DIGITAL I/O MODULE
OB-215

OPERATION MANUAL
TECHNICAL PASSPORT

Quality Management System of the device designing and production complies with the requirements of ISO 9001:2015, IDT

Dear Customer,
NOVATEK-ELECTRO LLC. Company thanks you for purchasing our products.
You will be able to use properly the device after carefully studying the Operation Manual.
Keep the Operation Manual throughout the service life of the device.

ATTENTION! ALL REQUIREMENTS OF THIS OPERATION MANUAL ARE COMPULSORY TO BE MET!

WARNING! THE DEVICE TERMINALS AND INTERNAL COMPONENTS ARE UNDER POTENTIALLY LETHAL VOLTAGE.

TO ENSURE THE DEVICE SAFE OPERATION IT IS STRICTLY FORBIDDEN THE FOLLOWING:

– TO CARRY OUT INSTALLATION WORKS AND MAINTENANCE <u>WITHOUT DISCONNECTING THE DEVICE FROM THE MAINS;</u>

– TO OPEN AND REPAIR THE DEVICE WITHOUT ANY PROFESSIONAL HELP;

– TO OPERATE THE DEVICE WITH MECHANICAL DAMAGES OF THE HOUSING.

IT IS NOT ALLOWED WATER PENETRATION ON TERMINALS AND INTERNAL ELEMENTS OF THE DEVICE.

During operation and maintenance, the regulatory document requirements must be met, namely:
Regulations for Operation of Consumer Electrical Installations;
Safety Rules for Operation of Consumer Electrical Installations;
Occupational Safety in Operation of Electrical Installations;

Installation, adjustment and maintenance of the device must be performed by the skilled professionals having studied this Operation Manual.

The device is safe for use under keeping of the operating rules.

This Operation Manual is intended to familiarize you with the design, the requirements for safety, operation and maintenance procedures of the digital I/O module OB-215 (hereinafter referred to as the "device", OB-215).

The device meets the requirements of the following:

- DSTU EN 60947-1:2014, Low-voltage switchgear and controlgear; Part 1; General rules;
- DSTU EN 60947-6-2:2014, Low-voltage switchgear and controlgear; Part 6-2; Multiple function equipment; Control and protective switching devices;
- DSTU EN 55011:2014, Electromagnetic compatibility; Industrial, scientific and medical RF equipment; Electromagnetic interference characteristics; Limits and methods of measurement;
- DSTU IEC 61000-4-2:2008, Electromagnetic compatibility; Part 4-2; Testing and measurement techniques; Electrostatic discharge immunity test.

Harmful substances in amounts exceeding maximum permissible concentrations are not available.

Terms and Abbreviations:

- **W/R –** write/read.

SERVICE

OB-215 can be used as the following:

- remote DC voltage meter (0 – 10 V);
- remote DC meter (0 – 20 mA);
- remote temperature meter with the ability to connect sensors NTC (10 KV), PTC 1000, PT 1000 or digital temperature sensor D18B20;
- temperature regulator for cooling and heating plants;
- pulse counter with saving the result in memory;
- pulse relay with switching current up to 8 A;
- interface converter for RS-485 – UART (TTL).

OB-215 provides:

- equipment control using relay output with switching capacity up to 1.84 kVA;
- tracking the state (closed/open) of the contact at the dry contact input.

RS-485 interface provides control of the connected devices and reading of the sensors readings via the ModBus protocol.

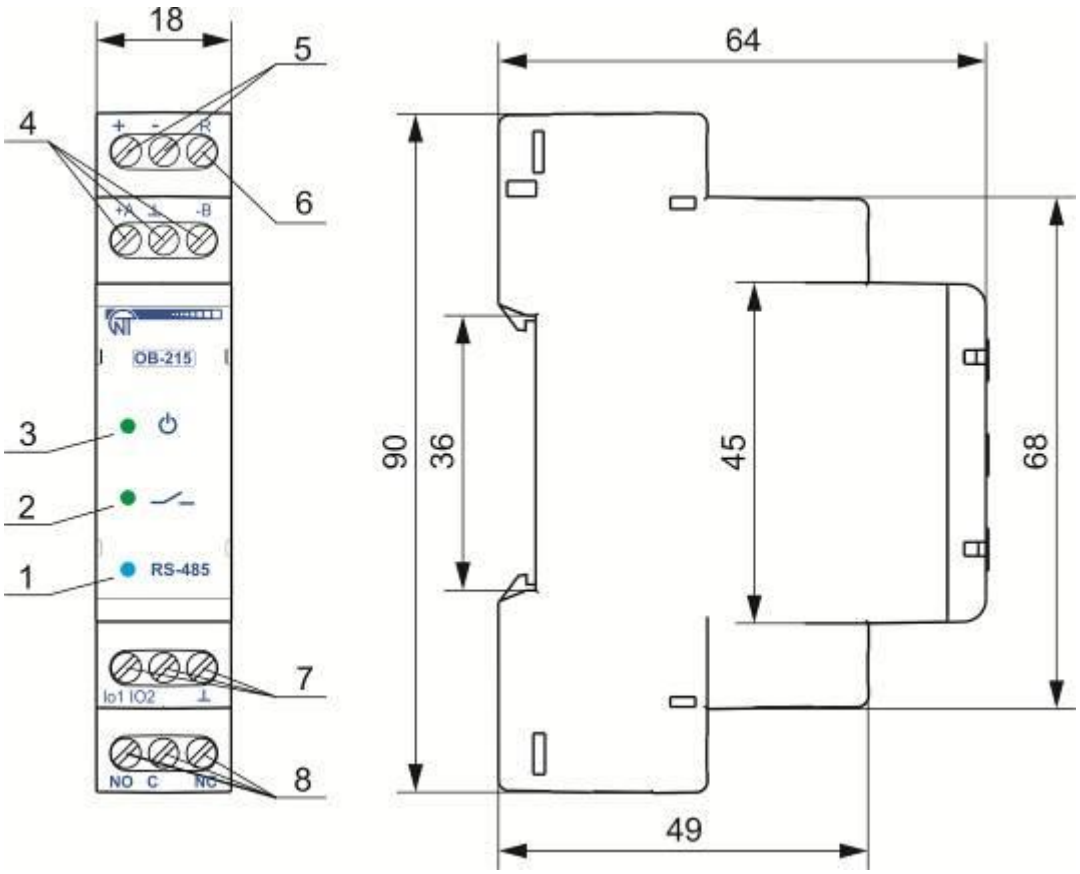
Parameter setting is set by the user from the Control Panel using the ModBus RTU/ASCII protocol or any other program that allows working with the ModBus RTU / ASCII protocol.

The status of the relay output, the presence of the power supply and the data exchange are displayed using indicators located on the front panel (Fig. 1, it. 1, 2, 3).

The overall dimensions and layout of the device are shown in Fig. 1.

Note:

Temperature sensors are included in the delivery scope as agreed upon.



1 – indicator of data exchange via RS-485 interface (it is on when data is being exchanged);
2 – indicator of the status of the relay output (it is on with closed relay contacts);
3 – indicator ⏻ is on when there is supply voltage;
4 – terminals for connecting RS-485 communication;
5 – device power supply terminals;
6 – terminal for reloading (resetting) the device;
7 – terminals for connecting sensors;
8 – output terminals of relay contacts (8 A).

Fig. 1 – Layout and overall dimensions of OB-215

1. TECHNICAL SPECIFICATIONS AND OPERATION CONDITIONS

1.1. Basic Technical Specifications

The basic technical specifications of the device are given in Table 1.
The relay output contacts specifications are given in Table 2.
Parameter settings for OB-215 are given in Table 3.

Table 1 – Basic Technical Specifications

Description	Value
Rated power supply voltage, V	12 – 24
The error of measuring DC voltage in the range of 0-10 V, min	1%
The error of measuring DC in the range of 0-20 mA, min	1%
Temperature measurement range (NTC 10 KV), °C	-25…+125
Temperature measurement range (PTC 1000), °C	-50…+120
Temperature measurement range (PT 1000), °C	-50…+250
Temperature measurement error, °C	±2
Max. pulse frequency in the "pulse counter" mode, Hz	200
Max. pulse frequency in the "logic input" mode, Hz	20
Readiness time, max, s	0.4
Max. switched current with active load, A	8
Consumed current, max, mA	100
Weight, max., kg	0.3

Table 1 (Continued)

Overall dimensions, mm	18 x 90 x 64
Quantity and type of relay contact (switching contact)	1
Wire cross-section for connection, mm²	0.5 – 1.0
Tightening torque of screws, N*m	0.4
Installation is on standard 35 mm DIN-rail	
Protection rating of the device	IP20
Electric shock protection class	II
Climatic design version	UHL 3.1
Permissible contamination level	II
Overvoltage category	II
Position in space	arbitrary
Rated operating condition	continuous
Communication Interface	RS (EIA/TIA)-485
ModBus data exchange protocol	RTU / ASCII
Housing material is self-extinguishing plastic	

Table 2 – Output Contact Specifications

Operation mode	Max. current at U~250 V, A	Max. switching power at U~250 V, VA	Max. continuous permissible AC / DC voltage, V	Max. current at U_{cont}=30 V, A
cos φ=1	8	2000	250/30	0.6

Table 3 – Settings for OB-215

Description	Range	Factory setting	Type	W/R	Address (DEC)
Digital signals measurement: 0 – pulse counter; 1 – logic input/pulse relay. **Analog signals measurement:** 2 – voltage measurement; 3 – current measurement. **Temperature measurement:** 4 – NTC sensor (10 KV); 5 – PTC sensor 1000; 6 – PT sensor 1000. **Interface transformation mode:** 7 – RS-485 – UART (TTL); 8 – digital sensor (1-Wire, I2C)*.	0…8	0	UINT	W/R	100
Connected digital sensor					
0 – DS18B20 (1-Wire); 1 – DHT11 (1-Wire); 2 – DHT21/AM2301 (1-Wire); 3 – DHT22 (1-Wire); 4 – HTU21 (1-Wire); 5 – BMP180 (I2C); 6 – INA219 (I2C).	0…6	0	UINT	W/R	101
Relay control: 0 – control is disabled; 1 – relay contacts are opened at a value above the upper threshold, they are closed at a value below the lower threshold; 2 – relay contacts are closed at a value above the upper threshold, they are opened at a value below the lower threshold.	0…2	0	UINT	W/R	102

Table 3 (Continued)

Upper threshold	-500…2500	250	UINT	W/R	103
Lower threshold	-500…2500	0	UINT	W/R	104
Pulse counter mode: 0 – counter on the leading edge of the pulse; 1 – counter on the trailing edge of the pulse; 2 – counter on both edges of the pulse.	0…2	0	UINT	W/R	105
Number of pulses per counting unit**	1…65534	8000	UINT	W/R	106
RS-485: 0 – Modbus RTU; 1 – Modbus ASCII.	0…1	0	UINT	W/R	107
Modbus UID	1…127	1	UINT	W/R	108
Rate of exchange: 0 – 1200; 1 – 2400; 2 – 4800; 3 – 9600; 4 – 14400; 5 – 19200.	0…5	3	UINT	W/R	109
Parity check and stop bits: 0 – no, 2 stop bits; 1 – even, 1 stop bit; 2 – odd, 1 stop bit.	0…2	0	UINT	W/R	110
Rate of exchange UART(TTL)->RS-485: 0 – 1200; 1 – 2400; 2 – 4800; 3 – 9600; 4 – 14400; 5 – 19200.	0…5	3	UINT	W/R	111
Stop bits for UART(TTL)->RS-485: 0 – 1 stop bit; 1 – 1.5 stop bits; 2 – 2 stop bits.	0…2	0	UINT	W/R	112
Parity check for UART(TTL)->RS-485: 0 – None; 1 – Even; 2 – Odd.	0…2	0	UINT	W/R	113
ModBus password protection *****:** 0 – disabled; 1 – enabled.	0…1	0	UINT	W/R	114
ModBus password value	A-Z, a-z,0-9	admin	STRING	W/R	115-122

Note:

**** The sensor to be connected is selected at address 101.***

***** Only used if the pulses counter is on. The column "Value" indicates the number of pulses at the input, after registration of which, the counter is incremented by one. Recording to memory is performed with a periodicity of 1 minute.***

****** If ModBus Password Protection is enabled (address 114, value "1"), then to access the recording functions, you must write the correct password value to addresses 51-59.***

1.2. Operation Conditions

The device is intended for operation in the following conditions:

- Ambient temperature: from minus 35 to +45 °C;
- Atmospheric pressure: from 84 to 106.7 kPa;
- Relative humidity (at temperature of +25 °C): 30 … 80 %.

ATTENTION!

The device is not intended for operation in the following conditions:

- Significant vibration and shocks;
- High humidity;

– Aggressive environment with content in the air of acids, alkalis, etc., as well as severe contaminations (grease, oil, dust, etc.).

2. THE INTENDED USE

2.1. Preparation for Operation

- Unpack the device (we recommend to keep the original packing for the entire warranty period of the device operation);
- Check the device for damage absence after transportation; in case of such damages detection, contact the supplier or the manufacturer;
- Carefully study the Operation Manual (pay special attention to the diagram of the device connection to power);
- If the temperature of the device after transportation or storage differs from the ambient temperature at which it is supposed to be operated, then before connecting to the mains keep the device under the operating conditions within two hours (because of condensation may be on the device elements);
- If you have any questions regarding the installation of the device, please contact the manufacturer by telephone number indicated at the end of this Operation Manual.

DURING INSTALLATION PERFORMING IT IS NOT ALLOWED TO LEAVE EXPOSED PORTIONS OF WIRE PROTRUDING BEYOND THE TERMINAL BLOCK.

2.2. General

ATTENTION!
ALL CONNECTIONS MUST BE PERFORMED WHEN THE DEVICE IS DE-ENERGIZED.

Error when performing the installation works may damage the device and connected devices.
For a reliable contact, tighten the terminal screws with the force indicated in Table 1.
When reducing the tightening torque, the junction point is heated, the terminal block may be melted and wire can burn. If you increase the tightening torque, it is possible to have thread failure of the terminal block screws or the compression of the connected wire.

2.3. The Device Connection

2.3.1. Connect the device as shown in Fig. 2 (when using the device in the analog signals measurement mode) or in accordance with Fig. 3 (when using the device with digital sensors).
To connect the device to the ModBus network, use CAT.1 or higher twisted pair cable.

Note: Contact "A" is for transmission of a non-inverted signal, contact "B" is for an inverted signal. The power supply for the device must have galvanic isolation from the network.

2.3.2. Check that the connection is correct according to the diagrams shown in Fig. 2 or Fig. 3.

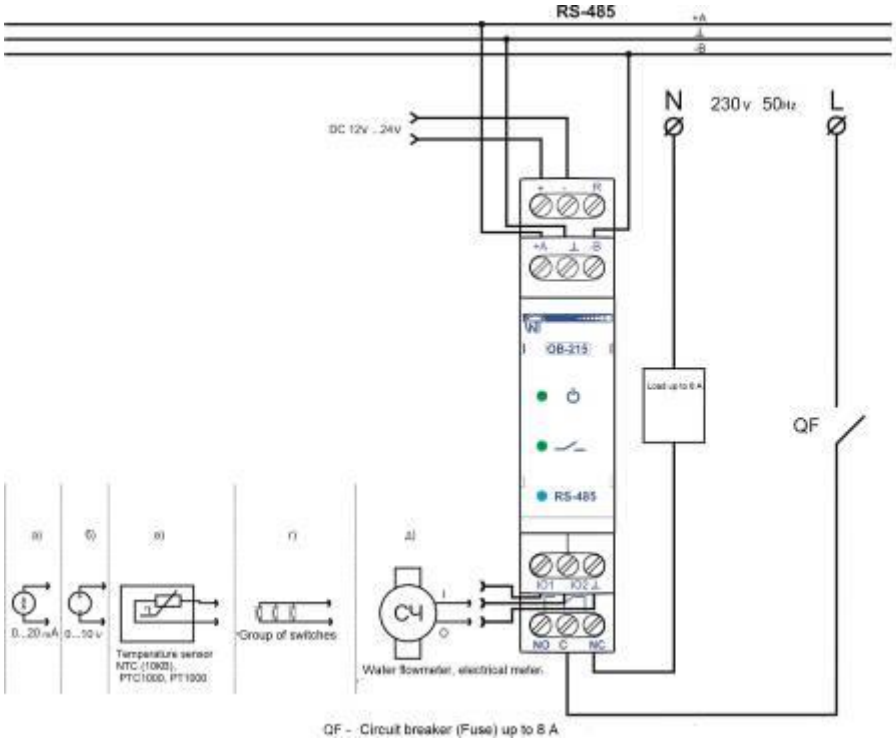


Fig. 2 – Connection diagram in measurement mode

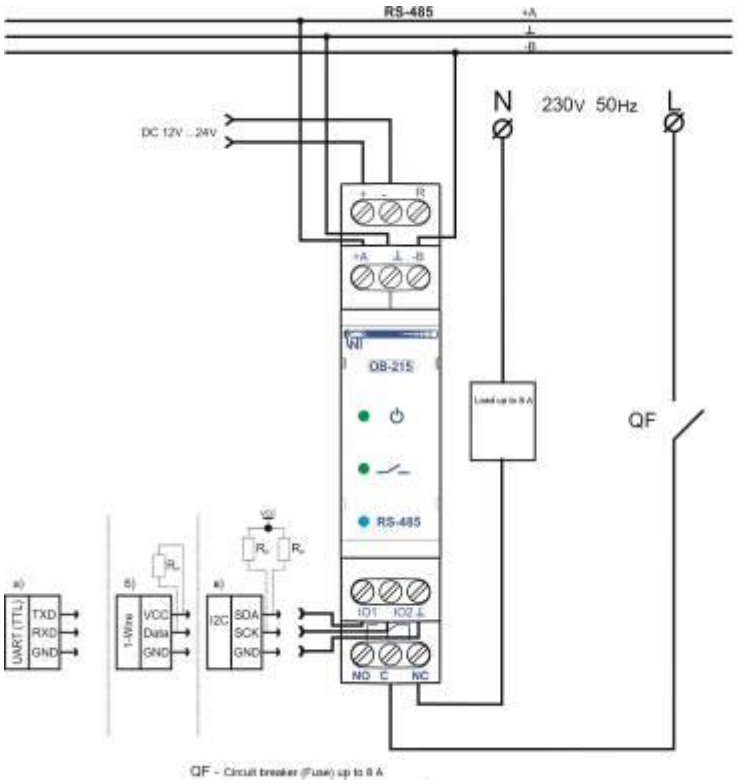


Fig. 3 – Connection diagram in interface transformation mode

NOTE:
The output relay contact "NO" is "normally open". If necessary, it can be used in signaling and control systems defined by the User.

3. Using the Device

3.1. General

Switch on the power of the device.

After the power is turned on the indicators ⏻, ⎍ and RS-485 will light up for 0.5 s (Fig. 1, it. 1, 2, 3).

To change any parameters you need:
– Download the OB-215 Control Panel program at http://novatek-electro.com/ua/programne-zabezpechennya.html or any other program that allows you to work with ModBus RTU/ASCII protocol;
– Connect to the device via RS-485 interface;
– Perform the necessary settings for the OB-215 parameters.
During the data exchange, the "RS-485" indicator flashes, otherwise the "RS-485" indicator does not light up.

3.2. Operation Modes

3.2.1. Measurement Mode
In this mode, the device measures the readings of sensors connected to the inputs “io1” or “io2” (Fig. 1, it. 7), and depending on the settings, performs the necessary actions.

3.2.2. Interface Transformation Mode
In this mode, the device converts the data received via the RS-485 interface (Modbus RTU/ASCII) to the UART (TTL) interface (Table 3, address 100, value “7”). To operate in this mode, two user functions are used (0x66 - reading data from UART (TTL), 0x67 - writing data in UART (TTL)). These functions are described in more detail in it. 3.5.4.3 and 3.5.4.4.

3.3. The Device Operation

3.3.1. Pulse Counter
Connect the external device as shown in Fig. 2 (e). Set up the device for operation in the Pulse Counter Mode (Table 3, address 100, value “0”).
In this mode, the device counts the number of pulses at the input “io2” and stores the data in memory with a periodicity of 1 minute.
When the value specified in the register (address 106) is reached, the counter is incremented by one (Table 7, address 4:5).

3.3.2. Logical Input/Pulse Relay

3.3.2.1. Logic Input Mode
Connect the device according to Fig. 2 (d). Set up the device for operation in the Logic Input/Pulse Relay Mode (Table 3, address 100, value “1”), set the required pulse count mode (Table 3, address 105, value “2”).
If the logic state on the “io2” terminal (Fig. 1, it. 6) changes to a high level, the device opens the contacts of the "C - NO" relay and closes the contacts of the "C - NC" relay (Fig. 1, it. 7).
If the logic state on the “io2” terminal (Fig. 1, it. 6) changes to a low level, the device will open the contacts of the "C - NC" relay and close the "C - NO" contacts (Fig. 1, it. 7).

3.3.2.2. Pulse Relay Mode
Connect the device according to Fig. 2 (d). Set up the device for operation in the Logic Input/Pulse Relay Mode (Table 3, address 100, value “1”), set Pulse Counter Mode (Table 3, address 106, value “0”). With a short pulse (at least 50 ms) at the “io2” terminal (Fig. 1, it. 6), the device closes the contacts of the "C - NO" relay and opens the contacts of the "C - NC" relay. If the pulse is repeated for a short time, the device will open the contacts of the "C - NO" relay and close the "C - NC" relay contacts.

3.3.3. Voltage Measurement
Connect the device according to Fig. 2 (b). Set up the device for operation in the Voltage measurement mode (Table 3, address 100, value “2”). If it is necessary that the device monitors the threshold voltage, it is required to write a value other than "0" in the "Relay control" register (Table 3, address 102). If required, set the operation thresholds (Table 3, address 103 - upper threshold, address 104 - lower threshold).
In this mode, the device measures the DC voltage. The measured voltage value can be read at address 6 (Table 7).

3.3.4. Current Measurement
Connect the device according to Fig. 2 (a). Set up the device for operation in the "Current measurement" mode (Table 3, address 100, value “3”). If it is necessary for the device monitors the threshold current, it is required to write a value other than "0" in the "Relay control" register (Table 3, address 102). If required, set the operation thresholds (Table 3, address 103 - upper threshold, address 104 - lower threshold).
In this mode, the device measures DC. The measured current value can be read at address 6 (Table 7).

3.3.5. Temperature Measurement

Connect the device according to Fig. 2 (c). Set up the device for operation in the Temperature measurement mode (Table 3, address 100, value “4”, “5”, “6”). If it is necessary for the device monitors the threshold temperature value, it is required to write a value other than "0" in the register "Relay control" (Table 3, address 102). If required, set the operation thresholds (Table 3, address 103 - upper threshold, address 104 - lower threshold).
In this mode, the device measures the temperature with the help of thermistor. The measured temperature can be read at address 6 (Table 7).

3.3.6. Connection of Digital Sensors

The device supports the digital sensors listed in Table 3 (address 113).
The measured value of the digital sensors can be read at the addresses 10:11 – 14:15, Table 7 (depending on what value the sensor measures).

Note: When connecting sensors via the 1-Wire interface, you need to install an external resistor to connect the "Data" line to the power supply.

3.3.7. Converting RS-485 interface to UART (TTL)

Connect the device according to Fig. 3 (a). Set up the device for operation in RS-485-UART (TTL) mode (Table 3, address 100, value “7”).
In this mode, the device receives (transmits) data via the RS-485 ModBus RTU/ASCII interface (Fig. 1, it. 4) and converts them to the UART interface.
Example of query and response is shown in Fig. 10 and Fig. 11.

3.4. Restarting the device and reset to factory settings

If the device needs to be restarted, the “**R**” contact and “**–**“ terminals 4 (Fig. 1) must be closed and held for 3 seconds.
If you want to restore the factory settings of the device, you must close and hold the “**R**” contact and “**–**” terminals 4 (Fig. 1) for more than 10 seconds.

3.5. Operation with RS (EIA/TIA) -485 Interface via MODBUS Protocol

3.5.1. General

OB-215 allows data exchanging with external devices via the serial interface of RS (EIA/TIA)-485 via ModBus protocol with the limited set of commands (see Table 5 for a list of supported functions).
When constructing a network, the principle of the master-slave organization is used where OB-215 acts as the slave. There can be only one master node and several slave nodes in the network. As the master node is a personal computer or a programmable logic controller. With this organization, the initiator of the exchange cycles can only be the master node.
The queries of the master node are individual (addressed to a particular device). OB-215 performs transmission, responding to individual queries of the master node.
If errors are found in receiving queries, or if the received command cannot be executed, OB-215 as the respond generates an error message.

Addresses (in decimal form) of command registers and their purpose are given in Table 6.

Addresses (in decimal form) of additional registers and their purpose are given in Table 7.

Table 5 – List of supported functions

Function (hex)	Purpose	Remark
0x03	Reading one or more registers	Maximum 50
0x06	Writing one value to the register	----
0x65	Reading via UART (TTL) protocol	Maximum 50
0x66	Recording via UART (TTL) protocol	Maximum 50

Table 6 – Command Register

Name	Description	W/R	Address (DEC)
Command register	Command codes: 0x37B6 – switch on the relay; 0x37B7 – switch off the relay; 0x472C – write settings to flash memory; 0x4757 – load settings from flash memory; 0xA4F4 – restart the device; 0xA2C8 – reset to factory settings; 0xF225 – reset the pulse counter (all the values stored in the flash memory are deleted).	W/R	50
Entering ModBus Password (8 characters ASCII)	To access the recording functions, set the correct password (the default value is "admin"). To disable the recording functions, set any value other than the password. Admissible characters: A-Z; a-z; 0-9.	W/R	51 – 59

Notes:
- **W/R** – type of access to the register as write / read;
- address of the form "**50**" means the value of 16 bits (UINT);
- address of the form "**51 – 59**" means a range of 8-bit values.

Table 7 – Additional registers

Name	Description			W/R	Address (DEC)
Identifier	Device identifier (value 22)			R	0
Firmware version	Bit 15 – Bit 8	1	10	R	1
	Bit 7 – Bit 0	0			
Status register	Bit 0	0 – pulse counter is disabled; 1 – pulse counter is enabled.		R	2:3
	Bit 1	0 – counter for leading edge of the pulse is disabled; 1 – counter for leading edge of the pulse is enabled.			
	Bit 2	0 – counter for trailing edge of the pulse is disabled; 1 – counter for trailing edge of the pulse is enabled.			
	Bit 3	0 – counter for both pulse edges is disabled; 1 – counter for both pulse edges is enabled.			
	Bit 4	0 – logical input is disabled; 1 – logical input is enabled.			
	Bit 5	0 – voltage measurement is disabled; 1 – voltage measurement is enabled.			
	Bit 6	0 – current measurement is disabled; 1 – current measurement is enabled.			
	Bit 7	0 – temperature measurement by NTC sensor is disabled (10 KV); 1 - temperature measurement by NTC sensor is enabled (10 KV).			
	Bit 8	0 – temperature measurement by the PTC 1000 sensor is disabled; 1 - temperature measurement by the PTC 1000 sensor is enabled.			

Table 7 (Continued)

	Bit 9	0 – temperature measurement by PT 1000 sensor is disabled; 1 – temperature measurement by PT 1000 sensor is enabled.		
	Bit 10	0 – RS-485 -> UART(TTL) is disabled; 1 – RS-485 -> UART(TTL) is enabled.		
	Bit 11	0 – UART (TTL) protocol data is not ready to be sent; 1 – UART (TTL) protocol data is ready to be sent.		
	Bit 12	0 – DS18B20 sensor is enabled; 1 – DS18B20 sensor is disabled.		
	Bit 13	0 – DHT11 sensor is enabled; 1 – DHT11 sensor is disabled.		
	Bit 14	0 – DHT21/AM2301 sensor is enabled; 1 – DHT21/AM2301 sensor is disabled.		
	Bit 15	0 – DHT22 sensor is enabled; 1 – DHT22 sensor is disabled.		
	Bit 16	0 – HTU21 sensor is enabled; 1 – HTU21 sensor is disabled.		
	Bit 17	0 – BMP180 sensor is enabled; 1 – BMP180 sensor is disabled.		
	Bit 18	0 – INA219 sensor is enabled; 1 – INA219 sensor is disabled.		
	Bit 19	0 – relay is open; 1 – relay is closed.		
	Bit 20	0 – there is no overvoltage; 1 – there is overvoltage.		
	Bit 21	0 – there is no reduction in voltage; 1 – there is reduction in voltage.		
	Bit 22	0 – there is no overcurrent; 1 – there is overcurrent.		
	Bit 23	0 – there is no decrease of current; 1 – there is decrease of current.		
	Bit 24	0 – there is no temperature rise; 1 – there is temperature rise.		
	Bit 25	0 – there is no temperature reduction; 1 – there is temperature reduction.		
	Bit 30	0 – the device settings are correct; 1 – the device settings are not correct.		
	Bit 31	0 – instrument is not calibrated; 1 – instrument is calibrated.		
Pulse counter	–		R	4:5
Measured value*	–		R	6
Supply voltage of the device	–		R	7

Notes:
- **W/R** – type of access to the register as write / read;
- address of the form "**1**" means the value of 16 bits (UINT);
- address of the form "**2:3**" means the value of 32 bits (ULONG).

* Measured value from analog sensors (voltage, current, temperature).

3.5.2. Message formats

The exchange protocol has clearly defined message formats. Compliance with the formats ensures the correctness and stability of the network.

3.5.2.1. Byte format

OB-215 is configured to operate with one of two formats of data bytes: with parity control (Fig. 4) and without parity control (Fig. 5). In parity control mode, the type of control is also indicated: Even or Odd. Transmission of data bits is performed by the least significant bits forward.
By default (during manufacture) the device is configured to operate without parity control and with two stop bits.

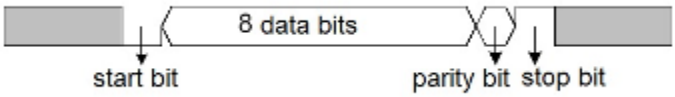


Fig. 4 – Byte format with parity control

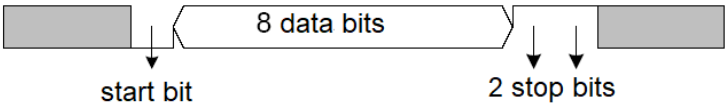


Fig. 5 – Byte format without parity control (2 stop bits)

Byte transfer is performed at speeds of 1200, 2400, 4800, 9600, 14400 and 19200 bps. By default, during manufacturing, the device is configured to operate at a speed of 9600 bps.

Note: *for* ***ModBus RTU*** *mode 8 data bits are transmitted, and for* ***ModBus ASCII*** *mode 7 data bits are transmitted.*

3.5.2.2. Frame format

The frame length cannot exceed 256 bytes for **ModBus RTU** and 513 bytes for **ModBus ASCII**.
In **ModBus RTU** mode the start and end of the frame are monitored by silence intervals of at least 3.5 bytes. The frame must be transmitted as a continuous byte stream. The correctness of frame acceptance is additionally controlled by checking the CRC checksum.
The address field occupies one byte. The addresses of the slaves are in the range from 1 to 247.
Fig. 6 shows the RTU frame format.

Silence interval >3.5 bytes	Address	Function code	Data	CRC checksum	Silence interval >3.5 bytes
	1 byte	1 byte	up to 252 byte	2 bytes	

Fig. 6 – RTU frame format

In **ModBus ASCII** mode the start and end of the frame are controlled by special characters (symbols (':' 0x3A) – for start of the frame; symbols ('CRLF' 0x0D0x0A) – for the end of the frame). The frame must be transmitted as a continuous stream of bytes. The correctness of frame acceptance is additionally controlled by checking the LRC checksum.
The address field occupies two bytes. The addresses of the slaves are in the range from 1 to 247.
Fig. 7 shows the ASCII frame format.

:	Address	Function code	Data	LRC checksum	CRLF
1 byte	2 bytes	2 bytes	up to 504 bytes	2 bytes	2 bytes

Fig. 7 – ASCII frame format

Note: *In* ***ModBus ASCII*** *mode each byte of data is encoded by two bytes of ASCII code (for example: 1 byte of data 0x25 is encoded by two bytes of ASCII code 0x32 and 0x35).*

3.5.3. Generation and verification of checksum

The sending device generates a checksum for all bytes of the transmitted message. OB-215 similarly generates a checksum for all bytes of the received message and compares it with the checksum received from the transmitter. If there is a mismatch between the generated checksum and the received checksum, an error message is generated.

3.5.3.1. CRC checksum generation

The checksum in the message is sent by the least significant byte forward, it is a cyclic verification code based on the irreducible polynomial 0xA001.

Subroutine for CRC checksum generation in C language:

```
1:  uint16_t GenerateCRC(uint8_t *pSendRecvBuf, uint16_t uCount)
2:  {
3:      cons uint16_t Polynom = 0xA001;
4:      uint16_t crc = 0xFFFF;
5:      uint16_t i;
6:      uint8_t byte;
7:      for(i=0; i<(uCount-2); i++){
8:          crc = crc ^ pSendRecvBuf[i];
9:          for(byte=0; byte<8; byte++){
10:             if((crc& 0x0001) == 0){
11:                 crc = crc>> 1;
12:             }else{
13:                 crc = crc>> 1;
14:                 crc = crc ^ Polynom;
15:             }
16:         }
17:     }
18:     returncrc;
19: }
```

3.5.3.2. LRC checksum generation

The checksum in the message is transmitted by the most significant byte forward, which is a longitudinal redundancy check.

Subroutine for LRC checksum generation in C language:

```
1:  uint8_t GenerateLRC(uint8_t *pSendRecvBuf, uint16_t uCount)
2:  {
3:      uint8_t lrc = 0x00;
4:      uint16_t i;
5:      for(i=0; i<(uCount-1); i++){
6:          lrc = (lrc + pSendRecvbuf[i]) & 0xFF;
7:      }
8:      lrc = ((lrc ^ 0xFF) + 2) & 0xFF;
9:     returnlrc;
10: }
```

3.5.4. Command system

3.5.4.1. Function 0x03 – reads a group of registers

Function 0x03 provides reading of the contents of registers OB-215. The master query contains the address of the initial register, as well as the number of words to read.

OB-215 response contains the number of bytes to return and the requested data. The number of registers returned is limited to 50. If the number of registers in the query exceeds 50 (100 bytes), the response is not divided into frames.

An example of the query and response in **MODBUS RTU** is shown in Fig. 8.

Query

Address	Function	Init. address HB	Init. address LB	QTY of words HB	QTY of words LB	CRC LB	CRC HB
01h	03h	00h	A0h	00h	02h	C4h	29h

Response – register value 00A0h = 1000 (FLOAT)

Address	Function	QTY of bytes	HW HB data	HW LB data	LW HB data	LW LB data	CRC LB	CRC HB
01h	03h	04h	44h	7Ah	00h	00h	CFh	1Ah

Fig. 8 – Example of query and response of 0x03 function – reading a group of registers

3.5.4.2. Function 0x06 – recording the register

The function 0x06 provides recording in one OB-215 register. The master query contains the address of the register and the data to be written.
The device response is the same as the master query and contains the register address and the set data. An example of the query and response in **MODBUS RTU** mode is shown in Fig. 9.

Query – Register 00A0h = 1000 (INT)

Address	Function	Init. address HB	Init. address LB	HB data	LB data	CRC LB	CRC HB
01h	06h	00h	A0h	03h	E8h	89h	56h

Response

Address	Function	Init. address HB	Init. address LB	HB data	LB data	CRC LB	CRC HB
01h	06h	00h	A0h	03h	E8h	89h	56h

Fig. 9 – Example of query and response of 0x06 function – register setting

3.5.4.3. Function 0x66 – reading data from UART (TTL) to RS-485

The 0x66 function provides the conversion and reading of data from the UART (TTL) interface to RS-485. The master query contains the wait timeout in seconds (5 seconds maximum) and quantity of bytes to read (50 maximum).
After the first query, the device starts the timeout for waiting for a response in the UART (TTL) line. The response to the query will contain the code "0x4A" (Fig. 10). Repeat the query after the time-out.
If the repeated query is made before the time-out specified in the first query ends, the response will contain the code "0x06" - the device is busy and waits data from the UART (TTL) line (Fig. 11).
If the data from the UART (TTL) were received before the time-out expires, the device response will contain data received from the UART (TTL) line and the time after which the device received data from the UART (TTL) (Fig. 12).

Codes of the device response for the query in UART (TTL) mode -> RS-485:
0x06 – device is busy, waiting for data;
0x4A – timeout waiting.

Query 1

Device address	Function	Wait timeout, s	QTY of bytes, HB	QTY of bytes, LB	CRC, LB	CRC, HB
0x01	0x66	0x00	0x00	0x02	0x87	0x31

Response

Device address	Function	Code of device response	CRC, LB	CRC, HB
0x01	0xE6	0x4A	0x87	0x31

Fig. 10 – Example of the first query and response of the function 0x66

Query 2

Device address	Function	Wait timeout, s	QTY of bytes, HB	QTY of bytes, LB	CRC, LB	CRC, HB
0x01	0x66	0x00	0x00	0x02	0x87	0x31

Response

Device address	Function	Code of device response	CRC, LB	CRC, HB
0x01	0xE6	0x06	0x87	0x42

Fig. 11 – Example of the second query and response of the 0x66 function made before the end of the timeout

Query 2

Device address	Function	Wait timeout, s	QTY of bytes, HB	QTY of bytes, LB	CRC, LB	CRC, HB
0x01	0x66	0x00	0x00	0x02	0x87	0x31

Response

Device address	Function	Wait timeout, s	QTY of bytes, HB	QTY of bytes, LB	Data 1, HB	Data 1, LB	Data 2, HB	Data 2, LB	CRC, LB	CRC, HB
0x01	0x66	0x02	0x00	0x02	0xA1	0x21	0x82	0xA5	0xCC	0xB6

Fig. 12 – Example of the second query and response of the 0x66 function made after the end of the timeout

3.5.4.4. Function 0x67 – recording data via UART (TTL) protocol

Function 0x67 provides conversion and transfer of data from the interface RS-485 to UART (TTL). The master query contains the quantity of bytes and data to be sent.

The device response is the same as the master query. An example of the query and the response is shown in Fig. 11.

Query

Device address	Function	QTY of bytes, HB	QTY of bytes, LB	Data HB0	Data LB0	Data Hbn	Data Lbn	Data HB50	Data LB50	CRC LB	CRC HB
0x01	0x67	-	-	0x11	0x21	-	-	0xA5	0xDD	-	-

Response

Device address	Function	QTY of bytes, HB	QTY of bytes, LB	Data HB0	Data LB0	Data Hbn	Data Lbn	Data HB50	Data LB50	CRC LB	CRC HB
0x01	0x67	-	-	0x11	0x21	-	-	0xA5	0xDD	-	-

Fig. 11 – Example of query and response of 0x67 function

3.5.5. ModBus error codes

Error code	Name	Comments
0x01	ILLEGAL FUNCTION	Invalid function number
0x02	ILLEGAL DATA ADDRESS	Invalid address
0x03	ILLEGAL DATA VALUE	Incorrect data
0x04	SERVER DEVICE FAILURE	Failure of controller equipment
0x05	ACKNOWLEDGE	Data is not ready
0x06	SERVER DEVICE BUSY	System is busy
0x08	MEMORY PARITY ERROR	Memory error

4. MAINTENANCE

4.1. Safety precautions

Maintenance of the device must be carried out by persons who have studied this Operation Manual.

THE DEVICE TERMINALS AND INTERNAL COMPONENTS ARE UNDER POTENTIALLY LETHAL VOLTAGE.

DURING MAINTENANCE IT IS NECESSARY TO DISABLE THE DEVICE AND CONNECTED DEVICES FROM THE MAINS.

Recommended frequency of maintenance is every six months.

4.2. Maintenance Procedure

1) Check the connection reliability of the wires, if necessary, clamp with the force specified in Table 1;
2) Visually check the integrity of the housing;

3) If necessary, wipe the front panel and the housing of the device with cloth.
Do not use abrasives and solvents for cleaning.

5. SERVICE LIFE AND MANUFACTURER WARRANTY

5.1. The lifetime of the device is 10 years. Upon expiration of the service life, contact the manufacturer.
5.2. Shelf life is 3 years.
5.3. Warranty period of the device operation is 5 years from the date of sale.
During the warranty period of operation, the manufacturer performs free repair of the device, if the user has complied with the requirements of the Operating Manual.
ATTENTION!
THE USER LOSES THE RIGHT FOR WARRANTY SERVICE IF THE DEVICE IS USED WITH VIOLATION OF THE REQUIREMENTS OF THIS OPERATION MANUAL.
5.4. Warranty service is performed at the place of purchase or by the manufacturer of the device.
5.5. Post-warranty service of the device is performed by the manufacturer at current rates.
5.6. Before sending for repair, the device should be packed in the original or other packing excluding mechanical damage.
You are kindly requested, in case of the device return and transfer it to the warranty (post-warranty) service please indicate detailed reason for the return in the field of the claims data.

6. TRANSPORTATION AND STORAGE

The device in the original package is permitted to be transported and stored at the temperature from minus 45 to +60 °C and relative humidity of no more than 80 %, not in aggressive environment.

7. ACCEPTANCE CERTIFICATE

The device No. _____ is checked for operability and accepted in accordance with the requirements of the current technical documentation, is classified as fit for operation.

Head of QCD _____

Seal Date of manufacture: _____

8. CLAIMS DATA

The Manufacturer is grateful to you for the information about the quality of the device as well as for comments and suggestions for its operation:

_____
_____
_____

For all questions, please contact the manufacturer:
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