HUMIDITY/TEMPERATURE/DOOR AND WINDOW/ACCELERATION SENSOR

SMART-HS0101

User Manual

Vega Smart-HS0101 sensor combines a several functions, namely: door and window sensor, accelerometer, which determines the presence of vibration and the angle of deviation from the vertical, control of temperature and humidity parameters of the environment with the ability to set the ranges of these parameters. When any of the alarm events occur the message with corresponding information sent to LoRaWAN™ network.

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Product name	Type number
Vega Smart	Vega Smart-HS0101

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Revision	Date	Name	Comments
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CONTENTS

INTRODUCTION

This manual is designated for Vega Smart-HS0101 humidity/temperature/door and window/acceleration sensor (hereinafter – device, sensor) manufactured by Vega-Absolute LLC 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.

The device shall be installed and adjusted by qualified specialists in order to ensure proper operation of the device

1 DESCRIPTION AND OPERATION

DEVICE DESCRIPTION

Vega Smart-HS0101 sensor designed for distance control both opening and closing different doors and windows, for determine an angle of deviation from the vertical of some objects or for fix an move starting and also for measurement of humidity and temperature parameters including control of coming out the specified range of these parameters. All controlled parameters may be a source of triggering with initiate of alarm communication session and transmitting the message with alarm flag.

Sensors producing in modern plastic case of four colors versions: black, brown, white and grey.

The sensor powered by a CR123A 1400 mAh replaceable battery.

The sensor configuring via USB with special software «Vega LoRaWAN Configurator».

COMUNICATION AND DATA COLLECTION ALGORITHM

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.

Data collection period when measurements are out of specified temperature or humidity 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. 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 temperature/humidity 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 forming and sending 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 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-HS0101 sensor is class A device (LoRaWAN classification) and has the following features:

- o Frequency plans RU868, EU868, IN865, AS923, AU915, KR920, US915, KZ865 supported
- o ADR support (Adaptive Data Rate)
- o Sending of confirmed packets (configurable)
- o OTAA or ABP activation (configurable)
- o Communication period - every 5, 15, 30 minutes, 1, 6, 12, 24 hours (configurable)
- o Extra communication in case of Hall sensor triggering
- o Extra communication in case of accelerometer triggering
- o Extra communication in case of humidity value come out of specified range
- o Extra communication in case of temperature value come out of specified range
- o Temperature and humidity measurements
- o Battery charge measurment (%)
- o Sensitivity: up to -138dBm
- o Saving collected data in "black box" for the next transmitting

MARKING

Device marked with sticker that contain the next information:
- o Device model;
- o DevEUI;
- o Month and year of manufacture;
- o 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:
- o Information about firmware version;
- o QR-code containing DevEUI and keys for device registration in network via OTAA method.

2 SPECIFICATION

Main	
USB-port	micro-USB, type B
Operating temperatures	-40...+85 °C
Built-in temperature sensor	yes
Built-in humidity sensor	yes
LoRaWAN	
AppEui by default	736D687330313031
LoRaWAN class	A
Quantity of LoRa channels	16
Frequency plan	RU868, EU868, IN865, AS923, AU915, KR920, US915, KZ865, custom (EU868 based)
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)
Maximum transmitter power	100 mW
Power	
Replaceable battery	CR123A 3V, 1400 mAh
Warranty number of packets sent by the device, not less	15 000
Case	
Housing dimensions	63 x 36 x 21 mm
Magnetic part dimensions	15 x 36 x 21 mm
Ingress protection rating	IP43

3 OPERATION

INDICATION

A triple color indicator is located on the front of the sensor case and it informs a user about the device state.

Indicator on the front of the device case
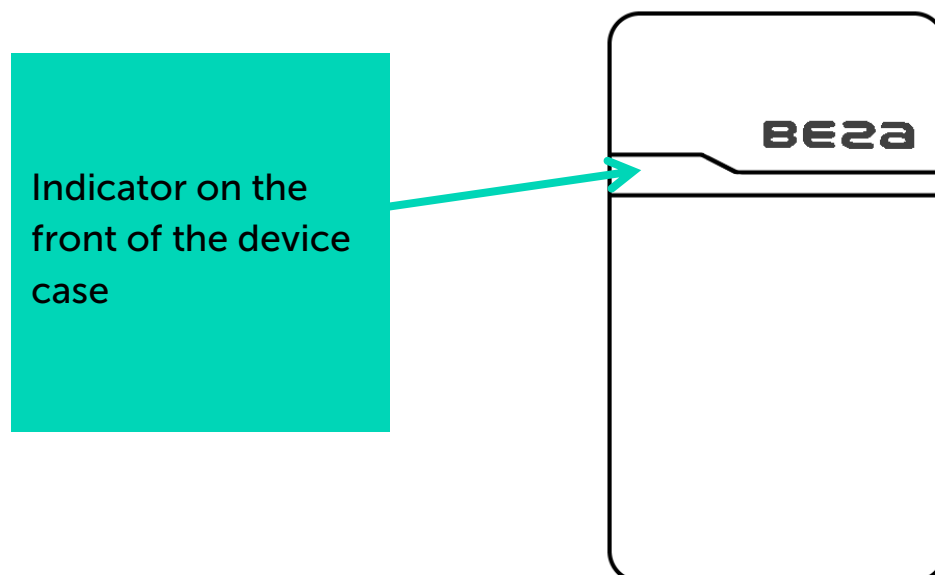
Indicator signal		Meaning
●●●	A series of short blue flashes	Linking to the network in progress
▬	One long blue flash	The device connected to the network and in «Active» mode
▬	One long red flash	Linking to the network is unsuccessful or the device switched to the «Storage» mode
●	One short blue flash	Data transmitting in progress
● ●	One green flash every 10 seconds	Device in «Active» mode
● ●	One red flash every 10 seconds	Battery charge is lower than 10 %

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 OPTIONS

Door and window sensor considers interdependent placement of two components:

- main part including all of electronics,

- magnet.

Device contain two Hall sensors located in two different places on a board. That allows mounting device in two ways.

1. The magnet is located above the main part. With this placement, the Hall sensor 1 responds to the movement of the magnet.
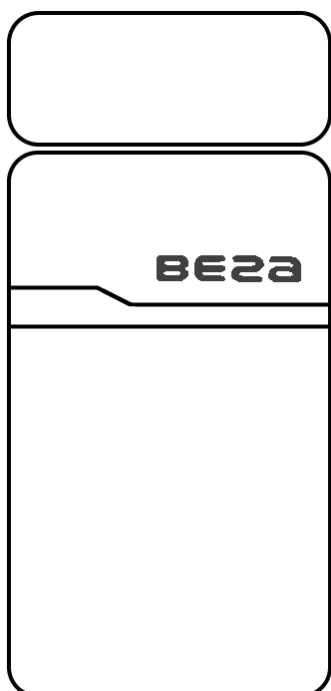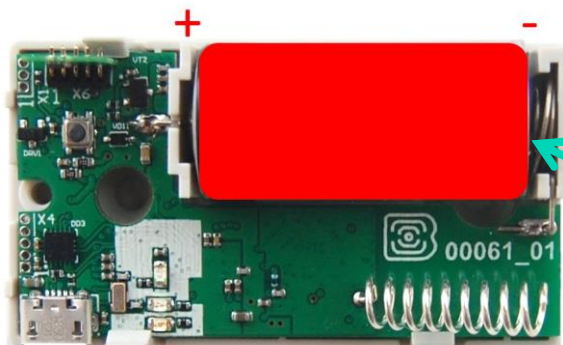
Magnet is above,
Hall sensor 1 works

2. The magnet is located to the left of the main part. With this placement, the Hall sensor 2 responds to the movement of the magnet.
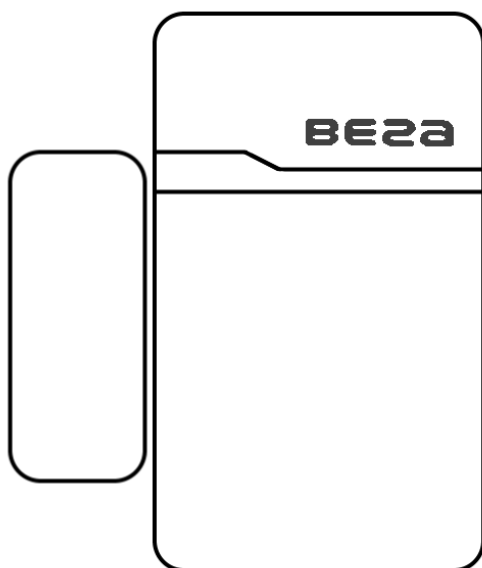
Magnet to the left, Hall sensor 1 works

INITIAL STARTUP

Vega Smart-HS0101 sensor powered by the CR123A 3V 1400 mAh replaceable battery. You need to insert the battery observing the polarity before start.

Insert the battery CR123A into the battery compartment

The sensor supports two activation methods in the LoRaWAN network - ABP and OTAA. Select one of the methods using "Vega LoRaWAN Configurator" application (See part 4).

1. ABP. After pressing the start button, the device immediately starts working in the "Active" mode.

Press the start button located on the board

2. **OTAA.** After pressing the start button, the device makes three attempts to connect to the network within the set frequency plan. After the activation request confirmed by LoRaWAN network, the device sends a signal and switches to the "Active" mode. If all attempts fail, the sensor will continue to accumulate data and will attempt to connect to the network every 6 hours.

To switch the device from the "Active" mode to the "Storage" mode, you can use the long press of the start button (more than 5 seconds).

Before connecting the device, make sure that its registration data is entered in the network - Device EUI, Application EUI and Application Key for OTAA, or Device address, Application session key and Network session key for ABP

CONNECTING VIA USB

The device Smart-HS0101 can be configured with the "Vega LoRaWAN Configurator" application (See part 4).

micro-USB
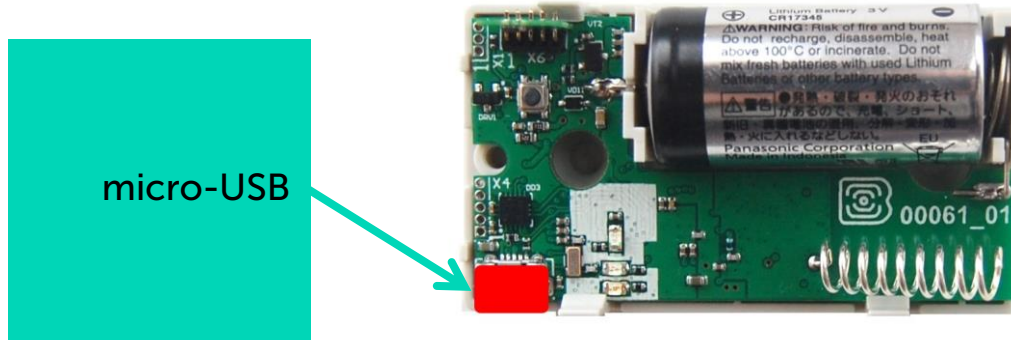
Before connecting the device to the computer for the first time, you must install the driver for the COM port **stsw-stm32102**, which can be downloaded from iotvega.com. After running the executable file **VCP_V1.4.0_Setup.exe**, the installer window will appear:
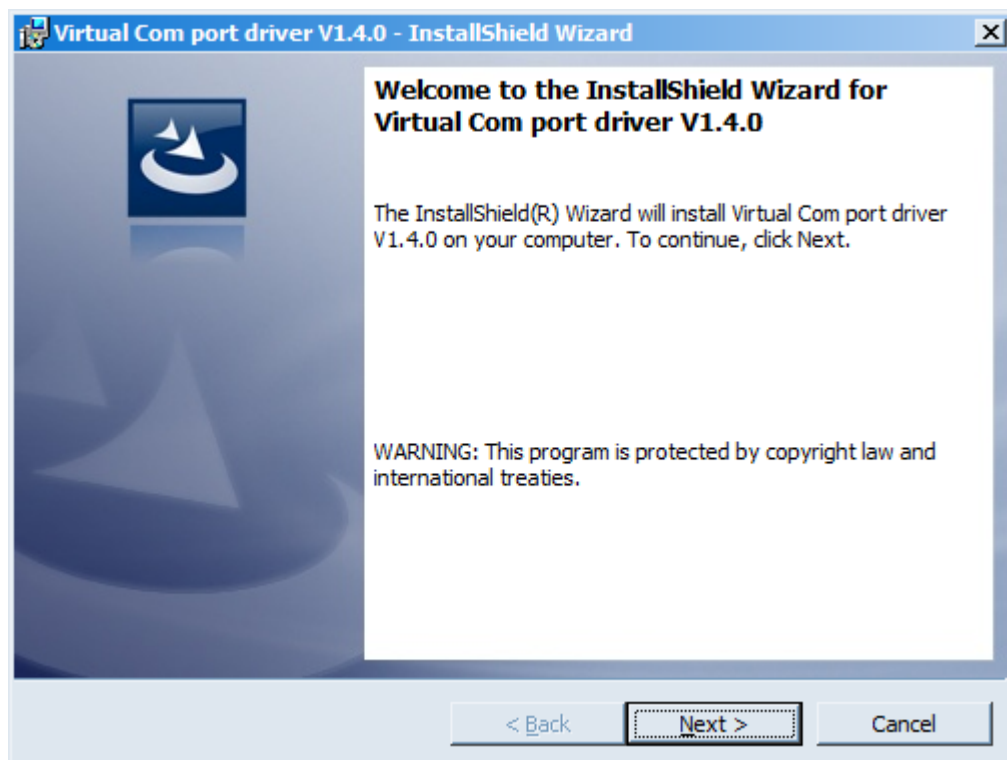
In this window, you need to click **Next**, then **Install**, and then the installation will begin. When the installation is completed successfully, the following screen appears:
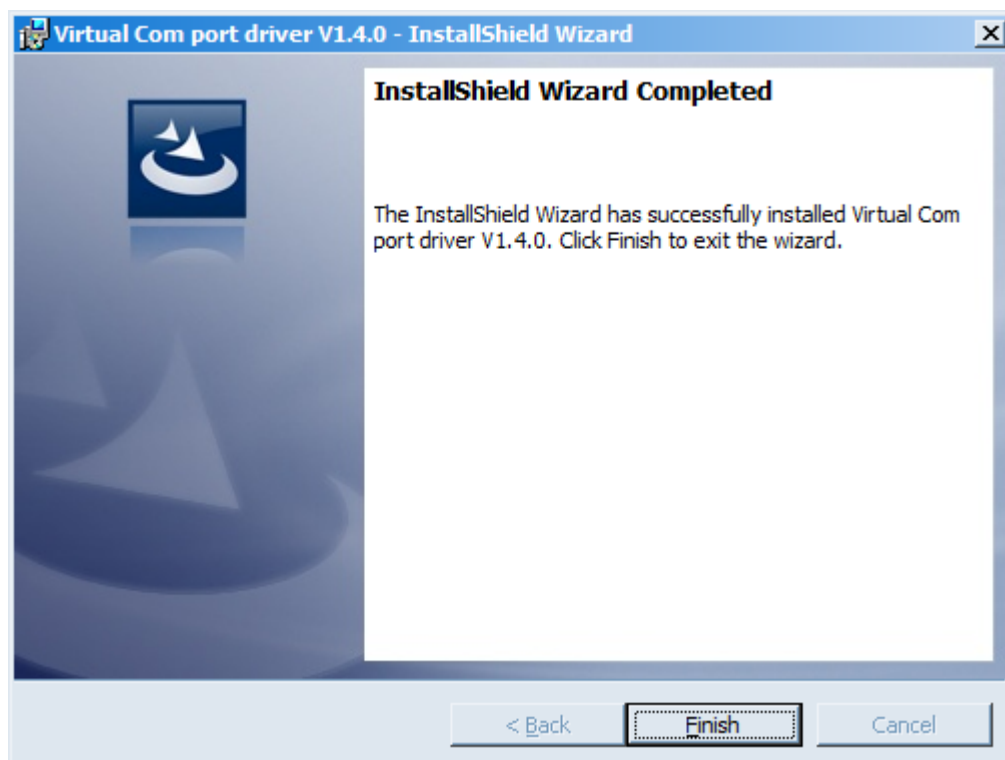
After pressing **Finish** the driver is ready for operation, - it is possible to connect the device via USB.

4 VEGA LORAWAN CONFIGURATOR

The "Vega LoRaWAN Configurator" application (hereinafter referred to as the configurator) is intended for setting up the device via USB.

The configurator has two modes of operation - "Simple" and "Expert". In the "Simple" mode, only basic settings are available. In the "Expert" mode the basic settings, advanced settings and the ability to check the coverage area of the signal from the gateways are available. Next, the work of the configurator is considered in the "Expert" mode.

INTERFACE OF THE APPLICATION

The "Vega LoRaWAN Configurator" application does not require the special installation. When the executable file is launched, the window for working with the application appears.
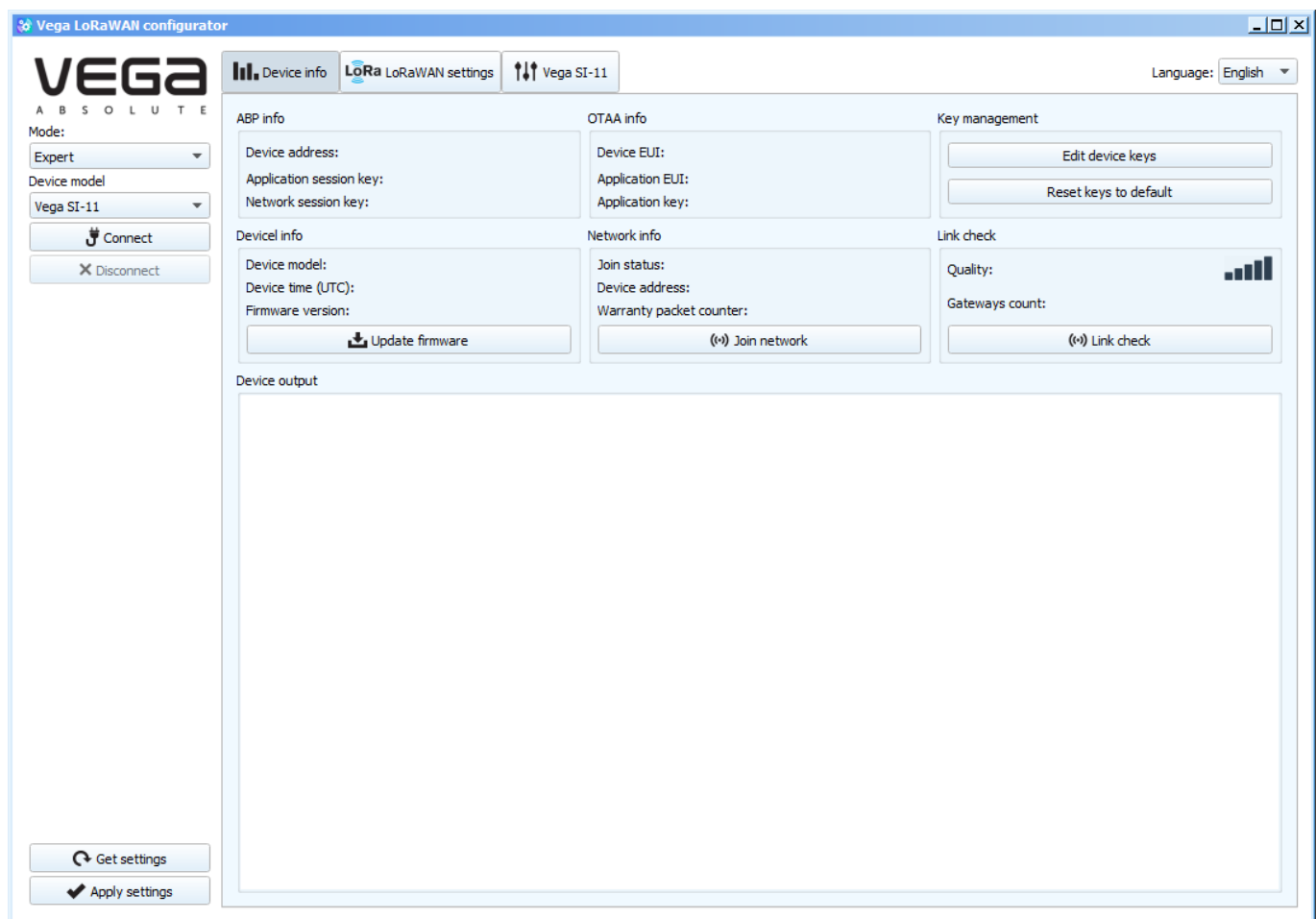
The menu on the left allows you to switch between the "Simple" and "Expert" modes, select the device model, connect to the device or disconnect from it, get and apply settings.

The application window contains three tabs – Device info, LoRaWAN settings and device settings.

The language selection menu is in the upper right corner.

CONNECTION TO THE DEVICE

For the connection to the device, perform the following steps:

1. Connect the USB cable to the device.
2. Start the "Vega LoRaWAN Configurator" application.
3. Click the "Connect" button in the menu on the left.

The configurator automatically recognizes the type of device, and the device selection menu becomes inactive.
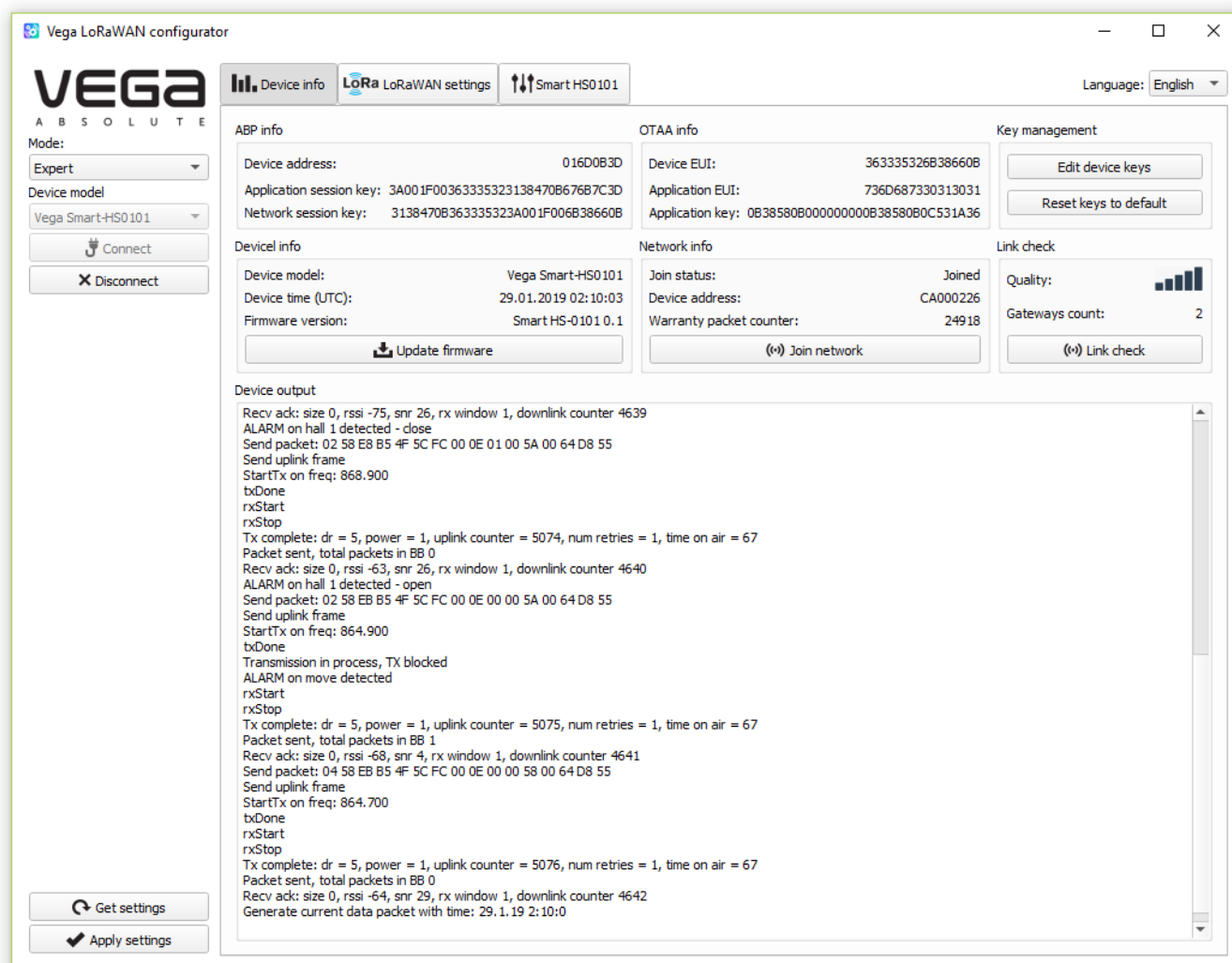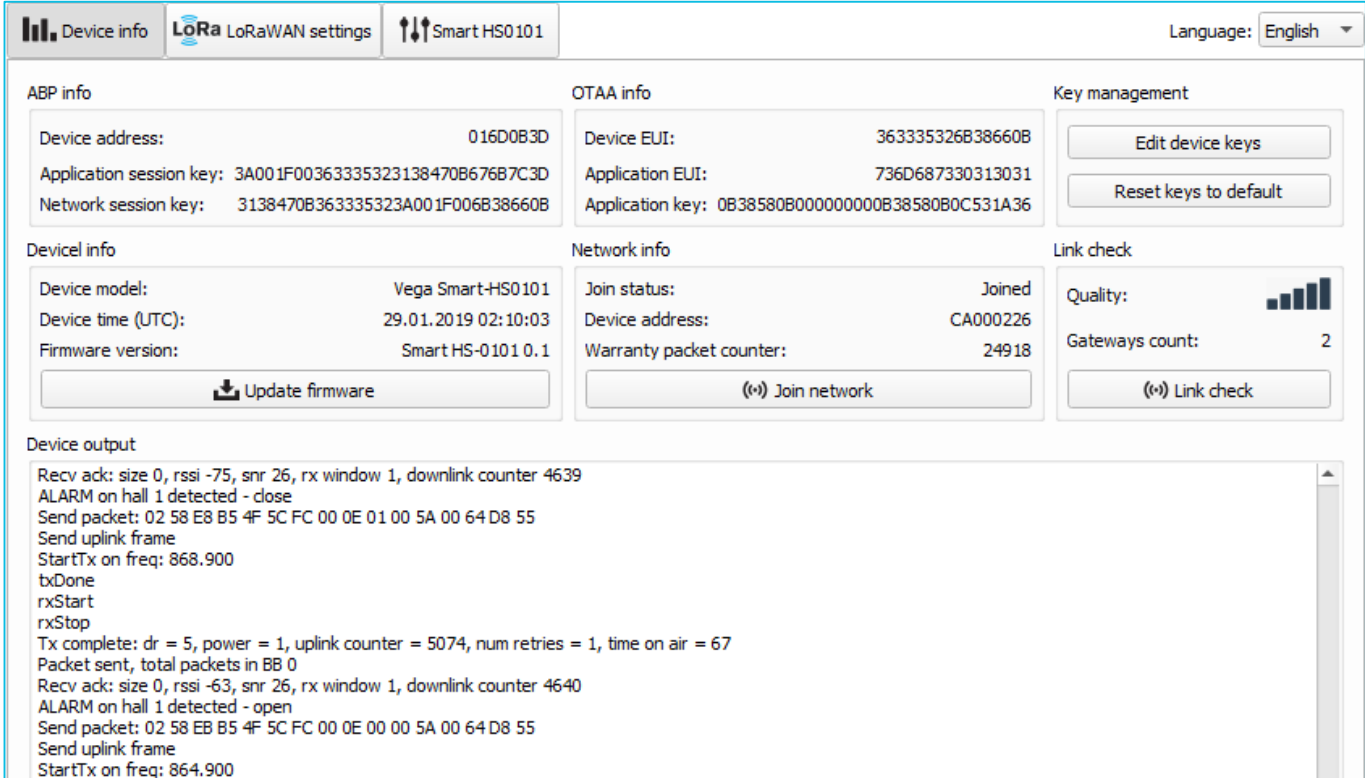

To read the settings from the device, you need to click the "Get settings" button, until this point the application will display the default settings or from the last connected device.

After making the necessary changes to the settings, you should click the "Apply settings" button and only then disconnect from the device with the "Disconnect" button.

"DEVICE INFO" TAB

The "Device info" tab displays information about the device, its status, and the data needed to register the device in the LoRaWAN network.

ABP info – displays the data necessary to register the device in the LoRaWAN network with ABP method (Activation By Personalization).

OTAA info – the data required to register the device in the LoRaWAN network with OTAA method (Over The Air Activation) is displayed.

Key management (not displayed in the "Simple" mode) – allows you to change the factory keys to register the device on the network, and reset the keys back to the factory settings.

Device info – the configurator reads information about the device model, its firmware and automatically corrects the device's time when connected to it.

Update firmware – allows you to select the firmware file from your computer's hard drive and load it into the device. The device will automatically disconnect from the configurator when the download is complete. The current version of the device firmware can be downloaded from iotvega.com.

Network info – shows whether the device is connected to the LoRaWAN network and its network address.

Join network button - launch the LoRaWAN network connection procedure with the previously selected ABP or OTAA method. If the device is already connected to the network, reconnection procedure will occurs.
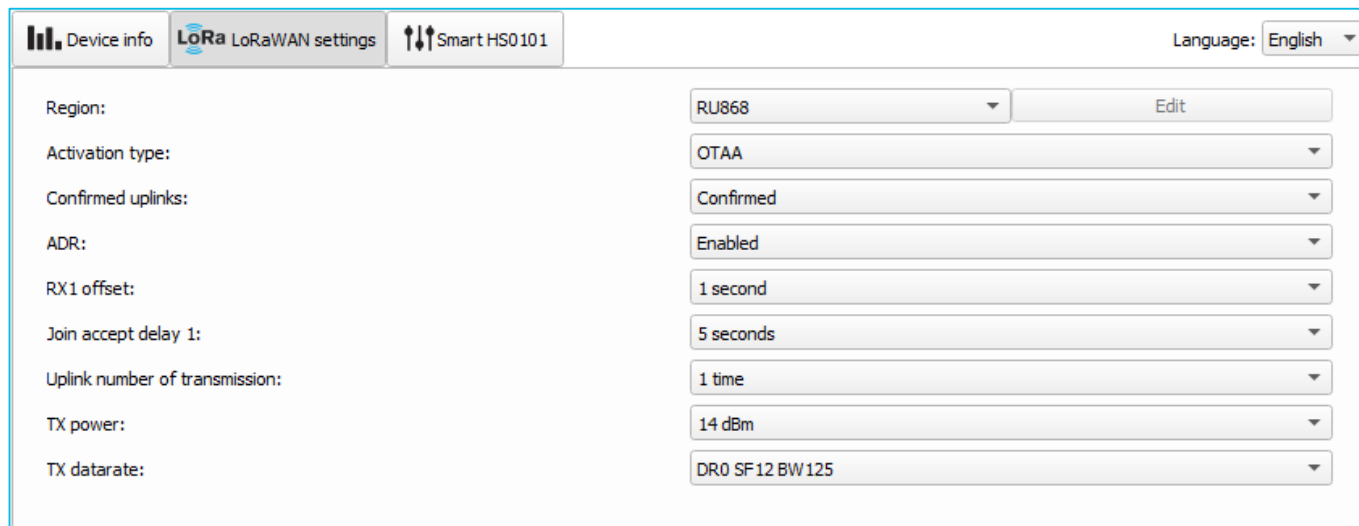
Link check (not displayed in the "Simple" mode) - when pressed, the device sends a special signal to the LoRaWAN network, in response to which the network informs it of the number of gateways that received this signal and the signal quality. This button only works when the device is connected to the network.
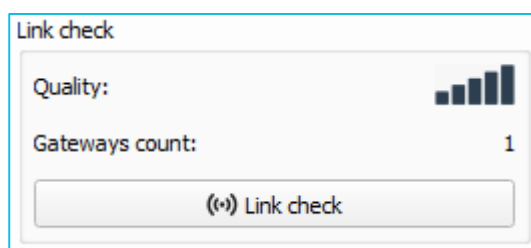
Device output (not displayed in the "Simple" mode) - monitoring the device status, all events in real time are displayed.
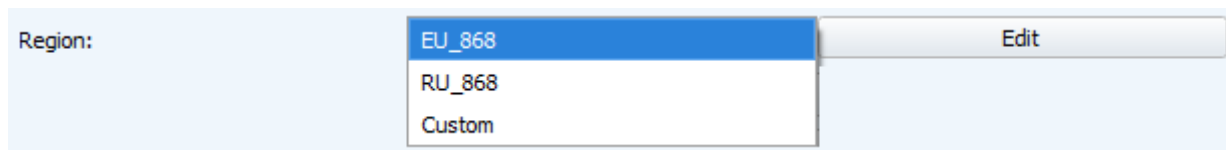
"LORAWAN SETTINGS" TAB

The "LoRaWAN Settings" tab allows you to configure various parameters of the LoRa network.

Region - allows you to select one of installed frequency plans or specify a custom frequency plan. Custom frequency plan is EU-868 based.

In the device frequency plan, only those channels are active by default, on which sending requests for connection to the network (join channels). The remaining channels (that the device should use) can be transferring by the LoRaWAN network server during the device activation procedure (only OTAA).

If you select "Custom" in the "Region" field, you must manually specify the frequencies that the device will use. To do this, click the "Edit" button, the channel frequency editing window will appear:

This frequency plan allows you to set up to 16 channels, as well as the frequency and speed of the second receiving window.

The first three channels and the second receiving window parameters are mandatory. Without these parameters the custom frequency plan will be considered empty.

Activation type – selecting ABP or OTAA device activation method.

Confirmed uplinks – when you choose "confirmed", the device will retry sending the packet until it receives the server confirmation, or until the "Uplink number of transmission" is over (see below).

If you choose to send packets without confirmation, the modem will not know whether the packet delivered or not

ADR – this option activates the Adaptive Data Rate algorithm for automatic control of the data transfer rate from the LoRaWAN network server side. The higher the quality of the

signal received by the network, the higher the speed will be installed on the device. This option is recommended only on permanently installed devices.

ADR:	Enabled
	Disabled

RX1 offset (not displayed in the "Simple" mode) – specifies the time between end of packet transmission and first receiving window opening. The second receiving window always opens after 1 second after the first.

RX1 offset:	1 second
	2 seconds
	3 seconds
	4 seconds
	5 seconds
	6 seconds
	7 seconds
	8 seconds
	9 seconds
	10 seconds
	11 seconds
	12 seconds
	13 seconds
	14 seconds
	15 seconds

Join accept delay 1 (not displayed in the "Simple" mode) – sets the time that the device will open the first receiving window to receive confirmation for the join request from the LoRaWAN network while OTAA mode active. The second window always opens after 1 second after the first.

Uplink number of transmission (not displayed in the "Simple" mode) – if the "Confirmed uplinks" function is disabled, the device will simply send each packet as many times as specified in this option. If "Confirmed uplinks" is enabled, the device will send packets until it receives a confirmation or until it sends as many packets as specified in this option.

TX power (not displayed in the "Simple" mode) – the device RF transmitter power is adjusted to this value when sending packets to the LoRaWAN network. This option can be change by the network server.
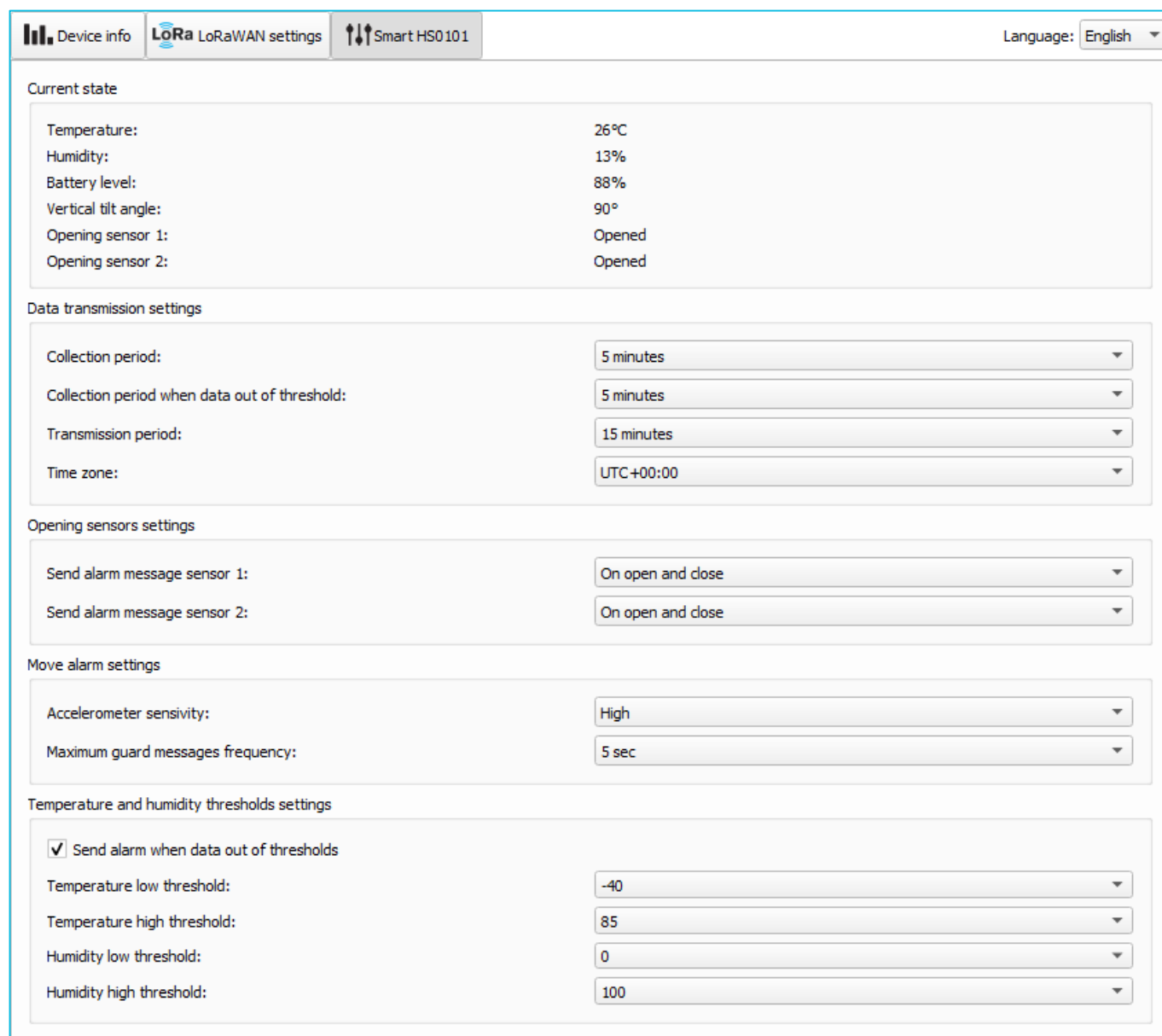
TX power:	2 dBm
	5 dBm
	8 dBm
	11 dBm
	14 dBm
	20 dBm

TX datarate (not displayed in the "Simple" mode) – the device transmission datarate at which it will transfer packets to the LoRaWAN network. This speed can be change by the network server if the ADR algorithm enabled.

TX datarate:	DR0 SF12 BW125
	DR1 SF11 BW125
	DR2 SF10 BW125
	DR3 SF9 BW125
	DR4 SF8 BW125
	DR5 SF7 BW125

"SMART-HS0101" TAB

The "Smart-HS0101" tab contains the settings of the connected device.

Current state – displays the current parameters measurement by the device - the temperature, humidity, vertical tint angle, the battery level and two Hall sensors state.

Data transmission settings – a group of parameters that allows you to configure the collection and transmission periods, and the time zone for the internal clock of the counter will be set which.

When temperature/humidity values come out of range then transmission period remains unchanged except the case of "Send alarm when data out of thresholds" parameter is active (see below).

The readings stored in the device memory at 00.00 on the internal clock of the device if the data collection period is set to 24 hours, at 00.00 and at 12.00, if the period is 12 hours and so on. All readings are stored in the device memory until the next communication session will

come. The data transfer period adjustable 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.

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.

Data collection period when measurements are out of specified temperature/humidity range set independently and may change from 5 minutes to 24 hours.

Opening sensors settings – allows to setting the alarm message sending option for every Hall sensor, exactly by the close or open door (window) or in both of these cases. In addition, you can switch off one or both Hall sensors. Inactive sensor means that there is no alarm message sending and message have no alarm flag but sensors state will transmitting in standard message.

Move alarm settings – allows setting the internal accelerometer sensitivity on one of the three levels: low, mid or high or to switch off the sensor. Inactive sensor means that there is no alarm message sending and message have no alarm flag but vertical tint angle value will transmitting in standard message.

Maximum alarm sending frequency may be equal to 1, 2, 3, 4, 5, 10, 15, 30 and 60 seconds.

Temperature and humidity thresholds settings – allows specify range of values for which alarm message will be sent.

Temperature thresholds may change from -40 °C to +85 °C in increments of 1 °C.

Humidity thresholds may change from 0% to 100% in increments of 1%.

«Send alarm when data out of thresholds». If that parameter active then immediately as temperature/humidity value come out of specified range then will be form and transmit alarm message. Every following message, which will form according to the data collection period, will have sent according to the communication period.

5 COMMUNICATION PROTOCOL

This part describes the Smart-HS0101 communication protocol with LoRaWAN network.

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

SMART-HS0101 TRANSMITS THE FOLLOWING TYPES OF PACKETS

1. Packet with current readings and alarm events

Size in bytes	Field description	Data type
1 byte	Packet type 1 – current state 2 – Hall sensor 1 alarm 3 – Hall sensor 2 alarm 4 – accelerometer alarm 5 – humidity value out of range 6 – temperature value out of range	uint8
1 byte	Battery charge, %	uint8
4 bytes	Reading time for values in this packet (for packet type 1) Time of the modem at the moment of the packet transmission (for the packets type 2…5) (unixtime UTC)	uint32
2 bytes	Temperature in ^{0}C, multiplied by 10	int16
1 byte	Humidity in %	uint8
1 byte	Sensor 1 state (0 – open, 1 – close)	uint8
1 byte	Sensor 2 state (0 – open, 1 – close)	uint8
1 byte	Vertical tint angle (0…90)	uint8
1 byte	Humidity low threshold in %	uint8
1 byte	Humidity high threshold in %	uint8
1 byte	Temperature low threshold	uint8
1 byte	Temperature high threshold	uint8

2. Packet with time correction request, sent every seven days on LoRaWAN port 4

Size in bytes	Field description
1 byte	Packet type, this packet == 255
4 bytes	Time of the modem at the moment of the packet transmission (unixtime UTC)

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	
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-HS0101 RECEIVES THE FOLLOWING TYPES OF PACKETS

1. Real-time clock adjustment – sent by application on LoRaWAN port 4

Size in bytes	Field description
1 byte	Packet type, this packet == 255
8 bytes	The value in seconds for which you need to adjust the time.

When receiving the packet the pulse counter 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
1 byte	Packet type, this packet == 1

Answering that packet the device sent 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-HS0101 parameters and these possible values

ID of parameter	Description	Data length	Possible values
4	Confirmed uplinks	1 byte	1 – confirmed 2 – unconfirmed
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	Send alarm message sensor 1	1 byte	1 – short (close) 2 – open 3 – short and open (close and open) 4 – disabled
39	Send alarm message sensor 2	1 byte	1 – short (close) 2 – open 3 – short and open (close and open) 4 – disabled
44	Accelerometer sensitivity	1 byte	1 – low 2 – middle 3 – high 4 – disable
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
78	Collection period when data out of threshold	1 byte	1 – 1 hour 2 – 6 hours 3 – 12 hours 4 – 24 hours 5 – 5 minutes 6 – 15 minutes 7 – 30 minutes
79	Send alarm when data out of thresholds	1 byte	0 – off 1 – on
80	Temperature low threshold	1 byte	from -40 °C to +84 °C
81	Temperature high threshold	1 byte	from -39 °C to +85 °C
88	Humidity low threshold	1 byte	from 0 to 100%
89	Humidity low threshold	1 byte	from 0 to 100%

6 STORAGE AND TRANSPORTATION REQUIREMENTS

The Smart-HS0101 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.

7 CONTENT OF THE PACKAGE

The sensor is delivered complete with:

Sensor Vega Smart-HS0101 – 1 pc.

CR123A battery – 1 pc.

Factory certificate – 1 pc.

8 WARRANTY

The warranty period for the device is 5 years from the date of sale.

The manufacturer is obligated to provide repair services or replace the failed device during the entire warranty period.

The consumer undertakes to comply with the terms and conditions of transportation, storage and operation specified in this user manual.

Warranty does not apply to:

- power supplies of devices sending more than 15,000 packets;

- the device with mechanical, electrical and / or other damages and defects caused by violation of the transportation, storage and operation requirements;

- the device with traces of repair performed not by the manufacturer's service center;

- the device with traces of oxidation or other signs of liquids leaking inside the device.

In the event of a warranty claim, contact the service center:

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

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

vega-absolute.ru

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