

Memory Radio Analyser

MRA-3Q

User Manual

Read this manual before use.

Version Q1.2

The new MRA-3Q is an advanced automatic radio scanner suited for instant detection of various types of radio bugs in the frequency range 36–3600MHz. The basis of the system is the radio spectrum memory combined with an ultrafast scanning. The whole frequency range is scanned every eight seconds and the currently received signals are compared with the initially stored „clean“ background spectrum. The presence of a new signal activates a three level alarm output. All new signals with frequency, time and a statistic information are stored in an independent alarm memory.

MRA-3Q allows to automatically acquire audio records of new signals which have been causing alarms. Recorded audio samples together with the stored statistic information are reliably indicating if the object was attacked by RF eavesdropping.

MRA-3Q can be used as a part of the QM-4000 bus system. QM-4000 allows parallel connection of up to 32 MRA-3Q devices within an object network. The bus system allows full remote control of each device, and additionally it contains numerous additional features like spectrum analysis in the range of 36–3600MHz, background statistic, new signal statistic, automatic audio sampling, frequency and spectrum records, selective statistic, system statistic etc. QM-4000 is not only a comprehensive solution for object permanent protection, but also a very effective tool for electronic countermeasures specialists since it gives a clear graphical picture of the current RF signals. By using QM-4000 we can detect and record even such dangerous systems like spread spectrum, or modified WiFi, DECT, and GSM.

I. Controls, inputs, outputs and their function

Front panel:

1. 2 x 16 character LCD display
2. POWER switch: ON / OFF
3. AUDIO switch: ON = internal loudspeaker ON
4. AUDIO knob: internal loudspeaker volume control
5. SEARCH knob: fine tuning
6. Button MODE: function switch
7. Button MENU (NEXT):
 - a) short push = switch to manual tuning
 - b) in manual tuning = frequency measurement
 - c) long push in modes SCAN, Background and New Signal activates context menu, user is navigated by displayed instruction to other functions
8. Button DOWN (-):
 - a) frequency tuning down
 - b) memory records listing down
 - c) other context selections
9. Button UP (+):
 - a) frequency tuning up
 - b) memory records listing up
 - c) other context selections
10. Green LED ON: indicator ON
11. Yellow LED CHARGE: external power supply and battery charge
12. Red LED ALARM:
 - a) flashing each 8 sec. = PRE-ALARM
 - b) continues light = ALARM

Rear panel:

13. ANTENNA telescopic antenna

- 14. Connector CHARGER: external power 12 – 25 V DC, centre = + pole
- 15. Connector PHONES, ALARM LED:
 - a) earphones 2 x 32 ohm, disconnect internal loudspeaker
 - b) external LED ALARM output: 2mA, right channel = -pole, stereo ground = +pole
- 16. Connector OPTIONS: QM4000 system bus or audio recorder interface SCAN-R. Left channel = +RS485, right channel = -RS485, stereo ground = line audio

Bottom:

- 17. Trimmer GAIN: antenna attenuation, maximum = clock-wise

II. MRA-3Q adjustment

Push out the antenna and place the MRA-3Q in the room in such place to avoid direct contact with persons sitting or walking in the room. For long term usage connect the power supply adapter, indicated by the yellow CHARGE LED.

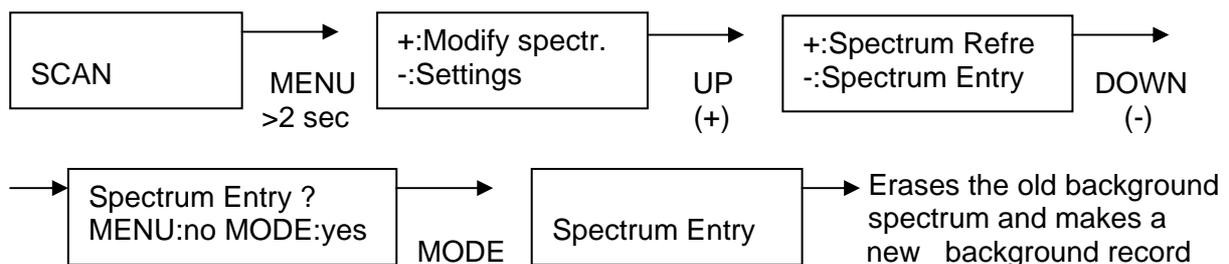
III. Power ON and battery check

After switching on (the POWER switch) the green POWER LED lights up, the red ALARM LED flashes shortly and the LCD displays the software version and language (EN = English version). If the AUDIO is ON the loudspeaker is tested. A weak battery (bellow 7V) is indicated by BATT! message in the bottom line of the LCD. A weak battery must be changed as soon as possible. If the battery is very weak (bellow 6.5V) the device cannot be switched ON. DO NOT USE non-rechargeable alkaline batteries when the device is used with external power supply! Preferably use NiMH or NiCd accumulators.

IV. Spectrum entry

Spectrum entry erases old content of the spectrum memory and makes the new record, gain = SCAN + 3.5dB

- a) Use the MODE button to set the SCAN mode
- b) Push the MENU (NEXT) button for several seconds
- c) Select + (UP) "Modify spectr."
- d) Select – (DOWN) "Spectrum Entry"
- e) Push MODE: "yes" to confirm

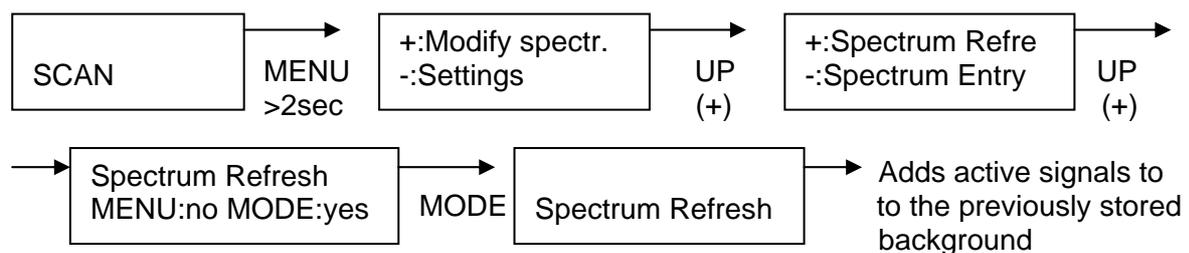


During the 24 seconds of spectrum entry or spectrum refresh (see section V) people should walk in the room to imitate the usual situation. Human bodies are reflecting or damping radio waves and the aim of spectrum entry is to store as much as possible legal signals to avoid later false alarms. If more than 160 channels are occupied the LCD shows a hint to shorten the antenna or to reduce the GAIN (trimmer on the bottom anti-clock-wise).

V. Spectrum refresh

Spectrum refresh adds to previously stored spectrum other active signals with higher sensitivity, more specifically with gain = SCAN + 7dB. This command is recommended for quick recording of varying spectrum to record as much as possible signals and so to reduce later false alarms.

- a) By MODE button set SCAN
- b) Long push button MENU (NEXT)
- c) Select + (UP) "Modify spectr."
- d) Select + (UP) "Spectrum Refre"
- e) Push MODE: "yes" to confirm



Because the Spectrum Refresh instruction could reduce the overall sensitivity of the device to new signals it is recommended to add varying signals using the new signal management described in section X, which allows to only add those signals which are really causing false alarms.

VI. Background check – detection of already installed bug

All signals recorded in the background (section IV or V) should be checked. This is the fastest and most effective way of selective detection of any active wireless bug already installed in the room (see section XVII dangerous signals).

Tuning and checking of background signals:

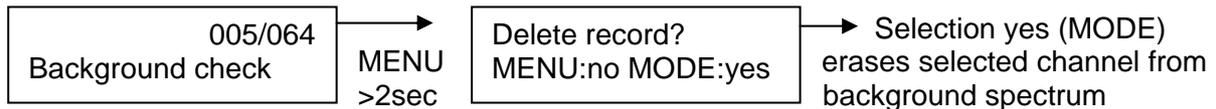
- a) Using the MODE button set the "Background check" mode
- b) By using the UP or DOWN buttons check all background channels. The current channel number is alternated by the sequential number of the channel and the sum of occupied channels in the background memory

- c) Tune the best reception by using the SEARCH knob (the LCD measures the signal level in the DIST area)

<p>005/064 (chn 041) Background check</p>

The 5th record from 64 occupied channels is checked, the number of this channel is 041 (indication in brackets is alternated)

- d) Pushing the MENU (NEXT) button for several seconds opens a submenu allowing to erase the channel from the background spectrum.



During the background check the system is automatically tuning the strongest signal when going to a new channel. If you use the SEARCH knob, return it back to the central position before pushing UP or DOWN to allow symmetric fine tuning of the next background channel.

VII. SCAN

The scan mode provides a permanent protection against wireless eavesdropping.

- Using the MODE button set SCAN mode
- Note the ID of the last background #XXXX. The ID is a security code with 65536 combinations, which gives a good protection against non-authorized manipulation. The ID is a random number automatically generated during any spectrum entry or refresh. The ID code and all memory records remain stored in the memory also after switching off. If the ID is changed it is sure that somebody was manipulating with the device. The manipulation could be caused by an attacker who installed a bug and programmed its frequency to the background. In such a situation a background check (section VI) should be done.
- To allow detection of sophisticated pulse and digital devices the default sensitivity of MRA-3Q is very high. Such high sensitivity is causing unwanted detection of different sporadic signals like air communication, mobile systems, different pulses etc. To avoid disturbance by such "pre-alarms" it is recommended to switch the AUDIO off and just time to time check the ALARM LED.
- Avoid usage of wireless systems like DECT, WiFi, GSM gates, radio controls, wireless security, wireless cameras etc. in the protected area. Those signals can mask most dangerous eavesdropping devices in the same frequency range.

VIII. Pre-alarm, Alarm, Past-alarm

The alarm status is indicated in the SCAN mode when the MRA-3Q is permanently protecting against eavesdropping. Alarms are caused by detection of a new signal which is not stored in the background memory.

- **Pre-alarm:** a short flash of red LED and a short beep if AUDIO is ON. In the bottom right corner of the LCD the percentage of achieved alarm level is indicated. The alarm level increases in the case of continuous presence of the new signal.

SCAN #C05B	48%
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- ID of the last background record is C05B
- A new signal is reaching 48% of the alarm limit (Status below 100% is PREALARM)

- **Alarm:** the alarm is activated when any of new signals reaches 100% of alarm level. The default time for reaching the 100% alarm is 10 minutes. This parameter can be adjusted (see section XV.c1). Alarm is indicated by continuous light of red ALARM LED, continuous audio tone (if AUDIO is ON) and the ALARM! message on the LCD alternated by the duration of the alarm HH:MM (hours:minutes).

ALARM!	(01:17)
SCAN #C05B	100%

- Duration of the ALARM is 1 hour and 17 minutes (indication in brackets is alternated)

- **Past-alarm:** indicated in the top right corner of the LCD by message ALARM! alternated by -HH:MM which is time information how many hours:minutes ago the last alarm has stopped

ALARM!	(-47:17)
SCAN #C05B	22%

- Last ALARM stopped before 47 hours and 17 minutes
- At the same time a new signal is reaching 22% of the alarm limit (indication in brackets is alternated)

IX. New signal check

This function allows checking of signals which are causing or caused an alarm. In the SCAN mode all signals which are not stored in the background memory are written to the new signal memory. The new signal memory can store up to 100 records. If more than 100 new signals are received the less important records are automatically erased. The less important signals are usually sporadic, very weak, caused by electric pulses etc.

- a) Using the MODE button set the "New signal" mode
- b) By UP or DOWN buttons check all new signal channels. The current channel number is alternated by sequential number of the channel / the total number of new channels
- c) If a dangerous signal appears, disconnect the power supply, see LCD DIST and find the strongest signal in the room.

- **The information displayed about each new signal:**

- SM** the sum of new signal activity time DD:HH:MM (days:hours:minutes)
- F** the time of first appearance of the signal -DD:HH:MM
- L** the time of last appearance of the signal -DD:HH:MM

- XX%** % of achieved alarm limit
- *** informs that this channel caused an alarm in the past
- ◀** this signal has an audio record in the connected recorder (see SCANr mode in section XI)

	002/023 (chn 480)
New signal	* 56%
(SM=00:12:35	* 56%)
(F= -21:14:24	* 56%)
(L= -00:00:00	* 56%)

002/023 2nd new signal from total 23 new channels
chn 480 signal is on channel 480
***** this channel has caused an alarm in the past
56% alarm level in the last scan cycle
SM sum of this channel activity is 12 hours, 35 min
F first appearance of the signal before 21d, 14h, 24m
L last appearance of the signal before 0d, 0h, 0m
 (the signal is active)
 (indication in brackets is alternated)

- Listing of new signals:

The current channel number (chnXXX) is alternated by sequential number of the channel and the total number of new channels YYY/ZZZ (YYY is the sequential number and ZZZ is the total number).

The signals are listed according to the following priorities:

1. XX% % of actual alarm
2. ◀ or * information that the signal caused an alarm
3. SM sum of time of the signal activity

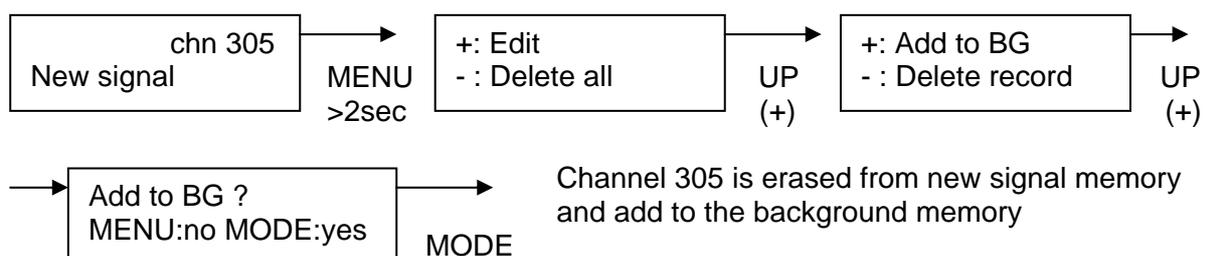
X. New signal management

This section describes working with the new signal memory and optimisation of the background memory.

1. In the “New signal” mode push the MENU (NEXT) button for several seconds. The LCD offers the following selection:
 - + (button UP) “Edit”, see 1.a
 - (button DOWN) “Delete all” see 1.b

1.a “Edit”, choices:

- + (button UP) “Add to BG”, add the selected channel into the background. It is recommended to add legal signals (broadcast, TV, GSM, BTS etc.) which have a high SM value. More specifically those signals marked * or ◀ which have caused alarms in the past.
- (button DOWN) “Delete record”, erase this channel from the new signal memory.



1.b “Delete all” it means erase all new signal records. This instruction should be executed if all new signals had been checked and the user is satisfied with the already programmed background spectrum (no false alarms). Erasing of all new signals ensures that during next new signal revision only the actual signals will be displayed.

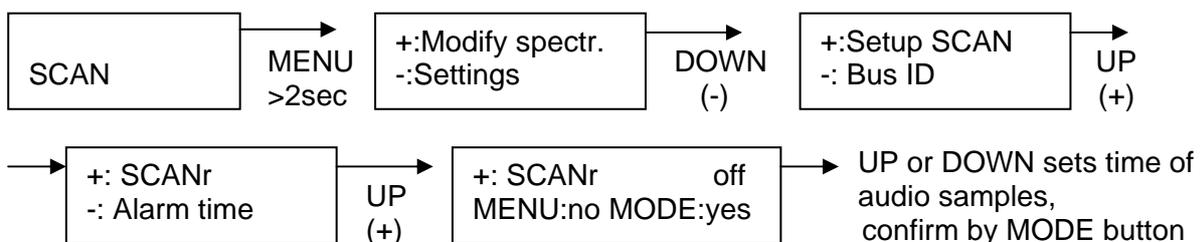


Note: pushing different buttons than the menu offers returns to the previous mode.

XI. SCANr

The SCANr mode is an extension of the SCAN mode. In this mode MRA-3Q automatically records audio samples of alarm signals. This allows detection of time delayed bugs and in particular it enables expert analyses at any time after a VIP meeting.

- a) In the SCAN or the SCANr mode push the MENU(NEXT) button for several seconds
- b) – (button DOWN) “Settings”
- c) + (button UP) “Setup SCAN”
- d) + (button UP) “SCANr”. LCD displays SCANr and status of audio sampling.
Buttons UP or DOWN allow to set the length of audio sample recording:
off = SCANr is off, 010, 020, 030, 040, 050, 060 = time of audio samples in seconds.
- e) Confirm selected time by MODE button



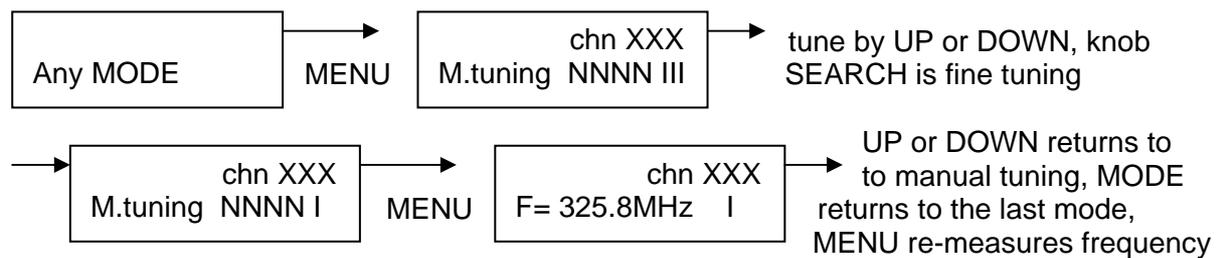
If SCANr is off the permanent protection (section VII) is indicated as SCAN. SCANr is activated if any time 10–60s is selected. In SCANr all functions are equivalent to the SCAN mode, but additionally the signals causing alarm are recorded on connected audio recorder. Each audio record has the selected length (10–60s) and if any of signals is active for a long time period its next records are repeated in a random period between 5–25 minutes. For audio recording any type of recorder with VOX (voice activated), external microphone input and external 3V power can be used. Connect the SCAN-R adapter to the OPTIONS connector (stereo 3.5mm) and the CHARGER connector. Connect the mono 3.5mm connector and a small 3V power connector to the recorder. Set the recorder to VOX mode, set the SCANr mode on the MRA-3Q and push the MENU(NEXT) button. MRA-3Q switches to “M.tuning”. Adjust recorder VOX sensitivity to start recording. Push the MODE button for

returning to SCANr and the recording must stop in approx. 3 sec. time. New signal history is the same as for the SCAN mode, see section IX. The channels with audio record(s) are marked by ◀ symbol instead of *. Check all audio records and compare them with signals on channels marked ◀. Legal signals causing false alarms should be added to the background memory, see section X.1.a+.

XII. Manual tuning and frequency measurement

This function can be activated from any mode and allows frequency tuning by UP or DOWN buttons and fine tuning by the SEARCH knob.

- Push the MENU(NEXT) button shortly. The LCD displays “M.tuning” (manual tuning).
- Use the UP and DOWN buttons for tuning in a wide frequency range. Use the SEARCH knob for fine tuning.
- To measure the frequency of tuned signal push the MENU(NEXT) button shortly (wait for few sec till the frequency is measured and displayed)
- The MODE button returns to the previous mode



XIII. Signal level measurement – transmitter distance

The bargraph DIST 50–1m is indicating approximately the distance of a transmitter 100–1200 MHz effectively radiating 1mW RF power. In practice the radiation efficiency of hidden bugs is problematic and the declared RF power usually does not correspond with real ERP. Use the DIST bargraph for an exact localisation of a bug (see also section IX.c).

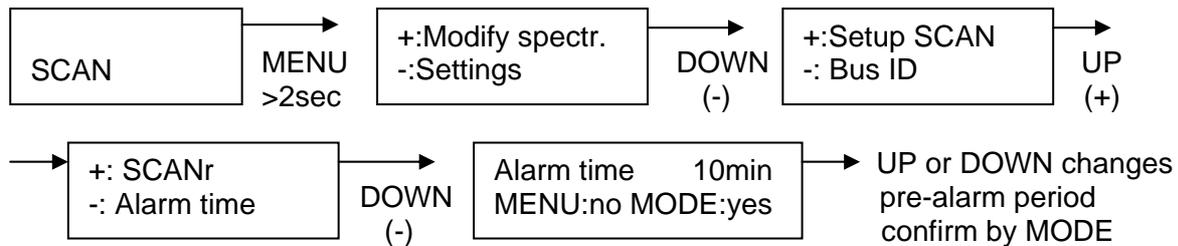
XIV. Automatic tuning

Using the MODE button set the “Autom.tuning” mode. The MRA-3Q is automatically tuning at a speed of 50s per the whole frequency range. At each signal the tuning stops for 4 seconds. For searching more or for listening to the signal push the MENU(NEXT) button to activate the manual tuning. The MODE button then returns back to the automatic tuning (see section XII).

The automatic tuning function is designed specifically for security officers who provide permanent physical spectrum supervision. For better uninterrupted reception use external earphones.

XV. Setting of system parameters

- a) Set the SCAN mode
- b) Push the MENU(NEXT) button for several seconds
- c) Select: - (DOWN) "Settings"
- c1) Selection + (UP) "Setup SCAN", SCANr=off or SCANr (see section XI)
Selection - (DOWN) "Alarm time", buttons UP or DOWN change the pre-alarm period (time to start ALARM). Possible choices: 1, 5, 10, 20, 30, 40, 60 minutes



- c2) Selection - (DOWN) "Bus ID", buttons UP or DOWN change the ID for communication within the QM-4000 system (see section XVI)

XVI. The QM-4000 system

Manually set the ID for communication on the QM-4000 bus (see XV.c2). The QM-4000 system can take control over the connected MRA-3Q only if the MRA-3Q is in the "SCAN" or "Autom.tuning" modes. If the device is connected to the bus the QM-4000 changes the SCANr mode to SCAN because all audio records in the system must be controlled from master PC. Reactivation of the SCANr mode is possible after disconnecting of the bus and restarting MRA-3Q (power OFF/ON). The LCD of MRA-3Q is displaying the main functions or a "REMOTE" message in other sub-functions. Local alarm indicating on the MRA-3Q remain unchanged and the MRA-3Q can also be locally controlled. All background and new signal changes are displayed on the master PC and recorded in a history file. When the MRA-3Q is disconnected from the bus it continues its function with the latest system parameters.

XVII. Frequently received signals and their characteristic

- a) broadcast and TV sound – clear sound like TV or FM reception
- b) TV carrier – 50Hz noise, sharper on both sides from the maximum
- c) radio networks and mobile telephones – telephone calls etc.
- d) data transmission, data channel of mobile phones – white noise on the carrier with intermittent breaks and tones
- e) hopping systems, GSM, WiFi – short pulses, random changes of DIST

Dangerous signals:

- f) FM or AM bug in the room – reception of room sounds
- g) scrambled bug – distorted sound from the room
- h) carrier frequency – when tuned the noise disappears – make noise in the room and listen to any response
- i) digital signal – noise little different than the normal noise of MRA-3Q. For other signs see d), e)
- j) spread spectrum – signal intensity increases, but the noise is still the same like without any signal

If signals like f) or g) are received it is sure that the bug is installed in the checked area. In cases h), i), j) the signal source test has to be done to find if the signal is originated in the checked room or incoming from outside. For localisation of the signal source disconnect the power supply adapter and slowly with the MRA-3Q walk around the room. If the strongest signal is near the window and the same frequency is also in the next room then the signal is coming from outside. If any dangerous signal is originated in checked area the real source is producing a very sharp signal maximum. Near the transmitter (bug) when DIST displays a value below 5m, the telescope antenna should be shorten. If the most common bug type f), g) is installed in the room, the sound of acoustic feed-back appears in the loudspeaker. To achieve more legible reception the earphone can be used instead of the built-in loudspeaker.

XVIII. Power and low battery indication

- a) The device is designed for permanent protection and it should be used with external mains power supply
- b) If battery voltage drops below 7V the LCD is warning and displaying BATT!
Charge or change the battery
- c) Battery voltage bellow 6.5V automatically switches off the device
- d) If the switch POWER is ON and the external power is reactivated the MRA-3Q automatically restarts and continues the last function which was selected before the automatic switch off.

Note:

The manufacturer does not bear any responsibility if the device is incorrectly used or connected to non-homologated accessories. In case of permanent protection the correct function of MRA-3Q should be periodically proved by an appropriate test device.

Technical Specification of MRA-3Q, Version 1.2

- Frequency range 36-3600 MHz
- Sensitivity for S/N=10dB 36-1200 MHz 20–40uV, 1200–3600 MHz 40–1000 uV
- Demodulation WBFM, NBFM, AM
- Bandwidth 36-240 MHz 270KHz, 240 – 3600 MHz 400 kHz
- LCD display 2 x 16 character alphanumeric
- S-meter dynamic range 73 dB
- Signal strength measurement 40 level LCD bar
- Distance measurement for 1 mW source 1–50 meters
- Battery backup of background spectrum and new signal memory
- Background memory 512 multifrequency channels
- New (alarm) signal memory 100 re-writable channels
- ID codes against unauthorised use 65536
- Fine tuning +/- 1 multifrequency channel
- Automatic scan cycle duration 8 sec / cycle
- Frequency measurement 36–4000MHz, resolution 0.1MHz
- Optical and acoustic alarm output
- Pre-alarm period one scan cycle 8 sec.
- Alarm delay adjustable 1 – 60 minutes of new signal activity
- Common alarm time information max. 100 hours
- Time information about specific signals: sum, first appearance, last appearance, max. 45 days
- Remote & system audio output 1.4Vpp for SCAN-R or QM-4000
- External audio recorder, period of automatic alarm signal audio sampling 1–60 sec
- System bus RS485, max. 32 devices, bus up to 1200 m
- Adjustable audio output, internal loudspeaker, external earphone
- Power 9V, internal NiCd accumulator or 6F22 battery
- Current consumption SCAN 34mA, OFF below 2uA
- Low battery indicator below 7V, automatic switch off below 6.5 V
- External power & charging 12 – 25V DC, automatic re-start after power drop out
- Built-in telescopic antenna
- Size 136 x 49 x 137 mm
- Weight 620 g incl. battery
- Device attests: EN 50131-1, EN 50130-4, EN 55022, EN 50130-5