LORAWAN® DEVICE

VEGA SI-13

USER MANUAL

DOCUMENT REVISION	SI-13 REVISION	FIRMWARE VERSION
20	2	3.2

CONTENTS

INTRODUCTION

This manual is designated for Vega SI-13-232 and Vega SI-13-485 modems (hereinafter – the modem) manufactured by Vega-Absolute OOO and provides information on powering and activation procedure, control commands and functions of the modem.

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 DEVICE PURPOSE AND OPERATION PRINCIPAL

DEVICE PURPOSE

Vega SI-13 has two design options, varying by data exchange interface:

- Vega SI-13-232 with RS-232 interface;
- Vega SI-13 -485 with RS-485 interface.

Vega SI-13 modem is designed for counting of pulses incoming to 2 independent inputs, further accumulating and transmitting of this information in the LoRaWAN® network.

Vega SI-13 can be used as a security device - all inputs can be configured as security inputs.

The modem can be used for any utilities' meters and industrial equipment with RS-232 and RS-485 interfaces or pulse outputs, including water-, electricity-, and heat meters. Vega SI-13 can work as a wireless modem in the transparent mode or poll meters by itself.

Equipment supported in independent polling mode:

- Mercury 206 R****
- Pulse STK-15-M RS-485
- Energomera CE102M

The modem is powered by an 9...36 V (DC) external power supply.

Equipment with NAMUR pulse output is not supported

OPERATION ALGORITHM

Vega SI-13 operates in modes listed below:

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

Vega SI-13 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 connecting the power, the device immediately starts working in the "Active" mode.

OTAA method. After power is applied, the device will start counting a random time interval from 1 second to 5 minutes, after it will start trying to connect to the network.

If you need to reconnect to the network or initiate an extraordinary communication session, you must bring the magnet to the Hall sensor for 10 seconds. The device will make 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 1 hour.

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 calculates 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 via USB-UART, FSK radio channel or using a MAC command.

FUNCTIONAL

Vega SI-13 modem is class C device (LoRaWAN® classification) and has the following features:

- Operation as LoRaWAN® <-> RS-232 or LoRaWAN® <-> RS-485 wireless modem
- Independent polling of external equipment via the ModBus RTU protocol
- Independent polling of external equipment by custom commands
- Independent polling of metering devices via manufacturer's protocols
- ADR support (Adaptive Data Rate)
- Sending of confirmed packets (configurable)
- Inputs can be switched to «security» mode for connection to external leakage and safety sensors, etc.
- Communication in case of security inputs actuation
- Temperature measurement

MARKING

Device marked with sticker that contain the following information:

- Device model;
- DevEUI;
- Month and year of manufacture;
- Certification marks.

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 device activation keys in the LoRaWAN® network, production date and other identifiers.

2 SPECIFICATION

DEVICE SPECIFICATION

MAIN	
Double-contact digital inputs	up to 2
Maximum input frequency	200 Hz
Security inputs	up to 2
Interface	RS-232 or RS-485
USB-port	mini-USB, type B
Operating temperatures	-40...+85 °C
Built-in temperature sensor	yes
LORAWAN®	
LoRaWAN® class	C
Quantity of LoRa 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
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	9...36 V / 0.2 A
CASE	
Device dimensions, no more than	90 x 49 x 46 mm
Ingress protection rating	IP65
Mounting	Clamp fastening to the support, DIN-rail, wall-mounting
PACKAGE	
Dimensions	95 x 50 x 46 mm
Weight	0.071 kg

DEFAULT DEVICE SETTINGS

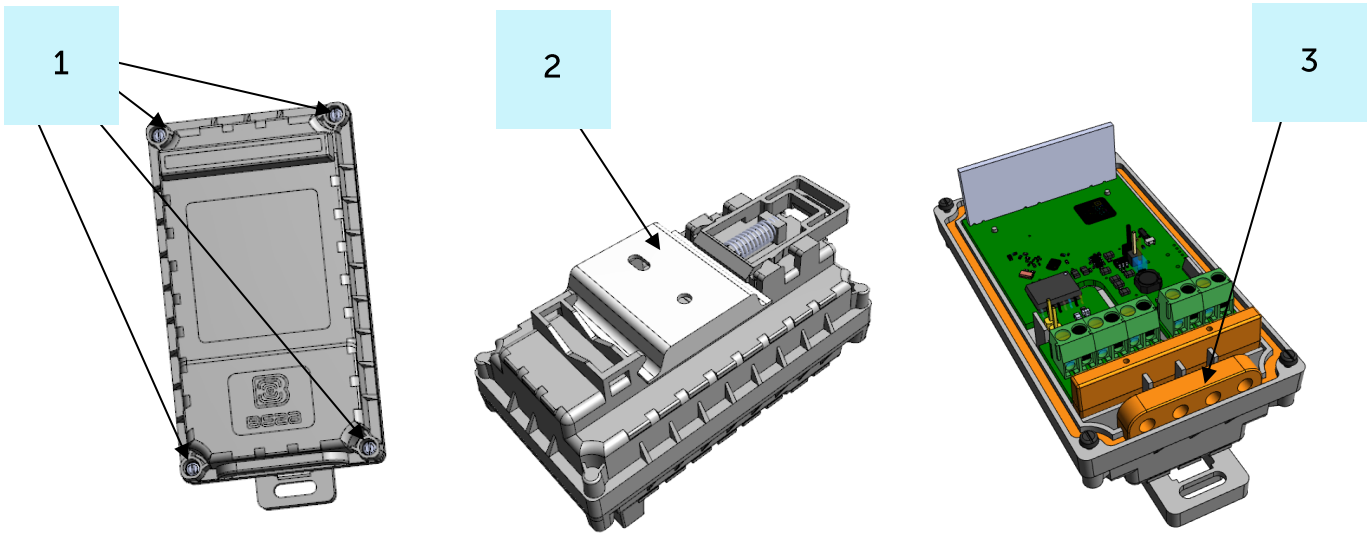
PARAMETER	VALUE
Frequency plan	RU868
Activation type	OTAA
Adaptive Data Rate (ADR)	ON
Confirmed Uplinks	OFF
Rx 1 Delay	1 second
Join Accept Delay	5 seconds
Uplink number of transmissions	1
Data rate	DR0
Power	14 dBm
Communication period	24 hours
Collecting data period	24 hours
Time zone	UTC +00:00
Inputs operate in mode	pulse
Interrogate plugged devices	Polling off (only transparent radio channel)
Speed	9600
Data bits	8 bit
Parity	None
Stop bits	1 stop bit
Answer timeout	100 ms

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-13 is represented in small plastic case which has four screws and mounting for DIN-rail.

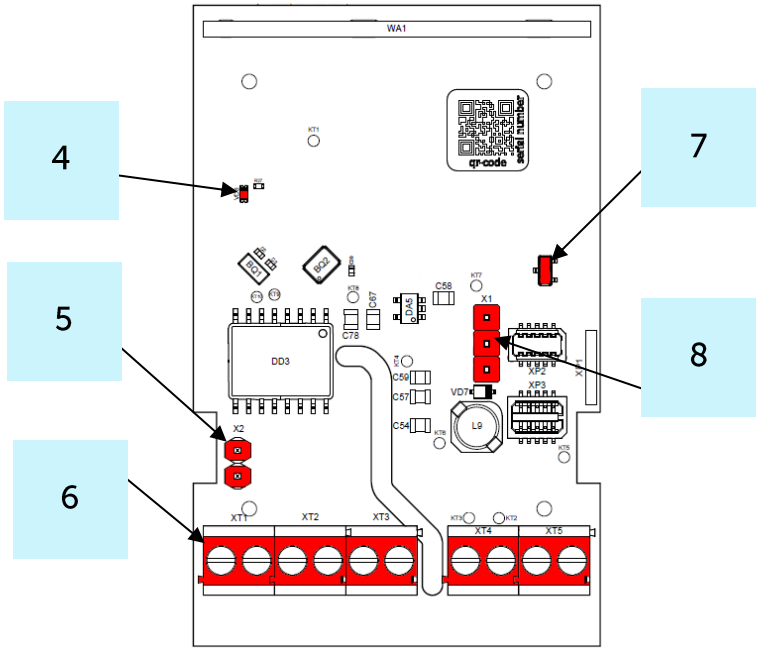


1 – screw ø 2 mm x 8 mm, cross

2 – DIN-rail with mounting holes ø 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 – LED indicator

5 – X2 interface

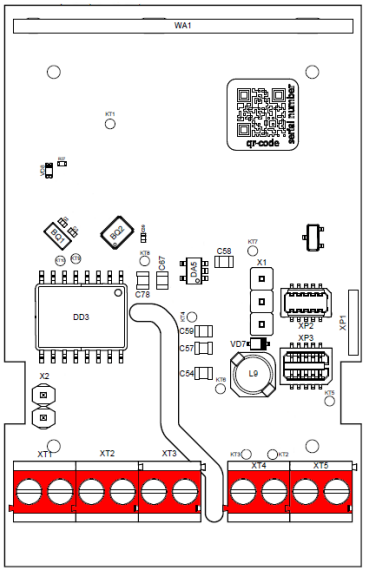
6 – contacts

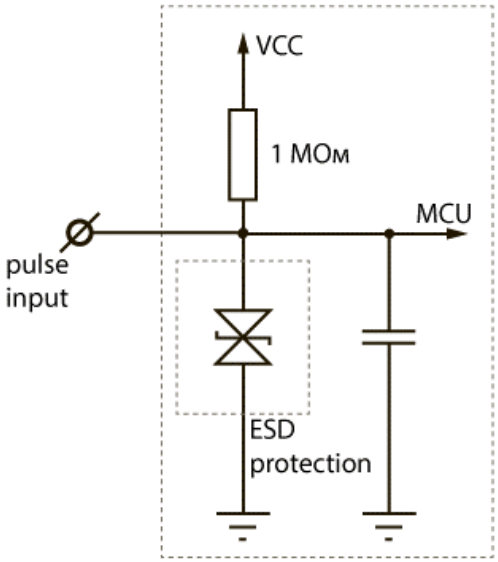
7 – Hall sensor

8 – UART

CONTACTS DESCRIPTION

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





The modem has 10 contacts, see table below:

CONTACT	DESCRIPTION
A	RS-485 A
B	RS-485 B
Tx	RS-232 TX
Rx	RS-232 RX
GND OUT	Ground
GND OUT	Ground
COUNT 1	Input 1
COUNT 2	Input 2
GND	Ground
+V	Power +

Ground **GND** contact is used for connecting of **RS-232** or **RS-485**; ground **GND OUT** is used for connecting of **COUNT 1** and **COUNT 2** pulse inputs.

The modem has an adjustable pulse filter (debounce). For each pulse input, it is possible to set the parameters: the minimum pulse duration and the minimum duration of the pause between. Pulse counting is carried out for frequencies up to 200 Hz.

Pulse and security inputs can be configured to read closing (default) inputs, opening inputs, or both at the same time

Modem's contacts allow to connect circuits with the following types of NO contacts:

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

Equipment with NAMUR pulse output is not supported

Polarity effects only "open collector" circuits.

The pulse readings at the inputs are reset through the "Vega LoRaWAN Configurator" application or by bringing the magnet to the Hall sensor for a set time (see HALL SENSOR).

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.

The maximum possible frequency of sending alarm packets is one per 1 second.

PULSE INPUTS SETTINGS

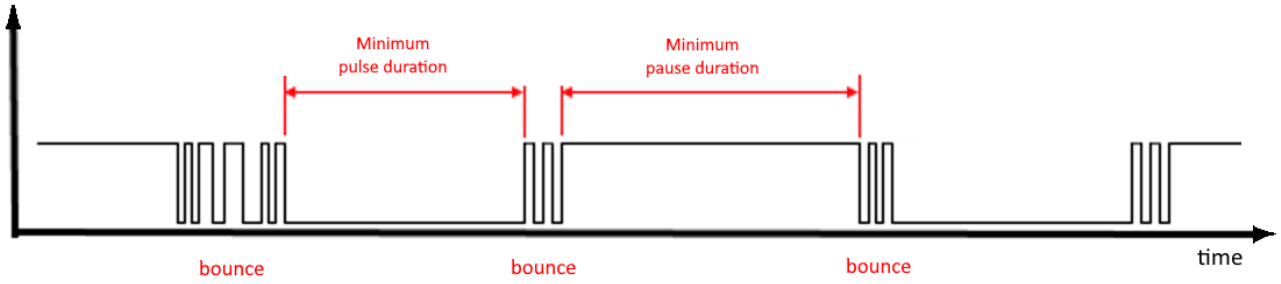
When you connect the modem to metering devices with a pulse output, it is necessary to consider the features of the pulse of a specific type of metering device: bounce, minimum pulse and pause duration. To do this, it is necessary to record the characteristics of the pulse with an oscilloscope or obtain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

The modem has a special software pulse filter (debounce). 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

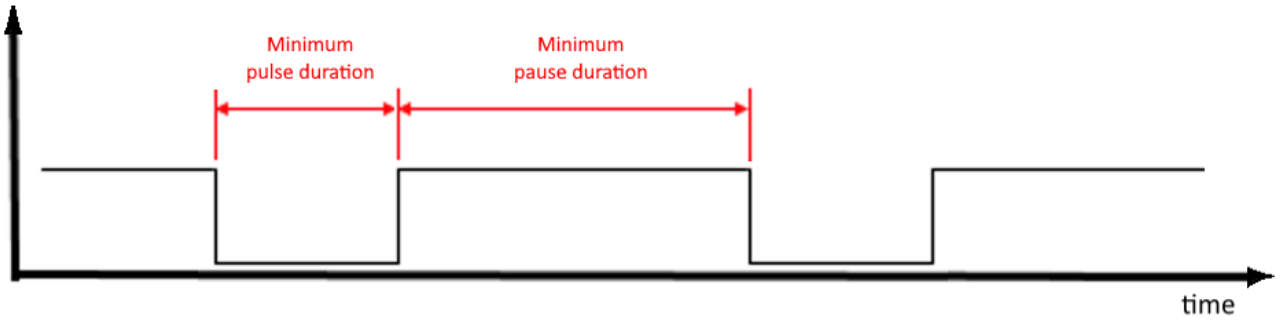
Usually, the mechanical pulse output in metering devices is implemented on a reed switch, but it can also be a button or other mechanics. The main problem with such outputs is contact bounce. At a moment of falling and rising, there are many additional impulses that need to be no considered in the calculation. 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.



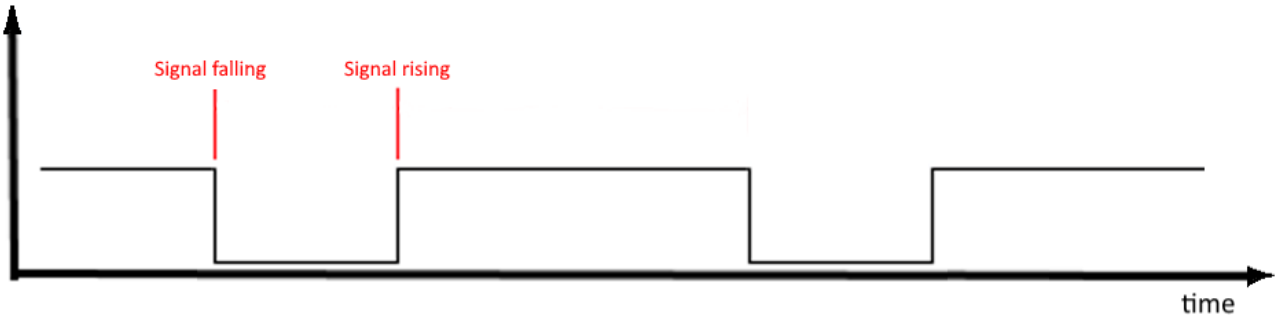
2. Electronic pulse output

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.



3. In addition to filtering pulses by the duration of the pause and pulse, the modem provides the ability to filter the pulse by rising and falling. For detailed settings, refer to the group of parameters for clamping pulses at the inputs. The available values are "make" (falling), "open" (edge), or "make and break".

The pulse inputs of the modem are by default in the logic one state (open). If one of the inputs is shorted to the GND contact, then the signal will drop to a logic zero state. When setting the default pulse clamp (by closing), such a pulse will be counted.



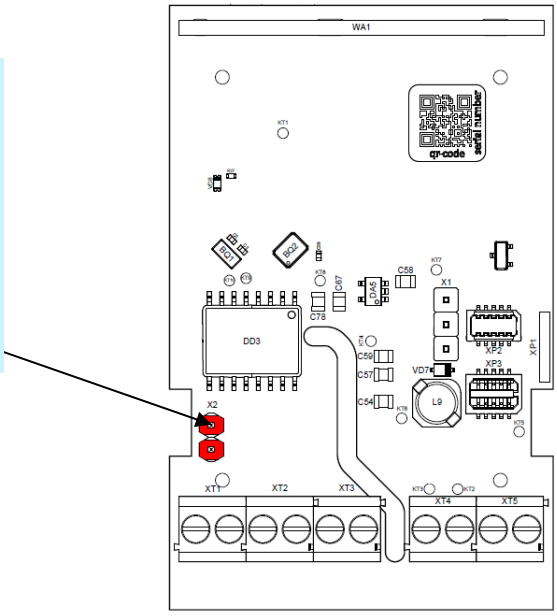
CONNECTION OF TERMINATOR

Terminator installed on the board is a resistor with nominal of 120 Ohm which is inactive by default.

For resistor activation you need to install a jumper at the X2 connector on the board.

Terminator is used for defense from distortion in long transmission lines RS-485, therefore it must be activated when line is longer than 100 meters.

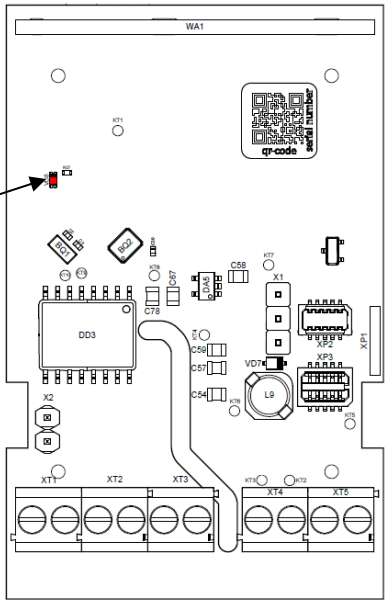
Location of X2 connector on the board



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 location on the board

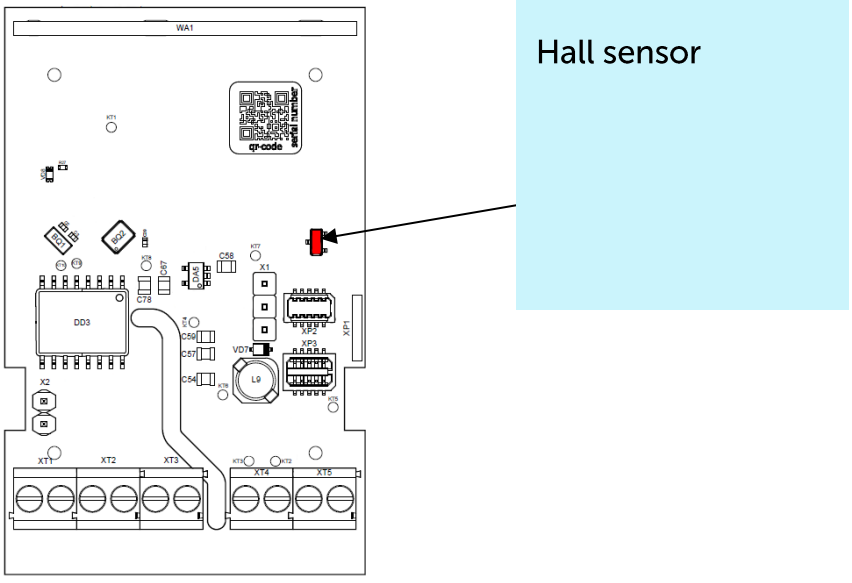


LED SIGNAL		MEANING
	Short flashings	Linking to the network in progress
	One long flashing during 5 sec	The device has been successfully connected to the network and is in active mode
	Three flashings each by 1 sec	Linking to the network has been failed
	Constant glow	Waiting or device connected to Configurator application

In case of connection attempt fail, the device will continue to accumulate data and will attempt to connect to the network every 1 hour

HALL SENSOR

The device is equipped with a Hall sensor.



DURATION OF MAGNET EXPOSURE	RESULT
1 second	Activation of connection to the device via FSK radio channel or UART interface

3 seconds	Network connection
10 seconds	Pulse reset

FSK RADIO CHANNEL

For a local wireless connection to a personal computer (PC), the device implements switching between LoRa and FSK modulation modes, that is, an FSK radio channel is implemented. To organize such a connection, an additional device "Vega FSK Dongle" is used, which is connected to the USB port of the PC. To read and change the modem parameters, the «Vega LoRaWAN Configurator» program is used.

CONNECTING MODEM TO A PERSONAL COMPUTER

The FSK radio channel allows you to organize a local wireless (up to several tens of meters) connection to the modem for reading and changing its parameters.

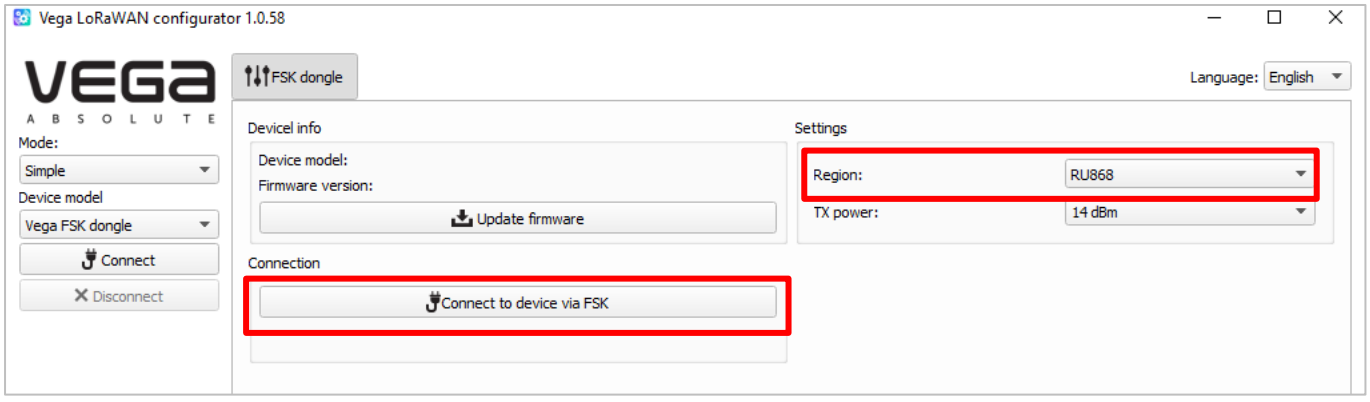
To connect via FSK you will need:

- device "Vega FSK Dongle", which is connected to the USB port of a PC;
- FSK key, which is individual for each device and is contained in a QR code on a sticky label along with activation keys in the LoRaWAN® network and other identifiers.

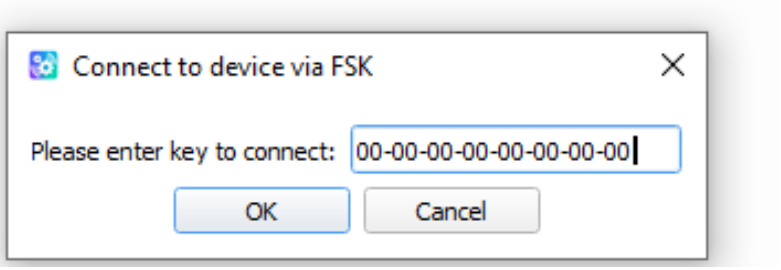
The connection order is as follows:

1. Connect the "Vega FSK Dongle" to the USB port of the PC;
2. Run the «Vega LoRaWAN Configurator» program;
3. Click the "Connect" button in the menu on the left

The program will automatically recognize the device type and the device selection menu will become inactive.



4. Click the "Get settings" button and make sure that the frequency plan matches the frequency plan of the device to which you plan to connect via FSK.
5. Click the "Connect to device via FSK" button.
6. In the window that appears, enter the FSK key of the desired modem and click "OK".



7. Exposure the magnet to the Hall sensor of the device for 1-2 seconds or wait for automatic connection (the device activates the FSK radio channel once every two minutes).

It will connect to the device as if it was connected via USB, only a window with FSK communication parameters will appear in the menu on the left. All settings are made, as with a USB connection, using the "Get Settings" and "Apply Settings" buttons.

At the time of an active communication session using the FSK radio channel, data transmission to the LoRaWAN® network will be unavailable. If the device settings have been changed, it will start the registration procedure on the network again, immediately after the session with the «Vega LoRaWAN Configurator» program is completed.

CONNECTING MODEM TO A PERSONAL COMPUTER VIA VEGA USB-UART CONNECTOR

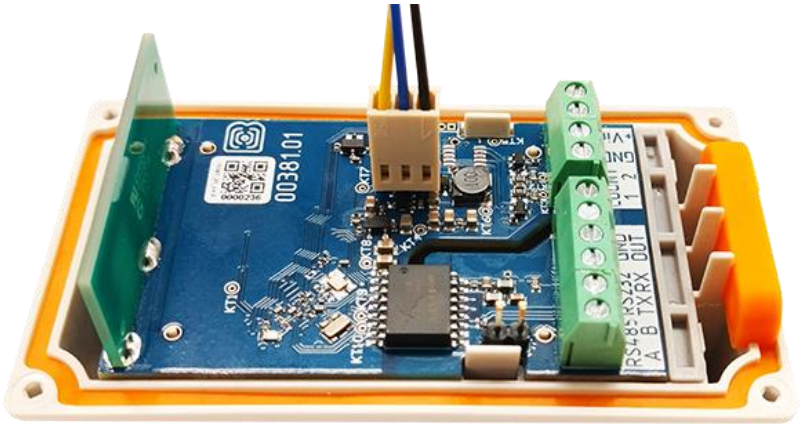
Vega USB-UART converter allows to organize a wired connection to the modem for reading and changing its parameters. To connect, it is necessary to install the driver for the MCP2200 or CP210x COM port, which can be found on website in the "Downloads" section.

To connect you will need:

- Vega USB-UART converter connected to the USB port of a PC.

Connection procedure as follows:

1. Connect the "Vega USB-UART Converter" to the service UART connector on the device board.



2. Connect the converter to the USB connector of a PC;
3. Run the «Vega LoRaWAN Configurator» program;
4. Expose the magnet to the Hall sensor and wait for the LED signal;
5. In the «Vega LoRaWAN Configurator» switch to the Expert mode in the menu on the left, select the device model and the assigned COM port. After that, click the "Connect" button.

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:

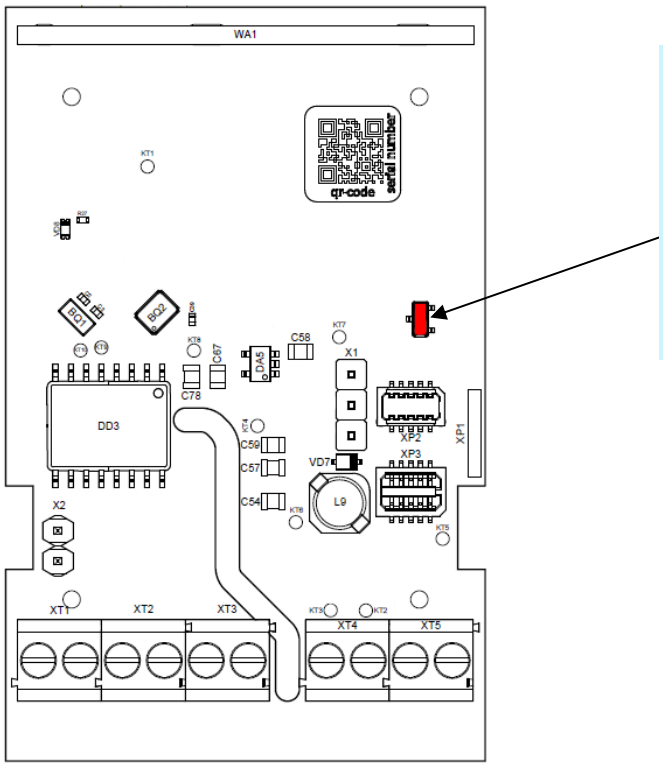
- cross-shaped screwdriver;
- awl;
- wire stripper;
- laptop.

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-13 contacts.
6. Device launching – connecting power and registering the modem in the network (automatic or by bringing the magnet to the Hall sensor for 10 seconds).



Hall sensor

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 pressing a special button in the “Vega LoRaWAN Configurator” application.
9. Assembling the device.
10. DIN-rail mounting or another available way to mount the device on the object.

TRANSPARENT MODE OPERATION

For enable using modem in conjunction with various software systems dispatching of meters and industrial equipment, there is an ability to operate in a transparent mode. In this mode, the modem operates as a simple communication channel between the LoRaWAN® network server and connected external device. Vega SI-13 can receive data from the LoRaWAN® network for external devices and transfer them to the RS-232/RS-485 interface without any processing. If the external device responds to the request, the modem sends the received data back to the network, also without processing, as one or more packets.

Thus, in transparent mode, the modem does not form a request and does not process the response from the metering device. The duty to form requests and analyze the responses lies entirely on the external application that works with Vega SI-13 via LoRaWAN® network.

To provide device operation in the transparent mode it is necessary to install "LoRa2TCP" and "IoT Vega Server" application (or any other application supporting work with Vega SI-13) downloading on the iotvega.com. There is a manual about initial setting of the transparent mode on the device page.

In Vega SI-13, the transparent mode is always available, regardless of the settings.

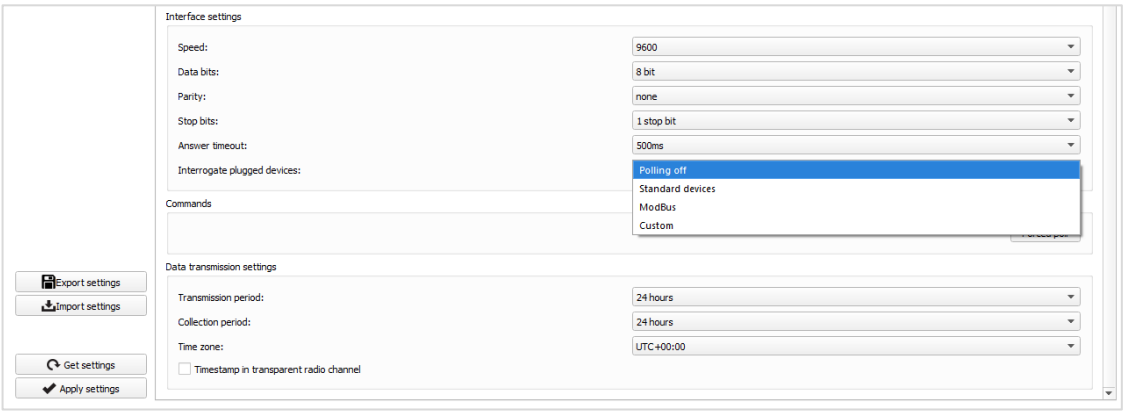
INDEPENDENT POLLING MODE

Vega SI-13 can operate in the mode of an independent polling of any connected via RS interface devices. You need to create and set up the required commands and suspected responses in the «Vega LoRaWAN Configurator» application. After that, the modem polls the connected device with the specified period from 1 to 65535 seconds or according to the standard data collection period.

When the modem receives one of the suspected responses, it may send a packet into the LoRaWAN® network.

Since requests and responses are configured manually, the Vega SI-13 modem can poll any connected devices using any protocol via the RS-232 or RS-485 interface.

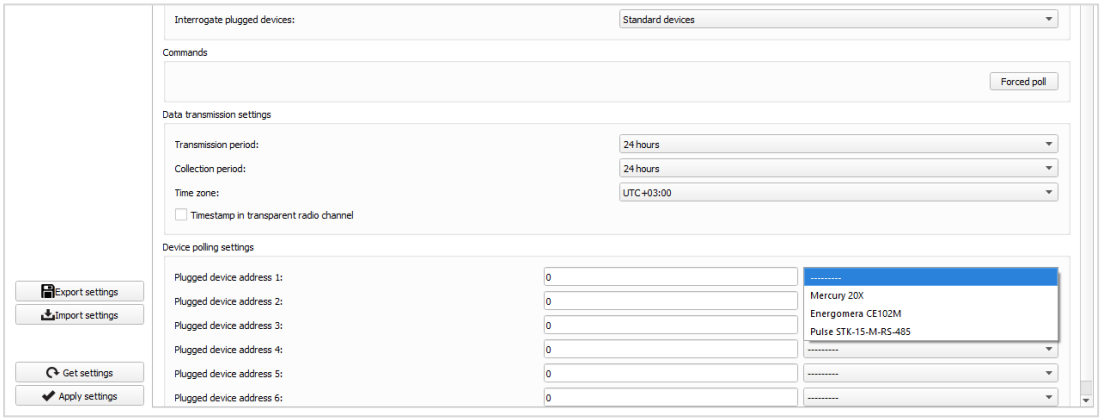
To configure the independent mode, select the required item in the "Vega SI-13 232" or "Vega SI-13 485" tab in the "Interrogate plugged devices" drop-down menu.



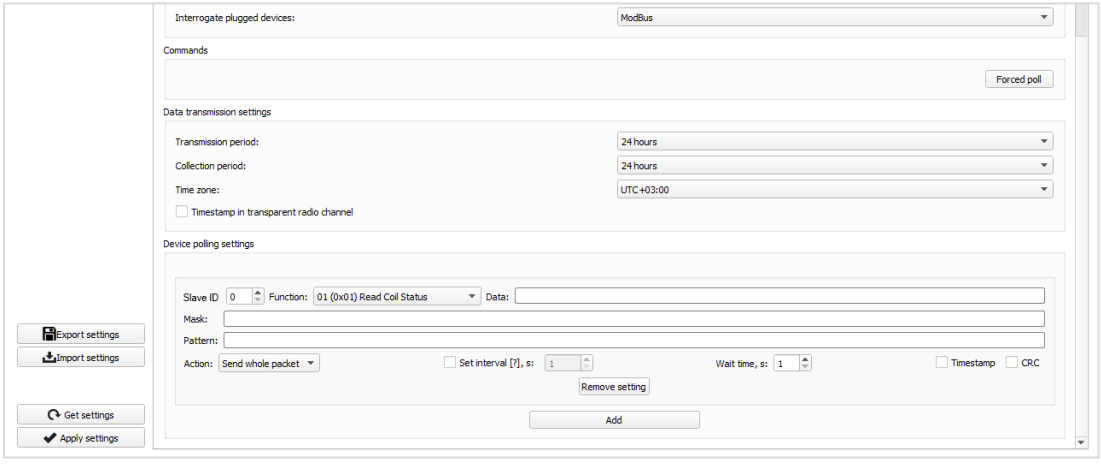
In the independent mode, there can be 4 working options. In all modes, a “transparent mode” is active and periodically sending data about accumulated impulses, alarms and other parameters of the Vega SI-13 device.

Polling off. In this case, independent polling of connected devices is not performed.

Standard devices. A mode that allows you to configure polling of up to 6 devices of supported types.



ModBus RTU. Data exchange with the device connected to the Vega SI-13 takes place using the ModBus RTU protocol. If necessary, this mode can be configured using the "Add" button. In the drop-down menu, you can configure the following settings:



Slave ID – address of the connected device.

Function – register polling function via ModBus RTU protocol.

Data - a field in which the PDU should be written according to the ModBus RTU protocol, as well as the checksum, if the CRC flag is not set in the settings group of this request.

CRC – flag, the setting of which allows you to automatically calculate the checksum and include it in the request. When the CRC flag is set, the checksum is also checked in the responses of the connected device. But sending a response to the LoRaWAN® network is done without the CRC field.

Wait time – a parameter responsible for the time of waiting for a response after sending a request. If the response from the connected device is not received within the specified period, then a packet with the relevant information is sent to the LoRaWAN® network.

Set interval – enabling this option allows you to set the period for sending a request to the interface of the connected device more flexibly than it is offered in the format of standard data collection and transmission periods.

Mask – a mask that is superimposed on the response from the connected device.

Pattern – a sequence of bytes with which the response from the connected device is compared.

Timestamp – enabling this option allows to include in the package sent to the LoRaWAN® network the timestamp when the external device was polled.

Examples

Option 1 (full match):

In response to the request, the connected device sent such a data packet: *010203040506070809* (9 bytes of data)

Pattern registered by the user:
019999990506070809 (9 bytes of data)

Mask registered by the user:
FF000000FFFFFFFF (mask size – 9 bytes)

FF – indicates that this byte from the data packet from the connected device is fully compared with the pattern

00 – means that this byte is not compared with the pattern

\01\02\03\04\05\06\07\08\09
\FF\00\00\00\FF\ FF\ FF\ FF\FF
\01\99\99\99\05\06\07\08\09

Option 2 (no match):

Device response: *010203040506070809* (9 bytes of data)

Mask: FF000000FFFFFFFF (mask size – 9 байт)

Pattern: *019999990506070101* (9 bytes of data)

\01\02\03\04\05\06\07\08\09
\FF\00\00\00\FF\ FF\ FF\ FF\FF
\01\99\99\99\05\06\07\01\01

If matched – parameter, the value of which allows you to determine what should be done with the response of the connected device after comparing with the pattern. Send if matched or don't send. If there is no match, the packet is not sent to the LoRaWAN® network.

Custom. In this mode, the user is prompted to register requests that will be sent to the interface of the connected device with a set period. The user can set any sequence of bytes, which allows him to independently organize work with a device whose exchange protocol is not supported in SI-13. For fine-tuning, you must click the "Add Setting" button.

The functionality of the Mask, Pattern and other parameters is similar to the independent mode via the ModBus RTU protocol (p. 17).

4 COMMUNICATION PROTOCOL – VERSION 2.1

This part describes the recent review of SI-13 data exchange protocol with LoRaWAN® network. Protocol version is displayed in «Vega LoRaWAN Configurator» in the "Information" tab.

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

VEGA SI-13 MODEM TRANSMITS THE FOLLOWING TYPES OF PACKETS

1. Packet with information about accumulated impulses and alarms on security inputs

   Sent regularly or upon request on LoRaWAN® port 2

Size in bytes	Field description	Data type
1 byte	Packet type 00 – current packet 01 – by security input 1 02– by security input 2 21 - threshold exceeded at pulse input 1 22 - threshold exceeded at pulse input 2 30 - custom	uint8
4 bytes	Packet time (unixtime)	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
1 byte	Basic settings value (bit field)	uint8

Bit field decoding «Basic settings value»

Bit	Value
0 bit	Packet Confirmation Request 0 - off, 1 – on
1 bit	Input 1 mode: 0 – pulse, 1 - security
2 bit	Input 2 mode: 0 – pulse, 1 – security
3,4,5 bit	Communication period: |3 == 0|4 == 0|5 == 0| - 5 minutes |3 == 1|4 == 0|5 == 0| - 15 minutes |3 == 0|4 == 1|5 == 0| - 30 minutes |3 == 1|4 == 1|5 == 0| - 1 hour |3 == 0|4 == 0|5 == 1| - 6 hours |3 == 1|4 == 0|5 == 1| - 12 hours |3 == 0|4 == 1|5 == 1| - 24 hours
6,7 bit	Interface operation mode: |6 == 0|7 == 0| - only transparent mode

	|6 == 1|7 == 0| - survey of metering devices |6 == 0|7 == 1| - ModBus |6 == 1|7 == 1| - custom

2. Data packet from an external device for “Transparent Mode” and “Custom”
   Sent on LoRaWAN® port 2

Size in bytes	Field description	Data type
1 byte	Packet type, this packet = 13 - packet with data from an external device for the modes "Transparent Mode" and "Custom"	uint8
1 byte	Sequential number of the setting in the configurator (for transparent radio channel always 0. Counting starts from 0)	uint8
2 bytes	Total data size received via interface	uint16
1 byte	Data size in this packet	uint8
1 byte	Sequential number of the packet (in the case of transmitting several packets, when the data does not fit into one, counting starts from 0)	uint8
1 byte	Total number of the packets	uint8
Array	Data [1-39 bytes]	-

The LoRa data transfer technology limits the maximum packet size, depending on the speed of packet transmission. If the data received via the external interface cannot be transmitted in one packet, they are split into several packets, which are transmitted sequentially.

3. Data packet from an external device for “ModBus RTU” mode
   Sent on LoRaWAN® port 2

Size in bytes	Field description	Data type
1 byte	Packet type, this packet = 04 - packet with data from an external device for the mode "ModBus RTU"	uint8
1 byte	Sequential number of the setting in the configurator (counting starts from 0)	uint8
2 bytes	Total data size received via interface	uint16
1 byte	Data size in this packet	uint8
1 byte	Sequential number of the packet (in the case of transmitting several packets, when the data does not fit into one, counting starts from 0)	uint8
1 byte	Total number of the packets	uint8
2 bytes	Address of the first register	uint16
Array	Data [1-37 bytes]	-

4. Data packet from an external device for “Transparent Mode” and “Custom” with timestamp
   Sent on LoRaWAN® port 2

Size in bytes	Field description	Data type
1 byte	Packet type, this packet = 05 - packet with data from an external device for the modes "Transparent Mode" and "Custom"	uint8
4 bytes	Time of the modem at a moment of the packet generation (unixtime UTC)	uint32
1 byte	Sequential number of the setting in the configurator (counting starts from 0)	uint8
2 bytes	Total data size received via interface	uint16
1 byte	Data size in this packet	uint8
1 byte	Sequential number of the packet (in the case of transmitting several packets, when the data does not fit into one, counting starts from 0)	uint8
1 byte	Total number of the packets	uint8
Array	Data [1-35 bytes]	-

5. Data packet from an external device for “ModBus RTU” mode with timestamp
   Sent on LoRaWAN® port 2

Size in bytes	Field description	Data type
1 byte	Packet type, this packet = 06 - packet with data from an external device for the mode "ModBus RTU"	uint8
4 bytes	Time of the modem at a moment of the packet generation (unixtime UTC)	uint32
1 byte	Sequential number of the setting in the configurator (counting starts from 0)	uint8
2 bytes	Total data size received via interface	uint16
1 byte	Data size in this packet	uint8
1 byte	Sequential number of the packet (in the case of transmitting several packets, when the data does not fit into one, counting starts from 0)	uint8
1 byte	Total number of the packets	uint8
2 bytes	Address of the first register	uint16
Array	Data [1-33 bytes]	-

6. Packet with data from the electricity meter
   Sent on LoRaWAN® port 2

Size in bytes	Field description	Data type
1 byte	Packet type, this packet = 07 - poll of the electricity meter	uint8
1 byte	Device type 01 - Energomera 102M, 02 - Mercury 206	uint8
4 bytes	Serial number of the metering device	uint32
1 byte	Request result (1 – success, 0 - failure)	uint8
4 bytes	Time of the modem at a moment of the packet generation (unixtime UTC)	uint32
4 bytes	Readings *100, tariff 1	uint32
4 bytes	Readings *100, tariff 2	uint32
4 bytes	Readings *100, tariff 3	uint32

4 bytes	Readings *100, tariff 4	uint32

7. Packet with data from the heat meter
   Sent on LoRaWAN® port 2

Size in bytes	Field description	Data type
1 byte	Packet type, this packet = 08 - poll of the heat meter	uint8
1 byte	Device type 03 – Pulse STK-15	uint8
4 bytes	Serial number of the metering device	uint32
4 bytes	Time of the modem at a moment of the packet generation (unixtime UTC)	uint32
8 bytes	The amount of consumed heat energy, W	uint64
4 bytes	Total volume of heat medium, l	uint32
4 bytes	Operating time, h	uint32
2 bytes	Current flow temperature °C*100	uint16
2 bytes	Current reverse flow temperature °C*100	uint16
2 bytes	Current medium consumption, l/h	uint16
4 bytes	Current medium consumption, l/h	uint32
4 bytes	Power, W	uint32
1 byte	Medium[1] (environment)	uint8

8. Packet transmitted when there is no response from the connected metering device

Size in bytes	Field description	Data type
1 byte	Packet type, this packet = 09 – no response from the device	uint8
1 byte	Sequential number of the setting in the configurator	uint8
1 byte	Device type 01 - Energomera 102M, 02 - Mercury 206, 03 - Pulse STK-15	uint8
4 bytes	Serial number of the metering device	uint32

9. Packet transmitted when there is no response from the device to ModBus or a user request
   Sent on LoRaWAN® port 2

Size in bytes	Field description	Data type
1 byte	Reason for transmitting packet = 10 - no response to user or ModBus request	uint8
1 byte	Sequential number of the setting in the configurator	uint8

[1] The medium (environment) field is encoded according to the MBUS protocol (protocol section 8.4.1 Measured Medium Variable Structure)

10. Packet transmitted when restoring exchange with the metering device

Sent on LoRaWAN® port 2

Size in bytes	Field description	Data type
1 byte	Reason for transmitting packet = 11 - exchange with the metering device restored	uint8
1 byte	Sequential number of the setting in the configurator	uint8
1 byte	Device type 01 - Energomera 102M, 02 - Mercury 206, 03 - Pulse STK-15	uint8
4 bytes	Serial number of the metering device	uint32

11. Packet transmitted when the exchange with the metering device is restored by means of a user or ModBus request

Sent on LoRaWAN® port 2

Size in bytes	Field description	Data type
1 byte	Reason for transmitting packet 12 - exchange with the device has been restored by user or ModBus request	uint8
1 byte	Sequential number of the setting in the configurator	uint8

12. Settings packet

Transmitting on LoRaWAN® port 3

Size in bytes	Field description	Data type
1 byte	Packet type, this packet == 00	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-13 MODEM RECEIVES PACKETS OF THE FOLLOWING TYPES

1. 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 == 01	uint8

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

2. Packet with data for transmitting via RS-232 or RS-485 interface

   Sent by application on LoRaWAN® port 2

Size in bytes	Field description	Data type
1 byte	Reason for transmitting packet – 04	uint8
массив	Data	

3. Status query

   Sent by application on LoRaWAN® port 2

Size in bytes	Field description	Data type
1 byte	Reason for transmitting packet – 06	uint8

The device will send the packet with information about accumulated impulses and alarms on security inputs.

4. Packet with forced poll command

   Sent by application on LoRaWAN® port 2

Size in bytes	Field description	Data type
1 byte	Reason for transmitting packet – 15	uint8

5. Packet with settings

   Sent by application on LoRaWAN® port 3, 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 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-13 parameters and these possible values

The table contains values in DEC, when sending, these values must be converted to HEX

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
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
20	Interface speed	1 byte	1 – 4800 2 – 9600 3 – 14400 4 – 19200 5 – 38400 6 – 57600 7 – 115200 8 – 300 9 – 600 10 – 1200 11 – 2400
21	Answer timeout	2 bytes	- 100 - 500 - 1000 - 3000 - 5000
34	Data bits	1 byte	1 - 7 bit 2 - 8 bits
35	Stop bits	1 byte	1 - 1 bit 2 - 2 bits
37	Parity	1 byte	1 - none

			2 - even 3 - odd
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-13 modem shall be stored in the original packaging in heated room at temperatures +5 °C to +40 °C and relative humidity less than 85%.

The modem 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 modem is delivered complete with:

1. Vega SI-13-232 modem – 1 pc.

   Screw – 4 pcs.

   Factory certificate – 1 pc.

2. Vega SI-13-485 modem – 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

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Revision History

Revision	Date	Name	Comments
01	23.03.2017	KEV	Document creation date
02	14.04.2017	KEV	Photos were added, minor edits
03	10.05.2017	KEV	New photos of the appearance
04	29.05.2017	PKP	A little change at the communication protocol
05	21.06.2017	KEV	Technical characteristics were changed
06	05.09.2017	KEV PKP	Part “Vega LoRaWAN Configurator” was added, and some additions at the communication protocol
07	23.10.2017	KEV	Minor edits
08	04.05.2018	KEV	Edits concerning the field of application with meters with pulse outputs, minor edits, new illustrations in the “Operation” part
09	21.12.2018	KEV	“Transparent mode operation” and “Marking” parts added, device AppEui added in specification
10	21.05.2019	KEV	Typo in communication protocol fixed in bit field decoding table – bits 6 and 7
11	14.08.2019	KEV	Typo on the 28th page in the ‘5’ packet description
12	06.07.2020	KEV	Scheduled revision of the document, minor changes
13	23.09.2020	KEV	Device logic changes, new mode for external devices polling, changes in the communication protocol
14	06.08.2021	PAV	Scheduled revision of documentation. New warranty conditions, new parts
15	08.02.2022	KEV	New part “Connection Of Terminator”
16	11.03.2022	KMA	New protocol version
17	28.03.2022	KMA	Minor edits
18	25.10.2022	KMA	New board revision. Changes in the communication protocol, FSK radio channel was added

19	02.11.2022	KMA	Changes in the settings package
20	23.01.2023	KMA	Changes in communication protocol

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