VHF-UHF Search Receiver ESMA

Fast radiomonitoring from 20 to 1300 MHz

The Rohde & Schwarz VHF-UHF Search Receiver ESMA is the perfect central unit of a processor-controlled system for fast and efficient radiomonitoring.

Scanning

- Scan rate up to 5 GHz/s
- Signal verification processing
- User-definable threshold pattern variable over frequency axis for up to 10,000 channels

- Suppress function for single frequencies or subranges
- Scan based on frequency range or frequency list supporting up to 500 entries
- Multiple range operation

Interception and identification

- Aural monitoring
- Frequency
- Frequency offset
- Level

- Modulation
- Bandwidth

Occupancy monitoring

- On-line display for state of occupancy for frequency ranges and channel groups by means of panoramic and waterfall diagrams

Off-line functions (optional)

- Scan replay
- Statistical evaluation

ROHDE & SCHWARZ

VHF/UHF Search Receiver ESMA together with controller enables very fast and convenient radiomonitoring

Applications

Designed as a search receiver for fast radiomonitoring in the VHF/UHF range, the ESMA is setting standards :

- Wide frequency range, 20 to 3000 MHz (with option ESMA-T2 and ESMA-FE)
- Wide dynamic range
- Accurate measurement of signal level
- Measurement of frequency offset
- Detection of short-term signals due to high scan rate
- High-speed data link between frontend and process controller
- User support by means of sophisticated control panel and on-line help
- Man-machine interface running on standard IBM-compatible PC featuring flexible system upgrade (LAN, printer, data backup, etc)
- Built-in test equipment (BITE) down to submodule level
- Mains and battery operation

National organizations and authorities in charge of radiomonitoring and radio reconnaissance, such as radiomonitoring services, police, customs, security services, as well as military customers require equipment providing fast and efficient radiomonitoring with a minimum of accessories and staff.

Consequently, the ESMA has been designed as a fast search receiver which forms the key component of an advanced radiomonitoring system.

The versatile concept allows both stationary and mobile use in land vehicles, vessels and airplanes. The scope of ESMA applications ranges from statistical channel monitoring and dialog-based searching and identifying to continuous scenario monitoring of frequency bands. The monitoring of frequency-agile systems or burst transmissions is also possible.

Thanks to the wide dynamic range and the low-noise synthesizer the ESMA is perfectly suited for use as a frontend for digital postprocessing.

Features

Scan features of the ESMA
- Scan rate up to 5 GHz/s
- Predefinable sequence of up to nine frequency ranges and one frequency list for multiple range operation
- Overview mode for continuous monitoring
- Search mode for identification purposes
- Alarm threshold variable over frequency axis for monitoring of complex scenarios
- Suppress function for single channels and subranges via temporary and permanent suppress lists

Receive features
- Tracking preselection
- High sensitivity
- Wide dynamic range
- Low oscillator reradiation
- May be equipped with up to 5 IF bandwidths from 8 kHz to 8 MHz
- Synthesizer switching time better than 150 μs
- Low oscillator phase noise even close to carrier
- Thermostat-controlled reference crystal featuring an extremely high frequency accuracy

Operation

A standard stand-alone configuration consists of Search Receiver ESMA including control software and IBM-compatible PC, which is operated via keyboard, mouse and VGA monitor. The PC communicates with the receiver via a high-speed transputer link and a link adapter which is to be installed in the PC (see diagram).

The control software operates under MS-Windows 3.1 or Windows NT and features:

- Setting of all receiver and scanning parameters for overview and search mode including a global threshold level or polygonal threshold pattern which may be adapted to the current scenario during scanning
- On-line display of the event data gained, multiple ways of representation (panoramic, waterfall) in the overview mode
- Interactive panel for identification of channel and station in the search mode
- Transfer of receiver setting to slave receiver and direction finder
- Recording function for overview mode (optional)
- Off-line statistics (optional)
- Scan replay (optional)

Moreover, the stand-alone configuration can be upgraded to a standard monitoring system including:

- Extracting tools for off-line analysis
- Linking of several standard systems to form a multi-position system

The menu gives a complete overview of all operating modes. Even in time-relevant situations the user is effectively supported by the graphical user interface. A convenient on-line help is also part of the standard software.
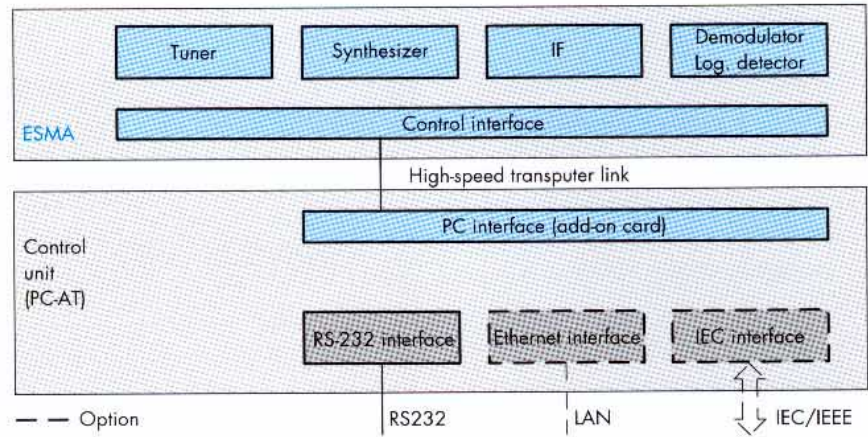
Block diagram of ESMA connected to PC via high-speed transputer link

Description

The ESMA is a double-heterodyne receiver with a second IF of 21.4 MHz. The tuners are provided with a tracking preselection so as to reduce the total signal load. High-level mixers ensure excellent intermodulation data. The extremely wide spurious-free dynamic range and the low oscillator reradiation are the result of extensive filtering and shielding.

An advanced synthesizer concept guarantees not only a highly accurate setting of the receive frequency, but also fast switching times of 150 µs. By using a low-noise reference oscillator an extremely low SSB phase noise is obtained even close to the carrier. Due to the thermostat-controlled oscillator in combination with a SC-cut reference crystal, a high degree of frequency stability is achieved over the whole operating temperature range.

The ESMA is equipped with demodulators for AM, FM and LOG. The logarithmic demodulator allows a dB-linear level indication within 9 decades where average weighting or peak evaluation may be selected. The absolute accuracy of the level indication is additionally enhanced by taking into account the frequency response of the preselection and the tolerances of the logarithmic amplifier.

The ESMA may be equipped with up to 5 IF bandwidths from 8 kHz to 8 MHz. Video filters matched to the bandwidth used and a switchable AF filter improve the S/N ratio.

The automatic gain control (AGC) covers a level range of 120 dB, 90 dB of which is used for IF control and 30 dB for an attenuator at the tuner input which may be switched in when strong signals are received. This attenuator is considered in the level indication. In case of manual gain control (MGC) the IF gain may be varied by 90 dB. The 30-dB attenuator may also be switched in if required.

As a result of the high search speed and the associated high data rate the frequency-occupancy data must be compressed so that they can easily be processed by the controller. This data compression which reduces the workload of the process controller is made possible by a transputer in the ESMA frontend. The transputer additionally guarantees fast and effective scan operation with its time-relevant setting and measuring routines.

Scanning

The ESMA frontend features fast frequency and memory scanning with signal verification processing for every channel.

The **frequency scan** (F SCAN) is based on the definition of a frequency range where suppress flags and threshold values are stored in a step memory. The step memory, which is part of the frontend processor, supports up to 10,000 steps which can be shared for multiple-range operation.

Standard precision mode (SP mode) is optimized for fast scanning and low occupancy.

Advanced precision mode (AP mode) features higher precision in dynamic level measurement at reduced scan rates and is useful for frequency ranges with dense channel occupancy.

The **memory scan** (M SCAN) allows recurrent monitoring of 1 to 500 channels. Each channel contains a complete receiver setting including bandwidth, demodulation mode, threshold, etc.

Scan performance

The scan rate depends on several parameters like channel spacing, receiving bandwidth, occupancy, verification process and scan precision.

The diagram shows typical figures for F SCAN performance in normal mode and advanced precision mode using a verification time of 0 ms.

For memory scan operation the scan rate for 0 % occupancy ranges from 400 to 2500 complete receiver settings per second.

To accelerate the search process individual frequencies or frequency ranges may be excluded from further scanning by means of a suppress list.
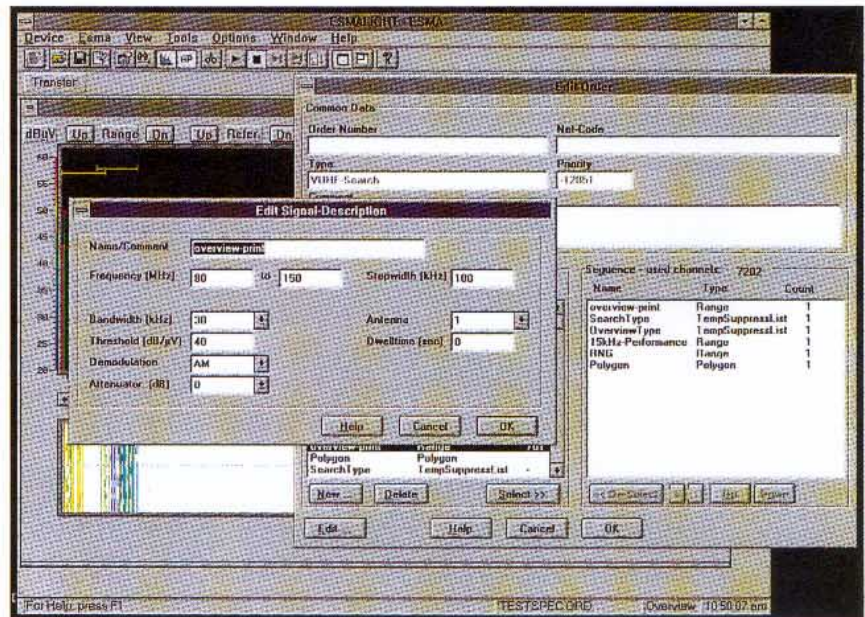
User interface for definition of frequency ranges and lists
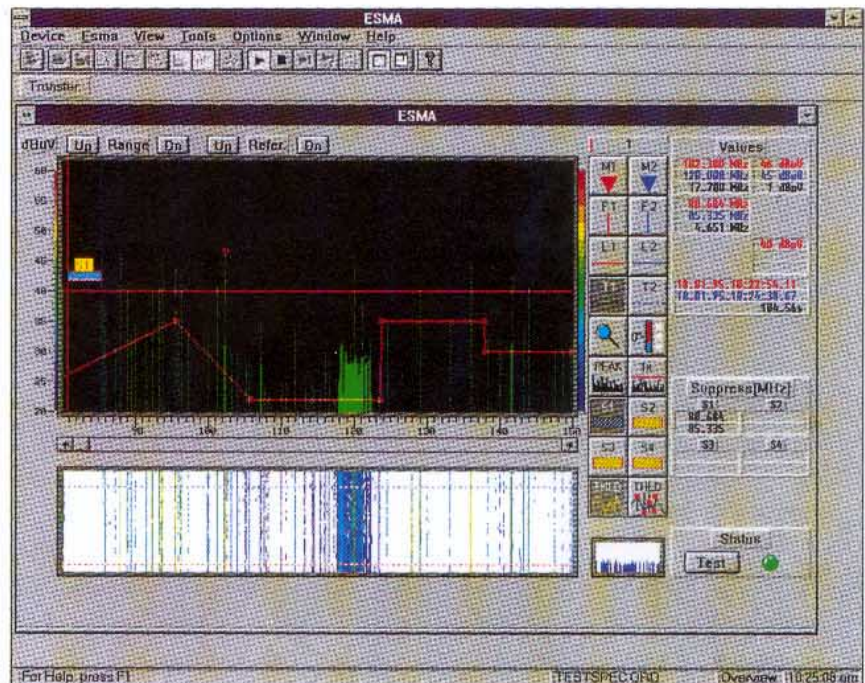
User interface for overview mode allows interactive definition of a polygonal threshold pattern even during scan operation

Signal verification processing

An essential feature of any high performance scan receiver is the ability to differentiate between pulse interference and CW signals. Therefore depending on the level-to-threshold ratio, a verification process will be started to reduce the false alarms produced by RF spikes. This verification pause will only be inserted at channels where a rough initial level measurement indicates occupancy.

Scan parameters

The user configures his monitoring tasks via dialog boxes which comprise parameters such as :

Name:	user-specific, eg AIRVHF
Frequency list:	list with up to 500 complete receiver settings
Suppress list:	list with all the frequencies excluded from scanning
Frequency range:	start, stop frequency, step width, IF bandwidth, demodulation, signal threshold

Up to 9 frequency ranges and one frequency list may be processed within one scan sequence.
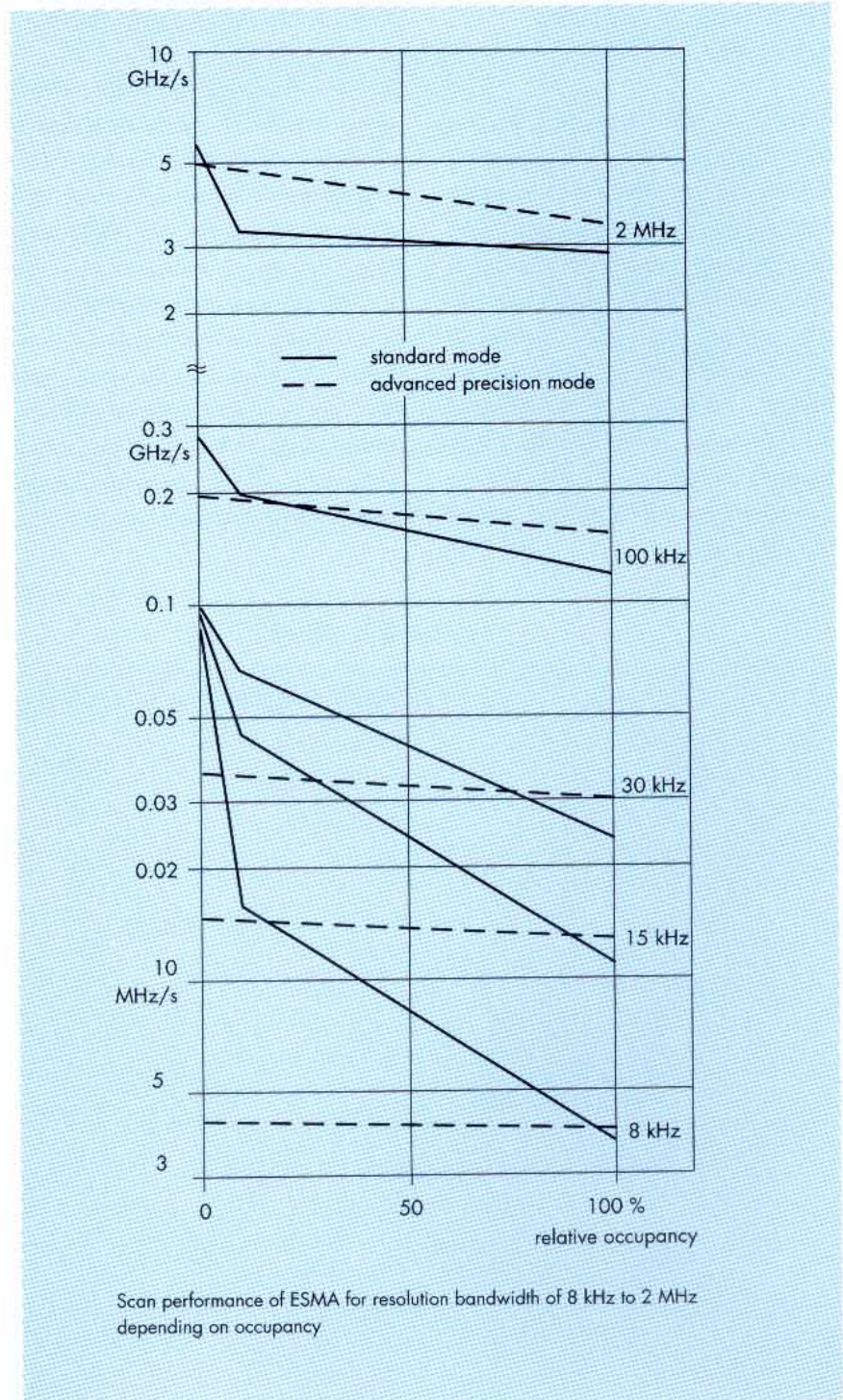
Overview mode

Allows continuous scan operation independently of occupancy for frequency ranges and frequency lists. The panoramic display provides the user with an on-line impression of the current frequency scenario. The threshold pattern may be set and changed during scan operation to meet user-specific requirements. In addition to the panoramic display, a waterfall diagram gives information about the density of occupancy over a user-definable period of time. Using the optional Data evaluation Package ESMA-EV, all event messages can be stored on file for off-line replay or statistical analysis.

Search mode

In this mode the ESMA searches either a frequency range (frequency scan) or a memory list (memory scan) and stops at any active channel for a selectable period of time, allowing identification and processing by the user. Moreover, the user may suppress this identified channel (suppress & continue) to speed up further scanning.

Static mode

This mode, which is also active during the identification phase in the search mode, allows fixed frequency monitoring and enables the user to tune the re-

ceiver to a selected signal with the aid of manual fine/coarse tuning to obtain information on the activity, frequency, field strength and modulation of this signal. In order to accurately correlate the receive frequency with the signal frequency, the user panel provides the following features for fine tuning, with the indicated offset value serving as a tuning criterion:

– Center Tune

The user triggers the automatic center tuning once on the basis of the measured offset value

– AFC

Unlike Center Tune, when this option is activated an automatic center tuning is carried out continuously

legend:
— standard mode
-- advanced precision mode

Scan performance of ESMA for resolution bandwidth of 8 kHz to 2 MHz depending on occupancy

Search and DF operation in parallel

For effective search operation, the user may wish to perform fixed frequency monitoring, recording and direction finding while searching for new activities. The open system architecture of industry-compatible PCs allows easy system upgrade, eg remote control of slave receivers and DF equipment via RS232 interface. Even the standard software which comes with the ESMA supports limited remote control of the Compact Receiver ESMC and related DF equipment.

## Built-in test equipment (BITE)

Built-in test equipment (BITE) permanently monitors the receiver down to submodule level. LEDs on the ESMA front panel indicate operating and alarm conditions for individual functions. In case of deviations from the nominal value an error message is output at the user panel of the process controller. Additionally, the user may check the complete signal path from the antenna input to the signal evaluation section by means of a loop test. This test uses an internally generated test signal.

Design

The receiver has been designed for stationary and mobile use according to DIN IEC 721 recommendations for class-C instruments. Careful shielding and filtering of all input and output lines ensures ultra-low spurious emissions and low EMS.

User-friendly maintenance

The advanced design based on plug-in modules guarantees short MTTR intervals. All modules of the unit may be exchanged without any adjustments being required.
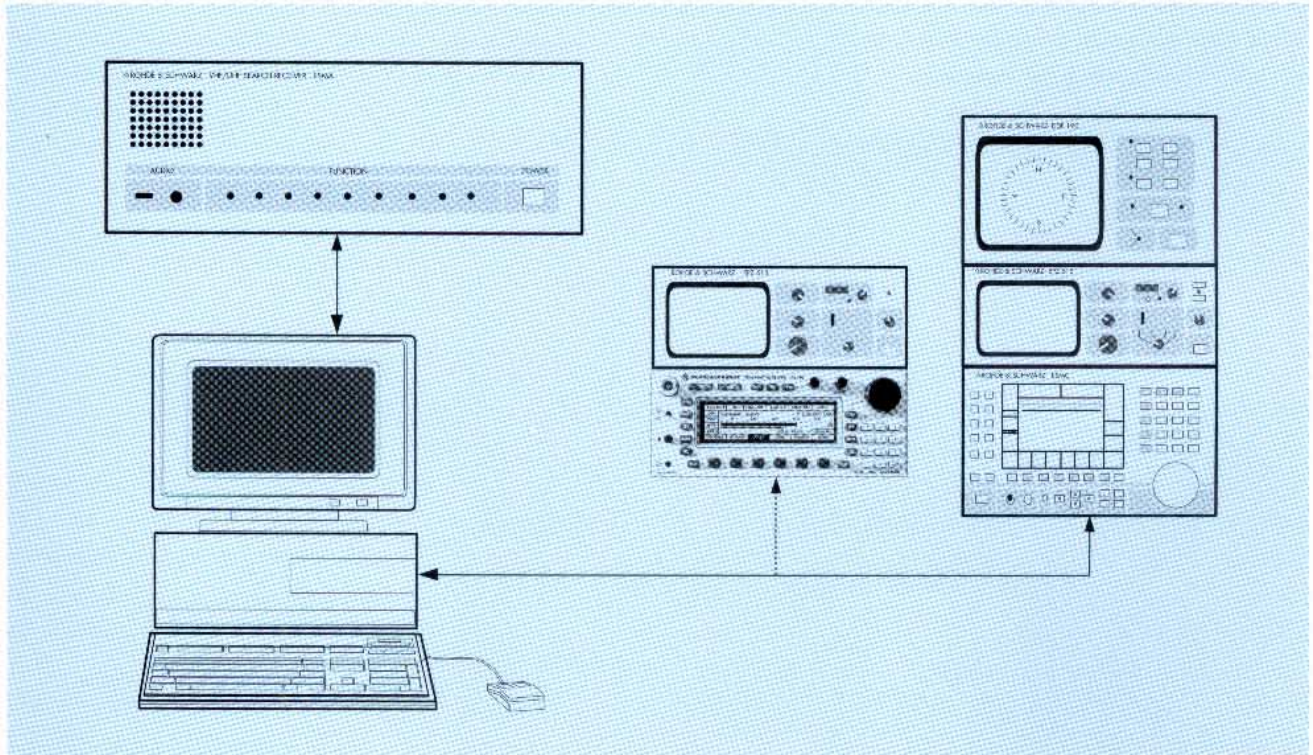
Possible system configuration consisting of ESMA, controller and two slave receivers; ESMC and EB200 can be extended by Panoramic Display EPZ513 and Direction Finder DDF190

Specifications

Frequency range

Frequency range	20 to 3000 MHz
Basic unit	20 to 650 MHz
Tuner 2	650 to 1300 MHz (optional)
Tuner FE	1300 to 3000 MHz
Frequency resolution	100 Hz
Stability	like reference frequency
Reference frequency	10 MHz
Temperature stability	$\leq 1.5 \times 10^{-8}$ (−10 to +55 °C)
Aging	$\leq 5 \times 10^{-10}$/day
After warm-up time	$\leq 3 \times 10^{-8}$/5 min
Antenna input	50 Ω, N socket, protected against overvoltage, VSWR ≤2.5
Oscillator reradiation	≤−107 dBm
Input selectivity	tuned filters
Oscillator phase noise	≤−115 dBc (10 kHz), typ. −120 dBc (10 kHz)
Synthesizer switching time	≤150 µs

Immunity to interference, nonlinearities

Image frequency rejection	typ. 110 dB, ≥90 dB
IF rejection	typ. 110 dB, ≥90 dB
2nd order intercept point	typ. 50 dBm, ≥40 dBm
3rd order intercept point	
20 to 650 MHz	typ. 11 dBm, ≥8 dBm
650 to 1300 MHz	typ. 9 dBm, ≥6 dBm
Spurious	≤−107 dBm

Sensitivity

Total noise figure (incl. AF section)	
20 to 650 MHz	typ. 10 dB, ≤13.5 dB
650 to 1300 MHz	typ. 11 dB, ≤14.5 dB
(S+N)/N ratio (CCITT)	
AM (m=0.5)	≥10 dB, for $V_{in} = 1.5$ µV, IF bandwidth 15 kHz
FM (deviation=5 kHz)	≥25 dB, for $V_{in} = 1.5$ µV, IF bandwidth 15 kHz
Signal level indication	graphic as vertical level line in panoramic display, numeric in static and search mode

IF bandwidths

IF bandwidths	8/15/30/100 kHz/2 MHz (standard), max. 8 MHz possible
Demodulation	AM, FM, LOG
Squelch	signal-controlled
Control	
Automatic AGC	90 dB signal variation for ≤ 4 dB AF variation
Manual MGC	IF control 90 dB
Attenuator	30 dB selectable

Built-in test equipment (BITE)

Continuous test	module monitoring, fault signalling
Loop test	automatic test of complete receive section including signal evaluation section
Status indication	LEDs on front panel

Outputs

IF outputs	
21.4 MHz, controlled	8 kHz to 8 MHz [1]), −10 dBm, BNC, 50 Ω
21.4 MHz, uncontrolled	±4 MHz wideband output, $V_{in} + 11$ dB, BNC, 50 Ω
AF outputs	AF filter 0.3 to 3.4 kHz, may be switched to any AF output
Balanced	0 dBm, 600 Ω
Unbalanced	0.5 V_{rms}, $R_i = 600$ Ω
AF loudspeaker output	500 mW, 4 Ω
Headphone output	1 V_{rms}, $R_i = 5$ Ω, jack socket, 6.35 mm, controllable
AM, FM, LOG video output	1/2 IF bandwidth, DC-coupled, BNC, 50 Ω, 2 V_{pp} (for LOG 1 V)
Reference frequency output	10 MHz, BNC, 50 Ω, 5 dBm

Special function ports

Special function ports	2 ports, configurable outputs: frequency information, control signals for antennas, log signal level, frequency offset input: IF analog voltage for external gain control
Control interface	transputer link (RS422)

[1]) depending on selected IF bandwidth

General data

Operating temperature range	−10 to +55 °C
Nominal temperature range	0 to +50 °C
Storage temperature range	−40 to +70 °C
Humidity	to DIN IEC 68-2-30, max. 95%, cyclic test 25/55 °C
Shock	to DIN IEC 68-2-27 (MIL-STD 810D, MIL T 28800D), shock spectrum 40 g
Vibration (sinewave)	to DIN IEC 68-2-6 (MIL T 28800D), 5 to 55 Hz, 0.15 mm amplitude
Vibration (noise)	to DIN IEC 68-2-36, 10 to 500 Hz, 1.9 g (rms)
Electromagnetic compatibility (EMC)	VDE 0875 (RFI suppression grade K) VDE 0871, MIL-STD 461 - CE 03, MIL-STD 461 - RE 02
Power supply	
AC	100/120/230/240 V, −12/+10%, 47 to 440 Hz, overvoltage protection to VDE 160
DC	20 to 32 V (reversed polarity protection)
Power consumption (without PC)	
AC	≤150 VA
DC	≤120 W
Dimensions (W x H x D)	436 mm x 192 mm x 460 mm
Weight	20 kg

Ordering information

VHF-UHF Search Receiver	ESMA	4024.5008.02
Accessories supplied	Transputer Card ESMA-TK (ISA-16), standard software, control cable ESMA–PC, operating manual, power cable	
Recommended controller	IBM-compatible PC-AT 486, at least 66 MHz, including SVGA adapter (800 x 600 pixels, 256 colours); one free ISA slot for ESMA-TK	

Options

Tuner 2 for frequency range extension 650 to 1300 MHz	ESMA-T2	4034.4256.02
Data Evaluation Package	ESMA-EV	4047.3060.01

Certified Quality System
ISO 9001
DQS REG. NO 1954-02
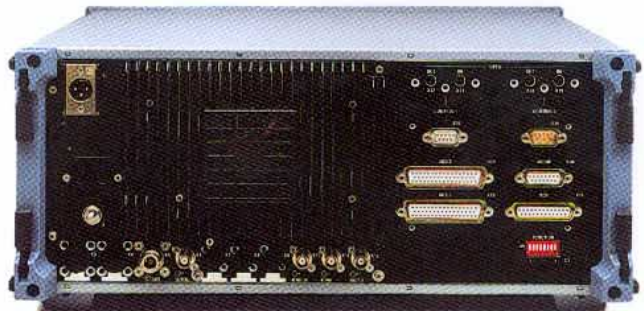
Rear of ESMA

Fax Reply (VHF-UHF Search Receiver ESMA)

❏   **Please send me an offer**

❏   **I would like a demo**

❏   **Please call me**

❏   **I would like to receive your free-of-charge CD-ROM catalogs**

Others: _____
                 _____
                 _____

Name: _____
Company/Department: _____
Position: _____
Address: _____
              _____
              _____

Country: _____
Telephone: _____
Fax: _____
E-mail: _____

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