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R&S®SFE100 Test Transmitter

Data sheet

ROHDE&SCHWARZ

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Introduction

The R&S®SFE100 is a single-standard test transmitter with realtime coding for broadcast signals. R&S®SFE100 models are available for all common TV standards and a number of sound broadcasting standards.

The R&S®SFE100 is a compact and reliable instrument that can be equipped with a power amplifier unique in this class, making it ideal for use in production test systems. Plus, it can be used as a simple and economical signal generator as well as for special applications as a second RF channel for the R&S®SFU.

Every R&S®SFE100 model can be equipped with the appropriate digital or analog baseband signal source with which test signals from Rohde & Schwarz libraries or customer-specific test signals can be replayed. The R&S®SFE100 thus combines two functions in one box, thereby significantly simplifying complex production test systems.

The R&S®SFE100 model with an arbitrary waveform generator enables you to generate modulation signals of any type and to replay customer-specific waveform files, irrespective of the available realtime coder models.

Occupying only one height unit, the R&S®SFE100 is extremely compact. Nevertheless, all functions can be selected locally on the instrument. Alternatively, the R&S®SFE100 can be remote-operated from a PC. In this case, operation is performed using the same convenient graphical user interface as for the R&S®SFE and R&S®SFU.

Overview

- Single-standard signal generator with realtime coding
- Models for all common digital and analog broadcasting standards
- Model with arbitrary waveform generator
- Wide frequency range with very good signal quality
- Integrated power amplifier for high output levels
- Integrated transport stream player or audio/video generator
- Convenient control elements and remote operation

Main features

Single-standard signal generator with realtime coding

- Coder for realtime signal generation
- Adjustable modulation parameters

Models for all common digital and analog broadcasting standards

- Terrestrial digital TV: DVB-T, DTMB, ATSC/8VSB, ISDB-T, ISDB-T_B
- Cable TV: DVB-C, J.83/B, ISDB-C
- Satellite TV: DVB-S/DSNG, DVB-S2, DirecTV
- Mobile TV: DVB-H, T-DMB, ISDB-T 1-segment, MediaFLO™, ATSC/AVSB
- Analog TV: B/G, D/K, I, M/N, L
- Sound broadcasting: DAB, ISDB-Tsb, DRM (as ARB waveform), AM/FM/RDS

Wide frequency range with very good signal quality in this class

- Frequency range 100 kHz to 2.5 GHz
- SSB phase noise at 300 MHz typ. <–115 dBc at 20 kHz carrier offset
- MER typ. >40 dB

Integrated power amplifier for high output levels

- Maximum output power +27 dBm (bands I to V)
- –37 dB to 0 dB attenuation, adjustable
- RF monitor output with 50 dB attenuation
- Signal level –110 dBm to +15 dBm CW without power amplifier

Integrated transport stream player or audio/video generator

- TS generator (R&S®SFE100-K20)
- Transport stream libraries from Rohde & Schwarz
- Compatible with the R&S®DV-ASC Advanced Stream Combiner from Rohde & Schwarz
- TRP player (R&S®SFE100-K22)
- ATV video generator (R&S®SFE100-K23)
- ATV video library from Rohde & Schwarz
- Audio generator

Model with arbitrary waveform generator

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

Convenient control elements and remote operation

- Keypad and display on front panel
- Remote control via LAN
- Remote-control commands compatible with those of the R&S®SFU and R&S®SFE
- Remote operation with Remote Desktop or VNC
- Easy software updates via USB 2.0 or LAN

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	$<2.7 \times 10^{-9}$/day
Temperature effect	in operating temperature range 0 °C to +50 °C	 $<6 \times 10^{-8}$
Input for external reference signal	frequency (sinewave)	10 MHz
	maximum deviation	3×10^{-6}
	input level	≥–5 dBm to ≤19 dBm
	limits recommended	0 dBm to 19 dBm
	input impedance	50 Ω/high-impedance, settable
	connector	BNC female, rear
Output for internal reference signal	frequency (sinewave)	10 MHz
	level	typ. +6 dBm, ±3 dB
	load impedance	>200 Ω
	connector	9-pin D-Sub female on rear panel, BNC female on rear panel (on request), alternatively trigger OUT

Level

RF output	connector	N female, front
	output impedance	50 Ω
Maximum level	f ≤ 1 GHz	+15 dBm (PEP) [1]
	1 GHz < f ≤ 2 GHz	+12 dBm (PEP)
	2 GHz < f	+10 dBm (PEP)
Setting range	level 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	 <±1.0 dB
Output matching VSWR in 50 Ω system	at maximum level	<1.8 (typ. <1.5)
	at maximum level – 15 dB	<1.5 (typ. <1.3)
Uninterruptible level setting	“fixed“ attenuator mode, setting range	 18 dB
Back-feed (from ≥50 Ω source)	maximum permissible RF power in output frequency range of RF path	 +30 dBm, permanent
	permissible DC voltage	±20 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	 reference: signal power
	100 kHz to 87 MHz	<–50 dBc
	>87 MHz to 1 GHz	<–60 dBc
	>1 GHz to 2.5 GHz	<–50 dBc
Broadband noise	carrier offset >10 MHz, measurement bandwidth 1 Hz	
	f > 87 MHz	<–135 dBc
	f ≤ 87 MHz	<–115 dBc
SSB phase noise	carrier offset 20 kHz, measurement bandwidth 1 Hz	
	f ≤ 87 MHz	<–100 dBc
	87 MHz < f < 375 MHz	<–110 dBc
	375 MHz ≤ f < 750 MHz	<–100 dBc
	750 MHz ≤ f < 1 GHz	<–100 dBc
	f > 1 GHz	<–95 dBc
	carrier offset 500 kHz, measurement bandwidth 1 Hz	
	f ≤ 87 MHz	<–100 dBc
	87 MHz < f < 375 MHz	<–130 dBc
	375 MHz ≤ f < 750 MHz	<–130 dBc
	750 MHz ≤ f < 1 GHz	<–120 dBc
	f > 1 GHz	<–115 dBc

RF characteristics with the R&S®SFE100-B90 option (power amplifier)

Frequency

Range		47 MHz to 862 MHz

Level

RF output	connector	N female, rear
	output impedance	50 Ω
Maximum level		≥+27 dBm (rms)
Setting range	level	–10 dBm to +30 dBm (rms)
	resolution	0.1 dB
Level uncertainty	"auto" attenuator mode, temperature range +18 °C to +33 °C	 <±1.5 dB
VSWR tolerance	in output frequency range	max. 10:1
	maximum permissible DC voltage	0 V
Linearity	shoulder distance in digital modulation systems level +27 dBm	typ. 40 dB (DVB-T)

Spectral purity

Harmonics	level ≤12 dBm, CW	<–30 dBc
	level ≤27 dBm	<–20 dBc

RF monitor output [2]

RF monitor output	connector	BNC female, front
	output impedance	50 Ω
Level	level ratio to RF output on rear panel	–50 dB ±5 dB
Back-feed (from ≥50 Ω source)	maximum permissible RF power in output frequency range of RF path	 0 dBm, permanent
	permissible DC voltage	0 V

[2] The amplifier input signal can be checked at the monitor output.

I/Q modulation

I/Q modulator

Modulation frequency range		DC to 35 MHz
Modulation frequency response [3]	up to 35 MHz up to 5 MHz	<±2 dB <±0.4 dB
Carrier leakage	without input signal, referenced to full-scale input [4]	<–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	100 MHz
	resolution	16 bit
	sampling rate	400 MHz (internal interpolation × 4)
Aliasing filter	with amplitudes, group delay, and Si correction	
	bandwidth 0.1 dB	35 MHz

Extended I/Q input (R&S®SFE100-K80 option)

The R&S®SFE100-K80 option allows external digital signals to be fed into the baseband signal processing of the R&S®SFE100.

Digital I/Q input	connector	mini D ribbon, 26 pins, rear
	level	LVDS
	word width	16 bit
	analog bandwidth	0 Hz to 35 MHz
	symbol rate	3 ksymbol/s to 100 Msymbol/s

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/SMPTE310M/ETI serial input	connector	BNC female, 2 × rear
	ASI input level	200 mV to 880 mV
	SMPTE310M input level	400 mV to 880 mV
	ETI input level	0 V to ±2.37 V (HDB3)
	input impedance	75 Ω
	ASI data rate	270 Mbit/s
	SMPTE310M data rate	19.392658 Mbit/s
	ETI data rate	2048 kbit/s
Stuffing	ASI, SMPTE310M	ON/OFF
	stuffing packets	see MPEG-2 TS packets under ″Internal test signals″
Display	measured values	packet length, input data rate, useful data rate

[3] This frequency response is superimposed on all frequency responses of this specification.

[4] 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.

TS generator (R&S®SFE100-K20 option)

Transport stream	files	Rohde & Schwarz data streams
	file format	generated transport streams (GTS) format
	length of transport stream packets	ATSC: 188 DVB: 188
	sequence length	generation of endless and seamless transport streams with repetition of video, audio, and data contents
	data rate	100 kbit/s to 214 Mbit/s (including null packets)
	net data rate	max. 90 Mbit/s
	data volume	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®SFE100-K22 option)

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

Analog baseband

Analog video/audio input

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

Internal audio signal generator

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

Internal NICAM audio signal generator

Audio signals	number of signals	2, can be set separately
	frequency	30 Hz to 15 kHz, in 1 Hz steps
	level	–60 dBu to +12 dBu, in 0.01 dB steps, 6 dBu corresponds to standard headroom

Internal video signal generator (R&S®SFE100-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

One digital/analog modulation method or the ARB option can be activated.

DVB-T/H (R&S®SFE100-K1 option)

DVB-T/H	in line with EN 300744/EN 302304	
Modulation	modulation	COFDM
	bandwidth	5 MHz, 6 MHz, 7 MHz, 8 MHz
	MER	>40 dB [5]
	modulation frequency response	<±0.2 dB
	shoulder distance	>48 dB
	back-off	13.5 dB
Coding	constellation	QPSK, 16QAM, 64QAM, hierarchical coding
	code rate	1/2, 2/3, 3/4, 5/6, 7/8
	guard interval	1/4, 1/8, 1/16, 1/32
	FFT mode	2k, 4k, and 8k COFDM
	interleaver	native and in-depth
	TPS	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®SFE100-K2 option)

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

[5] With internal test signals.

DVB-S/DVB-DSNG (R&S®SFE100-K3 option)

DVB-S/DVB-DSNG	in line with EN 300421/EN 301210	
Modulation	modulation	QPSK, 8PSK, 16QAM
	symbol rate	100 ksymbol/s to 45 Msymbol/s, settable
	pulse filtering	root raised cosine roll-off, alpha = 0.35 variable roll-off (0.25, 0.35)
	MER	38 dB (27.5 Msymbol/s)
	modulation frequency response	±0.25 dB
	shoulder distance	>45 dB
	back-off	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

DVB-S2 (R&S®SFE100-K8 option)

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

T-DMB/DAB (R&S®SFE100-K11 option)

T-DMB/DAB	in line with T-DMB/EN 300401	Korea/Europe
Modulation	modulation	COFDM
	mode	I, II, III, IV
	bandwidth	1.536 MHz
	modulation frequency response	<0.2 dB
	shoulder distance	>45 dB
	back-off	13 dB
Single-frequency network	network mode	MFN
	control	MID, manual
Special function	PRBS	can be inserted into a subchannel [6]

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

ATSC/8VSB (R&S®SFE100-K4 option)

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

J.83/B (R&S®SFE100-K5 option)

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

DirecTV legacy modulation (R&S®SFE100-K9 option)

DirecTV legacy modulation	in line with DirecTV transmission specifications	
Modulation	modulation	QPSK
	symbol rate	20 Msymbol/s
	overrange	1 Msymbol/s to 30 Msymbol/s
	pulse filtering	root raised cosine roll-off, alpha = 0.20 variable roll-off (0.15, 0.20, 0.25, 0.35)
	MER	38 dB (20 Msymbol/s)
	modulation frequency response	<±0.25 dB
	shoulder distance	45 dB
	back-off	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®SFE100-K22 option after convolutional encoder
Test signals		TS test packet (see "Internal test signals")

DTMB (R&S®SFE100-K12 option)

DTMB	in line with GB20600-2006	
Modulation	modulation	COFDM/single carrier
	bandwidth	6 MHz, 7 MHz, 8 MHz
	modulation frequency response	<0.2 dB
	shoulder distance	>50 dB
	back-off	12 dB
Coding	constellation	4QAM(QPSK), 4QAM-NR, 16QAM, 32QAM, 64QAM
	code rate	0.4, 0.6, 0.8
	guard interval guard interval pn	420, 595, 945 symbols variable/constant
	time interleaver	0, 240, 720 symbols
	FFT mode dual pilot tone	4k COFDM/single carrier ON/OFF (single carrier)
Network mode		MFN
Test signals		TS test packet (see "Internal test signals")

ISDB-T/ISDB-Tsb/ISDB-T_B (R&S®SFE100-K6 option)

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

MediaFLO™ (R&S SFE100-K10 option)

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

ARB/waveforms

Arbitrary waveform generator (R&S®SFE100-K35 option)

Waveform memory	length	512 sample to 256 Msample in one-sample steps
	resolution	2 × 16 bit
	loading time for 10 Msample	3 s
	memory location for data	hard disk
Clock generation	clock rate	400 Hz to 100 MHz
	uncertainty	0.001 Hz
	operating mode	internal
	frequency accuracy (internal)	accuracy of reference frequency
Interpolation	bandwidth	
	with clock rate = 100 MHz (no interpolation), bandwidth 0.1 dB	40 MHz
	with clock rate <100 MHz, reduction to –0.1 dB	0.31 × clock rate
	sampling rate	automatically interpolated to the internal 100 MHz data rate
Triggering	modes	auto
		retrigger
		armed auto
		armed retrigger
	source	internal
		external
	delay	0 to 2^{32} – 1 sample, settable
	inhibit	0 to 2^{32} – 1 sample, settable
Marker	position	restart waveform
	delay	0 to waveform length, settable in samples
Special function		can be used together with R&S®WinIQSIM™ [7] (R&S®SFE-K350 option)

R&S®SFE100-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 waveforms (R&S®SFU-K354 option)

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)

For specifications, see R&S®SFU.

[7] With software version 4.24 or later, files generated for the R&S®SFU can also be used for the R&S®SFE100.

Analog modulation systems

One digital/analog modulation method can be activated.

AM/FM/RDS (R&S®SFE100-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) [8]	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 [9]	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 %

[8] Generator without preemphasis, receiver with deemphasis.

[9] Generator and receiver without preemphasis/deemphasis.

Standard B/G (R&S®SFE100-K190 option)

Standard B/G	in line with country-specific standard	
Vision modulation	modulation	B/G
	group delay	
	precorrection	CCIR – B/G general half (can be switched off)
	frequency response	<20 ns (with/without vestigial sideband filtering)
	vestigial sideband	
	filtering	B/G, can be switched off
	amplitude frequency response	<0.5 dB (–0.6 MHz to +4.8 MHz) (with/without vestigial sideband filtering)
	signal-to-noise ratio	
	video	>60 dB, weighted
	back-off	6 dB
Sound modulation	operating mode	mono, stereo, dual tone, NICAM, mono/NICAM
	modulation of sound carrier 1, 2	
	modulation mode	FM
	frequency deviation	30 kHz (settable)
	preemphasis	50 µs/75 µs (can be switched off)
	vision/sound intercarrier frequency	5.5 MHz/5.74 MHz (settable)
	vision/sound carrier power ratio	13 dB/20 dB (settable)
	pilot tone	in sound carrier 2 (can be switched off)
	signal-to-noise ratio	
	sound	>60 dB, weighted (CCIR)
Video signals	internal video signal generator	see R&S®SFE100-K23
	external video input	see “Analog video/audio input”
Audio signals	internal audio generator	see ”Internal audio signal generator“
	external audio input	see ”Internal NICAM audio signal generator“ see “Analog video/audio input”

Standard D/K (R&S®SFE100-K191 option)

Standard D/K	in line with country-specific standard	
Vision modulation	modulation	D/K
	group delay	
	precorrection	OIRT – D/K half (can be switched off)
	frequency response	<20 ns (with/without vestigial sideband filtering)
	vestigial sideband	
	filtering	DK, DK-FM2, DK-NICAM, can be switched off
	amplitude frequency response	<0.5 dB (–1 MHz to +5.8 MHz) (with/without vestigial sideband filtering)
	signal-to-noise ratio	
	video	>60 dB, weighted
	back-off	6 dB
Sound modulation	operating mode	mono, stereo, dual tone, NICAM, mono/NICAM
	modulation of sound carrier 1, 2	
	modulation mode	FM
	frequency deviation	30 kHz (settable)
	preemphasis	50 µs/75 µs (can be switched off)
	vision/sound intercarrier frequency	6.5 MHz/6.74 MHz (settable)
	vision/sound carrier power ratio	13 dB/20 dB (settable)
	pilot tone	in sound carrier 2 (can be switched off)
	signal-to-noise ratio	
	sound	>60 dB, weighted (CCIR)
Video signals	internal video signal generator	see R&S®SFE100-K23
	external video input	see “Analog video/audio input”
Audio signals	internal audio generator	see ”Internal audio signal generator“
	external audio input	see ”Internal NICAM audio signal generator“ see “Analog video/audio input”

Standard I (R&S®SFE100-K192 option)

Standard I	in line with country-specific standard	
Vision modulation	modulation	I
	group delay	
	precorrection	UK – I (can be switched off)
	frequency response	<20 ns (with/without vestigial sideband filtering)
	vestigial sideband	
	filtering	I, I1 (can be switched off)
	amplitude frequency response	<0.5 dB (–1 MHz to +4.8 MHz) (with/without vestigial sideband filtering)
	signal-to-noise ratio	
	video	>60 dB, weighted
	back-off	6 dB
Sound modulation	operating mode	mono, mono/NICAM, NICAM
	modulation of sound carrier 1	
	modulation mode	FM
	frequency deviation	30 kHz (settable)
	preemphasis	50 µs/75 µs (can be switched off)
	vision/sound intercarrier frequency	6 MHz (settable)
	vision/sound carrier power ratio	13 dB (settable)
	modulation of sound carrier 2	
	modulation mode	NICAM
	vision/sound intercarrier frequency	6.552 MHz (settable)
	vision/sound carrier power ratio	20 dB (settable)
	signal-to-noise ratio	
	sound	>60 dB, weighted (CCIR)
Video signals	internal video signal generator	see R&S®SFE100-K23
	external video input	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®SFE100-K193 option)

Standard M/N	in line with country-specific standard	
Vision modulation	modulation	M/N
	group delay	
	precorrection	FCC – M/N (can be switched off)
	frequency response	<20 ns (with/without vestigial sideband filtering)
	vestigial sideband	
	filtering	M, N (can be switched off)
	amplitude frequency response	<0.5 dB (–0.6 MHz to +4 MHz) (with/without vestigial sideband filtering)
	signal-to-noise ratio	
	video	>60 dB, weighted
	back-off	6 dB
Sound modulation	operating mode	BTSC mono, stereo Korea, dual Korea
	modulation of sound carrier 1, 2	
	modulation mode	FM
	frequency deviation	25 kHz (settable)
	preemphasis	50 µs/75 µs (can be switched off)
	vision/sound intercarrier frequency	4.5 MHz/4.742 MHz (settable)
	vision/sound carrier power ratio pilot tone	13 dB/20 dB (settable) in sound carrier 2 (can be switched off)
	signal-to-noise ratio	
	sound	>60 dB, weighted (CCIR)
Video signals	internal video signal generator	see R&S®SFE100-K23
	external video input	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®SFE100-K194 option)

Standard L	in line with country-specific standard	
Sound modulation	modulation	L
	group delay	
	precorrection	TDF – L (can be switched off)
	frequency response	<20 ns (with/without vestigial sideband filtering)
	vestigial sideband	
	filtering	L, L NICAM (can be switched off)
	amplitude frequency response	<0.5 dB (–1 MHz to +5.8 MHz) (with/without vestigial sideband filtering)
	back-off	6 dB
Sound modulation	operating mode	mono, mono/NICAM, NICAM
	modulation of sound carrier 1	
	modulation mode	NICAM
	vision/sound intercarrier frequency	5.85 MHz (settable)
	vision/sound carrier power ratio	27 dB (settable)
	modulation of sound carrier 2	
	modulation mode	AM
	frequency deviation	modulation depth 54 % (settable)
	vision/sound intercarrier frequency	6.5 MHz (settable)
	vision/sound carrier power ratio	10 dB (settable)
Video signals	internal video signal generator	see R&S®SFE100-K23
	external video input	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”

Internal NICAM encoder

Included in the following options: R&S®SFU-K190, R&S®SFU-K191, R&S®SFU-K193, and R&S®SFU-K194.

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

Trigger inputs/outputs

Triggers and connectors for future use

Trigger OUT	connector	9-pin D-Sub female, rear BNC female, rear (on request) alternatively reference OUT
	load impedance	>200 Ω
	output level	LVTTL
1PPS input/trigger IN	connector	BNC female, rear
	input impedance	high impedance
	input level	LVTTL

General data

System data

System	operating system	PC platform Windows XP Embedded 40 Gbyte internal hard disk
Local control	display	LCD 200 × 64 pixels
	control	hardkeys
Remote control	command set	SCPI 1999.5
	Ethernet	10/100BaseT
	USB	2.0
Connectors	Ethernet	RJ-45, rear
	USB	USB, front and rear
	AC supply input	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 to 0.8 A
Electromagnetic compatibility	power factor correction	in line with EN 55011 class B, EN 61326 in line with EN 61000-3-2
Immunity against RF fields		up to 10 V/m
Environmental conditions	operating temperature range	+5 °C to +45 °C [10] in line with EN 60068-2-1, EN 60068-2-2
	storage temperature range	–20 °C to +60 °C
	climatic resistance, cyclic test at +25 °C/+40 °C	85 % rel. humidity
Mechanical resistance	vibration, sinusoidal °C	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
	vibration, random	10 Hz to 300 Hz, acceleration 1.2 g (rms), in line with EN 60068-2-64
	shock	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	427 mm × 44 mm × 450 mm (1 HU) [11] (16.81 in × 1.73 in × 17.72 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.

[11] For rack installation, the use of an additional dummy panel is recommended.

Ordering information

Option identification: R&S®SFE100-Bxy = hardware option, R&S®SFE100-Kxy = software option.
Delivery of R&S®SFE100 base unit only with one built-in coder.

Order designation	Type	Order No.
Test Transmitter For digital standards or ARB generator, including power cable, Quick Start Guide, CD-ROM (includes operating manuals)	R&S®SFE100	2112.4100.02
Test Transmitter For analog standards, including power cable, Quick Start Guide, CD-ROM (includes operating manuals)	R&S®SFE100	2112.4100.03

Options		
Digital modulation systems		
DVB-T/H Coder	R&S®SFE100-K1	2113.4003.02
DVB-C/ISDB-C Coder	R&S®SFE100-K2	2113.4026.02
DVB-S/DVB-DSNG Coder	R&S®SFE100-K3	2113.4049.02
DVB-S2 Coder	R&S®SFE100-K8	2113.4126.02
ATSC/8VSB Coder	R&S®SFE100-K4	2113.4061.02
J.83/B Coder	R&S®SFE100-K5	2113.4084.02
ISDB-T/ISDB-Tsb/ISDB-T_B Coder	R&S®SFE100-K6	2113.4103.02
MediaFLO™ Coder	R&S®SFE100-K10	2113.4161.02
T-DMB/DAB Coder	R&S®SFE100-K11	2113.4184.02
DTMB Coder	R&S®SFE100-K12	2113.4203.02
DirecTV Legacy Modulation Coder	R&S®SFE100-K9	2113.4149.02
Analog modulation systems		
ATV Standard B/G Coder	R&S®SFE100-K190	2113.4649.02
ATV Standard D/K Coder	R&S®SFE100-K191	2113.4661.02
ATV Standard I Coder	R&S®SFE100-K192	2113.4684.02
ATV Standard M/N Coder	R&S®SFE100-K193	2113.4703.02
ATV Standard L Coder	R&S®SFE100-K194	2113.4726.02
ARB/waveforms		
ARB Waveform Generator requires an installed R&S®SFE100-B3 option	R&S®SFE100-K35	2113.4926.02
Memory Extension	R&S®SFE100-B3	2112.4400.02
R&S®WinIQSIM™ Support	R&S®SFE100-K350	2113.4949.02
T-DMB/DAB Waveforms can be used with the R&S®SFE100-K35 option	R&S®SFU-K351	2110.4277.04
DVB-H Waveforms can be used with the R&S®SFE100-K35 option	R&S®SFU-K352	2110.4425.02
DRM Waveforms can be used with the R&S®SFE100-K35 option	R&S®SFU-K353	2110.4554.02
DTV Interferers can be used with the R&S®SFE100-K35 option	R&S®SFU-K354	2110.4690.02
MediaFLO™ Waveforms can be used with the R&S®SFE100-K35 option	R&S®SFU-K355	2110.2974.02
Cable Interferers can be used with the R&S®SFE100-K35 option	R&S®SFU-K356	2110.3212.02

Baseband inputs/outputs		
Extended I/Q Input	R&S®SFE100-K80	2113.5245.02
Digital baseband		
TS Generator including SDTV streams	R&S®SFE100-K20	2113.4861.02
DVB-H Stream Library requires the R&S®SFE100-K20 option	R&S®DV-DVBH	2085.8704.02
Test Card M Streams requires the R&S®SFE100-K20 option	R&S®DV-TCM	2085.7708.02
HDTV Sequences requires the R&S®SFE100-K20 option	R&S®DV-HDTV	2085.7650.02
H.264 Stream Library requires the R&S®SFE100-K20 option	R&S®DV-H264	2085.9052.02
ISDB-T Stream Library requires the R&S®SFE100-K20 option	R&S®DV-ISDBT	2085.9146.02
TRP Player requires an installed R&S®SFE100-B6 option	R&S®SFE100-K22	2113.5268.02
Second Hard Disk	R&S®SFE100-B6	2112.4539.02
T-DMB/DAB Streams requires the R&S®SFE100-K22 option	R&S®SFU-K221	2113.4348.02
MediaFLO™ Streams requires the R&S®SFE100-K22 option	R&S®SFU-K222	2110.2968.02
Analog baseband		
Video Generator	R&S®SFE100-K23	2113.4884.02
ATV Video Signals	R&S®ATV Video	2110.4831.02
Other extras		
High Power	R&S®SFE100-B90	2112.4900.02
Recommended extras		
Operating manual (English), printed		2112.4122.12
19" Rack Adapter	R&S®ZZA-111	1096.3254.00
Adapter for Telescopic Sliders	R&S®ZZA-T45	1109.3774.00
External USB CD-RW Drive	R&S®PSP-B6	1134.8201.12
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®RO2SFE100	please contact your local sales office
Two-Year Repair Service following the warranty period	R&S®RO3SFE100	please contact your local sales office
Four-Year Repair Service following the warranty period	R&S®RO5SFE100	please contact your local sales office
Two-Year Calibration Service	R&S®CO2SFE100	please contact your local sales office
Three-Year Calibration Service	R&S®CO3SFE100	please contact your local sales office
Five-Year Calibration Service	R&S®CO5SFE100	please contact your local sales office

Certified Quality System
ISO 9001
DQS REG. NO 1954 QM

Certified Environmental System
ISO 14001
DQS REG. NO 1954 UM

For product brochure, see PD 5213.9234.12
and www.rohde-schwarz.com

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