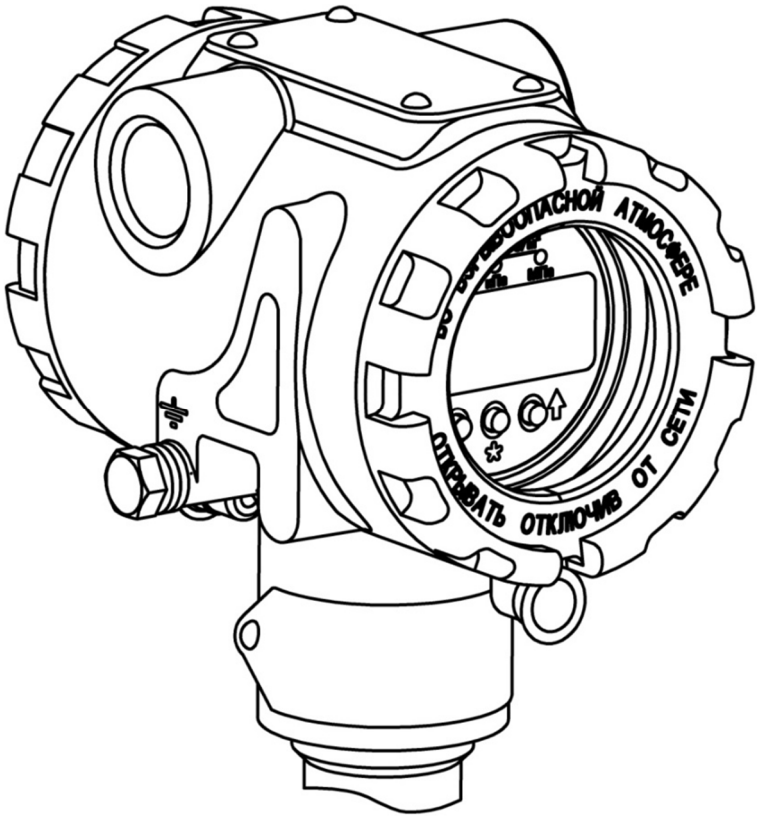
26.51.52

Agat-100MT PRESSURE TRANSMITTERS



Operation manual

AGST.300.000.00RE

Version 1.7

Content

The operation manual contains performance data, description of the operation principle and construction as well as data required for proper operation of Agat-100MT pressure transmitters with unified current output 4-20 mA and digital signal on the basis of HART-protocol.

The operation manual is valid for Agat-100MT transmitters that are manufactured for the production needs.

Continuous technical improvement of pressure transmitters can lead to non-fundamental differences between the design of the transmitter and the text of the accompanying documentation.

1 Description and work

1.1 Application

1.1.1 Agat-100MT Pressure Transmitters (hereinafter transmitters) provide continuous conversion of measured values of gauge, absolute, vacuum, gauge vacuum, differential, hydrostatic pressure of fluids (liquid, vapor, gas) into a unified current output and digital signal on the basis of HART-protocol.

The transmitters comply with the requirements of the technical regulations TR CU 020/2011.

The transmitters comply with the requirements of technical regulations TR CU 012/2011 and they are designed for operation in both explosion-proof and explosive conditions.

Explosion-proof transmitters with the type of protection "explosion-proof barrier "d" have the designation Agat-100MT-Exd with the marking of explosion protection "1Ex d IIS T5 Gb X" and meet the requirements of GOST 31610.0 and GOST IEC 60079-1 with the explosion protection marking "Gb" for explosive gas environments and are designed to work in explosive zones in which explosive mixtures of gases and vapors with air of category IIS can be formed.

The sign "X" in explosion type marking indicates special conditions for Agat-100MT-Exd transmitters operation, connected with the following:

- during operation, it is necessary to take measures of protection from high temperature of external transmitter surface because of heating of measured medium that is upper than it is permitted to have for temperature class T5 (GOST 31610.0);

- explosion protection is provided at pressure in main pipes where the transmitters are set. The pressure should not exceed maximal value that is permissible for this model;

- the transmitters must be operated with certified cable lead-ins and plugs that provide the required type and level of explosion protection of the shell in accordance with GOST IEC 60079-1.

The transmitters with type of protection "intrinsically safe electrical circuit" are designated Agat-100MT-Exi with the marking of explosion protection "0Ex ia IIC T5

Ga X" and meet the requirements of GOST 31610.0, GOST 31610.11 with the level of protection "ia" and "Ga" for explosive gas atmospheres.

The sign "X" in explosion type marking indicates special conditions for Agat-100MT-Exd transmitters operation, connected with the following:

- during operation, it is necessary to take measures of protection from high temperature of external transmitter surface because of heating of measured medium that is upper than it is permitted to have for temperature class T5 (GOST 31610.0);

- the usage of transmitters is allowed with secondary devices installed outside the explosive zones and outdoor installations that are intrinsically safe level "ia". Their maximum output voltage, maximum output current of intrinsically safe electrical circuits which do not exceed the values respectively 24V, 120mA, as well as having evidence of explosion protection.

Explosion proof transmitters, which use two types of protection "explosion-proof barrier" and "intrinsically safe electrical circuit", are called Agat-100MT-Exdia with the marking "1Ex d IIC T5 Gb X" and "0Ex ia IIC T5 Ga X".

1.1.2 The transmitters can transmit information about the measured value in digital form through 2-wire communication line together with a signal of direct current 4-20 mA. This digital signal can be received and processed by any other receiver that supports HART-protocol. Digital output can also be used for connection of the transmitter with a personal computer through a standard serial port and additional HART modem. In this case, the transmitter can be adjusted, its basic parameters can be chosen, measurement ranges are readjusted, zero setting and some other operations are done.

1.1.3 In ordering information there should be transmitter designation. An order is compiled according to a structural scheme. At designation of the transmitter in documentation of other products, the designation of specifications TU 26.51.52-002-65945295-2017 has to be specified.

Structural scheme of designation of the transmitter Agat-100MT

Agat-100MT-Exd	-	**DI-1151**	-	**(0...2,5)MPa**	-	**015**	-	**Hart42**	-	**TsI**
1		2		3		4		5		6

-	**t4580**	-	**N**	-	**B**	-	**K01**	-	**M20**	-	**SK**	-	**R1**	-	**KBust**	-	**KS**	-	**Rd**
	7		8		9		10		11		12		13		14		15		16

№	Code number	Codes of transmitter modifications
1		Model designation according to table 1
2		Code of modification according to the type and range of the measured pressure according to table 2
3		Lower and upper limit (range) of measurement, according to table 2
4		Code of permissible basic accuracy per table 3
5	**Hart42** **Hart42v** **Hart24** **Mbs**	Code of output: - analogue output 4-20 mA combined with digital signal on the base of HART-protocol; - analogue output 4-20 mA combined with digital signal on the base of HART-protocol, with root-extracting feature; - analogue output 20-4 mA combined with digital signal on the base of HART-protocol; - digital signal on the basis of RS-485 interface with Modbus communication protocol.
6	**TsI**	Build-in LED digital indicator
7	**t4380** **t4580** **t6080** **t1070**	Operating temperature range: - from minus 43 ºC to plus 80 ºC - from minus 45 ºC to plus 80 ºC - from minus 60 ºC to plus 80 ºC - from minus 10 ºC to plus 70 ºC
8	**N**	Additional technological elaboration
9	**B**	Marking tag
10		Code of cable lead-in Kxx or socket connector: ShRxx or GSP, according to Appendix E.
11		Code of mounting parts set per Appendix D
12		Mounting bracket code, according to Appendix D.
13	**-** **R1** **R2**	Connecting thread code (only for models according to Fig. A.4): - M20x1.5 male (basic option) - 1/2NPT female - 1/2NPT male
14	**KBust**	Valve unit, mounted to pressure transmitter. The passport is stamped on the conduct of leak testing assembly "transmitter + valve unit".
15	**KS**	Packaging for the Far North regions according to GOST 15846
16	**-** **Rd**	Housing color: - light gray RAL7035 (basic option) - red RAL3020

1.2 Features and specifications

1.2.1 Depending on the operating conditions and type of explosion-proof, the transmitters have the model designations shown in table 1.

Table 1

Model designation	Name of modification
Agat-100MT	Traditional
Agat-100MT-Exd	Explosion-proof with the type of protection “explosion-proof barrier “d”
Agat-100MT-Exi	Explosion-proof with the type of protection “intrinsically safe electrical circuit” with the level of protection “ia”
Agat-100MT-Exdia	Explosion-proof with 2 types of protection: “explosion-proof barrier “d” and “ intrinsically safe electrical circuit” with the level of protection “ia”

1.2.2 Name and designation of the transmitter, transmitter model, maximum upper range limit or measurement range of the model *Pmax*, minimal upper range limit or measurement range of the model *Pmin* are given in table 2.

1.2.3 The transmitters are multi-range ones and are set to the upper range limit or measurement range from *Pmin* to *Pmax* according to table 2.

Transmitters are available from the manufacturer with standard parameter settings:

- maximum upper limit (range) of *Pmax* measurement according to table 2 in MPa or kPa units;

- the lower limit of measurement is zero;

- linearly increasing dependence of the output signal;

- minimum output damping time 0.4 s (0.8 s for DG modifications);

- protection against unauthorized changes to settings – off.

Table 2

Type of pressure	Code of modification	Upper range limit	
		Minimum Pmin	Maximum Pmax
1	2	3	4
Absolute	DA-1020	2,5 kPa	10 kPa
	DA-1030	4,0 kPa	40 kPa
	DA-1040	25 kPa	250 kPa
	DA-1041	60 kPa	600 kPa
	DA-1050	250 kPa	2,5 MPa
	DA-1051		
	DA-1052		
	DA-1060	1,6 MPa	16 MPa
	DA-1061		
	DA-1062		
Gauge	DI-1110	0,16 kPa	1,6 kPa
	DI-1120	0,6 kPa	10 kPa
	DI-1130	1,6 kPa	40 kPa
	DI-1140	10 kPa	250 kPa
	DI-1141	25 kPa	600 kPa
	DI-1142		
	DI-1150	0,1 MPa	2,5 MPa
	DI-1151		
	DI-1152		
	DI-1160	0,6 MPa	16 MPa
	DI-1161		
	DI-1162		
	DI-1167	4 MPa	60 MPa
	DI-1168		
	DI-1170	4 MPa	100 MPa
	DI-1171		
Vacuum	DV-1210	0,16 kPa	1,6 kPa
	DV-1220	1,0 kPa	10 kPa
	DV-1230	4,0 kPa	40 kPa
	DV-1240	10 kPa	100 kPa

Table 2 (continued)

1	2	3	4
Gauge-vacuum	DIV-1310	Vacuum: 0,125kPa Gauge: 0,125 kPa	Vacuum: 0,8 kPa Gauge: 0,8 kPa
	DIV-1320	Vacuum:0,5 kPa Gauge: 0,5 kPa	Vacuum:5 kPa Gauge:5 kPa
	DIV-1330	Vacuum:2 kPa Gauge:2 kPa	Vacuum:20 kPa Gauge:20 kPa
	DIV-1340	Vacuum:12,5 kPa Gauge:12,5 kPa	Vacuum:100kPa Gauge:150 kPa
	DIV-1345	Vacuum:12,5 kPa Gauge:12,5 kPa	Vacuum:300kPa Gauge:330 kPa
	DIV-1341	Vacuum:31,5 kPa Gauge:31,5 kPa	Vacuum:100kPa Gauge: 530 kPa
	DIV-1342		
	DIV-1350	Vacuum:50 kPa Gauge:50 kPa	Vacuum:100 kPa Gauge:2,4 MPa
	DIV-1351		
	DIV-1352		
Differential	DD-1410	0,16 kPa	1,6 kPa
	DD-1420	0,63kPa	10 kPa
	DD-1430	1,6 kPa	40 kPa
	DD-1434		
	DD-1440	10 kPa	250 kPa
	DD-1444		
	DD-1450	0,16 MPa	1,6 MPa
	DD-1460	0,630 MPa	16 MPa
Hydrostatic	DG-1530	1,6 kPa	40 kPa
	DG-1540	10 kPa	250 kPa

1.2.4 The limits of transmitter's permissible basic error (γ), expressed in percent of upper range limit or measurement range are specified in table 3.

Table 3

Code	The limits of permissible basic error γ, % depending on upper range limit			Applicability by model depending on upper range limit P_{max}			
	$\frac{Pmax}{2} \le P_B \le Pmax$	$\frac{Pmax}{10} \le P_B \le \frac{Pmax}{2}$	$\frac{Pmax}{25} \le P_B \le \frac{Pmax}{10}$	$P_{max} \ge 600$ kPa	$Pmax \ge 250$ kPa	$P_{max} \ge 10$ kPa	$P_{max} \ge 1,6$ kPa
005	±0,05	±0,1	±0,5	+	-	-	-
006	±0,065	±0,1	±0,5	+	-	-	-
007	±0,075	±0,1	±0,5	+	+	+	-
010	±0,1	±0,1	±0,5	+	+	+	-
015	±0,15	±0,15	±0,5	+	+	+	-
020	±0,2	±0,2	±0,5	+	+	+	+*
025	±0,25	±0,25	±0,5	+	+	+	+*
050	±0,5	±0,5	±1	+	+	+	+
100	±1			+	+	+	+

Note.

* - except DA-1020

Pmax – the maximum upper limit (range) for a given model (the sum of the absolute maximum values of the upper limits of gauge pressure and vacuum for DIV), shown in table 2.

P_B – upper limit or measurement range of the model selected in accordance with columns 3, 4 of table 2:

- for DI, DA, DV, DD, DG, the range of measurement is numerically equal to the upper limit of measurement, the lower limit value of the measured value numerically equal to zero;
- for DIV - the sum of the absolute values of the upper limits of gauge pressure P_B and vacuum $P_B(-)$, the value of the measured parameter equal to zero is within the range.

1.2.5 Variation of output signal γ_G does not exceed the absolute value of permissible basic error $|\gamma|$.

1.2.6 Agat-100MT transmitters of all modifications have linearly increasing or linearly decreasing dependence of output analogue signal on input measurable quantity (pressure).

1.2.7 Rated static characteristic of a transmitter with linearly increasing dependance of output analogue signal on input measurable quantity corresponds as follows:

$$I = I_н + \frac{I_в - I_н}{P_в - P_н} \cdot (P - P_н), \qquad (1)$$

where I – current value of output signal;

P – value of measurable parameter;

$I_в$, $I_н$ – correspondingly, upper and lower limit values of output signal are equal to $I_н$=4 mA, $I_в$=20 mA;

$P_в$ – upper range limit;

$P_н$ – lower range limit for all transmitter, except DIV transmitters (for standard conditions $P_н$=0); for DIV transmitters, $P_н$ is equal to upper range limit of vacuum $P_в$(-) and is taken with minus sign for formula (1).

Nominal static characteristic of the transmitter with a linearly decreasing dependence of the analogue output on the measurable input value corresponds to the following equation:

$$I = I_в - \frac{I_в - I_н}{P_в - P_н} \cdot (P - P_н), \qquad (2)$$

where I, P, $I_в$, $I_н$, $P_в$, $P_н$ are the same as in formula.

Nominal static characteristic of the transmitter with function of measurable input value conversion according to square root law corresponds to the following equation:

$$I = I_н + (I_в - I_н) \cdot \sqrt{\frac{P}{P_в}} \qquad (3)$$

where P – measurable input value.

I, Iв, Iн, Pв are the same as in formula (1).

At this, on the initial section of the characteristic at pressure values P≤0.8% from *Pв* is piecewise linear dependence *Pв* (fig. 1).

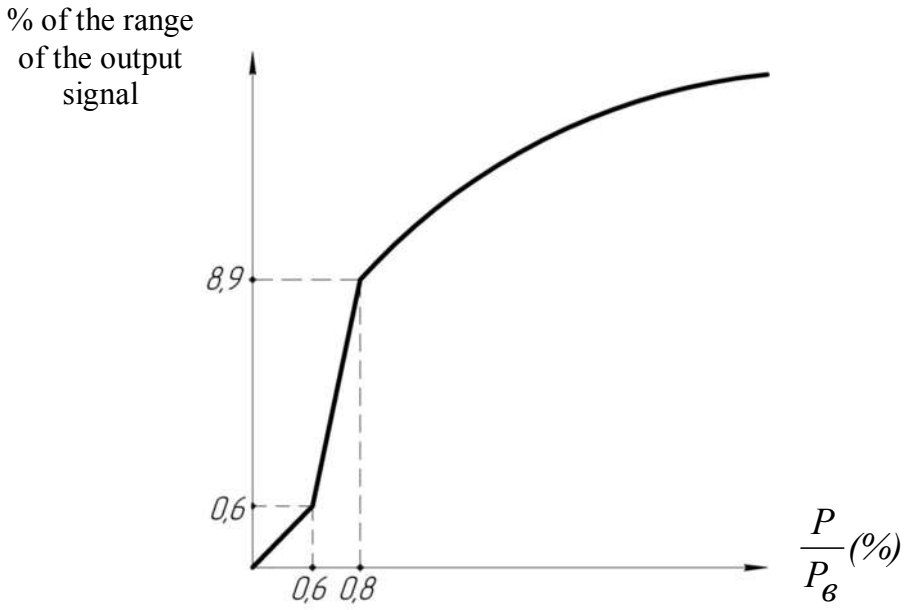


Figure 1 – Pressure conversion function according to the square root law

1.2.8 Output pulsation within frequency range from 0.06 to 5 Hz does not exceed value 0,7|γ|.

Pulsation of output analogue signal within the frequency range from 5 to 106 Hz shall not exceed 0.5 % of output turndown. Pulsation of output signal with frequency over 10^6 Hz is not normalized.

Output pulsation is normalized at load resistance 250 Om (when there is no communication with the transmitter through HART channel).

Note − Pulsation is normalized with minimal averaging time of measurement results.

1.2.9 The transmitter has a landau damping of an output signal, which characterized by measurement results averaging time (t_A). Measurement results averaging time increases an output signal setting time, smoothing an output signal at rapid change of input signal. Time value is selected from the following string: 0,2; 0,4; 0,8; 1,6; 3,2; 6,4; 12,8; 25,6 s.

1.2.10 Turn-on time measured as time after power is applied to the transmitter to analog output settling time with accuracy better than 5% of set value, is no more than 2 s at minimum damping of an output signal.

1.2.11 Output settling time (Tset) at stepwise variation of a measurable parameter, which is 90% of FS, is determined as delay time (Td) and transient time (Ttr).

Delay time does not exceed 90 ms, nominal value

Tdnom=45 ms.

Transient time Ttr does not exceed:

3,0 s – for modifications 1020,1030,1110, 1210,1310,1410;

0,1 c - for modifications 1141, 1150, 1151, 1160, 1161, 1167, 1168, 1170, 1171, 1350, 1351, 1050, 1041, 1051, 1060, 1061, 1152, 1162, 1052, 1062, 1352;

0,2 c - for other modifications.

Notes:

1. Output settling time is the time from stepwise variation of a measurable parameter to completely entering the output signal into stabilized zone, differing by ±5% from output change corresponding to the step of the measurable parameter.

2. Dynamic characteristics are rated at temperature (23±5)°C and at electronic output damping switched off (the indicator displays averaging time).

Bandpass of parameter sine waveforms is is from 0 to f at the level of 63% of output signal and is calculated by the following formulae:

$$f = \frac{1}{t_A}, \text{ Hz, at } t_A > T_T, \text{ at that } f \leq 25 \text{ Hz} \quad (4)$$

$$f = \frac{1}{T_T}, \text{ Hz, at } t_A < T_T, \text{ at that } f \leq 25 \text{ Hz} \quad (5)$$

If ripple frequency of input pressure is within the range from 3 Hz to до $\frac{1}{T_T}$ Hz, but no more than 25 Hz, output pulsation amplitude expressed in percentage of output turndown is equal to input pressure pulsation amplitude expressed in

percentage of measurement range, output ripple frequency is within the frequency band from $0\frac{1}{t_A}$ Гц.

1.2.12 The value of output analogue signal of transmitters, except DIV transmitters, which corresponds to lower limit value of measurable parameter, is equal to:

4 mA - for transmitters with increasing characteristic of type (1) and (3),

20 mA - for transmitters with decreasing characteristic of type (2).

The value of analogue output signal of DIV transmitters, which corresponds to gauge pressure, equal to zero (P=0), is determined by formula (6) for transmitters with increasing characteristic and by formula (7) for transmitters with decreasing characteristic:

$$I = I_н + \frac{I_в - I_н}{|P_в| + |P_{в(-)}|} \cdot |P_{в(-)}|, \qquad (6)$$

$$I = I_в - \frac{I_в - I_н}{|P_в| + |P_{в(-)}|} \cdot |P_{в(-)}|, \qquad (7)$$

1.2.13 Initial value change of Agat-100MT-DD and Agat-100MT-DG transmitters output caused by operating gauge pressure change in range from 0 to maximum permissible one and from maximum permissible one to 0, expressed in per cent of output change range does not exceed values γ_p, defined by the formula

$$\gamma_p = K_p \cdot P_{раб} \cdot \frac{P_{\max}}{P_в} \qquad (8)$$

Values of K_p are provided in table 4.

Table 4

Modification	K_p	P_{gauge}, MPa
DD-1410	±0,2/1MPa	4
DD-1420	±0,08/1MPa	10
DD-1430, DD-1440	±0,04/1MPa	25
DD-1434, DD-1444		40
DG-1530, DG-1540		4
DD-1450, DD-1460	±0,02/1MPa	25

1.2.14 Power supply of Agat-100MT, Agat-100MT-Exd transmitters is carried out from a direct current source with voltage from 14 to 42 V.

Nominal power supply: U_{nom} = 24±0,48 V.

Power supply of Agat-100MT-Exi transmitters is carried out from intrinsically safe circuits of barriers (blocks) that have explosion protection type «intrinsically safe electrical circuit» with explosion protection level «ia» for explosive mixtures of subgroup IIC. In this case, maximal output barrier voltage U_0 is 24V, and maximal output current I_0 is 120mA. The minimum DC supply voltage must be at least 14V.

1.2.15 Electrical parameters of Agat-100MT-Exi:

- maximum input voltage, U_i – 24V;
- maximum input current, I_i – 100 mA;
- maximum input power, P_i – 0.8 W;
- maximum internal inductance (L_i) - 150 mH;
- maximum internal capacity, C_i – 10 nF.

Supply source for transmitters in operation conditions must meet the following requirements:

- insulation resistance - more than 20 M Ohm;
- to withstand test voltage during check of insulation strength - 1.5 kV;
- pulsation of output voltage should not exceed 0.5% of nominal value of output voltage at harmonic vibrations frequency less than 500 Hz;
- interruption of supply shall not exceed 20 ms;
- have mean-square value of noise within the frequency band from 500 Hz to 10 kHz - less than 2.2 mV.

1.2.16 The limits of permissible load resistance (resistance of devices and communication line) must be between R_{min} to R_{max}.

R_{max} is determined by the formula:

$$R_{max} = \frac{(U - 14)}{0{,}02} \qquad (9)$$

where U — converter supply voltage, V.

R_{min} = 0 when there is no communication with the transmitter through HART.

R_{min} = 250 Ом when HART is used.

1.2.17 External electrical connections schemes are given in Appendix B.

1.2.18 Consumed power is no more than 1,0 V·A.

1.2.19 Transmitters are protected from reverse polarity of supply voltage.

1.2.20 Transmitters are stable to ambient temperature effect from minus 60 to plus 80°C.

Basic modification of transmitters is manufactured with an operating temperature range of ambient air ranging from minus 43 to plus 80°C (temperature code t4380). By request of the customer, the transmitter can be calibrated in accordance with the order code of the temperature version, for example:

а) code t1070 - from minus 10 to plus 70°C;

б) code t4580 - from minus to plus 80°C, except DD-1450;

в) code t6080 - from minus 60 to plus 80°C, except DD-1450.

Additional error caused by the change of ambient air temperature within the operating temperature range (1.2.20), expressed in per cent of the output change range, per each 10 °C shall not exceed values γm, given in table 5.

Table 5

<table>
<tr><td rowspan="2">Code</td><td colspan="2">γm, % of upper range limit</td><td rowspan="2">Note</td></tr>
<tr><td>Pmax/10 ≤ Pв ≤ Pmax</td><td>Pmax/25 ≤ Pв < Pmax/10</td></tr>
<tr><td rowspan="2">005
006
007
010
015</td><td>$\pm(0{,}03+0{,}04\frac{P_{max}}{P_в})$</td><td rowspan="3">$\pm(0{,}1+0{,}04\frac{P_{max}}{P_в})$</td><td>1141, 1151, 1161,1167, 1171, 1041, 1051, 1061, 1342, 1341, 1351</td></tr>
<tr><td>$\pm(0{,}05+0{,}05\frac{P_{max}}{P_в})$</td><td>For other modifications</td></tr>
<tr><td rowspan="2">020
025
050
100</td><td>$\pm(0{,}05+0{,}05\frac{P_{max}}{P_в})$</td><td>1141, 1151, 1161, 1167, 1171, 1041, 1051, 1061, 1341, 1342, 1351</td></tr>
<tr><td colspan="2">$\pm(0{,}1+0{,}05\frac{P_{max}}{P_в})$</td><td>For other modifications</td></tr>
</table>

1.2.21 For resistance to mechanical stress, transmitters correspond to the performances listed in table 6.

Table 6

Group	Modifications	Vibration-resistant version according to GOST R 52931
1	DI-1110, DV-1210, DIV-1310, DD-1410	L3
2	DA-1041, DA-1051, DA-1061 DA-1050, DA-1060, DA-1052, DA-1062, DI-1141, DI-1151, DI-1161, DI-1167, DI-1171, DI-1142, DI-1152, DI-1162, DI-1150, DI-1160, DI-1168, DI-1170, DIV-1341, DIV-1350, DIV-1351, DIV-1352	V2
3	Other modifications	V1

1.2.22 The additional reduced error caused by vibration (1.2.22), expressed as a percentage of the upper limit of measurement, does not exceed the values of γ_f, determined by the formulas:

- for modifications of groups 1, 3

$$\gamma_f = \pm 0{,}25 \cdot \left(\frac{P_{\max}}{P_в} \right) \%, \qquad (2)$$

- for modifications of group 2

$$\gamma_f = \pm 0{,}1 \cdot \left(\frac{P_{\max}}{P_в} \right) \%, \qquad (3)$$

1.2.23 Strength of magnetic fields caused by external sources of alternating current with frequency 50 Hz should not exceed 400A/m,and if it is caused by external sources of direct current, it also should not exceed 400A/m.

1.2.24 Complementary transmitter error caused by electromagnetic effects (Item 1.2.23), which is expressed in the percentage of output turndown, shall not exceed 20% of the limit of the permissible basic reduced error.

1.2.25 Transmitters are EMI-resistant:

a) per GOST 30804.4.3 within 80-1000 MHz frequency band, test hardness 3;

b) per GOST 30804.4.4, test hardness 3;

c) per GOST 30804.4.2, test hardness 4;

d) per GOST P 51317.4.6, test hardness 3;

e) per GOST P 50648, test hardness 5;

f) per GOST P 50649, test hardness 5;

g) per GOST P 50652, test hardness 5;

h) per GOST P 51317.4.5, test hardness 2 if supply is by “wire-wire”, test hardness 3 if supply is by “wire-ground”. Criterion of performance quality during ECM test - A.

1.2.26 Transmitters comply with the noise emission standards set for class B according to GOST R 51318.11.

1.2.27 Transmitters are resistant to atmospheric pressure from 84.0 to 106.7 kPa (group P1 GOST R 52931).

1.2.28 Transmitters are resistant to ambient relative humidity up to 95% at ambient temperature plus 35 and lower temperatures, without moisture condensation.

1.2.29 Transmitters survive after the solar irradiation exposure: irradiation fluence – 1120 W/m², ultraviolet spectrum fluence rate is 68 W/m² as per GOST 15150.

1.2.30 Transmitters are resistant to rainfall of the intensity 5 mm/min as per GOST 15150.

1.2.31 Degree of protection of transmitters against influence of dust and water corresponds to IP67 group in accordance with GOST 14254.

1.2.32 Agat-100MT-DD transmitters withstand the impact of one-side overload with operating gauge pressure equally both from the positive chamber and from negative one within 1 min. an overload pressure *Povrld*, according to table 7.

Table 7

Modification	Povrld, MPa
DI-1110, DV-1210, DIV-1310, DD-1410 DG-1530, DG-1540	4
DI-1120, DV-1220, DIV-1320, DD-1420	10
DI-1130, DV-1230, DIV-1330, DIV-1430 DI-1140, DIV-1240, DIV-1340, DIV-1345, DD-1440, DD-1450, DD-1460	25
DD-1434, DD-1444	40

1.2.33 Agat-100MT of fitting modification maintain an overload pressure of 1.5 times bigger, than upper limit of measurement:

- DA, modifications 1041, 1051, 1061, 1050, 1060, 1052, 1062.
- DI, modifications 1141, 1151, 1161, 1167, 1150, 1160, 1168,1142,1152, 1162.
- DIV, modifications 1341, 1350, 1351, 1352.

Modifications DI-1167 и 1168 maintain an overload pressure of 1.15 times and modifications DI-1170 и DI-1171 maintain an overload pressure of 1.1 times bigger, than upper limit of measurement.

Transmitters DA with an upper measurement limit of less than 0.1 MPa can withstand atmospheric pressure overload.

1.2.34 Transmitters are manufactured in two versions:

- without digital indicator;

- with built-in LED digital indicator ("TsI" code). The indicator can be rotated by ±360º in 90º increments.

1.2.35 The body of the electronic converter is rotated relative to the pressure transmitter 180º from the set position at the manufacturer.

1.2.36 Transmitters have an external button located on the body of the electronic converter to offset the sensor characteristics ("zero calibration") from the mounting position on the object.

1.2.37 The limits of the permissible shift "zero calibration" characteristics of the transmitter, depending on the set measurement range correspond to those in table 8.

Table 8

Limits of the set measurement range	Limit of shift of characteristic, % of measurement range
$0,25Pmax \le Pв \le Pmax$	±5
$0,1Pmax \le Pв < 0,25Pmax$	±10
$0,04Pmax \le Pв < 0,1Pmax$	±25

1.2.38 Transmitters can be adjusted to the shifted measurement range with the setting of the lower limit of measurements to any value within the permissible limits of measurement of the transmitter:

- measuring range greater than or equal to P_{min};

- the upper limit is less than or equal to P_{max} .

1.2.39 Adjustment and control of transmitters with build-in LED indicator is realized by built-in means located on the body of the indicator and remotely with the help of control device supported HART protocol, and for transmitters without indicator is only realized remotely with the help of control device supported HART protocol.

1.2.40 The limit values of the analog output signal correspond to:

- lower value, not more than: 3.73 ± 0.02 mA;
- upper value, no more: 22.0 ± 0.02 mA.

The values of the saturation signals of the analog output:

- lower value, not more than: 3.84 ± 0.02 mA;
- upper value, not more than: 21.6 ± 0.02 mA.

Saturation of the output signal occurs when the pressure goes beyond the specified range by more than 1% below the lower limit of measurement and more than 10% above the upper limit of measurement.

The limit value of the output signal is set when a mismatch occurs between the monitored parameters and the set values detected by a continuously functioning self-diagnosis system. Switching between the upper and lower limits of the output signal value is performed by a HART command transmitted via the communication line or sensor settings using the buttons on the front panel.

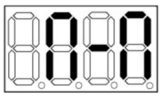
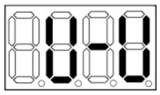
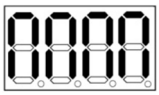
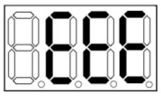
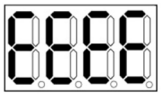
1.2.41 On transmitter display, the following parameters are indicated in pressure measurement mode :

a) value of pressure measurable value in digital form, in set units (in Gage/vacuum transmitters - with provision for sign) or in percents of range of output signal measurement.

Display limits of measured pressure depending are from minus $0,01P_в$ to plus $1,1P_в$.

b) symbols indication on transmitter display in failure mode or when the measured pressure surpasses its limits indicated in table 9.

Table 9

Indicator symbols	Mode
	Measurable pressure $P_в$ is out of upper limit - plus $1,1P_в$
	Measurable pressure $P_в$ is out of lower limit - minus $1,1P_в$
	Overfilling of indicator as a result of engineering units incorrectly chosen
	Analog part failure
	Lost communication with the board of digital indicator

1.2.42 Grounding mark is on electronic converter housing near to a clip for grounding as per GOST 21130.

1.2.43 Mean time between failures, taking into account the maintenance regulated by the manual at least 220 000 hours.

1.2.44 Average service life of transmitters is 20 years, except for transmitters operated at aggressive fluids measurements. Their average service life depends on aggressive medium characteristics, operation conditions and applied materials (1.2.48).

1.2.45 Stability of the transmitters is not worse ±0,1% from *Pmax* for 2 years.

1.2.46 Transmitters with ordering code "N" has an additional technological ellaboration for 360 hours.

1.2.47 The overall dimensions of the transmitters must comply with Appendix A.

1.2.48 Wetted materials:

- Diaphragm:

For modifications DI-1141, DI-1151, DI-1161, DI-1171, DA-1041, DA-1051, DA-1061, DIV-1341, DIV-1351 – titanium VT-9 GOST 19807;

For modifications DA-1052, DA-1062, DI-1142, DI-1152, DI-1162, DIV-1352 – alloy 06CrNi28MoCuTi.

For other modifications – alloy 36 NiCrTiAl GOST 10994.

- cavities wetted parts – 12Cr18Ni10Ti GOST 5632;
- drain valve – 14Cr17Ni2 GOST 5632 (for DD modifications).
- O-ring – NO 68-1 rubber TU 381051082.

1.2.49 Transmitter weight is no more than indicated one in table 10.

Table 10

Modification	Weight, kg
DI-1110	11,0
DI-1120, DI-1130, DI-1140	5,0
DI-1142, DI-1152, DI-1162	1,5
DI-1141, DI-1151, DI-1161, DI-1167, DI-1171	1,0
DI-1150, DI-1160, DI-1168, DI-1170	2,5
DA-1020, DA-1030, DA-1040	5,0
DA-1041, DA-1051, DA-1061	1,0
DA-1052, DA-1062	1,5
DA-1050, DA-1060	2,5
DV-1210	12
DV-1220, DV-1230, DV-1240	5,0
DIV-1310	11,0
DIV-1320, DIV-1330, DIV-1340, DIV-1345	5,0
DIV-1341, DIV-1351	1,0
DIV-1342, DIV-1352	1,5
DIV-1350	2,5
DD-1410	11,0
DD-1420, DD-1430, DD-1434, DD-1440, DD-1444, DD-1450, DD-1460	5,0
DG-1530, DG-1540	12

1.3 Design and operation of transmitter

1.3.1 Structure and main modules

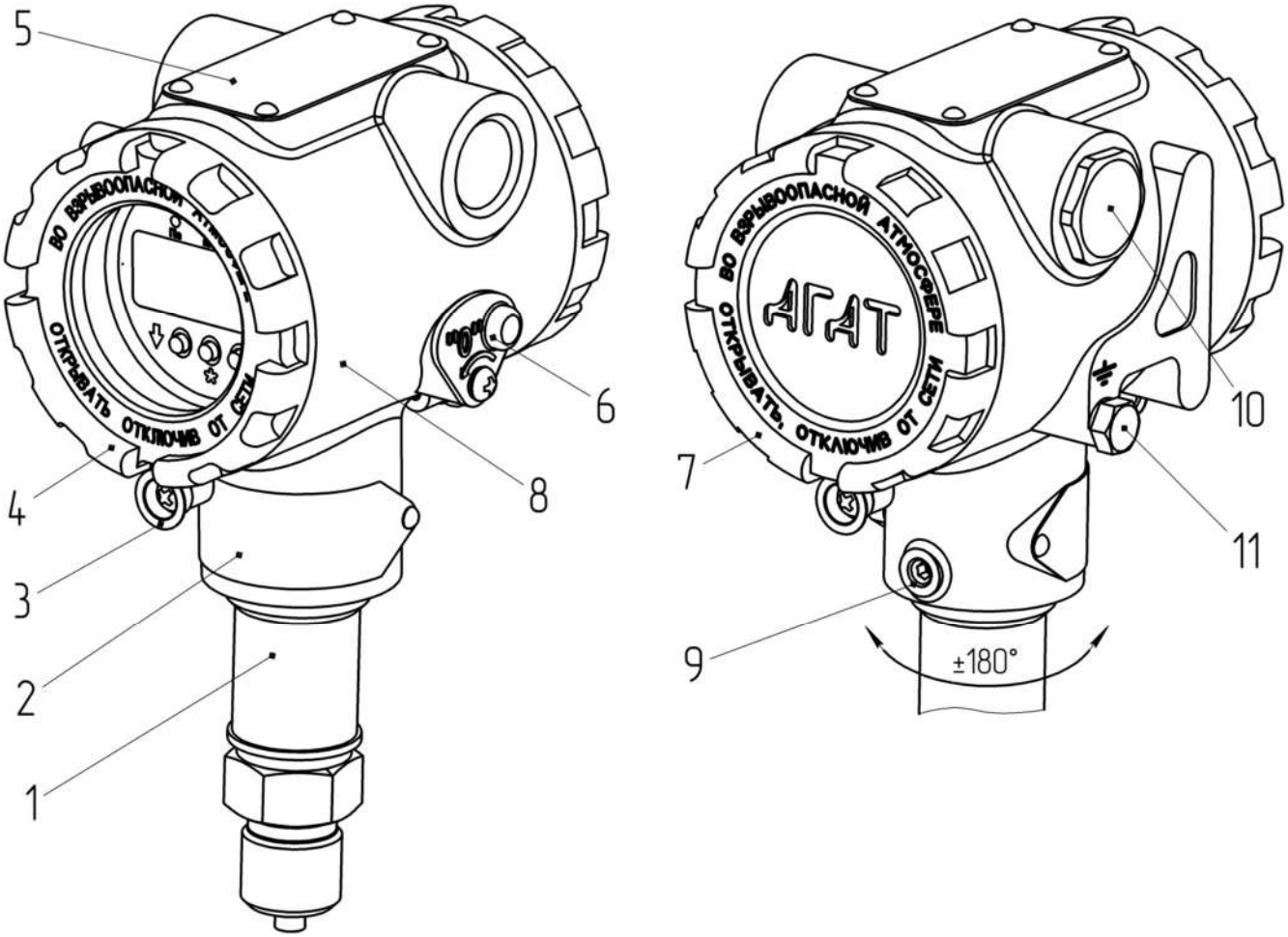


Figure 2 – General view of the pressure transmitter Agat-100MT

1 – Pressure converter
2 – Certification plate
3 – Lock bracket (for Exd)
4 – Front cover
5 – Plate
6 – External “zero” calibration button
7 – Rear cover
8 – Electronic converter
9 – Locking screw
10 – Plug
11 – External ground bolt

Structurally, the pressure sensor Agat-100MT consists of a pressure converter 1 and an electronic converter 8.

Electronic converter 8 consists of a housing in which are located: a microprocessor module, a power module, a connection module (terminal block) and a display unit (for transmitters with the “TsI” code).

The operating principle of the pressure transmitter is based on the strain-resistive effect in the semiconductor sensing element. Under the influence of the measured

value, the diaphragm is deformed, causing a change in the resistance of the strain gages of the sensing element, and consequently, a change of the output electrical signal. The electrical signal is converted by an analog-to-digital converter into a digital code proportional to the applied pressure. The digital code is transmitted to a digital display device, as well as to a device that generates a unified current output of 4-20 mA and a digital output HART signal.

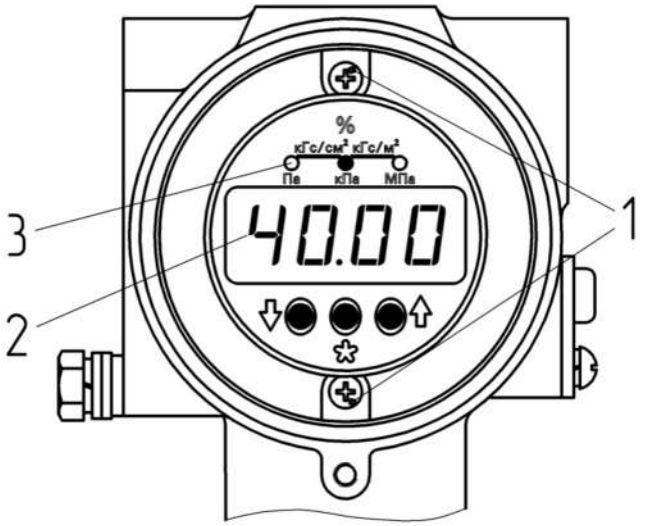


Figure 3 – Elements of digital indicator

The value of the measured pressure 2, the units of measurement 3 and the errors are displayed on the display unit code “TsI” (see figure 3).

The display unit can be rotated relative to the initial setting of ±360° in 90º increments. To do this, unscrew the two screws 1, remove the display unit, turn to the desired position and re-insert. On the housing of the display unit there are guides that serve to orient the unit during installation.

The indicator settings are controlled by buttons located on the front panel:

“⇩” - main menu entry, menu navigation;

“⇧” - edit parameter values, exit menu;

“✲” - enter the main menu submodes, save settings.

The algorithm of work with the indicator settings is described in item 2.5.5.

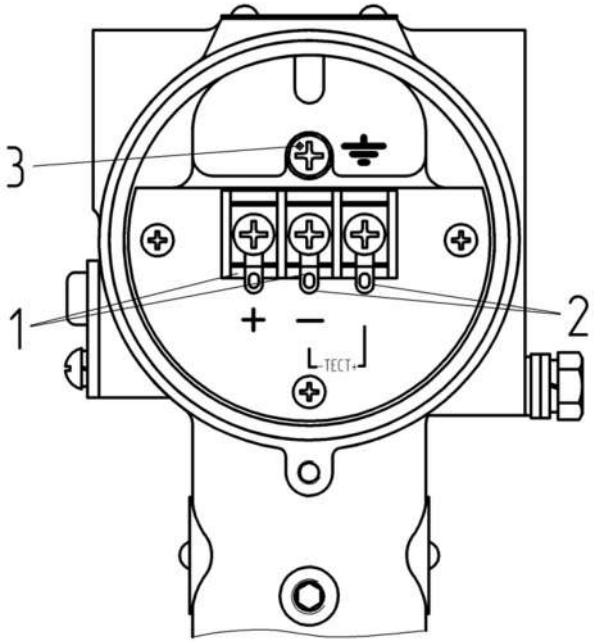


Figure 4 – Elements of connection module

The electrical connections are located on the connection module (figure 4) and have the following elements:

- plugs 1 for 4-20 mA current loop connection;

- plugs 2 for connection of an external measuring device for monitoring the current in the circuit (“TEST”);

- ground screw 3 of connection wires.

For a better view of the indicator or for easy access to the two compartments of the electronic unit (terminal block and control buttons), the housing of electronic converter 8 can be rotated relatively pressure converter 1 at an angle of ±180°. To do this, use a hex wrench S=3mm to loosen the locking screw 9 (see figure 2), rotate the housing of the electronic converter at an angle of not more than ±180° and re-tighten the screw 9.

1.4 Marking and sealing

1.4.1 On the label attached to transmitter, the following marks and inscriptions should be done:

- transmitter name;

- code limit of the permissible basic error;

- upper range limit *Pmax* with units indication. For Agat-100MT-DIV, both lower and upper limits are indicated;

- maximum permissible gauge operating pressure with units indication for Agat-100MT-DD, Agat-100MT-DG transmitters;

- supply voltage;

- output signal;

- IP rating according to GOST 14254;

- transmitter serial number according to manufacturer numeration system;

- release year and month;

- sign of the statement of type of measuring instruments on PR 50.2.107;

- name of the manufacturer;

- the inscription “Made in Russia”.

1.4.2 On a plate attached to an explosion-proof transmitter, marking according to GOST 31610.0, GOST IEC 60079-1, GOST 31610.11 is made. On the covers of the electronic converter of the transmitters with the type of explosion-proof “explosion-proof barrier”, there is a warning sign: “In the explosive atmosphere, open after disconnecting from the network”.

1.4.3 Grounding mark is on electronic converter housing near to a clip for grounding.

1.4.4 Marks “+” and “−“ on sensor block housing mean point marking of measurable parameter supply. (fig. 5). Mark “+” corresponds to supply point of measurable pressure or greater one of measurable pressures in Agat-100MT-DD transmitters, and the mark “−“ indicates the chamber communicated with static pressure or chamber for supply of smaller one of measurable pressures. For Agat-100MT-DV sign “−“ corresponds to the place of supply of measurable pressure.

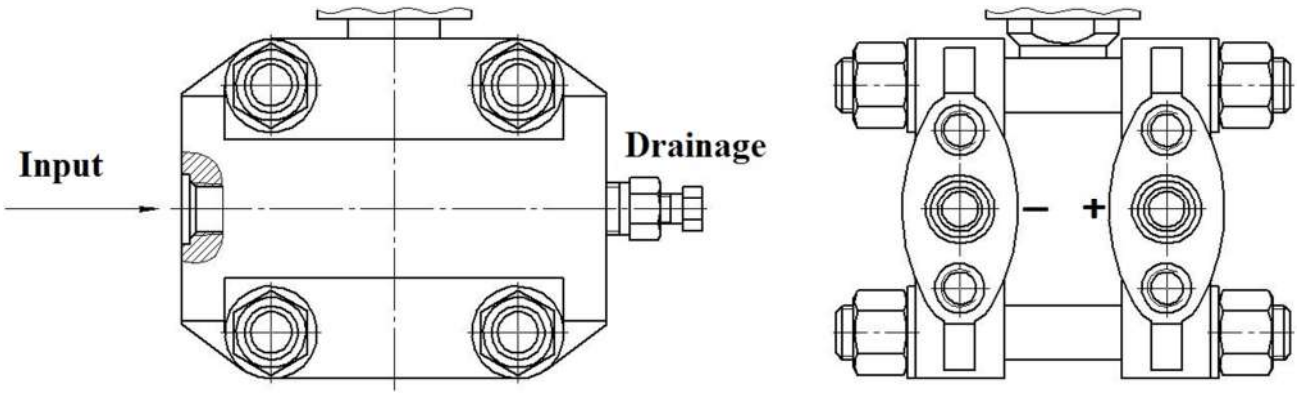


Figure 5 – Point marking of measurable parameter supply

1.5 Packaging

1.5.1 The transmitter is wrapped in wrapping paper in accordance with GOST 8828 or GOST 8273, placed in a cover made of polyethylene film in accordance with GOST 10354 with a thickness of 0.15−0.30 mm, and laid in consumer packaging box of cardboard according to GOST 7933 or corrugated cardboard according to GOST R 52901. The cover is welded.

1.5.2 The mounting parts, the bracket, the plug for cable entry and other accessories supplied with the sensor are packed in film covers and together with the transmitter are laid in the consumer box. The covers are welded.

1.5.3 The transmitter and mounting parts are separated from each other and sealed in a box with cardboard linings. Together with the transmitter and the mounting parts in the box, technical documentation are packed on top of the products.

1.5.4 Technical documentation is enclosed in a cover made of polyethylene film GOST 10354 with a thickness of 0.15−0.30 mm or other waterproof material specified in the design documentation. The cover is welded.

Preservation is ensured by placing the transmitter in a film case with a silica gel desiccant. Means of preservation correspond to the variant of protection B3-10 according to GOST 9.014. The maximum term of protection without re-preservation is 1 year. The mass of dry silica gel indicated in the passport.

1.5.5 Boxes are placed in transport containers - boxes of type II-1, II-2, III-1 GOST 2991, or boxes of type VI GOST 5959, or a box of corrugated cardboard according to GOST R 52901.

1.5.6 Shipping documentation is placed inside the transport container.

1.5.7 Mass of transport container with transmitters does not exceed:

- plywood or fiberboard - 50 kg;
- wood boards - 100 kg;
- corrugated cardboard - 35 kg.

1.6 Explosion protection

1.6.1 Ensuring the explosion-proof transmitters with the type of explosion protection “explosion-proof barrier” is achieved by placing their electrical parts in an explosion-proof enclosure according to GOST 31610 and GOST IEC 60079.10, which has a high degree of mechanical strength. This type of explosion protection eliminates the transmission of an explosion inside the sensor to the surrounding explosive atmosphere.

1.6.2 Explosion-proof barrier and its fasteners withstand pressure tests inside the enclosure equal to 4 times the explosion pressure.

1.6.3 Threaded flameproof connections are controlled by: cup, screw.

1.6.4 Threaded flameproof joints have at least 5 full, continuous, intact turns in meshing. All current-carrying and grounding clamps are protected from self-unscrewing using spring washers.

1.6.5 The maximum allowable temperature of the outer surface of the transmitter (85ºC) corresponds to the temperature class T5 according to GOST 31610.0.

1.6.6 The plate attached to the body of the transmitter Agat-100MT-Exd, has a marking of explosion protection:

1Ex d IIC T5 Gb X; $-60^0C \leq Ta \leq 80^0C$.

where Ta – the range of ambient temperature values.

The plate indicates the name of the certification body and the certificate number.

Near the external grounding clip there is a relief sign of grounding. On the removable covers there is a warning sign: “In the explosive atmosphere, open after disconnecting from the network”.

1.6.7 Ensuring the explosion-proof transmitters with the type of explosion protection “intrinsically safe electrical circuit” is achieved by:

- limits the maximum input current I_i = 120mA and maximum input voltage U_i = 24V in electrical circuits, working with them secondary devices to intrinsically safe values;

- perform the design of the entire transmitter in accordance with the requirements of GOST IEC 60079.1.

The current and voltage limit in the transmitter’s electrical circuits to intrinsically safe values is achieved due to the mandatory operation of the sensor complete with blocks (barriers) that have the “intrinsically safe electrical circuit” type of explosion protection with the intrinsically safe “ia” explosion protection level of the IIC subgroup according to GOST 31610.11, the voltage and current of the intrinsically safe electrical circuits of which do not exceed, respectively, the values of 24 V and 120 mA.

1.6.8 The plate attached to the body of the transmitter Agat-100MT-Exi, has a marking of explosion protection:

ExiaIICT5X, -60°C≤T_a≤+80°C, U_i≤24V, I_i≤120mA, L_i≤150mH, C_i≤10nF».

The plate indicates the name of the certification body and the certificate number.

U_i, I_i, – the maximum input voltage and current values.

L_i – the maximum internal inductance.

C_i – the maximum internal capacity.

2 Proper use

2.1 General guidelines

2.1.1 It is necessary to check container safety at transmitter case receipt. In case of its damage it is necessary to draw an act.

2.1.2 In winter, cases with transmitters are unpacked in a heated room no earlier than in 12 hours after they had been put into the room.

2.1.3 Check accessories according to transmitter data sheet.

2.1.4 It is necessary to indicate implementation date, act number and approval date of manufacturer management in transmitter data sheet.

It is recommended to include the information concerning to transmitter operation into the product data sheet: service records with malfunctions and their causes; periodical control data of main characteristics at operation; transmitter verification data etc.

The manufacturer is interested in information of transmitter operation and malfunctions for their elimination in future.

All recommendations on transmitters design should be directed to manufacturer address.

2.1.5 Prior to use remove shipping plugs:

- from fittings (flanges, housings) of static and dynamic cavity;
- from cable holes and from the socket connector of the electronic converter.

2.1.6 It is recommended to correct zero setting after maximal or minimal working temperatures effect.

2.1.7 Transmitters can be applied to measure pressure of liquids, steam or gas, including oxygen. It is necessary to provide careful system filling with liquid at liquid pressure measurement.

2.1.8 It is necessary to perform storage, transportation, verification and implementation following the requirements of static electricity protection namely:

- during transmitter verification and connection use, antistatic bracelets;
- the workplaces of transmitter verification should have conducting covering connected to grounding trunk;

- all devices and equipment used for calibration should be grounded;

- at transmitter connection on operation site, grounding should be connected firstly, and then one should connect supplying and measuring lines.

2.2 Security measures

2.2.1 According to the method of human protection against electric shock transmitters belong to the class 01 according to GOST 12.2.007.0. The transmitter housing must be grounded.

2.2.2 Operation of Agat-100MT-Exd, Agat-100MT-Exi transmitters should be realised according to the normative documents regulating electric equipment application in explosive conditions.

2.2.3 Transmitters operation is not permitted in systems where the pressure can exceed corresponding highest limits indicated in table 2 for each model.

2.2.4 Application of transmitters with measuring blocks, filled with liquid polymethylsiloxane PMS-5 (PMS-6) is not permitted in the processes where liquid entering into measurable medium is prohibited according to industry safety measures.

2.2.5 Transmitters connection/disconnection from main pipes brought measurable medium should be made after valve closing on the line before the transmitter. Transmitter disconnection should be made after pressure drop down to atmospheric.

2.2.6 Transmitters operation is permitted only with safety measures instruction approved by manufacturer chief and taken into account transmitter features in specified process.

2.3 Explosion protection of transmitters at mounting

2.3.1 Explosion-proof transmitters can be installed in explosive areas of premises and outside installations according to normative documents regulating application of electric equipment in explosive conditions.

2.3.2 When installing, the transmitter should be guided by the following documents:

- GOST 31610.0;

- GOST 31610.11;

- GOST IEC 60079-1;

- this manual and other regulatory documents.

Installation and operation of the transmitter should be allowed to persons who have studied this operating manual and have passed the appropriate instructions.

Before mounting, the transmitter should be inspected. At the same time, it is necessary to pay attention to the explosion protection marking, warning labels, no damage to both the flameproof enclosure housing (for a transmitter with an "explosion-proof barrier") and transmitter, the presence of a grounding clip on the electronic converter housing, the condition of the cable being connected, the availability of means for sealing cables and covers.

In order to avoid the operation of fuses in the spark protection barrier (for transmitters with the type of explosion protection "intrinsically safe circuit"), in case of accidental shorting of the connecting wires, terminate the cable and connect it with the power off.

Upon completion of installation, the electrical insulation resistance between the combined electrical circuits and the transmitter housing (at least 5 MOhm) and the electrical resistance of the ground line to 4 Ohms should be checked.

2.3.3 For transmitters with "explosion-proof barrier", the connection of external electrical circuits must be made through cable lead-ins certified in the prescribed manner for compliance with the requirements of GOST 31610.0. If only one cable lead-in is used to connect the transmitter, the unused input must be closed with a plug that is supplied by the manufacturer. The plug must comply with the requirements of GOST 31610.0.

2.3.4 When mounting the transmitter with the "explosion-proof barrier", it is necessary to check the condition of the explosion-proof surfaces of parts being disassembled (scratches, cracks, dents are not allowed).

Parts with threaded connections must be screwed to the full length of the thread and locked.

2.3.5 Seal the cable into the cable lead-in, connect the cable cores to the terminal block in accordance with the external connection scheme (Appendix B).

Connect the cable shield (in case of using shielded cable) to the case with screw 3 (see. Fig. 3). After mounting the cable and connecting it to the terminal block, install the cover, lock it using cup 3 (see Fig. 1).

The communication line can be made with any type of cable with copper wires with a cross-section of at least 0.35 mm^2.

2.3.6 At explosive mixture availability at the moment of Agat-100MT-Exd, Agat-100MT-Exi transmitter installation, it is not permitted to subject the transmitter to friction or shocks capable to cause spark-formation.

2.4 Order of installation

2.4.1 Mounting and connecting dimensions of transmitters are given in Appendix A.

When choosing an installation site, consider the following:

- Agat-100MT transmitters of traditional performance cannot be installed in explosive premises, explosion-proof sensors can be installed in explosive premises corresponding to 2.3.1;

- transmitter installation sites should provide convenient conditions for maintenance and disassembly.

For a better overview of the display or for convenient access to two electronic converter sections (to the connection module and the display unit), the electronic converter housing can be rotated relative to the pressure transducer from the set position by an angle of no more than ±180 ° in either direction.

ATTENTION! Rotating the electronic converter by an angle of more than ±180º may result in a breakdown of the electrical connections between the sensor and the electronic converter.

- ambient air temperature and relative humidity should correspond to values specified in items 1.2.13 and 1.2.22;

- vibration parameters should not exceed values given in item 1.2.15;

- strength of magnetic fields caused by external sources of alternating current with frequency 50 Hz should not exceed 400A/m,and if it is caused by external sources of direct current, it also should not exceed 400A/m;

- at transmitters operation in negative temperatures range, it is necessary to exclude: condensate accumulation and its freezing in working chambers and inside of connecting tubes (at measurement of gaseous media parameters); freezing, crystallization of medium or decrystallization of separate components from it (at measurement of liquid fluids).

2.4.2 Pressure measurement accuracy depends on the transmitter mounting correctness and connecting pipes from pressure tap point to the transmitter. Connecting pipes must be laid by shortest distance. Pressure tap should be executed in points, where flow velocity is minimal, flow has no vortexes, i.e. at pipeline straight runs at maximum distance from locking devices, elbow pipes and other hydraulic connections. At surge media pressure, hydraulic and gas impacts connection pipes should have offsets in the form of loop-shaped dampers.

Measurable medium temperature in the working cavity of the transmitter should not exceed permissible ambient temperature. Since there is no medium channel in the working cavity, input temperature should not exceed 120°C. To lower measurable medium temperature on working cavity input, the transmitter should be installed on a connecting line with recommended length no less than 3 m for DD transmitter and no less than 0.5 m for other transmitters. The specified lengths are approximate; they depend on medium temperature, diameter and material of connecting line and can be reduced. In order to avoid pulse lines' mechanical effect on pressure transmitters it is necessary to provide connecting lines mounting.

Connecting lines should have one-sided slope (no less than 1:10) from pressure supply place upwards to transmitter if measurable medium is gas, and downwards to transmitter if measurable medium is liquid. If it is impossible, it is necessary to install settling vessels at lower points of connecting line at pressure or differential pressure measurement of gas, and gascollectors at highest points at pressure or differential pressure measurement of liquid.

Also it is recommended to install settling vessels before the transmitter especially if the transmitter is installed below the point of pressure supply and if it is installed on long connecting lines.

Independent devices should be provided for connecting lines purging.

For transmitter disconnection from the line and its connection to atmosphere, it is recommended to install two valves or three-variant crane to pressure transmitter in connecting lines from pressure supply place.

It will simplify periodic control of output setting corresponding to the lower value of measurable pressure, and transmitter dismantle.

On each of lines, it is recommended to install valve for line connection with atmosphere and a valve for transmitter disconnection to differential pressure transmitter in connecting lines from orifice plate.

In connection lines from the restriction to the pressure-difference transmitter it is recommended to install on each line a valve for connection of a line with atmosphere and a valve for the transmitter disconnection.

2.4.3 Transmitters can be mounted on a pipe, wall or panel using brackets. The brackets are supplied according to the order.

The transmitter is connected to the connecting line by means of a nipple previously welded to the tube or by means of a mounting flange having a suitable thread.

When sealing the joints with a metal gasket to improve the sealing conditions, it is recommended to apply to the thread (M20) and a metal gasket before assembly:

- graphite lubricant or CIATIM lubricant, or lubricant used at the company - for transmitters of traditional performance.

Before connecting to the transmitter, the lines must be carefully purged to reduce the possibility of contamination of the sensor cells of the transmitter. Before connecting the transmitter, the connecting lines should be blown out with clean compressed air or nitrogen. Air or nitrogen should not contain oils.

2.4.4 After the installation of the transmitters, it is necessary to check the joints for tightness at the maximum working pressure.

2.4.5 The transmitter housing should always be grounded in accordance with local safety regulations or industry guidelines. The most effective way to ground the sensor body is to directly ground the wire with minimal impedance.

2.4.6 Connection of wires is carried out through openings of cable lead-ins. The cable lead-ins must be sealed with holes. Unused openings of cable entries on the body of the electronic converter should be sealed with plugs to avoid moisture ingress into the connection module.

Note - If it is impossible to seal the holes in the cable cable lead-in, install the transmitter so that the housing of the electronic converter is located at the bottom to ensure drainage. Ensure that the wires are bent near the transmitter so that moisture that condenses on the outside of the cable does not get into the housing of the electronic converter. The lowest bending point must be lower than the cable lead-in and the housing of the electronic transducer.

When installing the cable, remove the cover from the side of the connection module. Connect the wires to the terminals in accordance with the diagrams given in Appendix B. After connecting the wires, install the cover.

Covers (pos. 4, 7 fig. 2) must be turned up to the stop to ensure reliable compaction.

When installing explosion-proof transmitters with the “explosion-proof barrier” type in explosion-hazardous areas of all classes, it is not allowed to use cables with polyethylene insulation.

It is recommended to use shielded cable with an insulating sheath when staying close to the places of laying the communication line of electrical installations with a capacity of more than 0.5 kW.

Insulated cores of one cable can be used as signal circuits and transmitter supply circuits, and the insulation resistance should be at least 50 M Ohms.

For transmitters with a digital output signal based on the HART protocol, it is recommended to use shielded twisted pair of wires, the shield is grounded only on the receiving side (for load resistance). Unshielded cable can be used if electrical noise in the line does not affect the quality of communication. To ensure a stable connection,

use a wire with a cross section of at least 0.2mm^2, the length of which does not exceed 1500m.

2.4.7 Supply source for transmitters in operation conditions must meet the following requirements:

- insulation resistance - more than 20 MOhm;

- to withstand test voltage during check of insulation strength - 1.5 kV;

- pulsation of output voltage should not exceed 0.5% of nominal value of output voltage at harmonic vibrations frequency less than 500 Hz;

- interruption of supply shall not exceed 20 ms.

Supply source for transmitters on the basis of HART-protocol in operation conditions must meet the stated above requirements to insulation resistance and to pulsation of output voltage at harmonic vibrations frequency up to 500 Hz, and have mean-square value of noise within the frequency band from 500 Hz to 10 kHz - less than 2.2 mV.

2.5 Measurement of parameters, regulation and adjustment of transmitters

2.5.1 Setup and calibration of transmitters using a digital indicator is carried out according to 2.5.5.

Measuring parameters, setting up and calibrating transmitters with a digital output signal based on the HART protocol is used by a HART modem.

It is possible to execute “zero” calibration by the external button located on the housing of the electronic converter. “Zero” calibration operation by external button is executed at the transmitter input pressure equal to zero. The limits of the offset characteristics of the transmitter when calibrating “zero” depending on the set measurement range (dP) are listed in Table 12.

The established limits for performing “zero” calibration with an external button allow you to compensate for the effect of the installation position on the object or to eliminate the effect of static pressure when operating transmitters on the output signal. To perform the calibration operation, it is necessary to unscrew the fastening screw of the cover 6 (see fig. 1) 0.5-turn, move the cover to the left against the stop, stand for at

least 3 s and then move the cover back again. With a digital indicator, the current pressure value starts to flicker on the indicator. After 3 seconds, the pressure value is set close to zero, then it is necessary to transfer the cover to the initial position.

Calibration of "zero" is carried out with accuracy 0,3γ.

If during the transmitter installation, the zero offset is outside the limits specified in Table 12, then the zero calibration with the external button is prohibited by the transmitter program. It is necessary to reinstall the transmitter in such a position that provides permissible limits for the installation of "zero".

2.5.2 Operation of Agat-100MT with control device supporting HART-protocol.

Agat-100MT can operate with any HART-device because it is entirely corresponds to HART-protocol requirements.

It is possible to divide all commands of HART-protocol into 3 groups: universal, common and special. Universal commands are supported by all HART-compatible devices; common ones are applied to a wide range of devices. Often standard commands of HART-protocol are not enough for perfect transmitter operation, therefore, it is necessary to design some additional commands. In HART-protocol they belong to special commands and access to them with another manufacturer equipment is possible only with special driver. There are special commands in Agat-100MT transmitter: command 3 (sensor calibration), command to read unique sensor parameters, enter password, read display status, record display status. Access to other sensor commands does not require a special driver.

2.5.3 Setting the basic parameters that determine the operation of transmitter.

2.5.3.1 Before using the transmitter, it is recommended to review its settings that were set at the manufacturer's factory.

Transmitter setup includes the following operations:

1) setting the output parameters of the transmitter:

- installation of units of measure;
- setting the characteristics of the output signal;

To obtain the inverse characteristic of the output signal, it is necessary to assign a higher pressure value to the 4 mA point than for the 20 mA point.

- reconfiguration of the range;

- setting the averaging time of the output signal (damping);

2) Calibrate of analog output:

- calibration "zero" DAC;

- the operation establishes an exact correspondence (using exemplary means) to the initial value of the output signal of the current of the digital-analog converter to the nominal value.

During calibration, there is a parallel offset of the DAC characteristic and its slope does not change;

- calibration of the “tilt” of the DAC - the operation establishes an exact match (using exemplary means) of the upper value of the output signal current digital-analog converter rated value. With calibration is corrected tilt characteristics of the DAC;

3) sensor calibration.

Sensor calibration provides calibration of the lower limit of measurements (LLM) and the upper limit of measurements (ULM) transmitter readings and accurate inlet pressure.

When calibrating the LLM, a parallel shift of the transmitter characteristic occurs and its slope does not change.

Calibration ULM - operation establishes the correspondence between the transmitter readings and the exact pressure at the inlet. When calibrating the ULM, the slope of the characteristic is corrected.

Calibration of the sensor should always begin with the calibration of the LLM.

Calibrating the ULM gives tilt correction based on the calibration of the LLM.

2.5.4 To work with Agat-100MT transmitter on the digital HART channel, a HART modem is required, which is connected according to the scheme specified in Annex B.

2.5.5 Setting the parameters of the transmitter using a digital indicator

Table 11 – Items of the main menu of the display unit

Item number	Item name
1	Auto zero setting
2	Choice of units of measurement
3	Setting the upper limit (range) of measurement
4	Setting the lower limit (range) of measurement
5	Setting the position of the error signal level
6	The choice of time to establish (damping) the output signal
7	Selection of output characteristic
8	Calibration
9	Setting a PIN to protect parameter changes
10	Reset to factory settings

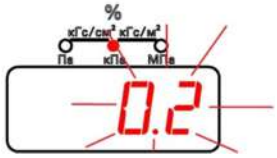
To enter the main menu, press and hold the button ⇩ for at least 3 seconds. The display shows the flashing current pressure value. Switching between the main menu items is performed by sequential pressing of the button ⇩.

If you do not perform any actions (pressing the buttons), then after 10 seconds the automatic transition from the menu to the measurement mode (with the last setting remaining) occurs. You can also exit the menu by pressing and holding for at least 2 seconds ⇧.

Item number 1. Auto zero setting

Press and hold the button ⇩ for at least 3 seconds.

The display shows the flashing current pressure value.

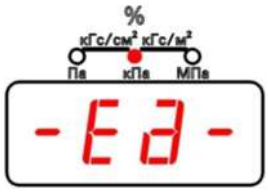


To set the zero value, press the button ☆, after what the indicator will set the pressure to zero and automatically switch to pressure measurement mode.

Item number 2. Choice of units of measurement

Press and hold the button ⇩ for at least 3 seconds.

Press the button ⇩ consecutively until the -Ed- symbol appears on the indicator with the current unit of measurement.



To enter the unit edit mode, press the button ☆. On the indicator, the previously set unit symbol starts to flicker..

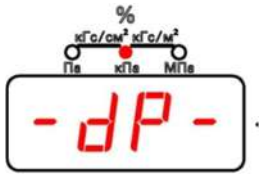
Use the button ⇧ to change the unit of measurement.

Use the button ☆ to save the selected unit of measurement. The unit symbol stops flashing.

Item number 3. Setting the upper limit (range) of measurement

Press and hold the button ⇩ for at least 3 seconds.

Press the button ⇩ consecutively until the -Ed- symbol appears on the indicator and the current value of the upper limit of measurement.



Enter the edit mode of the upper limit (range) of measurement by pressing ☆.

The value of the current upper measurement limit starts to flash.

Use the button ⇧ to change the upper limit value from the standard row.

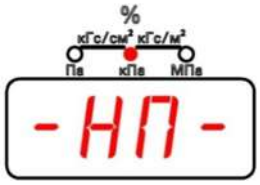
To save the selected value, press the button ☆. This takes you to the main menu.

If you do not want to save the value, press the button ⇩. This takes you to the main menu.

Item number 4. Setting the lower limit (range) of measurement

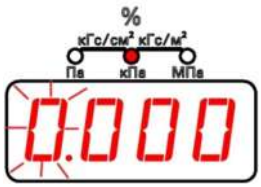
Press and hold the button ⇩ for at least 3 seconds.

Press the button ⇩consecutively until the -НП- symbol appears on the indicator and the current value of the lower limit of measurement.



Enter the edit mode of the lower limit (range) of measurement by pressing ✲.

The value of the current upper measurement limit starts to flash.



Use the button ⇧ to change the lower limit value from the standard row.

To save the selected value, press the button ✲.

Item number 5. Setting the position of the error signal level.

Press and hold the button ⇩ for at least 3 seconds.

Press the button ⇩consecutively until the ALAr symbol appears on the indicator.

Enter the edit mode by pressing ✲. The flickering value of the previously set position of the error current level appears, indicated by the luminous segments of all four indicators.

The upper segments indicate the current upper level of the error current (21.6 mA), the lower segments indicate the lower level (3.84 mA), respectively. OFF - disables the error signal function.

Use button ⇧ to change the position of the error current level and use button ✲ to save the new state.

Item number 6. The choice of time to establish (damping) the output signal.

Press and hold the button ⇩ for at least 3 seconds.

Press the button successively ⇩ until the display indicates the time the output signal is stabilized (damped).

Enter the edit mode by pressing ✲. The time value starts to flicker.

Change the time value out of the row ⇧.

Use the button ✲ to save the selected value. The time value stops flickering.

Item number 7. Selection of output characteristic

The indicator of the main menu displays the previously set characteristic of the output signal.

Enter the edit mode by pressing ✲. The characteristic value starts to flicker.

Change the characteristic with a button ⇧ from the row:

Use the button ☆ to save the selected characteristic. The symbol ceases to flicker.

Item number 8. Calibration

Indicator displays the symbol

Entering the calibration mode ☆.

The selection of calibration items from a row ⇩

Calibrate the initial value of the output signal of the DAC converter (“zero” calibration of the DAC converter)

Calibrate the final value of the output signal of the DAC converter (“tilt” calibration of the DAC converter)

Calibration of "zero" ADC

Range calibration

Calibrate the initial value of the output signal of the DAC converter (“zero” calibration of the DAC converter)

Indicator displays the symbol

The button ☆ enters the calibration mode of the initial value of the output signal of the DAC. The symbol starts to flicker.

Using buttons ⇩ (decrease) or ⇧ (increase) of the output signal of the DAC converter, set the required value of the output signal 4 mA using the reference instrument. Save value with button ☆.

Calibrate the final value of the output signal of the DAC converter ("tilt" calibration of the DAC converter)

Indicator displays the symbol

The button ☆ enters the calibration mode of the final value of the output signal of the DAC. The symbol starts to flicker.

Using buttons ⇩ (decrease) or ⇧ (increase) of the output signal of the DAC converter, set the required value of the output signal 20 mA using the reference instrument. Save value with button ☆.

Calibration of "zero" ADC

Indicator displays the symbol

Attention! The operation **Calibration of "zero" ADC** is performed at a pressure at the entrance to the transmitter equal to zero.

The button ☆ enters the ADC calibration mode "zero".

The display starts flashing the current pressure value.

Use the button ☆ to automatically calibrate the "zero" ADC..

Range calibration

Indicator displays the symbol

Attention! Before performing operations, it is necessary to calibrate the "zero" ADC.

At the input of the transmitter, it is necessary to establish a sample pressure equal to the set dP in the established units of measurement.

Use the button ☆ to enter the range calibration mode.

The display starts flashing the current value of the set pressure.

Use the button ☆ to automatically calibrate the range..

Note *- when performing calibration of the dP measurement range, the sensor program automatically performs control of gross pressure setting errors and prohibits calibration at a pressure of less than 50% of the LLM + dP and more than 150% of the LLM + dP. The calibration ban is accompanied by a flashing character on the indicator:*

In this case, to perform the calibration, it is necessary to exit the calibration mode by pressing and holding the button ⇧, for at least 2 seconds, set the required pressure at the inlet and repeat the operation.

Item number 9. Setting the PIN - code to protect changes in settings.

Press and hold the button ⇩ for at least 3 seconds.

Press the button successively ⇩ until the symbols appear on the indicator:

Enter the mode by pressing the button. ☆.

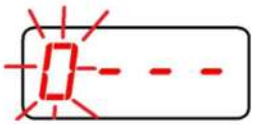
If the PIN code is **not set**, the symbol will flash

If the PIN code is **set**, the symbol will flash

1. The PIN code is not set

Enter the PIN code setting mode using the button ☆.

On the indicator, the first digit starts to blink:



Change the value from 0 to 9 with the button ⇧.

Go to the next digit with the button ⇩.

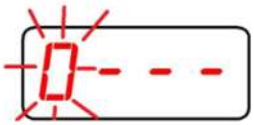
Save the entered PIN-code with the button ☆.

If you need to exit to the main menu without saving the password, you must press and hold the button for at least 2 seconds. There is a transition to the main menu item:

1. The PIN code is set

Enter the PIN code setting mode using the button ☆.

On the indicator, the first digit starts to blink

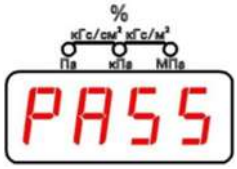


Change the value from 0 to 9 with the button ⇧.

Go to the next digit with the button ⇩.

Enter a PIN-code by the button ☆.

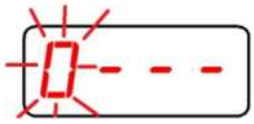
If the entered password coincides with the current one, then the indicator will highlight the symbol:



indicating that the code has been accepted and protection has been removed.

If the entered password does not match the current one on the indicator, the symbol is displayed:

and the symbols reappear:

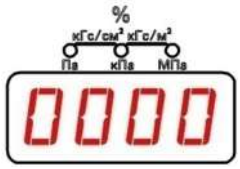


ATTENTION!!!

Protection starts to act again, as soon as the exit to the measurement mode.

In order to completely remove the protection, you must first enter the PIN - code, re-enter the point 

and set the 4th zero:



Item number 10. Reset to factory settings

Press and hold the button ⇩ for at least 3 seconds.

Press the button successively ⇩ until the symbols appear on the indicator:

Enter the mode by pressing the button ☆. The symbols begin to flicker..

To return to the factory settings, click the button ☆ .

The transmitter is rebooted.

2.6 Technical status check

Technical status check of transmitters will be done after its receipt (incoming control) before the installation to the operation place, and also at operation (directly on installation site and in laboratory conditions).

While checking transmitters at operation site, as a rule, output signal that corresponds to lower limit of measurements is checked and, if necessary, corrected; hermiticity check is carried out by visual check of connection points, and performance check is controlled by the presence of output changes when measured parameter is changing.

At incoming control, before installation for operation, while the device is operating in laboratory conditions, it is recommended to correct an output (zero and range) if it is necessary.

Further verification is carried out according to the verification procedure.

Periodic verification is done on term foreseen by the consuming enterprise depending on operation conditions and required accuracy of measurements performance, but minimum once in five years.

3 Maintenance and repair

3.1 Maintenance procedure for the product

3.1.1 Transmitters should be serviced by the persons having studied this instruction and trained appropriately.

When operating transmitters, it is necessary to follow the instructions of this manual, local instructions and other reference documents functioning in this industry.

3.1.2 Maintenance of the transmitters means mainly periodic verification and, when it is necessary, condensate draining or air purging out of working chambers is effected, and transmitter performance check is done.

The transmitter is verificated in accordance with the document MP-03-2018-20 “Pressure transmitters Agat-100MT. Method of verification”. The interval between the verifications is 5 (five) years.

Metrological features of the transmitter comply with regulation norms taking into account transmitter's reliability factors and under observation of storage, transportation and operation rules given in this operation manual by a consumer during inter-calibration period.

It is necessary to make certain that tubes of connection lines and valves are leak-proof and not obstructed. There should not be any gas blockages (at fluid pressure difference measurement) and liquid (at gas pressure difference measurement) in the tubes and valves. To this effect it is recommended to purge the tubes periodically, avoiding transmitter's overcharge. A consumer specifies periodicity depending on operation conditions.

Purging and fill-up of connection lines with operating fluid is prohibited to be performed through inlet cavities and drain valves of the transmitter. To the purpose of purge and fill-up of connection lines, it is necessary to use standard blow-off devices or detachable joints of transmitter's inlet cavities to valve system or block for disconnection of the transmitter before purging of the lines. Also when there are built-in purge valves in the construction of valve system and valve block it is possible to use these valves for purging of the lines at closed insulating valves of valve system and valve block.

It is necessary to dispose liquid out of the transmitter by purging transmitter cavities with air when drain valves are open for precision error measurement during transmitter inspection in laboratory after its operation.

At seal failure of measuring block, it is necessary to tighten all threaded fasteners (choke plug, connecting pipe, bolts for tightening of flange to the housing).

3.1.2 During operation, transmitters should be subjected to methodical visual inspection as well as cyclic checks, repair.

During visual inspection it is necessary to check:

- integrity of housing, absence of corrosion and other damages on it (for Agat-100MT-Exd transmitters);

- presence of all fasteners and their elements, presence and integrity of seals;

- presence of explosion protection marking and warning inscriptions (for Agat-100MT-Exd, Agat-100MT-Exi transmitters);

- the status of grounding, grounding bolts must be tightened and do not contain rust. In case of necessity they should be cleaned;

- state of cable seal (for Agat-100MT-Exd transmitters). Check-up should be carried out when the cable is OFF the circuit. Cable should not be pulled out or twisted in sealing assembly.

Operation of the transmitters with damages and other malfunctions is strictly prohibited.

While operating and repairing explosion-proof transmitters, it is necessary to follow the instructions in section "Provision of explosion protection while mounting" of this operation manual.

When repairing explosion-proof transmitters, it is also necessary to take into account the requirements set forth in instruction RD 16.407 “Explosion-proof electrical equipment. Repair”, and the requirements of GOST 30852.18 “ Explosion-proof electrical equipment. Part 19. Repair and inspection of electrical equipment used in explosive atmospheres”.

Periodicity of transmitters' preventive maintenance inspection is specified depending on operation conditions but more than once a year.

At preventive maintenance inspections, it is necessary to fulfill all works in the amount of visual check as well as the following measures:

- open a cover of inlet device after disconnection of the transmitter from power-supply source. Check explosion proof surfaces (for Agat-100MT-Exd transmitters). If there are some damages of explosion proof surfaces, the transmitter should be repaired;

- make sure of electric contact serviceability preventing heat and short circuit and check resistance of insulation and grounding while cover of inlet device is removed;

- check reliability of input cable seal;

- check state of terminal block. It should not have any defects and other damages.

Claims for a transmitter with defects caused by violation of operating, transportation and storage rules are not accepted.

Warranty service of the transmitters produced by the manufacturer.

Post-warranty repair is made under a separate contract.

3.2 Possible failures and methods of their elimination

Possible failures and methods of their elimination are given in table 12.

If you suspect a malfunction, despite the absence of diagnostic messages on the display of the indicator, carry out the procedures described here to check the functioning of the hardware and process connections.

Table 12

Failure	Cause and elimination methods
1	2
The transmitter does not turn on	Check the voltage at the terminals. Check the polarity of the power supply. Low power supply. *Check and adjust.* Short circuit in the power circuit. *Find and repair the closure.*
No output signal	Break in load line or in line of communication with power supply. *Find and eliminate this break.* Failure of power supply connection polarity. *Eliminate misconnection of power supply.*
The output signal is above 21.8 mA or less than 3.7 mA	Check the pressure applied. Check the 4 and 20 mA range points in the DAC calibration mode.
Output is unstable	Leakage in pressure supplying line. *Find and eliminate the leakage.* The sealing of the mounting flange or transmitter nipple is impaired. *Replace sealing ring.* The tightness of the sensor flange tube is broken. *Tighten the plugs.* Oxidized contact surfaces. *Turn off the power. Free up access to contact surfaces. Clear contacts.*

Table 12 (continued)

1	2
The transmitter does not respond to changes in applied pressure	Check measuring equipment. Check whether the impulse piping or the valve unit is clogged. Verify that the applied pressure is within the calibrated range.
Leakage	The tightness between the valve unit and the transmitter or between the valve unit and the mounting flange or nipple is broken. *Repeat the assembly or replace the sealing ring.*
The output signal does not match the specified parameters	Malfunction in the electronics unit. *Return the transducer for replacement or repair.*

4 Storage and transportation rules

4.1 The transmitters may be kept both in transport cases with block stowage up to 5 stack high, and in internal packing and without packing - on shelves.

Storage conditions for transmitters in transport cases and in the inner packaging - 3 according to GOST 15150.

Storage conditions for transmitters without packaging - 1 according to GOST 15150.

It is not recommended to open transmitter's cover of polyethylene skin before incoming control.

4.2 The transmitters in packaging are transported by any covered transport means including air transport in heated pressurised pod according to freight regulations functioning at every means of transport.

Method of box stowage in transport means should exclude any possibility of transmitters' displacement.

During handling operations and transportation, boxes should not undergo harsh blows and atmospheric precipitation effect.

During rail transportation of the transmitters, dispatch should be part-load or low- tonn. Transportation of transmitters in containers is allowed.

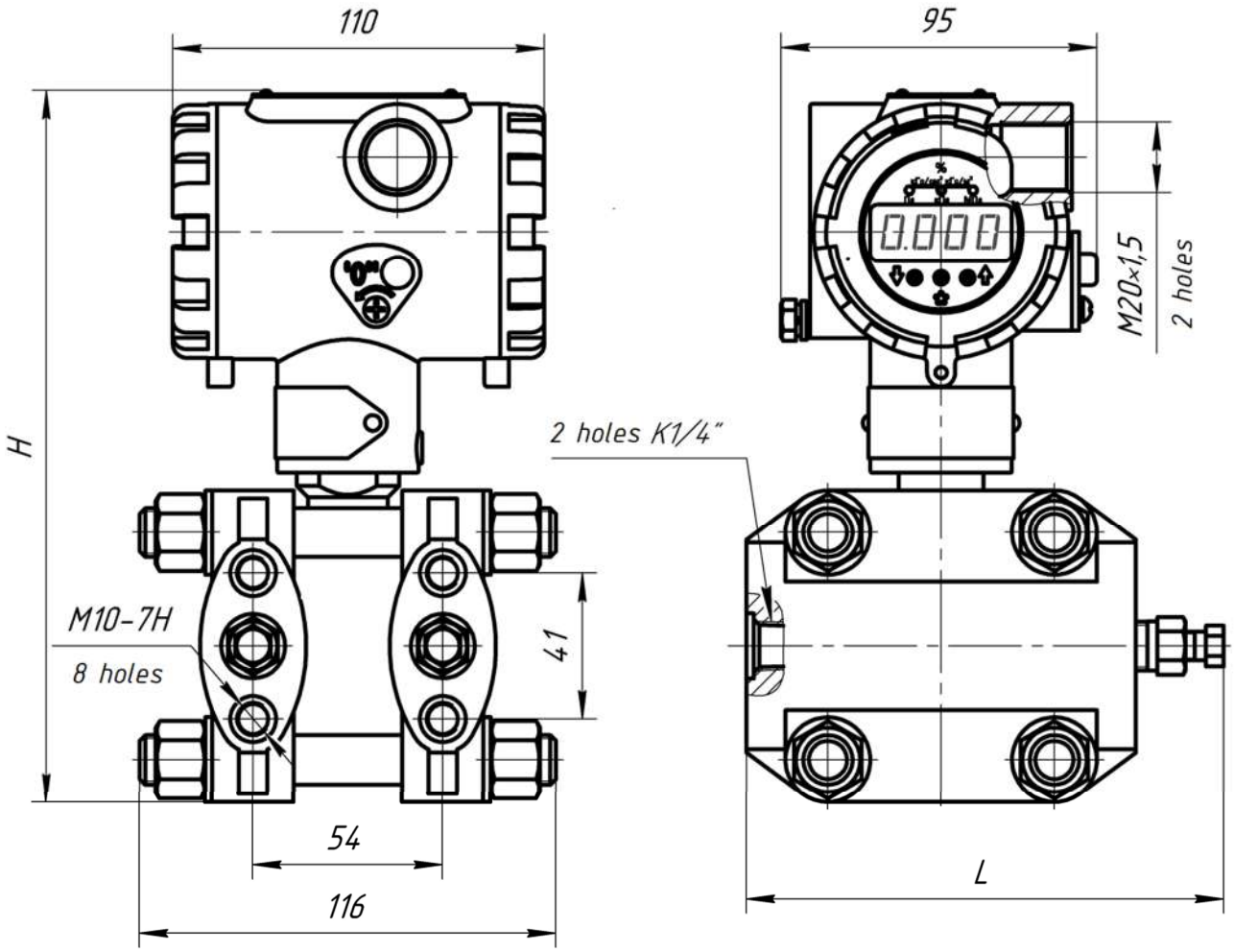
4.3 Period of transmitter storage in appropriate transportation conditions should not exceed three months.

4.4 Transportation conditions in terms of the impact of climatic factors should comply with the storage conditions of 6 or 3 (for maritime transport in the holds) according to GOST 15150.

5 Recycling

Disposal of transmitters is made according to the instructions of the operating organization.

Appendix A
(compulsory)
Mounting and connection transmitters dimensions



Modifications	H, mm	L, mm
1110, 1210, 1310, 1410	250 max	190
1120, 1130, 1140, 1220, 1230, 1240, 1320, 1330, 1340, 1345, 1420, 1430, 1434, 1440, 1444, 1450, 1460	205 max	130

Figure A.1 – Agat-100MT-DI modifications 1110, 1120, 1130, 1140
Agat-100MT-DV modifications 1210, 1220, 1230, 1240
Agat-100MT-DIV modifications 1310, 1320, 1330, 1340, 1345
Agat-100MT-DD modifications 1410, 1420, 1430, 1434, 1440
1444, 1450, 1460

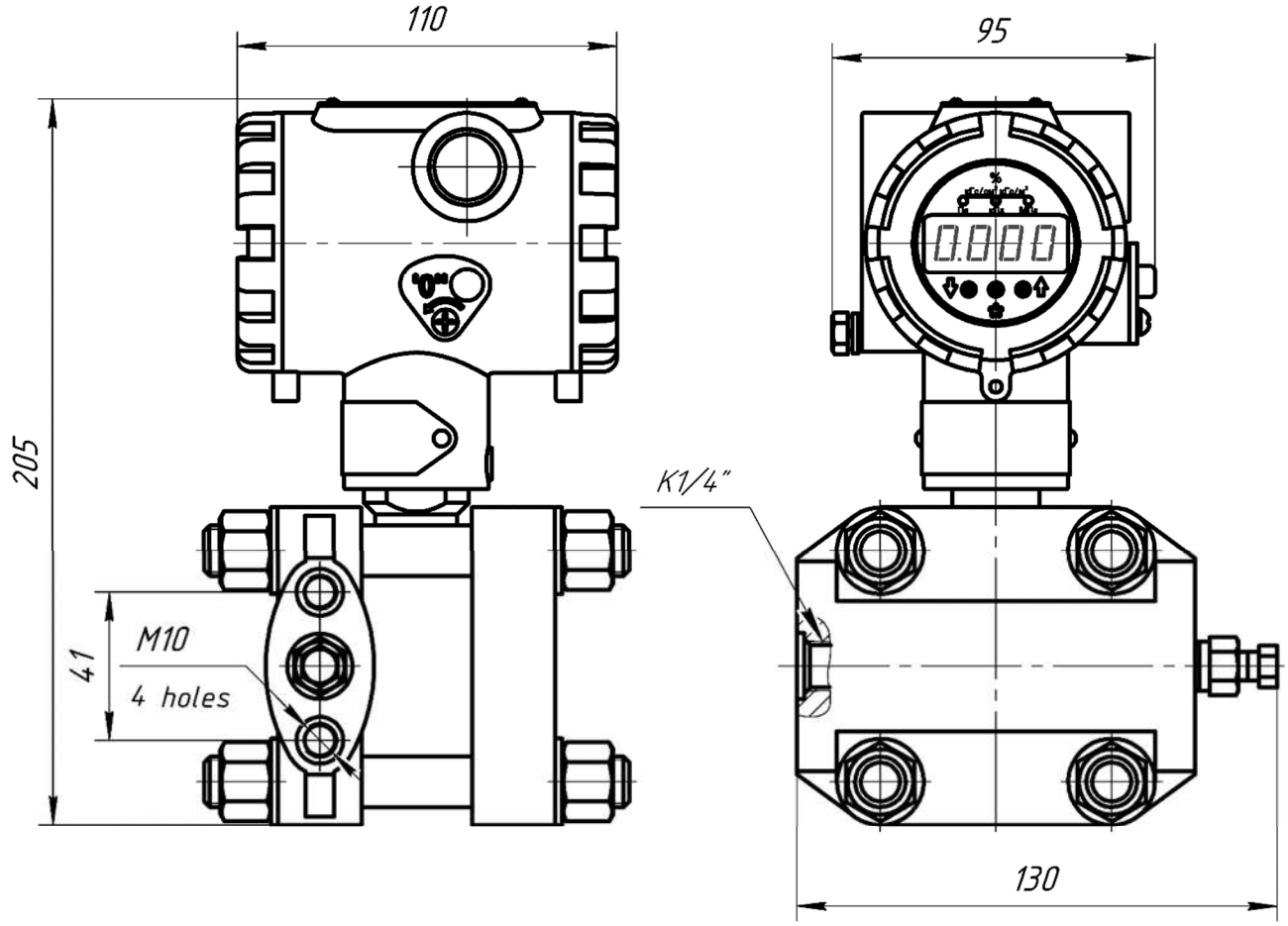


Figure A.2 – Agat-100MT-DA modifications 1020, 1030, 1040

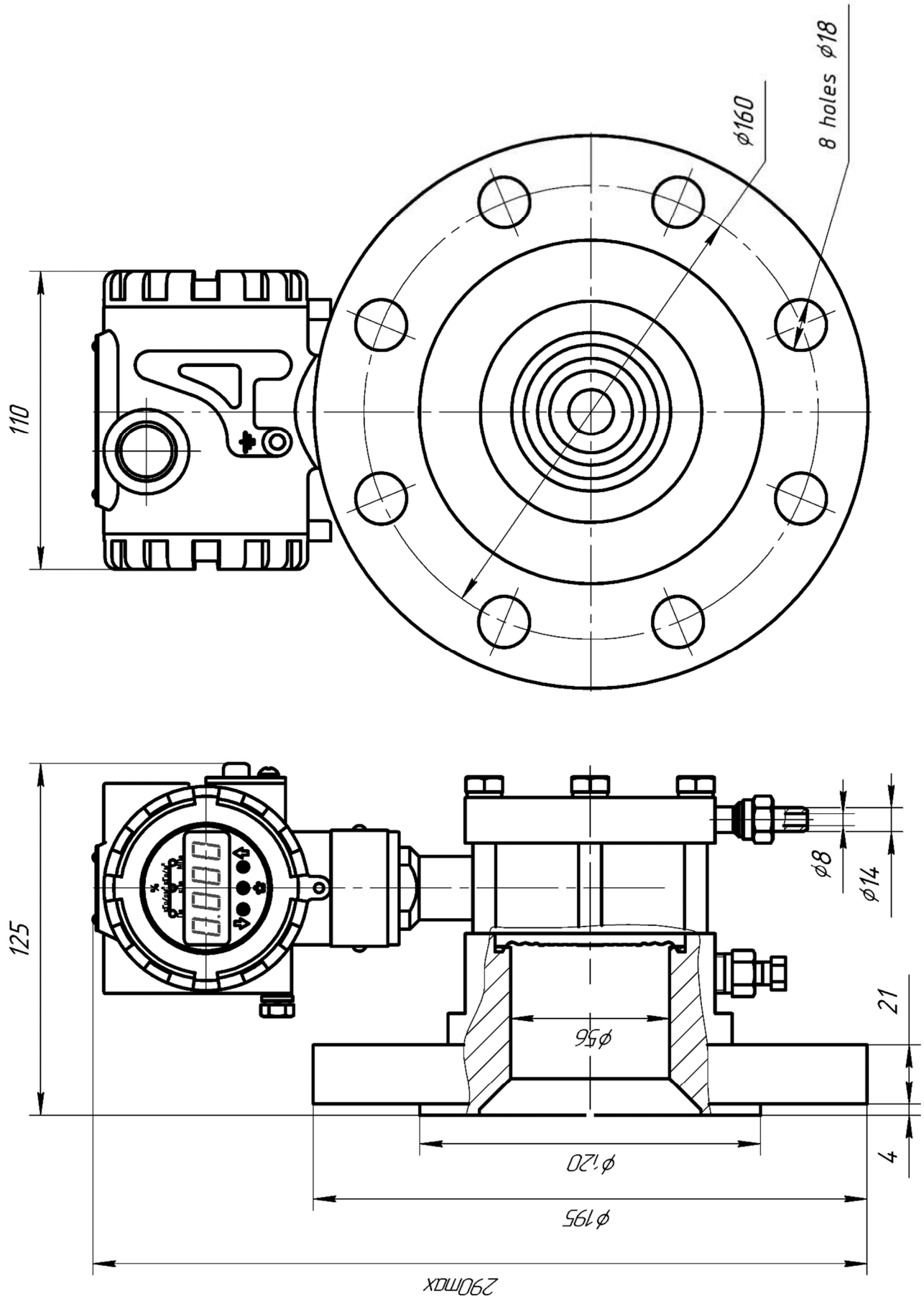


Figure A.3 – Agat-100MT-DG modifications 1530, 1540

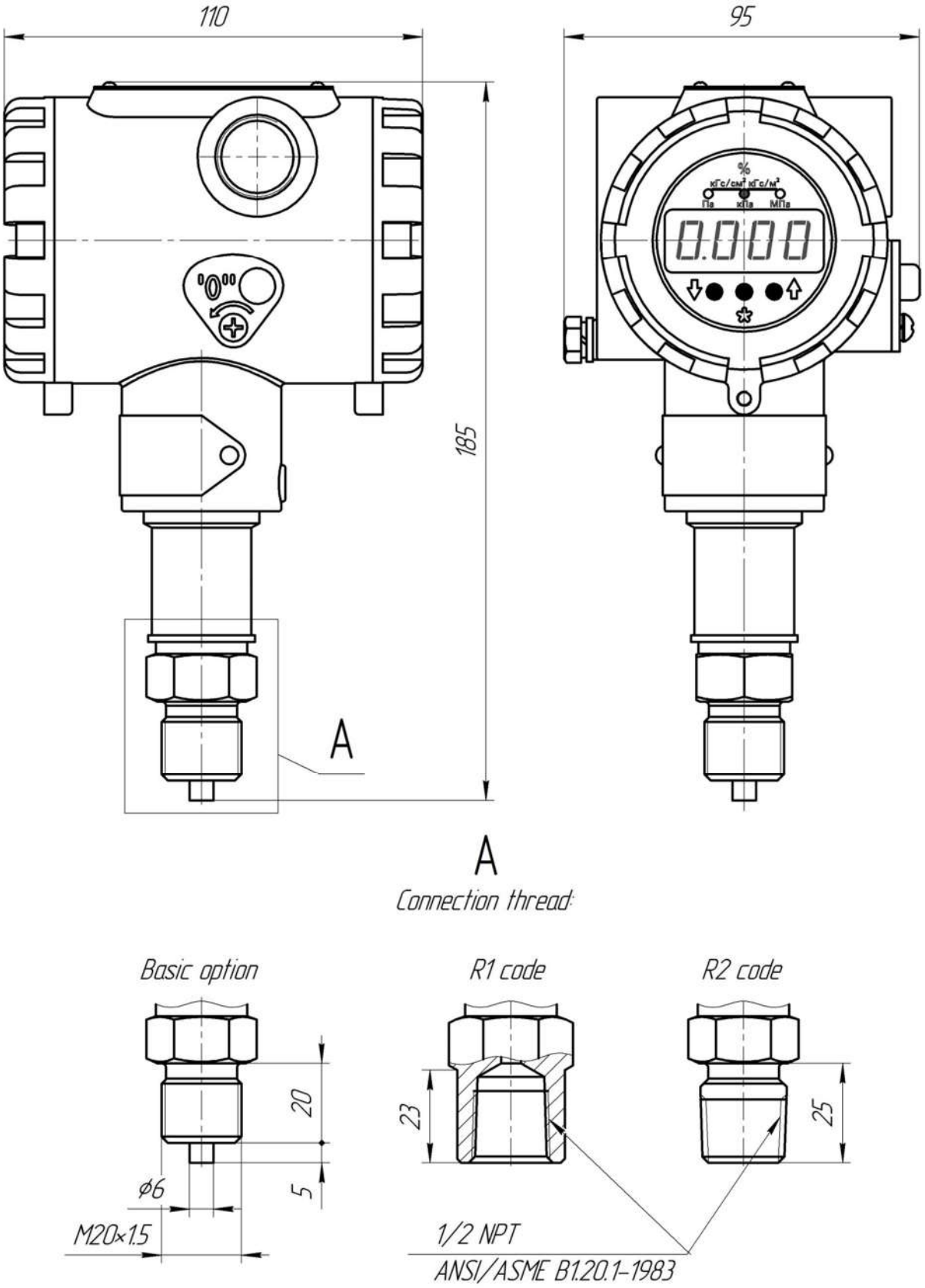
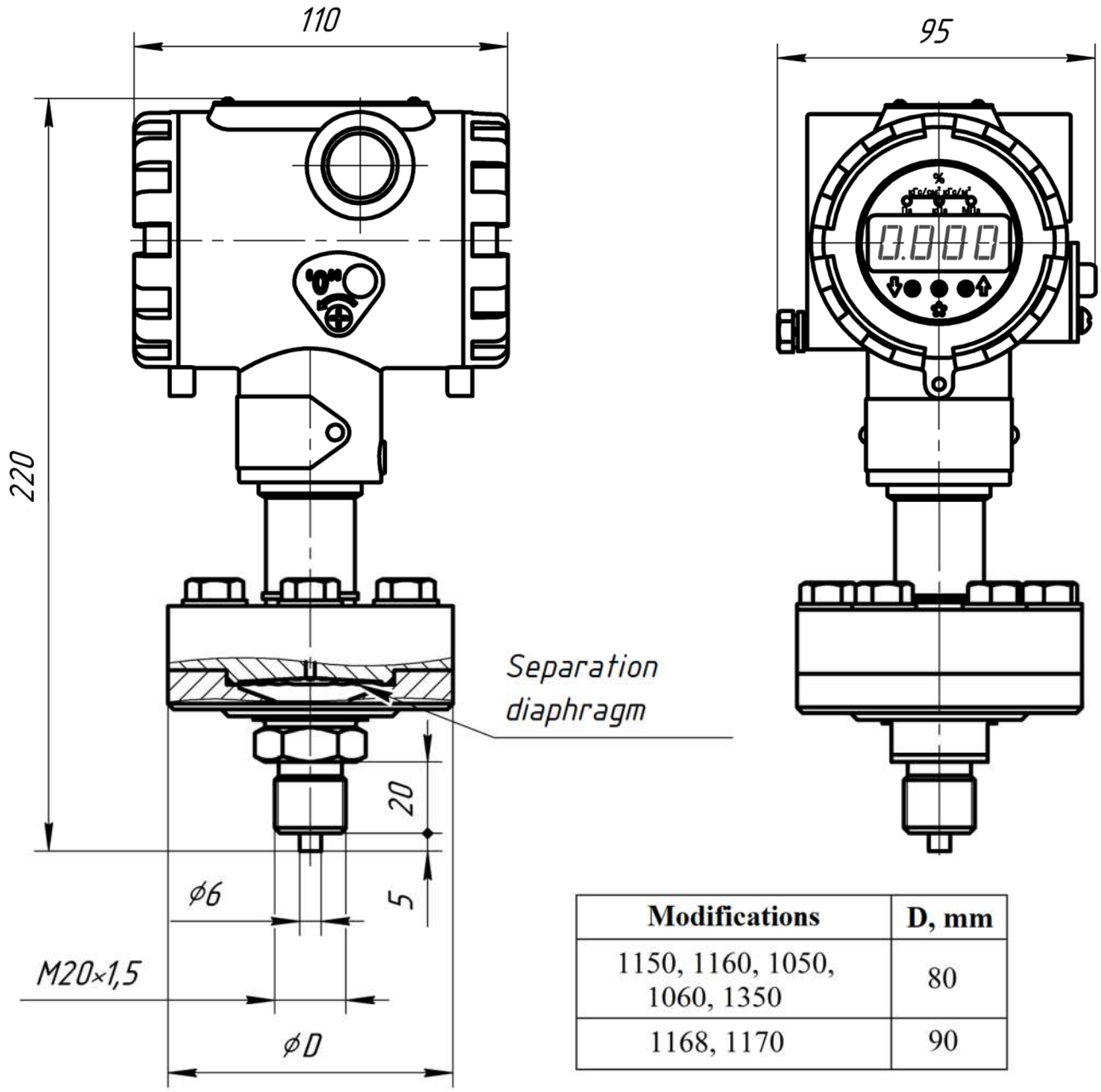


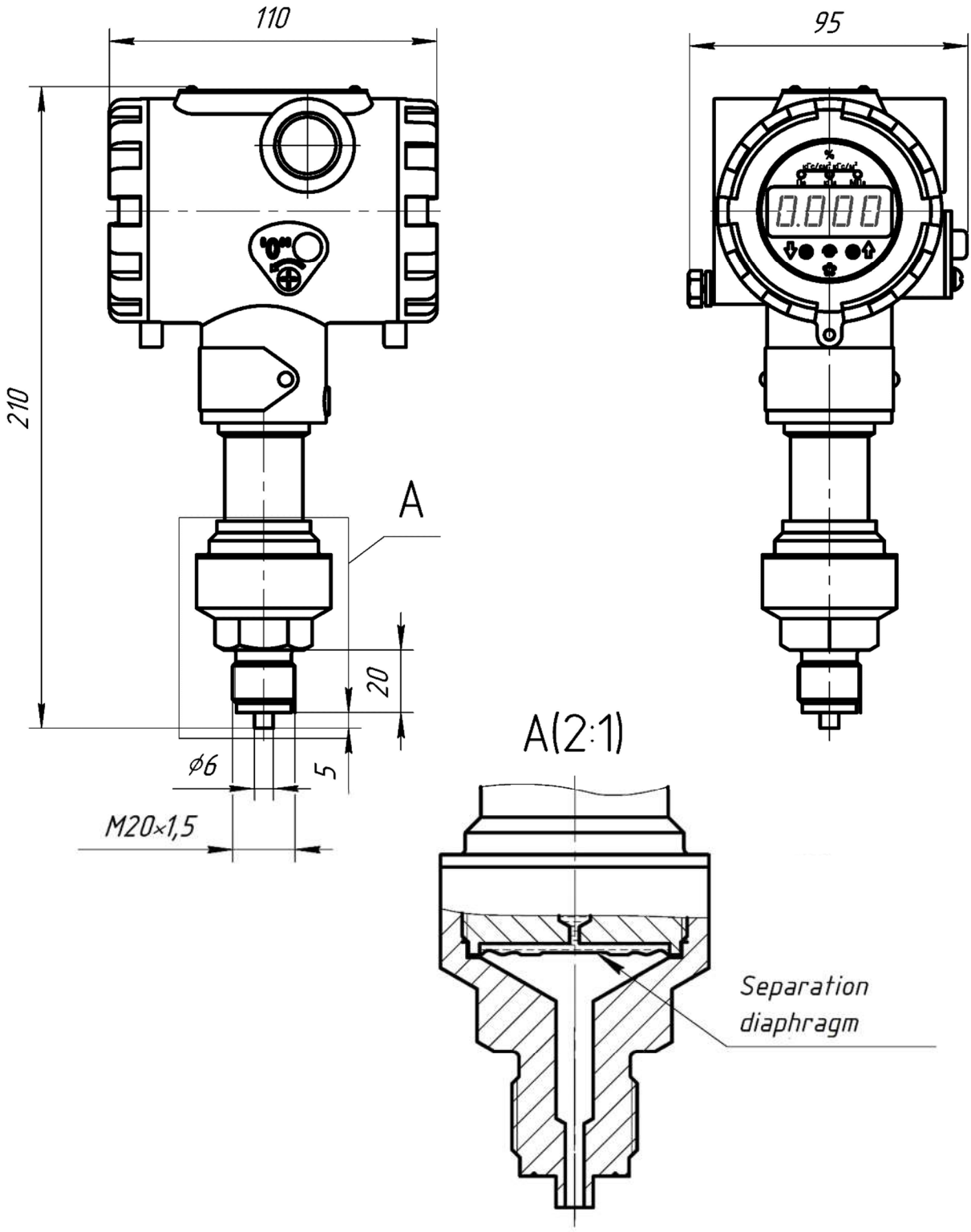
Figure A.4 – Agat-100MT-DI modifications 1141, 1151, 1161, 1167, 1171
Agat-100MT-DA modifications 1041, 1051, 1061
Agat-100MT-DIV modifications 1341, 1351



Modifications	D, mm
1150, 1160, 1050, 1060, 1350	80
1168, 1170	90

Construction of models with the separation diaphragm, collapsible.
Separation fluid – PMS-5.

Figure A.5 – Agat-100MT-DI modifications 1150, 1160, 1168, 1170
Agat-100MT-DA modifications 1050, 1060
Agat-100MT-DIV-1350



Construction of models with the separation diaphragm.
Separation fluid – PMS-5.

Figure A.6 – Agat-100MT-DI modifications 1142, 1152, 1162
Agat -100MT-DA modifications 1052, 1062
Agat-100MT-DIV - 1342, 1352

Appendix B
(compulsory)
Scheme of external electrical connections

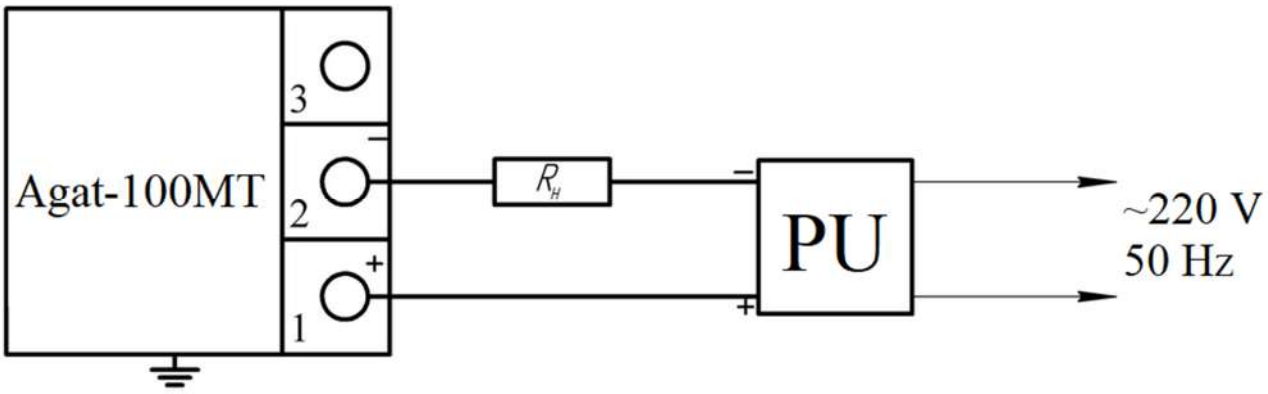
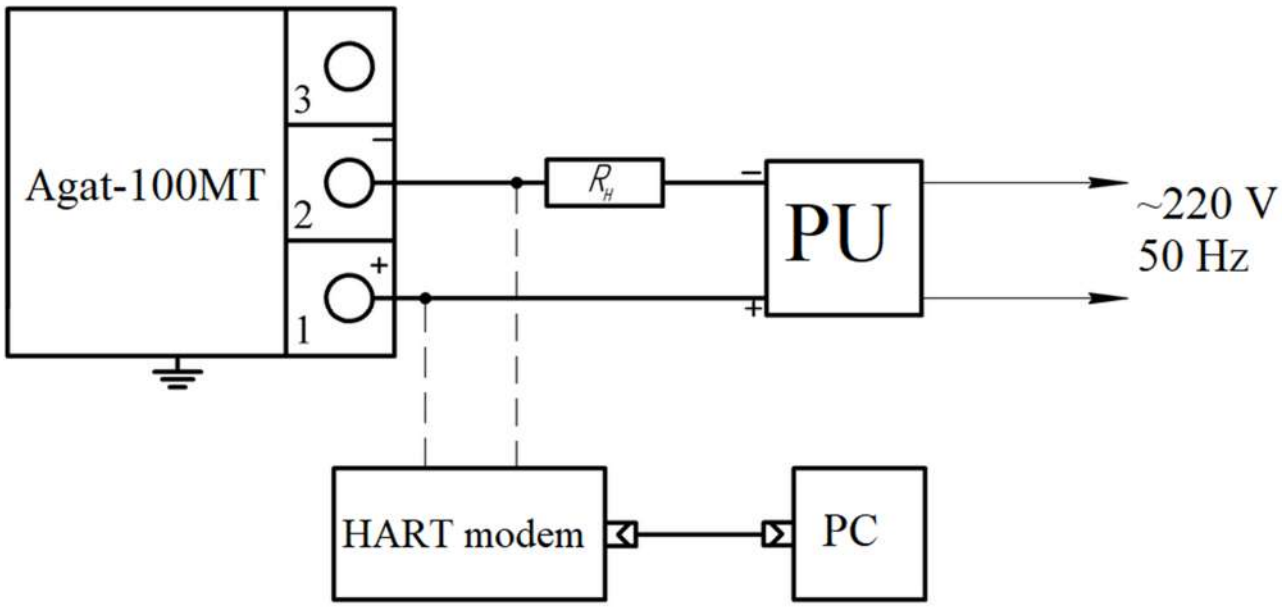
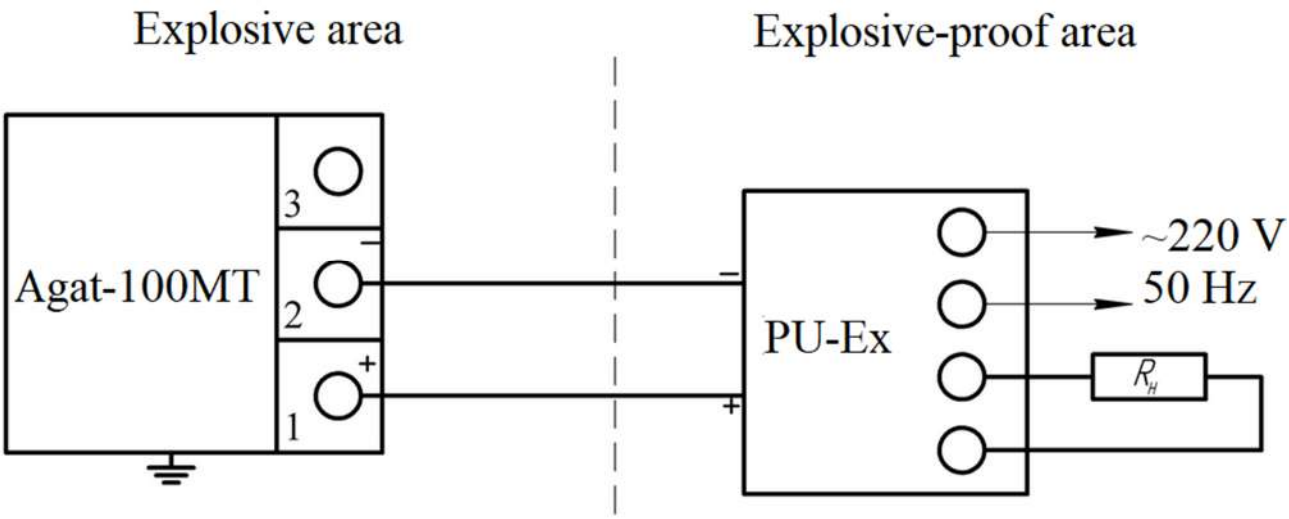


Figure B.1 – Output signal 4-20 mA (two wire connection)



Note – The signal circuit must have resistance
not less than 250 Ohms for communication.
PU – power unit
Rн – load resistance according to 1.2.16
PC - personal computer

Figure B.2 – Connecting transmitters with HART modem
on the two-wire connection



PU-Ex - intrinsically safe power unit according to 1.2.14

Figure B.3 – Connection diagram for Agat-100MT-Exi
with intrinsically safe power unit (PU-Ex)

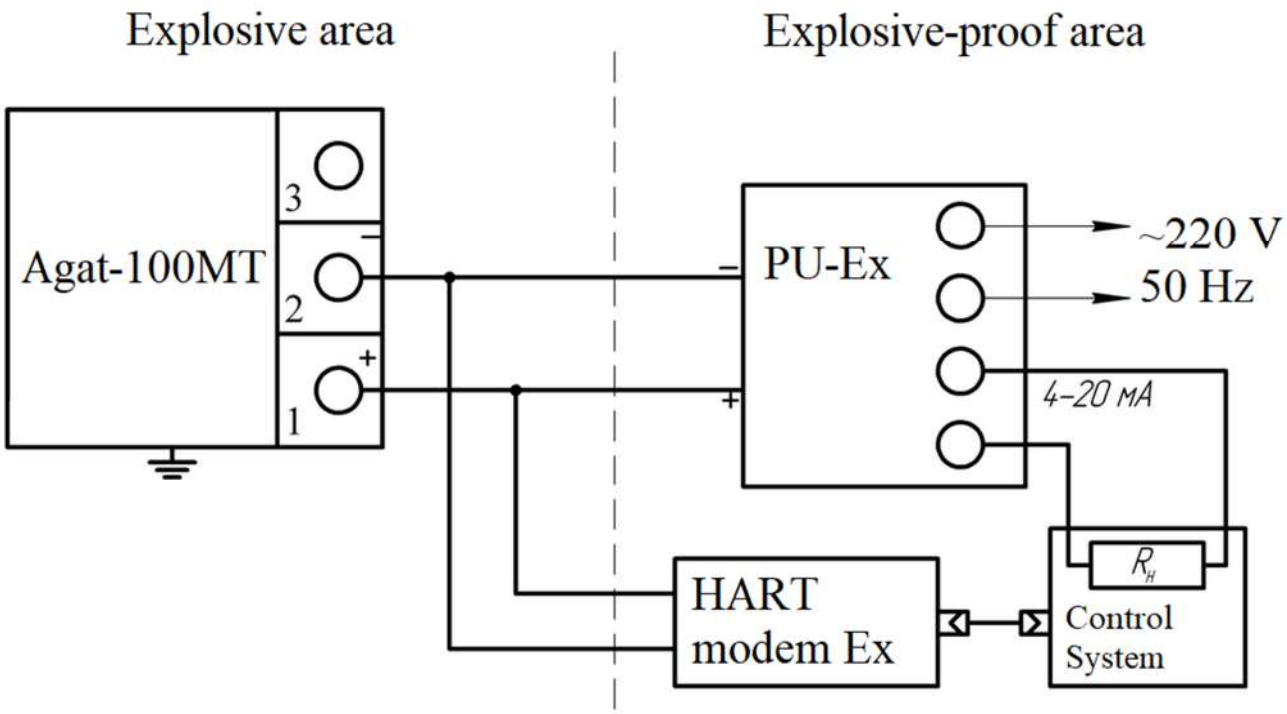
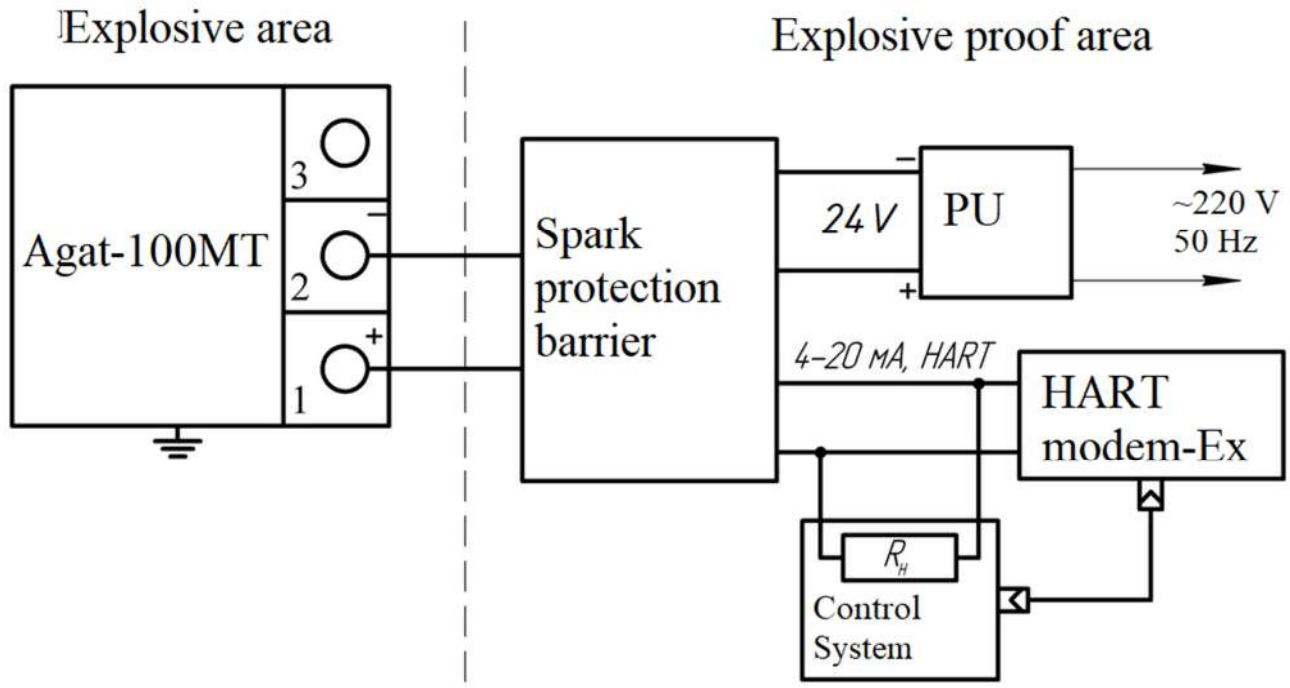


Figure B.4 – Connection diagram for Agat-100MT-Exi
with HART modem and intrinsically safe power unit



Note - Rн is the total resistance of all loads in the control system determined by the parameters of the barrier, but not less than 250 Ohms.

Figure B.5 – Transmitter with spark protection barrier, with galvanic decoupling of signal circuits and power circuits

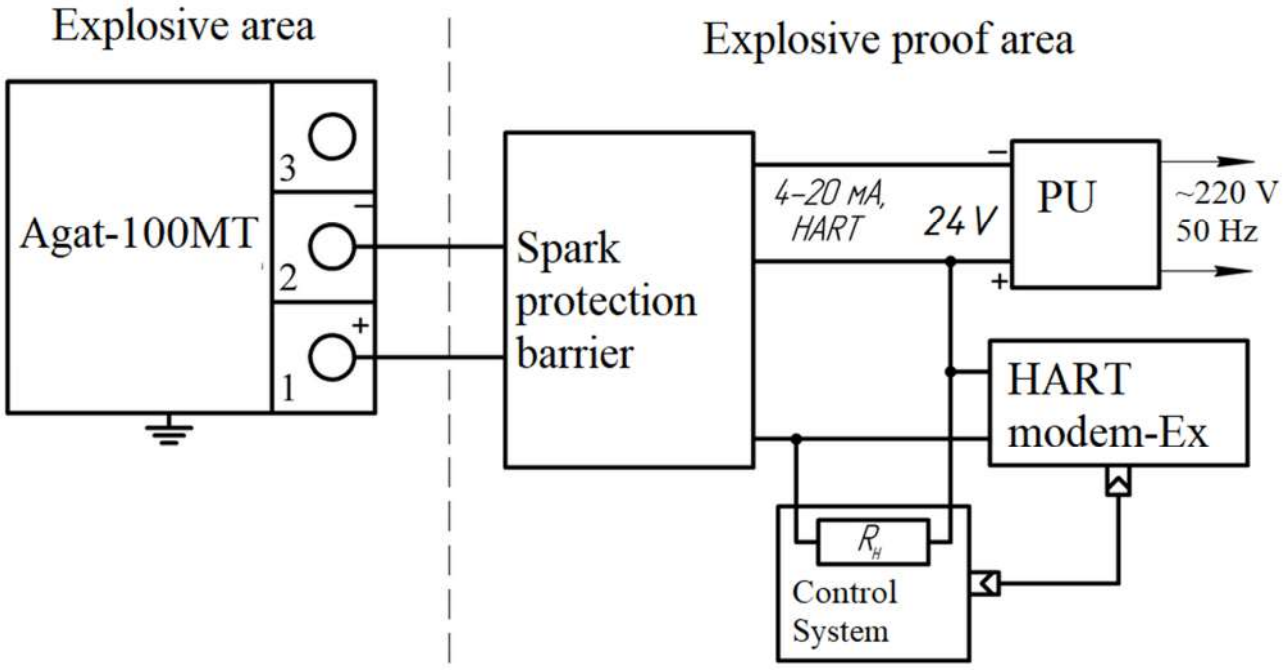


Figure B.6 – Transmitter with spark protection barrier, without galvanic decoupling of signal circuits and power circuits

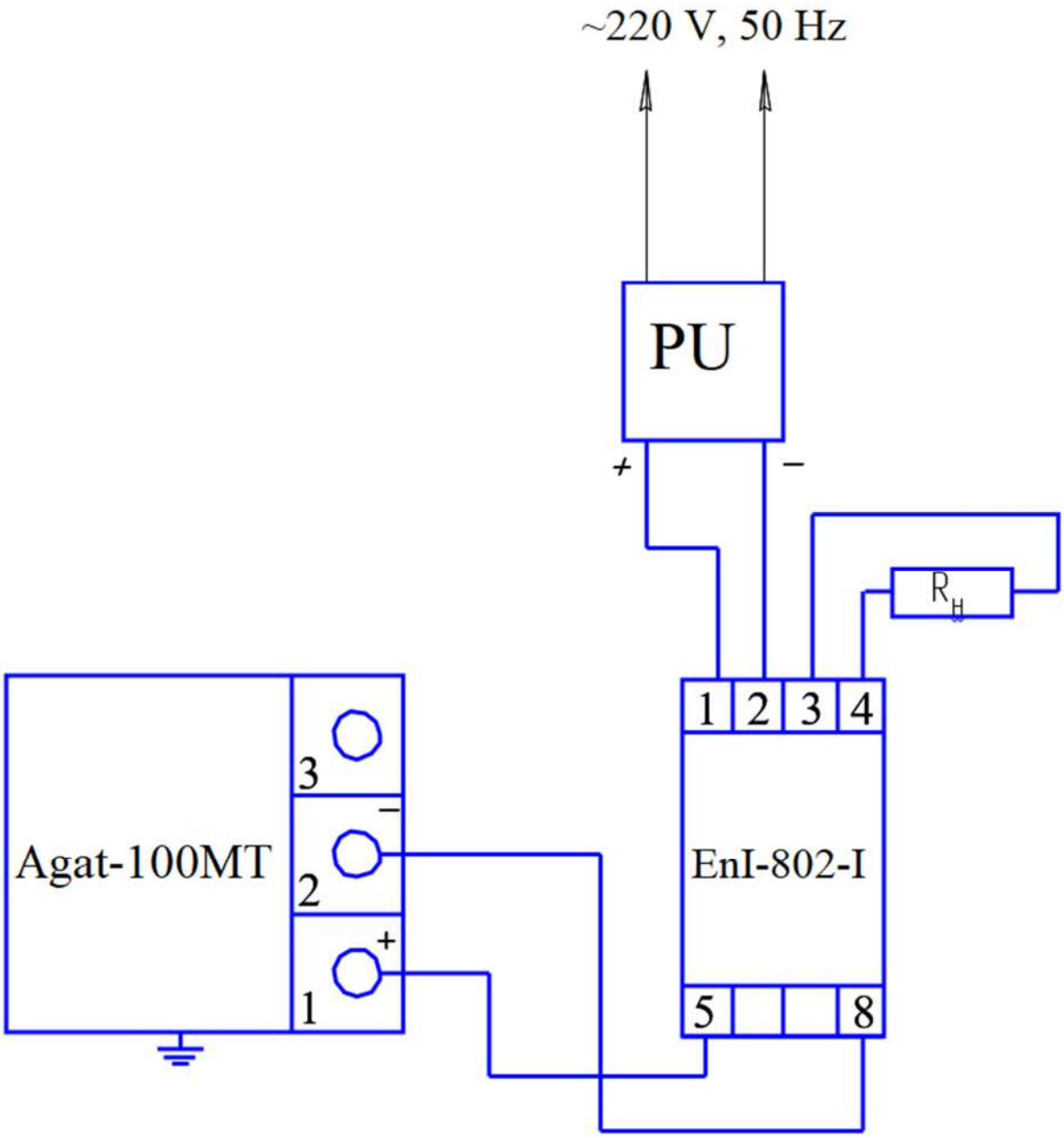


Figure B.7 – Agat-100MT transmitter with measuring transducer EnI-802-I

Appendix C

(recommended)

Cable lead-ins and socket connectors

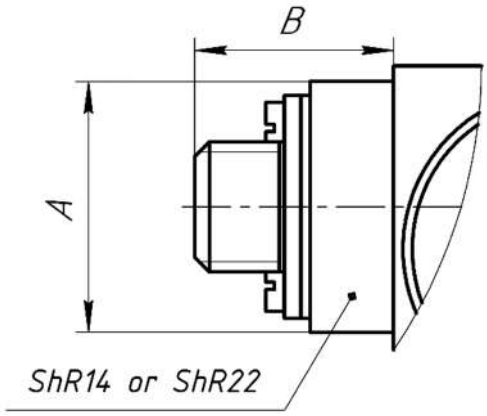
Code	Description
K01	Cable lead-in with M20x1.5 thread for unarmored cable 6.5-13.6 mm in diameter. Material - nickel plated brass.
K02	Cable lead-in with M20x1.5 thread for unarmored cable 6.5-13.6 mm in diameter. Material - stainless steel. Type of protection - ExdIIC.
K03	Cable lead-in with M20x1.5 thread, for unarmored cable with a diameter of 6.1-11.6 mm. Material - nickel plated brass. Type of protection - ExdIIC
K05[1)]	Cable lead-in with M20x1.5 thread, for armored cable with a diameter of 6.5-13.6 mm, diameter of armor 12.5-20.9 mm. Material - nickel plated brass. Type of protection - ExdIIC
K06[1)]	Cable lead-in with M20x1.5 thread, for armored cable with a diameter of 6.1-11.6 mm, diameter of armor 9.5-15.9 mm. Material - nickel plated brass. Type of protection - ExdIIC
K07	Cable lead-in with M20x1.5 thread, for unarmored cable with a diameter of 6.5-13.9 mm, in a metal hose type R3-TsH-20. Material - nickel plated brass. Type of protection - ExdIIC
K08	Cable lead-in with M20x1.5 thread, for unarmored cable with a diameter of 6.5-13.9 mm, in a metal hose type R3-TsH-15. Material - nickel plated brass. Type of protection - ExdIIC
Note - the degree of protection of cable lead-ins from exposure to dust and water corresponds to the group IP67 according to GOST 14254. [1)] Cable lead-in seals armored cable with different types of armor (mesh braid, single-row wire, aluminum or steel tape)	

Socket connectors

Code	Description
ShR14	Socket connector: plug 2RMT14B4Sh1V1BV GEO.364.140 TU (Socket 2RM14KPN4G1V1 GEO.364.126 TU)
ShR22	Socket connector: plug 2RMT22B4Sh3V1 GEO.364.140 TU (Socket 2RM22KPN4G3V1 GEO.364.126 TU) or plug 2RMT22B4Sh3V1V GEO.364.140 TU (Socket 2RM22KPN4G3V1V GEO.364.126 TU)
GSP	GSP connector DIN 43650 (plug - socket)

Notes:

1. The ShR14, ShR22 and GSP connectors are not used for explosion-proof sensors Agat-100M-Exd.
2. The degree of protection of socket connectors from dust and water corresponds to the group IP65 according to GOST 14254.



Code	A	B
ShR14	27	25
ShR22	32	28

Figure C.1 – Socket connector ShRxx

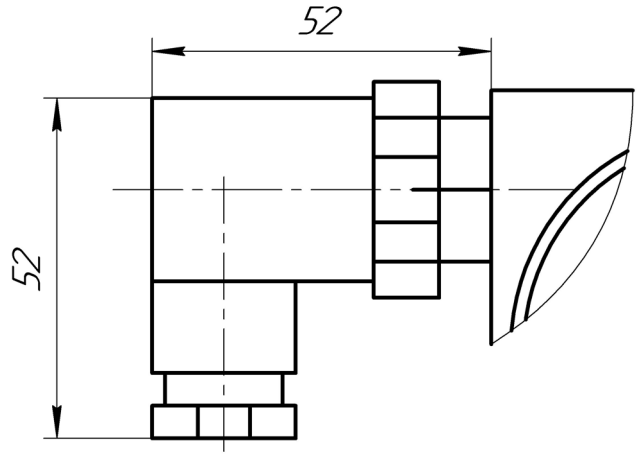


Figure C.2 – GSP connector

Appendix D

(recommended)

Mounting parts codes

Table D.1

Code	Mounting parts	Application (Mod. number)
1	2	3
M20	Mounting flange, nipple with coupling nut M20x1.5 Material – stainless steel.	1020, 1030, 1040, 1110, 1120, 1130, 1140, 1210, 1220, 1230, 1240, 1310, 1320, 1330, 1340, 1345, 1410, 1420, 1430, 1434, 1440, 1444, 1450, 1460
M20U	Mounting flange, nipple with coupling nut M20x1.5 Material - carbon steel.	
M20 (09G2S)	Mounting flange, nipple with coupling nut M20x1.5 Material – 09G2S steel.	
K1/2	Mounting flange with K1/2 female Material – stainless steel	
K1/4	Mounting flange with K1/4 female Material – stainless steel	
1/2NPT	Mounting flange with 1/2NPT female Material – stainless steel	
1/4NPT	Mounting flange with 1/4NPT female Material – stainless steel	
K1/2$_{nar}$	Mounting flange with K1/2 male Material – stainless steel	
K1/4$_{nar}$	Mounting flange with K1/4 male Material – stainless steel	
1/2NPT$_{nar}$	Mounting flange with 1/2NPT male Material – stainless steel	
1/4NPT$_{nar}$	Mounting flange with 1/4NPT male Material – stainless steel	

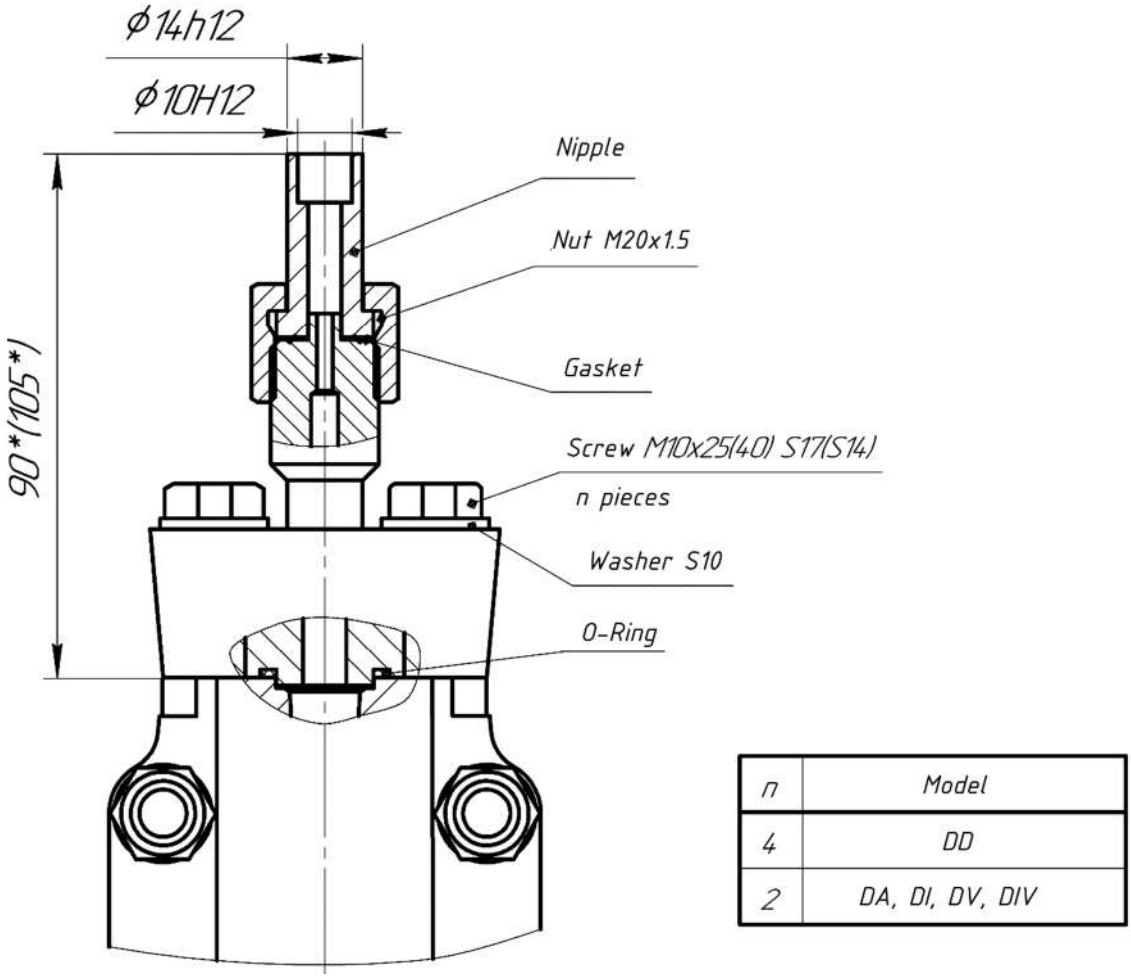
Table D.1 (continued)

1	2	3
M20	Nipple with coupling nut M20x1.5 Material - stainless steel.	1041, 1051, 1061, 1141, 1151, 1161, 1167, 1171, 1341, 1351, 1142, 1152, 1162, 1052, 1062, 1342, 1352, 1050, 1060, 1150, 1160, 1168, 1170, 1350
M20U	Nipple with coupling nut M20x1.5 Material - carbon steel.	
M20 (09G2S)	Nipple with coupling nut M20x1.5 Material - 09G2S steel.	
PR3	Adapter to K½ female	
PR4	Adapter to K¼ female	
PR7	Adapter to ¼NPT male	
PR8	Adapter to ½NPT male	
PR9	Adapter to ¼NPT female	
PR10	Adapter to ½NPT female	
PR11	Adapter to K¼ male	
PR12	Adapter to K½ male	
PR20	Adapter to G½ male	

Codes of brackets

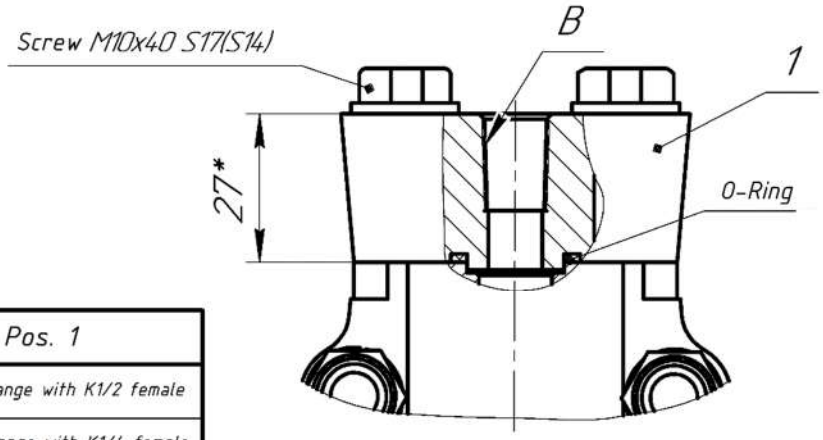
Table D.2

Code	Mounting brackets	Application (Mod. number)
SK	Clamp, transmitter mounting bracket for 50 mm diameter pipe and panel	All



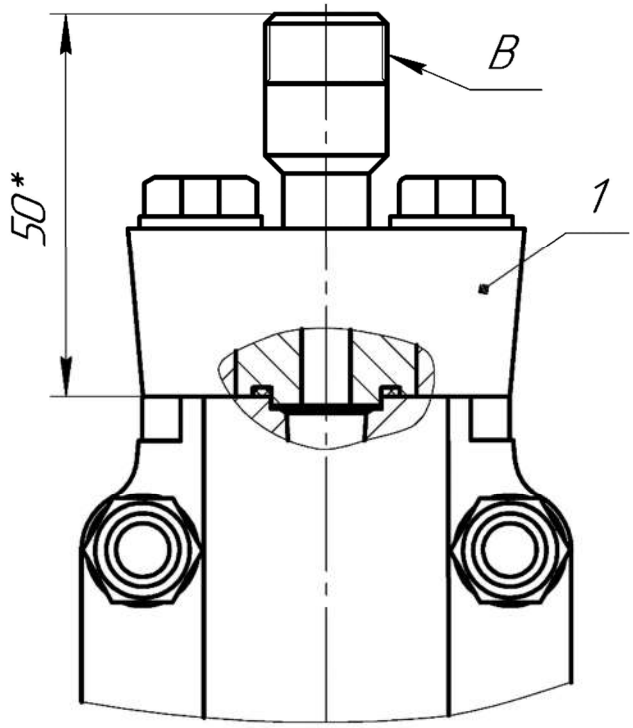
n	Model
4	DD
2	DA, DI, DV, DIV

Figure D.1 – Mounting parts «M20» for modifications of transmitters according to fig. A.1, A.2



B	Pos. 1
K1/2	Mounting flange with K1/2 female
K1/4	Mounting flange with K1/4 female
1/2NPT	Mounting flange with 1/2NPT female
1/4NPT	Mounting flange with 1/4NPT female

Figure D.2 – Mounting parts «K1/2», «K1/4», «1/2NPT», «1/4NPT» for modifications of transmitters according to fig. A.1, A.2. The rest is in figure D.1



B	Pos. 1
K1/2	Mounting flange with K1/2 male
K1/4	Mounting flange with K1/4 male
1/2NPT	Mounting flange with 1/2NPT male
1/4NPT	Mounting flange with 1/4NPT male

Figure D.3 – Mounting parts «K1/2$_{nar}$», «K1/4$_{nar}$», «1/2NPT$_{nar}$», «1/4NPT$_{nar}$» for modifications of transmitters according to fig. A.1, A.2. The rest is in figure D.1

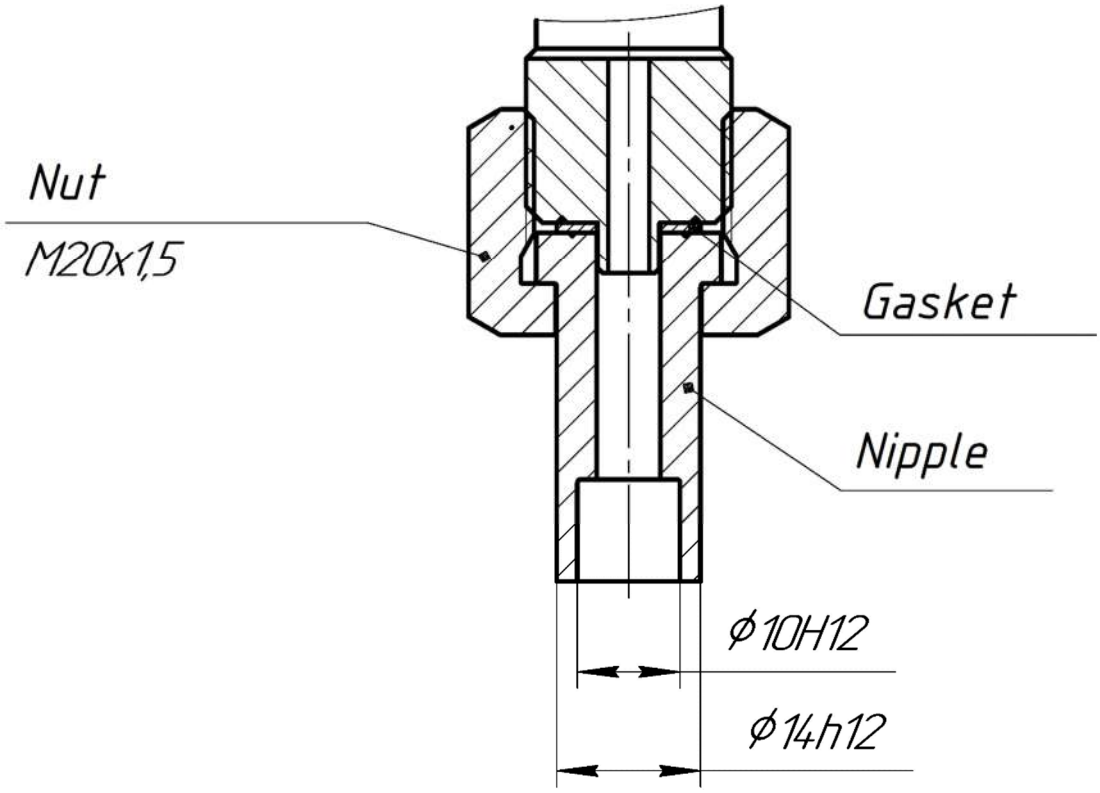
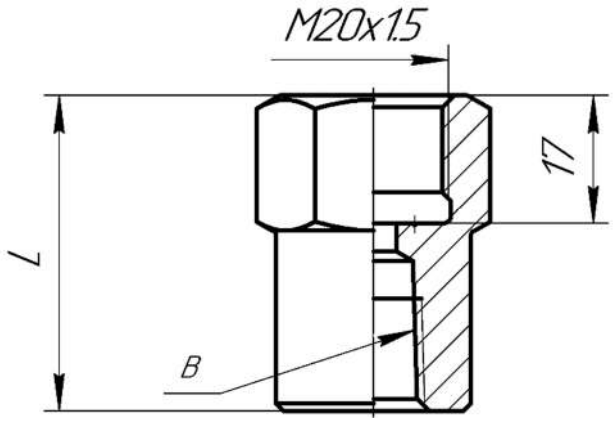
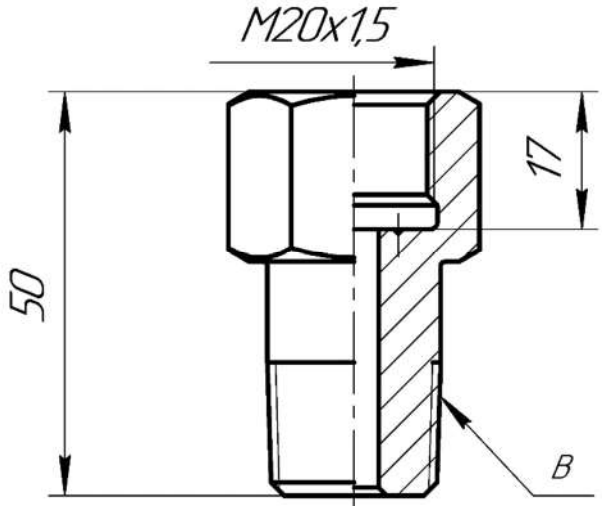


Figure D.4 – Mounting parts «M20» for modifications of transmitters according to fig. A.4, A.5, A.6



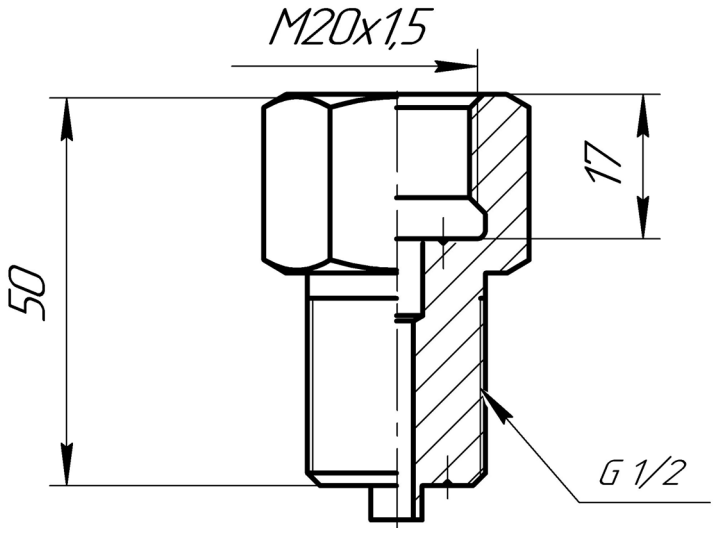
Code	B	L
PR3	K1/2	50
PR4	K1/4	42
PR9	1/4NPT	42
PR10	1/2NPT	50

Female adapter



Code	B
PR7	1/4NPT
PR8	1/2NPT
PR11	K1/4
PR12	K1/2

Male adapter



Adapter to G1/2 male (PR20)

Figure D.5 – Adapters for modifications of transmitters according to fig. A. 4, A. 5, A. 6

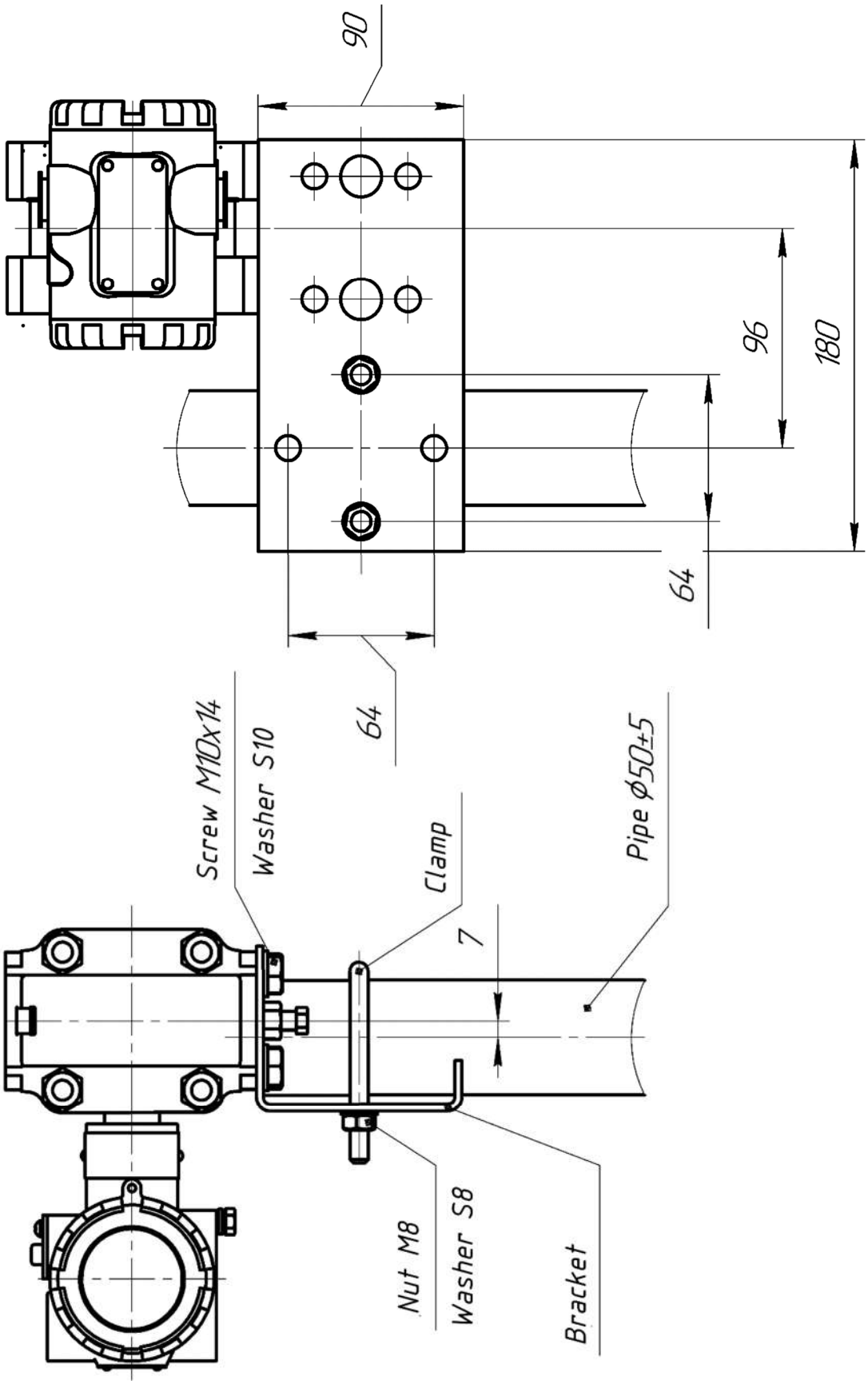


Figure D.6 – Mounting bracket «SK» for modifications
of transmitters according to fig. A.1, A.2

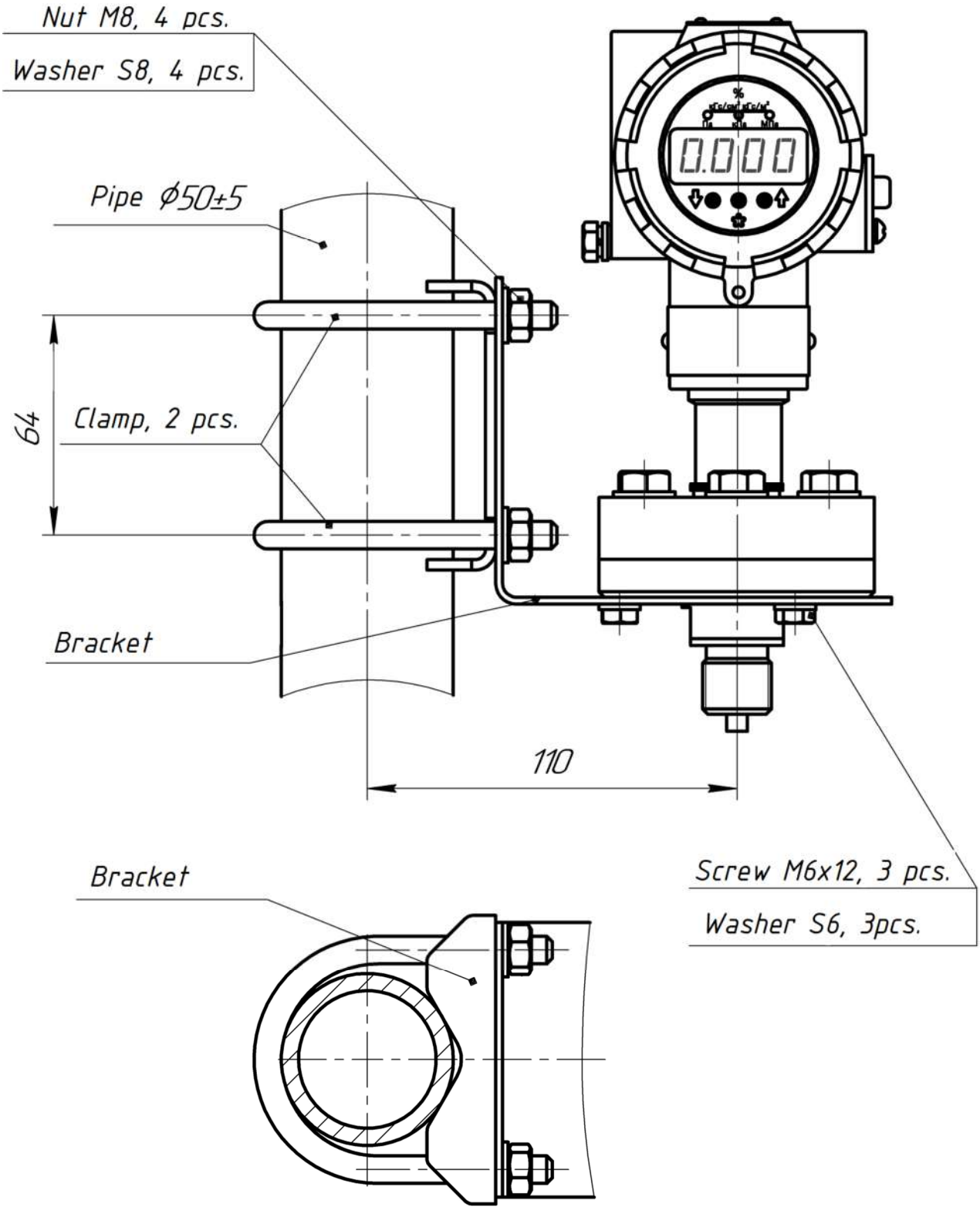


Figure D.7 – Mounting bracket «SK» for modifications
of transmitters according to fig. A.5

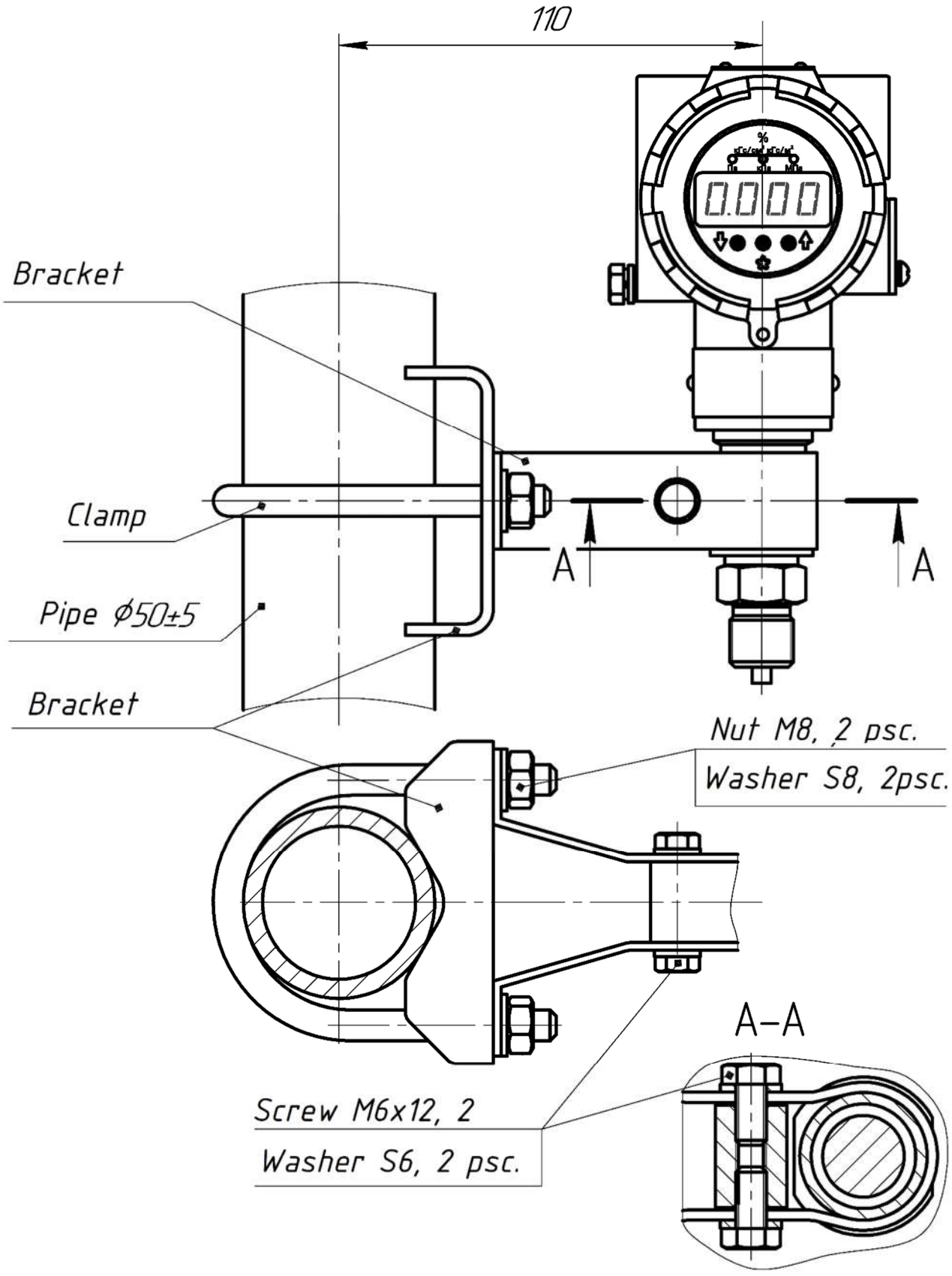


Figure D.8 – Mounting bracket «SK» for modifications
of transmitters according to fig. A.4, A.6

Appendix E (compulsory)
Drawing of explosion protection for Agat-100MT-Exd

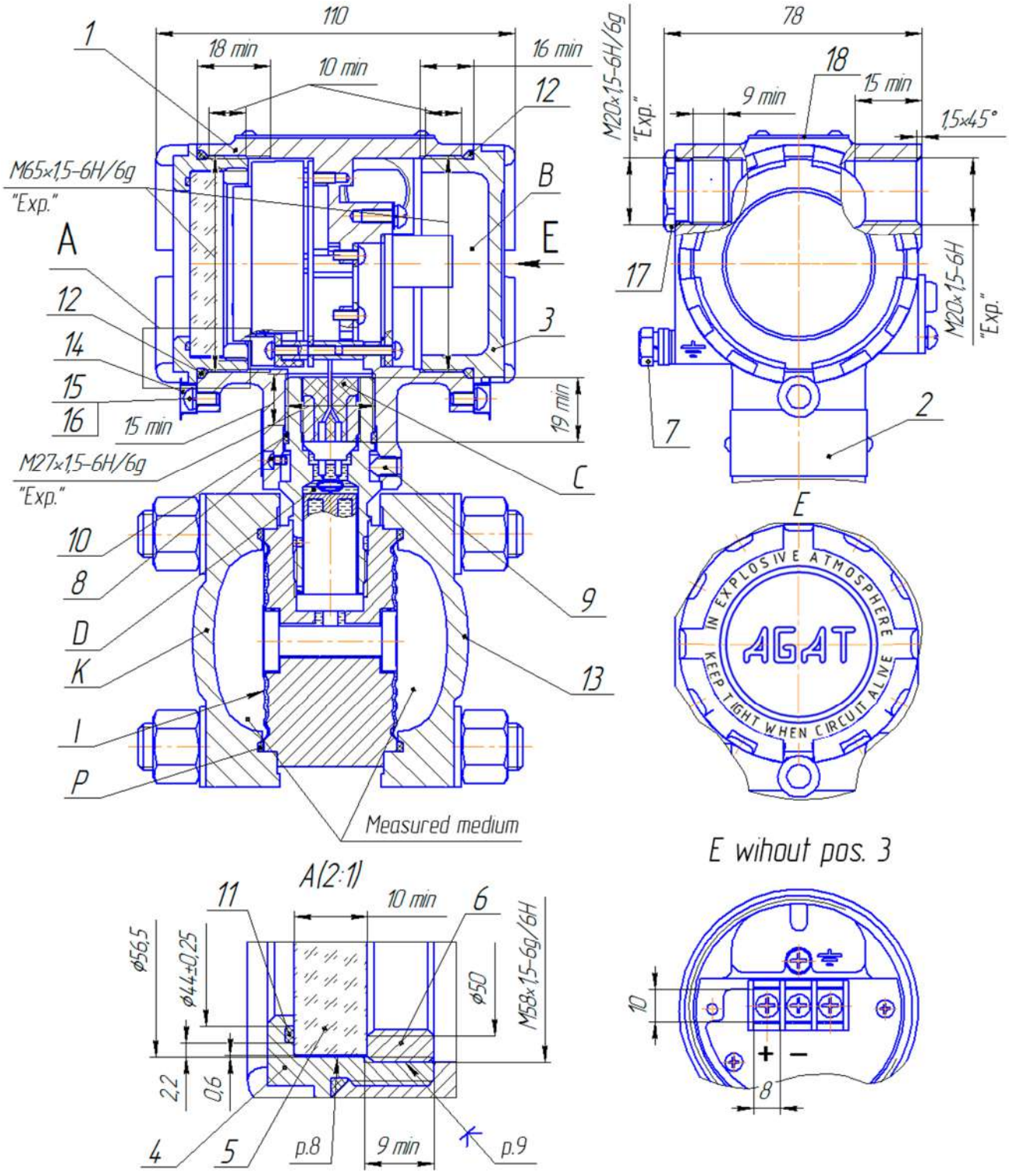


Figure E.1 – For transmitters
with build-in digital indicator

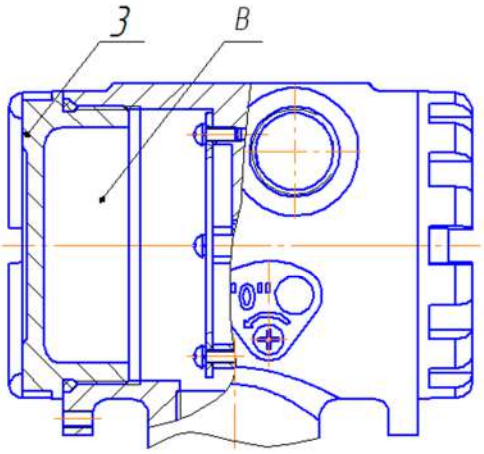


Figure E.2 – For transmitters without digital indicator. The rest see fig. E.1

Pos.	Name	Designation
1	Case	EK-0010B
2	Nameplate	AGST.300.000.06
3	Cover	EK-0011A
4	Cover	EK-0012
5	Disk	AGST.100.110.02
6	Ring	EK-0013
7	Bolt	M6x12.A2 DIN 933
8	Screw	M2,5-6g×4.48.016 GOST 17473
9	Screw	M6-6g×8.21 GOST 8878
10	Ring	024-028-25-2-3 GOST 9833/GOST 18829
11	Ring	048-052-19-2-3 GOST 9833/GOST 18829
12	Ring	063-068-30-2-3 GOST 9833/GOST 18829
13	Pressure Transmitter	TU 4212-002-59541470-2009
14	Staple	AGST.100.000.08
15	Screw	M4×8 GOST 28963, 2 pcs.
16	Washer	4.A2 DIN 7980
17	Cap	M20×1,5-AOS.217.901-02 with sealing ring AOS.217.902 AOS.217.000 TU
18	Nameplate	AGST.300.000.02

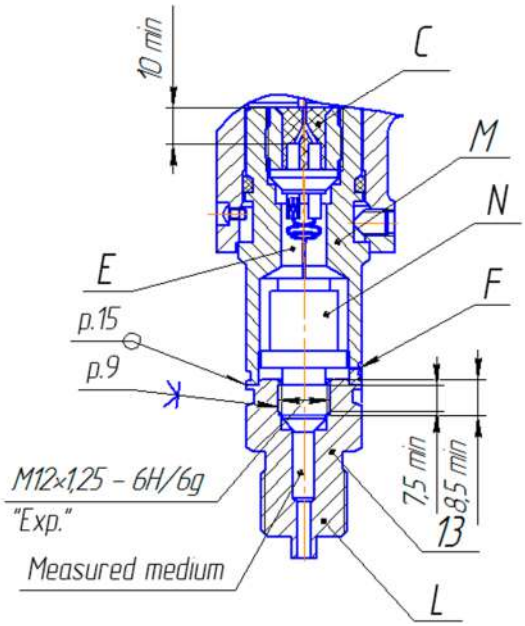


Figure E.3 – For modifications of absolute pressure transmitters with an upper measurement limit of more than 600 kPa. The rest see fig. E.1

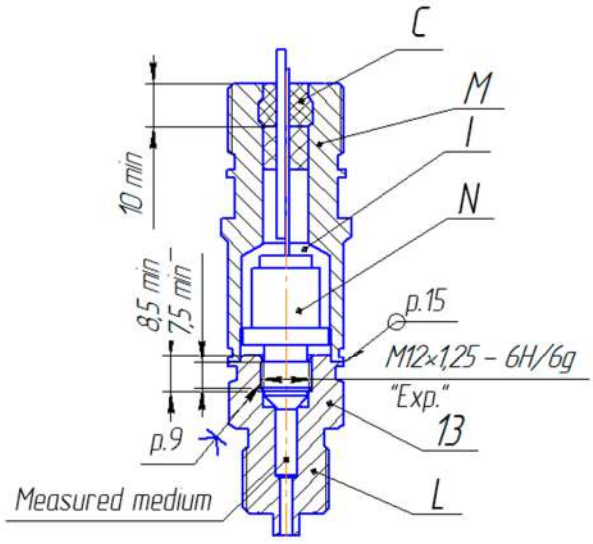


Figure E.4 - For modifications of gauge pressure transmitters with an upper measurement limit of more than 600 kPa. The rest see fig. E.1

1 Case material pos. 1 and cover material pos. 3 and pos. 4 - Alloy ADC-12 JIS H 5302-2000. Corrosion protection of explosion-proof surfaces - powder coating, transparent - RAL 7035, coating thickness - 0.1...0.2 mm.

2 The free volume of the flameproof enclosure in cavity B is 200 cm.

3 The wall thickness of the case in the thinnest places, blind holes - at least 3 mm.

4. Hydraulic tests: the prescribed test pressure equal to 1.5 times the pressure of the explosion - 1.3 MPa during the time required for inspection, but not less than 10 seconds. The strength of the explosion-proof enclosure is confirmed by a single test of prototypes with a pressure equal to four times the pressure of the explosion.

5 On the surfaces marked "Exp." nicks, cracks and other defects are not allowed.

6 Threaded connections must have at least 5 complete, undamaged, continuous thread threads in engagement.

7 Threaded flameproof joints will counteract:

- covers pos. 3. and pos. 4 with the case pos. 1 - cup pos. 14 (2 pcs.), Screw pos. 15 (2 pcs.);

- housing pos. 1 with pressure transmitter pos. 13 - screw pos.9.

8 The gap "A" between the disk pos.5 and the cover pos.4 and the cavity C of the pressure transmitter pos. 13 are filled with Vixint K-68 compound TU38.103508-81, it is operational in the temperature range from minus 70 to 250 ° C.

9 Anaerobic sealant UNIGERM-9 TU 2257 - 516 - 00208947 - 2009 is applied to the threaded surface. It is efficient from minus 60 to 150 ° C.

10 Cavity D of the pressure transmitter pos. 13 filled with PMS-6 polymethylsiloxane fluid GOST13032-77.

11 Cavity E (Fig. E.3) is evacuated after installing a pressure seal through hole F and welded by electron beam welding. The volume of the cavity E is 6 cm.

12 Cavity I (Fig. E.4) of the pressure transmitter pos. 13 is filled with air at atmospheric pressure. The volume of the cavity I is 6 cm.

13 The material of the rings pos. 10, 11, 12 - group 3 rubber according to GOST 18829.

14 Ex marking is printed on the plate pos. 2. The name of the manufacturer, the serial number, the designation of the transmitter and other additional information is printed on the plate pos. 18.

15. Argon-arc welding by fusion of edges according to GOST 14771-76.

16 Grounding terminal pos. 7 made of stainless steel.

17 Materials of pressure transmitter parts pos. 13: membrane I (Fig. E.1) - alloy 36NiCrTiAl GOST 10994, housing and strain gauge membrane N (Fig. D.3, D.4) - titanium VT9 GOST 19807, parts K, L, M - steel 12Cr18Ni10Ti GOST5632, O-ring P - group 3 rubber according to GOST 18829.

Appendix F

(compulsory)

List of HART Protocol commands

F.1 **Command #0** - Read unique identifier.

Returns the extended device type code, version, identification number. This command is executed by devices using both short and long frame formats. The device type code is always returned in extended three-byte format (“254”, manufacturer ID, manufacturer device type code).

DATA IN COMMAND

NONE

DATA IN REPLY

Byte 0	"254"(expansion)
Byte 1	manufacturer identification code (8)
Byte 2	manufacturer's device type code (8)
Byte 3	number of preambles required (8)
Byte 4	universal command revision (8)
Byte 5	device-specific command revision (8)
Byte 6	software revision (8)
Byte 7	hardware revision (8)
Byte 8	device ID number (8)
Byte 9-11	device function flags (8)

RESPONSE CODES

0	No Command Specific Error
6	Transmitter specific command error
16	Access restricted

F.2 **Command #1** - Read primary variable.

DATA IN COMMAND

NONE

DATA IN REPLY

Byte 0	PV units code (8); see table F.1
Byte 1-4	primary variable, IEEE 754 (jun. byte 1, sen. byte 4)

RESPONSE CODES

0	No Command Specific Error
6	Transmitter specific command error
8	Warning: update failed
16	Access restricted

F.3 **Command #2** - Read current and percent of range.

Reading the primary variable as current and percentage of the PV range always corresponds to the output current of the device, including alarm conditions and set values. The percentage of the range is not limited to values between 0% and 100%, but it is also tracked beyond the boundaries of the PV range to the boundaries of the sensor range (if defined).

DATA IN COMMAND
NONE
DATA IN REPLY
Byte 0-3 Current PV (IEEE754), mA
Byte 4-7 Percent of range PV (IEEE 754), %
RESPONSE CODES
0 No Command Specific Error
6 Transmitter specific command error
8 Warning: update failed
16 Access restricted

F.4 **Command #3** - Read current and four (predefined) dynamic variables.

The primary variable corresponds to the pressure in the established units.

DATA IN COMMAND
NONE
DATA IN REPLY
Byte 0-3 current, (F), mA
Byte 4 PV units code (8);
see table F.1
Byte 5–8 primary variable (IEEE754)
RESPONSE CODES
0 No Command Specific Error
6 Transmitter specific command error
8 Warning: update failed
16 Access restricted

F.5 **Command #6 -** Write polling address.

This command writes the polling address to the field device. The address is used to control the Primary variable using an analog signal and provides the ability to identify the device in multi-drop mode.

The primary variable provides information about the ongoing process using an analog signal only when the polling address of the device is set to zero. When an address is assigned from 1 to 15, the analog output is inactive and is not suitable for determining process parameters. When the analog output is inactive, the analog output is set to minimum; bit 3 (“Analog output is fixed”) is set in the Status of the device, and the warning “Out of range” is not available. If the polled address is changed back to 0, the primary variable for the analog output can again be used to analyze the process.

DATA IN COMMAND

Byte 0	Polling address (8)	
	0	Analog output active
	1–15	Analog output inactive
	16–255	Invalid

DATA IN REPLY

Byte 0	Polling address (8)	
	0	Analog output active
	1–15	Analog output inactive
	16–255	Invalid

RESPONSE CODES

0	No Command Specific Error
6	Transmitter specific command error
8	Warning: update failed
16	Access restricted

F.6 **Command #11 -** Read unique identifier associated with tag.

This command returns the extended device type code, version and device identification number including the device tag. This can be done when either the extended or broadcast addresses are received. The extended address in the response is identical to the address received in the request.

This command is unique in the sense that there is no response until there is full correspondence between the request tag and the device tag. Device type code returned in response data bytes always has an extended three-byte format. ("254", manufacturer ID, device code assigned by the manufacturer).

DATA IN COMMAND
Byte 0-5 Tag, (A)
DATA IN REPLY
Byte 0 "254" (expansion) (8)
Byte 1 ID производителя (8)
Byte 2 Manufacturer identification code (8)
Byte 3 Number of preambles required (8)
Byte 4 Universal command revision (8)
Byte 5 Device-specific command revision
Byte 6 Software revision (8)
Byte 7 Hardware revision (8) in format xxxx.yyyy
x — hardware edition, 5-bit unsigned integer
y — physical implementation of the signal code, 3-bit unsigned integer; see table F.6
Byte 8 Device function flags (8) ; see table F.6
Byte 9 Device ID number (24)
RESPONSE CODES
0 No Command Specific Error
5 Too little data received
6 Transmitter specific command error
16 Access restricted

F.7 **Command #12** - Read message.

Read the message contained in the device.

DATA IN COMMAND
NONE
DATA IN REPLY
Byte 0-23 Message (A)
RESPONSE CODES
0 No Command Specific Error
6 Transmitter specific command error
16 Access restricted

F.8 **Command #13** - Read tag, descriptor, date.

DATA IN COMMAND
NONE
DATA IN REPLY
Byte 0–5 Tag (A)
Byte 6–17 Descriptor ((A)
Byte 18–20 Date (D), respectively day, month, year - 1900

RESPONSE CODES

0	No Command Specific Error
6	Transmitter specific command error
16	Access restricted

F.9 **Command #14** - Read PV sensor information.

Reads the Serial Number of the Primary Variable Sensor, Primary Variable Sensor Limits, Units, Upper, Lower Sensor Limits.

DATA IN COMMAND

NONE

DATA IN REPLY

Byte 0–2	Sensor serial number (24)
Byte 3	Units code for sensor limits & min. span (8)
Byte 4–7	Upper sensor limit (F)
Byte 8–11	Lower sensor limit (F)
Byte 12–15	Minimum span (F)

RESPONSE CODES

0	No Command Specific Error
6	Transmitter specific command error
16	Access restricted

When the Serial Number of the sensor is not used to identify the instrument or Primary Variable, it must be set to "0". Other parameters, when not in use, should be set to 7F A0 00 00, “not a number”, or “250”, “not used”.

F.10 **Command #15** - Read output information.

This command reads the selective warning code of the primary variable, the transfer function code, units of measurement, the upper and lower ranges of the primary variable, the damping value of the primary variable, the write protection code, the individual distributor label code associated with the device or Primary variable.

Damping is used for both analog and digital output.

DATA IN COMMAND

NONE

DATA IN REPLY

Byte 0	Alarm select code (see table F.2)
Byte 1	Transfer function code (see table F.3)
Byte 2	PV/range units code (see table F.1)
Byte 3–6	Upper range value (F)

Byte 7–10 Lower range value (F)
Byte 11–14 Damping value (seconds) (F)
Byte 15 Write-protect code (see table F.4)
Byte 16 Private-label distributor code

RESPONSE CODES
0 No Command Specific Error
6 Transmitter specific command error
16 Access restricted

Note - The default write protection code is "251" - No, (or "250" - "Not Used"). The default individual distributor label is the manufacturer ID (or "250", "not used").

F.11 **Command #16** - Read final assembly number.

DATA IN COMMAND
NONE
DATA IN REPLY
Byte 0–2 Final assembly number (24)
RESPONSE CODES
0 No Command Specific Error
6 Transmitter specific command error
16 Access restricted

F.12 **Command #17** - Write message.

DATA IN COMMAND
Byte 0–23 Message (A)
DATA IN REPLY
Byte 0–23 Message (A)
RESPONSE CODES
0 No Command Specific Error
5 Too little data received
6 Transmitter specific command error
7 The device is in write protection mode
16 Access restricted

F.13 **Command #18** - Write tag, descriptor, date.

DATA IN COMMAND
Byte 0-5 Tag (A)
Byte 6-17 Descriptor (A)
Byte 18-20 Date (D), respectively day, month, year – 1900

DATA IN REPLY

Byte 0-5 Tag (A)
Byte 6-17 Descriptor (A)
Byte 18-20 Date (D), respectively day, month, year – 1900

RESPONSE CODES

0 No Command Specific Error
5 Too little data received
6 Transmitter specific command error
7 The device is in write protection mode
16 Access restricted

F.14 **Command #19** - Write final assembly number.

DATA IN COMMAND

Byte 0–2 Final assembly number (24)

DATA IN REPLY

Byte 0–2 Final assembly number (24)

RESPONSE CODES

0 No Command Specific Error
5 Too little data received
6 Transmitter specific command error
7 The device is in write protection mode
16 Access restricted

F.15 **Command #33** - Read transmitter variables.

Selected device variables are read. Each slot will accept any sensor variable code defined by the device. This operation is available in exclusive mode.

DATA IN COMMAND

Byte 0 Transmitter var. code for slot #0 (8); (see table F.1)
Byte 1 Transmitter var. code for slot #1 (8); (see table F.1)
Byte 2 Transmitter var. code for slot #2 (8); (see table F.1)
Byte 3 Transmitter var. code for slot #3 (8); (see table F.1)

DATA IN REPLY

Byte 0 Transm. variable code for slot #0 (8); (see table F.1)
Byte 1 Units code for slot #0 (8); (see table F.1)
Byte 2–5 Variable for slot #0 (F)
Byte 6 Transm. variable code for slot #1 (8); (see table F.1)
Byte 7 Units code for slot #1 (8); (see table F.1)
Byte 8–11 Variable for slot #1 (F)

Byte 12 Transm. variable code for slot #2 (8); (see table F.1)
Byte 13 Units code for slot #2 (8); (see table F.1)
Byte 14–17 Variable for slot #2 (F)
Byte 18 Transm. variable code for slot #3 (8); (see table F.1)
Byte 19 Units code for slot #3 (8); (see table F.1)
Byte 20–23 Variable for slot #3 (F)

RESPONSE CODES

0 No Command Specific Error
2 Wrong choice
5 Too little data received
6 Transmitter specific command error
8 Warning: no data update occurred
16 Access restricted

F.16 **Command #34** - Write damping value.

The damping value of the primary variable is a temporary constant. (The response of the output signal to the input value is 63% of the steady-state value after this time has passed). Both the analog and digital outputs of the primary variable use this value. Damping applied to these signals can also be done by other commands.

Some devices provide only discrete damping values (e.g. 1, 2, 4). The device can round the value received with the command. The response will contain the actual value used by the device. If the damping value is rounded, the device warns about it.

DATA IN COMMAND

Byte 0–3 Damping value (F), sec.

DATA IN REPLY

Byte 0–3 Damping value (F), sec.

RESPONSE CODES

0 No Command Specific Error
3 Sent parameter too large
4 Sent parameter too small
5 Too little data received
6 Sensor specific command error
7 The device is in write protection mode
8 Warning: the value closest to this value is set
16 Access restricted

F.17 **Command #35** - Write range values.

The upper limit of the range of the primary variable is independent of the lower.

The units of the primary variable range sent with this command do not affect the units of measurement of the PV device. The boundaries of the application range of the primary variable will be returned in the same units that were sent.

Most devices allow the upper end of the PV range to be lower than the lower, allowing the device to operate in inverse mode.

DATA IN COMMAND

Byte 0	Range units code (8); (see table F.1)
Byte 1–4	Upper range value (F)
Byte 5–8	Lower range value (F)

DATA IN REPLY

Byte 0	Range units code (8); (see table F.1)
Byte 1–4	Upper range value (F)
Byte 5–8	Lower range value (F)

RESPONSE CODES

0	No team related errors
2	Wrong choice
5	Too little data received
6	Sensor specific command error
7	The device is in write protection mode
9	The low end of the range is too high.
10	Bottom of range too small
11	The upper limit of the range is too high.
12	The upper limit of the range is too small.
13	Values of upper and lower limits out of range
14	Range is too small
16	Access restricted

F.18 **Command #36** - Set upper range value.

Changing the upper limit of the PV range does not affect the lower limit of the PV range. This command performs the same function as pressing the “Range” button on the device.

Most devices allow the upper end of the PV range to be lower than the lower, allowing the device to operate in inverse mode.

DATA IN COMMAND
NONE
DATA IN REPLY
NONE
RESPONSE CODES

0	No team related errors
6	Sensor specific command error
7	The device is in write protection mode
9	The applied parameter is too high.
10	Applicable parameter is too small
14	Range is too small
16	Access restricted

F.19 **Command #37** - Set lower range value.

This command performs the same function as pressing the “Zero” button on the device. Changing the lower end of the range proportionally shifts the upper end of the PV range so that the range remains constant. If, with such a change, the upper boundary of PV goes beyond the boundary of the PV sensor, response code #14 will be returned: “Warning: a new lower range limit has shifted the upper limit outside the range of the sensor”

DATA IN COMMAND
NONE
DATA IN REPLY
NONE
RESPONSE CODES

0	No team related errors
6	Sensor specific command error
7	The device is in write protection mode
9	The applied parameter is too high.
10	Applicable parameter is too small
14	Range is too small
16	Access restricted

F.20 **Command #38** Reset "configuration changed" flag.

Resets the changed response code, bit 6 of the device status byte.

The secondary master with address 0 should not send this command. The primary master, having address 1, should send this command only after the response

code "Configuration changed" is detected and the corresponding commands are executed.

DATA IN COMMAND
NONE
DATA IN REPLY
NONE
RESPONSE CODES

0	No team related errors
6	Sensor specific command error
7	The device is in write protection mode
16	Access restricted

F.21. **Command #40** Enter/exit fixed current mode.

The device is placed in a fixed current mode with the current (primary variable) set to the received value. This value, returned in the response Bytes, displays the rounded value that was actually written to the DAC. Level "0" removes from fixed current mode. The device exits this mode also when its power is turned off.

DATA IN COMMAND
Byte 0–3 Current (F), mA
DATA IN REPLY
Byte 0–3 Current (F), mA
RESPONSE CODES

0	No Command Specific Error
3	Sent parameter too large
4	Sent parameter too small
5	Too little data received
6	Sensor specific command error
7	The device is in write protection mode
11	Multipoint mode enabled
16	Access restricted

F.22 **Command #41** Perform device self- test.

Initiates a self-test function in the device. The device immediately responds to the command, then performs a self-test. Refer to the device's documentation to learn about the diagnostics that it performs and the information available through command # 48 ("Read additional device status").

The execution of this command may take a sufficiently long period of time. If the device cannot execute the command during the self-test, it may not respond. If the device can execute commands during the self-test, command # 48 is used to detect its completion.

DATA IN COMMAND
NONE
DATA IN REPLY
NONE
RESPONSE CODES
0 No team related errors
6 Sensor specific command error
16 Access restricted

F.23 **Command #42** Perform master reset.

Instant response and microprocessor reboot.

The execution of this command may take a sufficiently long period of time. The device may not be able to respond to another command until the reboot completes.

DATA IN COMMAND
NONE
DATA IN REPLY
NONE
RESPONSE CODES
0 No team related errors
6 Sensor specific command error
16 Access restricted

F.24 **Command #43** Set (trim) PV zero.

Rebuilds the primary variable so that it reads 0 from an existing process. The result should be combined with the limits defined by each device.

DATA IN COMMAND
NONE
DATA IN REPLY
NONE
RESPONSE CODES
0 No team related errors
6 Sensor specific command error
7 Device in write protection mode
9 The applied value is too large.

10 Applicable value is too small
16 Access restricted

F.25 **Command #44** Write PV units.

Selects the units in which the primary variable and the range of the primary variable will be returned. It also sets the units for the PV sensor limits and the minimum PV range.

DATA IN COMMAND
Byte 0 PV units code (8), see table F.1
DATA IN REPLY
Byte 0 PV units code (8), see table F.1
RESPONSE CODES
0 No team related errors
2 Wrong choice
5 Too little data received
6 Sensor specific command error
7 The device is in write protection mode
16 Access restricted

F.26 **Command #45** Trim DAC zero.

Adjusts 0 or the lower point of the output signal, so the current at this output is set exactly to the minimum. This procedure is performed by adjusting the DAC of the device to a value of 4.0 mA. The value sent in the command can be rounded by the device. The response byte contains the value that is used by the device.

Use command # 40 (“Entry / exit to fixed current mode”) to set the current exactly to the minimum PV before applying this command. If the device has not been set to fixed current mode or the current is not set to the minimum value exactly, response code # 9 (“Not in fixed current mode”) is returned.

DATA IN COMMAND
Byte 0–3 Measured current (F), mA
DATA IN REPLY
Byte 0–3 Measured current (F), mA
RESPONSE CODES
0 No team related errors
3 Sent parameter too large
4 Sent parameter too small
5 Too little data received

6 Sensor specific command error
7 The device is in write protection mode
9 Not in fixed current mode
11 In multipoint mode
16 Access restricted

F.27 **Command #46** Trim DAC gain.

Adjusts the gain for the upper point of the output signal, so the current at this output is set exactly to the maximum.

This procedure is performed by adjusting the DAC of the device by a value of 20.0 mA. The value sent in the command can be rounded by the device. The response byte contains the value that is used by the device.

Use command # 40 (“Entry / exit to fixed current mode”) to set the current exactly to the maximum PV value before applying this command. If the device has not been set to fixed current mode or the current has not been set to the maximum value accurately, response code # 9 (“Not in fixed current mode”) is returned.

DATA IN COMMAND
Byte 0–3 Measured current (F), mA
DATA IN REPLY
Byte 0–3 Measured current (F), mA
RESPONSE CODES
0 No team related errors
3 Sent parameter too large
4 Sent parameter too small
5 Too little data received
6 Sensor specific command error
7 The device is in write protection mode
9 Not in fixed current mode
11 In multipoint mode
16 Access restricted

F.28 **Command #47** Write transfer function.

The choice of the transformation function of the primary variable.
DATA IN COMMAND
Byte 0 Transfer function code (8), see table F.3
DATA IN REPLY
Byte 0 Transfer function code (8), see table F.3

RESPONSE CODES

0	No team related errors
2	Wrong choice
5	Too little data received
6	Sensor specific command error
7	The device is in write protection mode

F.29 **Command #48** Read additional device status.

Returns device status information not included in the response code. This command also returns the results of the device self-test (Command # 41). For information contained in each status byte.

Response code # 8 ("Warning: data is being updated") will be returned whenever a response can be made and status information is waiting for the completion of a command that takes a sufficiently long time to complete.

DATA IN COMMAND

NONE

DATA IN REPLY

Byte 0	Device-specific status (8)
Byte 6	Operational mode #1 (8)
Byte 7	Operational mode #2 (8)
Byte 8–10	Analogue outputs saturated
Byte 11–13	Analogue outputs fixed
Byte 14–24	Device-specific status (8)

RESPONSE CODES

0	No Command Specific Error
6	Transmitter specific command error
8	Warning: data is being updated
16	Access restricted

F.30 **Command #59** Write number of response preambles.

This is a data link management command.

DATA IN COMMAND

Byte 0	Number of response preambles (8)

DATA IN REPLY

Byte 0	Number of response preambles (8)

RESPONSE CODES

0	No Command Specific Error
3	Sent parameter too large
4	Sent parameter too small
5	Too little data received

6 Sensor specific command error
7 The device is in write protection mode
16 Access restricted

F.31 **Command #100** Write error code level code.
DATA IN COMMAND
Byte 0 Error Signal Strength Code (8)
0 – high level
1 – low level
DATA IN REPLY
Byte 0 Error Signal Strength Code (8)
0 – high level
1 – low level
RESPONSE CODES
0 No Command Specific Error
2 Wrong choice
5 Too little data received
7 The device is in write protection mode
16 Access restricted

Data types:
A ASCII line (4 characters per 3 bytes packed)
B Bit flags (bit 0 = multi-parameter device; bit 1 = EEPROM required to control)
D Date (day, month, year - 1900)
F Floating Point Number (4 bytes in IEEE 754 format)
H Integers
8 8-bit unsigned integer
16 16-bit unsigned integer
24 24-bit unsigned integer

Table F.1 — Unit codes (temperature and pressure)

Unit Code	Description
Temperature	
32	Degrees Celsius
Pressure	
5	mmHg Art. at 0 ° C
10	kg per cm2
11	Pa
12	kPa
57	%
237	MPa
239	mm water at 4 ° C

Table F.2 — Warning codes

Warning code	Description
0	Tall
1	Low
39	Holding the last value of the output quantity
50	Not used
240-249	Numbers may be used by the manufacturer for special definitions
251	No
252	Unknown
253	Special

Used to indicate warnings on the analog output.

Table F.3 — Transfer Function Codes

Transfer Function Code	Description	Note
0	Linear	Equation y = mx + b
1	Square root	Equation y = sqrt (x)

Table F.4 — Write Protect Codes

Write Protect Code	Description
0	No write protection
1	Write protection
250	Not used

Table F.5 — Flag assignment

Flag value code	Description
0x01	Multisensor device
0x02	Electronic Reprogrammable Read-Only Memory Management (EEPROM)
0x04	Protocol bridge device

Table F.6 — Physical implementation of signal codes

Physical signal code	Description
0	Bell 202 current
1	Bell 202 voltage
2	RS-485
3	RS-232
6	Special
7	Reserved