Анализатор спектра и сигналов FMU36

FMU36 Baseband Signal Analyzer

Universal analyzer for baseband signals

Features

◆ FFT-based spectrum analyzer with 36 MHz I and Q bandwidth
◆ Analog baseband input
 – Balanced/unbalanced
 – 50 Ω/1 MΩ
◆ Time domain analyzer

Performance

◆ Noise floor typ. < 4 nV [1 Hz]
◆ I/Q imbalance < 0.1 dB
◆ Signal-to-noise ratio typ. > 143 dB [1 Hz]
◆ Level uncertainty < 0.25 dB

Functions

◆ Vector signal analyzer
◆ For all major mobile adiocommunications standards:
 – GSM, EDGE
 – WCDMA-QPSK
 – CDMA2000®-QPSK
 – Bluetooth®
 – TETRA
 – PDC
 – PHS
 – DECT
 – NADC
 – BPSK, QPSK, OQPSK
 – $\pi/4$ DQPSK
 – 8PSK, D8PSK, $3\pi/8$ 8PSK
 – (G)MSK
 – 2, 4, (G)FSK
 – 16, 32, 64, 128, 256 (D)QAM
 – 8VSB
◆ Max. symbol rate 25 MHz
◆ 16 Msample I and Q memory, extendable up to 705 Msample

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Analysis of spectrum and signal quality of baseband signals

In today's wireless communications systems, more and more of the transmitter and receiver functionality is performed in the baseband. This is true for mobile radios, as well as for base stations.

With the R&S®FMU36, you can easily analyze these signals going in or out of the baseband. This, for example, makes it possible for baseband designers to test the modulation quality of a signal immediately after it leaves the baseband. A receiver designer can verify the quality of the signal before it enters the baseband.

Dual inputs

In the baseband, digitally modulated signals can be described with two signals, an in-phase signal and a quadrature-phase signal. To measure these signals, the R&S®FMU36 has two analog inputs. They can be operated either as single-ended or balanced. The impedance can be set to either 50 Ω or 1 MΩ to match the impedance of the DUT.

For users who want to use probes to connect to their DUT, the R&S®FMU36 provides a calibration source so that the influence of the probes on the measurement results can be minimized.

Full-feature spectrum analyzer

The R&S®FMU36 contains a full-fledged FFT analyzer equipped with a bandwidth of 36 MHz on both the I and Q branch, providing a total bandwidth of 72 MHz for complex signals. With the FFT-based structure, signals with high sensitivity can also be analyzed at low frequencies where analyzers based on the super-heterodyne structure have lower sensitivity. This makes the R&S®FMU36 the ideal choice for the analysis of low frequency signals, such as mechanical vibrations, audio signals, ADSL modems or RFID readers.

The R&S®FMU36 provides all the functionality you expect from a Rohde & Schwarz analyzer.

◆ Markers, delta markers, noise markers, phase noise markers
◆ Measurement functions for adjacent channel power, carrier to noise, third order intercept point, occupied bandwidth, modulation depth
◆ Trace operations such as average, max. or min. hold
◆ Detectors: RMS, average, sample, positive and negative peak
◆ Filters from 0.5 Hz to 20 MHz in 1-2-3-5-10 steps
◆ Flattop, Gaussian, rectangular, Hamming, Hanning, Chebyshev windowing functions
◆ Number of measurement points/trace selectable between 155 and 30001

Time domain analysis

To measure, for instance, pulse durations or rise and fall times of pulses, it can be very useful to analyze a signal not only in the frequency domain but also in the time domain. In the frequency domain, there is often not only one signal present but several signals from different sources. In the time domain, they may be impossible to separate. The R&S®FMU36 provides a frequency-selective time domain analyzer that is comparable to the zero span in a standard spectrum analyzer.

Take, for instance, a weak pulsed signal close to a strong signal. In traditional FFT analyzers, time domain analysis is missing or cannot be done on a frequency-selective basis and therefore the signals cannot be separated. With the R&S FMU36, the weak pulsed signal can be filtered out, and the pulse duration and rise and fall times can easily be measured.

Capturing long sequences

With a time-capture memory of 16 Msample on I and Q, the R&S®FMU36 can capture long sequences. Before the signal is stored in the memory, it is resampled to optimize memory usage. With a WCDMA signal, 100 consecutive frames can be stored for later analysis. With a GSM signal, the memory can store more than 3500 frames. The data can then be analyzed either in the firmware or on external analysis tools after being exported.

The memory can be extended in two steps to 235 Msample and 705 Msample, corresponding to more than 8.5 seconds at the maximum sampling rate of 81.6 MHz.
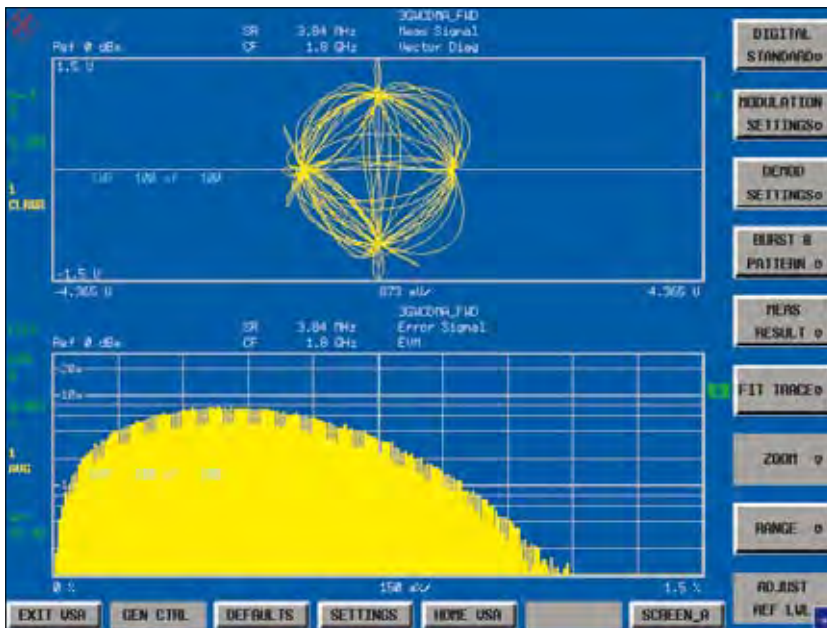
Universal vector signal analysis

The R&S®FMU36 comes equipped with the high-performance R&S®FSQ-K70 vector signal analyzer, adding universal demodulation and analysis down to the bit stream level for digital signals. You can easily perform standard measurements such as modulation accuracy, carrier leakage or I/Q imbalance. Furthermore, you can study the statistical performance of these signals or the spectrum of the error signals.

For maximum flexibility, mappings, receive filters, and transmit filters can be designed externally, using free-of-charge tools. With these tools, you have all the freedom needed to create new digital formats.

The instrument's high flexibility is by no means accompanied by complex operation. All major digital modulation standards, including training sequences, can be activated at a keystroke.

Wide dynamic range and future-proof performance

Convenient analysis with vector diagram. The upper screen (A) shows the complete constellation diagram, the lower screen (B) the probability distribution of the error vector magnitude (EVM).
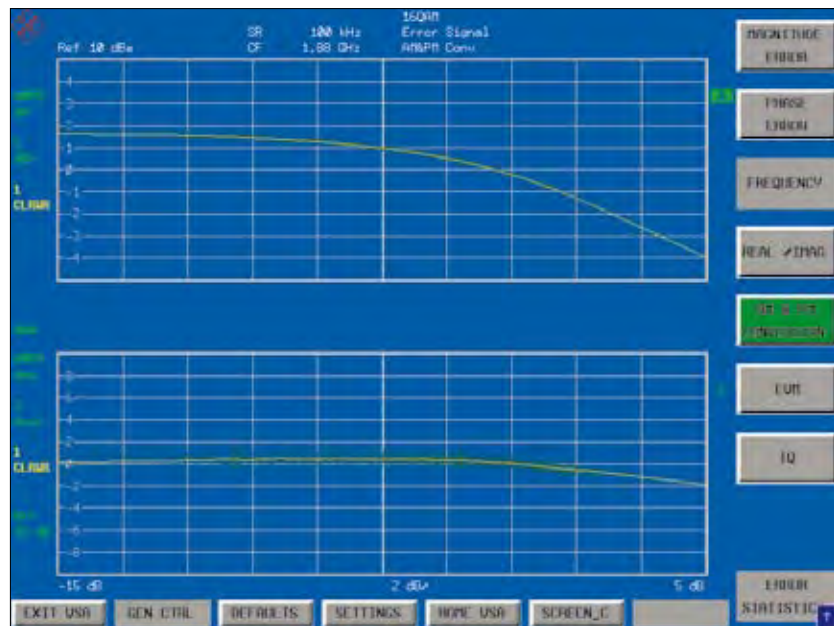
Universal analysis of digital radio signals

The standard vector signal analyzer provides universal demodulation and analysis capability down to the bit stream level for digital radio signals.

For all major mobile radio-communications standards:
◆ GSM and EDGE
◆ WCDMA-QPSK
◆ CDMA2000®-QPSK
◆ Bluetooth®
◆ TETRA
◆ PDC
◆ PHS
◆ DECT
◆ NADC

AM/φM and AM/AM distortion example with a 16QAM signal. The figure shows the AM/AM and AM/φM conversion curve of the same signal.

For all common digital modulation modes:
◆ BPSK, QPSK, OQPSK
◆ π/4 DQPSK
◆ 8PSK, D8PSK, 3π/8 8PSK
◆ (G)MSK
◆ 2, 4, (G)FSK
◆ 16, 32, 64, 128, 256 (D)QAM
◆ 8VSB

Optimum representation of results:
◆ In-phase and quadrature signals versus time
◆ Magnitude and phase versus time
◆ Eye diagram
◆ Vector diagram
◆ Constellation diagram
◆ Table with modulation errors
◆ Demodulated bit stream
◆ Spectral evaluation

◆ Statistical evaluation of modulation parameters
◆ Amplifier distortion measurements

25 MHz symbol rate
**36 MHz baseband input bandwidth**

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Ready for 3G mobile radio

Standard 3GPP modulation and code domain power measurements

◆ Additional measurement functions in line with 3GPP specifications for FDD and TDD LCR modes
◆ High measurement speed of 1 s/measurement for 3 GPP BTS signals
◆ Code domain and CPICH power
◆ Code domain power and rho (CDMA2000®/3GPP2)
◆ EVM and PCDE
◆ Code domain power versus slot
◆ EVM/code channel
◆ Constellation (symbol, composite)
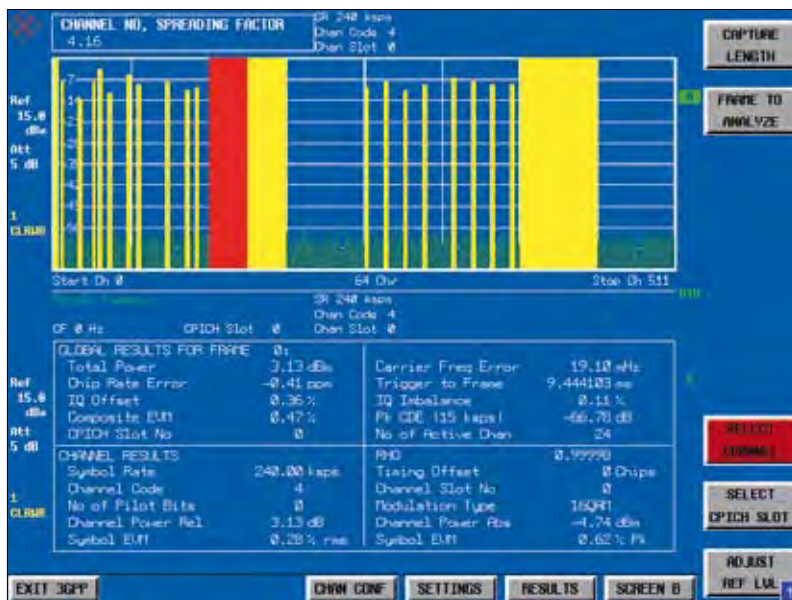
*WCDMA code domain power measurement with the R&S®FMU36 and R&S®FS-K72.*

Firmware options for mobile radio applications

Type	Designation and/or application
R&S®FS-K5	Modulation and spectrum measurements on GSM/EDGE base station and mobile station signals
R&S®FS-K8	Bluetooth® transmitter measurements
R&S®FS-K9	Power sensor measurements (supports the R&S®NRP-Z11/-Z21 with R&S®NRP-Z4 USB adapter)
R&S®FS-K72	Modulation and code domain power measurements in line with 3GPP TS 24.141 on base station signals (node B)
R&S®FS-K73	Modulation and code domain power measurements in line with 3GPP TS 25.121 on mobile station signals (UE)
R&S®FS-K74	HSDPA extension for R&S®FS-K72
R&S®FS-K76	Modulation and code domain power measurements on TD-SCDMA base station signals
R&S®FS-K77	Modulation and code domain power measurements on TD-SCDMA mobile station signals (UE)
R&S®FS-K82	Modulation and code domain power measurements in line with CDMA2000®/3GPP2 on base station signals (also for measurements on IS-95/cdmaOne signals)
R&S®FS-K83	Modulation and code domain power measurements on CDMA2000®/1xEV-DV mobile station signals (UE)
R&S®FS-K84	Modulation and code domain power measurements on CDMA2000®/1xEV-DO mobile station signals (UE)
R&S®FS-K85	Modulation and code domain power measurements in line with CDMA2000®/1xEV-DO on base station signals
R&S®FSQ-K91	Modulation measurements on WLAN signals in line with IEEE 802.11 a/b/g/j
R&S®FSQ-K92	Modulation measurements on WiMAX OFDM signals in line with IEEE 802.16-2004
R&S®FSQ-K93	Modulation measurements on WiMAX OFDMA signals in line with IEEE 802.16e

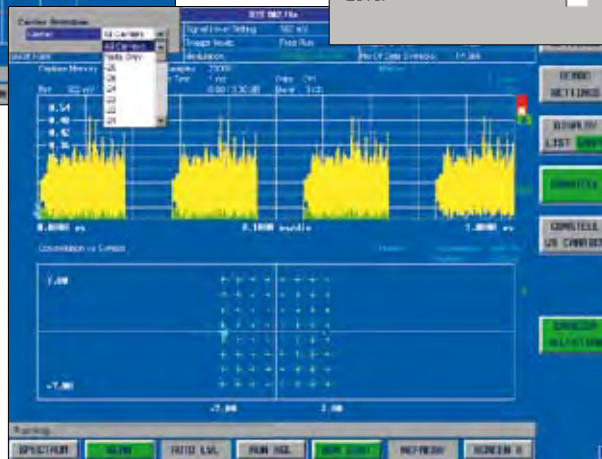# WLAN measurements
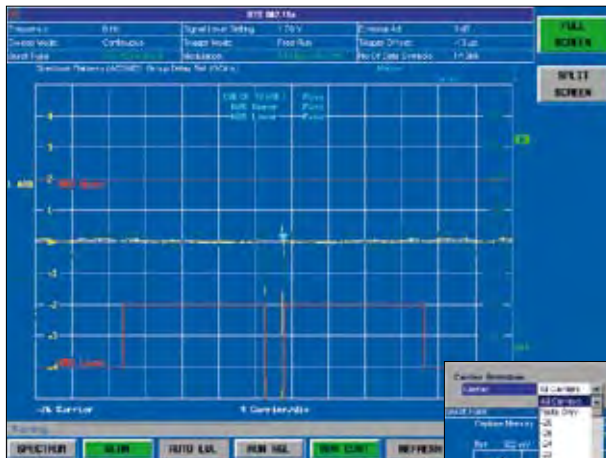
Group delay and spectrum flatness are determined via channel estimation of the preamble or (user-selectable) for the entire burst including payload.

Constellation diagram of all or (user-selectable) individual carriers.

Application Firmware R&S® FSQ-K91 provides the R&S® FMU36 with modulation measurements on WLAN signals in line with IEEE 802.11 a/b/g/j.

ODFM (IEEE 802.11a/g/j)	DSSS (IEEE 802.11/b)
Modulation formats	
ODFM with BPSK, QPSK, 16QAM, 64QAM	DBPSK, DQPSK, CCK, short PLCP, long PLCP
Modulation measurements	
Constellation diagram	Constellation diagram
Constellation diagram per OFDM carrier	–
I/Q offset and I/Q imbalance	I/Q offset and I/Q imbalance
Carrier and symbol frequency error	Carrier and symbol frequency error
Modulation error (EVM) per OFDM carrier or symbol	Modulation error (EVM)
Amplitude flatness and spectral flatness	–
CCDF and crest factor	CCDF and crest factor
FFT, also across a selected part of the signal, e.g. preamble	FFT
Payload bit information	Payload bit information header
Sample size selectable up to 50 ms	Sample size selectable up to 50 ms
Trigger	
Free run	Free run
External	External
Typical inherent errors for IEEE 802.11a measurements	**Typical inherent errors for IEEE 802.11b measurements**
EVM –45 dB	EVM 0.7 %
Spectral flatness 0.5 dB	–

Demodulation of analog signals

With the optional R&S®FS-K7, an AM/FM/PM demodulator can be added, allowing not only the measurement of frequency deviation, phase deviation or modulation depth but also providing an FFT of the demodulated signal or the calculation of THD and SINAD.

Interfaces for data exchange

The R&S®FMU36 comes equipped with a number of interfaces to accommodate all requirements for transferring data to and from the instrument:

◆ GPIB interface, IEEE 488.2
◆ LAN interface 100BaseT
◆ RS-232-C serial interface, 9-pin D-Sub
◆ Four USB host connectors

Time domain analysis

The following figure (left) shows an EDGE signal close to a CDMA2000® carrier. In the figure on the right, the time domain structure and the power of the EDGE signal are measured. This is a measurement that a standard FFT analyzer cannot perform.
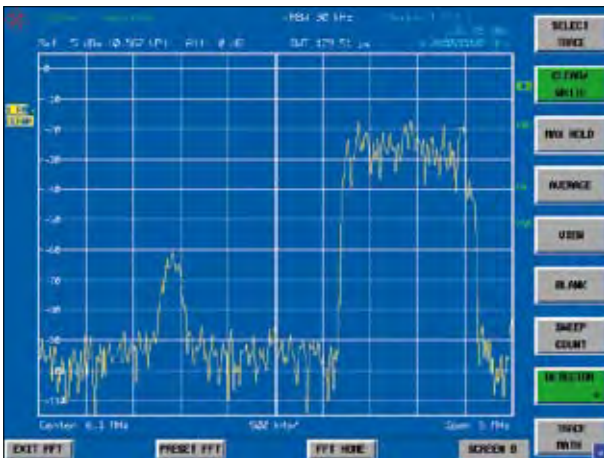
An EDGE signal in the presence of a strong CDMA2000® signal.
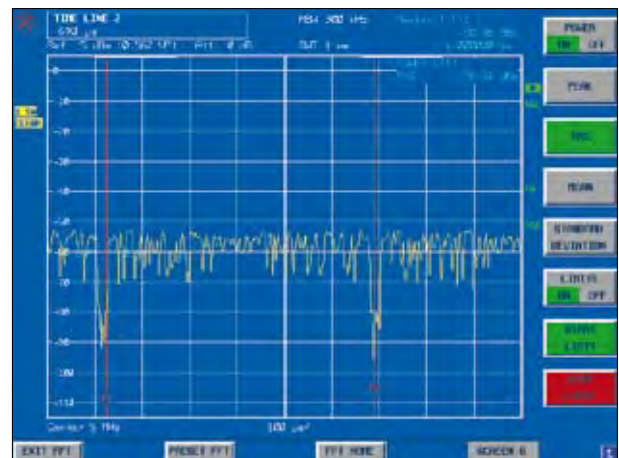
Measurement of time domain structure and power of EDGE signal.
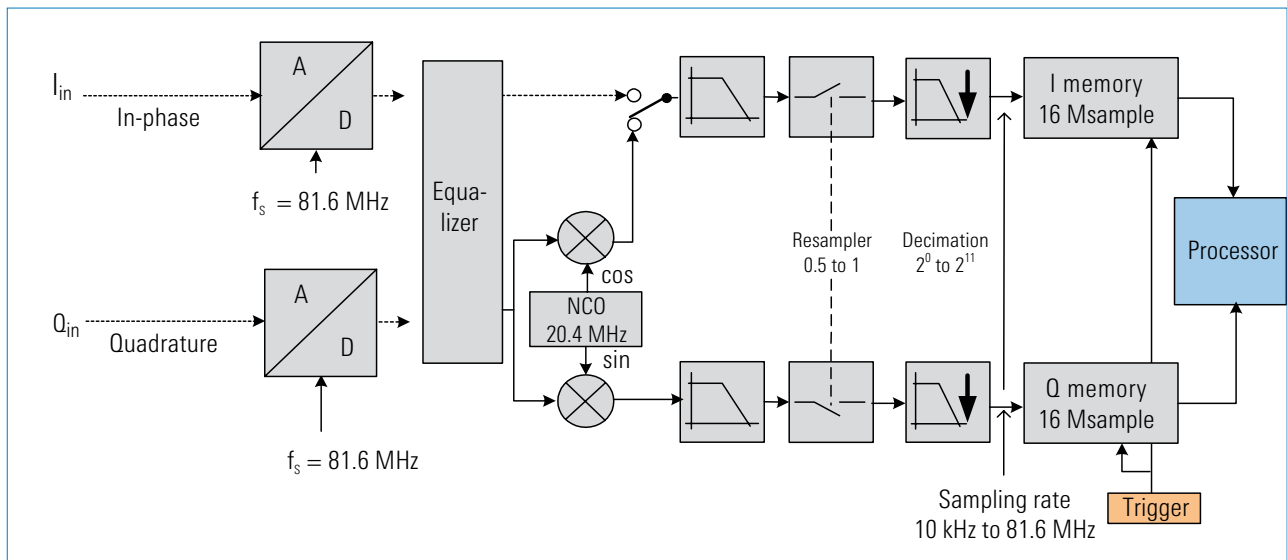
Block diagram of vector signal analysis section in the R&S®FMU36.

Benefit from networking

Versatile documentation and networking capabilities

The Windows XP Embedded operating system coupled with a wide variety of interfaces makes it easy to insert measurement 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 the data as an ASCII file (CSV format), which not only documents trace data but also the main instrument settings.

Advantages of networking
The standard LAN interface opens up versatile networking capabilities:

◆ Link to standard network (Ethernet 10/100BaseT)
◆ Running under Windows XP Embedded, the R&S®FMU36 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®FMU 36 can thus be optimally matched to your work environment

◆ Screen contents can be imported directly into Word for Windows or, by using an Excel macro, into documentation programs, thus enabling you to immediately create data sheets for your products or documents for quality assurance.

Remote control via Ethernet becomes even simpler with the built-in VXI11 compatibility. It links your application to the TCP/IP protocol and acts like an IEC/IEEE bus driver. VXI11 is supported by commercial VISA libraries. The R&S®FMU36 can be programmed and remote-controlled via this interface just like on the familiar IEC/IEEE bus.

Server

Printer

Ethernet network

R&S®FMU36 remote-controlled from a PC
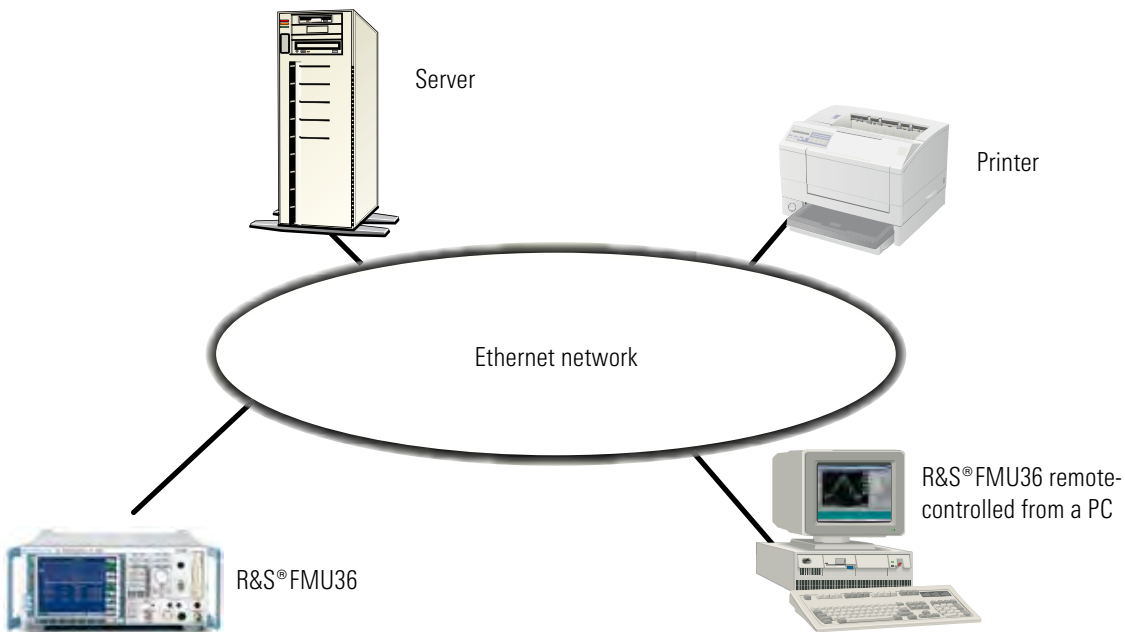
R&S®FMU36

The R&S®FMU 36 in network operation.

Ordering information

Designation	Type	Order No.
Baseband Signal Analyzer, DC to 36 MHz	R&S®FMU36	1303.3500.02

Options

Designation	Type	Order No.
I/Q Memory Extension to 235 Msample	R&S®FSQ-B100	1169.5244.02
I/Q Memory Extension to 705 Msample	R&S®FSQ-B102	1169.5444.04
Low-Aging OXCO	R&S®FSU-B4	1144.9000.02
High Impedance Probe	R&S®FMU-Z1	1409.7508.00

Rear view of the R&S®FMU36.