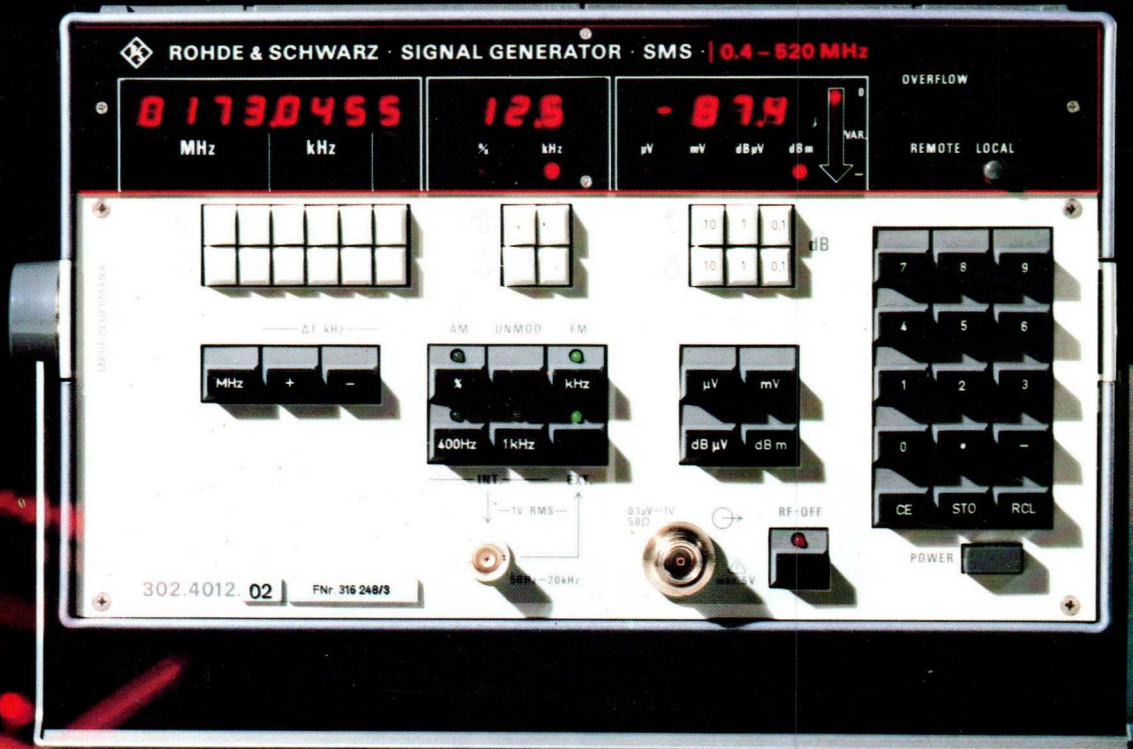




ROHDE & SCHWARZ



electronic
measuring instruments
and **systems** 1979





ROHDE & SCHWARZ

This catalog describes the measuring instruments and accessories manufactured by Rohde & Schwarz. For most of the instruments, in particular those up to medium size, the same amount of information is given in this book as in the relevant individual data sheets (which have a larger photo). The company issues more detailed data sheets for measuring instruments of larger size and measuring systems, as well as specialized publications for particular equipment groups.

The documentation is available on request from your nearest R&S office or representative at the address listed at the end of this catalog. A number of enquiry cards are also included for your use. The company's offices and representatives are always available to deal with any questions you may have, and should always be contacted in the first instance when any servicing is required. The experienced engineering staff at the head office in Munich will gladly reply to any technical queries.

Published by Rohde & Schwarz GmbH & Co. KG, department 5 ZW · Edited by G. Strohbach · English translation by E. Märkl, C. Neumann, D. Picken, U. Renner · Printed in the Federal Republic of Germany · Subject to change without notice

Since this catalog has a relatively long validity please ask for confirmation of all data at the time of ordering or when considering a purchase.

new

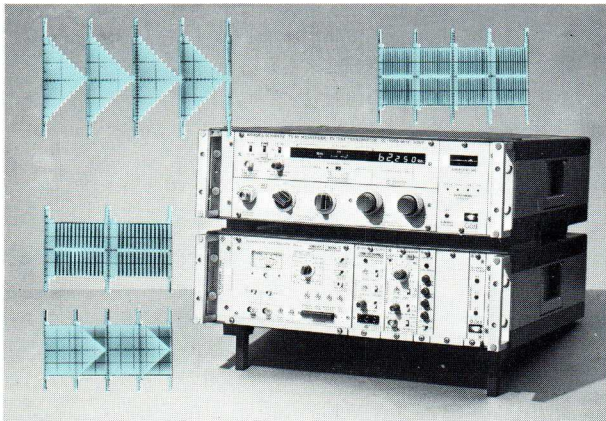
Identifies the latest developments, i.e. all R&S products newly introduced since the 1978 catalog.

IEC 625 Bus

Identifies equipment having IEC-bus capability, the worldwide standardized interface for use in test systems in line with IEC 625-1 and IEEE 488. For the complete story see section 1.

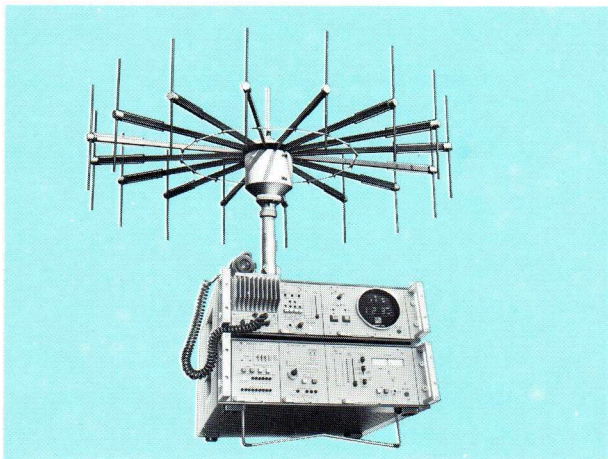
Explanations of the symbols used in the tables and texts and of the order designations are given on page 267.

OTHER PRODUCTS



Sound broadcasting and television

R&S measuring instruments and equipment for television and sound broadcasting are presented in a separate 200-page catalog; please use reader service card (at the end of this catalog) if you would like to receive a copy.















Radio equipment

The R&S line of radio equipment for HF, air-traffic control and radiomonitoring is described in various system data sheets and specialized catalogs, which will be sent on request.

Part of the field of **radiomonitoring**, closely related to the measurement domain, is treated in section 8 of this catalog.

contents

1	Automated test systems – the IEC bus		4 to 17
2	Signal generators for AF and RF Power signal generators · Synthesizers		18 to 59
3	RT test assemblies Automatic AF and RF test systems		60 to 89
4	Swept-frequency test equipment Network analyzers		90 to 117
5	Standard-frequency and standard-time systems		118 to 135
6	Broadband voltmeters · Recorders Power meters · Reflectometers		136 to 165
7	Test receivers · Field-strength meters Signal analyzers · Modulation meters		166 to 189
8	Radiomonitoring equipment		190 to 201
9	Acoustic test equipment Sound-level meters · Noise meters		202 to 221
10	Test equipment for passive and active components and subassemblies		222 to 235
11	Load resistors · Attenuators		236 to 245
12	Power supply units Cabinets		246 to 268

See end of catalog for R&S addresses, type listing and index

R&S INFORMATION

Electronic precision

is the motto under which Rohde & Schwarz has been developing and manufacturing electronic measuring and communications equipment for over forty years. R&S is an independent concern founded in 1933 as a physical and technical development laboratory by physicists Dr. Lothar Rohde and Dr. Hermann Schwarz. Both men are still active in the management of the company. Since 1971 the second generation of owners has been represented by the involvement of Dipl.-Ing. Friedrich Schwarz.

The company has 4500 employees throughout the world and its sales network covers a total of 80 countries. R&S has manufacturing plants in Munich, Memmingen and Teisnach. The company has subsidiary operations in Messgerätebau GmbH and Rohde & Schwarz Vertriebs-GmbH; it also works in close cooperation with other reputable manufacturers such as Tektronix, Inc.

Some R&S milestones are the world's first portable crystal clock (1938), the first VHF broadcast transmitter in Germany (1949), the first automatic IC tester developed in Europe (1967) and the first intelligent RT test assembly with microcomputer and IEC bus (1974). The latest instrument developments are presented in this catalog.

Quality control

The company's style is characterized by dynamism and energy, its products by precision and quality. As the instruments advance in design so too do the circuit techniques used in their realization. R&S develops and manufactures microcircuits in-house and makes use of the latest computer aids for the generation of printed-circuit-board masters. The assembly of the boards is automated.

All stages of development and manufacture of R&S products are performed in close cooperation with the quality assurance department, which reports directly to the R&S management and is responsible for quality planning, reliability, environmental testing, component testing, incoming inspection and, in the production stages, for preproduction control, finish control, assembly control, final acceptance and manufacturing equipment studies. Of course all tests are performed with calibrated instruments and aids.

All these phases – from incoming inspection through in-process control and burn-in to servicing – are watched over by a computer-based fault-acquisition system. The R&S quality assurance system is widely approved by national authorities and civilian services and complies with the most stringent NATO requirements.



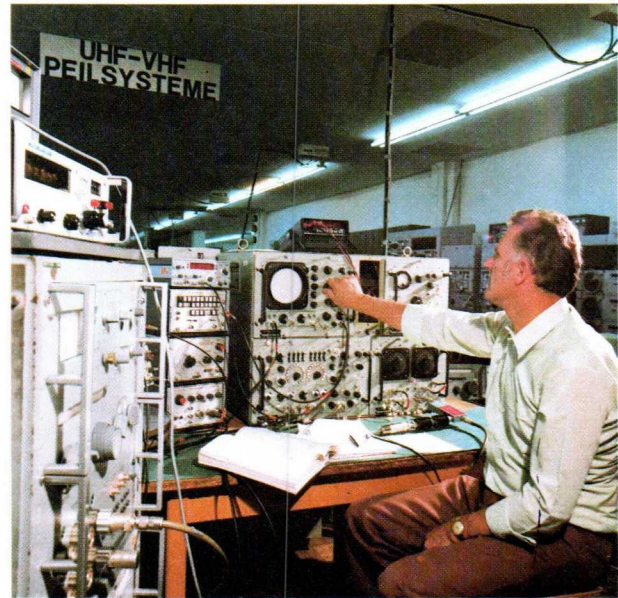
Training

Courses of introduction to new products and on maintenance and repair know-how are run at R&S Munich and at the R&S Service Center Cologne for the staff of the worldwide R&S sales organisation. System initiation and basic technical instruction courses are much appreciated by customers.

Official calibration

The Rohde & Schwarz works in Cologne offer a calibration service for electronic instruments and systems in their own standards laboratory and in calibration vehicles. The works, which were established in 1960, are the largest industrial service centre for electronic measuring and communication equipment, their main taste being calibration and repair.

In October 1977 the R&S works in Cologne were officially approved as a calibration office of the Federal-German calibration service (DKD) for measuring instruments used in communications. Commercial and industrial enterprises and institutions can have their instruments calibrated and receive an official certificate. The Federal-German standards office (PTB) provides the calibration offices of the DKD with access to national measuring standards and devices and constantly supervises the quality of the work performed by the offices.



Demonstrations

Rohde & Schwarz presents its products every year at nearly fifty fairs and exhibitions all over the world. A spacious demonstration van more over brings the latest developments directly to the door. The visitors' interest generally centres around the automation of measurements and the resulting rationalization.

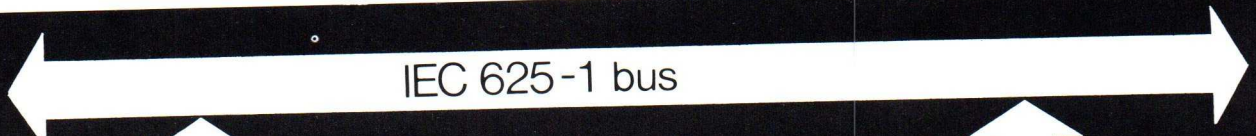
Four numbers of News from Rohde & Schwarz are issued per year. This technical journal is published in German, English and French – total circulation 45,000 – and is supplied free of charge to qualified readers.



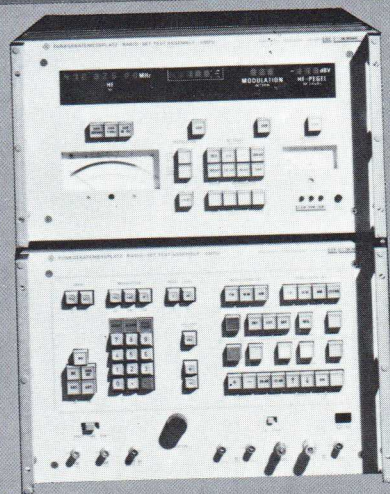
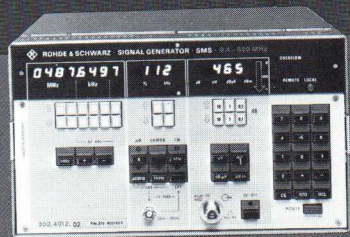
Rohde & Schwarz demonstration van, equipped with precision instruments for automatic AF and RF measurements

The new measuring instrument generation can be controlled via the IEC interface bus and combined to form test assemblies of any required size

automated test systems the iec bus



test item

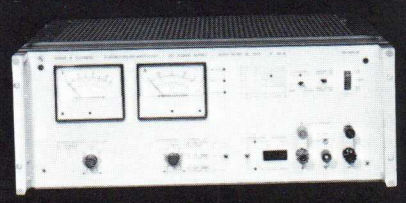


measuring instruments



system controller

power supply



1 IEC BUS

automated test systems

The development of favourably priced desktop calculators and intelligent measuring instruments has opened the way – both at the control and the measuring ends – for the implementation of **automated measurements** on a broad front. The application of automated instrumentation is no longer restricted to a few large-scale users – as it was before for financial reasons – but has become attractive for all users of measuring instruments in development, production and quality control.

The key which permits full use to be made of all the possibilities offered by this new intelligent instrumentation is the **IEC bus**.

What is the IEC bus?

The IEC bus is a worldwide **standardized data bus for use in test systems**, permitting measuring instruments from different manufacturers to be combined at will with freely selectable computers without requiring an instrument-compatible interface or special data couplers. The controllers both send commands to the measuring instruments and receive data from them via the IEC bus, which constitutes, so to say, a teletype line between the individual units of a test system, enabling data transfer in either direction.

The IEC bus is designed such that combining the instruments into a system requires **no special knowledge** and is achieved by simply linking up the IEC bus connectors of the

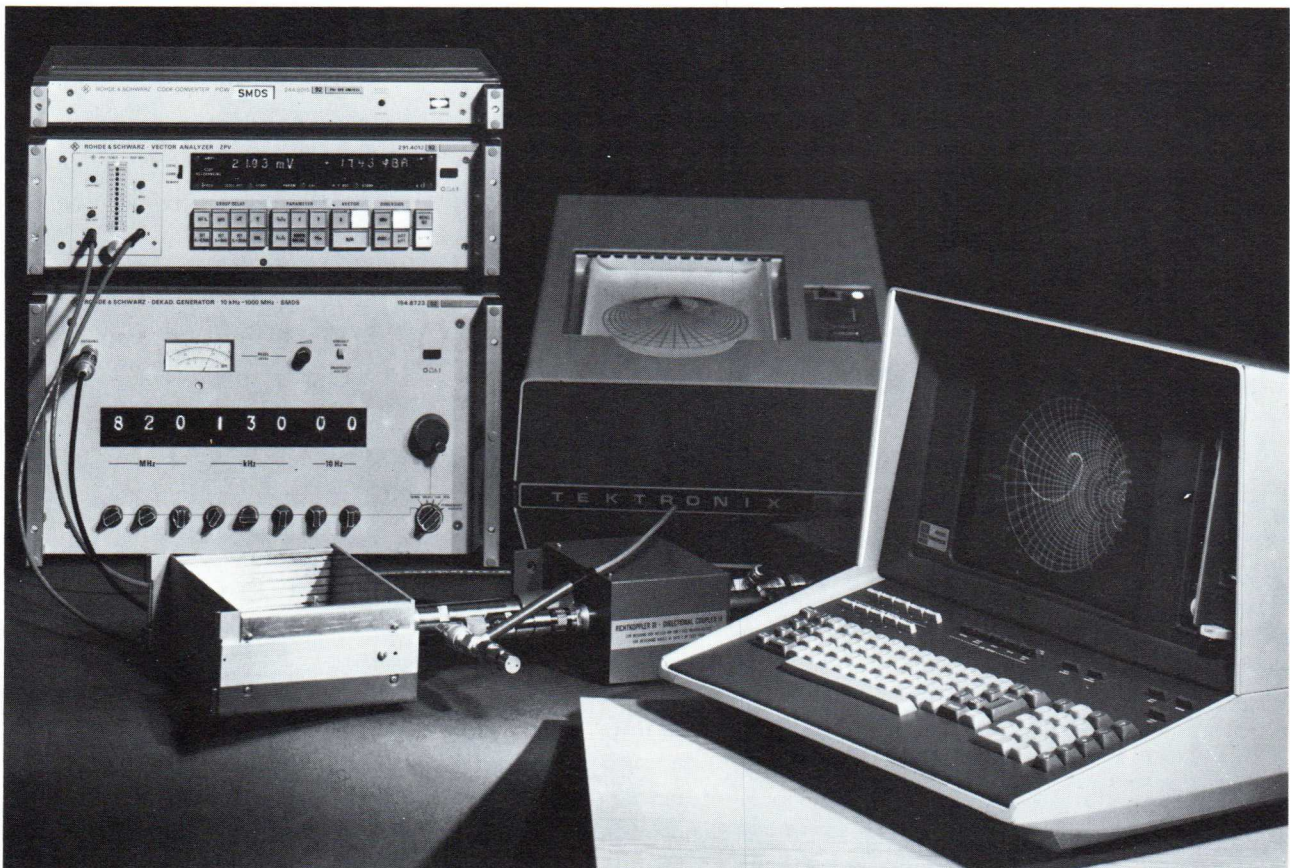
individual units. All other functions, such as monitoring the usually different data transfer rates of the individual instruments, are performed automatically. The code used for transmitting information via the IEC bus is ASCII, which normally also provides the communication between computers and their peripherals and delivers characters which can be written and read directly.

Desktop calculators featuring a favourable price/performance ratio are ideal for controlling IEC-bus-compatible equipment. In general they are smart enough to meet all usual requirements. Desktop calculators using **standard programming languages** are of special advantage since changing the computer then presents no problems, their speed being generally sufficient for analog test systems. With increasing speed requirements it is best to use processors which R&S offers with IEC-bus connectors.

The IEC bus permits the configuration of automatic test systems which are extremely low-priced and feature high flexibility and reduced space requirements.

How does the IEC bus function?

The IEC bus consists of three parts: the **data lines**, the **control lines** for the timing of what occurs and the **control lines** necessary for the management of the system.



Application of IEC bus: automatic network analyzer, consisting of Vector Analyzer ZPV, Decade Frequency Generator SMDS, Code Converter PCW and Tektronix calculator 4051 plus hard-copy unit

The actual data transfer is made over eight data lines DIO (data input/output) which carry all information and also addresses. The data bus is bidirectional, the data flowing in both directions.

As mentioned, the characters are encoded in ASCII, with 7 or 8 bits per character, so that one complete character per clock is transferred over the data bus. The control line ATN (attention) serves for identifying whether instrument addresses or data are being transferred.

The other lines for system control are: IFC (interface clear) for resetting the system to a defined initial state, SRQ (service request) and EOI (end or identify) for interrupt control, which enable the instrument to request the attention of the control computer for delivering a test result, and REN (remote enable) for putting the measuring devices into programmed operation.

In addition to the manual and remote-control modes which are performed via the REN line, most programmable Rohde & Schwarz instruments feature the **combined mode** permitting simultaneous programmed and manual operation. This capability considerably facilitates the preparation of test routines and the checking of automated test systems. Thus the computer and the operator are able to work so to speak hand in hand.

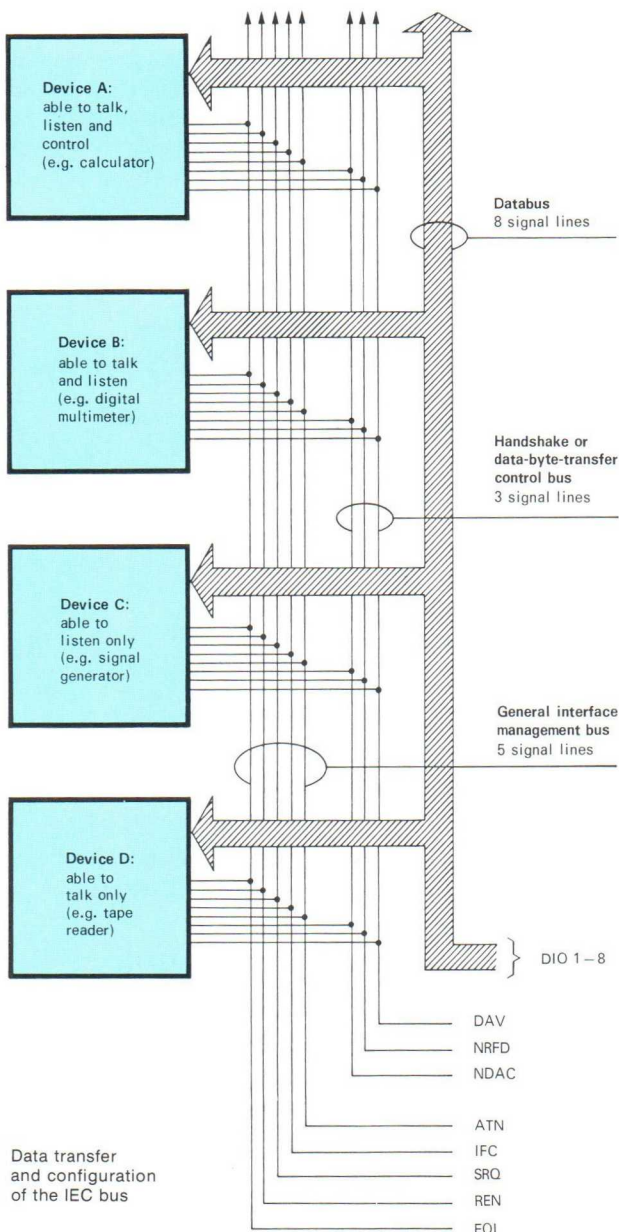
The timing of data transfer is controlled via the lines DAV (data valid), NDAC (not data accepted) and NRFD (not ready for data) by the handshake process, that is to say, the slowest device determines the speed of operation. Although this method is not the best from the point of view of speed, it ensures that the user does not have to worry about timing the data transfer. Any combination of IEC-bus-compatible instrumentation can be assembled and automatically adjusts to its own speed of data flow. In general the minimum data flow rate of Rohde & Schwarz instruments is very high, so that normally no noticeable delay of the programming speed is entailed. Since, moreover, in analog measurements the instruments need quite some time to settle to steady state, it can be assumed that even desktop-calculator control does not reduce the physically feasible maximum test speed significantly.

The IEC bus is consequently a self-driving and self-controlling data bus enabling measuring instruments and computers to be put together quite at random.

How is an IEC-bus-compatible test system set up?

The most important criterion is the selection of suitable **measuring instruments**. Thus the configuration of an IEC-bus-compatible test assembly does not differ from that of a setup consisting of manually operated devices. The measuring instruments are selected for their specific technical characteristics to meet all the requirements involved. Next the necessary interconnection is made. Now the user is able to check in the **manual mode** whether the test assembly complies with his idea. All measuring functions and accuracy specifications are verified.

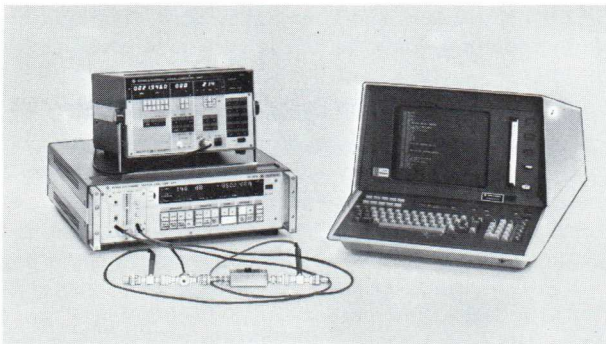
The step towards **automation** is taken by linking up the IEC-bus connectors located on the rear of the instruments and by connecting them to a desktop calculator. Criteria for selecting this calculator are the programming language, storage capacity, computing speed and operating convenience. The test assembly obtained in this way performs all test routines which are possible in the manual mode in fully automatic operation. Thus in the **first stage** the IEC-bus-compatible test equipment is a configuration of instruments which are operated from a calculator.



Data transfer and configuration of the IEC bus



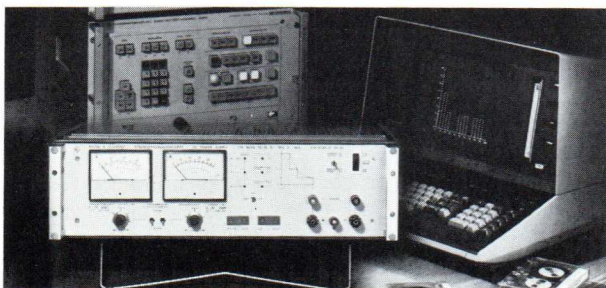
Automatic VHF-UHF test assembly for wanted- and unwanted-signal measurements (MSUP plus Tektronix desktop calculator 4051)



Automatic test assembly for s-parameter measurement (ZPV, SMS and Tektronix desktop calculator 4051)



Automatic test assembly for intermodulation and crossmodulation measurement (3x SMLU plus SMLU-Z and PCW, ESU 2 plus EZK and PCW, Tektronix desktop calculator 4051)



Automatic test assembly for RT equipment and modules (partial view of SMPU, Tektronix desktop calculator 4051); front: programmable Power Supply NGPU 70/10

In the **second stage**, efficient use of the computer capabilities permits optimizing the instrument characteristics. This can be achieved by suitable programs for error correction and self-calibration in accordance with standard curves. In this way, the accuracy can be increased considerably in most cases.

In the **third stage**, measurement evaluation can be expanded from simple test result logging to error statistics, error diagnosis, nominal-to-actual comparison and graphic display.

In practice, the configuration of IEC-bus systems is so easy that the user himself can take care of the assembly. However, Rohde & Schwarz naturally also offers comprehensive system consultancy and assistance for any questions or problems that may arise. Finally, ready-to-use systems are available on request.

For frequent standard applications, the Rohde & Schwarz line includes **complete IEC-bus systems** with data sheet specifications. The delivery comprises problem-oriented software enabling the user to operate these systems without any extra programming.

Instruments used in IEC-bus systems

The configuration of IEC-bus test systems does not only require **measuring instruments** but also different **system-related devices** to perform control and auxiliary functions. For the measuring instruments see the corresponding sections of this catalog; the system-related devices are described on the following pages.

Measuring instruments

- Test Assembly for Radio Sets SMPU, 10 Hz to 1 GHz
- Vector Analyzer ZPV, 100 kHz to 1 GHz/300 kHz to 2 GHz
- Signal Generator SMS, 0.4 to 520 (1040) MHz
- Millivoltmeter URV 4, 10 kHz to 2 GHz, 700 μ V to 1000 V, -50 to +73 dBm
- Programmable VHF-UHF Test Equipment MSUP
- RF Step Attenuator DPSP, 0 to 2700 MHz
- Programmable Voltage Source NGPS
- Programmable Power Supplies NGPU, 175 W and 70 V/ max. 10 A; 350 W and 70 V/max. 20 A
- Temperature Controller PTC
- Digital Thermometer PTM

Adaptable via Code Converter PCW:

- Decade Frequency Generator SMDS, 10 kHz to 1 GHz
- Power Signal Generator SMLU, 25 MHz to 1 GHz
- Precision LF Generator SSN 0.01 Hz to 120 kHz (1.2 MHz)
- Programmable Attenuator Set DPVP, 0 to 1000 MHz
- VHF-UHF Test Receiver ESU 2, 25 to 1000 MHz

System-related devices

- Tektronix Graphic Computing System 4051
- IEC-bus Cable PCK
- AF Relay Matrix PSN
- RF Relay Matrix PSU
- Card Reader PCL
- Code Converter PCW

IEC-bus-compatible measuring instruments for sound- and TV-broadcasting equipment are described in a separate catalog; see note on inside-front cover.