



## 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 EN300421/EN301210

DVB-T

## R&S SFL-C

- ◆ For digital standard DVB-C  
Broadcasting via cable to ITU-T J.83/A, C and EN300429

DVB-S

## R&S SFL-T

- ◆ For digital standard DVB-T  
Terrestrial broadcasting via antenna to EN300744

DVB-DSNG

## R&S SFL-V

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

DVB-C

ATSC/8VSB

## R&S SFL-J

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

ITU-T/J83.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.

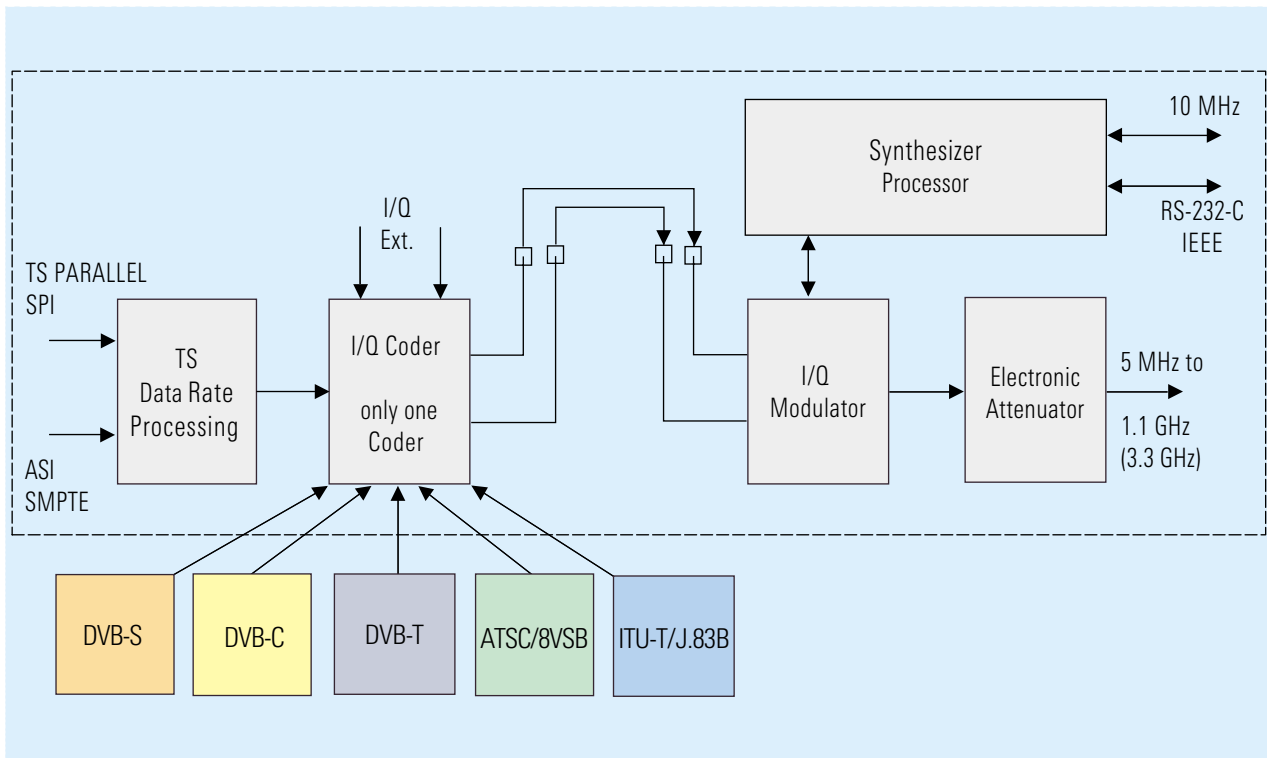
## Applications

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

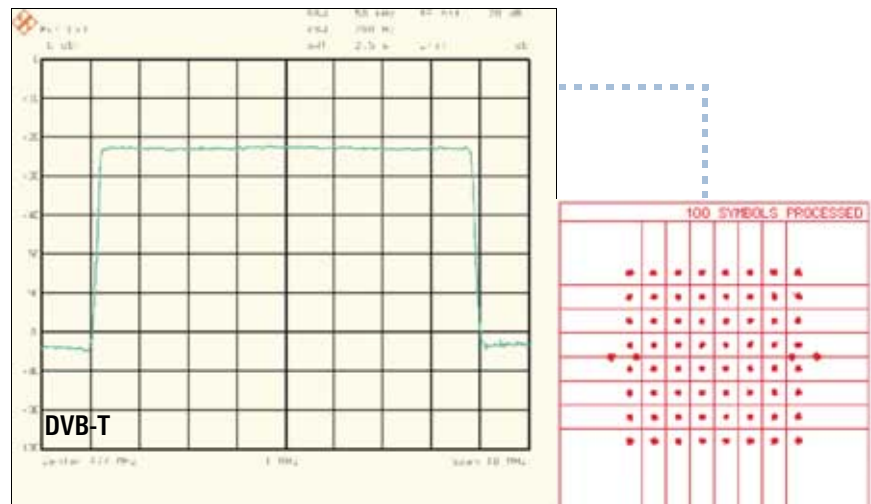
#### **DVB: coding and mapping for antenna, satellite and cable**

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.

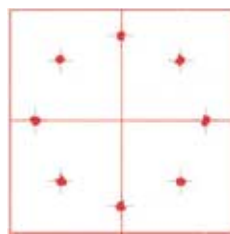
With DVB-S satellite transmission, mapping to the I and Q paths is performed at this point. Instead of the convolutional encoder (DVB-S), pragmatic trellis coding is used for DVB-DSNG satellite transmission.

For terrestrial transmission, the signal is made to pass through further FEC stages because of the inherently unfavourable

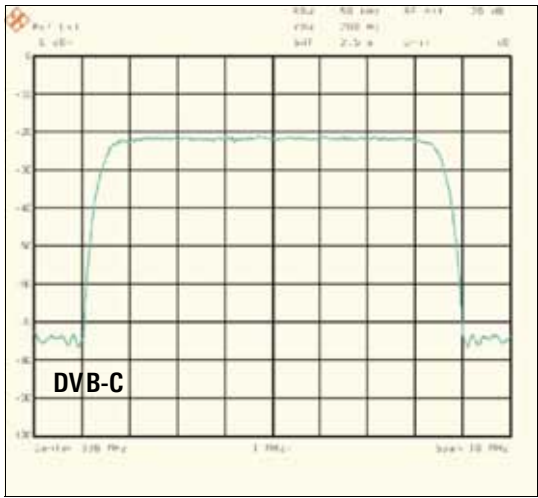
propagation conditions: an inner bit interleaver (at the antenna end) and a symbol interleaver. Next, mapping is performed according to the selected QPSK, 16-QAM or 64-QAM constellation. After insertion of the pilot and TPS (transmission parameter signalling) carriers in the frame adapter, conversion 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.

# DVB-S



# DVB-C



10000 SYMBOLS PROCESSED

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420	421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460	461	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479	480	481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496	497	498	499	500	501	502	503	504	505	506	507	508	509	510	511	512	513	514	515	516	517	518	519	520	521	522	523	524	525	526	527	528	529	530	531	532	533	534	535	536	537	538	539	540	541	542	543	544	545	546	547	548	549	550	551	552	553	554	555	556	557	558	559	560	561	562	563	564	565	566	567	568	569	570	571	572	573	574	575	576	577	578	579	580	581	582	583	584	585	586	587	588	589	590	591	592	593	594	595	596	597	598	599	600	601	602	603	604	605	606	607	608	609	610	611	612	613	614	615	616	617	618	619	620	621	622	623	624	625	626	627	628	629	630	631	632	633	634	635	636	637	638	639	640	641	642	643	644	645	646	647	648	649	650	651	652	653	654	655	656	657	658	659	660	661	662	663	664	665	666	667	668	669	670	671	672	673	674	675	676	677	678	679	680	681	682	683	684	685	686	687	688	689	690	691	692	693	694	695	696	697	698	699	700	701	702	703	704	705	706	707	708	709	710	711	712	713	714	715	716	717	718	719	720	721	722	723	724	725	726	727	728	729	730	731	732	733	734	735	736	737	738	739	740	741	742	743	744	745	746	747	748	749	750	751	752	753	754	755	756	757	758	759	760	761	762	763	764	765	766	767	768	769	770	771	772	773	774	775	776	777	778	779	780	781	782	783	784	785	786	787	788	789	790	791	792	793	794	795	796	797	798	799	800	801	802	803	804	805	806	807	808	809	810	811	812	813	814	815	816	817	818	819	820	821	822	823	824	825	826	827	828	829	830	831	832	833	834	835	836	837	838	839	840	841	842	843	844	845	846	847	848	849	850	851	852	853	854	855	856	857	858	859	860	861	862	863	864	865	866	867	868	869	870	871	872	873	874	875	876	877	878	879	880	881	882	883	884	885	886	887	888	889	890	891	892	893	894	895	896	897	898	899	900	901	902	903	904	905	906	907	908	909	910	911	912	913	914	915	916	917	918	919	920	921	922	923	924	925	926	927	928	929	930	931	932	933	934	935	936	937	938	939	940	941	942	943	944	945	946	947	948	949	950	951	952	953	954	955	956	957	958	959	960	961	962	963	964	965	966	967	968	969	970	971	972	973	974	975	976	977	978	979	980	981	982	983	984	985	986	987	988	989	990	991	992	993	994	995	996	997	998	999	1000
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## R&S SFL-J

### 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  $\pm 10\%$  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.

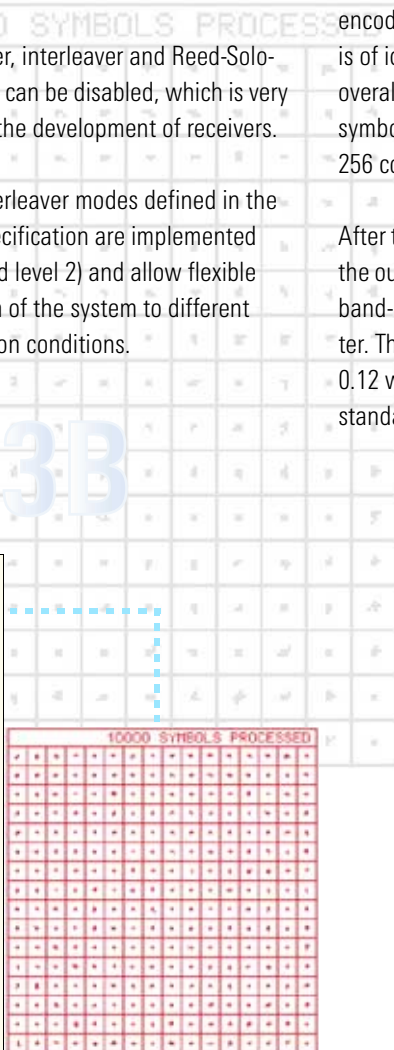
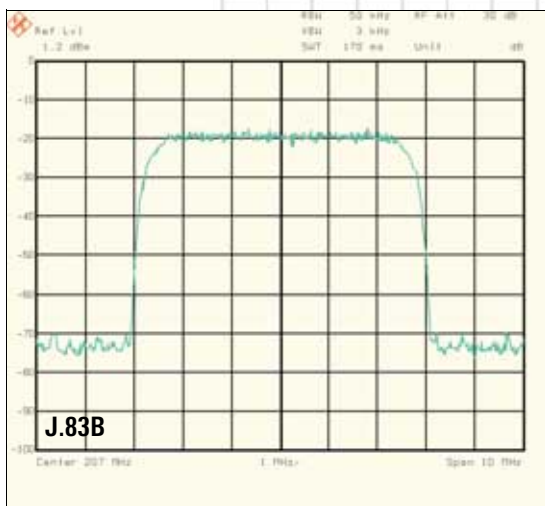
FEC frame generation: With 64-QAM, a frame sync trailer is inserted after 60 Reed-Solomon packets to form a FEC frame (with 256-QAM after 88 Reed-Solomon packets).

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  $\sqrt{\cos}$  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  $90^\circ$  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	$<1 \times 10^{-6}$
Aging (after 30 days of operation)	$<1 \times 10^{-6}$ /year
Temperature effect (0°C to +55°C)	$<1 \times 10^{-6}$
Internal reference frequency output	10 MHz
Output voltage (V rms, sinewave)	$>0.5$ V into 50 $\Omega$
Output impedance	50 $\Omega$
External reference frequency input	10 MHz
Permissible frequency drift	$5 \times 10^{-6}$
Input voltage (V rms, sinewave)	0.5 V to 2 V into 50 $\Omega$
Input impedance	50 $\Omega$
Spectral purity	
Spurious signals	
Harmonics	$<-30$ dBc for levels $\leq 0$ dBm
Subharmonics	$<-50$ dBc
Nonharmonics (offset from carrier $>10$ kHz)	
f $\leq 250$ MHz	$<-60$ dBc
f $>250$ MHz to 3.3 GHz	$<-70$ 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	$-140$ dBm to +7 dBm
R&S SFL-C, R&S SFL-J, R&S SFL-T, R&S SFL-V	$-140$ dBm to 0 dBm
R&S SFL-S	$-140$ dBm to $-3$ dBm
Resolution	0.1 dB
Total error for level $\geq -127$ dBm (operating period $>1$ h, temperature variation $<5$ °C)	$<\pm 0.8$ dB
Characteristic impedance	50 $\Omega$
VSWR	
f $<1.5$ GHz	$<1.6$
f $>1.5$ GHz	$<2.3$
Non-interrupting level setting <sup>1)</sup>	0 dB to $-20$ dB of current level
I/Q modulator	
Modulation frequency response	
5 MHz to 1100 MHz	
DC to 3.5 MHz	$<\pm 0.2$ dB
R&S SFL-S: 425 MHz to 3000 MHz	
DC to 5 MHz	$<\pm 0.4$ dB
DC to 25 MHz	$<\pm 0.8$ dB
DC to 50 MHz	$<\pm 2$ 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	0% to +50%
Resolution	0.1%
I/Q amplitude (imbalance)	
Setting range	$-25\%$ to $+25\%$
Resolution	0.1%
Quadrature offset (phase error)	
Setting range	$-10^\circ$ to $+10^\circ$
Resolution	0.1°
External I/Q input	
Modulation inputs for I and Q signals	front panel
Input impedance	50 $\Omega$
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 $\Omega$ )
Connectors	BNC female
Data input	
TS PARALLEL input	synchronous parallel, without stuffing (LVDS) meet EN 50083-9
Characteristics	
Input impedance	100 $\Omega$
Input level	100 mV to 2 V
Connector	25-pin female, shielded
SPI input	synchronous parallel, with stuffing (LVDS) meet EN 50083-9
Characteristics	
Input impedance	100 $\Omega$
Input level	100 mV to 2 V peak-peak
Connector	25-pin female, shielded
ASI input	asynchronous serial with stuffing meet EN 50083-9
Characteristics	
Input impedance	75 $\Omega$
Input level	200 mV to 880 mV peak-peak
Connector	BNC female
Input signal	270 Mbit
Stuffing bytes	single byte and block mode
SMPTE310 input	asynchronous serial (only with R&S SFL-V) meet SMPTE310M
Characteristics	
Input impedance	75 $\Omega$
Input level	400 mV to 880 mV peak-peak
Connector	BNC female
Data rate	19.393 Mbit/s
Symbol rate	
TS PARALLEL, SMPTE310	directly dependent on applied MPEG signal
ASI, SPI	selectable independently of MPEG signal (stuffing)
Internal data clock accuracy	$<\pm 1 \times 10^{-5}$
External clock	switchable to external bit/byte syn- chronization
Signal	squarewave
Level	TTL
Input impedance	high
Connector	BNC female

<sup>1)</sup> Effect on spectral purity.

## R&S SFL-S

<b>DVB-S/-DSNG coder</b>	
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. 0.151)
PRBS before convolutional encoder	$2^{15}-1/2^{23}-1$ to ITU-T Rec. 0.151
Modulation frequency response	$\pm 0.25$ dB
Shoulder attenuation	48 dB

## R&S SFL-C

<b>DVB-C coder</b>	
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. 0.151)
PRBS before mapper	$2^{15}-1/2^{23}-1$ to ITU-T Rec. 0.151
Modulation frequency response	$\pm 0.25$ dB
Shoulder attenuation (6.9 Msymbol/s)	48 dB
MER	41 dB

## R&S SFL-T

<b>DVB-T coder</b>	
Characteristics	meet EN 300744
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. 0.151)
PRBS before convolutional encoder	$2^{23}-1/2^{15}-1$ to ITU-T Rec. 0.151
PRBS after convolutional encoder	$2^{23}-1/2^{15}-1$ to ITU-T Rec. 0.151
PRBS before mapper	$2^{23}-1/2^{15}-1$ to ITU-T Rec. 0.151
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	$\pm 0.2$ dB
Shoulder attenuation	48 dB

## R&S SFL-V

<b>ATSC/8VSB coder</b>	
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. 0.151)
SYNC PRBS	sync byte with 187 byte PRBS payload
PRBS before trellis	$2^{23}-1/2^{15}-1$ to ITU-T Rec. 0.151
PRBS after trellis	$2^{23}-1/2^{15}-1$ to ITU-T Rec. 0.151
Symbol rate	10.762 Msymbol/s
Range	$\pm 10\%$
Bandwidth	6 MHz
Range	$\pm 10\%$
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	$\pm 0.25$ dB
Shoulder attenuation	53 dB
MER	41 dB

## R&S SFL-J

<b>J.83/B coder</b>	
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. 0.151)
SYNC PRBS	sync byte with 187 byte PRBS payload (PRBS: $2^{23}-1/2^{15}-1$ to ITU-T Rec. 0.151)
PRBS before trellis	$2^{23}-1/2^{15}-1$ to ITU-T Rec. 0.151
PRBS after trellis	$2^{23}-1/2^{15}-1$ to ITU-T Rec. 0.151
Symbol rate	5.0569 Msymbol/s (64-QAM), 5.360 Msymbol/s (256-QAM)
Range	$\pm 10\%$
Bandwidth	6 MHz
Range	$\pm 10\%$
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	$\pm 0.25$ 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
<b>Mechanical resistance</b>	
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

<b>Climatic resistance</b>	
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



## Ordering information

<b>Order designation</b>		
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
<b>Option</b>		
Noise Generator	R&S SFL-N	on request
BER Measurement	R&S SFL-K17	on request
<b>Recommended extras</b>		
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
<b>Matching Pads 50 Ω/75 Ω</b>		
Matched at both ends, attenuation 5.7 dB, no DC isolation	R&S RAM	0358.5414.02
Matched at one end, attenuation 1.7 dB	R&S RAZ	0358.5714.02
Bag (2 height units)	R&S ZZT-214	1109.5119.00



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