LORAWAN® CONVERTER
VEGA TP-11

USER MANUAL

DOCUMENT REVISION	FIRMWARE VERSION
12	2.2

CONTENTS

INTRODUCTION

This manual is designated for Vega TP-11 device (hereinafter – device, converter) manufactured by Vega-Absolute OOO 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.

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

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 sensors and industrial equipment with 4-20 mA interface, temperature sensors, waste sensors, pressure sensors.

The converter is powered by a 6400 mAh battery. The converter can be powered by the 10…36 V external power supply.

There is a function of current value range control in the device. During device setting while external power supplying, you may set allowed current value low and high thresholds. When current value measurements are out of specified range then extraordinary communication session appears. Data collection periods are set independently when measurements are in and out of specified range.

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.

OPERATION ALGORITHM

Vega TP-11 operates in modes listed below:

"Storage" – is a mode for storing and transporting. In this mode the device does not communicate regularly with the network.

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

Before start using you need to switch the device out of "Storage" mode.

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

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

OTAA method. After pressing the start button, the device makes three attempts to connect to the network within the set frequency plan. After the activation in the LoRaWAN® network is confirmed, the device sends a signal (LED flashing for 5 seconds) and switches to

the "Active" mode. If all attempts fail, the device will continue to accumulate data and will attempt to connect to the network every 6 hours.

Hold the start button pressed (min. 5 seconds) to switch the device from the "Active" mode back to the "Storage" mode without turning off the power (battery or external).

The device forms the data packet with current state with a configurable period from 5 minutes to 24 hours. The packets stored in the device memory and transmitting during the next communication session with the LoRaWAN® network.

Examples

If the data collection period is set to 24 hours the packet is formed at 00.00 on the internal clock of the device

If the data collection period is 12 hours then at 00.00 and at 12.00, and so on.

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

The adjustable data transfer period can be from 5 minutes to 24 hours. When beginning of communication session, the device starts sending packets with readings from the earliest packet. The time of data transmitting cannot be specified, it's defined in random way for every device in chosen period of transmission from the moment of connection to the network.

Example

Transmission period is 30 minutes, and device was started at 16:40 by the internal device clock. In random way the device calculate data transmitting time and set it at 16:41 in the half-hour period from 16:40 to 17:10. Thus, packets from this device will transmit at 16:41, at 17:11, at 17:41, at 18:11 and so on every 30 minutes by the internal device clock.

When measurements are out of specified current value range the communication period still the same if parameter "Immediately send data when current is out of range" is not active.

If that parameter is active and external power supplying, then the alarm message will be forming and sending during 2 minutes after the moment of current value measurements are out of specified range. If external power not supplying, then the converter will detect exceeding the specified limits during the following data collection session according to the schedule only, but the modem will send that data immediately too. Every following message, which will form according to the data collection period, also will have sent immediately until the current value measurements are back in range.

Current value range set in the "Vega LoRaWAN Configurator" application with parameters "Current low threshold" and "Current high threshold". Current threshold set in mA multiplied by 100.

Example

In the device settings the low threshold value is 200 and high – 2500. It means the low threshold of current value is 2 mA and high is 25 mA.

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

FUNCTIONAL

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

⦿ Extra communication in case of current value measurements are out of specified range

⦿ Temperature measurement by the internal temperature sensor

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

⦿ Ability to configure security input triggering on short, open or both cases

⦿ Ability to set different data collection period for case of current value measurements are out of specified range

⦿ Immediately data sending at moment of message forming for case of current value measurements are out of specified range

MARKING

Device marked with sticker that contain the next information:

- ◉ Device model;

- ◉ DevEUI;

- ◉ Month and year of manufacture.

Sticker located in three places – on device case, in factory certificate and on the packing box.

Besides, there is an additional sticker located on the packing box which contains:

- ◉ Information about firmware version;

- ◉ QR-code containing keys for device activation in the LoRaWAN® network and other IDs.

2 SPECIFICATION

DEVICE SPECIFICATION

MAIN	
Current loop 4-20 mA interface	1
Security inputs	2
'Open-drain' outputs	2
Accuracy of current measurement	±1.2 %
USB-port	mini-USB, type B
Operating temperatures	-40…+85 °C
LORAWAN®	
LoRaWAN® class	A or 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
Data collection period	5, 15, 30 minutes, 1, 6, 12 or 24 hours
Memory amount for storing packets	200 packets
Type of the LoRa antenna	external, SMA connector
Sensitivity	-138 dBm
Radio coverage in restrained urban conditions	max 5 km
Radio coverage within line of sight	max 15 km
Transmitter power by default	25 mW (configurable)
POWER	
Built-in battery	6400 mAh
External power supply	10…36 V
4-20 mA interface power supply	24 V
Calculated number of packets sent by the device while default settings	15,000
CASE	
Housing dimensions, no more than	93 x 78 x 66 mm
Ingress protection rating	IP65
Mounting	clamp fastening to the support, DIN-rail, wall-mounting
PACKAGE	
Dimensions	140 x 80 x 85 mm
Weight	0.270 kg

DEFAULT DEVICE SETTINGS

PARAMETER	VALUE
Frequency plan	RU868
Activation type	OTAA
Adaptive Data Rate	ON
Confirmed Uplinks	OFF
Rx 1 Delay	1 second
Join Accept Delay	5 seconds
Uplink number of transmissions	1
Data rate	DR0
Power	14 dBm
Communication period	24 hours
Data collection period	24 hours
Data collection period when temperature is out of range	1 hour
Time zone	UTC +00:00
Inputs operate in mode	pulse

For changing the device settings, you need to connect to it with "Vega LoRaWAN Configurator" application. You can download app on the iotvega.com site in SOFT section as well as User Manual for configurator. Go to the app page.

3 OPERATION

DEVICE APPEARANCE

Vega TP-11 is represented in black plastic case which has six screws and mounting for DIN-rail. The device case is equipped with a hermetic gland of M12 size. A sealant is installed inside the gland, ensuring compliance with the declared Ingress Protection rating of the device case.
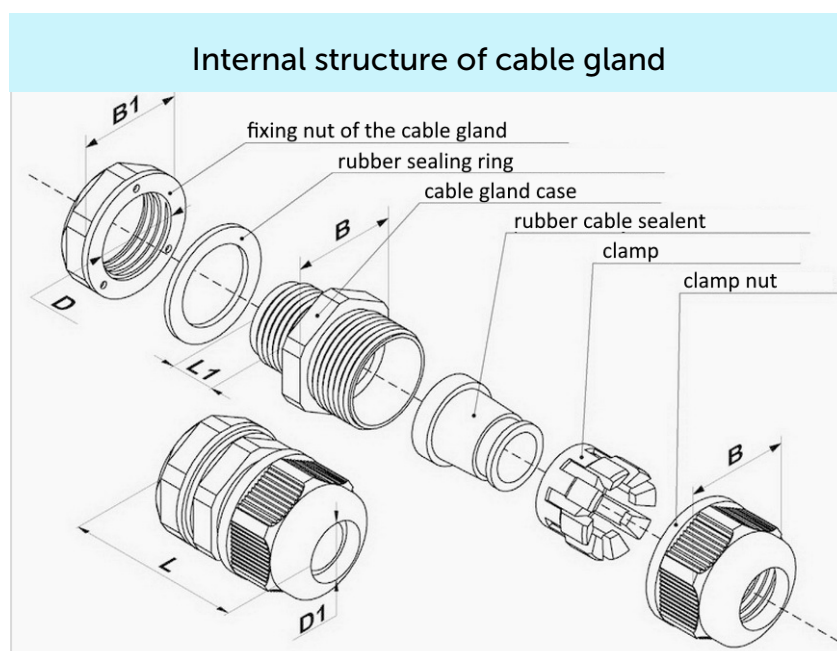

1 – screws ø 3 mm x 16 mm, cross ✚

2 – DIN-rail with mounting holes ø 3 mm

3 – input of external antenna

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

Internal structure of cable gland

fixing nut of the cable gland
rubber sealing ring
cable gland case
rubber cable sealent
clamp
clamp nut

All of elements for manage and indication as well as connecting contacts are placed on the board inside the case.
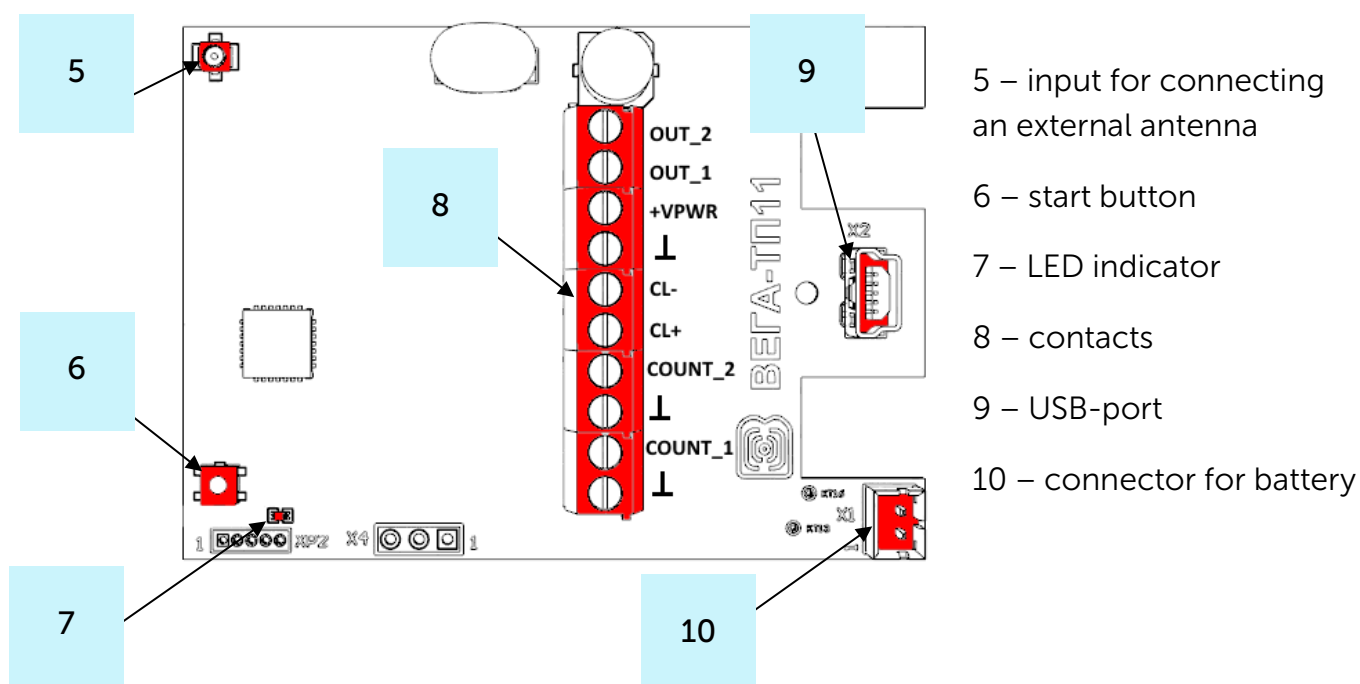
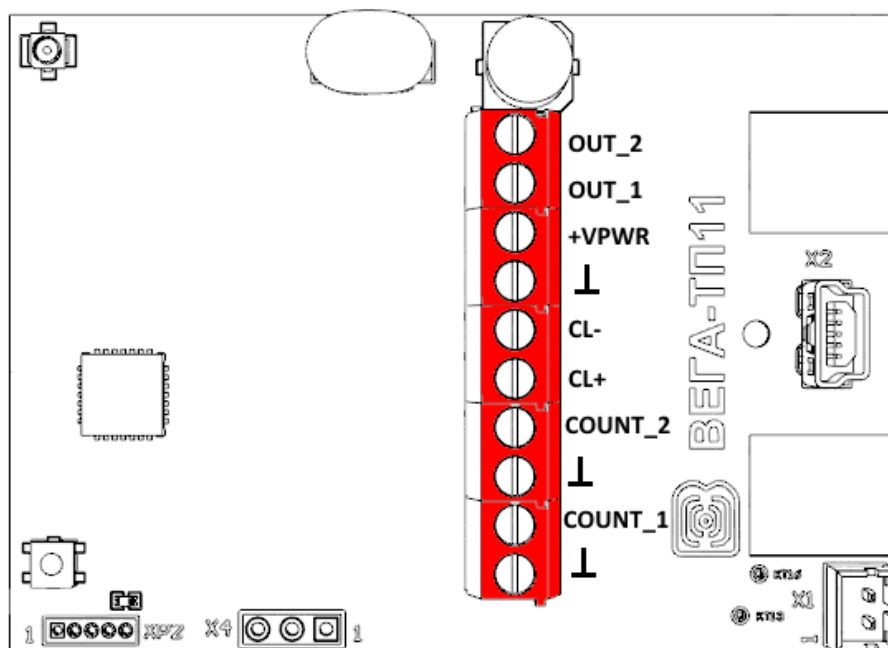5 – input for connecting an external antenna

6 – start button

7 – LED indicator

8 – contacts

9 – USB-port

10 – connector for battery

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 state change (closure/unlocking or both of it – depend on the settings). 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.
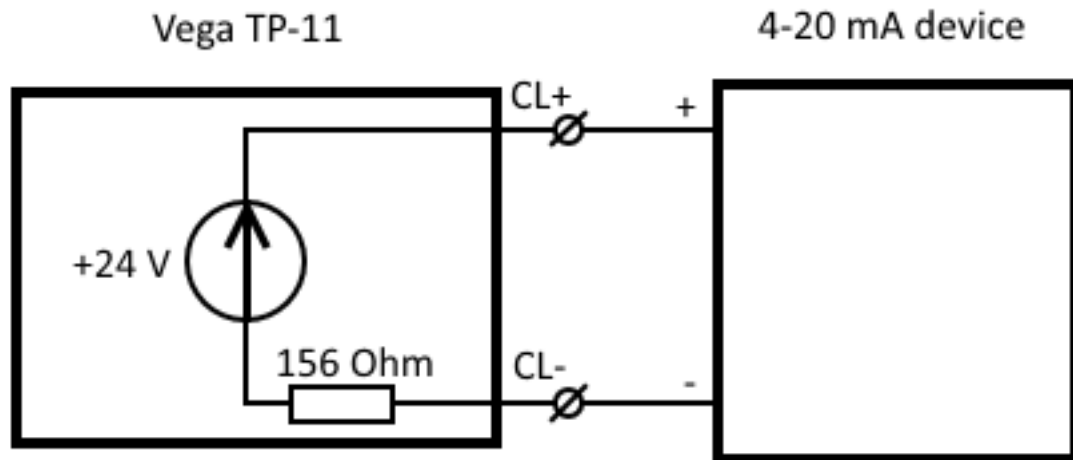
To save the battery life of the converter, the 24 V supply voltage is not continuously supplied. The 24 V voltage is applied to the 4-20 mA device a few seconds before the polling is performed so that the sensor can turn on and set the current corresponding to the measured parameter. This time, the so-called "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.
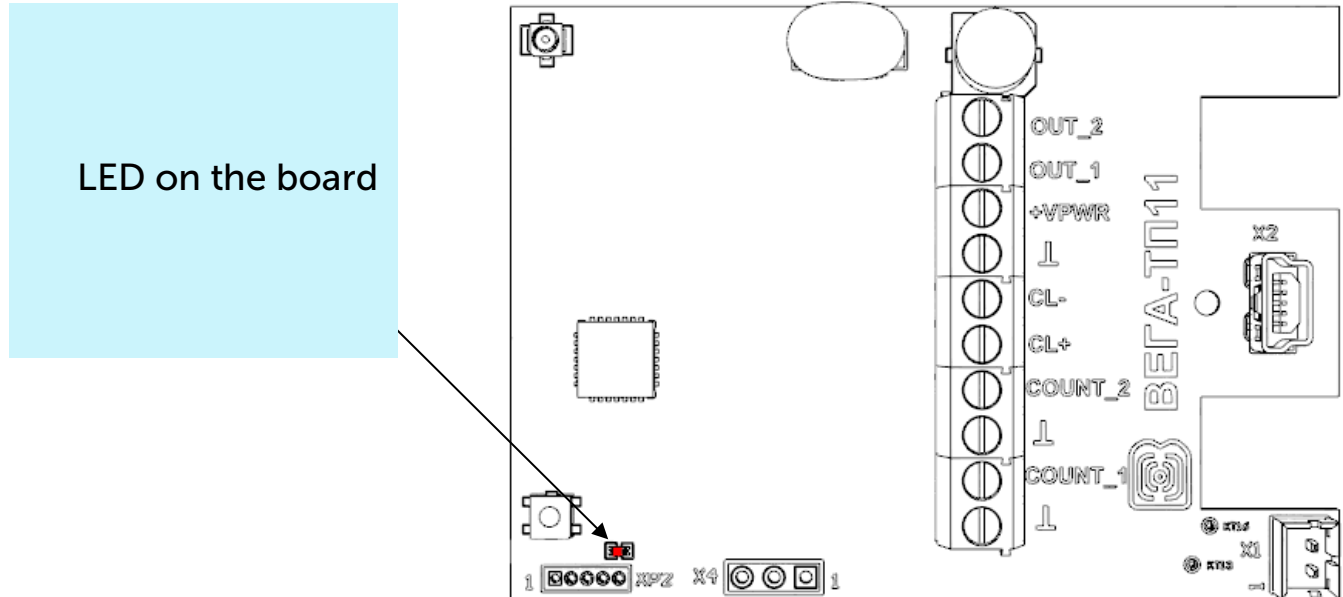
> *i*   **Permissible load for each digital output is 200 mA**

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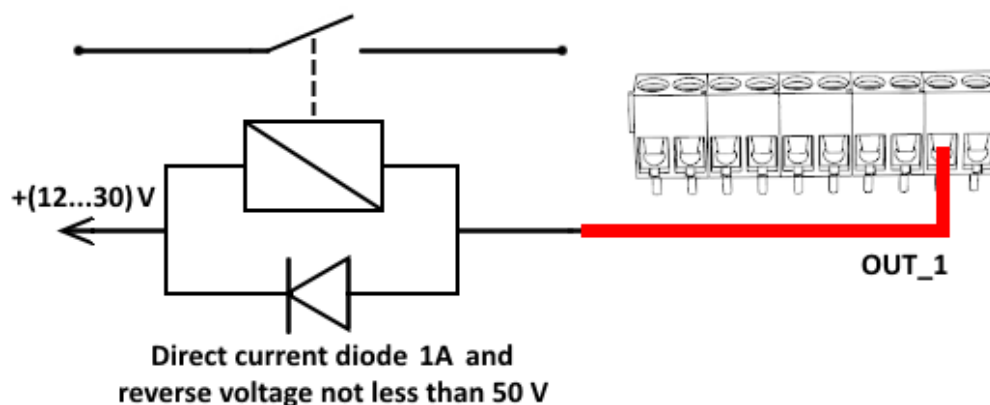
INDICATION

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

LED on the board

LED SIGNAL		MEANING
▉▉▉▉▉▉▉▉▉	Short flashings	Linking to the network in progress
▉▉▉▉	One long flashing during 5 sec	The device has been successfully connected to the network and is in active mode
▉▉▉░░░░	Three flashings each by 1 sec	Linking to the network has been failed or the device switched to the "Storage" mode

In case of connection attempt fail, the device will continue to accumulate data and will attempt to connect to the network every 6 hours

MOUNTING RECOMENDATIONS

To provide the stable radio between the gateway and the end device it 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.

For mounting you will need:

⊚

⊚ wire stripper;

⊚ laptop.

Step by step mounting be like:

1. Setting the devices and connecting them to the network are usually carried out in the office (see Network Deployment Manual).
2. Determination of suitable places for mounting at the object with a network tester.
3. De-energizing the connected equipment, metering devices, etc.
4. Placement the wires in the cable gland. It must be remembered that the wires must be united in one cable of circular cross-section with diameter of 5...6 mm.

> **Inside the cable gland there is a sealant ensuring compliance with the declared Ingress Protection rating of the device case. When removing the sealant, as well as when installing wires of a different diameter or cross-section, device performance may deteriorate until failure due to moisture entering the case**
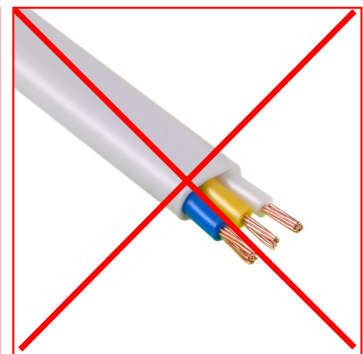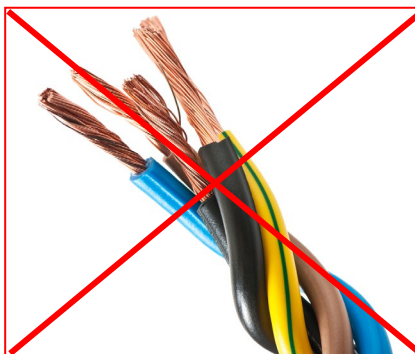
5. Connecting all necessary wires to the TP-11 contacts.
6. TP-11 converter can be powered from an external power source as well as from a battery. For working with battery, it is necessary to connect it to battery connector

on the board. For working with external power source you should use the contacts +VPWR and ⊥.

Contacts for connecting an external power source

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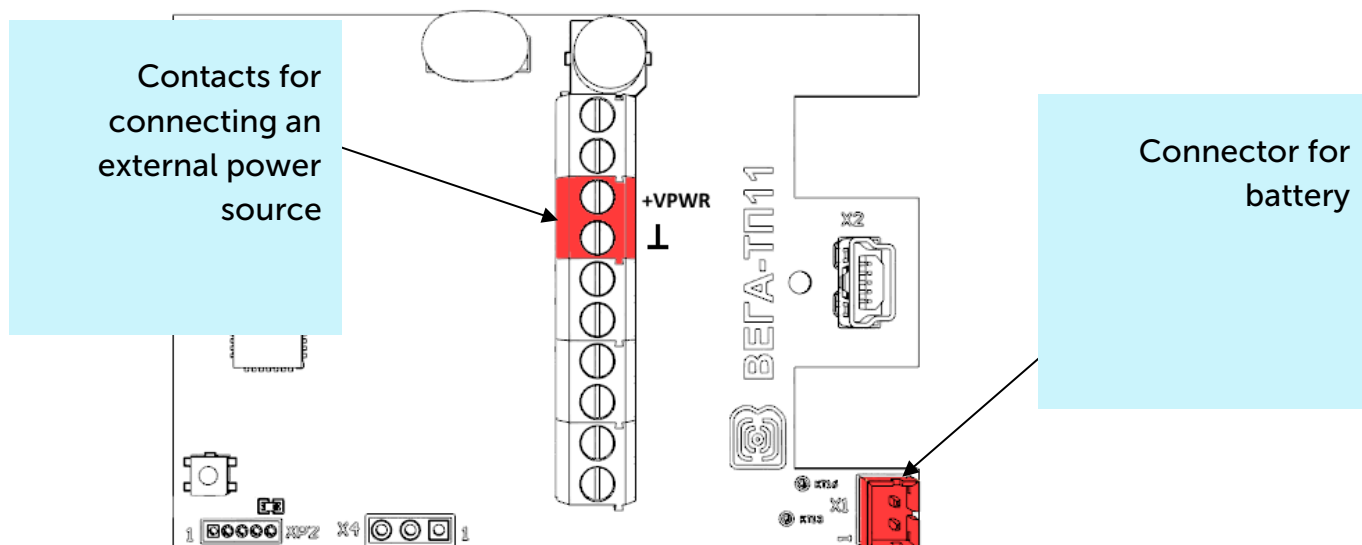
7. When the power is connected at the first time the device automatically switches to the "Active" mode and starts registration in the network. But if the device with connected battery or an external power has been switched to the "Storage" mode (by the pressing on the start button more than 5 sec) then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

Start button on the board
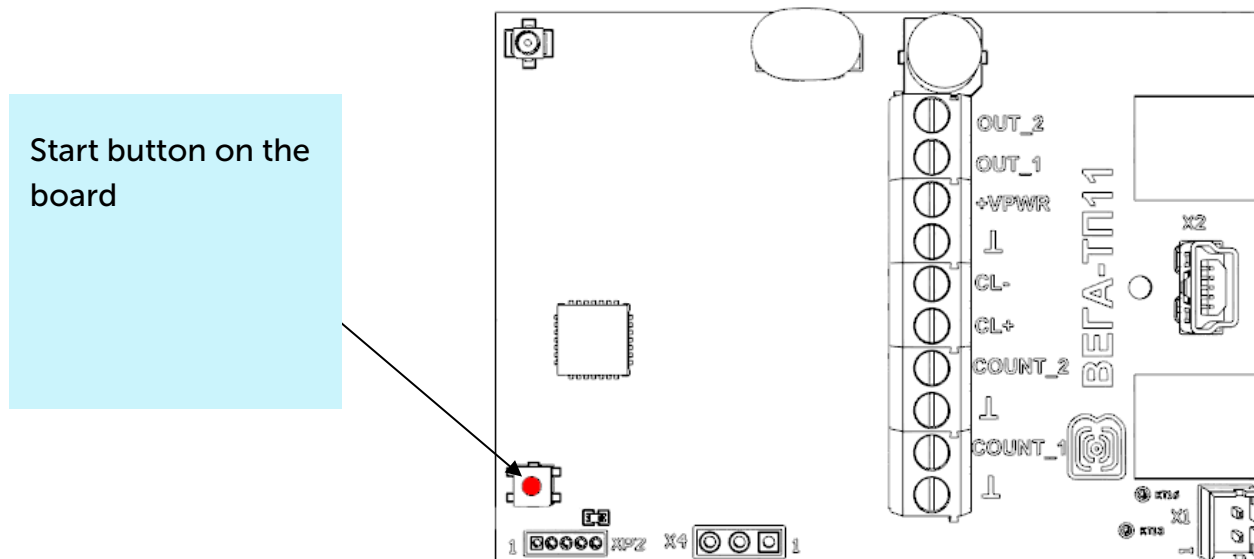
8. By the laptop make sure that the device successfully sends the data.
9. Assembling the device.
10. DIN-rail mounting or another available way to mount the device on the object.

> 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

4 COMMUNICATION PROTOCOL – version 2.0

This part describes the TP-11 data exchange protocol with LoRaWAN® network.

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	Over limits («0» – there is no, «1» - there is)	uint8
4 byte	Time of current readings in that packet (unixtime UTC)	uint32
1 byte	Current device temperature	int8
2 bytes	Current low threshold (mA*100)	uint16
2 bytes	Current high threshold (mA*100)	uint16
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

"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
0x04	Measurement is out of the specified limits
0x05	Transmitting by the request

"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 (always 0)

| 6 bit | reserve (always 0) |
| 7 bit | reserve (always 0) |

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

Size in bytes	Field description	Data type
1 byte	Packet type, this packet == 5	uint8
1 byte	Battery charge, %	uint8
1 byte	Output number (1 или 2)	uint8
1 byte	Output state (0 - off, 1 - on)	uint8
4 bytes	Time of the modem at a moment of the packet transmission (unixtime UTC)	uint32

3. Packet with time correction request

Sent every seven days on LoRaWAN port 4.

Size in bytes	Field description	Data type
1 byte	Packet type, this packet == 255	uint8
4 bytes	Time of the modem at a moment of the packet transmission (unixtime UTC)	uint32

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

4. Settings packet

Transmitting on LoRaWAN port 3 when settings request command received, or device connected to the network.

Size in bytes	Field description	Data type
1 byte	Packet type, this packet == 0	uint8
2 bytes	ID of parameter	uint16
1 byte	Data length (len)	uint8
len bytes	Parameter value	-----
2 bytes	ID of parameter	uint16
1 byte	Data length (len)	uint8
len bytes	Parameter value	-----
...	...	...
2 bytes	ID of parameter	uint16
1 byte	Data length (len)	uint8
len bytes	Parameter value	-----

CONVERTER TP-11 RECEIVES PACKETS OF THE FOLLOWING TYPES

1. Query of readings log

Send by application on LoRaWAN port 2.

Size in bytes	Field description	Data type
1 byte	Packet type, this packet == 2	uint8

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

2. Output ON command

Send by application on LoRaWAN port 2.

Size in bytes	Field description	Data type
1 byte	Packet type, this packet == 3	uint8
1 byte	Output no. (1 - 2)	uint8
1 byte	Output ON for the time in seconds (1…255), (0 – forever ON).	uint8

Upon receiving this package TP-11 will close the correspond output and transmits the packet with current readings.

3. Output OFF command

Send by application on LoRaWAN port 2.

Size in bytes	Field description	Data type
1 byte	Packet type, this packet == 5	uint8
1 byte	Output no. (1 - 2)	uint8

Upon receiving this package TP-11 will unclose the correspond output and transmits the packet with current readings.

4. Real-time clock adjustment

Send by application on LoRaWAN port 4.

Size in bytes	Field description	Data type
1 byte	Packet type, this packet == 255	uint8
8 bytes	The value in seconds for which you need to adjust the time. Can be positive or negative	int64

5. Packet with request of settings

Sent by application on LoRaWAN port 3.

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

Answering that packet, the device sent the packet with settings.

6. Packet with settings

Is identical to such packet from device.

Size in bytes	Field description	Data type
1 byte	Packet type, this packet == 0	
2 bytes	ID of parameter	uint16
1 byte	Data length (len)	uint8
len bytes	Parameter value	-----
2 bytes	ID of parameter	uint16
1 byte	Data length (len)	uint8
len bytes	Parameter value	-----
...	...	...
2 bytes	ID of parameter	uint16
1 byte	Data length (len)	uint8
len bytes	Parameter value	-----

The package with settings sent to the device may not contain all the settings supported by the device, but only the part that needs to be changed.

Table of ID of TP-11 parameters and these possible values

ID of parameter	Description	Data length	Possible values
4	Confirmed uplinks	1 byte	1 – confirmed 2 – unconfirmed
5	Adaptive data rate	1 byte	1 – on 2 – off
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
38	Guard input 1, Send alarm message	1 byte	1 – on short 2 – on open

			3 – short and open
39	Guard input 2, Send alarm message	1 byte	1 – on short 2 – on open 3 – short and open
48	Sensor startup time	1 byte	From 1 to 255
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
85	Current low threshold, in mA*100	2 bytes	from 200 to 2500
86	Current high threshold, in mA*100	2 bytes	from 200 to 2500

5 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.

6 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.

7 WARRANTY

The manufacturer guarantees that the product complies with the current technical documentation, subject to the storage, transportation and operation conditions specified in the "Operation Manual".

The warranty period for device is 36 months.

The warranty period for battery is 36 months or 5,000 sent packets if it will have been happened before.

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

DOCUMENT INFORMATION	
Title	Vega TP-11 LoRaWAN converter
Document type	Manual - Translation from Russian
Document number	V02-TP11-01
Revision and date	12 of 12 October 2021

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
06	17.08.2018	TII	Communication period is changed, typo in battery capacity is fixed
07	04.02.2019	KEV	Changes in specification, in communication protocol, in device operation logic, in warranty, "Marking" and "Indication" parts added
08	31.07.2019	KEV	Typo on 26th page
09	08.04.2020	KEV	Fixed inaccuracy about data type in "Current device temperature" field, minor changes
10	21.12.2020	KEV	Changes due to introduction of protocol version, the protocol itself was not changed The number of warranty packets is changed
11	12.05.2021	KEV	Changes in the protocol at the 2^d type packet on the 27 page – added last field with packet time The warranty is changed
12	12.10.2021	KEV	Scheduled revision of documentation

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