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Crypto products for confidential voice and data communication

Liquid-cooled VHF transmitters for analog and digital television

EMS test system with automatic assessment of picture degradations

2002/I
173

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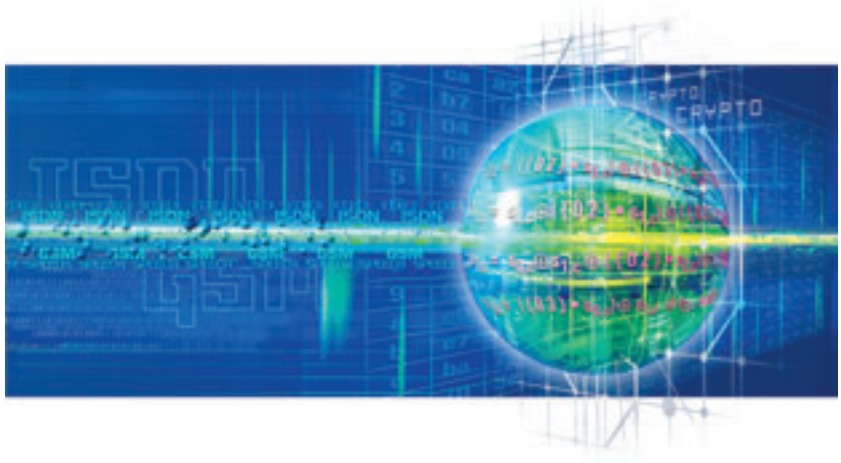

Photo 43846

Anyone who has suffered damage once will be very careful the next time. But what happens if you fail to notice the damage in the first place? This may be the case when a business becomes the victim of industrial espionage. Such dangers can be effectively eliminated by using IT security products from Rohde&Schwarz SIT GmbH (page 48).

MOBILE RADIO

Radiocommunication testers

The most recent example of the outstanding versatility of the R&S TSVP production test platform is the fully automatic performance testing of business telephones in the Siemens production line in Leipzig.

Test methods

Photo 43813/3

GENERAL PURPOSE

Test systems

Network analyzers

Test signals

The System Extension TV-MON enables the Test System R&S TS9980 to perform fully automatic assessment of analog and digital picture degradations.

Photo 43206/7

EMC/FIELD STRENGTH

Test receivers

Test systems

BROADCASTING

Test receivers

Photo Author

Acrodyne Industries Inc., Rohde&Schwarz's US partner, scored with a TV transmitter order for the Houston Tower in Texas. The liquid-cooled transmitter from Rohde&Schwarz won out where air-cooled transmitters otherwise dominate.

TV transmitters

Generators

Reference

FOCUS

ATM in broadcasting

IT SECURITY

Crypto products

Rohde & Schwarz has added a shopping option to its Web site. The new online shop offers demonstration and loan equipment at drastically reduced prices.

MISCELLANEOUS

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Universal Radio Communication Tester R&S CMU 200

CDMA2000 – a new challenge for 3G mobile radio testers

The CDMA world is facing its next decisive step: the introduction of CDMA2000 1X, handling packet data rates of up to 307.2 kbit/s. The future-oriented measurement platform Universal Radio Communication Tester R&S CMU 200 also supports this third-generation mobile radio standard.

The CDMA2000 market

Since the launch of the first commercial cdmaOne network in Hong Kong in September 1995, CDMA has established itself worldwide as a mobile radio standard. It has advanced triumphantly far beyond the USA, its country of origin, Korea and Japan. With rocketing growth rates, CDMA ranks besides GSM as a major digital standard of the second generation. Now the CDMA world is entering a new and decisive phase, the introduction of CDMA2000 1X, which is capable of working with packet data rates of up to 307.2 kbit/s.

In recent years, cdmaOne has expanded tremendously fast. In April 1998, there were around ten million subscribers worldwide, but now more than 100 million customers make their calls through CDMA networks (FIG 1). This development is remarkable in as much as GSM had already established itself worldwide as the de facto standard.

Asia paved the way for this enormous growth, headed by South Korea, which placed all its bets on cdmaOne. Japan also became an important CDMA bastion. KDDI, the only cdmaOne network operator in Japan, can boast more than ten million subscribers and a market share of about 20 %, making it serious competition for the market leader NTT DoCoMo. While the market in Korea and Japan is almost saturated, the highest growth rates have lately come from North and South America, and a large market is emerging in China. The network operator China Unicom is presently setting up a cdmaOne / CDMA2000 network, with capacity expected to serve some 50 million subscribers by the year 2005.

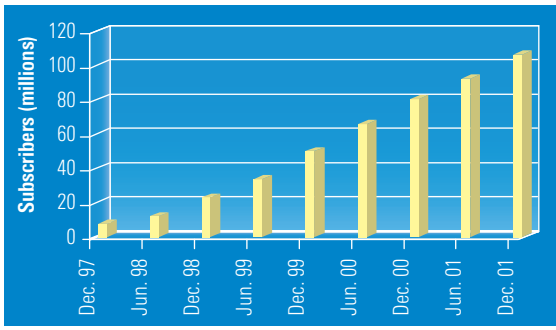
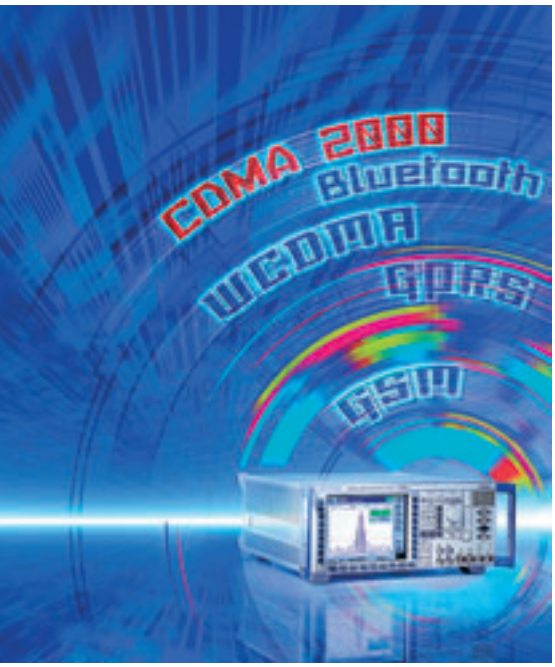


FIG 1 Development of cdmaOne / CDMA2000 subscriber figures

CDMA2000 is the logical successor to cdmaOne. Since cdmaOne is a subset of the IS 2000 standard, operators can easily upgrade their networks without losing functionality. CDMA2000 base stations are capable of communicating with cdmaOne phones and CDMA2000 phones can do the same with a cdmaOne base station. It is understandable that almost all cdmaOne network operators plan to offer additional services based on CDMA2000.

Photo 43 238/16



Further articles on the R&S CMU 200 can be found on pages 9 and 12 of this edition.

As was the case with cdmaOne, Korea again led the way and SK Telecom was the first to put a CDMA2000 network into operation in October 2000. Most cdmaOne network operators plan to put their CDMA2000 networks on the air by the beginning of 2002 (FIG 2). First networks are also planned in Eastern Europe (Romania, Moscow, Saint Petersburg) in the 450 MHz band, which became vacant a short time ago.

Producers of CDMA mobile radio equipment need a platform that offers high accuracy and speed as well as multimode capabilities. Just in time for the introduction of CDMA2000 in North America, the future-oriented measurement platform R&S CMU 200 is now also able to support this third-generation mobile radio standard.

Characteristics of forward link

The individual physical channels are distinguished by means of orthogonal Walsh codes (FIG 3). Codes of different length are used to obtain different data rates from a constant chip rate for the actual information bits. Convolutional coders are used for conventional voice and data services, and turbo coders for the high data rates of the supplemental channels.

If the number of Walsh codes is no longer sufficient because the orthogonal vector space is exhausted, channel separation can be continued with the aid of non-orthogonal functions. Quasi-orthogonal functions (QOFs) are created by masking existing Walsh codes. The frame lengths for signalling and user informa- ▶

FIG 2 Most CDMA2000 networks will go into operation by early 2002.

Country	Operator	Test / start
Australia	Telstra	Test 3rd quarter/2000
Brazil	Global Telecom	Start 4th quarter/2001
Brazil	Telesp Celular	Start 4th quarter/2001
Brazil	Vesper	Start 4th quarter/2001
Canada	Bell Mobility	Start 4th quarter/2001
Canada	Telus Mobility	Test 3rd quarter/2000
Chile	SmartCom PCS	Start 1st half/2002
Japan	KDDI	Start 1st half/2002
Korea	KT Freetel	In operation
Korea	LG Telecom	In operation
Korea	SK Telecom	In operation
Mexico	Pegaso PCS	Start 4th quarter/2001
New Zealand	Telecom Mobile Limited	Start 4th quarter/2001
Ukraine	CST Invest Limited	Start 1st quarter/2002
USA	AirGate PCS	Start 1st quarter/2002
USA	Alamosa PCS	Start 1st quarter/2002
USA	ALLTEL Communications	Start 2nd half/2001
USA	Horizon PCS	Start 3rd quarter/2002
USA	Sprint PCS	Start 4th quarter/2001
USA	Verizon Wireless	Start 2nd half/2001
Venezuela	Telcel	Test 1st half/2001
Vietnam	Saigon Postel	Start 2nd half/2001

CDMA2000 overview

CDMA2000 is a follow-on development of the established TIA/EIA 95 A/B standard for second-generation mobile radio. The extensive backward compatibility of signalling and network characteristics considerably simplifies introduction. For instance, CDMA2000 islands can be implemented in the overlay of an existing cdmaOne network during a transition period. Basically, two introductory phases are distinguished for CDMA2000.

In the first step, CDMA2000 1X (1xRTT*) is implemented with a signal bandwidth of 1.25 MHz and a spreading rate (SR) of 1 (i.e. 1.2288 Mchip/s). This corresponds to the physical characteristics of cdmaOne. CDMA2000 1X offers more code channels (128 Walsh codes) on the forward link, the connection from the base station to the mobile station. In addition, fast power control is introduced also on the forward link. Packet data rates of up to 307.2 kbit/s for stationary and mobile applications can be handled; voice quality and capacity are almost doubled. CDMA2000 1X supports new antenna techniques such as spot beams for covering limited areas with high traffic volume for short periods.

In the subsequent phase, CDMA2000 3X (3xRTT) with an SR of 3 (3.6864 Mchip/s) offers three times the bandwidth of cdmaOne. Peak data rates of up to 2 Mbit/s allow true multimedia applications. A precise time schedule for the introduction of 3X is not yet available. Presently, the CDMA2000 1xEV-DO system is being promoted – a CDMA method developed by Qualcomm and optimized for data transmission.

* RTT: radio transmission technology

tion vary between 5 ms, 20 ms, 40 ms and 80 ms. Another specified possibility is that under certain conditions system capacity can be increased by splitting up the forward link signal to several transmit antennas (transmit diversity).

Characteristics of reverse link

In contrast to cdmaOne, the channels of a true CDMA2000 link are distinguished by different Walsh codes and split up in the complex baseband into the inphase (I) and the quadrature (Q) path. Different channels can be used depending on the quality of service (QoS) and physical channel characteristics (FIG 4). On the reverse link, a continuous pilot simplifies synchronization to the base station. Traffic data is transmitted in an independent fundamental channel (FCH) and in supplemental channels (SCHs) with separate power and targets for frame error rate (FER).

As on the forward link, convolutional coders are used for low-rate voice and data transmissions and turbo coders for the new, high data rates of the supplemental channels. A new feature is fast control of base station power by the mobile station (forward link power control).

Nine different radio configurations (RCs) on the forward link and six on the reverse link determine the different connection modes defined by the IS 2000 standard:

- RC1 and RC2 define cdmaOne connections for rate sets 1 and 2
- RC3 to RC5 on the forward link (RC3 and RC4 on the reverse link) define CDMA2000 connections for spreading rate 1 (CDMA2000 1X)
- RC6 to RC9 on the forward link (RC5 and RC6 on the reverse link) are reserved for CDMA2000 connections for spreading rate 3 (CDMA2000 3X)

Service options define possible connection modes and their parameters, e.g. the different speech modes (depending on the voice coder used), SMS, fax and other data links, or especially test loopbacks.

CDMA2000 operates worldwide in different frequency bands. Presently, the standard defines eleven different band classes, all of which are of course covered by the R&S CMU 200.

FIG 3 New physical channels on the forward link of CDMA2000

New forward link common channels for CDMA2000 mobile phones	
Pilot channels (PICH)	Permit transmit diversity (F-TDPICH, F-ATDPICH); support smart antenna applications (F-APICH)
Quick paging channel (QPCH)	Improved slotted mode, longer battery lifetime; Walsh codes W_{80}^{128}, W_{48}^{128}, W_{112}^{128}, reserved for F-QPCH
Common control channel (CCCH)	F-CCCH transmits mobile directed messages for CDMA2000 mobile phones
Broadcast channel (BCCH)	F-BCCH transmits broadcast and overhead messages (e.g. SMS)
Common power control channel (CPCCH), common assignment channel (CACH)	Used together with enhanced access channel procedures

New forward link dedicated channels for CDMA2000 mobile phones	
Forward fundamental channel (F-FCH)	Transmits signalling/user information for a specific mobile phone; each traffic channel may contain an F-FCH
Forward dedicated control channel (F-DCCH)	Transmits signalling information for a specific mobile phone; each traffic channel may contain an F-DCCH
Forward supplemental channel (F-SCH)	Transmits user information for a specific mobile phone; used for high data rates; each traffic channel may contain two F-SCHs
Power control subchannel	Used together with F-FCH or F-DCCH

CDMA2000 in R&S CMU 200

Implementation of the CDMA2000 1X standard in the R&S CMU 200 is based on the TIA/EIA specification IS 2000 Rev. 0. Like in all mobile radio networks supported by the R&S CMU 200, there is a distinction between signalling and non-signalling mode. All major network, base station and link parameters are clearly organized and configurable (FIG 5). The implementation of CDMA2000 in the R&S CMU 200 particularly takes into account all innovations of the IS 2000 standard.

For instance, the R&S CMU 200 also supports the quick paging channel (QPCH) used to extend battery lifetime. In addition to the normal configuration, it is possible to define in the test system whether or not the QPCH addresses the DUT. This ensures that the mobile phone observes the QPCH and not the normal pilot channel or the common control channel F-CCCH.

CDMA2000 measurements

The R&S CMU 200 supports common cdmaOne measurements such as standby/access probe power, sideband suppression, gated output power, open-loop time response, min./max. output power and receiver quality (frame error rate). In contrast to cdmaOne, a CDMA2000 mobile phone sends on different code channels, possibly with different data rates and levels. A signal of this complexity typically has a higher peak/average power ratio than a signal with only one channel as in cdmaOne. This calls for power amplifiers with a wider dynamic range. CDMA2000 alleviates this problem through the use of QPSK modulation with a peak-limited spreading function. The result is the hybrid phase shift keying (HPSK) modulation mode (FIG 6). Consequently, completely new modulation measurements and – new on the CDMA reverse link – a code domain power measurement are required (FIG 7).

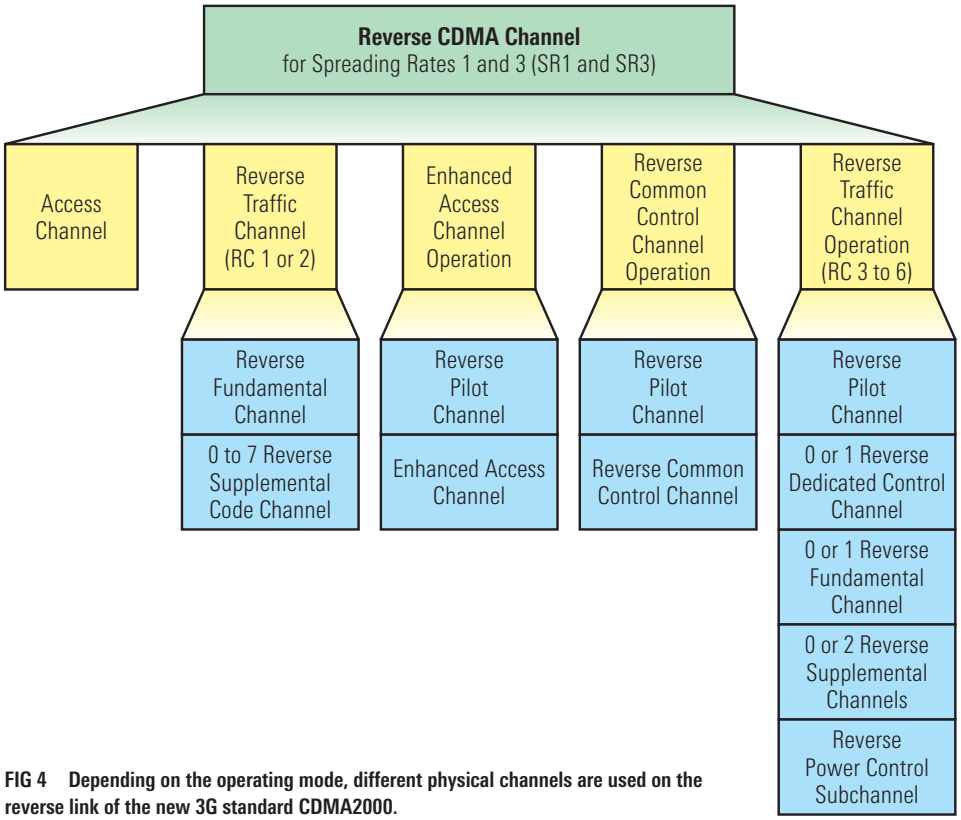


FIG 4 Depending on the operating mode, different physical channels are used on the reverse link of the new 3G standard CDMA2000.

FIG 5 All relevant base station, network and link parameters are clearly organized on the R&S CMU 200.

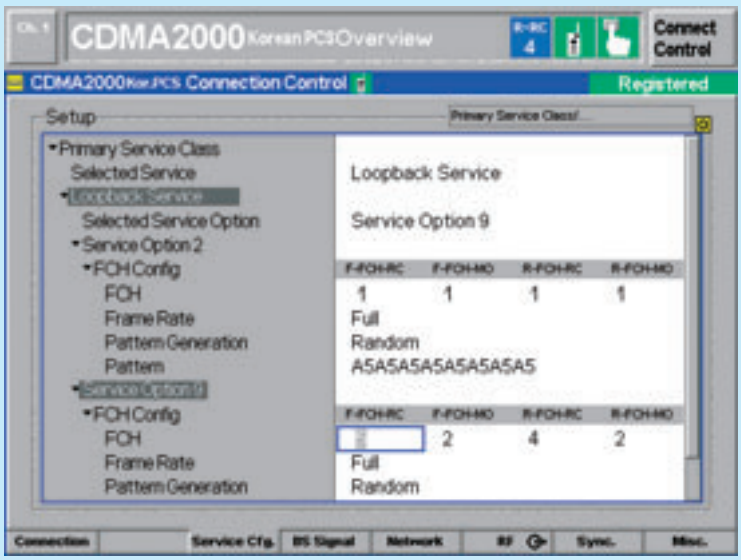
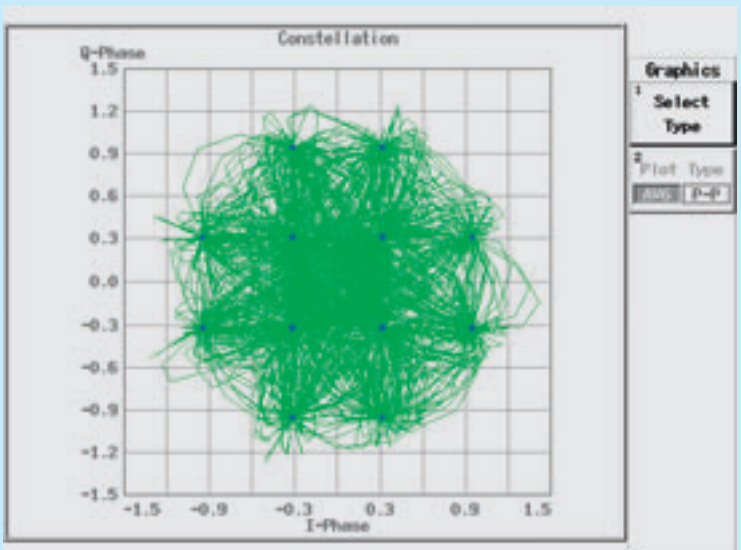


FIG 6 Constellation diagram of a CDMA2000 reverse link signal with F-PICH, F-FCH and one active F-SCH.



Another innovation, forward power control, enables the mobile station to control the output power of the base station in the dedicated channels. The R&S CMU 200 performs a comprehensive function check of this new CDMA2000 feature (FIG 8).

AMPS measurements

Especially in North America, mostly dual-mode CDMA mobile phones using AMPS (advanced mobile phone system) are sold. For this reason, the R&S CMU 200 also supports this analog standard of the first network generation. Its AMPS functionality boasts innovative concepts such as multitone measurement to check AF frequency response in the transmitter and receiver of the mobile phone.

R&S CMU 200 rises to the occasion

In terms of CDMA2000, the hardware and software concept of the R&S CMU 200 has again proven its great flexibility. The test system is now all set to go for measurements on future CDMA generations such as CDMA2000 1xEV-DO, etc.

Michael Altmann; Thomas Rösner

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

Data sheet R&S CMU 200

REFERENCES

The Universal Radio Communication Tester R&S CMU 200 has continually been upgraded to keep pace with technical developments. There have been reports on the measurement capabilities and innovations of this state-of-the-art communication tester in almost every edition of this journal since the instrument was first introduced in News from Rohde&Schwarz No. 165 (1999). See REFERENCES on page 14.

FIG 7 The code domain power measurement verifies the correct level of the physical channels on the reverse link.

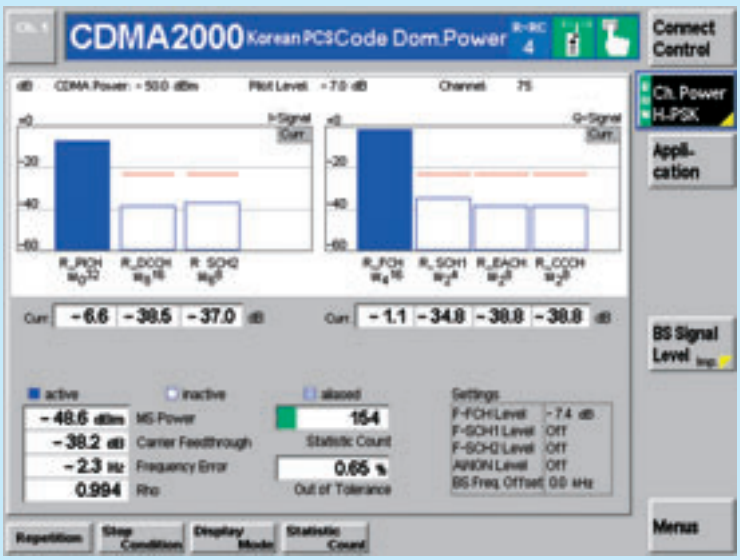
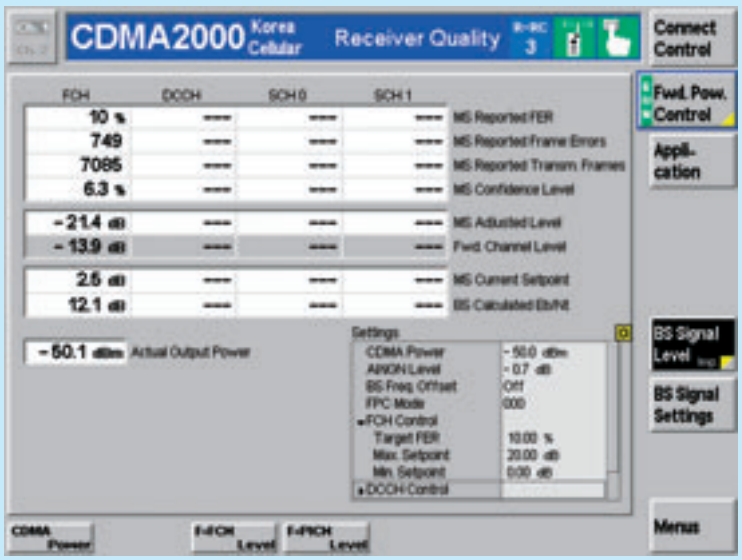


FIG 8 Forward power control measurement.



WCDMA generator for fast testing of 3G mobile radios

The first public WCDMA (FDD) network to the NTT DoCoMo standard went into operation in Japan in October 2001, so an increase in the production of mobile phones can be expected for the year 2002. In mid-2001 already, Rohde & Schwarz presented the first Universal Radio Communication Tester R&S CMU 200 with WCDMA measurement functions. The following article illustrates how to make excellent use of this tester in the development and production of 3G mobile radios.

All the essentials for production tests

The *BER** – and for packet switching services the *BLER* – is of particular importance when checking the receiver characteristics of mobile phones. Receiver sensitivity can be measured at very low generator levels; at high levels you determine overdriving strength. These measurements are described in 3GPP TS 34.121 section 6 [1].

The WCDMA options for the R&S CMU 200 provide all key functions for production tests and can be adapted to the required test functions in two steps (FIG 1).

Unidirectional BER measurement

During a unidirectional *BER* measurement, the tester transmits on different channels, to which the DUT – a mobile or simply a module – synchronizes in time or frequency. The *DPDCH* channel contains a selectable data sequence, for instance a random *PRBS9*. A *3GPP* mobile selects this sequence from the demodulated data channel, synchronizes itself and independently calculates the deviations from the expected *PRBS*. This yields the *BER*, which can be queried via a mobile phone interface.

This method does not require a link setup, which is an important advantage. It is a time-saving factor in the production test; in addition, the *BER* measurement can also be performed on RF/layer 1 modules without higher layers.

The current configuration of the R&S CMU 200 enables the simultaneous operation of up to five channels: *P-CPICH*, *P-SCH*, *S-SCH*, *P-CCPCH* and *DPCH*. The power of all channels can be set separately. The *P-CPICH* serves as an absolute reference, whereas the power of the other channels is given as a relative value. Since there is no real signalling during communication with the DUT, the *P-CCPCH* cannot transmit complete *BCH* information; only the system frame number is included. A mobile phone can synchronize to this and identify the R&S CMU 200 as the *UTRAN*.

3GPP-conformant configuration of primary and secondary scrambling codes is possible. The primary scrambling code affects only *P-CPICH* and *P-CCPCH*, whereas both scrambling codes are of importance for coding the *DPCH*. The *P-SCH* and *S-SCH* channels, on the other hand, are not scrambled and thus do not necessarily behave orthogonally to the other code channels.

Model/option	Designation	Functions
R&S CMU 200	Basic model	
R&S CMU-U65/K65	Hardware upgrade and software	Transmitter measurements on WCDMA uplink signals
R&S CMU-B66/K66	Hardware upgrade and software for WCDMA downlink generator	Receiver measurements, *BER/BLER* measurement with evaluation in mobile phone, synchronization

FIG 1 Options for upgrading the R&S CMU 200 for WCDMA tests

* Abbreviations in the text are explained in the box on page 11.

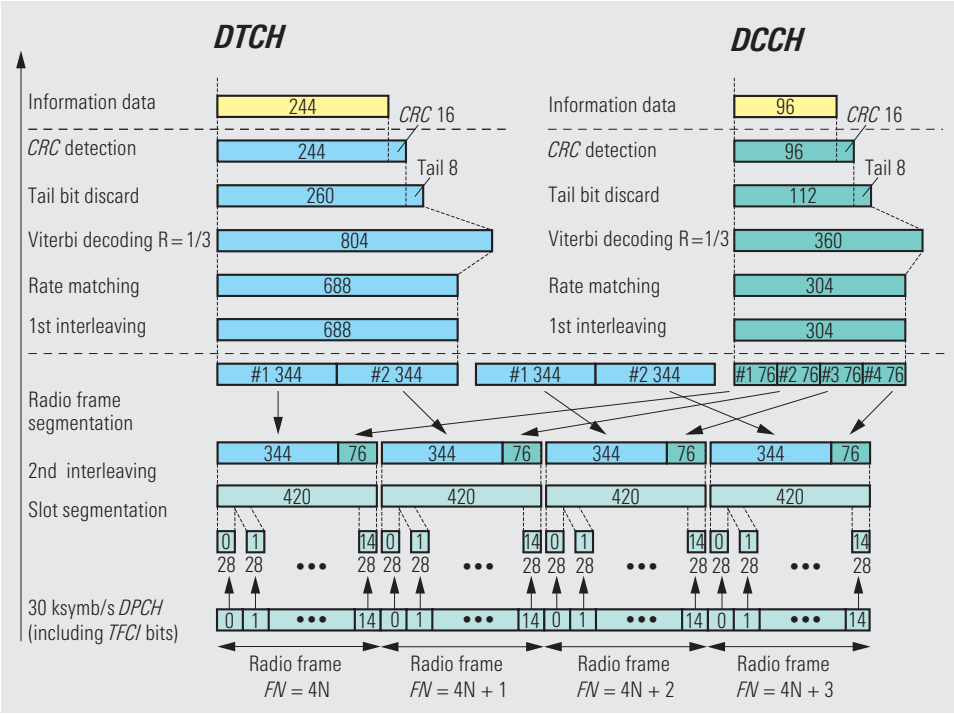


FIG 2 Coding of transport channels up to *DPCH* in *RMC* with data rate of 12.2 kbit/s (example)

The R&S CMU 200 provides multiple settings for the *DPCH*, which far exceed the *RMCs* specified by *3GPP* (see 3GPP TS 34.121 appendix C). The channel coding mode and the direct data insertion mode are available on the physical layer (FIG 3).

If channel coding is active, an *RMC* specified by *3GPP* is transmitted. The data to be sent via the *DPCH* is fed in at the transport layer and transmitted to the physical layer after the channel coding is completed.

In the physical mode for instance, the *DPCH* data fields are filled directly with a *PRBS*; the slot format is user-selectable. Compared to the *RMC*s, even higher data rates of up to 960 kbit/s can be transmitted. For the *DPCH*, the channelization code determines that part of the code domain to be used for data transmission to the DUT. The R&S CMU 200 prevents entries that would overlap with other channels such as the *P-CCPCH*.

Reference measurement channels

3GPP defines standardized generator parameters (TS 34.121, [1]) and so creates a uniform measurement environment for the DUT. These reference measurement channels are available with data rates of 12.2, 64, 144 kbit/s and 384 kbit/s; the WCDMA generator option of course generates *RMC*s with all these data rates (FIG 4).

An *RMC* specifies how to code the user data from the transport layer and how to transmit them on the physical layer (FIG 2). At the transport layer, the data consists of the *DTCH* and the *DCCH*. All parameters relevant for channel coding – such as the *TTI* (time transmission interval) or the coding method – are specified in a *3GPP RMC*. At the physical layer, for instance, the *DPCH* slot format is ready defined.

The transmitter characteristics of a WCDMA mobile can be determined by the measurement functions described in [2]. By synchronizing to the generator signal, the transmitter measurements are not only performed more quickly; it is also possible to select a specific slot number to be measured. The frequency error of the mobile phone is determined without external synchronization.

Performance in a WCDMA network depends on good power control . Here the newly added inner loop power measurement (FIG 5) takes effect, where the transmit power of the mobile is continuously increased and decreased in steps by *TPC* bits from the base station. The R&S CMU 200 simulates this process, measures the power and determines deviations from the nominal value.

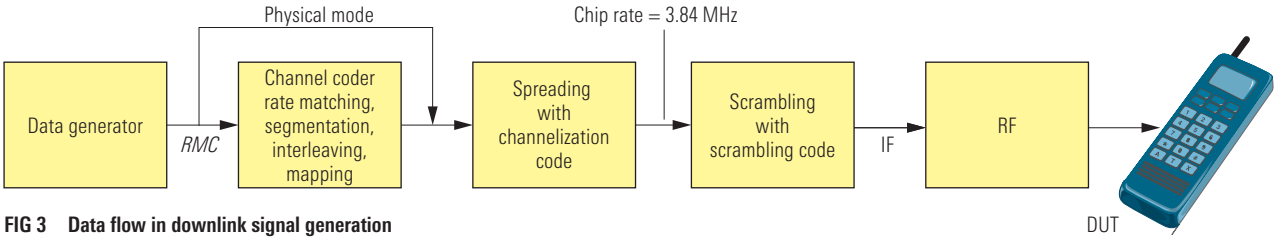


FIG 3 Data flow in downlink signal generation

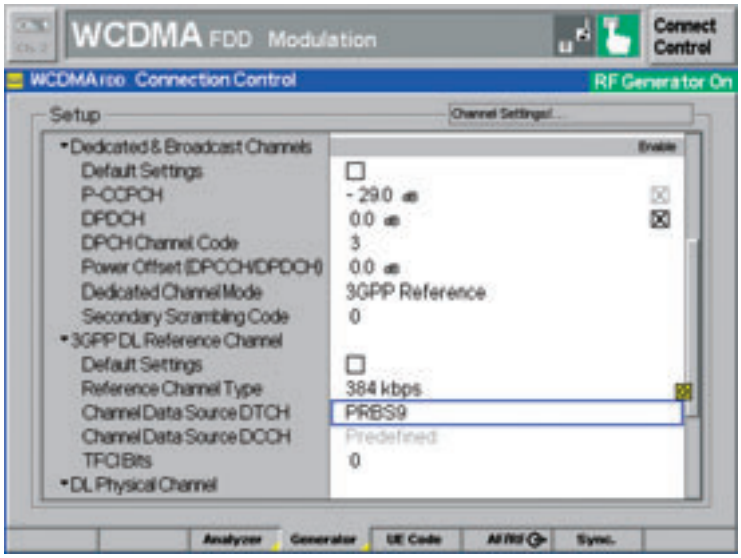


FIG 4
R&S CMU200 menu for transparent setting of generator parameters such as data rate and bit sequences

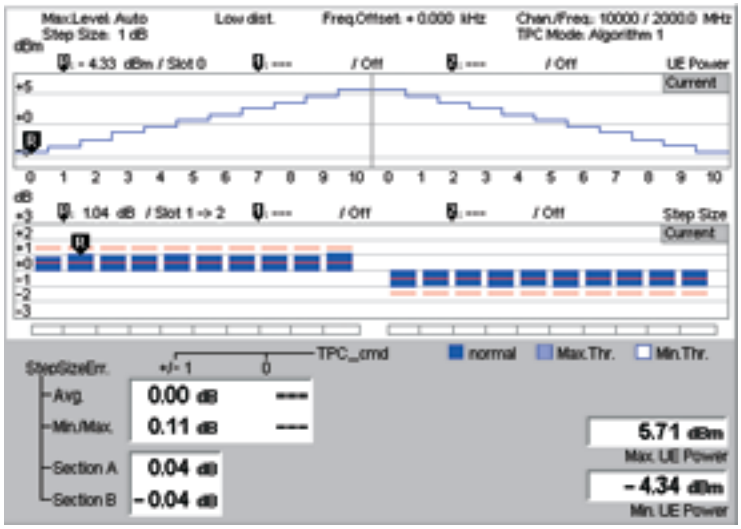


FIG 5
Inner loop power measurement

Abbreviations

ACLR	Adjacent channel leakage power ratio
BER	Bit error rate
BLER	Block error rate
BCH	Broadcast channel
CRC	Cyclic redundancy checksum
DCCH	Dedicated control channel
DL	Downlink (signal from base station to mobile phone)
DPCCH	Dedicated physical control channel
DPCH	Dedicated physical channel
DPDCH	Dedicated physical data channel
DTCH	Dedicated transport channel
EVM	Error vector magnitude
FN	Frame number
ME	Magnitude error
PE	Phase error
PRBS9	Pseudo random bit sequence with bit length 2^9-1
P-CCPCH	Primary common control physical channel
P-CPICH	Primary common pilot channel
PCDE	Peak code domain error
P-SCH	Primary synchronization channel
RMC	Reference measurement channel
SEM	Spectrum emission mask
S-SCH	Secondary synchronization channel
TFCI	Transport block combination indicator
TPC	Transmitter power control
TTI	Time transmission interval
UL	Uplink (signal from mobile phone to base station)
UTRAN	UMTS terrestrial radio access network
3GPP	3rd generation partnership project

Future functions

In addition to the ready implemented, unidirectional *BER* measurement described above, there are plans for a layer 1 loopback measurement. Here the mobile reflects back the signal transmitted by the R&S CMU200, which compares it to the signal originally sent and thus calculates the *BER*. Since no link setup is required, this method saves considerable time.

An important future functionality will be the link setup, where the R&S CMU200 acts as a base station to which the mobile registers with subsequent call setup. Here, too, a *BER* measurement can be performed in the loopback mode.

Gottfried Holzmann; Thomas Zeising

REFERENCES
[1] 3GPP specifications: www.3gpp.org
[2] R&S CMU200: First WCDMA measurement functions. News from Rohde&Schwarz (2001) No. 171, pp 13–15

Condensed data of WCDMA options for R&S CMU200

Standard	3GPP-FDD, testing mobile phones
Transmitter measurements	
Modulation analysis	*EVM, PE, ME*, frequency error, I/Q offset, I/Q imbalance, *PCDE*
Power measurement	max., min., off, ILP (inner loop power)
Spectrum measurement	*ACLR, SEM*
Code domain power	
Generator	downlink signal, *P-CPICH, P-SCH, S-SCH, P-CCPCH, DPCH*

Universal Radio Communication Tester R&S CMU 200

Measuring EDGE signals

Photo 43238/16

The mobile radio future means even greater speed on the data highway. The HSCSD [1] and GPRS [2] technologies recently introduced by network operators are just the beginning; the potential for more speed in 2.5G networks is far from exhausted.

What EDGE is all about

EDGE [3] is the magic formula for more speed. The idea behind it is really very simple: a modified form of modulation transmits every three data bits simultaneously, and so makes transmission three times faster.

But new kinds of modulation also make new demands on test and measurement technology. The Universal Radio Communication Tester R&S CMU 200 [1 to 5] is already able to perform all measurements required of future EDGE technology. Thus the R&S CMU 200 again consolidates its leading role in mobile radio measurement.

The speed in GSM networks is 271 kbit/s; transmitting one bit takes approx. 3.7 µs. To increase the transmission rate of existing GSM networks, you must under no circumstances expand the bandwidth, since this would interfere with the networks currently operated. The idea of combining three bits into a symbol and transmitting them simultaneously does not work with the GMSK modulation (Gaussian minimum shift keying) used in GSM networks. 8PSK (8 phase shift keying) is instead used to modulate EDGE signals. To reduce the crest factor, the transition between two symbols is shifted by $3\pi/8$ in phase, and the frequency spectrum is then matched to that of GMSK (FIG 1).

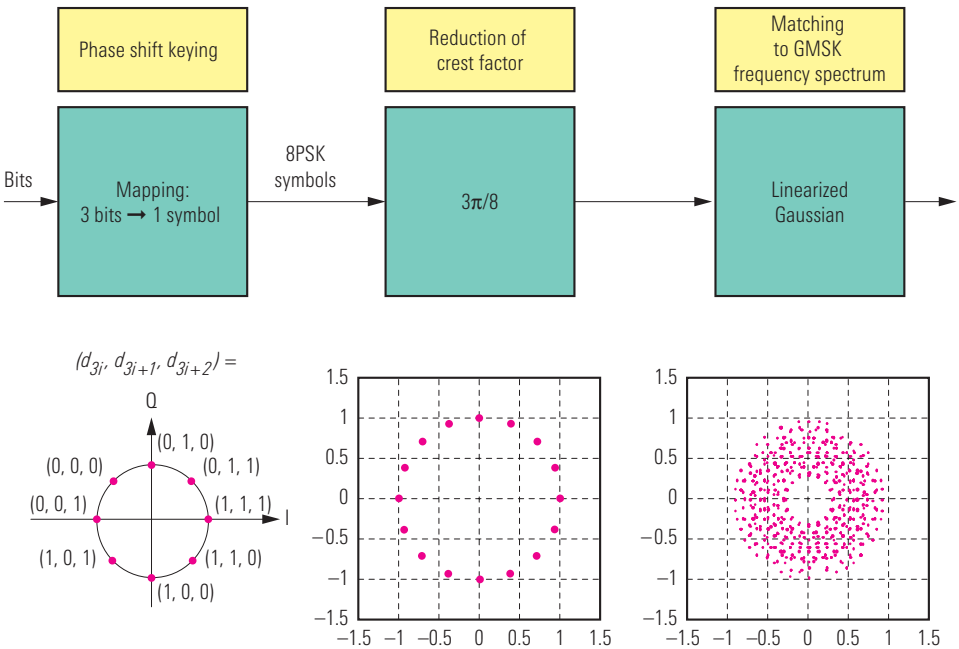
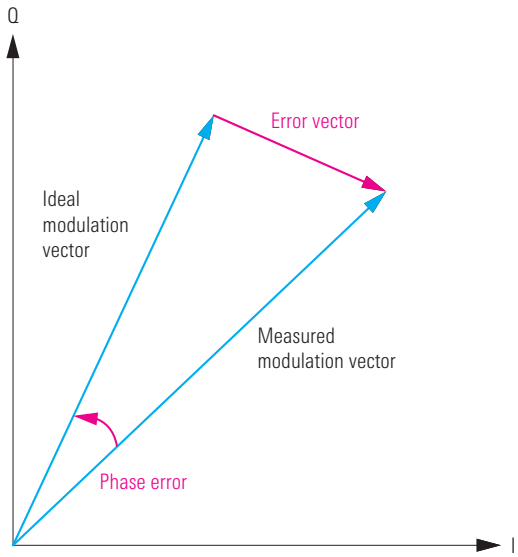


FIG 1 EDGE 8PSK modulation consists of mapping, rotation and filtering

1) HSCSD: high-speed circuit switched data
2) GPRS: general packet radio service
3) EDGE: enhanced data rate for GSM evolution



Error vector magnitude = |error vector|
Magnitude error = |ideal modulation vector| – |measured modulation vector|

FIG 2 Error vector magnitude is an important variable in quality assessment. It indicates the absolute length of the error vector between ideal and measured symbol time.

New measurement requirements through EDGE

Frequency error, peak phase error and RMS phase error are measured to judge the quality of a GMSK-modulated signal. These variables are also important when assessing 8PSK-modulated signals. EVM (error vector magnitude) is particularly significant as a measure of the deviation of the ideal symbol pointer from the symbol pointer detected (FIG 2).

An 8PSK signal cannot match the familiar power time template of a GSM burst because its crest factor is much higher. The GSM standardization committee consequently defined a new power time template for EDGE signals (FIG 3) and relaxed the limits of the spectrum due to modulation and switching somewhat.

EDGE measurements in practice

The R&S CMU 200 already meets the demands of future EDGE T&M technology; its measurement range even far exceeds the requirements. In modulation measurements (FIG 4) for instance, its clear menu shows magnitude error (peak and RMS) and origin offset in addition to the obligatory parameters frequency error, phase error (peak and RMS) and EVM (peak and RMS). All results appear not only for the currently measured burst but also as a mean and min./max. value across a set number of bursts.

Another special feature of the R&S CMU 200 is the determination of the 95:th percentile. For this purpose, it measures in a burst the phase error, EVM and magnitude error of each symbol (3 to 144) transmitted in the useful part. From these figures it determines the value below which 95 % of all symbols measured are at the respective quantity. In addition, all the symbol values measured can be graphically displayed.

For power measurement, the set provides the power time template for measuring EDGE signals. As usual, this template is user-editable.

The R&S CMU 200 really demonstrates its unrivalled performance in the measurement of multislot power ramping (FIG 5). It analyzes the received signal and positions the correct power time template on up to four timeslots. Separately for each timeslot, it automatically determines the template type (GMSK or 8PSK), the template position on the time axis using the decoded midamble in the burst, and the template position on the power axis using the average burst power in the useful part of the burst. In line with the standard, it then joins the part templates of the individual bursts in the transition areas – a more convenient way is hardly conceivable.

What is not so nice about 8PSK signals is that, due to the high crest factor, they only yield stable measurement results for a very high averaging depth. But

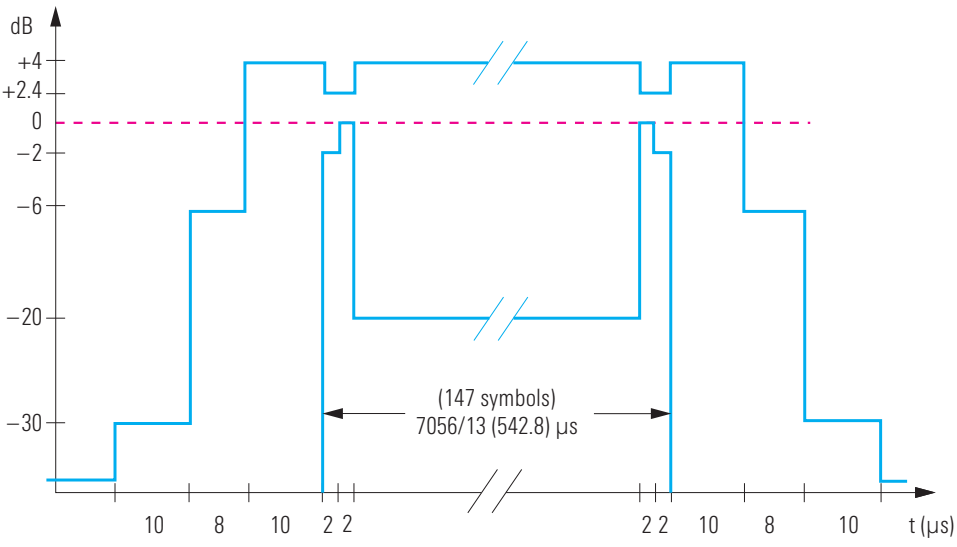


FIG 3 Power time template for EDGE signals

that is synonymous with long measurement time – which is naturally not welcomed in production. The R&S CMU 200 shows you how to get round this. For average burst power it provides not only single burst assessment (with strongly varying results) and averaged measurement (stable results but a long time to measure them) but also data-compensated measurement. Here the tester calculates the nominal power ramp from the symbols received, taking into account only the difference between the nominal and the measured power ramp. The results are stable even at a low averaging depth and match those with high averaging depth.

In spectrum measurements, the tester of course automatically adapts the permissible limits to the modulation mode.

EGPRS

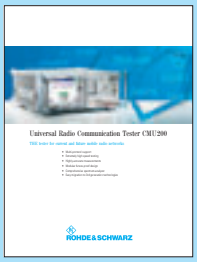
EGPRS is the logical combination of GPRS technology and EDGE modulation. Standardization committees have defined nine channel coders for EGPRS (MCS-1 to MCS-9). MCS-1 to MCS-4 are GMSK-modulated, the other five are 8PSK-modulated. The R&S CMU 200 supports all nine coders and is thus optimally suited in the reduced signalling mode for the development of EGPRS modules for example.

Conclusion

Opting for the R&S CMU 200 makes you state of the art and up to the minute, and keeps you there. Even before the first mobile with EDGE technology is ready to go into production, this tester provides the required T&M technology in the GSM software packets.

Rudolf Schindlmeier

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



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[2] CMU 200 – Speeded-up test of GSM mobiles without signalling. News from Rohde & Schwarz (2000) No. 168, pp 16–17

[3] CMU 200 – Measuring bit error rate on GSM mobiles. News from Rohde & Schwarz (2000) No. 169, pp 11–13

[4] CMU 200 – Multislot measurements on HSCSD and GPRS mobile phones. News from Rohde & Schwarz (2001) No. 172, pp 15–17

[5] CMU 200 – Audio measurements on mobile phones. News from Rohde & Schwarz (2001) No. 172, pp 18–19

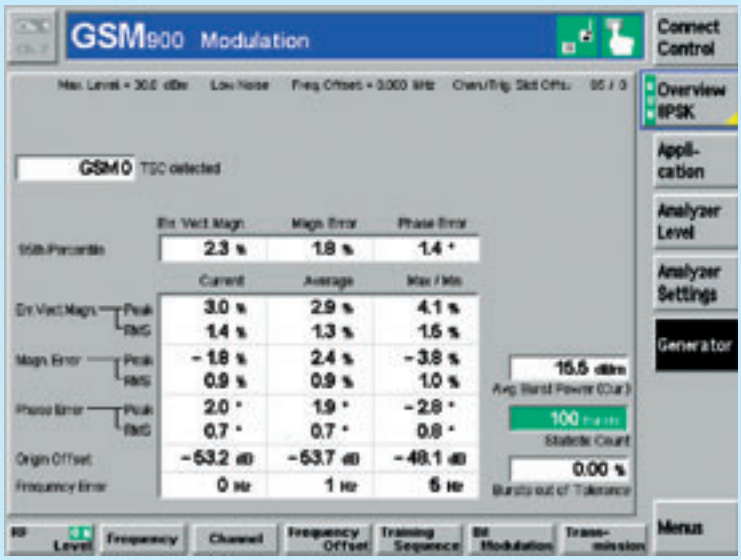

FIG 4 The R&S CMU 200 displays all important EDGE modulation variables in a clear menu. The values measured for origin offset are particularly useful for conveniently adjusting or checking a mobile's I/Q modulator. In addition, the tester determines the 95:th percentile for phase error, error vector magnitude and magnitude error.

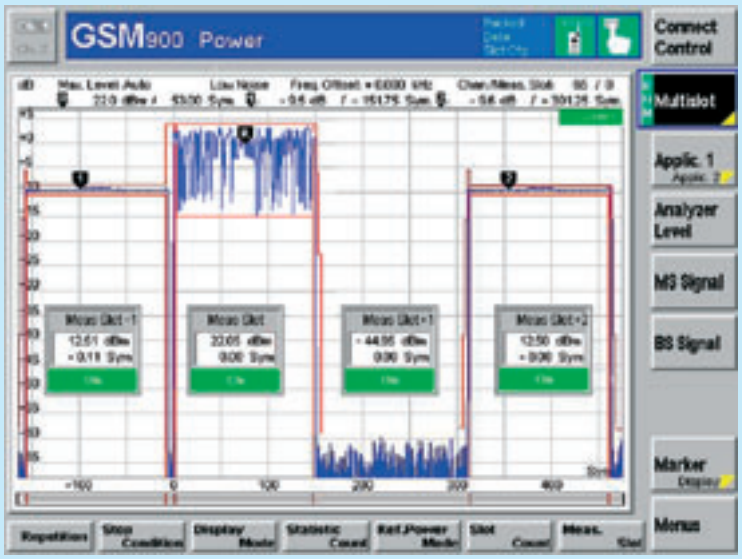

FIG 5 The measurement of multislot power ramping displays up to four timeslots, with the power time template automatically matched to the received signal. The user no longer needs to bother selecting the correct template.

Audio Analyzer R&S UPL

Measuring the acoustic characteristics of 3G mobile phones

Good acoustic reproduction quality is the most important characteristic for troublefree communication with mobile phones. The trend towards ever smaller and lighter phones does not exactly make life easier for the designer. With the new UPL-B9 option, all the tests for handset measurements defined in 3GPP TS26.132 are now available on the Audio Analyzer R&S UPL together with the Radio Communication Tester R&S CMU200 (FIG 1).

Acoustic measurements are indispensable

Measuring the acoustic characteristics of mobile phones is very important, since users themselves do not immediately recognize the deficiencies. Considerably deviating transmit frequency response, distortion and noise do not become noticeable until callers complain of difficulty understanding each other – and they usually tend to suspect a poor connection via the base station before exposing their own mobile as the culprit.

Rohde&Schwarz already developed methods several years ago that also enabled the acoustic quality of GSM mobile telephones to be measured on the air interface [1]. Using speech-like multitone signals and sophisticated measurement methods, the same results, with only minor deviations, were achieved as when measuring via the digital audio interface (DAI). Implemented in the R&S UPL [2] with the Radio Communication Tester R&S CMD or the more recent R&S CMU200 [3], a test setup was produced that was soon adopted by manufacturers, test houses, and service providers throughout the world. The great advantage of this method is that any commercially available telephone can be measured without special modifications. However, the method is not standardized worldwide, so it cannot be used for type-approval tests.

Photo 43845

FIG 1 Acoustic measurement of 3G mobile phone with Audio Analyzer R&S UPL and Radio Communication Tester R&S CMU200

Perfecting a proven concept

During the development of third-generation mobile radio, it was suggested that methods enabling measurement of acoustic characteristics via the normal air interface (similar to that devised by Rohde&Schwarz) should be specified in international standards, and that a special DAI interface should not be used. Thus, it should be possible to measure all characteristics in the mode in which the telephone is normally used. All the signal processing algorithms in the mobile phone should remain active during measurement. Specific measuring problems arose from the voice activity detector, which uses the signal's mod-

Test	Section of 3GPP TS 26.132	Section of 3GPP TS 51.010
Sending frequency response and loudness rating	7.4.1 and 7.2.2.1	30.12 and 30.13
Receiving frequency response and loudness rating	7.4.2 and 7.2.2.2	30.14 and 30.15
Sidetone masking rating STMR	7.5.1	30.16
Echo loss (terminal coupling loss)	7.7.3	30.17.1
Stability margin	7.6	30.17.2
Sending distortion	7.8.1	30.18
Receiving distortion	7.8.2	–
Idle channel noise sending	7.3.1	–
Idle channel noise receiving	7.3.2	–
Ambient noise rejection	7.9	30.19

FIG 2 The Audio Analyzer R&S UPL can handle these tests in conjunction with the Radio Communication Tester R&S CMU 200.

ulation to determine whether the signal involved is unwanted interference or the useful voice signal. So, in order to be recognized as the useful signal, the test signal must be modulated in time like speech. Consequently, the first draft of the test standard 3GPP TS26.132 suggested artificial voice to ITU-T P.50 as the test signal. However, the unfavourable ratio between peak value and rms value creates problems for some measurements. A test signal to ITU-T P.501, which can be generated as an amplitude-modulated multitone signal for example, was consequently approved. It provides much better signal/noise ratio and increases dynamic range by more than 10 dB compared to artificial voice. This is essential for measuring echo suppression in mobile phones (box next page).

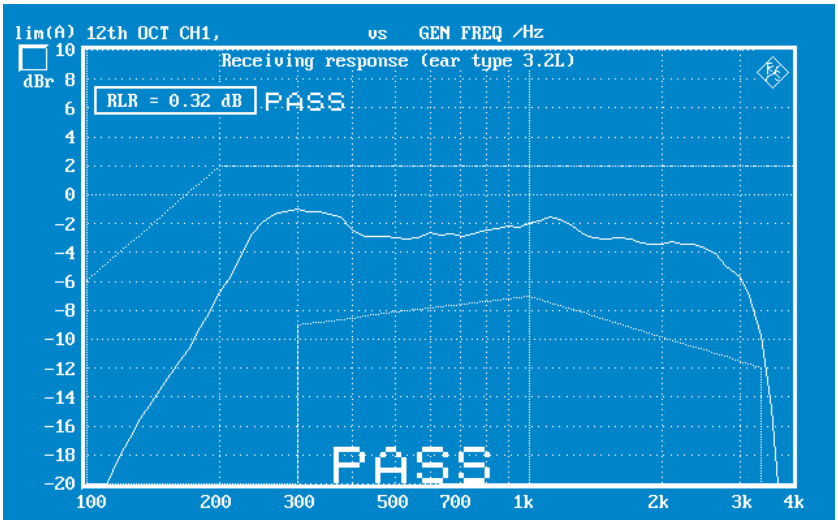

FIG 3 Typical result of frequency response and loudness rating measurement in the receive direction of a GSM mobile phone

Well equipped with the new option

All acoustic measurements for 3G mobile telephones are described in 3GPP TS 26.132 and the required values defined in 3GPP TS26.131. When the test specifications were updated, far-reaching harmonization of GSM and 3GPP specifications was also implemented. The previous GSM 11.10 was revised and is now available as 3GPP TS 51.010. It describes all acoustic tests on GSM mobile phones. Up to Release 1999 the previous instructions still apply, and as of Release 4 the new specifications 3GPP TS 26.132 and 3GPP TS 26.131 apply to both GSM and 3GPP telephones. Consequently, there are now uniform test specifications for both standards for measurements via the air interface.

With the new UPL-B9 option, all the tests for handset measurements defined in 3GPP TS 26.132 are now available on the Audio Analyzer UPL together with the Radio Communication Tester CMU 200 (FIG 2). The option comprises a cable for connecting the UPL to the CMU and a matching transformer for driving the artificial mouth. The necessary acoustic interfaces, such as test rack, artificial mouth, artificial ears with preamplifier and, if necessary, an anechoic test chamber, are not supplied with the option and must be purchased separately (FIG 4).

Since the Radio Communication Tester CMU 200 is currently only equipped with a GSM speech coder, all the tests can be carried out only in GSM mode. At present, 3GPP TS 51.010 stipulates that the full rate coder be used for testing GSM telephones. However, the enhanced full rate coder corresponds exactly to the 12.2 kbit/s mode of the adaptive multi-rate (AMR) coder prescribed for 3GPP. As a result, there are currently moves to have this mode permitted for future testing on GSM telephones. Since all 3GPP mobile phones launched on the market

Multitone signals for measuring echo suppression

Most mobile phone users are familiar with the irritating echo that sometimes makes normal conversation practically impossible. In many cases this is due to poor echo suppression in the mobile phone.

GSM 11.10 required echo attenuation of 46 dB and stipulated artificial voice to ITU-T P.50 as the test signal, because sinusoidal signals could not be used. Since artificial voice has a crest factor of approx. 20 dB and the peak value must not overdrive the coder, only an rms value of at least 20 dB below the full-scale value can be attained. The theoretical maximum S/N ratio of the GSM system is about 66 dB, so a pure interfering signal of at least 46 dB is still measured even if no echo is present. Echo signals of >46 dB are normally masked by the noise. As a result of the measuring problems detected early on, this important test was practically no longer carried out and excluded from the obligatory measurements, which had a negative impact on the features of many mobile phones.

When the tests were defined for 3GPP mobile phones, emphasis was placed on finding a method with sufficient dynamic range for echo suppression measurement. Rohde&Schwarz prepared several suggestions and presented them for discussion. It was ultimately decided to use an optimized, amplitude-modulated multitone signal that contains a signal for each third-octave band at the center frequency of the band and thus optimally uses the signal energy. Echo suppression is measured and calculated in the same way as defined in the earlier GSM 11.10. Concentrating the signal energy on the third-octave center frequencies results in a considerably higher signal/noise ratio, which allows the required 46 dB echo suppression to be measured with a sufficiently large margin. FIG 5 shows a typical result of the measurement on a modern GSM mobile phone.

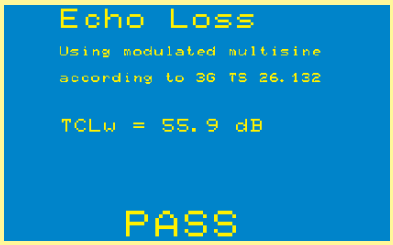

FIG 5 Such values for echo suppression are obtained with modern mobile phones.

in the near future will presumably be dual-mode, supporting both GSM and WCDMA, it is quite sufficient to test their acoustic characteristics in GSM mode (FIG 3).

FIG 4 Recommended equipment for acoustic measurements on 3G mobile phones (B&K: Brüel & Kjaer)

Telephone test head	B&K 4602 B
Ear simulator	B&K 4185 type 1 B&K 4195 type 3.2 low leakage and high leakage
Artificial mouth	B&K 4227
Head and torso simulator	B&K 4128 D
Acoustic calibrator	B&K 4231
Microphone power supply	B&K 2690 A0 S2
Acoustic test chamber	e.g. Studio Box type S

The tests that can be performed with the UPL-B9 option comply exactly with the test specification 3GPP TS 26.132 for narrowband telephony and have been validated by an independent test house for type-approval tests. This means that, for the first time, a complete, favourably priced system solution is available for the development, quality assurance and type-approval testing of 3GPP and GSM mobile phones without a DAI interface.

Tilman Betz

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

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[1] New for GSM mobile phones: multitone analysis via air interface. News from Rohde&Schwarz (1999) No. 162, pp 18–19

[2] Audio Analyzer UPL16: Speech quality of GSM mobile phones improved by precise audio measurement. News from Rohde&Schwarz (1998) No. 159, pp 16–17

[3] This issue contains several articles on the R&S CMU 200.

Production test systems based on R&S TSVP

Electrical, mechanical and optical performance testing of telephones

The R&S TSVP [*] test platform, the basis of many Rohde & Schwarz production test systems, allows optical testing of displays by cameras thanks to a newly implemented image processing function. The latest application demonstrating the versatility of this production test platform is the fully automatic performance test of business telephones in the Leipzig Siemens production line. The test system allows the stimulation of the devices under test (DUTs), electrical and acoustic tests, as well as optical inspection of display elements.

FIG 1 Production Test Platform R&S TSVP with cameras for optical test of displays (rack configuration)

Comprehensive performance – example telephones

The test system (FIGs 1 and 3) described here and based on the R&S TSVP is optimized for the automatic final test of business telephones in production lines. After assembly, the telephones are transported to the fully automatic inline test system in carriers and checked for all essential functions. The following tests were implemented:

- Actuating and testing the keypad by pneumatic plungers (artificial fingers)
- Inspection of LEDs with optical sensors
- Testing the LCD by cameras with different test patterns
- Testing the handsfree facility by an acoustic coupler in the test adapter
- Testing the electrical interfaces for telephone handsets and add-ons
- Testing the telecom interfaces (analog, ISDN and the like)

Test Platform R&S TSVP: Optimal for complex production tasks

The R&S TSVP is based on the industrial bus standards cPCI and PXI (PCI eXtension for Instrumentation), so it can be expanded by a whole variety of switching and measuring functions and is thus ideal for complex tasks of this kind.

The larger number of slots (up to 31) compared to competitor solutions allows the configuration of complex systems for the verification, performance and final testing of modules or units of equipment.

To implement these widely differing tests, it was necessary to develop new modules, integrate OEM boards and customer components. In addition to the CPU board, the system contains numerous modules for electrical and

optical tests and for simulating interfaces (FIG 5). The test system also controls the contacting station via a PLC (programmable logic control) interface and the pneumatic and electrical relays in the test adapter by digital I/O signals (FIG 2).

Space-saving mechanical integration into production line

The R&S TSVP concept allows integration of the entire T&M equipment into just one frame. Externally, only power supplies and line filters are required. A system rack (FIG 1) is not absolutely necessary. The test system can be integrated straight into a production line (FIG 3).

Economizing on the floor space and wiring compartment for the system rack means that is possible to design a more compact production line and thus increase productivity.

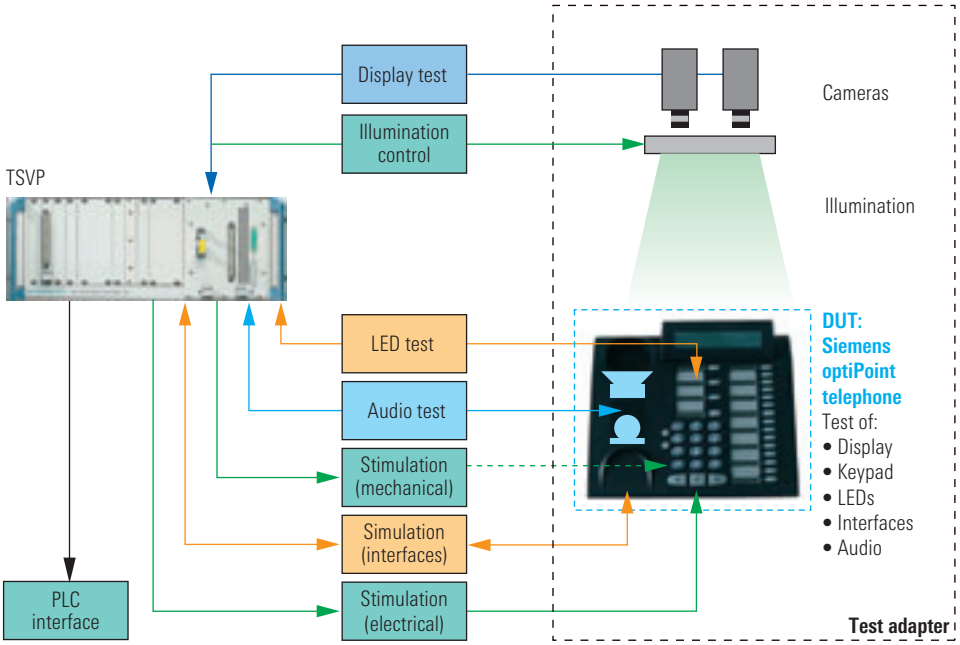


FIG 2 Block diagram of complete system

Convenient system software

The generic test operator interface (GTOP) from Rohde&Schwarz allows selection and manual or automatic initiation of various test sequences. The user is also informed about the running and the results of the individual tests and testing overall. The results are logged for repairs and can be archived.

GTOP accesses the comprehensive Rohde&Schwarz generic test sequence library (GTSL) in the TSVP through TestStand software from National Instruments. The modular structure permits straightforward integration of custom and external modules such as a frame grabber for the display test.

Photo 43813/1

FIG 3
Thanks to its compactness, the test system can be integrated into the production line of Siemens in Leipzig.

Fully automatic display test with cameras

The integration of optical inspection of displays into the test system completes the electrical performance and final tests ready implemented. These optical tests can be used for all applications with electrical modules plus display functions, e.g. in mobile phone or automobile production.

The reliability of displays and the tougher outgoing inspection carried out by producers mean that testing can increasingly be limited to programming displays and checking their functionality in terminals, i.e. with little quality assurance follow-up. So a display test will focus on the following:

- Measuring the contrast and the brightness of active areas in a non-driven state for optimally setting the display operating points
- Evaluation of symbols (correct character set)
- Display illumination (LEDs)

Definition of these test routines is implemented in application-oriented software for the inspection of monochrome displays. It is characterized by ease of operation and configuration of the display test functions. Of course, the modular concept of the GTSL driver library from Rohde&Schwarz allows integration of software modules for analysis of graphical colour displays (FIG 4).

A special advantage is the subsequent analysis of collected result parameters under TestStand, where further quality criteria can be added.

Considerable effort went into surmounting technical barriers during the implementation of the optical performance tests, yielding interesting solutions:

- Selection of suitable cameras that can be accommodated in the test adapter
- Choice of effective lighting to avoid reflections on the protective foil and polarization effects
- Use of suitable routines for analysis of contrast in the absence of a chessboard pattern (FIG 6)

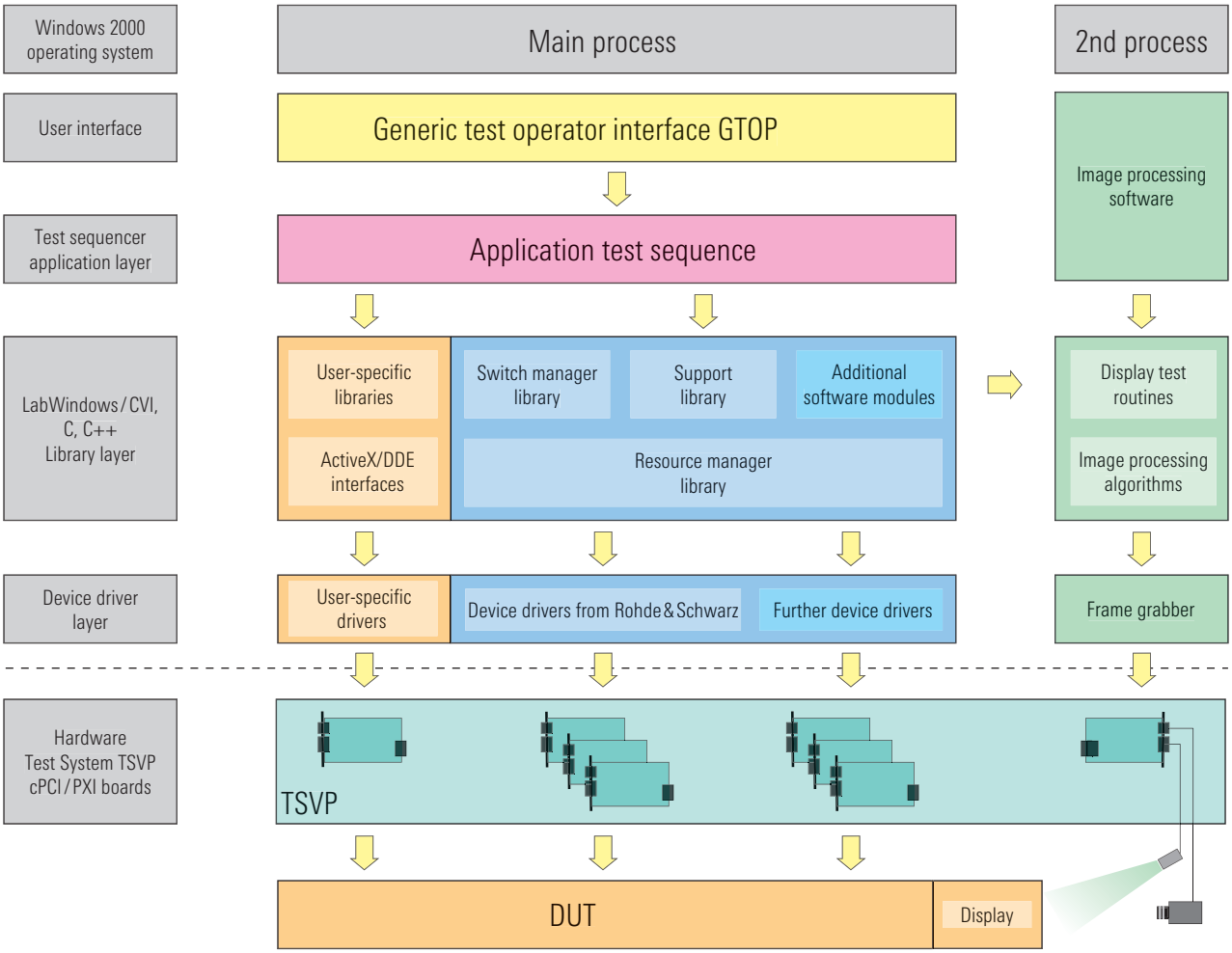


FIG 4 The modular software structure of the Test Platform R&S TSVP allows retrofitting of numerous applications.

User benefit – system solutions from a single source

Rohde&Schwarz is a provider of complete system solutions for production tests. In addition to basic expandability, the open and modular structure of the R&S TSVP system allows the user to add and integrate his own components. This speeds up user familiarization and promotes his own sense of responsibility for the further development and support of the system.

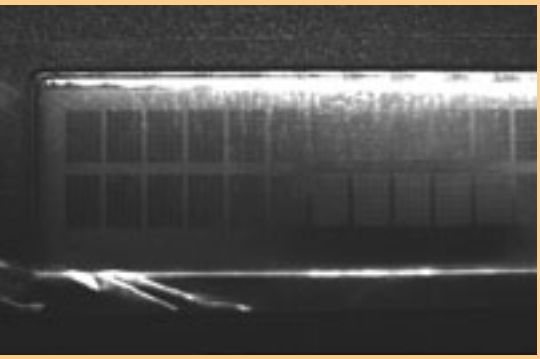
Thanks to the integration of electrical and optical tests and the driving of mechanical components in only one frame, the Test System Versatile Platform R&S TSVP, the user gets a compact solution from a single source with immense benefits:

- The concentration of components reduces the layout and allows them to be optimally attuned to one other
- Responsibility for the correct interaction of components lies with Rohde&Schwarz
- Space requirements are reduced by integration of the test system into the production line

Erwin Böhler; Gert Heuer

Type	Board	Function
TS-PDMM	Digital multimeter*	Selftest, LED test
TS-PMA	Matrix board*	Signal switching
TS-PRL1	TTL I/O board*	Digital I/O functions
TS-ADIO	Optocoupler board*	Programmable logic control (PLC)
TS-PDM1	Open-collector board*	Relay control keypad plungers
TS-PIM	PCM adaptation board*	PCM interface control
TS-SER	Serial interface board*	Carrier control
TS-ABI	a/b test board	Simulation of a/b interface AF generator, AF analyzer
External	LAN board*	DUT control
External	Frame grabber *	Picture recording, lighting control
Supplied by customer	Module	Telephone control

FIG 5 Boards used in R&S TSVP (* in cPCI version)



Photos: authors

FIG 6 Top: display inspection not possible due to polarization effects and visible protective foil. Bottom: suitable lighting ensures unimpaired view.

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

Data sheet R&S TSVP

Data sheet Universal Relay Card R&S TS-PRL1 for R&S TSVP

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[*] Cellular Phone Production Test Platform TS7100 – Compact, flexible and ready to go for mass production. News from Rohde&Schwarz (2000) No. 169, pp 4–7

Network Analyzers Advantest R 3765 CG / R 3767 CG

Accurate, realtime characterization of balanced and multiport components

There is increasing use of balanced components in modern electronic products such as mobile phones. They consume less power than unbalanced components, yielding the advantage of longer operation and standby. But balanced components mean completely new test requirements – optimally met by two network analyzers from Advantest.

FIG 1 Network Analyzer R 3767 CG from Advantest

Two specialists for multiport measurements

The two-port measurements customary for unbalanced components are inadequate for balanced ones. Duplexers and balanced filters require three-port or four-port measurements. Filters can come with an unbalanced input and balanced output (three ports) or balanced input and output (four ports).

Multiport measurements and special calculations are necessary to characterize components of this kind. Advantest – a long-standing cooperating partner of Rohde & Schwarz – has two specialists for the purpose in its product portfolio, the Network Analyzers

- R 3765 CG for 300 kHz to 3.8 GHz and
- R 3767 CG for 300 kHz to 8 GHz (FIG 1).

Both can optionally be fitted with an integrated three-port or four-port test set. The three-port test set enables measurement of all 9 S parameters, the four-port test set of all 16 S parameters.

Advantages of integrated test sets

The full calibration in the integrated three-port or four-port test sets from Advantest avoids all reflection errors that cannot be eliminated by two-port calibration. This leads to improved measurement accuracy, which matters in particular with DUTs that require more than 40 dB dynamic range.

The analyzers can be calibrated with an automatic calibration kit. This considerably accelerates the calibration process and then automatically verifies the results, excluding any source of degradation due to operator error, loose connectors or defective cables for example.

The analyzer display can be split into four windows, each simultaneously showing two S parameters (FIG 1). This means you can analyze reflections and response at different ports at the same time.

Four special features

The two analyzers from Advantest come with four major features that make them ideal for measurements on balanced and multiport components:

1. Impedance transformation

A filter with an unbalanced input and balanced output has different impedances. The input impedance is 50 Ω, the output impedance 150 Ω for instance. The two Advantest network analyzers are able to internally calculate the impedance transformation, making external impedance converters unnecessary. In addition, you only need one 50 Ω calibration kit for all measurements and are still able to measure a wide variety of impedances. Impedance can be selected for each port separately.

2. Simulation of matching circuits

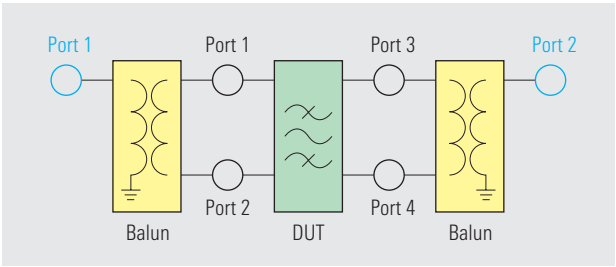
Simulation of matching circuits in the analyzer saves configuration of the required hardware. You can select different matching circuits in both Advantest instruments or use your own defined circuits that can be loaded as files in touchstone format.

Software simulation enables you to eliminate the hardware matching circuits connected, so the behaviour of the component alone can be tested. Both simulation of matching circuits and their elimination by simulation are possible separately for each port. A matching circuit can also be simulated between two ports.

3. Two different baluns

You need baluns (balance-to-unbalance transformers) to characterize a three-port or four-port component as a two-port component with one input and one output. The analyzers from Advantest offer a choice of two different baluns, one differential and the other floating. They enable you to characterize a filter with balanced input and output – e. g. with two floating baluns – like a two-port component (FIG 2). In addition, the level and phase of the degree of balance can be measured to achieve optimum balance of the DUT for example.

FIG 2
Conversion by baluns



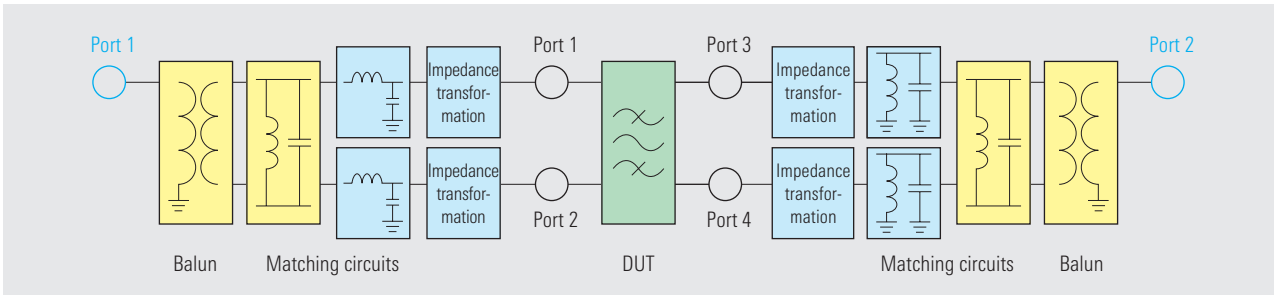


FIG 3 Combination of software simulations in four-port measurement

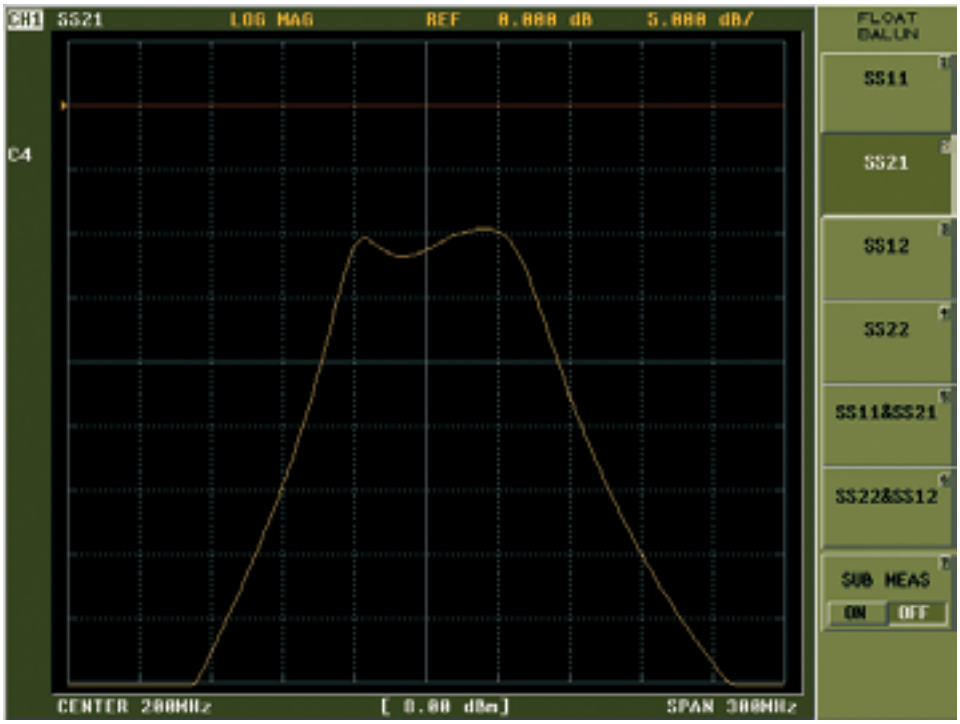


FIG 4 Result of measurement on balanced four-port

4. Differential S parameters

Differential S parameters can also be analyzed:

- Sdd (differential input, differential output)
- Scd (common input, differential output)
- Sdc (differential input, common output)
- Scc (common input, common output)

All four software simulations are implemented in the Advantest network analyzers and can be combined as required and used simultaneously. FIG 3 shows a combination of impedance transformation, simulation of matching circuits at each port and between the ports, as well as the use of baluns to characterize a four-port.

Highly flexible measurement functions and realtime measurements are of paramount importance especially in research, development and production. With their powerful and combinable simulation possibilities, both analyzers optimally fulfil these requirements. Plus, all measurements are realtime, so different influences can directly be analyzed (FIG 4).

The trend on the components market is towards integration of an increasing number of functions into a single component – there are, for instance, components with five or six ports available. These can be measured by means of an external five-port or six-port test adapter controlled by the network analyzer.

Conclusion

The Network Analyzers R3765CG and R3767CG from Advantest in conjunction with their integrated three-port or four-port test set and flexible and powerful simulation functionality are an excellent solution for measurements on balanced and multiport components. They offer:

- accurate measurements in realtime,
- a wide variety of measurement and analysis functions,
- display with up to four separate windows,
- impedance transformation,
- simulation of matching circuits,
- two baluns,
- differential S parameters.

Andreas Henkel

More information and data sheet at www.rohde-schwarz.com (search term: R3765)

Data sheet on analyzers

I/Q Modulation Generator R&S AMIQ / Signal Generator R&S SMIQ

Test signals for wireless LAN 802.11b with WinIQSIM™

Adding the 802.11b wireless LAN standard to the I/Q Simulation Software WinIQSIM™ again considerably expands its wide-ranging functionality for generating test signals in combination with the tried and tested R&S AMIQ and R&S SMIQ generators [1 to 3].

Increasing importance of wireless networks

The modern work environment increasingly requires the quick and straightforward creation of local networks, e. g. for data exchange between PCs or mobile access to databases and the Internet. Wireless LANs enable you to do this without any cabling of rooms and terminal equipment. All the functions a permanent connection to a wired LAN offers should also be available in wireless form. There are different approaches such as HiperLAN/2, HomeRF, the proposals drawn up by the Japanese MMAC* and in particular the standards specified by the IEEE under 802.11.

The total turnover in the WLAN sector is forecast to grow from € 1.1 billion in 2001 to € 5.5 billion in 2005**. The IEEE 802.11b standard introduced in 1999 stimulated WLAN business. The standard operates at 2.4 GHz and permits maximum data rates of 11 Mbit/s (FIG 1).

In 1990, the IEEE founded the 802.11 working group, which issued an initial version of the 802.11 standard in June 1997. The standard defines an infrared interface and radio transmission in the ISM (industrial, scientific and medical) band around 2.4 GHz.

Radio transmission can alternatively use frequency hopping spread spectrum (FHSS) or direct sequence spread spectrum (DSSS). Originally, two data transmission modes were defined for DSSS:

- data rates up to 1 Mbit/s with differential binary phase shift keying (DBPSK),
- data rates up to 2 Mbit/s with differential quadrature phase shift keying (DQPSK).

Both modes spread the information data sequence with an 11 chip Barker sequence, and operate with a rate of 11 Mchip/s.

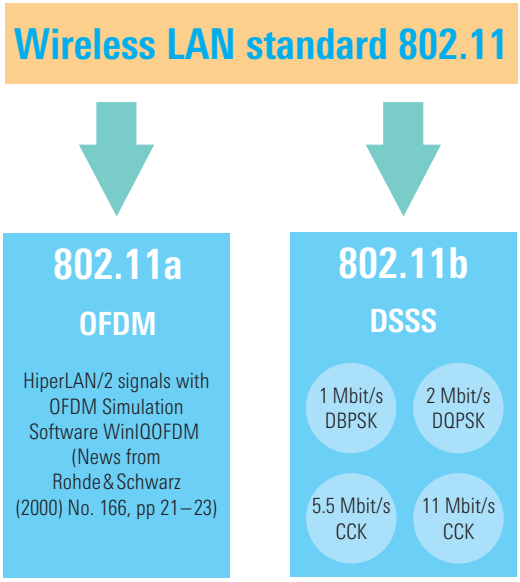
Early in 1999, the OFDM mode 802.11a for the 5 GHz frequency was added to the standard. The combination of the software products WinIQOFDM [4] and WinIQSIM™ from Rohde&Schwarz can simulate test signals to this standard.

Soon afterwards, in summer 1999, the DSSS mode, too, was extended by the new data rates of up to 5.5 Mbit/s and 11 Mbit/s and defined in the 802.11b standard. Two modulation modes were additionally included: CCK (complementary code keying) and PBCC (packet binary convolutional coding).

Simulation of 802.11b signals with WinIQSIM™

The 802.11b wireless LAN standard is a packet-oriented method of data transfer. Data packets are transmitted and received on the same frequency in time division duplex (TDD), but without a fixed timeslot raster. An 802.11b component can either only transmit or only

FIG 1 Development of 802.11 standard



* Multimedia mobile access communication systems

** Source: Frost & Sullivan report 3984 (May 2001)

receive packets at any particular time. A distinction must be made between packet types with a long or short physical layer convergence protocol (PLCP).

WinIQSIM™ can generate 802.11b signals in two different modes. In framed mode, the software generates data packets with the frame structure defined in the standard. In unframed mode, a non-packet-oriented signal is generated without a frame structure but with the modulation and data rates defined in 802.11b. This mode is suitable for simple initial tests focusing only on the modulation and spectrum of the test signal.

Framed mode

Framed mode allows configuration of a signal that generates a series of PLCP protocol data units (PPDUs), separated by the idle time. The information data is spread to the consecutive packets, i.e. it is not repeated from one packet to the next. This allows transmission of long PRBS data sequences to measure BER for example.

Such a packet always consists of a preamble, a header and the actual information data part. In addition to the number of packets to be transmitted, you can select between the two formats long and short PLCP defined in the standard (FIG 2). The frame structure of the packets is adapted automatically. All fields of the preamble and header such as SYNC, SERVICE and CRC are generated automatically in line with the standard. Besides the data rates 1 Mbit/s with DBPSK and 2 Mbit/s with DQPSK defined in 802.11, the software also provides the higher data rates 5.5 Mbit/s and 11 Mbit/s. The standard defines two different modulation modes for higher data rates: CCK and PBCC. With CCK modulation, 8 chips make up a CCK symbol. At a data rate of 5.5 Mbit/s, 4 data bits are mapped to a CCK symbol, and 8 data bits at a data rate of 11 Mbit/s.

PBCC uses a convolutional coder with half rate to realize the coding gain required. BPSK is used for data modulation at a data rate of 5.5 Mbit/s, QPSK at a data rate of 11 Mbit/s. Another coding layer generates the complex output symbols. For detailed information on the modulation methods, refer to the standard and [5].

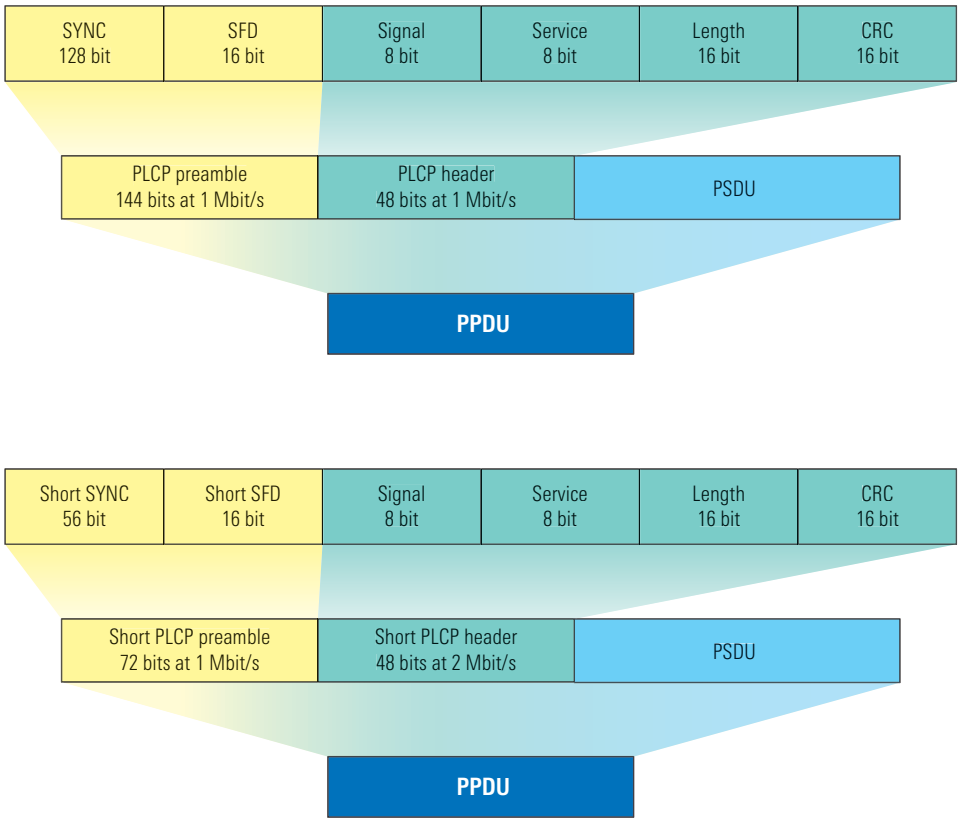


FIG 2 PPDU format with long PLCP (top) and short PLCP (bottom)

MAC header

In real IEEE 802.11b systems, a medium access control (MAC) header is transmitted in the PSDU before the actual data part; the header contains control information from higher layers. In addition, it is possible to protect the PSDU by means of a checksum. These two functions can be set in WinIQSIM™ (FIG 3).

Signals for receiver tests

The 802.11b standard defines RF parameters to which receivers must conform. Four tests are specified to verify these parameters:

- minimum input level sensitivity,
- maximum input level,
- adjacent channel rejection,
- clear channel assessment (CCA).

WinIQSIM™ can generate signals for all these tests. The receiver must demodulate the signals and measure the frame error rate for example.

Further tests

It is possible to configure the MAC header in WinIQSIM™, so all the frame formats defined in the standard can be generated (see also [5]). This permits the generation of a wide variety of 802.11b-conformant signals for all kinds of tests, e.g. RTS/CTS (request to

send/clear to send), or simulation of packet retransmission to examine a receiver's reaction to corrupted packets (see also [5]).

R&S SMIQ or R&S AMIQ?

The new standard is offered together with WinIQSIM™ as software option K16 for both the R&S AMIQ and the option SMIQB60 (arbitrary waveform generator). These two platforms offer solutions for WLAN 802.11b measurement tasks with different focuses.

R&S SMIQ standalone

Equipped with the options Arbitrary Waveform Generator SMIQB60 and SMIQK16 (option 802.11b), the R&S SMIQ is the perfect solution for testing receivers as defined in the standard and thus for verifying the RF parameters of 802.11b equipment.

R&S AMIQ

The same applies to the I/Q Modulation Generator R&S AMIQ (with option AMIQK16), but with further advantages.

This solution is particularly suitable for extended receiver tests and tests with different MAC frame formats. Long BER measurements are possible because of the capability to generate sequence lengths with up to 200 frames (with AMIQ04, oversampling 4, maximum number of data bits per frame). The R&S AMIQ demonstrates its proven assets such as digital and differential outputs and allows precise tests directly in the baseband. If an RF test signal is required, an R&S SMIQ should be added.

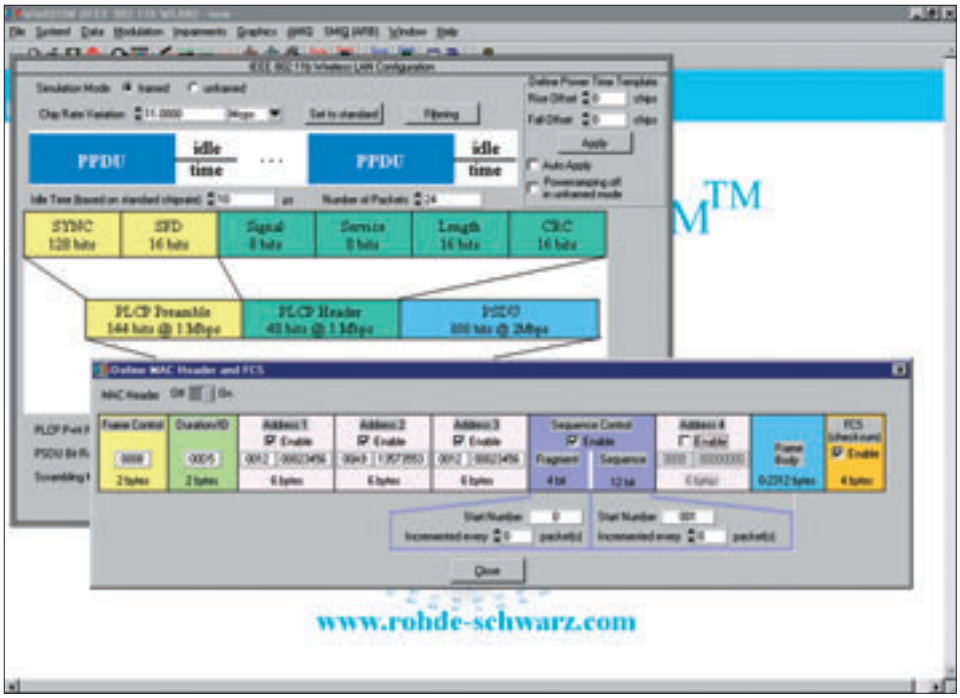


FIG 3 MAC header configuration

Summary

With the new 802.11b standard, WinIQSIM™ together with the R&S AMIQ and the R&S SMIQ presents comprehensive functionality for generating signals to test components and systems that considerably surpasses the scenarios specified in the standard.

Andreas Pauly

More information, data sheets and application notes at www.rohde-schwarz.com (search terms: AMIQ / SMIQ / WinIQSIM / 1GP49)

Application Note 1GP49

REFERENCES

[1] I/Q Simulation Software WinIQSIM – New approaches in calculating complex I/Q signals. News from Rohde & Schwarz (1998) No. 159, pp 13–15

[2] I/Q Modulation Generator R&S AMIQ – New models 03 and 04 as well as digital I/Q output option. News from Rohde & Schwarz (2000) No. 166, pp 22–23

[3] Signal Generator R&S SMIQ – Fit for 3G with new options. News from Rohde & Schwarz (2000) No. 166, pp 10–12

[4] R&S AMIQ / SMIQ – HiperLAN/2 signals with OFDM Simulation Software WinIQOFDM. News from Rohde & Schwarz (2000) No. 166, pp 21–23

[5] Application Note 1GP49 from Rohde & Schwarz

EMI Test Receivers R&S ESIB 26 / ESIB 40

Internal preamplifiers for improved sensitivity above 7 GHz

The new Internal Microwave Preamplifier Option R&S ESIB-B2 improves the sensitivity of the standard-compliant EMI Test Receivers R&S ESIB 26 and ESIB 40* (FIG 1) in the frequency range above 7 GHz.

Photo 43 176/5

Configuration and integration of preamplifier option

All test receivers of the ESIB [*] family already come with an internal 20 dB preamplifier for the 9 kHz to 7 GHz range as standard. Models 26 and 40 of the R&S ESIB-B2 option cover the frequency range 7 GHz to 26.5 GHz (receiver model 26) and 7 GHz to 40 GHz (model 40).

The new option with nominal gain of 20 dB clearly reduces the total noise figure of the two test receivers in the microwave range. So even the most exacting sensitivity requirements, e.g. to military standards such as MIL-STD-461, are satisfied more easily.

The option is inserted in the frontend signal path between the diplexer, which suppresses frequency components below 7 GHz, and the tracking YIG filter of the microwave converter. Placed here, it ensures an optimum increase of input sensitivity. FIG 2 outlines the design of the 26.5 GHz and 40 GHz models.

In the receiver, preamplification can be activated in the RECEIVER or ANALYZER modes by softkey. It is activated for the entire frequency range of the receiver and, depending on instrument settings, either the RF attenuation or the reference level are adjusted. The level display of the ESIB automatically considers the preamplification.

Installation of the option increases the displayed average noise level in the bypass mode, i.e. with preamplification deactivated, by approx. 2 dB to 3 dB above 7 GHz compared to a receiver without the option. This is due to the attenuation of the additional relays and the cabling.

If the receiver comes with the option ready installed, the additional frequency response will have been allowed for in factory calibration. If the option is subsequently integrated, the R&S ESIB must be recalibrated.

Increased sensitivity simplifies MIL measurements

The new option improves the input sensitivity of receiver models 26 and 40 for measurements above 7 GHz by up to 18 dB. This means that even higher cable attenuation, which occurs with field-strength measurements in large shielded enclosures with cables of up to 20 m in length, can be compensated. This applies at least partially also to the correction factors of the antennas used, which in the case of horn antennas, for example, can exhibit values exceeding 40 dB, depending on frequency range.

FIG 3 shows the displayed average noise level of the R&S ESIB 40 with the preamplifier switched on, recorded with a peak detector (MAX PK), 1 MHz IF band-

FIG 1
The EMI Test Receivers R&S ESIB provide standard-compliant EMI measurements up to 40 GHz.

* The previous name of the ESI test receiver family was changed to R&S ESIB (models 7, 26 and 40) for legal reasons.

width (RBW) and taking into account cable attenuation and transducer factors of three horn antennas up to 18 GHz, 26.5 GHz and 40 GHz. The inserted limit line (red) corresponds to MIL-STD-461E RE102-1. The parallel line (green) at a distance of –10 dB marks the noise display specified in the standard.

In extreme cases (e. g. above 26.5 GHz) another external preamplifier might be required directly at the antenna terminal to satisfy even the most stringent requirements of the MIL standard.

Karl-Heinz Weidner

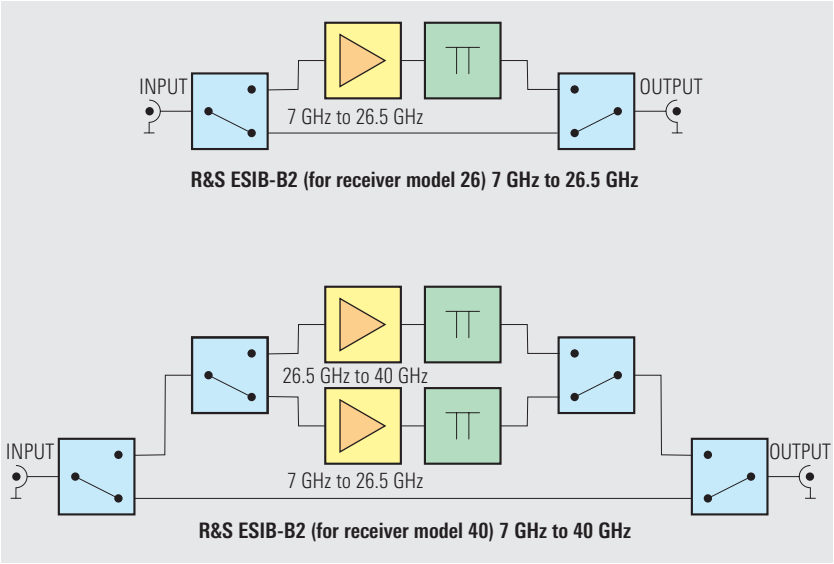


FIG 2 Block diagram of the Internal Microwave Preamplifier Option R&S ESIB-B2, model 26.5 GHz (top) and model 40 GHz (bottom). The latter comprises two preamplifier modules optimized for the particular frequency range.

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

Data sheet R&S ESIB

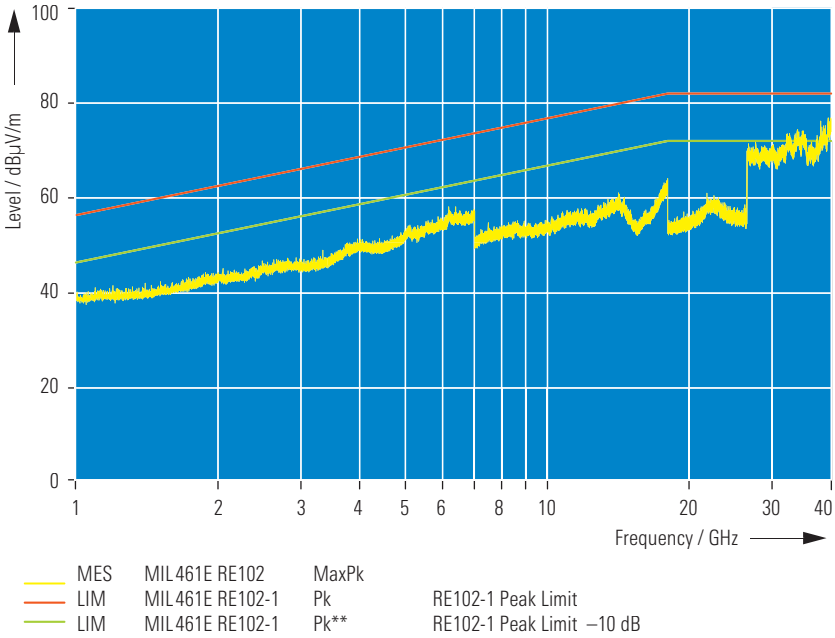


FIG 3 Noise display of the R&S ESIB40 from 1 GHz to 40 GHz weighted by peak detector; RF attenuation 0 dB, preamplification 20 dB, RBW 1 MHz and active transducer set: antenna transducer: R&S HF906, EMCO 3160-09, EMCO 3160-10; cable transducer: R&S HFU-Z5, RTK081, RTK050, RTK040.

REFERENCES

[*] EMI Test Receiver ESI – EMI professionals through to 40 GHz. News from Rohde & Schwarz (1999) No. 162, pp 7–9

TV-MON for EMS Test System R&S TS 9980

Automatic assessment of analog and digital picture degradations

Photo 43 206/7

FIG 1 Automatic Test System R&S TS 9980 DVB for analog and digital TV receivers and set-top boxes

The Test System R&S TS 9980 for measuring electromagnetic susceptibility of sound and TV broadcast receivers and associated equipment has established itself as a worldwide standard for compliance measurements [1]. The System Extension TV-MON now adds fully automatic assessment capability for analog and digital picture degradations.

Advantages of objective picture assessment

To date, the picture quality of monitors has mostly been determined by visual observation. Such subjective assessment calls for specially skilled and trained operators. Apart from high personnel costs, the accuracy, being non-quantifiable, is a marked disadvantage, because results depend on the expertise and day by day form of personnel as well as on test conditions like lighting, distance from the object monitored, characteristics of the observation window, etc. Consequently, there is a strong demand for objective and thus automatic picture assessment.

The System Extension TV-MON for the Test System R&S TS 9980 from Rohde & Schwarz (FIG 1) performs these tests fully automatically, which offers the user a number of advantages:

- Reproducible results
- No need for qualified personnel for picture assessment
- User gets familiarized quickly with operation of TV-MON
- Measurements can be integrated into production process
- Test sequences can be optimized to boost production throughput

Picture assessment in compliance with EN 55020

The method of objective picture assessment described here uses the same interference mechanism and is based on the same wanted signal definition as specified in the European Standard EN 55020 [2]. Assessment criteria, too, are in

compliance with this standard. The relevant criterion for picture quality is a barely perceptible degradation observed in visual picture monitoring (limit of visibility). CCIR Recommendation 471 (100/0/75/0) specifies an arrangement of vertical colour bars as the test pattern. This allows direct comparison of results obtained with objective and subjective picture assessment.

Objective picture assessment by comparison with reference picture

Objective picture assessment is based on comparison with a reference picture orienting on algorithms. Both the reference picture and the test picture are recorded from the monitor of the equipment under test (EUT) by a video camera (FIG 2). If an EUT has no integrated monitor, the video signal (CCVS) at the EUT's video output is taken instead.

Objective picture assessment is performed in four steps:

1. **Set up the picture recording system**

- Picture alignment: perpendicular alignment of the optical axes (horizontal and vertical) of the video camera and the EUT.
- Automatic white balance: to this effect, select a 100% white picture on the test pattern generator.
- Setting the optimal picture size by the automatic zoom function of the lens.
- Automatic focussing: optimum sharpness is achieved when the moiré pattern formed by optical components or the structure of the screen mask have no significant influence on the deviations to be determined.
- Positioning the regions of interest (ROIs) and plausibility check (size, position and homogeneity of the ROIs).

2. **Take at least five reference pictures**
   A mean regression function is calculated from the reference pictures. The assessment threshold is given by the maximum deviation of measured values from this function. The assessment threshold is determined as a reference value only once before starting a test sequence.

3. **Apply the required interference signal and take one or more test pictures for each variation of the interference variable (frequency or level)**
   Test sequences may consist of several thousand assessment steps.

4. **Calculate a regression function for each assessment step**
   If the deviation is greater than that determined for the reference pictures, there is visible picture degradation.

Identifiable picture degradation

The picture assessment algorithm used here is capable of identifying analog as well as digital picture degradations. The following analog picture degradations are detected:

- Superimposed patterns (sets of lines), moiré patterns
- Reduction in brightness and contrast
- Colour loss
- Sync loss

The following digital picture degradations are detected by the system:

- Blocking
- Total picture loss
- Freeze of moving element

The colour test pattern stipulated by the standard is not suitable for assessing digital MPEG2 data streams because data stream interruptions cannot be identified visually. A moving element was therefore introduced in the test pattern (FIG 3), and a bit rate of 6 Mbit/s selected for the video data stream.

Photo 43700/1

FIG 2 Video camera taking pictures from a TV receiver

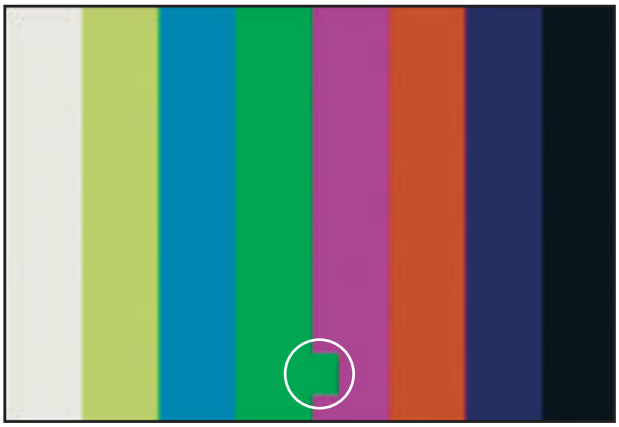
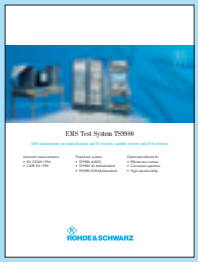


FIG 3
Test pattern for visual assessment of picture quality of MPEG2 data streams (moving element marked by white circle)

More information and data sheet at www.rohde-schwarz.com (search word: TS 9980)



Data sheet R&S TS 9980

Test setup for checking TV receivers

For objective picture quality assessment of TV receivers, the RGB signal from the camera must be taken to the signal input of the RGB frame grabber (FIG 4). The camera must be fed a sync signal from the video generator for synchronization with the picture refresh rate. The two signal paths use fiber-optic links to avoid electromagnetic pickup.

Standardization of the procedure is presently being discussed by the responsible committees, and it is due to be included in the European Standard EN 55020 in 2003.

Jens Medler; Gert Heuer

Summary

The System Extension TV-MON for R&S TS 9980 allows for the first time fully automatic picture assessment in susceptibility tests on TV receivers and associated video equipment. This is a special advantage in the very time-consuming and repetitive procedures required for type-approval and quality acceptance testing.

The results obtained by the objective method are directly comparable to those of the subjective method since the same interference and wanted signals are applied to the EUT. The method of objective picture assessment is, therefore, an attractive alternative.

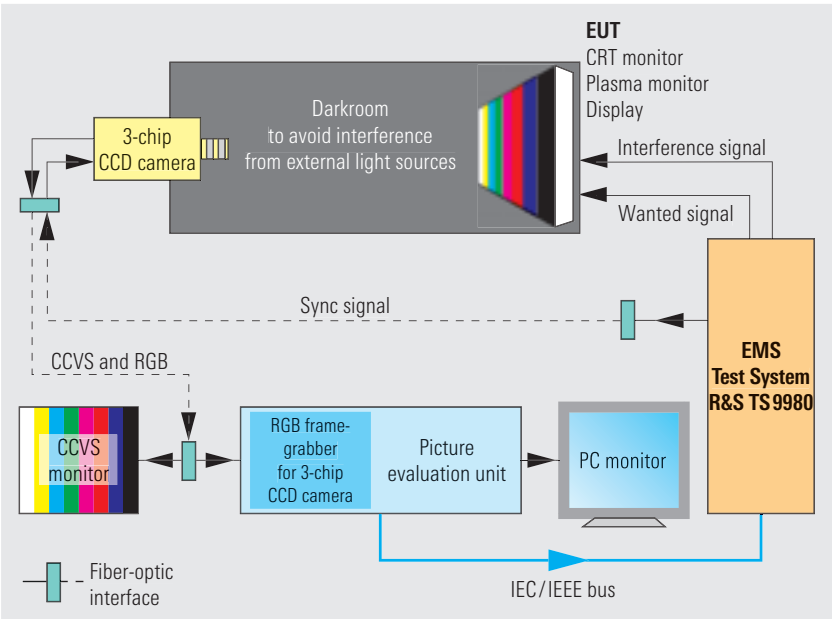


FIG 4 Block diagram illustrating objective picture quality assessment of TV receivers

REFERENCES
[1] Test System R&S TS 9980 measures electromagnetic immunity of radio and television receivers. News from Rohde & Schwarz (1990) No. 128, pp 32–33
[2] DIN EN 55020:2000 – Electromagnetic immunity of broadcast receivers and associated equipment. January 2000. Published by VDE, 10625 Berlin, Germany

Bargains on the Internet

Rohde & Schwarz has added a shopping option to its Web site. The new online shop will offer demonstration and loan equipment at drastically reduced prices. The instruments, fitted with a large variety of options, are in first-class condition and come with a full warranty.

Click "Bargain Shop" on the homepage (www.rohde-schwarz.com) or directly enter "www.shop.rohde-schwarz.com". The products offered are categorized, and you can read the catalog in the lefthand column. The links to "registration", "shopping cart" and "terms" (general conditions of sale) appear in the header.

If you are interested in a product, click on its photo for a detailed view. You can browse through what is offered anonymously, find out about built-in options, click "type details" to read product documentation such as data sheets, description of options, application notes and published articles.

Once you have made your choice, you can put the product into your shopping cart by clicking "add to cart" and check what is in it by calling up "shopping cart". Note that all the products are one-time items.

To send the order form, you have to register. Click "registration" to get to the registration form, choose your own user ID and a personal password for any subsequent registration. The red boxes must be filled in.

When you have filled your cart with what you want, call up the "order form". Check the shipping address that is suggested here on the basis of your registration, and choose your method of payment. Under "terms" you will find our General Conditions of Sale. Check to accept the conditions and send off the form.

The Rohde & Schwarz server automatically confirms receipt of your order form by a number. The shopmaster will handle your order as quickly as possible and fax you confirmation after clarification. To ensure confidentiality, data transfer between you and the Rohde & Schwarz server is SSL encrypted.

Rohde & Schwarz hopes that this new sales channel will be widely accepted. It is not meant to do away with traditional contact between customers and sales staff, but instead to support us in getting our products to you faster.

If you have any questions about this new shopping option, you can find your local sales representative by clicking "contact", or send an e-mail to shopmaster@rohde-schwarz.com. We will be pleased to assist you.

Karl Kislinger

TV Test Receiver R&S EFA

Eye monitoring for continuous detection of digital TV signals

Rohde & Schwarz presents a new display for the analysis of digitally modulated signals (QAM and 8VSB) to go with the Test Receivers R&S EFA, making a valuable contribution to the evaluation and monitoring of advanced communication systems. This innovative method (patent pending) is based on the classic constellation diagram, expanded by the dimension time. It opens up completely new possibilities for judging quality and errors.

Starting point – the classic constellation diagram

Usually, digitally modulated signals are presented graphically in a constellation diagram, the most important display form for such signals to date. Examples of it are shown in [*]. But this kind of display still has distinct shortcomings. In particular, the constellation diagram lacks sufficient information about the nature of possible interference with time. Periodically occurring interference pulses cannot be detected for instance. Plus, the method shows only a small part of the actually present I/Q data, because it records and displays samples only within a narrow time window. Numerous samples are not detected at all, causing large time gaps (FIG 1).

Eye monitoring – time in the picture

Eye monitoring measures and stores the I/Q data of numerous consecutive constellation diagrams (FIG 2). The I component of each of these diagrams is shifted by 90° and then represented, together with the Q component, in vertical direction. The result is a one-dimensional display (I/Q projection) of the constellation diagram without information loss.

In a second step, the I/Q projections of the consecutive constellation diagrams are represented side by side. Time is thus added as a further dimension, allowing reliable detection of periodic interference for instance.

Continuous I/Q detection

The advanced hardware concept of the Test Receivers R&S EFA makes eye monitoring possible. A large number of detectors operating in parallel are used to permanently monitor the entire range of I/Q samples. When the receiver acquires a specific measured value, the corresponding detector stores the information. This configuration permits the continuous collection of measurement results. Interference with very short pulses of only 10 ns, for instance, is recorded even if just a single symbol is impaired in transmission.

Eye monitoring differs from the familiar eye diagram in its clear time assignment of the measured I/Q samples; redundant information is not displayed. Both dia-

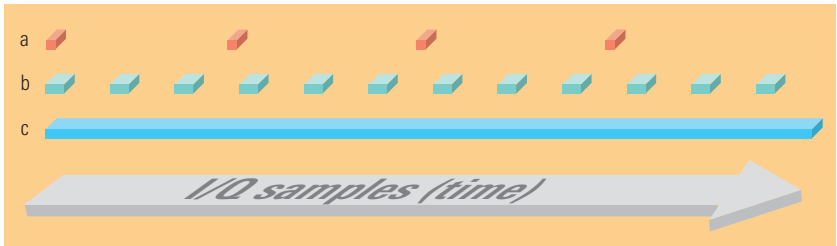
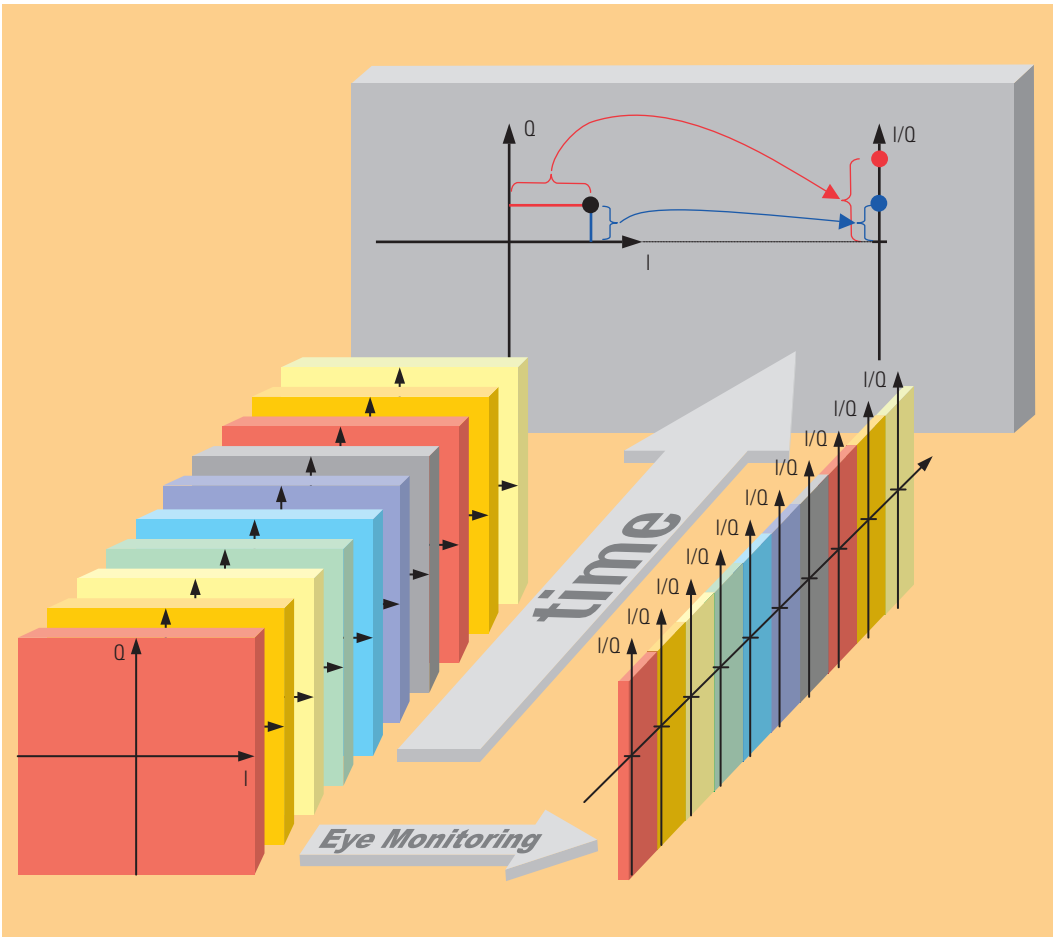


FIG 1
Means of displaying I/Q samples as a function of time: a) other producers (slow screen update with few I/Q samples); b) TV Test Receiver R&S EFA (constellation diagram); c) TV Test Receiver R&S EFA (eye monitoring) with continuous detection of samples

FIG 2
Eye monitoring: consecutive constellation diagrams are each reduced by one dimension (projection of I axis onto Q axis) and then graphically displayed as a function of time.



grams graphically display the eye height, but only eye monitoring permits continuous detection. It can consequently be interpreted as a follow-on development of the eye diagram.

Flexible result display

The required time window can be configured within wide limits. The user defines a time window (e. g. one hour), and measurement starts in the narrowest window (20 s). Once this has been monitored, the instrument automatically keeps switching to the next highest window (40 s, etc) until the total time required is displayed. The display then changes to scroll mode, where new samples are added at the right display edge and the oldest ones at the left edge are deleted. The entire specified time window is thus visible on the display with the current values at any time. A maximum of 1000 days can be displayed. Of course, this mode too ensures continuous collection of results.

Examples

In the new eye monitoring function, Rohde & Schwarz presents a method of monitoring and displaying measurement results that is unique worldwide. Two examples, recorded for 64QAM and 6.9 Msymb/s, illustrate this. The first shows a section of 20 s that was impaired by very short pulses (25 ns) from a pulse generator exactly every 2 s. The measurement (FIG 3) clearly indicates the regular interference; the red markers at the pulse times illustrate this. All occurring pulses are continuously detected and displayed.

The second example shows monitoring over a four-day interval (FIG 4). You can clearly recognize the periodicity of increasing and decreasing interference, depending on the time of day. This may be due to EMC problems (man-made noise) or differences in temperature, for instance.

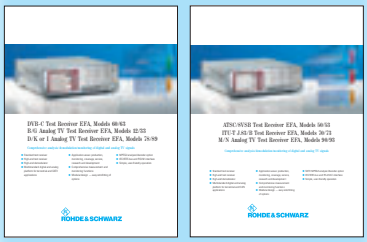
Backed by forward-looking hardware

Eye monitoring shows up to advantage compared to other methods. Unlike bit error ratio measurement, a problem is perceived before limits are violated. And the short pulse interference is reliably detected whereas modulation error ratio measurement (MER) does not detect it because of the rare appearance of the pulses. What is more, short interference pulses would not significantly contribute to the effective MER value.

The new eye monitoring function is now included in models 50/53 (ATSC), 60/63 (DVB-C), 70/73 (J.83/B) and option EFA-B20 of the TV Test Receiver R&S EFA. Instruments already in use can be upgraded with a firmware update. This is possible because the advanced hardware concept of the receivers featured the field-programmable gate arrays needed to implement eye monitoring right from the start.

Christoph Balz

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



Various data sheets on the R&S EFA family can be downloaded.

REFERENCES

[*] TV Test Receiver R&S EFA: Digital multistandard platform for the analysis of QAM-modulated signals. News from Rohde & Schwarz (2001) No. 172, pp 34–37

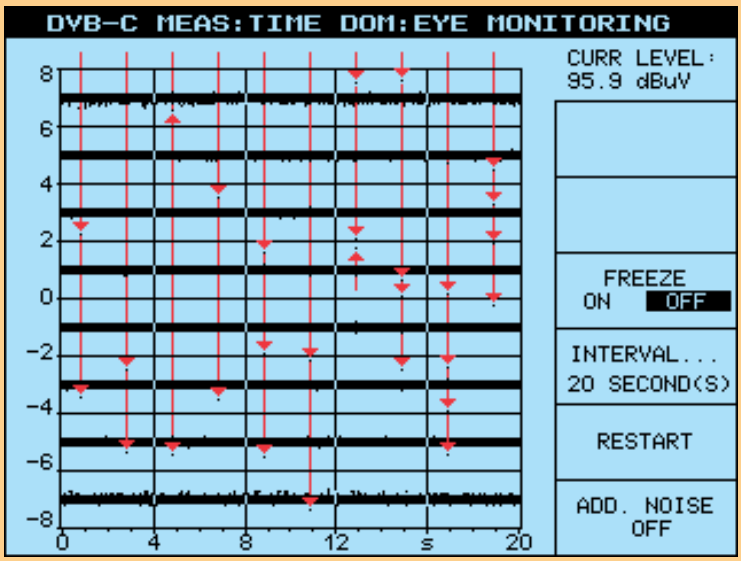


FIG 3 Eye monitoring with 20 s display time: pulses of 25 ns cause interference of the 64QAM signal every 2 s (red markers). The Test Receiver R&S EFA continuously monitors all pulses. At least two impaired test points (I and Q components) are visible for each pulse, depending on whether just one or two symbols were impaired.

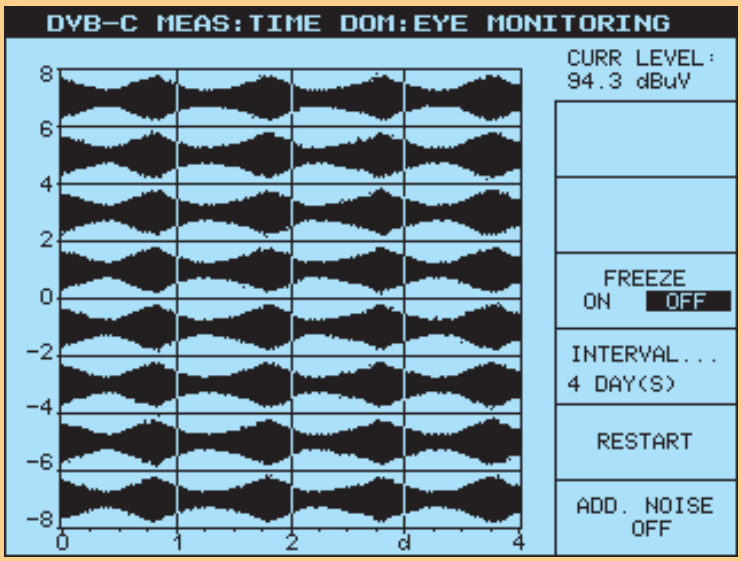


FIG 4 Eye monitoring over four-day interval: periodic interference of 64QAM signal

VHF Transmitter Family R&S NM / NW 7000

Liquid-cooled VHF TV transmitters

The introduction of the R&S NM/NW 7000 expands the family of liquid-cooled, high-power transmitters to the VHF range. The transmitters of the UHF family [1] have already met with excellent acceptance on the market, more than 350 systems having been sold since they were launched two years ago. Rohde & Schwarz is thus able to offer a uniform transmitter concept for the two major TV frequency bands. Thanks to their modular design, the transmitters can be configured for both digital and analog TV.

Especially compact and modular

The VHF transmitters of the R&S NM/NW 7000 family (FIG 1) are similarly compact to the UHF transmitters. An entire transmitter is accommodated in a rack just 630 mm wide. The VHF transmitters are also equipped with the well-proven **Exciter R&S Sx 700** [2], which works in both bands without any modification. Transmitters can thus be configured for the digital TV standard DVB-T in line with ETS 300 744, the American standard ATSC and for the analog standards PAL, SECAM and NTSC.

Photo 43 392/5

FIG 1
Liquid-cooled TV Transmitters R&S NM/NW 7000

The use of modern, powerful MOSFETs – in conjunction with innovative, compact transformer networks – produces identical amplifier dimensions for VHF and UHF. The high efficiency of the amplifier stages and a special cooling technique ensure very low junction temperature of the transistors and thus long lifetime and attractive cost of ownership.

Identical racks for VHF/UHF

The rack with complete infrastructure (rack control, cabling, test points, interfaces), the exciter and the cooling system are identical for VHF and UHF. Subsequent upgrading of an analog transmitter to DVB-T or ATSC standard is possible with minimum cost and effort. All it takes is replacement of an exciter module and installation of an output filter (FIG 2).

The use of uniform components very much reduces the number of spares that need to be stocked. In conjunction with the high reliability and long lifetime of the transmitters, this means substantial cost savings for maintenance, logistics and servicing.

Analog TV transmitters for up to 10 kW including up to five video amplifiers and one audio amplifier are accommodated in a single rack. The vision/sound diplexer is installed in the lower part of the transmitter for ease of access to perform adjustments. Transmitters for DVB-T up to 2.8 kW and ATSC up to 3.4 kW are also housed in just one rack. For higher output, transmitter racks are linked by power combiners. Amplifiers, like the cooling system, are fitted with self-engaging connectors, so they can be replaced during operation. A transmitter can be configured with one or two

exciters plus central control unit (CCU) and an **automatic switchover control unit of the type R&S GB 700** [3] to create a system for (n+1) standby. The exciters are held in a 19-inch drawer-type frame. In this way, all common standby concepts can be implemented.

In case of exciter standby, the CCU is driven by an additional power supply. A bypass circuit is also provided for the CCU so that it can be replaced without interrupting operation in the event of failure.

Power amplifier

The **VHF Power Amplifier R&S VM 602A1** (FIG 3) produces a DVB output of 485 W or sync peak power of 2.2 kW for analog TV. The broadband amplifier operates in the range 170 MHz to 250 MHz. The input signal is applied to the multi-stage preamplifier, which also comprises a power control circuit, amplitude and phase controls and several monitoring functions. It is followed by a driver amplifier and four output stage modules. The combiner and transformer networks are entirely in microstrip and suspended substrate technology. Total gain is approx. 63 dB. In case of a transistor failure, a special protective circuit prevents the other transistors from being overdriven. The operating point of the other transistors is not changed. The amplifiers can be used unmodified for digital and analog TV. Like in the UHF version, there is a three-phase switching power supply fitted on the underside of the heatsink in the amplifier module. An overtemperature- and reflection-responsive circuit plus an input level monitor are provided for amplifier protection. Amplifier malfunctions are detected by a monitoring circuit.

The amplifier PCBs need no adjustment and are fitted with SMT components throughout. Thus all components can be easily accessed and replaced without the need to exchange the whole PCB.

For diagnostic purposes, two service connectors are provided for determining transistor currents, power supply voltages and currents as well as all parameters from the RF detectors. The values can be measured with a simple multimeter, or more conveniently with the optional **Test Box R&S GT 610 A1** and displayed on a laptop. The software simplifies the adjustment of quiescent transistors currents by graphic support during servicing.

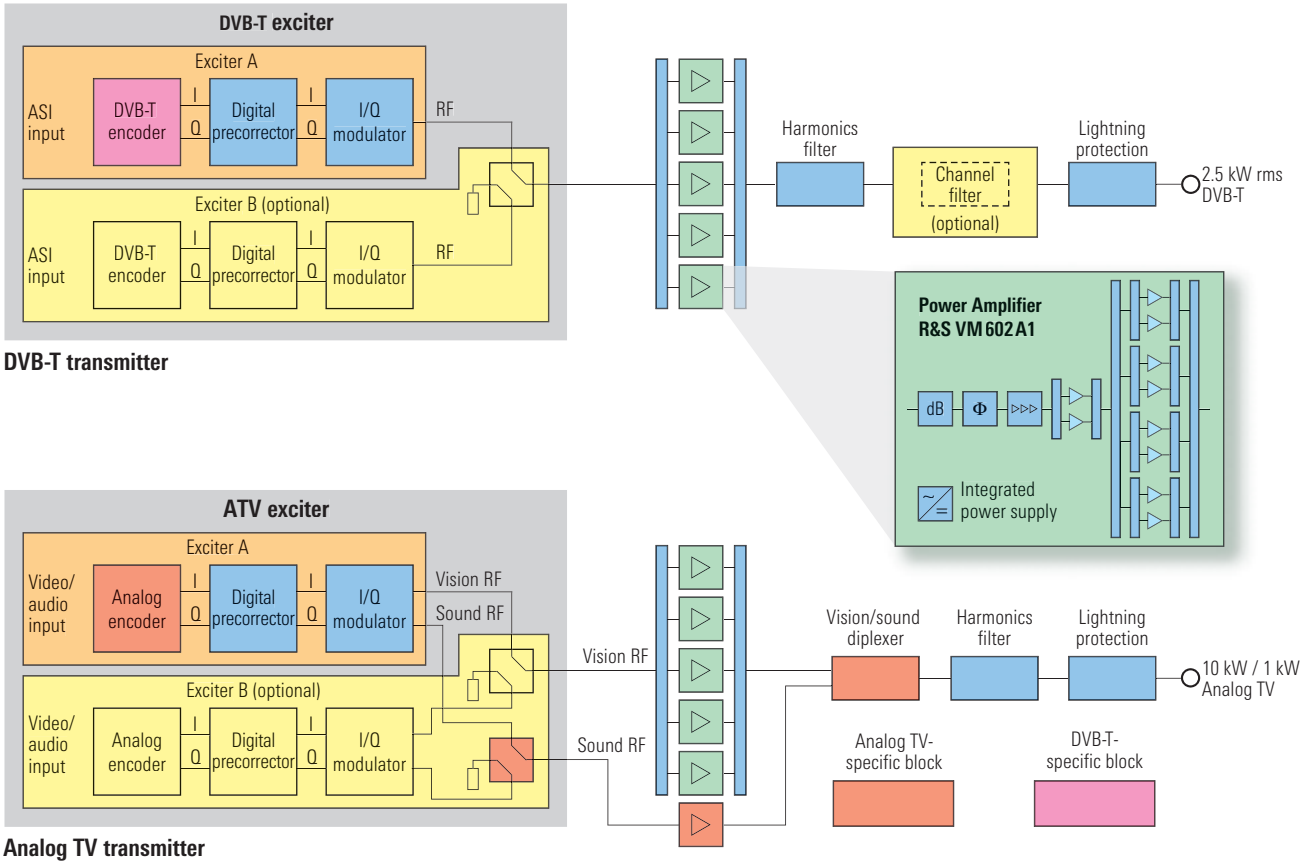


FIG 2 Schematic of R&S NM / NW 7000

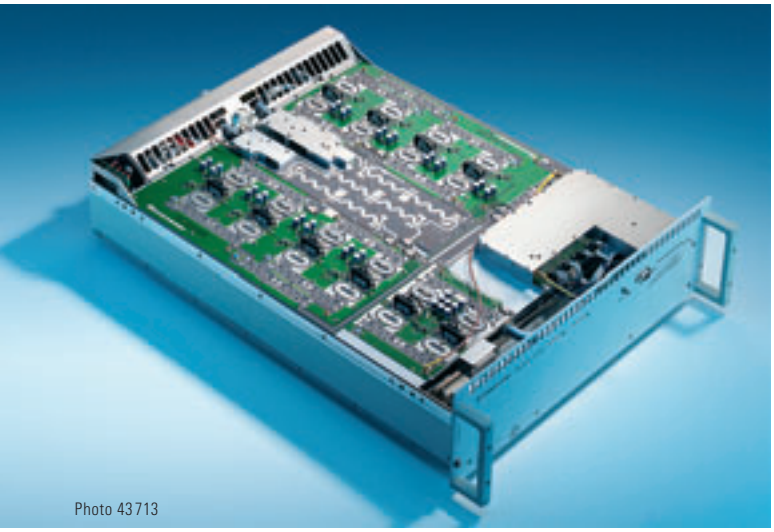


FIG 3 VHF Power Amplifier R&S VM602 A1

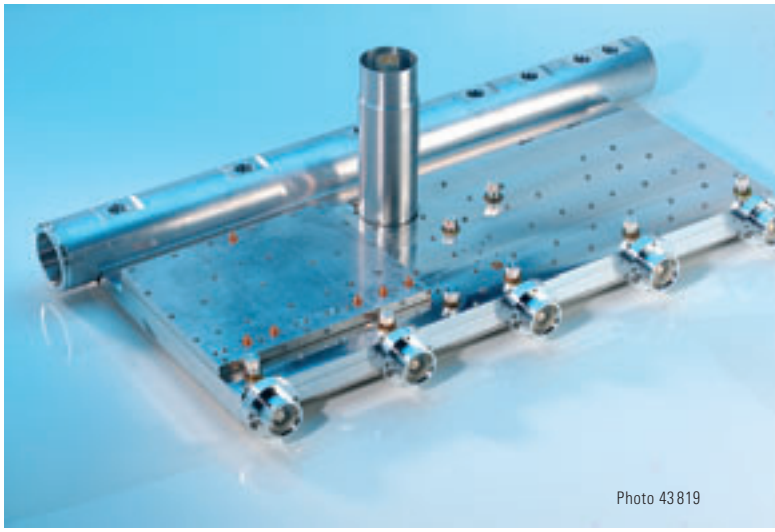


FIG 4 10 kW Combiner R&S BV610 M5

High-power combiners

The concept of the high-power combiners (FIG 4) is based on cascaded 3 dB/90° couplers [4]. Up to eight Power Amplifiers R&S VM602A1 can be connected in parallel. The broadband combiners operate in the 170 MHz to 250 MHz range, are easily accessible and service-friendly. The absorber resistors required for decoupling in the case of a malfunction are arranged on the combiner on the liquid collector and so optimally cooled. Due to the high decoupling of the individual RF inputs and the self-engaging connectors (RL13-30), amplifiers can easily be replaced during operation without program interruption. The power splitter required for driving the amplifiers is integrated in the power combiner, which produces compact RF routing and minimum transmission loss.

Effective cooling

The cooling system consists of a pump assembly and a heat exchanger for each transmitter rack. For redundancy purposes, the pump assembly comprises two pumps, a three-way mixer for temperature control and to avoid condensation in the transmitter system at low ambient temperatures, as well as a separate control unit. This ensures reliable operation of the system at outdoor temperatures between −30 °C and +50 °C. The heat exchangers may be installed anywhere outside the transmitter room. Each heat exchanger is fitted with two fans in active standby. If wished, the cooling system can also be configured as an (n+1) standby system.

Remote control over NetLink

The **NetLink** option [5] is an efficient and future-oriented medium for system monitoring, remote maintenance and central logging of measured data from individual transmitters or whole networks. The plug-in of just one height unit is accommodated in the transmitter rack. Available infrastructure like LAN, WAN and Internet can be used for remote control via analog telephone lines, ISDN or GSM. The use of standard protocols (TCP/IP, UPD/IP) together with standard software (Web browser or SNMP management platform) makes the user flexible and able to avoid uneconomical special-purpose solutions. The same user interface is displayed on the exciter and on the PC at site.

Uwe Dalisda; Bernhard Kaehs

More information and data sheet at www.rohde-schwarz.com (search term: NM 7000)

Data sheet R&S NM/NW 7000

REFERENCES

[1] Liquid-cooled TV transmitters for terrestrial digital TV. News from Rohde & Schwarz (1999) No. 165, pp 11–13

[2] Exciter R&S SV700 – Digital TV standard ATSC for Transmitter Family R&S Nx700x. News from Rohde & Schwarz (2001) No. 172, pp 40–41

[3] (n+1) standby configuration of TV transmitters – Always "on air" through automatic switchover. News from Rohde & Schwarz (2001) No. 172, pp 38–39

[4] Power combiners for UHF Transmitters R&S NH/NV7000. News from Rohde & Schwarz (2000) No. 169, pp 24–25

[5] Remote control and monitoring of transmitters on the Internet. News from Rohde & Schwarz (2001) No. 170, pp 27–29

MPEG2 Generators R&S DVG / R&S DVRG

High-definition TV pictures of the future

The MPEG2 Generators R&S DVG and R&S DVRG can be used in many ways, e.g. in the production of set-top boxes, for the installation of transmission links or for performing test sequences. A special and important feature is the large signal repertoire stored in the generators. The versatile signal set has now been extended by the new DV-HDTV option, adding pictures for high-definition TV (HDTV). This makes the generators true allrounders in digital TV measurements.

Digital home movies are on the way in

The digitization of television is rewarding the viewer with more and more programs, since MPEG2 coding fits four to six programs into one analog TV channel. But instead of doing it this way, a single program of high picture quality and definition could be transmitted in a TV channel instead of four programs of the usual picture quality and standard definition. In the USA and Australia, there was consequently early focus on implementing HDTV with the introduction of digital TV. When you compare the size of the pictures, it becomes clear that, with HDTV, home movies are just around the corner (see box next page).

With the new option, the MPEG2 Measurement Generator R&S DVG [1] and the DTV Recorder Generator R&S DVRG [2] allow infinite and therefore interruption-free replay of standard HDTV signals so that measurements of any duration can be performed at any time. This is indispensable for producing, testing and repairing HDTV receivers, decoders and displays. The option provides special test patterns (colour bars, sweep, grids with circle, etc) in all formats, for optimal testing and alignment of analog circuitry, too (FIG 1).

The picture is accompanied by an appropriate audio signal, also contained in the transport streams provided by the option – background noise and music for live sequences as well as test tones (multitone, sweep) for the test patterns. This gives an audible impression and allows you to test the frequency response of analog output amplifiers and loudspeakers. The audio signals are in line with the coding standards MPEG1 Layer 2 and Dolby AC-3.

As for the audio coding, two different protocol standards have become established for the picture: ATSC in the USA and DVB in Europe, Asia and Australia. The signal set of the DV-HDTV option is of course generated for both standards: ATSC using a picture refresh rate of 24, 29.97 and 59.94 Hz, and DVB also comprising 25 Hz and 50 Hz signals.

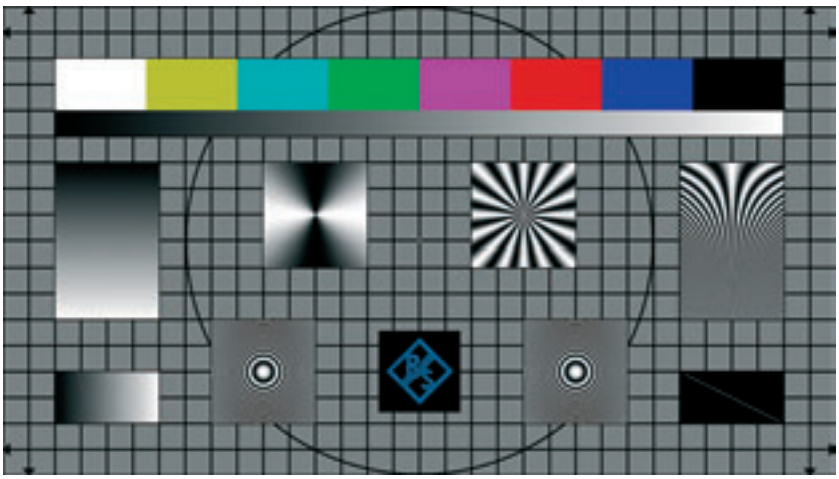


FIG 1
HDTV test pattern

The user can generate individual transport streams with the aid of the optional Stream Combiner™ DVG-B1 and the HDTV elementary streams provided by the DV-HDTV option. The elementary stream library comprises signals of the following formats and picture refresh rates:

Pixels	Sampling	Picture refresh rate
704 x 480	P	59.94 Hz
1280 x 720	P	50 / 59.94 Hz
1920 x 1080	I	25 / 29.97 Hz
1920 x 1080	P	24 Hz

With the DV-HDTV option, Rohde&Schwarz contributes to the improvement of TV broadcasting towards higher quality and technical perfection so that the peep-hole to the world is widened to a panoramic view and the change from analog to digital TV produces a significant added value for the viewer.

Thomas Tobergte; Harald Weigold

More information and data sheets at www.rohde-schwarz.com (search terms: DVG / DVRG)

Data sheet R&S DVG

Data sheet R&S DVRG

REFERENCES

[1] MPEG2 Generator R&S DVG and MPEG2 Measurement Decoder R&S DVMD – Test equipment for digital TV in line with MPEG2. News from Rohde&Schwarz (1996) No. 152, pp 20–23

[2] DTV Recorder Generator R&S DVRG – Recording, processing and replaying MPEG2 transport streams. News from Rohde&Schwarz (2000) No. 167, pp 8–10

The formats in comparison

FIG 2 shows standard-definition TV (SDTV) with approx. 400 000 pixels as the viewer is accustomed to (USA: 704 pixels, 480 lines, 29.97 Hz picture refresh rate).

The high-definition TV (HDTV) picture with 921 600 pixels (1280 pixels, 720 lines) gives a much wider view, allowing the gaze to wander (FIG 3). This picture format was created for better compatibility with the computer world. The picture is no longer made up of two interlaced fields but is a progressive full field with double picture refresh rate (59.94 Hz).

Staying with TV and thus the simple picture refresh rate, the picture size can be further increased to 1920 pixels and 1080 lines. The result is more than two million pixels and five to six times the definition of SDTV (FIG 4).

The new formats use an aspect ratio of 16:9 similar to that of movies.

FIG 2
704 pixels x 480 lines

FIG 3
1280 pixels x 720 lines

FIG 4 1920 pixels x 1080 lines

UHF Transmitter Family R&S NH/NV 7000

20 kW TV transmitters – compact and mobile

In 1998, Crown Castle International was the world's first operator to set up a nationwide, terrestrial digital broadcasting network with four multiplexers. Rohde & Schwarz supplied more than 80 transmitters of the power classes 750 W to 3 kW for this network in Britain. Staff of Crown Castle International and of the Rohde & Schwarz UK subsidiary jointly set up the network over a number of months and put it into operation. In addition, Rohde & Schwarz supplied eight mobile digital transmitters as backups.

Since the analog network will be operating in parallel to the digital network for a number of years, Crown Castle International decided to acquire mobile systems to insure against major equipment failure. The containerized equipment will also be suitable for conversion to digital when the analog network is shut down.

Because of their good experience with Rohde & Schwarz, Crown Castle International commissioned four containers, each equipped with a 20 kW TV transmitter. The orders are in good hands, as Rohde & Schwarz can profit from its long-standing experience in equipping containers with broadcasting facilities. So far, some 50 systems have been delivered worldwide.

The supplied Transmitters R&S NH 7200 V from the R&S NH 7000 family [1] are each fitted with two exciters in passive standby and two output stage racks in active standby. This concept ensures high availability of the entire system. The transmitters are designed for standard i1 and NICAM sound with separate video and audio amplification. All remote control commands and messages can be provided via a serial RS-232-C interface, a parallel interface or NetLink [2].

Thanks to the compact design of the liquid-cooled high-power transmitters, it is possible to accommodate the entire system including peripherals in a 20" container (photo). In addition to the transmitter, which consists of two racks with the cooling

Sophisticated solutions – a Rohde & Schwarz speciality

This order also involved some tricky technical problems:

- **Retuning channels must be possible in minimum time:** the new R&S NH 7000 transmitter generation from Rohde & Schwarz offers an elegant solution to this problem. The digital exciter can be quickly tuned across the entire UHF band via a softkey without hardware changes. The liquid-cooled R&S VH 602 A2 amplifiers are suitable for broadband use without tuning. A minimum amount of effort is involved in retuning the filters.
- **It must be possible to operate two containers in parallel, i. e. with 2 x 20 kW output power:** here Rohde & Schwarz implemented an operating mode in which the exciters and control unit can each additionally communicate with the output stages in a second container.
- **Increased demands on the left sideband for adjacent channel operation with a digital transmitter:** to prevent the analog transmitter from interfering with the digital signal of the lower adjacent channel, a shoulder distance of –45 dB below the vision carrier starting at –1.6 MHz is necessary. This was optimally solved by a newly developed, tunable coaxial eight-circuit bandpass filter.

systems (pump assembly and cooler), an antenna switch panel with power splitter for half-antenna operation, power distribution, a control rack and bandpass filter with eight circuits are integrated.

To ensure safe operation even at extreme temperature fluctuations, the steel containers are of a highly insulating sandwich structure. Air conditioning regulates the temperature inside. The containers are fitted with grilles as protection against falling ice when set up below antenna towers. They were built and fitted out in cooperation with the Gföllner company of Markttrenk, Austria. They have been operating since February 2002.

Friedrich Rottensteiner

Data sheet for Transmitter Family R&S NH/NV 7000 at www.rohde-schwarz.com (search term: NH 7000)

REFERENCES

[1] UHF Transmitter Family R&S NV/NH7000 – Liquid-cooled TV transmitters for terrestrial digital TV. News from Rohde & Schwarz (1999) No. 165, pp 11–13

[2] NetLink – Remote control and monitoring of transmitters on the Internet. News from Rohde & Schwarz (2001) No. 170, pp 27–29

Photo: Author

Compact and mobile – each of these containers houses a complete 20 kW TV transmitter.

TV Transmitter R&S NH 6050

Liquid-cooled TV transmitter at airy height

Acrodyne Industries Inc., Rohde & Schwarz's US partner, scored with a TV transmitter order for the Houston Tower in Texas. The system installed there is one of the first liquid-cooled transmitters in the USA. The Rohde & Schwarz concept won out where air-cooled transmitters otherwise dominate. This report by the operator once more confirms customer satisfaction with high-tech transmitters from Rohde & Schwarz.

Third Coast Broadcasting operates numerous TV stations in the USA and is also active as a consulting company for the operators of independent LPTV (low-power TV) stations. In the past, the company was regularly involved in the standardization process of the Federal Communications Commission (FCC) for digital TV in the USA. A number of proposals in favour of LPTV operators were implemented.

The Third Coast TV station KHMV-LP in Houston, Texas, was to be one of the first stations equipped with a 5 kW NTSC transmitter in accordance with new FCC rules. To minimize antenna line losses and maximize coverage, the requirement called for installation of the transmitter in a small container on a tower platform at a height of 365 m (1200 ft).

An exposed location like this makes special demands on the installation, the air conditioning being a particularly critical

aspect. An air-cooled transmitter was ruled out because of the high salt content of the air and extreme humidity in the Gulf area. Looking for a suitable system, Third Coast Broadcasting hit upon the liquid-cooled TV Transmitter R&S NH 6050 from Rohde & Schwarz/Acrodyne, a perfect match for all the conditions (photos).

It is optimally compact for the available space and, thanks to its self-contained liquid-cooled system, the transmitter is completely impervious to environmental hazards like humidity, salt, dust or low temperature. Modularity and solid-state technology guarantee high redundancy and reliability.

The transmitter radiates very little heat, so a lean air-conditioning plant was adequate for the container, an extra cost-saving factor.

The transmitter was delivered to schedule and Rohde & Schwarz's partner Acrodyne put all its efforts into setting it up. Installation was carried out in the late autumn under adverse conditions. Although the weather was warm, it rained every afternoon, which considerably shortened the workday. Otherwise there were no major difficulties and the transmitter started to work straight after evacuating the air trapped in the coolant system. The heatsinks of the power amplifiers are just warm to the touch, the container's air conditioning operates on a hot day with a 10% duty cycle, and the heat exchanger runs with a temperature difference of only 5°C between input and output. The parameters measured are well above the requirements for low-power and high-power transmitters defined in FCC specifications, sections 74 and 73.

The system currently operates as an NTSC transmitter, but can easily be reconfigured with very little modification to transmit 8VSB or DVB-T.

Liquid-cooled 5 kW TV transmitter at airy height – a small air-conditioning plant is quite sufficient thanks to the low heat dissipation.

The TV transmitter installed is very likely unique in the USA. It enables Third Coast Broadcasting to provide good and reliable television coverage at low cost in a densely populated area. In Acrodyne, Third Coast Broadcasting has chosen a dependable and competent partner who offers full support to guarantee optimum transmitter operation.

Bob Fisher (President of Third Coast Broadcasting)

Free software device drivers for remote control of T&M equipment

Many Rohde & Schwarz customers prefer the graphical programming languages LabVIEW from National Instruments or VEE from Agilent when writing applications for T&M equipment. Quite often, C-based LabWindows/CVI from National Instruments and Visual Basic or Visual C++ from Microsoft/Borland are also used.

As a service, Rohde & Schwarz provides software device drivers free of charge for all these programming languages. All recent T&M equipment is supported, and demo programs are also often available.

Why a device driver?

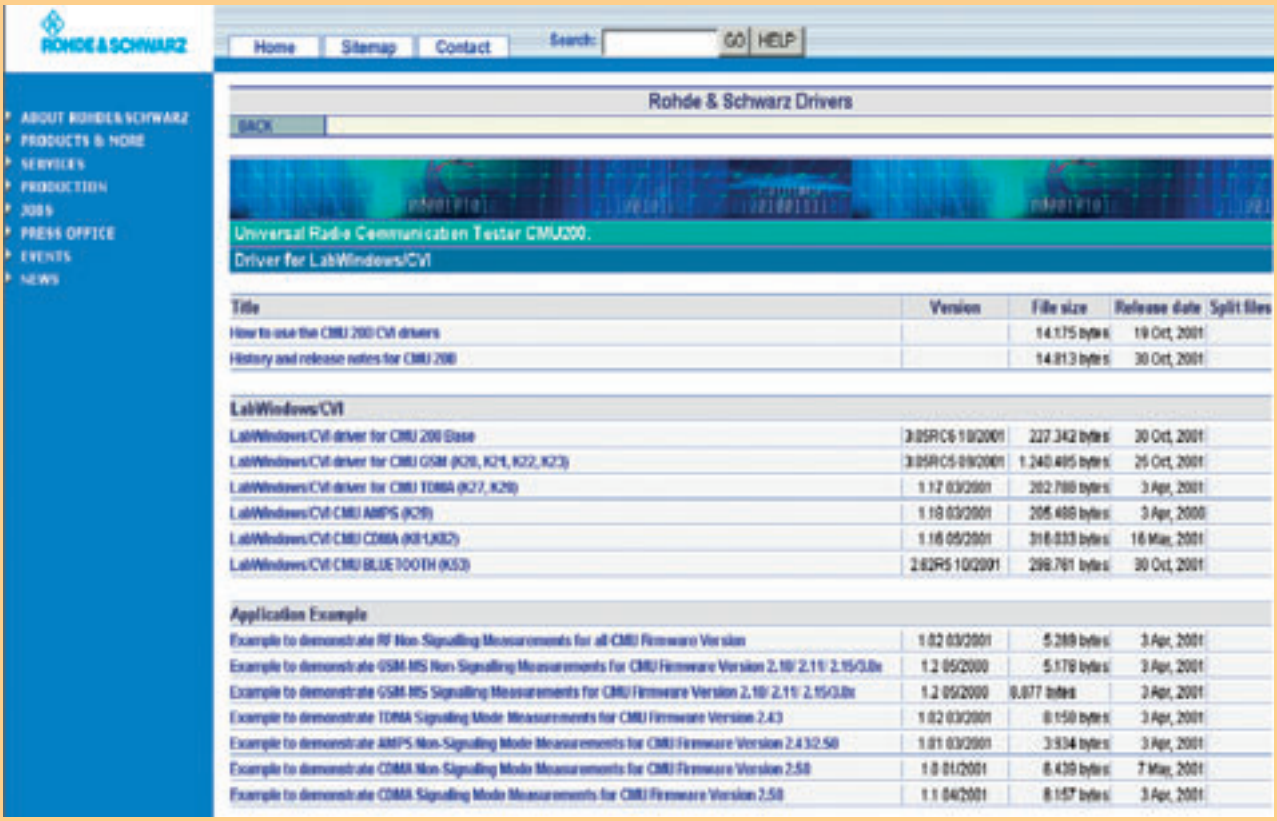
Writing an application can take a lot of time. But writing the application is not the end of the story, since the T&M device must also be driven. That is not so simple with complex equipment, since just the description of the command set may comprise several hundred pages. Applying yourself to this task can be quite time-consuming. Which is why Rohde & Schwarz provides ready-to-use software device drivers for all major interfaces, relieving designers of these efforts to a great extent. You no longer have to leaf through manuals looking for commands; this has already been done when developing the driver.

Which interfaces are supported?

As a rule, Rohde & Schwarz T&M equipment is driven via IEC 625 and RS-232-C interfaces, and increasingly also LAN interfaces. To avoid providing different driver software for every device interface, all Rohde & Schwarz device drivers use interface-independent virtual instrument software architecture (VISA).

The Rohde & Schwarz Internet pages featuring drivers are newly designed to improve user-friendliness with added search functions for T&M equipment and types of drivers. You can find current device drivers and demo programs at www.rohde-schwarz.com ➞Drivers.

Werner Klotzsche



MPEG2 over ATM – the state of the art

In recent years, ATM (asynchronous transfer mode) has established itself as a standard in many telecommunication networks because of its many benefits. In contrast to circuit-switched modes, ATM is packet-oriented and allows assignment of transmission capacity to meet demand.

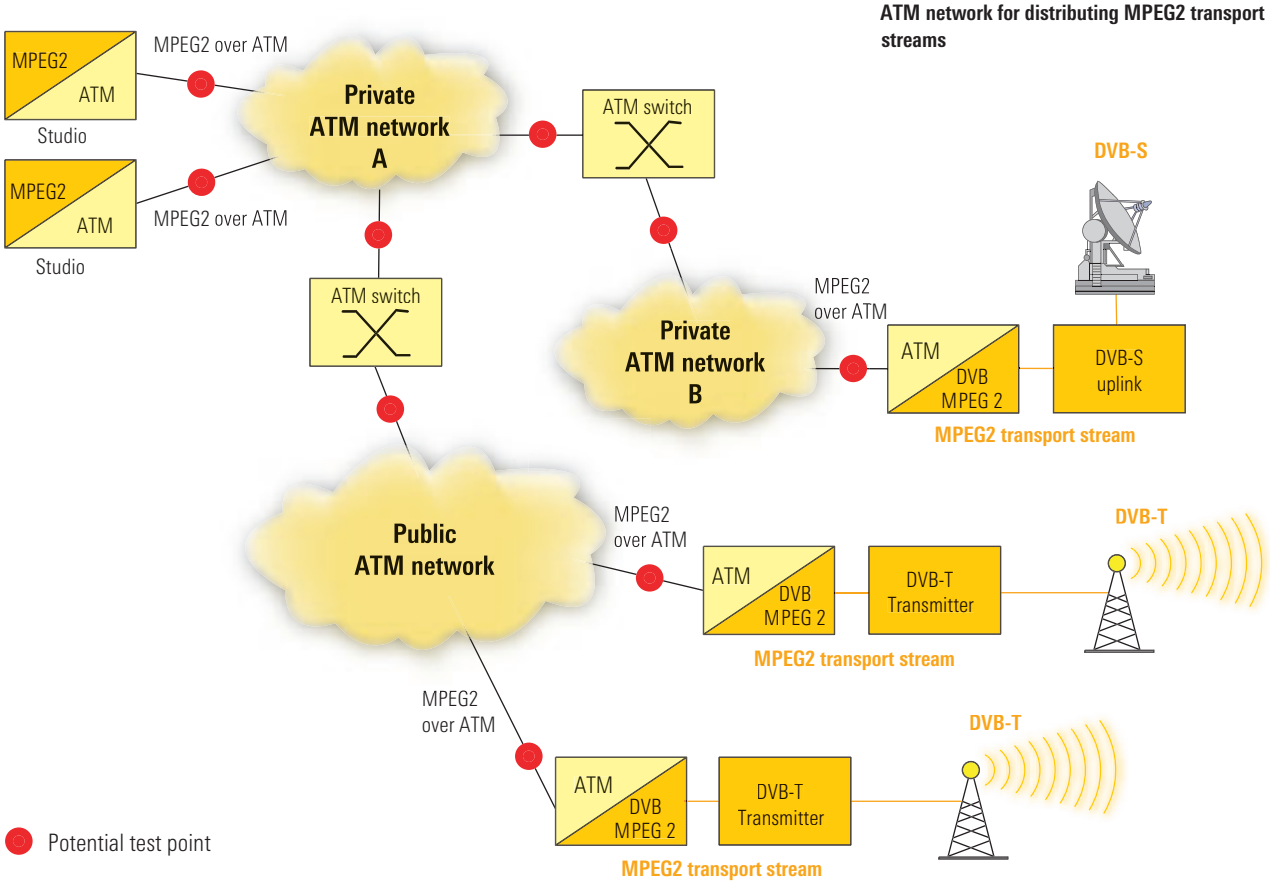
Intelligent utilization of expensive transmission capacity

Depending on the specific application, transmission systems have to satisfy very different requirements. The ATM standard provides different classes of service that can be assigned to connections as required. A constant bit rate (CBR) or a variable bit rate (VBR) is possible for example. For services with less demanding requirements on the transmission system, such as the exchange of files, free capacity in the system can be used in the form of available bit rate (ABR) or unspecified bit rate (UBR).

ATM offers intelligent and flexible bandwidth management, ensuring at the same time a certain end-to-end quality of service. The inevitable jitter of a packet-oriented method is also kept within tolerable limits, and the delays in realtime transmission are relatively insignificant.

All this means that ATM technology is being used to an increasing extent in broadcasting (see box next page). Applications in broadcasting are characterized by high bit rates, tight tolerances for delay (in realtime transmission) and jitter. In the past few years, numerous

ATM network for distributing MPEG2 transport streams



ATM networks meeting precisely these requirements have been installed.

The triumphant advance of the MPEG2 standard * for video and audio coding has been very helpful in this context. MPEG2 and ATM are both based on the transport of data packets and can be linked up relatively easily.

Measurement equipment from Rohde & Schwarz

The jitter problem typical of packet-oriented modes is particularly critical in the case of realtime video, since the jitter components added by the ATM network may impair recovery of the program clock reference (PCR) in the MPEG2 data stream at the receiver. For realtime video transmission, a constant delay between MPEG2 source and sink is an important prerequisite for errorfree operation. The 25 video frames per second taken by the TV camera in realtime should be displayed on the TV set in the same time. Impairments of the PCR that exceed certain limits become clearly visible in the video picture and are therefore incompatible with a high quality level.

Monitoring the quality criteria of the various classes of services in MPEG2 over ATM applications is a very special challenge for measurement technology. Rohde & Schwarz started very early to work in this field and, through basic research carried out within a research project in cooperation with several partners from the broadcasting and telecommunication sectors, has created the basis for an instrument that satisfies the exacting requirements in this application area. The technical features of ATM, focusing on the transmission of MPEG2 transport streams over ATM, will be described in more detail in one of the next issues. Measurement solutions for the problems that may arise in this context will also be looked at.

Dr Jürgen Lauterjung

* ISO/IEC 13818: Information Technology – Generic Coding of Moving Pictures and Associated Audio

Some typical application examples

A typical application is **program contribution in broadcasting networks**. The EUROVISION network used by European broadcasters to feed and distribute programs is a good example. Whether by fiber-optic cable or satellite, the exchange of video and audio programs in the form of MPEG2 over ATM has been successfully tested and will soon be widely adopted because of the associated benefits.

ATM is also being used to an increasing extent in the **close-to-the-studio production area**. With ATM it is no problem to distribute both studio signals at 270 Mbit/s as well as MPEG2-compressed video material, suitable for postprocessing, at approx. 50 Mbit/s on internal LANs. In many cases the interpolation and extrapolation of video frames contained in the MPEG2 standard is not suitable for postprocessing, so only intra-frames are transmitted. A new MPEG2 encoding is performed only upon generation of the material to be broadcast.

Trials have also shown that even **distributed video productions** such as generation of individual picture components like background landscape and foreground actors at different places can be handled with the aid of data transmission over ATM.

Another typical application in broadcasting is **distribution of MPEG2 transport streams to transmitter stations (primary distribution)**. The ready-to-broadcast data streams are transferred, for example, to the network operator, who handles distribution of the video and audio data in MPEG2 format to the various transmitter stations on an ATM network. These can be terrestrial transmitters, headends of cable TV networks or uplinks to satellites (FIG). The MPEG2 transport streams of approx. 15 Mbit/s to 40 Mbit/s on this transmission link usually contain 5 to 15 programs (video, audio, additional information). All possibilities of data reduction provided by the MPEG2 standard are fully utilized in this case.

Recently, **data transmission in ATM format to the end-user** has also gained in importance. The benefits of ATM are already being used in many countries especially on ADSL (asynchronous digital subscriber line) connections, e. g. for Internet access.

R&S TopSec product family

Members only – confidential telephone and data communication

Anyone who has suffered damage once will be very careful the next time, that is what the proverb "once bitten, twice shy" is meant to convey. But what happens if you fail to notice the damage in the first place? This may be the case when a business becomes the victim of industrial espionage. So the maxim "better safe than sorry" seems to be the better one, because the losses caused by industrial espionage in Germany alone have been estimated at € 10 billion every year. For this reason, both the German Information Security Agency and the EU Commission advise all businesses to protect, i.e. encrypt, all communication channels used to transmit sensitive information.

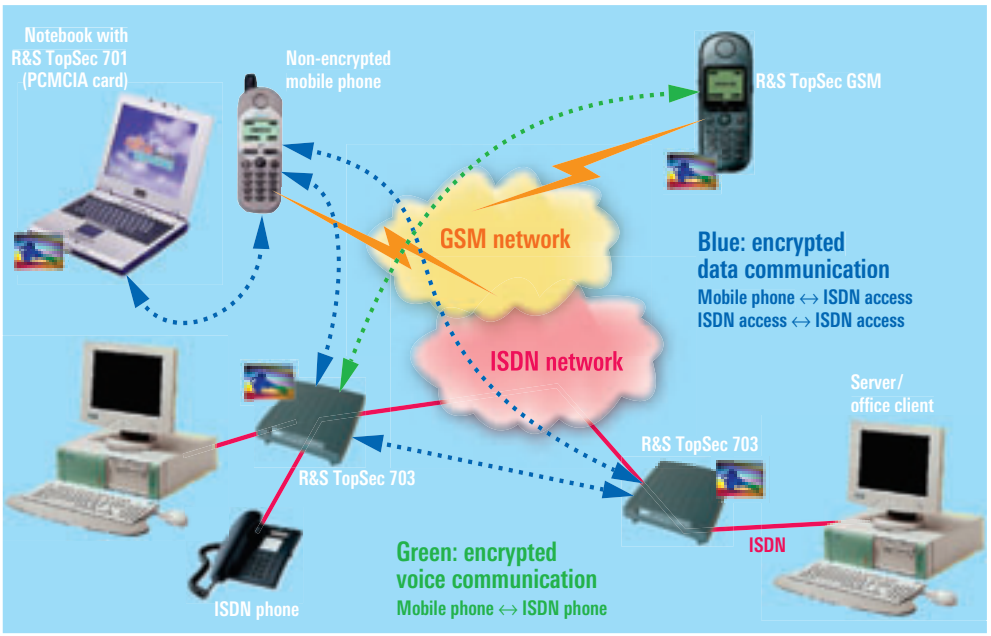


FIG 1 The crypto products from the R&S TopSec family allow secure voice and data communication in any scenario.

IT security products are a must

Have you ever used your mobile phone to talk about confidential business matters? Have you ever downloaded data to your notebook from the corporate network while on a business trip? Is there teleworking in your company? Does your company have different sites between which project and design teams exchange sensitive data? Do you make use of videoconferencing to save travel expenses?

Business people are likely to answer "yes" to most of these questions. Nowadays there are more means than ever for fast transfer of data and information. But that also increases the potential for misuse. The usual means of communication – telephone, mobile phone, fax, e-mail – have enormous security failings. Data theft, eavesdropping and industrial espionage are by no means abstract terms but concrete dangers.

Such dangers can be effectively eliminated by using IT security products from Rohde&Schwarz SIT GmbH. Any of the scenarios described above – and many more – can be secured against information theft by products from the R&S TopSec family.*

* The use of crypto products is subject to the relevant national legislation which must be observed, e.g. when taking crypto products along on business trips.

A product for every need

The name R&S TopSec stands for a series of high-grade encryption devices to protect voice and data communication in ISDN and GSM and also in analog networks. The R&S TopSec GSM crypto mobile phone (FIG 3) already described in News 172 [*] is a good choice for business people or politicians en route who have to talk about confidential matters on the phone. The R&S TopSec 701 is a PCMCIA encryption card for safeguarding data transfer between your laptop and mobile phone and the corporate network. The product family also comprises the R&S TopSec 703 and 703+ encryption units for ISDN basic rate access S_0, and the R&S TopSec 730 for ISDN primary rate access S_{2M}. These devices effectively protect telephone calls, faxes, data transmission, online connections and video conferences against unauthorized access by third parties. FIGs 1 and 2 give an overview of the product family.

R&S TopSec 701

The PCMCIA card R&S TopSec 701 is simply inserted into the PCMCIA slot of a laptop and connected to a modem-capable mobile phone by a data cable (FIG 4). The card is ready for use after installing the driver and configuring the card. The R&S TopSec 701 protects data transferred via mobile phone by high-grade encryption. The only prerequisite is that the called station must be equipped with a partner device from the TopSec family. Connections between two R&S TopSec 701 cards by way of mobile phones suitable for data transmission can thus be encrypted. It is also possible to use the R&S TopSec 703 or 703+ units, in conjunction with the V.110 protocol, at the other end in the Euro-ISDN network. Encrypted communication is furthermore possible on a modem link between two R&S TopSec 701 cards.

FIG 3 R&S TopSec GSM crypto mobile phone (described in detail in previous issue)

R&S TopSec 703 / 703+ / 730

The TopSec devices 703, 703+ and 730 offer encryption of communication via Euro-ISDN B channels. The device is connected between the Euro-ISDN interface and the terminal, e.g. a telephone or router. Setup of a connection only takes about three seconds more than for non-encrypted ISDN calls. The R&S TopSec 703 (FIG 5) and 703+ allow encryption of two B channels independently of each other. In contrast to the TopSec 703, the TopSec 703+ can also encrypt calls to the crypto mobile phone. The R&S TopSec 730 (FIG 6) is ideal for use on the primary rate access and can simultaneously encrypt up to 30 connections (FIG 6). Call status (standby, setup, encrypted, plain) is displayed by a LED for each B channel, or for every three channels in the case of the TopSec 730.

FIG 2 R&S TopSec product family

- **R&S TopSec GSM** Crypto mobile phone
- **R&S TopSec 701** PCMCIA card for data encryption and transmission via GSM mobile phone or modem
- **R&S TopSec 703** Encryption unit for connection to ISDN basic rate access S_0
- **R&S TopSec 703+** For encrypted communication between crypto mobile phone and ISDN network (S_0 interface)
- **R&S TopSec 730** Encryption unit for connection to ISDN primary rate access S_{2M}
- **Administrator software** For configuration of TopSec user groups and parameterization of encryption units (optional)

Powerful encryption

TopSec devices use a hybrid form of encryption, combining an asymmetrical algorithm with a 1024 bit key for key agreement and a symmetrical algorithm with a 128 bit key for user data encryption. In the encryption mode, a 128 bit key is randomly selected from 10^{38} possibilities for each connection established, and immediately deleted when a call is cleared down.

FIG 4 R&S TopSec 701 PCMCIA card

groups. Device IDs and certificates are loaded into user terminals and used for authentication on connection setup with a partner device. Authentication means that user terminals identify each other by exchanging certificates. Subsequent adaptation of user terminal parameters is usually made via an encrypted ISDN connection (remote administration). A terminal may belong to up to three user groups.

Apart from automatic authentication, user groups offer the possibility of excluding certain terminals from the user group by blacklisting them. This will be necessary if a terminal is stolen or lost. The administrator is responsible for handling and updating the black list. On an incoming encrypted call or request for a connection, the certificate exchange procedure checks to see if the particular terminal is blacklisted. Only if this is not the case will the connection be established, otherwise it is denied.

Administrator software enhances operational reliability

In addition to the protection of communication provided by encryption, the security-conscious user can optionally acquire administrator software, which is a powerful tool to enhance the operational reliability of TopSec devices.

This software allows optimum administration of the R&S TopSec devices within the communication network, from mutual authentication through logging of overall activities to dynamic management of several user groups.

Before devices go into operation for the first time, the administrator initializes them and combines them in closed user

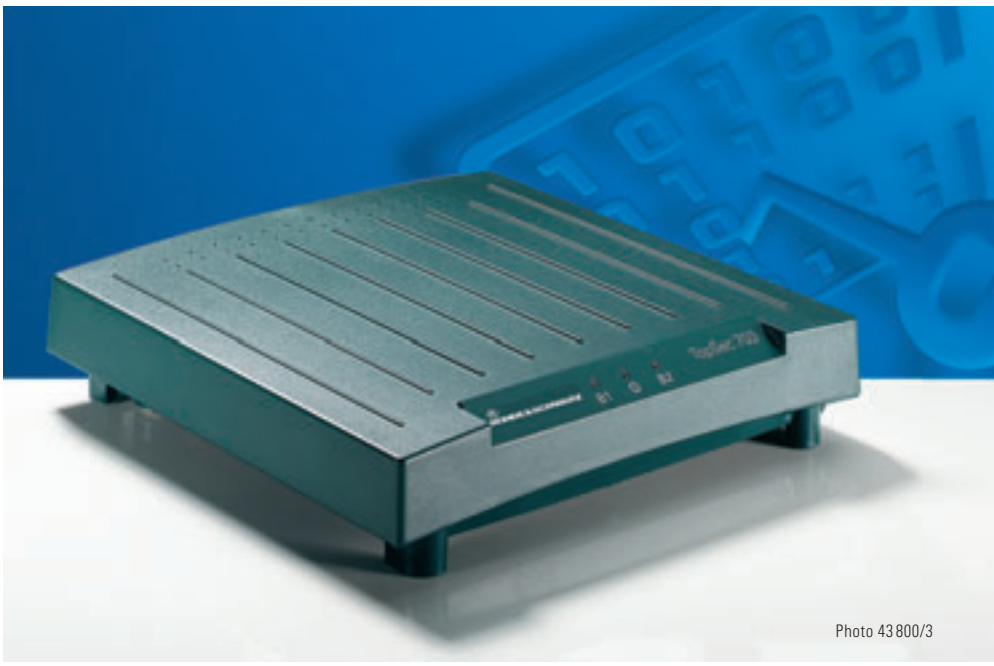


FIG 5 R&S TopSec 703 for encrypted communication on Euro-ISDN B channels

Absolute confidentiality by keystroke

Operation of TopSec devices is extremely user-friendly and limited to selecting the mode of transmission (plain/encrypted). This is done simply at a keystroke, i.e. by dialling a code number before entering the required call number. 0 means plain mode, while 1, 2 or 3 is used to select a specific user group previously configured by the administrator. 9 means that the connection to another TopSec device is to be encrypted without administrator control. If devices are not administered, you can only choose between 0 (plain) and 9 (encrypted). No further entries are required during operation.

FIG 6 R&S TopSec 730 for simultaneous encryption of up to 30 connections

Versatility for enhanced security

TopSec devices ensure confidentiality, authenticity and integrity, and they protect important corporate data against industrial espionage. Data transmission from corporate networks to telework and service stations is protected. Personal data governed by data protection legislation can be securely transmitted and design data confidentially exchanged between distributed project teams.

R&S TopSec is also ideal for protecting fax transmission or video conferences. Service interfaces provided for remote administration can be secured.

Frequently used but completely inadequate security mechanisms like callback are replaced by powerful encryption and authentication procedures.

The user alone is responsible for key management, allowing configuration of closed user groups.

The TopSec products for mobile users – R&S TopSec GSM and R&S TopSec 701 – are small and lightweight and look just like comparable devices without crypto functionality (mobile phones, PCMCIA cards).

Due to their versatility, TopSec products attract the interest of a wide range of users, like corporate executives in many different branches of business, consultants, service providers, mobile and stationary teleworkers, field and service staff and design engineers.

TopSec products are widely used by public authorities and suitable for both national and international use.

Christine Hagn

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

REFERENCES

[*] Crypto Mobile Phone R&S TopSec GSM: Secure communication – protected against data thieves. News from Rohde & Schwarz (2001) No. 172, pp 49–51

Digital Video Recorder Generator R&S DVRG

High-speed data streams of extreme length for versatile use

The R&S DVRG (FIG 1) is primarily a universal platform for recording and replaying MPEG2 transport streams. Optionally it is capable of recording and replaying uncompressed *SDI video signals with data rates up to 270 Mbit/s. Its special features can be utilized in many ways. Two examples from R&D show how the *SPI* interface can be used for special tasks.**

* Abbreviations in the text are explained in the yellow box on page 53.

FIG 1 Digital Video Recorder Generator R&S DVRG

Photo 43401/1

Powerful interfaces

The R&S DVRG records data transparently, so it can also be used to record and replay non-MPEG2-conformant data structures. Individually defined data streams of this kind may be extremely long, with very high data rates. This opens up completely new fields of application that are of particular interest in R&D.

The R&S DVRG optionally comes with up to 72 Gbytes of hard disk memory for storing data streams. When the parallel interface is used (*SPI* to EN 50083-9, *LVDS*), up to 10 bits can be transmitted or received simultaneously (T10 mode of R&S DVRG: data bits 1 to 8, Dvalid and Psync signal, see FIG 2). *SPI* clock rates between 80 kHz and 20 MHz are available for recording and replay. In the case of a 10-bit parallel transmission, this means a maximum data rate of 200 Mbit/s. The clock rate for replaying recorded data streams, e. g. for the stress test of a DUT, can be user-selected.

In addition to the recording of data streams and subsequent analysis or replay, individually calculated data streams in the form of files can also be replayed. The examples below illustrate the versatile possibilities.

R&S DVRG as a generator

Example: replay of non-standard transport streams

When you are looking for ways to improve a digital TV standard, simple and economical means are needed for generating the necessary RF signals. New ways have to be found, for instance, for the transmission of data with non-standard *FEC* or if additional training sequences are to be inserted. The development of special hardware must in most cases be avoided for reasons of costs.

An excellent solution for such tasks is the combination of the R&S SFQ and the R&S DVRG. The *FEC* modifications required for a predefined sequence of sufficient length can easily be calculated. The results obtained are transferred to the R&S DVRG. The *FEC* commonly used in a test transmitter is disabled and the data from the generator is directly sent to the mapper (FIG 3).

Thus, a DTV signal with non-standard *FEC* can in no time be generated as the RF signal without special hardware.

R&S DVRG as a recorder

Example: recording the IF of test signals for analysis

When developing a new TV standard, a research center may be looking for a simple and economical way to analyze the signals sent in the new standard. The focus is on the intermediate frequency because impairments of the transmitted signal are to be investigated without the effects caused by signal processing in the receiver. But displaying the IF in digital form yields high data rates that cannot be analyzed in realtime without special effort.

The problem can easily be solved with the TV Test Receiver R&S EFA and the R&S DVRG (FIG 4). The receiver provides the IF. The IF signals in digital form are forwarded as 10-bit words via the parallel interface to the recorder, where the data stream is recorded and then analyzed offline by user-specific software.

This reduces the originally complex problem with high realtime requirements to the development of software for analyzing the digitized IF.

Thomas Tobergte

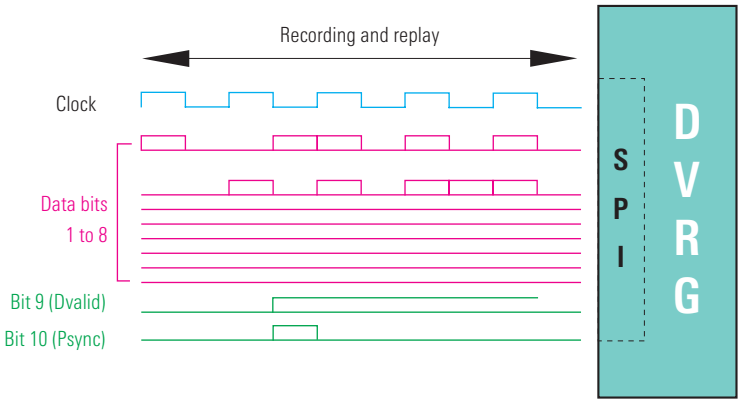


FIG 2 Recording and replay via the *SPI* interface of the R&S DVRG with data rates up to 200 Mbit/s and memory capacity of up to 72 Gbytes opens up versatile applications.

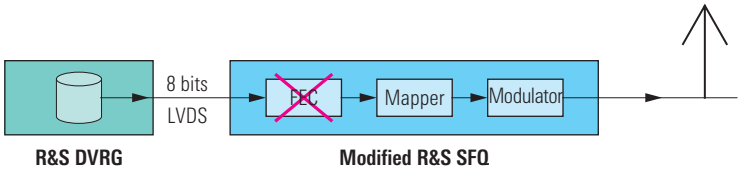


FIG 3 Simple generation of DTV signal with non-standard *FEC*

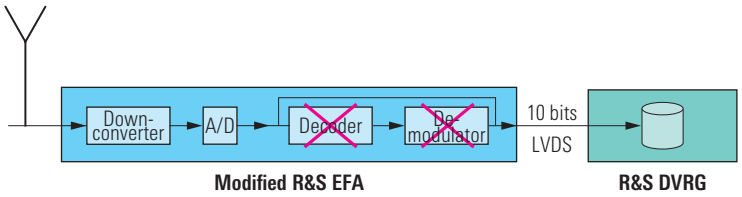
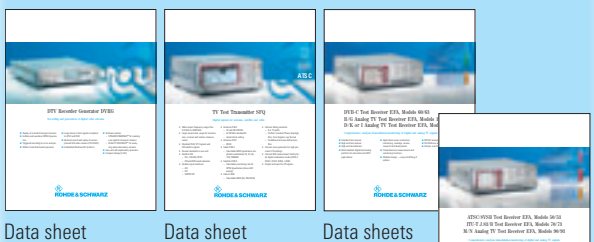


FIG 4 Instrument combination for recording transmitted signals for subsequent analysis

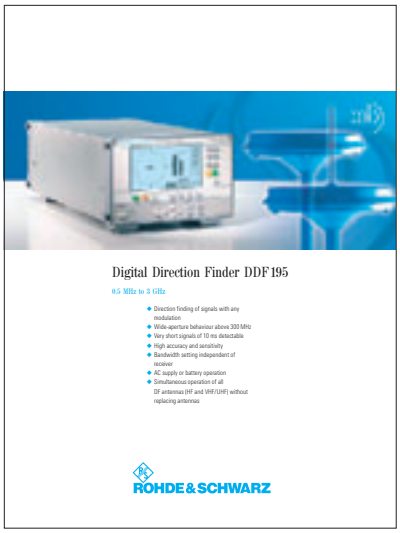
Abbreviations

ASI	Asynchronous serial interface
FEC	Forward error correction
LVDS	Low-voltage differential signalling
SDI	Serial digital interface
SPI	Synchronous parallel interface

More information and data sheets at www.rohde-schwarz.com (search terms: DVRG / SFQ / EFA)



Data sheet R&S DVRG | Data sheet R&S SFQ | Data sheets R&S EFA



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Digital Direction Finder R&S DDF195 Features of the new digital direction finder (frequency range 0.5 MHz to 3 GHz) are positioning of signals with any modulation, wide-aperture behaviour above 300 MHz, high accuracy and sensitivity as well as bandwidth setting independent of the receiver; minimum duration of detectable signals is 10 ms.
Data sheet PD 0757.7146.21

Reliable encryption of Euro-ISDN with the R&S TopSec 730 Encryption of up to 30 simultaneous Euro-ISDN connections (data, voice, fax, video); see article on page 48.
Data sheet PD 0757.6927.21

Reliable encryption of Euro-ISDN with the R&S TopSec 703 Encryption of Euro-ISDN connections between two users (data, voice, fax, video); see article on page 48.
Data sheet PD 0757.6910.21

Encryption with PCMCIA card R&S TopSec 701 Laptop PCMCIA card for data encryption; see article on page 48.
Data sheet PD 0757.7046.21

R&S Optiset E privacy module Encryption module for connection between handset and telephone.
Data sheet PD 0757.7052.21

Digital Sound Broadcast Data Inserter R&S DSIP020 Generates STI and ETI signals (content: Web sites and pages, e-mails, etc); transmission via DAB system.
Data sheet PD 0757.6662.21

RF Test System R&S TS8950G for GSM/GPRS / EDGE Mobiles Test system for GSM/GPRS / EDGE mobile phones operating in all GSM frequency bands between 850 MHz and 1900 MHz.
Flyer PD 0757.6965.21

Bluetooth™ Production Test System R&S TS7160 Compact production test system for *Bluetooth* products that can be integrated into other test systems (e.g. R&S TS7100) to expand functionality by the whole range of *Bluetooth* test scenarios.
Data sheet PD 0757.7200.21

Production Test Systems – short overview The 6-page flyer shows typical system solutions for testing mobile phones, infotainment components in cars and other DUTs from the telecommunications sector; based on the flexible Test System Versatile Platform R&S TSVP.
Flyer PD 0757.7275.21

Simulation Software WinIQSIM™ Summary of digital standards in one data sheet, previously contained in the following separate data sheets:
AMIQ / WinIQSIM (PD 0757.3970)
Digital standards IS-95 and CDMA2000 (PD 0757.5908)
Modulation Generator AMIQ / Simulation Software WinIQSIM (supplement to technical specifications) (PD 0757.5314)
Data sheet PD 0757.6940.21

Facts and Figures 2002 32 pages of the most important information about Rohde&Schwarz: business fields and products at a glance, plants, subsidiaries, partners and the addresses and phone numbers of representatives in Germany and abroad.
Brochure PD 757.1431.28

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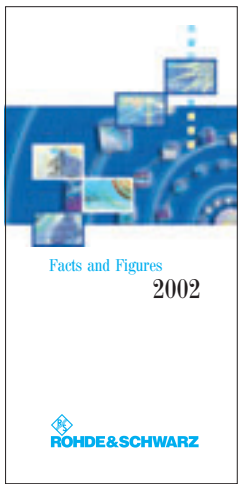

Publications and more information at www.rohde-schwarz.com (search term: equipment or PD number)

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VXI HF Receiver R&S EM010 A DSP-based VXI HF receiver of advanced design for the frequency range 300 Hz to 30 MHz, a key component and integral part of the AMMOS radiomonitoring and analysis systems from Rohde&Schwarz. Its excellent RF characteristics paired with powerful signal processors create the prerequisites for optimum system solutions.
Data sheet PD 0757.6704.21

LVDS Interface for I/Q Online Interface R&S PTW-B9 PCI bus PC plug-in card for connecting the I/Q interface of the R&S FSP to a PC.
Data sheet PD 0757.7130.21

Antenna Switch Matrix R&S NVX The new antenna switch matrix is characterized by modular design, custom adaptability and flexible control via optical Ethernet.
Data sheet PD 0757.7198.21

Extreme Temperature Tester R&S E-Line Shielded, temperature-controlled climatic chamber for testing wireless RF equipment such as mobile phones, Bluetooth devices and remote keyless entry systems.
Data sheet PD 0757.7181.21

EMI Measurement Software R&S EMC32-L Measures conducted and radiated emissions and runs on 32-bit operating systems from Microsoft. It is based on the EMI Measurement Software R&S EMC32-E and mainly supports precompliance EMI measurements in line with all civil standards.
Data sheet PD 0757.7223.21

TIP certification confirms TETRA interoperability

Rohde & Schwarz BICK Mobilfunk has received TETRA interoperability profile (TIP) certification, confirming compatibility of the company's TETRA systems with other TETRA terminal equipment.

The certification, granted by TeleDanmark, the test company accredited by TETRA MoU (memorandum of understanding), validates interoperability of the *ACCESSNET*®-T system with terminal equipment from other manufacturers.

TETRA mobile radio network for police in Lower Saxony

Rohde & Schwarz BICK Mobilfunk was awarded a contract by the regional administration of Lüneburg to supply a TETRA mobile radio network *ACCESSNET*®-T. The system is being deployed by the police in Lower Saxony as an independent digital radio cell for security-related operations.

The TETRA system was selected because of its excellent features such as fast call setup, group call function and security against eavesdropping. The possibility of integrating other networks, such as ISDN and GSM, as well as the open standards used were also important factors.

The contract comprises planning of the network, including radio coverage, as well as delivery, installation and commissioning. The network consists of a DSS-500 base station, a local call switching unit with an integrated radio base station, and TETRA terminal equipment. The TETRA system, delivered in November 2001, operates in the 380 MHz to 400 MHz band. Gateway functions to branch and special networks are an important component of the base station. These functions enable other communication networks, such as ISDN or GSM, to be addressed from the TETRA network, which is implemented via a digital S_0 interface with ISDN.

Sales agreement between Rohde & Schwarz and PLLB

Rohde & Schwarz has concluded a sales agreement with PLLB, the leading Italian manufacturer of T&M products for optical fiber and wireless networks. In future, Rohde & Schwarz will market PLLB's equipment for communications and networks in both Germany and Spain.

The products involved focus on mobile and stationary test, measurement and monitoring systems for telecommunication networks and their components. In the case of roaming agreements or cooperation between various operators, these products enable the quality of an entire transmission link and any weak points to be determined immediately.

According to Robert Fröhler, Managing Director of Rohde & Schwarz Engineering and Sales: "The huge expansion of mobile communication makes quality of service even more vital than in the past. The T&M systems from PLLB help us to offer our customers in the communications business an even broader range of solutions tailored to their needs."

▽

"This agreement with an internationally renowned company such as Rohde & Schwarz, the European leader in test and measurement products and systems, is part of our strategy aimed at global expansion reinforced by commercial partnerships. We are pleased that Rohde & Schwarz has chosen our technologies. It is a clear sign that they believe in us and our products, and I trust that this agreement will be the starting point of a long cooperation", added Sergio Leali, Managing Director of PLLB.

Joint development of programmable logic components

Xilinx and Rohde & Schwarz have entered a partnership aiming at the joint development of programmable logic components for Rohde & Schwarz T&M equipment. The agreement will see Xilinx, the American market leader in this field, involved early on in product development at Rohde & Schwarz.

Specific T&M requirements are to be taken into consideration at the development stage of new FPGA and CPLD generations at Xilinx, resulting in even shorter time to market.

Stefan Böttinger

Photo: PLLB

Multiport PDA/SDH Tester PJB-2000, to be marketed in future by Rohde & Schwarz Engineering and Sales

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