



Pulse Counter

VEGA SI-21

User manual

Pulse Counter Vega SI-21 is used for reading of values from metering instruments, such as water- and electricity meters and further transmitting of this data to LoRaWAN network.

Vega SI-21 can be used as a security device by sending alarm signal in case a specific contact pair is closed.

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02	11.01.2018	KEV	Ingress protection rating corrected
03	15.02.2018	TII	Minor changes at the exchange protocol
04	04.05.2018	KEV	Edits concerning the field of application with meters with pulse outputs
05	24.07.2018	KEV	Added frequency bands, changes in the communication protocol, in technical characteristics

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INTRODUCTION

This manual is designated for Vega SI-21 pulse counter (hereinafter – the counter) manufactured by Vega-Absolute LLC 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.



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

1 DESCRIPTION AND OPERATION

Vega SI-21 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-21 can be used as a security device - pulse inputs can be configured as security inputs.

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-21 has ability to connect an external temperature sensor for taking temperature readings from objects which require such control.

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 is powered by a 3400 mAh built-in battery with service life up to 10 years, provided data transmitted once a day.

The readings are read from the meter with a configurable period from 5 minutes to 24 hours. The readings are stored in the device memory and transmitted during the next communication session with the LoRaWAN network.

The data transfer period can be adjusted from 5 minutes to 24 hours. Data transfer is carried out by a random time at the selected period. At the next communication session, the device starts sending accumulated packets with readings, from the earliest to the latest.

If the option "Confirmed uplinks" is enabled, the device will send the next packet only after receiving a confirmation of the delivery of the previous one. If such confirmation is not

received after the fulfilled in the settings number of re-requests, SI-21 completes the communication session until the next according to the schedule. In this case, the device continues to collect data according to the data collection period and store it in memory. Non-transmitted packets remain in the pulse counter memory until the next communication session.

With the "Confirmed uplinks" option turned off, the device just sends all accumulated packets to the network in order from the earliest to the latest. There are no checks of package delivery in this mode. There are no unsent packets in the device memory.

The internal clock is set automatically when device connected to the "Vega LoRaWAN Configurator" via USB, and can also be adjusted via LoRaWAN.

2 SPECIFICATION

Main

Double-contact digital inputs	up to 4
Maximum input frequency	200 Hz
Security inputs	up to 4
USB-port	mini-USB, type B
Operating temperatures	-40...+85 °C
Ability to connect an external temperature sensor	B57861-S 103-F40 10 kOhm ,1% B57619C103J60 - 10 kOhm, 5% B3950 – 10 kOhm

LoRaWAN

LoRaWAN class	A
Quantity of LoRaWAN channels	16
Frequency band	RU868, EU868, IN865, AS923, AU915, KR920, US915, custom (EU868 based)
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	external
Sensitivity	-138 dBm
Radio coverage in restrained urban conditions	up to 5 km
Radio coverage within line of sight	up to 15 km
Power output	25 mW (configurable)

Power

Built-in battery	3400 mAh
Wireless operation with battery	up to 10 years

Case

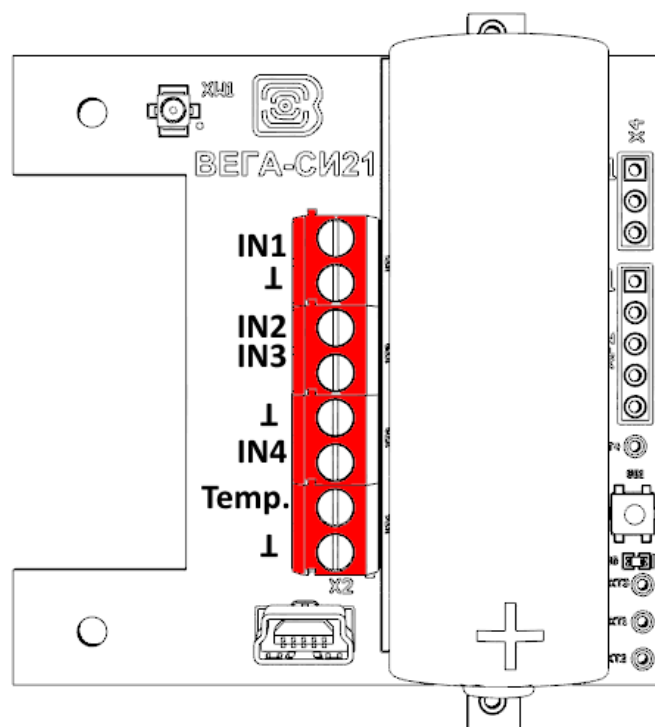
Housing dimensions	78 x 58 x 30 mm
Ingress protection rating	IP67

Vega SI-21 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
- Time referencing of readings by internal clock
- Communication in case of security inputs actuation
- Temperature measurement
- Charge measuring of the built-in battery (%)

3 OPERATION

CONTACTS



The pulse counter has 4 pairs of contacts and is able to 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.

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.

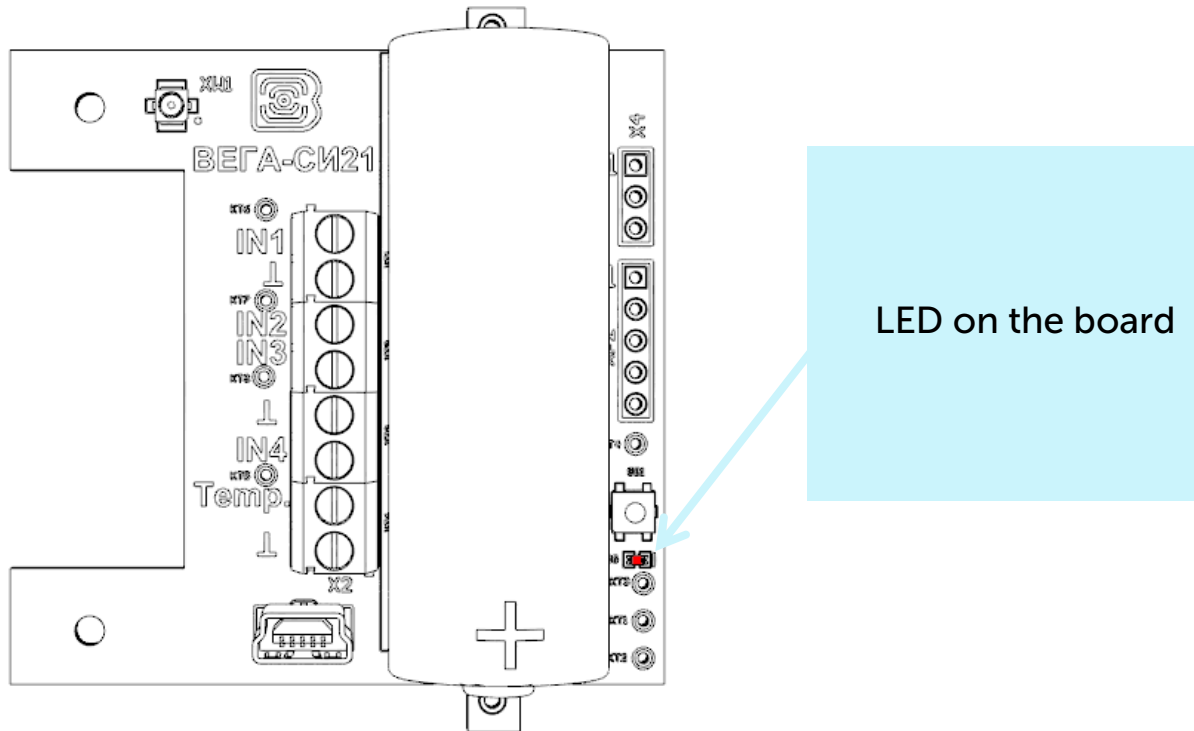
Also there are a couple of contacts on the board for connection an external thermistor, it is contacts «Temp.» and « \downarrow ». It is necessary to configure sending parameters for thermistor readings in the «Vega LoRaWAN Configurator» application.

Thermistors are available to connection:

1. B57861-S 103-F40 10 kOhm ,1%
2. B57619C103J60 - 10 kOhm, 5%
3. B3950 – 10 kOhm

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 signal

Meaning



Series of short flashings

Linking to the network



One long flashing

The device connected to the network and is in active mode



Three long flashings

Linking to the network is unsuccessful or the device switched to the «Storage» mode



In case the device fails to connect the network, it automatically switches to the "Storage" mode

INITIAL STARTUP

Vega SI-21 pulse counter is constantly on, but can operate in a special "Storage" mode, designed for storage and transportation. The device does not regularly transmit data to the network in this mode. Before use switch the counter from the «Storage» mode.

Vega SI-21 supports two activation methods in the LoRaWAN network - ABP and OTAA. Select one of the methods using the «Vega LoRaWAN Configurator» application (see part 4).

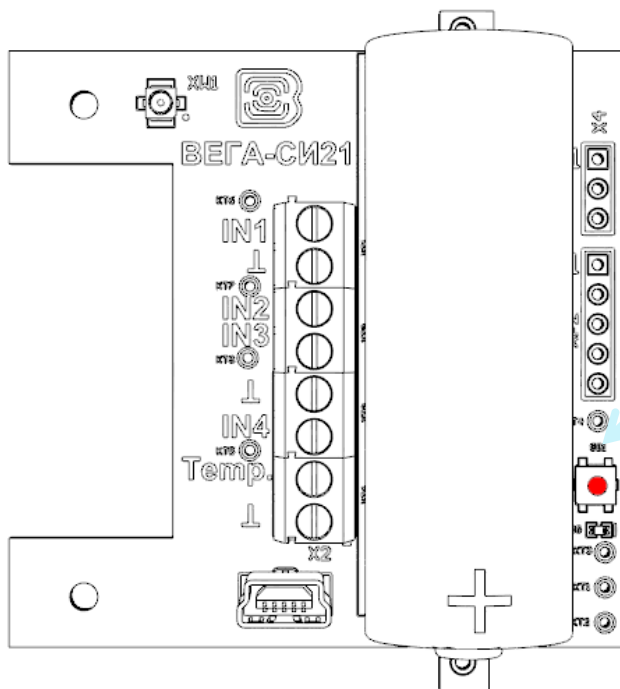
1. ABP. After pressing the start button, the device immediately starts working in the "Active" mode.

2. OTAA. After pressing the start button, the device makes three attempts to connect to the network within the set frequency band. After the activation in the LoRaWAN network is confirmed, the device sends a signal (LED flashing for 3 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.



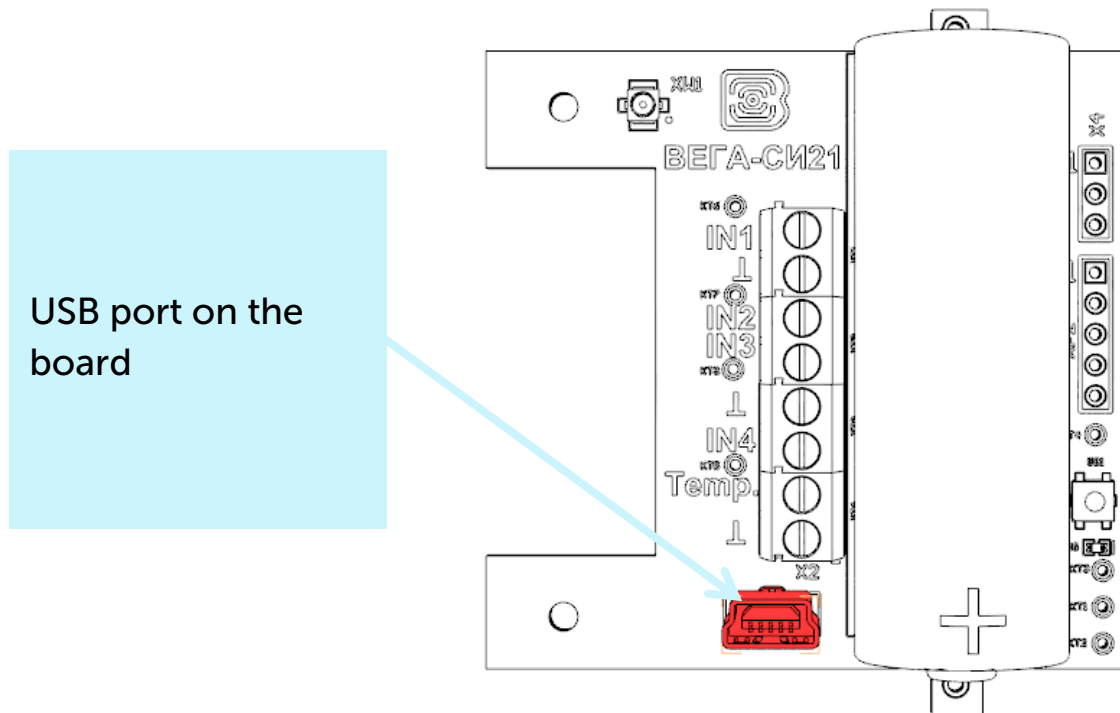
When switching to the "Storage" mode, all readings from the pulse inputs accumulated in the device memory are reset



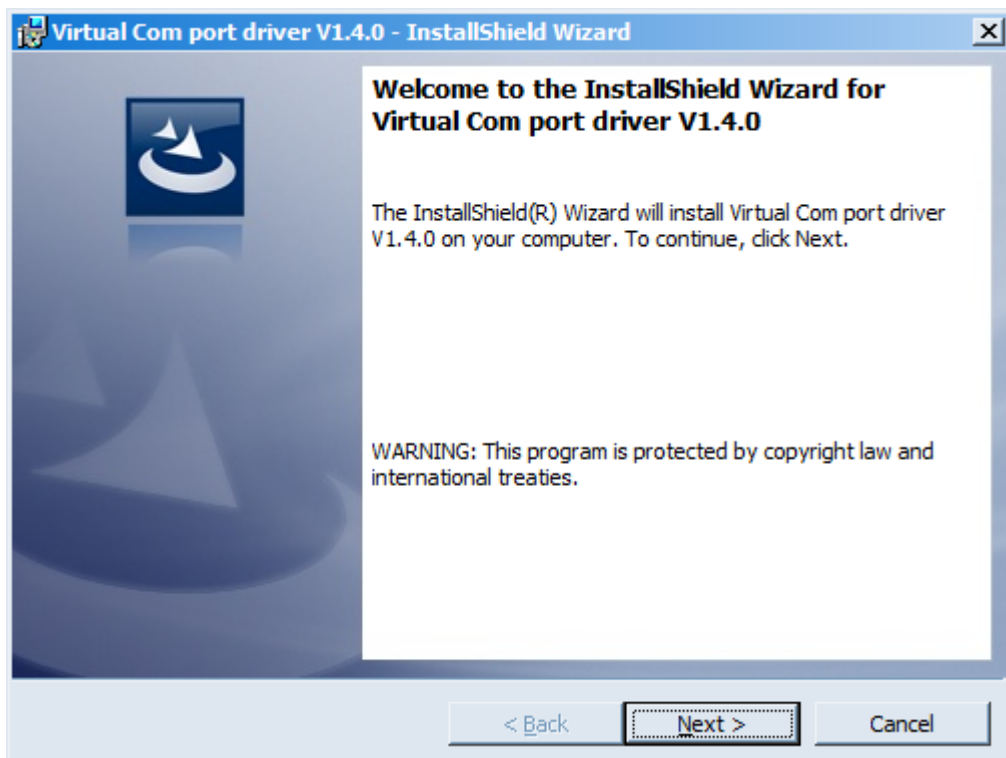
Push start button on the board

CONNECTING VIA USB

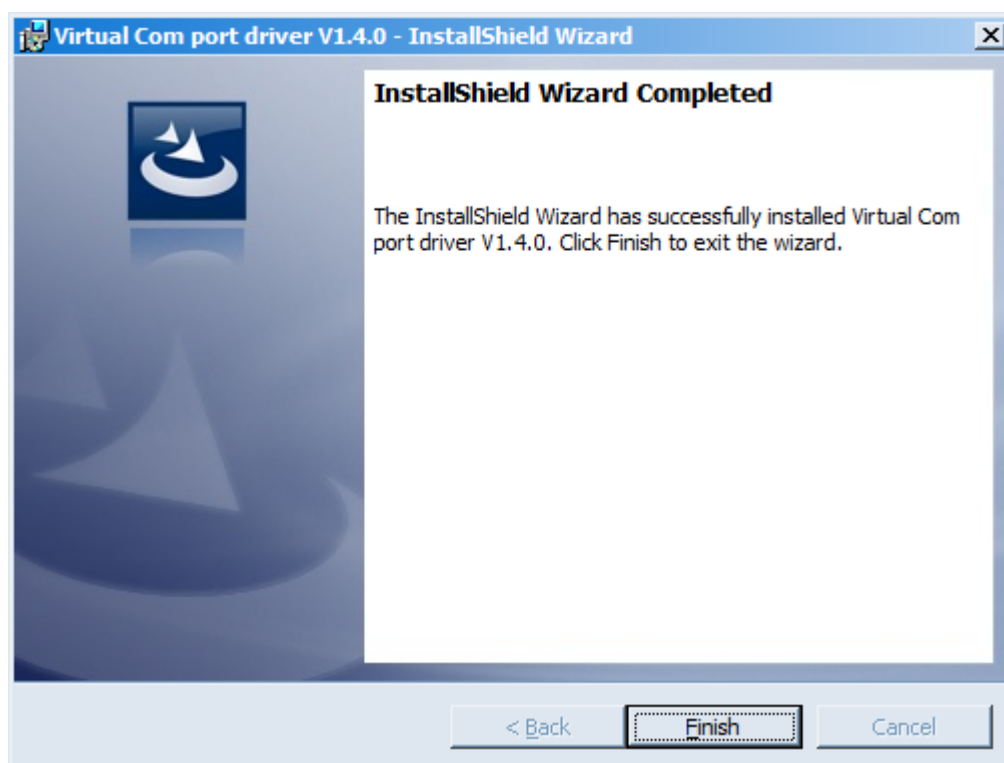
The pulse counter can be adjusted with the "Vega LoRaWAN Configurator" application (See part 4).



Before connecting the device to the computer for the first time, you must install the driver for the COM port `stsw-stm32102`, which can be downloaded from iotvega.com. After running the executable file `VCP_V1.4.0_Setup.exe`, the installer window will appear:



In this window, you need to click **Next**, then **Install**, and then the installation will begin. When the installation is completed successfully, the following screen appears:



After pressing **Finish** the driver is ready for operation, - it is possible to connect the pulse counter via USB.

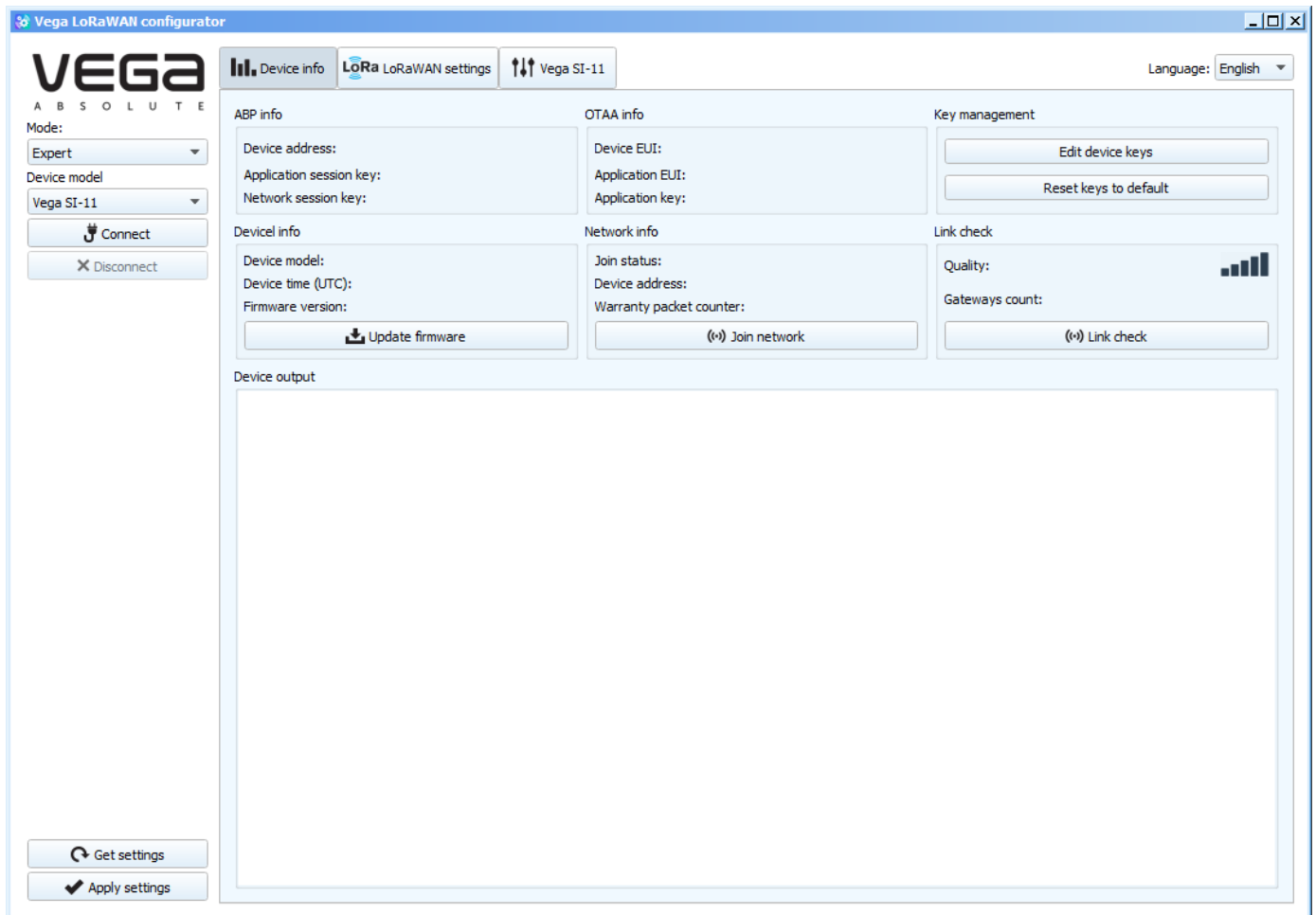
4 VEGA LORAWAN CONFIGURATOR

The "Vega LoRaWAN Configurator" application (hereinafter referred to as the configurator) is intended for setting up the device via USB.

The configurator has two modes of operation - "Simple" and "Expert". In the "Simple" mode, only basic settings are available. In the "Expert" mode, the basic settings, advanced settings and the ability to check the coverage area of the signal from the gateways are available. Next, the work of the application is considered in the "Expert" mode.

INTERFACE OF THE APPLICATION

The "Vega LoRaWAN Configurator" application does not require the special installation. When the executable file is launched, the window for working with the application appears.



The menu on the left allows you to switch between the "Simple" and "Expert" modes, select the device model, connect to the device or disconnect from it, get and apply settings.

The application window contains three tabs – Device info, LoRaWAN settings and device settings.

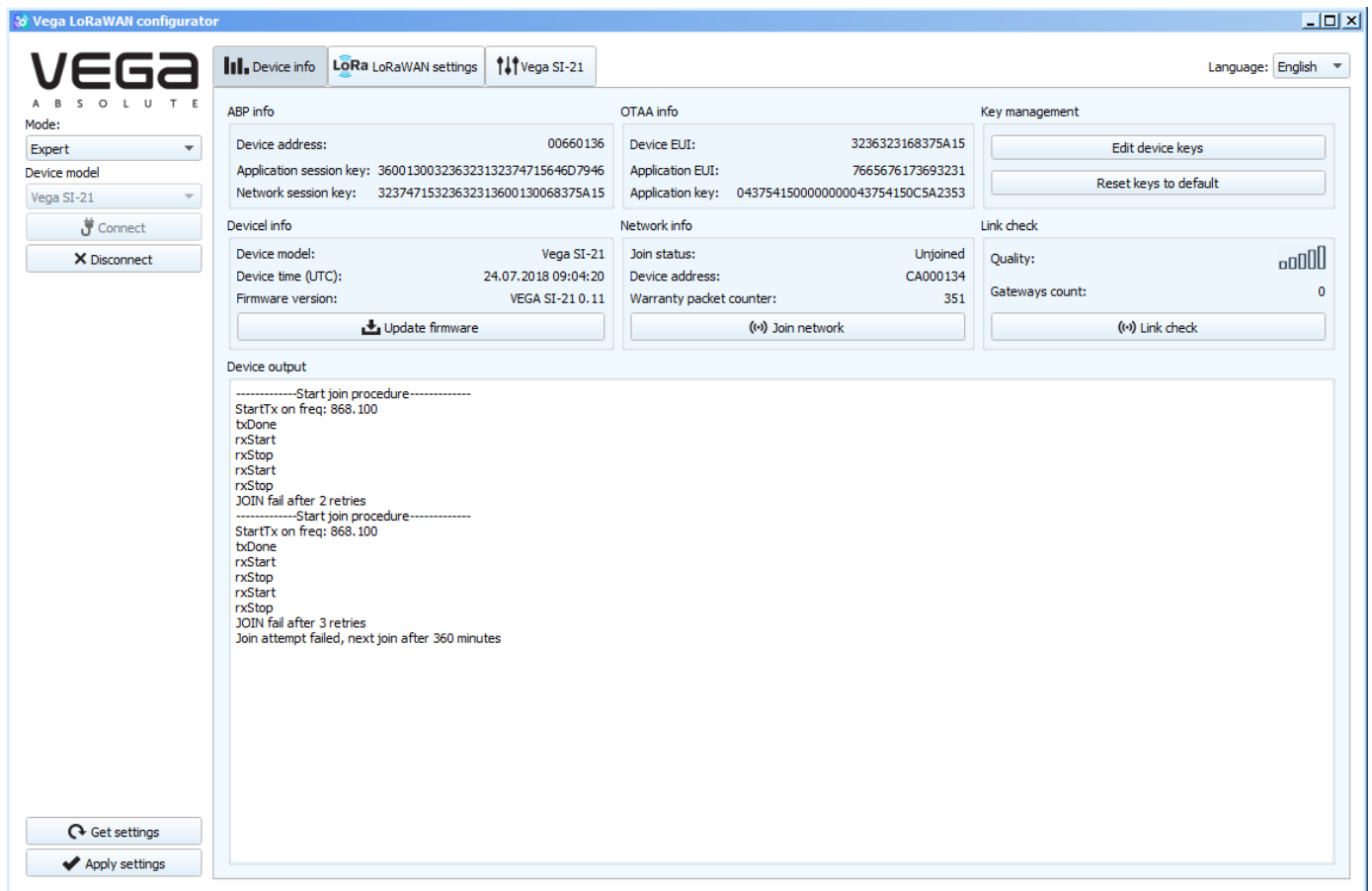
The language selection menu is in the upper right corner.

CONNECTION TO THE DEVICE

For the connection to the device, perform the following steps:

1. Connect the USB cable to the device.
2. Start the "Vega LoRaWAN Configurator" application.
3. Click the "Connect" button in the menu on the left.

The application automatically recognizes the type of device, and the device selection menu becomes inactive.

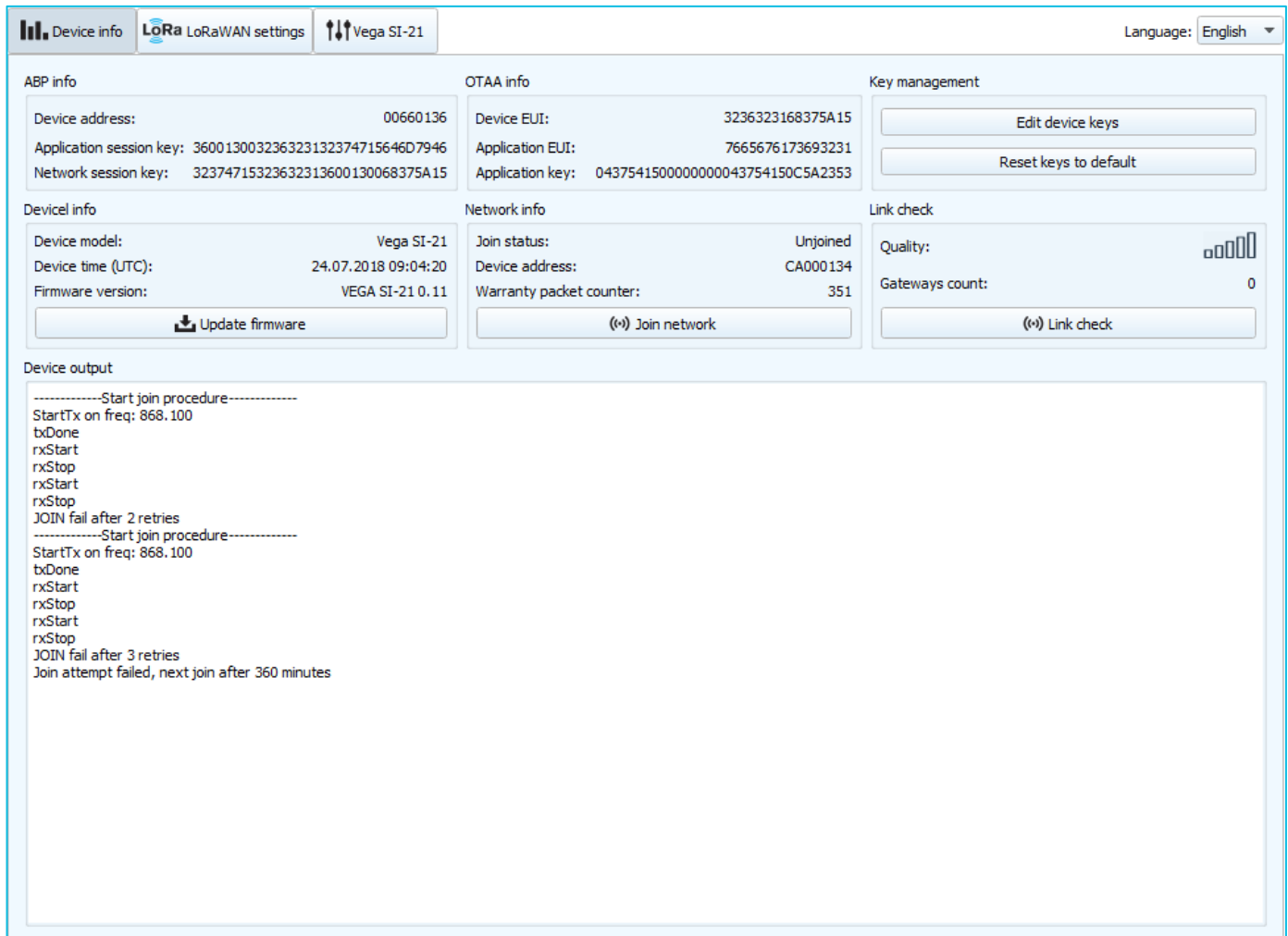


To read the settings from the device, you need to click the "Get settings" button, until this point the application will display the default settings or from the last connected device.

After making the necessary changes to the settings, you should click the "Apply settings" button and only then disconnect from the device with the "Disconnect" button.

"DEVICE INFO" TAB

The "Device info" tab displays information about the device, its current status, and also the data needed to register the device in the LoRaWAN network.



ABP info - displays the data necessary to register the device in the LoRaWAN network with ABP method (Activation By Personalization).

OTAA info - the data required to register the device in the LoRaWAN network with OTAA method (Over The Air Activation) is displayed.

Key management (not displayed in the "Simple" mode) - allows you to change the factory keys to register the device on the network, and also reset the keys back to the factory settings.

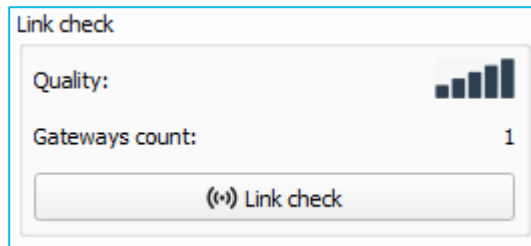
Device info - the configurator reads information about the device model, its firmware and automatically corrects the device's time when connected to it.

Update firmware - allows you to select the firmware file from your computer's hard drive and load it into the device. The device will automatically disconnect from the configurator when the download is complete. The current version of the device firmware can be downloaded from iotvega.com.

Network info - shows whether the device is connected to the LoRaWAN network and its network address.

Join network button - launch the LoRaWAN network connection procedure with the previously selected ABP or OTAA method. If the device is already connected to the network, reconnection procedure will occur.

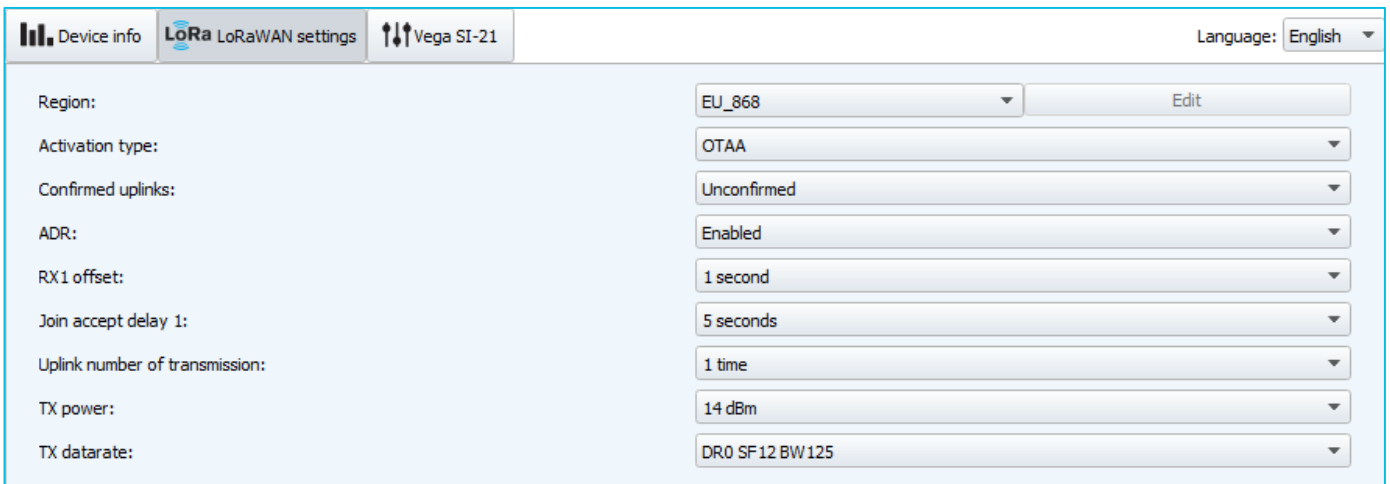
Link check (not displayed in the "Simple" mode) - when pressed, the device sends a special signal to the LoRaWAN network, in response to which the network informs it of the number of gateways that received this signal and the signal quality. This button only works when the device is connected to the network.



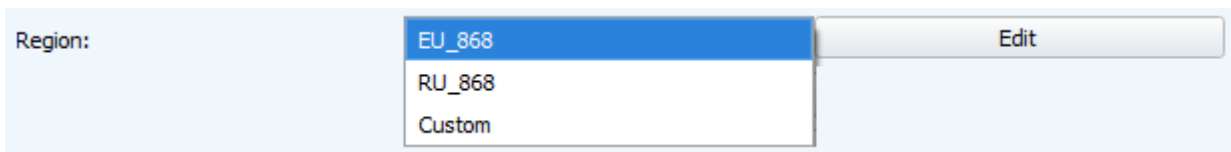
Device output (not displayed in the "Simple" mode) - monitoring the device status, all events in real time are displayed.

"LORAWAN SETTINGS" TAB

The "LoRaWAN Settings" tab allows you to configure various parameters of the LoRa network.



Region - allows you to select RU-868, EU-868 or specify a custom frequency band.

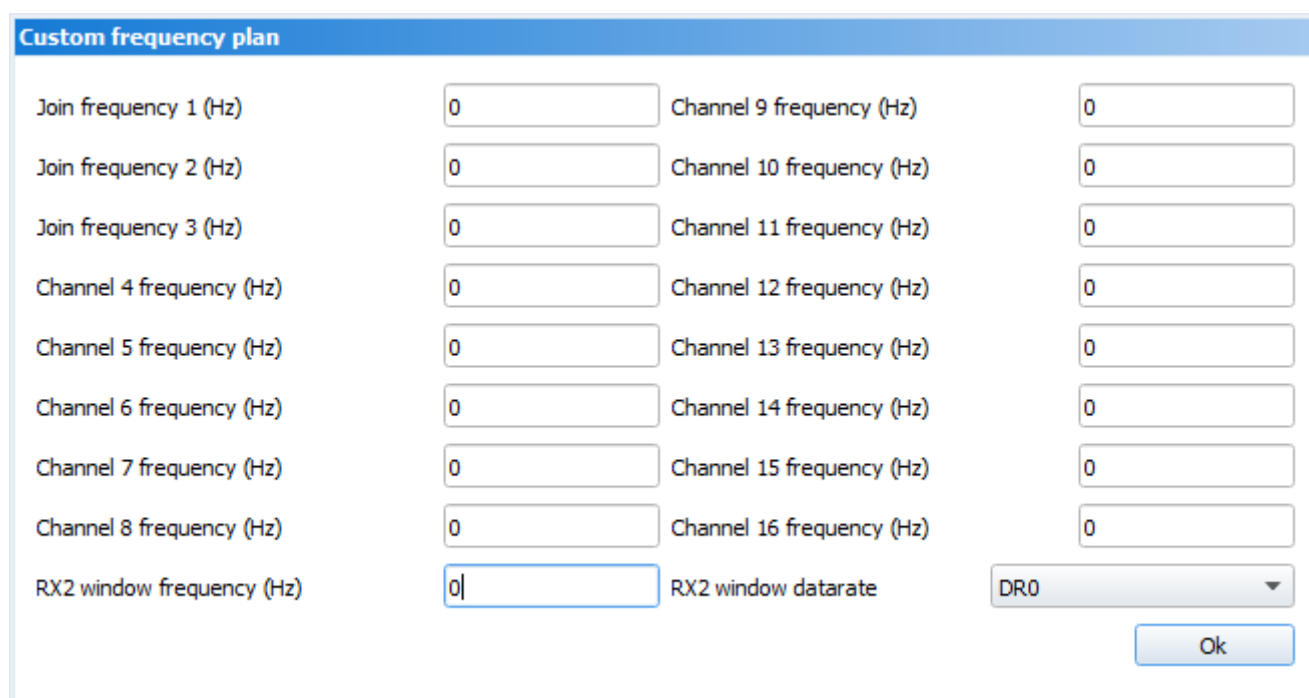


The pulse counter supports the following frequency bands:

Frequency band ¹	Channel	Frequency	Modulation
EU-868	1	868.1	MultiSF 125 kHz
	2	868.3	MultiSF 125 kHz
	3	868.5	MultiSF 125 kHz
	RX2	869.525	SF12 125 kHz
RU-868	1	868.9	MultiSF 125 kHz
	2	869.1	MultiSF 125 kHz
	RX2	869.1	MultiSF 125 kHz
Custom	Set with «Vega LoRaWAN Configurator» application		

In the EU_868 and RU_868 frequency bands, only those channels are active by default on which send requests for connection to the network (join channels). The remaining channels that the device should use can be transferred by the LoRaWAN network server during the device activation procedure (only OTAA).

If you select "Custom" in the "Region" field, you must manually specify the frequencies that the device will use. To do this, click the "Edit" button, the channel frequency editing window will appear:



Custom frequency plan

Join frequency 1 (Hz) Channel 9 frequency (Hz)

Join frequency 2 (Hz) Channel 10 frequency (Hz)

Join frequency 3 (Hz) Channel 11 frequency (Hz)

Channel 4 frequency (Hz) Channel 12 frequency (Hz)

Channel 5 frequency (Hz) Channel 13 frequency (Hz)

Channel 6 frequency (Hz) Channel 14 frequency (Hz)

Channel 7 frequency (Hz) Channel 15 frequency (Hz)

Channel 8 frequency (Hz) Channel 16 frequency (Hz)

RX2 window frequency (Hz) RX2 window datarate

This frequency band allows you to set up to 16 channels, as well as the frequency and speed of the second receiving window.



The first three channels and the second receiving window parameters are mandatory. Without these parameters the custom frequency band will be considered empty

¹ By default, the device supports two frequency bands and the custom, but it is possible to order firmware for other frequency bands: IN865, AS923, AU915, KR920, US915, KZ865

Activation type – displays ABP or OTAA device activation method.

Confirmed uplinks – when you choose "confirmed", the device will retry sending the packet until it receives the server confirmation, or until the "Uplink number of transmission" is over (see below).



If you choose to send a packet without confirmation, the modem will not know whether the packet is delivered or not

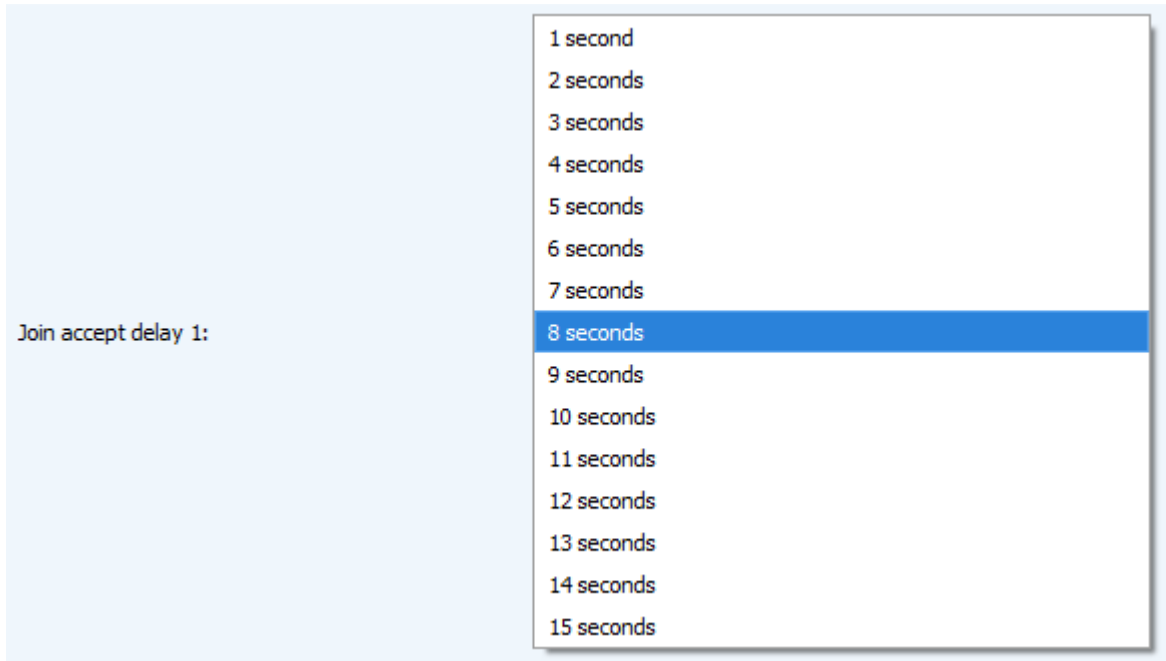
ADR – this option activates the Adaptive Data Rate algorithm for automatic control of the data transfer rate from the LoRaWAN network side. The higher the quality of the signal received by the network, the higher the speed will be installed on the device. This option is recommended only on permanently installed devices.

ADR:	<div style="border: 1px solid #ccc; background-color: #e0e0e0; padding: 2px;"> <div style="background-color: #0070c0; color: white; padding: 2px;">Enabled</div> <div style="padding: 2px;">Disabled</div> </div>
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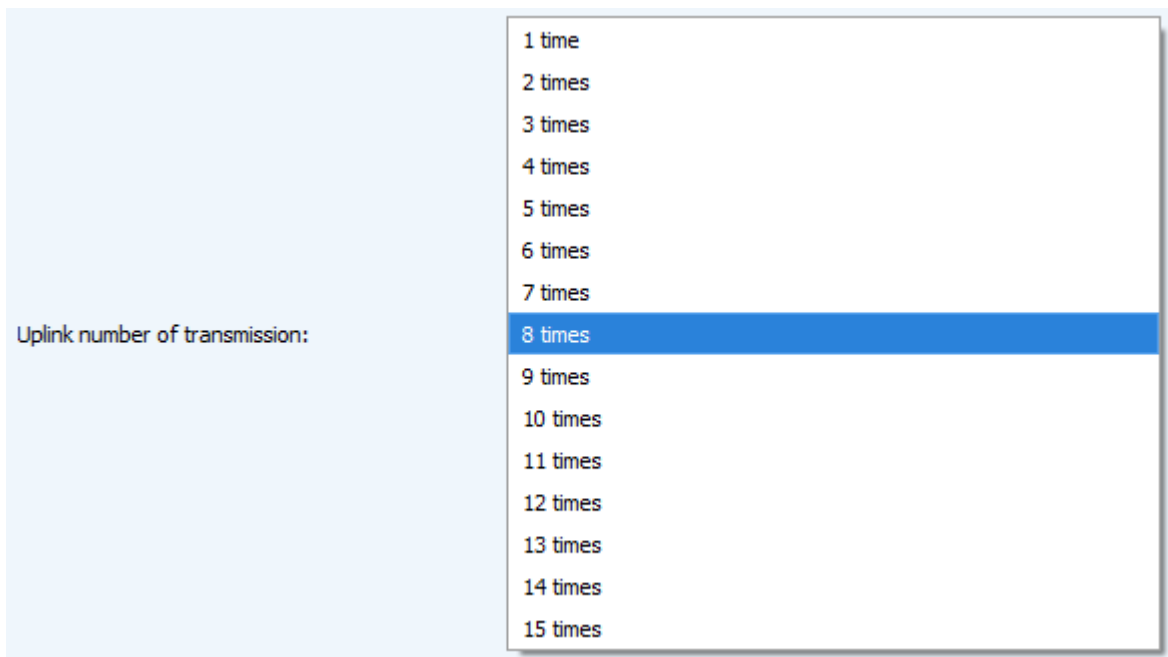
RX1 offset (not displayed in the "Simple" mode) – specifies the time between end of packet transmission and first receiving window opening. The second receiving window always opens after 1 second after the first.

RX1 offset:	<div style="border: 1px solid #ccc; background-color: #e0e0e0; padding: 2px;"> <ul style="list-style-type: none"> 1 second 2 seconds 3 seconds 4 seconds 5 seconds <li style="background-color: #0070c0; color: white;">6 seconds 7 seconds 8 seconds 9 seconds 10 seconds 11 seconds 12 seconds 13 seconds 14 seconds 15 seconds </div>
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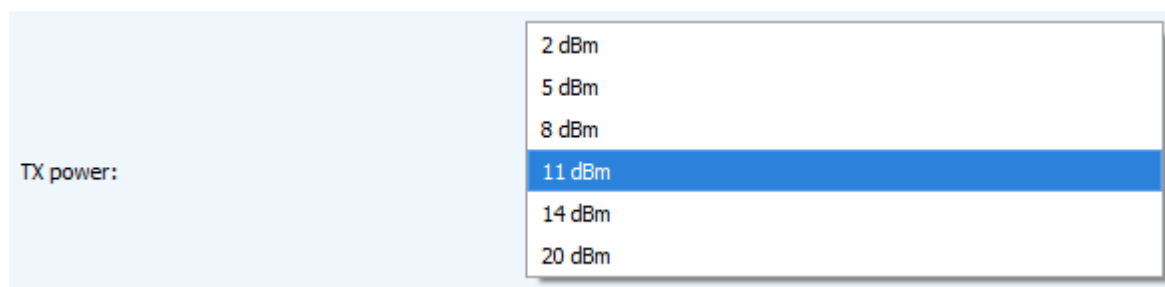
Join accept delay 1 (not displayed in the "Simple" mode) – sets the time that the device will open the first receiving window to receive confirmation for the join request from the LoRaWAN network. The second window always opens after 1 second after the first.



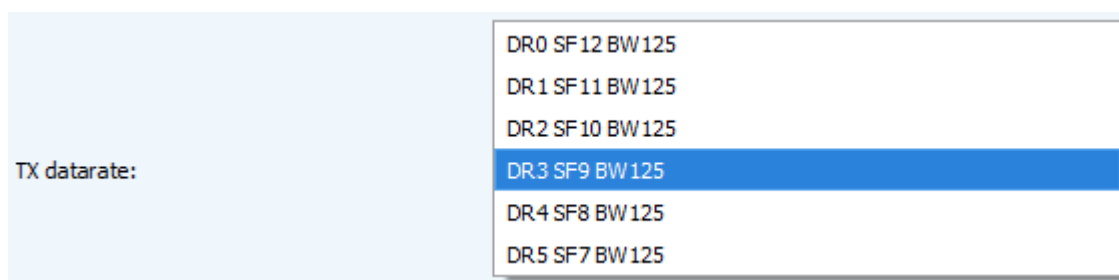
Uplink number of transmission (not displayed in the "Simple" mode) – if the "Confirmed uplinks" function is disabled, the device will simply send each packet as many times as specified in this option. If "Confirmed uplinks" is enabled, the device will send packets until it receives a confirmation or until it sends as many packets as specified in this option.



TX power (not displayed in the "Simple" mode) – the device RF transmitter power is adjusted to this value when sending packets to the LoRaWAN network. This option can be changed by the network server.

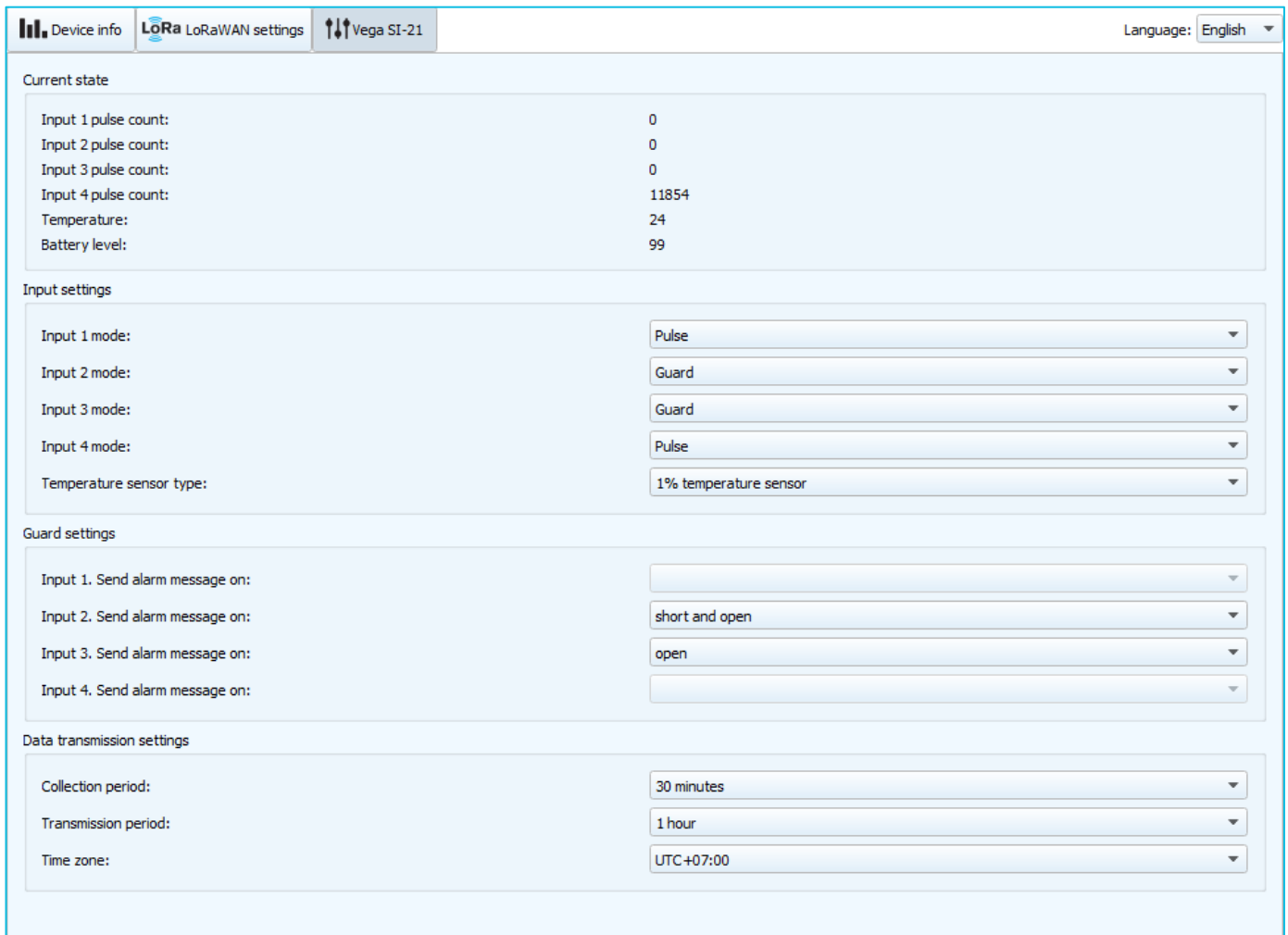


TX datarate (not displayed in the "Simple" mode) – the device transmission datarate at which it will transfer packets to the LoRaWAN network. This speed can be changed by the network server if the ADR algorithm is enabled.



“VEGA SI-21” TAB

The “Vega SI-21” tab contains the settings of the connected device.



The screenshot shows the configuration interface for the Vega SI-21 device. It features a top navigation bar with tabs for 'Device info', 'LoRa LoRaWAN settings', and 'Vega SI-21'. A language dropdown menu is set to 'English'. The main content area is divided into four sections:

- Current state:** A table showing real-time data:

Input 1 pulse count:	0
Input 2 pulse count:	0
Input 3 pulse count:	0
Input 4 pulse count:	11854
Temperature:	24
Battery level:	99
- Input settings:** Four dropdown menus for input modes (Pulse, Guard) and one for temperature sensor type (1% temperature sensor).
- Guard settings:** Four dropdown menus for alarm message triggers (short and open, open, or blank).
- Data transmission settings:** Three dropdown menus for collection period (30 minutes), transmission period (1 hour), and time zone (UTC+07:00).

Current state – displays the current parameters of the device - the number of counted pulses at the inputs, the external thermistor’s temperature and the battery level.

To reset the pulse count at the inputs, it is necessary to put the device in the "Storage" mode by pressing the button on the board for a long time (more than 5 seconds) (see section "Initial startup").

Input settings – allows setting up the current mode of inputs and temperature sensor type (it can be 1% or 5% error sensor). When transferring the input to the security mode, the device will send an alarm packet to the network (see part 5, packet 2) whenever this input is closed. The maximum possible frequency of sending alarm packets is one per 10 seconds.

Guard settings – allows to set up the work of security inputs, namely what kind of security circuit state is reason to send an alarm message: short, open, or both of them

Data transmission settings – a group of parameters that allows you to configure the collection and transmission periods, and the time zone for the internal clock of the counter will be set which. The readings are read from the connected device at 00.00 on the internal clock

of the device if the data collection period is set to 24 hours, at 00.00 and at 12.00, if the period is 12 hours and so on. All readings are stored in the device memory until the next communication session. The data transfer period can be adjusted from 5 minutes to 24 hours. Data transfer is carried out by a random time at the selected period. At the next communication session, the device starts sending accumulated packets with readings, from the earliest to the latest. With the "Confirmed uplinks" option turned off, the device just sends all accumulated packets to the network in order from the earliest to the latest thus clearing the queue for sending packets in memory. If the "Confirmed uplinks" option is enabled, the device will send the next packet only after receiving a confirmation of the delivery of the previous one. If such confirmation is not received after the fulfilled in the settings number of re-requests, device completes the communication session until the next according to the schedule. In this case, the device continues to collect data according to the data collection period and store it in memory. Non-transmitted packets remain in the pulse counter memory until the next communication session.

5 COMMUNICATION PROTOCOL

This part describes the SI-21 data exchange protocol with LoRaWAN network.

VEGA SI-21 PULSE COUNTER TRANSMITS THE FOLLOWING TYPES OF PACKETS



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

1. Packet with current readings, sent regularly

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



If thermistor is not connected to the pulse counter (contacts «Therm» and « \perp »), in the «Temperature» field will be sent an -100 °C value for breakage or fault indication

The counter has internal clock and calendar; time and date is 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, set by the switches:

- 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

Size in bytes	Field description
0 bit	Activation type: 0 - OTAA, 1 – ABP
1 bit	Query for packet confirmation: 0 – off, 1 – on

2,3 bits	Communication period: 2==0 3==0 - 1 hour 2==1 3==0 - 6 hours 2==0 3==1 - 12 hours 2==1 3==1 - 24 hours
4 bits	First input type: 0 – pulse, 1 - security
5 bits	Second input type: 0 – pulse, 1 - security
6 bits	Third input type: 0 – pulse, 1 - security
7 bits	Fourth input type: 0 – pulse, 1 - security

2. «Alarm» packet sent in case of security input closure

Size in bytes	Field description
1 byte	Packet type, this packet = 2
1 byte	Battery charge, %
1 byte	Values of basic settings (bit field)
1 byte	Input No, where the alarm is detected (1 - 4)
4 bytes	Input 1 reading (depending on the type – number of pulses or status: 0 – open, 1 - closed)
4 bytes	Input 2 reading (depending on the type – number of pulses or status: 0 – open, 1 - closed)
4 bytes	Input 3 reading (depending on the type – number of pulses or status: 0 – open, 1 - closed)
4 bytes	Input 4 reading (depending on the type – number of pulses or status: 0 – open, 1 - closed)

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

3. Packet with time correction request, sent every seven days on LoRaWAN port 4

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

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

VEGA SI-21 PULSE COUNTER RECEIVES PACKETS OF THE FOLLOWING TYPES

1. Real-time clock adjustment – send by application on LoRaWAN port 4

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

6 STORAGE AND TRANSPORTATION REQUIREMENTS

Vega SI-21 pulse counter shall be stored in the original packaging in heated room at temperatures $+5^{\circ}\text{C}$ to $+40^{\circ}\text{C}$ 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 $+85^{\circ}\text{C}$.

7 CONTENT OF THE PACKAGE

The pulse counter is delivered complete with:

Vega SI-21 pulse counter – 1 pc.

LoRaWAN antenna – 1 pc.

Factory certificate – 1 pc.

8 WARRANTY

The warranty period for the device is 5 years from the date of sale or 80,000 packages sent by the device, whichever comes first.

The manufacturer is obligated to provide repair services or replace the failed device during the entire warranty period.

The consumer is obliged to comply with the conditions and rules of transportation, storage and operation specified in this user manual.

Warranty does not apply to:

- devices that sent more than 80,000 packets;
- the device with mechanical, electrical and / or other damages and defects caused by violation of the transportation, storage and operation requirements;
- the device with traces of repair performed not by the manufacturer's service center;
- the device with traces of oxidation or other signs of liquids leaking inside the device.

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

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

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



vega-absolute.ru

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