DSR Test Receiver EDSR

Transmission reliability in digital radio

Test Receiver EDSR monitors, analyzes and processes DSR (digital satellite radio) signals broadcast via satellite or cable networks. It detects, assigns and logs faults and interference on transmission links, and is used for fully automatic signal monitoring at cable head-ends and at service providers as well as for on-site troubleshooting.

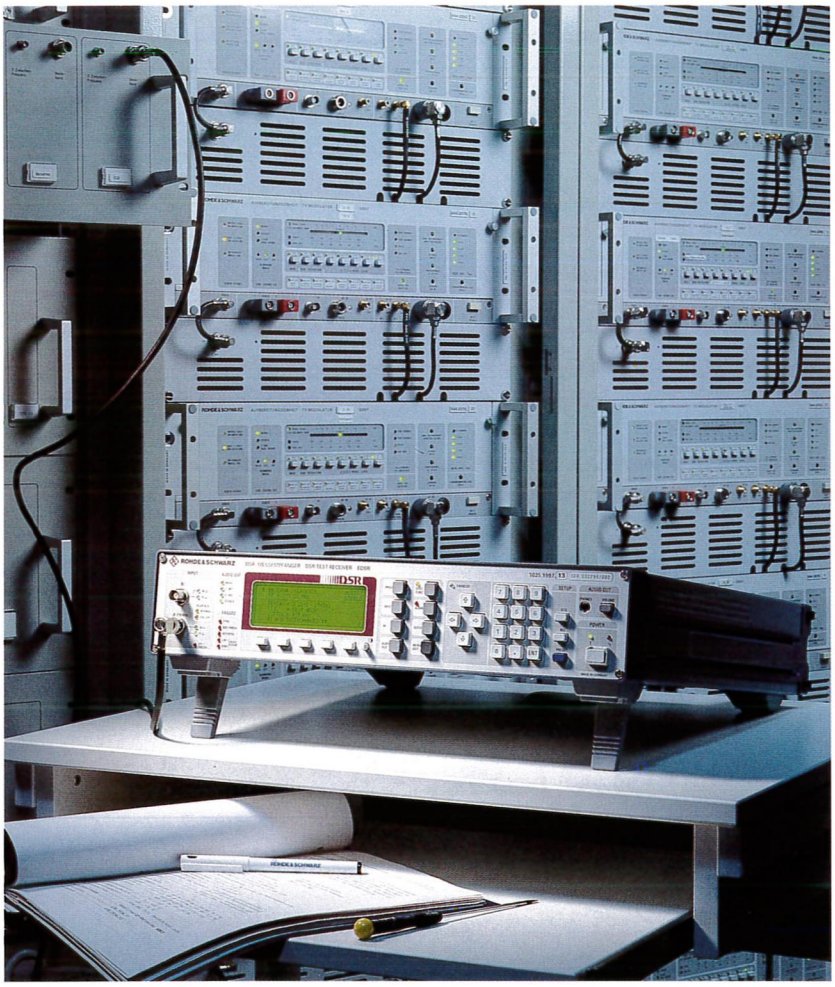

FIG 1 DSR Test Receiver EDSR monitoring a cable head-end

Photo 41 589/1

A test receiver for digital sound-broadcast signals, EDSR (FIG 1) comes equipped with a high-grade AF section. The digital audio signal first passes through an interpolation filter, which markedly improves transmission quality in the event of adverse receiving conditions (ie high BER). The signal is then routed through a digital oversampler and a digital filter, and reconverted into an analog sound signal by two highly linear, extremely low-noise 16-bit D/A converters. An analog filter chain then follows, with extremely low phase distortion even at the limits of the transmission range. A practically stepless, digital level control is provided for volume adjustment of headphones and loudspeaker. The audio signal is output via rear connectors for further processing. A special version of EDSR with additional balanced and floating outputs of highest quality (XLR male connectors) is available, in particular for relay reception and studio applications.

Special **features** of EDSR include:

- tunable input (54 to 854 MHz), impedance switchable between 50 and 75 Ω ,
- continuous monitoring of BER without interruption of ongoing program,
- outputs for I/Q signals for visual assessment of transmission quality on oscilloscope (FIG 2),
- digital inputs and outputs for mainframes A and B [1; 2],
- simultaneous acquisition of BER, input level, jitter, synchronization, interpolation and headroom,
- display of input level in dBm, dBpW, dBµV or µV/mV,
- instantaneous display of alarm messages by LEDs on front panel,
- alarm messages when user-selected limit values are exceeded, storage of messages with date and time in alarm register,
- statistical evaluation of alarm messages,
- variety of analog and digital interfaces,
- remote control via IEC/IEEE bus,
- Centronics printer interface and user port,
- decoding of selected sound channel,
- correction of digital audio signal in line with detected bit errors,
- display of program identification and program type,
- automatic program selection according to desired program type,
- digital audio output to standard IEC-958-C, eg for connecting DAT recorder,
- balanced, floating audio outputs (option),
- high reliability due to automatic self-test routines,
- user-friendly, menu-guided operation via LCD display and combined hardkeys and softkeys; direct callup of all important functions.

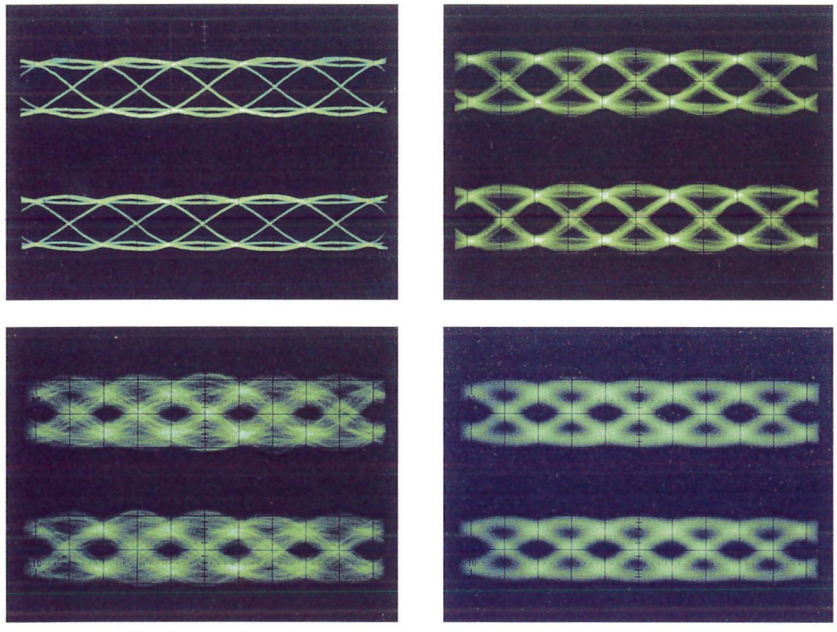

FIG 2 I/Q eye patterns measured with EDSR displayed on oscilloscope. Settings: 500 mV/div, 50 ns/div
a) Ideal test signal, generated by DSR Modulator SFP [3]; measured BER: 0×10^{-9}
b) Real DSR signal, generated by SFP; measured BER: 0×10^{-9}
c) Receive signal disturbed by reflections on transmission path; measured BER: 2×10^{-3}
d) Noise in cable channel amplifier, disturbed reception; measured BER: 2×10^{-3}

Acquiring bit errors

Beside quality assessment of the transmission characteristics of the DSR signal, quantitative evaluation of the signal, ie determination of bit error rate, is one of the main tasks performed by EDSR. A new test method enables EDSR to evaluate the BER directly, ie without inserting test signals into the program signal. This is necessary because the transmitter, into which a PRBS (pseudo-random bit sequence) signal would have to be fed, is not accessible as a rule. With the method used here, the error-protection data of the DSR signal are evaluated and the BER is determined by bit-by-bit nominal/actual value comparison. The measurement range extends over seven powers of ten from 10^{-2} to 10^{-9}.

A special feature of EDSR in measuring BER is the automatic adaptation of gate time to measured value. This means that the measurement is carried out fully automatically and operator errors are thus avoided. If, with a low BER, the gate time has not yet elapsed, eg shortly after power-up, the elapsed gate time as well as the total gate time will be displayed, providing information on the BER after just a few seconds.

Recording faults and interference

Various faults can occur in the transmission of DSR signals. For example, mismatch in the cable network may cause reflections, distorting the original signal to such an extent that unimpaired reception is no longer ensured. Similar degradation is possible when there is noise in channel amplifiers and converters or if there is insufficient headroom. In contrast to analog technology, overloading of digital audio channels is perceived to be unpleasant and simply must be avoided.

In EDSR the user has a tool that reliably detects errors of this kind: input level, synchronization, BER, interpolation and headroom are continuously monitored (FIG 3). The user may define threshold values for level, BER and headroom; an alarm will be generated if a threshold is exceeded. Synchronization loss and interpolation are signalled too. The status is indicated for each parameter by red LEDs on the front panel.

What is DSR?

With digital satellite radio (DSR), which is also offered by Deutsche Bundespost Telekom in cable networks, a sound-broadcast system is available that fulfills all requirements as to sound quality and convenience of use [1; 2]. 16 stereo channels, or 32 mono channels, are transmitted on a digital basis – providing sound quality comparable to that of the compact disk. The sound channels are coded, provided with error protection information, and made into two digital data streams of 10.24 Mbit/s each, which are superimposed on a carrier for phase modulation. As a result of the two data streams, four phase states are possible (quadrature phase-shift keying, QPSK).

The QPSK-modulated carrier, ie the DSR packet, supplies 16 radio programs in digital quality. The receiver decodes the desired program from the data stream. The display reads out the name of the selected broadcasting station (program identification) and the type of program selected, eg news, sport, classical music. Some DSR receivers feature automatic program selection according to the program type desired by the user.

At present a DSR packet with 16 stereo programs is broadcast in Germany nationwide via cable and satellite. Some neighbouring countries, eg Switzerland, use the same system. Negotiations on further DSR packets for use in Germany are in progress.

Alarm messages can be stored with date and time in an internal alarm register that provides the user with a chronological list of fault events (FIG 4). The list can also be output on a printer. The user can configure the program to select what alarm messages are to be stored in the alarm register, eg headroom threshold exceeded (FIG 5). In addition, EDSR forms statistics of the alarm messages collected over the last 24-hour period.

Versatile digital interfaces

To meet very different requirements for program feed, EDSR not only has analog inputs but also digital inputs for mainframes A and B. Data streams A and B contain the entire information of a DSR packet with a data rate of 10.24 Mbit/s each [1; 2]. The data applied require no additional clock as the latter is generated by the unit itself. Both differentially encoded and uncoded signals may be applied.

The following **signals** are available at the outputs for mainframes A and B:

- digitized I/Q signals prior to synchronization,
- digitized I/Q signals after synchronization,
- mainframe signals A and B after differential decoding,
- mainframe signals A and B after differential decoding and descrambling.

In addition, the system clock of 10.24 MHz is available. All outputs are TTL-compatible and can be loaded with 75 Ω.

Ease of operation

Despite the wide variety of functions provided, EDSR affords great ease of operation. The user is able to see at the same time all essential status information and test results on the clear-cut LCD display. Menus are called via hardkeys, whereas menu items are selected via softkeys, which are directly assigned to the respective menu fields. Lateral menus were deliberately not included in the menu structure; submenus exist only for a few special functions. A status line on the display indicates the currently active menu. In the alarm configuration menu (FIG 5), for example, the user can define by means of toggle keys the type of messages that are to be saved in the alarm register (enable) and those that are not (disable). Up to 50 user-definable device setups can be stored in nonvolatile memory in addition to the basic configuration. Upon power-off, the setup last active will be retained.

Christoph Balz

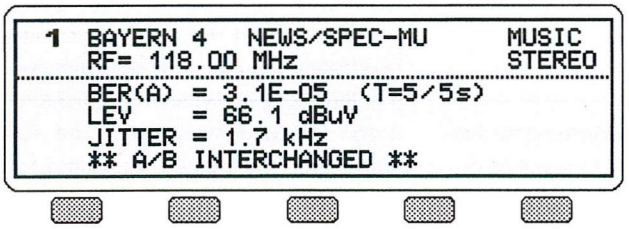

FIG 3 Display of EDSR with test results

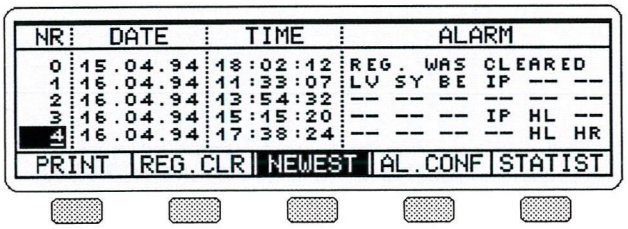

FIG 4 Example of messages enabled for storage in alarm register (LV = level, SY = synchronization, BE = bit error rate, IP = interpolation, HR = headroom right, HL = headroom left)

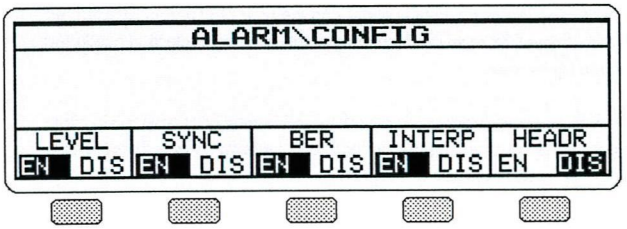

FIG 5 In alarm configuration menu, individual messages can be disabled, ie they will not be stored in alarm register.

REFERENCES

[1] Treytl, P. (ed.): Digitaler Hörfunk über Rundfunksatelliten. 2nd edition, revised. Deutsche Forschungsanstalt für Luft- und Raumfahrt (DLR). Published by Federal German Ministry for Research and Technology

[2] ARD/ZDF: Techn. Richtlinie Nr. 3R1: Digitaler Satelliten-Rundfunk (DSR). Spezifikation des Hörfunk-Übertragungsverfahrens im TV-SAT. Published by Institut für Rundfunktechnik, Munich

[3] Dietl, A.; Kleine, G.: SFP, DSRU and DSRE – the pleasure of digital sound with CD quality. News from Rohde & Schwarz (1991) No. 135, pp 22 – 24

Condensed data of DSR Test Receiver EDSR

Frequency range	
RF input	54 to 854 MHz
IF input	118 MHz
Input impedance (RF/IF)	50/75 Ω, selectable
Input level range	-60 to +10 dBm
Demodulation	QPSK
IF bandwidth	10.5 MHz
Data rate	2 x 10.24 Mbit/s
Audio frequency response (20 Hz to 14.5 kHz)	±0.3 dB
Distortion (40 Hz to 14.5 kHz)	≤0.02 %
Interfaces	IEC 625-1, RS-232-C, Centronics

Reader service card 145/01