VEGA
ABSOLUTE

# TEMPERATURE LOGGER

# VEGA TL-11

## USER MANUAL

| DOCUMENT REVISION | FIRMWARE VERSION |
|---|---|
| 06 | 2.3 |
| | |

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# INTRODUCTION

This manual is designated for Vega TL-11 device (hereinafter – device, logger) 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

Logger designed for a long autonomic collection and storing of a data about controlled environment (air, non-aggressive gases, liquids, bulk materials, food). Temperature is measuring through two thermistors: external probe connecting to the logger and built-in external temperature sensor. The device archives temperature measurements with the time check at the device memory and then transmits that archived data in the LoRaWAN® network when there is a stable radio connection.

Continuous autonomic work is provided by a 6400 mAh battery 3.6 V type A.

**The device is powered by a non-rechargeable lithium-thionyl chloride ($LiSOCl_2$) battery**
**Attempts to charge the battery may result in fire**

Long-term storage of equipment outside the operating mode leads to battery passivation, which does not allow the equipment to operate in the declared mode.
For correct operation, before starting the equipment, carry out the depassivation process. To request the instructions please e-mail us support@vega-absolute.ru

Logger Vega TL-11 may be used in systems where it's needed to control the temperature through the long time without ability to operatively transmit data to the network, for example, when transporting perishable goods or when it's needed to control the transportation conditions. In transit the device puts product temperature values to the memory and when it's come to the destination the device will transmit saved data to the LoRaWAN® network.

The device setting up is via the "Vega LoRaWAN Configurator" application.

## COMUNICATION AND DATA COLLECTION ALGORITHM

Vega TL-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 TL-11 supports two activation methods in the LoRaWAN® network - ABP and OTAA. You can choose one of the methods using the "Vega LoRaWAN Configurator" application (see the "User Manual" for 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 3 seconds) and switches to the "Active" mode. If all attempts fail, the counter will continue to accumulate data and will attempt to connect to the network every 6 hours.

Hold the start button pressed (min. 5 seconds) to switch the device from the "Active" mode back to the "Storage" mode.

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.

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 1 hour by the internal device clock.

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

## FUNCTIONAL

Vega TL-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 (%)
- Two operating modes – “Active” mode and “Storage” mode
- ADR support (Adaptive Data Rate)
- Sending of confirmed packets (configurable)
- Extra communication in case of tamper sensor actuation

## MARKING

Device marked with sticker that contain the following information:

- Device model;
- DevEUI;
- Month and year of manufacture;
- QR-code containing DevEUI for automatized count.

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 keys for device registration in the LoRaWAN® network and other indicators.

# 2 SPECIFICATION

## ХАРАКТЕРИСТИКИ УСТРОЙСТВА

| MAIN | |
|---|---|
| USB-port | micro-USB, type B |
| Operating temperatures | -40...+85 °C |
| Measurement temperatures | -55...+100 °C |
| Accuracy of temperature measurement | ±0.5 °C in range -10...+40 °C<br>±1 °C in range -55...+100 °C |
| Temperature sensor type | RT103F3950AFA0-401 |
| **LoRaWAN®** | |
| LoRaWAN® class | A |
| Quantity of LoRa channels | 16 |
| Frequency plans supported by default | RU868, EU868, KZ865 |
| Frequency plans available as order option | Any regional according to "LoRaWAN® 1.1 Regional Parameters" |
| 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 | 1300 packets |
| Antenna type | 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) |
| **POWER** | |
| Built-in battery | 6400 mAh 3.6 V, type A |
| Warranty number of packets sent by the device, not less | 80 000 |
| **CASE** | |
| Housing dimensions | 93 x 78 x 38 mm |
| Ingress protection rating | IP67 |
| Tamper sensor | yes |
| Mounting | clamp fastening to the support |
| **PACKAGE** | |
| Package dimensions | 140 x 80 x 85 mm |
| Weight of the package kit | 0,208 kg |

## DEFAULT DEVICE SETTINGS

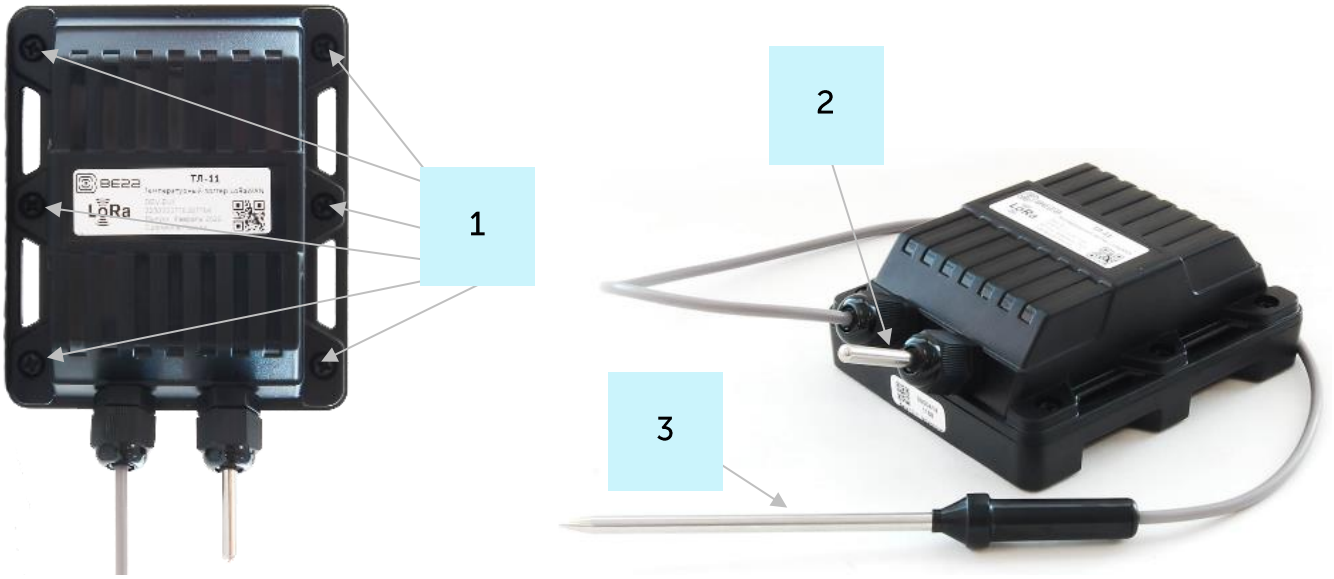
| PARAMETER | VALUE |
|---|---|
| Frequency plan | RU868 |
| Activation type | OTAA |
| Adaptive Data Rate | ON |
| Confirmed Uplinks | OFF |
| Rx 1 Delay | 1 second |
| Join Accept Delay | 5 seconds |
| Uplink number of transmissions | 1 |
| Data rate | DR0 |
| Power | 14 dBm |
| Communication period | 24 hours |
| Data collection period | 24 hours |
| Time zone | UTC +00:00 |

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 TL-11 is represented in black plastic case which has six screws.

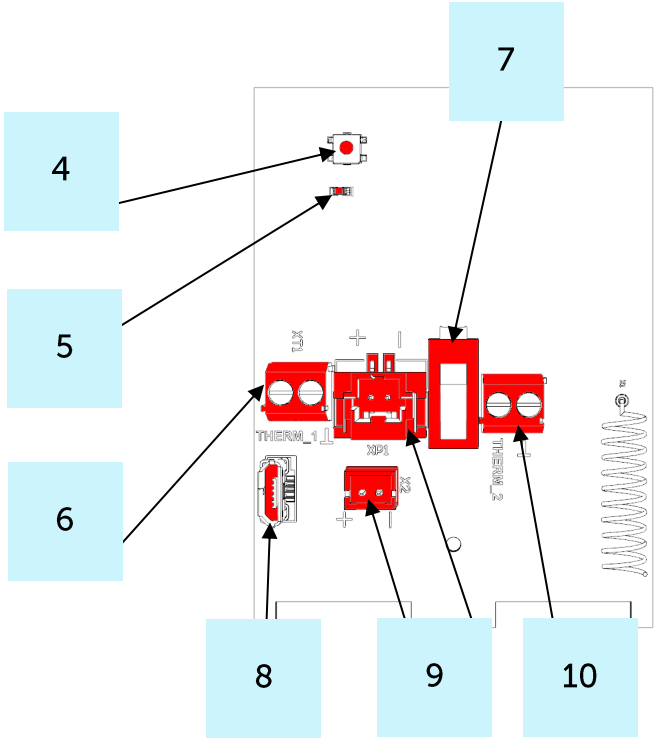



1 – screws ø 3 mm x 16 mm, cross

2 – built-in temperature sensor

3 – external probe

All control and indication elements are located inside the housing on the board.




4 – start button

5 – LED indicator

6 – contacts for connecting the built-in temperature sensor

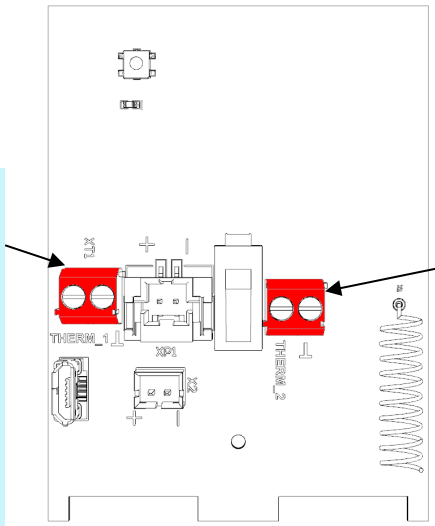
7 – tamper

8 – USB-port

9 – connectors for batteries

10 – contacts for connecting external probe

## CONTACTS

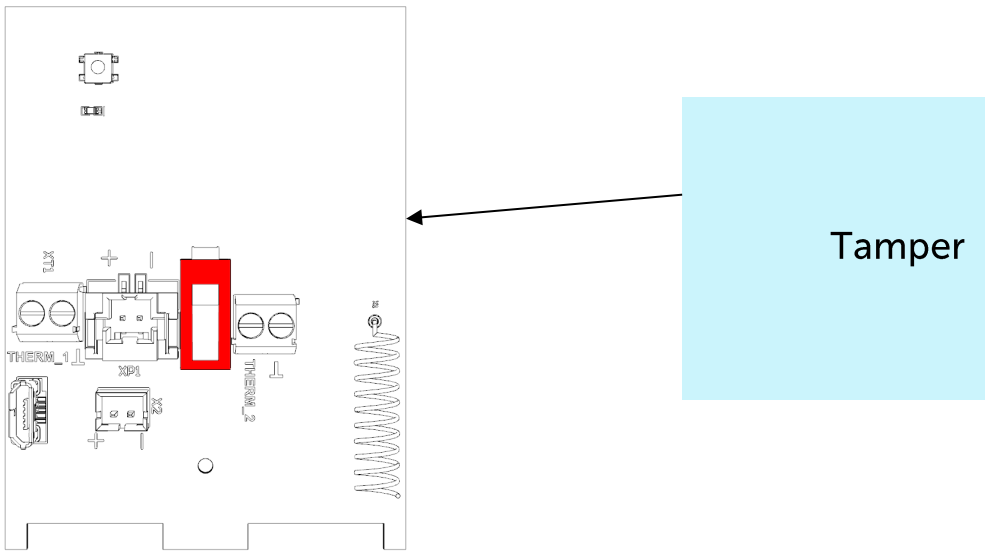



Temperature logger has a two contact pairs. One pair ("Therm_1" and " ⊥ " contacts) is for connect to built-in thermistor, another one is for external probe ("Therm_2" and " ⊥ " contacts).

You should configure sending data parameters in "Vega LoRaWAN Configurator" application.

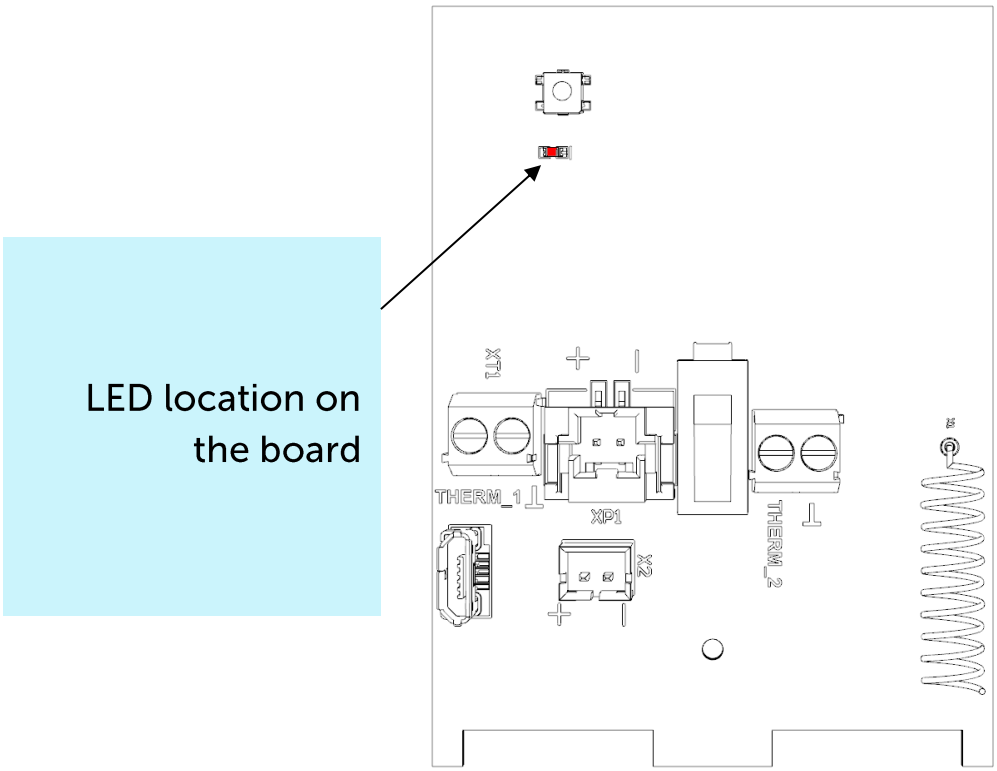
## DEVICE SENSORS

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 |
|---|---|---|
| ▮▮▮▮▮▮▮▮▮ | Series of short flashings | Linking to the network |
| ▮▮▮▮▮▮▮ | One long flashing | The device connected to the network and is in active mode |
| ▮▮▮▯▯▯ | Three long flashings | Linking to the network is unsuccessful or the device switched to the «Storage» mode |

In case 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 to avoid 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.

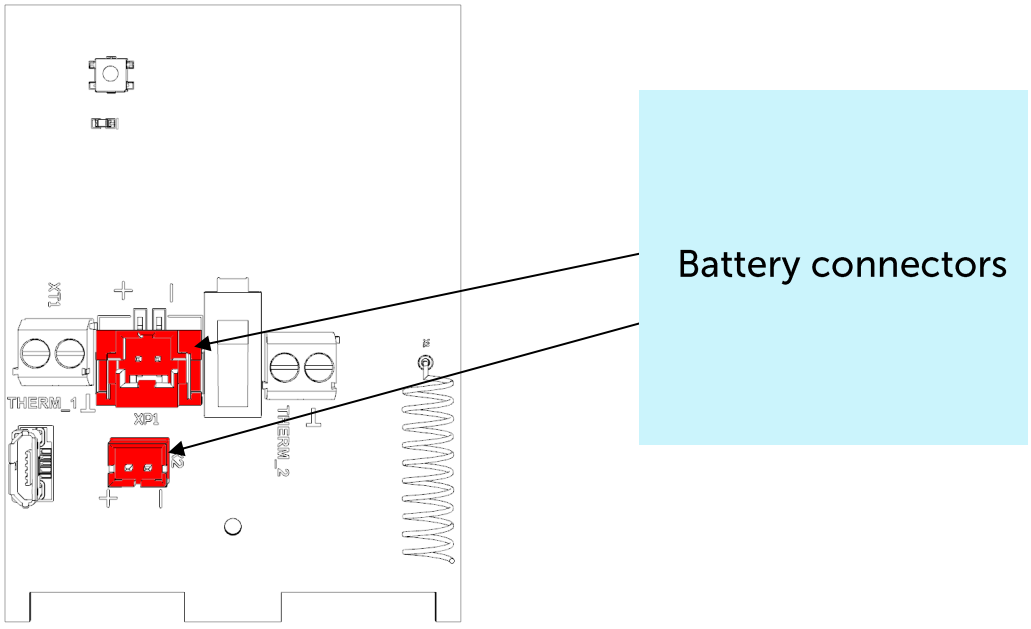
**Before mounting, make sure that the equipment has the latest firmware version**

For mounting you will need:

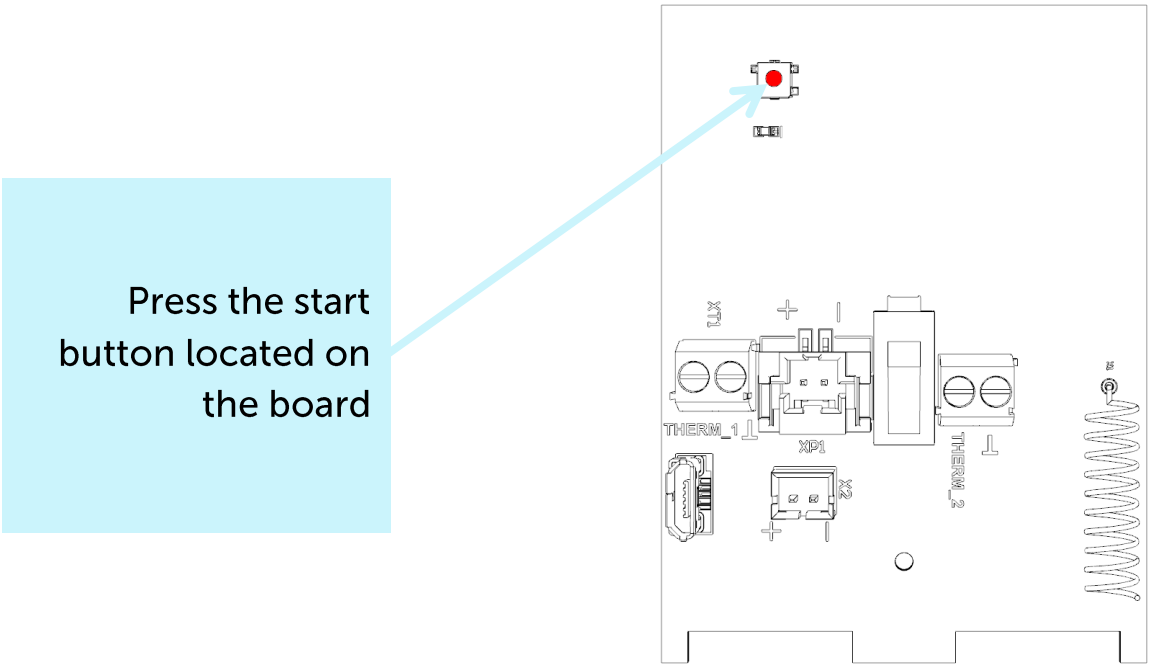
- cross-shaped screwdriver ⊕;
- laptop.

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. Vega TL-11 device powered with built-in battery, which necessary to connect it to any of two battery connectors on the board.



4. 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 pressing on the start button more than 5 sec) then you need to press the button to start.




5. By the laptop make sure that the device successfully sends the data.

6. Assembling the device. It is necessary to make sure that the silicone gasket is installed exactly in the groove of the housing, the fasteners are tightened tightly enough, the housing cover is tightly adjacent to the mating part.

# 4 COMMUNICATION PROTOCOL – VERSION 1.1

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

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

## SENSOR TL-11 TRANSMITS THE FOLLOWING TYPES OF PACKETS

1. Packet with current readings sent regularly at the interval specified in the settings

| Size in bytes | Field description | Data type |
|---|---|---|
| 1 byte | Battery level, % | uint8 |
| 4 bytes | Time of sending readings (unixtime UTC) | uint32 |
| 2 bytes | Temperature of built-in thermistor in °C multiplied by 10 | int16 |
| 2 bytes | Temperature of external probe in °C multiplied by 10 | int16 |
| 1 byte | Main parameters | uint8 |

**If thermistor is not connected to the TL-11 in the «Temperature» field of the corresponding thermistor will be sent an -1000 value for breakage or fault indication. In case of thermistor short circuit will be sent an -1270 value**

"Main parameters" bit field decoding

| Bits | Field description |
|---|---|
| 0-1 bits | Reason of message forming |
| 2 bit | Tamper state (“0” – case not open, “1” – case open) |
| 3...7 bits | Reserved (0 always) |

“Reason of message forming” field codes

| Code | Value |
|---|---|
| 0x00 | Sending packet by the time |
| 0x01 | By the tamper triggering |
| 0x02 | Reserved |
| 0x03 | Reserved |

2. 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) | uint16 |

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

3. Settings packet – transmitting on LoRaWAN® port 3

| 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 | ----- |

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

1. 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 |

2. 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 sends the packet with settings.

3. Packet with settings is identical to such packet from device

| 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 | ----- |

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 TL-11 parameters and these possible values

| ID of parameter | Description | Data length | Possible values |
|---|---|---|---|
| 4 | Confirmed uplinks | 1 byte | 1 – confirmed<br>2 – unconfirmed |
| 5 | Adaptive data rate | 1 byte | 1 – on<br>2 – off |
| 8 | Uplinks number of transmission | 1 byte | from 1 to 15 |
| 16 | Communication period | 1 byte | 1 – 1 hour<br>2 – 6 hours<br>3 – 12 hours<br>4 – 24 hours<br>5 – 5 minutes<br>6 – 15 minutes<br>7 – 30 minutes |
| 49 | Data collection period | 1 byte | 1 – 1 hour<br>2 – 6 hours<br>3 – 12 hours<br>4 – 24 hours<br>5 – 5 minutes<br>6 – 15 minutes<br>7 – 30 minutes |
| 55 | Time zone, in minutes | 2 bytes | from -720 to 840 |

# 5 STORAGE AND TRANSPORTATION REQUIREMENTS

Vega TL-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.

Long-term storage of the device in the "Storage" mode can lead to battery passivation

# 6 CONTENT OF THE PACKAGE

Vega TL-11 device is delivered complete with:

Temperature logger Vega TL-11 – 1 pc.

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.

The warranty does not apply to batteries.

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 | |
|---|---|
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| Revision and date | 06 – 23 August 2022 |

This document applies to the following products:

| Product name | Type number |
|---|---|
| End devices | Vega TL-11 |

Revision History

| Revision | Date | Name | Comments |
|---|---|---|---|
| 01 | 09.08.2019 | KEV | Document creation date |
| 02 | 09.04.2020 | KEV | Minor changes |
| 03 | 07.09.2020 | KEV | Temperature sensor type is added |
| 04 | 01.03.2021 | KEV | Remove warranty packets, changes in communication protocol (1st packet, bytes) |
| 05 | 09.11.2021 | KMA | Planned revision |
| 06 | 23.08.2022 | KMA | Minor edits |

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