TV Test Transmitter R&S SFL

Digital signals for use in production

- Various optimized models:
  - R&S SFL-S for standards DVB-S, DVB-DSNG
  - R&S SFL-C for DVB-C standard
  - R&S SFL-T for DVB-T standard
  - R&S SFL-V for ATSC/8VSB standard
  - R&S SFL-J for ITU-T J.83/B standard
- Satellite DVB-S/DVB-DSNG
  - QPSK
  - 8PSK
  - 16-QAM
- Cable DVB-C
  - 16-, 32-, 64-, 128-, 256-QAM
- Antenna DVB-T
  - 2K and 8K COFDM
  - 6 MHz, 7 MHz and 8 MHz
  - QPSK, 16-QAM, 64-QAM
- Antenna ATSC
  - 8VSB
- Cable ITU-T J.83/B
  - 64-QAM, 256-QAM
  - Data interleaver level 1 and level 2
- Standard-conformant DVB and DTV signals
- Wide output frequency range from 5 MHz to 1100 MHz or 3300 MHz
- Large output level range for broadcast and receiver measurements
- Operating parameters variable in a wide range
- Internal test signals
- Special signals and error signals for limit testing and troubleshooting
- For use in production environments:
  - Wear-free electronic attenuator
  - Fast setting times
- Flexible input interfaces
  - SPI
  - ASI
  - SMPTE310
- I/Q input for external signals
- Sweep mode for frequency and level
- User-defined correction tables

ROHDE&SCHWARZ

A suitable model for each digital standard

R&S SFL-S

- For digital standards DVB-S and DVB-DSNG
  Broadcasting via satellite to EN 300421/EN 301210

R&S SFL-C

- For digital standard DVB-C
  Broadcasting via cable to ITU-T J.83/A, C and EN 300429

R&S SFL-T

- For digital standard DVB-T
  Terrestrial broadcasting via antenna to EN 300744

R&S SFL-V

- For digital standard 8VSB
  Terrestrial broadcasting via antenna to ATSC Doc. A/53 (8VSB)

R&S SFL-J

- For digital standard J.83/B
  Broadcasting via cable to ITU-T J.83/B

Key features

- Wide frequency range 5 MHz to 1.1 GHz or 3.3 GHz
- Large level range –140 dBm to 0 dBm
- Wear-free electronic attenuator
- Fast setting times
- Simple, user-friendly hardkey and softkey control
- Clearly arranged display with main parameters in headline
- Status menu for overview of settings
- Storage of instrument settings
- List function for automatic command sequence, e.g. measurement of frequency and amplitude response
- Online help
- IEC625/IEEE bus, RS-232-C
- Software update via RS-232-C

General

The TV Test Transmitter Family R&S SFL is a complete solution for testing digital TV receivers and integrated receiver modules, as well as for testing digital TV links for broadcasting via terrestrial antennas and cable. It covers all main standards currently used worldwide as well as those to be introduced soon.

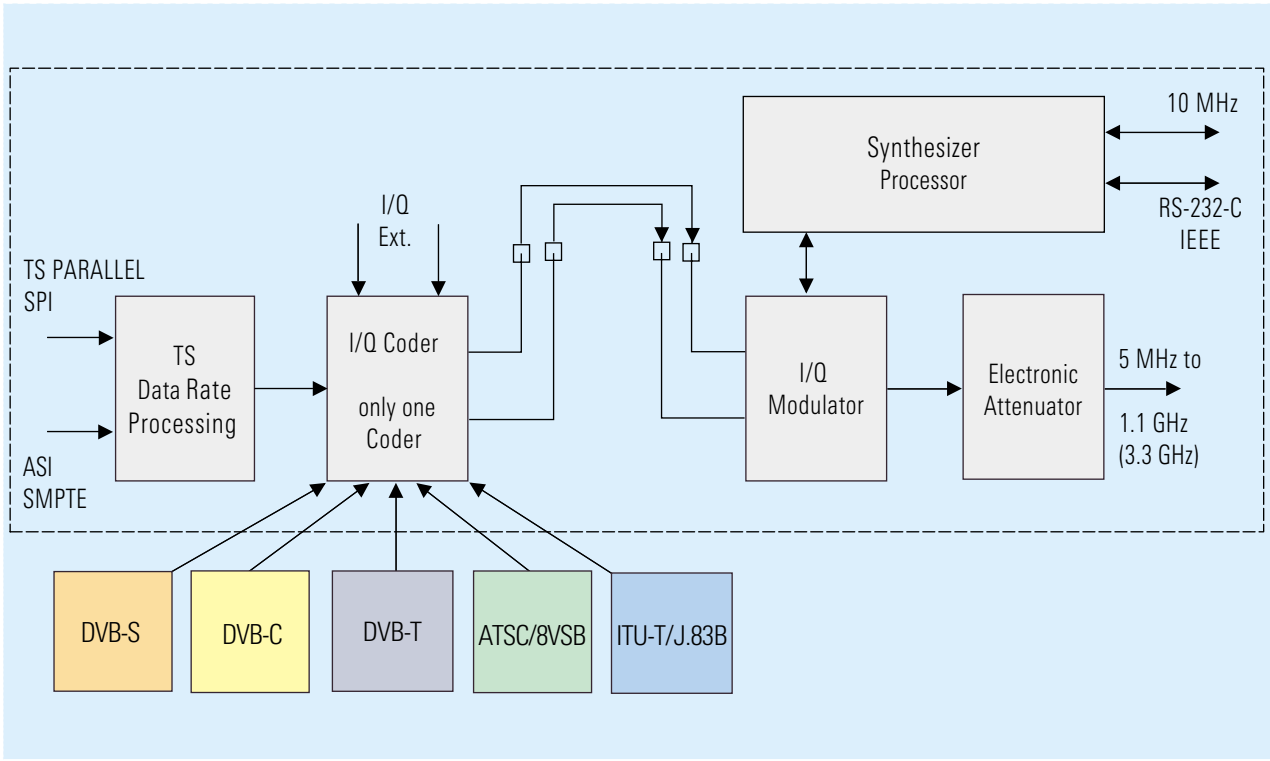
The standard-conformant test signals exhibit a high level of precision. To determine the full functionality and the performance of your products at their limits, the test signal parameters can be varied within a wide range and provided with predefined errors. Realistic transmission/reception conditions can be reproducibly simulated with the aid of the noise generator option.

Applications

The high signal quality and the versatile parameter variation capabilities make the R&S SFL family ideally suited as a standard signal generator for use in production environments. The wide output frequency range allows testing beyond the limits defined by the relevant standard. The benefit of the large level range is that, on the one hand, the functional limits of LSI (large-scale integration) circuits can be quickly determined and recorded during production; on the other hand, it is easy to simulate a receive link for a TV receiver.

The operating parameters (e.g. roll-off, puncturing, QPSK mode, QAM mode, pilot level, interleaver level, etc) can easily be varied even beyond the limits defined by the relevant standard. A number of special signals or signals with predefined errors are provided in order to determine the true functional limits or to quickly detect malfunctions; it is also possible to switch off signal characteristics defined in the standard or partial signal functions (e.g. modulation, individual carriers and groups of carriers, pilot, etc).

Irrespective of the model, a sweep mode is available for the total frequency range, as well as an external I/Q input for signals with external coding.



Block diagram of TV Test Transmitter R&S SFL

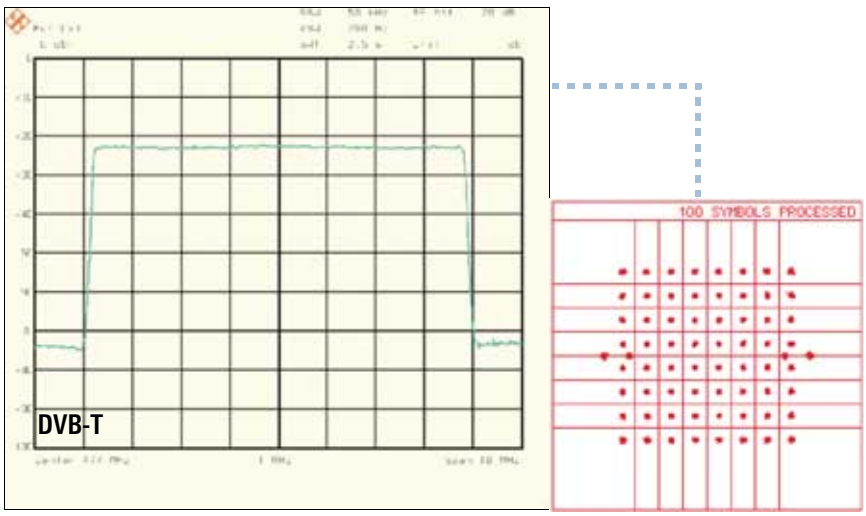
R&S SFL-T/SFL-S/SFL-C

DVB: coding and mapping for antenna, satellite and cable

The DVB models of the TV Test Transmitter R&S SFL encode the applied transport stream for terrestrial transmission via antenna or for satellite or cable transmission in line with standards and condition it so that I and Q (inphase and quadrature) signals are obtained. The R&S SFL accepts MPEG transport streams with a packet length of 188 or 204 bytes.

The input interfaces are synchronous parallel (TS parallel, SPI) and asynchronous serial (ASI). The input data rate and the symbol rate for the R&S SFL-C and R&S SFL-S are selectable. With the R&S SFL-T, the channel bandwidths of 6 MHz, 7 MHz and 8 MHz can be selected; the default settings can be varied.

Instead of the external transport data stream (DATA) being used, an internal data source can generate null transport stream packets (NULL TS PACKET, as defined in the DVB Measurement Guidelines), or an unpacketed random sequence (PRBS). The PRBS sequence is also available in packeted form in the null transport stream packets (NULL PRBS PACKET). The R&S SFL warns the user if the input signal fails, the set data rate does not match the incoming one or the USEFUL DATA RATE is too high.



The input data stream is linked to a random sequence, ensuring that the signal energy is evenly distributed (energy dispersal). Energy dispersal can be switched off. The same applies to SYNC BYTE inversion.

Following energy dispersal, a Reed-Solomon coder (204,188) is provided as an outer encoder for forward error correction (FEC). 16 parity bytes are added to the unchanged 188 data bytes of each transport stream packet. These 16 parity bytes form the redundancy that allows eight errored bytes of a frame to be corrected by the receiver.

A convolutional interleaver distributes the data so that consecutive bits are separated. Burst errors occurring on the transmission path are split up by the de-interleaver into single errors that can be corrected by the Reed-Solomon decoder. The interleaver, too, can be disabled.

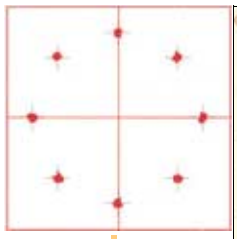
Up to and including the convolutional interleaver, coding is identical for antenna (COFDM), satellite (QPSK, 8PSK, 16-QAM) and cable (QAM) transmission. No further FEC coding is provided for cable transmission, as in this case interference due to noise, nonlinearities and interruptions is less likely than on satellite links or with antenna transmission. With cable transmission, mapping to the I and Q paths is performed next.

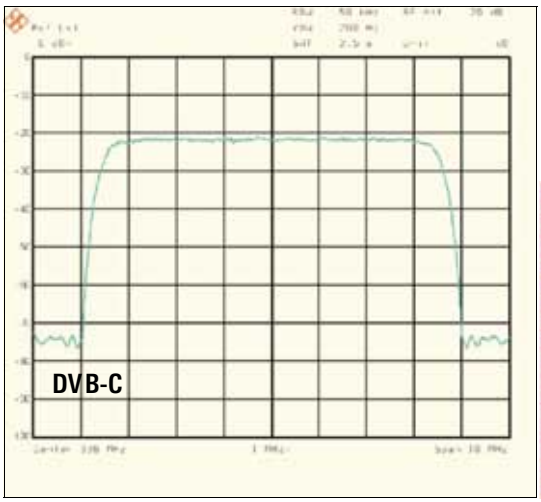
For terrestrial transmission via antenna and for satellite transmission, additional inner FEC coding is performed after the convolutional interleaver. The procedure, which is known as convolutional encoding, doubles the data rate. Puncturing is carried out next, i.e. certain bits are left out in the transmission according to a defined algorithm, so that the data rate is reduced again.

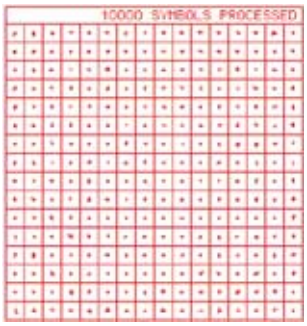
With DVB-S satellite transmission, mapping to the I and Q paths is performed at this point. Instead of the convolutional encoder (DVB-S), pragmatic trellis coding is used for DVB-DSNG satellite transmission.

For terrestrial transmission, the signal is made to pass through further FEC stages because of the inherently unfavourable propagation conditions: an inner bit interleaver (at the antenna end) and a symbol interleaver. Next, mapping is performed according to the selected QPSK, 16-QAM or 64-QAM constellation. After insertion of the pilot and TPS (transmission parameter signalling) carriers in the frame adapter, conversion of the frequency domain to the time domain is effected by inverse fast Fourier transform, to a 1705 (2K) or 6817 (8K) carrier depending on the selected mode. As a last step, the guard interval is inserted.

Prior to modulation, the spectrum has to be limited by filtering. The roll-off factor (root cosine) can be varied for the R&S SFL-C and R&S SFL-S.







ATSC/8VSB: coding and mapping for antenna

The TV Test Transmitter R&S SFL for 8VSB encodes the applied transport stream for terrestrial transmission via antenna in line with standards and processes it so that I and Q (inphase and quadrature) signals are obtained.

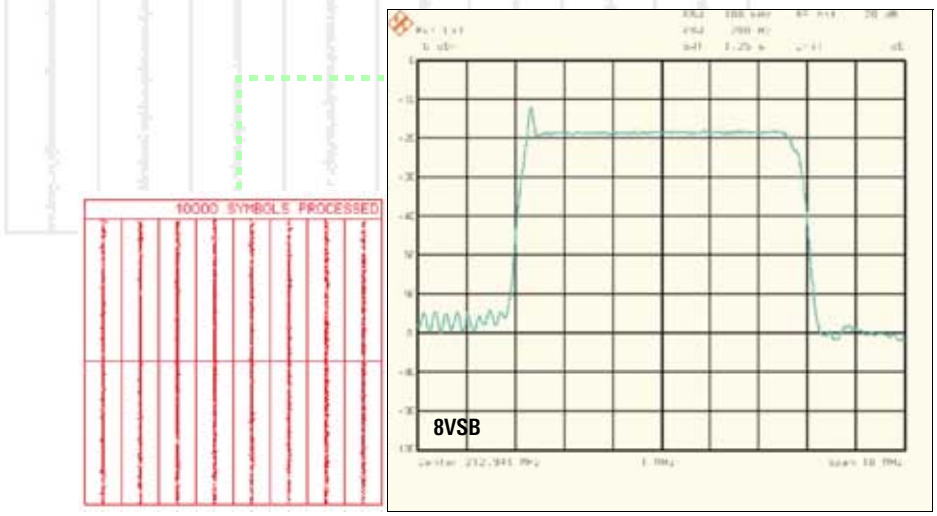
With 8VSB, the R&S SFL accepts MPEG transport streams with a packet length of 188 bytes. The input interfaces are synchronous parallel (TS parallel, SPI) and asynchronous serial (ASI and SMPTE310). When using the TS parallel input, an input data rate of 19.3926 Mbit/s ±10% can be attained.

The R&S SFL warns the user if the input signal fails or if the USEFUL DATA RATE is too high. Instead of the external transport stream (DATA) being applied, an internal data source can generate null transport stream packets (NULL TS PACKET, NULL PRBS PACKET). A SYNC PRBS is implemented for bit error evaluation in receivers. An unpacketed random sequence may also be selected. The PRBS sequence can be selected before (PRBS BEFORE TRELLIS) or after the trellis coder (PRBS AFTER TRELLIS). The PRBS sequence is also available in packeted form in the null transport stream packets (NULL PRBS PACKET).

Generation of the standard frame is followed by a randomizer which ensures that energy is evenly distributed in the channel (energy dispersal). The randomizer can be disabled. Following energy dispersal, a Reed-Solomon coder (208,188) is provided for forward error correction (FEC).

20 parity bytes are added to the unchanged 188 data bytes. Up to ten errors per segment can thus be corrected. A convolutional interleaver changes the position of the individual bytes so that consecutive bytes are separated. Burst errors occurring on the transmission path are split up by the receiver into single errors that can be corrected by the Reed-Solomon decoder. The interleaver can be disabled.

A trellis coder follows for further FEC. After the interleaver or trellis coder, the segment sync and the field sync pulses are inserted. The mapper assigns the relevant amplitude steps to the symbols. The pilot used by the receiver for synchronization is also added in the mapper. The pilot amplitude can be modified and switched off. Prior to modulation, the spectrum must be limited by appropriate filtering. The roll-off is permanently set to 0.115 (root cosine).



ITU-T J.83/B: coding and QAM modulation for cable

The symbol rate of the coder and thus the output signal bandwidth can be varied in a wide range of ±10% of the standard symbol rate.

Internal test sequences (NULL TS PACKETS, NULL PRBS PACKETS, SYNC PRBS) can be substituted for the applied data signal and are helpful for bit error measurements.

Processing stages of the coder: The coder receives an MPEG-coded standard-conformant input data stream with a packet length of 188 bytes.

J.83/B specifies additional error control at the transport stream level. The sync byte is replaced by the sliding checksum calculated from the content of the transport stream packets. In addition to packet synchronization, the receiver can thus detect any errors that occur.

The subsequent FEC layer processes the data without synchronization to the transport structure.

According to J.83/B, FEC consists of four processing layers that allow reliable data transport via the cable transmission channel. These layers are:

- Reed-Solomon coding (128, 122) for outer error correction, allowing up to 3 symbols in one Reed-Solomon block to be corrected
- A subsequent convolutional interleaver that uniformly disperses consecutive symbols across the data stream and so protects the data stream against burst-type impairments
- A randomizer that ensures uniform power density in the channel
- Trellis coding for inner error correction, involving convolutional encoding of data and inserting of defined redundant information into the symbols

Randomizer, interleaver and Reed-Solomon coder can be disabled, which is very helpful in the development of receivers.

All the interleaver modes defined in the J.83/B specification are implemented (level 1 and level 2) and allow flexible adaptation of the system to different transmission conditions.

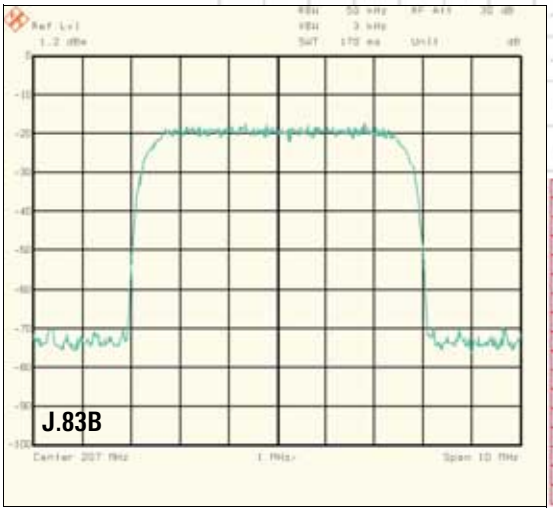
FEC frame generation: With 64-QAM, a frame sync trailer is inserted after 60 Reed-Solomon packets to form a FEC frame (with 256-QAM after 88 Reed-Solomon packets).

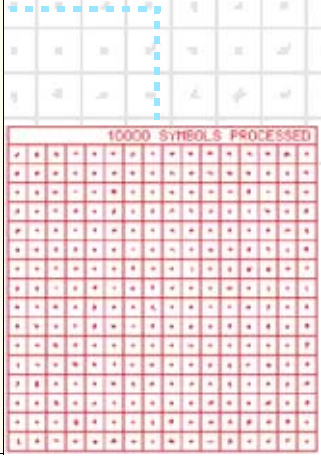
The frame sync trailer is used for FEC synchronization in the receiver and transmits coded information about the current interleaver configuration. The trailer is inserted immediately ahead of the trellis coder.

The trellis coder for 64-QAM performs differential and convolutional encoding with subsequent puncturing (CR = 14/15). The output symbol width of the trellis coder is 6 bits which reflects the modulation level of 64-QAM.

The differential coder/convolutional encoder in the trellis block for 256-QAM is of identical design, but generates an overall code rate of 19/20. The output symbol width is 8 bits, corresponding to 256 constellation points.

After the mapper and before modulation, the output spectrum is pulse-shaped and band-limited by a digital √cos roll-off filter. The roll-off is 0.18 with 64-QAM and 0.12 with 256-QAM in line with the standard.





Data inputs

The R&S SFL has a suitable data input for every application. Via the TS PARALLEL (with LVDS format) and SMPTE310 inputs, the input signal is passed on without modification to the coder. The symbol rate directly depends on the input data rate. The SPI and ASI inputs adapt the signal prior to coding to the desired symbol rate with the aid of the stuffing function.

These inputs allow setting of the symbol rate independently of the input data rate, so that the input data rate is independent of the DVB-T/8VSB channel bandwidth. To this effect, all null packets are removed. The data rate required for a given symbol rate or bandwidth is obtained by stuffing, i.e. by inserting new null packets. The PCR (program clock reference) values are adapted. A built-in synthesizer ensures an accurate data clock at all inputs. For synchronization to a receiver, an external clock can be applied to the ASI and SPI inputs instead of the internal clock.

I/Q modulation

In the I/Q modulator, the orthogonal I and Q components of the RF signal are controlled in amplitude and phase by the analog I and Q signals from the coder. The two RF components are added to give an output signal that can be amplitude- and phase-modulated as required. Assignment of I and Q components can be interchanged in the R&S SFL so that an inverted RF signal is obtained. High demands are placed on the I/Q modulator, particularly regarding high-order quadrature amplitude modulation.

The internal calibration of the R&S SFL ensures that the I and Q paths have identical gain, the phase is exactly 90° and carrier suppression is at least 50 dB. Non-ideal behaviour of an I/Q modulator can be simulated by detuning amplitude, I/Q imbalance, phase error and carrier leakage in the R&S SFL. As a result, bit errors are produced that allow quality assessment of receivers and demodulators.

Rear view of R&S SFL

Specifications

Frequency	
Range	5 MHz to 1.1 GHz R&S SFL-S: 5 MHz to 3.3 GHz
Resolution	0.1 Hz
Error limits	<1 x 10^{-6}
Aging (after 30 days of operation)	<1 x 10^{-6}/year
Temperature effect (0 °C to +55 °C)	<1 x 10^{-6}
Internal reference frequency output Output voltage (V rms, sinewave) Output impedance	10 MHz >0.5 V into 50 Ω 50 Ω
External reference frequency input Permissible frequency drift Input voltage(V rms, sinewave) Input impedance	10 MHz 5 x 10^{-6} 0.5 V to 2 V into 50 Ω 50 Ω
Spectral purity	
Spurious signals Harmonics Subharmonics Nonharmonics (offset from carrier >10 kHz) f ≤250 MHz f >250 MHz to 3.3 GHz	 <–30 dBc for levels ≤0 dBm <–50 dBc <–60 dBc <–70 dBc
SSB phase noise (f=500 MHz, carrier offset 20 kHz, 1 Hz bandwidth)	< –115 dBc
Spurious AM	<0.05% (0.03 kHz to 20 kHz)
Level	
Range CW R&S SFL-C, R&S SFL-J, R&S SFL-T, R&S SFL-V R&S SFL-S	 –140 dBm to +7 dBm –140 dBm to 0 dBm –140 dBm to –3 dBm
Resolution	0.1 dB
Total error for level >–127 dBm (operating period >1 h, temperature variation <5 °C)	<±0.8 dB
Characteristic impedance	50 Ω
VSWR f <1.5 GHz f >1.5 GHz	 <1.6 <2.3
Non-interrupting level setting[1)]	0 dB to –20 dB of current level
I/Q modulator	
Modulation frequency response 5 MHz to 1100 MHz DC to 3.5 MHz R&S SFL-S: 425 MHz to 3000 MHz DC to 5 MHz DC to 25 MHz DC to 50 MHz	 <±0.2 dB <±0.4 dB <±0.8 dB <±2 dB
Carrier leakage at 0 V input voltage, referred to nominal value	<–50 dBc (after I/Q calibration in CALIB menu)
Carrier suppression (residual carrier) Setting range Resolution	 0% to +50% 0.1%
I/Q amplitude (imbalance) Setting range Resolution	 –25% to +25% 0.1%
Quadrature offset (phase error) Setting range Resolution	 –10° to +10° 0.1°
External I/Q input	
Modulation inputs for I and Q signals	front panel
Input impedance	50 Ω
VSWR (DC to 30 MHz)	<1.1
Input voltage for full-scale level	$(I^2 + Q^2)^{1/2}$ = 0.5 V (1 V EMF, 50 Ω)
Connectors	BNC female
Data input	
TS PARALLEL input Characteristics Input impedance Input level Connector	synchronous parallel, without stuffing (LVDS) meet EN 50083-9 100 Ω 100 mV to 2 V 25-pin female, shielded
SPI input Characteristics Input impedance Input level Connector	synchronous parallel, with stuffing (LVDS) meet EN 50083-9 100 Ω 100 mV to 2 V peak-peak 25-pin female, shielded
ASI input Characteristics Input impedance Input level Connector Input signal Stuffing bytes	asynchronous serial with stuffing meet EN 50083-9 75 Ω 200 mV to 880 mV peak-peak BNC female 270 Mbit single byte and block mode
SMPTE310 input Characteristics Input impedance Input level Connector Data rate	asynchronous serial (only with R&S SFL-V) meet SMPTE310M 75 Ω 400 mV to 880 mV peak-peak BNC female 19.393 Mbit/s
Symbol rate TS PARALLEL, SMPTE310 ASI, SPI	 directly dependent on applied MPEG signal selectable independently of MPEG signal (stuffing)
Internal data clock accuracy	<±1 x 10^{-5}
External clock Signal Level Input impedance Connector	switchable to external bit/byte synchronization squarewave TTL high BNC female

[1)] Effect on spectral purity.

R&S SFL-S

DVB-S/-DSNG coder	
Characteristics	meet EN 300421/EN 301210
Type of modulation	QPSK, 8PSK, 16-QAM
Code rate	QPSK: $^1/_2$, $^2/_3$, $^3/_4$, $^5/_6$, $^7/_8$ 8PSK: $^2/_3$, $^5/_6$, $^8/_9$ 16-QAM: $^3/_4$, $^7/_8$
Symbol rates	0.1 Msymbol/s to 80 Msymbol/s (selectable)
Pulse filtering	root cosine roll-off, alpha = 0.35 variable roll-off (0.25 to 0.45)
Energy dispersal	can be disabled
Reed-Solomon coder (204,188, t = 8)	can be disabled
Convolutional interleaver	can be disabled
Convolutional encoder	can be disabled
Mode	
DATA	MPEG2 input signal (without input signal automatic switchover to PRBS with TS PARALLEL, stuffing with ASI, SPI)
NULL TS PACKET	null packets (PID = 1FFF, payload = 0)
NULL PRBS PACKET	null packets (PID = 1FFF, payload = PRBS, 2^{15}-1/2^{23}-1 to ITU-T Rec. O.151)
PRBS before convolutional encoder	2^{15}-1/2^{23}-1 to ITU-T Rec. O.151
Modulation frequency response	±0.25 dB
Shoulder attenuation	48 dB

R&S SFL-C

DVB-C coder	
Characteristics	meet EN 300 429
Type of modulation	16-QAM, 32-QAM, 64-QAM, 128-QAM, 256-QAM
Symbol rates	0.1 Msymbol/s to 8 Msymbol/s (selectable)
Pulse filtering	root cosine roll-off, alpha = 0.15 variable roll-off (0.1 to 0.2)
Energy dispersal	can be disabled
Reed-Solomon coder (204,188, t = 8)	can be disabled
Convolutional interleaver	can be disabled
Mode	
DATA	MPEG2 input signal (without input signal automatic switchover to PRBS with TS PARALLEL, stuffing with ASI, SPI)
NULL TS PACKET	null packets (PID = 1FFF, payload = 0)
NULL PRBS PACKET	null packets (PID = 1FFF, payload = PRBS, 2^{15}-1/2^{23}-1 to ITU-T Rec. O.151)
PRBS before mapper	2^{15}-1/2^{23}-1 to ITU-T Rec. O.151
Modulation frequency response	±0.25 dB
Shoulder attenuation (6.9 Msymbol/s)	48 dB
MER	41 dB

R&S SFL-T

DVB-T coder	
Characteristics	meet EN 300744, non-hierarchical
Mode	
DATA	MPEG input signal synchronized to input data rate
NULL TS PACKET	null transport stream packets as defined by DVB Measurement Guidelines
NULL PRBS PACKET	null transport stream packets with PRBS (PRBS: 2^{23}–1/2^{15}–1 to ITU-T Rec. O.151)
PRBS before convolutional encoder	2^{23} –1/2^{15} –1 to ITU-T Rec. O.151
PRBS after convolutional encoder	2^{23} –1/2^{15} –1 to ITU-T Rec. O.151
PRBS before mapper	2^{23} –1/2^{15} –1 to ITU-T Rec. O.151
Special functions	scrambler, sync byte inversion, Reed-Solomon encoder, convolutional interleaver, bit interleaver, symbol interleaver; can be disabled
Bandwidth	6 MHz, 7 MHz, 8 MHz; selectable for variable bandwidth 5.164 MHz to 7.962 MHz
Constellation	QPSK, 16-QAM, 64-QAM
Code rate	1/2, 2/3, 3/4, 5/6, 7/8
Guard interval	1/4, 1/8, 1/16, 1/32, OFF
FFT mode	2K and 8K OFDM
Carrier modification	carriers or groups of carriers can be switched off; modulation for groups of carriers can be switched off
Modulation frequency response	±0.2 dB
Shoulder attenuation	48 dB

R&S SFL-V

ATSC/8VSB coder	
Characteristics	meet ATSC Doc. A/53 (8VSB)
Mode	
DATA	MPEG input signal with synchronization to input data rate
NULL TS PACKET	null transport stream packets as defined by DVB Measurement Guidelines
NULL PRBS PACKET	null transport stream packets with PRBS (PRBS: 2^{23} –1/2^{15} –1 to ITU-T Rec. O.151)
SYNC PRBS	sync byte with 187 byte PRBS payload
PRBS before trellis	2^{23} –1/2^{15} –1 to ITU-T Rec. O.151
PRBS after trellis	2^{23} –1/2^{15} –1 to ITU-T Rec. O.151
Symbol rate	10.762 Msymbol/s
Range	±10%
Bandwidth	6 MHz
Range	±10%
Pilot addition	can be switched off
Nominal	1.25 for 8VSB
Range	0 to 5, in steps of 0.125 for 8VSB
Pulse filtering (root cosine)	0.115 roll-off
Special functions	Reed-Solomon, randomizer, interleaver; can be disabled
Modulation frequency response	±0.25 dB
Shoulder attenuation	53 dB
MER	41 dB

R&S SFL-J

J.83/B coder	
Characteristics	meet ITU-T J.83/B
Mode	
DATA	MPEG input signal with synchronization to input data rate
NULL TS PACKET	null transport stream packets as defined by DVB Measurement Guidelines
NULL PRBS PACKET	null transport stream packets with PRBS (PRBS: 2^{23} –1/2^{15} –1 to ITU-T Rec. O.151)
SYNC PRBS	sync byte with 187 byte PRBS payload (PRBS: 2^{23} –1/2^{15} –1 to ITU-T Rec. O.151)
PRBS before trellis	2^{23} –1/2^{15} –1 to ITU-T Rec. O.151
PRBS after trellis	2^{23} –1/2^{15} –1 to ITU-T Rec. O.151
Symbol rate	5.0569 Msymbol/s (64-QAM), 5.360 Msymbol/s (256-QAM)
Range	±10%
Bandwidth	6 MHz
Range	±10%
Pulse filtering (root cosine)	0.18 (64-QAM), 0.12 (256-QAM)
Data interleaver	level 1 and level 2; can be disabled
Special functions	Reed-Solomon, randomizer, interleaver; can be disabled
Modulation frequency response	±0.25 dB
Shoulder attenuation	53 dB
MER	42 dB

General data

Memory for instrument settings	50
Remote control	IEC60625 (IEEE 488) RS-232-C
Command set	SCPI 1995.0
Rated temperature range	+5 °C to +45 °C
Operating temperature range	0 °C to +50 °C
Storage temperature range	–40 °C to +70 °C
Mechanical resistance	
Vibration, sinusoidal	5 Hz to 150 Hz, max. 2 g at 55 Hz, 55 Hz to 150 Hz, 0.5 g const., meets IEC60068, IEC61010 and MIL-T-28800D, class 5
Vibration, random	10 Hz to 300 Hz, acceleration 1.2 g (rms)
Shock	40 g shock spectrum, meets MIL-STD-810D and MIL-T-28800D, class 3/5

Climatic resistance	
Damp heat	95% rel. humidity, cyclic test at +25 °C/+40 °C, meets IEC60068
Electromagnetic compatibility	EN50081-1, EN50082-2 (EMC Directive of EU)
Immunity to RFI	10 V/m
Electrical safety	EN61010-1, IEC61010, UL3111-1, CSA-C22.2 No.1010.1
Power supply	100 V to 120 V (AC), 50 Hz to 60 Hz 200 V to 240 V (AC), 50 Hz to 60 Hz autoranging max. 250 VA
Dimensions (W x H x D)	427 mm x 88 mm x 450 mm
Weight	11 kg

Certified Environmental System
ISO 14001
REG. NO 1954

Certified Quality System
ISO 9001
DQS REG. NO 1954

Ordering information

Order designation		
TV Test Transmitter DVB-S/-DSNG	R&S SFL-S	2084.4005.10
TV Test Transmitter DVB-C	R&S SFL-C	2084.4005.15
TV Test Transmitter DVB-T	R&S SFL-T	2084.4005.20
TV Test Transmitter ATSC/8VSB	R&S SFL-V	2084.4005.30
TV Test Transmitter J.83/B	R&S SFL-J	2084.4005.40
Option		
Noise Generator	R&S SFL-N	on request
BER Measurement	R&S SFL-K17	on request
Recommended extras		
Documentation of R&S SFL Calibration Values	R&S SFL-DCV	2082.0490.22
Service Kit		2084.4340.02
Service Manual		2084.4128.24
19" Adapter for rackmounting	R&S ZZA-211	1096.3260.00
Matching Pads 50 Ω/75 Ω Matched at both ends, attenuation 5.7 dB, no DC isolation Matched at one end, attenuation 1.7 dB	 R&S RAM R&S RAZ	 0358.5414.02 0358.5714.02
Bag (2 height units)	R&S ZZT-214	1109.5119.00

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