



ACCELERATION SENSOR SMART-AS0101

User Manual



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02	22.01.2019	KEV	Communication protocol changed, setting via 'air' described, indication changed. Frequency plans added, specification changed, blackbox described, warranty changed, configurator updated. "Marking" part added.
03	24.01.2019		Исправлена неточность в протоколе обмена – тип пакета с запросом настроек и с настройками
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CONTENTS

INTRODUCTION	4
1 DESCRIPTION AND OPERATION	5
Device description	5
Communication and data collection algorithm	5
Functional	6
Marking	6
2 SPECIFICATION	7
3 OPERATION	8
Indication	8
Initial startup	9
Connecting via USB	11
4 VEGA LORAWAN CONFIGURATOR	13
Interface of the application	13
Connection to the device	14
"Device info" tab	15
"LoRaWAN settings" tab	17
"Smart-AS0101" tab	21
5 COMMUNICATION PROTOCOL	22
SMART-AS0101 transmits the following types of packets	22
SMART-AS0101 receives the following types of packets	24
6 STORAGE AND TRANSPORTATION REQUIREMENTS	26
7 CONTENT OF THE PACKAGE	27
8 WARRANTY	28

INTRODUCTION

This manual is designated for Vega Smart-AS0101 acceleration 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.



To provide the stable radio between the gateway and the end device it is recommend 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

Vega-Absolute OOO reserves the right to make changes to the manual related to the improvement of equipment and software, as well as to eliminate typos and inaccuracies, without prior notice.

1 DESCRIPTION AND OPERATION

DEVICE DESCRIPTION

The sensor is triggered by shaking or moving due to the built-in accelerometer with three levels of sensitivity and sends an alarm signal to the LoRaWAN network. It can be installed on any movable parts, such as doors, drawers and windows as motion or shake indicator.

Can be used as a sensor for breaking windowpanes. The sensor is produced in four color variants and will look organically in any interior. Vega Smart-AS0101 can be used to protect premises, buildings, and structures, as well as in Smart Home systems, built on LoRaWAN technology.

It is produced in four color versions and will look organically in any interior.

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

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.

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.

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

Vega Smart-AS0101 acceleration sensor is class A device (LoRaWAN classification) and has the following features:

- Frequency plans RU868, EU868, IN865, AS923, AU915, KR920, US915, KZ865 supported
- 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 alarm event
- Temperature measurement by the internal temperature sensor
- Battery charge measurement (%)
- Sensitivity: up to -138dBm

MARKING

Device marked with sticker that contain the next information:

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

- Information about firmware version;
- 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

LoRaWAN

AppEui by default	7661616330313031
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

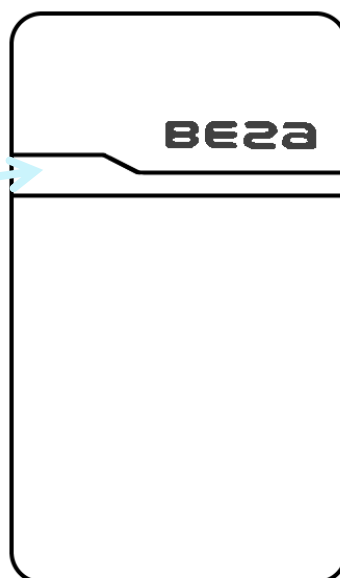
Housing dimensions	63 x 36 x 21 mm
Ingress protection rating	IP43







3 OPERATION

INDICATION

A double 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



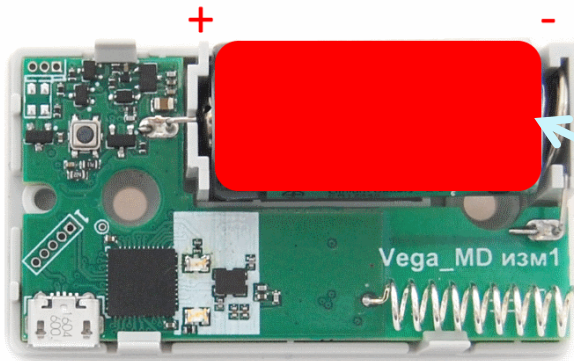
Indicator signal	Meaning
 A series of short green flashes	Linking to the network in progress
 One long green flash	The device connected to the network and is in «Active» mode
 One long red flash	Linking to the network is unsuccessful or the device switched to the «Storage» mode
 One short red flash	Every sensor triggering
 One green flash every 10 seconds	Device in «Active» mode and the battery charge is more than 10%
 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

INITIAL STARTUP

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

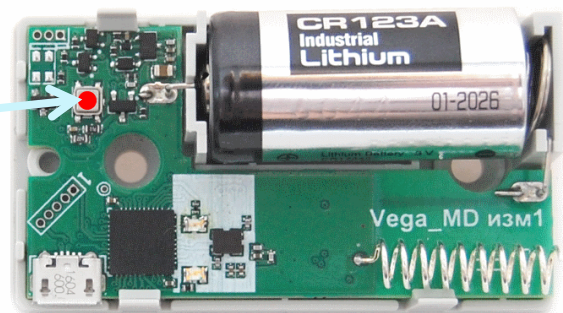


Insert the battery
CR123A into the
battery
compartment

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 is 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.

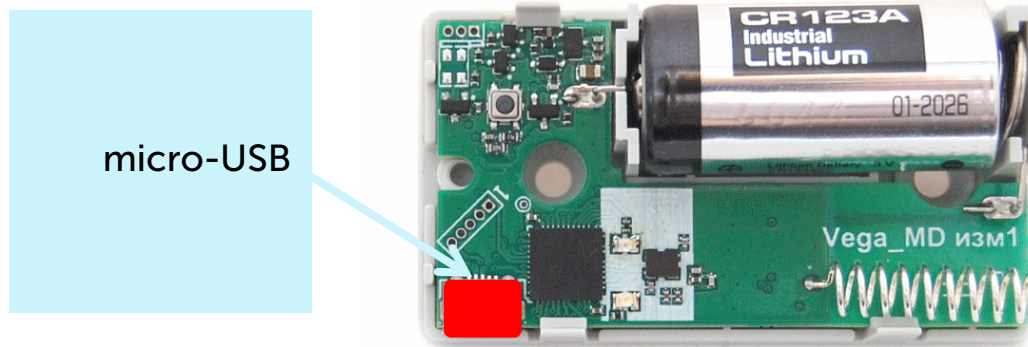
To manually switch the device from the "Active" mode to the "Storage" mode, you can use the long press of the start button (more than 5 seconds).



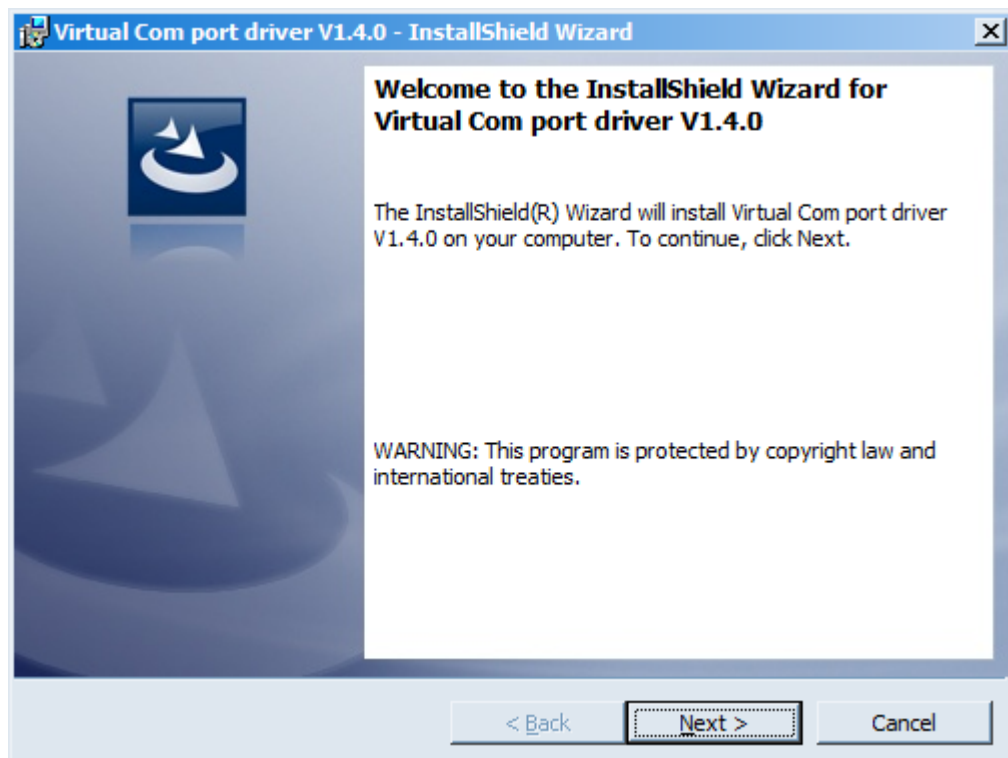
Before connecting the device, make sure that its registration data is entered in the network - Device EUI, Application EUI and Application Key for OTAA, or Device address, Application session key and Network session key for ABP

CONNECTING VIA USB

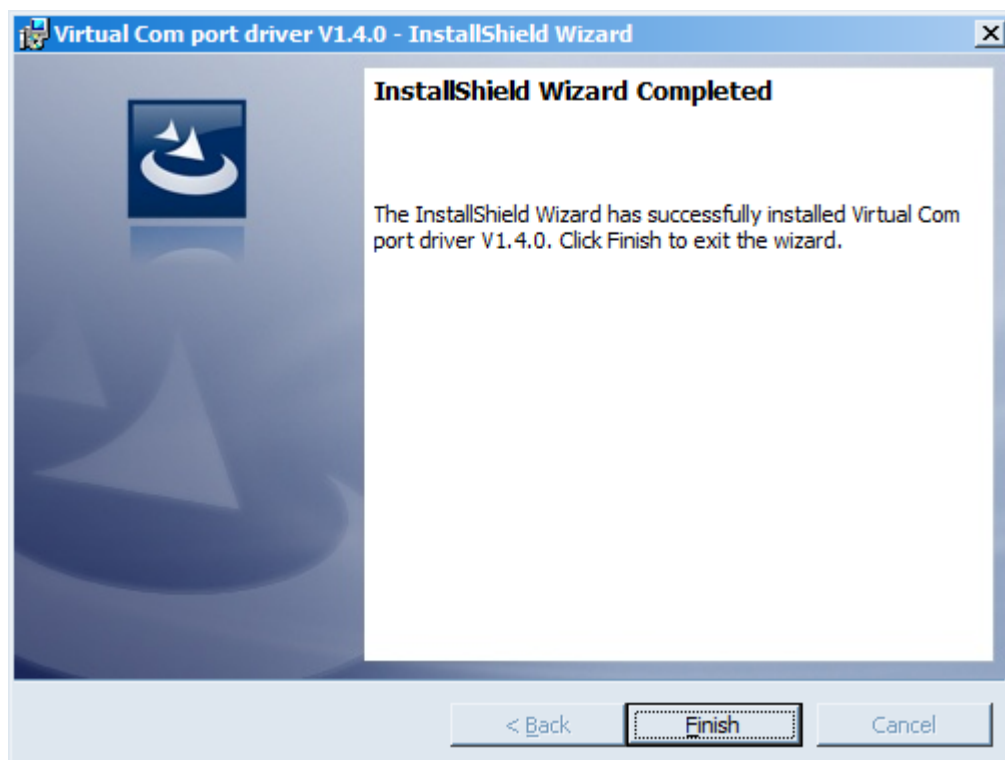
The device Smart-AS0101 can be configured with the "Vega LoRaWAN Configurator" application (See part 4).



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.

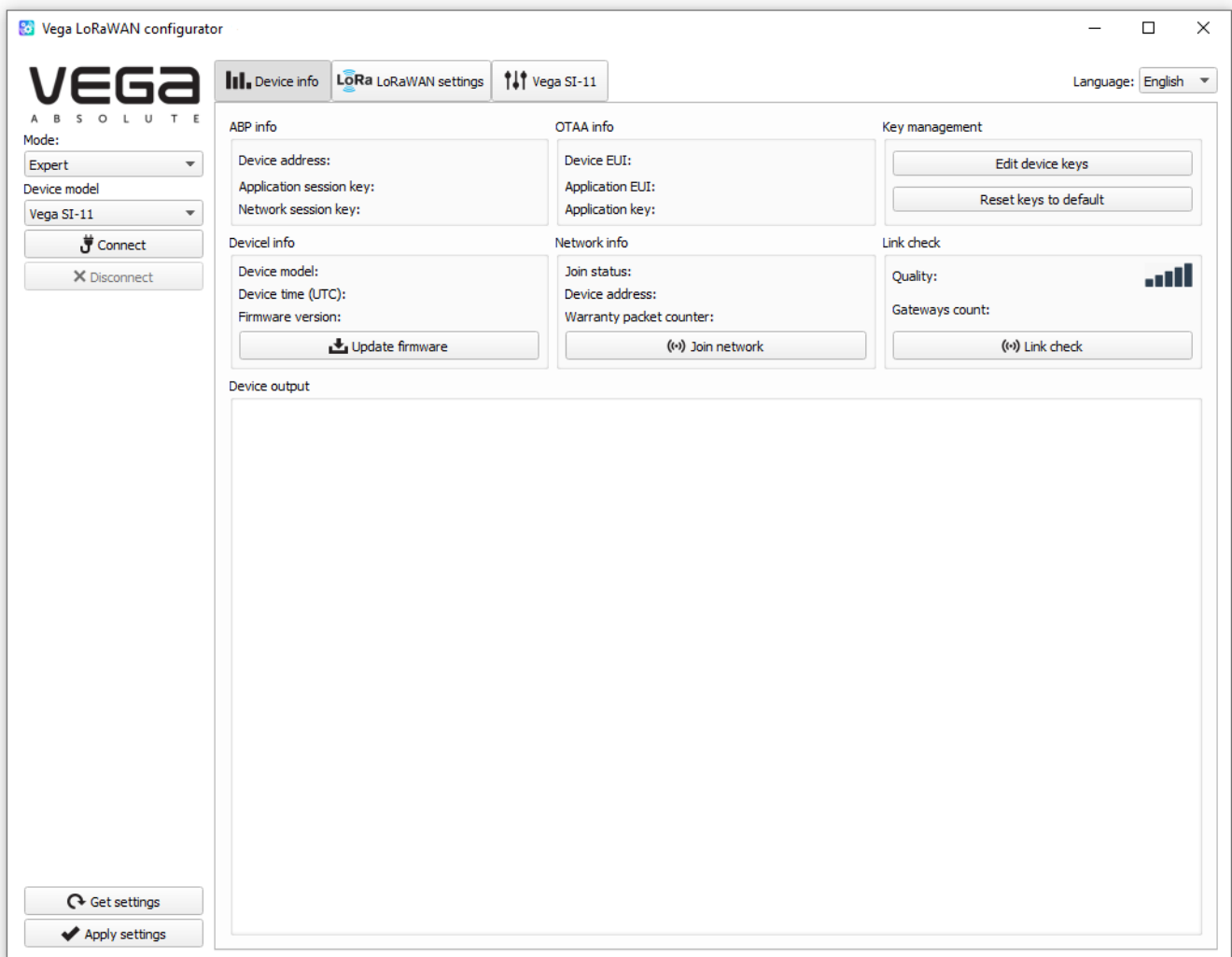
4 VEGA LORAWAN CONFIGURATOR

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.



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.

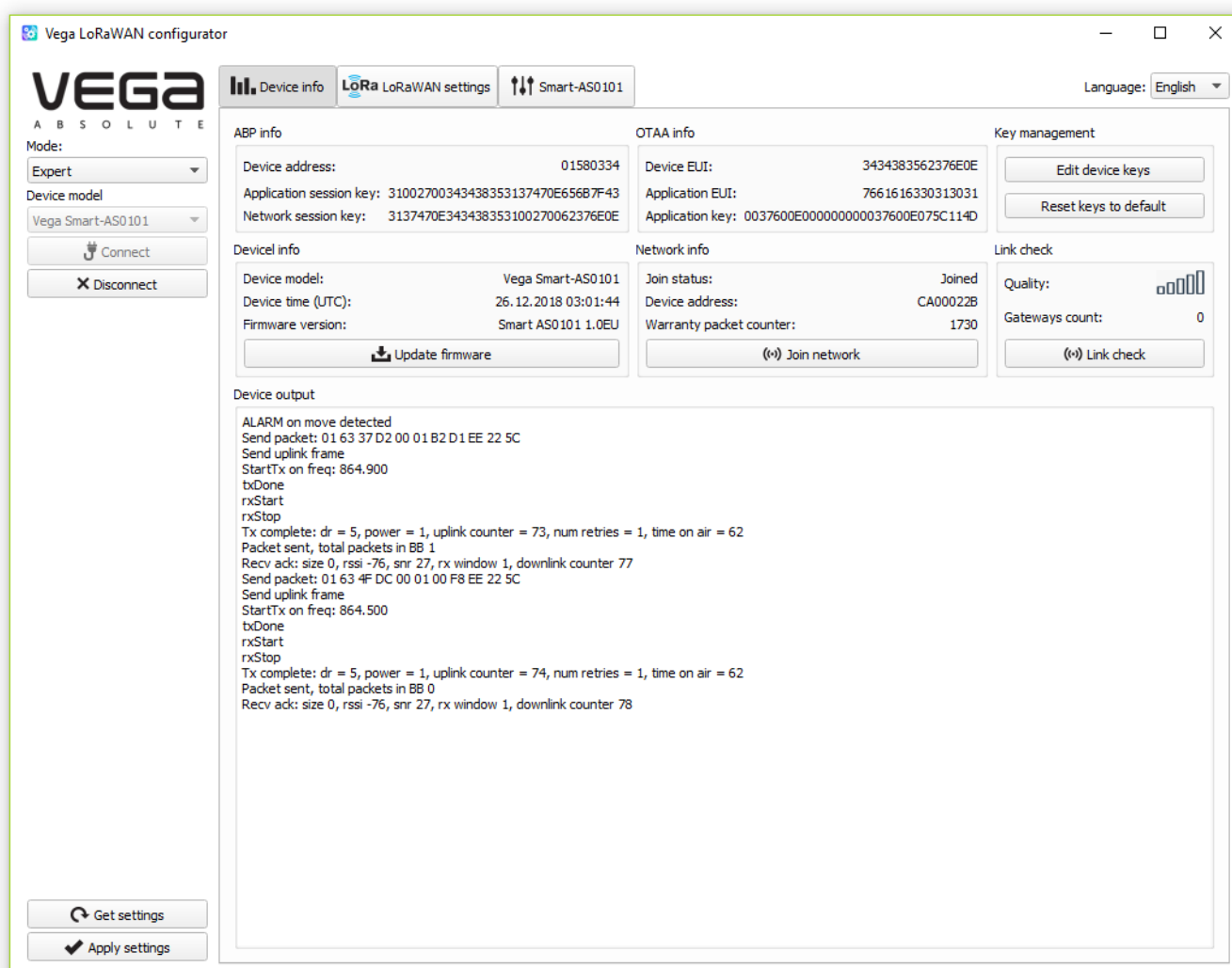
The language selection menu is in the upper right corner.

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.

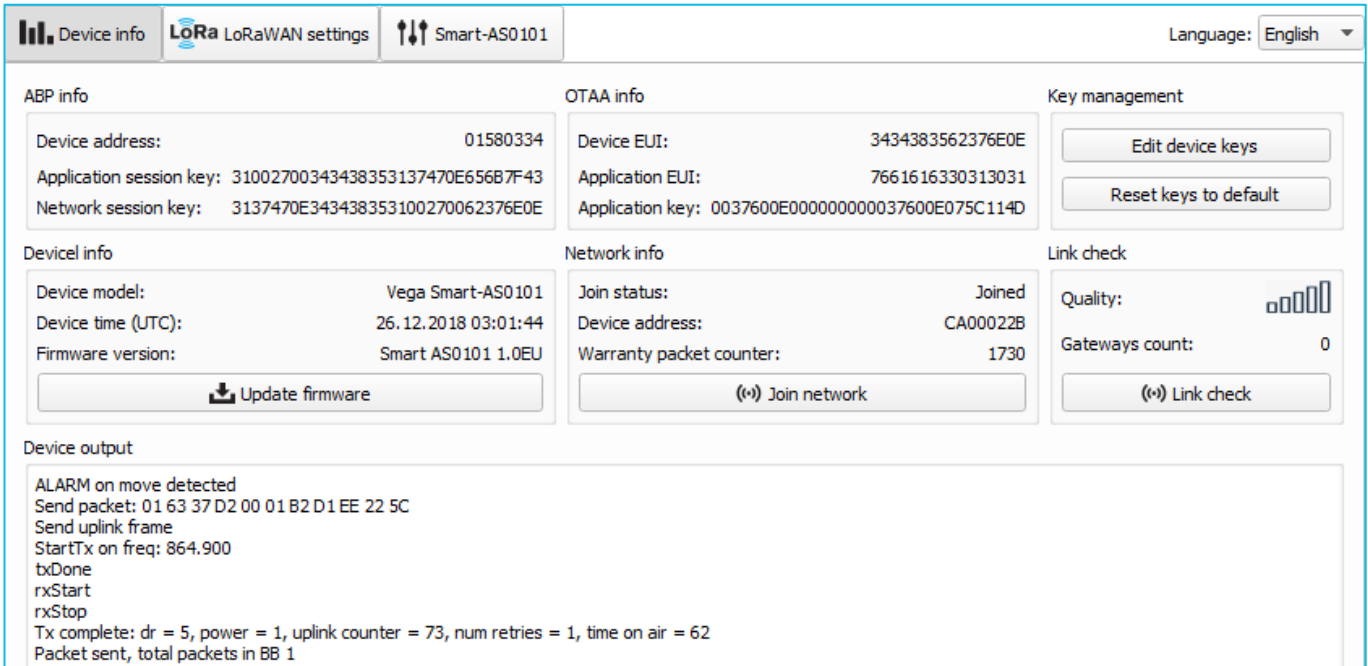


To read the settings from the device, you need to click the "Get settings" button, until this point the application will display the default settings or from the last connected device.

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 state, and the data needed to register the device in the LoRaWAN network.



The screenshot shows the 'Device info' tab selected in the configurator. The interface includes a top navigation bar with 'Device info', 'LoRa LoRaWAN settings', and 'Smart-AS0101'. A language dropdown is set to 'English'. The main content area is divided into several sections:

- ABP info:** Displays Device address (01580334), Application session key (31002700343438353137470E656B7F43), and Network session key (3137470E343438353100270062376E0E).
- OTAA info:** Displays Device EUI (3434383562376E0E), Application EUI (7661616330313031), and Application key (0037600E000000000037600E075C114D).
- Key management:** Includes buttons for 'Edit device keys' and 'Reset keys to default'.
- Device info:** Displays Device model (Vega Smart-AS0101), Device time (UTC) (26.12.2018 03:01:44), and Firmware version (Smart AS0101 1.0EU). It includes an 'Update firmware' button.
- Network info:** Displays Join status (Joined), Device address (CA00022B), and Warranty packet counter (1730). It includes a 'Join network' button.
- Link check:** Displays Quality (represented by a signal strength icon) and Gateways count (0). It includes a 'Link check' button.
- Device output:** A text area showing logs: 'ALARM on move detected', 'Send packet: 01 63 37 D2 00 01 B2 D1 EE 22 5C', 'Send uplink frame', 'StartTx on freq: 864.900', 'txDone', 'rxStart', 'rxStop', 'Tx complete: dr = 5, power = 1, uplink counter = 73, num retries = 1, time on air = 62', and 'Packet sent, total packets in BB 1'.

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.

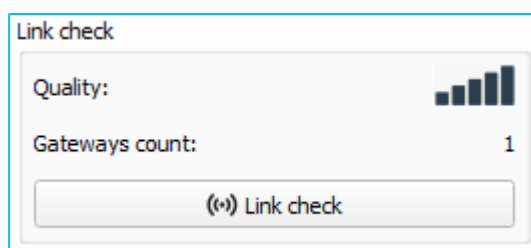
Device info - the configurator reads information about the device model, its firmware and automatically corrects the device's time when connected to it.

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 occur.

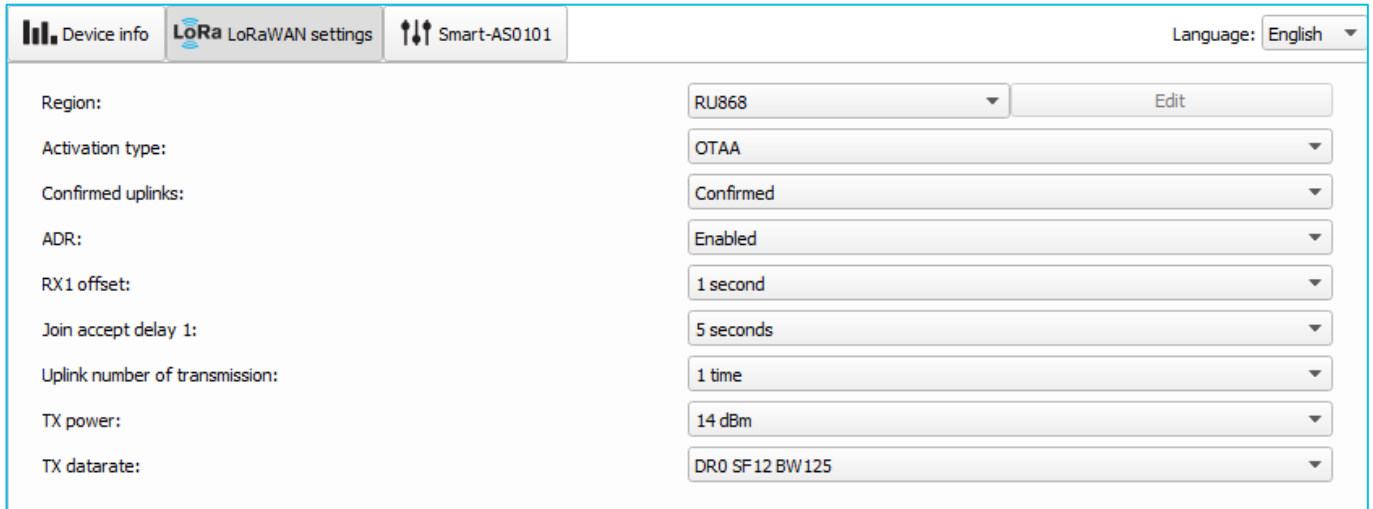
Link check (not displayed in the "Simple" mode) - when pressed, the device sends a special signal to the LoRaWAN network, in response to which the network informs it of the number of gateways that received this signal and the signal quality. This button only works when the device is connected to the network.



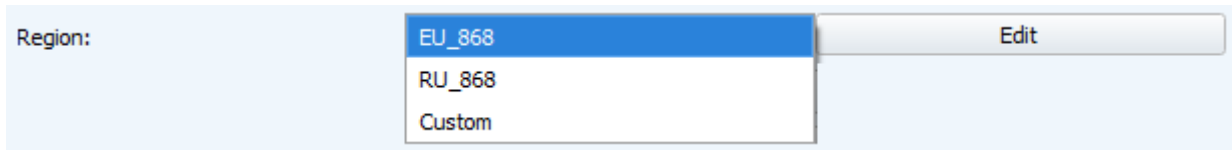
Device output (not displayed in the "Simple" mode) - monitoring the device status, all events in real time are displayed.

"LORAWAN SETTINGS" TAB

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

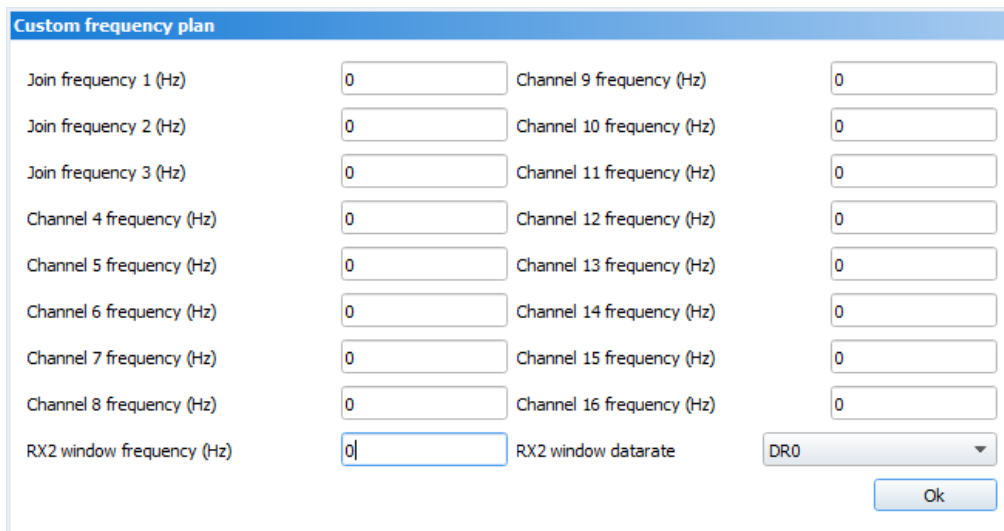


Region - allows you to select one of installed frequency plans or specify a custom frequency plan. Custom frequency plan is EU-868 based.



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.

Activation type:	<div>OTAA</div> <div>ABP</div>
------------------	--------------------------------

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:	<div>Confirmed</div> <div>Unconfirmed</div>
--------------------	---

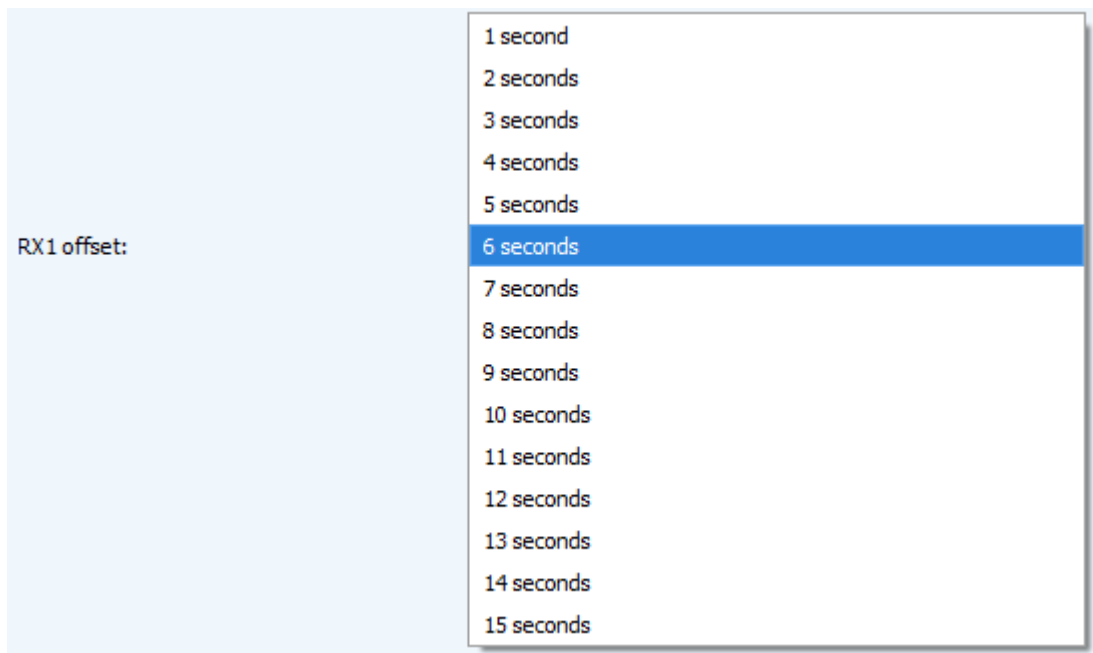


If you choose to send packets without confirmation, the modem will not know whether the packet delivered or not

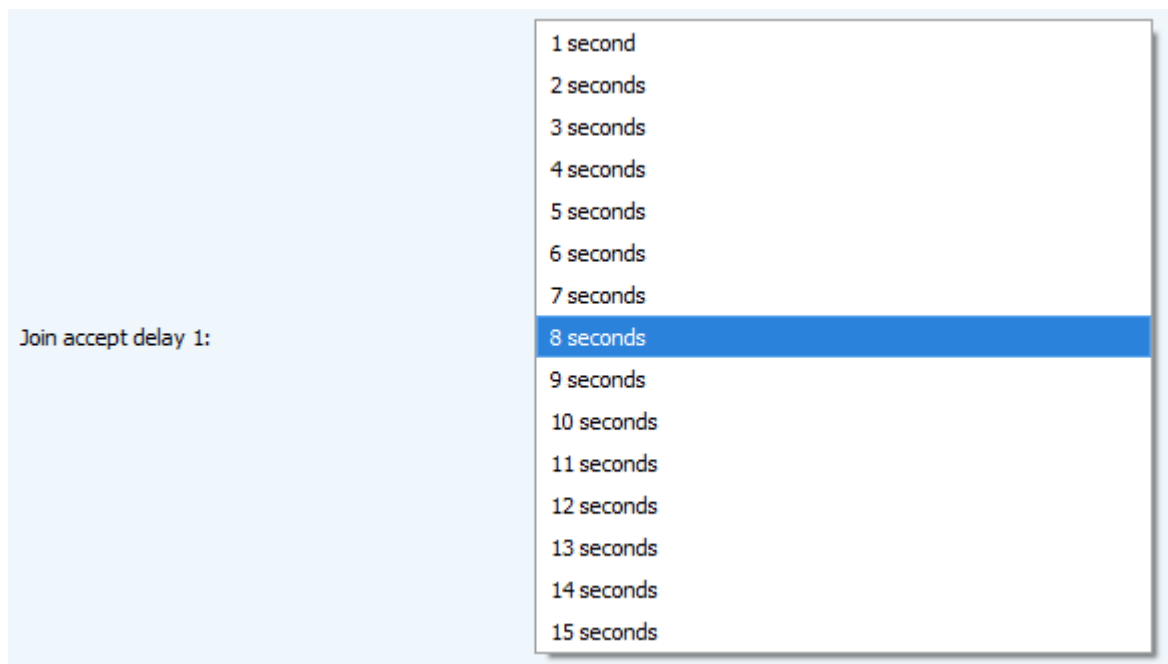
ADR – this option activates the Adaptive Data Rate algorithm for automatic control of the data transfer rate from the LoRaWAN network server side. The higher the quality of the signal received by the network, the higher the speed will be installed on the device. This option is recommended only on permanently installed devices.

ADR:	<div>Enabled</div> <div>Disabled</div>
------	--

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 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.

Uplink number of transmission:	1 time
	2 times
	3 times
	4 times
	5 times
	6 times
	7 times
	8 times
	9 times
	10 times
	11 times
	12 times
	13 times
	14 times
	15 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 change by the network server.

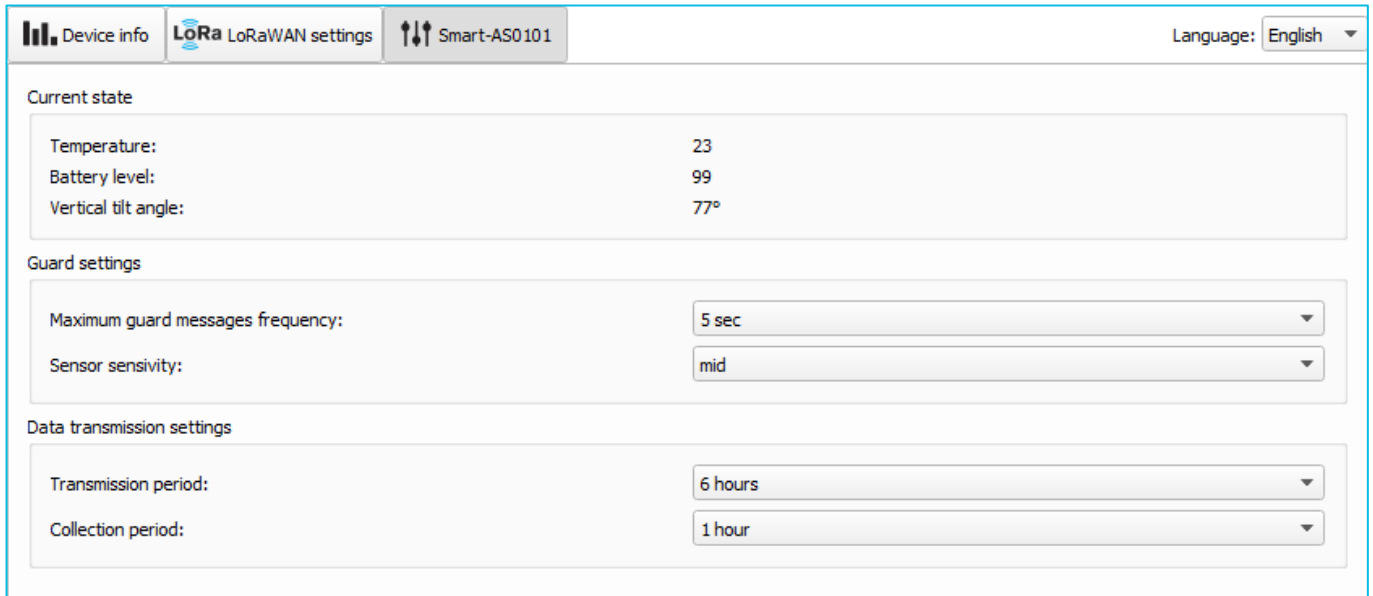
TX power:	2 dBm
	5 dBm
	8 dBm
	11 dBm
	14 dBm
	20 dBm

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-AS0101" TAB

The "Smart-AS0101" tab contains the settings of the connected device.



Section	Parameter	Value
Current state	Temperature:	23
	Battery level:	99
	Vertical tilt angle:	77°
Guard settings	Maximum guard messages frequency:	5 sec
	Sensor sensitivity:	mid
Data transmission settings	Transmission period:	6 hours
	Collection period:	1 hour

Current state – displays the current parameters of the device - the internal temperature of the device, the battery level and sensor deviation angle from vertical.

Guard settings – allows to vary the alarm sending frequency from 1 to 60 seconds and to set the internal accelerometer sensitivity on one of the three levels: low, mid, or high.

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. 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 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.

5 COMMUNICATION PROTOCOL

This part describes the Smart-AS0101 communication protocol with LoRaWAN network.



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

SMART-AS0101 TRANSMITS THE FOLLOWING TYPES OF PACKETS

1. Packet with current readings, sent regularly, and every time alarm event occurs on LoRaWAN port 2

Size in bytes	Field description	Data type
1 byte	Packet type, this packet == 1	uint8
1 byte	Battery charge, %	uint8
1 byte	Sensor deviation angle from vertical	uint8
2 bytes	Temperature in °C, multiplied by 10	int16_t
1 byte	Sending reason (0 – by the time, 1 – sensor triggered)	uint8
1 byte	Inputs state (byte field)	uint8
4 bytes	Reading time for values in this packet (unixtime UTC)	uint32

"Inputs state" bit field decoding

Bits	Field description
0 bit	Accelerometer state (1 – move, 0 – not move)
1-7 bit	Reserved

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

Size in bytes	Field description	Data type
1 byte	Packet type, this packet == 255	uint8
4 bytes	Time of the modem at a moment of the packet transmission (unixtime UTC)	uint32

After receiving this type of package, the application can send to modem the packet with time correction.

3. Settings packet – transmitting on LoRaWAN port 3 when settings request command received, or device connected to the network

Size in bytes	Field description	Data type
1 byte	Packet type, this packet == 0	uint8
2 bytes	ID of parameter	uint16
1 byte	Data length (len)	uint8
len bytes	Parameter value	-----
2 bytes	ID of parameter	uint16
1 byte	Data length (len)	uint8
len bytes	Parameter value	-----
...
2 bytes	ID of parameter	uint16
1 byte	Data length (len)	uint8
len bytes	Parameter value	-----

SMART-AS0101 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

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	Data type
1 byte	Packet type, this packet == 1	uint8

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	uint8
2 bytes	ID of parameter	uint16
1 byte	Data length (len)	uint8
len bytes	Parameter value	-----
2 bytes	ID of parameter	uint16
1 byte	Data length (len)	uint8
len bytes	Parameter value	-----
...
2 bytes	ID of parameter	uint16
1 byte	Data length (len)	uint8
len bytes	Parameter value	-----

The package with settings sent to the device may not contain all the settings supported by the device, but only the part that needs to be changed.

Table of ID of Smart-AS0101 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
44	Accelerometer sensitivity	1 byte	1 – low 2 – mid 3 – high
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

6 STORAGE AND TRANSPORTATION REQUIREMENTS

The Smart-AS0101 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:

Acceleration sensor Vega Smart-AS0101 – 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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