



LORAWAN TRACKING DEVICE

VEGA LM-1

USER MANUAL



DOCUMENT REVISION	FIRMWARE VERSION
10	0.8

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INTRODUCTION

This manual is designated for Vega LM-1 tracking device (hereinafter – the device) 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 of 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

Vega LM-1 tracking is designed to determine a height above the sea level, an angle of deviation from the vertical, a moving beginning, and the coordinates by GLONASS/GPS satellites with the accumulating and transferring that data to a LoRaWAN® network.

Vega LM-1 can determine the angle of deviation from the vertical with high accuracy thanks to the built-in three-axis accelerometer. This information can be used by the device to initiate a special communication session, and be transmitted in a standard packet to the LoRaWAN® network.

The case has magnetic mounts on neodymium magnets, as well as lugs for fastening with clamps. The high degree of protection of the case IP67 and the operating temperature range from -40 to +70 ° C allow the device to be installed in unheated rooms and outdoors.

Depending on chosen battery's capacity there is two options:

Vega LM-1 6400 mAh

Vega LM-1 12800 mAh.

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

COMUNICATION AND DATA COLLECTION ALGORITHM

Vega LM-1 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 LM-1 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 1 hour, 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 17:41, at 18:41 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 LM-1 tracking device is A class device (LoRaWAN® classification) and has the following features:

- ⦿ ADR support (Adaptive Data Rate)
- ⦿ Sending of confirmed packets (configurable)
- ⦿ Two operating submodes: "Static" and "Movement"
- ⦿ Time referencing of coordinates determination by internal clock
- ⦿ Communication in case of accelerometer actuation
- ⦿ Temperature measurement
- ⦿ Charge measuring of the built-in battery (%)

MARKING

Device is marked with the sticker which contains following information:

- ◉ Device model;
- ◉ DevEUI;
- ◉ Month and year of manufacture;

Sticker is in the three places – on the device case, in the 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 registration in the LoRaWAN® network and other indicators.

2 SPECIFICATION

DEVICE SPECIFICATION

MAIN	
Built-in GPS-antenna	yes
Built-in accelerometer	yes
USB-port	micro-USB, type B
Operating temperatures	-40...+70 °C
Internal temperature sensor	yes
Accuracy of measurement the angle of deviation from the vertical	±1 °
LoRaWAN®	
LoRaWAN® class	A
Quantity of LoRaWAN® 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	1, 5, 15, 30 minutes, 1, 6, 12 or 24
Memory amount for storing packets	240 packets
Type of the LoRaWAN® antenna	internal
Sensitivity	-138 dBm
Transmitter power by default	25 mW (configurable)
POWER	
Built-in battery	6400 mAh or 12800 mAh
Warranty number of packets sent by the device, not less	10 000 or 20 000
CASE	
Housing dimensions (without cable gland and SMA-connector)	90 x 75 x 40 mm
Ingress protection rating	IP67
Mounting	on magnets
PACKAGE	
Package dimensions	140 x 80 x 50 mm
Weight of the package kit	0,232 or 0,282 kg

DEFAULT DEVICE SETTINGS

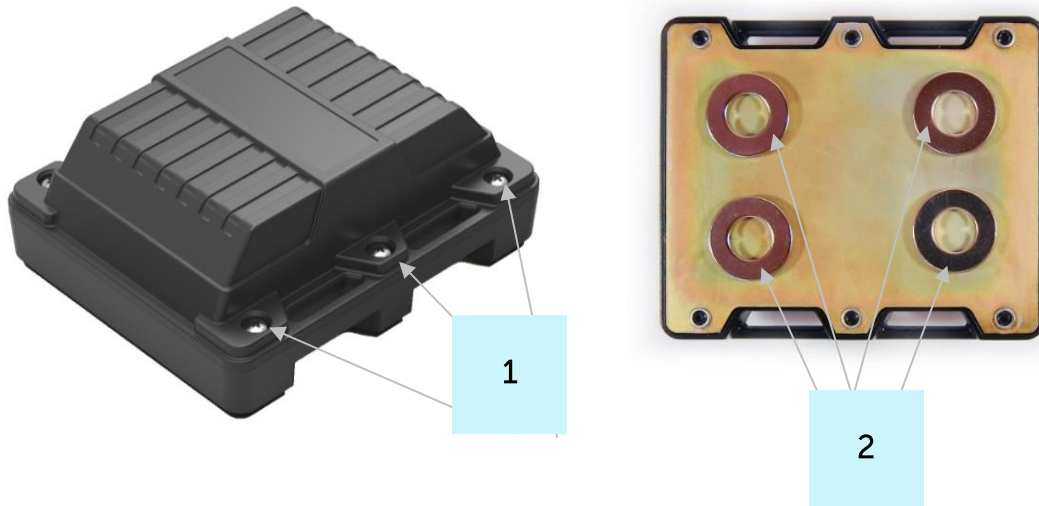
PARAMETER	VALUE
Frequency plan	RU868
Activation type	OTAA
Adaptive Data Rate	ON
Confirmed Uplinks	OFF
Rx 1 Delay	1 second
Join Accept Delay	5 seconds
Uplink number of transmissions	1
Data rate	DR0
Power	14 dBm
Communication period	24 hours
Data collection period	24 hours
Communication period in movement	5 minutes
Data collection period in movement	1 minutes
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

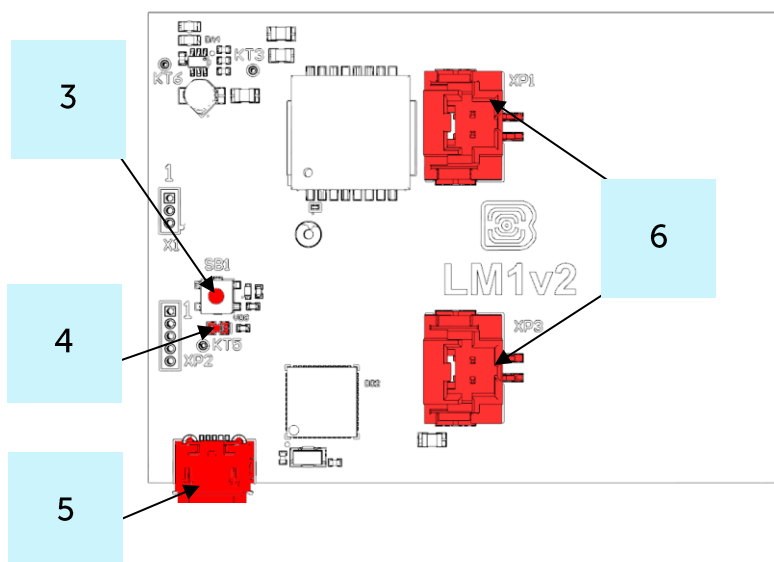
Vega LM-1 is represented in black plastic case which has six screws.



1 – screws $\varnothing$ 3 mm x 16 mm, cross 

2 –magnetic mounting

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



3 – start button

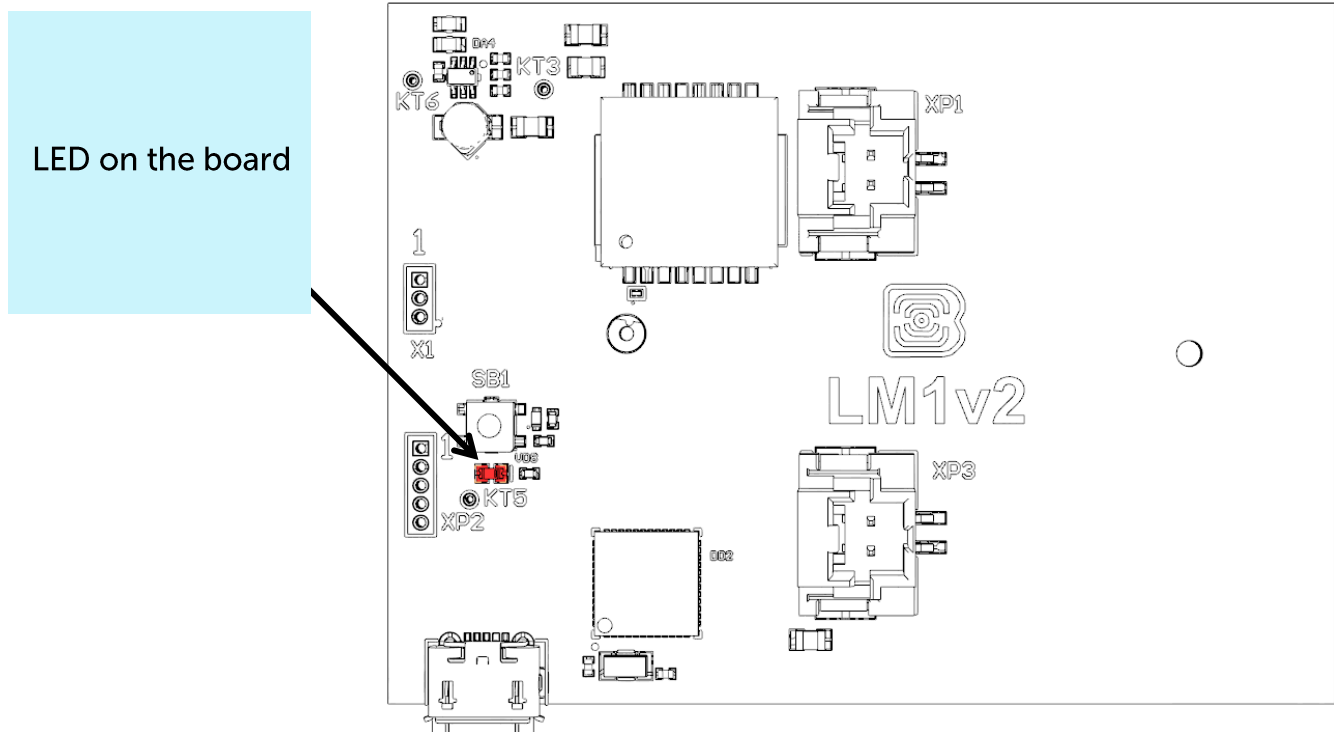
4 – LED indicator

5 – USB-port

6 – connectors for batteries

INDICATION

There is one red LED on the board. The indication is only used when the device is activated in the LoRaWAN® network.



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.



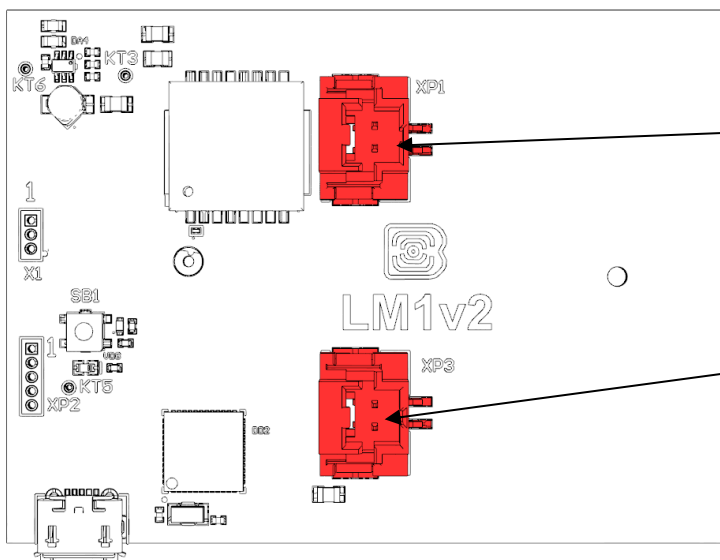
Before mounting, make sure that the equipment has the latest firmware version

For mounting you will need:

- cross-shaped screwdriver ;
- laptop.

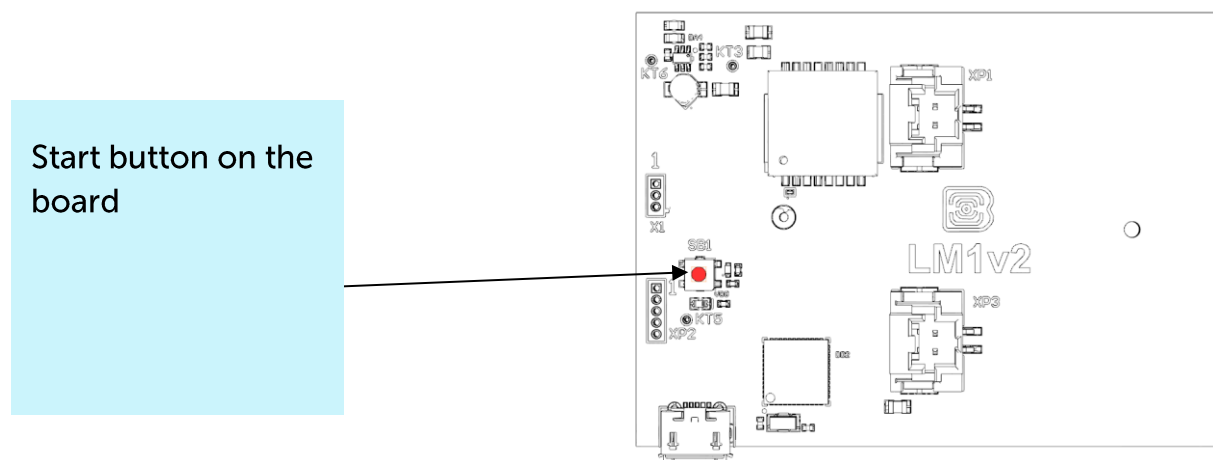
Step by step mounting be like:

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 LM-1 6400 mAh searching device powered with built-in battery, which necessary to connect it to any of two battery connectors on the board. For Vega LM-1 12800 mAh it is necessary to connect two batteries to two connectors.



Battery connectors

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.
7. Mounting the device by magnets.

SUBMODES DESCRIPTION

Tracking device Vega LM-1 operates in two submodes – "Static" and "Movement".

Switching between the submodes is carried out automatically by the built-in accelerometer signals. The device switches from the "Static" submode to the "Movement" at a moment the accelerometer fixes the movement. Device switches from the "Movement" submode to the "Static" after two minutes without moving.

For every submode the communication and data collection periods set up separately in "Vega LoRaWAN Configurator" application.

Moreover, there is an ability to set the alarm message sending when the device switch from the "Static" submode to the "Movement".

Also, you can disable accelerometer so the device will always operate in the "Static" submode and will not switch to the "Movement" one.

4 COMMUNICATION PROTOCOL – VERSION 1.1

This part describes the LM-1 data exchange protocol with the LoRaWAN® network.



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

VEGA LM-1 TRACKING DEVICE 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 charge, %	uint8
4 bytes	Reading time for values in this packet (unixtime UTC)	uint32
1 byte	Temperature, °C	int8
1 byte	Movement presence byte 0 – the static 1 – the movement	uint8
2 bytes	An angel of deviation from the vertical	uint16
1 byte	Coordinates validation byte 0 – not valid 1 – valid	uint8
4 bytes	Latitude in degrees multiplied by 1000000	int32
4 bytes	Longitude in degrees multiplied by 1000000	int32
2 bytes	Course in degrees	uint16
2 bytes	Speed, in km/h	uint16
2 bytes	The height above the sea level	int16
1 byte	The number of visible satellites at a moment when the packet formed	uint8
1 byte	The number of satellites used in navigation decision	uint8
1 byte	Alarm byte 0 – normal 1 – alarm	uint8

The device has internal clock and calendar; time and date are factory preset. When sending a packet with the current readings, the device uses the data taken at the nearest time, which is multiple to the interval, set by the switches:

- ⦿ 5 minutes period: 00:05, 00:10 readings are sent;
- ⦿ 15 minutes period: 00:15, 00:30 readings are sent;
- ⦿ 30 minutes period: 00:30, 01:00 readings are sent;
- ⦿ An hour period: the readings of the beginning of the current hour are sent;
- ⦿ 6 hours period: 00:00, 06:00, 12:00, 18:00 readings are sent;

- ⦿ 12 hours period: 00:00, 12:00 readings are sent;
- ⦿ 24 hours period: the readings of 00:00 of the current day are sent.

Time zone considered during collection data from an external meter.

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)	uint32

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 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	-----

VEGA LM-1 TRACKING DEVICE 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

When packet received then the device set the internal clock and the date according to the data in that packet.

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

The packet 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 LM-1 parameters and these possible values

ID of parameter	Description	Data length	Possible values
4	Confirmed uplinks	1 byte	1 – confirmed 2 – unconfirmed
5	Automatically Data Rate (ADR)	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
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
62	Collection period in movement	1 byte	1 – 1 hour 2 – 6 hours 3 – 12 hours 4 – 24 hours 5 – 5 minutes 6 – 15 minutes 7 – 30 minutes 8 – 1 minute
63	Transmission period in movement	1 byte	1 – 1 hour 2 – 6 hours 3 – 12 hours 4 – 24 hours 5 – 5 minutes 6 – 15 minutes 7 – 30 minutes 8 – 1 minute
71	Generate alarm event at movement start	1 byte	0 – do not generate 1 – generate

5 STORAGE AND TRANSPORTATION REQUIREMENTS

Vega LM-1 tracking device 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

The tracking device is delivered complete with:

Vega LM-1 tracking device – 1 pc.

Battery 6400 mAh – 1 or 2 pcs.¹

Factory certificate – 1 pc.

¹ Depend on order options.

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 battery warranty period is 36 months or 5,000 data packets sent by the product with 6400 mAh battery and 10,000 data packets sent by the product with two 6400 mAh batteries, whichever comes first.

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	LoRaWAN tracking device Vega LM-1
Document type	Manual – Translation from Russian
Document number	V02-LM1-01
Revision and date	10 - 08 November 2021

Revision History

Revision	Date	Name	Comments
01	01.06.2018	KEV	Document creation date
02	12.11.2018	KEV	Minor changes
03	24.12.2018	KEV	" Marking " part added, device AppEui added in specification , setting "by the air" description, communication protocol changed
04	03.04.2019	KEV	Minor changes
05	15.04.2019	KEV	Warranty changed, minor changes
06	02.07.2020	KEV	Scheduled revision of the document, minor changes
07	15.09.2020	KEV	Data type for "Latitude" and "Longitude" fields was changed to int32
08	07.10.2020	KEV	New ability to disable accelerometer
09	22.01.2021	KEV	Fixed an error in a content of the package
10	08.11.2021	KMA	Planned revision



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