

R&S® SFU

Broadcast Test System

Specifications



75 Years of
Driving
Innovation

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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
- Internal arbitrary waveform generator
- Use of waveform and data stream libraries
- Wide choice of libraries with test waveforms available
- 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 pixels (XVGA format)
- Intuitive user interface with Windows XP Embedded
- Context-sensitive help system
- User-definable favorites for fast access

Outstanding signal quality

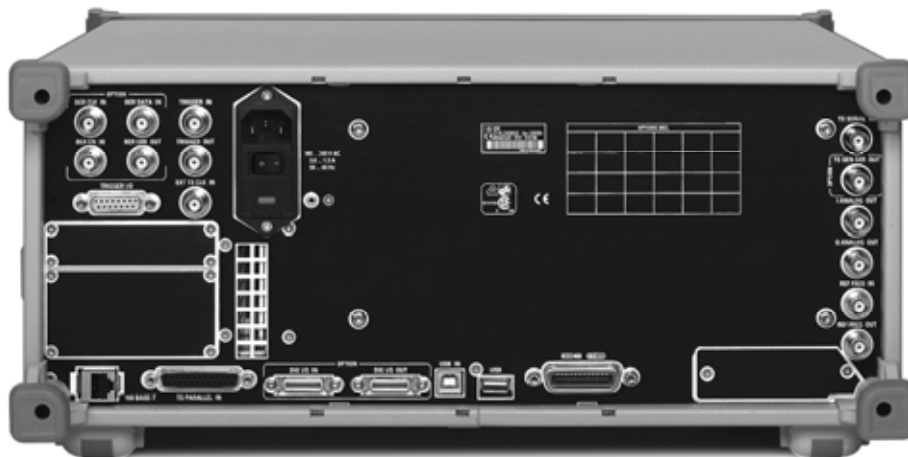
- I/Q modulator with 180 MHz RF bandwidth
- Very low SSB phase noise of typ. -135 dBc at 1 GHz (20 kHz carrier offset, 1 Hz measurement bandwidth)
- High optional output power of up to +19 dBm (PEP), overrange +26 dBm
- High-stability reference oscillator as standard

Unrivalled 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
- Video generator for realtime signal generation
- Arbitrary waveform generator with 64 Msample, supported by R&S®WinIQSIM™ 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 μ Hz

Frequency sweep

Digital sweep in discrete steps	operating modes	automatic, single shot, manual or external trigger, 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	$<1 \times 10^{-9}/\text{day}$
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. sinewave)	5 MHz, 10 MHz or 13 MHz
	maximum deviation	3×10^{-6}
	input level	≥ -6 dBm to ≤ 19 dBm
	limits recommended	0 dBm to 19 dBm
	input impedance	50 Ω
Output for internal reference signal	connector	BNC female, rear
	frequency (approx. sinewave)	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	$\geq +13$ dBm (PEP) ¹
	with R&S®SFU-B90 option (high power)	$\geq +19$ 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 \leq 3 GHz / level \geq -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 \leq 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
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 \leq 1 GHz	50 W
	1 GHz < f \leq 2 GHz	25 W
2 GHz < f \leq 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 offset from carrier and outside the modulation spectrum	
	$0.3 \text{ MHz} \leq f \leq 200 \text{ MHz}$	< -77 dBc
	$200 \text{ MHz} < f \leq 1.5 \text{ GHz}$	< -80 dBc
	$1.5 \text{ GHz} < f \leq 3.0 \text{ GHz}$	< -74 dBc
	> 850 kHz offset from carrier and outside the modulation spectrum	
	$0.3 \text{ MHz} \leq f \leq 200 \text{ MHz}$	< -77 dBc
	$200 \text{ MHz} < f \leq 1.5 \text{ GHz}$	< -86 dBc
	$1.5 \text{ GHz} < f \leq 3.0 \text{ GHz}$	< -80 dBc
	caused by power supply unit or mechanical components, at RF = 1 GHz, 50 Hz to 10 kHz offset from carrier	< -70 dBc
Subharmonics	$f > 1.5 \text{ GHz}$ to 3.0 GHz	< -74 dBc
Wideband noise	carrier offset > 10 MHz, measurement bandwidth 1 Hz CW	
	$20 \text{ MHz} \leq f \leq 200 \text{ MHz}$	< -146 dBc
	$200 \text{ MHz} < f \leq 1.5 \text{ GHz}$	< -150 dBc
	$1.5 \text{ GHz} < f \leq 3 \text{ GHz}$	< -148 dBc
	vector modulation with full-scale input	
	I/Q input gain +3 dB	
	$20 \text{ MHz} \leq f \leq 200 \text{ MHz}$	< -143 dBc
	$200 \text{ MHz} < f \leq 1.5 \text{ GHz}$	< -146 dBc
	$1.5 \text{ GHz} < f \leq 3 \text{ GHz}$	< -145 dBc
SSB phase noise	carrier offset 20 kHz, measurement bandwidth 1 Hz	
	$20 \text{ MHz} \leq f \leq 200 \text{ MHz}$	< -128 dBc
	$f = 1 \text{ GHz}$	< -131 dBc
	$f = 2 \text{ GHz}$	< -125 dBc
	$f = 3 \text{ GHz}$	< -121 dBc
Residual FM	rms value at $f = 1 \text{ GHz}$	
	300 Hz to 3 kHz	< 1 Hz
	20 Hz to 23 kHz	< 4 Hz
Residual AM	rms value 20 Hz to 23 kHz at $f = 1 \text{ GHz}$	< 0.02 %

High power (R&S®SFU-B90 option)

Extends the output level	
Maximum level	19 dBm

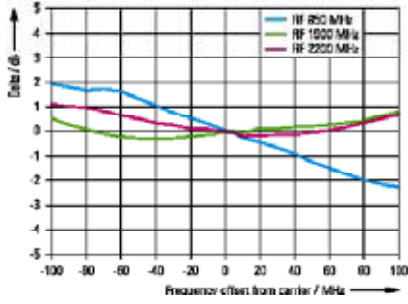
I/Q modulation

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	$\sqrt{V_i^2 + V_q^2} = 0.5 \text{ V}$
	minimum input voltage for ALC state ON	0.1 V
Static error vector	rms value	
	f \leq 200 MHz	<0.3 %
	f > 200 MHz	<(0.2 % + 0.1 % \times f/GHz)
	peak value	
	f > 200 MHz	<(0.4 % + 0.2 % \times 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	0.01 %
	gain imbalance	
	setting range	-1 dB to +1 dB
	resolution	0.001 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	$\sqrt{V_i^2 + V_q^2} = 0.5 \text{ V}$
Modulation frequency range ³	minimum input voltage for ALC state ON	0.1 V
	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, symbol rate 10 kHz	
	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	
	bandwidth 0.1 dB	40 MHz
I/Q impairment	I offset, Q offset	
	setting range	-10 % to +10 %
	resolution	0.01 %
	gain imbalance	
	setting range	-1 dB to +1 dB
	resolution	0.01 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 $R_L = 50 \Omega$, 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	$\sqrt{V_i^2 + V_q^2} = 0.5 \text{ V}$	
	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	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	16 bit	
	symbol rate	100 Msps	

Digital baseband

Internal test signals

MPEG-2 TS packet	header + 184 byte payload PID	00 (hex), FF (hex), PRBS (selectable) 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 at "Internal test signals"
TS EXT CLK	connector	BNC female, rear
	input level	TTL, sinewave (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, ETI NA5592, ETI NA5376
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
Serial ETI output ⁵	coding	HDB3
	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 C.I. >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 streams (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	sinewave, rectangle, triangle
	frequency	1 MHz to 100 kHz
	amplitude	0 ms to 1 ms, in increments of 0.1 μs
Signal set		moving picture sequences and test patterns with test tones, for 625 and 525 lines; DVB/ATSC systems, additional signals via options

TS recorder (R&S® SFU-K21 option) (see ordering information)

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) (see ordering information)

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

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 input	connector	included in R&S®SFU-K190 to -K194 BNC female, front panel, I input with R&S®SFU-Z19 adapter
	input level CCVS	$V_{pp} = 1 \text{ V}$
	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

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	
	stereo1	AF L: 1 kHz AF R: 2 kHz
	stereo2	AF L: 1 kHz AF R: 1 kHz
	stereo3	AF L: 1 kHz AF R: OFF
	stereo4	AF L: OFF AF R: 1 kHz
	dual1	AF L: 2 kHz AF R: 5 kHz
	dual2	AF L: 1 kHz AF R: 1 kHz
	dual3	AF L: 1 kHz AF R: OFF
	dual4	AF L: OFF AF R: 1 kHz
	mono1	AF: 1 kHz
	mono2	AF: 4 kHz
	mono3	AF: 10 kHz
	mono4	AF: 100 Hz

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

Internal video signal generator		included in R&S® SFU-K190 to -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	
	lines 8, 10	2T pulse
	line 16	data line 1
	line 17	CCIR17
	line 18	CCIR18/1
	line 19	CCIR18/2
	lines 20, 21	teletext test line
	second field	
	line 329	data line 2
	line 330	CCIR330/5
	line 331	2T pulse
	line 332	CCIR331/1
	line 333	sinx/x
	lines 334, 335	teletext test line
	PAL M – color bar 75 %	first field
line 17		NTC7 composite
line 18		FCC composite
second field		
line 17		NTC7 combined
line 18		sinx/x

PAL N – color bar 75 %	first field	
	lines 8, 10	2T pulse
	line 16	data line 1
	line 17	CCIR17
	line 18	CCIR18/1
	line 19	CCIR18/2
	lines 20, 21	teletext test line
	second field	
	line 329	data line 12
	line 330	CCIR330/5
	line 331	2T pulse
	line 332	CCIR331/1
	line 333	sinx/x
	lines 334, 335	teletext test line
NTSC – color bar 75 %	first field	
	line 17	NTC7 composite
	line 18	FCC composite
	second field	
	line 17	NTC7 combined
	line 18	sinx/x
SECAM – color bar 75 %	first field	
	lines 7 to 15	discriminating signal
	line 16	data line 1
	line 17	CCIR17
	line 18	CCIR18/1
	line 19	CCIR18/2
	lines 20, 21	teletext test line
	second field	
	lines 320 to 328	discriminating signal
	line 330	CCIR330/5
	line 331	2T pulse
	line 332	CCIR331/1
	line 333	sinx/x
	line 334, 335	teletext test line
PAL – FuBK	first field	
	lines 8, 10	2T pulse
	line 16	data line 1
	line 17	CCIR17
	line 18	CCIR18/1
	line 19	CCIR18/2
	lines 20, 21	teletext test line
	second field	
	line 329	data line 2
	line 330	CCIR330/5
	line 331	2T pulse
	line 332	CCIR331/1
	line 333	sinx/x
	lines 334, 335	teletext test line
Additional video signals	ATV video	see R&S® ATV video option

Digital modulation systems

Terrestrial standards

DVB-T/H (R&S®SFU-K1 option)

DVB-T/H	in line with EN 300744/EN 302304	
Modulation	mode	COFDM
	bandwidth	5 MHz, 6 MHz, 7 MHz, 8 MHz (settable for variable bandwidth: 1 MHz to 10 MHz)
	MER	>40 dB ⁶
	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

T-DMB/DAB (R&S®SFU-K11 option)

T-DMB/DAB	in line with T-DMB/EN 300401	Korea/Europe
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 ⁷
	Gaussian fading profiles	included; requires R&S®SFU-B30 option

⁶ With internal test signals.

⁷ Can be inserted into an existing, user-selectable subchannel of an incoming, valid ETI data stream.

DMB-T (TDS-OFDM, R&S®SFU-K7 option) (see ordering information)

DMB-T (TDS-OFDM)	in line with TDS-OFDM	field trials in China
Modulation	mode	COFDM
	bandwidth	6 MHz, 7 MHz, 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")

DTMB/DMB-TH (R&S®SFU-K12 option) (see ordering information)

DTMB (TDS-OFDM)	in line with GB20600-2006	
DMB-TH	in line with LS specification	field trials in China
Modulation	mode	COFDM/single carrier
	bandwidth	6 MHz, 7 MHz, 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	
	PN sequences	420, 595, 945
	PN sequences 420, 945	variable/constant
	PN sequence 595	constant
	time interleaver	off, 240, 720 symbols
	FFT mode	4k COFDM/single carrier
	pilot carrier	can be switched off (single carrier)
Special functions	GI power boost	can be switched off
	guard interval PN	can be switched over, variable, constant
	LDPC output	I first, Q first, can be switched over, plus, minus
	QAM and QPSK constellation	can be switched over
Single-frequency network	DMB-TH mode	can be switched on
	network mode	MFN, SFN
Test signals	control	MIP, manual
		TS test packet (see "Internal test signals")

CMMB (R&S®SFU-K15 option) (see ordering information) ⁸

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
Special functions	constellation	BPSK, QPSK, 16QAM
	Reed Solomon, byte interleaver, bit interleaver, scrambling	can be switched off

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 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
Coding	shoulder attenuation	>48 dB
	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")

MediaFLO™ (R&S®SFU-K10 option) (see ordering information)

MediaFLO™	in line with QUALCOMM 80-T0455-1 Rev. E	
Modulation	mode	COFDM
	bandwidth	5 MHz, 6 MHz, 7 MHz, 8 MHz
	modulation frequency response	<0.2 dB
	shoulder attenuation	50 dB
Coding	FFT mode	4k COFDM
Special function	TDM1	can be switched off
Test signals		PRBS

⁸ In preparation; data preliminary.

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, $\alpha = 0.115$
	MER	>40 dB ⁹
	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

ATSC-M/H (R&S[®] SFU-K18 option) (see ordering information)¹⁰

ATSC-M/H	in line with ATSC	mobile TV USA
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ATSC/A-VSB (R&S[®] SFU-K14 option)

ATSC/A-VSB	in line with ATSC	mobile TV USA field trials
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, $\alpha = 0.115$
	MER	>40 dB
	modulation frequency response	<±0.25 dB
	shoulder attenuation	>45 dB
Coding	input data rate	19.392658 Mbit/s
	range	±5 % (depending 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

⁹ With internal test signals.

¹⁰ In preparation; data preliminary.

Cable standards

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, $\alpha = 0.15$, 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 (R&S® SFU-K5 option)

J.83/B	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, $\alpha = 0.18$ (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	

Satellite 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, $\alpha = 0.35$, 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
	Test signals	can be switched off TS test packet (see "Internal test signals") PRBS before convolutional encoder

DVB-S2 (R&S® SFU-K8 option) (see ordering information)

DVB-S2	in line with EN 302307, broadcast services	
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, $\alpha = 0.20$, 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
Special function	pilot insertion	can be switched off
Test signals	error insertion	after CRC-8, BCH or LDPC
Test signals		TS test packet (see "Internal test signals")

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

DIRECTV legacy modulation	in line with DIRECTV transmission specifications	
Modulation	mode	QPSK
	symbol rate	20 Msps
	overrange	1 Msps to 30 Msps
	pulse filtering	root raised cosine roll-off, $\alpha = 0.20$, variable roll-off (0.15, 0.20, 0.25, 0.35)
	MER	38 dB (20 Msps)
	modulation frequency response	$\leq \pm 0.25$ 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, R&S® SFU-K22 option
	error insertion	after convolutional encoder
Test signals		TS test packet (see "Internal test signals")

AMC (R&S® SFU-K108 option) (see ordering information)

AMC (advanced modulation coding)	in line with AMC	supports DIRECTV as well as parts of DVB-S and phase noise
Modulation	mode	QPSK, H8PSK
	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, $\alpha = 0.20$, variable roll-off (0.15, 0.20, 0.25, 0.35)
	MER	38 dB (20 Msps)
	modulation frequency response	$<\pm 0.25$ dB
	shoulder attenuation	45 dB
Coding	constellation	QPSK
	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

Analog modulation systems

AM/FM/RDS (R&S® SFU-K170 option) (see ordering information)

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, deviation ±50 kHz)	
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	<0.1 % (at 60 kHz audio frequency deviation, AF = 1 kHz)
	SNR (stereo/RDS signal) ¹¹	at audio frequency deviation ±40 kHz
	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 ¹²	<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 %

¹¹ Generator without preemphasis, receiver with deemphasis.

¹² Generator and receiver without preemphasis/deemphasis.

Standard B/G (R&S®SFU-K190 option) (see ordering information)

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

Standard D/K (R&S®SFU-K191 option) (see ordering information)

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)
	S/N ratio	
Sound modulation	video	>60 dB weighted
	mode	mono, stereo, dual sound, NICAM, mono/NICAM
	modulation of sound carrier 1, 2	
	modulation mode	FM
	frequency deviation	30 kHz (settable)
	preemphasis	50 µs/75 µs (can be switched off)
	vision/sound 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	
Video signals	sound	>60 dB weighted (CCIR)
	internal video generator	see R&S®SFU-K23 option
Audio signals	external video input	see video input
	internal audio generator	see audio generator
	external audio input	see audio input

Standard I (R&S®SFU-K192 option) (see ordering information)

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)
	S/N ratio	
Sound modulation	video	>60 dB weighted
	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)
Video signals	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

Standard M/N (R&S®SFU-K193 option) (see ordering information)

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)
	S/N ratio	
Sound modulation	video	>60 dB weighted
	mode	BTSC mono, stereo Korea, dual sound Korea
	modulation of sound carrier 1, 2	
	modulation mode	FM
	frequency deviation	25 kHz (settable)
	preemphasis	50 µs/75 µs (can be switched off)
	vision/sound 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
external video input		see video input
Audio signals	internal audio generator	see audio generator
	external audio input	see audio input

Standard L (R&S® SFU-K194 option) (see ordering information)

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
Sound modulation	amplitude frequency response	<0.5 dB (-1 MHz to +5.8 MHz) (with/without vestigial sideband filtering)
	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	modulation depth 54 % (settable)
	vision/sound carrier frequency spacing	6.5 MHz (settable)
Video signals	vision/sound carrier level spacing	10 dB (settable)
	internal video generator	see R&S® SFU-K23 option
Audio signals	external video input	see video input
	internal audio generator	see audio generator
	external audio input	see audio input

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

Multi ATV predefined	in line with country-specific standards and MBRAI		
Modulation	standards	B/G, B/G N, I, I1, D/K, D1, 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 B/G – 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 B/G – 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 ¹³ 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 I – 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 ¹³ roll-off = 100 %/6,552 MHz /20 dB	
	audio coding	mono	
	sound 1	1 kHz	
	group delay precorrection	none	
	residual carrier	20 %	

¹³ Simulation of NICAM spectrum by means of PN sequence and appropriate pulse shaping.

Standard PAL I1	implementation	in line with MBRAI PAL-I1
	video test signal	PAL I1 – 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 ¹⁴ 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
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 %
Standard PAL D1		implementation
	video test signal	PAL D1 – 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 ¹⁴ 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 M/N	video test signal
insertion test signal structure		see below
sound subcarrier		FM 50 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
	video test signal	SECAM L – color bar 75 %
	insertion test signal structure	see below
	sound subcarrier	
	sound 1	NICAM ¹⁴ 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 %

¹⁴ 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 and standard 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	sinx/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	
Standard L and standard 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) (see ordering information)

Waveform memory	length	512 sample to 128 Msample in one-sample steps
	resolution	16 bit
	loading time for 10 Msample	3 s
	nonvolatile 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™ ¹⁵ R&S®SMU-K15 custom OFDM

¹⁵ 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.

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

T-DMB/DAB waveforms	I/Q sequences with audio and video contents	for details see description of option
Transmission	modulation	I, II
Signal set	video	
	resolution	CIF (352 × 288), QCIF (176 × 144), QVGA (320 × 240)
	sequences	diver, fishes
	audio	background music
	audio program service	
	signal	1 kHz sinewave
	level	0 dBFS
	sampling rate	48 kHz
Special function	mode	stereo
	data rate	192 kbit/s
	Gaussian fading profiles	included, can be used with R&S®SFU-B30 option

DVB-H waveforms (R&S®SFU-K352 option)

DVB-H waveforms	I/Q sequences with audio and video contents	for details see description of option
Transmission	mode	different DVB-H modes
Signal set	video/audio	different resolutions and sequences

DRM waveforms (R&S®SFU-K353 option)

DRM waveforms	I/Q sequences with audio contents	for details see description of option
Transmission	mode	A, B, C, and D
	constellation	4QAM, 16QAM, and 64QAM (OFDM)
	bandwidth	4.5 kHz, 5 kHz, 9 kHz, 10 kHz, 18 kHz, 20 kHz
	sampling rate	12 kHz, 48 kHz
Signal set	audio	
	signal	different sequences
	level	-10 dBFS, -12 dBFS
	mode	mono
	coding	MPEG-4 AAC, MPEG-4 CELP
	data rate	4.8 kbit/s to 30.6 kbit/s

DTV interferers (R&S®SFU-K354 option)

DTV interferers	I/Q sequences in line with country-specific standards, IEC 62002 MBRAI, NORDIG, Dbook, A.74	for details see description of option
Waveforms	length	512 sample to 128 Msample
	resolution	16 bit
	loading time for 64 Msample	20 s
	nonvolatile memory	hard disk
Signal set	standards	DVB-T, ATSC/8VSB, T-DMB/DAB, MediaFLO™, ISDB-T, ISDB-T _{SB} , FM
DVB-T standard	length	superframe
	single-interferer sequence	
	bandwidth	5 MHz, 6 MHz, 7 MHz, 8 MHz
	FFT mode	8k
	constellation	16QAM
	code rate	2/3
	guard interval	1/8
	multi-interferer sequence	
	pattern	pattern L3 (2 DVB-T signals N+2/N+4)
	bandwidth	8 MHz
	FFT mode	8k
	constellation	16QAM
	code rate	2/3
	guard interval	1/8

ATSC/8VSB standard	length	1 data frame	
	sequences	center frequency, pilot frequency	
Standard MediaFLO™	length	1 s	
	bandwidth	6 MHz	
Standard DTMB (GB20600-2006)	length	1 s	
	mode	single carrier/multicarrier	
	bandwidth	8 MHz	
	constellation	4QAM, 16QAM, 32QAM, 64QAM/16QAM	
T-DMB/DAB standard	length	frame	
	mode	mode I	
	bandwidth	8 MHz	
	single-interferer sequence	center frequency	
	multi-interferer sequence		
	two channels	A, D, with frequency gap B, C A, C, with frequency gap B, D with frequency offset 1.712 MHz A, B, with frequency gap C, D, with frequency offset 3.424 MHz	
	three channels	A, B, C, with frequency offset 1.712 MHz A, C, D, with frequency gap B A, B, D, with frequency gap C	
	four channels	A, B, C, D	
	Standard ISDB-T	length	approx. 231 ms
		single-interferer sequence	
OFDM segments		1, 3	
Standard ISDB-T _{SB}	length	approx. 202 ms, 231 ms	
	single-interferer sequence		
	OFDM segments	1, 3	
Standard FM	length	frame	
	single-interferer sequence		
	FM jammer	infinite seamless	
	frequency	1 kHz	
	frequency deviation	±50 kHz (in line with GSM900 TX)	

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

MediaFLO™ waveforms	I/Q sequences in line with MediaFLO™	for details see description of option
Transmission	content	data
	length	6 superframes, 6 seconds
	bandwidth	6 MHz
Signal set	wide area ID	15
	local area ID	10 and 15
	data	several MediaFLO™ IDs with different TX modes depending on sequence

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

Cable interferers	I/Q sequences in line with country-specific standards	for details see description of option
Signal set	standards	digital: J.83/B analog: M/N
Standard J.83/B	sequences	64QAM, 256QAM: digital/digital
Standard M/N	sequences	analog/analog

HD Radio™ waveforms (R&S® SFU-K357 option) ¹⁶

HD Radio™ waveforms	I/Q sequences in line with Iqicity™	for details see description of option
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CMMB waveforms (R&S® SFU-K358 option) ¹⁷

CMMB waveforms	I/Q sequences in line with CMMB	for details see description of option
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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) ¹⁸
	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

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

¹⁶ In preparation; preliminary data.

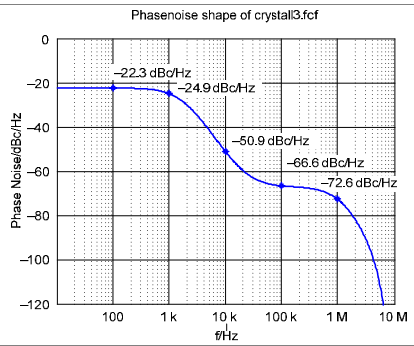
¹⁷ In preparation; preliminary data.

¹⁸ High interferer power is at the expense of diminished useful signal values.

Phase noise (R&S® SFU-K41 option)

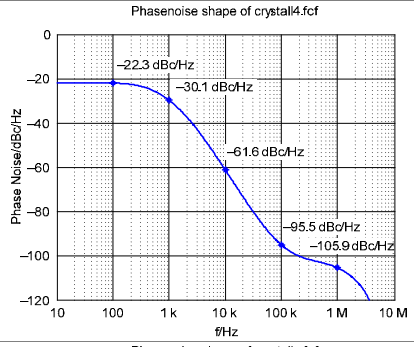
Phase noise	frequency response	selection from profile files												
	amplitude at $f_{\text{carrier}} \pm 100$ Hz													
	setting range	-10.0 dBc/Hz to -110.0 dBc/Hz, depending on selected profile												
	resolution	0.1 dB												
	max. phase angle	$\pm 180^\circ$												
System bandwidth	density distribution function	Gaussian												
Profile files	sampling rate	10 MHz												
	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													
PLL1	<p>Phasenoise shape of pll1.fcf</p>	<table border="1"> <thead> <tr> <th>frequency</th> <th>max. phase noise</th> </tr> </thead> <tbody> <tr> <td>100 Hz</td> <td>-18.5 dBc/Hz</td> </tr> <tr> <td>1 kHz</td> <td>-30.2 dBc/Hz</td> </tr> <tr> <td>10 kHz</td> <td>-44.5 dBc/Hz</td> </tr> <tr> <td>100 kHz</td> <td>-56.5 dBc/Hz</td> </tr> <tr> <td>1 MHz</td> <td>-77.8 dBc/Hz</td> </tr> </tbody> </table>	frequency	max. phase noise	100 Hz	-18.5 dBc/Hz	1 kHz	-30.2 dBc/Hz	10 kHz	-44.5 dBc/Hz	100 kHz	-56.5 dBc/Hz	1 MHz	-77.8 dBc/Hz
frequency	max. phase noise													
100 Hz	-18.5 dBc/Hz													
1 kHz	-30.2 dBc/Hz													
10 kHz	-44.5 dBc/Hz													
100 kHz	-56.5 dBc/Hz													
1 MHz	-77.8 dBc/Hz													
PLL2	<p>Phasenoise shape of pll2.fcf</p>	<table border="1"> <thead> <tr> <th>frequency</th> <th>max. phase noise</th> </tr> </thead> <tbody> <tr> <td>100 Hz</td> <td>-22.4 dBc/Hz</td> </tr> <tr> <td>1 kHz</td> <td>-32.0 dBc/Hz</td> </tr> <tr> <td>10 kHz</td> <td>-43.5 dBc/Hz</td> </tr> <tr> <td>100 kHz</td> <td>-83.5 dBc/Hz</td> </tr> <tr> <td>1 MHz</td> <td>-99.4 dBc/Hz</td> </tr> </tbody> </table>	frequency	max. phase noise	100 Hz	-22.4 dBc/Hz	1 kHz	-32.0 dBc/Hz	10 kHz	-43.5 dBc/Hz	100 kHz	-83.5 dBc/Hz	1 MHz	-99.4 dBc/Hz
frequency	max. phase noise													
100 Hz	-22.4 dBc/Hz													
1 kHz	-32.0 dBc/Hz													
10 kHz	-43.5 dBc/Hz													
100 kHz	-83.5 dBc/Hz													
1 MHz	-99.4 dBc/Hz													
VCXO phase noise masks	simulation of typ. oscillator circuits													
Cyrstall1	<p>Phasenoise shape of crystal1.fcf</p>	<table border="1"> <thead> <tr> <th>frequency</th> <th>max. phase noise</th> </tr> </thead> <tbody> <tr> <td>100 Hz</td> <td>-12.9 dBc/Hz</td> </tr> <tr> <td>1 kHz</td> <td>-15.4 dBc/Hz</td> </tr> <tr> <td>10 kHz</td> <td>-38.6 dBc/Hz</td> </tr> <tr> <td>100 kHz</td> <td>-59.7 dBc/Hz</td> </tr> <tr> <td>1 MHz</td> <td>-79.3 dBc/Hz</td> </tr> </tbody> </table>	frequency	max. phase noise	100 Hz	-12.9 dBc/Hz	1 kHz	-15.4 dBc/Hz	10 kHz	-38.6 dBc/Hz	100 kHz	-59.7 dBc/Hz	1 MHz	-79.3 dBc/Hz
frequency	max. phase noise													
100 Hz	-12.9 dBc/Hz													
1 kHz	-15.4 dBc/Hz													
10 kHz	-38.6 dBc/Hz													
100 kHz	-59.7 dBc/Hz													
1 MHz	-79.3 dBc/Hz													
Cyrstall2	<p>Phasenoise shape of crystal2.fcf</p>	<table border="1"> <thead> <tr> <th>frequency</th> <th>max. phase noise</th> </tr> </thead> <tbody> <tr> <td>100 Hz</td> <td>-13.2 dBc/Hz</td> </tr> <tr> <td>1 kHz</td> <td>-16.1 dBc/Hz</td> </tr> <tr> <td>10 kHz</td> <td>-40.3 dBc/Hz</td> </tr> <tr> <td>100 kHz</td> <td>-61.5 dBc/Hz</td> </tr> <tr> <td>1 MHz</td> <td>-80.7 dBc/Hz</td> </tr> </tbody> </table>	frequency	max. phase noise	100 Hz	-13.2 dBc/Hz	1 kHz	-16.1 dBc/Hz	10 kHz	-40.3 dBc/Hz	100 kHz	-61.5 dBc/Hz	1 MHz	-80.7 dBc/Hz
frequency	max. phase noise													
100 Hz	-13.2 dBc/Hz													
1 kHz	-16.1 dBc/Hz													
10 kHz	-40.3 dBc/Hz													
100 kHz	-61.5 dBc/Hz													
1 MHz	-80.7 dBc/Hz													

Cyrstall3



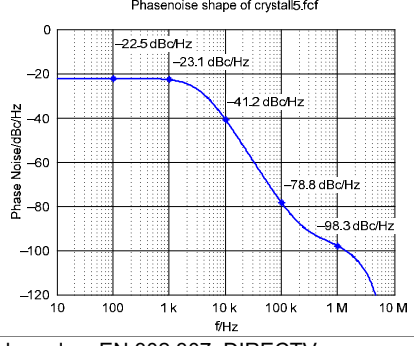
frequency	max. phase noise
100 Hz	-22.3 dBc/Hz
1 kHz	-24.9 dBc/Hz
10 kHz	-50.9 dBc/Hz
100 kHz	-66.6 dBc/Hz
1 MHz	-72.6 dBc/Hz

Cyrstall4



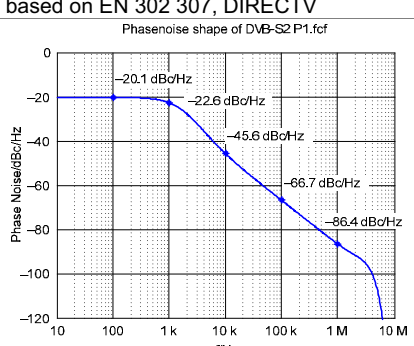
frequency	max. phase noise
100 Hz	-22.3 dBc/Hz
1 kHz	-31.1 dBc/Hz
10 kHz	-61.6 dBc/Hz
100 kHz	-59.5 dBc/Hz
1 MHz	-105.8 dBc/Hz

Cyrstall5



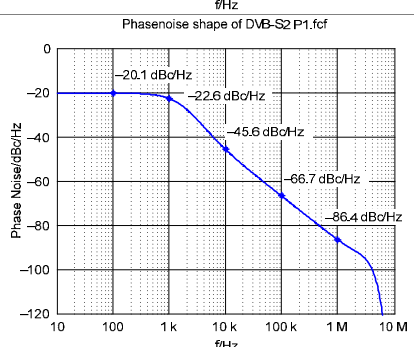
frequency	max. phase noise
100 Hz	-22.5 dBc/Hz
1 kHz	-23.1 dBc/Hz
10 kHz	-41.2 dBc/Hz
100 kHz	-78.8 dBc/Hz
1 MHz	-98.2 dBc/Hz

DVB-S2 phase noise masks
DVB-S2 P1



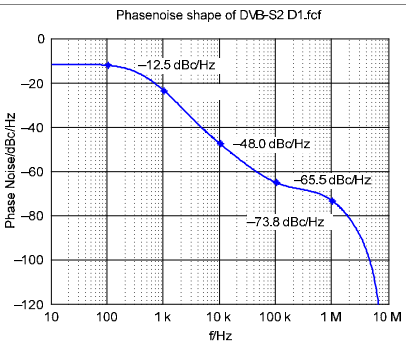
frequency	max. phase noise
100 Hz	-20.1 dBc/Hz
1 kHz	-22.6 dBc/Hz
10 kHz	-45.6 dBc/Hz
100 kHz	-66.7 dBc/Hz
1 MHz	-86.4 dBc/Hz

DVB-S2 P2



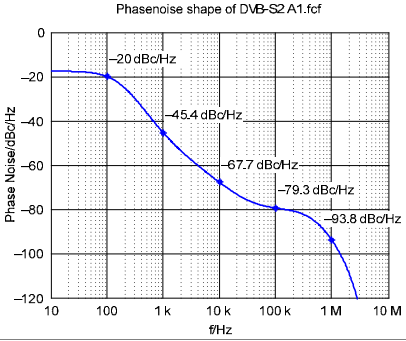
frequency	max. phase noise
100 Hz	-20.1 dBc/Hz
1 kHz	-22.8 dBc/Hz
10 kHz	-46.9 dBc/Hz
100 kHz	-68.2 dBc/Hz
1 MHz	-87.5 dBc/Hz

DVB-S2 D1



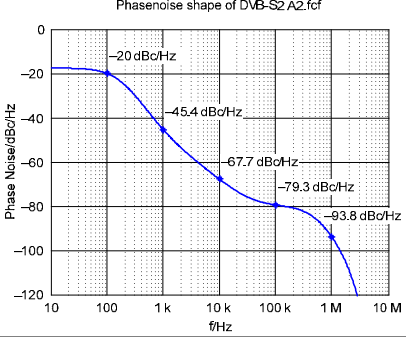
frequency	max. phase noise
100 Hz	-12.5 dBc/Hz
1 kHz	-24.0 dBc/Hz
10 kHz	-48.0 dBc/Hz
100 kHz	-65.5 dBc/Hz
1 MHz	-73.8 dBc/Hz

DVB-S2 A1



frequency	max. phase noise
100 Hz	-18.6 dBc/Hz
1 kHz	-44.2 dBc/Hz
10 kHz	-66.35 dBc/Hz
100 kHz	-86.0 dBc/Hz
1 MHz	-97.5 dBc/Hz

DVB-S2 A2



frequency	max. phase noise
100 Hz	-20.0 dBc/Hz
1 kHz	-45.4 dBc/Hz
10 kHz	-67.7 dBc/Hz
100 kHz	-79.3 dBc/Hz
1 MHz	-93.8 dBc/Hz

Special function

own files can be used

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) (see ordering information)

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.**¹⁹

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

¹⁹ 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 ms 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 ²⁰	-30 dB to +30 dB
GAUSS+DOPPLER (PI, PO profile)	amplitude distribution	pseudo noise interval >93 h
	power density function	$S(\tau, f) = G(0.1A; 0; 0.08fd) + \delta(f - 0.5fd)$
GAUSS(0.08fd) (PI, PO profile)	amplitude distribution	pseudo noise interval >93 h
	power density function	$S(\tau, f) = G(A; f; 0.08fd)$
GAUSS(0.1fd) (VU30, MR100 profile)	amplitude distribution	pseudo noise interval >93 h
	power density function	$S(\tau, f) = G(A; f; 0.1fd)$
Lognormal fading	standard deviation	0 dB to 12 dB
	resolution	1 dB
	local constant	12 m to 200 m for $f_{RF} = 1$ GHz

²⁰ Ratio of discrete component to distributed component.

Enhanced fading (R&S® SFU-K30 option) (see ordering information)

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 µs 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
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 µs to 40 µs ²¹
delay grid		100 ns to 40/3 µs ²¹
resolution		1 ns
grid positions		3 to 50 ²¹
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
	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	

²¹ The maximum delay range of 40 µs may not be exceeded.

Gaussian fading (R&S®SFU-K32 option) (see ordering information)

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	$S(\tau_i, f) = G(A, \pm 0.7fd, 0.1fd)$ 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 measurement (R&S®SFU-K55 option)

The power measurement requires the use of R&S® NRP-Zxx power sensors.

RF power measurements	for analog and digital modulation modes	
Power measurement	display	measured power
	units	relative power W, dBm, dBμV, selectable
Operating mode	auto	measurement frequency coupled to RF frequency
	user	measurement frequency user-selectable
Filter	auto	automatic setting of filter length
	user	manual setting of filter length
	optimization length	auto once 0 to 128, settable
Range	frequency range	depending 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)

For DVB-S2, DIRECTV, DTMB/DMB-TH and MediaFLO™, BER measurements cannot be performed at all or only to a limited extent.

BER measurements	for all digital modulation modes	
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

General data

System data

System	operating system	PC platform Windows XP Embedded internal hard disk
	memories for settings	50
	display	XVGA 1024 × 768
Local control	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	USB	2.0
	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 ²² 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 Nr. 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

²² 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 quick start guide, CD-ROM (includes operating manuals and quick start guide)	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		
DVB-T/H Coder	R&S®SFU-K1	2110.7301.02
DVB-C/ISDB-C Coder	R&S®SFU-K2	2110.7324.02
DVB-S/DVB-DSNG Coder	R&S®SFU-K3	2110.7330.02
DVB-S2 Coder (requires an installed R&S®SFU-B1 or R&S®SFU-B10)	R&S®SFU-K8	2110.7399.02
ATSC/ 8VSB Coder	R&S®SFU-K4	2110.7353.02
ATSC/ A-VSB Coder	R&S®SFU-K14	only on request
ATSC M/H ²³ Coder	R&S®SFU-K18	only on request
J.83/B Coder	R&S®SFU-K5	2110.7360.02
ISDB-T/ISDB-T _B /ISDB-T _{SB} Coder	R&S®SFU-K6	2110.7376.02
MediaFLO™ Coder (requires an installed R&S®SFU-B10)	R&S®SFU-K10	2110.7524.02
T-DMB/DAB 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 or R&S®SFU-B10)	R&S®SFU-K12	2110.7760.02
Coder CMMB ²³ (requires an installed R&S®SFU-B1 or R&S®SFU-B10)	R&S®SFU-K15	2110.7818.02
DIRECTV Legacy Modulation Coder (requires an installed R&S®SFU-B1 or R&S®SFU-B10)	R&S®SFU-K9	2110.7401.02
AMC Coder (requires an installed R&S®SFU-K8 (DVB-S2) and an installed R&S®SFU-B1 or R&S®SFU-B10)	R&S®SFU-K108	only on request
Coder Extension 1	R&S®SFU-B1	2110.7424.02
Coder Extension 10	R&S®SFU-B10	2110.7747.02
Analog modulation systems		
Coder AM/FM RDS (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
Coder Extension 2 preinstalled in R&S®SFU from serial no. 101000	R&S®SFU-B2	2110.7430.02

²³ In preparation.

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
Memory Extension 1 preinstalled in R&S®SFU from serial no. 101000	R&S®SFU-B3	2110.7447.02
T-DMB/DAB Waveforms (can be used with R&S®SFU-K35)	R&S®SFU-K351	2110.4277.02
DVB-H Waveforms (can be used with R&S®SFU-K35)	R&S®SFU-K352	2110.4425.02
DRM Waveforms (can be used with R&S®SFU-K35)	R&S®SFU-K353	2110.4554.02
DTV Interferers (can be used with R&S®SFU-K35)	R&S®SFU-K354	2110.4690.02
MediaFLO™ Waveforms (can be used with R&S®SFU-K35)	R&S®SFU-K355	2110.2974.02
Cable Interferers (can be used with R&S®SFU-K35)	R&S®SFU-K356	2110.3212.02
HD Radio™ Waveforms (can be used with R&S®SFU-K35, Ibiqity license required)	R&S®SFU-K357	only on request
CMMB Waveforms ²⁴ (can be used with R&S®SFU-K35)	R&S®SFU-K358	only on request
Interferer Management	R&S®SFU-K37	2110.7647.02
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)	R&S®SFU-K43	2110.7682.02
Custom OFDM (generates customer-specific OFDM signals)	R&S®SMU-K15	1160.6402.02
Baseband inputs/outputs		
Extended I/Q	R&S®SFU-K80	2110.7953.02
ETI Input/Output	R&S®SFU-B11	2110.7553.03
Digital baseband		
TS Generator including SDTV streams	R&S®SFU-K20	2110.7476.02
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 (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
Memory Extension 2	R&S®SFU-B4	2110.7453.02
Additional Hard Disk for instruments with serial numbers <101000	R&S®SFU-B6	2110.7501.02

²⁴ In preparation.

Additional Hard Disk for instruments with serial numbers >101000	R&S®SFU-B6	2110.7501.03
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

Analog baseband		
Video Generator (included in R&S®SFU-K190 to -K194)	R&S®SFU-K23	2110.7799.02
ATV Video Signals (can be used with R&S®SFU-K190 to R&S®SFU-K194)	R&S®ATV Video	2110.4831.02
Impedance Matching Pad 75/50 Ohms (can be used with R&S®SFU-K190 to R&S®SFU-K194)	R&S®SFU-Z19	2110.7276.02
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
Other expansions		
User I/O (additional input/output) (supported by R&S®SFU firmware versions <V1.70)	R&S®SFU-B5	2110.7460.02
Upgrade Kit for R&S®SFU-K43	R&S®SFU-U43	2110.7699.02
Recommended extras		
Hardcopy of operating manuals; includes quick start guide (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®LVDS BU-BU 26-pol. 2 m	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 can only be ordered in connection with the purchase of an instrument		
One-Year Repair Service following the warranty period	R&S®RO2SFU	please contact your local sales office
Two-Year Repair Service following the warranty period	R&S®RO3SFU	please contact your local sales office
Four-Year Repair Service following the warranty period	R&S®RO5SFU	please contact your local sales office
Two-Year Calibration Service	R&S®CO2SFU	please contact your local sales office
Three-Year Calibration Service	R&S®CO3SFU	please contact your local sales office
Five-Year Calibration Service	R&S®CO5SFU	please contact your local sales office

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