



RESEARCH AND PRODUCTION COMPANY "RADIO-SERVICE" JSC

Approved

CEO

JSC Radio-Service

V. O. Shchekaturov

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RF Marker Locator
STALKER
PM-2

Operation Manual

RAPM.464419.001 OM

The Operation Manual describes components and the operating principle of the RF marker locator PM-2 (hereinafter refer to as the locator) and contains information relevant for proper operation, safety and verification procedure.

Operating conditions:

- Operating range: -20 °C up to 55 °C;
- Operating humidity: 90% RH at 30 °C max
- atmospheric pressure of 60 to 106,7 kPa (460 to 800 mm Hg)

The protective grade of the casing is IP54 according to GOST14254

In terms of electromagnetic compatibility, locator comply with requirements of GOST R 52459.32-2009 and GOST 32134.1-2013.

Due to permanent upgrade of locator, design changes improving their reliability and operation conditions, the items produced and the design described in this Operation Manual may differ to some extent.



Warning! Please read the Operation Manual before switching on the marker locator.

1 Description and Operation

1.1 The locator is intended for locating the passive electronic markers of buried utilities. Locator provides depth readings and may be connected with GPS / GLONASS module which allows transferring recorded data and coordinates to PC.

1.2 Main specifications

1.2.1 Main specifications are given in Table 1.2.1.

Table 1.2.1 – Main specifications

1 Compatible Markers				
type	Indication		color	Operating frequency
	Search mode	Scan mode		
General water	<i>Gen. purp.</i>	<i>Gen. purp.</i>	purple	66,35 kHz
Cable TV	<i>CATV</i>	<i>CATV</i>	black / orange	77 kHz
Gas	<i>Gas</i>	<i>Gas</i>	yellow	83 kHz
FOC	<i>FOC</i>	<i>FOC</i>	yellow / black	92 kHz
Telephone	<i>Telecom</i>	<i>Tel.</i>	orange	101.4 kHz
Sanitary	<i>Sanitary</i>	<i>Sanitary</i>	green	121.6 kHz
Power EU	<i>Power EU</i>	<i>Power EU</i>	red / blue	134.0 kHz
Water	<i>Water</i>	<i>Water</i>	blue	145.7 kHz
Power	<i>Power</i>	<i>Power</i>	red	169.8 kHz
2 Common depth of the buried utility electronic markers (<i>subject to placing in accordance with a manufacturer's instructions</i>)		Near-surface:	20 mm (0,8')	0,6 m
		Ball marker:	114 mm (4,5')	1,5 m
			104 mm (4,1')	1,5 m
			138 mm (5,4')	1,8 m
		Disk marker:	133 mm (5,2')	1,5 m
			213 mm (8,4')	1,8 m
		Full-range:	380 mm (15')	2,5 m
	225 mm (8,9')	2,3 m		
3 Depth measurements accuracy			±(15%+5 cm)	
4 Minimum continuous operation time with fully charged storage battery, at the temperature range of +15 °C up to 25 °C , hours			4	
5 Maximum dimensions, mm			700×300×140	
6 Maximum weight, kg			2,0	

1.2.2 The locator provides for step-by-step regulation of the input signal's amplification with a 6 dB step (each step doubles the amplification)

1.2.3 The power supply voltage range is 15 to 9.5V. The power supply is provided with a nickel metal hydride (Ni-Mh) storage battery of 6 V rated voltage and 2000 mA/h capacity, or with eight replaceable AA batteries placed in a battery compartment.

1.2.4 The locator ensures indication of the battery charge level and auto off to avoid overdischarge.

1.2.5 The locator provides battery charging and overcharge protection provided the power unit connection

1.2.6 Life time is at least 6 years.

1.3 The delivery set is given in Table 1.3.

Table 1.3 – Delivery set

Item	Quantity
Marker locator STALKER PM-2	1
Power unit (12 V/1 A)	1
4*AA battery compartment	2
Operation Manual	1
Carry bag	1
Sun-protective cover	1
Package	1
Headphones	Shipped separately.

1.4 Design and operation

1.4.1 Locator appearance is shown in Figure 1.4 a.

Figure 1.4 a – Locator appearance.

On the figure: 1 – power unit jack, $\oplus \ominus$; 2 – headphones jack 6,3 mm; 3 – power compartment cover; 4 – receiving antenna unit

To make it easy to handle the locator in sunny weather, a sun-protective cover may be installed. The cover is attached with two sticker bands to the locator handle. A base block with a cover installed is shown in the figure.



1.4.2 The front panel is shown in the Figure 1.4 b.

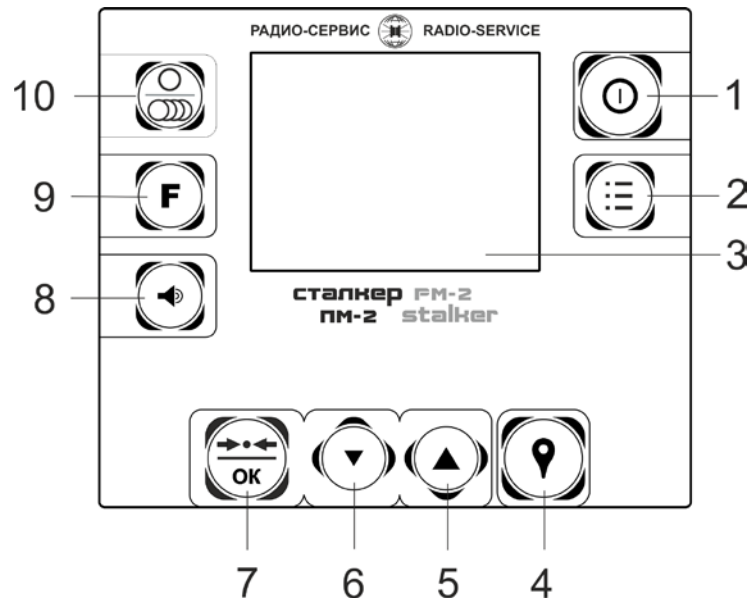








Figure 1.4 b – Front panel:

- 1 –  is on / off key;
- 2 –  – is key to enter or exit the MENU;
- 3 – LCD;
- 4 –  is key to record the displayed parameters and GPS coordinates for following transfer to PC;
- 5, 6 – keys to increase or decrease signal gain and to move up and down in the MENU list.
- 7 –  is key to set up the optimal gain for a given signal and to enable/disable the selected item in the MENU;
- 8 – Volume key;
- 9 –  is key to switch the marker type mode;
- 10 –  is key to switch the scanner mode or the single type marker search mode.

1.4.3 Operation principle of the marker locator

The transmitting antenna of the locator emits electromagnetic field pulses at the operating frequency of certain types of markers. These pulses excite the marker RLC and it generates magnetic field, which is received by receiving antenna of the locator and amplified and processed with a digital signaling processor. After that levels of these signals are displayed on the screen as linear scales and digital values in "dB". Readings of scales on the screen may be duplicated with an audio signal.

2 Intended Use

2.1 Preliminary Procedures

Take the locator from the bag and verify serviceability of protective covers, fasteners, absence of mechanical damages on the receiver body and on the power unit.

If the locator was exposed to a temperature differing from the operating one, first it shall be held under the operating temperature for 30 minutes.

2.2 Charging the Storage Battery

The locator is powered by two nickel metal hydride storage batteries “5H-AA2000B-1” of 2000 mA/h rated capacity with inner temperature sensor.

Note. Before changing make sure that storage batteries rather than non-rechargeable batteries are in the battery compartment. Ignoring this rule may lead to damage of the locator

Note. A storage battery is charged at an ambient air temperature of plus 10 to plus 30 °C. Failure to follow this instruction may reduce the storage battery life.

A state of storage battery charge is shown on the display with a miniature battery icon.

To charge the storage battery, connect the plug of the power unit from the delivery set to the instrument jack. Plug in the power unit to the 220 V mains. Charging progress is shown by filling of a miniature battery on the display. After charging is finished, a miniature battery is full.

Charging a dead storage battery requires 6 - 8 hours.

If the instrument has not been in use for a long time, recharging a storage battery every three months is recommended.




3 Operation




To power the locator on/off, press  key. When the locator has powered on, it switches the last operation mode.

The battery level is shown by miniature battery in the upper left corner of the display. The level of supply voltage is proportional to the level of the miniature battery fullness. When the voltage supply is lower than 9 V, the message “Storage battery discharged” appears on the LCD and the locator switches off automatically. Charge the storage battery in accordance with p. 2.2 or replace non-rechargeable batteries in battery compartment in accordance with p. 5.3.

3.1 Menu

Press  key to enter or exit the main menu (Figure 3.1a). Once entered, the menu

is navigated using   keys. To edit selected menu item (selected item has an inverse color) and to confirm the action, press the  key.

In “Set of markers” submenu (Figure 3.1a) you may add or exclude marker types available for search. The added marker types are marked with «» and may be selected in search mode by pressing  key. To add or delete the marker from your set, select the item and press  key.

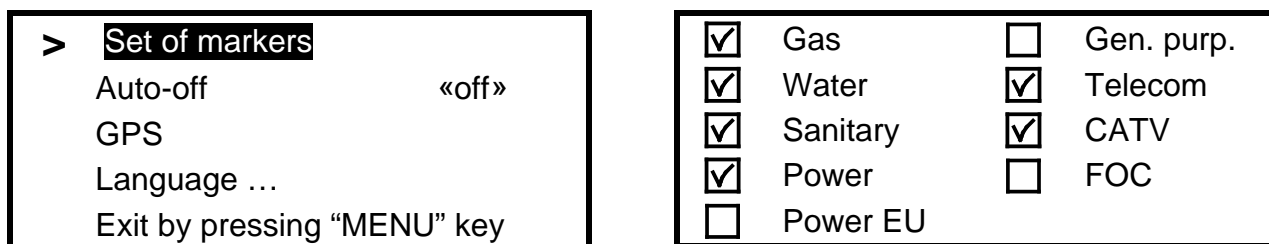


Figure 3.1a – “Set of markers” submenu

In “**Auto-off**” sub menu you may set the auto-off time after the last button pressed (Figure 3.1b). The auto-off time may be set in range of 10 to 90 minutes in 10 minute increments. The auto-off time is 30 minutes by default.

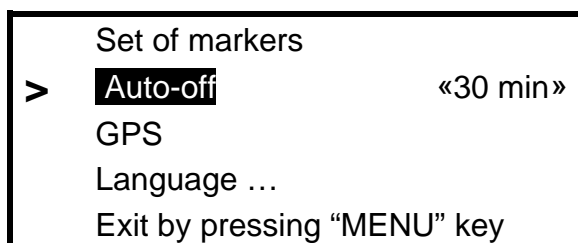


Figure 3.1b – Setting auto-off time

In the «**GPS**» submenu (available only in search mode) you may establish a connection to GPS “Bluetooth” unit or to PC, configure operations with GPS unit or edit the log of tracks saved in the locator memory.

Detailed description is given in p. 4.

In the «**Language**» submenu (Figure 3.1c) you may select the language

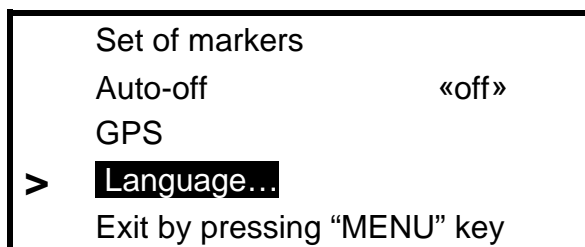


Figure 3.1r – Language submenu

3.2 - Locating RF Markers and Measuring their Depth

Note. All methods of RF Markers locating are based on analysis of relative variations in signal values and require certain practical skills from the operator.

3.2.1 Single Type Marker Search Mode (Search Mode) and Depth Measurement

The view of the search mode with simultaneous depth measurement is shown in the Figure 3.2a.

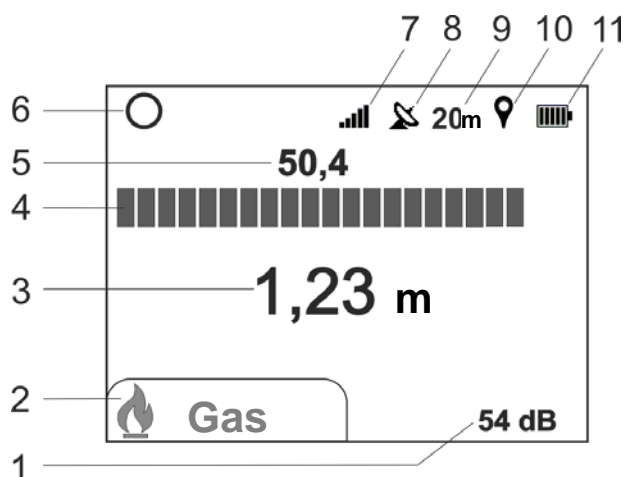










Figure 3.2a – search mode:

- 1 – amplification;
- 2 – marker type;
- 3 – depth of the marker;
- 4 – scale of input signal from marker
- 5 – level of the input signal in «dB» (changes its color to red when overloaded)
- 6 – icon of the single type marker search mode;
- 7 – volume indicator;
- 8 – icons of the state of connection to the GPS module, «» or «» (p. 4.1);
- 9 – distance covered (p. 4.3).
- 10– icon of recording to track " ", displayed during recording (p. 4.2);
- 11 – icon of power unit voltage level;

Switch the search mode «O» by pressing  key and select the desired marker type by pressing  key.

Hold the locator vertical. Set the amplification to make 1/3 of the scale illuminate using   keys. Then walk over the territory with expected marker at low speed, moving the locator from side to side. When locating marker in unknown territory, walk according to a spiral-like pattern, with a pitch of no more 1 m.

When the marker is located, the scale and the level of input signal increase as well as the volume and tone of sound change (Figure 3.2b). Upon approaching the marker, the signal level will be growing and will lead to overload of scale. To avoid that, set the amplification to make 3/4 of the scale illuminate by pressing   key. The marker locator has an option of amplification autsetting. Press  key anytime you want to set the amplification to make only 3/4 of the scale illuminate.

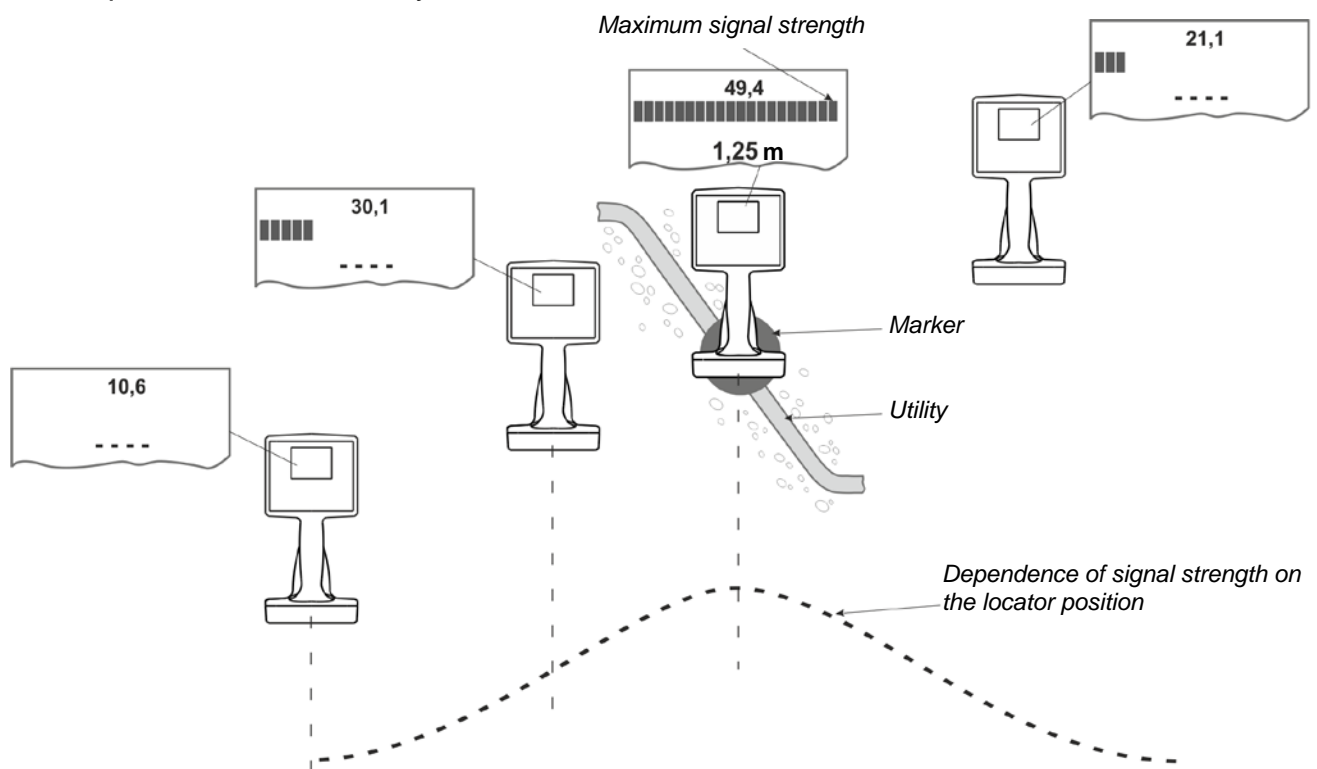


Figure 3.2b – Dependence of signal strength on the locator position

To specify the marker position, move the locator in all directions. When the locator is directly above the marker, the input signal level is maximum. Shifting the locator away from the marker leads to reducing signal.

Note. Search signal of the locator can be received and reflected in a less degree by markers of another type. When the marker of another type is located closer to the surface than the target marker, its signals may not differ from the signals of the target one. Therefore when operating on the territory with different types of markers,

it is recommended to check the input signal at other frequencies (by switching marker type mode) or switch the scan mode (item 3.2.2).

To measure the depth of the marker, hold the locator directly above the marker for not less than 3 seconds (Figure 3.2c). Depth readings are displayed automatically. Only depth readings of green color may be considered accurate. Depth readings of red color mean that input signal level is not high enough for correct depth measurement. If the input signal is too low, the indicator « - - - » appears instead. It means that marker depth is too high or the locator is at the considerable distance from the marker.

Attention! The depth value is found from the bottom edge of the receiver to the marker's centre.

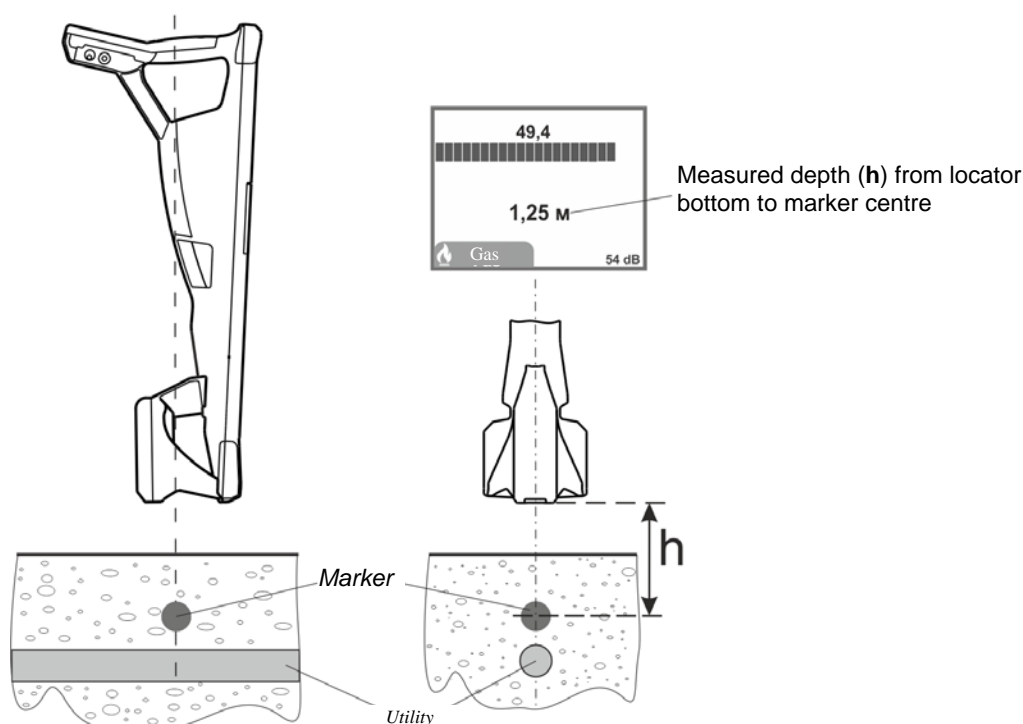


Figure 3.2c – Depth measurement

Note. Upon moving the locator away from the marker for a short distance the reading of marker depth is increasing. Thus, only the minimum depth value may be considered reliable.

Error in depth measurements may be caused by magnetic field distortion from the neighboring markers and close metal subjects.

Accuracy of the measured depth may be verified, if it does not exceed the limit for certain type of marker, by raising the locator to the high of 0.2 m. The reading shall increase to the height value.

3.2.2 Locating several markers at the same time (scan mode)

The marker locator is able to determine the presence and expected location of up to 4 marker types. View of scan mode is given in Figure 3.2d.

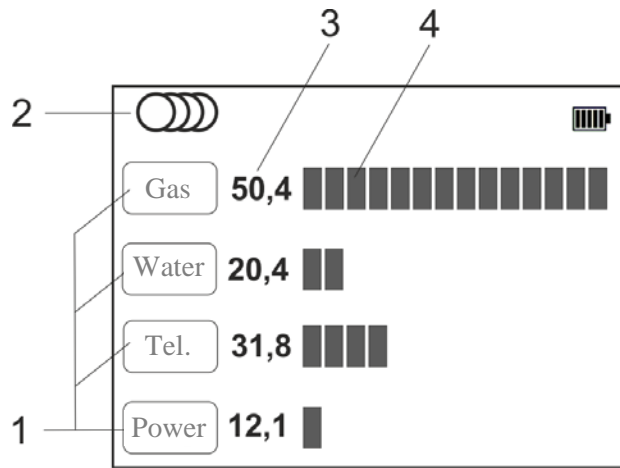






Figure 3.2d – Scan mode view:

- 1 – marker type;
- 2 – scan mode indicator;
- 3 – level of input signal from markers in dB;
- 4 – scale of the input signal from marker

Switch the scan mode «  » by pressing  key. In the “Set of markers” (p. 3.1) submenu select up to 4 marker types, which presence and location you desire to determine.

Set the amplification to make 1/3 of any scale illuminate by   keys. Then walk over the territory with expected markers at low speed, moving the locator from side to side

When the locator appears in the coverage area of any markers, the scale and input signal level of that marker increase, as it shown in the Figure 3.2d.

Then specify the location and depth of certain type of marks by switching the search mode and continue as described in p. 3.2.1.

Note. *With active scan mode the scale respond on the changing position of the locator is more abrupt and slow. It also less sensitive to markers on the high depth, which may be considered as disadvantage of scan mode comparing with the search mode.*

4 Saving Results, Use of GPS

The locator enables saving readings in a non-volatile memory, including references to the coordinates received from an external GPS/GLONAS module. Communication with an external GPS "Bluetooth" module (versions 2.0, 2.1 or 3.0) is effected via Bluetooth connection.

The coordinate accuracy depends on many factors, including quantity of available satellites, satellites location, presence of reflected signals, influence of ionosphere, satellite clock error, specifications of GPS/GLONASS module, etc.

Attention! *The locator has been tested with GPS «Bluetooth» modules Holux*



M1000, GPS/GLONASS Holux 3000. Proper operation of the locator with other GPS "Bluetooth" modules is not guaranteed.

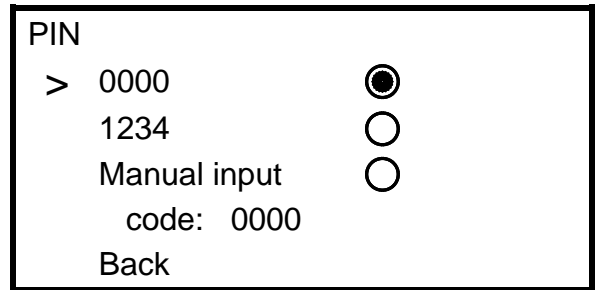
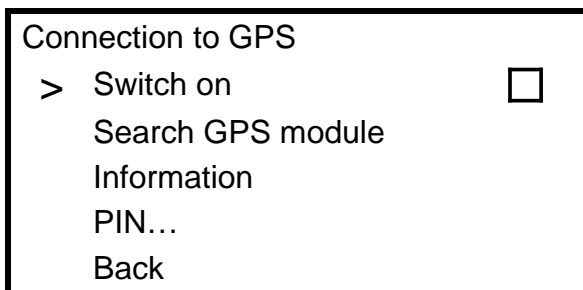
Using other GPS receivers enabling coordinate transmission via Bluetooth and, for example, having high accuracy characteristics, make sure that the GPS receiver send the data in NMEA-0183 RMC and GGA formats with refresh rate of 1 second.




4.1 Settings for Operation with a GPS Module

A GPS module shall be placed immediately next to the receiver, for example, in a pocket of a sun-protective cover.

To connect the locator to GPS module, at the first connection select «GPS» > «Connection GPS» > «PIN» in the main menu.

Set PIN code of GPS module. Most frequently it is "0000" or "1234". If the code differs and includes a random combination of four figures, enter the code using   keys.



Then in the main menu of the locator, select "GPS" > "Connection to GPS" > "Search GPS module". After the search is finished, select the GPS module from the list of identified devices using   keys. Confirm the selection by pressing  key. Name and address of the GPS module, number of available satellites, coordinates and times it finds are available in "Menu" > "GPS" > "Connection to GPS" > "Information",









Status of connection to the GPS module is indicated with "" or "" icons (item 8 in Figure 3.2a).

Table 4.1 – Status to connection the GPS module

Icon	Description
- none	No connection to the GPS module
 yellow	Connecting to the GPS module 1 minute max.
 yellow	Connection to the GPS module is established but there are no GPS coordinates (cold start of the GPS module, bad conditions of GPS signals reception)


 green	Connection to the GPS module is established, receiving the coordinates...
 red	Connection to the GPS module is lost


Further the locator will connect to the GPS module automatically by pressing  key and selecting the track for record or by selecting «GPS» > «Connection to GPS» > «Switch on» in the main menu.

Note. Cold start (for example, switching on for the first time after being not used for a long time), depending on the GPS module model and number of available satellites, may reach 20 minutes. In this case '  ' icon on the display is yellow. Next hot starts will take several seconds.



4.2 Recording tracks


Attention! Track record is only available in search mode. This option is unavailable with scan mode on.

To record the information on the input signal level and marker depth, press the  key holding the locator above the marker.

The first pressing of the  key after the locator is switched on opens submenu «Menu» > «Save track as», where one should specify whether to create a new track (“New”) or to continue recording in the existing track (“Continue in”). When selection is done, the locator establishes connection to the GPS module, which has already been connected before (p. 4.1).

Save track as
> New
Continue in ...
Cancel
Back

Next pressing of the  key will record the data in selected track. At the moment of record, the  icon shortly appears on the display (item 10 in the Figure 3.2a). The icon is green if the point saved in the track contains GPS coordinates and red if no reference to coordinates has been saved

To create points marked specifically, for example, for marking pipeline branches or cable coupling boxes, press and hold the  for 2 seconds (a long sound will follow). When browsing the saved data in "Stalker-terminal" software, this point in "Mark" column will be marked with the " ! ".

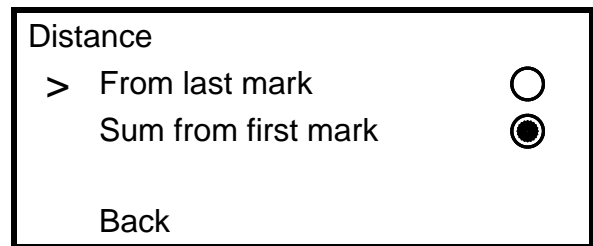
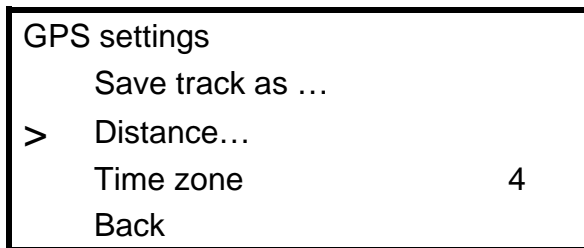
4.3 Distance

Basing on coordinates received from the external GPS module, the locator calculates and displays the distance covered on the display (item 9 on Figure 3.2a):

- as the distance of the straight line from the last point marked by pressing "📍" button to the current location;

- as a sum of distances between points marked with "📍" button, starting from the first point, plus the distance from the last point to the current location. It allows displaying the distance covered not only for straight lines but also for parts consisting of broken lines. To make it, press "📍" button each time the direction of movement is changed.

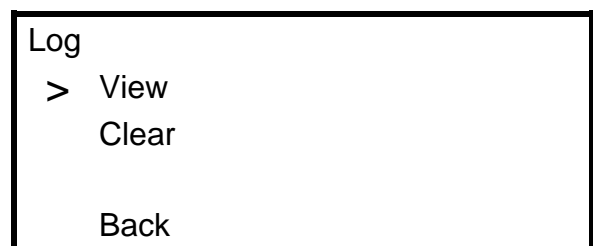
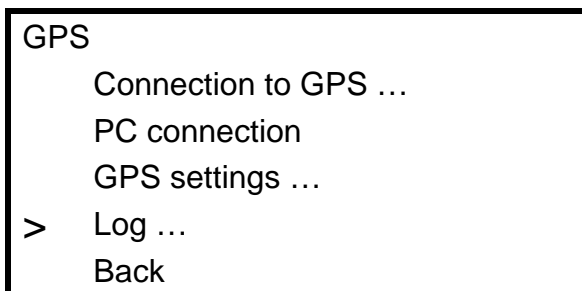
Any option is selected via "Menu" > "GPS"> "GPS settings" > "Distance".






The distance value is not saved in the non-volatile memory and is deleted as the locator is switched on.

4.4 Log

List of tracks saved in the receiver memory may be browsed via "Menu" > "GPS" > "Log" > "View"



Every track has information on its number, date and time of the first saved point (optional) and total number of points per track. To select track use   keys, to delete a track press the  key.

4.5 Track transfer to PC

The locator enables transfer the data to PC via wireless connection. The locator is compatible with PCs running with Microsoft Windows (Vista, 7,8,10). The PC shall be fitted with a Bluetooth device, or an external Bluetooth-USB adapter shall be used.

Note. The computer shall be located within the sight at a distance of not more than 8 meters from the locator.

Reception and transmission of data is performed by operating system tools of a computer. Data are transmitted from the locator memory and saved in PC as files containing tracks

To facilitate handling the data, you may use the special "Stalker-terminal" software (version not less than 1.15). It allows transferring the data stored by locator, saving track in PC memory, editing tracks, etc. To get more information about "Stalker-terminal" or/and to download it visit company's site www.radio-service.ru/en, section "Stalker cable and pipe locating complex"

To transmit the data to the computer:

- run "Stalker-terminal" on PC;
- on the locator , establish the connection to PC: "Menu" > "GPS" > "PC connection";
- To read the track form locator, select "Load track from locator" in "Stalker-terminal".

Select track in the window appeared and click "OK". Wait till track reading is finished.

The software allows applying track on maps of "Yandex. Maps" and "OpenStreetMap". It requires internet connection. If the Internet is accessed via a proxy server, set its parameters in "Stalker-terminal" settings. If connection to the Internet is not available, the map will not be displayed but the software will work in all other aspects.

5 Potential Failures and Troubleshooting

Potential failures and troubleshooting procedure are provided in Table 5.

Table 5 – Possible failures and troubleshooting procedures

Failure symptoms	Probable cause	Troubleshooting procedure
The locator does not switch on or switches off spontaneously	The storage battery is discharged or failed	Charge or replace the storage battery or install the batteries
The storage battery is not charging, the locator does not respond to the connection of the power supply unit	Power supply or storage batter failure	Check the power supply unit and restore the storage battery if needed
	The storage battery is fully discharged	Charge the locator at least for 4 hours
No sound can be heard in headphones, though the locator speaker operates normally.	No contact in headphones connector	Replace the headphone jack
	Headphones failure	Replace or repair the headphones
Error of depth measuring exceeds the limit.	Parameter drift of the measurement duct	Setting by the manufacturer is required

6 Maintenance and Repair

6.1 Maintenance includes compliance with the rules of storage battery operation, storage, charging, regular checks and troubleshooting.

6.2 Repair of the locator is only allowed at the manufacturer's site or in special repair agencies.

6.3 Replacement of storage batteries or non-rechargeable batteries.

Proceed as follows to replace power components:

- take storage battery cover screws out and remove the cover;
- Remove the first storage battery (battery compartment), unplug the storage battery lead. Then remove the second one.
- replace the storage batteries or non-rechargeable batteries;
- plug the battery lead into the battery connector and install the first storage battery, then the second one. Put an insulations gasket between storage batteries;
- Put the buttery cover and tighten buttery cover screws;
- Charge storage batteries.

7 Transportation and Storage

The locator packed in a standard package allows transportation by all transport means, excluding unpressurized and unheated aircraft compartments.

Transportation conditions:

- ambient air temperature of plus 50 to plus 70 °C;
- relative humidity of 95 % at the temperature of plus 30°C;
- transportation vibration up to 120 impacts per minute with 30 m/s² acceleration, for not longer than 1 hour;
- atmospheric pressure of 60 to 106.7 kPa (460 to 800 mm Hg).

8 Utilization

The utilization shall be performed by an operating organization in compliance with standards and rules applicable in the country.

The locator does not include any environmentally hazardous elements.

9 Acceptance Certificate

RF Marker Locator PM-2 № _____
Reg. No.

complies with factory specifications and has been found fit for operation.

QCD HEAD

Stamp here

Personal signature

Full name

date

10 Manufacturer's Warranty

The manufacturer guarantees that the locator meets the specification requirements provided that operation, transportation and storage rules are observed.

The guaranteed service life of locator is 18 months from the date of manufacture or date of sale (if a note on sale is available), but not more than 24 months from the date of manufacture.

The guaranteed service life is prolonged through the period from claim presentation till elimination of failures.

The guaranteed service does not cover the storage battery.

Manufacturer's details:

268, Pushkinskaya street, 426000 Izhevsk, Russia, Radio-Service, JSC

Phone. (3412) 43-91-44. Fax. (3412) 43-92-63.

E-mail: office@radio-service.ru Website: www.radio-service.ru

To be filled in by the seller:

Date of sale _____

Seller _____

Seller's address _____

Seller's phone _____

Stamp here

11 9 In-Service Transfer Record

11.1 The in-service transfer record is given in Table 11.1.

Table 11.1 – in-service transfer record

Date of installation	Place of installation	Date of removal	Operating time		Cause of removal	Signature of person in charge of installation (removal)
			Since the beginning of operation	Since the last repair		

11.2 Data on acceptance and handover is given in Table 11.2.

Table 11.2 – Data on acceptance and handover

Date	Instrument status	Base (document title, number and date)	Enterprise, position and signature of person in charge of		Note
			handover	acceptance	

