

THERMAL CONVERTERS WITH UNIFIED OUTPUT SIGNAL

ТСМУ 0104, ТСПУ 0104

Operation manual

HKГЖ.411521.001PЭ



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1. INTRODUCTION

1.1. The present complete set of operation documentation including operation manual, certificate and calibration technique is designed for familiarization with the instrument and operation regulations of the thermal converter with unified output signal TCMY 0104, TCIY 0104, provided in the table 1.1 (hereinafter – thermal converters), and contains information certifying guarantees of the manufacturer.

Table 1.1

Code of thermal converter	Number of the picture in accordance with the Appendix Б	Designation	Embodiment	
			constructive	as to resilience to external exposure
1	2	3	4	5
TCMY 0104/АГ08	Picture Б.1	HKГЖ.411521.001	Housing of the head АГ08	Corrosion proof
TCIY 0104/АГ08				Explosion proof «spark-proof electr. circ.»
TCMY 0104Ex/АГ08		HKГЖ.411521.003		Enhanced Reliability (for NPS)
TCIY 0104Ex/АГ08				Explosion proof «explosion impenetrable jacket»
TCMY 0104A/АГ08				
TCIY 0104A/АГ08				Explosion proof «spark-proof electr. circ.»
TCIY 0104Exd/АГ02	Picture Б.2	HKГЖ.411521.005	Housing of the head АГ02	Explosion proof «explosion impenetrable jacket»
TCMY 0104Exd/АГ02				
TCIY 0104/НГ01	Picture Б.3	HKГЖ.411521.007	Housing of the head НГ01	Corrosion proof
TCMY 0104/НГ01				Explosion proof «spark-proof electr. circ.»
TCIY 0104Ex/НГ01		HKГЖ.411521.009		Enhanced Reliability (for NPS)
TCMY 0104Ex/НГ01				
TCIY 0104A/НГ01				Explosion proof «explosion impenetrable jacket»
TCMY 0104A/НГ01				
TCIY 0104/МГ	Picture Б.4	HKГЖ.411521.011	Small size МГ	Corrosion-proof
TCIY 0104Ex/МГ				Explosion proof «explosion impenetrable jacket»

2. PURPOSE

2.1. Thermal converters are designed for measuring and constant conversion of temperature of hard, liquid, gaseous and loose materials into unified output signal of constant current 4...20 mA.

Thermal converters ensure measurement of temperature of neutral as well as aggressive media.

Thermal converter is used in different technological processes in industry and power engineering.

2.2. Thermal converter consists of a primary converter and a measuring converter in accordance with the table 2.1.

Table 2.1

Modification, Version of Thermal converter	Primary converter		Version of the Measuring converter	Notes
	HCX	In accordance with		
TCMY 0104, TCMY 0104Exd, TCMY 0104A	50M, 100M	State Standards 6651	ИП 0104/М	Measuring converters ИП 0104 are registered in State Register СИ
TCMY 0104Ex			ИП 0104Ex/М	
ТСПУ 0104	50П, 100П or Pt100	State Standards 6651 or DIN № 43760	ИП 0104/П	
ТСПУ 0104Exd	50П, 100П or Pt100	State Standards 6651 or DIN № 43760	ИП 0104/П	
ТСПУ 0104А	50П, 100П or Pt100	State Standards 6651 or DIN № 43760		
ТСПУ 0104Ex	50П, 100П or Pt100	State Standards 6651 or DIN № 43760	ИП 0104Ex/П	

2.3. In accordance to State Standards 13384-94 and State Standards 13384-93 thermal converters belong to:

- as to the number of converted input and output signals – single channel instruments;
- as to dependence of output signal on converted temperature – with linear dependence;
- as to interdependence between input and output circuits - with galvanic coupling;
- depending on a possibility to convert measuring range – multirange, regulated instrument.

2.4. As to resilience to climatic impact during operation thermal converters correspond to:

- execution group C2 (without humidity condensation) at the temperature of ambient air from minus 50 to plus 70 °C (for the order index t5070) according to State Standards 12997-84;
- execution group C3 at the temperature of ambient air from minus 10 to plus 60 °C. (for the order index t1060) according to State Standards 12997-84;
- the type of climatic version T3 at the temperature of ambient air from minus 10 to plus 60 °C (for the order index t1060) according to State Standards 15150-69.

2.5. According to State Standards 12997-84 as to resilience to mechanical impact during operation thermal converters correspond to the version group N3.

2.6. Thermal converters TCMY 0104A, TCIIY0104A (enhances reliability) belong to the I category of seismic stability by HII-031-01 and to the version group 3 by ПД 25818-87.

2.7. Thermal converters TCMY 0104Ex and TCIIY 0104Ex are manufactured in the explosion proof version, they have a special explosion proof level of protection from an explosion, provided by the type of protection « spark proof electrical circuit» of the level «ia», marking of implosion protection ExiaIICT6 X and correspond to requirements of State Standards P 51330.0-99, STATE STANDARDS P 51330.10-99.

2.8. Thermal converters TCMY 0104Exd, TCIIY 0104Exd are manufactured in the explosion proof version in accordance with the requirements of State Standards STATE STANDARDS P 51330.0-99, STATE STANDARDS P 51330.1-99, they have an explosion proof level of protection " explosion impenetrable jacket", level of protection from explosion is "explosion proof" for mixtures of gases and vapours with air of the category IIC according to State Standards P 51330.11-99, marking of implosion protection 1ExdIICT6.

2.9. Explosion proof thermal converters TCMY 0104Ex, TCIIY 0104Ex, TCMY 0104Exd, TCIIY 0104Exd are designed for use in highly explosive premises zones and outdoor units in accordance with preset marking of implosion protection, requirements of the chapter 7.3 ПЙЭ, chapter 3.4 ИТЭЭИ and State Standards P 51330.9-99, State Standards P 51330.13-99 and other normative documents, regulating employment of this type of equipment in highly explosive zones, where formation of highly explosive mixtures of the category IIC and groups T1...T6 is possible.

2.10. According to State Standards 14254-96 as to protection from an environmental impact thermal converters are manufactured in dust and water proof version. The degree of protection from penetration of hard bodies particles, dust and water for them is as follows:

- | | | |
|--|---|--|
| - TCMY 0104, TCIIY 0104
TCMY 0104Ex, TCIIY 0104Ex
- TCMY 0104A, TCIIY 0104A
- TCMY 0104Exd, TCIIY 0104Exd | } | IP54 or IP65 depending on the type of the housing of the head of the cable input (Table B.2 of appendix B) |
|--|---|--|

2.11. According to State Standards P 50746-2000 as to resilience to electromagnetic interferences thermal converters belong to the version group IV, criteria of operation quality - A.

3. TECHNICAL DATA AND CHARACTERISTICS

3.1. The lower limit and a number of upper limits correspond to the limits provided in the table 3.1.

3.2. The limits of the tolerable basic reduced errors for thermal converters relative to the nominal static characteristic of conversion (HCX) at the loads resistance provided in paragraph 3.3, correspond to the ones provided in the table 3.1.

Table 3.1 – Basic metrological characteristics of TCMY 0104, TCIIY 0104

Lower limit of measurement, °C	A number of upper limits of measurements, °C	HCX of primary converter		
		50M, 100M	Pt100 (only for TCIIY 0104 in the housing МГ)	50П, 100П, Pt100
		Limits of the tolerable basic reduced error, % (length of the mounting part of the thermal converter, мм)		
minus 50	0; 20; 30	±1,0; ±0,75; ±0,5 (60); ±0,75; ±0,5 (80); ±0,5 (≥100)	-	-
	0; 20; 30; 50	-	±0,75; ±0,5; ±0,25 (≥60)	
	50; 70; 80; 100	±1,0; ±0,75; ±0,5 (60); ±0,75; ±0,5; ±0,25 (80); ±0,25 (≥100)	-	
	70; 80; 100	-	±0,75; ±0,5; ±0,25 (≥60)*;	
	120; 130; 150	±0,25 (≥100)	±0,15** (≥100)	
0	50	±1,0; ±0,75; ±0,5 (60)*; ±0,75; ±0,5 (80); ±0,5 (≥100)	±0,75; ±0,5; ±0,25 (≥60)	-
	70; 80; 100 120; 130; 150; 170; 180; 200	±1,0; ±0,75; ±0,5 (60); ±0,75; ±0,5; ±0,25 (80); ±0,25 (≥100)	±0,75; ±0,5; ±0,25 (≥60)*; ±0,15** (≥100)	
	0			
minus 50	0			±1,0 (60); ±0,75 (80); ±0,5 (≥100)
	50; 100			±1,0 (60); ±0,5 (80); ±0,25 (≥100)
	150; 200; 250; 300; 350; 400; 450; 500			±1,0 (80); ±0,5 (100); ±0,25 (≥120)
0	50		-	±1,0; ±0,75 (60); ±0,75; ±0,5 (80); ±0,5; ±0,25 (≥100)
	100; 150; 200			±1,0; ±0,75; ±0,5 (60)*; ±0,75; ±0,5; ±0,25 (80); ±0,5; ±0,25; ±0,15* (≥100)
	250; 300; 350; 400; 450; 500; 550			±1,0; ±0,75 (100); ±0,5; ±0,25 (120); ±0,25; ±0,15* (≥160)
Notes				
1 * – at $\ell_m = 60$, $t_b = 100$ °C.				
2 ** By separate order.				

3.3. Load resistance $R_H = 1 \text{ k}\Omega$ at voltage of power supply $U_H = 36 \text{ V}$ and $R_H = 0,5 \text{ }\Omega$ $U_H = 24 \text{ V}$.

3.3.1. Maximum load resistance $R_{H_{\max}}$, $\text{k}\Omega$, for power supply voltage within the range of from 12 to 36 V calculated from the formula

$$R_{H_{\max}} = \frac{(U - U_{\min})}{I_{\max}}, \quad (3.1)$$

where : U - power supply voltage, V;

$$U_{\min} = 12 \text{ V};$$

$$I_{\max} = 24 \text{ mA}.$$

3.4. Time of setting of operation mode (preliminary warming up) not more then 15 min.

3.5. Time of setting of output signal (time, during which output signal of thermal converter enters the zone of the limit of tolerable basic error) not more than 10 sec for measuring converter and 30 min for thermal converter.

3.6. The limit of the tolerable auxiliary error, caused by ambient air temperature variation:

- from minus 50 °C to minus 10 °C for every 10 °C of temperature variation, not more than the limit of the tolerable basic error;
- from minus 10 °C to plus 70 °C for every 10 °C of temperature change, not more than 0,5 of the limit of tolerable basic error.

3.7. The limit of the tolerable additional error of thermal converters caused by an impact of increased humidity (up to 95 % at 35 °C), does not exceed 0,5 of the limit of the tolerable basic error.

3.8. The limit of tolerable additional error of thermal converters, caused by an impact of magnetostatic fields and (or) variable fields of line frequency voltage up to 400 A/m does not exceed 0,5 of the limit of tolerable basic error.

3.9. The limit of auxiliary error of thermal converters, caused by variation of power supply voltage from minimal 12 V to maximal 36 V, does not exceed 0,05 %.

3.10. The limit of the tolerable auxiliary error, caused by deviation of resistance load from extreme values, preset in par. 3.3 to zero, does not exceed 0,05 %.

3.11. Power supply of thermal converters of TCMY 0104, TCIY 0104, TCMY 0104Exd, TCIY 0104Exd, is performed from the direct current source with voltage of from 12 to 36V at nominal value $(24_{-0,48}^{+0,48}) \text{ V}$ or $(36_{-0,72}^{+0,72}) \text{ V}$.

3.12. Power supply of explosion proof thermal converters TCMY 0104Ex, ТСПУ 0104Ex with marking of explosion protection ExiaIICT6 X is performed from the spark-safe power source with voltage напряжением ($24^{+0,48}_{-0,48}$) В.

3.12.1. Electrical parameters of spark-safe circuit of explosion-proof thermal converters TCMY 0104Ex, ТСПУ 0104Ex with marking of explosion protection ExiaIICT6 X:

- maximum input voltage U_i : 24 V.
- maximum input current I_i : 120 mA.
- maximum input power P_i : 0,75 Вт.
- maximum internal capacitance C_i : 22 nF.
- maximum internal inductance L_i : 0,1 мГн.

3.13. Power, consumed by thermal converters TCMY 0104, ТСПУ 0104, TCMY 0104Exd, ТСПУ 0104Exd does not exceed 0,8 Вт.

3.13.1. Power, consumed by explosion-proof thermal converters TCMY 0104Ex, ТСПУ 0104Ex does not exceed 0,75 Вт.

3.14. The length of the assembly part of thermal converters correspond to State Standards 6651-94 and is selected from the series: 60, 80, 100, 120, 160, 200, 250, 320, 400, 500, 630, 800, 1000, 1250, 1600, 2000, 2500, 3150 mm.

3.14.1. Dimensional sizes, design version of thermal converters correspond to the ones provided in the appendix B.

3.15. Mass of thermal converters is from 0,4 to 2 kg depending on dimensional sizes.

3.16. Insulation of electrical circuits of thermal converters relative to the housing withstands during 1 minute the impact of testing voltage of practically sinusoidal form of frequencies from 45 to 65 Hz:

- 500 V at the temperature of ambient air (20 ± 5) °C and relative humidity from 30 to 80 %;
- 300 V at ambient air temperature (35 ± 3) °C and relative humidity (95 ± 3) %.

3.17. Electrical resistance of insulation between electrical circuits and the housing is not less than:

- 20 MΩ at the temperature of ambient air (20 ± 5) °C and relative humidity from 30 to 80 %;
- 5 MΩ at the temperature of ambient air (50 ± 3) °C and relative humidity from 30 to 80 %;
- 1 MΩ at the relative humidity (95 ± 3) % and temperature of ambient air (35 ± 3) °C.

3.18. Thermal converters have linear increasing dependence of input signal from converted temperature T_i , calculated from the formula

$$I = \frac{(T - T_H)}{(T_B - T_H)} \cdot (I_B - I_H) + I_H, \quad (3.2)$$

where : I - measured value of input signal, corresponding to measured temperature, mA;

I_H, I_B - lower and upper limits of unified output signal, mA;

T_H, T_B - lower and upper limits of temperature measurements, °C;

T - value of measured temperature, °C.

3.19. Thermal converters are resistant to ambient air temperature influence from minus to 10 to plus 60 °C (from minus 50 to plus 70 °C).

3.20. Thermal converters are stable to humidity influence from 95 % at temperature of 35 °C.

3.21. Thermal converters in transport tare withstand temperature from minus 50 to plus 50 °C.

3.22. Thermal converters in transport tare are stable to influence of ambient air with relative humidity of 98 % at the temperature 35 °C.

3.23. Thermal converters in transport tare are stable to an impact of bumps with 80 shocks per minute, and average quadratic acceleration value of 98 m/s² and durability of an impact of 1 hour.

3.24. Requirements to thermal converters TCMY 0104A, TCIIY 0104A (of increased reliability) in the part of stability and durability to mechanical impacts.

3.24.1. Thermal converters TCMY 0104A, TCIIY 0104A are durable and stable to an influence of sinusoidal vibrations in the range of frequencies from 1 to 100 Hz at an amplitude of vibro - acceleration of 20 m/s².

3.24.2. Thermal converters TCMY 0104A, TCIIY 0104A have no constructive elements and units with resonance frequencies from 5 to 25 Hz.

3.24.3. Thermal converters TCMY 0104A, TCIIY 0104A are durable and stable to an impact of mechanical shocks of singular action with peak impact acceleration of 20 m/s², duration of a shock pulse from 2 to 20 ms and 30 total number of shocks.

3.24.4. Thermal converters TCMY 0104A, TCIIY 0104A are durable and resistant to an impact of mechanical shocks of multiple action with peak impact acceleration of 30 m/s², with a preferable durability of action of shock acceleration of 10 msec (tolerable durability - from 2 to 20 msec) and 20 shocks in every direction.

3.24.5. Thermal converters TCMY 0104A, TCIIY 0104A are durable at a seismic impact equivalent to action of vibration with parameters provided in table 3.2.

Table 3.2

Frequency, Hz	1,0	2,0	3,0	4,0	5,0	6,0	8,0	10,0	15,0	20,0	30,0
Acceleration, m/s ²	6,0	15,0	29,0	51,0	48,0	43,0	38,0	31,0	20,0	19,0	14,0

3.25. Provision of electromagnetic compatibility and noise immunity of thermal converters.

3.25.1. In accordance to State Standards P 50746-2000 as to stability to electromagnetic interferences thermal converters correspond to version group IV.

In accordance to State Standards P 50746-2000 in case of influence of interferences thermal converters correspond to functioning quality criteria A.

3.25.2. In accordance to State Standards P 51317.4.5-99 thermal converters are stable to microsecond pulse interferences of major energy in the circuit of input- output and withstand testing impact with an amplitude of 2 kV.

3.25.3. In accordance to State Standards P 51317.4.4-99 thermal converters are resistant to nanosecond pulse interferences in the circuits of input - output and withstand testing influence with an amplitude of 4 kV during supply of interference pulses to inputs of power supply circuits and 2 kV during supply of interference pulses to circuits of input output.

3.25.4. In accordance to State Standards P 51317.4.2-99 thermal converters are resistant to electrostatic discharges and withstand testing influence of voltage of 8 kV during a contact discharge and 15 kV in case of an air discharge.

3.25.5. In accordance to State Standards P 51317.4.3-99 thermal converters are resistant to radiofrequency electromagnetic fields in the band 80 – 1000 MHz with voltage 10 V/m in 800 – 960 MHz with voltage 30 V/m.

3.25.6. In accordance to State Standards P 50648-94 thermal converters are resistant to magnetic fields of industrial frequency and withstand influence of constant magnetic field with an amplitude of 40 A/m.

3.25.7. In accordance to State Standards 30336-95 State Standards P 50649-94 thermal converters are resistant to pulse magnetic field with an amplitude of 600 A/m.

3.25.8. In accordance to State Standards P 51317.4.6-99 thermal converters are resistant to conductive interferences, caused by radio frequencies electromagnetic fields, and withstand influence of testing voltage 10 V (140 dB relative to 1 mkV) in the frequency band 0,15...80 MHz.

3.25.9. Thermal converters are resistant to conductive interferences, presenting general non-symmetrical voltages in the frequency band of 0...150 kHz, on input power supply ports and signal ports, and withstand the following testing influence in accordance with State Standards P 51317.4.16-2000:

- long time interferences at the frequency of 50 Hz during supply of testing voltage of 30 V;
- short time interferences at the frequency of 50 Гц during supply of testing voltage of 100 V;
- long time in the frequency band:
 - from 15 to 150 Hz when supplying testing voltage of 30...3 V (voltage is decreased for 20 dB/decade);
 - from 150 Hz to 1,5 kHz when supplying testing voltage of 3 V;
 - from 1,5 to 15 kHz when supplying testing voltage of 3...10 V (voltage is increased for 20 dB/decade);
 - from 15 to 150 kHz when supplying testing voltage of 30 V.

3.25.10. In accordance to State Standards P 50652-94 thermal converters are resistant to influence on the port of the housing of damped vibration of magnetic field with voltage of 100 A/m

3.25.11. Thermal converters function normally and do not produce any interferences in conditions of joint operation with the equipment of systems and elements for which they are designed as well as with the equipment of different function, which may be used together with the present thermal converter in a typical interference situation.

3.26. Provision of explosion protection

3.26.1. Explosion proof thermal converters TCMY 0104Ex, TCIY 0104Ex with the type of explosion protection "spark-proof electrical circuit" correspond to requirements of State Standards 51330.0-99, State Standards P 51330.10-99 for explosion proof electrical equipment of the group II subgroup IIC of the temperature class T6 and level of explosion protection - especially explosion-proof.

Explosion proof thermal converters TCMY 0104Ex, TCIY 0104Ex are designed for operation power supply and registration equipment, having spark-safe circuits of the level «ia». Electrical parameters, correspond to electrical equipment of the electrical subgroup IIC.

Output circuits of explosion-proof thermal converters TCMY 0104Ex, TCIY 0104Ex are designed for connection to spark-proof signalling circuits with unified signal of direct current of 4...20 mA by State Standards 26.011-80.

3.26.2. Explosion protection of thermal converters TCMY 0104Exd, TCPIY 0104Exd is provided by the type of explosion protection "explosion-proof shell" according to State Standards P 51330.1-99 and it is achieved by encapsulating electrical circuits of thermal converters TCMY 0104Exd, TCPIY 0104Exd into explosion proof shell, which withstands without being damaged the pressure of an explosion of 1,5 MPa of inflamed mixture and excludes transfer of inflammation into surrounding media.

3.27. Reliability indexes.

3.27.1. Average nonfailure operating time not less than 15000 hours.

3.27.2. Average lifetime is not less than 6 years.

4. COMPLETE SET

4.1. Complete set of delivery corresponds to the one provided in the table 4.1.

Table 4.1

№ п/п	Name	Designation	Num- ber	Notes
1	Thermal converters with unified signal TCMY 0104 ___/___ TCPIY 0104 ___/___	HKГЖ.411521.001 ___ HKГЖ.411521.003 ___ HKГЖ.411521.005 ___ HKГЖ.411521.007 ___ HKГЖ.411521.009 ___ HKГЖ.411521.011 ___	1 1 1 1 1 1	Quantity, modification, version and value of error in accor- dance with the order
2	Socket (for TCPIY 0104/МГ)	GDM 3009 («Hirschmann»)	1	
3	Seal (for TCPIY 0104/МГ)	GDM 3-16 («Hirschmann»)	1	
4	Operation manual TCMY 0104, TCPIY 0104	HKГЖ.411521.001PЭ	1	

5. DESIGN AND OPERATION OF THE DEVICES

5.1. Thermal converters consist from a primary converter (III) of temperature and a measuring converter (III). As a primary converter of temperature thermal converters of resistance (TC) 50M, 100M and 50П, 100П, Pt100 are used.

TC convert temperature into electrical resistance.

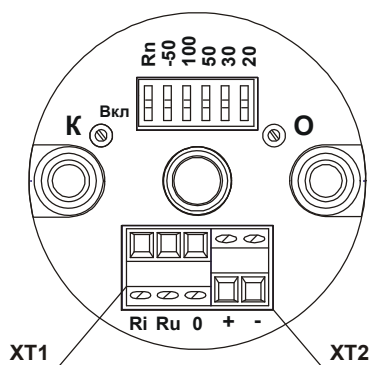
III converts signals coming from the primary converter into a unified current signal of 4÷20 mA. It is designed in the form of a single construction unit, which is installed into the head of the primary converter.

5.1.1. In thermal converters there is envisaged a possibility of readjustment of upper and lower limits of temperature measurement with the help of corresponding switches, located on the upper (front) panel of III (see. pictures 5.1 and 5.2).

5.2. Under the cover of the head of the body of thermal converters TCMY 0104, TCIY 0104 on the front panel of III (see. pictures 5.1 and 5.2) are located:

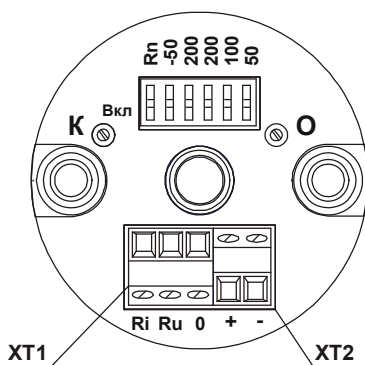
- potentiometer of zero tuning «O»;
- potentiometer of gain constant tuning «K»;
- switch of selection of nominal resistance value (50 or 100 Ohm) TC «Rи»;
- switch of lower limit of measurement «-50»;
- switch of upper limit of measurement:
 - «100», «50», «30», «20» for TCMY 0104;
 - «200», «200», «100», «50» for TCIY 0104;
- clamp connectors XT1 and XT2 for connection of primary converter of power supply +24 V (+36 V) and load.

**Measuring converters III 0104/M.
Front panel**



Picture 5.1

**Measuring converters ИП 0104/П.
Front panel**

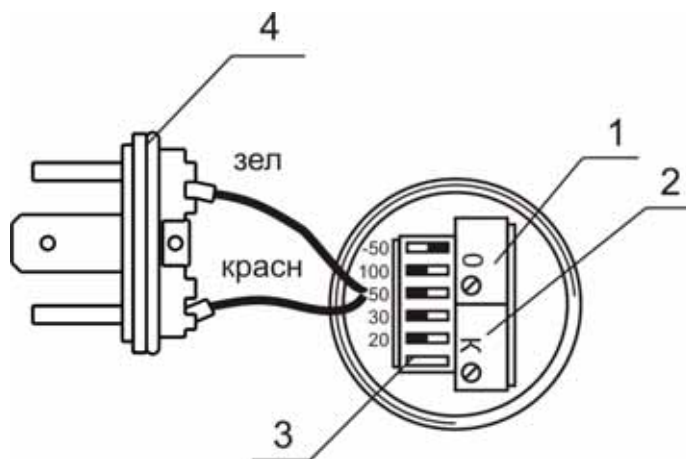


Picture 5.2

5.2.1. Under the plug GSP 311 4 thermal converters ТСПУ 0104/МГ, designed for power supply connection +24 V (+36 V) and load (see. picture 5.3), are located:

- potentiometer 1 of zero tuning «0»;
- potentiometer 2 of gain constant tuning «К»;
- switch 3 of lower limit of measurement «- 50» and upper limits of measurement: «100», «50», «30», «20».

**Measuring converters ИП 0104/П МГ
(for thermal converter ТСПУ 0104/МГ).
Front panel.**



Picture 5.3

5.3. Means of explosion protection of thermal converters with unified output signal ТСМУ 0104Ex, ТСПУ 0104Ex

5.3.1. Explosion protection of thermal converters ТСМУ 0104Ex, ТСПУ 0104Ex is provided during operation in complete set with power supply and registration equipment, having spark-proof electrical circuit for measurement of unified current signal of 4...20 mA and a Cer-

tificate of Conformance to requirements of explosion protection as well as in compliance to the design and diagrammatic version of the electrical circuit in accordance with State Standards P 51330.0-99, State Standards P 51330.10-99.

5.3.2. From the side of primary converter into the circuit are connected two current-limiting resistors R1 and R2 two stabilitrons VD4 and VD5 (hereinafter components are indicated in accordance with the circuit of electrical principal HKГЖ.468332.003 Э4).

5.3.3. From the side of power supply two diodes VD2 and VD3 are installed, which exclude any possibility of discharging of the capacitor C3 to the power supply circuit.

5.3.4. All other capacitors have no direct connection to power supply circuits and primary converter and together with other circuit components are covered by thermosetting insulating compound Nomakon K-2.

5.3.5. Electrically safe material are used in the process of housing manufacturing.

5.3.6. Sign X, following the marking of explosion protection denotes that during operation of thermal converters TCMY 0104Ex, TCIIY 0104Ex it is necessary to follow the below requirements:

- thermal converters TCMY 0104Ex, TCIIY 0104Ex should be used in complete set with power supply and registration equipment having spark-proof electrical circuit and a Certificate of Conformance to requirements of explosion protection;
- during operation it is necessary to take protective measures from temperature rising in the external part of thermal converters TCMY 0104Ex, TCIIY 0104Ex due to heat transfer from measured media above the tolerable value for a corresponding category of surrounding dangerously explosive gas and vapour mixture with air;
- repair and adjustment of thermal converters TCMY 0104Ex, TCIIY 014Ex in the operation site is not permissible;
- changing, connecting and disconnection of thermal converters TCMY 0104Ex, TCIIY 0104Ex should be performed only when pressure in the main lines is absent.

5.3.7. Employed primary converters in accordance with для thermal converters TCMY 0104Ex, TCIIY 0104Ex are selected with due consideration to requirements of State Standards P 51330.0-99 and State Standards P 51330.10-99 to the degree of protection of the shell, mechanical durability, resistance to influence of a flame and providing spark-proof protection from electrical discharges (housing and cover material: steel 12X18H10T – according to State Standards 5632-72; alloys: AK-12, AK-7 – by State Standards 1583-93).

5.3.8. Maximal temperature of structural components of thermal converters TCMY 0104Ex, TCIIY 0104Ex in normal and mode operation and in case of a malfunction does not exceed 80 °C, determined for the class T6.

5.3.9. Thermal converters TCMY 0104, TCIIY 0104, TCMY 0104A, TCIIY 0104A, TCMY 0104Ex, TCIIY 0104Ex have build-up design, making it possible to change III, ИП, housing of the head or cable input provided in Appendixes Б, В.

5.4. Explosion protection means of thermal converters with unified output signal TCMY 0104Exd, TCIIY 0104Exd.

5.4.1. Explosion protection of thermal converters TCMY 0104Exd, TCIIY 0104Exd is provided by the type of explosion protection «explosion-proof shell» by State Standards P 51330.1-99 and it is attained by encapsulating of electrical circuits TCMY 0104Exd, TCIIY 0104Exd into explosion-proof covering, that withstands explosion pressure and precludes transmission of an explosion into the surrounding explosive media. Durability of the covering is tested in accordance with State Standards P 51330.0-99 and State Standards P 51330.1-99. At the same time every shell undergoes testing by static hydraulic pressure of 1,5 MPa, during time, sufficient for inspection, but not less than (10+2) sec. Thermal converters TCMY 0104Exd, TCIIY 0104Exd have no sparking components or components heated over 80 °C (for the temperature class T6).

5.4.2. In the drawing of explosion protection means there are indicated couplings providing explosion protection of the type «explosion-proof shell». These couplings are designated by the word «explosion» with indication of tolerable according to State Standards P 51330.1-99 parameters of explosion protection: minimal developed length of the thread, thread pitch, a number of complete continuous undamagable threads. All screws are stooped by «Ремос» remedy, having thermal stability.

5.4.3. Explosion protection surfaces of thermal converters TCMY 0104Exd, TCIIY 0104Exd are protected from corrosion:

- paintwork of exterior surfaces of the housing and cover;
- by covering of all surfaces with greasing remedy ЦИАТИМ-221 according to State Standards 9433-80.

5.4.4. Temperature of the surface of the shell does not exceed the tolerable value according to State Standards P 51330.0-99 for equipment of the temperature class T6 in every possible mode of operation of thermal converters TCMY 0104Exd, TCIIY 0104Exd.

5.4.5. All screws, bolts, nuts and supporting components of the shell as well as current conducting and grounding clamps, connection pipes of cable inputs are protected from self-unscrewing with the help of lock-nuts. The heads of outside fastening bolts are located in safety cavities, which are accessible only by means of a special wrench. In order to avoid self-unscrewing of the covers of TCMY 0104Exd, TCIIY 0104Exd a special locking device is used. Locking device is fixed with the aid of screws to the housing and its tab catches hold of the skirting on the cover and fixes it from self-unscrewing.

Upper part of the inner pocket of protective armature 5 mm deep is filled with epoxy compound Э3К-6 ОСТ4 ГО.029.206.

5.4.6. Thermal converters TCMY 0104Exd, TCIY 0104Exd have such a design that makes it impossible to change the housing of the head and IIII, it is possible only to change cable input.

5.5. Marking and sealing.

5.5.1. Marking of thermal converters is performed in accordance with the State Standards 26828-86 E, State Standards 9181-74 E, State Standards 30232-94 and the drawing HKГЖ.411521.001СБ.

5.5.2. On the side surface of the head housing of thermal converter the following is indicated:

- trade mark of the manufacturing company;
- the mark of State Registry of measuring instruments;
- symbol of modification and version of a thermal converter;
- date of manufacturing (year);
- symbol of HCX;
- the range of measured temperatures;
- the limit of tolerable value of basic error;
- factory number.

5.5.3. Marking of explosion-proof thermal converters TCMY 0104Ex, TCIY 0104Ex

5.5.3.1. On the external side of the cover of the head of TCMY 0104Ex, TCIY 0104Ex the following is indicated:

- marking of explosion protection «ExiaIICT6 X».

5.5.3.2. On the side surface of the housing of the head of TCMY 0104Ex, TCIY 0104Ex the electrical parameters of the spark-protected circuit are indicated:

- maximum input voltage U_i : 24 V.
- maximum input current I_i : 120 mA.
- maximum input power P_i : 0,75 Wt.
- maximum inner capacitance C_i : 22 nF
- maximum inner inductance L_i : 0,1 mGn and
- range of temperatures of surrounding media $-50\text{ }^{\circ}\text{C} \leq t_a \leq +70\text{ }^{\circ}\text{C}$ or $(-10\text{ }^{\circ}\text{C} \leq t_a \leq +60\text{ }^{\circ}\text{C})$.

5.5.4. Marking of explosion protected thermal converters TCMY 0104Exd, TCIY 0104Exd

5.5.4.1. On the inside surface of the cover of the head TCMY 0104Exd, TCIY 0104Exd are indicated:

- marking of explosion protection «1ExdIICT6»;
- warning inscription «Open only after disconnecting from the mains».

5.5.5. The method of marking – sticking label (with the help of 2-sided sticking tape), manufactured on the film with the help of serigraphy, providing safety of marking during the whole term of operation.

5.5.6. Sealing is not performed at the manufacturing - factory.

Sealing is performed by a customer after mounting at the operation site.

5.6. Packaging

5.6.1. Packaging is performed in accordance with State Standards 23170-78 E, State Standards 9181-74 E and provide total safety of thermal converters.

6. SAFETY MEASURES REGULATIONS

6.1. As to the method of protection of a human being from electric current shock thermal converters correspond to the class III in accordance with State Standards 12.2.007.0-75

6.2. Thermal converters TCMY 0104Exd, TCIIY 0104Exd are equipped with threaded elements of grounding with diameter not less than 4 mm. The grounding element is manufactured from metal stable to corrosion in relation to environment and it should not have surface painting. It is not possible to use for grounding bolts, screws, studs that are fixing elements of the device or its component parts. Around the grounding element there should be a contact platform without a paint film not less than 12 mm in diameter.

The value of resistance between the grounding element (a grounding place) and every accessible for touching metal not current conducting part of the device which can be energised, should not exceed 0,1 Ohm.

6.3. Safety requirements during testing insulation and measuring its resistance - in accordance with State Standards 12997-84 and State Standards 12.3.019-80.

6.4. Thermal converters TCMY 0104A, TCIIY 0104A (of enhanced reliability) according to HII-001-97 (ОПБ-88/97) belong to:

- as to values - to elements of standard operation;
- as to influence on safety - to elements important for safety.

An example of a classification designation of 2H or 3H.

6.5. During operation of thermal converters it is necessary to follow requirements of State Standards 12.3.019 -80, «User rules for operating electrical devices" and «User Safety Rules for operating electrical devices" approved by State Energy Inspection.

6.6. Connection of thermal converters to the electric circuit should be carried out when the source of direct current is switched off.

6.7. During operation of thermal converters the requirements of safety precautions stated in the documentation on measuring instruments and equipment complete with which they operate should be adhered to.

6.8. Elimination of defects, replacement, connection of external cables, installation and detachment of primary converters should be carried out when power is off.

7. PREPARATION FOR OPERATION

7.1. Unpack thermal converters. Make external inspection during which conformity should be established with the following requirements:

- thermal converters should be completed according to the section 4 of the present operation manual ;
- the factory number on the thermal converter should correspond to the one specified in the operation manual;
- thermal converters should not have mechanical damages that make their operation impossible.

7.2. Testing of factory setting of the range of measurements

7.2.1. Connect the thermal converter to the unified measuring calibrator of unified signals ИКСУ-2000 (hereinafter - ИКСУ) (or to the power supply of direct current БП 96/36 and ИКСУ) under the diagram provided in the pictures 7.1 or 7.2.

7.2.2. Place the thermal converter in an ice and water mixture and hold it at temperature 0 °C during not less than 30 minutes.

7.2.3. ИКСУ measure output current $I_{\text{вых.i}}$.

7.2.4. If a zero value of measured temperature is inside of the range of measurements the basic reduced error is calculated from the formula

$$\gamma = \frac{(I_{\text{вых.i}} - I_{\text{расч.}})}{(I_B - I_H)} \times 100 \%, \quad (7.1)$$

where: $I_{\text{вых.i}}$ - the measured value of unified output signal, mA ;

$I_{\text{расч.}}$ - calculated value of unified output signal,
corresponding to temperature 0 °C , mA ;

I_H, I_B - the lower and upper limits of unified output signal, mA.

Calculated from the formula (7.1) the basic reduced error γ should not exceed 0,5 of the limits of tolerable basic error.

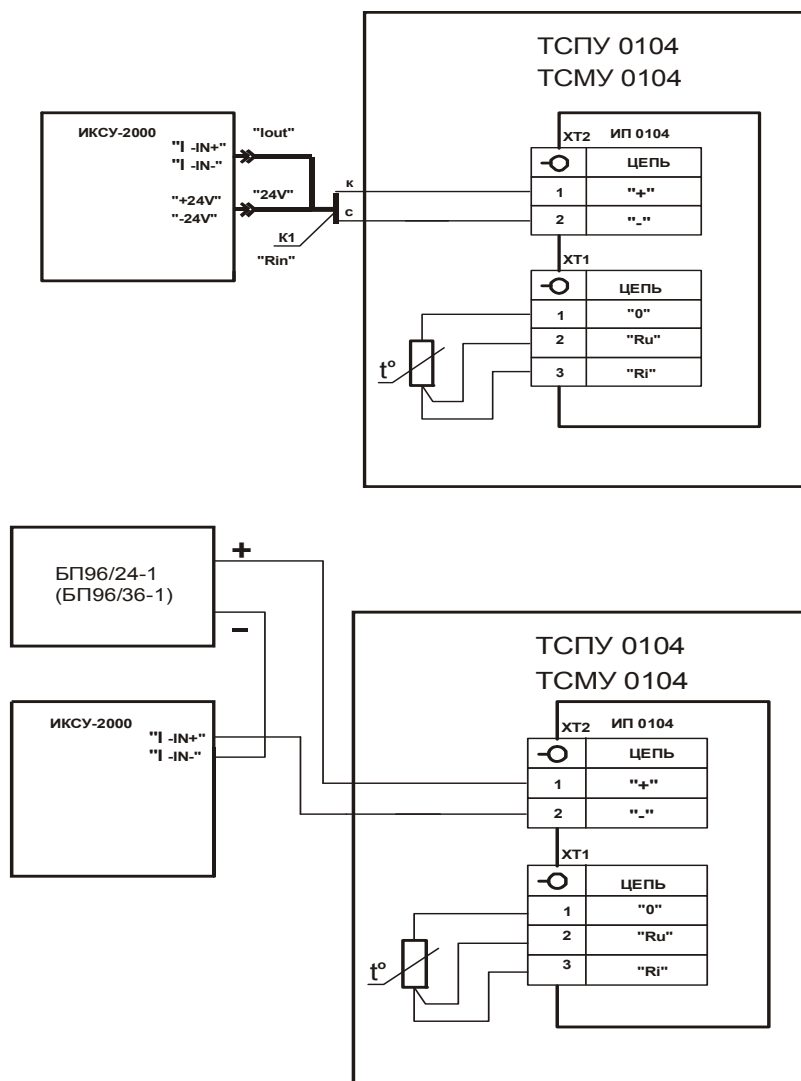
7.2.5. If the zero value of measured temperature corresponds to the lower limit of measurements the output current should be within the limits (4±0,005) mA.

7.2.6. If the zero value of the measured temperature corresponds to the upper limit of measurements, the output current should be within the limits :

- (20±0,005) mA for the lower limit of measurements minus 50 °C for ТСПУ 0104 ;
- (19,985±0,005) mA for the lower limit of measurements minus 50 °C for ТСМУ 0104 .

* The value γ should not exceed 0,8 of the limit of the basic tolerable error for thermal converters with the value of the basic error of 0,15 %.

Electrical connections diagrams of ТСПУ 0104, ТСМУ 0104 during testing and tuning



ИКСУ-2000 – standard measuring calibrator of unified signals:

(range of current measurement $0 \dots 25 \text{ mA}$,

limits of tolerable basic absolute error $\pm 0,003 \text{ mA}$).

K1 – connecting cable №6 (from the complete set of ИКСУ);

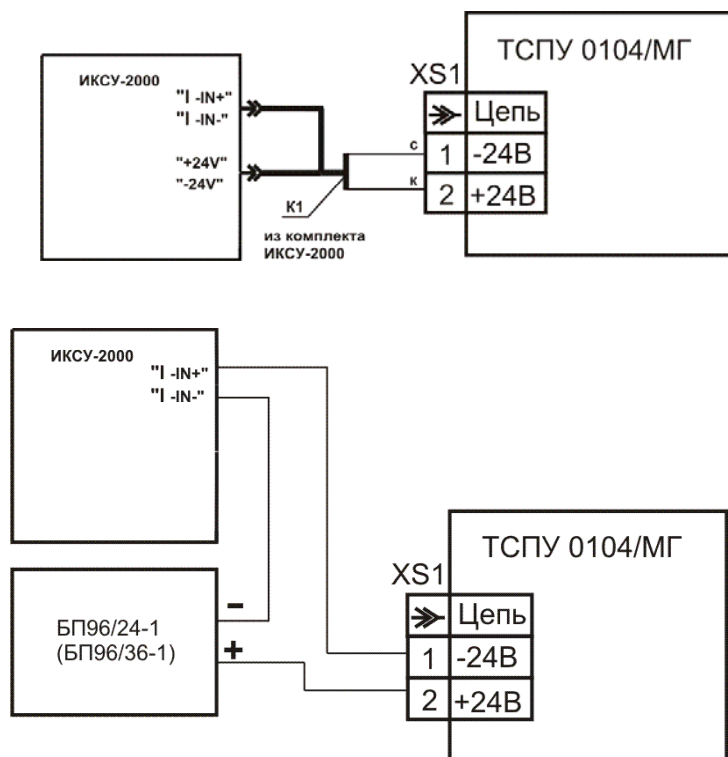
«к», «с» – red, blue wires of cables;

БП 96/24, БП 96/36 – power supply source of direct current with voltage of 24 and 36 V correspondingly

Notes – It is possible to use different measuring instruments if their characteristics are not inferior to the mentioned above.

Picture 7.1

Electrical connections diagrams of ТСПУ 0104/МГ during testing and tuning



XS1 – socket GDM 3009 («Hirschmann»)

ИКСУ-2000 – standard measuring calibrator of unified signals:

range of current measurement

0...25 mA,

limits of tolerable basic absolute error

±0,003 mA).

К1 – connecting cable №6 (from the complete set of ИКСУ);

«к», «с» – red, blue cable wires;

БП 96/24, БП 96/36 – power supply of direct current with voltage of 24 and 36 V correspondingly.

Notes – It is possible to use different measuring instruments as to their characteristics not inferior to the mentioned above.

Picture 7.2

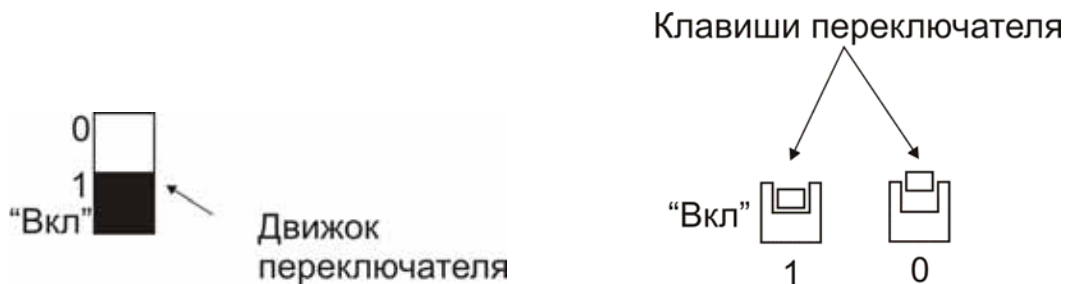
7.3. Tuning of measurement range

7.3.1. When using the range of measurements different from the preset ones at the manufacturing factory it is necessary to make tuning of the measuring ranges of a thermal converter. For this purpose the following operations are made:

7.3.1.1. Operation of thermal converters TCMY 0104, ТСПУ 0104 with input signal from TC is selected with nominal value of resistance $R_0 = 50 \text{ Ohm}$ or $R_0 = 100 \text{ Ohm}$ with the help of the switch «RП» (see. pictures 5.1 and 5.2). The position «On» of this switch correspond to the resistance value $R_0 = 100 \text{ Ohm}$, its opposite value to the value $R_0 = 50 \text{ Ohm}$.

7.3.1.2. Lower limit of measurements is set with the help of the switch «-50». The position of «On» of this switch corresponds to the temperature $0 \text{ }^\circ\text{C}$, its opposite position – temperature minus $50 \text{ }^\circ\text{C}$.

7.3.1.3. Upper limits of measurement T_B are set in accordance with the picture 7.3 and tables 7.1,...7.6.



0; 1 – symbols of positions of the switch (key) arm

Picture 7.3

Table 7.1 – Position of switches for TCMY 0104 with lower limit of measurements $T_H = -50 \text{ }^\circ\text{C}$

Position of switches					$T_B, \text{ }^\circ\text{C}$
«-50»	«100»	«50»	«30»	«20»	
0	0	1	0	0	0
0	0	1	0	1	20
0	0	1	1	0	30
0	1	0	0	0	50
0	1	0	0	1	70
0	1	0	1	0	80
0	1	1	0	0	100
0	1	1	0	1	120
0	1	1	1	0	130
0	1	1	1	1	150

Table 7.2 - Position of switches for TCMY 0104 with lower limit of measurements $T_H = 0\text{ }^\circ\text{C}$

Position of switches					$T_B, \text{ }^\circ\text{C}$
«-50»	«100»	«50»	«30»	«20»	
1	0	1	0	0	50
1	0	1	0	1	70
1	0	1	1	0	80
1	1	0	0	0	100
1	1	0	0	1	120
1	1	0	1	0	130
1	1	1	0	0	150
1	1	1	0	1	170
1	1	1	1	0	180
1	1	1	1	1	200

Table 7.3 - Position of switches for TCIY 0104 with lower limit of measurements $T_H = -50\text{ }^\circ\text{C}$

Position of switches					$T_B, \text{ }^\circ\text{C}$
«-50»	«200»	«200»	«100»	«50»	
0	0	0	0	1	0
0	0	0	1	0	50
0	0	0	1	1	100
0	1	0	0	0	150
0	1	0	0	1	200
0	1	0	1	0	250
0	1	0	1	1	300
0	1	1	0	0	350
0	1	1	0	1	400
0	1	1	1	0	450
0	1	1	1	1	500

Таблица 7.4 - Position of switches for TCIY 0104 with lower limit of measurements $T_H = 0\text{ }^\circ\text{C}$

Position of switches					$T_B, \text{ }^\circ\text{C}$
«-50»	«200»	«200»	«100»	«50»	
1	0	0	0	1	50
1	0	0	1	0	100
1	0	0	1	1	150
1	1	0	0	0	200
1	1	0	0	1	250
1	1	0	1	0	300
1	1	0	1	1	350
1	1	1	0	0	400
1	1	1	0	1	450
1	1	1	1	0	500
1	1	1	1	1	550

Table 7.5 - Position of switches for TCIY 0104/MГ with lower limit of measurements $T_H = -50$ °C

Position of switches					$T_B, \text{°C}$
«-50»	«100»	«50»	«30»	«20»	
0	0	1	0	0	0
0	0	1	0	1	20
0	0	1	1	0	30
0	1	0	0	0	50

Table 7.6 - Position of switches for TCIY 0104/MГ with lower limit of measurements $T_H = 0$ °C

Position of switches					$T_B, \text{°C}$
«-50»	«100»	«50»	«30»	«20»	
1	0	1	0	0	50
1	0	1	0	1	70
1	0	1	1	1	80
1	1	0	0	0	100
1	1	0	0	1	120
1	1	0	1	0	130
1	1	1	0	0	150
1	1	1	0	1	170
1	1	1	1	0	180
1	1	1	1	1	200

7.4. Testing and tuning of thermal converters in the selected measurement range

7.4.1. In calibrator KT-500 (KT-650, KT-110 or thermostat)* temperature is set, corresponding to the lower (upper) limit of temperature measurements.

7.4.2. Thermal converter is connected to ИКСУ (or direct current power supply source БП 96/36 and ИКСУ) according to the diagram provided in the pictures 7.1 or 7.2.

7.4.3. Thermal converter is placed into KT-500 (KT-650, KT-110 or thermostat) at the depth corresponding to the length of the mounting part (for calibrator – at the depth no less than 160 mm for KT-500, KT-650, KT-110, or thermostat – at the depth corresponding to the length of the mounting part of thermal converter or, if the length of mounting part is more than 250 mm – for the depth not less than 250 mm), and it is held at the temperature provided in the item 7.4.1, during not less than 30 min.

7.4.4. ИКСУ measure output current $I_{\text{обтх.и}}$.

7.4.5. For lower limit of measurements of thermal converters with the help of the potentiometer «О», located on the upper panel of ИП 0104 of the thermal converter, output current is set, corresponding to $(4 \pm 0,005)$ mA.

7.4.6. For upper limit of measurement of thermal converters with the help of potentiometer «К», located on the upper panel of ИП 0104 of the thermal converter, output current is set corresponding to:

- $(20 \pm 0,005)$ mA for the lower measurement limit 0 °C (for ТСМУ 0104 and ТСПУ 0104) and for lower limit of measurement minus 50 °C (for ТСПУ 0104);
- $(19,985 \pm 0,005)$ mA for lower limit of measurement minus 50 °C (for ТСМУ 0104).

7.4.7. Measurement of output current of thermal converter is repeated for the lower limit of measurements (in accordance with item 7.4.1 – item 7.4.5) and make sure that the value of output current is in the range $(4 \pm 0,005)$ mA, if otherwise items 7.4.1 – 7.4.7 are repeated.

7.4.8. If necessary it is possible to gradually (within the limits of ± 3 % from the range of output unified signal of direct current) move lower and upper limits of measurements by tuning of zero and the gain factor correspondingly.

* KT-500 (KT-650, KT-110 or thermostat) is selected in accordance with to item 9.

7.5. Setting procedure

7.5.1. Measuring converters ИП 0104/М (ИП 0104/П) from the composition of thermal converters with unified output signal ТСМУ 0104 (ТСИУ 0104) are fixed to the basis of the housing head of the corresponding thermal converter with the help of two screws.

7.5.2. Mounting of thermal converters should be performed with strict observance of requirements of actual «Regulations of electrical equipment» (ИУЭ chapter. 7.3), «Regulations of technical operation of electrical equipment by users» (ИТЭЭП), State Standards P 51330.13-99 «Electrical equipment in explosion dangerous zones».

7.5.3. When mounting it is necessary to make sure that at the temperature of measured media:

- from -50 to 600 °C the length of the external part ≥ 60 mm;
- from 600 to 900 °C the length of the external part ≥ 120 mm;
- from 900 to 2500 °C the length of the external part ≥ 200 mm.

7.5.4. When mounting explosion-proof thermal converters ТСМУ 0104Exd, ТСИУ 0104Exd it is necessary to check the following:

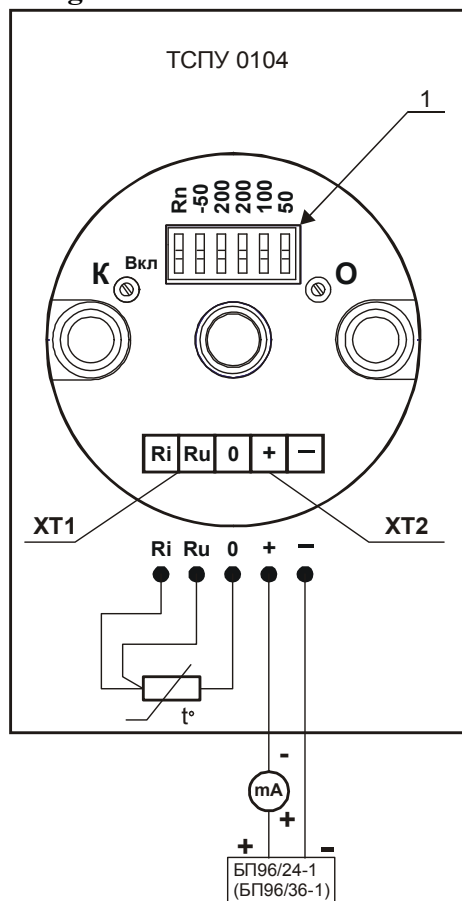
- condition of protected from explosion surfaces, fastening elements (all fastening elements should be tightened, all removable parts should adjoin to the housing of the shell tightly, as far as the design of the thermal converter makes it possible).

7.5.5. Thermal converters should be grounded with the help of external grounding clamps in accordance with State Standards 21130-75.

8. OPERATION PROCEDURE

8.1. Power supply source and load are connected to thermal converters (for example milliammeter) in accordance with the diagrams, provided on the pictures 8.1, 8.2, 8.3 or 8.4 for TCMY 0104, TСПУ 0104, according to diagrams provided on the pictures, 8.5, 8.6, 8.7 or 8.8 for TСПУ 0104/МГ.

Measuring thermal converter TСПУ 0104. Diagram of external connections



1 – switches of measurement limits of TСПУ 0104, sm. as well picture 5.2, (switches of measurement limits of TCMY 0104 correspond to the ones provided in the picture 5.1);
XT1, XT2 – terminal blocks

Picture 8.1

8.2. Direct current power supply is switched on. After 15 minutes thermal converter is ready for operation.

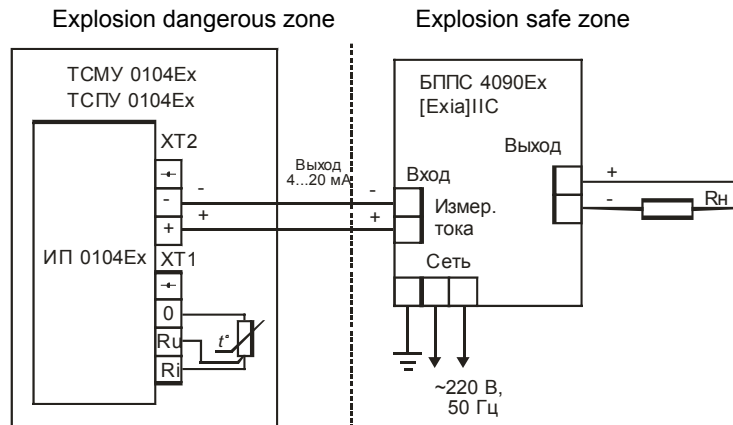
8.3. Measured temperature is determined form the formula

$$T = \frac{(I - I_H)}{(I_B - I_H)} \times (T_B - T_H) + T_H, \quad (8.1)$$

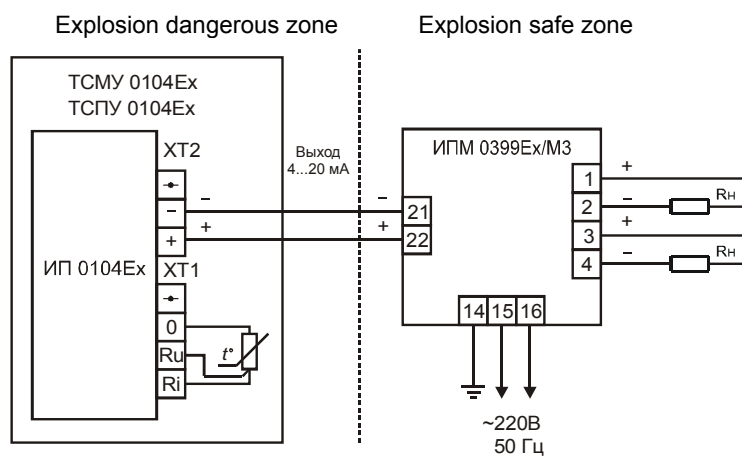
where T, I, I_H, I_B, T_B, T_H - are decoded in the item 3.11.

Thermal converters with unified output signal TCMY 0104Ex, ТСПУ 0104Ex.

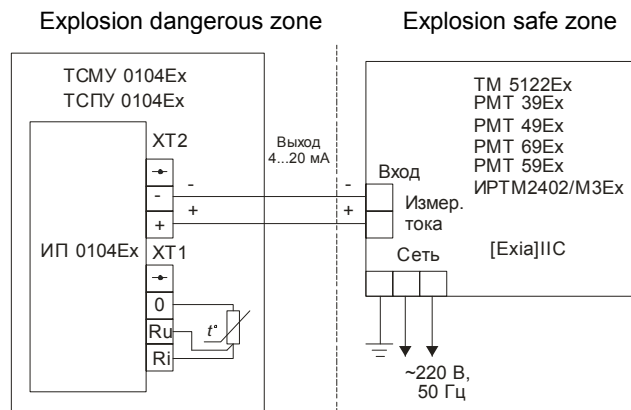
Connection layout



Picture 8.2



Picture 8.3



Picture 8.4

To pictures 8.2, 8.3, 8.4

ТСМУ 0104, ТСПУ 0104 may operate in complete set with the following measuring instruments produced by SRC «ELEMER»:

БППС 4090Ex

– power supply blocks and signal conversion.

ИПМ 0399Ex/M3

– modular measuring converter.

ТМ 5122Ex

– multi-channel thermometer.

PMT 39DEx, PMT 49DEx,

PMT 69Ex, PMT 59Ex

– multi-channel technological monitor.

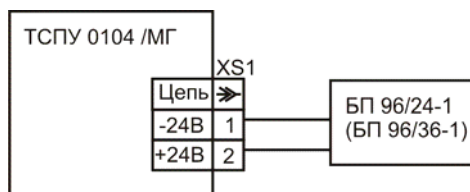
ИРТМ 2402/M3Ex

– multi-channel technological measuring gauge.

R_н

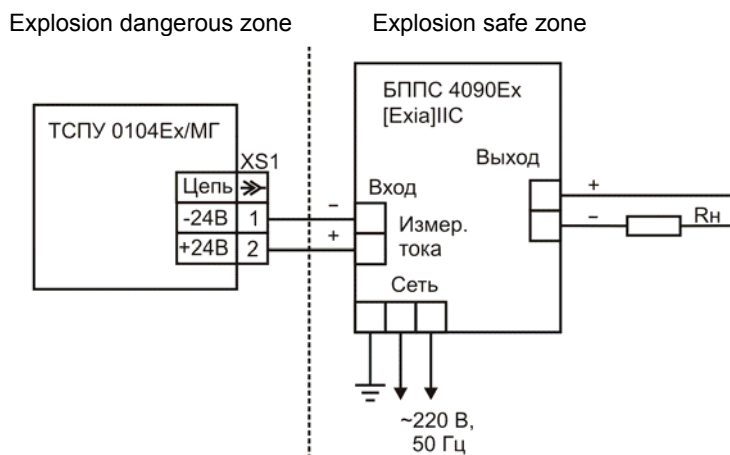
– load resistance.

**Thermal converters with unified output signal ТСПУ 0104/МГ,
ТСПУ 0104Ex/МГ.
Connection layout**



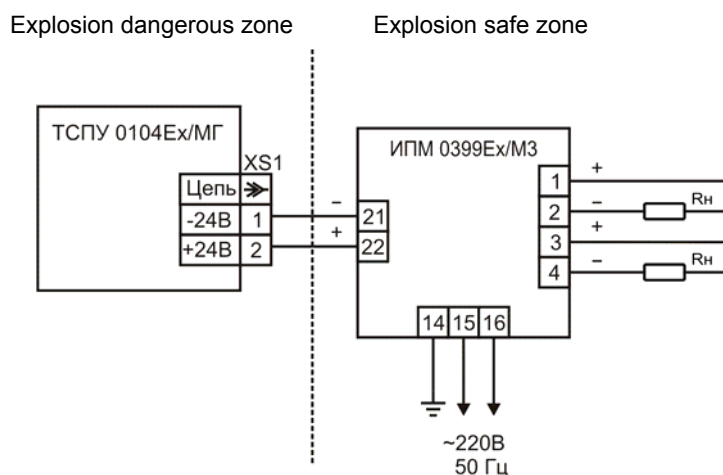
XS1 – socket GDM 3009 («Hirschmann»)

Picture 8.5



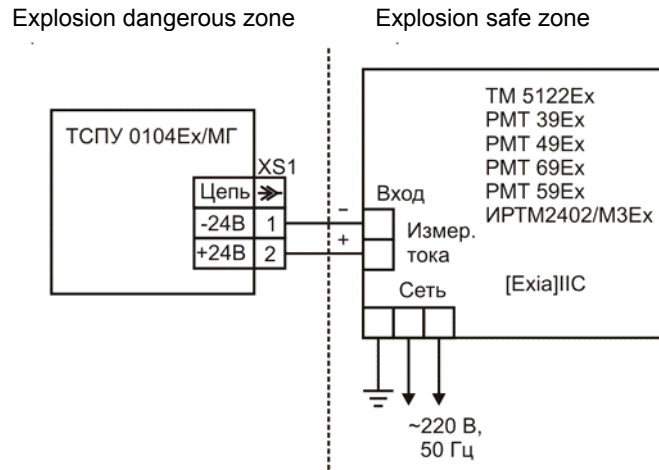
XS1 – socket GDM 3009 («Hirschmann»)

Picture 8.6



XS1 – socket GDM 3009 («Hirschmann»)

Picture 8.7



XS1 – socket GDM 3009 («Hirschmann»)

To pictures 8.5, 8.6, 8.7, 8.8

ТСПУ 0104/МГ, ТСПУ 0104Ex/МГ may operate in complete set with the following measuring instruments produced by SRC «ELEMER»:

БП 96/24, БП 96/36 – direct current power supply sources with voltage 24 and 36 V correspondingly.

БПС 4090Ex – power supply blocks and signal conversion.

ИПМ 0399Ex/М3 – modular measuring converter.

ТМ 5122Ex – multi –channel thermometer.

PMT 39DEx, PMT 49DEx, PMT 69Ex, PMT 59Ex – multi –channel technological monitor.

ИРТМ 2402/М3Ex – multi –channel technological measuring gauge.

R_н – load resistance .

Picture 8.8

9. VERIFICATION METHODS

9.1. Verification of thermal converters is performed by State metrological service or other authorized agencies, organizations having the right of verification. Requirements to the organization, an order of conducting verification and the form providing results are defined by IIP 50.2.006-94 "GSI. Verification of measuring equipment. Organizing and a conducting order».

9.2. The interval between verifications makes two years.

9.3. Operations and verification instruments

During verification procedure the operations are performed and verification instruments and equipment is used as it is presented in the table 9.1

Table 9.1

Operation name	Item number	Instruments and equipment recommended	Obligation of conducting operations	
			Primary verification	Repeated verification
1	2	3	4	5
1. External examination	9.6.1		Yes	Yes
2. Testing	9.6.2	Dewar Vessel for reproduction of ice melting temperature with a margin error not more than $\pm 0,02$ °C. Measuring-calibration of unified signals of standard ИКСУ-2000 ТУ 4381-031-13282997-00: range of current measurement from 0 to 25 mA, limits of tolerable basic absolute error $\pm 0,003$ mA, output voltage of incorporated voltage line conditioner ($24 \pm 0,48$) V. Power supply of direct current БП 96/36 ТУ 4229-018-13282997-99: output voltage ($36 \pm 0,72$) V, load current not more than 45 mA	Yes	Yes
3. Testing of electrical resistance of insulation	9.6.3	Megohmmeter Ф 4102/1-1М ТУ 25-7534.005-87: range of measurements from 0 to 20000 MOhm	Yes	Yes
4. Testing of electrical Durability of insulation	9.6.4	Device for testing electrical safety of GPI-745A: range of output voltages 500 V, range of measured resistances at voltage of 500 V from 1 to 9999 MOhm	Yes	No

Continuation of the table 9.1

1	2	3	4	5
5. Determination of the basic reduced error	9.6.5	<p>Verification instruments and equipment in accordance with item 2 of the present table</p> <p>as well as:</p> <p>Standard temperature calibrator KT-500 TY 4381-030-13282997-00: range of temperatures reproduction (from +50 to +500) °C, basic error not more than $\pm(0,05+0,0006 \cdot t)$ °C, unstability of temperature maintenance during 5 minutes, °C, within the ranges: (from +50 to +200) °C $\pm 0,015$, (from +200 to +500) °C $\pm 0,05$.</p> <p>Standard temperature calibrator KT-650 TY 4381-056-13282997-04: range of temperatures reproduction (from +50 to +650) °C, basic error not more than $\pm(0,05+0,0006 \cdot t)$ °C, unstability of temperature maintenance during 30 min , °C $\pm 0,0002 \cdot t$.</p> <p>Standard temperature calibrator KT-110 TY 4381-049-13282997-03: range of temperatures reproduction (from minus 40 to +110) °C, basic error $\pm 0,15$ °C, unstability of temperature maintenance during 30 min $\pm 0,03$ °C.</p> <p>Hydraulic thermostat U15C ТГЛ 32386: range (from minus 60 to +260) °C, error of thermostating not more than $\pm 0,02$ °C.</p> <p>Standard thermometer (exemplary) 1-st class ПТС-10. ПИЗ.879.001 ТУ: range(from minus 183 to +630) °C, basic error not more than 0,01 °C</p>	Yes	Yes
6. Registration of verification results	9.6.6		Yes	Yes
Notes				
<p>1 Manufacturing company of ИКСУ-2000, КТ-500, КТ-650, КТ-110, БП 96/36 is SPC «ELEMER».</p> <p>2 It is possible to use separate or newly developed or used verification instruments and equipment, as to its characteristics not inferior to the ones specified in the present recommendation.</p>				

9.4. Safety requirements

9.4.1. While carrying out verifications, safety requirements described in documents for the equipment in use are to be adhered to.

9.5. Conditions of verification and preparation for it

9.5.1. While conducting verifications meet following conditions:

- ambient air temperature, ° C 20±5;
- relative air humidity, % 30-80;
- atmospheric pressure, kPa (mm mercury) 84,0-106,7
(630-800);
- supply voltage, V 24±0,48;
or 36±0,72.

External electric and magnetic fields should be absent or at a distance which does not influence operation of devices.

Verified thermal converters and used verification instruments and equipment should be protected from shocks, vibration, jolting, affecting their operation.

9.5.2. Operations, performed employing verification means and verified thermal converters should correspond to regulations, provided in operation documentation and the present operation manual.

9.5.3. Prior to conducting verification the following preparation operations are performed:

9.5.3.1. Thermal converters withstand in conditions, determined in item 9.5.1, during 4 hours 4.

9.5.3.2. Verification instruments and equipment is prepared for operation in accordance with operational documentation.

9.6. Verification procedure

9.6.1. External examination Внешний осмотр

9.6.1.1. External examination of verified thermal converter is carried out according to the item 7.1 of the present operation manual.

9.6.2. Testing

9.6.2.1. Testing of the verified thermal converter is carried out according to the item 7.2 or sub item 7.3, 7.4 of the present operation manual.

9.6.3. Checking of electrical resistance of insulation

9.6.3.1. Checking of electrical resistance of insulation of circuits of a thermal converter is performed by megohmmeter Φ 4102/1-1M (GPI-745A) or other instrument for measuring of electrical resistance with operational voltage of not more than 500 V and error not more than 20 %.

Readout of indications should be made after 1 minute after voltage application between contacts of power circuit and the housing.

Resistance of insulation should be not less than 20 MOhm .

9.6.4. Checking of electric strength of insulation

9.6.4.1. Checking of electric strength of insulation is made using instrument GPI-745A, allowing to lift voltage smoothly or in regular intervals which are not exceeding 10 % of test voltage.

Test voltage should be raised smoothly, from zero or from the point which is not exceeding rated voltage of the circuit to tested one within 5 – 10 sec., but not more than 30 sec.

The measurement error of test voltage should not exceed ± 5 %.

Test voltage should be applied between contacts of power circuit and the housing.

Thermal converters are maintained under the influence of test voltage 500V for 1 minute. Then voltage is being reduced smoothly to zero or the point which is not exceeding nominal, then they disconnect the testing instrument.

Insulation of chains of thermal converter should sustain the full test voltage without disruptions and superficial overlapping.

9.6.5. Determining of the basic reduced error

9.6.5.1. Verification is performed for the following measuring ranges:

- from minus 50 to 0 °C and from 0 to plus 200 °C for TCMY 0104 and TCIIY 0104/MF;
- from minus 50 to 0 °C and from 0 to plus 500 °C for TCIIY 0104.

9.6.5.2. The lower limit of measurements is set in accordance with item 7.3.1.2.

9.6.5.3. The upper measurement limit is set according to item 7.3.1.3.

9.6.5.4. Operation of thermal converters TCMY 0104, TCIIY 0104 with input signal from TC is selected with nominal resistance value $R_0=100$ Ohm, setting the switch « R_{II} » in the position «On».

9.6.5.5. Basic reduced error of thermal converters is determined using the procedure described in item 7.4.1 – item 7.4.4 in the points, corresponding to 25, 50 75 % of the measurement range.

9.6.5.6. Reading from the indicator KT-500 (KT-650 or KT-110) are taken, when using a thermostat a standard (exemplary) thermometer is placed into the thermostat and temperature is measured by a standard (exemplary) thermometer T_0 as well as an output signal of thermal converter – ИКСУ.

9.6.5.7. Computing the value of the basic reduced error γ_i from the formula

$$\gamma_i = \frac{(T_i - T_0)}{(T_{\max} - T_{\min})} \times 100\%, \quad (9.1)$$

where T_i - temperature in the verified point, calculated by the formula (8.1)

The maximum of calculated values of the basic reduced error should not exceed the corresponding value provided in the table 3.1.

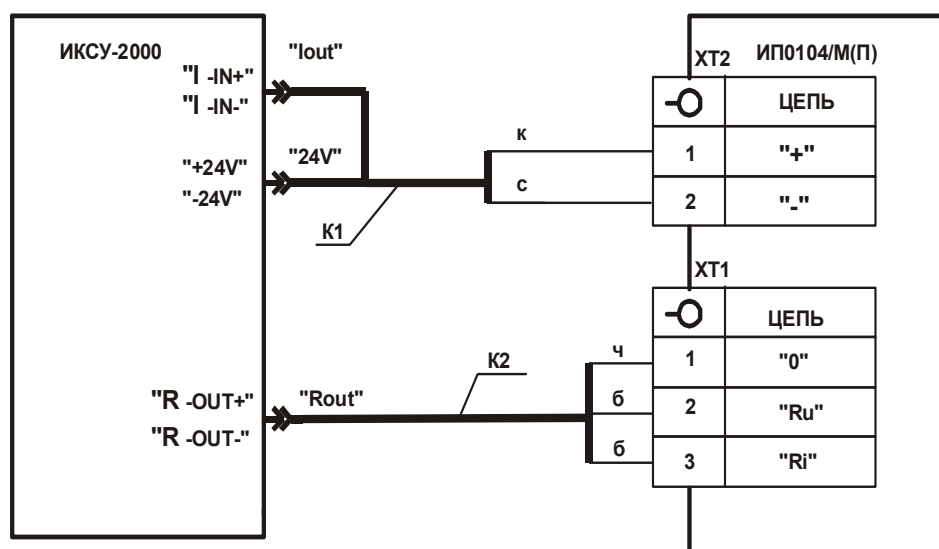
Notes – It is possible to determine the basic reduced error of thermal converters in two points, corresponding to 5 and 95 % of the range of measurements of temperature, during preliminary checking of ИП linearity with the help of ИКСУ with tolerable deviation of not more than 0,5 from the basic reduced error of the thermal converter.

Non-linearity of ИП is checked when determining the basic reduced error in accordance with the procedure provided in item 9.6.5.8.

9.6.5.8. The basic reduced error and nonlinearity of ИП incorporated into ТСМУ 0104 and ТСПУ 0104 is determined by the method of comparison of ИКСУ readings with calculated value of the output signal.

ИП of the verified thermal converter is connected to ИКСУ according to the diagram provided in the picture 9.1.

Connection layout of ИП 0104/М(П)



ИКСУ-2000 – standard measuring calibrator of unified signals:

(range of resistance reproduction

0...180 Ohm, 180...300 Ohm,

basic error

$\pm 0,015$ Ohm, $\pm 0,025$ Ohm;

range of temperature reproduction (TC)

-200...+550 °C,

basic error

$\pm 0,05$ °C.

range of current measurements

0...25 mA,

limits of the tolerable basic absolute error

$\pm 0,003$ mA).

K1 – connecting cable №6 (from the complete set of ИКСУ);

K2 – connecting cable №4 (from the complete set of ИКСУ);

«к», «с», «б», «ч» – red, blue, white, black wires of cables.

Notes – It is possible to use different measuring instruments if their characteristics are not inferior to the mentioned above

Picture 9.1

9.6.5.8.1. Power supply of ИКСУ is switched on and the following operation modes of signals generation of TC with HСХ 100М for ТСМУ 0104 or 100П (Pt100) for ТСПУ 0104 are set.

9.6.5.8.2. ИП is held in switched on position during 15 minutes.

9.6.5.8.3. With the help of ИКСУ the signals are set, corresponding to the lower and upper measuring limits of a verified thermal converter and adjusted to zero and to gain constant in accordance with item 7.4.5 – item 7.4.8.

9.6.5.8.4. To the input of ИП signals from ИКСУ are supplied corresponding to 25, 50 and 75 % of the measuring range. Measuring of output signal $I_{\text{облxi}}$ is performed corresponding to verified temperature.

9.6.5.8.5. The basic reduced error is calculated from the formula

$$\gamma = \frac{(I_{\text{блх.и}} - I_{\text{блх.р.}})}{(I_B - I_H)} \times 100 \%, \quad (9.2)$$

where: $I_{\text{блх.и}}$ - measured value of unified output signal, mA;

$I_{\text{блх.р.}}$ - calculated value of unified output signal, mA, in the verified point in accordance with the table 9.1;

I_H, I_B - lower and upper limits of the unified output signal, mA.

Table 9.1 – Calculated values of output signal

№ of the step	1	2	3
% from the range of output signal	25	50	75
$I_{\text{блх.р.}}$, mA in the verified point	8	12	16

The maximum value received of the basic reduced error should not exceed corresponding value determined in the item 3.2.

9.6.5.9. Determination of the basic reduced error for the version of thermal converters with a specific measuring range.

9.6.5.9.1. The basic reduced error for the specific measuring range is determined in the points corresponding to 5, 25, 50, 75, 95 % of the measuring range using the procedure from the item 7.4.1 – item 7.4.4, п. 9.6.5.6.

9.6.5.9.2. The basic error is calculated in every verified point using the formula (9.1).

The maximum value of the basic error received should not exceed corresponding values determined in item 3.2.

9.6.6. Registration of verification results.

9.6.6.1. Positive results of verification of thermal converters are registered by entering corresponding records in the certificate of results of verification, verified by the verification officer with making a verification countermark or a certificate on state verification in the set form according to ПП.50.2.006-94.

9.6.6.2. Verification results of thermal converters for a specific range of measurements are registered using the certificate of state verification of the certain form according to ИП.50.2.006-94 with indication of verification results on its opposite side (or the protocol of free form) or by entering a record in the certificate of verification results, verified by the verification officer with making a verification countermark

***Attention!** In this case it is not permissible to reconfigure thermal converters for other measuring ranges.*

9.6.6.3. In case of negative verification results thermal converters are considered unfit for operation.

10. TRANSPORTATION AND STORAGE REGULATIONS

10.1. Thermal converters are transported by all types of transport in covered vehicles.

In transport vehicles tare should be fixed in accordance with regulations valid for corresponding types of vehicles.

10.2. Conditions of transportation should correspond to conditions 5 according to State Standards 15150-69 at the temperature of ambient air from minus 50 to plus 50 °C taking into account protective measures from shocks and vibration.

10.3. Conditions of storage of thermal converters in transport tare in the stores of the manufacturer and consumer should correspond to conditions 1 according to State Standards 15150-69.

11. ACCEPTANCE CERTIFICATE

11. Thermal converter with unified output signal TC__Y 0104_____ factory number № _____ manufactured and accepted in accordance with requirements of the state standards, of the current technical documentation and it is accepted fit for operation and it is acknowledged ready for operation.

- 11.1. Type of the housing + cable input in accordance with the table B.2 _____.
- 11.2. Climatic version _____.
- 11.3. Range of temperature measurement, °C _____.
- 11.4. HCX _____.
- 11.5. Number of the picture in accordance with appendix Б Б._____.
- 11.5.1. Length of the mounting part, мм _____.
- 11.5.2. Diameter of the mounting part, мм _____.
- 11.6. The limit of the tolerable basic error, % _____.
- 11.7. Content of precious materials, gr: silver _____.
platinum _____.

Head of the Quality department

Seal

(personal signature) (signature decoding)

(year, month, day)

11.7. Result of primary verification (calibration) of TC__Y 0104_____ positive.

Date of verification (calibration) _____

Seal

Verification officer _____
(surname and signature)

12. PACKAGING CERTIFICATE

12.1. Thermal converter with unified output signal

TC ___Y 0104_____ factory number № _____ is
packed by science – production company «ELEMER» in accordance with requirements of design
documentation.

Date of packaging _____

Seal

Packed by _____
(signature)

13. RESOURCES, VALIDITY AND STORAGE TERMS AND MANUFACTURER'S GUARANTEES (SUPPLIER'S)

13.1. Resource of thermal converters with unified output signal TCMY 0104, TCIY 0104
is 15 000 hours during service life of 6 years, from the time of manufacturing on the package of
manufacturer in the storage premises.

The above stated resource, service life and storage life are valid only if a customer strictly
follows all requirements of the current operation documentation.

13.2. Guarantee term is - 24 months from the selling date of TCMY 0104, TCIY 0104.

13.3. In case of lost operation ability of thermal converters they may be repaired by the
manufacturing company at the address :

124460, Moscow, Zelenograd,
building. 1145, entrance 1, SPC «ЭЛЕМЕР»

Tel .: (495) 925-5147

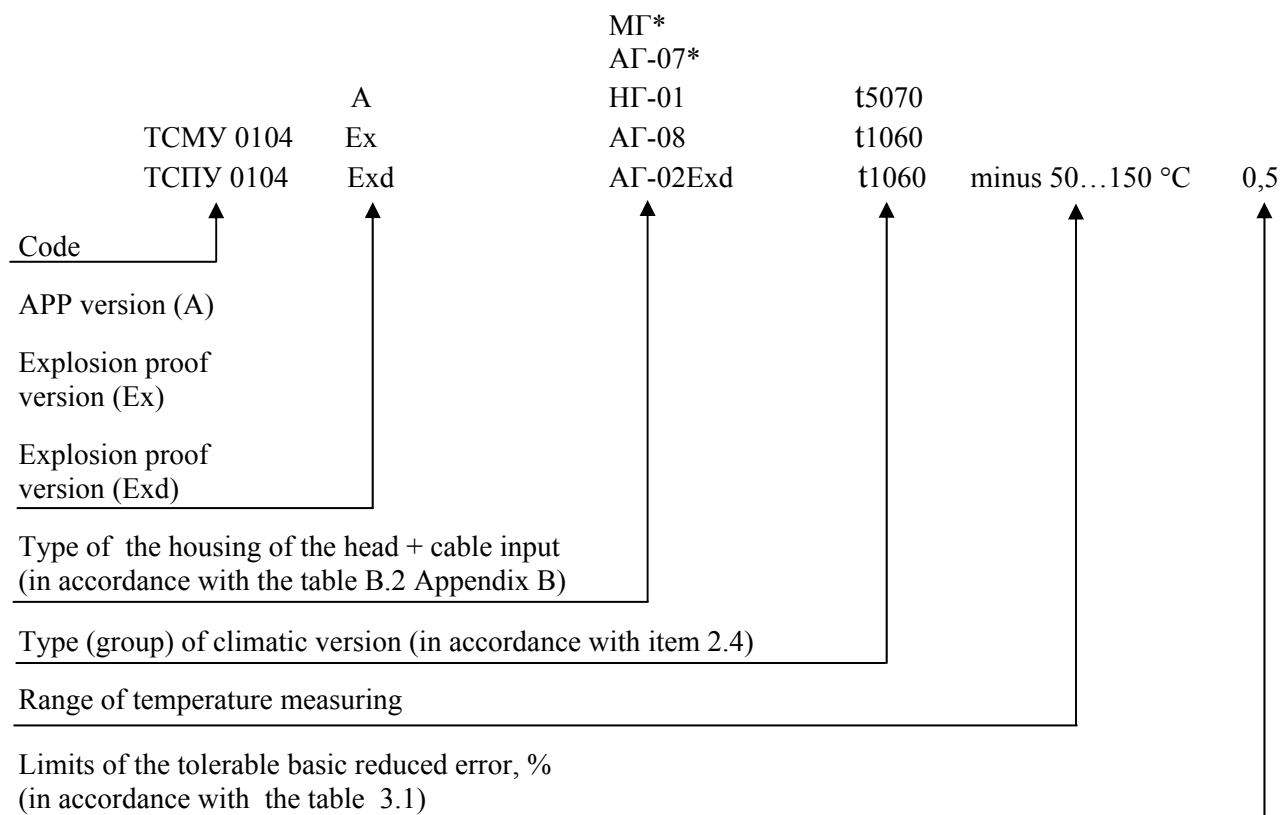
Fax: (499) 710-00-01

E-mail: elemer@elemer.ru

APPENDIX A

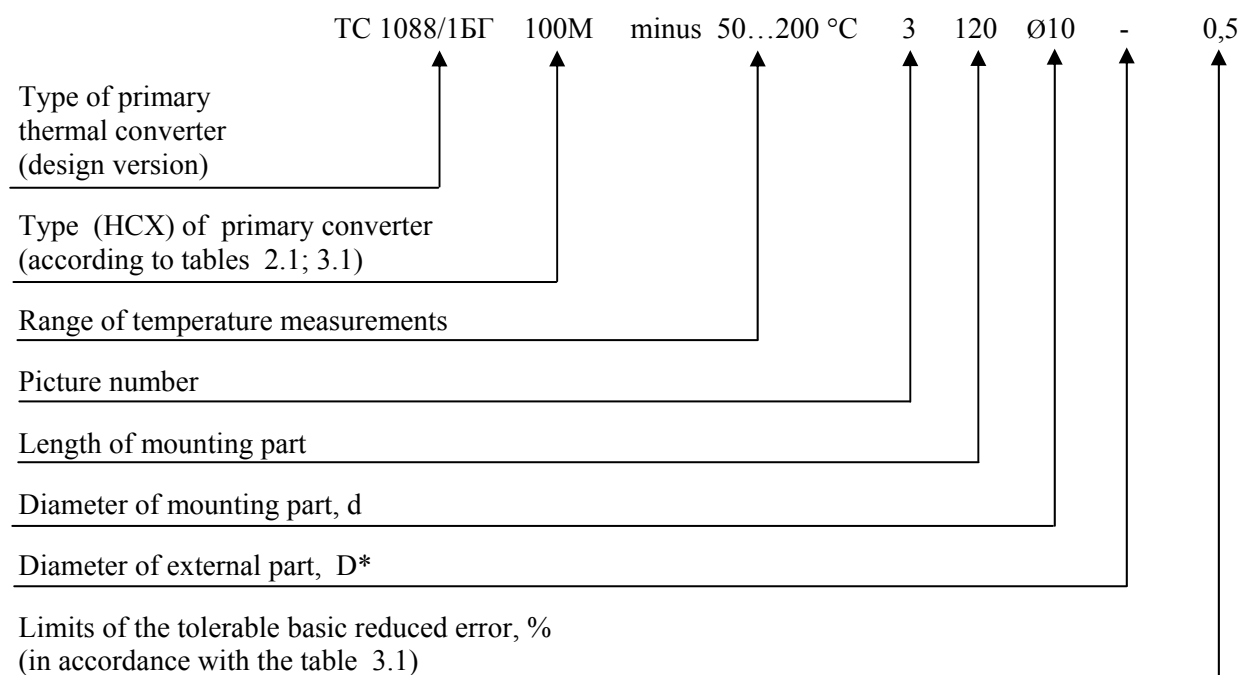
Recording example of symbols when ordering

Part 1 – housing of the head + measuring converter (III)



Notes - * Only for TCHY 0104.

Part 2 – hot probe

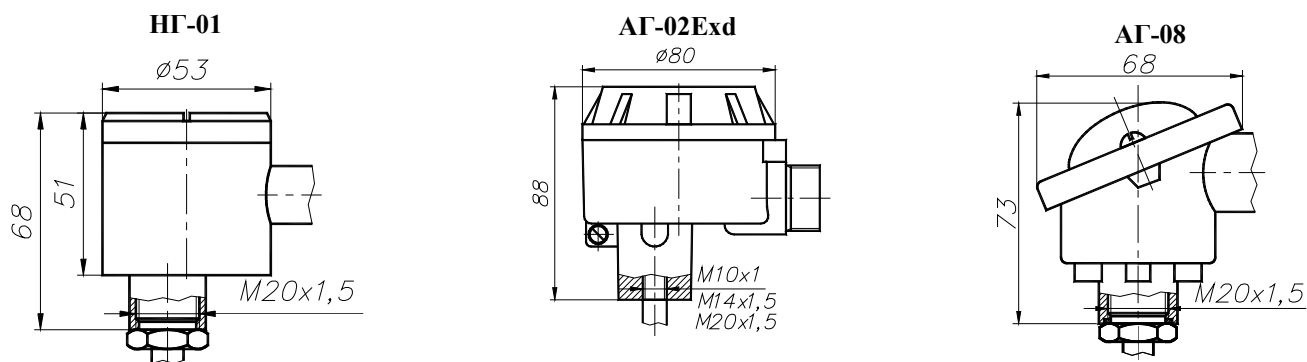


Notes 1 * It is stated in case of necessity.

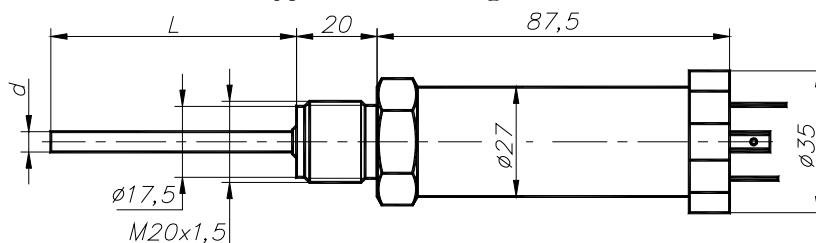
2 When ordering TCMY 0104, TCHY 0104 first of all the order form is filled for the head of the thermal converter (part 1), after that the order form for the hot probe (part 2).

ПРИЛОЖЕНИЕ В

Thermal converters with unified output signal
ТСМУ 0104, ТСПУ 0104.
Housings of the heads



Type of the housing МГ*

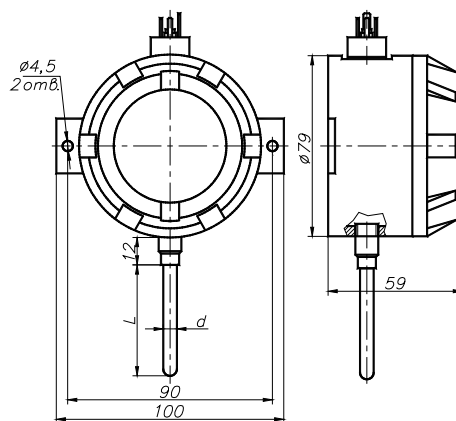


L – length of the mounting part, mm: 60; 80; 100; 120; 160; 200; 250; 320.

d – diameter, mm: 2; 3; 4; 5; 6.

* Only for ТСПУ 0104 with HCX Pt100.

Type of the housing АГ-07* (wall version)



L - length of the mounting part, mm: 60; 80; 100.

d – diameter of mounting part, mm: 4; 6.

* Only for ТСПУ 0104 with HCX Pt100.

The diagram of internal connections of the terminal block (ХТ2) ИП 0104 with the plug of the external connector (ХР1) PLT-164-R for the housing НГ-01 and АГ-08, GSP 311 for the housing МГ, GSSNA for the housing АГ-07.

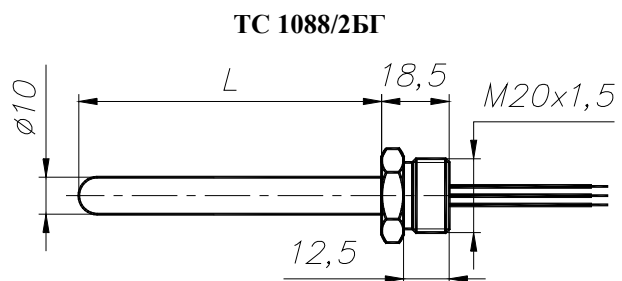
Цепь	ХТ2		ХР1	Цепь
-U	-	-----	1	-Упит
+U	+	-----	2	+Упит

Continuation of the appendix B

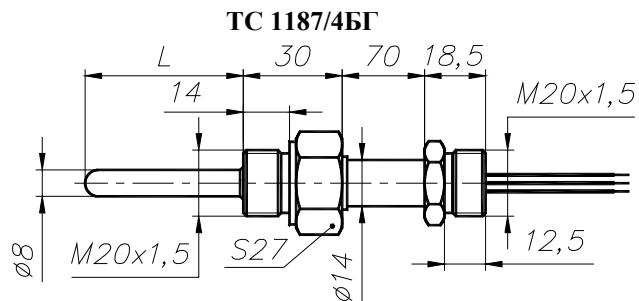
Thermal converters with unified output signal

TCMY 0104, TСПУ 0104.

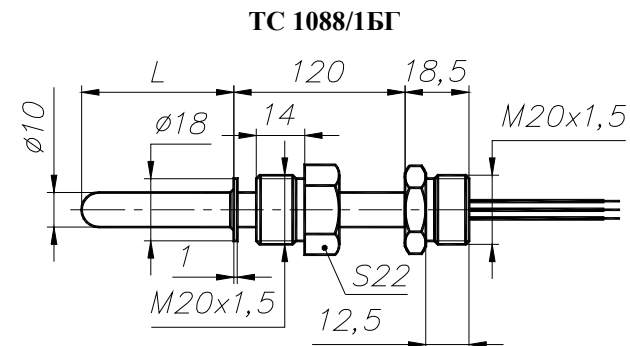
In accordance with the type TC



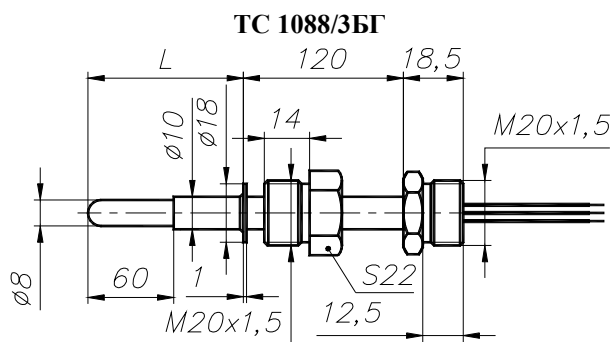
Picture B.1 $L=100...3550$



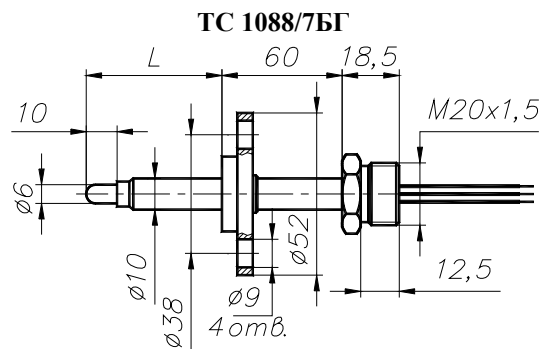
Picture B.2 $L=60...1250$



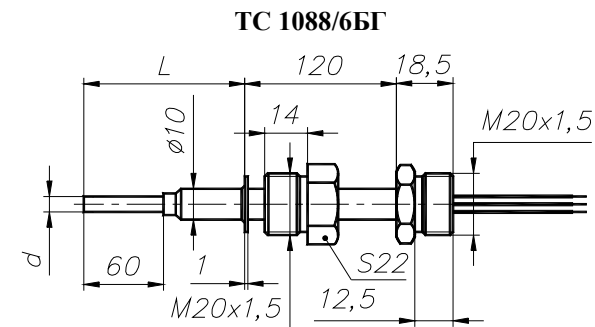
Picture B.3 $L=80...3550$



Picture B.4 $L=80...3550$



Picture B.5 $L=60...320$



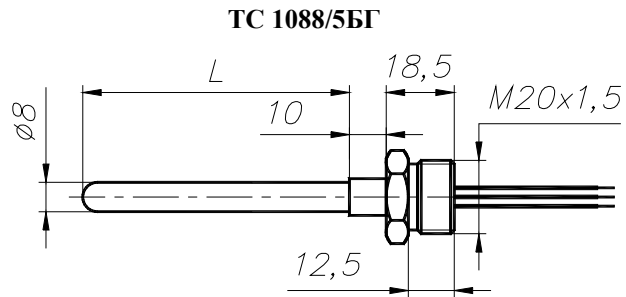
Picture B.6a $d=4$; $L=60...200$

Picture B.6б $d=5$; $L=60...500$

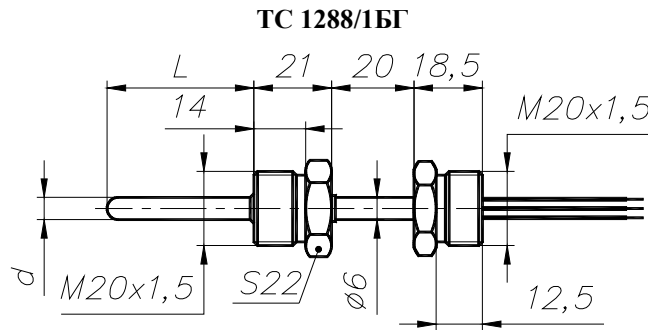
Picture B.6в $d=6$; $L=60...1600$

Continuation of the appendix B

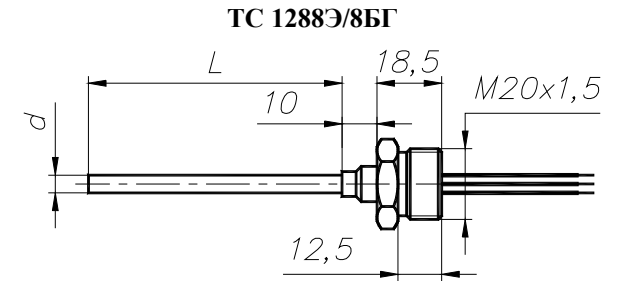
Thermal converters with unified output signal
TCMY 0104, TCPY 0104.
In accordance with TC type



Picture B.7 L=100...1250



Picture B.8a d=4; L=60...320
Picture B.8б d=6; L=60...500
Picture B.8в d=8; L=60...500

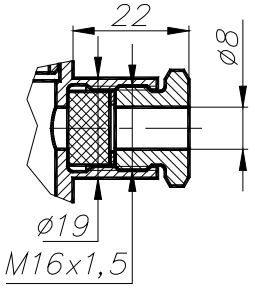
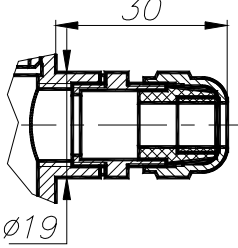
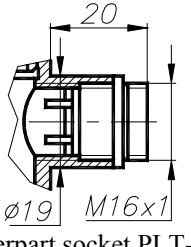
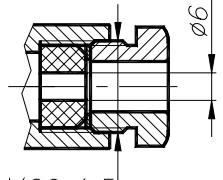
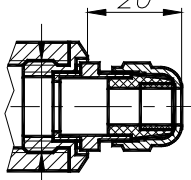
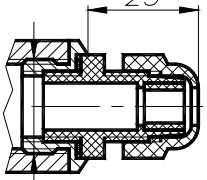
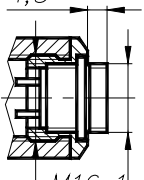
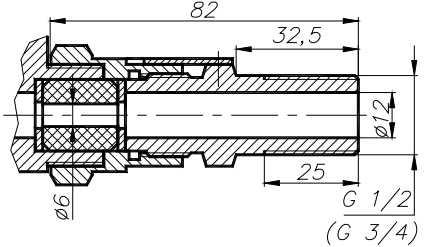
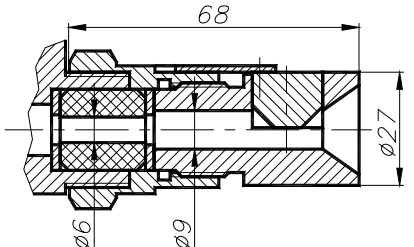


Picture B.9a d=3; L=100...200
Picture B.9б d=4; L=100...200
Picture B.9в d=6; L=100...320

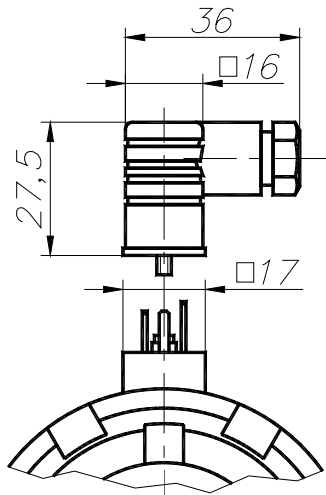
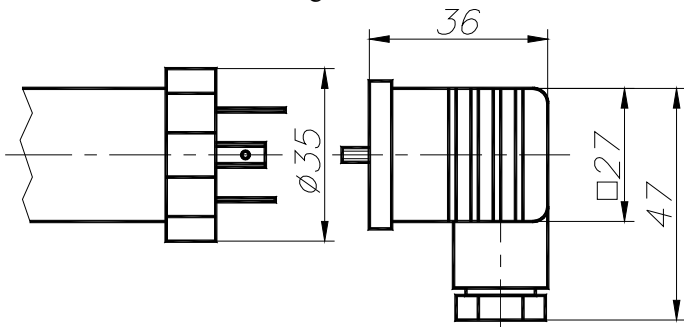
APPENDIX C

Thermal converters with unified output signal
TCMY 0104, TCIY 0104.
Cable outputs

Table C.1

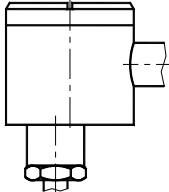
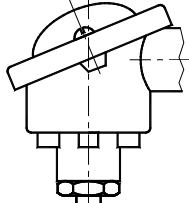
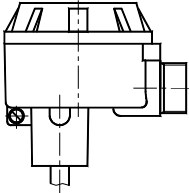
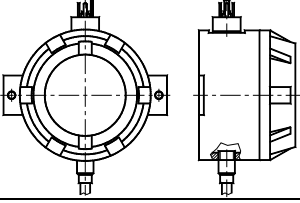
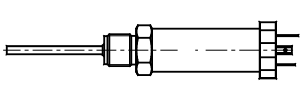
For HF-01		
<p style="text-align: center;">Gasket M16x1,5</p>  <p style="text-align: center;">1</p>	<p style="text-align: center;">VG9-MS68 (metal)</p>  <p style="text-align: center;">2</p>	<p style="text-align: center;">Plug PLT-164-R</p>  <p style="text-align: center;">3</p>
For AF-08		
<p style="text-align: center;">Gasket M20x1,5</p>  <p style="text-align: center;">4</p>	<p style="text-align: center;">VG9-MS68 (metal)</p>  <p style="text-align: center;">5</p>	<p style="text-align: center;">VG9-K68 (plastic)</p>  <p style="text-align: center;">6</p>
<p style="text-align: center;">Plug PLT-164-R</p>  <p style="text-align: center;">7</p>		
for AF-02Exd		
<p style="text-align: center;">Mounting set Exd G 1/2 or G 3/4</p>  <p style="text-align: center;">8</p>	<p style="text-align: center;">Mounting set . Exd for armoured cable</p>  <p style="text-align: center;">9</p>	

Continuation of the table C.1

<p>for АГ-07 Plug GSSNA</p>  <p>Counterpart socket GDSN</p> <p>10</p>
<p>for МГ Plug GSP 311</p>  <p>Counterpart: plug GDM 3009; Gasket GDM 3-16</p> <p>11</p>

Continuation of the table C

Table C.2 – Housings of the heads and their designation, cable inputs and protection degree of IP

Designation of the housing of the head	Housings of the heads	Number of cable inputs according to table B.1								
		1	2	3	4	5	6	7	8	9
		Gasket M16x1,5	VG9- MS68 (metal)	Plug PLT-164-R	Gasket M20x1,5	VG9-K68 (plastic)	Mounting head .Exd G1/2 or G3/4	Mounting set.Exd For armoured cable	Plug GSSNA	Plug GSP 3 I1
HF-01		+	+	+	-	-	-	-	-	-
AF-08		-	+	+	+	+	-	-	-	-
AF-02Exd		-	-	-	-	-	+	+	-	-
AF-07		-	-	-	-	-	-	-	+	-
MT		-	-	-	-	-	-	-	-	+
Sign “+” denotes possibility of constructive version. Sign “-“ denotes that constructive version is impossible.										

