Monitoring Receiver ESMB

Military and civil monitoring from 9 kHz to 3 GHz
ITU-compliant measurements

The Monitoring Receiver ESMB from Rohde & Schwarz is ideally suited for military monitoring tasks and spectrum monitoring in line with ITU recommendations as well as for use in radio investigation services.

The range of applications includes:

◆ Signal detection
◆ Signal search in frequency and memory scan mode

◆ Spectrum occupancy measurement
◆ RF and IF analysis
◆ Coverage measurements (option)
◆ Field-strength measurements

ROHDE & SCHWARZ

General

The ESMB is a monitoring and test receiver for all radio detection and radiomonitoring tasks in line with ITU-R, and for radio investigation services. The compact and sturdy design combined with low weight makes the ESMB a versatile and universal unit for stationary and mobile use.

Applications

The following measurements in line with ITU-R specifications can be performed by the ESMB:

◆ Frequency and frequency offset to ITU-R SM 377
◆ Field strength to ITU-R SM 378
◆ Modulation to ITU-R SM 328
◆ Spectrum occupancy and identification with external PC to ITU-R SM 182
◆ Bandwidth to ITU-R SM 328

The optimized features of the ESMB allow fast performance of the following additional tasks in military radiomonitoring and radio investigation services:

◆ Frequency scan with predefined frequency ranges
◆ Memory scan of up to 1000 memory channels
◆ RF frequency spectrum (option)
◆ Audio monitoring of CW, AM, SSB and FM transmissions
◆ Identification

Description

As a ½ 19" unit, the ESMB is ideal both for mobile use and for rack-mounting. It contains the following functional units:

◆ A/D and DSP module with digital IF filters, digital demodulators for CW, AM, LSB, USB, PULSE, FM, PM, IQ and ISB, parameter measurements and FFT processing of IF panoramic display
◆ Band and tracking preselection
◆ RF frontends for converting the antenna signal into an IF of 10.7 MHz
◆ Fast synthesizer
◆ Processor system
◆ Display and control unit
◆ Remote control interface
◆ DC/DC converter

Digital IF section

The ESMB covers a frequency range from 9 kHz to 3 GHz. A large number of IF bandwidths is required to process the various signals with optimum signal-to-noise ratio. Maximum quality in a minimum of space can only be ensured by using ultramodern digital signal processing throughout. The ESMB is equipped with 18 IF filters from 150 Hz to 300 kHz, and up to 1 MHz in the IF panoramic mode.

Operation

The Monitoring Receiver ESMB features full remote control capability as well as manual control via the front panel.

The operating concept meets all the demands made on a state-of-the-art spectrum monitoring receiver, i.e. all the main functions such as type of modulation, bandwidth, etc can easily be set directly via labelled keys.

Menu control is organized in priority levels so that signal processing is not interrupted by menu changes and the user has an optimized view of current operations.

Scan modes

Frequency scan

It is possible to define a frequency range to which a complete data set can be allocated. In addition to receiver settings, the following scan parameters are included in the data set:

◆ Step width
◆ Signal threshold (dBµV)
◆ Dwell time
◆ Hold time
◆ Number of scans
◆ Signal-controlled continuation
◆ Suppression (individual frequencies or search ranges)

Memory scan

The ESMB uses 1000 definable memory locations. A complete data set such as frequency, mode of demodulation, bandwidth, squelch level, etc can be assigned to each memory location. The content of any memory location can be transferred to the receiver manually using the RCL key.

Frequency spectrum

Fitted with the frequency spectrum option **DIGI Scan**, the ESMB scans the frequency range of interest with digital control and displays the associated spectrum.

Emissions detected can be seen at a glance. Aural monitoring of the information is possible by simply pressing a softkey. The ESMB then goes to the DIGI Scan listen mode. The stored spectrum is displayed in the background, and the emission of interest can be selected and monitored by marking it with the frequency cursor.

Location of miniature transmitters at close range is possible in the **differential mode** of the DIGI Scan option. In this mode, the displayed spectrum is stored as a reference. Current spectra are superimposed on the reference spectrum, and any new signals or variations in signal strength are clearly discernible as peaks. If the measurement is carried out while walking across the room, the field strength of transmitters at close range

varies to a greater extent than that of transmitters located far away. This differential display ensures fast and reliable location of miniature transmitters even in the case of spread-spectrum transmission.
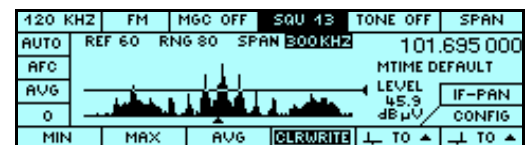
In conjunction with the Digital Direction Finder DDF190, the Monitoring Receiver ESMB forms a monitoring system with excellent price/performance ratio
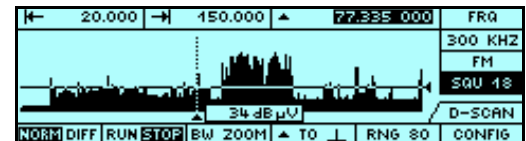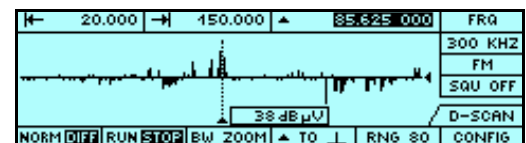
Optimized view for current task

Overview
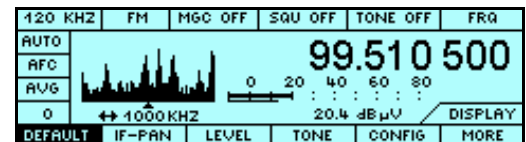
IF panoramic display

DIGI Scan listen mode

DIGI Scan differential mode

ESMB in measurement mode

Bandwidth measurement

300 KHZ	FM	MGC OFF	SQU OFF	TONE OFF	FRQ
AUTO	REF 30 RNG 80 SPAN 300KHZ				105.700 000
AFC					MTIME 5.0000 S
AVG					BANDW MC
0					153.00 KHZ / DISPLAY
FREQ	BANDW	MVALUE		CONFIG	MORE

Modulation measurement

9 KHZ	AM	MGC OFF	SQU OFF	TONE OFF	FRQ
AUTO	MOD DEPTH	FREQ DEV			0.801 000
AFC	80.6 % +:	+:	1.296 KHZ 1.343 KHZ		MTIME 2.5000 S
AVG	79.5 % -:	-:	1.250 KHZ		MC
0	OFFSET 0.000 KHZ	LEVEL 41.2 dBµV	BANDW 1.750 KHZ /		DISPLAY
FREQ	BANDW	MVALUE		CONFIG	MORE

120 KHZ	FM	MGC OFF	SQU OFF	TONE OFF	FRQ
AUTO	MOD DEPTH	FREQ DEV			105.700 000
AFC	39.4 % +:	+:	53.27 KHZ 53.46 KHZ		MTIME 2.5000 S
AVG	5.5 % -:	-:	53.08 KHZ		MC
0	OFFSET -0.087 KHZ	LEVEL 53.7 dBµV	BANDW 60.25 KHZ /		DISPLAY
FREQ	BANDW	MVALUE		CONFIG	MORE

9 KHZ	PM	MGC OFF	SQU OFF	TONE OFF	FRQ
AUTO	MOD DEPTH	PHASE DEV			0.801 600
AFC	78.6 % +:	1.57 RAD			MTIME 2.5000 S
AVG	70.3 % -:				MC
0	OFFSET -0.730 KHZ	LEVEL 42.8 dBµV	BANDW 1.500 KHZ /		DISPLAY
FREQ	BANDW	MVALUE		CONFIG	MORE

Interfaces

For system applications, the receiver is equipped with a number of important interfaces:

◆ Baseband output (digital)
◆ AF output (digital)
◆ IF 10.7 MHz ± 1 MHz, VHF-UHF
   IF 10.7 MHz ± 5 kHz, HF
   uncontrolled for external panoramic display
◆ AF balanced 600 Ω, 0 dBm
◆ Output for external loudspeaker, 4 Ω, 500 mW
◆ Headphone socket via volume control
◆ Output for antenna control with antenna number
◆ Connector for internal/external reference frequency, 10 MHz

Remote-control interface

LAN TCP/IP (Ethernet 10Base-T), optional 9-pin RS-232-C. The LAN interface (Ethernet 10Base-T) with TCP/IP protocol fitted as standard enables the ESMB to be integrated into systems of varying complexity. The high data rate of this interface not only allows full control of all device functions as well as data output, but also transmission of the digital AF. With the aid of the DIGI Scan option, data for 20 000 channels/s can be output in the scan mode.

Designed to meet the standards

State-of-the-art design

The receiver is designed for both mobile and stationary operation. Careful screening and filters in all the input and output lines ensure extremely low spurious emissions and high interference rejection.

BITE

The receiver is permanently monitored by built-in test equipment (BITE). If deviations from the nominal specifications are detected, an error message is output with a code indicating the type of error.

Serviceability

Modern design and the use of plug-in modules ensure short repair times. All the modules can be replaced without any re-calibration or adjustments being required.

Block diagram of Monitoring Receiver ESMB

- - - - data and control bus

———— RF, IF, AF analog
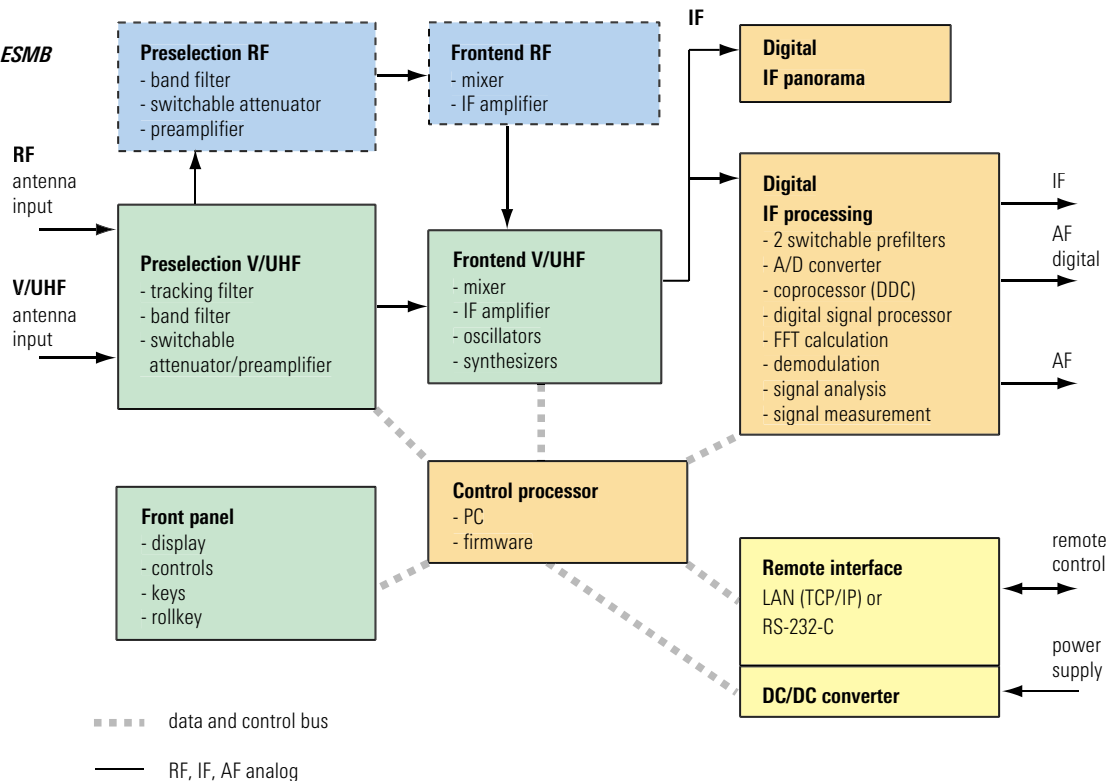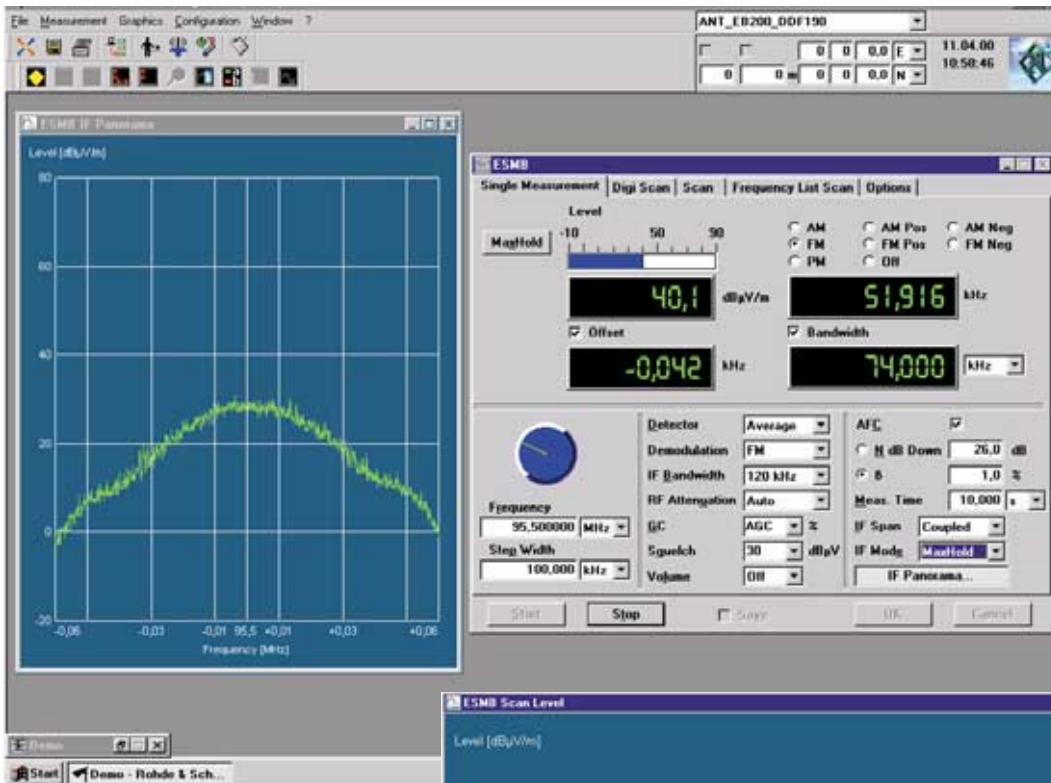
Bandwidth and modulation measurements with panoramic display

Scan with 3D waterfall diagram

Use in computer-controlled systems

Full use of the performance features of the receiver can be made in the remote-control mode via LAN using a suitable PC and the Rohde & Schwarz Spectrum Monitoring Software ARGUS or RAMON.
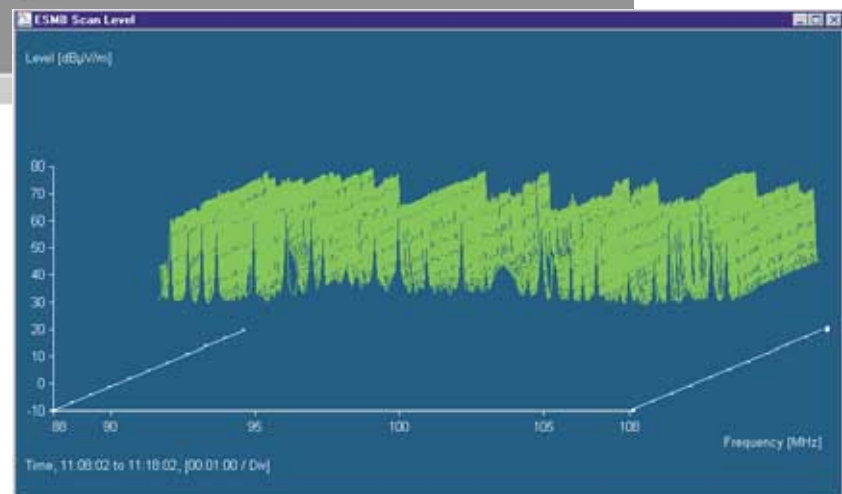
RAMON, which is primarily used in military and security applications, enables fast frequency detection and transfer to support monitoring receivers (concentration on interactive operation and signal identification).

ARGUS is intended for applications focussing on measurements, and therefore particularly suitable for frequency management tasks.

For basic tasks, the ARGUS MON software is available for remote control of the ESMB. The functionality of this software, which features a favourable price/performance ratio, is optimally tailored to the capabilities of the ESMB. It allows remote control of all settings, measurement and scan functions as well as saving of measured data such as frequency, level, offset, date and time. The basic ARGUS MON software can be upgraded to ARGUS for

use in more complex systems. The pictures above show how easy-to-use and user-friendly ARGUS MON is. The ESMB together with ARGUS MON is a low-cost basic system that fulfills all the ITU recommendations.
Detailed information is provided in the ARGUS data sheet (PD 757.4818.2x) and in the brochure "Solutions for Spectrum Monitoring and Spectrum Management" (PD 757.6285.2x).

Specifications

Frequency range

Basic unit | 20 MHz to 3 GHz
Basic unit with
HF Option ESMBHF | 9 kHz to 3 GHz
Frequency setting
via keypad or rollkey | 1 kHz, 100 Hz, 10 Hz, 1 Hz;
or in selectable increments
Frequency accuracy | $\leq 0.5 \times 10^{-6}$ (0 °C to +45 °C)
Input for external reference | 10 MHz
Synthesizer setting time | ≤ 3 ms, typ. 1 ms
Oscillator phase noise | ≤ -120 dBc/Hz at 10 kHz offset
(HF range)
≤ -100 dBc/Hz at 10 kHz offset
(VHF/UHF range)

Antenna inputs | N socket, 50 Ω
VSWR | ≤ 3, typ. 1.5 for HF range ≤ 30 MHz,
≤ 2.5, typ. 1.8 for VHF-UHF range
≥ 20 (30) MHz
Oscillator reradiation | ≤ -107 dBm
Input selection
9 kHz to 30 MHz | 5 bandpass filters
20 (30) MHz to 1500 MHz | tracking preselection
1500 MHz to 3000 MHz | highpass, lowpass

Interference rejection, nonlinearities – HF range
(only with HF Option ESMBHF)

Image frequency rejection | ≥ 90 dB, typ. 100 dB
IF rejection | ≥ 90 dB, typ. 100 dB
2nd order intercept point | ≥ 50 dBm, typ. 58 dBm (ATT off)
3rd order intercept point | ≥ 20 dBm, typ. 25 dBm (ATT off)
Internal spurious signals | ≤ -107 dBm

Interference rejection, nonlinearities – VHF-UHF range

Image frequency rejection | ≥ 80 dB, typ. 95 dB
IF rejection | ≥ 90 dB, typ. 100 dB
2nd order intercept point | ≥ 45 dBm, typ. 55 dBm
(f=20 (30) to 2700 MHz,
low distortion mode)
3rd order intercept point | ≥ 12 dBm, typ. 18 dBm
(f=20 (30) MHz to 2700 MHz,
low distortion mode)
Internal spurious signals | ≤ -107 dBm

Sensitivity – HF range (only with HF Option ESMBHF)

Overall noise figure
(including AF section) | ≤ 14 dB, typ. 11.5 dB,(f ≥ 50 kHz, ATT off)
Signal-to-noise ratio
(f=0.1 to 30 MHz) | ≥ 10 dB, measurement with telephone filter
  CW, bandwidth 300 Hz,
  V=0.6 μV
  SSB, bandwidth 2.5 kHz
  V=1 μV
  AM, bandwidth 9 kHz
  f_{mod} =1 kHz, m=0.5
  V=1 μV

Sensitivity – VHF-UHF range

Overall noise figure
(including AF section) | ≤ 12 dB, typ. 9.5 dB
f= 20 (30) MHz to 2700 MHz,
(low noise mode)
Signal-to-noise ratio | measurement with telephone filter
  AM, bandwidth 9 kHz,
  f_{mod}=1 kHz, m=0.5
    20 (30) MHz to 2700 MHz,
    V=1 μV
    2.7 GHz to 3 GHz,
    V=1.3 μV | ≥ 10 dB (low noise mode), typ. 16 dB
  FM, bandwidth 15 kHz
  f_{mod} = 1 kHz, deviation=5 kHz
    20 (30) MHz to 2700 MHz,
    V=1 μV
    2.7 GHz to 3 GHz, V=1.3 μV | ≥ 25 dB (low noise mode), typ. 30 dB

Detection modes | AM, FM, PM, USB, LSB, CW, ISB, PULSE, IQ
IF bandwidths for level detection
and offset measurement | 23 filters (150 Hz to 1 MHz)
IF bandwidths with standard
demodulation (–6 dB bandwidth) | 0.15, 0.3, 0.6, 1, 1.5, 2.4, 3, 4, 6, 8, 9,
15, 30, 100, 120, 150, 250, 300 kHz
(reduced IF bandwidth in HF range: ±5 kHz)
Squelch, signal-controlled | –30 dBµV to 110 dBµV
Gain control | AGC, MGC (120 dB)
AFC | digital retuning for unstable signals

Modulation measurement

AM (f_{max}=100 kHz) | m=1% to 99% (resolution 0.1%)
Indication error | <5% for m=50%,
S/N >40 dB, AF=1 kHz
FM (f_{max}=100 kHz) | deviation max. 125 kHz less modulation
frequency
(resolution 0.001 kHz)
Indication error
  narrow bandwidths (≤ 15 kHz) | 100 Hz plus 3% of reading
  broad bandwidths (≤ 250 kHz) | 2 kHz plus 3% of reading for
S/N >40 dB, AF=1 kHz
PM (f=0.3 kHz to 5 kHz) | $\Delta\varphi$=0 to 4π
$\Delta\varphi$=0 to 12.5 rad
(resolution 0.01 rad)
Indication error | <0.1 rad plus 5% of reading for
S/N >40 dB, AF=1 kHz

Level and offset measurement

Offset indication | graphically with tuning markers or
numerically
Signal level indication | –30 dBµV to 110 dBµV (dBµV/m)
numeric 3 digits
resolution 0.1 dB
error max. ±1.5 dB, typ. ±0.8 dB for HF
range ≤ 30 MHz, typ. ±1.0 dB for
VHF-UHF range ≥ 20 (30) MHz
(for V = 20 dBµV to 100 dBµV,
AVG, 0°C to +45°C)
or graphic as level line
acoustic indication by level tone
Level indication mode | AVG, PEAK, FAST, RMS
IF panoramic display | internal module
Span range | 0.15 kHz to 1000 kHz (23 steps)

Scan characteristics

Automatic memory scan | 1000 definable memory locations,
typ. 200 channels/s (300 kHz IF filter)
Frequency scan | start/stop/step and 100 suppress ranges,
typ. 250 channels/s (300 kHz IF filter)
DIGI Scan (option) | RF spectrum with user-selectable start/
stop frequency,
typ. 3000 MHz/s (300 kHz IF filter)

Inputs/outputs

Reference frequency connector | 10 MHz, SMA, bidirectional
IF 10.7 MHz, wideband | ±1 MHz, VHF-UHF range,
±2.5 MHz typ., ±5 kHz, HF range
uncontrolled for external panoramic dis-
play, SMA
Baseband output (digital) | serial, 2 x 16 bit (clock, data, frame)
AF output (digital) | AF signal, 2 x 16 bit, AES/EBU to
AES3-1985 (ANSI S4.40-1985)
AF output, balanced | 600 Ω, 0 dBm
Loudspeaker output | 4 Ω, 500 mW
Headphone output | via volume control

BITE | monitoring of test signals by
means of loop test

Data interface | LAN (ETHERNET 10Base-T) or
9-pin RS-232-C, PPP

General data

Rated temperature range	0 °C to +45 °C
Operating temperature range	−10 °C to +50 °C
Storage temperature range	−40 °C to +70 °C
Humidity	max. 80%, cyclic test 25 °C/40 °C
	max. 95% without condensation
Shock	DIN IEC 68-2-27 (MIL-STD-810D,
	MIL-T-28800D),
	40 g, spectrum 45 Hz to 2 kHz
Vibration (sinusoidal)	DIN IEC 68-2-6 (MIL-T-28800D),
	5 Hz to 55 Hz, 0.15 mm amplitude,
	55 Hz to 150 Hz, 0.5 g
Vibration (random)	DIN IEC 68-2-36, 10 Hz to 500 Hz,
	1.9 g rms
EMC	EN 50081-1/ 82-2
Power supply	10 V to 32 V DC (max. 40 W) or via exter-nal AC/DC power supply
Dimensions (W x H x D)	227 mm x 153 mm x 474 mm
Rack model (1/2 19" x 3 HU)	210 mm x 132 mm x 460 mm
Weight	8 kg

Ordering information

Monitoring Receiver with external power supply	ESMB	4056.6000.02
HF Option 9 kHz to 30 MHz	ESMB HF	4056.6100.02
Coverage Measurement Option	EB200CM	4052.9804.02
Frequency Spectrum Option DIGI Scan	ESMB DS	4056.6200.02
RS 232 Serial Interface	ESMB R2	4052.9056.02
ARGUS MON Software with ARGUS driver for ESMB		4049.9859.15
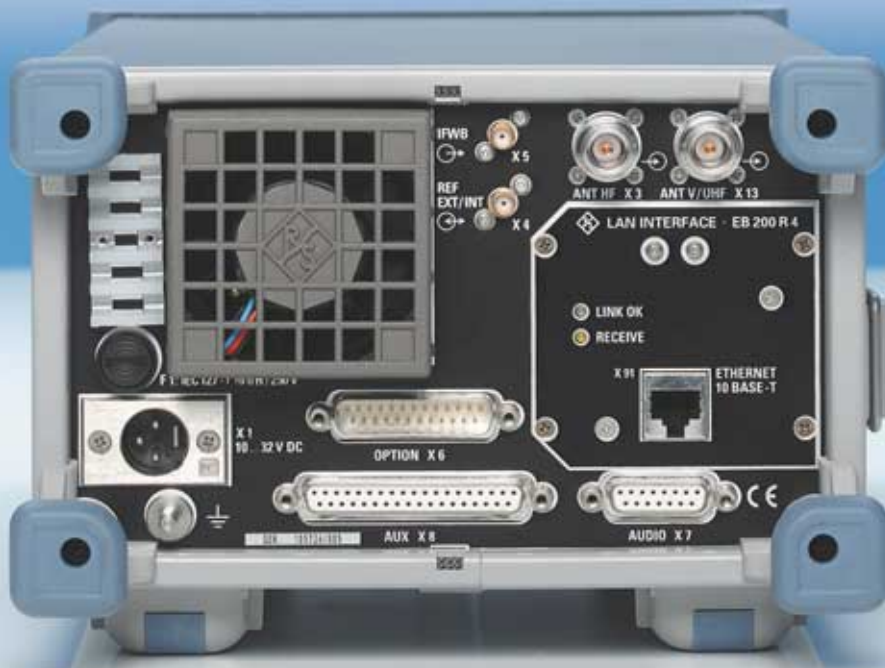
Rear view of the ESMB

Certified Environmental System
ISO 14001
REG. NO 1954

Certified Quality System
ISO 9001
DQS REG. NO 1954

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