NB-IOT PULSE COUNTER

VEGA NB-11

USER MANUAL

DOCUMENT REVISION	FIRMWARE VERSION
08	2.1

CONTENTS

INTRODUCTION

This manual is designated for Vega NB-11 pulse counter (hereinafter – the counter) manufactured by Vega-Absolute OOO and provides information on powering and activation procedure, control commands and functions of the counter.

This manual is targeted at specialists familiar with installation work fundamentals of electronic and electrical equipment.

Vega-Absolute OOO reserves the right to make changes to the manual related to the improvement of equipment and software, as well as to eliminate typos and inaccuracies, without prior notice.

1 DEVICE PURPOSE AND OPERATION PRINCIPAL

DEVICE PURPOSE

Vega NB-11 pulse counter is designed for counting of pulses incoming to 6 independent inputs, further accumulating and transmitting of this information in NB-IoT network.

In addition, Vega NB-11 can be used as a security device – all inputs can operate in security mode, there is also Hall sensor.

The pulse counter can be used for any utilities' meters and industrial equipment with pulse output of herkon type or open-drain type.

> **Equipment with NAMUR pulse output is not supported**

The counter is powered by a 6400 mAh built-in battery.

> **Long-term storage of equipment outside the operating mode leads to battery passivation, which does not allow the equipment to operate in the declared mode.**
> **For correct operation, before starting the equipment, carry out the depassivation process. To request the instructions please e-mail us support@vega-absolute.ru**

OPERATION ALGORITHM

The readings collecting from the meter with a configurable schedule. The readings stored in the device memory and transmitting during the next communication session with the NB-IoT network.

Data are transferred with a configurable schedule too. Data can be transferred in random point in time during set period or in the set time. At the next communication session, the device starts sending accumulated packets with readings, from the earliest to the latest.

The device operates with confirmation all the time and send the next packet only after receiving a confirmation of the delivery of the previous one. If such confirmation was not received, NB-11 completes the communication session until the next one according to the schedule. Herewith, the device continues to collect data according to the data collection period and store it in memory. Non-transmitted packets remain in the device memory until the next communication session.

The internal clock is set automatically when device connected to the "Vega NB-IoT Configurator" via USB.

FUNCTIONAL

Vega NB-11 pulse counter has the following features:

- ◉ Six pulse inputs for connecting the external devices with pulse output

- ◉ All inputs can operate in «security» mode for connecting the external leakage and safety sensors, etc.

- ◉ Queue of sending when delivery is not possible

- ◉ Time referencing of readings by internal clock

- ◉ Communication in case of security inputs or Hall sensor actuation

- ◉ Temperature measurement

- ◉ Charge measuring of the built-in battery (%)

- ◉ Ability to filter the pulses by the duration

MARKING

Device marked with sticker that contain the next information:

- ◉ Device model;

- ◉ IMEI;

- ◉ Month and year of manufacture.

Sticker located in three places – on device case, in factory certificate and on the packing box.

2 SPECIFICATION

DEVICE SPECIFICATION

MAIN	
Pulse inputs	6
Maximum input frequency	200 Hz
USB-port	micro-USB, type B
Operating temperatures	-40...+85 °C
Built-in temperature sensor	yes
Hall sensor	yes
Quantity of black box records	up to 100 000
CELLULAR COMMUNICATIONS	
Supported Cellular Standards	LTE Cat NB1
Data transfer protocol	MQTT
Calculated number of transmitted packets if the data transferring once a day	3600
LTE NB-IoT antenna type	external
POWER	
Built-in battery	6400 mAh
CASE	
Housing dimensions	95 x 95 x 50 mm
Ingress protection rating	IP67
PACKAGE	
Dimensions	165 x 118 x 57 mm
Weight	0,350 kg

DEFAULT DEVICE SETTINGS

PARAMETER	VALUE
Confirmed Uplinks	OFF
Uplink number of repeats	0
Repeating period	0
Communication period	24 hours
Data collection period	24 hours
Time zone	UTC +00:00
Guard inputs operate	on short
Hall sensor	ON
Send network statistics	OFF
Pulse filtering settings	50 ms for pulse and pause

For changing the device settings, you need to connect to it with "Vega NB-IoT Configurator" application. You can download app on the iotvega.com site in SOFT section as well as User Manual for configurator. Go to the app page.

3 OPERATION

DEVICE APPEARANCE

Vega NB-11 is represented in gray plastic case which has six screws and mounting for DIN-rail. The device case is equipped with a hermetic gland of M12 size. A sealant is installed inside the gland, ensuring compliance with the declared Ingress Protection rating of the device case.
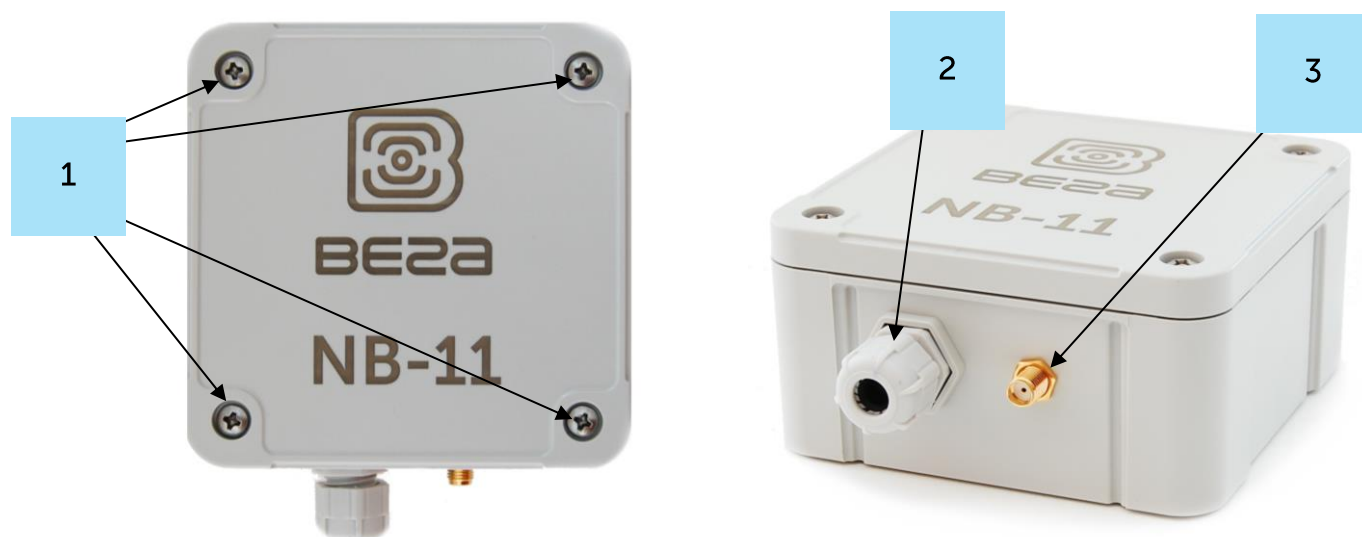
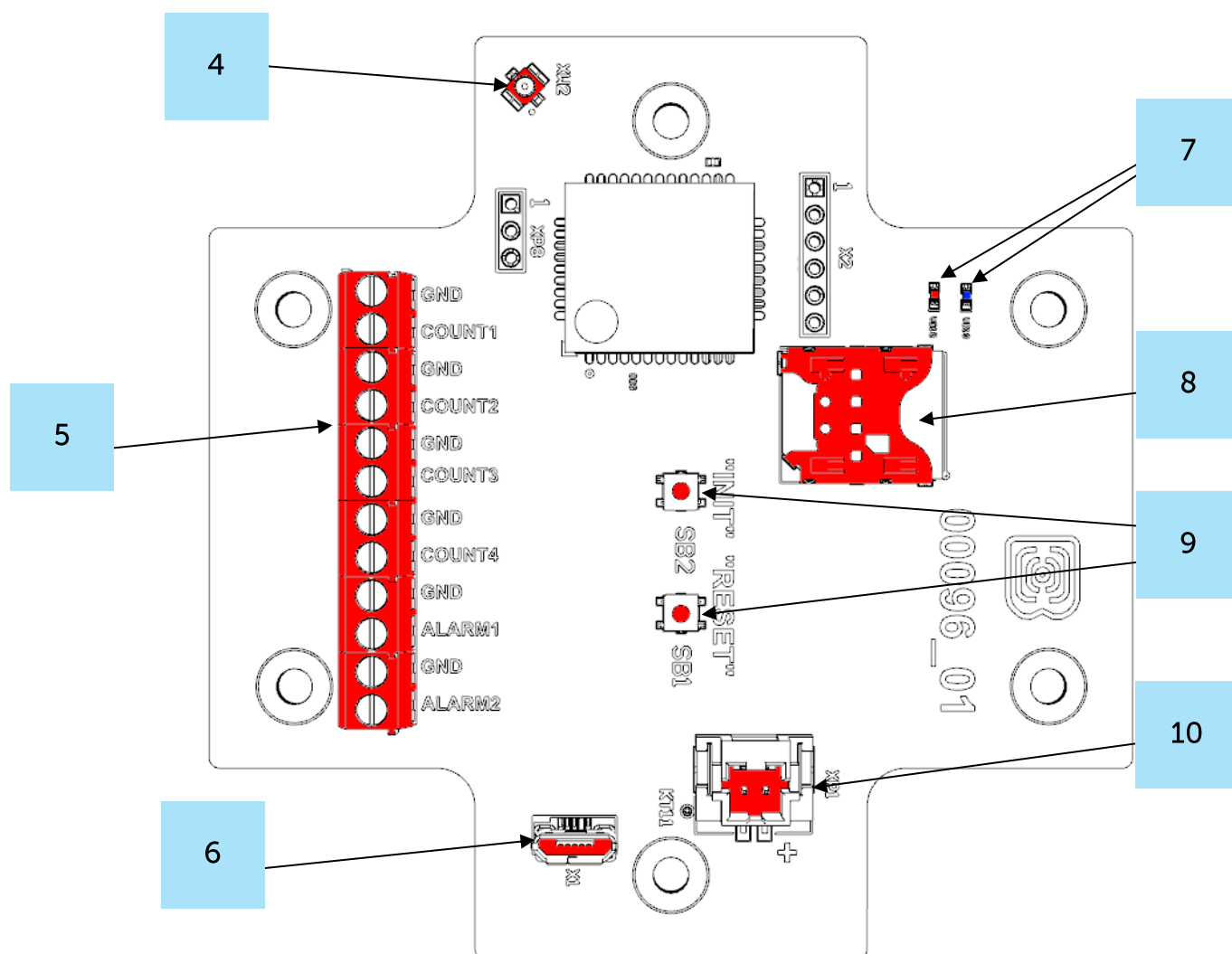

1 – screw ⌀ 4 mm x 27 mm, cross ✚

2 – cable gland of M12 size for installing the cables and wires with circular cross-section with a diameter of 5...6 mm

3 – input of external antenna

Internal structure of cable gland
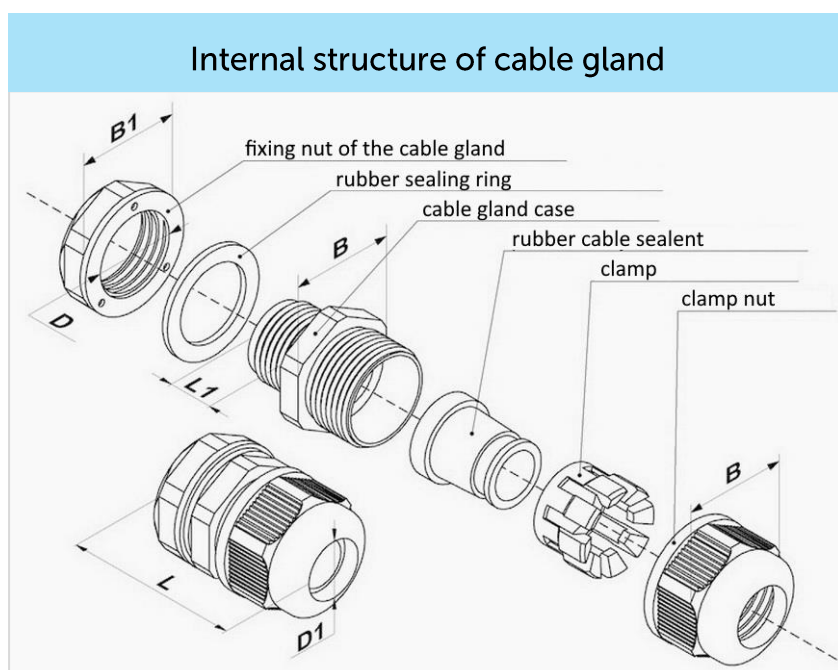
All of elements for manage and indication as well as connecting contacts are placed on the board inside the case.

4 – input for connecting an external antenna

5 – contacts[1]
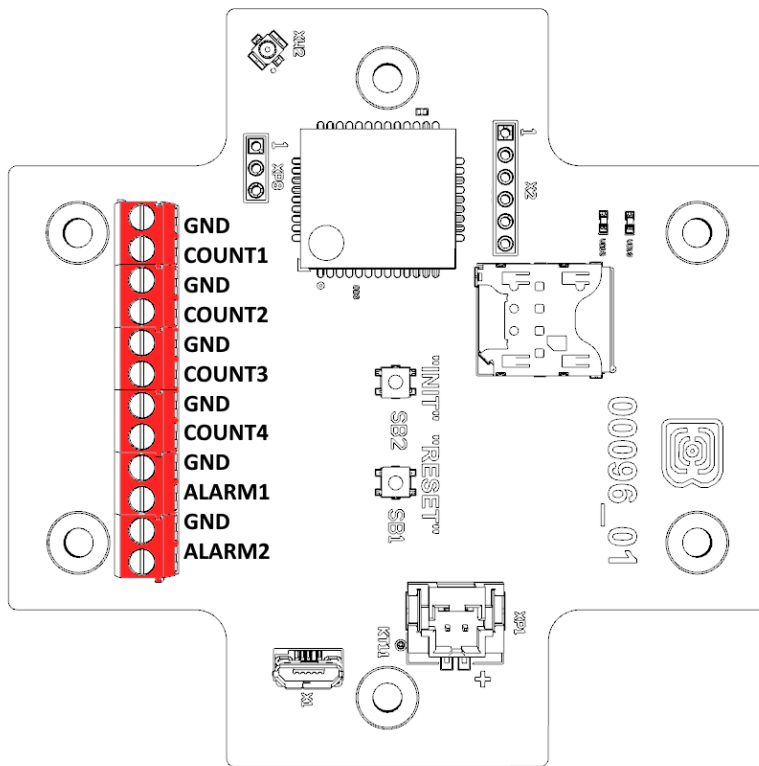
6 – USB-port

7 – LED indicators

8 – SIM holder

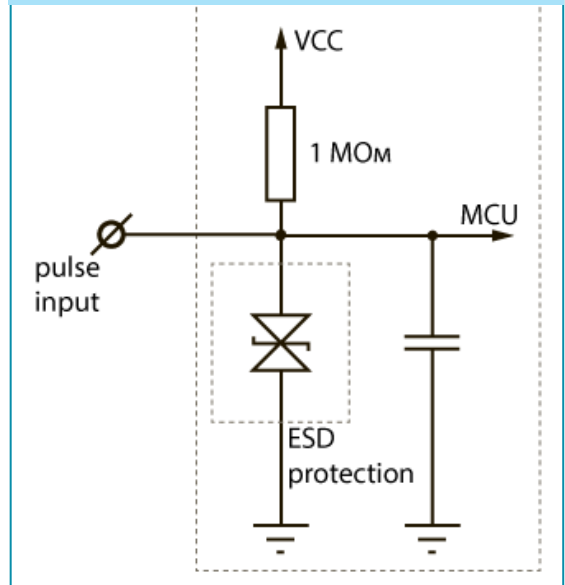9 – manage buttons

10 – input for connecting a battery

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[1] In various versions of the board, digital inputs can be designated as COUNT or ALARM, while all digital inputs have the same functionality.

When connecting a radio modem to external devices, consider the internal circuitry of its pulse inputs shown below.

Circuit design of the pulse inputs

De-bouncing logics with 5 msec time constant is integrated in the pulse counter. The pulse counting is carried out for frequencies up to 200 Hz.

The pulse counter allows to connect circuits with the following types of NO contacts:

- reed switch;
- mechanical pushbutton;
- open-collector output.

> ℹ **Equipment with NAMUR pulse output is not supported**

Polarity effects only "open collector" circuits.

There are two security inputs on the board. The device monitors status changes on the security inputs and when the security input triggers, the device is activated and sends an alarm message to the network.

PULSE INPUTS SETTINGS

When you connect the modem to metering devices with a pulse output, it is necessary to consider the features of the pulse of a specific type of metering device: bounce, minimum pulse and pause duration. To do this, it is necessary to record the characteristics of the pulse with an oscilloscope or obtain information from the manufacturer of the meter.

The modem has a special software pulse filter. The filter is represented by two settings for each pulse input (see section 4, "Settings" tab). Consider the features of filtering settings for different pulse outputs.

1) Mechanical pulse output

Usually, the mechanical pulse output in metering devices is implemented on a reed switch, but it can also be a button or other mechanics. The main problem with such outputs is contact bounce. At a moment of falling and rising, there are many additional impulses that need to be no considered in the calculation. In addition, the pulse duration floats and depends on the current flow rate of the meter. For correct counting, it is necessary to determine the minimum useful pulse duration and the minimum pause between useful pulses (all that is less is bounce). The obtained values must be set in the modem settings.

The minimum useful pulse duration is the pulse duration that the meter produces at the maximum flow rate (the maximum flow rate is indicated in the meter's passport). This duration does not include bounce time. The minimum pause duration can be set equal to the minimum pulse width, or longer if necessary. Usually, the pause between pulses is an order of magnitude higher.
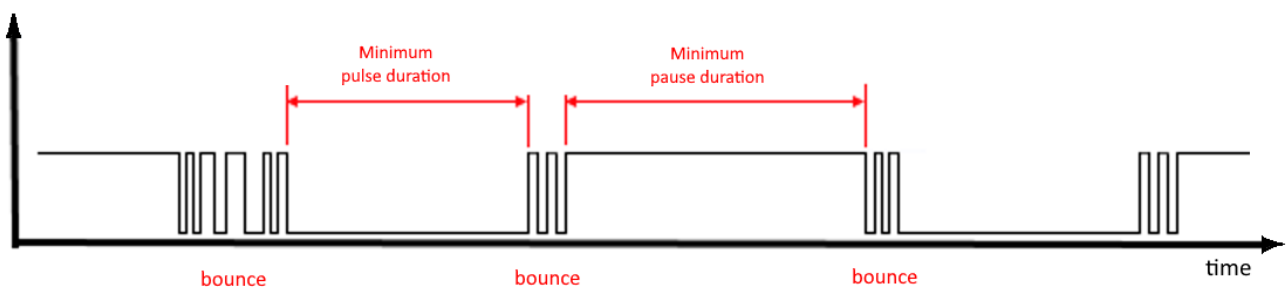

2) 2) Electronic pulse output

The electronic pulse output has no bounce (open collector output). This output usually has a fixed pulse width. For the modem to fix the pulse, it is necessary to set in the settings the minimum pulse duration less than the actual pulse duration issued by the meter.
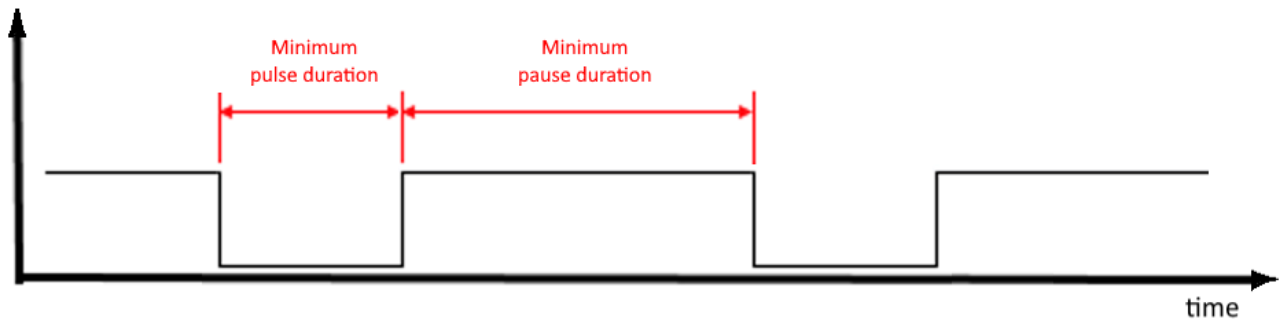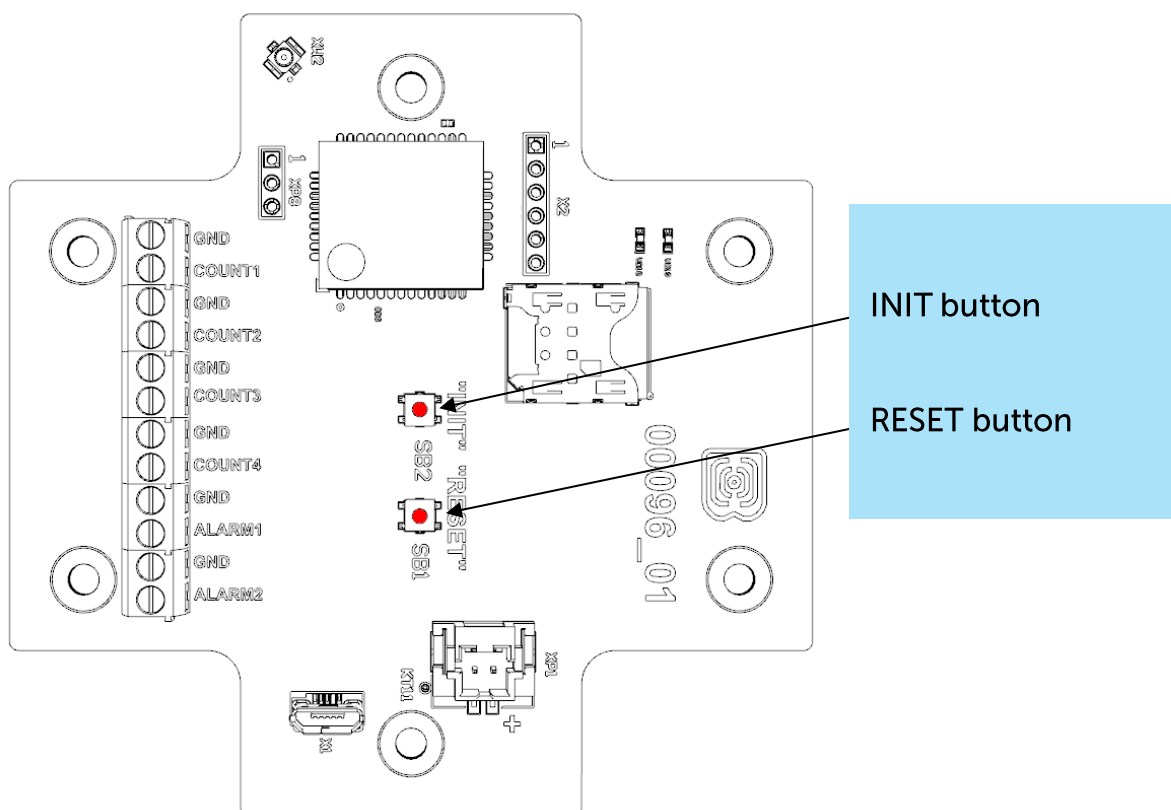
HALL SENSOR

The device has Hall sensor which located on the board edge on the bottom side. When the magnet is brought up the sensor triggered, and the device can form the alarm message which immediately transmitted to the server.
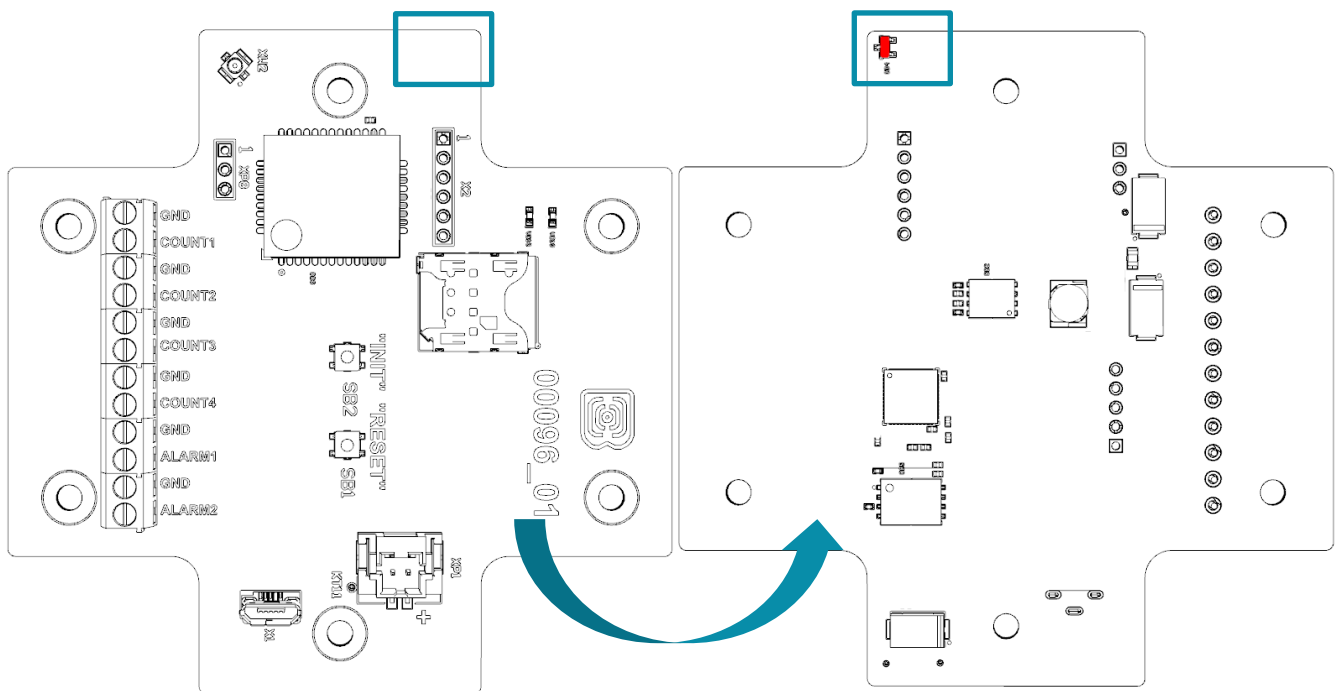
BUTTONS

There are two buttons on the board which can help you to manage the device. Buttons are described in the table below.


RESET	
Short pressing	Device reloading
INIT	
Pressing for 1 second	Registration at the network
Pressing for 2 seconds	Data transmitting
Pressing for 3 seconds	LTE-modem switching off
Pressing for 4 seconds	To form record to the black box

When you hold down the button, the red LED starts flashing once a second, which will help you to find out the duration of pressing. Pressing for 1 second corresponds to one flash of the LED, pressing for 2 seconds corresponds to two and so on.

INDICATION

There are two LEDs on the board: red and blue. Blue LED VD19 shows LTE-modem state, and red LED VD18 – the device state.

LEDs location on the board
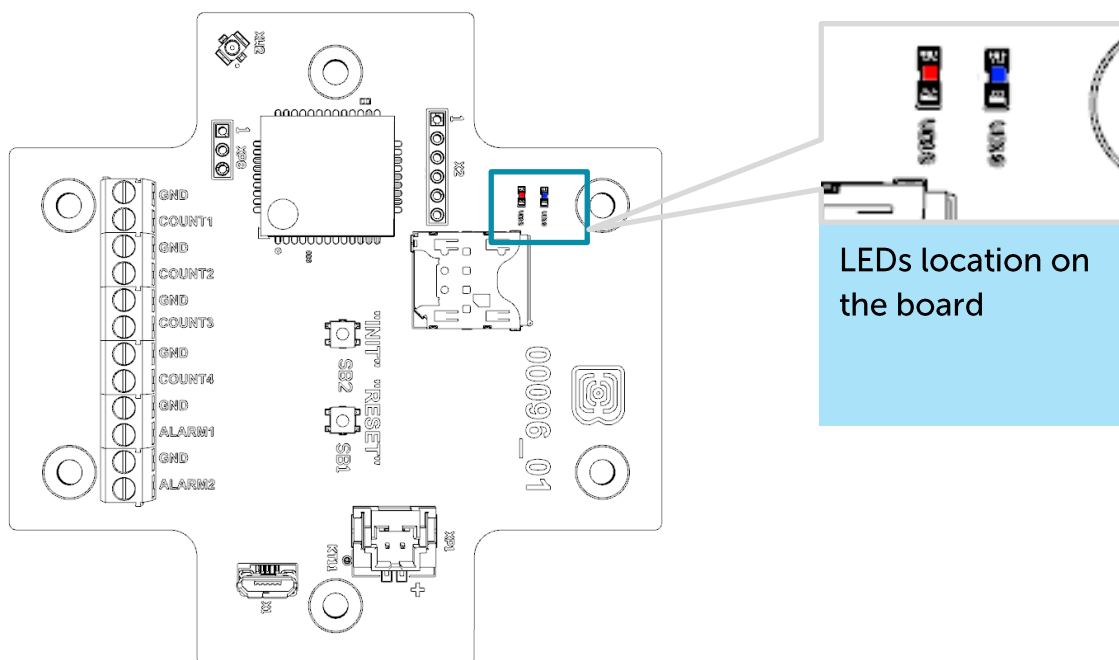
LTE-modem		
	Short flash every three seconds	Device searches the network
	Short flash every second	Device is successfully registered, and it is in the network
	Two short flashes every one second	Device transmits data to the network
	No light	LTE-modem is switched off
Device		
	Short flash every second	Battery charge is lower than 5%
	Short flash every five seconds	Device is in the 'Operation' mode
	No light	Device is in the 'Sleep' mode or switched off

MOUNTING RECOMENDATIONS

The counter shall be installed and adjusted by qualified specialists to ensure proper operation of the device.

When connecting the pulse output of the metering device to the counting input of the modem, it is recommended to use cables with a shielding braid, and to install the metering device with the modem away from sources of radio interference. It is recommended to use a two-wire shielded cable. The shield is connected on the side of the impulse counter to its ground.

1st wire – signal from pulse output is connecting to contact COUNT/ALARM

2nd wire – ground is connecting to contact GND

Shield – is connecting to contact GND

Before starting mounting work, you must make sure that the latest firmware version is installed on the equipment

For mounting you will need:

- SIM-card;
- cross-shaped screwdriver ✚;
- wire stripper;
- laptop.

Step by step mounting be like:

1. Installing SIM-card into holder;
2. Setting the device through the "Vega NB-IoT Configurator" – the first and second steps are usually carried out in the office.
3. De-energizing the connected equipment, metering devices, etc.
4. Placement the wires in the cable gland. It must be remembered that the wires must be united in one cable of circular cross-section with diameter of 5…6 mm.

Inside the cable gland there is a sealant ensuring compliance with the declared Ingress Protection rating of the device case. When removing the sealant, as well as when installing wires of a different diameter or cross-section, device performance may deteriorate until failure due to moisture entering the case
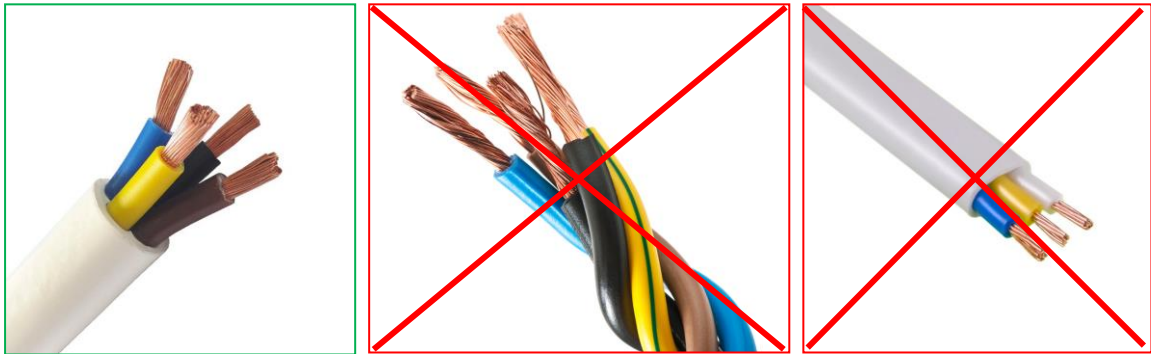
5. Connecting all necessary wires to the contacts.
6. Connecting the battery at the connector. After the battery connection the device loads and comes to sleep until the next communication session.

Location of SIM-holder on the board (if there is)
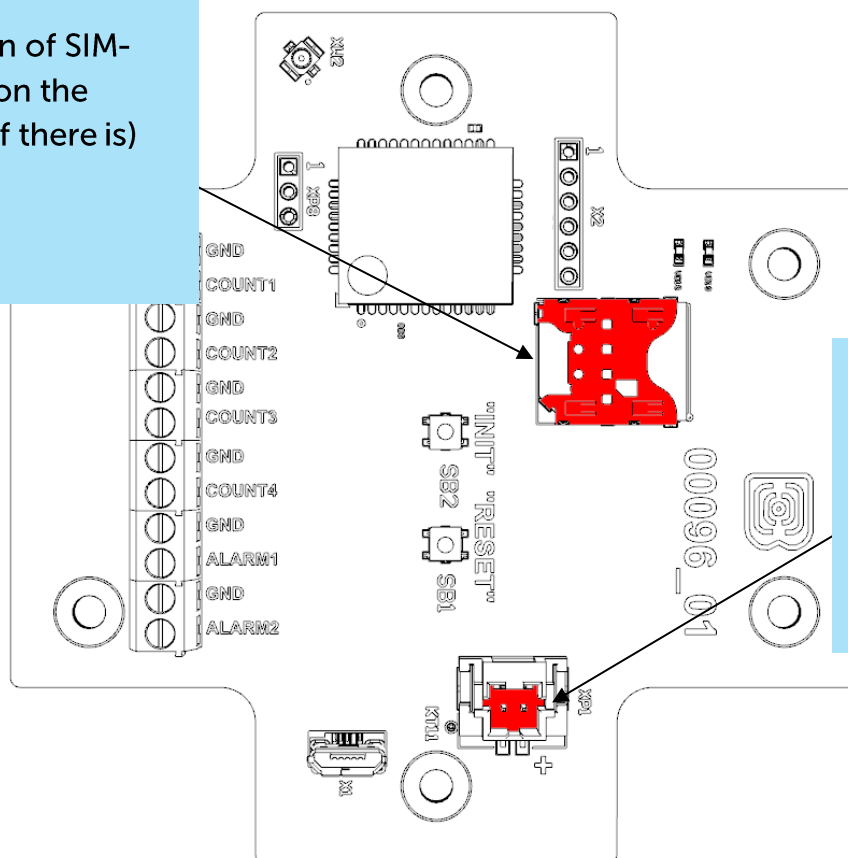
Location of the battery connector on the board

7. If you need to test the data transmitting, then press and hold the INIT button for the 2 seconds.
8. Before assembling the device, you can reset the pulses accumulated during testing and connection through the "Vega NB-IoT Configurator" if it is necessary.
9. Assembling the device.

4 COMMUNICATION PROTOCOL

Data transmits via MQTT protocol. You should specify in the device settings the address and port of the server where the data will be sent. Those settings specified in application "Vega NB-IoT Configurator". It must be MQTT broker as a server (received side). You should specify in the device settings the address and port of the broker. Also, you should specify a topic name where the data published and a client name – the name which the device use for publishing. All those settings specified in "Vega NB-IoT Configurator" in part "MQTT settings". For watching the data sending by the device you should deploy MQTT broker on a PC and subscribe some application on MQTT broker.

Vega NB-11 sends the message on the server as a text of JSON format. See example below.

```
{
 "Message": {
  "dev": "NB-11 v0.5",
  "IMEI": "867723030711633",
  "IMSI": "250990283462252",
  "ICCID": "8970199170730496963",
  "num": 3,
  "UTC": 1571227504
},
 "CellStatus": {
  "SQ": 19,
  "EARFCN": 1240,
  "PCID": 26,
  "RSRP": -822,
  "RSRQ": -108,
  "RSSI": -744,
  "SNR": 119
},
"Telemetry": {
  "reason": "time",
  "UTC": 1663560300,
  "bat": 99,
  "temp": 24.9,
  "pulse1":{"C":72,"H":0,"L":0}
  "pulse2":{"C":72,"H":0,"L":0}
  "pulse3":{"C":72,"H":0,"L":0}
  "pulse4":{"C":72,"H":0,"L":0}
  "pulse5":{"C":74,"H":0,"L":0}
  "pulse6":{"C":73,"H":0,"L":0}
 "states"
 {"I1":1
 "I2":1
 "I3":1
 "I4":1
 "I5":1
 "I6":1
 "M":0}}}
```

Transcription of the message fields:

Message – part with information about current message.

  dev – name and version of the device firmware

  IMEI – LTE-modem identifier

  IMSI, ICCID – SIM-card (SIM-chip) identifiers

  num – the number of the message

  UTC – the date and the time of message sending in UTC format by Greenwich

CellStatus – part with information about the cellular state

  EARFCN – the number of radio frequency channel (absolute)

  PCID – physical network address

  RSRP – input signal power

  RSRQ – input signal quality

  RSSI – indicator of the input signal power

  SNR – signal to noise ratio

Telemetry – part with collected data (one packet)

  reason – reason for packet forming*

  UTC – the date and the time of message collecting in UTC format by Greenwich

  bat – battery charge

  temp – processor temperature

  pulse1 – pulse number on the input 1

  pulse2 – pulse number on the input 2

  pulse3 – pulse number on the input 3

  pulse4 – pulse number on the input 4

  pulse5 – pulse number on the input 5

  pulse6 – pulse number on the input 6

  C – pulse quantity

  H – higher than the specified number of pulses per period (0 - no threshold exceeded, 1 - exceeded)

  L – lower than the specified number of pulses per period (0 - no threshold exceeded, 1 - exceeded)

*Possible values for **Reason** field (Reason for packet forming):

  time – packet formed by the time (data collection period set up in the Configurator for the device)

  alarm1 – packet formed by the alarm on the input "COUNT1" (communication session initiated by this event)

  alarm2 – packet formed by the alarm on the input "COUNT2" (communication session initiated by this event)

  alarm3 – packet formed by the alarm on the input "COUNT3" (communication session initiated by this event)

  alarm4 – packet formed by the alarm on the input "COUNT4" (communication session initiated by this event)

alarm5 – packet formed by the alarm on the input "COUNT5/ALARM1" (communication session initiated by this event)

alarm6 – packet formed by the alarm on the input "COUNT6/ALARM2" (communication session initiated by this event)

cnfg – packet formed by the command from Configurator

hall sensor – packet formed by the Hall sensor (communication session initiated by this event)

button – packet formed by the button pressing (communication session initiated by this event)

pulse limit - the packet was formed by an alarm, since the number of pulses exceeds the set thresholds

settings_change - confirmation of delivery of the package with settings (the checkbox "Send confirmation to the server about changing device settings" must be checked)

States – section contains information about the status of inputs

I – Input+input number - input state: 0 - logical zero at the input, 1 - logical one at the input

M –**magnet** – the presence of an external magnetic field, where "0" - absent, "1" - present.

5 STORAGE AND TRANSPORTATION REQUIREMENTS

Vega NB-11 pulse counter shall be stored in the original packaging in heated room at temperatures +5 °C to +40 °C and relative humidity less than 85%.

The counter shall be transported in covered freight compartments of all types at any distance at temperatures -40 °C to +85 °C.

Long-term storage of the device in the "Storage" mode (more than 6 month) can lead to passivation of the battery.

6 CONTENT OF THE PACKAGE

The pulse counter is delivered complete with:

Vega NB-11 pulse counter – 1 pc.

Antenna – 1 pc.

Battery 6400 mAh – 1 pc.

Factory certificate – 1 pc.

7 WARRANTY

The manufacturer guarantees that the product complies with the current technical documentation, subject to the storage, transportation and operation conditions specified in the "User Manual".

The warranty period is 36 months.

The warranty does not apply to batteries.

The warranty period of operation is calculated from the date of sale marked in the product factory certificate, and from the release date when such a mark is absent. During the warranty period, the manufacturer is obliged to provide repair services or replace a failed device or its components.

The manufacturer does not bear warranty obligations in the event of a product failure if:

- the product does not have a factory certificate;

- the factory certificate does not have an TCD stamp and / or there is no sticker with information about the device;

- the serial number (DevEUI, EMEI) printed on the product differs from the serial number (DevEUI, EMEI) specified in the factory certificate;

- the product has been subject to alterations in the design and / or software which are not provided for in the operational documentation;

- the product has mechanical, electrical and / or other damage and defects arising from violation of the conditions of transportation, storage and operation;

- the product has traces of repair outside the manufacturer's service center;

- the components of the product have internal damage caused by the ingress of foreign objects / liquids and / or natural disasters (flood, fire, etc.).

The average service life of the product is 7 years.

In the event of a warranty claim, contact the service center:

119A, Bol'shevistskaya Str., Novosibirsk, 630009, Russia.

Tel.: +7 (383) 206-41-35.

e-mail: remont@vega-absolute.ru

Document Information	
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Revision History

Revision	Date	Name	Comments
01	17.06.2019	KEV	The first release
02	14.07.2020	KEV	Minor changes
03	08.10.2020	KEV	We recalculate the number of transmitted packets in warranty conditions
04	02.03.2021	KEV	New parts "Pulse inputs settings", "Mounting recommendations", we replace configurator screenshots, new function of the pulse filtering
05	01.07.2021	KEV	New settings of schedule in the "Configurator"
06	12.01.2022	KEV	Planned revision, new parts, new warranty
07	22.08.2022	KMA	Minor edits
08	21.09.2022	KMA	Communication protocol changes

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