R&S®SFE100
Test Transmitter
Powerful broadcast signal generator for production test systems

ROHDE & SCHWARZ

R&S®SFE100
Test Transmitter
At a glance

The R&S®SFE100 is a multistandard test transmitter providing realtime coding for broadcast signals. It supports all common digital and analog TV standards and a number of audio broadcasting standards. Its flexible customization options make the R&S®SFE100 suitable for a wide variety of applications – from production and quality assurance to simple development applications.

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

The R&S®SFE100 can be equipped with the appropriate digital or analog baseband signal sources. This makes it possible to replay test signals from Rohde & Schwarz libraries as well as proprietary test signals. The R&S®SFE100 thus combines two functions in one box, which significantly simplies even complex production test systems. An optional arbitrary waveform generator allows the user to generate any type of modulation signal and to replay proprietary waveform files regardless of the available realtime coders.

Occupying only one height unit, the R&S®SFE100 is extremely compact. Nevertheless, all functions can be selected locally on the instrument. Alternatively, the R&S®SFE100 can be remotely controlled from a PC. In this case, the test transmitter is operated via the same convenient graphical user interface as is used for the R&S®SFE and the R&S®SFU. For applications that do not require local control, an R&S®SFE100 model without display and keys is available.

Key facts
▪ Unlimited standards in a single instrument
▪ Frequency range up to 2700 MHz
▪ Output power up to 27 dBm with integrated power amplifier
▪ High-precision modulator (MER typ. +43 dB)
▪ Integrated transport stream generator

Front view of the R&S®SFE100 (models .02 and .03).

R&S®SFE100 Test Transmitter

Benefits and key features

Versatile multistandard test transmitter with realtime coding

▪ Digital and analog TV standards for cable, satellite and terrestrial transmission
▪ Digital and analog audio broadcasting standards
▪ Realtime signal generation with selectable modulation and coding parameters
▪ Standards available as software options

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High-precision signal generation over wide frequency and level range

▪ Frequency range 100 kHz to 2700 MHz
▪ Level range –110 dBm to +15 dBm
▪ Extremely short switching times
▪ Low phase noise and high MER
▪ Integrated noise generator

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Integrated baseband signal sources

▪ Transport stream generator, transport stream player and comprehensive test signal libraries
▪ Audio/video generator with test pattern library for analog TV
▪ ARB waveform generator with waveform libraries
▪ Digital I/Q input

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User-friendly control elements and convenient remote operation

▪ Control keys and LC display on front panel
▪ Local control via USB mouse, USB keyboard and monitor
▪ Remote control and remote operation via LAN

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Economical instrument models without local controls

▪ For all digital or analog standards
▪ Full remote control capability

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Optimized for use in production test systems

▪ Integrated power amplifier for high output levels
▪ Optional RF output on the rear
▪ Compatible with system control software from Rohde & Schwarz
▪ Low power consumption

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Versatile multistandard test transmitter with realtime coding

Signal generation for satellite, terrestrial and cable TV with the R&S®SFE100.
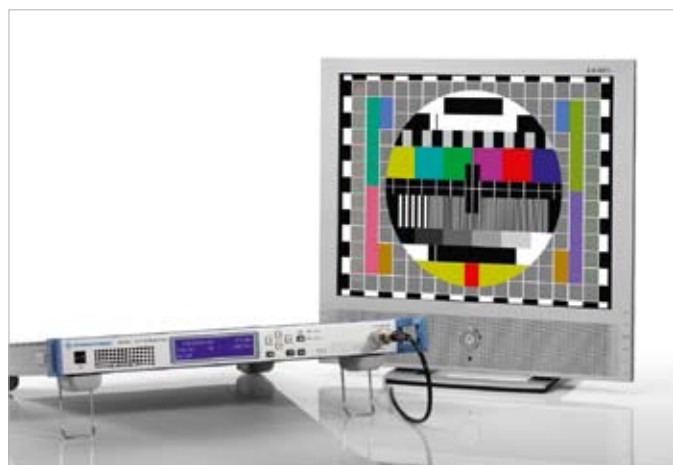
The R&S®SFE100 test transmitter supports all common broadcast systems. Whether audio or TV, analog or digital, terrestrial, satellite or cable – the R&S®SFE100 covers all these standards in a single unit. Switching between different standards is quick and easy – at the press of a key. Additional and future standards can be added at any time with a software update.

Digital and analog TV standards for cable, satellite and terrestrial transmission

The R&S®SFE100 supports the following TV standards:
❙ Digital terrestrial TV: DVB-T, DVB-T2[1], ATSC/8VSB, ISDB-T, ISDB-T$_B$, DTMB
❙ Digital satellite TV: DVB-S, DVB-S2, DirecTV
❙ Digital cable TV: DVB-C, J.83/B, ISDB-C
❙ Digital mobile TV: DVB-H, T-DMB, ISDB-T 1-Segment, CMMB, MediaFLO™, ATSC-M/H
❙ Analog TV: B/G, D/K, M/N, I, L standards

Digital and analog audio broadcasting standards

The R&S®SFE100 supports the following audio broadcasting standards:
❙ Digital audio broadcasting: DAB, DAB+, HD Radio™, ISDB-T$_{SB}$, DRM, DRM+[1]
❙ Analog audio broadcasting: FM stereo with RDS, FM mono, AM

Realtime signal generation with selectable modulation and coding parameters

The key functionality of the R&S®SFE100 test transmitter is to generate modulated signals for various transmission standards in realtime. The test transmitter achieves this by means of a powerful universal hardware platform for baseband signal processing. This platform provides the I and Q bit streams for the broadband vector modulator. A highly accurate spectrum is thus obtained for all modulation modes. The required transmission standard is made available simply by loading the appropriate FPGA firmware. For each transmission standard, various modulation parameters such as constellation, code rate and FFT mode have to be defined. These parameters can be varied regardless of the transport stream to be transmitted, making it possible to test all the conceivable configurations of a standard. The realtime coder automatically adapts the signaling information as required for the receiver.

Standards available as software options

All modulation modes for the realtime coder of the R&S®SFE100 have been implemented as firmware, making it quick and easy to add transmission standards. The standards are pre-installed and can be enabled by entering a key code.

[1] Currently in preparation.

High-precision signal generation over wide frequency and level range

Despite its compact design and favorable price, the instrument features RF characteristics that clearly make it a high-quality signal generator. It covers the entire frequency range for broadcasting applications, from IF, VHF and UHF up to the S band. And it does so with a signal quality unprecedented in this class.

Frequency range 100 kHz to 2700 MHz [1]
The frequency can be set in steps of 1 Hz. Either the channel center frequency or the vision carrier frequency or a channel number from the selected channel table can be entered.

Level range –110 dBm to +15 dBm [2]
The output level of the R&S®SFE100 is adjustable in steps of 0.1 dB over a wide dynamic range of –110 dBm to +15 dBm by means of the instrument's built-in electronic attenuator. It is thus possible to test tuners through their full drive range, from the sensitivity threshold up to saturation, without requiring any external amplifiers or attenuators.

Extremely short switching times
Short test times boost efficiency and reduce costs in the production of consumer electronics equipment. Featuring extremely short switching times, the R&S®SFE100 significantly contributes toward minimizing test times. Level, frequency and parameter switching is accomplished in less than 20 milliseconds, and even switching between modulation standards takes no more than approx. six seconds.

Low phase noise and high MER
Advanced COFDM modulation methods place high demands on the stability and spectral purity of the oscillator signal. With an SSB phase noise of typ. < –115 dBc (at 300 MHz and 20 kHz carrier offset), the R&S®SFE100 offers very high MER values of typically over 40 dB. Moreover, the R&S®SFE100 stands out for its low broadband noise and high harmonics suppression.

Integrated noise generator
The R&S®SFE100 can be equipped with a noise generator to test receivers under realistic conditions. The signal-to-noise ratio (SNR) can be adjusted over a wide range. The noise generator supplies narrowband white noise, i.e. a noise signal limited to the signal bandwidth. This makes it possible to configure different channels with different SNRs in a production test system.

Constellation diagram of a DVB-T signal with excellent MER.

[1]   Without R&S®SFE100-B90 power amplifier.
       With R&S®SFE100-B90 power amplifier: frequency range 47 MHz to 842 MHz.
[2]   Without R&S®SFE100-B90 power amplifier.

Integrated baseband signal sources

Digital transmission methods require transport streams as baseband signals, whereas modulators for analog TV require CCVS signals. Both of these are fed to the R&S®SFE100 via inputs on the rear panel. Alternatively, baseband sources appropriate for the enabled transmission standards can be installed in the R&S®SFE100 – eliminating the need for external transport stream or test pattern generators. This significantly reduces the number of instruments required, especially in complex production test systems. An arbitrary waveform generator (ARB) can additionally be installed in the R&S®SFE100.

Transport stream generator, transport stream player and comprehensive test signal libraries

The optional internal transport stream generator supplies test streams in the baseband for the realtime coder. It can be used to generate endless and seamless high-bit-rate MPEG-2 transport streams. The transport stream generator comes with a comprehensive SDTV transport stream library.

The optional transport stream player ideally complements the transport stream generator and allows customers to replay their own transport streams in TRP format. The transport stream player is also used to replay DAB and T-DMB ETI streams as well as MediaFLO™ and CMMB streams. Moreover, it replays MPEG-2 transport streams endlessly and seamlessly. In the process, it continuously updates the PCR, DTS, PTS time stamps and continuity counter information, and overwrites the TDT and TOT time information with the R&S®SFE100 system time.

Rohde & Schwarz offers a large number of transport stream libraries for its broadcast signal generators [3]. For the transport stream generator, libraries for SDTV, HDTV, H.264, DVB-H, ISDB-T and TCM are available. The transport stream player supports libraries for DAB, DAB+, CMMB, ATSC-M/H, ISDB-T$_B$ and MediaFLO™.

## Audio/video generator with test pattern library for analog TV

The audio/video generator delivers test patterns and audio signals for analog TV. It comes with a set of FuBK and color bar test patterns for PAL, SECAM and NTSC. In addition, an ATV video library is available from Rohde & Schwarz that provides a broad range of test patterns for analog TV that far exceeds the basic set of test patterns supplied with the audio/video generator.

[3] See data sheet "Stream Libraries for broadcasting T & M equipment from Rohde & Schwarz", PD 5213.7202.32.

Test pattern from the HDTV transport stream library for the R&S®SFE100.
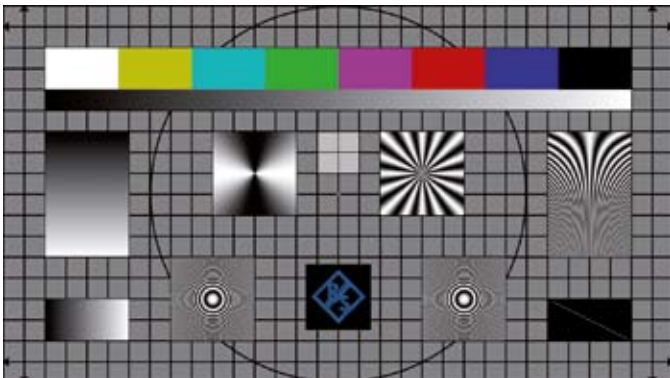
R&S®SFE100-K22 integrated transport stream player.
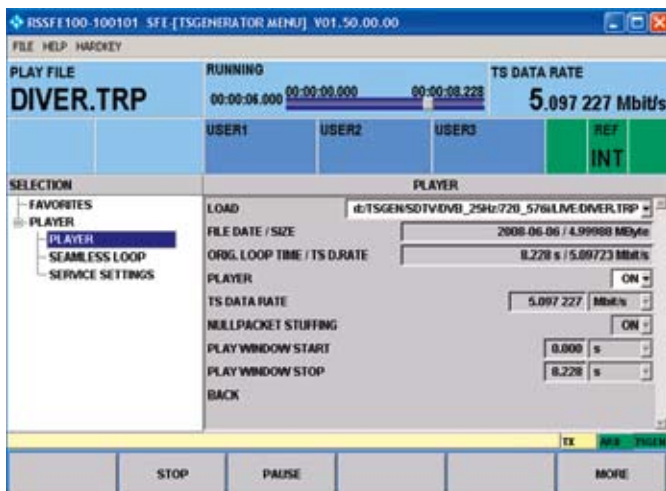
ARB waveform generator with waveform libraries

The optional integrated arbitrary waveform (ARB) generator of the R&S®SFE100 can replay proprietary I/Q waveforms as well as waveforms from Rohde & Schwarz libraries. It is thus possible to generate any externally computed RF signal. In particular, this allows modulation signals to be generated regardless of the realtime coders installed. Offering 256 Msample memory space and sample rates up to 100 Msample/s, the ARB generator of the R&S®SFE100 is among the most powerful generators in its class.

The R&S®SFE100 supports the use of the R&S®WinIQSIM™ simulation software. Waveforms generated with R&S®WinIQSIM™ can be loaded into the ARB generator of the R&S®SFE100 and replayed.

In addition, Rohde & Schwarz offers waveform libraries for the following broadcasting standards: HD Radio™, DRM, DRM+ [4)], DVB-T2, MediaFLO™, T-DMB/DAB. The range of available waveform libraries is continuously being expanded.

Digital I/Q input

Via the optional digital I/Q interface, I/Q signals from other Rohde & Schwarz instruments can be applied directly to the R&S®SFE100 modulator. This makes it possible, for example, to expand an R&S®SFU broadcast test system into a dual-channel TV signal generator capable of testing receivers operating in antenna diversity mode.

[4)] Currently in preparation.

Signal generation for HD Radio™ with the R&S®SFE100-K35 ARB waveform generator.

Block diagram of the R&S®SFE100 with the various baseband signal sources
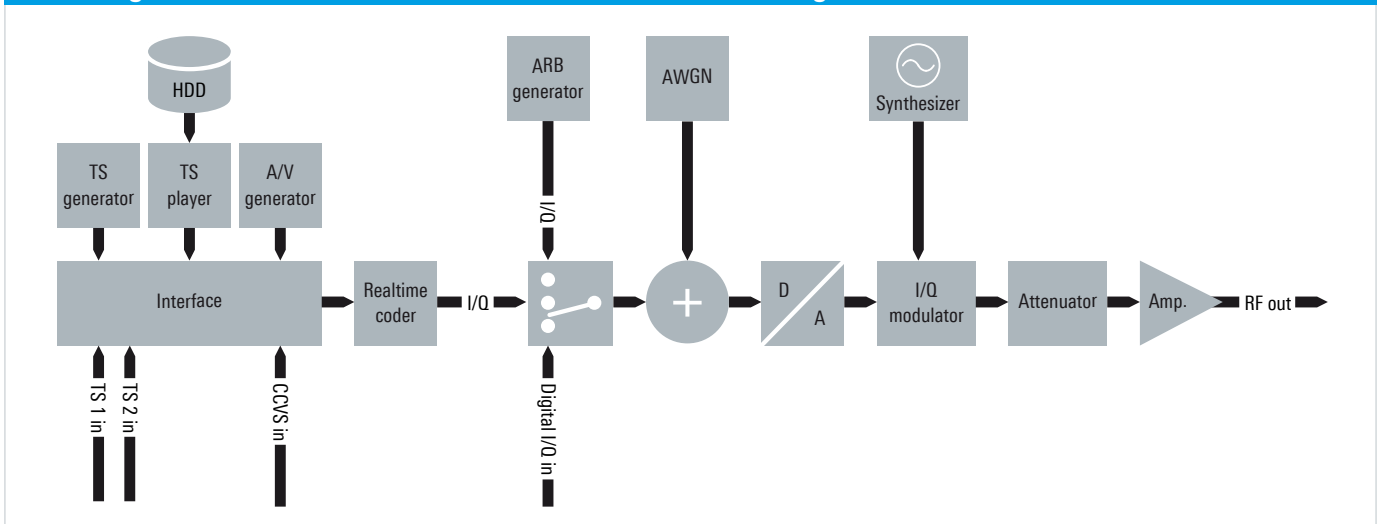
User-friendly control elements and convenient remote operation

When used in production environments, signal generators are usually set up in racks where space is very limited. This calls for all functions to be selectable directly on the instrument. On the other hand, it must also be possible to configure and monitor all instruments throughout the system via remote control. The R&S®SFE100 meets both requirements – featuring control keys and an LC display on the front panel for local control as well as a convenient graphical user interface for remote control.

Control keys and LC display on the front panel
The display is easy to read and presents current settings in a clear-cut manner. Parameters and numeric values can be selected with the cursor keys and the Enter key.
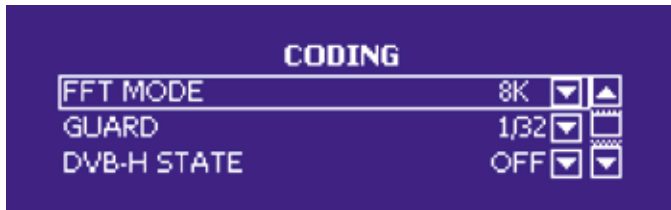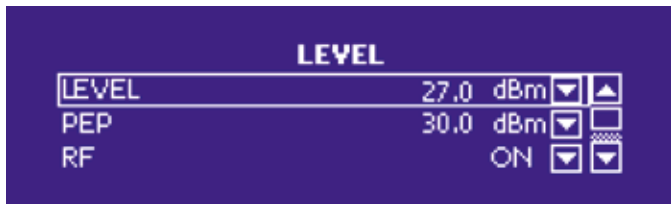
Local control via USB mouse, USB keyboard and monitor
The R&S®SFE100 can be operated more conveniently by connecting a mouse and keyboard to the two USB ports on the instrument's front panel. The graphical user interface is displayed on a monitor connected to the monitor output of the R&S®SFE100. A third USB port is available on the rear of the instrument and can be used for connecting a USB memory stick, for example.

Remote control and remote operation via LAN
The R&S®SFE100 can be remotely controlled via an Ethernet connection or in a LAN over IP. It is preconfigured for the use of DHCP. Remote operation is very easy with the pre-installed Remote Desktop software or the additional VNC software supplied with the instrument, and uses the same graphical user interface as the R&S®SFU and R&S®SFE. Remote control is by means of SCPI commands via LAN (VXI11). The R&S®SFE100 can thus be easily integrated into existing test programs. Remote control commands are compatible with those used for the R&S®SFU and R&S®SFE. Rohde & Schwarz additionally provides drivers for LabWindows/CVI, LabView and VXIplug & play.

Menus on the LC display of the R&S®SFE100 (models .02 and .03).

FREQUENCY

FREQUENCY	1 000.000 000	MHz
CHANNEL		0
BACK		

LEVEL

LEVEL	27.0	dBm
PEP	30.0	dBm
RF		ON

CODING

FFT MODE	8K
GUARD	1/32
DVB-H STATE	OFF

Remote control via Remote Desktop.

Local control via monitor and USB keyboard.

Economical instrument models without local controls

Rohde & Schwarz offers the R&S®SFE100 models .12 and .13 without local controls for applications involving full remote control of the instrument. Because these models support only part of the R&S®SFE100 options, they are very economically priced.

For all digital or analog standards
The R&S®SFE100 model .12 supports realtime coder options for all digital audio and TV broadcasting standards. The R&S®SFE100 model .13 supports realtime coder options for analog TV and analog audio broadcasting, i.e. AM and FM, with FM including RDS/RDBS. The models do not support ARB-based standards.

Full remote control capability
The R&S®SFE100 models .12 and .13 offer the same remote control and remote operation capabilities via LAN as models .02 and .03, plus USB and monitor ports.

Front and rear views of the R&S®SFE100 (models .12 and .13).

Overview of R&S®SFE100 models				
	Model .12	**Model .13**	**Model .02**	**Model .03**
Front-panel control			●	●
Remote control via LAN	●	●	●	●
USB and monitor ports	●	●	●	●
Digital standards	●		●	●
Analog standards		●		●
Transport stream generator			●	●
Transport stream player	●		●	●
Audio/video generator		●		●
Noise generator	●	●	●	●
ARB generator			●	●
Power amplifier			●	●

Optimized for use in production test systems

The R&S®SFE100 as part of a test system.

Integrated power amplifier for high output levels

In production test systems, the signals from multiple test transmitters are combined via a coupling network and then distributed over large distances. High signal levels are required in order to compensate for the accompanying losses. The R&S®SFE100 delivers this high output power by means of an optional amplifier that is built into the instrument. It enables the R&S®SFE100 to generate an output power of up to 27 dBm in the VHF and UHF ranges [1] – a value competitive products do not achieve even with external add-on equipment.

Optional RF output on the rear

For rack installations, it is more useful to have the RF output connector on the rear. Therefore, customers have the option of ordering the R&S®SFE100 with the RF output fitted on the rear of the instrument. If the R&S®SFE100-B90 power amplifier is installed, the RF output is always on the rear.

Compatible with system control software from Rohde & Schwarz

The free R&S®Central TX System Control software from has been designed specifically for controlling production test systems configured with multiple R&S®SFE100 test transmitters. The software allows convenient control and monitoring of the generators in a test system via LAN. It displays the system configuration in a straightforward manner on a graphical interface and indicates the current system status.

Low power consumption

Test systems in production run around the clock, usually seven days a week. The energy consumed by the signal generators and the air-conditioning system for the transmitter room therefore accounts for the major part of a system's operating costs. With energy prices on the rise, this percentage will grow even more. Over a system's lifetime, energy costs could even exceed equipment purchase costs. The R&S®SFE100 helps reduce energy costs in two ways: First, it stands out for extremely low power consumption of approx. 55 W without a power amplifier and approx. 82 W with a power amplifier. Second, its ability to integrate a transport stream generator and a power amplifier eliminates the need for a number of units that would otherwise be required. This significantly reduces energy consumption, and thus the cost of ownership for a system. Plus, this solution is friendly to the environment.

[1] Frequency range 47 MHz to 842 MHz with the R&S®SFE100-B90 power amplifier.

Application examples

Central transmitter room for production tests on TV receivers

Production facility

Central transmitter room

DTV channel 1

R&S®SFE100

DTV channel 2

R&S®SFE100

DTV channel 3

R&S®SFE100

DTV channel n

R&S®SFE100

Transport stream player | Modulator | Power amplifier

ATV channel 1

R&S®SFE100

ATV channel 2

R&S®SFE100

ATV channel 3

R&S®SFE100

ATV channel 1

R&S®SFE100

Test pattern generator | Modulator | Power amplifier

Coupling network

RF

Test station 1 Test station 2 Test station 3 • • • Test station n

Test systems in consumer electronics and automobile production

To comply with the wide range of transmission standards, producers of consumer electronics – such as set-top boxes and TV sets – require a variety of test signals at different frequencies and with different contents. The signals are delivered by signal generators, which are usually accommodated in a separate room. A coupling network combines the signals and distributes them to the individual test stations in the factory via cable, partly over considerable distances. A baseband signal is generated for each channel, modulated onto the appropriate RF and amplified as required for distribution. In conventional systems, this process requires three different instruments – a baseband generator, a modulator and a power amplifier.

A similar concept is used in the automobile industry to simulate realistic transmitter scenarios. Each transmitter that can be received in a specific region is simulated by a signal generator. Transport streams that were recorded from the real transmitters are transmitted as contents. Such systems are used, for example, to test station scanning and automatic frequency changes on multimedia receivers in vehicles under realistic conditions.

The R&S®SFE100 is an ideal choice for such applications, combining a baseband signal source, a modulator and a power amplifier in a single unit. This significantly reduces test system complexity. The advantages are obvious: Systems using the R&S®SFE100 are more cost-effective, smaller in size, more reliable and easier to service than conventional solutions. Plus, they require fewer replacement units than similar competitive solutions. And last but not least: They considerably cut down on energy consumption.
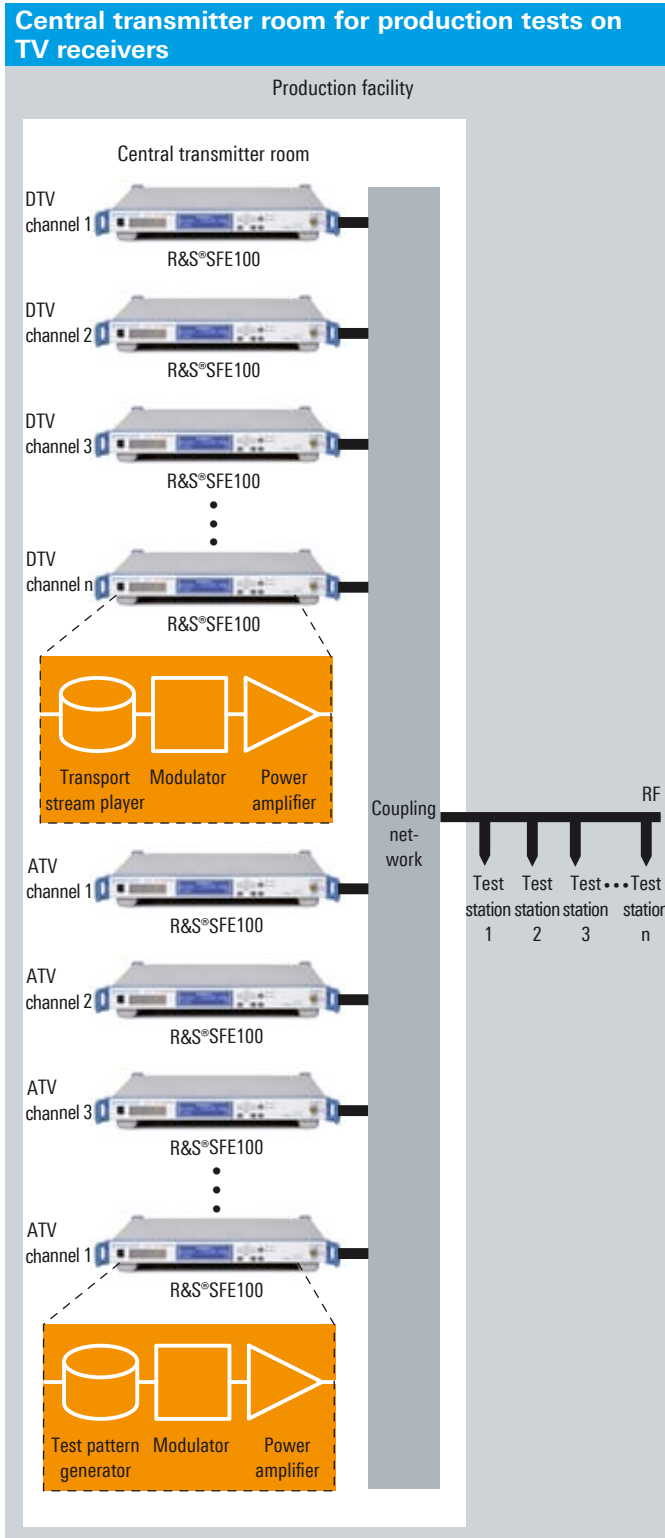
Specifications in brief

Specifications in brief		
RF signal		
Frequency range	without power amplifier	100 kHz to 2.7 GHz
	with power amplifier	47 MHz to 862 MHz
Frequency resolution		1 Hz
Level	without power amplifier	–110 dBm to +15 dBm
	with power amplifier	+27 dBm, adjustable from 0 dB to 30 dB
Spectral purity		
SSB phase noise	at 300 MHz and 20 kHz carrier offset	< –115 dBc (1 Hz)
Broadband noise	> 10 MHz	< –135 dBc (1 Hz)
Digital realtime modulation systems		
Terrestrial TV		DVB-T2 [1], DVB-T, DTMB, ISDB-T, ISDB-T$_B$, ASTC/8VSB
Cable TV		DVB-C, J.83/B, ISDB-C
Satellite TV		DVB-S, DVB-S2, DirecTV
Mobile TV		DVB-H, T-DMB, ISDB-T 1-Segment, MediaFLO™, CMMB, ATSC-M/H
Digital audio broadcasting		DAB, DAB+, ISDB-T$_{SB}$
Analog realtime modulation systems		
Analog TV		B/G, D/K, I, M/N, L
Analog audio broadcasting		AM, FM mono, FM stereo with RDS
ARB-based modulation systems		
Digital audio broadcasting		HD Radio™, DRM, DRM+ [1]
Digital TV		DVB-T2, CMMB, MediaFLO™
Baseband signal sources		
Transport stream generator	file format	Rohde & Schwarz proprietary
	data rate (including null packets)	100 kbit/s to 214 Mbit/s
Transport stream player	file format	TRP, T10, ETI, FLO, MFS, PMS, BIN
	data rate	100 kbit/s to 90 Mbit/s
ARB waveform generator	memory	256 Msample
	sample rate	up to 100 Msample/s
Noise generator [1]		
AWGN	signal-to-noise ratio (SNR)	–30 dB to +60 dB
General data		
Operating temperature range		+5°C to +45°C
Power supply		90 V to 240 V AC, 50 Hz to 60 Hz
Dimensions		427 mm × 44 mm × 450 mm (16.81 in × 1.7 in × 18 in)
Weight		< 6 kg (< 13.23 lb)

[1] Currently in preparation.

Ordering information

Designation	Type	Order No.
Test Transmitter, model .02	R&S®SFE100	2112.4100.02
Test Transmitter, model .03	R&S®SFE100	2112.4100.03
Test Transmitter, model .12	R&S®SFE100	2112.4100.12
Test Transmitter, model .13	R&S®SFE100	2112.4100.13
Options		
Digital modulation systems		
DVB-T/H Coder	R&S®SFE100-K1	2113.4003.02/.12
DVB-C/ISDB-C Coder	R&S®SFE100-K2	2113.4026.02/.12
DVB-S/DVB-DSNG Coder	R&S®SFE100-K3	2113.4049.02/.12
DVB-S2 Coder	R&S®SFE100-K8	2113.4126.02/.12
ATSC/8VSB Coder	R&S®SFE100-K4	2113.4061.02/.12
J.83/B Coder	R&S®SFE100-K5	2113.4084.02/.12
ISDB-T/ISDB-T$_{SB}$/ISDB-T$_B$ Coder	R&S®SFE100-K6	2113.4103.02/.12
MediaFLO™ Coder	R&S®SFE100-K10	2113.4161.02/.12
T-DMB/DAB Coder	R&S®SFE100-K11	2113.4184.02/.12
DTMB Coder	R&S®SFE100-K12	2113.4203.02/.12
DirecTV Legacy Modulation Coder	R&S®SFE100-K9	2113.4149.02/.12
CMMB Coder	R&S®SFE100-K15	2113.4261.02/.12
DVB-T2 Coder	R&S®SFE100-K16	2113.4282.02
ATSC-M/H Coder	R&S®SFE100-K18	2113.4326.02/.12
Analog modulation systems		
AM/FM/RDS Coder	R&S®SFE100-K170	2113.4426.02
ATV Standard B/G Coder	R&S®SFE100-K190	2113.4649.02
ATV Standard D/K Coder	R&S®SFE100-K191	2113.4661.02
ATV Standard I Coder	R&S®SFE100-K192	2113.4684.02
ATV Standard M/N Coder	R&S®SFE100-K193	2113.4703.02
ATV Standard L Coder	R&S®SFE100-K194	2113.4726.02
ATV Multistandard Coder	R&S®SFE100-K195	2113.4749.02
ARB waveform generator		
ARB Waveform Generator	R&S®SFE100-K35	2113.4926.02
ARB Memory Expansion	R&S®SFE100-B3	2112.4400.02
R&S®WinIQSIM™ Simulation Software	R&S®SFE100-K350	2113.4949.02
Digital baseband		
TS Generator including SDTV streams	R&S®SFE100-K20	2113.4861.02
TRP Player	R&S®SFE100-K22	2113.5268.02/.12
TS Generator/Player	R&S®SFE100-PK20	2113.6041.02
Analog baseband		
Video Generator	R&S®SFE100-K23	2113.4884.02
Other options		
Noise Generator	R&S®SFE100-K40	2113.4903.02
Power Amplifier	R&S®SFE100-B90	2112.4900.02
Additional Hard Disk (CompactFlash)	R&S®SFE100-B6	2112.4539.02
Coder Expansion Board	R&S®SFE100-B15	2112.4222.02
Digital I/Q Input	R&S®SFE100-K80	2113.5245.02/.12
Rear RF Output Configuration	R&S®SFE100-U1	2112.4297.02

The data sheet with complete specifications (PD 5213.9234.21) is available at www.rohde-schwarz.com.

Your local Rohde&Schwarz representative will help you find the optimum solution for your requirements and will be glad to provide you with a customized quotation.
You will find your local contact at
www.sales.rohde-schwarz.com

About Rohde & Schwarz

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.

Environmental commitment

❙ Energy-efficient products
❙ Continuous improvement in environmental sustainability
❙ ISO 14001-certified environmental management system

Certified Quality System
ISO 9001

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