TEMPERATURE SENSOR
VEGA TD-11

User Manual

Vega TD-11 is used for measurement air and non-aggressive gases temperature and further transmitting of this data to the LoRaWAN network

Vega TD-11 can act as a security sensor and send extraordinary alarm message by the triggering security input

Document Information

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02	2018.03.13	KEV	Changes in specification

CONTENTS

INTRODUCTION

This manual is designated for Vega TD-11 device (hereinafter – device, converter) manufactured by Vega-Absolute LLC and provides information on powering and activation procedure, control commands and functions of the device.

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

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

1 DESCRIPTION AND OPERATION

The device Vega TD-11 is designed for measurement atmosphere temperature (air and non-aggressive gases) by the external thermistor and further transmitting of this data to the LoRaWAN network.

Also, device can act as a security sensor and send extraordinary alarm message by the triggering security input.

Vega TD-11 may be used in systems where temperature control is required but its directly measurement is difficult. For example, car engine temperatures control and temperature control at the production rooms, stocks.
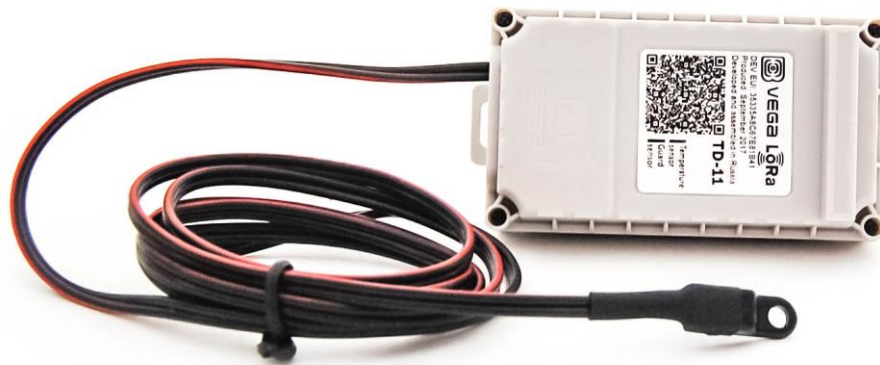
TD-11 is powered by a 3400 mAh built-in battery with service life up to 10 years, provided data transmitted once a day.

The device is configured via USB with special software "Vega LoRaWAN configurator".

The label on the board contains the information for registering of the device in the LoRaWAN network:

- Device EUI,
- Device address,
- Network session key,
- Application session key,
- Application EUI,
- Application key.

Moreover this information is available via "Vega LoRaWAN configurator" application.

2 SPECIFICATION

| Main	
USB-port	yes
Operating temperatures	-40...+85 °C
Measurement temperatures	-55...+100 °C
Accuracy of temperature measurement: With 5% thermistor	±2 in range -10...+40 ºC ±4 in range -55...+100 ºC
With 1% thermistor	±0.5 in range -10...+40 ºC ±1 in range -55...+100 ºC
Hall sensor sensitivity	5 mT
LoRaWAN	
LoRaWAN class	A
Quantity of LoRa channels	16
Frequency band	EU-868, RU-868, custom
Activation type	ABP or OTAA
Communication period	1, 6, 12 or 24 hours
Antenna type	internal
Sensitivity	-138 dBm
Radio coverage in restrained urban conditions	max 5 km
Radio coverage within line of sight	max 15 km
Power output	up to 100 mW (configurable)
Power	
Built-in battery	3400 mAh
Built-in battery lifetime	up to 10 years
Case	
Housing dimensions	95 x 50 x 45 mm
Ingress protection rating	IP65
Tamper sensor	yes
Mounting	clamp fastening to the support, DIN-rail, wall-mounting

Vega TD-11 temperature sensor is class A device (LoRaWAN classification) and has the following features:

- o Temperature measurement in range of -55... +100 ºC
- o Charge measuring of the built-in battery (%)
- o Extra communication in case of security inputs actuation
- o Extra communication in case of tamper sensor actuation
- o Extra communication in case of Hall sensor (1 or 2) actuation
- o Two operating modes – Active mode and Storage mode
- o ADR support (Adaptive Data Rate)

- o Sending of confirmed packets (configurable)
- o Ability to use one of two types of thermistors with 1 or 5% measurement error (termistor type is selected in «Vega LoRaWAN configurator» application)
- o Ability to configurate security input triggering on short, open or both of this cases

3 OPERATION

CONTACTS

External thermistor connection contacts

Contact pair for connection with the security circuit
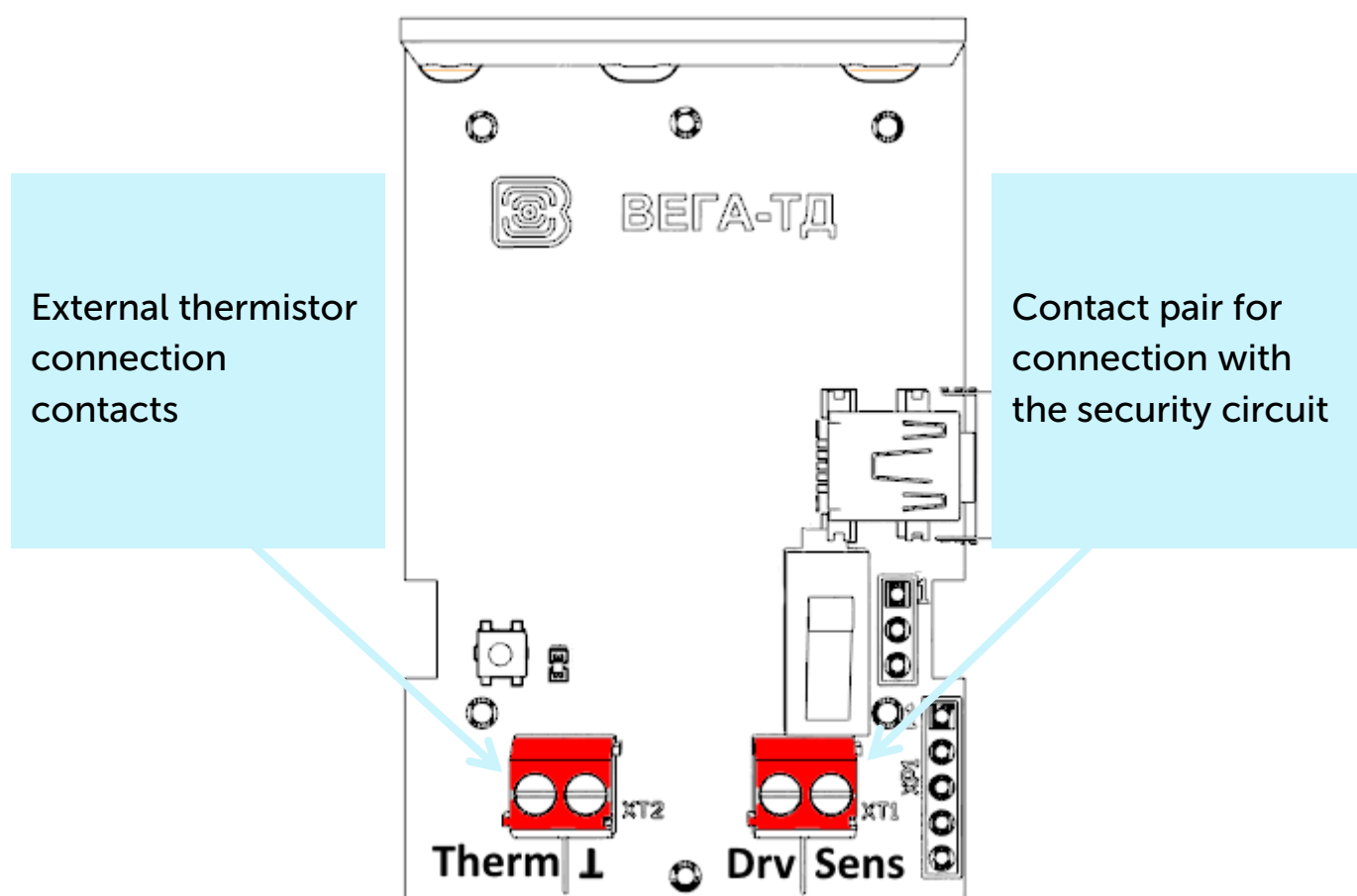
Temperature sensor has a two contact pairs. One pair ("Therm" and " ⊥ " contacts) is for connect to external thermistor, another one is security input ("Drv" and "Sens" contacts).

Security input of the device can be used for connect to circuits with the following types of NO contacts:

- reed switch (Herkon);
- mechanical pushbutton;
- open-drain output.

Polarity is matter only for open-drain circuit. Open drain output must be connected to "Drv" contact and ground to "Sens".

Security input can trigger on short, open or both of this cases. It is configured by the "Vega LoRaWAN Configurator" application (See part 4). Should the security input triggering, the device is activated and sends an alarm message to the network.

DEVICE SENSORS

Two Hall sensors are located on the board bottom. Hall sensor triggers in the presence of magnetic field what allows using temperature sensor for reed switch control. Should the any sensor triggering, the device sends a corresponding message to the LoRaWAN network (see part 5).

DVR2 – Hall sensor 2

DVR1 – Hall sensor 1
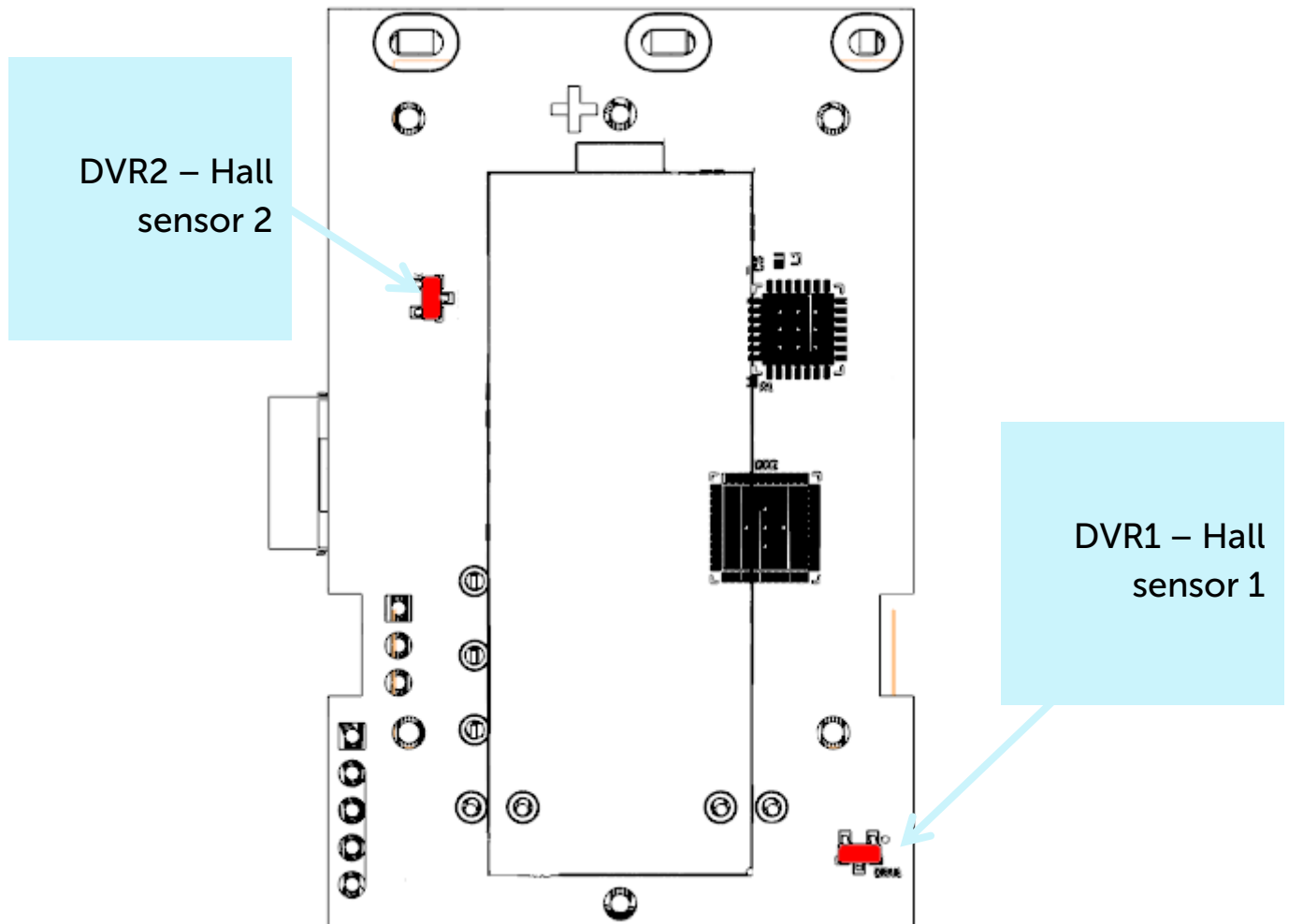
Tamper is located on the board top. Should the tamper triggering, the device sends a corresponding message to the LoRaWAN network.

Tamper
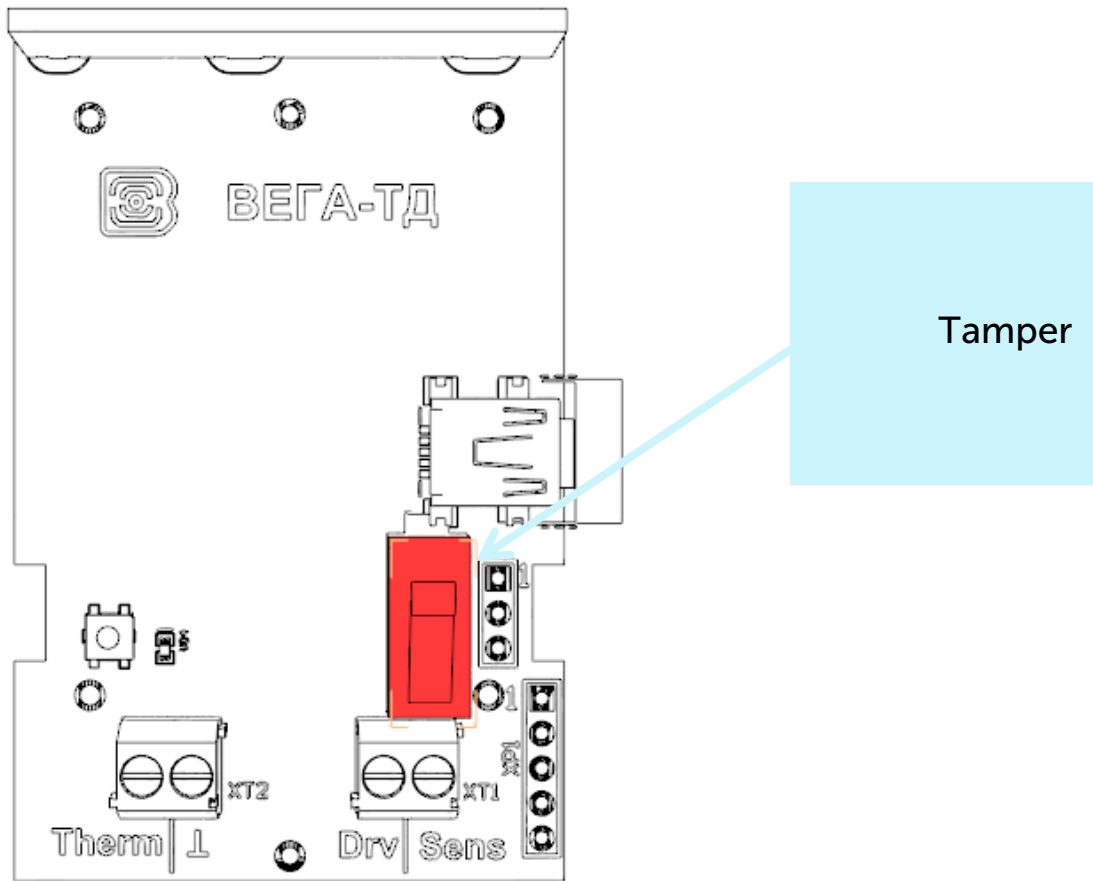
INDICATION

The device has one red LED located on the board. Indication is only used during device activation step in the LoRaWAN network and when operation modes are switch.

LED location on the board
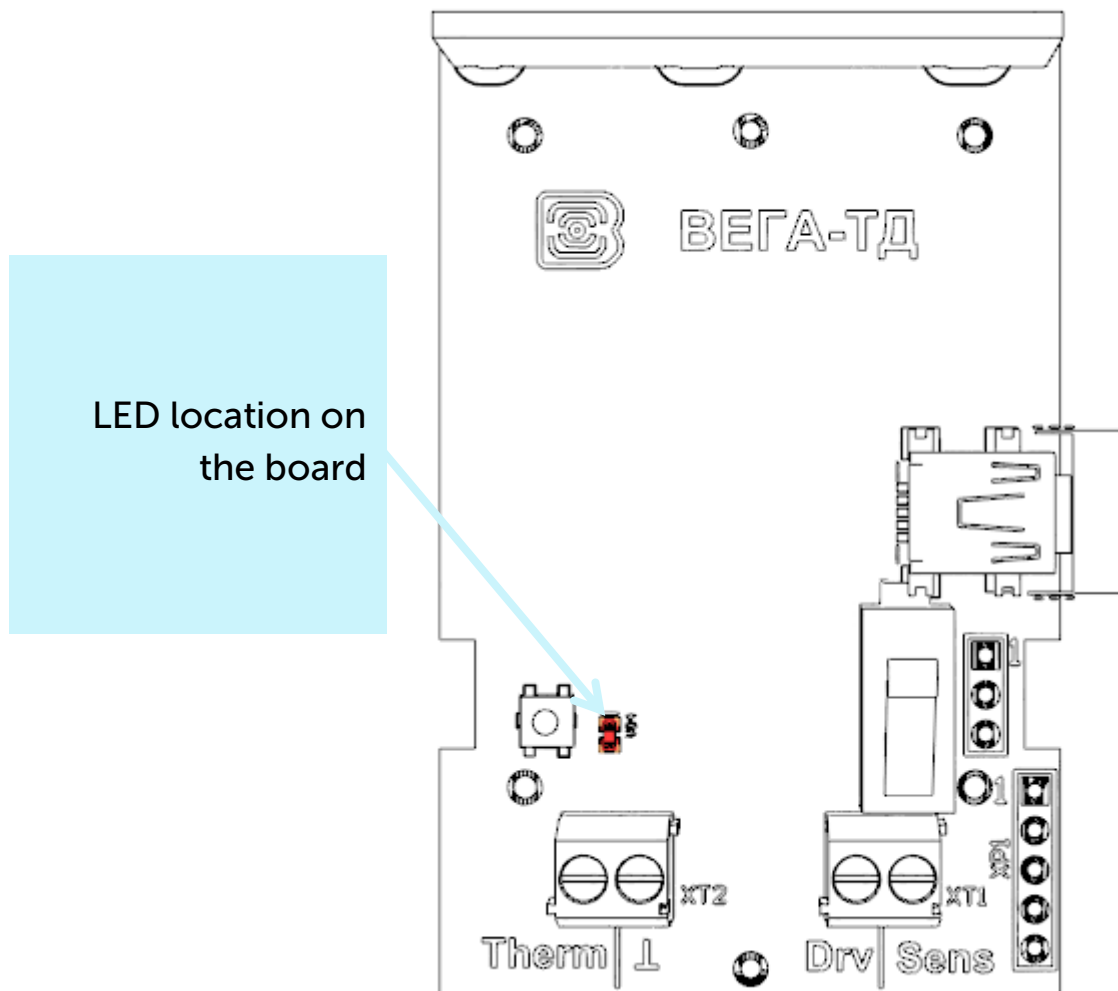
LED signal		Meaning
●●●	Series of short flashes	Connection to the network is proceed
▬▬▬	One long flash	Device connection to the network is success
▬▬ ▬▬ ▬▬	Three long flashes	Device went to the "Storage' mode

ℹ️ The device go to the "Storage" mode automatically in case of invalid connection to the network

INITIAL STARTUP

Vega TD-11 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 sensor from the "Storage" mode.

The temperature sensor supports two activation methods in the LoRaWAN network - ABP and OTAA. Select one of the methods using "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 5 seconds) and switches to the "Active" mode. If all attempts fail, the converter became to the "Storage" mode.

To transfer the device from the "Active" mode to the "Storage" mode, you can use the long press of the start button (more than 5 seconds).


Press the start button located on the board
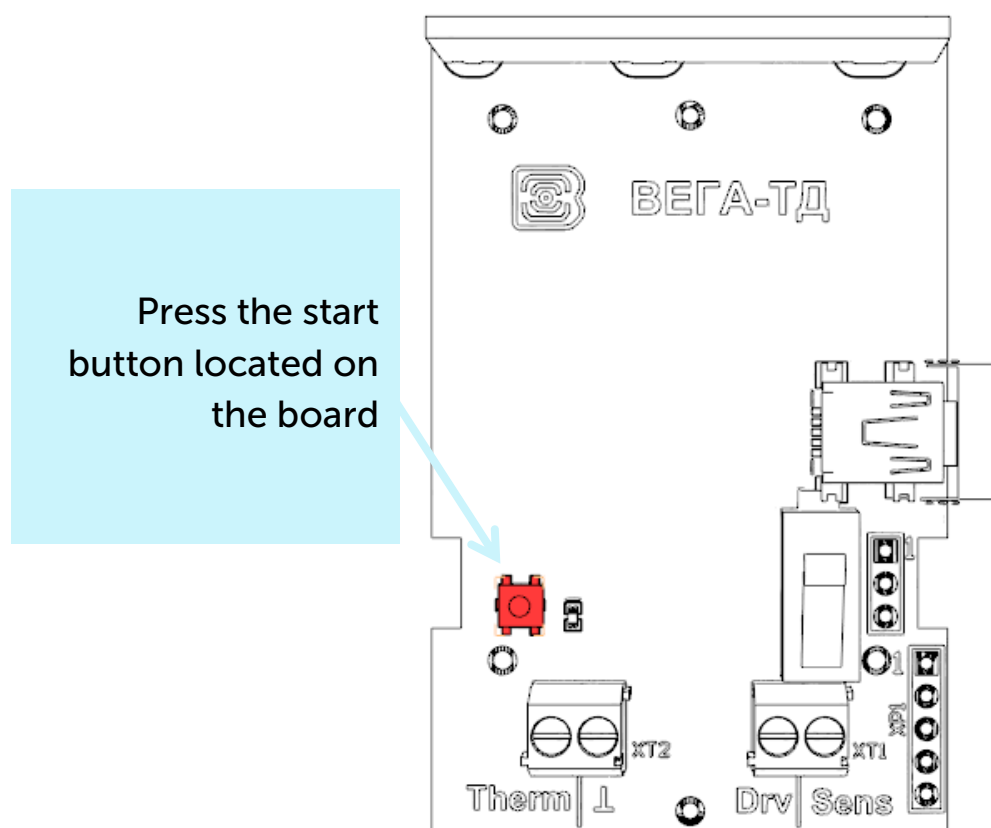
CONNECTING VIA USB

Vega TD-11 adjusted with the "Vega LoRaWAN Configurator" application (See part 4).

USB port is located
on the board
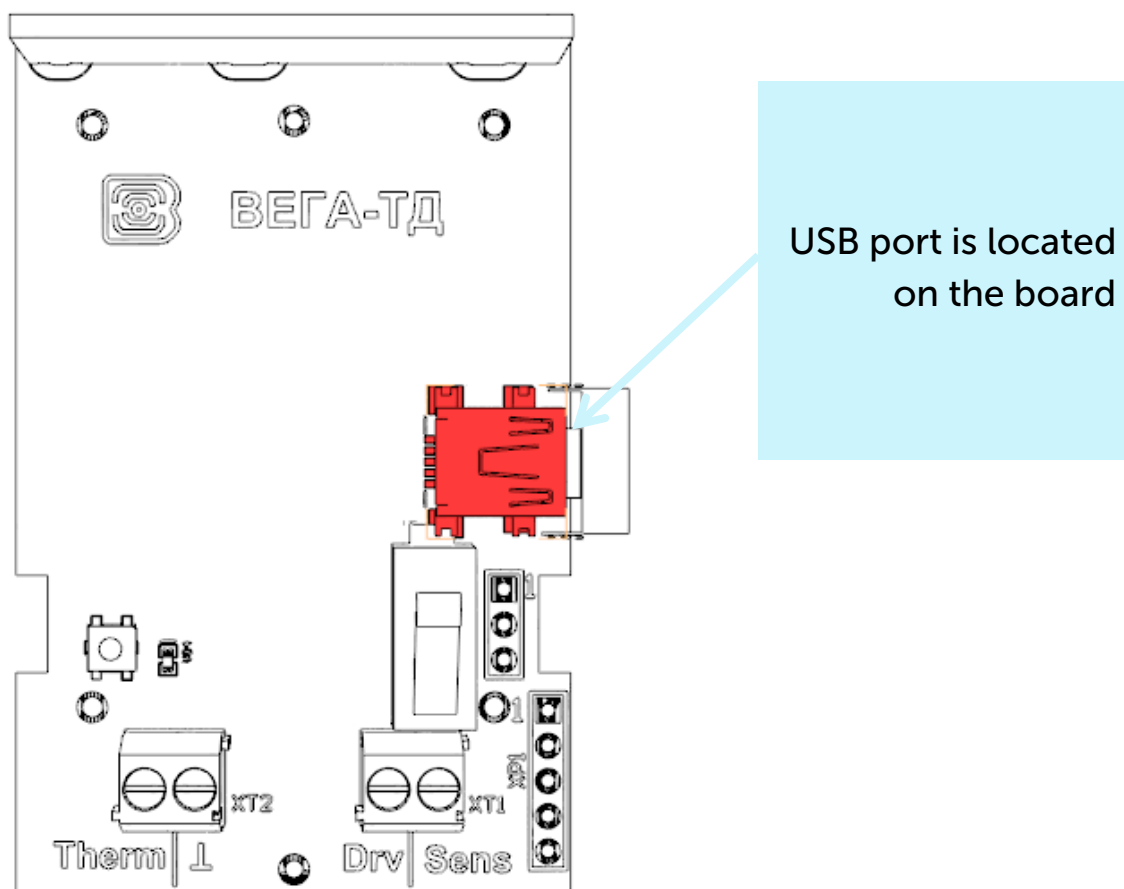
Before connecting the device to the computer for the first time, you must install the driver for the COM port **stsw-stm32102**, which can be downloaded from iotvega.com. After running the executable file **VCP_V1.4.0_Setup.exe**, the installer window will appear:
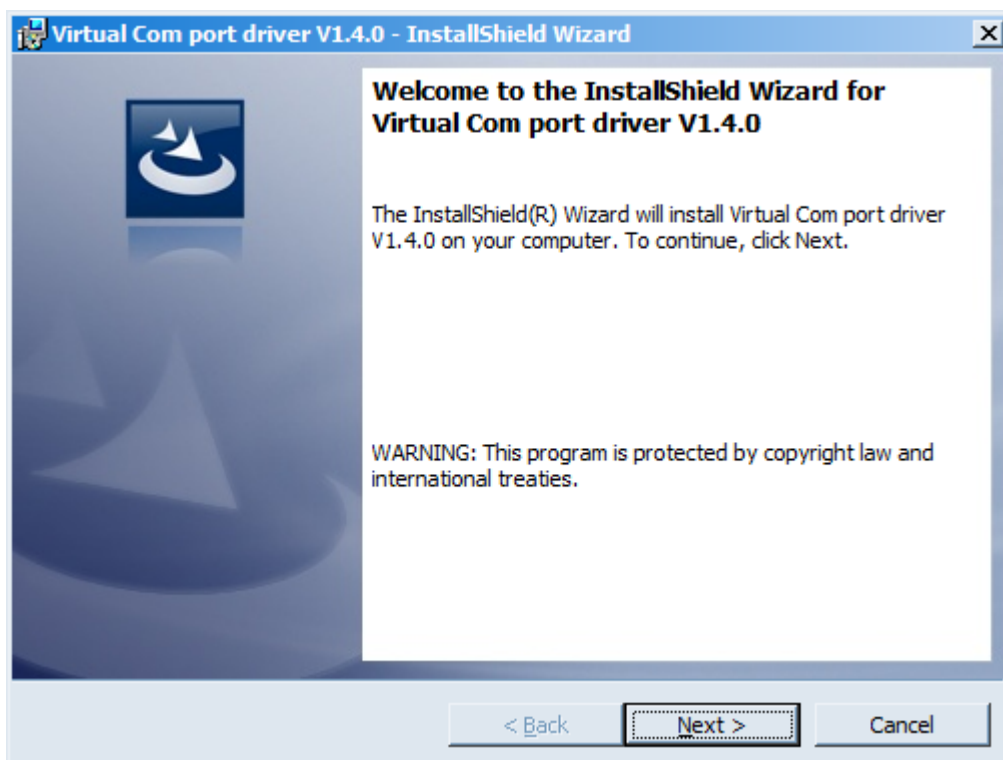
In this window, you need to click **Next**, then **Install**, and then the installation will begin. When the installation is completed successfully, the following screen appears:
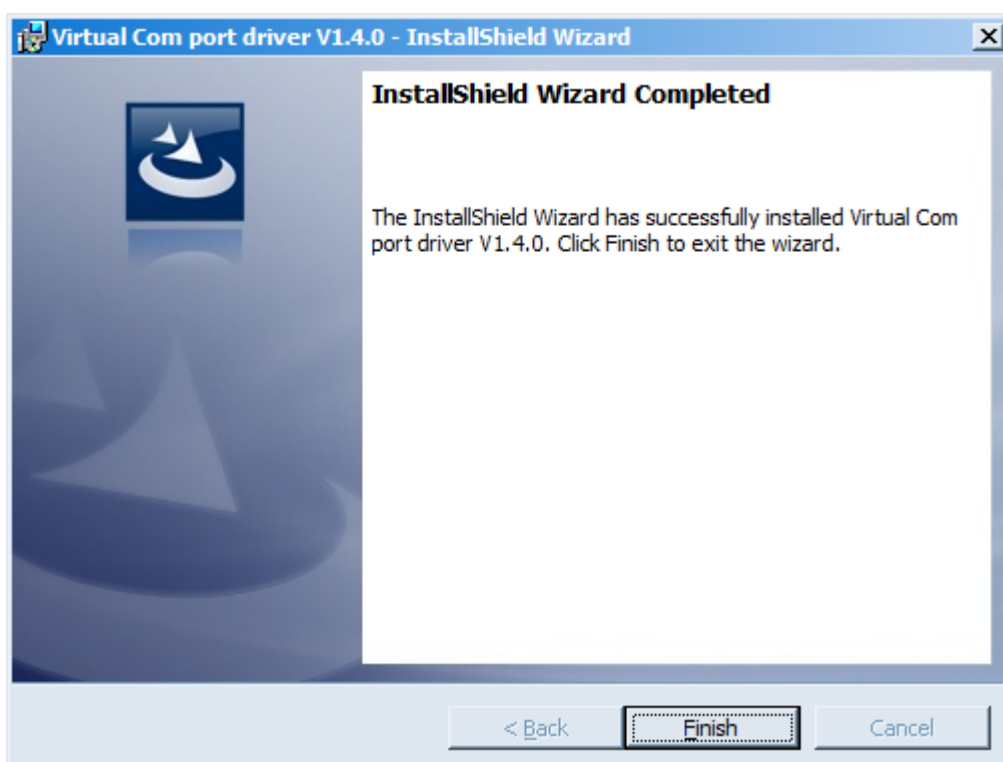
After pressing **Finish** the driver is ready for operation, - it is possible to connect the device via USB.

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 (See Fig. 4.1).
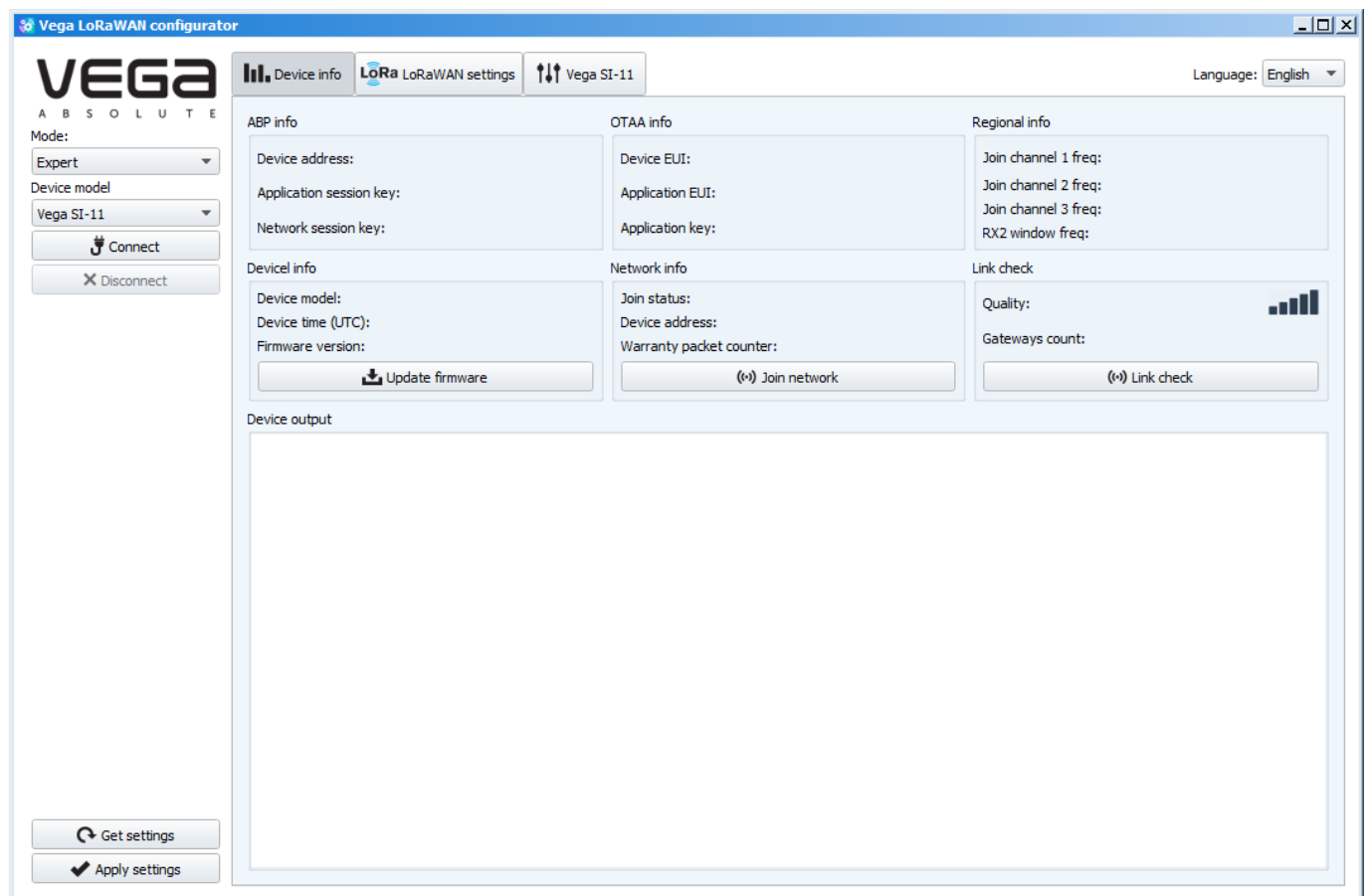

Fig. 4.1. The «Vega LoRaWAN Configurator» application interface.

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.
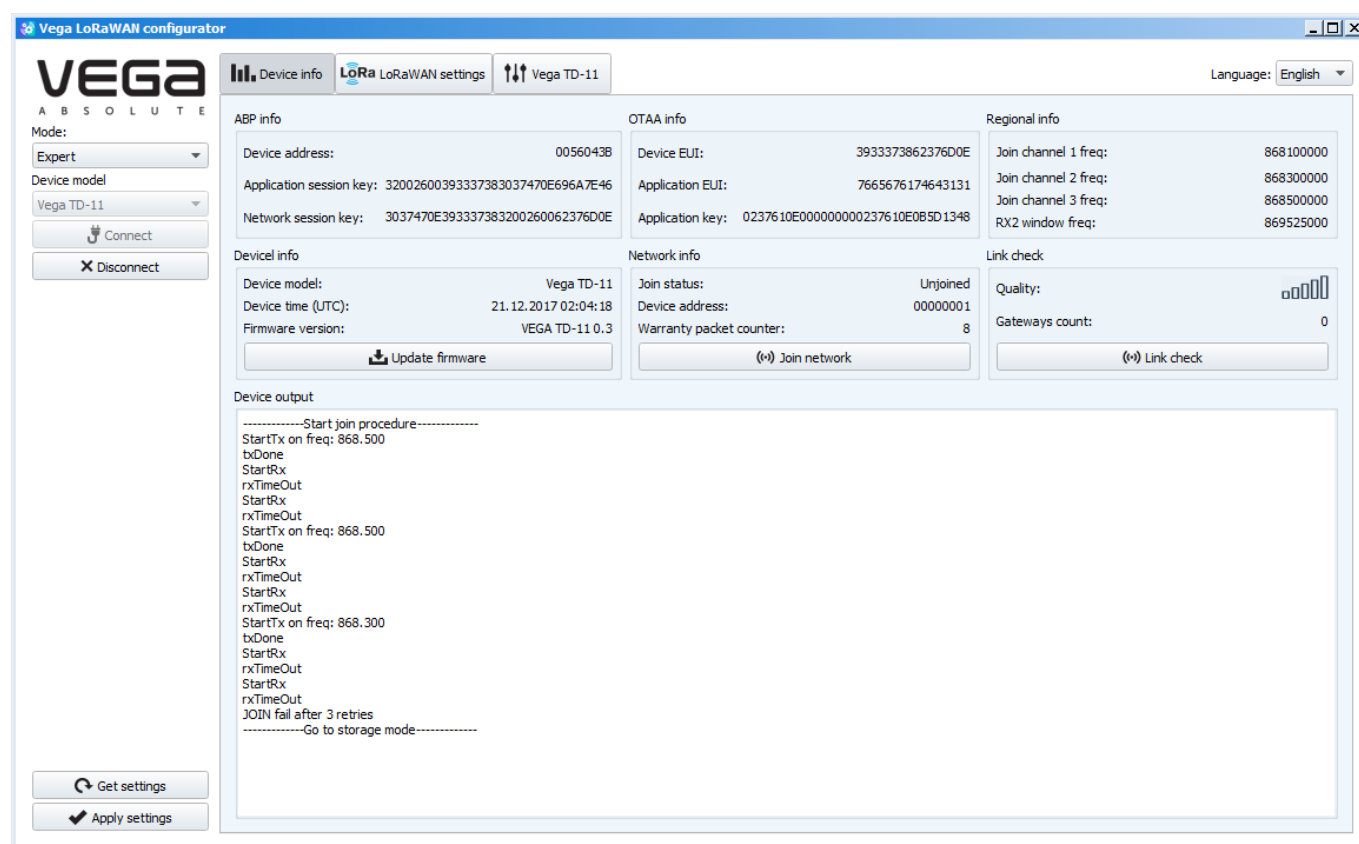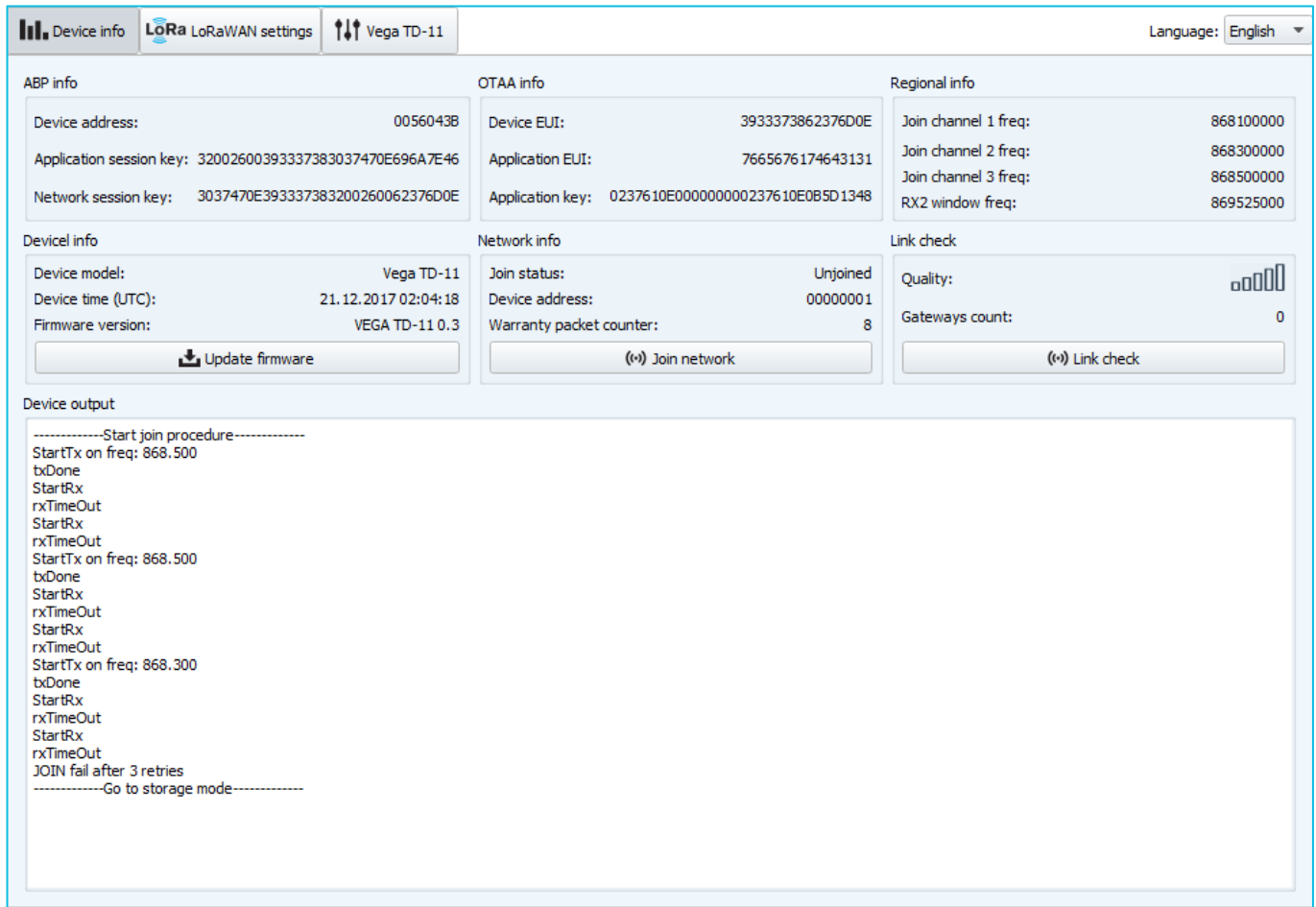

Fig. 4.2. Connection to the device.

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 (Fig. 4.3).

Fig. 4.3. The "Device info" tab.

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.

Regional info (not displayed in the "Simple" mode) - shows the frequencies of the JOIN channels and the second receiving window. These frequencies can be changed in the "LoRaWAN Settings" tab when selecting a frequency plan.

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 occurs.

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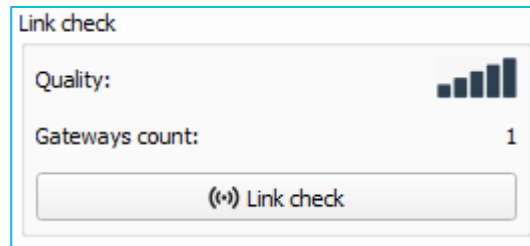
Device output (not displayed in the "Simple" mode) - monitoring the device status, all events in real time are displayed.

"LORAWAN SETTINGS" TAB

The "LoRaWAN Settings" tab allows you to configure various parameters of the LoRa network (Fig. 4.4).
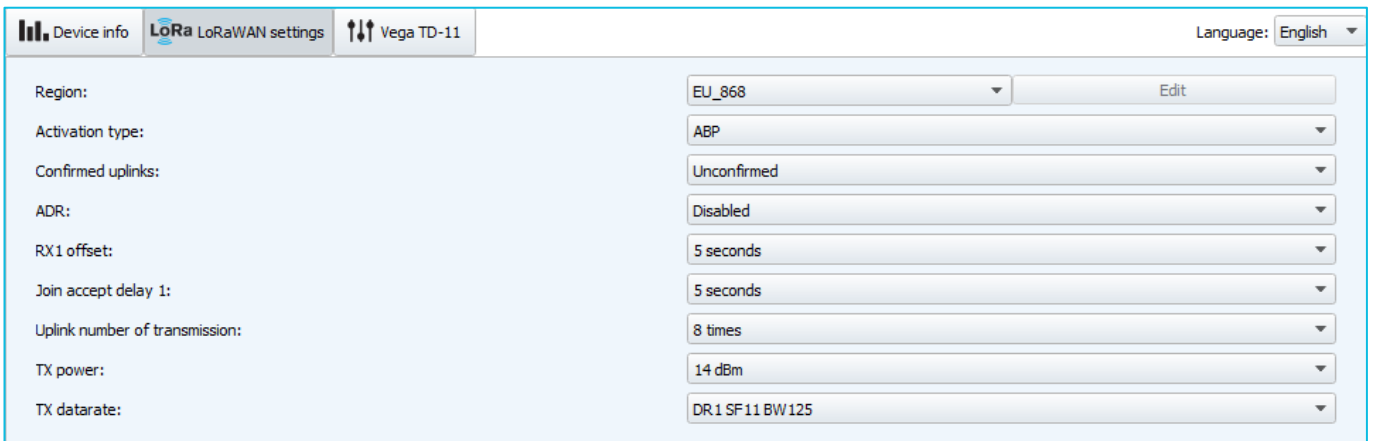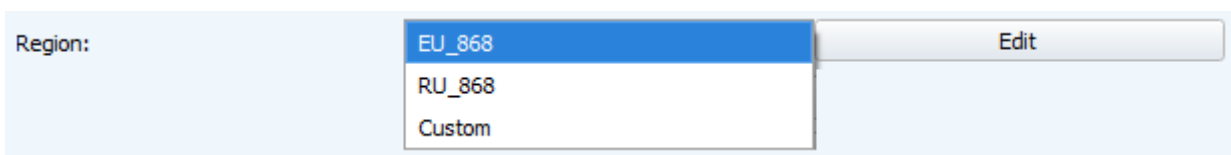

Fig. 4.4. "LoRaWAN settings" tab.

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

The converter supports the following frequency bands:

Frequency band	Channel	Frequency	Modulation

	1	868.1	MultiSF 125 kHz
EU-868	2	868.3	MultiSF 125 kHz
	3	868.5	MultiSF 125 kHz
	RX2	869.525	SF12 125 kHz
RU-868	1	864.5	MultiSF 125 kHz
	2	864.7	MultiSF 125 kHz
	3	864.9	MultiSF 125 kHz
	RX2	869.05	SF12 125 kHz
Custom	Set with «Vega LoRaWAN Configurator» application		

In the EU_868 and RU_868 frequency bands, only 3 channels are active by default. The device sends requests for connection to the network on this "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:

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**

Activation type – selecting ABP or OTAA device activation method.

Activation type:	OTAA
	ABP

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).

Confirmed uplinks:	Confirmed
	Unconfirmed

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:	Enabled
	Disabled

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.

	1 second
	2 seconds
	3 seconds
	4 seconds
	5 seconds
RX1 offset:	6 seconds
	7 seconds
	8 seconds
	9 seconds
	10 seconds
	11 seconds
	12 seconds
	13 seconds
	14 seconds
	15 seconds

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.

Join accept delay 1:	1 second
	2 seconds
	3 seconds
	4 seconds
	5 seconds
	6 seconds
	7 seconds
	8 seconds
	9 seconds
	10 seconds
	11 seconds
	12 seconds
	13 seconds
	14 seconds
	15 seconds
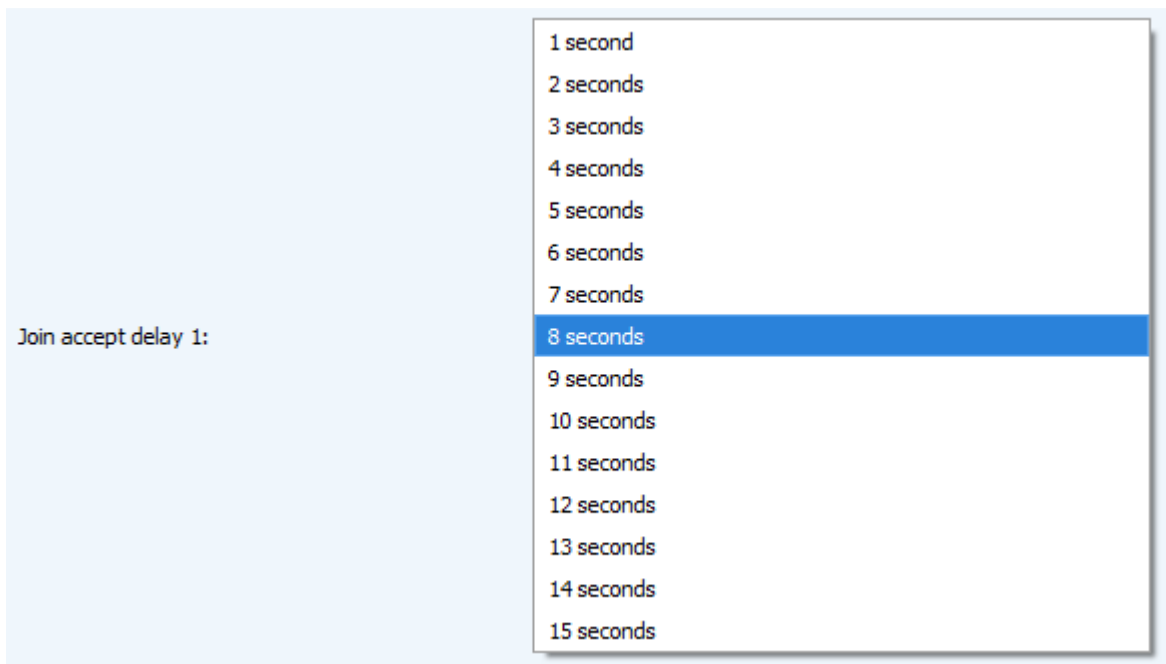
Uplink number of transmission (not displayed in the "Simple" mode) – if the "Confirmed uplinks" function is disabled, the device will simply send each packet as many times as specified in this option. If "Confirmed uplinks" is enabled, the device will send packets until it receives a confirmation or until it sends as many packets as specified in this option.

Uplink number of transmission:	1 time
	2 times
	3 times
	4 times
	5 times
	6 times
	7 times
	8 times
	9 times
	10 times
	11 times
	12 times
	13 times
	14 times
	15 times
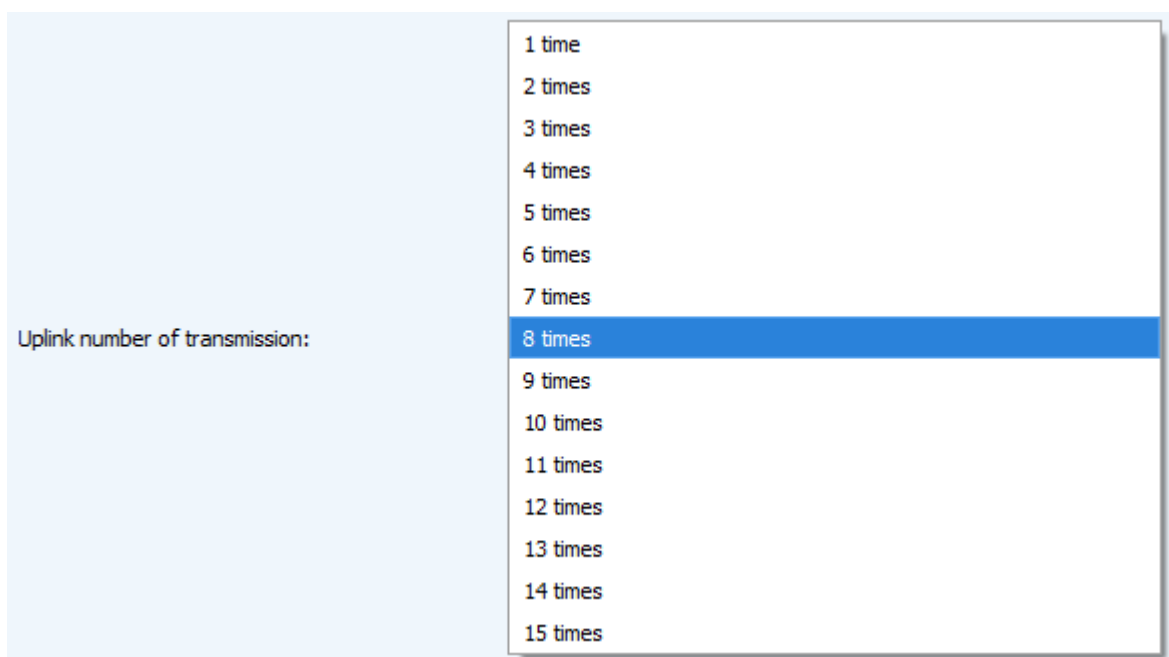
TX power (not displayed in the "Simple" mode) – the device RF transmitter power is adjusted to this value when sending packets to the LoRaWAN network. This option can be changed by the network server.
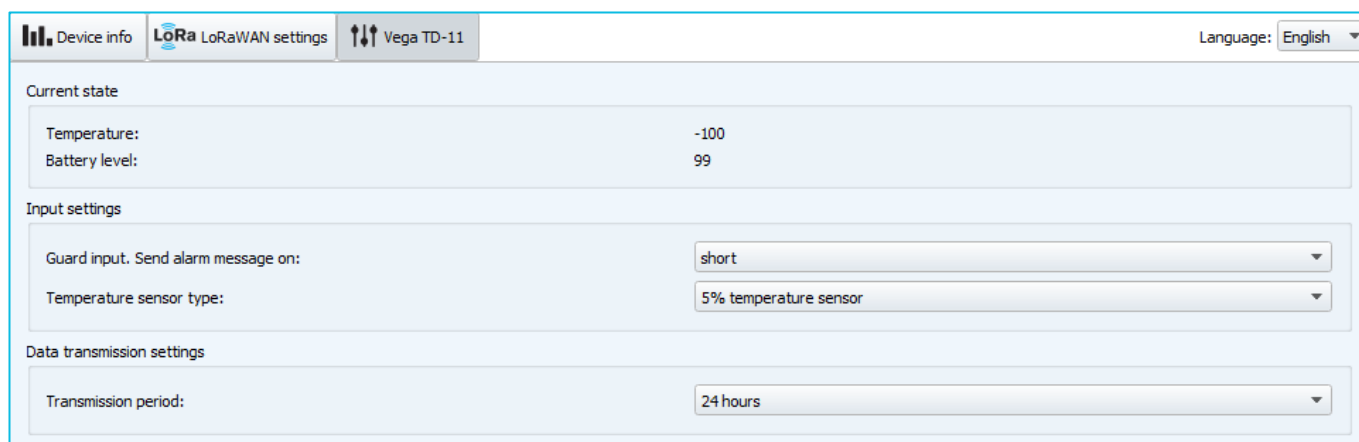
TX power:	2 dBm
	5 dBm
	8 dBm
	11 dBm
	14 dBm
	20 dBm

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.

TX datarate:	DR0 SF12 BW125
	DR1 SF11 BW125
	DR2 SF10 BW125
	DR3 SF9 BW125
	DR4 SF8 BW125
	DR5 SF7 BW125

«VEGA TD-11» TAB

The "Vega TD-11" tab contains the settings of the connected device (Fig. 4.5).

Fig. 4.5. "Vega TD-11" tab.

Current state – displays the current parameters of the device - the internal temperature of the device, the battery level and the current LoRaWAN class.

Input settings – allows to setting inputs. Alarm message can be sent by the short or open security circuit or in both of these cases. Maximum frequency of alarm messages sending is one per 10 seconds. Temperature sensor can be one of two types – 1% and 5% measurement error.

Data transmission settings – the transmission period which the packet with the current readings is transmit (See part 5, packet 1).

5 COMMUNICATION PROTOCOL

Vega TD-11 uses the LoRaWAN port 2 for uplink and downlink messages. In fields consisting of several bytes, the little endian byte order is used.

CONVERTER TD-11 TRANSMITS THE FOLLOWING TYPES OF PACKETS

1. Packet with current readings from connected heat meter, sent regularly or by the request or by the one of "Reason of sending message" field events

Size in bytes	Field description	Data type
1 byte	Packet type, this packet = 1	uint8
1 byte	Battery level, %	uint8
1 byte	Values of basic settings (bit field)	uint8
1 byte	Current temperature in °C multiplied by 10	uint8
1 byte	Reason of sending message	uint8
1 byte	TD-11 inputs/outputs state	uint8

> If thermistor is not connected to the TD-11 (contacts «Therm» and «⊥»), in the «Temperature» field will be sent an -1000 value for breakage or fault indication

"Values of basic settings" bit field decoding

Bits	Field description
0 bit	Activation type 0 - OTAA, 1 – ABP
1 bit	Query for packet confirmation 0 – off, 1 – on
2,3 bit	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 bit	reserve
5 bit	reserve
6 bit	reserve
7 bit	reserve

" Inputs state " bit field decoding

Bits	Field description	Value
0 bit	Security input state	"0" – short, "1" – open
1 bit	Tamper state	"0" – case not open, "1" – case open
2 bit	Hall sensor 1 state	"0" – sensor triggered, "1" – sensor not triggered
3 bit	Hall sensor 2 state	"0" – sensor triggered, "1" – sensor not triggered
4 bit	reserve	
5 bit	reserve	
6 bit	reserve	
7 bit	reserve	

"Reason of sending message" field codes

Code	Value
0x00	Sending packet by the time
0x01	By the security input triggering
0x02	By the tamper triggering
0x03	By the Hall sensor 1 triggering
0x04	By the Hall sensor 2 triggering

6 STORAGE AND TRANSPORTATION REQUIREMENTS

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

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

7 CONTENT OF THE PACKAGE

Vega TD-11 device is delivered complete with:

Temperature sensor Vega TD-11 – 1 pc.

External thermistor – 1 pc.

Screw – 4 pcs.

Factory certificate – 1 pc.

8 WARRANTY

The warranty period for the device is 5 years from the date of sale or 80,000 packets 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 undertakes to comply with the terms and conditions of transportation, storage and operation specified in this user manual.

Warranty does not apply to:

- on 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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