

TV Test Transmitter SFQ

# Now signals to digital cable standard ITU-T/J.83B

Rohde & Schwarz proves again the innovative and universal concept of TV Test Transmitter SFQ. Equipped to match the North-American terrestrial ATSC standard a year ago (FIGs 1 and 2), SFQ now comes with a coder for the North-American standard ITU-T/J.83B.

## Excellent signal quality

SFQ provides a signal at maximum quality that conforms in all functions to standard ITU-T/J.83B [2]. This makes it an indispensable test modulator for all companies involved in American cable broadcast. All standard parameters can be modified as required for a given measurement task. Selectable coder-internal test data sequences, which substitute the transport stream input signal in the different function blocks of the FEC (forward error correction), enable comprehensive quality classification of receiving equipment. A BER option allows measurement of the system failure limit even when the program is running without extra equipment. The SFQ-Z17 adapter card is especially useful. It enables BER measurements by using any consumer

set-top boxes even without transport stream output, provided they have a common interface.

To simulate real transmission conditions, the quality of the RF signal from SFQ can be specifically modified and degraded (e.g. by fading or noise).

## Quadrature amplitude modulation

The selection of the transmission method depends to a large extent on the transmission medium. Cable channels (including glass fiber) are assumed to be band-limited and linear, with the system prone to white noise, interference and echoes. The quadrature amplitude modulation (QAM) selected in standard J.83B is ideal for these media.

Depending on the application, SFQ allows selection between two formats: 64QAM and 256QAM (FIGs 3 and 4). Root-raised cosine filtering (transmitter and receiver use the same filtering) carried out at symbol level with subsequent I/Q modulation limits the output spectrum to the US channel spacing of 6 MHz and minimizes symbol interference in the receiver.

## Structure of coder

The ITU-T/J.83B coder consists of five processing blocks: checksum generator, Reed-Solomon encoder, convolutional interleaver, randomizer and trellis coder.

FIG 1  
Number 166 of News from Rohde & Schwarz reported on SFQ for ATSC [1]



FIG 2  
Keeping pace with developments: TV Test Transmitter SFQ now also supports the digital cable standard to ITU-T/J.83B



New optional noise generator for SFQ see page 37

Photo 42591/2x

## Standard ITU-T/J.83B

ITU-T/J.83B is the prevailing standard for digital TV program distribution through cable networks in North America. Its outstanding features have convinced prestigious organizations to standardize it as the physical layer also for data services via cable. Among them are the Society of Cable Telecommunication Engineers (SCTE DVS-031), Multimedia Cable Network Systems (MCNS-DOCSIS) and the IEEE 802.14 Committee. The SFQ coder extends far beyond TV broadcast applications via cable – data broadcast has also been readied.

All these standards were defined, besides TV applications, for equipment that provides data services via broadband cable networks (e.g. cable modems).

ing the sync byte). This function block can be switched off for broadband data services (cable modem).

The Reed-Solomon encoder as outer error protection operates – like all other function blocks in the FEC – in symbols (7 bit) and calculates six parity symbols for a block of 122 input symbols. The receiver can then correct up to three faulty transmitted symbols per block.

The configurable interleaver (13 different operating modes) performs convolutional coding adaptable to current transmission conditions and protects the signal from burst-type transmission interference.

The randomizer ensures efficient and secure synchronization of the receiver as well as constant power density in the transmission channel. Trailer symbols, which perform framing via data symbols, help the receiver to synchronize and transmit information about the current interleaver mode.

The trellis coder forms the inner error protection block. It improves the signal/noise ratio (and so reduces the system failure limit in case of poor S/N)

by adding redundant information. This enables the receiver to increase decoding security by means of a probability evaluation (maximum likelihood). A differential encoder is part of the trellis coder and performs differential coding of data prior to the generation of trellis output symbols. This feature forms an excellent basis for the development of robust receivers.

The mapper handles the output symbols of the trellis coder, assigning a defined point in the signal constellation to every possible output symbol.

The sum of the successive coding blocks means an excellent coding gain of the system, i.e. high immunity to noise while simultaneously protecting against burst-type transmission interference.

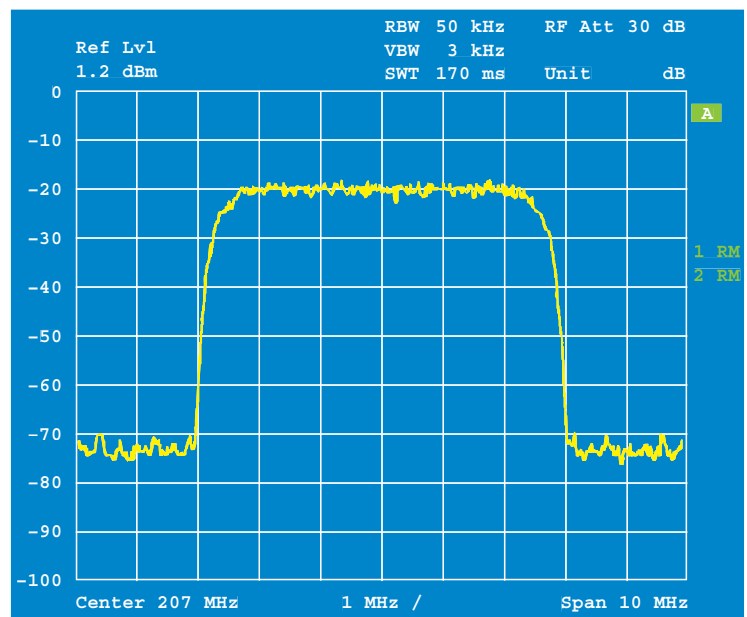
## Every kind of useful data

The ITU-T/J.83B coder in SFQ accepts the input data byte by byte. In the TV broadcast mode, i.e. if the checksum generator and transport stream data feed are activated, the coder accepts the input data in packets of 188 bytes in line with the data structure. ▶

The coder processes input data in MPEG2 transport stream format in the TV mode. In J.83B systems however, transport stream synchronization is completely independent of the FEC synchronization procedure. This allows for instance the application and transmission of ATM (asynchronous transfer mode) packets in data mode without interfering with the ATM synchronization procedure.

When feeding MPEG2 transport stream data, the checksum generator allows in the TV mode, in addition to packet data synchronization, detection of errored data in the block (by specifically modify-

**FIG 3**  
Standard output spectrum in 64QAM mode



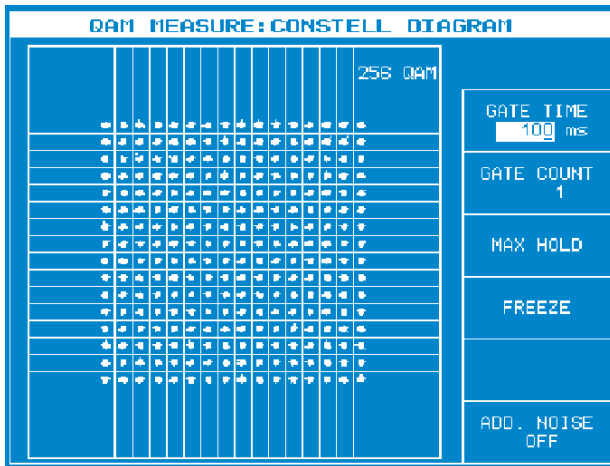


FIG 4  
Constellation  
diagram for  
256 QAM

- The system data rate is 26.90735 Mbit/s in the 64 QAM mode and 38.81070 Mbit/s in the higher-order 256 QAM mode in conformance with the standard. Deviating from the standard, the SFQ coder accepts data rate variation by  $\pm 10\%$ . This results in a linear bandwidth variation of  $\pm 10\%$  compared to the standard 6 MHz system.

The input interface ensures that the required output symbol rate is always available, independently of input data rate [3]. For this purpose, the coder data stream is filled with null blocks up to the required symbol rate. Plus, the user receives a warning if the permissible

useful data rate is exceeded at the input. The input interface comes with comprehensive interfaces for the coder data:

- synchronous parallel interface (TS parallel and SPI),
- asynchronous serial interface (ASI),
- externally clocked asynchronous serial interface at the output (ASI ext. Clk),
- externally clocked parallel interface at the output (SPI ext. Clk).

### Wide range of test capabilities

Standard and high-quality signals as generated by SFQ are useful in functional tests on receivers and transmission facilities, but in most cases do not reflect the conditions prevailing in real transmission systems [4]. SFQ consequently offers numerous features for simulating all signal degradations occurring in practice [1].

### Looking ahead

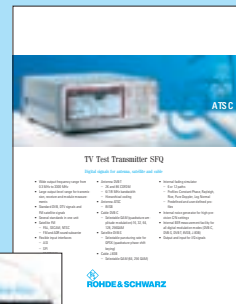
With the ITU-T/J.83 B coder, the innovative concept of SFQ proves itself once again. New, low-cost upgrades for the test transmitter will in future also ensure that SFQ keeps pace with rapid developments and pays back longterm on the investment (see next page).

Günter Huber

### Simple upgrade of ATSC SFQ

Upgrading SFQ to the new standard is very cost-effective and easy for owners of SFQ02 with ATSC coder (option SFQ-B12) and optional input interface (SFQ-B6). ATSC and J.83 B are implemented in the same coder hardware, so both standards can be activated simply by enabling the software without having to make any modifications in SFQ. Switchover between the two standards takes just a few seconds.

More information and data sheet at  
[www.rohde-schwarz.com](http://www.rohde-schwarz.com) or enter 170/10  
on reader service card



CD-ROM "DTV Dream Team" available free from your R & S representative

### REFERENCES

- [1] TV Test Transmitter SFQ: SFQ goes North America – with digital TV standard ATSC. News from Rohde & Schwarz (2000) No 166, pp 13–15
- [2] International Telecommunication Union, Recommendation J.83, Digital Multi-program Systems for Television, Sound and Data Services for Cable Distribution
- [3] Optional input interface for TV Test Transmitter SFQ. News from Rohde & Schwarz (1997) No. 156, pp 34–35
- [4] TV Test Transmitter SFQ Model 20 – TV via antenna: digitally fit. News from Rohde & Schwarz (1999) No. 161, pp 4–6