2620.72
19″ rackmount	110.2620.71

Accessories supplied

Graticules (lin. and log.), filter plate, 10:1 Attenuator Probe UTKS, Termination RMF (75 Ω), RF connecting cable (75 Ω, 50 cm), power cable

Sideband Adapter SWOF 3-Z

Input frequency range	30 to 90, 135 to 852 (1068) MHz
Input requirement (V_{rms}) for full display height on Videoskop	150 mV (vision carrier sync peak)
Sweep voltage component in composite video signal	70% with modulation depth compensation 0 dB 7% with modulation depth compensation +20 dB 2.1% with modulation depth compensation +30 dB
Max. input level (V_{rms})	5 V
Input attenuator	0/5/10/15/20/25/30 dB
Input level indication	on meter with 5-dB range for adjustment
Input impedance	50 Ω
Return loss	>34 dB at input attenuator setting ≥10 dB >26 dB at input attenuator setting <10 dB
Connector	Dezifix B, adaptable
Tuning to sideband frequencies	automatic by conversion with the sweep oscillator frequency from Videoskop
Frequency range of sideband display	±8 MHz, referred to vision carrier
Frequency response flatness (Sideband Adapter + Videoskop)	±0.3 dB in the display range, referred to 0.2 MHz
Selectivity (Sideband Adapter + Videoskop)	3-dB bandwidth approx. 2 kHz; >110 dB at ±9 kHz
Modulation depth compensation	0/20/30 dB by attenuator set provided at the 2nd IF output
Input voltage from sweep oscillator	V_{rms} = 150 mV (into 60 Ω); fluctuations by ±3 dB are levelled out
2nd IF output voltage (24.92 MHz)	V_{rms} = 1 mV (into 60 Ω) for full display height

General data

Rated temperature range	+10 to +35 °C
AC supply	115/125/220/235 V +10/−15%, 47 to 63 Hz (38 VA)
Dimensions, weight	
19″ bench model	484 mm×105 mm×509 mm, 18.5 kg
19″ rackmount	483 mm×88 mm×498 mm, 17 kg

Ordering information

Order designation	▶ Sideband Adapter SWOF 3-Z
19″ bench model	110.2636.52
19″ rackmount	110.2636.51

Accessories supplied

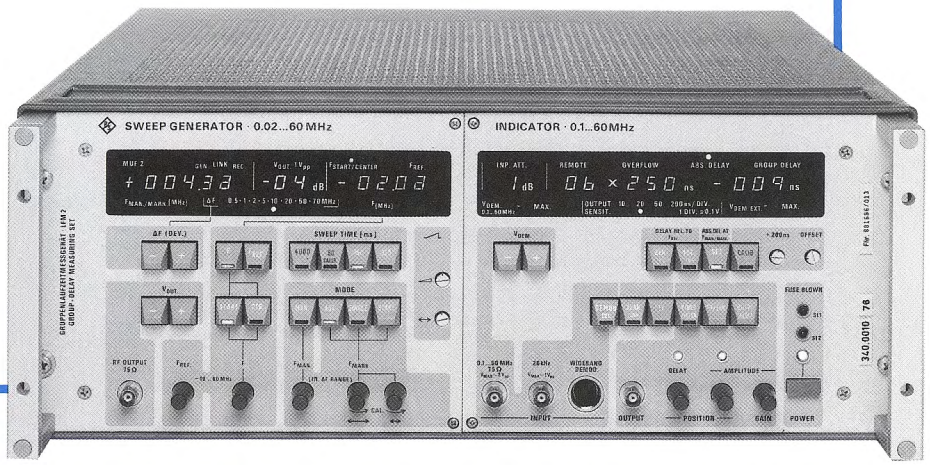
Cable for connection to SWOF 3, power cable

Group-delay Measuring Set LFM 2

LFM 2

- up to ±1000 ns
  0.1 to 60 MHz
  (1000 MHz)

- Measurement of group delay up to ±1000 ns of absolute delay up to 12 µs
- Resolution ±1 ns
- Digital display – curve representation on external VDU
- Suitable for measurements on TV links



IEC 625 Bus

The **Group-delay Measuring Set LFM 2** is used to determine the group delay and the absolute delay of active and passive two-port networks; it is also suitable for measurements on TV systems with line sync pulses (measurements with field-sync pulses are possible if certain restrictions are acceptable for the DELAY mode) and on **TV links.** Compensation of absolute delay is automatic. Fitted with the IEC-bus Option LFM 2-B (IEC 625-1), the LFM 2 can be used in **automatic test assemblies.**

Configuration The LFM 2 consists of the

Generator with
a frequency range of 0.1 to 60 MHz,
digital frequency readout, and the

Indicator with
a probe-frequency generator (20 kHz, test and reference signals), a phase meter (digital readout, chopper for simultaneous display of delay and amplitude on external VDU), a demodulator (0.1 to 60 MHz).

Measuring principle The Group-delay Measuring Set LFM 2 uses the probe-frequency method. The RF carrier is amplitude-modulated with the 20-kHz probe-frequency signal. After passing through the item under test, the signal is demodulated and the phase difference between the demodulated probe frequency and the 20-kHz reference signal determined. The LFM 2 uses two different measuring methods:

Method A The reference signal is routed via the item under test. This offers the following advantages:

- Compensation of the absolute delay is not required.
- Measurements on TV links are possible.
- A high measuring accuracy is achieved.

Method B The reference signal is taken directly to the phase meter (measurements on TV links are not possible). This offers the following advantages:

- The absolute delay is indicated and can be compensated.
- Measurements can be performed with separate generators modulated with the probe frequency.

Frequency range extension is possible using the Selective Demodulator LDS or TV Transcope MUF 2:

LDS (up to 900 MHz) for selective transmitter tests with a wide dynamic range for amplitude response measurement and without interference by harmonics of the test frequency; display of SB amplitude and group-delay response on an oscilloscope (eg OPF or ODF).

MUF 2 (up to 1000 MHz) for selective tests on active and passive two-port networks and for broadband transposer measurements (also possible with LFM 2, Mixer MUF 2-Z2 – to handle the different input and output frequencies of the transposer – and Wideband Demodulator LFM 2-Z1); display on CRT of MUF 2.

Output signals For display on a VDU, the group-delay and frequency-response characteristics are available separately or in chopped form. The LFM 2 supplies a 200-ns square-wave signal for calibrating the VDU.

TV system measurements If the LFM 2 is used for measurements on TV systems requiring sync pulses for operation (eg TV transmitters), the test signal must be added to a TV sync signal (comprising the sync plus blanking components) using an external video mixer. Evaluation in the Indicator is performed with the TV button pressed.

Digital readout Two displays are provided on the Generator to permit indication of the frequencies, which are freely selectable within the sweep range (see bottom left):

start or centre frequency and sweep width,
marker or reference frequency.

When using method A, the group-delay difference between the reference signal and the selected frequency (point-by-

Digital display on Generator: Display 1: either start, centre, reference or manually set frequency; display 2: either marker or reference frequency; centre, top: output level; centre, bottom: selected sweep

Digital display on Indicator: From left: input attenuation of wideband demodulator, absolute or group delay; centre, bottom: set scale of delay signal output for display on CRT

point measurements) or the marker frequency highlighted on the display (swept operation) is indicated on the readout of the Indicator (see previous page, bottom right).

When using method B, the absolute delay at the selected frequency in the manual mode or the marker frequency unblanked on the CRT in the sweep mode is displayed on the indicator after pressing the DELAY button. The absolute delay of the test item is determined by subtracting the value previously measured with the test item shorted across. The maximum absolute delay that can be measured is 12 µs.

TV link measurements For measurements on TV transmission links two LFM 2 sets are required. All the signals required for the test sequence at the receiver end are transmitted via the link.

Additional characteristics

An ALC circuit in the **Generator** ensures that the level value is maintained at all frequencies.

The probe-frequency generator in the **Indicator** produces the crystal-controlled probe (20 kHz), reference (20 kHz) and identification (10 kHz) frequencies.

The phase meter included in the Indicator delivers the reference signal (20 kHz) with crystal accuracy and keeps it in phase with the transmitted probe-frequency signal (method A).

The generator-output and the demodulation signals can be adjusted via calibrated attenuators. An overload indicator (LED) permits the signal coming from the item under test to be kept at the optimum level for driving the demodulator.

Extras

Wideband Demodulator LFM 2-Z1 (10 to 1000 MHz) for AF and probe-frequency signals

Mixer MUF 2-Z2 for measurements on TV transposers

XY Recorder Adapter LFM 2-Z3 (for instance for XYT Recorder ZSKT)

Impedance Transformer SBTF 2-Z for measuring instruments with a characteristic impedance of 50 Ω

Amplifier MUF 2-Z3 for boosting the test item output voltage by 27 dB

IEC-bus Option LFM 2-B (24-contact connector to IEEE 488); can be used instead of LFM 2-B3

Specifications

Group-delay measurement range	up to ±1000 ns
Absolute-delay measurement range	up to 12 µs
Resolution	±1 ns
Interface (option)	IEC 625-1 (IEEE 488)

Generator

Frequency range	0.1 to 60 MHz (for range extension see text)
Sweep range	−10 to +60 MHz
Sweep width (adjustable)	0.5/1/2/5/10/20/50/70 MHz
Frequency setting within sweep range	start or centre frequency, frequency marker (brightup marker on VDU), reference frequency, manual
Resolution of readout	10 kHz (manually: 1 kHz)
Readout accuracy	≤±1.5 kHz ±1 digit
Output voltage	1±0.05 V_{pp} (stabilized)
Output attenuator	30 ±0.5 dB in steps of 2 ±0.01 dB
Harmonics	≥40 dB down
FM noise	≤1 kHz
Modulation	probe frequency (approx. 60% mod.)
Total sweep times	40/80/160/320 ms
Control signal for VDU	0 to +10 V or −10 V (sawtooth), adjustable by −10 dB

Indicator

Probe-frequency generator

Probe frequency	20 kHz ±5×10⁻⁶
Reference signal	20 kHz ±5×10⁻⁶
Identification pulse frequency	10 kHz ±5×10⁻⁶
Output voltage	1 V_{pp} ±5%
Output impedance	75 Ω ±5%

Phase meter

Measurement range	±1 to ±1000 ns
Indication	3½ digits with ± display
Error	≤±1% ±1 ns
Output signal for VDU	10/20/50/200 ns
Input voltage range	
Probe frequency	8 mV_{pp} to 0.8 V_{pp}
Reference signal	25 mV_{pp} to 0.8 V_{pp}
Identification pulse frequency	25 mV_{pp} to 0.8 V_{pp}
Delay error in input voltage range	0.8 to 0.08 V: ±5 ns 80 to 24 mV: ±10 ns
Compensation of absolute delay	in 250-ns steps

Demodulator

Frequency range	0.1 to 60 MHz
Input voltage range	2 V_{pp} to 50 mV_{pp}
Group-delay error in the case of input voltage variation of 10 dB/20 dB	≤10 ns/≤20 ns
Group-delay error	100 kHz to 15 MHz: ≤±2 ns 15 to 60 MHz: ≤±5 ns
Input attenuator	7 dB ±0.5 dB in 1-dB steps ±0.1 dB
Input impedance	75 Ω
Return loss	100 kHz to 20 MHz: ≥34 dB 20 to 60 MHz: ≥30 dB

Extras

Wideband Demodulator LFM 2-Z1	10 to 1000 MHz
Max. input voltage	≤5 V_{rms}, ≤10 V DC
for group-delay measurement	≥1 V_{rms}
Group-delay error	≤10 ns/100 MHz (10 to 1000 MHz) ≤50 ns over total range
Connector, RF input	N female; 50 Ω
XY Recorder Adapter LFM 2-Z3	deflection time: approx. 1 min
X output signal	approx. 0 to 5 V
Signal for pen lift	TTL (polarity internally switchable)
Connectors	BNC (power supply: 6-contact)

General data

Rated temperature range	+5 to +40 °C
Operating temperature range	0 to +45 °C
Storage temperature range	−20 to +70 °C
AC supply	110/120/220/240 V +10/−15%, 47 to 63 Hz (110 VA)
Dimensions, weight	
19″ bench model (design 80)	492 mm×205 mm×514 mm, 18 kg
19″ rackmount	483 mm×177 mm×506 mm, 14 kg

Ordering information

Order designation	▶ Group-delay Measuring Set LFM 2	
	19″ bench model	19″ rackmount
Line frequency 15,625 Hz	340.0010.72	340.0010.71
15,750 Hz	340.0010.74	340.0010.73

Recommended extras

Wideband Demodulator	LFM 2-Z1	340.6302.53
Mixer	MUF 2-Z2	349.8820.50
XY Recorder Adapter	LFM 2-Z3	340.5906.02
Impedance Transformer	SBTF 2-Z	341.6935.57
Amplifier	MUF 2-Z3	353.5816.50
IEC-bus Option, for LFM 2 with Serial Nos. 871 739 and 300 974	LFM 2-B1	340.3103.02
for other LFM 2 models	LFM 2-B2	340.3103.03
Connecting Cable (to MUF 2) for LFM 2 with Serial Nos. 871 739 and 300 974	MUF 2-Z1	337.7824.00
for other LFM 2 models	MUF 2-Z4	337.7830.00

Selective Demodulator LDS (for LFM 2) LDS

♦ 20 kHz to 900 MHz

- Extension of application range of Group-delay Measuring Set LFM 2
- Increase of dynamic range
- Elimination of faulty measurements caused by spurious frequencies
- Separate measurement of TV transmitter sidebands
- Storage of front-panel settings
- Microprocessor control

IEC 625 Bus

In conjunction with the **Group-delay Measuring Set LFM 2**, the **Selective Demodulator LDS** permits selective measurement of amplitude and group-delay response

- in the video band up to 60 MHz
- in the TV IF range
- in the individual TV channels of bands I, III and IV/V and the special channels.

Selective measurement enables determination of the **vestigial sideband amplitude and group-delay characteristics** of a TV transmitter even with the sync signal. Moreover, the dynamic range is increased and faulty results due to harmonics and spurious frequencies are avoided.

Operation Front-panel operation is via the microprocessor which also controls the storage of the front-panel settings and data exchange on the IEC bus.

Tuning to the channel frequency in the RF range is made from the keyboard. The frequency is entered either in MHz or as the channel number. Since the synthesizer locks in steps of 1 kHz, the channel offset can be taken into account.

Sweep frequency, test parameters The sweep frequency from 0 to 60 MHz for the video range or −9/+11 MHz for IF and RF measurements is produced by the LFM 2. The individual test parameters such as the deviation and the centre frequency are also set on the LFM 2.

Filters The filter circuits in the LDS are provided such that both peak indication of a video-modulated carrier in the analysis mode and display of amplitude and group-delay characteristics of TV transmitters is possible in the video range.

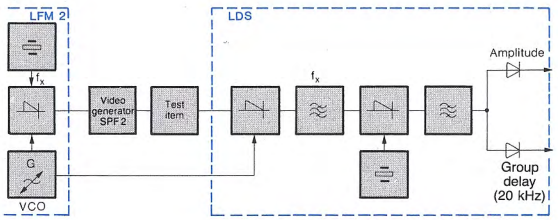
Display The TV Oscilloscope OPF, TV Digital Oscilloscope ODF or TV Transcope MUF 2 can be used as a VDU which is driven with X, Y and Z signals supplied by the LDS. Amplitude and group-delay response can be displayed simultaneously.

Calibration generator A calibration generator is incorporated for absolute measurements.

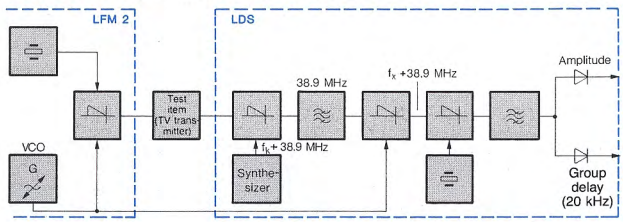
Applications

Measurement of amplitude and group-delay responses

VF mode The LDS considerably extends the dynamic range (>80 dB) for amplitude measurements (Fig. 1 on page 136), meaning that filters with high stopband attenuation can also be measured and return-loss measurements become easier. Resolution or 0.5, 1.5 or 10 dB/div for amplitude display and of 10, 20, 50 or 200 ns/div for group-delay display, any two test curves can be displayed simultaneously.



LFM 2 and LDS in VF mode ▲ and RF mode ▼



IF and RF modes LDS allows measurement of the vestigial sideband characteristic of modulators and TV transmitters under operational conditions. Due to the narrowband demodulation of the sweep signal, the test curve can be evaluated in the gaps between the spectral lines of the line sync pulses down to a picture component of about 10% of the video signal; a special TV blanking circuit permits measurement of the group delay close to the vision carrier (Figs. 2 and 3).

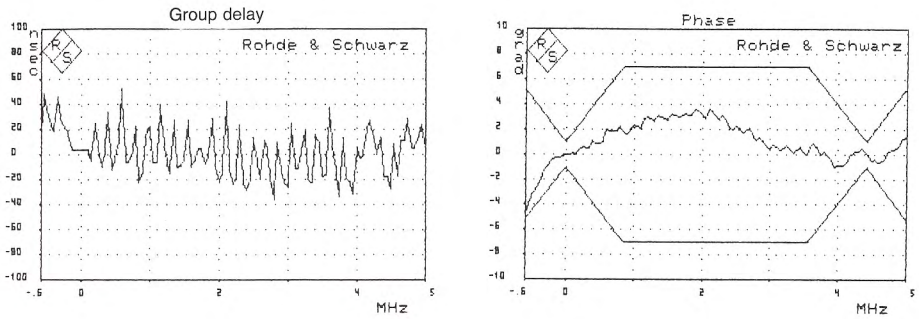
LDS – Selective Demodulator

Analysis mode The LDS may also be used as an analyzer in all fields of operation. In the example shown in Fig. 4, it is difficult to evaluate the intermodulation product at $f_{sound} - f_{SB} + f_{vision}$ because of the high density of the line spectrum. Fig. 5 shows a particularly revealing test result, the intermodulation products being displayed in the form of a swept curve as a function of frequency, with the synthesizer tuned to the sound carrier.

The system software allows the measured $\Delta\varphi$ curve to be displayed within a defined tolerance range. Moreover, it enables output on a printer such as the Universal Ink-jet Printer PUD 3.

Measurements on transmitter with annular beam control (ABC)

To increase the efficiency of TV transmitters, the sync pulse is separated ahead of the IF stage and the RF preamplifier and added at the output of the final RF stage.



Group-delay/frequency response of modulator with SAW filter in RF range (left) and associated phase/frequency response $\Delta\varphi$ (right)

Phase measurement in RF range

In conjunction with a process controller eg PUC, PCA 2 or PCA 5 (see measuring equipment catalog) for driving the Group-delay Measuring Set LFM 2 and the LDS, the LDS can be used for measuring the phase/frequency response of TV transmitters and modulators in the RF range.

For ABC measurements using the LDS, external sync pulses must be applied. The sync pulse must be matched to the delay of the test signal. The delay time can be varied with the rotary pulse generator of the LDS.

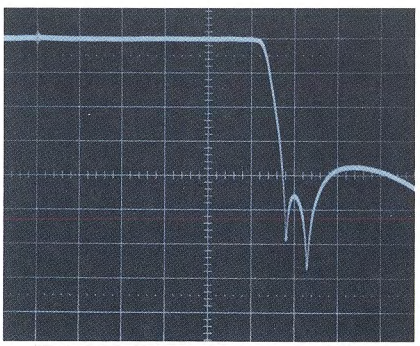
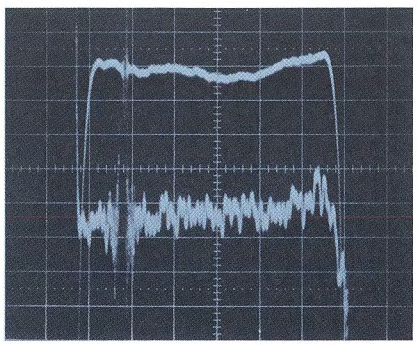


Fig. 1 Amplitude/frequency response of 5 MHz video lowpass filter (10 dB/div)



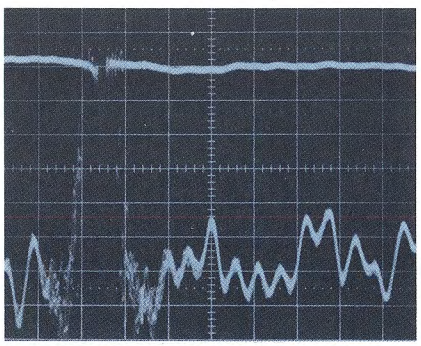


Fig. 3 Amplitude/frequency and group-delay/frequency response of same test item as below in Fig. 2, f_{vision} −0.5/+1.5 MHz; left with 1 dB/div and 50 ns/div; right with 1 dB/div and 20 ns/div

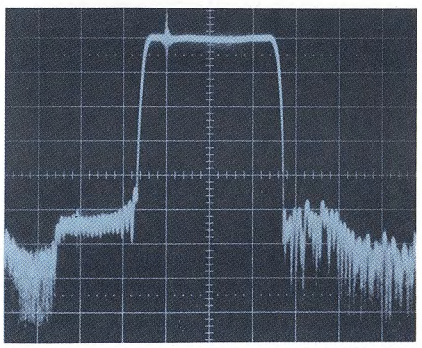


Fig. 2 Amplitude/frequency response of CATV modulator with SAW filter (10 dB/div) for f_{vision} −8/+12 MHz

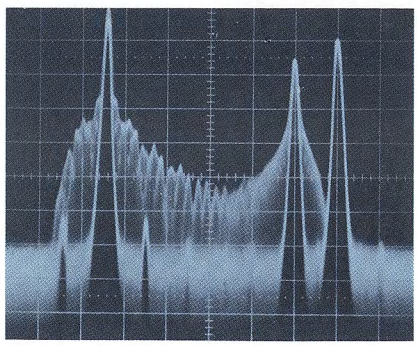


Fig. 4 Result of intermodulation measurement using three-signal method (1 MHz/div; 10 dB/div)

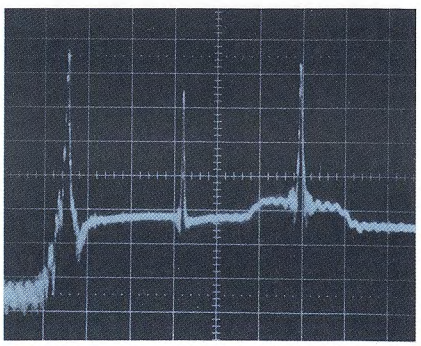


Fig. 5 Intermodulation products displayed as swept curve (1 MHz/div; 10 dB/div)

Specifications

VF demodulator input

Frequency range	20 kHz to 60 MHz
Tuning	with sweep oscillator of Group-delay Measuring Set LFM 2
Input voltage (for full signal level with maximum dynamic range and 0 dB of input and IF attenuators)	100 mV_{rms}
Dynamic range	>80 dB
Max. input voltage	3 V_{rms}
Indication of input level	by LED row
Range of indication	±10 dB
Inputs	75 Ω and 1 MΩ || 35 pF (BNC female connectors)
Frequency response flatness (referred to 0.2 MHz)	
75-Ω inputs	
20 to 100 kHz	<±0.3 dB
100 kHz to 10 MHz	<±0.2 dB
10 to 60 MHz	<±1.0 dB
1-MΩ input	
20 to 100 kHz	<±0.5 dB
100 kHz to 10 MHz	<±0.4 dB
10 to 60 MHz	<±1.5 dB
Input attenuator (1-dB steps)	0 to 30 dB
Attenuator error	±0.2 dB/step, max. 0.5 dB
Return loss	
20 kHz to 20 MHz	>34 dB
20 to 60 MHz	>20 dB

IF/RF demodulator input

Frequency range	−9 to +11 MHz (referred to vision carrier)
IF	vision carrier depending on standard
Standard B/G	38.9 MHz
L	32.7 MHz
M/N	45.75 MHz
RF	45 to 900 MHz
Vision carrier tuning	by synthesizer in 1-kHz steps
Fine tuning	±1 kHz, continuously
Channel offset	20 M to 20 P
Sweeping	in channel, MHz, kHz or programmed steps
Input voltage (for full signal level with maximum dynamic range and 0 dB of input and IF attenuators)	100 mV_{rms}
Dynamic range	>80 dB
Max. input voltage	≤5 V_{rms}
Indication of input level	by LED row
Range of indication	±10 dB
Display of frequency range	−9 to +11 MHz (referred to vision carrier)
Tuning	by sweep oscillator of Group-delay Measuring Set LFM 2
Frequency response flatness	
in displayed range	<±0.3 dB via generator of LFM 2 (referred to 0.2 MHz)
in entire RF range	<3 dB
IF/RF input	N female connector (Z = 50 Ω)
Return loss	
Input attenuator ≥6 dB	≥34 dB
Input attenuator <6 dB	≥26 dB
Input attenuator (1-dB steps)	−6 to +90 dB
Attenuation error	±0.2 dB/step, max. 0.5 dB
Suppression of intermodulation products	
−8/−10/−16 dB (vision/sound/SB)	≥76 dB (typ. 80 dB), for 0 dB corresponding to 100 mV
−8/−16 dB (vision/SB)	≥76 dB (typ. 80 dB), for 0 dB corresponding to 100 mV
0/−10 dB (vision/sound)	≥64 dB/≥70 dB, for 0 dB corresponding to 100 mV/30 mV
Reference level readout	
VF	dBµV
Error of reading	±1.5 dB
RF/IF	dBµV, dBm, dBpW
Error of reading	−3 to +2 dB
Calibration generator (for amplitude calibration)	38.9 MHz

IF section

Frequency range	10.7 MHz
Bandwidth for	
amplitude measurement	300/80/5 kHz, switch-selected
group-delay measurement	80 kHz, fixed
IF gain	0 to 70 dB
Setting	in 1-dB steps
Attenuation error	±0.3 dB/step, max. ±1 dB
Fine adjustment	±1 dB
Video filter	can be switched into circuit
Channel A	150 Hz
Channel B	600 Hz
Demodulator	logarithmic
Resolution	0.5/1/5/10 dB/div
Display	1 or 2 curves, chopped
Relative measurement in channel A	ΔdB or Δns
Measured value	depending on test curve
Displayed value	at frequency marker of LFM 2
Group-delay measurement	
Level-dependence of display in VF, IF and RF modes	≤10 ns/10 dB
referred to full signal level	≤20 ns/20 dB
Frequency response	<1 ns/MHz
VF: 0.15 to 20 MHz	<7 ns
0.15 to 60 MHz	<15 ns
IF, RF: −3 to +7 MHz	<7 ns
−9 to +11 MHz	<15 ns

Connectors

Outputs for VDU	X: sawtooth (from LFM 2), 0 to 5 V for 10 div Y: 0 to 1 V for 10 div Z: ±12 V (BNC female)
Tracking signal input	BNC female (50 Ω)
VF measurement	144 to 214 MHz
RF/IF measurement	145 to 165 MHz
Required level	100 to 200 mV
External synchronization	BNC female (75 Ω)
Required level	−4 V_{pp}
System connector for Group-delay Measuring Set LFM 2	37-contact male
System connector for TV Digital Oscilloscope ODF	37-contact female
IEC-bus interface	to IEC 625-1 and IEEE 488; 24-contact (Cannon)

General data

Rated temperature range	+5 to +40 °C
Operating temperature range	0 to +45 °C
Power supply	100/120/220/240 V ±10%, 47 to 63 Hz (120 VA)
Dimensions, weight	
19″ bench model	492 mm×205 mm×514 mm, 18 kg
19″ rackmount	483 mm×177 mm×506 mm, 14 kg
Seated depth	451 mm

Ordering information

Order designation	▶ Selective Demodulator LDS
Standard B/G (IF = 38.9 MHz, with IEC bus and ABC interface)	
19″ bench model	376.2013.52
19″ rackmount	376.2013.51
Standard D/K (IF = 38.0 MHz)	
19″ bench model	376.2013.54
19″ rackmount	376.2013.53
Standard I (IF 38.9 MHz)	
19″ bench model	376.2013.62
19″ rackmount	376.2013.61
Standard L (IF = 32.7 MHz)	
19″ bench model	376.2013.56
19″ rackmount	376.2013.55
Standard M (IF = 45.75 MHz)	
19″ bench model	376.2013.58
19″ rackmount	376.2013.57
Accessories supplied	power cable, connecting cable LDS-Z1 for LFM 2

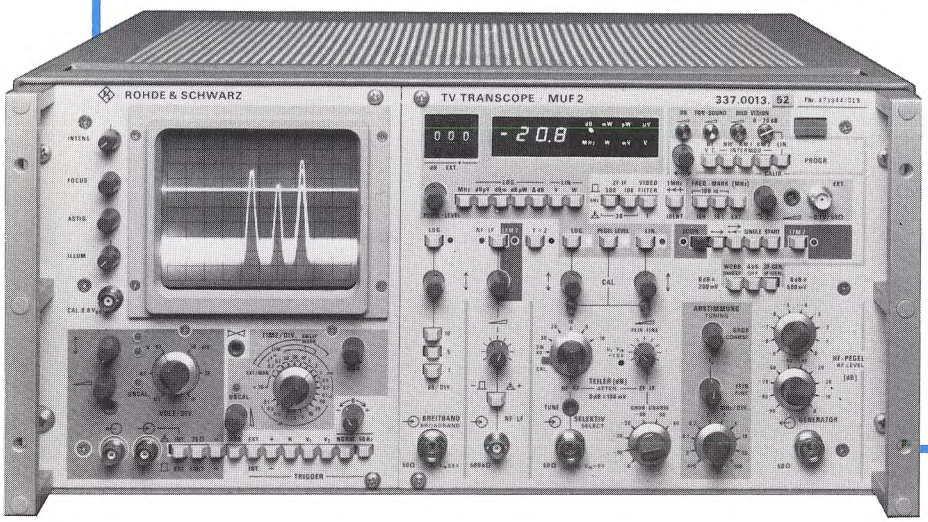
Recommended extras

Impedance Transformer LFM 2-Z4 (75/50 Ω)	340.6148.75

TRANSMITTER/TRANSPOSER MEASUREMENT

MUF 2

TV Transcope MUF 2 ♦ 3 to 1000 MHz



- RF sweeper with selective and broadband demodulators
- Voltmeter, power and VSWR meter
- Oscilloscope for field servicing
- Chopper for simultaneous display of two test curves
- IF generator for three-signal measurement on transposers
- Ease of operation thanks to microprocessor control

The **TV Transcope MUF 2** is a general-purpose sweep tester which can also be used as a voltmeter, power and VSWR meter. Thanks to its wide frequency range, it is suitable for measurements on transmitters, transposers and antennas for VHF sound broadcasting and television as well as on cable TV and community antenna systems. Special facilities for transposer measurement permit a large part of the tests stipulated in the specifications to be performed on site.

The TV Transcope combines the following measuring instruments in a compact unit:

sweep generator and selective receiver,
VSWR meter (with VSWR bridge only),
vision/sound/sideband carrier generator (IF region),
display section,
oscilloscope (for field service),
microvoltmeter,
power meter,
analyzer,
broadband demodulator.

The unit is suitable for use in conjunction with the Group-delay Measuring Set LFM 2.

Sweep generator

Swept signal With its built-in YIG oscillator the sweep generator enables swept-frequency measurements from 3 to 1000 MHz to be performed in a single-sweep mode or with seven adjustable subranges with any desired centre frequency; manual tuning is possible. The centre frequency is displayed at the push of a button.

Discrete frequencies can be identified by internal markers in decade steps and/or external **frequency markers.**

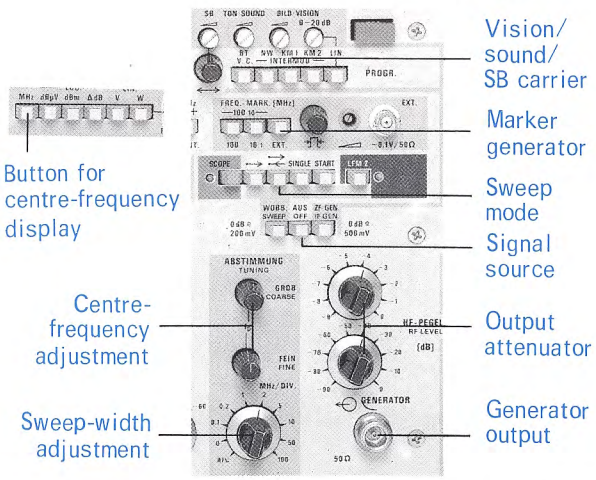
The **output signal** of 200 mV maximum can be attenuated by 99 dB in calibrated 1-dB steps.

Vision/sound/sideband carrier Instead of swept RF, generation of a vision/sound/sideband carrier in the television IF range can be selected. This feature is useful for measurements of modulation depth and harmonic distortion on TV transposers. The sideband is frequency-adjustable.

The combination of carriers and their levels that is required for spurious-frequency, intermodulation and linearity measurements can be selected with pushbuttons. The signals can be continuously varied by 3 dB. The vision carrier can be transmitted without any other components contained in the output. Its amplitude is adjustable from 0 to −20 dB to allow linearity measurements. The **output sum signal** can be attenuated by 99 dB in calibrated 1-dB steps.

MUF 2 mode	Vision carrier	Sound carrier	SB carrier
Spurious signals	0 dB	−10 dB	–
Intermodulation	−8 dB	−10 dB	−16 dB
Intermodulation (higher level)	−3 dB	−10 dB	−20 dB
Nonlinearity	−3/−20 dB*)	−10 dB	−20 dB
Vision carrier	0 to −20 dB		

*) switched in continuous sequence



Sweep generator

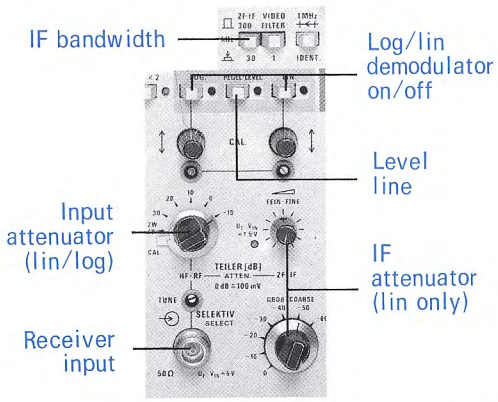
For **intermodulation measurements** the vision/sound/sideband signal is used to drive the transposer at the IF. If the first mixer stage of the transposer has an oscillator output, the vision/sound/sideband signal can be transposed to the transposer reception channel, using the add-on **Mixer MUF 2-Z2.** This allows measurements to be performed on all sections of the transposer, including the RF section without the use of a channel signal generator. At 50 mV input level – corresponding to about 5 mV output level – the MUF 2-Z2 does not produce any distortions of its own. The power supply is from the MUF 2.

Selective demodulator

Receiver The triple superhet receiver for 25 to 1000 MHz is coupled to the YIG oscillator and tracks the sweep generator frequency. It has switch-selected bandwidths of 30, 100 and 300 kHz and is suitable for demodulation of AM signals.

Linear and logarithmic display is possible via the selective demodulator (simultaneously if desired, thanks to the chopper in the MUF 2). The dynamic range with logarithmic display and selective demodulation of sweep-generator signals is greater than 80 dB. The selective demodulator has a 50-dB input attenuator and, for linear display, a 60-dB IF attenuator in addition. A demodulated signal available at the rear output can be applied by cable to the Y input of the scope for display in the time domain.

Analyzer Whenever the sweep generator of the MUF 2 is not used as a signal source, the selective demodulator can work as an analyzer with the same characteristics as above, for example for power or intermodulation measurements. To achieve optimum accuracy, selective **power measurements** are made with linear display. Conversion into watts for display is performed by the internal microprocessor. Tuning is stabilized at zero sweep by AFC to the incoming signal.



Selective demodulator

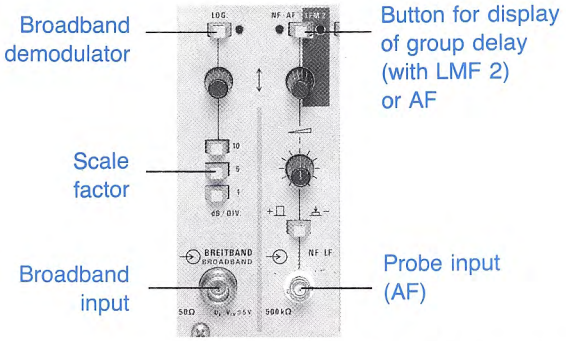
Calibration of selective demodulator

Using the swept signal (kept constant within ±0.3 dB) in a short-circuit measurement the selective demodulator can be calibrated at the test frequency. When the generator output is connected to the receiver input and the LEVEL button pressed, the lin or log display can be adjusted to the level line. Power can thus be measured with an error of less then ±0.3 dB.

Broadband demodulator

The broadband demodulator permits detection of transposed signals of 3 to 1000 MHz and logarithmic display over a dynamic range of 60 dB. It contains a match-terminated diode detector and a reference diode which compensates via a regulating circuit for temperature effects and level-dependent detector-coefficient variations.

An AF input is provided for measurements using a probe.



Broadband demodulator

For matching measurement via the wideband demodulator, the **Amplifier MUF 2-Z3** permits the output signal of the VSWR bridge to be boosted for the demodulator input (powered from the MUF 2).

Display section

Oscilloscope When the SCOPE button is pressed the MUF 2 display section works as an oscilloscope; its 12 MHz bandwidth at 3 dB meets all requirements concerning to the display of television signals.

Y axis The input sockets form a loop-through connection. If only one input is to be used, an internal 75-Ω termination can be switched in, otherwise the impedance is high. The EXT./INT. pushbutton internally applies the video signal obtained in the wideband demodulator to the oscilloscope input. In this case, the Y input can be used as a loop-through input for a monitor. The input sensitivity is sufficient for measurements using a 10:1 probe. AC or DC coupling can be switch-selected. A squarewave **calibration signal** is available with a maximum error of ±1%.

X axis The sweep time can be switched from 0.2 s/cm to 0.1 µs/cm in 21 steps. A 20-times expansion can be switched on for some of the sweep times. The X axis can be triggered by external signals. Switchover between free-running and triggered mode is automatic.

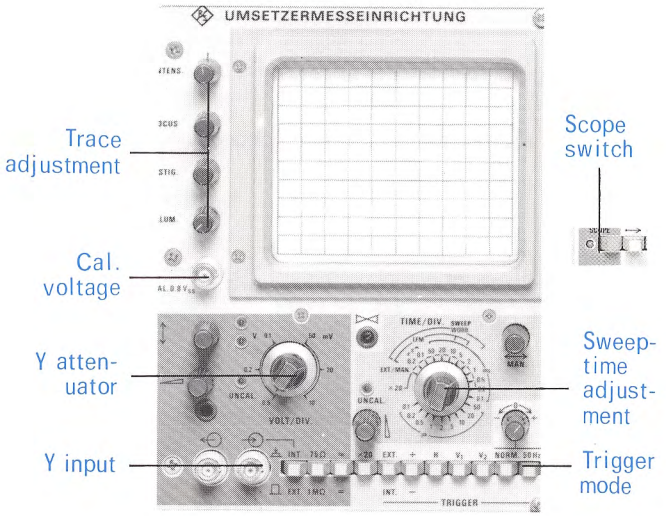
The H trigger mode permits line display.

With the trigger modes V_1 and V_2 the **television fields** I and II can be displayed; for the display of the **test lines** the sweep time 0.2 ms/cm and expansion ×20 are to be used.

Selectable trigger polarity and adjustable trigger level (with NORMAL trigger mode) are useful features for use in **field service.**

TRANSMITTER/TRANSPOSER MEASUREMENT

TV Transcope MUF 2, continued



Display section

Sweep display Unless the SCOPE button is pressed the oscilloscope operates as a display with the X position and the Y amplitude controlled from the sweep generator. The swept signals from the selective and broadband demodulators can be displayed as well as the signals analyzed by the selective demodulator. A zero reference line can be displayed in the return sweep.

A pushbutton-selected chopper in the MUF 2 allows **simultaneous display of two test signals** or of a test signal and a level line. The level line is coupled to the digital display. To enhance the reading accuracy on the screen, the Y axis can be expanded by a factor of 2.

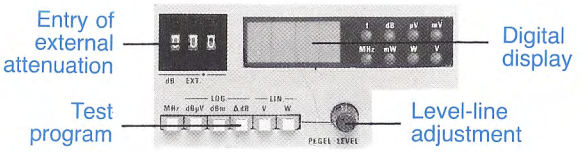
The two demodulators make the simultaneous display of two important parameters – input impedance match and amplitude characteristic – possible. Measurement of the input impedance requires a directional coupler or a VSWR bridge (e.g. ZRB 2). Both logarithmic and linear display of the measured quantities is possible. In conjunction with the Group-delay Measuring Set LFM 2, the amplitude characteristic of the transposer can be displayed together with the group-delay characteristic.

The **XY Recorder Adapter LFM 2-Z3** enables logging of amplitude and group-delay characteristics on a recorder (power supplied from MUF 2).

Digital display (selective demodulator)

The measurements displayed on the screen are evaluated using the level line and the microprocessor. With **log operation** of the selective demodulator the LED display indicates input level in dBμV, dBpW or dBm. External attenuation by attenuators or directional couplers can be entered via push-buttons and is then taken into account automatically by the microprocessor. Pressing the ΔdB button sets the displayed value to 0. By shifting the level line one can then perform relative measurements with direct indication.

In the **lin mode** of the selective demodulator input levels are indicated in μV, mV or V; external attenuation can again be taken into account by the microprocessor. Conversion of these voltages into mW and W is also possible.



Digital display

Specifications

Sweep generator

Frequency range	3 to 1000 MHz
Sweep width	100, 50, 10, 5, 2, 1, 0.2, 0.1, 0 MHz/cm; AFC
Centre frequency	adjustable
Display	digital, pushbutton-controlled
Display error	≤±3 MHz
Sweep nonlinearity	≤1.5%
Spurious FM (Δf ≤2 MHz/cm)	≤3 kHz
Harmonics	≥40 dB (typ. 46 dB) down
Nonharmonic spuria	≥40 dB (typ. 50 dB) down
Frequency markers (pulse)	100, 100/10, 10/1 MHz; ext.
Marker input	0.1 V into 50 Ω; BNC female
RF suppression	during retrace
Test output (rear)	25 mV into 50 Ω (constant)
Ext. modulation (e.g. from LFM 2)	f_{mod} = 20 kHz, V_{pp} = 1 V (25-contact female conn., rear)

Vision/sound/sideband carrier generator

Vision/sound/SB frequency	38.9/33.4/33 to 40 MHz (Standard B/G; please enquire for other standards)
Carrier selection (pushbuttons)	vision carrier/spuria/intermodulation/linearity measurement
Nonharmonic spuria	>70 dB down
Test output (rear)	25 mV into 50 Ω
Output (switch-selected)	swept or vision/sound/SB signal
Swept-frequency signal (V_{rms})	100 mV (−7 dBm) ±0.3 dB with output attenuator: −6 dB (corresponding to input attenuator: CAL.)
Vision/sound/SB carrier (V_{rms})	500 mV (into 50 Ω) each; all variable by 3 dB (vision carrier also 0 to −20 dB)
Frequency response flatness, SB	≤±0.2 dB
Level with LIN, KM, NW	depends on mode selected
Output attenuator	in 1-dB steps (down to −99 dB)
Attenuator error	typ. ≤±0.25 dB
Connector	N female (50 Ω)
VSWR	≤1.3 (6 dB attenuation) ≤1.2 (≥10 dB attenuation)

Selective demodulator (receiver)

Frequency range	25 to 1000 MHz
Tuning	by YIG oscillator of sweep generator; switch-selected AFC
Maximum input (V_{rms})	≤10 V (input attenuator 40 dB)
Input sensitivity	<2 μV ≙ −101 dBm (attenuator −10 dB, IF bandwidth 30 kHz, video bandwidth 1 kHz), ≙ −116 dBm/kHz
Power range	0 to 2 W; with ext. attenuation (max. 60 dB) up to 2 kW depending on IF attenuator
Connector	N female (50 Ω)
Input attenuator	−10/ ... /+40 dB (10-dB steps)
VSWR	≤1.3 for switch position ≥0 dB
Attenuator error	≤±0.2 dB/10 dB; max. ±0.5 dB
IF attenuator (lin display only)	0/ ... /−60 dB (10-dB steps), continuous between steps
Attenuator error	≤±0.2 dB/10 dB (down to −50 dB); max. ±0.8 dB (down to −60 dB)
Dynamic range with log display	>80 dB ±1 dB (down to −70 dB)
Dynamic range with lin display	20 dB ±≤3% of fsd
Display range (V_{rms})	10 V to 2 μV (≙134 dB), depending on attenuator settings
IF bandwidth	30, 100 or 300 kHz
Demodulator	for AM signals
Video bandwidth	150 kHz approx. or ≤1 kHz

Usable screen area	limited by top horizontal graticule line with position control fully clockwise and Y×1
Frequency response flatness	≤2 dB from 25 to 600 MHz ≤3 dB from 600 to 1000 MHz (max. 0.4 dB/10 MHz)
AF output (rear)	0.1 V/div., f_{max} = 150 kHz

Analyze mode (specifications continued)

Intermodulation products (input attenuation 0 dB)	≥64/≥70 dB down with vision carrier amplitude (rms) 100/30 mV (for vision/sound carrier ratio 0/−10 dB)
Harmonics (input atten. 0 dB)	≥40/≥50 dB down at 100/30 mV rms input
Any spurious frequencies (without input signal)	≥70 dB down (ref.: max. display)

Broadband demodulator

Frequency range	3 to 1000 MHz
Display sensitivity	1/5/10 dB/div.
Max. input voltage	V_{rms} ≤5 V, V_{DC} ≤10 V
Connector	N female (50 Ω); VSWR ≤1.2
Dynamic range	60 dB (5 V to 5 mV)
Display error	≤±1.5 dB (down to −50 dB)
Input voltage from LFM 2	≥200 mV_{rms}

AF input

Connector	BNC female; Z_{in} ≥500 kΩ
Frequency range	0 to 10 kHz
Deflection factor	0.5 mV/div.

Display section

CRT screen	80 mm×100 mm; illuminated graticule
Colour/persistence	green/medium (GP)

Y axis

Deflection factor	10 mV/div. to 0.5 V/div.
Expansion (sweep mode)	×2
Frequency range	0 to 12 MHz (DC coupling) 0.3 to 12 MHz (AC coupling)
Bandwidth (3 dB)	12 MHz (≤±0.2 dB at 5 MHz)
Tilt 50 Hz/15 kHz	≤±1%
Black level modulation	≤±1%
Permissible DC voltage components	±250 mV for 10 mV/div. up to ±2.5 V for ≥100 mV/div.

Y input

Loop-through filter input	75 Ω (switch-selected termination); suitable without termination for attenuator probe (1 MΩ shunted by 35 pF); BNC female
Return loss	≥34 dB (up to 6 MHz)
Attenuation, continous	≥1:2.5
steps	1:1/2/5/10/20/50
Calibration squarewave generator (oscilloscope mode)	V_{pp} = 0.8 V
Amplitude error	≤±1%
Duty cycle	2

Timebase

Scale (oscilloscope mode)	0.1 µs to 0.2 s/cm; external; manual
Expansion	×20 (not for <5 µs/cm)
X input (rear)	0 to +5 V; max. 50 Hz
Sweep control	automatic
Single (sweep mode)	by pushbutton or external 5-V pulse

Triggering

Trigger level	normal/50 Hz: adjustable, V_1/V_2/H: fixed
Trigger sources	ext./int./AC supply
Polarity	+/− switch-selected
Threshold, internal	3 divisions
external (BNC female, rear)	V_{pp} = 1 to 4 or 4 to 20 V

Beam brightup

MAN/EXT mode	forward sweep and retrace on
Sweep and analyze modes	
→	forward sweep on, retrace blanked
⇄	forward sweep and retrace on, zero line in retrace
Oscilloscope mode	forward trace on, retrace blanked

Digital display

Level-line adjustable	manually
Digital display	3½ digits (LED)
Units	V, mV, µV, W, mW, dBµV, dBpW, dBn, ΔdB (storage for forming difference), MHz
External attenuation setting taken into account by microprocessor	up to 59.9 dB, adjustable (depending on attenuator setting)

Calibration

Switch position CAL	10 dB input attenuation, sweep generator on, output level 100 mV ±0.3 dB
Calibration procedure	connect generator output to receiver input, adjust lin or log display to level line

Group-delay measurement (in conjunction with LFM 2)

Selective demodulator (MUF 2) in LIN mode

Input voltage range	min. 10 mV_{rms}	max. 10 V_{rms}
with attenuator setting	IF: −20 dB RF: 0 dB	IF: 0 dB RF: 40 dB
Group-delay error	≤20 ns/10 dB with level variation ≤8 ns/10 MHz with frequency var.	

Wideband demodulator (MUF 2)

Input voltage range (V_{rms})	200 mV to 1 V (internally adjustable to 5 V)
Group-delay error	same as above

Recommended extras

Mixer MUF 2-Z2	25 to 1000 MHz; 50 Ω
Frequency response flatness	≤±0.1 dB (over 10 MHz)
Conversion loss, 25 to 800 MHz	20 dB ±2.5 dB
above 800 MHz	20 dB +3/−2 dB
IF input	≤50 mV_{rms} ≤100 mV_{rms} for approx. measurement
Mixer oscillator input	50 to 250 mV_{rms}
Return loss	>10 dB (IF input: >20 dB)
Connectors	N female (IF input: N male)
Intermodulation (100 to 1000 MHz, V_{in} = 50 mV_{rms})	
Spurious frequency rejection	>60 dB (V/S ≙ 0/−10 dB)
Intermodulation rejection	>70 dB (V/S/SB ≙ −8/−10/−16 dB or −3/−10/−20 dB)
Supply voltage	+15 V (MUF 2) or +12 V (LFM 2)

Amplifier MUF 2-Z3	10 to 1000 MHz; 50 Ω
Gain	27 dB ±1.5 dB
RF input	max. 25 mV_{rms} } for harmonics
RF output	0.5 V (into 50 Ω) } down ≥40 dB
Return loss	input: ≥15 dB; output: ≥11 dB
Connectors input/output	N female/N male
Supply voltage	same as Mixer MUF 2-Z2

VSWR Bridge (50 Ω)	**ZRB 2**
Frequency range	5 to 2500 MHz
Connector: input and output	N female
Test item	N female
Directivity	≥46 dB
Insertion loss	7 dB

Demodulator SWOB 3-Z (probe with BNC male connector)

Frequency range	0.5 to 400 MHz (approx. measurement up to 1000 MHz)
Impedance at 50/200 MHz	≥30 kΩ shunted by 2 to 3 pF/≥10 kΩ
Input voltage	min. 50 mV (full display height), max. 5 V RF, DC component up to 100 V

General data

Rated temperature range	+5 to +40 °C
Operating temperature range	0 to +50 °C
Storage temperature range	−20 to +70 °C
AC supply	115/125/220/235 V +10/−15%, 47 to 63 Hz (120 VA)
Dimensions, weight	492 mm×250 mm×530 mm, 24 kg

Ordering information

Order designation (50 Ω)	▶ TV Transcope MUF 2	
	IF 38.9 MHz	Diff. IF
	337.0013.52	337.0013.55

Accessories supplied: RF connecting cable (100 cm, 50 Ω, N male connector) 155.0055.00, power cable, manual

Recommended extras

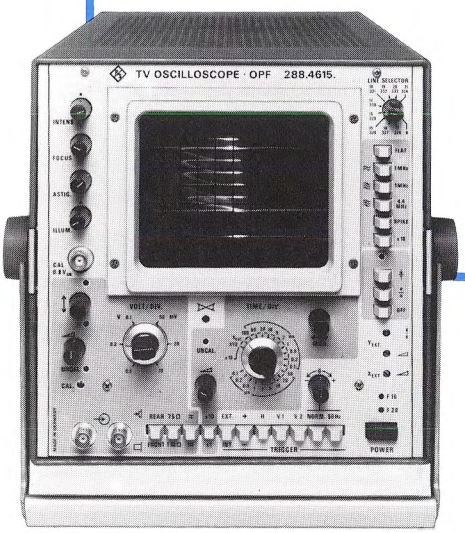
Connecting Cable for LFM 2 with Serial Nos. 871739 and 300974	MUF 2-Z1	337.7824.00
for remaining LFM 2 models	MUF 2-Z4	337.7830.00
Mixer	MUF 2-Z2	349.8820.50
Amplifier	MUF 2-Z3	353.5816.50
Cover (plus holder for mixer, amplifier and VSWR bridges)	MUF 2-Z5	337.7747.00
XY Recorder Adapter	LFM 2-Z5	340.5735.02
VSWR Bridge	ZRB 2	373.9017.52
Demodulator (probe)	SWOB 3-Z	241.2116.00
10:1 Attenuator Probe (compensation range 10 to 40 pF)	UTKS	241.0013.00
1:1 Probe	UTKS	241.1310.93
Carrying case (750 mm×550 mm×380 mm)		190.5695.00

OPF

TV Oscilloscope OPF

♦ 0 to 12 MHz

- Oscilloscope for monitoring and servicing with test line selection and exchangeable masks
- Phase angle measurement on vision carrier (also in test line 17)
- High overdrive capability and noise voltage suppression
- Use as VDU



The **TV Oscilloscope OPF** is used for in-service monitoring of video signals and for maintenance. It enables high-accuracy measurements in the **full field** and in the **test lines.** Moreover, in conjunction with the TV Demodulator AMF 2 (Q signal), **phase angle measurements** can be performed on the vision carrier.

Y inputs, switch-selected (female BNC connectors), AC or DC coupling:

1. 75-Ω loop-through filter input on front panel (termination switch-selected); without termination suitable for probe (1 MΩ || 35 pF)
2. 75-Ω loop-through filter input on rear panel
3. Y input for XYZ mode on rear panel

The Y deflection can be adjusted in steps and continuously between 10 mV/div. and 0.5 V/div.

Calibration voltage A 1-kHz generator delivers a 0.8-V squarewave signal with an amplitude error of less than 0.5%.

Signal quality assessment For this purpose, the OPF provides the following facilities:

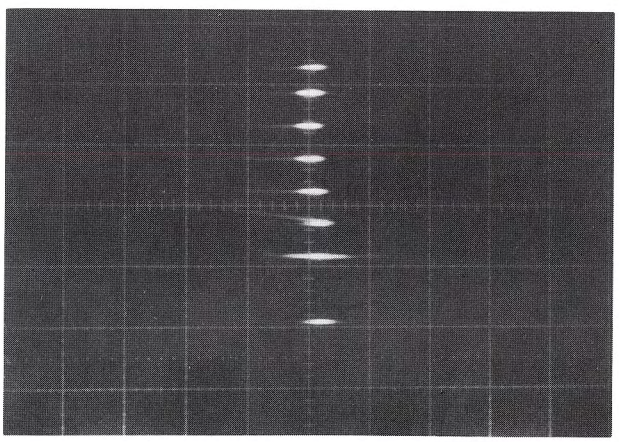
- **1-MHz lowpass filter** for suppressing higher-frequency signal components and the colour subcarrier
- **1-MHz and 4.43-MHz bandpass filters** for measuring the chrominance nonlinearity with the superimposed RF removed
- **S/N measurement** with 10×Y
- **Differentiator** with additional amplification for measuring the luminance nonlinearity with the aid of staircase signals

Clamping To suppress low-frequency noise signals, clamping to the back porch is provided. The circuitry is effective also for a superimposed satellite energy-dispersal signal.

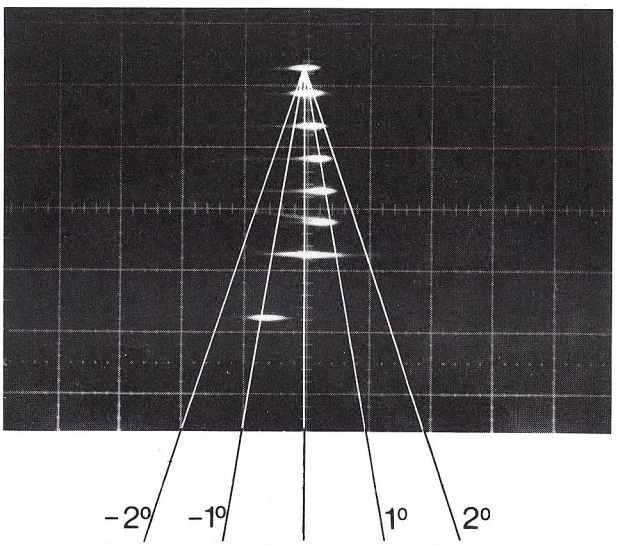
Timebase The timebase can be set between 0.1 µs/div. and 100 ms/div. From 5 µs/div., a tenfold expansion can be key-selected.

Triggering is possible in the internal and external modes (loop-through filter input on rear panel). In the case of internal V1 and V2 triggering, test lines 13 to 21 and 326 to 334 can be selected.

Measurement of the phase angle variation of the vision carrier is required for rapid evaluation of a TV transmitter (eg intercarrier S/N ratio, modulator balance, modulation characteristic). In the X_{EXT} mode, the OPF measures phase angle



Test line 17 (staircase), zero reference pulse and steps of staircase are located on straight line



Phase angle variation of vision carrier with overdriven amplifier stage

variations of 0.5° in the range of the video modulation. To this effect, the CVS is applied to the Y input and the quadrature component Q (which is a direct measure of the phase angle variation of the carrier) coming from the Q output of the TV Demodulator AMF 2 is fed to the X_{EXT} input. With H triggering, the full field is automatically unblanked on the screen whereas V1 or V2 triggering unblanks the selected test line and line 15 into which the zero reference pulse from the AMF 2 is inserted. The Q component appears on the screen as a horizontal marker set off from a vertical line (see diagrams on page 142).

Use as VDU To display **group-delay, amplitude** and **RF sideband characteristics** of TV transmitters (for instance in conjunction with the Group-delay Measuring Set LFM 2 and the Selective Demodulator LDS), the OPF can be used as a VDU via its rear inputs. In this case, fixed driving levels are used for the three axes so that no setting on the OPF is required. For **eye pattern** display of teletext signals, the OPF can be connected as a VDU for the Data Distortion Meter DZF (timebase via X_{EXT} input).

Design The OPF is easy to service: the individual PCBs can be swung out and the front panel lifted off without removing any panel controls. The ½ of 19″ unit is accommodated in a portable cabinet. A 19″ adapter is available for incorporation into racks. In addition, this adapter can also accommodate a monitor.

Specifications

CRT
Screen . . . . . 100 mm×80 mm (10 div.×12 div.); with plug-on graticules
Colour . . . . . green
Persistence . . . . . medium (GH)

Y axis
Deflection factor . . . . . 10 mV/div. to 0.5 V/div.
Frequency range . . . . . 0 to 12 MHz (DC coupling)
0.3 Hz to 12 MHz (AC coupling)
Frequency response
flatness up to 5 MHz . . . . . ≤±0.2 dB
12 MHz . . . . . ≤−3 dB
Tilt at 50 Hz . . . . . ≤±1%
15 kHz . . . . . ≤±1%
Black-level discontinuities . . . . . ≤±1%
Permissible DC voltage components . . . . . ±2.5 V at 100 to 500 mV/div.
±250 mV at 10 mV/div.

Y inputs
Loop-through filter inputs . . . . . switch-selected, front/rear panel; 75 Ω; switch-selected termination for front-panel input (without termination 1 MΩ || 35 pF, suitable for probe)
Coupling . . . . . DC/AC, switch-selected
Return loss . . . . . ≥34 dB (up to 6 MHz)
Isolation between inputs . . . . . ≥50 dB (each input terminated with **75 Ω**)
Total attenuation 1:125
continuous . . . . . ≥1:2.5 (balance point at 1 div.)
in steps . . . . . 1:1/2/5/10/20/50 corresponding to 10/20/50/100/200/500 mV/div.
Error . . . . . ≤±1%

Y_{REAR} input . . . . . time selector set to XYZ
Deflection factor . . . . . 0.1 V/div., ±10% adjustable (Z_{IN} approx. 10 kΩ)
Bandwidth (3 dB) . . . . . 500 kHz

Lowpass filter
Attenuation at 1 MHz/4.43 MHz . . . . ≤3 dB/≥40 dB

Bandpass filters
Centre frequencies . . . . . 1 MHz, 4.43 MHz
Gain . . . . . 3.6 × (superimposed chrominance (28%) amplified to CVS amplitude)
Inherent error . . . . . ≤1%

Staircase differentiator . . . . . for test lines 17, 330
Gain . . . . . 7.14 × (riser height amplified to CVS amplitude)
Inherent error . . . . . ≤1%

Signal/noise measurement (Y × 10)
Level . . . . . 10×display height
Frequency range . . . . . 0.5 Hz to 5 MHz
Offset . . . . . 10×display height
Inherent signal/noise ratio . . . . . ≥40 dB

Clamping
for CCVS (CVS) with negative-going sync pulse . . . . . to black level
Hum suppression with ≤30% superimposed, referred to CVS . . . . . ≥40 dB
Black level discontinuities with any picture component, referred to CVS . . . . . ≤1%
Level . . . . . 2×display height

Calibration voltage generator
Amplitude . . . . . 800 mV_{pp} ±1%
Frequency . . . . . approx. 1 kHz
Duty cycle 2

X axis
Timebase (scope mode) . . . . . 1 µs/div. to 1 s/div. plus XYZ and X_{EXT}. (switch-selected in 21 steps)
Sweep control . . . . . automatic switchover from free-running mode to triggered mode in the presence of sync signals
Expansion . . . . . ×10 (not for 0.1 to 2 µs/div.)

X_{REAR} input, 10 kΩ . . . . . time selector set to XYZ
Deflection voltage . . . . . 0 to +5 V corresponding to full display width
Bandwidth (3 dB) . . . . . 500 kHz

X_{EXT} input, 75 Ω . . . . . time selector set to X_{EXT}
Deflection factor . . . . . 0.2 V/div., ±10% adjustable
Bandwidth (3 dB) . . . . . >4 MHz

Triggering
NORM., 50 Hz . . . . . level adjustable
V1, V2 . . . . . fixed level with test line selector set to zero
H . . . . . fixed level setting
Test lines for V1 . . . . . 13 to 21 | switch-
V2 . . . . . 326 to 334 | selected
Trigger source . . . . . EXT., INT., 50 Hz
Polarity . . . . . +, −
Response threshold
Position INT. . . . . ≤2 div.
Position EXT. (loop-through filter input for S signal) . . . . . 0.1 to 5 V_{pp}

Z axis
Unblanking . . . . . in forward sweep, in selected test line and line 15 with X_{EXT} and V1/V2 triggering or with H triggering in full field
Z_{EXT} input . . . . . 0/+5 V | for blanking
Z_{REAR} input . . . . . 0/+5 V | (Z_{IN} approx. 10 kΩ)

General data
Rated temperature range . . . . . +5 to + 40 °C
Operating temperature range . . . . . 0 to +50 °C
Storage temperature range . . . . . −20 to +70 °C
AC supply . . . . . 100/120/220/240 V +10/−15%, 47 to 63 Hz (80 VA) safety class 1 (VDE 0804)
Dimensions (W×H×D), weight
Bench model (½ 19″) . . . . . 260 mm×250 mm×490 mm, 12 kg
19″ rackmount . . . . . 483 mm×221 mm×506 mm, 10 kg
19″ bench model . . . . . 492 mm×250 mm×514 mm, 14 kg

Ordering information

Order designation . . . . . ▶ TV Oscilloscope OPF
Standard B/G, bench model (½ 19″) 288.4615.53
Standard M, bench model (½ 19″) 288.4615.56
Standard B/G, 19″ rackmount 288.4615.51
Standard B/G, 19″ bench model . . . 288.4615.52

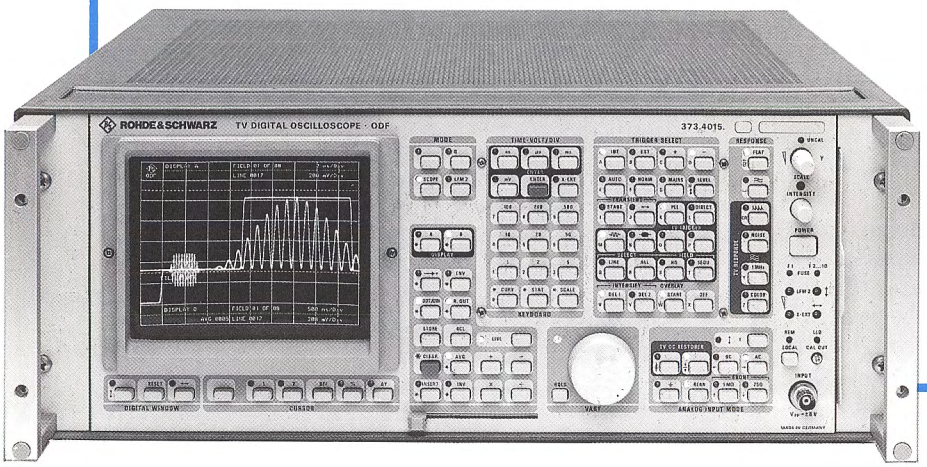
Accessories supplied
Graticules
for CCVS0 (RF) level . . . . . OPF-Z1 . . . 288.4750.00
for transient response . . . . . OPF-Z2 . . . 288.4738.00
for 2T pulse evaluation . . . . . OPF-Z3 . . . 288.4744.00
Phase angle graticule . . . . . OPF-Z4 . . . 288.4721.00
Power cord for bench model

Recommended extra
Junction Panel for 19″ rackmount . . . . . OPF-Z 288.4938.00

VIDEO SIGNAL DISPLAY

ODF

TV Digital Oscilloscope ODF ♦ 0 to 10 MHz



- High measurement accuracy due to 10-bit A/D converter (resolution 1024 steps)
- Great operating convenience and high-speed evaluation (16-bit processor)
- Flicker-free and bright display of insertion test signals thanks to digital storage
- Random noise suppression by signal averaging
- Display of tolerance masks as well as of data and parameters in alphanumerics
- Two cursors for evaluation
- Evaluation of differences between measured and stored signals

IEC 625 Bus

The **TV Digital Oscilloscope ODF** is a precision instrument designed especially for measurements on TV equipment. Comprehensive **storage capabilities** and test run control by a **16-bit microprocessor** open up completely new possibilities at high operating convenience. For system use the ODF is fitted with an IEC bus interface as standard.

Y inputs, switch-selected (female BNC connectors), DC coupling:

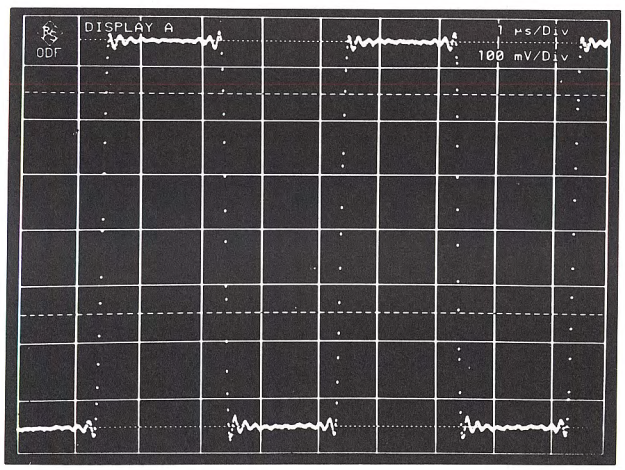
1. Front-panel input, switch-selected 75 Ω/1 MΩ || ≤30 pF
2. 75-Ω loop-through filter input on rear panel

Signal processing The sampled test signal is processed in a 10-bit A/D converter (1024 steps) and then stored. Random **noise** can be **suppressed** to a very large extent (diagrams on page 145) by multiple sampling and averaging.

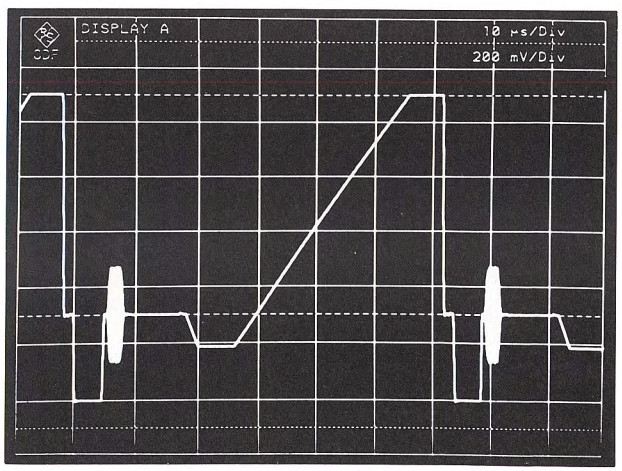
Display For display on the screen the stored digital values are read out with a repetition frequency higher than 50 Hz. This permits insertion test signals to be displayed **flicker-free and with the same brightness** as full field signals. Moreover, digital storage permits even single-shot signals to be retained for permanent display.

Display modes The ODF permits dot and vector display. If very steep edges are represented in the dot mode, only the edge sampling points are displayed (bottom left). In the vector display mode, the dots are joined yielding a full-line trace (bottom right).

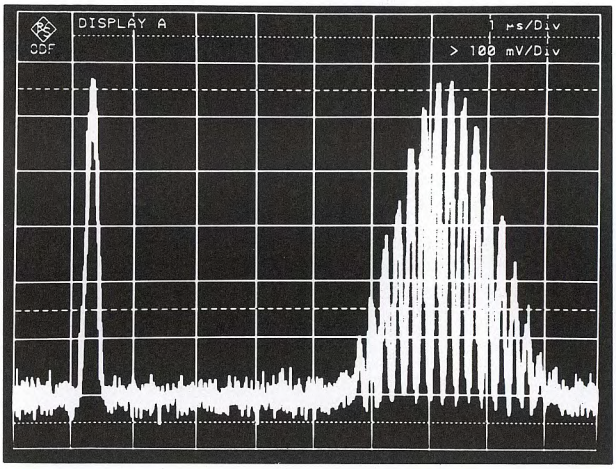
Insertion of stored quantities Both storable reference curves (e.g. shortcircuit measurement of test setup) and **resident tolerance masks** (eg for amplitude/or group-delay/frequency response in VDU mode) can be displayed together with the test curve. This helps to avoid parallax errors. Two **cursors** for evaluation can be independently positioned on two different traces. The relevant time and voltage differences are **displayed alphanumerically** on the screen (as well as the scaling of the Y and X axes).



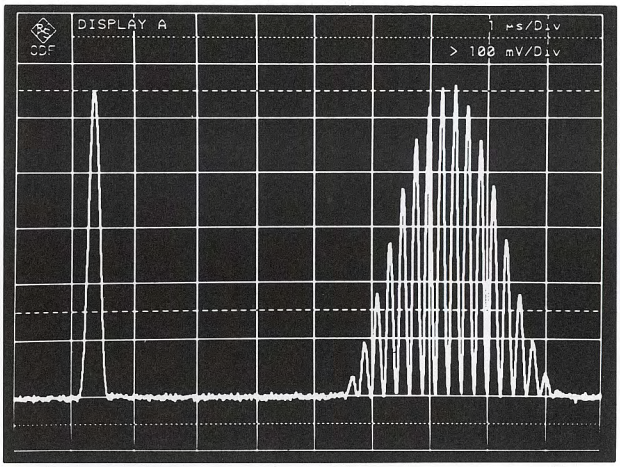
Dot display of 250-kHz squarewave
(Y: 100 mV/div.; X: 1 µs/div.)



Vector display of sawtooth signal with burst as solid trace
(Y: 200 mV/div.; X: 10 µs/div.)



Vector display of 2T/20T pulse (Y: not calibrated; X: 1 µs/div.), superimposed noise 34 dB_{rms}



Vector display of same signal, however, noise reduced by averaging 16 times; PLL-stabilized triggering

TV signal measurement For measuring TV signals, the ODF includes the following circuits:

- clamping circuit for hum suppression
- 1-MHz lowpass filter
- 1-MHz and 4.43-MHz bandpass filters
- staircase differentiator

Moreover, two independent display channels permit flicker-free display of two different sweep start delays with alternating refresh.

Timebase The timebase can be set between 100 ns/div. and 0.5 s/div. Down to about 500 ns/div., the test curve is digitized into about 1000 samples. At 500 ns/div. this corresponds to a cycle time of 5 µs for the entire screen width (maximum effective sampling frequency 200 MHz). This cycle time is maintained for 200 and 100 ns/div., the number of samples being reduced accordingly. Intermediate values are interpolated by the microprocessor.

Use as VDU An X deflection input enables use of the ODF as a VDU for swept-frequency measurements. The large number of sampling points as well as the capabilities of random noise suppression and signal storage ensure excellent test results even for extremely noisy signals.

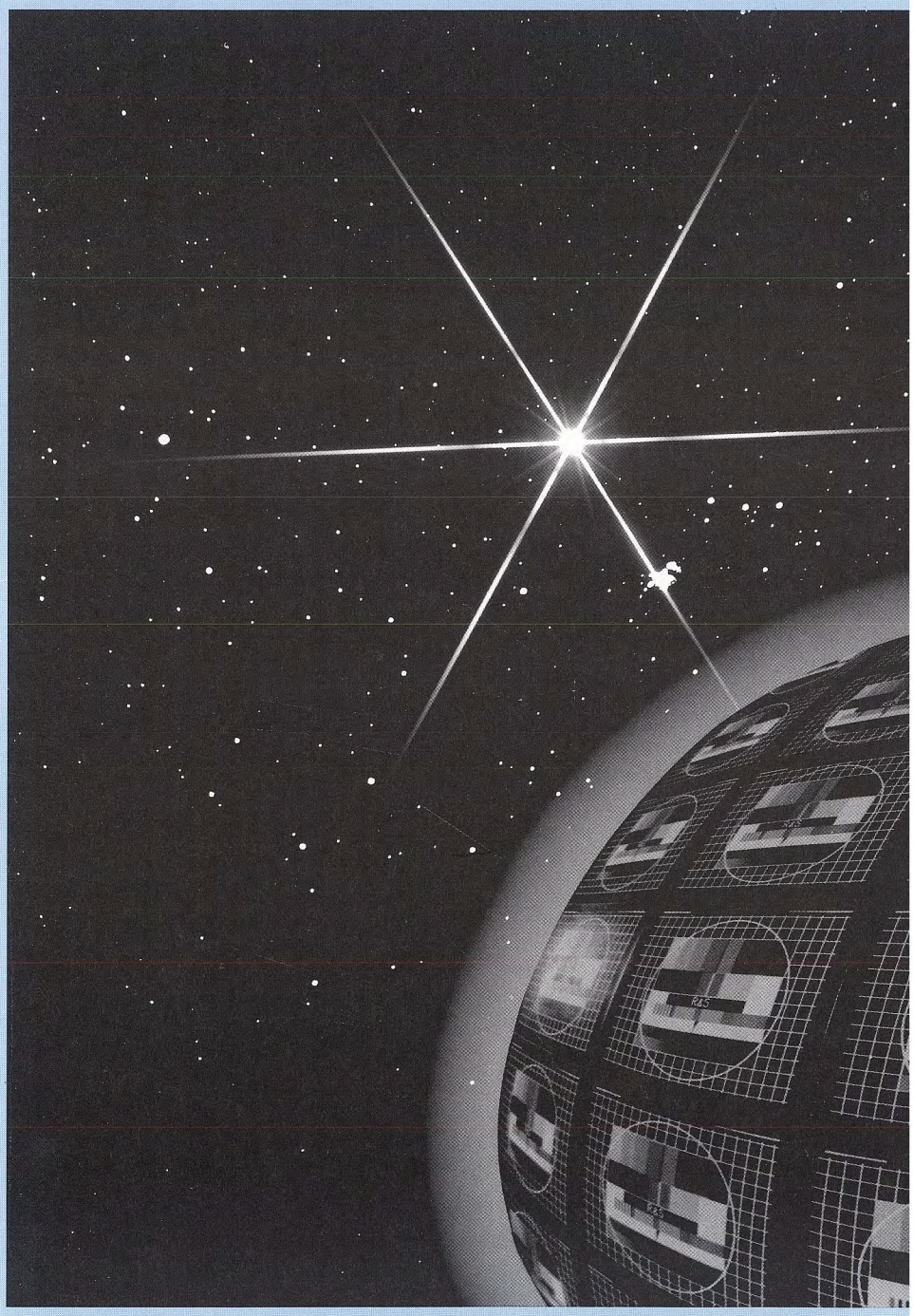
Specifications

Display	magnetically deflected CRT
Screen	130 mm×100 mm (flat-faced)
Colour	green
Persistence	medium (GH)
Repetition rate	about 60 fields/s
Graticules, tolerance masks and front-panel parameters	electronically inserted
Modes	dot or vector display
Y axis	
Resolution	1024 steps (≙ 10 bits)
Deflection factor	10 to 500 mV/div.
Frequency range	0 to 10 MHz (DC coupling)
Compensated DC voltage components	>±1.5 × display height
Y inputs	female BNC connectors
Front panel	1 MΩ ‖ ≤30 pF; 75 Ω can be added in parallel
Rear panel	75-Ω loop-through filter
Return loss	≥34 dB (up to 6 MHz)
Total attenuation	1:50
continuous	≥1:2.5
in steps	1/2/5/10/20
TV measurements	
Lowpass filter	
Attenuation at 1 MHz	≤4 dB
at 4.43 MHz	≥40 dB
Bandpass filters	1 MHz and 4.43 MHz
Gain	3.6× (superimposed chrominance (28%) amplified to CVS amplitude)
Staircase differentiator	
Gain	7.14 × (riser height amplified to CVS amplitude)
Clamping for CCVS (CVS)	to black level
Hum suppression with ≤30% superimposed, referred to picture signal	≥40 dB
Black level discontinuities with any picture signal	≤1%
X axis	
Timebase	100 ns/div. to 500 ms/div., switchable in 1/2/5 steps
Number of sampling points	
at ≥500 ns/div.	997
at ≤200 ns/div.	40/div.
Intermediate values for display	obtained by interpolation
X input	BNC, Z_{in} = 10 kΩ (max. 100 Hz)
Input voltage	0 to 5 V (full display width)
Triggering	
Trigger source	int./ext./mains
Trigger level NORM, AUT	adjustable
Mains	fixed
Field, line	automatically set to half the sync pulse height
Line selection	lines 1 to 625
Polarity selection	+/−
Start after delay	2 independent, selectable delay times with alternating refresh
Step width	1/1000 display width (min. 10 ns)
Max. expansion	≙ ×100
Remote control	interface to IEC 625-1 (IEEE 488)
General data	
Rated temperature range	+5 to +40 °C
Operating temperature range	0 to +50 °C
Storage temperature range	−20 to +70 °C
AC supply	100/120/220/240 V ±10%, 47 to 63 Hz (330 VA)
Dimensions (W×H×D), weight	
19″ bench model	492 mm×205 mm×514 mm, 25 kg
19″ rackmount	483 mm×177 mm×506 mm, 22.5 kg

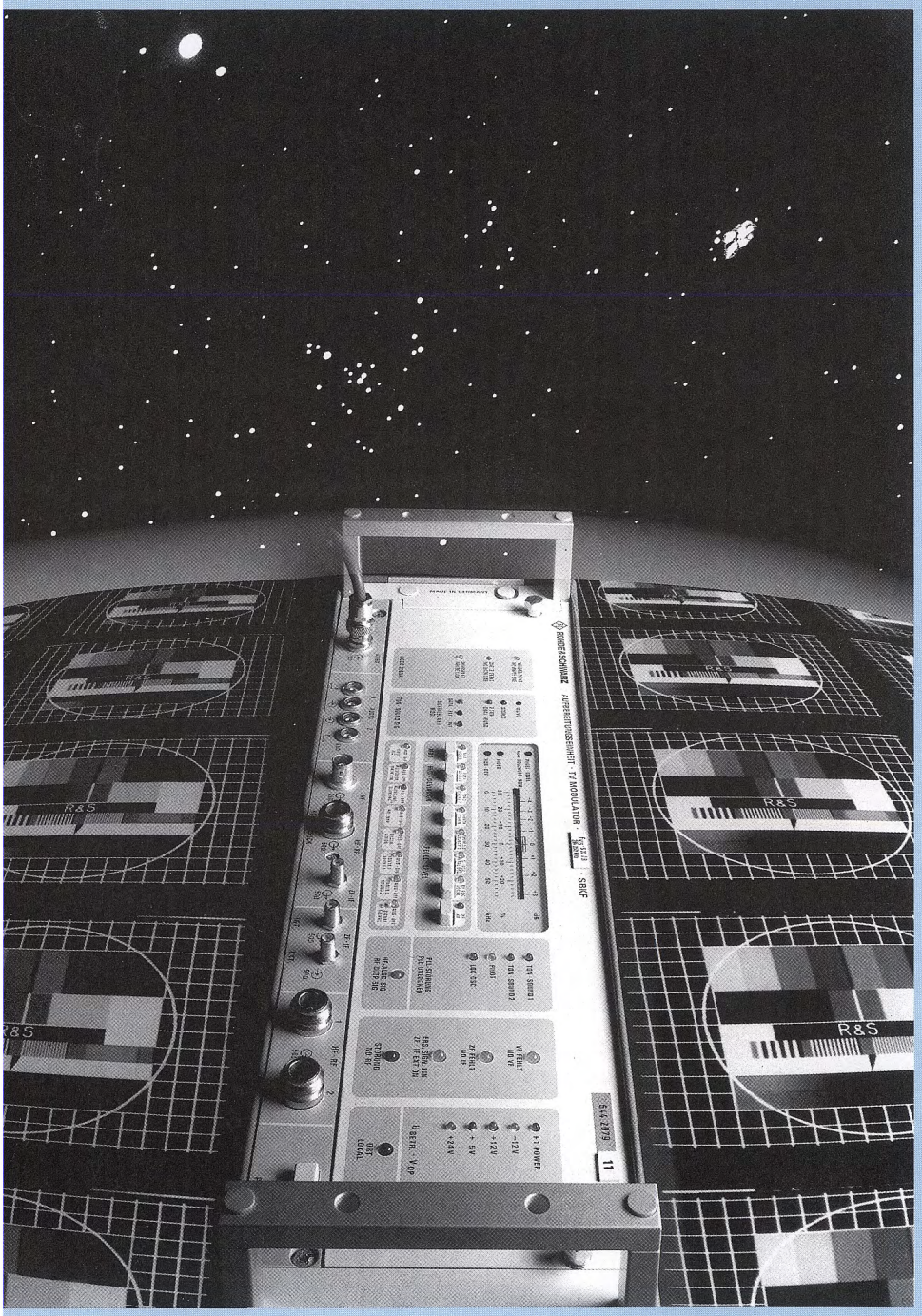
Ordering information

Order designation	▶ TV Digital Oscilloscope ODF
19″ bench model	373.4015.52
19″ rackmount	373.4015.51
Accessories supplied	power cord

Broadband TV Transmitter SBKF
for feeding programs in the
47 to 440 MHz cable frequency range;
see page 150 for further details



broadband and satellite measuring and communications equipment



This section contains equipment for the transmission and distribution of sound and television broadcasting signals using broadband cable systems and satellites.

Section 1 of this catalog describes general radio-relay measuring equipment.

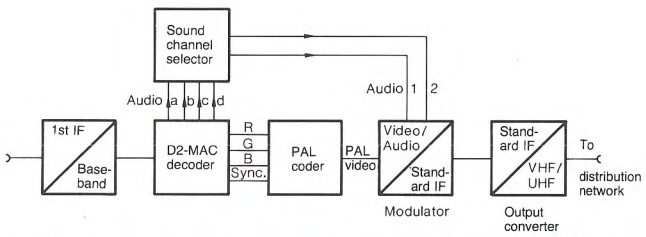
Satellite and broadband communications

Satellite communications The satellites, which are currently in operation, transmitting radio and television programs for Europe, operate at a transmit frequency band of 11.7 to 12.5 GHz with five channels (TDF 1) or 16 channels (Astra).

The receiver systems comprising parabolic antennas with diameters of 30 to 400 cm. Converters in the outdoor units convert the incoming signal into the first satellite IF of 950 to 1750 MHz (see frequency spectrum below) and, with sound broadcasting, to the 1 GHz level (DS1 standard, ie Digital Sound 1.024 Mbit/s) between 950 and 1350 MHz.

Television programs In the indoor unit, the signals are then converted to the VHF special channels S3 to S10 and S11 to S20 in the 118 to 300 MHz band or to the special channels S21 to S40 in the hyperband of 300 to 470 MHz. The signals are converted for distribution in cable networks.

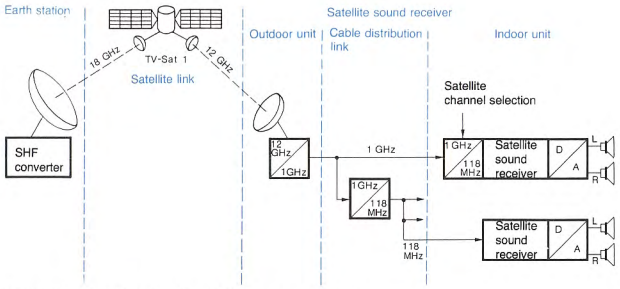
With D2-MAC signals, remodulation into existing standards such as PAL and SECAM is necessary (figure below) if no wide hyperband channels are available. Experimental broadcasts via satellite in the D2-MAC standard are starting in 1989. D2-MAC receivers will be available as of Autumn 1989.



Block diagram of converting D2-MAC signals into PAL signals with vestigial sideband modulation

D2-MAC signals are transmitted over satellites in frequency modulation. For existing broadband communication networks, they are first converted to vestigial sideband modulation at bandwidths of 5.5 MHz, for example (channel spacing 7 or 8 MHz). The D2-MAC signals can also be transmitted in these cable networks, although at lower quality.

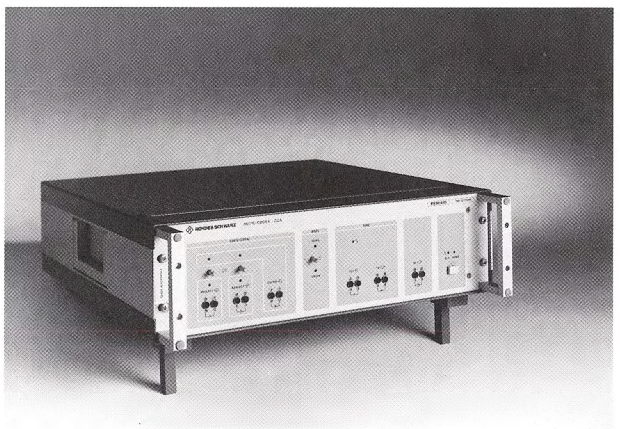
Radio programs In digital satellite sound broadcasting, the program signals are converted to the DS1 standard at the studio output. In West Germany, the data stream is passed on in a DS2 data channel (2 Mbit/s). After 4-PSK modulation (four-phase shift keying), the signals are converted to the satellite IF and then to SHF in the transmit frequency band of 17.7 to 18.1 GHz for the TV satellite transmission link. In this transmission link, a maximum of 16 DS1 signals are combined by data multiplexers. The satellite transmits in the 12 GHz band, from which the outdoor unit converts into the 1 GHz band.



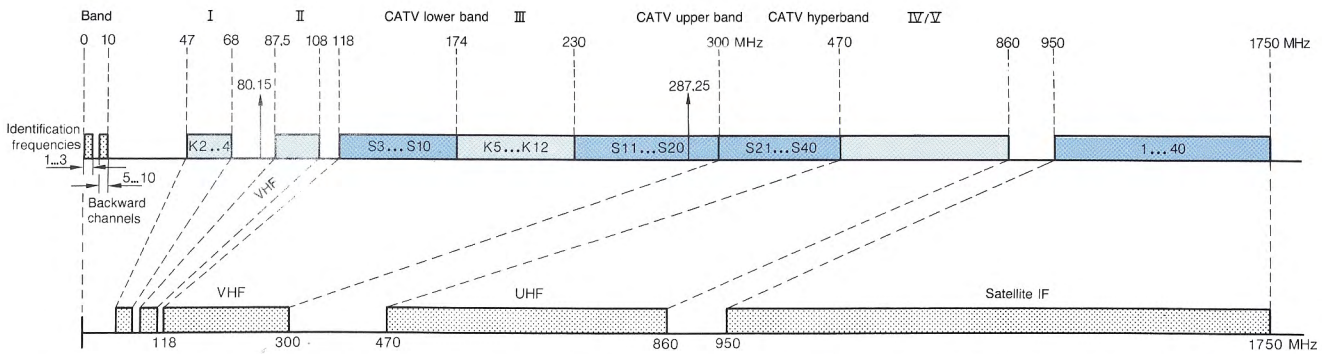
Transmission diagram for digital sound signals

In-service and measuring equipment

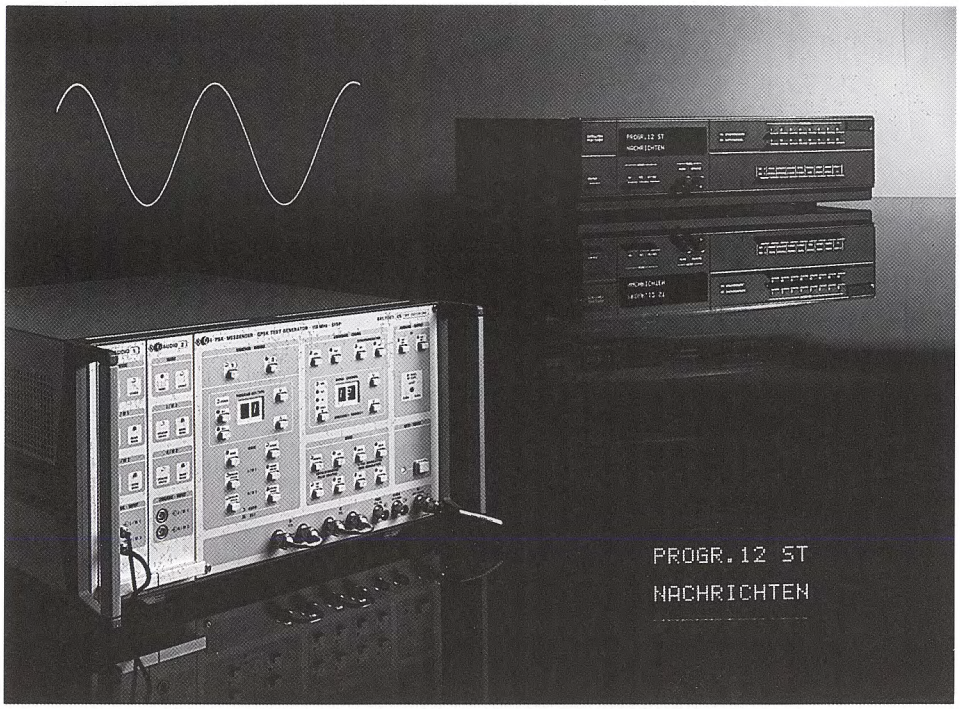
Digital sound transmission The **Audio Coder DCA** (photo below) and, as a reference, the **Audio Decoder DDA** (see catalog Section 1) are used to measure sound microwave receivers which decode in the data format DS1. The units are also used as in-service equipment in radio-relay.



Audio Coder DCA



Frequency distribution in satellite and broadband communications; CATV lower and CATV upper bands: special channels for cable networks; CATV hyperband: hyperband special channels



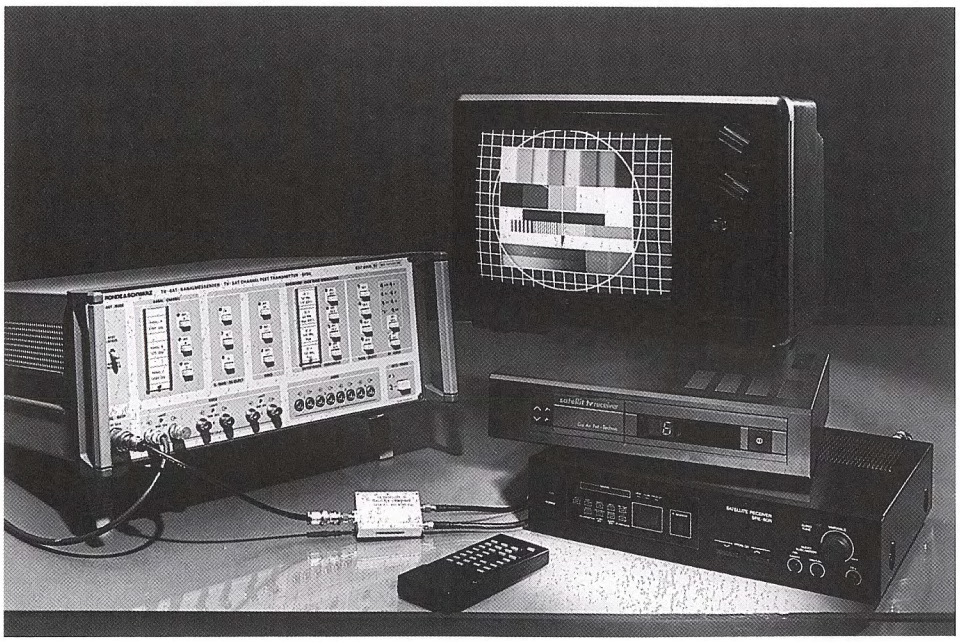
4-PSK Test Transmitter SFSP

The **4-PSK Test Transmitter SFSP** (photo above) and the **Satellite IF Test Transmitter SFSZ** are available for measurement at satellite sound signal receivers. The SFSP supplies a signal containing a maximum of 16 digital or analog stereo signals on a 118 MHz carrier (corresponding to a signal reflected by the satellite). This signal is converted in the SFSZ to one of the standardized satellite intermediate frequencies between 50 and 1750 MHz. It is also used as a test signal in satellite tuner production and testing.

Transmission of television pictures Not only the SFSZ and the **TV Satellite Base Signal Combiner SFSA** but also the **TV Satellite Channel Test Transmitter SFSK** (photo below) are used in receiver production. The SFSK generates three carrier signals in the 900 to 1750 MHz band and they can be modulated by a video signal and a maximum of four sound subcarriers.

The **TV Syncer** (photo below), which keys sync pulses to the D2-MAC signal, is for D2-MAC signals. Monitors and oscilloscopes with sync signal inputs can thus show a television still. The SYNCER is also used as an indicator for CVS signals.

TV Syncer

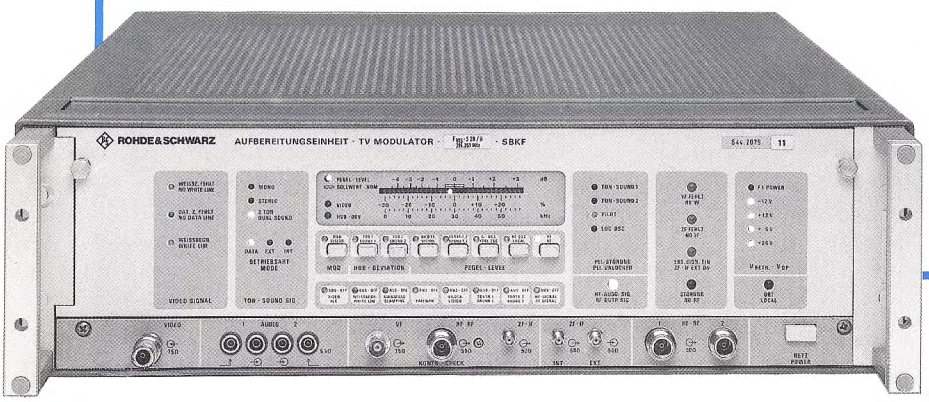


TV Satellite Channel Test Transmitter SFSK

SBKF

TV Modulator SBKF*) ♦ 47 to 68 and 104 to 440 MHz
10 dBm (into 50 Ω)

- Single-channel TV modulator for standard RF signal
- Crystal-referenced conversion to channel frequency
- Dual-sound modulation – integrated dual-sound coder
- Simple channel changing by module exchange



The **TV Modulator SBKF** is a low-power TV transmitter whose main application is for feeding programs into the headend stations of cable television networks. The baseband signals are sent via satellites, radio-relay links or lines. They are modulated on the standard intermediate frequencies and converted crystal-referenced to the TV channel frequency.

The SBKF has a very flexible, low-maintenance modular system. It can be equipped with four flat modules (see circuit diagram on the opposite page):

- **vision modulator,**
- **sound modulator** for sound 1 and sound 2 with integrated dual-sound coder,
- **transmitter section** (10 dBm max. into 50 Ω) for band I, lower band, band III, upper band or hyperband (see specifications),
- **video module** (option) with automatic video-level control and/or integrated data-line decoder.

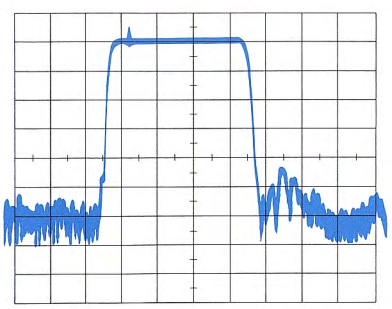
High availability All units providing wide-area coverage of TV signals from a receiving system must have a guaranteed high availability. The transmitter section of the SBKF is therefore of broadband design with separate passive and active sections. All selective filters are contained in a passive subassembly, thus eliminating the need for time-consuming retuning and adjustments when a transmitter section needs to be changed for servicing. This ensures high reliability of the transmission characteristics.

*) The TV Modulator SBKF bears the Deutsche Bundespost designation AbETV(M) in compliance with the Technical Terms of Delivery No. 5820-3035 of the DBP.

Vision modulator

In the vision modulator, the applied video signal is fed via a receiver group-delay equalizer (can be bypassed) to the modulator stage. The ring modulator operates with level clamping (back-porch clamping or simple average-value rectification). A white-level limiter in the signal path operates in the event of excessive video level, ensuring the maintenance of the residual carrier necessary for intercarrier formation in the domestic receiver. The operation of the white-level limiter is indicated on the front panel. The IF carrier signal (38.9 MHz) is generated by a crystal oscillator. Voltage-controlled frequency adjustment is available on the front panel of the module.

Adjacent-channel occupancy The large number of channels to be transmitted in broadband cable networks makes it necessary to utilize adjacent channels. The vision modulator is therefore fitted with a SAW filter of high selectivity (Standard B/G; for selectivity response, see below).



Selectivity response of SAW filter in vision modulator of SBKF

At the output of the modulator, a coupler adds the vision and sound IF signals together. In a further coupler, the combined IF signal is divided to provide for the control of the transmitter section and for a front-panel check output. By switching a relay, the transmitter section can be controlled with an external IF signal applied to the front panel. The sync pulses processed in the vision modulator are monitored for compliance with permissible tolerances regarding amplitude and frequency. Failure of the composite video signal is signalled.

Sound modulator

The sound modulator is available as a mono or dual-sound module. The dual-sound model contains a TV dual-sound coder and modulators for sound 1 and sound 2. The frequency-modulated IF signals for mono, stereo or dual-sound operation are added to the IF vision carrier by couplers. The IF levels are set to −13 dB (V/S1) and −20 dB (V/S2). An adjustment of about ±3 dB is possible in the sound-modulator module.

Dual-sound coder The integrated dual-sound coder in the sound-modulator module encodes the AF signals according to the dual-sound carrier technique. The type of program – mono/dual-sound/stereo – is identified by a pilot carrier amplitude-modulated with an identification frequency. The pilot carrier and identification frequency are synchronized with the line frequency when vision modulation is present. The frequencies of the pilot carrier and identification signal are derived by dividing the signal from a crystal oscillator. The operating modes (mono/dual-sound/stereo) can be selected externally with two lines connected to the 30-contact connector or by the data-line decoder in the video module (option).

Frequency stabilization The frequencies of the free-running oscillators for the sound -1 and sound -2 IFs in the sound modulator are frequency-modulated by the output signals of the dual-sound coder. The centre frequency is stabilized by frequency and phase control using the line frequency as a reference or – if this deviates by more than 2 Hz from its nominal value – the unmodulated vision IF. Thus extremely high accuarcy of the spacing between vision and sound carriers is ensured.

Transmitter section

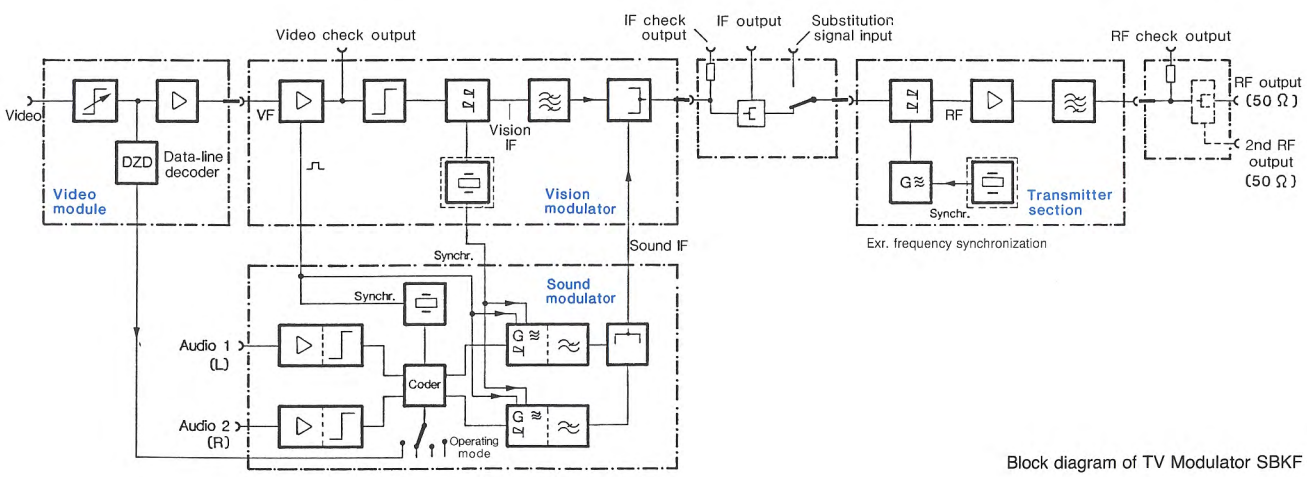
The transmitter section converts the combined standard IF signals output by the modulators into the required output channel for the broadband cable network. The oscillators for converting the vision and sound IF signals to the channel frequency can, in each case, be tuned through one broadband communication frequency band.

SBKF band filters and oscillators

Broadb. com. band	Frequency range	Conversion oscillator
Band I	47 to 68 MHz	85 to 107 MHz
CATV lower	108 to 174 MHz	147 to 213 MHz
Band III	174 to 230 MHz	213 to 169 MHz
CATV upper	230 to 300 MHz	269 to 339 MHz
CATV hyper*)	300 to 440 MHz	330 to 480 MHz

The conversion oscillators are synchronized with one of the harmonics of the channel-frequency crystal in a phase-locked loop. The conversion oscillator may be synchronized by an external frequency source. The frequency-determining sections are, as already mentioned, grouped in an active subassembly (conversion oscillator and channel-frequency crystal) and a passive subassembly (channel filter, output filter, selection filter for reference frequency and generation of display and control voltages), which can easily be exchanged in the event of a fault.

*) on request



Block diagram of TV Modulator SBKF

SBKF – TV Modulator

RF outputs Depending on the model, the RF outputs available on the front panel are a single output of 10 dBm into 50 Ω or two identical outputs of 7 dBm into 50 Ω isolated by at least 26 dB. In both cases, a check output is provided, coupled out with an attenuation of 25 dB.

Level control Level variations at the IF interface or temperature-dependent level changes in the transmitter section are compensated for by automatic level control, thus providing a constant system level for the connected cable-TV network. The level control is practically independent of the sound carrier (if the sound carrier is switched off, the vision carrier varies by a maximum of 0.3 dB). The level control can be turned off for test purposes.

Impedance transformers The input and output impedances of the coupling networks are 50 Ω. For matching the 50 Ω coupling network to the 75 Ω distribution system, 50 Ω/75 Ω impedance transformers are provided. If the video signals need to be fed by cable over long distances, for instance from the satellite receiving system to the cable-TV distribution equipment, video-amplitude equalizers (cable equalizers) for each channel can also be accommodated in the SBKF rack as can equipment for automatic or remotely controlled switching of substitution signals.

Video module (option)

The video module option contains two functional units:

- data-line decoder
- video level control

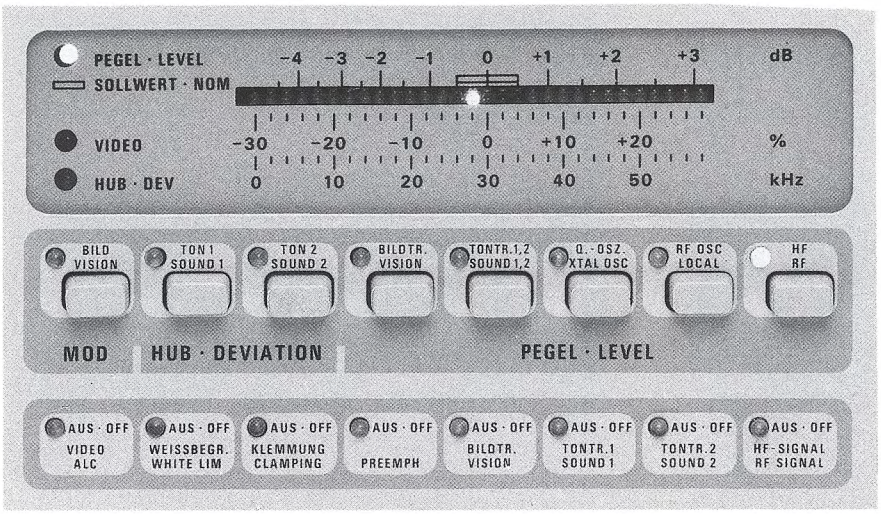
Data-line decoder The data-line decoder evaluates word 5 in data line 16 and controls the mono/dual-sound/stereo operating modes in the dual-sound coder with bit 1 and bit 2. If more than three data lines fail, reset to dual-sound operation is initiated after about 3 s. The indications "no data line", operating mode (mono/dual-sound/stereo) and "data" for control from the data-line decoder or "ext" for external control lines are displayed on the front panel.

Video level control After demodulation, the video level control circuit compensates for level variations occurring on the signal path via satellite or microwave links so that, after remodulation in the SBKF according to the standard in use, a precise residual carrier is ensured. The luminance bar in test lines 17 and/or 330 is used as the reference between the black and white levels. A freely programmable counter also allows luminance bars differing from the CCIR standard to be evaluated. If the luminance bar is missing or is not transmitted, switchover to nominal value of the video gain is made and "no white line" and "video ACL off" are signalled on the front panel. The automatic level control can be turned off for text purposes.

System application

Coupling networks Up to six TV Modulators SBKF (if required, one as standby) can be accommodated in a 19″ rack (40 units high)(photo right); one SBKF is required for each TV channel. Coupling networks combine the output signals of the SBKFs into a carrier-frequency multiplexed signal. The coupling networks between the TV signals and non-interaction between the selective outputs of the transmitter sections with their narrowband matching.

Two 19″ racks each with six TV Modulators SBKF



LED display with selector keys for modulation voltage of video signal, deviation and level (RF, oscillator, IF) as well as status indicators

Design

Display of operating parameters Operating parameters such as RF output level, mixer current, crystal oscillator level with PLL lock, IF level, video level and sound-carrier deviation can be easily checked with a display (row of LEDs) on the front panel. The setting controls for the operating parameters are in the modules concerned and are accessible after hinging the front panel open.

Inputs and outputs The input connectors (video, audio, external IF) and output connectors (IF, RF and check outputs for video, IF, RF) are all mounted on a fixed strip on the front panel. Remote-control commands, signalling and fault messages can be input and output via a 30-contact connector on the rear panel of the SBKF.

Hinged front panel For test and servicing purposes, the front panel can be swung open; it is also fitted with fault and monitoring indicators. Switches for functions such as white limiter, clamping, preemphasis, IF and RF signals are only accessible with the front panel hinged, thus preventing settings from being unintentionally altered during the transmission of TV signals. The operating status is indicated by LEDs on the front panel. With the front panel swung open, the plug-ins can be pulled out like drawers on telescopic rails for servicing without having to disconnect cables or connectors.

Specifications

Vision modulator

Video input signals	CCVS (PAL, NTSC, SECAM)
Signal level for 10% residual carrier	0.7 to 1 V_{pp} CCVS, internally adjustable
Permissible DC offset	≤±6 V
Video signal input	BNC connector (front panel); 75 Ω
Return loss	≥34 dB (10 Hz to 5 MHz)
IF section	
Input/output of crystal oscillator	SMA connector, 50 Ω (rear panel of module), adaptable for use as input or output
Output voltage	approx. 200 mV (with external feed-in)
Input voltage	>100 mV
Vision carrier frequency (f_{vision})	38.9 MHz (Standard B/G)
Frequency deviation	≤±2 kHz
Type of modulation	C3F (A5C), negative (Standard B/G)
Operating mode	vestigial sideband operation with receiver group-delay precorrection (can be bypassed)
Level clamping (selectable)	
Sampled	clamping to back-porch blanking level
Average value	for symmetrical modulation if there are no sync signals
Receiver group-delay precorrection	see next page, diagram below right
IF outputs	1st IF output (front panel) 2nd IF output (internal operating output) IF check output (front panel)
Signal	sum signal vision + sound 1 + sound 2
Output level vision/ sound 1/sound 2	83/70/63 dBpW for IF output 58/45/38 dBpW for IF check output
Output impedance	50 Ω (SMA connectors)
Return loss	≥20 dB (33.15 to 40.15 MHz)
Isolation between 1st and 2nd IF output	≥30 dB (30 to 50 MHz)
Required substitution signal level	83/70/63 dBpW (same as IF output)

Dual-sound coder

AF input signals	audio 1/audio 2 or L/R signals
Nominal signal level	+6 dBm for 30-kHz deviation, continuously adjustable from −4 to +10 dBm
Preemphasis	50 µs ±5%, switch-selected

TV Modulator SBKF

AF inputs (front panel)	approx. 12 kΩ, balanced; 2 pairs of connectors (RAX 0650 from Lemosa), can be connected to multi-contact connector (rear panel)	
AF output signals (coded)	sound channel 1	sound channel 2
Mono mode	mono (M1)	mono (M1) + pilot
Dual-sound mode	mono 1	mono 2 + pilot
Stereo mode	0.5 (L+R)	R + pilot
Deviation symmetry (adjustable in channel 2)	amplitude approx. ±0.5 dB, phase approx. ±3° (at 15 kHz)	
Pilot carrier	in sound channel 2	
Level	−15.6 dBm, ±6 dB adjustable (≙ deviation component ±2.5 kHz)	
Frequency	54.6875 kHz (≙ 3.5 f_H)	
Frequency stabilization		
with sync signals	synchronization with line frequency f_H	
without sync signals	by crystal oscillator, error ≤±5 Hz	
Mode identification	AM of pilot carrier with identification frequencies	
Mono mode	unmodulated	
Dual-sound mode	274.1 Hz (≙ f_H/57)	
Stereo mode	117.5 Hz (≙ f_H/133)	
Mode switchover	by external signal (CMOS) +12 V/0 V; e.g. from data-line decoder (see further below)	
Modulation depth, adjustable	m = 50% ±20%	

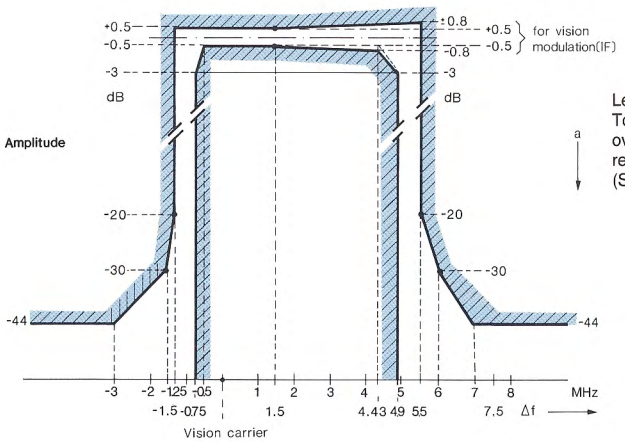
Sound modulator (sound 1 and sound 2)

Sound carrier frequency sound 1	33.4 MHz	} Standard B/G
sound 2	33.158 MHz	} Standard B/G
Centre frequency stabilization	by frequency and phase control	
Reference frequency	line sync pulse frequency or vision carrier frequency	
Output level		
Sound 1	76 dBpW	
Sound 2	69 dBpW	
Setting range	≤±3 dB, carrier can be separately switched off	

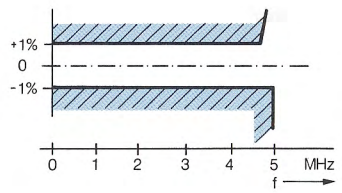
Modulation characteristics (Standard B/G)	measured with parallel-sound demodulation and decoder
Type of modulation	F3E (F3), with preemphasis
Modulation frequency response	≤±0.3 dB (40 Hz to 15 kHz), for channel 1 and 2, referred to 500 Hz, preemphasis off
Preemphasis	50 µs ±5%, switch-selected
Modulation distortion	≤0.5% (40 Hz to 15 kHz), deviation ±50 kHz (preemphasis off)
Crosstalk stereo	≥46 dB down (0.1 to 5 kHz) ≥40 dB down (40 Hz to 15 kHz)
dual sound	≥70 dB down (40 Hz to 15 kHz)
S/N ratio, referred to f_{mod} 500 Hz and ±30-kHz deviation, with deemphasis	
unweighted	≥70 dB
weighted (CCIR Rec. 468-2)	≥70 dB
Synchronous AM S/N ratio with f_{mod} 1 kHz and ±30-kHz deviation, referred to m = 100%	≥40 dB

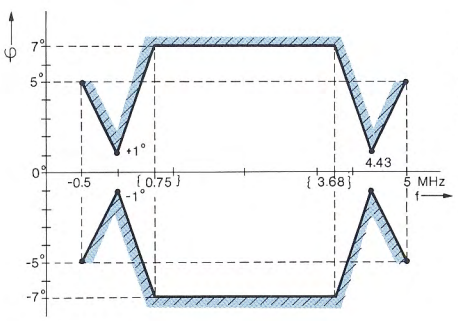
Transmitter section

Frequency range of broadband section	47 to 400 MHz
Frequency range of filter and mixer oscillator	tunable within one band, easily exchangeable modules
Band I	47 to 68 MHz
CATV lower band	104 to 174 MHz
Band III	174 to 230 MHz
CATV upper band	230 to 300 MHz
CATV hyperband	300 to 440 MHz (on request)
Frequency range of crystal oscillator	43.5 to 83.5 MHz; harmonics used as reference frequency for all bands; simple change of crystal
Frequency drift	≤±1×10⁻⁶, aging ≤2×10⁻⁸/day, pulling range approx. 5×10⁻⁶
External synchronization	via reference frequency input (SMA connector on rear panel)
IF input signal (Standard B/G)	
Carrier level vision/sound 1/sound 2	83/70/63 dBpW (≙ 0/−13/−20 dB), separately adjustable about ±3 dB

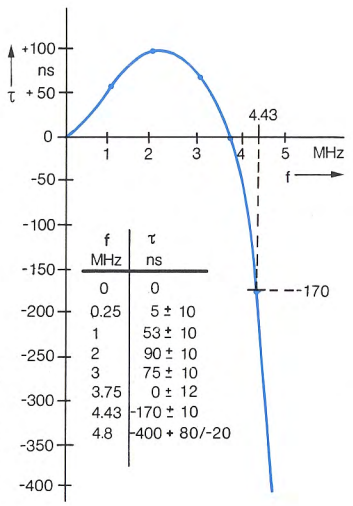


Left: Tolerance mask of overall frequency response of SBKF (Standard B/G)





Left: Tolerance mask for the phase characteristic calculated from the group delay response



f MHz	τ ns
0	0
0.25	5 ± 10
1	53 ± 10
2	90 ± 10
3	75 ± 10
3.75	0 ± 12
4.43	-170 ± 10
4.8	-400 + 80/-20

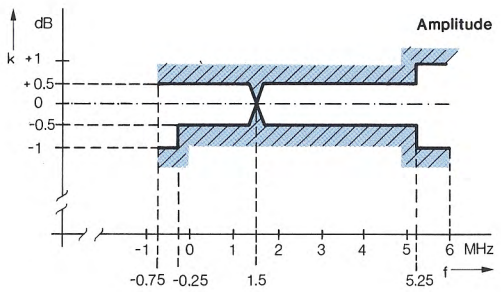
Right: Amplitude and group-delay characteristic of receiver group-delay precorrection in SBKF vision modulator

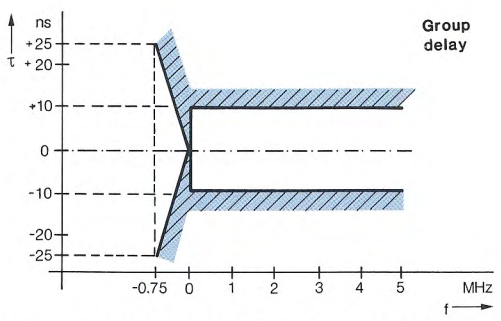
Group delay

RF output signal . . . . . max. +10 dBm into 50 Ω; automatic control, can be changed to manual control by shorting plug; 2 isolated 7-dBm outputs also possible
Output . . . . . N connector (50 Ω) on front panel; can be retrofitted to two isolated outputs
Return loss . . . . . ≥20 dB (−1.25 to +5.75 MHz, referred to f_{vision})
Level instability . . . . . ≤±0.5 dB

Transmission characteristics (Standard B/G)
Amplitude/frequency response . . . . .
Group-delay/frequency response . . . } see diagram on previous page left
RF S/N ratio (ref. to vision carrier level, nominal value: +9 dBm)
Spurious emissions . . . . . ≥63 dB down
Harmonic emissions . . . . . ≥70 dB down
Intermodulation products . . . . . ≥72 dB down (−0.75 to +5.85 MHz, referred to f_{vision})
Non-linearity of modulation characteristic . . . . . ≤3%, modulation 8 to 100%
Differential gain at colour subcarrier frequency . . . . . ≤2%, modulation 10 to 85%
Differential phase at colour subcarrier frequency . . . . . ≤1%, modulation 10 to 85%
VF S/N ratio (ref. to black-to-white transition)
0.1 to 5 MHz (weighted to CCIR Rec. 567-1) . . . . . ≥66 dB (rms value)
0 to 1 kHz . . . . . ≥56 dB (peak value)
1 kHz to 5 MHz, periodic distortion ≥60 dB, selective measurement, bandwidth ≤30 kHz

Checking facilities (vision modulator, sound modulator, transmitter section)
Analog display (row of LEDs) . . . . . key-selected indication of: video signal; deviation for sound 1 and sound 2; level of IF vision carrier, IF sound carrier 1 and 2, crystal oscillator, RF oscillator, RF output
LED indication of internally disconnectible operating functions . . . video ALC, white-level limiting, clamping, preemphasis, IF vision carrier, IF sound carrier 1 and 2, RF level
LED indication of . . . . . abnormal operating conditions and modes of the sound modulators: mono, stereo, dual sound, switchover (DATA, external)





Tolerance mask of amplitude and group-delay characteristic of SBKF transmitter section

Video check output . . . . . 1 V_{pp} into 75 Ω, BNC connector (front of vision modulator)
IF check output . . . . . −25 dB ±1 dB, referred to output level (front of vision modulator)
RF check output . . . . . −25 dB ±1 dB, referred to output level (on front panel of SBKF)
Return loss of all outputs . . . . . ≥20 dB
AF, control and signalling lines . . . . . 30-contact connector to DIN 41622 (on rear panel)

Video module (option)
Video input signal . . . . . 0.7 to 1 V_{pp} into 75 Ω, internally adjustable
Return loss . . . . . ≥30 dB with external termination
Video level control (disconnectable) . ±3 dB, referred to selected value
Reference . . . . . black/white level in line 17 and/or 330
Output level . . . . . 1 V_{pp} ±0.1 V
Output impedance . . . . . 75 Ω
Return loss . . . . . ≥34 dB (10 Hz to 5 MHz)
Data-line decoder . . . . . for DATA mode of sound modulator
Coding from data line 16, word 5 (bit 1 and 2) . . . . . mono: 0,1
stereo: 1,0
dual sound: 1,1 (also 0,0)
No data line . . . . . previous mode (stored proof against power failure) or dual-sound mode (can be selected)

General data
Rated temperature range . . . . . +5 to +40 °C
Operating temperature range . . . . . 0 to +45 °C
Storage temperature range . . . . . −20 to +70 °C
Recommendations . . . . . SBKF complies with CCIR Rec. 468-2/473-3/567-1 and CCIR Rep. 624 and complies with Technical Terms of Delivery No. 5820-3035 of the Deutsche Bundespost
Internal connector system . . . . . SMA (SMB), 50 Ω
Power supply . . . . . 110/125/220/235 V +10/−15%, 47 to 63 Hz (80 VA)
Dimensions (W × H × D), weight
19″ bench model (design 80) . . . . . 492 mm × 161 mm × 514 mm, 17 kg with vision/sound modulator, 21 kg, fully equipped
19″ rackmount . . . . . 483 mm × 132 mm × 506 mm, 18 kg, fully equipped

Ordering information

Order designation . . . . . ▶ SBKF TV Modulator
Standard B/G (PAL)
Model
without transmitter section . . . . . 644.2091.XY*)
with transmitter section band I . . 644.2010.XY*)
with transmitter section CATV lower band . . . . . 644.2033.XY*)
with transmitter section band III . 644.2056.XY*)
with transmitter section CATV upper band . . . . . 644.2079.XY*)
with transmitter section CATV hyperband on request Video Module (option)
SBKF-E4
with data-line decoder and video level control 644.3917.11
only with video level control 644.3917.12
only with data-line decoder 644.3917.13
Standard M (NTSC) . . . . . on request

Accessories supplied
Power cable 025.2365.00 for bench model

Model with two isolated outputs on request

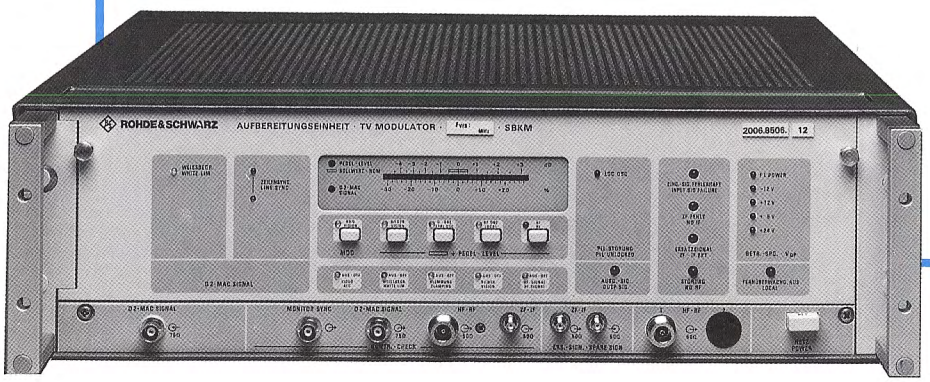
Systems comprising
several TV modulators,
combiners,
impedance transformer 50/75 Ω,
video cable equalizer and
switching panel for automatic connection of substitution signal
on request

*) Explanation of models

Mono version . . . . . X = 1
Dual-sound version . . . . . X = 2
19″ rackmount
with SBKF-E4 option
model 644.3917.11 . . . . . Y = 3
model 644.3917.12 . . . . . Y = 5
model 644.3917.13 . . . . . Y = 7
without SBKF-E4 option . . . . . Y = 1
19″ bench model
with SBKF-E4 option
model 644.3917.11 . . . . . Y = 4
model 644.3917.12 . . . . . Y = 6
model 644.3917.13 . . . . . Y = 8
without SBKF-E4 option . . . . . Y = 2

new

SBKM



TV Modulator SBKM (for D2-MAC)

- 300 to 450 MHz
  9 dBm (at 50 Ω)

- TV modulator with channel transmitter section for D2-MAC signals
- Standard IF modulation (38.9 MHz)
- Crystal-reference conversion to channel frequency
- Selective modules are easily replaceable

The **TV Modulator SBKM** is used to feed picture and data signals into the special channels of the hyperband in broadband communication systems. The mainframe is fitted with a maximum of the following flat modules:

- **Vision/data modulator**
- **Nyquist filter**
- **Transmitter section**

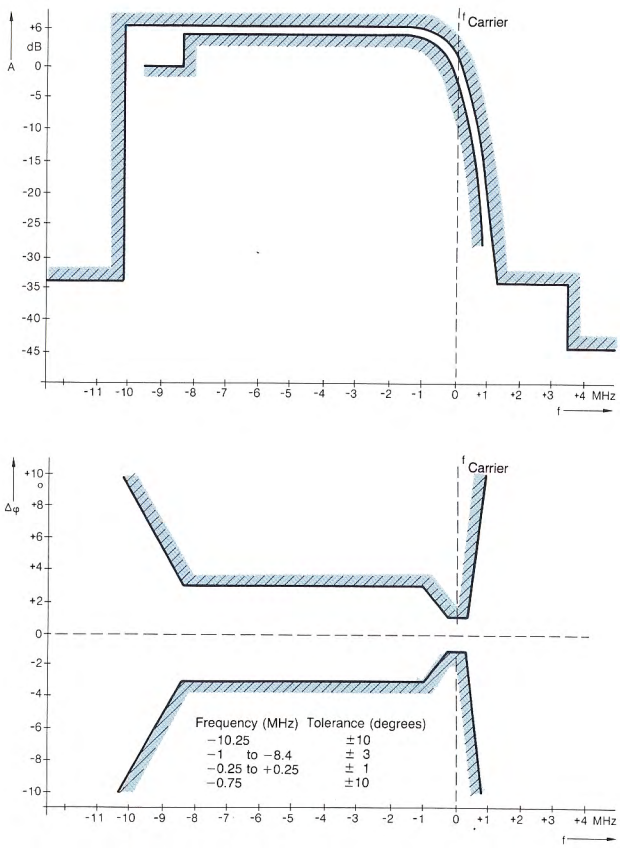
Output frequency The output signal is any channel within the hyperband of 300 to 450 MHz (CATV hyperband, channel spacing 12 MHz).

Front panel The front panel is fitted with the operating, failure and monitoring indicators. LEDs signal the switch statuses. The front panel can be swung out for measurement and maintenance purposes. The setting elements for the operating functions on the modules, such as white limiter, clamping circuit, IF and RF signals, are **only accessible when the front panel is open.** This prevents settings from being unintentionally altered during the transmission of a program. The test outputs of the modules are only accessible when the front panel is swung out. The input and output connectors are mounted on a fixed strip on the front panel.

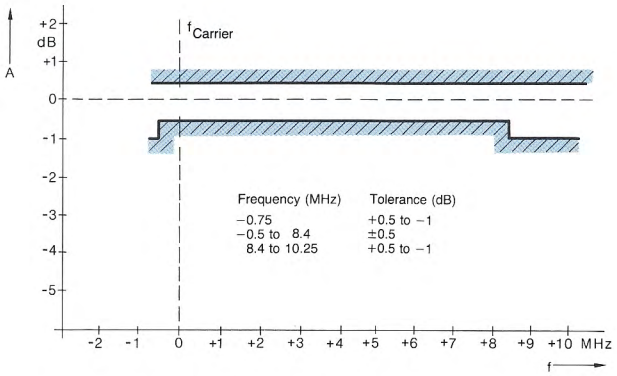
Remote control Fault signals and remote-control commands are sent via a 30-contact male connector on the rear panel of the equipment.

Modulator The D2-MAC signal is sent from the front panel to a ring modulator via a level clamping circuit. Level clamping uses either back-porch clamping or simple average-value rectification. The IF carrier signal for the ring modulator is generated by a crystal oscillator. Its frequency can be voltage-controlled.

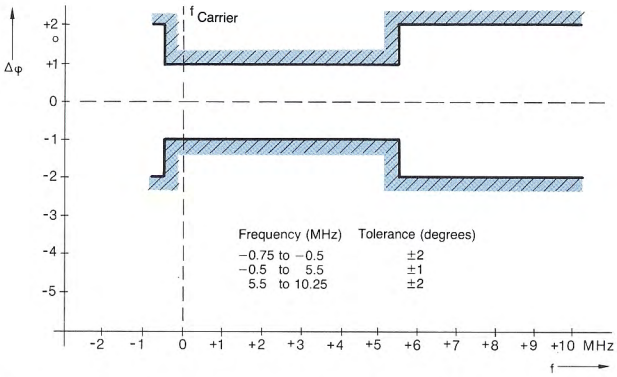
Adjacent channel occupancy is usual in broadband communications. The modulator is therefore fitted with a SAW filter for D2-MAC signals for perfect selection.



Tolerance mask for amplitude/frequency (above) and phase/frequency response (below) of vestigial sideband filter with Nyquist slope in D2-MAC modulator



Tolerance mask for amplitude/frequency response in transmitter section (channel spacing 12 MHz)



Tolerance mask for phase/frequency response in transmitter section (channel spacing 12 MHz)

The modulator is provided with two signal outputs, one for controlling the transmitter section and the other is sent to the front panel where there is also a test output.

In the event of a fault, the **modulator can be bypassed** using a selector switch fitted with a relay and the transmitter section can be driven by an external IF signal from the front panel.

Transmitter section The transmitter module converts the IF signal supplied by the modulator into any channel between 300 and 450 MHz and amplifies it to a maximum of 9 dBm into 50 Ω. On the front panel there is either only one RF output or two equivalent outputs isolated at min. 26 dB and with a 3 dB lower level. There is also a test output which is isolated from the RF output at approx. 25 dB.

IF signal input level variations of more than ±3 dB are compensated by **automatic level control** (they can be switched off for test purposes).

The oscillator frequency used for mixing is stabilized by a reference frequency via a phase-locked loop. The mixer oscillator is continuously tunable in any of the selected ranges. A harmonic of the crystal oscillator is used as the **internal reference frequency.** The internal reference frequency can also be linked to an **external reference frequency.**

The frequency is converted in a ring mixer followed by a channel filter, a broadband amplifier and an output filter. The channel filter, output filter, filter for the reference frequency and the processing unit for the display and control voltage are combined in a separate subassembly which determines the channel frequency so that the **channels can easily be changed.** The same applies to the mixer oscillator.

By separating the components for active and passive frequency determination, a high constancy of transmission characteristics is ensured and the channels are rapidly changed by replacing the filter modules without cable connections. When changing channels, the operating parameters such as output level, mixer current, PLL lock, IF level, etc., can easily be checked on the front panel using a built-in monitor (row of LEDs) with pushbutton selection.

Specifications

Modulator

Input signal	D2-MAC signal
Signal level for 10% residual carrier	V_{PP} = 0.7 to 1.1 V, continuously adjustable
DC component	≤±6 dB
Input	BNC female (front panel), 75 Ω
Return loss (at V_{PP} = 1 V)	
10 kHz to 5.5 MHz	≥34 dB
5.5 to 8.4 MHz	≥30 dB
IF output	
Vision carrier frequency	38.9 MHz, crystal-stabilized
Frequency deviation	≤±2 kHz
Level at module output	89 dBpW (vision carrier peak value)
Setting range	approx. ±3 dB (carrier can be switched off)
Output for IF 1	operating output, connected to transmitter section input
IF 2	front panel output
IF 3	test output (front panel)
Level for IF 1 and IF 2	83 dBpW
IF 3	58 dBpW
Connectors	SMA female (50 Ω)
Return losses	≥20 dB (30 to 40.15 MHz)
Isolation for IF 1/IF 2	≥30 dB (30 to 50 MHz)
Vision carrier input/output	monitor output for crystal oscillator or input for IF carrier (switch-selected)
Output/input level	approx. 89 dBpW/≥83 dBpW
Connector	SMA female (rear panel), 50 Ω

SBKM – Specifications

Modulation characteristics	
Modulation mode	negative, D2-MAC
Operating modes	vestigial sideband operation (with Nyquist filter in modulator)
Level clamping (switch-selected)	
Keyed	clamping to line blanking interval (grey value)
Average value	for balanced modulation if there is no data signal
White-level limiting (can be switched off)	adjustable limiting threshold
Transmission characteristics of vestigial sideband filter with Nyquist slope	see figure on page 156
Non-linearity of modulation characteristic	≤3% with modulation 8 to 100%
S/N ratio 0.1 to 5 MHz	≥64 dB (rms value)
0 to 1 kHz	≥60 dB (peak value)
	≥57 dB with 30% hum superposition
Monitoring display	for modulation and carrier levels

Transmitter section

Frequency range	
CATV hyperband	300 to 450 MHz
Channel spacing	12 MHz
Filter and oscillator	tunable within a range, easily replaceable for frequency change
Broadband transmitter section	47 to 450 MHz
Crystal oscillator	
Frequency range	43.5 to 96 MHz
Frequency deviation	≤±10 kHz (without oven)
Aging	≤2×10^{-8}/day
Trimming range	approx. 5×10^{-6}
Reference frequency	harmonics used as references for all ranges
External ref. frequency	switch-selected to external in output frequency range
IF input	
Signal level	83 dBpW ±3 dB
Connector	SMA female (50 Ω)
Return loss	≥20 dB (30 to 40.15 MHz)
RF output	either one output or two outputs via 3 dB coupler (≥26 dB)
Signal level	99 dBpW ±3 dB
At two outputs	lower by approx. 3 dB
Level instability	≤±0.5 dB, automatically keyed to data signal (regulated for input level 80 to 86 dBpW)
Connectors	N or SMA female (front panel), 50 Ω
Return loss	≥20 dB (−1.25 to +8.4 MHz, referred to vision carrier)
Transmission characteristics	
Amplitude/frequency response	see figure on page 157
Phase/frequency response	see figure on page 157
RF S/N ratios (referred to vision carrier level)	
Secondary transmission	≥60 dB
Harmonics	≥66 dB
VF S/N ratios (referred to black-to-white transition)	
0.1 to 5 MHz	≥60 dB (rms value, unweighted)
0 to 1 kHz	≥54 dB (peak value)
0.1 to 5 MHz, periodic noise sources	≥60 dB (peak value), measured selectively

Monitoring equipment

Analog displays (row of LEDs), selected via keys for	video signal, IF carrier level, crystal oscillator and RF
LED displays for operating functions which can be switched off internally	video ALC, white limiter, clamping, IF and RF carrier levels
LED displays for signalling	faulty input signal no IF substitute signal on fault output signal remote monitoring off line sync
Output for D2-MAC signal	V_{pp} = 1 V into 75 Ω (front panel of modulator)
IF test output	−25 dB, referred to IF operating output (front panel of modulator)
RF test output	−25 dB, referred to RF rated power (front panel of modulator)
Return loss of all outputs	≥20 dB in respective operating channel
Control and signalling connector	30-contact male (DIN 41 622), rear panel of modulator
Messages (stored power-failure-proof)	faulty input signal no IF substitute signal on fault remote monitoring off
Signals	floating transfer contacts, pulse duration 100 ms

General data

Rated temperature range	0 to +40 °C
Operating temperature range	−5 to +45 °C
Storage temperature range	−20 to +70 °C
Power supply	110/125/220/235 V −10/+15%, 47 to 63 Hz (80 VA)
Dimensions (W×H×D), weight	
19″ bench model	492 mm × 161 mm × 514 mm, 20 kg
19″ rackmount	483 mm × 132 mm × 506 mm, 17 kg

Ordering information

Order designation	▶ TV Modulator SBKM
19″ bench model	2006.8506.12
19″ rackmount	2006.8506.11

Accessories supplied

Power cable 025.2365.00 for bench model

Models with two isolated outputs, on request

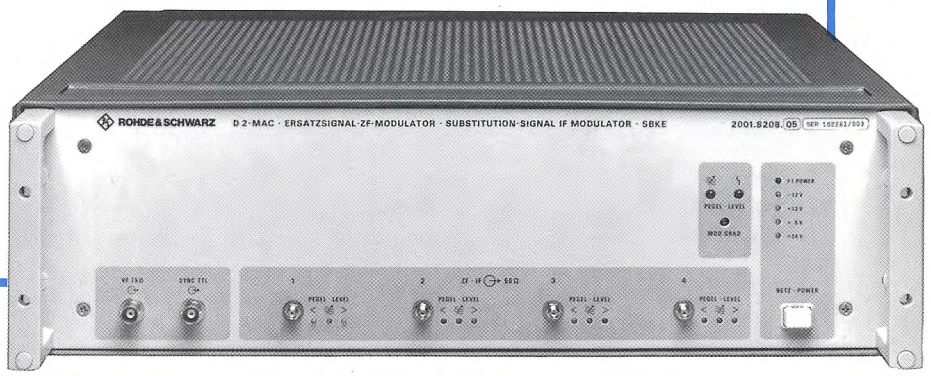
Systems, containing
several TV modulators,
couplers,
50/75 Ω impedance transformer,
video cable equalizer and
switching panel for automatic substitute signal switch-on
on request

D2-MAC Substitute Signal IF Modulator SBKE

SBKE

new

- D2-MAC test pattern generator to FuBK specifications
- Identification of substitute signal source in test pattern
- Data signal with two AF sound signals
- Modulation of D2-MAC vision/data signal on a 38.9 MHz IF carrier



The **D2-MAC Substitute Signal IF Modulator SBKE** generates a 38.9 MHz IF carrier signal modulated by a D2-MAC vision/data signal. This signal is used to drive transmitter sections in broadband systems if the operating modulator fails.

The SBKE is also extremely suitable for use as a generator in the **laboratory and testing.** In conjunction with the TV Test Transmitter SBUF, it is the ideal signal source for tuning D2-MAC-compatible television receivers.

Text insertion Text can be inserted into the generated test pattern in the specific application in compliance with FuBK specifications.

Test sound signals The SBKE generates an HQI-1-encoded stereo signal and an MQI-1-encoded mono signal as test sound signals.

Outputs In the models 07 and 08, the D2-MAC IF television signal is applied to an 83 dBpW signal output. The level can be continuously varied internally by ±2 dB.

The models 03 and 04 also contain an IF amplifier and apply signals to a 101 dBpW signal output. The models 05 and 06 are provided with another IF amplifier and four 101 dBpW signal outputs. The levels are internally separated by ±2 dB and can be adjusted in steps of 0.5 dB.

Displays LEDs on the front panel indicate all the main operating statuses and signal faults.

Specifications

Substitute video generator

Video signal specifications	D2-MAC test pattern to FuBK
Crystal reference rating	2.5×10^{-5}
Clock frequency	20.25 MHz
Text insertion	texts in compliance with FuBK specifications
Text field 1 and 2	max. 9 characters each
Text field 3, line 1	max. 18 characters
line 2	max. 16 characters
Signal specifications for data	as in "Manual for the D2-MAC packet"
Signal specifications for sound	sound to D2-MAC
Coding	HQI-1 stereo and MQI-1 mono coding
Left/right channel	1 kHz/5 kHz; 500 Hz (mono)
Sound modulation	10 dB below nominal level
Sond status and source identification	to FuBK specifications in teletext format (vertical blanking interval)
Text line insertion	any test lines in max. four successive fields

Output signal	
Bandwidth (3 dB)	9 MHz
Amplitude	V_{pp} = 1 V ±5 mV
Amplitude/frequency response	≤0.2 dB (ripple)
Group delay	≤15 ns

Modulator

Signal level for 10 (±2)% Residual carrier	V_{pp} = 0.7 to 1.1 V
Setting range (internal)	6 to 15%
IF output signal	
Vision carrier frequency	38.9 MHz ±≤2 kHz, crystal-stabilized
Rated output level (separately adjustable)	
Models 07 and 08	83 dBpW ±0.5 dB
Variable (internal)	81 to 85 dBpW, continuously
Models 03 to 06	101 dBpW ±0.5 dB
Variable (internal)	99 to 103 dBpW, in steps of 0.5 dB
IF outputs	front panel
Number, models 05 and 06	4
models 03, 04, 07 and 08	1
Output impedance	50 Ω
Return loss	≥20 dB (30 to 40.15 MHz)
Isolation for IF 1/IF 2	≥30 dB (30 to 50 MHz)
Connectors	SMA female
Modulation characteristics	
Modulation mode	negative (D2-MAC)
Operating modes	vestigial sideband operation with Nyquist filter in modulator
Transmission characteristics	
Vestigial sideband filter	amplitude and phase as in "Manual for the D2-MAC packet"
Non-linearity of modulation characteristic	≤4%, measured with staircase signal
S/N ratio, 0.2 to 5 MHz	≥64 dB (rms value)
0 to 1 kHz	≥60 dB (peak value)
Output for D2-MAC signal	
Level	V_{pp} = 1 V (±2%) at 75 Ω
Connector	BNC female, front panel
Return loss	≥30 dB (10 Hz to 8.4 MHz)
Control and signalling lines	30-contact male connector (DIN 41 622), rear panel
Message (stored power-failure-proof)	no IF
Signals	floating transfer contacts, pulse duration >100 ms

General data

Rated temperature range	0 to +40 °C
Operating temperature range	−5 to +45 °C
Storage temperature range	−40 to +70 °C
Power supply	110/125/220/235 V −10/+15%, 47 to 63 Hz (60 VA)
Dimensions (W×H×D), weight	
19″ bench model	492 mm × 161 mm × 514 mm, 12 kg
19″ rackmount	483 mm × 132 mm × 506 mm, 10 kg

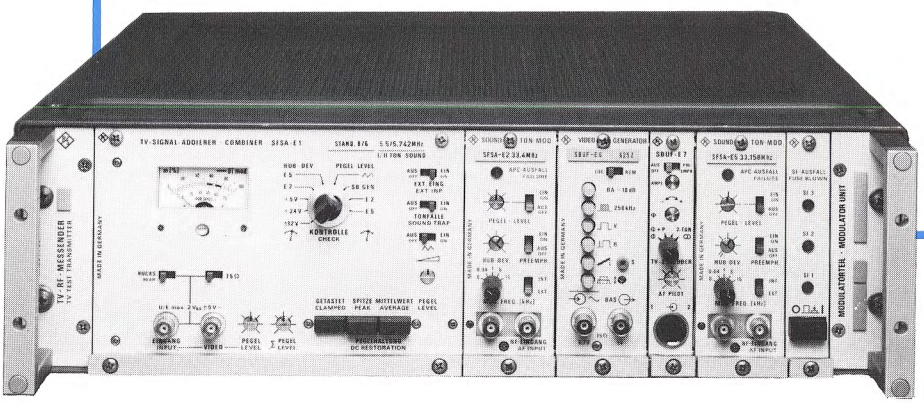
Ordering information

Order designation	▶ D2-MAC Substitute Signal IF Modulator SBKE	
	19″ bench model	19″ rackmount
SBKE with		
one 101 dBpW IF output	2001.8208.04	2001.8208.03
four 101 dBpW IF outputs	2001.8208.06	2001.8208.05
one 83 dBpW IF output	2001.8208.08	2001.8208.07

SFSA

TV-Sat Base Signal Combiner SFSA ♦ 10 Hz to 8 MHz

- Processing of baseband modulation signal for satellite IF test transmitter
- Several sound modulators can be used
- Video test signal generator available as option



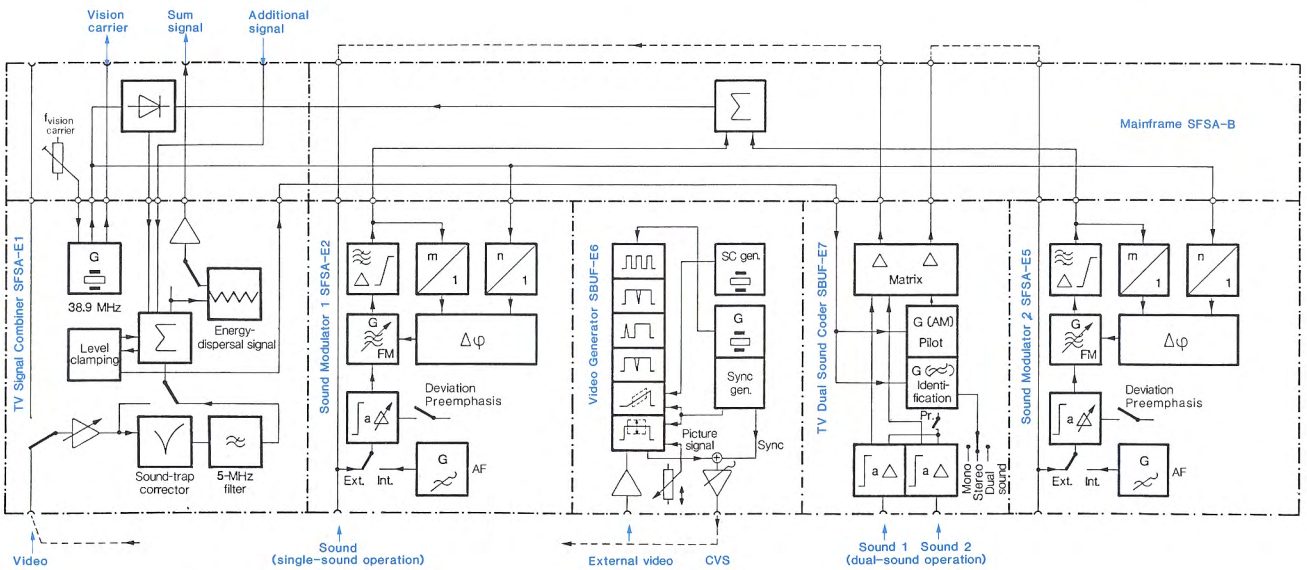
The **TV-Sat Base Signal Combiner SFSA** is used for non-reactive combination of a video signal, up to three sound signals and an additional signal (in the range 6 to 8 MHz) into a multiplex signal with sound subcarriers.

This baseband signal is used for broadband frequency modulation in the Satellite IF Test Transmitter SFSZ.

Mechanical construction The SFSA is of modular design and fitted with the following plug-in modules and subassemblies (see block diagram):

TV Signal Combiner with 5-MHz lowpass filter with energy-dispersal signal	SFSA-E1
Sound Modulator (sound 1)	SFSA-E2
Sound Modulator (sound 2)	SFSA-E5
TV Dual Sound Coder	SBUF-E7
Video Generator (option)	SBUF-E6

The Sound Modulators SFSA-E2 and -E5 (having the same characteristics as the SBUF-E2 and -E5), the TV Dual Sound Coder SBUF-E7 and the Video Generator SBUF-E6 of the TV Test Transmitter SBUF, which is recommended as an extra for the SFSA, are described in **catalog Section 1 B.**



 Block diagram of TV-Sat Base Signal Combiner SFSA

TV Signal Combiner SFSA-E1 is used for non-reactive combination of video signal, sound signals and additional signal and makes available the multiplex signal at two isolated outputs. An external video signal or the test signal supplied by the Video Generator SBUF-E6 may be used as video signal. The SFSA-E1 also supplies a crystal-accurate 38.9-MHz signal for the sound subcarrier modulation (internal frequency control is possible).

5-MHz lowpass filter and group-delay correction circuit contained in the signal combiner limits the video signal and frees the sound signal range from the harmonics.

Energy-dispersal signal Depending on the SFSA model, this subassembly is also contained in the signal combiner and produces the energy-dispersal signal of the carrier (triangular signal superimposed on the baseband signal).

Sound Modulator SFSA-E2 (for single-sound operation) and **Sound Modulator SFSA-E5** (additionally for multisound operation). These carriers are derived from the 38.9-MHz signal of the combiner module, which in turn is used in the signal addition for reconversion to the subcarrier frequencies. The carriers are added to the band-limited video signal.

TV Dual Sound Coder SBUF-E7 is required in dual-sound operation for encoding the AF signals to obtain a stereo signal or two mono signals in accordance with the IRT method.

Levels The levels of all individual signals and of the sum signal can be adjusted and checked on a meter with selector switch.

Specifications

For specifications of Sound Modulators SBUF-E2 and -E5, of TV Dual Sound Coder SBUF-E7 and of Video Generator SBUF-E6 recommended as an extra see catalog Section 1 B.

Input signals

Frequency range	
Video signal	10 Hz to 6 MHz
Sound signal 1 and 2	40 Hz to 15 kHz/54 kHz
Additional signal	6 to 8 MHz
Level	
Video signal	1 V_{pp} ±3 dB
Permissible DC offset	±5 V
Sound signal 1 and 2	1.55 V, ±1 dB for ±30 or ±64 kHz deviation
Additional signal	1 V_{pp} ±6 dB
Input impedance	
Video signal	loop-through filter, 75 Ω, with external or internal termination (selectable)
Return loss	≥34 dB with external termination ≥26 dB with internal termination
Sound signal 1 and 2	approx. 5 kΩ, balanced; external/internal switchover
Additional signal	75 Ω, unbalanced
Return loss	≥20 dB
Connectors	
Video signal	BNC
Sound signal 1 and 2	30-contact connector DIN 41622 (rear panel)
Additional signal	BNC

Output signal

Frequency response flatness of multiplex signal	
Video signal	
without sound trap	≤±0.3 dB (10 Hz to 6 MHz)
with sound trap	≤±0.5 dB (10 Hz to 4.8 MHz)
Sound signal 1	≤±0.5 dB
2	≤±0.5 dB
Additional signal	≤±1 dB (6 to 8 MHz)
Outputs	
Multiplex signal outputs	2 (isolated by 34 dB)
Output connectors	BNC (rear panel)
Output impedance	75 Ω
Return loss	≥20 dB
Output level	adjustable within ±3 dB
Video signal	1 V_{pp} (CCVS) into 75 Ω (≙ 0.7 V picture component)
Sound signal 1	329 mV_{pp} into 75 Ω
2	329 mV_{pp} into 75 Ω
Additional signal	0.5 to 1 V_{pp}, internally adjustable
Intermodulation products between video and sound signals (ref. to picture component)	≥46 dB down, typ. 54 dB
Level clamping for video signal (pushbutton-selected)	1. clamped to back porch 2. clamped to sync peak 3. average value

Sound subcarriers

Subcarrier frequency sound 1	5.5 MHz ±100 Hz
sound 2	5.742 MHz ±100 Hz
Type of modulation	F3E (F3)
Preemphasis, disconnectible	50 µs/75 µs/J17 ±5%
Modulation frequency response flatness (ref. to 1 kHz)	≤±0.3 dB (40 Hz to 15 kHz)
Distortion from 40 Hz to 15 kHz with ±75-kHz deviation	≤0.5%
S/N ratio for mono signals, ref. to useful deviation of ±40 kHz, pre- and de-emphasis switched on	
unweighted	≥70 dB
weighted to CCIR Rec. 468-2	≥70 dB
Energy-dispersal signal	symmetrical triangular signal, can be internally switched to asymmetrical signal to 447 TBr 15
Amplitude	corresponds to a deviation (Δf_{pp}) of 0.6 to 2 MHz (internally adjustable)

General data

Rated temperature range	+5 to +35 °C
Operating temperature range	+5 to +45 °C
Storage temperature range	−20 to +70 °C
Power supply	110/125/220/235 V +10/−15%, 47 to 63 Hz
Power consumption	
with signal combiner and sound modulator	70 VA
fully equipped	125 VA
Dimensions (W × H × D), weight (fully equipped)	
19″ bench model	492 mm×161 mm×514 mm, 21 kg
19″ rackmount	483 mm×132 mm×506 mm, 19 kg
Colour and markings	grey, RAL 7035; German + English

Ordering information

Order designation	▶ TV-Sat Base Signal Combiner SFSA 19″ bench model	
With TV stereo sound section (Standard B/G)	390.0014.78	
Without sound modulator	390.0014.10	
Modulator (module)	▶ FM sound modulator SFSA-E5	
	Preemph. 50 µs dev. ±40 kHz	Preemph. J 17 dev. ±423 kHz
31.34 MHz, sound carrier 7.56 MHz	390.2917.18	
32.25 MHz, sound carrier 6.65 MHz	390.2917.12	390.2917.17
32.30 MHz, sound carrier 6.60 MHz	390.2917.15	390.2917.19
32.40 MHz, sound carrier 6.50 MHz	390.2917.11	390.2917.20
For Wegener stereo: left-hand channel, sound carrier 7.02 MHz	390.2917.13	
right-hand channel, sound carrier 7.20 MHz	390.2917.14	
Recommended extra	Video Generator SBUF-E6 (625-line standard, CCIR) 340.8211.76	

SFSZ

Satellite IF Test Transmitter SFSZ ♦ 50 to 1750 MHz

- Measurement at all satellite IFs
- FM peak deviation up to 27 MHz, high deviation linearity
- Crystal-accurate frequency setting

The **Satellite IF Test Transmitter SFSZ** supplies an RF signal which is frequency-modulated with the baseband signal and tunable throughout the range 50 to 1750 MHz. It permits measurement of the parameters of satellite signal receiving systems both in development, production and in servicing. The output signal may also be used for driving an SHF converter. The output frequency range covers **all the usual IF ranges** of satellite transmission systems.

With respect to frequency range and modulation characteristics, the SFSZ is a further development of the transposer section from the well-proven TV Test Transmitter SBUF.

Input signal The SFSZ has an **input for a TV baseband signal (**10 Hz to 8 MHz) which is supplied by the TV-Sat Base Signal Combiner SFSA, or for **a video signal with digital sound** (10 Hz to 7 MHz); it also contains a highly linear modulator for the output frequency.

Modulator The FM modulator produces a highly linear broadband signal with a peak-to-peak deviation of 27 MHz. With an input peak voltage of 1 V, the deviation can be switched over between 13.5 and 25 MHz. In addition, an internal fine adjustment of the deviation is possible by varying the video signal level by +1/−6 dB. The direction of deviation can also be internally changed by means of a switch. The preemphasis can be disconnected.

Frequency setting The baseband signal (10 Hz to 8 MHz) from the TV-Sat Base Signal Combiner SFSA or from any other source is up-converted and down-converted to obtain any frequency in the range 50 to 1750 MHz. Unwanted spurious emissions are suppressed by fixed bandpass filters and a lowpass filter.

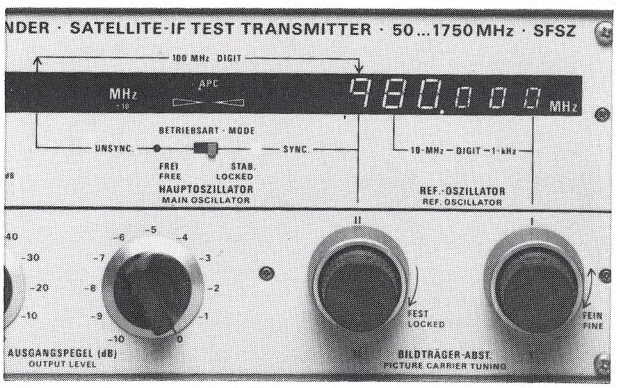
The frequency can be set in two different ways:

"Unsync." mode Adjustment with tuning knob II only; frequency indication calibrated in MHz (error ≤±10 MHz), 3½ digits (produced by analog/digital conversion of tuning voltage).

"Sync." mode Additional setting with tuning knob I; frequency indication calibrated for 0 to 100 MHz to an accuracy of ±1 kHz via a counter. The channel frequency is set without the 100-MHz decade, which is derived from the adjustment of tuning knob II after phase locking.

The desired channel frequency can thus be set and read off without an input signal being applied.

Output level The levelled output signal can be continuously adjusted by varying the overall gain and is indicated by a row of LEDs. A **calibrated attenuator** further allows the output level to be set in smallest steps of 1 dB.



Frequency setting (bottom right) and readout (top) on SFSZ

Specifications

Frequency

Range	50 to 1750 MHz
Frequency stabilization	APC (with indicator), disconnectable
Indication of tuning frequency	1. with APC via counter accurate to 10 kHz ±1 kHz 2. without APC accurate to ±10 MHz

Output

Output voltage	60 μV_{rms} to 200 mV_{rms} into 50 Ω
Output attenuator	60 dB in steps of 10 dB ±0.5 dB, error ≤2 dB 10 dB in steps of 1 dB ±0.2 dB, error ≤0.5 dB
Frequency response flatness	≤3 dB with automatic level control
Source impedance	50 Ω
Return loss	≥3 dB with attenuator set to 0 dB
Connector	N type (front panel)

Input

Signal	TV multiplex signal (baseband) with analog sound (from TV Signal Combiner SFSA) or video signal with integrated digital sound; 10 Hz to 8 MHz
Nominal input level video	1 V_{pp}
sound 1	329 mV_{pp}
sound 2	329 mV_{pp}
Input impedance	75 Ω
Return loss	≥34 dB
Connector	BNC (front panel)

Modulation characteristics	measured with pre- and de-emphasis
Frequency range	10 Hz to 8 MHz
Type of modulation	F3E (F3)
Deviation with video signal of 1 V_{pp} and 1.5 MHz modulation frequency	Δf_{pp} 13.5 MHz or 25 MHz (switch-selectable)
Fine adjustment of deviation	internal by varying video signal level by +1/−6 dB
Direction of deviation	can be internally changed
Preemphasis (disconnectable)	for 625-line system to CCIR Rec. 405-1
Frequency response flatness	
without preemphasis	±0.2 dB (10 Hz to 8 MHz)
with preemphasis	±0.3 dB (10 Hz to 6 MHz)
Level clamping	average value (AC coupling)
Deviation linearity	measured with standard video signal
Differential gain	
with 13.5-MHz peak deviation	≤1%
with 27-MHz peak deviation	≤2%
Differential phase	
with 13.5-MHz peak deviation	≤1°
with 27-MHz peak deviation	≤2°
Group-delay variation	≤±5 ns (100 kHz to 8 MHz)

Transmission characteristics

S/N ratio (ref. to 13.5 MHz peak deviation and 1.5 MHz modulation frequency)	
0.1 to 5 MHz	≥70 dB (rms measurement), unweighted
0 to 1 kHz	≥56 dB (peak measurement), typ. 60 dB
RF S/N ratio, referred to vision carrier level	
Harmonics	≥34 dB down, typ. 40 dB
Spurious emissions	≥40 dB down
Video-frequency intermodulation products (deviation video/sound 1/sound 2: 13.5/5.6/5.6 MHz)	≥44 dB down (ref. to picture signal)

General data

Rated temperature range	+5 to +35 °C
Operating temperature range	+5 to +45 °C
Storage temperature range	−20 to +70 °C
Power supply	115/125/220/235 V +10/−15%, 47 to 63 Hz
Power consumption	130 VA
Dimensions (W × H × D)	
19″ bench model	492 mm × 161 mm × 514 mm
19″ rackmount	483 mm × 132 mm × 506 mm
Weight of bench model/rackmount	25 kg/22 kg
Colour and markings	grey, RAL 7035; German + English

Ordering information

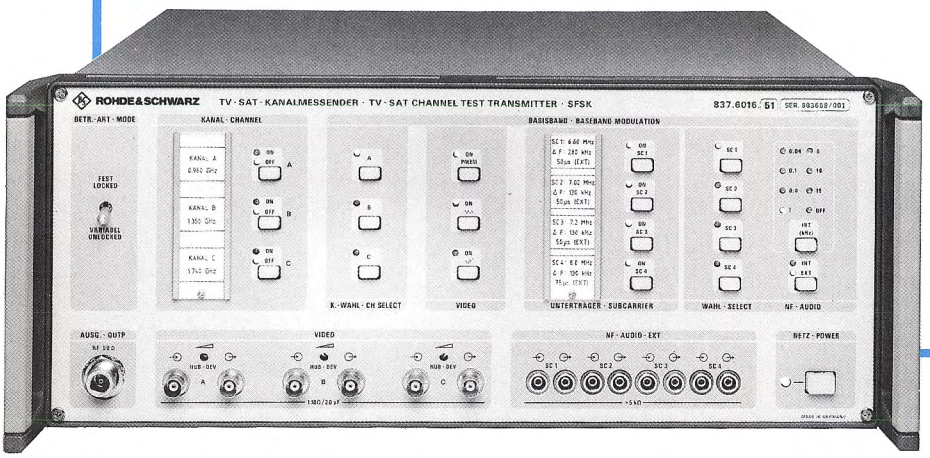
Order designation	▶ Satellite IF Test Transmitter SFSZ
19″ bench model	397.4709.52

new

SFSK

TV Satellite Channel Test Transmitter SFSK ♦ 900 to 1800 MHz

- 3 TV channels in satellite IF range
- Max. 4 sound subcarriers per channel
- High modulation linearity
- Modular design to match measurement function
- Suitable for D2-MAC



The **TV satellite channel test transmitter SFSK** generates three frequency-modulated RF carrier signals for developing and testing satellite signal receiver equipment. They can be adjusted to one of the following ranges:

900 to 1200 MHz,
1200 to 1450 MHz,
1450 to 1800 MHz.

This means that the band-edge channels and a band centre channel can be occupied, for example when testing the TV receiver. Adjacent channel operation is also possible when the SFSK is equipped accordingly.

Output signal The RF carriers can be modulated by external video signals and internally generated sound subcarrier signals at a total peak deviation of 25 MHz. A switch-off dispersal signal is superimposed on the video signals and the subcarriers which are frequency-modulated with audio signals. A coupling network combines the RF carrier to form the output signal. An external channel signal (from another SFSK or the satellite IF test transmitter SFSZ) can be added via an input on the rear panel.

Video signal Group-delay-equalized lowpass filters limit the three external video signals to a transmission bandwidth of 5 MHz. Any superimposed low-frequency interference signals (hum) are suppressed by clamping circuits.

Sound subcarrier A maximum of four sound subcarrier signals which are switched on as required can be added to any of the video signals. Internal or external VF signals are used for modulation (FM). Three preemphasis networks can be switched over internally. A subcarrier or digital sound signal can be fed into one of the channels via an input on the rear panel.

Dispersal signal The dispersal signal which can be switched off for all channels modulates the RF carrier at a deviation of 2 MHz when driven by video signals and at 4 MHz without video signals.

Settings on the front panel are indicated by LEDs and can be protected by a front panel switch against incorrect setting and power failure.

Specifications

(All deviations given as peak-to-peak values)

Frequency range	900 to 1800 MHz
sub-band	900 to 1200/1200 to 1450/1450 to 1800 MHz
RF carrier	1 per sub-band
Frequency setting	internally via synthesizer at BCD switches
Output level per channel	0 dBm ±0.5 dB into 50 Ω
Baseband modulation	
Modulated signal spacing	≥50 dB
Max. permissible modulation deviation	27 MHz ±5%
dispersal signal deviation	2 MHz ±5%
without CCVS modulation	4 MHz ±5%
Non-linear distortions at 25 MHz deviation	
diff. amplitude modification	≤3%
diff. phase modification	≤3°
Video modulation signal	V_{pp} = 1 V ±2% for 25 MHz deviation
Video frequency response (with band limit)	≤0.5 dB (10 Hz to 4.8 MHz)
Preemphasis (adjustable per video signal)	CCIR reference: 1.25 MHz, D2-MAC: 1.3 MHz
Band limit (group-delay-equal.)	5 MHz (switched off internally)
Modulation deviation calibration	via MPX signal output for each channel to V_{pp} = 1 V for 25 MHz deviation (BNC, rear panel)
video level setting	−6 to +3 dB (front panel)
Video signal-to-noise ratio, ref. to 25 MHz deviation	≥70 dB (rms), weighted to CCIR
Sound subcarrier signals	max. 4 in 6 to 8 MHz range
Frequency setting	internally in steps of 10 kHz
Subcarrier deviation	2 to 7 MHz, internally adjustable
Subcarrier modulation deviation	±30 to ±300 kHz, internally adjustable
bandwidth (decrease <1 dB	30 kHz to 100 kHz
distortion at max. deviation	0.5%
Preemphasis	50 µs/75 µs/J17, internally adjustable
VF signal-to-noise ratio, ref. to 50 kHz deviation	≥70 dB (weighted and unweighted)
Internal modulation signals	40/100/400 Hz/1/5/10/15 kHz/off
Dispersal signal	picture frequency (PAL)
Signal shape	triangular signal, 50 Hz

General data

Rated temperature range	+5 to +35 °C
Operating temperature range	+5 to +45 °C
Storage temperature range	−20 to +70 °C
Power supply	220 V −10/+15% 47 to 63 Hz (160 VA)
Dimensions (W × H × D), weight	435 mm×192 mm×475 mm, 25 kg

Ordering information

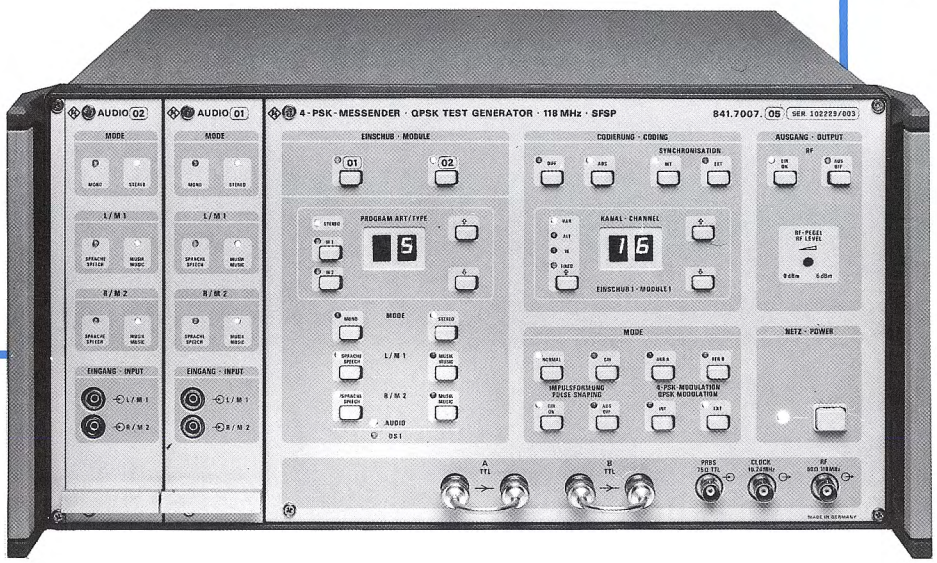
Order designation	▶ TV Satellite Channel Test Transmitter SFSK
With 1 channel per sub-band 19″ bench model	837.6016.51

4 PSK Test Transmitter SFSP
♦ 118 MHz, 70 MHz

SFSP

new

- 4-PSK-modulated carrier signal for digital sound satellite transmission
- Max. 16 stereo or 32 mono channels
- Audio signal input



The **4 PSK test transmitter SFSP** generates a 118 MHz carrier signal modulated with max. 16 stereo channels (or 32 mono channels) and an additional 70 MHz signal for model 55. This carrier signal complies with the recommendations for digital satellite radio issued by the ARD (Association of public-service broadcasting organizations of the Federal Republic of Germany) and ZDF (Second German Television System).

Basic unit The basic unit is provided with two input module drawers for the modulation signal (L/R or two mono, 14 bit digitization with a scale factor from the 16 bit A/D converter). The operating modes mono/stereo and voice/music are switch-selectable on the front panel. The modulation signal can be switched off for precise output power control.

For expansion to 16 stereo channels, seven modules can be used in two additional carrier frames connected by cable to the basic unit.

Modulation in the basic unit with two mainframes (each 10.24 Mbit/s) to a 118 MHz carrier in the 4 PSK method. In model 55, the 70 MHz carrier is then generated by conversion. The channel assignment in the mainframe is selectable. The frame signals are scrambled by a random-signal generator.

Specifications

Max. number of sound channels	16 stereo (32 mono)
in basic unit	2 stereo (4 mono)
Transmission frame	to ARD/ZDF Rec. 3R1
Structure	2 parallel data streams for every 8 stereo channels (16 mono channels)
Frame frequency	32 kHz
Number of bits per frame	320
Transfer rate	20.48 Mbit/s
per data stream	10.24 Mbit/s
Error protection, sound channels	BCH 63/44
	4 × 11 MSB, each of 4 (8) channels
scale factor	BCH 14/6, shortened
Modulation	4 PSK
Differential coding	can be switched off
Spectral formation	50% cos roll-off
(×/sin ×) accentuation	can be switched off

Transmission characteristics

RF output signal	f_m = 118/70 MHz ±5 kHz
modulation error	≤±1°
useful bandwidth	20 MHz
return loss	≥26 dB
out-of-band S/N ratio	≥50 dB
Audio signal rackmount	
frequency range	40 Hz to 15 kHz
frequency response	
40 Hz to 15 kHz	≤±0.2 dB
0.1 to 12.5 kHz	≤±0.1 dB
>16 kHz	≤−80 dB
distortion	≤0.02%
crosstalk attenuation	≥80 dB (40 Hz to 15 kHz)

Interfaces

RF output	BNC (front panel)
centre frequency	118/70 MHz ±5 kHz
output impedance	50 Ω
output level (can be switched off)	0 to +6 dBm (adjustable)
Audio signal input (rackmount)	female connector on front panel (Lemo-Triax)
input impedance	≥5 kΩ and 600 Ω (symmetrical)
nominal input level	+6 dB
clip limit	+4 to +12 dB, adjustable in steps of 1 dB
Data stream input of mainframes (10.24 Mbit/s)	BNC (front panel)
Output for reference clock (10.24 MHz)	BNC (front panel)

Possible settings

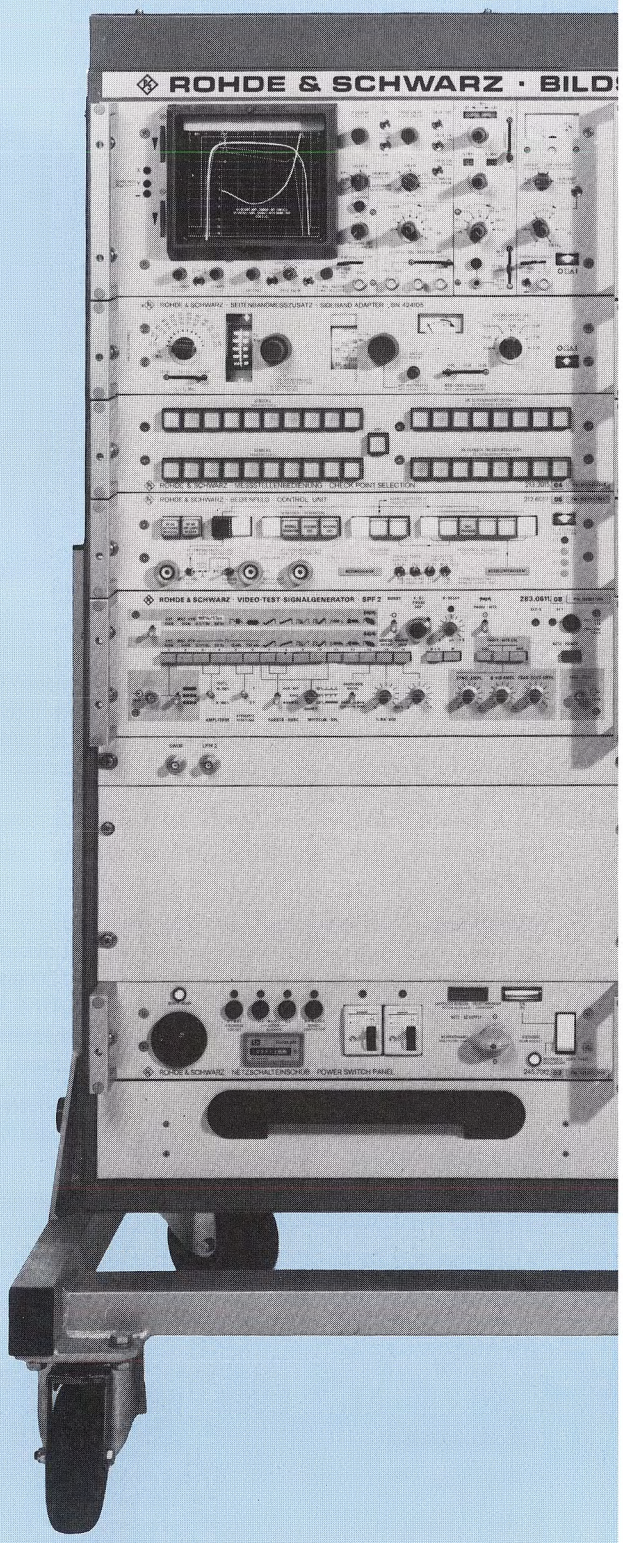
Audio signal rackmount	operating modes mono/stereo and voice/music, type of program
Coding: differential coding	on/off
pulse shaping	on/off
modulation	internal/external
RF signal output	signal on/off
level setting, fine	0 to +6 dBm

General data

Rated temperature range	+5 to +45 °C
Operating temperature range	+5 to +45 °C
Storage temperature range	−20 to +70 °C
Power supply	220 V ±10%
	47 to 63 Hz (130 VA)
Dimensions (W × H × D), weight	435 mm×236 mm×470 mm, 25 kg

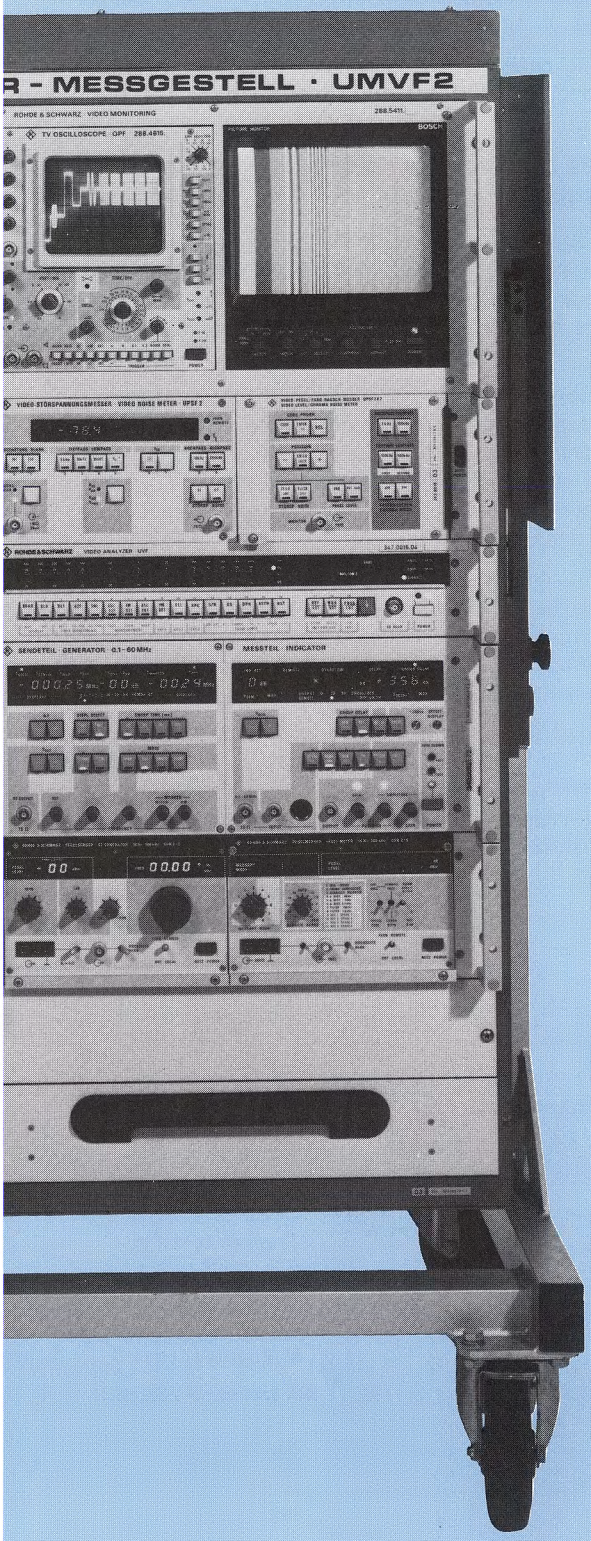
Ordering information

Order designation	▶ 4 PSK Test Transmitter SFSP
19″ bench model (with two audio signal rackmounts)	
118 MHz	841.7007.05
70 MHz and 118 MHz	841.7007.55



Picture Transmitter Test Assembly UMVF 2
with signal generators and evaluation equipment
for video and RF measurements
on vision transmitters, radio links and
four-terminal networks;
details on page 190

monitoring and measuring assemblies



Depending on the specific tasks to be fulfilled within the transmission systems, monitoring and measuring assemblies may differ considerably. Since, however, similar measuring problems frequently occur, certain basic configurations have crystallized.

The individual instruments included in the assemblies listed here are described in catalog Section 1.

Monitoring and measuring assemblies

For measurement and monitoring of sound broadcasting and especially of TV transmitters a multitude of measuring instruments is required, all of which must be suitably connected to the test items and to each other. A practical solution is to combine the instruments in assemblies and consoles. The necessary connections for the individual measurements can then be established via central switching panels by remote control or manually. The time required for the measurements can thus be considerably cut down.

Assemblies Especially for TV transmitters it is necessary to distinguish between monitoring assemblies, which mainly enable checking of the outgoing programs, and measurement assemblies, which contain all the necessary measuring instruments. Since for sound broadcasting transmitters only a few measuring instruments are required, one common assembly is generally used for both measurement and monitoring.

Consoles are used for joint operation with simultaneous monitoring of several transmitters in one station. They contain facilities for switching on and off the transmitters, as well as control and monitoring equipment.

Equipment configuration All these assemblies and consoles will be configured according to the customer's requirements and, naturally, the operational needs. In the course of development the basic configurations described in this section have, however, crystallized.

Setup of assemblies There are two possibilities:

- Integration of the associated assemblies in the transmitter racks (in the majority of cases)
- Separate central setup for several transmitters (as recommended for the Picture Transmitter Test Assembly UMVF 2).

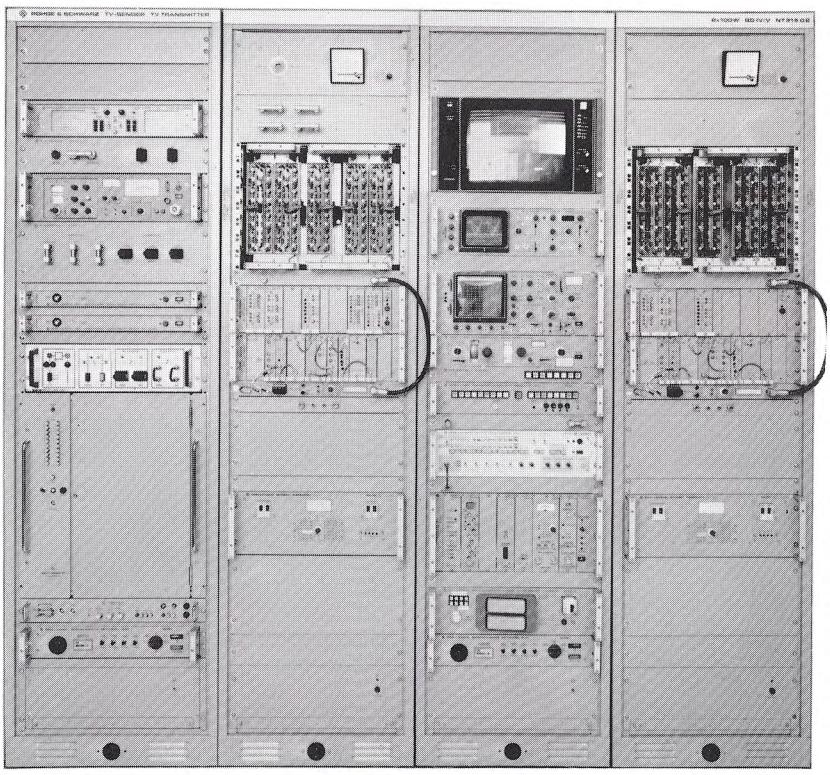
Examples of customized monitoring and measuring assemblies

The **first example** shows a 100-W TV dual transmitter for band IV/V supplied by Rohde & Schwarz with customized monitoring and measuring assemblies (see photo). The second and the fourth rack from the left contain the transmitters a and b.

In the **second example** the operational requirements allowed only little space for the accommodation of a 2-kW TV dual transmitter (band IV/V) with all the monitoring and measuring equipment as well as with all the accessories required for the operation (except for the transmitting antenna and antenna cable).

The dual transmitter, which has been designed for use at different places, is accommodated in a standard container (length 7.2 m, width 2.5 m, height 2.7 m). This container can be transported on a suitable truck (photo right) to the place of use where the transmitter is operated stationary.

The transmitters a and b are set up at the narrow sides of the container. Each of them is additionally equipped with a VIT Inserter SPRF (usually contained in the input equipment). To the left of transmitter a there is a TV Transmitter Monitoring Assembly UKFZ 2.



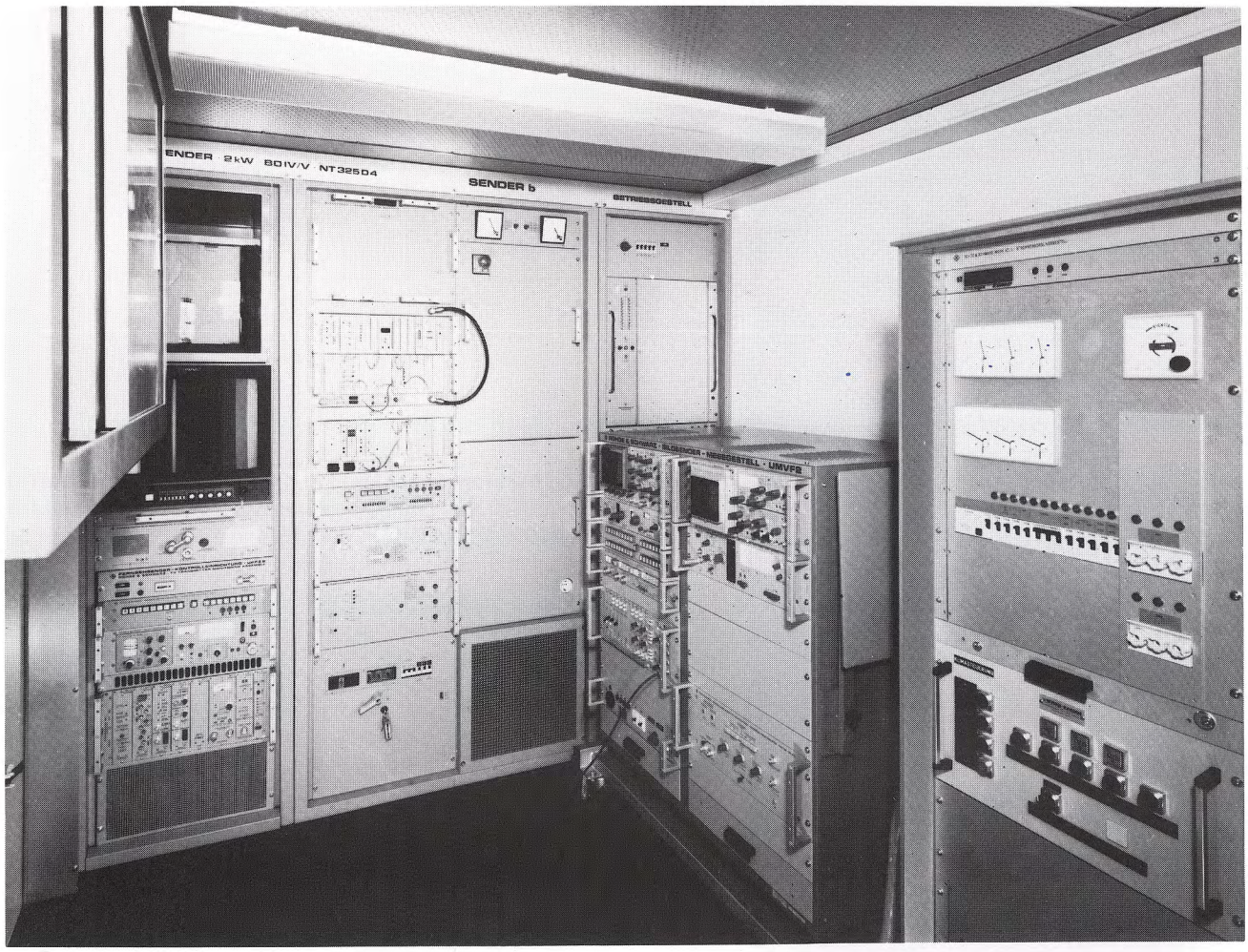
100-W UHF TV Dual Transmitter with customized monitoring and measuring assemblies

The lower part of the central rack (in transmitter a) contains the junction panel for the mobile Picture Transmitter Test Assembly UMVF 2 which is set up to the right in front of transmitter b as long as no measurements are carried out.

The TV Transmitter Monitoring Assembly UKFZ is set up to the left of transmitter b (photo below). This assembly also contains a switching panel for the input signals of the FM/AM Demodulator and a colour monitor. The additional rack to the right of transmitter b contains a slide scanner.

The system contains an AC supply voltage stabilizer. For reliability of operation, the container has a thermostat-controlled ventilation. Due to noise-reducing measures there is only a maximum noise level of 62 dB(A) inside the container. The monitoring concept (remote signalling, commanding, intruder and fire alarm) corresponds to that of a stationary transmitter system.

Container with 2-kW dual transmitter including monitoring and measuring equipment on truck



Transmitter b with monitoring assembly (including monitor) on the left and transmitter rack on the right; to the right of Transmitter Test Assembly UMVF 2 and AC supply rack (with stabilizer) along right-hand wall

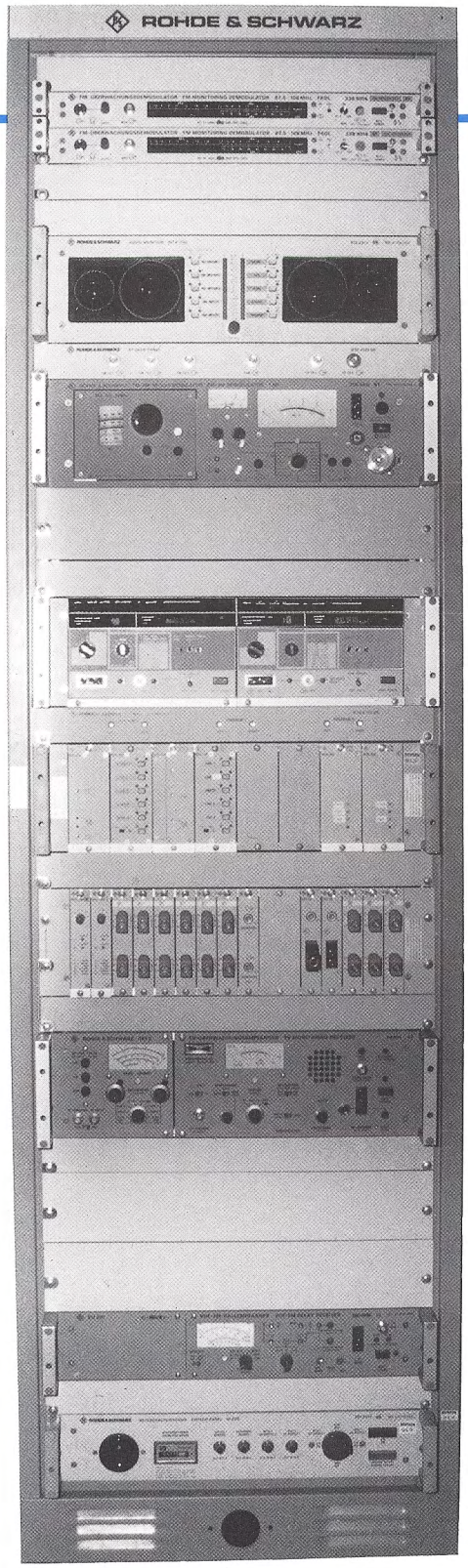
new

UMT-S

FM Transmitter Input and Monitoring System UMT-S

Uses:

- Quality measurements on FM mono and stereo transmitters
- Program signal through-connection via limiter and stereo coder for max. 3 sound transmitters
- Monitoring transmitter reference characteristics using AF signals and FM monitoring demodulators
- Measurement parameters: frequency deviation, interference FM, interference AM, level, crosstalk, distortion, weighted and unweighted signal-to-noise ratio



FKDL

FKDL

(FKDL)

MTA 702

RF jack panel

FAB

(MSDC 2)

SUN 2

Limiter

MTA S01

AF jack panel

(EKF)

(GC 003)

(GC 003)

GC 003

Power supply jack panel

The **FM Transmitter Input and Monitoring System UMT-S** combines the **function of an transmitter input and a measuring assembly.** The equipment configuration can be adapted to customer requirements.

Program supply (see block diagram on page 171) The maximum of five input signals per program travel from the AF connection panel via the AF jack panel to the Automatic Switchover Equipment MTA S01 with the AF Selector Switches "MPX" MTA 401 in which the signals are routed via the Control Modules MTA 400. The selected signals pass travel AF Stereo Line Amplifiers MTA 504, AF Limiters MTA 900 and another AF jack panel to the Stereo Coders GC 003. The MPX signals supplied by the GC 003 are sent to the transmitter inputs via the MPX/RF connection panel.

Program monitoring The FM Monitoring Demodulators FKDL monitor **radiated carrier signals** which are modulated with mono or stereo signals. They are provided via outputs for multiplex, L, R and mono signals for the purpose of control measurements of transmitter quality data.

The FM/AM Demodulator FAB with its oscillator plug-ins (Band II for FM sound broadcasting and Bands I, III, IV and V for TV) are used for the exact measurement of the **FM wanted and interference deviation** and the **modulation factor.**

A connected Precision Stereo Decoder MSDC 2 supplies an AF analyzer (either Audio Analyzer UPA or two Level Meters SUN 2/U) with the decoded signals from the MPX signal of the FAB. The AF from the FAB is also supplied to this AF analyzer when measurements are performed on TV sound transmitters. The **signal-to-noise ratio, frequency response, crosstalk and distortions** are measured in the AF analyzer.

The Audio Monitor MTA 702 is designed for **measuring the modulation** of all incoming and demodulated AF signals and for acoustic monitoring, as required.

The AF Generators MTA 200 supply test signals for the purpose of monitoring unoccupied program paths.

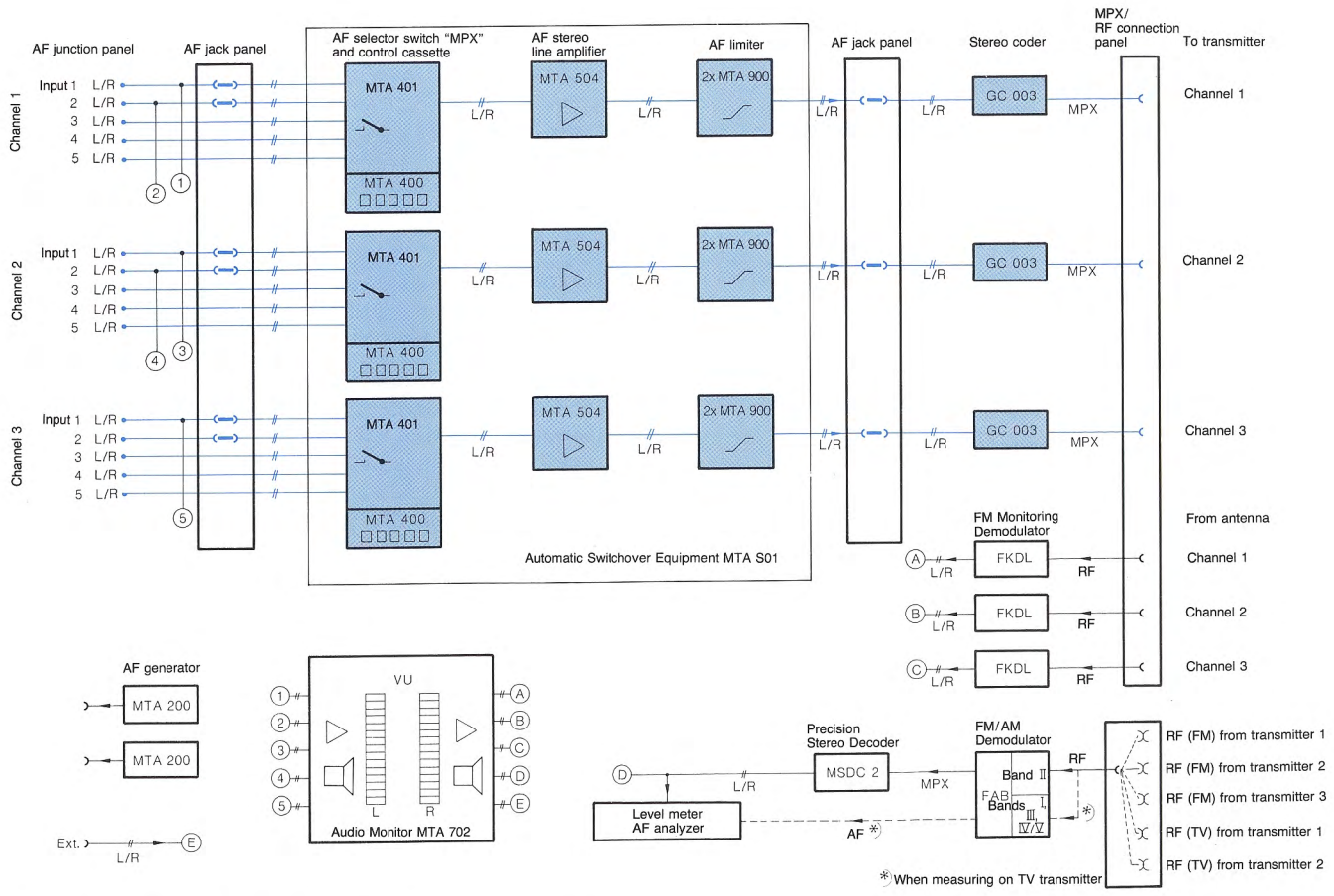
Condensed data

Number of inputs	max. 5 per channels, can be connected to 3 program paths
L/R crosstalk attenuation between any signal paths (terminated with 600 Ω), 30 Hz to 15 kHz, program input up to stereo coder	>80 dB
Power supply	220 V ±10%, 47 to 63 Hz (max. 400 VA)
Dimensions (W×H×D)	550 mm × 1960 mm × 693 mm
Weight	max. 170 kg
Cooling	3 ventilators on rear panel of rack-mount are automatically switched on by thermostat

Ordering information

Order designation ▶ FM Transmitter Input and Monitoring System UMT-S

Please specify the desired configuration for measuring, monitoring and input rackmount functions when requesting a quotation



Block diagram of the FM Transmitter Input and Monitoring System UMT-S in fully expanded configuration

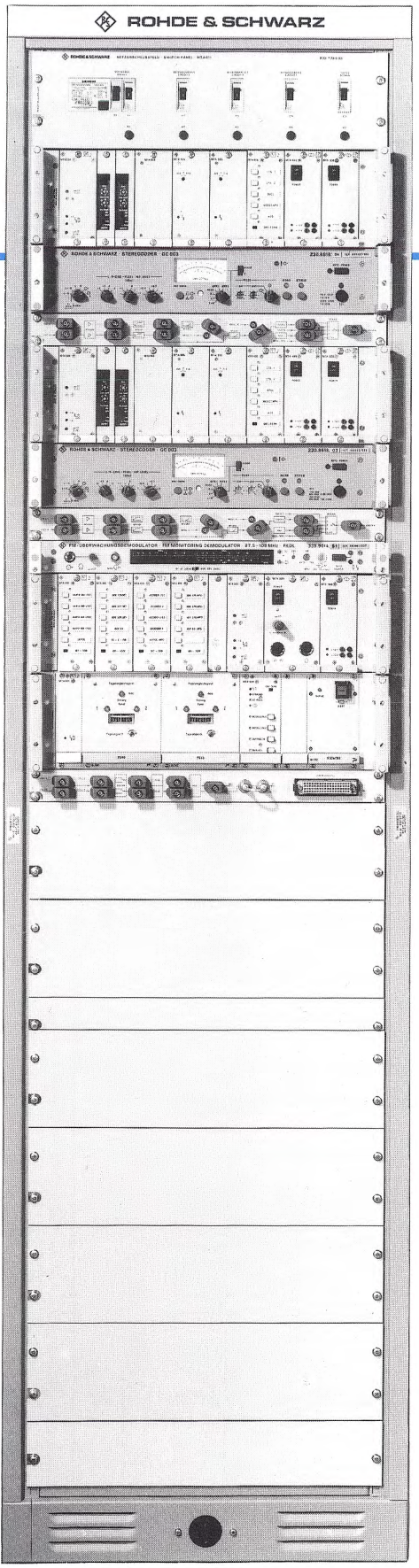
new

MST 01

FM Input Assembly MST 01

Uses:

- Monitoring measurements on FM mono and stereo transmitters
- Signal distribution, level adjustment of AF signals and in-service monitoring of a dual transmitter
- Internal and external switchover control



The **FM Input Assembly MST 01** combines the functions of a transmitter input and a monitoring assembly (see block diagram on page 173). It contains equipment for monitoring not only the AF input signals but also the demodulated RF signals of a dual transmitter. The equipment configuration of the MST 01 can be adapted to customer requirements and expanded for data transmission services and automatic monitoring systems.

Program signal processing An **AF Processor MST 011** is allocated to each transmitter for the incoming L/R signal. The AF Processor MST 011 consists of the following:

- AF Stereo Line Amplifier MTA 504
- AF Limiter MTA 901
- Lowpass Filter MTA 906
- Variable Preemphasis MTA 905
- Stereo Coder GC 003
- AF Selector Switch "MPX" MTA 406
- Jack panel

The AF Stereo Line Amplifier MTA 504 can be used for level adjustments between the L and R signals. The level of the incoming signals is adjusted after the AF Limiters MTA 901.

Level monitoring The **Level Comparator MST 013** is used for monitoring the transmitted signals and for switchover control in the event of a fault. The Level Comparator MST 013 consists of the following:

- AF Switch "Matrix" MTA 409
- FM Monitoring Demodulator FKDL
- 2 Level Comparators MTA 908
- Switchover Control MTA 800
- Jack panel.

In the level comparator, the L/R input signals are compared with the signals (L + R) supplied by the FM Monitoring Demodulator FKDL. Depending on the threshold and limit value settings, an error message is issued. This results in a switchover from the program line to the stand-by line via the Switchover Control MTA 800. The transmitter can also be switched over by remote-control.

AF signal monitoring can be performed by connecting the checkpoints to the checkpoints of the program paths and the level comparator. The **AF Selector MST 012** contains the following:

- AF Selector Switch "MPX" MTA 406
- AF Stereo Line Amplifier MTA 504 and
- AF Monitoring Amplifier MTA 505.

The AF Selector can be expanded to a maximum of 10 inputs (L + R/MPX). Outputs are provided for displaying the AF voltages and for acoustic monitoring purposes.

Jack panels are used to interrupt the program paths and bypass the rackmounts, either partially or entirely, for the purpose of system maintenance and in the event of a fault. The jack panel for the Level Comparator MST 013 is provided with a connector for a measuring assembly.

The assembly can be **expanded** with units such as the Radio Data Coder DMC, Data Decoder and Audiodat Transmitter SPT for transmitting RDS and traffic program signals and for data transmission in automatic monitoring systems.

Condensed data

Inputs

Program lines 1 and 2	L + R
Nominal level	–12 to +9 dBm, adjustable
Input impedance	Z_{in} = 600 Ω to 10 kΩ
Relay receivers 1 and 2	MPX
Nominal level	+6 dBm
Measurement signal	L + R, MPX
RF signal	V_{rms}, approx. 1 V into 50 Ω

Outputs

Transmitters a and b	MPX
Nominal level	+6 dBm
Output impedance	Z_{out} <30 Ω
Measurement signal	L + R (max. 10 checkpoints)
Monitoring	loudspeaker connector, ≥4 Ω, 2 × 3 W

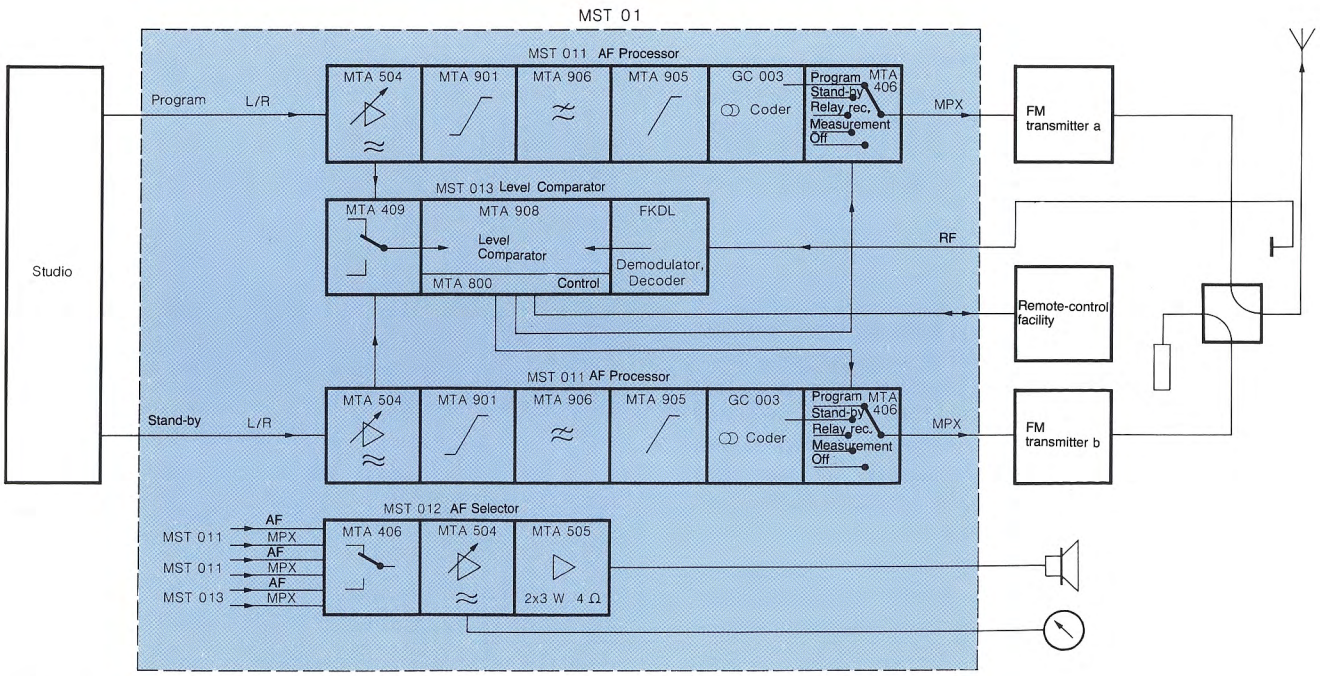
General data

System connector for measurement rackmount	72-contact female connector
Remote-control connector	72-contact female connector
Jack panels	Triax (AF) and BNC (RF)
Power supply	220 V ±10%, 47 to 63 Hz (max. 200 VA)
Dimensions (W×H×D)	550 mm × 2320 mm × 793 mm
Net configuration height	45 U
Weight	max. 130 kg

Ordering information

Order designation ▶ FM Input Assembly MST 01

Please specify the desired number of checkpoints and the configuration for additional operating services when requesting a quotation.



FM Input Assembly MST 01 between studio and transmitter

new

MTA/MFA

Audio/Video Cassette System MTA/MFA

♦ Signal matching, distribution, isolation, monitoring

- For sound broadcasting and TV in-service, studio and measuring systems
- For flexible combinations of program and measuring signals
- Extensive range of cassettes and accessories

See page 180 for equipment overview

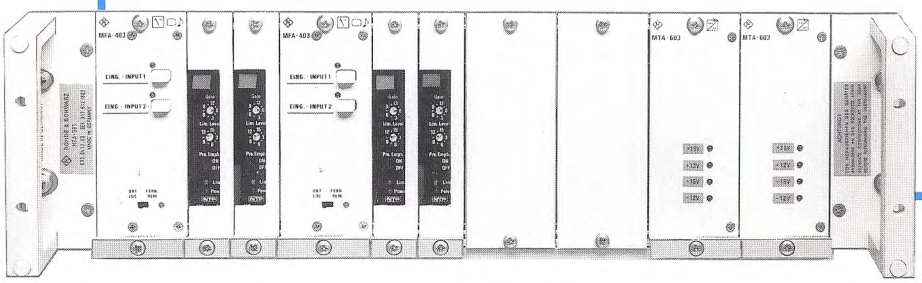


Photo: Configuration example of MTA 002 (front panel) with MTA 603, MTA 901 and MFA 403; audio selector with limiters and distribution amplifiers

The **cassette system MTA/MFA** matches, distributes, isolates and monitors program and measuring signals in in-service, studio and measuring systems.

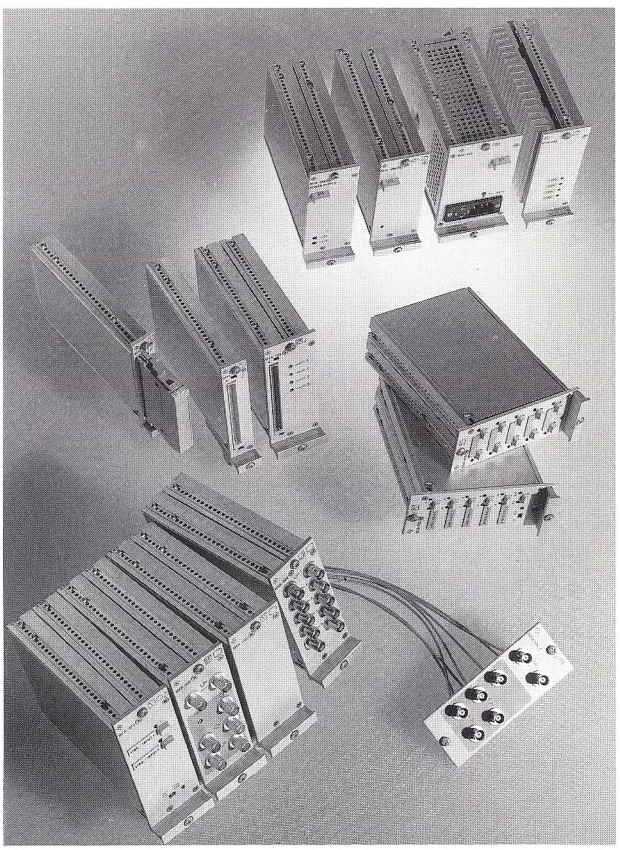
The system's state-of-the-art modular design means that it is variable and adaptable so that the individual modules can be easily integrated into **existing installations.**

Cassette types A wide range of modules is available (see overview on pages 180/181) for the different requirements involved:

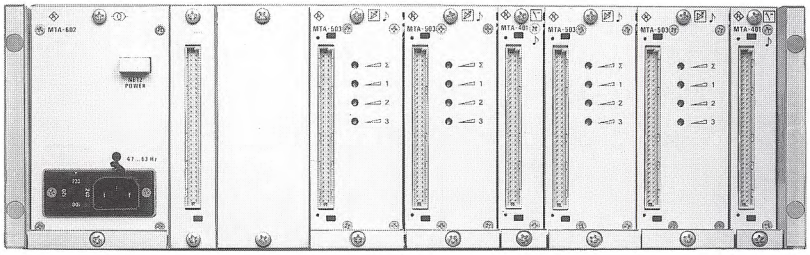
- program preview
- program selection
- program path measurement
- program monitoring

The cassettes MTA for audio and MFA for video are supplemented by different units which can all be used for controlling, supplying and connecting. Several mainframes are available for optional configuration. They can be integrated into racks, or retrofitted, and extended to form **mini and compact systems.** The Audio Monitor MTA 702 (see page 178 for further details) is a compact sound monitoring unit comprising modules of this system.

R&S provides **system planning** on request. Publications are available on equipment features, giving detailed specifications beyond the information given here. The wide range of possible applications for the MTA/MFA system ensures continuity in the further development of new and existing modules.



Cassettes from the MTA/MFA system



Configuration example: MTA 002 (rear panel) with MTA 602, MTA 401 and MTA 503; audio selector with limiters and distribution amplifiers

Application example
(block diagram below)

Input control and monitoring of TV transmitter systems are two of the main fields of application for MTA/MFA components.

The monitored system consists of AF and VF program processors and monitoring equipment. A maximum of five programs can be switched to the TV transmitter. Their **VF signals** are equalized by the VF Cable Equalizer MFA 404 and looped through to the VF Switch MFA 401. The video signal selected using the Control Cassette MTA 400 is sent to the VF outputs via the VF Distribution Amplifier MFA 501.

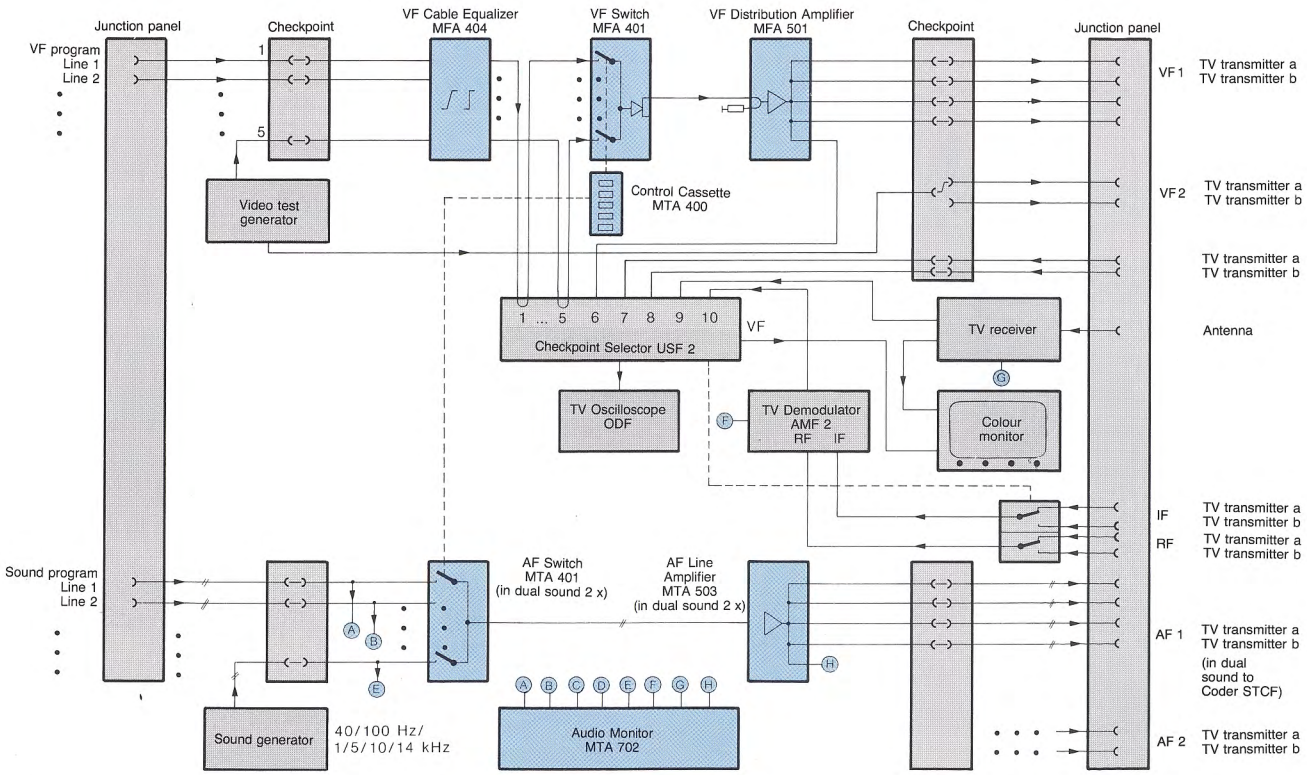
The video signals which are equalized in the MFA 404, through-connected to the outputs and received via a TV Demodulator AMF 2 and a TV receiver, can be sent as required via a Checkpoint Selector USF 2 to a TV Oscilloscope OPF and a colour monitor. The USF 2 is used to connect the RF and IF checkpoints of the transmitters to the AMF 2.

An Audio Monitor MTA 702 monitors the incoming and outgoing **AF signals** and the AF of a TV receiver. The AF input signals are also selected on the Control Cassette MTA 400 via the VF Switch MTA 401. The sound signals are distributed to the AF outputs via the AF Line Amplifier MTA 503. The MTA 401 can also be used to select a sound generator signal for measuring the transmission link.

Audio Cassettes MTA

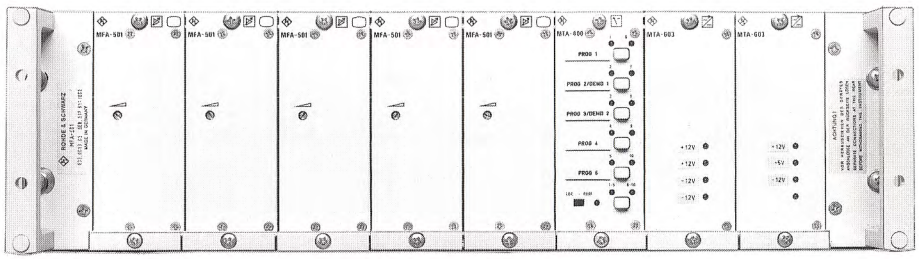
The **Control Cassette MTA 400** is constructed in relay technology and is used as a control unit for AF and VF switches. Keys on the front panel can be used to select ten switching points with common switchover and the switching statuses are indicated by LEDs.

The **AF Switch MTA 401** is symmetrically designed with 2 × 5 inputs and 2 × 1 output and can be used as a program and checkpoint selector.

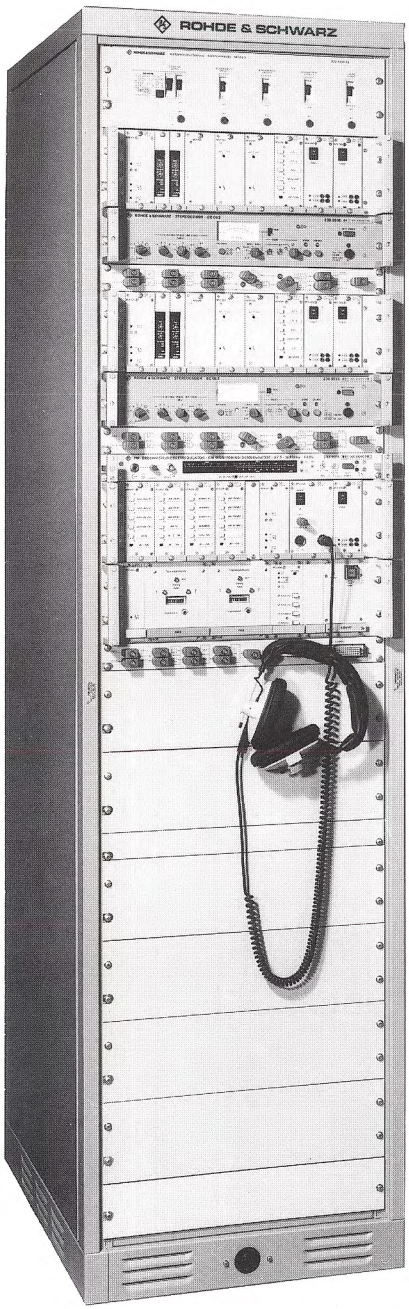


Input and monitoring system for a TV transmitter system (the MTA/MFA components are marked in blue)

MTA/MFA – Cassette System



Configuration example: MTA 002 (front panel) with MTA 603, MTA 400 and MFA 501; video distribution amplifier and selector



FM Input Assembly MST 01 for FM sound broadcasting transmitters, equipped with different MTA components

The **AF Switch MTA 402** is an active electronic switch equipped with JFET modules and provided with 2 × 5 balanced inputs and 2 × 1 output.

The **Control Cassette MTA 405** is implemented in relay technology and provided with five independent control functions which are selected via five ON and OFF keys.

The **AF Selector "MPX" MTA 406** houses a control unit with control logic and AF switching relays with common switchover for 2 × 5 inputs/outputs.

The **Control Cassette MTA 408** is an electronically operated control unit with relay contacts and switching point storage. Row, column and program matrix switching operations can be performed using five keys with LED displays in conjunction with AF or VF switches.

The **AF Switch "Matrix" MTA 409** is provided with four independent relay switches with switching point storage and acknowledgment signals.

The **AF Switch "MPX" MTA 410** is equipped with 10 independent balanced switches for MPX matrix switching operations or for program selection of 2 × 5 inputs to 2 × 1 outputs.

The **AF Amplifier MTA 502** contains a high-quality, externally adjustable 20 W output stage for loudspeakers.

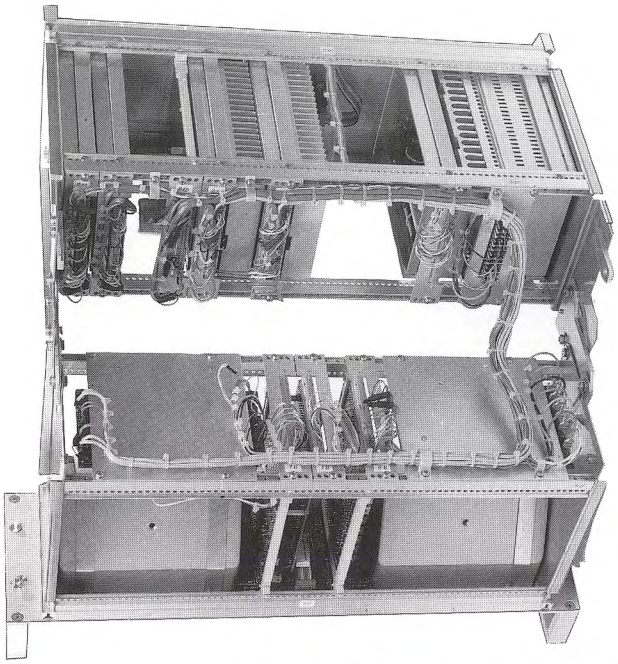
The **AF Line Amplifier MTA 503** distributes the signals of a balanced input to six balanced outputs. Every pair of outputs the same level setting has and a master setting for all outputs. Inputs and outputs are isolated by transformers.

The **AF Stereo Line Amplifier MTA 504** with 1 × 2 balanced inputs and 2 × 2 balanced outputs is provided with independently adjustable amplifiers with transformers in inputs and outputs.

The **AF Monitoring Amplifier MTA 505** has a 2 × 3 W output stage with adjustable volume and outputs for loudspeaker and headphones.

The **Power Supply MTA 600** is a compact power supply unit with integrated voltage regulators for different power levels.

The combination of the **Transformer Module MTA 602 and Voltage Regulator MTA 603** results in high-capacity power supplies for all voltages required in the system.



Open mainframe MTA 002 (configuration: MTA 702), all connectors can be easily accessed.

The **Power Supply Unit MTA 606** powers components such as LEDs, relays, etc., with unregulated DC voltages.

The **Power Supply Unit MTA 610** supplies a stabilized control voltage and is intended for mounting on the rear panel of the rackmount.

For the **Audio Monitor MTA 702,** see page 178.

The **AF Limiter MTA 901** is a controllable level limiter for one channel and houses the Limiter Circuit NTP 179/400 R/S.

Video Cassettes MFA

The **VF Switch MFA 401** is a fully electronic video signal switch with five bridging inputs and two mutually isolated outputs. Depending on the model concerned, the inputs and outputs are mounted on the front panel (with BNC connectors) and on the rear panel (with SMB connectors).

The **VF/AF Switch MFA 403** with two VF inputs and 2 × 2 balanced AF inputs to one VF output and 1 × 2 AF outputs is implemented in relay technology. Automatic reset (eg. in the case of power failure) to inputs 1 or 2 is selectable. It is operated using the front panel keyboard (with LEDs).

The **VF Cable Equalizer MFA 404** operates passively and can compensate frequency-dependent level losses for defined cables on five lines with a maximum length of 160 m.

The **VF Distribution Amplifier MFA 501** is a video buffer amplifier with bridging filters for one input and five isolated outputs. The integrated passive cable equalizer compensates distortions on lines with a maximum length of 160 m. Depending on the model concerned, the inputs and outputs are mounted on the front panel (with BNC connectors) and on the rear panel (with SMB connectors).

For the **Control Cassettes** and **Power Supply Modules,** see MTA 4 and MTA 6.

General

Suitable junction panels are available for system solutions for all MTA and MFA cassettes. The **Function Panels MFA 401Z** and **MFA 501Z** are fitted with the suitable SMB connection cables and BNC connector configurations for the different cassettes. The **Function Panel MFA 403Z** can be used for externally connecting the audio and video signal lines routed to the cassette. The **Function Panel MTA 702Z** is used for directly connecting the AF input and output lines to the Audio Monitor MTA 702 via three-contact DIN sockets.

Several mainframes are available for mounting into existing systems and for setting up compact systems.

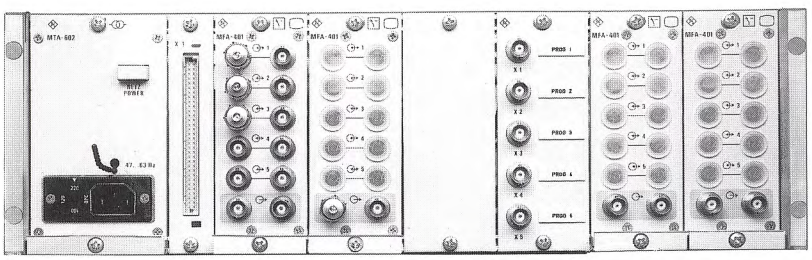
The **Mainframe MTA 002** can be equipped with a maximum total of 32 units for both the front and rear panel. The main feature of the MTA 002 is its low-maintenance design. The frame can be opened by 90° after loosening two locking screws; this means that there is unobstructed access to all connectors (photo above). Subsequent expansion with additional wiring and maintenance work is considerably simplified.

The **Mainframe MTA 003** can be equipped with a maximum of 16 units on one panel and only requires minimum depth for mounting.

In a special version, the MTA 003 can be pulled out on telescopic runners and opened by 90°. The **Parts Kit MTA 003T** contains the component parts.

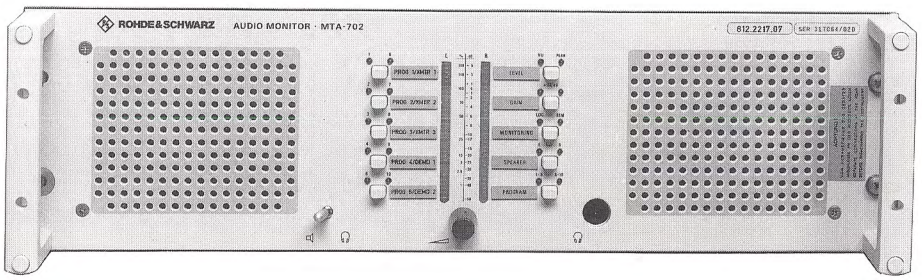
The **Mainframe MTA 004** also houses a maximum of 16 units. Its junction panels on the rear panel are used for automatically inserting cassettes into the frame.

The **Mainframe MTA 005** is designed for mounting on rackmount struts and walls. It can house between two and eight units and can also be integrated into completely equipped rackmounts using its mounting fixture on the rear panel.



Configuration example: MTA 002 (rear panel) with MTA 602, MFA 401 and MFA 401Z; video distribution amplifier and selector

MTA/MFA – Cassette System



Audio Monitor MTA 702

Audio Monitor MTA 702

- 2 × 10 inputs
- VU/peak meter
- 2 × 20 W stereo amplifiers
- Built-in stereo loudspeakers

The **Audio Monitor MTA 702** is a monitoring unit for stereo program lines and receiver systems. The input channels can be selected via TTL lines and external loudspeakers and volume controls can be switched on for **remote-monitoring.**

The **levels** of the monitored signal are indicated on LED scales on the front panel either as VU or peak values (photo right). The measurement range can be switch-selected between −50 and +5 dB and between −70 and −15 dB, referred to +4 dBm with VU and +6 dBm with peak values respectively.

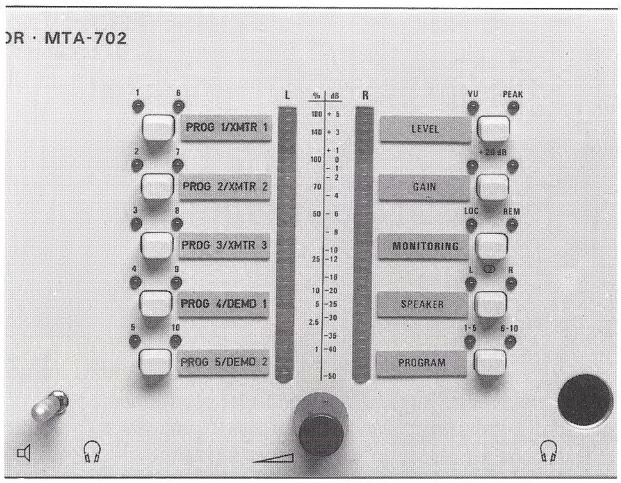
In addition to the **20 W stereo output stages** and the high-quality loudspeaker systems integrated in the front panel, there are 1 V outputs for active loudspeaker boxes and headphone connectors.

The loudspeakers of external headphones can be switched over from mono to stereo and from sound 1 to sound 2 for stereo signals or TV dual sound programs. The headphone loudspeakers can be switched off.

Design The 19″ unit consists of MTA system modules. A fold-down mainframe is equipped with cassettes, plug-in modules and sub-assemblies on both the front and rear panels. Both backplanes are located at the hinge level and are easily accessible for modification and maintenance purposes after releasing the lock and swivelling the front part of the frame open (see photo on page 177).

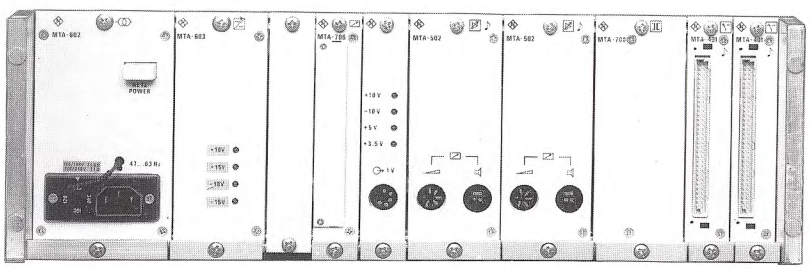
The main modules contained in the Audio Monitor are as follows:

1 mainframe (for folding down)	MTA 002
1 front panel module (with loudspeakers, checkpoint memory and VU/peak meter)	MTA 703
2 AF switches (10 stereo inputs)	MTA 401
2 AF amplifiers (20 W)	MTA 502
1 transformer module	MTA 602
1 voltage regulator (±15 V/±18 V)	MTA 603
1 transformer module	MTA 700

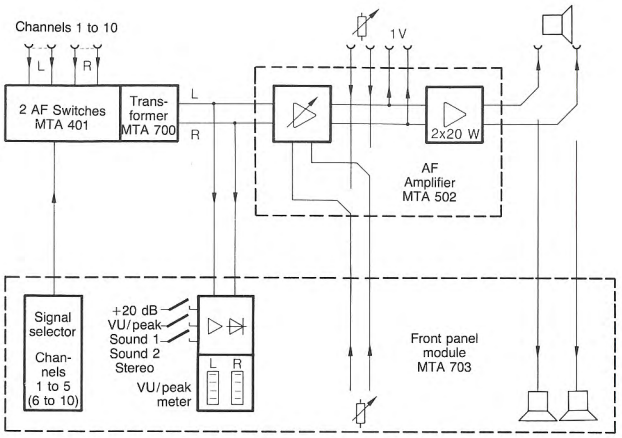


Controls and VU/peak meter of Audio Monitor MTA 702

Functional description The checkpoint signal selected at the signal selector passes via the VF switch and the transformer to the VU/peak meter where it is indicated on LED



Rear panel configuration of MTA 702



Block diagram of MTA 702

General data MTA 702

Rated temperature range	–5 to +45 °C
Power supply	100/120/220/240 V +10/–15%, 47 to 63 Hz
Power consumption	80 VA
Dimensions (W×H×D)	
Bench model	492 mm × 161 mm × 514 mm
19″ rackmount	483 mm × 132 mm × 506 mm
Weight	
Bench model	18 kg
19″ rackmount	17 kg

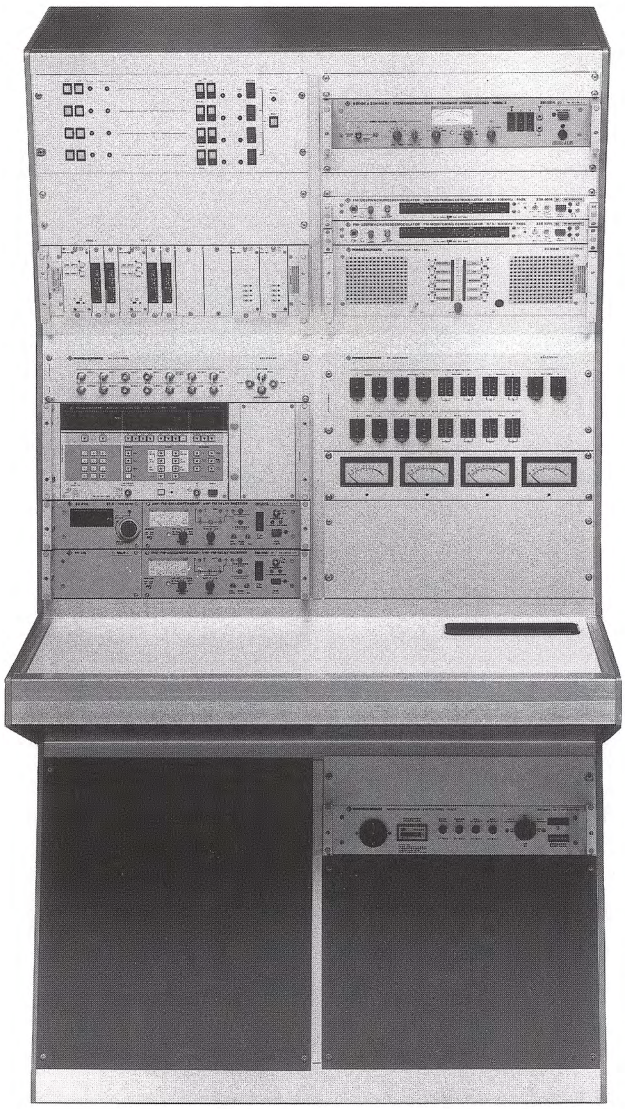
Recommended extras

See page 181 for AF Junction Panel MTA 702Z and panelling

scales after amplification and rectification. The measurement range can be increased by 20 dB (eg for measuring the noise voltage).

The AF signal is also passed to the loudspeakers via the AF preamplifier and the output stage. The input signal of the preamplifier can be electronically adjusted, also externally; its output voltage is 1 V_{rms}. Two output stages in a bridge circuit are used for power gain.

Program input and monitoring console with MTA 702 and additional MTA components



Specifications (MTA 702)

Inputs and outputs

Number of inputs	2 × 10, balanced, floating
Output for Hifi speakers	2
active speakers	2
Headphones output	1

AF amplifier

Output power	2 × 20 W at 4 Ω (sine-wave)
Frequency response	1 dB (30 Hz to 20 kHz)
Distortion factor at full load	<0.2%
Unweighted signal-to-noise ratio, referred to full load	≥80 dB
Output voltage at 1 V output	V_{rms} = 1 V at 0 dBm (= 0.775 V) input level
Pushbuttons on front panel for output switchover operations	for internal/external loudspeakers, 2 left, 2 right, stereo, off
Volume control	internal/external, with 0 to +10 V DC

VU/peak meter

Frequency response	<±0.6 dB (30 Hz to 20 kHz)
Measurement range for	
VU (switch-selectable)	–50 to +5 dB/–70 to –15 dB, (referred to continuous signal +4 dBm)
peak	180% (referred to continuous signal +6 dBm)
Scale resolution + 5 to 0 dB	1 dB per LED (red)
0 to –10 dB	1 dB per LED (yellow)
–10 to –16 dB	2 dB per LED (yellow)
–16 to –49 dB	3 dB per LED (yellow)

MTA/MFA – Cassette System

Overview and order numbers

Type	Designation	Application	Data	▶ Order number
MTA modules				
MTA 002	Mainframe	Equipped on both panels with MTA/MFA cassettes and Eurocards (max. 32 units)	19″ rackmount, fold-down; including rackmount runners with slide lock	389.3013.03
MTA 003	Mainframe	Equipped on one panel with MTA/MFA cassettes and Eurocards (max. 16 units)	19″ rackmount Telescopic runners (extendible, fold-down, 19″)	833.9510.03 832.3260.05
MTA 003T	Parts Kit	MTA 003, model 03; mounted on telescopic runners in 19″ rackmounts	Telescopic nunners, articulated cable arm, helical power cable, accessories	2007.9006.05
MTA 004	Mainframe	Equipped on one panel with MTA/MFA cassettes and MFA junction panels (max. 16 rackmounts)	19″ rackmount; automatic cassette insertion	832.3119.03
MTA 005	Mainframe	Equipped with MTA/MFA cassettes; for mounting on rear panel of rackmount	Frame for between 2 and 8 units, for mounting on struts	389.3513.08
MTA 400	Control Cassette	Selection of AF, MPX and VF switches	10 switching functions, 6 pushbuttons, TTL level controls, LEDs, floating contacts	811.8611.03
MTA 401	AF Switch	AF preview and program matrix, AF checkpoint switch	2 × 5 input, 2 × 1 outputs; relay switches	811.8763.03
MTA 402	AF Switch	AF preview and program matrix, AF checkpoint switch	2 × 5 inputs, 2 × 1 output; FET switches	811.8911.03
MTA 405	Control Cassette	For switching five independent functions on and off	5 × 4 floating switchover contacts, LED display	812.5116.03
MTA 406	AF Selector „MPX“	Equipment selection, program connection, checkpoint selection, switch for 5 (10) independent inputs and outputs	5 (2 × 5) balanced inputs, floating contacts (with status storage in the event of power failure); relay switches	832.6118.03
MTA 408	Control Cassette	Control unit for line and column switches in a program matrix	5 pushbuttons (with stored switching points), LEDs, pulse triggering	830.4360.03
MTA 409	AF Switch “Matrix”	AF switching matrix for stereo signals	4 independent relay switches (with stored switching points), acknowledgment signal via switchover contacts	830.4160.03
MTA 410	AF Switch “MPX”	MPX switching matrix or program switch	10 independent switches (2 × 5 balanced inputs) (2 × 1 balanced output)	830.4560.03
MTA 502	AF Amplifier	Output stage for loudspeakers	20 W sinusoidal power, adjustable	811.9218.03
MTA 503	AF Line Amplifier	Distribution amplifier, line amplifier	1 balanced input, 6 balanced outputs	811.9360.03
MTA 504	AF Stereo Line Amplifier	Line amplifier for 2 channels, distribution amplifier	2 × 1 balanced input, 2 × 2 balanced outputs	830.5014.03
MTA 505	AF Monitoring Amplifier	Stereo amplifier for loudspeaker and headphones connector	2 × 3 W sine-wave power; input transformer; inputs on front and rear panels, headphones connector on front panel	830.5214.03
MTA 600	Power Supply Unit	Power supply for MTA/MFA cassettes	2 × 5 V, 1 A; 2 × 12/15/18 V, 0.8 A (can be changed)	830.6004.03
MTA 602	Transformer Module	Generation of low voltage in mainframe	each 4 × 5/12 V, 1 A; 15/18/24 V, 0.8 A	811.9660.05

Type	Designation	Application	Data	▶ Order number
MTA 603	Voltage Regulator	Voltage stabilization	2 × 5 to 24 V (adjustable), 1 A	811.9818.03
MTA 606	Power Supply	Power supply for external relays, LEDs	12/24 V, 1.5 A; unregulated	812.5616.03
MTA 610	Power Supply	Control voltage generation (stab.); for mounting on rear panel of rack-mount	24 V, 0.1 A; unregulated; with casing	833.1210.03
MTA 702	Audio Monitor	Monitoring of program lines and receiver systems, remote-controlled	2 × 10 inputs, VU/peak meter, 2 × 20 W amplifiers; 19″ rackmount	812.2217.07
MTA 702Z	AF Junction Panel	MTA 702; AF inputs/outputs	22 DIN female connectors, 3-contact, with 2 connection cables, 64-contact	2001.4854.03
MTA 901	AF Limiter	Adjustable level limiting (1 channel)	Limiter circuit NTP 179/400 R/S, 64-contact male connector	830.9010,03
MFA modules	See MFA for mainframes, power supplies, etc.			
MFA 401	VF Switch	Program preview, program matrix, VF checkpoint switch-selection	5 inputs (75 Ω), 2 outputs (75 Ω), connectors: 12 × BNC	811.8163.03
			12 × SMB	811.8163.05
			10 × SMB, 2 × BNC	811.8163.07
			10 × BNC, 2 × SMB	811.8163.09
			11 × BNC, 1 × SMB	811.8163.11
MFA 401Z	Junction Panel	MFA 401, model 05	BNC connectors (with connection cable to SMB)	812.3188.05
		MFA 401, model 07		812.3188.07
		MFA 401, model 09		812.3188.09
		MFA 401, model 11		812.3188.11
MFA 403	VF/AF Switch	Program and relay receiver signal switch-selection; selectable reset input	Inputs: 2 × VF, 2 × 2 AF (balanced) Outputs: 1 × VF, 1 × 2 AF	389.3613.04
MFA 403Z	Junction Panel	MFA 403	Connectors: 3 × BNC, 6 × DIN (3-contact)	399.9543.03
MFA 404	VF Cable Equalizer	Compensation of linear distortions	Insertion loss 3 dB; 5 channels	812.5416.03
MFA 501	VF Distribution Amplifier	Isolation of input and output lines, signal distribution, equalization	1 input (75 Ω), 5 outputs (75 Ω), connectors: 7 × BNC	811.8463.03
			7 × SMB	811.8463.05
			2 × SMB, 5 × BNC	811.8463.07
MFA 501Z	Junction Panel	MFA 501, model 05	BNC connectors (with connection cable to SMB)	811.8586.05
		MFA 500, model 07		811.8586.07

General data

Rated temperature range	+5 to +45 °C
Power supply	100/120/220/240 V +10/–15%, 47 to 63 Hz
Power consumption	dependent on configuration
eg MTA 702	80 VA
Dimensions (W×H×D)	
Bench model	492 mm × 161 mm × 514 mm
19″ rackmount	483 mm × 132 mm × 506 mm
Weight	dependent on configuration
eg MTA 702, bench model	18 kg
19″ rackmount	17 kg

Ordering information

See tables for **order designations** and **order numbers** of cassettes and most frequently used auxiliary modules.

Recommended extras

Terminating resistor 75 Ω, BNC	ERST.2	0812.3307.00
75 Ω, SMB	ERST.2	0812.3359.00

Junction panel parts kit, 1/16 width units		
with 4 DIN female connectors, 3-contact (including male connector)	MTA 010T	0832.8110.03
with 4 DIN female connectors, 5-contact (including male connector)	MTA 010T	0832.8127.03
with 4 BNC female connectors each with 2 BNC and DIN female connectors (3-contact; including 2 male connectors)	MTA 011T	0832.8162.03
	MTA 014T	0832.8179.03
Cassette adapter 64-contact	MTA 040	0833.0865.03
64-cont., 12×SMB	MTA 041	0833.0959.03
96-contact	MTA 042	0833.1361.03
Panelling for Mainframe MTA 002 (and for MTA 702)		085.1465.00
for Mainframe MTA 004		085.1336.00
Filler panel, 1/16 width unit	ERST.2	0085.4687.00
2/16 width unit	ERST.2	0085.4693.00

Other information about cassettes, built-in accessories and **system design** available on request.

UERF Vision Transmitter Input Equipment UERF

Uses:

- Distribution of main program line to main and stand-by transmitters
- Interface for TV transmitter monitoring and test assemblies

Additional option:

- Decentralized automatic vision and sound monitoring with the TOPAS system

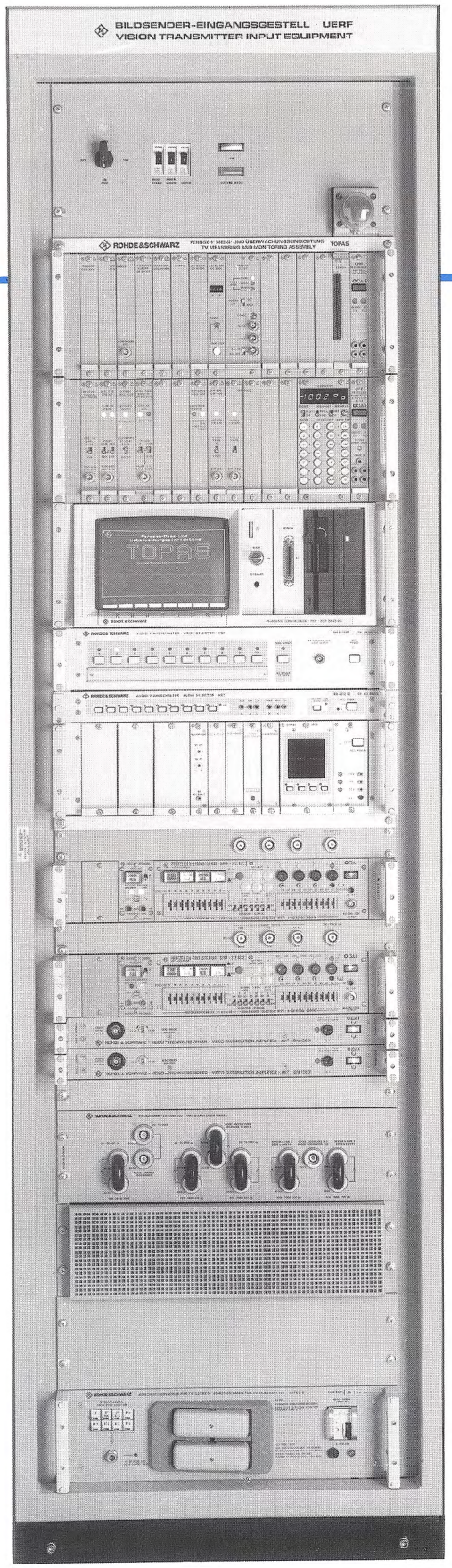


Photo: Vision Transmitter Input Equipment UERF (bottom) and (top) in a common rack

The **Vision Transmitter Input Equipment UERF** is used for distribution and processing of the program signal for single or dual transmitters. It is equipped according to the customer's requirements and usually contains VIT Inserters SPRF (see catalog Section 1) for the insertion of test lines and for automatic gain control (AGC), sync pulse regeneration and, if required, automatic chrominance control (ACC) of the program signal. Jack and junction panels enable the connection of additional equipment as well as special link-up of the signal path.

The Sound and ITS Monitoring Assembly TOPAS (see catalog Section 4) can be housed in the UERF for decentralized automatic vision and sound monitoring. The TOPAS system can also be equipped for both vision monitoring and dual sound monitoring.

The junction panel for connection to the TV transmitter monitoring or test assembly can be accommodated in the lower part of the UERF, which is integrated into the transmitter front.

The illustrated **Vision Transmitter Input Equipment UERF** is the standard model for dual transmitters of the Federal German Posts and Telecommunications Administration and contains in the upper part the Sound and ITS Monitoring Assembly TOPAS for the purpose of vision and sound monitoring; the jack panel is housed at the very bottom. The program signal (see block diagram on right page) passes through bridging filters to the Video Distribution Amplifiers AVF and then via the program jack panel to the VIT Inserters SPRF. The unused program channel can be disconnected on the program jack panel and instead a video test signal can be applied to the corresponding SPRF; this signal is derived from the Picture Transmitter Test Assembly UMVF 2 via the junction panel.

Test line signals are inserted on the UERF front panel via the junction panel located above the SPRF in the rack. Here, the (composite colour video) program signal and the associated S_H and BL_H signals are also available for the external insertion-signal generator to ensure colour-subcarrier and line frequency synchronization. If the insertion signal generator is incorporated, the generator can also be synchronized from the program-carrying UERF via the automatic switchover unit of the transmitter.

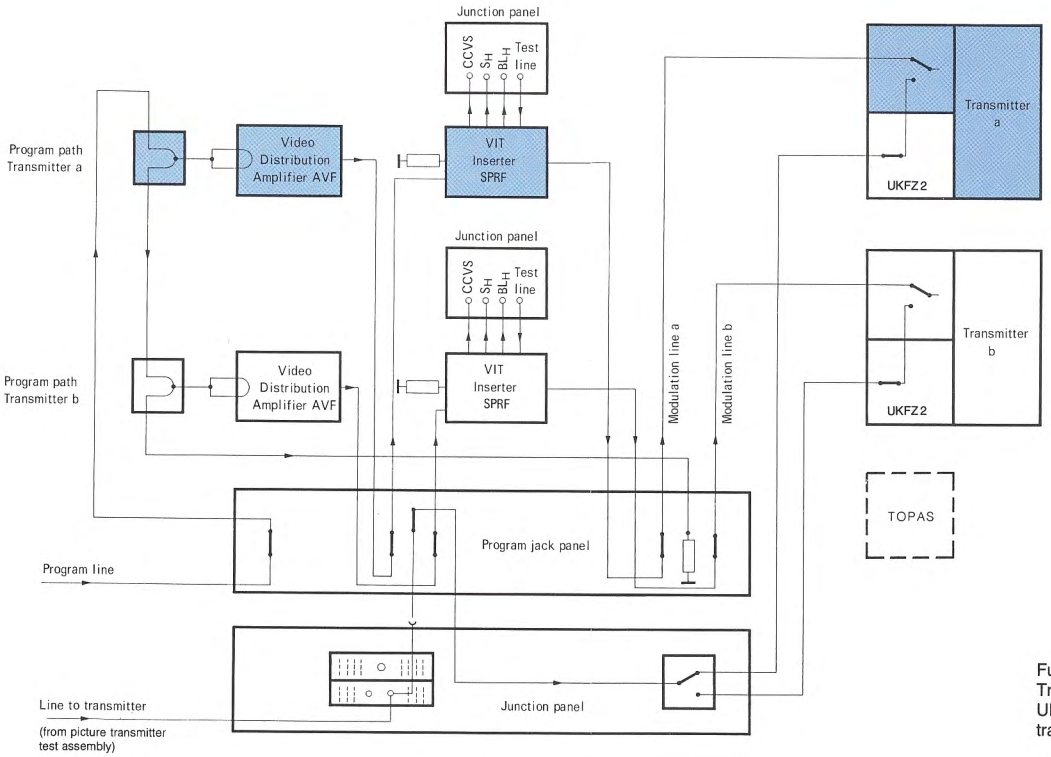
Condensed data

Video input impedance	75 Ω
Return loss up to 6 MHz	≥34 dB (inputs) ≥26 dB (outputs)
Crosstalk attenuation (between lines carrying different signals) up to 6 MHz	≥60 dB
Signal-to-noise ratio (weighted, rms value without hum)	≥60 dB, referred to 0.7 V video signal
Gain of program paths	0 dB (nominal)
Setting range for level adjustment	±6 dB for AVF (max. 1.5 V_{pp} CVS), ±1 dB for SPRF
Range of automatic control	±3 dB
Ventilation	built-in blower with air filter

Ordering information

Order designation ▶ Vision Transmitter Input Equipment UERF

When requesting a quotation, please indicate whether configuration is required for use with a single or dual transmitter.



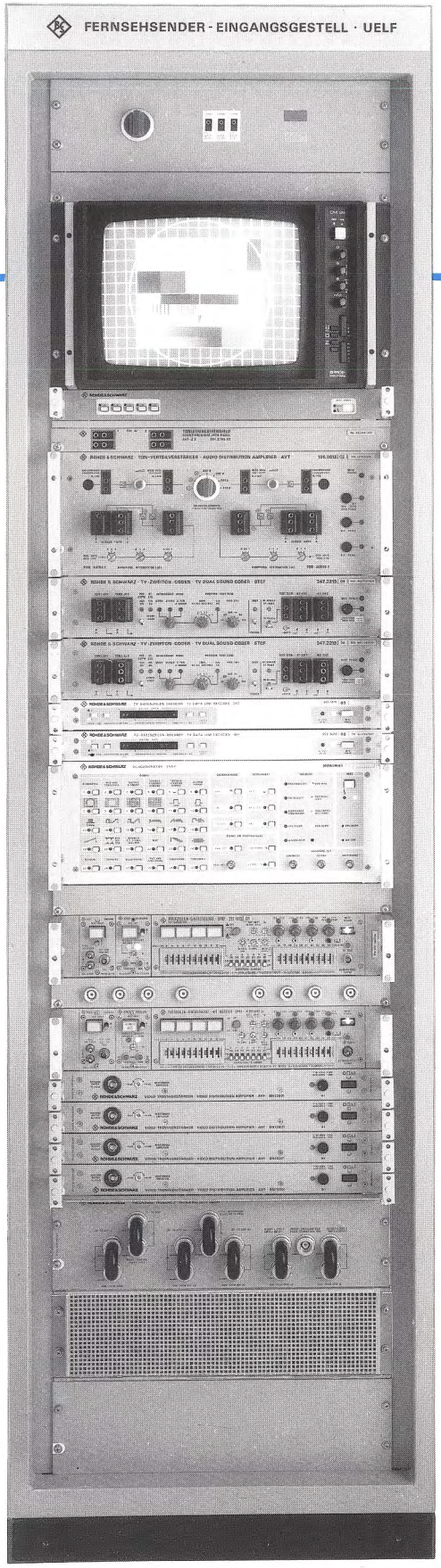
Functional diagram of Vision Transmitter Input Equipment UERF with junction panel and transmitter input

new

UELF TV Transmitter Input Assembly UELF

Uses:

- Switching vision and sound program signals to main and stand-by transmitters
- Automatic substitution vision signal switching with text insertion
- Test line insertion in program and substitution signal
- VF monitor for monitoring incoming or radiated signals
- Dual sound signal processing
- Data line monitoring



The **TV Transmitter Input Assembly UELF** switches the vision/sound program signals to a dual transmitter.

The VF program signal passes via the VF program jack panel, the Vision Generator SVDF and the VF program jack panel to the Video Distribution Amplifiers AVF with a subsequent VIT Inserter SPRF for each transmitter (see block diagram on page 185). In the SPRF, the **sync pulses are regenerated** and the VF signal is adjusted to the **standard level** of 700 mV (reference: luminance bar, line 17). The incoming VF signal and the radiated signal can be monitored on a **monitor** if required. The VF Monitor Switch MSF 07B is used for signal selection.

Two TV Data Line Decoders DEF.03 also receive the video signals from the distribution amplifiers in order to evaluate the data line for monitoring and control purposes.

In the event of program signal failure, a preset **substitution signal** is automatically switched into the signal path by the Video Test and Pattern Generator SVDF. The substitution signals provided are the FuBK test chart to German standards (with and without circle and with inserted transmitter identification) and different text pages which provide viewers with information in the event of a disturbance. Operation is automatically reset to the program signal after the disturbance has been eliminated. The Video Test and Pattern Generator SVDF can also be controlled via the video signal using the data line.

The Audio Distribution Amplifier AVT is housed in the UELF in order to select AF signals. It supplies the AF signals for sound 1 and 2 to the TV Dual Sound Coder STCF for each transmitter. The STCF then encodes these signals to channel signals 1 and 2. The pilot signal which is amplitude-modulated with an identification frequency depending on the operating mode (mono/stereo/dual sound) is added to channel 2.

The VF program jack panel and sound circuit jack panel AVT-Z2 enable interruption of the signal paths for **measurement and monitoring purposes** and by-passing for emergency operation, if a unit fails in the signal path.

A **reference frequency** for controlling the TV transmitter can be passed to the transmitter exciters via another Video Distribution Amplifier AVF in the UELF.

Condensed data

Vision signal paths

VF input impedance	75 Ω
Return loss up to 6 MHz	≥34 dB (inputs) ≥26 dB (outputs)
Crosstalk attenuation between lines with different signals up to 6 MHz	≥60 dB
Signal-to-noise ratio (weighted, rms, without hum)	≥60 dB, referred to 0.7 V video signal
Program path gain	0 dB (nominal value)
Level adjustment range	±6 dB for AVF (max. V_{pp} = 1.5 CVS), ±1 dB for SPRF
Automatic gain control	±3 dB

Sound signal paths

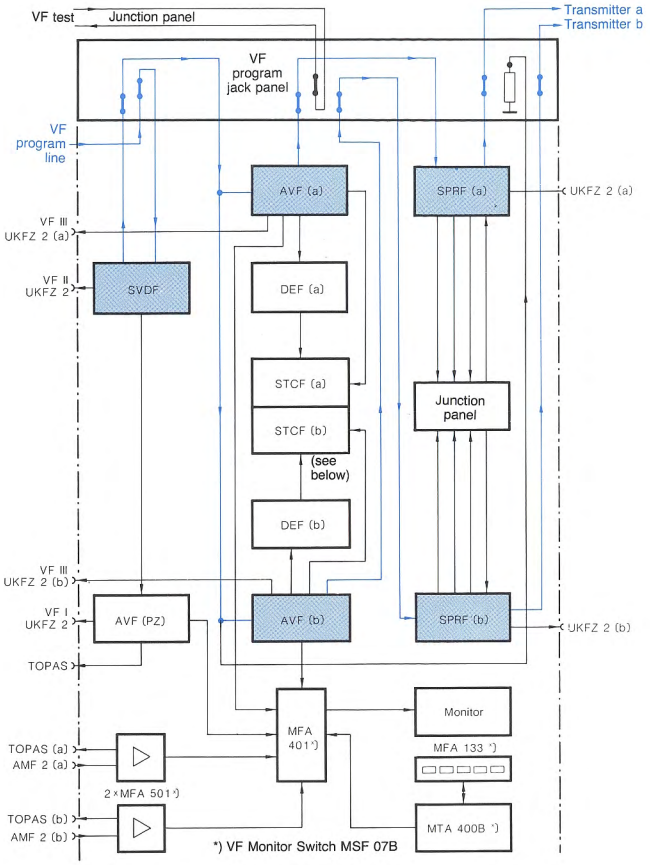
AF input impedance	600 Ω
Program path gain	0 dB (setting range –9 to +6 dB)
Crosstalk attenuation between lines with different signals	>76 dB
Signal-to-noise ratio (weighted)	>66 dB, referred to +6 dBm

General data

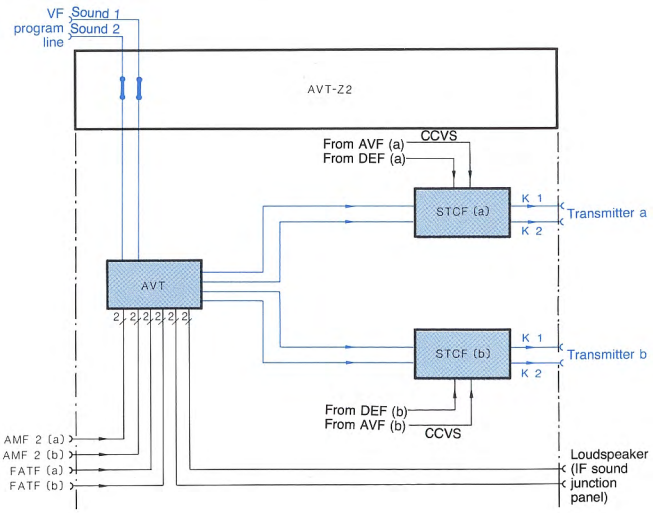
Ventilation	built-in blowers with air filter
Power consumption (fully equipped)	730 VA
Dimensions (W×H×D)	600 mm×2200 mm×1000 mm
Weight (fully equipped)	300 kg

Ordering information

Order designation	▶ TV Transmitter Input Assembly UELF



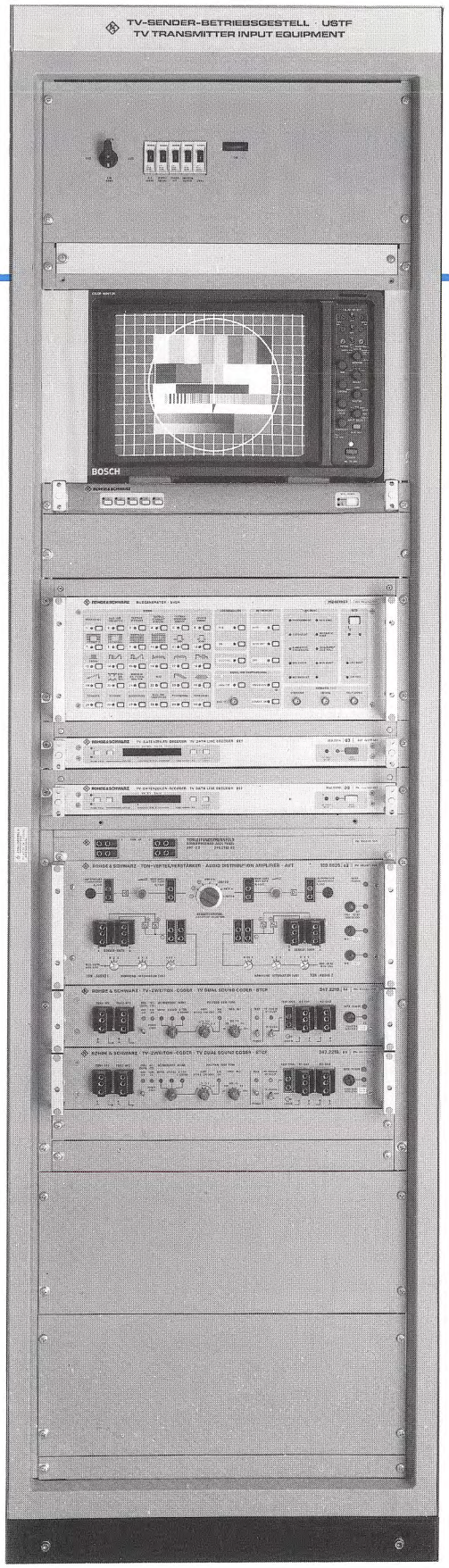
Block diagram of TV Transmitter Input Assembly UELF; above: video section; below: audio section



USTF TV Transmitter Input Equipment USTF

Uses:

- Switching sound program signals to main and stand-by transmitters
- Dual sound signal processing
- VF monitor for monitoring incoming or radiated signals
- Automatic substitution vision signal switching with text insertion
- Data line monitoring



Junction panel

Monitor

MSF 07B

SVDF

DEF.03

DEF.03

AVT-Z2

AVT

STCF

STCF

Space for precision offset control generator

The **TV Transmitter Input Equipment USTF** switches the sound program signal to a TV dual transmitter and monitors the vision program signal.

The USTF houses the Audio Distribution Amplifier AVT for selecting the **AF signals.** It supplies the AF signals for sound 1 and 2 to the TV Dual Sound Coder STCF for each transmitter. The STCF then encodes these signals to channel signals 1 and 2. The pilot signal which is amplitude-modulated with an identification frequency depending on the operating mode (mono/stereo/dual sound) is added to channel 2.

The sound circuit jack panel AVT-Z2 enables the interruption of the signal paths for **measurement and monitoring purposes** and by-passing for emergency operation if a unit fails in the signal path.

The incoming **VF signal** and the radiated signal can be monitored on a **monitor** if required. The VF Monitor Switch MSF 07B is used for signal selection.

In the event of vision program signal failure, a preset **substitution signal** is automatically switched into the signal path by the Video Test and Pattern Generator SVDF. The substitution signals provided are the FuBK test chart to German standards (with and without circle and with inserted transmitter identification) and different text pages providing viewers with information in the event of a disturbance. Operation is automatically reset to the program signal after the disturbance has been eliminated. The Video Test and Pattern Generator SVDF can also be controlled via the video signal using the data line.

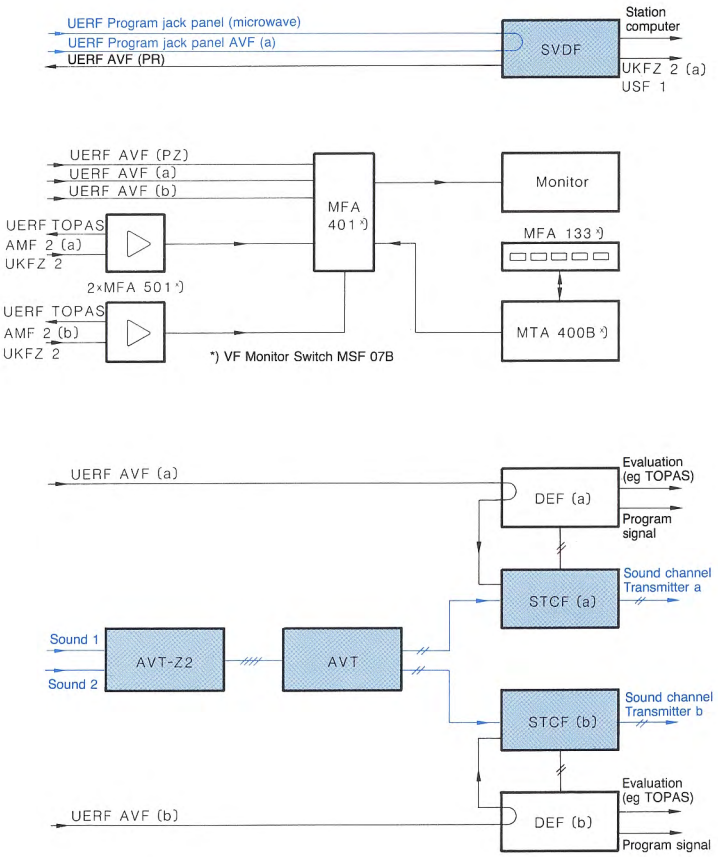
The USTF houses two TV Data Line Decoders DEF.03 in order to evaluate the **data line** for monitoring and control purposes.

Condensed data

VF signal	CCVS signal with data lines
Input impedance	75 Ω, bridging filter
Return loss	>34 dB (up to 6 MHz)
AF signal	
Input impedance	600 Ω
Program signal gain	0 dB (nominal value)
Crosstalk attenuation between lines with different signals	>76 dB
Signal-to-noise ratio (weighted)	>66 dB
Cooling	convection, can be connected to transmitter overpressure ventilation
Dimensions	19″ version, adapted to transmitter model

Ordering information

Order designation	▶ TV Transmitter Input Equipment USTF



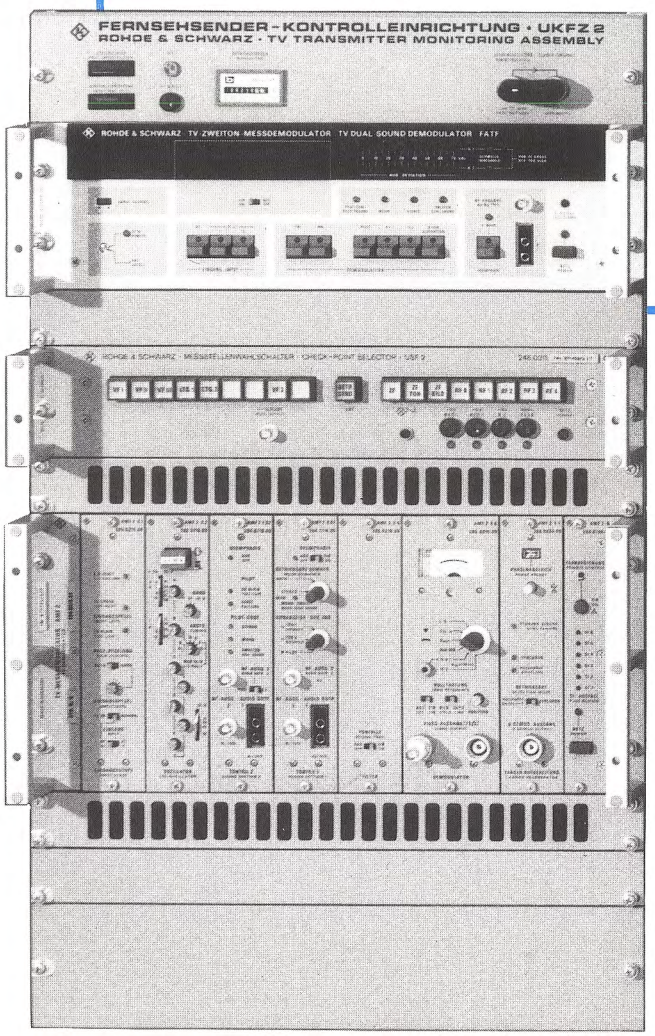
Block diagram of TV Transmitter Input Equipment USTF with (in descending order)

- automatic substitution vision signal switching
- VF monitoring (incoming and radiated signal)
- sound signal processing and switching and data line monitoring

UKFZ 2 TV Transmitter Monitoring Assembly UKFZ 2

Uses:

- General checking of audio, video, IF and RF signals for adherence to laid down tolerances
- Signal tracing at the video, IF and RF checkpoints in the transmitter
- Performance monitoring of the transmitter (vision, sound)
- Linearity monitoring with test signals



Junction panel

FATF

USF 2

AMF 2

(XSRM)

The **TV Transmitter Monitoring Assembly UKFZ 2** is used for monitoring the radiated RF signal. The RF signal tapped at the transmitter output is demodulated for this purpose and passed to a Picture Transmitter Test Assembly UMVF 2.

The UKFZ 2 is designed for single transmitters and can for instance be accommodated in the exciter rack of the transmitter. There are two units for a dual transmitter.

In the case of Deutsche Bundespost standard transmitters designed as dual transmitters, each single transmitter contains a special Monitoring Assembly UKFZ 2 which is housed as a rackmount in the exciter rack of the transmitter. This monitoring assembly houses the TV Demodulator AMF 2 and the TV Dual-Sound Demodulator FATF in addition to a Checkpoint Selector USF 2 which connects the requested checkpoints in the transmitter via appropriate RF/IF relays. The TV Demodulator of the main transmitter is permanently switched automatically to the antenna output of the transmitter, because it powers the automatic quality monitoring system of the transmitter station (eg TOPAS, see catalog Section 4, or UPKF).

For precision offset operation of the transmitter, the Rubidium Frequency Standard XSRM is often fitted in the Monitoring Assembly UKFZ 2.

Both monitoring assemblies of a dual transmitter are connected via the same junction panel to the mobile Picture Transmitter Test Assembly UMVF 2 (see block diagram). From there, the checkpoint selectors of the transmitters can also be remote-controlled, so that the stand-by transmitter can be fully measured during program operation. The junction panel can be housed in the central rack, in the Vision Transmitter Input Equipment UERF or in the TV Transmitter Input Equipment UELF of the dual transmitter.

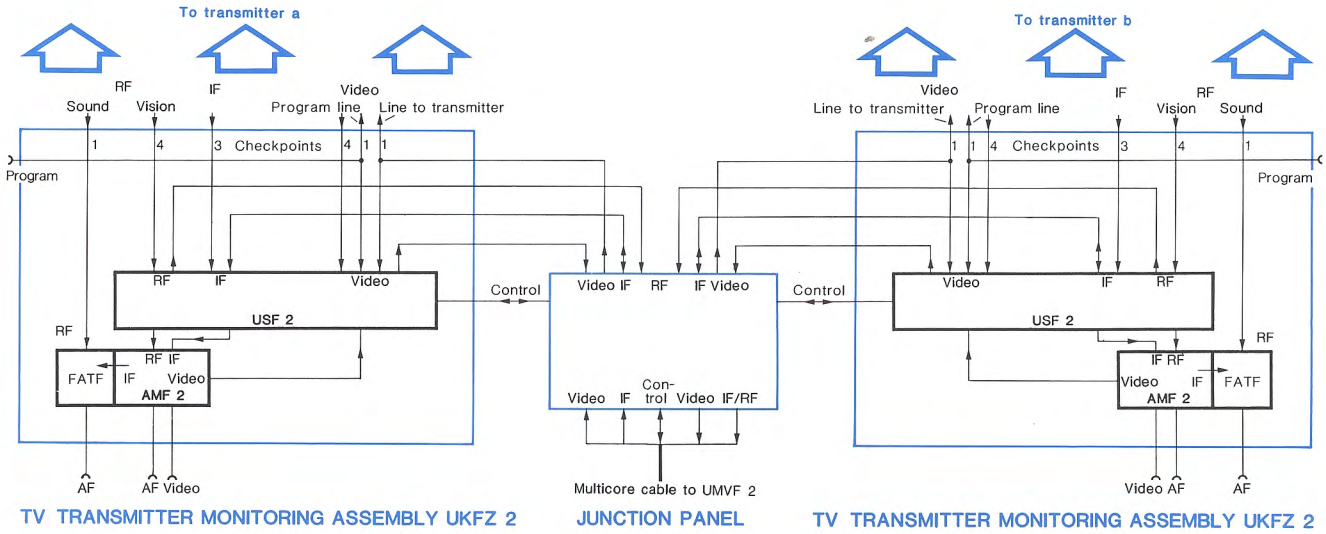
Specifications (rack)

Inputs/outputs	RF	IF	Video
Characteristic impedance	50 Ω	50 Ω	75 Ω
Return loss	≥34 dB	≥34 dB	≥34 dB (up to 10 MHz)
Connector systems	N	N	BNC 4/13
Dimensions, weight	483 mm × 845 mm × 600 mm, 75 kg		

Ordering information

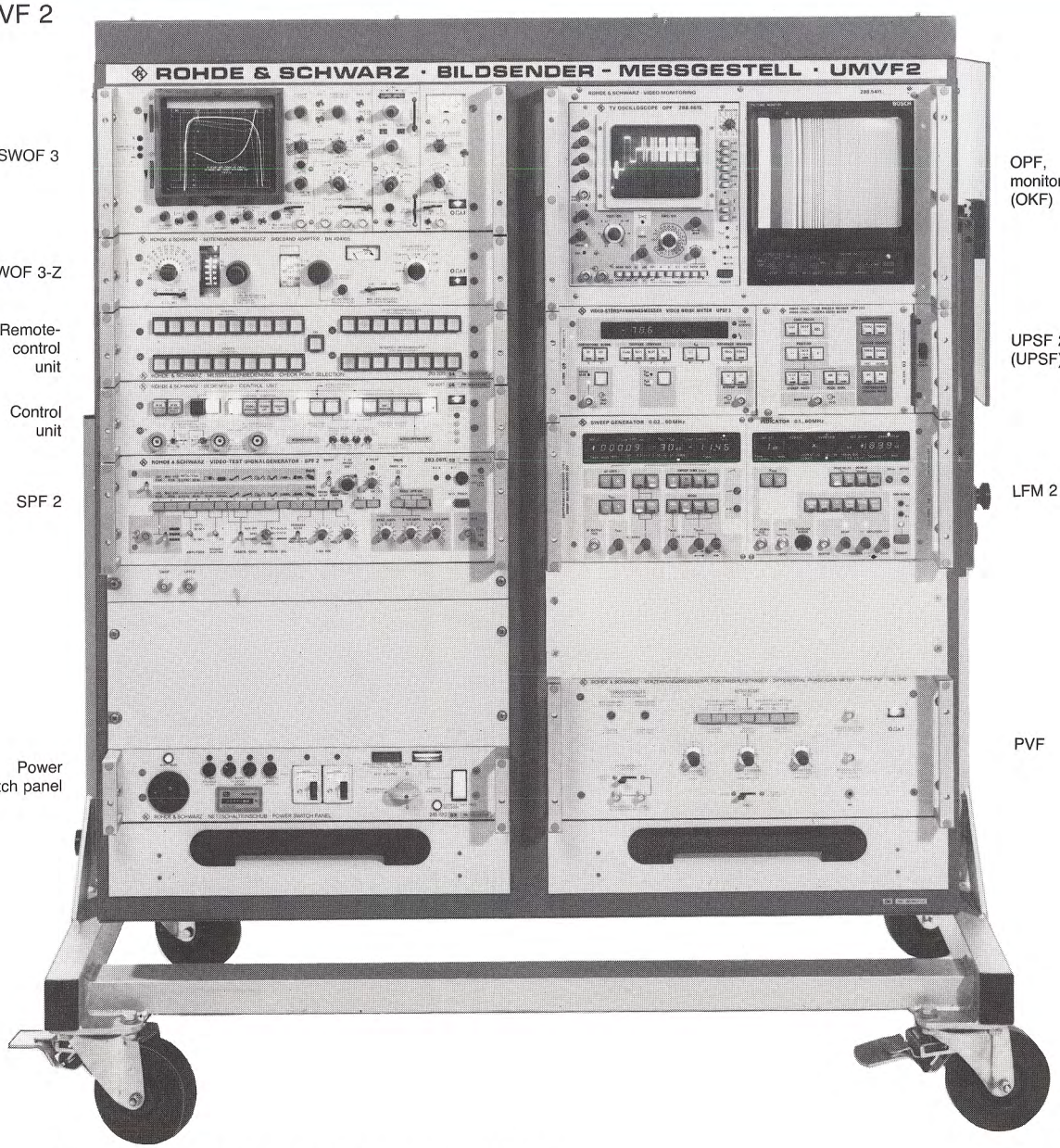
Order designation ▶ TV Transmitter Monitoring Assembly UKFZ 2

When asking for a quotation, please indicate the transmitter concept (single or dual transmitter) and the desired equipment.



Basic connections between TV Transmitter Monitoring Assembly UKFZ 2, junction panel (accommodated in central rack, in Vision Transmitter Input Assembly UERF or in TV Transmitter Input Assembly UELF of transmitter) and Picture Transmitter Test Assembly UMVF 2

UMVF 2



Picture Transmitter Test Assembly UMVF 2

Uses:

- Video and RF measurements on vision transmitters, microwave links and other active and passive four-terminal networks
- Signal generation: video signal
  test lines
  video sweep signal
- Signal evaluation: full field
  frequency response
  sideband characteristic
  group delay
  transient response
  differential gain
  differential phase
  level control
  noise voltages

Special features of UMVF 2:

- ▷ Mobile test assembly which can be moved to all checkpoints of single or dual transmitter systems
- ▷ Swivel-suspended twin rack with fold-out table allowing the operator to work seated or standing
- ▷ Selection of checkpoints, generators and evaluation equipment from central keyboard
- ▷ Suitable for time- and frequency-domain measurements on all black-and-white and colour TV systems
- ▷ Insertion signal generation, including test lines, in accordance with CCIR for time-domain measurements
- ▷ Measurements in the frequency domain (also in the sideband) with selective indication on linear or logarithmic amplitude scale

The **Picture Transmitter Test Assembly UMVF 2** contains all signal generators and evaluation equipment (block diagram see below) required for measurements in the video, IF and RF ranges in accordance with CCIR standards and relevant specifications. The UMVF 2 configuration is custom-tailored. The test assembly can include the following equipment:

Video Test Signal Generator SPF 2 for producing video and testline signals and for synchronization to the program signal, thus permitting full-field measurement.

TV Oscilloscope OPF (also available with picture monitor) or **TV Waveform Monitor OKF** for test line evaluation. Suitable for intermodulation, linearity and noise-voltage measurement.

Videoskop SWOF 3 Video tester for point-by-point or swept-frequency measurement with broadband indication; highly selective receiver section.

Sideband Adapter SWOF 3-Z for measurement of sideband characteristics in all TV bands including the IF down to 10 kHz from the carrier.

Group-delay Measuring Set LFM 2 for determination of group delay, overall delay and amplitude characteristics as well as for link measurements.

Video Noise Meter UPSF or UPSF 2 Weighted and unweighted noise voltage measurement with fast-responding indication in terms of rms or peak-to-peak values, chroma noise measurement with UPSF 2.

Differential Phase/Gain Meter PVF permitting simultaneous display of differential gain and phase in conjunction with the OPF or OKF.

Control Unit (with or without cable equalizer) for interconnecting the measuring instruments.

Remote Control Unit fitted with 2×10 pushbuttons for remote control of the video checkpoint selector in the UKFZ and with 2×8 pushbuttons for selecting the IF and RF checkpoints of the transmitter and the junction panel. Permits all measurements necessary on TV transmitters also of extensive systems to be performed from a central station in rapid test cycles.

Power Switch Panel Power supply with elapsed-time meter; monitors ventilation and temperature at the same time.

Multicore Cable This cable comprises all signal, control and supply lines required for connecting the UMVF 2 to the picture transmitter.

Construction The measuring instruments are arranged in the rack so that the visual display units are at eye level when the operator is seated. A fold-out table (420 mm × 320 mm) is fixed to the right-hand side of the cabinet rack. The rack is swivel-suspended in the frame and can be tilted back by 20° (with mechanical locking), allowing the operator to work also while standing. The supporting frame has four wheels, those in front being fitted with a foot brake. Free rack space is available in the UMVF 2 for incorporating additional instruments.

Condensed data (general)

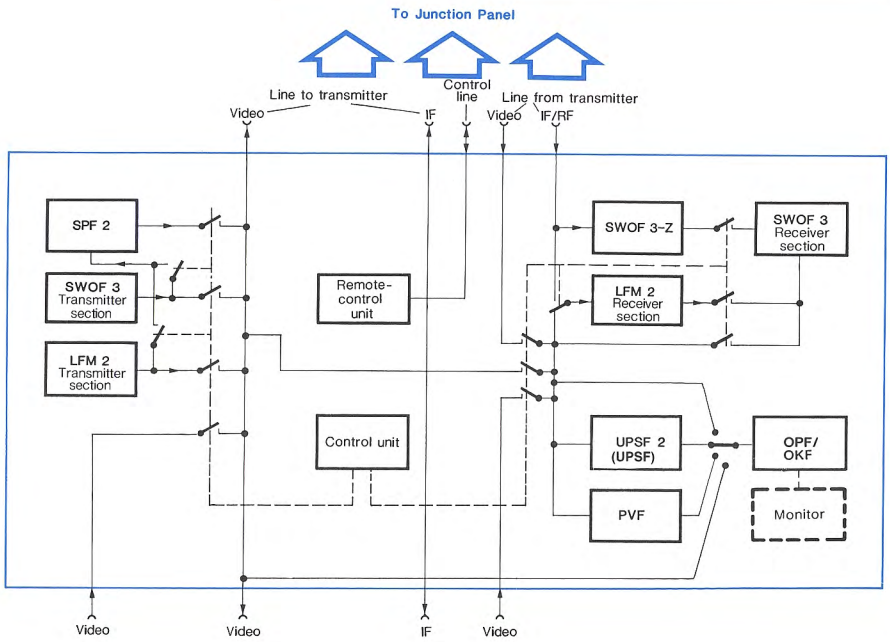
Connectors: video	RF system 4/13, adaptable; BNC
RF and IF	N internal: RF system 7/16 (50 Ω)
Cooling	from built-in blower
Air filter	two exchangeable filter mats
Power supply	115/125/220/235 V ±10% (47 to 63 Hz); via the multicore cable or a separate power cord (the multicore cable having priority)
Maximum power consumption	about 895 VA
Dimensions	1160 mm×1296 mm×755 mm
Height of equipment complement alone	37 units (1 unit = 44 mm)
Total weight	about 310 kg

Ordering information

Order designation ▶ Picture Transmitter Test Assembly UMVF 2

When asking for a quotation, please indicate the desired equipment.

Recommended extras
Junction Panel for TV Transmitters, tolerance templates for different standards, see Videoskop SWOF 3 (catalog Section 1 D).

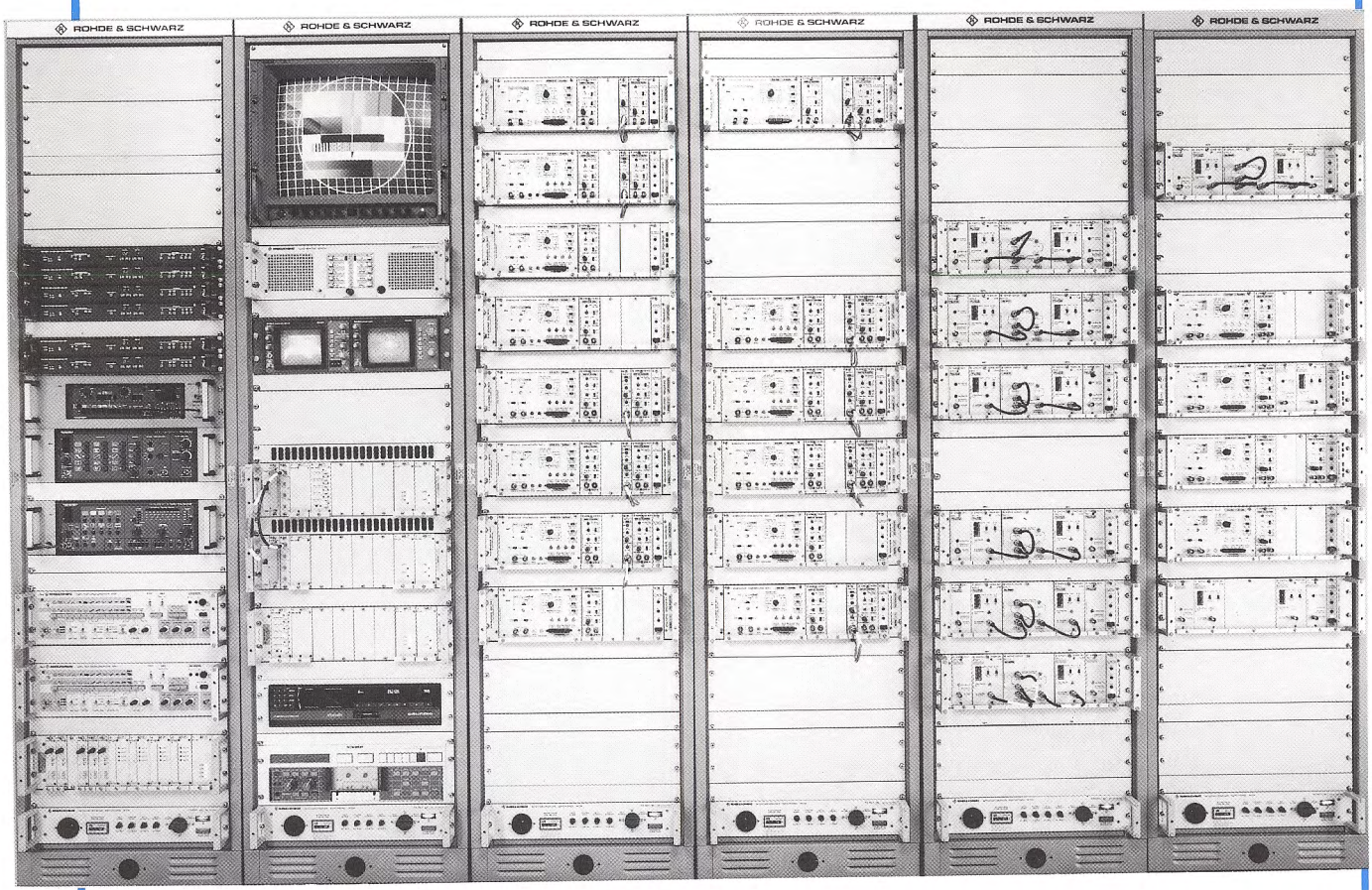


Block diagram of Picture Transmitter Test Assembly UMVF 2

Test assemblies for TV receiver and video recorder production

♦ Bands I, III, IV/V; CATV channels

- Planning and configuration custom-tailored
- Available for all conventional standards



Rack 1:
VF generators
VF text generators
AF generators

Rack 2:
Colour monitor
Audio monitor
TV oscilloscope
PAL vectorscope
VECAM-scope
Video recorder
Cassette deck

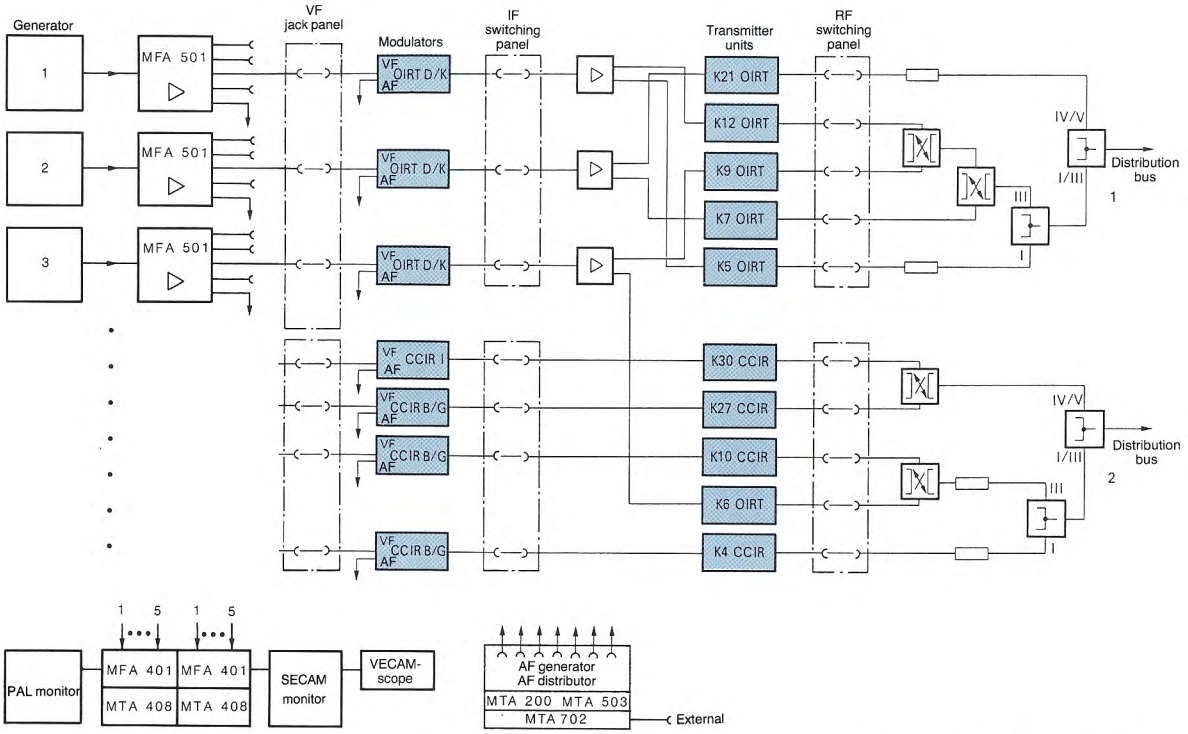
Racks 3 to 6:
Modulator and channel transmitter modules SBTF 2

Photo: Dual-sound TV test assembly for 22 channels (CCIR and OIRT) in bands I, III and IV/V, colour signals according to PAL and SECAM, signal processing for standards B/G, D/K, L

The **test assemblies for production plants** from Rohde & Schwarz are **custom-tailored** and are specially planned and designed for each case of application. A large number of such assemblies have given fully satisfactory service in production plants all over the world.

Ordering information:

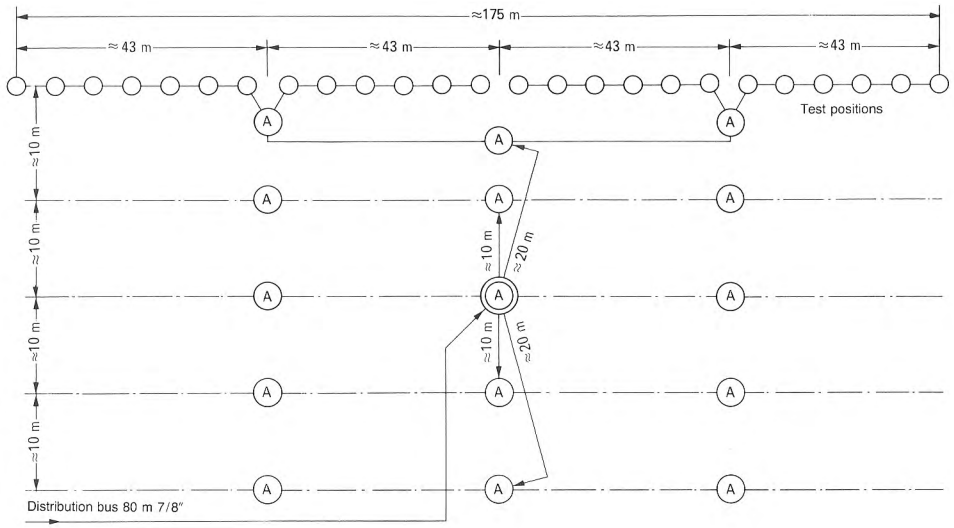
▶ Please inquire specifying your requirements.



Block diagram of a TV test assembly in accordance with CCIR and OIRT for PAL and SECAM, blue: SBTF modules; for block diagram of a distribution network supplying the test positions see next page

Existing test assemblies can be retrofitted for CATV channels and dual sound operation.

Test assembly for alignment and measurement of video recorders for 17 channels (bands III and IV/V) with four programs, colour systems: PAL and SECAM, signal processing for standards B/G (including dual sound signals), D/K, I, L and M, channel identification numbers can be inserted in the test signals



Supply of 125 test positions with test signals in a TV receiver production plant; the second distribution bus feeds another 125 test positions

Tasks of test assemblies

Test departments in TV receiver and video recorder production require standard TV signals in bands I, III and IV/V. It is best to have several programs for each band, sometimes even with different standards. The signals must be made available simultaneously to a large number of test positions.

For this purpose **low-power TV transmitters** are used, their outputs being taken to a common output line via combination networks. Since the power required at the test positions is extremely low (fractions of a microwatt), the combination networks can be broadband and consist only of directional couplers and resistors in contrast to the combining filters used for transmitters and transposers.

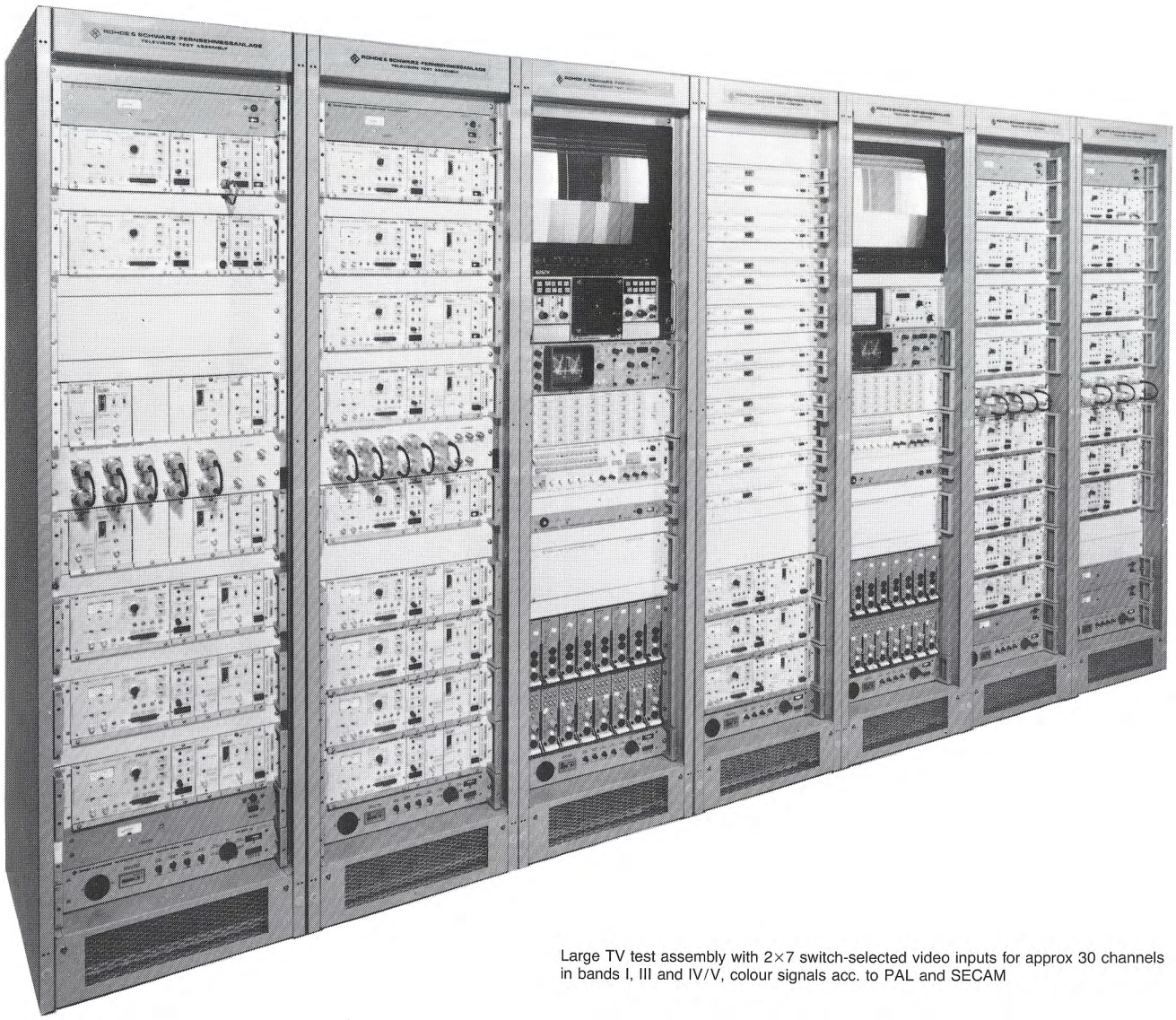
The network combining the different signals is followed by the network distributing these signals to the individual test positions, which may be located either along the production lines or in the laboratory.

Dual-sound TV test assembly (standards B/G, I, L; PAL, SECAM)

Basic setup

Signal generators. The basic unit of all the systems is the TV Test Transmitter SBTF 2 (see catalog Section 1) which consists of a vision-sound modulator with IF output and subsequent transmitter units. It delivers a standard RF signal. If more than one RF channel is required, the corresponding number of transmitter units with different channels are necessary; emitting different test signals requires several modulators possibly using different TV standards. For identification of channels and types of modulation a numerics inserter is used especially in large systems.

Additional modules Video Test Signal Generators SPF 2 supply the VF signals required for modulation. The VF signals are passed to the modulators via a VF switching panel consisting of VF Distribution Amplifiers MFA 501 and VF Switches MFA 401.



Large TV test assembly with 2×7 switch-selected video inputs for approx 30 channels in bands I, III and IV/V, colour signals acc. to PAL and SECAM

The signals generated in AF Generators MTA 200 pass from an AF generator/AF distribution panel to the modulators via AF Line Amplifiers MTA 503. An Audio Monitor MTA 702 can be used to monitor all outgoing AF signals and measure their levels.

IF distribution amplifiers are used for system-specific distribution of the IF signals sent by the IF modulators to the transmitter units.

Connection of the different signal sources to the modulators – sometimes also between modulators and transmitter units – and connection of the RF outputs to the combination networks at the output is made via switching panels which also permit performance checking of the individual units at the VF, IF and RF using measuring instruments.

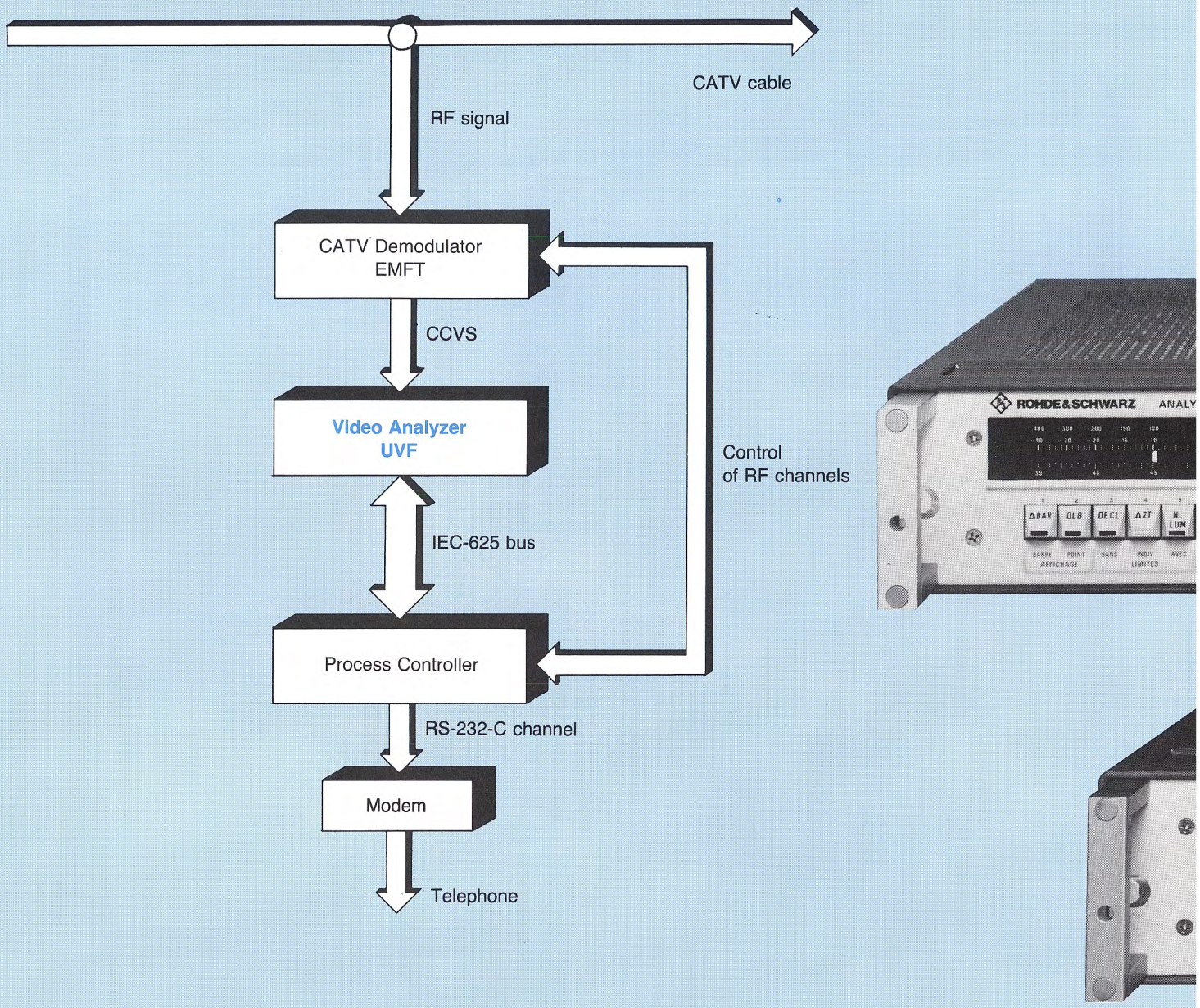
Generally a transmitter **output power** of 0.5 W is sufficient; higher powers may sometimes be required for larger, more comprehensive distribution networks. For this purpose amplifiers of up to 10 W output power are available.

For application to the distribution network the different RF frequencies are **combined** via "star" resistor networks and directional couplers. The distribution network should provide the same voltage (a few mV) to all test positions and for all channels. This can be realized to the largest extent possible by proper configuration, selection of suitable cable types and, if required, by insertion of attenuators, taking into account the frequency-dependent cable attenuation.

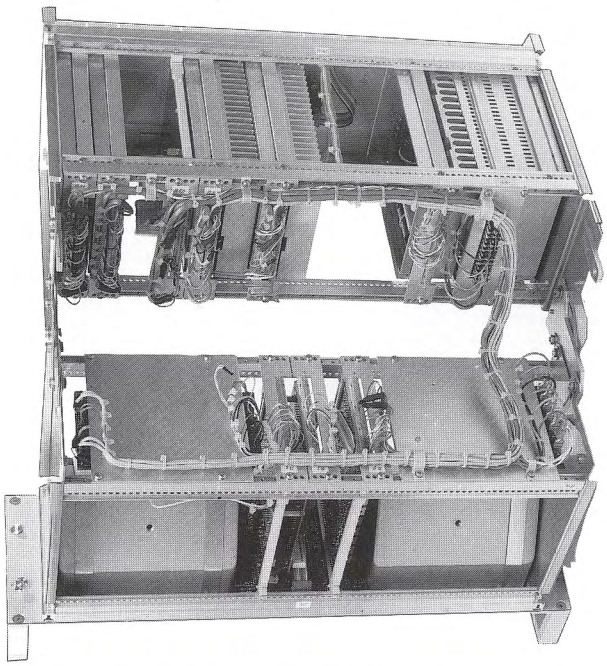
Monitoring equipment is required to ensure the quality of the outgoing signals. Comprehensive monitoring of the outgoing RF channels is possible with the TV Test Receiver EMFT or the TV Monitoring Receiver EKF 2, which feature a wide range and rapid frequency setting. The usual video monitoring equipment can be connected after these instruments.

All these instruments are incorporated in racks and constitute the central station. In addition, the test assemblies from Rohde & Schwarz include the distribution network.

The planning and configuration of the central station depend on the desired test signals, channel frequencies and TV standards, and the design of the distribution network should take into account the number of test positions and the local conditions.



Automatic monitoring of broadband communication systems (top) with Video Analyzer UVF (right) for evaluation;
details on page 218



Open mainframe MTA 002 (configuration: MTA 702), all connectors can be easily accessed.

The **Power Supply Unit MTA 606** powers components such as LEDs, relays, etc., with unregulated DC voltages.

The **Power Supply Unit MTA 610** supplies a stabilized control voltage and is intended for mounting on the rear panel of the rackmount.

For the **Audio Monitor MTA 702,** see page 178.

The **AF Limiter MTA 901** is a controllable level limiter for one channel and houses the Limiter Circuit NTP 179/400 R/S.

Video Cassettes MFA

The **VF Switch MFA 401** is a fully electronic video signal switch with five bridging inputs and two mutually isolated outputs. Depending on the model concerned, the inputs and outputs are mounted on the front panel (with BNC connectors) and on the rear panel (with SMB connectors).

The **VF/AF Switch MFA 403** with two VF inputs and 2 × 2 balanced AF inputs to one VF output and 1 × 2 AF outputs is implemented in relay technology. Automatic reset (eg. in the case of power failure) to inputs 1 or 2 is selectable. It is operated using the front panel keyboard (with LEDs).

The **VF Cable Equalizer MFA 404** operates passively and can compensate frequency-dependent level losses for defined cables on five lines with a maximum length of 160 m.

The **VF Distribution Amplifier MFA 501** is a video buffer amplifier with bridging filters for one input and five isolated outputs. The integrated passive cable equalizer compensates distortions on lines with a maximum length of 160 m. Depending on the model concerned, the inputs and outputs are mounted on the front panel (with BNC connectors) and on the rear panel (with SMB connectors).

For the **Control Cassettes** and **Power Supply Modules,** see MTA 4 and MTA 6.

General

Suitable junction panels are available for system solutions for all MTA and MFA cassettes. The **Function Panels MFA 401Z** and **MFA 501Z** are fitted with the suitable SMB connection cables and BNC connector configurations for the different cassettes. The **Function Panel MFA 403Z** can be used for externally connecting the audio and video signal lines routed to the cassette. The **Function Panel MTA 702Z** is used for directly connecting the AF input and output lines to the Audio Monitor MTA 702 via three-contact DIN sockets.

Several mainframes are available for mounting into existing systems and for setting up compact systems.

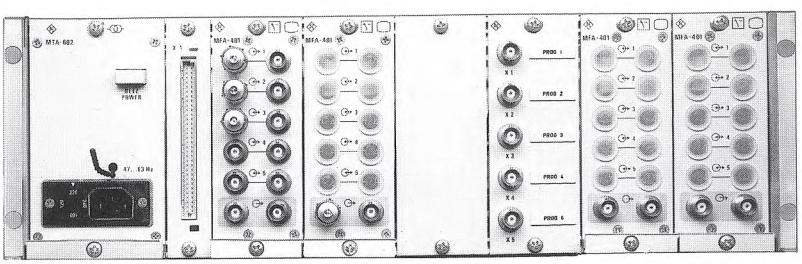
The **Mainframe MTA 002** can be equipped with a maximum total of 32 units for both the front and rear panel. The main feature of the MTA 002 is its low-maintenance design. The frame can be opened by 90° after loosening two locking screws; this means that there is unobstructed access to all connectors (photo above). Subsequent expansion with additional wiring and maintenance work is considerably simplified.

The **Mainframe MTA 003** can be equipped with a maximum of 16 units on one panel and only requires minimum depth for mounting.

In a special version, the MTA 003 can be pulled out on telescopic runners and opened by 90°. The **Parts Kit MTA 003T** contains the component parts.

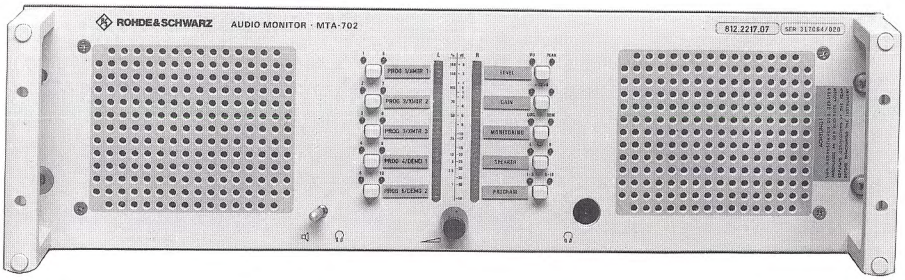
The **Mainframe MTA 004** also houses a maximum of 16 units. Its junction panels on the rear panel are used for automatically inserting cassettes into the frame.

The **Mainframe MTA 005** is designed for mounting on rackmount struts and walls. It can house between two and eight units and can also be integrated into completely equipped rackmounts using its mounting fixture on the rear panel.



Configuration example: MTA 002 (rear panel) with MTA 602, MFA 401 and MFA 401Z; video distribution amplifier and selector

MTA/MFA – Cassette System



Audio Monitor MTA 702

Audio Monitor MTA 702

- 2 × 10 inputs
- VU/peak meter
- 2 × 20 W stereo amplifiers
- Built-in stereo loudspeakers

The **Audio Monitor MTA 702** is a monitoring unit for stereo program lines and receiver systems. The input channels can be selected via TTL lines and external loudspeakers and volume controls can be switched on for **remote-monitoring.**

The **levels** of the monitored signal are indicated on LED scales on the front panel either as VU or peak values (photo right). The measurement range can be switch-selected between −50 and +5 dB and between −70 and −15 dB, referred to +4 dBm with VU and +6 dBm with peak values respectively.

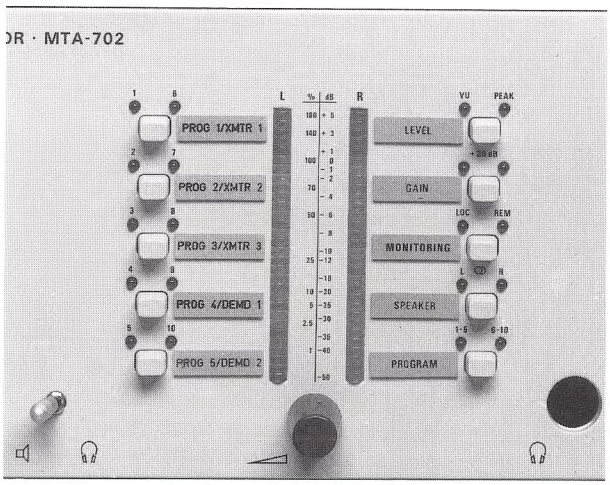
In addition to the **20 W stereo output stages** and the high-quality loudspeaker systems integrated in the front panel, there are 1 V outputs for active loudspeaker boxes and headphone connectors.

The loudspeakers of external headphones can be switched over from mono to stereo and from sound 1 to sound 2 for stereo signals or TV dual sound programs. The headphone loudspeakers can be switched off.

Design The 19″ unit consists of MTA system modules. A fold-down mainframe is equipped with cassettes, plug-in modules and sub-assemblies on both the front and rear panels. Both backplanes are located at the hinge level and are easily accessible for modification and maintenance purposes after releasing the lock and swivelling the front part of the frame open (see photo on page 177).

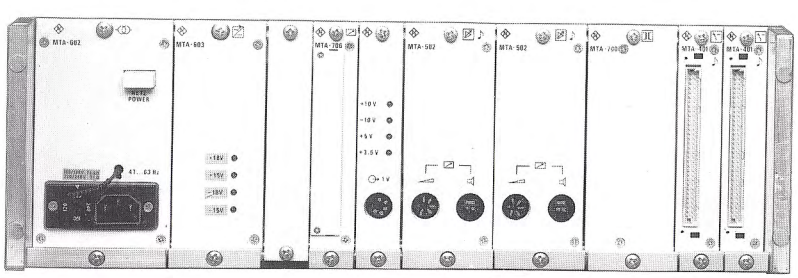
The main modules contained in the Audio Monitor are as follows:

1 mainframe (for folding down)	MTA 002
1 front panel module (with loudspeakers, checkpoint memory and VU/peak meter)	MTA 703
2 AF switches (10 stereo inputs)	MTA 401
2 AF amplifiers (20 W)	MTA 502
1 transformer module	MTA 602
1 voltage regulator (±15 V/±18 V)	MTA 603
1 transformer module	MTA 700

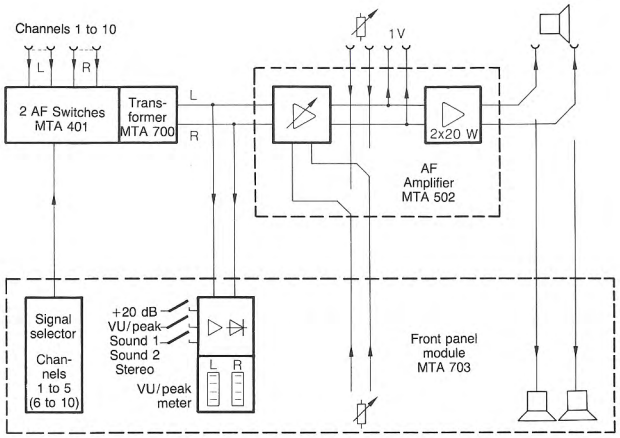


Controls and VU/peak meter of Audio Monitor MTA 702

Functional description The checkpoint signal selected at the signal selector passes via the VF switch and the transformer to the VU/peak meter where it is indicated on LED



Rear panel configuration of MTA 702



Block diagram of MTA 702

General data MTA 702

Rated temperature range	–5 to +45 °C
Power supply	100/120/220/240 V +10/–15%, 47 to 63 Hz
Power consumption	80 VA
Dimensions (W×H×D)	
Bench model	492 mm × 161 mm × 514 mm
19″ rackmount	483 mm × 132 mm × 506 mm
Weight	
Bench model	18 kg
19″ rackmount	17 kg

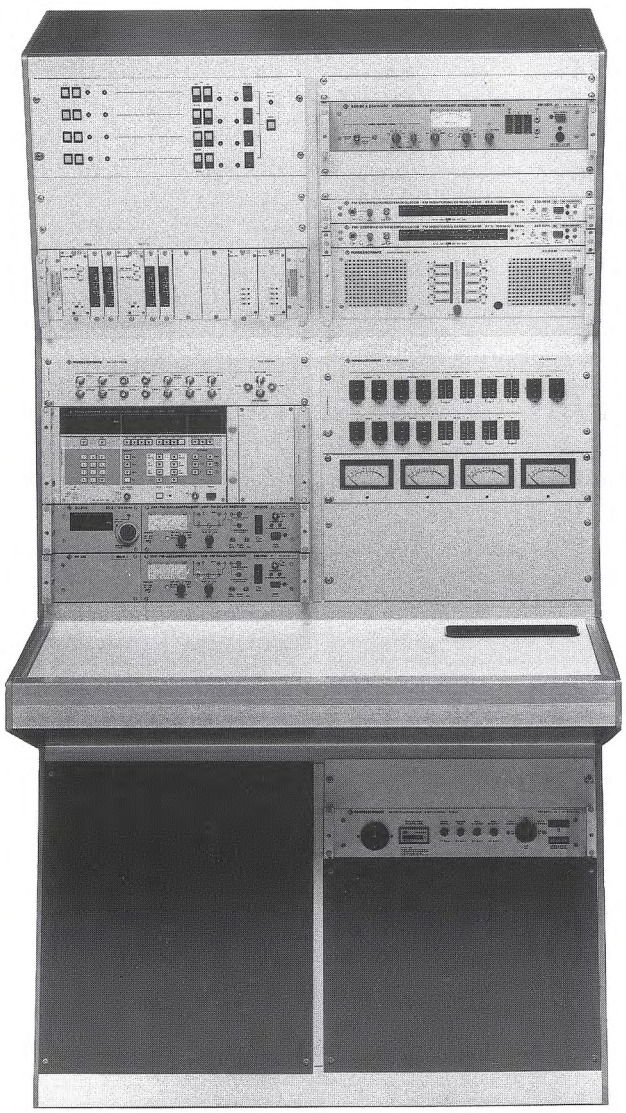
Recommended extras

See page 181 for AF Junction Panel MTA 702Z and panelling

scales after amplification and rectification. The measurement range can be increased by 20 dB (eg for measuring the noise voltage).

The AF signal is also passed to the loudspeakers via the AF preamplifier and the output stage. The input signal of the preamplifier can be electronically adjusted, also externally; its output voltage is 1 V_{rms}. Two output stages in a bridge circuit are used for power gain.

Program input and monitoring console with MTA 702 and additional MTA components



Specifications (MTA 702)

Inputs and outputs

Number of inputs	2 × 10, balanced, floating
Output for Hifi speakers	2
active speakers	2
Headphones output	1

AF amplifier

Output power	2 × 20 W at 4 Ω (sine-wave)
Frequency response	1 dB (30 Hz to 20 kHz)
Distortion factor at full load	<0.2%
Unweighted signal-to-noise ratio, referred to full load	≥80 dB
Output voltage at 1 V output	V_{rms} = 1 V at 0 dBm (= 0.775 V) input level
Pushbuttons on front panel for output switchover operations	for internal/external loudspeakers, 2 left, 2 right, stereo, off
Volume control	internal/external, with 0 to +10 V DC

VU/peak meter

Frequency response	<±0.6 dB (30 Hz to 20 kHz)
Measurement range for	
VU (switch-selectable)	–50 to +5 dB/–70 to –15 dB, (referred to continuous signal +4 dBm)
peak	180% (referred to continuous signal +6 dBm)
Scale resolution + 5 to 0 dB	1 dB per LED (red)
0 to –10 dB	1 dB per LED (yellow)
–10 to –16 dB	2 dB per LED (yellow)
–16 to –49 dB	3 dB per LED (yellow)

See pages 180 and 181 for an **overview** of the MTA/MFA system and for the **order designations.**

MTA/MFA – Cassette System

Overview and order numbers

Type	Designation	Application	Data	▶ Order number
MTA modules				
MTA 002	Mainframe	Equipped on both panels with MTA/MFA cassettes and Eurocards (max. 32 units)	19″ rackmount, fold-down; including rackmount runners with slide lock	389.3013.03
MTA 003	Mainframe	Equipped on one panel with MTA/MFA cassettes and Eurocards (max. 16 units)	19″ rackmount Telescopic runners (extendible, fold-down, 19″)	833.9510.03 832.3260.05
MTA 003T	Parts Kit	MTA 003, model 03; mounted on telescopic runners in 19″ rackmounts	Telescopic nunners, articulated cable arm, helical power cable, accessories	2007.9006.05
MTA 004	Mainframe	Equipped on one panel with MTA/MFA cassettes and MFA junction panels (max. 16 rackmounts)	19″ rackmount; automatic cassette insertion	832.3119.03
MTA 005	Mainframe	Equipped with MTA/MFA cassettes; for mounting on rear panel of rackmount	Frame for between 2 and 8 units, for mounting on struts	389.3513.08
MTA 400	Control Cassette	Selection of AF, MPX and VF switches	10 switching functions, 6 pushbuttons, TTL level controls, LEDs, floating contacts	811.8611.03
MTA 401	AF Switch	AF preview and program matrix, AF checkpoint switch	2 × 5 input, 2 × 1 outputs; relay switches	811.8763.03
MTA 402	AF Switch	AF preview and program matrix, AF checkpoint switch	2 × 5 inputs, 2 × 1 output; FET switches	811.8911.03
MTA 405	Control Cassette	For switching five independent functions on and off	5 × 4 floating switchover contacts, LED display	812.5116.03
MTA 406	AF Selector „MPX“	Equipment selection, program connection, checkpoint selection, switch for 5 (10) independent inputs and outputs	5 (2 × 5) balanced inputs, floating contacts (with status storage in the event of power failure); relay switches	832.6118.03
MTA 408	Control Cassette	Control unit for line and column switches in a program matrix	5 pushbuttons (with stored switching points), LEDs, pulse triggering	830.4360.03
MTA 409	AF Switch “Matrix”	AF switching matrix for stereo signals	4 independent relay switches (with stored switching points), acknowledgment signal via switchover contacts	830.4160.03
MTA 410	AF Switch “MPX”	MPX switching matrix or program switch	10 independent switches (2 × 5 balanced inputs) (2 × 1 balanced output)	830.4560.03
MTA 502	AF Amplifier	Output stage for loudspeakers	20 W sinusoidal power, adjustable	811.9218.03
MTA 503	AF Line Amplifier	Distribution amplifier, line amplifier	1 balanced input, 6 balanced outputs	811.9360.03
MTA 504	AF Stereo Line Amplifier	Line amplifier for 2 channels, distribution amplifier	2 × 1 balanced input, 2 × 2 balanced outputs	830.5014.03
MTA 505	AF Monitoring Amplifier	Stereo amplifier for loudspeaker and headphones connector	2 × 3 W sine-wave power; input transformer; inputs on front and rear panels, headphones connector on front panel	830.5214.03
MTA 600	Power Supply Unit	Power supply for MTA/MFA cassettes	2 × 5 V, 1 A; 2 × 12/15/18 V, 0.8 A (can be changed)	830.6004.03
MTA 602	Transformer Module	Generation of low voltage in mainframe	each 4 × 5/12 V, 1 A; 15/18/24 V, 0.8 A	811.9660.05

Type	Designation	Application	Data	▶ Order number
MTA 603	Voltage Regulator	Voltage stabilization	2 × 5 to 24 V (adjustable), 1 A	811.9818.03
MTA 606	Power Supply	Power supply for external relays, LEDs	12/24 V, 1.5 A; unregulated	812.5616.03
MTA 610	Power Supply	Control voltage generation (stab.); for mounting on rear panel of rack-mount	24 V, 0.1 A; unregulated; with casing	833.1210.03
MTA 702	Audio Monitor	Monitoring of program lines and receiver systems, remote-controlled	2 × 10 inputs, VU/peak meter, 2 × 20 W amplifiers; 19″ rackmount	812.2217.07
MTA 702Z	AF Junction Panel	MTA 702; AF inputs/outputs	22 DIN female connectors, 3-contact, with 2 connection cables, 64-contact	2001.4854.03
MTA 901	AF Limiter	Adjustable level limiting (1 channel)	Limiter circuit NTP 179/400 R/S, 64-contact male connector	830.9010,03
MFA modules	See MFA for mainframes, power supplies, etc.			
MFA 401	VF Switch	Program preview, program matrix, VF checkpoint switch-selection	5 inputs (75 Ω), 2 outputs (75 Ω), connectors: 12 × BNC	811.8163.03
			12 × SMB	811.8163.05
			10 × SMB, 2 × BNC	811.8163.07
			10 × BNC, 2 × SMB	811.8163.09
			11 × BNC, 1 × SMB	811.8163.11
MFA 401Z	Junction Panel	MFA 401, model 05	BNC connectors (with connection cable to SMB)	812.3188.05
		MFA 401, model 07		812.3188.07
		MFA 401, model 09		812.3188.09
		MFA 401, model 11		812.3188.11
MFA 403	VF/AF Switch	Program and relay receiver signal switch-selection; selectable reset input	Inputs: 2 × VF, 2 × 2 AF (balanced) Outputs: 1 × VF, 1 × 2 AF	389.3613.04
MFA 403Z	Junction Panel	MFA 403	Connectors: 3 × BNC, 6 × DIN (3-contact)	399.9543.03
MFA 404	VF Cable Equalizer	Compensation of linear distortions	Insertion loss 3 dB; 5 channels	812.5416.03
MFA 501	VF Distribution Amplifier	Isolation of input and output lines, signal distribution, equalization	1 input (75 Ω), 5 outputs (75 Ω), connectors: 7 × BNC	811.8463.03
			7 × SMB	811.8463.05
			2 × SMB, 5 × BNC	811.8463.07
MFA 501Z	Junction Panel	MFA 501, model 05	BNC connectors (with connection cable to SMB)	811.8586.05
		MFA 500, model 07		811.8586.07

General data

Rated temperature range	+5 to +45 °C
Power supply	100/120/220/240 V +10/–15%, 47 to 63 Hz
Power consumption	dependent on configuration
eg MTA 702	80 VA
Dimensions (W×H×D)	
Bench model	492 mm × 161 mm × 514 mm
19″ rackmount	483 mm × 132 mm × 506 mm
Weight	dependent on configuration
eg MTA 702, bench model	18 kg
19″ rackmount	17 kg

Ordering information

See tables for **order designations** and **order numbers** of cassettes and most frequently used auxiliary modules.

Recommended extras

Terminating resistor 75 Ω, BNC	ERST.2	0812.3307.00
75 Ω, SMB	ERST.2	0812.3359.00

Junction panel parts kit, 1/16 width units		
with 4 DIN female connectors, 3-contact (including male connector)	MTA 010T	0832.8110.03
with 4 DIN female connectors, 5-contact (including male connector)	MTA 010T	0832.8127.03
with 4 BNC female connectors each with 2 BNC and DIN female connectors (3-contact; including 2 male connectors)	MTA 011T	0832.8162.03
	MTA 014T	0832.8179.03
Cassette adapter 64-contact	MTA 040	0833.0865.03
64-cont., 12×SMB	MTA 041	0833.0959.03
96-contact	MTA 042	0833.1361.03
Panelling for Mainframe MTA 002 (and for MTA 702)		085.1465.00
for Mainframe MTA 004		085.1336.00
Filler panel, 1/16 width unit	ERST.2	0085.4687.00
2/16 width unit	ERST.2	0085.4693.00

Other information about cassettes, built-in accessories and **system design** available on request.

UERF Vision Transmitter Input Equipment UERF

Uses:

- Distribution of main program line to main and stand-by transmitters
- Interface for TV transmitter monitoring and test assemblies

Additional option:

- Decentralized automatic vision and sound monitoring with the TOPAS system

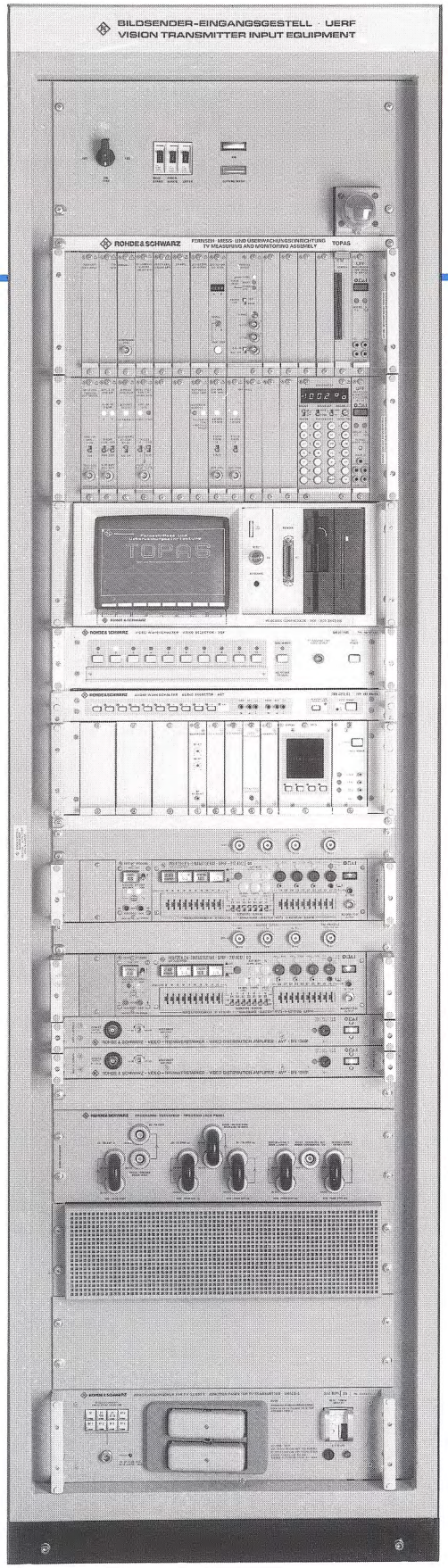


Photo: Vision Transmitter Input Equipment UERF (bottom) and (top) in a common rack

The **Vision Transmitter Input Equipment UERF** is used for **distribution and processing of the program signal** for single or dual transmitters. It is equipped according to the customer's requirements and usually contains VIT Inserters SPRF (see catalog Section 1) for the insertion of test lines and for automatic gain control (AGC), sync pulse regeneration and, if required, automatic chrominance control (ACC) of the program signal. Jack and junction panels enable the connection of additional equipment as well as special link-up of the signal path.

The Sound and ITS Monitoring Assembly TOPAS (see catalog Section 4) can be housed in the UERF for decentralized automatic vision and sound monitoring. The TOPAS system can also be equipped for both vision monitoring and dual sound monitoring.

The junction panel for connection to the TV transmitter monitoring or test assembly can be accommodated in the lower part of the UERF, which is integrated into the transmitter front.

The illustrated **Vision Transmitter Input Equipment UERF** is the standard model for dual transmitters of the Federal German Posts and Telecommunications Administration and contains in the upper part the Sound and ITS Monitoring Assembly TOPAS for the purpose of vision and sound monitoring; the jack panel is housed at the very bottom. The program signal (see block diagram on right page) passes through bridging filters to the Video Distribution Amplifiers AVF and then via the program jack panel to the VIT Inserters SPRF. The unused program channel can be disconnected on the program jack panel and instead a video test signal can be applied to the corresponding SPRF; this signal is derived from the Picture Transmitter Test Assembly UMVF 2 via the junction panel.

Test line signals are inserted on the UERF front panel via the junction panel located above the SPRF in the rack. Here, the (composite colour video) program signal and the associated S_H and BL_H signals are also available for the external insertion-signal generator to ensure colour-subcarrier and line frequency synchronization. If the insertion signal generator is incorporated, the generator can also be synchronized from the program-carrying UERF via the automatic switchover unit of the transmitter.

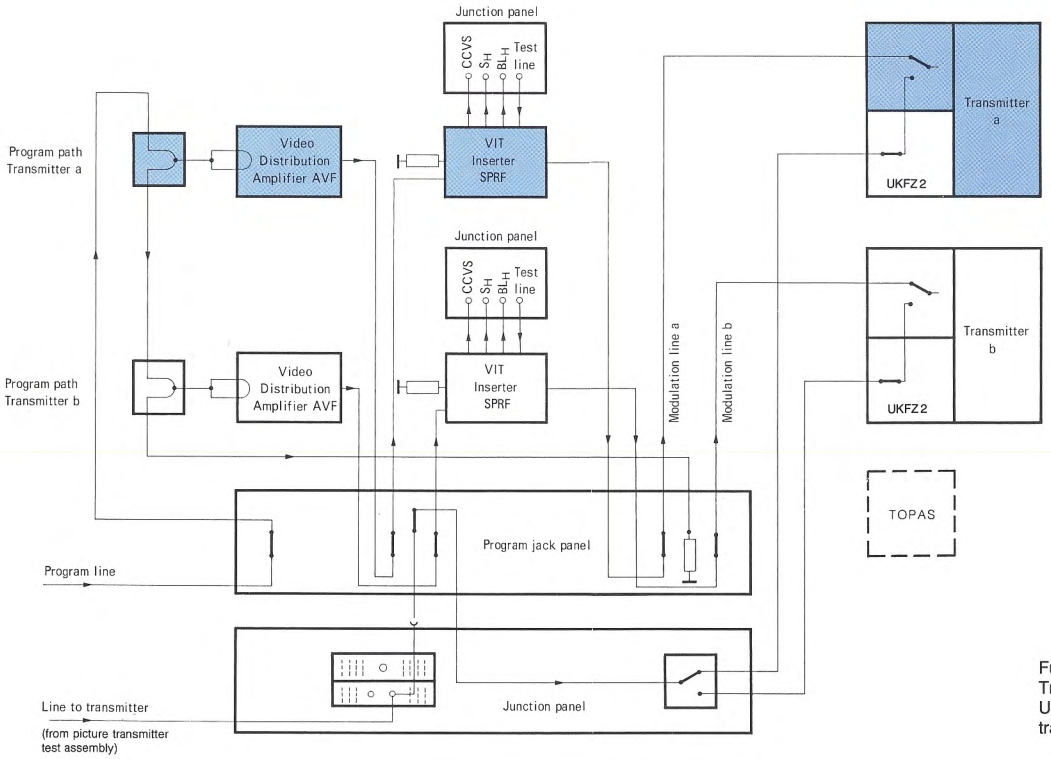
Condensed data

Video input impedance	75 Ω
Return loss up to 6 MHz	≥34 dB (inputs) ≥26 dB (outputs)
Crosstalk attenuation (between lines carrying different signals) up to 6 MHz	≥60 dB
Signal-to-noise ratio (weighted, rms value without hum)	≥60 dB, referred to 0.7 V video signal
Gain of program paths	0 dB (nominal)
Setting range for level adjustment	±6 dB for AVF (max. 1.5 V_{pp} CVS), ±1 dB for SPRF
Range of automatic control	±3 dB
Ventilation	built-in blower with air filter

Ordering information

Order designation ▶ Vision Transmitter Input Equipment UERF

When requesting a quotation, please indicate whether configuration is required for use with a single or dual transmitter.



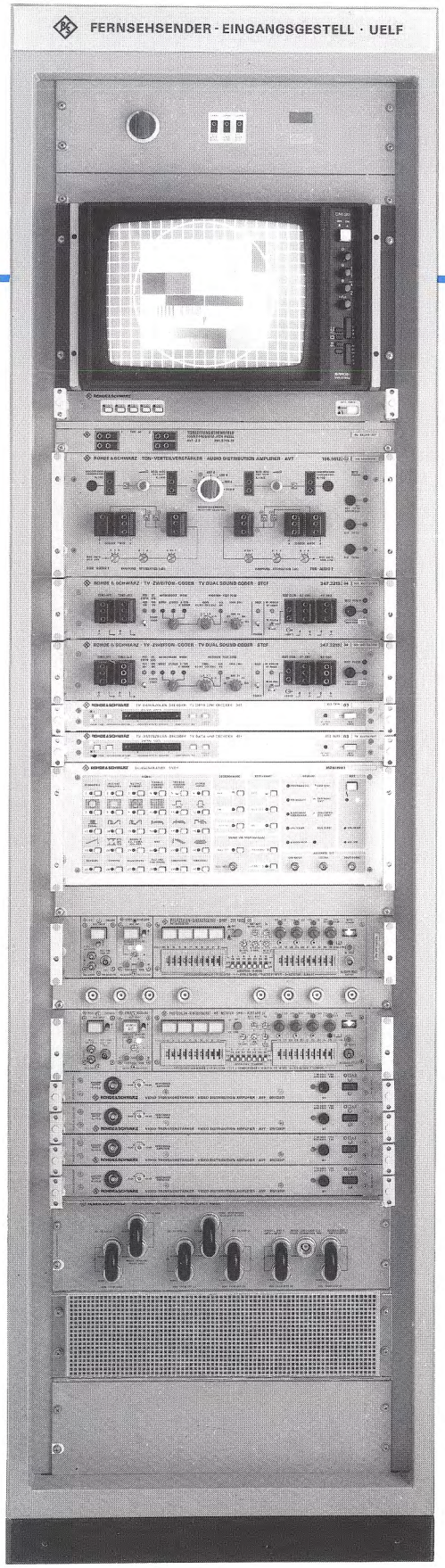
Functional diagram of Vision Transmitter Input Equipment UERF with junction panel and transmitter input

new

UELF TV Transmitter Input Assembly UELF

Uses:

- Switching vision and sound program signals to main and stand-by transmitters
- Automatic substitution vision signal switching with text insertion
- Test line insertion in program and substitution signal
- VF monitor for monitoring incoming or radiated signals
- Dual sound signal processing
- Data line monitoring



The **TV Transmitter Input Assembly UELF** switches the vision/sound program signals to a dual transmitter.

The VF program signal passes via the VF program jack panel, the Vision Generator SVDF and the VF program jack panel to the Video Distribution Amplifiers AVF with a subsequent VIT Inserter SPRF for each transmitter (see block diagram on page 185). In the SPRF, the **sync pulses are regenerated** and the VF signal is adjusted to the **standard level** of 700 mV (reference: luminance bar, line 17). The incoming VF signal and the radiated signal can be monitored on a **monitor** if required. The VF Monitor Switch MSF 07B is used for signal selection.

Two TV Data Line Decoders DEF.03 also receive the video signals from the distribution amplifiers in order to evaluate the data line for monitoring and control purposes.

In the event of program signal failure, a preset **substitution signal** is automatically switched into the signal path by the Video Test and Pattern Generator SVDF. The substitution signals provided are the FuBK test chart to German standards (with and without circle and with inserted transmitter identification) and different text pages which provide viewers with information in the event of a disturbance. Operation is automatically reset to the program signal after the disturbance has been eliminated. The Video Test and Pattern Generator SVDF can also be controlled via the video signal using the data line.

The Audio Distribution Amplifier AVT is housed in the UELF in order to select AF signals. It supplies the AF signals for sound 1 and 2 to the TV Dual Sound Coder STCF for each transmitter. The STCF then encodes these signals to channel signals 1 and 2. The pilot signal which is amplitude-modulated with an identification frequency depending on the operating mode (mono/stereo/dual sound) is added to channel 2.

The VF program jack panel and sound circuit jack panel AVT-Z2 enable interruption of the signal paths for **measurement and monitoring purposes** and by-passing for emergency operation, if a unit fails in the signal path.

A **reference frequency** for controlling the TV transmitter can be passed to the transmitter exciters via another Video Distribution Amplifier AVF in the UELF.

Condensed data

Vision signal paths

VF input impedance	75 Ω
Return loss up to 6 MHz	≥34 dB (inputs) ≥26 dB (outputs)
Crosstalk attenuation between lines with different signals up to 6 MHz	≥60 dB
Signal-to-noise ratio (weighted, rms, without hum)	≥60 dB, referred to 0.7 V video signal
Program path gain	0 dB (nominal value)
Level adjustment range	±6 dB for AVF (max. V_{pp} = 1.5 CVS), ±1 dB for SPRF
Automatic gain control	±3 dB

Sound signal paths

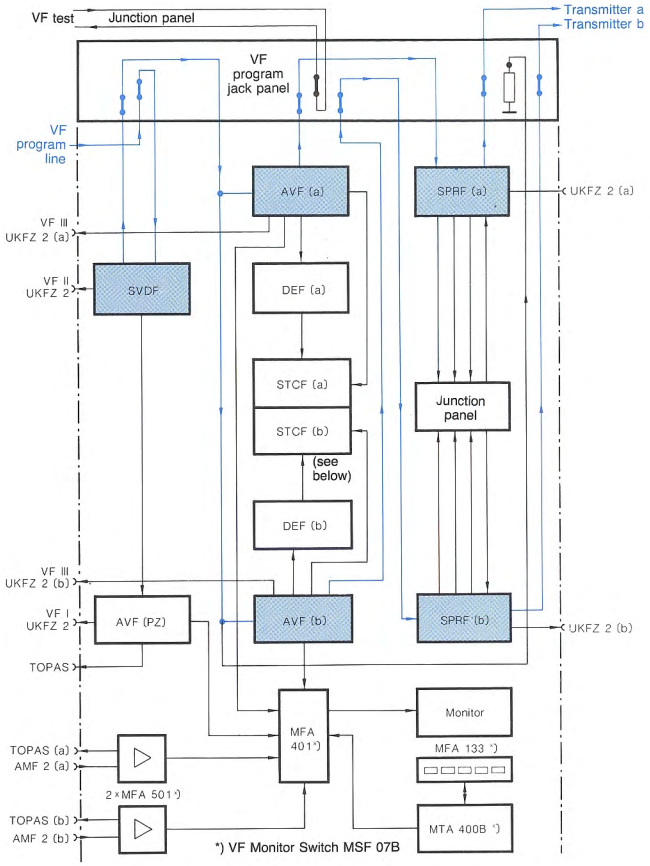
AF input impedance	600 Ω
Program path gain	0 dB (setting range −9 to +6 dB)
Crosstalk attenuation between lines with different signals	>76 dB
Signal-to-noise ratio (weighted)	>66 dB, referred to +6 dBm

General data

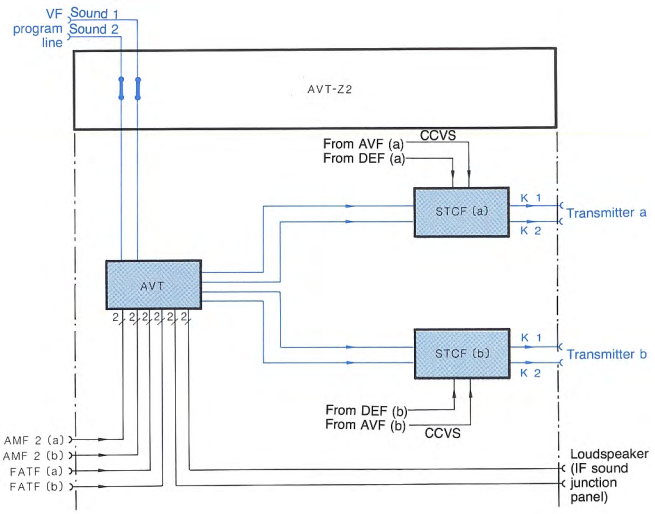
Ventilation	built-in blowers with air filter
Power consumption (fully equipped)	730 VA
Dimensions (W×H×D)	600 mm×2200 mm×1000 mm
Weight (fully equipped)	300 kg

Ordering information

Order designation ▶ TV Transmitter Input Assembly UELF



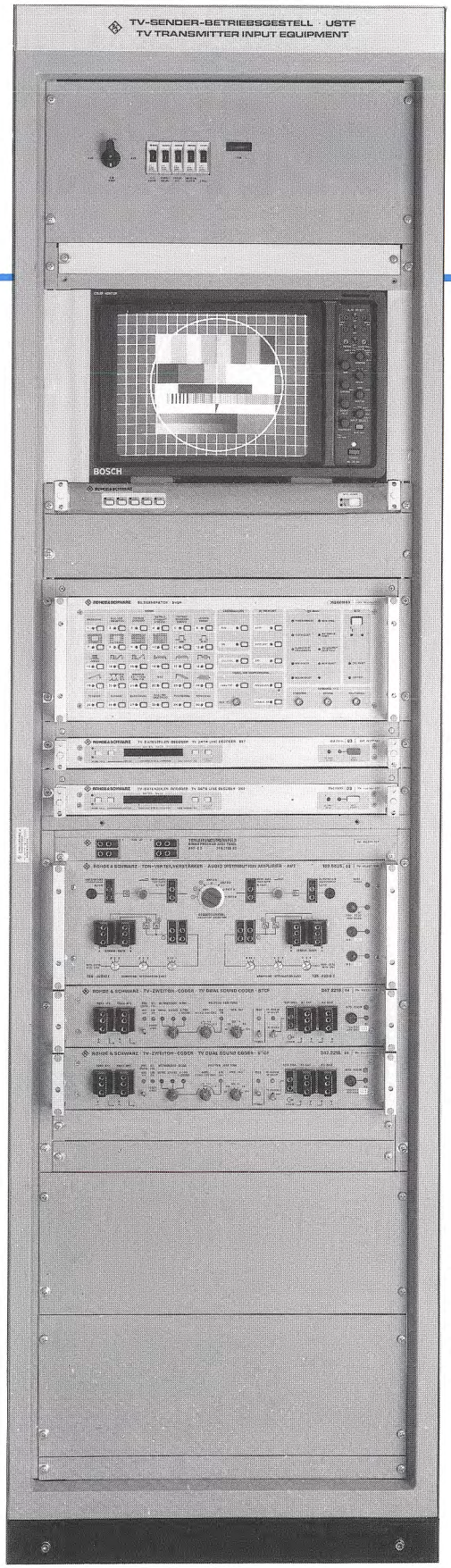
Block diagram of TV Transmitter Input Assembly UELF; above: video section; below: audio section



USTF TV Transmitter Input Equipment USTF

Uses:

- Switching sound program signals to main and stand-by transmitters
- Dual sound signal processing
- VF monitor for monitoring incoming or radiated signals
- Automatic substitution vision signal switching with text insertion
- Data line monitoring



Junction panel

Monitor

MSF 07B

SVDF

DEF.03

DEF.03

AVT-Z2

AVT

STCF

STCF

Space for precision offset control generator

The **TV Transmitter Input Equipment USTF** switches the sound program signal to a TV dual transmitter and monitors the vision program signal.

The USTF houses the Audio Distribution Amplifier AVT for selecting the **AF signals.** It supplies the AF signals for sound 1 and 2 to the TV Dual Sound Coder STCF for each transmitter. The STCF then encodes these signals to channel signals 1 and 2. The pilot signal which is amplitude-modulated with an identification frequency depending on the operating mode (mono/stereo/dual sound) is added to channel 2.

The sound circuit jack panel AVT-Z2 enables the interruption of the signal paths for **measurement and monitoring purposes** and by-passing for emergency operation if a unit fails in the signal path.

The incoming **VF signal** and the radiated signal can be monitored on a **monitor** if required. The VF Monitor Switch MSF 07B is used for signal selection.

In the event of vision program signal failure, a preset **substitution signal** is automatically switched into the signal path by the Video Test and Pattern Generator SVDF. The substitution signals provided are the FuBK test chart to German standards (with and without circle and with inserted transmitter identification) and different text pages providing viewers with information in the event of a disturbance. Operation is automatically reset to the program signal after the disturbance has been eliminated. The Video Test and Pattern Generator SVDF can also be controlled via the video signal using the data line.

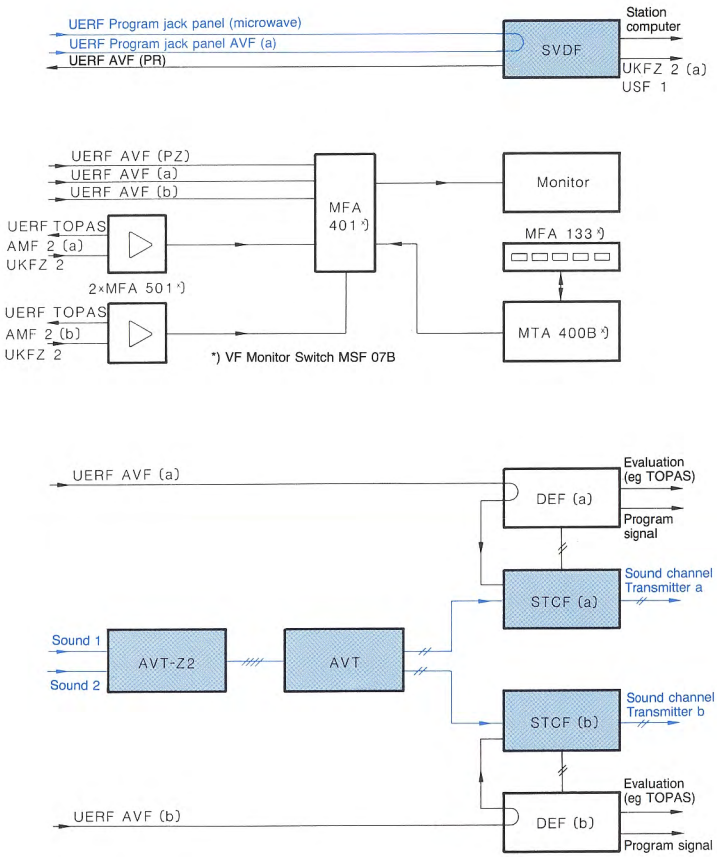
The USTF houses two TV Data Line Decoders DEF.03 in order to evaluate the **data line** for monitoring and control purposes.

Condensed data

VF signal	CCVS signal with data lines
Input impedance	75 Ω, bridging filter
Return loss	>34 dB (up to 6 MHz)
AF signal	
Input impedance	600 Ω
Program signal gain	0 dB (nominal value)
Crosstalk attenuation between lines with different signals	>76 dB
Signal-to-noise ratio (weighted)	>66 dB
Cooling	convection, can be connected to transmitter overpressure ventilation
Dimensions	19″ version, adapted to transmitter model

Ordering information

Order designation	▶ TV Transmitter Input Equipment USTF



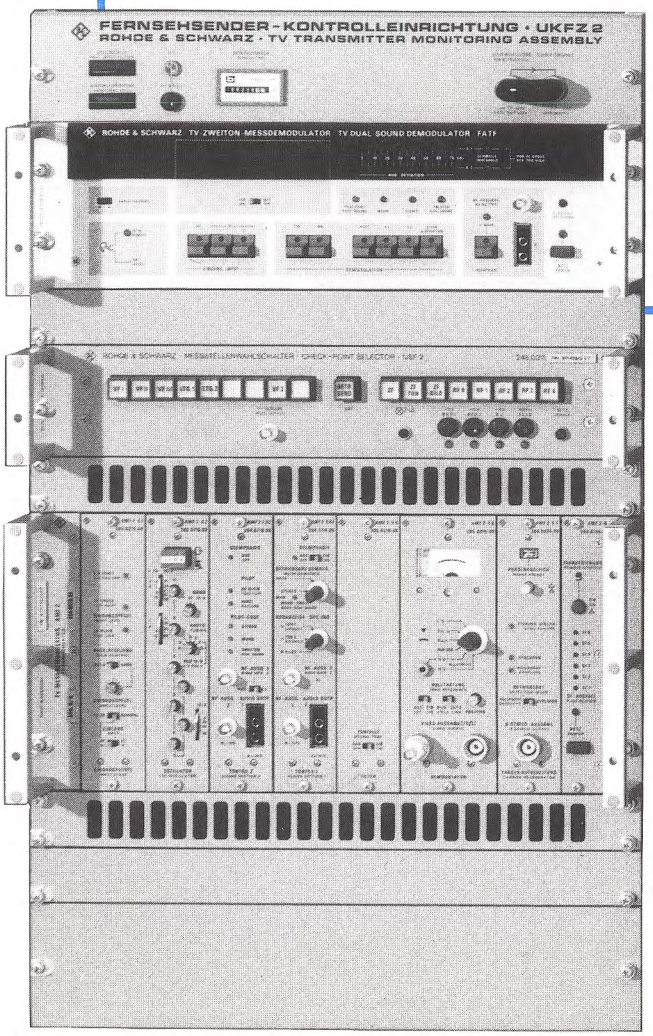
Block diagram of TV Transmitter Input Equipment USTF with (in descending order)

- automatic substitution vision signal switching
- VF monitoring (incoming and radiated signal)
- sound signal processing and switching and data line monitoring

UKFZ 2 TV Transmitter Monitoring Assembly UKFZ 2

Uses:

- General checking of audio, video, IF and RF signals for adherence to laid down tolerances
- Signal tracing at the video, IF and RF checkpoints in the transmitter
- Performance monitoring of the transmitter (vision, sound)
- Linearity monitoring with test signals



Junction panel

FATF

USF 2

AMF 2

(XSRM)

The **TV Transmitter Monitoring Assembly UKFZ 2** is used for monitoring the radiated RF signal. The RF signal tapped at the transmitter output is demodulated for this purpose and passed to a Picture Transmitter Test Assembly UMVF 2.

The UKFZ 2 is designed for single transmitters and can for instance be accommodated in the exciter rack of the transmitter. There are two units for a dual transmitter.

In the case of Deutsche Bundespost standard transmitters designed as dual transmitters, each single transmitter contains a special Monitoring Assembly UKFZ 2 which is housed as a rackmount in the exciter rack of the transmitter. This monitoring assembly houses the TV Demodulator AMF 2 and the TV Dual-Sound Demodulator FATF in addition to a Checkpoint Selector USF 2 which connects the requested checkpoints in the transmitter via appropriate RF/IF relays. The TV Demodulator of the main transmitter is permanently switched automatically to the antenna output of the transmitter, because it powers the automatic quality monitoring system of the transmitter station (eg TOPAS, see catalog Section 4, or UPKF).

For precision offset operation of the transmitter, the Rubidium Frequency Standard XSRM is often fitted in the Monitoring Assembly UKFZ 2.

Both monitoring assemblies of a dual transmitter are connected via the same junction panel to the mobile Picture Transmitter Test Assembly UMVF 2 (see block diagram). From there, the checkpoint selectors of the transmitters can also be remote-controlled, so that the stand-by transmitter can be fully measured during program operation. The junction panel can be housed in the central rack, in the Vision Transmitter Input Equipment UERF or in the TV Transmitter Input Equipment UELF of the dual transmitter.

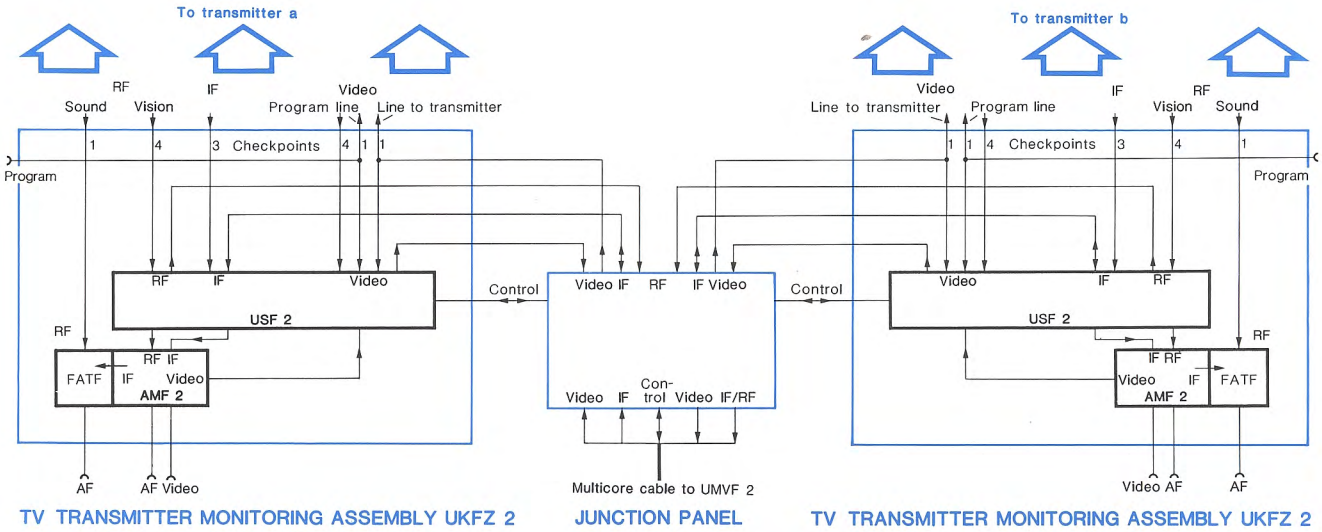
Specifications (rack)

Inputs/outputs	RF	IF	Video
Characteristic impedance	50 Ω	50 Ω	75 Ω
Return loss	≥34 dB	≥34 dB	≥34 dB (up to 10 MHz)
Connector systems	N	N	BNC 4/13
Dimensions, weight	483 mm × 845 mm × 600 mm, 75 kg		

Ordering information

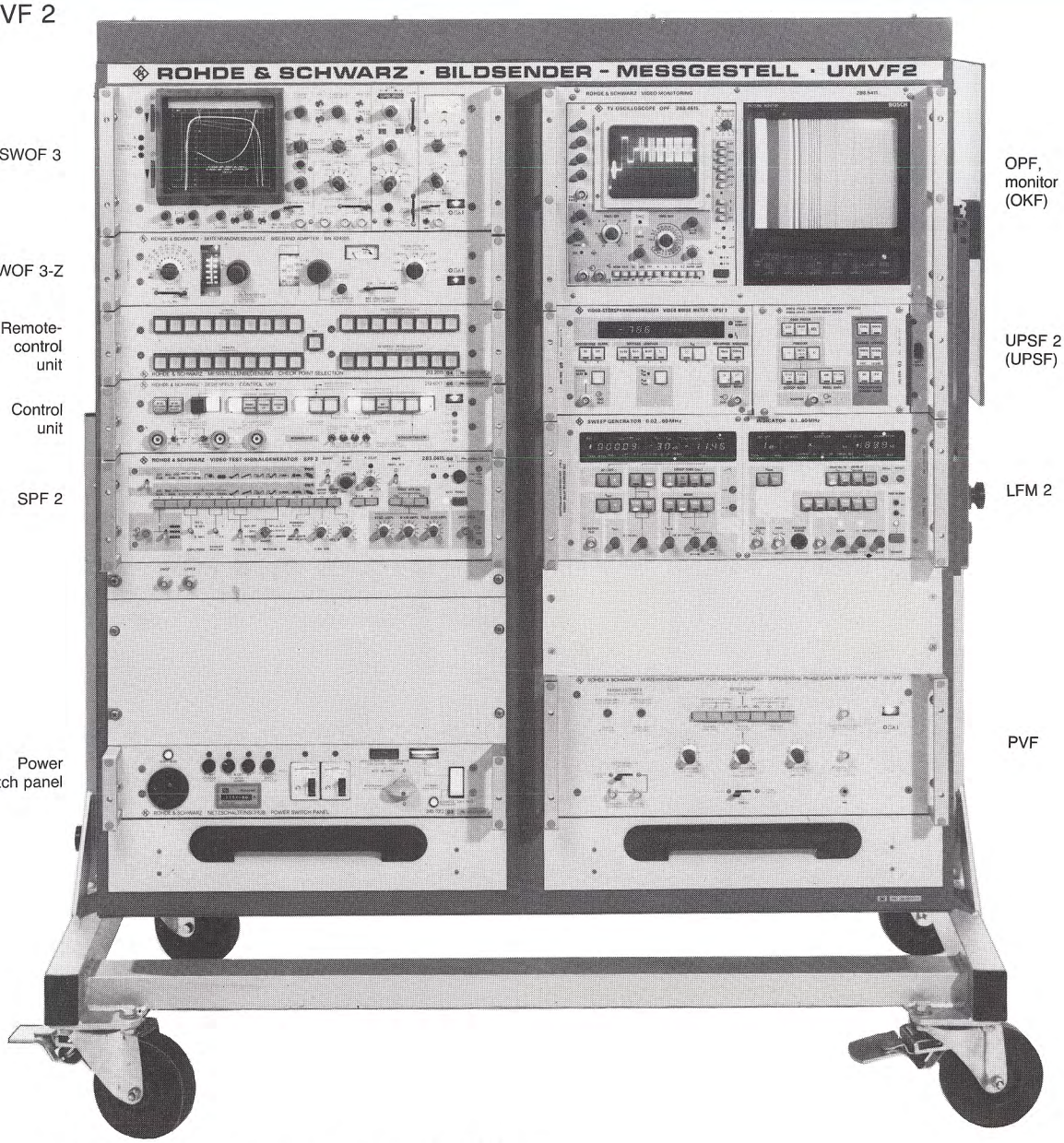
Order designation ▶ TV Transmitter Monitoring Assembly UKFZ 2

When asking for a quotation, please indicate the transmitter concept (single or dual transmitter) and the desired equipment.



Basic connections between TV Transmitter Monitoring Assembly UKFZ 2, junction panel (accommodated in central rack, in Vision Transmitter Input Assembly UERF or in TV Transmitter Input Assembly UELF of transmitter) and Picture Transmitter Test Assembly UMVF 2

UMVF 2



Picture Transmitter Test Assembly UMVF 2

Uses:

- Video and RF measurements on vision transmitters, microwave links and other active and passive four-terminal networks
- Signal generation: video signal
  test lines
  video sweep signal
- Signal evaluation: full field
  frequency response
  sideband characteristic
  group delay
  transient response
  differential gain
  differential phase
  level control
  noise voltages

Special features of UMVF 2:

▷ Mobile test assembly which can be moved to all checkpoints of single or dual transmitter systems

▷ Swivel-suspended twin rack with fold-out table allowing the operator to work seated or standing

▷ Selection of checkpoints, generators and evaluation equipment from central keyboard

▷ Suitable for time- and frequency-domain measurements on all black-and-white and colour TV systems

▷ Insertion signal generation, including test lines, in accordance with CCIR for time-domain measurements

▷ Measurements in the frequency domain (also in the sideband) with selective indication on linear or logarithmic amplitude scale

The **Picture Transmitter Test Assembly UMVF 2** contains all signal generators and evaluation equipment (block diagram see below) required for measurements in the video, IF and RF ranges in accordance with CCIR standards and relevant specifications. The UMVF 2 configuration is custom-tailored. The test assembly can include the following equipment:

Video Test Signal Generator SPF 2 for producing video and testline signals and for synchronization to the program signal, thus permitting full-field measurement.

TV Oscilloscope OPF (also available with picture monitor) or **TV Waveform Monitor OKF** for test line evaluation. Suitable for intermodulation, linearity and noise-voltage measurement.

Videoskop SWOF 3 Video tester for point-by-point or swept-frequency measurement with broadband indication; highly selective receiver section.

Sideband Adapter SWOF 3-Z for measurement of sideband characteristics in all TV bands including the IF down to 10 kHz from the carrier.

Group-delay Measuring Set LFM 2 for determination of group delay, overall delay and amplitude characteristics as well as for link measurements.

Video Noise Meter UPSF or UPSF 2 Weighted and unweighted noise voltage measurement with fast-responding indication in terms of rms or peak-to-peak values, chroma noise measurement with UPSF 2.

Differential Phase/Gain Meter PVF permitting simultaneous display of differential gain and phase in conjunction with the OPF or OKF.

Control Unit (with or without cable equalizer) for interconnecting the measuring instruments.

Remote Control Unit fitted with 2×10 pushbuttons for remote control of the video checkpoint selector in the UKFZ and with 2×8 pushbuttons for selecting the IF and RF checkpoints of the transmitter and the junction panel. Permits all measurements necessary on TV transmitters also of extensive systems to be performed from a central station in rapid test cycles.

Power Switch Panel Power supply with elapsed-time meter; monitors ventilation and temperature at the same time.

Multicore Cable This cable comprises all signal, control and supply lines required for connecting the UMVF 2 to the picture transmitter.

Construction The measuring instruments are arranged in the rack so that the visual display units are at eye level when the operator is seated. A fold-out table (420 mm × 320 mm) is fixed to the right-hand side of the cabinet rack. The rack is swivel-suspended in the frame and can be tilted back by 20° (with mechanical locking), allowing the operator to work also while standing. The supporting frame has four wheels, those in front being fitted with a foot brake. Free rack space is available in the UMVF 2 for incorporating additional instruments.

Condensed data (general)

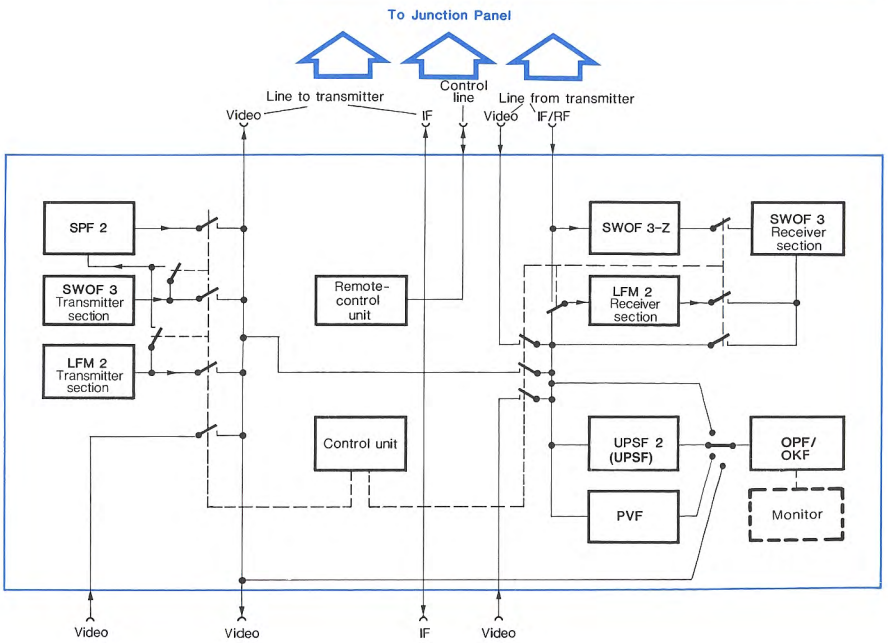
Connectors: video	RF system 4/13, adaptable; BNC
RF and IF	N internal: RF system 7/16 (50 Ω)
Cooling	from built-in blower
Air filter	two exchangeable filter mats
Power supply	115/125/220/235 V ±10% (47 to 63 Hz); via the multicore cable or a separate power cord (the multicore cable having priority)
Maximum power consumption	about 895 VA
Dimensions	1160 mm×1296 mm×755 mm
Height of equipment complement alone	37 units (1 unit = 44 mm)
Total weight	about 310 kg

Ordering information

Order designation ▶ Picture Transmitter Test Assembly UMVF 2

When asking for a quotation, please indicate the desired equipment.

Recommended extras
Junction Panel for TV Transmitters, tolerance templates for different standards, see Videoskop SWOF 3 (catalog Section 1 D).

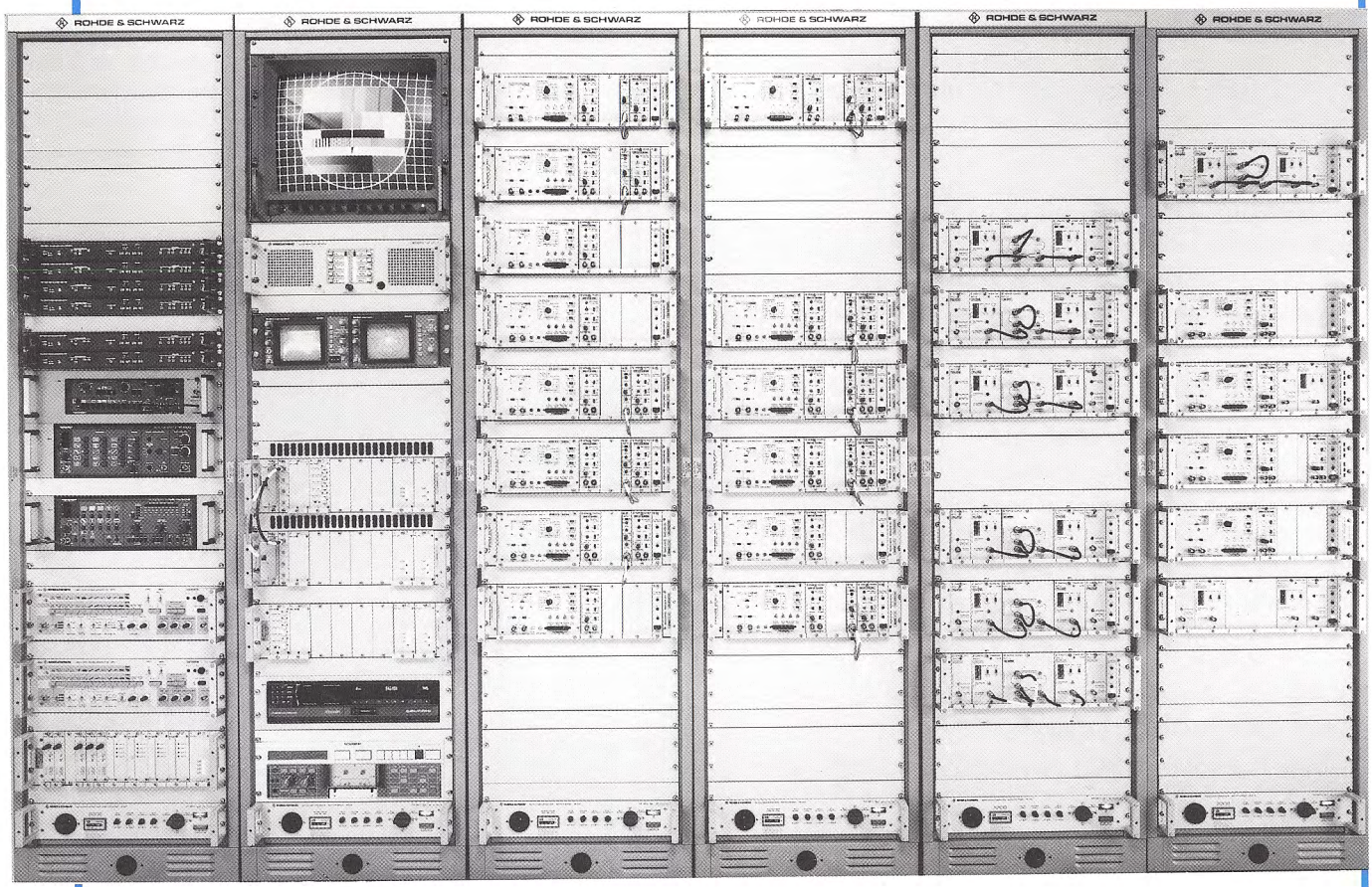


Block diagram of Picture Transmitter Test Assembly UMVF 2

Test assemblies for TV receiver and video recorder production

♦ Bands I, III, IV/V; CATV channels

- Planning and configuration custom-tailored
- Available for all conventional standards



Rack 1:
VF generators
VF text generators
AF generators

Rack 2:
Colour monitor
Audio monitor
TV oscilloscope
PAL vectorscope
VECAM-scope
Video recorder
Cassette deck

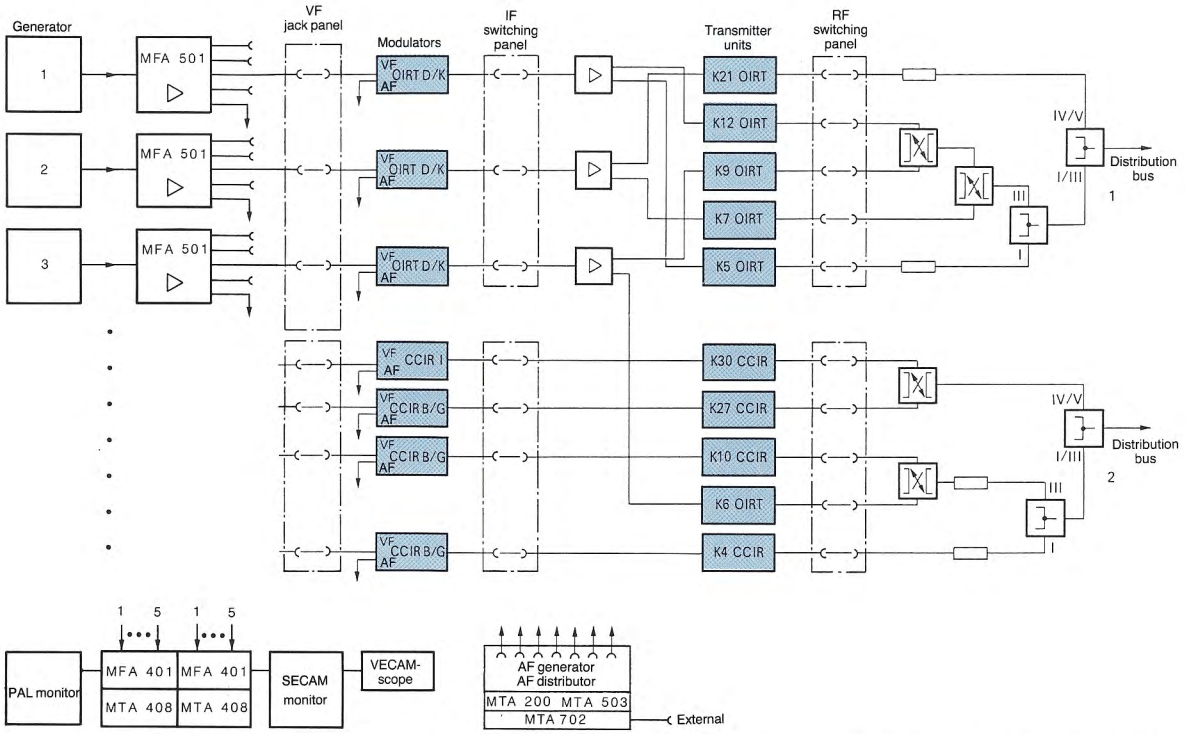
Racks 3 to 6:
Modulator and channel transmitter modules SBTF 2

Photo: Dual-sound TV test assembly for 22 channels (CCIR and OIRT) in bands I, III and IV/V, colour signals according to PAL and SECAM, signal processing for standards B/G, D/K, L

The **test assemblies for production plants** from Rohde & Schwarz are **custom-tailored** and are specially planned and designed for each case of application. A large number of such assemblies have given fully satisfactory service in production plants all over the world.

Ordering information:

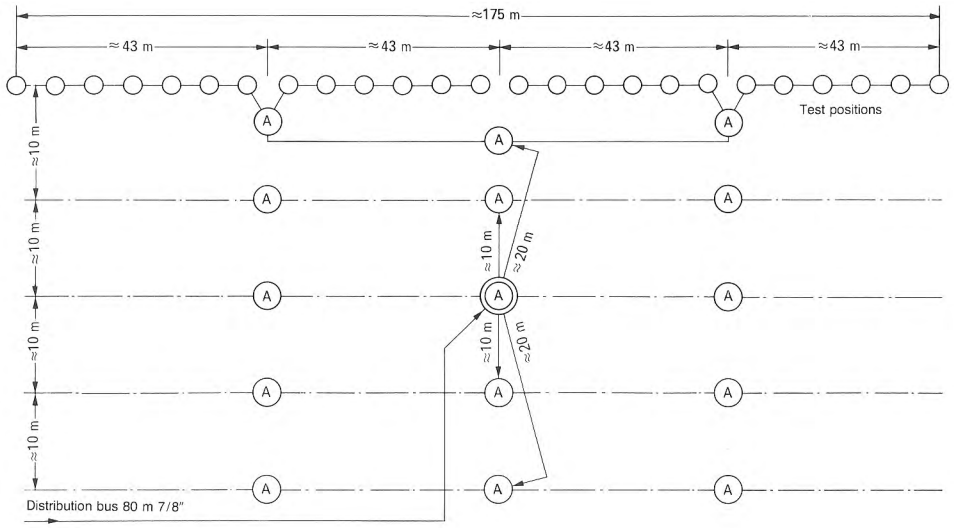
▶ Please inquire specifying your requirements.



Block diagram of a TV test assembly in accordance with CCIR and OIRT for PAL and SECAM, blue: SBTF modules; for block diagram of a distribution network supplying the test positions see next page

Existing test assemblies can be retrofitted for CATV channels and dual sound operation.

Test assembly for alignment and measurement of video recorders for 17 channels (bands III and IV/V) with four programs, colour systems: PAL and SECAM, signal processing for standards B/G (including dual sound signals), D/K, I, L and M, channel identification numbers can be inserted in the test signals



Supply of 125 test positions with test signals in a TV receiver production plant; the second distribution bus feeds another 125 test positions

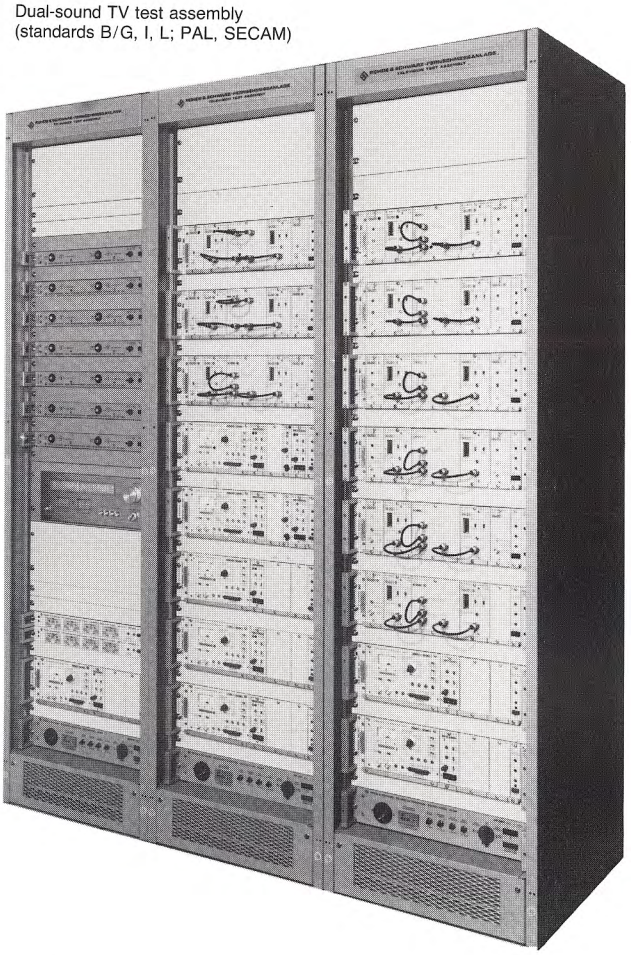
Tasks of test assemblies

Test departments in TV receiver and video recorder production require standard TV signals in bands I, III and IV/V. It is best to have several programs for each band, sometimes even with different standards. The signals must be made available simultaneously to a large number of test positions.

For this purpose **low-power TV transmitters** are used, their outputs being taken to a common output line via combination networks. Since the power required at the test positions is extremely low (fractions of a microwatt), the combination networks can be broadband and consist only of directional couplers and resistors in contrast to the combining filters used for transmitters and transposers.

The network combining the different signals is followed by the network distributing these signals to the individual test positions, which may be located either along the production lines or in the laboratory.

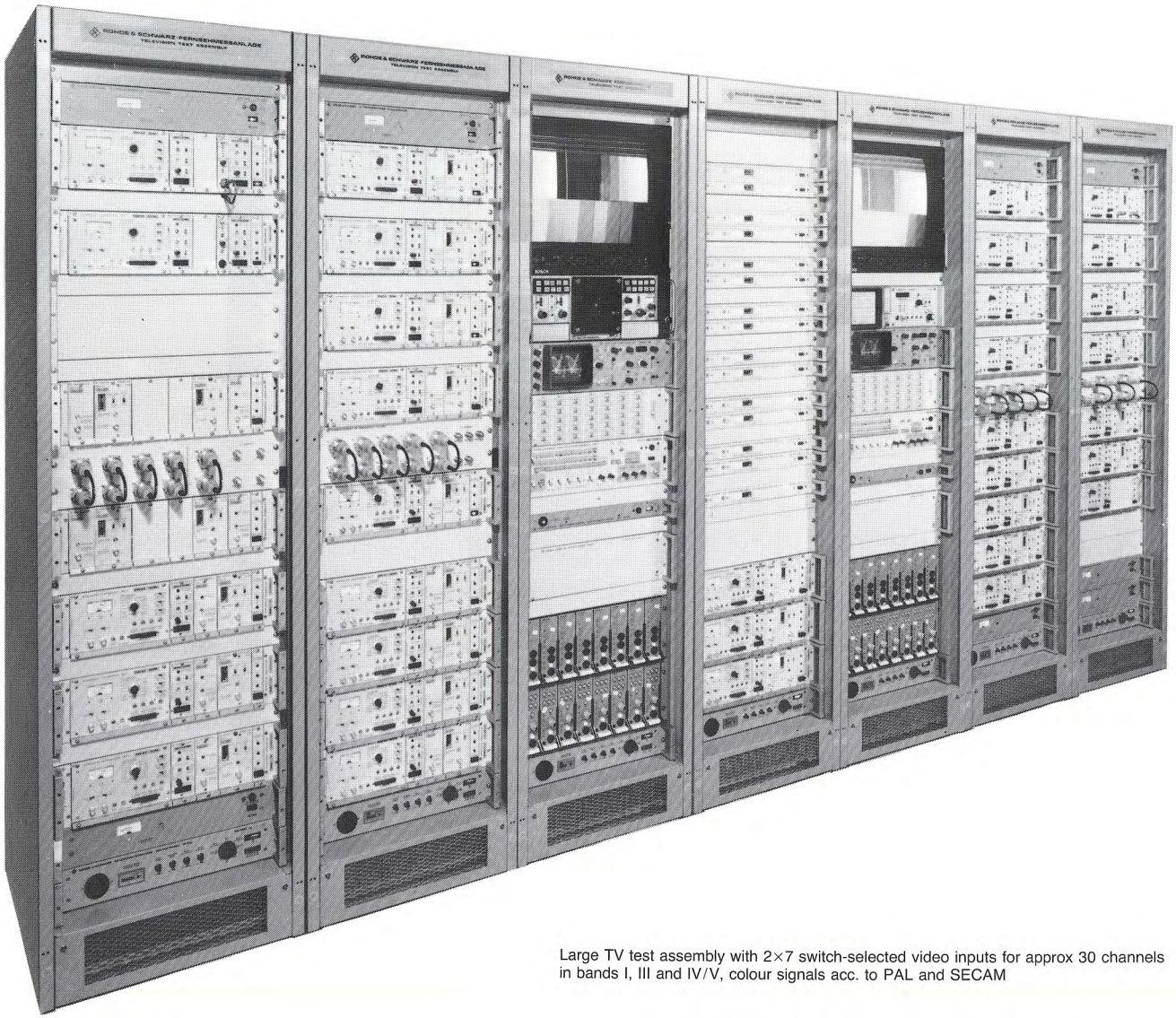
Dual-sound TV test assembly (standards B/G, I, L; PAL, SECAM)



Basic setup

Signal generators. The basic unit of all the systems is the TV Test Transmitter SBTF 2 (see catalog Section 1) which consists of a vision-sound modulator with IF output and subsequent transmitter units. It delivers a standard RF signal. If more than one RF channel is required, the corresponding number of transmitter units with different channels are necessary; emitting different test signals requires several modulators possibly using different TV standards. For identification of channels and types of modulation a numerics inserter is used especially in large systems.

Additional modules Video Test Signal Generators SPF 2 supply the VF signals required for modulation. The VF signals are passed to the modulators via a VF switching panel consisting of VF Distribution Amplifiers MFA 501 and VF Switches MFA 401.



Large TV test assembly with 2×7 switch-selected video inputs for approx 30 channels in bands I, III and IV/V, colour signals acc. to PAL and SECAM

The signals generated in AF Generators MTA 200 pass from an AF generator/AF distribution panel to the modulators via AF Line Amplifiers MTA 503. An Audio Monitor MTA 702 can be used to monitor all outgoing AF signals and measure their levels.

IF distribution amplifiers are used for system-specific distribution of the IF signals sent by the IF modulators to the transmitter units.

Connection of the different signal sources to the modulators – sometimes also between modulators and transmitter units – and connection of the RF outputs to the combination networks at the output is made via switching panels which also permit performance checking of the individual units at the VF, IF and RF using measuring instruments.

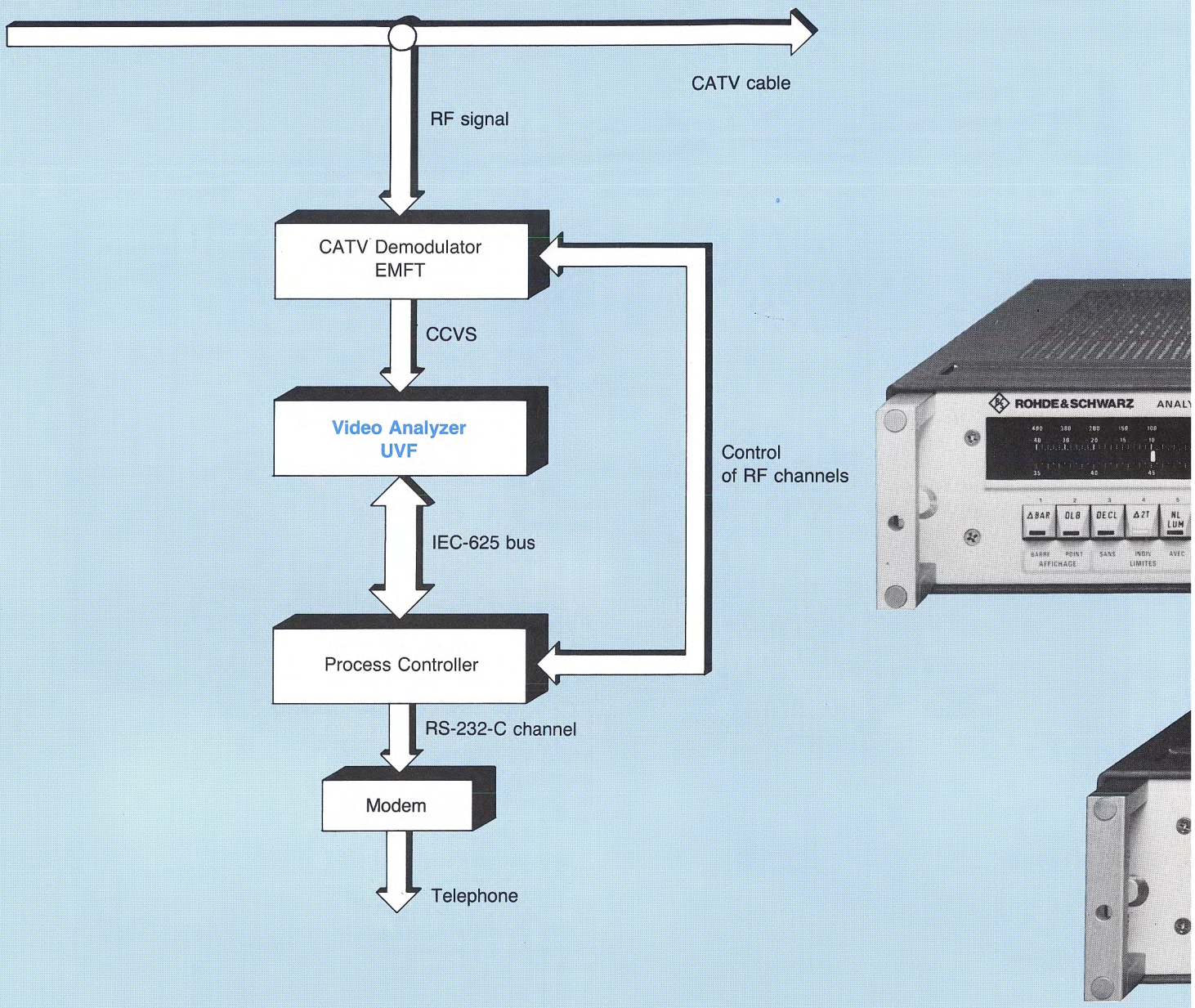
Generally a transmitter **output power** of 0.5 W is sufficient; higher powers may sometimes be required for larger, more comprehensive distribution networks. For this purpose amplifiers of up to 10 W output power are available.

For application to the distribution network the different RF frequencies are **combined** via "star" resistor networks and directional couplers. The distribution network should provide the same voltage (a few mV) to all test positions and for all channels. This can be realized to the largest extent possible by proper configuration, selection of suitable cable types and, if required, by insertion of attenuators, taking into account the frequency-dependent cable attenuation.

Monitoring equipment is required to ensure the quality of the outgoing signals. Comprehensive monitoring of the outgoing RF channels is possible with the TV Test Receiver EMFT or the TV Monitoring Receiver EKF 2, which feature a wide range and rapid frequency setting. The usual video monitoring equipment can be connected after these instruments.

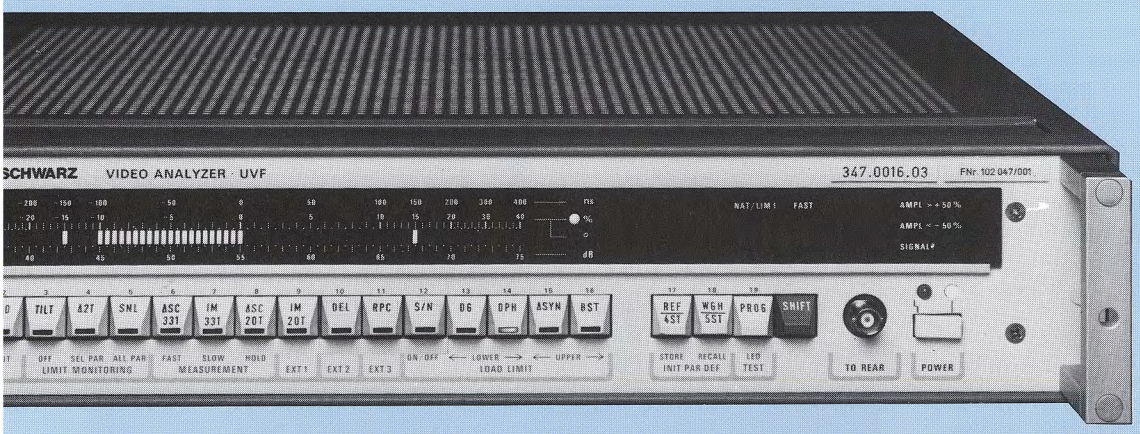
All these instruments are incorporated in racks and constitute the central station. In addition, the test assemblies from Rohde & Schwarz include the distribution network.

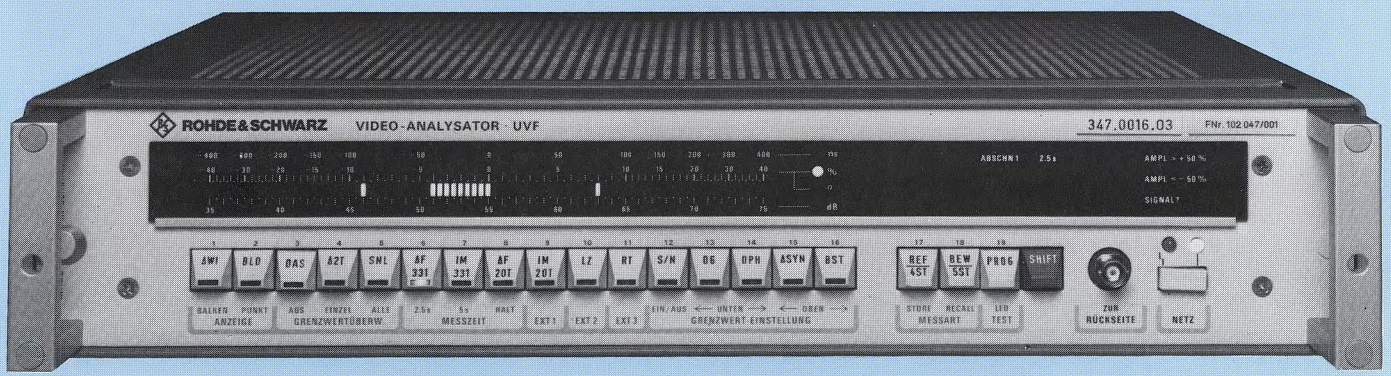
The planning and configuration of the central station depend on the desired test signals, channel frequencies and TV standards, and the design of the distribution network should take into account the number of test positions and the local conditions.



Automatic monitoring of broadband communication systems (top) with Video Analyzer UVF (right) for evaluation;
details on page 218

automatic measuring and monitoring systems





Automatic systems for function and performance monitoring in VHF sound and television broadcasting networks operate with essentially fixed test cycles.

Automatic systems for measurements in laboratories and production and repair departments, however, have to be more flexible.

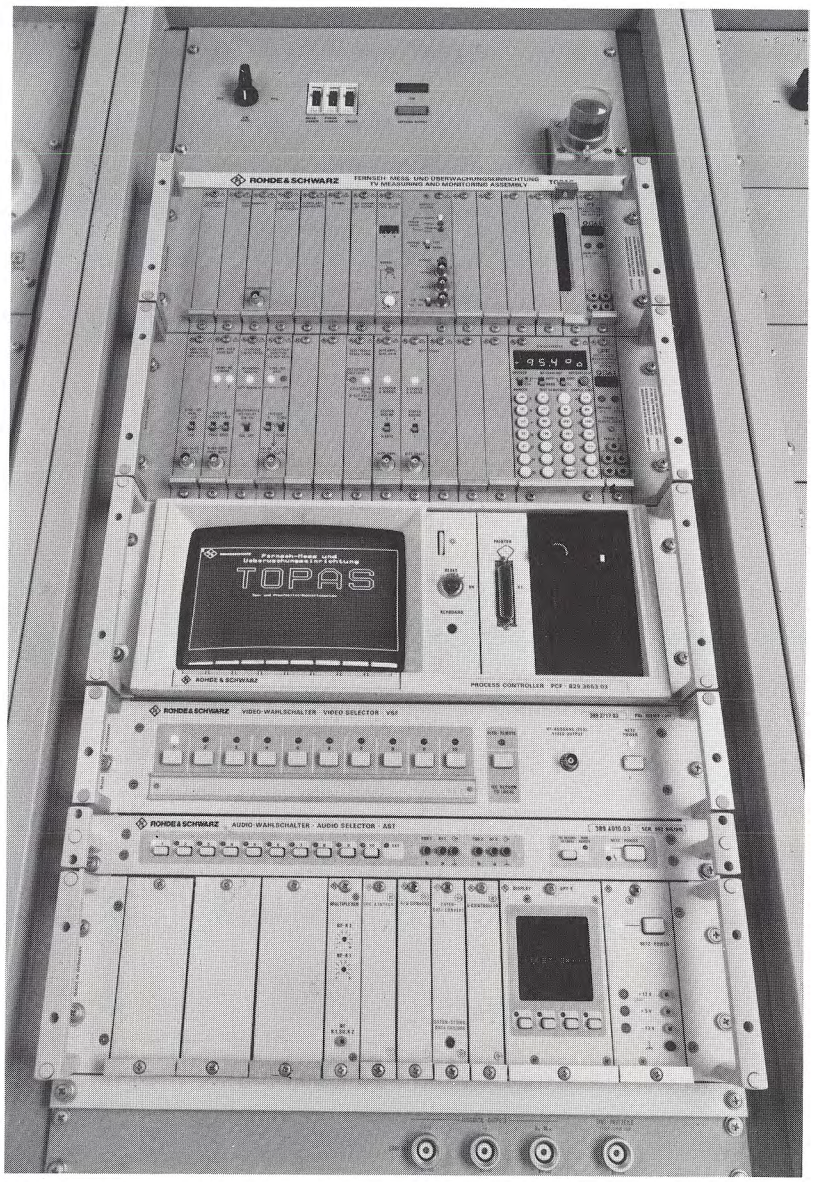
This section describes monitoring systems for VHF sound and television, and video measuring systems.

Automatic transmitter monitoring systems

The enhanced operational reliability and the early detection of faults in transmitting systems require special high-grade measuring equipment for the automation of operating processes and for efficient automatic function and performance monitoring.

Pure **function monitoring** has now been largely perfected. VHF sound and television transmitters are usually found in the form of dual transmitters with passive standby. Automatic switchover units substitute the standby transmitter for the main if the latter becomes faulty, the criteria for this switchover being various operating parameters such as supply voltages, anode currents and RF power. Unsatisfactory operating status or automatic substitutions are signalled to a control centre, which will then initiate remedial steps.

Systematic **performance monitoring** however is as important as operating reliability. The higher degree of complexity inherent in picture transmission makes it, in comparison to sound transmission, more inclined to failure and demonstrates the necessity for performance monitoring, particularly in colour TV systems. As, on the other hand, most of the sound transmitter stations broadcast several sound programs simultaneously, continuous monitoring is possible only by means of automated systems.



Sound and ITS Monitoring Assembly TOPAS with built-in Audiodat Receiver S/UPT-A (below) from the Audiodat system

For the **TV picture** the **Video Distortion Analyzer UPF** and the **Video Analyzer UVF** (both see catalog Section 1) are available as analyzers for automatic test equipment (see further below), to which they supply accurate measurement values of various parameters derived from the insertion test lines which do not appear on the screen. For **sound broadcasting** and **TV sound** the Audiodat system is available which comes as a complete monitoring system. The **Audiodat System** consists of the Transmitter **SPT** and the Receiver **UPT** and determines the performance data of the transmission by analysis of the modulation signals and comparison.

Due to their high complexity, TV picture transmitters should be monitored at several points. The **Sound and ITS Monitoring Assembly TOPAS** (photo above) was specially designed for this application. It also houses a checkpoint selector for the UPF.

Audiodat System and the Sound and ITS Monitoring Assembly permit single transmitters as well as whole transmitter networks to be monitored. In addition, they enable the transmission of remote control commands and status messages, thus permitting central monitoring of sound broadcasting transmitter networks.

There are various ways of configuring a monitoring network made up of several transmitters, the performance data of all transmitters being brought to a monitoring centre.

1. Centralized monitoring system The emissions of the transmitters to be monitored are received at a central location. The prerequisite for this is that the received field strength be high enough (at least 1 mV antenna signal) to provide signals that are sufficiently free of interference.

Advantages: Only **one** performance-measuring installation is required. It generally includes a computer for polling and data processing.
Video and sound signals are available, permitting the measurement of the transmission parameters and checks using video and sound monitors.

Drawbacks: Strong common-channel interference, which is often caused by meteorological factors, can affect the observation. Only overall measurements are available, which do not allow any exact conclusion on the source of error (transmission link or transmitter).

2. Decentralized monitoring system There is performance-measuring equipment at each transmitter site. All measured data are available at any time. Any fault is signalled. In unattended stations, the measured data in numerical form are transmitted digitally to the monitoring centre – if returning relay links are available, they can be inserted in the data line or the sound channel.

Advantages: No particular topographical or spatial requirements as regards the locations of the transmitters and the monitoring centre; propagation factors are irrelevant; separate observation of input and output signals is possible; measurement of standby equipment is possible.

Drawbacks: At each transmitter location with up to three dual transmitters there must be at least one complete set of performance-measuring equipment together with special equipment for transferring measured data to the transmission channel to the centre; the possibility of observing the picture and aurally monitoring the sound at the monitoring centre is only provided with suitable receiving conditions.

3. Hybrid monitoring system The transmitters which are near enough are monitored over the air as in 1. The others are supervised as in 2, with the possibility of interposing unattended subcentres operating as in 1, but without picture observation and aural monitoring. These subcentres will then transmit their measured data back to the centre as in 2.

The **advantages and drawbacks** can be deduced from 1 and 2.

Automatic video test systems

For automatic measurements, eg in development and production, a test line analyzer can be fitted with a control computer and flexible software.

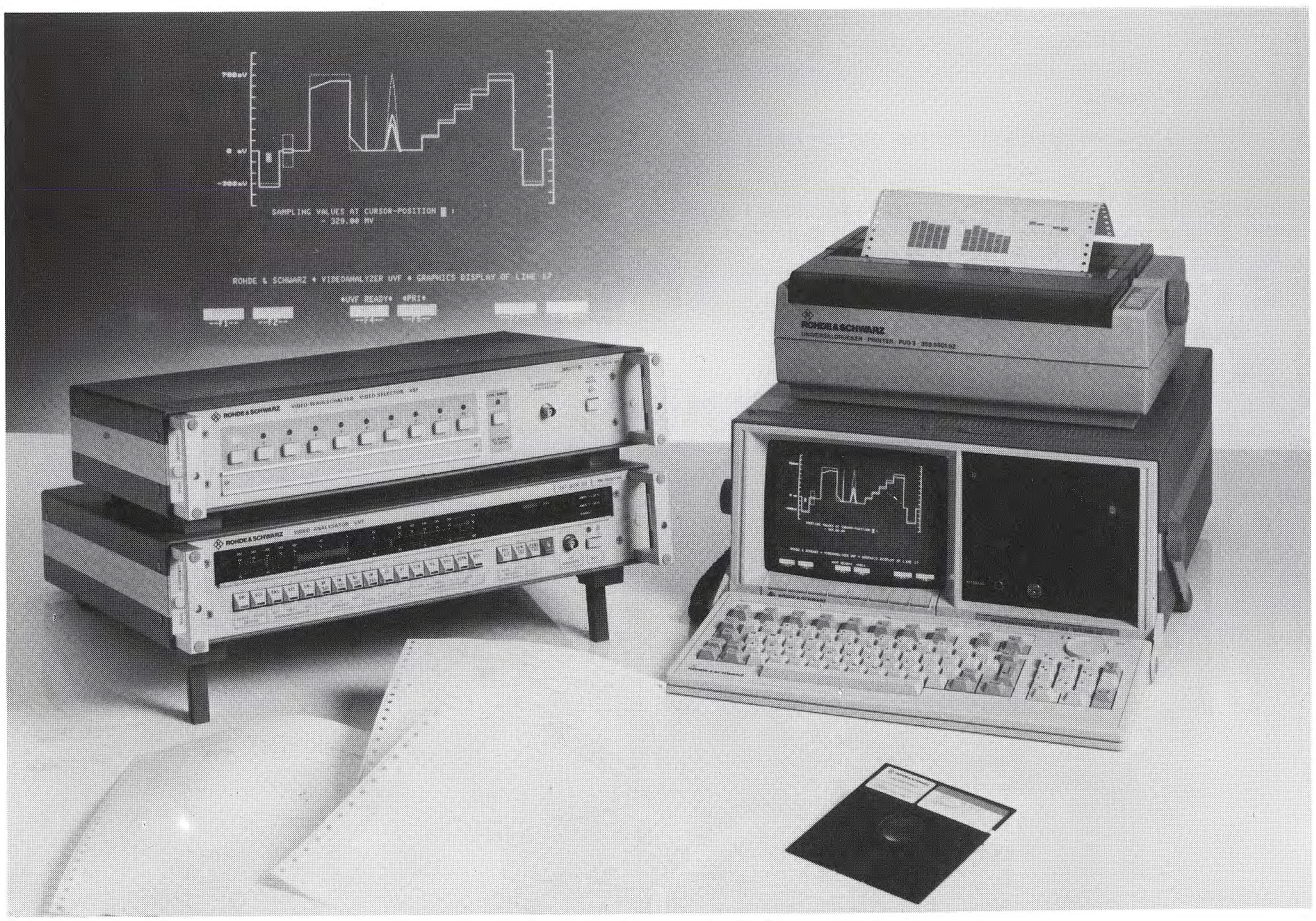
Automatic video test systems that can be adapted to any measurement tasks are obtained by combining the Video Analyzer UVF or the Video Noise Meter UPSF 2 with a Process Controller such as PCA 5 from Rohde & Schwarz.

Ordering information:

Rohde & Schwarz designs to **customer's requirements** and supplies

automatic vision and sound monitoring systems for function and performance checks in transmission networks and

automatic general-purpose video test systems.



Video measuring system with Video Analyzer UVF and Checkpoint Selector VSF can be adapted for any measurement

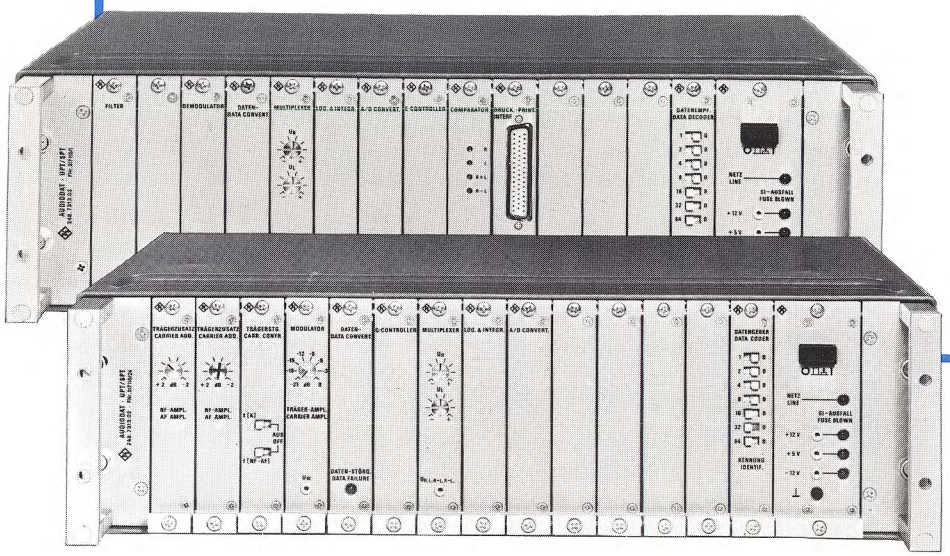
SPT/UPT

Audiodat System SPT/UPT

Audiodat System SPT/UPT

♦ 15 kHz, 60 kHz

- 15-kHz system for quality monitoring of sound programs – transmission of program-related data with 25 bits/s
- 60-kHz system for transmission of control data and status signals of automated transmitter networks with 200 bits/s
- TV dual-sound quality monitoring in the TOPAS system with transmission in the TV data line



Photos: Audiodat Receiver UPT and Audiodat Transmitter SPT (front)

The **automation of transmitter networks** involves the handling of large quantities of quality measurements, control and status data. For technical and economical reasons it is advisable to use the available channels of the sound and TV transmitter networks for the transmission of these data (see also example on page 205).

The data of the **sound broadcasting transmitters** are transmitted at the unused frequencies 15 kHz and 60 kHz of the sound transmission range. The amplitudes are far below the audibility threshold.

The data of **TV sound transmitters** can also be transmitted in the data line.

The **Audiodat System SPT/UPT** consists of two versions which differ especially with respect to their application:

quality-control system for VHF and TV sound equipment; uses **15-kHz carrier frequency** and transmits measured data with a bit rate of 25 bits/s;

data-transmission system for all control data and status signals in VHF and TV transmitter networks; uses **60-kHz carrier frequency** and a rate of 200 bits/s.

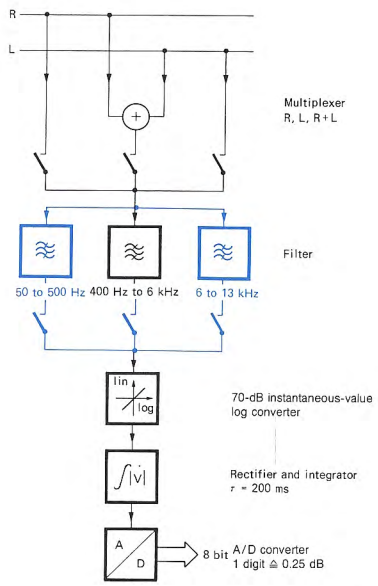
In principle, both systems use an Audiodat Transmitter SPT for nominal value measurement at the data sending site and an Audiodat Receiver UPT for comparison at the data receiving site; these two units are available as 19″ rackmounts or 19″ bench models with the plug-in modules fitted in accordance with the requirements.

Audiodat quality-control system

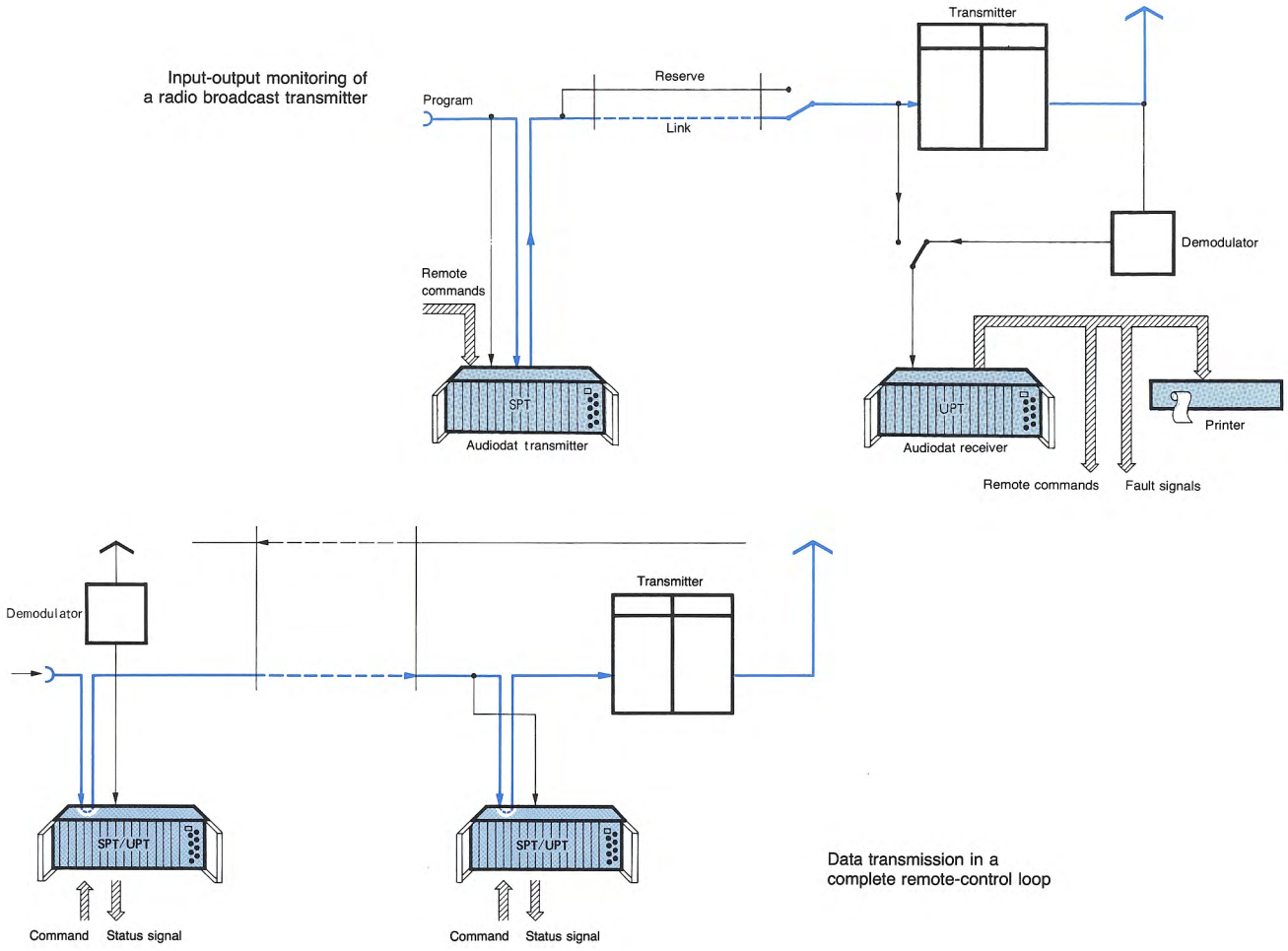
- Continuous, automatic quality control during the ongoing program
- Signalling of faults and out-of-limit conditions – logging of results by an additional printer
- Transmission of program identification (source identification), remote commands and status signals in addition to measured data

Checkout during ongoing program The **change in the program signal** passing through the transmission equipment is **used as a criterion** for monitoring.

At the transmitter and the program is analyzed and the **nominal value** obtained.



Block diagram of level meter in Audiodat system for quality checking; blue: additional module for frequency-response measurement



The **actual value** obtained at the receiver end is here compared with the nominal value permitting comprehensive **function checking.** Moreover, level analysis permits the following **quality parameters** to be evaluated:

level faults, optionally separated into three frequency ranges (frequency-response measurement),

program interruptions or **mix-ups** caused by switching errors,

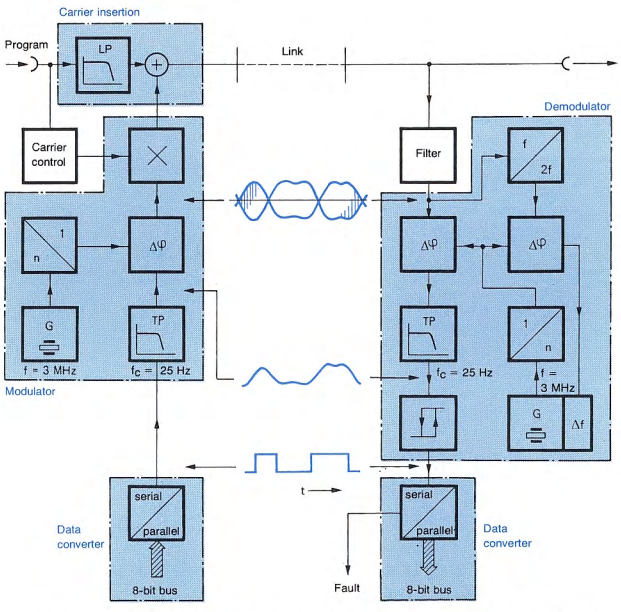
signal-to-noise ratio deterioration detected by measuring input and output noise voltage during the pauses before or after announcements,

channel changeover or **polarity inversion** in stereo programs – revealed by measuring left, right and sum signals in sequence,

stereo sound-quality deterioration due to the use of transposers in which it is not necessary to decode the multiplex signals.

Data transmission For nominal/actual comparison the reference value has to be transmitted to the monitoring station (diagrams above and right). Moreover, the data channel of the Audiodat System is available for transmitting an **identification** to provide confirmation that the program material being analyzed by both transmitter and receiver comes from the same source. In addition, mono/stereo switchover and switching in the traffic program identification are possible via the data channel.

The 15-kHz Audiodat System can also be used for simple remote-control functions (with status signals fed back; centre of illustration). For systems handling larger quantities of data the 60-kHz system is, however, to be preferred because of its higher transmission rate.

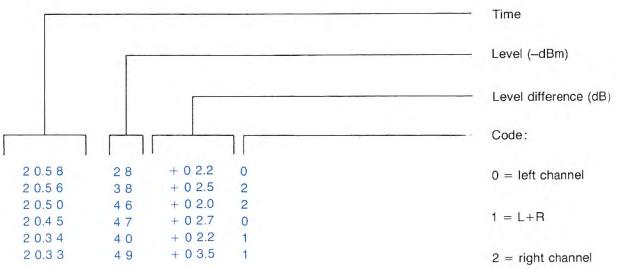


Block diagram illustrating transmission of reference-value data in Audiodat system for quality control

SPT/UPT – Audiodat System

The carrier for data transmission can be accommodated in **radio broadcast monitoring** within the 15-kHz band (or at 60 kHz, see page 204). The 15-kHz carrier is of special advantage if direct reference to the program is required or desired (identification of program source, control information for program-dependent switching procedures, etc.). The limitation of the AF band by a semitone necessary for this purpose is not discernible. The carrier power is still about 15 dB below the noise of the audio channel.

In **TV sound monitoring,** the data line can be used in addition to the 15 (or 60) kHz carrier. The Audiodat System converts the measured values, generated in the 8-bit parallel format, into a serial data train. The bit period (40 ms) corresponds to the duration of a full field so that 1 bit is transmitted per data line. In conjunction with the TOPAS system (page 206), the TV dual-sound signals are monitored for level and frequency response errors in parallel to the video signal.

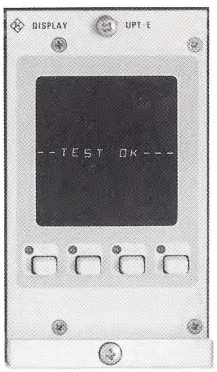


Printout of measurement with 15-kHz Audiodat System

Data logging (see above) and further **information processing** from the measured values are possible with the aid of a printer or computer (a microprocessor bus or an output module can be connected directly).

Display/Comparator S.UPT-E

new



- Three-line alphanumeric display
- Menu control
- Interfaces: IEC bus; options: V.24/RS-232-C and parallel

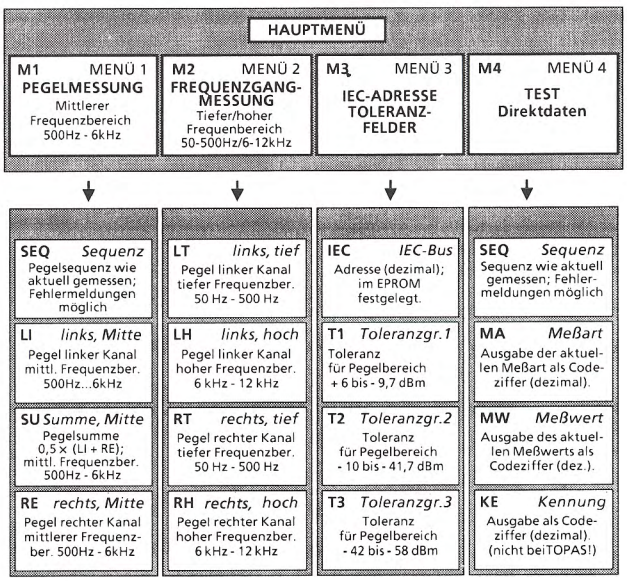
The unit **Display/Comparator S.UPT-E** means that the Audiodat System SPT/UPT is equipped with its own evaluation and display unit with a built-in 16-bit microcomputer, display, comparator for monitoring limit values, softkeys and an IEC-bus interface which prints out the measured values on the receiver side of the system.

The **operation** uses four softkeys with easy-to-understand menus to request the measuring modes, measured values, limit values, identification, etc.

The reference level, actual level, their difference and error messages are shown on a three-line alphanumeric **display** (12 characters/line).

Menu structure (for details see figure showing main menu)

The **level measurement** menu shows the measured values in the centre frequency range for the left channel, sum signal and right channel according to the evaluation of the multiplexer unit (500 Hz to 6 kHz). The display consists of three lines:
Line 1: Source data/reference value (from start of test link)
Line 2: Receive data/actual value (from end of test link)
Line 3: Difference between source and receive data



Menu structure

Text error messages

NO DATA LINE	Messages from upstream TV Data Line Decoder DEF
LEVEL ERROR	Limit value overshoot of current levels (see menu 3 – T1/T2/T3)
DATA FAULT IN SPT/UPT	Data link between SPT and UPT is interrupted
A/B POLARITY REVERSED	The wires A and B are interchanged in one of the channels

The frequency response menu shows the separate measured values at low (50 to 500 Hz) and high (6 to 12 kHz) frequencies for the left and right channels, depending on the frequency response unit which must be present in the system. Meaning of lines 1 to 3 as for level measurement.

The **IEC address and tolerances menu** shows the IEC bus address defined in the EPROM (address 10) and the three level-dependent internal (IN) and external (OUT) tolerance categories stored in the EPROM.

The **test menu** permits the display of "direct data" on the internal system bus. All outputs are decimal-encoded. The display consists of two or three lines:

Line 1:	Title/value	TEST SEQUENCE
Line 2:	Interrupt cause	INT-2-URS
Line 3:	Interrupt data	UPT-DATEN

Specifications

Level and frequency-response measurement (units: Multiplexer, Frequency-response Measurement, Log Amplifier/Integrator, A/D Converters in Transmitter and Receiver)

Dynamic range	0 to −64 dB (≙8 bits)
Resolution	0.25 dB
3-dB filter limits	f_1 = 400 Hz ±5%, f_2 = 6 kHz ±5%; without frequency-response measurement
Ranges of frequency-response measurement	50 to 500 Hz/400 Hz to 6 kHz/6 to 13 kHz
Input impedance	≥5 kΩ
Permissible input level	≤+6 dBm (may be modified to +12 dBm)

Level-difference monitoring (unit: Comparator)

Level ranges (0 dB ≙ nominal level)	0 to −15.75/−16 to −47.75/−48 to −64 dB
Warning and fault signalling limits	codable in 0.5-dB steps within each level range
Signalling on front panel	4 LEDs for warning, lamp for fault
Fault-signal line	TTL levels

Stereo decoding (unit: Stereodecoder)

Channel separation	≥58 dB (30 Hz to 15 kHz)
S/N ratio, unweighted	≥74 dB
Distortion	≤0.1%

Printer output (unit: Printer Interface)

Signal voltage	TTL levels (active ≙ high); BCD code
Printing speed	max. 2 lines/s
Printer connection	50-contact socket

Information processing (unit: Bus Interface)

Output format	8-bit words
Output	calculator I/O module or microprocessor bus
Interrogation	asynchronous (intermediate memory in bus interface)
Control lines	codable, 4 to 12 (may be treated as address lines)

Data formatting (units: Data Converters in Transmitter and Receiver)

Bit rate (may be synchronized)	25 bit/s
Data format	start bit, 8 data bits, parity bit, 1 or 2 stop bits
Word synchronization	12 consecutive stop bits
Fault signalling	on occurrence of parity or synchronization error
Signalling	lamp/TTL levels

Data transmission (units: Carrier Inserter, Modulator, Carrier Control in Transmitter and Filter, Demodulator in Receiver)

Carrier frequency	15 kHz ±1 × 10^{-5}
Modulation	180° PSK
Bandwidth requirement	±25 Hz
Carrier amplitude (minimum)	−72 to −51 dB (relative to nominal audio signal level)
Adjustment range	0 to −21 dB at modulator
Carrier boost (may be switched off)	0 to 15 dB
Transmission reliability	≤ 1 × 10^{-5} error rate at S/N ratio of 10 dB (referred to 100-Hz bandwidth)

External data (units: Data Coder in Transmitter and Data Decoder in Receiver)

Data input/output	7-bit parallel word, TTL levels
Transmission speed	approx. 2 words/s
Identification	7 bits, selectable
Fault signal at receiver	in case of non-agreement
Signalling	lamp/TTL levels

Measurement sequence control	by T-controller in Transmitter and R-controller in Receiver

Insertion into program path

Frequency response flatness	≤±0.2 dB (30 Hz to 14 kHz)
Stopband attenuation	≥43 dB (14.9 to 15.1 kHz)
Distortion factor	≤0.2%
Input and output levels	≤+16 dBm
S/N ratio, unweighted	≥80 dB (rms measurement)
Input impedance	≥2.2 kΩ
Output impedance	≤30 Ω
Inputs and outputs (guard)	floating, inputs balanced
Input/output transformers	may be included in connector strip
Switchover in event of power failure	automatic
Connectors on rear of cassette adapter	two 30-contact female connector strips

Specifications for the Display/Comparator

Processor

Central processing unit (CPU)	80186
Computer clock	8 MHz
Data bus	16 bits
Memory location RAM	max. 64 KB
EPROM	max. 64 KB
EEPROM	max. 2 KB
Data bus interface	8 bits
Control bus and handshake	10 bits

Interfaces

IEC bus	to IEC 625-1/IEEE 488
Function	listener/talker
Transfer rate	approx. 300 kbyte/s
Serial interfaces (option)	V.24/RS-232-C
Number	max. 2
Transmission modes	synchronuous/asynchronuous with/without handshake
Transfer rate	50 to 19200 Baud (in EPROM)
Parallel interfaces (option)	
Output port 1, 2, 3	8 bits each (separately addressable)
Address comparator	6 bits

General data see 60-kHz system on next page.

Ordering information

Order designation ▶ Audiodat System SPT/UPT

Please order all units separately. The modules required both for the Transmitter and the Receiver can readily be identified from the type designation. Please enquire for complex systems.

System module	Type	Ordering number	Cassette or module
Audiodat Cassette Adapter (with power supply)	S/UPT-B	248.7313.03	
Multiplexer[1])	S/UPT-E	249.1819.03	×
T Frequency-response Measurement Cassette[1])	S.SPT-E	213.4218.03	×
R Frequency-response Measurement Cassette[1])	S.UPT-E	213.4410.03	×
Logarithmic Amplifier/Integrator[1])	S/UPT-E	249.2115.03	×
A/D Converter[1])	S/UPT-E	249.2415.03	×
Comparator	S.UPT-E	247.0815.03	×
Stereodecoder	S/UPT-E	213.4024.03	×
Printer Interface	S.UPT-E	247.0515.03	×
Bus Interface	S/UPT-E	282.1714.03	×
Data Converter[1])	S/UPT-E	249.1519.03	×
Carrier Inserter	S.SPT-E	248.9116.03	×
Modulator	S.SPT-E	248.9716.03	×
Carrier Control	S.SPT-E	248.9416.03	×
Filter	S.UPT-E	249.0912.03	×
Demodulator	S.UPT-E	249.1219.03	×
Data Coder	S.SPT-E	248.8810.03	×
Data Coder (4 × identification)	S.SPT-E	248.7013.03	×
Data Decoder	S.UPT-E	249.0612.03	×
Data Decoder (4 × identification)	S.UPT-E	248.7165.03	×
T Controller[1])	S.SPT-E	248.8610.03	×
R Controller[1])	S.UPT-E	249.2715.03	×
Display/Comparator	S.UPT-E	829.5866.04	×
Status Output	S.UPT-E	213.4618.03	×
Connector Strip	S/UPT-Z	246.8512.03	
with 2 input transformers	S/UPT-Z	231.3678.02	
with 2 input transformers (transmitter)	S/UPT-Z	830.1460.03	
with 4 input transformers	S/UPT-Z	321.3678.05	
Bridging Unit with 4 input and 2 output transformers	S/UPT-Z	246.8612.00	
Blank Panel (1 cassette width)	S/UPT-Z	248.7420.00	
Panelling (for 1 Cassette Adapter)		085.1336.00	

[1]) With front panel, RAL 7035 grey; model 04

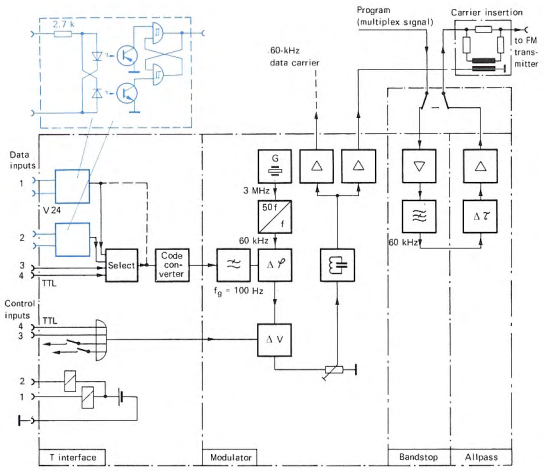
Audiodat data-transmission system

- Serial transmission at up to 200 Baud
- Economical alternative to leased transmission lines
- Data transmission also possible via relay links

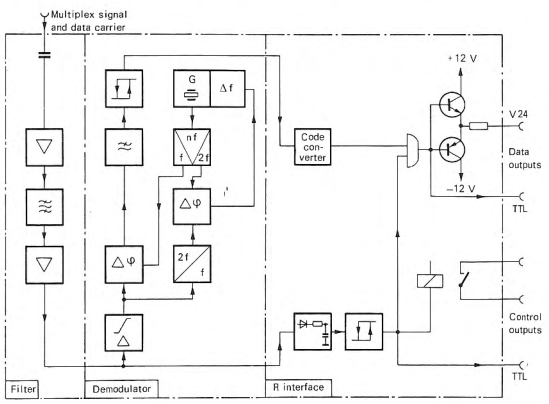
Data interfaces These are designed for universal use (compatible with interfaces of other data channels) according to the V.24-interface specification (RS-232-C) and are floating.

A selection circuit at the transmitter end connects whichever of four incoming lines first supplies data and, at the end of the transmission, restarts interrogation after a certain period. In this way, only noise signals occurring on the connected data channel may affect the transmission and the error probability is thus small.

Data transmitter A crystal oscillator with subsequent divider delivers the 60-kHz carrier frequency. Any previously inserted data carrier at 60 kHz – and remaining program components – are filtered out. The Bandstop and the Allpass Filters permit meeting the tight requirements on the amplitude/frequency and phase/frequency responses specified for low crosstalk in the stereo-multiplex channel. The transformer for insertion of the modulated carrier into the program signal can be accommodated separately from the Audiodat System (eg in the modulation input or exciter rack).



Functional diagram of Transmitter including the T Interface, Modulator, Bandstop and Allpass Filters as well as insertion transformer



Functional diagram of Receiver including the R Interface, Demodulator and Filter

Data receiver After synchronous detection it delivers a bandlimited data signal which a Schmitt trigger converts into a binary output signal. A control output signals data to be expected.

Combination with the 15-kHz system An existing 60-kHz system can also be used for transmission of the measured data from the 15-kHz system. The transmission speed is then 25 Baud and the required bandwidth ±25 Hz (see previous pages).

Specifications

Data and control inputs/outputs (units: T Interface and R Interface)

Data inputs	RS-232-C (V.24), floating
Data output	RS-232-C (V.24), floating only with DC/DC converter
Control input (reed relay)	12 V, 890 Ω (12 V available)
Control output (reed contact)	max. 60 V, max. 0.2 A

Data transmission (units: Modulator, Filter, Demodulator)

Carrier frequency	60 kHz $\pm 1 \times 10^{-5}$
Bit rate	200 bit/s
Modulation	180° PSK
Bandwidth requirement	±200 Hz
Carrier amplitude (relative to nominal level of multiplex signal), adjustable	−40 dB, during data transmission −60 dB, at other times

60-kHz carrier filtering (units: Bandstop, Allpass Filters)

Input impedance	≥2.2 kΩ
Output impedance	≤30 Ω
Distortion	≤0.2%
Maximum level	+16 dBm with 600-Ω load
Frequency response flatness	≤±0.07 dB (40 Hz to 43 kHz) ≤±0.2 dB (43 to 53 kHz)
Phase error	≤±0.7° (40 Hz to 43 kHz) ≤±2° (43 to 53 kHz)
Stopband attenuation	≥30 dB (59.5 to 60.5 kHz)
S/N ratio, unweighted	70 dB
Automatic bridging	in case of power failure

General data (15-kHz and 60-kHz systems)

Nominal temperature range	+5 to +45 °C
Power supply	110/125/220/235 V +10/−15% (47 to 63 Hz)
Power consumption of one cassette adapter	max. 45 VA
Dimensions and weight of (fully fitted) cassette adapter	
19″ rackmount	483 mm×132 mm×384 mm, 10.5 kg
19″ bench model	492 mm×161 mm×460 mm, 11 kg

Ordering information

Order designation ▶ Audiodat System SPT/UPT

Please order all units separately. Please enquire for complex systems.

System module	Type	Ordering number	Cassette or module
Data transmitter			
Modulator	S.SPT-E	282.0318.03	×
Carrier Inserter	S.SPT-E	282.9511.03	
T Interface	S.SPT-E	282.1114.03	×
Bandstop Filter	S.SPT-E	281.9711.03	×
Allpass Filter	S.SPT-E	282.0018.03	×
Bridging Unit	S.SPT-Z	282.1414.00	
Data receiver			
Filter	S.UPT-Z	282.0718.03	×
Demodulator	S.UPT-E	282.0918.03	×
R Interface	S.UPT-E	282.0518.03	×
DC/DC Converter	S.UPT-Z	282.1514.00	
Cassette adapter (including maximum of 1 data transmitter, 2 data receivers)			
Audiodat Cassette Adapter (with power supply)	S/UPT-B	281.9011.03	
Connector Strip (including maximum of 1 Bridging Unit and 3 DC/DC Converters)	S/UPT-Z	282.1314.03	

Automatic sound quality monitoring and central monitoring of a transmitter network

The following example depicts the basic configuration of an automatic central function and performance monitoring system for sound transmitters (VHF sound and TV sound), which permits integration of status-signal and command transmission for picture monitoring.

Function and performance monitoring are performed by the Audiodat System SPT/UPT, which comes in two versions:

15-kHz system, mainly for monitoring the quality of sound broadcasts and to a limited extent for transmission of data (eg program identification, mono/stereo switchover, traffic program switching);

60-kHz system, mainly for remote control. It can easily be combined with the 15-kHz system, containing in part the same modules.

Combination of the two versions provides very interesting remote-control and remote-monitoring capabilities for transmitter networks. Extensive automation of transmitter operation is possible in conjunction with computers and suitable peripherals.

Configuration of a central monitoring system

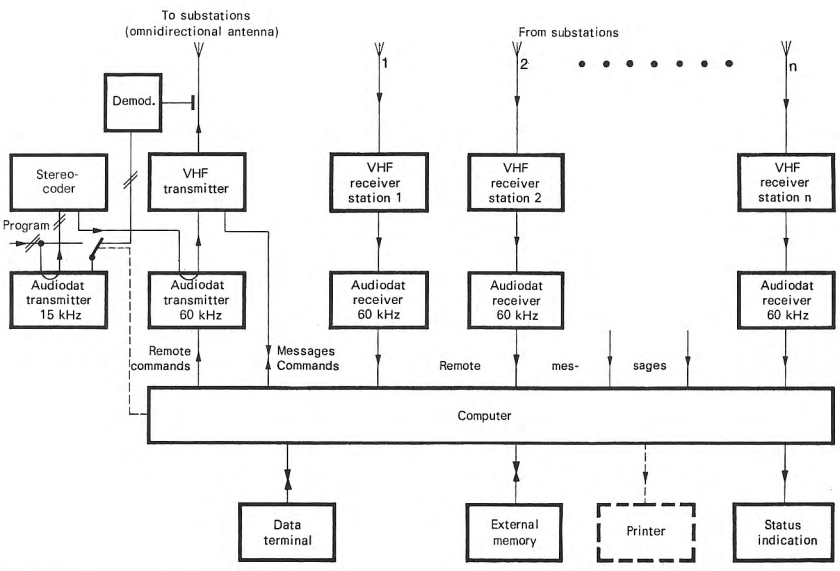
The block diagrams show the possibilities of a combined system. The program is first analyzed at the **central station** (bottom) with a 15-kHz Audiodat transmitter and the result added to the program in the form of serial data block. Relay links are used in this case to transmit the program to the substations. Additional control commands for the transmitters of the substations can be inserted into the program by a 60-kHz Audiodat transmitter.

The central station is moreover equipped with a relay receiver and a 60-kHz Audiodat receiver for each substation, conveying the messages from the substations to the computer.

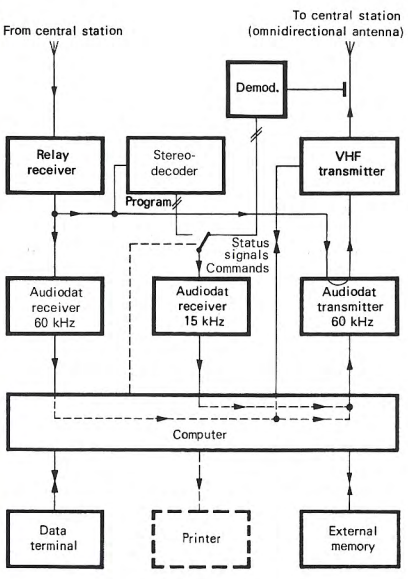
A relay receiver in the **substation** receives the program from the transmitter of the central station. The 60-kHz Audiodat receiver extracts the control commands from the program, evaluates them and applies them to the station computer. The program is conveyed to the transmitter, analyzed at the transmitter output by a 15-kHz Audiodat receiver and compared with the 15-kHz serial data block from the Audiodat transmitter at the central station. The result is evaluated and stored in the computer and also, through a 60-kHz Audiodat transmitter, added to the program and broadcast by the transmitter so that it can be received and evaluated in the central station.

The Audiodat receiver can be switched – automatically by the station computer or by remote control from the central station – to analyze the transmitter input signal. Thus it is possible to find out whether any faults occur in the transmitter or on the transmission path. Status signals of the transmitter (and of the substation) can be transmitted in the same way to the central station. A complete picture of the status of all stations of the network is thus available at any time in the central station.

The great **advantage of the system** lies in the existence of two independent paths without requiring any additional lines or radio channels: the 15-kHz path for quality monitoring and the 60-kHz path for remote control and status signals. Worthy of note is the excellent flexibility of the Audiodat System due to its modular design; the same kind of modules can be used to a large extent in combining the two paths and they can often be fitted in a single cassette adapter frame.



Configuration of central monitoring station



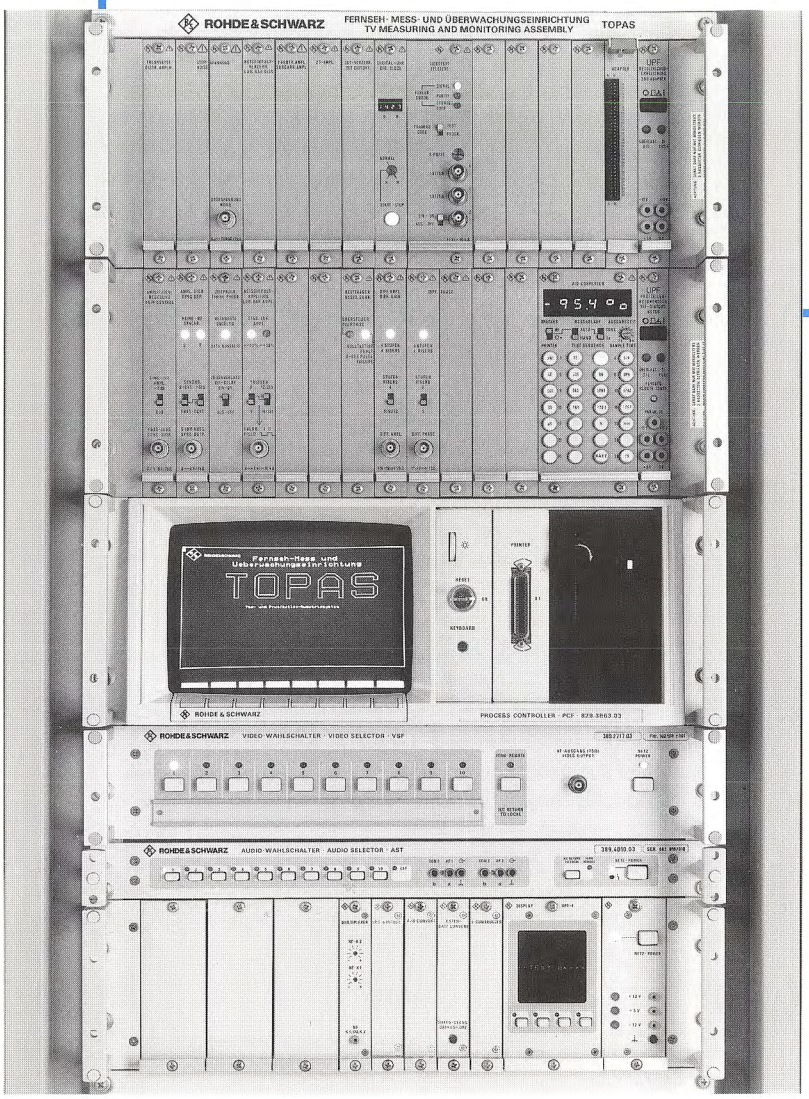
Configuration of substation

new

TOPAS

Sound and ITS Monitoring Assembly TOPAS

- Computer-controlled TV measuring system
- Comprehensive statistics and evaluation programs
- Customized software
- Automatic dual-tone measuring system
- Integration of customer system components



UPF

PCF

VSF
(USF 1)

AST

S/UPT-A

Photo: Sound and ITS Monitoring Assembly TOPAS with the fully expanded configuration for VF and AF measurement

Application

The **Sound and ITS Monitoring Assembly TOPAS** is used for decentral automatic measurement of video signals (test lines) and audio signals in TV studios, switching nodes and transmitter and receiver stations.

Video measurements

- **The Video Selector VSF** or **Checkpoint Selector USF 1** allows the connection of 10 VF checkpoints; expansion to 16 VF checkpoints is possible.
- The **Video Distortion Analyzer UPF** (only basic unit or with slave unit) evaluates the signals applied to the checkpoints (test lines) consecutively.
- The **Process Controller PCF** controls the Checkpoint Selector and the Video Distortion Analyzer and receives the measured values (measurement parameters) and status information from the Video Distortion Analyzer.

Audio measurements

- The **Audio Selector AST** allows the connection of 10 AF checkpoints; expansion to 16 AF checkpoints is possible.
- The **Audiodat Receiver S/UPT-A** evaluates the signals applied to the AF checkpoints consecutively.
- The **Process Controller PCF** controls the measurement process in sync with the VF measurement.

Measured value output The measured values of the scanned checkpoint and the most important status information of all the checkpoints are stored and can be automatically requested via serial data interfaces from a terminal at the main station.

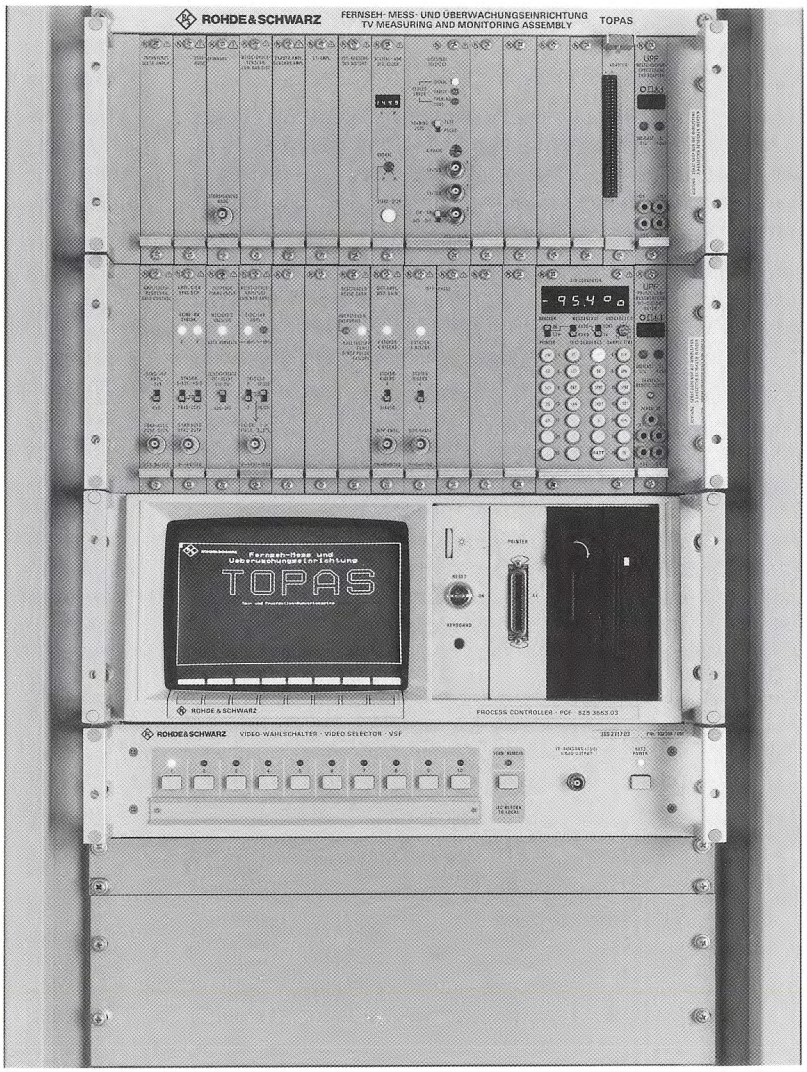
Example of a supplied TOPAS system consisting of new units

Video Distortion Analyzer UPF
(with slave unit)
Modules:
- Gain control
- Sync separator
- Timing program
- Luminance bar amplitude
- Residual carrier
- Differential gain
- A/D converter
- Luminance bar distortions
- 2T amplitude
- 20T distortions
- Sync amplitude
- Noise voltage
- Isolation amplifier
- Teletext

Process Controller PCF
with floppy disk drive,
hard disk and
customized software

Video Selector VSF
with IEC bus interface and
Cable Equalizer UPKF-Z

19″ rackmount
(completely wired)



Features

System configuration Under the name of TOPAS, Rohde & Schwarz supplies fully automatic television measurement systems which all include the Video Distortion Analyzer UPF for vision monitoring and the Process Controller PCF as control unit.

The different TOPAS versions are distinguished by their additional system components. Depending on the requirements, a TOPAS system can be equipped with or without the UPF slave unit, with the Checkpoint Selector USF 1 or the IEC-bus-controlled Video Selector VSF and, for dual-sound monitoring, with or without the Audiodat Receiver S/UPT-A and the IEC-bus-controlled Audio Selector AST (see the system examples depicted).

Retrofitting system components required for audio measurement, for example, is possible at any time.

The number of measurement parameters for the UPF can be easily increased by adding the required modules. For example, the teletext level, teletext eye height and teletext symmetry parameters can be measured by retrofitting the Teletext module. The new D2-MAC module can be used to monitor the D2-MAC level and D2-MAC symmetry. This module also detects the standard in which the video signal is presented.

Integration of existing equipment When setting up a TOPAS system, existing system components, such as UPF, USF 1 and UPKF cable equalizer, can be integrated in the TOPAS system and can therefore continue to be used. This helps to minimize the costs incurred by the system.

PCF concept The Process Controller runs on the MS-DOS operating system and the program language C. It is freely programmable and can be adapted to all existing TV monitoring systems and the appropriate specifications.

TOPAS – Sound and ITS Monitoring Assembly

System memory The floppy disk drive contained in the PCF and the integrated hard disk provide space for extensive statistics and control functions, eg for the software for operating the PCF only by softkey.

Design The units are combined in a mini-rackmount which is suitable for both bench-top operation and integration in a vision transmitter input assembly (eg UERF). The dimensions of the mini-rackmount are identical to those of the Automatic TV Test Equipment UPKF.

Video measurement A **Video Distortion Analyzer UPF** connected in series to a Checkpoint Selector USF 1 or Video Selector VSF and a cable equalizer is used for video monitoring and evaluation. Test lines and teletext parameters can therefore be detected and evaluated.

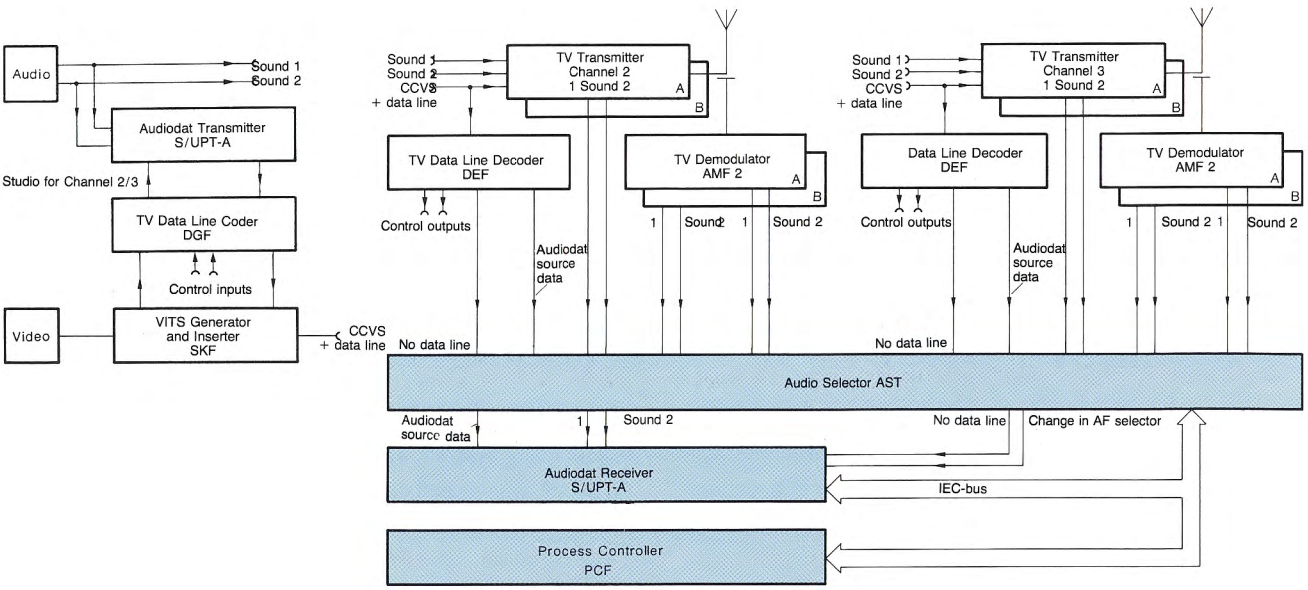
Due to its modular design, the high-precision Video Distortion Analyzer UPF can be adapted for any measurement work. It indicates measurement results and operating statuses which it sends to the Process Controller PCF for further evaluation. The measurement results at the PCF are displayed in the form of tables. The UPF can be operated both from the front panel and from the PCF. The number of parameters can be extended by mounting another 14 test-parameter cassettes in the UPF slave unit.

Audio measurement (see block diagram) Sound monitoring is based on the Audiodat System in its configuration for TV dual-sound transmission systems. The Audiodat source data supplied by the TV Data Line Decoder and the analog measured values from the transmitter or the TV Demodulator AMF 2 are sent via the Audio Selector AST to the **Audiodat Receiver S/UPT-A** for evaluation.

The Audiodat System can be used to measure level faults, external voltage, A/B polarity inversion, sound data interference and frequency response faults. The measured values are displayed on the PCF monitor in the form of tables.

The Audiodat System is also provided with its own display and evaluation unit comprising a built-in 16-bit microcomputer, display, comparator, softkeys and IEC-bus interface. The reference level, actual level and their difference as well as error messages are indicated in the display. Level faults and other faults (eg A/B polarity inversion) are displayed. The system is operated using the softkeys of the evaluation unit, and data are transmitted to the PCF via the IEC bus.

System control The **Process Controller PCF** means that the TOPAS system is provided with a wide range of operating, control and evaluation functions. The PCF has been specially developed for the requirements of television in-service systems. It combines state-of-the-art computer technology with experience gained over a period of many years in the field of measurement.



TV dual-sound monitoring; left: TV sound at studio output; right: TV sound at transmitter and TOPAS units Audio Selector AST, Audiodat Receiver S/UPT-A and Process Controller PCF

Example of a supplied TOPAS system
consisting of new units and components provided by the customer from a UPKF system

Video Distortion Analyzer UPF[1])
(with slave unit)
Modules:
– for different parameters

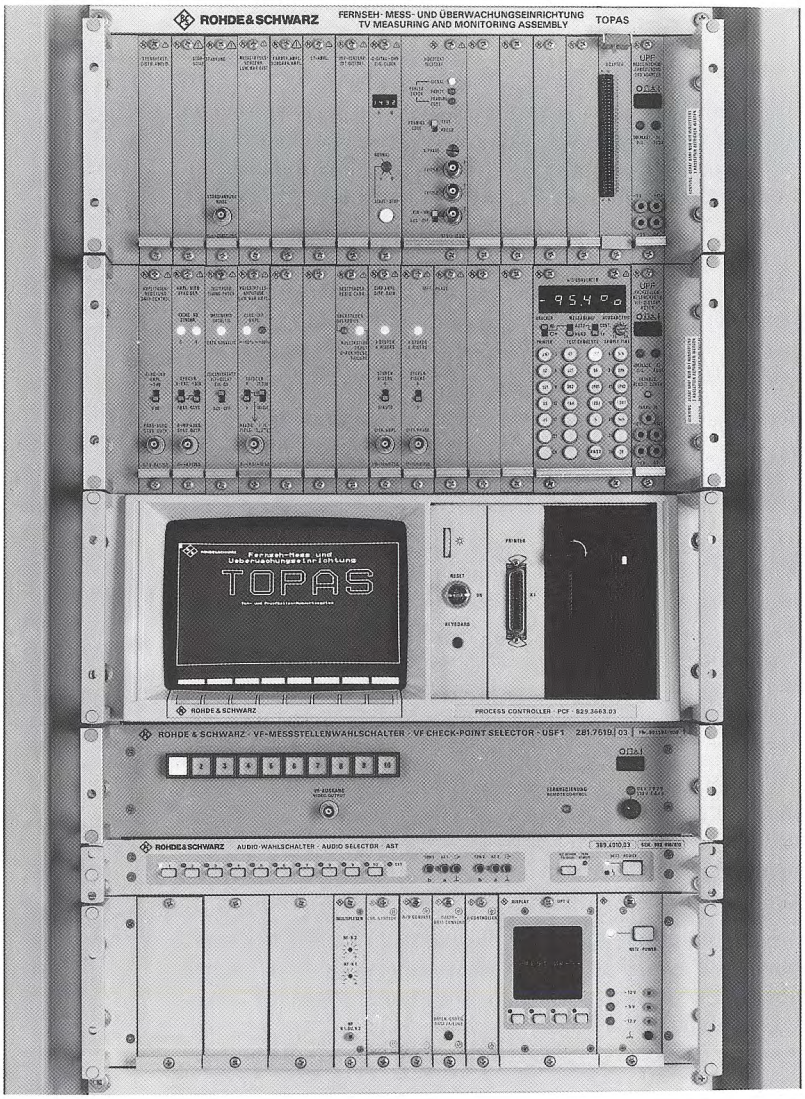
Process Controller PCF
with floppy disk drive,
hard disk and
customized software

Checkpoint Selector USF 1[1])
with Cable Equalizer UPKF-Z[1])

Audio Selector AST
with IEC-bus interface

Audiodat Receiver S/UPT-A
with IEC-bus interface
Modules:
– Multiplexer
– Logarithmic amplifier and integrator
– A/D converter
– R controller
– Data converter
– R frequency response measuring cassette
– Display/comparator

19″ rackmount
(completely wired)



[1]) Provision of existing TV monitoring system

Features of the PCF:

- MS-DOS operating system
- For automatic connection (via connector); therefore extremely suitable for measuring systems
- 9″ screen with softkeys for on-site operation (monitor or keyboard not required); screen only switched on during operation – therefore longer screen life (no danger from fusing)
- Watchdog function with significant increase in computer reliability during continuous unmanned operation (automatic reset)
- 1 MB RAM
- 21.3 MB hard disk (Winchester); contains the measurement program written in program language C and enables the management of detailed statistics on any checkpoint and parameter
- 1.2 MB floppy disk drive
- Real-time clock
- IEC-bus interface for each measuring unit
- Eight V.24 interfaces adapted to the requirements of a transmitter site (with backup for future requirements); three of the interfaces are used to integrate the data line into the test line measuring program for further evaluation (eg identification error, biphase error rate, data line contents) and control of data line transmitters at the studio output
- Parallel control inputs and outputs (with backup for future requirements); some can be switch-selected from the TTL level to the 12 V level
- Centronics-compatible printer interface (front panel)

TOPAS – Sound and ITS Monitoring Assembly

Measuring program

The TOPAS measuring program is normally contained in the **automatic checkpoint cycle,** ie all checkpoints (if not blocked) are continuously measured. Automatic measurement can be interrupted at the PCF or from a terminal at the central station.

Before measurement, a check is made whether the VSF or USF 1 and AST have **connected the checkpoint correctly.** If a fault is detected, the program repeats the connection attempt. If this also fails, the PCF and the terminal at the central station sends an in-service fault message.

After the correct selection of the required checkpoint, the program checks that the connected equipment **functions correctly** and then performs the measurements. The measurement results are available after a short time.

The program first checks for **signal errors** such as "No sync" or "No teletext". All parameters are then checked for **limit value overshoots.** Internal and external tolerance ranges can be set for this purpose. If these checks indicate that there has been a change since the last measurement, the measurement affected is repeated. If the second measurement confirms the change, a message is displayed on the monitors.

The number of limit value overshoots are counted for the purpose of **event statistics,** and the measurement results are saved. A first-time limit value overshoot results in a message. A hysteresis is inserted to prevent excessive frequency of messages.

As part of the **average value statistics,** a check is made for parameter overshoot of the previous maximum or undershoot of the previous minimum. The program uses the previous average and the new measured value to form the new average. The spread is also calculated for video parameters.

All statistics are **retrievable at any time.** One set of averages statistics comprises 100 measurement cycles, and the program creates event statistics for each new month. The measurement results are saved after 100 measurement cycles and remain available even after a power failure.

When the status of a checkpoint is modified, the program stores a **checkpoint record.** There are three possible statuses:

- no limit value overshoot
- internal tolerance range overshoot (one or more parameters)
- external tolerance range overshoot (one or more parameters)

If the status of a checkpoint again changes into a limit value overshoot, the PCF displays a message on its monitor. The terminal at the central station also displays a message.

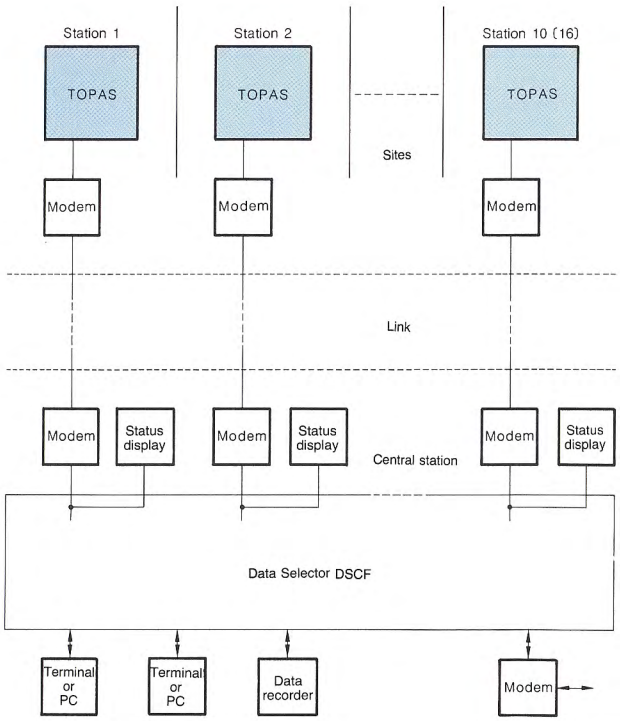
The PCF **monitor** also switches off automatically if it is not operated for a period of one hour.

System configuration and functional description

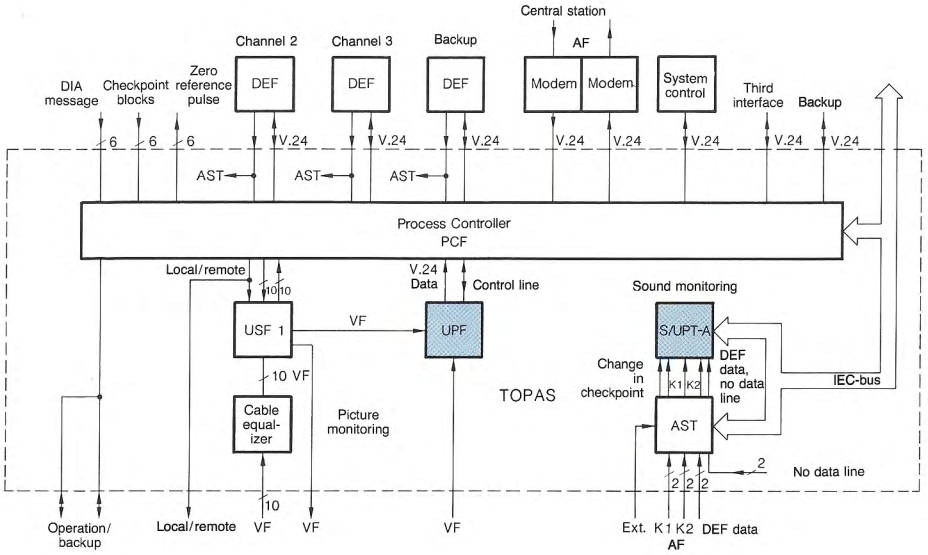
Configuration of monitoring systems Each **transmitter site** is equipped with a TOPAS system which is connected to the central station via a leased line. One pair of wires is used for transmitting data to the central station and another pair for sending commands to the site (see system overview).

The **central station** monitors several transmitter sites, each consisting of two or even three dual transmitters.

A Data Selector DSCF combines the monitoring results of a maximum of 16 sites. Measurement records can be displayed on two connected terminals or PCs for checking and documenting the system status. A permanent, simultaneous overview of the statuses of all connected sites and checkpoints is also provided on status decoders equipped with LED panels.



System overview



Block diagram of a TOPAS system at the transmitter site

Functional description of the TOPAS model shown on page 209 (see block diagram above) at the transmitter site. The maximum of 10 video and audio signals per transmitter are supplied on the rear panel of the rackmount and sent to the Checkpoint Selector USF 1 (video) and Audio Selector AST (sound 1/sound 2).

The Process Controller PCF is used to select the checkpoints at the USF 1 and AST and to **monitor the selection of the checkpoints.** Individual checkpoints can be excluded from automatic measurement by external loop locking, terminal commands and softkey operation, although they can continue to be requested. Only the signals of the checkpoints selected automatically or in dialogue are passed on for evaluation.

The **video signal** is through-connected on the Video Distortion Analyzer UPF (with slave unit) for the purpose of evaluation and can be extracted on the rear panel of the rackmount for further evaluation (normally terminated by a 75 Ω precision terminating resistor). Depending on the checkpoints, the UPF is set to the encoded operating values for video measurements. It also monitors the current operating values.

Depending on the checkpoints, a zero reference pulse is generated for the TV Demodulators AMF 2, which are allocated to the transmitters, in order to **measure the residual carrier** at the video level.

With the monitoring network – generally mounted on the rear panel of the Vision Transmitter Input Assembly UERF – **calibration of the UPF measured value transmitter rackmounts** can be monitored by means of comparison measurements.

The **audio signal** (sound 1/sound 2) from the AST is sent to the Audiodat Receiver UPT where it is analyzed and compared with the reference values.

The **measured values** from the UPF are sent to the PCF in the form of a serial data stream. Measured values received via the IEC-bus are buffered in the PCF where they remain until displayed on a terminal (in the central station or on site).

Depending on the checkpoints, the TOPAS system uses the measured values and the current operating values to form the **total site status.** It outputs a status word consisting of non-printable characters for the fault display as well as detailed records if required.

The TOPAS system normally operates in **remote mode;** ie data are sent to the central station via a modem, and commands are received from the central station. Individual on-site measurements are possible in the menu mode using the PCF softkeys.

TOPAS – Sound and ITS Monitoring Assembly

Operation

Softkey entry

When a softkey is pressed during automatic measurement, the title menu and main menu appear above the softkeys. The following items can be selected in the **main menu:**

- Measurement
- Statistics
- Operating parameter
- Status
- Setting
- Print
- Help
- Auto-cycle

– HELP is used to call up an overview of the possible softkey entries (see below).

– STATUS is used to display the total status of all the checkpoints.

The **sub-menus** are displayed by pressing a key:

"Measurement" menu

- Record
- Total record
- Source/section
- Others
- Previous record
- Return
- Auto-cycle

Example of a record The softkeys are used to set a checkpoint. Press RETURN to measure the checkpoint and display the record. The audio measurement is always performed in the centre frequency range.

```
MO: 04.02   MST01:      LEITUNG      30.06.88  9:06
Lfd.Nr: 1516  Fehl.Zeit: 8 Std 3 Min  Status: TOL-A

Videotextfehler
ABSCHNITT
WI     +6.1 %  RT      --.- %  FT     -5.3 %  SN   (+50.1)dB LZ    ( +49.0)ns
2T   ! -10.9 %  DG    (-38.4)%  DPH    -0.1 '  DG1    +0.1 %  DG2   ( -38.5)%
DPH1   +1.2 '  DPH2    -4.6 '  DS     +0.0 %  FAH    +0.1 %  I20T ( -22.9)%
F20T ( -2.5)%  VTA   (+62.4)%  VTP   (-20.3)%  VTS    +0.0 %

          Soll dBm      Ist dBm    Dif    dB
Ton1         -3.00        -3.00        +0.00
TonS         -3.00        -3.00        +0.00
Ton2         -3.00        -3.25        -0.25
```

"Statistics" menu

- Event statistics
- Average value statistics
- Return
- Auto-cycle
- Average value statistics output (automatic)

Example of event statistics Press a softkey to select the display of event statistics for either the previous or the current month, for either audio or video parameters and for either all or individual checkpoints (in the example given below are the video parameters for checkpoint 1 for the current month). Press RETURN key to display the statistics.

```
Ereignisstatistik MO:04.02   MST 1:      LEITUNG          30.09.87       VIDEO
von 01.09.87 00:00 bis 30.09.87 13:18  Anzahl der Messungen    32001
SYNC-FEHLT        0.00% MESSWERT-UNGUELTIG   0.31%          TOLERANZGRUPPE 1
KENNUNGSFEHLER    0.00% DATENZEILE FEHLT     0.00%
VIDEOTEXT FEHLT   0.00%
SUMME Gelb-A      3.96% SUMME Rot-A          0.07%

 PAR  !       TOL-I   !       TOL-A   ! PAR  !       TOL-I   !       TOL-A
 FAH  !        3.96   !        0.07   ! ---- !               !
```

```
Ereignisstatistik MO:04.02   MST 1:      LEITUNG          30.09.87        TON
von 01.09.87 00:00 bis 30.09.87 13:18  Anzahl der Messungen    32001
KEINE TONDATEN    0.00%                                    TOLERANZGRUPPE 1
SUMME Gelb-A      0.00% SUMME Rot-A          4.19%

 PAR  ! Messungen !  TOL-I  !  TOL-A  ! PAR  ! Messungen !  TOL-I  !  TOL-A
TON1-M!       534 !    0.19 !    0.19 !TONS-M!       539 !    1.67 !    0.56
TON2-U!       106 !    3.77 !    1.89 !TON2-M!       515 !    0.19 !    3.50
```

Example of average value statistics Softkeys are again used to select display of average value statistics for either the last 100 measurements or for the current measurement, for either audio or video parameters and for either all or individual checkpoints (in the example given below, video parameters of checkpoint 1 of the current month). Press RETURN to display the statistics.

```
Mittelwertstatistik MO:04.02    MST: 1       LEITUNG    28.09.87         VIDEO
von 11:40 bis 13:19 Anzahl der Messungen 50

 PAR  !  MW   ! MIN   ! MAX   ! STRW. ! PAR  !  MW   ! MIN   ! MAX   ! STRW.
 WI   !   4.7!    0.5!   42.5!    5.6! RT   ! ----- ! ----- ! ----- ! -----
 FT   !  -0.2!   -0.3!    0.0!    0.1! SN   !   75.9!   75.4!   78.7!    6.6
 LZ   ! -14.1! -23.0!   -9.0!   -5.3! 2T   !    0.3!    0.2!    0.4!    0.2
 DG   !   0.1!    0.1!    0.1!    0.0! DPH  !   -0.4!   -0.5!   -0.1!    0.0
 DG1  !   0.1!    0.1!    0.1!    0.0! DG2  !    0.0!    0.0!    0.0!    0.0
 DPH1 !   0.0!    0.0!    0.0!    0.0! DPH2 !   -0.4!   -0.5!   -0.1!    0.0
 DS   !   0.0!    0.0!    0.0!    0.0! FAH  !    0.0!    0.0!    0.1!    0.0
 I20T !  -34.5! -51.4!   -1.5!    3.4! F20T !  -33.8!  -48.1!   -1.7!    3.6
 VTA  !  89.1!   84.1!   93.9!    1.6! VTP  !   -1.1!   -6.1!    1.4!    1.3
 VTS  !  -3.5!   -6.5!    1.7!    1.7!      !        !       !       !
```

"Operating parameter" menu

- Computer data
- Block checkpoint
- Block parameter
- Time/date
- Others
- Video/sound
- Return
- Auto-cycle

"Status" menu

A status table showing all checkpoints, for example, is displayed in the following form:

```
MO: 06:08   28.09.87 16:33          VIDEO

  MST   1  2< 3  4  5  6  7  8  9 10
TOL-A
TOL-I
SYNC-F
MW-UNG
P-GESP  *  *  *  *  *  *  *  *  *  *
M-GESP        *  *  *  *  *  *  *  *


MO: 06:08   28.09.87 16:33            TON

  MST   1  2< 3  4  5  6  7  8  9 10
TOL-A
TOL-I
DATZ-F
MW-UNG
P-GESP
M-GESP     *  *  *  *  *  *  *  *  *
```

Explanation of abbreviations:

MST	Checkpoint
TOL-A	External limit value overshoot
TOL-I	Internal limit value overshoot
DATZ-F	No data line
SYNC-F	No sync signal
MW-UNG	Invalid measured value
P-GESP	Parameter blocked
M-GESP	Checkpoint blocked

The **VIDEO or SOUND status message** is sent if there is an error in one of the following operating units:

VIDEO	SOUND	
UPF Master	Audio selector	(AST)
UPF Slave	Audiodat receiver	(S/UPT-A)
Video selector		

of one of the allocated data line decoders

The **TOL-A message** is sent for VIDEO or SOUND
- if at least one video or audio parameter overshoots an external limit value
- if there are identification errors (if there is no substitute line)
- if there is no data line.

The **TOL-I message** for VIDEO or SOUND appears if at least one video or audio parameter overshoots an internal limit value and there is no TOL-A.

An **invalid SOUND measured value** is signalled
- if there are identification errors
- if there is a data line decoder error
- if there is no Audiodat transmitter
- if there is a data error in the Audiodat receiver.

"Setting" menu

- RS232
- Checkpoints
- Tolerance groups
- Help
- Others
- Return
- Auto-cycle

Example of a tolerance group display Softkeys are used to select the tolerance group to be displayed. The table of internal and external limit values with hysteresis is displayed. A video tolerance table is given as an example.

```
GRENZWERT TABELLE          V.4.0 STAND:     VOM 13.07.86                VIDEO
TOL.GRUPPE 1 (LEITUNG/ALT)
!       !     TOL-A (HYST)!    TOL-A (HYST)!    TOL-I (HYST)!    TOL-I (HYST)!
!WI    % !   -30.0    5.0 !    30.0   -5.0 !   -10.0    2.5 !    10.0   -2.5 !
!RT    % !  -100.0    0.0 !   100.0    0.0 !  -100.0    0.0 !   100.0    0.0 !
!FT    % !   -30.0    4.0 !    30.0   -4.0 !   -18.0    3.0 !    18.0    3.0 !
!SN    dB!    42.0    5.0 !   100.0    0.0 !    54.0    2.5 !   100.0    0.0 !
!LZ    ns!   120.0   10.0 !   120.0  -10.0 !   -90.0   10.0 !    90.0  -10.0 !
!2T    % !   -20.0    3.0 !    20.0   -5.0 !   -10.0    2.0 !    10.0   -2.0 !
!DG    % !   -15.0    3.0 !    15.0   -3.0 !   -10.0    1.5 !    10.0   -1.5 !
!DPH   ' !   -15.0    3.0 !    15.0   -3.0 !   -10.0    1.5 !    10.0   -1.5 !
!DG1   % !    -5.0    3.0 !    15.0   -3.0 !    -2.0    1.5 !    10.0   -1.5 !
!DG2   % !   -15.0    3.0 !     5.0   -3.0 !   -10.0    1.5 !     2.0   -1.5 !
!DPH1  ' !    -5.0    3.0 !    15.0   -3.0 !    -2.0    1.5 !    10.0   -1.5 !
!DPH2  ' !   -15.0    3.0 !     5.0   -3.0 !   -10.0    1.5 !     2.0   -1.5 !
!DS    % !    -8.0    1.0 !     8.0   -1.0 !    -5.0    0.5 !     5.0   -0.5 !
!FAH   % !    -8.0    1.0 !     8.0   -1.0 !    -6.0    0.5 !     5.0   -0.5 !
!I20T  % !   -12.0    2.0 !    12.0   -2.0 !   -10.0    1.0 !    10.0   -1.0 !
!F20T  % !   -30.0    4.0 !    30.0   -4.0 !   -16.0    2.0 !    16.0   -2.0 !
!VTA   % !    50.0    5.0 !   100.0    0.0 !    70.0    2.5 !   100.0    0.0 !
!VTP   % !   -20.0    3.0 !    20.0   -3.0 !   -10.0    2.0 !    10.0   -2.0 !
!VTS   % !   -30.0    5.0 !    30.0   -5.0 !   -10.0    2.5 !    10.0   -2.5 !



GRENZWERT TABELLE          V.4.0 STAND:     VOM  1.11.86                 TON
TOL.GRUPPE 2 (LEITUNG/NEU)
!          ! TOL-A (HYST)!    TOL-A (HYST)!    TOL-I (HYST)!    TOL-I (HYST)!
TON1-U dBm !-13.0    2.0 !    13.0   -2.0 !   -10.0    2.0 !    10.0   -2.0 !
TON1-M dBm ! -7.0    1.0 !     7.0   -1.0 !    -3.5    1.0 !     3.5   -1.0 !
TON1-O dBm ! -5.0    0.5 !     5.0   -0.5 !    -2.5    0.5 !     2.5   -0.5 !
TONS-U dBm !-13.0    2.0 !    13.0   -2.0 !   -10.0    2.0 !    10.0   -2.0 !
TONS-M dBm ! -7.0    1.0 !     7.0   -1.0 !    -3.5    1.0 !     3.5   -1.0 !
TONS-O dBm ! -5.0    0.5 !     5.0   -0.5 !    -2.5    0.5 !     2.5   -0.5 !
TON2-U dBm !-13.0    2.0 !    13.0   -2.0 !   -10.0    2.0 !    10.0   -2.0 !
TON2-M dBm ! -7.0    1.0 !     7.0   -1.0 !    -3.5    1.0 !     3.5   -1.0 !
TON2-O dBm ! -5.0    0.5 !     5.0   -0.5 !    -2.5    0.5 !     2.5   -0.5 !
```

"Print" menu

Press the PRINT key to switch the printer interface on and off on the front panel of the Process Controller PCF. It can be used to print out records, statistics, tolerance tables, etc., on site.

"Help" menu

Softkeys are used to provide the following overview of the possible entries:

```
MESSUNG:
              Protokoll     Gesamtprotokoll      Alte Protokolle
              ANDERE: Differenz Auswahlparameter Frequenzgang

STATISTIK:
              Ereignisstatistik            Mittelwerstatistik
              Neuer und alter Monat        Letzter und aktueller Mittelwert

              automatische Mittelwertstatistikausgabe

BETRIEBSPARAMETER:
              Computerdaten    gesperrte      gesperrte   Zeit/Datum
                               Meßstellen     Parameter
              ANDERE: Ortsbetrieb   Testen

STATUS:       Tabelle ueber den Zustand aller Meßstellen

EINSTELLUNG:  RS232   Meßstellen   Toleranzgruppen

DRUCKE:       Protokolle, Statistiken, Toleranzgruppentabellen u.s.w werden
              ausgedruckt

AUTOZYKLUS:   Rueckkehr in den automatischen Meßstellenzyklus
```

TOPAS – Sound and ITS Monitoring Assembly

Entering commands via the terminal
from the central station

The automatic checkpoint cycle and softkey operation at the transmitter site can be interrupted by entries in the terminal at the central station. The TOPAS system then signals that it is ready for operation. If no command is sent to the measurement system for a period of 50 seconds, it automatically returns to the automatic checkpoint cycle and sends a corresponding message to the central station.

The following **commands** can be called up by the central station (summary):

1. **Automatic average values statistics display** switches the average value statistics display function on or off for a checkpoint; ie the average value statistics are available at the terminal or interface after every 100 measurements at a checkpoint.
2. **Selection parameter** results in the measurement of only one group of parameters.
3. **Set computer data** switches on the operating mode with the checkpoint records in a compressed form.
4. **Request and set date** displays the date and enables date corrections.
5. **Set data line** assigns the TV Data Line Decoder DEF to a checkpoint.
6. **Assign DIA transmitter** assigns a DIA transmitter to a checkpoint.
7. **Differential measurement** performs differential measurements at two checkpoints and subtracts the results of the checkpoint specified second from those of the one specified first.
8. **Total event statistics** displays all the event statistics.
9. **Terminate terminal entry** resets the program to the automatic measurement cycle.
10. **Event statistics** calls up a specific set of event statistics for a specific checkpoint.
11. **Frequency response measurement** provides a measurement for the corresponding rackmount in the Audiodat Receiver S/UPT-A.
12. **List all installed commands** displays all the commands and command descriptions to the operator.
13. **Set identification** sets the identification of a data line with main and sub-identification for a checkpoint.
14. **Request communication interfaces** displays the serial interfaces of the PCF in the TOPAS system.
15. **Drive LEDs** switches the sequence on and off to drive the LED decoder panel.
16. **Total average value statistics** displays all the average value statistics.
17. **Message at interface** specifies at which interfaces the automatic messages are to be sent.
18. **Average value statistics** calls up the average value statistics of a specific checkpoint.
19. **Set type of checkpoint** determines the type of checkpoint, line, substitute line or transmitter.
20. **Release checkpoint** releases a checkpoint for measuring.
21. **Block checkpoint** blocks measurements at a checkpoint.
22. **Checkpoint designation** designates a checkpoint.
23. **Restart** restarts the system.
24. **Set zero reference pulse** assigns a zero reference pulse to a checkpoint.
25. **Release parameter** releases one or more blocked parameters of a checkpoint for measuring.
26. **Block parameter** blocks measurements for one or more parameters of a checkpoint.
27. **Total record** reads out a record for any checkpoint after a measurement cycle.
28. **Record** reads out a record for a checkpoint after measurement. Source or section can be selected for video measurements.
29. **Status display** displays the status table of all checkpoints.
30. **Set steps** determines for a checkpoint whether the differential distortions are measured in four or five steps.
31. **Test** checks all detected equipment.
32. **Set tolerance group** assigns a tolerance table to a checkpoint.
33. **Display tolerance table** displays the contents of a tolerance table in the terminal.
34. **Release sound measurement** releases a checkpoint for audio measurement.
35. **Block sound measurement** blocks audio measurement at a checkpoint.
36. **Select test line** determines the source and section test line for a checkpoint.
37. **Display and set time** requests the time and enables time corrections.

Specifications

Video measurements

VF inputs	10 (16)
Connector system	4/13 (BNC)
Input level	V_{pp} = 1 V
Characteristic impedance	75 Ω
Equalization	cable equalizer for cable with max. length of 160 m
Return loss	>30 dB (up to 6 MHz)
Crosstalk attenuation	>60 dB (up to 6 MHz)
Gain after on-site tuning	0 dB ±0.2 dB
Included equipment	series configuration consisting of test cable, equalizer and checkpoint selector

Inputs for automatic checkpoint blocking	3 × 2 (RF-OFF)
Assignment to VF inputs	using software
Control	using floating contact
Checkpoint blocking	contact made
Connector system	7-contact flange-type mini-receptacle for 2 inputs each

Outputs for zero reference control pulse	3 × 2
Assignment to VF inputs	using software
Level and polarity	internally encodable, 0 to 4 V and 0 to 1 V at 75 Ω
Connector system	BNC

VF outputs

Output 1	from USF 1/VSF
Output 2	from UPF (terminated at 75 Ω)

Audio measurements

AF inputs	10 × 2 (16 × 2)
Input level	+6 dBm (nominal value)
Connector system	3-contact flange-type mini-receptacles (to DIN standards)
Input impedance	>20 kΩ
Crosstalk attenuation	>80 dB (up to 20 kHz)

Data inputs	10 (16)
Input level	TTL level for S/UPT-A
Signal type	serial message
Data transmission rate	25 Baud (1 bit/frame; from TV Data Line Decoder DEF)
Data contents	AF measurement values (left/sound 1, right/sound 2, composite level)
Synchronization	direct from message

Other data

Serial interfaces

Connector system	25-contact, Cannon	
Interfaces	Main station	DTE
	System computer	DCE
	Third RS-232-C	DTE
	Transmitter 1	DTE
	Transmitter 2	DTE
	Transmitter 3	DTE
	Backup	DCE
	UPF	20 mA
Data characteristics (to main station) and control signals (from central station)	depending on user modem (AGT)	
Other system features	see catalog pages for UPF, VSF, USF 1, UPT and AST	

General data

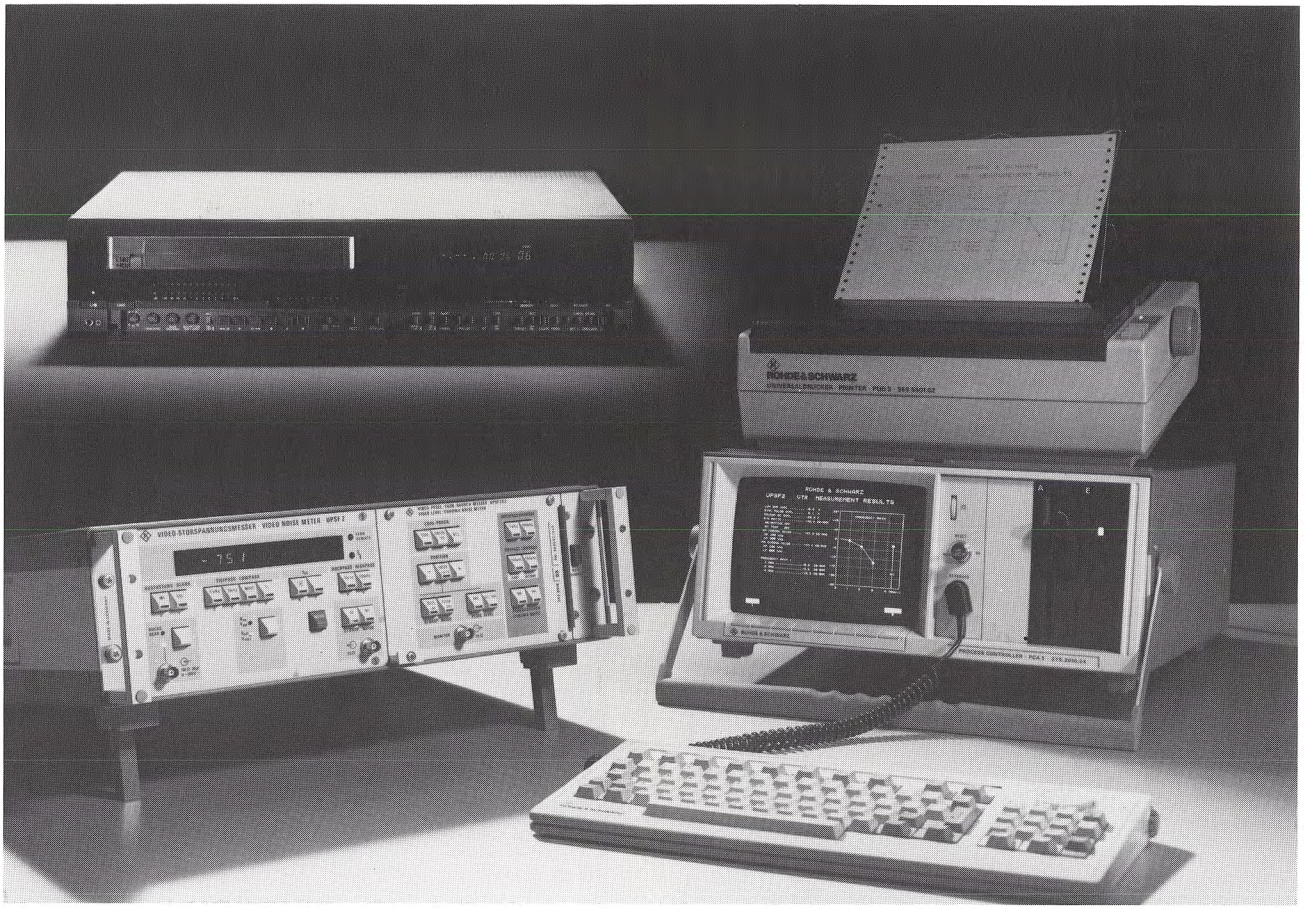
Rated temperature range	+5 to +40 °C
Operating temperature range	0 to +45 °C
Storage temperature range	−40 to +70 °C
Cooling	convection
Power supply	220 V, 50 Hz (400 VA)
Connector	Euro-type connector
Dimensions (W×H×D)	483 mm × 845 mm × 600 mm
Weight	85 kg

Ordering information

Order designation ▶ Sound and ITS Monitoring Assembly TOPAS

Please specify the monitoring design and the required components in your enquiries.

new



Automatic video test system with Video Noise Meter UPSF 2 (bottom left), Process Controller PCA 5 and Universal Printer PUD 3 (right)

IEC 625 Bus

Video test system with Video Noise Meter UPSF 2 and computer

- Independent test system with generator and analyzer
- For random sample measurements in development and quality assurance

In the designing of automatic test systems for use in the production of electronic equipment, a distinction is made between quality control on all items progressing on the assembly line and control on random samples.

Measurements on the assembly line To test all items, representative parameters must be measured within the progression time of the assembly line. Today, these item progression intervals are considerably shorter than one minute.

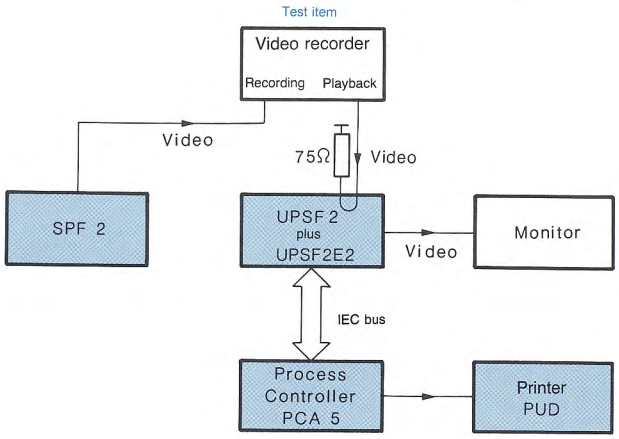
Rohde & Schwarz has included the video recorder Test System 6010 in its product range (see measuring equipment catalog). Thanks to its short measurement time (typically 10 s) and its capability of performing statistics, it is ideal for use in the assembly line or goods-outward inspections.

Random sample measurements The video test system depicted here for quality assurance is used to test random samples. With its test parameters and a measurement time of about 4 minutes, it was designed for the comprehensive quality control of selected samples.

The measuring time is not so significant for quality control of random samples in development and quality assurance, however a comprehensive test report is expected with precise information about the differences in quality of the products.

Using a single instrument (UPSF 2) – for an extra low-cost solution – an appropriate test signal yields clear information on all the essential **video parameters** of a recorder, ie:

- luminance-bar amplitude,
- sync-pulse amplitude,
- colour-subcarrier amplitude,
- luminance noise voltage,
- chroma noise (AM and φM components),
- frequency response at 1, 2 and 3 MHz.



Configuration of video test system using Video Noise Meter UPSF 2 + Video Level/Chroma Meter UPSF2E2 and Video Test Signal Generator SPF 2

Test setup (diagram above) The versatile Video Noise Meter UPSF 2 with its plug-in Video Level/Chroma Noise Meter UPSF2E2 is used for measuring operations; the Video Test Signal Generator SPF 2 supplies the test signal.

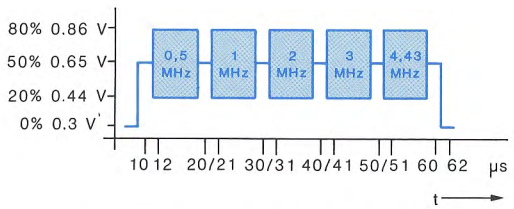
Test signals The SPF 2 supplies a special multiburst signal for measuring the frequency response (diagram below); in addition to the red area, the CCIR 17 and CCIR 331 test signals are used to evaluate the other parameters. These signals are provided twice at a spacing of two lines, so that vertical post-filtering in the chroma channel of the video recorders can be taken into account.

Column T (top) in the table on the right shows the coding of the test signals in the field-blanking interval. A slight modification of the signal generator ensures that the line range coded in this way is repeated over the complete field at a spacing of 16 lines. It is therefore possible to measure in the centre and at the lower edge of the screen.

Test run The test run is controlled by the IEC-bus controller using the "UPSF 2" test routine which is available for the Process Controllers PUC and PCA 5. To check the signal coming from the video recorder, it is best to use a monitor which indicates the precise location of the checkpoints on the screen.

After the program is started, the following **can be selected** from the menu:

- selection of parameters to be measured
- filter settings for noise measurement
- picture region (top, centre, bottom) in which the measurement is to be performed



Modified multiburst signal supplied by Video Test Signal Generator SPF 2

The settings are stored on the program floppy and automatically loaded each time the program is started.

Prior to the measurement the video recorder to be checked records the test signals: first the all-red picture (about 30 s) for chroma-noise measurement and then the special signal (about 3 min) with the modified multiburst for analyzing all the other parameters.

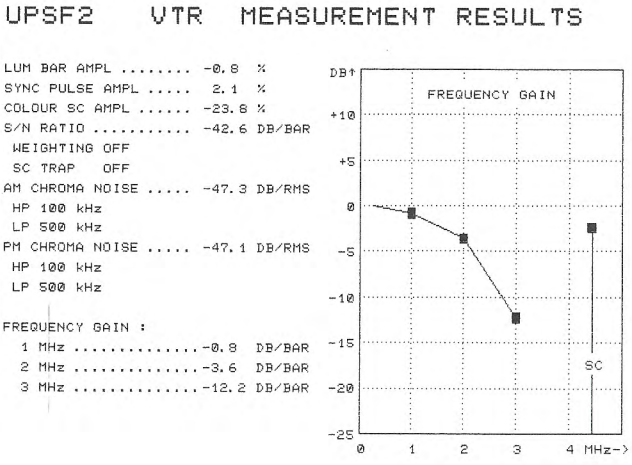
It is possible to start the test program while the test signals are being recorded to evaluate the behaviour of the recorder in the E/E mode during which the signal only passes through the electronic circuitry and is not recorded on the tape. The test program evaluates overall recorder quality when the tape is played back.

Test value output All the test results are displayed on the screen at the end of the measurement and can be printed out in the form of a report (shown bottom right) by the Universal Printer PUD 3.

1. Halbbild				2. Halbbild			
Zeilen-Nr.			Signal	Zeilen-Nr.			Signal
O	M	U		O	M	U	
7	151	279	----------	320	464	592	----------
8	152	280	Multiburst	321	465	593	----------
9	153	281	Multiburst	322	466	594	----------
10	154	282	Multiburst	323	467	595	----------
11	155	283	Multiburst	324	468	596	----------
12	156	284	Multiburst	325	469	597	----------
13	157	285	Multiburst	326	470	598	----------
14	158	286	Multiburst	327	471	599	Rotbalken
15	159	287	Multiburst	328	472	600	----------
16	160	288	Multiburst	329	473	601	Rotbalken
17	161	289	CCIR 17	330	474	602	----------
18	162	290	----------	331	475	603	----------
19	163	291	CCIR 17	332	476	604	CCIR 330
20	164	292	----------	333	477	605	CCIR 331
21	165	293	----------	334	478	606	----------
22	166	294	----------	335	479	607	----------

O = Oben M = Mitte U = Unten

Composition of test signal



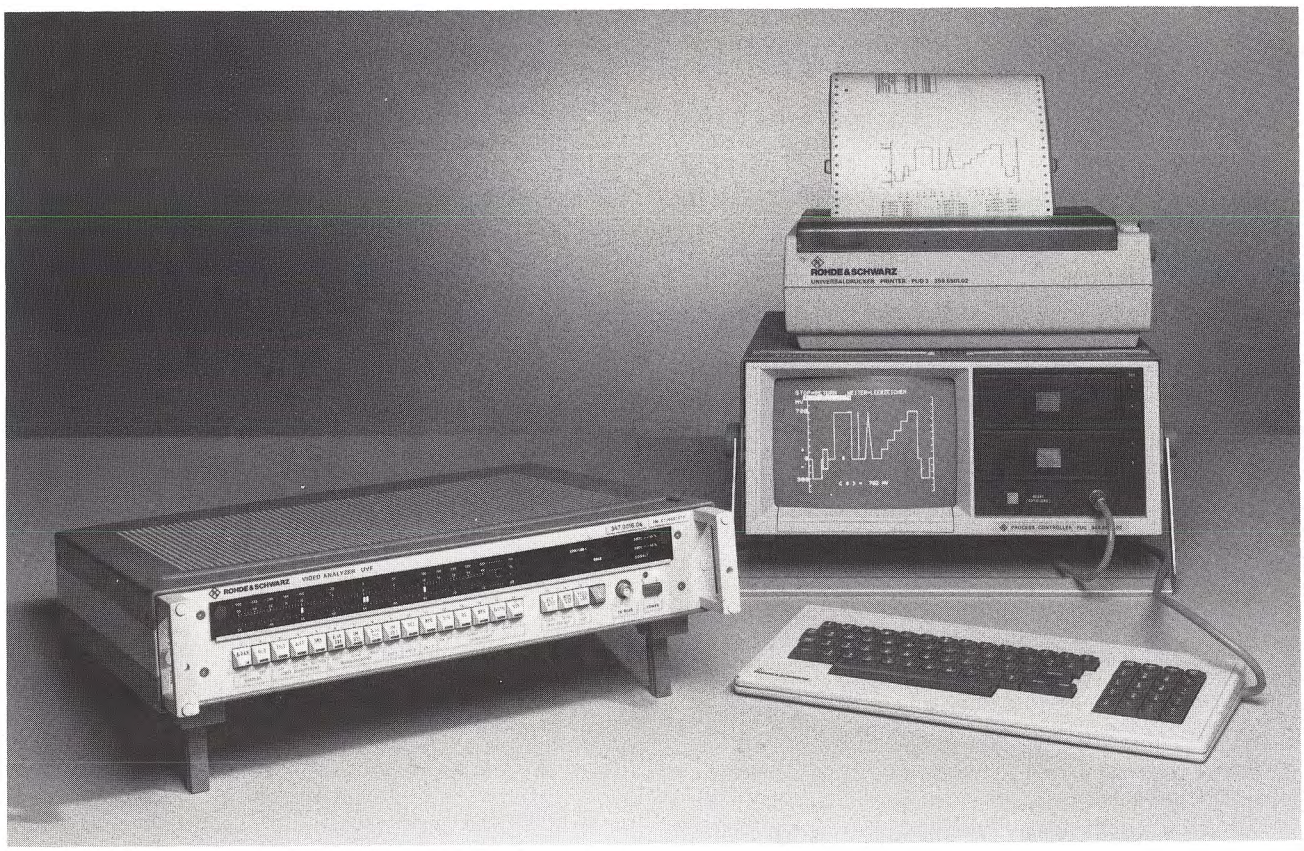
MEASUREMENT ON CENTRE PART OF SCREEN

MEASURED VTR : TEST UNIT

MODE : REPLAY

DATE/TIME : 09-16-87 / 10:53

Printout of VTR measurement



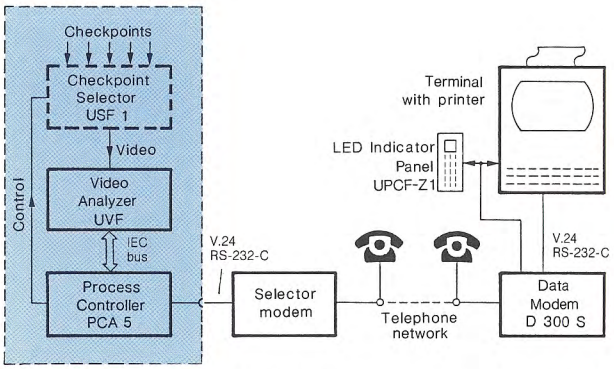
Automatic video test system with Video Analyzer UVF (left) and Process Controller with printer (right)

IEC 625 Bus

Video test system with Video Analyzer UVF and computer

- Automatic video measuring system for 16 fixed parameters
- Suitable for central monitoring tasks

The low-cost Video Analyzer UVF permits configuration of flexible video test systems with computer control similar to those using the Video Distortion Analyzer UPF and the Video Noise Meter UPSF 2 (see preceding pages). The UVF evaluates 16 test-line parameters and indicates the measured data on a quasi-analog bar display. It is fitted with an IEC-bus interface.



Block diagram of an automatic video test system with Video Analyzer UVF, Process Controller PCA 5 and Checkpoint Selector USF 1 (left) as part of a central monitoring system (data transmission via public telephone network possible)

Computer The Process Controller PCA 5 from Rohde & Schwarz (see measuring instruments catalog) is ideally suited for use in systems. It features

- 16-bit processor,
- 256-kbyte RAM with parity error detection and
- high-resolution graphics with 640×400 dots.

Program writing The program is written in extended BASIC; softkeys facilitate programming.

Memory A maximum of two floppy-disk drives, each with 640 kbytes, or one floppy-disk drive and one Winchester drive with a capacity of 13.3 Mbytes may be accommodated in the PCA 5.

Interfaces IEC-bus interface and connector for a printer (e.g. Rohde & Schwarz Universal Printers PUD 2 or PUD 3) are fitted as a standard. A second IEC-bus interface and an interface to V.24/RS-232-C (may also be used as 20-mA interface) can be retrofitted.

Universal applications Video test systems with the UVF can not only be used in laboratories and production testing, but also within a central monitoring system at a transmitter site (diagram left). By using the corresponding software for data transmission (see following paragraph) these systems may be operated at practically any site or at fixed stations. Status indication on the LED Indicator Panel UPCF-Z1 in the central station is also possible with the aid of the software.

Data transmission The software of the system can be designed for the use of a dedicated remote control line or of a selector modem which permits the connection to be established via the public telephone network for the duration of the transmission only. This means: if a limit value of the parameters monitored by the UVF is exceeded, the computer establishes the connection to the central monitoring station via the modem and interrupts it after transmission of the buffered measured values (thus cutting down the costs considerably).

difference of two signals with a maximum error of a nanosecond without using a special test signal.

Measuring accuracy Since the inherent errors of the system are measured in a loop test (measuring instruments loop) the measuring accuracy is considerably enhanced.

Control The computer of the system controls the signal generation, the test channel selection and the evaluation via a Code Converter PCW as well as logging on a printer. Program-controlled switching on the test items via the IEC-bus taken to the junction panel is also possible.

IEC 625 Bus

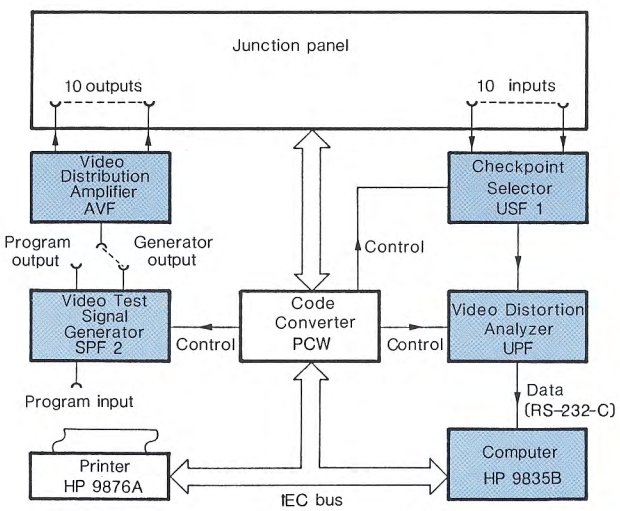
Mobile TV test system

- Independent measuring system with generator and evaluation section
- Maximum of 10 checkpoints

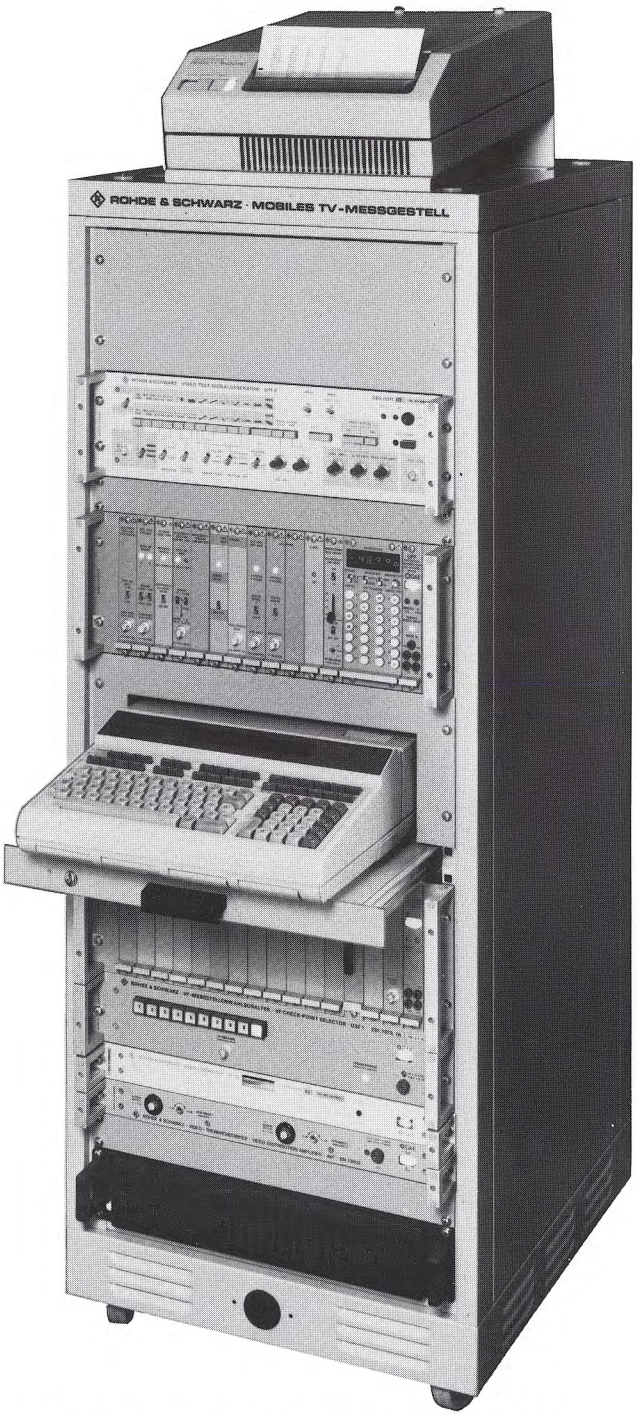
Based on the combination of the Video Distortion Analyzer UPF with a computer (see preceding pages), a mobile video test system for automated testing of individual units (e.g. recorders) and for automatic checking of complete signal paths with a maximum of ten checkpoints has been developed. It can be used in studios and TV switching stations and is fully independent due to the built-in signal source.

Signal generation The Video Test Signal Generator SPF 2 is used as signal source, permitting generation of full-field signals and insertion of test signals into an on-going program signal. The SPF 2 is followed by a Video Distribution Amplifier AVF which distributes the generator or the program signal to a maximum of ten test channels.

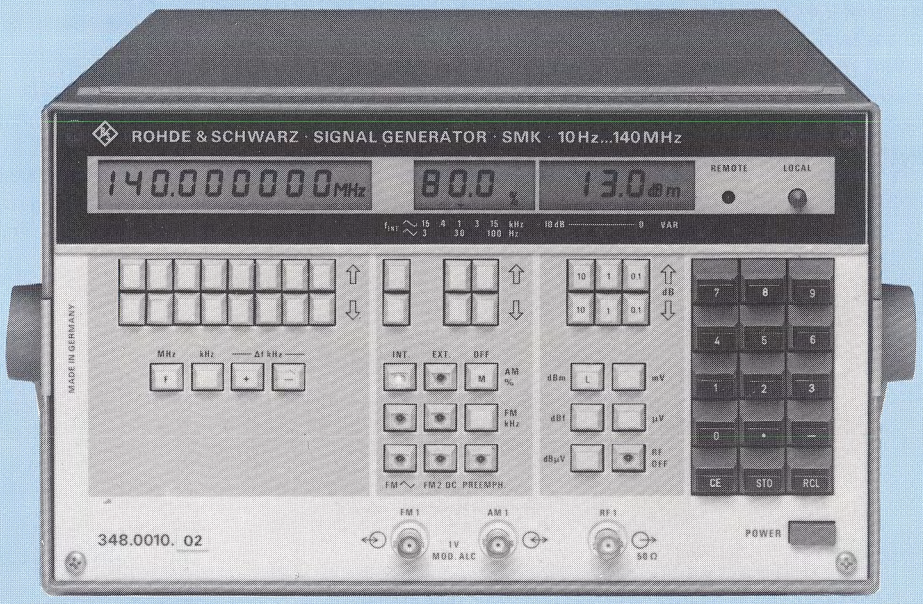
Evaluation The Video Distortion Analyzer UPF, which evaluates the test channels, can be fitted with plug-in modules as required for the measurements. The 20T absolute-delay-time module permits a comparison of the absolute time



Block diagram of mobile TV test system



Mobile TV test system for universal use in studios and switching stations

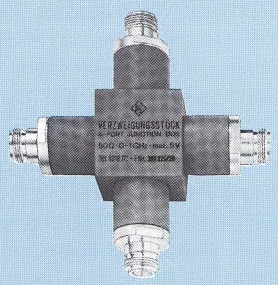


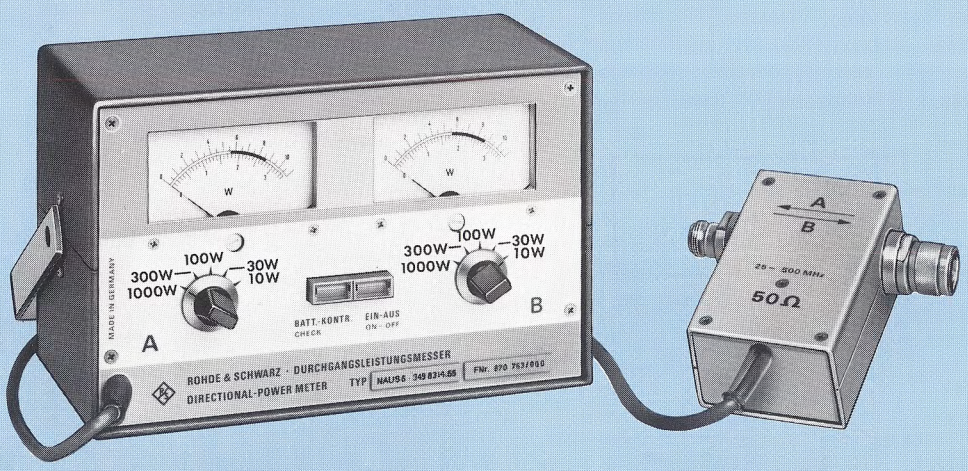
Above:
Signal Generator SMK (see page 222)

Right:
Junction Box DVU 4 (see page 287)

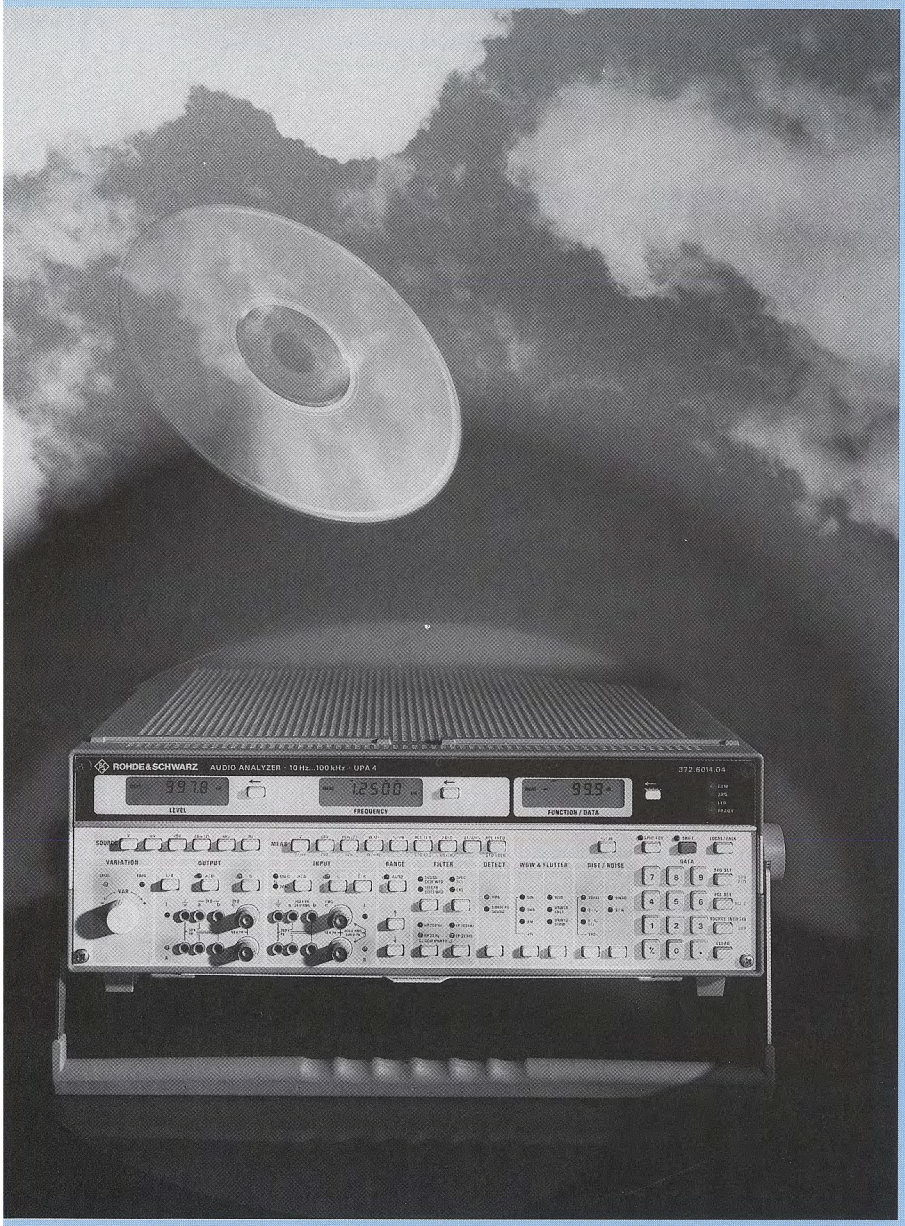
Below:
Directional Power Meter NAUS 6 (see page 250)

Right-hand page:
Audio Analyzer UPA 4 (see page 232)





peripherals connectors

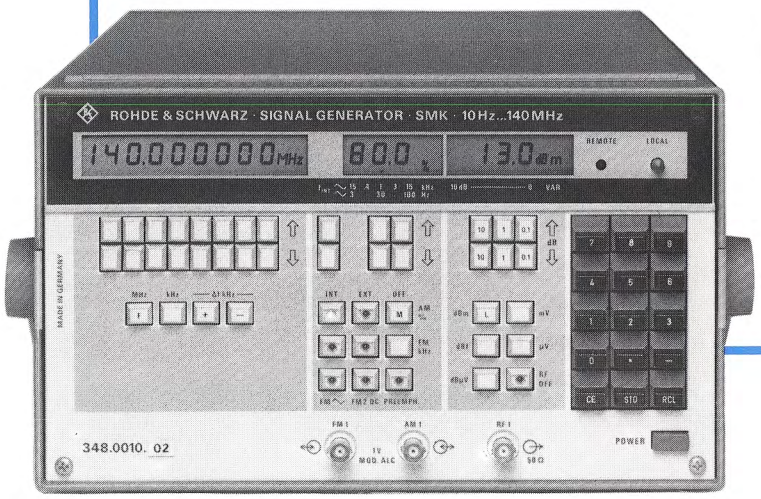


This section presents generators, modulation meters, power meters, sweep testers and accessories for use in the frequency ranges of VHF sound broadcasting and TV transmission. Information on other test equipment is given in the R&S measuring instruments catalog.

The connectors described provide solutions to most of the interconnection problems encountered in this field.

SMK

Signal Generator SMK ♦ 10 Hz to 140 MHz



- High frequency stability and resolution (1 Hz)
- Low spurious FM: <1 Hz in accordance with CCITT
- Output level 0.025 µV to 2 V into 50 Ω
- Large variety of modulation modes: 2-tone AM, 2-tone FM, AM+FM, AC/DC
- Low modulation distortion (0.02% with FM)
- Input for generating SSB test signals
- Nonvolatile storage of 40 instrument settings
- IEC-bus-compatible for all functions

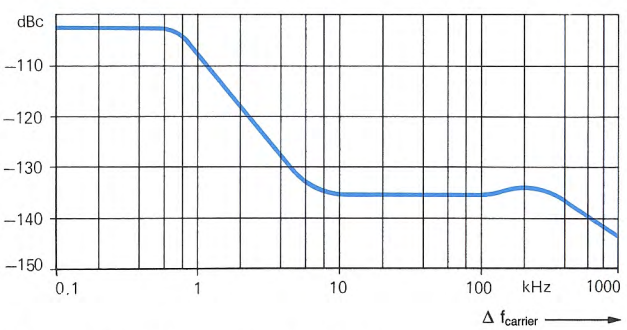
IEC 625 Bus

Characteristics, uses

The **Signal Generator SMK** is a fully programmable AM-FM synthesized generator covering continuously the frequency range from 10 Hz to 140 MHz. It contains AF sources for internal modulation and frequency sweeping.

These features as well as its frequency resolution, signal quality and modulation capability qualify the Signal Generator SMK for all measurements on **shortwave receivers** – including SSB equipment – and on AM and **hifi FM sound broadcasting receivers.** Stereo crosstalk for instance is down 60 dB.

The SMK is extremely convenient to operate and protected against incorrect settings, see right-hand column. Levels can be set in µV, mV, dBµV and dBm as well as in dBf (reference: femto watt = 10^{-15} W). Moreover, a comprehensive **self-test** of the synthesizer functions is possible; any errors are read out on the display.



Typical values of SSB phase noise, f = 120 MHz

Thanks to the **programmability** of all functions via the IEC bus (IEC 625-1 and IEEE 488), the SMK can be used in semi-automatic or fully automatic test assemblies.

Ease of operation

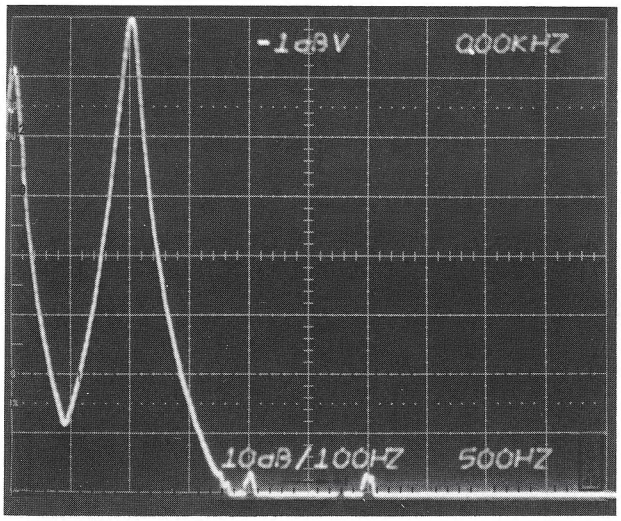
- Clear arrangement of the front panel by splitting up the keyboard and display into sections for frequency, modulation and level.
- Keyboard entries in the normal order – numerical value plus unit.
- Direct digital readout, high resolution and automatic shift of decimal point.
- Easy variation of all settings; frequency, modulation and level can be varied with the ⇧ and ⇩ keys. The settings are changed either in single steps or rapidly by holding the key down.
- Upward or downward change of frequency in steps of any size using the Δf kHz keys.
- The level can be read out in any of five units.
- Stored settings: Whenever the modulation, the level (RF OFF) or the instrument itself is switched off, the settings remain stored and are read out automatically upon power up. Independently 40 instrument settings can be stored in the nonvolative memory.
- Incorrect entries are not accepted by the instrument; the display section involved blinks to signal an erroneous setting.

Technical data

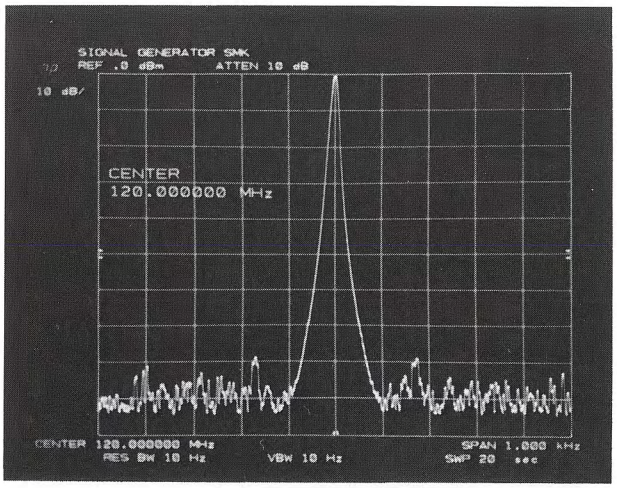
Frequency The frequency range covers 10 Hz to 140 MHz. The high resolution of 1 Hz permits measurements on SSB receivers and narrowband test items. Instead of the internal frequency standard, an external control frequency of 1, 5 or 10 MHz can be used.

Level The output level, which can be set in 0.1-dB steps from −138.9 to +19 dBm, is read out in four digits in µV, mV, dBµV, dBm or dBf. The level can be varied in steps of 10 dB, 1 dB and 0.1 dB. The 0.1-dB level variation is carried out without interruption of the RF level over a range of 20 dB, a characteristic that is indispensable for squelch measurements.

Spectral purity The output signal is of high spectral purity. The nonharmonic spurious signals (including power-related and microphonic spuria) are typically down more than 75 dB from the carrier level. The SSB phase noise at 20 kHz from the carrier is 135 dBc down for a bandwidth of 1 Hz. Thus the spurious FM remains extremely low, being <3 Hz for a test bandwidth of 30 Hz to 20 kHz. Thanks to this high spectral purity, the SMK can be used for all critical adjacent-channel measurements and measurements on SSB receivers.



Typical FM harmonic distortion at 100 kHz deviation and f_{mod}=1 kHz; resolution: 500 Hz/div., 10 dB/div.



Signal quality close to carrier (suppression of hum and microphonic sidebands); resolution: 100 Hz/div., 10 dB/div.

Modulation The Signal Generator SMK provides low-distortion, broadband AM and FM, both modes being adjustable in fine steps. The versatile modulation capability includes 2-tone AM, 2-tone FM, simultaneous AM and FM, sweeping with internal or external deflection signal as well as AC and DC coupling for all modulation modes.

To connect external modulation sources, the SMK is fitted with two inputs for AM and for FM. For 2-tone modulation and simultaneous AM and FM, either the internal and an external or two external modulation sources can be used. AM and FM can be adjusted independently even with simultaneous AM and FM.

(Internal) modulation generators The internal SMK modulation sources are provided by

- a generator producing low-distortion sinewave signals of 150/400 Hz, 1/3/15 kHz and
- a generator producing linear triangular sweep signals of 3/30/100 Hz.

External modulation/coupling One modulation input each for AM and FM (AM1 and FM1) is equipped with automatic level control. This level control facility ensures that the frequency deviation and modulation depth remain within the specified tolerances over a wide range of the modulation rms voltage (between 0.5 and 2 V).

The AM modulation input AM2 is DC-coupled, the FM modulation input FM2 can be switched to AC or DC coupling.

Pilot tone input FM3 A separate pilot tone input permits variation of the stereo signal deviation while holding the pilot tone constant.

AM DC The AM DC mode permits voltage-controlled variation of the signal amplitude. It is used when the signal generator is to be operated in an ALC loop with an external probe.

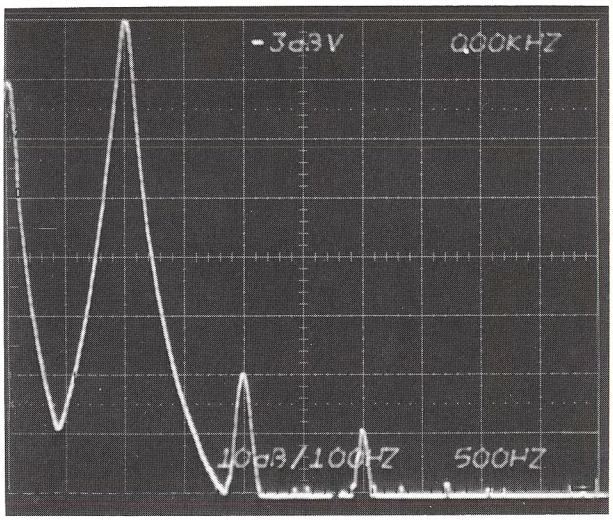
FM DC DC coupling is required for FSK modulation. A further application in conjunction with the Vector Analyzer ZPV is the determination of crystal resonances in a test assembly which is self-tuning with the aid of a phase-locked loop. DC coupling permits sweep operation with an external triangular or sawtooth voltage. With FM DC an internal frequency counter ensures correct frequency indication; the frequency can be read out via the IEC bus.

SMK

Sweep Sweeping can be controlled either by the internal triangular signal source or by an external signal via the FM2 input with DC coupling enabled. In both cases, the sweep width (max. ±500 kHz) can be selected from the keyboard.

Uses Thanks to the extremely low spurious FM of the SMK and its high frequency stability, sweeping of crystal and ceramic filters with extremely steep skirt selectivity is possible in addition to sweeping of tuned circuits, FM demodulators, IF amplifiers or IF filters.

FM and AM characteristics The wide FM range up to 100 kHz with small phase variation permits high-quality stereo modulation plus transmission of the 57-kHz auxiliary carrier for traffic radio identification. With an inherent distortion factor of less than 0.1%, the SMK is ideal for all distortion measurements on VHF receivers. Amplitude modulation is possible without restriction down to the lowest carrier frequency. Thus measurements in the low-frequency and AM IF ranges can also be performed with full capability. The extremely low AM distortion of typically only 0.2% permits measurements on high-quality AM receivers.



Typical AM distortion with m = 80% and f_{mod} = 1 kHz

Overvoltage protection The overvoltage protection fitted as standard protects the RF attenuator and is effective for powers up to 30 W in the range 1 to 500 MHz and for DC voltages up to 35 V.

SSB test input A −20-dBm signal of 40 MHz $\pm f_{AF}$ applied to the test input is converted to the set output level and the set carrier frequency $f_{carrier} \pm f_{AF}$. Intermodulation measurements on SSB receivers, which normally require two complete signal generators, can be carried out with a single SMK by applying two signals in the vicinity of 40 MHz to the test input.

Self-test The most important functions of the frequency synthesis are continuously monitored during operation. Errors are signalled on the display and an error message is output via the IEC bus.

Specifications

Frequency

Range	10 Hz to 140 MHz	
Setting	from keyboard, smallest step 1 Hz, stepwise or continuous variation (see "Ease of operation", page 222)	
Display	9-digit readout (LCD), resolution 1 Hz	
Error	same as reference frequency (±1 digit for FM DC)	
Setting time (after receiving last character via IEC bus)	<40 ms (to within 100 Hz from final frequency)	
Reference frequency	from internal reference oscillator or external source	
Internal reference oscillator	standard	option SMS-B1
Crystal aging	$<2 \times 10^{-8}$/day	$<2 \times 10^{-9}$/day
Temperature effect	$<1 \times 10^{-6}$/°C	$<2 \times 10^{-9}$/°C
Warmup time	30 min	15 min
Output/input for int./ext. reference frequency	common female connector, f_{ref} 1 MHz/5 MHz/10 MHz (internally selected); with SMS-B1 option: output frequency 10 MHz	
Output voltage with internal reference	TTL level	
Input voltage with external refernce	>100 mV, sinewave or TTL levels	

Output level

Level range for CW and FM	−138.9 to +19 dBm (0.025 µV to 2 V into 50 Ω)
for AM	−138.9 to +13 dBm (0.025 µV to 1 V)
Level units displayed	mV, µV, dBµV, dBm, dBf
Resolution	0.1 dB
Range of variation without interruption of RF level	10 dB (20 dB with special function)
Total error of RF level (including frequency response)	<±1.5 dB[1]) <±1 dB (level >−20 dBm)[1])
Frequency response flatness	<1 dB
Output impedance	50 Ω (BNC female connector)
VSWR	<1.2 (level <3 dBm) <1.35 (level ≥3 dBm)[2])
Level switchoff (RF OFF)	switchover to minimum output level: output impedance remains unchanged
Level at RF output 2	50 mV[1]) (for CW and FM)

Spectral purity

Harmonics	<−30 dBc, typ. <−36 dBc
Nonharmonic spuria	<−65 dBc, typ. <−75 dBc
Microphonic and power-related spuria	<−65 dBc, typ. <−75 dBc (with CW and AM)
Noise referred to 1-Hz bandwith (see also diagram on page 222)	
SSB phase noise	
20 kHz from carrier	<−130 dBc, typ. −135 dBc
5 kHz from carrier	<−125 dBc, typ. −130 dBc
Wideband noise	
>2 MHz from carrier	<−140 dBc[1]) (with CW and FM)
Spurious FM (rms)	<1 Hz (CCITT) <3 Hz (30 Hz to 20 kHz)

Modulation

Modulation modes	internal: AM, FM and sweep with triangular signal external: AM AC/DC, FM AC/DC
2-tone AM	AM INT + AM EXT (AM 2 connector) or 2 × AM EXT (AM 1 and AM 2 connectors)
2-tone FM	FM INT + FM EXT (FM 2 connector) or 2 × FM EXT (FM 1 and FM 2 connectors)
AM + FM	any combination of AM, FM, ext., int.
Internal modulation	sinewave 150 Hz, 400 Hz, 1 kHz, 3 kHz, 15 kHz; sweep 3 Hz, 30 Hz, 100 Hz
Frequency error	<0.1%
Outputs	AM 1, FM 1 on front panel; EMF: 1 V sinewave, ±5 V sweep; Z_{out} = 600 Ω
External modulation	
Inputs	AM 1, FM 1 on front panel, AM 2, FM 2, FM 3 on rear panel; inputs AM 1 and FM 1 provided with ALC
Input impedance	600 Ω (AM 1, FM 1), 10 kΩ (AM 2, FM 2, FM 3)
Input level (V_{rms})[2]	0.5 < V < 2 V for AM 1, FM 1; 1 V for AM 2, FM 2, FM 3
Input voltage V_{DC} at AM 2	
for level reduction by approx. 50 dB	0 to −1.41 V
for level increase by approx. 6 dB (max. 19 dBm)	0 to +1.41 V

Amplitude modulation

Modulation frequency range for AM EXT	20 Hz (DC) to 20 kHz
Modulation frequency response flatness for 20 Hz to 10 kHz	<1 dB, typ. 0.3 dB
Modulation depth setting	0.5 to 100%
Resolution	0.5%
Error up to m = 80%	<5% of set value[1])
Distortion for m = 80% and f_{mod} = 1 kHz	
up to 2 MHz	<0.5%, typ. 0.2%
above 2 MHz	<1%, typ. 0.4%
Spurious AM (rms)	<0.01% (CCITT) <0.02% (30 Hz to 20 kHz)
Incidental φM for m = 30% and f_{mod} = 1 kHz	<0.1 rad (0.02 rad, 10 to 110 MHz)

Frequency modulation

Modulation frequency range	
for FM EXT AC	20 Hz to 100 kHz
for FM EXT DC	DC to 3 kHz
Modulation frequency response flatness	<0.2 dB (20 Hz to 100 kHz)[3])
Frequency deviation setting	0.05 to 500 kHz
Resolution up to 10 kHz dev.	0.05 kHz
up to 100 kHz dev.	0.5 kHz
up to 500 kHz dev.	2 kHz
Deviation error	<3% of set value or 10 Hz
Distortion (deviation = 100 kHz)	
for f_{mod} = 1 kHz	<0.05%, typ. 0.02%[3])
for f_{mod} = 10 kHz	<0.1%
Distortion for stereo (deviation = 40 kHz)	<0.1% for 1 kHz AF[1])
Stereo crosstalk (deviation = 40 kHz)	down >45 dB at 40 Hz to 15 kHz[3]) down >56 dB at 500 Hz to 10 kHz[3])
Unweighted S/N ratio	
Stereo (40 kHz deviation, 50 µs)	80 dB (CCIR, quasi-peak[3]) from 30 Hz to 20 kHz)
Mono (40 kHz deviation, 50 µs)	86 dB (CCIR, quasi-peak[3]) from 30 Hz to 20 kHz)
Weighted S/N ratio	
Stereo (40 kHz deviation, deemphasis 50 µs)	72 dB (CCIR, quasi-peak)[3])
Mono (40 kHz deviation, deemphasis 50 µs)	85 dB (CCIR, quasi-peak)[3])
Preemphasis (switch-selected)	50 µs; 75 or 750 µs can be link-selected
Incidental AM on FM (f_{mod} = 1 kHz, dev. = 40 kHz)	<0.2% at carrier frequency >10 MHz[3])

[1]) When level VAR readout is 0 dB.
[2]) Input level required for specified accuracy.
[3]) With FM AC.

Sweeping

Internal frequencies	3/30/100 Hz
Sweep width	0.05 to 500 kHz
Resolution	same as for FM
Swept output signal	±5 V, triangular at female connector FM 1

Input for SSB test signals

Frequency	40 MHz ± Δf (Δf ≤500 kHz)
Level	−20 dBm for set output level; lower level values yield correspondingly lower output level values
max. level	−10 dBm
Third-order intermodulation products with two input signals	
d_3 in sideband with J3E	down >60 dB
d_3/Δf ≥30 kHz	down >60 dB

Remote control and data output

System	IEC 625-1
Connector	24-contact, Amphenol
Interface functions	T6 basic talker, serial poll, unaddress if MLA L4 basic listener, unaddress if MTA SR1 service request function, complete capability RL1 remote/local function, complete capability DC1 device clear function, complete capability

Overload protection	protects the RF output from externally applied RF (1 to 500 MHz) or DC voltages
Max. permissible RF power	30 W
Max. permissible DC voltage	35 V
Response indication	LED in RF OFF key and "O.L." in level display

General data

Rated temperature range	+5 to +45 °C
Storage temperature range	−40 to +70 °C
AC supply	100/120/220/240 V ±10%, 47 to 420 Hz (135 VA, 110 W), safety class I to VDE 0411 (IEC 348)
RF leakage	in accordance with VDE 0871 (radiated and conducted interference) and VDE 0875 (limit values of radio interference grade K)
Shock and vibration resistance	shock-tested in accordance with DIN 40 046, Part 7 (30 g, 11 ms), and vibration-tested in accordance with DIN 40 046, Part 8 (5 to 55 Hz, 2 g); corresponding to IEC Publications 68-2-27 and 68-2-6
Dimensions, weight	347 mm×206 mm×462 mm, 20.5 kg[4])

Ordering information

Order designation	▶ Signal Generator SMK 348.0010.03
Accessories supplied	power cord

Options

Reference Oscillator SMS-B1	302.8918.02
19″ Rack Adapter SMK-Z6	358.8213.02

Recommended extra

Service Kit for SMK ... SMK-Z1	358.8413.02

[4]) With 19″ Rack Adapter SMK-Z6, the overall mounting height is 221 mm.

SMG

Signal Generator SMG ♦ 0.1 to 1000 MHz without frequency doubling

- Frequency resolution 1 Hz
- Frequency setting time 15 ms
- High spectral purity
- No subharmonics
- AF and RF sweep
- Precise modulation: AM, FM, φM and pulse; FM: DC to 100 kHz

IEC 625 Bus

The **Signal Generator SMG** is a fast, high-resolution synthesizer featuring great ease of operation and universal modulation and sweep capabilities. Precise level setting using a mechanical attenuator is as a matter of fact as modern processor technique. The high technical standard of the SMG is manifested in the spectral purity, short measuring and setting times, low spurious as well as in the automatic and permanent functional monitoring.

Characteristics, uses

With its high-quality characteristics and comprehensive basic equipment the Signal Generator SMG features full system compatibility and versatile modulation capabilities in all essential communications bands.

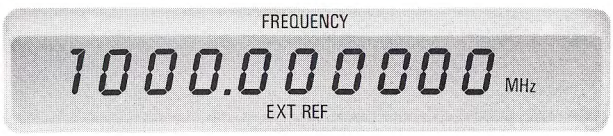
Standard basic equipment

- Overload protection up to 50 W
- Non-volatile memory for 50 complete instrument setups
- Modulation generator with eight fixed frequencies
- Remote-control interface IEC 625-1 (IEEE 488)

Available options

- Oven-controlled Reference Oscillator SMG-B1 for extremely high frequency accuracy
- AF Synthesizer SMG-B2 (10 Hz to 100 kHz) as an internal modulation source; can be used as AF signal source with variable amplitude (1 mV to 1 V) for external applications
- X output for oscilloscope and recorder control in sweep mode

Frequency indication with EXT REF statement (external synchronization)



Frequency range 100 kHz to 1000 MHz The wide frequency range is produced without a doubler. Underranging is possible down to a lower limit of 10 kHz. With a frequency resolution of 1 Hz throughout the frequency range and the low spurious FM, the SMG is ideally suited for testing SSB receivers as well as for feeding narrowband test items.

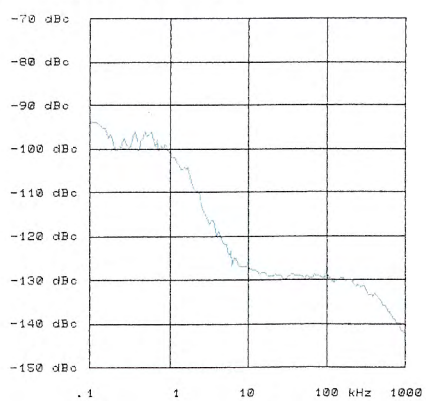
The frequency setting time of the RF signal is less than 15 ms. This makes for short measurement times in computer-controlled operation and ensures fast frequency scan in the SWEEP MODE.

Spectral purity, outstanding in this price class The spectral purity of the RF signal is distinctly better than the usual requirements for all in-channel measurements on AM, FM and SSB receivers. In the frequency range below 250 MHz, signal purity is adequate even for out-of-channel measurements meeting the most stringent requirements.

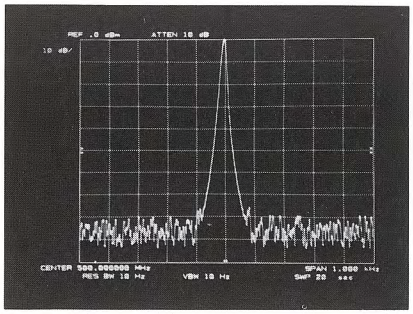
Non-harmonic spurious signals remain below −70 dBc throughout the frequency range and over wide parts even below −80 dBc. SSB phase noise 20 kHz from the carrier at 1000 MHz is −122 dBc and as good as −142 dBc at 100 MHz. Power-line and microphonically generated spurious signals remain below −60 dBc in the vicinity of the carrier.

Typical SSB phase noise:
Measured curve at 500 MHz, stating frequency and level

FREQ	RPEGEL
0.1	-94
0.17	-96.4
0.31	-99.4
0.56	-96
1	-102
1.77	-106.5
3.16	-117.1
5.62	-124.4
10	-127.1
17.78	-128.5
31.62	-129.1
56.23	-128.5
100	-129.2
177.82	-129.5
316.22	-131.3
562.34	-135.2
1000	-141.4

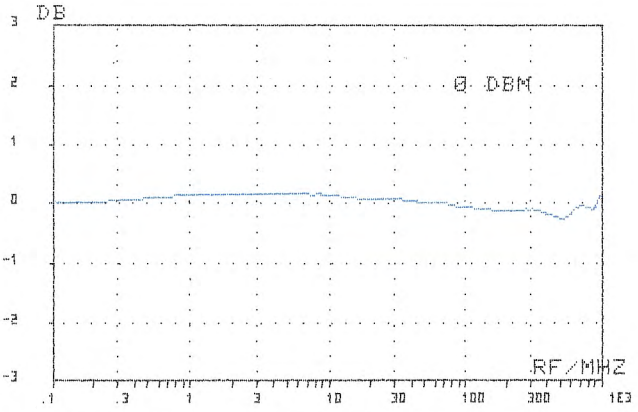


The great advantage of signal generation without using a doubler is that no subharmonics occur in the entire frequency range up to 1000 MHz.



Signal quality of SMG close to carrier at 500 MHz; analyzer span: 100 Hz/division

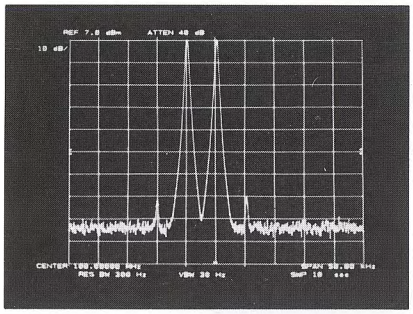
Controlled output level from −137 to +13 dBm, with overrange up to +16 dBm The low total level error of <±1.5 dB and the resetting error of 0.05 dB ensure precise and reproducible sensitivity measurements. The total level error also includes the level frequency response of <±0.5 dB between 100 kHz and 1000 MHz.



Typical level frequency response of SMG with 0 dBm output level

The **mechanically switched attenuator** is designed for continuous use and therefore suitable for automatic test systems. If switching of the attenuator disturbs the measurement, the purely electronic level setting allows non-interrupting level variation within a range of 20 dB. Irrespective of the preset level, the full 20-dB range of electronic level variation is always available.

For intermodulation measurements the internal level control of the SMG can be inhibited while retaining the selected level. By the use of this special function the intermodulation products of two Signal Generators SMG (combined via an ohmic 6-dB coupler) are kept under −60 dBc for output levels of 13 dBm and under −80 dBc for output levels of less than 3 dBm.

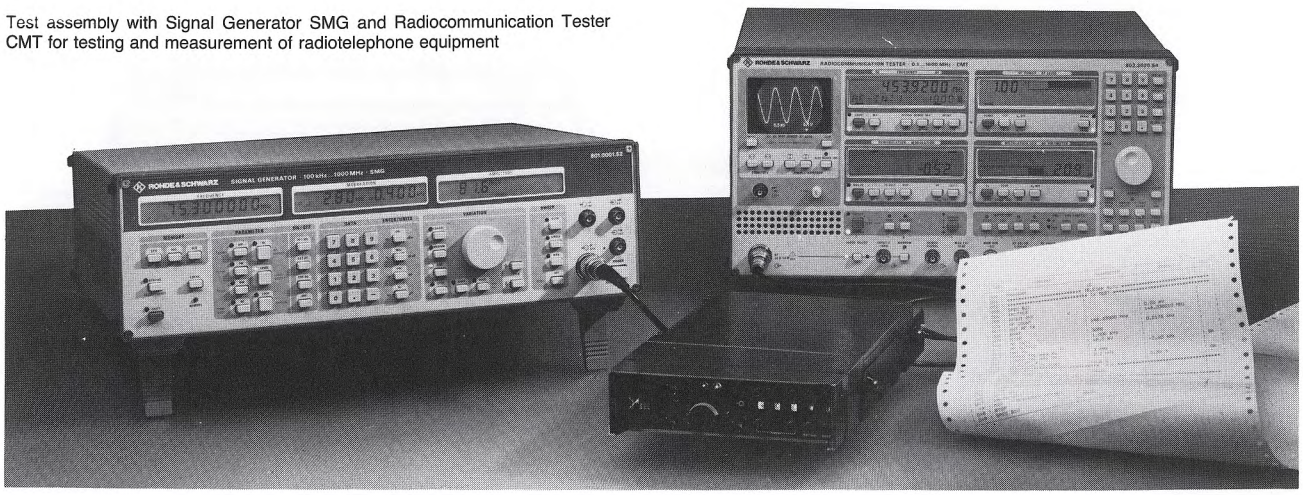


Intermodulation produced when two Signal Generators SMG are combined via ohmic 6-dB coupler (at 100 MHz, 13 dBm, 5 kHz offset)

Excellent RF shielding, a prerequisite for sensitivity measurements Due to the excellent RF shielding of the instrument housing, the smallest selectable useful levels can also be used for sensitivity measurements on unshielded receivers such as pagers. The voltage induced in a two-turn loop, 2.4 cm in diameter, loaded with 50 Ω and held **in the immediate vicinity of the SMG is under 1 µV.**

Modulation (AM, FM, φM and pulse) The SMG features versatile modulation capabilities for many applications, such as testing of communications, navigation and broadcasting receivers.

Test assembly with Signal Generator SMG and Radiocommunication Tester CMT for testing and measurement of radiotelephone equipment

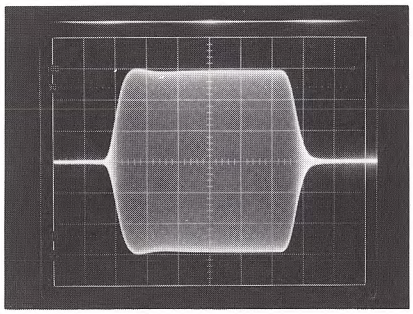


SMG

For AM, FM and φM the internal or an external modulation source may be used. Combination of the two sources allows two-tone modulation, which is also used for simultaneous generation of useful and pilot-tone modulation signals (eg free tone, pilot tone for cellular radio, controlled squelch and channel guard).

External AM and FM can be AC- or DC-coupled In FM DC mode any asymmetrical signals can be used for modulation as is required for generating FSK data telegrams for POCSAG receivers. The frequency offset which inevitably occurs in the FM DC mode is minimized by **automatic correction.** Due to the high quality of FM, the SMG is also suitable for measurements on stereo receivers. Distortion is 0.1% and a channel separation of 50 dB is achieved. The FM frequency response flatness up to 100 kHz is better than 0.5 dB. It remains below 3 dB with modulation frequencies up to 500 kHz and small deviations.

The modulation frequency range for AM (DC to 50 kHz) can be used without any restrictions down to a carrier frequency of 100 kHz. **Little phase shift at 30 Hz** (AM DC) and flat frequency response are AM characteristics which make the SMG particularly suitable for measurements on VOR/ILS navigation receivers.



Pulse-modulation characteristics of SMG; oscilloscope timebase: 2 µs/division

The pulse modulation of the SMG can also be used for testing AGC circuits or for measuring the response times of squelch circuits. The rise/fall times of the RF envelope are 2 µs, the on/off ratio is 40 dB.

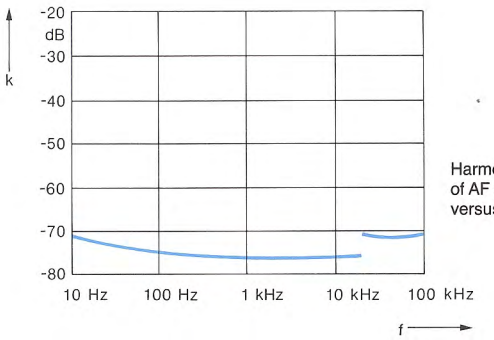
When using the optional AF Synthesizer SMG-B2, digital frequency modulation and pulse modulation are possible with TTL signals.

AF synthesizer, crystal-accurate and sweepable Two internal modulation sources are available in the SMG:

a) the **standard modulation generator** with eight fixed frequencies between 40 Hz and 15 kHz or

b) the **optional AF synthesizer** with a frequency range from 10 Hz to 100 kHz, resolution 1 Hz.

The AF synthesizer is also used as an AF signal source for external applications with a level adjustable from 1 mV to 1 V. The phase-continuous frequency change which takes less than 10 ms is particularly noteworthy. The AF synthesizer option also allows AF sweep mode. For determination of audio frequency responses, the internal modulation signal can be swept while an external pilot signal is simultaneously applied.



Harmonic distortion of AF synthesizer versus frequency

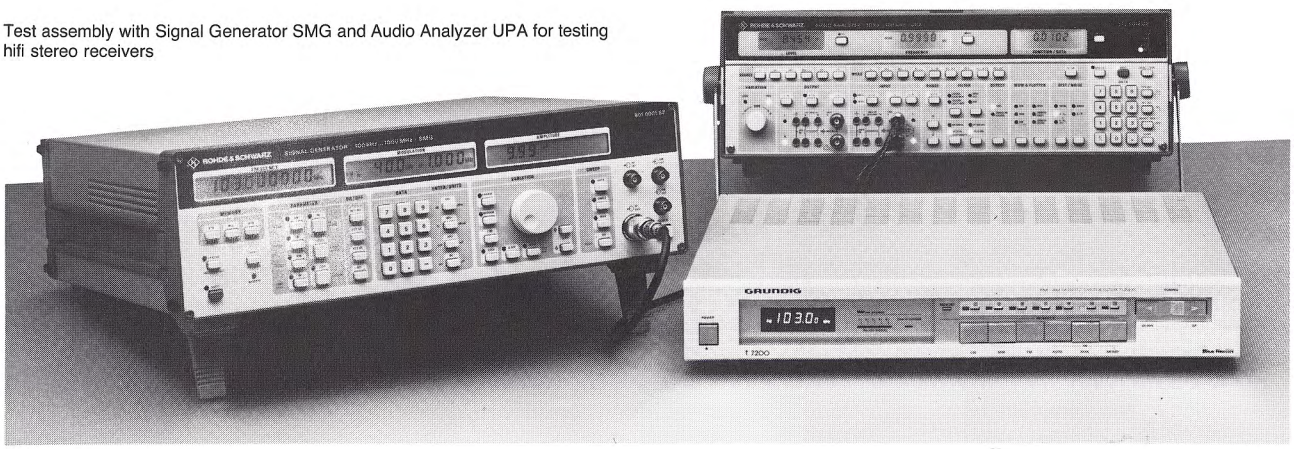
RF sweep and AF sweep, adaptable The SMG features two sweep modes,

a) the **RF sweep** in the frequency range 100 kHz to 1000 MHz and

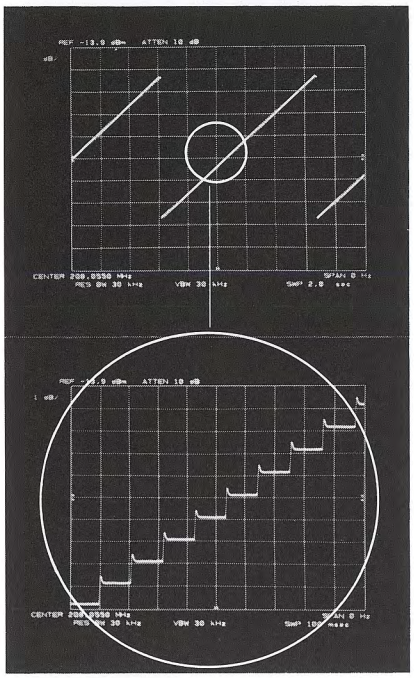
b) the **AF sweep** with the AF synthesizer option in the frequency range 10 Hz to 100 kHz.

In both modes the synthesized, digital start-stop sweep can be adapted to different tasks by setting parameters as desired. Start and stop frequency, step size, step time (min. 10 ms) as well as linear and logarithmic sweep can be chosen in automatic sweep, single sweep and manual frequency variation with the spinwheel.

Test assembly with Signal Generator SMG and Audio Analyzer UPA for testing hifi stereo receivers

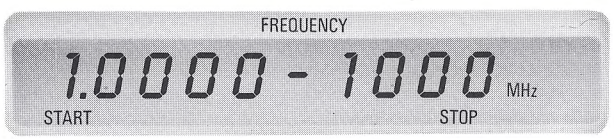


For measurements on narrowband test items it is important that **RF sweep and AF sweep are phase-continuous.** For the RF sweep the SMG fulfils this requirement with the aid of small steps, whereas for the AF sweep phase continuity is ensured with any step size. For display of the measured values on an oscilloscope or logging by a recorder the necessary trigger or penlift signals and a frequency-proportional deflection voltage are supplied by the optional X Output SMG-B3.



Frequency-setting characteristic of SMG in sweep mode (step size 1.5 kHz, step time 10 ms)

Ease of operation, time-saving setting facilities Carrier frequency (start/stop frequency in SWEEP MODE, photo below), modulation and output level with units as well as supplementary information can be simultaneously indicated on the illuminated LCD displays. Indication of the desired modulation parameter such as AM depth, FM deviation, φM deviation or internal AF modulation frequency can be selected at a keystroke.



For all parameters spinwheel variation is possible in three fixed step sizes or in any **preselected step size.** When using the spinwheel, frequency, level and modulation parameters can also be indicated as the difference to a reference value.

On/off parameter keys permit the parameters (level or functions like modulation or sweep) to be switched on and off and their stored values be recalled when switching on.

50 complete instrument setups can be stored in a non-volatile memory The SEQuence key allows the stored setups to be carried out in any previously defined sequence. An automatic sequence with selectable step time is also possible.

An offset adjustment can be used for frequency and level. The frequency offset is often required in LO applications in which case the input frequency of the receiver is to be indicated on the signal generator. A level offset is recommended whenever it is necessary to indicate on the signal generator the actual input power of the test item taking into account cable losses.

The user can **select level indication in dBm, dBμV, mV or μV** and display the RF voltage as EMF or as voltage into 50 Ω.

Switchover from internal to external reference is made at a keystroke.

Remote-control interface IEC 625-1 (IEEE 488) Remote control is possible for listener, talker and service request functions. In the TALK MODE all instrument settings can be read out, the output format being the same as used for the settings. The TALK MODE can be used to integrate manually made settings in a control program by means of a user request (LEARN MODE). A service request which can be masked by the user is provided for the following events: power on, user request, command error, execution error, query error, device-dependent error and operation complete.

The structure of the remote-control commands is particularly logical and gives the user a wide scope. Header and unit of the command are almost identical with the front-panel marking. The commands can be written in full or abbreviated, as desired, to a minimum length.

```
100 REM   SMG REMOTE-CONTROL EXAMPLES
110 REM
120 REM   IEC-BUS ADDRESS IS 28
130 REM
140 REM   SET TALK-TERMINATOR TO NEW LINE
150 REM
160 IEC TERM 10
170 REM
180 REM   FETCH SETTINGS RF,RF-OFFSET,LEVEL
190 REM
200 IEC OUT 28,"RF?;RF:OFFSET?;LEV?"
210 IEC IN 28,A$
220 REM
230 PRINT "RESPONSE MESSAGE OF SMG"
240 PRINT A$

RESPONSE MESSAGE OF SMG
RF  101000000;RF:OFFSET  -10700000;LEVEL:RF  -30.0
```

Example of remote-control routine for reading out (TALK MODE) setting data of Signal Generator SMG

High operational reliability, easy maintenance Due to permanent monitoring of the internal status a high percentage of functional faults, if any, which may yield erroneous measurement results, is detected. In the case of a fault the erroneous conditions are indicated and output via the IEC bus.

Fast fault diagnosis through 35 internal test points: the instrument can be checked without having to open it and without any external measuring devices. The test points include all essential points of signal generation as well as important RF signal levels. When a test point is called up via the keyboard or IEC bus, the number of the test point and the measured value are shown on the display. For data logging the displayed data can be output via the IEC bus.

SMG

Specifications

Frequency

Range/resolution	100 kHz to 1000 MHz/1Hz	
Setting time (after reception of last IEC-bus character)		
for RF ≥31.25 MHz	<15 ms with offset <2×10^{-7} from final frequency value	
for RF <31.25 MHz	<15 ms with offset <50 Hz from final frequency value	
Reference frequency	**standard** 50 MHz	**option SMG-B1** 10 MHz
Aging (after 30 days of operation)	2×10^{-6}/year	<1×10^{-9}/day
Temperature effect	2.5×10^{-6}/ 0 to 50 °C	<2×10^{-9}/°C
Warmup time	15 min	10 min
Frequency error for RF ≥31.25 MHz	<0.5×10^{-9} + error of reference	
for RF <31.25 MHz	<0.1 Hz + error of reference	
Input/output for external/internal reference frequencies		
Output	0.2 V_{rms} into 50 Ω	
Frequency	5 or 10 MHz, selectable by changing position of internal connector	
Input	>0.1 V_{rms} sinewave or TTL levels	
Frequency	5 or 10 MHz (±5×10^{-6})	

Spectral purity

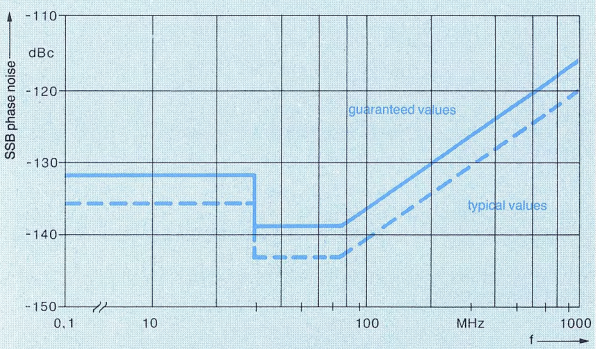
Spurious signals	
Harmonics	<−30 dBc
Subharmonics	none
Residual AM, rms (0.03 to 20 kHz)	<0.02%
Non-harmonic spurious signals (>5 kHz from carrier[1])	see line (a) in table
Residual FM, rms	
0.3 to 3 kHz (CCITT)	see line (b) in table
0.03 to 20 kHz	see line (c) in table

f =	0.1 to 31.25	31.25 to 62.5	62.5 to 125	125 to 250	250 to 500	500 to 1000	MHz
a	<−70	<−80	<−80	<−80	<−76	<−70	dBc
b	<2	<1	<1	<1	<2	<4	Hz
c	<6	<4	<4	<4	<6	<12	Hz

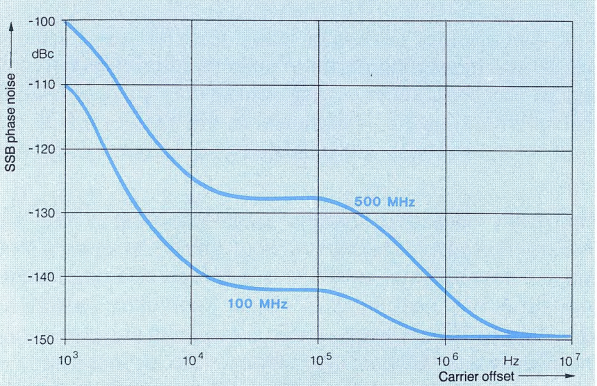
Broadband noise with CW[1]) (carrier offset >2 MHz, 1 Hz bandwidth) <−140 dBc (typ. <−145 dBc)

SSB phase noise (carrier offset 20 kHz, 1 Hz bandwidth)

f =	31.2	62.5	125	250	500	1000	MHz
	<−133	<−140	<−136	<−130	<−124	<−118	dBc
typ.	−137	−144	−140	−134	−128	−122	dBc



SSB phase noise with 20 kHz carrier offset, 1 Hz bandwidth



SSB phase noise at 100 and 500 MHz, 1 Hz bandwidth

Level

Range	−137 to +13 dBm
Overrange without guarantee of specification	adjustable up to +16 dBm
Resolution	0.1 dB
Total error for level >−127 dBm	<±1.5 dB[1])
Frequency response flatness at 0 dBm output level	<1 dB
Characteristic impedance	50 Ω
VSWR	<1.5 for level ≤0 dBm[1]), <1.8 for level >0 dBm
Setting time (after reception of last IEC-bus character)	<25 ms (<15 ms with non-interrupting level setting)
Non-interrupting level setting	
Setting range	0 to −20 dB, starting from any level
Resolution	0.1 to 0.4 dB, depending on atten.

Amplitude modulation

Modes	INT, EXT AC, EXT DC, two-tone
Modulation depth	0 to 99%
The modulation depth adjustable when adhering to AM specifications linearly decreases for output levels from 7 to 13 dBm; if the modulation depth is too high, a status signal is triggered	
Resolution	0.5%
Setting error at 1 kHz (<80%)[1])	<4% of reading +1%
AM distortion at 1 kHz[1])	
0 to 30% AM	<1%
30 to 80% AM	<2%
Modulation frequency	
AM EXT AC (DC)	10 Hz (DC) to 50 kHz
AM INT	0.04/0.15/0.3/0.4/1/3/6/15 kHz ±3%
AM INT with option SMG-B2	10 Hz to 50 kHz
Modulation frequency response flatness[1])	
30 Hz (DC) to 10 kHz	<0.4 dB (typ. 0.1 dB)
10 Hz (DC) to 50 kHz	<1 dB (typ. 0.5 dB)
Incidental φM, with AM (30%), AF 1 kHz	<0.2 rad
VOR/ILS navigation[1])	
VOR bearing error (108 to 118 MHz)	<0.1° with AM DC
AM frequency response flatness (108 to 118 MHz, 329 to 335 MHz)	<0.04 dB from 90 to 150 Hz, <0.1 dB from 9 to 11 kHz
Modulation input AM EXT	
Input impedance	100 kΩ, can be internally changed to 600 Ω
Input voltage for full modulation depth selected	
V_{rms}	1 V (±3% HIGH/LOW indication)
V_{DC} with AM DC	±1.41 V for level modulation acc. to selected modulation depth

Frequency modulation

Modes: INT, EXT AC, EXT DC, two-tone

f =	0.1 to 31.25	31.25 to 62.5	62.5 to 125	125 to 250	250 to 500	500 to 1000	MHz
Maximum deviation	200	50	100	200	400	800	kHz

Resolution	
up to 10 kHz deviation	10 Hz
up to 100 kHz deviation	0.1 kHz
above 100 kHz deviation	1 kHz
Setting error (at f_{mod} = 1 kHz)	<5% of set value +20 Hz
FM distortion at 1 kHz and 50% of maximum deviation	<0.5% (typ. 0.1%)
Modulation frequency	
FM EXT AC (DC)	10 Hz (DC) to 100 kHz
FM INT	0.04/0.15/0.3/0.4/1/3/6/15 kHz ±3%
FM INT with option SMG-B2	10 Hz to 100 kHz
Modulation frequency response flatness from 20 Hz to 100 kHz	<0.5 dB
Incidental AM at f_{mod} = 1 kHz, 40 kHz deviation	<0.1%
Stereo crosstalk (deviation 40 kHz, AF 1 kHz)	>45 dB down
Unweighted S/N ratio (30 Hz to 20 kHz, rms, 40 kHz deviation, deemphasis 50 µs)	
Stereo	80 dB
Mono	86 dB
Weighted S/N ratio (CCIR, rms, 40 kHz deviation, deemphasis 50 µs)	
Stereo	76 dB
Mono	86 dB
Frequency error with FM DC	
Carrier frequency offset when switching on FM DC	
for $f_{carrier}$ ≥31.25 MHz	1% of deviation +$1 \times 10^{-6} \times f_{carrier}$
for $f_{carrier}$ <31.25 MHz	1% of deviation +200 Hz

[1]) Does not apply if special function "non-interrupting level setting" is selected.

Recalibration by switchover to FM AC or FM OFF (duration 2 s)
Modulation input FM/φM EXT
- Input impedance ..... 100 kΩ, can be internally changed to 600 Ω
- Input voltage for full deviation selected
  - V_{rms} ..... 1 V (±3% HIGH/LOW indication)
  - V_{DC} with FM DC ..... ±1.41 V

Phase modulation
Modes ..... INT, EXT AC, two-tone

	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
Maximum deviation	20	5	10	20	40	80 rad

Resolution up to 1 rad ..... 0.001 rad
up to 10 rad ..... 0.01 rad
above 10 rad ..... 0.1 rad
Setting error (at f_{mod} = 1 kHz) ..... <5% of set value +0.1 rad
Phase modulation distortion at 1 kHz and 50% of maximum deviation ..... <0.5% (typ. 0.1%)
Modulation frequency
- φM EXT ..... 10 Hz to 10 kHz
- φM INT ..... 0.04/0.15/0.3/0.4/1/3/6 kHz ±3%
- φM INT with option SMG-B2 ..... 10 Hz to 10 kHz

Frequency response flatness up to 10 kHz ..... <1 dB
Modulation input FM/φM EXT
- Input impedance ..... 100 kΩ, can be internally changed to 600 Ω
- Input voltage for full deviation selected ..... 1 V_{rms} (±3% HIGH/LOW indication)

Pulse modulation
Mode ..... external
Pulse on/off ratio ..... 40 dB
Rise/fall time 10% to 90% ..... 2 µs
Max. repetition frequency ..... 50 kHz
Min. pulse width ..... 5 µs
Modulation signal (AM setting 100%) ..... 0 V for level on, −1.6 to −1.41 V for level off
Modulation input AM EXT
- Input impedance ..... 100 kΩ, can be internally changed to 600 Ω

If option SMG-B2 (AF synthesizer) is fitted, a TTL signal may be used as external control signal in special function "PM"
- Modulation signal (AM EXT) ..... TTL, LOW for level on, HIGH for level off
- Input impedance ..... 100 kΩ, can be internally changed to 600 Ω

FSK modulation
The shift ±Δf about the set RF is to be entered as with FM; FSK modulation is possible with AC or DC coupling
- Settling time of RF ..... 10 µs
- Tilt during 10 ms with AC coupling 3%
- Frequency accuracy with DC coupling ..... see data for FM DC
- Modulation signal (FM, φM EXT) ..... +1.41 V for $f_{carrier} + \Delta f$, −1.41 V for $f_{carrier} - \Delta f$

If option SMG-B2 (AF synthesizer) is fitted, a TTL signal may be used as external control signal in special function "FSK modulation"
- Modulation signal (FM, φM EXT) ..... TTL, HIGH level for $f_{carrier} + \Delta f$, LOW level for $f_{carrier} - \Delta f$
- Input impedance ..... 100 kΩ, can be internally changed to 600 Ω

Internal modulation generator
Standard
- Frequency ..... 0.04/0.15/0.3/0.4/1/3/6/15 kHz ±3%
- Output level, socket AF INT ..... 1 V_{rms} (Z_{out} = 10 Ω, Z_I >200 Ω)

AF Synthesizer Option SMG-B2
Frequency ..... 10 Hz to 100 kHz
- Resolution ..... 1 Hz
- Readout ..... 4-digit, floating decimal point

Frequency error ..... $<4 \times 10^{-5}$
Output level (V_{rms}), socket AF INT ..... 1 mV to 1 V (Z_{out} = 10 Ω, Z_I >200 Ω)
Level resolution ..... 1 mV
Level error at 1 kHz ..... ±1% + 1 mV
Frequency response flatness
- up to 20 kHz ..... <±2.5% (typ. 1%)
- up to 100 kHz ..... <±3.5% (typ. 1%)

Distortion (level >0.5 V)
- up to 20 kHz ..... <0.1% (typ. 0.03%)
- up to 100 kHz ..... <0.1% (typ. 0.05%)

Phase-continuous frequency change
- Frequency setting time (after reception of last IEC-bus character) ..... <10 ms

RF sweep, AF sweep
(AF sweep with AF Synthesizer Option SMG-B2)
Digital start/stop sweep in discrete steps
- Modes ..... automatic following sawtooth function, single sweep, manual control via spinwheel, linear or logarithmic

Sweep range freely selectable over entire frequency range
- AF ..... 10 Hz to 100 kHz
- RF ..... 100 kHz to 1000 MHz

Step size ..... freely selectable, smallest step 1 Hz, log. 0.1% to 50% per step
Time per step ..... freely selectable between 10 ms and 10 s

X output (with option SMG-B3)
X output ..... 0 to 10 V, staircase sawtooth, 0 V at start frequency, 10 V at stop frequency, max. 1000 steps
Z output ..... 0/5-V logic signal for penlift control of recorders or for blanking of oscilloscope displays

Remote control
System ..... IEC 625-1 (IEEE 488)
Connector ..... 24-contact, Amphenol
Remote-controlled functions ..... all functions that can be manually set on the front panel, with the exception of power on/off and spinwheel settings
IEC-bus address ..... selectable via keyboard from 00 to 30
Interface functions ..... listener and talker, SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT0, C0

Overload protection
Protects the instrument against externally applied (50-Ω source) RF power and DC voltage
Max. permissible RF power ..... 50 W
Max. permissible DC voltage ..... 35 V
Max. pulse loading capacity (pulse width <10 µs) ..... 1 mWs or 150 V_p

Options
SMG-B1 Reference Oscillator
- OCXO ..... see specifications for frequency

SMG-B2 AF Synthesizer ..... see specifications for internal modulation generator
SMG-B3 X Output ..... see specifications for RF sweep, AF sweep

General data
Rated temperature range ..... 0 to 50 °C
Storage temperature range ..... −40 to +70 °C
Power supply ..... 100/120/220/240 V ±10%, 47 to 440 Hz (max. 115 VA, 90 W); safety class I to VDE 0411 (IEC 348)
RF leakage ..... complies with VDE 0871 and MIL-STD 461B (methods CE 03 and RE 02) requirements (radiated and conducted interference) as well as VDE 0875 requirements (limit values of radio interference grade K)
Mechanical resistance ..... shock-tested to DIN 40046, Part 7 (30 g, 11 ms) and vibration-tested to DIN 40046, Part 8 (5 to 55 Hz, 2 g); corresponding to IEC Publications 68-2-27 and 68-2-6
Dimensions, weight ..... 427 mm×132 mm×460 mm, 16 kg

Ordering information

Order designation ..... ▶ Signal Generator SMG 801.0001.52
Accessories supplied ..... power cable

Recommended extras

Option Reference Oscillator OCXO	SMG-B1	802.0005.02
AF Synthesizer	SMG-B2	802.0405.02
X Output	SMG-B3	801.9609.02
Rear-panel connectors for RF and AF	SMG-Z10	801.9515.02
19" Rack Adapter, 3 units in height, 1/1	ZZA-93	396.4892.00
Service Kit	SMG-Z2	801.9809.02

new

UPA
UPA 3, UPA 4

Audio Analyzer UPA ♦ 10 Hz to 100 kHz

- Psophometric measurements to DIN, CCIR, CCITT
- Broadband level meter with built-in frequency counter; simultaneous measurement of level and frequency
- DC voltage measurement
- Combined digital and analog displays for all functions
- Fully automatic test run with logging of measured values without process controller

New functions

- Switch-selectable generator output impedance
- Enhanced filter functions
- Two filter options at a time

IEC 625 Bus

Characteristics

The **Audio Analyzer UPA** is a system-compatible, broadband level meter and psophometer with built-in frequency counter which can be extended by options to form a complete audio test assembly (see page 233 for UPA 3 and UPA 4):

- Synthesizer generator (10 Hz to 100 kHz, 0.1 mV to 12.4 V, distortion >80 dB, floating outputs, switch-selectable output impedance: 30, 200 or 600 Ω)
- Fully automatic distortion meter for measurement of total and selective harmonic distortion or SINAD (10 Hz to 100 kHz with readout of d_2 to d_9 or d_{TOTAL} and THD down to 0.003%)
- Special filters: A-weighting, stop filters, bandpass and lowpass filters, tracking bandpass filter, customized filters
- Wow and flutter meter to DIN, CCIR, IEC, NAB, JIS with amplitude variation meter

The integration of all measuring functions in one instrument allows system performance which could not be achieved by separate instruments, since many functions such as level and frequency measurement are carried out simultaneously and the results are available at the same time.

Applications In addition to the usual highpass and lowpass filters, the Audio Analyzer UPA is fitted with special filters, all standard weighting filters and rectifiers. The balanced and unbalanced inputs and outputs are fully floating. The UPA is thus suitable for virtually all **AF and audio applications** and considerably facilitates and improves these measurements.

Besides the use in development laboratories, a major application of the UPA will be in automated testing of mass-produced consumer electronics equipment, eg for final inspection of radios with a cassette recorder, where practically all measurement functions of the UPA are required. Since the balanced inputs of the UPA exhibit a common-mode rejection of more than 110 dB at 50 Hz with a permissible common-mode voltage of 250 V, all standard measurements on balanced studio lines can be carried out which until now were practically not possible in automatic mode.

Configuration, uses

The **basic configuration** of the **UPA** already features excellent system characteristics as a:

- **Level meter**
  It allows broadband measurement of voltages in the AF range (10 Hz to 100 kHz) with switch-selected readout of the result as true rms or quasi-peak value. A measurement range from a few µV up to 300 V for the unbalanced input and up to 35 V for the balanced input as well as a total error of less than 1% in the frequently used AF range from 30 Hz to 20 kHz make for the great variety of applications of the UPA. The two test inputs can be switched as two-channel inputs, eg for measurement of crosstalk or level differences in stereo equipment.
- **Frequency counter**
  The frequency counter of the UPA measures in the range from 8 Hz to 250 kHz. It provides reliable results even with voltages of less than 10 mV and a signal-to-noise ratio of less than 20 dB.
- **Phase meter**
  With the aid of an automatic test routine the UPA determines the phase difference between 0 and 180° of two audio signals with equal frequency. For this purpose the audio signals are measured at the unbalanced inputs and their difference at a balanced input.
- **DC voltmeter**
  DC voltages in the range from 10 mV to 300 V can be measured at the unbalanced test inputs.

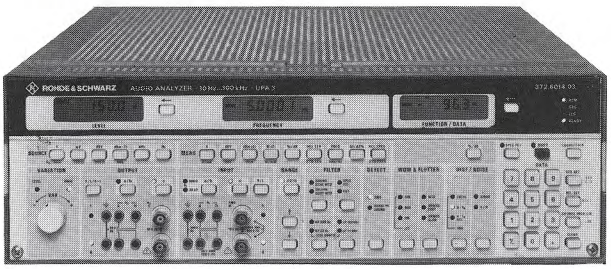
Two separate displays A great advantage in all applications in the **simultaneous indication of level and frequency** on two separate displays, both parameters being **measured fully automatically.** If required, automatic level measurement can be switched off or internal measurement ranges programmed. To meet the different requirements, the measurement speed can be selected separately for level and frequency. In system operation via the IEC/IEEE bus, fast rates up to about 20 measurements per second can be obtained, each individual measurement providing a stable result.

UPA 3 and UPA 4

In addition to the basic UPA model – configuration and uses see preceding page – there are two further models whose characteristics are completely identical to those of the basic model, but which provide additional attractive options and uses.

UPA 3

The cost-effective overall solution



The UPA 3 is a cost-effective combination of the Audio Analyzer UPA fitted with generator (option UPA-B6) and distortion meter (option UPA-B8).

Characteristics This equipment configuration makes the UPA 3 a complete AF test set for measuring the transmission characteristics of audio components.

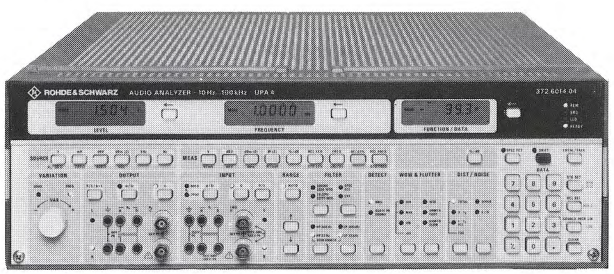
Uses Fitted with distortion meter and generator, the UPA 3 reflects the most frequently used option configuration of the UPA. The range of applications includes, for instance, measurement of

- frequency response
- phase
- S/N ratio
- attenuation/gain
- crosstalk
- distortion/SINAD
- noise voltages

Further options can be fitted to enhance the measurement capabilities of the UPA 3 (see specifications).

UPA 4

Improved model for CD measurements



Special features

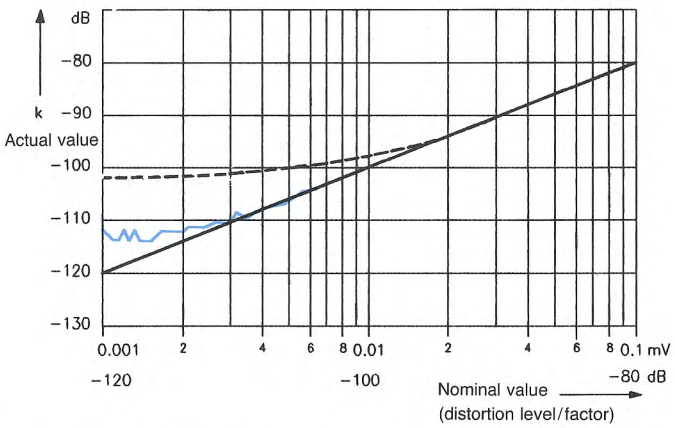
- Built-in distortion meter
- Inherent distortion better than −97 dB
- Frequency response <0.03 dB
- Inherent noise voltage <3 µV

Characteristics The UPA 4 reliably measures distortions down to −90 dB (0.003%) within a test bandwidth up to 20 kHz in line with relevant specifications. The measurement range can even be extended to −100 dB (0.001%), if the displayed value is corrected by the noise components; due to rms weighting, the noise power components are added according to the following equation:

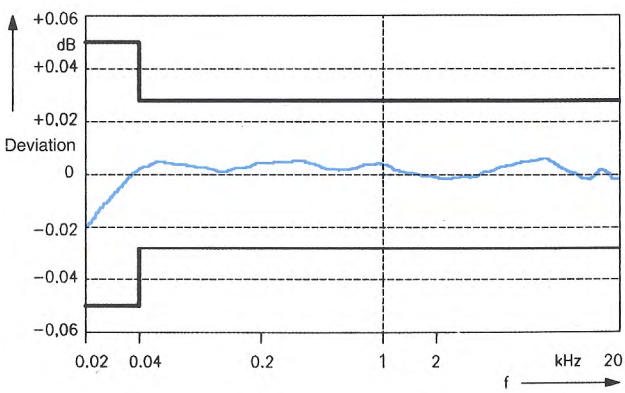
$$V_{display} = \sqrt{V^2_{inh.\ dist.} + V^2_{meas.}}$$

Uses Measuring the signal quality of digital sound storage media such as the CD (compact disc) and also DAT (digital audio tape) is extremely demanding.

The Audio Analyzer UPA 4 has specially been designed for this purpose. Its built-in distortion meter has more capabilities than previously required for checking analog recording techniques. It can additionally be fitted with the options of the Audio Analyzer UPA, such as generator, various filters as well as wow and flutter meter. The Audio Analyzer UPA 4 is ideally suited for all measurements on CD players and high-performance audio equipment in production, quality assurance and servicing.



Enhanced measurement linearity in distortion measurement using UPA 4 by calculating inherent distortion:
Curves shown (test condition: 1 V_{meas}, 1 kHz fundamental):
dash-dotted = typical results without correction
blue = typical curve with calculated correction
black = nominal curve (theoretical)

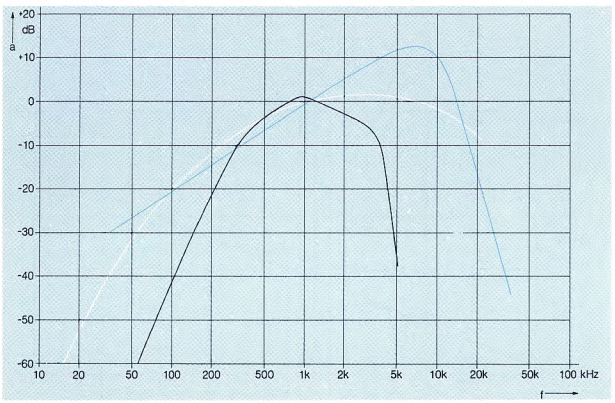


Frequency response of UPA 4 in range 20 Hz to 20 kHz (blue curve = typical response, unbalanced input, RMS, measurement range 1 V); **curves shown:**
black = error limits
blue = typical response

UPA

Further UPA characteristics, configuration

Weighting filters, meter rectifiers A psophometric determination of the signal-to-noise ratio in audio engineering according to CCIR and DIN and in telephone or speech channels to CCITT requires weighted measurements which simulate the physiological effect of disturbance on a listener with average hearing. The UPA is therefore fitted with suitable weighting filters and meter rectifiers with standard-defined dynamic response for the indication of quasi-peak or rms values. For an assessment of a sound channel an unweighted noise measurement is also defined by standards. For this purpose a 22.4-Hz highpass and a 22.4-kHz lowpass filter can be switched into circuit. Other switch-selectable filters, eg a 300-Hz highpass and a 100-kHz lowpass, as well as the connection of an external filter or incorporation of special filters offer a large variety of possibilities for limiting the test bandwidth or suppressing special interfering frequencies. One or two optional special filter PCBs can be inserted into the UPA, if required.



Passband curves of noise weighting filters:
blue Weighting to CCIR 468-4 and DIN 45405 for professional audio engineering
black Weighting to CCITT O.41/P53 for telephone channels
white A-weighting to DIN IEC 651 (fitted in option UPA-B2) for audio equipment in the home

Special Filter UPA-B2

The special filter (option UPA-B2) comprises:

- A-filters to IEC DIN 651 for noise weighting of home audio equipment
- Pilot-tone trap with 15 kHz lowpass filter
- Line-frequency trap with 13 kHz lowpass filter
- Narrowband bandpass filters for selective voltage measurement at the standard frequencies 315 Hz, 1 kHz, 3.15 kHz, 6.3 kHz, 10 kHz and 12.5 kHz
- Continuously tunable narrowband bandpass filter for selective level measurement in the frequency range of 23 Hz to 15.5 kHz (generator tracking filter)
- Telephone bandpass filter 320 Hz to 3.4 kHz for unweighted measurements in telephone of speech filter
- Lowpass filters with cutoff frequencies of 350 Hz, 1.04 kHz, 3.5 kHz, 7 kHz, 10.4 kHz and 15 kHz

The **filter curves** illustrate the setting possibilies of Special Filter UPA-B2. The desired filter can be switched into the signal path by direct entry of a number (1 to 19) and combined with filters of the UPA basic configuration as desired.

Bandpass filter No. 19 provides a further possiblity of setting the passband frequency either directly or by allocating the generator frequency in the range from 23 Hz to 15.5 kHz. This narrowband tracking filter allows selective level measurements throughout the specified frequency range.

A-filter
2 dB/div Marker 1 kHz
No. 1
100 Hz 0,4 1 4 10 20 kHz

Pilot-tone trap with lowpass filter
10 dB/div Marker 19 kHz
No. 2
0 50 kHz

Line-frequency trap with lowpass filter
10 dB/div Marker 15.625 kHz
No. 3
0 50 kHz

A-filter + pilot-tone trap
A-filter + line-frequency trap
2 dB/div Marker 1 kHz
No. 4 + 5
100 Hz 0,4 1 4 10 20 kHz

Bandpass filter 315 Hz
10 dB/div Marker 315 Hz
No. 6
0 630 Hz

Bandpass filter 1 kHz
10 dB/div Marker 1 kHz
No. 7
0 2 kHz

Bandpass filter 3.15 kHz
10 dB/div Marker 3.15 kHz
No. 8
0 6,3 kHz

Bandpass filter 6.3 kHz
10 dB/div Marker 6.3 kHz
No. 9
0 12,6 kHz

Bandpass filter 10 kHz
10 dB/div Marker 10 kHz
No. 10
0 20 kHz

Bandpass filter 12.5 kHz
10 dB/div Marker 12.5 kHz
No. 11
0 27,6 kHz

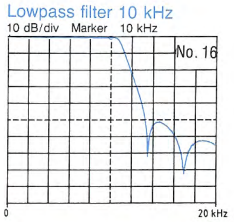
Lowpass filter 350 Hz
10 dB/div Marker 350 Hz
No. 12
0 1 kHz

Lowpass filter 1 kHz
10 dB/div Marker 1 kHz
No. 13
0 2 kHz

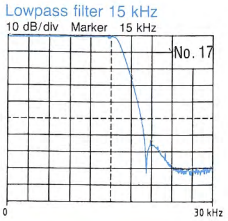
Lowpass filter 3.5 kHz
10 dB/div Marker 3.5 kHz
No. 14
0 7 kHz

Lowpass filter 7 kHz
10 dB/div Marker 7 kHz
No. 15
0 14 kHz

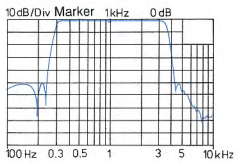
Lowpass filter 10 kHz



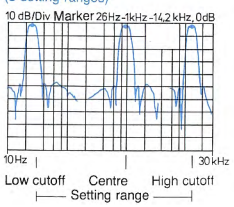
Lowpass filter 15 kHz



Telephone bandpass filter 320 Hz to 3.4 kHz



Contin. tunable bandpass (3 setting ranges)



Filter Circuit Board UPA-B3/UPA-B4

The special filter (option UPA-B3) is a printed circuit breadboard with 8-bit control section, decoder and analog switch, partly fitted with components and prepared for configuration of customer-specific filters. On request, such customized filters will be developed and made by R&S (UPA-B4).

These filters, which can be combined with the filters of the UPA basic configuration as desired, can also be switched into the signal path simply by entering a number.

Two slots are provided in the UPA for insertion of the Special Filter UPA-B2 and Filter Circuit Boards UPA-B3/-B4 or even of two different Filter Circuit Boards UPA-B3/-B4.

Generator

The generator (option UPA-B6, fitted as standard in UPA3) extends the UPA to form an **audio test assembly.** With a SINAD of more than 80 dB, the generator provides highly stable sinewave voltages with great level accuracy which are adjustable from 0.1 mV to 12.4 V. The voltage can be set in V or mV, or the level in dBV or dBm(Z), the latter being the output of the actual power level referred to any value of impedance Z. The frequency is crystal-accurate from 10 Hz to 110 kHz with a resolution of 0.1 Hz in the lower range, 1 Hz in the medium and 10 Hz in the upper frequency range. Short level and frequency setting times allow fast rates in computer-controlled measurements.

Outputs Connection of the generator to a device under test is very easy due to universal outputs with precise reference values and special features, such as

- coaxial or balanced (switch-selectable), floating, matching with the test inputs of UPA;
- high internal crosstalk attenuation: better than 80 dB at 20 kHz;
- output signal can be switched either to right or left channel or to both channels simultaneously – this makes signal allocation easy when measuring crosstalk as well as level or phase differences in stereo channels;
- real, ohmic output impedance with narrow tolerances, switch-selectable: 30, 200 or 600 Ω.

Signal-to-noise ratio measurement With the aid of the generator the UPA can measure the signal-to-noise ratio fully automatically. It is necessary to preselect the reference level and reference frequency for the S/N ratio. As a result of this automatic measurement the logarithmized ratio of signal to noise is read out in dB.

Automatic sweep The generator can be set to automatic sweeping of level or frequency increments. The limit and increment value, the time between the individual sweeps and the desired sweep mode (single sweep or automatic repetition) can be entered via the keyboard.

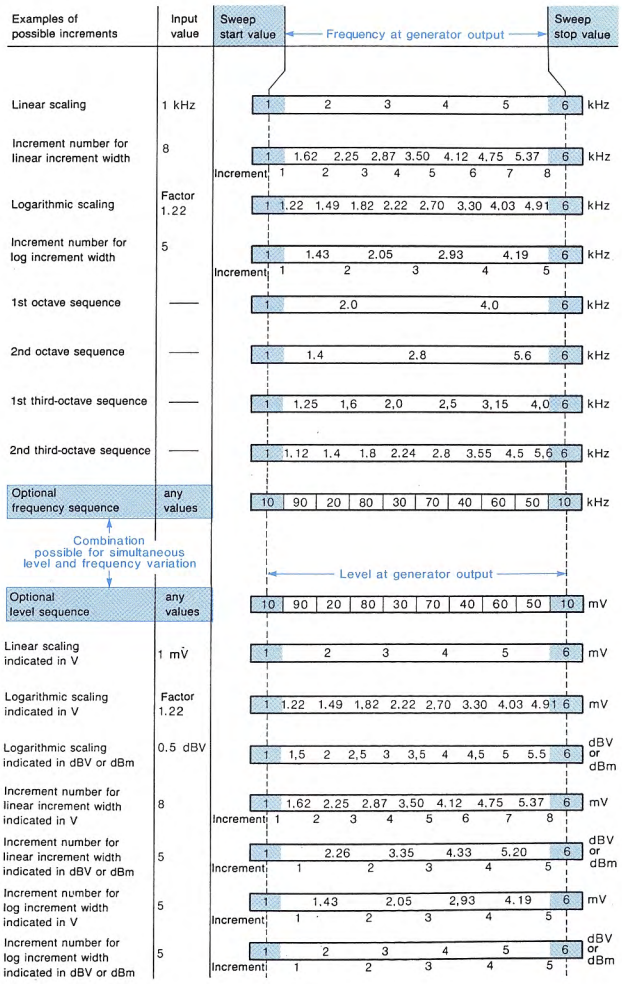
For special applications, any desired level and/of frequency sequence can be defined in 1 to 99 steps.

The sweep function allows fast and convenient investigations of test items, such as measurement of

- frequency response,
- phase difference (as a function of input frequency),
- distortion (as a function of input voltage of frequency),
- signal-to-noise ratio (as a function of input voltage) and
- dynamic range.

The results are automatically plotted or listed on a printer.

Sweep possibilities for frequency and level
(values shown as example)



UPA

Wow and flutter meter

Fitted with the wow and flutter meter (option UPA-B9), the Audio Analyzer is able to penetrate into fields of AF engineering where complete automatic test systems have virtually not been available until now. The wow and flutter meter is used to **determine pitch variations or wow and flutter** of magnetic tape units, record players and drives using different weighting criteria in line with international standards. Pitch variations are weighted by the UPA with

a) quasi-peak-responding rectification to DIN, CCIR and IEC at a reference frequency of 3.15 kHz,

b) average-responding rectification to NAB at 3 kHz and

c) rms-responding rectification to JIS at 3 kHz.

A standard filter with a centre frequency of 4 Hz is used for physiological assessment of wow and flutter.

Wow and flutter measurements Broadband wow and flutter in the range 0.1 to about 300 Hz can be measured without weighting. The inherent noise of the wow and flutter meter is 0.001%, ensuring precise evaluation of all kind of equipment from a simple cassette recorder through to professional studio machines or precision record players. For sound-recording equipment it is also of vital importance to **measure the absolute or rotational speed.** The frequency counter integrated in the UPA measures the reproduction frequency. After input of a nominal frequency the error or drift can be indicated on the frequency display, pitch variations being simultaneously read out.

The optional wow and flutter meter can also **measure amplitude variations** to allow further quality judgement of magnetic sound equipment. Tape-guide problems in the area of the sound heads but also faults in the premagnetization or defects due to inhomogeneity of the magnetic layer of the tape are thus detected quickly. At recording frequencies of about 2 to 20 kHz amplitude variations can be read out in % or dB with or without weighting. The variation measurement range extends from 0 to nearly 100% or 0 to 20 dB.

A special feature in the case of heavily fluctuating results in pitch and amplitude measurements is the **statistical weighting** on the basis of the normalized **2−σ frequency** of the Gaussian distribution curve over a defined test period of 5,10 or 20 s.

Distortion meter

The distortion meter (option UPA-B8, fitted as standard in UPA 3 and UPA 4) allows continuous measurement of non-linear amplitude distortion at fundamental frequencies from 10 Hz to 100 kHz, the following modes being selectable:

- Measurement of total harmonic distortion including broadband noise
- Selective measurement of harmonic distortion d_2 to d_9
- Indication of SINAD
- Indication of distortion or SINAD level, with selected reference
- Indication of total harmonic distortion (THD), with order of harmonics preselected

Distortion can be measured down to 0.003% or −90 dB (−100 dB when calculating noise components, see above UPA 4) or SINAD up to +90 dB.

The distortion or SINAD measurement is carried out fully automatically. Internal presetting based on the result of frequency measurement and automatic fine tuning are made to ensure suppression of the fundamental. A HOLD function allows current presettings of the fundamental rejection filter to be maintained. This presetting is however also possible by direct entry of the frequency value or generator frequency selection. This will increase the measurement rate or improve the setting accuracy in the case of heavily disturbed signals.

An important field of application for selective distortion measurement is the direct display of the third harmonic, especially on magnetic sound equipment. After suitable evaluation signal spectra up to an upper frequency limit of about 300 kHz can also be displayed.

SINAD measurement The SINAD value is a measure used in radiotelephony for joint evaluation of harmonic distortion and receiver sensitivity; it is read out in dB and defined as the logarithmic ratio of

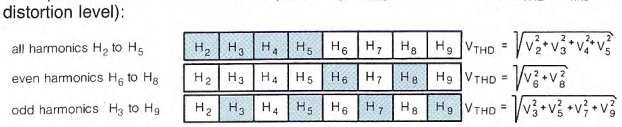
$$\frac{\text{signal}+\text{noise}+\text{distortion}}{\text{noise}+\text{distortion}}$$

In addition to broadband measurement, the SINAD ratio is also often weighted to CCITT. For this purpose the telephone- or speech-channel filter can be switched on.

The **distortion or SINAD level** of the harmonic distortion can be read out for special applications, derived as a reference value from the current measurement or entered via the UPA keyboard. If a distortion or SINAD level measurement with reference is selected, the relative deviation from the reference value is read out in Δ% or ΔdB.

In addition to the measurement function TOTAL, which includes both harmonics and broadband interference in the measurement, the **THD function** (total harmonic distortion) permits the selective measurement of combinations of 2nd- to 9th-order harmonics **excluding** broadband interference. Especially with noisy signals, such as occur in radiotelephones with a lot of inherent noise, THD measurements provide qualitative statements about harmonic distortion.

Examples of THD measurements (V_2 to V_9: V_{rms} of harmonics; V_{THD}: V_{rms} of distortion level):



DC output

A two-channel DC output (option UPA-B1) allows XY representation with many different scales of measurement functions, eg on a connected recorder. The two output channels may be allocated as desired to the three measurement parameters: level, frequency and function. In conjunction with the sweep capabilities of the generator, the measurement functions can be recorded without the use of a process controller.

Operation

The UPA is operated by **function keys** and for a large variety of settings by direct entry on a **numerical keypad** with monitoring facility on the DATA display. With linear and logarithmic increment selection, quasi-continuous variation of the generator level and frequency is possible using the **spinwheel.** Special functions allow less common functions, auxiliary or service settings to be recalled. Since all entries are internally checked by the microprocessor program, incorrect operation is excluded to a large extent.

Examples of special functions

Definition	Input sequence
Select IEC-bus address 7	1 . 7 SPEC FCT
Write protection for total setup	6 . 1 1 SPEC FCT
Select FAST level measurement	1 0 . 1 SPEC FCT
Start frequency sweep	2 9 SPEC FCT
Enter 0.01 V as distortion reference value	3 7 . 2 SPEC FCT 0 . 0 1 V/mV STO LEV
Select phase measurement	3 8 . 1 SPEC FCT

Selection of display mode Keys for selection of the display mode allow voltage- or power-referred values, eg in dBV, dBm(Z), W(Z), to be displayed in addition to the absolute units for voltage and frequency. Values referring to power require a reference impedance Z which can be entered on the UPA. For everyday measurements the indication of relative values for voltage (%, dB) and frequency (Δf, Δf%) proves particularly useful. Reference values can be entered directly or taken from the ongoing measurement:

Display and conversion possibilities

	Key	Display
Voltage	V	V_{in}
Level	dBV	$20 \lg \frac{V_{in}}{1\,V}$
	dBm (Z)	$10 \lg \frac{V_{in}^2}{Z \times 1\,mW} = dBV = (Z = 600\,\Omega)$
	%/dB	$\frac{V_{in} - V_{ref}}{V_{ref}} \times 100\%$ or $20 \lg \frac{V_{in}}{V_{ref}}$
	W (Z)	$\frac{V_{in}^2}{Z}$
Frequency	FREQ	f_{in}
	Δf/Δf%	$f_{in} - f_{ref}$ or $\frac{f_{in} - f_{ref}}{f_{ref}} \times 100\%$

Function	%/dB		**Special function**	
Wow and flutter	in %		Distortion or	
AM, distortion	in % or dB		SINAD level	in V, Δ% or Δ dB
SINAD, S/N	in dB		Phase	in degrees

Basic setting In addition to the internal basic setting of the UPA, the user can select a self-defined setting after switch-on, or the last setting used before the UPA was switched off. This basic setting can also be recalled at any time during operation.

Non-volatile memory Up to 50 complete instrument setups including all functions and numerical entries can be stored in a non-volatile memory with battery backup. Existing setups can be protected against inadvertent overwriting. The last setting is stored automatically. After a power failure or after switching the UPA off and on, each stored setup can be recalled by simply pressing two keys. This also facilitates operation if complicated function or display settings, for instance with indication of relative measured values, are frequently needed.

Display of test results For indication of the test results the UPA has three liquid-crystal displays for level, frequency and function/data. In many cases – for example during adjustment or setting to a given nominal value – it is very helpful if in addition to the **digital display** with high resolution there is also an analog presentation showing changes of the test results. Major changes can easily be detected on an **analog display,** whereas minor changes can better be recognized on the digital display.

The LCDs of the UPA allow the user to choose between three display modes by pressing the appropriate key:

- 7-segment digital display
- digital display combined with analog bar display
- analog bar display with indication of range

Setting values, background illumination The LCDs also permit digital readout of the generator setting values or reference values. For adaptation to ambient light, the displays are provided with continuously variable background illumination.

Remote control With a remote-control interface to IEC 625-1, even the basic model of the UPA can be remotely controlled and used in automatic test assemblies. The great variety of IEC-bus commands for instrument setting and output of the results allows flexible and clear programming in system operation. The IEC-bus commands are given in easy-to-read plain text which may also be in abbreviated form.

An interesting feature is the **IEC/IEEE-bus request function.** Each header of an IEC/IEEE-bus command transmitted from the controller to the UPA can be complemented with"?". The UPA responds with an ASCII string in plain text representing the instrument setting. This considerably simplifies the preparation of IEC/IEEE-bus control programs.

Logging of results Logging of the test results is possible on a recorder via the analog outputs or on a printer via the IEC/IEEE-bus interface fitted as standard. The hardcopy is printed out at a keystroke or in automatic sweep mode as a graphics plot or as a list. The complete automatic test run with data logging and output of diagrams is performed without the use of an external process controller.

UPA

Examples of IEC-bus commands

Definition	Plain-text command	Shortest form
Result of level measurement in dBV	"MEASUREMENT (LEVEL DBV)"	"M(L DBV)"
FAST frequency measurement rate	"RATE (FREQUENCY FAST)"	"RAT(F F)"
Selection of distortion measurement	"DISTORTION (TOTAL MODE (AUTO))"	"DIST(T M(A))"
Wow and flutter Select 2-sigma measurement	"WOWFLUTTER (DIN WTD ONSIGMA)"	"W(D W ON)"
Trigger single measurement	"TRIGGER (SINGLE)"	"T(SI)"

```
MACDDB    -005.37E+0   SOUHZ     02.500E+3
MACDDB    -005.63E+0   SOUHZ     02.800E+3
MACDDB    -005.75E+0   SOUHZ     03.100E+3
MACDDB    -007.68E+0   SOUHZ     03.400E+3
MACDDB    -012.37E+0   SOUHZ     03.700E+3
MACDDB    -017.75E+0   SOUHZ     04.000E+3
MACDDB    -022.92E+0   SOUHZ     04.300E+3
MACDDB    -027.87E+0   SOUHZ     04.600E+3
MACDDB    -032.84E+0   SOUHZ     04.900E+3
MACDDB    -038.21E+0   SOUHZ     05.200E+3
MACDDB    -044.69E+0   SOUHZ     05.500E+3
MACDDB    -055.22E+0   SOUHZ     05.800E+3
```

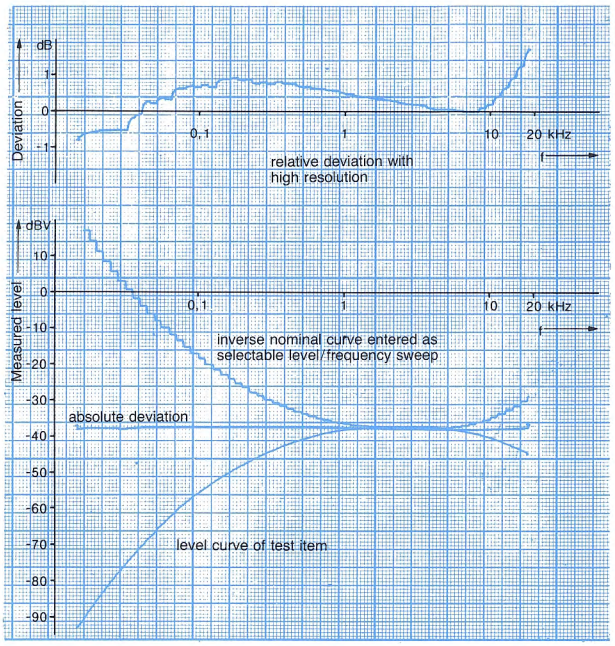
Above Listing of results on IEC-bus printer, in talk only mode

Below Data logging on IEC-bus printer, in talk only mode

```
+-------------------------------------------------------------------------+
|                F R E Q U E N C Y - S W E E P - R E P O R T              |
+-------------------------------------------------------------------------+
|                  [x] Scale      0       -7.5      -15      -22.5     -30 |
|    Level                   dB  +---R-----+---------+--------+---------+ |
|                  [.] Ref-Line      -3                                   |
|=================================|                                       |
|                  [*] Scale      90       67.5      45       22.5      0 |
|    Phase                   DEG +---------+---------R--------+---------+ |
|                  [:] Ref-Line                      45                   |
+----------+-----------+---------+-------------------------------------------+
|   Freq   |   Lev [x] | Fnct [*] |                                          |
+----------+-----------+---------+-------------------------------------------+
| 200.0  Hz -000.26E+0   001.10E+0| x   .   |         :         |          *  |
| 247.8  Hz -000.19E+0   001.36E+0| x   .   |         :         |         *   |
| 307.0  Hz -000.14E+0   001.68E+0| x   .   |         :         |         *   |
| 380.4  Hz -000.09E+0   002.08E+0| x   .   |         :         |         *   |
| 471.3  Hz -000.06E+0   002.58E+0| x   .   |         :         |         *   |
| 583.9  Hz -000.03E+0   003.19E+0| x   .   |         :         |         *   |
| 723.5  Hz -000.03E+0   003.95E+0| x   .   |         :         |        *    |
| 896.4  Hz -000.03E+0   004.88E+0| x   .   |         :         |        *    |
| 1.111 kHz -000.04E+0   006.04E+0| x   .   |         :         |       *     |
| 1.376 kHz -000.07E+0   007.46E+0|x----.---+---------+---------+------*----+
| 1.705 kHz -000.11E+0   009.21E+0| x   .   |         :         |     *       |
| 2.112 kHz -000.18E+0   011.34E+0| x   .   |         :         |    *        |
| 2.617 kHz -000.29E+0   013.96E+0| x   .   |         :         |   *         |
| 3.243 kHz -000.44E+0   017.08E+0|x  .     |         :         |  *          |
| 4.018 kHz -000.68E+0   020.81E+0|x  .     |         :         | *           |
| 4.978 kHz -001.01E+0   025.14E+0|x  .     |         :        *|             |
| 6.168 kHz -001.47E+0   030.09E+0| x .     |         :      *  |             |
| 7.642 kHz -002.09E+0   035.59E+0|  x.     |         :   *     |             |
| 9.468 kHz -002.89E+0   041.41E+0|   x     |         : *       |             |
| 11.73 kHz -003.89E+0   047.42E+0|+---x----+---------*---------+-------------+
| 14.53 kHz -005.08E+0   053.14E+0|    . x  |     *   :         |             |
| 18.01 kHz -006.43E+0   058.57E+0|    .   x|   *     :         |             |
| 22.31 kHz -007.92E+0   063.35E+0|    .    |x*       :         |             |
| 27.64 kHz -009.53E+0   067.50E+0|    .    |  * x    :         |             |
| 34.25 kHz -011.16E+0   070.99E+0|    .  * |    x    :         |             |
| 42.44 kHz -012.88E+0   073.79E+0|    .  * |      x  :         |             |
| 52.58 kHz -014.64E+0   076.22E+0|    . *  |         x         |             |
| 65.14 kHz -016.43E+0   078.26E+0|    .*   |         : x       |             |
| 80.71 kHz -018.21E+0   080.12E+0|    *    |         :   x     |             |
|100.00 kHz -020.01E+0   083.54E+0|+---*.---+---------:-------x-+-------------+
+-------------------------------------------------------------------------+

Additional Status Information :

Output      : RIGHT C
Generator   : Level =  1.0000 V
Sweep       : Start =  200.00 Hz , Stop =  100.00 kHz
 (Freq.)      Increment = log / 29 Steps over SWEEP-Range
              Delay = 150 ms

Input       : LEFT  C
Range       : Auto
Filter      : HP 22 Hz
Detector    : RMS
Rate        : Level (Fast) , Freq. (Fast)

Display     : Level (Meas) , Freq. (Source)
References  : Level =   0.9893 V  , Freq. =  1000.0 Hz
              Impedance =  600.00 Ohm


+- Notes ------------------------------------------- Date    /    /    ---+
|                                                                          /\|
|                                                                         /R|\
|                                                                         \/S|
+- END -- Report generated with UPA ------------------ c/86 Rohde & Schwarz \/
```

AC output is provided eg for connection of an oscilloscope, monitor or headphones for voltage and frequency measurements. When wow and flutter as well as distortion are measured, the variation or distortion signal is available at the AC output (isolation between the test inputs and the AC output).

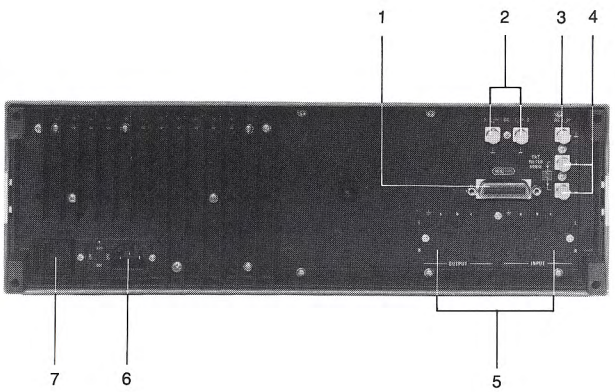
DC outputs for connection of a recorder, eg XY recorder, for XY representation of test results.



Recording of results via DC outputs on XY recorder
Freely selectable level/frequency sweep for documenting the departure of the measured results from the nominal response

Design

The UPA is made up of the front-panel display and control unit, a power supply module on the rear and a motherboard with four plug-in modules for the measurement section and processor control. Depending on the configuration desired, the UPA can be fitted with up to seven plug-in options plus the DC output option mounted on the rear panel.



Rear connector panel
1 IEC-bus connector
2 DC outputs (option 1)
3 AC output
4 Connector for external filters
5 Space provided for incorporation of test inputs and generator outputs
6 AC supply connector, voltage selector
7 Power switch

Specifications of UPA, UPA 3

(Specificatcns of UPA 4 see page 241)

AF level meter

Voltage measurement range	10 µV to 300 V, unbalanced 10 µV to 35 V, balanced
Range selection	autoranging or manual
Frequency range	10 Hz to 100 kHz
3-dB bandwidth	3 Hz to 300 kHz
Weighting filters	
Highpass filter	22 Hz[1]), 300 Hz
Lowpass filter	22 kHz[1]), 100 kHz
Noise filters	noise weighting filter to DIN 45405/CCIR 468-4, telephone weighting filter to CCITT O.41/P53, A-filter to DIN IEC 651 (contained in option UPA-B2)
Special filters	plug-in cards, options UPA-B2 and UPA-B3
Test inputs	
Balanced	two three-contact female connectors to DIN 41628, switchable R/L channel
Unbalanced	two BNC female connectors, floating, switchable R/L channel
Input impedance	selectable 1 MΩ ±1% (unbal.) or 600 Ω, 20 kΩ ±1% (bal.)
Input capacitance	<130 pF (unbal.), <200 pF (bal.)
Unbalance rejection for balanced input	>110 dB at 50 Hz, >60 dB at 16 kHz, to DIN 45405
Common-mode rejection for unbalanced input	>50 dB at 50 Hz
Crosstalk attenuation R/L	>80 dB at 20 kHz (termination 600 Ω)
Permissible input voltage (AC + DC)	
Unbalanced input	V_{rms} = 300 V, V_p = 500 V, V_p = 10 V (BNC outer conductor referred to ground)
Balanced input	V_{rms} = 35 V, V_p = 100 V (a referred to b), V_p = 350 V (a or b referred to ground)
Rectifiers	rms-responding rectifier, max. crest factor = 5; quasi-peak-responding rectifier to DIN 45405 and CCIR 468-4
Level indication	
Digital display	5-digit readout in mV, V, dBm(Z), mW(Z) or W(Z), derived from measured voltage and reference impedance; relative indication in % or dB, referred to reference value entered
Maximum resolution	1 µV, 0.01 dB or 0.01%
Analog display	fast bargraph indication of absolute or relative values with simultaneous digital display of full-scale deflection or measured value
Error limits with RMS (sinewave)[2])	
10 to 30 Hz	±3% ±1 digit, additionally ±1% in 0.3-mV range
30 Hz to 20 kHz	±1% ±1 digit
20 to 100 kHz	±3% ±1 digit
Additional error with	
crest factor <3	±0.5%
≥3 <5	±1.5%
Error limits with quasi-peak (sinewave)[2])	
10 to 30 Hz	±4% ±1 digit
30 Hz to 20 kHz	±1% ±1 digit
20 to 100 kHz	±3% ±1 digit
Inherent noise	
Unbalanced (600 Ω)	
CCITT, weighted (RMS)	<2 µV
CCIR, weighted (QPK)	<10 µV
CCIR, unweighted (QPK)	<7 µV
Without filter (RMS)	<15 µV
Without filter (QPK)	<30 µV
Balanced (600 Ω)	
CCITT, weighted (RMS)	<5 µV
CCIR, weighted (QPK)	<20 µV
CCIR, unweighted (QPK)	<30 µV
Measuring time[3])	
in level mode SLOW, f >10 Hz	<1.2 s/measurement, about 3 display changes/s in manual mode
FAST, f >300 Hz	<50 ms/measurement with RMS, <85 ms/measurement with QPK

DC voltage measurement

Voltage measurement range	0 to ±300 V
Range selection	autoranging or manual
Test inputs	see AF level meter, but unbalanced only
Indication	
Digital display	2½ digits, units and relative measurement see AF level meter
Max. resolution	10 mV
Analog display	see AF level meter
Error limits	±1% ±1 digit
Measurement rate	SLOW, FAST, switch-selected

Frequency counter

Frequency measurement range	8 Hz to 250 kHz
Required input voltage	>10 mV (S/N ratio >20 dB)
Frequency indication	5-digit readout in Hz, kHz or relative value in Hz, kHz or in %
Analog display	fast bargraph indication of absolute or relative values with simultaneous digital display of full-scale deflection or measured value
Resolution	
8 to 99.999 Hz	0.001 Hz
90 to 999.9 Hz	0.01 Hz
900 Hz to 9.9999 kHz	0.1 Hz
9 to 99.999 kHz	1 Hz
90 to 249.99 kHz	10 Hz
Error limits	±0.005% ±1 digit

Measuring time[4])

		Level mode SLOW	Level mode FAST
Frequency mode	SLOW	<660 ms or 380 ms + 9 × period[5])	<330 ms
	FAST	<420 ms or 380 ms + 2 × period[5])	<90 ms

Generator (option UPA-B6, standard in UPA 3)

Principle of operation	AF synthesizer
Frequency range	10 Hz to 100 kHz, adjustable up to 110 kHz
Setting	entry via keyboard in Hz or kHz, manually using spinwheel or sweep mode
Indication	5-digit display
Resolution	
10 Hz to 999.9 Hz	0.1 Hz
1 kHz to 9.999 kHz	1 Hz
10 kHz to 110 kHz	10 Hz
Error limits	±0.01%
Frequency switching time	<50 ms (frequency error ±0.5%), <100 ms (frequency error ±0.1%)
Outputs	
Balanced	two three-contact female connectors to DIN 41628, switchable R/L, R+L channel
Unbalanced	two BNC female connectors, floating, switchable R/L, R+L channel
Unbalance rejection (bal. output >1 V)	>80 dB at 1 kHz, >60 dB at 16 kHz, to DIN 45404, IEC 268-1, with termination 2 × 300 Ω (bal.) and 10 kΩ (unbal.)
Crosstalk attenuation	>80 dB at 20 kHz between R and L, with termination of 600 Ω
Output impedance (throughout level range)	30 Ω, 200 Ω or 600 Ω, switch-selected; tolerance ± (0.5 Ω + 0.5%)
Output voltage, unloaded	0.1 mV to 12.4 V
Level setting	entry via keyboard in V, mV, dBV or dBm or manually using spinwheel or sweep mode
Indication	5-digit readout
Resolution	
dBV and dBm	0.01 dB
0.1 to 2.999 mV	0.001 mV
3 to 29.99 mV	0.01 mV
30 to 299.9 mV	0.1 mV
300 mV to 2.999 V	1 mV
3 to 12.4 V	10 mV
Load impedance	>200 Ω
Max. load current	54 mA
Output circuit	short-circuit-proof, switched off in case of external feeding

Footnotes see page 241.

UPA, UPA 3

Specifications, continued

Distortion (incl. noise voltage, the greater value of inherent distortion or 20 log $\frac{\text{noise voltage}}{\text{output voltage}}$ dB being applicable)

Frequency range	<10 mV	Output voltage 10 to 300 mV	>300 mV	Lowpass filter
30 Hz to 20 kHz	<−75 dB, 7 µV	<−75 dB, 10 µV	<−80 dB	100 kHz
10 to 30 Hz and 20 to 100 kHz	<−65 dB, 10 µV	<−65 dB, 15 µV	<−70 dB	—

Error limits of output voltage
at 1 kHz . . . . . ±1%
Frequency response flatness
(ref. to 1 kHz)
10 Hz to 20 kHz . . . . . ±0.5%
20 to 100 kHz . . . . . ±1%
Level setting time . . . . . <10 ms

S/N ratio measurement
(with generator, option UPA-B6)

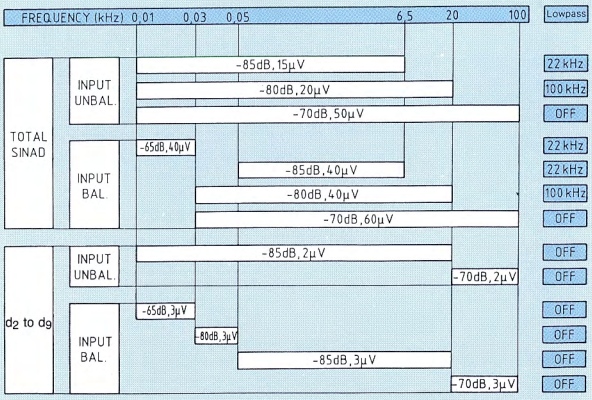
Signal frequency range . . . . . 30 Hz to 100 kHz
Indication of S/N . . . . . digital and analog in dB
Range of indication . . . . . 0 to 120 dB
Resolution . . . . . 0.1 dB
Error limits (without consideration of inherent noise) for
S/N ≤60 dB . . . . . ±1 dB
>60 dB . . . . . ±2 dB
Inherent S/N ratio
(the smaller value of
S/N ratio or 20 log $\frac{\text{output voltage}}{\text{noise voltage}}$ dB
being applicable)
>85 dB or <20 µV, with highpass filter 22 Hz and lowpass filter 100 kHz
Measuring time[6])
in level mode SLOW (f >30 Hz) . . . . 4 s
FAST (f >300 Hz) . . . . 1.7 s

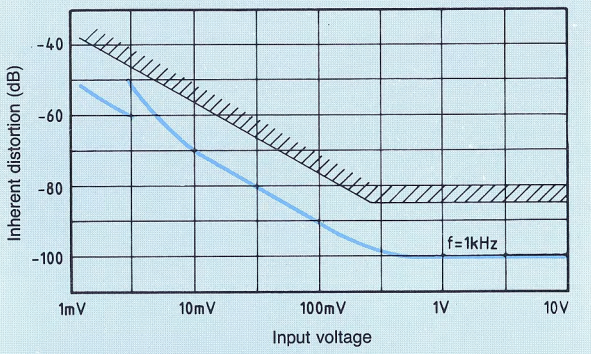
Distortion meter (option UPA-B8, standard in UPA 3 and UPA 4)

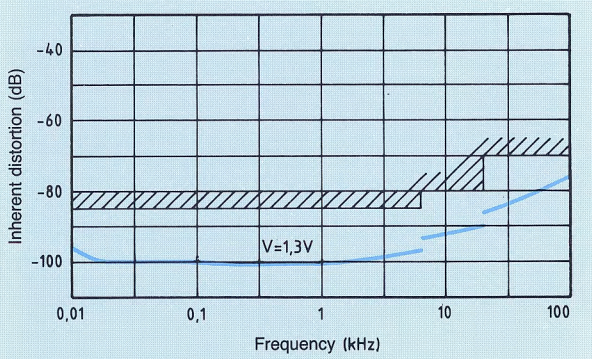
Frequency range (fundamental) . . . . 10 Hz to 100 kHz
(harmonics) . . . . . 20 Hz to 300 kHz
Frequency adjustment . . . . . automatic or by frequency preselection
Minimum input voltage . . . . . 12 mV (10 to 400 Hz), 1.2 mV (>400 Hz to 100 kHz)
Display modes (digital, analog) . . . . total harmonic distortion d_{TOTAL} in % or dB, selective distortion d_2 to d_9 in % or dB, SINAD in dB, distortion or SINAD level in mV, V or relative in % or dB, referred to reference value entered
Range of indication . . . . . 0.0001 to 100%, −120 to 0 dB (distortion); 0 to 120 dB (SINAD); 1 µV to 300 V (distortion or SINAD level); −100 to 1000% or ±140 dB (relative distortion or SINAD level)
Error limits (in automatic mode, without additional error caused by inherent noise)
d_{TOTAL} or SINAD
20 Hz to 20 kHz . . . . . ±1 dB (harmonics up to 100 kHz)
10 to 20 Hz and 20 to 100 kHz . . ±2 dB (harmonics up to 300 kHz)
d_2 to d_9 (for signals with frequency components up to max. 400 kHz)
Harmonics up to 100 kHz . . . . . ±2 dB (d_n, max. −10 dB)
Harmonics up to 300 kHz . . . . . ±3 dB ($d_{±n}$, max. +30 dB above d_n)
Measuring time (d = −20 to −70 dB, without switchover of level range)

	min.	max.	typ.
10 to 400 Hz (SLOW level meas.)			
d_{TOTAL} or SINAD	1.8 s	10 s	3.4 s
d_2 to d_9	2.3 s	22 s	9 s
0.3 to 100 kHz (FAST level meas.)			
d_{TOTAL} or SINAD	0.6 s	5.5 s	1.3 s
d_2 to d_9	0.7 s	6.5 s	1.5 s

Limit values of inherent distortion
(automatic mode, the greater value of
inherent distortion or 20 log $\frac{\text{noise voltage}}{\text{input voltage}}$ dB
being applicable)







The blue curves represent the typical inherent distortion (d_{TOTAL}/SINAD, unbalanced input)

Wow and flutter meter (option UPA-B9)

Wow and flutter meter
Reference frequency . . . . . 3.15 kHz to DIN, IEC, CCIR; 3 kHz to NAB, JIS
Tolerance range . . . . . within ±5%
Range of frequency variation . . . . . 0.1 to 300 Hz
Weighting, rectification . . . . . quasi-peak-responding to DIN 45507, IEC 386 and CCIR 409-2, average-responding to NAB, rms-responding to JIS
Maximum resolution 0.001%
Unweighted measurement . . . . . SLOW, FAST, selectable
Statistical weighting . . . . . 2-σ weighting, selectable
Measurement range . . . . . 0.003 to 5%
Error limits . . . . . ±10%
Required input voltage . . . . . 30 mV
Measuring time . . . . . 2 s
with 2-σ weighting . . . . . 5, 10 or 20 s

Amplitude variation meter

Frequency range	2 to 20 kHz
Range of variation	
Level	0 to 20 dB
Frequency	0.1 to 300 Hz
Weighting	with quasi-peak-responding rectifier to DIN 45507
Unweighted measurement	SLOW, FAST, selectable
Statistical weighting	2-σ method, selectable
Indication	digital and analog readout in dB and %
Maximum resolution	0.001 dB or %
Error limits	
0 to 3 dB	±0.25 dB
>3 to 12 dB	±1 dB
>12 to 20 dB	±2.5 dB
Measuring time	2 s
with 2-σ weighting	5, 10 or 20 s

Phase measurement

Indication	digital readout in degrees
Range of indication	0 to 180 degrees
Resolution	0.1 degree

DC output (option UPA-B1)

Two-channel design, measurement function and scaling selectable	±10 V, Z_{out} = 1 kΩ
Resolution	12 bits

Special filter (option UPA-B2)

A-filter	to DIN IEC 651
Bandstop filters	pilot-tone trap with 15-kHz lowpass filter, line-frequency trap with 13-kHz LP filter (both filters can also be combined with A-filter)
Bandpass filters	standard frequencies 315 Hz, 1 kHz, 3.15 kHz, 6.3 kHz, 10 kHz and 12.5 kHz; with adjustable passband frequency from 23 Hz to 15.5 kHz (generator tracking function) telephone bandpass filter 320 Hz to 3.4 kHz
Lowpass filters	350 Hz, 1.04 kHz, 3.5 kHz, 7 kHz, 10.4 kHz and 15 kHz
Passband ripple	better than ±0.5 dB for bandstop, bandpass and lowpass filters (passband corresponds to cutoff frequencies defined above)
S/N ratio	>40 dB for bandpass and lowpass filters
	>40 dB for f ≥130 Hz | adjustable
	>35 dB for f ≥ 65 Hz | bandpass
	>30 dB for f ≥ 23 Hz | filter

Filter circuit board (option UPA-B3)	plug-in filter board for customized filters (can be fitted in UPA together with special filter option UPA-B2)

Remote control

Interface	IEC 625-1 (IEEE 488), connector: 24-contact Amphenol, control of all instruments functions, incl. Serial Poll, Parallel Poll
Interface functions	SH1, AH1, L4, T5, SR1, RL1, DC1, DT1, PP1

General data

Rated temperature range	0 to +50 °C, for use in class 1 to IEC 359 (excluding condensation)
Storage temperature range	−40 to +70 °C
Power supply	100/120/220/240 V ±10%, 47 to 63 Hz (50 VA), safety class 1 to VDE 0411 and IEC 348
RFI suppression	DBP approval number to regulations 527/1979
Mechanical stress	to IEC 359, class 1
Compact unit	width: 19″, height: 3 units
Dimensions (W×H×D), weight	470 mm × 162 mm × 480 mm, 16 kg

Specifications of UPA 4

The Audio Analyzer UPA 4 has the same specifications as the Audio Analyzer UPA with built-in option UPA-B8. The following additional data refer to the unbalanced inputs with rms weighting:

Frequency response, referred to 1 kHz, range 100 mV to 10 V

20 to 40 Hz	±0.05 dB
40 Hz to 20 kHz	±0.03 dB

Total inherent distortion

In 1-V range from 0.5 to 1.1 V, in 3-V range from 1.5 to 3.5 V, 22-kHz lowpass filter connected	<−97 dB
With 2 mV, 1 kHz and A-weighting filter switched on (contained in UPA-B2)	<−50 dB

Inherent noise voltage

Unbalanced input terminated with 50 Ω, 22-kHz lowpass filter connected .... ≤3 µV

Ordering information

Order designation	▶ Audio Analyzer	
UPA (basic model)		372.6014.02
UPA 3 (with generator and distortion meter)		372.6014.03
UPA 4 (especially for CD measurements)		372.6014.04

Extensions (options)

Generator (stand. in UPA 3)	UPA-B6	373.0010.02
Distortion Meter (stand. in UPA 3, 4)	UPA-B8	373.6016.02
Wow and Flutter Meter	UPA-B9	373.2612.02
Special Filter	UPA-B2	373.1216.02
Filter Circuit Board, without components	UPA-B3	373.1545.02
Customized Filter	UPA-B4	1002.1200...
DC output	UPA-B1	373.2512.02

Recommended extras

19″ Rack Adapter	ZZA-8	078.8439.00

An application program and application note for UPA 4 is available free of charge on request.

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[1]) The combination of these two filters corresponds to a filter for unweighted noise measurement to DIN and CCIR.

[2]) In automatic mode; SLOW measurement rate without additional error caused by inherent noise. With FAST measurement rate for f >300 Hz additional error of max. −2% from 300 Hz to 1 kHz.

[3]) Valid for digital display of level in line with IEC-bus TRIGGER (MODE [LEV]) and DISPLAY (LEVEL VALUE), triggered measurement with Group Execute Trigger without range switching. Measurement functions wow and flutter, distortion, SINAD and S/N switched off.

[4]) Valid for digital display of frequency in line with IEC-bus TRIGGER (MODE [FREQ]) and DISPLAY (FREQ VALUE), triggered measurement with Group Execute Trigger without level range switching. Measurement functions wow and flutter, distortion, SINAD and S/N switched off.

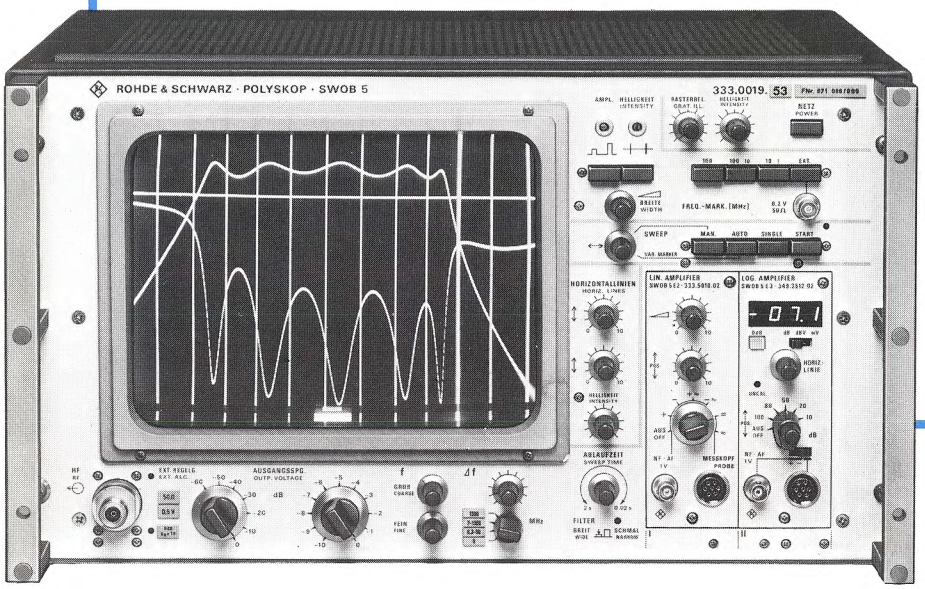
[5]) The greater value is applicable.

[6]) Valid in FAST frequency mode.

SWOB 5

Polyskop SWOB 5 ♦ 0.1 to 1300 MHz

- Compact sweep tester for single-channel or dual-channel display with linear or logarithmic amplification (variable configuration)
- Wide dynamic range (75 dB) through low inherent noise and high output voltage
- Calibrated level line with logarithmic amplification plus two independently shiftable level lines
- Pulse or vertical-line frequency markers with crystal accuracy



Characteristics and uses

Polyskop SWOB 5 combines in a compact unit all the measuring facilities needed in an up-to-date sweep tester:

sweep generator with an output EMF of 1 V (+6 dB if required), with output attenuator covering 70 dB;

display section with linear or logarithmic amplifiers, with a dynamic range of 76 dB; large-size screen, marker generator, calibrated level marker and additional horizontal reference lines.

The display section can be equipped with different amplifiers, see next page.

SWOB 5 is ideal for **use** in laboratories, test and production departments and wherever ease of operation is required together with large-screen display, high dynamic range and accurate results for either one-off tests or long series of measurements.

As the sweep width of SWOB 5 covers the whole frequency range, the frequency response of very broadband test items can be easily displayed within and even outside their service ranges.

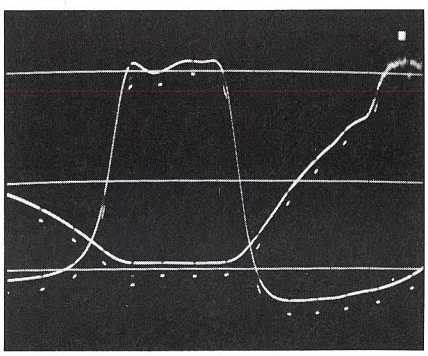
Although broadband frequency-response and matching measurements are the most frequent applications, the very small spurious FM and high frequency stability also permit narrowband test items to be measured.

Description

The **Sweep Generator** delivers the swept RF in one band from 0.1 to 1000 MHz or 0.1 to 1300 MHz with model 53. Four modes can be switch-selected for sweep width:

1000 MHz	1300 MHz
5 to 1000 MHz	7 to 1300 MHz
0.3 to 50 MHz	0.3 to 50 MHz
0	0 (CW mode without sweeping and return blanking)

The output voltage of 0.5 V into 50 Ω (for 1 V into 50 Ω by switchover on the rear) or 0.35/0.7 V for the 75-Ω model ensures an excellent dynamic range for the whole instrument. Even with the doubled output voltage the frequency response is guaranteed in the range from 5 to 300 MHz (flatness typically ±0.25 dB, plus 0.2 dB with voltage doubling).



Reflection-coefficient and attenuation curves of 25-MHz bandpass filter with pulse frequency markers

The low spurious FM of typically 3 kHz allows a sharp display of steep filter slopes. Good harmonic suppression is also important when filters are to be checked without measurement errors; the typical value for SWOB 5 is 40 dB.

The **Display Section** consists of two units:

measuring head and
deflection amplifier.

Terminating probes and insertion units with different characteristic impedance and high-impedance probes are available for use as **measuring head.**

The **deflection amplifiers** are in the form of plug-in units, permitting optimum adaptation of the set to different measurement tasks and to the customer's requirements for price and performance. The following amplifier combinations are possible for linear and/or logarithmic display.

1. One linear amplifier
   (low-priced single-channel version)
2. Two linear amplifiers
3. One linear and one logarithmic amplifier
4. Two logarithmic amplifiers
   (high comfort for most exacting requirements).

The **linear amplifier** amplifies the detected voltage from the measuring head for display. It may be used wherever a display range of 20 to 30 dB and a deflection factor of about 2 mV/cm are adequate.

The **logarithmic amplifiers** have, in conjunction with a terminating probe or insertion unit, a noise limit of typically 170 µV, corresponding to a dynamic range of 70 dB with a sweep-generator output voltage of 0.5 V (even 76 dB is obtainable if the maximum output voltage of the sweep generator is changed to 1 V with the rear switch).

Use of the **Active Demodulator SWOB5Z4** gives a limit sensitivity of 20 µV. With a permissible driving level of 50 mV for the Active Demodulator, the dynamic range is then about 70 dB.

Characteristics of logarithmic amplifier plug-ins

Logarithmic Amplifier SWOB 5 E1

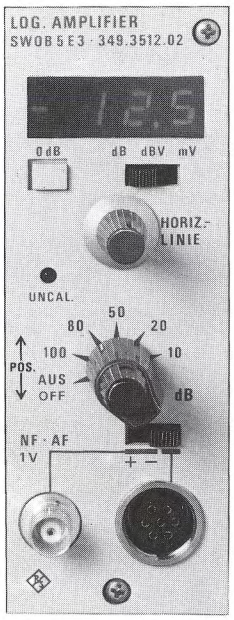
Range The display range on the screen can be switched to 80/60/40/20 or 10 dB and shifted by more than 70 dB with the aid of a potentiometer. Any part of the display can thus be spread.

A shiftable **calibrated horizontal line** facilitates accurate level measurement. A ten-turn helical potentiometer permits vertical shifting with 0.1 dB resolution. The zero position can be varied with a control knob, the detent position of which corresponds to a reference level of 1 V. A lamp lights when the knob is not in this calibrated position. A filter can be switched into circuit for the observation of very small signals on the screen.

Compensation of spurious signals Spurious signals such as may arise, for example, from the oscillator voltage of a tuner and which may limit the useful dynamic range are measured by both the linear and logarithmic amplifiers during the return sweep – while the RF is blanked – and compensated for.

Logarithmic Amplifier SWOB 5 E3

The Logarithmic Amplifier plug-in SWOB 5 E3 (photo) operates with the same broadband probes as the Logarithmic Amplifier SWOB 5 E1, namely: demodulator, insertion unit, logarithmic probe or active demodulator.



Front panel of Logarithmic Amplifier plug-in SWOB 5 E3

The **dynamic characteristics** – maximum input voltage 1 V, typical noise level 170 µV – make for a dynamic range of 76 dB. The display range can be switch-selected for 100, 80, 50, 20 or 10 dB. The horizontal graticule of the SWOB 5 screen thus provides scales of 10, 8, 5, 2 and 1 dB/div. A positioning potentiometer allows shifting of the display over more than 70 dB, so any detail of the display curve may be spread.

The main **advantages of this plug-in** are:

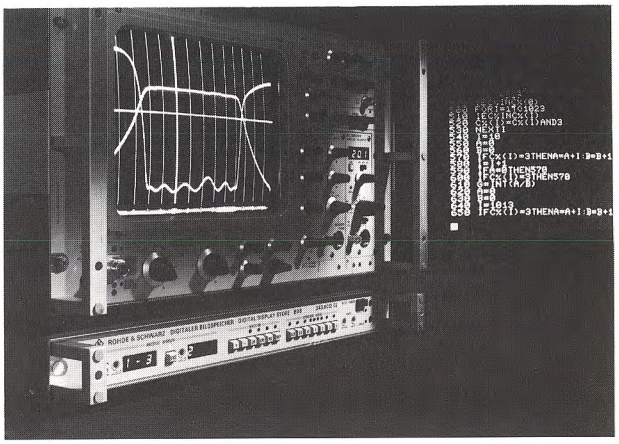
- AF input for the connection of test items with a built-in rectifier,
- digital level indication,
- automatic setting of reference levels,
- signalling of excessive spurious levels,
- gain of active demodulator taken into account in level measurements.

The characteristics when using the **AF input** are the same as for operation with an RF probe: maximum test voltage 1 V, noise level 170 µV, dynamic range 76 dB, display range 100, 80, 50, 20 or 10 dB and vertical-positioning range greater than 70 dB. Positive or negative polarity can be selected with a switch.

Polyskop SWOB 5, continued

Logarithmic Amplifier SWOB 5 E3, continued

With the aid of a **horizontal line,** which is calibrated in level and can be shifted through about 100 dB with a front-panel potentiometer, the level can be accurately measured at any point of the curve.



Filter characteristics (transmission/reflection) and level line on Polyskop SWOB 5 with plug-in E3 and Digital Display Store BDS

Level indications on the log. amplifier is in 3½ digits. The measured value can be indicated as an absolute value in dBV or mV or as a relative value in dB.

Autoranging is provided for **absolute measurements** in mV, the display ranges being 20, 200 and 2000 mV. The resolution of the digital display is 10 μV, 100 μV or 1 mV depending on the voltage range, or 0.1 dB for dBV or dB indication.

The reference level for **relative measurements** can be set at any point between 0 and −100 dBV. For this purpose the level switch is set to "dB", the calibrated level line adjusted to the desired position and the "0 dB" button pressed. The digital display is thus set automatically to 0 dB and when the level line is shifted the measured level is indicated in ±dB referred to the reference level. It is of course possible, by changing the level-switch position, to display the absolute level again whilst retaining the reference-level setting.

The automatic setting of the reference-level display is very expedient in transmission-factor measurements: the level line is adjusted to the input level of the test item.

The level switch is set to "dBV" and the level line adjusted to this reference value, then the level switch changed to "dB" and the "0 dB" button pressed. The level line can now be adjusted to the point of the displayed curve where the transmission factor is to be determined, for instance the maximum of a filter characteristic. The gain or attenuation of the test item is then read out in dB.

It is also possible to set the reference level by removing the test item and connecting the measuring head directly to the RF output of the Polyskop. If the reference line is shifted to make it coincide with the display line and the "0 dB" button is pressed, the display is calibrated with reference to the sweep-generator output level.

To prevent measuring errors being introduced by superimposed **spurious signals** a **pilot lamp** is provided on the amplifier plug-in. A spurious signal is produced when the RF probe connector is used, for example in tuner measurements, through the local-oscillator reradiation that is practically always present; its maximum permissible level is 40 mV (4 mV with an active demodulator). Superimposed DC of as much as ±6 V is permissible at the AF input. The spurious voltage is measured during the return sweep and the pilot lamp lights whenever the permissible limits are exceeded.

If an **active demodulator** is connected to the amplifier plug-in, the calibrated level line is automatically raised by 20 dB (gain of active demodulator), so in absolute measurements the level actually present at the input of the active demodulator is displayed. The noise level with the active demodulator is about 20 μV or −94 dBV. Since the calibrated level line covers a range of about 100 dB (0 to −100 dBV), this level can be measured accurately.

The **display** of the results is obtained on a long-persistence screen. The screen size of 21 cm×16 cm enables unstrained working. Four level lines (configuration with two amplifiers) and crystal-controlled vertical-line markers yield a coordinate grid of excellent clarity.

Frequency markers Pulse or vertical-line markers provide a scale on the frequency axis with the decades identified by higher intensity. A bright bar at the lower edge of the screen marks the adjusted sweep range on a scale.

IF markers option An IF marker generator is available for measurements on TV tuners; see specifications under recommended extras. This option permits IF markers for the vision and sound carriers to be generated and to be displayed in addition to the other markers.

A **recorder output** with pen-lift contact and the possibility of triggering a counter connected at the rear by means of a manually adjustable brightup marker complete the outstanding measuring capabilities of SWOB 5.

Digital Display Store BDS

The **Digital Display Store BDS** – described in detail below – yields a flicker-free display even with slow sweep times and considerably extends the applications of the sweep tester thanks to a number of additional functions. The characteristic features of the BDS are:

- display of slow sweeps as a stationary pattern
- four independent memories
- combination of contents of any memory by addition or subtraction
- insertion of additional frequency markers
- IEC-bus capability with option

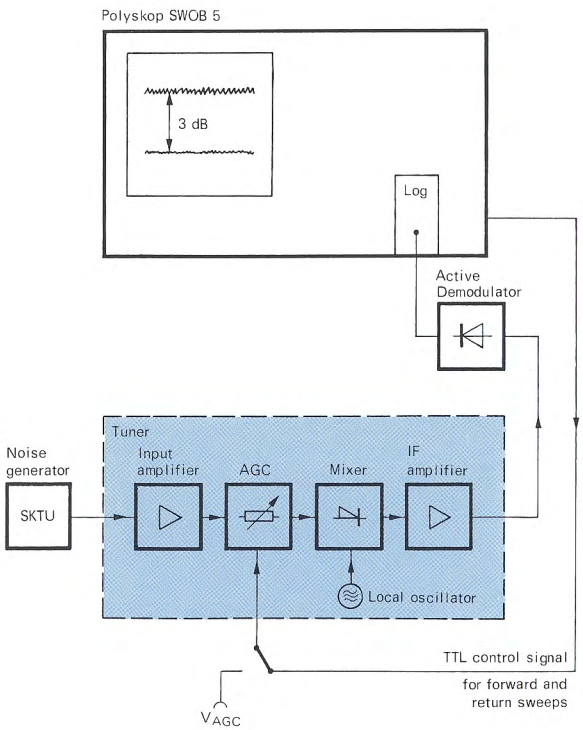
Moreover, an additional option to the Digital Display Store permits noise suppression by taking the average over several sweeps.

The Digital Display Store is an ideal extension for the Polyskop SWOB 5 and specially designed for use with this instrument. The flat, 78-mm high bottom or top add-on unit has the same width and depth as the SWOB 5 and is connected to the Polyskop via a 36-contact female connector.

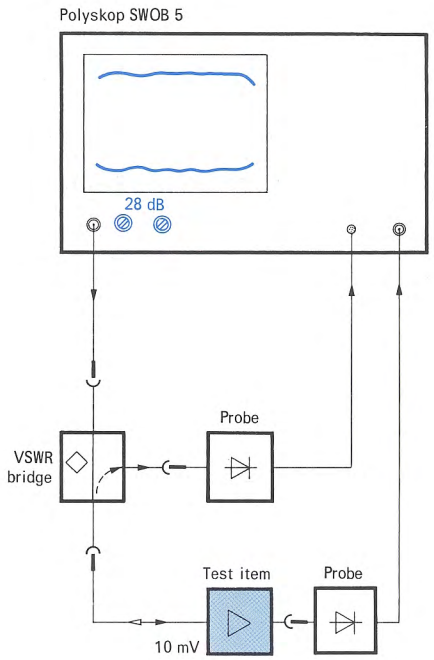
For operation of the SWOB 5 in conjunction with the BDS, the Display-store Interface Option SWOB5B6 is required (Order No. 333.5410.02). Instruments from Serial No. 871 551 on are ready for the interface to be fitted.

Examples

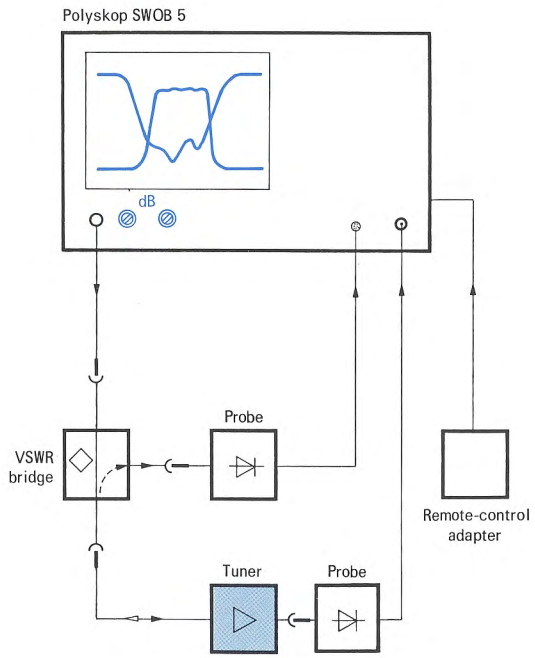
Task Measurement of noise characteristics of TV tuners.



Task Measurement of amplitude/frequency response and matching on active broadband test items, such as cable-TV and antenna amplifiers.



Task Measurement of amplitude/frequency response and matching on TV tuners using automatic sweep-width adjustment.



Polyskop SWOB 5

Specifications of SWOB 5

(Frequencies up to 1300 MHz are valid for model 53)

Frequency range	0.1 to 1000 MHz (0.1 to 1300 MHz) (in one band; only centre frequency and sweep width need be adjusted)
Sweep width	four ranges
1000 (1300) MHz	full frequency range
5 to 1000 (7 to 1300) MHz	variable: 5 to 1000 MHz (7 to 1300 MHz)
0.3 to 50 MHz	variable: 0.3 to 50 MHz
0	no sweep (CW)
Spurious FM (narrow)	5 kHz, typ. 3 kHz (test bandwidth 50 Hz to 10 kHz)
Sweep linearity	1 : 1.01
Linearity of display	better than 1 : 1.1
Sweep adjustment	Δf and centre frequency (coarse/fine)
external	via remote-control input
Scale error of range indication	±40 MHz (model 53: ±52 MHz)
Remote control	via 7-contact female connector on rear
Centre-frequency adjustment	≈3 to 8 V
Sweep-width adjustment (ext. potentiometer ≈ 5 kΩ)	0 Ω for Δf_{min}, R_{max} for Δf_{max}
Sweep time	0 to 5 V for 2 to 0.02 s
RF monitoring output	50 mV into 50 Ω, BNC female connector on rear
Output EMF	50 Ω: 1 V ±5%; 75 Ω: 0.7 V ±5% (can be increased by 6 dB by rear switch)
Connector	N female
Frequency-response flatness of output voltage with match-termination	< ±0.5 dB (typ. ±0.25 dB) for 0.1 to 1000 MHz (0.1 to 1300 MHz), <0.15 dB for 10 MHz sweep
with 6-dB increase	±0.2 dB in addition (5 to 300 MHz, otherwise +1 dB)
Output attenuator	0 to 70 dB in 1-dB steps
Error coarse (10-dB steps)	≤ ±0.5 dB } overall error
fine (1-dB steps)	≤ ±0.2 dB }
Harmonics (for output EMF = 1 V or 0.7 V)	
0.1 to 1 MHz	≥30 dB down
>1 MHz	≥36 dB (typ. 40 dB) down
Non-harmonic spurious signals (for output EMF = 1 V or 0.7 V)	
>1 to 1000 MHz	≥40 dB down
0.1 to 1 and 1000 to 1300 MHz	≥30 dB down

Frequency sweep

Mode	AUTO	forward/return with RF blanked during return
	MAN	manual sweep adjustment
	SINGLE	triggered by button, recorder operation
Sweep time	AUTO	forward 0.02 to 2 s, continuously adjustable; return 0.01 to 0.3 s
	SINGLE	≈0.02 to 2 s, continuously adjustable
Triggering		in SINGLE mode
Ext. trigger level		≈ +5 V (at rear input)
Frequency markers internal[1])		100 MHz; 100/10 MHz; 10/1 MHz; error < $\pm 1 \times 10^{-4}$
external		1 to 1300 MHz, ≈0.2 V (50 Ω)
Marker type		pulse and vertical-line markers
Oriented along frequency axis (internal)		marker amplitude or brightness modulated to highlight the decades
Brightup marker		by MAN adjustment in AUTO mode
Trigger signal for counter		TTL H during unblanked period (>10 ms), BNC female connector (TTL L by changing internal connection)
Level lines		two; separate adjustment of vertical position; common adjustment of intensity
Useful display area		21 cm×16 cm
Recorder output		±2.5 V for max. X deflection 2.5 V for max. Y deflection R_{out} ≈ 5 kΩ
Connector		6-contact female (1 channel) or BNC female (2 channels)
External X deflection		±1 V (symmetrical about zero) for full display width; rising edge: forward 0.02 to 2 s, falling edge: return 0.01 to 0.3 s
Connector		7-contact female on rear

[1]) Spurious markers may appear with increased output level (rear switch on +6 dB setting).

Amplifier plug-ins

Logarithmic Amplifier SWOB 5 E1

Measurement range (full display height)	10/20/40/60/80 dB
Noise level (with Demodulator SWOB 5 Z1 or RF Insertion Unit SWOB 5 Z3)	typ. 170 µV (with filter)
Max. test voltage	1 V (with SWOB 5 Z1 or Z3)
Display adjustment range	>70 dB
Level line, calibrated in dB	
Reference level	shiftable by −12 dB; detent position calibrated at 1 V ≙ 0 dB
Adjustment range	0 to < −100 dB, resolution 0.1 dB
Error limits	typ. ±1.5 dB (with SWOB 5 Z1 or Z3)
Lowpass filter	switch-selected, indicated
3-dB point	≈40 Hz
Connector for measuring head	7-contact female
Compensation of spurious signals	25 mV RF (2.5 mV with active demodulator)

Logarithmic Amplifier SWOB 5 E3

Inputs	**AF**	**Meas. head**
Connector	BNC female	7-contact female
Input impedance	≈100 kΩ	suitable for measuring heads SWOB 5 Z1, Z2, Z3 Z4

Measurement using Demodulator SWOB 5 Z1 or RF Insertion Unit SWOB 5 Z3

Measurement range	10/20/50/80/100 dB
Display adjustment range	>70 dB
Noise level	typ. 170 µV
Error limits	typ. ±1.5 dB
Max. test voltage	1 V (measuring-head RF input)

Measurement via AF input

Measurement range (full display height)	10/20/50/80/100 dB
Display adjustment range	>70 dB
Noise level	typ. 170 µV
Error limits	typ. ±1 dB (down to −60 dBV)
Max. test voltage	1 V
Max. permissible input voltage	14 V

Level line calibrated in mV, dBV and dB

Adjustment range			
Absolute measurement	10 µV to 1 V/−100 to 0 dBV		
Relative measurement	0 to 100 dB		
Level indication	3½ digits		
Voltage indication range	20 mV	200 mV	2000 mV
Resolution	10 µV	100 µV	1 mV
dBV and dB ranges	>100 dB		
Resolution	0.1 dB		
Indication error	0.1 dB or 2% ±1 digit		

Lowpass filter	switch-selected on basic unit, indicated	
3-dB point	≈40 Hz	
Compensation of spurious signals	AF ±6 V	Meas. head 40 mV RF (4 mV with active demodulator)

A pilot lamp lights when the spurious level exceeds the permissible limit.

Linear Amplifier SWOB 5 E2

Inputs	**AF[2])**	**Meas. head connector**
Input impedance	500 kΩ	500 kΩ
Connector	BNC female	7-contact female
Input selector positions	+/−/+≈/−≈	=/≈ (compensation for spurious RF signals in test item)
Deflection coefficient	0.2 mV/cm	
Voltage required for full display height with max. sensitivity	<3 mV	<15 mV
Max. permissible input voltage	10 V (= or ≈)	5 V (≈) or 10 V (=)

[2]) Connector for probe or test item containing a demodulator.

Measuring heads

Demodulator SWOB 5 Z1 (with built-in termination)

Impedance	50 Ω	75 Ω
Connector	N male	N male
Frequency range	0.1 to 1300 MHz	0.1 to 1000 MHz
VSWR	≤1.1 up to 1000 MHz ≤1.2 up to 1300 MHz	≤1.1
Frequency-response flatness (ref. to 100 MHz) 0.4 to 1000 MHz	≤ ±0.5 dB typ. ±0.25 dB	≤ ±0.5 dB typ. ±0.25 dB
0.1 to 1300 MHz	≤ ±1 dB	
Max. test voltage, rms	1 V	
Max. permissible input voltage	5 V AC or 10 V DC	
Connection to lin/log amplifier	via cable (1 m) and 7-contact male connector	

RF Insertion Unit SWOB 5 Z3

Impedance	50 Ω	75 Ω
Connector	N male	N male
Frequency range	0.1 to 1300 MHz	0.1 to 1000 MHz
VSWR	≤1.15 up to 1000 MHz ≤1.3 up to 1300 MHz	≤1.25
Frequency-response flatness (ref. to 100 MHz) 0.4 to 1000 MHz	≤ ±0.5 dB typ. ±0.25 dB	≤ ±0.5 dB typ. ±0.25 dB
0.1 to 1300 MHz	≤ ±1 dB	
Max. test voltage, rms	±1 V	
Max. permissible input voltage	5 V AC or 10 V DC	
Connection to lin/log amplifier	via cable (1 m) and 7-contact male connector	

Log. Probe SWOB 5 Z2

Impedance (depending on frequency and attenuator)	>3 kΩ to >20 MΩ || 0.5 to 2.5 pF
Frequency range	0.1/10/5 to 500 MHz (coarse indication up to 1300 MHz)
Frequency-response flatness	< ±1 dB (ref. to 100 MHz)
Attenuation of probe tips	0/20/40 dB
Input voltage range	0.2 mV to 1 V/2 mV to 10 V/ 20 mV to 100 $V_{(rms)}$
Input circuit	unbalanced, non-floating

Demodulator SWOB 3-Z (probe with BNC male connector)

Frequency range	0.5 to 400 MHz (rough indication up to 1300 MHz)
Input impedance	
at 50 MHz	≥30 kΩ || 2 to 3 pF
at 200 MHz	≥10 kΩ
Input voltage	min. 50 mV for full display height, max. permissible 5 V RF, superimposed DC up to 100 V
Output signal[3])	+ DC ≥5 mV into >500 kΩ, for 50 mV_{rms} (0.5 to 400 MHz)

Active Demodulator (50 or 75 Ω depending on model)

Input voltage range	20 µV to 50 mV
Frequency-response flatness (ref. to 500 MHz)	≤ ±2 dB for 5 to 1300 MHz
Input VSWR	≤1.3

Specifications of recommended extras

VSWR Bridges ZRB2	50 Ω	50 Ω	75 Ω
Frequency range 5 MHz to	2500 MHz	2500 MHz	2000 MHz
Directivity (up to 2 GHz)	≥46 dB	≥40 dB	≥40 dB
(up to 2.5 GHz)	≥40 dB		
Insertion loss			
Total	13 dB	13 dB	13 dB
Input – test port	7 dB	7 dB	7 dB
Test port – output	6 dB	6 dB	6 dB
Connectors	precision N female		

Overvoltage Protection (for RF input or output)

Response threshold	4 V DC or RF
Switching time	≤5 ms

Digital Display Store ... see next page

Extension (options)

(mounting with electrical connections via irreversible connectors of basic unit)

External Control SWOB 5 B1

Switchover	int./ext. via slide switch; lamp lights in ext. mode
Input	7-contact female connector for RF Insertion Unit SWOB 5 Z3
Voltage adjustment	0.1 to 0.5 V, continuous

Slow Sweep SWOB 5 B2

X voltage	±2.5 V for max. deflection
Y voltage	1 V for max. deflection
Sweep time	0.02 to 2 s; ≈ 30 s with recorder cable plugged in
Connectors	6-contact female (1 channel) 3 BNC female

IF Markers SWOB 5 B3/B4

Input	frequency markers
Frequency range	0.5 to 150 MHz
Input impedance	50 Ω
VSWR	≤1.15 in range 5 to 150 MHz
with lowpass filter	≤1.3 in range 5 to 150 MHz
Input voltage for perfect marker display	min. 10 mV (1 mV in range 5 to 150 MHz), max. 200 mV
Max. permissible input voltage	5 V AC or 10 V DC
Number of markers	2, produced by plug-in crystal oscillators
Marker frequencies	33.4 MHz, 38.9 MHz
Max. frequency error	2×10^{-5}

Display-store Interface SWOB 5 B6 ... required for operation of SWOB 5 with BDS

Connector ... 50-contact female, suitable for connection of BDS

General data

Rated temperature range	+5 to +40 °C
Storage temperature range	−25 to +60 °C
Power supply	110/125/220/235 V ±10%, 47 to 63 Hz (180 VA)
Dimensions, weight	484 mm×294 mm×392 mm, 25 kg

Ordering information

Order designation ... ▶ Polyskop SWOB 5

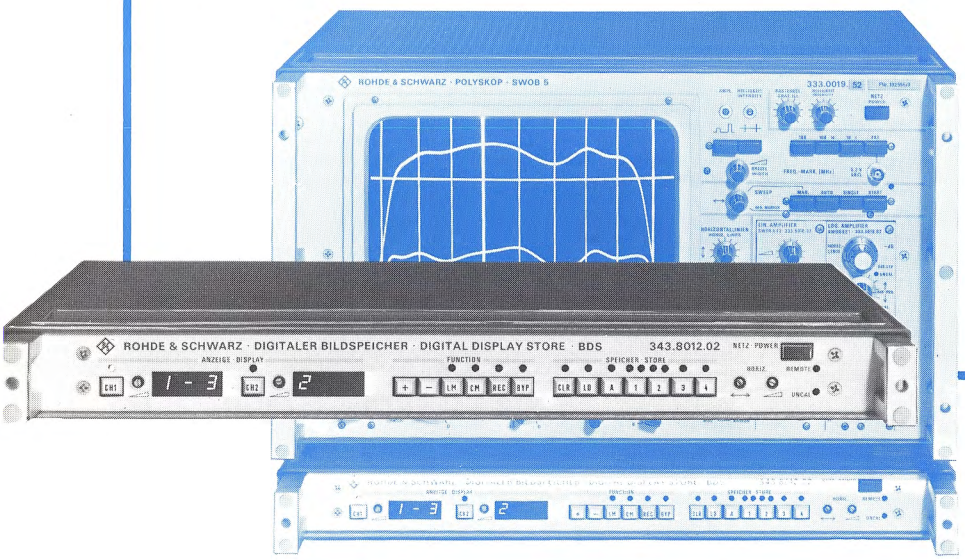
SWOB 5, without amplifier plug-ins:		
50-Ω model, 0.1 to 1000 MHz		333.0019.52
50-Ω model, 0.1 to 1300 MHz		333.0019.53
75-Ω model, 0.1 to 1000 MHz		333.0019.72
Accessories supplied	power cable	
Amplifier plug-ins:		
Log. Amplifier	SWOB 5 E1	333.5610.02
Log. Amplifier	SWOB 5 E3	349.3512.02
Lin. Amplifier	SWOB 5 E2	333.5010.02
Measuring heads:		
Demodulator	SWOB 5 Z1	
50-Ω model		333.7513.52
75-Ω model		333.7513.72
RF Insertion Unit	SWOB 5 Z3	
50-Ω model		333.8010.52
75-Ω model		333.8010.72
Log. Probe	SWOB 5 Z2	333.9016.02
Demodulator Probe	SWOB 3-Z	241.2116.00
Active Demodulator	SWOB 5 Z4	
50-Ω model		333.8510.52
75-Ω model		333.8510.72
Options		
External Control Option	SWOB 5 B1	333.6700.02
Slow Sweep Option	SWOB 5 B2	333.9616.02
IF Markers Option		
Motherboard	SWOB 5 B3	333.9716.02
additionally required:		
Crystal Oscillator	SWOB 5 B4	
33.4 MHz and 38.9 MHz		333.9916.30
Recommended extras		
VSWR Bridge	ZRB2	
50 Ω, 46/40 dB		373.9017.52
50 Ω, 40 dB		373.9017.53
75 Ω, 40 dB		802.1018.73
Overvoltage Protection	SWOB5-Z5	333.9316.52
Recorder Adapter Cable	SWOB4-Z	289.5450.02 (for ZSK2)
Recorder Adapter Cable	SWOB4-Z	289.5450.03 (for ZSKT)
RF connecting cable		
(1 m, 50 Ω, N male conn.)		100.7670.10
(1 m, 75 Ω, N male conn.)		100.7687.10
Digital Display Store BDS		343.8012.02
Display-store Interface	SWOB 5 B6	333.5410.02
IEC-bus Interface	BDS-B4	343.9602.02
Average-value Memory	BDS-B5	343.9802.02
Basic Software for control of BDS/SWOB5 via Process Controller PUC	BDS-K1	358.1919.02

[3]) Non-linear signal characteristic: up to ≈30 mV (V_{RF}) squarewave, from ≈0.5 V (V_{RF}) linear.

BDS

Digital Display Store BDS ♦ Stores four curves

- Flicker-free display even with slow sweep speeds
- Error compensation by storage and addition or subtraction of correction curves
- Memory space for a total of four curves
- Noise suppression by taking the average over several sweeps
- IEC-bus-compatible



IEC 625 Bus

Characteristics, uses

In conjunction with Polyskop SWOB 5, the **Digital Display Store BDS** permits simultaneous, flicker-free display of two curves plus the associated frequency markers, level lines and frequency range. The 1024-point horizontal and 256-point vertical resolution of the pattern yields an accurate representation of the original curve.

Moreover, the Digital Display Store offers a number of functions which considerably extend the applications of the Polyskop SWOB 5.

Memory space In addition to the two curves represented as a flicker-free pattern, two further curves can be saved in additional memories. But data can also be stored in the buffer memories used for displaying the instantaneous values measured, so that a total of four curves can be stored.

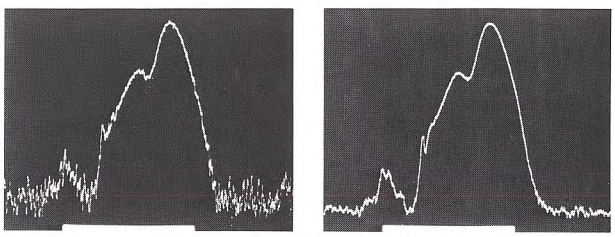
A built-in battery ensures that the stored data are maintained even in the case of AC supply failure or after the Digital Display Store has been switched off.

Modes Both channels permit the sum or difference of any two memory contents to be displayed; thus **error correction** and displaying the **drift from nominal** are possible.

Additional frequency markers An additional memory permits markers to be inserted at any position in addition to the SWOB 5 frequency marker graticule; in this way, frequencies which are of special interest can be highlighted, for instance.

Recording The stored curves can be output via a built-in interface directly to an XY recorder. In this mode, the sweep time increases to about 60 seconds.

Noise suppression To complement the basic version of the BDS, an option is available permitting the average to be taken over from 4, 8 or 16 successive sweeps. Thus random interference on the sweep curve, eg noise, can be suppressed to a large extent.



Frequency response display: (left) signal with heavy noise component and (right) after taking the average over successive sweeps with the corresponding BDS option

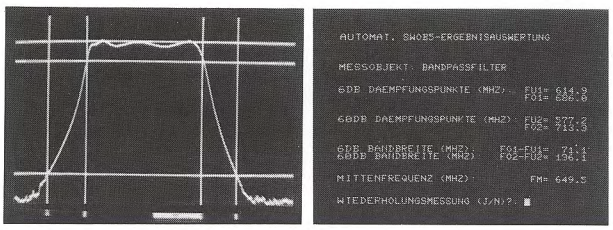
Computer-aided evaluation

The **IEC-bus Interface** (Option BDS-B4) enables not only the transfer of all stored data but also problem-free computer-aided evaluation of the results on the sweep system SWOB 5 using for instance the R&S Process Controller PUC. The advantages of using a computer become most evident where previously lengthy manual settings or calculations were required. Via the **bidirectional data interface** (IEC bus) of the BDS the resulting curves and markers can be directly displayed on the Polyskop screen.

Measurement examples The position of any **frequency markers** or **level lines** can be easily and accurately calculated and output on the PUC; on the other hand markers and lines can be superimposed on the Polyskop screen at exactly defined positions.

For measurements on amplifiers and filters, criteria like the **3-dB point** can automatically be selected from the measured data, the associated frequencies be recorded and the corresponding markers be superimposed on the screen.

It is not only possible to evaluate individual measuring points numerically, but to convert **complete curves into any other waveform** and output it again, for example if the VSWR is to be determined from the measured return loss or if a frequency axis with linear scale is to be converted into one with logarithmic scale.



Measured curve with additionally superimposed frequency markers and level lines as well as displaying on PUC

BDS software In order to relieve the user from lengthy programming, a BDS software (BDS-K1) has been prepared. It offers a great number of applications through single routines which are mostly independent of each other. These routines can be combined by means of a few program steps for the evaluation of whole test sequences; this evaluation can be made very rapidly since most of the subroutines are written in machine language.

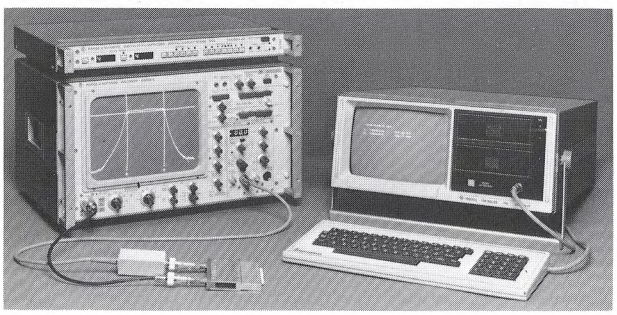
Description

The analog signal corresponding to the measured voltage/deflection is converted into digital signals in the Digital Display Store BDS. For this purpose 1024 addresses – each with a word length of 8 bits – are available. 8-kbit memory chips enable separate storage of four different curves. Additional memory chips save the information on frequency markers, frequency range and level lines.

The RAMs used are of the CMOS type. Their low current drain permits the data to be stored for extended periods with the aid of dry batteries.

The information stored can be combined via an 8-bit adder/subtracter. The optional average-value memory adds up the analog/digital-converted test voltage during 4, 8 or 16 successive sweeps. The intermediate result is available at each specific moment in a separate memory with a 12-bit word length. The average value of the signal applied is obtained by dividing the final result by the number of sweeps.

Sweep test assembly: SWOB 5 plus Digital Display Store BDS and desktop computer (Process Controller PUC) for outputting and storing measured data



Specifications

Screen

Display refresh time	≈20 ms
Minimum sweep time	≈20 ms
Resolution: horizontal	1024 points
vertical	256 points
Inputs	36-contact female connector
X input	Z_{in} >100 kΩ, deflection voltage positive-going; max. amplitude 10 V; position of starting point can be set between −10 and 0 V
Y input	Z_{in} >100 kΩ, V_{in}: nominal 0 to 2.5 V; maximum voltage adjustable from 2 to 3 V
Trigger input	TTL level, forward sweep L (low)
Frequency-marker and level-line inputs	match SWOB 5
Outputs	36-contact female connector
X output	Z_{out} <1 kΩ } output corresponds
Y output	Z_{out} <1 kΩ } to input voltage
Trigger output	TTL level, forward sweep L (low)
Frequency-marker and level-line outputs	match SWOB 5

Recorder outputs

X output	Z_{out} <1 kΩ } magnitude of
Y output for level line	Z_{out} <3 kΩ } output corresponds
with AF signal	Z_{out} <1 kΩ } to input voltage
	connectors: BNC female
Pen lift	connector on rear panel

Curve display and storage

Number of curves displayed	
simultaneously	2
saved	2 (can be expanded to 4)
in intermediate storage	2
total storable	4
Storage without AC supply voltage	up to 6 months depending on charge remaining in built-in dry batteries, charging check provided
Functions	a) addition and subtraction of two curves b) insertion of additional frequency markers c) slow sweep in recording mode (≈60 s)
With option	averaging over 4, 8 or 16 sweeps to reduce noise component
IEC-bus connector	interface in accordance with IEC 625-1, 24-contact Amphenol connector
Interface functions	AH1, SH1, L4, T8, DC1

General data

Operating temperature range	+5 to +45 °C
Storage temperature range	−40 to +70 °C
Power supply	100/120/220/240 V ±10%, 47 to 63 Hz (20 VA)
Dimensions	492 mm×78 mm×383 mm
Weight	5 kg

Ordering information

Order designation	▶ Digital Display Store BDS 343.8012.02
Accessories supplied	power cord

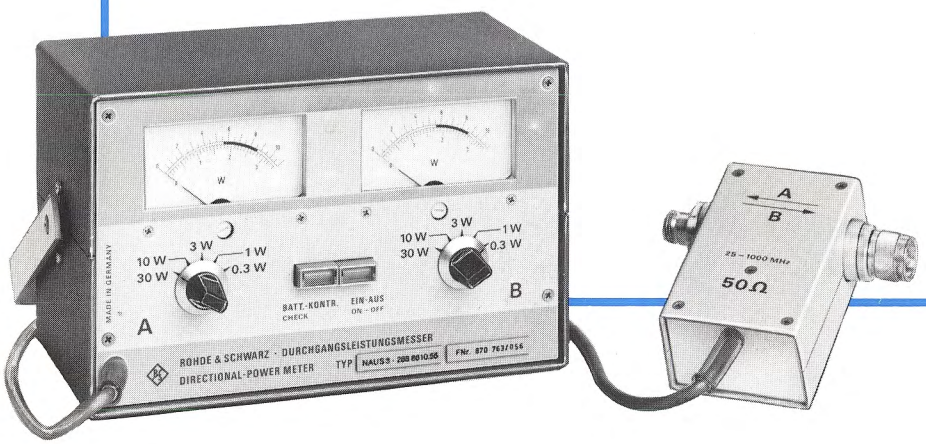
Extensions (options)

IEC-bus Interface	BDS-B4	343 9602 02
Average-value Memory	BDS-B5	343.9802.02
Display-store interface	SWOB5-B6	333.5410.02
Basic Software	BDS-K1	358.1919.02

NAUS

Directional Power Meters NAUS 3 to 6 ♦ 25 to 1000 MHz up to 1100 W

- Separate measuring head – forward direction arbitrary
- Simultaneous indication of incident (forward) and reflected power – independent range setting
- Lowest power reading:
  NAUS 3 NAUS 4 NAUS 5 NAUS 6
  20 mW 50 mW 200 mW 500 mW



The **Directional Power Meters NAUS** are handy, easy to operate and designed for in situ servicing of transmitting equipment. They have similar appearance and design; they differ only in their power-handling capacities. The instruments consist of an **indicator** (case with carrying handle, see photo) and a separate **measuring head,** which can be connected in either direction. The incident and the reflected power are indicated on separate meters so that – also due to the wide continuous frequency range – operating errors are precluded.

Measurement ranges The power ranges are divided into five subranges; the total range for each instrument is as follows:

NAUS 3	NAUS 4	NAUS 5	NAUS 6
20 mW	50 mW	0.2 to	0.5 to
to 34 W	to 110 W	340 W	1100 W

The range of the NAUS 3 can be extended to 68 W by inserting a High-power Attenuator RBU (3 dB).

Indication and accuracy The instruments deliver correct results under all conditions: the indication is highly stable and insensitive to temperature fluctuations. Both meter scales are linearly calibrated and the indications can be easily read. True average indication is also given of non-sinusoidal signals (modulated transmitters). The negligible internal losses do not impair the measurements.

Input and output The measuring head is available in the following versions:

NAUS 3	50 Ω	Dezifix B or N female/male, all adaptable
NAUS 4, 5	50 Ω	N female/male, adaptable
NAUS 6	50 Ω	Dezifix B, adaptable

Suitable screw-in assemblies for conversion to other connector systems: please enquire.

Since the two measuring channels are alike, the forward direction is arbitrary.

The **power supply** uses five 1.5-V batteries (R 20, acc. to DIN or IEC). These can easily be replaced after removing the cabinet cover (voltage check on the left-hand meter by pressing a pushbutton). Owing to the very low current drain, a set of commercially available, leakproof batteries has a lifetime of almost one year with continuous operation (>7000 operating hours).

A diagram for determining the VSWR as a function of the incident and reflected power is provided on the rear of the instrument.

Specifications

Frequency range ..... 25 to 1000 MHz

	NAUS 3	NAUS 4	NAUS 5	NAUS 6
Permissible incident and reflected power	34 W	110 W	340 W	1100 W
Indication ranges	0.34/1.1/ 3.4/11/ 34 W	1.1/3.4/ 11/34/ 110 W	3.4/11/ 34/110/ 340 W	11/34/ 110/340/ 1100 W
Lowest power reading	20 mW	50 mW	0.2 W	0.5 W
Indication error	≤3% of rdg	±2% of fsd	≤4% of rdg	±2% of fsd
Transmission loss				
up to 300 MHz	≤0.1 dB	≤0.08 dB	≤0.08 dB	≤0.05 dB
up to 500 MHz	≤0.25 dB	≤0.15 dB	≤0.15 dB	≤0.1 dB
up to 1000 MHz	≤0.75 dB	≤0.35 dB	≤0.2 dB	≤0.15 dB

Effect of temperature on reading ... ≤0.25%/°C
Directivity
at and above 30 MHz ..... ≥30 dB
up to 30 MHz ..... ≥26 dB
Characteristic impedance ..... 50 Ω
VSWR ..... ≤1.03
Electrical length of transmission channel ..... 140 mm

General data (all models)

Rated temperature range ..... −20 to +55 °C
Power supply ..... 5 single cells 1.5 V, R 20 IEC
Battery life ..... >7000 hours
Dimensions indicator ..... 230 mm×150 mm×130 mm
measuring head ..... 125 mm×105 mm×45 mm
Weight ..... 4 kg

Ordering information

Order designation ..... ▶ Directional Power Meter
NAUS 3, Dezifix B 288.8610.54
N connectors 288.8610.55
NAUS 4, N connectors 289.9010.55
NAUS 5, N connectors 349.8014.55
NAUS 6, Dezifix B 349.8314.54

Microwave Power Meter NRS

NRS

- 0 to 15 GHz
  0.1 to 330 mW
- Automatic zero adjustment

The **Microwave Power Meter NRS** makes high-accuracy power measurements on test items to be terminated with 50 Ω (coaxial lines). Its wide frequency range ensures a large field of application, especially in the RF range.

Power range The power range of 0.1 to 330 mW is divided into five subranges 3/10/30/100/300 mW, corresponding to 5-dB steps. Continuous **range extension up to 60 kW** is possible by means of attenuators of high power-handling capacity or load resistors with an output for an accurately known insertion loss.

Indication and accuracy Only active power is measured and indicated. AC signals of any waveform, even very short pulses, are correctly measured. As the NRS has a flat frequency response from DC to 15 GHz it also provides a true power indication of frequency spectra. The error limits are ±2% of the reading of the mW scale. The accuracy can be greatly improved through the use of an external indicator. The rear output of the NRS delivers a DC voltage V_0 which equals to within ±0.2% the original rms voltage V_s of the source. The power is calculated from the voltage V_0 read on a digital voltmeter

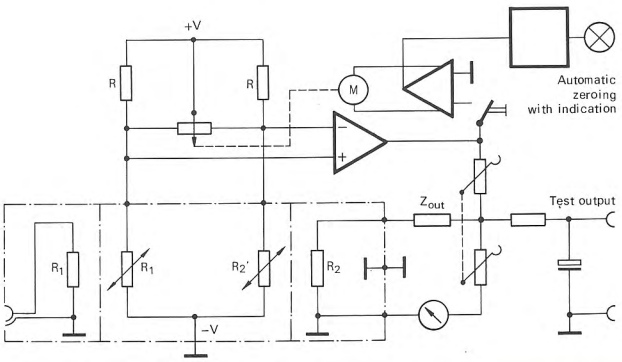
$$P = \frac{1}{Z_L}\left(\frac{V_o}{2}\right)^2 = \frac{V_o^2}{4Z_L}$$

The error of power measurement is in this case <±0.4% of reading.

The response time of the NRS is short relative to other calorimetric power meters. It is less than 10 s for powers>1mW.

Connection (probe) The unknown power is picked up by a probe (to be ordered separately). It can be used with any basic unit and is replaceable. The coaxial connector can readily be adapted to the Dezifix B system (adapter is supplied with the probe).

Test output A test output for the connection of a DC recorder or analog/digital converter is provided at the rear of the NRS. (For output voltage see "indication and accuracy"; Z_{out} = 2 kΩ±10%). Moreover, the NRS has an input for triggering the automatic zeroing facility, which makes it suitable for incorporation into automatic test assemblies.



Simplified diagram of Power Meter NRS

Specifications

Basic unit

Power ranges (fsd)	3/10/30/100/300 mW
Calibration	in mW and dBm
Indication error	≤±1.5% at fsd ≤±2.3% at 31.6% of fsd
Frequency range	0 to 15 GHz
Input impedance	50 Ω
Recorder output	Z_{out} = 2 kΩ
Temperature effect	≤±0.03%/°C
Response time for powers ≥1 mW	≤10 s
Dimensions, weight	484 mm×150 mm×336 mm, 12 kg
Probe	50 Ω, 0 to 15 GHz
Reflection coefficient, 0 to 4.5 GHz	<1% +2%/GHz
up to 11 GHz	<10%
above	<20%
Connector	Dezifix A[1])

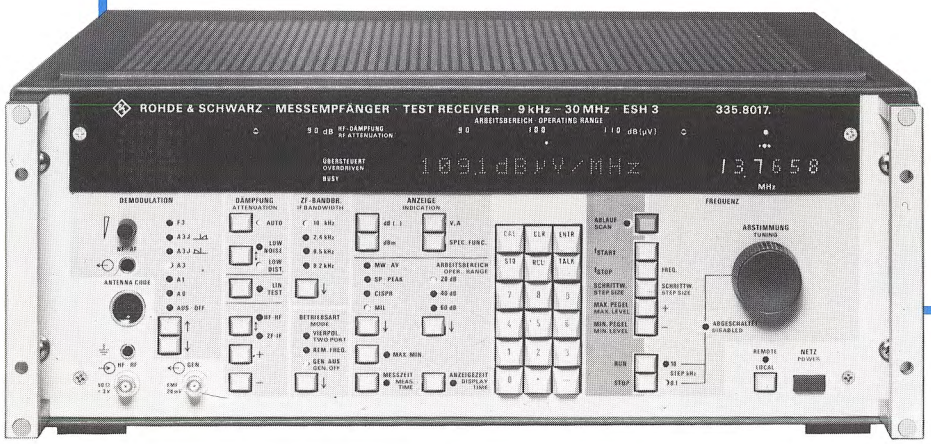
Ordering information

Order designation	▶ Microwave Power Meter NRS 100.2433.92 ▶ Probe for NRS, 100.2440.50
Accessories supplied	
for basic unit	power cable, 1 connecting cable (2 m, basic unit – probe)
for probe	1 adapter from Dezifix A to B

[1]) Adapter from Dezifix A to B is delivered with the probe.

ESH 3

Test Receiver ESH 3 ♦ 9 kHz to 30 MHz −30*) to +137 dBµV



- Field-strength measurements in conjunction with test antennas
- Radio-interference (EMI) measurements to CISPR, VDE and FCC regulations
- Interference measurements to MIL and VG standards (model 56)
- Frequency-range extension down to 20 Hz when using model 56 with Spectrum Monitor EZM (model 56)

*) With Preamplifier ESH3-Z3: −37 dBµV

IEC625Bus

The automatic **Test Receiver ESH 3** which measures and demodulates AM double-sideband, single-sideband, pulse-modulated and FM signals as well as interference in the range of 9 kHz to 30 MHz is suitable for **manual and programmed use** as a

- ▶ field-strength meter in conjunction with the test antennas of the HFH 2
- ▶ selective RF voltmeter
  (in conjunction with a current probe, it can also measure RF currents)
- ▶ system unit in automatic test systems.

The ESH 3 has the same RF, IF and demodulator circuits as the ESH 2 (see measuring equipment catalog); it thus features the same excellent characteristics and covers the same fields of application. In addition, the ESH 3 is equipped with microcomputer circuitry and an evaluation unit, which make it a versatile, intelligent test receiver with a **maximum of operating convenience.**

Extended signal evaluation capabilities and **extra features and functions** characterize the ESH 3:

- – Four selectable IF bandwidths: 0.2/0.5/2.4/10 kHz for model 52 and 0.2/1/2.4/10 kHz for model 56
- – Average, peak and quasi-peak indication to CISPR 16 and VDE 0876 with programmable measuring times
- – 75-MHz broadband IF output for panoramic display (Spectrum Monitor EZM) or Spectrum Analyzer
- – Digital level indication in selectable units
- – Measurement of frequency offset, frequency deviation and modulation depth
- – Automatic ranging (for low noise or low distortion) or presetting of RF and IF attenuation
- – Tuning in programmed steps, eg 9-kHz channel pattern or for harmonic measurements
- – Automatic scanning with data output to printers or recorders (XY, YT or radiomonitoring recorder)
- – Storage of last and nine additional device settings even when the unit is switched off or the supply interrupted
- – Automatic correction after calibration, ensuring full measurement accuracy at all frequencies, IF bandwidths, display modes and types of demodulation

Further characteristics, uses

The ESH 2 is ideal when only manual operation is required and portability and battery-power capability are wanted; the ESH 3 comes into its own when automation is needed to improve efficiency, when **computer control** is required and the maximum versatility in terms of measurement functions is important.

In conjunction with the Test Receiver ESVP (page 256), signals and interference can be measured automatically in the range 9 kHz to 1 or 1.3 GHz in accordance with the relevant international regulations.

The antennas, the RF current probe, the probes and the artificial mains network available for the ESH 2 can also be used with the ESH 3.

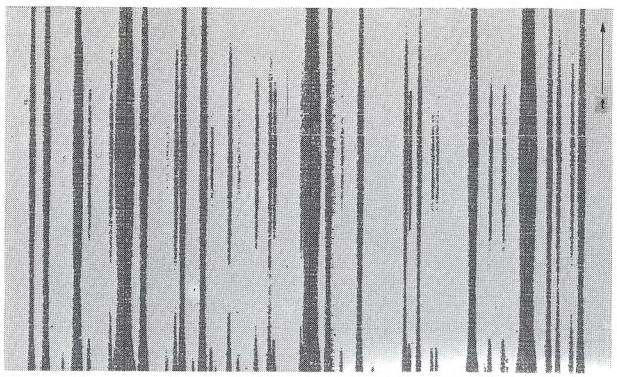
Selective voltage measurement For use in the laboratory and test department for measurements on signal generators (level of fundamental, harmonics and non-harmonic spurious signals, sideband noise, frequency deviation and modulation depth); twoport measurements (filter attenuation up to >100 dB, gain up to 57 dB) with automatic recording of frequency response with an XY recorder; amplifier measurements (frequency response, noise figure, overdrive capacity, intermodulation and crossmodulation characteristics).

Field-strength measurement Propagation and coverage measurements are possible in conjunction with the rod, loop and probe antennas of the field-strength meter HFH 2 (see measuring equipment catalog).

In **radiomonitoring** the ESH 3 can be used to measure: field strength and range of fluctuation of field strength with max./min. indication, frequency (remote measurement with add-on frequency counter), frequency offset, frequency deviation and modulation depth.

Data-logging capabilities in radiomonitoring

1. Output of all measured data to a printer via the IEC-bus interface with the ESH 3 in the talk-only mode.
2. Recording of amplitude spectrum on a XY recorder. The values entered for start and stop frequencies and minimum and maximum levels determine the end values of the scales.
3. Long-term recording of frequency-band occupancy using the R&S Radiomonitoring Recorder ZSG 3. One ESH 3 permits up to five different frequency bands with different recording thresholds to be constantly observed and their occupancy to be recorded on five ZSG 3 recorders; see recording below.



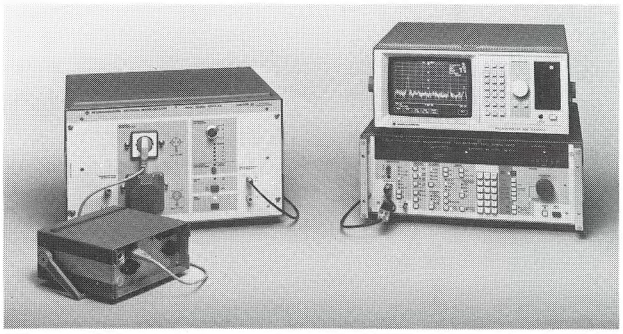
Recording of frequency-band occupancy using Test Receiver ESH 3 and Radiomonitoring Recorder ZSG 3

Interference measurements In the field of interference measurements the ESH 3 offers considerable advantages over earlier test receivers, featuring programmable automatic frequency scanning and data logging with **direct control** of a printer or XY recorder. The following accessories are available for measuring interference voltages, currents and field strengths according to the relevant standards (CISPR, VDE, MIL, VG):

– RF Current Probe	ESH 2-Z1
– Active Probe	ESH 2-Z2
– Passive Probe	ESH 2-Z3
– Artificial Mains Network (four-wire system)	ESH 2-Z5
– Pulse Limiter	ESH 3-Z2
– Preamplifier	ESH 3-Z3
– T-network	ESH 3-Z4
– Two-line V-network	ESH 3-Z5
– V-network 5 µH‖50 Ω	ESH 3-Z6
– Loop Antenna	HFH 2-Z2
– Inductive Probe	HFH 2-Z4
– Rod Antenna (for MIL-STDs)	HFH 2-Z6
– Interference Measurement Software	EZM-K1

The ESH 3 offers the following further advantages for measuring interference:

- Bandwidth correction factor automatically taken into consideration when measuring pulse spectral density to MIL and VG standards; readout of measured data in dBµV/MHz, dBµA/MHz and dBµV/m · MHz
- Indication modes and bandwidths for interference measurements according to MIL-STDs (also according to an SAE AE4 draft for MIL-STD-462 B), British DEF STAN 59-41 and VG standards



Automatic interference-voltage measurement with programmed phase-switching: Test Receiver ESH 3, Artificial Mains Network ESH 2-Z5, Spectrum Monitor EZM

- Frequency-range extension down to 20 Hz by combining model 56 with Spectrum Monitor EZM (model 56)
- Average-value indication with programmable integration time for measuring narrowband interference
- CISPR indication mode with determination of maximum value within programmed measuring time
- Programmable measuring times ensuring optimum adaptation of automatic measurements to time-dependent variations of the interference
- Automatic, frequency-dependent switching of quasi-peak-value indication for CISPR band A (9 to 149.9 kHz) and band B (0.15 to 30 MHz)
- 60-dB operating range: ideal for measurements to MIL and VG standards
- 20-dB operating range: for measurements to CISPR, autoranging in consideration of CISPR settling times ensuring error-free measurements
- Selectable logarithmic frequency scale for data output on XY recorder, permitting direct recording of measured data on tolerance charts

Since the characteristic of broadband noise spectra is a continuous curve, frequency scanning in constant linear or logarithmic steps is possible and appropriate. Each single value, especially with CISPR weighting, is measured with due consideration of the overall settling time (charging and discharging time constant, time constant of lowpass filter simulating meter response).

Operation, functions

The front-panel **controls and displays** of the ESH 3 are arranged for optimum clarity in spite of the multitude of functions, and logically organized according to frequency, display mode, IF bandwidth, attenuation (sensitivity) and demodulation.

A 13-digit alphanumeric display facilitates data entry (frequencies, measuring times, limit levels) and reads out the measured results. In addition, the analog value of the input voltage is indicated within the limits of the demodulator operating range by a row of LEDs. Another LED row indicates the frequency offset.

All active functions are indicated by LEDs. If major operating errors are made, or when a fault occurs in the main modules, an error message is issued with an error code. The end of long-term tests is indicated by a buzzer.

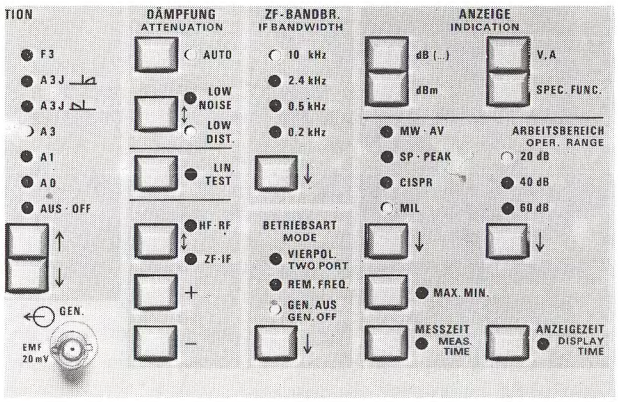
ESH 3

Frequency setting Frequency setting or frequency entry can be carried out in different ways:

1. with tuning knob in steps of 100 Hz or 10 kHz (quasi-continuous)
2. at a keystroke in steps of any preset size, eg in 9-kHz steps, or in steps of the fundamental-frequency width to measure harmonics
3. by keyboard entry
4. by automatic frequency scanning over up to five sub-ranges, with any desired preset start and stop frequencies and step sizes.

Tuning is facilitated by a calibrated offset indication. The last and nine further complete device settings can be stored.

Sensitivity, measurement ranges The voltage range in the average mode extends from −30 to +137 dBµV. Frequency offset is indicated – depending on IF bandwidth – from −5 to +5 kHz, frequency deviation from 0 to 5 kHz; modulation depth can be measured from 0 to 100% and gain from −110 to +57 dB.



Front-panel section with operating controls for indication, IF bandwidth, mode, attenuation and demodulation

Calibration Two different calibration processes are initiated depending on whether the calibration button is pressed for a shorter or longer period:

1. Check and, if necessary, correction of level and frequency-offset calibration
2. Measurement of all the calibration correction values that do not vary with time, for frequency response, IF bandwidth, logarithmic amplifier and detector – and storage in a non-volatile memory.

Output of results The measured value is converted into a level with or without logarithmic conversion; RF and IF attenuation, all correction values and transducer conversion factors – if applicable – are added and conveyed together with their physical unit to the alphanumeric display and the IEC-bus interface.

A 24-contact output permits the connection of three types of recorders XY, YT and radiomonitoring recorders. The ESH 3 automatically adjusts to the recorder type connected by selecting the required drive to the A/D converter.

The IEC-bus interface is provided with all the listener and talker capabilities covered in the standard: the limited capabilities of the widely commercial available controllers have, however, also been taken into consideration. For example, it is also possible to use computers without serial- and parallel-poll capability.

Computer control of the ESH 3 via the IEC bus provides the following capabilities:

- Execution of complex test programs
- Automatic evaluation of large quantities of data from various points of view
- Use of the ESH 3 together with other programmable measuring instruments.

Specifications

Frequency range . . . . . 9 kHz to 29.9999 MHz
Frequency setting . . . . . 1. quasicontinuous with knob in steps of 100 Hz or 10 kHz
2. keyboard entry
3. in steps of any preset size
4. automatic scanning
Indication . . . . . 6-digit LED display
Resolution . . . . . 100 Hz
Setting error[1]) . . . . . 1.5×10^{-5} +50 Hz

RF Input . . . . . Z_{in} = 50 Ω, BNC female connector
VSWR . . . . . <1.2 with RF attenuation ≥10 dB
<2 with RF attenuation 0 dB
Oscillator reradiation . . . . . <0 dBµV
Input filter[2])
Range 1 model 52: 9 to <150 kHz, bandpass filter
model 56: 20 Hz to <150 kHz, bandpass filter

2	100 to <200 kHz	10	2.0 to <2.7 MHz
3	200 to <280 kHz	11	2.7 to <3.7 MHz
4	280 to <390 kHz	12	3.7 to <5.2 MHz
5	390 to <540 kHz	13	5.2 to <7.2 MHz
6	540 to <750 kHz	14	7.2 to <10 MHz
7	0.75 to <1.05 MHz	15	10 to <20 MHz
8	1.05 to <1.45 MHz*	16	20 to <30 MHz*
9	1.45 to <2.0 MHz		

* (8: sub-octave filter, 16: tracking filter)
Maximum input level with
RF attenuation 0 dB . . . . . 130 dBµV
RF attenuation ≥10 dB . . . . . 137 dBµV

Interference immunity, non-linearities
Image frequency rejection . . . . . >100 dB, typ. 120 dB
IF rejection . . . . . >100 dB, typ. 110 dB
Non-linearities: signal spacing (d_2, d_3) ≥40 kHz
a) frequency range 9 kHz to <150 kHz
b) frequency range 150 kHz to 30 MHz

Type		Signal level dBµV	Intermod. ratio dB	Intercept point guaranteed dBm	typical dBm
a)	k_2	100	>52	+45	+50
	d_2	100	>50	+43	+55
	d_3	90	>64	+15	+20
b)	k_2	100	>77	+70	+90
	d_2	100	>60	+55	+75
	d_3	90	>64	+15	+20

Crossmodulation
An interference signal of m = 30% and f = 1 kHz spaced >100 kHz away produces 3% spurious modulation of 20-dBµV signal at a level of . . . . . >100 dBµV
Shielding effectiveness
Difference in reading with field strength 10 V/m ($f = f_{in}$) . . . . . <1 dB

Radio interference (EMI) from internal microcomputer, etc. . . . . . below the tolerance limits of FTZ regulation 527/1979

Intermediate frequencies
1st IF . . . . . 75 MHz
2nd IF . . . . . 9 MHz
3rd IF . . . . . 30 kHz

IF bandwidths (average and peak value)

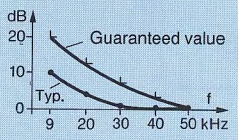
Nominal bandwidth	3-dB bandwidth (±10%)	6-dB bandwidth	6:60 dB ratio
200 Hz[3]	160 Hz[4]	200 Hz	approx. 1 : 5
500 Hz (model 52)	550 Hz[4]	630 Hz	approx. 1 : 5
1 kHz (model 56)	800 Hz[4]	1 kHz	approx. 1 : 2
2.4 kHz	2.4 kHz	2.6 kHz	approx. 1 : 1.8
10 kHz	8 kHz[4]	9.5 kHz	approx. 1 : 2.4

IF bandwidth (−6 dB) for measurements to CISPR (Band A and Band B) and VDE 0875 ..... 0.2 kHz / 9 kHz (automatically switched over)

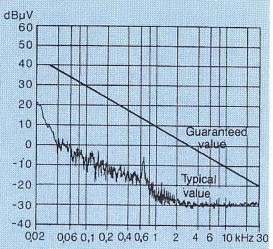
Noise indication a (f_{in} >50 kHz)

Average value	B = 200 Hz	<−27 dBµV, typ. −31 dBµV
Peak value	B = 200 Hz	<−19 dBµV, typ. −22 dBµV
CISPR band A	B = 200 Hz	<−26 dBµV, typ. −30 dBµV
CISPR band B	B = 9 kHz	<− 6 dBµV, typ. − 9 dBµV
Spectral pulse density (MIL)	B = 10 kHz	typ. 38 dB(µV/MHz)

Increase of noise indication ..... (f <50 kHz, B = 200 Hz)



Noise indication for combination of ESH3 (model 56) and Spectrum Monitor EZM (function RF/IF analysis of EZM with 10-Hz bandwidth)



Measurement ranges

Voltage
- Lower limit (3 dB above noise level) ..... see internal noise
- Upper limit ..... +137 dBµV; for pulse spectra: 146 dBµV/10 kHz
- Measurement error average, 20 dB ..... <1 dB with V_{in} ≥16 dB above internal noise

Frequency offset ..... −5 to +5 kHz, depending on IF bandwidth

Frequency deviation ..... 0.05 to 5 kHz, depending on IF bandwidth

AM modulation depth ..... approx. 2 to 100%

Gain ..... −110 to +57 dB

Indication of measured value .... 13-digit alphanumeric display of numerical value and unit of measurement for level, frequency offset, deviation, modulation depth or gain

Level
- digital in dBµV etc. ..... 4 digits, resolution 0.1 dB
- in µV, mV etc. ..... 3 digits, resolution 1 LSD
- analog ..... row of 31 LEDs within operating range of IF detector, with digital indication of range limits

Operating range of IF detector ... 20, 40, 60 dB

Indicating modes ..... average, peak
CISPR (Publ. 1 & 3)
spectral density to MIL stand.
max./min. levels over preset period of observation

Frequency offset
- digital in kHz ..... 3 digits, resolution 10 Hz
- analog ..... row of 16 LEDs

Frequency deviation in kHz ..... 3 digits, resolution 10 Hz

Modulation depth in % ..... 2 digits, resolution 1%

Gain in dB ..... 4 digits, resolution 0.1 dB

Types of demodulation ..... N0N (A0, zero beat)
A1A (A1, 1-kHz beat note)
A3E (A3, double-sideband AM)
J3E (A3J, LSB, USB)
F3E (F3, frequency modulation)

Outputs

Generator (ref. voltage, can be switched off) ..... 86 dBµV ±0.5 dB; 50 Ω, BNC female connector

Connector for antenna supply and antenna coding ..... 12-contact Tuchel female

AF signal, adjustable ..... up to 3.5 V, 10 Ω; jack JK 34

IF 75 MHz ..... 50 Ω, BNC female

EMF ..... 10 ±3 dB above input level with 0 dB attenuation

Bandwidth ..... corresponding to RF bandwidth

IF 30 kHz ..... 1 kΩ, BNC female connector

EMF at max. analog indication ... 2 V, bandwidth corresponds to IF bandwidth

AM demodulator ..... 10 kΩ, BNC female connector

EMF ..... 1 V at 100% modulation

FM demodulator ..... 10 kΩ, BNC female connector

EMF ..... ±0.5 V for 5 kHz deviation

Frequency offset ..... ±5 V for 5 kHz offset
Z_{out} = 10 kΩ, BNC female connector

Analog level output 1 ..... 0 to +5 V between limits of analog indication
(average, peak, MIL)

CISPR ..... 0 to +2 V

Analog level output 2 ..... 0 to +2 V, Z_{out} = 10 kΩ, BNC female connector, includes lowpass network to CISPR for simulation of meter response
(CISPR)

Recorder output ..... 24-contact Amphenol female connector for coding lines to identify recorder type, analog X and Y outputs, penlift control, paper advance for ZSKT, connection of five ZSG 3

Reference frequency input ..... 5/10 MHz, switch-selected; required EMF: 1 V into 50 Ω

Remote control ..... interface according to IEC 625-1, 24-contact Amphenol connector; functions: AH1, L4, SH1, T5, RL1, SR1, PP1, DC1, DT1, C0

General data

Rated temperature range ..... +5 to +45 °C

Storage temperature range ..... −25 to +70 °C

Power supply, AC ..... 100/120/220/240 V ±10%, 47 to 440 Hz (70 VA)

Battery ..... 22 to 32 V, 2.5 A at 24 V

Dimensions, weight ..... 492 mm×205 mm×514 mm, 25 kg

Ordering information

Order designation ..... ▶ Test Receiver ESH 3

Model: standard 335.8017.52

for MIL-STDs 335.8017.56

Accessories supplied ..... power cable

Option

Oven-controlled Crystal Oscillator .. ESVP-B1 ... 358.1119.02

Recommended extras

For interference measurements

RF Current Probe (9 kHz to 30 MHz)	ESH 2-Z1	338.3516.52
Active Probe (9 kHz to 30 MHz, high impedance)	ESH 2-Z2	299.7210.52
Passive Probe (9 kHz to 30 MHz, VDE 0876)	ESH 2-Z3	299.7810.52
Artificial Mains Network (9 kHz to 30 MHz, VDE 0876, CISPR 3)	ESH 2-Z5	338.5219.53
Connecting Cable (ESH 3-ZSKT)	ESH 3-Z1	349.6011.02
Pulse Limiter	ESH 3-Z2	357.8810.52
Preamplifier	ESH 3-Z3	827.8016.52
T-network	ESH 3-Z4	800.1510.52
Two-line V-network	ESH 3-Z5	831.5518.52
V-network 5 µH || 50 Ω	ESH 3-Z6	836.5016.52
Attenuator	ESH 2 Z11	349.7518.52

Field-strength measurement accessories:

Rod Antenna	HFH 2-Z1	335.3215.52
Loop Antenna	HFH 2-Z2	335.4711.52
Loop Antenna	HFH 2-Z3	335.6214.52
Tripod	HFU-Z	100.1114.02
Inductive Probe	HFH 2-Z4	338.3016.52

General:

Headphones		110.2959.00

Recorders:

XY Recorder ZSK 2		290.2016.02
XYT Recorder ZSKT		301.9010.02
Radiomonitoring Recorder ZSG 3		242.6015.92
Universal Impact Printer (220 V)	PUD 2	359.5018.02
Universal Ink-jet Printer (220 V)	PUD 3	359.5501.02
Universal Ink-jet Printer (117 V)	PUD 3	359.5501.03
IEC-bus interface option	PUD 2-B4	359.5418.02
HF Preselector	FK 101	617.8011.02

Frequency counter for remote frequency measurements, sensitivity better than 10 mV into 50 Ω, such as PM 6676/04 from Philips

Sinewave inverter for operating the ESH3 from a 12-V battery, such as SWR from Audiotechnik, Bad Salzuflen

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[1]) For greater setting accuracies, the ESH3 has an input for an external reference frequency of 5 or 10 MHz.

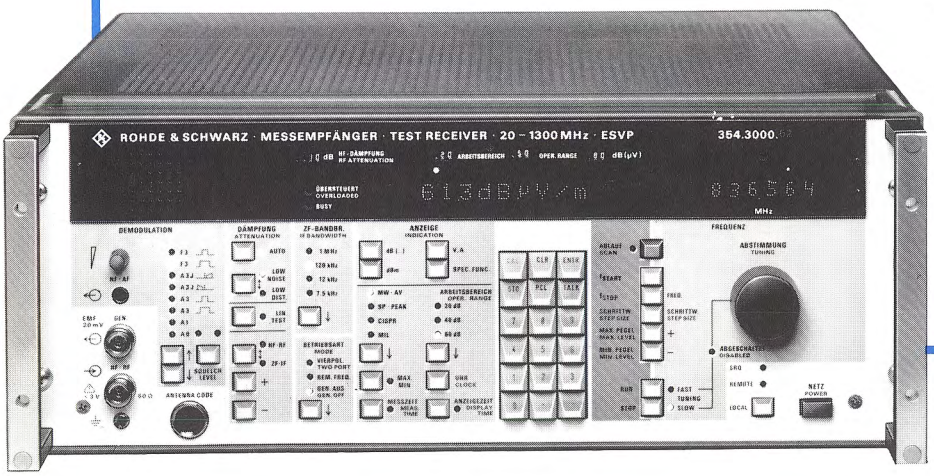
[2]) For extreme requirements, the HF Preselector FK 101 can be used (data sheet N 2-322).

[3]) The accuracy is reduced when measuring sinewave signals at 200 Hz bandwidth (additional measuring error 1.5 dB) because the receiver is tuned in 100-Hz steps.

[4]) ±20%.

ESVP

Test Receiver ESVP ♦ 20 to 1300 MHz −20 to +137 dBμV



- Programmable test receiver for selective voltage measurements and twoport measurements in laboratories and test departments
- Field-strength measurements with test antennas
- RFI measurements to CISPR, VDE and FCC
- Interference measurements to MIL and VG standards
- Radiomonitoring
- AC supply and battery operation

IEC625Bus

The **Test Receiver ESVP** measures and demodulates AM double-sideband, single-sideband, pulse-modulated and FM signals as well as narrowband and broadband interference. High overload capacity, a wide dynamic range and manifold evaluation capabilities make the ESVP suitable for

selective voltage and twoport measurements – in automatic test systems too –

and all applications in the field of radiomonitoring and EMC measurements.

In its frequency-related characteristics and application capabilities the ESVP is very similar to the Test Receiver ESV (see measuring equipment catalog), in measurement convenience, intelligence and system compatibility to the ESH 3 (see above); its frequency range overlaps and extends that of the ESH 3.

Different ESVP models are available for the **main fields of application:**

Model	Frequency (MHz)	Bandwidths (kHz)	Application
52	20 to 1300	7.5/12/120/1000	Radiomonitoring/CISPR, VDE/MIL, VG standards
53	20 to 1300	7.5/12/120/200	Radiomonitoring, FM radio/CISPR, VDE
54	20 to 1000	7.5/12/120/1000	same as model 52
55	20 to 1000	7.5/12/120/200	same as model 53
56	20 to 1300	10/100/120/1000	CISPR, VDE/MIL, DEF STAN, VG standards

Special features of ESVP

- Synthesizer; frequency resolution 1 kHz, with SSB 100 Hz
- High measurement accuracy (error <1 dB)
- Wide dynamic range:
  noise figure typically 8 dB (preamplifier on)
  3rd-order IP typically +20 dBm (preamplifier off)
- Automatic gain correction in the whole frequency range after calibration
- Measurement of voltage, field strength, current, spectral density and attenuation constant with display of physical unit; conversion and bandwidth correction factors are automatically taken into account.
- Additional evaluation capabilities for radiomonitoring: modulation-depth and frequency-deviation measurements, remote frequency and frequency-offset measurements thanks to internal IF counter, connection of radiomonitoring recorders (maximum of five ZSG 3), SSB demodulator, AF filter, squelch with programmable threshold, indication of date and time of day.
- Storage of 10 complete device settings and of 5 data sets for automatic frequency scanning
- Special functions for frequency scanning with a set of up to 50 freely selectable fixed frequencies
- Special functions for fast field-strength measurements in a moving vehicle

Further characteristics, uses

Selective voltage measurement With its measurement range −20 to +137 dBμV the ESVP on its own is an automatic high-precision selective voltmeter for laboratory, testing and servicing applications. RF currents in the frequency range 20 to 300 MHz can be measured in conjunction with the VHF Current Probe ESV-Z1. Excellent receiver selectivity permits the measurement of adjacent-channel power and of nonharmonic spurious signals of generators. Other important applications are the measurement of intermodulation, crossmodulation and distortion and the determination of noise figures.

Frequency-response/attenuation measurement with calibration generator The calibration generator output of 90 dBμV into 50 Ω is ideally suited for frequency-response measurements on amplifiers and filters; attenuation can be measured up to 105 dB and gain up to 47 dB. The VHF Current Probe ESV-Z1 facilitates the measurement of shielding effectiveness on cables and connectors and a VSWR bridge can be used for return-loss measurements on two-terminal networks (e.g. antennas) and twoports.

Remote control The IEC-bus interface possesses all standard listener and talker capabilities. Commercial controllers without parallel poll capability can be used.

Signal evaluation capabilities

Four switch-selected IF bandwidths:
Models 52 and 54: 7.5/12/120/1000 kHz
Models 53 and 55: 200 kHz instead of 1000 kHz
Model 56: 10 and 100 kHz instead of 7.5 and 12 kHz

Average and peak indication, pulse weighting to CISPR 2 and 4 with programmable measurement times

Demodulation of commonly used FM and AM modes, SSB (USB, LSB) included

Broadband IF output of 10.7 MHz for panoramic display and spectrum analyzer

Narrowband IF output for oscilloscope

AM and FM demodulator outputs

Recorder outputs for level and frequency offset

Digital readout of modulation depth, frequency offset and frequency deviation

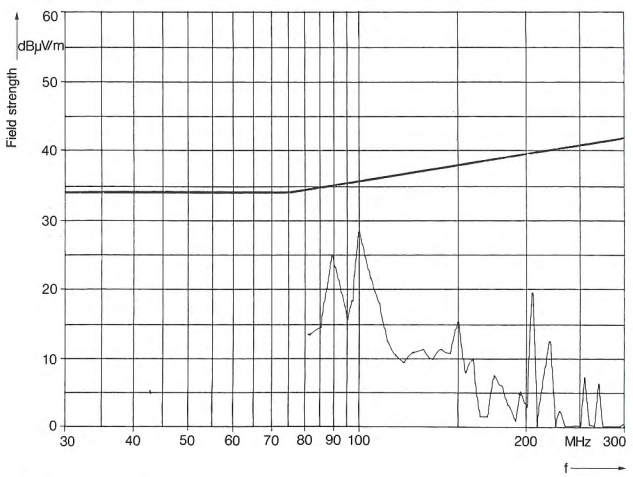
Trigger input for level and frequency measurement of short signals.

Recording Harmonic, nonharmonic and sideband noise spectra, gain and attenuation curves can be readily plotted on an XY recorder. The start and stop frequencies and the maximum and minimum levels set on the ESVP define the recorder writing area. The frequency scale can be linear or logarithmic. Chart paper complying with VDE/FCC/FTZ/MIL/VG can be used.

Special applications of ESVP

EMI measurements Programmable automatic frequency scanning with direct printer/recorder control gives the ESVP a considerable advantage over earlier test receivers. The following accessories are available for measuring interference voltages, currents and field strengths in line with the relevant standards (CISPR, VDE, MIL, VG):

– V-network (5 µH || 50 Ω)	ESH 3-Z6
– VHF Current Probe (20 to 300 MHz)	ESV-Z1
– Absorbing Clamp (30 to 1000 MHz)	MDS 21
– Broadband Dipole (20 to 80 MHz)	HUF-Z1
– Biconical Antenna (20 to 200 MHz)	HUF-Z2
– Log-periodic Antenna (200 to 1000 MHz)	HUF-Z3
–Conical Log-spiral Antenna (200 to 1000 MHz)	HUF-Z4
– Log-periodic Broadband Antenna (80 to 1300 MHz)	HL 023 A1



Interference field strength of a motor vehicle: automatic frequency scanning of ESVP with 50 fixed frequencies

Further advantages of ESVP in interference measurements:

– Automatic consideration of correction factors of any probes and indication of physical unit (eg dBµA, dBµV, dBµV/m, dBpW)
– Suitable bandwidths for measurements to MIL-STDs provided by model 56 (also in line with SAE draft for MIL-STD 462 B), British DEF STAN 59-4 and VG standards
– Bandwidth correction factors considered in measurement of spectral pulse density to MIL and VG: readout of measured data in dBµV/MHz, dBµA/MHz, dBµV/m MHz
– Frequency range 20 Hz to 1.3 GHz together with ESH 3 and EZM
– Bandwidth factors are taken into account in measurements of spectral density to MIL and VG
– Peak indication with programmable hold time for narrowband and broadband interference measurements to MIL and VG
– Average indication with programmable integration time for narrowband interference measurements
– Indication to CISPR with determination of maximum within the programmed measurement time

Radiomonitoring, propagation and coverage measurements Thanks to its outstanding RF characteristics, switch-selected IF bandwidths and types of demodulation, the wide range of available test antennas and its programmability, the ESVP is ideal for use in radiomonitoring with remote frequency measurement, determination of frequency-band occupancy and for propagation and coverage measurements. It offers the following possibilities:

– Graphical representation of field strength in particular of frequency bands, in the form of line spectra or segmented curves, on an XY recorder, with additional output of field-strength levels and, eg frequency offset on a printer
– Measurement of the variation range of field-strength level within a preset time (1 to 1000 s)
– Recording of field strength as a function of time for plotting antenna radiation patterns, for example in helicopters, and for measurement of channel occupation
– Recording of frequency-band occupancy as a function of time, using the Radiomonitoring Recorder ZSG 3
– Reduction of data volume in automatic scanning mode: only signal levels above the preset threshold are taken to the computer.
– Trigger functions: "internal" for automatic monitoring of intermittent carriers; "at time x" and every x seconds, minutes, hours for exact observation of occupancy and level variations
– Special functions for field-strength statistics in moving vehicles: fast binary data output or internal field-strength classification with the output of 15 field levels that are exceeded by predetermined percentages of individual values; triggering independent of speed through external displacement transducers
– Automatic frequency scanning with a maximum of 50 fixed frequencies to be entered at choice
– Use in automatic field-strength test systems

ESVP

The parallel use of several receivers is of particular interest for **radiomonitoring.** The controller instructs each ESVP (and ESH 3) to permanently scan a particular frequency range and to issue an SRQ when the programmed level is exceeded – whereupon the controller identifies the calling receiver by a serial poll and accepts the measured data – or to answer a parallel poll of the controller.

Automatic field-strength test sets furnish the data for statistical evaluation of spatial and time-dependent field-strength variations thus providing **fundamental data for transmitter planning.** In an industrial environment it is necessary to permanently **check the coverage** by all radio communication services (sound and TV broadcasting, car telephone, European radiopaging and non-public services). The **fast field-strength measurement in moving vehicles** with statistical evaluation (ESVP with special function Fast A/D, with or without internal classification) is particularly important for mobile radio networks in the VHF-UHF range, where strong spatial field-strength variations may occur due to scattering, diffraction and reflection. A pulse displacement generator triggers each individual measurement in the ESVP (trigger rate up to 1 kHz), whereupon the measurement rate is independent of the speed of the vehicle. In computer-controlled **in-flight measurements on transmitting antennas** (usually from helicopter) the high measurement speed of the ESVP is a great advantage: it takes only 0.2 s for one measurement at three different frequencies. Vertical patterns are determinded in an ascending flight, horizontal patterns in a circular flight. The graphical representation of the results – circular diagram, standardization of the field strength in the direction of maximum radiation, etc. – is carried out by the computer immediately on completion of the measurements.

Calibration By a short or long stroke of the calibration button, function 1 or 1 plus 2 is initiated:

1 Adjustment of IF gain and frequency offset to the rated value at 100 MHz, followed by a check of the level measurement at the set frequency.

2 Measurement and storage of all calibration correction values that are constant over a long time: frequency response, gain differences between IF bandwidths and demodulator linearity.

During operation the IF gain is adjusted each time a new frequency and IF bandwidth is set, so the rated levels are obtained at the IF and recorder outputs.

Thanks to this method, calibration of individual functions is very seldom necessary and automatic measurements take much **less time** than would be required if a calibration were performed at each new frequency.

Storage A non-volatile memory in the ESVP can store the last and nine more complete device settings. It also stores all the correction values response, IF bandwidths and demodulator characteristics.

Specifications

Frequency range	20 to 1300 (1000) MHz		
Frequency setting	1. in 1 kHz/100 kHz steps with knob; least increment in SSB mode: 100 Hz 2. keyboard entry 3. in steps of any preset size 4. automatic scanning		
Indication	8-digit LED display		
Resolution	1 kHz/100 Hz (SSB)		
Setting error (freq. prop.)	$<5\times10^{-6}$ (max. 5 kHz at 1 GHz)		
With Oven-controlled Crystal Oscillator Option ESVP-B1			
Setting error in temperature range +5 to +45 °C	$<1\times10^{-9}$/°C		
Warmup time	<10 min at 5 °C/<5 min at 25 °C		
Aging	$\leq1\times10^{-9}$/day		
Pulling range of oven-controlled crystal oscillator	$\geq1\times10^{-6}$		
RF input	Z_{in} = 50 Ω, N female connector		
VSWR	<1.2 with RF attenuation ≥10 dB <2 with RF attenuation 0 dB		
Oscillator reradiation at RF input without preamplifier and with RF attenuation 0 dB	<10 dBµV for f_{in} = 20 to <520 MHz		
(with preamplifier 15 dB less)	<20 dBµV for f_{in} = 520 to <1020 MHz		
	typ. 40 dBµV (f_{01}) } for f_{in} = 1.02 to 1.3 GHz		
	typ. 50 dBµV ($2\times f_{01}$) } for f_{in} = 1.02 to 1.3 GHz		
Preamplifier	can be switched into circuit between RF attenuator and input filter: ≈+10 dB		
Input filters	10 tracking filters		
Maximum input level at RF atten.	0 dB	≥10 dB	
DC voltage	7 V	7 V	
Sinewave AC voltage	130 dBµV	137 dBµV (at ≥10 dB)	
Max. pulse voltage		150 V	
Max. pulse energy (10 µs)		1 mWs	
Interference rejection, non-linearities	off	**preampl.**	on
Image frequency rejection			
20 to 1020 MHz		80 dB, typ. 100 dB	
1020 to 1300 MHz		>70 dB, typ. 100 dB	
Rejection of spurious responses in range 1.02 to 1.3 GHz for frequencies $2\times f_{in}-932.1$ MHz	typ. 30 to 80 dB		
IF rejection	>80 dB, typ. 100 dB		
Intercept point d_3	>+13 dBm, typ. +20 dBm	>+1 dBm, typ. +8 dBm	
Intercept point k_2	>+40 dBm, typ. +50 dBm	>+20 dBm typ. +40 dBm	
Desensitization (typical, frequency-dependent)			
An interfering signal spaced >2 MHz from the receive freq. varies the indication of the measured signal by <1 dB (RF attenuation 0 dB) at a level of	110 dBµV	100 dBµV	
RF shielding			
Voltage indication at a field strength of 3 V/m	<0 dBµV	0 dBµV	
Radio interference from internal microcomputer, etc.	below the limits to VDE 0876 and MIL-Std. 461 A and B		
IF frequencies			
1st IF f_{in} <520 MHz	810.7 MHz		
f_{in} ≥520 MHz	310.7 MHz		
2nd IF	10.7 MHz		

IF bandwidths (for average and peak values)

Nominal bandwidth	−3 dB (±20%)	−6 dB (±10%)	typ. ratio 6/60 dB
7.5 kHz (models 52 to 55)	7.5 kHz	8.3 kHz	1:1.8
10 kHz (model 56)	9 kHz	10 kHz	1:1.8
12 kHz (models 52 to 55)	12 kHz	13.4 kHz	1:1.8
100 kHz (model 56)	90 kHz	100 kHz	1:2.1
120 kHz (all models)	110 kHz	120 kHz	1:2.1
200 kHz (models 53, 55)	200 kHz (±10%)	225 kHz (±20%)	1:2.5
1 MHz (models 52, 54, 56)	0.8 MHz	1 MHz	1:3.5

IF BW (−6 dB) for radio interference measurements to CISPR Publ. 16) and VDE 0876	120 kHz		
IF bandwidth (−3 dB) for SSB demodulation (aural monitoring only)	2.4 kHz		
Noise indication	**off**	**preampl.**	**on**
Average value, B = 7.5 kHz			
20 to <520 MHz	<−10 dBµV, typ. −13 dBµV		<−16 dBµV, typ. −21 dBµV
520 to 1300 MHz	<−8 dBµV, typ. −11 dBµV		<−14 dBµV, typ. −19 dBµV
Peak value (typ. increase as against average value)	+11 dB		
CISPR	typ. +4 dBµV		typ. −4 dBµV
MIL (B_{IF} = 1 MHz)	typ. +20 dBµV/MHz		typ. 14 dBµV/MHz
Voltage measurement range (with preamplifier)			
Lower limit	3 dB above noise level (see left)		
Upper limit	137 dBµV (RF attenuation ≥10 dB)		

Inherent spurious responses	<−5 dBµV (equivalent input voltage)
Readout	
digital in dBµV, dBm	4 digits max., resolution 0.1 dB
in µV, mV, V	3 digits
analog	LED row (31 LEDs) over operating range of IF rectifier and with digital display of range limits
Operating ranges of IF rectifier	20, 40, 60 dB
Display modes	average value (progr. averaging time) peak value (progr. hold time) spectral density measurements to MIL, CISPR (Publ. 2 and 4); programmable averaging, hold and measuring times: 5 ms to 100 s
Measurement of maximum and minimum levels	the maximum and minimum levels are determined from individual measurements of 0.1 s duration each; progr. measuring time: 1 to 1000 s
Measuring error (level indication)	
Average indication for unmodulated sinewave signal ≥16 dB above noise indication	<1 dB
Additional error in operating ranges 40 und 60 dB	typ. <0.5 dB
Level calibration facility	
Average/peak	tracking generator (sinewave)
CISPR, MIL in addition	pulse generator
Error of analog level indication	
Operating range 20 dB	typ. <2 dB
40, 60 dB	typ. <4 dB
Frequency offset	indication: digital in kHz, resolution 0.1 to 100 Hz, analog with LED row
Measuring times	10 ms to 10 s
Frequency deviation (+/−, peak)	indication in kHz, 4 digits, resolution 0.1/0.01 kHz
Measurement range	1 to 400 kHz
Measuring error for S/N = 40 dB, f_{mod} ≤1 kHz (mod. meas. filter switched in)	
at B_{IF} = 7.5/10/12 kHz, deviation < $B_{IF}/2$	<0.5 kHz (typ.)
at B_{IF} = 100/120 kHz, deviation < $B_{IF}/2$	2 kHz (typ.)
at B_{IF} = 200 kHz, deviation <100 kHz	<5 kHz (typ.)
at B_{IF} = 1 MHz, deviation < 400 kHz	< 5 kHz + 0.02 × deviation/kHz (typ.)
Modulation depth (AM)	indication in %, 3 digits, resolution 0.1%
Measurement range	≈1 to 99% (150% pos. peak)
Measuring error for S/N ≥40 dB	<5 absolute (typ.)
Gain measurement	indication in dB, 4 digits, resolution 0.1 dB
Measurement range	−110 to +47 dB
Error	<1 dB, <0.5 dB typ.
Demodulation modes	N0N (A0, zero beat) A1A (A1, 1-kHz beat note) A3E (A3, double-sideband AM) J3E (A3J, LSB, USB) F3E (F3, frequency modulation)
Squelch	carrier squelch, threshold adjustable −20 to +137 dBµV
Date, time of day	internal clock module, permanently in operation from internal battery
Remote control	interface to IEC 625-1, 24-contact Amphenol connector; functions: AH1, L4, SH1, T5, SR1, PP1, DC1, DT1, RL1, C0
Max. data rate	
Talker mode	approx. 25 kbyte/s
Listener mode	approx. 20 kbyte/s
Setting times	
Internal frequency, eg scan mode in steps <100 MHz	typ. 20 to 40 ms
exceeding a 100-MHz digit	typ. 70 ms
Internal RF level switch	25 ms/step
Max. measuring rate with PUC, measuring time 5 ms	
with automatic frequency scanning	16 measurements/s
with measurement at one freq.	30 measurements/s
with special function Fast A/D	1000 measurements/s

Front-panel outputs

Generator output (switch-selected)	Z_{out} = 50 Ω, N female connector
EMF	96 dBµV ±0.3 dB
Connector for supply and coding of test antennas, etc.	12-contact Tuchel female connector
AF output	Z_{out} = 10 Ω, telephone jack JK34
EMF	adjustable up to 3.5 V

Rear-panel outputs

IF 10.7 MHz	
wide (B ≈2 MHz)	Z_{out} = 50 Ω, BNC female connector
gain ref. to RF input (RF attenuation 0 dB)	typ. 7.5 dB (without preamplifier) typ. 17.5 dB (with preamplifier)
narrow (B = IF bandwidth)	Z_{out} = 50 Ω, BNC female connector
EMF in range of analog level indication	
Operating range 20 dB	10 to 100 mV
40 dB	10 to 1000 mV
60 dB	1 to 1000 mV
AM demodulator	Z_{out} = 330 Ω, BNC female connector
EMF / $B_{-3\,dB\,max}$	1 V at m = 50% / ≥0.3 MHz
FM demodulator	Z_{out} = 330 Ω, BNC female connector
EMF at B_{IF} = 7.5/10/12 kHz	1 V/1 kHz offset
at 100/120/200/1000 kHz	1 V/100 kHz offset
$B_{-3\,dB\,max}$	≥0.3 MHz
Analog recording outputs	
Frequency offset	Z_{out} = 10 kΩ, BNC female connector
EMF at IF bandw.	
7.5/10/12 kHz	±1 V/±1 kHz offset
0.1/0.12 MHz	±1 V/±10 kHz offset
0.12/0.2 MHz (model 53)	±1 V/±20 kHz offset
1 MHz	±1 V/±100 kHz offset
Level 1 in AV, PEAK, CISPR, MIL modes	+4 V for max. analog indication
Level 2 in CISPR mode	+2 V for max. analog indication (includes LP filter simulating meter response, to CISPR 2 and 4)
Recorder output	24-contact Amphenol female connector; includes X and Y analog outputs for D/A-converted signal for recording of scanning process X = 0 V: start frequency = 10 V: stop frequency Y = 0 V: Min. level = 10 V: Max. level; pen-lift control: (L ≙ pen up); formatted paper feed for ZSKT (H pulse, duration 10 ms); connecting of five Radiomonitoring Recorders ZSG 3 possible

Rear-panel inputs

Ext. trigger	Z_{in} ≥3 kΩ, BNC female connector
Trigger threshold	TTL (H ≥2 V, L ≤0.8 V hysteresis), switch-selected positive or negative slope
Ext. reference frequency	Z_{in} = 50 Ω, BNC female connector
Required level	EMF = 1 V from 50 Ω, sinewave
Frequency	5/10 MHz (switch-selected)

General data

Rated temperature range	+5 to +45 °C
Storage temperature range[1]	−25 to +70 °C
Power supply/AC supply	100/120/220/240 V ±10%, 47 to 440 Hz (90 VA)
Battery	22 to 32 V, 3 A at 24 V
Dimensions, weight	492 mm×205 mm×514 mm, 29 kg

Ordering information

Order designation	▶ Test Receiver ESVP	
Frequency range	20 to 1300 MHz	20 to 1000 MHz
B_{IF} = 7.5/12/120/1000 kHz	354.3000.52	354.3000.54
B_{IF} = 7.5/12/120/1200 kHz	354.3000.53	354.3000.55
B_{IF} = 10/100/120/1000 kHz	354.3000.56	
Accessories supplied	power cord, battery cable	

Option

Oven-controlled Crystal Oscillator	ESVP-B1	358.1119.02

Recommended extras

VHF Current Probe (20 to 300 MHz)	ESV-Z1	353.7019.02
Applications Software ESH3/ESVP with PUC	ESVP-K1	397.6018.02
with PCA5	ESVP-K2	399.9014.02
Absorbing Clamp (30 to 1000 MHz)	MDS-21	194.0100.50
Adapter BNC/N		118.2812.00
Broadband Dipole (20 to 80 MHz)	HUF-Z1	358.0512.52
Log-periodic Broadband Antenna (80 to 1300 MHz)	HL 023 A1	577.8017.02
Tripod	HFU-Z	100.1114.02
Mast (for tripod)	HFU-Z	100.1120.02
RF connecting cable (7 m)	HFU 2-Z5	252.0055.55
Headphones		110.2959.00
Service Kit	ESVP-Z1	358.1019.02
V-network 5 µV || 50 Ω	ESH3-Z6	836.5016.52

Other accessories
XYT Recorder ZSKT/ZSK2, Radiomonitoring Recorder ZSG3, Universal Printer PUD2 or PUD3, Spectrum Monitor EZM

[1]) The ESVP is fitted with a lithium battery for buffering the CMOS-RAMs. Storage at high temperatures over extended periods curtails the lifetime of the battery.

FSA

Spectrum Analyzer FSA ♦ 100 Hz to 2 GHz

- Exceptionally high sensitivity
- Large dynamic range
- Small RF frequency response
- Extremely low phase noise
- Selectable level range with display in all usual units
- High frequency accuracy
- Quasi-continously adjustable resolution bandwidth

Useful data outputs

- Hardcopy on printer, video printer or plotter (labelling using external keyboard)
- Display also possible on external (colour) monitor or oscilloscope
- Remote control facility
  – IEC bus (IEC 625-1, IEEE 488)
  – Programmable user port

IEC 625 Bus

Features

Simple operation

- Single-key operation
- Fixed keys for single functions
- Menu-controlled softkey operation
- Parameter entry on keypad or variation using spinwheel
- Status display

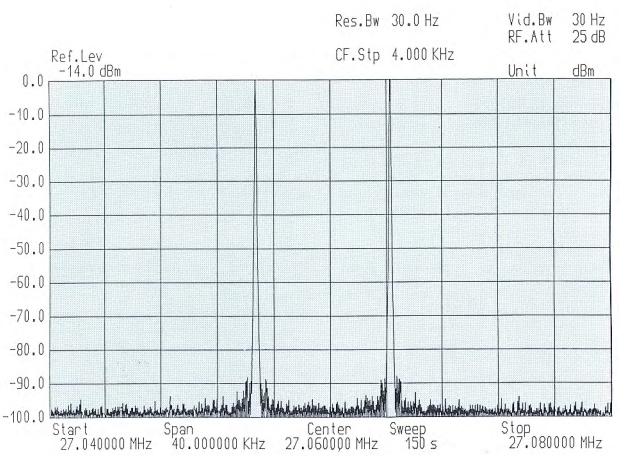
High measuring convenience

- Numerous automatic test routines
- Clear colour monitor
- Display of all important functions and parameters on monitor
- Integrated AM/FM demodulators

Operating principle

The **Spectrum Analyzer FSA** operates by a principle of search frequency analysis, in which the frequency range to be analyzed is sampled by varying an internal oscillator frequency using an analysis filter with matched resolution bandwidth and defined by any combination of the start, centre and stop frequencies as well as the span.

By means of a corresponding algorithm, the **resolution bandwidth, video bandwidth and sweep time,** which are important for the analysis, are selected depending on the displayed frequency range. The analysis is displayed on a colour monitor, the frequency in the X direction and the associated amplitudes in the Y direction.



Wide dynamic range of FSA: printout of two-tone signal test

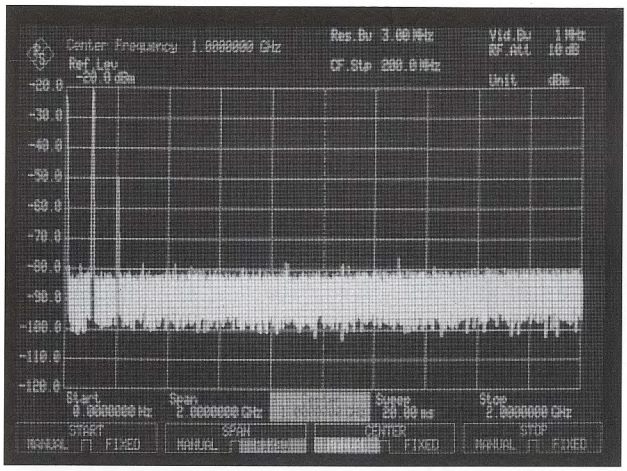
Uses

The **Spectrum Analyzer FSA** is used to measure the spectral distribution of signals in the frequency range from 100 Hz to 1.8 GHz. The quasi-continuously adjustable frequency resolution and the precise and long-term stability of synthesizer tuning make the Spectrum Analyzer suitable both for swept-frequency analysis and for fixed-frequency mode as a selective level meter.

The large range of resolution bandwidths (<10 Hz, typically 6 Hz, up to 3 MHz), the frequency span (0/10 Hz to 2 GHz) and the level display (1 to 110 dB) in a measuring range of 175 dB (−145 to +30 dBm) make the FSA highly suitable for all selective level measurements for instance on

- **generators**
  - small resolution bandwidths (<10 Hz, typically 6 Hz)
  - high frequency resolution (0.1 Hz)
  - low phase noise: <−110 dBc (1 Hz) at 1-kHz spacing
  - frequency counter function
- **modulators**
  - AM-FM demodulators as standard
  - wide dynamic range and high linearity of display for measurement of AM
- **broadband systems**
  - flat frequency response (<0.6 dB)
  - high sensitivity (<−145 dBm)
  - excellent overdrive capability
  - intermodulation products >100 dB down
  - large resolution bandwidths (3 MHz)

Simple operation using the keyboard, softkeys or merely a spinwheel, the clear display on a colour CRT, the internal intelligence of the FSA and the large variety of documentation facilities for results ensure that problems can be solved rapidly with the minimum of possible errors. In addition, temperature-dependent control of the internal blowers reduces the air throughput to the minimum necessary, thus also reducing noise.



Display of complete span

All FSA functions can be remote-controlled via the standardized IEC-bus interface (IEEE 488), thus ensuring easy integration even into large test systems.

Wide dynamic range with flat frequency response

An excellent thermal noise characteristic has been achieved by computer-based optimization of the signal-to-noise ratio of all stages in the RF and IF branches, the use of a balanced mixer with a wide dynamic range and a low-noise GaAs FET amplifier. The dynamic range at large signal levels is however not reduced. The RF attenuation is adjustable in 1-dB steps and enables optimum adaptation of the input level to the most favourable mixer level. The balanced configuration of this mixer largely suppresses even-order noise products (eg 2nd harmonic).

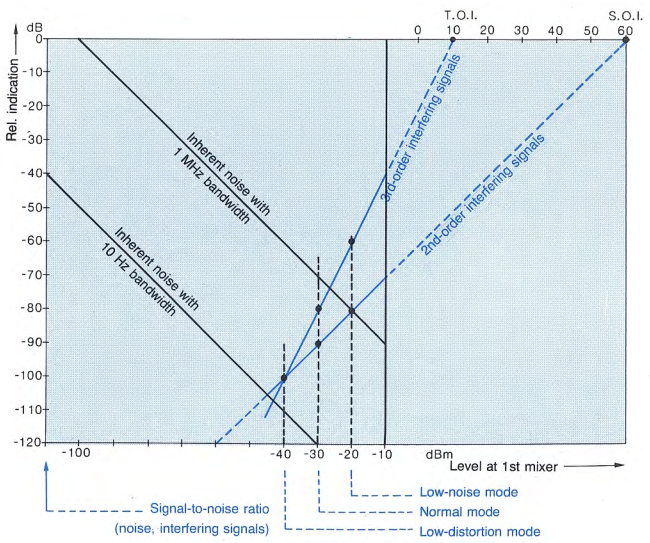
The mixer loss which is almost independent of the frequency, together with an electronic frequency response correction, results in a constant amplitude display over the complete frequency range.

Operation

The Spectrum Analyzer FSA is easy to operate even with complex measurements. This applies equally to operator's entry, data output on the screen, instrument protection as a result of the RF limiter fitted as standard, automatic detection of particular types of overload even outside the displayed frequency range, and optimum coupling of the three test parameters bandwidth, span and sweep time.

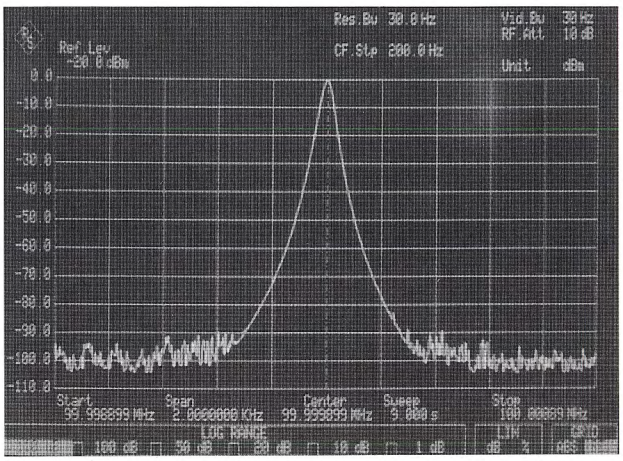
A single spinwheel, a clearly divided front panel (each key is only assigned one function) and softkeys at the bottom edge of the screen whose functions depend on the respective menu, exemplify the convenience of the FSA. Parameters are entered using the numeric keypad. The parameters can be modified using step keys or the spinwheel.

An overview of the currently active settings in the form of a list is provided by the status display using the help menu. The status list can be output as a hardcopy just as the display contents.

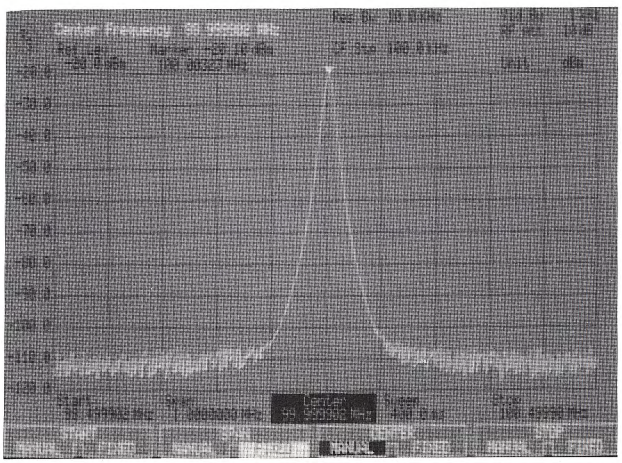


Inherent noise and effect of interfering signals are extremely low with FSA

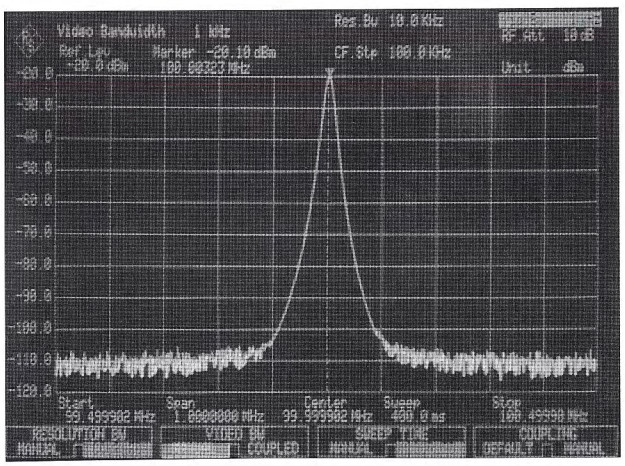
FSA – Characteristics



Output of measurement values in the 110-dB level display range



High frequency accuracy, start and stop points precisely measurable with frequency marker



Automatic coupling of most important test parameters with selectable ratio to one another guarantees optimum reliability in measurement – manual setting is also possible

Selectable level display range with a large number of level units

The display range of the Spectrum Analyzer FSA can be modified from a high level resolution (LIN or 0.1 dB per division) up to a high level range display (LOG 100 or 110 dB). When using a logarithmic precision amplifier, the improvement of linearity in the displayed level range by electronic means can be dispensed with. The high resolution of the internal A/D converter also results in a high and useful resolution of the measured levels. Level display is possible in all common units. Transducers of all types connected at the input can be considered in the level display by way of a level offset.

High frequency accuracy and stability

The use of a state-of-the-art synthesizer concept allows a frequency resolution of 0.1 Hz at extremely low phase noise. For spans of ≤5 MHz, the frequency variation is obtained by very small phase-locked steps (down to 0.003 Hz) producing a quasi-continuous frequency sweep. With spans of >5 MHz, synchronization to the start and stop frequencies ensures a high frequency accuracy.

Quasi-continuous frequency resolution

The five-stage electronic analyzer filter enables quasi-continuous modification of the resolution bandwidths in very small steps across almost the complete range from less than 10 Hz (typically 6 Hz) up to 3 MHz. Thus specified selection requirements can be optimally met for certain applications, eg with adjacent-channel measurements.

High measuring convenience

A large number of automatic test routines in the Spectrum Analyzer FSA such as

- marker output,
- level, frequency and bandwidth corrections,
- self-test,
- adaptation to type of signal or
- selectable operating modes LOW NOISE and LOW DISTORTION

facilitate operation, reduce possible errors and speed up measurements.

The display on the 9″ colour screen with output of all functions and parameters important to the measurement helps the user, in particular with complex applications. This is especially useful for measurements with several curves displayed simultaneously. Using an external keyboard, additional information can be entered and displayed.

The FSA also contains a demodulator module as standard thus enabling unknown signals which are AM- or FM-modulated to be identified using headphones. The demodulated signal can be displayed on the colour screen at the same time with a high level resolution in the frequency range up to 20 kHz.

Useful data outputs

Several facilities are available to output the data:

- Hardcopy of screen using a printer, video printer or IEC-bus plotter thus ensuring cost-effective and permanent documentation with the best possible resolution and display size.
- Connection of several colour monitors to the FSA distributed at different locations.
- Connection of an oscilloscope to the video output for (real-time) examination of signals whose frequency is above 20 kHz.

Future-oriented

The exceptional RF characteristics, the large variety of test facilities available in manual operation and IEC-bus-control ensure that the Spectrum Analyzer FSA is exceptionally well equipped for the future.

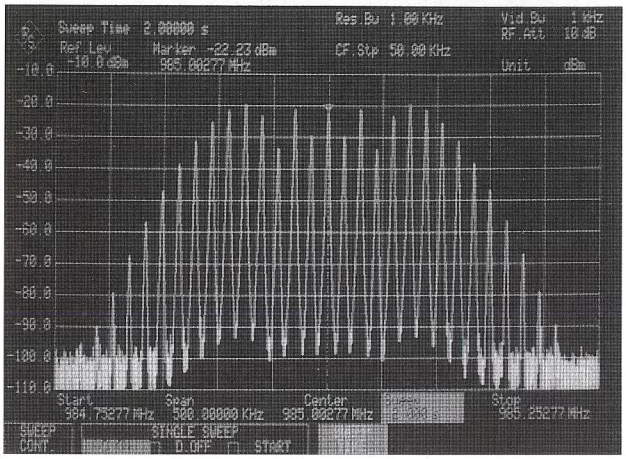
Design

The Spectrum Analyzer FSA has a design 90 housing and consists of the following subunits:

- **RF unit** (4 height units of the 19″ system) and
- **display unit** (5 height units).

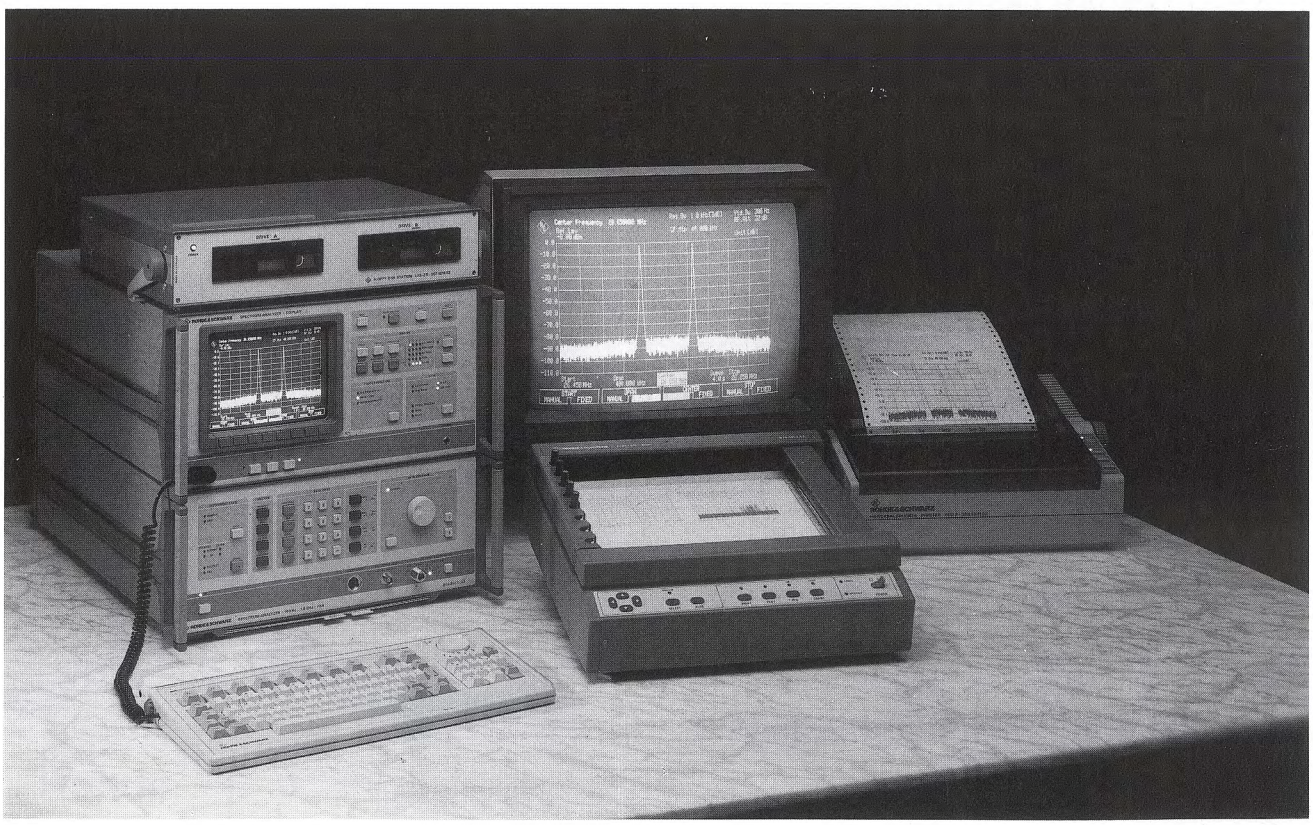
Both subunits of the FSA are connected together for normal operation and are linked mechanically. This link can be removed to enable separate transportation of the two units.

The electric connections between the two units are made using two screwed-on multiple cables. Both subunits are fitted with their own power supply and AC supply connections.



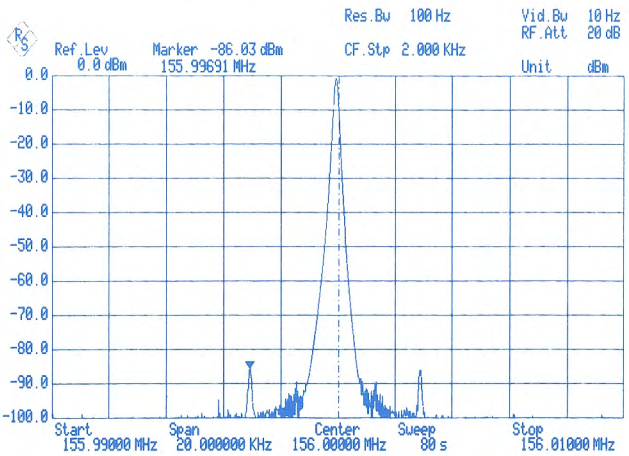
Spectral display of an FM-modulated signal

Spectrum Analyzer
with Universal Printer PUD 3,
Colour Monitor PMC, Plotter DOP and Keyboard PCA-Z1

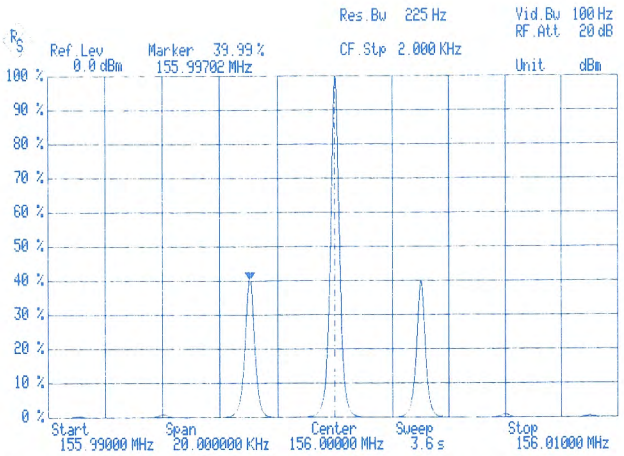


FSA – Applications

Measurement of amplitude modulations

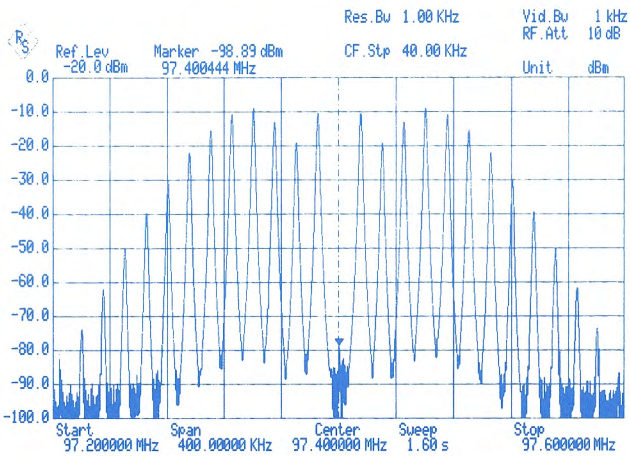


The large dynamic range of the FSA means that measurements of small modulation depths (in this case m = 0.01% with f_{mod} = 3 kHz) are also possible

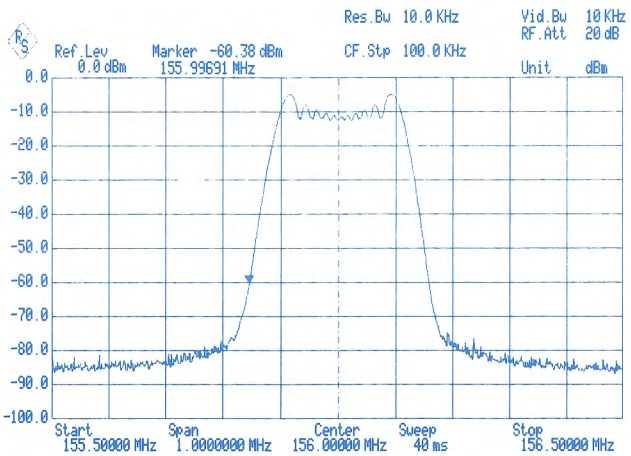


Measurement of a high modulation depth (m = 80%) in the linear display range

Measurement of frequency modulations

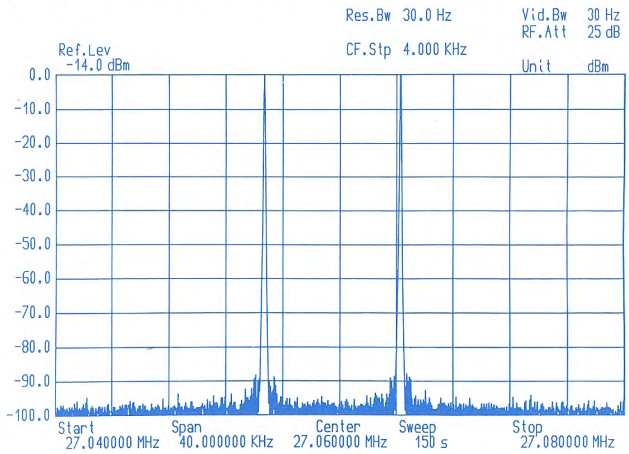


Calibration of the deviation of 82.8 kHz at a modulation frequency of 15 kHz. The second zero of the carrier can be clearly seen ($\tau = 5.52$)

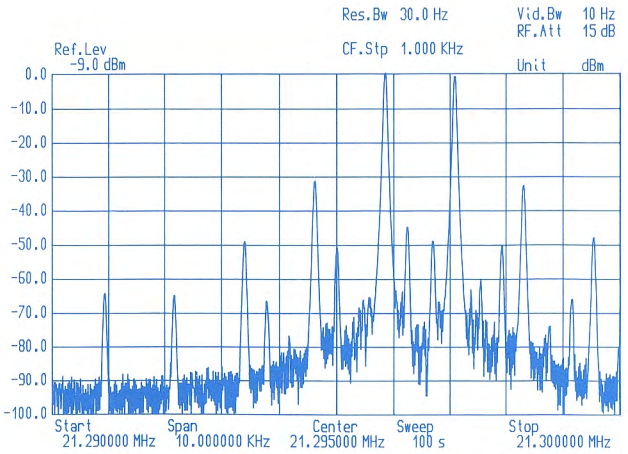


Broadband FM spectrum with 100 kHz span and a modulation frequency of 6 kHz

Linearity measurements



Inherent intermodulation of the FSA, measured using two crystal oscillators (f_1 = 27.055 MHz and f_2 = 27.065 MHz)



SSB two-tone test with an RF transceiver modulated with two frequencies (f_1 = 860 Hz and f_2 = 2100 Hz)

Specifications

Frequency

Frequency range

DC coupling ..... 100 Hz to 1.8 GHz (2 GHz)
AC coupling ..... 100 kHz to 1.8 GHz (2 GHz)
Frequency offset ..... max. possible entry ±500 GHz
Frequency setting resolution ..... 1 Hz
  Step keys span/10
  Control knob span/900
Frequency display (selectable)
  LIN ..... linear process, shown on linear frequency axis with relative scale (10 divisions at deviation/10)
  LOG ..... n linear sweeps, shown on logarithmic frequency axis with absolute scale (10[5] divisions per decade) – (stop/start frequency >1.4)

Frequency reference

Internal ..... reference frequency error = RA (reference accuracy)
  Mechanical setting ..... $<1 \times 10^{-8}$
  Aging ..... $<5 \times 10^{-10}$/day (after 30 days), $<1 \times 10^{-7}$/year
  Temperature drift ..... $<5 \times 10^{-8}$ (0 to 55 °C)
  Run-in response ..... $<1 \times 10^{-7}$ after 10 minutes at + 25 °C
External (switch-selected) ..... 10 MHz

Frequency display

Auxiliaries ..... marker and cursor lines
Resolution span/900
Error
  Span >5 MHz ..... $<8 \times 10^{-3} \times$ span, $<5 \times 10^{-3} \times$ span (sweep time ≥100 ms)
  Span 10 Hz to 5 MHz ..... $<2.5 \times 10^{-3} \times$ span ±RBW ± frequency × RA $<2.5 \times 10^{-3} \times$ span ± frequency × RA (sweep time ≥100 ms); RBW ≙ resolution bandwidth

Additional frequency error ..... using deviation of IF filter centre frequency

Without calibration
  RBW <3 kHz ..... <700 Hz
  3 kHz ≤RBW ≤30 kHz ..... <15% RBW
  80 kHz ≤RBW ≤150 kHz ..... <35% RBW
  150 kHz <RBW ..... <15% RBW
With calibration ..... <10% RBW or <10 Hz (the greater value applies)

Drift of filter centre frequency at constant ambient temperature after warm-up period of 1 hour
  RBW <1 kHz ..... <10 Hz/minute

Frequency drift ..... after warm-up period of 1 hour and constant ambient temperature

Span >5 MHz
(Frequency drift only occurs during a processs and is not summed from process to process) .. < ±200 kHz per minute of sweep time
Span ≤5 MHz ..... corresponds to reference frequency drift

Frequency counter ..... measures frequency of signal at whose display the marker has been set; the marker must have a min. spacing of 20 dB to noise and to the point where signal display intersects with an immediately adjacent signal
Counter resolution ..... 10 kHz to 0.1 Hz
Error ..... (frequency × RA) ±2 × resolution

Frequency deviation

Setting range ..... 0 Hz/10 Hz to 2 GHz
Resolution of setting ..... 2 Hz
  Step key increment ..... 0.5 × span or 1 × span
  Control knob span/900
Error
  Span ≤5 MHz ..... $\pm 2 \times 10^{-3} \times$ span
  Span >5 MHz ..... $\pm 5 \times 10^{-3} \times$ span
Frequency steps per span ..... ≥1000

Spectral purity

Phase noise

At f_e ≤100 MHz ..... phase noise in dBc (1 Hz)

Frequency span	≤100 kHz	>100 kHz to 5 MHz	>5 MHz
Frequency offset			
>100 Hz	≤−100	–	–
>1 kHz	≤−110	–	–
>10 kHz	≤−115	≤−112	–
>30 kHz	≤−118	≤−115	–
>100 kHz	≤−118	≤−120	≤−120
>300 kHz	≤−118	≤−125	≤−125

At f_e >100 MHz frequency offset
  Frequency offset <1 kHz ..... phase noise increases linearly with f_e by max. 10 dB at 1.8 GHz
  >1 kHz ..... phase noise increases linearly with f_e by max. 6 dB at 1.8 GHz

Side lines ..... at discrete frequencies (in dBc)
Frequency offset
  n × main frequency ..... >70
  m × line frequency (29.4 kHz) ..... >80
  100 kHz (span ≤5 MHz) ..... >90
  −10.7 MHz ..... >90
  Offset ..... >75

Interference span

Span >5 MHz ..... <10 kHz PP/2 in 0.1 s (measurement bandwidth 10 kHz)
Span ≤5 MHz ..... <1 Hz PP/2 in 10 s (RBW = 10 Hz; VBW = 10 Hz; VBW ≙ video bandwidth)

Filter

Resolution filter

Type of filter ..... 5 isolated one-section filters
Bandwidths (−3 dB) ..... <10 Hz (typical 6 Hz) to 3 MHz
Error
  Uncalibrated (bandwidth error at a relative humidity of >50% does not apply in the range of 10 to 300 kHz) ..... < ±30%
  Calibrated ..... < ±10% (RBW ≥10 Hz), < ±1.5 Hz (RBW <10 Hz)
Setting ..... using step keys in steps of 1, 3 and 10 and control knob and keyboard in steps of typ. 5% (with exception of 30 to 80 kHz)
Bandwidth factor
  −60 dB/−3 dB ..... <12
  −80 dB/−3 dB ..... <20

Video filter ..... first-order RC lowpass filter behind IF rectifier
Bandwidths (−3 dB) ..... 1 Hz to 3 MHz
Error (VBW = 1 Hz to 1 MHz) ..... ±20%
Setting ..... in steps of 1, 3 and 10

Amplitude

Amplitude range

(at RBW = 10 Hz) ..... <−145 to +30 dBm

Maximum input level

DC ..... 0 V for DC coupling, ±20 V for AC coupling
AC ..... +30 dBm (RF attenuation ≥10 dB), otherwise +20 dBm
Max. pulse spectral density ..... 61 dBµV/MHz (attenuation >10 dB)
Max. pulse energy (τ = 10 µs)
  RF attenuation ≥10 dB ..... 1 mWs
Max. pulse voltage ..... 150 V

Level compression

RF level at input mixer (measured at IF OUTPUT, 21.4 MHz) ≤0 dBm ..... <1 dB

Inherent noise display ..... not applicable to interference signals
RF attenuation 0 dB, RBW = 10 Hz, VBW = 1 Hz
  200 Hz <f< 1 kHz ..... <−100 dBm
  1 kHz <f< 10 kHz ..... <−110 dBm
  10 kHz <f<100 kHz ..... <−115 dBm
  100 kHz <f< 1 MHz ..... <−120 dBm
  1 MHz <f< 20 MHz ..... <−135 dBm
  f> 20 MHz ..... <−145 dBm

Measurement value display ..... electronic internal graticule with 11 to 13 (horizontal) level lines (top line = reference level)

Measuring ranges ..... linear or logarithmic 110/100/50/20/10/1 dB

Resolution

Marker ..... measuring range/4096, min. 0.01 dB
Display
  110 dB ..... 352 steps
  otherwise ..... 360 steps
A/D converter ..... 12 bits

Setting range of reference level ..... the setting of reference level and display of measurement result are possible in all standard units. A level offset of −116 to +120 dB can be entered
LOG scale/LIN scale ..... −90 to +30 dBm/−130 to +30 dBm
Resolution
  Keyboard, control knob ..... 0.1 dB
  Step keys
    LIN, 100 dB, 110 dB ..... 10 dB
    otherwise ..... 0.1 × measuring range

FSA – Specifications (continuation)

Measurement error

Internal calibration source (CAL OUTPUT)
- Level ..... −20 dBm ±0.2 dB
- Frequency ..... 100 MHz ±10⁸ × RA

RF frequency response (RF attenuation = 10 dB and AC coupling, referred to 100 MHz)
- f >20 MHz ..... <±0.6 dB
- f ≤20 MHz (ref. level >−30 dBm) ..... <±1 dB (lower frequency limit f_e >100 kHz)

Level drift ..... typ. <0.05 dB/°C (RF attenuation 10 dB, RBW = 3 kHz, ref. level = −20 dBm). Summing this error can be prevented by triggering a calibration

Switchover of a resolution bandwidth (reference bandwidth = 3 kHz; (applies for RBW <10 Hz at ambient temperature of +20 to +30 °C)
- Uncalibrated ..... +2 dB, −3 dB
- After calibration,
  - RBW ≥10 Hz ..... <±0.3 dB
  - RBW <10 Hz ..... <±0.5 dB

Switchover of IF gain, referred to reference level of −20 dBm (RF attenuation 10 dB)

	without	with calibration
Ref. level 0 to −60 dBm	<±1 dB	<±1 dB, typ. <±0.4 dB
Ref. level −60.1 to −130 dBm ...	<±2 dB	<±1.3 dB, typ. <±0.6 dB

RF attenuation switch ..... set in range of 0 to 81 dB
- Setting steps
  - Keyboard, control knob ..... 1 dB
  - Step keys ..... 5 dB
- Error per 5 dB step ..... <±0.2 dB
- Total error[1] ..... <±(0.3 + 1.3% of D value) dB
- Maximum ..... 1 dB

Switchover of input coupling AC/DC
- RF attenuation ≥10 dB, f_e>100 kHz ..... <+0.2/−0.3 dB

Switchover of measuring range .... referred to LOG 100 dB at reference level
- LOG 110/100/50/20/10 dB ..... <±0.2 dB
- LOG-LIN/LOG 1 dB
  - Uncalibrated ..... <±1 dB
  - After calibration ..... <±0.2 dB

Scaling
- LOG scale (reference: 10 dB below ref. level)
  - Display
    - 0 to −20 dB
      - RBW ≥30 Hz ..... <±0.1 dB/dB
      - RBW ≥10 Hz ..... <±0.2 dB/dB
      - RBW <10 Hz ..... <±0.5 dB/dB
    - −20 to −90 dB ..... <±0.2 dB/dB
    - Sum error 0 to −100 dB <±1.5 dB
- LIN scale
  - RBW ≥10 Hz ..... <±5% of reference level
  - RBW <10 Hz ..... <±10% of reference level

Calibration routine error ..... <±0.2 dB

Interference signals

Internal (without input signal)
- Input terminated at 50 Ω
- RF attenuation = 0 dB ..... <−110 dBm

Oscillator breakdown at f = 0 ..... <−15 dBm

Second-order harmonic distortions, mixer level ≤−30 dBm,
- RF attenuation ≥10 dB, f <20 MHz . <−65 dBc→HSOI ≥+35 dBm, HSOI ≙ Harmonic Second-Order Intercept Point
- f ≥20 MHz ..... <−80 dBc→ HSOI ≥+50 dBm

Third-order intermodulation (Δf >100 kHz)
- Mixer level ≤−30 dBm
- RF attenuation ≥10 dB
  - f <20 MHz ..... <−75 dBc→ TOI >+7 dBm, TOI ≙ Third-Order Intercept Point
  - f ≥20 MHz ..... <−80 dBc→ TOI >+10 dBm; corresponds to a signal-to-intermodulation ratio of 100 dBc at a mixer level of −40 dBm

Others
- Mixer level ≤−40 dBm,
- RF attenuation ≥10 dB
  - f <20 MHz ..... <−70 dBc
  - f ≥20 MHz ..... <−75 dBc

Immunity to noise

Immunity to image frequency ..... referred to reference level
- f_e + (2 × 2221.4 MHz) ..... >90 dB, typ. 100 dB
- f_e −42.8 MHz ..... >100 dB, typ 115 dB
- f_e +8.388 MHz ..... >100 dB, typ. 115 dB

IF immunity to noise ..... referred to reference level
- 2221.4 MHz ..... >75 dB, typ. 90 dB
- 21.4 MHz ..... >100 dB, typ. 110 dB
- 4.194 MHz ..... >100 dB, typ 110 dB

Sweep

Deflection time

Span >0 Hz

Setting ranges	increment
20 ms to 2 s	20 ms
2 to 20 s	200 ms
20 to 1980 s	2 s

Error ..... <±10⁻³

Span = 0 Hz

Setting ranges	increment
200 µs to 10 ms	1-2-4-8-10
20 ms to 1980 s	see span >0 Hz

Error
- 200 µs to 10 ms ..... <±1%
- 20 ms to 1980 s ..... <±10⁻³

Sampling rate ..... 1/8.9 µs

Time measurement ..... using markers and cursor lines
- Resolution ..... deflection time/900

Deflection mode ..... recurring/non-recurring

Trigger

Operating modes ..... free run, line, video, external

Voltage range ..... ±5 V with external triggering

Trigger threshold resolution ..... 64 steps

Demodulation

"Receiver" mode ..... demodulation of received RF signal

Display of demod. signal ..... vertical in 10 graticules, as function of time horizontal

Marker function for measuring ..... AM modulation factor as a percentage, FM modulation span, centre frequency offset

Resolution
- AM 0.1%
- FM ..... span range/4096
- Time ..... sweep time/900

FM demodulator ..... values apply with signal levels of 0 to −30 dB below ref. level; VBW = 10 kHz; signal-to-noise ratio >40 dB

Centre frequency offset after AF calibration (AF calibration no earlier than 5 minutes after switching on FM demodulation)
- Span range
  - 2 kHz, 20 kHz, 200 kHz ..... <2% of span range
  - 200 Hz ..... <40 Hz
- Drift at constant ambient temperature after warm-up period of 1 hour ..... <10 Hz/minute

Span display error
- Span range 2/20/200 kHz
  - Modulation frequency
    - 100 Hz to 5 kHz ..... <3% of measurement value
    - DC to 15 kHz ..... <5% of measurement value

FM linearity error (span <20 kHz, modulation frequency <5 kHz) ..... <1%

Interference span (PP/2), information about 5 sweeps ..... <20 Hz

Synchronous FM at 50% AM, modulation frequency 1 kHz, VBW = 3 kHz ..... <500 Hz, typ. <100 Hz

AM demodulator ..... values apply for signal level of −6 to −35 dB below ref. level

Centre offset of unmodulated signal
- Measuring range
  - 100% AM ..... <2% of fsd
  - 10% AM ..... <5% of fsd

Error of modulation factor display, AM <80% (in addition to interference AM), modulation frequency 0.4 to 10 kHz ..... <6% of rdg (with measuring range 10% AM <8% of rdg)

Interference AM
- PP/2 ..... <1%
- weighted to CCITT (VBW = 3 kHz, RBW = 30 kHz, information about 5 sweeps) ..... typ. <0.1%

Synchronous AM, RBW = 3 MHz, FM span = 50 kHz, modulation frequency = 1 kHz ..... <3%

[1] Applies to attenuation values deviating from the basic setting of 10 dB. Frequency-dependent attenuation values are calibrated in the 10 dB setting.

Display unit

Screen	9″ in-line colour picture tube with 0.29 mm colour triplet
Useful surface	157 mm × 118 mm
Brightness	set in 64 steps
Colours	selectable (16 from 4096)
Number of picture memories	4
X resolution (electric)	1024 pixels
Y resolution (electric)	512 pixels
Scaling	electronically inserted graticule
Additional information	alphanumeric insertion of main measurement parameters and instructions in English
Plotter output	R&S: DOP plotter; HP-GL
Functions	curve arithmetic (substitute, subtract), formation of average value, peak value storage
Marker	reference marker + delta marker + 6 multimarkers
Functions	signal track, marker to peak, marker to ref. level, marker to centre freq. step size, marker to start/stop freq., marker to peak/next peak/min./next min., marker zoom, noise marker with reset in dBm/Hz, delta marker to span, delta marker with noise reset in dBc (Hz), N dB down, form factor definition 60/3 dB and 60/6 dB, multimarker peak search, multimarker set/clear/clear all, marker to next/previous multimarker, receiver mode: delta marker (definition of (AM) modulation factor (FM) span und offset)

Inputs and outputs

Front panel of RF unit

RF INPUT 50 Ω		
(100 Hz to 1.8 GHz)	N female connector	
Impedance	50 Ω	
VSWR at input coupling	DC	AC
RF attenuation = 0 dB	≤2.5	≤2.8
RF attenuation ≥10 dB	≤1.5	≤1.5
CAL OUTPUT		
(100 MHz, −20 dBm	BNC female connector	
Impedance	50 Ω	
VSWR	≤1.1	
PROBE/CODE		
(power supply and coding connector, eg for active or passive probes or antennas	12-contact Tuchel connector	
Supply voltage	+10 V/−10 V, max. 100 mA	

Front panel of display unit

PHONES	JK 34 jack
Frequency range (−3 dB)	100 Hz to 15 kHz
EMF	10 V (V_{pp}), Z_{in} = 30 Ω
KEYBOARD	JK 34 jack (for PCA-Z1)

Rear panel of RF unit

IF output, 21.4 MHz	BNC female connector
Impedance	50 Ω
VSWR	≤2
Gain, referred to level at input mixer	
Reference level − RF attenuation	
≤−20 dBm	+10 dB ±2 dB
>−20 dBm	0 dB ±2 dB
Bandwidth (−6 dB)	>10 MHz
10 MHz reference	BNC female connector
Output level at internal reference (Z_{in} = 50)	+10 dBm +3/−1 dB
Input level at external reference (Z_{out} = 500 Ω)	0.1 to 1 V (V_{rms})
SWEEP OUTPUT	BNC female connector
Output voltage (Z_L >500 Ω)	0 to +5 V
START SWEEP STOP	BNC female connector; positive TTL pulse (τ = 1.4 µs) at start or stop

Rear panel of display unit

IF OUTPUT (narrow), 21.4 MHz	BNC female connector
Impedance	50 Ω
VSWR	<2
Level at reference level up to −90 dBm	−15 dBm ±3 dB
Bandwidth	corresponds to resolution bandwidth
EXT SWEEP TRIG	BNC female connector
Input impedance	>8 kΩ
Voltage range	±5 V; max. ±20 V
VIDEO OUTPUT	BNC female connector
Source impedance	75 Ω
Output voltage	0 to +0.5 V at 75 Ω in proportion to vertical display of measurement value
EXTERNAL MONITOR	
Outputs	BNC female connector
RED, GREEN, BLUE, COMP VIDEO	
Clock frequency	40 MHz
Impedance	75 Ω
Output voltage	+0.3 to 1.4 V at 75 Ω
V SYNC	
(vertical synchronization)	TTL level, fan-out 20 LS-TTL, polarity selected by jumper plug
Picture frequency	50 Hz ±2%
Sync pulse	0.8 ms
H SYNC/COMP SYNC	
(horizontal synchronization)	TTL level, fan-out 20 LS-TTL, function and polarity selected by jumper plugs
Line frequency	29.4 kHz ±2%
Sync pulses	2 µs
EXT FLOPPY	Cannon D, female connector, 37-contact, for LAS-Z11 accessories
RS-232-C	Cannon D, female connector, 25-contact
PARALLEL INTERFACE	
(Centronics)	Amphenol, female connector, 36-contact
USER PORT	Cannon D, female connector, 25-contact, function defined in setup mode
KEYBOARD	JK 34 jack, for PCA-Z1 accessories
IEC-625 bus (IEEE 488)	Amphenol female connector, 24-contact
Bus functions	AH1, SH1, T6, L4, SR1, RL1, PP1, DC1, DT1, C1 to C4, C11
Data transmission rate	≥350 kbps

General data

Note	all specifications, if not stated otherwise, are calibrated for continuous sweep with coupled functions in "default coupling"
Ambient conditions	to IEC 359, class I
Rated temperature range	0 to +55 °C
Storage temperature range	−40 to +70 °C to buffer CMOS-RAMs, the analyzer contains an alkaline battery; its capacity at low temperatures and its lifetime at high temperatures is considerably reduced
Real-time clock error	≤2 minutes per 24 hours
Max. permitted relative humidity	20 to 90% (without condensation)
EMC	VDE 0871, limit value class B; DBP designation 526/527.79; CISPR publication 11, 22; FCC DOC 20780; Part 15, subpart 5
Thermal warm-up time (0 to +55 °C), operating temperature reached after cold start	1 hour
Internal thermal balance (at constant outside temperature)	4 hours
Power supply	100/120/220/240 V ±10%, 47 to 440 Hz (500 VA), safety class I (to IEC 348 and VDE 0411)
Dimensions	435 mm × 413 mm × 590 mm
Weight	58 kg

Ordering information

Order designation ▶ Spectrum Analyzer FSA 804.8010.52

Accessories supplied

Power cables (2), connection cables (2)

Recommended extras

Service kit	FS-Z1	811.0010.02
Connection cable set (for servicing, 1 m)	FS-Z2	811.0304.02
Filter disc	FS-Z3	805.7900.02
Software for computer function	FS-K1	811.0610.02
Computer function (FS-K1 + PCA-Z1 + LAS-Z11)	FS-Z4	811.8010.02
Keyboard	PCA-Z1	375.7511.02
Double floppy disk station	LAS-Z11	357.4014.02
Plotter	DOP	375.1213.02
Universal ink-jet printer		
220 V	PUD 3	359.5501.02
117 V	PUD 3	359.5501.03
IEC bus cable (1 m)	PCK	292.2013.10
19″ adapter	ZZA-94	396.4905.00
	ZZA-95	396.4911.00
Matching pads, 75 Ω		
L section	RAM	358.5414.02
Series resistor, 25 Ω	RAZ	358.5714.02

LAS

Logic Analysis System LAS ♦ 96 analyzer channels (max.); sampling frequency 20/100/400 MHz

- Modular design
- Up to 48 generator channels, 20 MHz
- 2-channel analog recorder
- 16-bit IEC-bus controller

IEC 625 Bus

Overview

The **Logic Analysis System LAS** represents a progressive solution for measuring tasks in development, testing and in-service monitoring of digital and hybrid systems. The state-of-the-art instrument sets new standards for processing and for displaying the results of analysis. Thanks to the large number of modular options available, the LAS opens up a variety of new **applications:**

- Hardware analysis
- Software program analysis
- Software performance analysis
- Integration of hardware and software
- Function test of digital circuits
- Analysis of hybrid (analog/digital) circuits
- Automatic process control capability via processor using CP/M-86 operating system and BASIC programming language
- Test pattern generation for circuit stimulation

Options	Channels
● 20-MHz logic analyzer	24 up to 72
● Event timing analysis (time stamp facility for 20-MHz analyzer)	
● 100-MHz logic analyzer	8 up to 24
● 400-MHz logic analyzer	8
● 20-MHz analog recorder	2
● 20-MHz logic generator	16 + 32
● Processor with CP/M-86 operating system and floppy disk drive	

New options will enable the Logic Analysis System to handle the increasing number of measurement tasks to come. The convenient **display capability** of the LAS facilitates measurement tasks and provides easy-to-read representation even in the case of large amounts of data:

- State display
- Timing display
- Disassembler display
- Performance analysis with
  - event timing histogram
  - event timing diagram
- Analog recorder display
- BASIC processing (special displays easily programmable by the user in BASIC)

Clear **menus** provide a high degree of operational convenience and are available for

- entry of test conditions and data
- display of test results
- storage of results and setups
- activation of specific options

Accessories/software

- Double floppy disk station
- Performance test software
- Freely programmable disassembler

Characteristics

Softkey control In spite of the variety of setups and evaluation facilities, operation of the LAS remains easy and practice-oriented. The LAS is operated by softkeys; programs resident in the test control processor are automatically configured depending on the options used. The system is thus ready for use immediately after power up.

Setup memory Setup storage in the LAS is performed with the aid of the floppy disk drive; the setup memory manages overall instrument setups as well as subsets such as trigger words and channel configurations. In this way, preprogrammed basic setups and additional measurement-specific instructions can be usefully combined.

Microprocessor probes To analyze microprocessor systems, Rohde & Schwarz is constantly increasing the number of LAS microprocessor probes. In conjunction with the 20-MHz analyzer, these probes allow observation of program execution and location of software and hardware errors. A disassembler program associated with each probe and loaded from the floppy processes the test results and provides a mnemonic display.

Probes for 8-bit microprocessors

- 8080
- 8085
- 8031/51
- Z 80
- 6800/02/08
- 6809/09E
- NSC 800
- 6502

Probes for 16-bit microprocessors

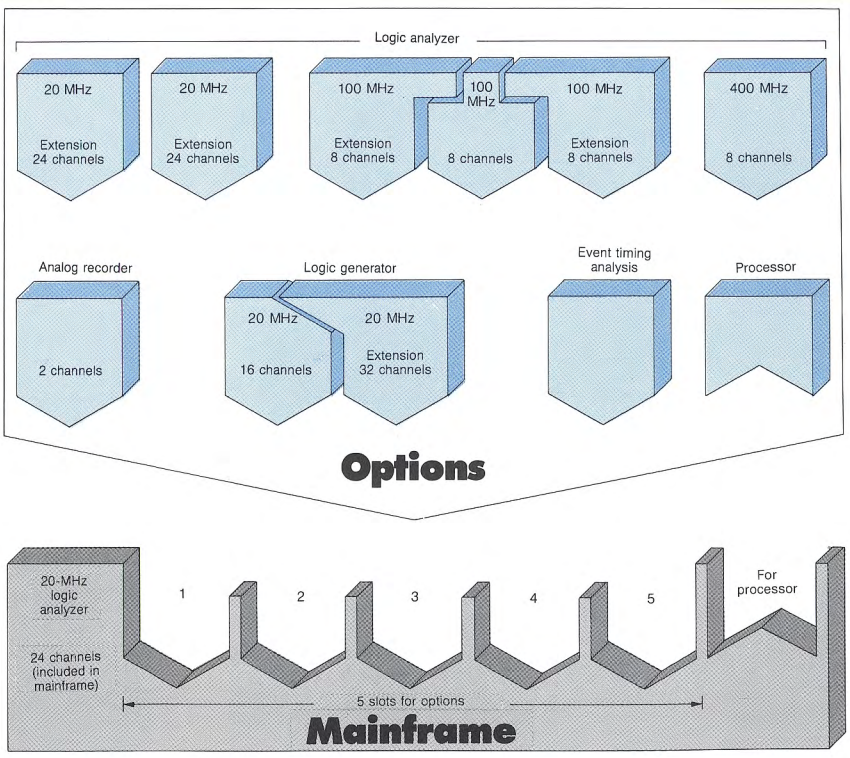
- 8086/88
- 80186/88
- 68000/10
- 68020

Interface probes

- IEC bus (IEEE 488)
- RS-232-C
- Ethernet
- MIL-STD-1553 B

Master/slave operation All the analyzer and generator functions of the Logic Analysis System LAS can be used either separately or independently in parallel, as well as for triggering each other; this allows sequential execution of measurements, an important feature for many applications. Using this facility, which is implemented partly via internal and partly via external connections of the trigger lines, the occurrence of a trigger event can be monitored first with the 20-MHz analyzer for instance. Upon recognition of the trigger condition, the 100-MHz analyzer can take over automatically and analyze timing errors in specific portions of the data stream with high time resolution (in a type of magnified display). After the output of data by the generator, the analysis of received data can be performed as may be required when testing modules, gate arrays and data interfaces.

Modularity The Logic Analysis System LAS consists of a mainframe which can be extended by plug-in options. It comprises the processor, display, power supply, keyboard and a 24-channel logic analyzer. Five slots for options and one additional slot for processor extension are provided. The modular front panel allows accommodation of option-dependent connectors. Thanks to the flexibility of the system, it will be possible to retrofit future options without any problems. All options are connected to the test control processor via a bus. Real-time control of the interactive options is possible via a link bus.



Modular design of Logic Analysis System LAS

LAS

Specifications

LAS mainframe

Display	CRT with 9″ diagonal screen
Colour	green
Characters per line	80
Number of lines	23 + 2 softkey lines
Graphics (freely programmable)	with Processor Option LAS-B4
Number of dots	225 × 608
Video output	BNC female connector on rear panel of instrument
Level	2 V_{pp} EMF
Impedance	75 Ω
Number of 20-MHz analyzer channels	24 (for specifications see 24-channel analyzer extension)

Setup memory

Storage of instrument setups and reference data	on floppy disk with Option LAS-B4
Storage for disassembler	CMOS memory

IEC bus

System	interface to IEC 625-1 and IEEE 488
Interface functions	L4, T5, RL1, DC1, DT1, SR1, C1; additional functions with Option LAS-B4: C2, C3, C4
Recommended extras	3 × 8-channel Data Probes LAS-Z1 for 20-MHz analyzer, Clock Probe LAS-Z2 for 20-MHz analyzer
Accessories supplied	miniclips, power cable, carrying case

General data

Rated temperature range	+5 to +45 °C
Storage temperature range	−20 to +70 °C
AC supply	190 to 265 V/95 to 130 V, 47 to 60 Hz (250 to 400 VA), protection class I (VDE 0411 or IEC 348)
Dimensions (W × H × D)	470 mm × 251 mm × 491 mm
Weight	20 kg

Processor

CPU	8088
Memory	256 kbytes, RAM
Operating system	CP/M-86
Programming languages	BASIC, ASM 86
BASIC functions	IEC-bus controller for LAS and external instruments, on-line processing, freely programmable display of data collected for analysis
Mass storage	3½″ micro-floppy disk drive; double density; built in
Number of tracks	80
Memory depth	240 kbytes (formatted)
Virtual floppy disk drive	
Variable memory depth	256 kbytes for copying diskettes; 64 kbytes for simultaneous use of measuring functions and BASIC program
Connector for additional external floppy disk drive	37-contact Cannon female
Real-time clock	
Resolution	1/10 s

Interfacing

System	interface to CCITT V.24 and EIA RS-232-C
Connector	25-contact (Cannon)
Transmission rate	50, 75, 110, 134.5, 150, 300, 600, 1200, 1800, 2000, 2400, 3600, 4800, 7200, 9600, 19 200 Baud
Parity	even, odd
Character length	5 to 8 bits

20-MHz logic analyzer

Number of channels	– 24 data and 4 clock channels in mainframe; – 48 data and 4 clock channels with 24-channel analyzer extension (Option LAS-B3); – 72 data and 4 clock channels with 2 × LAS-B3

Memory

Memory depth	1000 words
Reference memory depth	1000 words
Data probe	8-channel Data Probe LAS-Z1
Input impedance	1 MΩ ‖ 6 pF
Number of channels per probe	8
Skew of channels	≤15 ns
Min. input overdrive	by ± (0.5 + 0.05 × V_{PP}) V of signal amplitude above threshold
Max. input voltage	±100 V DC
Setting of threshold	
Threshold range	−9.9 V to +9.9 V
Resolution of setting	100 mV
Error of setting	±3% ±50 mV
Clock probe	Clock Probe LAS-Z2
Number of clock inputs	4
Setup time	20 ns
Hold time	0 ns
Other specifications	same as for Data Probe LAS-Z1

Internal clock

Frequency range	0.5 Hz to 20 MHz in 1, 2, 5 sequence
Error	1%

External clock

Frequency range	DC to 20 MHz

Channel groups

Number	max. 8
Labels	freely selectable, max. 5 characters
Coding	hexadecimal, decimal, octal, binary, ASCII
Data model menu	definition of trigger words and fields
Data model contents	individual data, data groups, data ranges
Range width	16 bits for channels 0 to 15, 8 bits for all further channels (within range of one data probe)
Number of ranges or words	max. 99 per data model
Models simultaneously used	max. 8 (only 1 model using 16 bit range)

Trigger sequencer menu (sequence control)

Sequencer levels	max. 8
Delay between two levels	max. 50 ns
Pretrigger setting	0 to 1000 words
Parallel condition monitoring on each level	max. 99
Branching	max. 99
Functions	
GOTO X	branching
TRACE ALL	collect all data
TRACE SELECTOR	collect via selector
TRACE STOP	collection inhibited
TRIGGER	triggering
Delay counter	0 to 4000
Delay functions	clocks or data
Frequency of delay counter	max. 17 MHz

Selector menu (data filtering)

Delay between two levels	max. 50 ns
Selector levels	max. 8
Parallel condition monitoring on each level	max. 99
Branching	max. 99
History qualification	5 clocks
Functions	
GOTO X	branching
STORE WORD	qualification
PRESTORE	history qualification of words 1 to 5
Delay counter	0 to 15
Delay functions	clocks or data
Frequency of delay counter	max. 17 MHz

State display

Display format	corresponding to channel grouping
Group designation	labels of max. 5 characters
Coding	hexadecimal, decimal, octal, binary, ASCII
Displayed lines	18
Information displayed per data word	line number data contents clock input identification sequencer status selector status time marker (event timing analysis option) selection marker

Evaluation functions	reference memory comparison search word function

Timing display

Number of channels displayed simultaneously	16
Channel designation	channel group labels with index number
Magnifier ranges	×1, ×2, ×4, ×8, ×16, ×32
Display order	freely selectable
Time difference measurement	by way of two cursor lines
Number of cursors	2

Disassembler display

Function	disassembled display of program sequences

Performance analysis

Event timing diagram (Event Timing Analysis Option LAS-B5)

Function	logic events displayed along horizontal timebase
Number of samples	max. 1000
Modes	time measurement clock counting

Measurement ranges

Resolution	Max. range displayed
100 ns	1.7 min
1 µs	17 min
10 µs	2.9 hrs
100 µs	29 hrs
1 ms	12 days
ext. clock	2^{30} clocks

Magnification of display	max. 2^{23}, switch-selected in 1, 2, 5 sequence
Error of time markers	max. 1% ±1 digit
Max. event repetition frequency	20 MHz
Processes displayed	max. 12 simultaneously
Display elements	
Single event	vertical line
Start/stop event	bar of correct length and position related to time

Event timing histogram (Event Timing Analysis Option LAS-B5)

Function	total of logical event timing displayed in histogram form
Measurement ranges and definition of processes	same as event timing diagram

Recommended extras 3 × 8-channel Data Probes LAS-Z1

100-MHz logic analyzer

Number of channels
- 8 with 8-channel 100-MHz analyzer (Option LAS-B1);
- 16 with LAS-B1 and 8-channel analyzer extension (Option LAS-B2);
- 24 with LAS-B1 and 2 × LAS-B2

Memories

Main memory depth	1000 words
Reference memory depth	1000 words

Data probe	4-channel Data Probe LAS-Z3 (accessory supplied)
Input impedance	1 MΩ || 5 pF
Number of channels per probe	4
Cable length between instrument and probe	1.5 m
Threshold range	−9.9 to +9.9 V
Resolution of setting	100 mV
Min. input overdrive	≥250 mV or 25% of signal amplitude above threshold (higher value applicable)
Max. input voltage	±100 V DC
Clock probe	Clock Probe LAS-Z4 (accessory supplied)
Inputs	1 clock input, 1 qualifier input
Polarity	switch-selected
Other specifications	same as for data probe
Glitch detection	latch mode can be selected for all channels, glitch mode can be selected for half the channel number
Glitch width	>5 ns

Internal clock

Frequency	0.5 Hz to 100 MHz in 1, 2, 5 sequence

External clock

Frequency	DC to 100 MHz

Triggering

Trigger levels	2
Trigger words	4 per level, ORed
Trigger functions	
Normal mode	state triggering
Glitch mode	state and glitch triggering
Posttrigger	≤1000 clocks
Delay between trigger and arm words	0 to 61,438 clocks or arm words
Trigger filter	1 to 14 clocks
Arm filter	1 to 14 clocks
Master-slave control	via link in both directions
Master-slave timing	the moment of triggering by the 20-MHz analyzer is marked in the timing diagram

Timing

Asynchronous operation	
Skew of data channels	typ. 3 ns
Synchronous operation	
Setup time	7 ns
Hold time	0 ns

Timing display

Simultaneously displayed channels	16
Designation of channels	5-character label
Magnifier ranges	× 1, × 2, × 4, × 8, × 16, × 32
Display order of channels	freely selectable
Time difference measurement	by way of two cursor lines
Window shift	by SHIFT WINDOW softkey or cursor control
Positioning of window	symmetrically about active cursor
Number of cursor lines	2
Glitch display	in glitch mode by special glitch markers

State display

Channel grouping	corresponding to probe configuration
Coding	hexadecimal, decimal, octal, binary, ASCII
Displayed lines	18
Evalution function	reference memory comparison

Accessories supplied

For 8-channel 100-MHz analyzer (LAS-B1)	4-channel data probe (2 ×), clock probe (1 ×)
For 8-channel 100-MHz analyzer extension (LAS-B2)	4-channel data probe (2 ×)

400-MHz logic analyzer

Number of channels

Data inputs	4 probes with 2 channels each
Clock inputs	1 probe with 2 channels
Threshold range	−9.9 to +9.9 V
Resolution	100 mV
Max. input voltage	±100 V
Input impedance	1 MΩ
Skew	2 ns (typ.)

Memories

Main memory	4000 words
Reference memory	4000 words

Internal clock

Frequency range	0.5 Hz to 400 MHz in 1, 2, 5 sequence

External clock

Frequency range	DC to 100 MHz

Triggering

Number of levels	2
Trigger word elements	0, 1, X, positive- or negative-going edge
Trigger filter	1 to 7 clocks (for first trigger level only)
Posttrigger	<4000 clocks
Accessories supplied	2 × 4-channel Data Probes LAS-Z32
Recommended extras	2-channel Clock Probe LAS-Z31

LAS – Specifications (continued)

Logic generator

Number of channels	– 16 with 16-channel logic generator (Option LAS-B6); – 48 with LAS-B6 and 32-channel Generator Extension LAS-B7
Number of strobe outputs	3 with 16 channels, 7 with 48 channels
clock outputs	1 synchronous, 1 asynchronous for handshake mode
Connection	via separate data and clock drivers
Memory depth	4096 words
Total number of words	max. 1024
Data groups	data lines combined in modules or macros
Name of modules or macros	freely selectable max. 5 characters
Number of modules	max. 35
macros	max. 45
Channel groups	
Number	max. 8 groups of variable length per data module
Label	freely selectable, max. 5 characters
Coding	binary, octal, decimal, hexadecimal, ASCII
Data editor	for data entry and modification
Designation of data lines	by line numbers
Labelling of data lines	max. 5 characters
Number of data lines displayed simultaneously	18
Information displayed per line	label line number data in accordance with channel grouping tristate control information strobe control information
Instructions	
CALL (macro)	callup of macro
Setting range	1 to 255 calls
GOTO (label)	jump to labelled data line
HOLD	repeated data output without strobe output
Setting range	1 to 255 clocks
REPEAT	repeated data output with strobe output
Setting range	1 to 255 clocks
PAUSE	wait time asynchronous
Setting range	2 ms to 60 s in steps of 2 ms
Error	+280 µs ±5% of pause
Number of pauses per cycle	max. 5
HALT	Interruption of data output
Interrupt control	
Number of interrupt channels	4 (can be disabled individually)
Interrupt inputs	1 BNC female connector on rear panel per channel ORed with 1 probe input on clock driver
Interrupt activities	GOTO (label) IN (module) STOP START (module)
Interrupt timing	
Time interval between interrupts	>500 µs +1 data clock (not more than 2 interrupts within 20 ms)
Setup time (interupt to ext. clock) to stop data output	<50 ns
Start delay of data output	<10 ms
Data output	
Modes	individual steps: 1st line, advance, return, line repetition internal clock, external clock 2-wire, 3-wire handshake
Start mode	at 1st line at line number at label
Tristate control	
TTL data driver	
Data tristate	possible separately in each data line for each data driver
Strobe tristate	possible separately in each data line with 16 channels for 2 strobes (using two data channels), with 48 channels for 4 strobes
General-purpose data driver	same as TTL data driver
Daten tristate	open-collector high state
Strobe tristate	tristate programming ignored
Strobe control	
Strobe selection	each strobe signal can be set separately in each data line
Polarity	can be selected separately for each strobe output
Timing control	
Period for data	50 ns to 10 s (20 MHz to 0.1 Hz without strobe output) 100 ns to 10 s (10 MHz to 0.1 Hz with strobe output)
Clock frequency in handshake mode	0 to 1.8 MHz (with TTL data driver)
Resolution of internal clock setting	2 digits
Error of internal clock setting	±2%
External clock	max. 20 MHz
Time setting for strobe outputs	
Settable parameters	strobe delay and strobe length (for each strobe separately)
Resolution of strobe time setting	
Period ≥10 µs	0.5% of period
1 to 9.9 µs	5%
250 to 990 ns	20%
200 to 240 ns	25%
150 to 190 ns	33%
100 to 140 ns	50%
Basic delay of strobe signals	25 to <50 ns
Clock output	
Timing for period	
100 ns to 10 s	identical with that of strobe signal of clock driver
50 ns to 100 ns	fixed
8-channel TTL Data Driver	LAS-Z5
Max. clock frequency	20 MHz
Data outputs	8
Strobe output	1
Level	TTL
Fanout	10 standard TTL loads
Rise and fall times	typ. 13 ns and 6 ns (with 10 standard TTL loads)
Skew	<2 ns within one driver <5 ns for all drivers
Max. permissible input voltage	−1 to +6 V (overvoltage protection)
TTL Clock Driver	LAS-Z6
Clock output	1
Strobe output	1
Asynchronous control lines (for 2-wire and 3-wire handshakes)	DAV, NDAC, NRFD with terminating resistors to IEC 625-1
Dummy listener	incorporated, can be connected into circuit via jumper
Fanout	10 standard TTL loads
Level	TTL
Rise and fall times	typ. 13 ns and 6 ns (with 10 standard TTL loads)
Max. permissible input voltage	−1 to +6 V (overvoltage protection)
Interrupt inputs Number	4
Function	identical with interrupt inputs on LAS rear panel
General-purpose Data Driver	LAS-Z7
Data outputs	8, open collector, 500 Ω, shortcircuit-proof
Strobe output	1, open collector, 500 Ω, shortcircuit-proof
Low level	<0.8 V
High level, programmable	3 to 9.9 V (same for all channels within one driver)
Rise time (10 to 90%, 20-pF load)	<70 ns
Max. permissible input voltage	−1 to +12 V (overvoltage protection)
General-purpose Clock Driver	LAS-Z8
Clock output	1
Strobe output	1
Asynchronous control lines (for 2-wire and 3-wire handshakes)	DAV, NDAC, NRFD
Dummy listener	incorporated, can be connected into circuit via jumper
Max. permissible input voltage	−1 to +12 V (overvoltage protection)
Interrupt inputs Number	4
Function	identical with interrupt inputs on LAS rear panel
Outputs	open collector, 500 Ω, shortcircuit-proof
Low level	<0.8 V
High level	3 to 9.9 V (same for all outputs)
Rise time (10 to 90%, 20-pF load)	<70 ns
Input threshold	0.4 × programmable high level of outputs

Control connectors on rear panel

Connector type	BNC
Level	TTL
Inputs	
CLOCK EXT/START EXT	input for external clock and for trigger of data output function
Active edge	selectable
Pulse width	≥10 ns
Delay between CLOCK EXT/START EXT and data output	typ. 70 ns
Recovery time	
Internal stop to ext. start	<20 ms
Internal stop to start of current module in first line	≤1.5 ms
Interrupt inputs Number	4
Active edge	positive-going / negative-going (pulse width ≥10 ns) } 2 inputs each
WAIT input	interruption of data output
Polarity	active low
Output	
END output	end of data output
Polarity	active low

The generators come without drivers which must be ordered separately.

Recommended extras 8-channel TTL data driver
TTL clock driver
8-channel general-purpose data driver; general-purpose clock driver
1 set of miniclips (20×)

Analog recorder

Number of channels	2 (A and B)
Total measurement range	50 mV/FS to 50 V/FS in 10 subranges (0.5 V to 500 V/FS with 10 : 1 probe)
Coupling	DC, AC, GND
Polarity	NORM, INV
Frequency range (−3 dB)	0 to 5 MHz (DC), 10 Hz to 5 MHz (AC)
Resolution	8 bits
Measurement error	±3%
S/N ratio	dB
Measurement range (V) 50	48
20	48
10	42
5	38
2	48
1	38
0.5	36
0.2	42
0.1	38
0.05	31
Input impedance	1 MΩ ‖ 60 pF
Memory depth	4094 words/channel
Recording	either channel A or B, or both
Sampling frequency int.	0.5 Hz to 20 MHz, programmable in 1, 2, 5 sequence
ext.	0 to 20 MHz (with 20-MHz analyzer)
Offset	separate setting for channels A and B, automatic zero adjustment
Resolution	1%
Setting range	0 to ±39% of selected measurement range
Trigger characteristics	separate setting for channels A and B
Trigger threshold range	0 to ±49% of selected measurement range
Resolution	1%
Trigger edge	positive- or negative-going, selectable
Uncertainty of trigger marker	max. 1 clock (f >10 MHz)
Posttrigger	programmable, 0 to 3999 clocks
Trigger source and linking	channels A, B; A and B; A or B; master/slave operation with analyzer
Display	channels A, B; A and B simultaneously; A−B; B−A; A+B; software-implemented lowpass filtering provided
Amplitude measurement	absolute value output at current cursor location; difference between cursors 1 and 2
Timebase	400 s/div. to 0.5 µs/div. or CLK/div.
Magnification	×1, × 2, × 4, × 8, ×16, × 32
Time measurement	output of time difference between cursors 1 and 2

Accessories supplied 2 probes, 1 : 1/10 : 1, switch-selected

Ordering information

Mainframe

Order designation ▶ Logic Analysis System LAS
Mainframe with keyboard and 24 analyzer channels, 20 MHz, IEC-bus interface 811.2965.02

Accessories supplied miniclips, power cable, carrying case

Options

			Max. number used
Processor[1]) with 3½″ floppy disk drive, 256-kbytes of RAM, CP/M-86, BASIC, real-time clock, RS-232-C, IEC-bus controller	LAS-B4	356.8900.02	1
Logic analyzer			
24-channel Analyzer Extension, 20 MHz	LAS-B3	345.8210.03	2
Event Timing Analysis	LAS-B5	345.8410.02	1
8-channel Analyzer, 100 MHz	LAS-B1	345.8010.02	1
8-channel Analyzer Extension, 100 MHz	LAS-B2	345.8810.02	2
8-channel Analyzer, 400 MHz	LAS-B8	357.2711.02	1
2-channel Analog Recorder, 20 MHz, 8-bit resolution	LAS-B9	357.2411.02	1
Logic generator			
16-channel Logic Generator, 20 MHz (without driver)	LAS-B6	345.8510.02	1
32-channel Logic Generator Extension, 20 MHz (without driver)	LAS-B7	357.0619.02	1
Maximum number of options that can be fitted (not including LAS-B4)			5

Recommended extras

8-channel Data Probe for 20-MHz analyzer	LAS-Z1	345.9016.03
Clock Probe for 20-MHz analyzer	LAS-Z2	345.9116.03
8-channel Data Probe[2]) for 100-MHz analyzer	LAS-Z3	345.9216.02
Clock Probe for 100-MHz analyzer	LAS-Z4	345.9316.02
8-channel TTL Data Driver for LAS-B6 and -B7	LAS-Z5	345.9416.02
TTL Clock Driver for LAS-B6 and -B7	LAS-Z6	345.9516.02
8-channel General-purpose Data Driver for LAS-B6 and -B7	LAS-Z7	345.9616.02
General-purpose Clock Driver for LAS-B6 and -B7	LAS-Z8	345.9716.02
Floppy Disk Station (5¼″)	LAS-Z11	357.4014.02
5¼″ Floppy Disk (10 ×)	PCA-Z2	376.0210.02
3½″ Floppy Disk (10 ×)	LAS-Z20	357.3118.02
Performance Test Software for LAS-B4	LAS-K1	398.5015.02
Service Kit	LAS-Z12	345.9816.02
Set of Miniclips (20 ×)	IGA-Z8	344.1905.00
Adapter (for probe exchange)	IGA-Z3	344.3614.02
Ink-jet Printer (220 V)	PUD 3	359.5501.02
IEC-bus Interface for PUD 3	PUD 2-B4	359.5418.02
IEC-bus Cable (1 m)	PCK	292.2013.10
2-channel Clock Probe for 400-MHz analyzer	LAS-Z31	345.9916.02
4-channel Data Probe for 400-MHz analyzer	LAS-Z32	389.9910.02
Freely Programmable Disassembler	LAS-K3	350.4502.02

Standard LAS configurations

Logic Analysis System	LAS5	811.2936.05 (consisting of 20 MHz/48-ch. analyzer, 100 MHz/8-ch. analyzer, LAS-B5, LAS-B4, 6× LAS-Z1, LAS-Z2)
Standard Logic Test System	LAS6	811.2942.06 (consisting of 20-MHz/48-ch. analyzer, 20-MHz/16-ch. generator, LAS-B5, LAS-B4, 6× LAS-Z1, LAS-Z2)
LAN Test System for Ethernet/802.3	LAS7	811.2959.07 (consisting of 20-MHz/72-ch. analyzer, 20-MHz/16-ch. generator, event timing analysis and Ethernet test probe)
High-speed Logic Analysis System	LAS8	811.2988.08 (consisting of 20-MHz/48-ch. analyzer, 400-MHz/8-ch. analyzer, LAS-B5, LAS-B4, 6× LAS-Z1, LAS-Z2)

[1]) Processor LAS-B4 can be combined with all the other LAS options.
[2]) Consisting of two 4-channel data probes plus adapter.

PCA 5, PCA 15

Process Controller PCA 5, PCA 15 ♦ 16-bit computer

- PCA 5: 80186-CPU
  8 MHz
  2 graphics processors
  Keyboard processor
- PCA 15: 80286-CPU,
  8 MHz
  Coprocessor 80287
  I/O processor 80186
  2 graphics processors
  Keyboard processor

See "General measuring systems" in the measuring equipment catalog for detailed description and specifications.

IEC 625 Bus

Photo: PCA 5

The equipment family **Process Controller PCA** is designed for industrial applications. Its modular configuration enables the standard basic unit to be adapted to the work concerned using a large number of options.

In addition to their application as control computers in automatic measurement and test systems, their software design means that PCA computers can be used in all fields of computer technology up to and including microprocessor software development.

The PCA family includes the following computers:
- PCA 5 and PCA 15 with built-in 9″ monochrome monitor
- PCA 2 and PCA 12 (equivalent to PCA 5 and PCA 15) for operation with external monochrome or colour monitor
- the rugged PCA 1 with connection for monochrome monitors.

Hardware

- 1 MB RAM with parity error detection
- Maximum of two floppy disk drives: 5¼″ (1.2 MB; one permanently integrated) or 3½″ (1.44 MB; option)
- Winchester disk drive with 21.3 MB (option)
- Rugged semiconductor memory 0.5 or 1 MB (option)
- High-resolution graphics with 640 × 480 pixels
- DMA-driven IEC-bus with 350 kbps data rate
- Versatile I/O possibilities via 16 plug-in slots
- Ergonomic keyboard with rollkey
- Program and programming support using softkeys
- Efficient RF shielding
- MS-DOS operating system
- User software and basic software for measurement

Programming languages

The PCA provides the possibility of using a series of different powerful programming languages. The scope of delivery includes a very easy-to-use Basic interpreter.

The main feature of the **PCA Basic unit** is its user-friendly operating concept. It includes an editor for entering and modifying the program and test aids. If the entry is not correct, the cursor indicates the error position, and the type of error is displayed as a text message. The available memory location in Basic is about 56 KB for the program and 63 KB for data.

R&S has specifically optimized the interpreter for measurement work; it enables software written in Basic to be applied for standard measurements using the specially expanded set of Basic commands for measurement routines and colour graphics.

The **Pascal Compiler** (PCA-K11) is suitable for complex technical and commercial applications. Pascal's block and data structure provides a full range of possibilities for compiling clear, structured programs with a maximum length of 1 MB. The ability to distinguish between three language levels means that the compiler is portable as opposed to other Pascal systems. Pascal programs can be combined with the other Microsoft languages.

The MS-Pascal was expanded for the PCA family by powerful procedures and functions for both the IEC-bus and all interfaces and options. These are extremely useful, particularly for measurement applications.

System interfaces

The PCA interfaces are designed as plug-in modules which can be easily inserted into the unit. Sixteen plug-in slots are available.

IEC-bus The standard PCA is equipped with an IEC-bus interface. The IEC-625 Interface PCA-B4 can be integrated as an option.

In order to reduce the amount of software required when compiling programs for automatic operation, Basic and Pascal contain a set of extensive but easily comprehensible IEC-bus commands. All special functions are possible, such as service request, etc., as well as PCA operation as a talker/listener in multi-controller systems, in addition to pure data exchange using other equipment.

Printer connection The standard PCA is equipped with a Centronics-compatible **8-bit parallel interface** for printer connection. All commands and drivers required to drive the printer are integrated in the Basic and Pascal operating systems.

The **V.24/RS-232-C Interface PCA-B5** (option) can be used to transmit data to all equipment with serial interfaces or to receive data from such equipment. It also enables the controller to be connected to computer systems. A standard terminal for inputs and outputs can also be connected to the PCA via this interface.

Measurement interfaces

The **TTL I/O Interface PCA-B11** (option) is used to drive units under test and equipments without standard interfaces. Using this interface, bit patterns can also be applied to or read in by units under test. The TTL I/O Interface PCA-B11 offers 56 TTL lines which can be programmed as outputs (max. sink current 24 mA) or inputs in independent groups of 8 lines. A 16-bit bus can be used for bidirectional bus systems with handshake lines. The PCA-B11 also enables max. 8 interrupts to be triggered for fast hardware-compatible control functions. A maximum of three options, PCA-B11 and/or Universal Control Interface PCA-B27 (see below) can be inserted into the PCA.

The **A/D Converter PCA-B12** (option) is a multi-function module for analog inputs and digital inputs/outputs. It permits signal analysis, Fast Fourier Transformation (FFT), transient analysis and the generation of digital control signals. Noise and crosstalk are very low, even at high sampling rates. The A/D Converter has a minimum conversion period of 2.5 µs per channel, permitting 400,000 conversions per second.

Four digital input and output lines are available for digital sampling and control functions in addition to **eight analog input channels.** The sampling rate can be adjusted over a wide range, and there are a number of trigger procedures for the start of analog measurement.

The **Analog I/O Interface PCA-B13** (option) enables measurement of analog parameters with a resolution of 14 bits plus the sign bit. Programmable measurement ranges and the TRUE-RMS converter suitable for AF measurements up to 40 kHz mean that the PCA-B13 is a high-speed, accurate multimeter in the computer. DC voltages or complex curve shapes up to ±10 V can be generated using a 12-bit D/A Converter.

The Analog I/O Interface is much superior over external equipment solutions due to its short access time for the measured value, its easy-to-use commands of standard languages and its ability to easily read the measured value into the variables in high-speed analog value processing. User-friendly driver routines also support the high-speed display of measurement curves on the monitor.

The **Relay Interface PCA-B24** (option) provides eight high-quality relays each equipped with one bistable break-make contact. These relays can be software-switched using simple commands. Contact passivation through a protective gas atmosphere ensures a constant low level of contact resistance throughout the interface lifetime. The interface can switch both DC signals of up to 1 A and 50 V (max. 20 W) and AC signals with frequencies up to several MHz. A maximum of four plug-in modules can be inserted into a PCA.

The **Universal Control Interface PCA-B27** (option) is used for switching and sampling a maximum of 40 external lines. A user-configured breadboard enables the user to define the electrical characteristics of the control signals himself. This means that a simple, cost-effective solution is available for customized functions. A maximum of three options PCA-B27 and/or the TTL I/O Interface PCA-B11 (see above) can be inserted into the PCA.

Ordering information

Order designations	▶ Process Controller	
PCA 5	375.2010.04	
PCA 15	376.1100.02	
Options		
Second IEC-625 Bus Interfaces	PCA-B4	375.9514.02
V.24/RS-232-C Interfaces	PCA-B5	375.9714.02
Second Floppy Disk Drive	PCA-B6	376.0710.02
Winchester Disk Drive (21.3 Mbyte)	PCA-B7	376.0810.02
Real-Time Clock (for PCA 5)	PCA-B10	375.9814.02
TTL I/O Interface	PCA-B11	813.0518.02
A/D Converter	PCA-B12	813.0718.02
Analog I/O Interface	PCA-B13	813.0918.02
EPROM Disk 1 MB	PZ-21	812.8515.02
0.5 MB	PZ-22	812.9905.02
RAM Disk 0.5 MB	PZ-23	351.5719.02
EPROM Disk Adapter	PCA-B21	813.5610.02
Relay Interface	PCA-B24	813.3517.02
Universal Control Interface	PCA-B27	812.9611.02
3½" Floppy Disk Drive	PCA-B36	351.2010.02
Pascal	PCA-K11	813.5010.02
Recommended extras		
Universal Impact Printer	PUD 2	359.5018.02
Universal Ink-Jet Printer	PUD 3	359.5501.02
Floppy Disks (10)		
5¼", formatted	PCA-Z2	376.0210.02
3½", unformatted	PCA-Z3	351.2390.02
Cable for IEC-bus, 0.5 m	PCK	292.2013.05
1 m	PCK	292.2013.10
2 m	PCK	292.2013.20
4 m	PCK	292.2013.40
19" rackmount adapter (4U)	PUC-Z9	345.2611.02

See "General measuring systems" in Rohde & Schwarz measuring equipment catalog for detailed description and specifications of the PCA 5, PCA 15, Process Controller PCA 1, PCA 2 and PCA 12 (without screen), Monocrome Monitor PMM, Colour Monitor PMC, further software and extras.

DOP

Eight-pen Plotter DOP

- 18 different ASCII character sets
- 8 colours selectable for each program
- DIN-A4 paper format
- Variable scaling
- Error 0.1%, resolution 0.05 mm
- Maximum plotting speed 45 cm/s
- IEC-bus interface with 1 kbyte buffer capacity
- Digital readout of coordinates via IEC bus

Scale 1:5

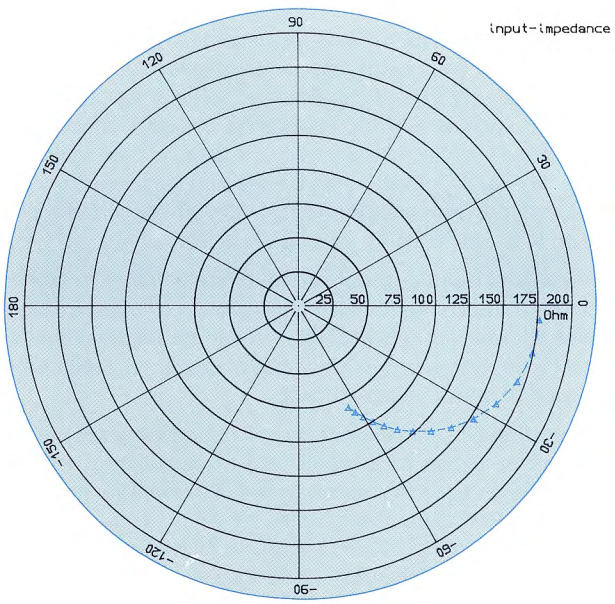
IEC 625 Bus

The **Eight-pen Plotter DOP** permits drawing of complex and high-resolution graphical representations on paper or overhead-projector transparencies in DIN-A4 format. As a high-speed flatbed plotter it is an excellent add-on for automatic test systems where simple and clear representation of mathematical quantities is required. Thanks to a comprehensive command set the DOP can be conveniently controlled via an IEC-bus interface by the Process Controllers PCA or PUC from Rohde & Schwarz or by any other controller with IEC-bus interface. Moreover, special digitizing commands permit coordinates to be read out from the plotter, thus avoiding the laborious task of measuring points and entering endless columns of figures.

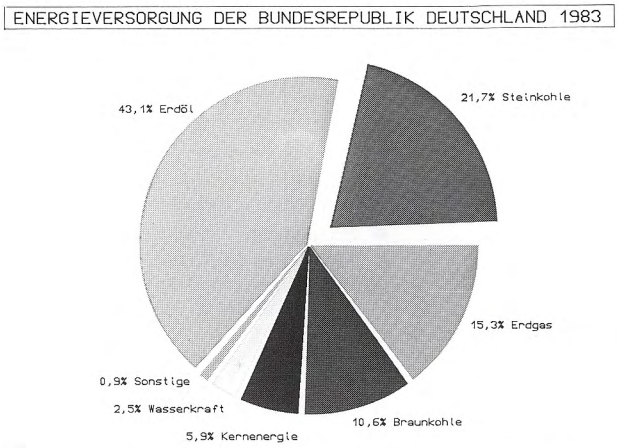
Command set A decisive feature contributing to the user-friendliness of a plotter is the available command set. Unlike simpler instruments, the DOP offers a maximum in programming ease with 18 different character sets including calligraphic and macrocharacter commands. A single command is all that is required in each case to plot vectors, circles, sectors of circles, axes, bars, with or without hatching. Six types of line (full, dash, dash dot, dash double-dot, double dash and dotted) and five different marker symbols together with the eight colours provide a large number of ways to present and distinguish hardcopy. Text can be plotted in a vast number of different heights, widths and angles to the horizontal. User coordinates, programmable scaling factors for the X and Y axes and definable clipping areas are additional capabilities which simplify the programming and application of the DOP.

Printer/monitor For testing of programs and recording of command sequences the DOP can also be operated as a monitor or a printer.

Plotting The DOP is able to write high-quality hardcopies with fibre-tip pens on paper or overhead-projector transparencies and with drawing ink on drawing media. The excellent quality of the print image and the extremely high accuracy along with the fast plotting speed result from the plotting arm being controlled at both ends.

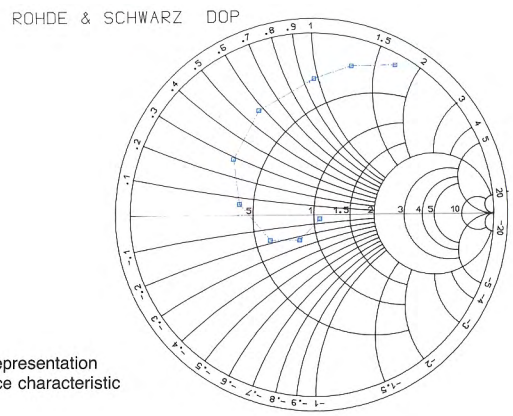


Graphical representation of input impedance as a function of frequency



The DOP plots pie diagrams with coloured solid or hatched areas with utmost accuracy

Plotting speed With a plotting speed of up to 45 cm/s or three characters per second with alphanumeric text, the DOP can be counted among the fastest in its class. The plotting speed can be programmed in two levels to match the writing characteristics of different pens. With its 1-kbyte input buffer and also thanks to the compressed command structure, the DOP is able, for instance, to quickly respond to a request for graphical evaluation of test data from a process controller and to plot the data while the controller executes the next series of measurements. Removing the handicap of plotting speed from the controller effectively doubles the processing speed of the bus system.



Graphical representation of impedance characteristic

Printer/monitor In addition to its prime funciton as a plotter, the DOP can also be operated as a printer or a monitor. This capability simplifies the testing of programs and the recording of command sequences. In the PRINT mode, incoming characters are not interpreted as commands but written directly on the plotting media. In the MONITOR mode, the control characters are also plotted out.

Digitizer A further facility offered by the DOP is the ability to digitize the coordinates of the position of the pen and to read these out via the IEC bus. Thus, curves can easily be evaluated and predetermined reference points or limits for the plotting area of forms transferred to a graphics program. If the supplied digitizing sight is used instead of the pen, more accurate positioning can be obtained.

Specifications

Paper format	DIN A4 (ANSI A)
Paper holddown	electrostatic
Colours	eight, programmable selection
Pen types	fibre tip in eleven colours for paper and overhead-projector transparencies, Pentel Ceramicron pens, drafting pens (Rotring Isograph or similar)
Plotting speed	two speeds selectable; 45 cm/s max. or 22 cm/s, three characters 3 mm high per second
Programmable step	0.1 mm
Internal resolution	0.05 mm
Repeatability error	<0.1 mm with same pen <0.3 mm with different pen
Commands	move, plot, calligraphy, standard script, select pen, select speed, circles, sectors, bars, hatching, axes, type of line, markers, clipping area, scaling, digitize
Operating modes	PLOT, PRINT, MONITOR
Input buffer	1 kbyte
Interface	IEC 625-1 (IEEE 488)
Connector	Amphenol, 24-contact
Interface capabilities	T 6, L 3, SR 1, RC 0, PP 1, PP 2, DC 1, PT 0

General data

Operating temperature range	−5 to +40 °C
Storage temperature range	−25 to +65 °C
Power requirements	115/220 V ±20%, 47 to 63 Hz (45 VA max.) instrument safety class 1 (VDE 0411 or IEC 348)
Dimensions (W×H×D)	404 mm×138 mm×366 mm
Weight	7.8 kg

Ordering information

Order designation	▶ Plotter DOP 375.1213.02	
Accessories supplied	accessory case with: 4 fibre-tip pens (black, blue, red, green) 4 adapters for Rotring Isograph ≥0.35 mm 1 adapter for Rotring Isograph <0.35 mm 4 adapters for Pentel Ceramicron SRM 03 1 digitizing sight spare fuses dust cover block of paper power cable description	
Recommended extras		
Paper (DIN A4, 250 sheets)	DOP-Z1	375.1313.00
Overhead-projector transparencies (DIN A4, 100 sheets)	DOP-Z2	375.1336.00
Fibre-tip pens[1]) (0.3 mm) red	DOP-Z4	375.1413.03
blue	DOP-Z4	375.1420.03
black	DOP-Z4	375.1436.03
green	DOP-Z4	375.1442.03
brown	DOP-Z4	375.1459.03
yellow	DOP-Z4	375.1465.03
violet	DOP-Z4	375.1471.03
pink	DOP-Z4	375.1488.03
light green	DOP-Z4	375.1494.03
light blue	DOP-Z4	375.1507.03
orange	DOP-Z4	375.1513.03
Fibre-tip pens 0.6 mm, eg for solid areas black	DOP-Z4	375.1436.06
red	DOP-Z4	375.1413.06
blue	DOP-Z4	375.1420.06
green	DOP-Z4	375.1442.06
yellow	DOP-Z4	375.1465.06
violet	DOP-Z4	375.1471.06
brown	DOP-Z4	375.1459.06
Adapter for Rotring ≥0.35 mm		375.1688.00
Rotring <0.35 mm		375.1694.00
Pentel SRM 03		375.1707.00
User software		available on request

[1]) Supplied in packs of 5.

PUC

Process Controller PUC
♦ CPU 6502, 2 MHz clock

- Compact IEC-bus controller
- 32-kbyte nonvolatile memory
- Two built-in floppy-disk drives of 156 kbyte capacity each
- Programming in BASIC
- High-speed IEC-bus operation with data rates >50 kbyte/s for input and >70 kbyte/s for output operations
- Efficient RF shielding affords optimal EMC
- Monitor keyboard (softkeys) as option
- Connector for Universal Impact Printer PUD 2 or Universal Ink-jet Printer PUD 3
- Compact 19″ design for easy rack-mounting
- Many options available

IEC 625 Bus

The **Process Controller PUC** is an economical control computer for the automatic measurement and control of IEC-bus operated systems. The PUC possesses numerous interfaces and functions. Modern **measuring techniques** make special demands on process controllers. Compact and reliable design, powerful interfaces and **low RF leakage** make the PUC outstanding for use in RF test systems. The main unit is accommodated in a 19″ cabinet which may easily be fitted into a 19″ rack.

Equipment configuration

Basic unit Even in its basic version (main unit with one floppy-disk drive, display of characters and symbols, no keyboard), the PUC without operating controls finds application in automatic production cycles, in the test department, incoming goods inspection and communications services. For the large majority of other applications the PUC can be supplied with a **standard keyboard.**

Options Based on a series of retrofit options the performance of the PUC can be enhanced easily and cost-effectively for the special problem on hand. The storage capacity can be enlarged with a **second floppy-disk drive** whereas a **serial interface** (RS-232-C) and an **I/O interface** are available in addition to the standard IEC and printer interfaces. The **Real-time Clock Option** allows the measurement of time, real-time reference and time-related control. The **High-resolution Graphics Option** provides the PUC with every possible graphic display. The option is indispensable in reproducing test curves (eg Smith charts) and in many other tasks.

Characteristics

Memory The storage capacity of the PUC is 64 kbytes, half of which is available to the user as RAM space. The 32-kbyte memory is a buffered CMOS RAM and retains the entered data for well over 60 hours.

The **program language** of the PUC (BASIC) is simple to learn yet powerful so that complex test programs can be set up. The BASIC in use is significantly extended and has a comprehensive set of editor commands. Program writing is therefore very much simplified. Important aids for program writing are:

Editing over the whole scrren
Forward and reverse scroll
Autonumbering of lines
Renumbering of program lines
Searching and changing of single characters or texts in BASIC

Interference immunity Due to the fast logic, computers generate interfering voltages and RF interference. The latter not only "pollutes" the environment but also leads to erroneous results of measurements. As a result of proper shielding the PUC has an extremely low interfering effect on power supply and environment. On the other hand, shielding makes the PUC also insensitive to strong external fields, sparkovers or interference from power lines. To prevent low-frequency interference, the monitor screen can be switched on and off with the commands

DSPN display on
DSPF display off

during ongoing measurements.

The **9″ screen** serves for the purpose of writing programs as well as for the display of results of measurements and calculations. The bright flicker-free display made up of 25 lines with 40 characters in each guarantees relaxed working with the PUC.

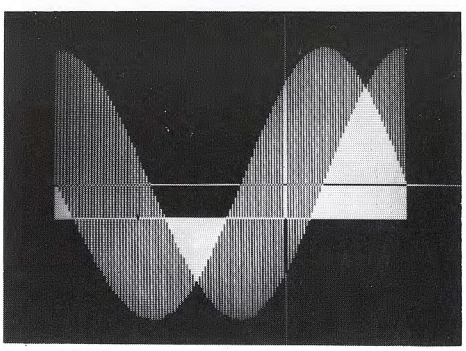
Monitor keyboard The Process Controller PUC can be supplied or retrofitted with a monitor keyboard (option PUC-B4). The softkeys of the monitor keyboard make program branching possible. The labelling of the softkeys is displayed on the screen via a driver routine.

The Standard **Keyboard** (PUC-Z1) has 75 alphanumeric and special keys for the input, processing and testing of programs. All characters and symbols can be entered for normal (bright) or reverse (dark on bright background) display. All keys have repeat capability.

Options

High-resolution Graphics Option PUC-B6 For the clear presentation of results of automatic measurements, for mathematical functions and diagrams a resolution which is higher than that offered by the graphic characters of the basic model is called for.

The High-resolution Graphics Option has the capability to drive each of the 320×200 points singly. An easy-to-use set of commands enables the drawing of bright or dark lines, or the transfer of graphic characters entered via the keyboard to the display memory of the option. Since this memory is independent of the graphics memory of the PUC, two different displays may at the same time be shown on the screen. A graphics display may then be stored on a floppy disk and be fetched when required. For hardcopies of test results, the Universal Printer PUD 2 outputs the graphics displays.



Sinewave function displayed on PUC using graphics option PUC-B6

Floppy-disk Drive Option PUC-B2 The standard built-in and the retrofit optional floppy drives are identical. The mass storage medium used is the 5¼″ floppy disk which provides access to data and programs within seconds. The floppies are of single-density type written on both sides. Each floppy has a storage capacity of 156 kbytes and is divided into 305 areas/side, 256 bytes/area.

Rohde & Schwarz supplies formatted and tested floppy disks, although floppies can be formatted by the user with the supplied mother disk.

A comprehensive set of commands enables the control of the floppy drives.

Real-time Clock Option PUC-B10 The option has a battery backed-up clock which outputs information on date and time. The resolution is 100 ms. Accurate time measurements can therefore be carried out, and date and time are entered on test records. Program branching via a command can be made at a given time of day.

IEC-bus Interface The standardized interface (also conforming to IEEE 488) can simultaneously handle up to a maximum of 14 devices (including other controllers). Its high transfer rate of 50 kbytes/s for data input and 70 kbytes/s for data output allows the efficient operation of high-speed instruments which have to handle large volumes of data. For controlling the instruments, a simple and easy-to-use IEC-bus instruction set is provided, which eliminates the need for concern with the details of the IEC-bus system.

RS-232-C Interface Option PUC-B5 The serial interface enables the transfer of data to or the reception of data from all devices equipped with a serial interface, such as EPROM programming unit, tape reader, tape punch and printer. In addition, the PUC can be hooked up to a computer.

The interface complies with specifications laid down by the RS-232-C I/O Standards, CCITT Recommendations V.24 as well as the DIN 66020 Standard. The RS-232-C Option can be changed to a current-loop interface (20 mA) with the aid of plug-in links. Data transfer is asynchronous with handshaking. The transfer rate is selectable in steps between 50 and 9600 Baud. Data formats between 5 and 8 bits as well as parity and stop bits can be processed.

Printer connection A printer can be connected via a Centronics-compatible interface on the rear of the PUC leaving the IEC-bus connector free for other equipment. Without any extra work involved for the user, the printer (eg PUD 2 from R&S) produces printouts of test reports, measurement results and program listings. Commands for the control of the printer are part of the operating system of the PUC. A complete ASCII upper- and lower-case character set for printing texts and figures is available together with the choice of four character styles.

PUC

I/O Interface Option PUC-B7 A great variety of measurement and control tasks, otherwise requiring extra equipment, can be carried out from the computer with the aid of the I/O Interface. The option is plugged into one of the vacant slots of the PUC. The interface consists of:

32 TTL lines arranged in groups of 8 lines programmable either as outputs (max. sink current of 24 mA) or as inputs; controlling test items and devices without standard interface; also applying and reading of bit patterns;

7 relays for supply voltages of up to 50 V and current up to 0.5 A as well as for any DC and AF signals; they can be selected individually or in groups;

A/D converter (0 to +2.55 V), for DC and AF measurements with 8 bit resolution (0.4%), referenced to ground potential; apart from DC measurements, AF signals can be analyzed with the use of machine language;

D/A converter (0 to +2.55 V), DC voltages are generated with 8 bit resolution corresponding to 0.4%.

Specifications

CPU	6502	
Clock	2 or 1 MHz (at choice)	
Available RAM space	31743 bytes	
Number range	$\pm 3 \times 10^{-39}$ to $\pm 1.7 \times 10^{38}$	
Programming languages	BASIC, with numerous extensions, machine language	
VDU	9″, non-reflecting, non-flicker	
Display	25 lines, 40 characters/line	
Cursor	4 keys plus indirect addressing	
Character set	upper- and lower-case or ASCII and graphic symbols (normal or inverse display)	
Keyboard	shielded; 2.5 m long connecting cable	
Standard keyboard	75 keys, full ASCII character set with double functions, separate numerical pad and special keys for editor as well as RETURN and REVERS	
Floppy-disk drives		
Mini-floppy drive	5¼″, standard 2nd drive as option	
Writing density/type	single density/double-sided	
Storage capacity	156 kbytes	
Disk organization (soft-sectored)	305 areas/side, 256 bytes/area	
IEC-bus interface	IEC 625-1 and IEEE 488	
Functions	SH1, AH1, T1, L1, PP1, DC1, DT1, C1 to C4, C10	
Data transfer rate (without interpreter time)	>50 kbyte/s with IN >70 kbyte/s with OUT	
Connector	shielded 24-contact Amphenol female	
Printer connection	Centronics-compatible interface with data strobe and busy signal	
Number of data lines	8	
Permissible output current	I_L <24 mA	I_H >−15 mA
Required input level	V_L <0.4 V	V_H >2.4 V
Specifications of options		
Floppy-disk Drive PUC-B2	see above	
RS-232-C Interface (V.24) PUC-B5	bidirectional with additional 20-mA current-loop interface	
Data transfer	asynchronous	
Transfer rate	50 to 9600 Baud	
Connector	25-contact Cannon female	
I/O Interface PUC-B7	4×8 TTL inputs/outputs, 7 relays	
Permissible output current	I_H >−15 mA	I_L <24 mA
Required input level	V_H >2 V	V_L <0.8 V
Relay rating	$I_{max.}$ <0.5 A	$V_{max.}$ <50 V
Converters	A/D	D/A
Number of bits	8	8
Input/output voltage range	V_{in}/V_{out} 0 to +2.55 V	
Resolution	10 mV/digit	10 mV/digit
Limit values for V_{in}	−0.5 and 3.5 V	—
Offset	1 digit	1 digit
Non-linearity	2 digits	2 digits
Conversion time	max. 15 µs	—
Input/load impedance	100 kΩ	100 Ω min
Connector	50-contact Amphenol female	
High-resolution Graphics PUC-B6		
Resolution	64,000 points	
horizontal	320 points	
vertical	200 points	
Real-time Clock PUC-B10		
Functions	output of time and date; branching at given time	
Resolution	100 ms	
Accuracy	$<1 \times 10^{-5}$	
Battery back-up operation	700 hours	

General data

Rated temperature range	0 to +45 °C
Storage temperature range	−40 to +70 °C[1])
Relative humidity	20 to 80%
Power supply	100/120/220/240 V ±10%, 47 to 63 Hz; safety class I
Power rating of basic unit	88 VA
with options	112 VA
RF leakage	
Unwanted voltage	satisfies VDE 0875 (RFI grade K) and requirements of MIL-STD 461B regarding conducted interference
RF interference	satisfies VDE 0871. Complies with limit class B; Radio Protection Mark granted
Mechanical stress capacity	shock and vibration tested to Parts 7 and 8 of DIN 40046 (corresponding to IEC Publ. 68-2-27 and 68-2-6)
Dimensions, weight	
Basic unit	470 mm×198 mm×491 mm, 19 kg

Ordering information

Ordering designation		▶ Process Controller PUC
PUC without keyboard		344.8900.10
Standard Keyboard	PUC-Z1	345.2011.04
Accessories supplied		1 mother disk with programs to format and copy floppies, power cable
Options		
2nd Floppy-disk Drive	PUC-B2	345.2711.02
Monitor Keyboard	PUC-B3	345.3618.02
RS-232-C Interface	PUC-B5	343.6103.02
High-resolution Graphics	PUC-B6	345.3118.02
I/O Interface	PUC-B7	345.2811.02
MPG Interface	PUC-B8	342.3218.02
Real-time Clock	PUC-B10	345.3418.02
19″ Rack Adapter	PUC-Z9	345.2611.02
Service Kit	PUC-Z7	345.2511.02
Recommended extras		
10 formatted floppy disks	PPC-Z2	343.7900.02
IEC-bus cable 0.5 m	PCK	292.2013.05
1 m	PCK	292.2013.10
2 m	PCK	292.2013.20
4 m	PCK	292.2013.40
Universal Impact Printer	PUD 2	359.5018.02
Universal Ink-jet Printer	PUD 3	359.5501.02
Print Paper for PUD 2		079.7107.00
Print Paper for PUD 3	PUD 3-Z1	359.5347.02
Ink Container for PUD 3	PUD 3-Z2	359.5324.02
IEC-bus Interface for PUD 2 and 3	PUD 2-B4	359.5918.02
RS-232-Interface for PUD 2/PUD 3	PUD 2-B5	373.3019.02

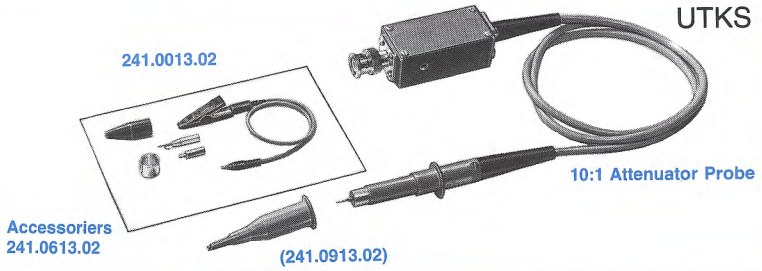
[1]) +5 to +55 °C for Floppy-disk PPC-Z2

10:1 Attenuator Probe
1:1 Probe
BNC Adapter

UTKS

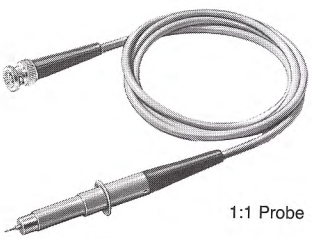
- Universal accessories for use with instruments having matching input characteristics

Photo: 10:1 Attenuator Probe and accessories (components shown in frame plus Probe Tip 241.0913.02)

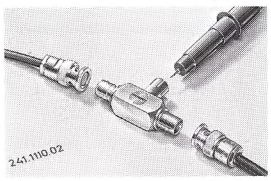


10:1 Attenuator Probe UTKS (see photo above) for point-by-point measurements; only light loading of checkpoint; for instrument input impedances of 1 MΩ ||10 to 40 pF. Built-in cable equalizing network for frequency response correction up to 70 MHz.

1:1 Probe UTKS for voltage measurements up to 400 V. The frequency range (rise time) depends on the input impedance of the measuring instrument.



1:1 Probe



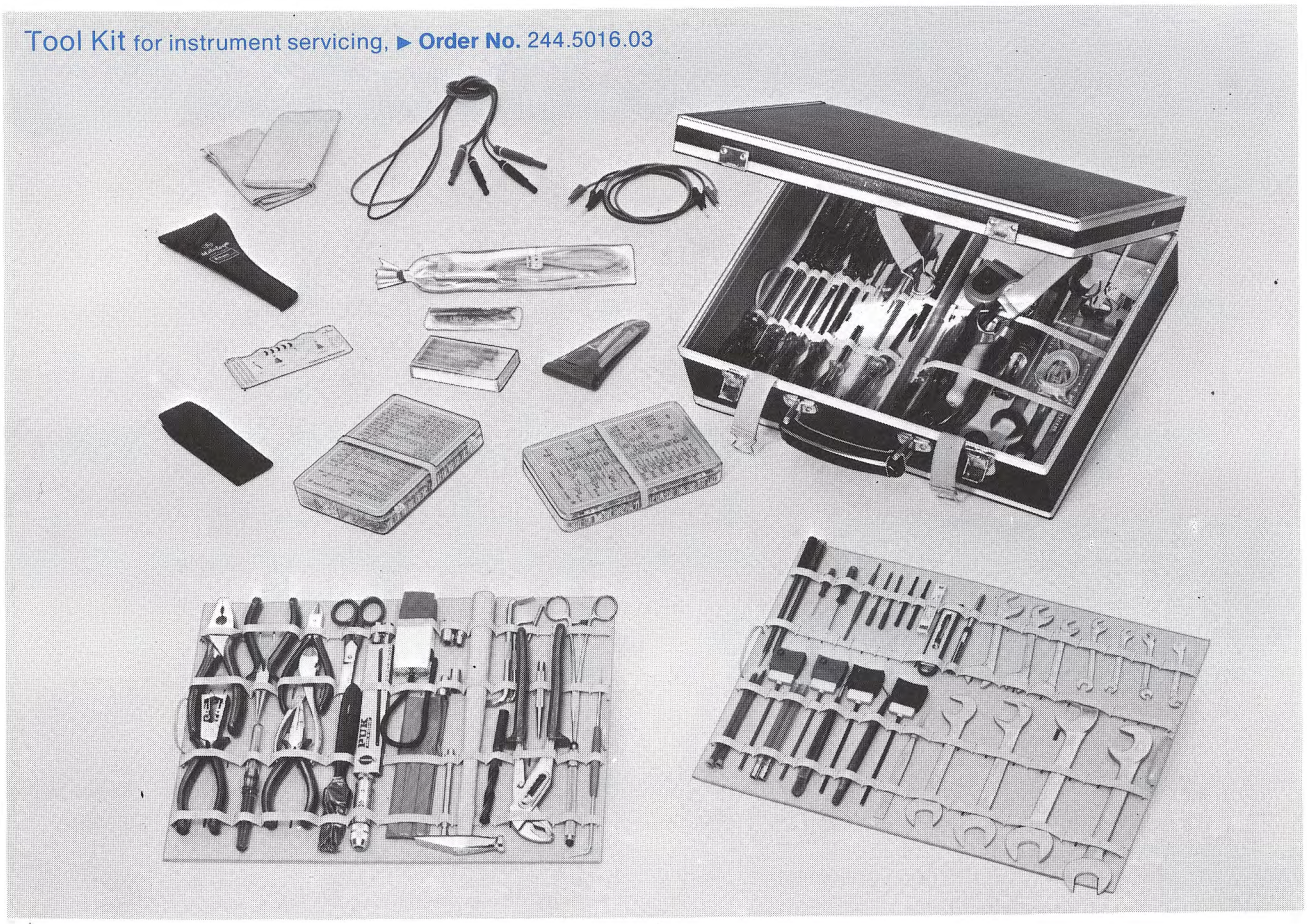
BNC Adapter
(shown ready for connection)

BNC Adapter URV-Z Coaxial insertion adapter for use in conjunction with the 10:1 Attenuator Probe or the 1:1 Probe.

Specifications	10:1 Att. Probe UTKS	1:1 Probe UTKS	BNC Adapter URV-Z
Input Impedance, connector	10 MΩ || 12 pF; BNC	1 MΩ || 40 pF; BNC	— BNC
Permissible test voltage (including DC component)	250 V_{pp}	400 V_{pp}	—
Frequency-response flatness			
0 to 20 MHz	< ±0.2 dB	—	—
20 to 70 MHz	< ±0.5 dB		
Z_{in} of measuring instrument	1 MΩ || 10 to 40 pF	—	—
▶ **Order No.** for compl. unit	241.0013.02	241.1310.93	241.1110.02
Delivery comprises*	see photo above	Probe (left) plus access.	Adapter

* Probe Tip 241.0913.02 and Accessories 241.0613.02 are available separately.

Tool Kit for instrument servicing, ▶ **Order No.** 244.5016.03

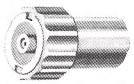


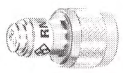
RAU, RBS 1000, RBU, RMC, RMF, FMF 2, RNA, RNB
Terminations and high-power attenuators

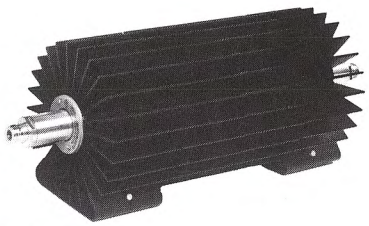
RNA

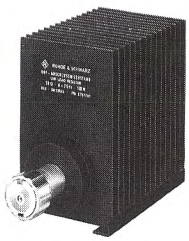
RMF 2

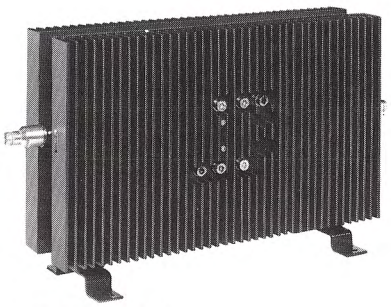
RMF


RMC


RNB


RBU, 100 W


RAU, 100 W


RBS, 1000 W
(shown on smaller scale)

Overview Terminations

Notes: [1]) adaptable [2]) with calibration curve ±0.1 dB.

Power rating W	Designation	Type	Order No.	Characteristic impedance Ω	Frequency range GHz	VSWR	Attenuation dB	Connector	Dimensions mm
Terminations for measurements									
1	Precision Termination	RNA	272.4510.50	50	0 to 2 0 to 18	<1.02 <1.07	— —	N male	20.5 dia.×35
0.25	Termination	RMF 2	265.6863.00	75	0 to 0.02	<1.01	—	BNC male	16 dia.×23
0.5	Termination	RMF	100.2927.50	50	0 to 0.01 0 to 0.03	<1.02 <1.06	— —	BNC male	16 dia.×55
			100.2927.70	75	0 to 0.01 0 to 0.03	<1.02 <1.06	— —	BNC male	16 dia.×55
1	Termination	RMC	100.2940.50	50	0 to 3 0 to 5	<1.02 <1.03	— —	Dezifix B[1])	45 dia.×55
			100.2940.60	60	0 to 3 0 to 5	<1.02 <1.03	— —		
			100.2940.70	75	0 to 3	<1.03	—		
		RNB	272.4910.50	50	0 to 1 0 to 4	<1.05 <1.2	— —	N male	20.5 dia.×35
High-power terminations and high-power attenuators									
30	High-power Attenuator	RBU	100.8654.27	50	0 to 1	<1.05	20 ±0.2	N female[1])	140 dia.×180
80		RBU	100.8654.07	50	0 to 1	<1.05	3 ±0.2	N female[1])	140 dia.×180
100		RBU	100.8654.37	50	0 to 1	<1.05	30 ±0.2	N female[1])	140 dia.×390
100		RBU	100.8654.17	50	0 to 1	<1.05	10 ±0.2	N female[1])	140 dia.×320
100	Termination	RAU	200.0019.02	50	0 to 1 0 to 2	<1.05 <1.4	— —	Dezifix B[1])	95×152×235
			200.0019.55	50	0 to 1 0 to 2	<1.05 <1.4	— —	N female[1])	95×152×235
1000	High-power Attenuator	RBS 1000	207.4010.55	50	0 to 0.4 0.4 to 1	<1.2 (with linear reduction of power-handling capacity to 600 W)	40 ±1[2])	N female	500×285×152

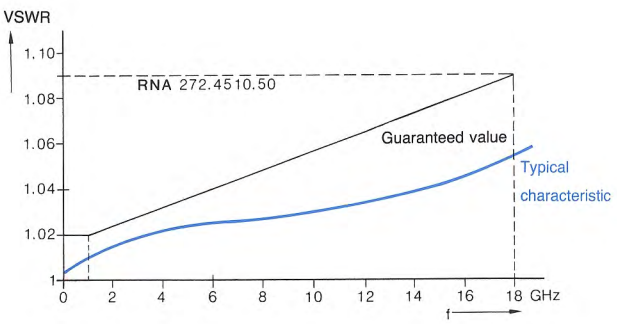
Characteristics and uses of terminations and high-power attenuators

Terminations provide a reflection-free termination of instruments and cables. They are also used as a reference impedance for VSWR measurements. In contrast to high-power attenuators, terminations are not fitted with a test output.

High-power attenuators are used as dummy loads for high-power amplifiers (eg transmitter output stages). They are provided with a test output with exactly defined attenuation for the connection of measuring equipment (eg power meter, analyzer or counter). For low-power attenuators, please refer to the following page.

Terminations for measurements

RNA A precision termination with N connector, featuring extremely low VSWR over the whole frequency range from DC to 18 GHz, mainly for use in electronic measurements.



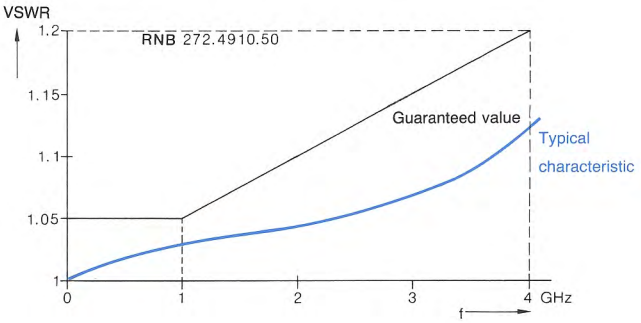
RMF Reflection-free termination for instruments and test setups with BNC connectors. It has a non-wound resistance element without cap, the inductive reactance being compensated up to 30 MHz. One end of the resistance element is connected to the inner conductor of the connector, the other end to the outer conductor.

The RMF can be used as a reflection-free termination for video transmission lines (VSWR ≤1.02 up to 10 MHz).

RMF 2 The **Termination RMF 2** is a reflection-free termination with narrow resistance tolerance, which meets the high **requirements of insertion-signal testing.** Power rating is adequate for semiconductor circuits. The return loss is >56 dB up to 1 MHz, >52 dB up to 5 MHz and >48 dB up to 20 MHz. The RMF 2 has a metal-film resistance element. It can remain plugged to the instrument during transport as it is only 23 mm long and does not protrude beyond the overall dimensions of the set.

RMC Standard termination for coaxial test setups (21-mm outer diameter); acts as a termination on slotted lines and impedance meters used for measurements on cables and two-port networks as well as for adjusting directional couplers.

RNB Termination with N connector for general use in the frequency range from DC to 4 GHz; use of a stable metal-film resistor affords a power-handling capacity of 1 W.



High-power terminations and high-power attenuators

RBU High-power attenuator with low VSWR and small attenuation error; particularly suitable for extending the measurement range of power meters and for match-terminating transmitters.

RAU Termination (dummy antenna), especially for mobile or stationary transmitters; low VSWR makes it also suitable for TV systems.

RBS 1000 This high-power attenuator is cooled by air convection. In addition to its use as a dummy antenna, it can be used for determining the fundamental-wave power and the harmonics ratio of transmitters as well as for extending the measurement range of microwave power meters.

Overview Attenuator pads

Frequency range	Designation	Type	Order No.	Characteristic impedance	Attenuation	Power rating	VSWR	Dimensions in mm	Text
0 to 1000 MHz	Attenuator	DSF	289.8766.00 289.8814.00 289.8866.00 591.4338.00	50 Ω 50 Ω 50 Ω 50 Ω	3 dB 6 dB 10 dB 20 dB	1 W 1 W 0.5 W 0.5 W	≤1.1 (up to 500 MHz) ≤1.2 (up to 1000 MHz)	50.5×36 dia.	see below
0 to 12.4 GHz	Attenuator	DNF	272.4010.50 272.4110.50 272.4210.50 272.4310.50 272.4410.50	50 Ω 50 Ω 50 Ω 50 Ω 50 Ω	3 dB 6 dB 10 dB 20 dB 30 dB	2 W 2 W 1 W 1 W 1 W	≤1.1 (up to 4 GHz) ≤1.2 (up to 10 GHz) ≤1.25 (up to 12.4 GHz)	56×21 dia.	see below

Characteristics and uses of attenuator pads

Attenuator pads (DSF/DNF) with optimally graded ratings are valuable accessories for test setups in which the attenuation values do not have to be frequently changed. Due to their compact design and simple handling (easy to replace), they are also suitable for use in mobile test setups.

Attenuators from Rohde & Schwarz are of coaxial design. They are made up of match-terminated resistors, whose reactances are made ineffective by compensation. The complete arrangement is accommodated in a sturdy metal tube with connectors at both ends.

As a rule, the internal reflection coefficient of a commercial signal generator is about 5%, and the reflection coefficient at the input of a test receiver about 10%. These values are too high for precise measurements. To **improve matching,** a 10-dB attenuator should be inserted after the signal generator output and another one ahead of the receiver input. In this way, the reflection coefficients will be reduced by a factor of 10 in both cases.

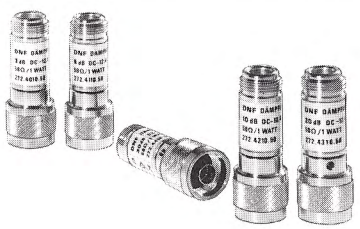
Often, signal generators do not have a defined source impedance. In these cases, it is advisable to insert a 15-dB (10+5 dB) attenuator. The internal reflection coefficient of such a signal source is thus reduced to about 3%, which is **small enough for accurate measurements.**

Attenuators can also be used as **reference standards** for attenuation and gain measurements according to the substitution method, for precise voltage division, and as buffers to isolate test circuits.

Attenuator pads

DSF The **DSF Attenuators** are low-cost, general-purpose components suitable for use at frequencies up to 1000 MHz. The attenuator elements are made up of π-networks of metal-film resistors.

DNF The **DNF Attenuators** have N connectors and are mainly intended for lab use, integration into systems and range extension of power meters. High attenuation accuracy and flatness of frequency response together with low VSWR guarantee precise measurements. The DNF pads are very robust and immune to vibration in line with MIL-A-3933 and will withstand short-time overloading. Models available between 3 and 30 dB (see table above); power-handling capacity 2 W for 3-dB and 6-dB models, 1 W for other models.



Overview Matching pads/feed-through terminations/power splitter

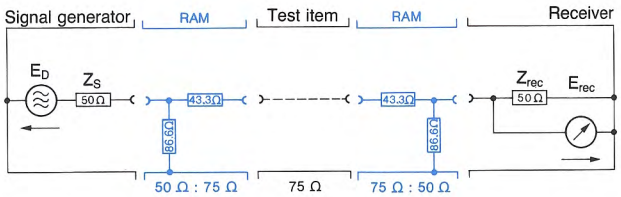
Frequency range	Designation	Type	Order No.	Characteristic impedance	Voltage transformation →/← dB	VSWR	Power rating	Dimensions in mm
0 to 2700 MHz	Matching Pad	RAM	358.5414.02	75:50 Ω Connectors: 50 Ω: N male, 75 Ω: N female	7.5/4.0	≤1.06 (1.2)	2 W	73×21 dia.
0 to 2700 MHz	Matching Pad	RAZ	358.5714.02	50:75 Ω Connectors: 50 Ω: N male, 75 Ω: N female	1.8	≤1.06 (1.2)	2 W	73×21 dia.
0 to 1000 MHz	Feed-through Termination	RAD	289.8966.00	50 Ω Connectors: BNC male/female		≤1.05 (up to 100 MHz) ≤1.1 (up to 500 MHz) ≤1.2 (up to 1000 MHz)	0.5 W	50.5× 14.5 dia.
0 to 500 MHz 0 to 10 MHz 0 to 10 MHz	2-W Feed-through termination	RAD 50 RAD 100 RAD 600	844.9352.02 844.9400.02 844.9452.02	50 Ω 100 Ω 600 Ω		data on next page	2 W 2 W 2 W	50.5× 15.3 dia.
0 to 2700 MHz	Power Splitter	RVZ	800.6612.52	50 Ω	Insertion loss 6 dB	≤1.1 ≙ φ<2°	1 W	47×70× 16

Characteristics and uses of matching pads

Matching pads create the necessary match between measuring instruments and transmission lines of different characteristic impedances of the standard values 50 and 75 Ω or (as feed-through termination) match 50-Ω lines to measuring instruments with high input impedance.

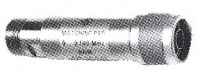
Matching pads

RAM The **Matching Pad RAM** is an L-section with differing input and output impedances; it provides the necessary match between measuring instruments and transmission lines having different characteristic impedances. The voltage transformation ratio depends on the direction, which is marked by arrows.



Two Matching Pads RAM to match a 75-Ω test item to a signal generator and receiver, each having a 50-Ω characteristic impedance

RAZ The **Matching Pad RAZ** enables the characteristic impedance to be matched at one end since it only has one series resistor. It is used specifically for matching the output impedance of a signal generator of 50 Ω to lines or leads of 75 Ω. A 50-Ω cable may be connected between signal generator and matching pad. The advantage of this matching pad lies in its low attenuation.

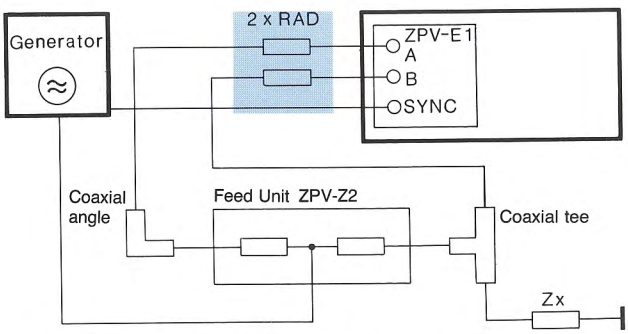


Feed-through termination

RAD The **Feed-through Termination RAD** is used for matching 50-Ω lines to measuring equipment with high input impedance (eg oscilloscope with 1-MΩ input). The RAD contains a metal-film resistor, which is connected in parallel with the input impedance of the measuring equipment. The RAD must be plugged directly into the input socket to ensure optimum matching.

Typical application

When measuring transmission and reflection parameters in conjunction with the Vector Analyzer ZPV and Tuner ZPV-E1, Feed-through Terminations RAD are used to match the 50-Ω network to the high-impedance inputs (1 MΩ || 17 pF) of the ZPV.



Measurement of reflection coefficient and low impedance values

2-W feed-through terminations 50, 100 and 600 Ω see next page

new

RAD-RVZ

2-W Feed-through terminations

RAD 50
RAD 100
RAD 600

The **2-W Feed-through Terminations RAD 50, RAD 100 and RAD 600** are used for matching low-impedance lines to high-impedance measuring equipment (eg oscilloscope with 1 MΩ input impedance). They incorporate a metal-film resistor, which is connected in parallel with the input impedance of the measuring device.

The feed-through terminations must be plugged directly onto the input connector of the measuring device to ensure optimum matching.

Typical application: see preceding page; the example shown there for measurement of transmission and reflection parameters using the Vector Analyzer ZPV is also valid for the 2-W feed-through terminations.

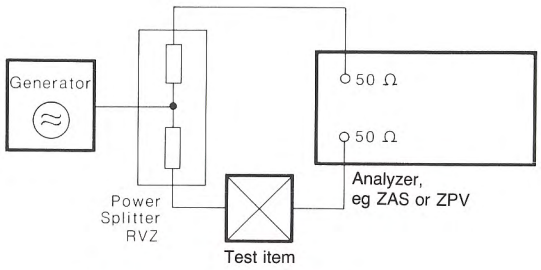
Specifications

Model	RAD 50	RAD 100	RAD 600
Impedance (±0.1%)	50 Ω	100 Ω	600 Ω
Power rating[1]	2 W	2 W	2 W
Frequency range to DC	500 MHz	10 MHz	10 MHz
VSWR s[2]			
up to 200 MHz	≤1.1	–	–
up to 500 MHz	≤1.25	–	–
Connectors	BNC female and BNC male (all models)		
Weight	22 g (all models)		
Order designation	▶ 2-W Feed-through Termination		
RAD 50	844.9352.02		
RAD 100	844.9400.02		
RAD 600	844.9452.02		

[1]) Continuous maximum power up to 70 °C ambient temperature, decreasing linearly to 0 W at 130 °C.
[2]) Measured with open-circuit output.

Power splitter

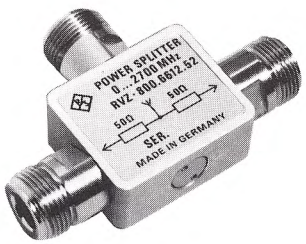
RVZ The **Power Splitter RVZ** is intended for use in test setups in which two signal paths are to be fed with exactly the same waves, eg
test item and power control or
test item and reference signal input,
see diagram below.



Test setup for transmission measurement

In the test setup shown above it is necessary to use a power splitter like the RVZ, which comprises two 50-Ω resistors. This is the only way to ensure that the incident wave fed to the test item is exactly identical to the wave in the reference channel. Since the incident wave is used as a reference, the correct transmission factor is always measured, irrespective of any mismatch of the test item or frequency response of the signal source. This requirement is not met by a three-port junction box. Therefore, the latter should only be employed for symmetrical splitting of power with matched load impedance.

The Power Splitter RVZ is fitted with N connectors at the input and at the outputs.



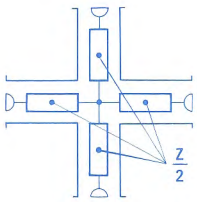
Power Splitter RVZ

Specifications

Frequency range	0 to 2700 MHz
Characteristic impedance	50 Ω
VSWR (input)	≤1.1
Equivalent VSWR of outputs*)	≤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
General data	
Connectors	input: female N outputs: female N
Nominal temperature range	0 to +55 °C
Storage temperature range	−40 to +75 °C
Dimensions	47 mm×70 mm×16 mm
Weight	100 g
Order designation	▶ Power Splitter RVZ 800.6612.52

*) The equivalent output VSWR determines symmetry and absolute accuracy of the two paths in the Power Splitter. For error assessment, it may be regarded as output VSWR of a generator in a test setup without splitter (measurment using the substitution method: comparison of measurements with test item and without test item).

DVU 4



Four-port Junction Box DVU 4

♦ 0 to 1500 MHz

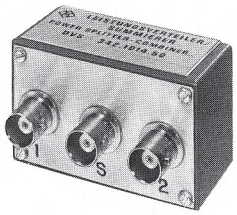
- Four-port junction box for splitting up into or combining three channels with correct impedance matching
- Application, eg for measurements involving three signal generators
- VSWR with impedance matching <1.1 (up to 1 GHz), typ. 1.3 (up to 1.5 GHz)

The Junction Box is of coaxial construction of four low-reflection N female connectors. The matching is achieved by Z/2 impedances in a star configuration. The Termination RMC or RNB is recommended for terminating any outputs which are not used.

Specifications

Characteristic impedance	50 Ω
Attenuation	9.54 dB
Max. load per input	0.25 W
Max. permissible pulse peak voltage	≤300 V
Dimensions	120 mm×120 mm×35 mm
Order designation	▶ Four-port Junction Box DVU 4
with N female connectors (adaptable)	201.4018.03

DVS

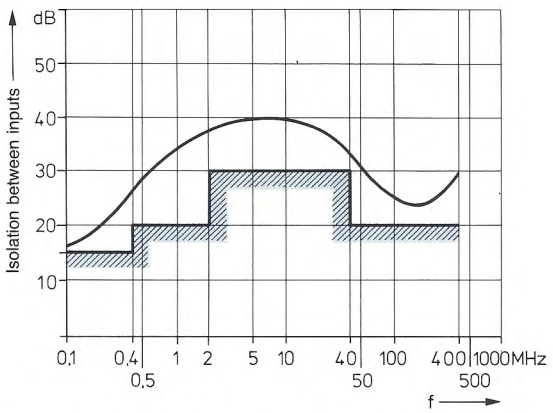


Power Splitter/Combiner DVS

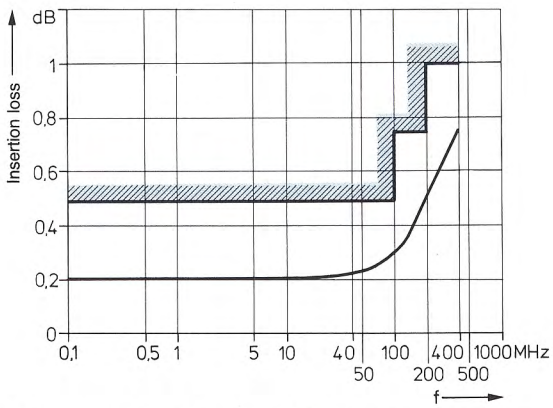
♦ 0.1 to 400 MHz

- Distribution or combination of higher-power signals (max. 1 W ≙ 7 V into 50 Ω)
- High isolation between inputs (20 to 40 dB)

No additional attenuators are required for use with the DVS, thanks to the high isolation between its inputs and its low transmission. Sufficient signal power is maintained.

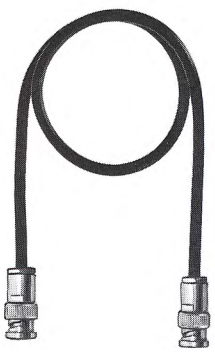


Isolation between inputs of DVS as á function of frequency



Frequency-dependence of insertion loss (in addition to 3-dB loss due to power splitting)

Coaxial connection cables



100.6980 ...

Connectors (at both ends)	Characteristic impedance Ω	Cable length cm	▶ Order No.
BNC male	75	50	100.6980.05
	75	100	100.6980.10
	75	200	100.6980.20
Dezifix B	50	50	100.6880.05
	50	100	100.6880.10
	50	200	100.6880.20
RF male 4/13 DIN 47284	75	50	100.6939.05
	75	100	100.6939.10
	75	200	100.6939.20
N male	50	100	100.7670.10
	75	100	100.7687.10

Specifications

Characteristic impedance	50 Ω
Connectors	BNC female
Transmission loss	≈3 dB
Isolation between inputs	20 to 40 dB
Maximum continuous load	1 W ≙7 V into 50 Ω
Dimensions	57 mm×36 mm×41 mm
Order designation	▶ Power Splitter/ Combiner DVS
50-Ω model	342.1014.50

Connectors

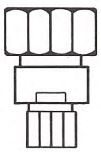
Rohde & Schwarz measuring equipment is generally equipped with the internationally used standard connectors. Depending on the requirements (eg frequency range, power-handling capacity, reflection characteristics), either N, BNC or Dezifix connectors are used.

All older Rohde & Schwarz instruments fitted with adaptable Dezifix A or B bases or with RF sockets 4/13 DIN 47284 can be adapted to other connector systems by means of screw-in assemblies or screw-in connectors and without the need for any modifications to the instrument: this is the best solution, ensuring minimum mismatch.

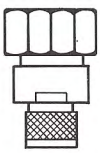
The following table also shows the most frequently required couplings, angle junctions and T connectors.

Adapters

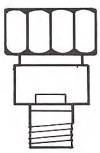
Dezifix B to other systems (50 Ω)



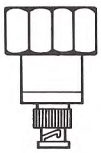
Dez. B/ Dez. A
408.4467.00



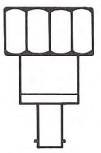
Dez. B/ Male N
408.4644.00



Dez. B/ Female N
408.4667.00



Dez. B/ Male BNC
431.0006.00



Dez. B/ Female BNC
430.8503.00

Dezifix A to other systems (50 Ω)

Dez. A/ Male N
408.4521.00

Dez. A/ Female N
408.4538.00

Dez. A/ Female BNC
430.9451.00

Adaptation of systems of other makes

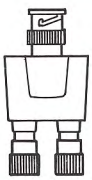
Male N/ Female BNC
118.2812.00

Screw-in connector Male 4/13/ Female BNC
017.5975.00

Female 4/13/ Male BNC
408.4509.00

Male 4/13/ Female BNC
408.4480.00

Male BNC/ Knurled terminal
017.6736.00



Male BNC/ Dual knurled terminal
017.6742.00

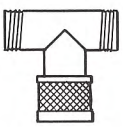
Couplings/Angle junctions and T connectors (50 Ω)

N Male/male
092.6581.00

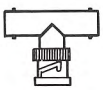
N Female/female
092.6700.00

BNC Female/female
017.6559.00

N Male/female
018.4495.00

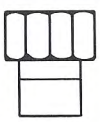


N Female-female/male
018.4537.00



BNC Female/female/ male
017.6588.00

Shortcircuits (50 Ω)



Dezifix B
408.5028.00

Dezifix A
408.4938.00

N connector (male)
017.8080.00

Most common RF connecting elements

Blue: R&S ordering numbers

Training centre Rohde & Schwarz, Cologne plant

Rohde & Schwarz (Cologne plant) holds introductory courses, seminars, training and refresher courses. The training concept and documents are prepared in agreement with the customer before the course starts. Subject and aim determine the duration of the courses, which are carried out with support of the **worldwide Rohde & Schwarz organization.** This is particularly useful for system introduction courses at the customer's site. In all cases, the instructors are well-experienced and have, besides teaching qualifications, comprehensive theoretical and practical knowledge.

Central Service Field Installation

The Central Service Department of **Rohde & Schwarz,** and its field installation group in particular, has decades of experience in planning, projecting and installing **Rohde & Schwarz** systems.

We are your partner for installation work on all five continents, whether you require a supervisor for installation work carried out by your own qualified team or want us to send specialists – we can do it. We can also supply the necessary material.

Central Service Spare Parts

For measuring and transmission equipment of our products, we elaborate **standardized spare part catalogs.**

For their elaboration, we bear in mind the operational reliability of a unit, the loading of the component in the unit, the overall frequency of the component as well as special characteristics of a component as to the unit.

For major projects and systems we also take into consideration the **logistic situation of our customer.**

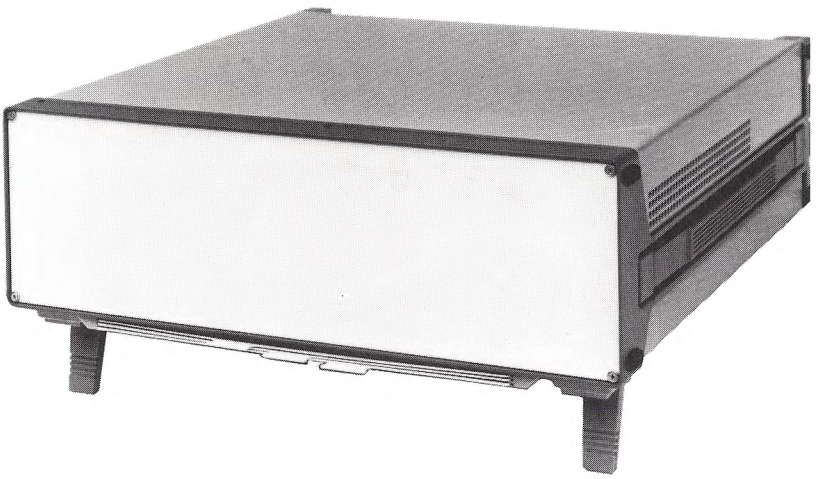
We take into account special wishes and necessities, eg the total number of units per series, the existence of the individual operational units, the training of the customer's service staff and the stocking of the spare parts on site or in a central stock.

CABINETS Pages 290 to 299

ADDRESSES Pages 300 to 301

INDEX BY INSTRUMENT TYPE Page 303

SUBJECT INDEX Inside back cover



R&S compact enclosures of
design 90
Details from page 296

R&S enclosures of
compact casing system
Details from page 294

R&S enclosures of
design 80
Details from page 292

Cabinet designs/dimensions

Design 80

Compact casing system

Design 90

Rackmounting, general instructions for mounting in 19″ and DIN racks

Dimensions

The **dimensions** of Rohde & Schwarz instruments are defined as follows:

Overall **width** × **height** × **depth** in mm, looking onto the front panel (this also holds for pocket-sized instruments). The specified dimensions generally refer to bench models.

Cabinet designs

New designs of cabinets and casing systems are the result of the constantly increasing degree of utilization of equipment volume made possible by ever smaller and more complex components.

The present Rohde & Schwarz line comprises the following three design forms:

R&S design 80 (see page 292)
R&S compact casing system (see page 294)
R&S design 90 (KB 90, see page 296)

Design 80 The width of a bench model (19″ rackmount plus panelling) is 492 mm; the height 1 to 6 units and the depth 392 or 514 mm.

Compact casing system These compact cases have widths[1]) of ½, ¾ and ⅓ of 19″, a height of 2 to 5 units and depths of 219, 349 or 471 mm.

Design 90 These compact units come in widths[1]) of ½ and ⅓ of 19″, heights of 1 to 5 units and in depths of 350, 460 or 570 mm.

Rackmounting

19″ rackmounts of **design 80** (table on page 292, description on page 293) may be inserted as required into 19″ racks or mounted in DIN racks using adapters. It may be necessary to retrofit the racks. **Compact cases** (table on page 294, description on page 295) and **units of design 90** (table on page 296, description on page 297) can be mounted in the same way after having been fitted with 19″ adapters.

Mounting in 19″ racks (DIN 41 494)

Guide rails are supplied in pairs for from R&S 19″ racks or singly for other 19″ racks (length 740 mm, no drilled holes); they are suitable for all designs (Fig. 1 left).

Brackets are used to secure the appropriate connection panel (specify equipment type when ordering) for self-engaging connection (Fig. 2).

Mounting in DIN racks (DIN 41 490)

Adapter bars (2 angle sections) extend the 19″ size to DIN width (Fig. 1 right and Fig. 3).

Front-panel adapters (three parts) reduce the width and height of the DIN frame to 19″ front-panel size (Fig. 3).

Guide rails for rack mounting (Fig. 1 right) can be made of commercial angle-profile bars.

Brackets see above and Fig. 2.

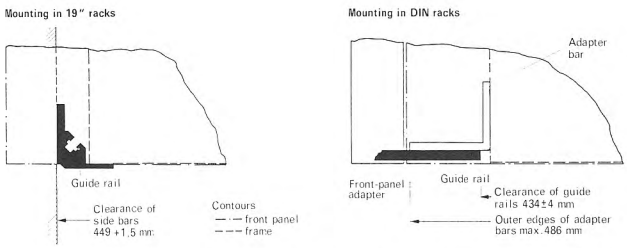


Fig. 1 Guide rails, adapter bars and front-panel adapter fitted for left side of rackmount

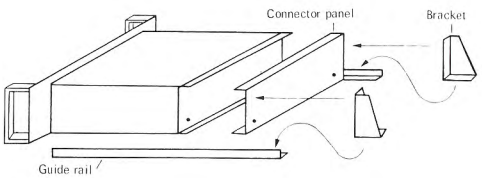


Fig. 2 Fitting the connector panel by means of brackets (19″ and DIN racks)

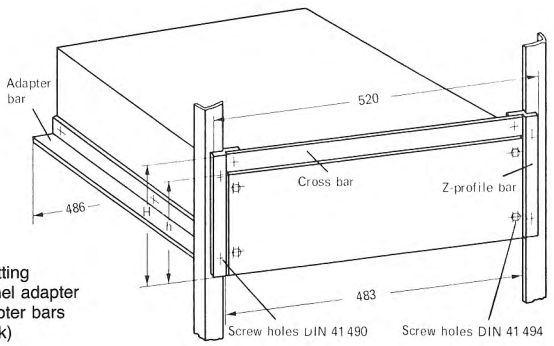


Fig. 3 Fitting front-panel adapter and adapter bars (DIN rack)

[1]) The actual width is less than the calculated width for constructional reasons.

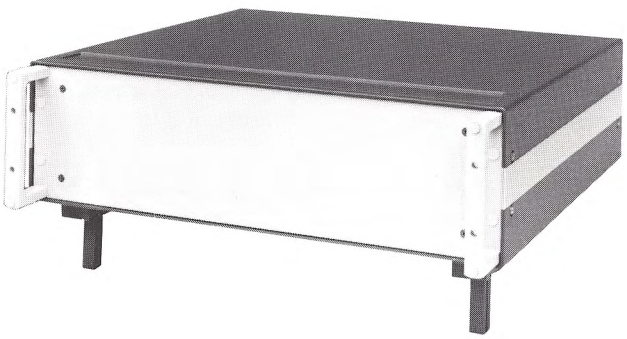
Design 80 – dimensions

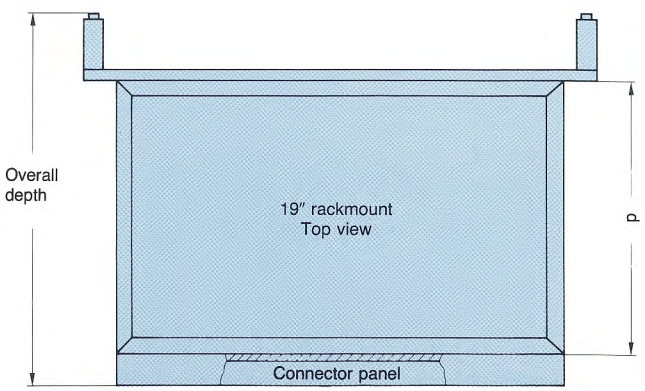
Dimensions in mm			Cabinet cover	Rackmounting		
Height in units (1 U ≈ 44 mm)	**Rackmount** Front-panel height		**Bench model** (width: 492) Overall height	**Cover for bench model** Order Nos.	**Brackets** Order Nos. (for 1 set) 19″ racks / DIN racks	**Front-panel adapter** Order Nos. (DIN racks) RAL 7001
1 U	43		71	085.6550.00	Please enquire	034.0910.00
2 U	88		116	085.6567.00	281.3765.00 / 281.3842.00	034.0990.00
3 U	132		161	085.6573.00	281.3771.00 / 281.3859.00	034.1074.00
4 U	177		205	085.6580.00	3 U brackets are used for heights of 4 U and more.	034.1145.00
5 U	221		250	085.6596.00		034.1222.00
6 U	266		294	085.6609.00		034.1300.00
	Overall depth	Depth d (s. drawing)	Overall depth without cover	**Adapter bars** Order Nos. (for DIN width)	**Guide rails** Order Nos. for 19″ racks[1])	
	384	305	392	281.3813.00	For R&S rack (1 pair): 281.3742.00 / For other racks[2]): 281.3759.00	
	506	427	514	281.3820.00		

[1]) Use commercial angle-profile bars for DIN racks.
[2]) Single guide rails: 740 mm long, no holes drilled.

Design 80

Design 80 is a modern and universal **modular system** which meets differing requirements. It is characterized by exemplary styling, optimum utilization of space, high strength and low weight. The system covers mainframes, panelling, adapters for rack mounting, plug-in PCBs and modules, and integrable small equipment.





Dimension d

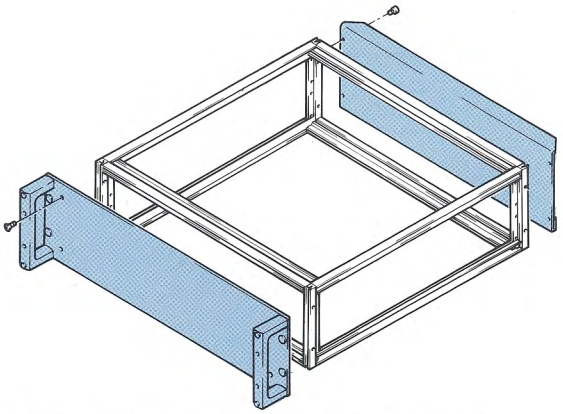
The dimension given in the table indicates the seated depth of 19″ rackmounts according to the diagram on the right. For the overall depth, 79 mm have to be added: front projection for front panel (4 mm) and handles, including plastic stoppers (51 mm), and rear projection for connecting panel (24 mm).

Basic mainframe

The mainframe corresponds to the 19″ standard in accordance with IEC Recommendation 297 and DIN 41 494.

Extruded aluminium profiles are used. The form of the profiles ensures that the mainframe is true in angle and stable while remaining light in weight and large in capacity, the latter making for high packing density.

Sizes of one to six units in height (1 unit corresponding to 44.45 mm) and two frame depths (305 and 427 mm) have been standardized.

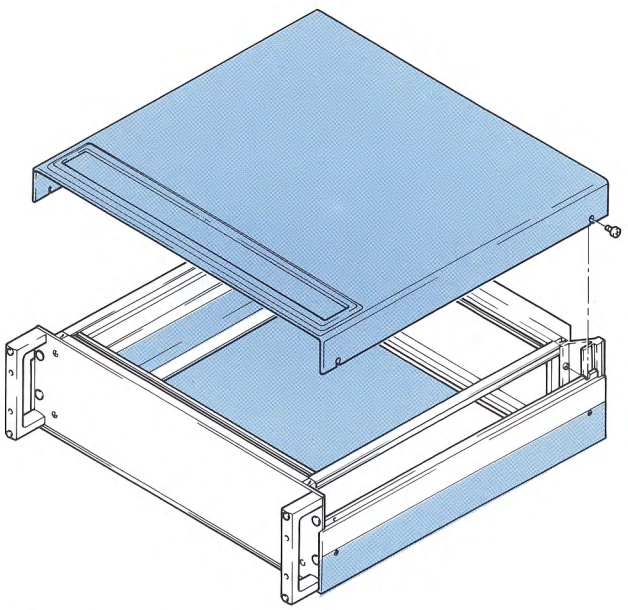


19″ basic rackmount in design 80; frame, front and rear panels

Panelling

In the standard bench model, the panelling consists of two metal-plate enclosures with extruded aluminium side strips (see photo below). With sizes of three units in height, a fold-out handle is provided at both sides.

Due to the use of panelling, it is normally only necessary to move the lightweight enclosure and not the heavy equipment when requiring access to the interior.



19″ bench model in design 80:
mainframe plus panelling (cover detached)

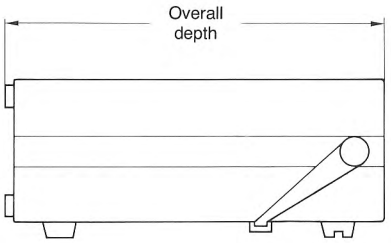
Compact casing system – dimensions

Dimensions in mm						Rackmounting	
Width			**Height**		**Depth**	**19″ Adapter**	
of 19″	overall	without handle	in units	overall	overall (without controls)	Type	Order Nos.
½	241	210	2	110	219	ZZA-12	079.0631.00
			2 *)		349	ZZA-12	079.0631.00
	245	210	3	154	349	ZZA-13	079.0702.00
¾	347	312	4	206	349	ZZA-4	078.8500.00
			4		471	ZZA-5	078.8645.00
1/1	470	435	2	118	349	ZZA-6	078.8274.00
			3	162	349	ZZA-7	078.8400.00
			3		471	ZZA-8	078.8439.00
			4	206	349	ZZA-10	078.8722.00
			4		471	ZZA-9	078.8751.00
			5	251	471	ZZA-11	079.1109.00

*) To combine a 2U and a 3U unit side by side in a rack, use 19″ Adapter ZZA-13.

Note on equipment depth

While for design 80 the overall depth is uniquely defined by the handles, these constituting the largest projections, the depth for compact cases can be given only by the diagram below, since the operating controls differ according to equipment type.



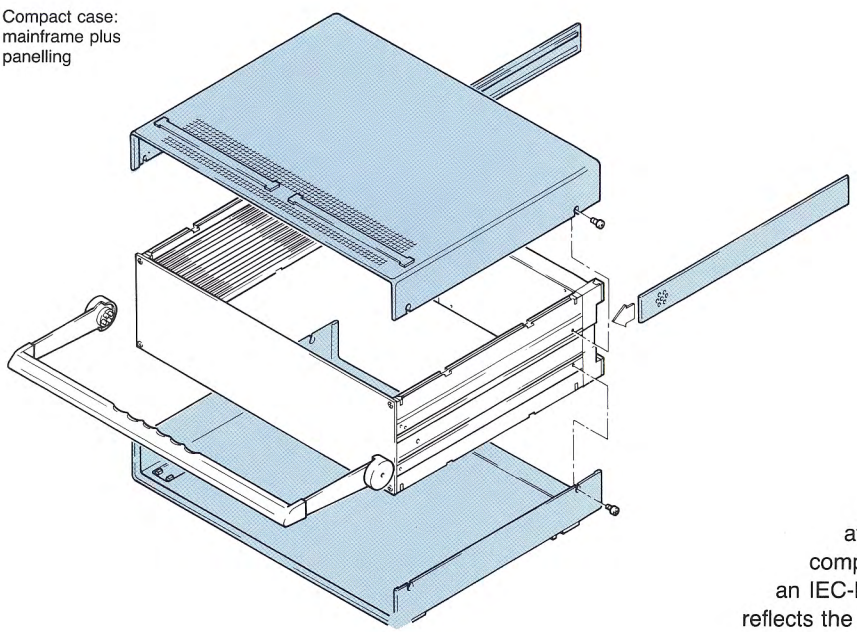
R&S compact casing system

Design 80 is rounded off by a casing system for compact instruments ½ or ¾ or 1/1 of 19″ wide, which are also suitable for mobile applications.

This compact casing system copes with the current trend towards complex modules integrating more and more functions in less and less space and complies with users' requirements for economizing space, on benches and in racks.

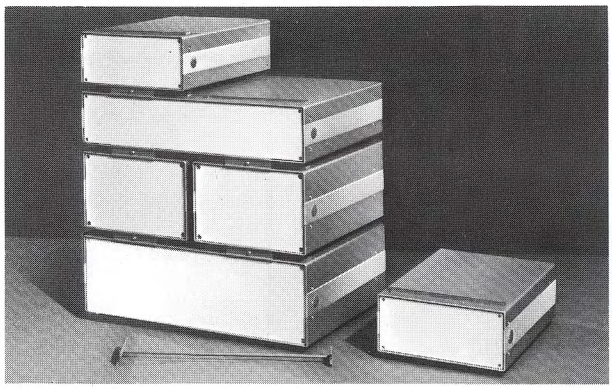
This easily assembled system is just as much in line with the international 19″ standard as design 80; it is similar in layout, but is even more compact and thus particularly suitable for space-saving setups on a bench.

Compact case: mainframe plus panelling

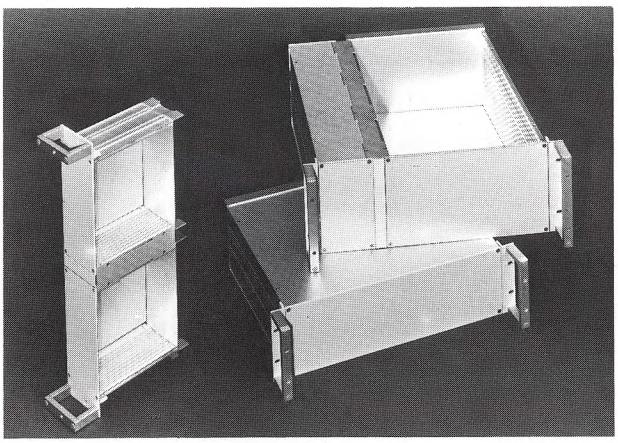


The **emphasis** of the R&S compact casing system is on producing compact, lightweight and thus easily transportable instruments for use singly and as building blocks in space-saving test bench setups.

The **system compatibility** of this packaging style enables simple bench setups of automatic and application-optimized measuring systems, using compact individual components, eg units with an IEC-bus interface. The compact casing system reflects the trend towards smaller assembly units.



Stacked compact cases, which may be screwed together with connecting elements

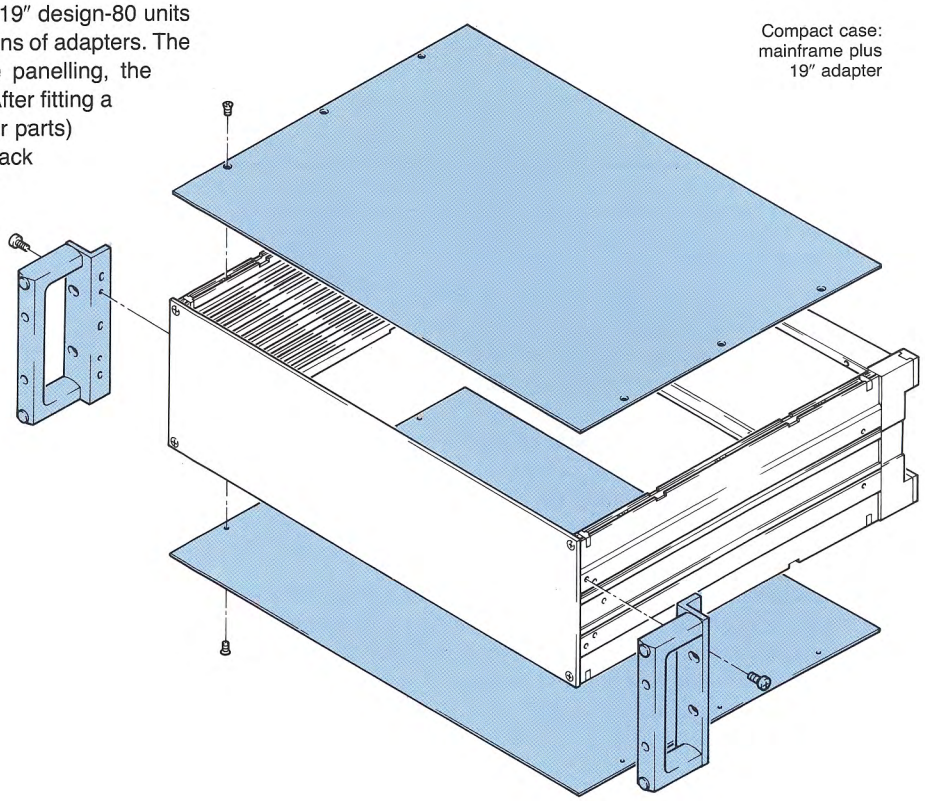


Compact cases adapted for 19″ rackmounting, with and without cover

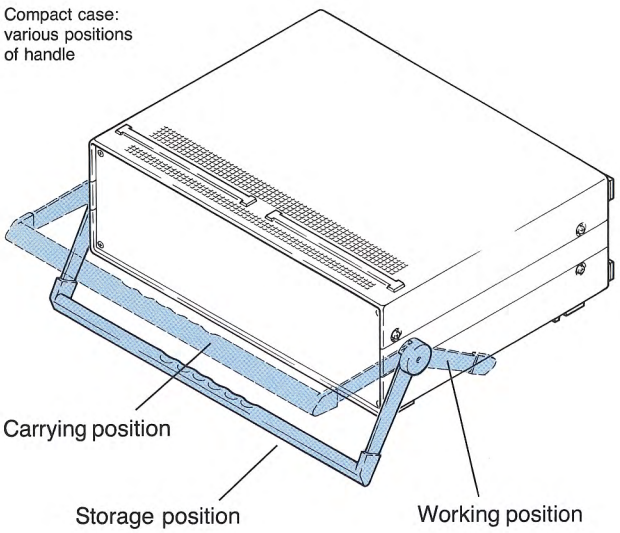
The compact cases can be stacked with 19″ design-80 units and can be fitted into any 19″ rack by means of adapters. The assembly is easy to carry out: first the panelling, the handle and the side strips are removed. After fitting a 19″ adapter (in the simplest case just four parts) the unit can be incorporated into a 19″ rack like a 19″ instrument built to design 80 (see drawing and photo above right). Where equipment dissipating a large amount of heat is involved, one unit of height should be left vacant on top and covered by a blank panel.

The **self-supporting construction** of the compact cases complies with standards DIN 40 046 (Sheet 8), IEC 68-2-6 and VG 95 332 (Sheet 24/25); it enables sturdy, space-and-weight-saving equipment forms. Despite compactness there is no lack of servicing ease. Fold-out or plug-in PC boards make for good accessibility in testing and servicing.

Compact case: mainframe plus 19″ adapter



Compact case: various positions of handle



The **swivel handle** of the compact units makes them easier to pick up and put down and also serves as a stand. When units are stacked, the handle can be tucked underneath. It is also easily removed by undoing two screws, if this should be desired, for example, in an assembly of several instruments.

The position of the handle is changed by simultaneously pressing both axles and swivelling.

Rear panel The compact cases also have a recessed rear panel to protect the connectors when the equipment is placed upright.

Design 90 – dimensions

Dimensions (in mm)					Rackmounting			Front handles[2]	
Width of 19″	overall	**Height** in units	overall	**Depth** overall (without controls)	**19″ adapters** for instruments without front handles with front handles Type	Order Nos.	**DIN adapters** Order Nos.	Type	Order Nos.
½	219	2	103	350	ZZA-97[1]	827.4527.00	—	ZZG-92	396.5147.00
		3	147	350	ZZA-98[1]	827.4533.00	—	ZZG-93	396.5153.00
¾	327	4	192	350	ZZA-99	839.5775.00	—	ZZG-94	396.5160.00
				460	ZZA-991	839.5975.00	—		
1/1	435	1	59	350	ZZA-91	396.4870.00	396.8569.00	ZZG-91	396.5130.00
				460	ZZA-911	396.9442.00			
		2	103	350	ZZA-92	396.4886.00	396.8575.00	ZZG-92	396.5147.00
				460	ZZA-921	396.9459.00			
		3	147	350	ZZA-93	396.4892.00	396.8581.00	ZZG-93	396.5153.00
				460	ZZA-931	396.9465.00			
				570					
		4	192	350	ZZA-94	396.4905.00	396.8598.00	ZZG-94	396.5160.00
				460	ZZA-941	396.9471.00			
				570					
		5	236	350	ZZA-95	396.4911.00	396.8600.00	ZZG-95	396.5176.00
				460	ZZA-951	396.9488.00			
				570					

[1]) The 19″ adapters for the units of ½ of 19″ widths are suitable for incorporation of 1 or 2 units. Two units of half width and different height (2U and 3U) can be mounted with the aid of the 19″ Adapter ZZA-98.

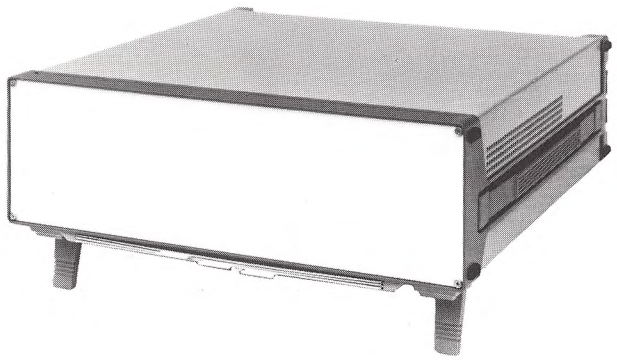
[2]) Included with 19″ adapters.

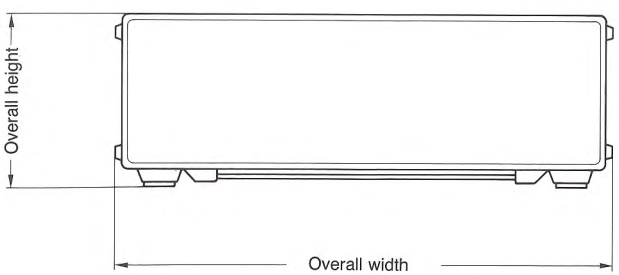
Adapter rails for DIN adapters, depending on depth (see also p. 291 Fig. 3)	Depth	Order Nos.
	350	396.8623.00
	460	396.8630.00
	570	396.8646.00

R&S design 90

Proceeding from the compact casing system, Rohde & Schwarz has developed a new cabinet style which is even more compact and system-friendly and, representing the **4th generation of casings,** takes full account of the ever increasing requirements.

Whilst retaining the advantageous modular system, the main aim was to optimize electromagnetic shielding, the system-compatibility in line with the international 19″ standard, the weight of the complete casing and the ways of adding a great variety of accessories.





Front view of design 90

The **new design 90** continues the well-proven R&S line of casing systems, combining the advantages of little space requirement, ergonomical use and ease of servicing with an attractive styling.

The self-supporting construction of equipment design 90 complies with the relevant standards to DIN 40046 (Sheet 8), IEC 68-2-6 and VG 95332 (Sheet 24/25).

Construction

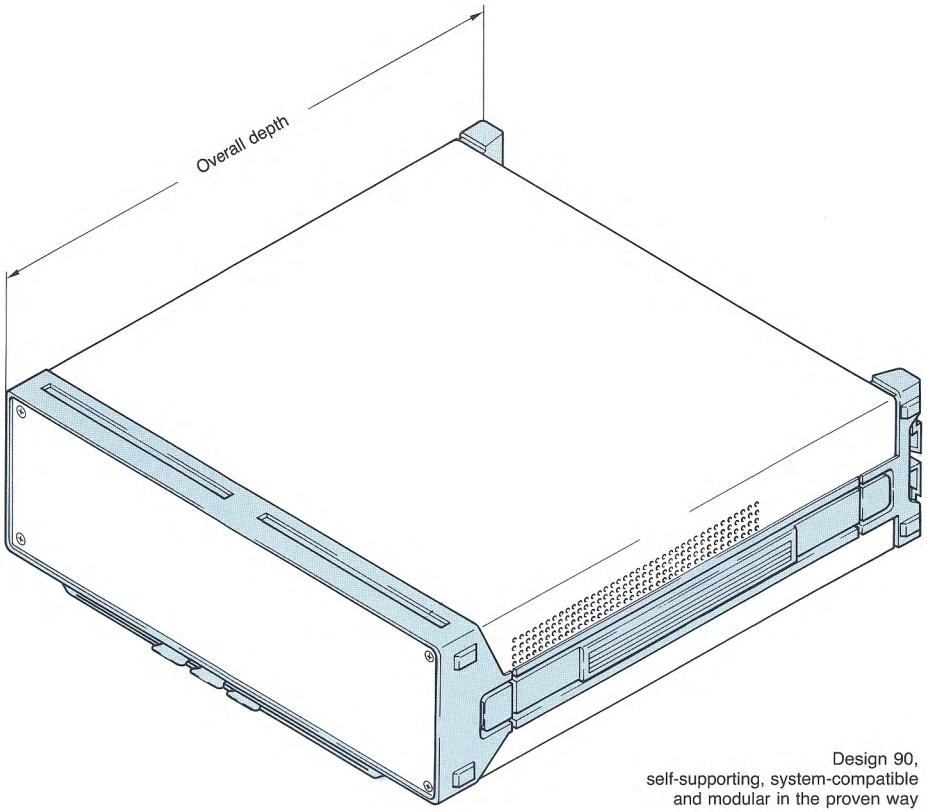
The construction consists of a self-supporting aluminium-cast frame with front and rear panel, top and bottom covers (= panelling).

The panelling is fixed and the instrument closed by screwing two feet (4 screws) to the rear panel.

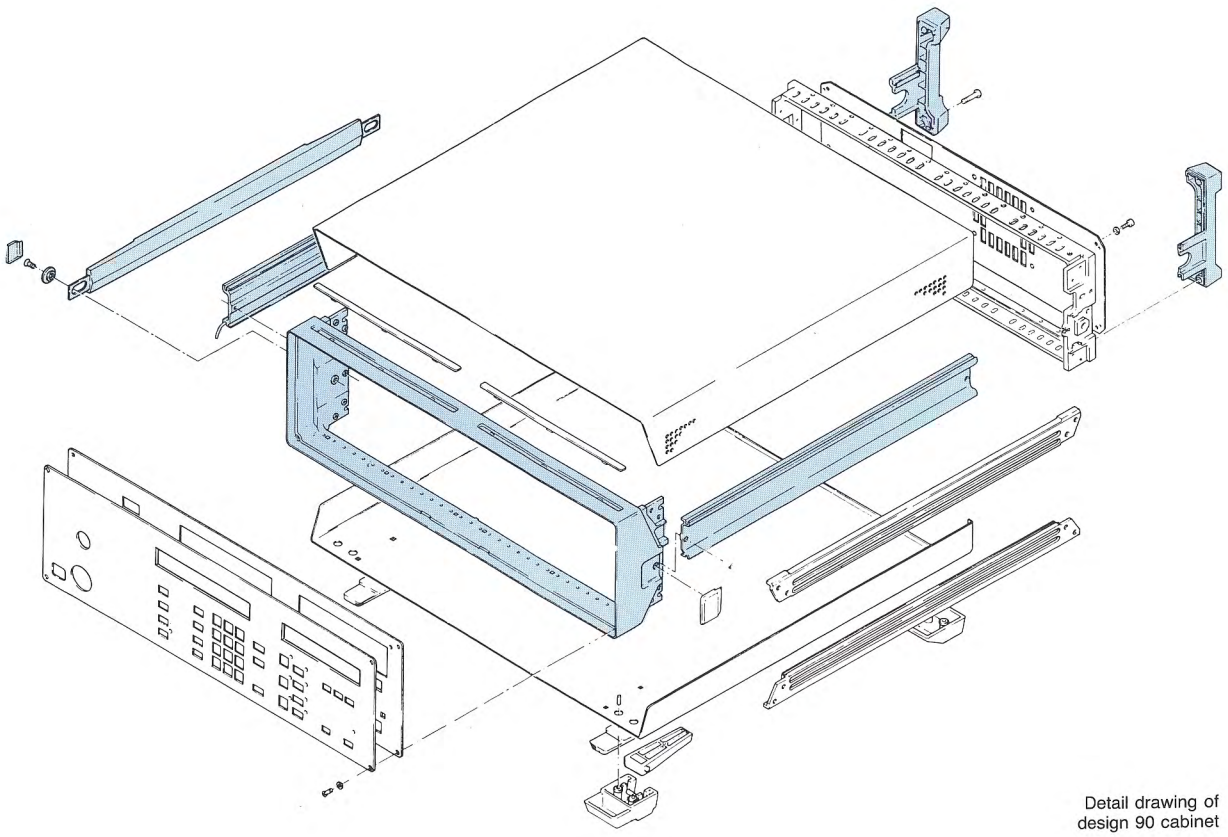
Depending on the type of equipment, one or two carrying straps fixed on the sides make for portability of the instruments.

The cabinet system is completed by feet at the bottom and on the sides as well as guide rails for the user instruction cards.

The compact design 90 features a better RF shielding which can be further improved, where required, by laying a braided cord into the grooves along the panelling edges.



Design 90,
self-supporting, system-compatible
and modular in the proven way



Detail drawing of
design 90 cabinet

System capability and special features

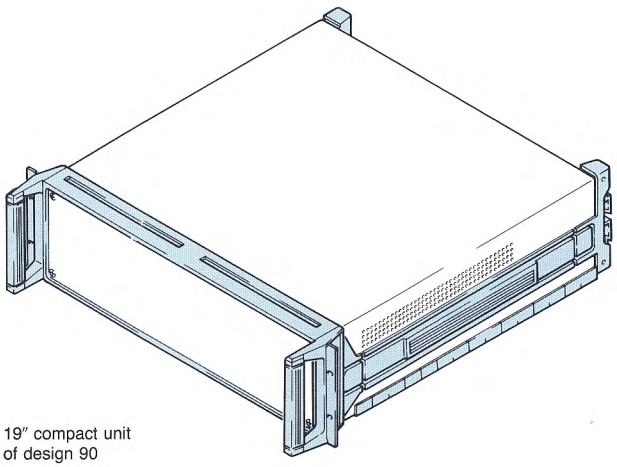
The compact units of design 90 can be stacked (photo below) also with 19″ units of the compact casing systems and of design 80.

The bottom feet serve for stacking the units to form test systems. Stacked units can be joined in pairs by two to four links (Order No. 396.9513.00).

The tilt stands at the bottom allow the instrument to be set up in the most ergonomical position. The tilt stands on the rear panel enable operation of the instrument in the upright position (except instruments of one or two height units). For AC supply and BNC cable connections on the rear panel cables with angle connectors are required.

The user guide cards that can be pulled out at the bottom contain all information required for routine operation of the instruments. For bench models additional front handles of suitable height are available as an option.

Mounting into 19″ racks in line with DIN 41494 has been greatly facilitated thanks to the universal system capability of design 90. For rackmounting it is only necessary to remove the side and bottom feet as well as the guide rails, and to fix the 19″ adapter brackets including the front handles. The 19″ adapter comes with mounting instructions and two self-adhesive edging for protecting the underside when inserting or removing the unit from the rack.



19″ compact unit of design 90

The compact cabinets of design 90 can be stacked not only with one another, but also with 19″ cabinets of the compact casing system and of design 70 and 80.

Design 90 – Accessories

Carrying Strap Set

ZZT-96 Order No. 396.9813.00
for design-90 instruments up to a total weight of 20 kg, except instruments of 1 height unit (44 mm)

The carrying strap is a polypropylene belt with nonslip rubber coating. The strap is hooked on two special fixtures supplied with the set. The special fixtures are fixed to the instrument according to the drawing supplied. The length of the strap can be varied between 0.75 and 1.3 m. The strap can be hooked on and off as often as required.

Standard Accessory Bag

ZZT-97 Order No. 396.9936.00
Dimensions 400 mm × 240 mm × 30 mm, max. carrying capacity 2 kg, made of waterproof nylon fabrics, for design-90 instruments of ½ width (427 mm) and instruments of similar width.

The bag has two compartments inside and one outside pocket with zip fastener for small parts. The bag has a velcro fastener.

The accessory bag is attached to the upper side of the cabinet by means of velcro fasteners. The mounting instructions supplied with the bag show how the bag is attached to the instrument. The velcro fasteners allow the bag to be detached as often as required.

Special Accessory Bag

ZZT-98 Order No. 396.9913.00
Dimensions 400 mm × 30 mm × 60 mm, max. carrying capacity 3 kg, made of waterproof nylon fabrics, for design-90 instruments of ½ width (427 mm) and instruments of similar width.

The bag has one compartment inside and one outside pocket with velcro fastener, rubber bands for securing cables, tools, etc. The bag is closed by a zip fastener over three sides.

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Notes on presentation

Frequency range The most important characteristics of each unit, include the frequency range, normally given in the text headings and highlighted by ♦.

The same **scale** has been used for all **photographs** of bench models and rackmounts. The photographs in the body of the text are to a somewhat smaller scale. It was, of course, necessary to choose a smaller scale for photographs of complete racks and systems, but about the same scale has been maintained within groups of similar equipment.

The **specifications** of each unit are to be found in almost all cases at the end of the equipment description.

Equipment **sizes** are given as overall dimensions in the order width × height × depth.

Weights are given only for individual units and small in-service units.

Ordering information Due to the wide variety of possible combinations of ten no order numbers are used for systems. For other units, 9-digit and recently even 10-digit order numbers are used, the first seven (or eight) digits identifying the equipment type (ID number) and the last two digits specifying the version (eg TV standard, 50 or 60 Ω impedance, bench model or rackmount, etc.).

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You will find the address of your nearest R&S representative on pages 300 and 301.

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