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Modular TETRA mobile radio system – autonomous, portable and quick to set up

Universal EMI software for diverse measurement applications

Complete operating and T&M product range for digital TV

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***ACCESSNET*®-T Cube is a TETRA communications system for mobile applications that is modular in design and thus highly versatile. It can be operated as a standalone system, but also integrated into existing networks (page 4).**

The Signal Generator R&S®SMU is continuously being enhanced. This development is reflected by the three articles in this issue that describe new features and functionalities of this high-end instrument (starting on page 16).

A Handheld Spectrum Analyzer R&S®FSH3 is currently being used on board the International Space Station (ISS) for distance-to-fault (DTF) measurements (page 28).

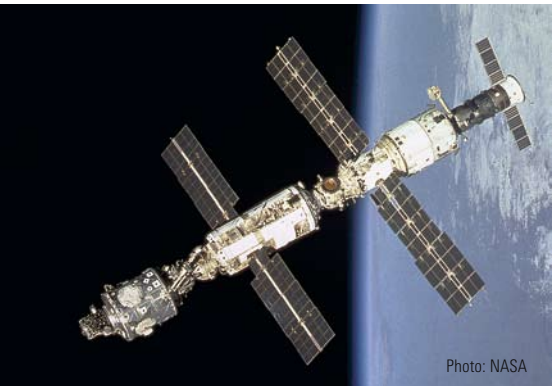

Photo: NASA

MOBILE RADIO

GENERAL PURPOSE

An automatic all-in-one solution for differential measurements directly on the wafer that can be used up to 20 GHz has been developed in cooperation with Advantest, Suss MicroTech Test Systems and Rohde & Schwarz (page 36).

The new digital TV standard DVB-H enables efficient transmission of multimedia content to mobile receivers. Digital TV, however, also offers data services that appeal to a large number of users. Rohde & Schwarz supports this development with a complete product portfolio for measurement and operation (pages 46 and 50).

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TETRA Mobile Radio System *ACCESSNET*®-T Cube

Autonomous modular TETRA system – portable and quick to set up

ACCESSNET®-T Cube is a TETRA communications system for mobile applications that is modular in design and thus highly versatile. It can be operated as a standalone system, but also integrated into existing networks. Initial orders were received soon after market launch, and these systems are now already in use. User feedback has been very positive.

Developed to customer specifications

Before developing *ACCESSNET*®-T Cube, Rohde & Schwarz carried out intensive market research and interviewed potential users from government authorities and organizations with public safety tasks, the military and emergency relief services as well as private network operators. Rohde & Schwarz specifically asked them about their requirements for a mobile TETRA communications system. The responses indicated the following main requirements:

- Easy to transport so that the system can be quickly taken to the site by vehicle or helicopter
- Quick and easy to set up on-site
- Ready to operate within a few minutes
- Designed with configuration or operating parameters that can be easily modified on-site, a must in practical use

These and numerous other requirements were implemented when the TETRA *ACCESSNET*®-T Cube communications system was developed. The Cube was planned and designed as a commercial off-the-shelf (COTS) system made from standard components.

Completely modular system components

The *ACCESSNET*®-T Cube is completely modular in design; all modules have standardized dimensions and none weighs more than 50 kg (FIGs 1 and 2). Due to these specifications, the logistics aspects involved in transportation and use of this system are easier to plan and to handle. Although the *ACCESSNET*®-T Cube is primarily designed for mobile use, it can, of course, also be operated as a fixed installation in a vehicle or temporary building.

All modules are installed in standard aluminum housing units with shock-mounted frames that ensure the safe transport and operation of the built-in COTS equipment even under adverse transport and environmental conditions. The modules were developed on the basis of current industrial standards. When necessary, MIL standards have also been taken into account. All connectors, including the RF connectors, are designed as instant plug-in connectors according to the IP 65* protection class. You thus receive a robust and reliable system while saving on the costs that a system developed completely in line with the MIL standard would incur. This method is gaining worldwide acceptance in the development of technical systems, including in the military.

Since different types of missions call for different system colors (systems for peacekeeping missions must be gray-beige, for example), the modules are available in three colors: gray-beige, olive-green and blue.

The *ACCESSNET*®-T Cube is based on the same components as the "large" *ACCESSNET*®-T [*]. The standardized basic hardware and software of the TETRA system technology from Rohde & Schwarz help keep costs low, plus they ensure a true synergetic effect in further development.

* IP: International Protection; labeling of housing using the internationally accepted IP abbreviation.

FIG 1 The TETRA *ACCESSNET*®-T Cube radio system is ready for operation in only a few minutes.

Base station module

The core of the *ACCESSNET*®-T Cube is the base station module (BSM) with the TETRA outdoor base station (TOB). If a 48 V DC voltage source and a transmitting and receiving antenna are available, the BSM can be used as a single-cell system. Setting up the BSM and putting it into operation takes no more than approximately ten minutes. After it is connected to the power supply and the antennas, the system is ready for operation. The BSM includes the following components:

- Local exchange
- Network management server
- Transmit and receive unit
- E1 and LAN interfaces for external connection
- Heating and cooling elements

If a high volume of communications is involved, the BSM can also be supplied with two TETRA RF carriers; the second carrier can also be used for (1+1) redundancy. The *ACCESSNET*®-T Cube can be deployed as a standalone system but also connected to *ACCESSNET*®-T exchanges, expanding existing networks.

The network management server (NMS) functions as a client/server. The server is located in the BSM and can be connected to a client via a protected LAN connection. Commercially available laptops with a LAN interface meet the system requirements for client controllers. A specially protected laptop is available so that the *ACCESSNET*®-T Cube can be used under adverse environmental conditions (FIG 3).

The NMS is of special importance for the flexibility of the *ACCESSNET*®-T Cube. For example, if the frequency that is set

Examples of *ACCESSNET*®-T Cube applications

Protests

Transports of material from the fuel reprocessing plant at La Hague in France to Germany are a regular target for protestors. The forces in the field are responsible for accompanying the transports and ensuring the security of protestors and passers-by. For roughly three years, the authorities responsible for transports have been using an *ACCESSNET*®-T TETRA radio system from Rohde & Schwarz, which ensures confidential and secure communications. The installed network covers a defined area and has a predefined capacity. However, even the best theoretical plans can go awry. Unanticipated gaps in coverage may occur at any time – for example, if it is not possible to stick to scheduled routes.

This type of problem can be easily solved with the *ACCESSNET*®-T Cube. The Cube can be quickly transported to the new site and put into operation, and it is just as quickly integrated into the stationary TETRA system. To do this, an S_0 line (128 kbit/s) is connected to the ISM, which instantly makes it possible for users to place calls to and from the radio cell of the Cube system. For the security forces, it is especially crucial that their control center be included in communications. With these measures, a cell is added to the existing TETRA network without compromising its features.

Large events

During large events, the security of thousands of visitors needs to be ensured. This is no easy task for the event organizers and especially not for police squads, rescue services, emergency relief services, fire brigades, etc, that are involved. If these events are held in remote parts of the country – such as is done with rallye competitions in order to minimize the level of noise that non-participants are exposed to – gaps in coverage or insufficient network capacity are not uncommon. Setting up a stationary network solely for such events is usually just too costly. In such a scenario, the *ACCESSNET*®-T Cube is ideal for companies that specialize in lending communications systems.

The basic model is a good solution at such events. It features a power supply module (PSM), a base station module (BSM) for two TETRA RF carriers and a branching equipment module (BEM) for operation with a transmitting and receiving antenna. If a connection to the control center or the telephone network is necessary, an ISM is simply added to the communications system. If there is a connection to the telephone network, calls can also be made from TETRA terminals to GSM networks, for example.

Before an event starts, the terminals are distributed to the various organizations involved; if problems occur, coordination and mission directives can be handled via the control center. TETRA functions such as dynamic group number assignment (DGNA), where groups are created by the control center according to the task at hand and where the terminals are assigned via the TETRA system, are, of course, supported. DGNA eliminates the loss of valuable time for coordination activities. Assignment is handled in the background without involving the group participants. The existing groups remain intact, and they are integrated into the communications only in the case of a group call to the new group. Confidentiality is ensured at all times; if necessary, the various groups can communicate with each other.

Out-of-area missions

This term refers to missions at locations where radiocommunications is not possible either because there is no infrastructure or the existing infrastructure is no longer available, e.g. after catastrophic floods or earthquakes as well as during military peacekeeping missions.

In such situations, it must be possible to set up a radiocommunications infrastructure and put it into operation within a minimum amount of time. But it must also be possible to connect various external systems – to the extent available. These are all challenges where the *ACCESSNET*®-T Cube excels. It takes only a few minutes to set up a radio network and put it into operation. External systems with transitions to other radio or telephone networks can quickly be integrated using the ISM. If broad areas need to be covered by radio, several BSMs can be connected to the exchange via microwave links or, if possible, via E1 lines. Thus, a multicell mobile TETRA system for communications among the forces in the field is available in no time at all.

at the site is already occupied by other systems, this might prevent operation of the Cube system. However, you can modify the on-site configuration within a few minutes by using the client for the configuration and error management in the NMS. For example, you can enter the transmit and receive frequencies in the client, which are then transferred to the Cube system. After a restart, the BSM operates at the new frequencies. The terminals do not have to be set since they scan the frequency range for a system channel, provided that they have been programmed to do so.

Voltage supply

With varying sites, the available voltage supply is often not known. In these cases, the power supply module (PSM) is used to supply power to the modules. It can process input voltages of either 24 V or 48 V DC as well as 90 V to 264 V AC. A plug-in for 12 V DC is also available as an option. A battery pack module (BPM) can be provided if there is no primary voltage supply available or to ensure uninterrupted operation.

Antenna coupling

Using more than one TETRA RF carrier would require up to six antennas. However, the branching equipment module (BEM) makes this unnecessary. It contains an antenna coupling network that supports two antennas installed at least six meters apart, ideally on two antenna masts.

Exchange

Special requirements also demand special solutions, such as when you need to set up a complete mobile system with multiple cells or provide transitions to other communications networks. In this case, the answer is the interconnection & switching module (ISM), which makes it possible to implement a transportable multicell TETRA network for mobile use. In addition to featuring a powerful exchange, it also provides interfaces and gateways. Various interface cards allow analog or digital systems or networks to be connected; they provide S_0 or S_2M/E1 interfaces, for example. An A-CAPI software interface that permits customer-specific applications to be connected to the Cube system is implemented by using a gateway controller in the ISM. The A-CAPI interface is also available in *ACCESSNET*®-T radio systems, making it possible to use the same applications in the Cube system.

Harald Haage

FIG 3 Laptop for outdoor use.

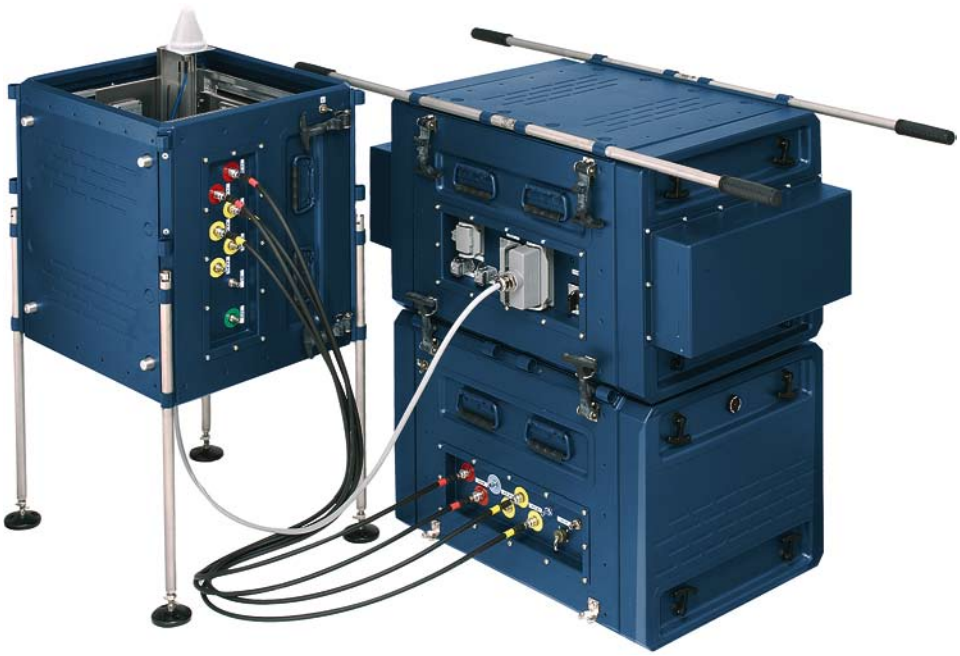


FIG 2 Each *ACCESSNET*®-T Cube module weighs less than 50 kg. Left: base station; top right: power supply; bottom right: antenna coupler.

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

REFERENCES

[*] *ACCESSNET*®-T – the digital mobile radio system from Rohde & Schwarz. News from Rohde & Schwarz (2003) No. 178, pp 6–13

Universal Radio Communication Tester R&S®CMU 200

Unprecedented speed in mobile phone production testing

During production, the transmit and receive levels (RSSI = receiver signal strength indicator) of GSM phones are aligned throughout the entire frequency range. Previous alignment procedures took several tens of seconds – depending on the number of frequency/level combinations to be measured. The R&S®CMU-K47 software option (Smart Alignment@GSM-MS) makes intelligent use of the GSM frame/slot structure and performs alignment in just 0.25 seconds – at a maximum of 50 frequencies and seven levels per frequency.

Previous alignment strategies were relatively slow

Conventional procedures for TX calibration set each frequency/level combination separately on the phone, and the tester measures the actual transmit level at each frequency. In the case of RX calibration, each frequency/level combination is separately set on the tester, and the phone logs the levels received. The results obtained by the tester and by the phone yield correction values that are stored in the phone.

The power versus slot measurement of the R&S®CMU 200 speeds up calibration. It accelerates TX calibration by a factor of 8 (= number of timeslots per frame). The phone must be able, however, to transmit at different levels in each of the eight timeslots of a frame.

Smart Alignment ensures high speed

The new Smart Alignment@GSM-MS option makes calibration very fast. Now that state-of-the-art GSM phones have multislot capability, this feature can be used to significantly speed up calibration owing to the fact that the mobile phones are able to perform the following:

- Output a different level in every timeslot of a frame
- Evaluate the level of every timeslot of a frame
- Identify the channel structure of every timeslot of a frame

This means that basically every timeslot of a frame can be used for a calibration step.

The frequency is set in line with the frame grid. Since the settling time of the synthesizer corrupts the measurement result, one timeslot (577 µs) per frame is used for settling instead of calibration. Smart Alignment uses timeslot 7 for settling; timeslots 0 to 6 are available for calibration.

RX calibration

FIGs 1 and 2 show the typical transmit signal characteristic of the R&S®CMU 200 and the related configuration. A frequency correction channel (FCH) is transmitted in the first timeslot of the first frame; the phone detects the FCH and uses it for frequency synchronization. The remaining timeslots are filled with dummy bursts. A positive side effect is that the synchronized frequency can also be used for calibrating the VCO in the phone.

Synchronization channels (SCHs) with user-configurable levels are transmitted in the other frames. SCHs have a longer training sequence and thus make time synchronization easier for the phone. The phone itself is the measuring instrument as it provides the results that are required in order to determine the correction values for the receive level.

The number of selected frequencies determines the cycle time of the transmit sequence. The maximum cycle time is 230 ms (= 50 frame periods).

TX calibration

FIGs 3 and 4 show the typical transmit signal characteristic of the phone and the TX calibration configuration. After the start of the measurement, the first timeslot of the first frame triggers the measurement sequence, which

More information and data sheet at www.rohde-schwarz.com (search term: CMU200)

then runs automatically until it is completed. It is subsequently possible to fetch all results and determine the correction values for the transmit levels of the phone. Here, too, the number of selected frequencies determines the measurement time, which is again max. 230 ms.

Combined TX/RX calibration

In the case of GSM, the uplink and downlink frequency ranges are separated by duplex spacing and are, therefore, not allowed to overlap. This means that receiver and transmitter can be calibrated simultaneously. This reduces the process time by half so that a phone can be calibrated in just 0.25 s.

Summary

The R&S®CMU-K47 option enables the Universal Radio Communication Tester R&S®CMU 200 to benefit from the advantages of the GSM standard and of modern GSM phones. With this option, the alignment of a GSM mobile phone in production – which is a significant part of total test time – can be performed at unprecedented speed.

Dieter Tiroch

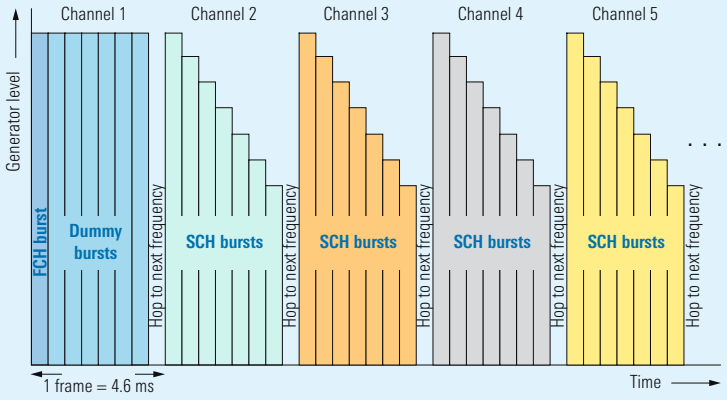


FIG 1 RX calibration: typical time characteristic of the R&S®CMU 200 transmit signal.

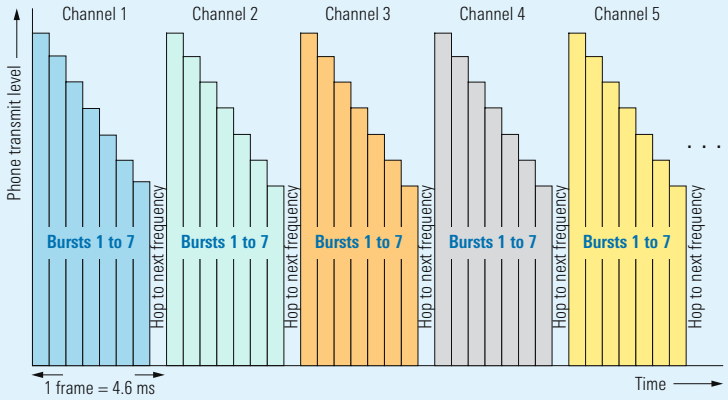


FIG 3 TX calibration: typical time characteristic of the mobile phone transmit signal.

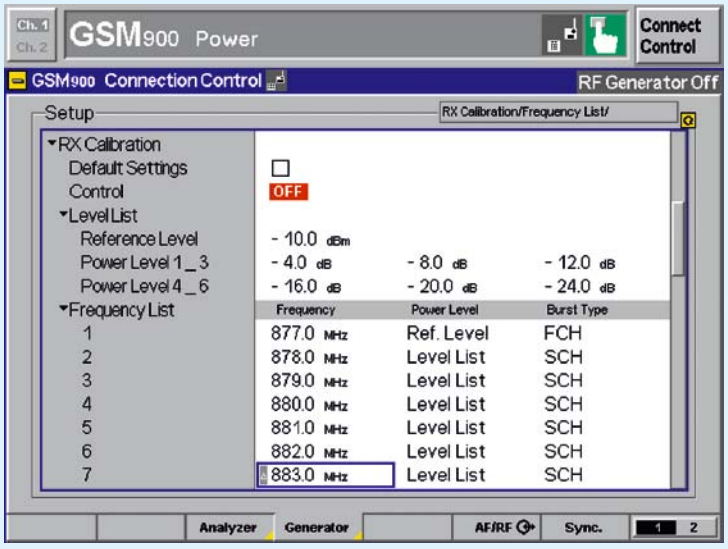


FIG 2 RX calibration: configuration of the R&S®CMU 200 transmit sequence.

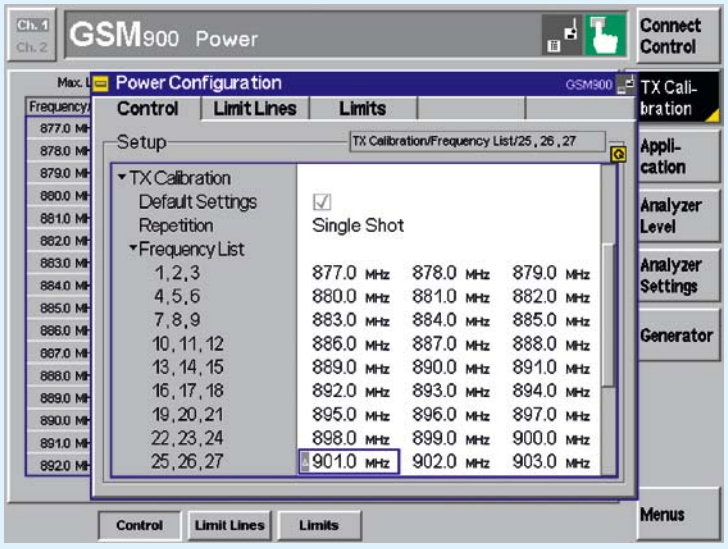
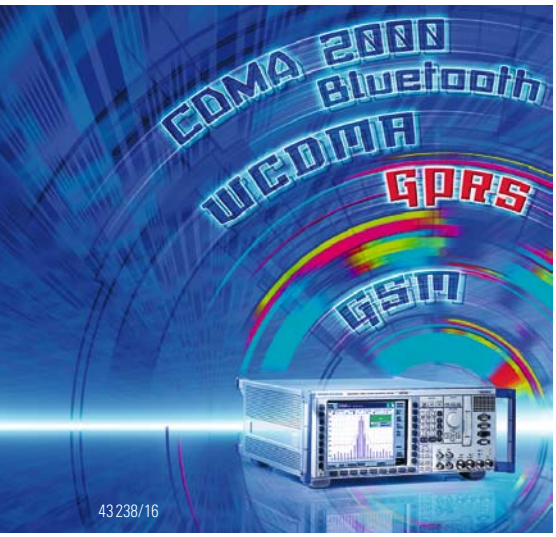


FIG 4 TX calibration: configuration of the R&S®CMU 200 receive sequence.

Universal Radio Communication Tester R&S®CMU 200

Versatile application tests in (E)GPRS mobile radio

A new software option for the R&S®CMU 200 allows you to test applications for 2.5G mobile phones. For example, you can now test the transmission or reception of multimedia message services (MMS), Internet browsing or video streaming within a simulated (E)GPRS network environment. In addition to measuring the known RF parameters of power, spectrum or modulation, you can now also perform such tasks as displaying data throughput or analyzing protocols.



New value-added services …

At the beginning of the mobile radio era, users were satisfied if they could simply make phone calls from virtually anywhere. Today, they enjoy a much wider range of communications services. By using state-of-the-art mobile phones fitted with a large color display and an integrated digital camera, they exchange photos and video sequences, browse the Internet or load videos. The push-to-talk voice service is becoming increasingly popular; based on the voice over IP data service, it provides a group of people with inexpensive voice communications in walkie-talkie mode.

Modern generations of mobile radio provide the necessary technical prerequisites for all these services. Yet they also present new challenges to manufacturers of T&M equipment. While it used to be sufficient to test the characteristics of the transmitter or receiver of a mobile phone, additional tests are now required to ensure smooth operation of the highly diverse applications. The R&S®CMU 200 has proven to be outstanding for this purpose. Due to its flexible platform concept, it effortlessly keeps pace with changes in mobile radio and ideally meets new requirements in application tests.

… require a number of tests

The tests required for available applications are just as varied as the applications themselves. The currently available applications can be differentiated by any number of factors, e.g. realtime requirements, error control, or point-to-point, point-to-multipoint or broadcast communications. The Internet protocol (IP) – which ensures data exchange across network boundaries – provides a common basis and means of accessing most applications. Together with the Internet, it has conquered the world and evolved into the international standard in data communications. Also in radiocommunications, these applications are usually implemented according to the client-server principle, where, for example, an Internet server provides the desired application on the mobile phones of a number of clients on demand.

To use several IP-based applications in mobile radio, additional signaling routines are required. For example, when transmitting an MMS via a GPRS or EGPRS(EDGE) mobile phone, the MMS center informs the receiver via the short message service (SMS) that a message has been sent and asks the receiver to retrieve it.

The range of possible application tests includes simple Go/NoGo tests, performance analyses, evaluations of the interaction between different applications running simultaneously on a mobile phone through to the testing of the interoperability between two mobile phones. To test applications on a mobile phone, the R&S®CMU 200 simulates a radio network; external computers connected to the radio tester provide the required servers (FIG 1). Yet another challenge is the detailed examination of protocol and signaling procedures (enablers) that are often necessary at the start and which usually require the use of protocol testers such as the R&S®CRTU-G [1]. Since the R&S®CMU 200 and the R&S®CRTU-G

share a common platform, the data that is obtained can be exchanged between them and analyzed further.

(E)GPRS application tests with the R&S®CMU 200

Owing to significant protocol stack extensions, the R&S®CMU 200 now also allows you to test applications via GPRS and EGPRS(EDGE) mobile phones simply by activating a new software option. In addition to the application test for CDMA2000® [2], this is yet another standard ideally supported by the R&S®CMU 200, proving its flexible, future-proof concept. The new software option makes it possible to test almost any IP-based applications in packet-oriented mode via an IP gateway. You can simply test proper functioning, but also check whether different applications that are simultaneously activated on a mobile phone run smoothly. GPRS and EGPRS, the offshoots of the GSM standard, achieve data transmission rates of up to 171.2 kbit/s and 473.6 kbit/s respectively, thus allowing a multitude of applications to be carried out, some of them even with realtime requirements. In addition to displaying the current data throughput of the IP packets exchanged between mobile phone and server (FIG 2), the R&S®CMU 200 also records various transmission protocols (FIG 3). Design engineers are thus able to thoroughly analyze not only the IP protocol, but also a number of other radio-specific protocols such as radio link control (RLC) or medium access control (MAC). Regardless of these activities, it is still possible to measure and analyze the RF signals transmitted by GPRS or EGPRS mobile phones on the R&S®CMU 200 with respect to power, spectrum or modulation (FIG 4). Unlike the previous transmitter test, the measurement is now performed as part of the application data transmission and no longer on the basis of pseudo-random binary sequences

FIG 1
Simulation of a radio network by means of the R&S®CMU 200. PCs connected via Ethernet to the radio tester provide one or more servers.

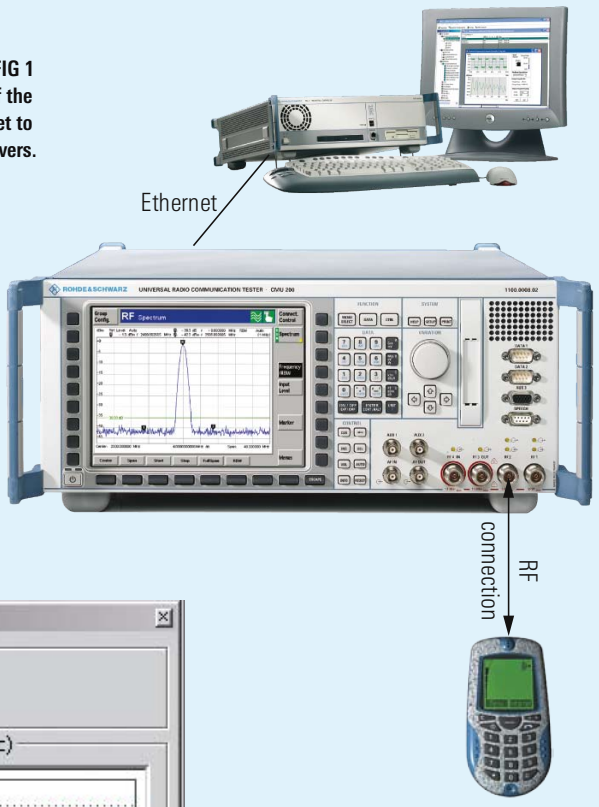


FIG 2
Throughput of the IP data packets exchanged between mobile phone and server.

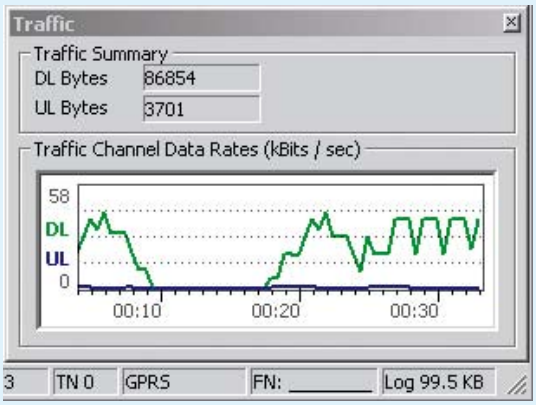
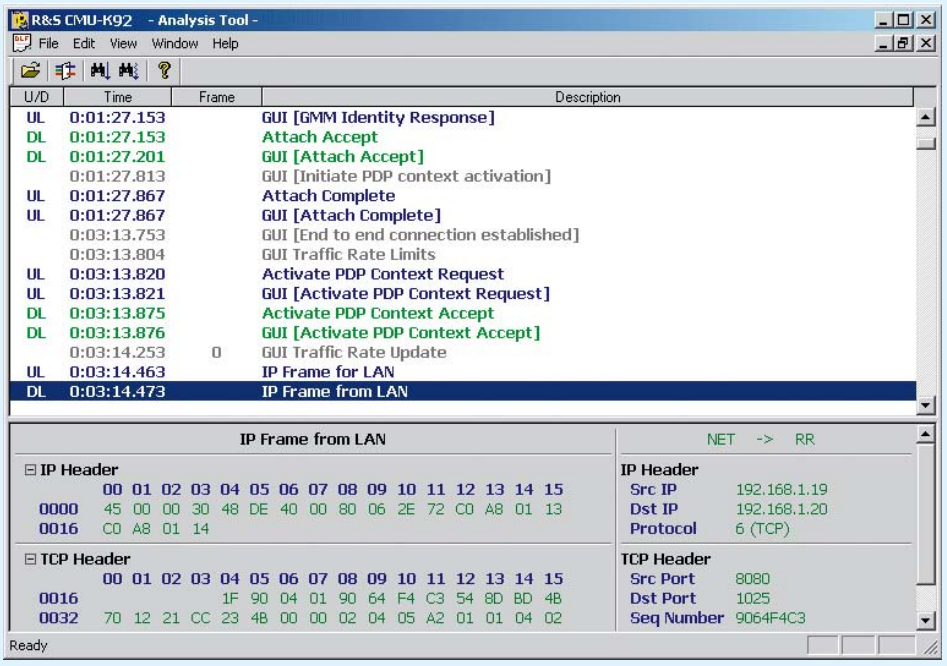


FIG 3 The R&S®CMU 200 also records different transmission protocols.



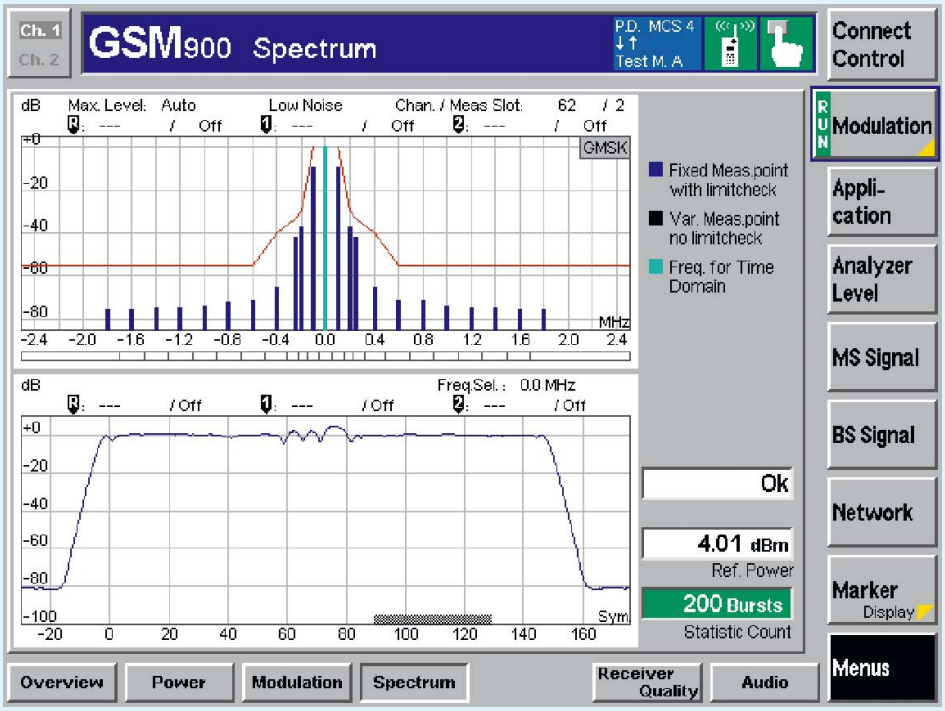


FIG 4 During the application test, the R&S®CMU 200 can also measure the RF signals transmitted by GPRS or EGPRS mobile phones with regard to power, spectrum or modulation. This figure shows an example of the 'due to modulation' spectrum measurement of a mobile phone transmitter.

FIG 5 Test setup for data end-to-end tests, for example for testing the exchange of an MMS message between two mobile phones.

(PRBS). If two R&S®CMU 200 testers are available, the application tests can be expanded to accommodate data end-to-end tests, for example for checking the exchange of an MMS message between two mobile phones (FIG 5). If only one R&S®CMU 200 is available, the transmission and slightly delayed reception of an MMS message with one mobile phone can also be implemented using the loopback setting in the MMSC.

Powerful aid in the development lab

The new software option R&S®CMU-K92 for the R&S®CMU 200 for the first time allows application design engineers to test their work in the lab on mobile phones in a simulated radio network. In this case, the main focus is on proving that the application runs smoothly on the mobile phone under normal operating and radio conditions. For these applications, which can be divided into mobile-originated and mobile-terminated applications, this represents the first realistic test after completion of the simulation tests on the development computer. When testing mobile-originated applications, data communication is initiated on the mobile phone, for example by calling up an integrated browser with subsequent access to the data of a web server connected via the Ethernet interface of the R&S®CMU 200. An example of a test of a mobile-terminated application is an SMS transmission, either from a computer connected to the tester or directly from the tester to the mobile phone.

Using this new option, mobile phone designers are now able to analyze the RF parameters of the mobile phone transmitter while the applications are running. Power consumption, feasible data rates at different signal levels or, for example, the behavior under fading conditions can thus be thoroughly examined.

In addition, network operators that perform these application tests to check new mobile phones before approving them for their networks can use this option to ensure smooth network operation.

Future prospects

Application tests are becoming more and more important in mobile radio. Rohde&Schwarz is meeting this trend by continuously developing new solutions in this field. The licensing authorities have responded to changes in the way mobile communications are used: By developing test scenarios with exact specifications, they are defining appropriate tests at the application level that will ensure that mobile radio networks will also operate smoothly in the future.

Thomas A. Kneidel

More information and data sheet at www.rohde-schwarz.com (search term: CMU200)

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[2] Universal Radio Communication Tester R&S®CMU 200: Testing CDMA2000® data applications. News from Rohde&Schwarz (2004) No. 182, pp 11–13

Universal Radio Communication Tester R&S®CMU 200

Convenience and flexibility – the key to successful mobile radio testers

Modern mobile radio systems sparkle with continuously new innovations, placing ever more complex development and production demands on mobile phone manufacturers. To meet such challenging tasks, you need a mobile radio tester that can keep pace with the rapid rate of innovation without compromising on operating convenience.

Automatic timeslot configuration

The expansion of the GSM standard to packet data services (GPRS and EGPRS) considerably increased the complexity of mobile radio systems. To meet this challenge, a tester must cover all relevant scenarios. Especially when you use testers in development, you must be able to set a large number of parameters to your specific requirements. However, this may present very difficult problems, for example if you want to determine which of the numerous parameters must be set and how to set them in order for the tester to generate the expected scenario. Therefore a state-of-the-art mobile radio tester must take a new approach in operation. The Universal Radio Communication Tester R&S®CMU 200 previously came with a configurator for the GSM system that automatically selected the optimum timeslot configuration in accordance with the mobile phone's capabilities and the desired type of connection [*]. This timeslot configurator has now been expanded by an automatic measurement configurator and a wizard.

Automatic measurement configuration

After you activate the configurator and the connection is set up, the tester automatically sets the measurements to the optimum timeslot configuration of the current connection and switches to the menu that is most probably needed. In most cases, you will not need to modify the configuration. With the multislot power ramp measurement, for example, the number of timeslots to be displayed and the measurement timeslot are set in such a way that as many active timeslots as possible can be displayed at maximum resolution on the screen (FIG 1).

Convenient wizard

Using the wizard, you can configure the entire tester for the measurement task at hand in a single step. To set the R&S®CMU 200 for 8PSK EGPRS measurements, for example, select the EGPRS 8PSK presetting in the wizard (FIG 2). This activates the automatic timeslot configurator and the automatic measurement configurator as well as any second transmitter that is available (option R&S®CMU-B95) for the BCCH. In addition, the network support parameter is set to GSM + EGPRS, the service selection to packet data and the coding scheme to MCS9.

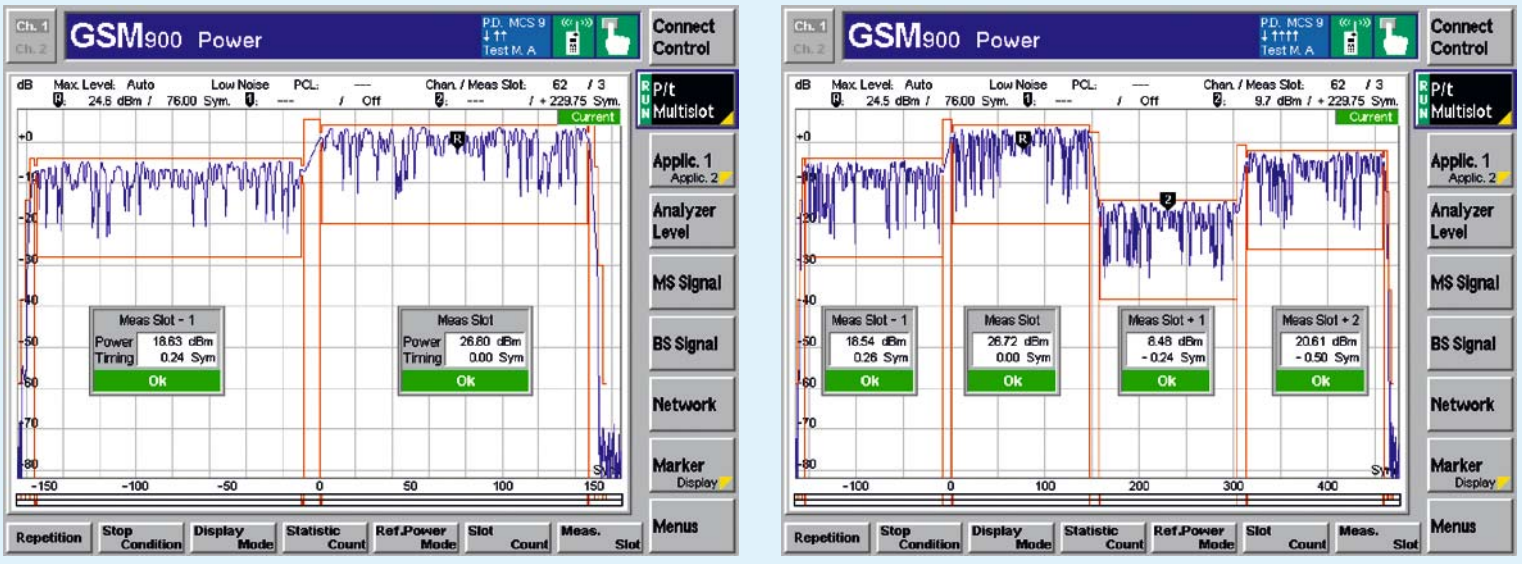
Limit weighting

The R&S®CMU 200 also makes it easy to set the off power limit in the case of multislot connections. In practice, there are two interpretations for this measurement. One of them references the off power limit for all timeslots to the timeslot with the maximum power, i.e. the permissible residual transmit power of a mobile phone on non-active timeslots is the same across all timeslots (FIG 3, left). The second interpretation references the off power limit to the specific power of the individual timeslots, i.e. the permissible residual transmit power of a mobile phone changes with each timeslot (FIG 3, right). Weighting the permissible residual transmit power in a non-active timeslot is difficult if the timeslot is surrounded by two active timeslots with different power because, in the non-active timeslot, the off power limit of the preceding active timeslot must be replaced by the off power limit of the succeeding active timeslot at some point. Whichever interpretation you prefer, the R&S®CMU 200 handles both; you can change between the two using a selection switch.

BER search routine

Determining the absolute RF level for a defined bit error ratio is very time-consuming and almost impossible to do manually. In this case, too, the R&S®CMU 200 supports you with its user-friendly search routine. Depending on the offset from the desired bit error ratio, the search routine automatically modifies the averaging depth of the measurement and the step size of the RF level change, thus very quickly determining the absolute RF level for a defined bit error ratio.

FIG 1 Fitted with the measurement configurator, the R&S®CMU 200 automatically sets both the optimum multislot power ramp measurement and the spectrum measurements, depending on the type of connection and active timeslot combination. The example on the left shows the selected power ramp measurement settings for a connection with two active uplink timeslots; on the right are the selected settings for a connection with four active uplink timeslots.



New GSM functionality

Apart from convenient operation, you also expect a tester to cover all necessary functionalities of a mobile radio standard. Here, too, the R&S®CMU 200 is always up to date. For example, if the latest software has been loaded and the option R&S®CMU-B95 installed, the R&S®CMU 200 is able to provide a PBCCH for (E)GPRS packet data transmissions – in addition to numerous other functionalities. Switchover between two- and three-digit MNC in all GSM networks is also available. With the new option R&S®CMU-K26, the R&S®CMU 200 even supports GT 800, the Chinese version of the R-GSM standard.

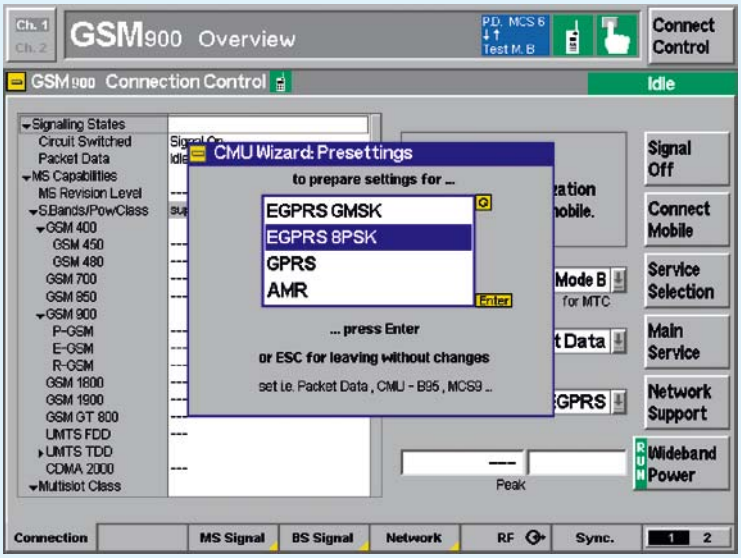


FIG 2
Using the wizard, you can optimally set the R&S®CMU200 for a specific measurement task in a single operating step. All you need to do is select the desired task from a list; everything else is done automatically by the tester.

Summary

The Universal Radio Communication Tester R&S®CMU 200 combines flexibility, operating convenience, measurement speed, functionality and precision in a single instrument. Such versatility makes the R&S®CMU 200 successful in all areas of mobile radio testing.

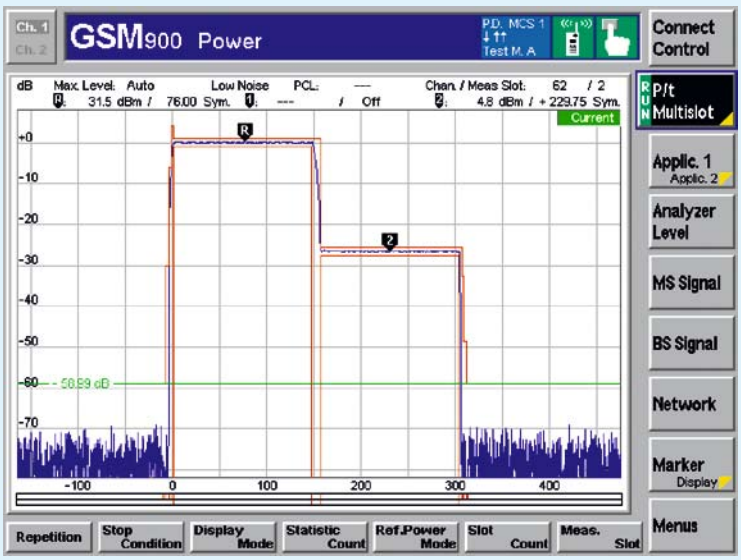
Rudolf Schindlmeier

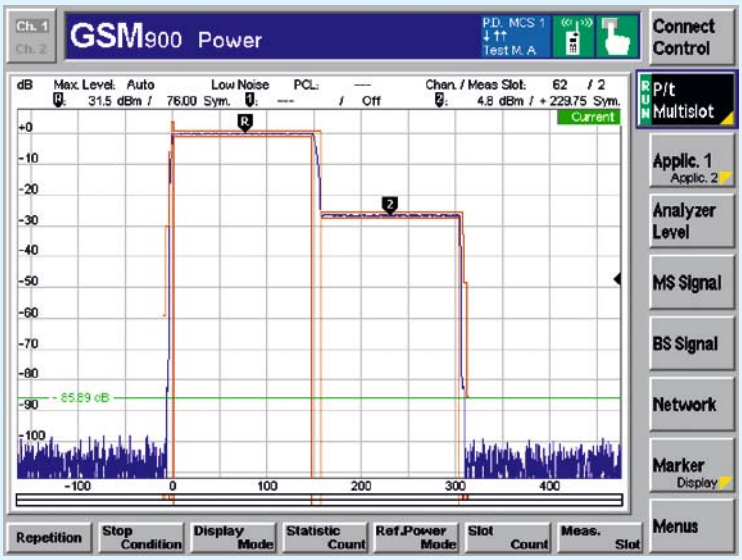
More information and data sheet at www.rohde-schwarz.com (search term: CMU200)

REFERENCES

[*] R&S®CMU 200 – Solutions not only for (E)GPRS mobile radio development. News from Rohde & Schwarz (2004) No. 181, pp 14–15

FIG 3 The R&S®CMU 200 can reference the off power limit both to the timeslot with the maximum power (left) and to the individual timeslots (right). The wide dynamic range that may be required when referencing the off power limit to the individual timeslots does not pose any problems for the tester.





Vector Signal Generator R&S®SMU 200 A

Digital fading simulator with unrivalled characteristics

Impairments and various problems such as Doppler shifts and constructive or destructive superposition of multipath propagation with different signal delays may occur during the radio transmission of signals. The mobile radio standards stipulate appropriate measurements with defined channel models to ensure that radio systems are not impaired by such channel characteristics.

Fading with all channel models

To perform these measurements, you need a fading simulator that is able to simulate the various channel models that occur when a signal is transmitted from the transmitter (e.g. a base station) to the mobile receiver (e.g. a mobile station). These channel models generally consist of superimposed single paths that are independent of each other and statistically modeled. With the two fading options R&S®SMU-B14 and R&S®SMU-B15 of the Vector Signal Generator R&S®SMU 200 A (FIG 1), you can model both stationary and dynamic systems (see box at right). In stationary systems – with constant delays in the paths – you can set the individual fading paths in the path profile and in the path delay as required. Dynamic systems that may suddenly be subject to new propagation paths or to a change in delay are simulated in accordance with stipulations laid down in the 3GPP standard. FIGs 2 and 3 show examples of baseband signals subjected to stationary and dynamic fading.

FIG 1 The Vector Signal Generator R&S®SMU 200 A offers two complete signal generators with digital modulation capability in a single instrument.

Unrivalled signal quality

The purely digital fading simulator in the R&S®SMU 200 A offers numerous advantages:

- Up/down conversion as well as A/D and D/A conversion of a conventional RF fading simulator are not required. The result is excellent and unrivalled signal quality even for signals with additive noise.
- The fading simulator is integrated into the vector signal generator. This provides a system solution at low cost, low weight and minimum space requirements. For example, if you install all options, you will have a single instrument that contains two independent signal generators. It will include fading and noise generation and occupy only four height units. Thus, it will meet performance test requirements for 3GPP FDD base stations in accordance with TS25.141.
- The fading simulators in the two paths may be connected in many different ways, thus significantly increasing the range of applications (e. g. for testing receive and transmit diversity).

With up to 40 paths for multipath fading and a delay resolution of up to 10 ps to meet the highest requirements for spatial resolution, the R&S®SMU 200 A fading simulator is ideal for all possible

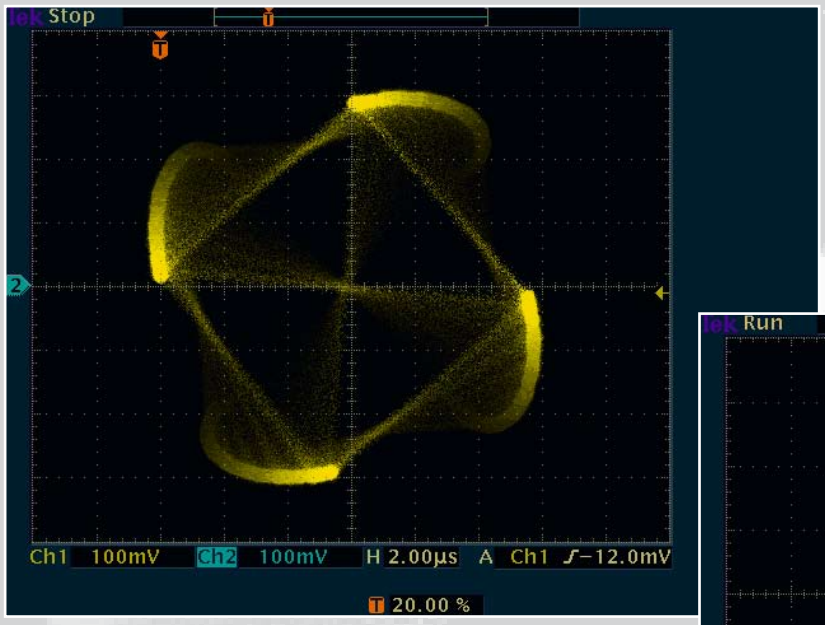


FIG 2
Baseband signal with QPSK modulation and rectangular filter that has been subjected to Rice fading (one path, stationary fading). As a result of the duration of luminescence set on the oscilloscope, the variation of the constellation points in phase and amplitude caused by the fading simulator is clearly visible.

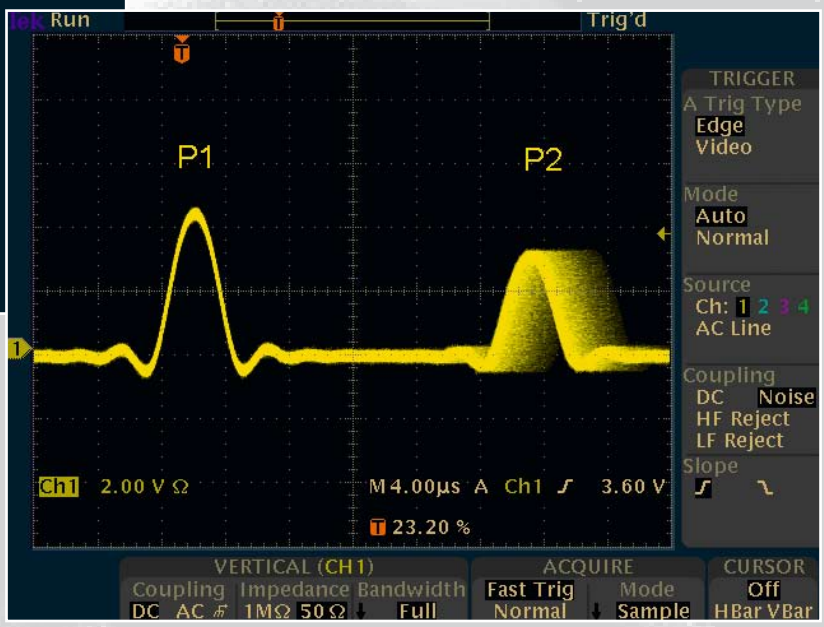


FIG 3
Baseband signal with ASK modulation (only one 1 bit, then many 0 bits) that has been subjected to dynamic fading (moving propagation). Path P1 remains still while path P2 moves in time relative to P1. This is clearly visible due to the long duration of luminance set on the oscilloscope.

The R&S®SMU200A offers all fading profiles

Fast fading profiles

Simulate fast signal level fluctuations that arise due to shifts between constructive and destructive interference during multipath propagation.

Pure Doppler fading Simulates a direct transmission path on which a Doppler shift occurs due to the receiver being in motion.

Rayleigh fading Simulates a radio hop that arises as a result of scatter caused by obstacles in the signal path (buildings, etc).

Rice fading Models a Rayleigh radio hop along with a strong direct signal.

Slow fading profiles

Simulate slow variations in level that can occur due to shadowing effects (e.g. in tunnels).

Lognormal fading Simulates an additional slow fluctuation of the received amplitude of a receiver in motion. This can occur due to landscape or topographical features (e.g. when driving through a depression). Lognormal fading has a multiplicative effect on the path loss. The multiplication factor is time-variable and lognormally distributed.

Suzuki fading Suzuki fading is lognormal fading while a Rayleigh profile is active.

Dynamic fading

Simulates dynamic propagation conditions in accordance with test cases specified in the 3GPP standard.

Birth death propagation Simulates sudden variations in delay, e.g. with sudden disappearance and reappearance of a signal. This may occur, for example, when a pedestrian making a call walks around the corner of a building).

Moving propagation Simulates slow variations in delay.

Special features of the R&S®SMU200A fading option

- Dual-channel fading with variable connections and paths that can be correlated
- Extremely high signal quality
- Visual overview of the fading simulator configuration
- Easy operation
- Multipath fading with up to 40 fading paths
- Very high resolution of delay (up to 10 ps)
- Comprehensive selection of predefined settings in accordance with test specifications of all important mobile radio standards

applications in research, development and testing. The technical implementation including state-of-the-art field programmable gate arrays (FPGAs) and 18 × 18 bit multipliers ensures adaptability to future requirements. Last but not least, the fading simulator is unrivalled owing to its easy installation and upgradeability, requiring no calibration as the instrument is implemented digitally.

Clear and convenient operation via a block diagram and independent menus make its configuration child's play for any requirement (FIG 4). Graphical displays allow you to perform visual checks of generated signals at any time. A wide selection of predefined settings in accordance with the specifications of all important mobile radio standards enables you to make complex settings with just one click. Yet, all important parameters can be changed individually.

Wolfgang Kufer; Silvia Brunold

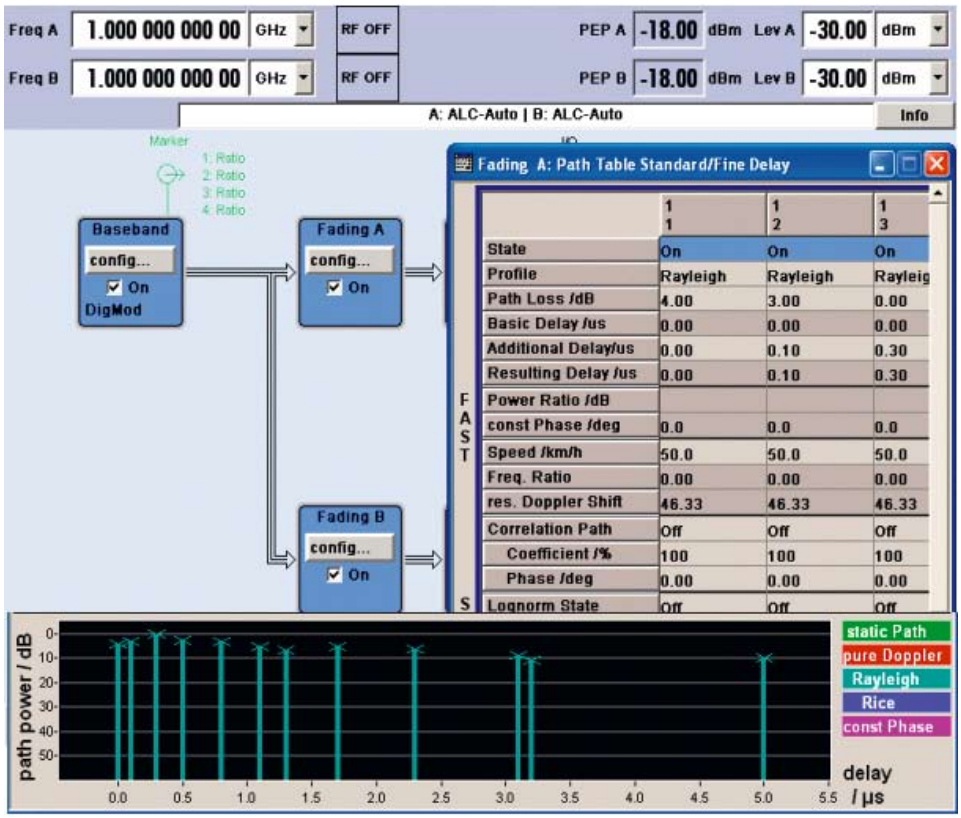
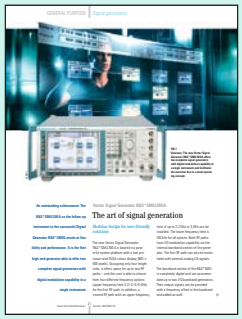


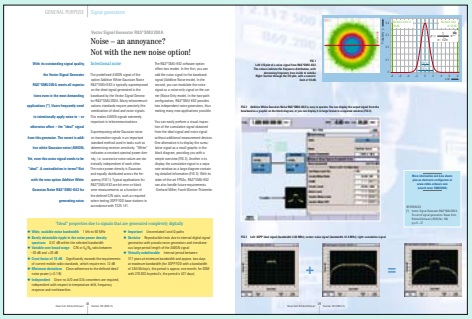
FIG 4 The R&S®SMU200A fading simulator is easy and safe to operate. The block diagram shows its circuitry and the selected configuration. The path table provides an overview of the numeric settings, and the path graphic allows you to perform a fast visual check of active paths.

Further information on the R&S®SMU200A

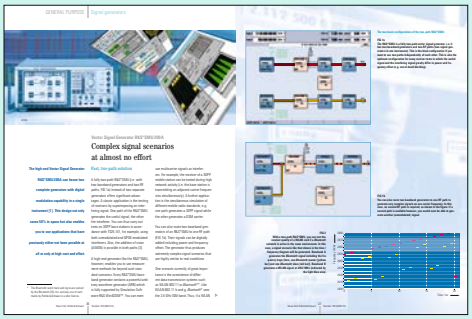
The Vector Signal Generator R&S®SMU is continuously evolving. This is reflected by many articles published in News from Rohde&Schwarz. There is hardly an issue that does not present an expansion of this signal generator. The current issue contains three articles on the R&S®SMU200A: The new fading option (page 16), CDMA2000® and 1xEV-DV signals for demanding test scenarios (page 19), convenient generation of 3GPP FDD HSDPA signals (page 22). Articles in previous issues (see below) plus extensive additional detailed information and manuals can be found on the Rohde&Schwarz website at **www.rohde-schwarz.com**.



The art of signal generation:
News from Rohde&Schwarz (2003) No. 180, pp 21–27



Noise – an annoyance? Not with the new noise option!
News from Rohde&Schwarz (2004) No. 182, pp 38–39



Complex signal scenarios at almost no effort:
News from Rohde&Schwarz (2004) No. 183, pp 36–38

CDMA2000® and 1xEV-DV signals for demanding test scenarios

The expansion of the CDMA2000® standard for ever higher data rates in both transmission directions is placing new demands on the development of base stations and user equipment. The Vector Signal Generator R&S®SMU 200 A now offers CDMA2000® signals, including the 1xEV-DV expansion for tasks such as amplifier and receiver tests.

CDMA2000® with 1xEV-DV expansion

The CDMA2000® standard (3GPP2 C.S0002-C) developed by the 3GPP2 standardization body has contained the 1xEV-DV expansion (1x evolution data & voice) since release C. In the 1x mode, which is downward-compatible to IS 95, the 1xEV-DV expansion offers data rates of up to 3.09 Mbit/s in the forward link (base station to user equipment). The new CDMA2000® option R&S®SMU-K46 generates the packet channels of radio configuration 10 (RC10) in addition to the regular channels that are generally used for voice communications. This makes the R&S®SMU an indispensable tool when testing new receiver components.

Just one generator for all base station tests

To meet the criteria of the 3GPP2 C.S0010-B specification for the minimum requirements of CDMA2000® base stations, you have to test their receivers with a series of wanted and unwanted signals.

For receiver power measurements, the R&S®SMU generates access, control and traffic channels of the various radio configurations in the 1x mode. The AWGN module (option R&S®SMU-K62) adds channel noise that is as precise as necessary for the measurement. Moreover, the optional Fading Simulator R&S®SMU-B14 (page 16) allows you to perform tests under fading conditions. Since the channel coding is fully implemented in the generator, no additional testers are necessary for the bit error ratio (BER): By evaluating the CRC fields, the base station is able to perform the frame error ratio (FER) measurement specified in the standard directly on the received signal.

The R&S®SMU also has no problem in detecting adjacent-channel rejection of the receiver. If the R&S®SMU 200 A is equipped with two paths, one generator is sufficient for generating wanted and unwanted signals with a power difference of 87 dB as defined in the standard. FIG 1 shows how easily you can configure the R&S®SMU.

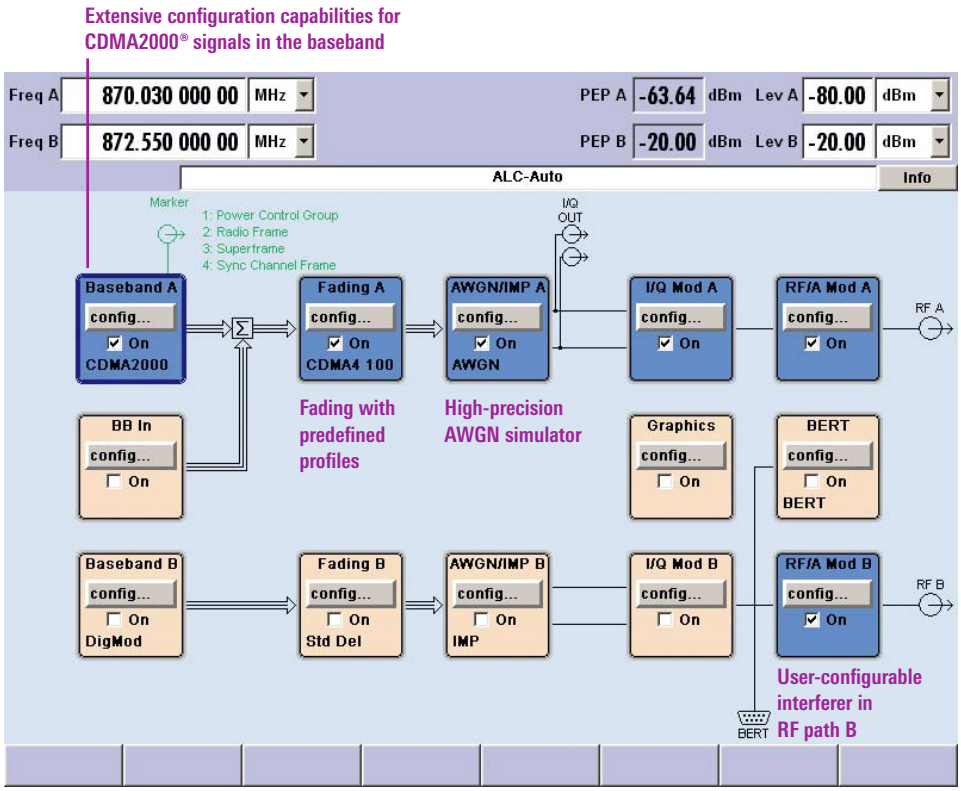


FIG 1
The block diagram on the screen of the R&S®SMU, with which you can easily configure the generator, is especially useful in complicated measurements.

Downlink signals without restrictions

In the forward link, the R&S®SMU supports a total of four user-selectable base stations for each carrier frequency. Each simulated base station provides all control channels of the standard and up to eight independently configurable traffic channels. You can set the channel coding for each fundamental, supplemental and dedicated control subchannel of a traffic channel in any manner within the parameters set by the standard. This makes it possible to set up complex test scenarios that far exceed the tests in 3GPP2 C.S00011-B.

Unlimited and complex 1xEV-DV scenarios

For the packet channels of radio configuration 10 (1xEV-DV), the R&S®SMU offers even more flexibility. 1xEV-DV uses free code domain and available output power of the base station to provide data services with a high data rate to user equipment. The concept of incremental redundancy, paired with powerful turbo codes, ensures optimum utilization of channel capacity.

The focus here is on two applications:

- To test power amplifiers at the base station's RF output, realistic signals as generated by the R&S®SMU are necessary. The fluctuating output power of burst packet channels places high demands on the power amplifiers of the base station.
- The R&S®SMU supports receiver tests with fully channel-coded F-PDCHs and F-PDCCHs. In addition to the packet channels, it is also possible to activate all regular control and useful channels.

The R&S®SMU and R&S®FSQ – an ideal combination

FIG 2 shows an example of F-PDCH settings. In the example, four subpackets of a data packet are active; the graphic shows their time characteristic. Each subpacket has a different configuration. Various modulation modes, different occupancy of the code domain and various subpacket lengths are used. In addition to the F-PDCH, a pilot is active.

By analyzing this signal with the Signal Analyzer R&S®FSQ, you can identify the pilot and the nine occupied codes of the first subpacket (FIG 3, top). The Walsh codes found match those listed in FIG 2; PDCH is displayed as the channel type in both figures. The lower half of FIG 3 shows various measurement results, e.g. the detected modulation mode 8PSK.

The second subpacket with 16QAM modulation occupies another code domain. The upper half of FIG 4 shows the occupancy of the code domain in the reverse bit sequence. The lower half of FIG 4 shows the constellation diagram of the second subpacket.

For the third subpacket, yet another code domain is occupied (FIG 5, top). The lower part of FIG 5 shows the time characteristic of the power for all subpackets and mirrors the graphic in FIG 2.

The example shown here provides just a glimpse of the diverse capabilities offered by the Vector Signal Generator R&S®SMU. Since this generator features flexible means of combining all channel types while simultaneously providing fully implemented channel coding, it meets every need. Thus, you can perform even the most demanding amplifier and receiver tests.

Gernot Bauer

Abbreviations

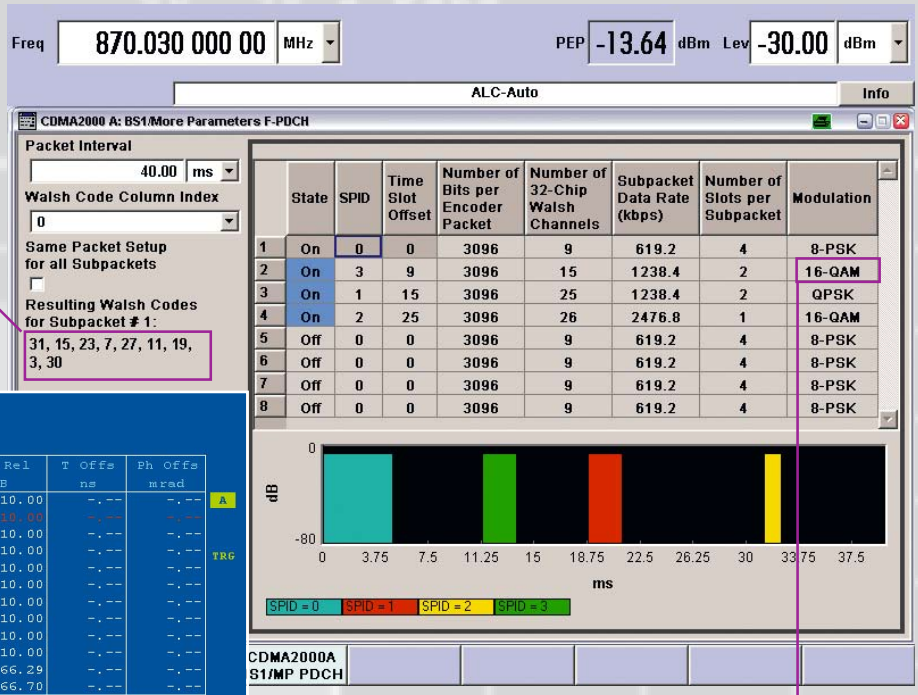
AWGN	Additive white Gaussian noise
CRC	Cyclic redundancy check
FER	Frame error ratio
F-PDCH	Forward packet data channel
F-PDCCH	Forward packet data control channel

R&S®SMU200A options for testing CDMA2000® applications

R&S®SMU-K46	Digital Standard CDMA2000® / 1xEV-DV
R&S®SMU-K62	Additive White Gaussian Noise (AWGN)
R&S®SMU-B14	Fading Simulator
R&S®SMU-B203	RF Path B – 100 kHz to 3 GHz

Further information on the R&S®SMU200A on page 18

FIG 2
Example of a 1xEV-DV signal configuration in the R&S®SMU.



Walsh codes with length 32 for the first subpacket

The set Walsh codes from FIG 2

16QAM, see FIG 4

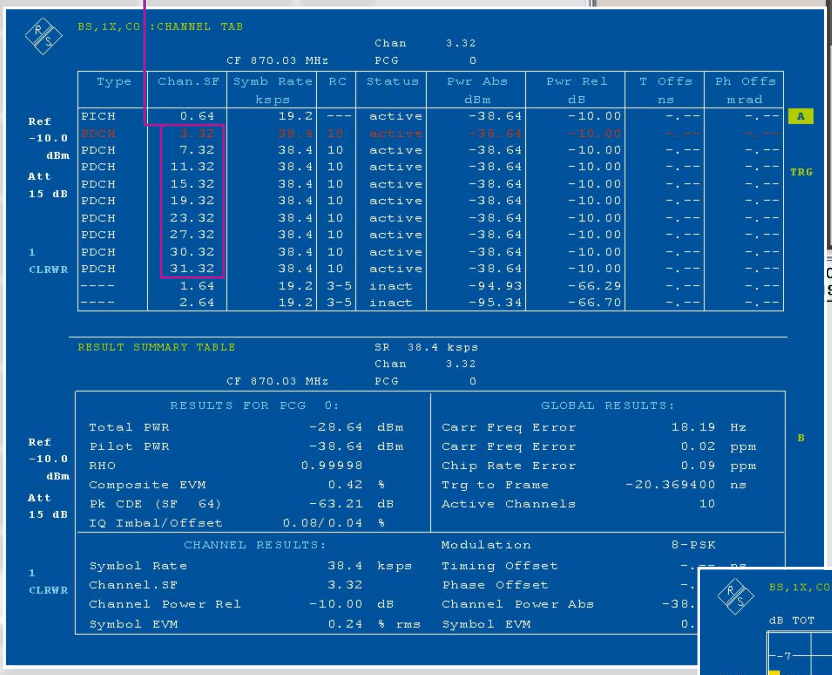


FIG 3
Measurement of the first subpacket: channel table and measurement results.

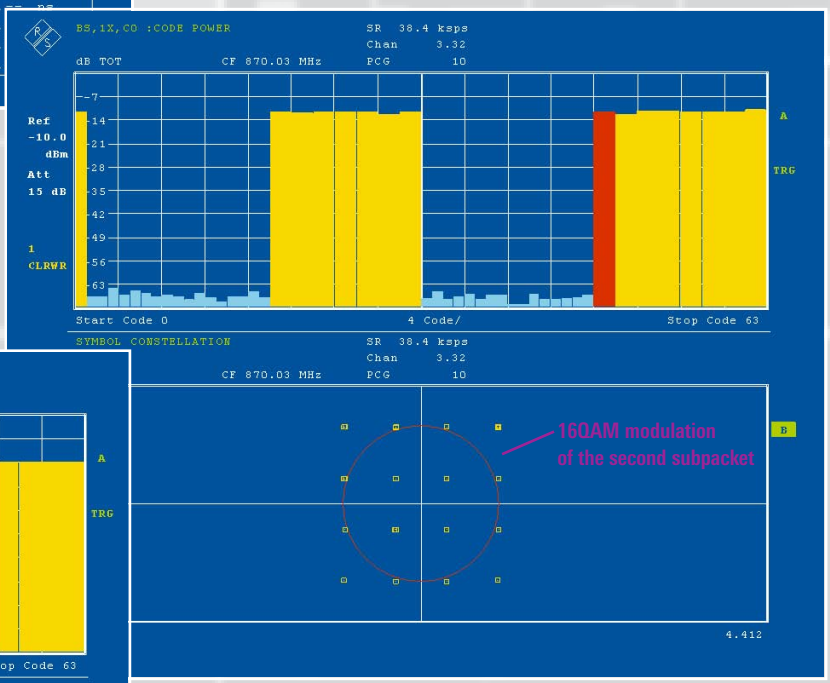


FIG 4
Code domain and constellation diagram of the second subpacket.

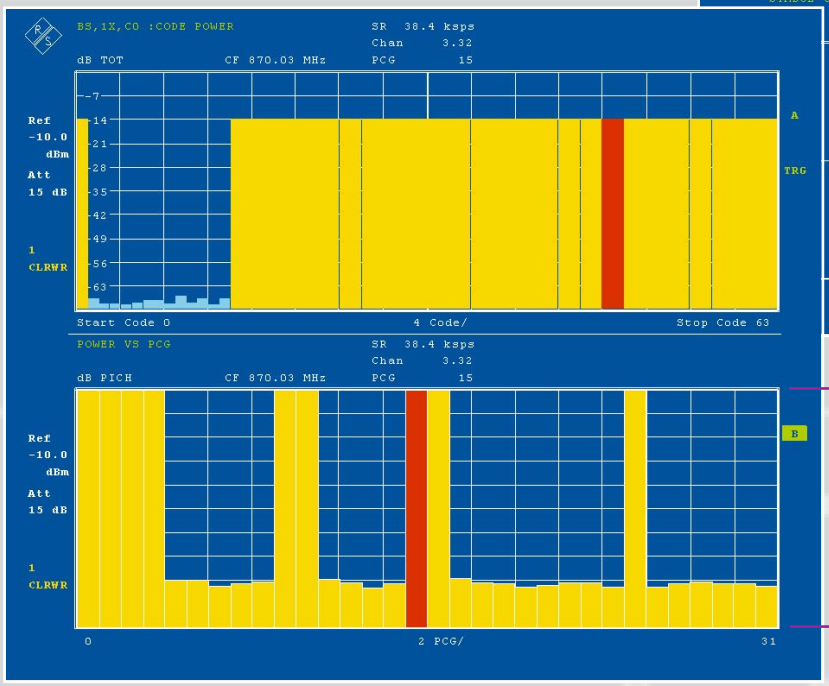


FIG 5
Code domain of the third subpacket (top), time characteristic of the signal power (bottom).

Vector Signal Generator R&S®SMU 200 A

Convenient generation of 3GPP FDD HSDPA signals

With its new option R&S®SMU-K43, the Vector Signal Generator R&S®SMU 200 A is suitable for testing base stations (Node Bs) and user equipment (UE) that support release 5 of the 3GPP standard (HSDPA). The R&S®SMU 200 A handles all necessary signaling tasks ranging from simple component tests to sophisticated performance tests with channel-coded realtime data and radio channel simulation.

44 104

Why HSDPA and what's new about it?

Up to release 4, the entire 3GPP FDD standard was connection-oriented, i.e. radio resources were provided exclusively to a specific user for the duration of the data transmission. Now, HSDPA is also adding packet services to 3GPP. These services have two major differences with respect to their earlier requirements:

- Higher peak data rates (e.g. for downloading an Internet page) are required. Yet, the intervals between the requests (e.g. the time needed for reading the page) are longer.
- The realtime requirements are lower and defective blocks may be repeated (this increases the net data throughput since the code error protection can be lower).

HSDPA meets these two requirements by using three new channels. On the downlink, HS-SCCH (control channel) and up to 15 HS-PDSCHs (data channels) are time-multiplexed among the UE, i.e. the packets are transmitted by interleaving.

On the uplink, the UE (e.g. a mobile phone) can acknowledge the correct reception of a packet (ACK/NAK) via the HS-DPCCH and can also indicate a preferred modulation mode (CQI).

TX measurements at a keystroke

Although 3GPP FDD with HSDPA is a very complex standard, some tests (especially on amplifiers and similar components) require only relatively simple measurement signals. The Vector Signal Generator R&S®SMU 200 A meets this requirement by offering factory-ready test models. You can activate them quickly from the upper control level. FIG 1 provides an example of EVM measurements on a base station.

Receiver tests on base stations

While correct modulation parameters (e.g. symbol rate, filter, signal amplitude distribution) are sufficient for the component test, the receiver test calls for signals with correct frame structure and data contents. You can primarily use channel-coded PRBS sequences, but precalculated data lists or even realtime dynamic data can also be fed in via USB.

The signal is generated by a DSP or FPGA, making setting times of significantly less than one second possible. FIG 2 shows the complete test setup. The Vector Signal Generator R&S®SMU 200 A, which is triggered by the base station, simulates a coded signal of a UE. The base station reverses modulation, spreading and channel coding and internally evaluates the bit or block error ratio.

Although the TS 25.141 test specification currently stipulates only very simple HS-DPCCH channels, option R&S®SMU-K43 supports this new channel with a variety of parameters to ensure that even complex UE responses can be simulated (FIG 3).

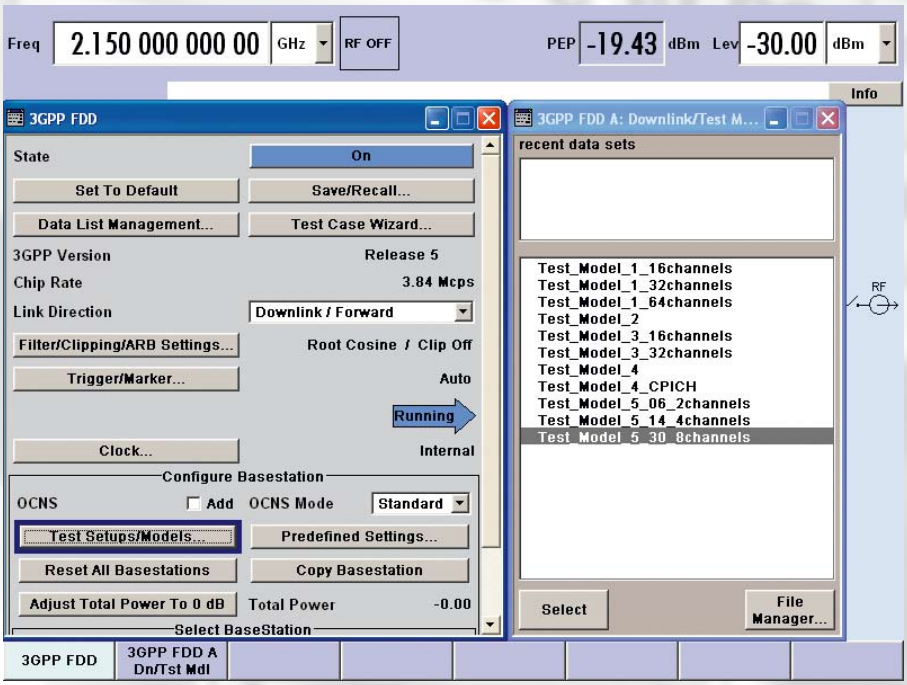


FIG 1 Easy selection of a test signal for EVM measurements on HSDPA base stations.

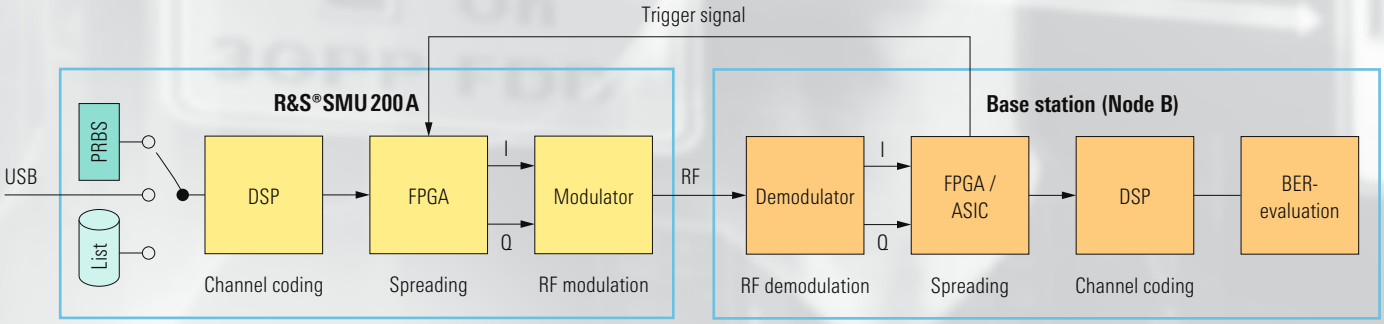


FIG 2 Basic schematic of the receiver test on base stations.

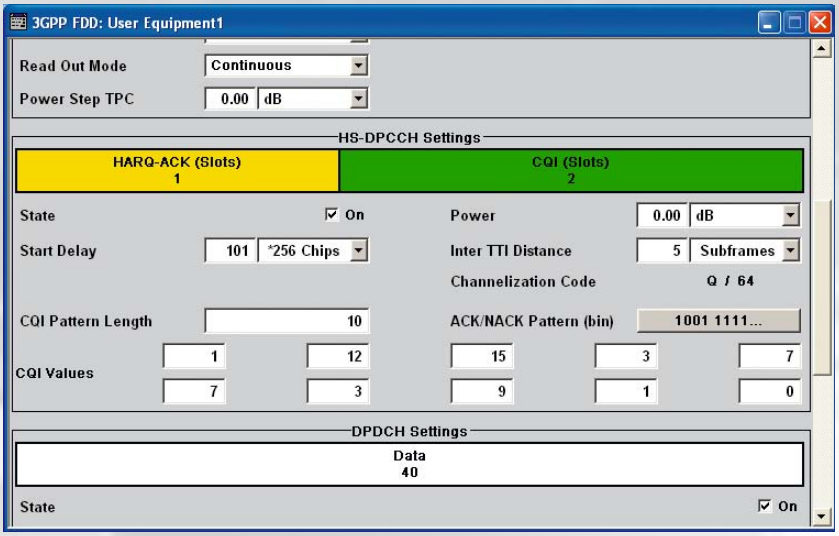


FIG 3 HS-DPCCH settings.

Receiver tests on UE

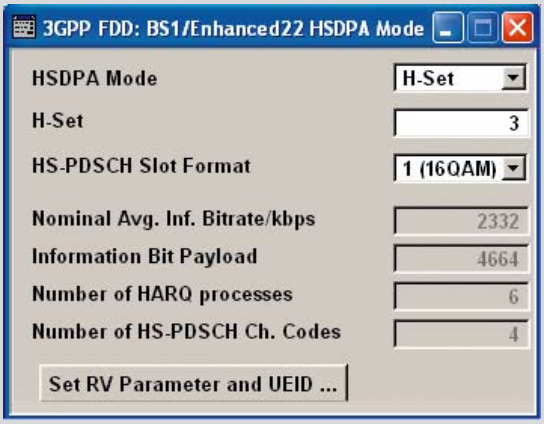
Receiver tests on UE place very high demands on test equipment since the maximum data rate on the downlink (so far only 384 kbit/s) has increased significantly. The new option supports information data rates of up to 2.3 Mbit/s (H-Sets 1 to 5). This corresponds to a physical data rate of 3.6 Mbit/s.

Owing to its user-friendly operating concept, the Vector Signal Generator R&S®SMU 200 A is impressive even when used for such sophisticated tests: When you select the H-Sets, the R&S®SMU 200 A sets all required parameters to standard-conforming values (FIG 4). During the test, you only have to set the number of the H-Set (e.g. 3) and the modulation mode (e.g. 16QAM). The measurement channel (consisting of one HS-SCCH and four HS-PDSCHs) will then be simulated.

All 3GPP FDD test cases for base stations and UE can be covered by a single generator. In addition to the second RF path (for transmit diversity tests), you also need the AWGN and fading simulator options. As the available fading profiles have already been expanded for HSDPA tests, the Vector Signal Generator R&S®SMU 200 A with option R&S®SMU-K43 is perfectly equipped for testing components and devices in accordance with release 5 of the 3GPP standard.

Thomas Braunstorfinger

FIG 4 Selection of an HDSPA measurement channel (left); (right) excerpt from the TS 25.101 test specification Table A.27: Fixed Reference Channel H-Set 3.



Parameter	Unit	Value	
Nominal avg. inf. bit rate	kbit/s	1601	2332
Inter TTI distance	TTIs	1	1
Number of HRQ processes	processes	6	6
Information bit payload (N_{INF})	bits	3202	4664
Number code blocks	blocks	1	1
Binary channel bits per TTI	bits	4800	7680
Total available SMLs in UE	SMLs	57600	57600
Number of SMLs per HRQ process	SMLs	9600	9600
Coding rate		0.67	0.61
Number of physical channel codes	codes	5	4
Modulation		QPSK	16QAM

Glossary

3GPP FDD	**Third Generation Partnership Project** Name of a standardization committee (www.3gpp.org) and official name of the mobile radio standard. The FDD version (frequency division duplex) is the most important one and is already used in Japan and Europe.
UMTS	**Universal mobile telephone standard** Mainly used in Europe; synonymous with 3GPP (FDD).
WCDMA	**Wideband code division multiple access** Multiple access method; often synonymous with UMTS/3GPP (FDD).
HSDPA	**High speed downlink packet access** Technology that clearly increases the information data rate on the downlink.
Node B	In 3GPP FDD, the base station is divided into two physical devices at the transport layer. Node B is the part that contains the physical layer, including the air interface.
UE	**User equipment** Term for the 3GPP terminals; can be a mobile phone, a PDA or a PCMCIA card.
HS-PDSCH	**High speed physical downlink shared channel** Data channel for HSDPA on the downlink; fixed spreading factor of 16.
HS-SCCH	**High speed shared control channel** Control channel for HSDPA on the downlink; fixed spreading factor.
HS-DPCCH	**High speed dedicated physical control channel** Control channel for HSDPA on the uplink.
H-Set	Downlink measurement channel for HSDPA receiver tests on user equipment.

Protocol Tester R&S®CRTU-W / CRTU-G

More efficient generation of custom 2G/3G InterRAT test scenarios

Equipped with a convenient and powerful TTCN interface, the R&S®CRTU-W is setting standards in conformance testing. The MLAPI software option (R&S®CRTU-WT02) has been introduced to also make this instrument a leader in the field of R&D tests. Adding 2G/3G InterRAT functionality to this intelligent programming interface opens up new applications for combined R&S®CRTU-W / CRTU-G systems.

Intelligent approach

Owing to the wide variety of parameters in the 3GPP standard and the diverse applications, UMTS protocol development places high demands on a programming interface. The software option named "Medium Level C++ Application Programming Interface (MLAPI)" represents an intelligent and widely recognized compromise between flexibility and convenience [1, 2]. You can now use this tool for efficient testing of the system transitions between 2G and 3G networks. The comprehensive GSM / GPRS / EDGE function library of the Protocol Tester R&S®CRTU-G was encapsulated in C++ modules to make it available to users. In line with the medium-level philosophy of the 3G programming interface, these new modules provide preferential access to the service access points (SAP) of layer 3 even for the GERAN protocol stack. This also covers setting up the underlying channel structure, which can even include intentionally configuring the lower layers incorrectly. Simple macros that allow state machines to be defined make it possible to efficiently program operations with complex branching. It is of course also possible to easily simulate dynamic behavior by linear programming of individual event queries.

Example scenarios

Predefined example scenarios make it easier to program complex test applications. In contrast to the conformance test cases formulated in TTCN, the focus is not only on signaling testing. Real applications such as voice or data can also be included in the test. The currently available example scenarios for the CS domain cover the following system transitions between second- and third-generation mobile radio networks:

- Handover of a CS voice or data link from UMTS to GSM, and vice versa (incl. U plane)
- Cell reselection from UMTS to GSM, and vice versa
- InterRAT measurements using compressed mode at the UMTS end

Future scenarios will also include the PS domain and describe the transitions between GPRS and UMTS in particular.

Uniform tools

The software tools installed on the R&S®CRTU-W have been enhanced to cover GERAN. As the central control unit, the Project Explorer also sets up the connected Protocol Testers R&S®CRTU-G. The Message Composer now makes it possible to configure GERAN-specific messages. And the Message Analyzer – the powerful tool for analyzing message sequence and contents – combines the synchronized signaling data from both worlds (UMTS and GERAN) in one sorted log file. These features provide a uniform, convenient and modern user interface.

Holger Jauch

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

REFERENCES
[1] Protocol Tester R&S®CRTU-G / -W: 2 in 1 – Software option for 2G/3G system simulation. News from Rohde&Schwarz (2003) No. 178, pp 22–24
[2] Protocol Tester R&S®CRTU-G / -W: Efficient programming interface for UMTS protocol development. News from Rohde&Schwarz (2004) No. 182, pp 17–20

Power Meter R&S®NRP

Measuring power in mobile radio: quick results with “Recall Standard”

The Power Meter R&S®NRP (FIG 1) provides numerous modes for measuring complex signal shapes of today’s communications standards such as GSM, EDGE, DECT, etc: Continuous, Average, Burst, Timeslot, Timegate and Scope mode. Extensive setting options are available for these modes, offering a high degree of flexibility during measurements. Yet, things can be done more easily: With the “Recall Standard” function, you can automatically set the configuration by just pressing a few keys.

14 mobile radio setups

Due to complex signal shapes, displaying the power envelope has become indispensable for checking signal details such as overshoots, glitches or interference pulses, which influence the result of a power measurement, and for defining gates [1, 2]. The Scope mode in the R&S®NRP is ideal for these measurements. You select the graphical result display, set the trigger and horizontally and vertically define the required size of the screen window. For measurements with gates, you additionally define the beginning and end to accurately exclude unwanted parts of the signal. You can select up to 16 different parameters to configure the gates in the Scope mode.

Just call up “Recall Standard” and the R&S®NRP is ready to go

Yet, things can be done more easily: The “Recall Standards” function largely frees you from most configuration tasks. You merely have to select one of 14 common mobile radio setups, and the power meter then configures itself. Not only TDMA standards but also all other common CDMA standards such as TD-SCDMA, WCDMA/3GPP FDD and CDMA2000® (FIG 2) can be selected.

Four keystrokes on the R&S®NRP base unit are enough to easily measure the entire frame content of a GSM/EDGE signal with all timeslots active, for example. You merely have to set the frequency correction for the sensor. To do this, just press the PRESET key on the front panel of the power meter, select “Standard Recall”, select the mobile radio standard in the “Preset” window, and press the “Recall” softkey. The R&S®NRP is now configured (FIG 3). Not even the exclude gates have to be calculated and set. The R&S®NRP sets everything automatically. All necessary trigger conditions – the base unit knows six different conditions – are correctly set by calling up the “Recall Standard” function. The R&S®NRP manual contains a list of all preconfigured parameters.

FIG 1 The Power Meter R&S®NRP.

43877/4

Automatic and complex measurements – no contradiction

All measurement modes available in the R&S®NRP will be completely configured if you call up “Recall Standard”. You can select the mode that best suits your needs. The default setting for “burst” signals is the Scope mode. By simply changing the tabs, you can call up “Gate” and “Timeslot” to perform your first measurements. If higher accuracy is required for your application, call up the corresponding mode in the sensor menu under “Mode…”. The R&S®NRP

is configured right for the measurement. If more exotic settings are required or you want to perform special measurements, additional menus are available. This eliminates having to manually configure the complete mode in advance. After you define the appropriate settings for an application, you can easily store them in a setup list in the "File" menu using customized or predefined names (setups 1 to 19).

Also convenient for remote control

The "Recall Standard" function is also convenient for remote control of the R&S®NRP. When you want to initialize the power meter for a measurement, you do not have to transmit the list of parameters in advance [3]. An example is provided below for a command sequence of only five "Remote Control" commands for GSM/EDGE set by the power meter for the Power Sensors R&S®NRP-Z11 and R&S®NRP-Z2x so that after configuration the first results are transmitted from the sensor to the controller:

*RST
:SYST:STAN:PRES "GSM/EDGE"
(Call-up of GSM/EDGE)
:SENS:FREQ 935E6
(Frequency-dependent correction value for the result)
:SENS:FUNC "POW:TSL:AVG"
(Call-up of the Timeslot mode in the Sensor menu)
:READ?
(Triggering of the measurement and fetching of the measured value)

These examples show that selective use of the "Recall Standard" function in the Power Meter R&S®NRP significantly facilitates operation of the instrument when complex measurements have to be performed. Taking a look at the manual is worthwhile.

Dr Markus Banerjee

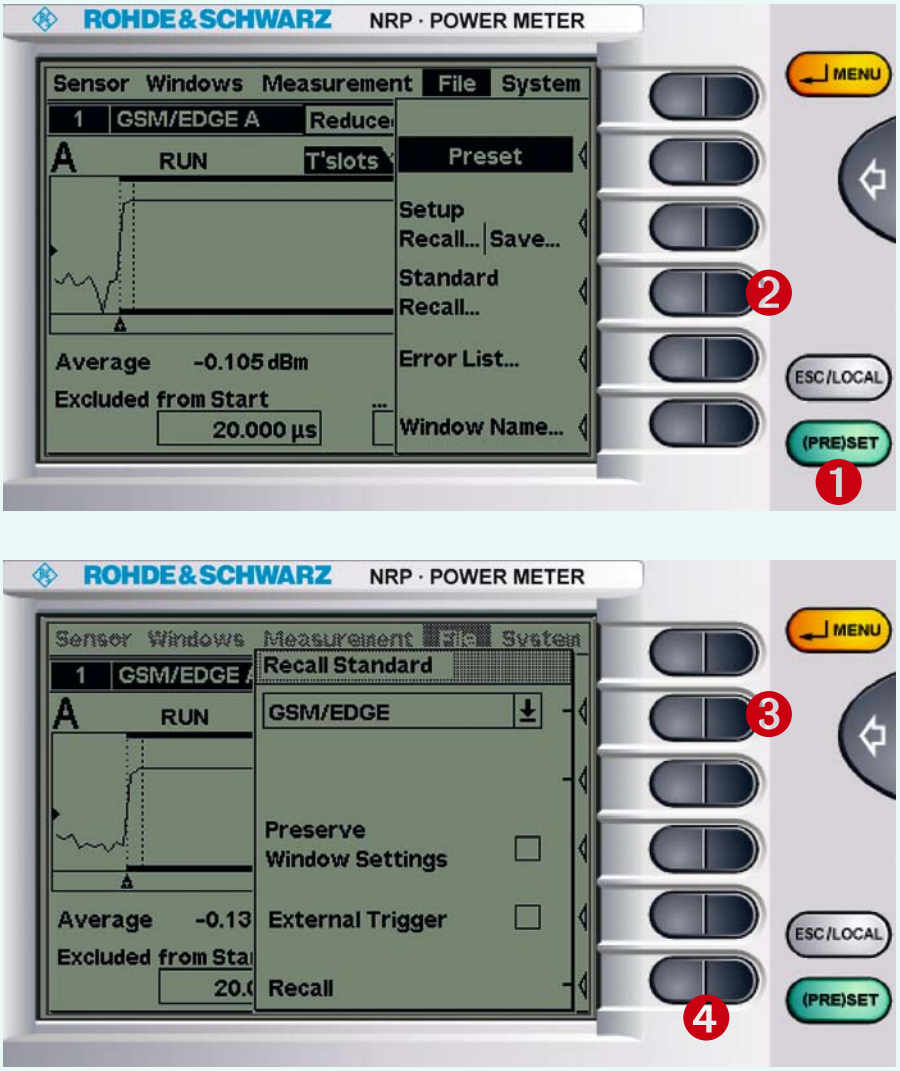
	Mobile radio standard
1	*Bluetooth*® DH1
2	*Bluetooth*® DH3
3	*Bluetooth*® DH5
4	CDMA2000®
5	DECT
6	GSM/EDGE
7	NADC/DOWNLINK
8	NADC/UPLINK
9	PDC/DOWNLINK
10	PDC/UPLINK
11	TD-SCDMA
12	WCDMA/3GPP FDD
13	WCDMA/3GPP TDD DL
14	WCDMA/3GPP TDD UL

FIG 2 The Power Meter R&S®NRP supports 14 mobile radio setups.

More information, operating manuals, and data sheet at www.rohde-schwarz.com (search term: NRP)

REFERENCES
[1] Power Meter R&S®NRP: Evolution in power measurement – intelligent sensor technology. News from Rohde & Schwarz (2002) No. 174, pp 12–16
[2] Power Meter R&S®NRP: Evolution in motion – new functions and sensors. News from Rohde & Schwarz (2003) No. 180, pp 42–44
[3] R&S®NRP operating manual

FIG 3 Only four keystrokes are required and the R&S®NRP is ready to measure complex signal scenarios.



Handheld Spectrum Analyzer R&S®FSH3

Put to the test on board the International Space Station ISS

The R&S®FSH3 (FIG 1) from Rohde&Schwarz is a high-end spectrum analyzer in handheld design that features low weight, minimum power consumption and outstanding RF performance [*]. It is currently being used on board the International Space Station (ISS) for distance-to-fault (DTF) measurements.

FIG 1 The R&S®FSH3 with VSWR bridge for vector reflection measurements.

Time signal system in the test phase

The global transmission services (GTS) system is a new system for the worldwide transmission of time signals to receivers on the ground, such as watches or clocks in vehicles. It is currently being tested as part of a pilot experiment on board the ISS (FIG 2). This is the first commercial experiment aboard the space station. Once the test phase has been completed, the GTS system is to be transferred to an operator company. Owing to a recently developed cryptographic modulation, further services such as vehicle theft protection or the tracking of specific items (e.g. containers or stolen goods) can also be implemented.

The GTS system consists of an active phased array antenna outside the ISS and an electronics unit inside the Russian service module, the space capsule, where the experiments are conducted. The electronics unit contains a highly stable crystal oscillator, transmitters for the UHF and L band and a controller which generates the transmission signals via software in realtime. This unit is directly controlled and measured from a special ground station in Stuttgart; otherwise, the controller functions autonomously. It also ensures correct antenna control which compensates the significant differences in free-space attenuation between the nadir and horizon direction by means of a specially designed directional pattern.

The antenna was installed in Moscow in December 1998 before the service module was launched. In summer 2000, the electronics unit was delivered by means of a Progress space transporter and installed by the crew (FIG 3).

Needed – a featherweight high-tech analyzer

However, when the electronics unit was initially put into operation in February 2002, it exhibited deviations from the precalculated receive field strength on the ground. Nevertheless, the telemetry performed both on board the ISS and via the ground station exhibited nominal values. One of the possible reasons for this deviation may have been two RF wiring harnesses that had already been installed prior to the launch and that had been in space for two years. The harnesses with a total length of 29 m are routed via special vacuum-tight coaxial ducts from the interior of the service module to the outside. Thus, they are partially outside the space station in the orbit vacuum, which makes them rather difficult to check.

When an onboard multimeter was used, only short circuits or cable breaks were able to be eliminated as possible causes of deviation. To measure the RF characteristics, it was thus crucial to procure a lightweight mobile device that offered battery operation and could be remote-controlled via a laptop – in other words, an instrument such as the Handheld Spectrum Analyzer R&S®FSH3. Since laptops are part of the basic equipment on board the space station, "all" that needed to be done was to transport the 2 kg analyzer to the space station: With each kilogram costing US$ 20000, every gram counts!

Photo: NASA

FIG 3
Cosmonaut Deschurow installs the electronics unit for the GTS system.

FIG 2
A joint project involving several countries: The International Space Station ISS is a manned science lab in space.

Photo: NASA

Moreover, a number of questions had to be clarified: Would the R&S®FSH3 withstand the extreme stress it is subjected to when being transported into orbit? Would its electronics work even under the increased radiation exposure at an altitude of 400 km? Would the spectrum analyzer meet the ISS security requirements so that it would neither endanger the crew nor interfere with onboard electronics? The most important and pressing question, however, was: Would the R&S®FSH3 be able to accurately measure the cables which are almost 30 m in length and outfitted with various connectors, or is the cable loss too high?

To answer these questions, the entire setup was simulated in Moscow with the aid of the phantom flight antenna model and the ground simulator of the service module. The R&S®FSH3 was set to distance-to-fault measurement mode, and the cables were tested. The measurement was a complete success: Despite the considerable cable lengths, the spectrum analyzer was able to display even the delay differences between the phase shifter elements in the active antenna and thus passed this first test for such an unusually sophisticated application with flying colors.

Off to the "gym"

Next, the R&S®FSH3 had to be prepared for launch and for operation on the space station. As is usual with commercial off-the-shelf (COTS) products, the safety experts completely dismantled the instrument and subjected it to a thorough inspection. In particular, materials containing PVC and electrolytic capacitors might endanger the astronauts and must therefore be replaced. However, since there was no viable alternative for the capacitors in the switching power supply, they were encapsulated in Teflon sleeves together with absorbent material. The rechargeable batteries were removed and replaced by a special power supply for matching the ISS power supply. Finally, the interior facings of the housing were completely covered with self-adhesive aluminum foil to meet fire protection requirements. Thus modified, the R&S®FSH3 once again immediately functioned without any problems even though the firmware had not been designed for operation without rechargeable batteries (FIG 4).

Thoroughly tested

The next challenge the R&S®FSH3 had to face were mechanical vibration tests. Again, the analyzer excelled because the quality standards at Rohde&Schwarz are so demanding that no further mechanical tests were necessary. When EMC and radiated emission were tested, the values measured were minimal and not significant enough to jeopardize the electronics on board the ISS. Thus, no further shielding was necessary.

Finally, thermal and vacuum tests had to be performed because such exceptional stress does not occur when the R&S®FSH3 is used on earth. The spectrum analyzer was subjected to a temperature range of –50 °C to +50 °C in a climatic chamber, simulating the extreme conditions that can occur during launch from Russia's Baikonur space center. Since a pressure loss might also occur in the Progress transport capsule, the instrument had to pass the corresponding tests. The R&S®FSH3 easily withstood vacuums up to 400 mbar in a tank.

To ensure that the instrument would not emit any toxic substances, it was wrapped in polyethylene foam rubber and subjected to an outgassing test in a high-temperature-resistant bag for 72 hours. The spectrum analyzer excelled once again and was finally granted launch permission. In December 2003, it was handed over to the Russian partner company RSC Energia, which transported it together with the Progress capsule to the ISS in February 2004.

In the meantime, the procedure for installing the R&S®FSH View software and for performing the measurements had been transmitted to the ISS crew. The big day finally came on 18 March: The R&S®FSH3 was installed and was ready to perform its first measurements (FIG 5).

A shooting star

As expected, the R&S®FSH3 functioned smoothly despite the increase in radiation exposure. The measured data was transferred from the spectrum analyzer to the ISS telemetry system via laptop and transmitted to the ground station for evaluation on 22 March 2004. The distance-to-fault measurement revealed everything: The discontinuities of the cable connections were clearly visible, as were two other spikes in the diagram that could not be replicated during the ground simulation (FIG 6). These interferences seem to be at least part of the reason for the reduced signal quality and are currently being analyzed in detail. Until final clarification, the R&S®FSH3 will remain on board the ISS. Then it will be sent back on a Progress transporter only to burn up as a shooting star when reentering the earth's atmosphere.

Dr Felix Huber
(Steinbeis Transfer Center
for Space Travel)

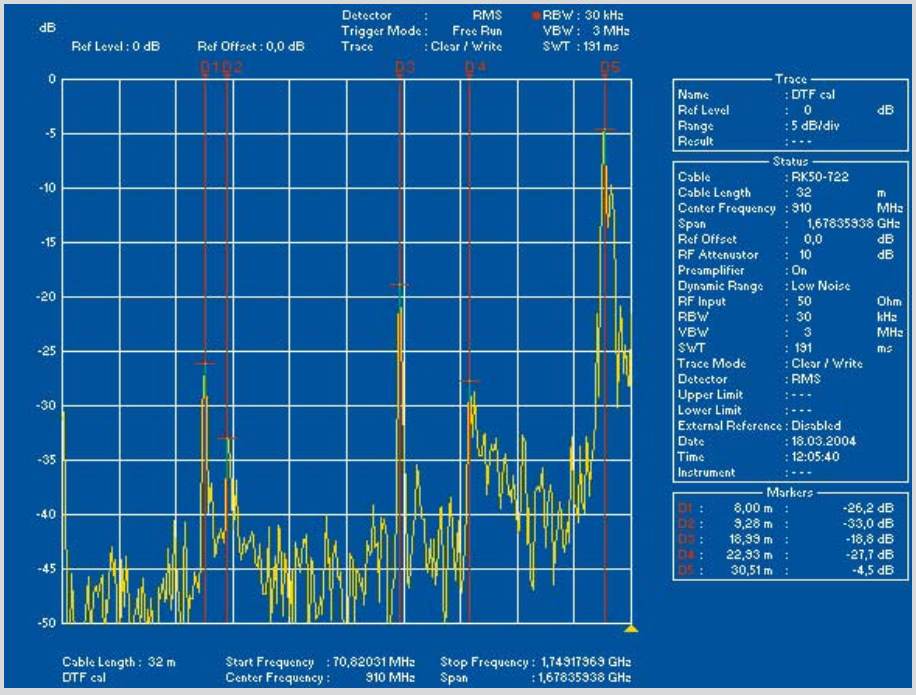
Photo: TZ Raumfahrt

FIG 4 Ready for a trip to space: the R&S®FSH3 after modification. Especially materials containing PVC and electrolytic capacitors could endanger the astronauts and thus had to be replaced.

FIG 5
After strenuous tests and a long journey, the R&S®FSH3 finally reached the ISS, where measurements then began.

Photo: RSCE

FIG 6
Results of the DTF measurement: cable discontinuity (marker D1); unwanted faults (marker D2 and D4); duct from space station to the antenna outside (marker D3); antenna (marker D5).



More information and data sheet at www.rohde-schwarz.com (search term: FSH3)

REFERENCES

[*] Handheld Spectrum Analyzer R&S®FSH3: Numerous expansions and a new model. News from Rohde&Schwarz (2004) No. 181, pp 32–35

Spectrum and Signal Analyzers R&S®FSP / FSU / FSQ

High-precision measurement of absolute levels with spectrum analyzers

In the past, high-precision measurements of absolute signal level were usually performed by means of power meters such as the R&S®NRP from Rohde & Schwarz. However, this is now changing with the new option R&S®FS-K9, which also turns the Spectrum Analyzers R&S®FSP and R&S®FSU and the Signal Analyzer R&S®FSQ into precise power meters.

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

A powerful combination

Every developer knows the problem that arises during power measurements: Spectrum analyzers can measure signal levels precisely and with high linearity relative to a specific reference power. But as soon as high absolute level accuracy is required for the reference power, power meters with precise sensors have always been preferred, since their absolute level accuracy exceeds the specifications of spectrum analyzers by a factor of five to ten.

Yet if the focus is on dynamic range, measurement speed or selectivity, spectrum analyzers gain the upper hand. The ideal solution would therefore be a combination of an analyzer and a power meter, thus offering the advantages of both worlds in one instrument.

This is exactly where the option Power Sensor Measurements R&S®FS-K9 comes into play. With this new option, you can connect the sensors for the Power Meter R&S®NRP directly to the Analyzers R&S®FSP, R&S®FSU and R&S®FSQ. The precise measurement results of the sensors are displayed on the screen of the analyzers (FIG 1). This converts the analyzers into power meters that offer functions such as zeroing, variable measurement time and a display unit directly from their operating

menus. To make level measurements as accurate as possible, you can link the frequency response correction of the sensor to either the current center frequency or the frequency of the marker.

Suddenly, your dreams will come true: The spectrum analyzer will perform power measurements with the same absolute level accuracy as the power sensor. To achieve this, you merely have to measure the signal under consideration using first the power sensor with the R&S®FS-K9 option, and then the spectrum analyzer. If a power splitter is available, both measurements can even be performed simultaneously. After the measured level difference has been converted into a correction factor (transducer), the marker will display the same value as the power meter (FIG 2). If you now vary the level of the signal source, you can measure the absolute level stages with the analyzer very accurately.

Summary

The R&S®FS-K9 option converts the spectrum analyzers from Rohde&Schwarz into high-precision power meters with variable selectivity, high sensitivity and maximum measurement speed – even if thermal power sensors are used. Due to the large number of available sensors (FIG 3), an optimum combination is available for almost any application. Due to their low measurement uncertainty, any of the sensor types is basically suitable for the reference measurement. Of course, the lowest measurement uncertainties will be achieved by using the Thermal Power Sensors R&S®NRP-Z51 and R&S®NRP-Z55. However, as a rule of thumb for all sensors, the reference level should be at least 15 dB above the lower measurement limit of the power sensor. This keeps the effects of zero drift and noise negligible.

Ottmar Steffke

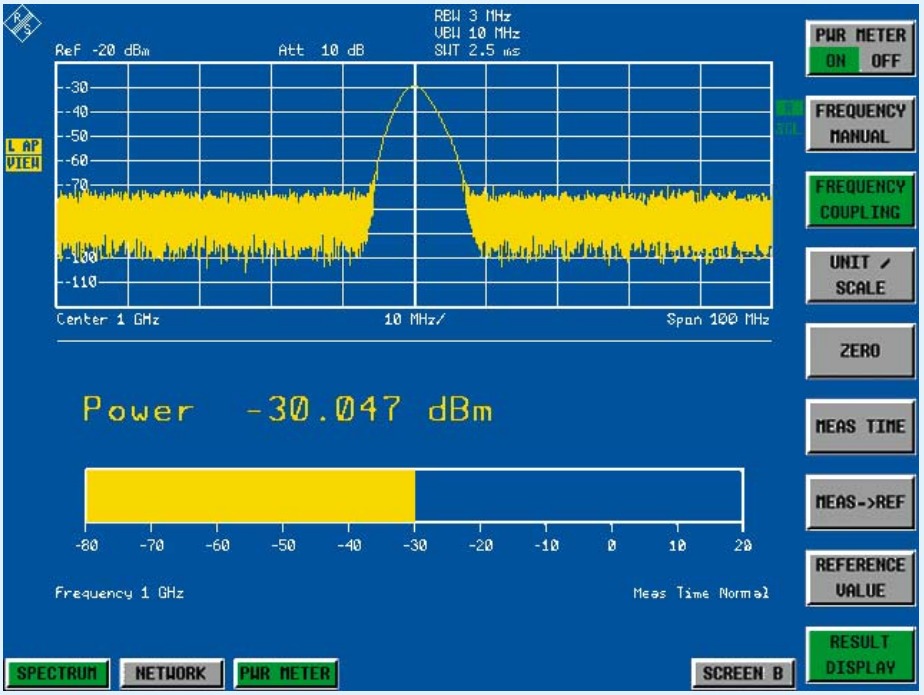


FIG 1 The measured power is shown on the screen of the spectrum analyzer.

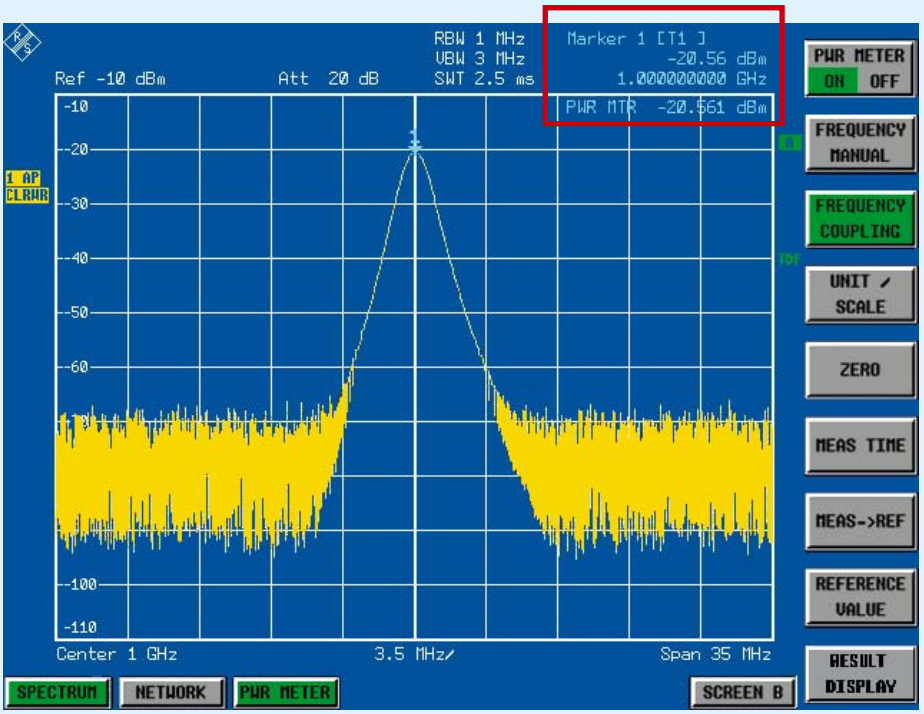


FIG 2 Adjustment of the marker display with the power meter by means of the correction factor (marked in red).

Sensor	Function / technology	Measurement range	Frequency range
R&S®NRP-Z11	Universal Power Sensor	–67 dBm to 23 dBm	10 MHz to 8 GHz
R&S®NRP-Z21	Universal Power Sensor	–67 dBm to 23 dBm	10 MHz to 18 GHz
R&S®NRP-Z22	Universal Power Sensor	–57 dBm to 33 dBm	10 MHz to 18 GHz
R&S®NRP-Z23	Universal Power Sensor	–47 dBm to 42 dBm	10 MHz to 18 GHz
R&S®NRP-Z24	Universal Power Sensor	–42 dBm to 44 dBm	10 MHz to 18 GHz
R&S®NRP-Z51	Thermal Power Sensor	–30 dBm to 20 dBm	DC to 18 GHz
R&S®NRP-Z55	Thermal Power Sensor	–30 dBm to 20 dBm	DC to 40 GHz
R&S®NRP-Z91	Average Power Sensor	–67 dBm to 23 dBm	9 kHz to 6 GHz

FIG 3 These power sensors can be connected to the Spectrum Analyzers R&S®FSU and R&S®FSP and to the Signal Analyzer R&S®FSQ.

Signal Analyzer R&S®FSQ

Analysis of VSB signals with the option R&S®FSQ-K70

While QAM[1] methods are gaining importance in the European TV standard DVB as cable TV networks are digitized, the US is using a digital method of vestigial sideband modulation (VSB). In the US TV standard ATSC[2], 8VSB [1] is used as a digital transmission method. The option R&S®FSQ-K70 now makes measurements on VSB signals possible.

Expanded measurement capabilities

The optional Vector Signal Analyzer R&S®FSQ-K70 [2, 3] has supported the analysis of QAM signals ever since it was first introduced. It now includes a VSB demodulator, thus expanding its range of applications, and offers all analysis capabilities that are customary for QAM (e.g. error vector magnitude (EVM) and eye diagram). Of course, the option R&S®FSQ-K70 also supports conventional measurements such as constellation diagrams, modulation accuracy tables (FIG 1) as well as statistical and spectral evaluations. A new function is the measurement of parameters that are typical of VSB signals, such as level error of the pilot carrier.

The display capabilities of the option R&S®FSQ-K70 make it easy to view the relationship between two different modulation modes, e.g. 8VSB and 64QAM. FIGs 2 and 3 show the probability distributions at the decision points for the two modes (compare constellation diagrams in the upper halves of the figures). In the real component of both modulation modes (horizontal axis in each constellation diagram), eight amplitude stages are possible. The 64QAM scheme transmits eight amplitude stages in the imaginary component, allowing the data rate to be doubled. In contrast, the 8VSB modulation scheme eliminates – as is typical with conventional cable television signals – the lower sideband, yielding a virtually Gaussian distribution of the amplitude stages in the imaginary component (FIG 2).

As usual, the unavoidable effects of nonlinearities that have to be taken into account when dimensioning output amplifiers can be checked and optimized by means of the AM/AM or AM/φM conversion curves. FIG 4 shows an example of the measurement result for an amplifier.

Summary

All measurement capabilities and evaluations of the vector signal analyzer option are also available for the digital vestigial sideband modulation (VSB). Thus, you can perform vector signal analysis on RF, IF and baseband signals with a single instrument. Whether VSB in America or QAM in Europe, the optional Vector Signal Analyzer R&S®FSQ-K70 always has the demodulator you need.

Since the new VSB demodulator does not require any additional measurement hardware, a simple update to the latest firmware version of the R&S®FSQ is sufficient.

Jochen Pliquett

More information and data sheet at www.rohde-schwarz.com (search term: FSQ-K70)

REFERENCES
[1] "Digital Television – A Practical Guide for Engineers". Walter Fischer, Springer Verlag 2003
[2] Signal Analyzer R&S®FSQ – Application software for precise vector signal analysis. News from Rohde&Schwarz (2003) No. 178, pp 32–34
[3] Signal Analyzer R&S®FSQ – New functions of the optional Vector Signal Analyzer R&S®FSQ-K70. News from Rohde&Schwarz (2004) No. 181, pp 27–29

1) Quadrature amplitude modulation.
2) Advanced Television Systems Committee.

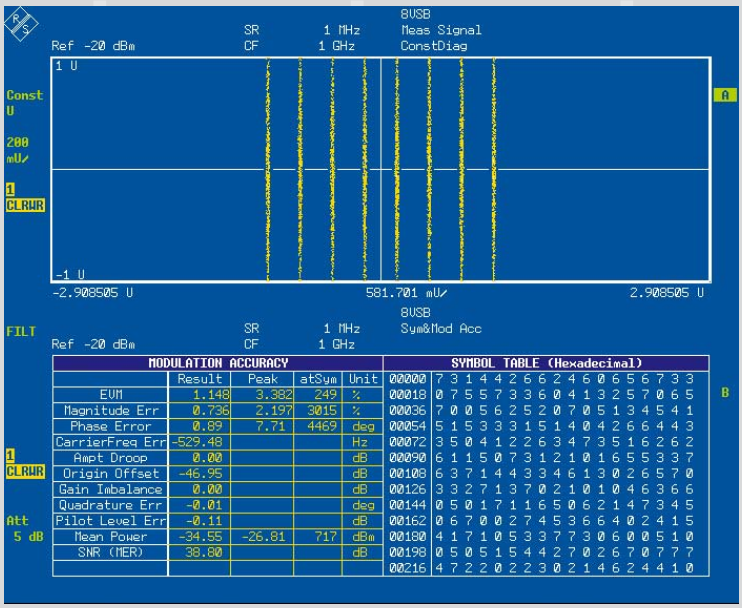


FIG 1
Constellation diagram and modulation accuracy table for 8VSB.

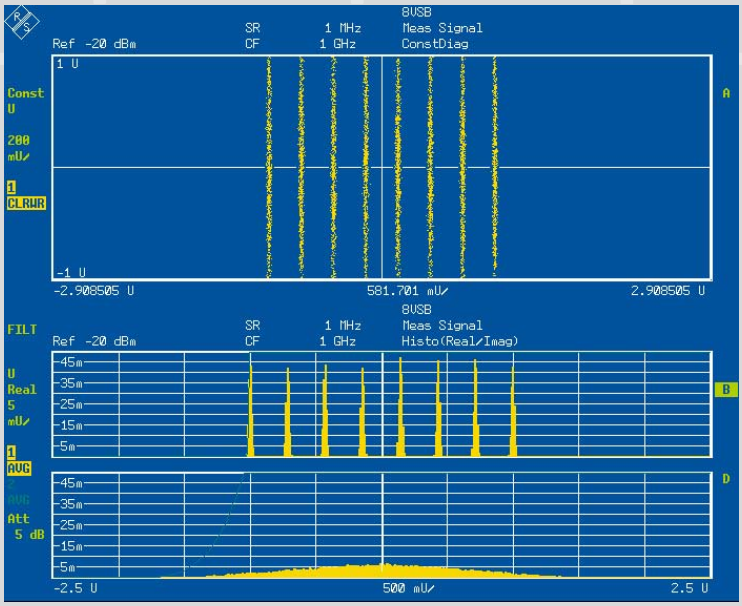


FIG 2 Distribution of real and imaginary components with 8VSB.

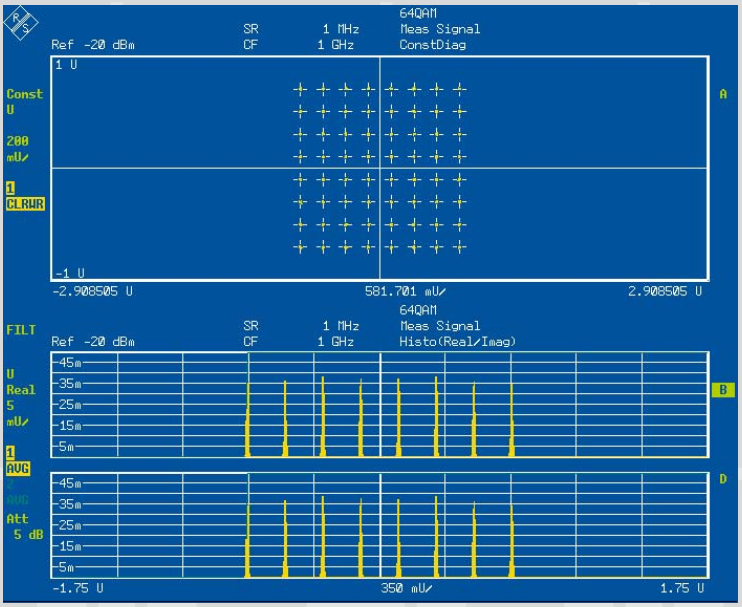


FIG 3 Distribution of real and imaginary components with 64QAM.

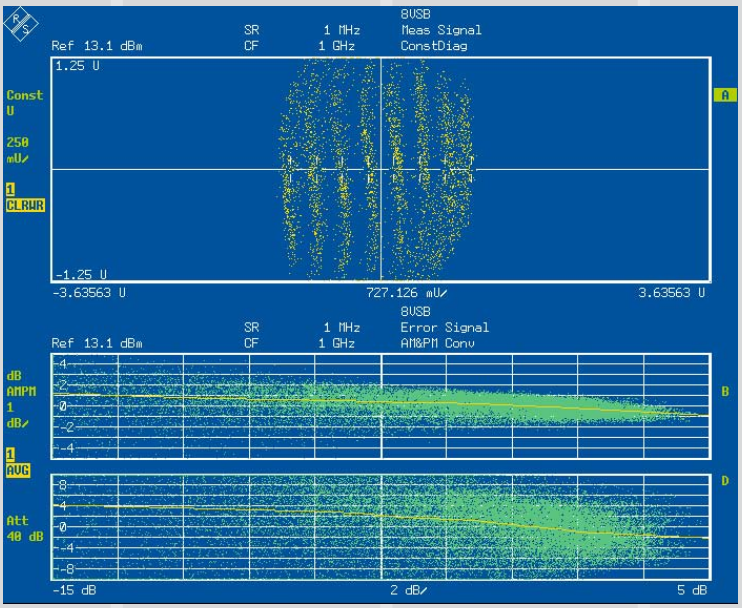


FIG 4
AM/AM and AM/φM conversion curves of an amplifier.

RF Network and Component Analyzer R 3860 A from Advantest

Differential measurements up to 20 GHz directly on the wafer

IC development and production involve tremendous investments, in large part for IC packaging. To save unnecessary costs caused by packaging defective ICs, T&M analysis and functional checks are carried out on the wafer.

All-in-one, fully automatic solution

Over the past several years, differential or balanced components have been used to an increasing extent, primarily for mobile phone production but also for other new technologies such as WLAN applications. To perform measurements of such components directly on the wafer, you need a 4-port network analyzer with differential measurement functions, a wafer tester with differential RF probes and control software.

An automatic all-in-one solution for differential measurements directly on the wafer that can be used up to 20 GHz (FIGs 2 and 4) has been developed in cooperation with Advantest, Suss MicroTech Test Systems and Rohde & Schwarz.

Suss MicroTech is a well-known supplier of wafer testers and has long-standing experience in wafer measurements.

As a vector network analyzer in this system, the R 3860 A from Advantest (FIG 1) is ideal for measuring differential components [*]. One of the main reasons for this is its multiport architecture in two different models, one up to 8 GHz and one up to 20 GHz. All required measurement functions such as embedding and deembedding, simulation of baluns and impedance matching can be defined in overview graphics. The main focus is on mixed mode analysis, i.e. the measurement of differential S parameters. One of the parameters measured is common-mode rejection, for example, which is used to determine the impact of electromagnetic interference on the DUT.

For multiport calibration, the analyzer offers the TOSM / SOLT calibration methods with an automatic 4-port calibration kit. To perform measurements at wafer level, you can use individual calibration standards to carry out a complete 4-port calibration directly on the wafer. Additional embedding / deembedding is thus avoided and the calibration plane is on the probe tips. The calibration standards may be processed directly on the wafer but they are usually offered as a calibration substrate by the probe manufacturer. The SussCal calibration software controls the probes and the network analyzer, makes the settings and thus automates the calibration process. Electrical lengths as well as the capacitive and inductive behavior of the calibration standards on the substrate are known. They can thus be taken into consideration by the software during calibration.

FIG 1 The RF Network and Component Analyzer R 3860 A from Advantest combines measurements on passive components, mixers, balanced components and complex modules in one instrument.

Photo: Suss Microtech

FIG 2
Differential dual |Z| probe.

FIG 3
Through connection (thru) between two differential probes.

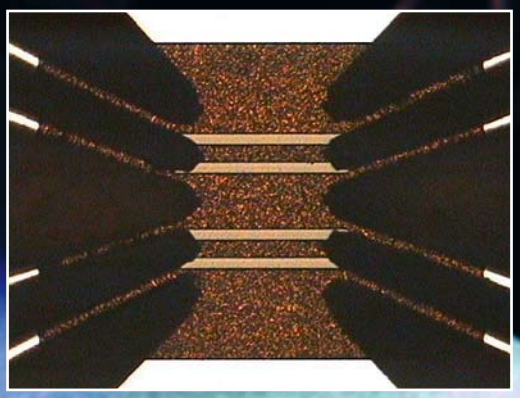


FIG 4
Differential measurements directly on the wafer with the RF Network and Component Analyzer R3860A from Advantest.

Photo: Suss Microtech

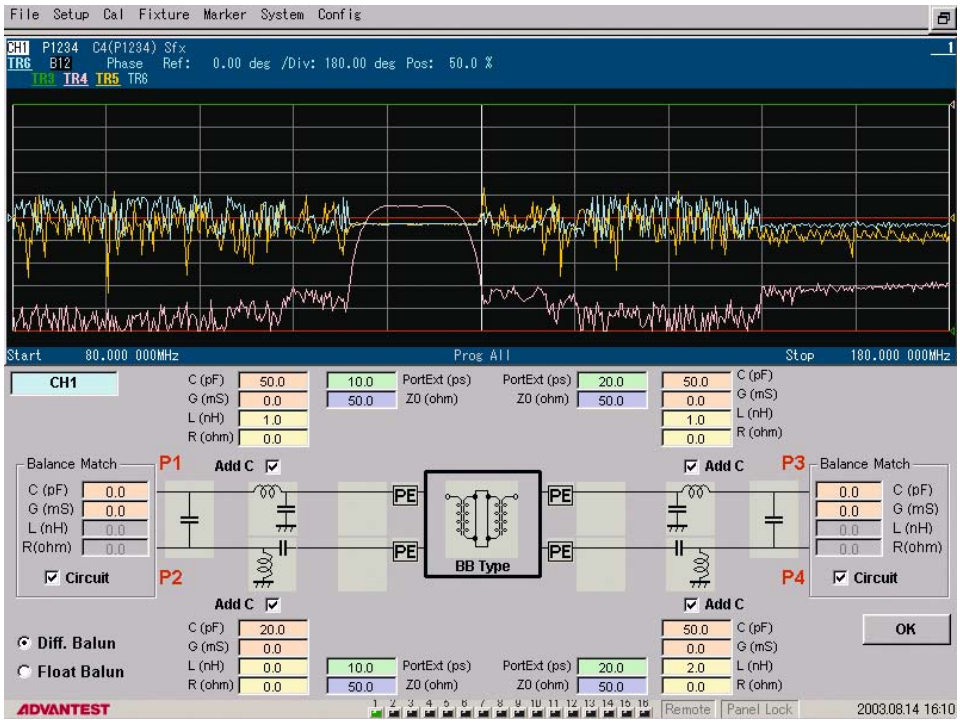


FIG 5 Analysis of a differential filter with the RF Network and Component Analyzer R 3860 A from Advantest.

Positioning and calibration process

First, the position of the |Z| probe is adjusted. Then, the wafer and the calibration substrate are set in an assigned coordinate system with X, Y, Z and theta (alignment process). After the zero point is defined in the software (home position), the probes can be positioned automatically. The SussCal calibration software manages up to three coordinate systems and can automatically switch between them.

The quality of the contacts is then checked by measuring a short through connection (thru). Probe contacts on the wafer are sufficient if the S parameters S_{11}, S_{22}, S_{33} and S_{44} are <20 dB. FIG 3 shows a thru between two differential probes.

You can now start the actual calibration process. The position of the probes remains constant while the wafer is moved by the control software in such a way that contact is made with the calibration standards on the wafer (SOLT).

For differential measurements, it is crucial that the probes used are highly balanced, exhibit reliable and reproducible contact behavior, and can tolerate different heights. The differential dual |Z| probes from Suss Microtech meet these requirements and are therefore highly suitable for wafer tests in production (FIG 2).

The structure of the dual |Z| probes consists of ground–signal–ground–signal–ground (GSGSG) so that the differential signal is present at the two S tips. Of course, only the differential balanced signal is wanted, not unbalanced components. Different cross sections and lengths may cause such mode conversions. To avoid these, the probe contacts are semicircular in shape and precisely designed in micro-electromechanical systems technology (MEMS).

After completing calibration, you can then start the actual measurement on differential filters (FIG 5), for example.

Summary

In the past, only unbalanced measurements were common, but balanced ones can now be added. However, this requires a combination of fast multiport network analyzers, differential probes and special calibration substrates. An all-in-one, fully automatic solution for differential measurements directly on the wafer is now available.

Andreas Henkel

More information and data sheet at www.rohde-schwarz.com (search term: R3860A)

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[*] RF Component Analyzer R 3860 A from Advantest: Network and component analysis made easy. News from Rohde & Schwarz (2003) No. 180, pp 39–41

Microwave Signal Generators R&S®SMR

Universal sweep generators for network analysis

The Microwave Signal Generators R&S®SMR are popular signal sources for the frequency range up to 60 GHz. With their outstanding technical characteristics, small dimensions and unparalleled price/performance ratio, they are crucial in research, development and production. Owing to a special interface, all generators can be combined with the Spectrum Analyzers R&S®FSP or R&S®FSU to form a tracking system for scalar network analysis that satisfies all requirements for frequency range, dynamic range and sweep time.

Tracking systems for all purposes

By combining a Microwave Signal Generator R&S®SMR with one of the Spectrum Analyzers R&S®FSP or R&S®FSU, you can obtain a tracking system for scalar network analysis (FIG 1). This system also allows you to perform measurements on frequency-converting two-ports such as mixers, frequency multipliers or dividers, since the frequency sweep settings of generator and analyzer can be offset. All models of the R&S®SMR family of generators come equipped with the necessary interface, making it easy to upgrade the spectrum analyzers with the option R&S®FSP-B10. And that's not all: The special interface of the generators also permits operation

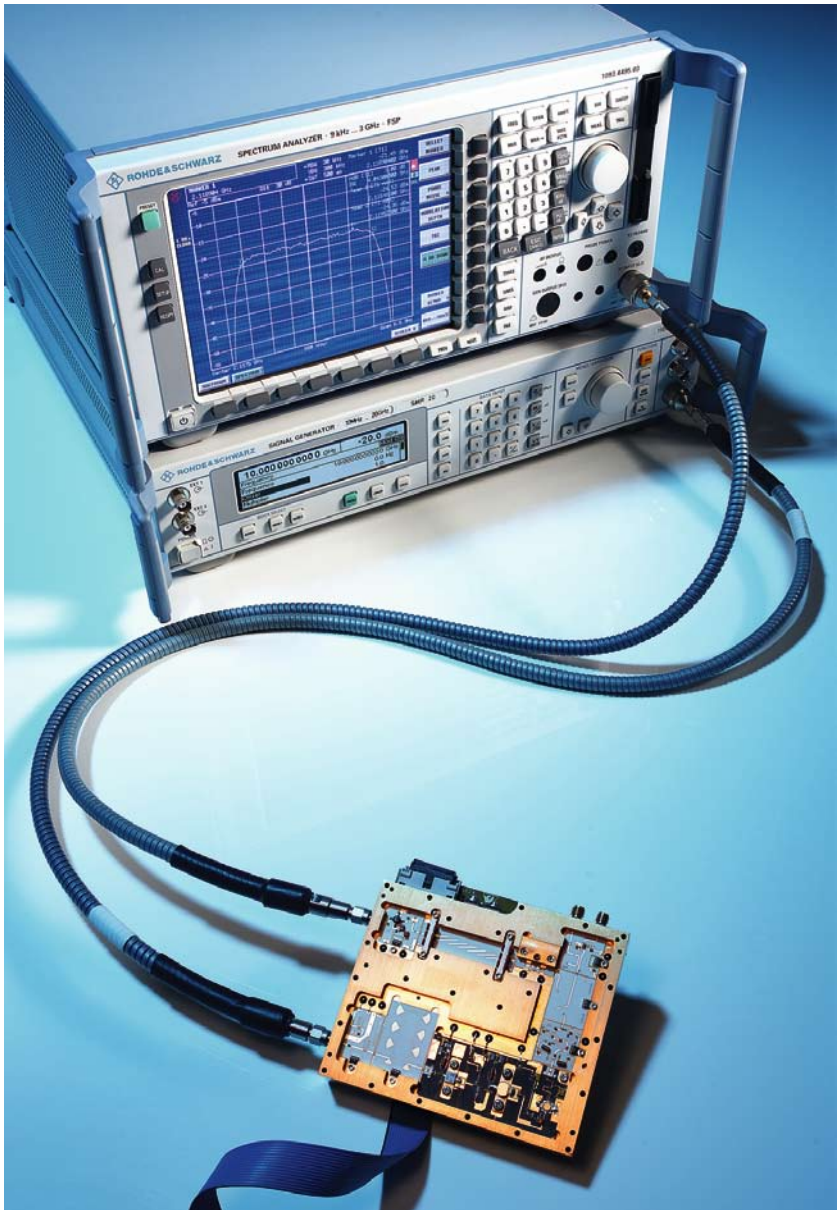

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FIG 1
A perfect match: Combined, the R&S®SMR generators and the R&S®FSP or R&S®FSU analyzers form a powerful tracking system for scalar network analysis.

with the Vector Network Analyzers R&S®ZVR, ZVC, ZVM and ZVK which cover the frequency range up to 40 GHz, depending on the model. Measuring frequency-converting DUTs thus becomes child's play (FIG 3).

Step sweep

The interaction of an R&S®SMR with a spectrum or vector network analyzer depends on a function that has been a standard feature in all Rohde & Schwarz generators right from the start, i.e. the List mode. In this operating mode, first a list with frequency values and their assigned level values is created. The generator can now work through this list step by step via Auto mode or external trigger. If the list contains ascending frequency values at a constant level, a crystal-controlled digital step sweep is performed that may be very fast.

Basically, these lists can be created either manually or via remote control. When the R&S®SMR is used as a tracking generator, the spectrum or vector network analyzer automatically generates the required list and loads it into the generator via the IEC/IEEE bus, without involving the user. Next, the analyzer activates the List mode in the generator via remote control. After the generator has processed a frequency point, it sends a BLANK signal as an acknowledgement, which prompts the analyzer to issue a new trigger, and so forth. This ensures that both the generator and the analyzer are on the correct frequency before the analyzer initiates a measurement. Of course, these frequencies are identical for DUTs that are not frequency-converting (attenuators, amplifiers, filters, etc); for frequency-converting DUTs (frequency dividers or multipliers, mixers, and so on), an appropriate frequency offset has been set.

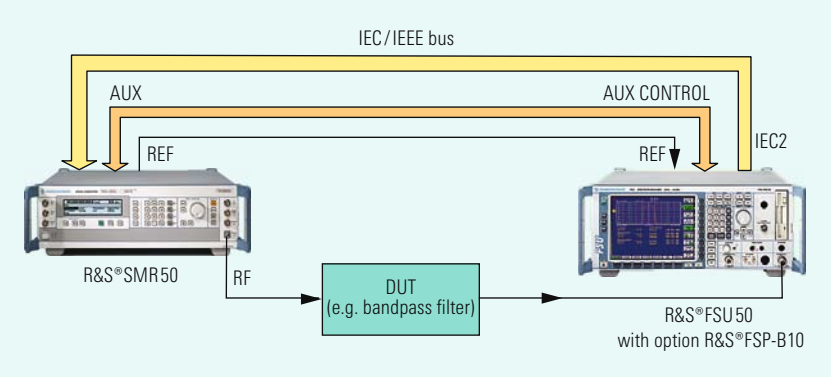


FIG 2 Transmission measurement with the R&S®SMR50 and the Spectrum Analyzer R&S®FSU50.

FIG 2 shows a transmission measurement (magnitude of S_{21}) with an R&S®SMR50 and an R&S®FSU50 as an example. This combination of instruments allows measurements up to 50 GHz without any difficulties. All measurement parameters (start and stop frequency, RF level, sweep time, etc) are set only on the spectrum analyzer. In addition to the transmission value measurements on twoports of any kind, harmonics and spurious suppression can be determined.

The outstanding selectivity and linearity characteristics of the spectrum ana-

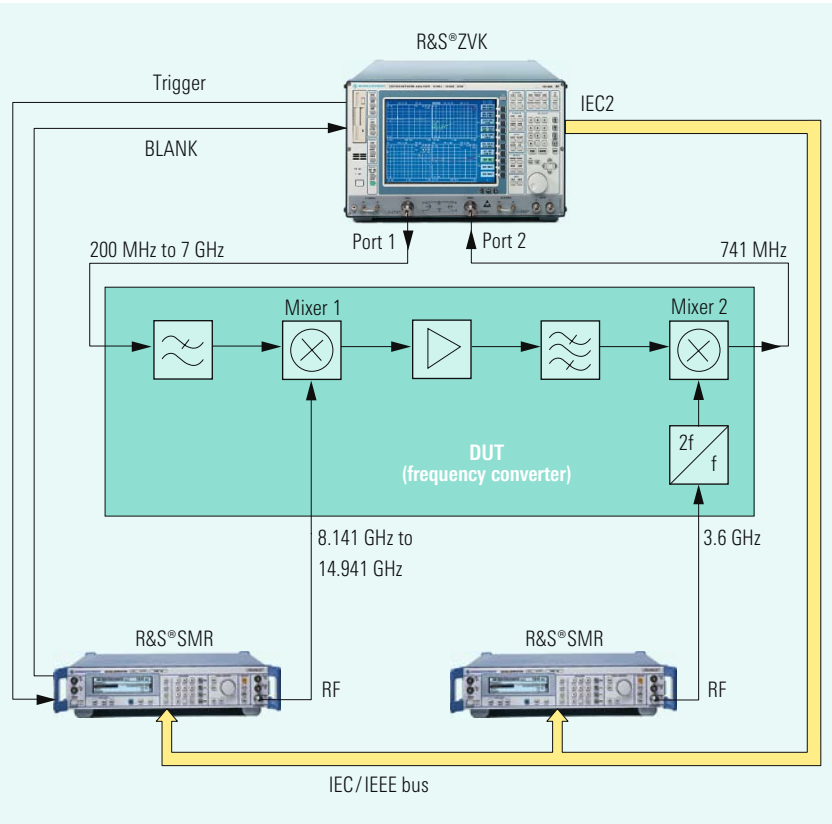


FIG 3 Measurement of a double frequency-converting receiver frontend using the R&S®SMR and R&S®ZVK.

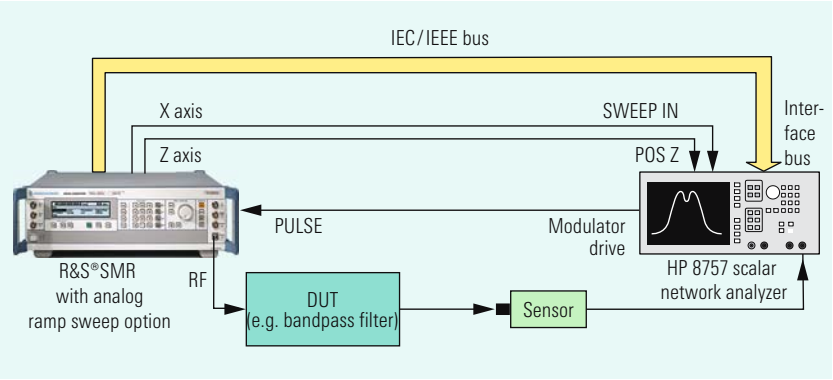


FIG 4 Transmission measurement with the R&S®SMR and the HP8757 scalar network analyzer.

lyzers yield a dynamic range of up to 80 dB. This is a huge advantage compared to the use of conventional scalar network analyzers which are extremely broadband at the high-frequency end. To obtain a minimum dynamic range of approx. 60 dB with conventional scalar network analyzers, considerable filtering is required at the low-frequency end; this, however, significantly reduces the measurement speed, e.g. to several seconds per sweep. Again, the test setup shown in FIG 2 is clearly superior; depending on the selected setting, up to three frequency sweeps per second are feasible.

FIG 3 shows measurements on a frequency converter with an input range from 200 MHz to 7 GHz. The fixed intermediate frequency at the output is 741 MHz. This test setup allows you to determine the conversion gain versus the frequency, which is a standard measurement on receiving components. The frequency must be set as follows:

- R&S®SMR on mixer 2 fixed at 3.6 GHz
- Receive frequency of the R&S®ZVK fixed at 741 MHz
- Generator of the R&S®ZVK set to a frequency sweep from 200 MHz to 7 GHz
- R&S®SMR on mixer 1 set to a frequency sweep from 8.141 GHz to 14.941 GHz

The levels must be set in such a way that the converter can function properly. All settings, including those of the two generators, are made via the convenient user interface of the R&S®ZVx.

Analog ramp sweep

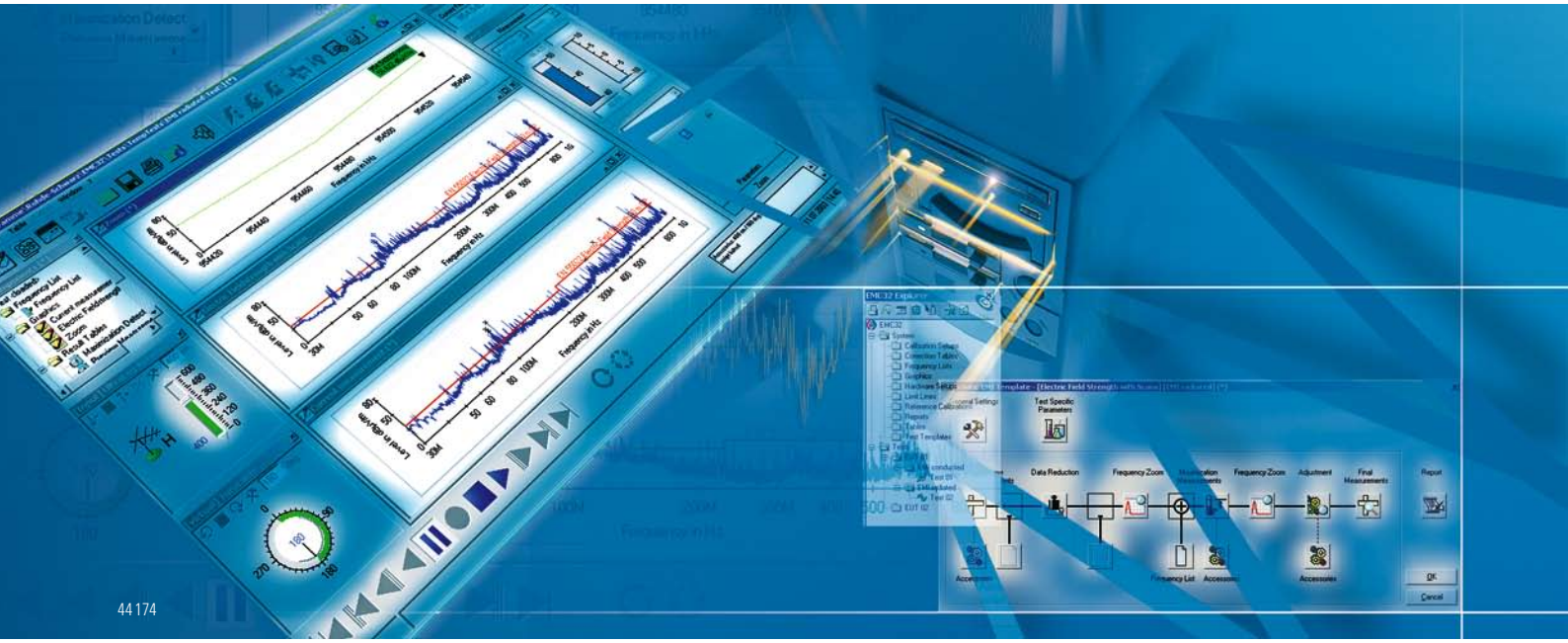
The R&S®SMR-B4 analog ramp sweep option adds a function to the microwave signal generators of the R&S®SMR family that corresponds to the analog frequency sweep of traditional sweep generators. The frequency sweep generated with this option is thus fully suitable for the operation of conventional scalar network analyzers such as the well-known HP8757. Depending on the setting, up to ten complete sweeps per second can be achieved. Large numbers of such network analyzers with diode sensors are still used in the upper microwave region because they are a favorably-priced alternative to vector network analyzers or systems with spectrum analyzers. Due to the broadband nature of diode sensors, however, strict requirements are specified for harmonics, subharmonics and spurious suppression in order to keep measurement errors to a minimum. All members of the R&S®SMR family fully satisfy these requirements.

FIG 4 shows a setup for transmission measurements (magnitude of S_{21}) on a twoport. In instrument combinations with spectrum or vector network analyzers, the generators are controlled by the analyzers; if you use the HP8757, it's just the other way round. All major parameters such as start and stop frequency, frequency markers, sweep time and RF level are set on the R&S®SMR. Each time new values are set, the generator transmits both the start and the stop frequency via the IEC/IEEE bus to the HP8757, which then displays the values. In a next step, the R&S®SMR assumes control of the entire sweep. The tasks of the HP8757 are limited to measuring and displaying; only basic settings need to be made on the analyzer.

The HP8757 can be operated in DC or AC mode. The AC mode setup is shown in FIG 4. During DC mode operation, the connecting line from the modulator drive output of the HP8757 to the PULSE input of the R&S®SMR may be omitted. Sensitivity in DC mode is limited to approx. –55 dBm, depending on the sensor used, while in AC mode it may be better by 3 dB to 4 dB.

Wilhelm Kraemer

More information about the individual instruments and data sheets at www.rohde-schwarz.com (search term: type designation)



EMI Measurement Software R&S®EMC32-E from Rohde&Schwarz has already proven to be a powerful tool for computer-controlled EMI measurements in accordance with commercial standards as well as for automatic test sequence control [1, 2]. The new module R&S®EMC32-E+ now adds many powerful features to the basic software – in the field of military RFI measurements, for example – and completely meets the requirements for detecting electromagnetic interference.

EMI Measurement Software R&S®EMC32-E+

All-purpose software for complete EMI measurements

Electromagnetic interference fully under control

The new EMI Measurement Software R&S®EMC32-E+ – the successor to the tried-and-tested EMI Software R&S®ES-K1 – is the latest addition to the advanced 32-bit R&S®EMC32 software platform from Rohde&Schwarz and runs on the current Windows® 2000/XP operating systems. The R&S®EMC32-E+ is used to precisely and completely collect, evaluate and document RFI voltage, power and field strength. You can perform purely manual and partially or fully automatic measurements in accordance with either commercial or military standards. In addition to current EMI test receivers and spectrum analyzers from Rohde&Schwarz, the software also supports many earlier-model test receivers. You can also control a variety of EMI measurement equipment such as masts and turntables, MDS absorbing clamps, artificial mains networks and switch units for switching transducers and antennas.

Versatile with numerous features

The R&S®EMC32-E concept takes different operational requirements into account: Expert users can personally define all test templates and test parameters, while users who are less familiar with all standards and regulations can quickly obtain reliable and reproducible results by means of predefined test templates, limit lines and fully automatic measurements.

The upgraded EMI Measurement Software R&S®EMC32-E+ now offers a wider range of integrated templates and

covers the fields MIL-STD, automotive applications and RFI power measurement. In addition, capabilities for selecting parameters and adapting automated test sequences to the measurement task and environment at hand have been expanded. The number of links performing operations during a scan or sweep has been increased as well so that even the highest demands with respect to flexibility, measurement speed and interactivity can be met (FIG 1). Moreover, a backup/restore function was added to quickly and easily store measurement data and device configuration in cyclic intervals. Also new is the System Check function stipulated by military standards in conjunction with a signal generator for verifying the signal path, for example (FIG 2).

The software offers the following predefined measurement types, including the corresponding limit lines and analysis methods for automatic EMI measurements:

Conducted EMI

- RFI voltage with probe (individual measurement point)
- RFI voltage with artificial mains network (single-phase, two-line and four-line systems)
- RFI current with current probe (individual line)
- RFI power with absorbing clamp and slideway
- RFI current with current probe in compliance with MIL-STD-461C/D/E
- RFI voltage/RFI current in compliance with EN 55025 (automotive)
- System check with direct or coupled signal supply

Radiated EMI

- Electric field strength with antenna mast and turntable
- Electric field strength with the Shielded TEM Cell R&S S-LINE including open-area correlation
- Electric field strength with GTEM cells (GHz transverse electromagnetic cells) including open-area correlation
- Magnetic/electric field strength in compliance with MIL-STD-461C/D/E
- Radiated emission with antenna in compliance with EN 55025 (automotive)
- System check with direct or radiated signal supply

Normalized site attenuation (NSA)

- Determination of normalized site attenuation using broadband antennas or
- Tuned half-wave dipoles

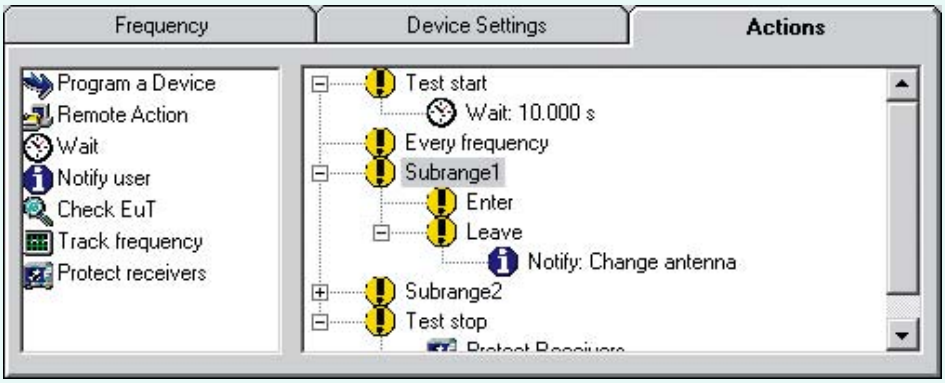


FIG 1 Any phase of a scan or sweep can be linked with specific actions. These actions include the display of messages during the test sequence, adjustable delays, and the programming or remote control of other instruments, e.g. via USB or IEC/IEEE bus interface.

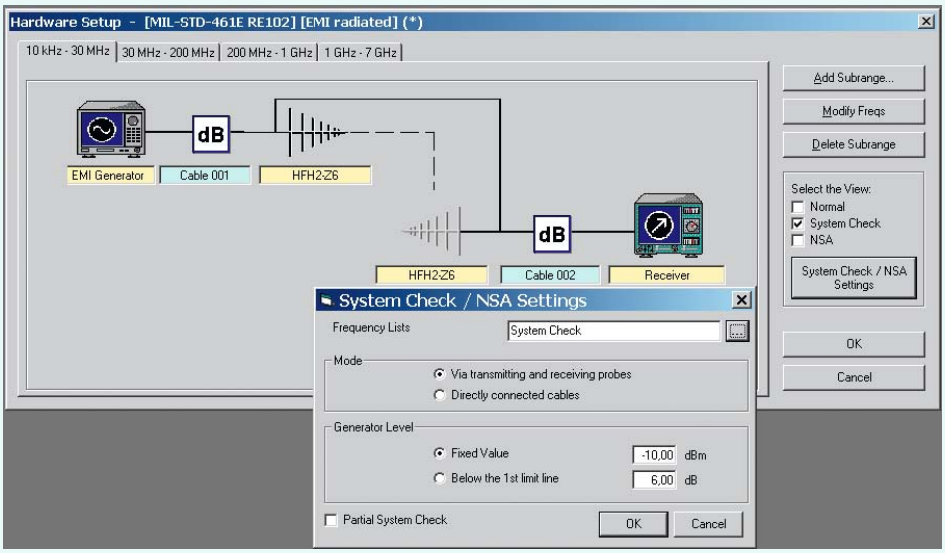


FIG 2 Configuration settings for performing measurements in compliance with MIL-STD-461E RE102 (radiated emission) in the System Check view, and entry window for the System Check parameters.

Optimum adaptation of automatic EMI measurements

An automatic test sequence contains the following phases regardless whether RFI voltage, RFI power or RFI field strength is being measured: prescan measurement, data reduction, maximization measurements, final measurement and report generation. R&S®EMC32-E+ offers very flexible test phases and can be adapted to widely different test conditions and specifications: Instead of performing a new, time-consuming prescan measurement, you can use an existing prescan result. This allows you, for example, to evaluate data whose limit line has changed compared to the previous measurement or to perform an evaluation using other settings for data reduction, frequency optimization and/or mast and turntable positions (FIG 3).

Instead of using the data reduction result, you can also apply an existing final measurement result obtained from a previous measurement. This is useful, for example, if you merely want to repeat the final measurement. The subsequent test phases for making the level or frequency more precise are then optional.

Another way to adapt the automatic test sequence to special specifications is to replace the data-reduced and frequency-optimized prescan measurement points with an existing frequency list, which enables you to analyze specific frequencies, for example. You can also add a frequency list to the frequency points that have already been determined (FIG 3).

Except for certain tests specified by MIL-STD-461C and with S-LINE and GTEM cells, data reduction itself consists of searching for the local frequency maxima within the specified subranges and, if additionally required, performing peak reduction based on a definable number of maximum levels, e.g. to detect conspicuous narrowband interferers. The subsequent acceptance analysis excludes irrelevant points. Finally, it is also possible to perform maxima reduction in order to limit the total number of final test points (FIG 4).

By selecting "Interactive data reduction", you can again edit the data reduction result table and change the list of frequencies to be analyzed.

If you activate "Flexible test flow", a dialog allows you to skip the rest of the test sequence for the current frequency subrange after data reduction has been completed and then immediately continue with the next subrange.

For certain tests specified by MIL-STD-461C, data reduction starts by differentiating between narrowband and broadband interferers in accordance with the tuning method or by performing a peak/average comparison. The remaining steps and the final evaluation with the narrowband/broadband limits are then performed separately for the two result tables (FIG 5).

Future-proof for many years to come

The modular design of the 32-bit R&S®EMC32 software platform and the flexible device driver concept have proven to be successful with all existing modifications and expansions as well as in the development of new application-specific modules. Likewise, EMI Measurement Software R&S®EMC32-E+ can be quickly and reliably adapted to future measurement tasks, amendments to standards or new hardware requirements.

Summary

Anyone who performs computer-controlled EMI measurements using state-of-the-art software expects the software to be a universal and convenient tool that can reliably collect, evaluate and document measurement results. In addition to being a time-saving tool, the software must also offer optimum reproducibility and accuracy of results. Further requirements include a clear operating concept, high stability and future-proofness. Moreover, automatic EMI measurements require the software to be easily adaptable to a variety of measurement tasks and individual measurement environments. This means that the software manufacturer must be highly experienced in the area of software design and development. The clear solution to all these requirements is the EMI Measurement Software R&S®EMC32-E+.

Karl-Heinz Weidner

More information and data sheet at www.rohde-schwarz.com (search term: EMC32-E+)

REFERENCES
[1] EMC Measurement Software R&S®EMC32: Comprehensive EMI and EMS measurements at a keystroke. News from Rohde&Schwarz (2001) No. 172, pp 27–29
[2] EMC Measurement Software R&S®EMC32-E: Automatic RFI field strength measurements. News from Rohde&Schwarz (2003) No. 179, pp 23–25

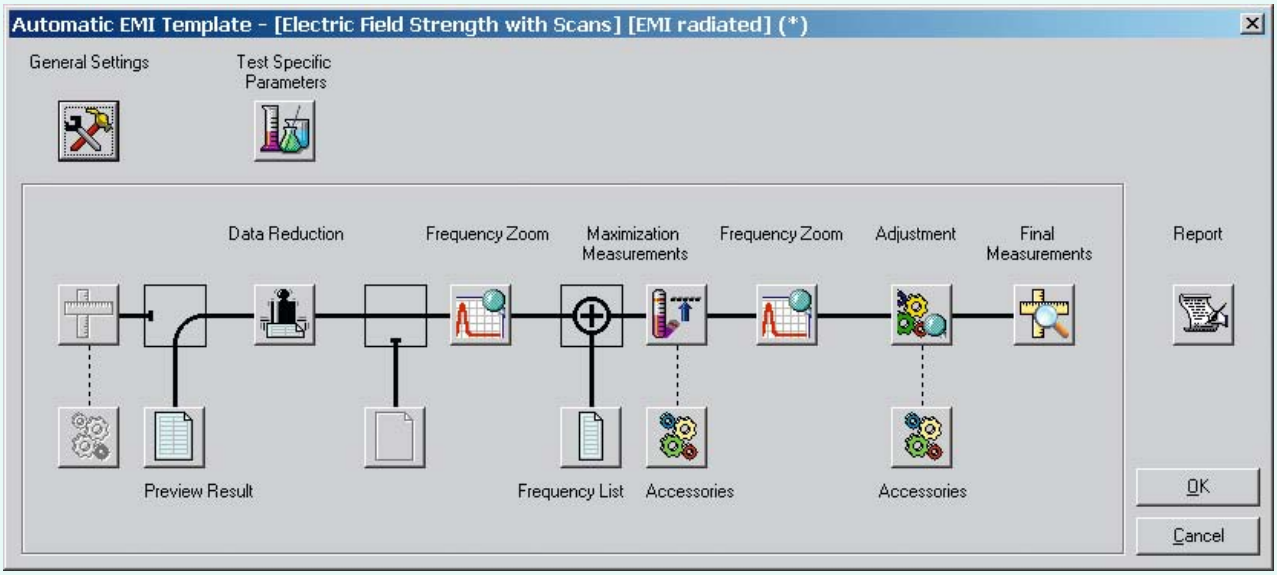


FIG 3 Test template editor for an automatic RFI field strength measurement. The editor shows setting elements for the parameters required for data reduction, frequency and level optimization including mast/turntable positioning, final measurement and report generation. Instead of the prescan measurement, an existing measurement result is used. In addition to the frequencies determined from data reduction and frequency zoom, the values from a separate frequency list are added for further analysis.

FIG 4
General data reduction editor: The subrange maxima reduction (lower path) and/or peak reduction with optional limitation to a predefined number of results (upper path) are followed by an acceptance analysis with reference to user-selectable limit line(s) and a further optional maxima limitation. Moreover, the result can be edited during the measurement ("Interactive data reduction"). By activating "Flexible test flow", you can skip subsequent steps in the test sequence, if required.

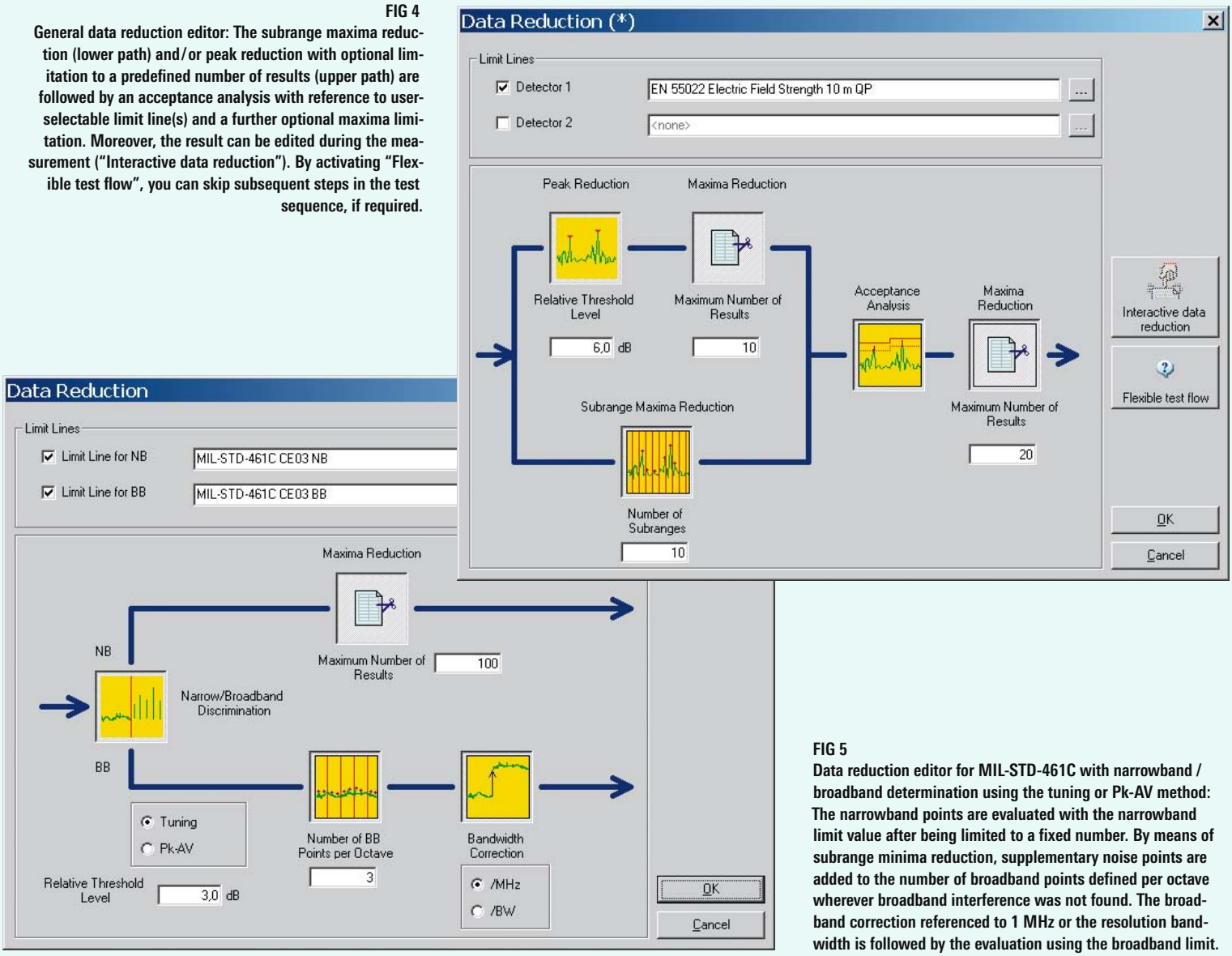


FIG 5
Data reduction editor for MIL-STD-461C with narrowband / broadband determination using the tuning or Pk-AV method: The narrowband points are evaluated with the narrowband limit value after being limited to a fixed number. By means of subrange minima reduction, supplementary noise points are added to the number of broadband points defined per octave wherever broadband interference was not found. The broadband correction referenced to 1 MHz or the resolution bandwidth is followed by the evaluation using the broadband limit.

MPEG-2 Monitoring System R&S®DVM

TV – just pictures and sound? Not with digital TV!

Digital data services enhance TV and are of great interest to viewers, network operators and TV program providers. With the Data Broadcast Analysis R&S®DVM-K11 option, the MPEG-2 Monitoring System R&S®DVM analyzes all transmission methods for data services that have been defined for DVB, including DVB-H.

Important abbreviations not explained in the text:

ACAP	Advanced common application platform
AIT	Application information table
ARIB	Association of Radio Industries and Businesses
ATSC	Advanced Television Systems Committee
BIOP	Broadcast inter ORB protocol
DDB	Download data block
DII	Download info indication
DSI	Download server initiate
DSM-CC	Digital storage media – command and control
INT	IP/MAC notification table
IP	Internet protocol
MAC	Medium access control
MHEG	Multimedia and Hypermedia Information Coding Experts Group
MHP	Multimedia home platform
PES	Packetized elementary stream
PID	Packet identifier
OCAP	Open cable application platform
UNT	Update notification table

Comprehensive analyses

With its error-protected transmission channels and high bandwidth, digital TV is opening up a broad scope of new data services that far surpass those known from analog TV, such as teletext or subtitles. Development of these services is rapidly progressing; however, standardization bodies and system groups such as MPEG, DVB, MHEG, ACAP, OCAP, ATSC and ARIB have defined standardized protocols and structures to ensure that services of different providers can be used with uniform hardware.

With the Data Broadcast Analysis R&S®DVM-K11 option, the MPEG-2 Monitoring System R&S®DVM analyzes all transmission methods for data services that have been defined for DVB, including DVB-H (FIG 3). It controls signaling as well as the syntax and timing of all protocol elements, thus allowing comprehensive testing of signal function and efficiency. The R&S®DVM tests the signaling of the data services, which ensures that set-top boxes can actually display the services received. With standardized signaling, the data service in the transport stream tree structure is shown in plain text. The R&S®DVM quickly detects any signaling not in line with the standard. To provide you with a concise overview, the data broadcast analysis option displays all references (descriptors) of this service in the Overview display. It also provides the table in which these descriptors are listed (FIG 1).

In addition to correct referencing in order to find the data service in the MPEG-2 transport stream, the receiver also needs additional tables with information specifying which section of the data is to be used in which way. This includes information about MHP applications, e. g. the name of the start program (Java Initial Class) in the AIT. There are also tables for DVB-H and IP services (INT) or the system software update of the set-top boxes (UNT). Using the table interpreter, all these tables can be clearly displayed and controlled.

Just as important are the applications or content a service provides. This appears to be quite complicated because the transmission protocols are not identical for all data services. For example, an MHP application (see also box on page 48) is transmitted via the object carousel, which is a complex structure of different DSM-CC sections (DSI, DII and DDB sections with BIOP messages). To provide a better overview, the R&S®DVM-K11 option graphically displays this structure in the form of a tree (protocol window in FIG 1). Apart from the elements for data transport, the structure of the actual data (application) is of interest. With an MHP application, the data consists of directories, files, stream references or timed references (stream events). To determine the content and to identify the transmission elements (protocol), the transmission structure must first be analyzed. The R&S®DVM automatically performs all of the above – and clearly displays all data – when a data service is selected.

If the content determined by the R&S®DVM does not correspond to the original application, problems in the receiver will occur. In such a case, the interpreter and raw data function in the R&S®DVM enables you to check and analyze the references (DSI, DII and

BIOP messages). FIG 2 shows a DII display as an example.

For other data services such as teletext, video programming service (VPS), wide screen signaling (WSS), or subtitling, a PES protocol is used. Although this structure is complex as well, it can be checked and analyzed down to the bit level using the interpreter. As a special feature with teletext and VPS, the content displayed is interpreted.

In addition to flawless data service structure, short response time (performance) is essential to gaining acceptance with viewers. By measuring timing, the performance of a data service can be optimized. Module loading time clearly shows how long it may take in the worst-case scenario until the corresponding part of the program or associated background image has been loaded in the receiver. These measurements make the testing and creation of measurement sequences (determination of the peak value) superfluous; together with the module-specific data rate measured, they enable efficient optimization of the data service in the carousel generator. FIG 4 shows the transmission time display of a module.

But timing also depends on the data rate, which is of crucial economic significance. Several program and service providers usually share a transport stream.

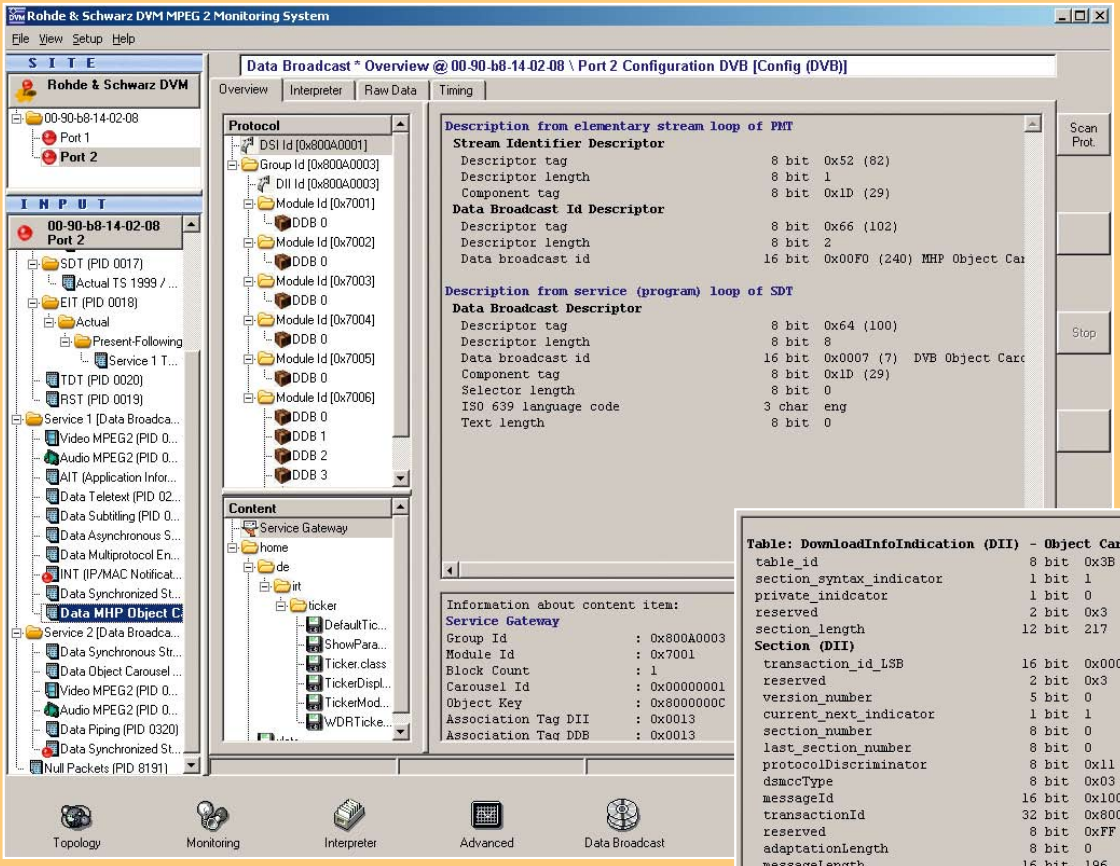


FIG 1
The R&S®DVM user interface with the data broadcast analysis option in the Overview view.

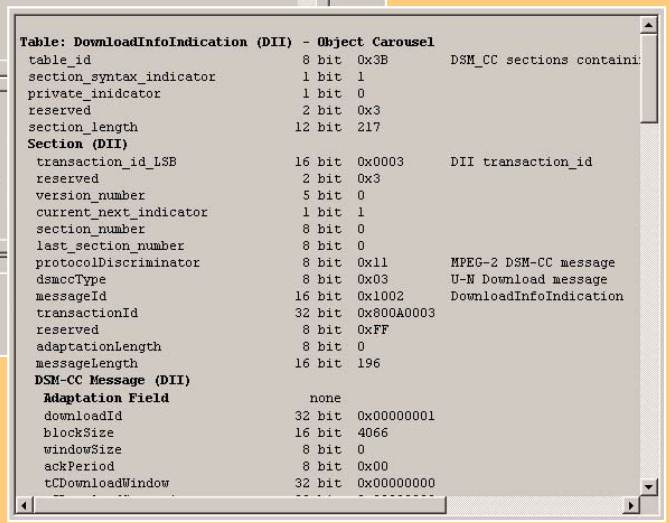


FIG 2
Interpreter function of the data broadcast analysis option.

Applications	Transmission method (protocol)
MHP / MHEG-5 application download	DVB object carousel
System software update (SSU)	DVB data carousel
IP data transmission DVB-H	Multiprotocol encapsulation
Teletext, subtitle, VPS, WSS, private data transmission	Data streaming
Private data transmission	Data piping

FIG 3
Overview of the applications and transmission methods specified for DVB.

The costs are allocated to the users in proportion to the individual data rate, which is why all users want to know the data rate of their service in the transport stream. Using the R&S®DVM, measuring the data rate of individual services is just as easy as measuring the data rate of all other elements of the transport stream.

Summary

The R&S®DVM family of instruments from Rohde&Schwarz already supports the analysis of current and future data services. Even in their basic configuration, these instruments recognize all data services listed in FIG 3, specify the basic parameters such as associated PID and type of data service and measure the data rates.

Moreover, the R&S®DVM-K11 option, which is available for all instruments of the R&S®DVM family, can perform all in-depth analyses and measurements described in this article.

Thomas Tobergte; Harald Weigold

Data services with digital TV

This box provides a brief overview of the variety of data services that are conceivably – or already – available:

Information services (text, usually expanded by multimedia elements):
- Information about the program currently being broadcast
- Overviews of TV programs
- Any kind of news

Interactive applications, or applications linked to a TV program:
- Subtitles
- Integration of the viewer into the current program
- Games

Services requiring a back channel:
- Pay per view/video on demand
- Home shopping/home banking
- Prize games
- E-mail

Services that control the viewer hardware:
- System-based programming and controlling of video recorders, if required
- Automatic software updates of set-top boxes

To implement these services, a wide variety of platforms and protocols has already been created. For example, the **MHP data service** expands the TV receiver via the set-top box to create a multimedia console. It supports numerous functions such as games, home shopping, browsing the Internet pages of TV stations, TV program guides with a standardized layout that is independent of the set-top boxes, display of a sign language interpreter, etc. MHP is actually a standardized operating system for set-top boxes; the MHP applications transmitted with the transport stream are Java programs or HTML documents that run on this operating system; thus, the programs or HTML documents define the individual functionality.

FIG 5 shows an example of the interactive T-commerce TV application for MHP, ACAP and OCAP platforms. The application can be combined with TV ads and allows viewers to order

FIG 5 Example of an MHP, ACAP and OCAP application.

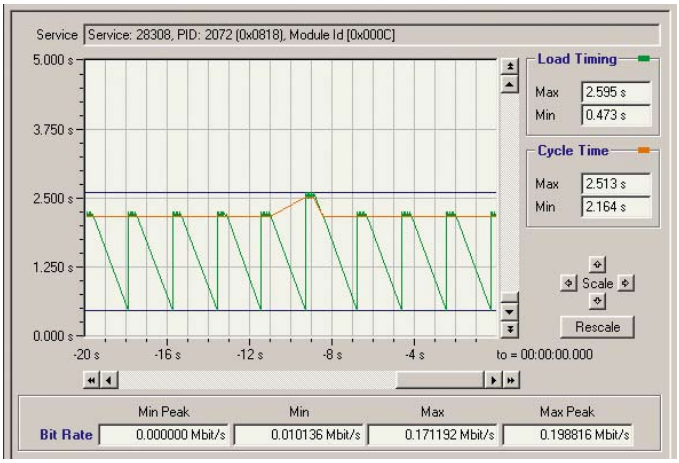


FIG 4 **Timing analysis of a module in the object carousel.**

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

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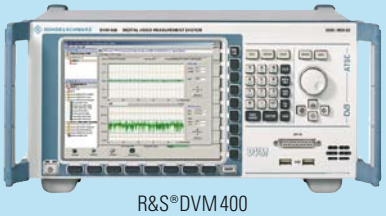


R&S®DVM400

an article directly via their TV set. This application was developed by the Nionex company and is based on their pontegra product. The program is transmitted via the object carousel protocol standardized for DVB.

The **SSU data service** (system software update) enables manufacturers of set-top boxes to update TV sets with state-of-the-art firmware directly at the customer's end and thus to expand functionality and to correct errors. For this purpose, the firmware is broadcast simultaneously with the TV program as a data service in accordance with a standardized method (data carousel protocol and signaling via UNT).

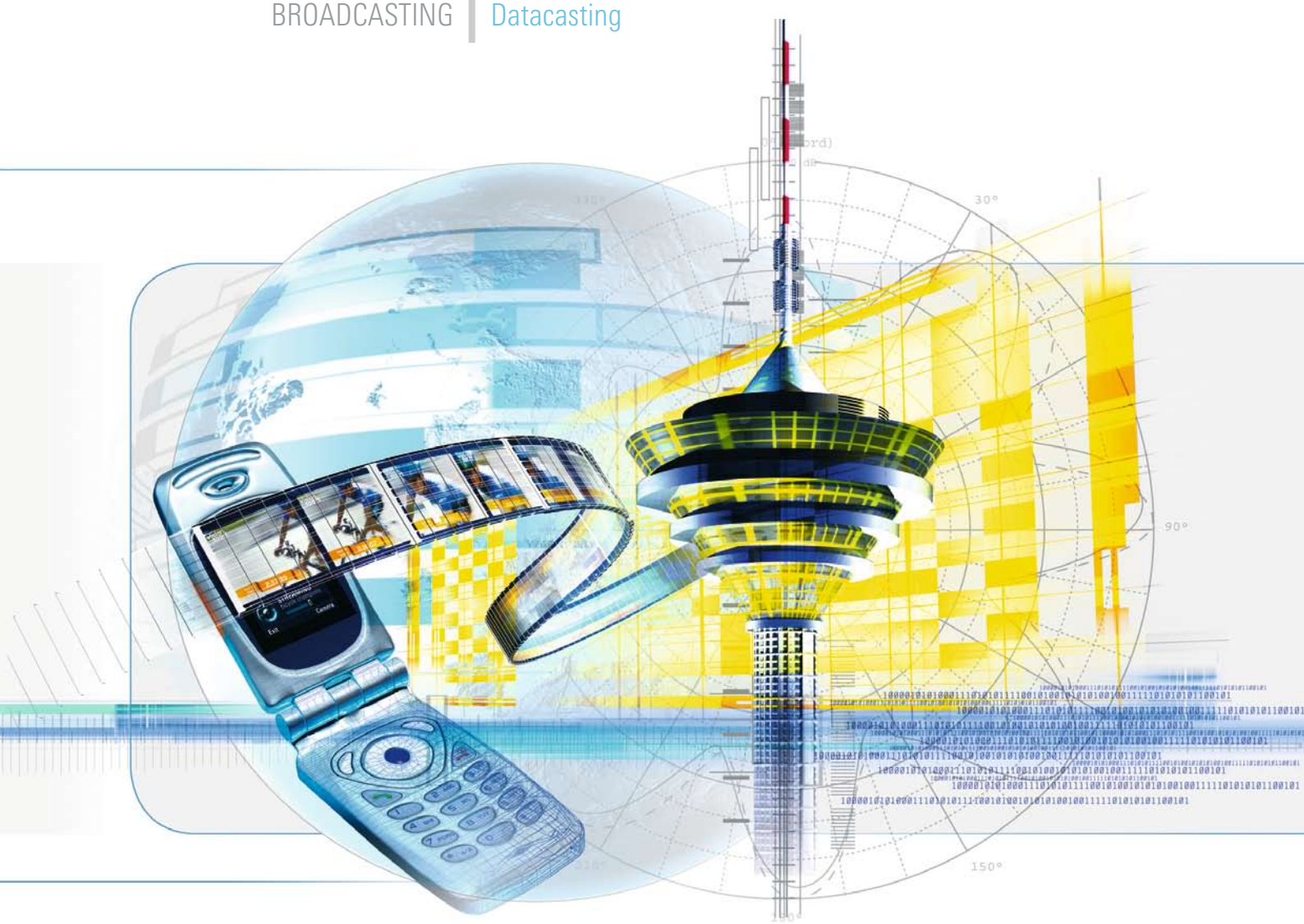
The **IP downstreaming data service** implements another type of firmware or program download. As an alternative to DSL, it uses the high capacity of the TV transmission channel for downloading large amounts of data (music or videos) to the Internet user (PC with DTV receive card). The back channel required for this purpose can be implemented via a telephone connection (modem), for example. This downstreaming occurs temporarily between client and server with fixed MAC and IP addresses. For this purpose, there is also the standardized **MPE transmission method** (multiprotocol encapsulation), which has been further expanded for DVB-H. This brand-new data service was specifically developed for mobile reception on portable, battery-operated equipment. DVB-H is already being broadcast in a test phase (detailed article on DVB-H on page 50).

All these services use protocols that can be checked for errors during transmission by means of a check sum (cyclic redundancy check, CRC). But there are also data services that do not require this protection and which use the PES protocol for transmission (referred to as data streaming), e.g. the **DVB subtitling system**. This system allows subtitles that are pleasing to the eye to be inserted into the picture. The data required is transmitted in its own data channel separately from the video signal; this is beneficial because subtitles for a film can be supplied in different languages without requiring the film to be recoded.

The **VBI data services** also have a PES structure. This designation refers to various applications that are transported in the case of analog TV signals in the vertical blanking interval (VBI). Digital TV transmits these signals in a separate data channel. The digital receivers/set-top boxes properly re-insert the signals into the analog video signal for the TV receiver so that the decoders in the analog equipment can be utilized. This method has the advantage that the existing infrastructures (editing tools, generators and decoders) can still be easily used for analog TV data services that are already well accepted, such as teletext. In addition to teletext, there are further examples:

- Video recorder programming system (VPS)
- Wide screen signaling (WSS)

Finally, there are **proprietary services** whose structures are not standardized. These services are transmitted via the **data piping protocol** (the data is embedded in MPEG-2 transport packets). FIG 3 provides an overview of all applications and transmission methods.



Operating and measurement equipment for the new digital TV standard DVB-H

The new digital TV standard DVB-H, an expansion of DVB-T, enables you to efficiently transmit multimedia content to mobile receivers [*]. Rohde&Schwarz supports the development of new services by offering an all-round portfolio of operating and measurement equipment.

Video goes mobile

The mobile radio industry and broadcasting network operators want to increasingly offer multimedia content such as TV and video streaming for mobile receivers. DVB-H is ideal for this purpose since data is not broadcast continuously but rather bundled in data packets (IP encapsulation), i.e. in bursts. This keeps the energy consumption of user equipment (UE) low. Owing to this timeslot technique, UE can switch off between data packets, thus saving up to 90% in energy. An additional error correction at the IP level (MPE forward error correction) improves reception quality even in the event of high packet loss. In addition to the modulation modes that are commonly used with DVB-T, DVB-H offers a further modulation mode: the 4k mode. This compromise between 8k (limited speed, large single-frequency networks (SFN)) and 2k (very high speed, small SFNs) ensures stable mobile reception even if the speed is very high. Transmission parameter signaling (TPS) bits signal whether the receiver uses DVB-H features and which ones.

Implementation of DVB-H networks

There are several scenarios describing how DVB-H networks may be implemented. Combined DVB-T/DVB-H networks are very likely to be set up specifically for initial implementation phases that need to be cost-efficient. In such cases, DVB-H services would be implemented in existing DVB-T networks (see figure).

Initial DVB-H pilot projects, most of which use Rohde&Schwarz products, have already been started in various countries. Rohde&Schwarz supports its customers in many ways to make existing products DVB-H-compatible. A brief overview of the main operating and measurement products is provided below. For further details, see the box on pages 52 and 53.

Test receiver

The realtime TV Test Receiver R&S®EFA for analog and digital systems identifies error sources fast and specifically. A DVB-T demodulator analyzes the RF signal, demodulates it and provides a realtime MPEG-2 signal for further processing at the output. The DVB-H specific TPS signaling will be evaluated.

MPEG-2 analyzer family

In the digital baseband (MPEG-2), the MPEG-2 Monitoring System R&S®DVM helps to analyze, monitor and check DVB-H implementations. The transmitted DVB-H services are displayed. The data broadcast option enables you to check the data structure and the content and to carry out timing measurements. You can extract and stream the IP content of the DVB-H service merely by pressing a button. Thus, the R&S®DVM offers all functions for complete protocol analysis.

From DVB-T to DVB-H

DVB-H (digital video broadcasting for handhelds) adapts the digital terrestrial TV standard DVB-T, which has been implemented successfully all over the world, to the requirements of mobile operation, especially battery-powered handhelds. The following goals were achieved with DVB-H:

- Transmission of multimedia services
- Energy savings for UE due to time slicing
- Optimum performance for mobile reception due to 4k modulation mode
- Optimum reception quality even in case of high packet loss due to additional error protection (MPE-FEC)

Measurement equipment

MPEG-2 recorder/generator

With the DTV Recorder Generator R&S®DVRG you can record and play digital MPEG-2 video streams of many formats. A comprehensive DVB-H stream library providing reference DVB-H signals for testing is available for the R&S®DVRG. This library also contains video content that was coded with MPEG-4, WM9 (VC1) or H264.

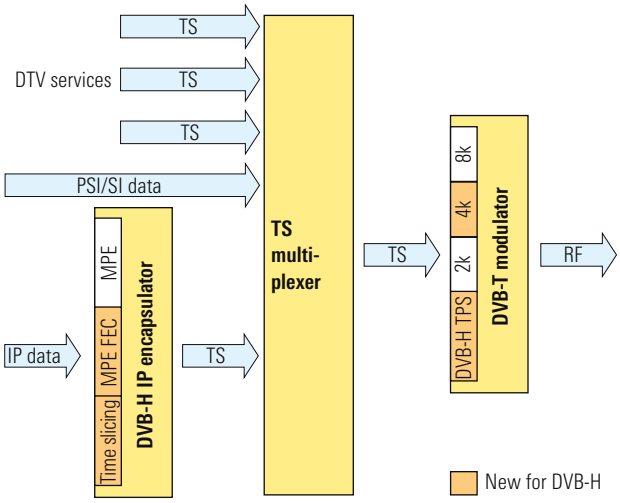
Test transmitter

When operated as a test transmitter, the new Broadcast Test System R&S®SFU offers the latest transmission standards, including DVB-T and DVB-H. Other standards established worldwide can be integrated as software options and expand the platform to create a multistandard system. The outstanding features of the test system are the simulation of the transmission channel by superimposing defined noise signals and the complete channel transmission simulation (fading).

Operating equipment

Datacasting

The DTV IP Inserter and Generator R&S®DIP010 is a key element within a DVB-H system. It inserts the multimedia IP content of the DVB-H services into the DVB transport streams. If the option R&S®DIPH is installed, it performs time slicing, MPE-FEC and multiprotocol encapsulation for standard-conforming DVB-H data streams and supports the current IPv4 Internet protocol as well as the future IPv6 protocol.



Playout center for combined DVB-H / DVB-T operation.

Transmitters

The TV Transmitter Family R&S®Nx7000 provides solutions for digital and analog transmitters, VHF and UHF, in the power classes ranging from 10 W to 20 kW.

All DVB-T TV transmitters for low, medium and high power including the Exciters R&S®SV700 and R&S®SV702 can be upgraded for DVB-H. Only a software and firmware upgrade is required in order to support the 4k modulation mode and TPS signaling. The transmitters of the R&S®Nx7000 family are thus fully compatible with DVB-H.

Simone Gerstl

More information, brochures and data sheets at www.dvb-h.rohde-schwarz.com or at www.rohde-schwarz.com

For a detailed description of the product portfolio from Rohde&Schwarz on DVB-H see the flyer "Video goes mobile", which can be downloaded from the Rohde&Schwarz website.

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[*] DVB-H – new digital multimedia services for mobile terminals. News from Rohde&Schwarz (2004) No. 182, pp 50–53

The product portfolio of DVB-H operating

Baseband/source

DTV IP Inserter and Generator R&S®DIP010

- Time slicing, FEC and signaling of data services via IP/MAC notification table supported for generation of DVB-H compatible data streams
- Insertion of additional data (IP packets) into MPEG-2 transport streams
- Utilization of dedicated MPEG-2 resources (null packets)
- Realtime data insertion at 15 Mbit/s
- DVB-conforming signaling of data services
- Two operating modes: MPEG-2 inserter and MPEG-2 generator mode
- Transport stream interfaces for input and output: ASI, SPI

DTV Recorder Generator R&S®DVRG

- Playing and recording of MPEG-2 / DVB-H transport streams
- Endless generation of transport streams
- Comprehensive library including DVB-H signals
- DVB-H streams with multiprotocol encapsulation, time slicing, FEC
- Software multiplexer for generating application-specific MPEG-2 / DVB-H transport streams

RF/baseband analysis

TV Test Receiver R&S®EFA

- Display of DVB-H signaling (TPS bits)
- Display of interleaver mode
- Support of 2k and 8k modes
- Realtime demodulation, analysis and monitoring
- Various analog and digital TV standards
- Wide selection of measurement functions
- Alarms for various measurement functions (stored internally)
- TS outputs: ASI and SPI
- Optional MPEG-2 decoder

and measurement equipment from Rohde & Schwarz (excerpt)

Modulator / transmitter

DVB-T Transmitter Families R&S®NV/NW7000 / R&S®SV7002

- Full compatibility with DVB-H (4k and TPS)
- Software upgrade of existing transmitters
- Output powers from 10 W to 10 kW
- Complete solutions for VHF and UHF
- Many common features among the various families save costs for spare parts, maintenance and training
- Easy adaptation to modifications of the standard
- Outstanding remote-control characteristics: Web server, SNMP, parallel bus, bit bus
- Various redundancy concepts: exciter standby, passive and active standby, N+1 standby
- Compact and flexible solutions in the low-power range

Broadcast Test System R&S®SFU

- Standard-conforming generation of DVB-H signals: in-depth interleaver, TPS carrier signaling
- DTV multistandard test platform (100 kHz to 3 GHz)
- Large output level range for receiver and chip test applications
- Digital noise source (AWGN) for transmission simulations
- Fading simulator with up to 40 paths
- Internal baseband signal generation
- BER measurement
- Inputs for ASI, SPI, SMPTE 310M and test signals

Digital Video Measurement System R&S®DVM400

- Realtime and detail analysis of MPEG-2 / DVB-H transport streams
- Simultaneous monitoring of up to 20 transport streams
- Playing and recording of MPEG-2 / DVB-H transport streams
- DVB-H data broadcast analysis
- Streaming of DVB-H IP contents

Friedrich Schwarz (left), President and CEO of Rohde & Schwarz, receives the International Headquarters Award from Teo Ming Kian, Chairman of EDB.

International Headquarters Award for Rohde & Schwarz in Singapore

Rohde & Schwarz Singapore is one of the most innovative companies in the region.

In addition to its service and support center, Rohde & Schwarz Singapore also set up the Rohde & Schwarz learning center and the regional development & applications center in a short period of time. In recognition, the company has received the International Headquarters Award from the Singapore Economic Development Board (EDB). Teo Ming Kian, Chairman of EDB, personally presented the award to President and CEO Friedrich Schwarz and praised the outstanding entrepreneurship of Rohde & Schwarz in Singapore.

Dr Günther Beckstein (left), Bavarian Minister of the Interior and vice leader of the Bavarian state, visited the Rohde & Schwarz stand at SYSTEMS 2004.

Rohde & Schwarz SIT GmbH at SYSTEMS 2004

At SYSTEMS 2004, Rohde & Schwarz SIT presented its proven encryption solutions in the IT security area, which was the clear winner of the fair.

The ATM version of the R&S®SITLine was presented as a solution for broadband encryption at SYSTEMS 2004. Dr Günther Beckstein, Bavarian Minister of the Interior and vice leader of the Bavarian state, paid a visit to the stand. Harry Kaube, Head of Sales, explained to him how to use of the ELCRODAT 6-2 devices for secure ISDN communications.

Rohde & Schwarz Japan offers its own repair and maintenance service

A new service center at Rohde & Schwarz Japan K.K. in Saitama is responsible for the maintenance and repair of Rohde & Schwarz devices since 01 November 2004. This task was previously handled successfully by the Advantest Customer Support Corporation.

Rohde & Schwarz has been expanding its presence in Japan over the last two years. In 2003, the company established the Support Center Japan (SCJ) in Tokyo. In March 2004, Rohde & Schwarz set up new sales offices in Shin-Yokohama, Osaka and Tokyo. With the new service center in Saitama, Rohde & Schwarz will offer its Japanese customers marketing, sales, support and maintenance for all products from a single source. Rohde & Schwarz is taking this step in order to gain an even better understanding of the specific requirements of this growth market and thus further strengthen its market position in Japan.

Encryption system for NATO

The Rohde & Schwarz subsidiary Rohde & Schwarz SIT GmbH has received an order from the NATO procurement department NC3A for devices of the ISDN high-end encryption system ELCRODAT 6-2. Rohde & Schwarz SIT GmbH has already supplied these devices to German government authorities and the German Armed Forces.

The NATO military committee chose the ELCRODAT 6-2 as a system for ISDN basic rate access of the NATO ISDN devices to be secured. These multifunctional crypto devices

can be used to encrypt and decrypt phone calls, fax and data transmissions at all security levels. They also protect messaging systems and video conferences. In future, communications between NATO users that are sent via public ISDN will also be secured as a result.

Modern radio network for new light rail in Lisbon

Siemens SA – Information & Communication has commissioned R&S BICK Mobilfunk, a subsidiary of Rohde & Schwarz, to supply and put into operation a TETRA radio system for the light rail metro system Metro Sul do Tejo (MST) in Lisbon. The radio system will serve as the backbone of a computer-controlled traffic management system that will keep passengers at central stops up to date with relevant information, such as departure times. In addition, the operating personnel and tram drivers will use the TETRA system as a voice communications network. The TETRA network and its wide range of possible applications can considerably lower operating costs for communications. The new radio system will go into operation in 2005.

A major reason for receiving the order was the integration of the *ACCESSNET*®-T system into the VICOS control center from Siemens. R&S BICK Mobilfunk had already successfully implemented this integration in the case of the radio network of the street car system in Würzburg, Germany.

Exclusive German distributor for EXFO E.O. Inc.

Effective immediately, Rohde & Schwarz Vertriebs GmbH will be exclusively responsible for marketing the telecommunications products of EXFO Electro-Optical Engineering Inc. (NASDAQ: EXFO, TSX: EXF) on the German market. The product range of the Canadian telecommunications supplier primarily covers test solutions for all major wireline and optical networks as well as physical / optical measurement products.

Software-based tactical transceivers for Swiss Air Force

The Swiss Air Force (armasuisse) has decided to procure tactical transceivers of the R&S®M3TR type.

These devices replace the transceivers SE-229 that are currently used by the Swiss Army and define the new standard SE-239. The software-based transceivers of the R&S®M3TR family from Rohde & Schwarz combine several complex radio techniques in one instrument. They can be upgraded via software and support different radio services. In 2003, several products were evaluated in laboratory and field trials. The VHF / UHF version of the R&S®M3TR also proved its value during the World Economic Forum in Davos. The Swiss sales office of Rohde & Schwarz, Roschi Rohde & Schwarz AG based in Ittigen, will supply the transceivers in 2005.

Success in mobile radio

The Radio Network Analyzer R&S®TSMU and the Handheld Spectrum Analyzer R&S®FSH3 have become standard measuring instruments for several mobile radio operators.

The Radio Network Analyzer R&S®TSMU is now the standard measuring instrument at T-Mobile International. The compact UMTS PN scanner has been designed for planning and setting up third-generation mobile radio networks. European network operators use the R&S®TSMU as a standard measuring instrument, especially for UMTS network setup and radio network optimization.

The handy R&S®FSH3 is now also used throughout Europe by some T-Mobile and Vodafone subsidiaries as well as by E-Plus and O_2. The spectrum analyzer is primarily used for applications around the antenna systems of mobile radio base stations.

The Radio Network Analyzer R&S®TSMU covers network planning, network setup, optimization, quality assurance and service.

The R&S®FSH3 provides all RF analysis functions that developers, service technicians and installation and maintenance crews need in their day-to-day work.

You can find out more about the R&S®FSH3 and its use even in space, specifically on the International Space Station ISS, on page 28 of this issue.

Joint effort between Rohde & Schwarz and NTT DoCoMo to develop test cases

Rohde & Schwarz and the Japanese telecommunications giant NTT DoCoMo, Inc. have developed 80 test cases to check interoperability between the NTT DoCoMo network and third-generation mobile radio equipment. This was done to ensure trouble-free operation of different mobile radio equipment under real network operating conditions. NTT DoCoMo is convinced that these test scenarios are indispensable for manufacturers of mobile radio equipment since the interoperability of mobile radio equipment can be checked even prior to field trials.

The test cases contain all expertise that NTT DoCoMo has acquired while putting its 3G mobile radio network into operation. Rohde & Schwarz is the ideal development partner since it plays a leading role in developing the official 3GPP test specifications. The development of approx. 185 more test cases by fall 2005 has already been agreed with NTT DoCoMo.

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