Pulse Counter

VEGA SI-22

User manual

DOCUMENT REVISION	FIRMWARE VERSION
11	2.3

CONTENTS

INTRODUCTION

This manual is designated for Vega SI-22 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 SI-22 pulse counter is designed for counting of pulses incoming to 4 independent inputs, further accumulating and transmitting of this information in the LoRaWAN® network.

In addition, Vega SI-22 can be used as a security device - pulse inputs can be configured as security inputs.

The pulse counter can check the specified temperature range. When configuring the device, you can set the low and high thresholds for permissible temperature values. When the temperature value goes beyond the range, the modem starts an extraordinary communication session. The data collection period for operation within the temperature range and outside is configurable separately.

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

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

Vega SI-22 has ability to connect an external temperature sensor for taking temperature readings from objects which require such control.

The counter is powered by a 3600 mAh battery.

> **The device is powered by a non-rechargeable lithium-thionyl chloride (LiSOCl$_2$) battery**
> **Attempts to charge the battery may result in fire**

OPERATION ALGORITHM

Vega SI-22 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-22 supports two activation methods in the LoRaWAN® network - ABP and OTAA. Select one of the methods via the "Vega LoRaWAN Configurator" application (see "User Manual" on the program).

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 device 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.

Data collection period when measurements are out of specified temperature range set independently and may be equal from 5 minutes to 24 hours.

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.

When measurements are out of specified temperature range the communication period still the same if parameter "Immediately send data when temperature is out of range" is not active. If that parameter is active, then the alarm message will be formed and sent during 2 minutes after the moment of temperature measurements become out of specified range.

Every following message, which will form according to the data collection period, also will have sent immediately until the temperature measurements are back in range.

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

FUNCTIONAL

Vega SI-22 pulse counter is A class device (LoRaWAN® classification) and has the following features:

- ⊙ ADR support (Adaptive Data Rate)

- ⊙ Sending of confirmed packets (configurable)

- ⊙ Two operating modes: "Active" and "Storage"

- ⊙ Inputs can be switched to «security» mode for connection to external leakage and safety sensors, etc.

- ⊙ Ability to connect an external temperature sensor

- ⊙ Unscheduled sending of an alarm packet when the temperature goes out the specified range

- ⊙ The ability to set a shortened data collection interval for the case when the measured temperature values go out the specified temperature range

- ⊙ Time referencing of readings by internal clock

- ⊙ Communication in case of security inputs actuation

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

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 DevEUI and keys for device registration in network via OTAA method.

2 SPECIFICATION

DEVICE SPECIFICATION

MAIN	
Double-contact digital inputs	up to 4
Maximum input frequency	200 Hz
Security inputs	up to 4
USB-port	micro-USB, type B
Operating temperatures	-40...+85 °C
Ability to connect an external temperature sensor	yes
LORAWAN®	
LoRaWAN® class	A
Quantity of LoRaWAN® channels	16
Frequency plans supported by default	RU868, EU868, KZ865, custom (EU868 based)
Frequency plans available as order option	IN865, AS923, AU915, KR920, US915
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 LoRa antenna	external, SMA-F connector
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)
Maximum transmitter power	100 mW
POWER	
Battery	SAFT LS 17500 3600 mAh
Calculated number of packets sent by the device with default settings	80 000
CASE	
Housing dimensions (without cable gland and SMA-connector), no more than	96 x 96 x 50 mm
Ingress protection rating	IP65
PACKAGE	
Dimensions	165 x 118 x 57 mm
Weight	0.365 kg

DEFAULT DEVICE SETTINGS

PARAMETER	VALUE
Frequency plan	RU868
Activation type	OTAA
Adaptive Data Rate	ON
Confirmed Uplinks	OFF
Rx 1 Delay	1 second
Join Accept Delay	5 seconds
Uplink number of transmissions	1
Data rate	DR0
Power	14 dBm
Communication period	24 hours
Data collection period	24 hours
Data collection period when temperature is out of range	1 hour
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-22 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.
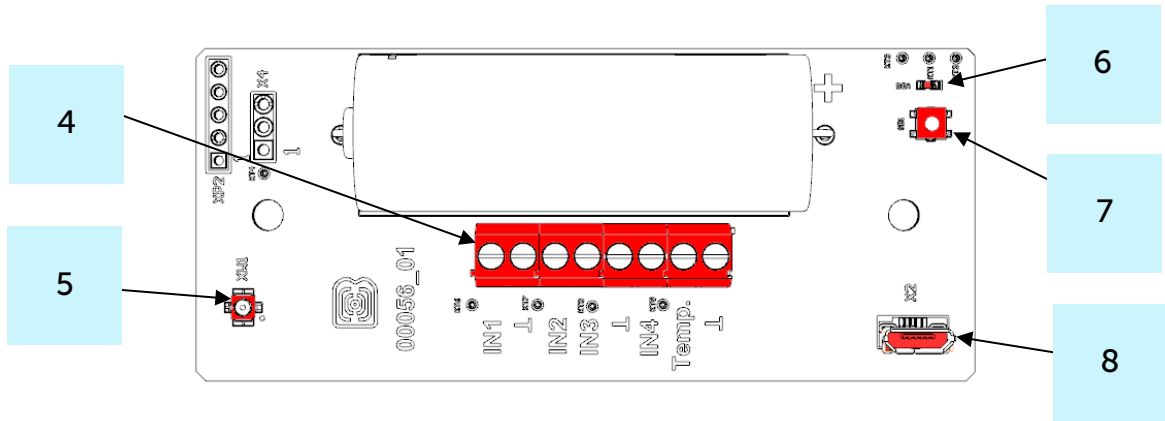

2 – cable gland of M12 size for installing the cables and wires with circular cross-section with a diameter of 5...6 mm

3 – input of external antenna

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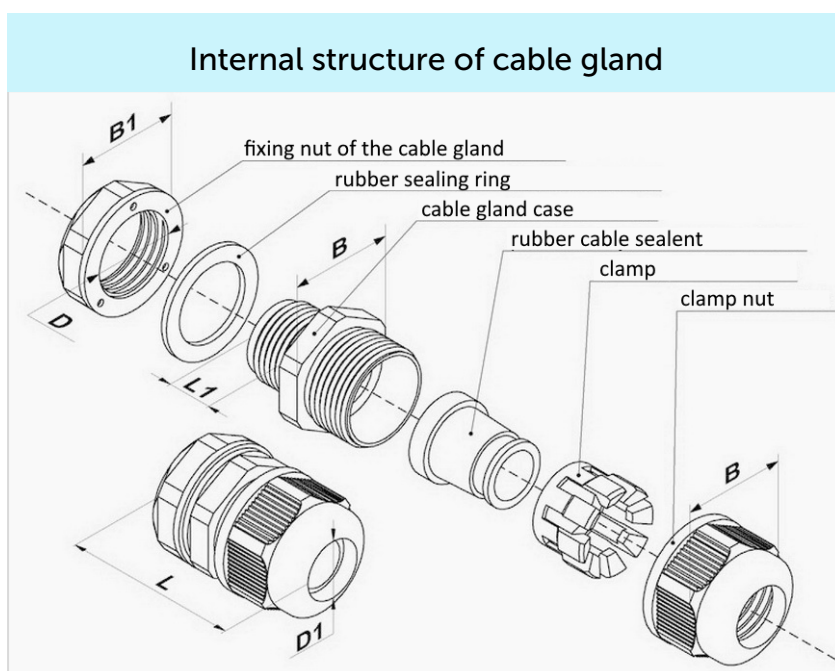
All of elements for manage and indication as well as connecting contacts are placed on the board inside the case.

4 – contacts

5 – input for connecting an external antenna

6 – LED indicator

7 – launch button

8 – USB-port

CONTACTS DESCRIPTION

When connecting a radio modem to external devices, consider the internal circuitry of its pulse inputs shown below.
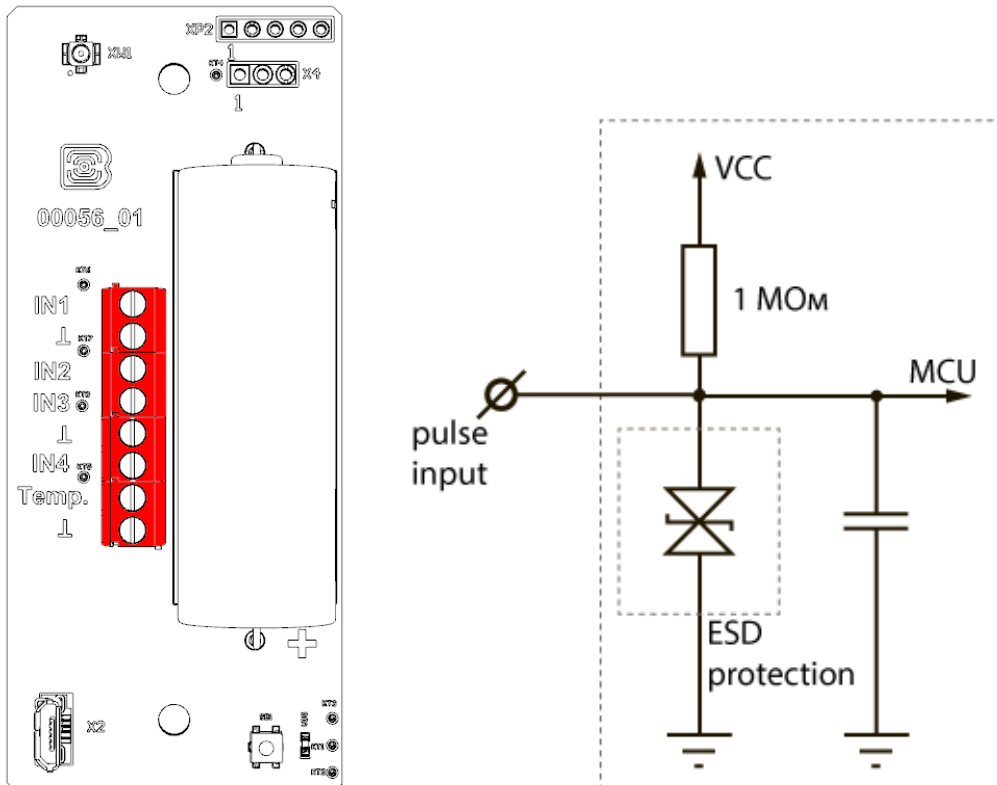
De-bouncing logics with 5 msec time constant is integrated in the pulse counter. The pulse counting is carried out for frequencies up to 200 Hz.

The pulse counter has 4 pairs of contacts and it can connect circuits with the following types of NO contacts:

- reed switch;

- mechanical pushbutton;

- open-drain output.

> Equipment with NAMUR pulse output is not supported

Polarity effects only "open collector" circuits.

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

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.

Also, there are a couple of contacts on the board for connection an external thermistor, it is contacts «Temp.» and «⊥». It is necessary to configure sending parameters for thermistor readings in the «Vega LoRaWAN Configurator» application.

INDICATION

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

LED on the board
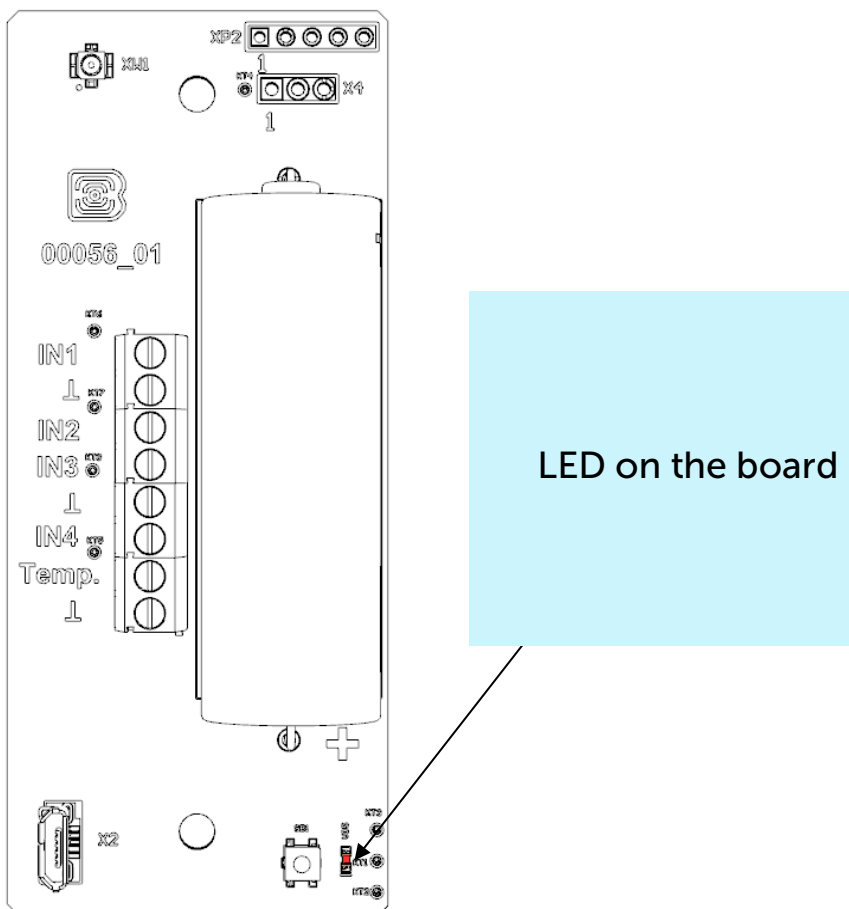
LED SIGNAL		MEANING
🟥🟥🟥🟥🟥🟥🟥🟥🟥	Short flashings	Linking to the network in progress
🟥🟥🟥🟥🟥🟥	One long flashing during 5 sec	The device has been successfully connected to the network and is in active mode
🟥🟥🟥⬜⬜⬜	Three flashings each by 1 sec	Linking to the network has been failed or the device switched to 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:

- ⊙
- ⊙ 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. 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**
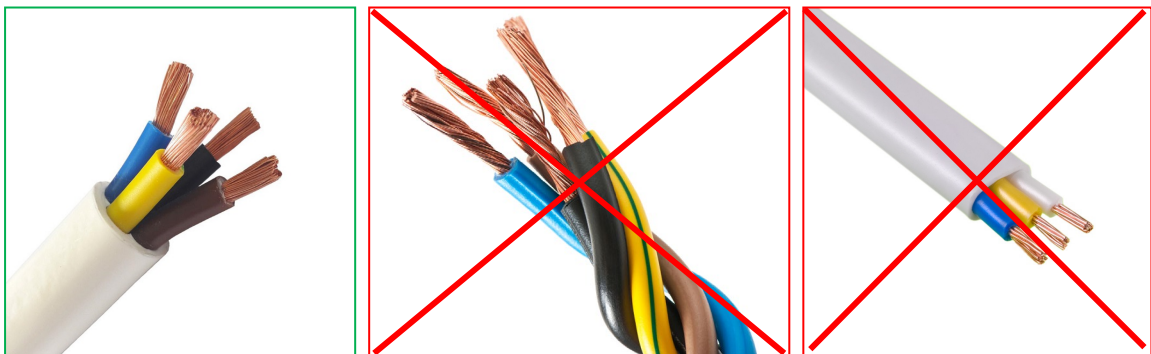
5. Connecting all necessary wires to the SI-22 contacts.

6. When the power is connected at the first time the device automatically switches to the "Active" mode and starts registration in the network. But if the device with connected battery has been switched to the "Storage" mode (by the pressing on the start button more than 5 sec) then you need to press the button to start.

Location of the launch button on the board
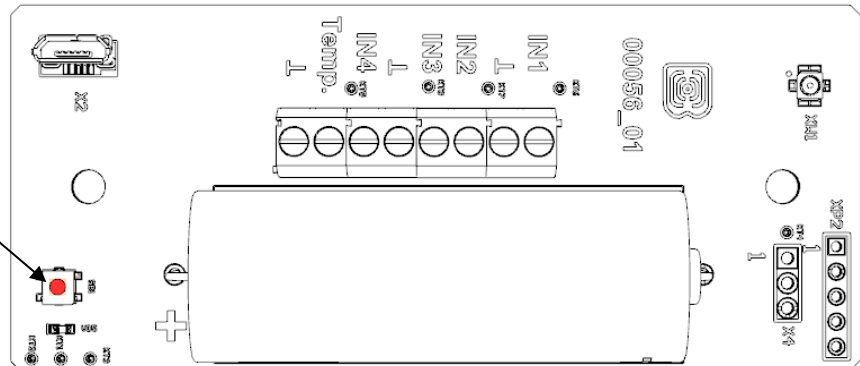
7. By the laptop you can make sure that the device successfully sends the data.
8. Before assembling the device, it is necessary to reset the pulses accumulated during testing and connection by switching the device to the "Storage" mode by pressing the button for 5 seconds.
9. Start the device by pressing launch button.
10. Assembling the device.

4 COMMUNICATION PROTOCOL – VERSION 2.0

This part describes the last version of the communication protocol for SI-22 data exchange with LoRaWAN® network. You can see the device protocol version number in the "Configurator" application in the "Device info" tab.

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

VEGA SI-22 PULSE COUNTER TRANSMITS THE FOLLOWING TYPES OF PACKETS

1. Packet with current readings

Sent regularly or by event on LoRaWAN port 2.

Size in bytes	Field description	Data type
1 byte	Packet transmitting reason: 00 - Transmitting by the schedule 01 - Input 1 triggered 02 - Input 2 triggered 03 - Input 3 triggered 04 - Input 4 triggered 05 - Temperature went out of range	uint8
1 byte	Battery charge, %	uint8
4 bytes	This packet time (unixtime UTC)	uint32
2 bytes	Temperature in °C multiplied by 10	int16
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
1 byte	Temperature is out of range («0» - no, «1» - out of range)	uint8t
1 byte	Low temperature threshold (from -128 °C to +127 °C)	int8t
1 byte	High temperature threshold (from -128 °C to +127 °C)	int8t

> If thermistor is not connected to the pulse counter (contacts «Therm» and «⊥»), in the «Temperature» field will be sent an -1000 °C value for breakage or fault indication
> When thermistor has a short circuit, in the "Temperature" field the value -1270 °C will transmit

The counter has internal clock and calendar; time and date on which are preset on the factory and it may be corrected during exploitation. Forming of packets with the current readings is going on for the time moments, which is multiple to the set 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.

Time zone considered during collection data from an external meter.

2. 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.

3. Settings packet

Transmitting on LoRaWAN port 3 when settings request command was received, or device was 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 bytes	Parameter value	-----
...	...	...
2 bytes	ID of parameter	uint16
1 byte	Data length (len)	uint8
len bytes	Parameter value	-----

VEGA SI-22 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

2. Packet with request of settings

    Sent by application on LoRaWAN port 3.

Size in bytes	Field description	Data type
1 byte	Packet type, this packet == 1	uint8

Answering that packet, the device will send the packet with settings.

3. Packet with settings

    It is 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 bytes	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-22 parameters and these possible values

ID of parameter	Description	Data length	Possible values
4	Confirmed uplinks	1 byte	1 – confirmed 2 – unconfirmed
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
78	Data collection period when temperature is out of the thresholds	1 byte	1 – 1 hour 2 – 6 hours 3 – 12 hours 4 – 24 hours 5 – 5 minutes 6 – 15 minutes 7 – 30 minutes
79	Immediately send data when temperature is out of range	1 byte	0 – OFF 1 – ON
80	Low temperature threshold	1 byte	from -128 to +127
81	High temperature threshold	1 byte	from -128 to +127

5 STORAGE AND TRANSPORTATION REQUIREMENTS

Vega SI-22 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-22 pulse counter – 1 pc.

LoRa antenna – 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 "Operation Manual".

The warranty period is 36 months if the number of data packets sent by the product is up to 25,000.

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 please contact the service center:

113/1, Kirova Str., Novosibirsk, 630008, Russia.

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

e-mail: remont@vega-absolute.ru

DOCUMENT INFORMATION	
Title	Pulse Counter Vega SI-22
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Document number	V02-SI22-01
Revision and date	11 of 11 August 2021

Revision History

Revision	Date	Name	Comments
01	27.11.2018	KEV	Document creation date
02	22.01.2019	KEV	"Marking" part added, device AppEui added in specification, setting "by the air" description, communication protocol changed, content of the package changed
03	24.01.2019	KEV	Inaccuracy in communication protocol fixed – packet type for packets with settings and request of settings
04	30.05.2019	KEV	Content of the package changed
05	10.09.2019	KEV	Specification changed (external sensor erased), new recommendation
06	13.12.2019	KEV	AppEui default value is changed, changes in communication protocol, information about the cable gland is added
07	09.04.2020	KEV	Changes in communication protocol
08	15.09.2020	KEV	AppEui devices have been removed from specification, changes in functionality, added temperature thresholds, changes in communication protocol
09	23.10.2020	KEV	We add version number for the communication protocol
10	30.04.2021	KEV	An error in communication protocol ("Packet transmitting reason" field is not bit), warranty has changed
11	11.08.2021	KEV	

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