



Wireless interface converter WIC-2101

Operation manual

Hardware version 01

Software version 4.0

Configuration 4.0

Amended on 21.10.2021

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1. Introduction

The Wireless Interface Converter WIC-2101 is designed to read Bluetooth Low Energy (BLE) wireless sensors data and transmit it to a data collection device via RS485 interface. The converter can receive data from up to 16 wireless sensors simultaneously and outputting them via a generic protocol, simulating up to 64 end devices. It has a universal setting algorithm and packet constructor. The converter is equipped with a built-in high-performance ceramic antenna and mounted on any surface.

2. Specification

Power supply	5 – 40 V, direct current. Impulse noise protection, reverse polarity protection, fuse.
Power consumption	Up to 0.2 W
Data transmission interface, software update and configuration	RS485, speed: 4800, 9600, 19200, 38400, 57600, 115200 bit/s. Default speed – 19200 bit/s.
Data request protocol by RS485	LLS
Wireless sensor communication technology	Bluetooth Low Energy (BLE)
Radio signal frequency	2.4 GHz
Transmitter power	+8 dBm
Wireless sensor quantity	Up to 16, simultaneously
Independent slots Quantity to work with radiotags	4 slots
Buffer size per slot	64 tags
The captured radio tags` quantity by 1 slot simultaneously	Up to 4, simultaneously
Cable length	1 m
Ingress protection	IP67
Operating temperature	From -40 to +85 °C
Dimensions	66 x 51 x 20 mm
Weight	70 g

3. General information

3.1 Power supply

Wireless interface converter (further “converter”) is designed to operate from DC voltage source from 5V to 40V as part of monitoring to control wireless sensors` parameters, which is using Bluetooth Low Energy (BLE) technology for data transmission.

3.2 Configuration

The converter has a set of commands for parameters set-up, status control and information output. (see Appendix).

3.3 Connection

Connection to a PC, satellite trackers or other devices is connected via the RS485 interface. It should be used RS485-USB-VirtualCom converter to connect to a PC.

The Picture below shows 1 of the options of converter`s connection to the PC. (Pic. 1)

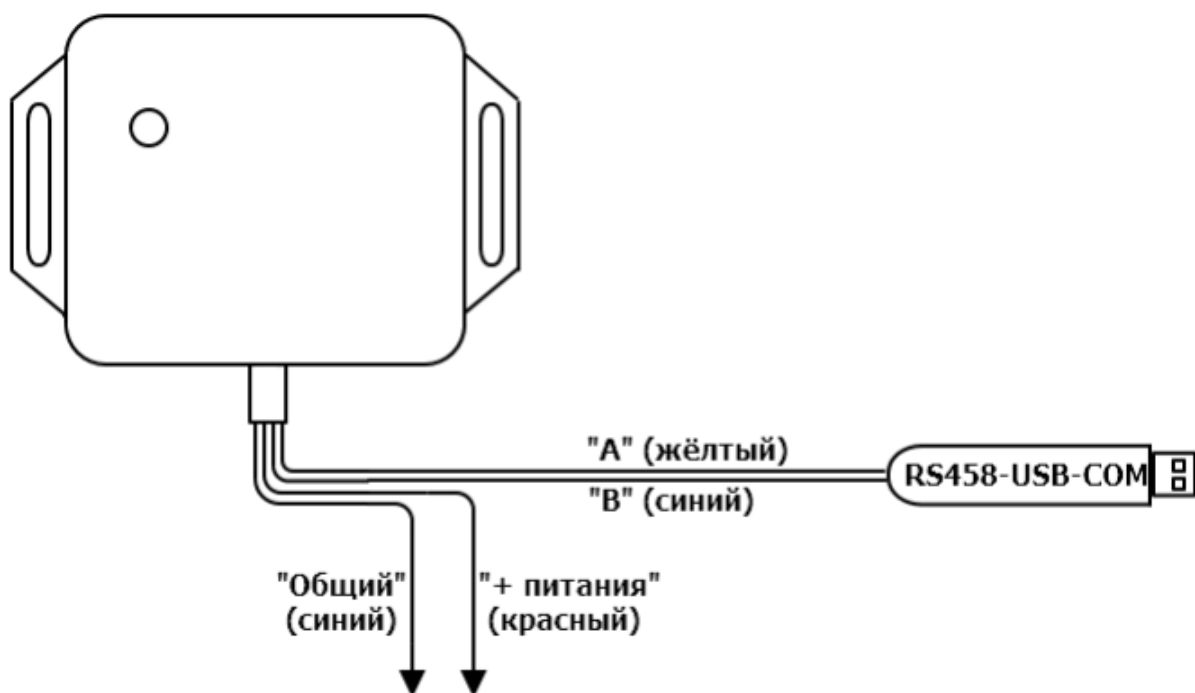



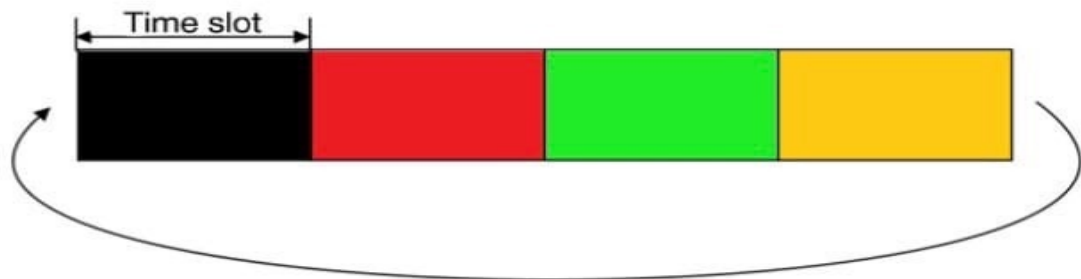
Image 1. Converter connection scheme.

"А" (yellow), "В" (blue); GND (blue), Vbat+ (red).

 To ensure the correct and safe operation of the digital interfaces, it is necessary to connect the mass potentials of the converter and connected devices, or to use an optical isolator.

3.4 Indication

The indication of the operating mode works according to the concept of time slots, when each LED status has fixed time of glow.



Pic. 2. The order of changing the color of the LED indication's glowing.

Green - RS485 incoming requests;
Red – converter sends responses to RS485;
Black (No light) - off;
Yellow - normal functioning of converter.

The duration of a time slot indicates the following conditions:

- 100 ms - there are no sensors in the converter's memory and the last received packet was less than 10 seconds ago (indication after power-on or when after a scanning, when there are no sensors in the memory).
- 300 ms - there are no sensors in the memory and there was no data received more than 10 seconds (a scanning is completed);
- 1 second - there are sensors in the memory and the data is received via BLE (operating mode);
- 3 seconds - there are sensors in the memory, but no data is received via BLE (sensors are out of sight).

4. Description of converter operation

The converter includes a transceiver, which works via BLE technology. In order to receive a data from required sensors, set-up should be saved in converter's memory to filter incoming data via radio channel. The converter is configured via configurator program on PC.

The converter memory can store data for up to 16 sensors, each of them can receive up to 9 parameters at the same time. If the sensor does not transmit some of parameters, then its value will be zero during reading. Parameter values are updated as packets are received over the radio channel. There is an additional parameter to control the relevance of parameter values, which shows the time in seconds after the moment of the last received

data from particular sensor (active time). When requesting the active time by command 06 LLS of the converter the value returns in minutes.

In the current software version, the converter is designed to work with Mielta Fantom wireless fuel level sensors and supports other wireless FLS with a universal protocol widely used on the market.

The software update is carried out using the configurator program on the PC.

5. Configurator

The configurator is designed to perform the following functions when working with the converter:

- Scanning and displaying a list of visible wireless sensors;
- Redaction of list of sensors in the converter memory;
- Real-time display of all current values of parameters measured by sensors stored in the memory of the converter;
- Software Update of the converter;
- Copying and restoring the settings of the converter within one session of work (without saving the settings to a file).

To work with the configurator, you need to connect the converter to a PC via an RS-485 - USB-COM adapter. In the configurator, click the "Scan ports" button, and then select the desired port and port speed. The standard speed of the reader port is 19200 b / s, if necessary, you can change it using the configurator (Img.3).

The converter can be operated in read mode and settings mode. In the read mode, the set of possible actions is limited only by the commands for reading the current settings and parameter values. Changing the settings, editing the list of sensors, restarting and updating the transmitter software is possible only in the settings mode.

The settings mode is switched on by default, but if necessary, you can set a password (recommended) to enter this mode, which will also be an additional protection against accidental changes in settings when receiving a data packet via the RS485 line during operation, which can be perceived as a command. After the password is written, the default mode will be the read mode, and to be able to change the settings, you must first authorize.

If the password is lost, you need to ask the converter for a key for a temporary password (the corresponding button will be displayed after unsuccessful authorization), which is valid until its next request or until it is restarted. A temporary password can be obtained based on the generated key by contacting Mielta technical support.

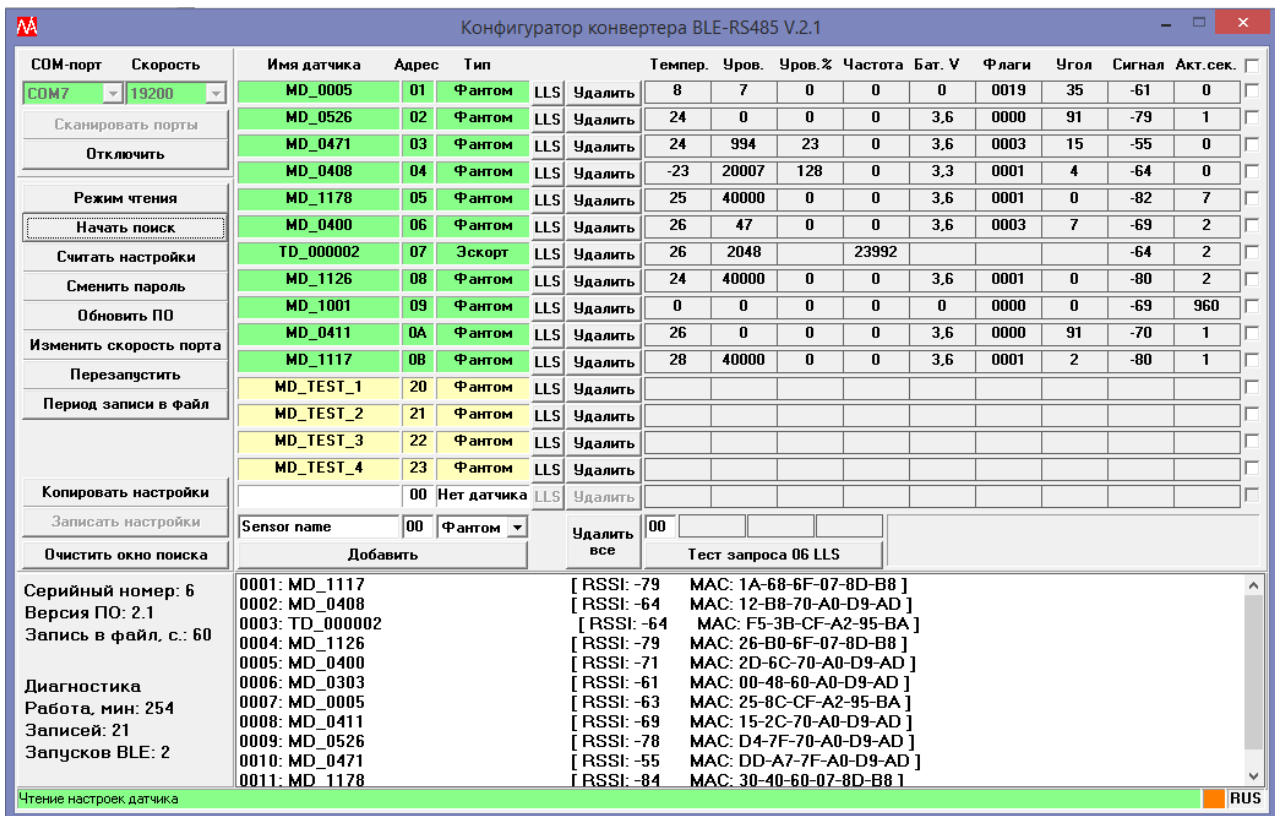


Image 3. The main window of the configurator with displaying the scan result.

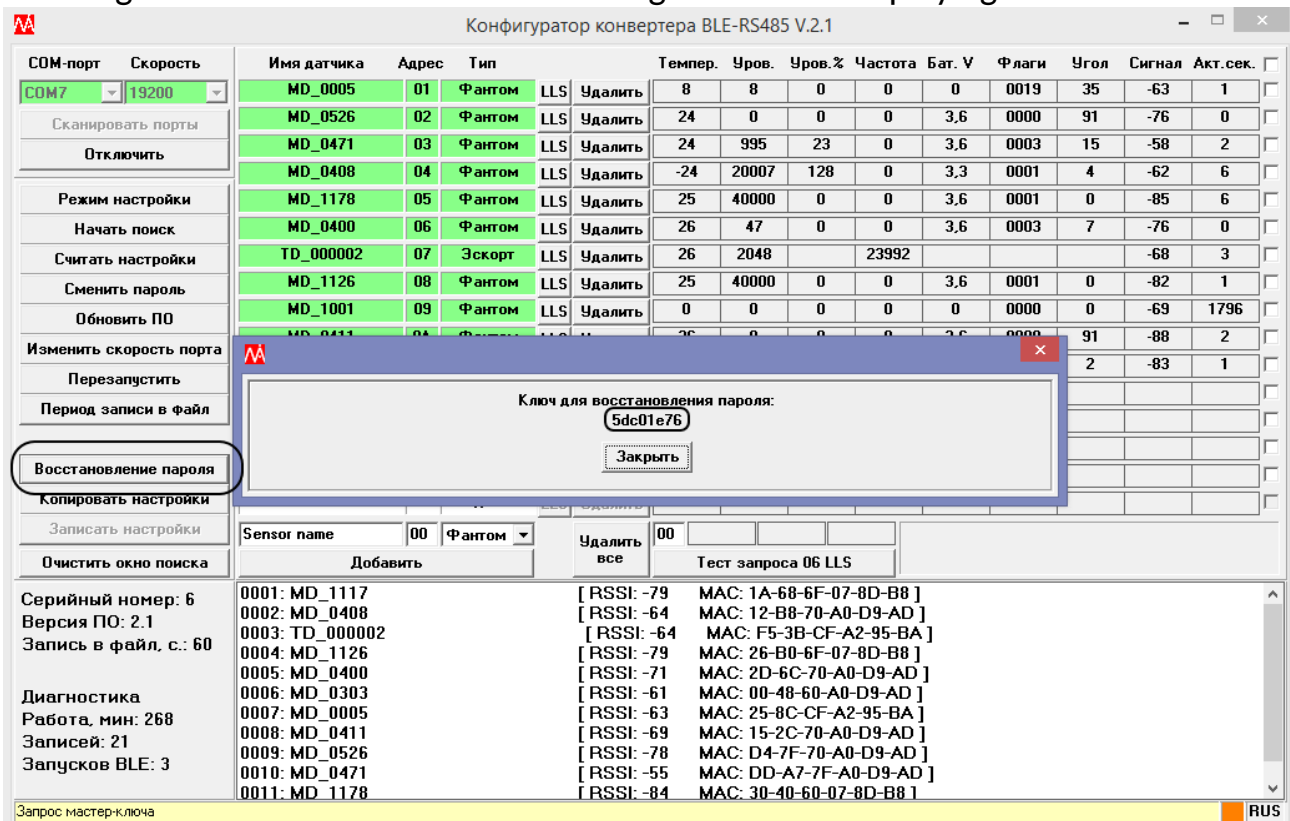


Image 4. Request for a key for password recovery.

To copy the key to the clipboard, click in the key area on the message window (img. 4). Using a temporary password, you can switch the converter to the settings mode and, if necessary, set a new password. To add a new sensor, enter its name in the appropriate

window, set the emulated network address for the LLS protocol, specify the type of wireless sensor (Phantom or Universal) and click the “Add” button. It is possible to obtain a list of visible sensors using a scan procedure.

To start it, click the "Start Search" button, after which a list of sensors sending data in the required format will begin to form in the lower window of the configurator.

The search will finish automatically or by clicking the Stop Search button. By clicking on the line with the required sensor, its name will be copied to the window for editing the name of the new sensor, then you should specify the network address, sensor type and click the “Add” button.

Removing a sensor is performed by pressing the corresponding button opposite each sensor. The yellow color of the sensor settings line means that the sensor has not yet been detected by the converter after adding; green - the sensor was detected after adding; white - the cell in the memory is not occupied (Img. 5).

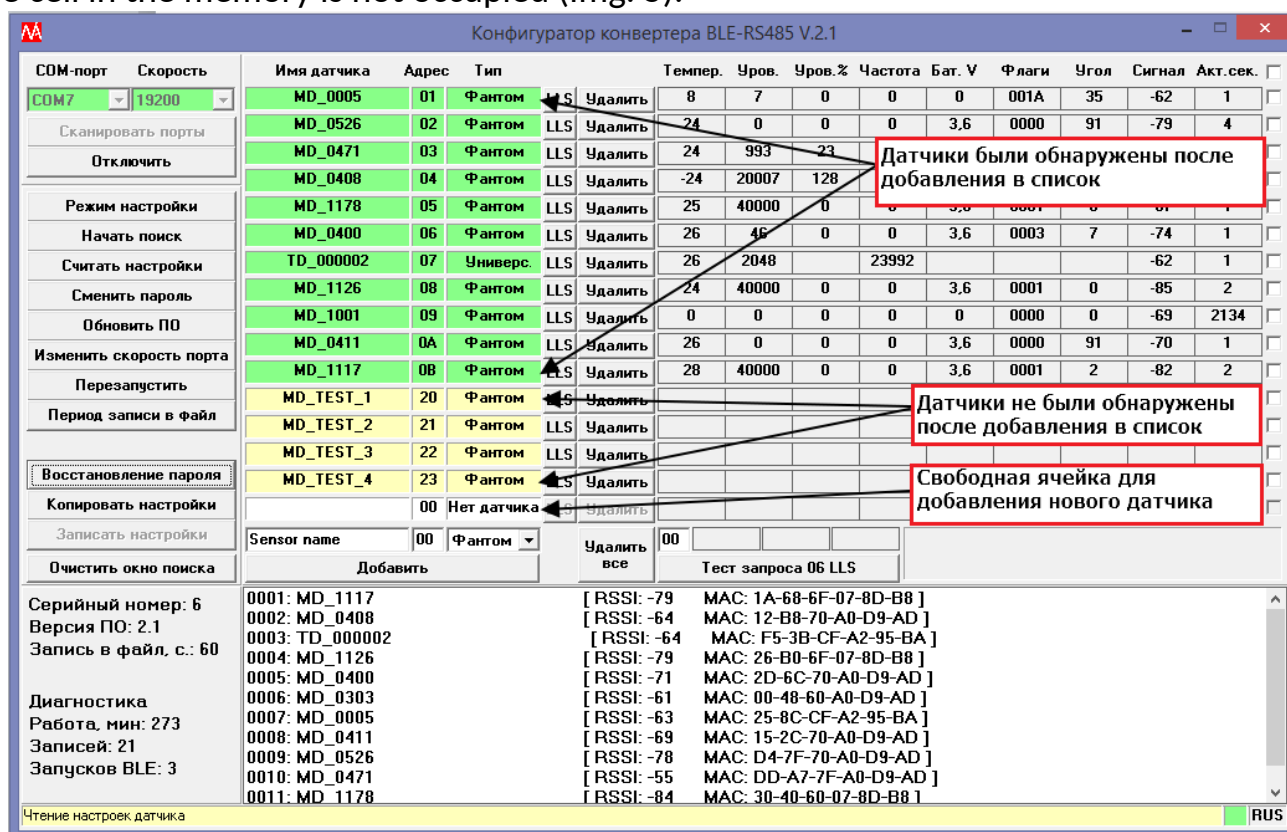


Image 2. Color coding of the statuses of the memory cells of the converter.

The table on the right shows the values of the measured parameters by each sensor in real time. If any parameters are not measured by the sensor or are not transmitted by the converter, then the corresponding cells will be empty. The non-standard parameter in the table is “Activity, sec.”. This parameter shows the time of absence of a signal from a specific sensor. For example (see Img. 5), data from the MD_0526 sensor was received 4 seconds ago, and from the MD_1001 sensor did not come at least for the last 2134 seconds.

Правее таблицы значений параметров включается запись данных в файл установкой галочки напротив соответствующего датчика. Если файл с именем датчика уже существует в директории с файлом конфигуратора, то он будет открыт для добавления новых данных, в противном случае будет создан новый

файл. Интервал записи данных в файл можно настроить после нажатия кнопки “Период записи в файл”. Минимальный интервал между записями – 1 секунда.

To the right of the table of parameter values, data recording to the file is enabled by checking the box opposite the corresponding sensor. If the file with the sensor name already exists in the directory with the configurator file, then it will be opened for adding new data, otherwise a new file will be created. The interval for writing data to a file can be configured after clicking the button “Recording to file”. The minimum interval between recordings is 1 second.

When performing any actions with the configurator or in emergency situations, a modal window appears with a corresponding message.

The bottom line of the configurator displays the name of the last command sent to the converter. The color of the bottom line indicates the current operating mode: yellow - the converter is in the read mode, green - in the setting mode. To change the interface language, click on the inscription in the lower right corner of the configurator window. To update the firmware, press the appropriate button and select the required * .bin file. After the update process is complete, the inverter will automatically restart and the configurator will be disconnected from the port. Next, you need to reconnect. Interrupting the software update process will not affect the converter's work.

The configurator memory stores the last port settings, file recording settings and the last entered password to switch to the configuration mode. This password is automatically sent to the converter upon connection. If the password is correct or it has not yet been set in the converter, an operating mode message is displayed. If the password is incorrect, then, in addition to displaying the corresponding message, the button for requesting a key to recover the password is displayed on the left side of the configurator window.

6. Transmition and collection of data via RS485

The converter responds to a data request by command 06 LLS, which is supported by most car satellite monitoring terminals working with wired fuel level sensors connected via the RS485 interface.

The structure of the response to this request is shown in Image 6.

Префикс (3Еh)	Сетевой адрес (0 .. 255)	Код команды (06)	Параметр 1 (1 байт)	Параметр 2 (2 байта)	Параметр 3 (2 байта)	Контрольная сумма
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Image 3. Structure of response to request 06 LLS.

In a standard response to a data request, the first parameter is the temperature value, the second parameter is the level value, and the third parameter is the frequency value.

This structure of the converter response is configured by default, but each sensor can measure more parameters, and the transducer can also transmit service data related to each sensor: the signal level and the time of the last activity.

To obtain additional data, the configurator allows you to reassign the measured parameters in the structure of the response packet. For example, instead of temperature, the signal level, level in percent or tilt angle can be transmitted as the first parameter. These parameters are 1 byte in size and can take values from -128 to +127. Similarly, instead of the value and level, you can configure the transmission of the values of other parameters, the dimension of which is 2 bytes (0 .. 65535), as the second and third parameters.

To configure the response packet in the configurator, press the LLS button opposite the corresponding sensor and then change the settings in the field "Structure of the response to the main request". The network address of the request and response will match the network address of the sensor, which was specified when it was added. When configuring the monitoring terminal or any other reader that supports the LLS protocol (command 06), remember that the "Temperature" parameter is "Parameter 1" in the request packet from the converter, "Level" is "Parameter 2", and "Frequency" is "Parameter 3", therefore, when the structure of the response packet is changed, the reader will send the corresponding parameter values. If you need to receive more than three parameters from one sensor, then in the same configurator window you can configure additional response packages for request 06.

Additional responses to this request simulate additional sensors with different network addresses, but physically they refer to the same sensor. The principle of setting up additional responses is similar to the principle of setting up the main response, except for the possibility of assigning a network address to simulate a sensor with the required set of parameters. The network address number must be specified from the list of previously unused sensors when configuring other sensors. If the assigned address has already been activated or is prohibited for use, the configurator will not provide an opportunity to write the corresponding setting to the converter.

Image 7 shows the LLS command 06 response package designer window. На рисунке 7 показано окно конструктора пакета ответа на команду 06 LLS.

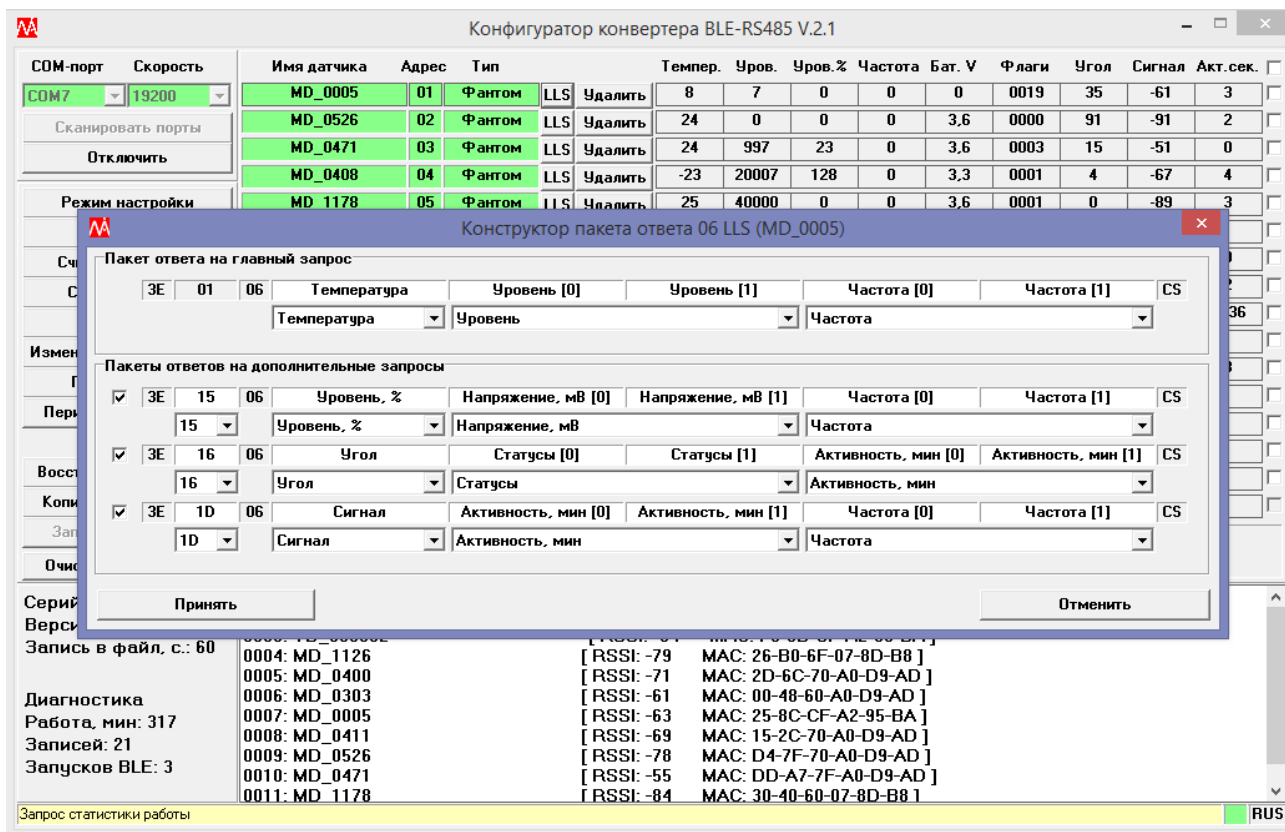


Image 7. Constructor of responses to request 06 LLS.

To check the converter's response to the 06 LLS request at a specific address, there is a corresponding test button in the configurator (Img. 8).

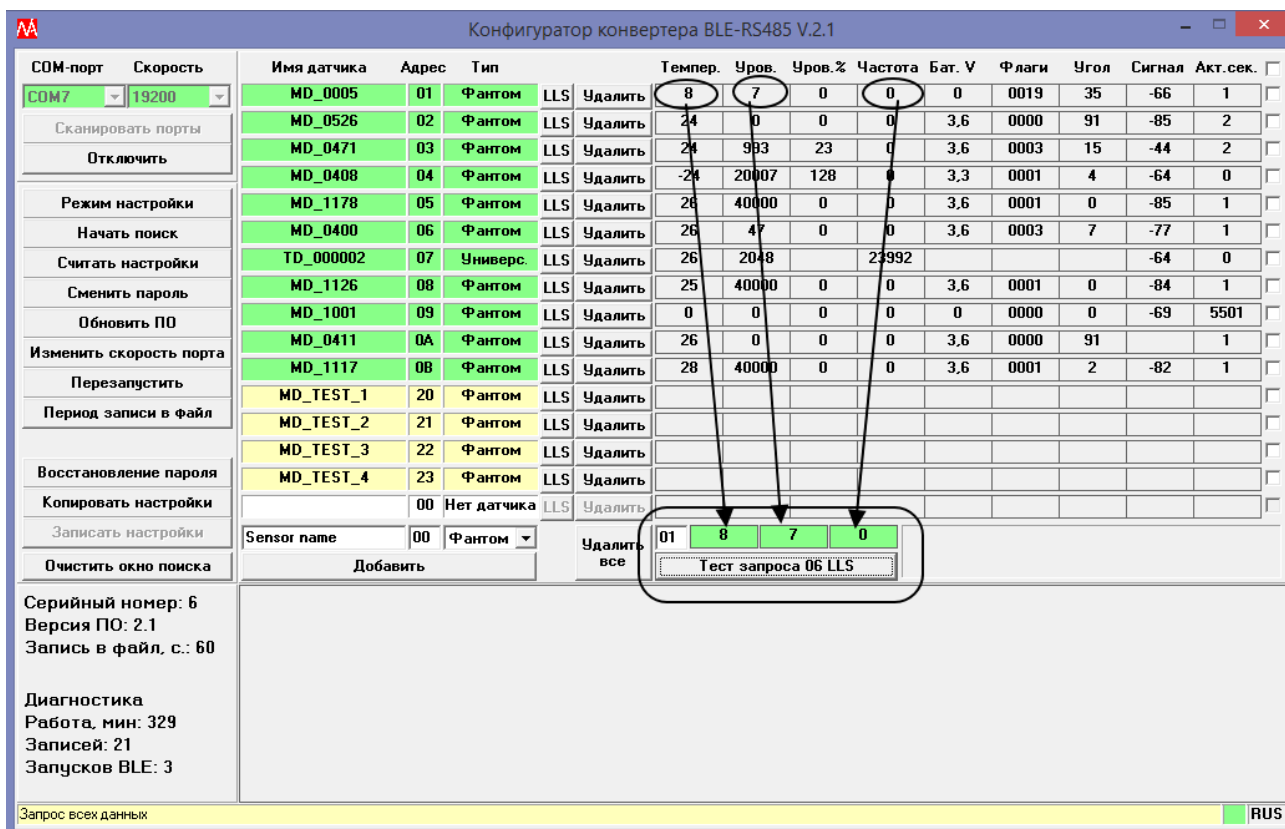


Image 8. Testing request 06 LLS.

After pressing this button, the corresponding request is sent to the converter to the network address specified in the cell. The returned result is displayed in three green cells. If the reader does not respond to the specified address, the color of the cells will remain orange and after 1-2 seconds the configurator will display a message stating that no response has been received.

The above algorithm for configuring response packets and the algorithm for obtaining parameter values is relevant if the reader, for example, a car controller, has support for the LLS protocol and there is no way to add new requests using this protocol within a reasonable time. If it is possible to add a new type of request, then all parameters of each sensor can be obtained by one request. Request and response structures are described in the appendix.

Appendix.

<Префикс><Адрес><Код команды>[Данные]<Контрольная сумма>

<Префикс> - байт 0x31

<Адрес> - сетевой адрес датчика (01h..F0h), адрес преобразователя – 255, остальные адреса зарезервированы.

Формат ответа:

<Префикс><Адрес><Код команды>[Данные]<Контрольная сумма>

There is a configurator for working with the reader, therefore the following is a description of the commands for reading data.

1. Request for data (command 06)

Command: 31 NET[1] 06 CS[1]

Response: 3E NET[1] 06 PARAM1[1] PARAM2[2] PARAM3[2] CS[1]

NET sensor network address (1 byte),

CS – checksum (1 byte),

PARAM1 – first parameter (1 byte), default temperature value,

PARAM2 – the second parameter (2 bytes) is the default level value,

PARAM3 – third parameter (2 bytes) default frequency value, actual for FLS with universal protocol (2 bytes).

Example:

Request 31 02 06 39

Response: 3E 02 06 1C 39 0D 00 00 1B

2. Request for a complete data set (command 88)

Command: 31 NET[1] 88 CS[1]

Response: 3E NET[1] 88 TEMP[1] LEVEL[2] FREQ[2] LEVEL_P[1] BAT_VOLT[2] FLAGS[2] INCLINE[1] TIME_NO_DATA[4] RSSI[1] RESERV[11] CS[1]

NET sensor network address (1 byte)

CS – checksum (1 byte),

TEMP – temperature (1 byte),

LEVEL – level (2 bytes)

FREQ – frequency value, relevant for FLS with universal protocol (2 bytes).

LEVEL_P – level in percentage, relevant for FLS FANTOM (1 byte)

BAT_VOLT – battery voltage in mV with 100mV resolution (2 bytes)

FLAGS – status flags (2 bytes)

INCLINE – inclination angle, relevant for FLS FANTOM (1 byte)

TIME_NO_DATA – time of absence of data from the sensor in seconds (4 bytes)

RSSI – received signal strength indicator (1 byte)

RESERV – reserved field (11 bytes)

CS – packet checksum (1 byte)

Example:

Request: 31 02 88 AA

Response: 3E 02 88 1C 39 0D 00 00 52 10 0E 03 00 02 03 00 00 00 AB 00 00 00 00 00
00 00 00 00 00 00 16

Checksum calculation:

```
static uint16_t LenData;
static uint8_t Buf[512];
static uint8_t crc;

static uint8_t LLS_CRC(uint8_t data, uint8_t crc){
    uint8_t i = data ^ crc;
    crc = 0;
    if(i & 0x01) crc ^= 0x5e;
    if(i & 0x02) crc ^= 0xbc;
    if(i & 0x04) crc ^= 0x61;
    if(i & 0x08) crc ^= 0xc2;
    if(i & 0x10) crc ^= 0x9d;
    if(i & 0x20) crc ^= 0x23;
    if(i & 0x40) crc ^= 0x46;
    if(i & 0x80) crc ^= 0x8c;
    return crc;
}

crc = 0;
for (i = 0; i < LenData - 1; i++){
    crc = LLS_CRC(Buf[i], crc);
}
Buf[LenData - 1] = crc;
```

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