Compact Receiver ESMC

Lightweight – compact – user-friendly:
optimized radiomonitoring from 0.5 MHz to 3000 MHz

- Signal reception
  - aural monitoring
  - radiomonitoring
  - recording
- 1 Hz frequency resolution

- Searching and scanning
  - continuous manual tuning
  - at any channel spacing
  - 5 start/stop frequency ranges
  - spectrum display with a speed of up to 13 GHz/s
  - within 1000 memory locations

- Measurement of
  - frequency occupancy
  - level and frequency
  - coverage
- RF and IF spectrum display
With the Compact Receiver ESMC, a universal and multipurpose receiver for radiomonitoring applications has been produced in a compact size that was thought not possible up to now.

The new receiver is only half the size of customary 19" multipurpose receivers of 3 height units but its technical data are even superior to those of such units.

The most important features are:
- custom-specific frequency extension from HF to UHF (see diagram)
- detection of frequency-agile emissions with analog sweep
- compact design and low weight
- simple operation via LC display
- wide dynamic range and high overload capacity
- 1 Hz frequency resolution
- low phase noise
- master/slave operation without a PC
- accurate measurement of signal level
- offset display for channel frequency
- remote control unit for mobile use
- AC/DC supply without changing the power supply unit

### Description

ESMC is a heterodyne receiver with a second IF of 21.4 MHz. In spite of the compact design, no compromises have been made in the operating concept. For reducing the total signal load, the tuners are each provided with a tracking preselection filter. High-level mixers ensure high immunity to intermodulation. The low oscillator reradiation is the result of elaborate filtering. An advanced synthesizer concept featuring a very low phase noise allows switching times of less than 1 ms. This permits highly efficient scanning and fast status assignment in slave operation.

### Operation

The operating concept meets all the demands made on a state-of-the-art radiomonitoring receiver, i.e., all main functions such as type of demodulation, bandwidth, etc., can be set directly via labelled keys. A hotkey permits returning to the main menu from any submenu. Menu control is organized in priority levels so that signal processing is not interrupted by menu changes and the user never loses sight of what is going on.
ESMC is equipped with demodulators for AM, FM, LOG and PULSE modes. SSB reception for LSB/USB and A1 is optional. The log demodulator allows a dB-linear level indication over 9 decades. Average value or peak weighting may be selected. The absolute accuracy of the level display is further improved by taking into account the frequency response of the preselection filter and the tolerances of the log amplifier in the measurement of the signal level.

ESMC may be equipped with up to 5 IF bandwidths between 500 Hz and 8 MHz. Video filters matched to the bandwidth used and a switchable AF filter improve the S/N ratio after demodulation.

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 automatically or manually when strong signals are received. This attenuator is considered in the level display. With manual gain control (MGC) the IF gain may be varied by 90 dB. The 30 dB attenuation too may be switched in if required.

A tuning indication controlled by the crystal discriminator simplifies tuning to the center of the selected IF bandwidth. When signals of unstable frequency are received, digital AFC may be used for retuning the receiver.

Search facilities

The ESMC uses highly advanced search routines. Fast synthesizer setting and short level measurement times guarantee highly effective search operations. The shortest period for scanning is 5 ms with an IF bandwidth of 1.5 kHz (incl. measurement time for level).

Frequency scan

Five start/stop frequency ranges (5 jobs) may be defined and a complete data set allocated to each range. In addition to receiver settings, the following scan parameters may be included in the data set:

- step width
- signal threshold (dBµV)
- dwell time (s)
- hold time (ms) plus the time required for external devices, if any
- number of scan repetitions
- signal-controlled continuation (on/off)
- suppression (individual frequencies or ranges)

Memory scan

ESMC uses 1000 memory locations, each holding a complete receiver setting, such as frequency, type of modulation, bandwidth, etc. The content of the memory can be modified manually or overwritten by results of a scan operation. User-definable code names, group ID and scan enable flags may also be defined for each location. Finally the whole memory can be sorted according to increasing frequency values. The content of any memory location can be transferred to the receiver manually, by using the RCL key, by turning the tuning knob or automatically by activating the memory scan.

Analog scan – full-speed detection of bursts and hoppers

The advantage of analog sweep is the extremely high speed. This allows detection of burst signals and frequency-agile transmissions. With the option ESMC-AS and an external PC a program under Windows™ is provided, which enables panoramic and waterfall displays. Start and stop frequency are freely selectable within any tuner range. Depending on the performance of the controlling PC, a scanning speed of up to 13 GHz/s can be achieved. With the aid of a printer, measurement results may be documented as a frequency-versus-time plot.

Click & listen

For fixed frequency monitoring a spectrum line can be selected by mouse click or by frequency marker.

With option ESMC-AS fast hopping frequencies can be detected
Real-time spectrum display with EPZ513

The external Spectrum Display EPZ 513 provides highly versatile display modes. An analog CRT guarantees display in real time.

**RF mode 650 MHz within 50 ms**
In this mode the tuner section of ESMC is directly controlled by the EPZ513. The period of the sweep is 50 ms, independent of the span.

The spectrum is displayed on the screen within the tuner range. A superimposed marker indicates the frequency to which the receiver has been tuned. With the aid of the start/stop frequency markers entered on the ESMC, the span may be expanded within a wide range. The amplitude range covers 80 dB and uses a selectable level line.

**IF mode**
In this mode the signal environment around the receive frequency is displayed. The span may be varied continuously or in steps of 7/2/0.2 MHz. Selection of resolution filters is automatic. The zoom capability of the EPZ is very useful in practical applications since details of the signal spectrum can be examined. In the double-trace mode, the total span (7 MHz) and any expanded section thereof may be displayed simultaneously.

The advantage of real-time spectrum display is that a quick overview of the receive range is obtained and unknown signal activities (bursts, frequency hopping) can be detected.

**Interfaces**
For system applications ESMC is provided with a number of important interfaces:

- IEC 625-2 (IEEE 488) for computer operation (standard)
- RS232C/RS422/RS485 for computer operation (option ESMC-R2)
- Outputs for antenna control (e.g. via Antenna Selector GS 050) with
  - antenna number and
  - coded frequency information
- 21.4 MHz IF output, controlled (50 Ω, BNC)
- 21.4 MHz IF output, uncontrolled (50 Ω, BNC)
- 21.4 MHz connector for external spectrum display (50 Ω, BNC)
- Video output, AM/FM/LOG, DC-coupled (50 Ω, BNC)
- DC connector for battery supply
- Connector for external bidirectional reference frequency, 10 MHz (BNC)
- Output for 1st LO (50 Ω, BNC)
- Output for 2nd LO (50 Ω, BNC)
- AF balanced, 600 Ω
- AF unbalanced via AF filter
- 4 Ω output for external loudspeaker
- Carrier-operated relay (COR)
- Output for signal > threshold
- Output for log signal level
- Internal/external control
- Input for control voltage (MGC)
- Output for channel offset
- Others (special function ports)

**Options**
Several "plug&play" options allow the user to tailor the ESMC to his special needs:

- **ESMC-T2** for frequency extension up to 1.3 GHz
- **ESMC-T0** for frequency extension from 0.5 MHz to 30 MHz instead of ESMC-T2 or for installation in ESMC-FE. (Max. IF bandwidth = 30 kHz).
ESMC-FE  separate 1/2 19" unit for frequency extension from 1.3 GHz to 3 GHz or 0.5 MHz to 3 GHz
ESMC-AN  antenna splitter for one antenna input, 20 MHz to 3 GHz (only with ESMC-FE)
ESMC-OR  10 MHz OCXO reference (error ≤ 0.1 x 10^-6) [1]
ESMC-S3  for reception of LSB/USB and A1
ESMC-SU  low-cost panoramic adapter using the LCD of the receiver
ESMC-AS  analog scan function and software for use with PC AT486 or Pentium
ESMC-R1  for remote control via IEC 625-2/IEEE 488 (instead of ESMC-R2)
ESMC-R2  for remote control via RS232, RS422 and RS485 bus (instead of ESMC-R1)

ESMC-GB  remote control unit (operator front panel) for controlling ESMC model .02 or .03 via serial link especially for mobile applications
ESMC-Z1  IF section with special bandwidth (see ordering information)

All these options can be added to the basic version of the ESMC without any software reconfiguration; whenever a module is changed or added, a recalibration process is started automatically after power-up.

Diagnostic center included
The receiver is permanently monitored by built-in test (BIT). If deviations from nominal values are detected, an error message is output with a code informing on the type of fault. For detailed information, the values of 48 internal test probes including upper and lower limits are available on the screen. Any values which are out of range will be highlighted on the display. In a loop test triggered by the user, the complete signal path between the antenna input and the loudspeaker or video output is checked out. This test is carried out with an internally generated and modulated test signal of calibrated frequency.

User-friendly maintenance
The advanced design, based on plug-in modules guarantees short MTTR. All modules of the unit may be exchanged without any recalibration or adjustments being required.

Remote control
All receiver functions can be remote-controlled by a controller via the standard IEC 625-2 (IEEE 488) interface or via the optional RS232C/RS422/RS485 interface. If no acknowledgement for the settings are required, simplified master-slave operation will be possible without the use of an additional controller. In this case the ESMC used as a master (talker) may address up to ten slave ESMCs (listeners) and transfer the corresponding setups to the slaves. The transferred setups are stored automatically in the master under the slave addresses and may be read out (electronic notebook).

Model .02/03 of ESMC for remote control or for detached front panel ESMC-GB, eg for convenient use in cars.
ESMC-RAMON – access to computer-aided radiomonitoring

Compact radiomonitoring system

With its favourable price, ESMC-RAMON is an ideal compact radio monitoring software. It is configured to control one ESMC and can be expanded to set additional ESMC and ESM500 slave receivers to perform radiomonitoring and radiosurveillance tasks.

The system provides three operating modes:

- Static mode: the receiver can be tuned for monitoring
- Search mode: the receiver scans frequency ranges and/or a frequency list and stops for a definable time at each signal activity
- Overview mode: the receiver scans frequency ranges and/or a frequency list continuously to display the frequency spectrum

The overview mode shows active signals with their levels as green lines. The duration of the signal activity is displayed in a waterfall, with the signal level being indicated in colour. Important parameters can be measured using markers and rulers in different colours.

ESMC-RAMON-Evaluate

The ESMC-RAMON-Evaluate option permits the recording of signal activities in the overview mode. Such recordings can be evaluated with the scan replay tool and analyzed in detail with the activity analyzer.

ESMC-RAMON-MasterSlave

This option allows up to six ESMC receivers to be connected to the system via IEC/IEEE bus. The slave receivers are set and enabled automatically. A free slave receiver will be set to a frequency, which is detected by the master receiver running in the search mode. The slave receiver will be enabled for new settings after the signal is below a selectable threshold for a selectable time. With this option, frequency bands and single frequencies can be monitored automatically.

ESMC-RAMON-Log

This option allows the logging of the master receiver settings.

The settings can be stored in a log file. In combination with the Log option or the Master Slave option, all transfers to slave receivers are also stored in the log file.

ESMC RAMON-IEEE488 Kit

This option contains the necessary IEEE488 board for the control PC, the board driver software, the driver installation manual and a 2 m IEEE488 cable for connecting the ESMC.

Upgrading possibility

The close relationship to RAMON® makes upgrading to the full RAMON software very easy. Existing equipment can still be used. All that remains to be done is to install the new software. As the operational concept is similar, existing knowledge can be used. All this shows that ESMC-RAMON is a Rohde & Schwarz product providing easy access to computer-aided radiomonitoring.

System requirements

- IBM-compatible PC
- minimum 486/DX2-66, 8 MByte RAM
- min. 10 MByte hard disk space
- colour graphics adapter with min. resolution 1024 x 768 pixels
- mouse or other pointing device
- Windows 3.1, Windows 95 or Windows NT
### Specifications

<table>
<thead>
<tr>
<th>Frequency range</th>
<th>20 MHz to 650 MHz</th>
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<tr>
<td>Basic unit (with tuner 1)</td>
<td>650 MHz to 1300 MHz (optional)</td>
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<tr>
<td>Tuner 2</td>
<td>1300 MHz to 3000 MHz (optional)</td>
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<tr>
<td>ESMC-FE (Tuner 3)</td>
<td>1300 MHz to 3000 MHz (optional)</td>
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<tr>
<td>Frequency setting</td>
<td>1 kHz, 100 Hz, 10 Hz, 1 Hz</td>
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<tr>
<td>Frequency error</td>
<td>$\leq 1.5 \times 10^{-6}$ to $\pm 5.5^\circ C$</td>
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<td>Frequency aging</td>
<td>$\leq 0.5 \times 10^{-6}$ per year</td>
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<tr>
<td>Oscillator phase noise</td>
<td>$\leq 110$ dB (10 kHz)</td>
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<tr>
<td>for tuner 0</td>
<td>$\leq 138$ dB (10 kHz)</td>
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<td>Synthesizer settling time</td>
<td>$\leq 1$ ms</td>
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<td>Antenna input s</td>
<td>N connectors, 50 $\Omega$, VSWR $\leq 2.5$, overload-protected</td>
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<tr>
<td>Oscillator reradiation</td>
<td>$\leq 117$ dB</td>
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<tr>
<td>Input selectivity</td>
<td>tuned filters</td>
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<tr>
<td>Tuner 0</td>
<td>4 switched bandpass filters</td>
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<tr>
<td>ESMC-FE (Tuner 3)</td>
<td>3 switched bandpass filters</td>
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</tbody>
</table>

#### Immunity to interference, nonlinearities

| Image frequency rejection, all tuners | typ. 110 dB, $>90$ dB |
| IF rejection, all tuners | typ. 110 dB, $>90$ dB |
| IP2 | typ. $50$ dB, $>40$ dB |
| ESMC-FE (Tuner 3) | typ. $43$ dB, $>35$ dB |
| Tuner 0 | typ. $70$ dB, $>55$ dB |
| IP3 | typ. $12$ dB, $>8$ dB |
| Tuner 1, ESMC-FE (Tuner 3) | typ. $10$ dB, $>6$ dB |
| Tuner 0 | typ. $35$ dB, $>28$ dB |
| Spurious | tuner 0, $\leq 107$ dB |
| Tuner 3 | $\leq 113$ dB |

#### Sensitivity

| Total noise figure (incl. AF section) | typ. $10$ dB, $<13.5$ dB |
| $\text{(S+N)/N ratio}$ | $20$ MHz to $650$ MHz |
| $\text{AM, B=8 kHz, } f_{\text{mod}}=1$ kHz, $m=0.5$ | $20$ MHz to $650$ MHz (tuner 1), $V_{\text{in}}=-107$ dBm (1 $\mu$V) $\geq 10$ dB |
| $V_{\text{in}}=-113$ dBm (1 $\mu$V) $\geq 10$ dB |
| $V_{\text{in}}=-47$ dBm (1 $\mu$V) $\geq 47$ dB |
| $V_{\text{in}}=-103.5$ dBm (1.5 $\mu$V) $\geq 10$ dB |
| $V_{\text{in}}=-47$ dBm (1 $\mu$V) $\geq 47$ dB |
| IP2 | typ. $10$ dB, $>6$ dB |
| Tuner 1, ESMC-FE (Tuner 3) | typ. $10$ dB, $>6$ dB |
| Tuner 0 | typ. $35$ dB, $>28$ dB |
| Tuner 3 | $\leq 117$ dB |
| USB/LSB, B=2.5 kHz, $\Delta f=1$ kHz | typ. $117$ dB (0.3 $\mu$V) $\geq 10$ dB |
| Tuner 0 | typ. $47$ dBm (1 $\mu$V) $\geq 47$ dB |
| Tuner 0 | typ. $50$ dB |
| Tuner 0 | typ. $60$ dB |
| Tuner 0 | typ. $70$ dB |
| Tuner 0 | typ. $80$ dB |
| Tuner 0 | typ. $90$ dB |

**Rear of ESMC:** the IEC/IEEE bus can optionally be replaced by RS232 and RS422/RS485 interface.
Loop test key-triggered, automatic test of complete receive section incl. AF section

Real-time display on Spectrum Display (EPZ 5131)
If
RF
±3.5 MHz, ±1 MHz, ±100 Hz or zoom
full receive range (max. 650 MHz) or any expanded section

Inputs and outputs
If 21.4 MHz, controlled output
0 Hz to 8 MHz²), BNC, 50 Ω, ±10 dBm
500 Hz to 8 MHz²), BNC, 50 Ω, V₀ = 12 dB
21.4 MHz, uncontrolled output
±4 MHz uncontrolled, BNC, 50 Ω, V₀ = 9 dB, for external spectrum display
Video output, AM/FM/LOG
1/2 IF bandwidth, DC-coupled, BNC, 50 Ω, 2 V (pp), for log 1 V
AF output, balanced
0.3 kHz to 3.4 kHz, fixed, 1 V (rms)
AF output, unbalanced
4 Ω, 500 mW

Demodulation
AM, FM, LOG, PULSE
Squelch
Squelch signal-controlled, adjustable
AGC speed for 90 dB range
AF output, channel offset
Output, log signal level
Output, channel offset
Input, ext. MOC voltage
Output, 1st LO
Output, 2nd LO
Bidirectional reference-frequency connector
AF loudspeaker output
AF output, 2nd LO
Special function ports
AF output
Output for controlling antenna selectors

General data
Nominal temperature range
Storage temperature range
Humidity
Shock
Vibration (sinewave)
Vibration (noise)
EMC
Power supply AC
Power consumption AC
Dimensions (W x H x D)
Weight

15 kHz, 3 dBm, Zout = 50 Ω
50 Ω, SMA, ±5 dB, ±2 V (pp); for log 1 V

Audio performance
IF mixer performance
Analog output
Digital I/Os
Miscellaneous

-10 °C to +55 °C
-40 °C to +70 °C
max. 95%, cycle test 25 °C/55 °C
max. 80%, cycle test 25 °C/40 °C
IEC 68-2-30, MIL-STD-810, MIL-T-28800D, shock spectrum 4.5 kHz to 2000 Hz, 40 g
IEC 68-2-6 (MIL-T-28800D), 5 Hz to 55 Hz, 0.15 mm amplitude to IEC 68-2-6, 10 Hz to 500 Hz, 1 g (rms)
VDE 0875 (RFI suppression grade K)
100/120/230/240 V, -12%/+10%, 47 Hz to 440 Hz, overvoltage protection to VDE 160
10 V to 32 V, reversed polarity protection ≤100 VA
≤75 W
≤100 VA
3.5 mm, 1.47 mm x 460 mm (1 1/16", 3 height units)
11.5 kg
12 kg

1.9 g (rms)
5 Hz to 55 Hz, 0.15 mm amplitude to IEC 68-2-6, +50 Hz, overvoltage protection to VDE 160
Power consumption AC
Dimensions (W x H x D)
Weight
model 02/03
model 22/23
47 Hz to 440 Hz, overvoltage protection to VDE 160
≤100 VA
3.5 mm, 1.47 mm x 460 mm (1 1/16", 3 height units)
11.5 kg
12 kg

Compact Receiver ESMC

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Compact Receiver ESMC
Ordering information

Compact Receiver ESMC (VHF/UHF basic unit)

Model .22, with front-panel control  4030.2007.22
Model .02, without front-panel control  4030.2007.02

models .22/.02 including:
- IEC 625 (IEEE 488) interface ESMC-R1
- IF Section (filters 2.5 kHz/8 kHz/15 kHz/100 kHz/2 MHz) ESMC-Z1

Model .23, with front-panel control  4030.2007.23
Model .03, without front-panel control  4030.2007.03

basic models .23/.03 without ESMC-R1 and ESMC-Z1

ESMC-RAMON

ESMC-RA  4037.6508.02
ESMC-RE  3013.4815.02
ESMC-AM  3013.4838.02
ESMC-RL  3013.4844.02
ESMC-RJ  3013.4867.02

Options for all models

Tuner 0 for 0.5 MHz to 30 MHz ESMC-T0(1)  4039.9004.03
Tuner 2 for 650 MHz to 1 300 MHz ESMC-T2(1)  4037.5201.02
[combination of tuner 0 and tuner 2 in one ESMC case not possible]
SGB Unit ESMC-S3  4037.5501.02
IF Spectrum Unit ESMC-SU  4037.5553.02

Analog Scan (software) ESMC-AS 4042.0404.02
IEC 625 (IEEE 488) Interface ESMC-R1  4037.5401.02
Serial Interface (RS232/422/485) ESMC-R2(4)  4037.5453.02
Remote Control Unit ESMC-GB  4039.8508.02
for model .02/.03
Frequency Extension ESMC-FE  4042.6002.02
1.3 GHz to 3 GHz (separate 1/4” 19” unit)
OCXO Reference ESMC-OR(1)  4042.6902.02
Antenna Splitter ESMC-AN  4042.6702.02

Recommended extras

Spectrum Display EP2513  4011.9500.04
(data sheet PD756.9451)
19” Adapter for
one or two ESMC
ZZA-98  0827.4533.00
one ESMC and one EK890/895
one ESMC and one EP2513
one ESMC and one ESMC-FE

1) External unit.
2) Depending on selected bandwidth (see table on this page).
3) Only one of these options to be fitted in ESMC.
4) Only one of these options to be fitted.
5) Slot in option ESMC-FE available, otherwise in ESMC basic unit instead of option ESMC-SU.

ISO 9001
Certified Quality System
DQS REG. NO 1954-04

ISO 14001
Certified Environmental System
13 NO 11424
**Option to choose for model 23/03**

IF Section [special bandwidths]

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Other combinations [5 out of 13] on request

The max. IF bandwidth of tunerT0 (0.5 MHz to 30 MHz) is 30 kHz.
Bandwidths >30 kHz cannot be used in this frequency range.