News from Rohde & Schwarz

Mobile-radio measurements
Fast go/nogo testing of GSM mobile phones

TFTS JETCALL
Voice, data, fax from the aircraft

Digital TV testing
Multifunction video measurement system

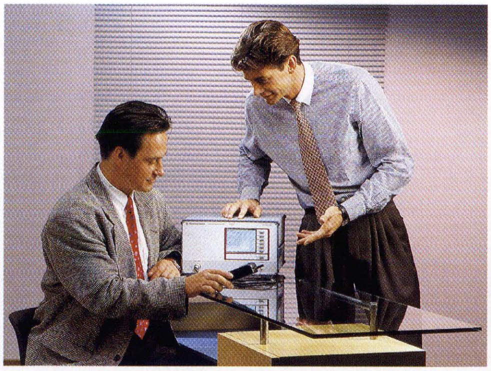
147

ROHDE & SCHWARZ

Number 147 1995/I Volume 35

GO/NOGO Tester CTD 52 is the ideal instrument for fast and favourably priced function testing of GSM phones in sales and servicing, in installation into vehicles, at network operators and so forth (photo on left). See the article beginning on page 4 for more details about CTD 52. Thanks to TFTS (terrestrial flight telecommunication system) passengers can now make phone calls from the aircraft without any interference or delay. Fax and data transmission will also be possible soon (see our final article on page 58).

Photos 41 896/1 and 41 900



Articles

Application notes

Refresher topic

Panorama

Regular features

Our family of microwave Signal Generators SMP – on the market for a whole year now – has two new members: SMP 03 for 10 MHz to 27 GHz and SMP 04 even up to 40 GHz. The new models, of course, feature the same excellent pulse, frequency and amplitude modulation characteristics as their "forefathers". Read all about it from page 10 onwards. Photo 41 881

Imprint

Published by ROHDE & SCHWARZ GmbH & Co. KG Mühldorfstraße 15 D-81671 Munich Telephone (0 89) 41 29-0 · international *(4989) 41 29-0 · Telex 523703 (rs d) · Editors: H. Wegener and G. Sönnichsen (German); I. Davidson, G. Koranyi (English) · Photos: S. Huber · Circulation 100 000 three times a year · ISSN 0028-9108 · Supply free of charge · State company or position · Printed in the Federal Republic of Germany by peschke druck, Munich · Reproduction of extracts permitted if source is stated and copy sent to R & S Munich

GSM GO/NOGO Tester CTD 52

The smallest base station in the world for testing GSM mobile phones

Since the GSM radio networks have now spread to virtually all parts of the world and the number of subscribers is rapidly increasing, the mobile phone as a mass product requires special service concepts. With CTD 52, a handy, easy-to-operate and extremely favourably priced GSM go/nogo tester, Rohde & Schwarz is meeting the requirements for new type of test equipment.

FIG 1 GSM GO/NOGO Tester CTD 52 for fast operational testing of GSM mobile phones
Photo 41 855/1

Given the trend to single-card equipment, in particular with handies, and VLSI, the repair of GSM phones is hardly appropriate in the usual way of replacing components and adjusting the unit but rather the card or unit is replaced on site and the repair is made at a service center. In most cases, an in-depth operational test is needed before and after replacement. At the service level, it is necessary to reject or prevent ungrounded customer complaints which involve costs for returning and testing the mobiles. The main reasons for such complaints are improper installation in the vehicle, operating errors, gaps in network coverage or a comparison made by the user with mobile phones from other network operators. In such cases, testing by means of a call in the public radio network is of no real value since it does not yield any information on the mobile phone characteristics such as compliance with transmitting power or sensitivity.

For such applications, Rohde & Schwarz has now added GO/NOGO Tester CTD 52 to its wide range of GSM test systems for type approval, development, quality assurance, module and final testing in production, service, repair and installation.

Test facilities and test sequence

CTD 52 is a small, lightweight unit of attractive appearance (FIG 1) which has all the necessary features of a GSM base station required for testing and can perform **transmitter and receiver measurements** under real conditions. The tester is easy to operate for anyone and requires no special knowledge or training on GSM (FIG 2). The tests run automatically at the press of a button

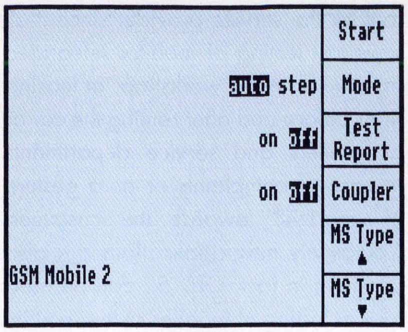


FIG 2 GSM GO/NOGO Tester CTD 52 easy to operate for anyone: prior to starting the test sequence, the operator needs merely to select at a keystroke the mobile type (MS Type), automatic or stepwise test mode (Mode) with or without antenna coupler (Coupler) and test report hardcopy, if required (Test Report).

```
+----------------------------------------------------------------------------+
| Test Station:            CTD 52  Rohde & Schwarz                           |
| Date:                    27.09.1994                                        |
| Time:                    12:06                                             |
| Mobile:                  Mobile 1 with R&S coupler                         |
+----------------------------------------------------------------------------+
| Power class:             4                                                 |
| IMEI:                    490005.10.056715.0                                |
| IMSI:                    123.45.67890                                      |
+----------------------------------------------------------------------------+
| Measurement results on channel:    1                                       |
| MS Output Power:                                                           |
|    Standard      Measured      Tolerance                      Evaluation  |
|     [dBm]         [dBm]          [dBm]                                     |
|      13            13.8          8...18                             OK     |
|      23            26.5         18...28                             OK     |
|      33            36.4         28...38                             OK     |
|                                                                            |
| MS Sensitivity:                                                            |
|     Level      RXLEV     Tolerance     RXQUAL    Maximum       Evaluation  |
|     [dBm]      [dBm]       [dBm]        [%]        [%]                     |
|     -100        -99     -105...-95      0.1        6.4               OK    |
+----------------------------------------------------------------------------+
| Dialled number:            112                                             |
+----------------------------------------------------------------------------+
| Measurement results on channel:  124                                       |
| MS Output Power:                                                           |
|    Standard      Measured      Tolerance                      Evaluation  |
|     [dBm]         [dBm]          [dBm]                                     |
|      13            13.9          8...18                             OK     |
|      23            26.3         18...28                             OK     |
|      33            36.0         28...38                             OK     |
|                                                                            |
| MS Sensitivity:                                                            |
|     Level      RXLEV     Tolerance     RXQUAL    Maximum       Evaluation  |
|     [dBm]      [dBm]       [dBm]        [%]        [%]                     |
|     -100        -99     -105...-95      0.1        6.4               OK    |
+----------------------------------------------------------------------------+
|                                                                            |
|                     Overview Of Measurement Steps:                         |
|                                                                            |
| Location Update                                                     OK     |
| Call to MS                                                          OK     |
| MS Power Channel           1                                        OK     |
| Sensitivity Channel        1                                        OK     |
| MS Release                                                          OK     |
| Call from MS                                                        OK     |
| MS Power Channel         124                                        OK     |
| Sensitivity Channel      124                                        OK     |
| Echo Test                                                           OK     |
| Network Release                                                     OK     |
+----------------------------------------------------------------------------+
| Final Conclusion                                            Test Passed    |
+----------------------------------------------------------------------------+
```

FIG 3 Report with test values and additional information for documentation and as repair notes

with hints displayed to prompt the user to take measures such as dialling the subscriber's number. In addition, the different measurements and tests can be called step-by-step. With the option enhanced measurements with **printer interface** (CTD-B5) incorporated, the printer outputs a test report or notes on the necessary repairs (FIG 3).

Adaptation of the DUT is the simplest possible: there is only one RF cable to connect the mobile to CTD 52. **Antenna Coupler** CMD-Z10 (FIG 4) is available for future mobiles without an RF connector or for testing the antenna together with the unit, the antenna being very often the cause for the customer's complaint. Attenuation through the coupler is automatically taken into account during the test sequence for the specific mobile phone under test.

To ensure correct operation of the mobile phone, CTD 52 performs measurements on different RF channels and even carries out the power change including **power measurement** depending on the possible power classes of the mobile. **Sensitivity** is evaluated via the RF input level quality (RX-QUAL) fed back by the phone and via the RF input level (RX-LEV). The **echo test** at very low RF levels shows the whole function of the mobile phone in a clear and comprehensible way. In this test, CTD 52 acting as a base station echoes the word or sentence spoken by the user into the microphone to the mobile's loudspeaker with some delay. The complete receive and transmit sections from the microphone to the mobile's loudspeaker including the RF and signalling characteristics are tested, a technique which exactly corresponds to real operating conditions and will convince even the 'difficult' customer. The test sequence has two types of **call setup** integrated (incoming and outgoing) so that it is possible to test the bell function with incoming calls and the keyboard function by selecting any subscriber's number. **Signalling** of the mobile phone is tested implicitly and continuously since

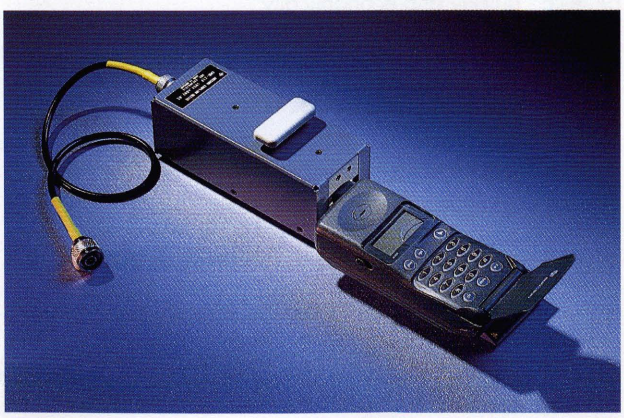


FIG 4 Antenna Coupler CMD-Z10 to be connected with CTD 52 for testing mobiles and antenna
Photo 41 898

without this function call setup and clearing as well as call hold, etc would not be possible. Of course, mobile-specific parameters such as IMEI (international mobile equipment identity) are determined and logged during the test.

The subscriber's SIM card (subscriber identity module) or the **Test SIM CRT-Z2** from Rohde & Schwarz available as an accessory can be used to operate the mobile on CTD 52. There are no call charges incurred. If the mobile operates correctly with the test SIM but not with the subscriber's SIM, the latter is obviously defective and so, an additional SIM card tester is superfluous.

CTD 52 with its simultaneous transmit and receive sections has the same design and operation as a base station. It generates all signalling required to test the control channel (BCCH) and traffic channels (TCH) according to the GSM specifications. With the powerful test facilities of CTD 52, measurements performed (eg RF power) and messages detected (eg RX-LEV/RX-QUAL) are evaluated for compliance with tolerances and the result of each measurement is displayed as pass or fail (FIG 5). After completion of the test, an **overall evaluation** is performed. The printer report includes test values and relevant information which serve as record or repair note. Service expenditure and repair costs can thus be minimized.

Uses

GSM GO/NOGO Tester CTD 52 finds **application** wherever mobiles have to be tested quickly and economically:

- in case of customer complaints to assess if a repair is required or if the customer equipment is to be replaced,
- in outgoing goods inspection, eg after module replacement in the service department or as final test prior to packing at the manufacturer's,
- in incoming goods inspection of retailers, service providers, network operators, car manufacturers or car workshops,

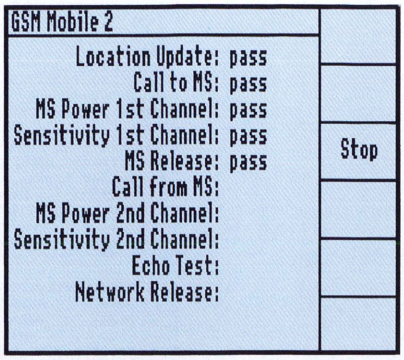


FIG 5 Clear representation of test sequence on illuminated screen with highlighted measurement, result display with tolerance evaluation (pass or fail)

- to detect defective components in complete on-bord systems (antenna, booster, handsfree equipment, control unit, cabling),
- for routine operational tests – in sales or as a service which might be charged at a later date.

The use of CTD 52 is extremely profitable for mobile retailers with or without a service department, network operators and service providers, in the car trade and for car leasing firms. The fact that time and costs for fault finding are saved or the return and testing of supposedly defective customer units are avoided altogether pays off the investment for CTD 52 within a short period of time. CTD 52 is an indispensable tool for the service provider since it allows fast testing of mobiles integrated in vehicles in the workshop, at leasing firms before and after renting the car or at retailers and service departments in case of complaints or as a gesture of goodwill towards the customer. Completely new applications are also possible; in fact, CTD 52 can be used for fast testing of mobiles at the security checks at airports – which is far more reliable than the usual weight check –, or it can be a help in sales for selecting the technically best equipment (eg the higher the sensitivity, the better the reachability). And last but not least, GSM GO/NOGO Tester CTD 52 from Rohde & Schwarz is the most favourably priced radio tester in the world.

Michael Vohrer

Condensed data GSM GO/NOGO Tester CTD 52

Design	RF transmit and receive sections, signalling generation and evaluation
Key functions	call setup in both directions, measurement of mobile power class, measurement of power change, channel change, sensitivity measurement, echo test (overall test from microphone to loudspeaker), call clearing, enhanced measurement with printer report (option CTD-B5)

Reader service card 147/01

Antenna AC002B5 and Receiving System EA002B5

Processor-supported monitoring system for 0.1 to 18 GHz

A receiving system for 0.1 to 18 GHz is now available to all authorities responsible for radiodetection and monitoring. Antenna, receiving and analysis equipment are combined to form an intelligent system. With the biaxial orientation capability of the antenna, all signals from terrestrial sources and geostationary satellites can be received. Detected sources together with their signal parameters can be listed and called up again. New signals are rapidly identified by comparison with stored signals in a file, a process which considerably simplifies the search for unknown signal sources.

Antenna AC002B5 as detached RF front end

The core of Antenna System AC002B5 (FIG 1) is a 3-m microwave antenna which can be remote-controlled in the azimuth and elevation. The different feeds arranged at its focus can be activated depending on the operational requirements. A broadband feed with switchable polarization (horizontal/vertical) and integrated low-noise broadband amplifier is provided for receiving signals in the whole range from 1 to 18 GHz. The amplified microwave signal is applied via short cables to the tuners (Gigatune receiving system), where it is converted to the IF (160 MHz), so that AC002B5 may be set up at max. 100 m from the operating room.

Signals from geostationary satellites in the C and Ku bands are received via narrowband feeds with integrated low-noise converters (LNCs) and switchable linear and circular polarization. The S/N ratio is better by 6 to 10 dB compared to the broadband feed. Frequency conversion of LNCs is performed in the usual range from 950 to 2050 MHz. Thus the microwave antenna functions as a complete RF front end.

The system is rounded off by two log-periodic antennas for the reception of horizontally and vertically polarized sources at VHF/UHF (0.1 to 1 GHz). An amplifier is provided to allow the received signals to be transferred over long distances without any loss in quality.

FIG 1 Antenna System AC002B5 with tuner system on telescopic rails and accommodated weatherproof in antenna base

Photo 41 559/1

Noteworthy is a special feature of the 3-m antenna, which considerably simplifies the search for unknown signal sources in the upper microwave range. The broadband feed may be set to two different positions with reference to the focus of the dish antenna so that either the full gain with a very narrow lobe (0.35° at 18 GHz) or an enlarged beamwidth (>1° at 8 to 18 GHz) with correspondingly reduced gain can be obtained.

Receiving System EA002B5

The complete receiving system is accommodated in a console (FIG 2) and comprises individual **units with the following features:**

- Receiver ESM 1001 for VHF-UHF reception (0.1 to 1 GHz),
- Receiver ESM 1003 with Control Unit GX 513 and detached Gigatune system for reception from 1 to 18 GHz,
- Spectrum Display EPZ 513 for reception and display of microwave signals converted to 160 ±50 MHz,
- VLF-HF Receiver EK 070 with Panoramic Adapter EPZ for display of band occupancy and demodulation of individual voice channels,
- Up/Down Converter UX 001 and Wideband Analog Recorder AE 3300 for converting the various receiver IFs to a frequency range suitable for baseband recording,
- Satellite Receiver EP 800 and Colour Monitor PVM 1440 for reception of satellite TV programs in the C and Ku bands,
- Antenna Control Unit RD 026GB for positioning the antenna in the azimuth and elevation and for selecting the required antenna feed,
- System Processor MERLIN GR 856 with VGA Colour Monitor PMC3 for processor-supported system control,
- Dual Timebase Oscilloscope PM 3072, a 100-MHz real-time scope for displaying (storing) short-duration signals such as radar pulses.

A patch panel is provided for interconnecting the various instruments as required. An optional Spectrum & Network Analyzer FSBS may be used for displaying and evaluating frequency spectra (0.1 to 1 GHz/160 ±50 MHz/950 to 2050 MHz).

Processor support

Detecting radio signals in the microwave range is rather difficult as dish antennas of high directivity are as a rule required for obtaining a sufficiently high signal level. Contrary to the VHF-UHF range where the whole frequency spectrum can be displayed in a single sweep, for instance with the aid of an omnidirectional antenna, in the micro-

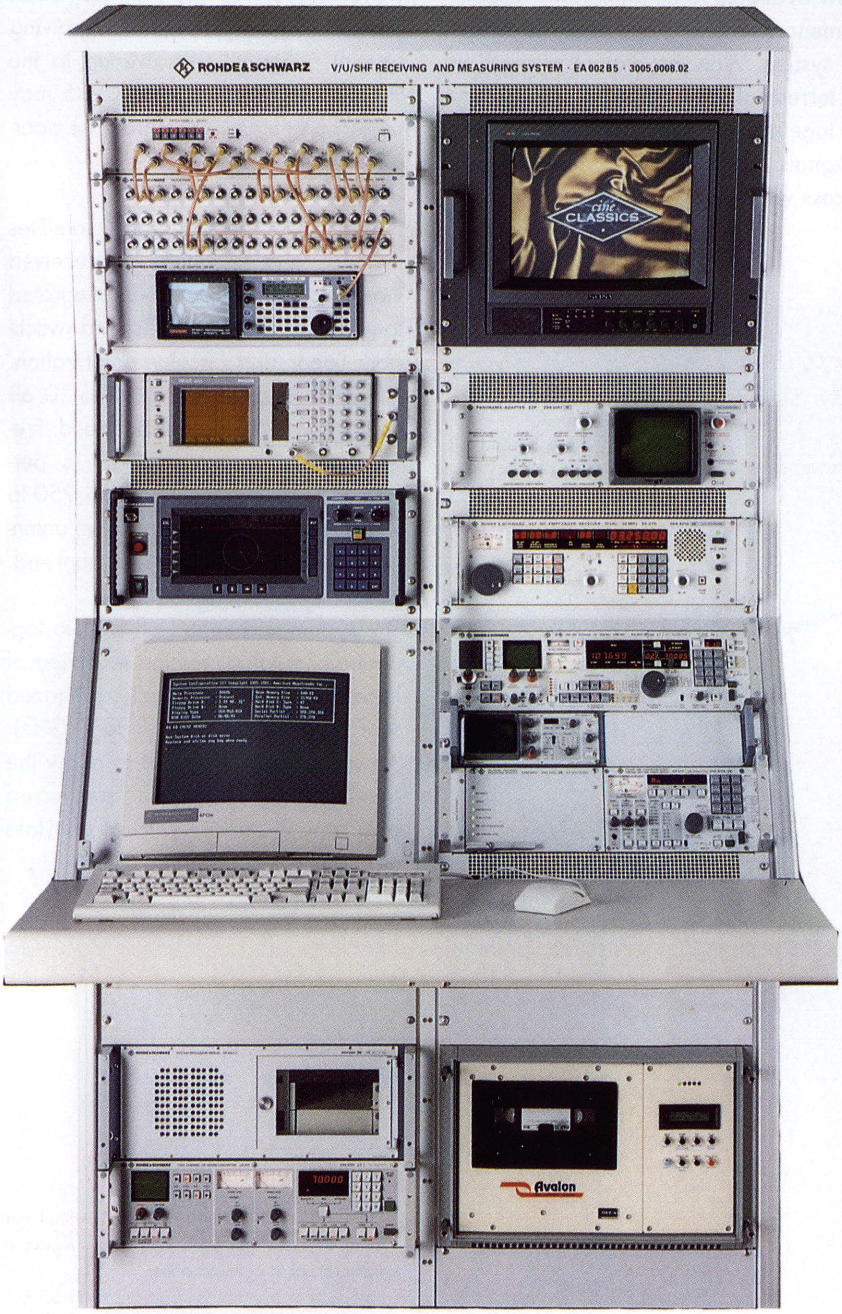


FIG 2 Console of Receiving System EA002B5
Photo 41 561/1

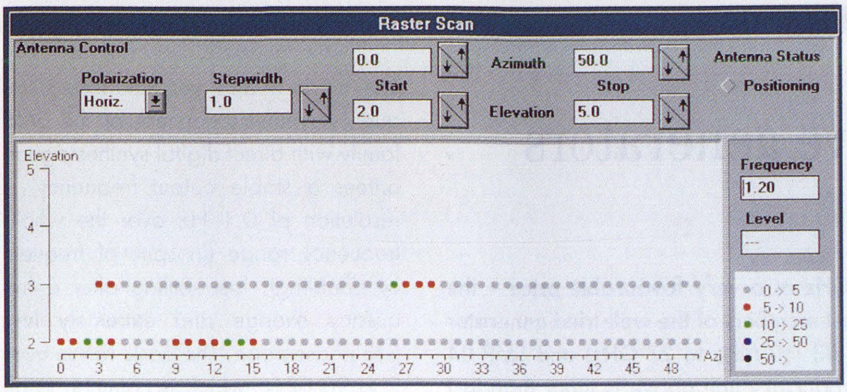
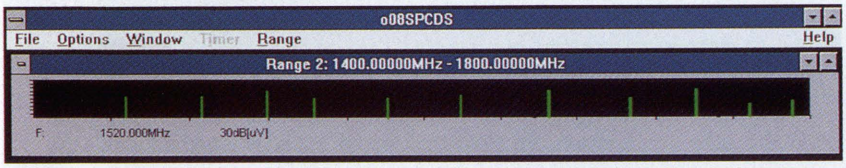


FIG 3 Display of radio activities in azimuth/elevation coordinate system

FIG 4 Display of frequency occupancy at discrete solid angle



wave range the entire solid angle has to be scanned sequentially. This procedure can be carried out quickly and reliably only with the aid of a processor. Not only because of the wide range from 1 to 18 GHz, various scan and display modes are provided, the most important of which are described below:

Activity raster scan

The ranges of frequencies and solid angles to be searched for radio activity are entered first. This mode uses wide frequency steps (100 MHz) for obtaining a fast overview. The whole 100-MHz window of the Gigatune system is searched for activities. The result is displayed in a raster scan display (FIG 3) in the form of points like pearls on a string indicating the number of windows, with activities colour-coded in an azimuth/elevation system of coordinates. Clicking the mouse on one of the points opens a 100-MHz window in which activities have been detected. Information on particular frequencies can be obtained with the frequency raster scan.

Frequency raster scan

As this in-depth mode is more time-consuming, the frequency and solid-angle ranges to be entered should be confined to the area of interest. The solid angle is divided in a raster of discrete azimuth and elevation angles. To ensure continuous coverage, the raster spacing and the 3-dB beamwidth of the antenna have to correlate with each other. A frequency scan is performed at every raster point (solid angle). The frequencies detected and their level are recorded. An overview of the results is provided by displaying them in the form of a string in a raster scan. The individual pearls of the string can be selected with the mouse and all frequencies received from this direction and their respective levels can then be read from a spectrum display (FIG 4).

Single frequency

Frequencies of interest may be set one after the other on the receiver. Their signal parameters are determined and stored in a file together with an identification number and, if required, with a report.

The following processor-supported functions are also available: With the aid of Satellite Receiver EP 800 a frequency or TV scan may be performed in the C and Ku bands. For recording the basebands of receivers ESM 1001 and ESM 1003, the main functions of the Wideband Analog Recorder AE 3300 such as recording, replay, fast wind/rewind, search and cassette ejection may be menu-controlled from the processor. The interconnection of instruments can also be controlled in a menu via the patch panel comprising six RF switches.

Manfred Schiller; Gerhard Sigl

Condensed data Antenna AC002B5 and Receiving System EA002B5

Antenna	
Frequency range	0.1 to 1 GHz/1 to 18 GHz
Gain	approx. 6 dBi/26 to 51 dBi
3-dB widths	100°, 60°/7 to 0.35°
Noise figure	3.1 dB/5 dB (3 dB optional)
Gain	approx. 30 dB
Receiving system	
Frequency range	0.1 to 18 GHz
Display modes	activity raster scan frequency raster scan single frequency activity scan frequency scan

Reader service card 147/02

Signal Generators SMP 03 and SMP 04

Powerful microwave generators up to 40 GHz

Excellent signal characteristics up to 40 GHz at a very favourable price – the uncompromising design of the two youngest members of the well-tried generator family SMP from Rohde & Schwarz, SMP 03 (10 MHz to 27 GHz) and SMP 04 (10 MHz to 40 GHz), ensures that the introductory line above is more than just an advertising slogan. As usual, Rohde & Schwarz stands for top quality and universal applications in R&D, production, EMC measurements, material testing and quality assurance.

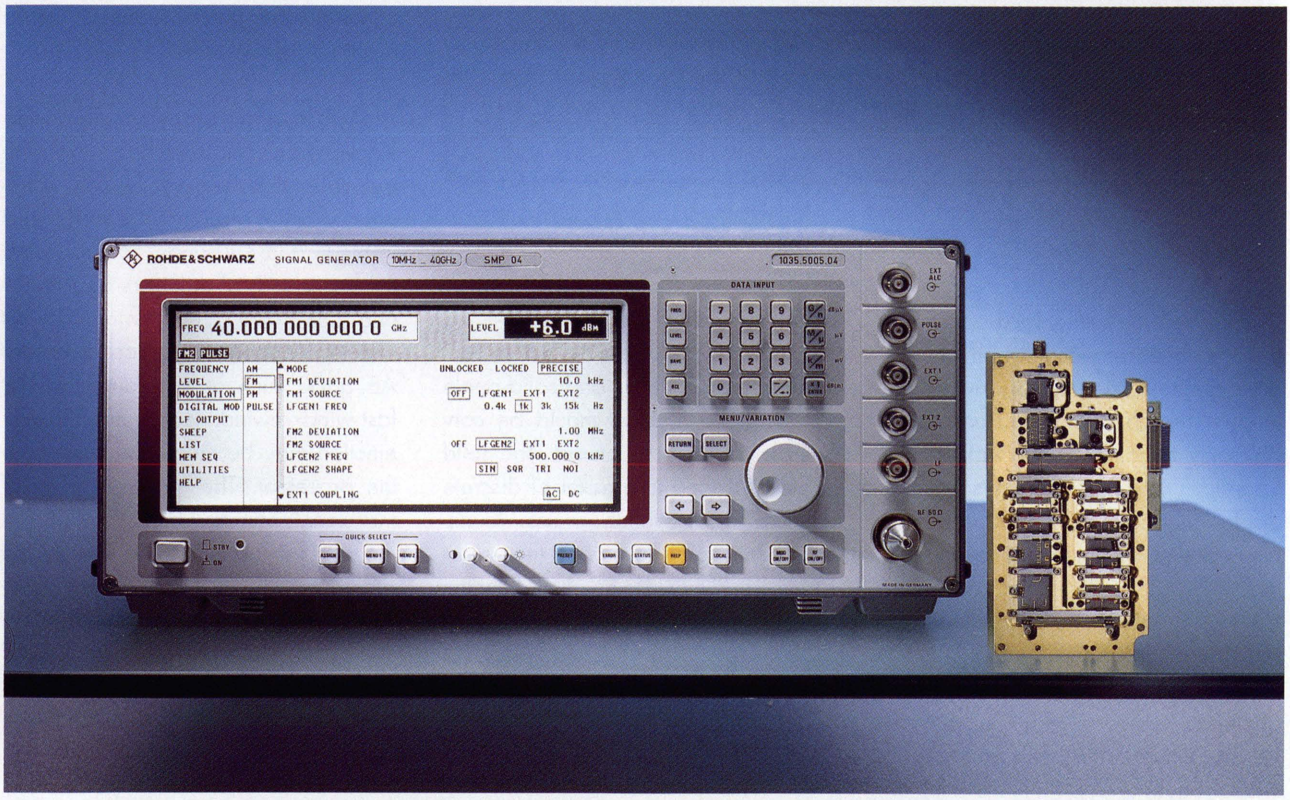


FIG 1 Signal Generator SMP, universal, economic and powerful microwave source available up to 40 GHz thanks to doubler module
Photo 41 881

Although SMP was launched on the market a relatively short time ago, Microwave Generators SMP 02 and SMP 22 have become a synonym for high output power and extremely high spectral purity [1]. Rohde & Schwarz has proven once again that top quality and a favourable price do not necessarily exclude each other. Based on these generators for the frequency range 10 MHz to 20 GHz, the new models SMP 03 and SMP 04 have been designed with state-of-the-art frequency doublers (FIG 1). The excellent performance data of the SMP family are thus extended to the millimeter range. Of course, the new models offer the same excellent pulse, frequency and amplitude modulation characteristics as their "forefathers".

Tried and tested concept

The modern and yet time-tested frequency-synthesis concept of the SMP family with direct digital synthesis guarantees a stable output frequency, a resolution of 0.1 Hz over the whole frequency range (in spite of frequency doubling), fast settling after a frequency change and extremely low SSB phase noise. The basic range from 2 to 20 GHz, which is common to all models, is generated by an extremely low-noise YIG oscillator, the lower band from 10 MHz to 2 GHz being obtained through frequency mixing. A highly accurate level control with automatic frequency-response correction and an extremely reliable mechanical attenuator ensure an RF level that can be accurately set in all frequency ranges.

With the SMP family, the excellent modulation characteristics, which are associated with high-quality, low-frequency signal generators, are available to the user also in the microwave range.

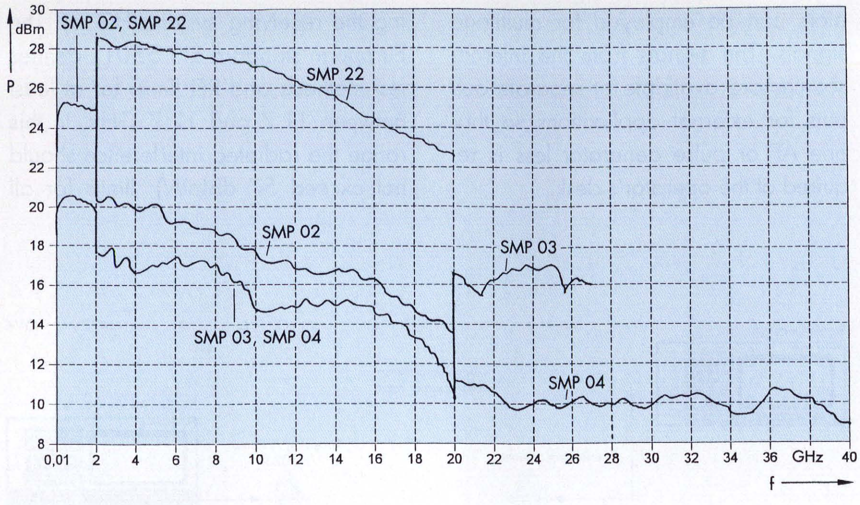


FIG 2 Typical maximum output power of Signal Generators SMP

AM is possible from DC to 100 kHz. The FM bandwidth ranges from DC to 1 MHz with a maximum deviation of 10 MHz at carrier frequencies up to 20 GHz, or a maximum deviation of 20 MHz at frequencies above. A feature that is offered by no other microwave generator: a special type of frequency control ensuring high carrier-frequency accuracy for the FM-DC mode. In addition, phase modulation can be used from DC to 100 kHz. High-grade pulse modulators equipped with the latest integrated circuits (MMICs) meet all requirements for pulse modulation which has always been the most important type of modulation in the microwave range. Rise and fall times shorter than 5 ns and a pulse width of typically less than 10 ns are obtained irrespective of the set frequency. The on/off ratio is always higher than 80 dB. It need not be particularly stressed that AM, FM/φM and pulse modulation can be combined without any restrictions.

High output level

And now to a problem well-known to all microwave engineers: the frequency response of a test setup drops more or less sharply at higher frequencies. Unfortunately the maximum level available from average signal generators also decreases in the same way. Amplifiers with sufficient output power can overcome the problem but would heavily burden one's budget. Bearing this in mind, SMP 02 and particularly the high-power model SMP 22 have been especially designed for a high output power. This also applies to the new members of the generator family. As shown in FIG 2, SMP 03 has an output power of +15 dBm from 20 to 27 GHz while SMP 04 can still boast of +9 dBm from 30 to 40 GHz.

This is good news for all developers and users of automatic test systems, who have to put up with high losses caused by RF cables, waveguides, power splitters, relay matrices or directional couplers in the centimeter and millimeter ranges. No expensive microwave amplifier will now be needed for compensating these losses.

The high output level and the extremely low SSB phase noise (FIG 3) are ideal for substituting local oscillators particularly with critical applications in digital transmission and radar systems. A high output power – in conjunction with a level sweep – is also a precondition for determining the compression behaviour of amplifiers, mixers, detectors and YIG filters rapidly and easily. Last but not least the high output power allows frequency ranges above 40 GHz to be "captured". It is possible, for instance, to use a commercial frequency tripler for generating test signals at 96 GHz in the weather radar band with the aid of SMP 04 (multipliers from the American manufacturer Millitech could be used, for example).

External level control

The higher the operating frequency, the more important the external level control. The reason for this has already been mentioned, namely feeding an RF signal via cables to the test setup, which is mostly located away from the generator, becomes more and more difficult at higher frequencies without losses or appreciable frequency response. "External level control" has been the subject of a "test hint" in News from Rohde & Schwarz [2]. The most important points of this article are recapitulated below:

All SMP models may use external detectors or power meters as level control sensors. At the point where the external sensor is connected to the test setup, the level can be set to a defined value and kept constant. Connection is normally via a directional coupler or a power splitter. This allows, for example, the output level of the frequency tripler mentioned above to be controlled.

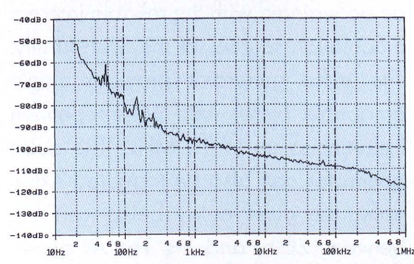


FIG 3 SSB phase noise of Signal Generators SMP at 10 GHz

Up to 26.5 GHz we recommend to use Power Meter NRVS which can be fully controlled from SMP. A power meter from Hughes could be employed for the 96-GHz frequency generated in the above example.

All SMP models offer the following **capabilities for frequency-response compensation** in addition to external level control:

- User correction, a function providing a user-selectable frequency response for the RF level; level-correction values can be entered for up to 160 frequency points (correction values for frequencies in between are automatically determined by interpolation).
- Memory sequence, a programmable sequence for up to 50 stored complete front-panel setups; the level can be stored as a function of the required frequency response.
- List mode, a programmable sequence for a maximum of 2048 pairs of frequency and level settings. Although especially designed for frequency hopping, this function can also be used for frequency compensation.

The advantage of all these compensation methods is that no external add-ons are needed, the frequency response to be compensated must be known, however. External level control, on the other hand, is very convenient and precise but requires external add-ons.

Internal modulation sources

Users having experience with the 20-GHz SMP model or with SME will be acquainted with the reliable internal modulation sources of the SMP family. The pulse generator provides single or double pulses with pulse-repetition frequencies up to 10 MHz. The pulse generator can also be triggered externally, the pulse delay being variable between 20 ns and 1 s. The AF generator produces sinewave signals up to 500 kHz, triangular and squarewave signals as well as noise. Two AF generators can be employed for multitone signals. The signals from the internal sources are available at separate outputs for external applications so that one AF or pulse generator less is required at the operator's desk.

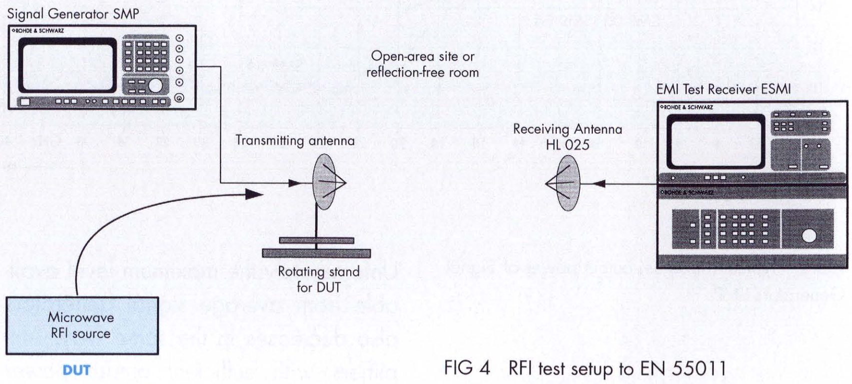


FIG 4 RFI test setup to EN 55011

Versatile in application

Thanks to the spectral purity and versatile modulation capabilities of SMP, all models are ideally suited for measurements on microwave receiving systems in the fields of EW, ECM, radar and radiocommunications. Multi-signal measurements, which usually comply with DIN 45004, are widely used for determining receiver characteristics like intermodulation distortion or interference rejection. In order to compensate for the insertion loss of the power combiner interconnecting the generators, a high output power is required for these measurements. Exactly the right job for SMP! A test setup to VDE 0855 standard, part 12, using three generators for measuring the in-band and out-of-band interference of converters in satellite receiving equipment is described in [1].

After dealing with this "classic" measurement, let's talk about a brand-new subject – RFI measurements in the microwave range. In this context it is natural to first think of a test receiver with antenna. In this case, however, a signal generator is required for calibrating the receiving system (FIG 4). The European standard EN 55011 defines test methods and RFI limits for at least between 11.7 and 12.7 GHz. In this range the radiated interference should not exceed 57 dB(pW); limits for all other frequencies in the range 1 to 400 GHz are being discussed at present. According to EN 55011 the DUT is to be placed on a rotating stand and the receiving antenna set up at a suitable distance. For calibrating the test setup, the DUT is replaced by a transmitting antenna which has the radiation characteristics of a half-wave dipole. The output power of the signal generator feeding the transmitting antenna is adjusted so that a stable and meaningful display is obtained on the test receiver at all test frequencies. A conversion factor is obtained from the transmitter power and the readout on the test receiver. With the aid of this factor the radiated power can be determined.

Well thought-out operation

The great number of satisfied customers proves it: from the very first day SMP can be operated without using the manual. The reason is the well thought-out menu control complemented by context-sensitive help functions – always at hand on a simple keystroke [3]. The user can see at a glance all parameters and conditions selectable for a specific function and can thus be sure that there are no secondary conditions he might overlook. A convenient list editor makes programming of long measurement sequences in the list or memory sequence mode simply a pleasure.

Investment for the future

Thanks to the well-tried, future-oriented configuration concept of the SMP family, the user can select the options he really needs. What he gets is a microwave generator exactly tailored to his applications at an optimum price/performance ratio.

The main **options** at a glance:

- Frequency extension, 0.01 to 2 GHz with high output power,
- RF attenuator, 27/40 GHz, extending the level setting range to −130 dBm,
- pulse modulators, 2 to 20/27/40 GHz and 0.01 to 2 GHz for fast pulse modulation,
- FM modulator with precision FM-DC function and high-quality phase modulation,
- AF generator for sinewave, triangular and squarewave signals as well as noise,
- pulse generator providing double pulses and external trigger capability.

SMP models are not only impressive for their low purchase price, but are equally convincing over their whole service life. The use of state-of-the-art MMICs, well-proven design and assembly techniques as well as computer-supported production and final testing guarantee top quality and reliability. Recalibration is required every three years at the earliest. For calibration the instrument need not be opened nor are there any mechanical adjustments to be made. If a fault yet occurs, a built-in diagnostic system and intelligent computer-supported measurement aids make troubleshooting easy and ensure short repair times. All in all: SMP is an investment that is open-ended for future needs.

Wilhelm Kraemer

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[2] Kraemer, W.: External, precision level control for microwave Signal Generator SMP. News from Rohde & Schwarz (1994) No. 144, p 14

[3] Lainer, K.; Rieger, A.: Operating concept of new Rohde & Schwarz signal generators. News from Rohde & Schwarz (1993) No. 142, pp 32–33

Condensed data Signal Generators SMP 03/04

Frequency range	
SMP 03	10 MHz to 27 GHz
SMP 04	10 MHz to 40 GHz
Resolution	0.1 Hz
Harmonics	
f ≤ 1.8 GHz/f >1.8 GHz	<−30 dBc/<−40 dBc
Subharmonics	
f ≤ 20 GHz/f >20 GHz	none/<−40 dBc
Spurious	
f ≤ 20 GHz/f >20 GHz	<−60 dBc/<−56 dBc
SSB phase noise	
(f = 10 GHz, spacing 10 kHz)	−103 dBc
Level	
SMP 03 (27 GHz)	>+10 dBm (typ. +15 dBm)
SMP 04 (40 GHz)	>+6 dBm (typ. +9 dBm)
AM/FM/φM	DC to 100 kHz/1 MHz/100 kHz
Pulse modulation	
On/off ratio	>80 dB
Rise and fall time	<10 ns
Pulse generator	
Pulse period	single pulse, double pulse, ext. trigger
Pulse width	100 ns to 85 s
Pulse delay	20 ns to 1 s
AF generator	sinewave, triangular, squarewave, noise

Reader service card 147/03

DECT Type-approval Test System TS 8930

Type-approval measurements on cordless telephones to TBR 06/10/11

Rohde & Schwarz offers test equipment and systems for all DECT applications – including automatic test systems for type-approval measurements on DECT mobile and base stations. DECT Type-approval Test System TS 8930 allows measurements to ETSI Specifications TBR 06/TBR 10/TBR 11. An essential feature of the system is its high degree of flexibility of hardware and software, which ensures that the user will have no problems in handling the DECT standard as it evolves.

The trend towards mobile communication is as strong as ever. To cover the wide range of applications of cordless voice and data communication, the European commission has developed a standard every DECT telephone must comply with (DECT = digital European cordless telephone).

DECT specifications

DECT was assigned the frequency range 1880 to 1900 MHz by the European commission. In all, ten carrier frequencies with a bandwidth of 1728 kHz each are available. Unlike GSM or DCS 1800, duplex operation under the DECT system is realized by TDD (time division duplex). Data transmission from the portable part (mobile) to the fixed part (base station) and vice versa is on the same frequency with a time offset. Each frequency is assigned 24 timeslots. Twelve timeslots are available for data transmission from the portable to the fixed part and the same number for transmission the other way round. DECT systems use GFSK modulation (Gaussian frequency shift keying) with BT = 0.5, where B refers to the 3-dB bandwidth of the Gaussian filter and T to the symbol duration.

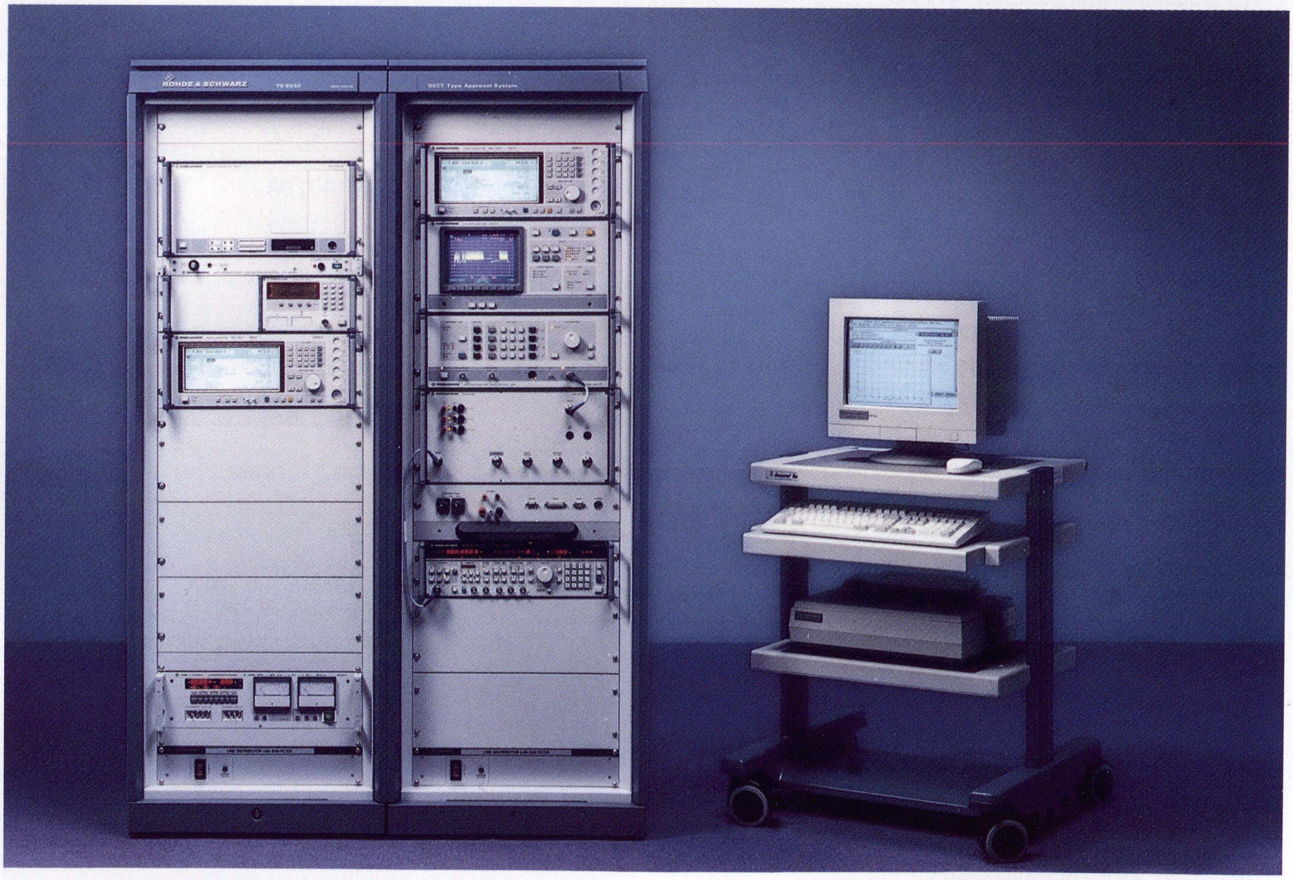

FIG 1 DECT Test System TS 8930 for type-approval measurements on cordless telephones to ETSI Specifications TBR 06, TBR 10 and TBR 11 Photo 41 583

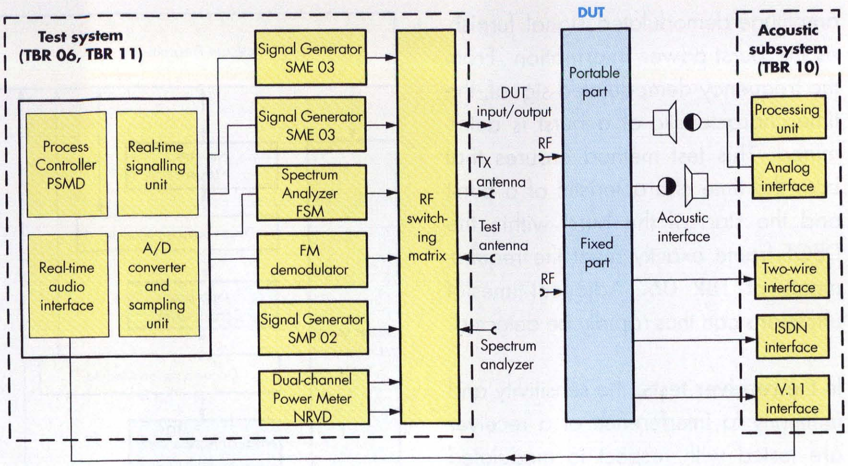

FIG 2 Block diagram of Type-approval Test System TS 8930 for TBR 06, TBR 10 and TBR 11

TS 8930 system architecture

Type-approval Test System TS 8930 (FIG 1) has been designed for measurements to ETSI Specifications TBR 06/10/11 (ETSI = European Telecommunication Standards Institute). Test Specification TBR 06 describes the measurements at the air interface, TBR 10 specifies the acoustic measurements, and TBR 11 describes the protocol tests. The high degree of flexibility provided by the hardware and software of Test System TS 8930 makes it easy to adapt to modified specifications (eg modification of burst time, changing from public access profile to generic access profile, etc).

The core of Type-approval Test System TS 8930 is Process Controller PSMD (FIG 2). It performs a variety of tasks: For one, PSMD controls all measuring equipment in the system via the IEC/IEEE bus. For another, PSMD acts as a real-time signalling unit, sampling device and evaluation unit in one. As a real-time signalling unit, it generates the DECT protocol for setting up a call with the DUT, which may be a portable or a fixed part. The data stream generated by PSMD is fed to a DECT modulator incorporated in Signal Generator SME 03 [1], which forms part of the test system. From the data stream, SME 03 generates the DECT air-interface signal.

The DUT is set to the loopback mode by means of a force-transmit message. Loopback mode means that the data sent from the test system to the DUT are returned to the test system after they have been received, demodulated and remodulated by the DUT. The RF signal is then demodulated by means of a broadband demodulator especially developed for DECT. This demodulator is integrated in Spectrum Analyzer FSM [2]. The demodulated signal is taken to the sampling unit of PSMD, which samples the signal at a rate of 2.3 MHz. The samples are fed to a powerful RISC processor (i860) for real-time evaluation. The processor performs a frequency, deviation or BER measurement every 10 ms. In addition to the useful data, PSMD generates a programmable signal defining the burst time. This signal is evaluated by SME 03. TS 8930 is thus able to furnish bursts of any duration in addition to half-, full- and double-slot bursts.

The signalling unit and the receive unit of PSMD are designed for two-channel operation to cater for the tests prescribed by TBR 11. The second channel is implemented by means of a second SME 03 fitted with a DECT modulator, and by a second FM demodulator. In TBR 06 tests, the second SME 03 simulates the DECT interferer, and the second demodulator maintains signalling during measurements with the spectrum analyzer. TBR 06 stipulates that BER measurements be made in the presence of an unmodulated interfering signal in the frequency range up to 12.75 GHz. The interfering signal is generated by broadband Signal Generator SMP 02 [3].

All signals are added, amplified and filtered in an RF switching matrix which includes relays, directional couplers, amplifiers, attenuators and several customer-specific filters. The RF switching matrix allows both line and antenna measurements to be performed. If all TBR 06 testcases are to be carried out via an antenna, four antennas are required: three for the stipulated frequency range 30 MHz to 12.75 GHz, and another one to cover the DECT band, as signalling must be maintained throughout the tests.

For line and antenna measurements it is necessary that the RF level be measured and generated with high accuracy. RF switching matrices, however carefully designed, exhibit an unpredictable frequency response over the wide range up to 12.75 GHz. To minimize this frequency effect, two RF probes are provided at important points of the matrix. The probes together with Dual-channel Power Meter NRVD determine the frequency-dependent attenuation in the individual signal paths. Any frequency-dependent level errors occurring in the measurements are automatically compensated by means of the reference values determined prior to the measurements.

Measurements to TBR 06

Test System TS 8930 in its basic configuration is capable of performing all measurements to Specification TBR 06, which subdivides measurements into transmitter and receiver tests.

In the **transmitter tests,** special significance is attached to bit 0, which is the first bit of a burst. Test System TS 8930 calculates the position of bit 0 by means of 32-bit correlation. The first 32 bits of a DECT burst are defined in the DECT specifications and are thus known to the test system. To measure the carrier frequency and the frequency deviation, TS 8930 first determines the position of bit 0, and from this the position of the loopback bits. The loopback bits are special bits included in the DECT burst. Only these bits are used for measuring the carrier frequency and the deviation (FIG 3).

In addition to frequency and deviation measurements, the time behaviour of the DECT telephone is examined in a further testcase. The prescribed time offset of 10 ms between subsequent bursts must be maintained to an accuracy of 1 µs. With the correlation technique implemented in TS 8930, the test system can measure the time offset with an accuracy by far exceeding the requirements of TBR 06.

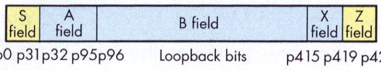

FIG 3 Structure of DECT burst (S field = synchronization field; A, B, X fields = data fields; Z field = optional synchronization field)

In power-ramp measurements, PSMD samples two signals at a time and evaluates them, ie the amplitude- and the frequency-demodulated signal. The amplitude-demodulated signal furnishes the burst-power information. From the frequency-demodulated signal, the time characteristic of a burst is determined. This test method ensures that both the time characteristic of a burst and the start of the burst within the DECT frame exactly meet the requirements of TBR 06. Adjacent-timeslot emissions can thus rapidly be detected.

In the **receiver tests,** the sensitivity and immunity to interference of a receiver are tested with respect to modulated and unmodulated interference. A call is first set up, then the DUT is switched to the loopback mode. The BER is measured with the level of the useful signal being reduced and in the presence of modulated and unmodulated interference.

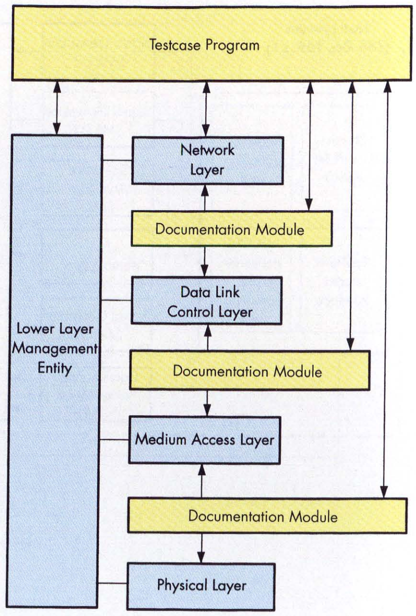

FIG 4 Software structure for TBR 11 tests

Measurements to TBR 10

Specification TBR 10 describes the acoustic measurements stipulated for type approval of a DECT telephone. TBR 10 defines measurements to be performed on complete DECT systems consisting of a fixed and a portable part, as well as tests to be carried out separately on a fixed and a portable part. An upgrade developed for Test System TS 8930 allows tests to TBR 10 to be performed, ie type-approval measurements can be made both on DECT systems and on separate fixed and portable parts. The portable part usually has an air interface and an acoustic interface, whereas the fixed part is equipped with an air interface and an analog two-wire interface or an ISDN connector or a PCM interface to CCITT V.11.

To test the **portable part,** TS 8930 must simulate the fixed part. For this, the signalling unit of TS 8930, ie Controller PSMD, is equipped with the real-time audio interface option. PSMD is thus fitted with a PCM interface to CCITT V.11. Via this interface, an acoustic subsystem (from Head Acoustics) is connected to TS 8930. The subsystem supplies the PCM interface of PSMD with test signals. PSMD and Signal Generator SME 03 send these test signals via the RF interface to the DUT. At the acoustic interface, ie the loudspeaker, of the DUT, the signal is received by means of an artificial ear, converted into an electrical signal and fed to the acoustic test system. The analog receive signal is sampled at a rate of 44.1 kHz and taken to the processing unit of the subsystem, where level, distortion, etc are calculated. All receive and transmit filters required for TBR 10 measurements are software-implemented. The system operates analogously in the transmit mode of the portable part. The signal generated by the acoustic test system is taken via the artificial mouth to the microphone of the DUT and, via Spectrum Analyzer FSM (demodulation), Controller PSMD (sampling) and the real-time audio interface of PSMD, to the processing unit of the acoustic subsystem. The subsystem is remote-controlled by PSMD via an RS-232-C interface; all TBR 10 testcases can be started from PSMD. Results are transferred from the acoustic subsystem to PSMD, which generates a test report.

For type-approval tests on **complete DECT systems** consisting of a fixed and a portable part, the acoustic subsystem not only serves the acoustic interface but also an analog two-wire interface or a digital ISDN, CCITT, G.703 or V.11 interface.

Measurements to TBR 11

All protocol tests, especially network-layer tests, are described in Specification TBR 11. Test System TS 8930 uses a powerful optional software package for tests to TBR 11. A testcase program written in a high-level programming language calls C-coded functions that provide the layer functions (FIG 4). The documentation modules can be operated in monitor or simulation mode. In the monitor mode, the data traffic at the interfaces can be monitored. In the simulation mode, data can be injected to corrupt the sent information. A special feature is the documentation module between the physical and the medium-access layer: The module allows bit-by-bit recording of the data traffic on the physical layer.

Wilfried Tiwald

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[2] Evers, C.: 100 Hz to 26.5 GHz – new level of performance for microwave region with Spectrum Analyzer FSM. News from Rohde & Schwarz (1991) No. 133, pp 4–7

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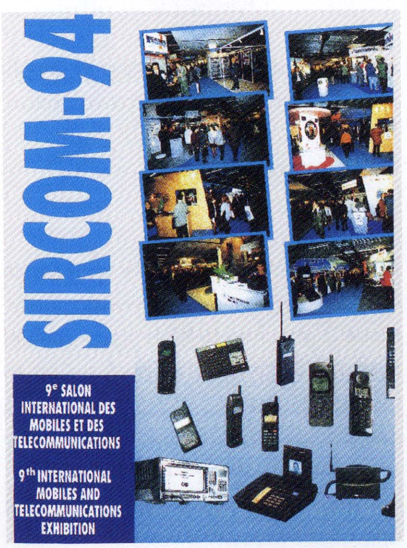
Condensed data DECT Type-approval Test System TS 8930

Frequency range	1880 to 1900 MHz
Channel width	1728 kHz
Number of carrier frequencies	10
Modulation	GFSK with BT = 0.5
Number of TX channels	2
Number of RX channels	
with FM demodulator	2
with AM demodulator	1
Multiplex method	TDD with 24 timeslots
Bit duration	0.869 µs
Timeslot duration	0.417 ms
Frame duration	10 ms
Data rate	1152 kbit/s
Audio interfaces	artificial mouth (loudspeaker), artificial ear (1/2" microphone), two-wire analog, V.11, G.703 to CCITT (64 kbit/s), ISDN Basic Rate

Reader service card 147/04

Sircom 94 in Paris – a must for communication specialists



Everyone having a name and reputation on the French mobile-radio and telecommunication market showed up at Sircom (Salon International des Radiocommunications Mobiles) in Paris-La Défense from 30 November to 3 December 1994. The fair held for the eighth time focused on test and system equipment for the mobile-radio and telecommunication section. 145 exhibitors were able to present the high standard of their products to around 15 000 visitors on a 6000 m² area.

Rohde & Schwarz exhibited a number of interesting new products at its stand (photo on right) such as the test systems for field-strength and coverage measurements required in the planning and operation of mobile-radio networks. The star of Sircom 94 was Digital Radiocommunication Tester CMD, setting new standards in the compact class of GSM and PCN testers. A good reason to have it on the official Sircom 94 poster (left) as the outstanding test system for mobile-radio units.

Video Measurement System VSA

Four TV measuring instruments plus controller in one compact unit

Video Measurement System VSA from Rohde & Schwarz is a digital TV test equipment designed for the present and the future. VSA combines the functions of a video analyzer, vectorscope, oscilloscope, monitor and system controller of impressive features in one single unit.

Engineers and technicians in both **laboratory and service environments** will highly value the comprehensive measurement capabilities of the four integrated instruments (for acquisition of numerous video parameters) and their high operating convenience.

The integrated VSA system controller makes VSA ideal for use as an **automatic test and monitoring system** (eg for TV transmitters or cable networks). No external controller is required for system control. An integrated hard disk allows a great number of measurement results and graphics to be stored for later evaluation. This is a valuable feature especially for mobile applications.

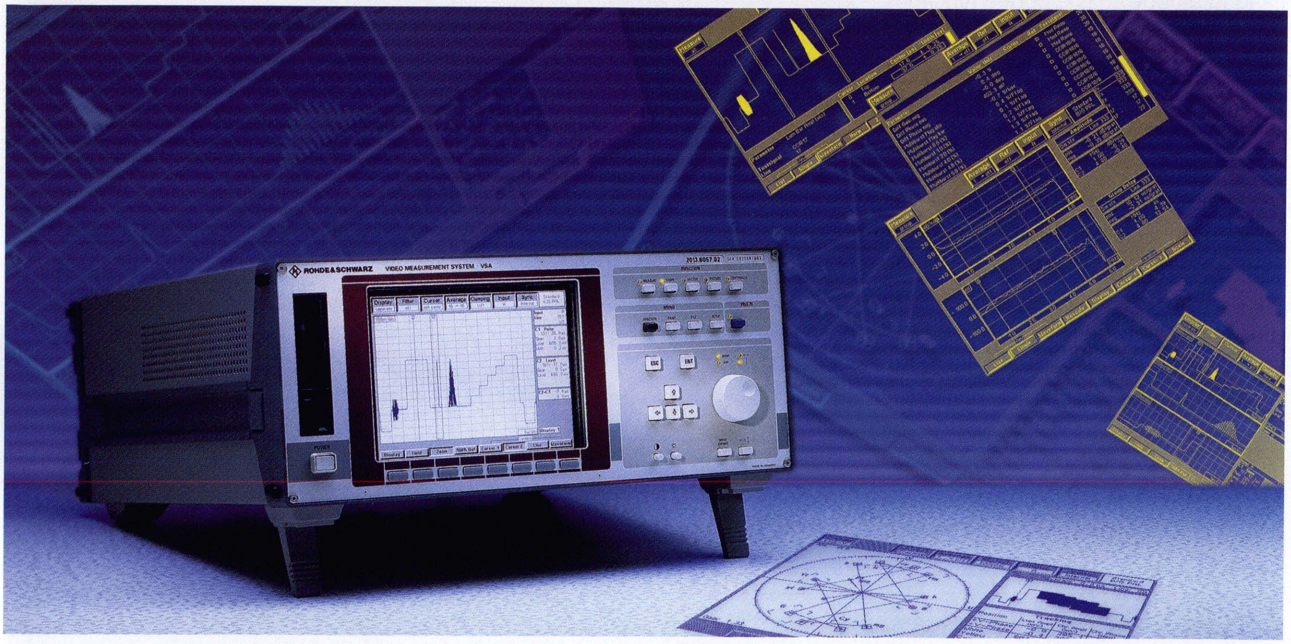


FIG 1 Video Measurement System VSA, digital TV test equipment for present and future

A whole variety of demands are placed on present-day video measuring instruments. Such an instrument should be able to analyze in detail all kinds of test signals rapidly and with great accuracy and to output measurement results in an attractive form on a graphics display or printer. Moreover, a variety of measurement functions should be available in a single unit featuring simple and convenient operation. With VSA Rohde & Schwarz developed a measuring instrument that goes far beyond all these requirements. VSA combines the **functions** of the following instruments:

- video and FFT analyzer for manual and automatic measurements,
- 3-channel oscilloscope with cursor function,
- video vectorscope with waveform display,
- monitor,
- PC-compatible system controller with 486 CPU.

Versatile use

The great versatility of Video Measurement System VSA (FIG 1) makes it suitable for a wide range of applications.

In **production and quality assurance** of video equipment particular importance is attached to high measurement speed. VSA is able to perform up to five test cycles in one second. Results are computed virtually in real time even if long test reports are called for, and this considerably reduces time and costs.

Function and design

VSA carries out the various measurement tasks with the aid of an internal state-of-the-art multiprocessor system which performs digital and highly accurate signal processing and controls all system interfaces. The main **features** in brief are:

- four loop-through video-signal inputs with analog 9-MHz bandwidth,
- A/D converter with 10-bit resolution and 27-MHz sampling rate,
- transputer system for data acquisition,
- full-field memory for short measurement times,
- fast floating-point signal processor system,
- 486 DOS PC with 8-Mbyte RAM and integrated IEC/IEEE-bus controller,
- protected-mode multitasking real-time operating system,
- monochrome LCD graphics screen with 640 x 480 pixels (colour LCD optional),
- connectors for external keyboard and colour monitor,
- two serial interfaces,
- SCPI remote control via IEC/IEEE-bus or serial interface,
- printer interface,
- hard disk for storing results and application programs,
- 3.5″ floppy-disk drive for the transfer of measurement data or for software options,
- hardware and software extensions thanks to the modular concept of VSA.

Operation

The VSA operating concept is outstanding for its clear front-panel layout and simple operation enabling the user to safely employ all functions of the measurement system without any previous knowledge of the instrument. Through the use of a screen with high-resolution graphics, windowing technique, pull-down menus and softkeys the front panel is simple and logically arranged. Only a few hard keys are provided for the most important functions which can be called up directly with one keystroke.

Program-controlled softkeys (below the result display), cursor keys and a roll-key are provided for the control of on-going measurements. Less frequently used functions are set in the pull-down menus. Thanks to the selective and well-organized presentation of information in the menus the user will not be overburdened when it comes to setting the different functions in all their complexity.

Settings and results may be stored on the hard disk or a floppy (DOS format), loaded into VSA for subsequent evaluation or output to a printer.

VSA can also be remote-controlled. In addition to standard instrument functions, a convenient SCPI-compatible set of commands provides auxiliary functions such as reading curves, remote polling of data stored on the hard disk or reloading and starting automatic measurement routines. Remote control is possible simultaneously via the IEC/IEEE-bus or a serial interface (important for remote control via modem).

Outline of individual instruments

The **video and FFT analyzer** of VSA simultaneously computes a great variety of different input-signal parameters and performs automatic limit monitoring with the aid of two independent sets of limit values. The user may choose between four operating modes:

1. Automatic overall measurement of all parameters
2. Individual measurement using extended capabilities
3. Test-signal and test-location display
4. Reference measurement separately selectable for each parameter

In the overall measurement mode all selected parameters are computed automatically and displayed in a tabulated form (FIG 2, top). Since the main information of the measured parameters such as reading, limit status and test signal can be directly read from this table, a rapid overview of a great number of measurement parameters (eg compliance with tolerance limits) can be obtained in this mode. If required, video parameters can be examined in greater detail using the extended measurement and display capabilities of VSA in the individual measurement mode. The increased measurement rate and accuracy of this mode as well as the special, parameter-specific graphic results display are of consider-

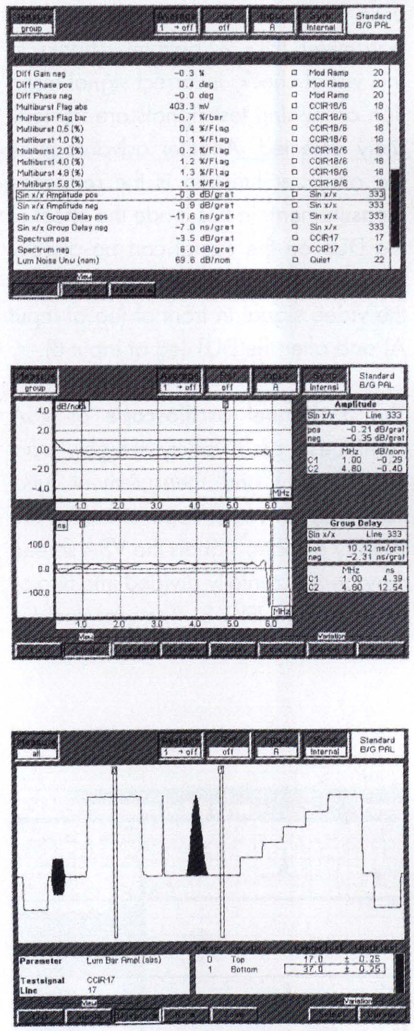


FIG 2 VSA analyzer function. Top: list of results of overall measurement; middle: individual measurement of amplitude-frequency response and group delay; bottom: display of CCIR 17 test signal

able advantage when carrying out adjustments. Some of the most interesting measurements are the evaluation of frequency and group-delay spectra of sin x/x signals using Fast Fourier Transform (FFT) (FIG 2, middle), the measurement of the 2T pulse and measurements of SC/H phase jitter and line jitter over the full field.

Accurate evaluation of individual frequency points in all spectrum displays is supported by cursors and user-definable tolerance graticules. If VSA detects out-of-tolerance conditions or other parameter errors, the test-signal display is a valuable tool for fast error diagnosis. The waveform of the evaluated test line is displayed with all locations used for the computation of a selected parameter (FIG 2, bottom). Thanks to this visual check, incorrect signal insertion or missing test signals are immediately detected. Another advantage of the analyzer function is the reference measurement. In this mode the effect of the DUT on the signal can be directly displayed by simultaneously evaluating the video signal in front of (eg at input A) and after the DUT (eg at input B).

The **3-channel oscilloscope** of VSA combines a great variety of highly practical display and measurement functions with convenient operation. For the display of video signals the VSA screen may be horizontally divided into two or three sections (FIG 3). The user decides whether a separate input is assigned to each section (eg for R, G, B components) or whether the signal from the same test input is displayed in all three sections with different scales (eg double or triple magnification of timebase).

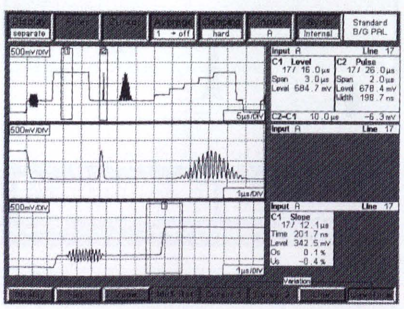


FIG 3 Oscilloscope with simultaneous display of three video signals and cursor window with edge evaluation in bottom display

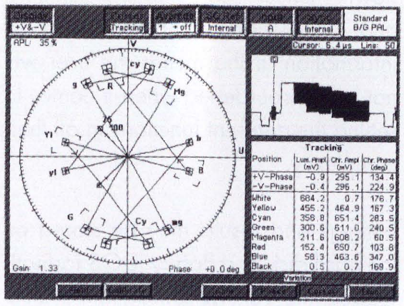


FIG 4 Vector diagram and waveform display of colour-bar signal with automatic computation of results

The displayed signal section may be moved continuously in the X and Y direction using the rollkey. A display window ranging from 200 ns to 20 ms (one field) is available to the user. For better orientation, the waveform is displayed on a dynamic measurement graticule which is automatically adapted to the displayed signal section.

A great number of digital filters, eg all CCIR filters for ITS measurements, are available for simulating signal manipulations. A special strength of the VSA oscilloscope is cursor measurements with two cursors being used for each partial display. Each cursor may be expanded to a measurement window of up to 10 µs. With the aid of the cursor measurement functions (level, peak, slope, pulse) a single cursor is able to analyze complete signal elements (FIG 3, bottom display). With two cursors active, level and time differences are computed automatically.

The VSA **vectorscope** displays the magnitude and phase of the colour information of a video line. For a fast diagnosis of measurement problems, the waveform of the selected line is simultaneously displayed (FIG 4). The most commonly used test signal for vector analysis is the standard colour bar. As soon as a colour-bar signal is detected by the integrated software, all colour-subcarrier amplitudes and phases are automatically computed and displayed. The phase difference of two colour subcarriers can also be accurately measured by alternately using the colour-subcarrier reference frequency of the two test signals.

A unique feature is the cursor measurement using a tracking cursor. A cursor line in the waveform window of the video line marks the measurement time for colour-subcarrier phase and amplitude. The cursor coincides with a marker in the vector diagram. Shifting the cursor line causes this marker to track the vector curve so that the user obtains a correspondence between the test location and the associated colour parameter.

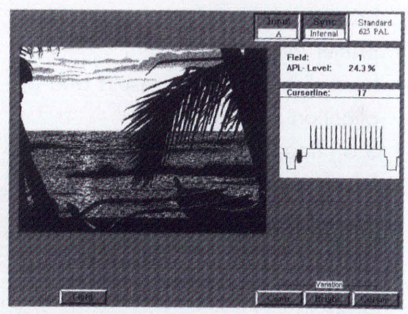


FIG 5 Monitoring video signal with waveform of single line

The VSA **monitor** permits a video signal to be displayed as a monochrome TV picture with eight grey levels. Any rollkey-selected video line of the TV picture can be displayed simultaneously in the waveform window (FIG 5). This is important for measurements at sites where several different program

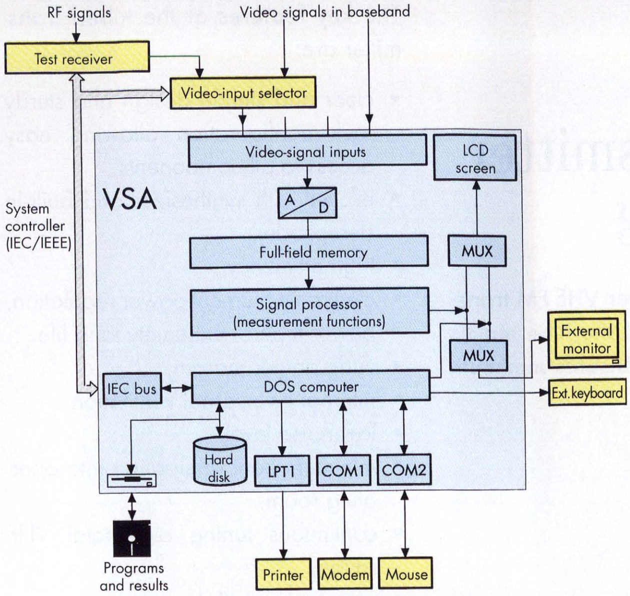


FIG 6 VSA used as measurement system

signals are received and the individual program sources have to be reliably identified (eg in cable networks).

The **system controller** function makes VSA a complete automatic test system capable of controlling external devices via the IEC/IEEE bus or the serial interface (FIG 6). In addition to the described measurement functions, the system-controller function provides the user with a complete DOS PC with integrated R&S IEC/IEEE-bus card and separate display. Programs available from previously used DOS system controllers (eg R&S BASIC programs) may be run on the integrated system controller without any modifications. Customized programs may be started via the pull-down menus without any DOS knowledge being required, or directly from the DOS command line. Programs in VSA are always executed in parallel to the measurement function, no matter whether the display is used by a measuring instrument or by the DOS computer. Switchover between measuring-instrument and DOS display is possible any time with one keystroke.

An external keyboard and a VGA colour monitor are available as options for writing customized programs. In this case the computer can be placed "next to the measuring instrument". Of course, the external keyboard may not only be used for the DOS computer but also for all VSA measurement functions. The colour monitor can be used either as an additional display for the DOS computer or as a large-size measurement display.

Future-proof VSA concept

The great number of integrated functions and system interfaces make VSA already today an essential tool for all video measurements and system applications. In addition to the versatile measurement capabilities, the modular software and hardware concept offers plenty of reserves for future applications.

Thomas Bichlmaier; Richard Finkenzeller

Condensed data Video Measurement System VSA

Functions	analyzer for a great variety of video parameters, vectorscope, 3-channel oscilloscope, monitor, 486 DOS PC
Standard	B/G, D/K, I PAL (625 lines)
Inputs	4 loop-through inputs
Bandwidth	0 to 9 MHz
Interfaces	1 parallel (Centronics), 2 serial (RS-232-C), 1 IEC/IEEE bus, 1 external keyboard, 1 external VGA colour monitor
Options	active colour LCD, 250-Mbyte hard disk, 16-Mbyte main memory, under preparation: standard NTSC, TV test receiver and videotext decoder

Reader service card 147/05

20-kW VHF FM Transmitter SR240B1

The high-power tubed transmitter for VHF sound broadcasting

With SR240B1 Rohde & Schwarz has brought out a high-power VHF FM transmitter coupled with high efficiency. The extremely long life of the tube makes the transmitter suitable for the coverage of large areas and ensures minimum maintenance and low operating costs.

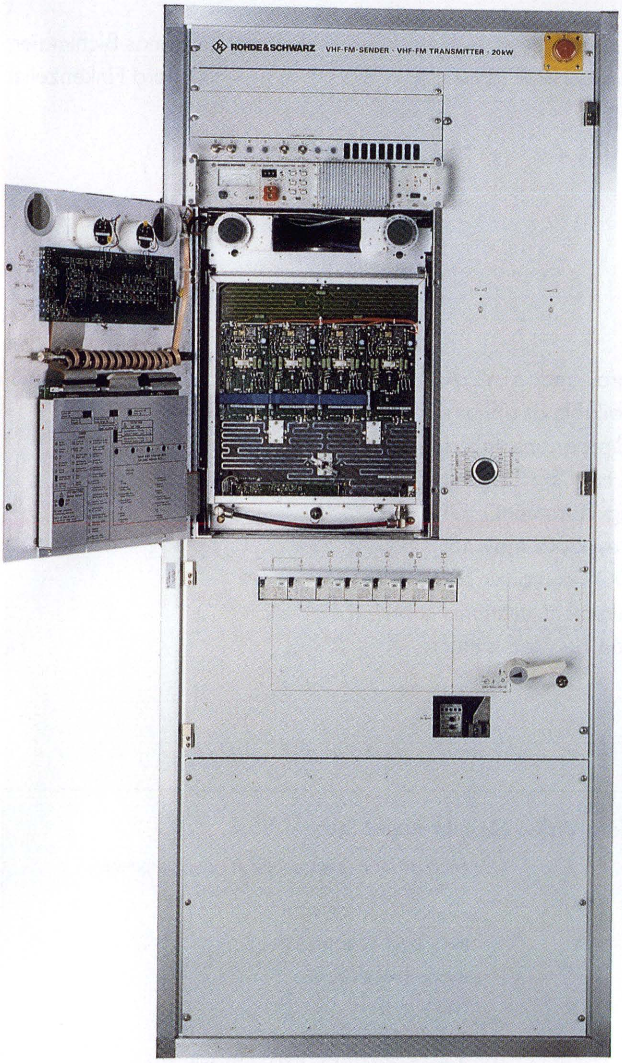


FIG 1 Tubed VHF FM Transmitter SR240B1 with 20-kW output power
Photo 41 530/2

High transmitter powers, as required for large-area coverage, have so far only been achieved with 10-kW transmitters in active standby, at correspondingly high outlay on equipment and costs. This was the reason why Rohde & Schwarz has extended its product line of the well-proven VHF FM Transmitters NR410R1 (10-kW tube) and NR410T1 (10-kW transistor) [1 to 3] by 20-kW tubed Transmitter SR240B1 (FIG 1).

The **key features** of the tubed transmitter are:

- clear and simple design and sturdy rack configuration allowing easy access to all components,
- exciter with synthesizer and built-in stereocoder,
- high efficiency,
- electronic filament-power regulation,
- power tube of extremely long life,
- wide power margin,
- internal or external ventilation,
- low noise level,
- minimum heat dissipation into operating room,
- continuous tuning over total VHF range,
- easy tuning with two elements,
- option for modifying transmitter to standby transmitter for (n+1) backup concepts (can be preset).

Description

The 20-W drive power from the exciter is routed to the solid-state driver amplifier where it is split up to four parallel 250-W amplifier modules via input dividers. The output coupler combines the individual powers to form a drive power of approximately 800 W. This power is transferred to the broadband input circuit of the tetrode amplifier stage where it is boosted to 20 kW (FIG 2). Harmonics are suppressed by a harmonic filter located between cavity resonator and RF transmitter output.

Within its wide range of applications, 20-W FM Transmitter SU 115 [4] is mainly used as an **exciter** for VHF FM transmitters with high output power. Fitted with a remotely controlled synthesizer/oscillator, SU 115 is ideal for use as an exciter in transmitter systems with active, passive or (n+1) standby. The output frequency can be selected in 10-kHz steps from 87.5 to 108 MHz. SU 115 can transmit mono and stereo signals as well as additional information such as traffic-radio, SCA and RDS signals.

The **800-W driver amplifier** provides the required drive power for the 20-kW tubed amplifier. It comprises a 1:4 input power divider, four 250-W push-pull amplifiers, a 4:1 output-power coupler with integrated measuring amplifier as well as monitoring circuits protecting the MOSFET stages against mismatch. All boards are made from double-sided copper-plated teflon. The 250-W amplifiers are used in the 1.3-kW amplifier module of the 10-kW transistorized transmitter and have been well-proven. No alignment of any kind is required for the input divider and output coupler. The directional coupler contains a harmonic-filter PCB. The monitor is implemented in SMD technology. State-of-the-art computer circuit-analysis routines were used for the development of the 800-W driver amplifier modules. The 800-W driver amplifier is integrated in the lid of the 20-kW cavity resonator and is cooled by the forced-air cooling of the transmitter.

The **20-kW cavity resonator** including a grid circuit and an anode circuit, which are separated from one another, is of extremely rugged yet simple design. The grid circuit with matching network is broadband and completely maintenance-free. When the frequency is changed, only two elements in the anode circuit have to be tuned, ie an inductive anode-circuit element and an inductive output-coupling element. The two tuning elements are shorting plungers which permit the frequency-determining inductances to be varied continuously over the entire frequency range. The tuning process can be automated. The preset option makes the transmitter a complete (n+1) standby transmitter with motor-driven tuning. The tube can be replaced within a minimum of time, since the cover of the cavity resonator for the 800-W amplifier with self-engaging connectors can easily be removed. By appropriate mounting of the coaxial, four-section harmonic filter, the RF output can be brought out at the top or bottom of the transmitter. The transmitter has a minimum power margin of 10%. When the anode voltage is reduced, it is possible to operate the transmitter with lower output power yet maintain the high anode efficiency.

Like for the "small brother" of SR240B1, ie the 10-kW tubed transmitter, a special circuit has been chosen offering the advantages of the grounded-grid circuit (high stability) as well as a better gain. The circuit is easy to balance by producing a bridge neutralization with the interelectrode capacitances. So the amplifier remains stable even with selective loading or incorrect operation. A further advantage of this circuit is the fact that the neutralization need not be readjusted after replacement of the tube. The 4CX20000C tube from EIMAC, which is known for its low failure rate and used in the 20-kW amplifier guarantees long life and large power margins. If a fault occurs in the 20-kW amplifier, the 800-W driver amplifier can be directly connected to the antenna output of the transmitter.

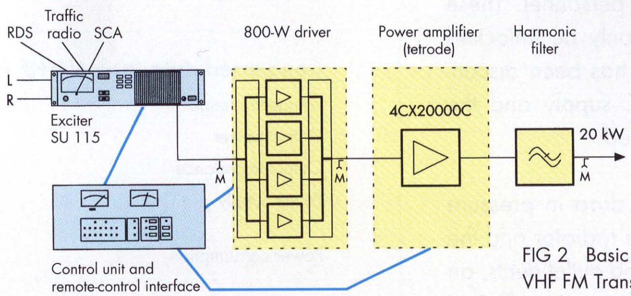


FIG 2 Basic circuit diagram of 20-kW VHF FM Transmitter SR240B1

Control, monitoring and measured-data acquisition

The transmitter control unit ensures the correct switch-on sequence for the cooling system, filament power and electrode voltages, monitors and indicates the currents and voltages of the tube, the inlet and outlet temperatures as well as the transmitter power. The unit comprises the switch-on sequence/operating control module and the display module. Both modules are located behind a pivot-mounted front door of the transmitter and so accessible for servicing without having to use adapter cables or interrupt operation. Because of the conventional logic circuits used, repair is possible even in emergencies by referring to the circuit diagram and using simple measuring devices. The modules are isolated by optocouplers at all inputs and outputs and thus protected against overvoltages.

All necessary fault indications appear on front-panel LEDs of the transmitter control unit and are stored in a non-volatile memory. Overcurrent, overtemperature and reflection thresholds are checked by auxiliary circuits in the transmitter control unit. The first failure message generated in case of a transmitter fault is available in BCD code at the remote-control interface. The displays, messages and commands as well as the transmitter quality data are in line with the international standard specifications.

The measuring amplifier, which is accessible from the transmitter front panel, provides all indicated measured values as analog voltages at a female connector. An optional analog/digital converter from Rohde & Schwarz can be connected to an external PC. Together with the software supplied, this converter allows convenient monitoring and storage of the operating data, even over long periods. In addition to the graphic display for measured values with indication of the date and time of day, the option is also provided with a printer output.

Cabinet rack and cooling system

The modules such as anode voltage supply, screen-grid and grid voltage supply, filament-power regulation and power distribution are of simple design, easy to service and yet extremely reliable. These components are easily accessible either from the pivot-mounted front door or the rear door of the rack. A key-switch interlock system or a safety switch are provided to protect personnel. These safety devices can only be unlocked after the transmitter has been disconnected from the AC supply and the high voltage grounded.

Because of the low drop in pressure across the large tube radiator and the optimized air inlet and outlet ducts, an internal low-noise blower is sufficient for cooling the transmitter. The blower is accommodated in a closed and thus sound-insulating cabinet, which also contains the anode voltage generator with transformer and rectifier. The heat is therefore not dissipated to the operating room but retained in the outlet air duct. The cooling air can be introduced and expelled either from the top, the bottom or diagonally. If required, the air can also be drawn in from the operating room via a fine filter integrated in the transmitter. The noise level of the transmitter is normally about 63 dB(A) because of the sound-proofing measures inside the rack.

Bernd Quirmbach; Rainer Steen

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Condensed data 20-kW VHF FM Transmitter SR240B1

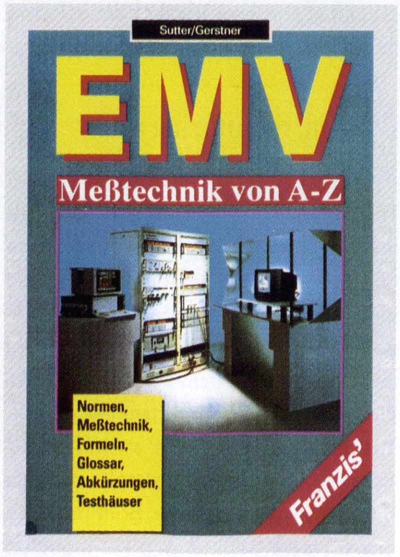
Frequency range	87.5 to 108 MHz
Output power	20 kW (10 kW), max. 22.5 kW
Output impedance	50 Ω
Power supply	3 x 400 V/230 V, 50 Hz (other voltages and frequencies optional)
Power consumption	34 kW (at 20-kW output power, with blower)
Cooling-air flow rate	15 m^3/min
Dimensions (W x D x H)	873 mm x 1000 mm x 2026 mm
Weight	approx. 750 kg
Tube	4CX20000C
RF output	EIA 3 $^1/_8$"

Reader service card 147/06

Booktalk

EMC measurements from A to Z

by Xaver Sutter and Achim Gerstner; this reference book is based on the authors' work as professional engineers and product managers in the field of EMC systems at Rohde & Schwarz. Published by Franzis Verlag, Poing near Munich, 1994. ISBN 3-7723-6193-5, 208 pages, 36 illustrations. Available in bookshops at a price of DM 59 (in German only).



In the course of the harmonization of EMC laws and standards in Europe, manufacturers and importers of electronic instruments, systems and components are obliged to make sure that their products are in compliance with the relevant regulations. The reference book "EMC measurements from A to Z" is intended to be a practical guide for all those who have anything to do with EMC. Thanks to the layout of the book, the required information can be readily found. Under the technical terms, the book provides abbreviations from ABB (abbreviation for the German committee for lightning protection and research) to ZZF (abbreviation for the German central approval office for telecommunications), definitions from absorber to TEM cell as well as the most important German EMC test houses listed according to the post code (as of April 1994). A bibliography and supplier index can be found in the annex; the cover page shows an EMC test system from Rohde & Schwarz.

wgr

Digital audio broadcasting – propagation measurements with Coverage Measurement System TS9954/55 DAB

Full coverage of service areas is of utmost importance to broadcasting authorities and private broadcasters alike. For this reason field tests have to be carried out with the aid of mobile transmitters already in the planning stage. Such field tests are the only way to find the optimum position for transmitter stations. For propagation measurements for the digital audio broadcasting networks presently being set up, Rohde & Schwarz has introduced Coverage Measurement System TS9954/55 DAB consisting of Mobile Measuring System TS9955 DAB and Stationary Evaluation System TS9954 DAB (FIG 1). The system is a further development of the coverage measurement system for digital services in general, which has already been supplied over 100 times [1]. The mobile measuring system determines all relevant data during a test tour and stores them together with location markers and geographical coordinates. The stationary evaluation system processes the measured data and, in addition, defines data for future test tours which are then made available on disks for use by the technician carrying out the measurements.

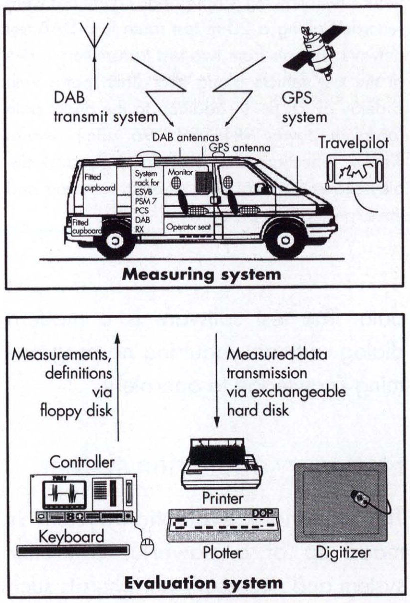


FIG 1 Principle of Coverage Measurement System TS9954/55 DAB

Mobile measuring system

The measuring system is accommodated in a vehicle that has been especially prepared for this purpose. A great number of extras in addition to standard fittings, such as the power supply and special furniture, ensure reliable and convenient operation of the built-in test equipment.

The measurement system is of modular design (FIG 2), the basic model consisting of **Test Receiver ESVB** [2] and **Industrial Controller PSM 7** [3]. The test receiver measures field-strength values at a rate of 2.5 ms at four frequencies and forwards the measured data to the controller where they are stored.

Automatic **navigation systems** continually determine the vehicle position during a test tour. The geographical position information and the location markers from a pulse generator are stored together with the measured data. This allows data evaluation over the whole distance covered, without any manual digitization being required. With the aid of Satellite Navigation System GPS (global positioning system) the position can be located with great accuracy to within 20 m for a period of one hour. This system can be used wherever satellite reception is possible. An alternative is travelpilot which uses digitized road maps stored on CD ROMs. Each of the two navigation systems has its advantages and disadvantages. The GPS system can be used worldwide but sat-

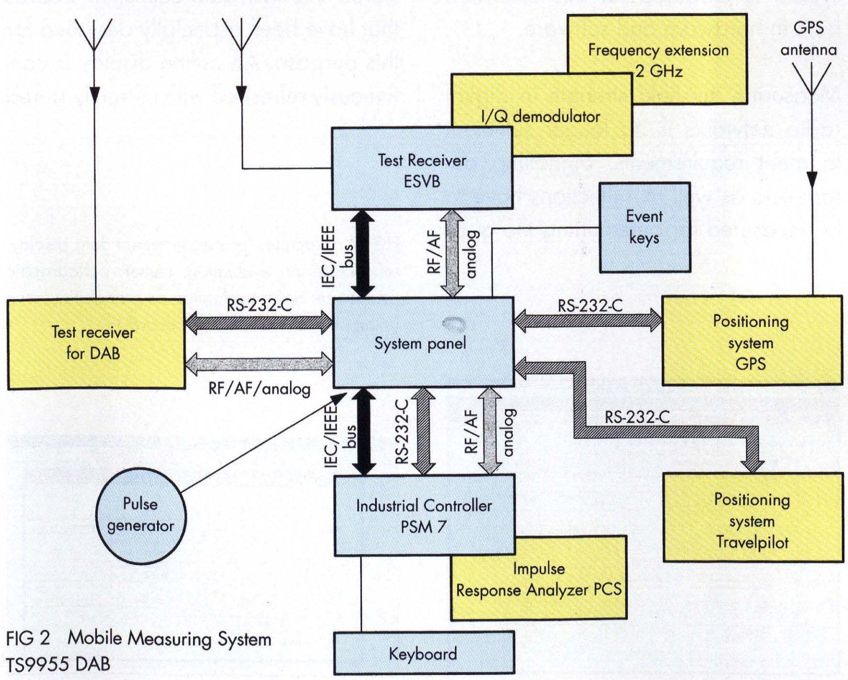


FIG 2 Mobile Measuring System TS9955 DAB

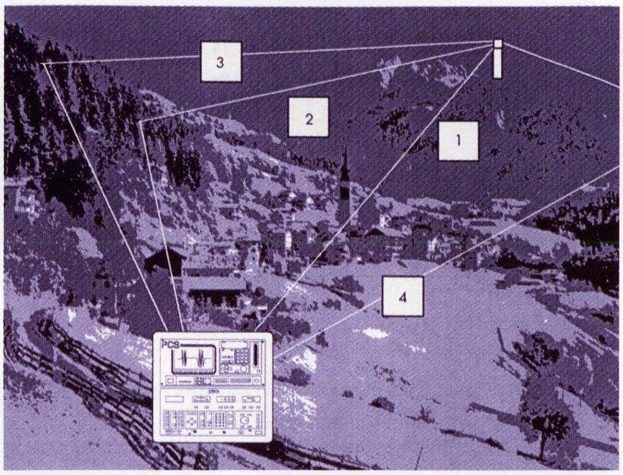
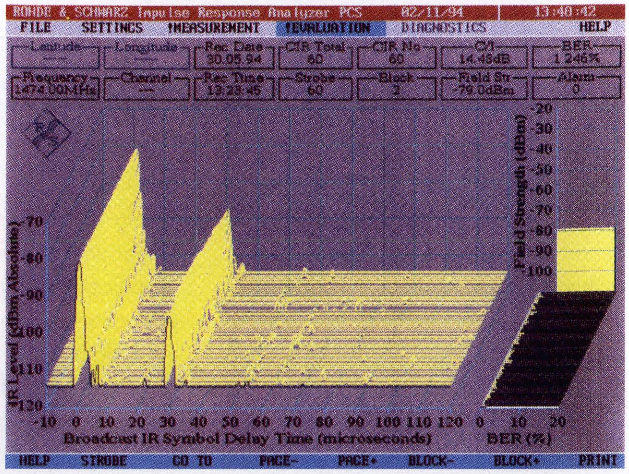


FIG 3 Multipath propagation measurement using Test Receiver ESVB and Impulse Response Analyzer PCS (way 1 direct transmitter 1, ways 2 and 3 reflected, way 4 direct transmitter 2)



ellite signal reception may be interrupted by shadowing. Travelpilot, on the other hand, functions reliably any time provided the vehicle is on a road that has been digitized on the CD ROM. The ideal solution is a combination of both. A processor hooked up to the two systems selects the best position information and forwards it to the controller.

This basic system may be extended later on by a **DAB test receiver** for measuring signalling parameters. The system is prepared for this extension both in hardware and software.

Measuring the field strength in digital radio networks is no longer sufficient to meet requirements. Signalling parameters as well as reflections have to be measured for determining the quality of a network. The measurement of the channel impulse response is the best method for assessing the field-strength values measured with Test Receiver ESVB. The channel impulse response can be measured with **Impulse Response Analyzer PCS** (FIG 3). All measurements are in real time, and in operative networks they may be carried out by a test transmitter system [4]. Results are output on a screen in the form of two- or three-dimensional graphics (FIG 4).

The measuring instruments are fully controlled by Industrial Controller PSM 7. Measured data (up to four field-strength values, location markers, navigation information and test-receiver data) are stored via fast data-collection boards that have been especially designed for this purpose. An online display is continuously refreshed with currently stored data. The test software is a modern dialog software requiring no programming knowledge to operate it.

FIG 4 Three-dimensional representation of channel impulse response measured in DAB network. The following propagation conditions were recorded along a 20-m test route in a DAB test network: signals from two test transmitters arrive at the test vehicle along two direct paths with a delay of 28 µs. In addition to the direct path (absolute power –81 and –96 dBm) several weaker reflections are received. A window display shows the total field strength received and the expected raw BER.

Stationary evaluation system

The stationary evaluation system is made up of a powerful controller system and necessary peripherals such as plotter and printer (see FIG 1). With the aid of a Windows-oriented evaluation software the raw measurement data are represented according to different criteria (FIG 5). The following types of **evaluation** are offered as standard:

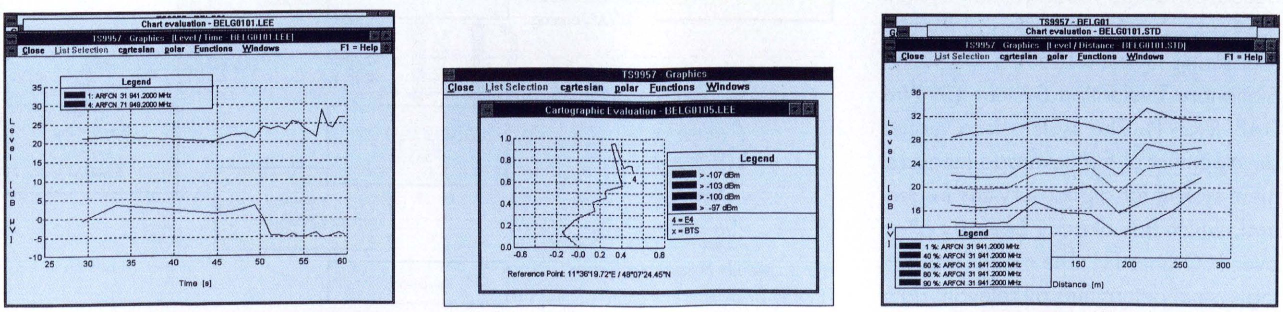


FIG 5 Examples for measurement data display. Left: Cartesian evaluation; center: cartographic evaluation; right: evaluation as probability curve (examples with GSM data records)

- Cartesian evaluation (output of measured parameters versus distance covered or versus time for representation in an XY display),
- cartographic evaluation in different systems of coordinates (output of data collected along a test route with position coordinates that are either generated automatically by the navigation system or manually digitized),
- probability curve with entry of a decile value in %,
- output of text in ASCII format (data can thus be transferred to other evaluation programs, eg EXCEL),
- output of control data (eg signalling parameters when a DAB receiver is used).

Enhancements

The modular, obsolescence-proof design of Coverage Measurement System TS9954/55 DAB allows virtually any kind of extension to be added on. For instance, the system may be supplemented by a portable system consisting of DAB test receiver, laptop, 12-V power supply and navigation system – all accommodated in a case – or by a transmitter system with SMHU 58, ADS and Software DAB-K1 for generating test signals [5]. Services like system integration into the test vehicle, training of operators or turnkey solutions are an integral part of the DAB measurement system.

Johann Maier

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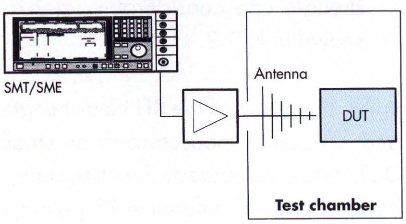
Test hint

Frequency-response compensation for EMC measurements

When EMC measurements are performed as indicated below, problems are often encountered because the field strength in the test chamber is strongly frequency-dependent. This is chiefly

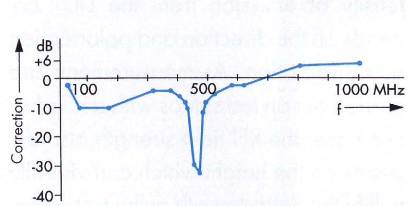


caused by the frequency response of the antenna and the amplifier, mismatch at the amplifier/antenna/test chamber interfaces, and reflections in the test chamber. Software correction performed by a controller has been the method commonly adopted to compensate for this frequency response.

Signal Generators SMT and SME (5 kHz to 1.5/3 GHz in both cases) provide a user correction function (UCOR) for generating user-defined level profiles giving a constant or well-defined level-vs-frequency characteristic at the end of a signal path. Cost-effective SMT, in particular, is ideal as an EMC signal source for this application. A relative level profile for the user correction function is formed by entering a number of frequency/level pairs as interpolation points, which are then joined with line segments to give a polygonal curve. The signal generator calculates the correction values for frequencies between these points by means of linear interpolation, and adds them to the set levels in each case. The frequency difference between the interpolation points is user-selectable, so that level profiles which are curve-like, and so a good approximation, can also be generated. The relative level profile obtained in this way is used in all operating modes – even in the sweep mode – when the user correction function is switched on. It is, therefore, possible to perform semi-automatic measurements without any extra equipment being required.

The user may enter up to 160 interpolation points in a correction table, with correction values between −40 dB and +6 dB referred to the set level. The typical level error is dependent on the size of the correction, it is ±0.3 dB for >−10 dB, ±0.5 dB for >−20 dB, and ±1 dB for >−30 dB level reduction. As, in general, at least one calibration measurement of the setup has to be performed, internal level errors, too, can be corrected with this function.

The user correction function is a powerful way of compensating for virtually any type of frequency response. As the level profile is calculated by SMT/SME alone, even complex level characteristics can be produced without any calculation or programming work performed by the user. The user correction function is of course also suitable



Example of level correction curve

for any other type of application where a defined level frequency response is needed. In addition to SMT and SME, the state-of-the-art microwave generators of the SMP family also have this function.

Roland Krüger

Reader service card 147/08 for further information on SME/SMT

Faster RFI field-strength measurements through prescanning with MDS clamp

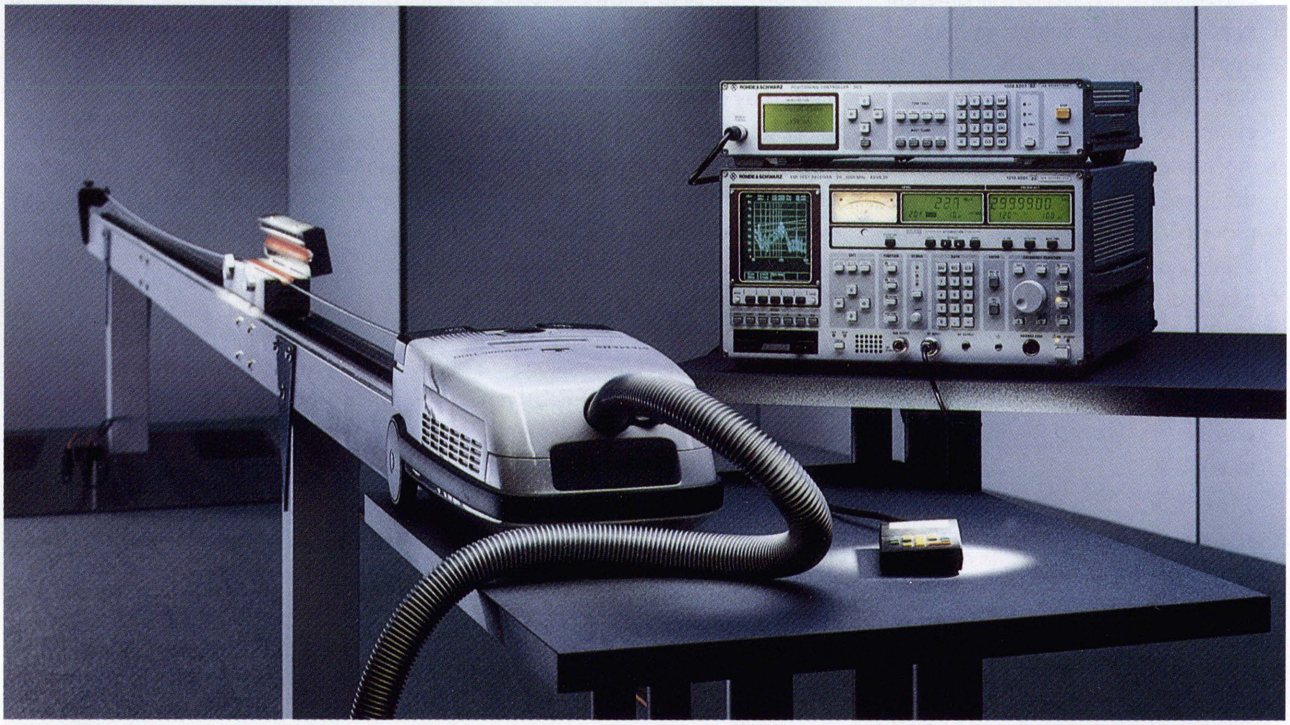


FIG 1 Fully automatic measurement of RFI power
Photo 41 351/1

Measuring the RFI field strength of electric and electronic instruments and systems in the frequency range from 30 to 1000 MHz is one of the most time-consuming tasks in RFI measurements. What are the reasons for this? The intensity of emission from the DUT depends on the direction and polarization of the radiation. As measurements are carried out on test setups with a conductive base, the RFI field strength also depends on the height which can virtually nullify the field strength at the test antenna. As the polarization, direction of radiation and antenna height for the maximum field strength cannot be generally predicted, the antenna height and the DUT azimuth have to be scanned with both horizontal and vertical polarization of the antenna by continuously observing the RFI spectrum. All this causes long measurement times. Any improvement towards reducing measurement times would therefore be desirable.

Replacing RFI field-strength measurements

Long measurement times is not a new problem and this is why proposals to avoid RFI field-strength measurements have been put forward over and over again. For DUTs whose size is small compared to the wavelength and whose radiated emission is mostly via connecting cables, it was proposed some 25 years ago to replace the RFI field-strength measurement by the measurement of the maximum RFI power on lines [1]. This has meanwhile become a standard for RFI measurements on domestic appliances and electric tools in the frequency range from 30 to 300 MHz. In contrast to test methods using current transducers and near-field probes, employing the MDS clamp is more advantageous since standing waves are attenuated in this case (FIG 1).

For DUTs, however, for which RFI field-strength measurement is prescribed, RFI power measurement cannot be used as an equivalent due to the following reasons:

1. RFI power measurement is mostly limited to the range 30 to 300 MHz as, above 300 MHz, the size of most DUTs is no longer small compared to the wavelength.
2. The correlation RFI power/RFI field strength can considerably vary as shown in FIG 2.

In [2], the results of the RFI field-strength and RFI power measurement on small DUTs were compared. The frequency-dependent level difference RF (relation factor) is equal to the logarithmic ratio of RFI power in pW to RFI field strength in μV/m of a DUT:

RF in dB (pW/μV/m)
= RFI power level in dBpW
– RFI field-strength level in dBμV/m.

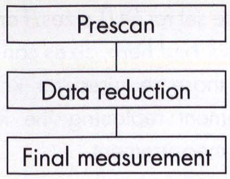
For this reason, RFI power measurements using an absorbing clamp are practically restricted to domestic appliances and electric tools assessed for compliance with CISPR 14 and

VDE 0875, part 14. For small ITE units (information technology equipment) limits are being drawn up, for other groups of equipment such as ISM units (industrial, scientific, medical) only RFI field-strength measurement has so far been used.

Other methods for replacing RFI field-strength measurements, such as estimating the far-field strength by means of near-field measurements or by current measurements on lines result in an even worse correlation with the field-strength measurement. Using an absorbing clamp slideway for prescans, the test time can be reduced considerably by confining the RFI field-strength measurement to the critical frequencies at which the prescribed limits are likely to be exceeded.

Saving time through fast prescans and data reduction

Computer-controlled EMI measurements bring about time saving together with high reproducibility and accuracy of results. Automatic measurement is not just manual measurement carried out by the computer. If the relevant standards are applied to automatic measurements without sufficient considerations, unduly long measurement times may result. It is for this reason that the measurements should be performed in the following sequence [3]:



The **prescan** is used to provide rough information about the RFI spectrum. If narrowband and broadband interferences are contained in the spectrum, the spectrum has to be analyzed in steps which are smaller than the measurement bandwidth. The prescan is carried out with the peak detector of the test receiver because of the following reasons:

1. The peak detector is faster than any other type of weighting detector as no transient times have to be taken into account.
2. This detector detects the interference maximum within the measurement time. If the DUT is in a mode that produces maximum interference and if the measurement time is sufficiently long to detect the interfering event, then the result of the prescan indicates the maximum spurious emission.

During the prescan it has to be made sure that the spectrum is completely detected even if it is subject to spatial and temporal fluctuations.

Data reduction is the vital link between prescan and final measurement for saving time. It allows critical frequencies to be determined in the RFI spectrum already during the prescan. Time-consuming measurements such as those with the quasi-peak detector or the determination of local emission maxima need not be carried out for every frequency. Measurements can be confined to frequencies whose peak value is either above or near the limit value. One practical method already in use with Test Receiver Family ESxS [4] and EMI Test Software ES-K1 [5] is to divide the entire frequency range into different subranges and to compare the maximum values of each subrange with the emission limit.

The **final measurement** comprises time-consuming measuring and evaluation procedures at the critical frequencies such as measurements with the quasi-peak detector and determination of emission maxima by moving the absorbing clamp or by changing the antenna height and turning the DUT.

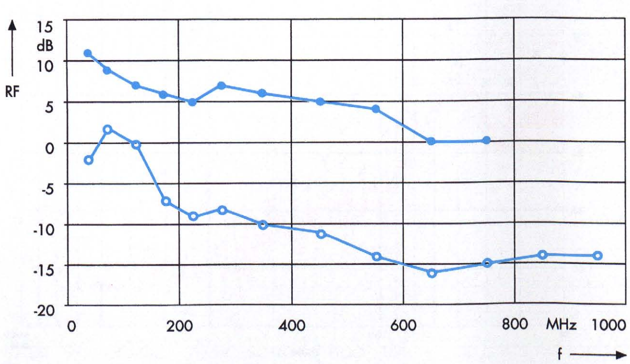


FIG 2 Extreme values of relation factor RF for small DUTs (to [2])

Common methods used for RFI field-strength measurements

For the detection of critical frequencies in RFI field-strength measurements, a setup for the DUT and test antenna for obtaining maximum field strength has to be found. The interference for this setup has to be correctly weighted, ie measured with the quasi-peak detector. Previous methods of determining the RFI field strength also make use of a field-strength measurement to find the critical frequencies. As there is a risk of wave cancellation at the test antenna, the height of the test antenna and the azimuth of the DUT for two antenna polarizations (horizontal and vertical) have to be found in repetitive frequency scans. Thus, **three parameters** – antenna height, antenna polarization and DUT azimuth – have to be varied in the determination of **critical frequencies.** To obtain the total prescan measurement time, the measurement time for a frequency scan using the peak detector thus has to be multiplied with the number of antenna and DUT azimuth positions.

Reduction of total measurement time through prescanning using absorbing clamp

A variation of the three parameters can be avoided by resorting to RFI power measurement to determine the critical frequencies (prescan) on DUTs which emit a considerable proportion of RFI via the connecting lines. For **RFI power measurements,** only **one parameter** – the position of the absorbing clamp on the cable to be measured – has to be varied. The method can be simplified by not varying the clamp position and by incorporating a higher safety margin into the test run. The subsequent RFI field-strength measurement is thus reduced to a repeat measurement of the critical frequencies. The provision "considerable proportion of RFI via the connecting lines" is with reference to the DUT size. DUTs with large dimensions such as 19" racks emit a high proportion of the interference energy via the cover and are thus unsuitable for this method. However, clear limits cannot be set for DUT sizes. For the prescan described here, sizes can be larger than those required for RFI power measurement replacing the RFI field-strength measurement.

To ensure that all critical frequencies at which the RFI field-strength limit might be exceeded are found using RFI power measurement, the limit LP for the RFI power measurement (FIG 3) has to be defined as follows:

$$LP/\mathrm{dBpW} = LF/\mathrm{dB\mu V/m} + RF/\mathrm{dB(pW/\mu V/m)},$$

with LF being the limit of the RFI field strength (FIG 5).

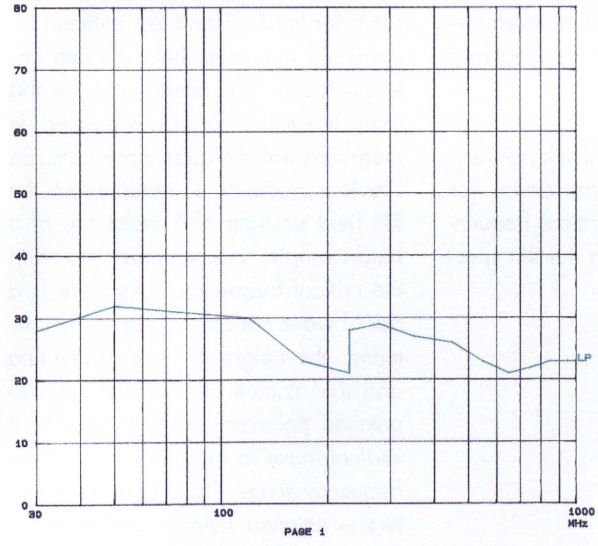
Comparison of measurement times required for prescans

Prescan by **measuring RFI power:** approx. 20000 measurements are required for the frequency range 30 to 1000 MHz with a recommended bandwidth of 120 kHz. With a measurement time of 10 ms per measured value approx. 3.5 min is required for the prescan with a fixed absorbing clamp. If the clamp positions are in addition determined at the critical frequencies giving maximum RFI power and the corresponding quasi-peak values are measured, the measurement time increases to approx. 7 min.

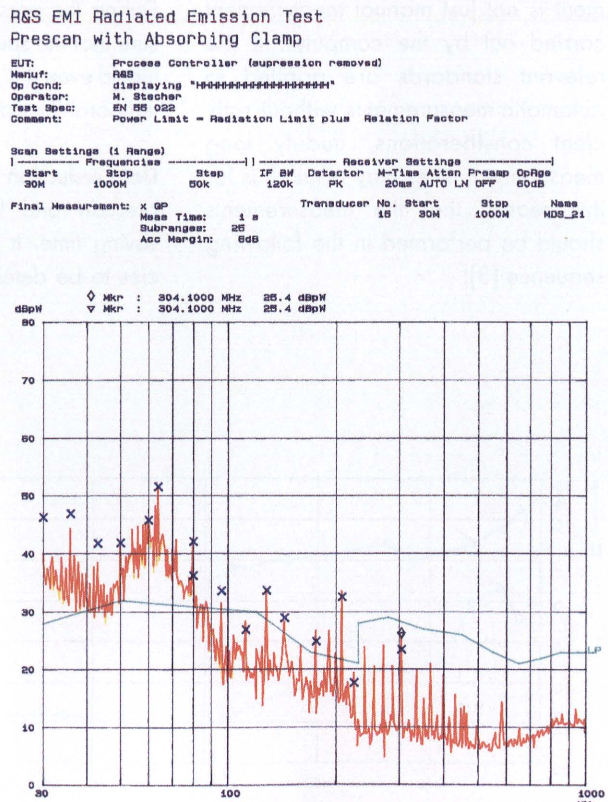
Prescan by **measuring RFI field strength:** spurious emission maxima are found using the following settings:

a) turntable positions: every 30° (12 positions),
b) positions of antenna height: 30 to 200 MHz every 1 m (4 positions), 200 to 500 MHz every 0.5 m (7 positions), 500 to 1000 MHz every 0.2 m (16 positions),
c) polarization of antenna: horizontal and vertical (2 positions).

With these settings providing a reliable detection of radiated emission, a total prescan time of 7.2 h is obtained at a measurement time of 10 ms per meas-



△ FIG 3 Limit value of RFI power for determination of critical frequencies. Limit value of RFI field strength to CISPR 22, class B.



▷ FIG 4 RFI power spectrum of prepared DUT, measured with Test Receiver ESVS, quasi-peak values of critical frequencies being marked. EMI Software ES-K1 and Absorbing Clamp Slideway HCA [6] allow automatic positioning of MDS clamp and use of critical frequencies for automatic field-strength measurement.

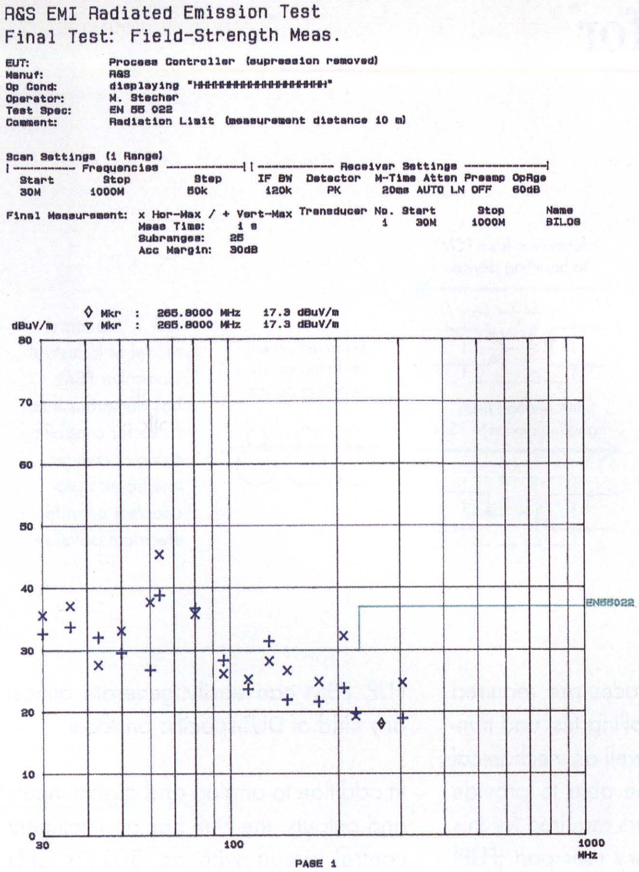


FIG 5 Results of RFI field-strength measurement (same DUT as in FIG 4) at critical frequencies, measured with Test Receiver ESVS. Software ES-K1 ensures automatic field-strength measurement including positioning of antenna using Mast HCM and of DUT using Turntable HCT 12.

ured value. The latter can be reduced, but this would also reduce the probability of detection of RFI signals subject to temporal fluctuation.

Practical test run

With the RFI power prescan, an accelerated RFI field-strength measurement is carried out as follows:

1. Determination of critical frequencies by RFI power measurement on a connecting cable of the DUT. LP is the limit value. For greater safety margin, small RF values are used to fix the limit value (see FIG 3). A freely-selectable, frequency-independent acceptance offset Δ LP/dB is used as an additional safety factor. If the DUT has a considerable spurious emission, frequencies at which the limit value of the RFI field strength might be exceeded are obtained by data reduction (FIG 4).
2. Carrying out the RFI field-strength measurement at the critical frequencies by varying the three parameters antenna polarization, antenna height and DUT azimuth. Using a setup configured for maximum field strength, the measurement has to be carried out with a quasi-peak detector as specified in all common standards for RFI field-strength measurements (FIG 5).

Conclusions

To reliably detect the RFI spectrum with short measurement times, RFI power measurement employing an absorbing clamp can be used for RFI field-strength measurements on small DUTs. As the proposed method is exclusively applied to prescans, the variation of the correlation between the RFI power and RFI field strength of a DUT only plays a minor role. In the final measurement of the field strength at critical frequencies, the actual RFI field strength is measured. Further experience has to be gained to allow conclusions to be made about the reliability of detection of critical frequencies. As the detection of the RFI field strength for interference that strongly fluctuates in time or is intermittent presents a practically unsolvable problem, the method described here improves the probability of success as practicable measurement times are obtained using a scan method of short run time which permits the RFI spectrum to be detected reliably.

Manfred Stecher

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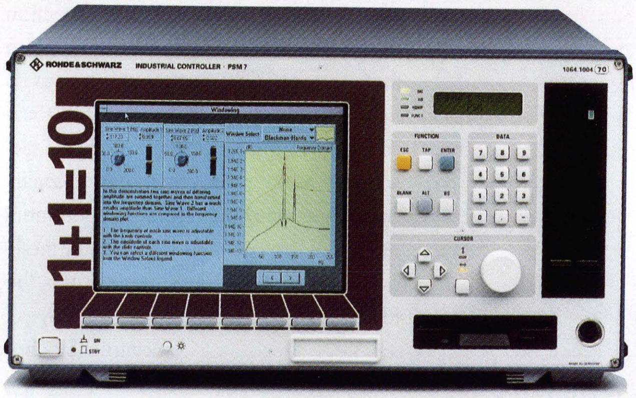
Reader service card 147/09 for further information on MDS clamps, 147/10 for EMI test receivers

Industrial Controller PSM for production rationalization



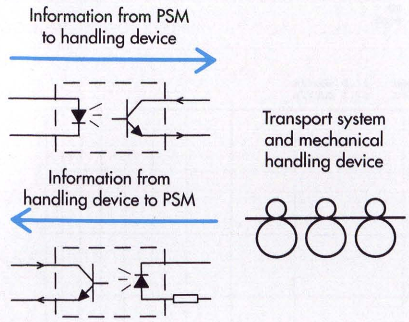


FIG 1 Standard model of Industrial Controller PSM has numerous interfaces for controlling external devices. Integrated optocouplers provide electrical isolation.

Although Industrial Controller PSM* was launched on the market only very recently, it is already being used by many customers in automatic production systems, particularly in the production of RF components. The reason is that PSM offers exactly the characteristics required for controlling automatic testing of, for instance, cordless telephones: high level of configurability, reliable operation and fast and therefore cost-effective integration into production lines.

Configurability

PSM has seven ISA slots over and above the numerous interfaces which are available as standard: IEEE 488, COM 1 to 4, two printer interfaces, four analog inputs and various control inputs and outputs. The seven slots and an efficient 200-W power supply may be used for really powerful expansions in every sense of the word.

Often, special interfaces are required in factories for controlling test and trimming equipment as well as mechanical handling tools. To be able to provide the floating connectors required for this equipment, the factory user port (FUP) of PSM has two optocouplers – one for each direction. The optocouplers not only provide floating control of external devices, they may also be used for polling their status (FIG 1). Logic levels can also be simply generated by the optocouplers, for instance the 12 V required by certain SPS control circuits. If more than two optocouplers are needed, PSM may be equipped with a TTL I/O interface providing another eight floating connectors. Program libraries for programming the numerous interfaces in various programming languages are also supplied with PSM.

Modern radiocommunication equipment is often fitted with digital test interfaces for storing alignment data in the DUT, setting the DUT to a special test mode and obtaining production information from the DUT (eg serial number). Test interfaces are not always standardized. As it may be more convenient to implement one's own protocols rather than standard protocols, logic levels and transfer protocols are frequently defined by the development engineers. With the aid of the FUP, PSM can easily generate almost any kind of DUT-specific protocol.

In addition to analog and digital inputs and outputs, the FUP has an intelligent control circuit with an 80196 CPU from Intel. This microcontroller was

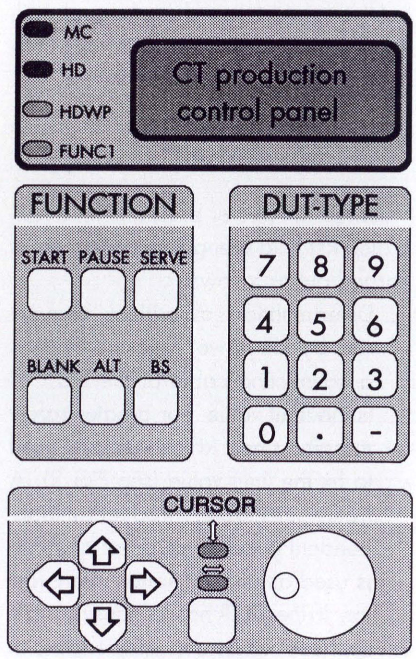


FIG 2 Integrated keyboard simplifies operation of even complex systems.

* Bues, D.; Stegmaier, J.; Vahldiek, D.: Industrial Controller PSM – Automated testing and control in production and lab. News from Rohde & Schwarz (1994) No. 146, pp 19–21

originally designed for use in vehicles (electronic ignition control and ABS) and is therefore ideal for the time-critical tasks encountered in automatic testing. Rohde & Schwarz has used this type of controller with great success in a control unit for large-scale manufacture of cordless telephones, where several production lines are in operation around the clock.

Thanks to the 80196 microcontrollers, PSM has digital high-speed input and output channels comparable to those of logic generators and analyzers. The integration of the 80196 FUP into PSM is very flexible so that the system hardware and software can be tailored to individual requirements. A special slot has been provided for accommodating the hardware necessary for adapting the FUP to external interfaces. The software (firmware) of the FUP can be generated with a C compiler and then be loaded directly from the IBM-AT-compatible core of PSM into the FUP. Experience has shown that the highly flexible FUP hardware and software make it possible to control almost any DUT, from cordless telephones to satellite receiving antennas.

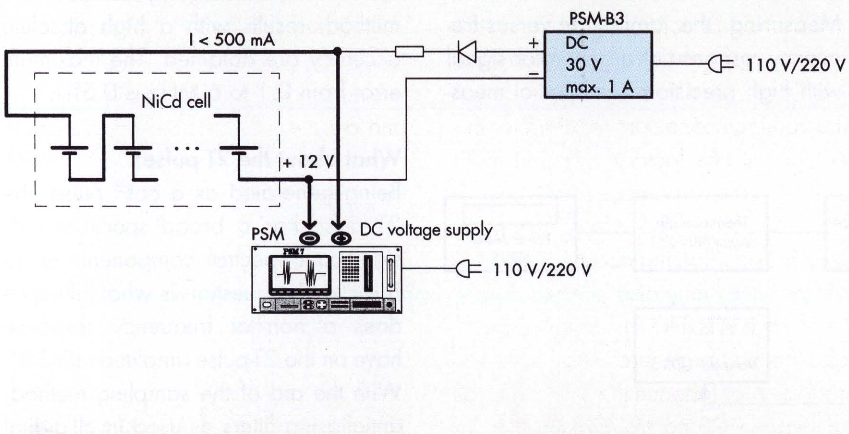


FIG 3 DC/AC Power Supply PSM-B3 and small add-on circuit ensure smooth operation of PSM – even if AC supply is unreliable.

Reliable operation

PSM has been designed to meet the stringent quality requirements of ISO 9000. Consequently, the controller has minimal spurious emissions so that even EMR-sensitive DUTs can be adjusted and tested without any problems. Two separate fans ensure that PSM does not overheat particularly when many interface cards are installed. Low temperatures in an instrument also considerably reduce the fault rate.

The keyboard integrated in PSM (FIG 2) is used to enter simple commands such as start production and stop production. When PSM is operated in a rack, the DUT types may be entered via the numerical keypad. A program library is available for evaluating keyed-in functions and for generating programs in, for instance, Visual BASIC or Visual C. The integrated keyboard also helps to reduce costs and at the same time enhances reliability: it only provides the keys that are really needed. This simplifies initial training and prevents operating errors.

Continuous, fault-free operation of the controller must be guaranteed – particularly in the case of plants that operate around the clock. The controller has to output a fault message whenever a unit fails in the plant. PSM can be equipped with a UPS (FIG 3) that guarantees proper operation of PSM for 30 minutes even after an AC supply failure – plenty of time to alarm the maintenance team.

Fast and therefore low-cost integration

Thanks to the full compatibility with the industry standard (486 CPU with 8-Mbyte DRAM and 250-Mbyte hard disk, VGA graphics, ISA slots), a large pool of standardized hardware and software is available to enhance PSM's production-specific characteristics. The internal design is optimized for type stability, which means that spares, options and support will still be available in five years time and that PSM will meet increasingly sophisticated user requirements for a longer period of time – a feature which distinguishes PSM from most of the other standard controllers.

Let's take a final look at the features of PSM – integrated keyboard, A/D converter, optocoupler, FUP processor for DUT control and 80486 computing power – this all means that PSM is an economically priced test set for production plants. PSM is not just competitively priced, if the supplied program library is taken into account as well, there are also reductions in integration and software development costs that benefit the purchaser.

Dieter Bues

Reader service card 147/11 for further information on PSM

Calibration of video test equipment

Since video signals are highly complex signals as far as their spectrum or group delay are concerned, special procedures are needed to calibrate each signal parameter objectively with absolute accuracy. For quite some time, Rohde & Schwarz has been using the methods described below with great success to calibrate TV Generators SGPF, SGMF, SFF and SAF as well as Video Analyzers UAF and UVF [1; 2]:

How do you measure the level of LF components such as the white bar?

When a sampling method like the one specified by ARD standard specifications 8/1.1 is used, the white bar and

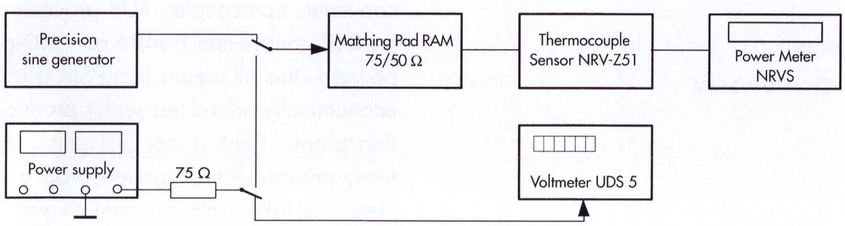


FIG 1 Calibrating thermocouple sensor and power meter from DC to 6 MHz

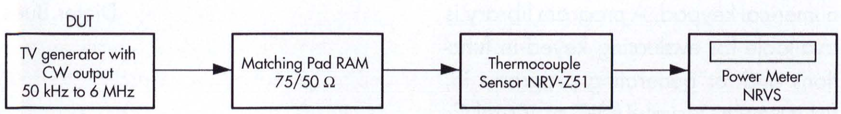


FIG 2 Calibrating amplitude-frequency response of TV Generators SGMF, SGPF, SGSF, SAF and SFF

the all-black level of a line-repetitive video signal are measured with the aid of a sampling pulse. The voltage difference between the two sampling points is the white level which is directly indicated on a precision DC voltmeter with a high input impedance (>100 MΩ). Of course, this measurement procedure must first be calibrated and verified. This is done with the same test setup by sampling and measuring a DC voltage with extremely high, absolute accuracy (error <0.01%). The ratio of the measured results reflects the reliability of the sampling procedure. With the aid of this method the bar amplitude, sync amplitude, line-time nonlinearities and various grey levels as defined by CCIR Rec. 473, 567 and 569 can be measured objectively with a very high accuracy (0.1%).

How do you measure the level of signal components in the range 0.1 to 6 MHz such as sinewave packets of a multiburst?

Measuring the amplitude-versus-frequency response of a generator signal with high precision is a special measurement problem. The solution is to use a level meter with a thermocouple sensor. Some thermocouple sensors cover the range from DC to several GHz, for example 50-Ω Sensor NRV-Z51 used together with Power Meter NRVS (and Matching Pad RAM 75/50 Ω for impedance matching). This setup, too, has to be calibrated before use with sine signals with frequencies from 0.1 to 6 MHz. The first condition to be met is that the harmonic distortion must not exceed 50 dB, as otherwise the calibration results would be well outside the permitted limits. Secondly, a precision sine generator with a flat amplitude-frequency response is required. The frequency response must be flat to within 0.2%. Such sine generators are available and continuously monitored by Rohde & Schwarz service to ensure all these criteria are met.

After the setup itself has been calibrated as shown in FIG 1, the video generator is set to the "sine generator" mode (FIG 2). All new TV generators from Rohde & Schwarz have this feature. When the amplitude-frequency response of a video signal from this generator is measured using the described method, results with a high absolute accuracy are obtained. The maximum error from 0.1 to 6 MHz is 0.5%.

What about the 2T pulse?

Being generated as a $\cos^2$ pulse, the 2T pulse has a broad spectrum with significant spectral components up to 8 MHz. The question is what influence does a non-flat frequency response have on the 2T-pulse amplitude (FIG 3). With the aid of the sampling method, antialiasing filters as used in all-digital TV generators can be calibrated (using calibration lists) with great accuracy at frequencies below 50 kHz. However, there may be alignment problems in the range from 2 to 6 MHz. It is highly fortuitous, however, that the maximum spectral power of a 2T pulse occurs

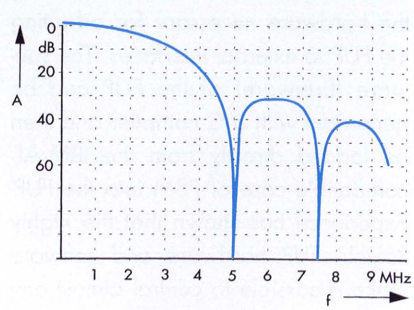


FIG 3 Spectrum of 2T pulse

at low frequencies. To determine the influence of a non-flat frequency response at higher frequencies, Rohde & Schwarz has carried out extensive calculations. The analysis covered 5% deviations from a flat response at 6 MHz using RC characteristics and 5% deviations in the case of a colour subcarrier with bandpass or bandstop characteristics and a bandwidth of 2 MHz. When the 2T-pulse amplitude was calculated, assuming these linear distortions were present, the worst-case deviation from the nominal amplitude was less than 0.8%. The amplitude-frequency response of the generator output filter can easily meet a tolerance of ≤1%. Therefore, the tolerance of the 2T-pulse amplitude is ≤0.2% – an excellent calibration value for the complex 2T pulse.

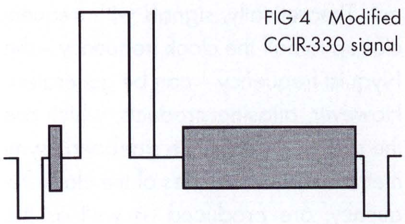


FIG 4 Modified CCIR-330 signal

How do you calibrate differential phase and gain?

Differential phase and gain are distortions of the colour subcarrier caused by nonlinearities which are a function of the luminance level. When a colour subcarrier is superposed on a constant grey level, both parameters are zero when they are measured. Consequently an IT signal similar to the CCIR-330 signal (FIG 4) with colour modulation but without the five-riser luminance staircase at the end of the line should have neither differential phase nor differential gain. To make sure that the two signal parameters are not affected by digital signal generation, an analog colour subcarrier can be superposed on the active part of the modified CCIR-330 signal via the external input of the TV

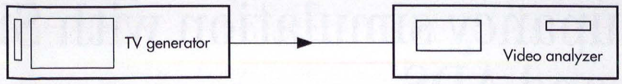


FIG 5 Checking Video Analyzer UAF with predistorted signals from TV Generator SAF or SFF

generator. This special signal makes it possible to perform error-free calibration of the zero points of the differential-phase and differential-gain parameters for any video analyzer.

How do you calibrate group delay?

As there is no special method for measuring the absolute group delay with test signals within a tolerance of <5 ns, a way has to be found for calibrating this parameter with the aid of a reference measurement. In this case, too, the required measurement accuracy is obtained thanks to the precise calibration protocol of the generator output filters, this time in relation to group delay. With the aid of TV Network Analyzer SWVF or SWKF [3] not only can the amplitude-frequency response of these filters be aligned precisely (error <1%) but the group-delay ripple is kept below 5 ns. This ripple is then compared with the results of the reference measurement, the input and output of SWVF or SWKF being connected together with a short piece of coaxial cable. Since this cable produces neither amplitude-frequency response variations nor group delay in the frequency range of interest, the difference of the two measurements is an exact measure of the group delay introduced by the signal path between the D/A converter and the output connector of the digital video generator with a resolution of 1 ns or better.

All-digital TV generators such as SGPF, SGMF, SFF and SAF use algorithms to produce output signals which, by definition, have negligible distortion. The 12-bit D/A converter, therefore, generates signals with a flat group delay. The group delay of the generator signal is solely determined by the output filter and can be measured with an accuracy of ≤1 ns using the procedures described above. The group delay of the 20T pulse is, therefore, also known and can be used to perform calibration.

These calibrated generators may be used as standards for calibrating all types of video analyzers. This has been done by Rohde & Schwarz with great success for quite some time with Video Analyzer UAF in the company's service and test departments. It is sufficient to calibrate one generator as a "primary" standard and use it to produce other calibration analyzers with the required accuracy.

How do you verify the linearity of a video analyzer?

The aim of all previous measurements was to calibrate the video analyzer at the zero points of the measurement parameters. What remains to be done is to check the linearity of the displayed parameters over the entire measurement range. With the aid of the SIGNAL EDIT menu of Generators SFF and SAF, the standard CCIR test signals can be created with predistorted signal elements. Anyone can quickly program these signals, selecting distortions of, say, ±5% and ±10% for the appropriate parameters (FIG 5). The high 12-bit resolution used for signal generation ensures that the signals produced by SFF and SAF remain within strict tolerances. Therefore, for the first time ever, it is possible to calibrate video analyzers with the highest precision over the whole measurement range.

Sigmar Grunwald

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Band-occupancy simulation with Signal Generator SMHU 58 and ADS

With up-to-date cordless telephones there is not just one dedicated channel for setting up calls between handset and base station, the system may chose a different channel from a great number of available channels each time a call is set up. Finding out what happens when almost all channels are occupied is an interesting measurement to carry out. The system must be able to rapidly identify occupied channels and set up a call on even the last free channel wherever it may be in the available frequency band. For the test, there has to be an RF carrier in every channel that is considered to be occupied. It may be possible to do this for half a dozen channels by combining a corresponding number of signal generators and applying their output to the free channels, but in systems with, for example, 20 or even several hundreds of channels, a test system of this kind would be completely unfeasible.

There is a much more elegant way of generating a signal spectrum. The modulation method used for digital radio broadcasting, COFDM (coded orthogonal frequency division multiplex), that is the transmission of information on several hundred carriers [1; 2], can also be employed to simulate band occupancy for the test in question: Signal Generator SMHU 58 comprising an I/Q modulator provides the carrier frequency and dual-channel Arbitrary Waveform Generator ADS [3] acts as a modulation signal generator for SMHU 58 (FIG 1).

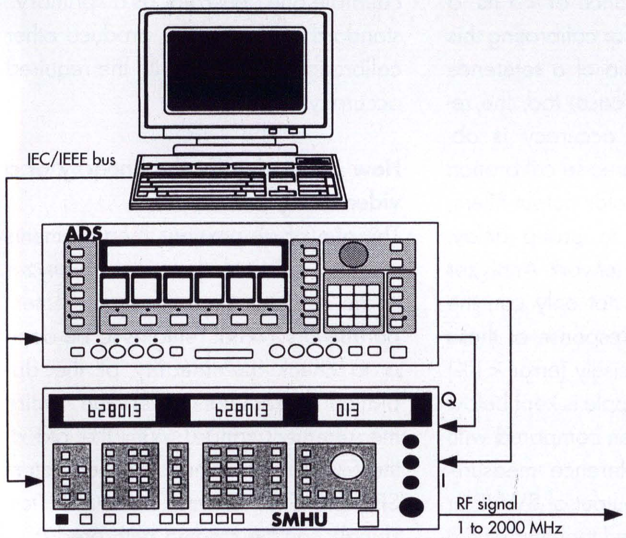

FIG 1 Instrument combination for generating signal spectrum required for band-occupancy testing

ADS has a memory where the samples of a particular signal are stored in digital form. The memory is read using a clock and a D/A converter transforms the digital values into an analog signal. Even highly complex signals can be generated with this method. The modulation signals are calculated using program DAB-K1, software originally designed for the calculation of COFDM signals run on a PC [2]. The number of RF carriers and their spacing can be selected within wide limits. It is also possible to suppress individual carriers to simulate free channels in the spectrum.

The center frequency of the spectrum can be set anywhere within the frequency range of 1 MHz to 2 GHz of Signal Generator SMHU 58. The maximum bandwidth of the RF spectrum is determined by the highest modulation frequency of Arbitrary Waveform Generator ADS. This frequency on the other hand depends on the clock rate at which ADS outputs the modulation signal. Theoretically, signals with frequencies up to half the clock frequency – the Nyquist frequency – can be generated. However, aliasing products, which are the sum and difference sidebands symmetrical about multiples of the clock frequency, are produced as well as the wanted signal (FIG 2). These products have to be rejected at the output of the ARB generator by means of lowpass filters. Since the characteristic of a lowpass filter cannot be infinitely steep, the highest frequency must be somewhat below the Nyquist frequency. As a result, the highest frequency is about 40% of the clock frequency. Since ADS has a maximum clock frequency of 40 MHz, a value of 16 MHz, which is quite considerable, is obtained.

As a separate upper and lower modulation sideband can be generated

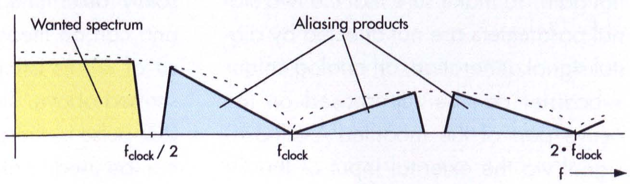

FIG 2 Signal spectrum from ARB generator

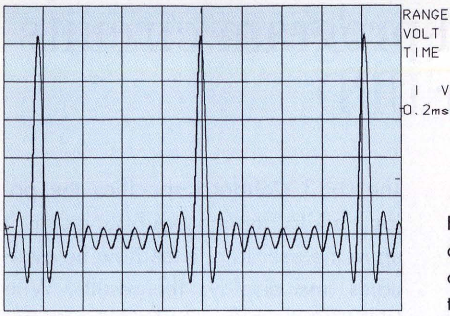

FIG 3 Cosine signal and nine harmonics of equal amplitude in time domain

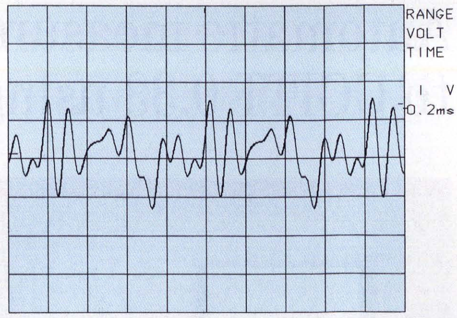

FIG 4 Cosine signal in FIG 3 with optimized phases

with a proper combination of the two output channels of ADS and the I/Q modulator of SMHU 58, the RF bandwidth is twice the bandwidth of the modulation signal, ie 32 MHz. Within this bandwidth more than 8000 carriers can be generated. It should be borne in mind, however, that the generator output power has to be divided between these carriers so that a correspondingly reduced power is available for each carrier. For example, if 100 carriers are produced with a generator output power of 1 mW, a power of 10 µW is available for each carrier.

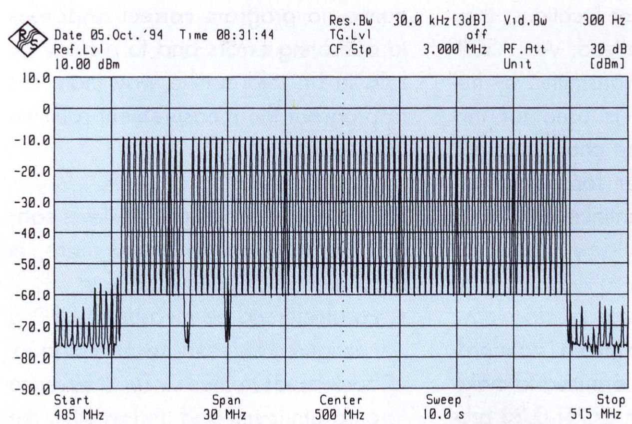

FIG 5 Spectrum with 75 occupied and two free channels for Japanese Personal Handy System

The power per carrier is also reduced by another effect: the peak power of this multi-carrier signal is considerably higher than the sum of the carrier powers. Since the generators must not be overdriven, the total power has to be reduced to the appropriate level. This high peak power occurs at certain points in time when the carrier amplitudes combine to give a very large total amplitude. This effect is illustrated in FIG 3 showing the sum of a cosine wave and nine harmonics of equal amplitude described by the formula

$$A(t) = \cos(\omega_o \cdot t) + \cos(2\omega_o \cdot t) + \ldots + \cos(10\omega_o \cdot t).$$

The peak amplitude of this signal is ten times higher than the amplitude of each wave. This means that the peak power corresponds to 100 times the power of each signal and therefore to 10 times the sum of the powers of each component. The greater the number of carriers, the worse the situation becomes.

The phase differences between the component signals play an important role when the signals are summed up. By choosing suitable carrier phases, the peak power can be considerably reduced:

$$A(t) = \cos(\omega_o \cdot t + \Phi_1) + \cos(2\omega_o \cdot t + \Phi_2) + \ldots + \cos(10\omega_o \cdot t + \Phi_{10}).$$

As is shown in FIG 4 the peak amplitude is now considerably lower than before; it is just under three times the amplitude of a component. With the aid of a small program supplied with Software DAB-K1, the carrier phases can be optimized and the peak power be kept so low that only about 5 dB of the carrier amplitude is lost. FIG 5 shows a spectrum that has been generated using this method. It simulates an almost complete band occupancy for the Japanese Personal Handy System. 75 of the 77 available channels are occupied by a carrier. A call between the mobile and the associated base station must be set up properly on one of the two free channels.

Albert Winter

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Reader service card 147/12 for further information on SMHU 58 and ADS

Automatic measurements on sound-program circuits to CCITT 0.33 using Audio Analyzer UPD

FIG 1 Versatile Audio Analyzer UPD
Photo 41 668

Audio Analyzer UPD (FIG 1) is a complete test system. It comprises the generators and analyzers required for all audio measurements on analog and digital interfaces [1]. At the same time (in multitasking mode) it also acts as a controller with integrated BASIC interpreter and program generator that leaves all comparable approaches using macro languages far behind [2]. With this controller, application programs that meet the latest requirements for user-friendly operation can be written.

To illustrate the comprehensive measurement capabilities of **Automatic Measuring System** UPD-K33, a UPD option, this article describes automatic measurements on sound-program circuits to CCITT 0.33. This standardized measurement is widely used internationally. Special about this method is that the IUTs may extend over several hundreds of kilometers (as is generally the case with program lines for sound and TV broadcasting transmitters, international program feed lines or telephone equipment). The send and receive units are set up at different locations. Unlike the special equipment mentioned in CCITT 0.33, universal Audio Analyzer UPD uses a loadable software option for automatic measurements on program circuits and requires no additional hardware.

CCITT 0.33 specifies the **type of measurements** as well as the timing. Since the signal generator and the receiver are set up at different locations, they have to be synchronized. An ASCII-character sequence transmitted by frequency shift keying is used for this purpose. Some of the characters are available to the user for sending a transmitter- or line-identification code.

CCITT 0.33 defines a sequence of measurements as a program. Up to now **five programs** have been standardized, but the user is permitted to make changes as he sees fit. CCITT-0.33 program 00 is for measuring received level, frequency response, harmonic distortion, weighted and unweighted S/N ratio as well as compander linearity. When carrying out measurements on pairs of stereo lines with the aid of program 01, interchannel difference in gain and phase as well as crosstalk and circuit transposition are also measured. Other defined sequences (programs 02 to 05) are for making measurements on (telephone) lines in a limited frequency band or just for measuring the alignment value.

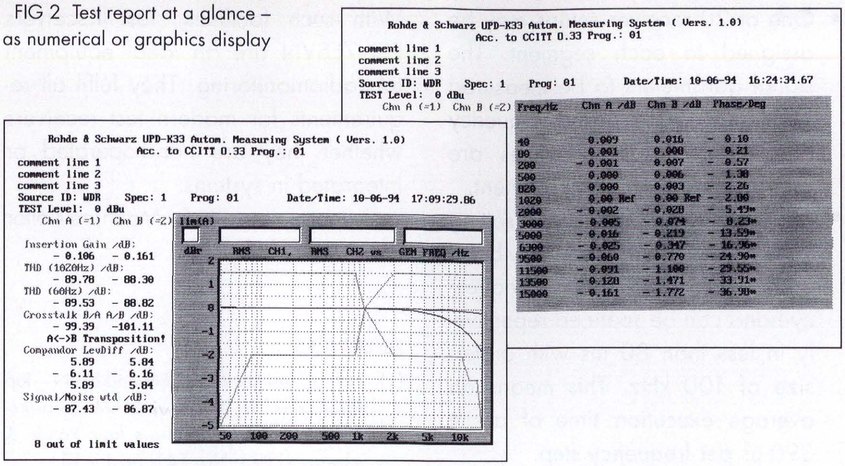
The 0.33 standard specifies the parameters to be measured but leaves it up to the user to choose how he **evaluates and displays the results.** With UPD-K33 the user can draw on a wide range of resources. Not only tables can be used for result analysis, there are also graphics showing the amplitude-frequency responses or the level and phase difference between stereo channels (FIG 2). The graphics display with appropriate scaling is, of course, also available for all other UPD applications. The measurement data may be stored in files or printed out for subsequent evaluation. The test reports in these files can be read any time and displayed.

About 70% of the optional software is assigned to the user interface. This means that it is a more complex task to make **operation** simple and ergonomic, to program correct responses to operating errors and to display results in an informative way than it is to program the measurement routines themselves.

UPD is operated via a three-level **softkey menu** which, in broad terms, is organized in the following way:

- Parameters to be measured: UPD is configured for send, receive or loopback measurements. The sequence program is selected and whether the individual measurement steps are carried out continuously, once only or in single steps.
- Result display: the user may choose the list mode or the graphics mode and select the scaling. For monitoring tolerances, limit values are stored in a file and displayed as tolerance masks.
- Logging of measurement data in files: "always", "on error" or "manual" can be selected. The user may even add a comment. Date and time are always stored.

FIG 2 Test report at a glance – as numerical or graphics display



- Selecting results for subsequent evaluation: since measured values may be stored in the file for an extended period of time, not only the file can be identified by its name but also the measurement sequence within the file can be selected.
- Automatic measurement: the time for the start and end of an automatic measurement can be set.
- When adapting to the interface to be measured, the transmitter identification code and the required test level are entered.

The software is of modular design and may be modified by the user. One module holds the main program and the user interface. The sequence programs are designed as separate modules and can be loaded as required. The limits for tolerance monitoring are contained in other modules.

Jürgen Hempel

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Reader service card 147/13 for further information on UPD

Radiomonitoring with Test Receivers ESN and ESVN

Authorities responsible for monitoring and regulating radio traffic are faced with more and more complex problems relating to radiomonitoring and frequency management since the occupancy of frequency bands is constantly on the increase.

Without exact data – a prerequisite for monitoring existing installations and planning new services – it is not possible to accomplish the tasks involved. To perform the associated complex measurements, it is essential to have the best equipment available on the market.

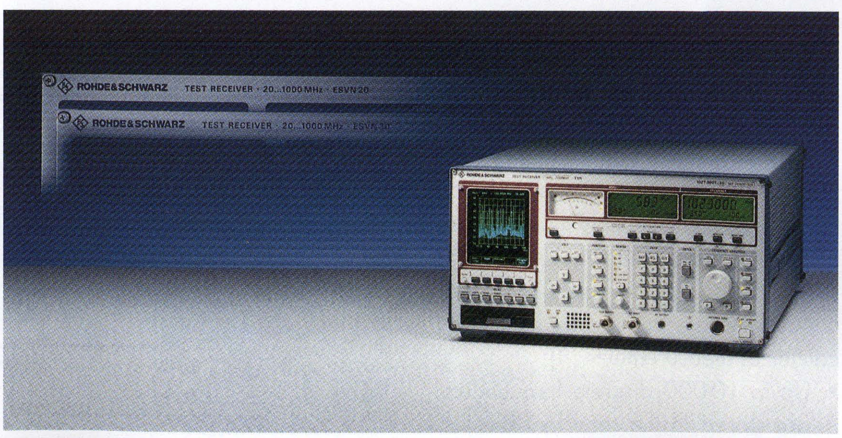

FIG 1 Test Receiver ESN (9 kHz to 2050 MHz) for useful and interference signals; ESVN models measure from 9 kHz to 2.75 GHz (ESVN 20/30 from 20 to 1000 MHz, ESVN 40 over whole range). Photo 40 626

The design and performance of Rohde & Schwarz Test Receivers ESN/ESVN (FIG 1) make them ideal for radiomonitoring measurements [1]. Their frequency range of 9 kHz to 2.7 GHz (model ESVN 40) covers the frequency bands for non-military use (WARC 92). Built-in digital signal processors demodulate and measure the modulation depth, the frequency and phase deviation. These receivers are highly suitable tools for radiomonitoring thanks to their high dynamic range, outstanding large-signal characteristics, high measurement speed and great measurement accuracy.

In manual operation and semi-automatic mode, a large number of integrated evaluating functions are provided to make radiomonitoring measurements easy. However, the test receivers reveal their full capabilities in mobile or stationary computer-controlled systems under remote control via an IEC/IEEE-bus interface [2]. The mode **measurement on frequency lists** has been devised for system applications (FIG 2). This flexible mode is particularly suited to the requirements of radiomonitoring; the versatile setting capabilities are tailored to the practicalities of measurements [3]:

- Up to 10 000 discrete frequencies are stored in the receiver. The list can be partitioned to give up to 100 segments. Segments are arranged in a sequence which is processed by the test receiver.
- One of 20 receiver setups may be assigned to each segment. The signal parameters to be measured (level, AM, FM, PM and frequency offset) and threshold values are user-selectable for each segment.
- The short measurement and setting time gives a high frequency-band scanning rate. A 20-MHz frequency band can be scanned repetitively in less than 80 ms with a step size of 100 kHz. This means an average execution time of about 390 µs per frequency step.
- In the alert mode the programmed sequences are executed autonomously by the receiver. Only when preset threshold values are exceeded does the controller receive an alarm signal. Minimizing data transfer in this way is particularly attractive for detached systems.
- Automatic activation via user port which is assigned to the individual frequency list segments and has programmable waiting times makes it possible to carry out complex measurements, for example, with automatic antenna switchover (FIG 3).

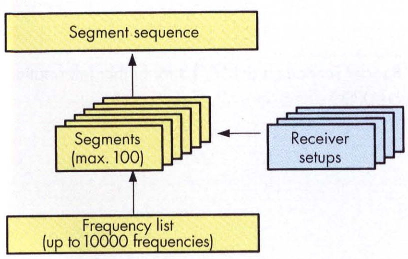

FIG 2 Configuration of measurement on frequency lists mode

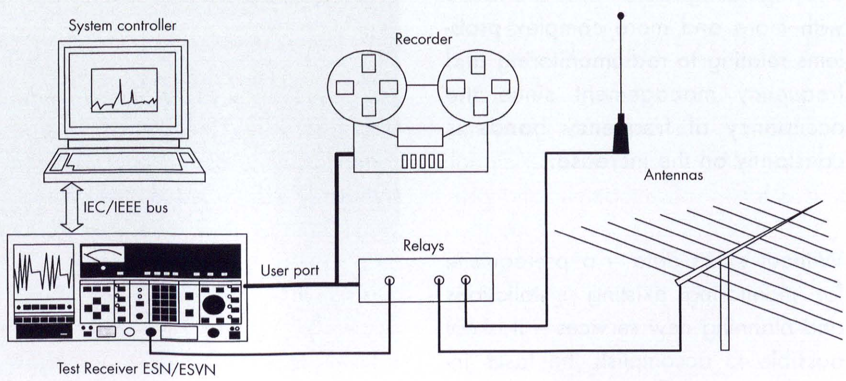

FIG 3 Radiomonitoring test setup with automatic antenna switchover

With such facilities, Test Receivers ESN/ESVN are an ideal equipment for radiomonitoring. They fulfil all requirements for modern test receivers whether they are hand-operated or integrated in systems.

Matthias Keller

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[2] Rohde & Schwarz Application Note 1EPAN13E: Radiomonitoring with Test Receivers ESN/ESVN

[3] ITU Handbook for Monitoring Stations, Geneva, 1988

Reader service card 147/14 for further information on ESN/ESVN

Power ramping to standard with Signal Generator SME

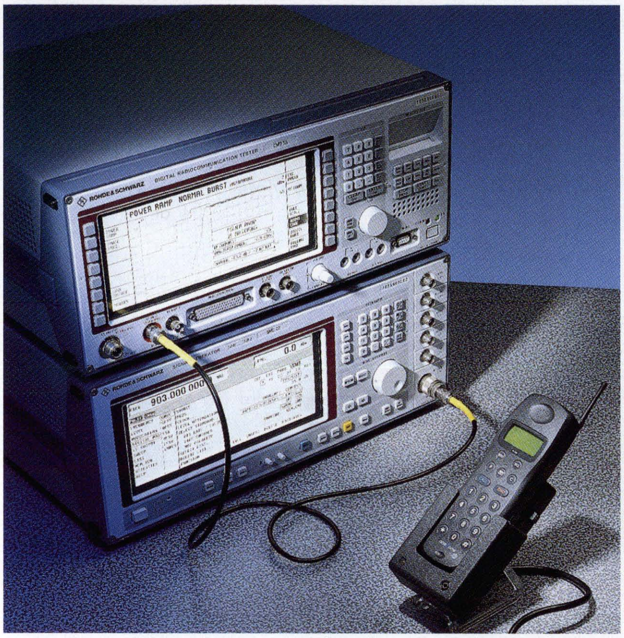

FIG 1 Power ramping to standard, measured with Digital Radiocommunication Tester CMD, Signal Generator SME providing test signal
Photo 41 849

Mobility and mobile communications are catchwords that have decisively shaped the past decade. Today's demand for mobile communications requires a system which affords high-quality, almost error-free speech, data and fax transmission as well as reachability beyond the national borders. GSM (global system for mobile communications) which has been adopted by more than 50 countries to date is the most successful system fulfilling these requirements.

Signal Generator SME generates standard-compatible signals for measurements to be made on GSM receivers (FIG 1). This generator gives the user a reliable and flexible signal source for the development and production of GSM units and modules.

GSM uses among other things **time-division multiplexing** to ensure efficient frequency utilization and to increase capacity. A GSM mobile phone transmits and receives information in a predefined 577-µs time slot. The subsequent seven time slots are used by other mobiles to transmit their messages before the mobile can transmit further information. Two **conditions** must be fulfilled so that this procedure can take place unnoticed by the subscriber. First, the data in a time slot should be compressed such that it can fill up the dead time of seven time slots after decompression in the receiver. Secondly, the carrier signal for the duration of seven time slots should be blanked out without causing interference and inserted into the time slot to be transmitted. This is called power ramping.

Interference may occur due to timing errors or when the switching procedure itself is not in line with the standard (rising edge too steep, switch-off too slow, excessive overshoots). Accurate switching procedures seem to be particularly difficult to put into practice. The GSM specifications [1] set exacting standards in this respect. Switching procedures with RF-carrier level variation cause spurious emissions in adjacent channels. Such spurious emissions have a greater effect the faster the switching (FIG 2) and may considerably affect reception in the adjacent channels. In addition, the specifications stipulate that the blanked out RF signal should have a very low residual level (base station <–30 dBc, mobile station <–59 dBc or –54 dBm, whichever the higher value). This corresponds to an on/off ratio >59 dB.

Signal generators as **typical signal sources** used in the development lab usually comprise amplitude modulators and possibly pulse modulators for varying the test-signal amplitude. An amplitude modulator has an on/off ratio of typically 30 to 50 dB with slow rise times (2 to 10 µs). In contrast, a pulse modulator attains a high dynamic range (>70 to 80 dB) with very steep rise and fall edges (<5 ns). One is faced with opposing requirements if a generator of this type is to generate the required burst signals. Apart from the fact that the generator must be able to generate digitally modulated signals (GSM is based on GMSK modulation = Gaussian (filtered) minimum shift keying), the amplitude modulator has an insufficient dynamic range for this purpose and the pulse modulator too fast a rise time.

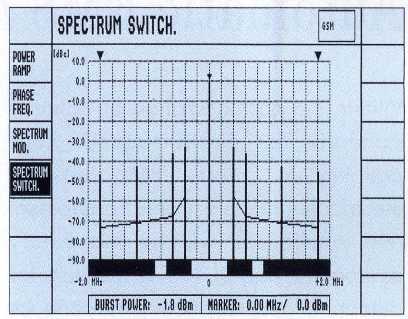

FIG 2 Switching spectrum from fast switching (rise/fall time <10 ns)

All this is no problem for Signal Generator SME [2]. Its data generator (option SME-B11) controls the amplitude modulator as well as the pulse modulator in synchronization with the data signal [3]. In addition, SME delivered with this option as from January 1995 will route the control signal of the amplitude modulator via an internal GSM filter to ensure very soft rise and fall edges. Rohde & Schwarz has developed a solution including an external GSM filter [3] for units delivered before this date. This enables a burst signal to be generated in line with the standard (FIG 3). SME is thus a generator which delivers GSM burst signals to standard. Moreover, Software SME-K1, an application program for industry-compatible computers, enables and supports the generation of effective and fast random data sequences. With its data generator provided with many standard digital modulation modes, SME is a signal source for the modern RF laboratory.

Mathias Leutiger

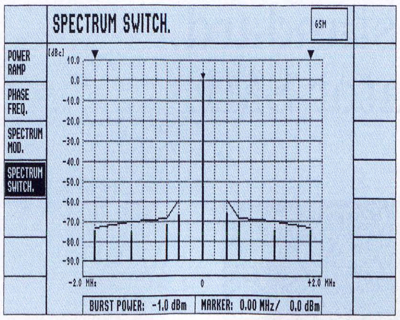

FIG 3 Switching spectrum in line with standard due to slow switching (test result from SME)

REFERENCES

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Reader service card 147/15 for further information on SME

Automatic EMS measurements to IEC 1000-4-6

Within the harmonization of national standards for electromagnetic compatibility in Europe, EMS tests for electrical and electronic equipment and appliances will be mandatory as from the end of 1995. The tests for determining susceptibility to conducted electromagnetic interference are defined in the international standard IEC 1000-4-6 (previously IEC 801-6). This draft standard is a basic standard from which European standards for product families and product-specific standards will be derived.

Conducted interference is caused by electromagnetic radiation being coupled into the connecting lines between a DUT and peripherals or an external power supply. In this configuration, the feed lines to the DUT act as antennas. For frequencies up to 100 MHz, or 230 MHz in the case of small-sized DUTs, line-coupled interference significantly contributes towards total interference. Real conditions are best simulated by a line impedance of 150 Ω.

The interfering signal is coupled into the feed line to the DUT via a **coupling decoupling network** (CDN). Via the CDN, the line to the DUT is terminated into a defined impedance and decoupled from any RF interference that might be introduced from the power supply or peripherals. Moreover, the 50-Ω generator output impedance is matched to the 150-Ω line impedance.

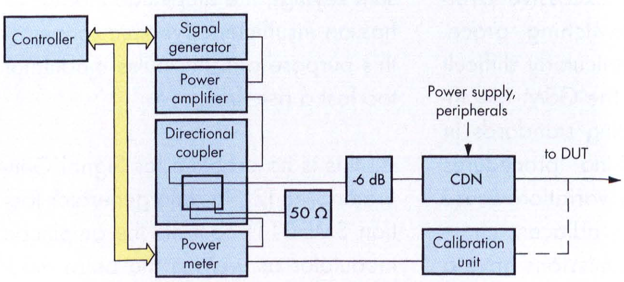

FIG 1
Block diagram of Test System TS9986

FIG 1 shows a test setup for measurements to IEC 1000-4-6 based on **Rohde & Schwarz Test System TS9986** (FIG 2).

IEC 1000-4-6 defines the (ideal) **open-circuit voltage V_0** (EMF) of an EMS signal generator as the magnitude of the interfering signal to be applied to the DUT. The open-circuit voltage however cannot be measured directly so that it has to be determined by way of calibration. According to the standard, a calibration network must be connected to the output of the CDN at the DUT end in order to verify or calibrate the test setup. The calibration network transforms the 150-Ω line impedance of the CDN output back to 50 Ω. The voltage V_M at the output of the calibration network is measured by means of an RF voltmeter and from this, the voltage to be set on the generator is calculated. Using the equivalent circuit shown in FIG 3, the relationship $V_M = 1/6\ V_0$ can easily be obtained for the test setup proposed in the standard. The equivalent circuit is valid not only for a single-port CDN but for all multiport CDNs defined in IEC 1000-4-6.

The interference signal levels specified by the standard cannot be produced by means of a signal generator alone; for this reason, a power amplifier is included in Test System TS9986. When setting the interference signal levels manually, the **frequency dependence of the amplifier output power** must be taken into account. Manual measurements to IEC 1000-4-6 therefore take up much time, so that automatic measurements are preferable.

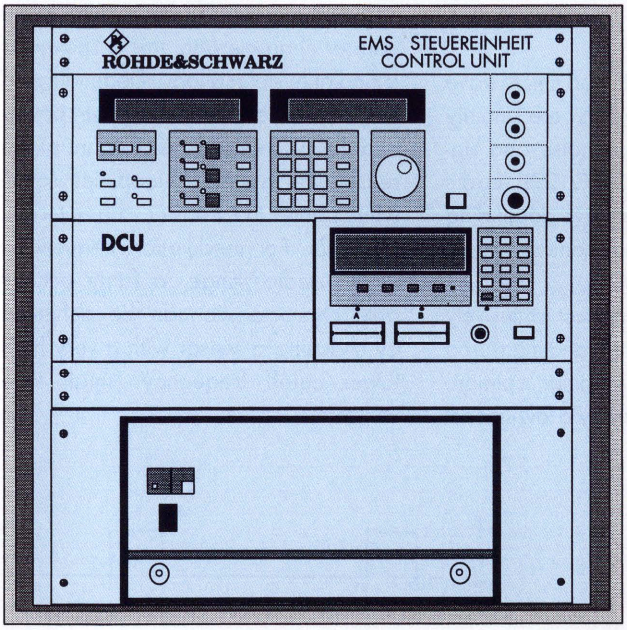

FIG 2 Rack layout of Test System TS9986

With the aid of **System Software EMS-K1** of Test System TS9986, detailed verification of the test setup can be performed fully automatically within a short time. This verification measurement is also used for compensating for the frequency response of the CDN and the RF cables used in the test setup. The output power $P_{cal}(f)$ of the interference signal generator (signal generator followed by power amplifier), which is required for generating a defined interference signal level $V_{0\ cal}$, is measured and stored for each frequency point. The frequency range and the number of frequency points are user-selectable. The calibration data thus obtained are stored in a file at the end of the measurement and can be called up at any time. The data of all CDNs used in a test system are accessible via convenient library functions. System Software EMS-K1 not only corrects the frequency response of the amplifier, it also takes into account and compensates other types of frequency response, eg cable losses.

For **performing EMS tests** with the DUT connected, the amplifier output power required for a desired interference signal level $V_{0\ test}$ is generated using the data stored in the calibration file. $V_{0\ test}$ need not be of the same value as $V_{0\ cal}$. With the CDN containing only linear components, interference signals of any level can be generated by interpolating the amplifier power. To set the interference signal level correctly, the amplifier output power is measured again and adjusted to the calibration data. In this way, temperature-dependent variations of the output power are eliminated.

Automated EMS measurements to IEC 1000-4-6 with Test System TS9986 guarantee reproducible measurements and make for the efficient execution of tests. Test System TS9986 allows the integration of manual or automatic DUT monitoring facilities, thus offering a versatile and efficient tool for use in the development and quality control of electrical and electronic products.

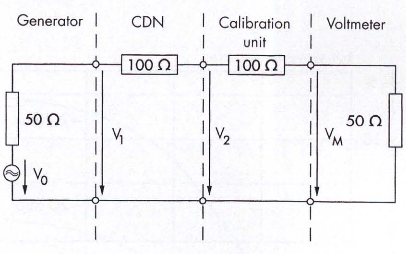

FIG 3 Equivalent circuit of calibration setup

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Dr. Klaus-Dieter Göpel

Reader service card 147/16 for further information on TS9986

RF power measured the right way (VI)

3.1.2.3 Weighting errors

Weighting errors outside the square-law region may occur with non-sinusoidal signals. While with low power levels applied to the sensor there is a fixed relationship between output voltage and input power, outside the square-law region each waveform has its own transfer characteristic. Since sinusoidal voltages are used for calibration, other waveforms cause measurement errors which increase in proportion to the deviation of the crest factor of the voltage to be measured from $\sqrt{2}$. The ratio of peak to RMS value is referred to as the crest factor. In the RF and microwave bands, weighting errors are mainly caused by broadband noise and signals with harmonics (FIG 29). Errors can be positive or negative depending on the phase of the harmonics.

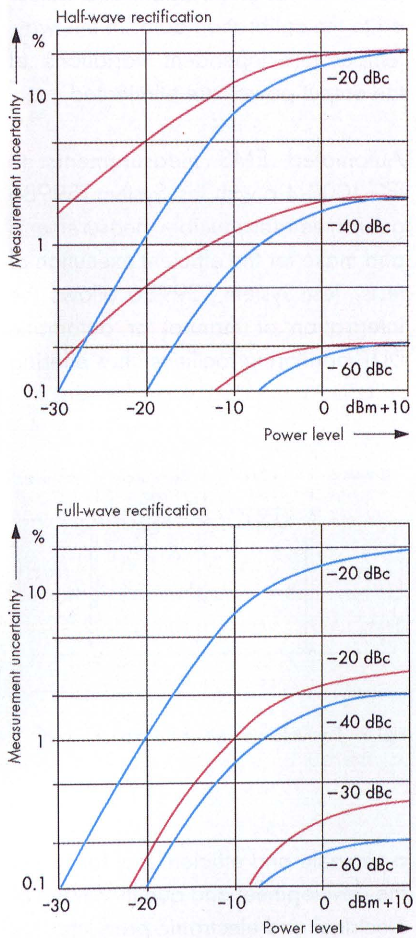


FIG 29 Power measurement uncertainty of diode sensors as result of weighting errors in case of sinewave signals with harmonics (red: 2nd harmonic, blue: 3rd harmonic). Parameter: harmonics. Top: half-wave rectification, bottom: full-wave rectification

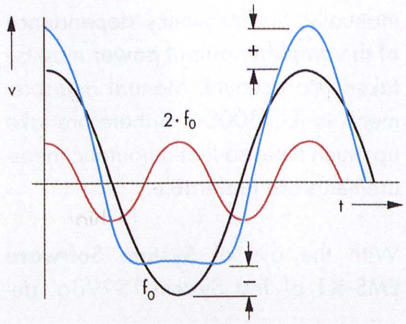


FIG 30 Waveform distortion caused by 2nd harmonic; f_0 = fundamental frequency

Weighting errors are almost exclusively dependent on waveform and measured power. Contrary to popular opinion, they cannot be reduced by a low-impedance load of the rectifier. An improvement can be achieved with full-wave rectifiers. They derive the average value from the positive and negative voltage peaks, thus eliminating the effect of even-numbered harmonics, in particular that of 2nd order (FIG 30). As shown in FIG 29, considerable measurement errors may occur with half-wave rectification even below 10 μW.

3.1.2.4 Dynamic linearity errors

Dynamic linearity errors occur in the measurement of the average power of modulated signals (FIG 31). In the square-law region the charging and discharging time constants of the sensor are equal and the output voltage corresponds to the average power level. With increasing power level, the rise time decreases and the fall time increases because of the non-conducting diode. The output voltage is thus greater than the average power level. In the transfer characteristic, this is shown as a kind of hysteresis loop. Depending on the modulation frequency, the power and the discharge time constant of the sensor, the hysteresis loop lies somewhat above the transfer characteristic (FIG 32). For modulation frequencies in the audio range, a fairly acceptable characteristic can be achieved by choosing a sensor with a very high lower cutoff frequency (small time constant).

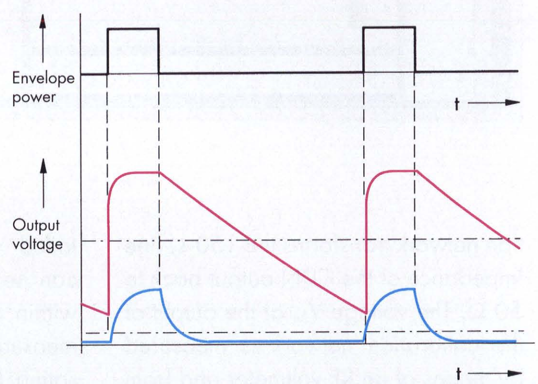


FIG 31 Transfer characteristic of diode sensor with pulse-modulated input signal within (blue) and outside (red) square-law region; average values dash-dotted

3.1.2.5 Frequency-dependent linearity errors

Even with numerically linearized diode sensors linearity errors may occur outside the square-law region. They are caused by the voltage-dependent junction capacitance (varactor effect) and become evident when the diode starts affecting the RF behaviour of the sensor (as a rule of thumb: from 1/4 of the upper frequency limit). Since the junction capacitance decreases with increasing input power, there is normally an increase in the frequency response, ie the linearity error is positive (FIG 33).

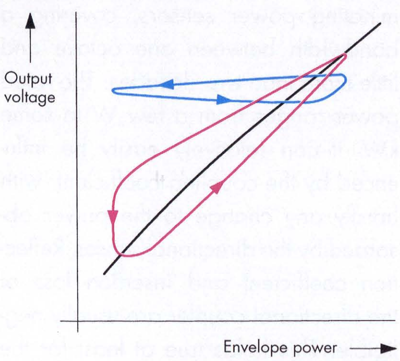


FIG 32 Dynamic transfer characteristic of diode sensor outside square-law region with low-frequency (red) and high-frequency (blue) amplitude modulation (static characteristic in black)

3.1.2.6 Peak power measurement

With high modulation frequencies and a voltage crest value of at least 1 V, any diode sensor can be used for measuring the peak power as can be seen from FIG 32. However, it will be used for this purpose in exceptional cases only, since the measurement error very much depends on the waveform and power. For universal applications, there are special peak power sensors. They consist of a fast diode sensor followed by an amplifier and peak hold circuit. This principle is for instance employed with Peak Power Sensor NRV-Z31 from Rohde & Schwarz. The charging time constant in the square-law region determines the lower cutoff frequency and rise time of the output voltage. To avoid dynamic measurement errors, the pulse width must be clearly greater than the specified rise time. Due to the relationship with the rise time, the lower cutoff frequency is still relatively high compared to that of normal diode sensors.

The rectified output voltage has a large noise component due to its wide bandwidth. Therefore it is not possible to measure powers that are considerably smaller than 1 µW with high accuracy. Peak power sensors are mainly used outside the square-law region. Such sensors are designed as full-wave circuits to minimize weighting errors with

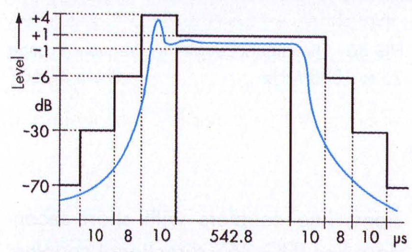


FIG 34 GSM burst specifications and possible power envelope

non-sinusoidal waveforms. Moreover, with modern sensors the frequency dependence of the linearity error is calibrated. Special sensors are available for TDMA radio networks. With these designs, the output signal of the rectifier is lowpass-filtered ahead of the peak hold circuit. Overshoots of the RF

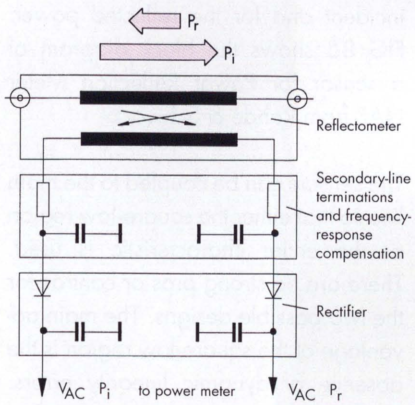


FIG 35 Block diagram of sensor for use with Power Reflection Meter NAP in frequency range 25 to 1000 MHz

burst can thus be suppressed on transmitter keying so that the power at the flat pulse top is indicated (FIG 34).

3.1.2.7 Envelope power measurement

Diode sensors for envelope power measurements must not only be able to trace the leading edge, but the entire envelope of the test signal. For this purpose it is not sufficient to simply reduce the charging capacity. Additional measures are a low-impedance load connected to the sensor output or the output short-circuited. The short-circuit current is converted to a broadband output voltage by a current-to-voltage transducer. Pulse rise times in the range of a few ns require the entire signal path from the sensor through to the A/D converter to be designed for high frequencies. Since the short-circuit current is an exponential function of temperature, measurement errors greater than that of normal sensors are to be expected.

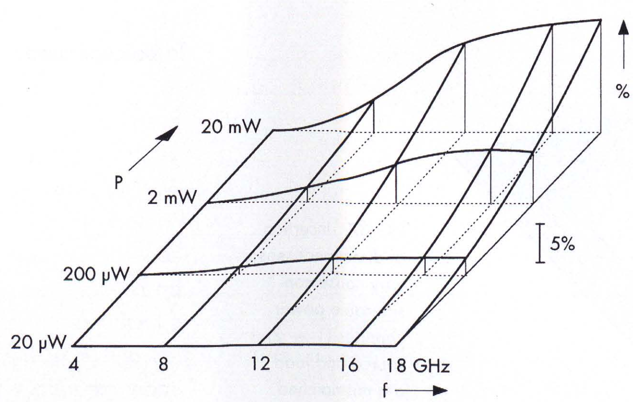


FIG 33 Measured linearity error due to varactor effect of 18-GHz detector

3.1.3 Directional power sensors

Directional sensors are connected between source and load to measure the power flow in both directions. They are fitted with a double directional coupler (reflectometer) to provide for separation between forward and reflected wave. The signals coupled out are measured by separate diodes for the incident and for the reflected power. FIG 35 shows the block diagram of a sensor for Power Reflection Meter NAP from Rohde & Schwarz.

The sensors can be coupled to the main line so that either the square-law region or the entire characteristic is used. There are no strong pros or contras for the two possible designs. The main advantage of the square-law region is the absence of dynamic linearity errors. Appropriately designed sensors are ideal for measuring the average power of envelope-modulated signals. If on the other hand the entire characteristic is used, a much greater power range can be measured. This may be of advantage for SWR measurements where only little power is available. Accurate measurements are also possible with well-matched loads and therefore low reflected power.

Weighting errors are of minor importance, at least in radiocommunications, since a high degree of harmonic suppression is prescribed by regulations. Some sensors can measure the peak power, the output signal of the sensors being boosted and applied to a peak hold circuit before it is transferred to the power meter.

3.1.3.1 Directional couplers

The main features of a directional power sensor, such as measurement accuracy, matching, frequency and power range are determined by the directional coupler. Due to rather small dimensions, line couplers with short secondary line (FIG 36), directional couplers with lumped components or similar designs are suitable for use with directional power meters. For the frequency range up to 100 MHz, the lumped coupler designed by Buschbeck is mostly used.

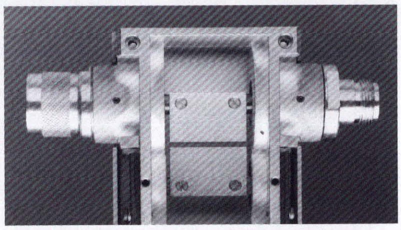


FIG 36 Directional coupler for frequency range 25 to 1000 MHz Photo 32 607

Due to the directional coupler, directional power sensors are always somewhat more narrowband than the terminating power sensors, covering a bandwidth between one octave and little more than two decades. The rated power ranges from a few W to some kW. It can relatively easily be influenced by the coupling coefficient, with hardly any change to the power absorbed by the directional sensor. Reflection coefficient and insertion loss of the directional coupler are usually negligible. This holds true at least for the lower band limit, where there is only a loose coupling between main line and secondary line. Depending on the type of coupler, the coupling coefficient may increase with the frequency, resulting in more power being taken from the main line and an increase in the insertion loss. With broadband sensors of low rated power, insertion losses up to about 0.5 dB may thus occur at the upper frequency limit.

Even with a loss-free and ideally matched directional sensor the insertion into the test circuit may cause a change of the power flow (FIG 37). The cause lies in a change of the phase between source and load reflection coefficient due to the line being extended by the inserted sensor. In the worst case, deviations attain twice the mismatch uncertainty. This effect need not be considered at the output of level-controlled sources, since the incident power is stabilized.

To be continued. Thomas Reichel

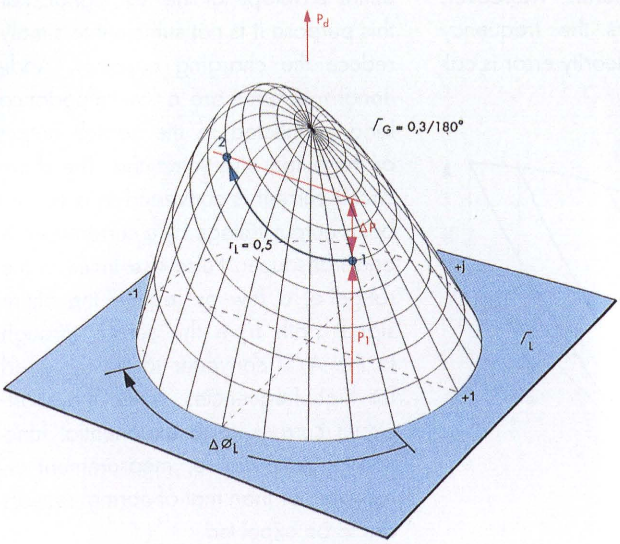
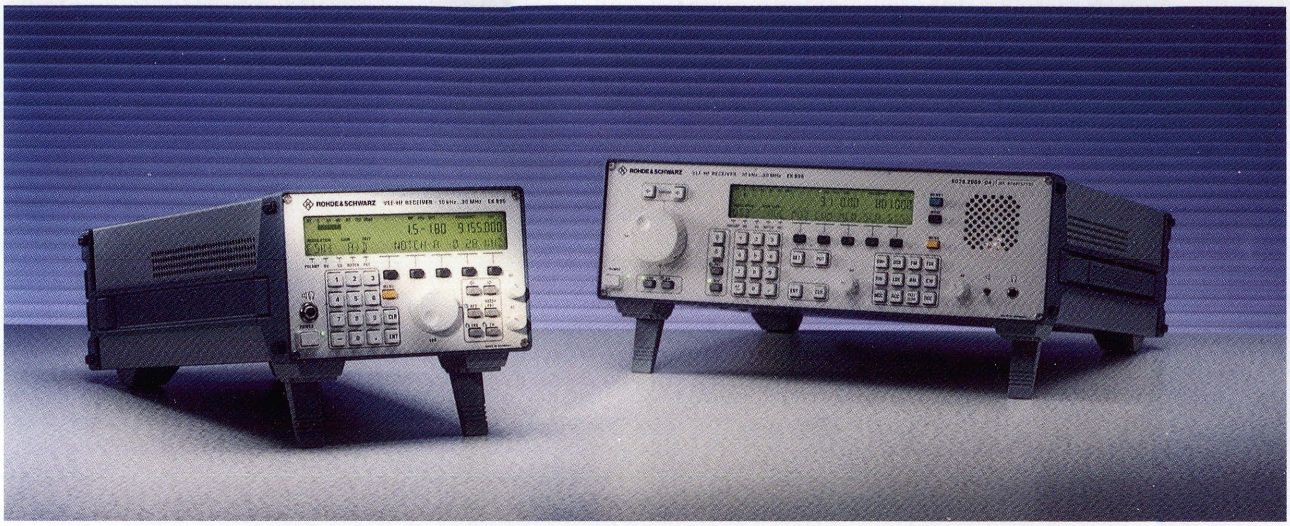


FIG 37 Insertion of directional sensor may cause considerable power changes (1 → 2) if source and load are mismatched.

VLF-HF Receivers EK 895 and EK 896 with digital signal processing optimize shortwave applications



VLF-HF Receivers EK 895 (left) and EK 896
Photo 41 623

Receivers EK 895 and EK 896 (FIG) are a further development of the tried and tested VLF-HF Receivers EK 890 and EK 891 from the EK 890 family of radio equipment [1 to 3], and make use of digital signal processing. They thus meet the most stringent demands made on modern HF receivers.

All the **features** of the worldwide-used VLF-HF Receiver EK 890 have been retained in these new receivers and are as follows:

- excellent large-signal behaviour with typical intercept points of +70 dBm (IP_2) and +35 dBm (IP_3),
- intermodulation-free dynamic range of 106 dB in SSB mode,
- low-noise synthesizer in 1-Hz steps,
- 1000 freely programmable memory locations,
- proven electromagnetic compatibility complying with MIL-STD 461/462,
- easy, menu-guided settings and diverse scanning programs,
- remote control of all settings and programs via standardized serial interface (RS-232-C/RS-485, bus-compatible, 50 to 38400 Bd) via PC, external Remote Control Unit GB 899 or EK 89x as a master receiver.

Digital signal processing allows the implementation of the following **special attributes:**

- demodulators for AM, CW, SSB, ISB, FM, FSK, AFSK, F7B (diplex telegraphy), fax (F1C and F3C), datalink demodulator according to MIL-STD 188-203-1A (option),
- 13 bandwidths from 150 Hz to 8 kHz as well as quasi-continuous bandwidth switching (option),
- special mark and space filters matched to the selected shift for FSK/AFSK mode of reception,
- double notch filter to suppress two interfering signals within the selected bandwidth,
- noise blanker with automatic matching to the repetition rate and width of the interference pulse,
- syllabic squelch (no threshold settings required),
- five selectable AGC time constants between 25 ms and 3 s,
- display of received field strength with 1-dB resolution using PC,
- digital IF as serial data,
- analog IF from 0 to 40 kHz in 100-Hz steps,
- I/Q channel output for further digital data processing.

Apart from the two options all features listed are integrated in the basic model. The new receivers also have an additional preamplifier reducing the noise figure down to a value of 9 kT_0. Thus, reception with short antennas (eg rod antennas) or reception in quiet environments (low man-made noise) can be improved considerably. The input voltage protection has been extended to an EMF of 100 V which can be applied indefinitely at the antenna input, thus permitting receivers to be used safely in the vicinity of strong transmitters.

The two models EK 895 and EK 896 have identical receive characteristics but differ in mechanical design – width of EK 896 19", width of EK 895 1/2 19" – and in their **typical applications.**

EK 895 is a compact communications or monitoring receiver whereas EK 896 with its direct access functions is especially suitable for use as radio-detection receiver or as master receiver in receiving systems. Like EK 890 these two receivers have two free slots for retrofitting options. Moreover, the EK 896 design allows the installation of a tracking digital preselector to improve reception in a strongly RF-polluted environment (eg collocation problems).

The well-proven excellent RF characteristics together with digital signal processing providing optimum conditioning and handling of the received signal as well as the easy, menu-guided operation make the new receivers the top of their class – at prices significantly below those of international competitors. These receivers are therefore suitable for all civil, administrative and military shortwave applications where extremely high reliability even under harsh environmental and EMC conditions and high economic efficiency are vitally important.

Gerhard Wachter; Berndt Helmke

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Reader service card 147/19

DC Power Supply NGSM 32/10 – simulating real operating conditions for mobile radios, car electronics and R&D

DC Power Supply NGSM 32/10 (FIG 1) is a compact but extremely powerful DC supply for use in labs with excellent features which make for a range of applications far beyond those of common power supplies. The arbitrary function of NGSM allows simple functional tests on DUTs which would otherwise only be possible with a large number of add-on units.

With its fine resolution of 100 µA for current **measurements on mobile radios,** Power Supply NGSM 32/10 permits the standby current to be measured and thus the maximum operating time of a handy (FIG 2) to be accurately predicted. The arbitrary generator is supplied with test pulse 4 programmed to DIN 40839 (FIG 3) allowing the user to simulate typical

FIG 1 NGSM 32/10 – power supply with arbitrary function Photo 41 418

onboard supply fluctuations in a car – eg during startup – at the touch of a key and to observe the behaviour of the DUT [1]. The trend indication of current is another useful aid for servicing: as the typical registration behaviour of a mobile phone is directly reflected by the current drain, the technician can immediately draw a conclusion on the call setup of the mobile radio with the base station [2]. DUT malfunction with regard to current drain is signalled by means of an acoustic alarm so that long-term testing can be carried out without the user having to continuously watch the displays. For different types of DUTs six device setups each can be stored in the 18-V and 32-V range.

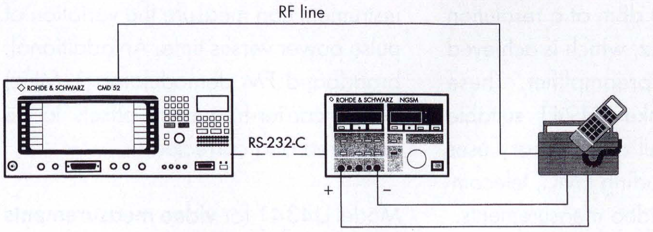


FIG 2 NGSM is the ideal power source for automatic testing of mobile radios.

NGSM supplies currents up to 20 A. Thus, **car audio equipment** – even boosters – can be reliably powered in tests even outside the car. The startup curve (test pulse 4) can also be simulated, eg to spot problems arising from unexpected data loss of code-protected theft-proof car radios.

Production and testing of **car electronic components** requires 12-V or 24-V onboard supplies. DC Power Supply NGSM 32/10 is therefore equipped with switchable 18-V and 32-V measurement and supply ranges. A 19" adapter and either an IEC/IEEE-bus or RS-232-C interface are available as options so that NGSM can easily be integrated into complete production systems. The startup curve in line with DIN 40839 can be reprogrammed to comply with the required factory standards.

Thanks to its compact design the unit has a place in any **development lab.** The regulated blower, large seven-segment display, simple setting via rollkey and storable setups offer high operating convenience. Sensing lines against polarity reversal, switchable foldback mode and optical as well as acoustic signalling of malfunctions provide a high degree of protection for the DUT and support the development engineer. The output ON/OFF key is another safety feature. With the integrated arbitrary function, the user can program up to 60 reference values per voltage range at intervals of 1 ms to 4 s and thus simulate brief DC voltage dips or peaks on the DUT supply line, allowing the DUT response to be determined already during the development stage. Furthermore, it can for example be tested whether the power-up reset of a microprocessor control circuit is correctly triggered by programming the relatively slow initial voltage rise of a switching regulator. The development engineer has sometimes the job of finding out the minimum buffering or stabilization required for the built-in power supply. Conclusions can be immediately drawn thanks to the peak-current measurement. Superposition of 100-Hz ripple on the supply voltage is again no problem for DC Power Supply NGSM 32/10.

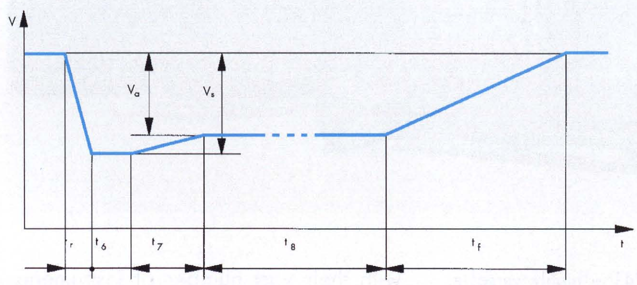


FIG 3 Test pulse 4 to DIN 40839

The list of further applications could be extended ad infinitum. The user of DC Power Supply NGSM 32/10 will soon realize: the unit offers a whole variety of useful features at an extremely favourable price.

Lutz Fischer

REFERENCES

[1] DIN 40839, part 1: Electromagnetic compatibility (EMC) in cars. Conducted emissions on supply lines in 12-V onboard supplies

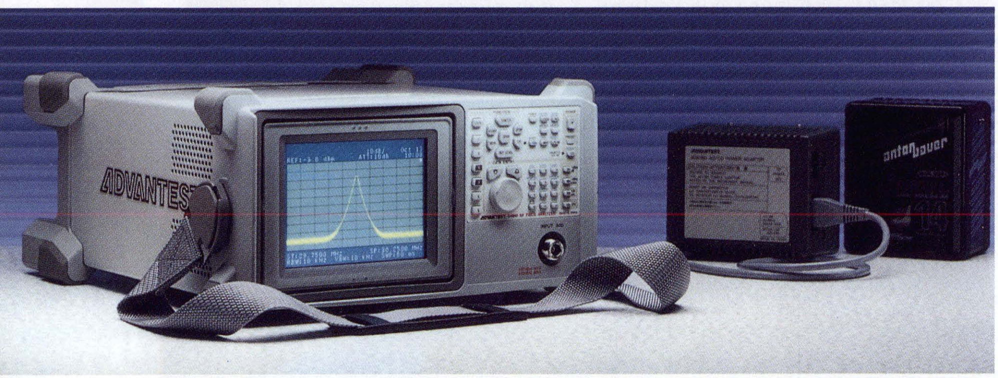
[2] Mauksch, T.: Measurements on GSM mobiles using Radiocommunication Tester CMD. News from Rohde & Schwarz (1994) No. 144, pp 31–32

Reader service card 147/20

Spectrum analysis made easy

Spectrum analyzers are developing more and more into standard measurement tools. Their use is by no means limited to the laboratory. There is a growing number of applications in which spectrum analyzers are needed for on-site measurements. This may be in buildings, on board of vehicles, or in the open. Obviously for such applications there will not always be a power outlet available nearby.

Advantest of Japan, represented Europe-wide by Rohde & Schwarz, offers an instrument exactly fitting the above applications. The U4941 basic unit (FIG), weighing just 8 1/2 kg, features a TFT colour monitor and a frequency range from 9 kHz to 2.2 GHz. The unit



Spectrum Analyzer U4941 – highly versatile, lightweight instrument for on-site measurements
Photo 41 350

can be operated on a variety of AC supply voltages, from battery or from an external DC supply. Battery in this case means a whole system enabling operation of the analyzer independent of the AC supply, comprising several batteries of different capacity and corresponding chargers. It is particularly noteworthy that the weight of 8 1/2 kg of U4941 is inclusive of the battery, which enables operation for up to two hours. Changeover between DC and battery operation or to a standby battery requires no more than a few seconds, and flat batteries are recharged within just an hour by means of the microprocessor-controlled battery chargers. Low weight need not be at the expense of performance data: this can be seen from the low noise floor of typ. down to –140 dBm at a resolution bandwidth of 1 kHz, which is achieved with the built-in preamplifier. These excellent data make U4941 suitable for portable as well as stationary uses in many fields including EMC, telecommunications and video measurements.

Following are a few examples from the field of **EMC measurements:** Electronic displays in buses or trams indicating the next stop can be EMC-tested installed in the vehicle. In aircraft cockpits with their vast number of instruments, sources of interference can be located by means of handheld probes. Antenna correction factors and limit lines can be stored in the analyzer to facilitate measurements. Of course, a quasi-peak detector is provided in addition to the min. and max. detectors.

Telecommunication measurements include monitoring of the frequency bands used. The low noise floor of –140 dBm, a built-in frequency counter with a resolution down to 1 Hz, and the capability of storing antenna factors as mentioned above make it possible to determine the field strength and frequency with high accuracy. A special version of U4941 has been developed for measurements on DECT telephones. With a minimum sweep time of 50 μs, combined with a variable time base (delayed sweep) and a pretrigger function such as used in oscilloscopes, the instrument can measure the variation of pulse power versus time. An additional, broadband FM demodulator (1 MHz) allows carrier-frequency offsets to be measured and corrected.

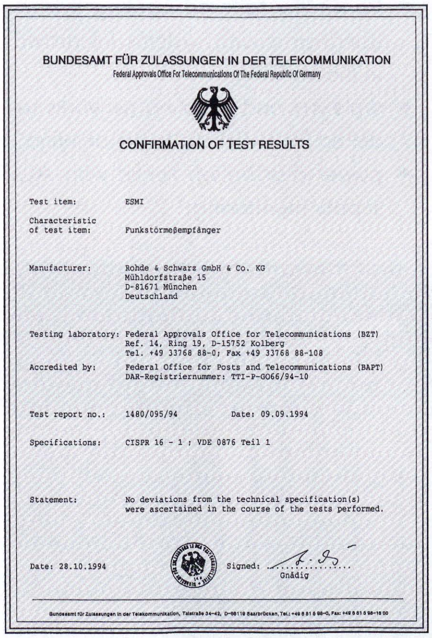
Model U4341 for **video measurements** has all the advantages of U4941, such as battery operation, preamplifier and colour display. As a special feature, U4341 incorporates a TV demodulator, which allows a colour TV picture including sound to be displayed on the analyzer. This is possible for PAL and NTSC and the relevant national standards such as M, B/G, etc. TV channels can be directly selected from predefined tables for VHF, UHF, CATV, BS and CS. In addition, special channels can be defined in user tables. U4341 is thus suitable for all applications that, in addition to the usual analyzer measurements, require identification of the video carrier. The built-in preamplifier proves very useful also for off-air measurements, affording a noise floor of the analyzer of typ. down to –30 dBμV into 50 Ω. This means that even propagation measurements can be made. A 75-Ω version of U4341 is also available to cater especially for the requirements of TV measurements. With lightweight Spectrum Analyzers U4941 and U4341, the user has a tool that enables on-site measurements for a wide variety of applications.

Robert Fröhler

Reader service card 147/21

Conformity of Rohde & Schwarz EMI test receivers with CISPR standards now confirmed officially

The German Federal Approvals Office for Telecommunications confirmed by document on 28 October 1994 (FIG 1) that EMI Test Receiver ESMI from Rohde & Schwarz is in conformity with standards. It thus became official what Rohde & Schwarz customers have always been able to rely on: EMI Test Receivers ESAI, ESBI, ESMI (FIG 2) and ESHS, ESVS and ESS with their wide dynamic range and internal overload detectors fully meet the exacting requirements of the international standard CISPR 16 and of the equally stringent national regulation VDE 0876. The overload capability of the receiver input stages with IP_3 values ranging between +15 and +20 dBm is truly unique on the market. Competitive products fall short of this value by 15 dB and more.



BUNDESAMT FÜR ZULASSUNGEN IN DER TELEKOMMUNIKATION
Federal Approvals Office For Telecommunications Of The Federal Republic Of Germany

CONFIRMATION OF TEST RESULTS

Test item: ESMI

Characteristic of test item: Funkstörmeßempfänger

Manufacturer: Rohde & Schwarz GmbH & Co. KG
Mühldorfstraße 15
D-81671 München
Deutschland

Testing laboratory: Federal Approvals Office for Telecommunications (BZT)
Ref. 14, Ring 19, D-15752 Kolberg
Tel. +49 33768 88-0; Fax +49 33768 88-108

Accredited by: Federal Office for Posts and Telecommunications (BAPT)
DAR-Registriernummer: TTI-P-G066/94-10

Test report no.: 1480/095/94 Date: 09.09.1994

Specifications: CISPR 16 - 1 ; VDE 0876 Teil 1

Statement: No deviations from the technical specification(s) were ascertained in the course of the tests performed.

Date: 28.10.1994 Signed: .... Gnädig

Bundesamt für Zulassungen in der Telekommunikation, Talstraße 34–42, D-66119 Saarbrücken, Tel.: +49 6 81 5 98-0, Fax: +49 6 81 5 98-16 00

FIG 1 Confirmation of test results by the German Federal Approvals Office for Telecommunications for EMI Test Receiver ESMI representing the whole series of EMI test receivers from Rohde & Schwarz. Certificates to the same effect were issued for the other EMI test receivers mentioned above.

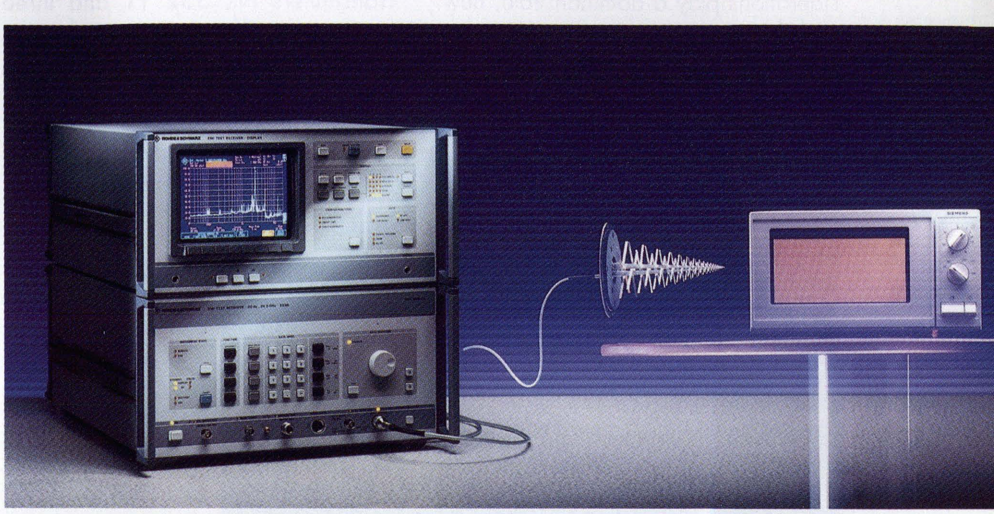


FIG 2 Rohde & Schwarz EMI Test Receiver ESMI for 20 Hz to 26.5 GHz Photo 40 639

What is hardly known to anyone but to the receiver specialist: It is the standards for non-military EMI suppression that make the most stringent demands on the dynamic range of test receivers. As a matter of fact, the test receiver has to take the place of the user as recipient of EMI noise, ie the receiver acts as an "interference sink". To render the impression of interference perceived by the human ear, the measured values are weighted. Weighting requires a 150-fold overload reserve of the level indication, a demand that is not easy to fulfil. Development engineers at Rohde & Schwarz are proud to have had this problem under control over a time span of three generations of EMI test receivers.

With new European standards for electromagnetic compatibility being introduced, the demands on EMI test receivers have become even more stringent. While the old national regulations specified limit values for narrowband and broadband interference, – a discrimination which was time-consuming and frequently ambiguous –, the new standards require that interference be correctly classified by the receiver itself. To this end, the new standards specify limit values for weighted interference indication as mentioned above and for the average interference level. This means that the average value even of pulsed interference must now be measured accurately, a requirement that is fulfilled by the new Rohde & Schwarz EMI test receivers with their high overload capability and pulse-optimized filters.

The official confirmation of Rohde & Schwarz test receivers being in line with the civil EMI standards goes to prove once more the technical competence of Rohde & Schwarz as a leading manufacturer in a field that is increasingly gaining importance worldwide with the growth of communication technology.

Karl-Otto Müller

Reader service card 147/10 for further information on EMI test receivers

Terrestrial broadcasting from prefabricated cabins

In a time where strong economical considerations play a dominant role, new ways have to be found in the construction of buildings for transmitter stations. To shorten the often time-consuming technical and administrative procedures required for the building of solid structures, Rohde & Schwarz and German Telekom have developed a concept for transmitter buildings which are made of prefabricated cabins. The cabins consist of laminated insulating material fitted in a steel frame and can be erected on a lamellar foundation in a very short time. Once the cabin is set up, the interior fixtures and equipment can be quickly installed.

As an example, German Telekom placed an order with Rohde & Schwarz for the installation of their main-network transmitter station Remda/Saalfeld in Thuringia. The station (FIG 1) is equipped with five 5-kW FM Dual Transmitters NR 352 T1 and three 20-kW TV Dual Transmitters NT 425 D1 (FIG 2). This transmitter station was up to this time the largest single project in Germany for which Telekom has placed an order. In addition to the price factor, completion according to time schedule is also a crucial factor for such a project. The FM programs went on air only three months after the start of the planning work and three months later the TV programs were being transmitted.

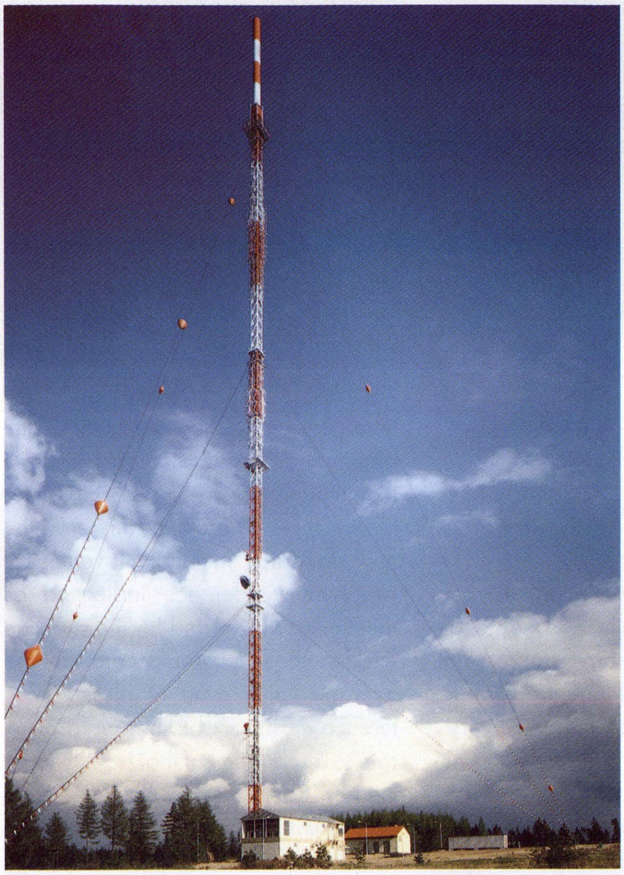


FIG 1 TV and VHF transmitter station of German Telekom in Remda/Saalfeld
Photo 41 685/1

The following **services** were provided with the supplied TV and VHF transmission equipment:

- all construction work for the two-storeyed transmitter building from the foundation to the anti-icing roof,
- complete interior fixtures (from folding chair to coat rack),
- air-conditioning of rooms (transmitter, program-feed equipment, operator's room),
- transmitter test and monitoring equipment,
- fire and burglary protection facilities,
- transmitter-tailored cooling system using air-mixing systems integrated in the building,
- diplexers and coupling networks required for switching to the antenna,
- power-distribution racks with AC-supply monitoring,

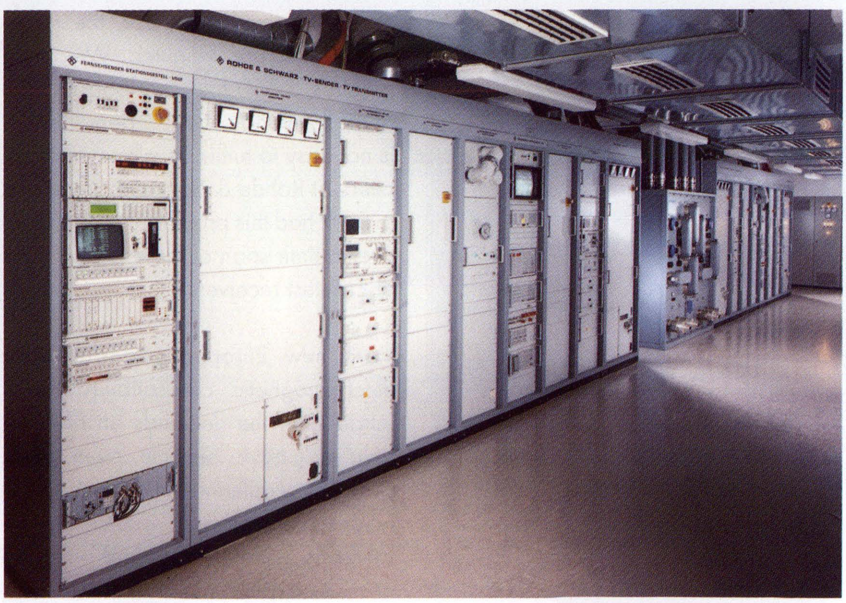


FIG 2 Transmitter room with TV Transmitter NT 425 D1
Photo 41 687/2

- project-tailored water-cooling system for transmitters and dummy antenna,
- crane for lifting equipment to the upper storey.

The benefits of such a station are obvious. The extremely short times required for planning and completion and the relatively simple construction of the buildings result in a correspondingly favourable price. Since the cabins and the complete technical equipment come from one supplier, optimum coordination is ensured. The variable configuration of the cabins permits buildings and technical equipment to be adapted to the intended purpose and even to the surrounding landscape. A transmitter station of this kind has a lifetime of more than 20 years.

Franz Harrer

Reader service card 147/22

High-tech equipment for Wireless Telegraphy in Malta

Within the framework of the EC financial protocol for Malta, Rohde & Schwarz has been awarded a contract for the modernization of facilities at Wireless Telegraphy. Malta applied for EC membership in 1987. The aim of the EC support is to integrate Malta into European telecommunication and associated standards (CCIR, CISPR, etc). With the supply of state-of-the-art equipment, the facilities at Wireless Telegraphy will improve in accuracy and reliability.

Rohde & Schwarz is supplying leading-edge test and measurement equipment with a total value of around 900 000 DM. An example of the supplied equipment is EMI Test Receiver ESMI which permits any EMI measurement task to be solved in compliance with relevant industry and military standards – an optimum solution for the frequency range 20 Hz to 26.5 GHz. VHF/UHF Direction Finder PA 1555 and Miniport Receiver EB 100, Active Directional Antenna HE 100 and Mini Panorama EPZ 100 serve for tracking down unauthorized radio transmissions. Modulation Analyzers FMA, Radiocommuncation Service Monitors CMS, Signal Generator SMT and TV measuring instruments will be used as lab equipment for radio testing at Wireless Telegraphy. Various antennas such as HL 026, HL 023A2, HE 010 and AC 008 are useful aids in radiomonitoring.

Joseph Bartolo, director of Wireless Telegraphy/Malta, is responsible for radio-traffic policy. The headquarters of the organization are housed in the Evans building in Valletta.

Photos: Mohacsy

Wireless Telegraphy was founded in 1957 and is located in the Maltese capital Valletta (FIG). It is the organization that is responsible in Malta for frequency-spectrum management and the authorization of radio equipment; it also regulates the use of sound and TV broadcasting equipment including cable TV. Joseph Bartolo, professional engineer and director of Wireless Telegraphy, says that the problems of the future clearly lie within the field of EMC: "One has to recognize that the demand for radio services, in particular mobile service, is increasing at a high rate. This increases the interference level these services are suffering, notwithstanding the safeguards that are taken within the framework of licensing. We therefore have electromagnetic pollution. We were already thinking along the lines of EC directives but with the purchase of this Rohde & Schwarz equipment the present situation will certainly improve."

Bela Mohacsy; Robert Reithofer

Digital Radiocommunication Testers CMD 54 (for GSM BTS testing) **and CMD 57** (for PCN (DCS 1800) BTS testing) provide high measurement accuracy and speed for all transmitter and receiver measurements without additional instruments in mobile and stationary use; RS-232-C interface, options eg for reference frequency, AF measurements (with 60-MHz frequency counter), A_{bis} and IEC/IEEE-bus interface.

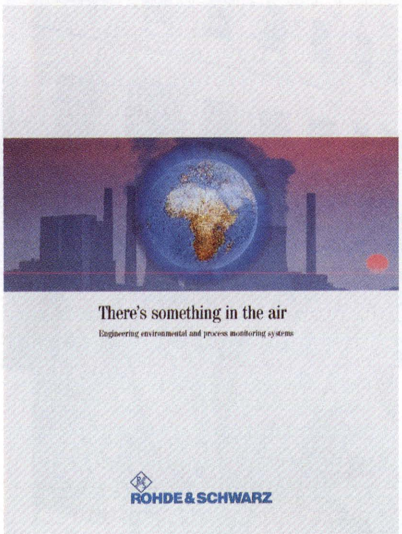
Data sheet PD 757.1231.21 Enter 147/23

Directional Power Sensor NAP-Z42 (0.9 to 2 GHz, 0.05 to 110 W) measures power in digital communication systems with an error of ≤5% + 1 digit + 0.01 W; 50 Ω, SWR ≤1.08, N connectors.

Data sheet PD 757.1360.21 Enter 147/24

TV Inserter/Regenerator VIR (lines 6/319 to 22/335) regenerates sync pulse, controls program-signal level and inserts test lines in the ongoing program (automatic bypass); three channels, eleven test signals (further signals reloadable), control lines and (optional) BIT bus.

Data sheet PD 757.1219.21 Enter 147/25



MUSICAM Codec MUSIC (40 Hz to 20 kHz) for high-quality digital data (and ancillary data) transmission serves for source coding and data compression to ISO-MPEG 11172-3; plug-in, bench and rackmount models.

Data sheet PD 757.1183.21 Enter 147/26

DSR Test Receiver EDSR (118 MHz and 54 to 854 MHz) detects simultaneously BER, input level (various display modes), jitter, synchronization, interpolation and headroom; monitoring of limit values (alarm messages and alarm register as well as statistical evaluation), headphones (adjustable) and outputs for I/Q signals, monitoring loudspeaker, analog and digital interfaces.

Data sheet PD 757.1248.21 Enter 147/27

Antenna Systems AK 451 (TX: 5 to 30/RX: 2 to 30 MHz) **and AK 471** (TX: 7 to 30/RX: 3 to 30 MHz), 1 kW, linear horizontal polarization, gain 6 to 13 dBi, options for manual/automatic control of direction of rotation, many components and interfaces available; N connector.

Data sheet PD 757.1377.21 Enter 147/28

Level Meter URV 35 (DC to 26.5 GHz) Power Sensors NRV-Z31 and NRV-Z53/Z54 as well as new optional Sensor Check Source NRVS-B1 (50 MHz, 1.00 mW) now included in data sheet.

Data sheet PD 756.9497.22 Enter 147/29

HF Transceiver Family XK 2000 (TX: 1.5 to 30 MHz/RX: from 10 kHz) now offers output powers of 150 W (XK 2100), 500 W (XK 2500) and 1 kW (XK 2900); frequency error with option $<10^{-9}/°C$; GMDSS for maritime applications and expandable for MAHRS/LINK.

Data sheet PD 757.0941.22 Enter 147/30

Series 200 VHF/UHF Communication System (118 to 144/225 to 400 MHz) The data sheet now also contains the new UHF systems.

Data sheet PD 757.0241.22 Enter 147/31

Terrestrial Flight Telecommunication System TFTS JETCALL for aircraft passenger communications (APC) has been developed by Rohde & Schwarz and Mors/France and provides voice, fax, data transmission and paging.

Info PD 757.1454.21 Enter 147/32

There's something in the air Environmental and process monitoring systems from **R&S Cologne works** are presented in this brochure: from standalone instruments to customized systems, for stationary or mobile use, with all the accessories required.

Info PD 757.1348.21 Enter 147/33

Turnkey System Engineering This brochure from **R&S Cologne works** introduces turnkey customized systems for environmental monitoring.

Info PD 757.1425.21 Enter 147/34

Power Supplies The catalog now includes new DC Power Supply NGSM 32/10 (0 to 18 V/10 A (20 A), 0 to 32 V/5 A (10 A)), designed for car electronics.

Catalog PD 756.3799.27 Enter 147/35

FM/TV Antennas (bands I to V) On 60 pages the catalog presents the know-how of Rohde & Schwarz in the field of broadcasting antennas. The main chapters deal with antenna arrays, combiners/splitters, switching matrices, cables/junction elements/accessories, antenna systems and planning.

Catalog PD 757.1125.21 Enter 147/36

Schz

New application notes

Remote control program to test GSM mobiles with CMD 52/55
Appl 1CMAN01E Enter 147/37

Remote control of a satellite dish antenna with the factory user port of Industrial Controller PSM
Appl 1CMAN10E Enter 147/38

File transfer using LPT port of Industrial Controller PSM
Appl 1CMAN11E Enter 147/39

Uninterruptible power supply for PSM
Appl 1CMAN12E Enter 147/40

Industrial controller on the factory floor
Appl 1CMAN14E Enter 147/41

Channel impulse response measurements in DAB networks
Appl 1CMAN15E Enter 147/42

Channel impulse response measurements in GSM, DCS1800 and PCS1900 networks
Appl 1CMAN16E Enter 147/43

Fundamentals of signal propagation in mobile radio and measurement of CIR (channel impulse response)
Appl 1CMAN17E Enter 147/44

Planning of new digital radio networks
Appl 1CMAN18E Enter 147/45

DC measurements done with Visual BASIC and factory user port of Industrial Controller PSM
Appl 1CMAN19E Enter 147/46

DC measurements done with R&S BASIC and factory user port of Industrial Controller PSM
Appl 1CMAN20E Enter 147/47

Text input using front-panel keypad of Industrial Controller PSM
Appl 1CMAN21E Enter 147/48

Line voltage monitoring with Industrial Controller PSM
Appl 1CMAN22E Enter 147/49

Plotting with DOP3 using RS-232 interface
Appl 1CMAN23E Enter 147/50

Softkeys for Industrial Controller PSM
Appl 1CMAN24E Enter 147/51

Battery tester with factory user port of Industrial Controller PSM
Appl 1CMAN25E Enter 147/52

Loudspeaker measurements with Audio Analyzer UPD and UPD-K
Appl 1GPAN16E Enter 147/53

Power and modulation measurements on VHF transmitters
Appl 1EPAN09E Enter 147/54

Carrier-to-noise measurements using the PHASE NOISE function
Appl 1EPAN11E Enter 147/55

Processing of stored ZWOB curves with a PC
Appl 1EPAN12E Enter 147/56

Radiomonitoring with Test Receivers ESN/ESVN
Appl 1EPAN13E Enter 147/57

Trunked-radio system technology from Rohde & Schwarz for Mecklenburg-Vorpommern

The magazine "MobilCom" 9/94 included a report on the creation of a new trunked-radio network in Mecklenburg-Vorpommern. Originally, the idea was to use the Smartnet standard which is not well-known in Germany. Now, for various reasons, there has been a change of mind:

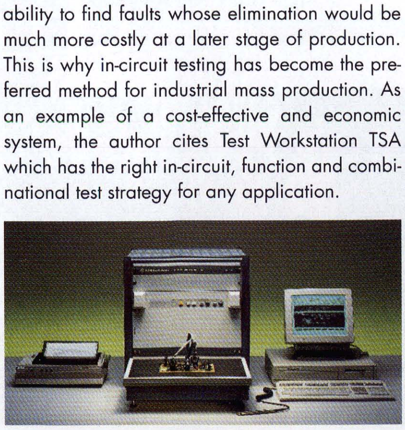
Accessnet from Rohde & Schwarz, ideal for regional applications, is now the final choice. Rohde & Schwarz's flexibility as a supplier was just one of the reasons for the rapid rethink.

Currently, EMC is attracting a lot of interest and has been given a high profile at ELECTRONICA 94. The automobile industry, for example, is using well-equipped test centers to check the electromagnetic compatibility of its electronics. The picture below from "VDI-nachrichten" No. 44/94, the official publication of the Association of German Engineers, shows just such a test center with EMC test technology supplied by Rohde & Schwarz.

In-circuit testing

In the September 1994 edition of the journal "Fachzeitschrift für Fertigungs- und Prüftechnik EPP", F.-P. Zantis made the following points in an article on the fundamentals of in-circuit testing:

The economic justification of every test level is the ability to find faults whose elimination would be much more costly at a later stage of production. This is why in-circuit testing has become the preferred method for industrial mass production. As an example of a cost-effective and economic system, the author cites Test Workstation TSA which has the right in-circuit, function and combinational test strategy for any application.



D2-MAC Generator SDMF for accessing all video, sound and data parameters defined in the MAC standard or by the user is featured on the front of the Italian electronics journal "elettronica". What is more, SDMF is the first generator to provide test signals using the Eurocrypt scrambling method.

Faster to the customer – slashing marketing time by more than half

In the "IHK-Journal" No. 10/94, Dieter Roßkothen, a Rohde & Schwarz project manager, revealed the following about the company's management project "Half Time to Market", designed to improve international competitiveness:

Our new concept is a much more rapid way of getting new products onto the market than conventional planning techniques. ... we are now handling 25 test product developments simultaneously with HTM. Before it took five years to reach market maturity, now the new systems will be available to the customer in just two years.

North/South divide

Analyzing the state of information technology in Bavaria in issue 9/94 of the business magazine "TopBusiness Report", Ulf J. Froitzheim concluded that:

As far as the location of the computer and the telecommunications industry is concerned, the North of Germany is out in the cold. All roads lead to Munich – in this sector anyway. ... and if transmitter systems are going to be built or tested you can be pretty sure Rohde & Schwarz will be involved.

Sony counts on the latest EMC test technology from Rohde & Schwarz

In the Munich electronics journal "HF-Report" No. 3/94, Christian Rockrohr quotes Senior Manager Kenji Okazaki whom he interviewed during a visit to the most up-to-date EMC test center for consumer electronics in Europe built by Sony at Fellbach near Stuttgart:

We went with Rohde & Schwarz because they were the only company who submitted an offer that gave us the highly specialized EMC test systems in the combination we wanted. What is more, Rohde & Schwarz has many years experience designing and implementing EMC test systems.

Asked how happy he was with Rohde & Schwarz, Kenji Okazaki didn't beat about the bush:

We would have no hesitation working with Rohde & Schwarz on the implementation of other projects.

The compact VHF/UHF Receiver ESMC for universal stationary or mobile-radio reception was featured on the front of the magazine for radio broadcasting "RadioWelt" No. 12/94.

World premiere

Nils Schiffhauer reporting from the 19th international amateur radio exhibition, HAM Radio 94, in "Funk" No. 9/94:

"This is a world premiere" enthused Berndt Helmke from Rohde & Schwarz. No wonder! – the Munich company was unveiling its new VLF-HF Receiver in Friedrichshafen. It is the successor to EK 890 and has a digital signal processor at the 3rd IF of 25 kHz. All this at a price just below DM 13 000.

25th anniversary of Teisnach works

On 18 November 1994, the Rohde & Schwarz works in Teisnach in the Bavarian Forest celebrated its 25th anniversary. Invitations were sent to

500 employees and 130 guests from the world of politics, the civil service and industry. After an extensive tour of the works for the visitors, everyone gathered for formal celebrations in Teisnach Hall which had been specially decorated for the occasion. The works manager, Hans Bühler, who has been in charge of the part manufacturing works since the early days, welcomed the guests and reviewed the past 25 years. Friedrich Schwarz too remembered how what he referred to as the "most beautiful works in the company" got off the ground, praised the workforce and outlined the challenges now facing them.

In her speech, Teisnach's mayoress, Rita Röhrl, emphasized the close cooperation between Rohde & Schwarz and the town and warmly welcomed the company's presence in the area. Everyone knows that this works is a tremendous boost for the town. Teisnach is proud of Rohde & Schwarz. The mayoress presented two citizen's medals with scrolls to Friedrich Schwarz and Hans Bühler to mark the occasion. Short of granting the freedom of the town, this is the highest accolade the town can award (photo above).

The mayoress presented Dr. Dr. h.c. Hermann Schwarz, a freeman of Teisnach, with a hand-carved Madonna from a Teisnach artist as a token of gratitude for setting up the works there (photo left). Dr. Schwarz took this opportunity to make an amusing speech to the guests and workforce describing how the decision to set up in Teisnach came about. Finally, he said, "The people here are wonderful, we are very happy to be here in Teisnach".

Resounding success for Rohde & Schwarz France

France Télécom Mobiles Radiomessagerie, a subsidiary of France Télécom, has decided to update all transmitters for its Eurosignal radiopaging service which covers the whole of France. Thanks to the technical expertise of Rohde & Schwarz, the company's competitive pricing policy, the efficiency of the projects and installation team and the excellent cooperation between head office and French subsidiary, Rohde & Schwarz France has been entrusted with the whole contract, namely, 36 10-kW and three 1-kW stations with passive standby, three single 1-kW stations, 73 single 500-W stations plus one 10-kW transmitter and one 500-W transmitter which will be used in the training center of France Télécom Mobiles Radiomessagerie. This amounts to 156 transmitters to the value of 55 million francs.

France Télécom Mobiles Radiomessagerie is using the replacement of all transmitters as an opportunity to set up an additional radiopaging service – Biplus from Alphapage – which uses POCSAG modulation. Every station is equipped with an FM Transmitter SU 115 for Eurosignal and a POCSAG Transmitter SU 116 which Rohde & Schwarz has specially developed for Biplus from Alphapage. A remote-controlled switching device makes it possible to change from one service to the other as the power amplifier stage in both systems is identical.

M. Henser (KAM France Télécom)

DAB for China

The government of the People's Republic of China has decided to introduce digital broadcasting (DAB). Two high-ranking Chinese delegations made a fact-finding mission to Munich to gather information on the latest research, production and the practical aspects of launching DAB. While the Chinese delegation from Beijing were visiting in spring 1994, the Bavarian state government made the decision to set up a DAB pilot project of its own in Bavaria. The project will be handled jointly by Bayerischer Rundfunk (BR), the Institut für Rundfunktechnik (IRT) and Rohde & Schwarz. The guests showed great interest in this milestone decision, as a DAB pilot project was planned for a major Chinese city. The Chinese are eager to cooperate with BR, IRT and Rohde & Schwarz on the practical aspects of the project.

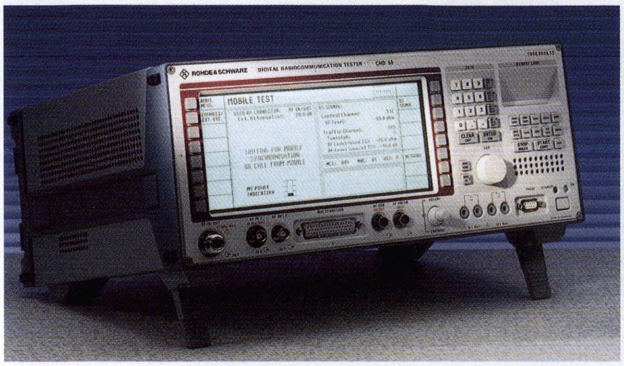
During their visit to Rohde & Schwarz (photo), the Chinese guests had an opportunity to familiarize themselves with the latest technological developments and the DAB equipment. In round-table talks with representatives of Bayerischer Rundfunk, the Federal German Ministry of Post and Telecommunications and German Telekom, there was a general exchange of information with special emphasis given to regulation and national and international activities.

Contact with the visitors will be maintained by the Rohde & Schwarz agency in Beijing. Negotiations about contracts for DAB transmitters will also take place there.

J. Beckmann

Mobile-radio Tester CMD 55 for US PCS networks

In autumn 1993, new frequency bands were assigned to PCS mobile-radio networks (personal communications services) in the US. In addition to the narrowband PCS networks operating in the 900-MHz band, it was the intention to introduce broadband networks operating from 1850 to 1990 MHz, meeting the GSM standard. The precise channel assignment is, however, still at the definition stage, but Digital Radiocommunication Tester CMD 55 (photo), which has been extraordinarily successful with GSM and DCS 1800, can already handle this frequency range thanks to option CMD-B19 (uplink 1850 to 1910 MHz, downlink 1930 to 1990 MHz). Naturally, the option still provides all the test functions of the basic version and the user-friendly operating concept (see News from Rohde & Schwarz No. 145). CMD 55 gives the user a universal, compact test setup, a highly flexible and rapid way of testing mobile-radio equipment in both production and service environments. G. Holzmann



New Rohde & Schwarz office in France

In the presence of the board, other top managers from head office and numerous representatives from Rohde & Schwarz subsidiaries all over Europe, the official opening of a new Rohde & Schwarz France office took place in June 1994 in Meudon – a few kilometers from Paris. Also invited were more than a hundred top managers from companies who do business with Rohde & Schwarz. After welcomes by Friedrich Schwarz and the two French directors, Paul Ducasse and Philippe Catherine, the guests were shown through the building. A quartet provided a musical accompaniment for the subsequent banquet.

An open day which took place one day after the official opening attracted over 250 visitors. They were able to sample the delights of both French and Bavarian cuisine as a French buffet and a Bavarian beer garden were both laid on. Bavarian beer and traditional veal sausages from Munich were great favourites. The whole RSF team – all wearing white Rohde & Schwarz T-shirts – looked after the guests (photo). At a raffle, one of the visitors won a weekend for two at the Munich beer festival. RSF

Radio Data Codec DMC 01 has new functions

DMC 01, a combined RDS coder and decoder (photo) now has an IEC/IEEE-bus interface for modifying all stored parameters and data. With this interface, the codec can be incorporated into automatic test and measurement systems controlled via the IEC/IEEE bus. Autoradio and tuner test systems with Signal Generator SMT or test setups with Radiocommunication Service Monitor CMS for testing RDS decoders are examples of this application.

DMC 01 already has the rebroadcast function. With this function, the user can analyze RDS data at repeater stations and rebroadcast selected RDS data. In this way, dynamic data can be passed on via repeater sections without the need for a direct data link (eg modem line) to the radio transmitter. Rohde & Schwarz is the only manufacturer to supply this cost-effective solution in one compact RDS codec. A simple software update is all that's needed to retrofit the rebroadcast function. W. Drews

Rohde & Schwarz seminars now in Berlin and Cologne

The positive response to the seminars in Munich and Vienna has encouraged Rohde & Schwarz to expand the program. To make things even more convenient for customers, the training center is presenting attractive topics from the overall program at venues in Berlin and Cologne from 1995. But that's not all. Seminars from the training center in the Cologne works have also been included in the overall program. This means that a whole series of seminars which have, until now, had restricted availability are now being run in Berlin, Munich and Vienna. The training team can now address a wide range of customer interests and problems by tackling topics like optical fibres, circuit technology and repair and soldering techniques. "Data protection for local networks", a topic that is becoming more and more vital, has been included in a revised collection of subjects under the heading EDP. The classic range of topics from the various fields of test and measurement technology have, of course, been updated and extended. Even more so than in the past, the main purpose of these activities will be to keep the seminar participants informed about changes in standards (eg CE conformity mark) that will be taking place in the EU from 1 January 1996.

The seminar organizers are looking forward to seeing you again in the Rohde & Schwarz training centers. If you do not receive the seminar program regularly, or have any other queries, just call us: Telephone hotline +49 89 41 29-30 51, fax hotline +49 89 41 29-33 35. L. Gabler

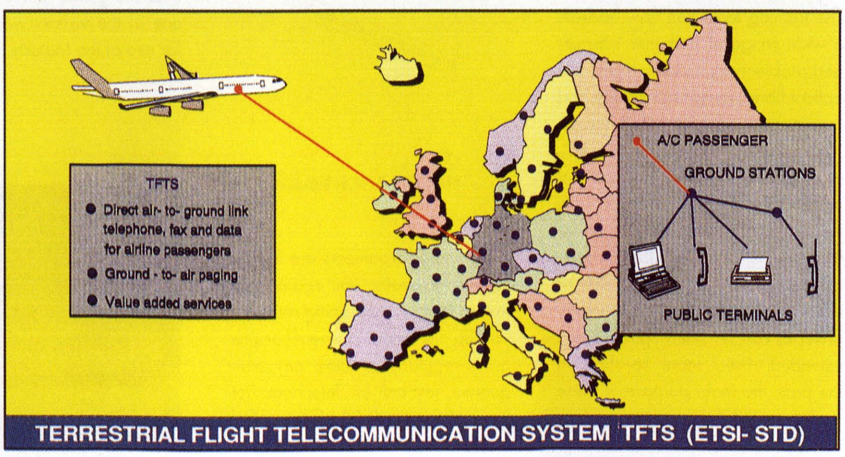
TFTS JETCALL in operation

"Hello, is that the AVIS office? I am just approaching the airport and would like to get a medium-size car on arrival. You would like to know my card number? It is 45632291. Is it all OK? Thank you and bye bye."

These words were spoken from air to ground during the first successful phone call made within the new telephone service. A call of this kind was made possible thanks to the **Rohde & Schwarz/Mors system TFTS JETCALL** installed in the electronic bay of the plane (TFTS = terrestrial flight telecommunication system). The conversation was crystal-clear and intelligible without any disturbing noise or delay which occur typically with satellite transmissions. This kind of quality is due to the digital design of the system and to the direct air-to-ground link. The call was set up via a newly installed ground station in the Frankfurt/Main area which is part of the West-European TFTS network currently being implemented (FIG 1). Other stations in the North and South of Germany will shortly be available and the link to the new network to be set up in Eastern Europe will be via a ground station near Frankfurt/Oder.

The major European airlines are intending to provide this new service on their medium- and long-range planes

FIG 1 TFTS network in Europe



Airbus A300-A600, A320, A321, Boeing 737-200 to 400 and 747-400. On the London-to-Paris route this telephone service has been in operation for quite a while and tests on other routes – also with Rohde & Schwarz equipment – have meanwhile been completed successfully.

The service for the European terrestrial flight telecommunication system is currently carried out by the **service provider** Jetphone. Jetphone is a company owned 50% each by France Cable Radio and British Telecom. Another service provider is Mercury Flight Link, a company founded by Mercury with holdings by the US company IN-Flight Link. The standard for this service has been developed since 1990 in the RES 5 body (radio equipment systems) of the European standardization institute ETSI with the active and continuous participation by Rohde & Schwarz. The standard was passed in 1994 by a large majority of the European postal organizations belonging to CEPT. Up to now, 14 European network operators have signed the agreement for setting up a Europe-wide network.

In addition to the **voice telephone service, fax and data transmission** from the aircraft will also be possible via TFTS by 1995, a feature strongly advanced by Rohde & Schwarz/Mors. Ground-to-air paging and many other services such as in-flight news, shopping, stock-market listings, business-traveller services (ie hotel and car reservation), weather forecast and information about aircraft and airports will follow.

JETCALL is an onboard radiocommunication system developed by Rohde & Schwarz/Mors in compliance with **standard ARINC 752.** This standard was first worked out in the European body EAEC (European Airlines Engineering Committee) and then submitted by ARINC to the general meeting of AEEC (Airlines Electronic Engineering Committee) which, in 1993, agreed to draft the Grey Cover (official standard) for worldwide use in aircraft.

The air-ground link is effected in the **frequency range** from 1670 to 1675 MHz (downlink) and from 1800 to 1805 MHz (uplink). In contrast to satellite-supported flight telecommunication systems, transmission to the system ground stations in this case is by means of line-of-sight operation. TFTS operates with the DQPSK **modulation method** (differential quadrature phase shift keying) and the TDMA **transmission method** (time division multiple access) for the air-ground link and time division multiplex (TDM) in the opposite direction. Signal transmission at the air interface is at 44.2 kbit/s. The transmission channel is subdivided in time slots so that four user channels with a rate of 9.6 kbit/s each are available in addition to the control channel.

The onboard system component consists of the radiocommunication system and the cabin equipment. The **radiocommunication system** is made up of a sharkfin-shaped antenna, the diplexer, the transmit/receive unit and the modem processor unit (FIG 2). The antenna is fixed at the belly of the aircraft and the other units are installed in the fuselage of the aircraft, ie in the electronic bay.

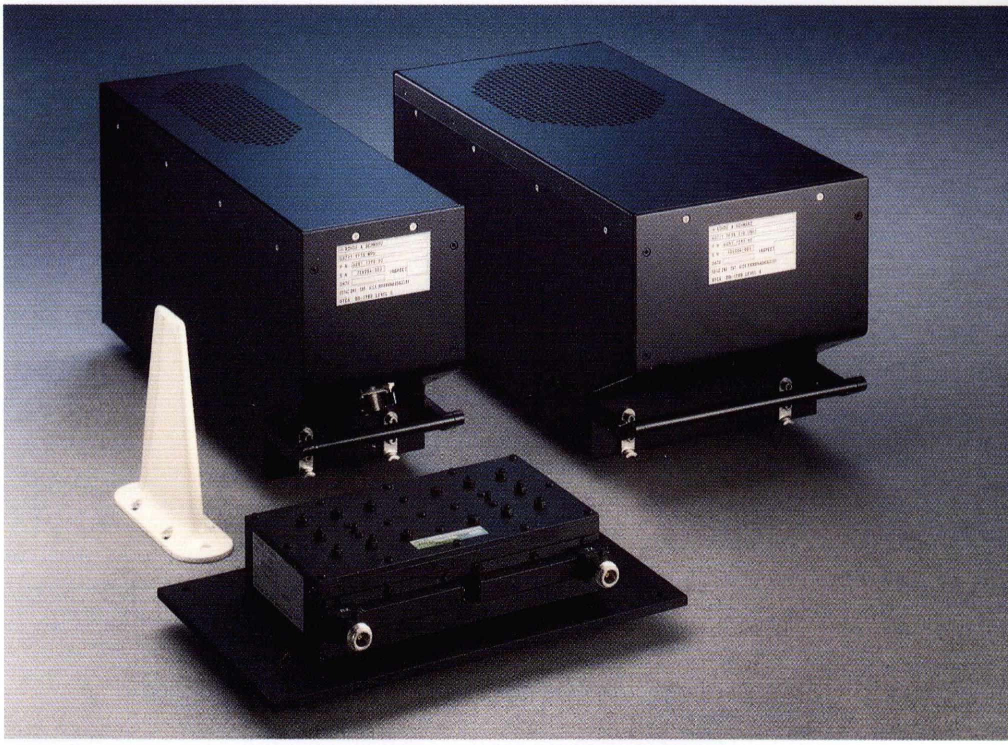


FIG 2 Radiocommunication system of TFTS JETCALL with antenna, diplexer, transmit/receive unit and modem processor unit Photo 41 591

Ekkehardt Claussen; Helmut Schöller

Reader service card 147/32

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News from Rohde & Schwarz 147 · PD 757.1390.21