DIGITAL TEMPERATURE RELAY

TR-100

OPERATING MANUAL

Quality control system on the development and production complies with requirements ISO 9001:2015

Dear customer,

Company NOVATEK-ELECTRO LTD. thanks you for purchasing our products.
You will be able to use properly the product after carefully studying the Operating Manual.
Keep the Operating Manual throughout the service life of the product.

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

WARNING! – PRODUCT TERMINALS AND INTERNAL COMPONENTS ARE UNDER POTENTIALLY LETHAL VOLTAGE
TO ENSURE THE PRODUCT SAFE OPERATION IT IS STRICTLY FORBIDDEN THE FOLLOWING:

– **TO CARRY OUT MOUNTING WORKS AND MAINTENANCE <u>WITHOUT DISCONNECTING THE PRODUCT FROM THE MAINS;</u>**

– **TO OPEN AND REPAIR THE PRODUCT INDEPENDENTLY;**

– **TO OPERATE THE PRODUCT WITH MECHANICAL DAMAGES OF THE CASE.**

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

ATTENTION!
1) THE PRODUCT IS NOT DESIGNED FOR LOAD COMMUTATION IN CASE OF SHORT CIRCUITS. THEREFORE, THE PRODUCT MUST BE OPERATED IN AN ELECTRIC MAINS PROTECTED BY AN AUTOMATIC CIRCUIT BREAKER WITH TRIPPING CURRENT NOT EXCEEDING 10 A.
2) DO NOT CONNECT THE LOAD OVER 2.5 kW TO THE PRODUCT.

To improve performance, it is recommended to use the product at load currents not exceeding 70% of the maximum value when digital filters are disabled.

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 when in Operation of Electrical Installations.

Installation, adjustment and maintenance of the product must be performed by qualified personnel having studied this Operating Manual.

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

Service manual is intended for getting acquaints with hardware, operation principals, modes of functioning and sitting rules of digital temperature relay TR-100 (hereinafter referred to as the "product", "TR-100").

The product meets the requirements of the following:

- EN 60947-1;
- EN 60947-6-2;
- EN 55011;
- EN 61000-4-2.

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

1. OPERATION AND DESCRIPTION

1.1. FUNCTION

TR-100 is designed for take measurement and control of temperature of product by 4 sensors which are may connected by two or three wire connection scheme. Temperatures will be indicated on digital display. It is possible to use alarm signals when some of parameters come out of user adjusted ranges. TR-100 can be use for protection of:

- Motors and generators;
- Tree-phase dry-type transformers with additional thermal sensors of core or environment.

TR-100 equipped for universal adapter and therefore it can use power supply from 24 to 260 V without reference to polarity.

In the capacity of thermal sensors, TR-100 is able to use next types of transducers:

- PT100 – Platinum transducer with rated resistance is 100 Ohms (0 °C);
- PT1000 – Platinum transducer with rated resistance is 1000 Ohms (0 °C);
- KTY83 – Silicon transducer with rated resistance is 1000 Ohms (25 °C);
- KTY84 – Silicon transducer with rated resistance is 1000 Ohms (100 °C);
- PTC (1, 3, 6 cascade) cold resistance of transducer is 20-250 Ohms;

1.2 TECHNICAL CHARACTERISTICS

1.2.1 Main technical characteristic are in the Table 1, which is given below.

Table 1

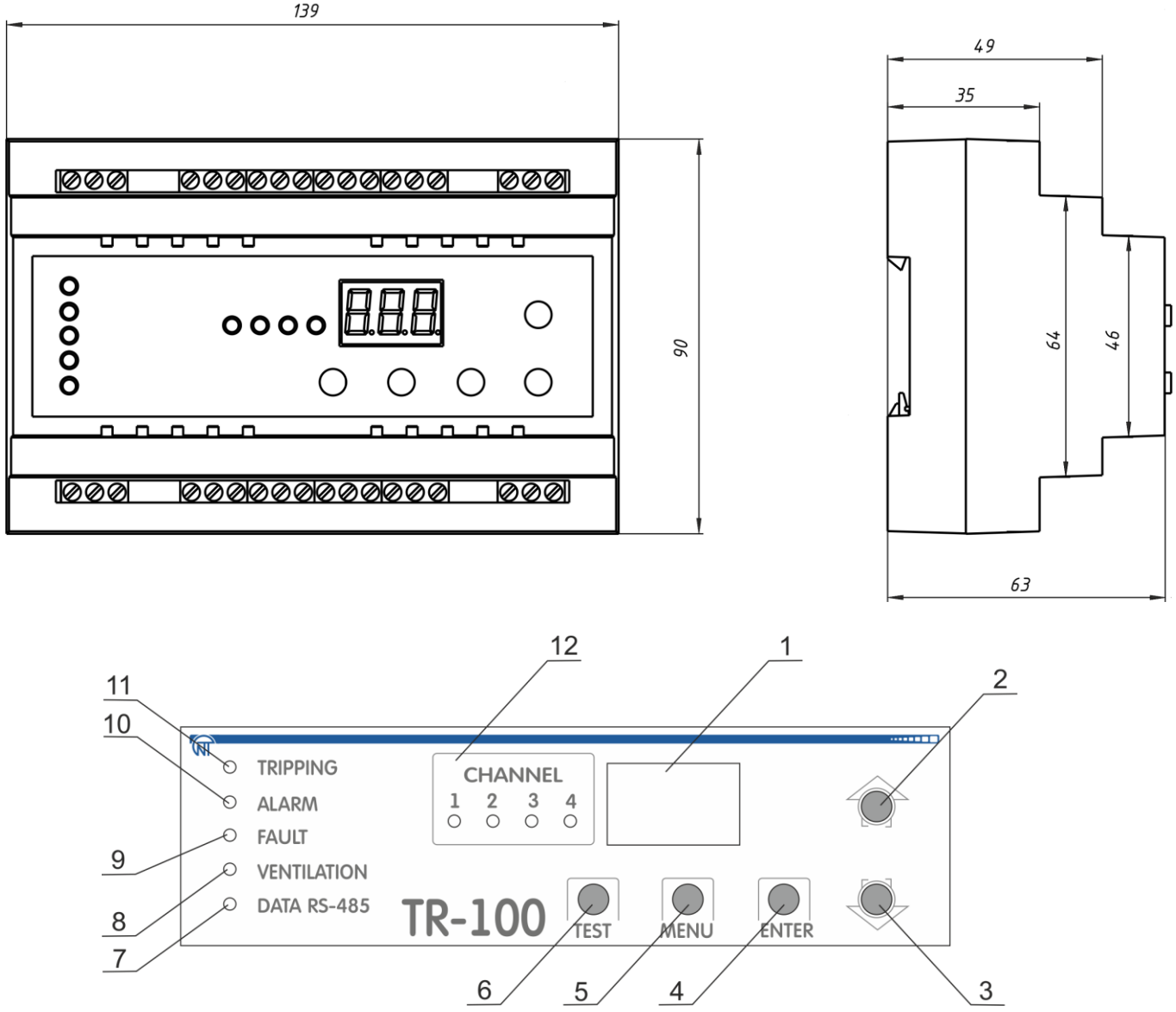
Supply power, V	24 – 260 AC/DC
Recommended fuse for equipment protection, A	1 – 2
Thermal transducers	PT100, PT1000, KTY83, KTY84, PTC
Connectable transducers, pcs.*	1 – 4
Method of hardwire	2 / 3 wired
Wire length of sensor (depending on method of hardwire), m:	2 wired up to 5 3 wired up to100
Amount of output relay, pcs.	4
Date-hold time, years, not less then	15
Temperature measurement error, °C	± 3
Temperature measurement range, °C	from - 40 to +240
Output relay test	Yes
Indication test	Yes
RS-485 MODBUS RTU	Yes
Time measurement, sec.**	≤ 2
Degree of protection: - body - terminal block	IP30 IP20
Climatic execution	NF 3.1
Power input (power load), VA, no more than	4.0
Weight, kg, no more then	0.370
Dimensions, mm	90 x 139 x 63
Operation temperature range, °C	from -40 to +55
Storage temperature, °C	from -50 to +60
Permissible contamination level	II
Overvoltage category	II
Rated insulation voltage, V	450
Rated impulse withstand voltage, kV	2.5
Wire cross-section for connection to terminals, mm²	0.5 – 2.0
Tightening torque of terminal screws, N*m	0.4
Commutation life of the output contacts: - under 10 A 250 V AC, times, not less than - under 3 A 24 V DC, times, not less than	 100 000 100 000

Montage to standard 35mm mounting frame
Free position in space
____ ** PTC transducers can be switched in series (1, 3, 6 pc.)* *** with digital filters disabled*

Characteristic of output contacts

Cos φ	Max. Current (U~250B)	Max. Power	Max. Voltage.~	Max. Current (U_{DC} =30B)
1.0	10 A	2500 VA	440 B	3 A

1.2.2 Appearance and dimensions are given at picture below.



1 – Digital display;
2 – Up button;
3 – Down button;
4 – Use to confirm adjusted sittings and to exit from programming mode;
5 – Button for entering in the view mode or programming mode;
6 – Test indication button;
7 – Indicator for switching on and actual connection with RS-485;
8 – Indicator for work of ventilation;
9 – Indicator for failure of product and switching on of bug relay;
10 – Indicator for ON state of alarm relay or for programmed mode is ON;
11 – Indication of tripping is ON;
12 –Indicator for number of current display channel.

Picture 1 – Appearance and dimensions

Indicators (7, 8, 12) image corresponded to itself parameters (ON / OFF), **(**FAn, rSA, ch 1, ch2, ch3, ch4**,** *Table 3).*

2. TR-100 OPERATION AND APPLICATION

2.1. TR-100 START-UP

2.1.1. Safety

All connection must be completed only BEFORE TR-100 gets power supply.

When testing the insulation of transformers for dielectric breakdown, it is necessary to disconnect all temperature transducers from the TR-100 temperature relay.

2.1.2. Connection TR-100 must be according to picture 2.

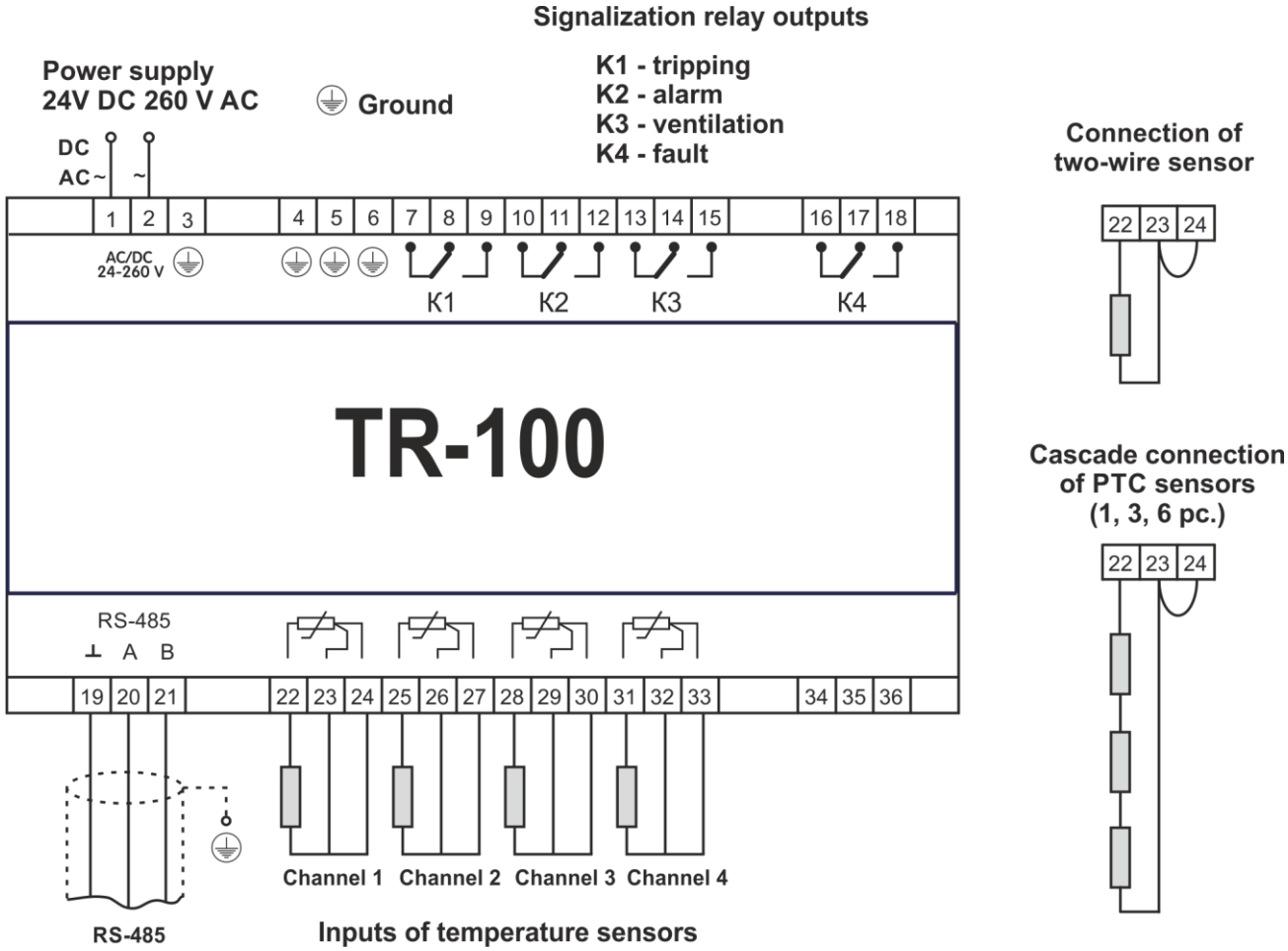
The TR-100 housing has insulation class II, which does not require a ground connection.

Terminals 3, 4, 5 and 6 are intended for connecting the ground in case the instrument readings are incorrect due to the interference effect on the measuring lines or internal elements of the TR-100, and by connecting the ground it is possible to reduce the influence.

***Note**:* All measurement transmission cables from temperature sensors should be corresponded with next requirements:

- Made of shielded twisted-pair cable (triplet), cable cross must be at least 0.5 mm²;
- Transducer cable shields should be connected to the ground;
- Hard connection to product clamps;
- Connection route must be separated from high voltage cables and from cables make inductive load;
- All cables must be in equal length.

2.1.3. Turn the power supply on and adjust, if it necessary, modes of operation in according to Table 3.



Picture 2 – Electrical connections of TR-100

2.2. APPLICATION TR-100

If the temperature of one of the transducers exceeds the temperature of the set threshold of ALARM (AL r for channels 1, 2, 3 and AL4 for channel 4 see Table 3), after the set time dLA the ALARM relay is ON with the appropriate indication.

The same thing happens when the tripping temperature threshold is exceeded (tr P for channels 1, 2, 3 and tP4 for channel 4), after a set time dLA the TRIP relay is ON with the appropriate indication.

Disabling of the ALARM relay will occur when the temperature of all transducer is lower than AL r - dFA (for channels 1, 2, 3) and AL4 – dA4 (for channel 4).

Disabling of the TRIP relay will occur when the temperature of all transducer is lower than trP - dFt (for channels 1, 2, 3) и tP4 – dP4 (for channel 4).

When the ALARM and TRIP relays are disabled, the corresponding LED indicators are also off.

2.2.1. Control TR-100

In initial state TR-100 indicates temperatures of sensors which are ON, in turns with 4 seconds interval (if parameter dSP is adjusted as 2).

Equipment control is carried out as follows:

- To changing between channels press ▼ ▲ buttons;
- To check all LED indicators press TEST button;
- To entering in view mode press MENU button;
- To entering in adjusting of parameter mode press and hold MENU button for 7 seconds.
- TR-100 display End (for 1 seconds) and return to initial state, unless any button has pressed for 20 seconds.

2.2.1.1. Viewing of parameters.

To viewing of parameters, press MENU once, LED indicator “**FAULT**” (pic.1 pt.9) will **ON** and first parameter of Table 3 will appear on the digital display.

Use ▼ ▲ buttons for scrolling. To enter in menu item, press MENU button, to return to previous item, press MENU once again. If any buttons are in inaction for more than 20 seconds, TR-100 will return to initial mode. In viewing mode, changing of parameters is impossible.

2.2.1.2 Changing of parameters.

To changing of parameters, press and hold MENU button for 7 seconds, and:

- If password has set, type it. Changing of current value digit due ▼ ▲ buttons, changeover to next item by MENU button. To confirm password press ENTER button. Cancel of password - if any buttons are inaction for more than 20 seconds, TR-100 will return to initial mode.
- If entered password is correct, then LED indicator “ALARM” (pic.1 pt.10) will ON and first parameter of Table 3 will appear on the digital display.
- If entered password is NOT correct, then TR-100 will return to initial mode.
- If PAS is set as “000”, then password checking will NOT affected, LED indicator “ALARM” (pic.1 pt.10) will ON and first parameter of Table 3 will appear on digital display.

Scrolling of parameters due ▼ ▲ buttons, to enter in menu item, press MENU button, to change value use ▼ ▲ button, to confirm adjusted parameters and to return to menu press ENTER button. Exit from menu without saving due MENU button. If any buttons are in inaction for more than 20 seconds, TR-100 will return to initial mode.

2.2.2. Restore factory defaults

There are two ways to restore factory defaults:

- Set rSt parameter as 1 when product is in change parameters mode, and press ENTER button whereupon TR-100 will be restarted with factory defaults. In this case, password WON’T be restored.
- Hold both ▼ ▲ buttons as pressed and Turn the supply power **ON**. Keep button holding for more than 2 seconds, whereupon nAU will appear on the digital display, release buttons. Cut off power. Factory defaults will be restored as well as password (password disable).

2.2.3. Testing TR-100.

2.2.3.1 Testing of LED indication.

Press TEST button, all LED indicators will ON for 5 seconds. If at least one of them does NOT light, TR-100 is considered faulty and requires under repair. During test of LED indication TR-100 continue normal operation.

2.2.3.2 Testing of output relays.

In TR-100 testing all relays together is provided and each relay separately, for this it is necessary:

• In change parameters mode, set value of tSt parameter according with Table 3 and press ENTER button, thus on the digital display oFF will be showed (it means testing relay stays in normally open (OFF) conditional) and all LED indicators will be OFF.

• Condition of testing relay change due single press ENTER button:
  oFF - Relay stays in open (OFF) condition;
  on - Relay stays in close (ON) condition.

Press MENU button to return in menu. If any buttons are in inaction for more than 20 seconds, TR-100 will return to initial mode.

2.2.4. Usage ventilation.

TR-100 is able to control of switching on and cutting off of cooling fan, for this it is necessary to set value of FAn parameter as different from 0 (see Table 3):

• *Mode 1* – In this mode, temperature is detected due THREE sensors 1, 2 and 3. As soon as temperature of one of sensors exceed of temperature of adjusted threshold of switching on of ventilation F.On, ventilation relay will ON with corresponding indication (flashing of LED indicator "VENTILATION" pic.1). Cutting off of ventilation relay will occur, if temperatures of all sensors drop below than F.On - dFF;

• *Mode 2* - in this mode, the temperature is determined by four transducers 1, 2, 3 and 4. Combination of mode 1 and mode 3;

• *Mode 3* - if channel 4 is enabled (ch4 = 1, see Table 3). In this mode the temperature is determined by the fourth transducer. As soon as the temperature of the transducer exceeds the temperature of the set threshold for cooling enabling Fn4, the FAN relay is on with the appropriate indication (LED "VENTILATION" is flashing, Fig. 1). Disabling the FAN relay will occur if the transducer temperature drops lower than Fn4 – dF4.

Notes:

1 *– LED "VENTILATION" (Fig. 1) is on when the cooling control is enabled (FAn not equal to 0) and flashes when the temperature of one of the transducers exceeds the temperature of the set threshold F.On (for channels 1, 2, 3) and Fn4 (for channel 4);*

2 *– the tripping time of the FAN relay after the temperature threshold has been exceeded F.On (for channels 1, 2, 3) and Fn4 (for channel 4) is 4 seconds (fixed time).*

2.2.5. Viewing of maximal reached temperature.

In TR-100 storage of maximal reached temperature of channel is provided. To display of maximal temperature it is necessary:

Come into menu of viewing or changing of parameters (pt.2.2.1.1 or pt.2.2.1.2), scroll to desired parameter (cn1/cn2/cn3/cn4 channels 1 to 4 accordingly) due ▼ ▲ buttons, press MENU button (enter in parameter), to restore maximal temperature press ENTER button. Return to menu - MENU button.

To restore temperature product should stays in change parameter mode.

2.2.6. Digital filtering

To improve the quality of the input signals the digital filters are used in the TR-100 to reduce the effect of random noise on the temperature measurement.

Programmable parameters:

- the digital filter band Frb;
- time constant of the digital filter Frt.

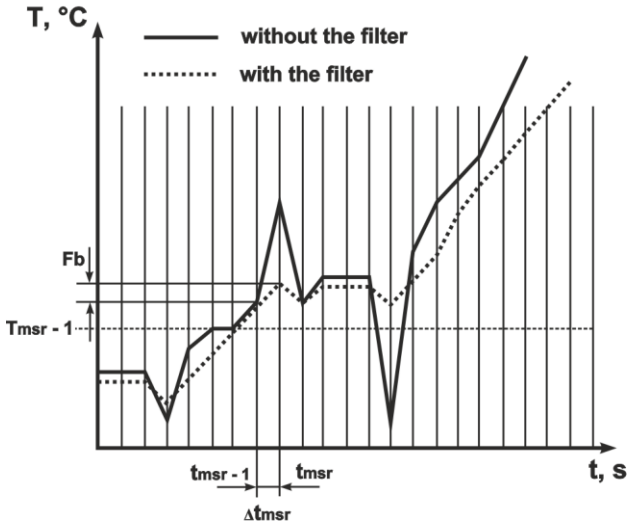
2.2.6.1 The band of the digital filter protects the measuring path against single interference and is set in degrees Celsius (ºC). If the measured value of "**Tmrs**" differs from the previous "**Tmrs** – 1" by a value greater than the parameter value Frb, the product assigns it a value equal to ("**Tmrs**" + Frb) (Fig. 3). Thus, the characteristic is smoothed.

As can be seen from Fig. 3, the small width of the filter band leads to a slower response of the product to a rapid temperature change. Therefore, in case of low noise level or when working with rapidly changing temperatures, it is recommended to increase the parameter value or disable the filter band effect by setting the parameter Frb to 0. When working in conditions of strong interference to eliminate their influence on the instrument operation, it is necessary to reduce the parameter value.

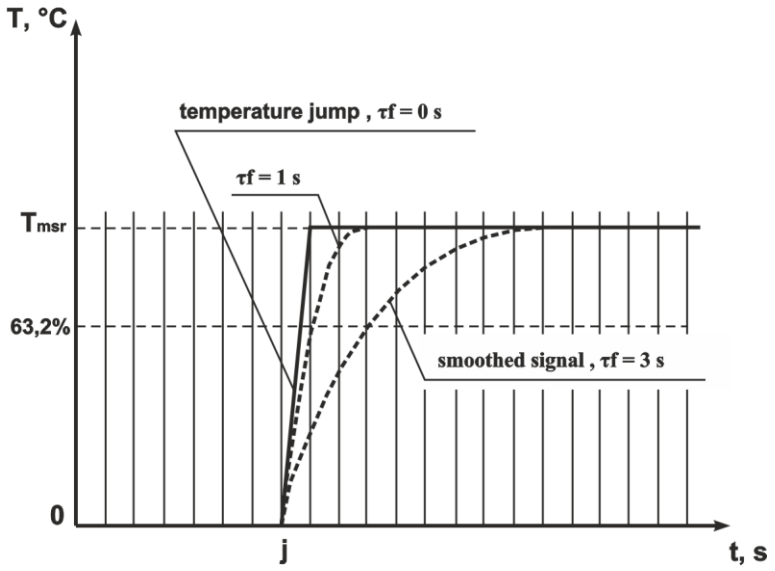
2.2.6.2 The digital filter eliminates the noise components of the signal by performing its exponential smoothing. The main characteristic of the exponential filter is:

"τf" is the time constant of the digital filter, the parameter Frt is the interval during which the temperature reaches **63.2%** of the measured value "Tmrs" (Fig. 4).

Reducing the value of **"τf"** leads to a faster response of the product to sudden changes in temperature, but reduces its noise immunity. Increasing **"τf"** increases the inertia of the product, the noise at the same time is significantly suppressed.



Picture 3



Picture 4

2.2.7. System of alert conditionals

Alert and tripping relays are ON only if threshold of adjusted temperatures is reached.

Fault relay operates in normally close conditional. It is ON, when product is turned ON, and it is OFF when there are faults of sensors or power is cut off, indication of faults is ON if there are faults of TR-100 or sensors. In case damage of one of connected thermal sensors indicators "TRIPPING", "ALARM", "FAULT" (pic.1) will be flashing, code of fault (Fcc/Foc) will be showed on the digital display and subsequent operation depends on adjustted parameter Act (see Table 3).

Kinds of faults are given in Table 2.

Table 2

CODE	Fault	Note
1	Error of parameter	TR-100 will load factory default instead of invalid parameter, thus ErP will be showed on the digital display and TR-100 will continue normal operation.
2	Fault EEPROM	All relay will OFF and EEP will be showed on the digital display.
3	Closing of any sensor	FAULT relay will OFF with corresponding indication, ALARM and TRIPPING indicators will be flashing. Fcc will be showed on the digital display.
4	Break of any sensor (except PTC)	FAULT relay will OFF with corresponding indication, alarm and tripping indicators will be flashing. Foc will be showed on the digital display.
5	Exceed of tripping temperature	Tripping relay will ON with corresponding indication on the channel.
6	Exceed of alarm temperature	Alarm relay will ON with corresponding indication.
7	Exceed of ventilation temperature	Ventilation relay will ON with corresponding indication.
8	Loss of connection with RS-485	"DATA RS-485" indicator will blink with 0,5 seconds interval.

2.2.8. Programming and using parameters of TR-100.

Programming and using parameters are given in Table 3.

Table 3

Address	Parameter	Mnemonics	Min./Max.	Factory Default	Action
hex	**General**				
0x100	Alarm	ALr	50/240 ºC	145	ALARM relay tripping temperature for channels 1, 2, 3
0x102	Diff. alarm	dFA	1/200 ºC	10	Differential of alarm disabling for channels 1, 2, 3

Address	Parameter	Mnemonics	Min./Max.	Factory Default	Action
0x104	Tripping	trP	50/240 ºC	155	TRIP relay tripping temperature for channels 1, 2, 3
0x106	Diff. Tripping	dFt	1/200 ºC	10	Differential of trip release for channels 1, 2, 3
0x108	Ventilation relay	FAn	0/3	1	Ventilation relay operation modes: 0 – Always OFF; 1 – works on channel1, 2, 3; 2 – works on channel 1, 2, 3, 4; 3 – works on 4th channel (if channel is ON).
0x10A	Ventilation is ON	F.On	30/240 ºC	130	Cooling enabling temperature for channels 1, 2, 3
0x10C	Diff. Ventilation	dF.F	1/200 ºC	20	Differential of cooling disabling for channels 1, 2, 3
0x10E	Delay	dLA	0/300 s	4	Delay of turning on when there is failure by temperature
0x110	Sensor malfunction	Act	0/2	0	Product action at sensor fault: 0 – indication with **fault** relay activation; 1 – pt.0 + switching on of **alarm** relay; 2 – pt.1 + switching on of **tripping** relay.
	RS-485				
0x112	Switching ON	rSA	0/2	0	Switching ON/Cutoff RS-485: 0 – OFF; 1 – ON. 2 – ON (remote operation by power relays)
0x114	Identifier	rSn	1/247	1	Product number (Net address)
0x116	Rate	rSS	0/3	2	Data transfer rate: 0 – 2400 (bit/sec); 1 – 4800 (bit/sec). 2 – 9600 (bit/sec); 3 – 19200 (bit/sec)
0x118	Parity	rSP	0/3	0	Parity check and stop bits: 0 – No : 2 stop bits 1 – Yes : even 2 – Yes : odd
0x11A	Timeout	rSL	0/300	0	Detection of connection loss (s): 0 – forbid (any other value activates current mode)
0x11C	Connection loss	AcL	0/1	0	Carrying out an action after connection loss: 0 – Only indication; 1 – Indication with switching on of fault relay
	System				
0x11E	Indication mode	dSP	0/2	2	Product indication mode of operation: 0 – the highest temperature is displayed with cannel number; 1 – user checks temperature manually; 2 – TR-100 displays temperature of sensors, which are ON, alternately with 4 s interval.
0x120	Test relays	tSt	0/4*	0	Output relays testing: 0 – To test the tripping relay; 1 – To test the alarm relay; 2 – To test the ventilation relay; 3 – To test the fault relay; 4 – To test ALL relays.
0x122	Password	PAS	000/999*	000	000 – password disable, any other value activates password
0x124	Reset to default settings	rSt	0/1	0	Reset to factory default. 0 – DON'T restore; 1 – To restore all adjusted sittings to factory

Address	Parameter	Mnemonics	Min./Max.	Factory Default	Action
					default.
0x126	Version	uEr	*	26	Product version
	Channel 1				
0x128	Channel is ON	ch1	0/1	1	Usage of channel1: 0 – Channel is OFF; 1 – Channel is ON;
0x12A	Calibration	cA1	-9/9 ºC	0	Scale shift on CA1 relatively measured by thermal sensor
0x12C	Type	ct1	0/4	0	Type of used sensor: 0 – PT100 (100 Ohms); 1 – PT1000 (1000 Ohms); 2 – KTY83 (1000 Ohms); 3 – KTY84 (1000 Ohms); 4 – PTC (1, 3, 6).
0x12E	Maximal value for channel 1	cn1	*	-40	Maximal detected value of temperature
	Channel 2				
0x130	Channel is ON	ch2	0/1	1	Usage of channel 2: 0 – Channel is OFF; 1 – Channel is ON;
0x132	Calibration	cA2	-9/9 ºC	0	Scale shift on CA2 relatively measured by thermal sensor
0x134	Type	ct2	0/4	0	Type of used sensor: 0 – PT100 (100 Ohms); 1 – PT1000 (1000 Ohms); 2 – KTY83 (1000 Ohms); 3 – KTY84 (1000 Ohms); 4 – PTC (1, 3, 6);
0x136	Maximal value for channel 2	cn2	*	-40	Maximal detected value of temperature
	Channel 3				
0x138	Channel is ON	ch3	0/1	1	Usage of channel 3: 0 – Channel is OFF; 1 – Channel is ON;
0x13A	Calibration	cA3	-9/9 ºC	0	Scale shift on CA3 relatively measured by thermal sensor
0x13C	Type	ct3	0/3	0	Type of used sensor: 0 – PT100 (100 Ohms); 1 – PT1000 (1000 Ohms); 2 – KTY83 (1000 Ohms); 3 – KTY84 (1000 Ohms);
0x13E	Maximal value for channel 3	cn3	*	-40	Maximal detected value of temperature
	Channel 4				
0x140	Channel is ON	ch4	0/1	0	Usage of channel 4: 0 – Channel is OFF; 1 – Channel is ON;
0x142	Calibration	cA4	-9/9 ºC	0	Scale shift on CA4 relatively measured by thermal sensor
0x144	Type	ct4	0/4	0	Type of used sensor: 0 – PT100 (100 Ohms); 1 – PT1000 (1000 Ohms); 2 – KTY83 (1000 Ohms); 3 – KTY84 (1000 Ohms); 4 – PTC (1, 3, 6);
0x146	Maximal value for channel 4	cn4	*	-40	Maximal detected value of temperature
0x300	Alarm 4	AL4	50/240 ºC	145	ALARM relay tripping temperature for channel 4

Address	Parameter	Mnemonics	Min./Max.	Factory Default	Action
0x302	Diff. of alarm 4	dA4	1/200 ºC	10	Differential of ALARM disabling for channel 4
0x304	Trip 4	tP4	50/240 ºC	155	TRIP relay tripping temperature for channel 4
0x306	Diff. of tripping 4	dP4	1/200 ºC	10	Differential of TRIP disabling for channel 4
0x308	Cooling enabling 4	Fn4	30/240 ºC	130	Cooling enabling temperature for channel 4
0x30A	Diff. of cooling 4	dF4	1/200 ºC	20	Differential of cooling disabling for channel 4
	Filter				
0x30C	Filter band	Frb	0/50 ºC	10	Digital Filter Band 0 – prohibited (any other value enables this mode)
0x30E	Filter time	Frt	0/60 c	2	Digital filter time constant 0 – prohibited (any other value enables this mode)

* Parameters is read only.

2.2.9. Sensors

2.2.9.1 Sensors of PT100 type.

Platinum sensor with 100 Ohms rated resistance at 0 °C. In using this type of sensor, measurement inaccuracy presents ±3 °C, all sensors are connected to 1, 2, 3, 4 channels by 2- or 3-hardwiring (see pic.2) with subsequent adjusting of value “0” of ct 1/ct2/ct3/ct4 parameters as per Table 3.

Measurement range of temperature is -40 to +240 °C.

TR-100 detects break and shorting of measuring lines.

2.2.9.2 Sensors of PT1000 type.

Platinum sensor with 1000 Ohms rated resistance at 0 °C. In using this type of sensor, measurement inaccuracy presents ±3 °C, all sensors are connected to 1, 2, 3, 4 channels by 2- or 3-hardwiring (see pic.2) with subsequent adjusting of value “1” of ct 1/ct2/ct3/ct4 parameters as per Table 3.

Measurement range of temperature is -40 to +240 °C.

TR-100 detects break and shorting of measuring lines.

2.2.9.3 Sensors of KTY83 type.

Silicon sensor with rated resistance range is 990 Ohms to 1010 Ohms at 25 °C. In using this type of sensor, measurement inaccuracy presents:

- ± 4 °C at - 40°C;
- ± 3 °C at 0°C;
- ± 7 °C at 175°C.

Sensors are connected to 1, 2, 3, 4 channels by 2- or 3-hardwiring (see pic.2) with subsequent adjusting of value “2” of ct 1/ct2/ct3/ct4 parameters as per Table 3.

Measurement range of temperature is -40 to +175 °C.

TP-100 detects break and shorting of measuring lines

2.2.9.4 Sensors of KTY84 type.

Silicon sensor with rated resistance range is 970 Ohms to 1030 Ohms at 100 °C. In using this type of sensor, measurement inaccuracy presents:

- ± 7 °C at - 40°C
- ± 6 °C at 0°C
- ± 12 °C at 200°C

Sensors are connected to 1, 2, 3, 4 channels by 2- or 3-hardwiring (see pic.2) with subsequent adjusting of value “3” of ct 1/ct2/ct3/ct4 parameters as per Table 3.

Measurement range of temperature is -40 to +200 °C. TR-100 detects break and shorting of measuring lines.

2.2.9.5 Sensors of PTC type.

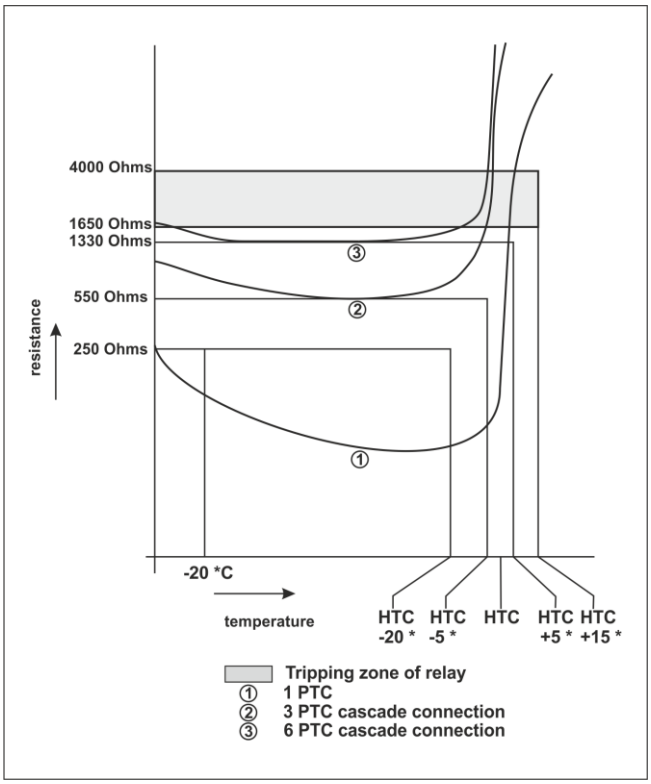
Semiconductor resistors which are able to sharply change electrical resistance under temperature changing on the body surface in range of sensitivity limit. Cold resistance of sensors is 20 Ohms to 250 Ohms. Sensors could be serial connected up to 6 (1-3-6) pcs. to one channel.

Sensors are classified on different NTC* (60°C to 180°C) with 10°C increment.

PTC sensors connection is possible ONLY to 1, 2, 4 channels by 2- or 3-hardwiring with subsequent adjusting of ct 1/ct2/ct4 parameters as “4” as per Table 3.

Temperature value corresponding with sensor NTC* is adjusted in trP/ALr/Fn4 parameters (1, 2, 4 channels accordingly).

TR-100 detects only shorting of <u>measuring lines</u>. If there is sensor breakage, then temperature accident corresponding to this sensor will be triggered.



Picture 3 – Resistance-Temperature diagram of PTC sensors

In temperature zone is up to NTC*, --- will be showed on the digital display. Value of NTC* sensor will be displayed if NTC* is reached or exceeded.

*NTC (rated temperature of triggering) is temperature at which sensor sharply changes own electrical resistance.

2.2.10. Using RS-485 interface by MODBUS RTU protocol.

TR-100 allows carry out data exchange with external product by serial interface (MODBUS protocol, see Programming Manual of TR100-MODBUS).

The software, allowing to print a current state on the display of the personal computer, it is possible to download from a site **<u>www.novatek-electro.com</u>** in part “Software”.

Addresses of registers of programming parameters in decimal style are given in Table 3.

Additional registers and their meaning are given in Table 4.

Table 4

Address	Item	Description		Note
0x150	Status register of TR-100	bit 0	0 – NO failure; 1 – Failure (Code in failure register).	bit 5 – bit 15 are reserved
		bit 1	0 – Tripping relay is OFF; 1 – Tripping relay is ON.	
		bit 2	0 – Alarm relay is OFF; 1 – Alarm relay is ON.	
		bit 3	0 – Ventilation relay is OFF; 1 –Ventilation relay is ON.	
		bit 4	0 – Fault relay is OFF; 1 – Fault relay is ON.	
0x152	Failure register	bit 0	0 – NO failure; 1 – Failure of EEPROM. EEP	bit 7 – bit 15 are reserved
		bit 1	0 – NO failure; 1 – Sensor(s) shorting. Fcc	
		bit 2	0 – NO failure; 1 – Sensor(s) break. Foc	

Address	Item	Description		Note
0x152	Failure register	bit 3	0 – NO failure; 1 – Tripping threshold excess. trP	bit 7 – bit 15 are reserved
		bit 4	0 – NO failure; 1 – Alarm threshold excess. ALr	
		bit 5	0 – NO failure; 1 – Ventilation threshold excess. F.On	
		bit 6	0 – NO failure; 1 – Loss of RS-485 connection. rSL	
0x154	Register of sensor 1 condition	bit 0	0 – NO failure 1 – Sensor shorting Fcc	bit 5 – bit 15 are reserved
		bit 1	0 – NO failure 1 – Sensor breakage Foc	
		bit 2	0 – NO failure 1 – Tripping temperature excess. trP	
		bit 3	0 – NO failure 1 – Alarm temperature excess. ALr	
		bit 4	0 – NO failure 1 – Ventilation temperature excess. F.On	
0x156	Register of sensor 2 condition	Similarly to register of sensor 1 condition.		
0x158	Register of sensor 3 condition	Similarly to register of sensor 1 condition.		
0x15A	Register of sensor 4 condition	Similarly to register of sensor 1 condition.		
0x15C	Temperature of the 1st sensor	Temperature value in °C		Integer
0x15E	Temperature of the 2nd sensor	Temperature value in °C		Integer
0x160	Temperature of the 3rd sensor	Temperature value in °C		Integer
0x162	Temperature of the 4th sensor	Temperature value in °C		Integer
0x200	Register to operate by Tripping relay	0x0000 – relay OFF; 0x0001 – relay ON.		Integer
0x202	Register to operate by Alarm relay	0x0000 – relay OFF; 0x0001 – relay ON.		Integer
0x204	Register to operate by ventilation relay	0x0000 – relay OFF; 0x0001 – relay ON.		Integer
0x206	Register to operate by Fault relay	0x0000 – relay OFF; 0x0001 – relay ON.		Integer

2.2.10.1 Remote control of power relays

When setting the parameter of rSA = 2 (Table 3), the TP-100 is switched to the remote control mode of the power relays. The control registers are specified in Table 4 (0x200 - 0x206). Filled in these registers the values 0 or 1, you can enable or disable the corresponding relays.

If detection for loss of connection over time rSL is enabled (the value is greater than zero, Table 3), and the TR-100 discovered that the connection was lost, the control of the power relays is transmitted to the TR-100. To restore remote control, you must set parameter rSA = 2.

After enabling the “Remote control of power relays” mode, the TR-100 continues operating in normal mode, with the exception that the control of the power relays is transferred to the remote operator.

3. MAINTENANCE

3.1. Safety precautions

THE TERMINALS AND THE PRODUCT INTERNAL ELEMENTS CONTAINS POTENTIALLY LETHAL VOLTAGE.
DURING MAINTENANCE IT IS NECESSARY TO DISABLE THE PRODUCT AND CONNECTED PRODUCTS FROM THE MAINS.

3.2. Maintenance of the product must be performed by the skilled professionals.

3.3. Recommended frequency of maintenance is **every six months.**

3.4. Maintenance Procedure:

1) Check the connection reliability of the wires to the terminals TR-100;

2) Visually check the integrity of the housing, in case of detection of cracks and damages take the product out of service and send for repair;

3) If necessary, wipe the front panel and the housing of the product with cloth.

Do not use abrasives and solvents for cleaning.

4. SERVICE LIFE AND MANUFACTURER WARRANTY

4.1. The lifetime of the product is 15 years. Upon expiration of the service life, contact the manufacturer.

4.2. Shelf life is 3 years.

4.3. Warranty period of the product operation is 5 years from the date of sale.

During the warranty period of operation (in the case of failure of the product) the manufacturer is responsible for free repair of the product.

ATTENTION! IF THE PRODUCT HAS BEEN OPERATED WITH THE VIOLATION OF THE REQUIREMENTS OF THIS USER MANUAL, THE USER WILL LOSE THE RIGHT TO WARRANTY MAINTENANCE.

4.4. Warranty service is performed at the place of purchase or by the manufacturer of the product.

4.5. Post-warranty service of the product is performed by the manufacturer at current rates.

4.6. Before sending for repair, the product should be packed in the original or other packing excluding mechanical damage.

5. TRANSPORTATION AND STORAGE

The product 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 %.

6. ACCEPTANCE CERTIFICATE

TR-100 has been manufactured and accepted in accordance with the requirements of valid technical documentation and classified as fit for operation.

Head of QCD _____

Date of manufacture _____

Seal

9. CLAIMS DATA

You are kindly requested, in case of the product return and transfer it to the warranty (post-warranty) service please indicate detailed reason for the return in the field of the claims data.

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_____

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The Company is grateful to you for the information about the quality of the product and suggestions for its operation.

♦♦♦♦♦

For all questions, please contact the manufacturer:

NOVATEK-ELECTRO Ltd,
59, Admiral Lazarev Str.,
Odessa, 65007, Ukraine.
Tel.: +38 (048)738-00-28,
Tel./fax: +38 (0482) 34-36-73.
www.novatek-electro.com

Date of sale: _____ **VN211118**

Appendix A
(reference)

A1. Adjustment

A1.1 General provisions

The adjustment should be executed by qualified specialists of metrology services in case of increase of deviation of input parameters from defined values.

Before adjustment it necessary to check defined value of parameter CA1 (CA2, CA3, CA4) of "characteristics shift" and define it equal to 0.

A1.2 Adjustment of TR-100

A1.2.1 To connect the resistor bank with accuracy rating of at least 0,05 (for example, MCP-63) to product input instead of sensor through three-wire line (Figure A.1). Wire resistances within the line should be equal to each other and each resistances should not exceed value of 15 Ohm. Fix at resistor bank:

R=100,00 in case of use of Pt100 sensors;
R=1000,00 in case of use of Pt1000 sensors;
R=820,00 in case of use of KTY83 sensors;
R=498,00 in case of use of KTY84 sensors.

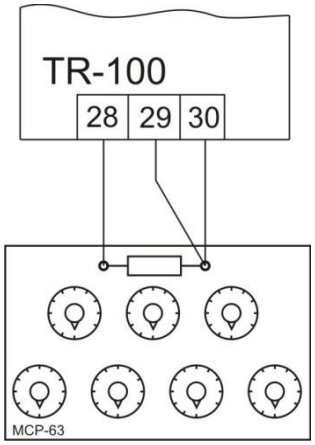

Figure A.1

A1.2.2 Apply the power to TR-100. Adjust the product within 20-30 seconds. Check that temperature value corresponding to 100, 1000, 820, 498 resistance (depending in type of used sensor) is equal to 0ºC. The limit of admissible absolute error is ±3 for Pt100, Pt1000 ºC sensors.

A1.2.3 Fix the value of parameter CA1 (CA2, CA3, CA4) equal to the value of temperature deviation, but with opposite sign. Check the correctness of defined value, for this purpose, do not change the values of resistor bank, wait while the product will be in mode of temperature measuring and check that its values will be equal to 0±1 ºC.

Appendix B
(reference)

TR-100 SOFTWARE VERSIONS

Version No.	Description
v10 29.02.2008	The first version of the software.
v11 27.01.2009	Added support for new types of transducers – PTC minika.
v12 02.06.2009	Corrected Modbus RTU operation in network with different addresses.
v20 18.06.2009	Added the relay remote control mode.
v21 23.06.2009	Changed algorithm of the watchdog timer.
v22 22.09.2009	Improved temperature measurement algorithm.
v23 24.06.2010	Optimized calibration algorithms. Corrected an error that occurs when the transducer breaks.
v24 28.09.2012	Hardware replacement of multiplexer 4052.
v25 02.04.2014	Improved reliability of data storage in EEPROM. In the process of work, the integrity of the calibration and settings are constantly monitored. Corrected an error of triggering only one channel when the others are in the hysteresis zone. Corrected an error when the breakage of one transducer led to the reset of alarms on other transducers.
v26 06.09.2018	Added separate temperature thresholds for the fourth channel (AL4, dA4, tP4, dP4, Fn4, dF4). Added digital filter settings (Frb, Frt).