



# TEMPERATURE SENSOR VEGA TD-11

## USER MANUAL



DOCUMENT REVISION	FIRMWARE VERSION
06	1.7

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## INTRODUCTION

This manual is designated for Vega TD-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 DESCRIPTION AND OPERATION

## DEVICE DESCRIPTION

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.

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

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 SAFT LS 17500 battery with capacity 3600 mAh.



**The device is powered by a non-rechargeable lithium-thionyl chloride (LiSOCl<sub>2</sub>) battery Attempts to charge the battery may result in fire**

## COMUNICATION AND DATA COLLECTION ALGORITHM

Vega TD-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 TD-11 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](#).



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

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 temperature 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 temperature range](#) the communication period still the same if parameter "Immediately send data when temperature is out of range" is not active. If that parameter is active, then the alarm message will be formed and sent during 2 minutes after the moment of temperature measurements become out of specified range. Every following message, which will form according to the data collection period, also will have sent immediately until the temperature measurements are back in range.

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

**FUNCTIONAL**

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

- ⦿ Temperature measurement in range of -55... +100 °C
- ⦿ Charge measuring of the built-in battery (%)
- ⦿ Extra communication in case of security inputs actuation
- ⦿ Extra communication in case of tamper sensor actuation
- ⦿ Extra communication in case of Hall sensor (1 or 2) actuation
- ⦿ Extra communication in case of temperature measurements coming out of specified range
- ⦿ Two operating modes – Active mode and Storage mode
- ⦿ ADR support (Adaptive Data Rate)
- ⦿ Sending of confirmed packets (configurable)
- ⦿ Ability to configure security input triggering on short, open or both cases
- ⦿ Ability to set different data collection period for case of temperature measurements are out of specified range
- ⦿ Immediately data sending at moment of message forming for case of temperature 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 and contains:

- ⦿ Information about firmware version;
- ⦿ QR-code containing DevEUI and keys for device registration in network via OTAA method.

## 2 SPECIFICATION

### DEVICE SPECIFICATION

MAIN	
USB-порт	mini-USB, type B
Operating temperatures	-40...+85 °C
Measurement temperatures	-55...+100 °C
Hall sensor sensitivity	5 mT, bipolar
External temperature sensor type	B57861-S 103-F40 10 kOhm
Accuracy of temperature measurement	±0.5 °C in range -10...+40 °C ±1 °C in range -55...+100 °C
LORAWAN®	
LoRaWAN® class	A
Quantity of LoRaWAN 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 LoRaWAN antenna	internal
Sensitivity	-138 dBm
Radio coverage in restrained urban conditions	up to 5 km
Radio coverage within line of sight	up to 15 km
Transmitter power by default	25 mW (configurable)
Maximum transmitter power	100 mW
POWER	
Battery	SAFT LS 17500 3600 mAh
Calculated number of packets sent by the device with default settings	80 000
CASE	
Housing dimensions	90 x 49 x 46 mm
Ingress protection rating	IP65
Mounting	Clamp fastening to the support, DIN-rail, wall-mounting

## DEFAULT DEVICE SETTINGS

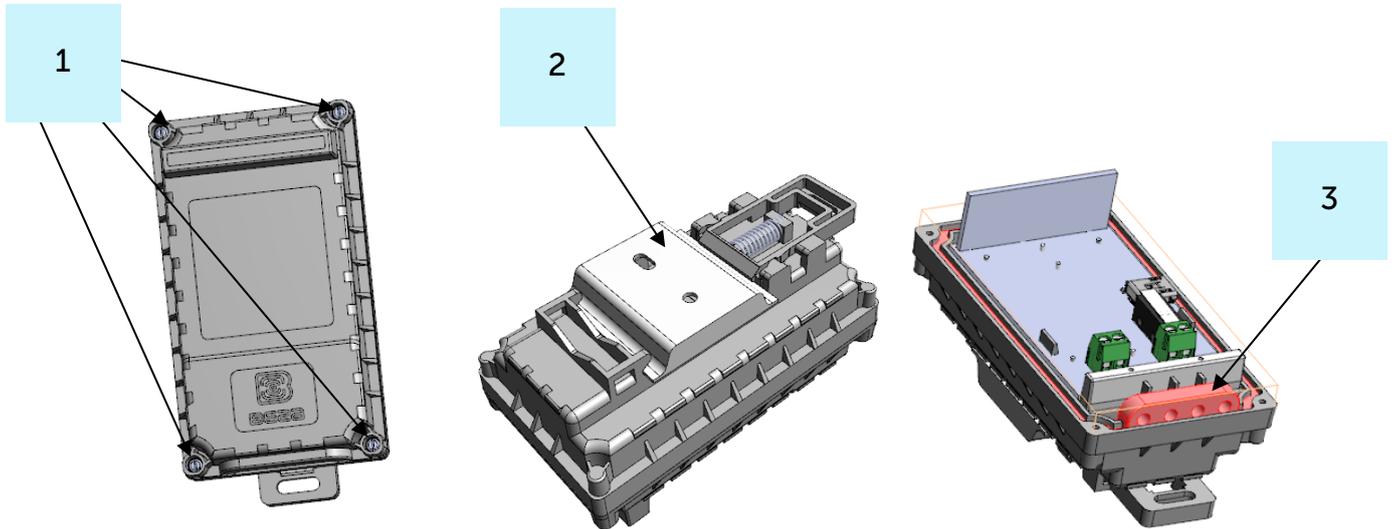
PARAMETER	VALUE
Frequency plan	RU868
Activation type	OTAA
Adaptive Data Rate	ON
Confirmed Uplinks	OFF
Rx 1 Delay	1 second
Join Accept Delay	5 seconds
Uplink number of transmissions	1
Data rate	DR0
Power	14 dBm
Communication period	24 hours
Data collection period	24 hours
Data collection period when temperature 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](http://iotvega.com) site in SOFT section as well as User Manual for configurator. [Go to the app page.](#)

### 3 OPERATION

#### DEVICE APPEARANCE

Vega TD-11 is represented in small plastic case which has four screws and mounting for DIN-rail.

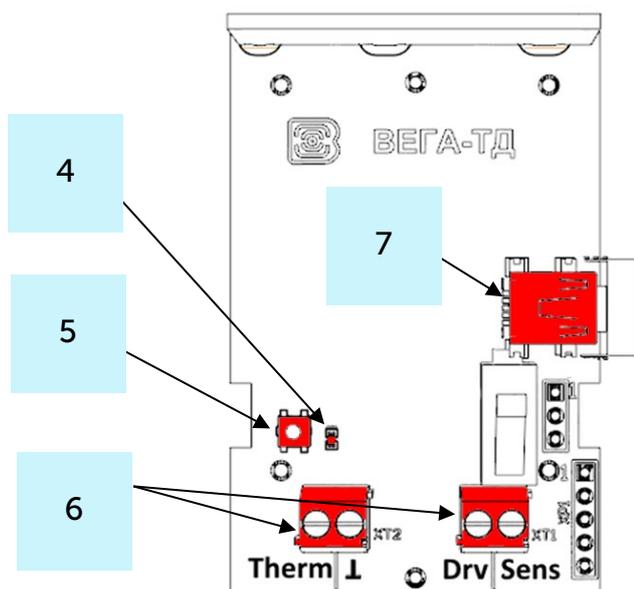


1 – screw  $\varnothing$  2 mm x 8 mm, cross 

2 – DIN-rail with mounting holes  $\varnothing$  3 mm

3 – silicone gasket without through holes, ensuring the protection rating of the device case IP65.

All of elements for manage and indication as well as connecting contacts are placed on the board inside the case.



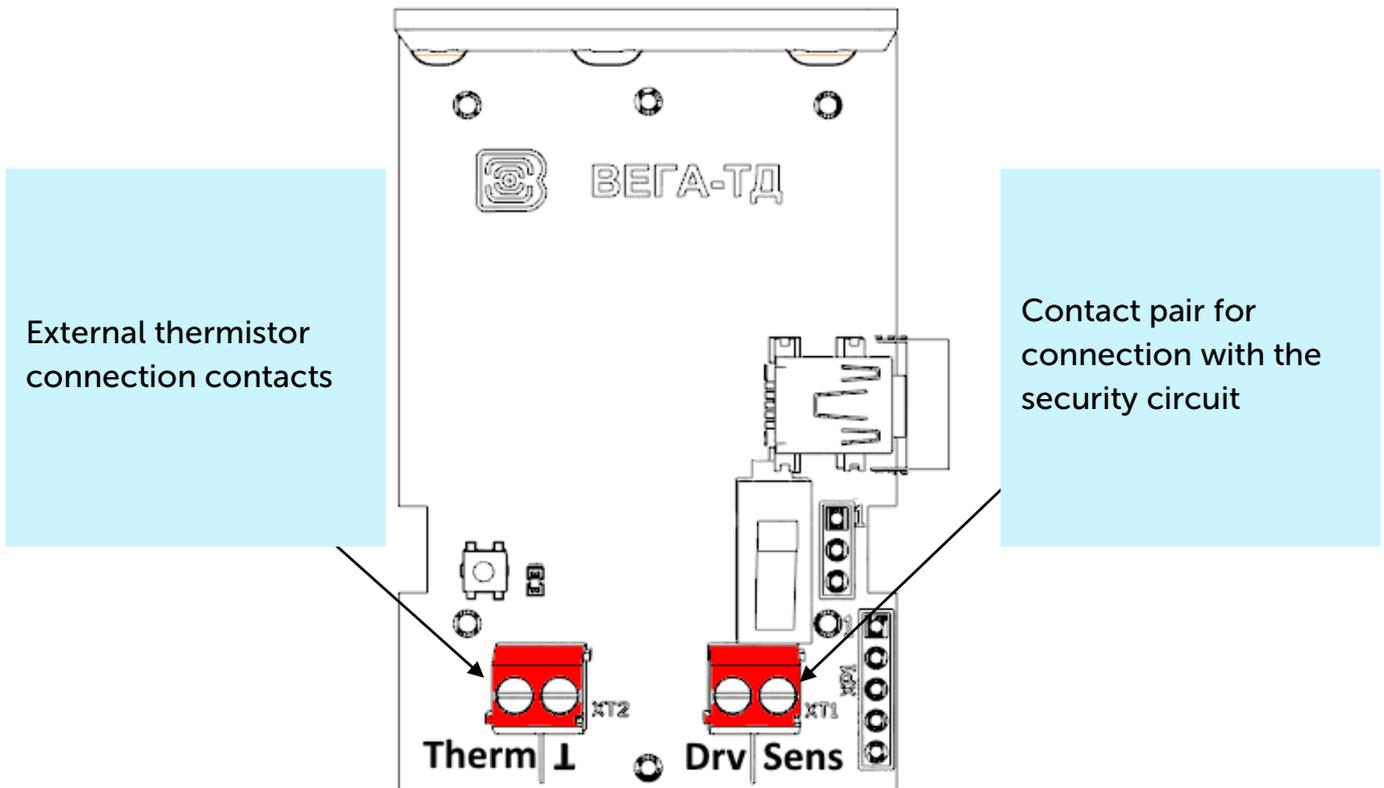
4 – LED indicator

5 – launch button

6 – contacts

7 – USB-port

## CONTACTS DESCRIPTION



Temperature sensor has a two contact pairs. One pair ("Therm" and "L" 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 connecting to circuits with the following types of NO contacts:

- ⦿ reed switch;
- ⦿ mechanical pushbutton;
- ⦿ open-drain output.

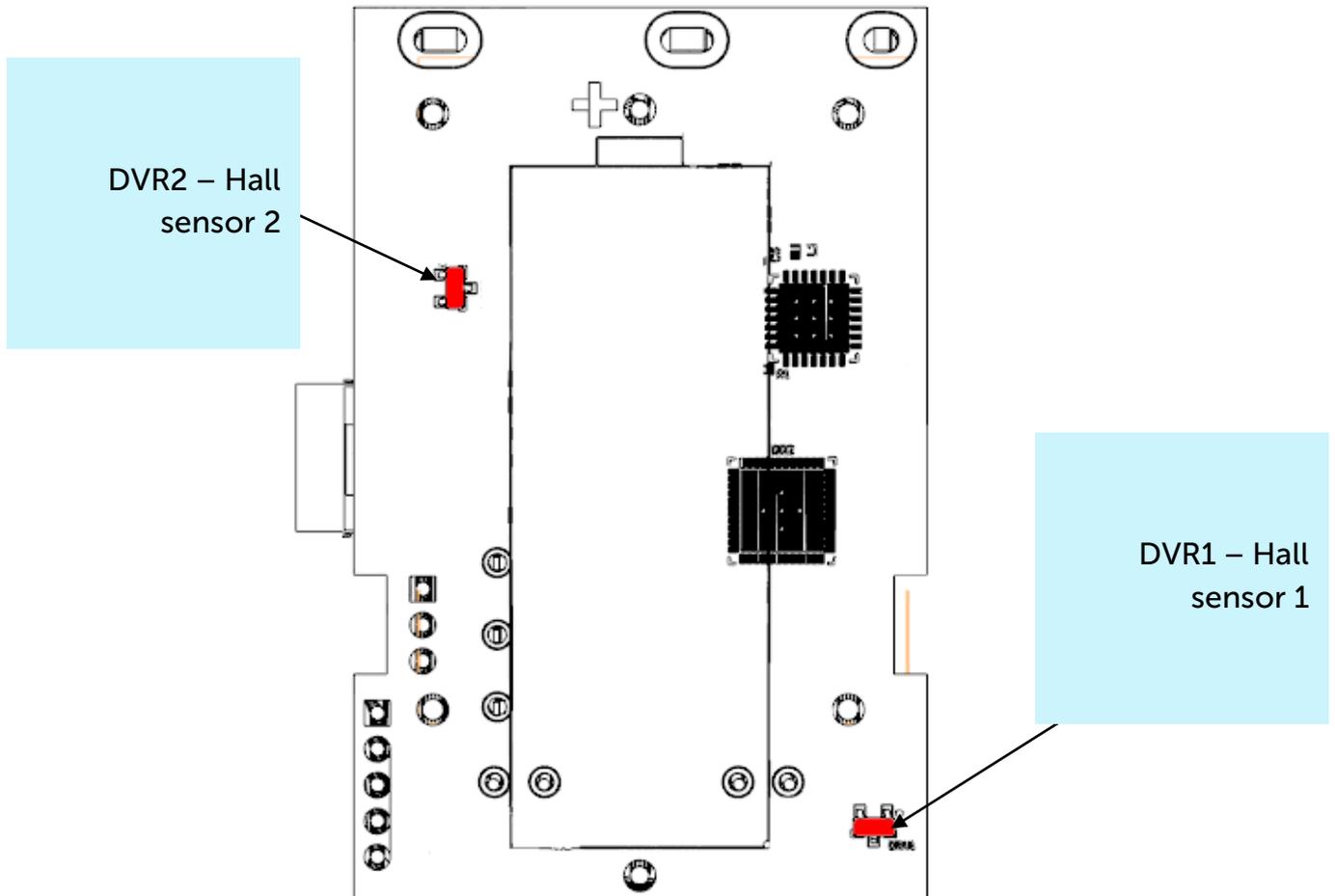
Polarity effects only "open collector" circuits. Open drain output must be connected to "Drv" contact and ground to "Sens".

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

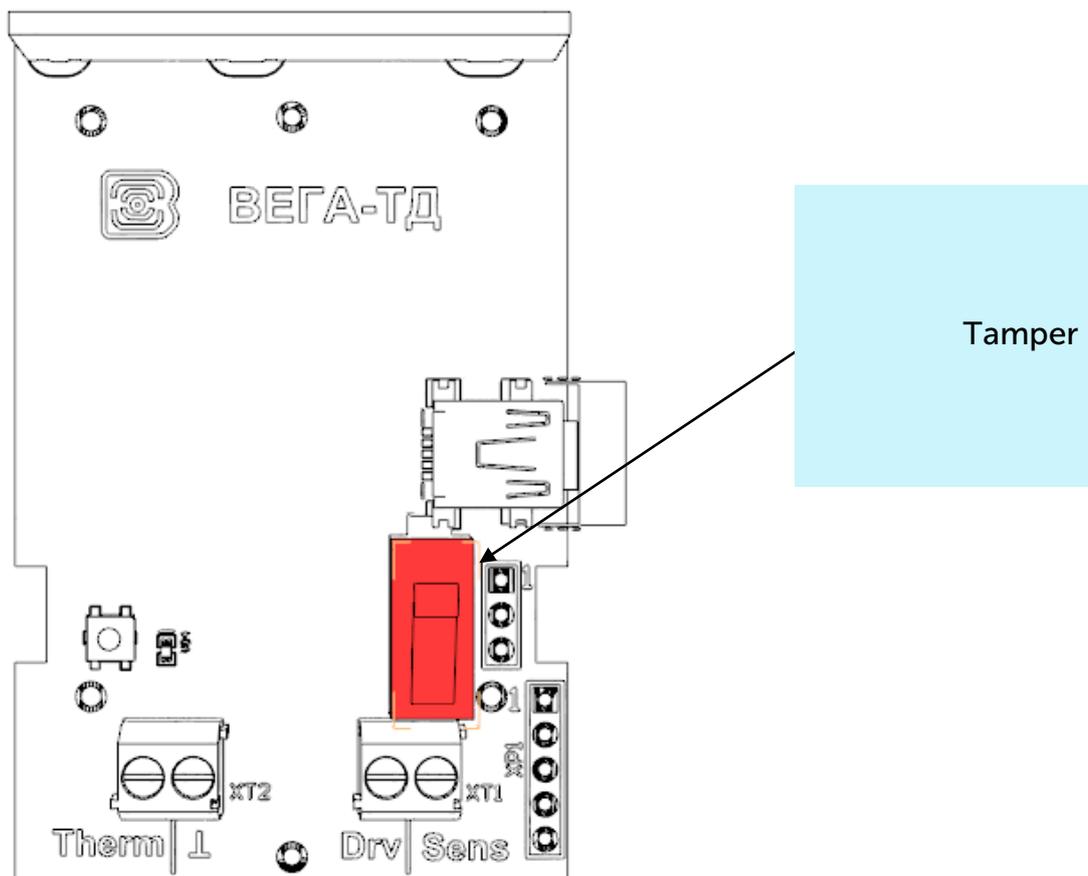
When thermistor connecting you should to configure sending data parameters in "Vega LoRaWAN Configurator" application.

## 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 trigger, the device sends a corresponding message to the LoRaWAN network (see [part 4](#)).

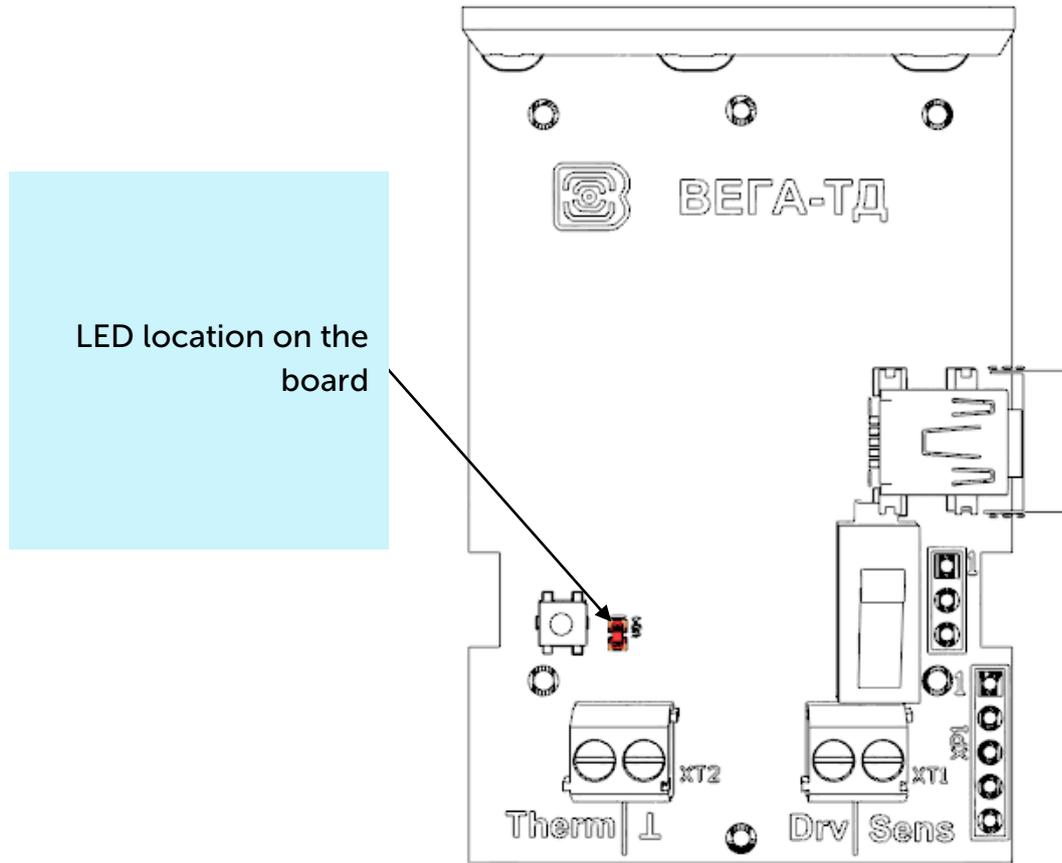


Tamper is located on the board top. Should the tamper triggering, the device sends a corresponding message to the LoRaWAN network.



**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 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 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:

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

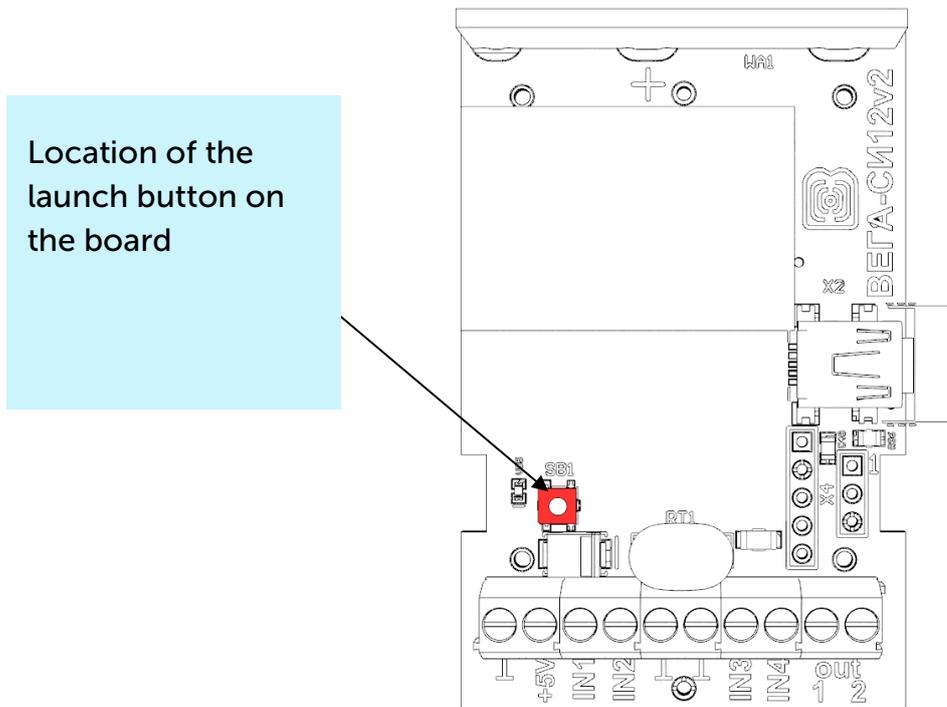
Step by step mounting be like:

1. Setting the devices and connecting them to the network are usually carried out in the office (see Network Deployment Manual).
2. Determination of suitable places for mounting at the object with a network tester.
3. De-energizing the connected equipment, metering devices, etc.
4. Making holes in the silicone gasket for wires - strictly according to the number of wires. It must be remembered that the wire must be of circular cross-section and no more than 3 mm in diameter.



**When removing the sealant, as well as when installing wires of a different diameter or cross-section, device performance may deteriorate until failure due to moisture entering the case**

5. Connecting all necessary wires to the TD-11 contacts.
6. Device launching – switching to the “Active” mode and registration in the network.



7. By the laptop you can make sure that the device successfully sends the data.
8. Before assembling the device, it is necessary to reset the pulses accumulated during testing and connection by switching the device to the "Storage" mode by pressing the button for 5 seconds.
9. Start the device by pressing launch button.
10. Assembling the device.
11. DIN-rail mounting or another available way to mount the device on the object.

## 4 COMMUNICATION PROTOCOL

This part describes the TD-11 communication protocol with LoRaWAN® network.



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

### SENSOR VEGA TD-11 TRANSMITS THE FOLLOWING TYPES OF PACKETS

#### 1. Packet with current readings

Sent regularly on LoRaWAN port 2

Size in bytes	Field description	Data type
1 byte	Packet type, this packet == 1	uint8
1 byte	Battery level, %	uint8
1 byte	Overlimits ("0" – no overlimits, "1" – there is overlimit)	uint8
4 bytes	Time of sending readings (unixtime UTC)	uint32
2 bytes	Current temperature in °C multiplied by 10	int16
1 byte	Temperature low threshold	Int8
1 byte	Temperature high threshold	Int8
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 « $\perp$ »), in the «Temperature» field will be sent an -1000 value for breakage or fault indication. In case of thermistor short circuit will be sent an -1270 value

"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 - 7 bits	not used	

### “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
0x05	Temperature measurements are out of specified range

#### 1. 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 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.

#### 2. 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	
2 bytes	ID of parameter	uint16
1 byte	Data length (len)	uint8
len bytes	Parameter value	-----
2 bytes	ID of parameter	uint16
1 byte	Data length (len)	uint8
len byte	Parameter value	-----
...	...	...
2 bytes	ID of parameter	uint16
1 byte	Data length (len)	uint8
len bytes	Parameter value	-----

## SENSOR VEGA TD-11 RECEIVES PACKETS OF THE FOLLOWING TYPES

### 1. Real-time clock adjustment

Sent 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

### 2. Packet with request of settings

Sent by application on LoRaWAN port 3

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

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

### 3. Packet with settings

Sent by application on LoRaWAN port 3, 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 byte	Parameter value	-----
...	...	...
2 bytes	ID of parameter	uint16
1 byte	Data length (len)	uint8
len bytes	Parameter value	-----

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

Table of ID of TD-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 transmission	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, Send alarm message	1 byte	1 – on short 2 – on open 3 – short and open
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
78	Data collection period when temperature is out of range	1 byte	1 – 1 hour 2 – 6 hours 3 – 12 hours 4 – 24 hours 5 – 5 minutes 6 – 15 minutes 7 – 30 minutes
79	Immediately send data when temperature is out of range	1 byte	0 – off 1 – on
80	Temperature low threshold	1 byte	from -55 to +100
81	Temperature high threshold	1 byte	from -55 to +100

## 5 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.

## 6 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.

## 7 WARRANTY

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

The warranty period is 36 months if the number of data packets sent by the product is up to 25,000.

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:

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

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

e-mail: [remont@vega-absolute.ru](mailto:remont@vega-absolute.ru)

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### Revision History

Revision	Date	Name	Comments
01	14.09.2017	KEV	Document creation date
02	13.03.2018	KEV	Changes in specification
03	22.01.2019	TII, KEV	Changes in specification, in communication protocol, in device operation logic, in warranty, "Marking" part added
04	24.01.2019	KEV	Inaccuracy in <a href="#">communication protocol</a> fixed – packet type for packets with settings and request of settings
05	10.06.2019	KEV	Settings 80 and 81 corrected
06	10.08.2021	PAV	Scheduled revision of documentation. New <a href="#">warranty</a> conditions, new parts



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