



MOTION SENSOR

SMART-MS0101

User Manual

Infrared motion sensor Vega Smart-MS0101 is designed to detect penetration into the protected area. The sensor alternately operates in two modes: «Guard» and «Neutral». Sends an alarm signal to the LoRaWAN™ network by the triggering.

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INTRODUCTION

This manual is designated for Vega Smart-MS0101 motion 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

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

The sensor alternately operates in two modes: «Guard» and «Neutral». In the «Guard» mode, the device sends an alarm message to the LoRaWAN™ network when motion is detected, after which it switches to the «Neutral» mode for a while. In the «Neutral» mode, 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» mode after a certain configurable period of time.

Auto-post time interval is setting up by the «Vega LoRaWAN configurator» application and may vary from 1 to 60 minutes.

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 sensor is configured via USB with special software «Vega LoRaWAN configurator».

Information for registering of the device in the LoRaWAN™ network is available via software «Vega LoRaWAN configurator».

2 SPECIFICATION

Main

USB-port	yes
Operating temperatures	-40...+70 °C
Built-in temperature sensor	yes

LoRaWAN™

LoRaWAN™ class	A
Quantity of LoRa channels	16
Frequency band	EU-868, RU-868, custom
Activation type	ABP or OTAA
Communication period	1, 6, 12 or 24 hours
Antenna	internal
Sensitivity	-138 dBm
Radio coverage in restrained urban conditions	max 5 km
Radio coverage within line of sight	max 15 km
Power output	up to 100 mW (configurable)

Power

Replaceable battery	CR123A 3V, 1400 mAh
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Case

Housing dimensions	35 x 50 x 70 mm
Ingress protection rating	IP41

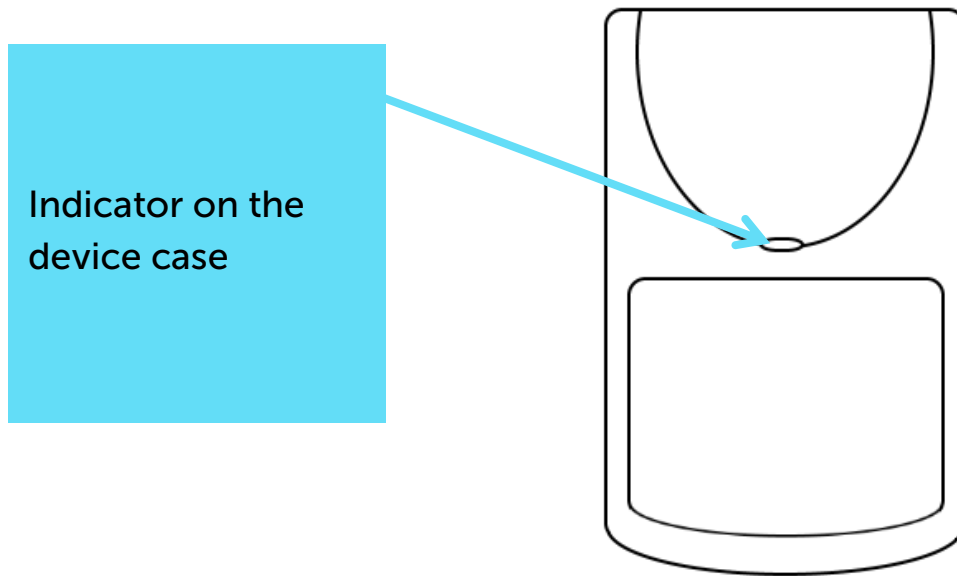
Vega Smart-MS0101 motion sensor is class A device (LoRaWAN™ classification) and has the following features:

- ADR support (Adaptive Data Rate)
- Sending of confirmed packets (configurable)
- Extra communication in case of alarm event
- Two working modes "Neutral" and "Guard"
- Temperature measurement by the internal temperature sensor
- Battery charge measurement (%)
- Sensitivity: up to -138dBm

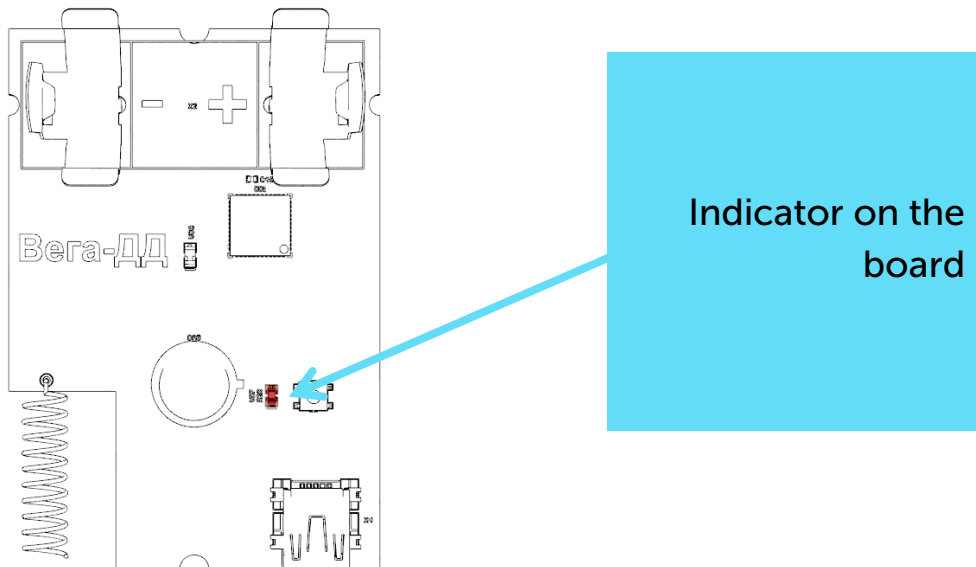
3 OPERATION

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 but no more than one at 10 seconds.



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



Indicator signal

Meaning



A series of short red flashes

Linking to the network

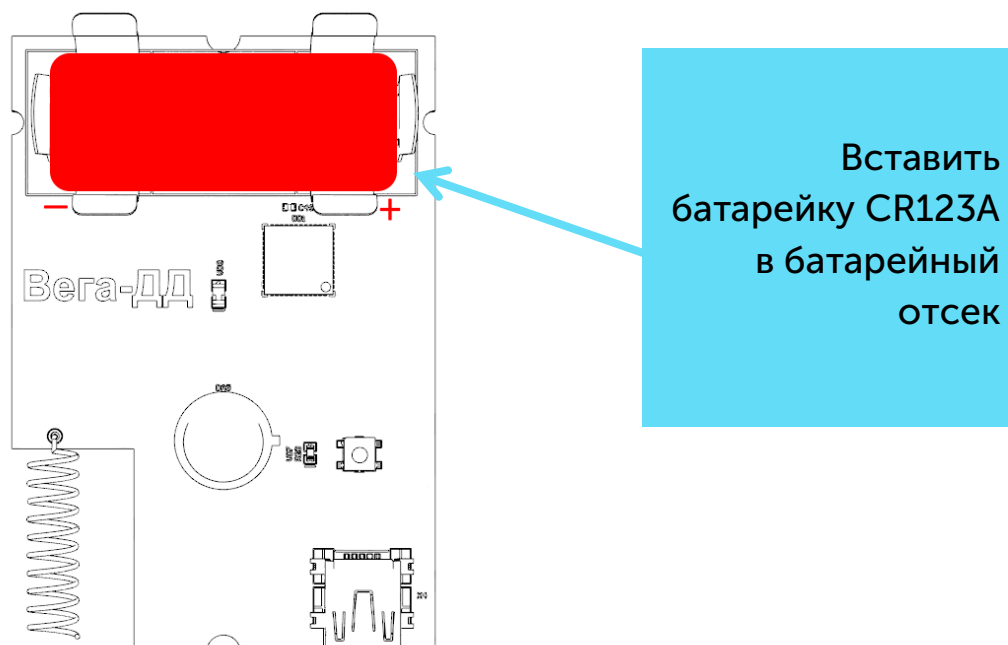


One long red flash

The device switched to the "Storage" mode

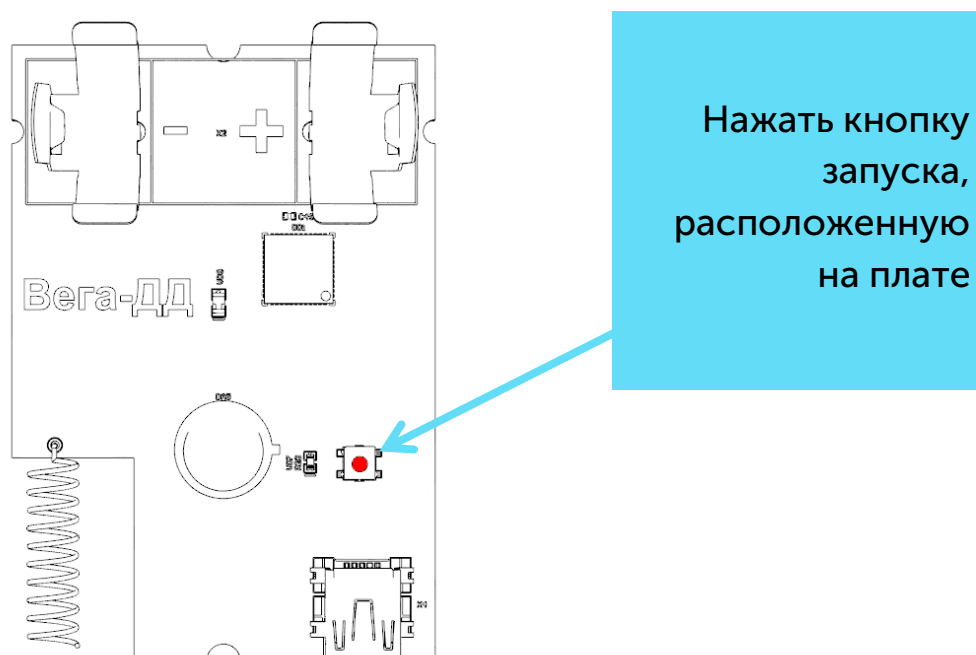
INITIAL STARTUP

Motion sensor is powered by the CR123A 3V 1400 mAh replaceable battery. You need to insert the battery observing the polarity before start.



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.



2. OTAA. After pressing the start button, the device makes three attempts to connect to the network within the set frequency band. After the activation request is confirmed by LoRaWAN™ network, the device sends a signal and switches to the "Active" mode. If all attempts fail, the sensor switches to the "Storage" mode.

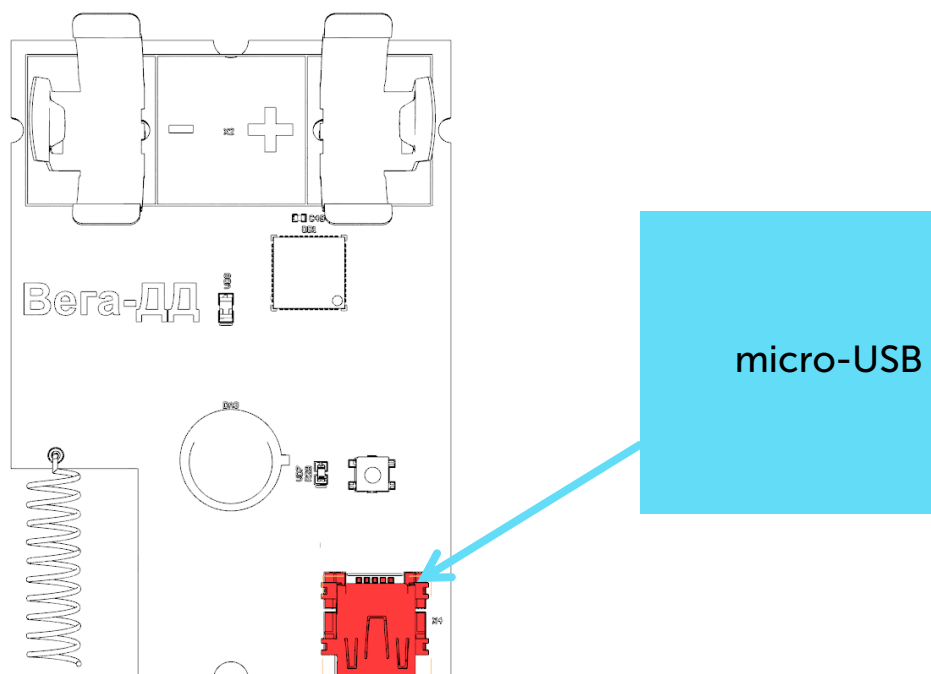
To manually switch the device from the "Active" mode to the "Storage" mode, you can use the long press of the start button (more than 5 seconds).



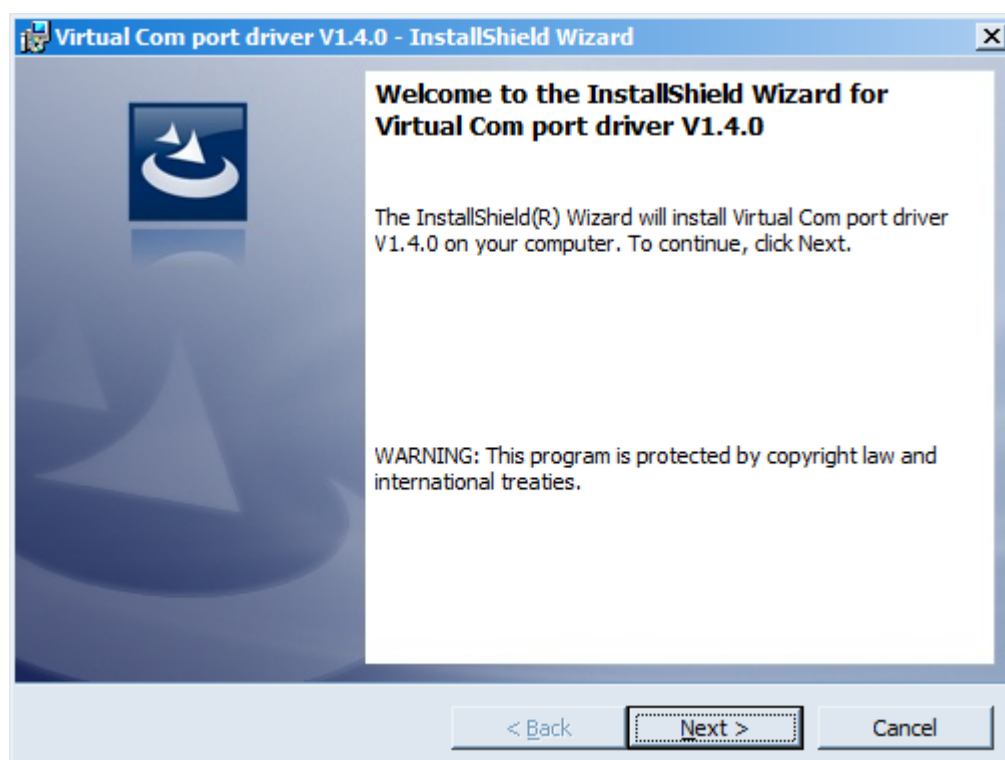
Before connecting the device, make sure that its registration data is entered in the network - Device EUI, Application EUI and Application Key for OTAA, or Device address, Application session key and Network session key for ABP

CONNECTING VIA USB

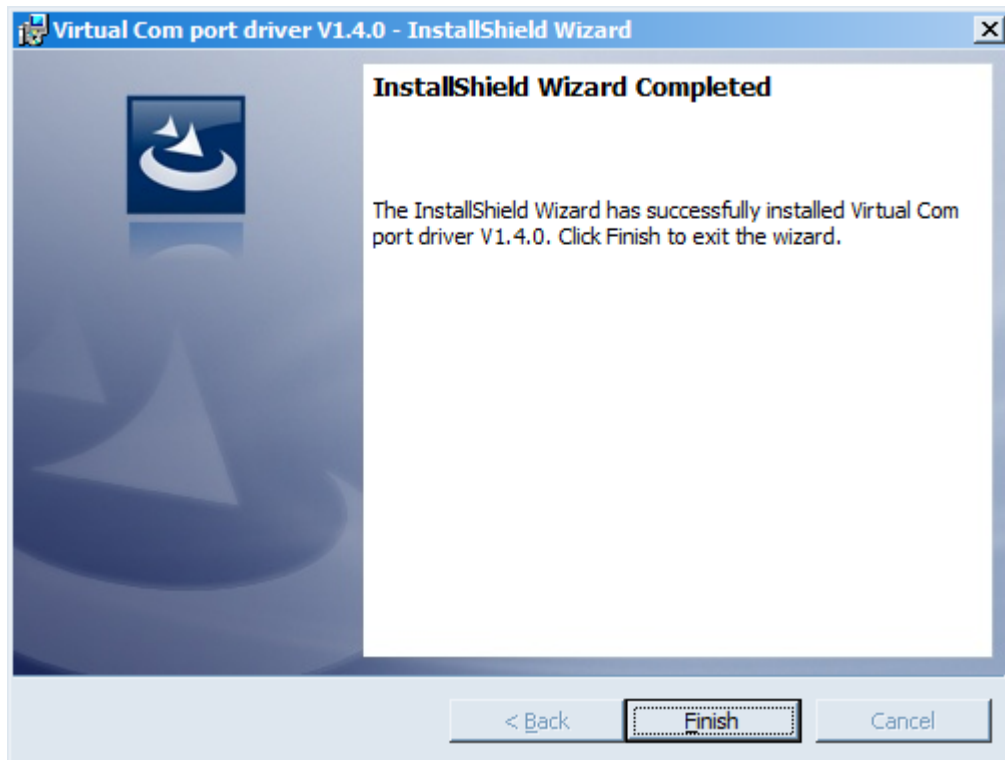
The device Smart-MS0101 can be configured with the "Vega LoRaWAN Configurator" application (See part 4).



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 (See Fig. 4.1).

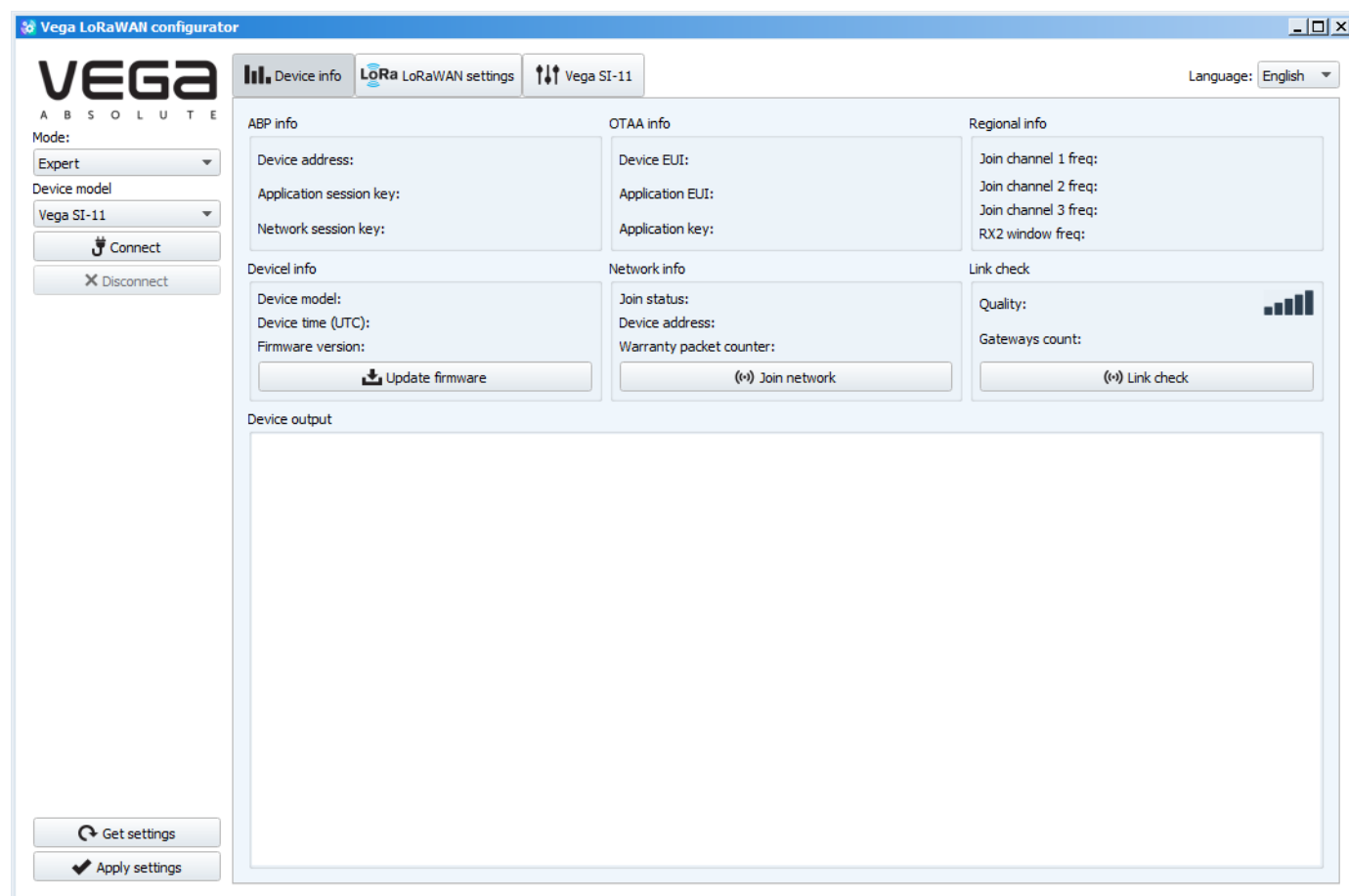


Fig. 4.1. The «Vega LoRaWAN Configurator» application interface.

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.

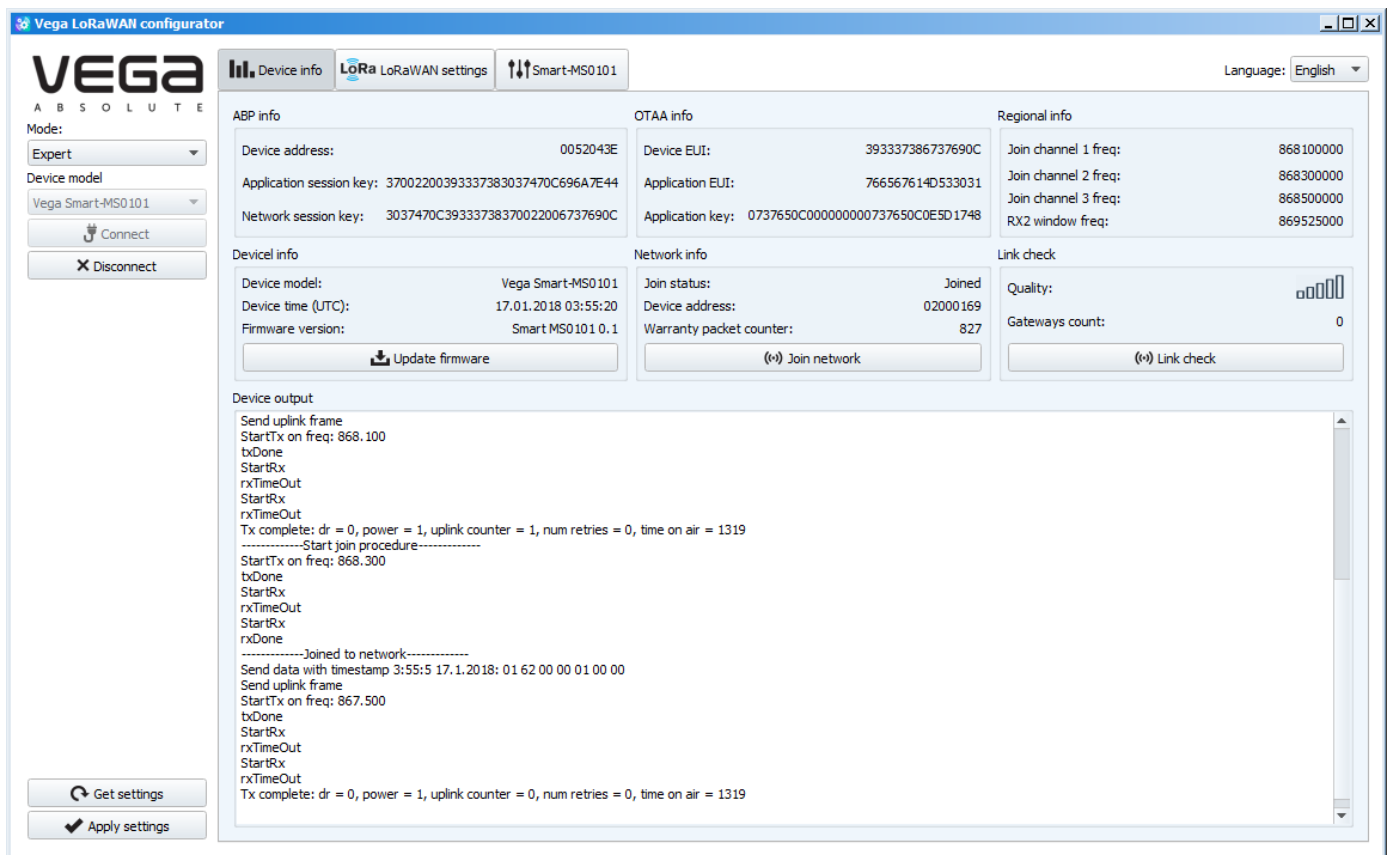


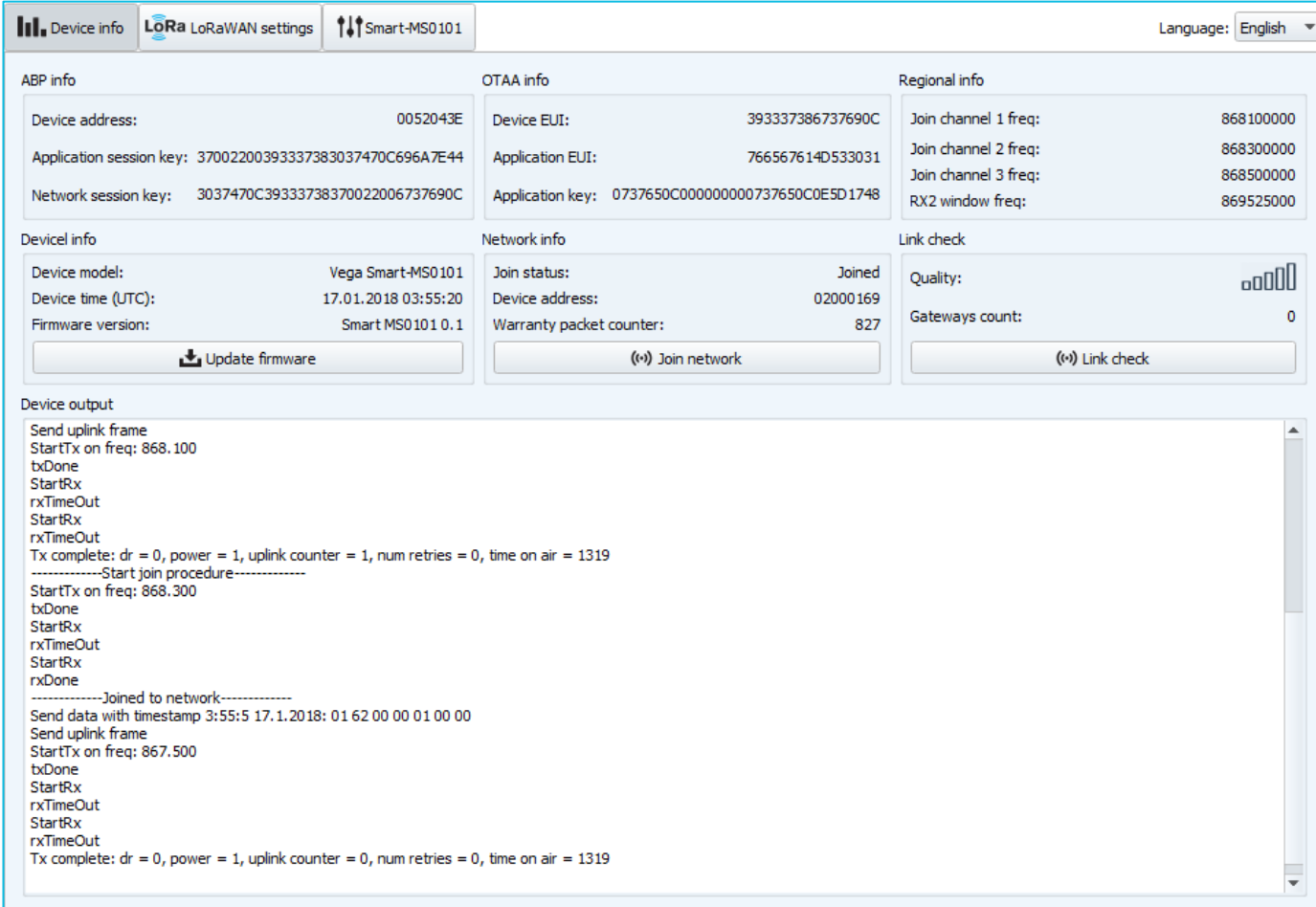
Fig. 4.2. Connection to the device.

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 current status, and also the data needed to register the device in the LoRaWAN™ network (Fig. 4.3).



The screenshot shows the "Device info" tab with the following data:

Section	Field	Value
ABP info	Device address:	0052043E
	Application session key:	37002200393337383037470C696A7E44
	Network session key:	3037470C39333738370022006737690C
OTAA info	Device EUI:	393337386737690C
	Application EUI:	766567614D533031
	Application key:	0737650C00000000737650C0E5D1748
Regional info	Join channel 1 freq:	868100000
	Join channel 2 freq:	868300000
	Join channel 3 freq:	868500000
	RX2 window freq:	869525000
Device info	Device model:	Vega Smart-MS0101
	Device time (UTC):	17.01.2018 03:55:20
	Firmware version:	Smart MS0101 0.1
Network info	Join status:	Joined
	Device address:	02000169
	Warranty packet counter:	827
Link check	Quality:	Signal strength indicator (4 bars)
	Gateways count:	0

The "Device output" section shows the following log:

```

Send uplink frame
StartTx on freq: 868.100
txDone
StartRx
rxTimeOut
StartRx
rxTimeOut
Tx complete: dr = 0, power = 1, uplink counter = 1, num retries = 0, time on air = 1319
-----Start join procedure-----
StartTx on freq: 868.300
txDone
StartRx
rxTimeOut
StartRx
rxDone
-----Joined to network-----
Send data with timestamp 3:55:5 17.1.2018: 01 62 00 00 01 00 00
Send uplink frame
StartTx on freq: 867.500
txDone
StartRx
rxTimeOut
StartRx
rxTimeOut
Tx complete: dr = 0, power = 1, uplink counter = 0, num retries = 0, time on air = 1319
  
```

Fig. 4.3. The "Device info" tab.

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.

Regional info (not displayed in the "Simple" mode) - shows the frequencies of the JOIN channels and the second receiving window. These frequencies can be changed in the "LoRaWAN™ Settings" tab when selecting a frequency plan.

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

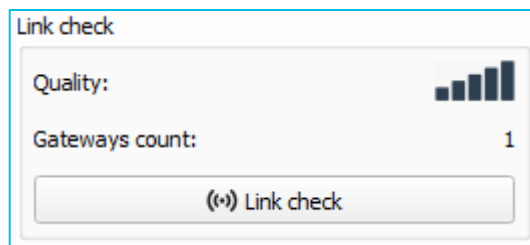
Update firmware - allows you to select the firmware file from your computer's hard drive and load it into the device. The device will automatically disconnect from the

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 (Fig. 4.4).

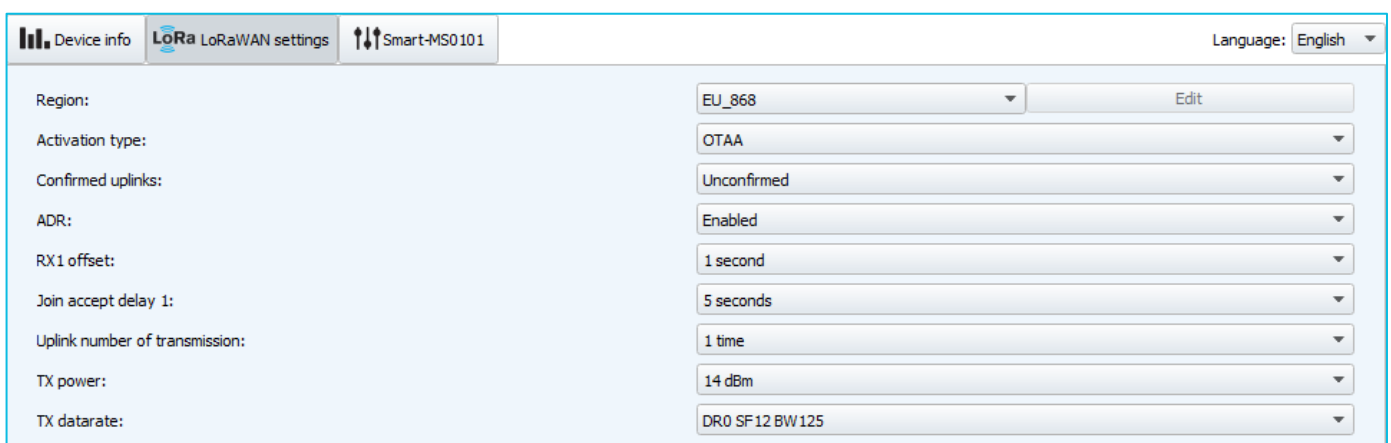


Fig. 4.4. "LoRaWAN settings" tab.

Region - allows you to select RU-868, EU-868 or specify a custom frequency band.

Region: EU_868 Edit

RU_868
 Custom

The sensor Smart-MS0101 supports the following frequency bands:

Frequency band	Channel	Frequency	Modulation
EU-868	1	868.1	MultiSF 125 kHz
	2	868.3	MultiSF 125 kHz
	3	868.5	MultiSF 125 kHz
	RX2	869.525	SF12 125 kHz
RU-868	1	864.5	MultiSF 125 kHz
	2	864.7	MultiSF 125 kHz
	3	864.9	MultiSF 125 kHz
	RX2	869.05	SF12 125 kHz
Custom	Set with «Vega LoRaWAN Configurator» application		

In the EU_868 and RU_868 frequency bands, only 3 channels are active by default. The device sends requests for connection to the network on this "join" channels. The remaining channels that the device should use can be transferred 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:

Custom frequency plan

Join frequency 1 (Hz)	<input type="text" value="0"/>	Channel 9 frequency (Hz)	<input type="text" value="0"/>
Join frequency 2 (Hz)	<input type="text" value="0"/>	Channel 10 frequency (Hz)	<input type="text" value="0"/>
Join frequency 3 (Hz)	<input type="text" value="0"/>	Channel 11 frequency (Hz)	<input type="text" value="0"/>
Channel 4 frequency (Hz)	<input type="text" value="0"/>	Channel 12 frequency (Hz)	<input type="text" value="0"/>
Channel 5 frequency (Hz)	<input type="text" value="0"/>	Channel 13 frequency (Hz)	<input type="text" value="0"/>
Channel 6 frequency (Hz)	<input type="text" value="0"/>	Channel 14 frequency (Hz)	<input type="text" value="0"/>
Channel 7 frequency (Hz)	<input type="text" value="0"/>	Channel 15 frequency (Hz)	<input type="text" value="0"/>
Channel 8 frequency (Hz)	<input type="text" value="0"/>	Channel 16 frequency (Hz)	<input type="text" value="0"/>
RX2 window frequency (Hz)	<input type="text" value="0"/>	RX2 window datarate	DR0 <input type="text"/>

This frequency band 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 band will be considered empty.

Activation type – selecting ABP or OTAA device activation method.

Activation type:	<input type="text" value="OTAA"/> <input type="text" value="ABP"/>
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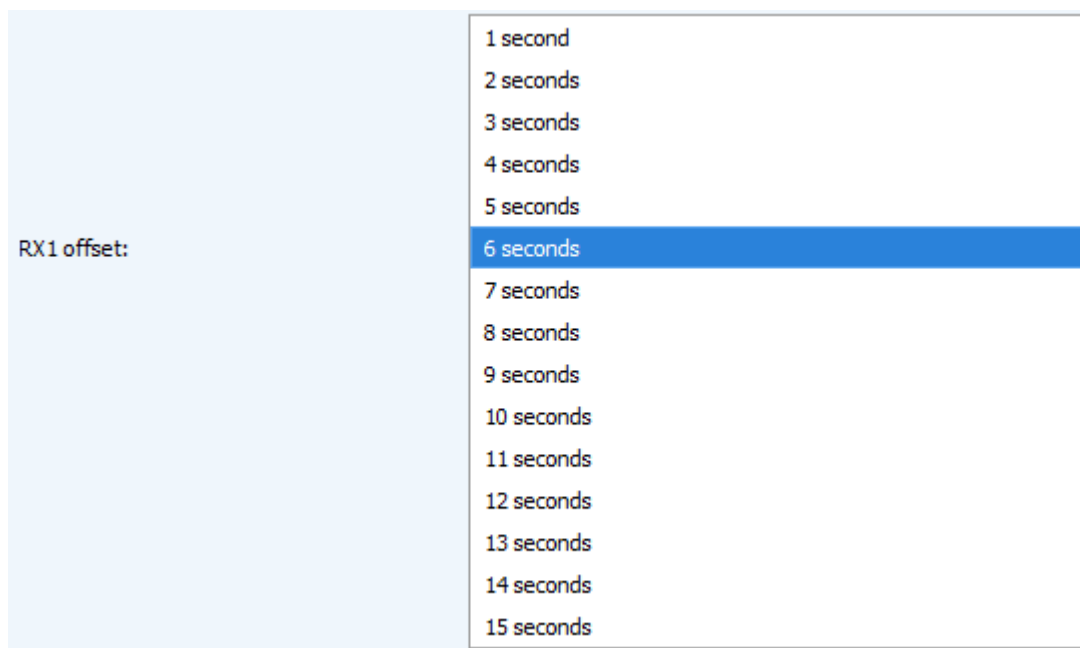
Confirmed uplinks – when you choose "confirmed", the device will retry sending the packet until it receives the server confirmation, or until the "Uplink number of transmission" is over (see below).

Confirmed uplinks:	<input type="text" value="Confirmed"/> <input type="text" value="Unconfirmed"/>
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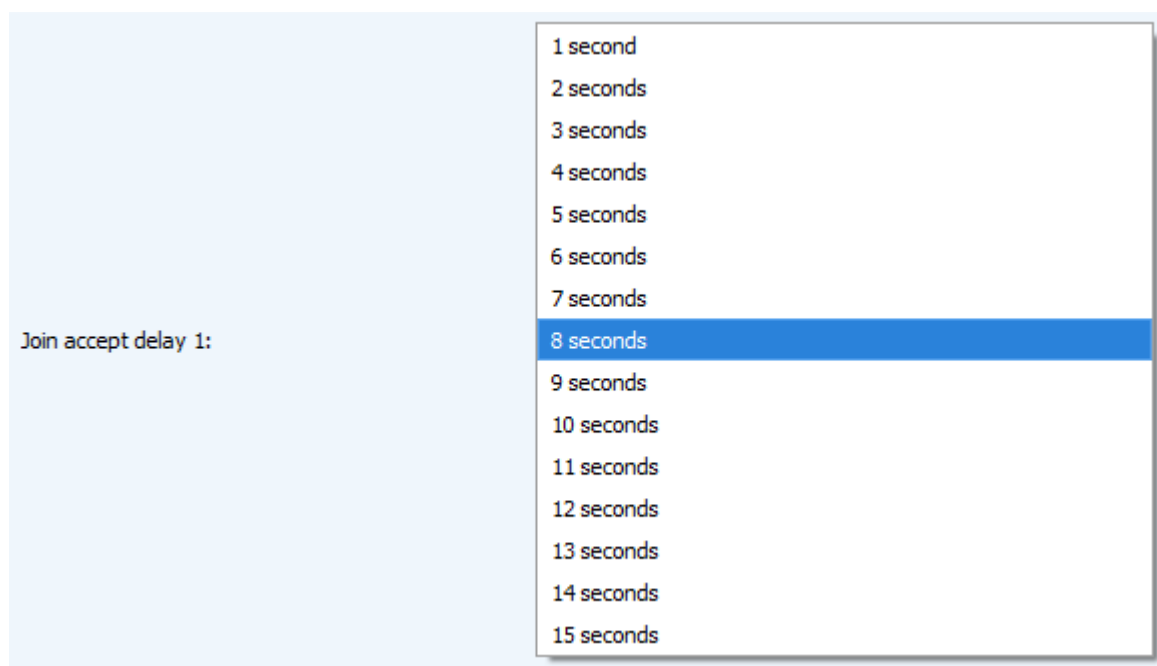
ADR – this option activates the Adaptive Data Rate algorithm for automatic control of the data transfer rate from the LoRaWAN™ network side. The higher the quality of the signal received by the network, the higher the speed will be installed on the device. This option is recommended only on permanently installed devices.

ADR:	<input type="text" value="Enabled"/> <input type="text" value="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.



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. 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.

Uplink number of transmission:	<ul style="list-style-type: none">1 time2 times3 times4 times5 times6 times7 times8 times9 times10 times11 times12 times13 times14 times15 times
--------------------------------	---

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 changed by the network server.

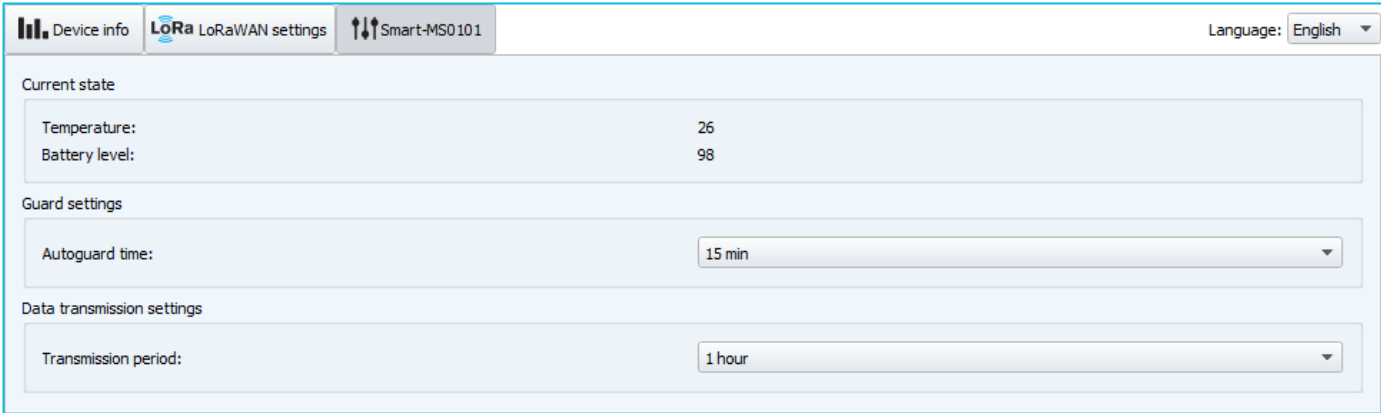
TX power:	<ul style="list-style-type: none">2 dBm5 dBm8 dBm11 dBm14 dBm20 dBm
-----------	---

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 changed by the network server if the ADR algorithm is enabled.

TX datarate:	<ul style="list-style-type: none">DR0 SF12 BW125DR1 SF11 BW125DR2 SF10 BW125DR3 SF9 BW125DR4 SF8 BW125DR5 SF7 BW125
--------------	---

"SMART-MS0101" TAB

The "Smart-MS0101" tab contains the settings of the connected device (Fig. 4.5).



Tab	Temperature	Battery level	Autoguard time	Transmission period
Device info				
LoRa LoRaWAN settings				
Smart-MS0101	26	98	15 min	1 hour

Fig. 4.5. "Smart-MS0101" tab.

Current state – displays the current parameters of the device - the internal temperature of the device and the battery level

Guard settings – allows setting the time interval of auto-post to the "Guard" mode from 1 to 60 minutes.

Data transmission settings – the transmission period which the packet with the current readings is transmit (See part 5, packet 1).

5 COMMUNICATION PROTOCOL

This part describes the Smart-MS0101 data exchange protocol with LoRaWAN™ network. Smart-MS0101 uses the LoRaWAN™ port 2 for uplink and downlink messages. 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.

Size in bytes	Field description	Data type
1 byte	Packet type (1 – for that packet)	uint8
1 byte	Battery charge, %	uint8
1 byte	Values of basic settings (byte field)	uint8
2 bytes	Temperature in °C, multiplied by 10	int16_t
1 byte	Sending reason (0 – by the time, 1 – alarm)	uint8
1 byte	Inputs state (byte field)	uint8

"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 - 1 hour 2==1 3==0 - 6 hours 2==0 3==1 - 12 hours 2==1 3==1 - 24 hours
4 bit	reserve
5 bit	reserve
6 bit	reserve
7 bit	reserve

6 STORAGE AND TRANSPORTATION REQUIREMENTS

The Smart-MS0101 sensor shall be stored in the original packaging in heated room at temperatures $+5^{\circ}\text{C}$ to $+40^{\circ}\text{C}$ 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 $+85^{\circ}\text{C}$.

7 CONTENT OF THE PACKAGE

The sensor is delivered complete with:

Motion sensor Vega Smart-MS0101 – 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 supply elements;
- 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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