MOTION SENSOR

SMART-MS0101

USER MANUAL

DOCUMENT REVISION	FIRMWARE VERSION
13	2.1 EU

CONTENTS

INTRODUCTION

This manual is designated for Vega Smart-MS0101 motion sensor (hereinafter – device, sensor) 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

Infrared motion sensor Vega Smart-MS0101 is designed to detect penetration into the protected area.

Vega Smart-MS0101 can be used to protect premises, buildings and structures, as well as in Smart Home systems, built on LoRaWAN® technology.

The sensor is powered by a CR123A 1400 mAh replaceable battery.

The device is powered by a non-rechargeable lithium manganese dioxide ($Li\text{-}MnO_2$) battery
Attempts to charge the battery may result in fire

OPERATION ALGORITHM

Vega Smart-MS0101 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.

Initially, the device is not connected to power, because a plastic plug is installed between the battery contact and the device contact, which must be removed before putting the sensor into operation.

Vega Smart-MS0101 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 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.

In the "Active" mode there are 2 possible submodes.

In the "Guard" submode, the device sends an alarm message to the LoRaWAN® network when motion is detected, after which it switches to the «Neutral» submode for a while.

"Neutral" - in this submode, the sensor does not send alarm messages when motion is detected. If the movement in the protected area has ceased, then the device switches back to the «Guard» submode after a certain configurable period. There is an option of message sending when the device switched to the "Guard" submode (configurable through the «Vega LoRaWAN Configurator»).

The device arming time interval is setting up by the «Vega LoRaWAN Configurator» application and may vary from 1 to 60 minutes.

The adjustable data transfer period can be from 5 minutes to 24 hours. The stored readings transmit during the next communication session with the LoRaWAN® network. Data transferring in random point in time during set period.

If there is no alarm mode, then data transferring in random point in time during set period. At the next communication session, the device starts sending accumulated packets with readings, from the earliest to the latest.

When alarm situation appears, the device forming alarm packet and transferring it immediately.

With the "Confirmed uplinks" option turned on, the device will send the next packet only after receiving a confirmation of the delivery of the previous one. If such confirmation have not received after the fulfilled in the settings uplink number of transmission, device completes the communication session until the next one according to the schedule. In this case, the device continues to collect data according to the data collection period and store it in memory. Non-transmitted packets remain in the device memory until the next communication session.

With the "Confirmed uplinks" option turned off, the device just sends all accumulated packets to the network in order from the earliest to the latest. There are no checks of package delivery in this mode. There are no non-transmitted messages in the device memory.

The internal clock is set automatically when device connected to the "Vega LoRaWAN Configurator" via USB, also adjustable via LoRaWAN®.

FUNCTIONAL

Vega Smart-MS0101 motion sensor is class A device (LoRaWAN® classification) and has the following features:

- ADR support (Adaptive Data Rate)
- Sending of confirmed packets (configurable)
- Extra communication in case of alarm event
- Message sending when the device arming

- Two working submodes “Neutral” and “Guard”
- Temperature measurement by the internal temperature sensor
- Battery charge measurement (%)

MARKING

Device marked with sticker that contains the following information:

- Device model;
- DevEUI;
- Month and year of manufacture;
- Certification marks.

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 device activation keys in the LoRaWAN® network, production date and other identifiers.

2 SPECIFICATION

DEVICE SPECIFICATION

MAIN	
USB-port	mini-USB, type B
Operating temperatures	0...+50 °C
Maximum detection range	not less than 10 m
Range of velocities of the intruder	0.3...3 m/s
Sensor mounting height	2.1 m
Sensor tilt angle in the vertical plane	12°
Sensor viewing angle in the horizontal plane	88,2°
Resistance to external light	6500 lux
Built-in temperature sensor	yes
LORAWAN®	
LoRaWAN® class	A
Quantity of LoRa channels	8
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
Memory amount for storing packets	200 packets
Antenna	internal
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	
Replaceable battery	CR123A 3V, 1400 mAh
Estimated number of packets sent by the device, not less	9 000
CASE	
Housing dimensions	36 x 50 x 70 mm
Ingress protection rating	IP30
PACKAGE	
Dimensions	45 x 80 x 95 mm
Weight	0,075 kg

DEFAULT DEVICE SETTINGS

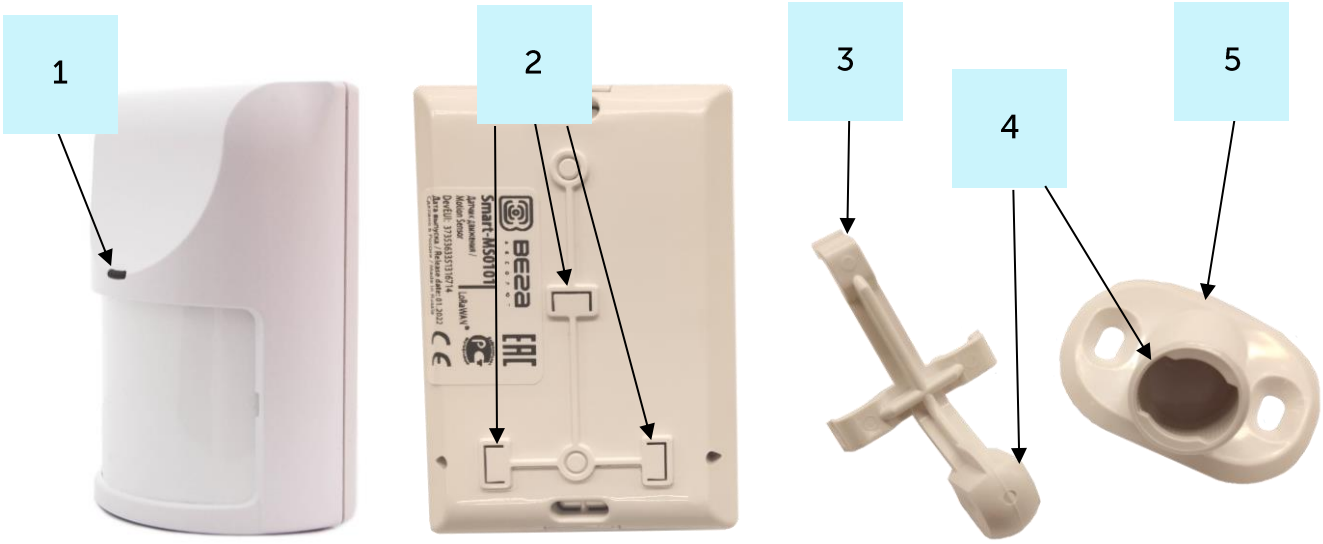
PARAMETER	VALUE
Frequency plan	RU868
Activation type	OTAA
Adaptive Data Rate	ON
Confirmed Uplinks	OFF
Rx 1 Delay	1 second
Join Accept Delay	5 seconds
Uplink number of transmissions	1
Data rate	DR0
Power	25mW (14 dBm)
Communication period	24 hours
Data collection period	24 hours
Time zone	UTC +00:00

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

The Vega Smart-MS0101 device is presented in a small plastic case with a separate mount.



1 – LED indicator

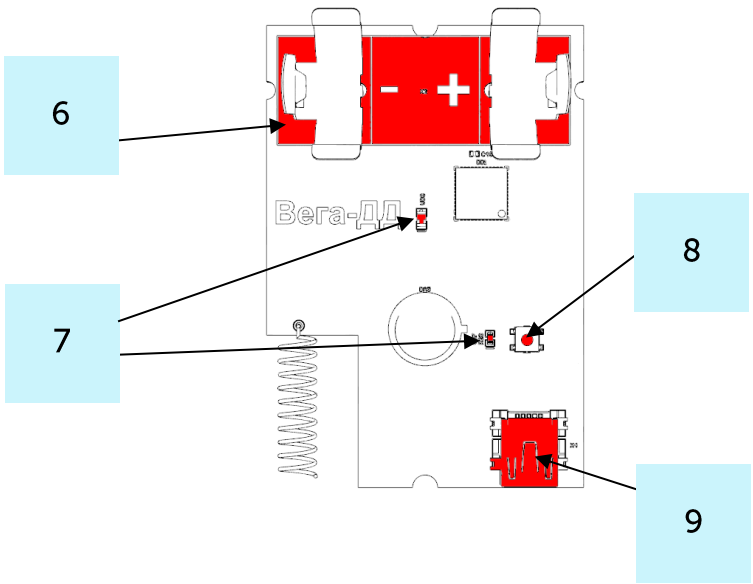
2 – mounting holes

3 – holder

4 – swivel

5 – support

All control and indication elements, as well as contacts for connection, are located inside the case on the board.



6 – contacts

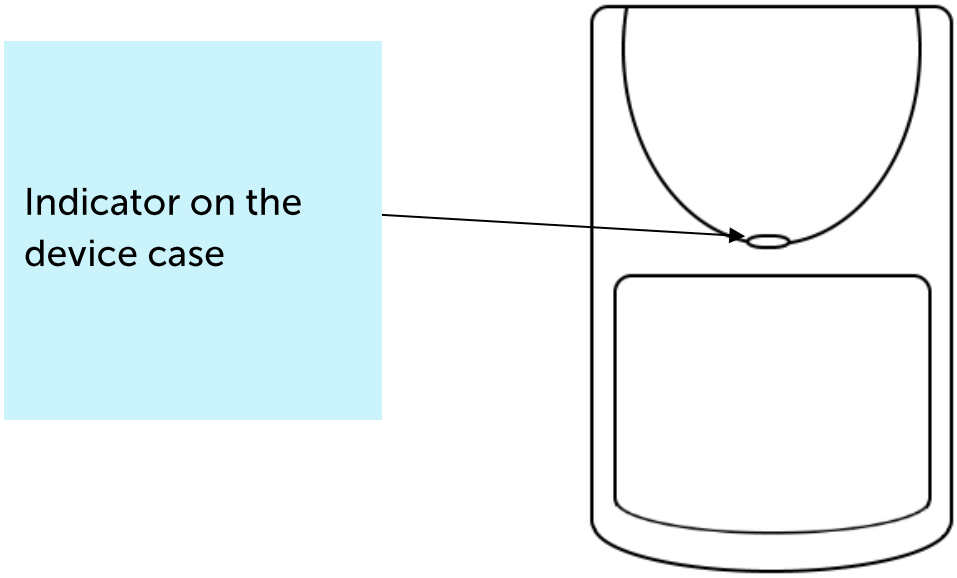
7 – LED indicator

8 – launch button

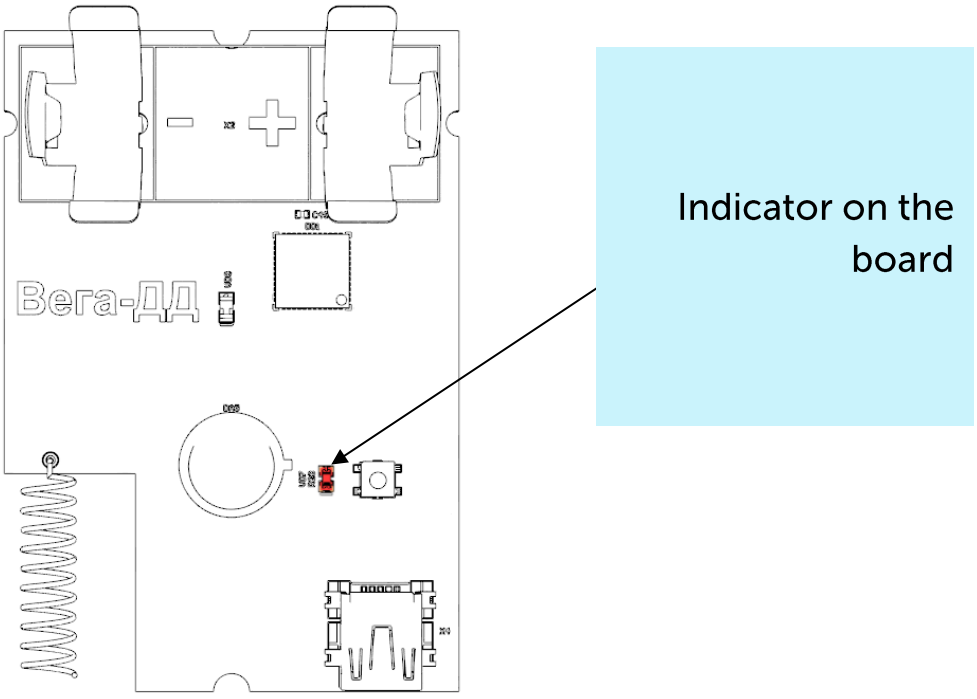
9 – USB-port

INDICATION

A double color indicator is located on the front of the sensor case, and it flashes red when detect motion in the protected area.



One more indicator is located on the board, and it shown only when cover off and displays a linking to the network state.



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

SENSOR MOUNTING RECOMMENDATIONS

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.

The sensor must be installed in such a way that the probable penetration paths of the intruder cross the central axis of the detection zone.

Recommended mounting height of the sensor is 2...2,5 m.

Do not install the sensor near objects that are powerful sources of heat or having the ability to quickly change their temperature (fireplaces, stoves, air conditioners, radiators, etc.), in places with strong air currents or the possibility of direct sunlight.

The wall on which the sensor is mounted should not be subjected to strong vibrations.

The presence in the detection zone of objects (curtains, screens, large objects, furniture, plants, etc.) creates behind them "dead zones", the detection of the offender behind these objects may not occur.

Before starting mounting work, you must make sure that the latest firmware version is installed on the equipment

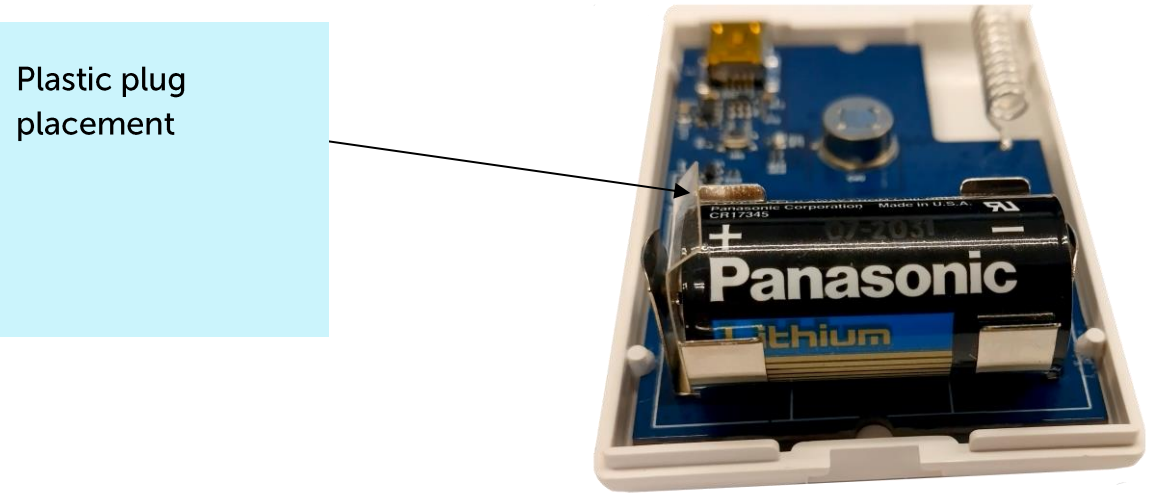
For mounting you will need:

- flathead screwdriver;
- laptop.

Initially, the device is not connected to power, because a plastic plug installed between the battery contact and the device contact which must be removed before commissioning

Step by step mounting guide:

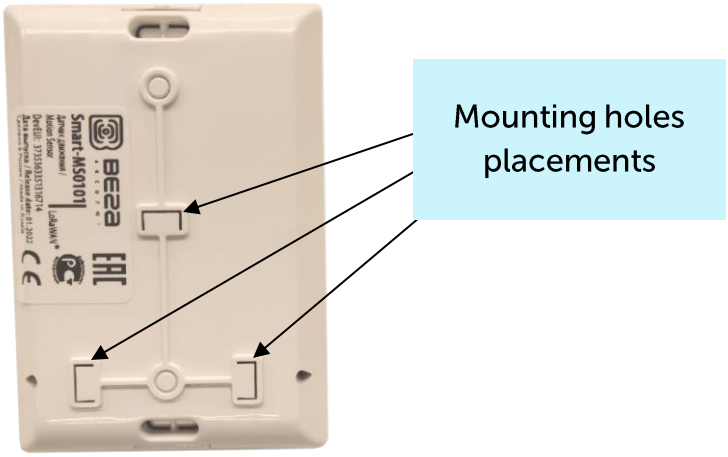
1. Setting the devices and connecting them to the network are usually carried out in the office (see Network Deployment Manual).
2. Determination of suitable places for mounting at the object with a network tester.
3. Remove the plastic plug between the battery and the device contact, if present, or install the battery if it has not been installed.



4. Device launching – switching to the “Active” mode and registration in the network will happen after removing the plug.

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

5. Assembling the device.
6. Making holes on the back of the case. To do this, remove the plastic plugs with a flathead screwdriver or similar tool.



7. Attaching the holder to the device
8. Installation of the support on site
9. Connection of the holder and support by a swivel as shown in the figure.

10. By the laptop you can make sure that the device successfully sends the data.

4 COMMUNICATION PROTOCOL – 2.0 VERSION

This part describes the Smart-MS0101 communication protocol with LoRaWAN® network.

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

SMART-MS0101 TRANSMITS THE FOLLOWING TYPES OF PACKETS

1. Packet with current readings, sent regularly, and every time alarm event occurs in "Guard" submode on LoRaWAN® port 2

Size in bytes	Field description	Data type
1 byte	Packet type (for that packet == 1)	uint8
1 byte	Battery charge, %	uint8
1 byte	Values of basic settings (byte field)	uint8
2 bytes	Temperature in ^{0}C, multiplied by 10	int16
1 byte	Sending reason (0 – by the time, 1 – by the alarm, 2 – by the arming)	uint8
4 bytes	Time of forming this packet (unixtime UTC)	uint32

"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: |2 == 0|3==0|4==0| - 5 minutes |2 == 1|3==0|4==0| - 15 minutes |2 == 0|3==1|4==0|- 30 minutes |2 == 1|3==1|4==0|- 1 hour |2 == 0|3==0|4==1|- 6 hours |2 == 1|3==0|4==1|- 12 hours |2 == 0|3==1|4==1|- 24 hours
5 bit	reserve
6 bit	reserve
7 bit	reserve

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 the packet sending moment (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	-----

SMART-MS0101 TRANSMITS THE FOLLOWING TYPES OF PACKETS

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 receiving the packet, the device sets its internal clock and calendar in compliance with the received 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 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 Smart-MS0101 parameters and these possible values

The table contains values in DEC, when sending, these values must be converted to HEX

ID of parameter	Description	Data length	Possible values
4	Confirmed uplinks	1 byte	1 – confirmed 2 – unconfirmed
5	ADR (Adaptive Data Rate)	1 byte	1 – enabled 2 – disabled
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
43	Time interval of auto-post to the “Guard” submode	1 byte	1, 2, 3, 4, 5, 10, 15, 30, 60 minutes
55	Time zone, in minutes	2 bytes	from -720 to 840
124	Send a packet when auto-post to the “Guard” mode	1 byte	0 – disabled 1 – enabled

Example: packet with settings sent to LoRaWAN® port 3 (value in HEX)

00040001020500010108000101100001042b000105370002000 07c000100

packet type	confirmed uplinks (OFF)	adaptive data rate (ON)	uplink number of transmissions (1)	communication period (24 hours)	time interval of auto-post to the “Guard” submode (5 minutes)	time zone (0 minutes)	send a packet during auto-arming to the “Guard” submode (off)
00	04000102	05000101	08000101	10000104	2b000105	370002000 0	7c000100

Coding example using setting 04 "request confirmation" as an example

04000102

setting ID «confirmed uplinks» (04 dec = 04 hex)	data length - 1 byte	value (02 – without request)
04	0001	02

Coding example using setting 55 «time zone in minutes»

3700020000

setting ID «time zone» (55 dec = 37 hex)	data length - 2 bytes	value (0 minutes)
37	0002	00000

5 STORAGE AND TRANSPORTATION REQUIREMENTS

The Smart-MS0101 sensor shall be stored in the original packaging in heated room at temperatures +5 °C to +40 °C and relative humidity less than 85%.

The sensor shall be transported in covered freight compartments of all types at any distance at temperatures -40 °C to +70 °C. After transportation at low temperatures, it is recommended to leave the device in a room temperature place for 48 hours before start of operation.

6 CONTENT OF THE PACKAGE

The sensor is delivered complete with:

Motion sensor Vega Smart-MS0101 – 1 pc.

CR123A battery – 1 pc.

Two-component fastening - 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 cover 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	
Title	Motion sensor Smart-MS0101
Document type	Manual – Translation from Russian
Document number	-
Revision and date	13 – 30 September 2024

Revision History

Revision	Date	Name	Comments
01	08.12.2017	KEV	Document creation date
02	08.08.2018	KEV	Technical characteristics are added, new part is added
03	28.09.2018	KEV	Typo at the communication protocol was fixed
04	22.01.2019	KEV	Communication protocol changed, setting via 'air' described. Frequency plans added, specification changed, warranty changed, configurator updated. "Marking" part added, "Indication" part changed
05	24.01.2019	KEV	Inaccuracy in communication protocol fixed – packet type for packets with settings and request of settings
06	17.06.2019	KEV	Inaccuracy in the table of settings fixed – setting 43 is 1-byte size
07	15.08.2019	KEV	Added new functionality's description, it's a sending message when the device arming
08	03.10.2019	KEV	Fixed an error in the device arming setting, p.27
09	15.04.2020	KEV	Tilt angle is changed from 6 to 12° and minor changes
10	07.12.2020	KEV	Changes in specification
11	21.01.2021	KEV	Operation temperature range is changed
12	30.03.2022	KMA	Planned revision
13	04.09.2024	NEE	Changing the number of LoRa channels

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