NOVATEK-ELECTRO LTD
Research-and-Manufacture Company

HEATING CONTROL UNIT

TR – 102

OPERATING MANUAL

Quality control system on the production complies with requirements ISO 9001:2008

Review the Operating manual before using the unit

UKRAINE, Odessa

www.novatek-electro.com

When moving from a cold to a warm location or, conversely, the details of the device can cause condensation that can cause undesired operation. In this case, before connecting the device to the mains keep it within two hours of operating conditions.
Never use abrasive materials or organic substances (alcohol, gasoline, solvents, etc.) to clean the device.


NEVER ATTEMPT TO REMOVE AND REPAIR THE UNIT.
Some of the unit components may be live.


NEVER ATTEMPT TO OPEN AND REPAIR THE PROTECTED EQUIPMENT, IF SWITCHED TO THE UNIT SOCKET.


NEVER ATTEMPT TO OPERATE THE UNIT WITH THE MECHANICAL DAMAGE OF THE HOUSING.
NEVER ATTEMPT TO OPERATE THE UNIT UNDER CONDITIONS OF HIGH HUMIDITY.
Do not let water into the unit.

Subject to the rules of operation of the device is safe to use

INTRODUCTION

This manual is provided in order to introduce the operating personnel to structure, operating principles, design, mode of operation and maintenance of TR-102 heating control unit (further referred to as “device”, “TR-102” or “TR-102 unit”).

1 APPLICATION

TR-102 is designed to maintain the temperature in four areas through the contacts of heat regulator (bimetallic sensor). The temperature is maintained in cycles with the indication of present controlled area.

The device allows for performing the following functions:

- Maintaining temperature in four thermal area in cycles;
- Blocking control over the uncontrolled area;
- Displaying information on the controlled area and time of control on the integrated LED display;
- Transferring information on the controlled areas to the PC via Modbus RTU standard protocol;
- Programming by the front panel keys and via PC;
- Settings backup when de-energized;
- Settings protection from unauthorized change.

TR-102 has a flexible power supply and can use any voltage from 24 to 260 V, regardless of polarity.

The bimetallic sensor of heat regulator is used as a sensor for TR-102 (functioning logic is set by the user at the programming stage).

2 TECHNICAL BRIEF AND OPERATING CONDITIONS

2.1 The basic technical parameters are shown below in table 2.1.

Table 2.1

Supply voltage, V				24 – 260 AC/DC
Recommended fuse, A				1 – 2
Types of sensor, "dry contact"				Bimetallic sensor
Quantity of sensors connectable, pcs				1 – 4
Quantity of output relays, pcs				4
Data memory, years, ≥				10
RS-485 MODBUS RTU				available
Protection degree: - enclosure - terminal block				IP30 IP20
Climatic resistance version				UHL3.1
Power consumption (under load), ≤, VA				4.0
Weight, ≤, kg				0.370
Dimensions, mm				90 x 139 x 63
Output contacts specification				
Cos φ	**Max. current U~ 250 V AC**	**Maximum power**	**Max. voltage ~**	**Max. current for U = 30V D.C.**
1.0	10 A	2500 VA	440 V	3 A
Output contacts commutation lifetime: - electrical life 10A, 250V AC, times, ≥ - electrical life 10A, 24V DC, times, ≥				 100 thousand 100 thousand
Mounting onto standard 35 mm DIN-rail				
Mounting position any				

2.2 The device is designed for operating under the following environment:

- Ambient temperature: from 35 °C to +55 °C;
- Storage temperature: from 45 °C to +70 °C;
- Atmospheric pressure from 84 to 106.7 KPa;
- Relative air humidity (at temperature 35 °C) 30…80%.

3 EQUIPMENT DESIGN AND OPERATION

3.1 TR-102 DEVICE EQUIPMENT

3.1.1 Design

The device is manufactured in plastic casing (9 S-type modules) to be mounted onto standard DIN rail. The casing outline with overall and mounting dimensions is presented in Figure 3.1.

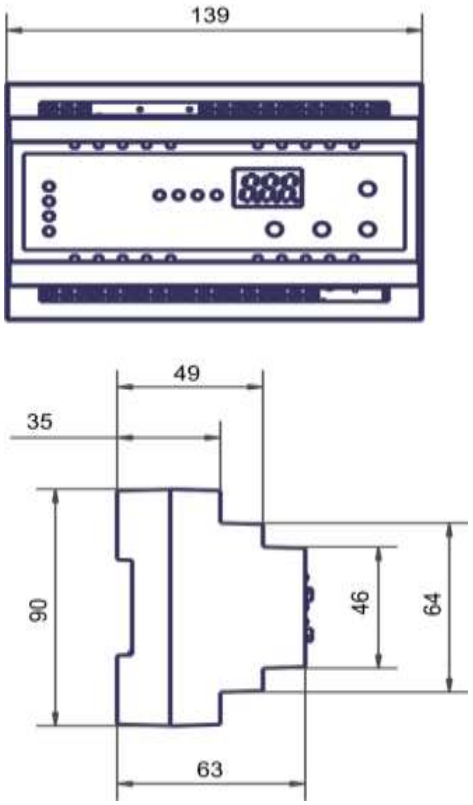

Figure 3.1 – TR-102 dimensions

3.1.2 Displaying and control

Figure 3.2 presents the TR-102 front panel exterior.

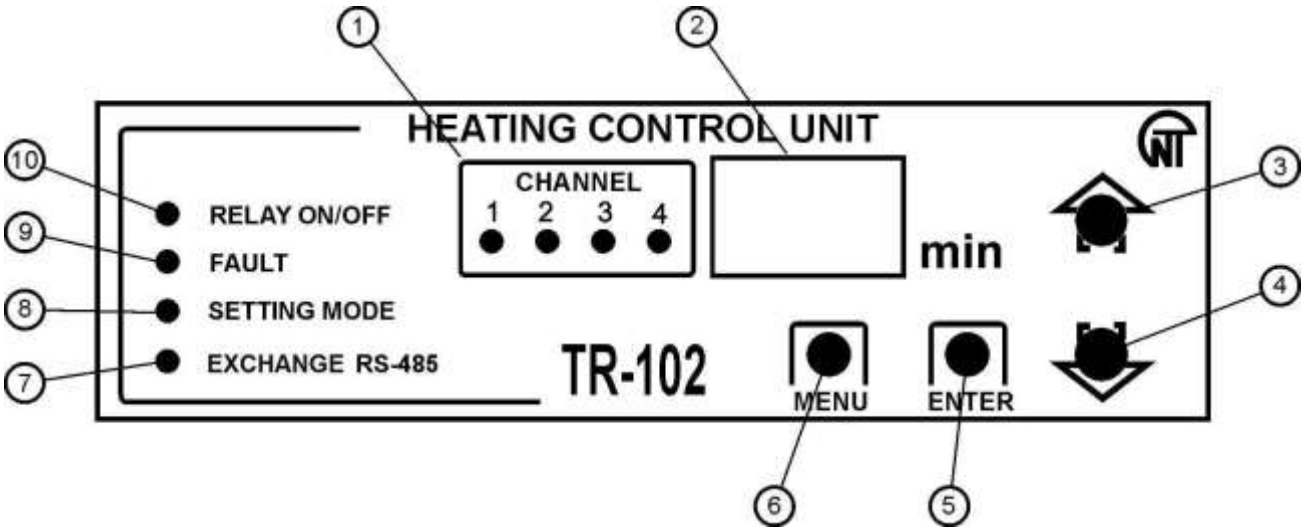

Figure 3.2 – TP–102 Front Panel

1 – Indicator of the number of present controlled channel;
2 – Seven-digit numerical display;
3 – Up key;
4 – Down key;
5 – Enter key, used in the device programming mode;
6 – View mode and parameters programming mode enter key;
7 – RS-485 connection and communication activity indicator;
8 – Parameter programming mode indicator;
9 – Device failure indicator;
10 – Loading relay close (open) indicator;

Device control:

- Use MENU key to enter the parameter view mode;

- To enter the parameter programming mode - press MENU key and hold it within 7 seconds, the “setting” indicator (fig. 3.2, 8) shall light.
- To list the menu and parameters – press ▼ ▲;
- To save modified value – use ENTER key;
- If no key has been pressed within 20 sec, TR-102 will display EHt sign (within 1 sec), and will switch to the initial state.

3.2 OPERATING PRINCIPLE AND INPUT SIGNAL PROCESSING

3.2.1 Operating principle

In course of its operation, TR-102 performs input sensors scanning. Depending on the selected function logics (normally closed or normally opened contact shall be considered as a signal, parameter cht) and in case of receiving a signal from the first sensor, the proper K1 relay shall be activated, contacts 8 and 9 closed, contacts 7 and 8 opened, the indicator starts displaying the time count, and the rest three channels 2, 3, and 4 are blocked. When the signal of the first sensor disappears or upon the end of the fixed time t.On (default value - 40 minutes), the loading relay of the first sensor is deactivated and TR-102 starts controlling the second sensor, then the third and the forth. The cycle is than repeated. All three sensors operate around a circle, with no priority. If no signal was provided to the TR-102 from any sensor, it will turn to control the other sensor.

While controlling one channel, the other three channels are blocked.

3.2.2 Input signal processing.

The TR-102 provides for a selection of functioning logics with respect to the sensors: normally closed or normally opened contact.

3.3. RS-485 COMMUNICATION INTERFACE

The use of communication interface is covered in Appendix A.

4 MAINTENANCE AND SAFETY

4.1 SAFETY

Open terminals of the device carry dangerous voltage of up to 260 V. Any connections to the device and its maintenance operations must be performed only on de-energized device and executive units.

Ingress of moisture to the output terminals and the device inside electronic elements is not allowed. The use of the device in aggressive environments containing acids, alkali, oils, etc. is prohibited.

The device connection, adjustment and maintenance must be performed only by authorized personnel that is familiar with this manual.

4.2 MAINTENANCE SCHEDULE

Recommended maintenance schedule – semiannually.

Maintenance scheduled operations consist of visual observation, during which wiring connection to terminals is checked, frame and casing integrity check for cracking and chipping.

During maintenance operations, the safety precautions listed in chapter 4.1 must be followed.

5 DEVICE CONNECTION

5.1 PERIPHERY CONNECTIONS

5.1.1 General instructions

Prepare cables for connecting the device to sensors, execution mechanisms and peripheral equipment, as well as to the power supply. To provide for the electric connections reliability it is recommended to use cables with copper stranded wires, the ends of which should be carefully cleaned and soldered prior to connecting. The wire core shall be cleared in such way, that its bare ends would not project beyond the terminals after connection to the device. The cable section must not exceed 2.5 mm^2.

5.1.2 Mounting instructions aimed at electromagnetic interference reduction.

When laying the “device-sensor” lines, they should be separated into an individual tract (or several tracts). The tracts shall be placed separately from the power cables, as well as from cables that produce high frequency and pulse interference.

5.1.3 Mounting instructions aimed at reduction of the power circuit interference.

The device shall be connected to 230 V 50 Hz, circuit feeder that is not connected with supplying power to heavy-duty industrial equipment. It is recommended installing in the peripheral supply line a feed switch providing disconnecting the device from the circuit, as well as 1A fuses.

5.2 DEVICE CONNECTION

The device shall be connected in accordance with the diagram on figure 5.1, observing the listed below sequence:

A) Connect the device to power supply and execution units;

B) Connect the “device-sensor” communication lines to the device inputs.

ATTENTION! The device terminals for connecting power circuit and peripheral heavy-duty equipment are designed for max voltage of 260 V. To avoid disruptive electric discharge or insulation arc-over it is prohibited to connect power sources with higher voltage that one mentioned to the device terminals.

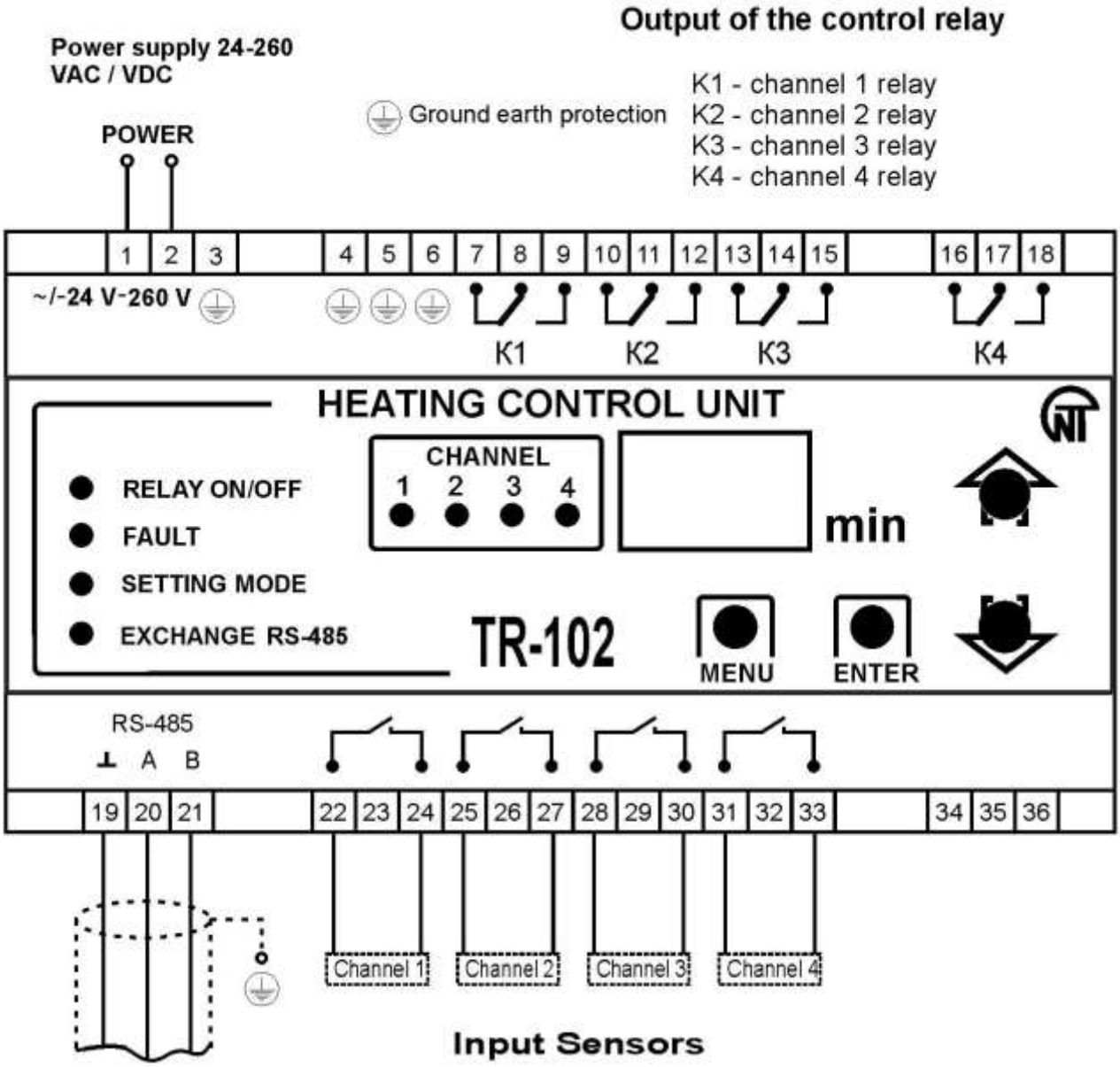

Figure 5.1 – TR–102 Connection Diagram

6 TR-102 OPERATION

6.1 GENERAL INFORMATION

6.1.1 When the device is powered on, all displays light up for 2 seconds. "---" symbols appear on the display, and the indicators of active channels are starting to switch with an interval of 1 second (defining what channel is currently monitored). When a signal is received from the monitored channel, a proper loading relay is activated and the digital display starts the time count with a blinking of a decimal point. The indicator of the channel number is activated all the time showing the number of the controlled channel. The loading relay will deactivate at the end of the time count or in case of signal failure of the sensor, and the process starts from the beginning.

The blinking of a decimal point occurs at an interval of 0.5 seconds.

6.1.2 In case of certain faults presence, the device displays the error code (Table 6.1).

Table 6.1

FAILURE	NOTE
Parameter error	Instead of the faulty parameter TR-102 loads the default value, the display shows ErP and TR-102 continues to function normally.
EEPROM failure	All relays are open and the display outputs message. EEP

7 PROGRAMMING

7.1. GENERAL INFORMATION

7.1.1 Programmable parameters are set by the user during programming session and are stored in device's nonvolatile memory.

The complete list of programmable parameter registers is given in table 7.1.

Table 7.1

Address	PARAMETER	Mnemonic	MIN/MAX	FACTORY SETTING	ACTION
dec	General				
21	Operating time	t.On	1/300 min	40	Operation time limit of the loading. The relay will deactivate at the end of the time irrespective of the sensor signal.
22	Operating time	t.OF	0/t.On min	0	Minimum operation time limit of the loading. The relay will deactivate at the end of the time in case of no signal from the sensor. Maximum value of the t.OF parameter is limited by the value of the t.On parameter.
23	Sensor logics	cht	0/1	0	Sensor logics: 0 – sensor is operating for closing; 1 – sensor is operating for opening.
	System parameters				
24	Password	PAS	000/999	000	000 – password is off, any other value activates password prompt
25	Reset	rSt	0/1	0	Resetting all settings to factory values 0 – do not reset; 1 – reset all parameters to default.
26	Version	uEr	*	30	Device version
	RS-485				
27	Switching	rSA	0/2	0	RS-485 ON/OFF: 0- OFF; 1 – ON; 2 – Remote Control for Power Relays.
28	Identifier	rSn	1/247	1	Device number (network address)
29	Bitrate	rSS	0/2	1	Data transfer bitrate: 0 – 2400 (bps); 1 – 4800 (bps) 2 – 9600 (bps);
30	Timing	rSL	0/999	0	Time delay for response. (x100us) One unit is equal to 100 us.

* - read-only parameter

7.1.2 Viewing parameters.

To view parameters, press MENU key once, the display will show parameter 1 from Table 7.1. To scroll the parameters press the ▼ ▲ button, to view the parameters press the MENU button, to return to the menu press MENU button.

7.1.3 Editing parameters.

To edit parameters, press and hold MENU key for 7 seconds, at that:

- If a password had been set up, enter it. Use ▼ ▲ keys to change current position, use MENU key to move to next position, use ENTER key to confirm the password. Cancel password prompt - if no key has been pressed during 20 sec the TR-102 device returns to the initial state.
- If the entered password is correct, the "Settings" LED will light, Figure 3.2 (8), and the display will present the first parameter from Table 7.1.
- If the password entered is incorrect, the TR-102 will return to its initial state.

• If PAS has been set to “0”, password prompt will not be activated. “Settings” LED will light (Figure 3.2 (8)), and the display will present the first parameter from Table 7.1.

Use ▼ ▲ keys to toggle parameters, use ENTER key to store parameter and return to menu, to return to menu without storing parameter, press MENU key. If no key is pressed during 20 sec the device goes into the initial state.

7.1.4 Reset to factory settings

• In the parameter edit mode (p.7.1.3) set rSt parameter to 1 and press ENTER key, after that, the device will perform resetting to default factory set parameters. Password will not be reset in this case.

• Energize the device while pressing down ▼ ▲ keys and hold them pressed for over 2 seconds, at that the display will show nAU message; release the keys. TR-102 will perform resetting to default factory set parameters in 6 seconds, to include the password (the password is deactivated by default).

7.2 PROGRAMMING SEQUENCE.

7.2.1 Setting up parameters for the functioning logic of the sensors

7.2.1.1 Enter the cht parameter value in accordance with the used type of logic:

0 – closed contact shall be considered as a signal of the sensor;

1 – opened contact shall be considered as a signal of the sensor;

7.2.2 Setting up parameters for the operating time of the loading relay

7.2.2.1 Setting up the t.On parameter may be required to limit the operating time of the loading. The loading relay is deactivated at the end of the time t.On in the presence of a signal from the sensor. (Default value is 40 minutes)

7.2.2.2 Setting up the t.OF parameter may be required to control the minimum operating time of the loading relay. The loading relay is deactivated at the end of the time t.OF in case of no signal from the sensor. (Default value is 0 minutes)

8 WARRANTY AND CLAIMS CONDITIONS

Service life is 10 years. Refer to the manufacturer upon the expire of the service life.

Warranty period is 36 month upon the day of sale.

The manufacturer shall repair the unit, in the compliance with the operating manual by the user, within the warranty period.

TR-102 is not subject to the warranty service in the following cases:

- expiry of the warranty period;
- availability of mechanical damages;
- attempts to open and repair ;
- traces of moisture attack or in the presence of foreign items inside the unit;
- damage caused by an electric current or voltage values which exceed the nameplate, improper or careless handling of the product is not subject to the instructions for installation and use;
- damage is caused by electric current or voltage in excess to the permissible values as indicated in the Operating manual.

Warranty service is provided in the place of purchase.

Post-warranty service shall be provided by the manufacturer.

9 TRANSPORTATION

Transportation of TR-102 in package may be performed by any type of transport according to the transportation rules and regulations valid for such mode transportation.

During transportation, shipping and storing in a warehouse TR-102 must be protected form blows, shocks and moisture.

10 ACCEPTANCE CERTIFICATE

The TR-102 heating control unit has been manufactured and accepted in conformity with the requirements of current technical documentation, and is approved fit for operation.

APPENDIX A

1 RS-485 COMMUNICATION INTERFACE

1.1 GENERAL INSTRUCTIONS

The communication interface is designed to connect the TR-102 to the mains in compliance with the RS-485 standard. Operating the device with the RS-485 mains provides with the following functions.

- Collecting data within SCADA system;
- Programming the device with the PC;
- Remote control of the channels output relays.

RS-485 as an interface standard has found extensive industrial application; it provides for establishing networks with node count of up to 247 and data transfer at distance of up to 1200 m. With use of duplicators, the number of nodes and the transmission distance can be increased.

All network devices are connected in a serial bus (Figure A1). To maintain the reliable operation of transmitters/receivers and to eliminate interference impact, the communication line ends must be equipped with a terminating resistor of impedance Rсогл = 120 Ohm that is connected immediately to the device terminals (see Figure A1).

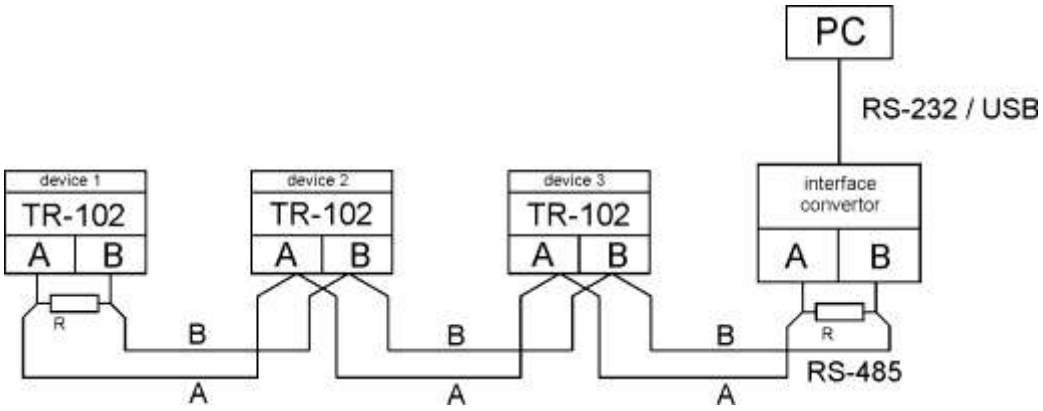

Figure A1

The device is connected to a PC via RS-485 / RS-232 or RS-485 / USB interface adapter.

The data exchange may take place at one of the following bitrates: 2400, 4800, and 9600 bps.

1.2 REMOTE CONTROL FOR POWER RELAYS

When the rSA parameter is set as = 2 (table 7.1), the device is shifted into the Remote control for power relays mode. The control registers are specified in table A2 (6 – 9). Corresponding loading relays can be turned on and off by entering values 0 or 1 into these registers.

After the Remote control for power relays mode has been set, the TR-102 continues to operate in the usual mode, except that the power relay control is passed to the remote operator.

1.3 DATA EXCHANGE VIA RS-485 INTERFACE SETUP

The data exchange is set by the following parameters:

rSA - assigns RS-485 activation (deactivation) and the output relay terminals remote control mode;

rSn - device base address (1 … 247);

rSS - network data exchange bitrates (2400, 4800, 9600 bps);

rSt - time delay for the response of the package 0-99.9us.

TR-102 has the following set data exchange parameters the are not displayed:

Number of stop-bits – 2; Data word length– 8; Parity control – none.

ATTENTION! New parameter values become active only after the device has been reloaded (de-energized, then re-energized) or reset via RS-485.

1.4 DATA EXCHANGE VIA RS-485 INTERFACE.

1.4.1 A proper connection should be made (see p.1.1 A1) and proper network settings (see p.1.3 A.1) introduced to operate through the RS-485 interface.

1.4.2 To establish network data exchange via RS-485 interface, the Network Guide is required; its main function is to initiate data exchange between the data sender and receiver. A PC with connected interface adapter can be used as the Network Guide.

TR-102 can function in Slave mode within the ModBus RTU data exchange protocol.

1.4.3 ModBus is an open networking protocol developed by Modicon Company. The protocol description is available at www.modbus-ida.org.

The addresses of programmable parameter registers are given in table 7.1.

The list of supported functions (Modbus) is provided in table A1.

Additional registers and their functions are shown in table A2.

Table A1

FUNCTION (hex)		DESCRIPTION	NOTE
0x03		Receiving value of one or several registers	Maximum 125
0x06		Recording one value to the register	
0x08	0x00	Return query data	Diagnostics
	0x01	Communication options restart	
	0x04	Setting up “listen only” mode	

Table A2

ADDRESS (dec)	NAME	DESCRIPTION		NOTE
0	Device identifier	MSB	TR-102 – 0x0001	ID
1		LSB	Firmware - v30.	Version
2	TR-102 status register	bit 0	0 - no fault 1- fault (code in fault register)	bit 9 – bit 15 reserved
		bit 1	0 – channel 1 relay open; 1 – channel 1 relay closed;	
		bit 2	0 – channel 2 relay open; 1 – channel 2 relay closed;	
		bit 3	0 – channel 3 relay open; 1 – channel 3 relay closed;	
		bit 4	0 – channel 4 relay open; 1 – channel 4 relay closed;	
		bit 5	0 – sensor 1 signal failure; 1 – sensor 1 signal available;	
		bit 6	0 – sensor 2 signal failure; 1 – sensor 2 signal available;	
		bit 7	0 – sensor 3 signal failure; 1 – sensor 3 signal available;	
		bit 8	0 – sensor 4 signal failure; 1 – sensor 4 signal available;	
3	Fault register	bit 0	0 - no fault 1– EEPROM failure. EEP	bit 2 – bit 15 reserved
		bit 1	0 - no fault parameters error	
4	Time register t.On	Remaining time of the timer. t.On		minutes
5	Time register t.OF	Remaining time of the timer. t.OF		minutes
6	Relay 1 control register	0 – open relay; 1 – closed relay.		Channel 1
7	Relay 2 control register	0 – open relay; 1 – closed relay.		Channel 2
8	Relay 3 control register	0 – open relay; 1 – closed relay.		Channel 3
9	Relay 4 control register	0 – open relay; 1 – closed relay.		Channel 4
10-20		Registers 10-20 are reserved		always equal to 0