UNIVERSAL OFFICE SENSOR 5 IN 1
SMART-UM0101

USER MANUAL

DOCUMENT REVISION	FIRMWARE VERSION
09	0.5

CONTENTS

INTRODUCTION

This manual is designated for Vega Smart-UM0101 universal sensor (hereinafter – device, sensor) manufactured by Vega-Absolute OOO and provides information on powering and activation procedure, control commands and functions of the device.

The guide is intended for 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 sensor is designed for purpose of using as a temperature sensor, a humidity sensor, also for measuring a CO_2 level, an ambient light level, a noise level including control of coming out the specified range of these parameters. All controlled parameters may be a source of triggering with initiate of the alarm communication session and transmitting the message with the alarm flag.

Sensors are produced in modern plastic case and have an option of producing without CO_2 concentration level sensor on the board by the request.

The sensor powered by two replaceable batteries CR123A 3V of the common capacity 2800 mAh, also has an option to connect to the external power.

> **The device is powered by a non-rechargeable lithium (Li) battery**
> **Attempts to charge the battery may result in fire**

OPERATION ALGORITHM

Vega Smart–UM0101 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–UM0101 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 removing the plastic plug or exiting the "Storage" mode, the device immediately starts working in the "Active" mode.

OTAA method. After removing the plastic plug or exiting the "Storage" mode, 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 by the indicator 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 readings store in the device memory with a configurable period from 5 minutes to 24 hours. The stored readings transmit during the next communication session with the LoRaWAN® network.

The adjustable data transfer period can be from 5 minutes to 24 hours. 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 measurements are out of specified 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 form and send during 2 minutes after the moment of temperature/humidity measurements are out of specified range. Every following message, which will form according to the data collection period, will have sent according to the communication period.

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 has not received after the fulfilled in the settings uplink number of transmissions, 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

Sensor is class A device (LoRaWAN® classification) and has the following features:

⊚ Frequency plans RU868, EU868, KZ865 supported

⊚ Ability to set a custom frequency plan

⊚ ADR support (Adaptive Data Rate)

⊚ Sending of confirmed packets (configurable)

⊚ OTAA or ABP activation (configurable)

⊚ Communication period - every 5, 15, 30 minutes, 1, 6, 12, 24 hours (configurable)

- Extra communication in case of humidity value come out of specified range
- Extra communication in case of temperature value come out of specified range
- Extra communication in case of CO_2 level value come out of specified range
- Extra communication in case of ambient light level value come out of specified range
- Extra communication in case of noise level value come out of specified range
- Measurement of temperature, humidity, CO_2 level, light level, noise level
- Battery charge measurment (%)
- Measurement of a deviation angle from the vertical
- Sensitivity: up to -138dBm
- Saving collected data in "black box" for the next transmitting

MARKING

Device marked with sticker that contain 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	micro-USB, type B
Operating temperatures	-40...+85 °C
Measurement temperatures	-40...+85 °C $\pm$ 1 °C
Measurement humidity	0...100% $\pm$ 3%
Measurement CO_2 concentration level	0...40 000 ppm $\pm$ 30 ppm
Measurement ambient light level	0...10,000 lx $\pm$ 0,5%
Measurement sound pressure level	40...110 dB $\pm$ 1 dB
LORAWAN®	
LoRaWAN® class	A
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
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 batteries, common capacity	2xCR123A 3V, 2800 mAh
External power	12...24 V
Estimated number of packets sent by the device while data collection period is 6 hours, and communication period is 12 hours	5 000
Estimated battery lifetime when polling sensors, forming a package and sending it once every 12 hours	3 years
CASE	
Housing dimensions	ø117 x 44 mm
Ingress protection rating	IP20
Removal sensor	yes

PACKAGE	
Dimensions	130 x 115 x 58 mm
Weight	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	25mW (14 dBm)
Communication period	24 hours
Data collection period	24 hours
Sensors poll period (battery powered)	15 минут
Send alarm when data out of thresholds	OFF
Time zone	UTC +00:00
Temperature high threshold, °C	85
Temperature low threshold, °C	-10
Humidity high threshold, %	80
Humidity low threshold, %	0
Noise level high threshold, dB	110
Noise level low threshold, dB	40
Light level high threshold, lx	10000
Light level low threshold, lx	10
CO_2 level high threshold, ppm	2000
CO_2 level low threshold, ppm	0

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

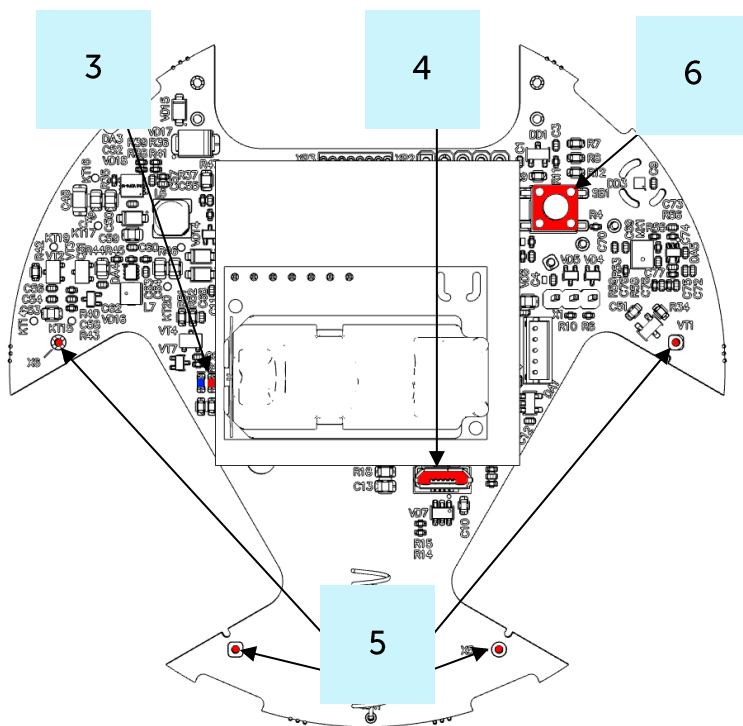## DEVICE APPEARANCE

The Vega Smart-UM0101 device is presented in a round case with a two-color indicator on the front.

1- LED indicator
2- Launch button 1

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

3 – LED indicators

4 – USB-port

5 – battery contacts

6 – launch button 2

INDICATION

A double color indicator is located on the sensor front and informs a user about the device state.

Indicator on the front of the device case

INDICATOR SIGNAL	MEANING
A series of short blue flashes	Linking to the network in progress
One long blue flash	The device connected to the network and in «Active» mode
One long red flash	Linking to the network is unsuccessful/ the device switched to the «Storage» mode/ the alarm went off

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 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.

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

For mounting you will need:

- ◉ double-sided tape or screws;
- ◉ screwdriver;
- ◉ USB cable;
- ◉ laptop.

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.

Since CO_2 gas is much heavier than ordinary air, it is advisable to install sensors at the level where it is necessary to control the concentration of CO_2, for example, in office premises at a level of 1...1.5 m.

The light sensor is located on the front of the case, which should also be considered when placing the device.

Light sensor

3.   The sensor can be powered by external power source as well as by CR123A batteries. To do this, you need to remove the body of the device from the platform. On the mounting platform there are contacts for connecting an external power supply of 12…24 V and a security input. If you select battery power, you must remove the plastic plug between the battery and the contact of the device, if there is a battery, or install the battery if it was not installed.

+ -

Security input

External power
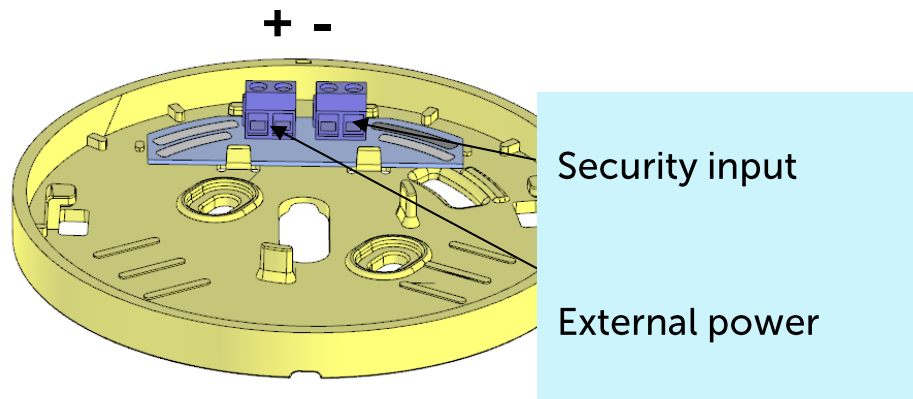
There are two battery slots on the inner surface of the case.
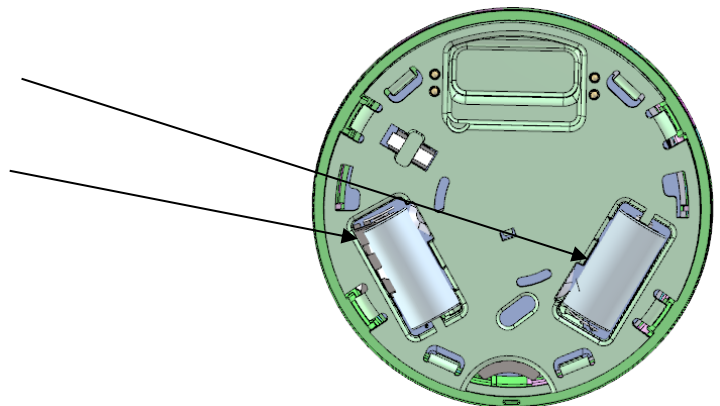
4.   Starting the device – switching to the "Active" mode and registering on the network. If the device is turned on for the first time, then the transition to the "Active" mode will occur automatically after the power is connected. If the device was switched to the "Storage" mode, then it is necessary to initiate the start of the device using the start button 1 located on the device case, or the start button 2 located inside the device case on the board.

Launch button 1 location
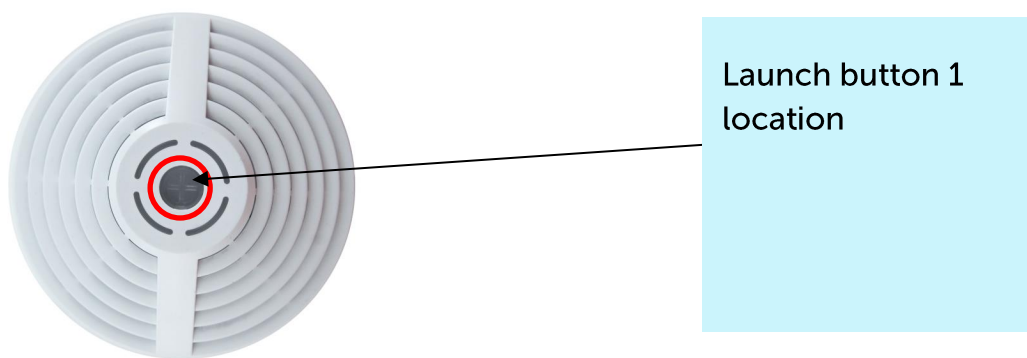
In order to use the button located on the board, it is necessary to remove the top cover of the device by pressing 4 fasteners of the case cover.
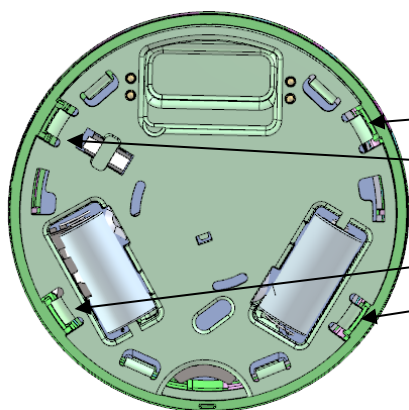
Fasteners of the case cover
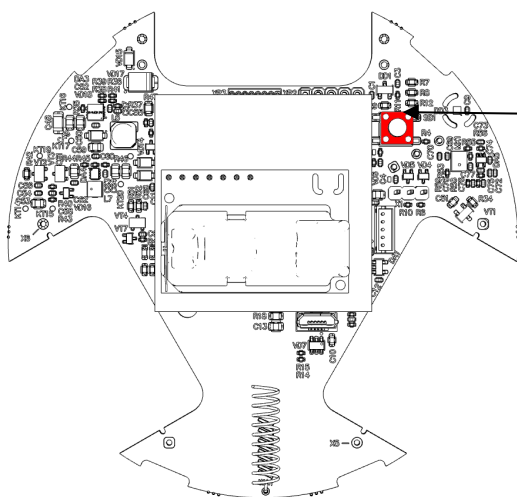
Launch button 2 location

5. By the laptop you can make sure that the device successfully sends the data.
6. Assembling the device.
7. Mounting the device on the object. Smart-UM0101 structurally consists of two parts: the device itself in an individual case (1) and a mounting platform (2).

1 **2**

Platform fasteners and corresponding holes on the sensor case
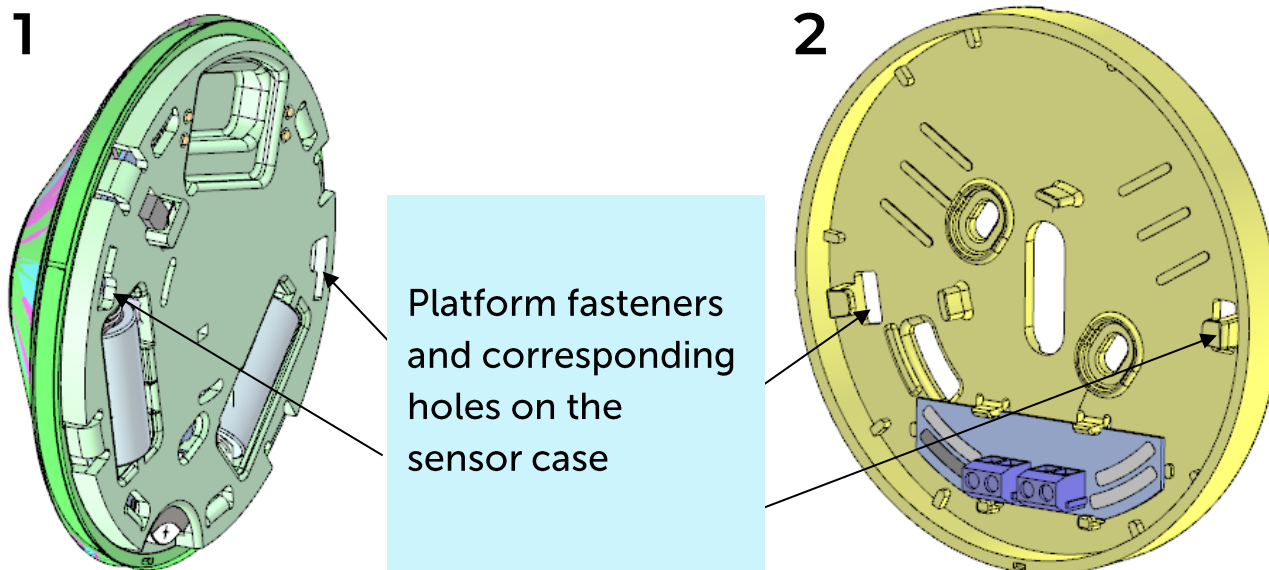
When mounting, the platform is first installed, all the necessary wires are connected to it, if necessary. After that, it is necessary to align the mounting holes on the sensor body and the fasteners on the platform and turn the sensor clockwise until it clicks into place.

4 COMMUNICATION PROTOCOL

This part describes the Smart-UM0101 communication protocol with LoRaWAN® network.

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

SMART-UM0101 TRANSMITS THE FOLLOWING TYPES OF PACKETS

1. Packet with current state is sent on LoRaWAN® port 2 according with the schedule or by the alarm

Size in bytes	Field description	Data type
1 byte	Packet type 1 – current state 2 –CO_2 level is out of range 3 – light level is out of range 4 – by the accelerometer 5 – humidity value is out of range 6 – temperature value is out of range 7 – noise level is out of range 8 – when removing if find out	uint8
1 byte	Battery charge, %	uint8
4 bytes	Reading time for values in this packet	uint32
1 byte	Power type (1 – batteries, 2- external)	uint8
2 bytes	Temperature in ^{0}C, multiplied by 10	int16
1 byte	Humidity in %	uint8
2 bytes	Ambient light level	int16
1 byte	Noise level	uint8
2 bytes	CO_2 concentration level in ppm	int16
1 byte	Vertical tint angle (0…180)	uint8
1 byte	Temperature low threshold in ^{0}C	int8
1 byte	Temperature high threshold in ^{0}C	int8
1 byte	Humidity low threshold in %	uint8
1 byte	Humidity high threshold in %	uint8
2 bytes	Light level low threshold	uint16
2 bytes	Light level high threshold	uint16
1 byte	Noise level low threshold	uint8
1 byte	Noise level high threshold	uint8
1 byte	CO_2 concentration low threshold in ppm, divided by 10	uint8
1 byte	CO_2 concentration high threshold in ppm, divided by 10	uint8

2. Packet with time correction request is 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)	int16

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 by the 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	-----

SMART-UM0101 RECEIVES 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

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 and is sent on LoRaWAN® port 3

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-UM0101 parameters and these possible values

ID of parameter	Description	Data length	Possible values
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
80	Temperature low threshold	1 byte	from -40 °C to +85 °C
81	Temperature high threshold	1 byte	from -40 °C to +85 °C
88	Humidity low threshold	1 byte	from 0 to 100%
89	Humidity high threshold	1 byte	from 0 to 100%
115	Noise level low threshold	1 byte	from 40 to 110
116	Noise level high threshold	1 byte	from 40 to 110
117	Light level low threshold	2 bytes	from 0 to 10,000
118	Light level high threshold	2 bytes	from 0 to 10,000
119	CO_2 concentration low threshold	2 bytes	from 0 to 40,000
120	CO_2 concentration high threshold	2 bytes	from 0 to 40,000

5 STORAGE AND TRANSPORTATION REQUIREMENTS

The Smart-UM0101 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 +85°C.

6 CONTENT OF THE PACKAGE

The sensor is delivered complete with:

Sensor Vega Smart-UM0101 – 1 pc.

CR123A battery – 2 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. 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	Universal office sensor 5 in 1 Smart-UM0101
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Revision History

Revision	Date	Name	Comments
01	15.08.2019	KEV	Document release date
02	20.02.2020	KEV	Minor changes
03	25.02.2020	KEV	We add new parameters at the data packet
04	08.04.2020	KEV	Unsupported settings with id 4 and 49 are removed
05	25.05.2020	KEV	Warranty number of packets is changed
06	27.05.2020	KEV	Measurement CO_2 concentration level is changed
07	03.06.2020	KEV	Measurement temperatures, humidity and light level are changed
08	31.08.2020	KEV	Added measurement errors
	26.01.2020	KEV	Fixed a typo in English version only in the first packet of the communication protocol (noise<->light)
09	18.04.2022	KMA	Planned revision