R&S®SFU
Broadcast Test System
Specifications

ROHDE&SCHWARZ

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Introduction

The R&S®SFU broadcast test system has been designed as a platform for different applications and for future options. It provides multiple instrument functionality in a cabinet of only four height units and offers unrivaled RF and baseband characteristics.

Due to its modular design, the R&S®SFU can be optimally adapted to the requirements of different applications. It is an ideal research and development tool for making improvements to introduced standards and for generating new standard signals. Applications that previously required many different instruments are now fully covered by the R&S®SFU. The modern, intuitive concept of the R&S®SFU ensures fast and easy operation.

Applications overview

- Broadcast test transmitter with all important digital and analog standards in one box
- Wide level range for receiver and chip test applications
- Wide range of inputs and outputs for research and development applications
- Wide frequency range for limit tests
- RF generator and IF generator functionality
- Frequency steps of 0.1 Hz and uninterrupted level change for margin tests (PLL, AGC)
- Digital noise source with highly precise carrier/noise ratio for channel simulation
- Variable noise signal by combining several internal noise sources
- Dynamic fading (channel) simulation for testing mobile and multipath reception, diversity simulations
- Intelligent interferer management for a variety of sources (ARB, ATV predefined, analog I/Q, digital I/Q)
- User-definable signal impairments and signal modifications for research and development
- Modifiable standard parameters for research and development
- BER measurement on PRBS as well as on MPEG-2 transport streams
- Internal transport stream and video generator and special test signals
- Internal transport stream and ETI recorder and player for recording and replaying data streams
- Internal TRP player for replaying data streams
- Multiplexer software for generating streams
- Internal arbitrary waveform generator
- Use of waveform and data stream libraries
- Wide choice of libraries with test waveforms available
- Additional software tools
- Remote control capability for use in production
- Wear-free electronic attenuator

Key features

General

- Analog TV, digital TV and audio broadcast multistandard test platform
- Output frequency from 100 kHz to 3 GHz
- Generation of internal noise and interferer signals
- Fully digital baseband signal processing
- Upgradeability to multifunctional broadcast test system
- Easy installation of most options at customer site

Intuitive, fast and easy operation

- Color display with 1024 × 768 pixel (XVGA format)
- Intuitive user interface with Windows XP Embedded
- Context-sensitive help system
- User-definable favorites for fast access

Outstanding signal quality

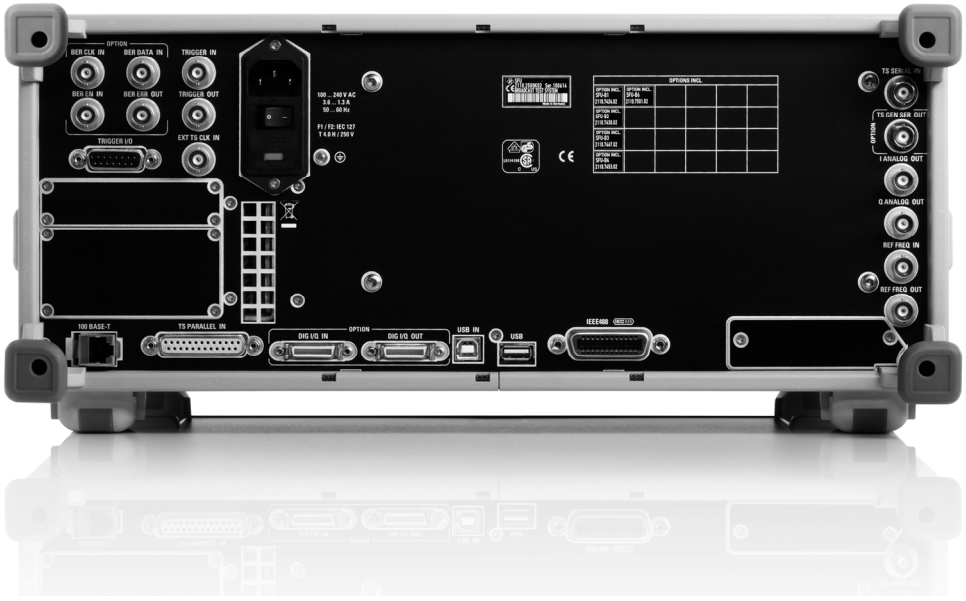
- I/Q modulator with 180 MHz RF bandwidth
- Very low SSB phase noise of typ. –135 dBc at 1 GHz (20 kHz carrier offset, 1 Hz measurement bandwidth)
- High optional output power of up to +19 dBm (PEP), overrange +26 dBm
- High-stability reference oscillator as standard

Unrivaled flexibility for research and development

- Multistandard platform that supports expansions
- Transmission simulations
- TS baseband generator and recorder with universal coder for realtime signal generation
- TRP baseband player for realtime signal generation
- Offline stream multiplexer software
- Video generator for realtime signal generation
- Arbitrary waveform generator with 1 Gsample, supported by R&S®WinIQSIM™, R&S®WinIQSIM2™ and R&S®ARB toolbox plus software
- Internal hard disk as standard for storing waveforms and modulation data
- Wear-free electronic attenuator of up to 3 GHz
- Minimum space requirements: signal generator and test transmitter accommodated in one instrument of only four height units

Easy remote access

- Remote control via GPIB and LAN
- User-friendly remote access by VNC or Remote Desktop
- USB connectors for keyboard, mouse and external storage media



Specifications

Specifications apply under the following conditions: 30 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.

RF characteristics

Frequency

Range		300 kHz to 3 GHz
	underrange	100 kHz to < 300 kHz
Accuracy		depends on reference frequency
Resolution of setting		0.1 Hz
Resolution of synthesis	standard, fundamental frequency range 750 MHz to 1500 MHz	 5 µHz

Frequency sweep

Digital sweep in discrete steps	operating modes	automatic, single shot, manual, linear or logarithmic
	sweep range	full range
	step width (lin)	full range
	step width (log)	0.01 % to 100 %

Reference frequency

Accuracy		$< 1 \times 10^{-7}$
Aging	after 30 days of uninterrupted operation	$< 1 \times 10^{-9}$/day
Temperature effect	in operating temperature range from 0 °C to +50 °C, standard	$< 6 \times 10^{-8}$
Warm-up time	to nominal thermostat temperature	≤ 10 min
Input for external reference signal	frequency (approx. sine wave)	5 MHz, 10 MHz or 13 MHz
	maximum deviation	3×10^{-6}
	input level	≥ –6 dBm to ≤ 19 dBm
	recommended limits	0 dBm to 19 dBm
	input impedance	50 Ω
	connector	BNC female, rear
Output for internal reference signal	frequency (approx. sine wave)	10 MHz or external input frequency
	level	typ. 5 dBm
	source impedance	50 Ω
	connector	BNC female, rear

Level

RF output	connector	N female, front
	output impedance	50 Ω
	overvoltage protection	35 V
Maximum level	without option	≥ +13 dBm (PEP) [1]
	with R&S®SFU-B90 option (high power)	≥ +19 dBm (PEP)
Setting range	without option	–120 dBm to +20 dBm
	with R&S®SFU-B90 option (high power)	–120 dBm to +30 dBm
	resolution	0.01 dB
Level accuracy	“auto” attenuator mode, temperature range +18 °C to +33 °C	
	f ≤ 3 GHz/level ≥ −100 dBm	< 0.5 dB
Additional uncertainty with ALC OFF, S&H (sample & hold)	(This function is needed only for some special applications.)	< 0.2 dB
Output impedance VSWR in 50 Ω system	ALC state ON, standard	
	f ≤ 3 GHz	< 1.6, typ. < 1.4
	ALC state ON, with R&S®SFU-B90 option	
	“normal” attenuator mode	< 1.8, typ. < 1.6
	“high power” attenuator mode	< 1.9, typ. < 1.7
Uninterrupted level setting	“fixed” attenuator mode, ALC state ON	
	setting range	> 20 dB
Back-feed (from ≥ 50 Ω source)	maximum permissible RF power in output frequency range of RF path	0.5 W
	overvoltage protection	
	maximum permissible DC voltage	35 V
	with R&S®SFU-B90 option (high power)	
	maximum permissible RF power in output frequency range of RF path	
	1 MHz < f ≤ 1 GHz	50 W
	1 GHz < f ≤ 2 GHz	25 W
	2 GHz < f ≤ 3 GHz	10 W

[1] PEP = peak envelope power (CW), for other modulation modes depending on crest factor.

Spectral purity

Harmonics	level ≤ 8 dBm, CW	< –30 dBc
	level ≤ 12 dBm with R&S®SFU-B90 option, “high power” attenuator mode, CW	< –30 dBc
Nonharmonics	level ≥ –50 dBm CW, vector modulation (full-scale input), > 10 kHz carrier offset and outside the modulation spectrum	
	0.3 MHz ≤ f ≤ 200 MHz	< –77 dBc
	200 MHz < f ≤ 1.5 GHz	< –80 dBc
	1.5 GHz < f ≤ 3.0 GHz	< –74 dBc
	> 850 kHz carrier offset and outside the modulation spectrum	
	0.3 MHz ≤ f ≤ 200 MHz	< –77 dBc
	200 MHz < f ≤ 1.5 GHz	< –86 dBc
	1.5 GHz < f ≤ 3.0 GHz	< –80 dBc
	caused by power supply unit or mechanical components, at RF = 1 GHz, 50 Hz to 10 kHz carrier offset	< –70 dBc
Subharmonics	f > 1.5 GHz to 3.0 GHz	< –74 dBc
Wideband noise	> 10 MHz carrier offset, 1 Hz CW measurement bandwidth	
	20 MHz ≤ f ≤ 200 MHz	< –146 dBc
	200 MHz < f ≤ 1.5 GHz	< –150 dBc
	1.5 GHz < f ≤ 3 GHz	< –148 dBc
	vector modulation with full-scale input	
	I/Q input gain +3 dB	
	20 MHz ≤ f ≤ 200 MHz	< –143 dBc
	200 MHz < f ≤ 1.5 GHz	< –146 dBc
	1.5 GHz < f ≤ 3 GHz	< –145 dBc
SSB phase noise	20 kHz carrier offset, 1 Hz measurement bandwidth	
	20 MHz ≤ f ≤ 200 MHz	< –128 dBc
	f = 1 GHz	< –131 dBc
	f = 2 GHz	< –125 dBc
	f = 3 GHz	< –121 dBc
Residual FM	RMS value at f = 1 GHz	
	300 Hz to 3 kHz	< 1 Hz
	20 Hz to 23 kHz	< 4 Hz
Residual AM	RMS value 20 Hz to 23 kHz at f = 1 GHz	< 0.02 %

High power (R&S®SFU-B90 option)

Extends the output level		
Maximum level		19 dBm

I/Q modulation

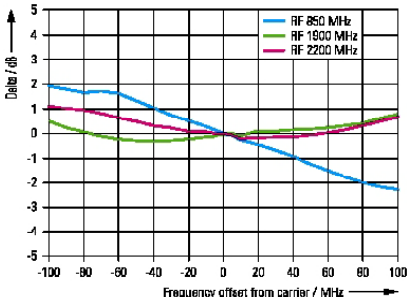
I/Q modulator

Operating modes		external wideband I/Q
		internal baseband I/Q
Modulation frequency range	I/Q wideband	100 MHz
I/Q modulation inputs	connector	BNC female, front
	input impedance	50 Ω
	VSWR up to 30 MHz	< 1.2
	input voltage for full-scale input	$\sqrt{V_i^2 + V_q^2}$ = 0.5 V
	minimum input voltage for ALC state ON	0.1 V
Static error vector	RMS value	
	f ≤ 200 MHz	< 0.3 %
	f > 200 MHz	< (0.2 % + 0.1 % × f/GHz)
	peak value	
	f ≤ 200 MHz	< 0.6 %
	f > 200 MHz	< (0.4 % + 0.2 % × f/GHz)
Modulation frequency response	I/Q wideband	
	up to 50 MHz	< 3 dB
	up to 5 MHz	< 0.6 dB
Carrier leakage	without input signal, referenced to full-scale input [2]	< –55 dBc
I/Q impairments	I offset, Q offset	
	setting range	–10 % to +10 %
	resolution	0.1 %
	gain imbalance	
	setting range	–10 % to +10 %
	resolution	0.1 dB
	quadrature offset	
	setting range	–10° to +10°
	resolution	0.1°
I/Q swap	I and Q signals swapped	ON, OFF

[2] Value applies after 1 hour warm-up and recalibration for 4 hours of operation and temperature variations of less than +5 °C.

External wideband I/Q

I/Q inputs (I/Q EXT) (connector equal to I/Q analog IN)	connector	BNC female, front
	input impedance	50 Ω
	VSWR up to 50 MHz	< 1.2
	input voltage for full-scale input	$\sqrt{V_i^2 + V_q^2}$ = 0.5 V
	minimum input voltage for ALC state ON	0.1 V
Modulation frequency range [3]	fast mode	100 MHz
Carrier leakage	without input signal, referenced to full-scale input [4]	< –55 dBc
Static error vector	16QAM, pulse filtering: root raised cosine roll-off, α = 0.15, 10 kHz symbol rate	
	RMS value	
	f ≤ 200 MHz	< 0.3 %
	f > 200 MHz	< (0.2 % + 0.1 % × f/GHz)
	peak value	
	f ≤ 200 MHz	< 0.6 %
	f > 200 MHz	< (0.4 % + 0.2 % × f/GHz)



Internal baseband I/Q

Signal characteristics		see digital modulation systems
D/A converter	data rate	100 MHz
	resolution	16 bit
	sampling rate	400 MHz (internal interpolation × 4)
Aliasing filter	with amplitude, group delay and Si correction	
	0.1 dB bandwidth	40 MHz
I/Q impairment	I offset, Q offset	
	setting range	–10 % to +10 %
	resolution	0.1 %
	gain imbalance	
	setting range	–10 % to +10 %
	resolution	0.1 dB
	quadrature offset	
	setting range	–10° to +10°
	resolution	0.1°

Internal optimization of RF parameters is always ON.

I/Q output

I/Q output	connector	BNC female, rear
	output impedance	50 Ω
	With R_L = 50 Ω, the output voltage depends on the set modulation signal.	
	output voltage	0.5 V (V_p)
Offset		< 1 mV

[3] I/Q wideband ON. This frequency response superimposes all frequency responses specified in the data sheet.

[4] Value applies after 1 hour warm-up and recalibration for 4 hours of operation and temperature variations of less than +5 °C.

Extended I/Q (R&S®SFU-K80 option)

The R&S®SFU-K80 option allows external analog and digital signals to be fed into the baseband signal processing of the R&S®SFU. Input signals can be faded in and noise signals superimposed if the fading simulator and noise options have been installed. In addition, the digital baseband signals are available externally.

Analog I/Q IN		
I/Q analog inputs (I/Q EXT) (connector equal to I/Q wideband IN)	connector	BNC female, front
	input impedance	50 Ω
	VSWR (up to 25 MHz)	< 1.2
	input voltage for full-scale input	$\sqrt{V_i^2 + V_q^2}$ = 0.5 V
	frequency response up to 30 MHz	0.5 dB
	A/D converter	100 MHz, 14 bit
	offset	< –55 dBFS
Digital I/Q IN		
I/Q digital input	connector	Mini D Ribbon, 26 pins, rear
	output level	channel link
I/Q digital modulation inputs	level	LVDS
	word width	2 × 16 bit
	analog bandwidth	0 Hz to 31 MHz
	symbol rate	400 sps to 100 Msps
Digital I/Q OUT		
I/Q digital output	connector	Mini D Ribbon, 26 pins, rear
	output level	channel link
I/Q digital modulation outputs	level	LVDS
	word width	2 × 16 bit
	symbol rate	100 Msps

Digital baseband

Internal test signals

MPEG-2 TS packet	header + 184 byte payload	00 (hex), FF (hex), PRBS (selectable)
	PID	NULL (1FFF hex)/variable
MPEG-specific TS packet	sync byte + 187 byte payload	00 (hex), FF (hex), PRBS (selectable)
DIRECTV TS packet	header + 127 byte payload	PRBS (DIRECTV only)
DIRECTV-specific TS packet	130 byte payload	PRBS (DIRECTV only)
PRBS	PRBS in line with ITU-T O.151	$2^{23} – 1$ / $2^{15} – 1$ (selectable)

MPEG-2 inputs

Parallel SPI input	connector	D-Sub female, 25 pins, front and rear
	input level	LVDS
	input impedance	100 Ω, differential
ASI/SMPTE 310 serial input	connector	BNC female, front and rear
	ASI input level	200 mV to 880 mV
	SMPTE 310 input level	400 mV to 880 mV
	input impedance	75 Ω
	ASI data rate	270 Mbit/s
	SMPTE 310 data rate	19.392658 Mbit/s
Stuffing	ASI, SMPTE 310, SPI	ON/OFF
	stuffing packets	see MPEG-2 TS packet under “Internal test signals”
TS EXT CLK	connector	BNC female, rear
	input level	TTL, sine wave (0 dBm)
	input impedance	50 Ω
Indication	measured values	packet length, data rate, useful data rate

ETI input/output (R&S®SFU-B11 option)

The R&S®SFU-B11 option allows external ETI data streams to be fed into the baseband signal processing of the R&S®SFU. T-DMB/DAB signals can be faded in and noise signals superimposed if the fading simulator and noise options have been installed.

ETI input/output		in line with ETI NI
Serial ETI input	connector	BNC female, rear
	ETI input level	0 V to ±2.37 V (ITU-T G.703/G.704)
	input impedance	75 Ω
	ETI data rate	2048 kbit/s
	coding	HDB3
Serial ETI output [5]	connector	BNC female, rear
	ETI output level	0 V to ±2.37 V (ITU-T G.703/G.704)
	output impedance	75 Ω
	ETI data rate	2048 kbit/s
	coding	HDB3

[5] Requires coder 2110.3306 with change index > 4.xx and R&S®SFU-B11 model .03 (2110.3887).

TS generator (R&S®SFU-K20 option)

Serial TS output	mode	ASI, SMPTE 310M (selectable)
	connector	BNC female, rear
	output impedance	75 Ω
	ASI	
	output level	800 mV
	data rate	270 Mbit/s
	mode	packet or continuous
	SMPTE 310M	
	output level	800 mV
	data rate	19.392658 Mbit/s
Transport stream	files	Rohde & Schwarz data streams
	file format	generated transport stream (GTS) format
	length of transport stream packets	ATSC: 188/208 bytes (selectable)
		DVB: 188/204 bytes (selectable)
	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
PCR jitter	shape	sine wave, rectangle, triangle
	frequency	1 mHz to 100 kHz
	amplitude	1 µs to 1 ms, in increments of 0.1 µs
Signal sets	included	moving picture sequences and test patterns with test tones, for 625 and 525 lines; DVB/ATSC systems
	optional	for additional digital signals and broadcasting standards (R&S®DV-xxx options), see ordering information or data sheet “Stream Libraries for broadcasting T&M equipment from Rohde & Schwarz”

DV transport stream libraries (R&S®DV-xxxx options)

A wide variety of libraries for different digital standards is available as a complement to the R&S®SFU-K20 TS generator option. For more information, see the data sheet “Stream Libraries for broadcasting T&M equipment from Rohde & Schwarz”.

TS recorder (R&S®SFU-K21 option)

The TS recorder can be used for recording ETI data streams if the ETI input/output (R&S®SFU-B11 option) is installed.

Parallel input	mode	SPI
	connector	D-Sub female, 25 pins, front and rear
	input impedance	100 Ω, differential
	input level	LVDS
	input clock	84.375 kHz to 7.5 MHz (60 Mbit/s NTFS)
		84.375 kHz to 11.25 MHz (90 Mbit/s CFS)
Serial TS input	mode	ASI, SMPTE 310M, ETI (selectable)
	connector	BNC female, front and rear
	input impedance	75 Ω
	ASI	
	input level	200 mV to 880 mV
	data rate	270 Mbit/s
	mode	packet or continuous
	SMPTE 310M	
	input level	400 mV to 880 mV
	data rate	19.392658 Mbit/s
Recording	mode	
	TRP	recording via ASI, SPI, SMPTE 310M or ETI; check of transport stream structure and packet size (188/204/208); SPI 8-bit interface: recording of data as a function of DVALID signal
	T10	recording via SPI or ETI; check of transport stream structure and packet size (188/204/208); recording of 8-bit data + DVALID + PSYNC or recording of 10-bit raw data
	BIN	recording via SPI; no checking of transport stream structure; recording of 8-bit data
	data rate	100 kbit/s to 90 Mbit/s (including null packets)
	data volume	max. data volume for recording limited only by hard disk size
	recording time	depends on net data rate of incoming transport stream and on hard disk size
Replay		see R&S®SFU-K22 option
Serial TS output		see R&S®SFU-K22 option
Serial ETI input/output		see R&S®SFU-B11 option

TRP player (R&S®SFU-K22 option)

To output ETI data streams to external T-DMB/DAB devices, the R&S®SFU-B11 ETI input/output option is required.

Replay	file format	TRP, T10, BIN, TS, MPG, DAB, DAB_C, DABP_C, ETI, FLO, FLO_C, ISDBT_C, MFS, CMMB_C, ATSC_C
	length of transport stream packets	corresponding to externally applied/recorded transport stream
	replay time/sequence length	endless
	seamless	TRP, MPG, TS
	not seamless	for all other supported file extensions, 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
Serial TS output	mode	ASI, SMPTE 310M (selectable)
	connector	BNC female, rear
	output impedance	75 Ω
	ASI	
	output level	800 mV
	data rate	270 Mbit/s
	mode	packet or continuous
	SMPTE 310M	
	output level	800 mV
	data rate	19.392658 Mbit/s
Serial ETI output		see R&S®SFU-B11 option
	active	BIN, ETI, DAB/DAB_C, DABP_C (ETI format)
Test signals	stop mode	head 184 payload, head 187 payload, head 200 payload, sync 187 payload, sync 203 payload, sync 207 payload
	play mode	null packets
		payload “00” , payload “FF”, payload “PRBS 15”, payload “PRBS 23”
Signal set	optional	for additional digital signals and broadcasting standards (R&S®SFU-K2xx options), see ordering information or data sheet “Stream Libraries for broadcasting T&M equipment from Rohde & Schwarz”

Transport stream libraries (R&S®SFU-K22x options)

A wide variety of libraries for different digital standards is available as a complement to the R&S®SFU-K22 TRP player option. For more information, see the data sheet “Stream Libraries for broadcasting T&M equipment from Rohde & Schwarz”.

Broadcast multiplexer (R&S®BCMux)

The broadcast multiplexer software is part of the R&S®SFU firmware and can also be used on external PCs [6]. The scope of software multiplexer applications in the R&S®SFU depends on the intended use and requires the R&S®SFU-K22 TRP player option and additional R&S®SFU-K2xx stream libraries.

Broadcast multiplexer	supported standards	CMMB, ATSC, ATSC-M/H, DVB-T2 MPLP
	release	1.00
		see description of option for details
Prerequisites	required option	R&S®SFU-K22 TRP player
	additional options	
	CMMB	R&S®SFU-K225 CMMB streams
	ATSC Mobile DTV	R&S®SFU-K226 ATSC Mobile DTV streams
	T2-MI	R&S®SFU-K227 DVB-T2 MI streams
Input	supported streams	customer streams and Rohde & Schwarz streams
Output	multiplexed streams	encrypted
	encryption formats	CMMB_C (requires R&S®SFU-K225), ATSC_C (requires R&S®SFU-K226), T2MI_C (requires R&S®SFU-K227)

CMMB software multiplexer		in line with GY/T 220.1-2006/220.2-2006
Input stream	file formats	BIN, MFS, CMMB_C (R&S®SFU-K225)
	structure	MFS with and without stuffing, PMS
	minimum sequence length	1 s (one valid channel frame)
	included input file	one file with 10 channel frames in MFS format

Output stream	file format	CMMB_C (requires R&S®SFU-K225)
	structure	MFS with stuffing, PMS
	minimum data rate	100 kbit/s
	maximum data rate	depends on transmission settings
	sequence length	corresponds to the number of valid multiplex frames in the input file
	file size	depends on data rate and sequence length
	file size limit	available hard disk capacity
	loop time	depends on sequence length
	service multiplex	
	number of PLCH services	0 to 39 (includes one CLCH service)
	service structure	1 control frame per channel frame and 0 to 38 service frames per channel frame
	added service content	empty service frames
	channel bandwidth	2 MHz, 8 MHz
	OFDM	1k, 4k (depending on channel bandwidth)
	PLCH settings	
	Reed-Solomon	0 (240, 240), 1 (240, 224), 2 (240, 192), 3 (240, 176)
	byte interleaver	1 to 3
	LDPC	1/2, 3/4
	constellation	BPSK, QPSK, 16QAM
	scrambling mode	0 to 7
	CLCH timeslots	one, start TS = 0, stop TS = 0
	SLCH timeslots	1 to 39, no overlapping of services

[6] The PC version of the R&S®BCMux broadcast multiplexer software is in preparation.

T2-MI software multiplexer		in line with ETSI TS 102 773
Input stream	number of input streams	one stream per PLP group
	file formats	TS, TRP, T2TRP_C
	structure	MPEG-2 TS, content files (big TS)
	data rate	up to 214 Mbit/s, calculated on file selection
	file size limit	available hard drive capacity
Output stream	file format	T2MI_C (requires R&S®SFU-K227)
	structure	DVB-T2 modulator interface (T2 MI)
	T2 MI PID	variable
	data rate	up to 80 Mbit/s, automatic estimation based on configuration and input data rate
	maximum file size	user-defined, limited by available target drive capacity
	actual file size	adjusted to match T2 frame boundary
	maximum number of PLPs	16
	PLP data source	
	single PLP in a group	all services of the selected MPEG-2 TS
	multiple data PLPs in a group	selected services extracted from content files (big TS) input by Annex D splitter
	common PLP	common data extracted by Annex D splitter
	PLP mode and stream adaptation	
	scheduling	static, dynamic
	PLP type	data type 1, data type 2, common
	baseband mode	high efficiency (HEM)
	ISSY	OFF, long
	max. buffer size	0 bit to 2 Mbit
	design delay	settable
	null packet deletion	OFF, ON
	in-band signaling	OFF, type A, type B
	PLP coding and modulation (BICM)	
	FEC frame	normal (64k), short (16k)
	code rate	1/2, 3/5, 2/3, 3/4, 4/5, 5/6
	constellation	QPSK, 16QAM, 64QAM, 256QAM
	rotation	OFF, ON
	time interleaver	settable
	frame interval (Ijump)	settable
	max. number of blocks	settable
	framing and OFDM	
	FFT size	1k, 2k, 4k, 8k, 16k and 32k COFDM
	guard interval	1/4, 19/128, 1/8, 19/256, 1/16, 1/32, 1/128
	extended carrier mode	OFF, ON
	pilot pattern	PP1, PP2, PP3, PP4, PP5, PP6, PP7, PP8
	bandwidth	1.7/5/6/7/8/10 MHz
	T2 frames per superframe (N_T2)	settable
	data symbols per T2 frame (L_DATA)	settable
	subslices per T2 frame (N_SUB)	settable
	T2 system	
	transmission system	SISO
	PAPR reduction	OFF, tone reservation (TR)
	T2 version	settable
	L1 post modulation	BPSK, QPSK, 16QAM, 64QAM
	L1 repetition	OFF, ON
	L1 RF signaling	OFF, ON (single frequency)
	cell id	settable
	network ID	settable
	T2 system ID	settable

Analog baseband

Analog video/audio input

If the external video/audio inputs are used, the analog I and Q inputs can no longer be assigned.

Video/audio input		included in R&S®SFU-K190 to R&S®SFU-K194
Video input	connector	BNC female, front panel, I input with R&S®SFU-Z19 adapter
	CCVS input level	V_{pp} = 1 V
	input impedance	75 Ω
	DC restoration	clamping of back porch
Audio input	connector	BNC female, front
	Q input	with R&S®SFU-K190 to R&S®SFU-K194, R&S®SFU-K170
	I input	with R&S®SFU-K170
	input level	0 dBm
	input impedance	50 Ω

Audio player

Waveform memory	play time	up to 80 s
	resolution	16 bit for AF1 and 16 bit for AF2
	non-volatile memory	hard disk, USB device
Audio	number of signals	2 channels, AF1 and AF2
	bandwidth	DC to 15 kHz
	level	16-bit full scale in each channel, corresponding to standard deviation
	frequency response	< ±0.3 dB
Clock generation	clock rate	50 kHz
Marker	position	restart waveform

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 dB to +12 dB, in 0.01 dB steps, 6 dBu corresponds to standard deviation
NICAM signals	fixed sequences	
	stereo 1	AF L: 1 kHz
		AF R: 2 kHz
	stereo 2	AF L: 1 kHz
		AF R: 1 kHz
	stereo 3	AF L: 1 kHz
		AF R: OFF
	stereo 4	AF L: OFF
		AF R: 1 kHz
	dual 1	AF L: 2 kHz
		AF R: 5 kHz
	dual 2	AF L: 1 kHz
		AF R: 1 kHz
	dual 3	AF L: 1 kHz
		AF R: OFF
	dual 4	AF L: OFF
		AF R: 1 kHz
	mono 1	AF: 1 kHz
	mono 2	AF: 4 kHz
	mono 3	AF: 10 kHz
	mono 4	AF: 100 Hz

Internal video signal generator (R&S®SFU-K23 option)

Internal video signal generator		included in R&S®SFU-K190 to R&S®SFU-K194
Video signals	ATV video basic	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	
	line 16	2T pulse
	line 17	CCIR17
	line 18	CCIR18/1
	line 19	CCIR18/2
	line 20	data line
	line 21	teletext test line
	second field	
	line 319	ramp
	line 329	modulated ramp
	line 330	CCIR330/5
	line 331	CCIR331/1
	line 332	red line
	line 333	sin(x)/x
	line 334	15 kHz, 200 ns
	line 335	250 kHz, 100 ns
PAL M – color bar 75 %	first field	
	line 16	2T pulse
	line 17	NTC7 composite
	line 18	FCC composite
	second field	
	line 11	ramp
	line 12	modulated ramp
	line 13	red line
	line 14	15 kHz, 250 ns
	line 15	250 kHz, 125 ns
	line 16	FCC multiburst
	line 17	NTC7 combined
	line 18	sin(x)/x
PAL N – color bar 75 %	first field	
	line 16	2T pulse
	line 17	CCIR17
	line 18	CCIR18/1
	line 19	CCIR18/2
	line 20	data line
	line 21	teletext test line
	second field	
	line 319	ramp
	line 329	modulated ramp
	line 330	CCIR330/5
	line 331	CCIR331/1
	line 332	red line
	line 333	sin(x)/x
	line 334	15 kHz, 200 ns
	line 335	250 kHz, 100 ns

NTSC – color bar 75 %	first field	
	line 16	2T pulse
	line 17	NTC7 composite
	line 18	FCC composite
	second field	
	line 11	ramp
	line 12	modulated ramp
	line 13	red line
	line 14	15 kHz, 250 ns
	line 15	250 kHz, 125 ns
	line 16	FCC multiburst
	line 17	NTC7 combined
	line 18	sin(x)/x
SECAM – color bar 75 %	first field	
	lines 7 to 15	discriminating signal
	line 16	2T pulse
	line 17	CCIR17
	line 18	CCIR18/1
	line 19	CCIR18/2
	line 20	data line
	line 21	teletext test line
	second field	
	line 319	ramp
	lines 320 to 328	discriminating signal
	line 329	modulated ramp
	line 330	CCIR330/5
	line 331	CCIR331/1
	line 332	red line
	line 333	sin(x)/x
	line 334	15 kHz, 200 ns
	line 335	250 kHz, 100 ns
PAL – FuBK	first field	
	line 16	2T pulse
	line 17	CCIR17
	line 18	CCIR18/1
	line 19	CCIR18/2
	line 20	data line
	line 21	teletext test line
	second field	
	line 319	ramp
	line 329	modulated ramp
	line 330	CCIR330/5
	line 331	CCIR331/1
	line 332	red line
	line 333	sin(x)/x
	line 334	15 kHz, 200 ns
	line 335	250 kHz, 100 ns
Additional signals	analog video signals	see R&S®ATV-Video option

Analog video library (R&S®ATV-Video option)

A library with different analog standards is available as a complement to the R&S®SFU-K23 analog video generator option. For more information, see the data sheet “Stream Libraries for broadcasting T&M equipment from Rohde & Schwarz”.

Digital modulation systems

Terrestrial standards

DVB-T2 (R&S®SFU-K16 option)

DVB-T2	in line with EN 302755	v1.1.1 and v1.2.1
	full support (multi PLP)	with R&S®SFU-B15
	limited support (only single PLP)	with R&S®SFU-B1 and R&S®SFU-B10
Input	transport stream	
	interface	ASI
	format	T2-MI (single PLP and multi PLP) or MPEG2-TS (single PLP only)
	T2-MI	supported with R&S®SFU-B15 only
	interface	ON/OFF
	PID filter	settable [7]
	analyzer	T2 specification check and logging
Modulation	modulation	COFDM
	PLP number	1 (single PLP) to 16 (multi PLP)
	single PLP	
	support	with R&S®SFU-B1/-B10/-B15
	T2-MI interface	OFF
	PLP number	1
	single PLP and multi PLP	
	support	with R&S®SFU-B15 only
	T2-MI interface	ON
	PLP number	1 to 16
Coding	bandwidth	1.7/5/6/7/8 MHz (overrange 10 MHz)
	bandwidth variation	< ±1000 ppm
	MER	> 40 dB [8]
	modulation frequency response	< ±0.2 dB
	shoulder attenuation	> 45 dB
	PLP type	common, data type 1, data type 2 [8]
	baseband mode	normal (NM), high efficiency (HEM)
	FEC frame	normal (64k), short (16k)
	code rate	1/2, 3/5, 2/3, 3/4, 4/5, 5/6
	constellation	QPSK, 16QAM, 64QAM, 256QAM
	rotation	ON/OFF
	time interleaver	settable [9]
	frame interval (I_{jump})	≥ 1
	FFT size	1k, 2k, 4k, 8k, 16k and 32k COFDM
	extended carrier mode	ON/OFF
	pilot pattern	PP1, PP2, PP3, PP4, PP5, PP6, PP7, PP8
T2 System	guard interval	1/4, 19/128, 1/8, 19/256, 1/16, 1/32, 1/128
	T2 frames per super frame	settable [9]
	data symbols per T2 frame	settable [9]
	in-band signaling	according to T2 version [10]
	network mode	MFN
	transmission system	SISO
	PAPR reduction	OFF, tone reservation (TR) [11]
	T2 version	settable [9]
	L1 post modulation	BPSK, QPSK, 16QAM, 64QAM
	L1 repetition	ON/OFF [11]
	cell ID	settable [9]
	network ID	settable [9]
	T2 system ID	settable [9]
Test signals	TS test packet with settable payload (PRBS, 0x00, 0xFF) (see “Internal test signals”)	

[7] With T2-MI interface switched ON.

[8] With internal test signals.

[9] With T2-MI interface switched OFF.

[10] With R&S®SFU-B15 only.

[11] PAPR reduction according to T2 version > 1.1.1 not supported yet. Reserved carriers are modulated with 0+j0 only.

DVB-T/-H (R&S®SFU-K1 option)

DVB-T/-H		in line with EN 300744/EN 302304
Modulation	mode	COFDM
	bandwidth	5/6/7/8 MHz (settable for variable bandwidth: 1 MHz to 10 MHz)
	MER	> 40 dB [12]
	modulation frequency response	< ±0.2 dB
	shoulder attenuation	> 48 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
	carrier modification	carriers and carrier groups can be switched off
Special functions	scrambler, sync byte inversion, Reed-Solomon encoder, convolutional interleaver, bit interleaver, symbol interleaver, guard interval	can be switched off
Test signals		TS test packet (see “Internal test signals”)
		PRBS before convolutional encoder
		PRBS after convolutional encoder
		PRBS before mapper

DVB-SH (R&S®SFU-K13 option) [13]

DVB-SH		SH-A in line with EN 302583
	support	up to R&S®SFU firmware version 2.14
Modulation	mode	CGC (COFDM) [14]
	control	manual [15]
	bandwidth	1.7/5/6/7/8 MHz
	MER	> 40 dB [16]
	modulation frequency response	< ±0.2 dB
	shoulder attenuation	> 48 dB
Coding	constellation	QPSK, 16QAM non-hierarchical coding
	code rate	1/5 (STD ID0), 2/9 (STD ID1), 1/4 (STD ID2), 2/7 (STD ID3), 1/3 (STD ID4), 1/3 (COMP ID5), 2/5 (STD ID6), 2/5 (COMP ID7), 1/2 (STD ID8), 1/2 (COMP ID9), 2/3 (STD ID10), 2/3 (COMP ID11)
	guard interval	1/4, 1/8, 1/16, 1/32
	FFT mode	1k, 2k, 4k and 8k COFDM
	time interleaver	configurable [17]
	TPS	in line with DVB-SH
Test signals		TS test packet with settable payload (PRBS, 0x00, 0xFF) (see “Internal test signals”)

[12] With internal test signals.

[13] The R&S®SFU-K13 DVB-SH option is available only on request.

[14] SC (TDM) not supported.

[15] SH-IP synchronization not supported.

[16] With internal test signals.

[17] Time interleaver profiles for class 1 and class 2 receivers supported (256 Mbit of interleaving RAM available).

T-DMB/DAB/DMB (R&S®SFU-K11 option)

T-DMB/DAB/DMB		in line with T-DMB/EN 300401, Korea/Europe/France
Transmission	modulation	COFDM
	mode	I, II, III, IV
	bandwidth	1.536 MHz
	modulation frequency response	< 0.2 dB
	shoulder attenuation	> 45 dB
Single-frequency network	network mode	MFN
	control	MID, manual
Special functions	external ETI data stream	requires R&S®SFU-B11 option
	PRBS	can be inserted into a subchannel [18]
	Gaussian fading profiles	included; requires R&S®SFU-B30 option
Test signals		mode I, UEP 1, 32 kbit/s

DRM (R&S®SFU-K353 option)

The R&S®SFU-K353 option is available as a waveform library (non-realtime solution).

DMB-T (TDS-OFDM, R&S®SFU-K7 option) [19]

DMB-T (TDS-OFDM)		in line with TDS-OFDM, field trials in China
	support	with R&S®SFU-B1 and R&S®SFU-B10
	no support	with R&S®SFU-B15
Modulation	mode	COFDM
	bandwidth	6/7/8 MHz (settable for variable bandwidth: 5.6 MHz to 7.962 MHz)
	modulation frequency response	< 0.2 dB
	shoulder attenuation	> 50 dB
Coding	constellation	QPSK, 16QAM, 64QAM
	code rate	4/9, 2/3, 8/9
	guard interval	420, 945
	time interleaver	48, 240, 720
	FFT mode	4k COFDM
Special functions	byte interleaver, randomizer, sync word randomizer, pilot data, guard interval, power boost	can be switched off
	randomizer restart	packet/frame
Single-frequency network	network mode	MFN
	control	MIP, manual
Test signals		TS test packet (see “Internal test signals”)

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

[19] The R&S®SFU-K7 DMB-T coder option is available only on request.

DTMB (R&S®SFU-K12 option)

DTMB		in line with GB20600-2006
	support	with R&S®SFU-B1, R&S®SFU-B10 and R&S®SFU-B15
Modulation	mode	COFDM/single carrier
	bandwidth	6/7/8 MHz
	modulation frequency response	< 0.2 dB
	shoulder attenuation	> 50 dB
Coding	constellation	4QAM, 4QAM-NR, 16QAM, 32QAM, 64QAM
	code rate	0.4, 0.6, 0.8
	guard interval	420, 595, 945
	guard interval PN	constant/variable (420, 945)
		constant (595)
	time interleaver	OFF, 240 symbols, 720 symbols
	FFT mode	4k COFDM
	pilot carrier	can be switched off (single carrier)
Special functions	GI power boost	can be switched off
	SI power normalization	can be switched on
	Co-channel interferer	can be switched on
Single-frequency network	network mode	MFN, SFN (in line with GY/T 229.1-2008)
	RF delay	settable
	delay offset	settable
	TX address	settable
Test signals		TS test packet (see “Internal test signals”)

CMMB (R&S®SFU-K15 option)

CMMB		in line with GY/T 220.1-2006
Modulation	modulation	COFDM
	bandwidth	2 MHz, 8 MHz
	modulation frequency response	< 0.2 dB
	shoulder attenuation	> 50 dB
Coding	FFT mode	1k, 4k
	scrambling mode	0 to 7
	number of timeslots	40
	services	
	Reed-Solomon	(240, 240) (240, 224) (240, 192) (240, 176)
	byte interleaver	1 to 3
	LDPC	1/2, 3/4
	constellation	BPSK, QPSK, 16QAM
Special functions	Reed-Solomon, byte interleaver, bit interleaver, scrambling	can be switched off
Test signals	CLCH test signal	PRBS 2^{15} – 1, PRBS 2^{23} – 1, 0x00, 0xFF
	test signal only	PRBS 2^{15} – 1, PRBS 2^{23} – 1, 0x00, 0xFF

ISDB-T/ISDB-T_B/ISDB-T_{SB} (R&S®SFU-K6 option)

ISDB-T		in line with ARIB STD-B31 version 1.7
ISDB-T_B		in line with Brazilian standard
ISDB-T_{SB}		in line with ARIB STD-B29
Modulation	mode	OFDM
	bandwidth	6/7/8 MHz (variable: ±1000 ppm)
	number of segments	
	ARIB STD-B31	13
	ARIB STD-B29	1, 3
	MER	> 40 dB
	modulation frequency response	< 0.2 dB
	shoulder attenuation	> 48 dB
Coding	FFT mode	2k, 4k and 8k
	number of layers	1 to 3
	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	
	ISDB-T	0, 1, 2, 4, 8, 16
	ISDB-T_{SB}	0, 1, 2, 4, 8, 16, 32
Special functions	scrambler, Reed-Solomon, byte interleaver, bit interleaver, frequency interleaver, guard interval, pilots, OFDM segments	can be switched off
	AC information	PRBS, All 1
Test signals		TS test packet (see “Internal test signals”)

ISDB-Tmm (R&S®SFU-K106 option)

The R&S®SFU-K106 option is in preparation as a realtime coder.

ISDB-Tmm (R&S®SFU-K365 option)

The R&S®SFU-K364 option is in preparation as a waveform library (non-realtime solution).

MediaFLO™ (R&S®SFU-K10 option)

MediaFLO™		in line with TIA-1099 Rev. A FLO air interface specification (AIS) Rev. 1.0 and 2.0
	support	with R&S®SFU-B10 and R&S®SFU-B15
	no support	with R&S®SFU-B1
Modulation	mode	COFDM
	bandwidth	5/6/7/8 MHz
	modulation frequency response	< 0.2 dB
	shoulder attenuation	50 dB
Coding	IFFT mode	2k, 4k, 8k
	cyclic prefix length	1/16, 1/8, 3/16, 1/4
	slot to interlace mapping	1, 2, 3
Special function	TDM1	can be switched off
	local OIS system parameters	can be switched off
	daylight saving time indicator	can be switched off
	position of pilot symbols	can be switched off
	transmitter position	can be switched off
	transmitter offset	can be switched off
Test signals		PRBS

ATSC 8VSB (R&S®SFU-K4 option)

ATSC 8VSB		in line with ATSC Doc. A/53 (8VSB)
Modulation	mode	8VSB
	bandwidth	6 MHz
	symbol rate	10.762 Msps
	range	±5 %, settable
	pilot	1.25 (can be switched off)
	range	settable (from 0 to 5 in steps of 0.001)
	pulse filtering	root raised cosine roll-off, α = 0.115
	MER	> 40 dB [20]
	modulation frequency response	< ±0.25 dB
	shoulder attenuation	> 45 dB
Coding	input data rate	19.392658 Mbit/s
Special functions	randomizer, interleaver	can be switched off
Test signals		TS test packet (see “Internal test signals”)
		PRBS before convolutional encoder
		PRBS after convolutional encoder
		PRBS before mapper

[20] With internal test signals.

ATSC-M/H (R&S®SFU-K18 option)

ATSC Mobile DTV, ATSC-M/H		in line with ATSC Doc. A/153 Mobile DTV (USA)
Modulation	mode	8VSB
	bandwidth	6 MHz
	symbol rate	10.762 Msps
	range	±5 %, settable
	pilot	1.25 (can be switched off)
	range	settable (from 0 to 5 in steps of 0.001)
	pulse filtering	root raised cosine roll-off, α = 0.115
	MER	> 40 dB [21]
	modulation frequency response	< ±0.25 dB
	shoulder attenuation	> 45 dB
Coding	input data rate	19.392658 Mbit/s
	range	±5 % (depends on symbol rate)
Special functions	RF-watermark	supported
	MTX ID-TR	supported
	randomizer, Reed-Solomon, interleaver, trellis initialization	can be switched off
Test signals		TS test packet (see “Internal test signals”)
		PRBS before convolutional encoder
		PRBS after convolutional encoder
		PRBS before mapper

HD Radio™ (R&S®SFU-K357 option)

The R&S®SFU-K357 option is available as a waveform library (non-realtime solution).

ATSC/A-VSB (R&S®SFU-K14 option) [22]

ATSC/A-VSB		in line with ATSC Mobile DTV, field trials in the USA
	support	up to R&S®SFU firmware version 2.14
Modulation	mode	8VSB
	bandwidth	6 MHz
	symbol rate	10.762 Msps
	range	±5 %, settable
	pilot	1.25 (can be switched off)
	range	settable (from 0 to 5 in steps of 0.001)
	pulse filtering	root raised cosine roll-off, α = 0.115
	MER	> 40 dB
	modulation frequency response	< ±0.25 dB
	shoulder attenuation	> 45 dB
Coding	input data rate	19.392658 Mbit/s
	range	±5 % (depends on symbol rate)
	SRS modes	0 to 4
	turbo stream modes	0 to 8
Special functions	randomizer, interleaver	can be switched off
Test signals		TS test packet (see “Internal test signals”)
		PRBS before convolutional encoder
		PRBS after convolutional encoder
		PRBS before mapper

[21] With internal test signals.

[22] The R&S®SFU-K14 ATSC/A-VSB coder option is available only on request.

Cable standards

DVB-C2 (R&S®SFU-K17 option)

DVB-C2		in line with EN 302769
	support	with R&S®SFU-B15
	no support	with R&S®SFU-B1 and R&S®SFU-B10
Input	transport stream	
	interface	ASI, SPI
	format	MPEG-2 TS
	PLP	
	number	1 to 4 PLPs
	payload	one live and 3 PRBS
	ID	settable
	type	normal data PLP
Modulation	modulation	OFDM
	mode	16QAM, 64QAM, 256QAM, 1024QAM, 4096QAM
	channel raster bandwidth	6 MHz, 8 MHz
	bundled channels [23]	
	number	1 and 2 channels [23]
	bandwidth	5.71 MHz, 7.61 MHz and 11.42 MHz [23], 15.22 MHz [23]
	MER	> 40 dB [24]
	modulation frequency response	< ±0.2 dB
	shoulder attenuation	> 45 dB
Coding	baseband mode	normal (NM), high efficiency (HEM)
	guard interval	1/64, 1/128
	BICM	
	FEC frame	normal (64k), short (16k)
	code rate (concatenated BCH/LDPC)	2/3, 3/4, 4/5, 5/6, 8/9 (short FEC frame), 9/10 (normal FEC frame)
	data slice	
	number	1 to 4 [23] data slices
	ID	settable
	packets	type 1 [23], type 2, stuffing
	tune position	settable
	tune offset	left, right, settable
	FEC frame header type	robust, high efficiency (DSlice packets type 2)
	XFEC frame number	1 and 2 (DSlice packets type 2)
	PLP number	1 to 4 PLP
	time interleaving	none, 4 symbols, 8 symbols, 16 symbols
	notch types [23]	narrowband, broadband
C2 system	C2 system ID	settable
	network ID	settable
	layer 1 part 2 signaling	
	time interleaving	none, best fit, 4 symbols, 8 symbols
	code rate (concatenated BCH/LDPC)	1/2 (16k LDPC)
	mode	16QAM
Test signals		TS test packet with settable payload (PRBS ITU-T O.151, 0x00, 0xFF) (see “Internal test signals”)

[23] In preparation.

[24] With internal test signals.

DVB-C/ISDB-C (R&S®SFU-K2 option)

DVB-C		in line with EN 300429 (ITU-T J.83/A)
ISDB-C		in line with ITU-T J.83/C
Modulation	mode	16QAM, 32QAM, 64QAM, 128QAM, 256QAM
	symbol rate	0.1 Msps to 8 Msps, settable
	pulse filtering	root raised cosine roll-off, α = 0.15, variable roll-off (0.1, 0.13, 0.15, 0.18, 0.20)
	MER	> 40 dB
	modulation frequency response	±0.25 dB
	shoulder attenuation	> 48 dB
Special functions	energy dispersal, Reed-Solomon encoder (204, 188, t = 8), convolutional interleaver	can be switched off
Test signals		TS test packet (see “Internal test signals”)
		PRBS before mapper

J.83/B / DOCSIS (R&S®SFU-K5 option)

J.83/B / DOCSIS		in line with ITU-T J.83/B
Modulation	mode	64QAM, 256QAM, 1024QAM
	bandwidth	6 MHz
	symbol rate	
	64QAM	5.0569 Msps
	256QAM	5.3600 Msps
	1024QAM	5.3600 Msps
	pulse filtering	root raised cosine roll-off, α = 0.18 (64QAM), 0.12 (256QAM/1024QAM)
	MER	> 40 dB
	modulation frequency response	±0.25 dB
	shoulder attenuation	
	64QAM	> 50 dB
	256QAM	> 45 dB
	1024QAM	> 45 dB
Coding	input data rate	
	64QAM	26.97035 Mbit/s
	256QAM	38.81070 Mbit/s
	1024QAM	49.02525 Mbit/s
	data interleaver	can be switched off, level 1 and level 2
Special functions	randomizer, Reed-Solomon encoder, interleaver, checksum	can be switched off
Test signals		TS test packet (see “Internal test signals”)
		PRBS before trellis encoder
		PRBS before mapper

MoCA® (R&S®SFU-K364 option)

The R&S®SFU-K364 option is in preparation as a waveform library (non-realtime solution).

Satellite standards

DVB-SH (R&S®SFU-K13 option) [25]

See specifications under terrestrial standards.

DVB-S/DVB-DSNG (R&S®SFU-K3 option)

DVB-S/DVB-DSNG		in line with EN 300421/EN 301210
Modulation	mode	QPSK, 8PSK, 16QAM
	symbol rate	0.1 Msps to 45 Msps, settable
	overrange	> 45 Msps to 66 Msps
	pulse filtering	root raised cosine roll-off, α = 0.35, variable roll-off (0.25, 0.30, 0.35, 0.40, 0.45)
	MER	38 dB (27.5 Msps)
	modulation frequency response	±0.25 dB
	shoulder attenuation	> 45 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	energy dispersal, Reed-Solomon encoder (204, 188, t = 8), convolutional interleaver	can be switched off
Test signals		TS test packet (see “Internal test signals”)
		PRBS before convolutional encoder

DVB-S2 (R&S®SFU-K8 option)

DVB-S2		in line with EN 302307, broadcast services
	support	with R&S®SFU-B1, R&S®SFU-B10 and R&S®SFU-B15
Modulation	mode	QPSK, 8PSK, 16APSK, 32APSK
	symbol rate	
	QPSK, 8PSK	1 Msps to 40 Msps (overrange 45 Msps)
	16APSK	2 Msps to 39 Msps
	32APSK	2 Msps to 32 Msps
	pulse filtering	root raised cosine roll-off, α = 0.20, variable roll-off (0.15, 0.20, 0.25, 0.35)
	MER	38 dB (20 Msps)
	modulation frequency response	±0.25 dB
	shoulder attenuation	45 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 bit; short, 16200 bit
	pilot insertion	can be switched off
Special function	error insertion	after CRC-8, BCH or LDPC
Test signals		TS test packet (see “Internal test signals”)

[25] The R&S®SFU-K13 DVB-SH option is available only on request.

DIRECTV legacy modulation (R&S®SFU-K9 option)

DIRECTV legacy modulation		in line with DIRECTV transmission specifications
	support	with R&S®SFU-B1, R&S®SFU-B10 and R&S®SFU-B15
Modulation	mode	QPSK
	symbol rate	20 Msps
	overrange	1 Msps to 30 Msps
	pulse filtering	root raised cosine roll-off, α = 0.20, variable roll-off (0.15, 0.20, 0.25, 0.35)
	MER	38 dB (20 Msps)
	modulation frequency response	< ±0.25 dB
	shoulder attenuation	45 dB
Coding	code rate	1/2, 2/3, 6/7
Special function	customer-specific DIRECTV streams	can be replayed in 188-byte format, requires R&S®SFU-K21 and R&S®SFU-K22 options
	error insertion	after convolutional encoder
Test signals		TS test packet (see “Internal test signals”)

AMC (R&S®SFU-K108 option)

Advanced modulation coding (AMC)		in line with AMC, supports DIRECTV as well as parts of DVB-S and phase noise
	support	with R&S®SFU-B1 and R&S®SFU-B10
	no support [26]	with R&S®SFU-B15
Modulation	mode	QPSK
	symbol rate	DVB-S: 1 Msps to 36 Msps (and up to 42 Msps depending on code rate) DIRECTV: 20 Msps
	overrange for DIRECTV	1 Msps to 30 Msps
	pulse filtering	root raised cosine roll-off, α = 0.20, variable roll-off (0.15, 0.20, 0.25, 0.35)
	MER	38 dB (20 Msps)
	modulation frequency response	< ±0.25 dB
	shoulder attenuation	45 dB
Coding	code rate	DIRECTV: 1/2, 2/3, 6/7
		DVB-S: 1/2, 2/3, 3/4, 5/6, 7/8
Special function	phase noise	can be switched on

ISDB-S (R&S®SFU-K362 option)

The R&S®SFU-K362 option is available as a waveform library (non-realtime solution).

[26] The advanced modulation coding (AMC) functionality on the R&S®SFU-B15 is available with the following options: R&S®SFU-K3 (DVB-S coder), R&S®SFU-K9 (DIRECTV coder) and R&S®SFU-K41 (phase noise).

Analog modulation systems

AM/FM/RDS (R&S®SFU-K170 option)

FM	FM operating modes	stereo, mono
	audio signals	
	internal audio signal generator	see audio generator
	external audio input	see analog audio input
	AF frequency range	30 Hz to 15 kHz
	AF frequency response	< 0.2 dB
	attenuation at 19 kHz	> 70 dB
	preemphasis	OFF, 50 µs, 75 µs
	residual AM	< 0.1 % (at AF = 1 kHz, ±50 kHz deviation)
FM stereo	stereo operating modes	L, R, L = R, L = –R, L ≠ R internal RDS signal generation, MPX and RDS signals can be generated simultaneously
	MPX frequency deviation	
	deviation	0 Hz to ±100 kHz
	resolution	10 Hz
	stereo crosstalk attenuation	> 50 dB (at AF = 30 Hz to 15 kHz)
	total harmonic distortion [27]	< 0.1 % (at 60 kHz audio frequency deviation, AF = 1 kHz)
	SNR (stereo/RDS signal) [28]	at ±40 kHz audio frequency deviation
	ITU-R weighted (quasi-peak)	> 64 dB
	ITU-R unweighted (RMS)	> 70 dB
	pilot tone	
	frequency	19 kHz ± 1 Hz
	deviation	0 Hz to ±15 kHz
	resolution	10 Hz
	phase	0° to ±180°
	resolution	0.1°
	RDS	
	subcarrier frequency	57 kHz ± 3 Hz
	deviation	0 Hz to ±10 kHz
	resolution	10 Hz
FM mono	mono frequency deviation	
	deviation	0 Hz to ±100 kHz
	resolution	10 Hz
	total harmonic distortion [29]	< 0.1 % (at ±67.5 kHz audio frequency deviation, AF = 1 kHz)
AM	audio signals	
	internal audio signal generator	see audio generator
	external audio input	
	AF frequency range	30 Hz to 2.25 kHz
	AF frequency response	< 0.2 dB
	attenuation at 3.15 kHz	> 35 dB
	modulation	
	modulation depth	0 % to 100 %
	resolution	1 %
	AM total harmonic distortion	at AF = 1 kHz
	m = 30 %	< 0.2 %
	m = 80 %	< 0.2 %

[27] Generator and receiver without preemphasis/deemphasis.

[28] Generator without preemphasis, receiver with deemphasis, and left/right input signal source set to audio generator.

[29] Generator and receiver without preemphasis/deemphasis.

RDS/RDBS		included in R&S®SFU-K170 AM/FM RDS coder
RDS		in line with IEC 62106/DIN EN 62106
RBDS (United States RBDS standard)		in line with NRSC-4-A
Group	group sequence	up to 38 groups
Programs	program identification (PI)	0000 to FFFF hex
	program service name (PS)	up to 8 characters
	program type code (PTY)	0 to 31 decimals
	program type name (PTYN)	up to 8 characters
Traffic programs/announcements	traffic program (TP)	ON/OFF
	traffic announcement (TA)	ON/OFF
Music speech	music speech (MS)	ON/OFF
Decoder identification (DI)	dynamic PTY	ON/OFF
	compressed PTY	ON/OFF
	artificial head	ON/OFF
	stereo	ON/OFF
Clock time	clock time and date clock time	information from system time
	offset	up to +99 hours and 59 minutes
Radio text	input line	up to 64 characters
Alternative frequencies, method A	number	up to 25 frequencies
	frequency range	87.6 MHz to 107.9 MHz
	resolution	in steps of 100 kHz
Alternative frequencies, method B	number	up to 5 frequency lists
	tuning frequency	one per list
	frequency range	87.6 MHz to 107.9 MHz
	resolution	in steps of 100 kHz
	frequencies per list	up to 25 frequencies
	frequency range	87.6 MHz to 107.9 MHz
	resolution	in steps of 100 kHz
	order per frequency	ascending or descending
Enhanced other network (EON)	program identification (PI)	0000 to FFFF hex
	program service name (PS)	up to 8 characters
	traffic program (TP)	ON/OFF
	traffic announcement (TA)	ON/OFF
	linkage actuator (LA)	ON/OFF
	extended generic (EG) indicator	ON/OFF
	international linkage set (ILS) indicator	ON/OFF, 0000 to FFFF hex
	program type code (PTY)	0 to 31 decimals
	program identification number (PIN)	0000 to FFFF hex
	alternative frequency	method A
	number of frequencies	up to 25 frequencies
	mapped frequencies	up to 4 frequencies
	tuning frequency	one
	frequency range	87.6 MHz to 107.9 MHz
	resolution	in steps of 100 kHz
Traffic message channel (TMC)	traffic message channel (TMC)	ON/OFF
	group 3A variant 00 (block 3)	0000 to FFFF hex
	group 3A variant 01 (block 3)	0000 to FFFF hex
	number of 8A groups	up to 6
	group 8A block 2	00 to 1F hex
	group 8A block 3	0000 to FFFF hex
	group 8A block 3	0000 to FFFF hex

Open format	open format	ON/OFF
	group 1A block 2/block 3/block 4	00 to 1F/0000 to FFFF/0000 to FFFF
	group 1B block 2/block 3/block 4	00 to 1F/ – /0000 to FFFF
	group 3A block 2/block 3/block 4	00 to 1F/0000 to FFFF/0000 to FFFF [30]
	group 3B block 2/block 3/block 4	00 to 1F/ – /0000 to FFFF
	group 4B block 2/block 3/block 4	00 to 1F/ – /0000 to FFFF
	group 5A block 2/block 3/block 4	00 to 1F/0000 to FFFF/0000 to FFFF
	group 5B block 2/block 3/block 4	00 to 1F/ – /0000 to FFFF
	group 6A block 2/block 3/block 4	00 to 1F/0000 to FFFF/0000 to FFFF
	group 6B block 2/block 3/block 4	00 to 1F/ – /0000 to FFFF
	group 7A block 2/block 3/block 4	00 to 1F/0000 to FFFF/0000 to FFFF
	group 7B block 2/block 3/block 4	00 to 1F/ – /0000 to FFFF
	group 8A block 2/block 3/block 4	00 to 1F/0000 to FFFF/0000 to FFFF [31]
	group 8B block 2/block 3/block 4	00 to 1F/ – /0000 to FFFF
	group 9A block 2/block 3/block 4	00 to 1F/0000 to FFFF/0000 to FFFF
	group 9B block 2/block 3/block 4	00 to 1F/ – /0000 to FFFF
	group 10A block 2/block 3/block 4	00 to 1F/0000 to FFFF/0000 to FFFF
	group 10B block 2/block 3/block 4	00 to 1F/ – /0000 to FFFF
	group 11A block 2/block 3/block 4	00 to 1F/0000 to FFFF/0000 to FFFF
	group 11B block 2/block 3/block 4	00 to 1F/ – /0000 to FFFF
	group 12A block 2/block 3/block 4	00 to 1F/0000 to FFFF/0000 to FFFF
	group 12B block 2/block 3/block 4	00 to 1F/ – /0000 to FFFF
	group 13A block 2/block 3/block 4	00 to 1F/0000 to FFFF/0000 to FFFF
	group 13B block 2/block 3/block 4	00 to 1F/ – /0000 to FFFF
	group 15A block 2/block 3/block 4	00 to 1F/0000 to FFFF/0000 to FFFF

Standard B/G (R&S®SFU-K190 option)

Standard B/G		in line with country-specific standard
Vision modulation	modulation	B/G
	group delay	
	precorrection	CCIR – B/G Germany general half, B/G Australia (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)
	residual carrier	0 % to 30 %, settable in 0.1 % steps
	S/N ratio	
	video	> 60 dB, weighted
Sound modulation	mode	mono, stereo, dual sound, mono/NICAM, NICAM
	modulation of sound carriers 1, 2	
	modulation mode	FM
	frequency deviation	30 kHz (settable)
	preemphasis	50 µs/75 µs (can be switched off)
	vision/sound carrier frequency spacing	5.5 MHz/5.74 MHz (settable)
	vision/sound carrier level spacing	13 dB/20 dB (settable)
	pilot tone	in sound carrier 2 (can be switched off)
	S/N ratio	
	sound	> 60 dB, weighted (CCIR)
Video signals	internal video generator	see R&S®SFU-K23 option
	external video input	see video input
Audio signals	internal audio generator	see audio generator
	external audio input	see audio input
	audio player	see audio player

[30] Visible if TMC = OFF; available with R&S®SFU V2.20 and R&S®SFU V1.50 software or later.

[31] Visible if TMC = OFF; available with R&S®SFU V2.20 and R&S®SFU V1.50 software or later.

Standard D/K (R&S®SFU-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)
	residual carrier	0 % to 30 %, settable in 0.1 % steps
	S/N ratio	
	video	> 60 dB, weighted
Sound modulation	mode	mono, stereo, dual sound, NICAM, mono/NICAM
	modulation of sound carriers 1, 2	
	modulation mode	FM
	frequency deviation	30 kHz (settable)
	preemphasis	50 µs/75 µs (can be switched off)
	vision/sound carrier frequency spacing	6.5 MHz/6.74 MHz (settable)
	vision/sound carrier level spacing	13 dB/20 dB (settable)
	pilot tone	in sound carrier 2 (can be switched off)
	S/N ratio	
	sound	> 60 dB, weighted (CCIR)
Video signals	internal video generator	see R&S®SFU-K23 option
	external video input	see video input
Audio signals	internal audio generator	see audio generator
	external audio input	see audio input
	audio player	see audio player

Standard I (R&S®SFU-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)
	residual carrier	0 % to 30 %, settable in 0.1 % steps
	S/N ratio	
	video	> 60 dB, weighted
Sound modulation	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 carrier frequency spacing	6 MHz (settable)
	vision/sound carrier level spacing	13 dB (settable)
	modulation of sound carrier 2	
	modulation mode	NICAM
	vision/sound carrier frequency spacing	6.552 MHz (settable)
	vision/sound carrier level spacing	20 dB (settable)
	S/N ratio	
	sound	> 60 dB, weighted (CCIR)
Video signals	internal video generator	see R&S®SFU-K23 option
	external video input	see video input
Audio signals	internal audio generator	see audio generator
	external audio input	see audio input
	audio player	see audio player

Standard M/N (R&S®SFU-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)
	residual carrier	0 % to 30 %, settable in 0.1 % steps
	S/N ratio	
	video	> 60 dB, weighted
Sound modulation	mode	BTSC mono, stereo Korea, dual sound Korea
	modulation of sound carriers 1, 2	
	modulation mode	FM
	frequency deviation	25 kHz (settable)
	preemphasis	50 µs/75 µs (can be switched off)
	vision/sound carrier frequency spacing	4.5 MHz/4.742 MHz (settable)
	vision/sound carrier level spacing	13 dB/20 dB (settable)
	pilot	in sound carrier 2 (can be switched off)
	S/N ratio	
	sound	> 60 dB, weighted (CCIR)
Video signals	internal video generator	see R&S®SFU-K23 option
	external video input	see video input
Audio signals	internal audio generator	see audio generator
	external audio input	see audio input
	audio player	see audio player

Standard L (R&S®SFU-K194 option)

Standard L		in line with country-specific standard
Vision 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)
	residual carrier	0 % to 30 %, settable in 0.1 % steps
Sound modulation	mode	AM mono, mono/NICAM, NICAM
	modulation of sound carrier 1	
	modulation mode	NICAM
	vision/sound carrier frequency spacing	5.85 MHz (settable)
	vision/sound carrier level spacing	27 dB (settable)
	modulation of sound carrier 2	
	modulation mode	AM
	frequency deviation	54 % modulation depth (settable)
	vision/sound carrier frequency spacing	6.5 MHz (settable)
	vision/sound carrier level spacing	10 dB (settable)
Video signals	internal video generator	see R&S®SFU-K23 option
	external video input	see video input
Audio signals	internal audio generator	see audio generator
	external audio input	see audio input
	audio player	see audio player

Multi ATV predefined (R&S®SFU-K199 option)

Multi ATV predefined		in line with country-specific standards and MBRAI
Modulation	standards	B/G, B/G N, I, I1, D/K, D1, D CHINA, M/N, L
	signals	one defined ATV signal per standard
Standard PAL B/G	implementation	in line with MBRAI PAL B/G with A2
	video test signal	PAL, color bar 75 %
	insertion test signal structure	see below
	sound subcarrier	
	sound 1	FM 50 kHz deviation, 5.5 MHz, 13 dB
	sound 2	FM 50 kHz deviation, 5.742 MHz, 20 dB
	audio coding	stereo
	left	1 kHz
	right	1 kHz
	group delay precorrection	CCIR B/G Germany
	residual carrier	10 %
Standard PAL B/G + NICAM	implementation	in line with MBRAI PAL B/G with NICAM
	video test signal	PAL, color bar 75 %
	insertion test signal structure	see below
	sound subcarrier	
	sound 1	FM 50 kHz deviation, 5.5 MHz, 13 dB
	sound 2	NICAM [32] roll-off = 40 %, 5.85 MHz, 20 dB
	audio coding	mono
	sound 1	1 kHz
	group delay precorrection	CCIR B/G Germany
	residual carrier	10 %
Standard PAL I	video test signal	PAL, color bar 75 %
	insertion test signal structure	see below
	sound subcarrier	
	sound 1	FM 50 kHz deviation, 6.0 MHz, 13 dB
	sound 2	NICAM [32] roll-off = 100 %, 6.552 MHz, 20 dB
	audio coding	mono
	sound 1	1 kHz
	group delay precorrection	none
	residual carrier	20 %
Standard PAL I1	implementation	in line with MBRAI PAL I1
	video test signal	PAL, color bar 75 %
	insertion test signal structure	see below
	sound subcarrier	
	sound 1	FM 50 kHz deviation, 6.0 MHz, 13 dB
	sound 2	NICAM [32] roll-off = 100 %, 6.552 MHz, 20 dB
	audio coding	mono
	sound 1	1 kHz
	group delay precorrection	none
	residual carrier	20 %
Standard PAL D/K	video test signal	PAL, FuBK
	insertion test signal structure	see below
	sound subcarrier	
	sound 1	FM 50 kHz deviation, 6.5 MHz, 13 dB
	sound 2	FM 50 kHz deviation, 6.74 MHz, 20 dB
	audio coding	stereo
	left	1 kHz
	right	1 kHz
	group delay precorrection	flat
	residual carrier	12.5 %

[32] Simulation of NICAM spectrum by means of PN sequence and appropriate pulse shaping.

Standard PAL D1	implementation	in line with MBRAI PAL D1
	video test signal	PAL, color bar 75 %
	insertion test signal structure	see below
	sound subcarrier	
	sound 1	FM 50 kHz deviation, 6.5 MHz, 13 dB
	sound 2	NICAM [33] roll-off = 40 %, 5.85 MHz, 20 dB
	audio coding	mono
	sound 1	1 kHz
	group delay precorrection	half, OIRT
	residual carrier	12.5 %
Standard PAL D CHINA	video test signal	PAL, color bar 75 %
	insertion test signal structure	see below
	sound subcarrier	
	sound 1	FM 50 kHz deviation, 6.5 MHz, 10 dB
	audio coding	mono
	sound 1	1 kHz
	group delay precorrection	half, OIRT
	residual carrier	12.5 %
Standard M/N	video test signal	NTSC, SMPTE color bar with PLUGE
	insertion test signal structure	see below
	sound subcarrier	FM 25 kHz deviation, 4.5 MHz, 7 dB
	audio coding	mono
	sound 1	400 Hz
	group delay precorrection	5 MHz/FCC
	residual carrier	12.5 %
Standard SECAM L	implementation	in line with MBRAI SECAM L
	video test signal	SECAM, color bar 75 %
	insertion test signal structure	see below
	sound subcarrier	
	sound 1	NICAM [33] roll-off = 40 %, 5.85 MHz, 27 dB
	sound 2	AM modulation depth = 54 %, 6.5 MHz, 10 dB
	audio coding	
	sound 1	mono
	sound 2	1 kHz
	group delay precorrection	full, TDF
	residual carrier	3 %

[33] Simulation of NICAM spectrum by means of PN sequence and appropriate pulse shaping.

Insertion test signal structure in line with country-specific standards		
Standards B/G, B/G N, I, I1, D/K, D1, D CHINA and IEC 62002 with 2 CH. PAL B (MBRAI) 2 CH. PAL G (MBRAI) 2 CH. PAL B N (MBRAI) 2 CH. PAL G N (MBRAI) 2 CH. PAL I1 (MBRAI) 2 CH. PAL D1 (MBRAI) DVB-T + PAL B (MBRAI) DVB-T + PAL G (MBRAI) DVB-T + PAL B N (MBRAI) DVB-T + PAL G N (MBRAI) DVB-T + PAL I1 (MBRAI) DVB-T + PAL D1 (MBRAI)	first field	
	lines 8, 10	2T pulse
	line 16	data line 1
	lines 17, 18	CCIR17
	line 19	CCIR18/2
	lines 20, 21	teletext test line
	second field	
	line 323	teletext test line
	line 329	data line 2
	lines 330, 331	CCIR330/5
	line 332	CCIR331/1
	line 333	sin(x)/x
	lines 334, 335	teletext test line
Standard M/N	first field	
	line 17	NTC7 composite
	line 18	FCC composite
	second field	
	line 17	NTC7 combined
	line 18	sin(x)/x
Standard L and IEC 62002 with DVB-T + SECAM L (MBRAI) 2 CH. SECAM L (MBRAI)	first field	
	lines 7 to 14	discriminating signal
	line 15	teletext test line
	line 17	CCIR17
	line 18	CCIR18, 6 multiburst packets
	second field	
	lines 320 to 328	discriminating signal
	line 330	CCIR330
	lines 331, 332	CCIR331
	line 333	CCIR331/1
MBRAI signal combinations		
Signal combinations		in line with IEC 62002 (MBRAI)
Digital/analog multi-interferer	pattern L1	
	digital N+2/analog N+4 signal	DVB-T + PAL B (MBRAI)
		DVB-T + PAL G (MBRAI)
		DVB-T + PAL B N (MBRAI)
		DVB-T + PAL G N (MBRAI)
		DVB-T + PAL I1 (MBRAI)
		DVB-T + PAL D1 (MBRAI)
		DVB-T + SECAM L (MBRAI)
Analog multi-interferer	pattern L2	
	2 analog N+2/N+4 signals	2 CH. PAL B (MBRAI)
		2 CH. PAL G (MBRAI)
		2 CH. PAL B N (MBRAI)
		2 CH. PAL G N (MBRAI)
		2 CH. PAL I1 (MBRAI)
		2 CH. PAL D1 (MBRAI)
		2 CH. SECAM L (MBRAI)

Simulation

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

Waveform memory	length	512 sample to 1 Gsample [34] in one-sample steps
	resolution	2 × 16 bit
	loading time for 10 Msample	3 s
	non-volatile memory	hard disk
Clock generation	clock rate	400 Hz to 100 MHz
	accuracy	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, bandwidth –0.1 dB	0.31 × clock rate
	sampling rate	automatically interpolated to the internal 100 MHz data rate
Trigger	operating mode	auto, retrigger, armed auto, armed retrigger
	source	internal, external
	delay	settable from 0 to 2^{32} – 1 samples
	inhibit	settable from 0 to 2^{32} – 1 samples
Marker	position	restart waveform
	delay	settable from 0 to waveform length in samples
Special function	software support	R&S®WinIQSIM™ [35] R&S®SMU-K15 custom OFDM
Signal sets	optional	for additional digital signals and broadcasting standards (R&S®SFU-K3xx options), see ordering information or data sheet “Waveform Libraries and Tools for broadcasting T&M equipment from Rohde & Schwarz”

Waveform libraries (R&S®SFU-K3xx options)

A wide variety of waveform libraries for different standards and interference scenarios is available as a complement to the R&S®SFU-K35 ARB generator option. For more information, see the data sheet “Waveform Libraries and Tools for broadcasting T&M equipment from Rohde & Schwarz ”.

Interferer management (R&S®SFU-K37 option)

Interferer	mode	ARB, ATV predefined, analog I/Q, digital I/Q
	bandwidth	< ±40 MHz (referenced to useful signal)
	level setting range	–60 dB to +60 dB (relative to useful signal) [36]
	frequency offset	–40 MHz to +40 MHz (relative to useful signal frequency)
	points for adding interferer signals	before noise addition/after noise addition
Signal set		activated options, waveforms and interferers, customer-specific waveforms

[34] Waveform memory size and supported length depend on the installed R&S®SFU-B3 memory extension.

[35] With R&S®WinIQSIM™: Software version 4.24 or later supports the download of I/Q data and the control of the R&S®SFU-K35.

[36] High interferer power is at the expense of diminished useful signal values.

Multichannel ARB waveforms (R&S®SFU-K38 option)

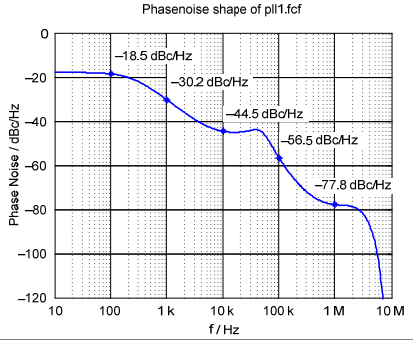
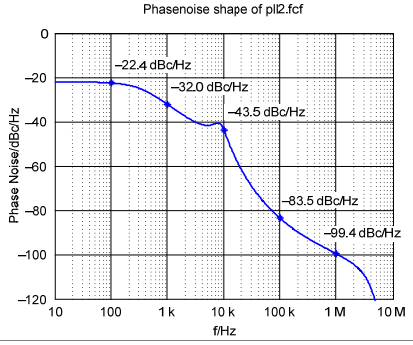
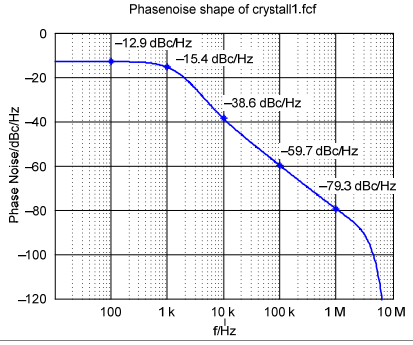
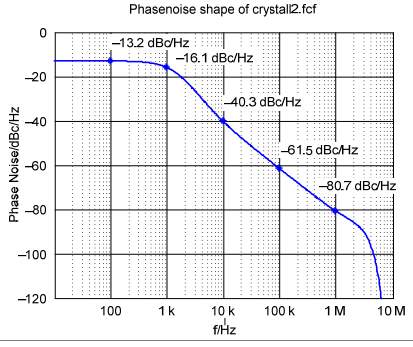
Multichannel ARB waveforms	software support	R&S®ARB toolbox plus
	features [37]	generating, manipulating, resampling, importing and flexible combining of waveforms
Signal set	input files	activated options, waveforms and interferers, customer waveforms
	output files	encrypted waveforms (related waveform library option is required for play out)

AWGN noise (R&S®SFU-K40 option)

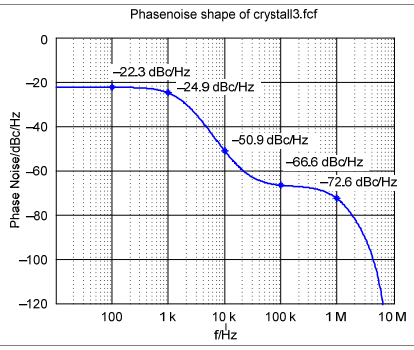
RF bandwidth	3 dB spectrum (AWGN)	> 96 MHz
Noise	density distribution function	Gaussian, statistical, separate for I and Q
	crest factor	18 dB
C/N	setting range	–30 dB to +60 dB
	resolution	0.1 dB
	uncertainty for system bandwidth = symbol rate and C/N < 20 dB	< 0.2 dB
System bandwidth (bandwidth for calculating the noise power)	range	100 kHz to 80 MHz

[37] For detailed information, please refer to the R&S®ARB toolbox plus.

Phase noise (R&S®SFU-K41 option)

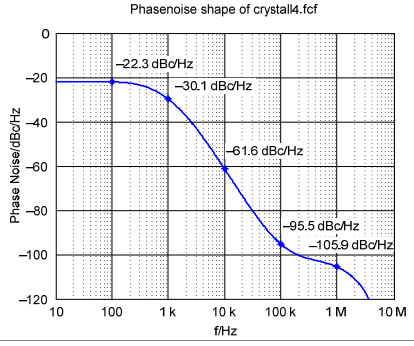
Phase noise	frequency response	selection from profile files	
	amplitude at $f_{carrier}$ ± 100 Hz		
	setting range	–10.0 dBc (1 Hz) to –110.0 dBc (1 Hz), depending on selected profile	
	resolution	0.1 dB	
	max. phase angle	±180°	
	density distribution function	Gaussian	
System bandwidth	sampling rate	10 MHz	
Profile files	phase noise masks	predefined files	
	format	text files, editable	
Special function		customer-specific files can be used	
PLL phase noise masks	simulation of typ. PLL circuits		
PLL 1		frequency	max. phase noise
		100 Hz	–18.5 dBc (1 Hz)
		1 kHz	–30.2 dBc (1 Hz)
		10 kHz	–44.5 dBc (1 Hz)
		100 kHz	–56.5 dBc (1 Hz)
		1 MHz	–77.8 dBc (1 Hz)
PLL 2		frequency	max. phase noise
		100 Hz	–22.4 dBc (1 Hz)
		1 kHz	–32.0 dBc (1 Hz)
		10 kHz	–43.5 dBc (1 Hz)
		100 kHz	–83.5 dBc (1 Hz)
		1 MHz	–99.4 dBc (1 Hz)
VCXO phase noise masks	simulation of typ. oscillator circuits		
Crystal 1		frequency	max. phase noise
		100 Hz	–12.9 dBc (1 Hz)
		1 kHz	–15.4 dBc (1 Hz)
		10 kHz	–38.6 dBc (1 Hz)
		100 kHz	–59.7 dBc (1 Hz)
		1 MHz	–79.3 dBc (1 Hz)
Crystal 2		frequency	max. phase noise
		100 Hz	–13.2 dBc (1 Hz)
		1 kHz	–16.1 dBc (1 Hz)
		10 kHz	–40.3 dBc (1 Hz)
		100 kHz	–61.5 dBc (1 Hz)
		1 MHz	–80.7 dBc (1 Hz)

Crystal 3



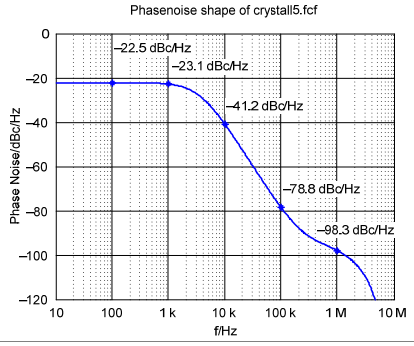
frequency	max. phase noise
100 Hz	–22.3 dBc (1 Hz)
1 kHz	–24.9 dBc (1 Hz)
10 kHz	–50.9 dBc (1 Hz)
100 kHz	–66.6 dBc (1 Hz)
1 MHz	–72.6 dBc (1 Hz)

Crystal 4



frequency	max. phase noise
100 Hz	–22.3 dBc (1 Hz)
1 kHz	–31.1 dBc (1 Hz)
10 kHz	–61.6 dBc (1 Hz)
100 kHz	–59.5 dBc (1 Hz)
1 MHz	–105.8 dBc (1 Hz)

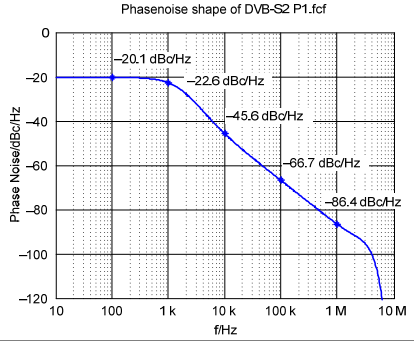
Crystal 5



frequency	max. phase noise
100 Hz	–22.5 dBc (1 Hz)
1 kHz	–23.1 dBc (1 Hz)
10 kHz	–41.2 dBc (1 Hz)
100 kHz	–78.8 dBc (1 Hz)
1 MHz	–98.2 dBc (1 Hz)

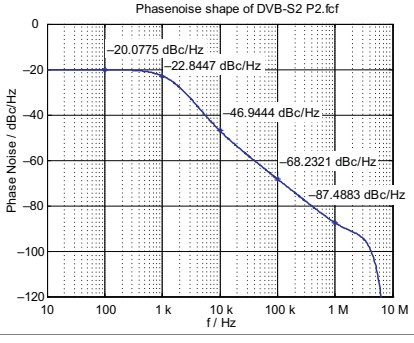
DVB-S2 phase noise masks — based on EN 302307, DIRECTV

DVB-S2 P1

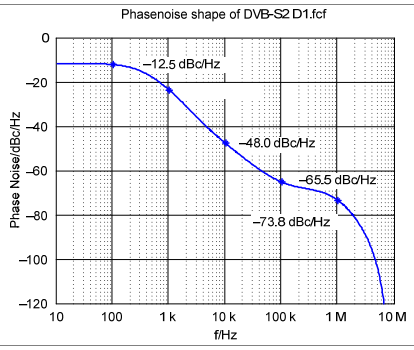
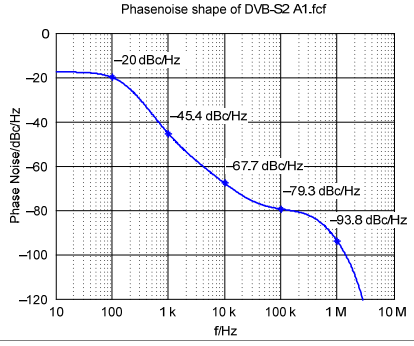
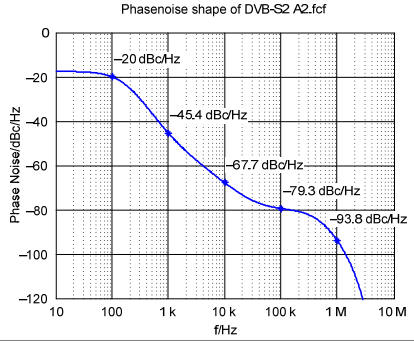
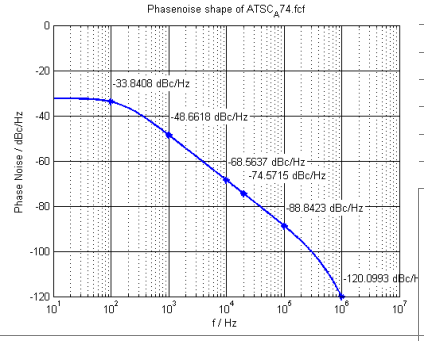


frequency	max. phase noise
100 Hz	–20.1 dBc (1 Hz)
1 kHz	–22.6 dBc (1 Hz)
10 kHz	–45.6 dBc (1 Hz)
100 kHz	–66.7 dBc (1 Hz)
1 MHz	–86.4 dBc (1 Hz)

DVB-S2 P2



frequency	max. phase noise
100 Hz	–20.1 dBc (1 Hz)
1 kHz	–22.8 dBc (1 Hz)
10 kHz	–46.9 dBc (1 Hz)
100 kHz	–68.2 dBc (1 Hz)
1 MHz	–87.5 dBc (1 Hz)

<table>
<tr><td>DVB-S2 D1</td><td> 
</td><td colspan="2"><table>
<tr><td>frequency</td><td>max. phase noise</td></tr>
<tr><td>100 Hz</td><td>–12.5 dBc (1 Hz)</td></tr>
<tr><td>1 kHz</td><td>–24.0 dBc (1 Hz)</td></tr>
<tr><td>10 kHz</td><td>–48.0 dBc (1 Hz)</td></tr>
<tr><td>100 kHz</td><td>–65.5 dBc (1 Hz)</td></tr>
<tr><td>1 MHz</td><td>–73.8 dBc (1 Hz)</td></tr>
</table></td></tr>
<tr><td>DVB-S2 A1</td><td> 
</td><td colspan="2"><table>
<tr><td>frequency</td><td>max. phase noise</td></tr>
<tr><td>100 Hz</td><td>–18.6 dBc (1 Hz)</td></tr>
<tr><td>1 kHz</td><td>–44.2 dBc (1 Hz)</td></tr>
<tr><td>10 kHz</td><td>–66.35 dBc (1 Hz)</td></tr>
<tr><td>100 kHz</td><td>–86.0 dBc (1 Hz)</td></tr>
<tr><td>1 MHz</td><td>–97.5 dBc (1 Hz)</td></tr>
</table></td></tr>
<tr><td>DVB-S2 A2</td><td> 
</td><td colspan="2"><table>
<tr><td>frequency</td><td>max. phase noise</td></tr>
<tr><td>100 Hz</td><td>–20.0 dBc (1 Hz)</td></tr>
<tr><td>1 kHz</td><td>–45.4 dBc (1 Hz)</td></tr>
<tr><td>10 kHz</td><td>–67.7 dBc (1 Hz)</td></tr>
<tr><td>100 kHz</td><td>–79.3 dBc (1 Hz)</td></tr>
<tr><td>1 MHz</td><td>–93.8 dBc (1 Hz)</td></tr>
</table></td></tr>
<tr><td>ATSC phase noise masks</td><td colspan="3">based on ATSC A.74</td></tr>
<tr><td>ATSC A.74</td><td> 
</td><td colspan="2"><table>
<tr><td>frequency</td><td>max. phase noise</td></tr>
<tr><td>100 Hz</td><td>–33.8 dBc (1 Hz)</td></tr>
<tr><td>1 kHz</td><td>–48.7 dBc (1 Hz)</td></tr>
<tr><td>10 kHz</td><td>–68.6 dBc (1 Hz)</td></tr>
<tr><td>20 kHz</td><td>–74.6 dBc (1 Hz)</td></tr>
<tr><td>100 kHz</td><td>–88.8 dBc (1 Hz)</td></tr>
<tr><td>1 MHz</td><td>–120.1 dBc (1 Hz)</td></tr>
</table></td></tr>
<tr><td>Special function</td><td></td><td colspan="2">user-specific files can be used</td></tr>
</table>

Impulsive noise (R&S®SFU-K42 option)

Pulsed addition of an AWGN signal to the useful signal with settable number of pulses per frame and within settable limits of randomly distributed pulse intervals.

AWGN signal (not pulsed)	data	see R&S®SFU-K40 option
Pulse generator		
Frame	duration	10 ms, 100 ms, 1000 ms
Pulse	duration	0.25 µs, fixed
Pulses per frame	setting range	1 to 40000
Minimum pulse interval	for number of pulses > 1	
	setting range	0.25 µs to 16 ms
	resolution	0.25 µs
Maximum pulse interval	for number of pulses > 1	
	setting range	0.25 µs to 16 ms
	resolution	0.25 µs
Distribution of pulse intervals	function	PRBS

Multinoise use (R&S®SFU-K43 option)

Selectable noise sources can be combined to form a cumulative noise signal, which is then added to the useful signal. The C/N and level can be set for the overall signal. **R&S®SFU broadcast test systems delivered before May 2006 require a hardware extension**. [38]

Signal sources	AWGN noise	see R&S®SFU-K40 option
	phase noise	see R&S®SFU-K41 option
	impulsive noise	see R&S®SFU-K42 option
Cumulative signal	signal sources that can be combined	depending on options installed
	AWGN noise	addition can be activated
	phase noise	addition can be activated
	impulsive noise	addition can be activated
C/N setting for cumulative signal	setting range	–30 dB to +60 dB
	resolution	0.1 dB
	uncertainty for system bandwidth = symbol rate and C/N < 20 dB	< 0.2 dB

[38] Check in SETUP -> HARDWARE INFO. Status of installed hardware extension: D/A converter board 2110.3406 model .03 required.

Fading simulator (R&S®SFU-B30 option)

Number of paths		20
	with R&S®SFU-B31 option	40
System bandwidth		80 MHz
Path loss	range	0 dB to 50 dB
	resolution	0.01 dB
	accuracy	< 0.01 dB
Path delay	range	0 s to 5.242 ms
	resolution	10 ns
	with R&S®SFU-K30 option	0.01 ns
Delay groups	maximum number	
	with R&S®SFU-B30 option	4
	with R&S®SFU-B31 option	8
	allowed delay differences	< 40 µs per group
Speed range	range	0 km/h to 1725 km/h for 1 GHz
	accuracy	< 0.128 %
Doppler frequency range	setting range	0 Hz to 1600 Hz
	accuracy	< 0.1 %
Restart		automatic, manual
Insertion loss		–3 dB to +18 dB, automatic or user-defined, with clipping indication
Correlation	correlation	with R&S®SFU-B31 option; two faded channels can be correlated in pairs
	correlation coefficient	
	setting range	0 % to 100 %
	resolution	5 %
	correlation phase	
	setting range	0° to 360°
	resolution	1°
Fading profiles		
Pure Doppler	frequency ratio	(–1 to +1) × current Doppler frequency
	resolution	0.01 × current Doppler frequency
Static and constant phase	path loss	0 dB to 50 dB
	phase	0° to 360°
	resolution	1°
Rayleigh fading	pseudo noise interval	> 93 h
Rice fading	combination of Rayleigh fading and pure Doppler	
	power ratio [39]	–30 dB to +30 dB
GAUSS+DOPPLER (PI, PO profile)	amplitude distribution	pseudo noise interval > 93 h
	power density function	$S(\tau i,f) = G(0.1A; 0; 0.08fd) + \delta(f - 0.5fd)$
GAUSS(0.08fd) (PI, PO profile)	amplitude distribution	pseudo noise interval > 93 h
	power density function	$S(\tau i,f) = G(A; f; 0.08fd)$
GAUSS(0.1fd) (VU30, MR100 profile)	amplitude distribution	pseudo noise interval > 93 h
	power density function	$S(\tau i,f) = G(A; f: 0.1fd)$
Lognormal fading	standard deviation	0 dB to 12 dB
	resolution	1 dB
	local constant	12 m to 200 m for f_{RF} = 1 GHz

[39] Ratio of discrete component to distributed component.

Enhanced fading (R&S®SFU-K30 option)

30 MHz fine delay mode	number of paths	12, 24 (with R&S®SFU-B31 option)
	system bandwidth	30 MHz
	path delay	see R&S®SFU-B30 option
	resolution	0.01 ns
50 MHz fine delay mode	number of paths	8, 16 (with R&S®SFU-B31 option)
	system bandwidth	50 MHz
	path delay	see R&S®SFU-B30 option
	resolution	0.01 ns
Moving delay mode	system bandwidth	50 MHz
	fading	
	number of fading paths	2 per signal path
	profile	none
	reference path	
	delay	0 s to 40 µs
	resolution	10 ns
	moving delay path	
	mean delay	150 ns to 39.85 µs
	delay variation	0.3 µs to 40 µs
	resolution	10 ns
	variation period	10 s to 500 s in steps of 100 ms
Birth-death mode	system bandwidth	50 MHz
	fading	
	number of fading paths	2 per signal path
	profile	pure Doppler
	speed range	see R&S®SFU-B30 option
	Doppler frequency range	see R&S®SFU-B30 option
	delay	
	minimum delay	0 s to 40 µs [40]
	delay grid	100 ns to 40/3 µs [40]
	resolution	1 ns
	grid positions	3 to 50 [40]
	hopping parameters	
	start offset	0 s to 429 s
	hopping dwell time	1 ms to 429 s
	total (start offset + hopping dwell time)	max. 429 s
	resolution	100 ns
Two-path dynamic delay	system bandwidth	50 MHz
	fading	
	number of fading paths	2 per signal path
	moving mode	hopping/sliding
	hopping positions	2/alternating
	sliding function	sinusoidal
	profile	static, pure Doppler, Rayleigh
	speed range	see R&S®SFU-B30 option
	Doppler frequency range	see R&S®SFU-B30 option
	delay	
	reference path (statistically in delay)	0 s to 1638.00 µs
	moving path	
	minimum delay	0 s to 1000.00 µs
	maximum delay	0 s to 1000.00 µs
	resolution	10 ns
	hopping dwell time	100 ms to 10 s
	sliding period	50 s to 1000 s
	resolution	10 ms

[40] The maximum delay range of 40 µs may not be exceeded.

Gaussian fading (R&S®SFU-K32 option)

Gaussian fading profiles		in line with EN 50248
GAUS1	amplitude distribution	pseudo noise interval > 93 h
	power density function	$S(\tau i,f)$ = G (A, –0.8fd, 0.05fd) + G (A1, +0.4fd, 0.1fd), where A1 is 10 dB less than A
GAUS2	amplitude distribution	pseudo noise interval > 93 h
	power density function	$S(\tau i,f)$ = G (B, +0.7fd, 0.1fd) + G (B1, –0.4fd, 0.15fd), where B1 is 15 dB less than B
GAUSDAB	amplitude distribution	pseudo noise interval > 93 h
	power density function	$S(\tau i,f)$ = G (A, ±0.7fd, 0.1fd) where +0.7fd is used for paths of even path number and –0.7fd is used for paths of uneven path number; path 1 is an exception and is parameterized with +0.7fd

Analysis

RF power measurements (R&S®SFU-K55 option)

Power measurements require the use of R&S®NRP-Zxx power sensors.

RF power measurements		for analog and digital modulation modes
Power measurement	display	measured power
		relative power
	units	W, dBm, dBµV, selectable
Operating mode	auto	measurement frequency coupled to RF frequency
	user	user-selectable measurement frequency
Filter	auto	automatic setting of filter length
	user	manual setting of filter length
	optimization	auto once
	length	0 to 128, settable
Range	frequency range	depends on the R&S®NRP-Zxx power sensor being used
	level range	
	dynamic range	
Power sensors	connectors	USB, BNC female, front
	calibration	zero
	supported power sensors	R&S®NRP-Z11, R&S®NRP-Z21, R&S®NRP-Z22, R&S®NRP-Z23, R&S®NRP-Z24, R&S®NRP-Z51, R&S®NRP-Z52, R&S®NRP-Z55, R&S®NRP-Z91

BER measurements (R&S®SFU-K60 option)

BER measurements	for digital modulation modes	
	support	digital standard
	internal	R&S®SFU-K1 (DVB-T)
		R&S®SFU-K2 (DVB-C/ISDB-C)
		R&S®SFU-K3 (DVB-S)
		R&S®SFU-K4 (ATSC)
		R&S®SFU-K5 (J.83/B)
		R&S®SFU-K6 (ISDB-T)
		R&S®SFU-K11 (T-DMB/DAB/DMB)
		R&S®SFU-K13 (DVB-SH)
		R&S®SFU-K14 (ATSC/A-VSB)
		R&S®SFU-K18 (ATSC-M/H)
	external [41]	R&S®SFU-K16 (DVB-T2)
		R&S®SFU-K17 (DVB-C2)
		R&S®SFU-K8 (DVB-S2)
		R&S®SFU-K9 (DIRECTV)
		R&S®SFU-K7 (DMB-T)
		R&S®SFU-K12 (DTMB/DMB-TH)
		R&S®SFU-K15 (CMMB)
	no support	R&S®SFU-K10 (MediaFLO™)
Display	measured value	BER
		error count
		measurement time
Start/restart		manual
PRBS measurements		
Inputs for BER clock, BER data, BER enable	connectors	BNC female, rear
	input impedance	50 Ω
	input level	HCT
BER data	input data rate	up to 90 Mbit/s
	PRBS	$2^{23} – 1$ / $2^{15} – 1$ (in line with ITU-T O.151)
BER clock, BER data	polarity	normal, inverted
BER enable		always, active high, active low
Output for BER error	connector	BNC female, rear
	output impedance	50 Ω
	output level	HCT
MPEG-2 TS measurements		
Input	input interfaces	ASI, SPI (stuffing off), SMPTE 310 (see “MPEG-2 inputs”)
	input signal	TS packet (see “Internal test signals”)
	payload (PRBS in line with ITU-T O.151)	$2^{23} – 1$ / $2^{15} – 1$
	PID	NULL (1FFF (hex)), variable
DATA VALID	applicable to SPI interface	active
		always

Trigger inputs/outputs

Triggers and connections reserved for future use

Triggers 1 to 10 IN/OUT	connector	D-Sub female, 25 pins, rear
	input impedance	high impedance
	load resistor	> 200 Ω
	input/output level	HCT
Main trigger IN	connector	BNC female, rear
	input impedance	50 Ω
	input level	HCT
Main trigger OUT	connector	BNC female, rear
	load resistor	> 200 Ω
	output level	HCT

[41] External support may be needed to perform BER measurement, e.g. by switching off FEC, LDPC or using T2MI gateway.

General data

System data

System	operating system	PC platform
		Windows XP Embedded
		internal hard disk
	memories for settings	50
Local control	display	XVGA, 1024 × 768 pixel
	controls	rotary knob, hardkeys and softkeys
External control	controls	external mouse and keyboard via USB
Remote control	command set	SCPI 1999.5
	IEC/IEEE	IEC 60625 (IEEE 488)
	address range	1 to 30
	IEC/IEEE interface functions	SH1, AH1, T6, L4, SR1, RL1, PP1, DC1, DT1, C0
	Ethernet	10/100BaseT
Connectors	IEC/IEEE	Amphenol, 24 pins, rear
	Ethernet	RJ-45, rear
	USB	USB, front and rear
	AC supply input	IEC 60320 C14, rear

Operating data

Power supply	input voltage range	100 V to 240 V
	AC, nominal	3.6 A to 1.3 A
	AC supply frequency	47 Hz to 63 Hz
	power factor correction	in line with EN 61000-3-2
EMC		in line with EN 55011 class B, EN 61326
Immunity to interfering field strength		up to 10 V/m
Environmental conditions	operating temperature range	+5 °C to +45 °C [42] in line with EN 60068-2-1, EN 60068-2-2
	storage temperature range	–20 °C to +60 °C
	climatic resistance	95 % rel. humidity, cyclic test at +25 °C/+40 °C, in line with EN 60068-2-3, EN 60068-2-30
Mechanical resistance	vibration, sinusoidal	5 Hz to 150 Hz, max. 2 g at 55 Hz, 55 Hz to 150 Hz, 0.5 g const., 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 61010B-1, CSA C22.2 No. 1010.1
Dimensions	W × H × D	435 mm × 192 mm × 460 mm (4 HU) (17.14 in × 7.56 in × 18.12 in (4 HU))
Weight	fully equipped	15 kg (33.1 lb)
Recommended calibration interval		3 years
Standard warranty period		1 year

[42] Reduced brightness of LCD at higher operating temperatures.

Ordering information

Option identification: R&S®SFU-Bxy = hardware option, R&S®SFU-Kxy = software option.
Delivery of R&S®SFU base unit only with at least one coder or with the R&S®SFU-K81 option installed.
If the R&S®SFU-K81 option is installed, no digital or analog modulation system can be used.

Designation	Type	Order No.
Broadcast Test System including power cable, hardcopy of getting started, CD-ROM (includes user manuals and getting started), R&S®SFU-B2 and R&S®SFU-B3	R&S®SFU	2110.2500.02
Options		
Basic configuration		
Realtime Disabled (option available only at initial delivery)	R&S®SFU-K81	2110.7960.02
Realtime Enabled (only if R&S®SFU-K81 is installed)	R&S®SFU-K82	2110.7976.02
RF path		
High Power	R&S®SFU-B90	2110.8008.03
Digital modulation systems		
Terrestrial standards		
DVB-T2 Coder (requires an installed R&S®SFU-B1 or R&S®SFU-B10 for single PLP or R&S®SFU-B15 for single PLP and multi PLP)	R&S®SFU-K16	2110.7847.02
DVB-T/-H Coder	R&S®SFU-K1	2110.7301.02
DVB-SH Coder	R&S®SFU-K13	only on request
T-DMB/DAB/DMB Coder	R&S®SFU-K11	2110.7518.02
DMB-T (TDS-OFDM) Coder (requires an installed R&S®SFU-B1 or R&S®SFU-B10)	R&S®SFU-K7	only on request
DTMB/DMB-TH (TDS-OFDM) Coder (requires an installed R&S®SFU-B1, R&S®SFU-B10 or R&S®SFU-B15)	R&S®SFU-K12	2110.7760.02
CMMB Coder (requires an installed R&S®SFU-B1, R&S®SFU-B10 or R&S®SFU-B15)	R&S®SFU-K15	2110.7818.02
ISDB-T/ISDB-T_B/ISDB-T_{SB} Coder	R&S®SFU-K6	2110.7376.02
ISDB-Tmm Coder (requires an installed R&S®SFU-B15)	R&S®SFU-K106	in preparation
ATSC/8VSB Coder	R&S®SFU-K4	2110.7353.02
ATSC-M/H Coder	R&S®SFU-K18	2110.7860.02
ATSC/A-VSB Coder	R&S®SFU-K14	only on request
MediaFLO™ Coder (requires an installed R&S®SFU-B10 or R&S®SFU-B15)	R&S®SFU-K10	only on request
Cable standards		
DVB-C2 Coder (requires an installed R&S®SFU-B15)	R&S®SFU-K17	only on request
DVB-C/ISDB-C Coder	R&S®SFU-K2	2110.7324.02
J.83/B / DOCSIS Coder	R&S®SFU-K5	2110.7360.02
Satellite standards		
DVB-S2 Coder (requires an installed R&S®SFU-B1, R&S®SFU-B10 or R&S®SFU-B15)	R&S®SFU-K8	2110.7399.02
DVB-S/DVB-DSNG Coder	R&S®SFU-K3	2110.7330.02
DIRECTV Legacy Modulation Coder (requires an installed R&S®SFU-B1 or R&S®SFU-B10 or R&S®SFU-B15)	R&S®SFU-K9	2110.7401.02
AMC Advanced Modulation Coder (requires an installed R&S®SFU-K8 and an installed R&S®SFU-B1, R&S®SFU-B10 or R&S®SFU-B15)	R&S®SFU-K108	only on request

Designation	Type	Order No.
Analog modulation systems		
AM/FM RDS Coder (requires an installed R&S®SFU-B2)	R&S®SFU-K170	2110.7830.02
ATV Standard B/G Coder (requires an installed R&S®SFU-B2)	R&S®SFU-K190	2110.8050.02
ATV Standard D/K Coder (requires an installed R&S®SFU-B2)	R&S®SFU-K191	2110.8037.02
ATV Standard I Coder (requires an installed R&S®SFU-B2)	R&S®SFU-K192	2110.8043.02
ATV Standard M/N Coder (requires an installed R&S®SFU-B2)	R&S®SFU-K193	2110.8066.02
ATV Standard L Coder (requires an installed R&S®SFU-B2)	R&S®SFU-K194	2110.8072.02
Multi ATV Predefined (requires an installed R&S®SFU-B3)	R&S®SFU-K199	2110.8089.02
Simulation		
Fading Simulator	R&S®SFU-B30	2110.7530.02
Fading Simulator Extension to 40 Paths (requires an installed R&S®SFU-B30)	R&S®SFU-B31	2110.7547.02
Enhanced Fading (requires an installed R&S®SFU-B30)	R&S®SFU-K30	2110.7560.02
Gaussian Fading (requires an installed R&S®SFU-B30) (included in R&S®SFU-B30 option)	R&S®SFU-K32	2110.7630.02
ARB Generator (requires an installed R&S®SFU-B3)	R&S®SFU-K35	2110.7601.02
Interferer Management	R&S®SFU-K37	2110.7647.02
Multichannel ARB Waveforms	R&S®SFU-K38	2110.7924.02
AWGN Noise	R&S®SFU-K40	2110.7653.02
Phase Noise	R&S®SFU-K41	2110.7660.02
Impulsive Noise	R&S®SFU-K42	2110.7676.02
Multinoise Use (requires at least one installed R&S®SFU-K40, R&S®SFU-K41 or R&S®SFU-K42 and installed hardware D/A converter board 2110.3406 model .03)	R&S®SFU-K43	2110.7682.02
Custom OFDM (generates customer-specific OFDM signals)	R&S®SMU-K15	1160.6402.02
Waveform libraries		
DVB-T2 Waveforms (can be used with R&S®SFU-K35)	R&S®SFU-K359	2112.3803.02
ISDB-Tmm Waveforms (can be used with R&S®SFU-K35)	R&S®SFU-K365	in preparation
CMMB Waveforms (can be used with R&S®SFU-K35)	R&S®SFU-K358	2112.3726.02
MediaFLO™ Waveforms (can be used with R&S®SFU-K35)	R&S®SFU-K355	2110.2974.02
DVB-H Waveforms (can be used with R&S®SFU-K35)	R&S®SFU-K352	2110.4425.02
T-DMB/DAB Waveforms (can be used with R&S®SFU-K35)	R&S®SFU-K351	2110.4277.02
DRM Waveforms (can be used with R&S®SFU-K35)	R&S®SFU-K353	2110.4554.02
DRM+ Waveforms (can be used with R&S®SFU-K35)	R&S®SFU-K361	in preparation
HD Radio™ Waveforms (can be used with R&S®SFU-K35, Ibiquity license required)	R&S®SFU-K357	only on request
DTV Interferers (can be used with R&S®SFU-K35)	R&S®SFU-K354	2110.4690.02
Cable Interferers (can be used with R&S®SFU-K35)	R&S®SFU-K356	2110.3212.02
MoCA® Waveforms (can be used with R&S®SFU-K35)	R&S®SFU-K364	in preparation

Designation	Type	Order No.
Satellite Interferers (can be used with R&S®SFU-K35)	R&S®SFU-K363	2115.2537.02
ISDB-S Waveforms (can be used with R&S®SFU-K35)	R&S®SFU-K362	2115.2450.02
Analog Signals (can be used with R&S®SFU-K35)	R&S®SFU-K360	2110.3941.02
Digital baseband		
TS Generator including SDTV streams	R&S®SFU-K20	2110.7476.02
TRP Player (requires an installed R&S®SFU-B6 and an installed R&S®SFU-B4)	R&S®SFU-K22	2110.7499.02
TS/ETI Recorder (requires an installed R&S®SFU-K22, R&S®SFU-B6 and R&S®SFU-B4)	R&S®SFU-K21	2110.7482.02
TS generator libraries		
DVB-H Stream Library (requires an installed R&S®SFU-K20)	R&S®DV-DVBH	2085.8704.02
Test Card M Streams (requires an installed R&S®SFU-K20)	R&S®DV-TCM	2085.7708.02
HDTV Sequences (requires an installed R&S®SFU-K20)	R&S®DV-HDTV	2085.7650.02
H.264 Stream Library (requires an installed R&S®SFU-K20)	R&S®DV-H264	2085.9052.02
ISDB-T Stream Library (requires an installed R&S®SFU-K20)	R&S®DV-ISDBT	2085.9146.02
TRP player libraries		
T-DMB/DAB Streams (requires an installed R&S®SFU-K22)	R&S®SFU-K221	2110.4348.02
DAB+ Streams (requires an installed R&S®SFU-K22)	R&S®SFU-K223	2110.4760.02
MediaFLO™ Streams (requires an installed R&S®SFU-K22)	R&S®SFU-K222	2110.2968.02
ISDB-T Streams (requires an installed R&S®SFU-K22)	R&S®SFU-K224	2110.4777.02
CMMB Streams (requires an installed R&S®SFU-K22)	R&S®SFU-K225	2112.3649.02
ATSC Mobile DTV Streams (requires an installed R&S®SFU-K22)	R&S®SFU-K226	2110.3812.02
DVB-T2 MI Streams (requires an installed R&S®SFU-K22)	R&S®SFU-K227	2115.2120.02
Transport Streams for EMC (requires an installed R&S®SFU-K22)	R&S®SFU-K228	2115.2520.02
DMB Streams France (requires an installed R&S®SFU-K22)	R&S®SFU-K229	2115.2543.02

Designation	Type	Order No.
Analog baseband		
Video Generator (included in R&S®SFU-K190 to R&S®SFU-K194)	R&S®SFU-K23	2110.7799.02
Analog video signal library		
ATV Video (can be used with R&S®SFU-K190 to R&S®SFU-K194)	R&S®ATV-Video	2110.4831.02
Measurement and analysis functions		
RF Power Measurements (can be used with R&S®NRP-Zxx power sensors)	R&S®SFU-K55	2110.7753.02
BER Measurements (cannot be used at all or only to a limited extent for DVB-S2, DIRECTV, DTMB, DMB-TH and MediaFLO™)	R&S®SFU-K60	2110.7782.02
Baseband inputs/outputs		
Extended I/Q	R&S®SFU-K80	2110.7953.02
ETI Input/Output	R&S®SFU-B11	2110.7553.03
User I/O (additional input/output) (supported by R&S®SFU firmware versions < 1.70)	R&S®SFU-B5	only on request
Coder extensions		
Coder Extension 1 (for digital TV)	R&S®SFU-B1	only on request
Coder Extension 10 (for digital TV)	R&S®SFU-B10	2110.7747.02
Coder Extension 15 (for digital TV)	R&S®SFU-B15	2110.7918.02
Coder Extension 2 (for analog TV) (preinstalled in R&S®SFU from serial no. 101000)	R&S®SFU-B2	2110.7430.02
Memory extensions		
Memory Extension 1 (512 Mbyte/128 sample) upgrade for R&S®SFU up to serial no. 101000 (not preinstalled in R&S®SFU up to serial no. 101000, preinstalled for R&S®SFU with serial no. 101000 to 101699)	R&S®SFU-B3	2110.7447.02
Memory Extension 1 (4 Gbyte/1 Gsample) upgrade for R&S®SFU starting with serial no. 101700)	R&S®SFU-B3	2110.7447.04
Memory Extension 2 (for TRP player) (preinstalled in R&S®SFU from serial no. 101000 to 101699 integrated in R&S®SFU from serial no. 101700)	R&S®SFU-B4	2110.7453.02
Additional Hard Disk (for TRP player) (for R&S®SFU with serial numbers < 101000)	R&S®SFU-B6	2110.7501.02
Additional Hard Disk (for TRP Player) (for R&S®SFU with serial numbers > 101000)	R&S®SFU-B6	2110.7501.03
Other expansions		
ARB Generator Upgrade Kit (for R&S®SFU with serial numbers < 101xxx)	R&S®SFU-U35	2110.2900.02
Upgrade Kit for R&S®SFU-K43 (for R&S®SFU with D/A converter board 2110.3406 models .01 and .02)	R&S®SFU-U43	2110.7699.02
Impedance Matching Pad 75/50 Ω (can be used with R&S®SFU-K190 to R&S®SFU-K194)	R&S®SFU-Z19	2110.7276.02

Designation	Type	Order No.
Recommended extras		
Hardcopy of user manuals; includes getting started (in English)		2110.2522.12
Documentation of R&S®SFU Calibration Values	R&S®SFU-DCV	2082.0490.30
LVDS Cable for digital I/Q input/output (2 m)	R&S®Digital IQ cable 26P2M	1130.1302.00
Adapter for Telescopic Sliders	R&S®ZZA-T45	1109.3774.00
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 DVD Drive	R&S®PSP-B6	1134.8201.22

Service options		
Two-Year Calibration Service	R&S®CO2SFU	Please contact your local Rohde & Schwarz sales office.
Three-Year Calibration Service	R&S®CO3SFU	
Five-Year Calibration Service	R&S®CO5SFU	
One-Year Repair Service following the warranty period	R&S®RO2SFU	
Two-Year Repair Service following the warranty period	R&S®RO3SFU	
Four-Year Repair Service following the warranty period	R&S®RO5SFU	

For product brochure, see PD 0758.1658.12 and www.rohde-schwarz.com

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- Uncompromising quality
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Rohde&Schwarz is an independent group of companies specializing in electronics. It is a leading supplier of solutions in the fields of test and measurement, broadcasting, radiomonitoring and radiolocation, as well as secure communications. Established more than 75 years ago, Rohde&Schwarz has a global presence and a dedicated service network in over 70 countries. Company headquarters are in Munich, Germany.

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- Continuous improvement in environmental sustainability
- ISO 14001-certified environmental management system

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