



LORAWAN PULSE COUNTER VEGA SI-12 RELAY

USER MANUAL



DOCUMENT REVISION

02

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INTRODUCTION

This manual is designated for Vega SI-12 RELAY 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 for 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 DESCRIPTION AND OPERATION

DEVICE DESCRIPTION

Vega SI-12 RELAY pulse counter is designed for counting of pulses incoming to 4 independent inputs, further accumulating and transmitting of this information to the LoRaWAN® network, and for controlling low-power actuators by means of built-in relays.

In addition, Vega SI-12 RELAY can be used as a security device - all inputs can be configured as security inputs.

The counter has two relay outputs and can be used as a control device.

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



Equipment with NAMUR pulse output is not supported

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 counter can be powered by the 8-35V and output current not less than 150 mA external power supply.

COMUNICATION AND DATA COLLECTION ALGORITHM

Vega SI-12 RELAY operates in modes listed below:

"Storage" – is a mode for storing and transporting. In this mode the device does not communicate regularly with the network.

"Active" – is a main mode of device operation.

Before start using you need to switch the device out of "Storage" mode.

Vega SI-12 RELAY supports **two activation methods in the LoRaWAN® network** - ABP and OTAA.

ABP method. After pressing the start button, the device immediately starts working in the "Active" mode.

OTAA method. After pressing the start button, the device makes three attempts to connect to the network within the set frequency plan. After the activation in the LoRaWAN® network is confirmed, the device sends a signal (LED flashing for 5 seconds) and switches to the "Active" mode. If all attempts fail, the counter will continue to accumulate data and will attempt to connect to the network every 6 hours.

Hold the start button pressed (min. 5 seconds) to switch the device from the "Active" mode back to the "Storage" mode.



When switching to the "Storage" mode, all readings from the pulse inputs accumulated in the device memory are reset

The device forms the data packet with current state with a configurable period from 5 minutes to 24 hours. The packets stored in the device memory and transmitting during the next communication session with the LoRaWAN® network.

Examples

If the data collection period is set to 24 hours the packet is formed at 00.00 on the internal clock of the device

If the data collection period is 12 hours then at 00.00 and at 12.00, and so on.

The adjustable data transfer period can be from 5 minutes to 24 hours. When beginning of communication session, the device starts sending packets with readings from the earliest packet. The time of data transmitting cannot be specified, it's defined in random way for every device in chosen period of transmission from the moment of connection to the network.

Example

Transmission period is 30 minutes, and device was started at 16:40 by the internal device clock. In random way the device calculate data transmitting time and set it at 16:41 in the half-hour period from 16:40 to 17:10. Thus, packets from this device will transmit at 16:41, at 17:11, at 17:41, at 18:11 and so on every 30 minutes by the internal device clock.

The internal clock is set automatically when you connect to the device through USB, also can be adjust via LoRaWAN® network.

FUNCTIONAL

Vega SI-12 RELAY pulse counter works as a device of class C (LoRaWAN® classification) and has the following features:

- ◉ ADR support (Adaptive Data Rate)
- ◉ Sending of confirmed packets (configurable)
- ◉ Simultaneous readings from 4 independent inputs
- ◉ Ability to control actuators using built-in relays
- ◉ Two operating modes: "Active" and "Storage"
- ◉ Inputs switching to the "Security" mode for connection of leakage, safety, and other external sensors
- ◉ Saving non-transmitted packets in device memory
- ◉ Time referencing readings by internal clock
- ◉ Communication in case of security inputs actuation
- ◉ Temperature measurement

MARKING

Device marked with sticker that contain the next information:

- ◉ Device model;
- ◉ DevEUI;
- ◉ Month and year of manufacture;

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

Besides, there is an additional sticker located on the packing box and contains:

- ◉ Information about firmware version;
- ◉ QR code containing activation keys for a device in the LoRaWAN® network and other indicators.

2 SPECIFICATION

DEVICE SPECIFICATION

| MAIN | |
|---|--|
| Double-contact digital inputs | up to 4 |
| Maximum input frequency | 200 Hz |
| Security inputs | up to 4 |
| Relay outputs | 2 |
| USB-port | mini-USB, type B |
| Operating temperatures | -40...+85 °C |
| Built-in temperature sensor | yes |
| Maximum switching current of the relay | up to 2 A |
| LORAWAN® | |
| LoRaWAN® class | C |
| Quantity of LoRaWAN® channels | 16 |
| Frequency plans supported by default | RU868, EU868, KZ865 |
| Frequency plans available as order option | Any regional according to "LoRaWAN 1.1 Regional Parameter" |
| Activation type | ABP or OTAA |
| Communication period | 5, 15, 30 minutes, 1, 6, 12 or 24 hours |
| Data collection period | 5, 15, 30 minutes, 1, 6, 12 or 24 hours |
| Memory amount for storing packets | 200 packets |
| Type of the LoRaWAN® antenna | internal |
| Sensitivity | -138 dBm |
| Radio coverage in restrained urban conditions | up to 5 km |
| Radio coverage within line of sight | up to 15 km |
| Transmitter power by default | 25 mW (configurable) |
| POWER | |
| External power supply | 8 – 35 V, direct current |
| Power supply output current | no less than 150 mA |
| CASE | |
| Housing dimensions, no more than | 90 x 49 x 46 mm |
| Ingress protection rating | IP65 |
| Mounting | Clamp fastening to the support, DIN-rail, wall-mounting |

DEFAULT DEVICE SETTINGS

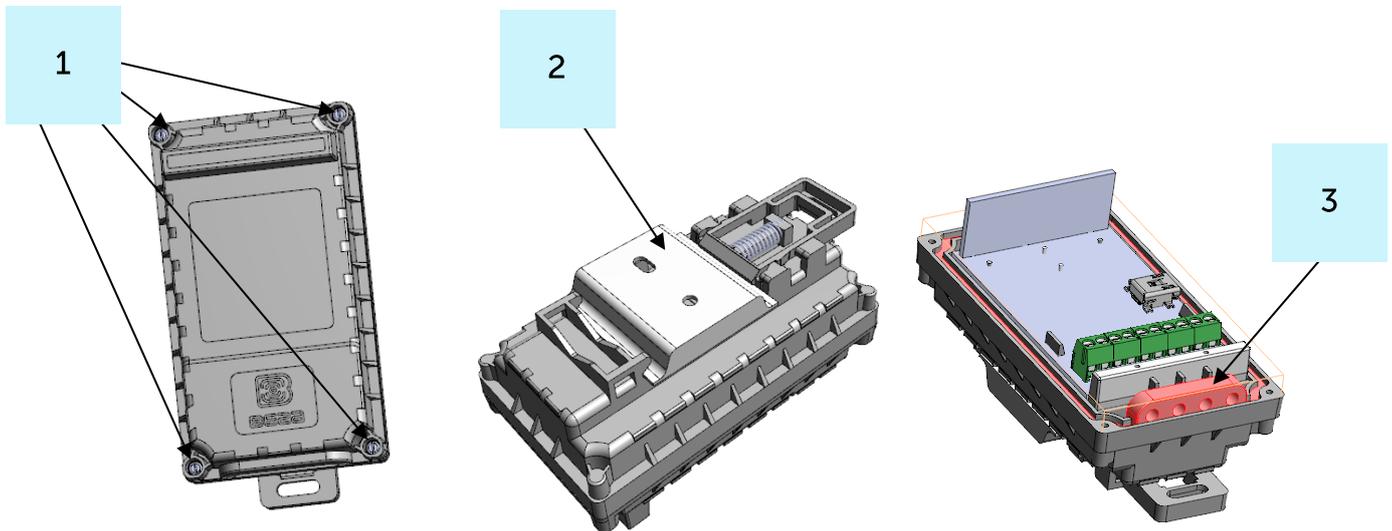
| PARAMETER | VALUE |
|---------------------------------------|------------|
| Frequency plan | RU868 |
| Activation type | OTAA |
| Adaptive Data Rate (ADR) | ON |
| Confirmed Uplinks | OFF |
| Rx 1 Delay | 1 second |
| Join Accept Delay | 5 seconds |
| Uplink number of transmissions пакета | 1 |
| Data rate | DR0 |
| Power | 14 dBm |
| Communication period | 24 hours |
| Data collection period | 24 hours |
| Time zone | UTC +00:00 |
| Inputs operate in mode | pulse |

For changing the device settings, you need to connect to it with “Vega LoRaWAN 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 SI-12 RELAY is represented in small plastic case which has four screws and mounting for DIN-rail.

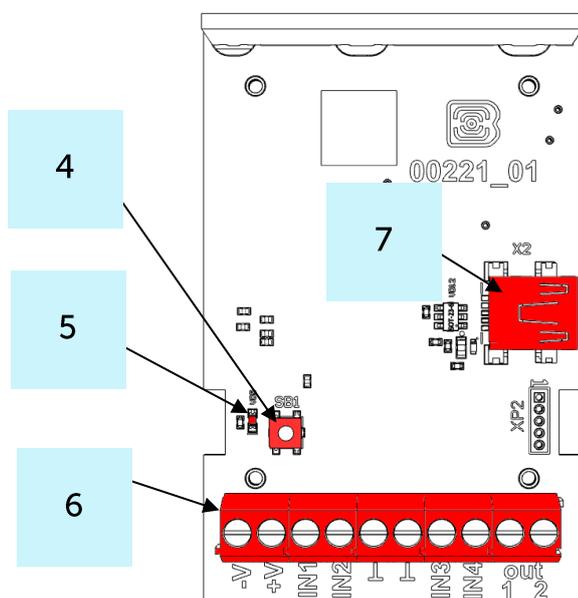


1 – screw \varnothing 2 mm x 8 mm, cross 

2 – DIN-rail with mounting holes \varnothing 3 mm

3 – silicone gasket without through holes, ensuring the protection rating of the device case IP65.

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



4 – launch button

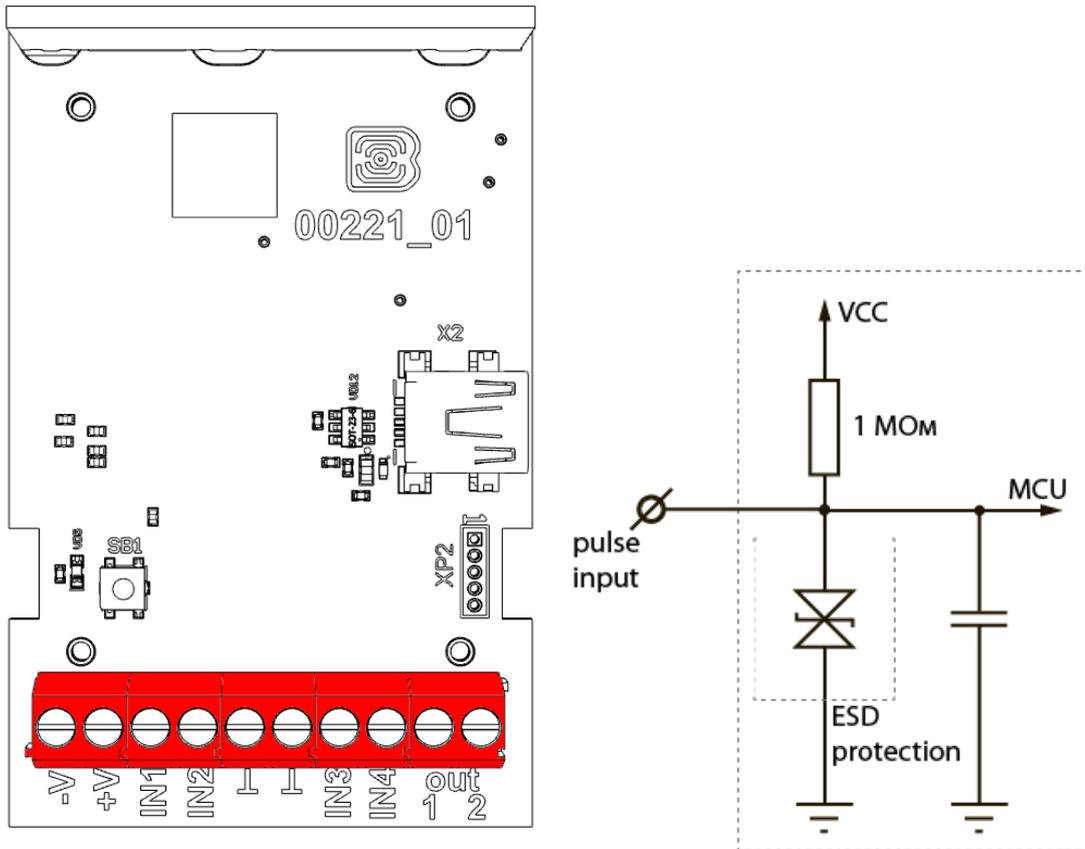
5 – LED indicator

6 – contacts

7 – USB-port

CONTACTS DESCRIPTION

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



The pulse counter has 10 contacts, see table below (in order from left to right):

| CONTACT | DESCRIPTION |
|--------------------|---------------|
| -V | Power - |
| +V | Power + |
| IN1, IN2, IN3, IN4 | Pulse inputs |
| 1,1 | Signal ground |
| out 1 out 2 | Relay outputs |

Ground contacts (**1,1**) are used for connection of pulse inputs IN1, IN2, IN3 and IN4.

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 inputs of the meter allow you to connect circuits with the following **types of closing contacts**:

- reed switch;
- mechanical pushbutton;

- ⦿ open-collector output.



Equipment with NAMUR pulse output is not supported

To reset all readings from the pulse inputs accumulated in the device memory you need to switch the device to the "Storage" mode by holding the start button pressed (min. 5 seconds).

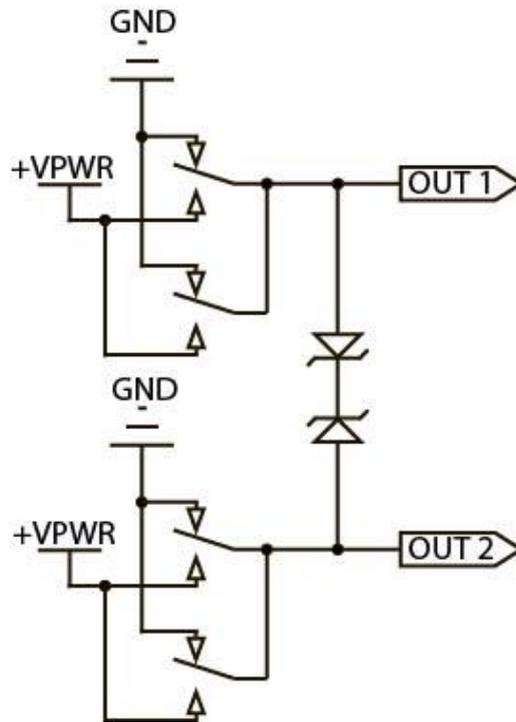
Pulse inputs can be configured for work in the "Security" mode via the "Vega LoRaWAN Configurator" application. In this mode, the device does not count pulses at the "Security" input, but only monitors its status. Should the "Security" input trigger, the device is activated and sends an alarm message to the network.

Outputs 1 and 2 are designed to control the state of an external connected device by supplying forward and reverse current for a short time. The maximum permissible load on the outputs is 2A.

On a command from the LoRaWAN® network, it is possible to change the state of outputs 1 and 2. See packet 5 in the communication protocol.

RELAY OUTPUTS OPERATION

The circuitry operation of the relay is organized as follows (see the picture)



Relay outputs can be in three states:

- 1) OUT_1 and OUT_2 connected to the "Ground". This is the initial state of the outputs after switching on the device.
- 2) Output OUT_1 connected to supply voltage +VPWR, OUT_2 connected to the "Ground".
- 3) Output OUT_2 connected to supply voltage +VPWR, OUT_1 connected to the "Ground".

Here +VPWR is the device power voltage.

In order to switch the device to state 2, it is required to send a command to LoRaWAN® port 2:

0x03 0x01 0xXX, where XX – time in seconds for which you want to close the output. If XX = 0, the output is closed forever.

In order to switch the device to state 3, it is required to send a command to LoRaWAN® port 2:

0x03 0x02 0xXX, where XX – time in seconds for which you want to close the output. If XX = 0, the output is closed forever.

To switch the outputs OUT_1 and OUT_2 to their initial state (the outputs are connected to the "Ground"), the following commands are provided:

To switch the OUT_1 output back to the "Ground", it is required to send the command to LoRaWAN® port 2: 0x04 0x01

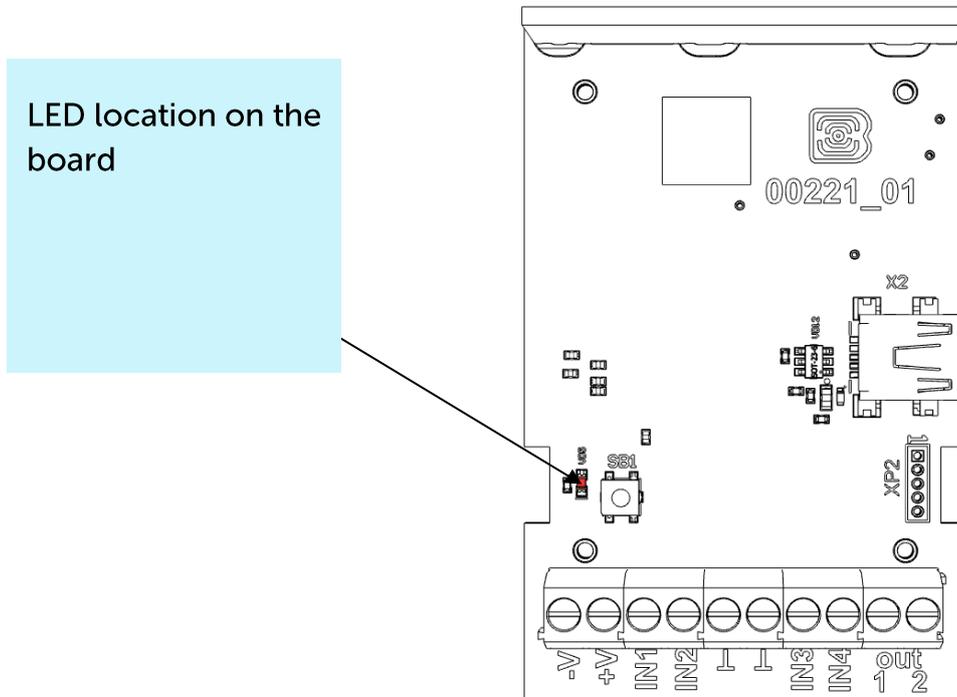
To switch the OUT_2 output back to the "Ground", it is required to send the command to LoRaWAN® port 2: 0x04 0x02

For a clearer presentation, the commands can be summarized in a table. All commands are sent to LoRaWAN® port 2.

| Command | OUT_1 state | OUT_1 state |
|-----------------------|---------------------------|---------------------------|
| The device is powered | Connected to the "Ground" | Connected to the "Ground" |
| 0x03 0x01 0x00 | Connected to device power | Connected to the "Ground" |
| 0x04 0x01 | Connected to the "Ground" | Connected to the "Ground" |
| 0x03 0x02 0x00 | Connected to the "Ground" | Connected to device power |
| 0x04 0x02 | Connected to the "Ground" | Connected to the "Ground" |

LED INDICATIONS

There is one red LED on the board. The indication is only used when the device is activating in the LoRaWAN® network and when the operating modes are changing.



| LED SIGNAL | | MEANING |
|---|--------------------------------|---|
|  | Short flashings | Linking to the network in progress |
|  | One long flashing during 5 sec | The device has been successfully connected to the network and is in active mode |
|  | Three flashings each by 1 sec | Linking to the network has been failed or the device switched to the "Storage" mode |



In case of connection attempt fail, the device will continue to accumulate data and will attempt to connect to the network every 6 hours

MOUNTING RECOMENDATIONS

To provide the stable radio between the gateway and the end device is recommended avoiding the device installation in the places which are barriers for the radio signal getting through like a reinforced floors and walls, a basement, an underground facilities and wells, a metal case etc.

The necessary stage for the network deploying including a big quantity of end devices is a radio planning work with nature experiments.



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

For mounting you will need:

- ⦿ cross-shaped screwdriver ;
- ⦿ awl;
- ⦿ wire stripper;
- ⦿ laptop.

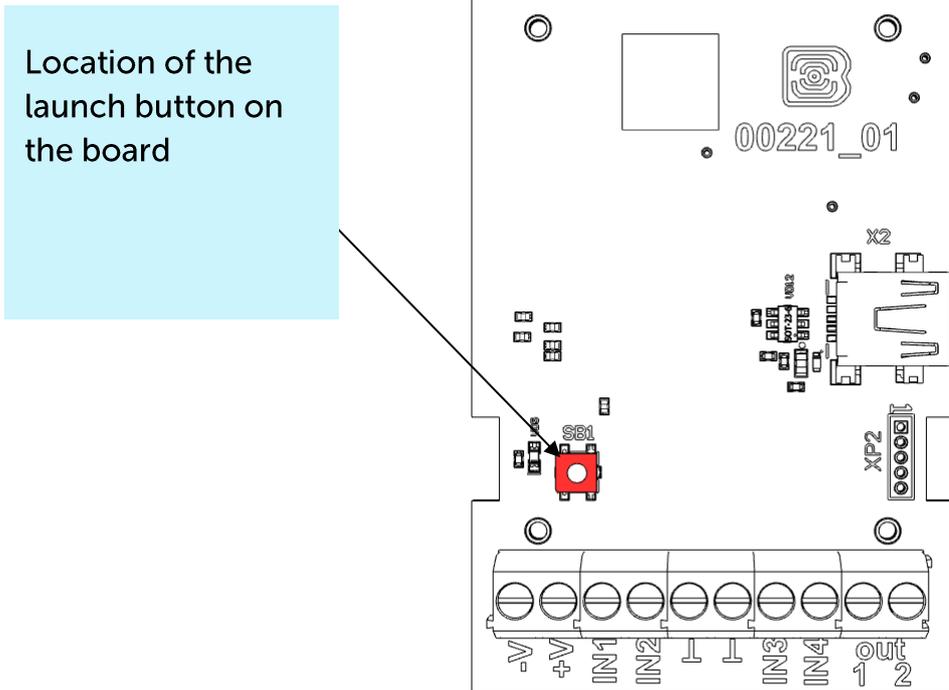
Step by step mounting be like:

1. Setting the devices and connecting them to the network are usually carried out in the office (see Network Deployment Manual).
2. Determination of suitable places for mounting at the object with a network tester.
3. De-energizing the connected equipment, metering devices, etc.
4. Making holes in the silicone gasket for wires - strictly according to the number of wires. It must be remembered that the wire must be of circular cross-section and no more than 3 mm in diameter.



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 SI-12 RELAY contacts.
6. Device launching – switching to the “Active” mode and registration in the network.



7. By the laptop you can make sure that the device successfully sends the data.
8. Before assembling the device, it is necessary to reset the pulses accumulated during testing and connection by switching the device to the "Storage" mode by pressing the button for 5 seconds.
9. Start the device by pressing launch button.
10. Assembling the device.
11. DIN-rail mounting or another available way to mount the device on the object.

4 COMMUNICATION PROTOCOL

This part describes the SI-12 RELAY communication protocol with LoRaWAN® network.



In fields consisting of several bytes, the little endian byte order is used

VEGA SI-12 RELAY PULSE COUNTER TRANSMITS THE FOLLOWING TYPES OF PACKETS

1. Packet with current readings

Передается регулярно на LoRaWAN® порт 2

| Size in bytes | Field description | Data type |
|---------------|--|-----------|
| 1 byte | Packet type, this packet == 1 | uint8 |
| 1 byte | Reserve, value always 0x64 | uint8 |
| 1 byte | Values of basic settings (bit field) | uint8 |
| 4 bytes | Reading time for values in this packet (unixtime UTC) | uint32 |
| 1 byte | Temperature, °C | int8 |
| 4 bytes | Input 1 reading (depending on the type – number of pulses or status: 0 – open, 1 - closed) | uint32 |
| 4 bytes | Input 2 reading (depending on the type – number of pulses or status: 0 – open, 1 - closed) | uint32 |
| 4 bytes | Input 3 reading (depending on the type – number of pulses or status: 0 – open, 1 - closed) | uint32 |
| 4 bytes | Input 4 reading (depending on the type – number of pulses or status: 0 – open, 1 - closed) | uint32 |

The counter has internal clock and calendar; time and date are factory set. When sending a packet with the current readings, the device uses the data taken at the nearest time, which is multiple to the interval according to data collection period:

- ⦿ 1 hour period: the readings of the beginning of the current hour are sent;
- ⦿ 6 hours period: 00:00, 06:00, 12:00, 18:00 readings are sent;
- ⦿ 12 hours period: 00:00, 12:00 readings are sent;
- ⦿ 24 hours period: the readings of 00:00 of the current day are sent.

"Values of basic settings" bit field decoding

| Bit | Meaning |
|--------------|---|
| 0 bit | Activation type: 0 - OTAA, 1 – ABP |
| 1, 2, 3 bits | Communication period: 1 == 0 2==0 3==0 - 5 minutes 1 == 1 2==0 3==0 - 15 minutes 1 == 0 2==1 3==0 - 30 minutes 1 == 1 2==1 3==0 - 1 hour 1 == 0 2==0 3==1 - 6 hours 1 == 1 2==0 3==1 - 12 hours 1 == 0 2==1 3==1 - 24 hours |
| 4 bit | First input type: 0 – pulse, 1 - security |
| 5 bit | Second input type: 0 – pulse, 1 - security |
| 6 bit | Third input type: 0 – pulse, 1 - security |
| 7 bit | Fourth input type: 0 – pulse, 1 - security |

2. "Alarm" packet

Packet sent in case of security input closure on LoRaWAN® port 2

| Size in bytes | Field description | Data type |
|---------------|--|-----------|
| 1 byte | Packet type, this packet == 2 | uint8 |
| 1 byte | Battery charge, % | uint8 |
| 1 byte | Values of basic settings (bit field) | uint8 |
| 1 byte | Input No, where the alarm is detected (1..4) | uint8 |
| 4 bytes | Time of the modem at a moment of the packet transmission (unixtime UTC) | uint32 |
| 4 bytes | Input 1 reading (depending on the type – number of pulses or status: 0 – open, 1 - closed) | uint32 |
| 4 bytes | Input 2 reading (depending on the type – number of pulses or status: 0 – open, 1 - closed) | uint32 |
| 4 bytes | Input 3 reading (depending on the type – number of pulses or status: 0 – open, 1 - closed) | uint32 |
| 4 bytes | Input 4 reading (depending on the type – number of pulses or status: 0 – open, 1 - closed) | uint32 |

When sending alarm packet, the device uses the data taken at moment of alarm triggers.

3. Output state information packet

Sent whenever each output is turned on to LoRaWAN® port 2

| Size in bytes | Field description | Data type |
|---------------|--------------------------------------|-----------|
| 1 byte | Packet type, this packet == 5 | uint8 |
| 1 byte | Reserve, value always 0x64 | uint8 |
| 1 byte | Values of basic settings (bit field) | uint8 |

| | | |
|---------|---------------------------------------|--------|
| 1 byte | Output number (1-2) | uint8 |
| 1 byte | New output state (0 – off, 1 - on) | uint8 |
| 4 bytes | Generation packet time (unixtime UTC) | uint32 |

4. Packet with time correction request

Sent every seven days on LoRaWAN® port 4

| Size in bytes | Field description | Data type |
|---------------|---|-----------|
| 1 byte | Packet type, this packet == 255 | uint8 |
| 4 bytes | Time of the modem at a moment of the packet transmission (unixtime UTC) | uint32 |

After receiving this type of package, the application can send to modem the packet with time correction.

5. Settings packet

Transmitting on LoRaWAN® port 3 when settings request command received, or device connected to the network

| Size in bytes | Field description | Data type |
|---------------|-------------------------------|-----------|
| 1 byte | Packet type, this packet == 0 | uint8 |
| 2 bytes | ID of parameter | uint16 |
| 1 byte | Data length (len) | uint8 |
| len bytes | Parameter value | ----- |
| 2 bytes | ID of parameter | uint16 |
| 1 byte | Data length (len) | uint8 |
| len byte | Parameter value | ----- |
| ... | ... | ... |
| 2 bytes | ID of parameter | uint16 |
| 1 byte | Data length (len) | uint8 |
| len bytes | Parameter value | ----- |

VEGA SI-12 RELAY PULSE COUNTER RECEIVES PACKETS OF THE FOLLOWING TYPES

1. Real-time clock adjustment

Sent by application on LoRaWAN® port 4

| Size in bytes | Field description | Data type |
|---------------|--|-----------|
| 1 byte | Packet type, this packet == 255 | uint8 |
| 8 bytes | The value in seconds for which you need to adjust the time. Can be positive or negative | int64 |

When receiving the packet, the pulse counter sets its internal clock and calendar in compliance with the received packet.

2. Output on command

Sent by application on LoRaWAN® port 2

| Size in bytes | Field description | Data type |
|---------------|---|-----------|
| 1 byte | Packet type, this packet == 3 | uint8 |
| 1 byte | Output no. (1 or 2) | uint8 |
| 1 byte | Output on time in seconds (1...255, 0 - forever). | uint8 |

The control of relay outputs is described in detail in the section "Operation of relay outputs"

3. Output off command

Sent by application on LoRaWAN® port 2

| Size in bytes | Field description | Data type |
|---------------|-------------------------------|-----------|
| 1 byte | Packet type, this packet == 4 | uint8 |
| 1 byte | Output no. (1 or 2) | uint8 |

4. Packet with request of settings

Sent by application on LoRaWAN® port 3

| Size in bytes | Field description | Data type |
|---------------|-------------------------------|-----------|
| 1 байт | Packet type, this packet == 1 | uint8 |

Answering that packet, the device sent the packet with settings.

5. Packet with settings

Sent by application on LoRaWAN® port 3, identical to such packet from device

| Size in bytes | Field description | Data type |
|---------------|-------------------------------|-----------|
| 1 byte | Packet type, this packet == 0 | uint8 |
| 2 bytes | ID of parameter | uint16 |
| 1 byte | Data length (len) | uint8 |
| len bytes | Parameter value | ----- |
| 2 bytes | ID of parameter | uint16 |
| 1 byte | Data length (len) | uint8 |
| len byte | Parameter value | ----- |
| ... | ... | ... |
| 2 bytes | ID of parameter | uint16 |
| 1 byte | Data length (len) | uint8 |
| len bytes | Parameter value | ----- |

The package with settings sent to the device may not contain all the settings supported by the device, but only the part that needs to be changed.

Table of ID of SI-12 RELAY parameters and these possible values

| ID of parameter | Description | Data length | Possible values |
|-----------------|---------------------------------|-------------|--|
| 4 | Confirmed uplinks | 1 byte | 1 – confirmed 2 – unconfirmed |
| 8 | Uplinks number of transmissions | 1 byte | from 1 to 15 |
| 12 | Input 1 mode | 1 byte | 1 – pulse 2 – guard |
| 13 | Input 2 mode | 1 byte | 1 – pulse 2 – guard |
| 14 | Input 3 mode | 1 byte | 1 – pulse 2 – guard |
| 15 | Input 4 mode | 1 byte | 1 – pulse 2 – guard |
| 16 | Communication period | 1 byte | 1 – 1 hour 2 – 6 hours 3 – 12 hours 4 – 24 hours 5 – 5 minutes 6 – 15 minutes 7 – 30 minutes |
| 49 | Data collection period | 1 byte | 1 – 1 hour 2 – 6 hours 3 – 12 hours 4 – 24 hours 5 – 5 minutes 6 – 15 minutes |

| | | | |
|----|-----------------------|---------|------------------|
| | | | 7 – 30 minutes |
| 55 | Time zone, in minutes | 2 bytes | from -720 to 840 |

5 STORAGE AND TRANSPORTATION REQUIREMENTS

Vega SI-12 RELAY 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.

6 CONTENT OF THE PACKAGE

The pulse counter is delivered complete with:

Vega SI-12 RELAY pulse counter – 1 pc.

Screw – 4 pcs.

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 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

| | |
|-------------------|-----------------------------------|
| Title | Pulse Counter Vega SI-12 RELAY |
| Document type | Manual – Translation from Russian |
| Document number | V02-SI12R-01 |
| Revision and date | 02 of 11.01.2022 |

Revision History

| Revision | Date | Name | Comments |
|----------|------------|------|------------------------|
| 01 | 06.10.2021 | KMA | Document creation date |
| 02 | 11.01.2022 | KMA | Minor changes |



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