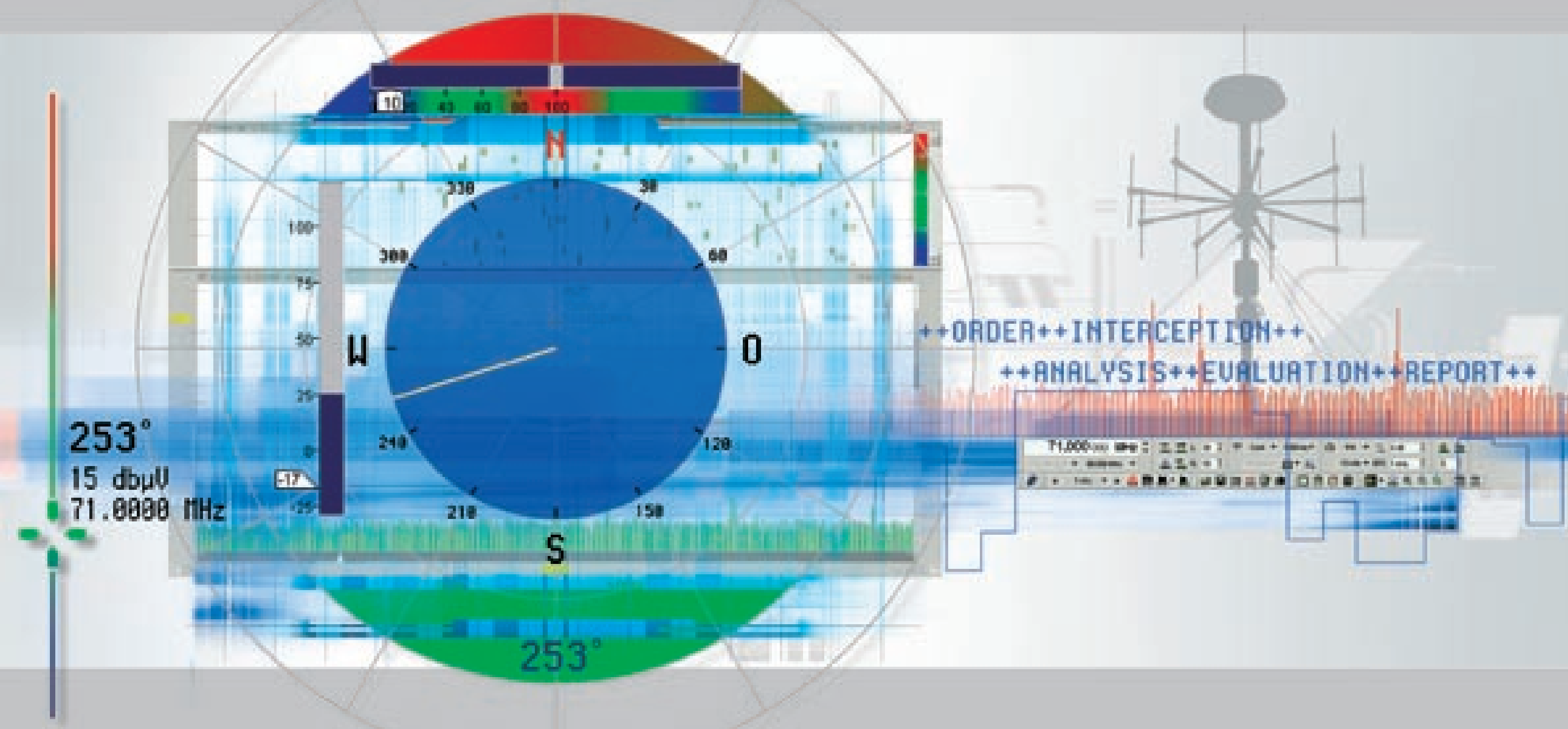
News from Rohde & Schwarz



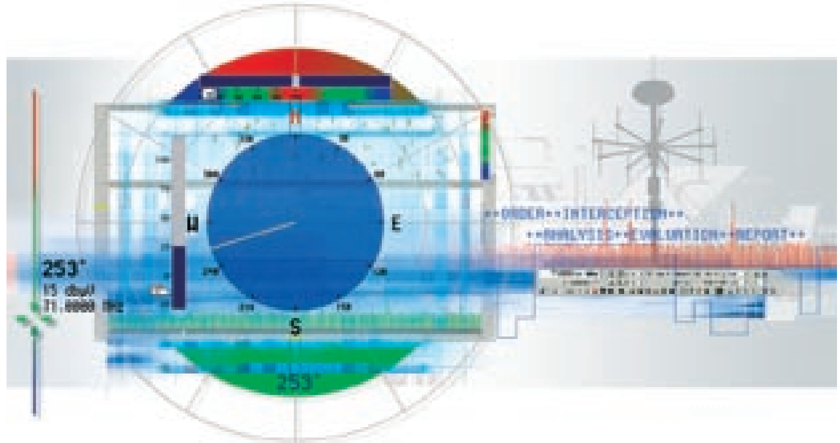
Modular and scalable systems for radiomonitoring

Compact digital broadband direction finders: extremely fast and highly precise

Comprehensive monitoring of MPEG-2 transport streams

2003/III
179

ROHDE & SCHWARZ



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The focus of this issue is radiomonitoring: The latest generation of the R&S®RAMON product family – systems for radiomonitoring and communications intelligence – is presented on page 39. The broadband Direction Finders R&S DDF®0xA unite top-class RF engineering and the fastest digital signal processing components (page 44).

44010/2

The new Shielded RF Test Fixture R&S®TS7110 can accommodate completely different tests, from initial board tests to complex final tests (function tests) of mobile phones and other small equipment (page 4).

44036/3

The Industrial Controller R&S®PSL3 – the first model of the new R&S®PSL family – succeeds the R&S®PSM, which has been a long-standing success in measurement systems (page 16).

MOBILE RADIO

GENERAL PURPOSE

EMC / FIELD STRENGTH

BROADCASTING

RADIOMONITORING

MISCELLANEOUS

44 042/2

The globally successful R&S®Netlink has been integrated in the new Transmitter Control Unit R&S NetCCU®700. Only one unit is therefore required for the control, monitoring and remote control of low-power transmitters (page 26).

43 983/1

The Portable SAT / TV / FM Test Receiver R&S®EFL 100 is primarily used for the installation and maintenance of antenna and signal distribution systems (page 36).

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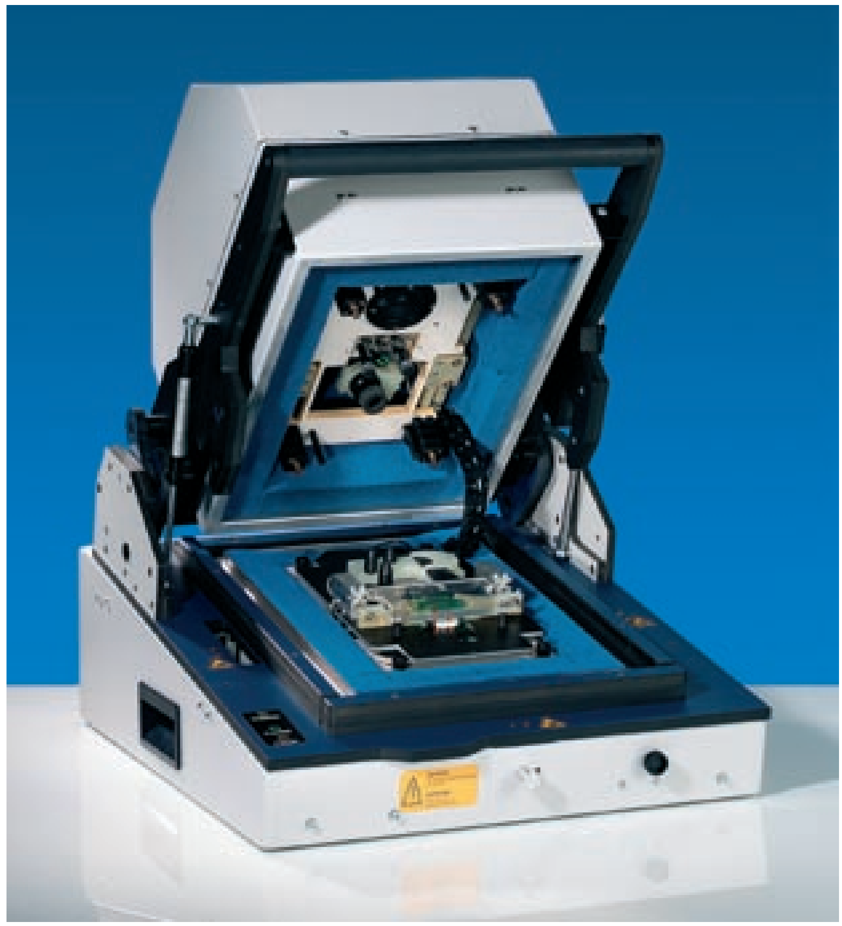
Versatile Shielded RF Test Fixture R&S®TS 7110

Test fixture for modules and units with radio interface

With the help of the Shielded RF Test Fixture R&S®TS 7110, users can implement individual test requirements in no time at all without facing the risks of new developments. And the best news first: The fixture can accommodate completely different tests, from initial board tests to complex final tests (function tests).



44 010/3

FIG 1 Test fixture (open) for PCB and final tests.

FIG 2 Test fixture (closed) for final testing, with raised cover for the picture processing components.

44 010/5

Versatile and shielded

The R&S®TS 7110 (FIGs 1 and 2) is a shielded test fixture for UUTs with a radio interface, such as mobile phones, personal digital assistants (PDA), remote keyless entry, wireless phones, etc. The UUTs can operate on the basis of diverse radio standards such as GSM, WCDMA (UMTS), *Bluetooth*™*, WLAN or Home RF.

* The Bluetooth word mark and logos are owned by the Bluetooth SIG, Inc. and any use of such marks by Rohde & Schwarz is under license.

The fixture was designed for the R&S®TS 7100 (cPCI) and R&S®TS 7180 (PC-based) production test systems [1] [2]. However, owing to its standardized USB interface and modular design, it can also be used in combination with other test systems. A DLL interface is provided on the software end to control the individual components.

The fixture is primarily used in production, but also in service, repair and quality assurance.

Design and functions

The semi-automatic R&S®TS7110 test fixture consists of a base and a fold-out upper part with pneumatic support for easier opening and closing (FIGs 1 and 2). The upper part includes a universal stabilizing piece for UUT positioning as well as other test fixtures for tasks that need to be performed from the upper side of the UUT (FIGs 3 and 4).

The base integrates the lower part of the RF chamber with the exchangeable test fixture including UUT mount. The test system interface is also fitted here, containing fixture control as well as additional built-ins, signal conditioning and level converters for communication with the UUT. Mechanically standardized interfaces make it easy to replace the UUT fixture for testing other units or models with similar testing tasks (FIG 5).

Shielded test chamber

When RF modules are tested, external sources of interference (nearby base stations, adjacent test systems, etc) must always be taken into account. To sufficiently suppress these signals, the test fixture is shielded against high-frequency interference. Pneumatic lines are conducted through specific wall feedthroughs, electrical signals through RF feed throughs or sub-D connectors with filters.

Absorber material on the interior walls absorbs reflections and prevents reverberating waves, permitting reproducible and reliable measurements (FIG 4). This absorber material also affects audio applications, effectively reducing ambient sound. Thus, acoustic measurements with artificial ear and mouth (loudspeaker and microphone) can be performed together with the RF tests in a single test fixture during the final testing of mobile phones.

Flexible antenna couplers are provided for testing wireless interfaces in the RF range. They are available for all common frequency ranges as are used for example with 2G and 3G mobile phones, WLAN adapters or *Bluetooth*.

Board test

A common problem that occurs when printed board assemblies are tested is that a lot of test points have to be connected to the measuring instruments. ▶

FIG 3
Setup of the test fixture for final tests including display and camera tests.

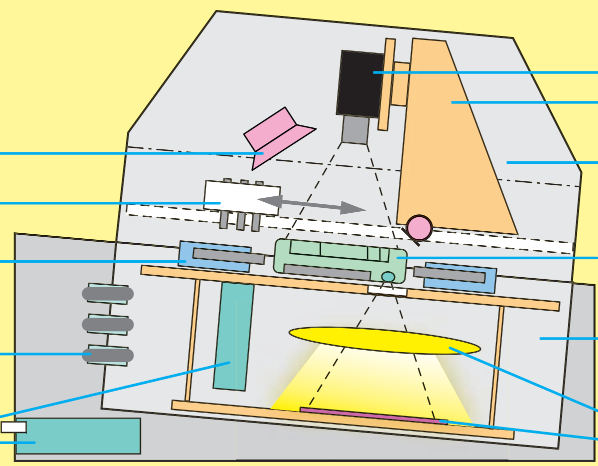
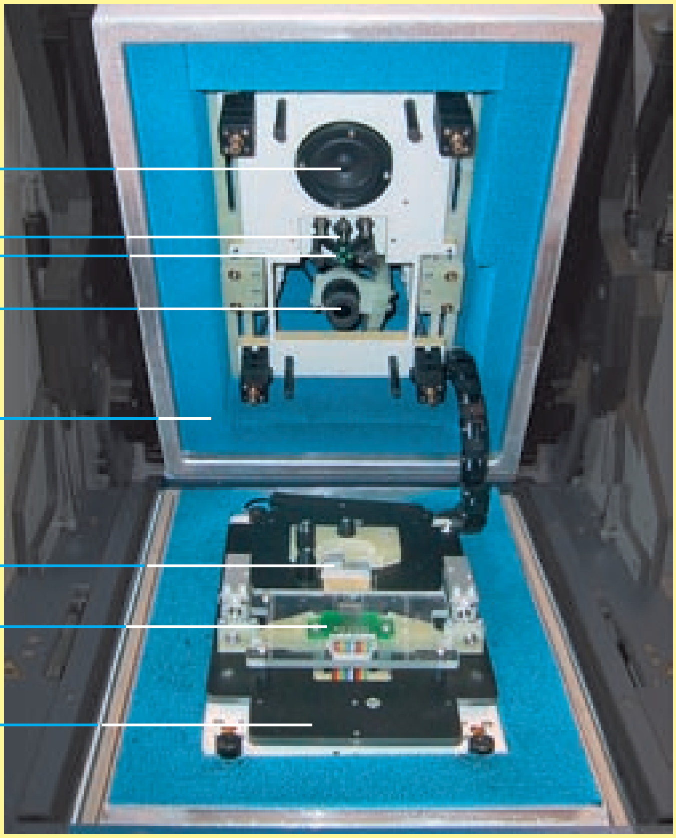


FIG 4
Interior of a final test fixture.



A multiplexer in the R&S®TS 7110 that is accommodated near the UUT ensures short lines and keeps the capacitive load of the test points low. Plus, the multitude of signal lines in the cabling of the entire test system was reduced, which is yet another advantage.

By installing a second needle board in the upper part of the fixture, the module can be contacted from both sides. Test points with electrically sensitive signals can be driven by separate pneumatic needles that are contacted only during a measurement or adjustment routine. High-frequency signals are coupled and decoupled via specific test needles that can also be operated pneumatically, if required. Pneumatically moving pins connect the module during the test by means of the standard interfaces that can be accessed by the end user (e.g. SIM card, headset, memory extension, etc).

Final test

Unlike the board test where plenty of electrical signals have to be contacted, the final test checks the ready assembled unit and, if required, performs further adjustment routines. Usually those components are submitted to a test that have been added after the board test was performed. Depending on the type and scope of the test specifications, these are various electrical tests, tests of the acoustic components, the control elements, the display, and with mobile phones of the latest generation, the testing of the built-in camera (FIG 4).

Mechanical components such as the keyboard are actuated via pneumatic fingers to test their functioning and response characteristics. **Electrical connectors** and functional extensions such as plug-in units for extension cards can usually only be tested via pneumatic control and contact since these interfaces are often located inside the UUT. **Acoustic components** must be adjusted with regard to sensitivity and sound pressure, and their frequency response measured.

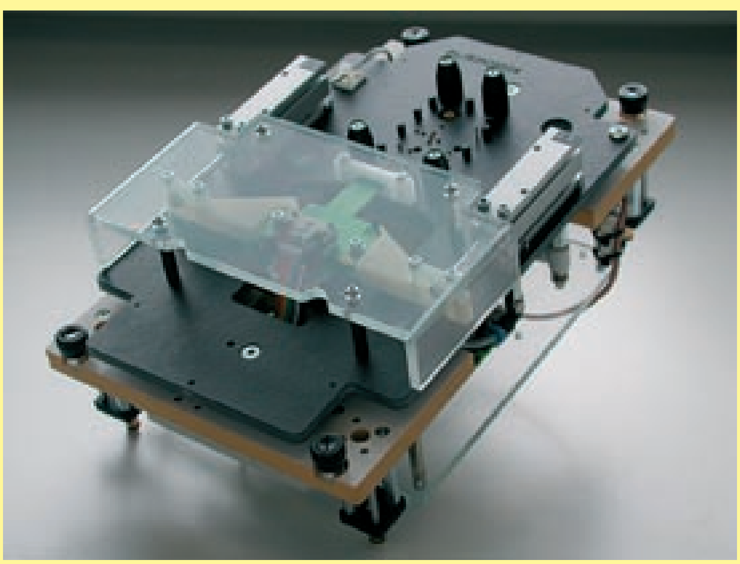


FIG 5 Exchangeable fixture for the board test.

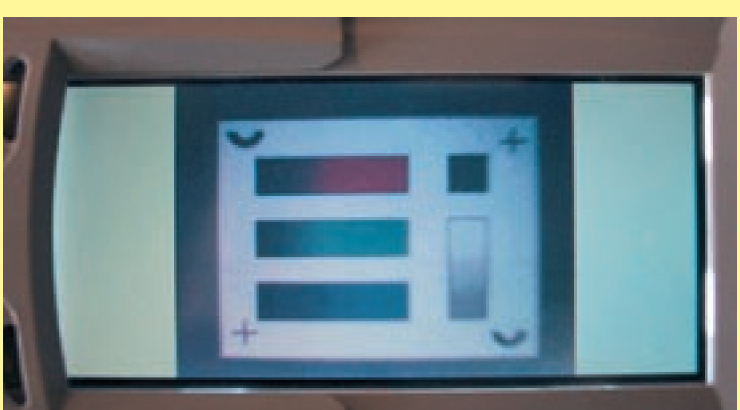


FIG 6 Display of a smart phone with an on-screen test pattern.

Display and camera test

Malfunctions of displays can be manually tested by the test personnel, or by means of an automatic optical test, which permits very reliable testing and the setting of reproducible operating conditions such as display contrast.

Display functionality, quality standards of the manufacturers and the applicable test strategy affect the focus of the optical test, including:

- Checking the fitting position
- Contrast and colour measurements
- Font and logo recognition
- Testing for rows and columns failure, and, less often,
- Testing for defects of individual display pixels

Crucial to the technical effort involved is the display resolution, whether a pixel-oriented test is required or a colour display is to be tested, and how homogeneous the display lighting is.

Applications of the Shielded RF Test Fixture R&S®TS 7110

- Production, service and quality assurance
- Tests of printed board assemblies
- RF tests via the built-in antenna
- Audio tests with artificial ear and mouth
- Keyboard test with pneumatic fingers
- Tests of black/white or colour displays
- Tests of UUT built-in cameras

Outstanding characteristics

- Overall concept for the function test (board and final test as well as testing the UUT user interface)
- RF- and audio-compliant setup of the test chamber
- Modular design
- Exchangeability of the UUT mount
- Subsequently upgradeable for new product versions
- Controllable via standardized USB interface
- Easy manual handling due to pneumatic support for fixture closing
- Status displays for user information
- Separate operating program for debug purposes and manual operation

Additional space in the upper part of the RF chamber of the R&S®TS 7110 test fixture has been provided for the installation of cameras above the UUT so that the automatic optical display test is integrated in the final test. The focus was on minimum height of the upper fixture part and low weight to ensure easy manual handling (FIG 2).

The narrow distance between camera and display due to the small height coupled with the often very high requirements placed on measurement accuracy require software correction of geometric distortions, vignetting of the objective and inhomogeneous lighting in order to reliably detect errors and measure values exactly.

Modern smart phones and PDAs are additionally equipped with a camera that must also be tested. Unlike the display test where different samples are applied, the camera test requires only a specific test pattern for testing the position, contrast and colours of the camera (FIG 6).

Due to the diverse test requirements of the manufacturers and the strongly deviating layouts of the UUTs, significant adaptations to the specific projects must always be made. This affects UUT mounting, but also the position and extent of the mechanical, electrical and optical components.

Summary

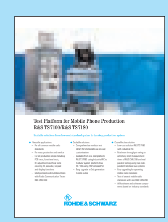
The modular concept of the Shielded RF Test Fixture R&S®TS 7110 permits fast and project-specific provision of system components for the function tests of UUTs with radio interface such as mobile phones. The scope of applications of the fixture ranges from module test to final test, which includes the electrical, mechanical, acoustic and optical test and thus enables the testing of all currently known elements.

The modular design of the fixture is an ideal basis for quality implementation of projects in due time, either by the Rohde & Schwarz integration centers, authorized systems houses or by the users themselves.

Gert Heuer; Georg Steinhilber

More information and data sheets at www.rohde-schwarz.com (search term: TS 7110)

Data sheet R&S®TS 7110



Data sheet R&S®TS 7180

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[2] Test platform for Mobile Phone Production R&S®TS 7180: Ready for mass production, incoming goods inspection and service. News from Rohde & Schwarz (2002) No. 176, pp 10–13

Universal Protocol Tester R&S®CRTU-G.

Universal Protocol Tester R&S®CRTU-G

Measurements on EGPRS systems

New technologies and continuous improvement in established mobile radio standards constantly increase the requirements placed on T&M equipment as to modularity and flexibility. This also applies to GPRS and EGPRS because the transition from connection-oriented to packet-oriented methods places new requirements on the signalling of mobile phones and thus on T&M equipment.

GPRS and EGPRS

With GPRS, a packet-oriented method has already established itself in mobile radio; numerous GSM networks are by now equipped with GPRS. Owing to flexible allocation, resources can be used more efficiently in packet-oriented transmission methods, thus achieving higher transmission rates, which is beneficial to users, but also to network operators who can now better utilize their systems.

In the course of increasing transmission rates, GPRS was expanded to EGPRS; for example, modulation was changed to 8PSK so that three bits per symbol can be transmitted. Transmission rates of up to 384 kbit/s can now be theoretically achieved. Sophisticated methods were implemented in EGPRS to avoid and correct transmission errors; one of them is incremental redundancy [1], a method that requests retransmission with different coding if previous transmission failed.

R&S®CRTU-G – an EGPRS test platform

This rapid follow-on development calls for new test strategies and functionalities which the Universal Protocol Tester

R&S®CRTU-G [2] satisfies, supporting both GPRS and EGPRS. Rohde & Schwarz provides a protocol stack that can be used for running test cases and writing individual test scenarios. Since all test cases provided by Rohde & Schwarz are available in source code, individual test cases can be easily derived by using parts thereof or by modifying them for individual purposes.

The R&S®CRTU-G runs on the Windows® 2000 operating system which facilitates the connection of external devices. Connections to the Internet or to networks can thus be easily set up. This feature is particularly important when developing mobile phones for GPRS and EGPRS since these technologies are intended for data exchange, which must be thoroughly checked during the development and test phases. For example, the R&S®CRTU-G makes it possible to transmit an Internet site available on a local network to a mobile phone and to check that this runs smoothly. Windows-based software is supplied as standard with the R&S®CRTU-G, providing fundamental GSM functionalities and analysis tools such as a sequencer for compiling and starting test sequences, a message viewer for analyzing the test results and a composer for modifying messages to be sent.

The optional R&S®CRGPRS1-3 software expansion provides both GPRS and EGPRS functionalities for the protocol tester. Based on this software, a wide variety of 3GPP test cases can be performed. The individual test cases are combined to form larger logical units and are offered in packets. The test cases are written in C and provided in the source code, ensuring maximum transparency and flexibility.

Multichannel tests

Up to eight R&S®CRTU-G / -S can be combined to form a multichannel system for the numerous test cases that require more than two RF channels. Even the most complex GPRS / EGPRS test cases with up to 16 RF channels can thus be performed. These test cases include handover, cell selection and reselection tests. In this case, an R&S®CRTU-G must be used as a master; all other protocol testers can either be an R&S®CRTU-S or R&S®CRTU-G. This flexibility helps to efficiently utilize the equipment available, and it is a cost-efficient introduction to multichannel test systems using the R&S®CRTU-S as a slave.

The GPRS test cases can run without any additional software in the 900 MHz, 1800 MHz and 1900 MHz frequency band. If they are to run also in the 850 MHz band, a software expansion is required which activates all test cases, not just GPRS and EGPRS, for this frequency band.

Standardized tools

The GPRS / EGPRS test cases are analyzed and generated by means of the same tools used for GSM log file analysis. The R&S®CRTU-G thus provides a standardized user interface for analyzing GSM, GPRS and EGPRS test cases. Analyzer, sequencer and message viewer are expanded by all relevant functions. In the message viewer, for example, logical GPRS and EGPRS channels can be blanked out, simplifying the display of the log file and accelerating analysis.

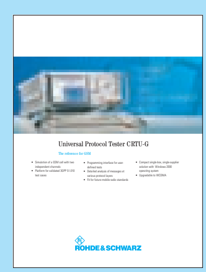
Since active GPRS / EGPRS tests frequently require interaction with the mobile phone, it is a good idea to transmit different commands via a serial interface to the phone directly from the test case, or via the SendAT tool directly from the R&S®CRTU-G.

Summary

The R&S®CRTU-G with its enhanced test capabilities for EGPRS has become even more appealing. Once more, its modular concept has proven successful, allowing expansions simply via a software update. And since the R&S®CRTU-G can also be expanded to form a WCDMA protocol tester, it covers the full scope of GSM and WCDMA. In combination with the R&S®CRTU-S, multichannel systems for as many as 16 channels can be quickly and efficiently set up. As a trailblazer in core technologies such as EGPRS, the R&S®CRTU-G with its comprehensive flexible design further strengthens its position as the market leader in protocol testing.

Reiner Götz; Markus Hendeli

More information and data sheet at www.rohde-schwarz.com (search term: CRTU-G)



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Universal Radio Communication Tester R&S®CMU 200

Transmitter and receiver measurements for cdma2000 1xEV-DO

To complement the cdma2000 1X standard [*], Rohde & Schwarz is now offering a fast test solution for its Radio Communication Tester R&S®CMU 200 for the new cdma2000 1xEV-DO data service standard.

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All measurements for development and production

The new option for the R&S®CMU 200 is an all-in-one solution with a flexible 1xEV-DO generator for receiver measurements and numerous transmitter measurements; its functionality covers all tests required in the development and production of access terminals for 1xEV-DO. Short measurement times and optimized test sequences ensure higher throughput in production.

cdma2000 1xEV-DO has been officially approved by the ITU as the IMT-2000 standard for third-generation mobile radio (3G). The standard has been optimized for pure data transmission and provides a maximum data rate of 2.4 Mbit/s in the forward link (from base station to mobile phone) in a channel of 1.25 MHz width; 153.6 kbit/s are available in the reverse link. This technology is ideally suited both for mobile high-speed and fixed wireless Internet services. In addition to the 47 cdma2000 1X networks, eight commercial 1xEV-DO networks are already operating in Korea, the USA and Brazil; another six are scheduled to officially start operation by the end of this year. The existing networks are usually on a smaller scale, mainly covering big cities. It remains to be seen whether entire areas will be covered at a later stage. Of course, convenient integration (in overlay) in existing cdma2000 networks makes it easier for cdma2000 network operators to provide customers in hot spots relatively quickly with the new data service.

1xEV-DO is often incorrectly considered a subset or superset of cdma2000. However, it is true that cdma2000 1xEV-DO exhibits the same RF characteristics as cdma2000 such as bandwidth, chip rate and time basis (which is also derived from the GPS signal), although the actual protocol stack is completely different. 1xEV-DO is a TDMA system using CDMA concepts for coding and addressing. Transmission in the forward link occurs in only one physical channel at a time, in the reverse link in up to four channels simultaneously; differentiation is via different Walsh codes in accordance with the CDMA principle (FIG 1). Handoff to a cdma2000 system has already been provided for in the current version of the 1xEV-DO standard, and will be included in the cdma2000 standard for future versions.

cdma2000 1xEV-DO measurements

The minimum requirements placed on 1xEV-DO access terminals are defined in the TIA / EIA IS-866 and 3GPP2 C.S0033 standards. Over the past few years, it has become evident that the manufacturers of mobile phones have increasingly tried to introduce a test strategy with reduced signalling on module level both in the calibration phase and final testing in their production lines instead of a complete signalling solution. Compared to testing with complete signalling, this offers significant advantages in speed. Moreover, this approach is considerably more flexible; plus, manufac-

Another article on the R&S®CMU 200 can be found on pages 13 to 15 of this issue.

Getting the names straight

1xEV-DO is known under various other names: HDR (high data rate), HRPD (high rate packed data), cdma2000-1x evolution – data oriented / optimized / only, TIA/EIA IS-856-1 (as named by the US-American standardization committee) and, last but not least, 3GPP2 C.S0024 V2.1 (3GPP2 standard).

The 1xEV-DO-specific name for base stations is access network (AN); the name for the mobile phone part is access terminal (AT).

turer-specific test scenarios can also be implemented. An asymmetric connection between forward link and reverse link (usually high data rates from the base station to the mobile phone, i.e. in forward link, lower data rates in reverse direction) makes conventional loopback testing impossible anyway.

Rohde & Schwarz has taken into account these requirements and, by providing the 1xEV-DO option for the R&S®CMU 200, supports the factory test mode that is implemented in most 1xEV-DO chipsets and their driver software. The factory test mode is a simple method for developers and manufacturers to reduce the test time for 1xEV-DO access terminals.

The basic test setup differs only minimally from that of a conventional signalling solution (FIG 2). The main difference is that the DUT is operated in the factory test mode during the test sequence.

Forward link simulation with the R&S®CMU 200

An outstanding feature is the wide variety of possible configurations of the access network signal of the 1xEV-DO option for the R&S®CMU 200. The radio tester can generate data for four different 1xEV-DO access terminals, thus permitting transmitter quality measurements on maximally four DUTs simultaneously. The MAC index (this is the address of the mobile station), data rate, data content and transmission interval can be defined for each access terminal. Different power control bit scenarios can also be defined (all up, all down, hold, range test as well as a configurable pattern mode). A limited "live" control channel is transmitted with a sync message which in turn is transmitted in realtime (FIG 3). Last but not least, comprehensive output trigger signals (e.g. even second clock, control channel, slot, AT reverse frame, AT forward slot) are available to the user.

Receiver measurements

The concept detailed above makes it possible to perform receiver measurements on up to four DUTs simultaneously by means of the control software of the access terminal, drastically cutting the measurement times of the very time-consuming packet error rate (PER) measurement.

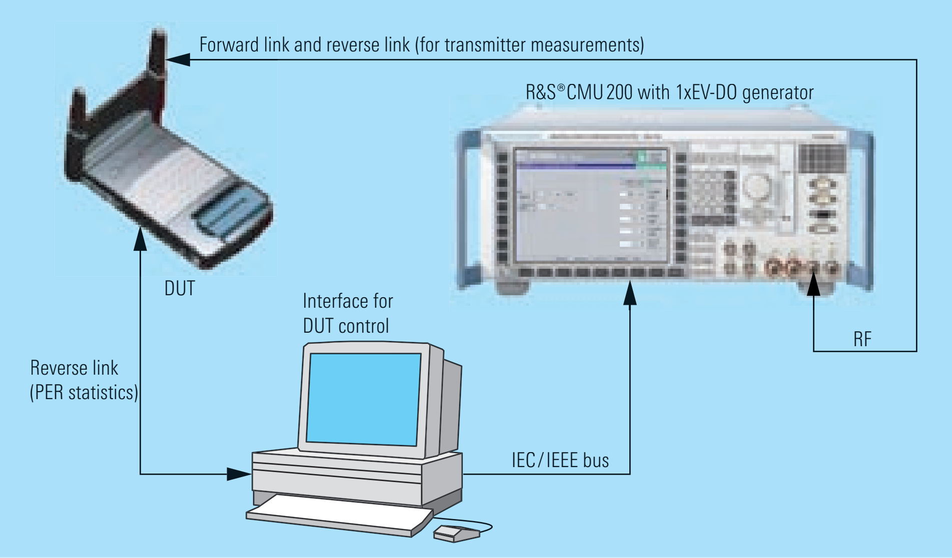
Transmitter measurements

The R&S®CMU 200 measures all important RF parameters of the transmit signal

FIG 1 Overview of the various 1xEV-DO channels.

Forward link	
Pilot	
DRCLock	Data rate control lock channel
RPC	Reverse power control channel
RAB	Reverse activity bit channel
Data	
Reverse link	
Pilot	
RRI	Reverse rate indicator channel
DRC	Data rate control channel
ACK	Acknowledge
Data	

FIG 2 Typical test setup of the 1xEV-DO solution with the R&S®CMU 200.



of 1xEV-DO access terminals, covering inband measurements such as vector error, waveform quality, code domain power (including code error power and channel power) and constellation diagrams. Moreover, the 1xEV-DO option also offers fast spectrum measurement capability. In accordance with the 1xEV-DO test specification, a power measurement is performed with a 30 kHz spectrum analyzer filter at up to four frequencies; the maximum offset is 2 MHz (FIG 4). By means of code channel filters, the precise DUT signal configuration to be used for the measurement can be defined, which is indispensable for a conclusive measurement with packet-oriented networks.

Summary

The cdma2000 1xEV-DO option once again proves the flexibility of the hardware and software concept of the Universal Radio Communication Testers R&S®CMU 200 for 3GPP2 technologies. Equipped with this new option, the radio tester is ready for future CDMA generations such as cdma2000 1xEV-DV.

Michael Altmann; Thomas Rösner

More information and data sheet at www.rohde-schwarz.com (search term: CMU 200)

REFERENCES

[*] Universal Radio Communication Tester R&S®CMU 200: cdma2000 – a new challenge for 3G mobile radio testers. News from Rohde & Schwarz (2002) No. 173, pp 4–8

1xEV-DO options

The 1xEV-DO option for the R&S®CMU 200 is based on the cdma2000 Signalling Unit R&S®CMU-B 83. The following options are required for retrofitting the radio tester to include 1xEV-DO functionality:

- **R&S®CMU-B 83 (model 12)**
  cdma2000 / IS-95 signalling unit
- **R&S®CMU-U 65**
  3G measurement DSP extension
- **R&S®CMU-B 88**
  1xEV-DO extension for R&S®CMU-B 83 (model 12)
- **R&S®CMU-K 88**
  1xEV-DO test software

Option R&S®CMU-U 83 allows radio testers already equipped with an IS-95 signalling unit (R&S®CMU-B 81) or a former version of the cdma2000 signalling unit (R&S®CMU-B 83 model 02) to be upgraded economically to the new cdma2000 signalling unit (R&S®CMU-B 83 model 12) which is necessary for the 1xEV-DO extension R&S®CMU-B 88.

FIG 3 Comprehensive configuration capabilities for access network simulation.

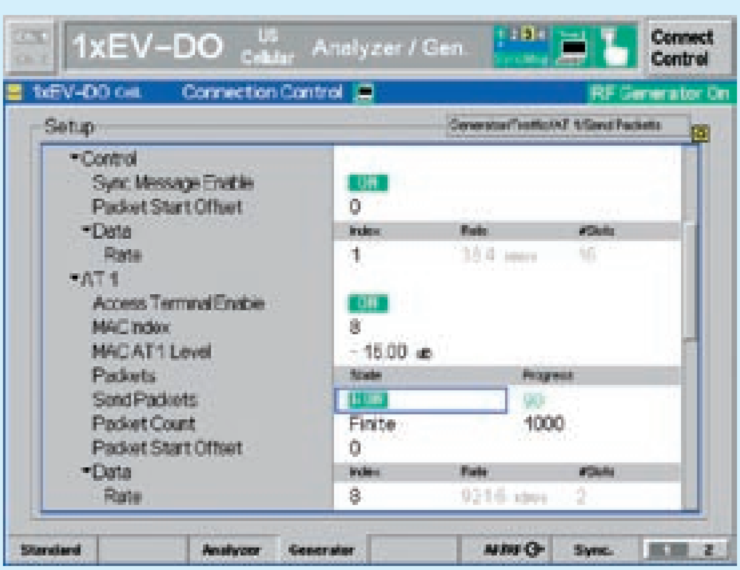
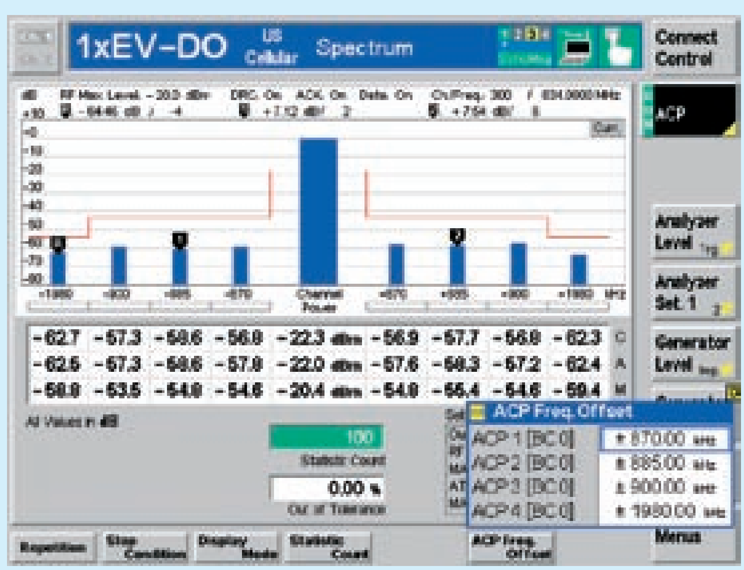


FIG 4 Fast 1xEV-DO spectrum measurement.



Universal Radio Communication Tester R&S®CMU200

Reducing measurement times by means of statistical BER measurements

State-of-the-art mobile radio testers can perform a multitude of measurements almost in realtime, making further reduction of measurement times by means of conventional methods nearly impossible. Measurement speed can be increased only by applying innovative methods, such as the statistical BER/BLER measurement which, due to its unconventional approach, opens up new dimensions in receiver measurements.

Special characteristics of receiver measurements

Testing the transmitter of a mobile phone takes considerably less time than testing the receiver; this is due the characteristics of the measurand involved. With transmitter measurements, it is basically the accuracy of the tester that determines measurement accuracy, whereas with receiver measurements, measurement duration is the determining factor. Bit error ratio (BER) or block error ratio (BLER) determines the receiver quality. Bit and block errors occur randomly as a function of time, which means that the accuracy of the measured error ratio increases the longer the measurement is performed (FIG 1). An exact determination of the actual error ratio would require that measurement be performed infinitely.

This can be demonstrated by means of a numerical example: If measurement is performed for one second at a transmission rate of 1000 bit/s, and two bit errors occur, the BER will be 0.2%. Had just one bit error less occurred, the BER would have been 0.1%. If, however, 200 bit errors are measured over a period of time of 100 seconds, the BER is also 0.2%. One bit error less, however, would in this case result in a BER of 0.199%. The influence of a single bit error on the overall result thus decreases with longer measurement times.

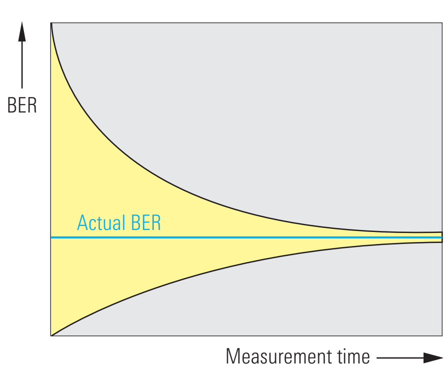


FIG 1
Measurement accuracy in relation to measurement time: the shorter the measurement time, the greater the deviation of the measurement results from the actual BER. The measurement results as a function of time are very likely to occur within the area marked in yellow.

The principle of statistical BER measurement

Statistical BER measurement does not determine the actual BER. Instead, it checks whether the receiver complies with a specified minimum quality. If the actual BER in FIG 1 is replaced by the defined limit value, and if the current BER value that is determined as a function of time is continuously checked, receiver quality can be rapidly assessed (FIG 2). As soon as the current measurement value is beyond the statistical variable bandwidth around the BER limit value, it is possible to ascertain with a certain statistical probability whether the receiver BER is better or worse than the limit value. FIG 2 also clearly shows that measurement time decreases the further the actual value departs from the limit value. This characteristic can also be used to reduce measurement time. If the receiver is developed in such a way that its BER is typically far better than the stipulated limit value, this measurement will usually be completed considerably faster in production.

In practice

The above rather simplified observations are, of course, not sufficient for implementing the statistical BER measurement in practice. If the complicated mathematical correlations behind the statistical BER measurement [*] are taken into account, the diagram in FIG 3 is obtained.

Compared to FIG 2, two substantial differences are evident: First, the pass and the fail lines intersect. If a receiver had a BER that corresponded exactly to the

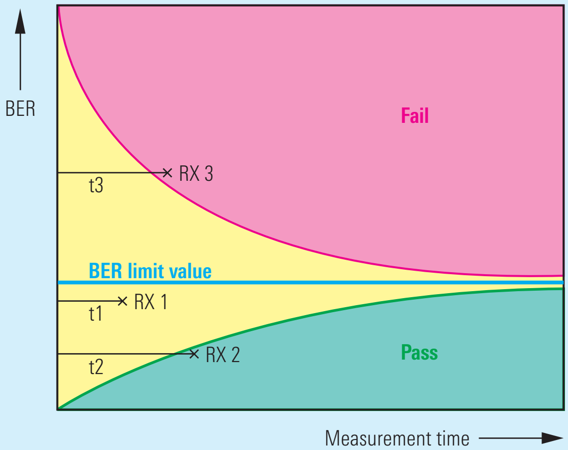


FIG 2
In the statistical BER measurement, the actual error ratio is continuously calculated and compared to the statistical result area (yellow) of the limit value. Receiver quality can be assessed once the measured value is outside the result area of the limit value. The figure shows the values of three different receivers (RX 1 to RX 3) at different measurement times (t1 to t3). In the case of RX 1 after t1, quality cannot yet be assessed because the associated measurement value is still within the result area of the limit value; measurement has to be continued. The value of the receiver RX 2 is already in the green pass area at t2. Measurement can be terminated because there is a high probability that the BER value of this receiver is better than the limit value. The value of RX 3, on the other hand, is in the red fail area at t3. This measurement can also be terminated because there is a very high probability that the BER value of this receiver is worse than the limit value.

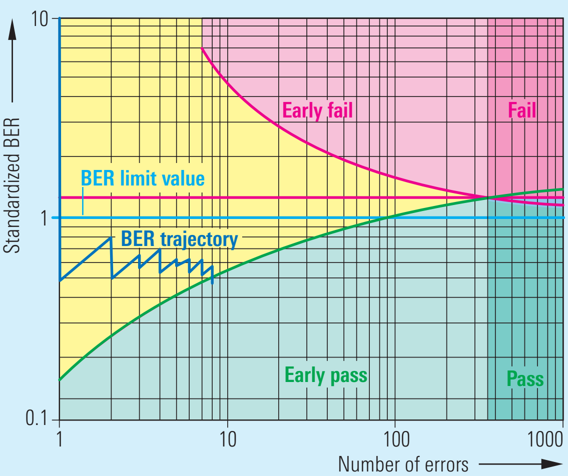


FIG 3
A time-independent evaluation diagram is used in practice. The BER standardized to the limit value is indicated vertically, and the bit and block errors are counted horizontally. The dark blue trace (BER trajectory) shows the evaluation process. As long as no new errors occur, the BER decreases constantly. If a new bit error occurs, the trace will extend by one error horizontally. At the same time, the BER deteriorates because of this error. This method is applied until the trace leaves the yellow area; measurement is then terminated and, depending on the location of the end point of the trace, the receiver BER – at a specified probability – is either better or worse than the limit value.

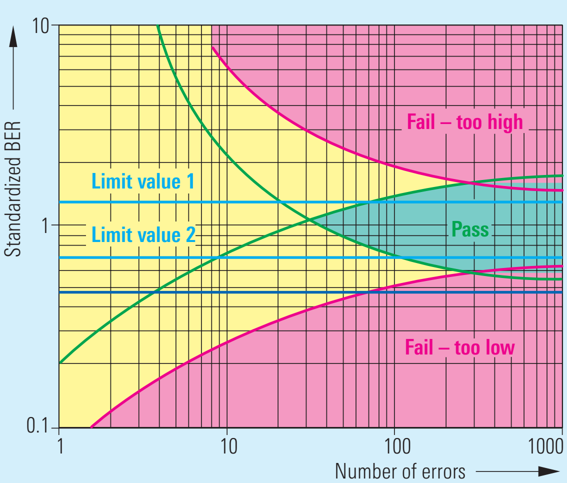


FIG 4
For the statistical BER/BLER measurement with two limit values, two diagrams with different limit values are simply placed one on top of the other. Evaluation is analogous to the measurement with just one limit value.

BER limit value, measuring the statistical BER would take an infinite amount of time. For this reason, an artificial termination criterion was introduced by simply shifting the pass limit value line a bit further up. This means basically that a slightly different limit value is used for pass evaluation than for fail evaluation. The rate of shifting is referred to as "bad DUT" factor M. The error ratio of the receiver may be M times worse than the specified error ratio in order to comply with the required pass criterion. In practice, M usually has a value of 1.5.

The second difference is that the time axis has been replaced by a number-of-errors axis. This change is easy to understand, considering that time is reflected only indirectly in the measurement accuracy. Measurement accuracy actually depends on the number of bits transmitted during measurement time. Time was therefore excluded from the diagram.

A crucial parameter of the statistical BER has not yet been considered in detail, i.e. the probability at which the forecast evaluation is likely to occur. This parameter affects the size of the diagram area in which no statement about receiver quality can be made. It is definitely a good idea to select different probabilities for the pass and fail criteria. Classifying a good receiver as bad is certainly less problematic than rating a bad receiver good. The statistical BER provides the following values as measurement results: "early fail" (premature termination of the measurement because the receiver is worse than the limit value), "fail" (after expiry of the maximum measurement time, the receiver was considered too bad), "early pass" (premature termination of the measurement because the receiver is better than the limit value) or "pass" (after expiry of the maximum measurement time, the receiver was classified good).

Statistical BER / BLER measurements with two limit lines

The above explanations only allow a conclusion to be made about whether a receiver is better or worse than a specified limit value. In practical use, however, the BER / BLER of a receiver may have to occur within a quality window, i.e. between two specified limit values.

This can be easily achieved by means of statistical BER: Simply place the diagram in FIG 3 with two different limit values on top of each other, thus obtaining a diagram as in FIG 4. The measurement results obtained from this diagram are the values "fail – too high" (the receiver BER is too high), "pass" (the BER is within the two limit values) or "fail – too low" (the BER is too low).

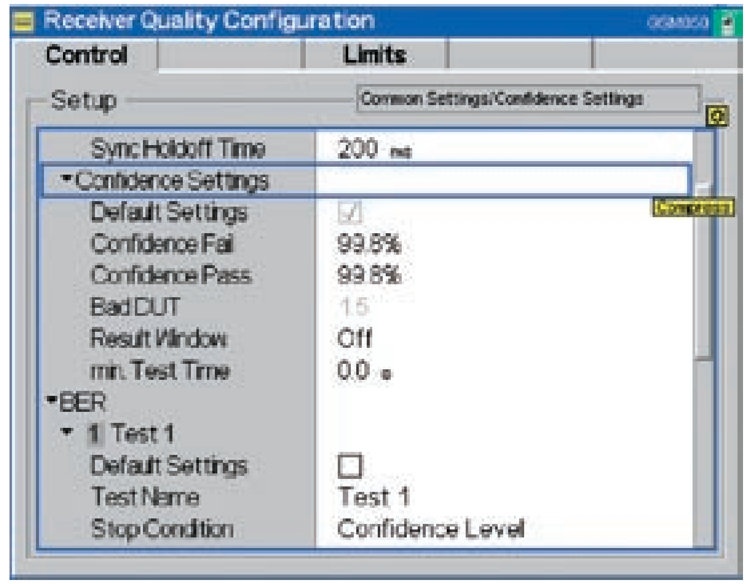


FIG 5 The user can set all parameters that are relevant to the statistical BER measurement on the R&S®CMU 200, and thus easily and conveniently adapt the measurement to customized requirements.

Statistical BER / BLER under fading conditions

The above applies under statistical conditions only if the bit errors occur statistically independently of each other. This is, however, not ensured under fading conditions because of the memory effect of the multipath fading channel. To obtain a correct statement with the statistical BER measurement even under fading conditions, a minimum measurement time must be complied with, which in turn depends on the fading profile used.

An approved measurement method?

Manufacturers of mobile radio equipment are faced with the question of whether the statistical BER / BLER measurement has been approved of and is thus permissible. This can be easily answered: The 3GPP standardization committee has included the measurement in the 3GPP specification [*], thus making it standard for conformance tests of receiver characteristics. The statistical BER / BLER measurements were defined both with one and with two limit values. In addition, the specification also defines the minimum measurement times for the different fading profiles.

Statistical BER measurement with the R&S®CMU 200

The Universal Radio Communication Tester R&S®CMU 200 supports the statistical BER measurement in GSM networks, both with one and with two limit values. All parameters relevant to the statistical evaluation are user-configurable (FIG 5), and can thus be easily and conveniently adapted to match customized requirements. Measurement time can be tremendously reduced. Whereas conventional GSM BER measurements require approx. 3 seconds to yield a conclusive result, the statistical BER measurement does so in just one second (approx.).

Rudolf Schindlmeier

More information and data sheet at www.rohde-schwarz.com (search term: CMU 200)

REFERENCES

[*] 3GPP specification TS 34.121 V3.12.0, Annex F.6.1, Statistical testing of receiver BER / BLER performance, pp 374 – 388

FIG 1 R&S®PSL 3 front view.

Industrial Controller R&S®PSL 3

New controller generation provides ideal characteristics for industry

The Industrial Controller R&S®PSL 3 – the first model of the new R&S®PSL family – succeeds the R&S®PSM, wich has been a long-standing success in measurement systems.

High requirements

Needless to say, measurement systems need a controller that satisfies a wide variety of requirements. Users want a compact, upgradeable device that can be relied upon to function properly under difficult ambient conditions. Such a controller should feature a future-oriented design to ensure that more powerful processors can be fitted also at a later time. It would need to include all common interfaces and much more. And, last but not least, it should be attractively priced.

Rohde & Schwarz focused on all these key characteristics when designing a controller generation to meet the interests in industry. The R&S®PSL 3 (FIGs 1 and 2) is the first member of this new family and was tailored to deliver these specific requirements.

State-of-the-art design

Controller compliance with the above requirements largely depends on the motherboard used. The core component of the R&S®PSL 3 is therefore the latest and most powerful version of the front module controller that is already operating in numerous Rohde & Schwarz devices (see box).

Fitted with four PCI and two ISA slots, the modular concept of the R&S®PSL 3 is extremely expandable. Mechanical clamps ensure the stability of the horizontally fitting plug-in cards. A 40 Gbyte hard disk, a CD-RW / DVD disk drive and a regular disk drive are standard equipment.

With three height units, the 19" housing can be economically fitted into racks while still being expandable. The R&S®PSL 3 requires only about 30 W of the 150 W power supply for its own consumption, thus offering a sufficient power margin for full expandability with plug-in cards.

Extremely reliable operation is a must for industrial controllers. The R&S®PSL 3 achieves excellent MTBF because of high-quality controller modules with energy-saving processors as well as a sophisticated cooling concept with a processor fan and a device fan, ensuring low temperature in the controller interior.

Nevertheless, should repair work or a spare part become necessary at any time in the future, this can be quickly dealt with: Since important spare parts such as controller and power supply are also used in numerous other measuring instruments from Rohde & Schwarz, they are available at all Rohde & Schwarz service centers.

Front module controller in the R&S®PSL 3

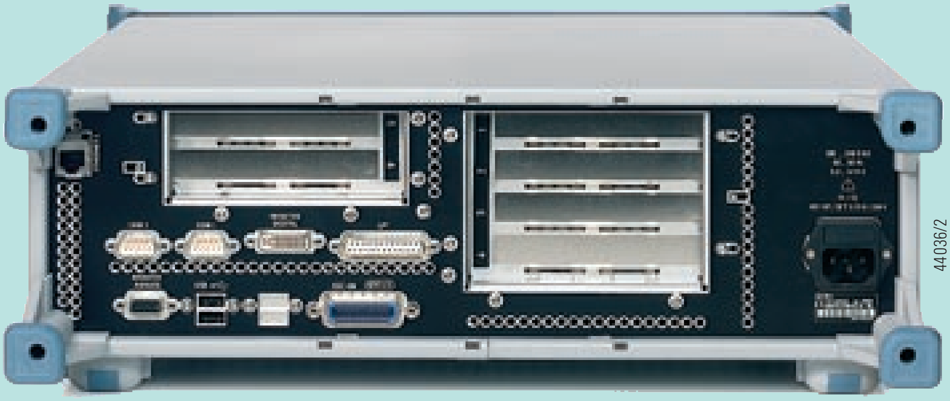
The performance of the R&S®PSL 3 is based on the front module controller, a standardized controller printed board used in numerous Rohde & Schwarz instruments, offering a multitude of advantages:

- Large-scale production, thus favourably priced.
- High quality and reliability, continuously confirmed in the QM acceptance tests for the numerous new developments by Rohde & Schwarz.
- Comprehensive inhouse know-how.
- BIOS changes are possible.
- Quick service: Front module controllers are available as spare parts in all Rohde & Schwarz service centers.
- Tried-and-tested printed board layout, EMC-optimized, test points for fault localization, IC- and function-tested.
- Ready for the future: Front module controllers are continuously developed and expanded by versions with state-of-the-art processors, chipsets and interfaces. The focus is on performance as well as on low power consumption and long availability.

The front module controller was developed exclusively for Rohde & Schwarz by a German company, where it is also manufactured in close cooperation with the Rohde & Schwarz quality management. Front module controllers of one generation are available in different configurations regarding processor, RAM and interfaces; the R&S®PSL 3 is always equipped with the most powerful version.

An IEC / IEEE bus controller on the front module controller board supplies the R&S®PSL 3 with this interface which is indispensable in T & M. Thus, there is no need for a plug-in card, one slot remains unoccupied and no additional costs will be accrued.

FIG 2 Rear view of the Industrial Controller R&S®PSL 3.



Easy to contact due to numerous interfaces

The R&S®PSL 3 interfaces leave virtually nothing to be desired:

- Two USB controllers provide four USB ports, two of which are located at the front panel.
- Two independent Ethernet controllers for 10 Mbit/s and 100 Mbit/s permit flexible integration of the industrial controller in fast networks.
- The IEC / IEEE bus interface is compatible with the quasi industrial standard set by National Instruments (AT-GPIB / TNT) and, since it is integrated in the controller board, does not even occupy a slot.
- To connect a monitor, the analog VGA standard interface and, for even more brilliant images, the digital DVI interface are used.
- Last but not least, serial interfaces (COM1 / COM2) and a parallel interface (LPT1), which are still required, are available.

Outstanding EMC characteristics

The outstanding electromagnetic characteristics of the R&S®PSL 3 are the result of consistent development coupled with decades of Rohde & Schwarz expertise in EMC. This becomes evident in the layout of the controller board and the internal cabling. Interface signals to the exterior are specially filtered; the disk drives are shielded by metal cages. Such sophistication is the reason for the minimum emission the controller radiates to the outside. Optional control media such as keyboard (R&S®PSL-Z2) and mouse (R&S®PSL-Z10) have been carefully chosen and tested.

Wide software support

The R&S®PSL 3 is characterized by a hardware architecture that is 100% compatible with the industrial standard. Thus, there are no problems with standard operating systems and programs. Another option on offer is the preinstalled Windows XP Embedded (option R&S®PSL-K 12), also in combination with LabWindows / CVI (option R&S®PSL-K 13). But the controller can also be used as a hardware platform for operating systems such as Linux and specific applications.

Summary

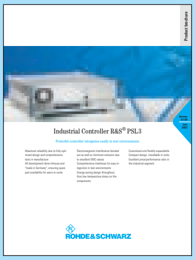
The R&S®PSL 3 is a compact, powerful industrial controller. A multitude of interfaces, upgradeability and secure follow-on development constitute a sustainable concept for the future. Excellent EMC characteristics, wide temperature range, robust design and high reliability complete the picture. Owing to the consistent development strategy focusing on the multiple use of important modules, the controller features an excellent price / performance ratio without compromising on the high-quality components.

Gottfried Holzmann

Condensed data of the R&S®PSL 3

Processor	Intel Mobile Pentium III Coppermine, 700 MHz
Memory	RAM 256 Mbyte
	40 Gbyte hard disk
	optional second hard disk with 40 Gbyte (option R&S®PSL-B 7)
	combined DVD / CD-RW disk drive
	floppy disk drive
Interfaces	VGA, DVI
	4 × USB
	2 × Ethernet 10 Mbit/s / 100 Mbit/s
	2 × RS-232-C
	1 × Centronics LPT1
	1 × IEC / IEEE bus
Slots	4 × PCI, 32 bit
	2 × ISA, 16 bit
Operating system	Windows XP Embedded (R&S®PSL-K 12)
Mechanical dimensions	19", 3 HU
Power supply	100 V to 240 V, max. 135 W
Operating temperature range	+5 °C to +45 °C

More information and data sheet at www.rohde-schwarz.com (search term: PSL 3)



Data sheet R&S®PSL 3

DC Voltage Current Sources / Monitors R 6243 / R 6244

Fast and precise tests on semiconductor components

Modern electronic circuits and modules provide increasingly more functions despite their continuously downsized dimensions. Their energy balance is reliably mastered by further reducing their supply voltages and current consumption. This development is a challenge to T&M technology since both resolution and test speed must be constantly improved, which applies in particular to tests performed on semiconductor components.

FIG 1 The bipolar DC Voltage Current Source / Monitor R 6243 is equipped with a guarding connector (blue) which, during operation in the lower nA range, compensates for measurement errors caused by parasitic external capacitance.

High output power with excellent resolution

An ideal tool for these complex measurements is the new DC Voltage Current Source / Monitor R 6243 from Advantest (FIG 1) which provides fast, low-noise and high-resolution linear and pulsed sweeps for parameter tests on electronic components (FIG 2).

Two units with equal functionality are available: The R 6243 model for high output voltages of up to ±110 V and the R 6244 model for high output currents of up to ±10 A (FIG 3). If the available current or voltage range is insufficient, each of the two units can be connected both in parallel and in series within its model series. The synchronization outputs and trigger inputs ensure that the interconnection is completely stress-free for the DUT and the power supply. The source resolution of 10 µV at a measurement resolution of 1 µV is identical for both models. As far as currents are concerned, the R 6243 is particularly attractive since it features resolutions of up to 1 nA for setting and up to 100 pA for measurement.

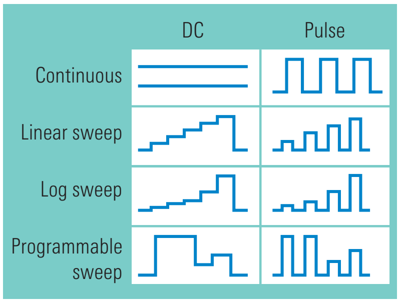


FIG 2 Different sweep options of the R 6243 and R 6244.

Versatile due to different operating modes

As true source measurement units (SMU), both models can be operated as a current source, voltage source, current meter or voltmeter in multiple combinations (VSIM, VSVM, ISIM, ISVM). Like a standardized assortment of T&M instruments, they can thus drastically cut the number of different types of measuring instruments that users have to manage and operate. A single unit is fully sufficient for uncomplicated applications; for more complex tasks, several instruments can be easily connected. Thus, the network analyzer in FIG 6 could be replaced by a third R 6243 which could then function in the ISVM mode as a synchronized, high-resolution voltmeter, provided the active electronic component under test contains an internal frequency/voltage converter that is used for adjustment purposes. The number of critical and complex RF measurements can be reduced, and costs thus saved.

Synchronization in time-critical test setups

Based on the comprehensive synchronization capabilities of the two voltage / current sources, it is possible to set up convenient small systems for component tests by using only one type of model (see box on the right for examples). Particularly when the units are used as the bias source for active components (e.g. transistors, FETs or power amplifiers), the selection of a suitable synchronization method helps to quickly determine the required operating point of an active DUT; plus, it can be reproduced for further measurements without requiring a program code transmission via the IEC / IEEE bus interface – a highly beneficial feature for test throughput. This high flexibility is achieved in particular by the possible multiple assignments of the rear BNC female connectors whose different functionalities can be preset (FIG 7).

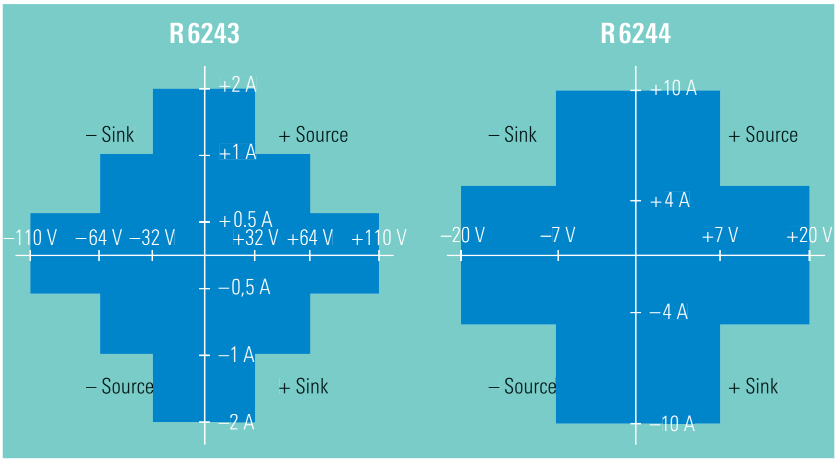


FIG 3 Output range of the two SMUs R 6243 and R 6244 from Advantest.

Examples of application:

The example of a bipolar transistor in FIG 4 shows how two R 6243 (❶ and ❷) can be synchronized to generate a linear ramp both in the input and the output range. ❷ operates in the ISVM mode and independently produces a linear sweep by means of which the base current of the transistor is generated. ❶ operates in the VSIM mode, though not in sweep but in DC mode. It supplies the transistor with the required V_{CE} voltage, and immediately after each new base current pulse measures the collector current consumed by the transistor. A comparator threshold is additionally entered in ❶ which, in the example, corresponds to the nominal value of the collector current to be set. As long as this limit value has not been reached, the internal ramp generator of ❷ continues to switch to the next level. Only when the nominal value has been

Other examples of application

- Transistor, FET and PA characteristics tests
- Bias source for S-parameter tests on RF transistors
- Diode characteristics tests (forward voltage, reverse current)
- Laser and photo diode test
- Latch-up tests on CMOS ICs
- DC / DC converter characteristics
- Low-noise source for noise measurements on PLLs
- Simulation of different resistance values on IC connectors by current injection
- Production test with Go / NoGo evaluation of components
- Quality assurance for incoming and outgoing goods inspection (comparator)
- Generation of loading profiles on rechargeable batteries
- Fully automated generation of battery charge / discharge cycles

DC parameter test or bias source for RF parameter tests on active components

FIG 4 **Determination of the base current required for the desired collector current during static transistor operation.**

FIG 5 **Determination of the base current required for the desired collector current in the pulse mode of a transistor.**

FIG 6 **Use of two R6243s as bias source for RF parameter tests on active components.**

reached does the “complete out” output of ❶ produce a trigger signal which in turn stops the ramp generator of ❷. ❷ thus remains on the currently attained base current level, and the required operating point of the transistor is reliably available.

FIG 5 shows a transistor or power amplifier to be supplied only in pulses with operating voltage. This operating mode applies if the power components for the parameter test are to be operated either without cooling or very close to their subsequent operating conditions. In this example, ❷ again functions as ISVM and in the sweep mode, this time however not independently, but triggered by an external event, which is generated by ❶ because after each current pulse of ❷, ❶ measures the current. Since the comparator output of ❶ was programmed to “low”, ❶ generates a trigger signal for ❷ until the “low” mode no longer applies. The test setup thus again remains in a stable mode, however this time in the pulse mode of the output range. For completeness sake, it should be mentioned that in this application ❶ is not functioning in DC mode, but in random sweep mode in order to feed a pulsed supply voltage to the DUT.

In FIG 6, the above application has been complemented by a network analyzer which can also start the measurement of the RF parameters at the right time, triggered by ❶.

FIG 4

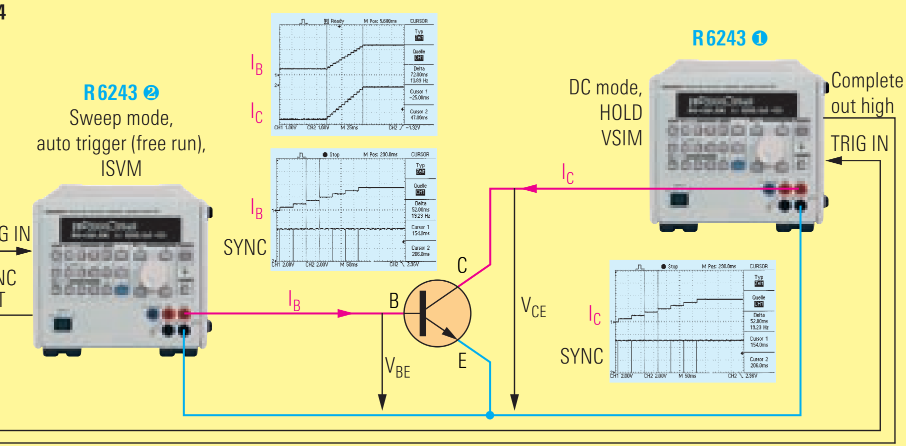


FIG 5

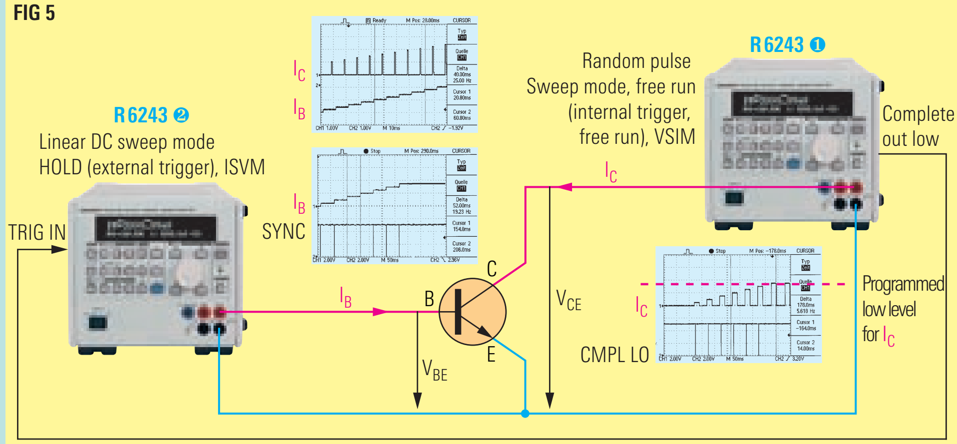
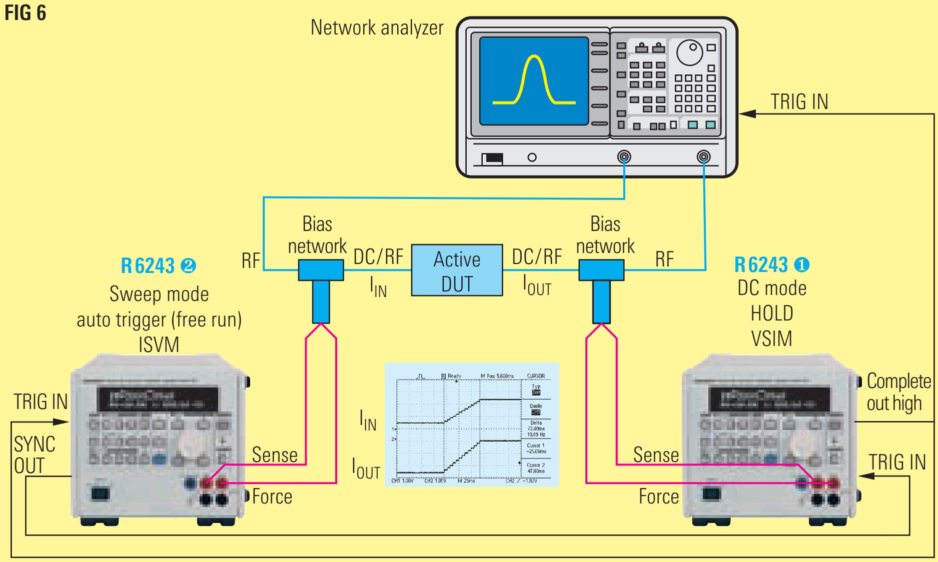


FIG 6



Well thought-out software support

The R 6243 and R 6244 can be operated in a mode that is compatible with their predecessor TR 6143 so that the existing test programs can be used with only minor changes. LabView drivers with practical and useful program examples complete the exceptional layout of these two SMUs from Advantest (FIG 8).

Summary

The two DC Voltage Current Sources / Monitors R 6243 and R 6244 are measuring instruments that can be flexibly used; they provide precise, reliable and fast services both as stand alone instruments and within a group of systems. The numerous small but highly beneficial features expand the possible fields of application far beyond the pure component test.

Lutz Fischer

More information and data sheet at www.rohde-schwarz.com (search term: R 6243 or R 6244)

Data sheet R 6243 / R 6244

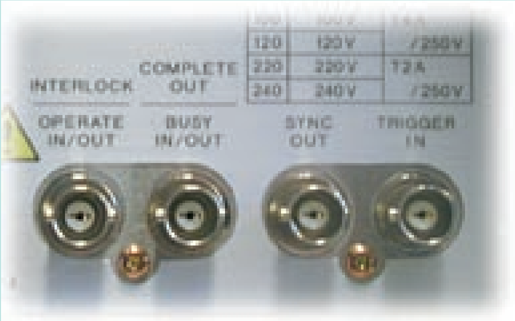


FIG 7 Versatile: The BNC female connectors on the voltage/current sources sometimes feature multiple assignments and are preset with different functions.

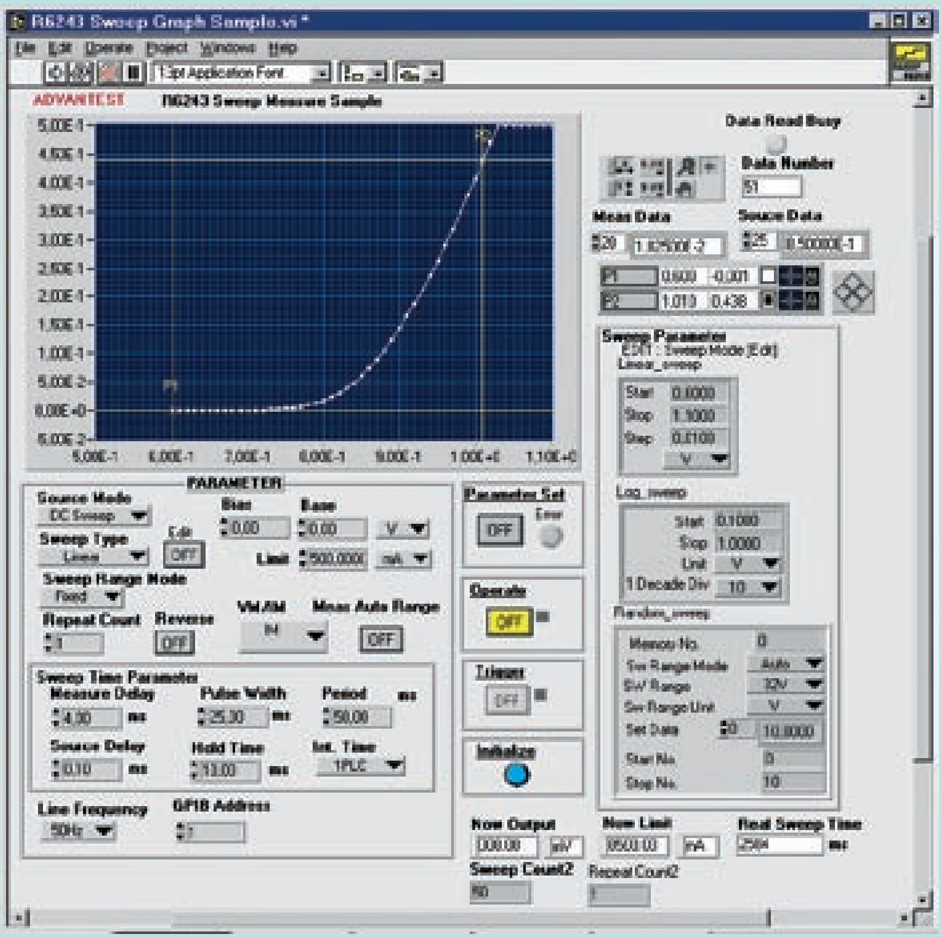


FIG 8 R 6243 application example under LabView.

EMC Measurement Software R&S®EMC 32-E

Automatic RFI field strength measurements

Numerous and often time-consuming measurements are required to ensure electromagnetic compatibility of a product. An automatic test sequence control saves time and ensures result reproducibility, thus increasing both efficiency and economy of the measurement. The capacity for performing automatic RFI field strength measurements in anechoic chambers and on open-area test sites is another important feature that has been added to EMC Measurement Software R&S®EMC 32-E.

Advantages gained from automatic measurements

Compared to RFI voltage and RFI power measurements, RFI field strength measurements involve considerably more technical effort, plus they are among the most time-consuming tasks in RFI measurements. Version 3.0 of EMC Measurement Software R&S®EMC 32-E (the module for EMI measurements from R&S®EMC 32 [*]) is now available and, by using automatic test sequences, reduces the required time while maintaining high reproducibility and reliability of the results. The main advantages of this method are:

- Time-saving due to automated sequence control
- High measurement certainty by avoiding entry and reading errors
- Ease of operation (measurements at a keystroke)
- Complete and reliably reproducible measurement results

These benefits are particularly useful for routinely recurring series measurements that should run as fast and reproducibly as possible and should be feasible also for less experienced users. The interactive, either partially automatic or purely manual measurement mode of R&S®EMC 32-E is usually the better way to handle analyses during development and precompliance measurements, or to solve highly complex and difficult EMI measurement problems.

Automatic measurement principle

The measurement mode for automatic EMI measurements – in R&S®EMC 32-E referred to as "EMI Auto Test" – makes it possible to fully automatically perform a test as a sequence of several individual steps; it is available for both conducted and radiated EMI. In the case of radiated EMI emission testing, the new software version 3.0 also supports the highly time-consuming measurement of the RFI field strength in shielded anechoic chambers, and if possible, on open-area test sites; it can therefore be reliably, quickly and reproducibly automated.

This test measures radiated emission via antennas, optionally with automatic control of a mast for setting the antenna height and polarization, and of a turntable for selecting the azimuth position of the EUT (FIG 1).

Manual operation is only required if the turntable and the antenna mast cannot be controlled automatically. In this case, the R&S®EMC 32-E interrupts the test sequence at the appropriate positions and continues after the mast and turntable position have been manually set. The associated setting data plus the measurement results are then automatically stored in a result table for further use and analysis (documentation). Initializing an EMI Auto Test also requires a few manual settings (e.g. definition and selection of the test templates used).

More information and data sheets at www.emc32.rohde-schwarz.com

REFERENCES

[*] EMC Measurement Software R&S®EMC 32: Comprehensive EMI and EMS measurements at a keystroke. News from Rohde & Schwarz (2001) No. 172, pp 27–29

Automatic test sequence

Since direction of radiation (azimuth) as well as antenna height and polarization of the maximum radiated emission cannot be predicted, these auxiliary parameters are varied by means of preprogrammed settings for each of the three measurement categories, preview measurement, maximization and final measurement. A log file documents each step in the test sequence and continuously provides information about the current measurement status. If required, the automatic sequence can be interrupted or discontinued at any time.

The test itself always consists of preview measurement, data compression, maximization of the preview measurement results, final measurement and report generation (FIG 2).

The preview measurement records the entire frequency spectrum via scan or sweep, provided the test receiver used supports the sweep. In this case, a worst-case result is determined by the number of test sequences; from this result, a frequency list is derived that contains the critical frequencies relevant to the final measurement. To minimize the number of time-consuming final measurements, a series of analysis and data compression techniques can be very flexibly used in R&S®EMC32-E (FIG 3): either peak reduction with subsequent maximization, or subrange maximization, i.e. the determination of the maximum level within each frequency subrange; both result series can then be combined. The subsequent acceptance analysis excludes irrelevant test results, and by means of further maximization the total amount of final test points can be limited.

Information about the final test points thus obtained can be made more precise by means of three optional maximization sequences: one for the frequencies of the preview measurement with

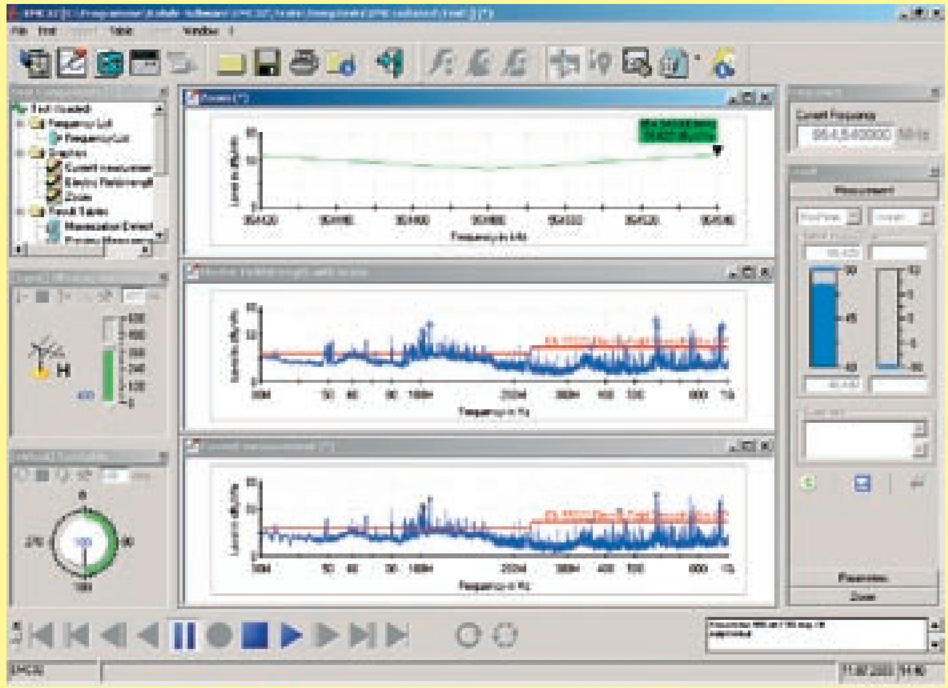


FIG 1 EMC Measurement Software R&S®EMC32-E as a virtual measurement instrument: measurement mode view during the automatic RFI field strength measurement. The test components explorer on the top left gives an overview of all loaded files of the current measurement. Below are the (automatic or manual) settings for mast and turntable. In the center are the measurement zoom graphics for frequency optimization, the overall result with a trace of its own for each result table as well as the active measurement (scan/sweep). The windows on the right provide information about the frequency setting of the test receiver and display the current measurement result numerically and as a bar graph (Clr.Write and Max.Hold). The symbols below control the test sequence (interval, end, start) and the log window next to them indicates its current status.

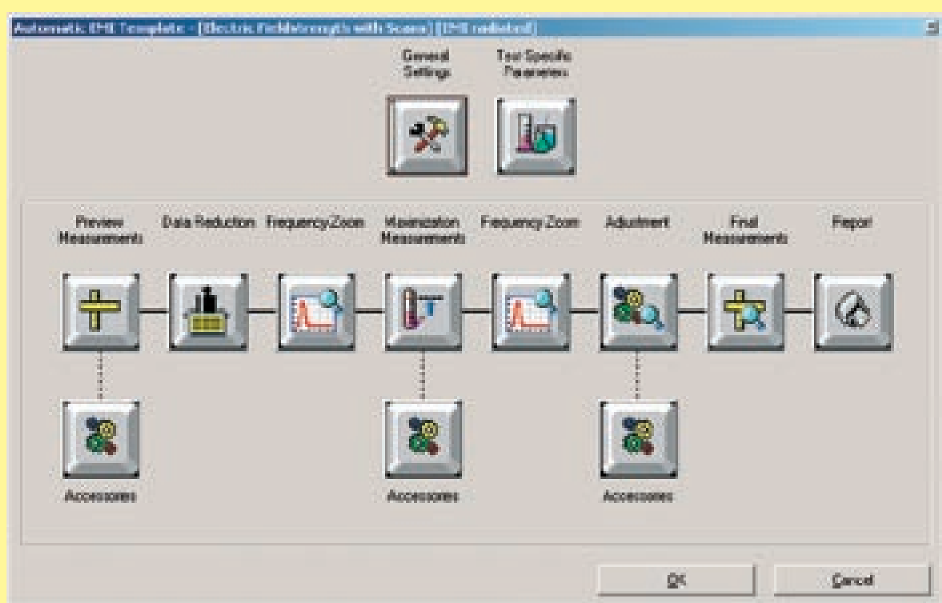


FIG 2 The test template of an automatic RFI field strength measurement with the setting elements for preview measurement, data compression, optional maximization of the critical frequencies with accessories positioning, final measurement and report generation. Test templates that were prepared in advance can be selected for each of these test sequences separately. The sequence (according to priority) for the mast and turntable movements is defined under "test-specific parameters".

partial scan or sweep (frequency zoom), and second for the levels by further varying the accessories settings (FIG 4) with another frequency zoom for fast drifting interferers. Another maximization across a defined local setting range of the accessories is used for definitively determining the location of the maximum interference.

The actual assessment of the critical signals for all determined settings of the three "dimensions", i.e. antenna height, antenna polarization and turntable azimuth, takes place in the final measurement.

The report finally combines the preconfigured test elements (e.g. test information, graphics, result lists, etc) and can be generated without further interaction directly as a printout or file (in HTML, RTF or PDF format), if required.

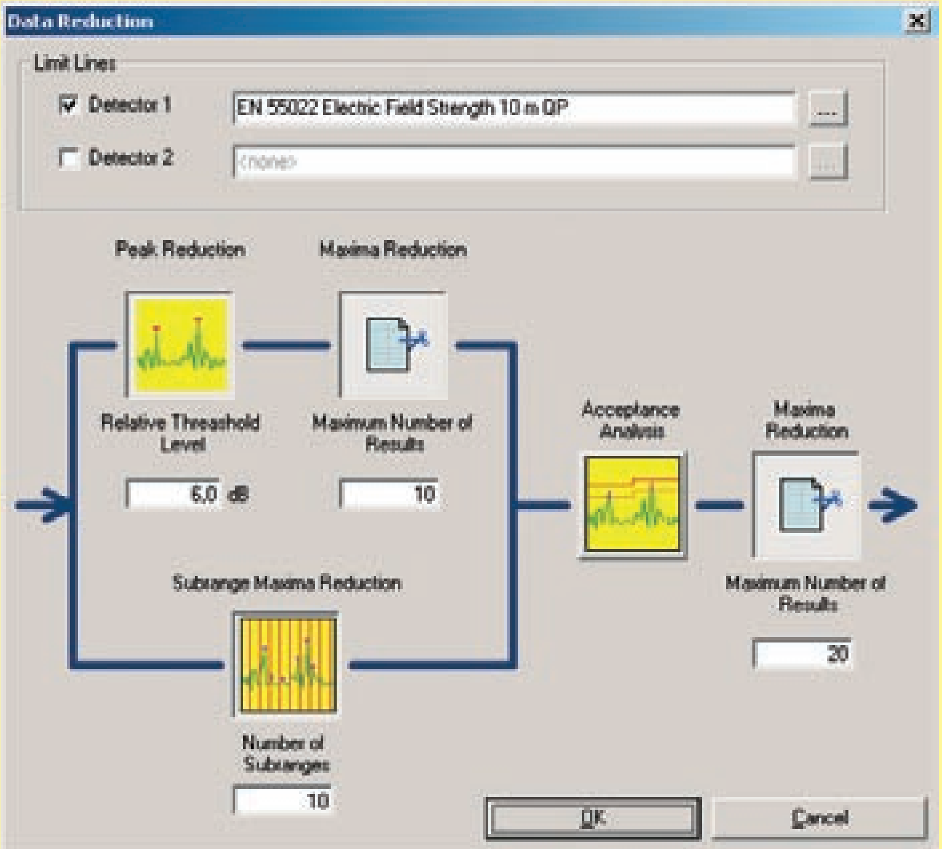


FIG 3 Data compression editor: Subrange maximization (lower path) and peak generation with subsequent limitation to a fixed number of results (upper path) can either be performed in parallel or as alternatives. This is followed by an optional acceptance analysis relative to the selected limit line or any other acceptance line as well as a further optional limitation of the number of maxima.

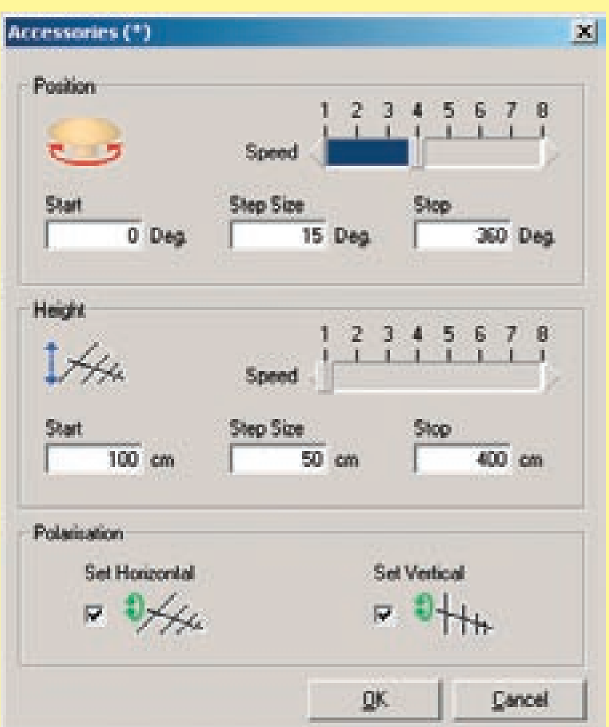


FIG 4
Editor for accessories settings for preview measurement and first maximization; the settings can be performed independently of each other.

Summary

Performing automated RFI field strength measurements is an important EMC application and requires a possible flexible selection and adaptation of the setting parameters to the measurement task at hand and to the individual measurement environment. The new version 3.0 of R&S®EMC32-E satisfies this requirement to a great extent, covering "measurements at a keystroke", e.g. for serial tests, just as well as it has been supporting EMC specialists in the interactive analysis and assessment of an EUT. It is available to all users of R&S®EMC32-E as a free-of-charge update.

Karl-Heinz Weidner

FIG 1 Control Unit R&S NetCCU®700.

Transmitter Control Unit R&S NetCCU®700

Transmitter control and remote monitoring in one unit

The globally successful R&S®Netlink has been integrated in the new Transmitter Control Unit R&S NetCCU®700. Only one unit is therefore required for the control, monitoring and remote control of low-power transmitters.

Compact transmitter control with numerous functions

In the TV transmitter family R&S®Nx7000, the control unit (CCU) is integrated in the Exciter R&S®Sx700. Remote control and monitoring is performed via an R&S®NetLink, a separate unit that has met with great success worldwide [1, 2].

The new Control Unit R&S NetCCU®700 (FIG 1) combines these closely linked tasks in one unit and more functions have been added. The R&S NetCCU®700 is used in the low-power transmitters of the R&S®SV7002 family together with the DTV Exciter R&S®SV702 (see box on page 28). The control unit contains the transmitter control unit and the automatic switchover unit for single transmitters, exciter standby, passive transmitter standby and (n+1) transmitter standby configurations. In the case of passive standby or (n+1) standby configurations, the R&S NetCCU®700 controls both exciter switchover and output stage switchover. The respective transmitter can be remote-controlled and monitored via the integrated R&S®NetLink software. The new control unit is also provided with a display for local operation and an Ethernet interface for control from a local PC or from a notebook.

Uniform control software

In contrast to the Windows-based user interface of the R&S®Nx7000, no special software is required on the PC for remote operation of a transmitter containing the new control unit. The user only needs a Web browser to access the transmitter via R&S®NetLink (FIG 2). This means that menu guidance via the Web browser is identical for transmitter control from a PC and by remote control.

The user is not confronted with different "control philosophies" and the software can be easily updated.

Menu guidance in the local display is largely identical to that used in the R&S®Nx7000 transmitter family (FIG 3). Operation of the R&S NetCCU®700 will therefore be easy for all customers familiar with the high-power and medium-power transmitters.

Linux operating system

The new R&S NetCCU®700 uses the Linux operating system because high reliability and short booting times are essential features of the instrument concept. Based on Linux, a basic software system was developed with a core of tree-structured XML files for the instruments to be controlled by the R&S NetCCU®700, e.g. exciters and amplifiers. The software applications read all information about instrument parameters from these XML files. Software applications exchange data via the new VDT (virtual device tree) bus (FIG 4) that has been especially developed for this purpose.

The R&S®NetLink software was ported to Linux for use in the new control unit. Applications such as Web server and SNMP agent – same as the graphical user interface described above – run within a Java virtual machine.

Integrated transmitter components

The R&S NetCCU®700 also contains other important functions required for a complete transmitter system so that only a minimum of external components is needed. Two rectifiers are included, for instance, for connecting a Directional Coupler R&S®GD 700 or for measuring the reflected power or the transmitter ▶

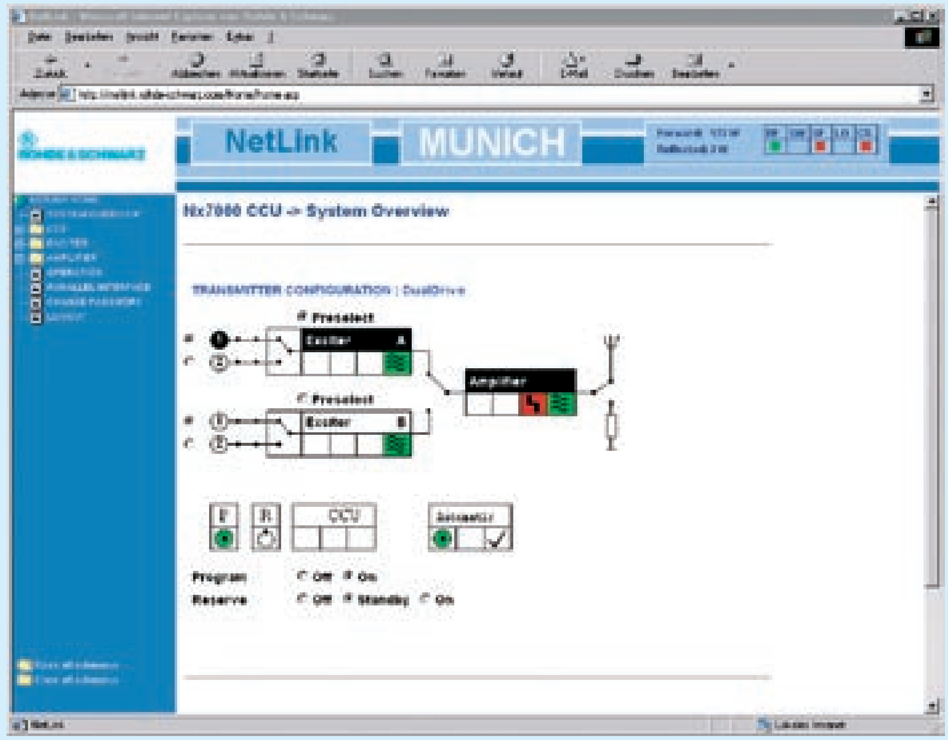


FIG 2 System overview in Web browser (remote transmitter control).

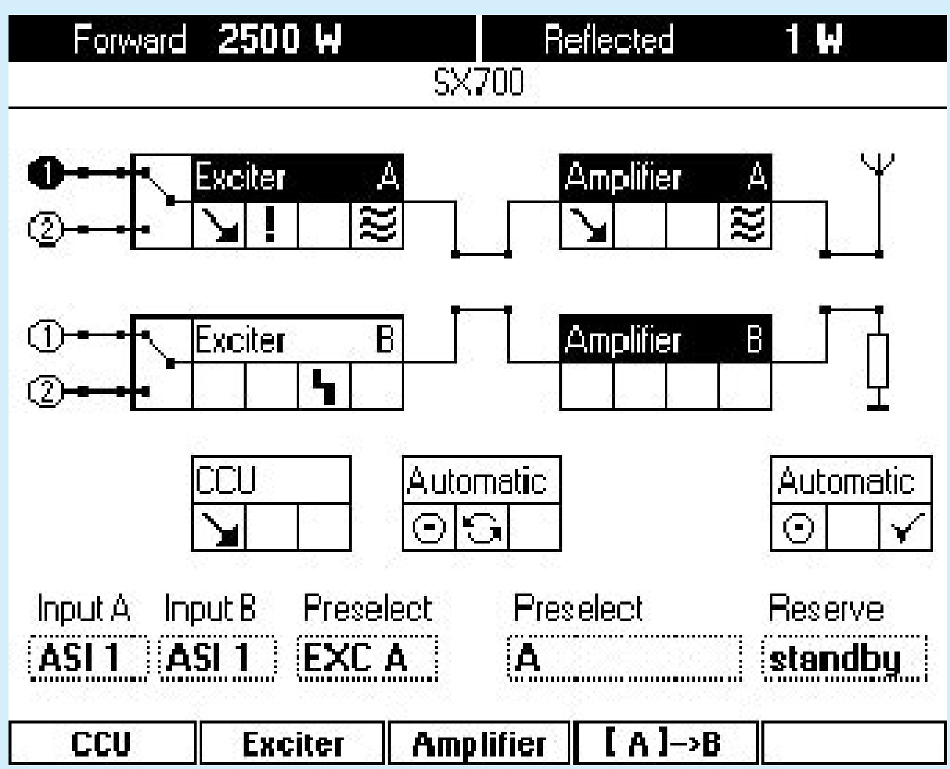


FIG 3 System overview on the display of the R&S NetCCU®700.

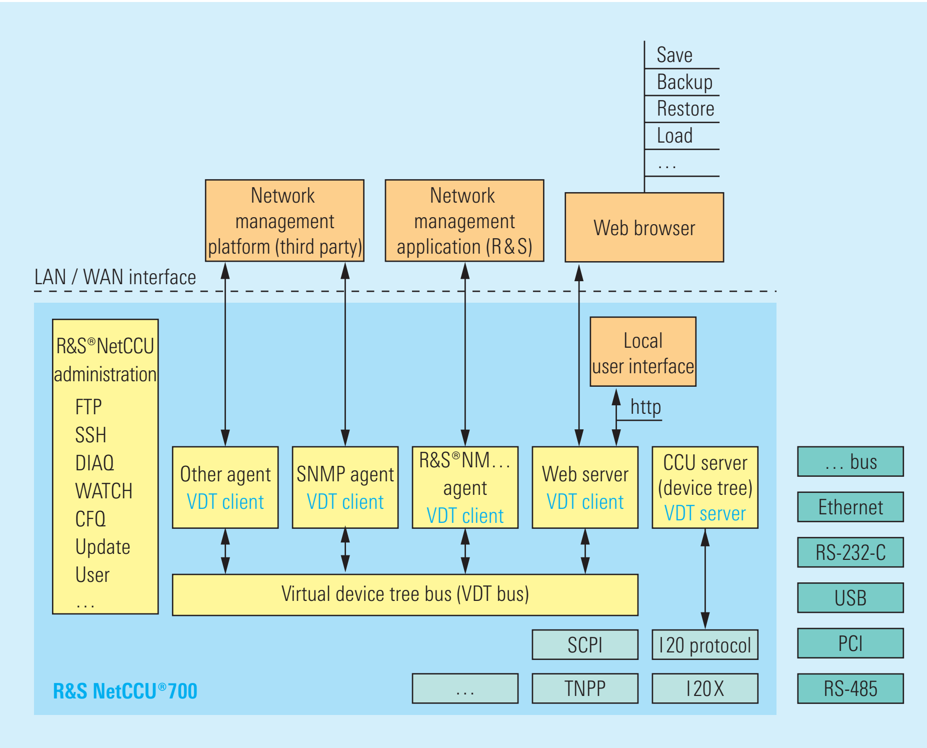


FIG 4 **Software architecture of the R&S NetCCU®700.**

output power after an additional output filter. An ASI distributor as is required for exciter standby or passive transmitter standby configurations may be optionally included. The emergency control provided in the unit ensures transmitter operation even if the control unit fails.

The R&S NetCCU®700 also contains a free PCI slot, e.g. for an I/O card with eight or 16 relay contacts, and a serial interface for modem connection.

Since several low-power transmitters can be accommodated in a rack, the control unit can also be used for operating and monitoring several single transmitters in an (n+0) configuration.

Thomas Janner

The members of the new Transmitter Family R&S®SV 7002 at a glance

The new Transmitter Family R&S®SV 7002 [3] includes the DTV Amplifiers R&S®VH 610 A2 / 620 A2 with DVB-T power of 55 W and 120 W, respectively, and two new low-power amplifiers, the 12.5 W R&S®VH 6010 A2 and the 25 W R&S®VH 6020 A2. With the new four-way coupler, up to four amplifiers can be interconnected. The family is complemented by the new DTV Exciter R&S®SV 702 [4] and the Control Unit R&S NetCCU®700.

44 039/2

Compact low-power TV Transmitter R&S®SV 7002 for DVB-T with 2 × 12.5 W output power (R&S NetCCU®700, two Exciters R&S®SV 702 and two Amplifiers R&S®VH 6010 A2).

More information and data sheets for the comprehensive program of sound and TV broadcasting equipment at www.rohde-schwarz.com

REFERENCES
[1] R&S®NetLink: Remote control and monitoring of transmitters on the Internet. News from Rohde & Schwarz (2001) No. 170, pp 27–29
[2] R&S®NetLink: Enhanced capabilities for management of broadcasting networks. News from Rohde & Schwarz (2003) No. 177, pp 42–43
[3] R&S®SV 7002: DTV low-power transmitters – modular and space-saving. News from Rohde & Schwarz (2003) No. 178, pp 48–50
[4] R&S®SV 702: Compact exciter for digital terrestrial TV. News from Rohde & Schwarz (2003) No. 77, pp 40–41

FIG 1 By using one R&S®DVM100 and two R&S®DVM120, up to 20 transport streams can be monitored simultaneously.

MPEG-2 Monitoring System R&S®DVM100/120

Comprehensive monitoring of MPEG-2 transport streams

Monitoring of even complex DTV transmission systems becomes easy with the new MPEG-2 Monitoring System R&S®DVM. Its scalability ensures optimum adaptation to the system to be monitored.

Demanding tasks

The requirements placed on test and measurement instruments for monitoring digital TV signals are constantly increasing: Due to the often high number of transport streams, these instruments must be compact and able to clearly display the multitude of measurement results. To avoid unnecessary alarms, it is essential to exclude individual elements from monitoring, depending on the currently monitored transport streams, or to specially set limit values for triggering an alarm. The idea is to provide a system that can be easily handled by the operator and at the same time offers specialists a wide variety of analysis functions.

Since the introduction of digital terrestrial emission, a monitoring mechanism for single-frequency networks (*SFN*) has become necessary. Other coveted features include easy integration into central network management systems and uncomplicated remote control.

Based on years of expertise and intensive interaction with its customers, Rohde & Schwarz has developed a new scalable measurement system for monitoring MPEG-2 transport streams that covers all of these diverse requirements: the R&S®DVM100 and the R&S®DVM120 (FIG 1).

Base units with excellent characteristics

The R&S®DVM100 (FIG 2) of only one height unit (HU) is the core of the system. Its large-scale integrated, fast analyzer board allows simultaneous monitoring of up to four transport streams in realtime. An integrated powerful controller prepares the measurement results transparently and provides the graphical user interface (GUI). The unit also offers a fast network connection (100Base-T) for integration in Ethernet networks. It is locally operated by means of the standard PC components keyboard and mouse via an intuitive GUI on a high-resolution screen. For remote control of the unit, the user interface can be ported to any controller via the integrated network connection. Multicolour LEDs on the front panel indicate the most important status information and measurement results, offering a snapshot of the current status directly on the unit. The system also provides twelve relay outputs which the user can assign to the individual measurement parameters. *SNMP* is supported for integration into central network management systems.

For monitoring more than four transport streams at one location, the R&S®DVM100 can be expanded by the R&S®DVM120, which also occupies 1 HU and covers up to eight transport streams. It is controlled by the R&S®DVM100 and contains two analyzer boards featuring characteristics identical to those in the R&S®DVM100.

An R&S®DVM100 manages up to five analyzer boards so that one R&S®DVM100 and two R&S®DVM120 – occupying together only three HU – permit simultaneous monitoring of up to 20 transport streams (FIG 1).

Monitoring of all parameters

The system monitors virtually all TR 101 290[1)] parameters listed in the Measurement Guidelines under priorities 1, 2 and 3. These include checking if

- a transport stream is present (*TS* sync loss),
- the continuity counters are correctly incremented,
- the *CRC* of the individual tables is correct,
- all referenced *PID*s are transmitted and if non-referenced *PID*s are present.

Moreover, the system checks the table refresh rates, the *PCR* jitter and the distances between the individual *PCR* values.

Practical experience shows that monitoring just these parameters is in many cases not sufficient. The R&S®DVM100 / 120 thus monitors additional parameters (FIG 3): For example, to detect unwanted changes in the transport stream it checks whether programs or elements are added or omitted and if the *TS ID* or the stream type are changing. If it has been correctly signalled in the transport stream, this type of change is not detected during monitoring purely in accordance with the guidelines. All the same, the omission of a program, for example, may not have been intended. In this case, the MPEG-2 Monitoring System R&S®DVM100 / 120 cannot be deceived and recognizes such events.

In particular if encrypted contents are emitted, for example with pay per view, it is vital that the contents are definitely encrypted. To ensure this, the system continuously monitors the conditional access information.

FIG 2 R&S®DVM100 (top) and R&S®DVM120 (bottom): LEDs on the front panels allow a quick overview of the system status.

Limit values for the data rates can be specifically defined for each transport stream and each elementary type so that the individual elements of the transport stream (tables and elementary streams) do not occupy bandwidths that are too high. Since lower limit values can be defined as well, a simple mechanism for checking the presence of the individual elements is available.

When *SFN*s are monitored, all additional parameters necessary for this specific transmission form are analyzed.

In-depth analysis functions

To complement the continuous monitoring of the individual parameters, the system offers several tools for more detailed analyses, including a table interpreter which enables the contents of any user-selected table to be read. Plus, the headers of the *TS* and *PES* packets can be displayed in interpreted form. The system graphically displays the data rates of all checked elements, complemented by numerous auxiliary information such as maximum and minimum value. To analyze problems with *PCR* values, both *PCR* accuracy and *PCR* overall jitter can be graphically displayed and analyzed as a function of time by using various filters[2]. In addition to further analysis functions, the time intervals between the individual *PCR* values are graphically displayed (FIG 4). All analysis functions can be performed without interrupting monitoring.

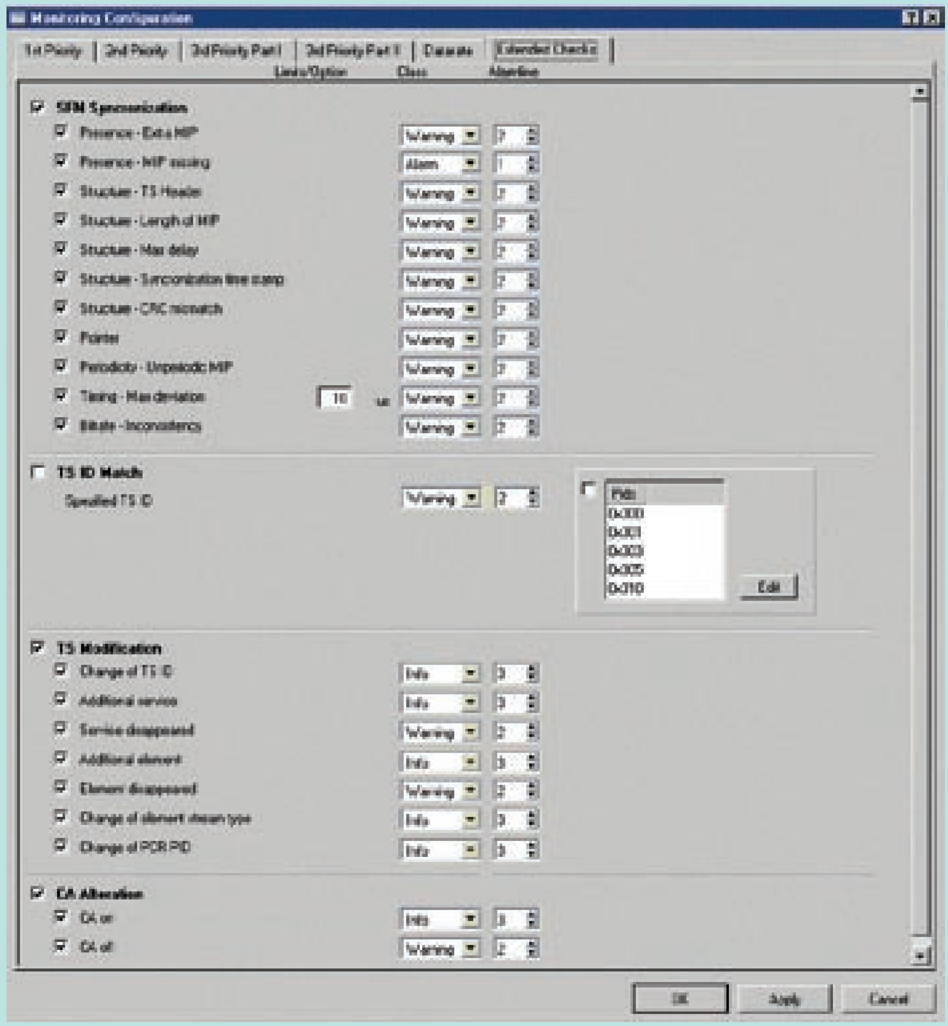
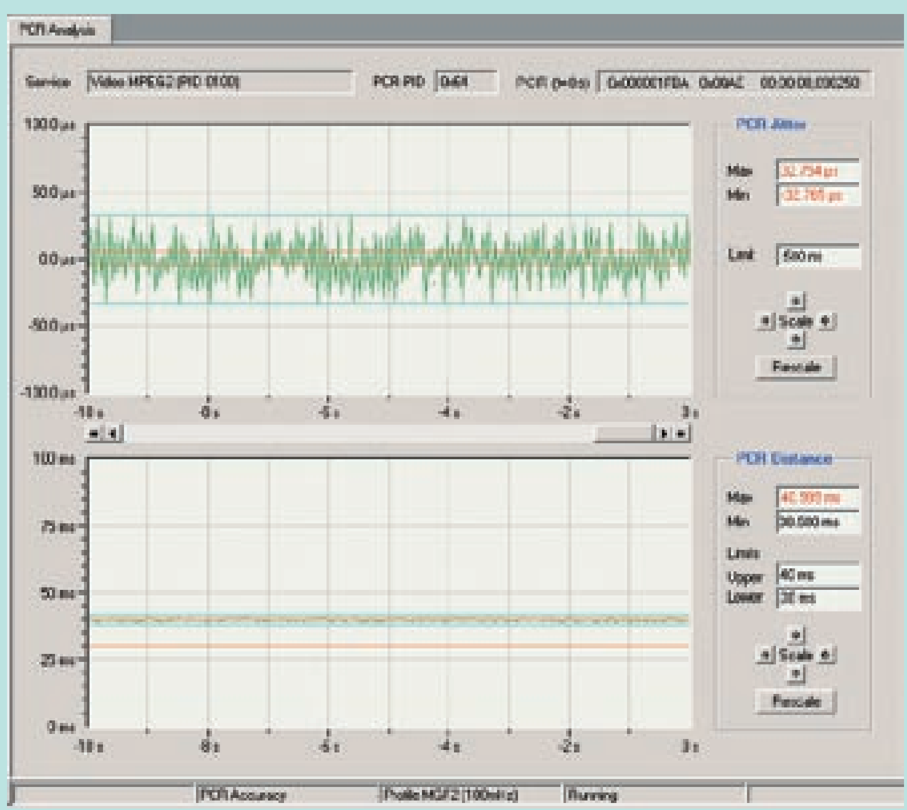


FIG 3 Configuration of the measurement parameters (in this case: Extended Checks).

FIG 4 Measurement of PCR jitter and PCR distance.



1) The only measurement not supported is the measurement of the buffer fill level (priority 3.3).

2) Profiles defined in the Measurement Guidelines.

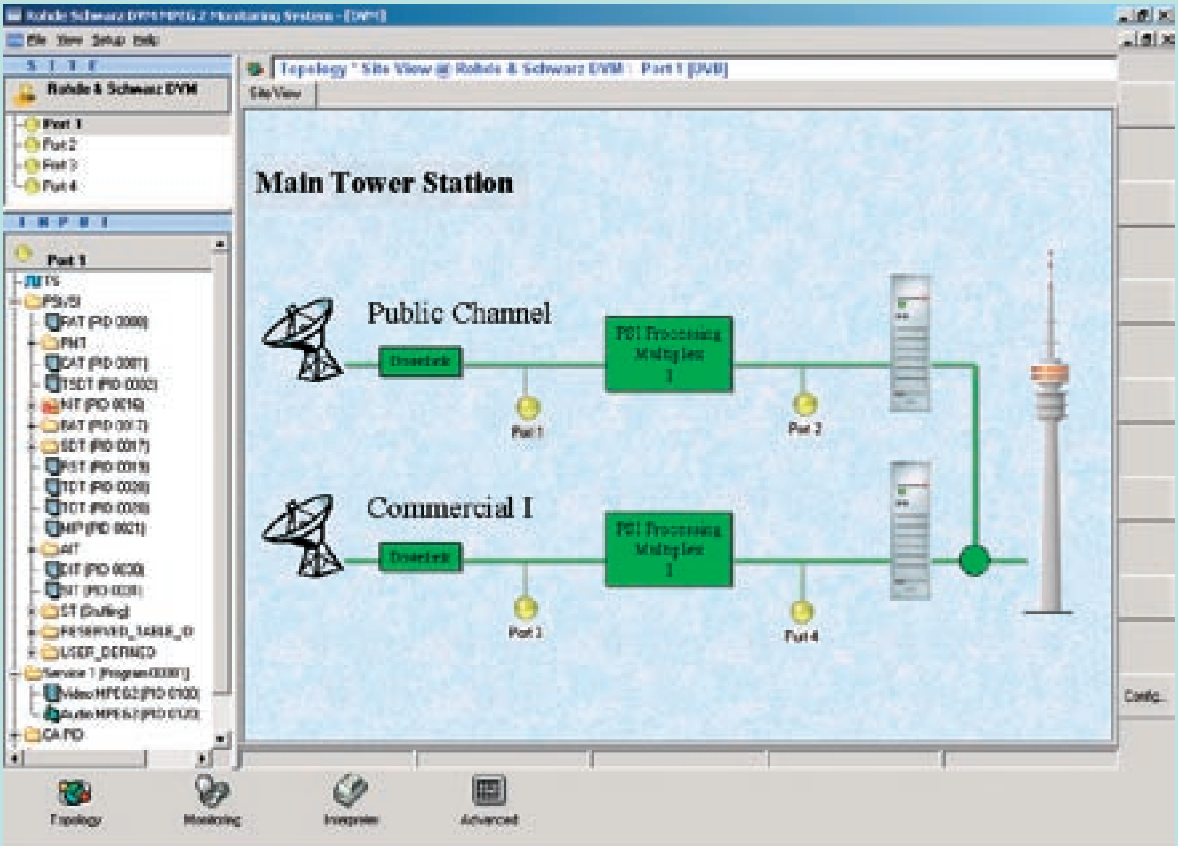


FIG 5
The graphical user interface in the Topology view with four measurement points (port 1 to port 4) in a system configuration diagram (example).

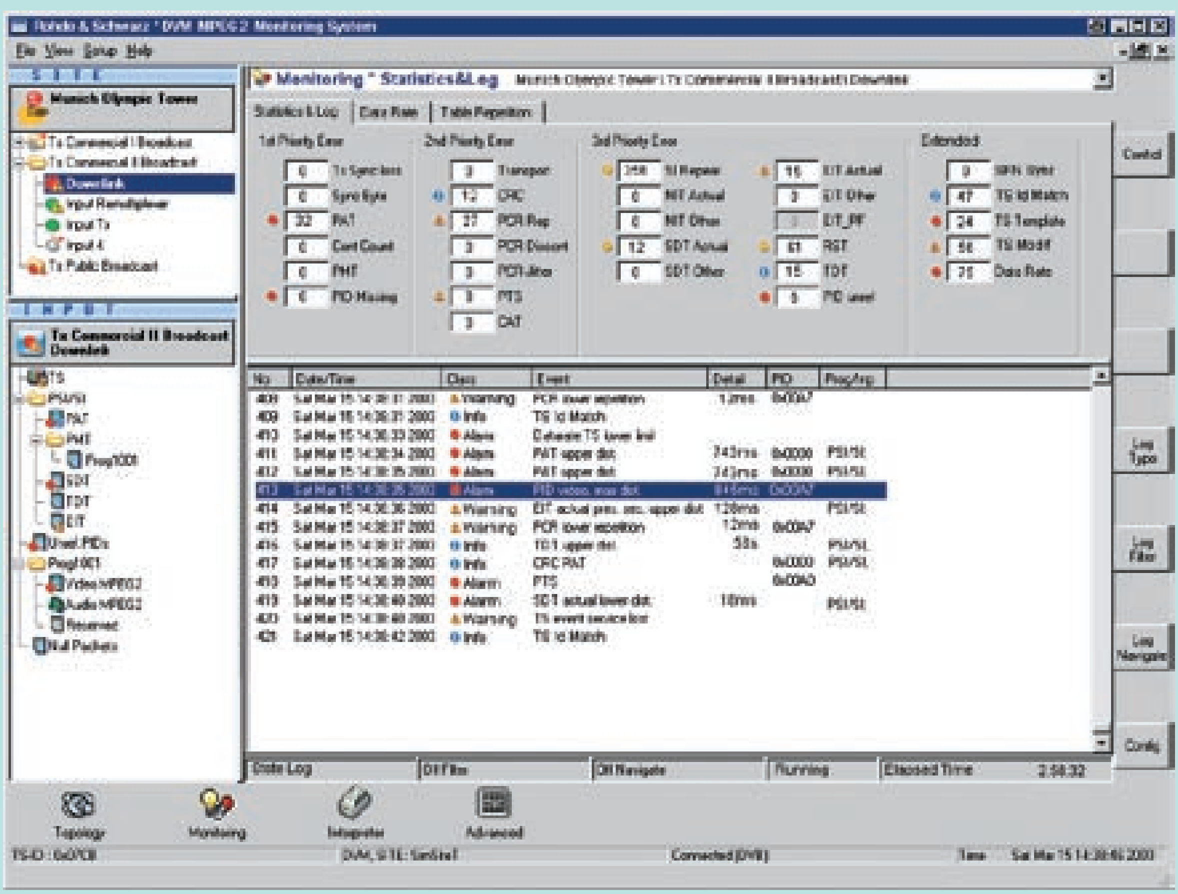


FIG 6
Display of the error counters and the report. Specially marked are the windows SITE and INPUT (displayed in each view) with the hierarchical structures for selecting a transport stream and its elements.

Versatile configuration

When the system was developed, great importance was placed on offering the user a wide spectrum of configuration options (FIG 3). For example, users can deactivate the monitoring of specific elements that are not included in the transport stream. They can also assign each of the well over 100 measurement parameters individually to one of the three groups, i.e. alarm, warning and information, so that an occurring error is displayed along with its associated class. Thus, even less practised users can immediately classify an error. To optimally match the individual transport streams, the users can set the limit values of the individual measurement parameters.

Self-explanatory user interface

FIG 5 shows the graphical user interface in the Topology view. The left area is for navigation within the transport streams and is always visible. All monitored transport streams are listed on the top left; on the bottom left is an overview of the contents of the selected transport stream. This allows quick navigation in the transport streams at all times. The display in the right area depends on the selected function.

The Topology view was specifically developed for clear visualization of the measurement results. It represents each measurement point of a transport stream by means of a symbol. The symbols are placed at any position in front of a user-stored picture, for example a block diagram of the monitored system or a photo of the rack used. The symbols visualize the current status of the transport stream and are also used for selecting the transport stream (FIG 5).

Convenient: view of the transport stream elements

All elements of a selected transport stream are listed in a hierarchical structure in the bottom left area of the user interface (FIG 6). For easy classification, they are represented as symbols, for example for video and for audio. If an error occurs in the transport stream, a report entry is generated and the error-causing element is marked for detailed analyses by means of a red highlighting.

The hierarchical structure also allows convenient filtering of the report: After an element has been marked, only the associated report entries remain visible, making it very easy to generate the error history of a transport stream element.

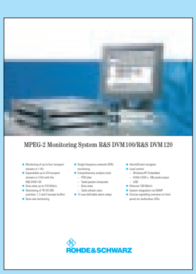
Summary

The MPEG-2 Monitoring-System R&S®DVM100 / 120 is an excellent solution for transport stream monitoring. It prepares the measurement results in a transparent way and can be intuitively operated; plus, it additionally provides all tools for in-depth analyses. Thus, it can be immediately run by the operator without any need for extensive training and still remains a versatile tool for specialists for analyzing MPEG-2 transport streams.

The system can be equally used in playout centers and networks both for terrestrial signals as well as for signals via cable or satellite; it allows easy adaptation to the required measurement range and the desired measuring depth and can be conveniently upgraded at a later time.

Thomas Tobergte

More information and data sheet at: www.rohde-schwarz.com (search term: DVM100)



Abbreviations

CRC	Cyclic redundancy check
ID	Identifier
PCR	Program clock reference
PES	Packetized elementary stream
PID	Packet identifier
SFN	Single frequency network
SNMP	Simple network management protocol
TS	Transport stream

TV Test Receiver R&S®EFA

Fast recording and documentation of measured values

No matter whether individual measurements or entire measurement sequences are performed, the results usually need to be documented. Both the measurements and their documentation can be very time-consuming. The new EFA-SCAN R&S®EFA-K1 measurement software reduces the work involved.

More information and data sheets at www.rohde-schwarz.com (search term: EFA-SCAN or EFA)

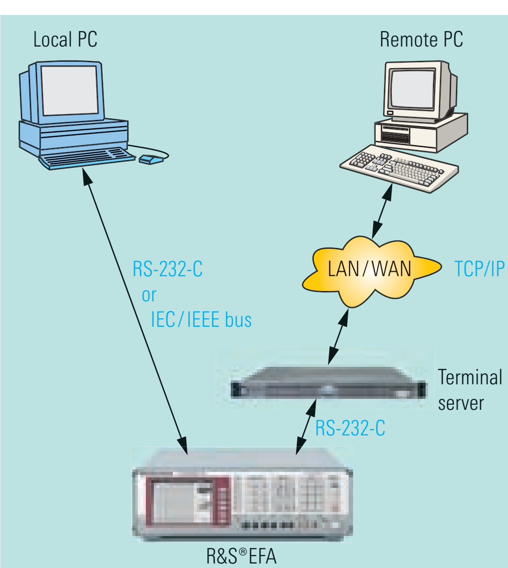
Measurement software for digital Test Receivers R&S®EFA

Recording and documenting measurement values is part of the everyday work of an engineer. Recording entire measurement sequences (e.g. at a cable headend) can be very time-consuming. A solution that helps to save time and work has now been developed specifically for the digital models 2x, 4x, 5x, 6x and 7x of the R&S®EFA test receiver family – it is called EFA-SCAN R&S®EFA-K1.

Interfaces

The new measurement software runs on any PC under Windows 98 / NT / 2000 or XP. The connection between the PC and the Test Receiver R&S®EFA can be set up via the RS-232-C interface or the IEC / IEEE bus. Another option is the use of a terminal server to establish the connection via LAN / WAN (FIG 1). The measurement software can be configured for all three types of connection.

FIG 1 Connecting options between PC and R&S®EFA.



Intuitive operation

EFA-SCAN is easy and intuitive to operate. Even the sequence of registers in the entry dialog specifies the steps that need to be carried out one after the other. After the interface and model have been selected, a dialog window appears for defining the measurement task at hand. First, the default setting of the receiver is determined, e.g. bandwidth, SAW filter or signal input (FIG 2).

In the next step, the user must enter the frequencies at which the measurements are to be performed, and this can also be a single frequency. The measurement parameters are then defined in a list that depends on the model and standard. The user can decide for each measured value parameter whether the measurand is only to be displayed and / or also stored to a file (FIG 3). The parameters thus set for device setup, frequencies and other parameters can be stored to a configuration file for reuse.

FIG 2 R&S®EFA 6x default setting.

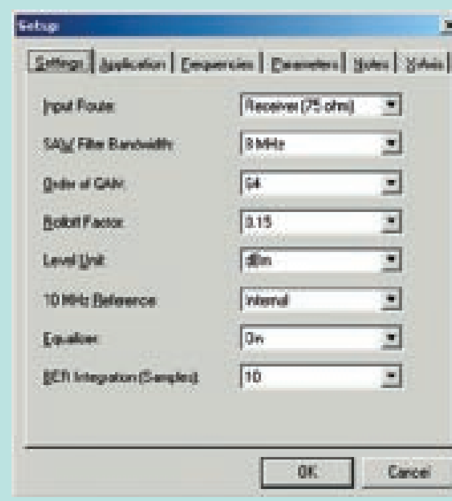
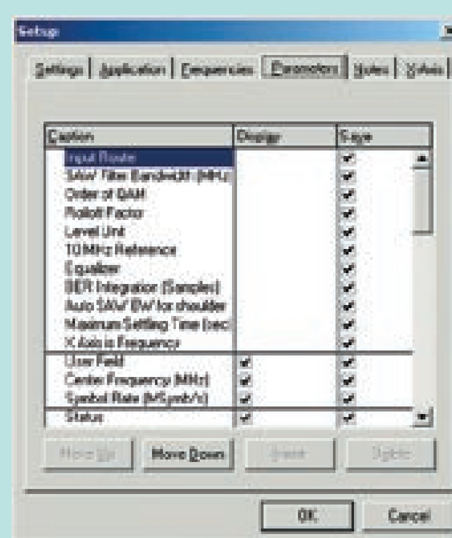


FIG 3 Parameter list for R&S®EFA 6x.



Two measurement modes

The measurements are started at a keystroke. Two modes are offered: In the Snapshot mode, the previously defined frequency list is processed just once; in the Run mode, it is cyclically processed until the measurements are explicitly stopped.The dwell time between the cycles can be individually set and the measured values thus obtained are displayed in tables for each frequency (FIG 4) and/or stored to a file.

Further processing

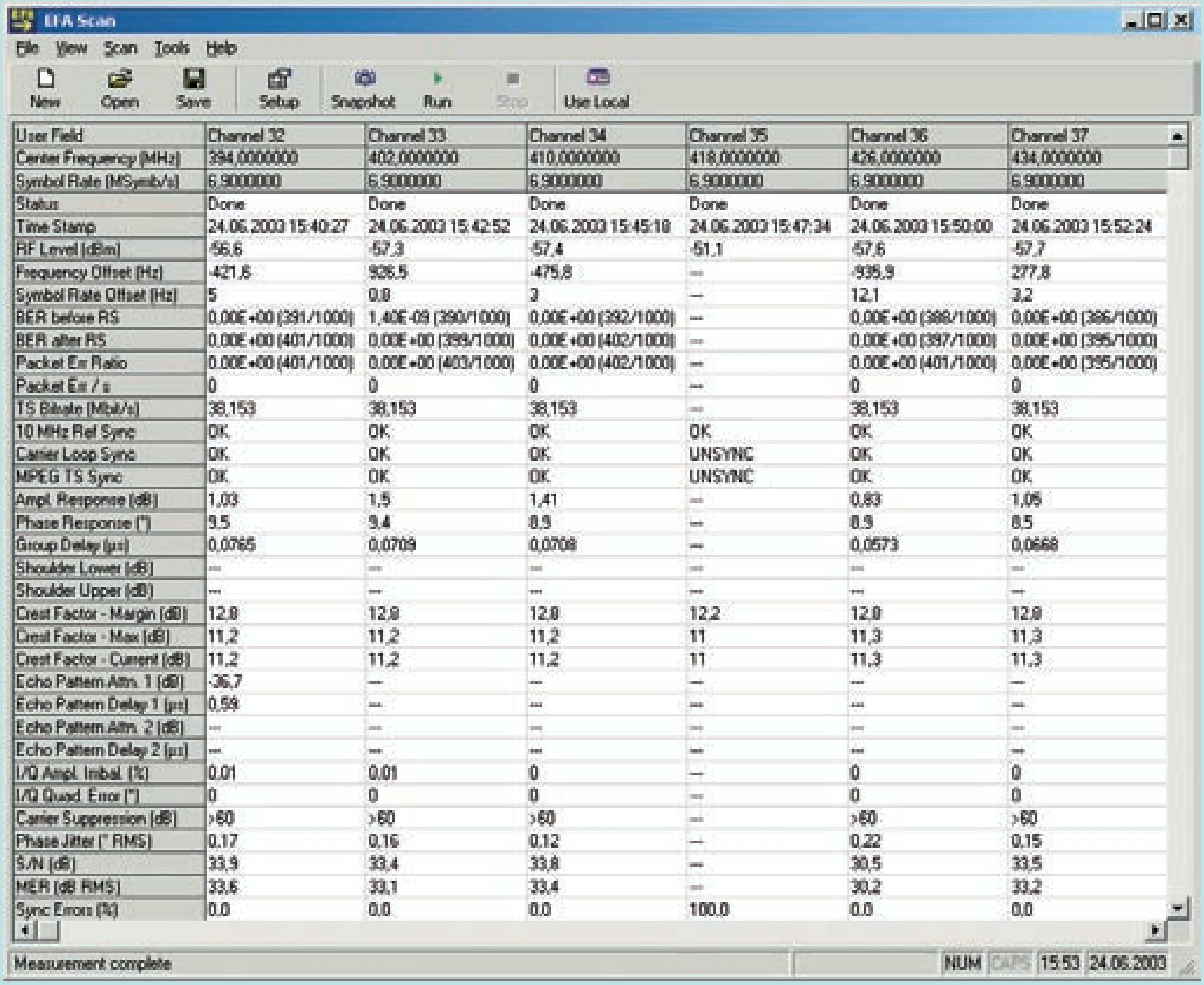
The measured values to be stored are saved in CSV format (comma-separated values) which is a commonly used file format enabling data to be ported to Excel or a database, for example.

Instantly ready for use

Measurement Software EFA-SCAN R&S®EFA-K1 is supplied on a CD-ROM together with a null-modem cable so that operation can start immediately once the software has been installed and the PC has been connected to the Test Receiver R&S®EFA via the serial RS-232-C interface.

Werner Dürport

FIG 4 Table for displaying the measured values (in this case: R&S®EFA 6x).



User Field	Channel 32	Channel 33	Channel 34	Channel 35	Channel 36	Channel 37
Center Frequency (MHz)	394,0000000	402,0000000	410,0000000	418,0000000	426,0000000	434,0000000
Symbol Rate (MSymb/s)	6,9000000	6,9000000	6,9000000	6,9000000	6,9000000	6,9000000
Status	Done	Done	Done	Done	Done	Done
Time Stamp	24.06.2003 15:40:27	24.06.2003 15:42:52	24.06.2003 15:45:10	24.06.2003 15:47:34	24.06.2003 15:50:00	24.06.2003 15:52:24
RF Level (dBm)	-56,6	-57,3	-57,4	-51,1	-57,6	-57,7
Frequency Offset (Hz)	-421,6	926,5	-475,8	—	-935,9	277,8
Symbol Rate Offset (Hz)	5	0,8	3	—	12,1	3,2
BER before RS	0,00E+00 (391/1000)	1,40E-09 (390/1000)	0,00E+00 (392/1000)	—	0,00E+00 (388/1000)	0,00E+00 (386/1000)
BER after RS	0,00E+00 (401/1000)	0,00E+00 (399/1000)	0,00E+00 (402/1000)	—	0,00E+00 (397/1000)	0,00E+00 (395/1000)
Packet Err Ratio	0,00E+00 (401/1000)	0,00E+00 (403/1000)	0,00E+00 (402/1000)	—	0,00E+00 (401/1000)	0,00E+00 (395/1000)
Packet Err / s	0	0	0	—	0	0
TS Bitrate (Mbit/s)	38,153	38,153	38,153	—	38,153	38,153
10 MHz Ref Sync	OK	OK	OK	OK	OK	OK
Carrier Loop Sync	OK	OK	OK	UNSYNC	OK	OK
MPEG TS Sync	OK	OK	OK	UNSYNC	OK	OK
Ampl. Response (dB)	1,03	1,5	1,41	—	0,83	1,05
Phase Response (°)	9,5	9,4	8,9	—	8,9	8,5
Group Delay (µs)	0,0765	0,0709	0,0708	—	0,0573	0,0668
Shoulder Lower (dB)	—	—	—	—	—	—
Shoulder Upper (dB)	—	—	—	—	—	—
Crest Factor - Margin (dB)	12,8	12,8	12,8	12,2	12,8	12,8
Crest Factor - Max (dB)	11,2	11,2	11,2	11	11,3	11,3
Crest Factor - Current (dB)	11,2	11,2	11,2	11	11,3	11,3
Echo Pattern Attn. 1 (dB)	-36,7	—	—	—	—	—
Echo Pattern Delay 1 (µs)	0,59	—	—	—	—	—
Echo Pattern Attn. 2 (dB)	—	—	—	—	—	—
Echo Pattern Delay 2 (µs)	—	—	—	—	—	—
I/Q Ampl. Imbal. (%)	0.01	0.01	0	—	0	0
I/Q Quad. Error (°)	0	0	0	—	0	0
Carrier Suppression (dB)	>60	>60	>60	—	>60	>60
Phase Jitter (° RMS)	0.17	0,16	0,12	—	0,22	0,15
S/N (dB)	33,9	33,4	33,8	—	30,5	33,5
MER (dB RMS)	33,6	33,1	33,4	—	30,2	33,2
Sync Errors (%)	0.0	0.0	0.0	100.0	0.0	0.0

43983/6

FIG 1 **The Portable SAT/TV/FM Test Receiver R&S®EFL100.**

Portable SAT/TV/FM Test Receiver R&S®EFL100

The versatile test receiver for mobile use

Step by step, analog TV transmitter networks are being converted to digital transmission methods. Until transition is completed, analog and digital programs are jointly transmitted, either via satellite, cable or terrestrial distribution. A TV test receiver should be suitably versatile, as is the R&S®EFL100 (FIG 1).

For digital and analog TV standards

Program providers are gradually converting to digital transmission methods. To allow viewers to keep track of this development, digital and analog programs are transmitted simultaneously during a transition period. Thus, modern TV test receivers should be designed for both transmission methods. This is where the new SAT/TV/FM Test Receiver R&S®EFL100 comes in.

The R&S®EFL100 is available in three models that build on one another. The base model is purely analog; it provides a series of test functions for the most common analog TV standards worldwide, including SAT. The second model additionally supports the digital DVB-S (satellite) and DVB-C (cable) standards. The comprehensive, highly versatile third model also includes the DVB-T (terrestrial) standard, making it a safe investment for the future.

Ideal for installation and maintenance

The R&S®EFL100 is primarily used for the installation and maintenance of antenna and signal distribution systems. Other applications include monitoring transmitter sites and determining signal level and signal quality during coverage test drives.

Common to all these applications is mobile use under frequently adverse conditions – which is definitely the receiver's specialty: Its built-in rechargeable battery ensures mains-independent operation for at least one hour. When the R&S®EFL100 is used in vehicles, it can also be fed directly from the 12 V car battery. Large handles and spacers at the front and rear in combination with a leather bag (option R&S®EFL100-Z1) provide sufficient protection from mechanical damage. An antiglare device can be put on the display when the incidence of light is unfavourable (option R&S®EFL100-Z2).

The key elements and the menu structure were designed with special emphasis on quick and easy operability, including the main measurement parameters which are clearly visible on a large TFT colour display. Measured values can thus be read even from a large distance. A built-in printer makes it possible to record the measurement results and even to output simple graphics.

Securing signal quality

When distributing broadcast programs via satellite, cable or terrestrial transmitters, it is of vital importance that the signal quality at the reception site complies with the specified minimum requirements (almost interference-free picture and sound). The measurement functions and performance of the R&S®EFL100 have sufficient leeway to satisfy these requirements.

Measurement functions

A spectrum display (FIG 2) shows the current channel assignment and allows conclusions as to whether the program is digital or analog.

The live picture on the display and the sound via a built-in loudspeaker give a first impression of the signal quality. For analog TV signals, measurements of the receive level, sound carrier spacing and the S / N ratio are available. A scope function allows you to take a precise glance into test lines (FIG 3).

In addition to the above mentioned spectrum display and the measurement of the receive level, further measurements are available for digitally modulated TV signals. An MPEG-2 decoder in the models with demodulators for DVB-S, DVB-C and DVB-T enables video and audio playback. The program can be selected directly from the program allocation table (PAT). Constellation diagrams for QPSK, QAM and OFDM-modulated signals allow the quality of digital signals to be evaluated (FIG 4). Colour-coding the symbol distribution in the specific decision field has made quality evaluation easier. The associated values for MER and BER are displayed in the constellation diagram.

Special features

All models are able to supply LNBs* via the RF input and to control them via DiSEqC signals**. The R&S®EFL100 can be remote-controlled via the RS-232-C interface with modem commands so that values for level, frequency, MER or BER, for example, can be polled.

The models with DVB demodulators are each fitted with a module for measurements in the return path as well as a parallel MPEG-2 transport stream output. If this output is connected to the MPEG-2 Monitoring System R&S®DVM, a favourably priced monitoring system with remote-control option can be set up.

Werner Dürport

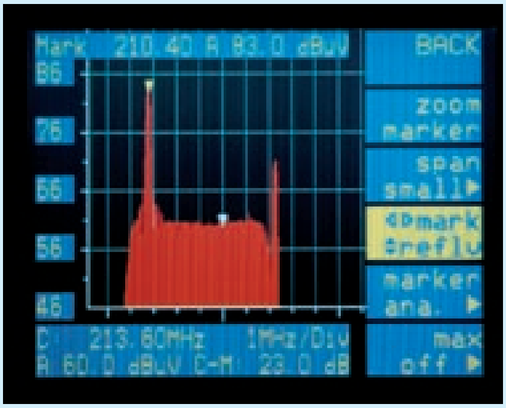


FIG 2 RF spectrum of an analog TV signal.

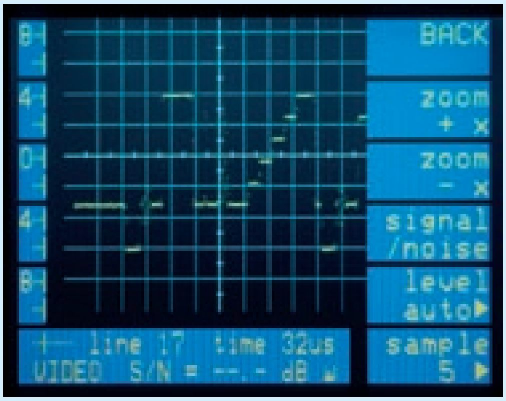


FIG 3 Scope function.

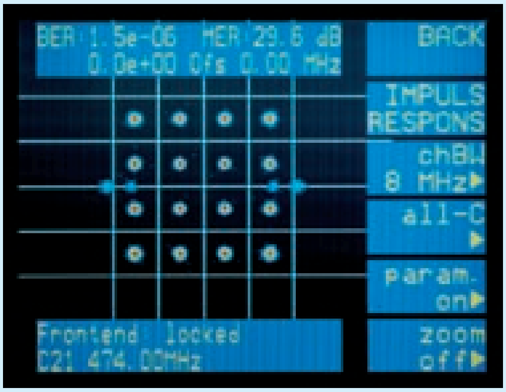
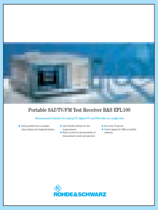


FIG 4 Constellation diagram of an OFDM signal.

More information and data sheet at www.rohde-schwarz.com (search term: EFL100)



Data sheet R&S®EFL100

* Low noise block

** DiSEqC: Digital DiSEqC – digital satellite equipment control. Switch signals generated by the satellite receiver to control and switch LNBs and matrices. DiSEqC is a trademark of the European Satellite Organization (EUTELSAT).

The R&S®ZW 700 dummy antennas feature outstanding reflection characteristics in the entire UHF frequency range as well as high thermal robustness. They can be used for versatile measurements, for example on the medium-power and high-power UHF Transmitter Family R&S®NH / NV 7000.

Dummy antenna for 8 kW (without lining).

44 026

Dummy Antennas R&S®ZW 700

Different power classes – easy to implement

Three power classes

Air-cooled 3 kW and 4 kW absorbers are the basic modules of the new dummy antennas. By means of a 2-way combiner, they can be easily expanded to form 6 kW or 8 kW absorbers so that three power classes, 4 kW, 6 kW and 8 kW, are available.

The 3 kW absorber includes 24 robust 250 W flange resistors made from aluminium nitride that are combined in four groups with six resistors each. Each group transforms to $Z_0 = 50\ \Omega$. Two of the four resistor groups are fitted with a 90° phasing line which reduces RF power reflection to a minimum. A subsequent power transformer in triplate technique combines the four groups and finally transforms to the reference characteristic impedance of 50 Ω.

The 4 kW absorber consists of an expanded 3 kW absorber and an unbalanced splitter in triplate technique which ensures uniform thermal load of all resistor groups.

Self-protecting system

To protect the dummy antennas from thermal overloading, the absorbers are fitted with temperature monitoring devices. At a heat sink temperature of 60 °C or higher, a sensor activates the fans; if the temperature exceeds 90 °C, a message is output to the transmitter control unit.

Minimum floor space

The dummy antennas are installed in sturdy racks of only 445 mm × 583 mm in floor space. RF is supplied from the top or the side. An integrated directional coupler (N connector, female) ensures precise measurement of the RF input power.

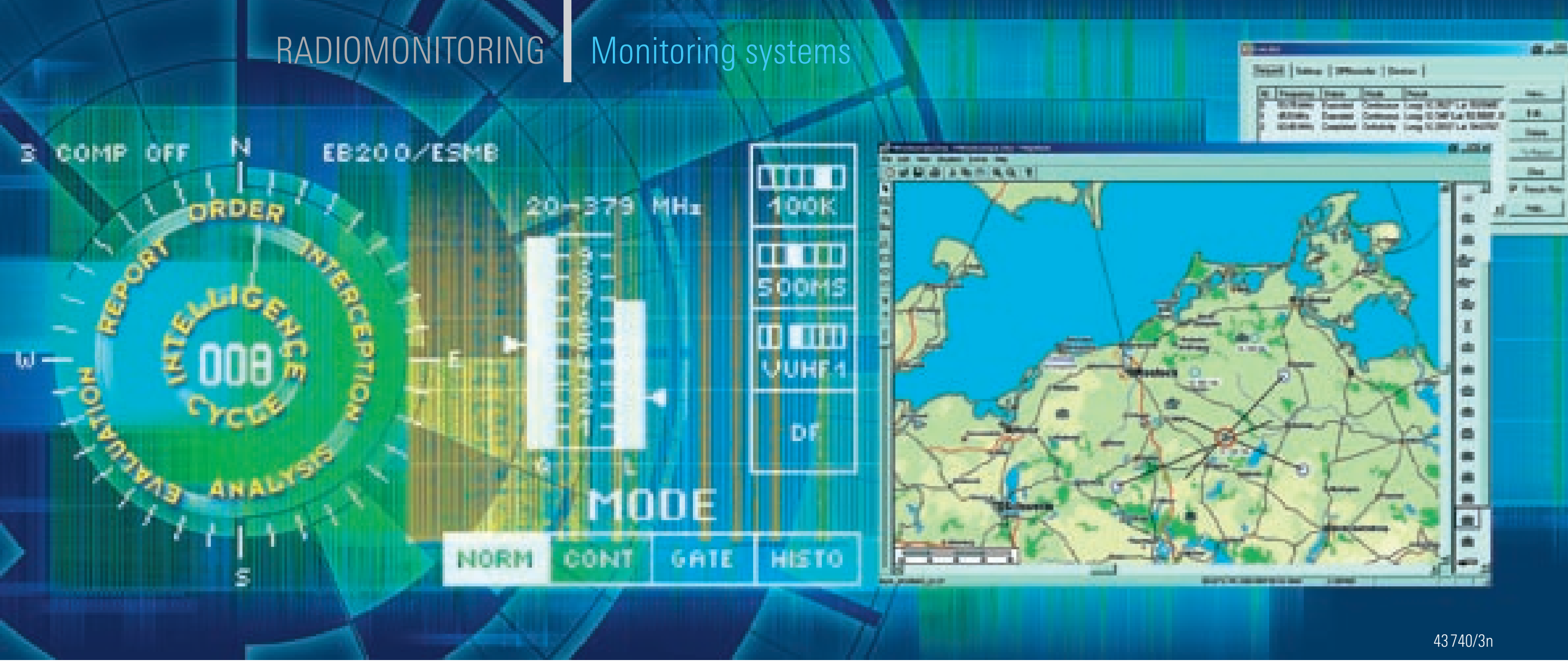
The dummy antennas can be optionally supplied with EIA conduit connectors and sound-proof lining (approx. 3 dB sound level reduction).

Find out more about the comprehensive Rohde & Schwarz transmitter portfolio at www.rohde-schwarz.com.

Ludwig Moll

Condensed data of the R&S®ZW 700

Frequency range	470 MHz to 862 MHz		
Return loss	≥33 dB		
Permissible ambient temperature	45 °C		
Power (rms)	4 kW	6 kW	8 kW
Noise level (without lining)	65 dBA	66 dBA	68 dBA
Weight	50 kg	61 kg	91 kg
RF input	RL58		
optional EIA	1 5/8"	3 1/8"	3 1/8"
Floor space (W × D)	445 mm × 583 mm		
Height	1100 mm	1100 mm	1370 mm



43 740/3n

Radiomonitoring System R&S®RAMON

Communications intelligence – systems that adapt to growing requirements

With its R&S®RAMON product family, which consists of systems for radiomonitoring and communications intelligence, Rohde & Schwarz set the course towards modularity and scalability early on. The latest generation is now available.

More information and data sheets at www.rohde-schwarz.com (search term: RAMON)

REFERENCES
- Technical Information R&S®RAMON
- Technical Information R&S®TMSR (available on request)

Flexibility due to optimum scalability

From an operational point of view, the scalability of radiomonitoring systems is gaining increasingly in importance. Owing to their modularity and scalability, the R&S®RAMON systems permit the following:

- Depending on the current mission, the systems can be adapted and reconfigured to comply with different tasks
- They can be easily expanded and upgraded to meet new and changing requirements
- Interfaces allow integration in an architecture the user already has with a minimum of effort
- The systems are remote-controllable

R&S®RAMON systems were designed for government authorities with security missions and the armed forces; they support the following tasks:

- Military missions as part of the UN peacemaking and peacekeeping missions (e.g. reconnaissance via fact-finding teams or protection of one's own forces)
- Information procurement as a basis for political decisions
- Combat of trafficking and illegal border crossing
- Protection of property and personal protection

System architecture

R&S®RAMON systems consist of sensor and IT components, various units of the radiomonitoring and radiolocation portfolio from Rohde & Schwarz, plus the R&S®RAMON system software as a user interface. The software permits:

- Direct control of the units that are connected to the controller
- Storage and evaluation of the data obtained

◆ Controlling and monitoring of the information flow in a networked system with several workstations or system locations

Special software modules are available for each of these tasks. FIG 2 shows the different modules and their integration in the information flow within a system. Depending on the size and type, the systems contain individual or several of these modules.

Development of the software modules is based on components, i.e. the modules are assembled from individual small software function units, offering users the great benefit that the graphical user interfaces for widely different units are identically designed throughout, making it easy to cope with diverse units.

Due to this component-based development, numerous open interfaces become available as well, which can provide the basis for the integration of the R&S®RAMON software into existing systems.

The software architecture permits the remote control of units, subsystems or entire radiomonitoring stations. For this purpose, the client / server architecture, which is the basis of every device control, offers an interface between the device driver and the user interface. The TCP / IP-based communication link between these two software parts can be set up both on a controller within a local area network (LAN) and via a wide area network (WAN).

The R&S®RAMON software also allows integration of Rohde & Schwarz equipment such as the following:

- Receivers R&S EB 200® / ESMB / ESMC / EK 895 / EK 896
- Direction finders R&S DDF®190 / DDF®195 / DDF®0xA / DDF®0xE / DDF®0xM
- R&S AMMOS® systems for HF and VHF / UHF

Operational concept

Communications intelligence is a step-by-step process in which radiocommunication signals are intercepted, analyzed, stored and evaluated. This process is generally referred to as intelligence cycle. R&S®RAMON systems map this process by means of different software modules. FIG 1 shows a simplified process.

The operation of larger systems with several workstations is usually organized by a supervisor who plans the interception tasks on the basis of a customer order. By means of the ReportEdit software module, specific tasks (orders) are assigned to the individual operators. The operator transfers the interception results (data, audio) by means of a mouse click to the reports and sends them to an evaluation workstation. The evaluator in turn stores the results of the tactical and operational evaluation to an Oracle-based database. The supervisor accesses this data, generates messages for the customer as well as new orders that include the findings thus obtained.

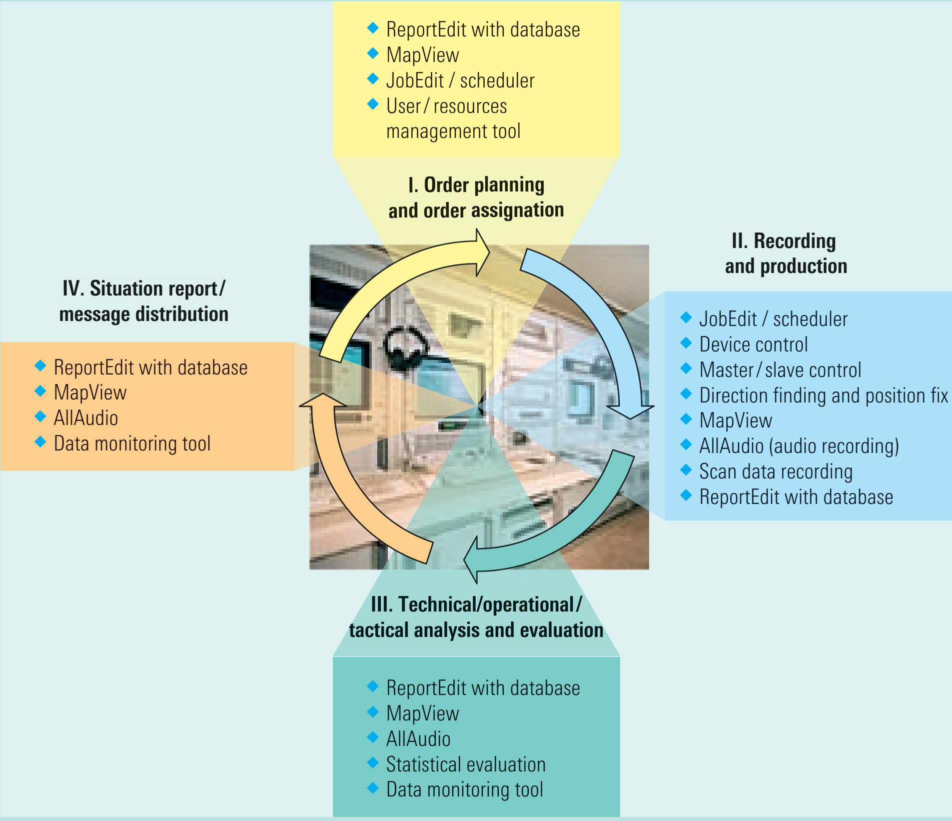


FIG 1
Intelligence cycles in R&S®RAMON systems.

System examples

The following two examples illustrate the scalability of the systems from the R&S®RAMON family.

Tactical Interception and Direction Finding System R&S®TMSR

Compact, highly mobile systems for electronic support measures (ESM) are required for international out-of-area missions, in particular for:

- Generation of a situation picture
- Onsite protection of one's own forces
- Support and complementation of stationary radiomonitoring systems

The R&S®TMSR consists of a search receiver, a direction finder and a laptop computer with the associated R&S®RAMON software (FIG 3). Owing to its modularity, the system can be adapted to changing tasks:

- As a manpack system, consisting of the R&S EB 200® receiver and the Active Directional Antenna R&S®HE 200; portable by an operator during operation, e.g. for the localization of miniature transmitters (homing)
- As a portable system, consisting of the R&S EB 200® receiver, the Active Directional Antenna R&S®HE 200 and a laptop computer (this assembly already forms a functioning interception system, e.g. for covert reconnaissance)
- As a fully transportable system with a direction finder in the transit case, e.g. as a compact mobile interception and DF station

Remote-controlled radiomonitoring with semi-mobile systems

It is often necessary to monitor radiocommunication in remote areas without setting up the necessary infrastructure onsite and providing highly qualified personnel. For this purpose, a number of unattended remote systems for radiomonitoring and direction find-

FIG 2 Modules and their interaction in R&S®RAMON systems.

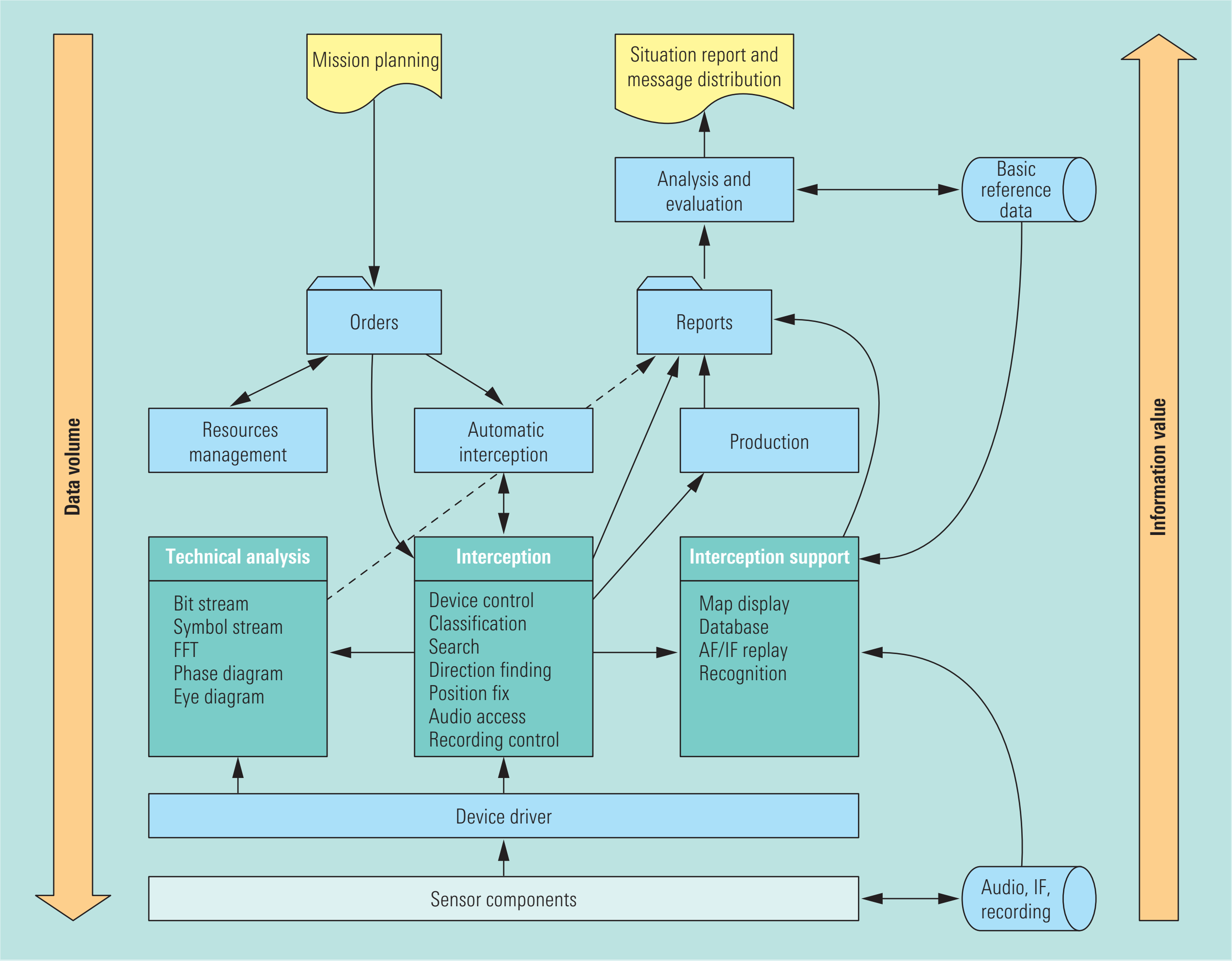


FIG 3 The R&S®TMSR with a detachable R&S EB200® receiver for manpack operation.

FIG 4 Semi-mobile radiomonitoring and direction-finding station – ready for transport.

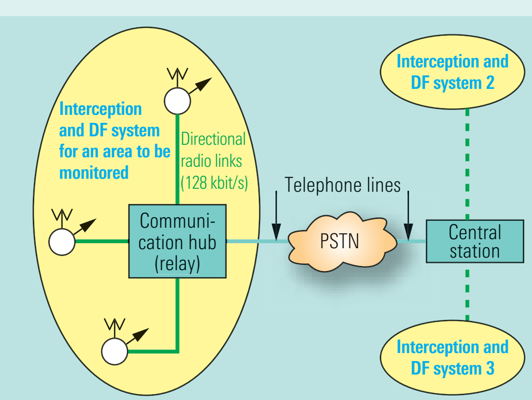


FIG 5 Configuration example of a remote-controlled interception / DF system.

ing can be remote-controlled by a central interception and evaluation station. Since the areas to be monitored can frequently change, the systems are fitted into cabins and quickly transported to their new sites by means of trucks. FIG 4 shows a radiomonitoring cabin that is mounted on a truck.

Such stations can be quickly set up, even by personnel not familiar with radiomonitoring. Operation in this case is from a radiomonitoring central station, which can either consist only of operator workstations, or it can be equipped with a radiomonitoring system of its own (receiver, direction finder). The central station is either accommodated semi-mobile in a shelter, or the units are integrated in portable transit cases so that they can be set up in a building or tent, for example.

FIG 5 shows a possible system configuration. The communication means used for data communication between radiomonitoring / DF stations are modems for analog dialled or leased lines and directional radio systems.

Additional relay stations (also semi-mobile) are offered to increase the distance between the radiomonitoring and DF stations and the central station, particularly for the use of directional radio systems.

The software permits resource management, i.e. the resources required for a specific task are selected by an authorized operator (supervisor) in the central station from the total available resources and temporarily assigned to one of the operator workstations. The entire system can be quickly rearranged, both on the hardware and software end, if the focus of the task changes.

External interfaces

R&S®RAMON systems are modular and flexible: To avoid having to renew the entire system when replacing parts of an existing interception system, users can also integrate individual system modules in existing systems, as in the following two examples:

Device control

The R&S®RAMON modules for device control have been optimized for fast operation, taking into account the requirements placed on military radiomonitoring systems. The capability of simultaneous, concurrent operation, i.e. either directly on the unit or via the graphical user interface of the controller, adds to the flexibility. The operators can optimize the settings of their receivers directly on the unit during the drive in an off-road vehicle, while at the same time keeping an eye on the result display of the control software on a TFT display of the controller.

FIG 6 shows the user interface of two radio receivers that are operated as search and handoff receivers, coupled with each other.

The modules for device control offer an external CORBA interface [1)], via which they can be conveniently included in other systems. For example, individual radio receivers or direction finders, together with the R&S®RAMON module for device control, can thus be integrated in external systems.

Data flow in the system

The ReportEdit software module is used to generate orders and reports. It generates files in XML format [2)] which are transmitted between the individual workstations and / or systems. An Oracle database stores the contained data. The reports include measurement data, links to recorded signals and screenshots of the current situation picture on a digital map. Units (e.g. receivers/direction finders) can also be directly controlled from this form. Users can easily modify or recreate the screen masks (FIG 7). This mechanism offers them the capability to provide R&S®RAMON-based workstations/systems with orders as well as to obtain result data from the system and process it further by means of their existing evaluation software.

Summary

With its R&S®RAMON systems for communications intelligence, Rohde & Schwarz offers a variety of individual system components up to turnkey systems. The individual modules can be conveniently combined according to customer and task to form tactical or strategic interception systems. In conjunction with services such as advice prior to procurement, installation, training, support of onsite operation and system maintenance, Rohde & Schwarz provides its customers with tailor-made all-in-one solutions from a single source.

Jürgen Koppitz

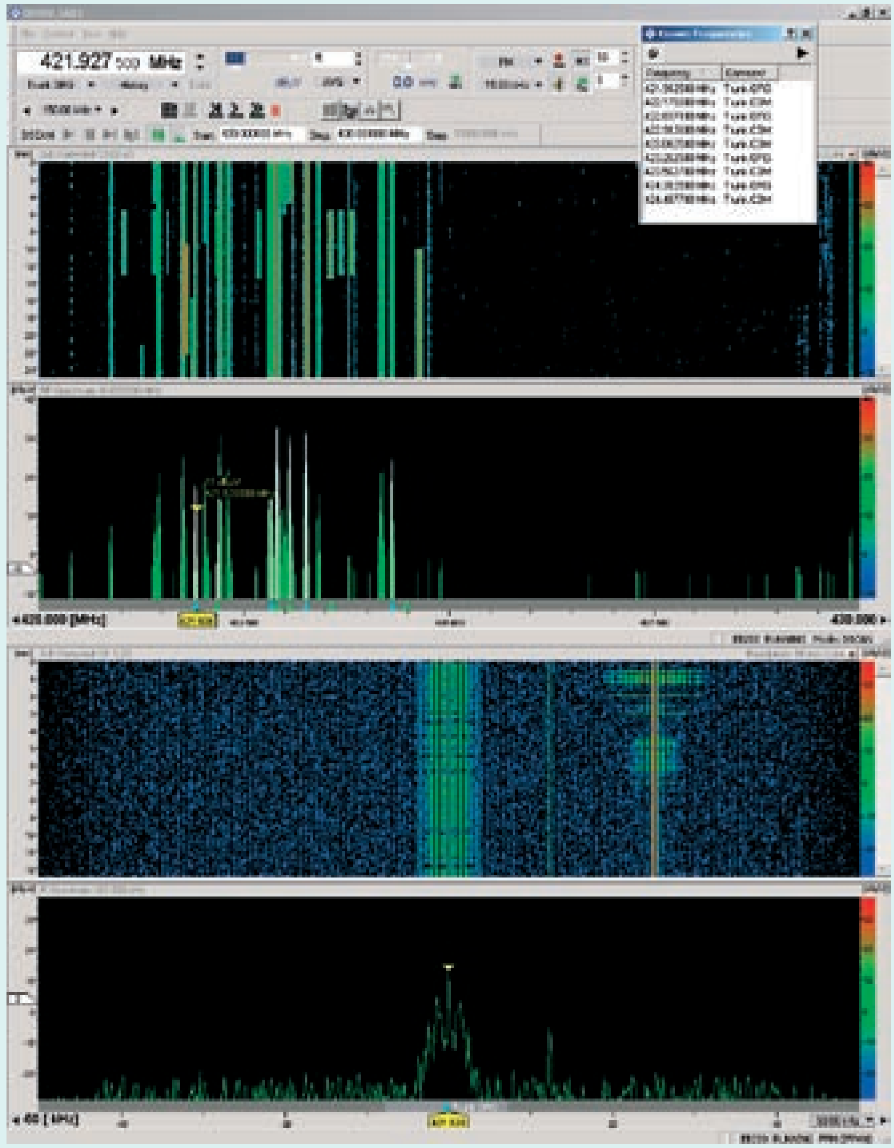
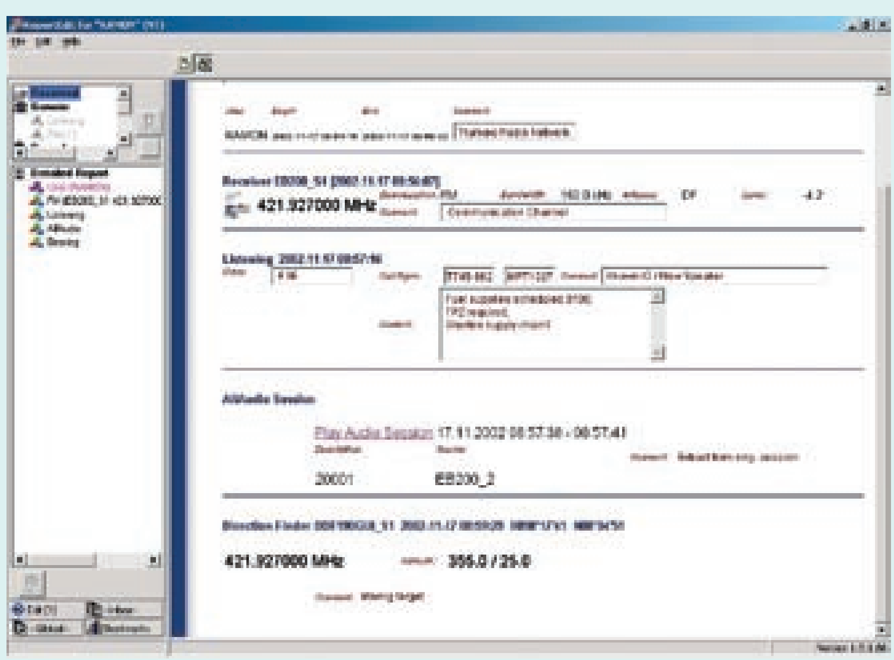


FIG 6 User interface of the search receiver with HF spectrum/waterfall (top) and of the handoff receiver with IF spectrum/waterfall (below).

FIG 7 Screen mask of the monitoring results in the ReportEdit module.



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1) CORBA: common object request broker architecture; a standard interface for data exchange that is independent of both platform and operating system.
2) XML: extensible markup language.

FIG 1 Two 19-inch instruments – the DF Converter R&S®ET 550 and the Digital Processing Unit R&S®EBD 660 – suffice to cover the entire VHF / UHF range. For expansion of this range from HF through to UHF, two DF converters and the R&S®EBD 660 are required.

Digital Broadband Search Direction Finders R&S DDF®0x A

Unrivalled performance and compact design

The new family of R&S DDF®0x A broadband search direction finders unites top-class RF engineering and the fastest digital signal processing components which yields an unrivalled combination of sophisticated performance and compact design.

Extremely fast and precise

The R&S DDF®0x A broadband search direction finders feature a high, occupancy-independent scanning speed of up to 20 GHz/s plus great reliability of bearings and a thoroughly object-oriented system interface. Whether they are used as stationary or mobile single workstations or as search and interrogation direction finders in complex radiomonitoring systems – they provide previously unheard-of potential for automatic operation. Three different configurations are available:

- **R&S DDF®01 A** HF range (0.3 MHz to 30 MHz)
- **R&S DDF®05 A** VHF / UHF range (20 MHz to 3000 MHz)
- **R&S DDF®06 A** HF to UHF range (0.3 MHz to 3000 MHz)

Design and function

Basically, each of the new direction finders consists of the Digital Processing Unit R&S®EBD 660 and one or two DF converters (FIG 1). The DF converter and digital processing unit constitute a fully coherent, three-path measuring system that is similar to a three-channel vector analyzer and divides the signals supplied by the antenna system into frequency channels using a filter bank and performs quasi-parallel calculation of the directions of incidence in up to 10 000 channels.

The DF converters filter the antenna signals and convert them to fixed intermediate frequencies with a bandwidth of up to 10 MHz. The DF Converter R&S®EH 110 is provided for the HF range, whereas the DF Converter R&S®ET550 handles the entire VHF/UHF range. The two converters feature excellent noise and linearity characteristics so that high-precision bearings are obtained even when adjacent-channel power is high. The third-order intercept of the HF Converter R&S®EH110 is 40 dBm and that of the R&S®ET550 typ. 20 dBm. These values are attained at a carrier offset of 30 kHz (HF) and 1 MHz (VHF/UHF) and are even significantly higher at larger carrier offsets.

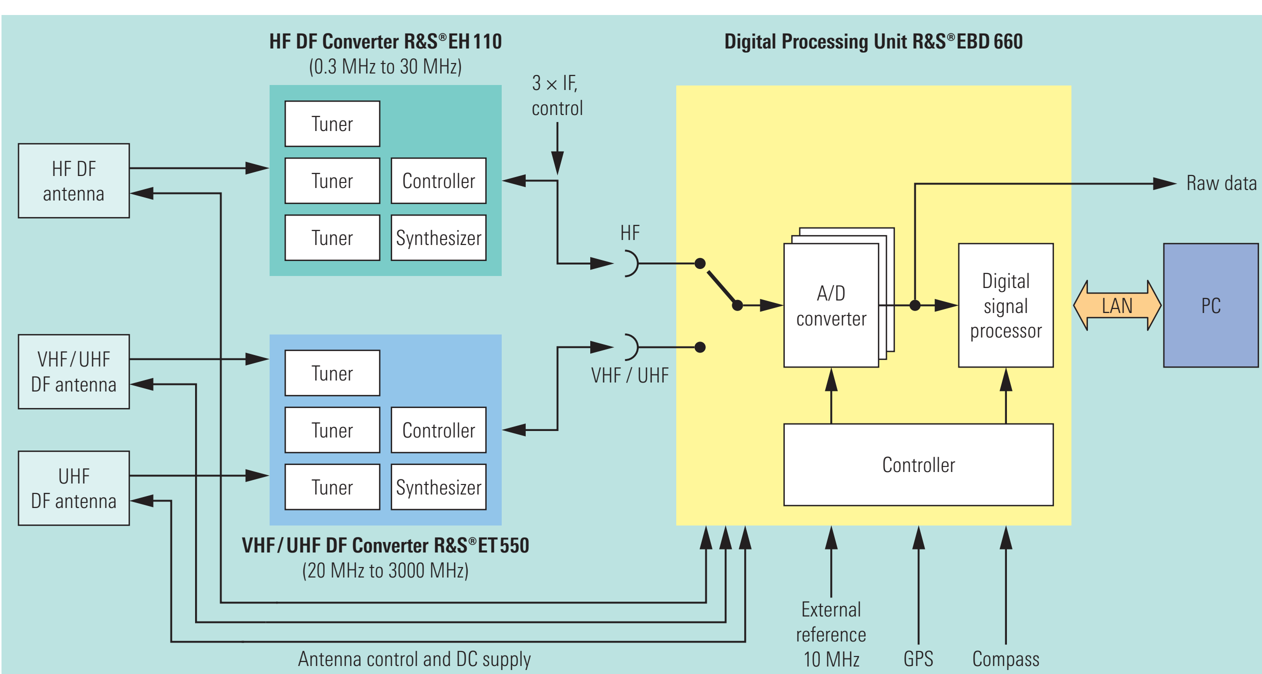
As phase noise is decisive for the permissible adjacent-channel power, the R&S®EH110 features –110 dBc/Hz (1 kHz frequency offset) and the R&S®ET550 an unrivalled –120 dBc/Hz (10 kHz).

The core of each R&S DDF®0xA is the **Digital Processing Unit R&S®EBD660** (FIG 2). It contains three parallel measurement paths with highly linear A/D converters at 14 bit resolution. The high sampling rates of the A/D converters and the resulting high decimation gain in the case of filtering plus the analog control circuit yield an excellent dynamic range: At a resolution bandwidth of 1 kHz, for example, it is more than 140 dB. Decimation is followed by the main filtering process that takes place in a digital filter bank. The use of prime FFT made it possible to implement the channel spacings usual with receivers without suffering any loss in speed (100/50/25/20/12.5/8.33/5/2/1 kHz in the VHF/UHF range; 20/10/5/2/1/0.5/0.2/0.1 kHz in the HF range). Many manufacturers, however, use the simpler Radix2 FFT method. This type of FFT only permits channel spacings of 1/2/4/8 kHz, for example, which do not coincide with the channel spacings used in practice and thus make it difficult to hit the channel precisely.

Filtering in the R&S DDF®0xA yields the complex amplitudes of up to 10000 channels at a time. These amplitudes are averaged if there are bottlenecks in data traffic to the PC and in order to achieve higher sensitivity. They are provided with the amplitude and phase correction values for the balance of the receivers and distributed to 16 signal processors for DF value calculation. The DF values plus the level values and the time stamps inserted before filtering are transferred to the communication processor that makes the information available to the control and display PC or the system network via an Ethernet interface at a data rate of 100 Mbit/s (FIG 2). This ensures an unvaryingly high scanning speed even in the case of very high channel occupancy. In the fixed frequency mode, the filtered data stream of the reference path is routed to a separate processor where the center channel is demodulated using a demodulation bandwidth that can be selected independently of the DF bandwidth.

The **DF methods** implemented as standard are based on the algorithms for the advanced principle of the correlative interferometer and for the tried-and-tested Watson-Watt method; the evaluation method is automatically selected depending on the connected antenna and the set frequency range. The Watson-Watt method is especially used in the HF range when space is at a premium, such as in vehicular applications in conjunction with the Antenna

FIG 2 **Basic configuration of the Broadband Search Direction Finder R&S DDF®06A for the frequency range 0.3 MHz to 3000 MHz.**



R&S®ADD119 and for semi-mobile HF applications. The correlative interferometer has become the standard DF method of today. In contrast to the Watson-Watt method, it provides high bearing accuracy even in environments with interference by obstacles and at low signal levels. The correlation algorithm employed as standard in the new direction finders uses nine spatial sampling values of the incoming waves obtained by 9-element circular antenna arrays in time multiplex in three parallel paths. This dimensioning makes for the following:

- Excellent bearing accuracy with a low number of antennas, especially in difficult environments (i.e. multiple-wave fields)
- Low expenditure on instrumentation (including reduction of parameters involved such as dimensions, weight, number of antenna cables, current drain, purchase price)
- Short measuring times owing to state-of-the-art DSP technology

Operating modes

The Direction Finders R&S DDF®0xA can operate in three different modes: SCAN, SEARCH and FFM (fixed frequency mode).

In the **SCAN mode**, the channels of a frequency range of up to 10 MHz (realtime bandwidth in the VHF / UHF range) are simultaneously detected and DFed. After the measurement has been completed, the measurement window is shifted by the realtime bandwidth by retuning the DF converter, and a new measurement is performed.

The **SEARCH mode** is equivalent to frequency scanning. When a signal has been detected, the direction finder dwells on this signal for a preselectable time; the bearings are presented in the same way as in FFM.

In **FFM** only one frequency channel is investigated. To obtain an optimal dynamic range, the bandwidths of the analog prefiltering circuit can be reduced to 20 kHz in the HF range and to 120 kHz in the VHF / UHF range. In addition to direction finding, an IF spectrum with a user-selectable width of 1 MHz, 5 MHz or 10 MHz is calculated for easy selection of the signal to be detected and demodulated.

Three different types of squelch-controlled averaging are available in FFM:

- **NORMal** (signals above the selected threshold are averaged for a selectable period of time; after this period has elapsed or the signal has dropped below the threshold, the averaging memory is cleared)
- **GATE** (same as NORM, except the averaging memory is not cleared after the signal has dropped below the threshold, which is important in the case of pulsed signals or modulation gaps)
- **CONTinuous** (averaging takes place irrespective of the set threshold)

Optimized operation

As a rule, an external PC is used to operate the new direction finders and to display the results. A fast Ethernet system interface connects the PC and the direction finder. The user interface supplied (FIG 3), which runs under Windows 2000 / XP, is similar to the sophisticated user interfaces of the R&S DDF®0xM und R&S DDF®0xS direction finders. It has been further enhanced as follows:

- Enlarged measurement windows
- Operating elements that are always required are permanently visible and conveniently arranged
- Numerous possibilities for visualizing measurement results in all modes

System compatibility ensured

The new direction finders are outfitted with a fast Ethernet system interface. The software interface for controlling the direction finder is based on CORBA (common object request broker architecture), a platform-independent component model. For maximum speed the result data is output via TCP / IP as standard. Owing to these features and the comprehensive interface documentation, only a minimum of effort is required to integrate the direction finder into complex systems – even systems with customer-specific software.

As regards system applications, it is particularly important that the time information can be precisely allocated to the measurement results. With the R&S DDF®0xA, time allocation takes place directly after A / D conversion so that the delays of the digital filters are of no importance. The GPS seconds pulse should preferably be used as the time standard if maximum accuracy requirements are to be met. Precise time information and strictly deterministic scanning sequences in the direction finder's DSP network are moreover the prerequisites for the synchronous operation of several direction finders (option R&S DDF®-TS), e.g. for locating frequency-agile transmitters with the R&S®ScanLoc radiolocation software from Rohde & Schwarz.

Interfaces for compasses, GPS and external frequency standard are of course available. At the customer's request, the direction finder can be equipped with a raw-data interface (option R&S DDF®-DR) that stores the baseband data of all three receive paths to an external medium.

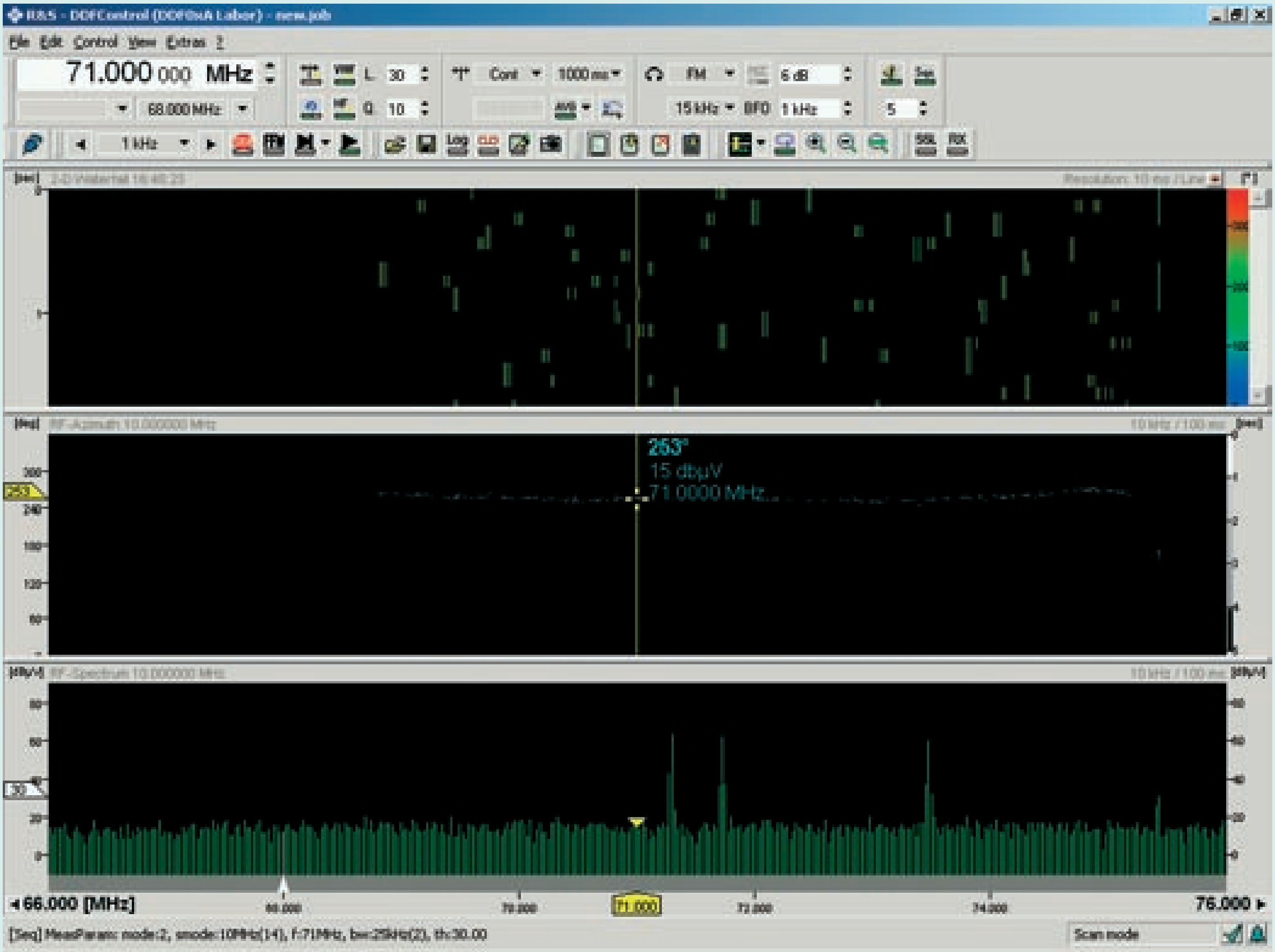


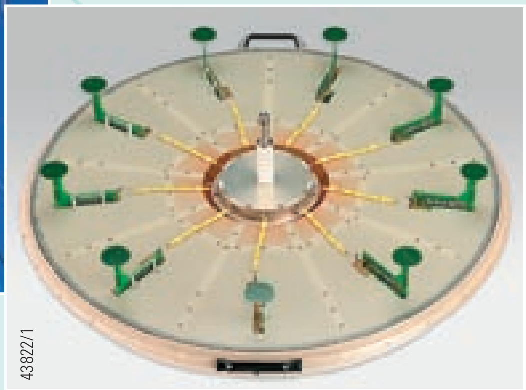
FIG 3 User interface of the Broadband Search Direction Finder R&S DDF®0xA in SCAN mode (span 10 MHz). The screenshot shows a frequency hopper with 6 MHz hop width. The measurement windows for azimuth versus frequency, azimuth versus frequency and time as well as level versus frequency are displayed.

Antennas for the new direction finders

The antennas for the Direction Finder Families R&S DDF®0xM and R&S DDF®0xS can be used with the new R&S DDF®0xA direction finders without any restrictions. The wide range of mobile and stationary antennas for the frequency range from 300 kHz to 3 GHz allows a custom solution to be configured for every application (FIG 4). The VHF / UHF DF Antenna R&S®ADD150 has been modified to provide about 10 dB higher sensitivity in the frequency range from 20 MHz to 100 MHz (FIG 5).

FIG 4 DF antenna system for 20 MHz to 3000 MHz in stationary use.

FIG 5 VHF / UHF DF antenna (without top cover) for 20 MHz to 1300 MHz with improved sensitivity in the range 20 MHz to 100 MHz.



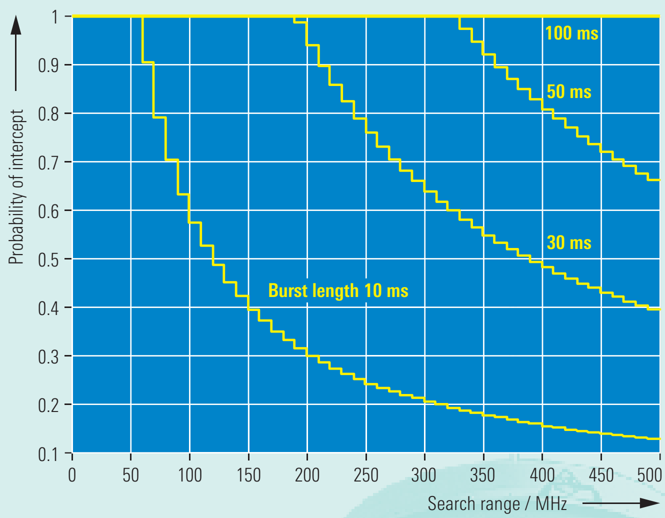


FIG 6
Probability of intercept for a single burst depending on the search range at a resolution bandwidth of 50 kHz (correlation method).

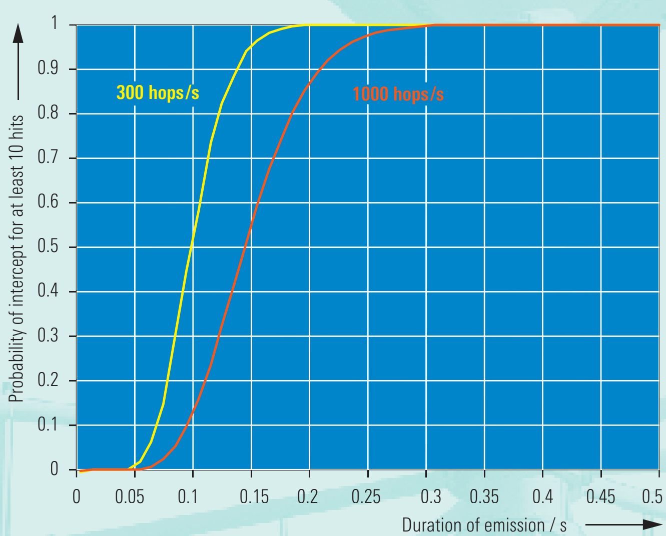


FIG 7
Probability of intercept of frequency-hopping signals in the VHF/UHF range as a function of the duration of the emission for a 60 MHz search range of the R&S DDF®05A direction finder and with at least 10 hits (direction finding with correlation antenna). The hopping range of the emitter and the overlapping range were also assumed to be 60 MHz. The resolution bandwidth is 50 kHz.

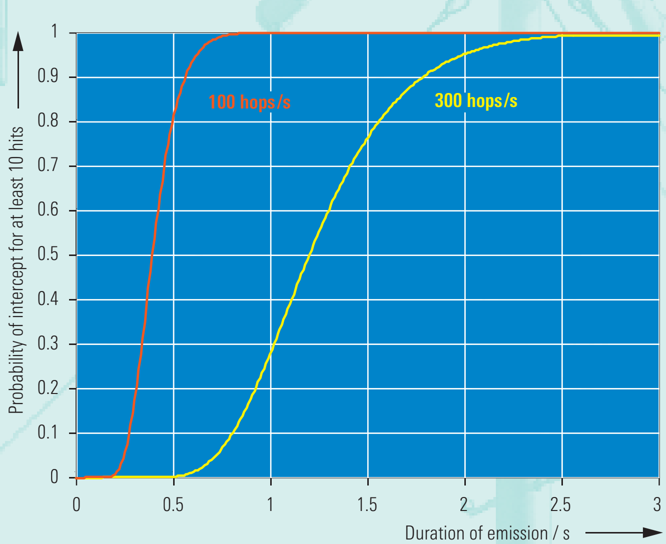


FIG 8
Probability of intercept of frequency-hopping signals in the HF range for at least 10 hits as a function of the duration of the emission (Watson-Watt evaluation). The hopping range and the search range were assumed to be 2 MHz, and the overlapping range is 1 MHz. The resolution bandwidth is 1 kHz.

An essential criterion of system compatibility is the efficiency of data reduction. As standard, the direction finder provides azimuth, level and quality filters in order to suppress irrelevant signals.

Detection of time-compressed and spread-spectrum signals

The ideal search direction finder is able to securely detect short-term signals of unknown center frequency and bandwidth in the relevant frequency range and to take the bearings with high precision.

While optimized DF methods and antenna arrays as well as excellent noise and linearity specifications ensure high bearing accuracy even under difficult conditions, short measurement times and the number of simultaneously processed frequency channels make it possible to detect short-term signals even without previous knowledge (e.g. of frequency range, bandwidth, time of emission) and to gain significant information from the collected data through high measurement precision.

Since information is transmitted in ever wider frequency bands, modern search direction finders must be able to monitor a large number of channels in the frequency ranges of interest in parallel and to detect and DF the signals almost simultaneously. The new Direction Finders R&S DDF®0xA can detect and average signals and take bearings in a maximum of 10000 channels in parallel. This means that frequency bands of up to 10 MHz (VHF/UHF range) with a resolution of 1 kHz are processed simultaneously. To handle wider frequency ranges, the 10 MHz window is shifted step by step at high speed in the SCAN mode. The processing speed is independent of channel occupancy.

Search direction finders from Rohde & Schwarz – a long-standing tradition

As early as1989, Rohde & Schwarz launched the world's first integrated search direction finder: the Integrated Broadband Signal Interception and Direction Finding System R&S®PA 2000 which used a fast-switching, conventional scanning receiver. It was followed by the Digital Scanning Direction Finder R&S DDF®0x S (1994) which was the first to make intensive use of digital signal processing and especially of fast Fourier transform (FFT).

An essential innovation compared to the previous generation of digital multichannel direction finders is the capability for threshold-controlled averaging of the three measurement channels in the SCAN mode. This feature improves sensitivity if signals are detected multiple times because of their duration or their repeated occurrence, but does not reduce the probability of single events being intercepted. In addition, it prevents signal loss even if the speed of the subsequent data processing circuit is low.

Interception of burst transmissions

For a burst to be intercepted, its duration must be at least as long as the required measurement time of the direction finder. With the R&S DDF®05A, it is only 0.5 ms at a resolution bandwidth of 50 kHz, for example, and with correlative evaluation. Other essential influencing quantities are the following:

- Frequency range in which the burst can occur (= search range of the direction finder or number of channels)
- Duration of burst

As the R&S DDF®05A processes a 10 MHz wide band in a single measurement, search ranges of up to 10 MHz and bursts with a duration of at least twice the measurement time can be detected, i.e. the probability of intercept is 100%. Shorter measurement times or larger search ranges reduce the probability of intercept. FIG 6 illustrates the probability of intercept for bursts of differing length as a function of the search range.

Interception of frequency-hopping (FH) signals

An FH emitter outputs a burst sequence where the frequency channel of each individual burst is selected according to a random sequence. The following parameters are decisive for intercepting such signals by means of a direction finder:

- Hopping range of the FH emitter (number of channels)
- Search range of the direction finder (number of channels)
- Overlapping between hopping range of emitter and search range of direction finder
- Entire duration of the emission
- Length of time the FH emitter dwells on a frequency channel
- Measurement time of the direction finder
- Specified number of hits (i.e. detection and direction finding of single bursts) for secure interception

As an example of the performance of the VHF Direction Finder R&S DDF®05A, FIG 7 shows the probability of intercept of FH emitters with different hopping rates (=1/dwell time per hop), and FIG 8 illustrates the situation for the HF range if the Antenna R&S®ADD119 is used (Watson-Watt evaluation).

Interception of DSSS signals

DSSS (direct sequence spread spectrum) signals are difficult to intercept because of their low spectral power density. If the cooperative receiver has a system gain of 17 dB due to despreading (corresponds to a spreading factor of about 50) and a signal-to-noise (S/N) ratio of 15 dB before demodulation, for example, a non-cooperative receiver at the same distance from the emitter and with identical antenna gain would have to perform detection and direction finding at an S/N ratio of –2 dB.

The R&S DDF®0xA direction finders feature high system gain in the correlation mode and are therefore able to take precise bearings even at very low S/N ratios. The high system gain is obtained by averaging and generating synthetic directional antenna patterns when the antenna signals are correlated with the comparative data. To successfully process DSSS signals, it is therefore necessary to select an antenna with a diameter that is large in comparison to the wavelength and to perform as much averaging as possible.

Franz Demmel, Ulrich Unselt

More information and data sheet at www.rohde-schwarz.com (search term: DDF)

Rohde & Schwarz founds support center in Japan

Rohde & Schwarz recently set up a support center in Japan to directly assist customers with T&M instruments and systems bought locally. Another task is to provide application support to the Advantest team that is in charge of Rohde & Schwarz marketing and sales in Japan.

The new support center was created in response to the high demand for T&M instruments on the Japanese market. Onsite, Rohde & Schwarz is better equipped to handle customer needs. The new office supports the entire product portfolio in communication, information and T&M technology.

Change in the Executive Board of Rohde & Schwarz

Effective 1 July 2003, Michael Vohrer (55) was appointed President and COO of Rohde & Schwarz GmbH & Co. KG. He is successor to Hans Wagner (64) who stepped down from the Executive Board. The Executive Board now consists of Friedrich Schwarz as Chairman, Reinhard Bruckner and Michael Vohrer.

In 1996, Michael Vohrer (right) became head of the Test and Measurement Division of Rohde & Schwarz and has since succeeded in significantly increasing the company's share in this segment of the world market. Before, he was in charge of the Mobile Radio T&M Products Subdivision. During this period of time, Rohde & Schwarz became the world market leader in mobile radio test and measurement.

Trade fair preview

IBC	Amsterdam	12 to 16 September 2003	Hall 8, Stand 250
European Microwave Week	Munich	6 to 10 October 2003	ICM Ground Floor Foyer, Stand G34
ITU Telecom World	Geneva	12 to 18 October 2003	Hall 7, Stand 7018
Systems	Munich	20 to 24 October 2003	Hall B2, Stand 530
Produktronica	Munich	11 to 14 November 2003	Hall A1, Stand A1.375

Secure radiocommunications at 2004 Olympics in Athens

The Greek National Telecommunications and Post Commission has contracted Rohde & Schwarz to supply and set up a nationwide spectrum monitoring and management system worth several million euros.

The system will monitor and manage the entire Greek frequency spectrum ranging from

Rohde & Schwarz opens Internet shop for R&S Smart Instruments™ T&M equipment

Rohde & Schwarz has opened an Internet shop offering customers a quick and easy means to acquire state-of-the-art T&M equipment. At www.shop.rohde-schwarz.com you can select and order T&M equipment via the Internet. For the time being, this service is only available in Europe. In addition to refurbished equipment, the shop will initially include T&M instruments of the R&S Smart Instruments™ family.

The Internet shop has the familiar user interface of e-commerce: The conveniently arranged product selection, shopping cart and user guidance facilitate ordering. To make order handling as fast as possible, the Internet shop was linked to the Rohde & Schwarz merchandise information system: Customers order directly on the Internet and thus initiate the request and delivery of "their" T&M equipment. Payment is handled by invoice, bank guarantee or in advance.

First, customers select their country of origin, thus loading the products, prices and options that currently apply to their region. A large amount of information and data is available for each product. The desired T&M instruments can be put into the shopping cart by means of a mouse click. Once the user has registered, the order can be initiated by selecting the method of payment.

www.shop.rohde-schwarz.com

civil authorities radio and TV and sound broadcasting to mobile radio. Part of the system was scheduled to be implemented by August of this year due to the preparations for the 2004 Olympic Games to be held in Athens, where this system is to secure interference-free radiocommunications.

The complete system, which is largely financed by the European Union, includes a central spectrum management system in Athens and two regional control centers in Athens and Thessaloniki. These centers are complemented by five stationary and five mobile monitoring stations for the VHF / UHF range (broadcasting, civil authorities radio, air traffic radio) and two monitoring vehicles for the SHF range (for example radio relay).

First TETRA radio system in the Ukraine along the oil pipeline

R&S BICK Mobilfunk has designed a TETRA radio system for the Kiev-based company New Technology. The system will ensure communication along the Ukrainian oil pipeline from the Caspian Sea to the Black Sea.

After successful completion of the factory acceptance test (FAT) including customer acceptance, during which the entire system was tested for proper functioning and performance in the German factory, the TETRA radio system – the first of its kind in Ukraine – will be shipped to Kiev where it will be set up. The radio system is to be installed this summer and will then provide radiocommunications for a 180 km section of the oil pipeline.

TV transmitters for Tianjin and Guangzhou

The initial order for a 30 kW UHF TV transmitter for the television tower in Tianjin, China, was placed back in 2001; now another 30 kW UHF TV transmitter has been contracted for the Broadcasting Centre Guangzhou in South China.

The small dimensions coupled with the highly attractive price/performance ratio were crucial factors for deciding in favour of the new liquid-cooled TV transmitters of the R&S®NH 7000 family from Rohde & Schwarz. Their operation, which is flawless right from the start, convinces not only operators but also visitors from both China and abroad.

The Tianjin television tower is part of the group of "leading TV towers of the world", which includes the Toronto tower in Canada and the Madrid tower in Spain, both of which are equipped with transmitters from Rohde & Schwarz.

ATVplus, a new channel in Austria

Rohde & Schwarz, a long-standing partner of the Austrian broadcasting corporation (ORF), was awarded the contract to supply five TV transmitters for Austria`s first privately operated channel ATVplus.

The ORF broadcasting stations Kahlenberg, Jauerling, Lichtenberg, Patscherkofel and Dobratsch have been equipped with the R&S®NH 7200S analog 20 kW transmitters (band IV/V). In addition to installing the systems and putting them into operation, Rohde & Schwarz also held training courses for ORF engineers. ATVplus started transmission Austria-wide on 1 June 2003, initiating the era of nationwide private TV via roof antennas also in Austria.

Visit us on Internet at www.rohde-schwarz.com

ROHDE & SCHWARZ

Rohde & Schwarz GmbH & Co. KG · Mühldorfstrasse 15 · 81671 München, Germany · P.O.B. 80 14 69 · 81614 München
Support Center: Tel. (+49) 18 05 12 42 42 · E-Mail: customersupport@rohde-schwarz.com · Fax (+49 89) 41 29-137 77

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