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R&S® SFE Broadcast Tester

Data sheet



ROHDE & SCHWARZ

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Introduction

The R&S®SFE is a multistandard-compatible broadcast signal generator that supports all common TV standards and a number of audio broadcasting standards. Whether analog or digital terrestrial TV, cable, satellite or mobile TV, digital and analog audio broadcasting – all these signals can be generated in realtime. For this purpose, the R&S®SFE combines a high-performance RF modulator, a universal realtime coder, and a baseband signal source in a single instrument.

Owing to its modular concept, the R&S®SFE can be optimally adapted to the specific conditions – e.g. with an integrated noise generator or a BER tester. By installing software options, the R&S®SFE can quickly and easily be expanded at a later time to include new modulation modes. This can be done on-site and without having to open the instrument.

The versatile baseband signal source for digital TV standards allows the generation of test signals from Rohde & Schwarz libraries and the replay of customer-specific transport streams. For analog TV, the R&S®SFE offers an integrated video/audio test signal generator. Alternatively, both transport streams and analog A/V signals can be fed in by external baseband generators. Irrespective of the realtime coders used, an ARB waveform generator can be used to generate any modulation signal needed and to replay waveform files of the customer.

The R&S®SFE is compact and space-saving in design. It offers the same convenient graphical user interface as the high-end R&S®SFU as well as comprehensive remote-control options.

Overview

- Broadcast multistandard platform
- Realtime signal generation for digital and analog transmission standards
- Wide frequency range with excellent signal quality
- Integrated transport stream player and video/audio generator
- Arbitrary waveform generator
- Integrated noise generator and BER tester
- Compact cabinet with convenient graphical user interface
- Digital I/Q input



Key features

Broadcast multistandard platform

- Digital terrestrial TV standards: DVB-T, ISDB-T, ISDB-T_B, ATSC/8VSB, DTMB (GB20600-2006)
- Cable TV standards: DVB-C/ISDB-C, J.83/B (up to 1024QAM)
- Satellite TV standards: DVB-S, DVB-S2, DirecTV
- Mobile TV standards: DVB-H, T-DMB, MediaFLO™, ISDB-T 1-segment (partial reception)
- Analog TV standards: B/G, D/K, M, N, I, I1, and L for the PAL, SECAM, and NTSC color systems
- Audio broadcasting standards: AM/FM/RDS, DAB, DRM, ISDB-Tsb
- Open for future standards

Realtime signal generation for digital and analog transmission standards

- Universal coder for realtime signal generation
- Settable modulation parameters
- Add-on of transmission standards as software options

Wide frequency range with excellent signal quality

- RF range 100 kHz to 2.5 GHz
- SSB phase noise (at f = 300 MHz) typ. -115 dBc at 20 kHz
- Signal level (PEP) -110 dBm to +15 dBm, 100 dB dynamic range

Integrated transport stream player and video/audio generator

- TS generator
- Transport stream libraries from Rohde & Schwarz
- Compatible with the R&S®DV-ASC Advanced Stream Combiner
- TRP player
- ATV video generator
- ATV video library from Rohde & Schwarz
- Audio generator

Arbitrary waveform generator

- 256 Msample memory
- Sample rate up to 100 Msample/s
- Waveform libraries from Rohde & Schwarz
- Compatible with R&S®WinIQSIM™

Integrated noise generator and BER tester

- Broadband AWGN generator
- BER measurement at transport stream level or bit level

Compact housing with convenient graphical user interface

- Housing: ½ 19" x 3 height units
- Large VGA color display with 640 x 480 pixels
- Intuitive user interface under Windows XP Embedded
- Context-sensitive Help system
- User-definable favorites for fast access
- Easy software updates via LAN or USB
- Remote control with Remote Desktop or VNC
- Remote control via LAN
- Command set compatible with the R&S®SFU



Specifications

Specifications apply under the following conditions: 60 minutes warm-up time at ambient temperature, specified environmental conditions met, calibration cycle adhered to, and all internal automatic adjustments performed. "Typical values" are designated with the abbreviation "typ." These values are verified during the final test but are not assured by Rohde & Schwarz. "Nominal values" are design parameters that are not assured by Rohde & Schwarz. These values are verified during product development but are not specifically tested during production.

Rohde & Schwarz equipment is designed for reliable operation up to an altitude of 2000 m above sea level, and for transport up to an altitude of 4500 m above sea level.

RF characteristics

Frequency

Range		100 kHz to 2.5 GHz
Uncertainty		depending on reference frequency
Resolution of setting		1 Hz

Reference frequency

Uncertainty		$<1 \times 10^{-6}$
Aging	after 14 days of uninterrupted operation	$<2.7 \times 10^{-9}/\text{day}$
Temperature effect	in operating temperature range 0 °C to +50 °C	$<6 \times 10^{-8}$
Input for external reference signal	frequency (sinewave) maximum deviation input level limits recommended input impedance connector	10 MHz 3×10^{-6} $\geq -5 \text{ dBm}$ to $\leq 19 \text{ dBm}$ 0 dBm to 19 dBm 50 Ω BNC female, rear
Output for internal reference signal	frequency (sinewave) level input impedance connector	10 MHz typ. +6 dBm, $\pm 3 \text{ dB}$ 50 Ω BNC female, rear, alternative to trigger OUT

Level

RF output connector	output impedance	N female, front 50 Ω
Maximum level	$f \leq 1 \text{ GHz}$ $1 \text{ GHz} < f \leq 2 \text{ GHz}$ $2 \text{ GHz} < f$	+15 dBm (PEP) ¹ +12 dBm (PEP) +10 dBm (PEP)
Setting range	resolution	-110 dBm to +20 dBm 0.1 dB
Dynamic range of attenuator		110 dB
Level uncertainty	"auto" attenuator mode, temperature range +18 °C to +33 °C	$<\pm 1.0 \text{ dB}$
Output VSWR in 50 Ω system	at maximum level at maximum level - 15 dB	<1.8 (typ. <1.5) <1.5 (typ. <1.3)
Uninterruptible level setting	"fixed" attenuator mode, setting range	18 dB
Back-feed (from $\geq 50 \Omega$ source)	maximum permissible RF power in output frequency range of RF path permissible DC voltage	+30 dBm, permanent $\pm 20 \text{ V}$

¹ PEP = peak envelope power (CW); for other modulation modes, depending on back-off.

Spectral purity

Harmonics	level ≤ 12 dBm, CW	< -30 dBc
Nonharmonics	level ≥ -20 dBm, CW, carrier frequency, carrier offset > 10 kHz 100 kHz to 87 MHz > 87 MHz to 1 GHz > 1 GHz to 2.5 GHz	reference: signal power < -50 dBc < -60 dBc < -50 dBc
Broadband noise	carrier offset > 10 MHz, measurement bandwidth 1 Hz $f > 87$ MHz $f \leq 87$ MHz	 < -135 dBc < -115 dBc
SSB phase noise	carrier offset 20 kHz, measurement bandwidth 1 Hz $f \leq 87$ MHz $87 \text{ MHz} < f < 375 \text{ MHz}$ $375 \text{ MHz} \leq f < 750 \text{ MHz}$ $750 \text{ MHz} \leq f < 1 \text{ GHz}$ $f > 1 \text{ GHz}$ carrier offset 500 kHz, measurement bandwidth 1 Hz $f \leq 87$ MHz $87 \text{ MHz} < f < 375 \text{ MHz}$ $375 \text{ MHz} \leq f < 750 \text{ MHz}$ $750 \text{ MHz} \leq f < 1 \text{ GHz}$ $f > 1 \text{ GHz}$	 < -100 dBc < -110 dBc < -100 dBc < -100 dBc < -95 dBc < -100 dBc < -130 dBc < -130 dBc < -120 dBc < -115 dBc

I/Q modulation

I/Q modulator

Modulation frequency range		DC to 35 MHz
Modulation frequency response ²	up to 35 MHz up to 5 MHz	$< \pm 2$ dB $< \pm 0.4$ dB
Carrier leakage	without input signal, referenced to full-scale input ³	< -55 dBc typ. < -65 dBc after local adjustment
Sideband suppression	modulation frequency ≤ 100 kHz, referenced to signal power	< -50 dBc typ. < -60 dBc after local adjustment
I/Q swap	I and Q signals swapped	ON, OFF

Internal baseband I/Q

Signal characteristics		see "Digital modulation systems"
D/A converter	sample rate resolution sampling rate	100 MHz 16 bit 400 MHz (internal interpolation $\times 4$)
Aliasing filter	with amplitudes, group delay, and Si correction bandwidth 0.1 dB	35 MHz

Extended I/Q input (R&S[®]SFE-K80 option)

The R&S[®]SFE-K80 option allows external digital signals to be fed into the baseband signal processing unit of the R&S[®]SFE. Noise signals can be superimposed on input signals if the noise option has been installed.

Digital I/Q input	connector level word width analog bandwidth symbol rate	mini D ribbon, 26 pins, rear LVDS 16 bit 0 Hz to 35 MHz 3 ksymbol/s to 100 Msymbol/s
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² This frequency response is superimposed on all frequency responses of this specification.

³ Value applies after 1 h warm-up time and recalibration for 4 h of operation as well as temperature variations of less than ± 5 °C.

Digital baseband

Internal test signals

MPEG-2 TS packet	header + 184 byte payload PID = 1FFF (hex)	payload: PRBS
MPEG-specific TS packet	sync byte + 187 byte payload	payload: PRBS
DirecTV TS packet	header + 127 byte payload	payload: PRBS
DirecTV TS packet without header	130 byte payload	payload: PRBS
PRBS	PRBS in line with ITU-T O.151	$2^{23} - 1$, $2^{15} - 1$ (selectable)

MPEG-2 inputs

ASI/SMPTE 310M/ETI serial input	connector ASI input level SMPTE 310M input level ETI input level input impedance ASI data rate SMPTE 310M data rate ETI data rate	BNC female, 2 × rear 200 mV to 880 mV 400 mV to 880 mV 0 V to ± 2.37 V (HDB3) 75 Ω 270 Mbit/s 19.392658 Mbit/s 2048 kbit/s
Stuffing	ASI, SMPTE 310M stuffing packets	ON/OFF see MPEG-2 TS packet under "Internal test signals"
Display	measured values	packet length, input data rate, useful data rate

TS generator (R&S®SFE-K20 option)

Transport stream	files file format length of transport stream packets sequence length data rate net data rate data volume	Rohde & Schwarz data streams generated transport streams (GTS) format ATSC: 188 DVB: 188 generation of endless and seamless transport streams with repetition of video, audio, and data contents 100 kbit/s to 214 Mbit/s (including null packets) max. 90 Mbit/s max. 80 Mbyte payload
Signal set		moving picture sequences and test patterns with test tones, for 625 and 525 lines; DVB/ATSC systems, additional signals via options

TRP player (R&S®SFE-K22 option)

Replay	file format length of transport stream packets replay time/sequence length data rate data volume	TRP, T10, BIN, DAB/DAB_C, FLO/FLO_C (any recorded data streams) corresponding to externally applied/recorded transport stream endless (but not seamless) replay with cut at transition from end of file to beginning of file corresponding to recording data rate and setting (100 kbit/s to max. 90 Mbit/s) from hard disk limited only by hard disk size
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Analog baseband

Analog video/audio input

Video input	connector CCVS input level input impedance level clamping	BNC female, rear $V_{pp} = 1 \text{ V}$ 75Ω back-porch clamping
Audio inputs 1/2	connector input level input impedance	D-Sub, 9-pin female, rear 100 mV to 1.55 V (V_{rms}) 600Ω , balanced
BTSC	connector input level input impedance	D-Sub, 9-pin female, rear 0.25 V to 2 V (V_{rms}) 75Ω

Internal audio signal generator

Audio signals	number of signals frequency level	2, can be set separately 30 Hz to 15 kHz, in 1 Hz steps -60 dBu to +12 dBu, in 0.01 dB steps, 6 dBu corresponds to standard deviation
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Internal NICAM audio signal generator

Audio signals	number of signals frequency level	2, can be set separately 30 Hz to 15 kHz, in 1 Hz steps -60 dBu to +12 dBu, in 0.01 dB steps, 6 dBu corresponds to standard headroom
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Internal video signal generator (R&S® SFE-K23 option)

Internal video generator		
Video signals	ATV video basic test signals	COLORBARS_75 (PAL) COLORBARS_75 (PAL M) COLORBARS_75 (PAL N) COLORBARS_75 (NTSC) COLORBARS_75 (SECAM) FUBK (PAL)
Insertion test signal structure	in line with country-specific standards	
PAL color bar 75 %	first field lines 8, 10 line 16 line 17 line 18 line 19 lines 20, 21 second field line 329 line 330 line 331 line 332 line 333 lines 334, 335	2T pulse data line 1 CCIR17 CCIR18/1 CCIR18/2 teletext insertion test signal data line 2 CCIR330/5 2T pulse CCIR331/1 sinx/x teletext insertion test signal
PAL M color bar 75 %	first field line 17 line 18 second field line 17 line 18	NTC7 composite FCC composite NTC7 combined sinx/x

PAL N color bar 75 %	first field lines 8, 10 line 16 line 17 line 18 line 19 lines 20, 21 second field line 329 line 330 line 331 line 332 line 333 lines 334, 335	2T pulse data line 1 CCIR17 CCIR18/1 CCIR18/2 teletext insertion test signal data line 2 CCIR330/5 2T pulse CCIR331/1 sinx/x teletext insertion test signal
NTSC color bar 75 %	first field line 17 line 18 second field line 17 line 18	NTC7 composite FCC composite NTC7 combined sinx/x
SECAM color bar 75 %	first field lines 7 to 15 line 16 line 17 line 18 line 19 lines 20, 21 second field lines 320 to 328 line 329 line 330 line 331 line 332 line 333 lines 334, 335	discriminating signal data line 1 CCIR17 CCIR18/1 CCIR18/2 teletext insertion test signal discriminating signal data line 2 CCIR330/5 2T pulse CCIR331/1 sinx/x teletext insertion test signal
PAL FuBK	first field lines 8, 10 line 16 line 17 line 18 line 19 lines 20, 21 second field line 329 line 330 line 331 line 332 line 333 lines 334, 335	2T pulse data line 1 CCIR17 CCIR18/1 CCIR18/2 teletext insertion test signal data line 2 CCIR330/5 2T pulse CCIR331/1 sinx/x teletext insertion test signal
Other video signals		see R&S® ATV Video

Digital modulation systems

DVB-T/H (R&S®SFE-K1 option)

DVB-T/H	in line with EN 300744/EN 302304	
Modulation	modulation bandwidth MER modulation frequency response shoulder distance back-off	COFDM 5 MHz, 6 MHz, 7 MHz, 8 MHz >40 dB ⁴ <±0.2 dB >48 dB 13.5 dB
Coding	constellation code rate guard interval FFT mode interleaver TPS	QPSK, 16QAM, 64QAM, hierarchical coding 1/2, 2/3, 3/4, 5/6, 7/8 1/4, 1/8, 1/16, 1/32 2k, 4k, and 8k COFDM native and in-depth in line with DVB-T/H
Special functions	Reed-Solomon encoder	can be switched off
Test signals		TS test packet (see "Internal test signals"), PRBS after convolutional encoder

DVB-C/ISDB-C (R&S®SFE-K2 option)

DVB-C	in line with ITU-T J.83/A (EN 300429)	
ISDB-C	in line with ITU-T J.83/C	
Modulation	modulation symbol rate pulse filtering MER modulation frequency response shoulder distance back-off	16QAM, 32QAM, 64QAM, 128QAM, 256QAM 1 Msymbol/s to 8 Msymbol/s, settable root raised cosine roll-off, alpha = 0.13, 0.15 >40 dB ±0.25 dB >48 dB 9 dB
Special functions	Reed-Solomon encoder	can be switched off
Test signals		TS test packet (see "Internal test signals"), PRBS before mapper

DVB-S/DVB-DSNG (R&S®SFE-K3 option)

DVB-S/DVB-DSNG	in line with EN 300421/EN 301210	
Modulation	modulation symbol rate pulse filtering MER modulation frequency response shoulder distance back-off	QPSK, 8PSK, 16QAM 100 ksymbol/s to 45 Msymbol/s, settable root raised cosine roll-off, alpha = 0.35, 0.25 38 dB (27.5 Msymbol/s) ±0.25 dB >45 dB 9 dB
Coding	code rate	QPSK: 1/2, 2/3, 3/4, 5/6, 7/8 8PSK: 2/3, 5/6, 8/9 16QAM: 3/4, 7/8
Special functions	Reed-Solomon encoder	can be switched off
Test signals		TS test packet (see "Internal test signals"), PRBS before convolutional encoder

⁴ With internal test signals.

DVB-S2 (R&S® SFE-K8 option)

DVB-S2	in line with EN 302307, broadcast services	
Modulation	modulation symbol rate QPSK, 8PSK 16APSK 32APSK pulse filtering MER modulation frequency response shoulder distance back-off	QPSK, 8PSK, 16APSK, 32APSK 1 Msymbol/s to 35 Msymbol/s (overrange 40 Msymbol/s) 2 Msymbol/s to 30 Msymbol/s 2 Msymbol/s to 25 Msymbol/s root raised cosine roll-off, alpha = 0.20 variable roll-off (0.15, 0.20, 0.25, 0.35) 38 dB (20 Msymbol/s) ±0.25 dB 45 dB 12 dB
Coding	code rate FEC frame pilot insertion	QPSK: 1/4, 1/3, 2/5, 1/2, 3/5, 2/3, 3/4, 4/5, 5/6, 8/9, 9/10 8PSK: 3/5, 2/3, 3/4, 5/6, 8/9, 9/10 16APSK: 2/3, 3/4, 4/5, 5/6, 8/9, 9/10 32APSK: 3/4, 4/5, 5/6, 8/9, 9/10 normal (64800 bit)/short (16200 bit) can be switched off
Special function	error insertion	after CRC-8, BCH, or LDPC
Test signals		TS test packet (see "Internal test signals")

T-DMB/DAB (R&S® SFE-K11 option)

T-DMB/DAB	in line with T-DMB/EN 300401	Korea/Europe
Modulation	modulation mode bandwidth modulation frequency response shoulder distance back-off	COFDM I, II, III, IV 1.536 MHz <0.2 dB >45 dB 13 dB
Single-frequency network	network mode control	MFN MID, manual
Special function	PRBS	can be inserted into a subchannel ⁵

ATSC/8VSB (R&S® SFE-K4 option)

ATSC/8VSB	in line with ATSC Doc. A/53 (8VSB)	
Modulation	modulation bandwidth symbol rate range pilot pulse filtering MER modulation frequency response shoulder distance back-off	8VSB 6 MHz 10.762 Msymbol/s settable ±5 % 1.25 root raised cosine roll-off, alpha = 0.115 >40 dB <±0.25 dB >45 dB 9 dB
Coding	input data rate range	19.392658 Mbit/s ±5 % (depending on symbol rate)
Test signals		TS test packet (see "Internal test signals")

⁵ Can be inserted into an existing, user-selectable subchannel of an incoming, valid ETI data stream.

J.83/B (R&S® SFE-K5 option)

J.83/B	in line with ITU-T J.83/B	
Modulation	modulation bandwidth symbol rate 64QAM 256QAM 1024QAM pulse filtering MER modulation frequency response shoulder distance 64QAM 256QAM 1024QAM back-off	64QAM, 256QAM, 1024QAM 6 MHz 5.0569 Msymbol/s 5.3605 Msymbol/s 5.3605 Msymbol/s root raised cosine roll-off, alpha = 0.18 (64QAM), 0.12 (256/1024QAM) >40 dB ±0.25 dB > 50 dB >45 dB >45 dB 9 dB
Coding	input data rate 64QAM 256QAM 1024QAM data interleaver	26.97035 Mbit/s 38.81070 Mbit/s 49.02525 Mbit/s level 1 and level 2
Special functions	Reed-Solomon encoder	can be switched off
Test signals		TS test packet (see "Internal test signals"), PRBS before mapper

DirecTV legacy modulation (R&S® SFE-K9 option)

DirecTV legacy modulation	in line with DirecTV transmission specifications	
Modulation	modulation symbol rate overrange pulse filtering MER modulation frequency response shoulder distance back-off	QPSK 20 Msymbol/s 1 Msymbol/s to 30 Msymbol/s root raised cosine roll-off, alpha = 0.20 variable roll-off (0.15, 0.20, 0.25, 0.35) 38 dB (20 Msymbol/s) <±0.25 dB 45 dB 11.5 dB
Coding	code rate	1/2, 2/3, 6/7
Special functions	customer-specific DirecTV streams error insertion	can be replayed in 188-byte format, requires R&S® SFE-K22 option after convolutional encoder
Test signals		TS test packet (see "Internal test signals")

DTMB (R&S® SFE-K12 option)

DTMB	in line with GB20600-2006	
Modulation	modulation bandwidth modulation frequency response shoulder distance back-off	COFDM/single carrier 6 MHz, 7 MHz, 8 MHz <0.2 dB >50 dB 12 dB
Coding	constellation code rate guard interval guard interval pn time interleaver FFT mode dual pilot tone	4QAM(QPSK), 4QAM-NR, 16QAM, 32QAM, 64QAM 0.4, 0.6, 0.8 420, 595, 945 symbols variable/constant 240, 720 symbols 4k COFDM/single carrier ON/OFF (single carrier)
Network mode		MFN
Special functions	DMB-TH mode	selectable
Test signals		TS test packet (see "Internal test signals")

ISDB-T/ISDB-Tsb/ISDB-T_B (R&S® SFE-K6 option)

ISDB-T, ISDTV	in line with ARIB STD-B31 version 1.5	
ISDB-Tsb	in line with ARIB STD-B29 ISDB-Tsb	
ISDB-T _B	Brazil	
Modulation	modulation bandwidth number of segments STD-B31 STD-B29 MER modulation frequency response shoulder distance back-off	OFDM 6 MHz (variable: ±1000 ppm) 13 1, 3 >40 dB <0.2 dB >48 dB 13 dB
Coding	FFT mode number of layers constellation code rate guard interval time interleaver	2k, 4k, and 8k 1 to 3 (1 or 2 in line with ISDB-Tsb) QPSK, DQPSK, 16QAM, 64QAM 1/2, 2/3, 3/4, 5/6, 7/8 1/4, 1/8, 1/16, 1/32 0, 1, 2, 4, 8, 16 (additionally 32 with ISDB-Tsb)
Special function	AC information	PRBS, all "1"
Test signals		TS test packet (see "Internal test signals")

MediaFLO™ (R&S® SFE-K10 option)

MediaFLO™	in line with QUALCOMM 80-T0455-1 Rev. E	
Modulation	modulation bandwidth modulation frequency response shoulder distance back-off	COFDM 5 MHz, 6 MHz, 7 MHz, 8 MHz <0.2 dB 40 dB 15.5 dB
Coding	FFT mode	4k COFDM
Test signals		PRBS

Analog modulation systems

AM/FM/RDS (R&S® SFE-K170 option)

FM		
Audio signals	internal external	see "Internal audio signal generator" see "Analog video/audio input"
	AF frequency range AF frequency response rejection at 19 kHz	30 Hz to 15 kHz <0.2 dB >70 dB
Preemphasis		OFF, 50 µs, 75 µs
Incidental AM	at AF = 1 kHz, deviation ±50 kHz	<0.1 %
FM stereo		
Stereo modes		L, R, L = R, L = -R, L ≠ R internal generation of RDS signal, simultaneous generation of MPX and RDS signals possible
MPX frequency deviation	deviation resolution	0 Hz to ±100 kHz 10 Hz
Stereo crosstalk attenuation	at AF = 30 Hz to 15 kHz	>50 dB
Distortion	at 60 kHz audio frequency deviation, AF = 1 kHz	<0.1 %
S/N ratio (stereo/RDS signal) ⁶	at ±40 kHz audio frequency deviation ITU-R weighted (quasi-peak) ITU-R unweighted (rms)	>64 dB >70 dB
Pilot tone	frequency deviation resolution phase resolution	19 kHz ±1 Hz 0 Hz to ±15 kHz 10 Hz 0° to ± 180° 0.1°
RDS	subcarrier frequency deviation resolution	57 kHz ±3 Hz 0 Hz to ±10 kHz 10 Hz
FM mono		
Mono frequency deviation	deviation resolution	0 Hz to ±100 kHz 10 Hz
Distortion ⁷	at ±67.5 kHz audio frequency deviation, AF = 1 kHz	<0.1 %
AM		
Audio signals	internal external	see "Internal audio signal generator" see "Analog video/audio input"
	AF frequency range AF frequency response rejection at 3.15 kHz	30 Hz to 2.25 kHz <0.2 dB >35 dB
Modulation	modulation depth resolution	0 % to 100 % 1 %
AM distortion	at AF = 1 kHz m = 30 % m = 80 %	<0.2 % <0.2 %

⁶ Generator without preemphasis, receiver with deemphasis.

⁷ Generator and receiver without preemphasis/deemphasis.

Standard B/G (R&S®SFE-K190 option)

Standard B/G	in line with country-specific standard	
Vision modulation	modulation group delay precorrection frequency response vestigial sideband filtering amplitude frequency response signal-to-noise ratio video back-off	B/G CCIR – B/G general half (can be switched off) <20 ns (with/without vestigial sideband filtering) B/G, can be switched off <0.5 dB (–0.6 MHz to +4.8 MHz) (with/without vestigial sideband filtering) >60 dB, weighted 6 dB
Sound modulation	operating mode modulation of sound carrier 1, 2 modulation mode frequency deviation preemphasis vision/sound intercarrier frequency vision/sound carrier power ratio pilot tone signal-to-noise ratio sound	mono, stereo, dual tone, NICAM, mono/NICAM FM 30 kHz (settable) 50 µs/75 µs (can be switched off) 5.5 MHz/5.742 MHz (settable) 13 dB/20 dB (settable) in sound carrier 2 (can be switched off) >60 dB, weighted (CCIR)
Video signals	internal video signal generator external video input	see R&S®SFE-K23 see "Analog video/audio input"
Audio signals	internal audio generator external audio input	see "Internal audio signal generator" see "Internal NICAM audio signal generator" see "Analog video/audio input"

Standard D/K (R&S®SFE-K191 option)

Standard D/K	in line with country-specific standard	
Vision modulation	modulation group delay precorrection frequency response vestigial sideband filtering amplitude frequency response signal-to-noise ratio video back-off	D/K OIRT – D/K half (can be switched off) <20 ns (with/without vestigial sideband filtering) DK, DK-FM2, DK-NICAM, can be switched off <0.5 dB (–1 MHz to +5.8 MHz) (with/without vestigial sideband filtering) >60 dB, weighted 6 dB
Sound modulation	operating mode modulation of sound carrier 1, 2 modulation mode frequency deviation preemphasis vision/sound intercarrier frequency vision/sound carrier power ratio pilot tone signal-to-noise ratio sound	mono, stereo, dual tone, NICAM, mono/NICAM FM 30 kHz (settable) 50 µs/75 µs (can be switched off) 6.5 MHz/6.742 MHz (settable) 13 dB/20 dB (settable) in sound carrier 2 (can be switched off) >60 dB, weighted (CCIR)
Video signals	internal video signal generator external video input	see R&S®SFE-K23 see "Analog video/audio input"
Audio signals	internal audio generator external audio input	see "Internal audio signal generator" see "Internal NICAM audio signal generator" see "Analog video/audio input"

Standard I (R&S® SFE-K192 option)

Standard I	in line with country-specific standard	
Vision modulation	modulation group delay precorrection frequency response vestigial sideband filtering amplitude frequency response signal-to-noise ratio video back-off	I UK – I (can be switched off) <20 ns (with/without vestigial sideband filtering) I, I1, can be switched off <0.5 dB (–1 MHz to +4.8 MHz) (with/without vestigial sideband filtering) >60 dB, weighted 6 dB
Sound modulation	operating mode modulation of sound carrier 1 modulation mode frequency deviation preemphasis vision/sound intercarrier frequency vision/sound carrier power ratio modulation of sound carrier 2 modulation mode vision/sound intercarrier frequency vision/sound carrier power ratio signal-to-noise ratio sound	mono, NICAM, mono/NICAM FM 30 kHz (settable) 50 µs/75 µs (can be switched off) 6 MHz (settable) 13 dB (settable) NICAM 6.552 MHz (settable) 20 dB (settable) >60 dB, weighted (CCIR)
Video signals	internal video signal generator external video input	see R&S® SFE-K23 see "Analog video/audio input"
Audio signals	internal audio generator external audio input	see "Internal audio signal generator" see "Internal NICAM audio signal generator" see "Analog video/audio input"

Standard M/N (R&S® SFE-K193 option)

Standard M/N	in line with country-specific standard	
Vision modulation	modulation group delay precorrection frequency response vestigial sideband filtering amplitude frequency response signal-to-noise ratio video back-off	M/N FCC – M/N (can be switched off) <20 ns (with/without vestigial sideband filtering) M, N, can be switched off <0.5 dB (–0.6 MHz to +4 MHz) (with/without vestigial sideband filtering) >60 dB, weighted 6 dB
Sound modulation	operating mode modulation of sound carrier 1, 2 modulation mode frequency deviation preemphasis vision/sound intercarrier frequency vision/sound carrier power ratio pilot tone signal-to-noise ratio sound	BTSC mono, stereo Korea, dual Korea FM 25 kHz (settable) 50 µs/75 µs (can be switched off) 4.5 MHz/4.742 MHz (settable) 13 dB/20 dB (settable) in sound carrier 2 (can be switched off) >60 dB, weighted (CCIR)
Video signals	internal video signal generator external video input	see R&S® SFE-K23 see "Analog video/audio input"
Audio signals	internal audio generator external audio input	see "Internal audio signal generator" see "Analog video/audio input"

Standard L (R&S®SFE-K194 option)

Standard L	in line with country-specific standard	
Vision modulation	modulation group delay precorrection frequency response vestigial sideband filtering amplitude frequency response back-off	L TDF – L (can be switched off) <20 ns (with/without vestigial sideband filtering) L, L NICAM, can be switched off <0.5 dB (–1 MHz to +5.8 MHz) (with/without vestigial sideband filtering) 6 dB
Sound modulation	operating mode modulation of sound carrier 1 modulation mode vision/sound intercarrier frequency vision/sound carrier power ratio modulation of sound carrier 2 modulation mode frequency deviation vision/sound intercarrier frequency vision/sound carrier power ratio	mono, NICAM, mono/NICAM NICAM 5.85 MHz (settable) 27 dB (settable) AM modulation depth 54 % (settable) 6.5 MHz (settable) 10 dB (settable)
Video signals	internal video signal generator external video input	see R&S®SFE-K23 see “Analog video/audio input”
Audio signals	internal audio generator external audio input	see “Internal audio signal generator” see “Internal NICAM audio signal generator” see “Analog video/audio input”

ATV multistandard (R&S®SFE-K195 option)

Standard B/G		see R&S®SFE-K190
Standard D/K		see R&S®SFE-K191
Standard I		see R&S®SFE-K192
Standard M/N		see R&S®SFE-K193
Standard L		see R&S®SFE-K194

Internal NICAM encoder

Included in the following options: R&S®SFE-K190, R&S®SFE-K191, R&S®SFE-K192, R&S®SFE-K194, and R&S®SFE-K195.

Audio coding	internal audio generator external audio input operating mode preemphasis headroom (400 Hz)	see “Internal NICAM audio signal generator” see “Analog video/audio input” mono, stereo, dual tone J.17, can be switched off –6 dB to +6 dB, can be set different from the standard
Encoder	data pulse filtering	audio coding, NICAM728 data input, PRBS, NICAM audio generator root raised cosine roll-off, alpha = 0.40 (B/G, D/K, L standards) alpha = 1.00 (I standard)
NICAM728 data input	connector input level input impedance	D-Sub, 9-pin female, rear 1 V to 10 V (V _{pp}) 50 Ω

ARB/waveforms

Arbitrary waveform generator (R&S®SFE-K35 option)

Waveform memory	length resolution loading time for 10 Msample memory location for data	512 sample to 256 Msample in one-sample steps 2 × 16 bit 3 s hard disk
Clock generation	clock rate uncertainty operating mode frequency accuracy (internal)	400 Hz to 100 MHz 0.001 Hz internal accuracy of reference frequency
Interpolation	bandwidth with clock rate = 100 MHz (no interpolation), bandwidth 0.1 dB with clock rate <100 MHz, bandwidth -0.1 dB sampling rate	40 MHz 0.31 × clock rate automatically interpolated to the internal 100 MHz data rate
Triggering	modes source delay inhibit	auto retrigger armed auto armed retrigger internal external 0 to 2 ³² - 1 sample, settable 0 to 2 ³² - 1 sample, settable
Markers	item delay	restart waveform 0 to waveform length, settable in samples
Special function		can be used together with R&S®WinIQSIM™ ⁸ (R&S®SFE-K350 option)

R&S®SFE-K35 supports the same waveform libraries as the ARB generator of the R&S®SFU.

T-DMB/DAB waveforms (R&S®SFU-K351 option).

For specifications, see R&S®SFU.

DVB-H waveforms (R&S®SFU-K352 option).

For specifications, see R&S®SFU.

DRM waveforms (R&S®SFU-K353 option).

For specifications, see R&S®SFU.

DTV interferers (R&S®SFU-K354 option).⁹

For specifications, see R&S®SFU.

MediaFlo™ waveforms (R&S®SFU-K355 option).

For specifications, see R&S®SFU.

Cable interferers (R&S®SFU-K356 option).⁹

For specifications, see R&S®SFU.

⁸ With R&S®WinIQSIM™: Software version 4.24 or later supports I/Q data download and R&S®SFE-K35 control.

⁹ Realtime signals and interferer signals cannot be used at the same time.

Simulation

AWGN generator (R&S® SFE-K40 option)

RF bandwidth	3 dB spectrum (AWGN)	96 MHz
Noise	density distribution function crest factor	Gaussian, statistical, separate for I and Q 18 dB
C/N	setting range resolution uncertainty for system bandwidth = symbol rate and C/N < 20 dB	-6 dB to +60 dB 0.1 dB <0.2 dB
System bandwidth	(bandwidth for calculating noise power) range	100 kHz to 96 MHz

Analysis

BER measurements (R&S® SFE-K60 option)

BER measurements	for all digital modulation modes	
Display	measured value	BER error counter measurement time
Start/restart		manual
Serial PRBS measurements		
Serial BER measurement is not possible with DVB-S2, DirecTV, DTMB, and MediaFLO™.		
Inputs for BER clock, BER data, BER enable	connector input impedance input level	BNC female, rear 50 Ω TTL/LVTTL
BER data	input data rate PRBS	up to 90 Mbit/s $2^{23} - 1$, $2^{15} - 1$ (in line with ITU-T O.151)
BER clock, BER data	polarity	normal, inverted
BER enable	polarity	always, active high, active low
Output for BER error	connector output impedance output level	BNC female, rear 50 Ω LVTTTL
MPEG-2 TS measurements		
Input	input interfaces input signal payload (PRBS in line with ITU-T O.151) PID	ASI, SMPTE 310M (see "MPEG-2 inputs") TS packet (see "Internal test signals") $2^{23} - 1$, $2^{15} - 1$ NULL (1FFF (hex))/variable

Trigger inputs/outputs

Triggers and connectors for future use

Trigger IN	connector input impedance input level	BNC female, rear high impedance LVTTTL
Trigger OUT	connector load impedance output level	BNC female, rear, alternative to reference OUT >200 Ω LVTTTL
1PPS input	connector input impedance input level	BNC female, rear high impedance LVTTTL

General data

System data

System	operating system	PC platform Windows XP Embedded 40 Gbyte internal hard disk
Local control	display control	VGA 640 × 480 pixels rotary knob, hardkeys, softkeys
External control	control	external mouse and keyboard via USB
Remote control	command set Ethernet USB	SCPI 1999.5 10/100BaseT 2.0
Connectors	Ethernet USB AC supply input	RJ-45, rear USB, front and rear IEC 60320 C14, rear

Operating data

Power supply	input voltage range, AC supply frequency	100 V to 240 V ±10 % 50 Hz to 60 Hz ±5 % 1.8 A to 0.8 A
Electromagnetic compatibility	power factor correction	in line with EN 55011 class A, EN 61326 in line with EN 61000-3-2
Immunity against RF fields		up to 10 V/m
Environmental conditions	operating temperature range storage temperature range climatic resistance, cyclic test at +25 °C/+40 °C	+5 °C to +45 °C ¹⁰ in line with EN 60068-2-1, EN 60068-2-2 –20 °C to +60 °C 85 % rel. humidity
Mechanical resistance	vibration, sinusoidal vibration, random shock	5 Hz to 150 Hz, max. 2 g at 55 Hz, 55 Hz to 150 Hz, 0.5 g constant, in line with EN 60068-2-6 10 Hz to 300 Hz, acceleration 1.2 g (rms), in line with EN 60068-2-64 40 g shock spectrum, in line with EN 60068-2-27, MIL-STD-810E
Electrical safety		in line with IEC 61010-1, EN 61010-1 and UL 61010-1, CSA C22.2 No. 61010-1
Dimensions	W × H × D	235 mm × 155 mm × 465 mm (3 HU) (9.25 in × 6.11 in × 18.3 in)
Weight	fully equipped	6 kg (13.28 lb)
Recommended calibration interval		3 years
Standard warranty period		1 year

¹⁰ Reduced LCD brightness at higher operating temperatures.

Ordering information

Option identification: R&S®SFE-Bxy = hardware option, R&S®SFE-Kxy = software option.
 Delivery of R&S®SFE base unit only with at least one modulation system (max. 3).

Order designation	Type	Order No.
Broadcast Tester including power cable, Quick Start Guide, CD-ROM (includes operating manuals)	R&S®SFE	2112.4300.02
Options		
Digital modulation systems		
DVB-T/H Coder	R&S®SFE-K1	2113.4010.02
DVB-C/ISDB-C Coder	R&S®SFE-K2	2113.4032.02
DVB-S/DVB-DSNG Coder	R&S®SFE-K3	2113.4055.02
DVB-S2 Coder	R&S®SFE-K8	2113.4132.02
ATSC/8VSB Coder	R&S®SFE-K4	2113.4078.02
J.83/B Coder	R&S®SFE-K5	2113.4090.02
ISDB-T/ISDB-Tsb/ISDB-T _B Coder	R&S®SFE-K6	2113.4110.02
MediaFLO™ Coder	R&S®SFE-K10	2113.4178.02
T-DMB/DAB Coder	R&S®SFE-K11	2113.4190.02
DTMB / DMB-TH Coder	R&S®SFE-K12	2113.4210.02
DirecTV Legacy Modulation Coder	R&S®SFE-K9	2113.4155.02
Analog modulation systems		
AM/FM/RDS Coder	R&S®SFE-K170	2113.4432.02
ATV Standard B/G Coder	R&S®SFE-K190	2113.4655.02
ATV Standard D/K Coder	R&S®SFE-K191	2113.4678.02
ATV Standard I Coder	R&S®SFE-K192	2113.4690.02
ATV Standard M/N Coder	R&S®SFE-K193	2113.4710.02
ATV Standard L Coder	R&S®SFE-K194	2113.4732.02
ATV Multistandard	R&S®SFE-K195	2113.4755.02
ARB/waveforms		
ARB Waveform Generator requires an installed R&S®SFE-B3 option	R&S®SFE-K35	2113.4932.02
Memory Expansion	R&S®SFE-B3	2112.4500.02
R&S®WinIQSIM™ Support	R&S®SFE-K350	2113.4955.02
T-DMB/DAB Waveforms can be used with the R&S®SFE-K35 option	R&S®SFU-K351	2110.4277.04
DVB-H Waveforms can be used with the R&S®SFE-K35 option	R&S®SFU-K352	2110.4425.02
DRM Waveforms can be used with the R&S®SFE-K35 option	R&S®SFU-K353	2110.4554.02
DTV Waveforms can be used with the R&S®SFE-K35 option	R&S®SFU-K354	2110.4690.02
MediaFLO™ Waveforms can be used with the R&S®SFE-K35 option	R&S®SFU-K355	2110.2974.02
Cable Interferers can be used with the R&S®SFE-K35 option	R&S®SFU-K356	2110.3212.02
Simulation		
AWGN Generator	R&S®SFE-K40	2113.4910.02

Baseband inputs/outputs		
Extended I/Q Input	R&S®SFE-K80	2113.5251.02
Digital baseband		
TS Generator including SDTV streams	R&S®SFE-K20	2113.4878.02
DVB-H Stream Library requires the R&S®SFE-K20 option	R&S®DV-DVBH	2085.8704.02
Test Card M Streams requires the R&S®SFE-K20 option	R&S®DV-TCM	2085.7708.02
HDTV Sequences requires the R&S®SFE-K20 option	R&S®DV-HDTV	2085.7650.02
H.264 Stream Library requires the R&S®SFE-K20 option	R&S®DV-H264	2085.9052.02
ISDB-T Stream Library requires the R&S®SFE-K20 option	R&S®DV-ISDBT	2085.9146.02
TRP Player requires an installed R&S®SFE-B6 option	R&S®SFE-K22	2113.5274.02
Second Hard Disk (Compact Flash)	R&S®SFE-B6	2112.4522.02
T-DMB/DAB Streams requires the R&S®SFE-K22 option	R&S®SFU-K221	2113.4348.02
MediaFLO™ Streams requires the R&S®SFE-K22 option	R&S®SFU-K222	2110.2968.02
Analog baseband		
Video Generator	R&S®SFE-K23	2113.4890.02
ATV Video Signals	R&S®ATV Video	2110.4831.02
Measurement and analysis		
BER Measurement possible for DVB-S2, DirectTV, DTMB, and MediaFLO™ to a limited extent or not possible at all	R&S®SFE-K60	2113.5151.02
Recommended extras		
Operating manuals; include Quick Start Guide (English)		2112.4322.12
Documentation of R&S®SFE Calibration Values	R&S®SFE-DCV	2082.0490.32
Keyboard with USB Interface (US assignment)	R&S®PSL-Z2	1157.6870.03
Mouse with USB Interface, optical	R&S®PSL-Z10	1157.7060.02
External USB CD-RW Drive	R&S®PSP-B6	1134.8201.12
19" Rackmount Kit for R&S®SFE and second instrument	R&S®ZZA-T33	1109.4458.00
19" Rackmount Kit for R&S®SFE and cover	R&S®ZZA-T34	1109.4464.00
LVDS cable for digital I/Q interface, length 2 m		1130.1302.00
Service options (can only be ordered in connection with the purchase of an instrument)		
One-Year Repair Service following the warranty period	R&S®RO2SFE	please contact your local sales office
Two-Year Repair Service following the warranty period	R&S®RO3SFE	please contact your local sales office
Four-Year Repair Service following the warranty period	R&S®RO5SFE	please contact your local sales office
Two-Year Calibration Service	R&S®CO2SFE	please contact your local sales office
Three-Year Calibration Service	R&S®CO3SFE	please contact your local sales office
Five-Year Calibration Service	R&S®CO5SFE	please contact your local sales office



For product brochure, see PD 5213.8596.12
and www.rohde-schwarz.com
(search term: SFE)



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