Spectrum Analyzer R&S FSU

The high-end spectrum analyzer with unmatched performance

Features

Versatile resolution filters
- Gaussian, FFT, channel, RRC

Comprehensive test routines
- TOI, OBW, CCDF
- Channel power, ACPR
- ACPR in time domain

Full choice of detectors
- Auto Peak, Max Peak, Min Peak, Sample, RMS, Average, Quasi Peak

Optional electronic attenuator

Standards
- GSM/EDGE
- *Bluetooth*™ wireless technology

Code domain power for 3GPP
- WCDMA and CDMA2000

Speed

- Fast ACP test routine in time domain
- User-configurable list for fast measurements at frequencies of interest
- Up to 60 measurements/s in time domain via IEC/IEEE bus (including trace data transfer)

Unmatched performance

Unmatched dynamic range
- TOI typ. +25 dBm
- 1 dB compression +13 dBm
- Phase noise
  –123 dBc (1 Hz) typ. at 10 kHz offset
  –160 dBc (1 Hz) typ. at 10 MHz offset
- Excellent display linearity<0.1 dB
- 84 dB ACLR/3GPP with noise correction

ROHDE&SCHWARZ

Milestones

The name Rohde & Schwarz has been synonymous with innovative spectrum analyzers since 1986, the unique features of which have repeatedly set standards in this technology. Examples are the analyzers of the R&S FSE and R&S FSIQ families.

The Spectrum Analyzer R&S FSU is another milestone. New circuit concepts, advanced RF components, A/D converters and ASIC technology, extensive experience gained from a variety of applications and customer requirements – all this combines to form a solid basis on which the R&S FSU was developed. Its unparalleled features enable the use of new test methods – to your advantage. The future-oriented concept combines unprecedented performance with continuity. The R&S FSU is compatible with the R&S FSE and R&S FSIQ, the industry standards to date. Test routines and sequences generated for the R&S FSE or R&S FSIQ can be used on the R&S FSU too. The R&S FSU family thus secures your investment.

The operating concept of the top analyzer R&S FSU is the same as that of the general-purpose analyzer R&S FSP, so these instruments offer a uniform platform for a variety of applications.

The R&S FSU family

R&S FSU 3	20 Hz to 3.6 GHz
R&S FSU 8	20 Hz to 8 GHz
R&S FSU 26	20 Hz to 26 GHz

Rohde & Schwarz innovation in spectrum analyzers

1986 **R&S FSA** – first colour display, first spectrum analyzer to feature –154 dBm (6 Hz) displayed average noise level without the use of preamplifiers, quasi-continuously variable resolution bandwidths, phase noise optimization

1995 **R&S FSE** – fastest analyzer

1996 **R&S FSE** – first spectrum analyzer with RMS detector

1997 **R&S FSE-B7** – universal vector signal analysis and spectrum analyzer capability combined for the first time

1998 **R&S FSIQ** – first analyzer offering 75 dB dynamic range for UMTS/WCDMA ACLR measurements

1999 **R&S FSP** – 0.5 dB total measurement uncertainty as standard, fast ACP test routines in time domain, digital channel filters, CCDF

2000 **R&S FSP-B25** – first electronic attenuator for wear-free use in production

2001 **R&S FSU** – 0.3 dB total measurement uncertainty, 50 MHz resolution bandwidth, +25 dBm TOI

Performance surpassing all expectations

R&S FSU – ideal for signals requiring wide dynamic range

The R&S FSU even surpasses the proven excellent RF data of the R&S FSE and R&S FSIQ families. Measurements calling for an extremely wide dynamic range become even simpler, faster and more reliable – in development, quality management and production. The R&S FSU can rightly be called the new reference in spectrum analysis, with an unprecedented dynamic range:

- TOI>20 dBm, typ. +25 dBm
- 1 dB compression: +13 dBm (0 dB RF attenuation)
- Displayed average noise level: –158 dBm (1 Hz bandwidth)
- 77 dB ACLR typ. for 3GPP, 84 dB typ. with noise correction
- HSOI 55 dBm typ.
- Phase noise: –160 dBc (1 Hz) typ. at 10 MHz carrier offset

These characteristics make it easy to find small spurious signals even in the presence of strong carriers (e.g. at a base station).

For 3GPP adjacent-channel power measurements, a figure of 84 dB ACLR allows good adjacent-channel power ratios to be verified and demonstrated very simply and with high accuracy. Build your node B better than others, and prove it.

The high harmonic second-order intercept point means optimum dynamic range for multichannel cable TV measurements.

Wealth of functions

The R&S FSU is launched with the most abundant functionality available on the spectrum analyzer market. All major functions come straight away in the basic unit:

- Highly selective digital filters from 10 Hz to 100 kHz
- Fast FFT filters from 1 Hz to 30 kHz
- Channel filters from 100 Hz to 5 MHz
- RRC filters
- Resolution bandwidth from 1 Hz to 50 MHz
- QP detector and EMI bandwidths 200 Hz, 9 kHz, 120 kHz
- 2.5 ms sweep time in frequency domain
- 1 µs sweep time in time domain
- Number of measurement points/trace selectable between 155 and 10001
- Time-selective spectrum analysis with gating function
- GPIB interface, IEEE 488.2
- RS-232-C serial interface, 9-pin Sub-D connector
- VGA output, 15-pin Sub-D
- PC-compatible screenshots on diskette or hard disk
- Up to 20 measurements/s in manual mode
- Up to 30 measurements/s on GPIB interface
- SCPI-compatible GPIB command set
- R&S FSE/R&S FSIQ-compatible GPIB command set
- Fast ACP measurement in time domain
- Statistical signal analysis with CCDF function
- RMS detector of 100 dB dynamic range
- Transducer factor for correcting antenna or cable frequency responses
- 2-year calibration cycle
- 3-year warranty[1)]
- External reference from 1 MHz to 20 MHz in 1 Hz steps

1) Except parts subject to wear and tear (e.g. attenuators).

In addition, various standard-specific modulation and spectrum measurement routines are available as options.

Ready today for tomorrow

Functions such as

- CCDF analysis
- Fast ACP measurement in time domain
- RMS detector
- Selection of filter characteristic
- Recording and readout of up to 2 x 512 ksamples of I/Q data (8 MHz RF bandwidth)
- High measurement accuracy
- Excellent display linearity

and features such as 50 MHz bandwidth mean that the R&S FSU is ready now for tomorrow's needs.

Shorter development cycles through versatile functions …

To handle the wide variety of measurement tasks in product development, an instrument must offer ample functionality and excellent performance in all areas of interest. The R&S FSU fully meets these requirements.

Full choice of detectors for adaptation to a wide range of signal types (Fig. 1):

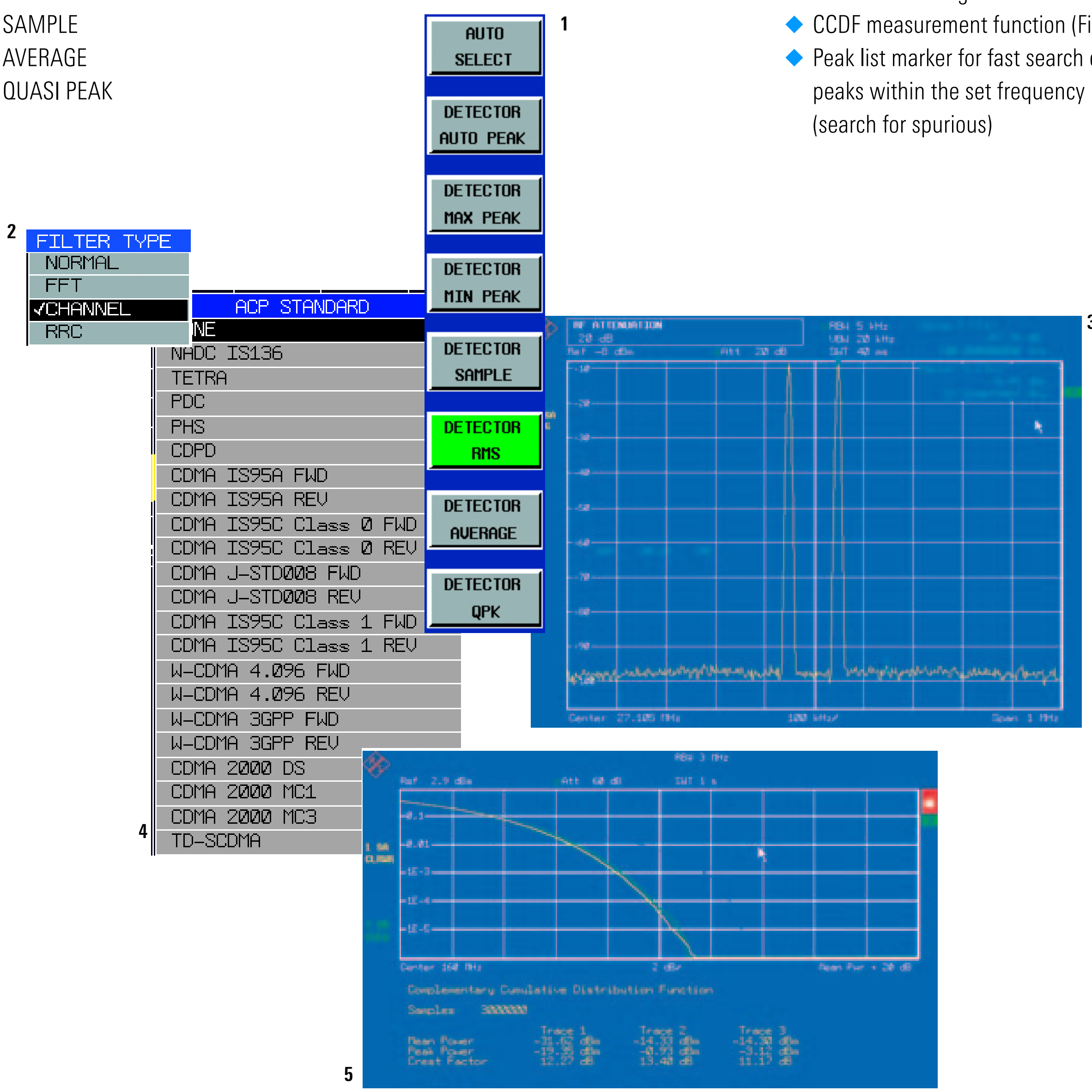
- RMS
- AUTO PEAK
- MAX PEAK
- MIN PEAK
- SAMPLE
- AVERAGE
- QUASI PEAK

The most versatile resolution filter characteristics and largest bandwidth found in a spectrum analyzer:

- Standard resolution filters from 10 Hz to 50 MHz in steps of 1, 2, 3, 5
- FFT filters from 1 Hz to 30 kHz
- 32 channel filters with bandwidth from 100 Hz to 5 MHz
- RRC filters for NADC and TETRA
- EMI filters: 200 Hz, 9 kHz, 120 kHz

Full range of analysis functions:

- Time-domain power in conjunction with channel or RRC filters turn the R&S FSU into a fully-fledged channel power meter (Fig. 2)
- TOI marker (Fig. 3)
- Noise/phase-noise marker
- Versatile channel/adjacent-channel power measurement functions with wide selection of standards, user-configurable (Fig. 4)
- Split-screen mode with selectable settings
- CCDF measurement function (Fig. 5)
- Peak list marker for fast search of all peaks within the set frequency range (search for spurious)



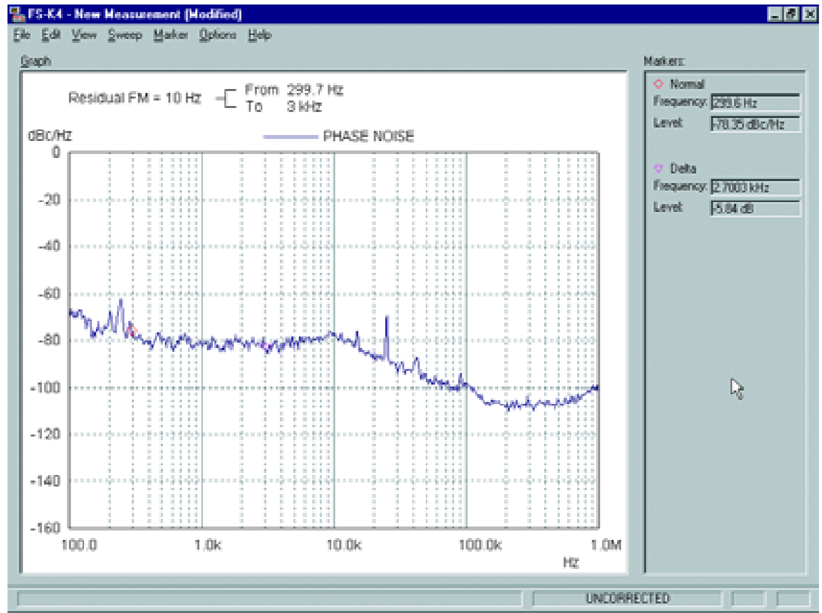
… wide dynamic range and future-proof performance

Whether in synthesizer development or frontend design, additional applications add to the R&S FSU functionality while user-friendliness is maintained:

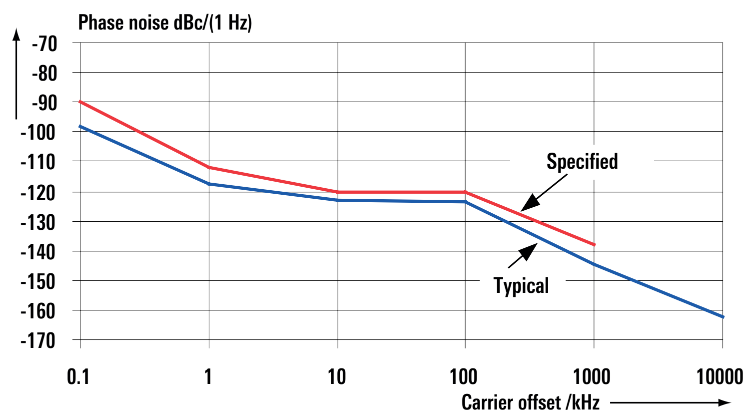
Phase Noise Measurement Software R&S FS-K4 automates measurement over a complete offset frequency range and determines residual FM from the phase noise characteristic. This in conjunction with the R&S FSU's extremely low phase noise generally does away with the need for an extra phase noise measurement system, which can be difficult to operate anyway.

Noise Measurement Software R&S FS-K3 is a convenient way to determine the noise figure of amplifiers and frequency-converting UUTs throughout the R&S FSU's frequency range, so enabling complete documentation. The high linearity and extremely accurate power measurement routines of the R&S FSU deliver precise and reproducible results. So why bother with a noise figure meter.

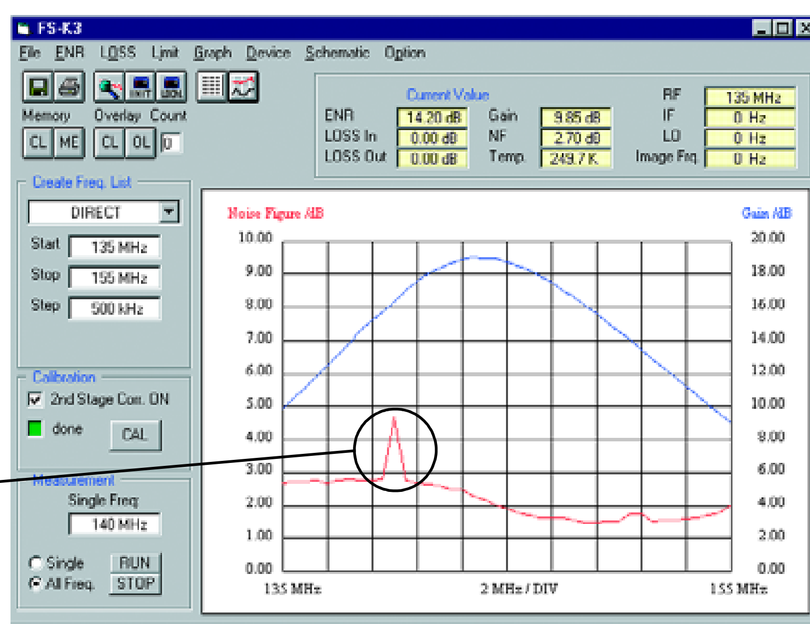
If the R&S FSU3/8 is equipped with the option R&S FSU-B25 and the R&S FSU26 with the options R&S FSU-B25 and -B23, a separate preamplifier is not required for measuring very low noise figures.



Phase noise measurement with Software R&S FS-K4



SSB phase noise of the R&S FSU



Noise figure measurement with Software R&S FS-K3

Fast and simple analysis of anomalies: the cause – spurious or RFI – can easily be traced with the basic analyzer function without additional measuring equipment

From GSM to UMTS …

From GSM to UMTS – ready for 3G mobile radio

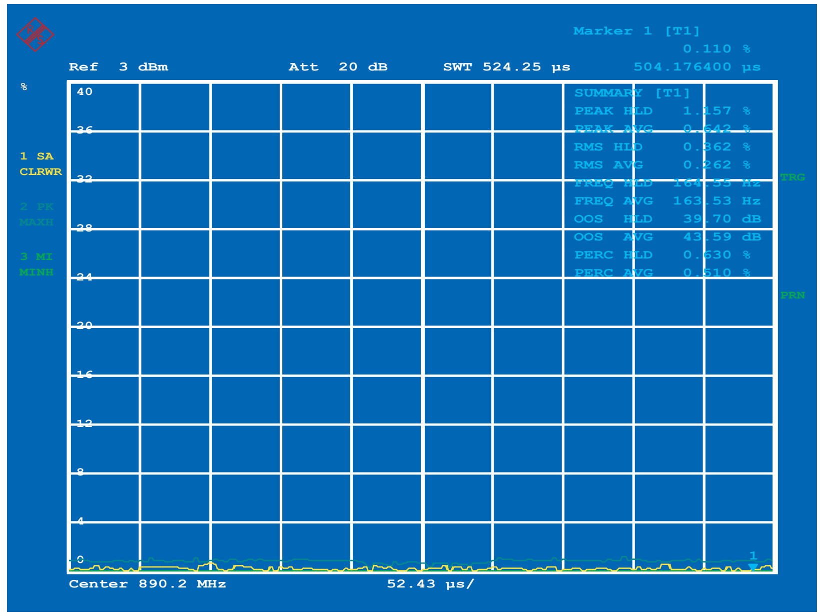
In conjunction with GSM/EDGE Application Firmware R&S FS-K5, the R&S FSU offers complete functionality for RF and modulation measurements in GSM systems. EDGE, which is the generation 2.5, is already included in the R&S FS-K5 option.

- Phase/frequency error for GSM
- Modulation accuracy for EDGE with:
  - EVM and ETSI-conformant weighting filters
  - OOS
  - 95:th percentile
  - Power versus time with synchronization to midamble
  - Spectrum due to modulation
  - Spectrum due to transients

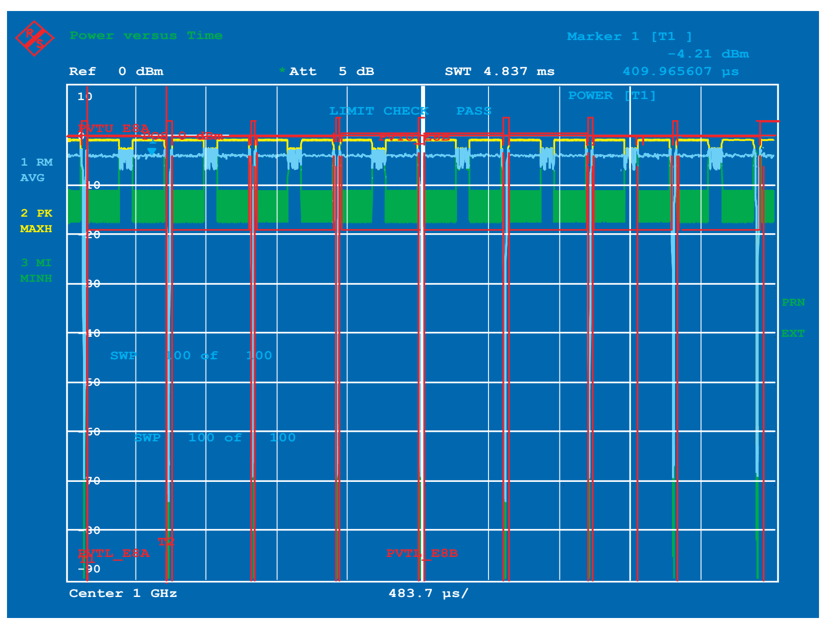
The above features plus its wide dynamic range make the R&S FSU an ideal tool in base station development and testing. This is enhanced by excellent characteristics ready incorporated in the standard unit, e.g.<0.3 dB total measurement uncertainty, gated sweep and IF power trigger.

Even in its basic version, the R&S FSU offers the functionality and characteristics needed to develop, verify and produce 3G mobile radio systems:

- RMS detector, provided as standard in Rohde&Schwarz analyzers for many years and allowing accurate power measurements independently of signal form; 3GPP specifications stipulate RMS power measurements for most tests
- ACP measurement function for 3GPP with 3.84 MHz bandwidth RRC filter for standard-conformant adjacent-channel power measurements with a dynamic range limit of 77.5 dB



Measurement of modulation accuracy on EDGE burst



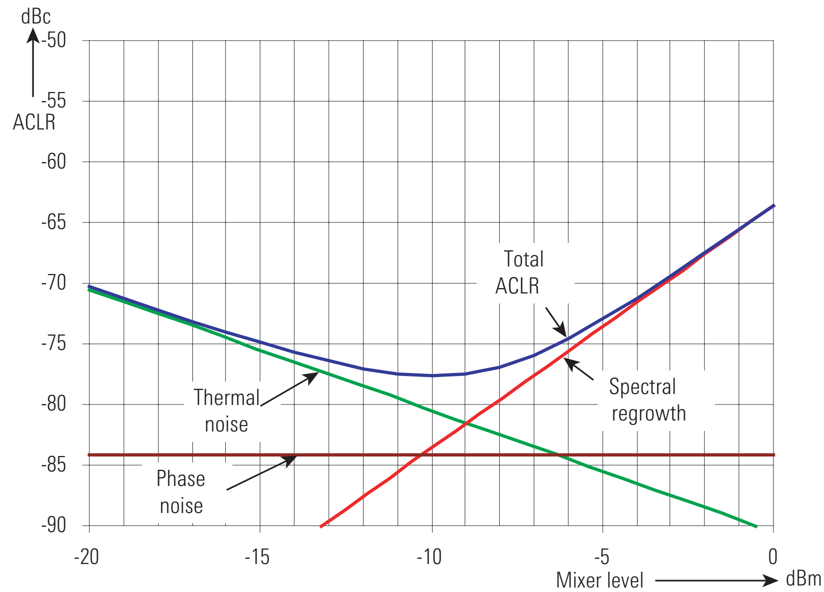
Measurement of power ramp on EDGE burst

- Dedicated CCDF measurement function that determines the probability of instantaneous signal power exceeding average power; CCDF measurement is indispensable to determine optimum transmit power for CDMA signals, assuming that clipping at known, short intervals is tolerable

… ready for 3G mobile radio

Bluetooth signal measurements

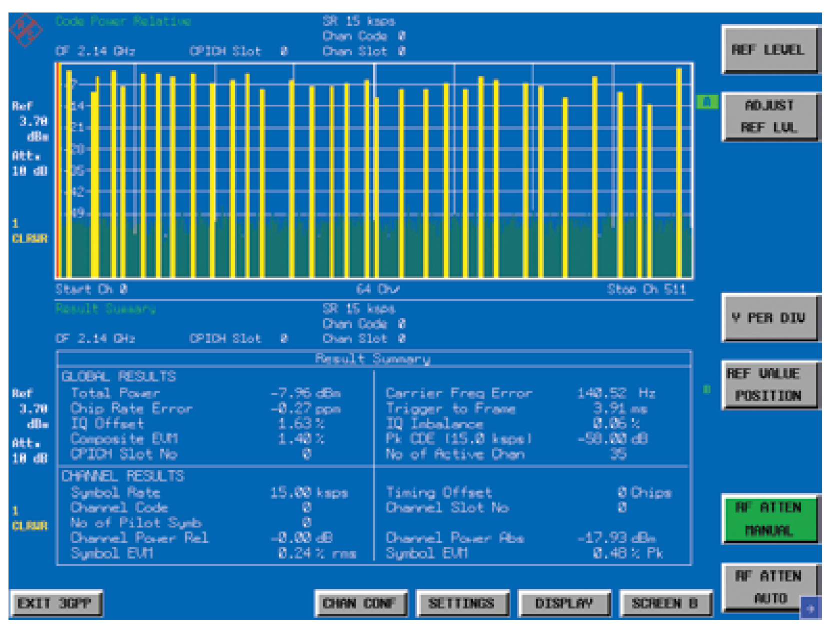
- Enhanced measurement functionality in line with *Bluetooth* RF Test Specification (*Bluetooth* SIG) Rev. 0.91
- Measurement functions
  - Output power
  - Adjacent channel power (ACP)
  - Modulation characteristics
  - Initial carrier frequency tolerance (ICTF)
  - Carrier frequency drift
- Simultaneous display of traces and all numerical measurement results
- Automatic limit value monitoring
- Ideal for use in development and production of *Bluetooth* modules



Dynamic range of the R&S FSU for adjacent-channel power measurement on WCDMA signal without noise correction

Standard 3GPP modulation and code domain power measurements

- Additional measurement functions in line with 3GPP specifications for FDD mode
- For BTS/node B signals: Application Firmware R&S FS-K72
- For CDMA2000/3GPP3 base station signals: Application Firmware R&S FS-K82
- For UE signals: Application Firmware R&S FS-K73
- High measurement speed of 4 s/measurement
- Code domain power and CPICH power
- Code domain power and rho (CDMA2000/3GPP2)
- EVM and PCDE
- Code domain power versus slot
- EVM/code channel
- Spectrum emission mask



WCDMA code domain power measurement with the R&S FSU and R&S FS-K72

Type	Designation and/or application
R&S FS-K5	Modulation and spectrum measurements on GSM/EDGE base station and mobile signals
R&S FS-K7	FM measurement demodulator for general applications
R&S FS-K8	*Bluetooth* transmitter measurements
R&S FS-K72	Modulation and code domain power measurements to 3GPP TS 24.141 on base station signals (node B)
R&S FS-K73	Modulation and code domain power measurements to 3GPP TS 25.121 on mobile station signals (UE)
R&S FS-K82	Modulation and code domain power measurements to CDMA2000/3GPP2 on base station signals (also for measurements on IS-95/cdmaOne signals)
R&S FS-K3	Noise figure measurements (Windows software) Recommended options: Preamplifier R&S FSU-B23, R&S FSU-B25
R&S FS-K4	Phase noise measurements (Windows software)

What can we do …

Short test cycles, high throughput

The R&S FSU is just the right instrument for this. Fast data transfer on the IEC/IEEE bus or an Ethernet LAN plus intelligent routines optimized for speed make for very short measurement times:

- FAST ACP: for the major mobile radio standards with high reproducibility and accuracy
- List mode: combined measurement of various parameters at a single command
- Fast time domain power measurement using channel or RRC filters
- Up to 60 measurements/s in zero span via IEC/IEEE bus including trace data transfer
- Fast-sweeping FFT filters for spurious measurement at low levels
- Fast frequency counter: 0.1 Hz resolution for a measurement time of<30 ms

Downtime and repair time cut to a minimum

No limited lifetime of mechanical attenuators due to high throughput

The optional electronic attenuator R&S FSU-B25 with 25 dB setting range does away with any mechanical switching – so the R&S FSU's high accuracy is maintained without any early failure. A two-year calibration cycle minimizes downtime for instrument calibration.

Spurious emission measurements without notch filter

The R&S FSU is the ideal choice for this type of measurement, even for tests on GSM base stations. The extremely low phase noise and high 1 dB compression point of the R&S FSU enable direct measurements without the use of extra automatic or manually tuned notch filters. This eliminates possible sources of error and makes measurements simpler and more reliable.

Another step enhancing the reliability of your test system!

Existing programs for the R&S FSE, R&S FSIQ or R&S FSP can be used on the R&S FSU

The R&S FSU complies with SCPI conventions and is IEC/IEEE-bus-compatible with respect to the R&S FSE and R&S FSIQ. These instruments can in most cases be directly replaced with no or only minor changes to the software. If changes have to be made, they affect only those program parts that concern the speed-optimized measurement routines of the R&S FSU.

External frequency standards

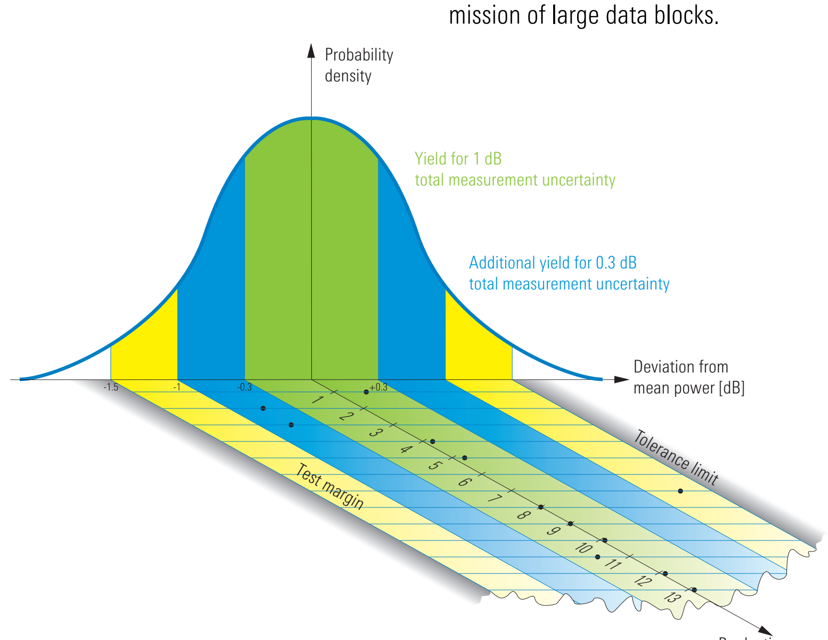
The R&S FSU accepts signals between 1 MHz and 20 MHz in steps of 1 Hz.

Higher production yield

Enhanced measurement accuracy makes for higher production yield. The safety margins that usually compensate for the measurement uncertainty of test systems can be reduced, so increasing the accept (passed) region. Given the same spread of results, more products will pass the test. The R&S FSU helps you boost your production yield due to a total measurement uncertainty of<0.3 dB (2σ).

LAN interface

With the aid of the optional LAN Interface R&S FSU-B16, the R&S FSU can be connected to common networks such as 100Base-T so that functions like file logging on network drives or documentation of measurement results via network printer are available. In addition, the R&S FSU can be remote-controlled via LAN. This yields a clear speed advantage over the IEC/IEEE bus in particular for the transmission of large data blocks.



Effect of measurement uncertainty on production yield

… to boost your production yield?

859x/8566-compatible IEC/IEEE bus command set

In many applications, existing test software is to be used in automatic test systems with new devices. For this reason, the R&S FSU is provided as standard with an IEC/IEEE bus command set that is compatible not only with the R&S FSEx/ R&S FSIQ family but also with the spectrum analyzers of the 859x/8566 series.

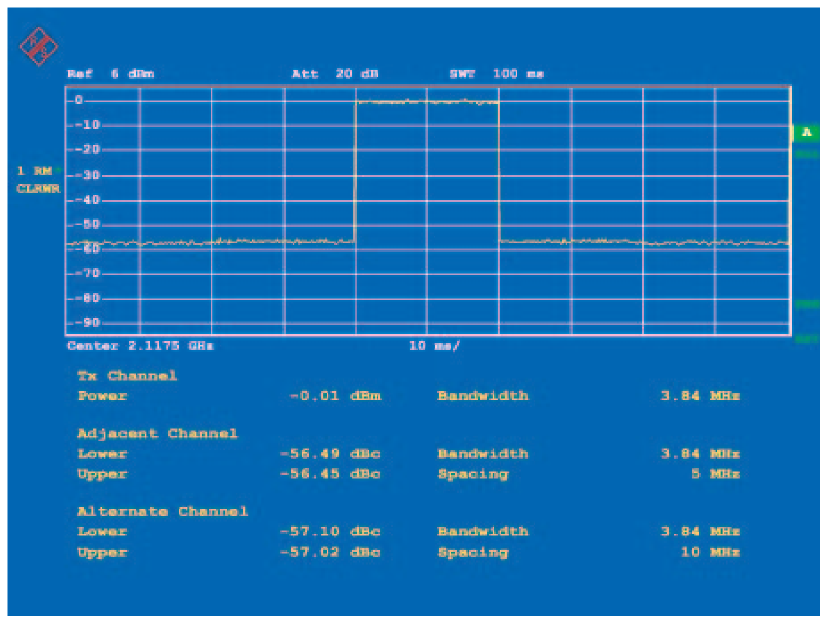
It was of utmost importance to achieve maximum compatibility in order to minimize the changing effort.

- Approx. 175 commands in IEEE488-2 format (incl. CF, AT, ST)
- The most important commands in IEEE488-1 format (8566A, for exclusive use only)
- Selectable presets
- Selectable trace format

The IEC/IEEE bus commands in IEEE488-2 format can be used together with the R&S FSU command set, so that it is possible to enhance and complete available software by using the innovative instrument functions of the R&S FSU (such as list mode, channel filters) without having to redesign the test software.

	Sweeps/s Span 10 MHz, sweep time 2.5 ms	**Sweeps/s** Span 0 Hz, sweep time 100 µs
ASCII format	30	40
Binary IEEE754 format	50	60

Measurement speed on GPIB interface
Settings: display off, default coupling, single trace, 625 points



Measurement of adjacent-channel power versus time: FAST ACP

With 30 measurements/s in manual mode, minimum sweep time of 2.5 ms and 1 µs zero span as standard, the R&S FSU is ideal for time-critical applications.

The highly selective, fast-sweeping digital filters featuring "analog response" allow measurements on pulsed signals as well as use of the built-in frequency counter.

Remote control of the R&S FSU via IEC/IEEE bus in list mode cuts down on measurement times

Profit from the advantages of networking

Versatile documentation and networking capabilities

The standard disk drive makes it easy for you to integrate results into documentation – simply save the screen contents as a BMP or WMF file and import them into your word processing system. To process trace data, save them as an ASCII file (CSV format), which not only documents trace data but also the main instrument settings.

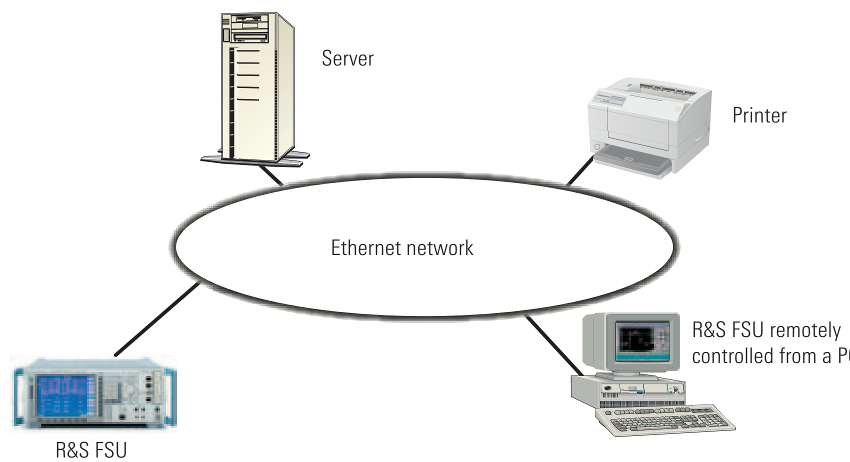
Make use of the advantages offered by networking

The option **R&S FSU-B16** opens up versatile networking capabilities:

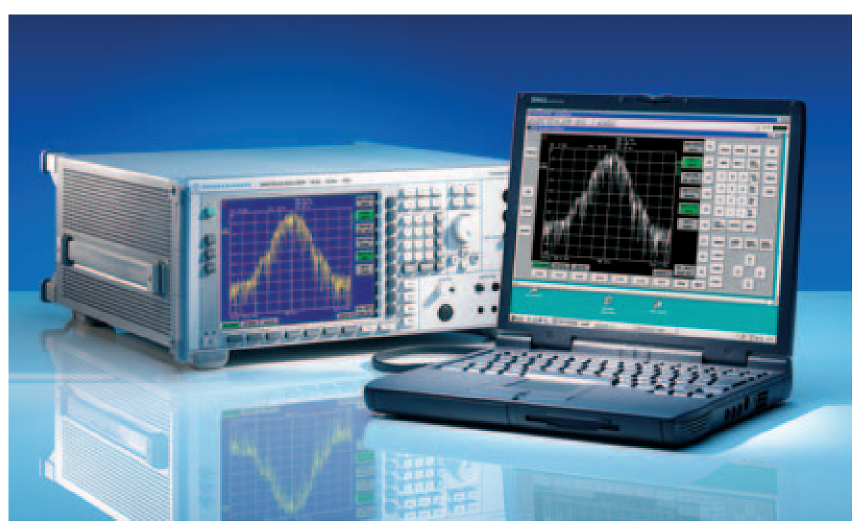
- Link to standard network (Ethernet 10/100BaseT)
- Running under Windows NT, the R&S FSU can be configured for network operation. Applications such as data output to a central network printer or saving results on a central server can easily be implemented. The R&S FSU can thus be optimally matched to any work environment.
- You can import screen contents directly into Word for Windows or, by using an MS Excel macro, into your documentation programs and so immediately create data sheets for your products or documents for quality assurance.

Remote control by Ethernet is even simpler:

- Remote control software: Allows mouse operation of the R&S FSU after assigning it a TCP/IP address. All elements of the R&S FSU screen are represented by a soft front panel function; the complete R&S FSU screen shows on the remote PC.
- Special RSIB interface: This links your application to the TCP/IP protocol and acts like an IEC/IEEE bus driver. The RSIB interface is available for Windows and the UNIX world. The R&S FSU can be programmed via this interface just like on the familiar IEC/IEEE bus.



Networked operation of the R&S FSU



Remote control of the R&S FSU

Specifications

Specifications apply under the following conditions:
30 minutes warm-up time at ambient temperature, specified environmental conditions met, calibration cycle adhered to, and total calibration performed.
Data without tolerances: typical values only.
Data designated "nominal" apply to design parameters and are not tested.
Data designated "σ = xx dB" are shown as standard deviation
.

	R&S FSU3	R&S FSU8	R&S FSU26
Frequency			
Frequency range DC coupled AC coupled	 20 Hz to 3.6 GHz 1 MHz to 3.6 GHz	 20 Hz to 8 GHz 1 MHz to 8 GHz	 20 Hz to 26.5 GHz 10 MHz to 26.5 GHz
Frequency resolution	0.01 Hz		
Internal reference frequency (nominal) with standard OCXO			
Aging per day [1]	1×10^{-9}		
Aging per year [1]	1×10^{-7}		
Temperature drift (0°C to +50°C)	8×10^{-8}		
Total error (per year) [1]	1.8×10^{-7}		
Internal reference frequency (nominal); option R&S FSU-B4			
Aging per day [1]	2×10^{-10}		
Aging per year [1]	3×10^{-8}		
Temperature drift (0°C to +50°C)	1×10^{-9}		
Total error (per year) [1]	5×10^{-8}		
External reference frequency	1 MHz to 20 MHz, 1 Hz steps		
Frequency display	with marker or frequency counter		
Marker resolution	0.1 Hz to 10 kHz (dependent on span)		
Max. deviation (sweep time>3 x auto sweep time)	±(marker frequency x reference error + 0.5 % x span +10 % x resolution bandwidth + ½ (last digit))		
Frequency counter resolution	0.1 Hz to 10 kHz (selectable)		
Count accuracy (S/N>25 dB)	±(frequency x reference error + ½ (last digit))		
Frequency span	0 Hz, 10 Hz to 3.6 GHz	0 Hz, 10 Hz to 8 GHz	0 Hz, 10 Hz to 26.5 GHz
Span resolution/max. span deviation	0.1 Hz/1 %		
Spectral purity (dBc(1Hz)), SSB phase noise, f = 640 MHz			
Residual FM	<1 Hz nominal		
Carrier offset 10 Hz	 typ. –73 dBc(1 Hz), with option R&S FSU-B4 –86 dBc typ.		
100 Hz	<–90 dBc(1 Hz), –100 dBc(1 Hz) typ.		
1 kHz	<–112 dBc(1 Hz), –116 dBc(1 Hz) typ.		
10 kHz	<–120 dBc(1 Hz), –123 dBc(1 Hz) typ.		
100 kHz	<–120 dBc(1 Hz), –123 dBc(1 Hz) typ.		
1 MHz	<–138 dBc(1 Hz), –144 dBc(1 Hz) typ.		
10 MHz	<–155 dBc(1Hz) nominal, –160 dBc(1 Hz) typ.		
Sweep			
Span 0 Hz	1 µs to 16000 s in steps of 5%		
Span ≥10 Hz	2.5 ms to 16000 s in steps ≤10%		
Max. deviation of sweep time	3%		
Sampling rate	31.25 ns (32 MHz A/D converter)		
Measurement in time domain	with marker and display lines (resolution 31.25 ns)		
Resolution bandwidths			
Analog filters			
3 dB bandwidths	10 Hz to 20 MHz in 1/2/3/5 sequence, 50 MHz		
Bandwidth error			
10 Hz to 100 kHz	<3%		
200 kHz to 5 MHz	<10%		
10 MHz, 20 MHz	–30% to + 10%		
50 MHz	–30% to +10%	–30% to +10% for f<3.6 GHz –30% to +100% for f>3.6 GHz	
Shape factor –60 dB: –3 dB			
≤100 kHz	<6		
200 kHz to 2 MHz	<12		
3 MHz to 10 MHz	<7		
20 MHz, 50 MHz	<6 nominal		
Video bandwidths	1 Hz to 10 MHz in 1/2/3/5 sequence		

1) After 30 days of continuous operation.

	R&S FSU3	R&S FSU8	R&S FSU26
FFT filters			
3 dB bandwidths	1 Hz to 30 kHz in 1/2/3/5 sequence		
Bandwidth error	<5% nominal		
Shape factor –60 dB: –3 dB	<3 nominal		
EMI filters			
6 dB bandwidths	200 Hz, 9 kHz, 120 kHz		
Bandwidth error	<3% nominal		
Shape factor –60 dB: –3 dB	<6 nominal		
Channel filters			
Bandwidths	100, 200, 300, 500 Hz, 1, 1.5, 2, 2.4, 2.7, 3, 3.4, 4, 4.5, 5, 6, 8.5, 9, 10, 12.5, 14, 15, 16, 18 (RRC), 20, 21, 24.3 (RRC), 25, 30, 50, 100, 150, 192, 200, 300, 500 kHz, 1, 1.228, 1.5, 2, 3, 5 MHz		
Shape factor –60 dB: –3 dB	<2 nominal		
Bandwidth error	2% nominal		
Level			
Display range	displayed average noise level to 30 dBm		
Maximum input level			
DC voltage (AC coupling)	50 V		
DC voltage (DC coupling)	0 V		
RF attenuation 0 dB			
CW RF power	20 dBm (= 0.1 W)		
Pulse spectral density	97 dBμV/1 MHz		
RF attenuation ≥10 dB			
CW RF power	30 dBm (= 1 W)		
Max. pulse voltage	150 V		
Max. pulse energy (10 μs)	1 mWs		
1 dB compression of input mixer (0 dB RF attenuation)	+13 dBm nominal	+13 dBm nominal up to 3.6 GHz	
		+10 dBm nominal from 3.6 GHz to 8 GHz	+7 dBm nominal from 3.6 GHz to 26 GHz
Intermodulation			
Third-order intermodulation			
Third-order intercept (TOI), level 2 x –10 dBm, Δf>5 x RBW or 10 kHz, whichever is larger	>17 dBm, 20 dBm typ. for f = 10 MHz to 300 MHz >+20 dBm, +25 dBm typ. for f>300 MHz	>17 dBm, 20 dBm typ. for f = 10 MHz to 300 MHz >+20 dBm, +25 dBm typ. for f = 300 MHz to 3.6 GHz >+18 dBm, +23 dBm typ. for f = 3.6 GHz to 8 GHz	>17 dBm, 20 dBm typ. for f = 10 MHz to 300 MHz >+22 dBm, +27 dBm typ. for f = 300 MHz to 3.6 GHz >+12 dBm, +15 dBm typ. for f = 3.6 GHz to 26.5 GHz
Second harmonic intercept point (SHI)			
f_{in} ≤100 MHz	>35 dBm		
100 MHz<f_{in}≤400 MHz	>45 dBm, 55 dBm typ.		
400 MHz<f_{in} ≤500 Hz	>52 dBm, 60 dBm typ.		
500 MHz<f_{in} ≤1 GHz	>45 dBm, 55 dBm typ.		
1 GHz<f_{in}≤1.8 GHz	>35 dBm		
f_{in}>1.8 GHz	–	>80 dBm nominal	
Displayed average noise level			
(0 dB RF attenuation, RBW 10 Hz, VBW 30 Hz, 20 averages, trace average, span 0 Hz, termination 50 Ω)			
Frequency			
20 Hz	<–80 dBm		
100 Hz	<–100 dBm		
1 kHz	<–110 dBm		
10 kHz	<–120 dBm		
100 kHz	<–120 dBm		
1 MHz	<–130 dBm		
10 MHz to 2 GHz	<–145 dBm, –148 dBm typ.		<–142 dBm, –146 dBm typ.
2 GHz to 3.6 GHz	<–143 dBm, –147 dBm typ.	<–143 dBm, –145 dBm typ.	<–140 dBm, –143 dBm typ.
3.6 GHz to 7 GHz	<–142 dBm, –146 dBm typ.	<–142 dBm, –144 dBm typ.	–
7 GHz to 8 GHz	–	<–140 dBm	–
3.6 GHz to 8 GHz	–	–	<–142 dBm, –146 dBm typ.
8 GHz to 13 GHz	–	–	<–140 dBm, –143 dBm typ.
13 GHz to 18 GHz	–	–	<–138 dBm, –141 dBm typ.
18 GHz to 22 GHz	–	–	<–137 dBm, –140 dBm typ.
22 GHz to 26.5 GHz	–	–	<–135 dBm, –138 dBm typ.

	R&S FSU3	R&S FSU8	R&S FSU26
Maximum dynamic range			
1 dB compression to DANL (1 Hz)	170 dB		
Immunity to interference			
Image frequency			
f ≤ 3.6 GHz	>90 dB,>110 dB typ.		
f>3.6 GHz	–	>70 dB, 100 dB typ.	
Intermediate frequency			
f ≤ 3.6 GHz	>90 dB,>110 dB typ.		
3.6 GHz ≤f ≤4.2 GHz f>4.2 GHz	–	70 dB typ. >70 dB,>90 dB typ.	
Spurious responses (f>1 MHz, without input signal, 0 dB attenuation)	<–103 dBm		
Other spurious (Δf>100 kHz)			
f_{in}<2.3 GHz	<–80 dBc (mixer level ≤–10 dBm)		
2.3 GHz≤ f_{in}<4 GHz	<–70 dBc (mixer level ≤–35 dBm)		
4 GHz≤ f_{in}<8 GHz	<–80 dBc (mixer level ≤–10 dBm)		
8 GHz≤ f_{in}<16 GHz	–		<–74 dBc
f_{in}>16 GHz	–		<–68 dBc
Level display (spectrum mode)			
Screen	625 x 500 pixels (one diagram), max. 2 diagrams with independent settings		
Logarithmic level axis	1 dB, 10 dB to 200 dB in 10 dB steps		
Linear level axis	10% of reference level per level division, 10 divisions or logarithmic scaling		
Traces	max. 6 with 2 diagrams on screen, max. 3 per diagram		
Trace detectors	Max Peak, Min Peak, Auto Peak (Normal), Sample, RMS, Average, Quasi Peak		
Trace functions	Clear/Write, Max Hold, Min Hold, Average		
Number of measurement points	625, settable between 155 and 100001 in steps of approx. factor 2		
Setting range of reference level			
Logarithmic level display	–130 dBm to (+5 dBm + RF attenuation), max. 30 dBm, in steps of 0.1 dB		
Linear level display	7.0 nV to 7.07 V, in steps of 1%		
Units of level axis	dBm, dBµV, dBmV, dBµA, dBpW (log level display) / µV, mV, µA, mA, pW, nW (linear level display)		
Level measurement accuracy			
Reference error at 128 MHz, RBW ≤100 kHz, reference level –30 dBm, RF attenuation 10 dB	<0.2 (σ = 0.07) dB		
Frequency response (DC coupling, RF attenuation ≥10 dB)			
10 MHz to 3.6 GHz	<0.3 dB (σ = 0.1 dB)[1]		
3.6 GHz to 8 GHz	–	<1.5 dB (σ = 0.5 dB)[2]	
8 GHz to 22 GHz	–	–	<2 dB (σ = 0.7 dB)[2]
22 GHz to 26.5 GHz	–	–	<2.5 dB (σ = 0.8 dB)[2]
Attenuator (≥5 dB)	<0.2 dB (σ = 0.07 dB)		
Reference level switching	<0.15 dB (σ = 0.05 dB)		
Display nonlinearity (20 °C to 30 °C, mixer level ≤–10 dBm)			
Logarithmic level display			
RBW ≤100 kHz, S/N>20 dB			
0 dB to –70 dB	<0.1 dB (σ = 0.03 dB)		
–70 dB to –90 dB	<0.3 dB (σ = 0.1 dB)		
10 MHz≥ RBW ≥200 kHz, S/N>16 dB			
0 dB to –50 dB	<0.2 dB (σ = 0.07 dB)		
–50 dB to –70 dB	<0.5 dB (σ=0.17 dB)		
RBW ≥ 10 MHz			
0 dB to –50 dB	<0.5 dB (σ = 0.17 dB)		
Linear level display	5 % of reference level		
Bandwidth switching uncertainty (ref. to RBW = 10 kHz)			
10 Hz to 100 kHz	–		
200 kHz to 10 MHz	<0.2 dB (σ = 0.07 dB)		
5 MHz to 50 MHz	<0.5 dB (σ = 0.15 dB)		
FFT 1 Hz to 3 kHz	<0.2 dB (σ = 0.07 dB)		
Total measurement uncertainty (0 dB to –70 dB, S/N>20 dB, span/RBW<100, 95 % confidence level) (20 °C to 30 °C, mixer level ≤–10 dBm)			
<3.6 GHz	0.3 dB for RBW ≤ 100 kHz 0.5 dB for RBW>100 kHz		
3.6 GHz to 8 GHz	–	<2.0 dB	
8 GHz to 18 GHz	–	–	<2.5 dB
18 GHz to 26.5 GHz	–	–	<3.0 dB

	R&S FSU3	R&S FSU8	R&S FSU26
Audio demodulation			
Modulation modes	AM and FM		
Audio output	loudspeaker and headphones output		
Marker hold time in spectrum mode	100 ms to 60 s		
Trigger functions			
Trigger			
Span≥10 Hz			
Trigger source	free run, video, external, IF level (selectable, mixer level 10 dBm to –50 dBm)		
Trigger offset	125 ns to 100 s, resolution 125 ns min. (or 1 % of offset)		
Span = 0 Hz			
Trigger source	free run, video, external, IF level (mixer level 10 dBm to –50 dBm)		
Trigger offset	± (125 ns to 100 s), resolution 125 ns min., dependent on sweep time		
Trigger offset accuracy	± (125 ns + (0.1 % x delay time))		
Gated sweep			
Trigger source	external, IF level, video		
Gate delay	1 µs to 100 s		
Gate length	125 ns to 100 s, resolution 125 ns min. or 1 % of gate length		
Gate length accuracy	±(125 ns + (0.05 % x gate length))		
Inputs and outputs (front panel)			
RF input	N female, 50 Ω		
VSWR; RF attenuation≥10 dB, DC coupling			
f<3.6 GHz	<1.5		
f<8 GHz	–	<2.0	<1.8
f<18 GHz	–	–	<1.8
f<26.5 GHz	–	–	<2.0
RF attenuation<10 dB or AC coupling	1.5 typ.		
Setting range of attenuator	0 dB to 75 dB, in 5 dB steps		
Probe power supply	+15 V DC, –12.6 V DC and ground, max. 150 mA nominal		
Power supply for antennas	5-pin connector		
Supply voltages	±10 V and ground, max. 100 mA nominal		
Keyboard			
Keyboard connector	PS/2 female for MF2 keyboard		
AF output			
AF output	3.5 mm mini jack		
Output impedance	10 Ω		
Open-circuit voltage	up to 1.5 V, adjustable		
Inputs and outputs (rear panel)			
IF 20.4 MHz	Z_{out} = 50 Ω, BNC female		
Bandwidth			
RBW≤ 100 kHz	1.5 x resolution bandwidth, 2.6 kHz min.		
10 MHz≥RBW≥200 kHz	same as resolution bandwidth		
Level			
RBW≤100 kHz, FFT	–20 dBm at reference level, mixer level>–70 dBm		
10 MHz≥RBW≥200 kHz	0 dBm at reference level, mixer level>–50 dBm		
IF 404.4 MHz	Z_{out} = 50 Ω, BNC female, 404.4 MHz IF output active only if RBW>10 MHz		
Bandwidth			
RBW>10 MHz	same as resolution bandwidth		
Level			
Mixer level≤0 dBm	mixer level –10 dB typ., only active if RBW 20.50 MHz		
Video output	Z_{out} = 50 Ω, BNC female		
Voltage (RBW≥200 kHz)	0 V to 1 V, full scale (open-circuit voltage), logarithmic scaling		
Reference frequency			
Output	BNC female		
Output frequency	10 MHz		
Level	>0 dBm nominal		
Input	BNC female		
Input frequency range	1 MHz to 20 MHz, in 1 Hz steps		
Required level	>0 dBm from 50 Ω		
Sweep output	BNC female, 0 V to 5 V, proportional to displayed frequency		
Power supply connector for noise source	BNC female, 0 V and 28 V, switchable, max. 100 mA		
External trigger/gate input	BNC female,>10 kΩ		
Trigger voltage	1.4 V (TTL)		

	R&S FSU3	R&S FSU8	R&S FSU26
IEC/IEEE bus remote control	interface to IEC 625-2 (IEEE 488.2)		
Command set	SCPI 1997.0		
Connector	24-pin Amphenol female		
Interface functions	SH1, AH1, T6, L4, SR1, RL1, PP1, DC1, DT1, C0		
Serial interface	RS-232-C (COM), 9-pin Sub-D female		
Printer interface	parallel (Centronics-compatible)		
Mouse connector	PS/2 female		
Connector for external monitor (VGA)	15-pin Sub-D female		

1) Valid for temperatures between +20 °C and +30 °C; <0.6 dB for temperatures between +5 °C and +45 °C.

2) Valid for temperatures between +20 °C and +30 °C and span<1 GHz; add<0.5 dB for temperatures between +5 °C and +45 °C or span>1 GHz.

General data

Display	21 cm TFT LCD colour display (8.4")	
Resolution	800 x 600 pixels (SVGA resolution)	
Pixel failure rate	$<1 \times 10^{-5}$	
Mass memory	1.44 Mbyte 3½" disk drive, hard disk	
Data storage	>500 instrument settings and traces	
Temperature range		
Operating temperature range	+5 °C to +40 °C	
Permissible temperature range	+0 °C to +50 °C	
Storage temperature range	–40 °C to +70 °C	
Damp heat	+40 °C at 95 % relative humidity (EN 60068-2-30)	
Mechanical resistance		
Vibration, sinusoidal	5 Hz to 150 Hz, max. 2 g at 55 Hz; 0.5 g from 55 Hz to 150 Hz; meets EN 60068-2-6, EN 60068-2-30, EN 61000-1, MIL-T-28800D, class 5	
Vibration, random	10 Hz to 100 Hz, acceleration 1 g (rms)	
Shock test	40 g shock spectrum, meets MIL-STD-810C and MIL-T-28800D, classes 3 and 5	
Recommended calibration interval	2 years for operation with external reference, 1 year with internal reference	
RFI suppression	meets EMC directive of EU (89/336/EEC) and German EMC law	
Power supply		
AC supply	100 V AC to 240 V AC, 3.1 A to 1.3 A, 50 Hz to 400 Hz, class of protection I to VDE 411	
Power consumption	typ. 130 VA	typ. 150 VA
Safety	meets EN 61010-1, UL 3111-1, CSA C22.2 No. 1010-1, EN 61000-1	
Test mark	VDE, GS, CSA, CSA-NRTL	
Dimensions (W x H x D)	435 mm x 192 mm x 460 mm	435 mm x 192 mm x 460 mm
Weight	14.6 kg	15.4 kg

Tracking Generator R&S FSU-B9

Unless specified otherwise, specifications not valid for frequency range from –3 x RBW to +3 x RBW, however at least not valid from –100 kHz to +100 kHz.
Maximum output level (peak modulation in the case of amplitude-modulated signals) +5 dBm.

Frequency	
Frequency range	100 kHz to 3.6 GHz
Resolution	1 Hz
Frequency offset	
Setting range	±200 MHz
Resolution	1 Hz
Spectral purity SSB phase noise, f = 500 MHz, carrier offset 10 kHz	
Normal mode	–120 dBc (1 Hz) typ.
With frequency offset	–110 dBc (1 Hz) typ.
With FM modulation on	–110 dBc (1 Hz) typ.
Level	
Level setting range	–30 dBm to 0 dBm in steps of 0.1 dB
Level setting range with with option R&S FSU-B12	–100 dBm to +5 dBm in steps of 0.1 dB
Max. deviation of output level	
Absolute,f=128 MHz, output level –20 dBm to 0 dBm	<1 dB (σ=0.34 dB)
Frequency response referenced to level at 128 MHz, sweep time>100 ms, 5 °C to 45 °C	
Output level –20 dBm to 0 dBm, 100 kHz to 3.6 GHz	<3 dB, 1.9 dB typ.
Output level –30 dBm to –20 dBm, f=100 kHz to 3.6 GHz	3 dB
Additional deviation with R&S FSU-B12, 100 kHz to 3.6 GHz	<1 dB

Dynamic range	
Attenuation measurement range, RBW = 1 kHz, f>10 MHz	100 dB
Spurious	
Harmonics, output level –10 dBm	–30 dBc typ.
Nonharmonics, output level 0 dBm	–30 dBc typ.

Modulation

Modulation format (external)	I/Q, AM, FM			
AM, $f_{Center}>f_{Mod}$, span = 10 Hz				
Modulation depth	0% to 99%			
Modulation frequency response				
0 Hz to 5 MHz	1 dB			
0 Hz to 30 MHz	3 dB			
FM, $f_{Center}>f_{Mod}$, span = 0 Hz				
Frequency deviation	0 Hz to 10 MHz			
Modulation frequency range	0 Hz to 1 kHz, max. Hub 10 MHz 0 Hz to 100 kHz, max. Hub 1 MHz			
Modulation frequency response, 0 kHz…100 kHz	1 dB			
I/Q modulation, $f_{Center}>f_{Mod}$, span = 0 Hz				
Modulation frequency response				
0 Hz to 5 MHz	1 dB			
0 Hz to 30 MHz	3 dB			
Modulation deviation of tracking generator with I/Q modulation, typical values, baseband signals generated by the R&S AMIQ				
	EVM		**Phase error**	
Standard	**RMS**	**Peak**	**RMS**	**Peak**
GSM/DCS1800/PCS1900	–	–	1.5°	5°
NADC/TETRA/PDC	2%	4%	–	–
PHS	2%	5%	–	–
IS-95 CDMA	rho factor 0.997			
Inputs and outputs (front panel)				
RF output	N female, 50 Ω			
VSWR 100 kHz≤f≤ 2 GHz 2 GHz≤f≤3.6 GHz	 1.2 1.5			
Inputs and outputs (rear panel)				
TG I/AM IN	$V_{max.(pp)}$=0.5 V; Z_{in}=50 Ω, BNC female			
TG Q/FM IN	$V_{max.(pp)}$=0.5 V; Z_{in}=50 Ω, BNC female			

Optional Extended Environmental Specification R&S FSU-B20

Temperature range (without condensation)	
Operating temperature range	0 °C to +50 °C
Permissible temperature range	0 °C to +55 °C
Mechanical resistance	
Vibration, random	10 Hz to 300 Hz, acceleration 1.9 g (rms)

Optional RF Preamplifier R&S FSU-B23 (for R&S FSU 26 only)

Level measurement accuracy (S/N>40 dB)	
Frequency response with preamp = ON	
3.6 GHz to 8 GHz	<2.0 dB (σ=0.7 dB)
8 GHz to 22 GHz	<2.5 dB (σ=0.8 dB)
22 GHz to 26.5 GHz	<3.0 dB (σ=1 dB)
Displayed average noise level RBW = 1 kHz, VBW = 3 kHz zero span, sweeptime: 50 ms, 20 averages, mean marker, normalized to 10 Hz RBW	
Preamp = OFF	
3.6 GHz to 8 GHz	R&S FSU specifications + 2.0 dB
8 GHz to 26.5 GHz	R&S FSU specifications + 3.0 dB
Preamp = ON	
3.6 GHz to 8 GHz	<–152 dBm
8 GHz to 13 GHz	<–149 dBm
13 GHz to 18 GHz	<–147 dBm
18 GHz to 22 GHz	<–144 dBm
22 GHz to 26.5 GHz	<–140 dBm

Optional Electronic Attenuator R&S FSU-B25

Frequency	
Frequency range	
R&S FSU 3 R&S FSU 8 R&S FSU 26	10 MHz to 3.6 GHz 10 MHz to 8 GHz 10 MHz to 3.6 GHz
Setting range	
Electronic attenuator	0 dB to 30 dB, 5 dB steps
Preamplifier	20 dB, switchable
Maximum level measurement error	
Frequency response, with preamplifier or electronic attenuator	
10 MHz to 50 MHz 50 MHz to 3.6 GHz 3.6 GHz to 8 GHz	<1 dB (σ=0.34 dB) <0.6 dB (σ=0.2 dB) <2.0 dB (σ=0.7 dB)
Reference error at 128 MHz, RBW ≤100 kHz, reference level –30 dBm, RF attenuation 10 dB	
Electronic attenuator	<0.3 dB (σ=0.1 dB)
Preamplifier	<0.3 dB (σ=0.1 dB)
Displayed average noise level	
RBW=1 kHz, VBW=3 kHz, zero span, sweep time 50 ms, 20 averages, mean marker, normalized to 10 Hz RBW	
Preamplifier on	
10 MHz to 2.0 GHz 2.0 GHz to 3.6 GHz 3.6 GHz to 8.0 GHz	<–152 dBm <–150 dBm <–147 dBm
With the R&S FSU-B25 built in, the average noise level values displayed by the basic units degrade by (R&S FSU-B25 off):	
20 Hz to 3.6 GHz 3.6 GHz to 8 GHz	1 dB 2 dB
Preamplifier off, electronic attenuator 0 dB	
20 Hz to 3.6 GHz 3.6 GHz to 8 GHz	2.5 dB typ. 3.5 dB typ.
Intermodulation	
Third-order intermodulation, third-order intercept (TOI), electronic attenuator on, Δf>5 x RBW or 10 kHz	
10 MHz to 300 MHz 300 MHz to 3.6 GHz 3.6 GHz to 8 GHz	>17 dBm >20 dBm >18 dBm

Ordering information

Order designation	Type	Order No.
Spectrum Analyzer 20 Hz to 3.6 GHz	R&S FSU3	1129.9003.03
Spectrum Analyzer 20 Hz to 8 GHz	R&S FSU8	1129.9003.08
Spectrum Analyzer 20 Hz to 26.5 GHz	R&S FSU26	1129.9003.26

Accessories supplied

Power cable, operating manual, service manual; R&S FSU26: test port adapter with 3.5 mm female (1021.0512.00) and N female (1021.0535.00) connector

Options

Order designation	Type	Order No.
Options		
Delete Manual	R&S FSU-B0	1144.9998.02
Highly Accurate Reference Frequency	R&S FSU-B4	1144.9000.02
Tracking Generator, 100 kHz to 3.6 GHz, I/Q Modulation, for all R&S FSU models	R&S FSU-B9	1142.8994.02
External Generator Control	R&S FSP-B10	1129.7246.02
Attenuator for Tracking Generator R&S FSU-B9	R&S FSU-B12	1142.9349.02
LAN Interface100BT	R&S FSU-B16	1144.9498.02
Removable Hard Disk	R&S FSU-B18[1) 2)]	1145.0242.02
Second Hard Disk for R&S FSU-B18	R&S FSU-B19[2)]	1145.0394.02
Extended Environmental Specification	R&S FSU-B20[1) 3)]	1155.1606.04
RF Preamplifier 3.6 GHz to 26 GHz for R&S FSU26	R&S FSU-B23[1) 4) 5)]	1157.0907.02
Electronic Attenuator, 0 dB to 30 dB, with integrated 20 dB preamplifier	R&S FSU-B25	1144.9298.02

Software		
Noise Measurement Software	R&S FS-K3	1057.3028.02
Phase Noise Measurement Software	R&S FS-K4	1108.0088.02
GSM/EDGE Application Firmware	R&S FS-K5	1141.1496.02
FM Measurement Demodulator	R&S FS-K7	1141.1796.02
Application Firmware for *Bluetooth* Measurements	R&S FS-K8	1157.2568.02
3GPP BTS/Node B FDD Application Firmware	R&S FS-K72	1154.7000.02
3GPP UE FDD Application Firmware	R&S FS-K73	1154.7252.02
CDMA2000 BTS FDD Application Firmware	R&S FS-K82	1157.2316.02
Service Kit	R&S FSU-Z1	1145.0042.02

1) Factory installation only.
2) Not with R&S FSU-B20.
3) Not with R&S FSU-B18/-B19.
4) Not for retrofit.
5) R&S FSU-B25 required.

Recommended extras

Order designation	Type	Order No.
Microwave Measurement Cable with Adapter Set (for R&S FSU26 only)	R&S FSE-Z15	1046.2002.02
Headphones	–	0708.9010.00
US Keyboard with trackball	R&S PSP-Z2	1091.4100.02
PS/2 Mouse	R&S FSE-Z2	1084.7043.02
Colour Monitor, 17", 230 V	R&S PMC3	1082.6004.04
IEC/IEEE Bus Cable, 1 m	R&S PCK	0292.2013.10
IEC/IEEE Bus Cable, 2 m	R&S PCK	0292.2013.20
19" Rack Adapter	R&S ZZA-411	1096.3283.00
Adapter for mounting on telescopic rails (only with 19" Adapter R&S ZZA-411)	R&S ZZA-T45	1109.3774.00
Probe power connector, 3 pin		1065.9480.02
Matching Pads, 75 Ω		
L Section	R&S RAM	0358.5414.02
Series Resistor, 25 Ω	R&S RAZ	0358.5714.02
SWR Bridges		
SWR Bridge, 5 MHz to 3000 MHz	R&S ZRB2	0373.9017.52
SWR Bridge, 40 kHz to 4 GHz	R&S ZRC	1039.9492.52
High-Power Attenuators, 100 W		
3/6/10/20/30 dB	R&S RBU100	1073.8820.XX (XX=03/06/10/20/30)
High-Power Attenuators, 50 W		
3/6/10/20/30 dB	R&S RBU50	1073.8895.XX (XX=03/06/10/20/30)
20 dB, 6 GHz	R&S RDL50	1035.1700.52

Certified Environmental System
ISO 14001
REG. NO 1954

Certified Quality System
ISO 9001
DQS REG. NO 1954

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