MV Beacon

- User Manual

User Manual

Introduction

MV Beacon is a device used to send SMS messages about emergency conditions from external sensors and short circuit indicators in medium and low voltage substations. Easy to install and especially popular with transmission network operators. MV Beacon is designed to monitor the electrical condition of airline lines, short-circuit measurement in airline cables, and also has a long service life – battery life is up to 8 years.

The MV Beacon can be used together with the WCC200 data collection device as a central router for receiving SMS messages and a protocol converter to industrial protocols (IEC 60870-5-101, IEC 60870-5-103, IEC 60870-5-104, SNMP, Modbus RTU/ ASCII, Modbus TCP). Using WCC200 routers, the customer can easily integrate up to 256 units. MV Beacon to SCADA system.

General product information
MV Beacon is designed for monitoring four discrete digital inputs and sending their status via SMS messages.

In order to ensure a long operating time, the device goes into sleep mode and wakes up from a discrete input signal change or from a periodic check (Heartbeat). After each SMS message sent, the device switches to Standby mode, where it waits for new events or configuration SMS messages. In this mode, the MV Beacon stays on for a user-defined time and then returns to sleep mode. Outgoing SMS messages can contain event (EVENT), device name (ID), message counter (CNT), input values (I1-I4), battery voltage level (BAT), signal quality (GSQ), date and time information. Two modifications of MV BEACON are produced:

MV BEACON A is a device powered directly from the 230 VAC mains, with an internal UPS (uninterruptible power supply) with a 2.6 Ah lithium-ion battery. Suitable for operation in substations, in places where monitoring of several discrete signals is required at the same time.
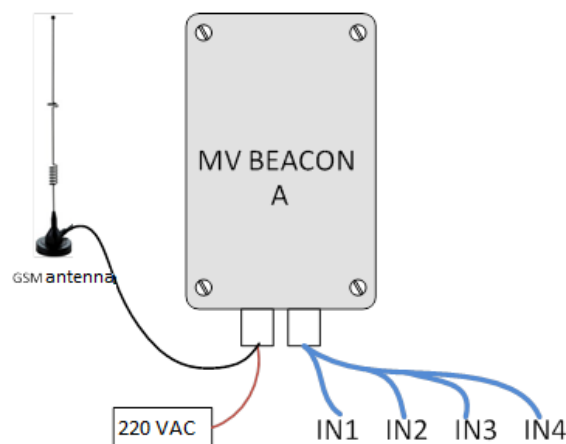
MV BEACON B+ is a device powered by internal 3.6 V, 22 Ah lithium-ion batteries. The signal cable is connected directly to the Linetroll 111k sensor. Suitable for operation in remote areas. Mounted to the line support. The set includes MV BEACON and 5 meters of special cable for connecting the Linetroll 111k sensor.
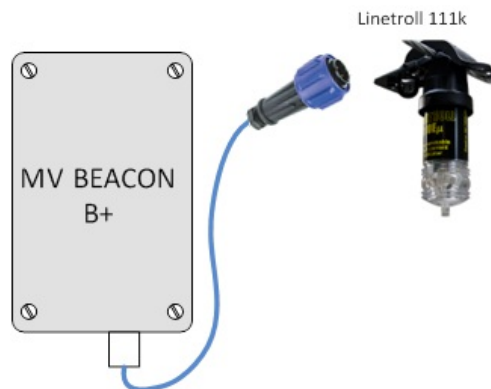
MV BEACON body tightness class IP-64. This means that the device is protected from any impact of dust and water drops in all directions.

Product documentation

- MV BEACON service manual
- MV BEACON operational documentation
- MV BEACON passport

Functions

4 discrete logic inputs
• Power failure message (AC version)
• Active level inversion function for discrete inputs
• Password for configuration and data reading
• Configuration USB interface
• Mobile operator and base station information
• Watchdog function
• IP64 housing tightness class
• GSM signal strength and battery level in each SMS message
• SMS message data reading and configuration in a human-readable format
• Updating the internal MV Beacon program via PC

Operation
When the input signal changes, MV Beacon sends an SMS message to the configured phone number(s). This can be a dispatcher's mobile phone or a SCADA system. After the message is sent, the MV Beacon goes into standby mode.

Specific operating intervals can be set, activity messages include device ID, discrete signal levels, battery voltage level, GSM antenna connection level, date, time information.

MV Beacon is designed to work with:
• Northtroll Linetroll 111k
• Northtroll Cabletroll 2700

Other devices can be connected using relays or optocouplers.

Equipment operation algorithm
1. An "EVENT PO" message is sent when the device is powered on or rebooted.
2. The device goes into standby mode, where it stays for the configured time (see SB (standby));
3. If nothing happens during this time, the device goes into sleep mode;
4. If no configured events occur during the HB or POL intervals (see HB (heartbeat) interval and see POL (polling)), the device wakes up from sleep at the end of any of these intervals. In case of HB, an "EVENT HB" message is sent. In the case of POL, the message is not sent, but a device configuration message is checked from other mobile devices;
5. If the input signal changes while the device is in sleep mode, the device wakes up and sends an "EVENT TG" message;
6. The algorithm is repeated from point 2.

This algorithm is shown in the figure below
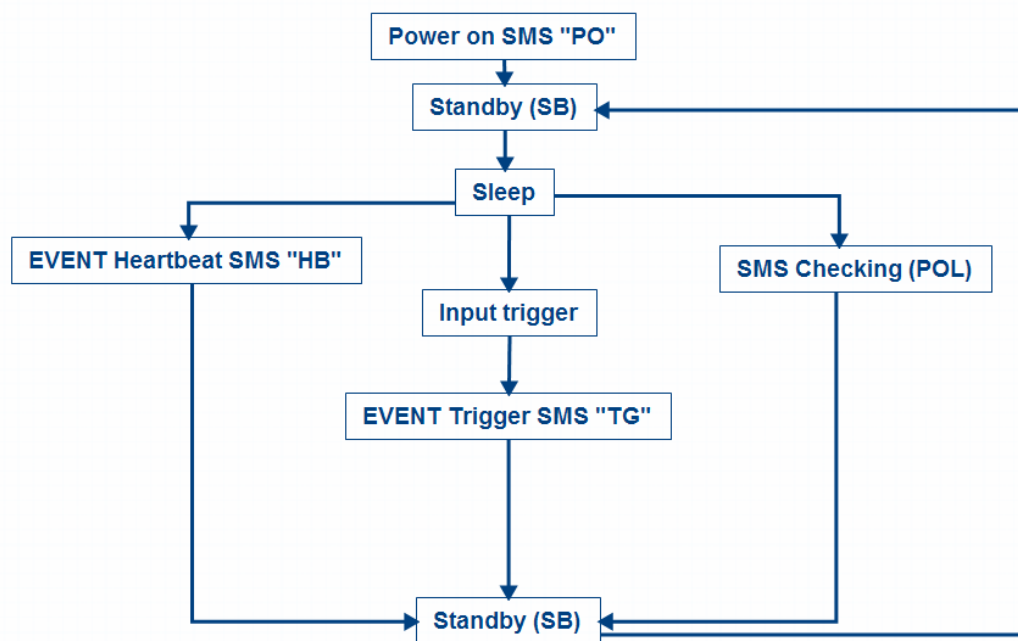
Device discrete input settings

Input triggering is registered after pulses of freely configurable width, but not shorter than 20 ms; shorter pulses wake up the device (for faster registration of the next input) but are ignored.

Each of these can be inverted (see IE1 – IE4). After inversion, the determined input is displayed inversely to its connection – if the contact is shorted, a logical zero is fixed; if the contact is released, a logical unit is displayed. Important: Care must be taken to properly connect the contacts, as the device may send misleading messages about the input signal.

The device has the ability to send messages about short-term and long-term errors. If this function is disabled, the device will only send input states (1 or 0); If this function is enabled, the device can send: 0, 1 (short-term error) or 2 (long-term error). A transient error occurs when an input signal goes to an active level but recovers within a set time (PTD). A permanent error occurs when a transient error does not recover within a set time interval (PTD (permanent/transient delay)), a second EVENT TG SMS message is sent. If the PTD time is zero, long-term error transmission is disabled.

Device time interval settings
Heart-beat interval and Poling interval are calculated in hours. These values can be changed from 1 to 720 hours. Standby time is measured in minutes, so the value can be changed from 1 to 60 minutes. Energy efficiency (device operation time) and the reliability of receiving SMS messages depend on the value of the standby mode – a longer standby mode will be less energy efficient, but will ensure the reception of SMS messages. It is recommended to choose the standby time between 7 and 10 minutes. Heartbeat and Polling intervals are linked to device time (T – Time and D – Date). If the time and date auto-calibration fails, the sending of messages associated with Heartbeat/Polling intervals may also fail. If the connection quality at the installation location is poor, it is suggested to turn off the automatic time update and use the time without daylight saving time.

Setting up SIM cards and phone numbers

All numbers used in the configuration must be active. If the number is not used, "0" is entered instead. The administrator (admin) number is mandatory: if it is not entered, the device is blocked. Numbers can be entered with "+370"; "370" or "8" prefix. The maximum number length is 14.

If the SIM PIN number is enabled on the card, the user must enter this number in the device settings. The device is locked before the last attempt to enter the SIM PIN code.

Device name (ID) and password:
The device ID will be written in each message to identify the device; The length of the ID can be up to 15 characters. The password is used when configuring the device via a USB terminal or SMS messages. Must be 4 characters long. The default password is "ADMV". For greater security, it is strongly recommended that you change this password to a different one.

Security setting:
The device has four different security level settings that limit the processing of SMS messages. Numbers registered in the settings (ADM, P1 and P2) will always receive all SMS messages and will be able to change all settings. Security levels:
• 0 – communicates with all numbers without restrictions.
• 1 – error responses (ERROR) are not sent to unknown (not recorded in the settings) phone numbers. For example, when sending the text "AAAA GET HB", only the numbers saved in the settings will receive the response "ERROR: WRONG PASSWORD"
• 2 – the same as in the 1st security level, but only the registered numbers can set and read the numbers, password, and security level. For example, sending the text "ADMV SET HB=1" from an unknown number will change the corresponding setting and the number will receive a confirmation. However, sending "ADMV SET PASS=1234" will not change the password and the number will not receive confirmation. Saved numbers can change all settings.
• 3 – communicates only with the specified numbers. All other received messages are ignored.

Technical information

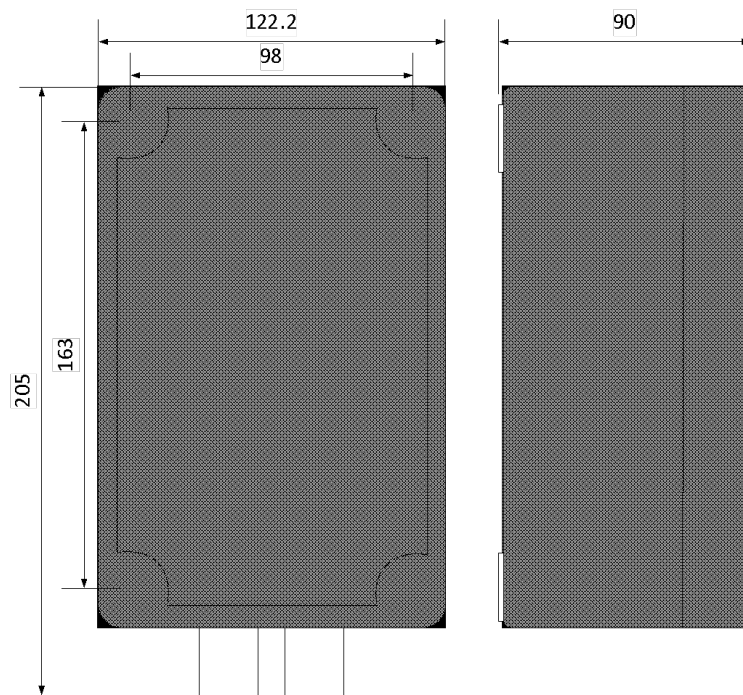| MV Beacon A	MV Beacon B+
Modem	U-blox Sara G350, Swiss made 2,5G GSM/GPRS module
Operating frequencies	Quadband 850/900/1800/1900 MHz
Discreet entrances	4 DI
Configuration link	Mini USB

Sensor connection	Internal terminals	Cable with 4-pin connectors *Buccaneer 400* (IP68 series)
GSM antennas	Internal/external antenna with 3m cable	Internal antenna

Software functions		
Configuration	Via USB or SMS	
Program update	Via USB, copying the file on virtual media	
Number of SMS users	Up to 3 users	

Power supply		
Power supply	External power source 230 VAC, 85-264 VAC, 47-440 Hz and 2.6 Ah Lithium Ion accumulator	3.6 V, 22 Ah Lithium Thionyl Chloride battery
Current used	Up to 130 mA	
Battery/accumulator life	Up to 36 h.	Up to 8 years

Mechanical data		
Measurements	187(H) x 122 (W) x 90 (L), mm	
Body tightness class	IP65	
Body	ABS, gray	
Operating temperature	-35 ÷ +75ºC	
Warranty	2 years	

Preparation for work
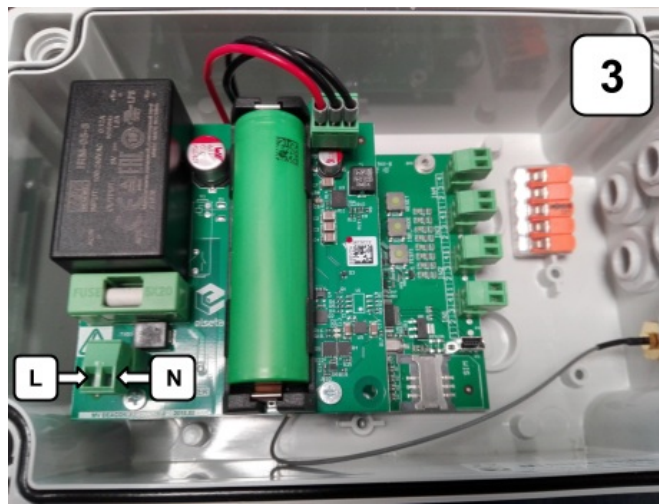**Mounting**
MV Beacon A has two attachment points.
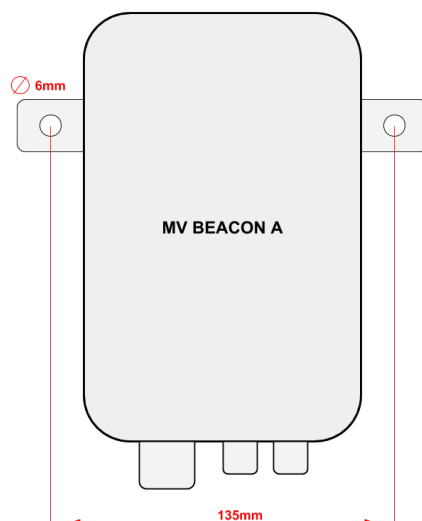
MV Beacon body measurements

Power connection

MV Beacon A Power Connection Instructions:

First, connect the three-wire cable as shown in steps 1-2 of the power connection instructions. Using a 2-wire cable, connect the unit's AC power as shown in step 3 of the connection instructions. Turn on the automatic power switch only when all the work of connecting the device has been completed (SIM card inserted, input cables connected).
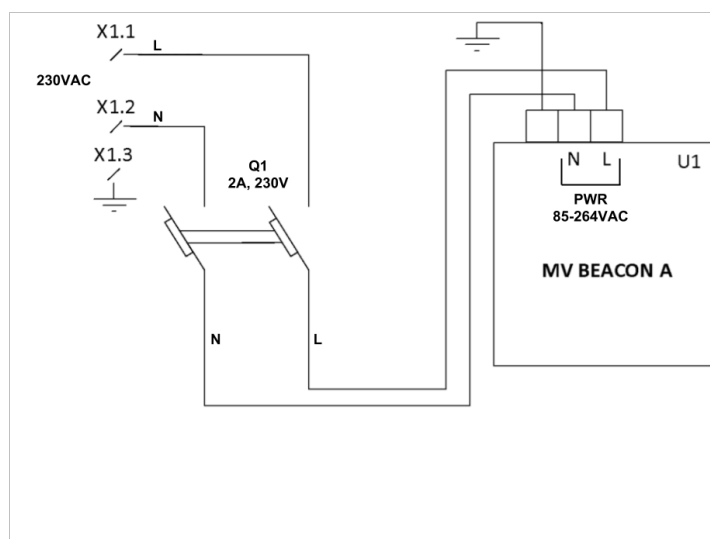
Recommended MV BEACON A power connection diagram

List of components:
X1 terminals
Q1 current automatic switch
U1 MV BEACON A

MV Beacon B+ power pin and battery layout

Antenna connection

MV BEACON B+ comes with an internal GSM antenna. If the GSM signal level is not good enough in the desired area, an external antenna can be used.
MV Beacon A comes with an external GSM antenna. It is suggested to install the GSM antenna taking into account the coverage quality of the mobile operator at the place of installation. Below is a picture showing the antenna connection.
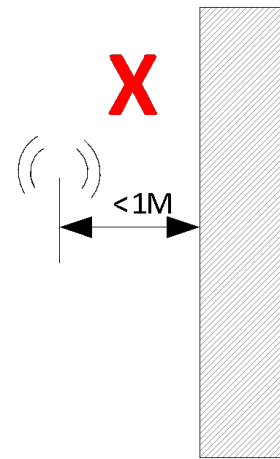

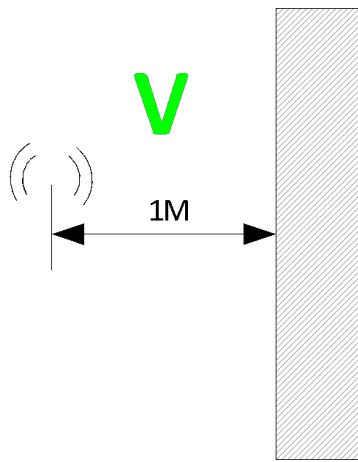A.   B.
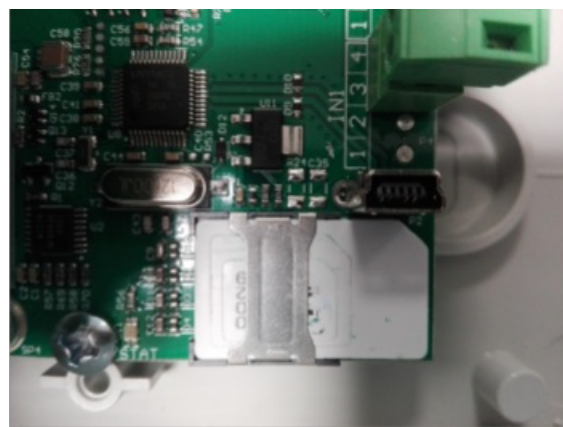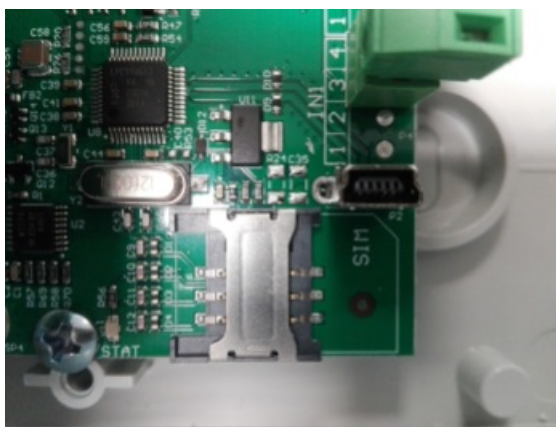
Omnidirectional (non-directional) (A) and directional (B) antennas can be used.
Recommended antenna distance to wall or metal objects:

In case of a weak communication signal, it is recommended to use a directional antenna to ensure the quality of communication transmission.
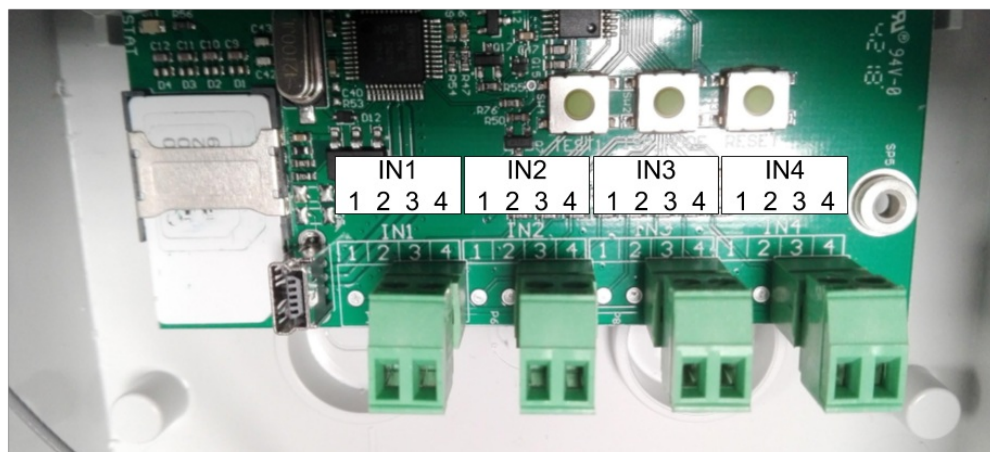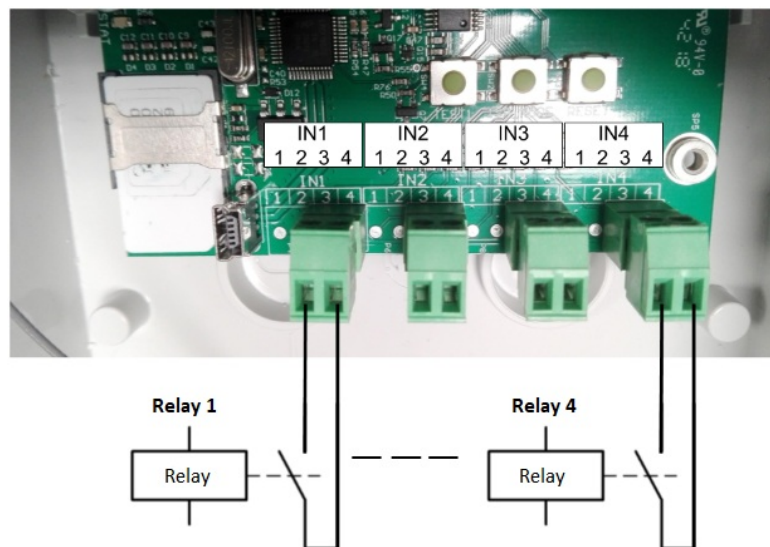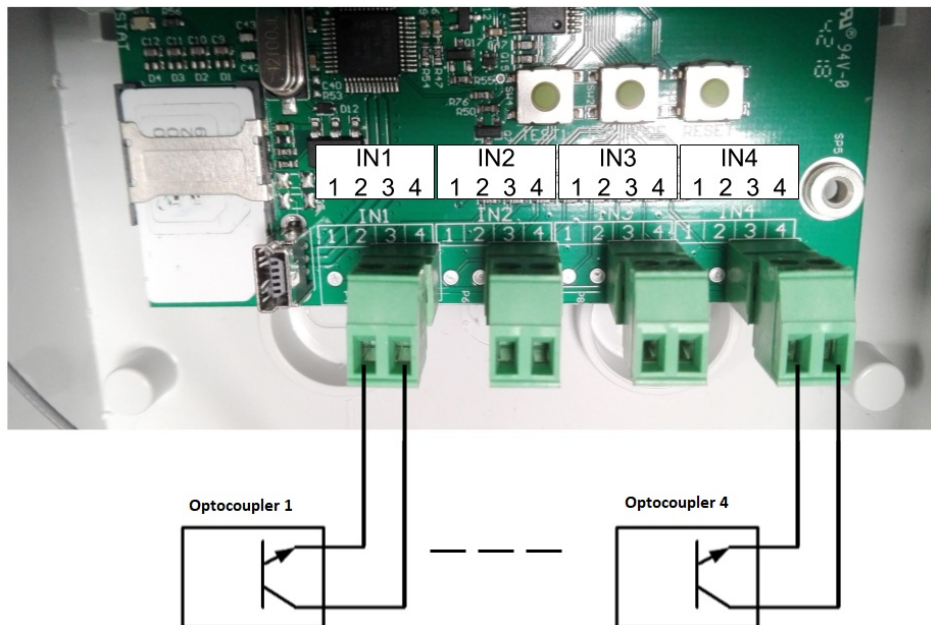
Installation of SIM card

SIM card connection diagram

Connection of external sensors

TEST 1	Button for testing the first discrete input
IN1-IN4	discrete signal activation terminals

Input contacts 3 and 4 are used to connect the input signal. Methods of transmitting external signals to MV BEACON:
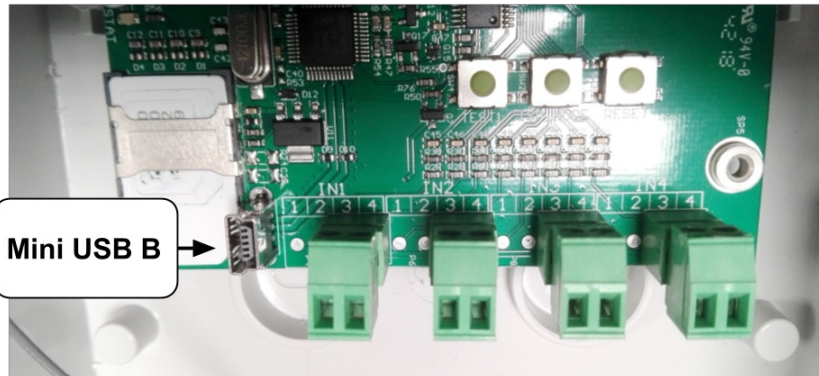
Ground the shields of the signal wires using the terminals shown in the figure below.

Configuration with computer's USB interface

Connecting the configuration cable

MV BEACON configuration works are performed after connecting the equipment to the USB interface of the computer. A Mini USB(B) to USB(A) type cable is used for this purpose:

Mini USB B →

Installing drivers on the computer

Device operation requires drivers. When the device is connected for the first time and the operating system does not find the drivers, a Device driver software was not successfully installed error is possible.
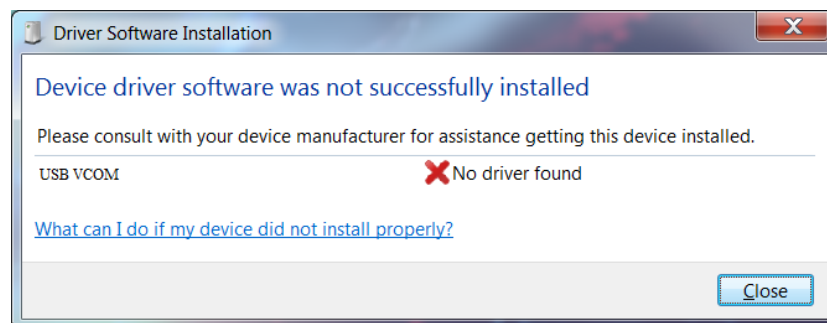
The user must then specify the location of the downloaded drivers on the computer manually:
• Go to Control Panel → Device manager
• Mark the device that failed to install (usually marked with an exclamation mark);
• Choose Update driver software; a selection window should appear:
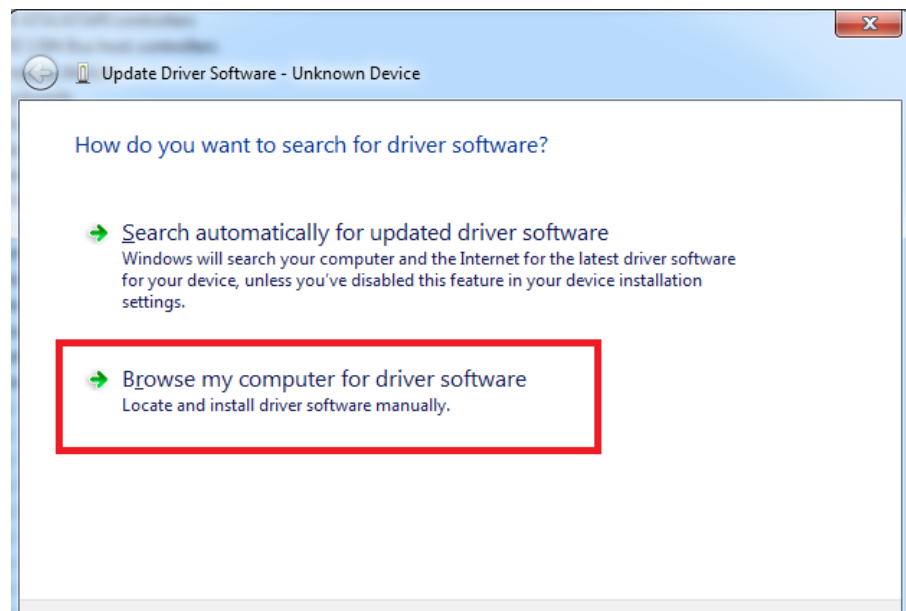
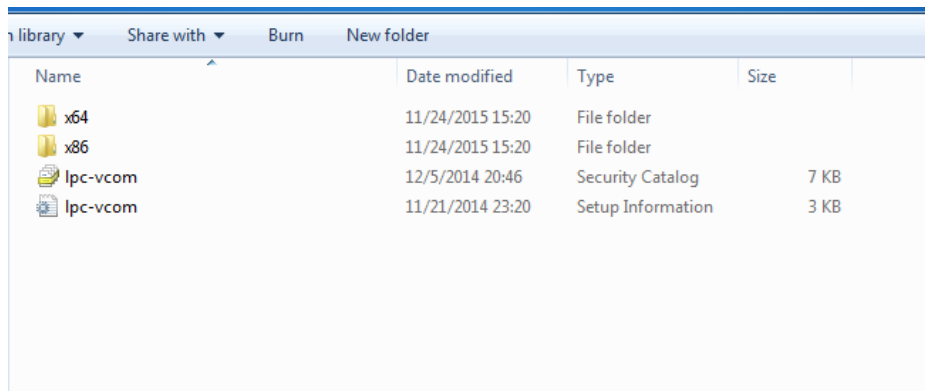- Choose Browse my computer for driver sofware;
- Find and select driver folders - "x86" for a 32-bit processor or "x64" for a 64-bit processor


MV Beacon configuration with PuTTY software

In order to open the configuration menu, the user must connect the device to the USB port, wait for the Virtual COM Port (Virtual COM Port - V-COM) to appear, and connect using a terminal program specifying the port number. The STATUS LED soldered on the board will blink several times when the device is powered on, and will be lit when connected to the terminal.

When the device connects successfully, a password prompt appears in the terminal window. The user enters a 4-character password (default is "ADMV") without pressing the key; if entered correctly, the main menu (Main screen) appears. Password can be entered incorrectly 4 times. Menu control – number keys. If the configuration is done on a Linux operating system, the requirement may not appear due to different management of USB devices. In this case, you should simply enter the configuration password and the device should connect successfully.

The PuTTY home screen is shown in the image below. You need to choose the right port for connection. In the Microsoft Windows operating system, they are usually named COMx, where x is some integer. On a Linux operating system, the port is usually named /dev/ttyx, where x is an appropriate combination of letters and numbers, for example /dev/ttyACM0.
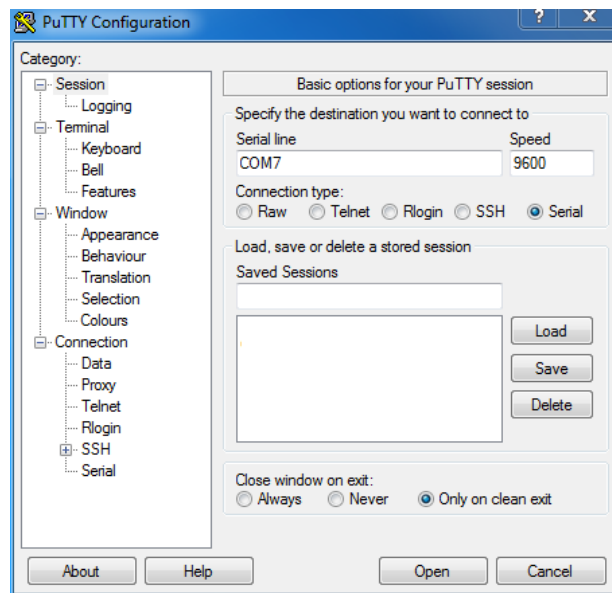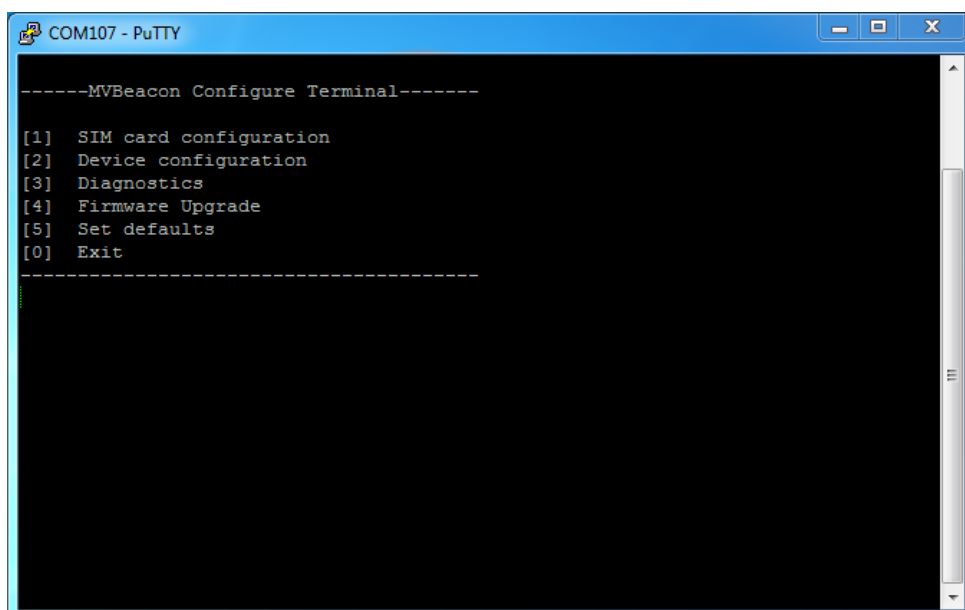
Enter 4-digit password. Default – ADMV:
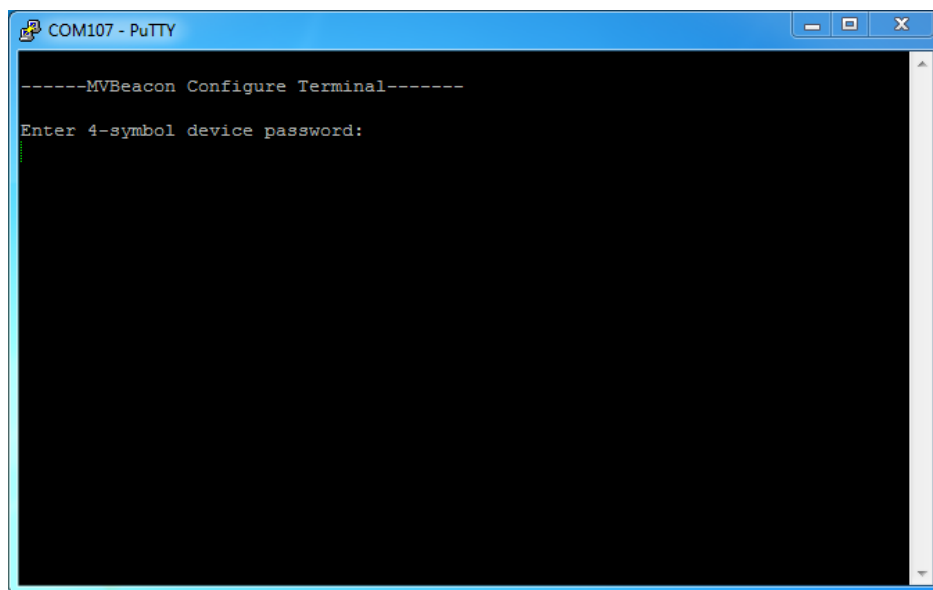
Main menu

After entering the correct password, the main menu will appear:

[1]	SIM card configuration	The SIM card configuration menu is selected. User can edit recipient and administrator numbers, PIN code and security settings
[2]	Device configuration	Device configuration menu. User can edit device settings: Device ID, date and time, work and sleep intervals
[3]	Diagnostics	Device check (diagnostics) menu. This menu shows the current status of the device. When entering this menu for the first time, it is necessary to wait for the device to register to the network
[4]	Firmware Upgrade	Confirmation menu for software update. After confirmation, the device goes into update mode and is initialized as a data carrier. To update the device, the user must delete the existing *firmware.bin* file and upload a new one instead.
[5]	Default Settings	Confirmation menu for resetting to default settings. After confirmation, the device loads the default settings, including the device password
[0]	Exit	Disconnecting USB mode. It is always recommended to exit before disconnecting the device from the USB port

SIM card configuration menu

SIM card configure menu		
[1]	First Recipient number (P1)	P1 recipient phone number configuration menu. "0" - the number is disabled; otherwise, a valid phone number must be used. This phone number is disabled by default.
[2]	Second Recipient number (P2)	P2 recipient phone number configuration menu. "0" - the number is disabled; otherwise, a valid phone number must be used. This phone number is disabled by default.
[3]	Admin number	ADM Administrator phone number configuration menu. "0" - the number is disabled; otherwise, a valid phone number must be used. This phone number is disabled by default. This number is required.
[4]	PIN number	PIN number configuration menu. If the PIN number is disabled on the SIM card, this setting is ignored.
[6]	Security	Security level configuration menu. Security level 0, 1, 2 or 3 can be selected.

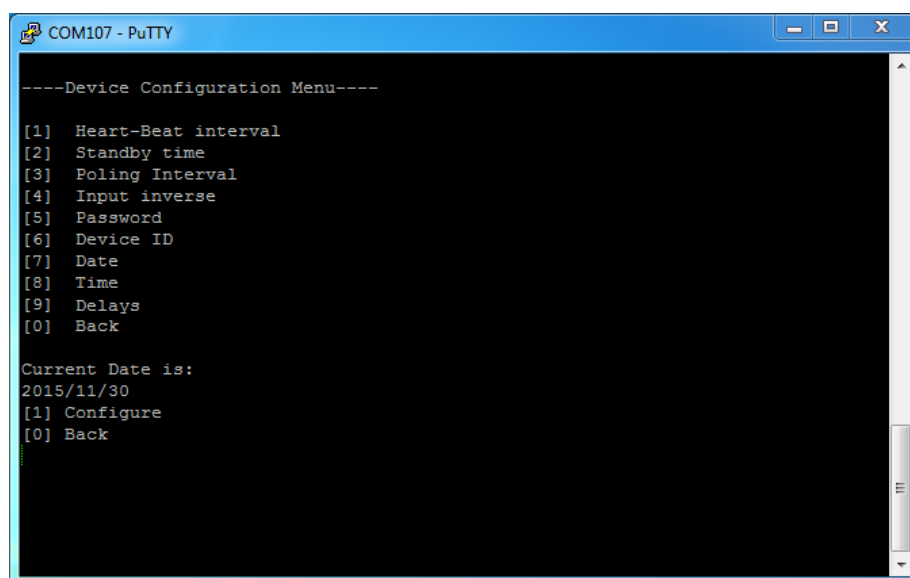| [7]	Access Point Name (APN)	It is allowed to change the name of the connection point.
[8]	Access Point User Name	It is allowed to change the user name of the access point
[9]	Access Point Password	It is allowed to change the access point user password
[0]	Back	Returns to the main menu.

PIN number editing:

1. To configure the PIN number and phone numbers, select "SIM card configuration": in the main menu - press [1];

2. Open the PIN number configuration window (by pressing [4]);

3. Edit PIN number (By pressing [1]);

4. Enter the PIN number, press to save, or to reject;

5. Enter the PIN number again.

Admin number editing:

1. Open the admin number configuration window (by pressing [3]);

2. Edit administrator number (By pressing [1]);

3. If "0" is entered, the number is disabled.

4. Enter the administrator's number, press to save, or to reject;

Device configuration menu

Device configuration menu		
[1]	Heart-Beat interval	*Heart-Beat* interval configuration menu. *Heart-Beat* interval – time between *Heart-Beat* SMS messages in hours. User can enter time from 1 to 720 (hours). The initial value is 12 hours.
[2]	Standby time	*Standby* configuration menu. *Standby* time – standby time before going to sleep mode. Used when waiting for SMS messages. A long waiting time will ensure that the SMS arrives at the device, but will reduce energy efficiency. The user can enter a time from 1 to 60 minutes. The default value is 10 minutes.

[3]	Poling Interval	POL interval configuration menu. POL (*Polling*) interval – the time between waking up the device to read SMS messages. User can enter time from 1 to 720 (hours). The expected interval is 12 hours.
[4]	Input inverse	Input inversion configuration menu. Each input can be inverted separately.
[5]	Password	Device password configuration menu. The password must consist of 4 characters. The default password is *ADMV*
[6]	Device ID	Allows you to change the device name (ID). The default ID is MVB001.
[7]	Date	Device date configuration menu. This date will be written in SMS messages. The default date is automatic.
[8]	Time	Device time configuration menu. This time will be written in SMS messages. The default time is automatic.
[9]	Delays	Time filters menu for discrete inputs.
[0]	Back	Returns to the main menu.

Delays menu		
[1]	Transient time limit	This time determines when the short-term error ends and when the long-term error takes effect. Default is "0" - disabled. This time is measured in seconds.
[2]	Filter time limit	This time determines how long (in milliseconds) the signal must be for it to be captured. The default is 80 ms.

Password editing:

1. Return to the main menu by pressing [0] (Back).

2. Enter the Device configuration menu by pressing [2];

3. To see the password configuration window - press [5];

4. Edit password - (by pressing [1]);

5. Enter the password, press <enter> to save, or <esc> to reject;

6. Enter the password again.

Time editing:

1. Enter the time editing window by pressing [8];

2. Edit time by pressing [1];

3. Enter the hour, press <enter> ;

4. Enter minutes, press <enter>;

5. Enter seconds, press <enter>.

Diagnostics menu
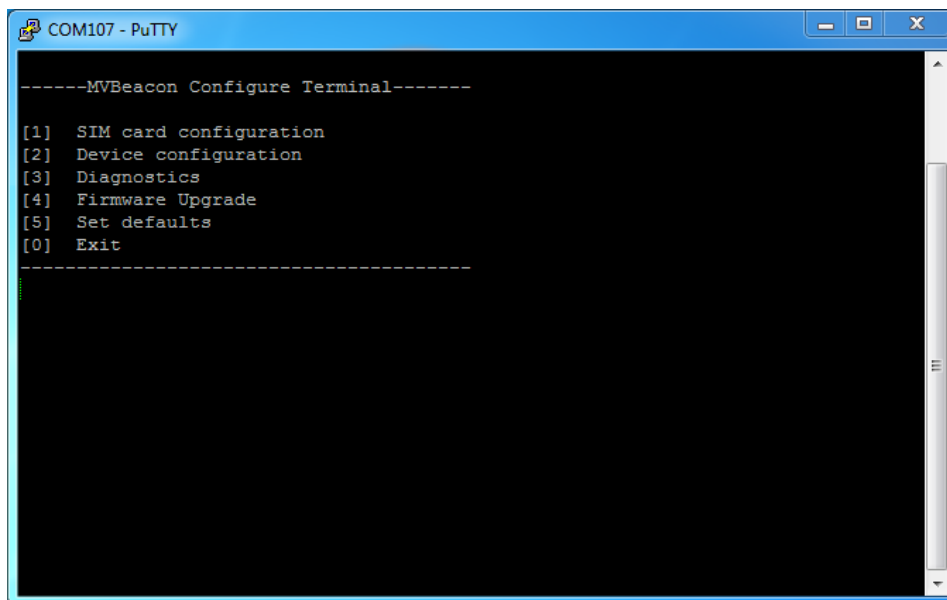
1. Return to main menu by pressing [0];
2. Enter the Diagnostics screen by pressing [3];
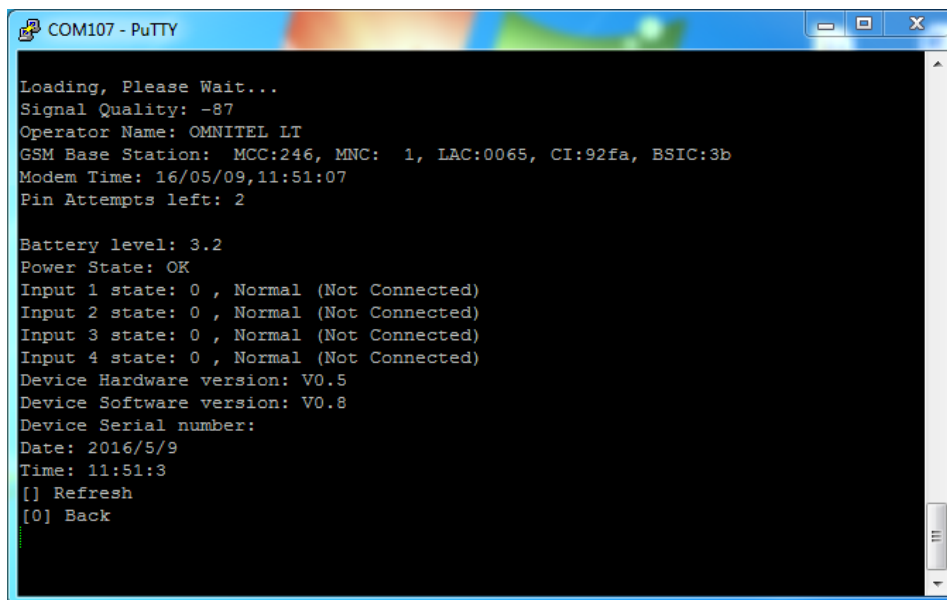3. Wait for the device to register to the network. When connected successfully, the operator name and signal quality will appear on the screen. If the modem does not connect to the network, the message Modem failed appears on the screen.

Diagnostics screen	
Signal Quality;	Signal quality; measured in dBm
Operator Name;	Operator name
GSM Base Station;	Data about the connected base station
Modem Time	Autocalibration time
Pin Attempts left;	Shows the balance of SIM PIN entry attempts
Battery level;	Battery level (in Volts)
Power State	Power status: OK – power is present / battery is not discharging; PWRLOW – if the battery voltage is below 2.7 V (Beacon B+) or if the power is lost and the device is running on internal batteries (Beacon A).
Input 1 state; Input 2 state Input 3 state; Input 4 state	Input status, input invert selections and whether it is connected.
Device Hardware version	Hardware version
Device Software version	Software version
Date	Device date
Time	Device time

Test result window:

```
COM107 - PuTTY
Loading, Please Wait...
Signal Quality: -87
Operator Name: OMNITEL LT
GSM Base Station:  MCC:246, MNC:  1, LAC:0065, CI:92fa, BSIC:3b
Modem Time: 16/05/09,11:51:07
Pin Attempts left: 2

Battery level: 3.2
Power State: OK
Input 1 state: 0 , Normal (Not Connected)
Input 2 state: 0 , Normal (Not Connected)
Input 3 state: 0 , Normal (Not Connected)
Input 4 state: 0 , Normal (Not Connected)
Device Hardware version: V0.5
Device Software version: V0.8
Device Serial number:
Date: 2016/5/9
Time: 11:51:3
[] Refresh
[0] Back
```

MV Beacon configuration with SMS messages
The first four characters of the SMS message must be the device password. The type of message is written after the password: SET – configuration setting type; or GET - read configuration type. Parameters and their values are written after the password and message type. The password, message type, and [parameter=value;] blocks must be separated by spaces. The [Parameter=value;] block must contain no spaces, and the end of the block is marked with a semicolon (;)

Function	Description	Answer
PASSWORD SET PARAM1=VALUE1; [PARAM2=VALUE2;]...	PASSWORD – 4 symbol password PARAM1 – Parameter name PARAM2 – Parameter name VALUE1 – Parameter value VALUE2 – Parameter value	SET PARAM=VALUE1; [PARAM=VALUE2;]... SET ERROR
PASSWORD GET PARAM1; [PARAM2;]...	PASSWORD – 4 symbol password PARAM – Parameter name	GET PARAM1=VALUE1; [PARAM2=VALUE2;]... GET ERROR

Function examples:

Description	Request	Answer
Set Recipient and Admin numbers, new password and Heart-beat interval.	ABCD SET P1=37060001001; ADM=37060001001; PASS=1234; HB=24;	SET P1=37060001001; ADM=37060001001; PASS=1234; HB=24;
Get battery level, signal quality and hardware version (with new password)	1234 GET BAT GSQ HWV	GET BAT=3,7; GSQ=-50; HWV=1,0;
Set password, Heart-Beat interval and standby time; Heart-beat interval and password do not meet the requirements (password too short, Heart-Beat too long)	AAAA SET PASS=K; HB=35600; SB=20;	SET Err PASS=AAAA; Err HB=12; SB=20;

List of functions, initial values and pemissions:

Configure and scan(SET/GET):				
Parameters	**Description**	**Type and possible values**	**Initial values**	**Access is allowed**
ID	Devide ID (name)	String(15) (eg.: MVB0001)	MVB	• For unknown numbers when SECURE is 0, 1, 2 • registered numbers

P1	The phone number of the first recipient. When SECURE 2 or 3, only registered numbers can be set and read.	Integer (0 – number is disabled)	0	- For unknown numbers, when SECURE is 0, 1 - registered numbers
P2	The phone number of the second recipient. When SECURE 2 or 3, only registered numbers can be set and read.	Integer (0 – number is disabled)	0	- For unknown numbers, when SECURE is 0, 1 - registered numbers
HB	Heartbeat interval (in hours)	integer (1 - 720)	24	- For unknown numbers, when SECURE is 0, 1, 2 - registered numbers
SB	Stand-by time (in minutes)	integer (1-60)	10	- For unknown numbers, when SECURE is 0, 1, 2 - registered numbers
FLR	Input sensitivity (in milliseconds)	Integer (10-1000)	80	- For unknown numbers, when SECURE is 0, 1, 2 - registered numbers
PTD	short-time / long-time error time (in seconds)	integer (0-240) (0 – long-time error is disabled)	0	- For unknown numbers, when SECURE is 0, 1, 2 - registered numbers
POL	*Polling* (wake-up) interval (in hours)	integer (1-720) (must be less than or equal to HB)	24	- For unknown numbers, when SECURE is 0, 1, 2 - registered numbers
ADM	Admin phone number. When SECURE 2 or 3, only registered numbers can set and read.	Integer (0 – number is disabled)	0	- For unknown numbers, when SECURE is 0, 1 - registered numbers

PASS	Device password When SECURE 2 or 3, only registered numbers can set and read	4 symbol string	ADMV	- For unknown numbers, when SECURE is 0, 1 - registered numbers
T	Device time	HH:MM:SS T=AUTO; - use autocalibration	00:00:00	- For unknown numbers, when SECURE is 0, 1, 2 - registered numbers
D	Device date	YYYY.MM.DD D=AUTO; - use time calibration	2015.12.01	- For unknown numbers, when SECURE is 0, 1, 2 - registered numbers
IE1 IE2 IE3 IE4	Input inverter settings	Integer 0-normal 1-inverted	0	- For unknown numbers, when SECURE is 0, 1, 2 - registered numbers
SECURE	Security level setting. When SECURE 2 or 3, only registered number can set and read	0 – all SMS are sent to all numbers. 1 – Error responses are not sent to unknown numbers. 2 – same as 1. 3 –Also, only registered (ADM, P1 and P2) numbers can set the marked settings. Communication only with registered numbers	0	- For unknown numbers, when SECURE is 0, 1 - registered numbers
	Read only (GET):			
BAT	Battery voltage (in Volts)	Float	3.7	- For unknown numbers, when SECURE is 0, 1, 2 - registered numbers

GSQ	Signal quality (dBm)	integer (-113 to -51)		• For unknown numbers, when SECURE is 0, 1, 2 • registered numbers
PWR	Power status	String PWRLOW= (0 – if OK; 1 – if power error)		• For unknown numbers, when SECURE is 0, 1, 2 • registered numbers
SWV	Software version	String	1.0	• For unknown numbers, when SECURE is 0, 1, 2 • registered numbers
HWV	Hardware version	String	1.0	• For unknown numbers, when SECURE is 0, 1, 2 • registered numbers
I1 I2 I3 I4	Input states	If normal: 0 – open 1 – triggered if inverted: 0 – triggered 1 – open	0	• For unknown numbers, when SECURE is 0, 1, 2 • registered numbers
GBS	GSM Base station data	String		• For unknown numbers, when SECURE is 0, 1, 2 • registered numbers
GON	Operator name	String		• For unknown numbers, when SECURE is 0, 1, 2 • registered numbers
FIRMWARE	Downloads software from an FTP server and writes it.	0 – download failed 1 – download succeeded		• For unknown numbers, when SECURE is 0, 1, 2 • registered numbers

SMSCNT	Sent / recieved SMS message reader (32 bit wide)	SMSRX: N; SMSTX: M; where N - recieved and M - sent		• For unknown numbers, when SECURE is 0, 1 • registered numbers

Spontaneous messages

	Syntax	Description	Example
1	EVENT TYPE PARAM=VALUE1; [PARAM=VALUE2;]...	TYPE – event type: • HB – Heart-beat message • PO – login message • TG – entry trigger message	• EVENT PO ID=BECON1; I1=0; I2=0; I3=0; I4=0; GSQ=99dB; BAT=3,2; D=2015.05.21; T=22:23:21; • • EVENT TG ID=BECON1; I1=1; I2=0; I3=0; I4=0; GSQ=50dB; PWRLOW=1; D=2015.05.21; T=22:23:21; EVENT HB ID=BECON1; GSQ=-50; BAT=1,1; D=2015.05.21; T=22:23:21;

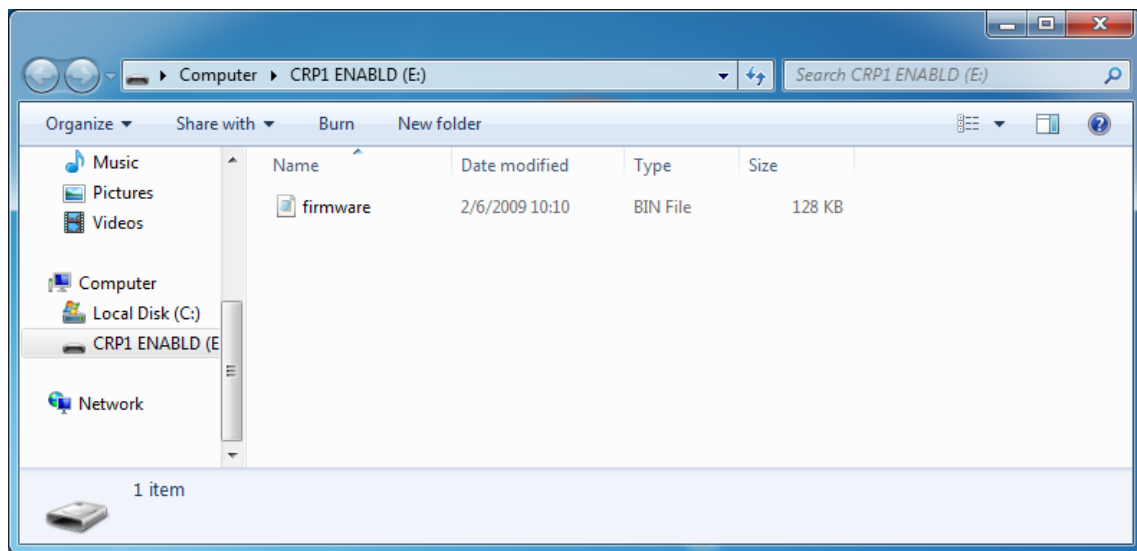**MV Beacon program update using USB port**

To update the software, the user must enter the main menu, enter the update confirmation menu by pressing [4] (Firmware upgrade) and confirm the update [1] (confirm update); The device is now in update mode.

The device disconnects and connects already as a data carrier:

The user must delete the existing firmware.bin file and load the new one by copying.

After all the steps are completed, the user needs to unplug the device and reboot it. The name of the new software version should have changed in the diagnostics menu window.

MV Beacon program update via internet

After the user sends the message "GET FIRMWARE" (see the configuration message tables), the device connects to the FTP server, downloads the firmware and sends an SMS message with a response whether the download was successful. The device then overwrites the downloaded firmware and sends an "EVENT PO" message. The software version can be checked by sending the message "GET SWV".

Testing
When the user has finished configuring the device and the Diagnostics menu shows a successful network connection, the user can test the device by pressing and holding the TEST1 button for a few seconds. The user should then receive a TG type SMS message with the changed value of the pressed input. When the button is released, a second SMS message is received.