TPM138

Multi-purpose eight-chanel meter-adjustier

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Р.№
Зак. №

Passport and
operaton manual

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Introduction

This **Operation Manual** is intended to familiarize service personnel with the design, principle of operation, working and maintenance procedures of the TRM138 multi-purpose eight-channel meter-adjuster (hereinafter referred to as the "instrument").

This **Operation Manual** is applied to TRM138-X instrument manufactured as per TU 4211 003 4652653603.

The instrument has a conformity certificate No.03.009.0306 and a measuring instrument approval certificate RU.C.32.004.A No.16445.

TRM138 instrument is manufactured in several versions which vary in types of built-in output equipment for control over actuating units. The version information is indicated in the code number which is the last symbols in the full name of the TRM138-X instrument; the code number meaning is as follows:

TRM138-X

Built-in output equipment types:

R – electromagnetic relays;
K – transistor optical couples of *n–p–n* type;
C – triac optical couples;
I – digital-analog converter «parameter – current" 4...20 mA.

Note. If required, the instrument can be supplied in various output equipment configuration. These required equipment configurations and number of equipment in each configuration type should be indicated in purchase order for TRM138.

Example of the instrument's full name title for ordering: **TRM 138-R**.

In this "Operation manual" the following acronyms and abbreviations are used:

OU – output unit;
LU – logical unit;
NSC – nominal static characteristic;
TC – thermocouple (thermoelectric converter);
RTT – resistive temperature transducer;
Cu – copper resistive temperature transducer;
Pt – platinum resistive temperature transducer;
DAC – digital-analog converter;
DI – digital indicator.

PURPOSE Section 1

1.1. TRM138 instrument is a component part for production process automatic monitoring and control systems used in various industries, agriculture and municipal services.

1.2. The instrument is designed for the following operations:

– measuring of physical properties;
– digital filtration of measured parameters from process impulse noise;
– correction of measured parameters for elimination of errors in sensing devices;
– indication of measurement data on built-in LED four-digit digital indicator;
– generation of alarm signal at fault of sensing devices with indication of the fault cause on the digital indicator;
– generation of actuating signals for outside actuating units in accordance with preset laws of control;
– indication of preset control parameters on the digital indicator;
– generation of manual control signals for actuating units from the keyboard;
– transfer of data on values of parameters controlled by sensors and preset working parameters to a computer as well as receiving from a computer of feedback data for change in parameters;
– recording of preset values of programmed parameters in the nonvolatile memory at power cut-offs.

1.3. Operation conditions:

– closed explosion-proof rooms without aggressive vapors and gases;
– ambient temperature: from +1 to +50 °C;
– upper limit of relative air humidity: 80 % at 25°C and lower temperatures without moisture condensation;
– atmospheric pressure: from 86 to 106.7 kPa.

Section 2 Technical Characteristics

The general characteristics of the TRM138 instrument are presented in Tables 1, 2, 3.

Table 1

General characteristics

Description	Value
Power supply voltage range	90...245 V alternate/direct current (47...63 Hz)
Power consumption	not greater than 12 VA
Number of measurement channels	1...8
Interrogation time per one channel	not longer than 0.6 sec
Number of control channels	1...8
Number of output devices	8
Voltage of active transducers	24±3 V direct current (150 mA max)
Computer communications interface	RS-485
Casing protection rating (from the front panel)	IP54
Overall dimensions	96x96x140 mm
Weight	not greater than 1.5 kg

Table 2

Input sensing devices

Description and NSC	Measurement range	Resolution	Basic reduced error limit
Resistive temperature transducers according to the State Standart (GOST) R 6651-94			
Cu 50M W_{100} = 1.426	–50 ... +200 °C	0.1 °C	0.25 %
Cu 50M W_{100} = 1.428	–190 ... +200 °C	0.1 °C	
Cu 100M W_{100} = 1.426	–50 ... +200 °C	0.1 °C	
Cu 100M W_{100} = 1.428	–190 ... +200 °C	0.1 °C	
Pt 50P W_{100} = 1.385	–200 ... +750 °C	0.1 °C	
Pt 50P W_{100} = 1.391	–200 ... +750 °C	0.1 °C	
Pt 100P W_{100} = 1.385	–200 ... +750 °C	0.1 °C	
Pt 100P W_{100} = 1.391	–200 ... +750 °C	0.1 °C	
According to the State Standart GOST 6651-78			
Cu gr. 23	–50 ... +200 °C		
Thermocouples according to the State Standart (GOST) R 8.585-2001			
L	–50 ... +750 °C	0.1°C	0.5 %
J	–50 ... +900 °C	0.1°C	
N	–50 ... +1300 °C	1 °C	
K	–50 ... +1300 °C	1 °C	
S	0 ... +1750 °C	1 °C	
R	0 ... +1750 °C	1 °C	
A-1	0 ... +2500 °C	1 °C	
Direct voltage and current signals according to the State Standart (GOST) 26.011-80			
0 ... 5 mA	0 ... 100 %	0.1 %	0.25 %
0 ...20 mA	0 ... 100 %	0.1 %	
4 ...20 mA	0 ... 100 %	0.1 %	
0 ...50 mV	0 ... 100 %	0.1 %	
0 ...1 V	0 ... 100 %	0.1 %	

Notes.

1. W_{100} – ratio of the transducer's resistance measured at 100 °C to its resistance measured at 0°C.
2. Only insulated thermocouples with unearthed measuring junctions can be used for operation with the device.

Table 3

Output equipment

Description (type)	Limit load
Electromagnetic relay	4 A at voltage not greater than 220 V, 50 Hz and cos φ > 0.4
Transistor thermocouples *n–p–n* type	200 mA at voltage not greater than 40 V, direct current
Triac thermocouples	50 mA at voltage up to 300 V (constantly open triac) or 0.5 A (switched on triac with frequency not greater than 50 Hz and t_{imp} = 5 msec)
Converters	"parameter – current" 4 ... 20 mA0 ... 800 Ohm

Notes.
1. Output equipment types are defined by the instruments modification.
2. Limit load of "parameter – current" converter is defined in view of Item 3.2.6.7.

3.1 Functional Block Diagram

3.1.1 The instrument's functional block diagram is presented in Figure 1.

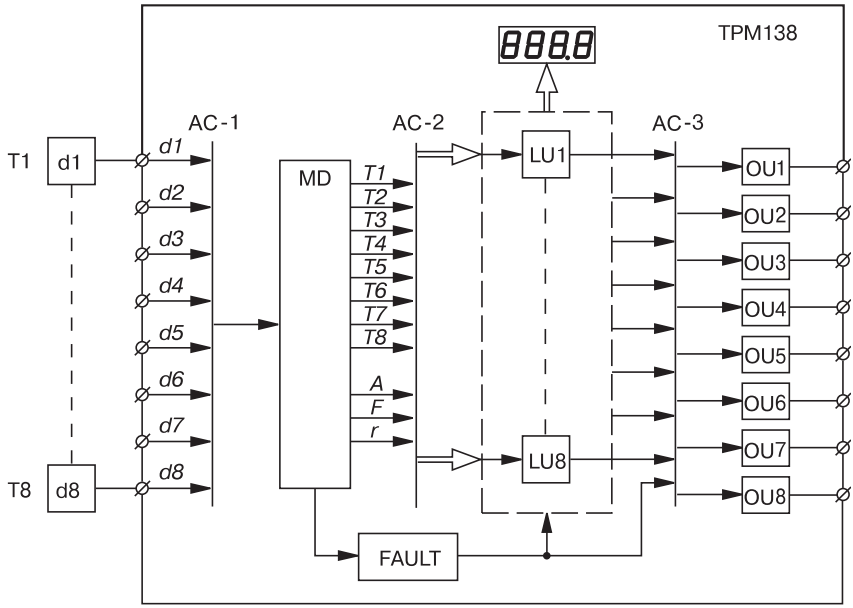


Figure 1. Functional block diagram

3.1.2 The functional block diagram includes the following components:

d1 ... d8 – input sensing devices (transducers) to monitor physical properties of the facility (are not part of the instrument, conventionally introduced in the diagram as a matter of convenience);

AC-1 – automatic commutation device to receive signals from primary sensing devices and transmit them to the measuring devise;

MD – measuring device to convert signals from sensing transducers to numerical values of parameters controlled by these transducers as well as to calculate mathematical values required for the instrument's operation;

AC-2 – automatic commutation device to receive measured input parameters and transmit them to the logical units;

LU1 ... LU8 – logical units to generate actuating signals by the output equipment and to output the measured values of input parameters to the digital indicator;

AC-3 – automatic commutation device to transmit signals from LUs to the output equipment;

OU1 ... OU8 – output units to synchronize actuating signals (generated by LU1 ... LU8) with operation of the peripherals which control the facility's parameters or monitor its status.

3.1.3 Connection pattern for LUs with input sensing transducers and OUs is defined by the user at setting the instrument's operation parameters which allows applying the instrument's configuration by the most convenient operational pattern.

Notes.

1. Segmentation in the presented diagram is conventional.
2. Describing the diagram's elements, temperature of the facility is considered as the input parameter, however, all above-stated refers also to other process parameters (pressure, level, etc.).

3.2 Block Diagram Elements

3.2.1 Input Sensing Devices

3.2.1.1 Input sensing devices (transducers) convert physical properties of the facility to electrical signals transmitted to the instrument for their further processing. Data on sensing devices used with instruments of various modifications are presented in Table 2.

3.2.1.2 Resistive temperature transducers (RTT) are used to monitor ambient temperature at the transducer's location. RTT's principle of operation is based on the conductor's ability to change electrical resistance when the ambient temperature is changed.

The sensing transducer shall be connected to the instrument by a three-wire circuit (see *Appendix* 2, Figure A2.7, *a)*.

If the RTT connection by a two-wire circuit is required, *Appendix 4* shall be followed.

3.2.1.3 Thermoelectric temperature transducers (thermocouples) (TC) are also used to monitor temperature. A TC represents a thermoelectric circuit arranged by two heterogeneous metallic conductors with two junctions.

Junction point of heterogeneous conductors is termed as a *"working"* junction of thermocouple and their ends are *tails* or *"cold"* junctions. The "working" junction of the thermocouple is placed in a temperature monitoring location while the tails are connected to the instrument's input pins (see *Appendix* 2, Figure A.2.7, *b)*.

ATTENTION! Only thermocouples with insulated and unearthed working junctions can beused with the instrument since negative sides of their tails are merged at the TRM138 entry point.

3.2.1.4 Active converters with analog output signal are used to monitor various physical properties (pressure, temperature, flow rate, level, relative humidity, etc.). The exit signal of such sensing transducers is a direct current voltage varying on the linear law or a current.

The connection diagram of the sensing transducer with a current terminal is presented in *Appendix* 2, Figure A.2.7, *c*.

ATTENTION! "Minus" terminals of active sensing transducers in the instrument are merged.

3.2.1.5 An instrument of any modification can work with various types of sensing transducers from those presented in Table 2 for the specified modification. When connected to the instrument, the sensing transducers are assigned with serial numbers of the entries to which they are connected (entry 1 corresponds to sensing transducer d1, entry 2 – sensing transducer d2, and so on). Type of each sensing transducer is set by the user in parameter **in-t (PL-1)** when the instrument is prepared for operation (see Section 6).

Note. When the instrument's programmed parameter is referred to, programming level number of this parameter is indicated in brackets. A full list of programmed parameters is presented in *Appendix 3*.

3.2.2 Input Parameters Measuring

3.2.2.1 The instrument measures the facility's input parameters (temperature, pressure, etc.) by consecutive interrogation of operational sensing transducers and conversion of signals received from them into digital values. When being processed the signals are filtered from noise and corrected.

3.2.2.2 Interrogation of Sensing Transducers

3.2.2.2.1 Sensing transducers are interrogated in a closed cycle by means of **AC-1** automatic commutation device controlled by the microprocessor under the program set by the user. This program includes the list of serial numbers of all operational sensing transducers (interrogation list) as well as interrogation priority for each of them.

3.2.2.2.2 Any sensing transducer included in the interrogation list is switched on automatically after its NSC type is set in **in-t (PL-1)** parameter. If **in-t (PL-1)** parameter is set to **oFF** ("switched off") the sensing transducer is excluded from the interrogation list.

The queue and frequency of interrogation of each sensing transducer are defined by the interrogation priority which is set as a dimensionless numerical value (from 1 to 8) in **Prt (PL-1)** parameter individually for each sensing transducer. The maximum numerical value corresponds to the highest interrogation priority.

Example. The interrogation list includes sensing transducers: **d1 (8), d3 (7), d4 (7), d5 (6), d6 (6) and d8 (5)** with appropriate priority values (in brackets). The transducers will be interrogated in the following order: **d1– d3 – d1 – d4 – d1– d5 – d1 – d3 – d1 – d4 – d1– d6 – d1 – d8** and so on by the cycle.

Note. The interrogation algorithm with set priority values makes it possible for the user to increase frequency of interrogation for those sensing transducers which are related to rapidly changing physical properties thus ensuring the fastest response for their output equipment. However, it is to bear in mind that increase in interrogation frequency of one sensing transducers shall decrease interrogation frequency of othertransducers.

3.2.2.3 Input Parameters Running Values Measuring

3.2.2.3.1 Signals of sensing transducers from **AC-1** automatic commutation device are transmitted to the MD measuring device entry. The MD evaluates running values of controlled physical properties and digitizes them to provide for their further processing.

3.2.2.3.2 When resistive temperature transducers and thermocouples are used temperature is computed by **standard NSCs**.

The instrument's readings are automatically adjusted by temperature of thermocouples' tails. The adjustment procedure is disabled (for example, at calibration of the instrument) by setting **Cj-.C (PL-0)** parameter to **oFF**.

3.2.2.3.3 When active converters (sensing transducer types "06", "10", "11", "12" or "13" in Table A3.2) are used controlled parameters' values are computed directly in their measuring units. Adjusting coefficients are set for each sensing transducer at identification of **Ain.L (PL-1)** parameters – the lower measurement limit and **AinH (PL-1)** – the upper measurement limit.

3.2.2.4 Measurements Digital Filtering

3.2.2.4.1 To reduce impact of environmental impulse noise on the instrument's operating performance measurements independent digital filtering is provided for each measuring channel. The filtering is made in two stages.

3.2.2.4.2 For the first stage the user sets "filter strip" **in.FG (PL-1)** parameter individually for each sensing transducer in measuring units of measured physical values. This filter is disabled by setting **0** value in **in.FG (PL-1)** parameter.

3.2.2.4.3 For the second stage of filtering the user sets "filter time response" parameter – **in.Fd (PL-1).**

ATTENTION! Increase in **in.Fd (PL-1)** parameter value provides for a better noninterference of the measuring channel but simultaneously increases its time lag, i.e., reduces the instrument's response to rapid changes of an input value. The instrument's response to abrupt change in arrival signal from 0.0 to 10.0% of the measured range at various **in.Fd (PL-1)** values is presented in Table 4 (**in.FG** filter isdisabled).

Table 4

Measured value (level)	Filter time response **in.Fd**														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	Number of measurements required to reach the level														
7,0	2	3	5	6	7	8	9	11	12	13	14	16	17	18	19
9,0	4	6	8	11	13	15	18	20	23	25	27	29	31	34	36
9,5	5	8	11	14	18	20	23	26	29	32	35	38	41	44	46

This filter is disabled by setting **0** value in **in.Fd (PL-1)** parameter.

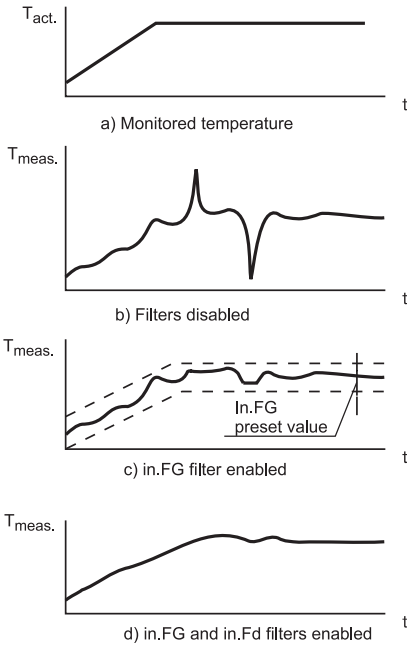


Figure 2. Digital filters operation timing waveforms

Digital filters operation timing waveforms are presented in Figure 2.

3.2.2.5 Measurements Adjustment

3.2.2.5.1. To eliminate initial error effect from primary sensing devices the filtered values of monitored parameters are adjusted by the instrument according to adjustment parameters and a set by the user for each monitoring channel which allow shifting and slope changing of conversion characteristic.

3.2.2.5.2. ***"Characteristic shift"*** adjustment is set in **in.SH** parameter (default setting d = 000.0) in measuring units of monitored parameter.

Exemplary "characteristic shift" adjustment is schematically presented in Figure 3.

3.2.2.5.3. **"Characteristic slope changing"** adjustment is set by the user for each monitoring channel in **in.SL** parameter (default setting a =1.000) in dimensionless units.

Exemplary "characteristic slope changing" adjustment is schematically presented in Figure 4.

Note. If changing both values (d and a) for the same sensor is required first d value and then a value shall be set.

ATTENTION! Applying adjustment coefficients different from default settings (d = 000.0 and a = 1.000) will change metrological characteristics of TRM138 and should be done only if such a change is technically reasonable, by skilled technicians.

3.2.3 Mathematical Values Computation

3.2.3.1. The instrument is able to compute, on the basis of received resultant data, a number of mathematical values used to control the facility:

F1 – arithmetical average by parameters of 2 transducers d1 and d2;
F2 – arithmetical average by parameters of 3 transducers d1 ... d3;
F3 – arithmetical average by parameters of 4 transducers d1 ... d4;
F4 – arithmetical average by parameters of 5 transducers d1 ... d5;
F5 – arithmetical average by parameters of 6 transducers d1 ... d6;
F6 – arithmetical average by parameters of 7 transducers d1 ... d7;
F7 – arithmetical average by parameters of 8 transducers d1 ... d8;
A1 – difference between d1 and d2;
A2 – difference between d3 and d4;
A3 – difference between d5 and d6;
A4 – difference between d7 and d8;
r1...r8 – change rate (per minute) of a parameter monitored by transducer d1...d8 accordingly.

Note. Calculated values of **r1 ... r8** are recommended to be used for secondary monitoring since the positional control law realized in the instrument for output equipment in most cases does not allow their adjustment with good quality.

To the values of **r1 ... r8** filter additional smoothing filters are applied whose performance characteristics are set in **in.rd(PL-1)** parameter individually for each transducer.

3.2.4 Measured Parameters Indication

3.2.4.1. Information on measured values of input parameters or computed mathematical values is displayed on a four-digit digital indicator **DI-1** located on the front panel of the instrument.

The **DI-1** receives data only from one of eight information output channels (**logic units LU1 ... LU8**) at a time. Information output channels are selected by setting "LU input signal" **C.in(PL-2)**

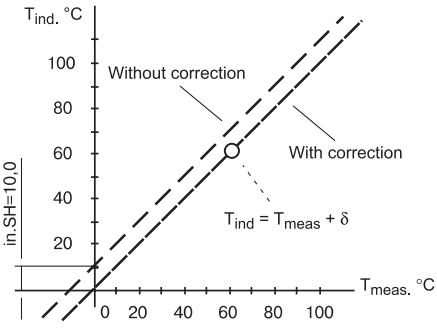


Figure 3. "Characteristic shift" adjustment

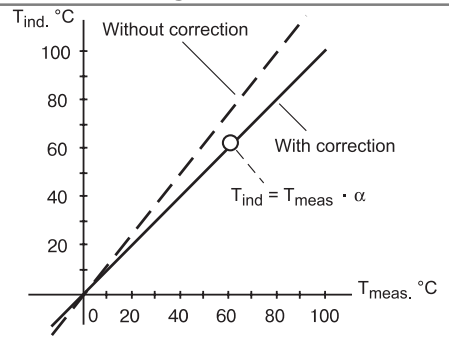


Figure 4. "Characteristic slope changing"

parameter of a corresponds logic unit: at setting **"1"** ... **"8"** values the digital indicator receives data on the values measured by sensors **d1 ... d8** accordingly; values **"9" ... "15"** – data on mathematical values **F1 ... F7** computed in accordance with Item 3.2.3; values **"16" ... "19"** – data on values **A1 ... A4**; values **"27" ... "20"** – data on values **r1 ... r8**; when **"0"** value is set this LU is disabled.

3.2.4.2. Information is displayed on **DI-1** in a format selected by the user – as whole or fractional numbers with specified quantity of numerals after the decimal symbol. The decimal symbol rule is set individually for each indication channel in **dP (PL-2)** parameter.

If the data displayed on **DI-1** does not fit its four-digit indication field the instrument automatically switches to indication of whole numbers. After the low-order digit the decimal point is displayed meaning that the digital indicator is overfilled. The significant digits hidden as a result of overfilling can be seen by depressing **RESET** / **SHIFT** button.

3.2.4.3. The **DI-1** refresh rate is set by the user in a range of 1 ... 60 sec in parameter **ind.r (PL-0)**. When **"0"** value is set the information is refreshed as it arrives from MD.

Note. The **DI-1** refresh rate set by the user does not have effect on the TRM138 output equipment operation.

3.2.4.4. Data is displayed on **DI-1** in two indication modes: static or cyclic.

In **static mode** indicated channel is selected by the operator by means of control buttons located on the front panel of the instrument and inspected by means of **"CHANNEL"** LED.

In **cyclic mode** information from each channel is displayed on **DI-1** successively within specified time in a closed cycle starting from an operational channel with low priority. Spare channels are skipped over.

Indication mode is selected in parameter **ind. A (PL-0): "on"** – cyclic mode, **"oFF"** – static mode.

The indication channel switching time is set by the user in parameter **ind.t (PL-0)**.

3.2.4.5. As a matter of convenience, when power is connected (or the microprocessor restarted) the instrument is automatically switched to the indication mode preset by the user.

3.2.5 Logic Units

3.2.5.1. Logic units (LU) are designed to process arriving input data on values measured (computed) by the instrument, to output these data to the digital indicator and to generate actuating signals for the peripherals in accordance with set values of programmed parameters.

The instrument is equipped with eight identical and functionally interchangeable units **LU1 ... LU8** connected by means of a special program tool customized by the user to measured input values and output equipment.

Each **LU** processes only one input value set by the user in parameter **C.in (PL-2)**.

To each LU one of eight output devices of the instrument can be connected; the device's serial number is set by the user (for the specified LU) in parameter **C.dr (PL-2)**.

Each LU can work in one of these modes: METER; COMPARATOR (COMPARISON DEVICE) or RECORDER.

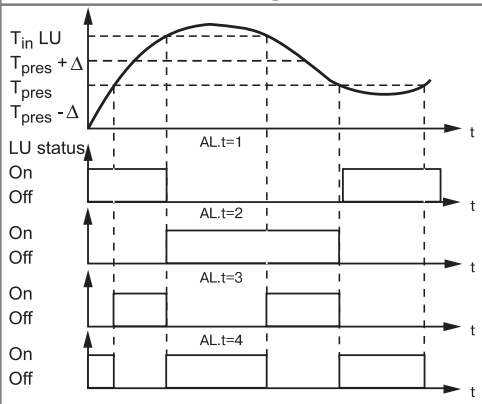


Figure 5. Comparators' output characteristics

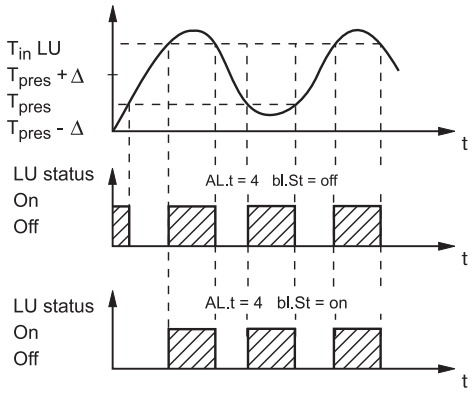


Figure 6. LU operation diagrams at various bL.St values

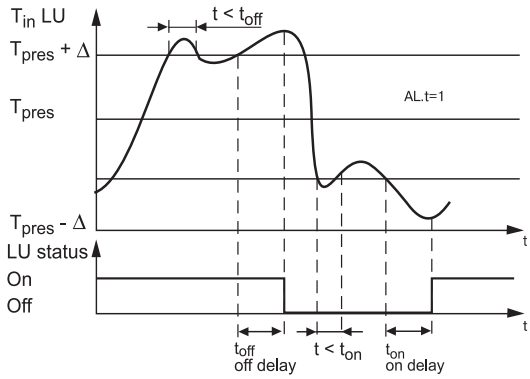


Figure 7. LU operation with reaction and falling delays

3.2.5.2. In METER mode a logic unit generates output signals to the digital indicator based on data arriving from an MD. Actuating signals for output equipment are not generated. The LU is switched to METER mode by setting **AL.t (PL-2)** parameter to **"0"**.

3.2.5.3. Working in COMPARATOR mode the logic unit compares input signal values to preset limits and the hysteresis range values, and generates control signals for the output equipment. **Preset limit** and **hysteresis range** values for a specified LU are set by the user in accordance with parameters **C.SP (PL-2)** and **HYSt (PL-2)**.

LU's output signal varies under the relay logical law whose logic type is set in parameter **AL.t (PL-2)**. The timing waveform of an OU's operation in COMPARATOR mode is presented in Figure 5.

If a LU is used as a warning indicator actuated when a monitored parameter goes beyond the **(AL.t = 4)** limits, the LU is blocked after energization of the comparator's switching device by setting the **bL.St (PL-2)** parameter to **"on"** position. The timing waveform of the LU operation for this case is presented in Figure 6.

To protect the commutation elements of the output equipment and peripherals against frequently repeated start-up "Falling delay" – **dL.on (PL-2)** and **dL.oF (PL-2)** parameters. The LU activates or deactivates related OU only in the event that these actions are required, at least, during the period of time set in parameters **Ht.on (PL-2)** and **Ht.oF (PL-2)** accordingly.

The timing waveform of the OU operation for this case is presented in Figure 7.

The user can set minimum holding time for the OU (after the LU is switched) in activated or deactivated state irrespective of the state of input signals in **Ht.on (PL-2)** and **Ht.oF (PL-2)** parameters, accordingly. The timing waveform of the output device operation for this case is presented in Figure 8.

3.2.5.4. Working in RECORDER mode, the logic unit converts arriving input values into actuating signals for the digital-analog converter "parameter – current" designed to output information to peripheral logger (graph plotter, computer, etc.).

The LU is switched to RECORDER mode by setting **AL.t (PL-2)** parameter to **"5"**.

The conversion is made under the linear law in a specified variation range of the input value in accordance with lower and upper limits set in parameters **Ao.L (PL-2)** and **Ao.H (PL-2)** accordingly.

DAC's output characteristics in the registration mode are presented in Figure 9.

3.2.6 Output Units

3.2.6.1. Output units (OU) are designed to synchronize actuating signals generated by LUs with the operations of the peripherals engaged in regulating the facility's parameters or monitoring its status.

Depending on version, the instrument can be equipped with a number of OUs varying in purpose and operation mode: key type (electromagnetic relay assemblies, transistor or triac optocouples) analog type (digital/analog converters "parameter-current").

Connection diagrams for TRM138 with various OUs are presented in *Appendix 2*.

3.2.6.2. **Key type OUs** are used to control final actuating devices (heaters, blowers, etc.) either directly, or through control starting units with a higher commutation capability (power starters, contactors, thyristors, triacs, etc.) under the positional law – "activated deactivated".

3.2.6.3. In TRM138-R instruments **electromagnetic relay assemblies** are used as OUs. These relays' normally open contacts are led out to exterior junction terminals. To increase relays' service life their contacts (especially at commutation of inductive loads) are recommended to be connected in parallel with spark protection RC circuits (Figure 10).

3.2.6.4. In TRM138-R instruments **transistor optocouples *of n-p-n-type*** are used as OUs. These optocouples' outlets have galvanic insulation from the instrument's circuit and are led out to the exterior junction terminals. Transistor optocouples are used, as a rule, to control low-voltage solid-state or electromagnetic relay assemblies commuting power circuits of electric load.

ATTENTION! When optocouples are used to control an electromagnetic relay assembly, the latter's winding shall be connected in parallel with a semiconductor diode whose parameters are selected at

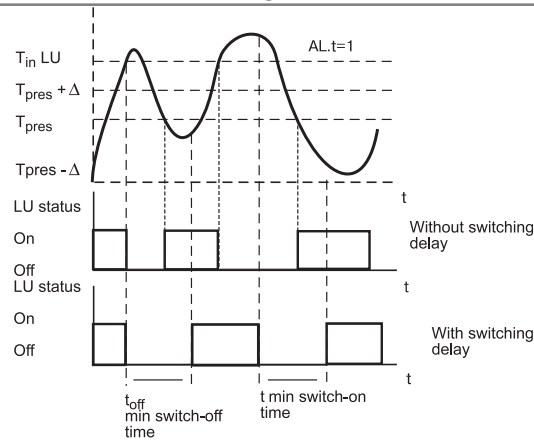


Figure 8. LU operation with the preset holding time

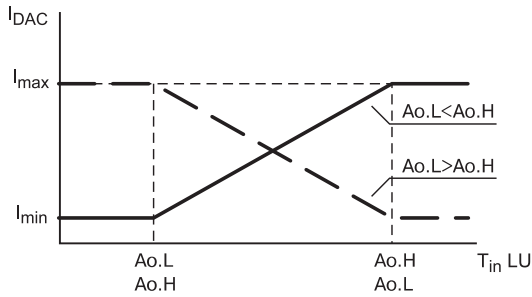


Figure 9. DAC output characteristics

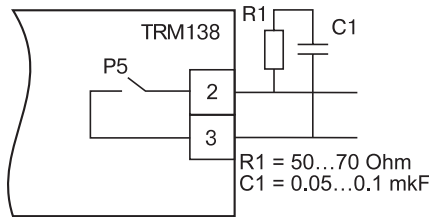


Figure 10. Relays' contacts connected in parallel at operation under inductive loads

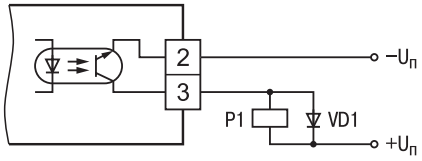


Figure 11. Application of transistor optocouple for control over electromagnetic relay assembly

the rate of: $U_{rev.max} > (2...3)\ U_{sv}$; $I_{fc\ max} > (1.5...2)\ I_{rpc}$, where $U_{rev.max}$ – diode maximum admissible reverse voltage; U_{sv} – relay assembly supply voltage; $I_{fc\ max}$ – diode maximum admissible forward current; I_{rpc} – relay assembly pickup current.

Example of transistor optocouple application is presented in Figure 11.

3.2.6.5. In TRM138-C instruments low-power **triac optocouples** are used as OUs. These optocouples' outlets have galvanic insulation from the instrument's circuit and are led out to the exterior junction terminals. These optocouples, as a rule, are used to control high-power thyristors or triacs commuting power circuits of actuating devices. Control pulses are generated by triac optocouples at the moment when the circuit voltage passes through the zero point which substantially reduces the interference level.

Examples of triac optocouple applications are presented in Figure 12 and 13.

Note. RC filters (see Figure 12, 13) are designed to protect circuit components from high voltage jumps.

3.2.6.6. TRM138-I instruments are equipped with **analog type** output equipment designed to convert input data in direct current signals ("parameter-current" conversion) by means of 10-digit DACs built in the OU. Converted signals can be used for parameters' recording (see Item 3.2.5.4).

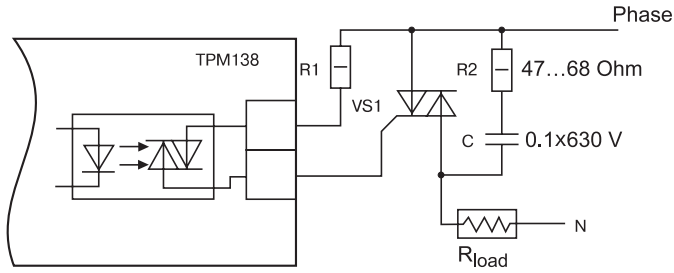


Figure 12. Triac optocouples applications for load control by means of a power triac

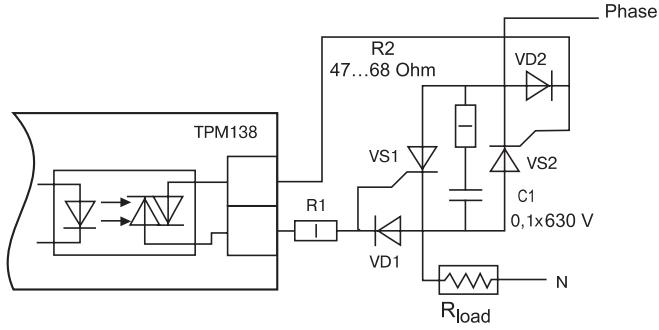


Figure 13. Triac optocouples applications for load control by means of a power thyristors

3.2.6.7. The DAC shall be powered from an independent direct current source providing galvanic insulation of the instrument's and the user's electrical circuit. Power source voltage is determined by the formulas:

$$U_{ps/min} < U_{ps/nom} < U_{ps/max};$$

$$U_{ps/min} = 7.5 + I_{CAD\,max} R_{load};$$

$$U_{ps/max} = U_{ps/min} + 2.5,$$

where: $U_{ps/nom}$ – power source nominal voltage, V;
$U_{ps/min}$ – power source minimal admissible voltage, V;
$U_{ps/max}$ – power source maximal admissible voltage, V;
$I_{CAD\,max}$ – DAC maximum output current, mA;
R_{load} – DAC load resistance, kOhm.

If on whatever reason pressure the DAC's power source voltage exceeds design value $U_{ps/max}$ than in series with the load a limit resistor shall be installed whose resistance is calculates by the formulas:

$$R_{lim/min} < R_{lim/nom} < R_{lim/max};$$

$$R_{lim/min} = \frac{U_{ps} - U_{ps/max}}{I_{DAC/max}} \qquad R_{lim/max} = \frac{U_{ps} - U_{ps/min}}{I_{DAC/max}}$$

Where: $R_{lim/nom}$ – limit resistor nominal value, kOhm;
$R_{lim/min}$ – limit resistor minimal admissible value, kOhm;
$R_{lim/max}$ – limit resistor maximal admissible value, kOhm;
$I_{DAC/max}$ – DAC maximum output current, mA;
U_{ps} – DAC power source voltage, V.

ATTENTION! The DAC's power source voltage shall not exceed 30 V.

An example of the DAC's connection to the power source and the load is presented on Figure 14.

To power the DAC, a built-in direct current source for 24 V not used for active sensors can be applied. When a built-in power source is used, the above requirements shall be complied with.

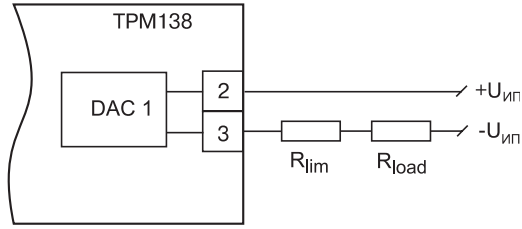


Figure 14. The DAC / load connection diagram

3.2.7 Emergency Alarm and Warning

3.2.7.1. The instrument monitors operability of primary converters connected to it and at fault of any of them generates a signal **"Sensor fault"** displaying on the digital indicator messages on the fault (description of the messages and their reasons are presented in Table 5).

Table 5

Fault cause	Message on DI-2
RTT short circuit	**0.0.0.0.**
RTT or TC rupture	**- - - -**
RTT, TC or active sensor falling beyond the lower limit of the control range (except for types 11, 12, 13 as per Table A3.2)	**LLLL**
RTT, TC or active sensor falling beyond the upper limit of the control range	**HHHH**
TC's tails overheating	**OtCL**
Measuring device fault	**AdEr**
Sensor number preset in **C.in (PL-2)** parameter is disabled programmatically by setting **in-t (PL-2)** = **oFF**	**in.oF**

By **"Sensor fault"** signal all LUs related to the faulty sensor switch OUs operated by them in states preset by the user in parameter **Er.St (PL-2)**.

3.2.7.2. The instrument monitors operability of built-in OUs and controls the units connected to them by defining the input parameter variation value and direction with periodicity set by the user in parameter **C.Lbt (PL-2)**. If within **C.Lbt (PL-2)** time the input parameter data do not reach a minimum level set in parameter **C.LbA (PL-2)**, or its variation direction does not comply with the control order, the monitoring circuit generates a fault signal **"LBA fault"**. By this signal the OU switches to the state set in parameter **Er. St (PL-2)**. The CHANNEL flashing LED is actuated where the fault is found, while the **DI-1** indicator still displays information on the monitored parameter. The **DI-2** displays a message on the fault cause in the form of the **LBA** prompt.

The signal is removed by depressing the **RESET/SHIFT** button.

When the LU operates in the warning indicator mode **(AL.t=3, 4),** the **"LBA"** is not generated. **C.LbA (PL-2)** and **C.Lbt (PL-2)** values are generated independently for each LU. When the **C.Lbt (PL-2)** parameter is set to **"0"**, "**LBA fault"** signal in this channel **is not generated**.

3.2.7.3. If required, **"Sensor fault"** and **"LBA fault"** signals can be transmitted to one of OUs to generate a combined signal **"Fault"**. Order number of the OU for the **"Fault"** signal processing is set in parameter **AL.dr (PL-0)**. At **AL.dr (PL-0) =0** of the **"0"** value, fault signals are not transmitted to the OU.

When any fault signal is transmitted to the **"Fault"** OU, the latter is automatically switched to the state set in parameter **AL.St (PL-0)** for a time period set in parameter **AL.Hd (PL-0)**. Upon termination of the **AL.Hd (PL-0)** time period, the OU returns in its reset state. But if the fault cause is not eliminated the OU will transiently operate (for 1 sec) each 60 sec.

The **"Fault"** OU can be returned in the reset state before the termination of the set delay time by depressing "RESET/SHIFT" button on the instrument's front panel.

3.2.7.4. The instrument generates ***warning signals*** to notify on actuation of an OU's in any control channel. At that, the flashing LED of a corresponding CHANNEL is switched on without generating a fault signal. The flashing LED is switched off automatically at the OU deactivation. Warning alarm operation mode is set individually for each LU in **L.oU (PL-2)** parameter: **"on"** value corresponds to actuation of a warning alarm in the specified control channel, **"oFF"** value – to its deactivation.

The warning alarm is used when the instrument or some of its channels act as automatic warning indicators to monitor status of any parameters of the facility.

3.3 Instrument Design

3.3.1. Overall and installation dimensions of the instrument are presented in *Appendix 1*.

TRM138 instrument is made in a plastic casing designed for flush mounting on the vertical plane of the control panel. The casing consists of two parts joined together with four screws. To provide for heat extraction at the instrument's operation, ventilating slots are made on lateral faces of the back part of the casing.

The instrument is fixed to the board with two clampers included in the delivery set.

3.3.2. In the casing four printed-wiring boards with the instrument's circuit components are located. The plates are joined together by means of flat cables fitted with plug connectors at one side.

For connection with primary sensing devices, power source and peripherals the instrument is equipped with four groups of terminal connectors with screwed fasteners located on its back surface. The connectors' location diagram and their purpose are presented in *Appendix 2*.

3.3.3. Overall and installation dimensions of the instrument are presented in Appendix 1.

3.4 Display and Control Elements

3.4.1. On the instrument's front panel (Figure 15) LED indicating devices are installed to display current information on parameters and operational modes of the TRM138 instrument as well as six buttons to control the instrument.

3.4.2. **The DI-1 4-digit digital indicating device** displays measured or computed parameter value in the channel selected for display; at fault the indicating device displays the order number of the faulty sensor. Two display modes (see item 3.2.4.4) are provided:

The DI-2 4-digit digital indicating device displays preset limit values for the displayed monitoring channel; at fault the indicating device displays the fault cause in character mode.

The DI-3 2-digit digital indicating device displays the order number of an input unit connected to the specified channel (for example, “d1” sensor).

The DI-4 2-digit digital indicating device displays the number of an output unit connected to the channel.

The “K1” LED is switched on at actuation of the OU assigned for displayed monitoring channel (only for key type OUs).

The “STOP” LED is switched on in the static display mode.

3.4.4. The [⩓] and [⩔] buttons are to select the display channel in the static mode as well as to control the OU manually.

The [PROG.] button is to switch the instrument in the PROGRAMMING mode.

The [RESET / SHIFT] button is to stop operation of a faulty OU as well as to shift information on the upper indicating device at overfilling.

The [MANUAL / EXIT] button is to switch a selected LU to MANUAL CONTROL mode as well as to return the instrument from the PROGRAMMING mode to OPERATION mode.

The [STOP / CYCLIC] button is to switch the instrument’s display mode from static to cyclic.

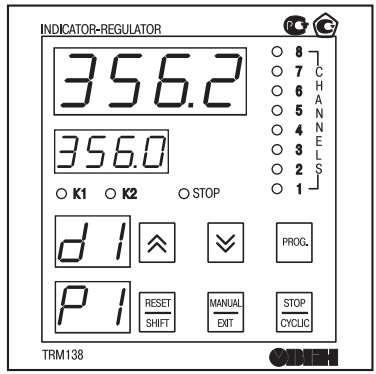


Figure 15. Instrument front panel

3.4.3. **“CHANNEL 1...8” LEDs** in steady lighting mode indicate the number of LU whose parameters are currently a displayed, in flashing mode warn on a fault in the specified monitoring channel or actuation of the warning alarm in it.

Safety Measures Section 4

4.1 TRM138 instrument is referred to protection class 0 as per GOST 12.2.007.0 75.

4.2 The instrument shall be operated and maintained in compliance with the requirements of GOST

4.3 12.3.019 80 Rules of Operation of User Electrical Equipment, Safety Rules at Operation of User Electrical Equipment.

4.4 Open contacts of the instrument's terminal block in operation are alive thus posing threat for human life. Installation of the instrument shall be performed inside of special boards accessed only by skilled technicians.

4.5 Any connections to TRM138 and operations on its maintenance shall be performed only after de-energization of the instrument and its operating units.

5.1. Installation of the Instrument

5.1.1. Prepare a mounting face on the control panel for installation of the instrument, see *Appendix 1*. The control panel design shall ensure protection of the instrument against penetration of moisture, dirt and outside objects.

5.1.3. Install TRM138 on the control panel by means of the fasteners included in the delivery set.

Note. Before installing the instrument it is recommended to configure the circuit to set programmed parameters of the instrument according to Item 6.1.

5.2. Installation of External Communications

5.2.1. General Requirements

5.2.1.1. The instrument is recommended to be powered from a source not related to high-power equipment. In the exterior circuit a power switch shall be provided to cut-off of the instrument, and safety fuses for 1.0 A.

Connection of feeders from any equipment to the instrument's power contacts is not allowed.

ATTENTION! The instrument's terminal connectors designed for power and exterior equipment connections are rated for the maximum voltage of 250 V. In order to prevent electrical breakdown, connection of sources with higher voltage to the instrument's contacts structurally integrated in one group (1...14 or 45...54) is not allowed. For example, operating within a three-phase circuit 380/220 V, connection of different power supply voltage phases to corresponding contacts from group 1...14 is not allowed.

5.2.1.2. Connection of the instrument to input resistive temperature transducers shall be performed by means of a three-wire line whose strands have equal resistance relative to each other. The communication line shall be not longer than 100 meters long, resistance of its every strand – not higher than 15.0 Ohm.

Note. Connection of resistive temperature transducers to the instrument is allowed to be made by a two-wire line (see *Attachment 4)*. The communication line shall be not longer than 100 meters long, resistance of its every strand – not higher than 15.0 Ohm.

5.2.1.3. Connection of the instrument to thermoelectric converters shall be made either directly (at sufficient length of the thermocouples' conductors) or by means of extension cables whose grade shall meet the type of used thermocouples. Extension cables shall be connected observing polarity directly to input contacts of the instrument. Only in this case temperature effect of thermocouples' free tails can be compensated. The communication link shall be not more than 20 meters long.

5.2.1.4. Connection of the instrument to active transducers shall be made by means of a double-wire line. The communication line shall be not longer than 100 meters long, resistance of its every strand – not higher than 50.0 Ohm.

5.2.1.5. The RS 485 interface communication line shall be made of a screened twisted pair. The communication line shall be not longer than 800 meters long.

5.2.1.6. TRM138 is equipped with an integrated 24 V power source which shall be used to power active transducers with analog output or the DAC's current loops with an output current of 4...20 mA (in view of Item 3.2.6.7) in appropriate modifications of the instrument.

ATTENTION! Using the integrated power source simultaneously for both the active transducers and the DAC is not allowed.

5.2.2. Installation Instructions

5.2.2.1. Prepare cables for connection of the instrument to the transducers, actuating units and peripherals, and to the power source.

To provide for reliable electrical connections cables with copper stranded conductors are recommended to be used; the cables' ends shall be carefully stripped and tin-coated before the connection. Cables' strands shall be stripped so that their bare ends remained within the terminal block after connection to the instrument.

The cable strands' section area shall not exceed 0,75 mm^2.

5.2.2.2. Installing the cables, individual communication line (or a number of lines) shall be provided to connect the instrument to the transducers; the lines shall be laid separately from power cables as well as cables which generate high-frequency and impulse noise.

To protect the input equipment of TRM138 against industrial electromagnetic interference, **the communication lines between the instrument and the transducers shall be shielded**. Shields may be made both of special cables with braided screens, and earthed steel pipes of suitable diameter.

Using screened cables, the maximum protection is provided by connection of their shields to a common point in the instrument's circuit (contacts 27, 28, 29, 42, 43, 44). However, in this case it shall be proved that braided screens of the cables are reliably insulated from earthed metal elements throughout the line route. If this requirement is not met for whatever reasons, the cables' shields shall be connected to an earthed contact in the control panel.

ATTENTION! Connection of a common point of the instrument's circuit to earthed parts of the facility is forbidden.

5.2.3. Instrument Connection

5.2.3.1. The instrument shall be connected by appropriate diagrams presented in *Appendix. 2*, observing the following operations sequence.

1) Connect the instrument to the actuating units and peripherals as well as to the power source.
2) Connect the communication lines "instrument – transducers" to the primary sensing devices.
3) Connect the communication lines "instrument – transducers" to the TRM138 inlets.
4) Install jumpers on measuring inlets not used at operation of the instrument.

ATTENTION! 1) Connection of active converters with an output signal in the form of constant voltage (0...50 mV or 0...1 V) can be made directly to the instrument's input contacts, and transducers with output signal in the form of current (0...5, 0...20 or 4...20 mA) – only after installation of an arc-shunting resistor for 100 Ohm (tolerance not greater than 0.1%).

2) To protect input circuits of TRM138 against possible breakdown by static electricity charges accumulated on the "instrument-transducers" communication lines, before connecting to the instrument's terminal block their strands shall be connected to the board's ground screw for 1 ... 2 sec.

5.2.3.2. After completion of the indicated operations the instrument is ready for use.

Section 6 Setting-up Procedures

6.1. General Requirements

6.1.1. The instrument is prepared for operation after completion of electrical installation works. The preparation consists in arranging for the instrument a circuit configuration defined by the facility process requirements and setting of programmed parameters' values.

The instrument is recommended to be prepared for operation at de-energized power equipment.

6.1.2. Energize the TRM138 from the power line and check the power by digital indicators (in 1 ... 2 sec) on the instruments' front panel. Prior to the first measurements results, the **DI-1** indicating device will display the number of a generalized configuration program entered in the TRM138 microprocessor at the manufacturer.

6.2. Configuring

6.2.1. The instrument's circuit configuring consists in programmed connection of transmitters and output units set by the user to operational LUs by way of changes in values of appropriate programmed parameters.

6.2.2. To preliminary configure the instrument's circuit select a generalized version relevant for the specified process from *Attachment 3*, Table A3.4, and install it in accordance with Figure 16.

Then it is recommended to actuate access protection for level **PL-3** by setting **"1"** value in **ACCS** parameter.

6.2.3. If a generalized configuration version does not suit the user, necessary changes are to be made.

To generate a required **measuring channel** an input signal is fed programmatically to a selected LU. The signal's parameters are displayed on the **DI-1 digital indicator**. The order number of a selected LU corresponds to the display channel number. The LU input signal (measured values of physical quantities or computed mathematical quantities (see Item 3.2.3.1)) is selected and connected by way of setting corresponding values in parameter **C.in (PL-2)** (Table A3.3 *Appendix 3)*.In the "LU output characteristic" of **AL.t (PL-2)** parameter **"0"** value is set corresponding to the meter's function.

To generate a **pilot channel**, to the selected LU the input signal is connected programmatically, to the LU's output the instrument's OU is connected whose order number is set in parameter **C.dr (PL-2)**. The LU's output characteristic is set in parameter **AL.t (PL-2)**.

Notes.

1. Only one input signal and one OU can be connected to each LU.
2. One input signal or one OU can be connected simultaneously to several LUs. By operation of one OU with several LUs the OU is actuated by an OR-circuit: the OU is actuated if just one LU generated an actuation signal.
3. Connection of any OU to a selected LU is a binding requirement of normal operation for the specified channel, except for operation in the meter mode when **"0"** value is in parameter **AL.t (PL-2)**. Not used channels shall be disabled by setting **"0"** value for corresponding LUs in parameter **C.in (PL-2)**.

6.3. Programmed Parameters Testing and Setting

6.3.1. Set the instrument's programmed parameters at the **PL-0 level** (see Figure 16).

6.3.1.1. To set warning alarm, set an order number for any not operational key type OU in parameter **AL.dr**. The values of **AL.Hd** and **AL.St** parameters are set in view of operating requirements.

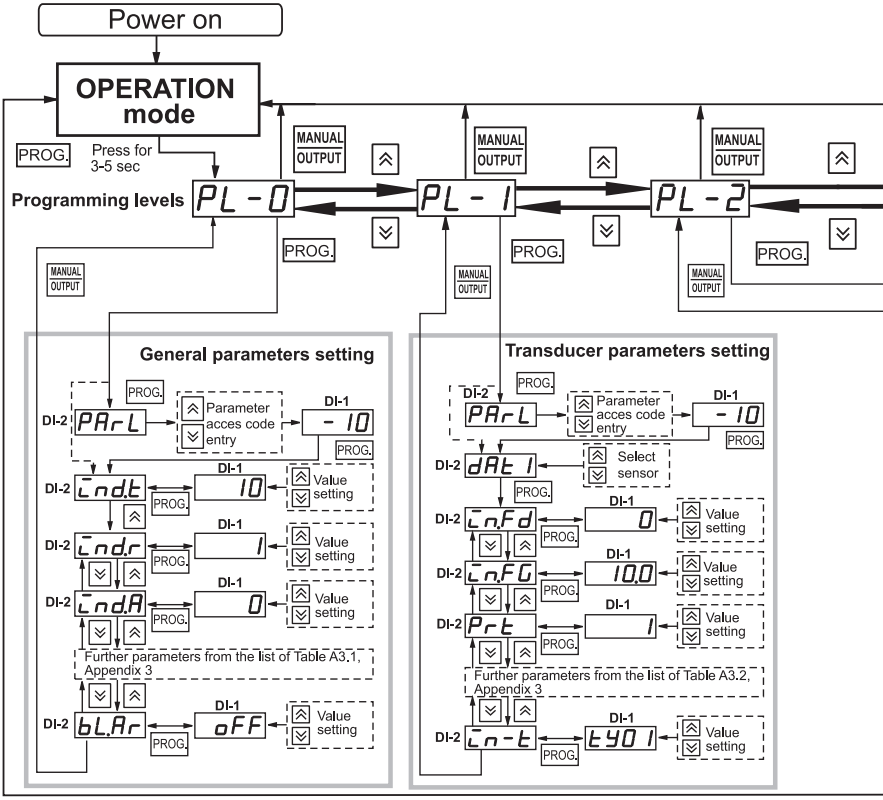
6.3.1.2. When thermocouples are used as transducers, set **"on"** value (actuated) n parameter **Cj-C**. Check up for automatic temperature correction on of the TCs' tails the **DI-3 indicating device** displaying an order number of a transducer connected to the channel: at enabled correction there is not a flashing dot after the transducer's order number on the indicating device, at disabled correction a flashing dot is displayed.

6.3.1.3. Make sure that in the **SYSt** parameter **"oFF"** value is set.

6.3.1.4. Set remaining parameters in accordance with the operating requirements.

To protect the parameters against unauthorized alternation set the access code to the **level PL-0**.

6.3.2. Set the programmed parameters of the instrument at the **level PL-1** for all input channels according to Figure 16.



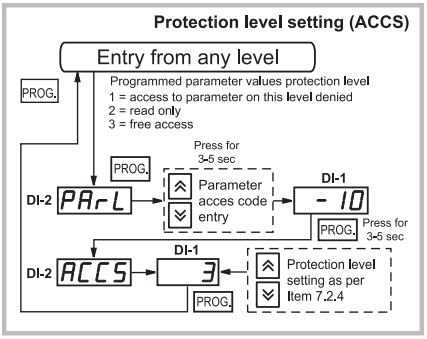
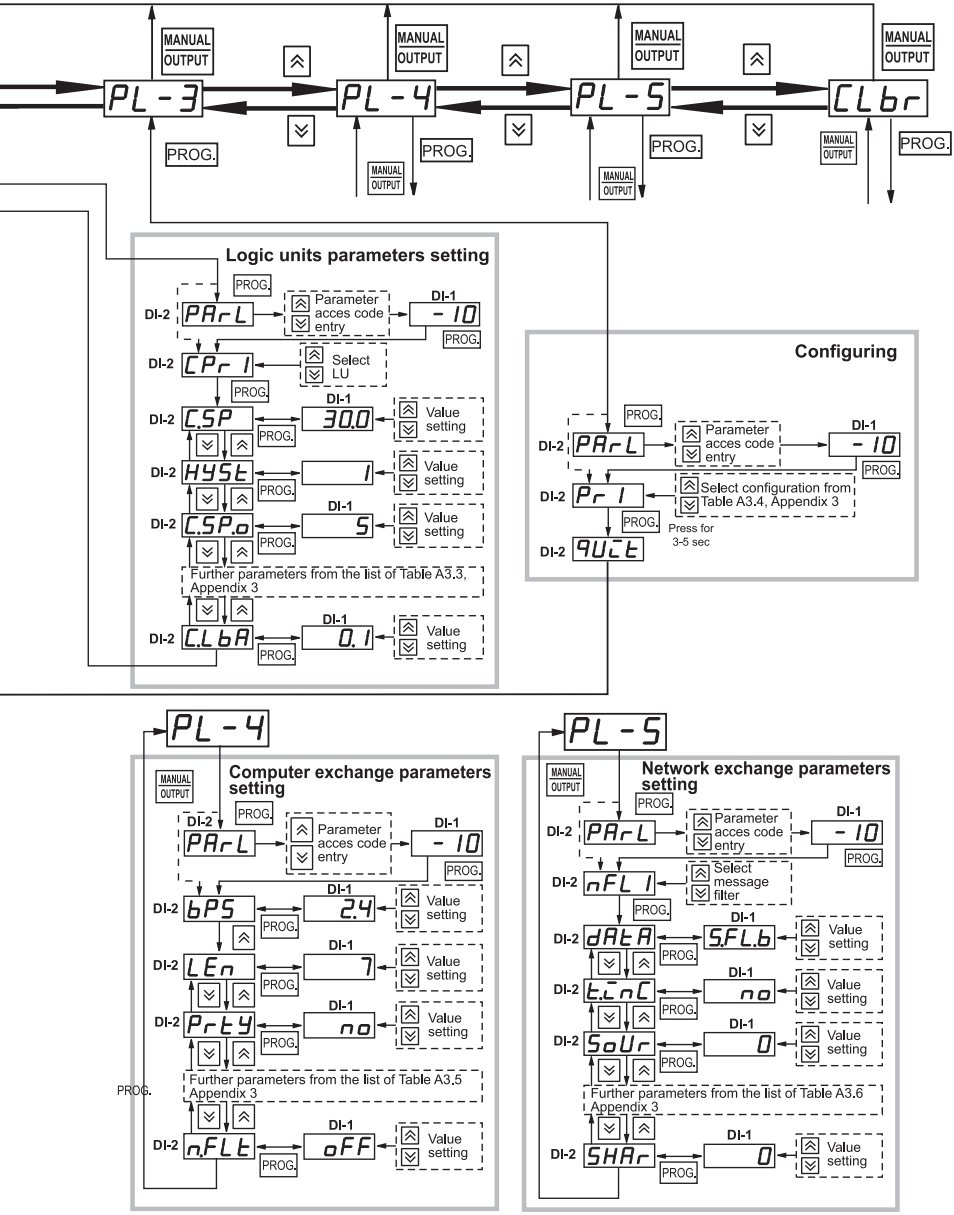


Figure 16. Programmed parameters setting diagram


PL - 3
PL - 4
PL - 5
CLbr
MANUAL OUTPUT
PROG.
Logic units parameters setting
DI-2
PArL
Parameter acces code entry
DI-1
- 10
CPr 1
Select LU
C.SP
30.0
Value setting
HYSt
1
C.SP.o
5
Further parameters from the list of Table A3.3, Appendix 3
C.LbA
0.1
Configuring
Pr 1
Select configuration from Table A3.4, Appendix 3
Press for 3-5 sec
9uCt
Computer exchange parameters setting
bPS
2.4
LEn
7
PrtY
no
Further parameters from the list of Table A3.5 Appendix 3
nFLt
oFF
Network exchange parameters setting
nFL 1
Select message filter
dAtA
SFL.b
t.LnC
no
SOUr
0
Further parameters from the list of Table A3.6 Appendix 3
SHAr
0

6.3.2.1. Check up for conformity of the transducers connected to the instrument to the nominal direct current characteristics set up for them in the **in-t** parameter. Disable non-operational transducers by setting **"oFF"** value in the **in-t** parameter.

6.3.2.2. To obtain stable observation data digital filters are recommended to be used. Parameters of the **in. Fd** and **in. FG** filters shall be set individually for each transducer based on the operating requirements and the data stated in Item 3.2.2.4.

6.3.2.3. If a more frequent interrogation of any transducers is required, relevant priority shall be set for them in the **Prt** parameter, see Item 3.2.2.2.

To protect the parameters against unauthorized alternation set the access code to the **level PL-1**.

6.3.3. Set programmed parameters at the PL-2 level, check operability for all LUs.

6.3.3.1. If required, re-configure the instrument's circuit in accordance with Item 6.2.3.

6.3.3.2. For each operational LU determine preset limit values in the **C.SP** parameter and hysteresis range in the **HYSt** parameter. To change a preset limit value during the operation, set an on-stream variation range for the preset limit value in the **C.SP.o** parameter (see Item 7.1.5).

6.3.3.3. Set output characteristics of each LU in the **AL.t** parameter according to the process requirements.

The LU operation the "Recorder" mode (**AL.t** option value is "5") is only possible for the instrument's version with a "parameter-current" digital/analog converter.

6.3.3.4. Set the **bL.St** parameter value. If the value is **"on"** the first actuation of the comparator will be blocked.

6.3.3.5. Set remaining level parameters in accordance with the operating requirements.

To protect the parameters against unauthorized alternation set the access code to the **level PL-2**.

Section 7 Operation Modes

The instrument operates in one of the following modes: OPERATION, PROGRAMMING, ADJUSTMENT.

7.1. OPERATION Mode

7.1.1. The OPERATION mode is the basic operational mode which is actuated automatically in 1...2 sec after energization of the instrument. In this mode TRM138, in accordance with the preset configuration and parameter values set by the user, performs the following main functions.

7.1.2. ***The instrument measures physical properties*** monitored by input primary sensing devices by the algorithm described in Item 3.2.2.

Information displayed on the indicating devices and display channel select modes are presented in Item 3.4.

Note. If the channel works in the meter mode, the preset limit value is not displayed on the **DI-2** indicating device, and on the **DI-4** indicating device two dashes (—) are displayed.

Information displayed on the **DI-1** can be presented in the format selected by the user (see Item 3.2.4.2).

7.1.3. ***The instrument controls the operation of primary sensing devices and at fault of any of them generates "Sensor fault" signal.***

On this signal flashing light is actuated in the relevant **"CHANNEL"** LED, the **DI-1** displays a message with the faulty transducer order number (for example, at fault of transducer 5: **d - - 5**). The **DI-2** displays a message on the fault cause (listed above, in Table 5). The information on the fault is stored until its cause is eliminated or up to programmed cut-off of the faulty channel.

A more detailed information on emergency mode see in Item 3.2.7.1.

The faulty channel can be disconnected by setting **"0"** value in the **C.in (PL-2)** parameter of the relevant LU. To reduce total interrogation cycle duration for primary sensing devices, the faulty sensor connected to this LU is recommended to be disabled by setting **"oFF"** value in the **in-t (PL-1)** parameter.

7.1.4. ***The instrument automatically controls the peripherals*** by means of LUs and OUs according to preset parameters. The operator can visually monitor key type OUs' operation by the status of the **K1** LED on the front panel of the instrument. The LED's flashing light indicates switching the OU to "enabled" status, and the light's extinction – "disabled" status. This OU's order number is displayed on the **DI-4** indicating device.

7.1.5. ***The instrument allows on-stream changing preset limit values for monitored parameters***. The instrument is switched to preset limit value changing mode on the selected display channel by momentary depression of the PROG. button, and monitored by way of actuation of the flashing light on the **DI-2 on** indicating device. The preset limit value is changed for one low-order digit by momentary depression ⩓ (up) or ⩔ (down) buttons. At continued depression (for 2...3 sec) the preset limit value will be changing continuously at increasing rate. The new preset limit value is recorded in the instrument's nonvolatile memory by a momentary depression the PROG. button and is indicated by flashing light of the **DI-2** indicating device.

The range for on-stream change of the preset limit values is set independently for each LU upward or downward in the **C.SP.o (PL-2)** parameter. For example, if a LU's preset limit value **C.SP (PL-2)** = **150°C** and its variation range **C.SP.o (PL-2)** = **50°C** the operator can change the preset limit values only within the range of **100...200°C** without switching the instrument to PROGRAMMING mode.

When **"0"** value is set in the **C.SP.o (PL-2)** parameter, on-stream change of the preset limit value is forbidden.

7.1.6. ***The instrument allows switching to manual operation*** any of in-process LUs, their related OUs and peripherals by depressing the buttons arranged on the front panel of the instrument.

A LU can be switched to manual operation only after switching the display to the static mode (**"stop"** LED flashing) and under condition that operation in this mode is allowed by setting **"oFF"** value in the **bL.Ar (PL-0)** parameter (unlocking).

The selected LU is switched to manual control mode by momentary depression the MANUAL EXIT button and is monitored by flashing light on the **DI-4** indicating device. The OU related to it is switched to manual control mode by momentary depression ⩓ or ⩔ buttons. The command execution is monitored by the **K1** LED. **ATTENTION!** At manual control operation any command is executed by the OU irrespective of the status of input signals from the LU until canceling. The issued command is canceled by repeated momentary depression ⩓ or ⩔ buttons.

The LU is switched to automatic control mode by momentary depression MANUAL EXIT button and is monitored by the flashing light of the **DI-4** indicating device.

Note. Manual operation cannot be engaged when an OU is connected simultaneously to several LUs.

7.2. PROGRAMMING Mode

7.2.1. The PROGRAMMING mode is intended to configure the TRM138 circuit and to set (change) programmed parameters' values. The set (changed) values of the parameters are recorded in the nonvolatile memory by momentary depression PROG. button and are stored there at the instrument's de-energization. The instrument starts operating with the changed values right after their recording to the memory. In the PROGRAMMING mode the instrument keeps on metering input values (without displaying them on the digital indicator) and generating signals for automatic control of peripherals.

7.2.2. The instrument is switched from the OPERATION mode to the PROGRAMMING mode by depressing and holding PROG. button for 3 sec (until the **ProG** prompt appears on the **DI-1** indicating device, and the **PL-0** prompt – on the **DI-2** indicating device). The level for the parameters' review or change is selected according to Figure 16.

Note. Presentation of any control button on the diagrams without indication of timing characteristics means its momentary depression for 0.5 sec.

7.2.3. The instrument is switched from the PROGRAMMING mode to the OPERATION mode by depressing PROG. button.

7.2.4. All programmed parameters of the instrument (according to their purpose) are divided into six groups (levels) **PL-0...PL-5**.

7.3. ADJUSTMENT Mode

The ADJUSTMENT mode is intended to restore the instrument's metrological characteristics after a long-term operation or repair related to input date measuring pattern.

The instrument adjustment procedure is presented in *Appendix 5*.

8.1. The maintenance procedure for TRM138 includes maintenance inspection and metrological calibration of the instrument.

Performing maintenance operations on the instrument, please, observe the safety rules described in Section 4.

8.2. **The maintenance inspection** of the instrument shall be performed by service personnel at least once in 6 months comprising the following operations:

– cleaning the instrument's casing and terminal blocks of dust, dirt and foreign objects;
– checking for the instrument's fastening to the control panel;
– checking for connection of external communications.

Defects discovered at the inspection shall be eliminated immediately.

8.3. **Instrument Calibration**

8.3.1. The instrument is calibrated by regional agencies or customer's departmental metrological services certified for such operations.

The recalibration interval is 2 years.

8.3.2. Calibration requirements, procedure and stages are established by the KUVF.421214.002 MT regulation.

8.3.3. The KUVF.421214.002 MT procedure for TRM138 instrument calibration is delivered by the instrument manufacturer on the customer's request.

9. MARKING AND PACKING

9.1. At manufacturing, the following information is marked on the TRM138:
– instrument's type and version;
– accuracy rating;
– manufacturer;
– manufactured date;
– measuring instrument type approval mark;
– compliance mark;
– instrument's power supply voltage and power demand;
– bar code.

9.2. The instrument is packed as per GOST 9181 74 in market container made of corrugated board.

10. TRANSPORTATION AND STORAGE

10.1. The instrument shall be transported packed at a temperature from –25 to +55°C and relative air humidity not higher than 95% (at +35°C).

10.2. Transportation is allowed by all enclosed means of transport.

10.3. At air transportation the instrument shall be placed in heated sealed compartments.

10.4. The instrument shall be stored packed in enclosed storage facilities at a temperature from –25 to +60°C and relative air humidity not higher than 95% (at +35°C). Air in the facility shall not contain aggressive vapors and gases.

11. DELIVERY LIST

TRM138 instrument	1 ea.
Fasteners	2 ea.
Passport	1 ea.
Operation manual	1 ea.
Guarantee card	1 ea.

12. WARRANTY

12.1. The manufacturer guarantees compliance of the instrument to the Technical Specifications requirements provided that the customer observes the operation, transportations, storage and installation conditions.

12.2. The warranty period is of 24 months from the day of sale.

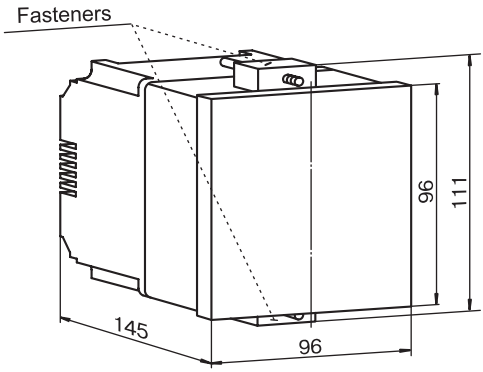
12.3. In the event of malfunction of the instrument within the warranty period at observance of the operation, transportation and storage regulations by the customer, the manufacturer shall repair the instrument free of charge.

12.4. To send the instrument for repair the following is required:
– fill in the Repair Coupon in the Guarantee Card;
– put the filled Guarantee Card in the box with the instrument;
– mail or deliver the box to the address:

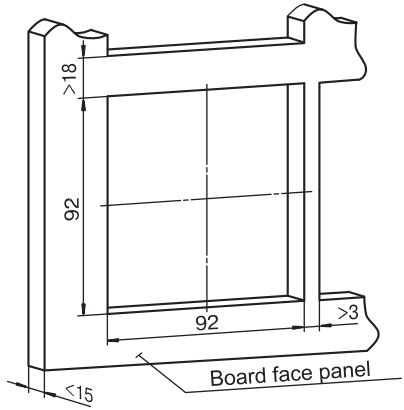
2, 1st Veshnyakovskiy Prd., 109456, Moscow, Russia
Tel.: (495) 742-48-45, e-mail: rem@owen.ru

ATTENTION! 1. The Guarantee Card is not valid without the day of sale and the seller's stamp.
2. Do not put fasteners in the box.

Appendix 1 Dimensional drawing



Instrument overall dimentions



Mountng location on the control board

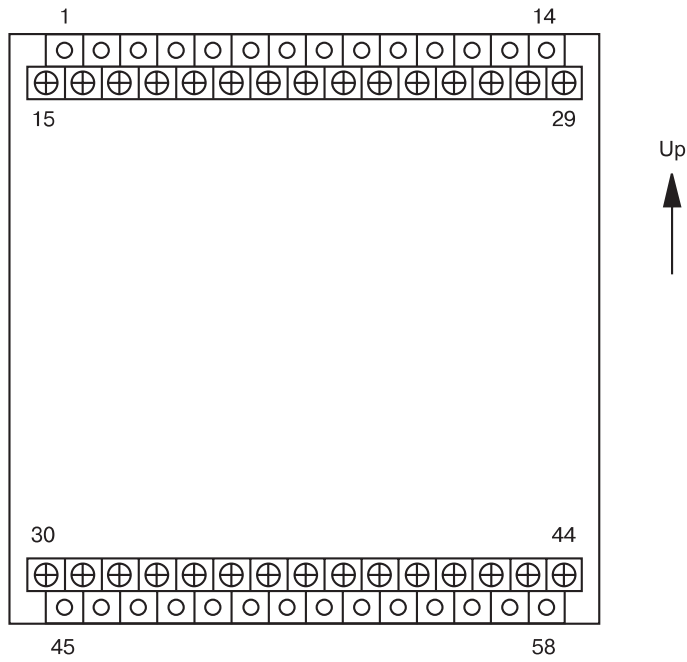


Figure A2.1. Instrument terminal block contacts arrangement diagram

Instrument terminal block contacts designation

Table A2.1

Contact No.	Designation	Contact No.	Designation
1	OU5 output (u/g contact)	30	Input 5-1
2	OU5 output (+ for DAC)	31	Input 5-2
3	OU5 output (- for DAC)	32	Input 5-3
4	OU6 output (u/g contact)	33	Input 6-1
5	OU6 output (+ for DAC)	34	Input 6-2
6	OU6 output (- for DAC)	35	Input 6-3
7	Not used	36	Input 7-1
8	Not used	37	Input 7-2
9	OU7 output (u/g contact)	38	Input 7-3
10	OU7 output (+ for DAC)	39	Input 8-1
11	OU7 output (- for DAC)	40	Input 8-2
12	OU8 output (u/g contact)	41	Input 8-3
13	OU8 output (+ for DAC)	42	Common (screen)
14	OU8 output (- for DAC)	43	Common (screen)
15	Input 1-1	44	Common (screen)
16	Input 1-2	45	Power
17	Input 1-3	46	Power
18	Input 2-1	47	OU1 output (- for DAC)
19	Input 2-2	48	OU1 output (+ for DAC)
20	Input 2-3	49	OU2 output (- for DAC)
21	Input 3-1	50	OU2 output (+ for DAC)
22	Input 3-2	51	OU3 output (- for DAC)
23	Input 33	52	OU3 output (+ for DAC)
24	Input 4-1	53	OU4 output (- for DAC)
25	Input 4-2	54	OU4 output (+ for DAC)
26	Input 4-3	55	RS-485 (B)
27	Common (screen)	56	RS-485 (A)
28	Common (screen)	57	+ 24 V
29	Common (screen)	58	- 24 V

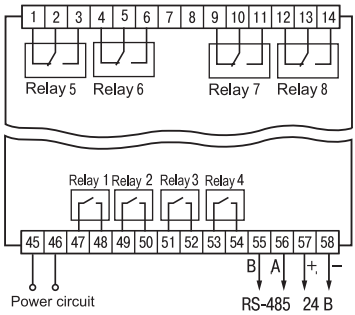


Figure A2.2 Connection diagram for electromagnetic relay in TRM 138-R type instrument

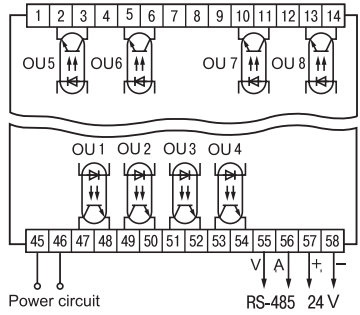


Figure A2.3 Connection diagram for optocouples in TRM 138-R type instrument

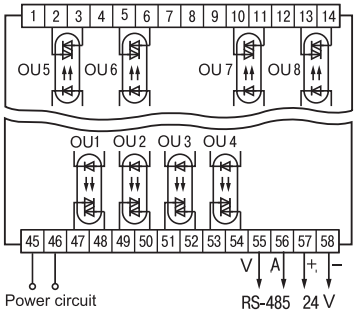


Figure A2.3 Connection diagram for symistor optocouples in TRM 138-C type instrument

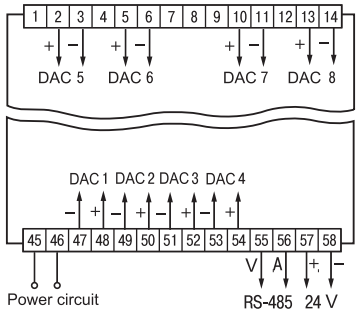


Figure A2.5 Connection diagram for DAC in TRM 138-I type instrument

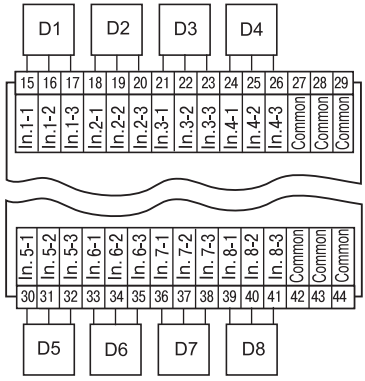


Figure A2.6 Measuring transducers connection diagram

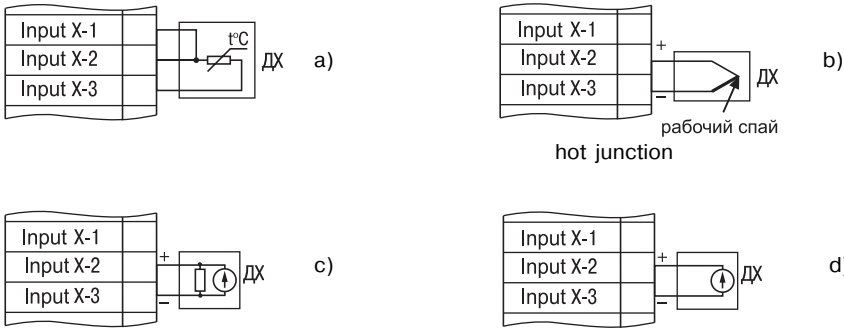


Figure A2.7 Connection diagram for measurement transducers:

a) resistive temperature transducer:
b) thermo couple;
c) transducer with 0(4)...20.0...5mA current output signal;
d) transducer with 0...50 mV, 0...1V voltage output signal

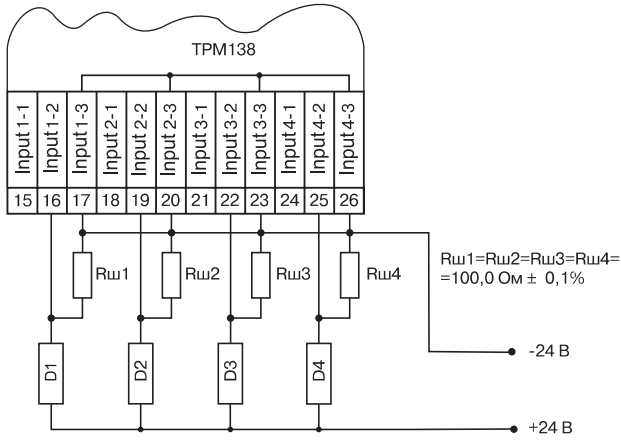


Figure A2.8 Connection diagram for active transducers d1...d4 with 4...20 mA output signal

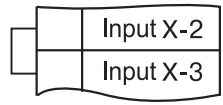


Figure A2.9. Installation diagram for jumpers at disabled input

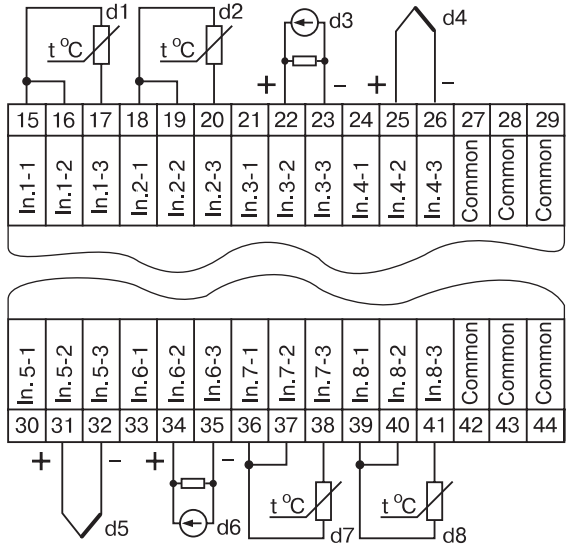


Figure A2.10. Example of connection of various type transducers

Appendix 3 Programmed parameters

Table A3.1

Level PL-0 (common parameters)

No.	Indication		Denomination	Accepted Values
	In letterpress	On DI-2		
1	ind.t	Ind.t	Channel change periodicity under cyclic indication	1...600 c
2	ind.r	Ind.r	Periodicity of information update on DI	0...60 c
3	ind.A	Ind.A	Cyclic indication status after the instrument restart	on / oFF
4	AL.dr	AL.dr	Number of the output unit for generation of FAULT signal	0...8
5	AL.Hd	AL.Hd	Actuation duration of AL.dr output unit under FAULT signal	1...600 c
6	AL.St	AL.St	Al.dr output unit status upon reception of FAULT signal	on / oFF
7	Cj-C	Cj-.C	Automated correction operation mode according TC free ends	on / oFF
8	SYSt	SYSt	“System errors” indication mode	on / oFF
9	bL.Ar	bL.Ar	Manual mode lock mode	on / oFF

Table A3.2

Level PL-1 (transducer signal processing parameters)

No.	Indication		Denomination	Accepted Values
	In letterpress	On DI-2		
1	2	3	4	5
1	in.Fd	in.Fd	Digital filter reaction time	0...15
2	in.FG	in.FG	Digital filter band	0...100*
3	Prt	Prt	Transducer priority rate	1...8
4	in.SH	in.SH	“Shift of characteristic” correction	–999...+9999*
5	in.SL	in.SL	“Slope of characteristic” correction	0,900...1,100*
6	Ain.L	AIn.L	Lower measurement limit of the active transducer	–999...+9999*
7	Ain.H	AIn.H	Upper measurement limit of the active transducer	–999...+9999*
8	in.rd	in.rd	Digital filter reaction time at calculating input parameter change rate	0...15

Continue table A3.2

1	2	3	4	5
9	in-t	in-t	Type of the transducer NSC: Датчик отключен (“Transducer off”) “Cu 100M W_{100} = 1.426” “Cu 50M W_{100} = 1.426” “Pt 100П W_{100} = 1.385” “Pt 100П W_{100} = 1.391” "L" "K" “Transducer 0...+50mV “Pt 50П W_{100} = 1.385“ “ Pt 50П W_{100} = 1.391 “ “ Cu 50M W_{100} = 1.428“ “Transducer 4...20 mA” “Transducer 0...20 mA” “Transducer 0...5 mA” “Transducer 0...1 V” “Cu 100M W_{100} = 1.428” “Cu гр. 23” "S" "R" "N" "J" "A-1"	 oFF tУ00 tУ02 tУ03 tУ04 tУ05 tУ06 tУ07 tУ08 tУ09 tУ10 tУ11 tУ12 tУ13 tУ14 tУ15 tУ17 tУ18 tУ19 tУ20 tУ21

Note. In values of parameters marked with “*” the decimal point position will be set by the User after depressing button

Table A3.3

Level PL-2 (logic devices parameters)

No.	Indication		Denomination	Accepted Values
	In letterpress	On DI-2		
1	2	3	4	5
1	C.SP	C.SP	Preset value of the controlled parameter (predetermined value)	–999...+9999*
2	HУSt	HYSt	Comparator hystoresistor range	0,001...9999*
3	C.SP.o	C.SP.o	Range on-line update of the predetermined value	0...9999*
4	Ht.on	Ht.on	Minimal hold time of OU in on state	0...9000 c
5	Ht.oF	Ht.oF	Minimal hold time of OU in off state	0...9000 c
6	dL.on	dL.on	OU turning on relay time	0...3600 c
7	dL.oF	dL.oF	OU turning off relay time	0...3600 c
8	bL.St	bL.St	Lock of output at getting started	on / oFF
9	AL.t	AL.t	LU output characteristic	

Continue table A3.3

1	2	3	4	5
			“Transducer” “Diect hysteresis” “Reverse hysteresis” “П-type characteristic” “U-type characteristic” “Recorder”	0 1 2 3 4 5
10	Er.St	Er.St	OU status at fault	on / oFF
11	C.in	C.in	LU input signal “Input off“ “Transducer d1...d8“ “Arithmetic average from d1, d2“ “Arithmetic average from d1...d3“ “Arithmetic average from d1...d4“ “Arithmetic average from d1...d5“ “Arithmetic average from d1...d6“ “Arithmetic average from d1...d7“ “Arithmetic average from d1...d8“ “Difference between d1 and d2“ “Difference between d3 and d4“ “Difference between d5 and d6“ “Difference between d7 and d8“ “Rate of change of the parameter controlled by transducer b1...d8”	 0 1...8 (accordingly) 9 10 11 12 13 14 15 16 17 18 19 27...20 (accordingly)
12	dP	dP	Position of the decimal point on the digital indicator No decimal point” “Decimal point after 3d digit” “Decimal point after 2nd digit” “Decimal point after 1st digit”	 0 1 2 3
13	Ao.L	Ao.L	Parameter lower limit during registration	–999...+9999*
14	Ao.H	Ao.H	Parameter upper limit during registration	–999...+9999*
15	C.dr	C.dr	Output unit sequential number	0...8
16	C.Lbt	C.Lbt	Preset time value for LBA fault	0...9000 c
17	C.LbA	C.LbA	Minimal input parameter change range for LBA fault	0,001...100*
18	AL.oU	AL.oU	LU ON warning indication (alarm)	on / oFF

Table A3.4

Level PL-3 (variants of the unit's circuitry configuration)

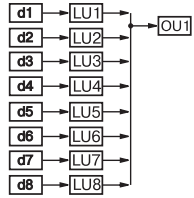
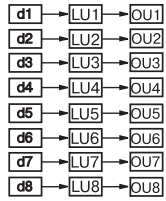
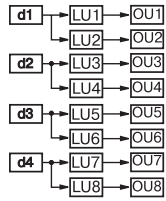
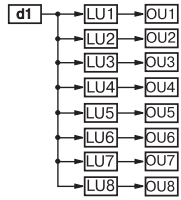
Circuit configuration indication		Prototype name	Circuit
In letterpress	On DI-2	General Parameters	Configuration
Pr 1	Pr 1	**Eight-channel warning devices UKT38-01** Transducers TSM 50M W_{100} = 1.426	
Pr 2	Pr 2	UKT38-03 Transducers TSP 100P W_{100} = 1.391	
Pr 3	Pr 3	UKT38-04 Transducers TP "chromel-copel"	
Pr 4	Pr 4	UKT38-10 Transducers 4...20 mA	
Pr 5	Pr 5	**Eight-channel two-position controllers** TRM38-01 Transducers TSM 50M W_{100} = 1.426	
Pr 6	Pr 6	UKT38-03 Transducers TSP 100P W_{100} = 1.391	
Pr 7	Pr 7	UKT38-04 Transducers TP "chromel-copel"	
Pr 8	Pr 8	UKT38-10 Transducers 4...20 mA	
Pr 9	Pr 9	**Four –channel three-position controllers** TRM34-01 Transducers TSM 50M W_{100} = 1.426	
Pr 10	Pr 10	UKT34-03 Transducers TSP 100P W_{100} = 1.391	
Pr 11	Pr 11	UKT34-04 Transducers TP "chromel-copel"	
Pr 12	Pr 12	UKT34-10 Transducers 4...20 mA	
Pr 13	Pr 13	**One-cannel two-position controller with eight predetermined values** Transducer TSM 50M W_{100} – 1.426	

Table A3.5

Level PL-4 (parameters of exchange with PC)

No.	Indication		Denomination	Accepted Values
	In letterpress	On DI-2		
1	bPS	bPS	Exchange rate (baud)	2,4; 4,8; 9,6; 14,4; 19,2; 28,8; 38,4; 57,6; 115,2
2	LEn	LEn	Data word length (bit)	7 or 8
3	PrtY	PrtY	In-transmission parity bit status “No parity check” “Odd parity check” “Even parity check”	 no EuEn odd
4	Sbit	Sbit	Quantity of stop-bits in transmission	1 or 2
5	A.Len	A.LEn	Network address length (bit)	8 or 11
6	Addr	Addr	Instrument base address	0 ...2040 (in 8)
7	n.FLt	n.FLt	Quantity of message filters	0...8

Table A3.6

Level PL-5 (network exchange parameters)

No.	Indication		Denomination	Accepted Valuess
	In letterpress	On DI-2		
1	dAtA	dAtA	Format of data transmitted in messages: “Character value with one-sided decimal point in binary notation” “Character value with one-sided decimal point in bidecimal notation” “Number format in binary notation” ‘Number format in bidecimal notation” “Untyped integer in binary notation” “Untyped integer in bidecimal notation” “Floating in IEEE-format or shorted (3-byte) floating number” “String variable”	 S.FL.b S.FL.d d.CLK b.CLK int d.int FLt StrG
2	t.inC	t.inC	Time modifier “No time modifier” “Time modifier exists, but 2 least significant bytes of the data field are circular time”	 no YES
3	SoUr	SoUr	Assembly unit address of the tuned filter	0...2047
C1	CHAr	CHAr	First character of the parameter name	40 characters
C2	CHAr	CHAr	Second character of the parameter name	The same
C3	CHAr	CHAr	Third character of the parameter name	The same
C4	CHAr	CHAr	Fourth character of the parameter name	The same

Connecting resistive temperature transducers over a two-wire circuit Appendix 4

A4.1. With a two-wire circuit the transducer readings depend upon variations of the environment temperature along the “transducer-instrument” communication line. The difference between the actual and indicated values can be observed after increase of the temperature measurement range, as well as at increase of the communication line resistance. Prior to operating the instruments the following steps must be completed.

A4.2. Connect the transducers to the corresponding input of the instrument over a two-wire circuit, as per figure P.4.1.

A4.3. Instead of temperature transducer connect resistance box of MSP-63 type (or similar, with at least 0.05 accuracy class) to opposite ends of “transducer-instrument” line.

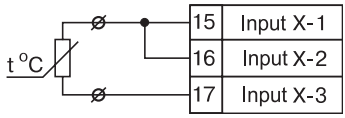


Figure A4.1. Connection diagram for resistive temperature transducer over a two-wire circuit.

A4.4. At the resistance box set the same value as for the resistive temperature transducer at 0 °C temperature (50.00; 53.00; or 100.00 Ohm, depending on a type of the transducer used).

A4.5. Power on the instrument. Based on **DI-1** indications for the corresponding channel record the temperature value deviated from 0 °C. The obtained deviation must be positive, its value depends upon the “transducer-instrument” communication line resistance.

A4.6. For this transducer set “shift of characteristic” correction value in **in.SH(PL-1)** parameter, this value shall be the same as the temperature deviation value but the opposite sighting.

A4.7. Check the correction results by measuring resistance at the box, and then set OPERATION mode for the instrument and make sure that DI-1 indicator readings for the corresponding channel are equal to 0 °C (with accuracy not less than 0.2 °C).

A4.8. Power off the instrument. Disconnect the “transducer-instrument” communication line from the resistive box, and connect it to the temperature transducer.

A4.9. In the similar manner (see A4.2 – A4.8) correct the rest resistive temperature transducers, which shall be connected to the instrument via a two-wire circuit. Any connections of the transducers must be carried out after the instrument is powered off.

Appendix 5 Instrument Adjustment

A5.1. General

A5.1.1 Adjustment of TRM138 is reduced to several procedures ensuring restoration of its metrological performances if they were changed in the course of operation.

ATTENTION! The necessity of adjustment must be determined based on the instrument inspection and to be performed by qualified metrologists only, authorized forinspection.

A5.1.2. The adjustment operations will be carried out with the use of reference signal sources connected instead of transducers and simulating their operation at contacts "Input 1" of the instrument. In the course of the adjustment the instrument calculates relations between the input signals received and the signals of the corresponding reference points of the circuit. The calculated ratios (adjustment ratios) are recorded to volatile memory and will be used as the basic values for further calculations.

The results obtained during adjustment of input 1, will be automatically transmitted to all inputs of the instrument.

A5.1.3. If for any reason the calculated value exceeds the instrument operation limits, the **DI-4** indicator will display "**Gt**" message. If this message is displayed, ensure the signal source connected to "Вход 1" ("Input 1") contacts corresponds to the predetermined type of the sensing device, also check proper circuit connections and the value of the signal set for the adjustment procedure. The troubleshooting completed, repeat the adjustment procedure.

A5.1.4. Individual adjustment is carried out for the following groups of sensing devices:

- resistive temperature transducers Cu and Cu with R_0 = 50.0 Ohm;
- resistive temperature transducers CRTT and CRTT with R_0 = 100.0 Ohm;
- thermal couples of TXK)L), TXA(K), THH(N), TJK(J) types, as well as active transducers with 0...50.0 mV output signal;
- thermal couples of R, S, A-10 types;
- active transducers with 0...1.0 V output signal;
- active transducers with 0...5.0 mV output signal;
- active transducers with 0...20.0 mV and 4...20.0 mA output signal.

The coefficients obtained after adjustment of one sensing device from the selected group will be automatically transmitted to the rest devices of the same group.

Except the groups of the sensing devices, there also provisioned adjustment of the instrument's free ends temperature transducers, as well as adjustment of output digital-analog converters "parameter-current" (only for modifications of the instrument when DAC operates as OU).

Note. It is practical to adjust only those groups of sensing devices that are used in operation.

A5.1.5. Prior to adjustment set **"0,0"** correcting value for **dat1** transducer in **in.SH (PL-1)** parameter, and "**1.000**" in **in.SL (PL-1)** parameter.

A5.1.6. During adjustment procedures observe safety measures specified in A4.

A5.2. Adjusting the instrument for operation with transducers CRTT 50 M and PRTT 50P

A5.2.1. Instead of the transducers connect the MSR-63 type (or with similar characteristics and accuracy class not less than 0.05) resistance box to the instrument's "Вход 1' ("Input 1") contacts, set 50.00 Ohm at the resistance box. The instrument to be connected to the resistance box over a three-wire circuit as per figure A5.1. The wire resistance must be the same and not exceed 15.0 Ohm.

A5.2.2. Power on the instrument and set any of the following values: **"01", "07", "08" or "09"** for transducer **dat 1** in parameter **in-t (PL-1)**, these values correspond to the numerical code of operation of TRM138 with one of the specified sensing devices.

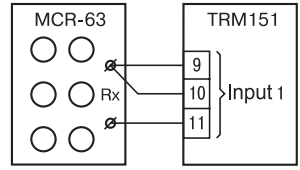


Figure A5.1. Connection diagram for resistance box during adjustment

Set the instrument to OPERATION mode, and after 5…10 s check indications of **DI-1** for the channel the resistance box is connected to. The value shall not exceed 0.0 ± 0.2 °C.

If the measurement absolute accuracy in this point is over 0.2 °C, perform the operations specified in A5.2.3 – A5.2.4.

A5.2.3 Adjust the instrument, following the procedure presented in A5.2.

The adjustment is over, the instrument will indicate on **DI-2** display the calculated coefficient value which will be recorded to volatile memory (provided that indication icon on **DI-4** is not available) by continuous depressing PROG. button (release the button after **CLb** appears on **DI-2**).

A5.2.4. Check the adjustment results (in OPERATION mode) by indications of DI-1, which must be 0.0 ± 0.2 °C.

A5.2.5. Power off the instrument, disconnect the resistance box.

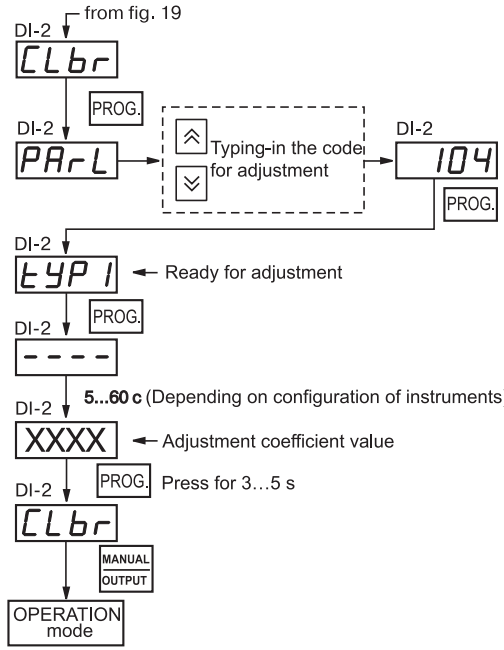


Figure A5.2. Diagram for adjusting the instrument for operation with a sensing device

A5.3. Adjusting the instrument for operation with transducers TC 100M and Pt 100P

A5.3.1. Set at the box 100.00 Ohm.

A3.2.2. Power on the instrument and set in **in-t (PL-1)** parameter any of the following values: **“00”, “02”’ “03” or “14**”.

A5.3.3. Complete steps of A5.2.3 – A5.2.4.

A5.4. Adjusting the instrument for operation with thermal couples of L, K, N, J types, and with active transducers with 0…50.0 mV output signal.

A5.4.1. Instead of the thermal couple connect to the instrument’s contacts “Input 1” the PP-63dc potentiometer, or any other reference power source with similar performances and accuracy class not less than 0.05. Connect the instrument to the potentiometer as per the diagram presented in figure A5.3. Observe polarity.

Set 40.29 mV voltage for the potentiometer output (the referenced value is 40.292 mV).

A5.4.2 Power on the instrument and set any of the following values: "**04"' "05'' "19" or "20"** in parameter **in-t (PL-1)** for transducer **dat1,** the corresponding value indicates operation of TRM138 with any of the specified thermal couples, or set **"06**" corresponding to operation with an active transducer 0...50.0 mV.

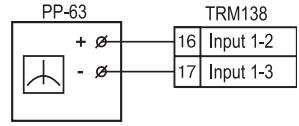


Figure A5.3. Connection diagram for the PP-63 potentiometer during adjustment

If the code in **in-t (PL-1)** parameter corresponds to operation with a thermal couple, by setting "oFF" in Cj-C (PI-0) parameter disable its automatic correction based on the free ends temperature.

If the code set in in-t (PL-1) parameter corresponds to operation with 0...50.0 mV active transducer, set for the latter "0.0" in Ain.L (PL-1) parameter, and "50.0" in Ain.H (PL-1) parameter.

Set the OPERATION mode for the instrument, and after 5..10 s check DI-1 indications for the channel the dc potentiometer is connected to. These readings shall correspond to the following figures:

– when operating with L thermal couple = 500.0 ± 1.0 °C;
– when operating with K thermal couple = 975.0 ± 1.0 °C;
– when operating with N thermal couple = 1105.8 ± 1.0 °C;
– when operating with J thermal couple = 718.6 ± 1.0 °C;
– when operating with active transducers = 40.29 ± 0.05 mV.

If the measurement accuracy in this point exceeds the specified value, follow the procedures specified in A4.3 and A4.4.

A5.4.4. Check the adjustment results by indications of DI-1 in OPERATION mode; these values shall be equal to those specified in A5.4.2.

ATTENTION! When performing operations of A5.4.2 – A5.4.4 the potentiometer output voltage shall be unchanged and equal to the value specified in A5.4.1.

A5.4.5. Power off the instrument and disconnect the PP-63 potentiometer from input 1.

A5.5. Adjusting the instrument for operation with thermal couples of TPP(S), TPP(R) and TVR(A-1) type.

A5.5.1. Instead of a thermal couple connect to the instrument's contacts "Input 1" the DC potentiometer PP-63, or any reference power source with similar performances and accuracy class not less than 0.05. Connect the instrument to the potentiometer as per the diagram presented in figure A5.3. Observe the polarity.

Set voltage 20.15 mV at the potentiometer output (the referenced value is 20.146 mV).

A5.2.2. Power on the instrument and set for transducer dat1 in parameter in-t (PL-1) any of the following values: "17",' "18''or "21" correspondent to operation of TRM138 with any of the specified thermal couples.

By setting "oFF" in Cj-C (PI-0) parameter disable the automatic correction on the base of the free end temperature.

Set the OPERATION mode for the instrument, and after 5..10 s check DI-1 indications for the channel the dc potentiometer is connected to. These readings shall correspond to the following figures:

– when operating with TPP(S) thermal coupling = 1908.0 ± 2.0 °C;
– when operating with TPP(R) thermal coupling = 1694.8 ± 2.0 °C;
– when operating with TVR(A-1) thermal coupling = 1269.8 ± 2.0 °C;

If the measurement accuracy in this point exceeds the specified value, follow the procedures specified in A5.4.3 and A5.4.4.

A5.5.3 Check the adjustment results following the procedure specified in figure A5.2.

The adjustment is over, the instrument will indicate on **DI-2** display the calculated coefficient value which will be recorded to volatile memory (provided that indication icon **Gt** is not available on **DI-4**) by continuous depressing PROG. button (release the button after **CLbr** appears on **DI-2**).

A5.5.4. Check the adjustment results (in OPERATION mode) by indications of DI-1, which must be equal the values specified in A4.2.

ATTENTION! When performing operations of A5.5.2...A5.5.4 the potentiometer output power shall be unchanged and equal to the value specified in A5.5.1.

A5.5.5. Power off the instrument and disconnect the PP-63 potentiometer from input 1.

A5.6 Adjusting transducer of thermal couples free ends temperature

Observing the polarity, connect to input 1 ends any graded thermal couple of L, K and J type. Place the thermal couple hot junction to a vessel with water-ice mixture (the mixture temperature shall be 0 °C).

A5.6.2 Power on the instrument, and set for transducer dat1 in parameter in-t (PL-1) the value correspondent to the type of thermal couple connected (see table A3.2). By setting “on” in Cj-C (PL-0) parameter enable reactance voltage automated correction for the thermal couple with respect to the temperature of its free ends.

A5.6.3 Set the instrument to OPERATION mode, and after 20 minutes adjust the free end temperature transducer following the procedure specified in figure A5.4.

The adjustment is over, the instrument will indicate on **DI-2** display the calculated thermal couple free ends temperature which (as the referenced value) will be recorded to volatile memory (provided that indication icon **Gt** is not available on **DI-4**) by continuous depressing button (release the button after **CLbr** appears on **DI-2**).

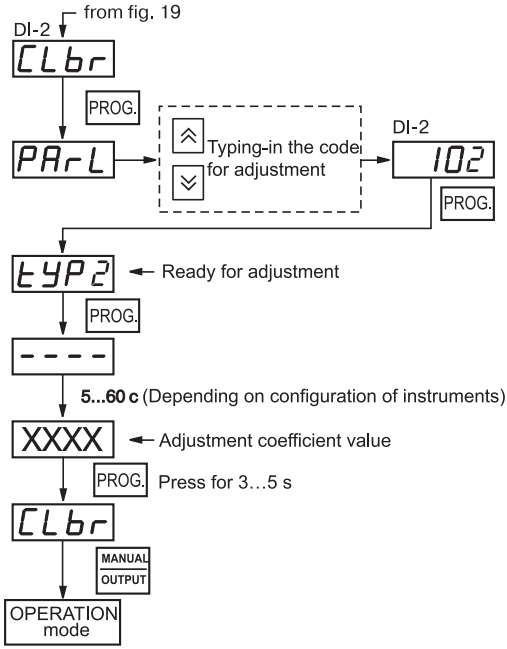


Figure 5.6.4. Diagram for adjusting thermal couple free ends transducer

A5.6.4. Check the adjustment results by reading out indications of DI-1 (in OPERATION mode), these readings shall be equal to 0 °C, with the absolute accuracy not less than 1.0 °C.

A5.7. Adjusting the instrument for operation with 0...1.0 V active transducers.

A5.7.1 Instead of the transducer connect to the instrument's contacts "Input 1" the P3003 type voltage comparator of, or any other reference voltage source with accuracy class not less than 0.05. Connection to be performed as per diagram presented in figure A5.5.

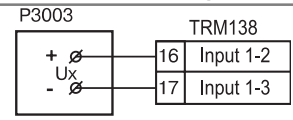


Figure A5.5. Connection diagram for voltage comparator during adjustment.

A5.7.2. Power on the instrument and set "13" for transducer dat1 in parameter **in-t (PL-1)**, this value corresponds to operation of TRM138 with an active transducer 0...1.0 V. At the same time set "0.0" in **Ain.L (PL-1)** parameter, and "100.0" in **Ain.H (PL-1)** parameter.

Set 1000 V dc voltage at the comparator output.

Set OPERATION mode for the instrument, and after 5..10 s check DI-1 indications for the channel the comparator is connected to. These readings shall be 100.0 ± 0.2 %.

If the measurement accuracy in this point exceeds the specified value, complete the operations specified in A5.7.3 – A5.7.4.

A5.7.3. Carry out the adjustment following the steps illustrated in figure A5.2.

The adjustment is over, the instrument will indicate on **DI-2** display the calculated thermal couple free ends temperature which (as the referenced value) will be recorded to volatile memory (provided that indication icon **Gt** is not available on **DI-4**) by continuous depressing PROG. button (release the button after **CLbr** appears on **DI-2**).

A5.7.4. Check the adjustment results by reading out indications of DI-1 (in OPERATION mode), the values shall not exceed 100.0 ± 0.1 %.

A5.7.5. Power off the instrument, and disconnect it from the voltage comparator.

A5.8. Adjusting the instrument for operation with 0...5.0 mA active transducers.

A5.8.1. Instead of the transducer connect to the instrument's contacts "Input 1" the P321 type current calibrator, or any other with accuracy class not less than 0.05. Connection to be performed as per diagram presented in figure A5.6.

A5.8.2. Power on the instrument and set for transducer dat1 in parameter in-t (PL-1) value "12"," correspondent to operation of TRM138 with an active transducer 0...5.0 mA. At the same time set "0.0" in **Ain.L (PL-1)** parameter, and "100.0" in **Ain.H (PL-1)** parameter.

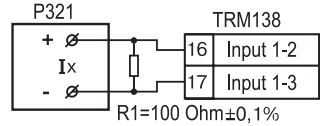


Figure A5.6. Connection diagram for current calibrator during adjustment

Set 5.00 mA at the calibrator output.

Set OPERATION mode for the instrument, and after 5..10 s check DI-1 indications for the channel the current calibrator is connected to. These values shall correspond to 100.0 ± 0.2 %.

If the measurement accuracy in this point exceeds the specified value, complete the operations specified in A5.8.3 – A5.8.4.

A5.8.3. Carry out the adjustment following the steps illustrated in figure A5.2.

The adjustment is over, the instrument will indicate on **DI-2** display the calculated coefficient value which will be recorded to volatile memory (provided that indication icon **Gt** is not available on **DI-4**) by continuous depressing PROG. button (release the button after **CLbr** appears on **DI-2**).

A5.8.4. Check the adjustment results by indications of DI-1 (in OPERATION mode), the read out values shall not exceed 100.0 ± 0.1 %.

A5.8.5. Power off the instrument, and disconnect it from the current calibrator.

A5.9. Adjusting the instrument for operation with active transducers 4...20.0 mA and 0...20.0 mA.

A5.9.1. Instead of the transducer connect to the instrument's contacts "Input 1" the current calibrator of P321 type, or any other with accuracy class not less than 0.05. Connection to be performed as per diagram presented in figure A5.6.

A5.9.2. Power on the instrument and set for transducer d1 in parameter in-t (PL-1) value "10" or "11"," correspondent to numeric code of operation of TRM138 with one of the specified sensing devices. At the same time set "0.0" in **Ain.L (PL-1)** parameter, and "100.0" in Ain.H (PL-1) parameter.

Set 20.00 mA at the calibrator output.

Set the OPERATION mode for the instrument, and after 5..10 s check DI-1 indications for the channel the current calibrator is connected to. These readings shall correspond to 100.0 ± 0.2 %.

If the measurement accuracy in this point exceeds the specified value, complete the operations specified in A5.9.3 – A5.9.4.

A5.9.3. Carry out the adjustment following the steps illustrated in figure A5.2.

The adjustment is over, the instrument will indicate on **DI-2** display the calculated coefficient value which will be recorded to volatile memory (provided that indication icon **Gt** is not available on **DI-4**) by continuous depressing PROG. button (release the button after **CLbr** appears on **DI-2**).

A5.9.4. Check the adjustment results by indications of DI-1 (in OPERATION mode), the read out values shall not exceed 100.0 ± 0.1 %.

A5.8.5. Power off the instrument, and disconnect it from the current calibrator.

A5.10. Adjusting the "parameter-current" output digital-analog converters

A5.10.1 Adjustment to be carried out for the instrument modifications provided with "parameter-current" digital-analog converter operating as OU, with output current signal 4...20 mA. The adjustment will be carried out **individually** for each DAC following the procedure specified in A5.10.2...A5.10.4.

ATTENTION! Before the adjustment procedure set "0" in parameters AL.t (PL-1) for all LUs (operation in METER mode).

A5.10.2 For the adjustment purpose connect the MSP-63 (or similar, with the accuracy class not less than 0.05) resistance box and the PP-63 type dc potentiometer to the selected DAC. Connection to be carried out as per figure A5.7.

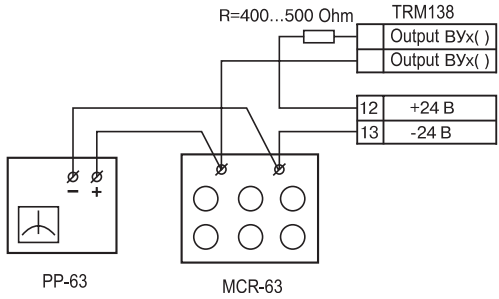


Figure A5.7. Connection diagram for the equipment during adjustment of the DAC.

At the resistance box set 4000 Ohm, and power on the instrument.

A5.10.3. Adjustment to be carried out by selecting DAC shift codes when its minimal and maximal output currents are equal to their nominals. DAC shift codes are generated with the use of buttons and then recorded to the memory at the end of adjustment. The output current is controlled by the voltage drop at MSR-63 box resistance, which under minimal current (4000 mA) shall be 16.00 mV, and under maximal value (20.00 mA) = 80.00 mV, with the limit of the reduced error not less than 0.1%.

Each DAC shall be adjusted following the procedures illustrated in figure A5.8.

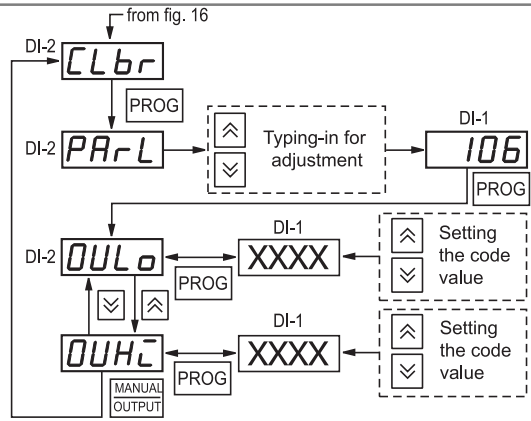


Figure A5.8. Diagram for DAC adjustment

Selection of the DAC order number for adjustment purposes is carried out by means of buttons and , and by indications of DI-3 indicator. The shift code for setting minimal current for DAC is set in **OULo** parameter, and the shift code for maximal current – in **OUHi** parameter.

Note. The current signal at the output of the DAC under adjustment will be generated after the preset shift code is changed.

The DI-4 digital indicator displays the order number of adjustment parameter (‘1” for **OULo**, or “2” for **OUHi**).

A5.10.4. The adjustment is over, power off the instrument and disconnect it from test equipment.

Record of Revisions

Appendix 6

Rev. No.	Page (Sheet) number				Total Pages (Sheets)	Date	Signature
	revised	replaced	new	canceled			