



LORAWAN CONVERTER

VEGA TP-11

User Manual

Vega TP-11 converter is used for reading of values from metering instruments via 4-20 mA current loop interface and further transmitting of this data to the LoRaWAN network.

Vega TP-11 has also two security inputs and two 'open drain' outputs.

Document Information

Title	Vega TP-11 LoRaWAN converter
Document type	Manual - Translation from Russian
Document number	V02-TP11-01
Revision and date	05 – 19 June 2018

This document applies to the following products:

Product name	Type number
End devices	Vega TP-11

Revision History

Revision	Date	Name	Comments
01	15.09.2017	KEV	Document creation date
02	03.10.2017	TII	Minor edits
03	26.10.2017	KEV	External devices connection was added
04	10.01.2018	PKP	Changes in the communication protocol: "Values of basic settings" bit field decoding table corrected
05	19.06.2018	TII	Changes in parts "Contacts" and "Vega TP-11" tab". An accuracy of current measurement added at the specification

CONTENTS

INTRODUCTION	4
1 DESCRIPTION AND OPERATION	5
2 SPECIFICATION	6
3 OPERATION.....	7
Contacts	7
Initial startup.....	9
External devices connection	10
Connecting via USB	11
4 VEGA LORAWAN CONFIGURATOR.....	13
Interface of the application	13
Connection to the device	14
“Device info” tab	15
“LoRaWAN settings” tab	17
«Vega TP-11» tab.....	21
5 COMMUNICATION PROTOCOL	22
Converter TP-11 transmits the following types of packets.....	22
Converter TP-11 receives packets of the following types	24
6 STORAGE AND TRANSPORTATION REQUIREMENTS	25
7 CONTENT OF THE PACKAGE	26
8 WARRANTY.....	27

INTRODUCTION

This manual is designated for Vega TP-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 TP-11 is designed for reading of values from devices via 4-20 mA current loop interface and further accumulating and transmitting of this data to the LoRaWAN network.

Converter can be used for any sensors and industrial equipment with 4-20 mA interface, temperature sensors, waste sensors, pressure sensors.

Converter is an autonomic device and provides connected sensors with 24 V power via 4-20 mA interface.

Vega TP-11 has two 'open-drain' outputs so it can be used as a control device. Also device has two security inputs.



The converter is powered by a 6800 mAh built-in battery with service life up to 10 years, provided data transmitted once a day. The converter can be powered by the 10...36 V external power supply.

The converter is configured via USB with «Vega LoRaWAN configurator» application.

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

Current loop 4-20 mA interface	1
Security inputs	2
'Open-drain' outputs	2
USB-port	yes
Operating temperatures	-40...+85 °C

LoRaWAN

LoRaWAN class	A or C
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 connector	SMA
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	6800 mAh
External power supply	10...36 V
Accuracy of current measurement	±1.2 %
4-20 mA interface power supply	24 V

Case

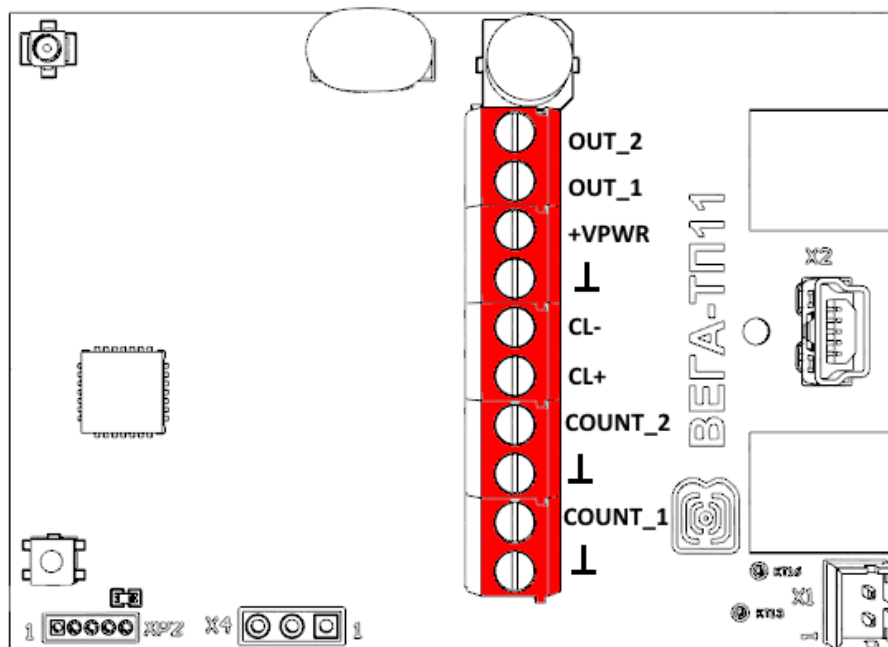
Housing dimensions	95 x 80 x 65 mm
Ingress protection rating	IP65
Mounting	clamp fastening to the support, DIN-rail, wall-mounting

Vega TP-11 converter can be either of class A or class C (LoRaWAN classification) and has the following features:

- Automatic change from A class to C class when powered from an external power supply
- ADR support (Adaptive Data Rate)
- Sending of confirmed packets (configurable)
- Extra communication in case of security inputs actuation
- Temperature measurement by the internal temperature sensor
- Charge measuring of the built-in battery (%)

3 OPERATION

CONTACTS



Converter has 10 contacts, see table below:

Contact	Designation on the board	Description
1	OUT_2	Open-drain output 2
2	OUT_1	Open-drain output 1
3	+VPWR	Power "+"
4	⌞	Power "-"
5	CL-	4-20 mA "-"
6	CL+	4-20 mA "+"
7	COUNT_2	Security input 2
8	⌞	Ground
9	COUNT_1	Security input 1
10	⌞	Ground

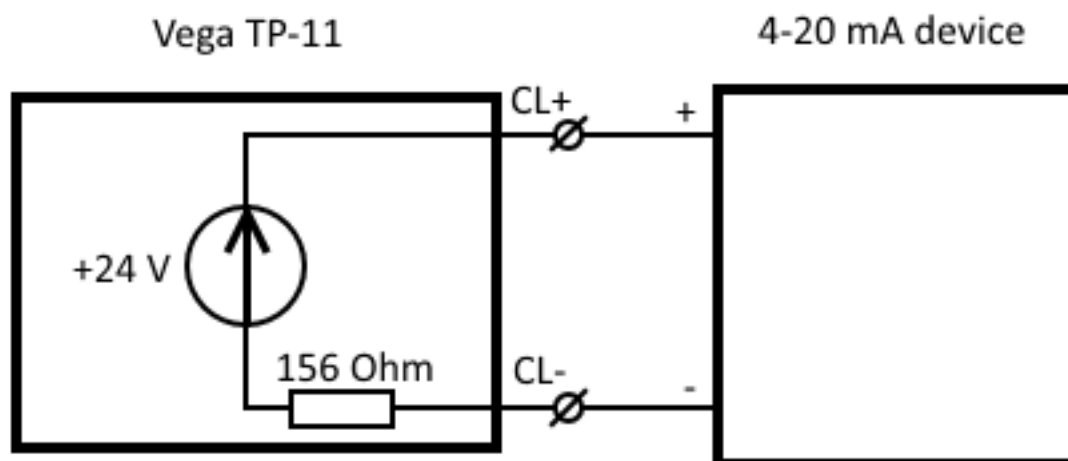
Ground contacts 8 and 10 are used for connection of security inputs COUNT_1 and COUNT_2.

Security inputs of the device are used to connect circuits with the following types of NO contacts:

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

While security input connected the device monitors its closure/unlocking. Should the security input triggering, the device is activated and sends an alarm message to the network.

For connect an external sensor contacts CL+ и CL- are used. Connection scheme see on the picture below.

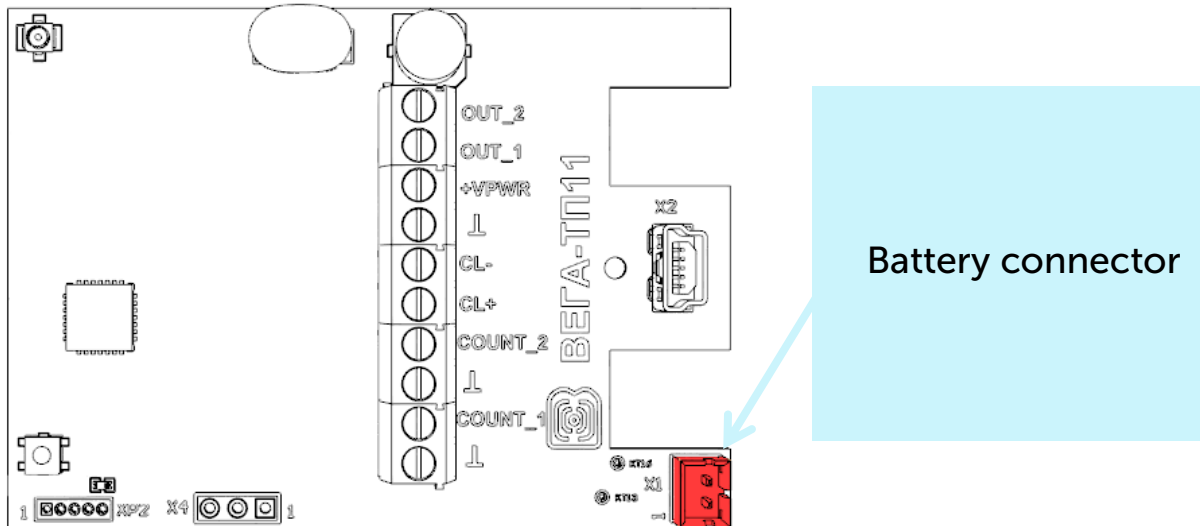


In order to save the battery life of the converter, the 24 V supply voltage is not continuously supplied. The 24 V voltage is applied to the 4-20 mA device a few seconds before the polling is performed so that the sensor can turn on and set the current corresponding to the measured parameter. This time, the so-called "startup time", is a configurable parameter from the configurator and can be set from 1 to 60 seconds.

The outputs OUT_1 and OUT_2 operate on the principle of open-drain and can be used to control external devices, such as electric cranes, lighting, sirens and so on. The load capacity of each output is no more than 200 mA.

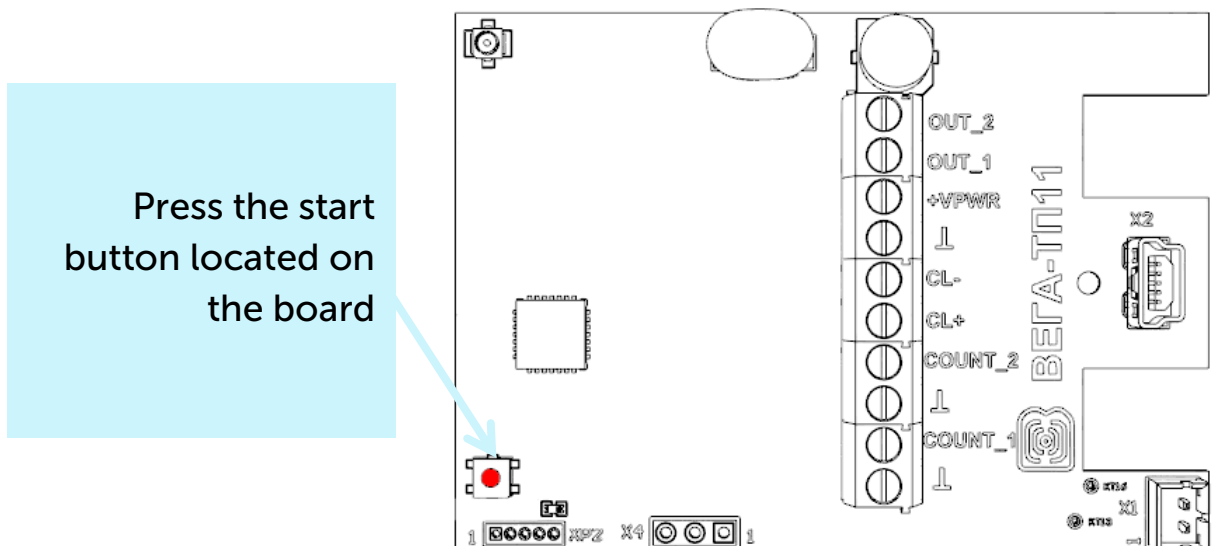
INITIAL STARTUP

Vega TP-11 can be powered from either an external power source or built-in battery. To operate from the built-in battery, you must connect the battery connector to the power connector on the board.



The converter 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).



Before connecting the device to the network, make sure that its registration data is entered in the network - Device EUI, Application EUI and Application Key for OTAA, or Device address, Application session key and Network session key for ABP

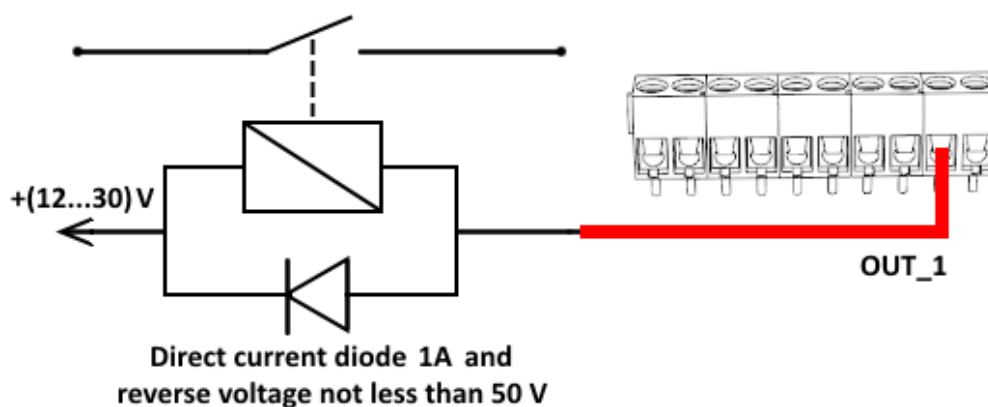
EXTERNAL DEVICES CONNECTION

The actuators are connected to the converter via outputs OUT_1 and OUT_2, which are of the open-drain type.



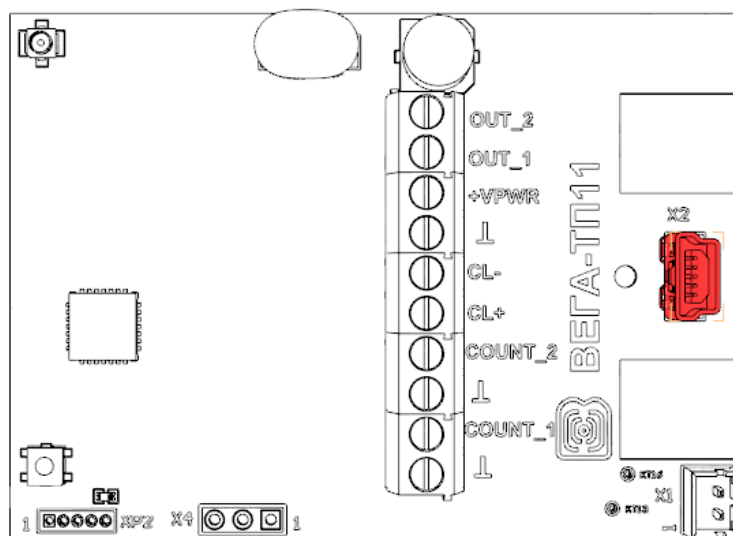
Permissible load for each digital output is 200 mA

To increase the load on the device outputs, it is necessary to use an external relay. The relay connection scheme is shown below.

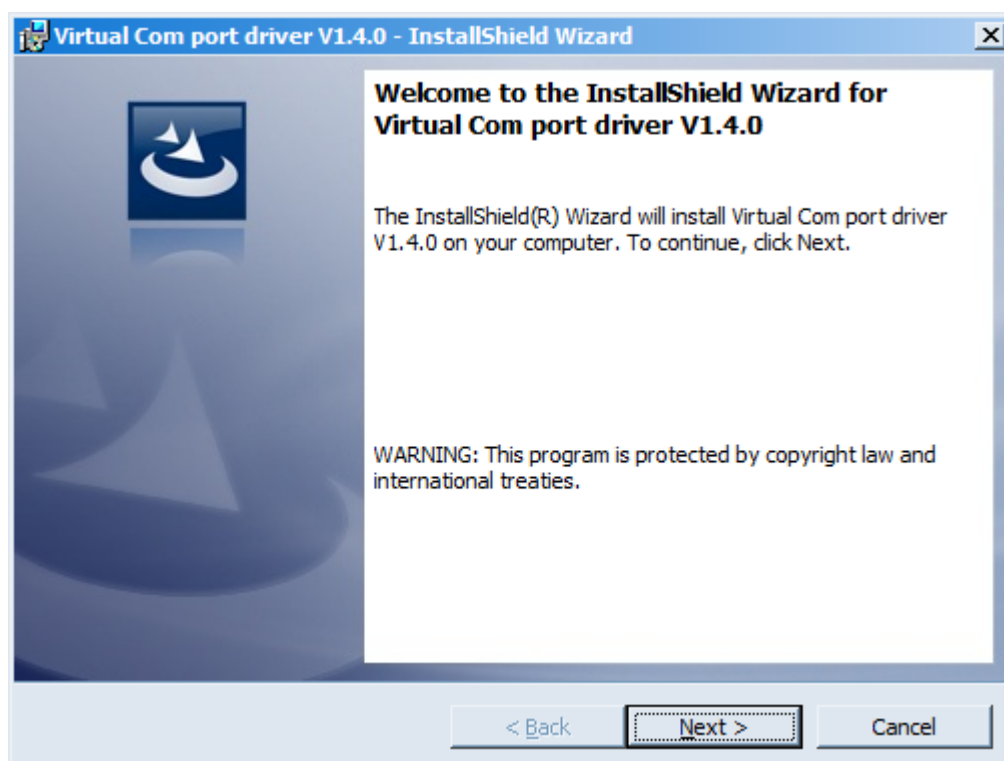


CONNECTING VIA USB

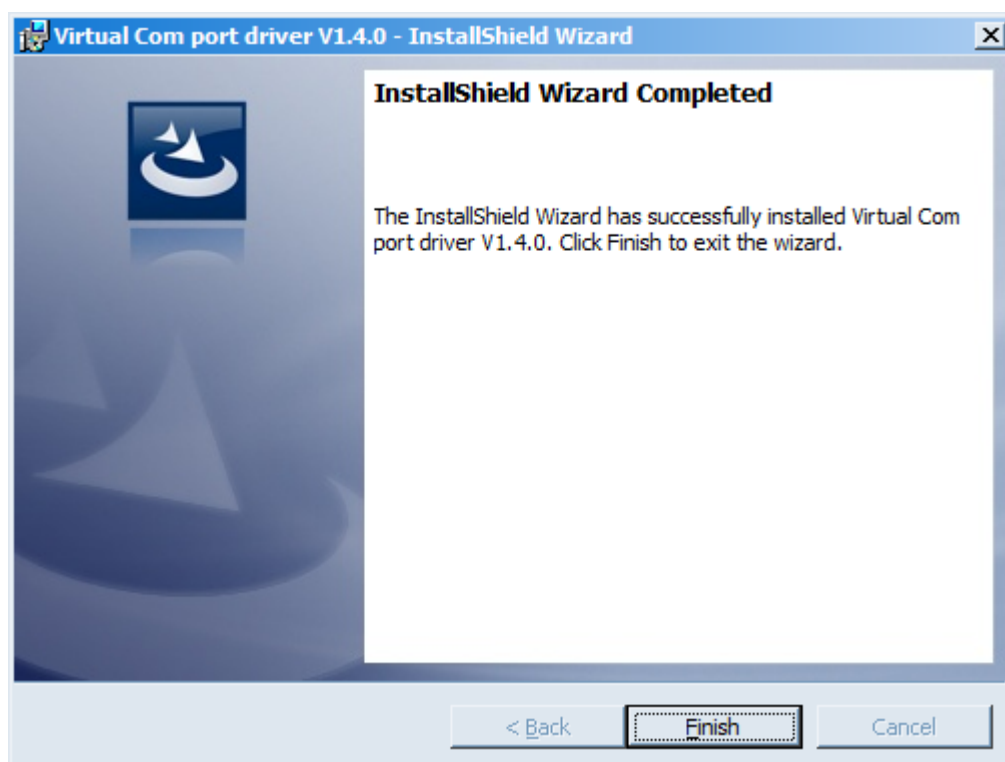
Vega TP-11 adjusted with the "Vega LoRaWAN Configurator" application (See part 4).



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 converter via USB.

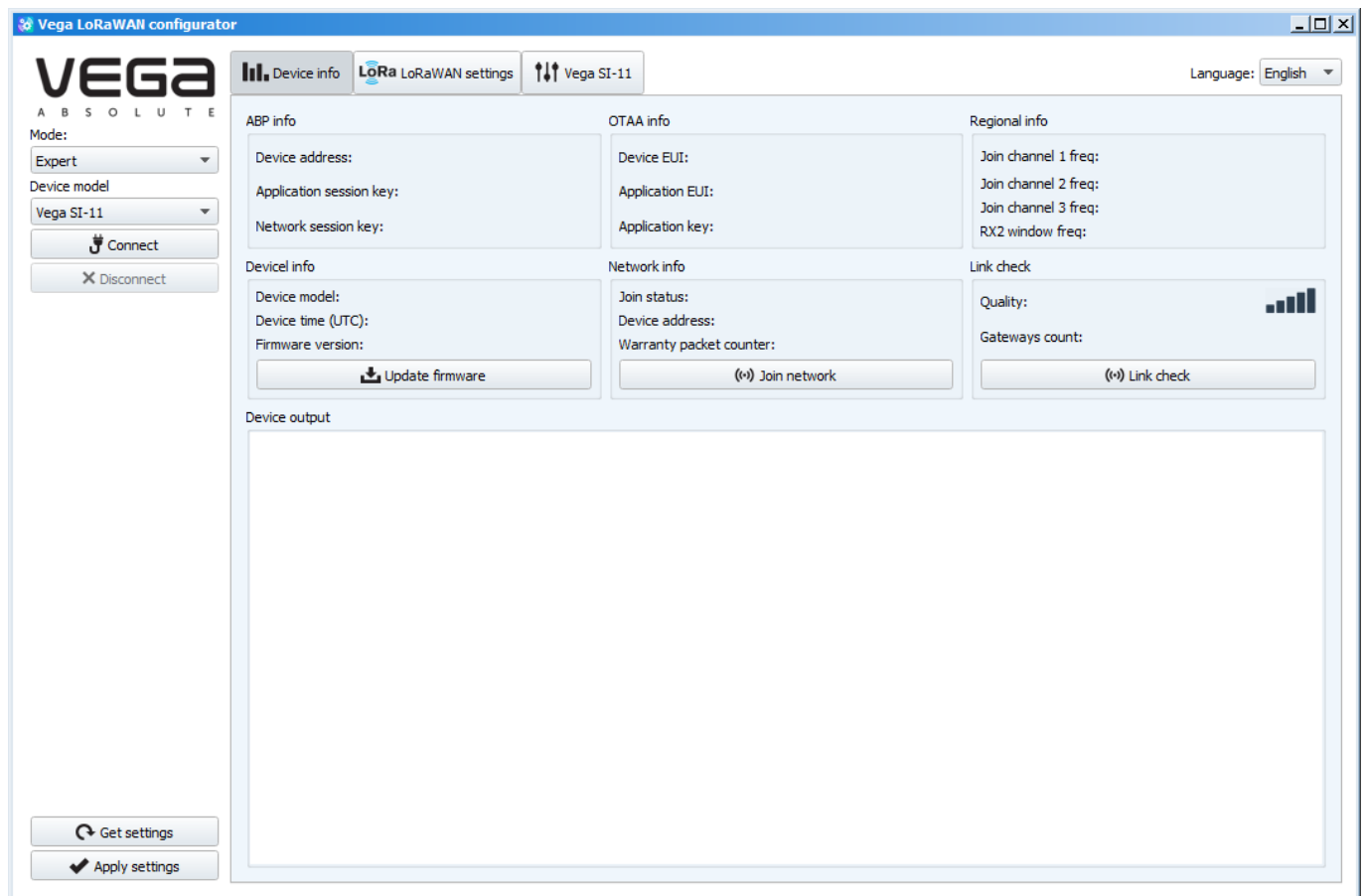
4 VEGA LORAWAN CONFIGURATOR

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.

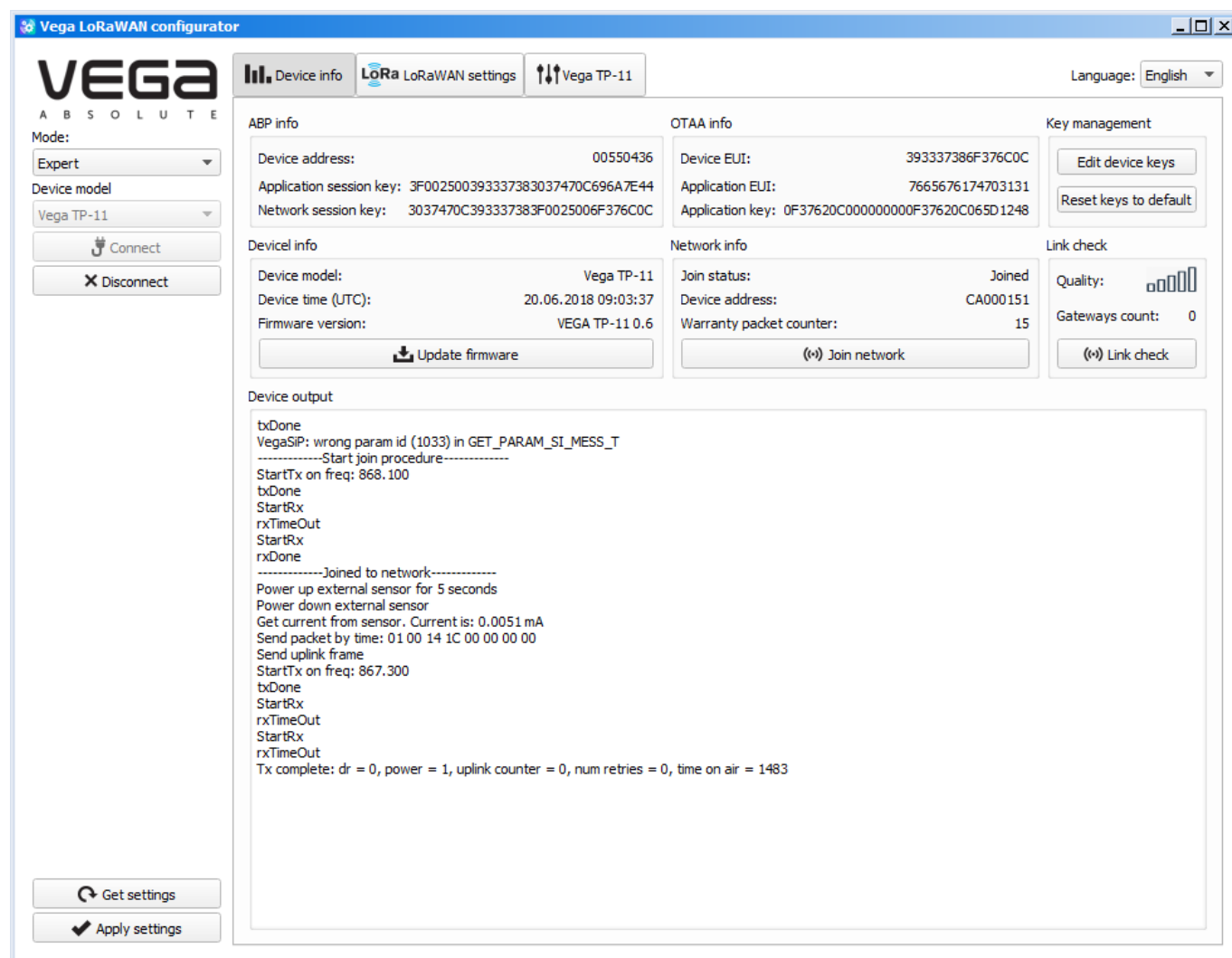
The language selection menu is in the upper right corner.

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.

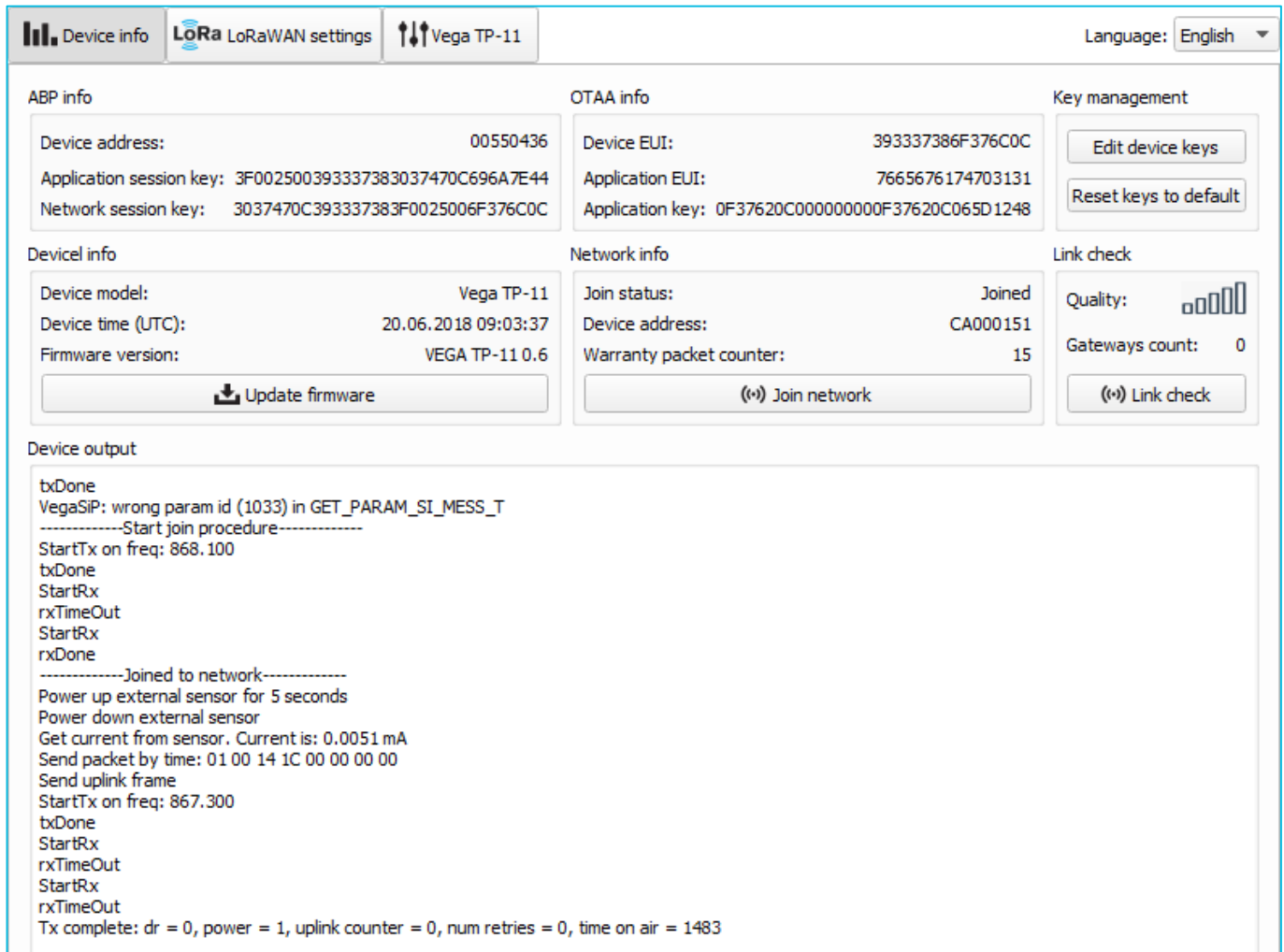


To read the settings from the device, you need to click the "Get settings" button, until this point the application will display the default settings or from the last connected device.

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.



The screenshot shows the "Device info" tab with the following data:

Section	Field	Value
ABP info	Device address:	00550436
	Application session key:	3F002500393337383037470C696A7E44
	Network session key:	3037470C393337383F0025006F376C0C
OTAA info	Device EUI:	393337386F376C0C
	Application EUI:	7665676174703131
	Application key:	0F37620C00000000F37620C065D1248
Device info	Device model:	Vega TP-11
	Device time (UTC):	20.06.2018 09:03:37
	Firmware version:	VEGA TP-11 0.6
Network info	Join status:	Joined
	Device address:	CA000151
	Warranty packet counter:	15
Link check	Quality:	00000
	Gateways count:	0

Device output

```

txDone
VegaSIP: wrong param id (1033) in GET_PARAM_SI_MESS_T
-----Start join procedure-----
StartTx on freq: 868.100
txDone
StartRx
rxTimeOut
StartRx
rxDone
-----Joined to network-----
Power up external sensor for 5 seconds
Power down external sensor
Get current from sensor. Current is: 0.0051 mA
Send packet by time: 01 00 14 1C 00 00 00 00
Send uplink frame
StartTx on freq: 867.300
txDone
StartRx
rxTimeOut
StartRx
rxTimeOut
Tx complete: dr = 0, power = 1, uplink counter = 0, num retries = 0, time on air = 1483

```

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.

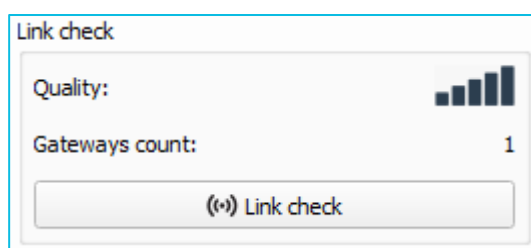
Update firmware - allows you to select the firmware file from your computer's hard drive and load it into the device. The device will automatically disconnect from the

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 occur.

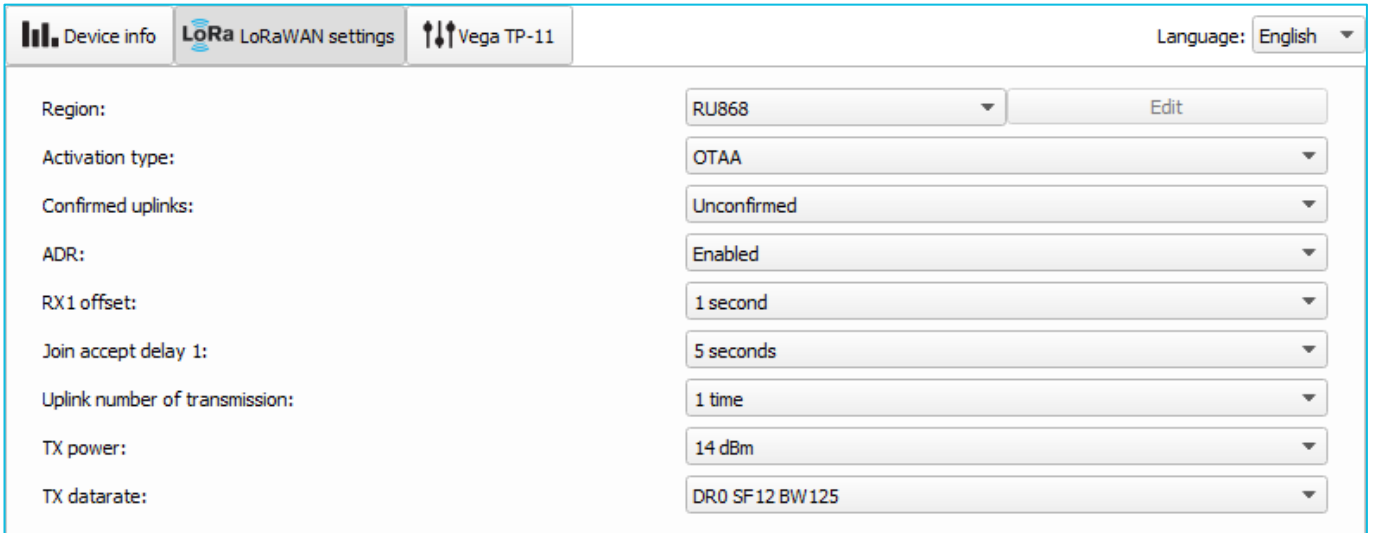
Link check (not displayed in the "Simple" mode) - when pressed, the device sends a special signal to the LoRaWAN network, in response to which the network informs it of the number of gateways that received this signal and the signal quality. This button only works when the device is connected to the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



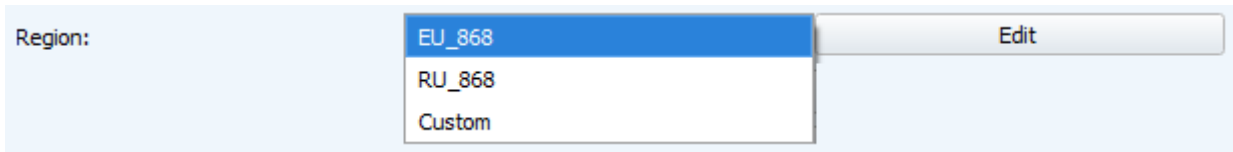
Device output (not displayed in the "Simple" mode) - monitoring the device status, all events in real time are displayed.

"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 converter supports the following frequency bands:

Frequency band	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	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:

Custom frequency plan

Join frequency 1 (Hz)	<input type="text" value="0"/>	Channel 9 frequency (Hz)	<input type="text" value="0"/>
Join frequency 2 (Hz)	<input type="text" value="0"/>	Channel 10 frequency (Hz)	<input type="text" value="0"/>
Join frequency 3 (Hz)	<input type="text" value="0"/>	Channel 11 frequency (Hz)	<input type="text" value="0"/>
Channel 4 frequency (Hz)	<input type="text" value="0"/>	Channel 12 frequency (Hz)	<input type="text" value="0"/>
Channel 5 frequency (Hz)	<input type="text" value="0"/>	Channel 13 frequency (Hz)	<input type="text" value="0"/>
Channel 6 frequency (Hz)	<input type="text" value="0"/>	Channel 14 frequency (Hz)	<input type="text" value="0"/>
Channel 7 frequency (Hz)	<input type="text" value="0"/>	Channel 15 frequency (Hz)	<input type="text" value="0"/>
Channel 8 frequency (Hz)	<input type="text" value="0"/>	Channel 16 frequency (Hz)	<input type="text" value="0"/>
RX2 window frequency (Hz)	<input type="text" value="0"/>	RX2 window datarate	<input type="text" value="DR0"/>

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:	<div style="border: 1px solid black; padding: 2px;"> <div style="background-color: #0070C0; color: white; padding: 2px;">Enabled</div> <div style="padding: 2px;">Disabled</div> </div>
------	---

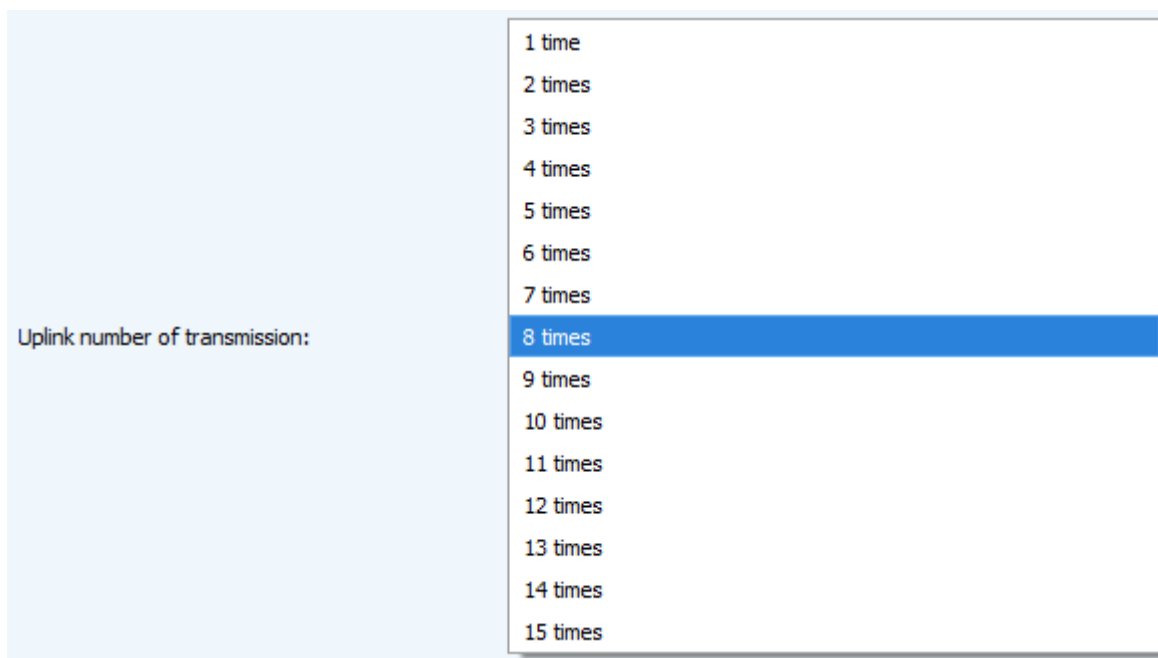
RX1 offset (not displayed in the "Simple" mode) – specifies the time between end of packet transmission and first receiving window opening. The second receiving window always opens after 1 second after the first.

RX1 offset:	<div style="border: 1px solid black; 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>
-------------	---

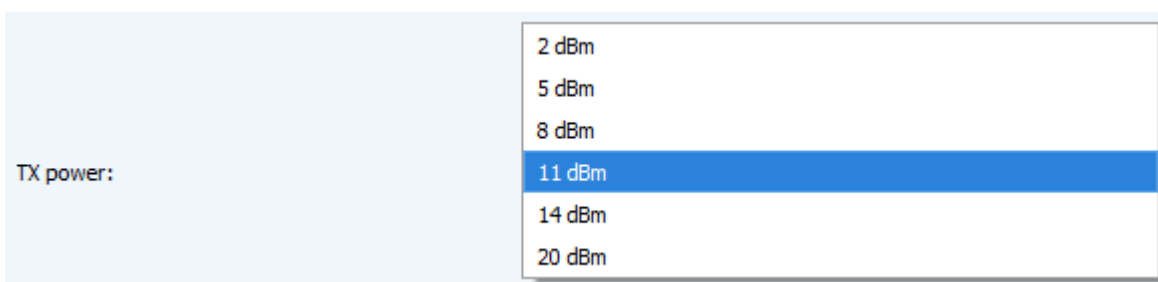
Join accept delay 1 (not displayed in the "Simple" mode) – sets the time that the device will open the first receiving window to receive confirmation for the join request from the LoRaWAN network. The second window always opens after 1 second after the first.

Join accept delay 1:	<div style="border: 1px solid black; padding: 2px;"> <ul style="list-style-type: none"> 1 second 2 seconds 3 seconds 4 seconds 5 seconds 6 seconds 7 seconds <li style="background-color: #0070C0; color: white;">8 seconds 9 seconds 10 seconds 11 seconds 12 seconds 13 seconds 14 seconds 15 seconds </div>
----------------------	---

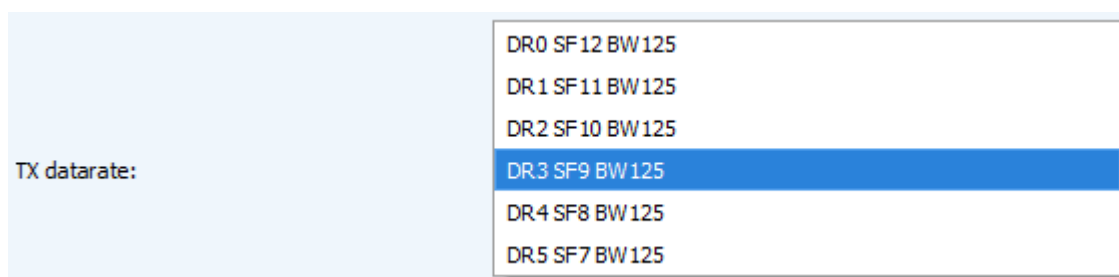
Uplink number of transmission (not displayed in the "Simple" mode) – if the "Confirmed uplinks" function is disabled, the device will simply send each packet as many times as specified in this option. If "Confirmed uplinks" is enabled, the device will send packets until it receives a confirmation or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

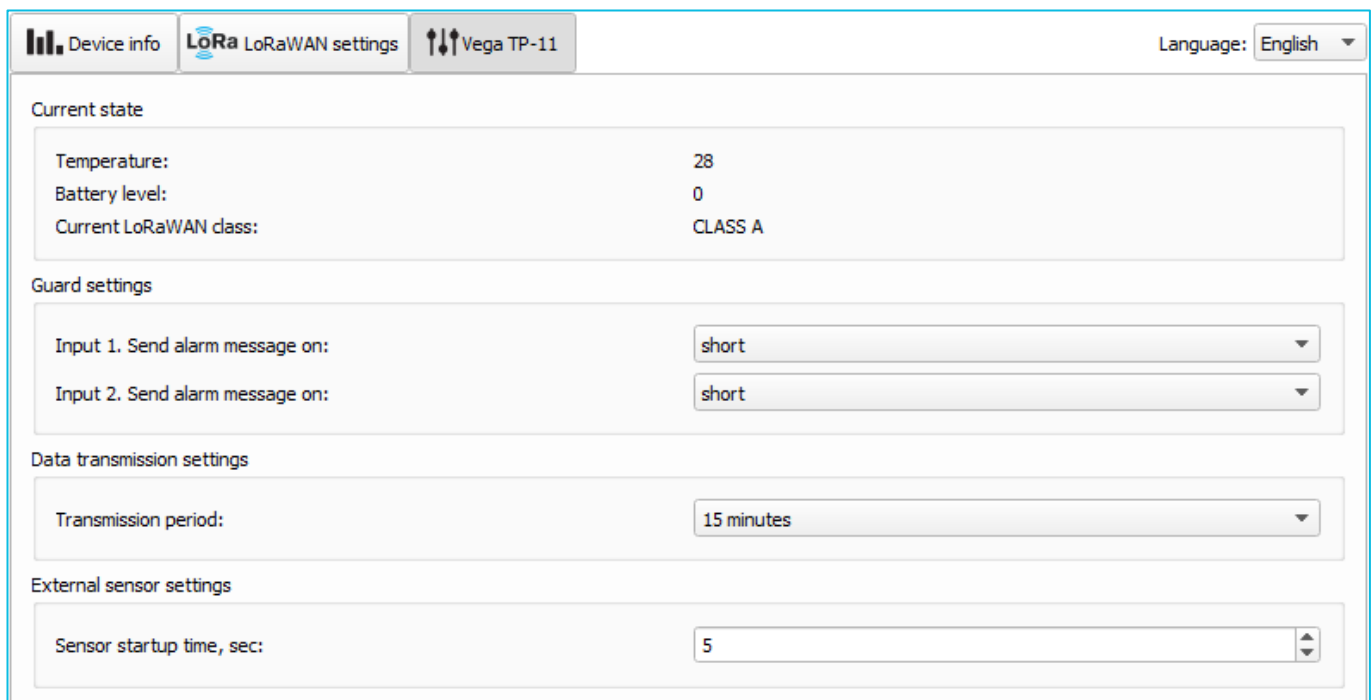


TX datarate (not displayed in the "Simple" mode) – the device transmission datarate at which it will transfer packets to the LoRaWAN network. This speed can be changed by the network server if the ADR algorithm is enabled.



«VEGA TP-11» TAB

The “Vega TP-11” tab contains the settings of the connected device.



Section	Parameter	Value
Current state	Temperature:	28
	Battery level:	0
	Current LoRaWAN class:	CLASS A
Guard settings	Input 1. Send alarm message on:	short
	Input 2. Send alarm message on:	short
Data transmission settings	Transmission period:	15 minutes
External sensor settings	Sensor startup time, sec:	5

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

Security settings – allows to setting security inputs. Alarm message can be sent by the short or open security circuit or in both of these cases.

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

External sensor settings – allows to set the startup time for external sensor supply. Startup time value can be varying from 1 to 60 seconds.

5 COMMUNICATION PROTOCOL

Vega TP-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 TP-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 device temperature	uint8
1 byte	Reason of sending message	uint8
1 byte	TP-11 inputs/outputs state	uint8
2 bytes	Measurement current of connected sensor (mA*100)	uint16

"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: 0000 - 1 hour 1000 - 6 hours 0100 - 12 hours 1100 - 24 hours 0010 - 1 minute 1010 - 3 minutes 0110 - 5 minutes 1110 - 10 minutes 0001 - 15 minutes 1001 - 30 minutes
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 1 triggering
0x02	By the security input 2 triggering

 0x03 External power state was change

" Inputs/outputs state " bit field decoding

Bits	Field description
0 bit	Power (0 – battery, 1 – external)
1 bit	Security input 1 (0 - unclosed, 1 – closed)
2 bit	Security input 2 (0 - unclosed, 1 – closed)
3 bit	Output 1 (0 – off, 1 – on)
4 bit	Output 2 (0 – off, 1 – on)
5 bit	reserve
6 bit	reserve
7 bit	reserve

2. Packet with data about state changes of the outputs OUT_1 or OUT_2

Size in bytes	Field description
1 byte	Packet type, this packet = 5
1 byte	Battery charge, %
1 byte	Output number (1 или 2)
1 byte	Output state (0 - off, 1 - on)

CONVERTER TP-11 RECEIVES PACKETS OF THE FOLLOWING TYPES

1. Query of readings log

Size in bytes	Field description
1 byte	Packet type, this packet = 2

Upon receiving this package, the converter will perform an extraordinary polling of connected sensor and send packet with current state.

2. Output on command

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

3. Output off command

Size in bytes	Field description
1 byte	Packet type, this packet = 5
1 byte	Output no. (1 - 2)

6 STORAGE AND TRANSPORTATION REQUIREMENTS

Vega TP-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 converter 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 TP-11 device is delivered complete with:

Converter Vega TP-11 – 1 pc.

Antenna LoRa – 1 pc.

Screw 3x16 – 6 pcs.

Factory certificate – 1 pc.

8 WARRANTY

The warranty period for the device is 5 years from the date of sale or 20,000 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 20,000 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

Operation Manual © Vega-Absolute LLC 2017