TV Test Transmitter SFQ Model 20

TV via antenna: digitally fit

TV Test Transmitter SFQ is the solution for testing all digital TV receivers in development, production, quality assurance and service. Its speciality is that it can work as a test transmitter for established standards and adapt very fast to any newly introduced ones. The new SFQ model 20 is suitable for all measurement tasks of terrestrial TV in line with DVB-T standard.

FIG 1 Model 20 of TV Test Transmitter SFQ is specially designed for DVB-T. Photo 45 592/2

The change from analog to digital TV transmission is in full swing. New services like cable (DVB-C) and satellite (DVB-S) are already transmitting in digital. And terrestrial TV, the television of the first hour, is now also going digital. The standard [1] has been adopted, pilot field trials are in progress in many European countries and a nationwide broadcast network is already starting up in Great Britain. The reliability requirements of the new type of transmission and expectations are much higher than for cable and satellite. The purpose of terrestrial TV is providing basic coverage for the public at large. Compared to cable and satellite, the transmitting conditions are much more difficult, being influenced by weather, multipath propagation through landscape features as well as by other electronic radio services. Nevertheless, high-quality reception will be possible not only in buildings but also in the open without a special antenna and with mobile receivers. The present transmission network is being renewed, so transmit frequencies can be used more economically. The solution to all of this is complex coding, highly efficient error correction, OFDM (orthogonal frequency division multiplex) coding and emission via a single-frequency network.

TV Test Transmitter SFQ model 20 (FIG 1) is the right signal source for the whole range of measurement tasks. It provides all necessary signals in excellent quality. For special requirements the user can vary almost any parameter. Errors can be simulated and interference superimposed to mirror real transmission conditions.

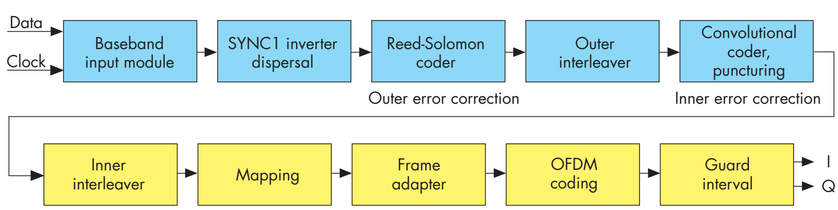


FIG 2 Block diagram of DVB-T coder (blue: modules identical for satellite system)

Function

SFQ generates a **DVB-T signal** fully compatible with ETS 300 744 in all its functions; the following **parameters can be set:**

- bandwidth 6 MHz, 7 MHz and 8 MHz with any intermediate values,
- QPSK, 16QAM or 64QAM modulation,
- code rate 1/2, 2/3, 3/4, 5/6, 7/8,
- guard interval 1/4, 1/8, 1/16, 1/32,
- COFDM with 2k or 8k mode,
- optional hierarchical coding.

The input signal to SFQ is the MPEG2-coded signal. After deriving the synchronizing information, the signal is taken to the scrambler where it is linked to a PRBS sequence for energy dispersal. The following stages are the same as for DVB-S: Reed-Solomon error correction, interleaver, convolutional encoder and puncturing (FIG 2). The rest of signal processing is DVB-T-specific. Due to the more unfavourable conditions of terrestrial propagation the signal is made to pass through further transmission correction stages: an inner bit interleaver (nearest to the antenna) and a symbol interleaver. Mapping is performed according to the selected QPSK, 16QAM or 64QAM coding. After insertion of the pilot and TPS (transmission parameter signalling) carriers in the frame adapter, digital data are changed to the time domain by an inverse fast Fourier transform, to a 1705 (2k) or 6817 (8k) carrier depending on the selected mode. Finally the guard interval is inserted. The further procedure is the same as for DVB-C/S: I/Q modulator, RF converter and lastly the attenuator for setting output level.

Simulation features

Functional tests with ideal signals are necessary but not very helpful for simulating a real situation. Errors and reception problems have to be simulated to define specifications and for

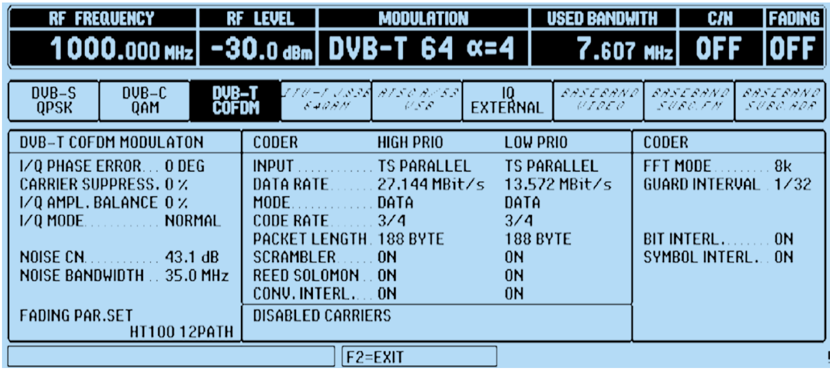


FIG 3 Menu of SFQ: DVB-T status display

functional testing under faulty conditions and at the operation limits. SFQ, designed as a stress generator, offers many features for such purposes. The I/Q modulation enables I and Q to be interchanged, which corresponds to a sideband switchover. The residual carrier can be set, the orthogonality between I and Q (I/Q phase) modified and the amplitude of I and Q (I/Q imbalance) varied.

The modulation can be switched off for all carriers but also for individual carrier groups. The carriers are still available but not modulated. This can be done separately for the data, pilot and TPS carriers. Not just the modulation, the carriers too can be switched off individually or in groups. The coder permits deactivation of operation-specific functions such as scrambler (energy dispersal), Reed-Solomon error correction, convolutional, bit and symbol interleavers. In this way errors can be generated and reproduced individually to investigate whether bit errors have been corrected by the error-control circuit or missing bits correctly replaced by the interleaver function. General transmission problems can be examined in addition to the separately selectable erroneous settings. An internal noise source allows poor receiving conditions to be simulated in a reproducible way. The precise setting of the noise power makes it possible to determine BER characteristics for DVB-T receivers for example.

The optional fading simulator is a big innovation. It serves for simulating reception by mobile receivers or in an unfavourable environment with a large number of reflections. The different paths of the fading simulator can also be used to simulate a single-frequency network.

Applications

The wide frequency range of SFQ from 0.3 MHz to 3.3 GHz enables tests to be performed beyond frequency limits and at any intermediate frequencies. The large level range from –6 dBm to –99 dBm permits testing of sensitive modules beside providing sufficient level for in-service measurements. At the input interface it is possible to select between SPI (synchronous parallel interface) with LVDS (low-voltage differential signalling) and ASI (asynchronous serial interface). The following internal substitution signals are available: Null TS Packet, PRBS sequence or PRBS packets [2]. Of course, the well-proven features of SFQ model 10 [3] and of DVB-T Modulator SDB-M [4] were retained: user-friendly operation, messages for anomalous settings or operating states, status menu (FIG 3), online help, IEC/IEEE bus and RS-232-C interface as well as firmware updates from a PC. The modular concept, which allows retrofitting for DVB-C/S, is a platform for future standards and coding.

With its flexible DVB-T test signals, TV Test Transmitter SFQ model 20 offers all the features needed in development, acceptance, quality assurance and servicing both for manufacturers of receivers of every kind and for operators of transmitters and receiving installations.

Josef Handl

REFERENCES

[1] Lauterjung, J.: DVB-T, the new terrestrial TV standard. News from Rohde & Schwarz (1997) No. 155, pp 31–32

[2] Schmidt, P.: Optional input interface for TV Test Transmitter SFQ. News from Rohde & Schwarz (1997) No. 156, pp 34–35

[3] Kretschmer, E.; Zimmermann, F.-J.: TV Test Transmitter SFQ – Digital test signals for the television future. News from Rohde & Schwarz (1997) No. 153, pp 14–16

[4] Wießmeier, R.: DVB-T Modulator SDB-M – Start into digital terrestrial TV. News from Rohde & Schwarz (1997) No. 156, pp 19–21

Condensed data of TV Test Transmitter SFQ Model 20 for DVB-T

Frequency range	0.3 MHz to 3.3 GHz
Level range	–6 dBm to –99 dBm
Bandwidths	6/7/8 MHz (settable intermediate values)
Inputs for MPEG2	LVDS, ASI (option)
FFT mode	2k and 8k
Modulation	QPSK, 16QAM, 64QAM
Guard interval	1/4, 1/8, 1/16, 1/32
Inner code rate	1/2, 2/3, 3/4, 5/6, 7/8
Carrier modification	switchable carrier and modulation
Error simulation	carrier suppression, I/Q imbalance, phase error
Special functions	switchable: scrambler, Reed-Solomon coder, inner interleaver, bit and symbol interleaver
Options	hierarchical coding, noise superimposition, fading simulation, DVB-C and DVB-S

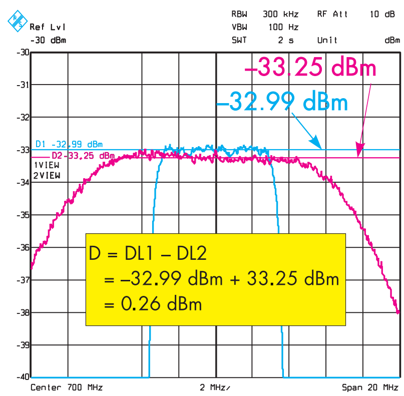
Reader service card 161/01

Test hint

Determination of bit error ratio in DVB

The following questions are salient when assessing the quality of a DVB (digital video broadcasting) system: How high is the available margin of a DVB transmission? Up to what C/N ratio can a set-top box still demodulate and decode DVB signals? The answers are obtained through deliberate deterioration of the C/N ratio by superimposing white noise on the DVB signal. Appropriate conversion produces the bit error ratio (BER) as a function of the C/N ratio for QPSK modulation and all QAM modes.

Due to the steepness of the BER versus C/N curve at BER values $<1 \times 10^{-4}$, the C/N ratio must be determined with high absolute accuracy (maximum permissible deviation 0.1 dB). This is ensured by a measurement method using **TV Test Transmitter SFQ** and **Spectrum Analyzer FSE.** SFQ modulates the internally generated PRB sequence in QPSK or QAM. FSE measures the level of the PRBS spectrum

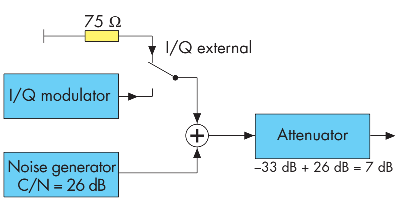


– for example –33 dBm – and marks it with a line at a resolution of 1 dB per division.

After switchover to external I/Q modulation – no signal is applied to these inputs, which are to be terminated with 75 Ω – SFQ no longer outputs a PRBS signal. Then the SFQ noise generator is switched on, which generates a C/N of 26 dB (example) referred to the switched-off PRBS level. To verify whether the noise is exactly 26 dB below the useful signal, the setting of the SFQ attenuator is changed by 26 dB. The two display lines for the useful signal and noise should coincide given a signal level of 33 dB and correction of 26 dB. If not, the difference between the useful signal and the noise signal can be read on Spectrum Analyzer FSE with the aid of a second display line (FIG, center).

The absolute accuracy of this measurement depends solely on the accuracy of the SFQ attenuator. Any overload effects caused by the noise crest factor or the like are excluded through the use of the extremely precise Analyzer FSE. The linearity of the SFQ attenuator is measured to an accuracy of 0.01 dB in acceptance testing and its value is available together with the calibration record. Taking into account the attenuator values, the C/N value can be objectively determined to an accuracy of <0.1 dB, so it is quite adequate for BER measurements in the range 1×10^{-6} to 1×10^{-8}. Because of the simplicity of the measurement, the C/N ratio should be checked prior to every precise BER measurement.

Sigmar Grunwald



Reader service card 161/02 (SFQ) and 161/03 (FSE)