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Metran-150
Pressure Transmitters
with HART 7 Output

Operation Manual
Appendix M

METRAN

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This Appendix applies to Metran-150 pressure transmitters (transmitters) models 150CD, 150CG (range codes 1T-6T), 150TG (range codes 0T–6T), 150TA (range codes 0T-5T), code HR7 with a HART 7 output and extended functionality and supplements Metran-150 Pressure Transmitters Operation Manual (SPGK.5225.000.00 RE) in terms of special requirements.

Each manufactured transmitter has a unique QR code that allows to access information about this device.

M.1 Description and Operation

M.1.1 Purpose

M.1.1.1 Transmitters are designed to measure gage, absolute, differential pressure. These transmitters provide continuous conversion of pressure into DC analog and/or digital HART output.

The transmitters are designed to measure operating fluids: liquid, steam, and gas.

The transmitters are designed for automatic monitoring, regulation and process control systems operated in various industries (including the food industry in contact with food products and drinking water), as well as on marine vessels, floating drilling rigs and offshore fixed platforms.

The transmitters are available in various models and configurations, including design material that fit to various applications. It is the customer's sole responsibility to make a careful analysis of all process variables (such as chemical composition, temperature, pressure, abrasive materials, contaminants, etc.), when selecting a transmitter model, materials and components for particular application. THE MANUFACTURER DOES NOT ANALYZE THE COMPATIBILITY OF THE SELECTED TRANSMITTER MATERIALS WITH THE PROCESS FLUIDS OR OTHER PROCESS VARIABLES.

The transmitters comply with the requirements of Technical Regulations of the Customs Union TP TC 020/2011.

The transmitters are designed for operation in explosion-proof and explosive environments. Explosion-proof transmitters are available with the following protection types:

- Explosion-proof Enclosure (Exd);
- Explosion-Proof Enclosure (Exd) and Dust Ignition Protection by Enclosures "t" (Ext);
- Intrinsically Safe Electrical Circuit (Exia);
- Explosion-Proof Enclosure and/or Intrinsically Safe Electrical Circuit (Exd and/or Exia);
- Explosion-Proof Enclosure and Dust Ignition Protection by Enclosures "t" (Ext) or Intrinsically Safe Electrical Circuit (Exd/Ext or Exia).

Explosion-proof transmitters are designed for installation and operation in explosion-hazard areas and outdoor installations in compliance with GOST IEC 60079-14 and other regulatory documents regulating the use of electrical equipment in explosive environments.

The explosion-proof transmitters comply with the requirements of Technical Regulations of the Customs Union TP TC 012/2011.

Exd/Ext transmitters (for EM code) meet the requirements of GOST 31610.0, GOST IEC 60079-1, GOST IEC 60079-31 and are available with explosion-proof protection level and the following explosion protection marking: 1Ex db IIC T6…T4 Gb X, Ex tb IIIC T85°C… T135°C Db X.

Exd transmitters (for EC code) meet the requirements of GOST 31610.0, GOST IEC 60079-1 and are available with explosion-proof mining protection level and the following explosion protection marking: PB Ex db I Mb X.

Transmitters with Intrinsically Safe Electrical Circuit protection type meet the requirements of GOST 31610.0, GOST 31610.11 and are available with extra explosion-proof level (for IM code), extra explosion-proof mining level (for IC code) and the following explosion protection marking: 0Ex ia IIC T6…T4 Ga X, Ex ia IIIC T_{200}85°C… T_{200}135°C Da X (for IM code), PO Ex ia I Ma X (for IC code).

Exd/Ext or Exia transmitters (KM code) meet the requirements published for Exd/Ext (EM code) or Exia (IM code) versions depending on the used protection type.

Exd or Exia transmitters (KC code) meet the requirements published for Exd (EC code) or Exia (IC code) versions depending on the used protection type.

Exd and Exia transmitters (TC code) meet the requirements published for Exd (EC code) and Exia (IC code) versions.

Exd and (or) Exia transmitters (KC code) meet the requirements published for Exd (EC code), Exia (IC code), Exd and Exia (TC code) versions depending on the used protection type.

Transmitters designated for deployment on offshore vessels, floating drilling rigs, and offshore fixed platforms must adhere to the specifications outlined in the following regulatory documents: 'Rules for the Classification and Construction of Offshore Ships' Part XV (referred to as RS/K Rules), 'Rules for the Classification and Construction of Offshore Ships' Part XVII supplemented with the WINTERIZATION(−50) notation, 'Rules for Technical Surveillance of Shipbuilding and Manufacture of Materials and Products for Ships,' Section 12, Part IV (referred to as RS/TN Rules), 'Rules for Classification, Construction, and Equipment of Floating Drilling Rigs and Offshore Fixed Platforms' (referred to as PBU/MSP Rules), and 'Rules for Classification, Construction, and Equipment of Offshore Floating Oil and Gas Production Complexes' established by the Russian Maritime Register of Shipping (referred to as RS). The transmitters are produced and tested with technical oversight from the Russian Maritime Register.

These transmitters designed for offshore vessels, floating drilling rigs, and fixed offshore platforms carry the version code MW1.

The transmitters intended for use on offshore vessels, floating drilling rigs, and fixed offshore platforms, bearing the additional symbol WINTERIZATION(−50), are identified with the version code MW2.

M.1.1.2 A model string should be specified in the order for the transmitter.

Transmitter model string should be made in accordance with block diagram provided in section M. 7

When referring to the transmitter in documents developed for other products this transmitter can be used with, such documents shall include the following information:

- reference designation of the transmitter;
- designation of Specifications TU 4212-022-51453097-2006.

M.1.2 Technical Data

M.1.2.1 Transmitter models, measured pressure codes, range codes, maximum upper range value (P_{max}), and minimum measurement ranges (P_{min}) are detailed in Tables M.1 - M.4.

The transmitters are recalibrated to the specific measurement range (P_u) within the maximum measurement range as detailed in Tables M.1 - M.4, ensuring that P_u is greater than or equal to P_{min}.

Note: The measurement range is determined by the mathematical difference between the upper and lower range values.

Transmitters are typically shipped from the Manufacturer with basic adjustment parameters unless a customized adjustment (code C1) is specifically requested.

In its basic configuration, the transmitter is set to P_{max} specified in either kilopascals (kPa) or megapascals (MPa), with a lower range value equal to zero. This adjustment is designed to ensure a linear increase in the output signal and a high level of fault output signal reliability.

Upon customer request, the transmitter can be tailored to accommodate any measurement range within the extreme values permitted for the model, as well as according to pressure measuring units outlined in section M.11, code C1 is not mentioned in the order line.

When ordering C1 code, the transmitter is configured in accordance with the Configuration Data Sheet (section M.12). When no measuring instruments are available, the transmitter is set to the nearest possible measurement range.

M.1.2.2 Maximum allowable reference accuracy (γ) of transmitters, which is expressed as a percentage of the measurement range, is better than the values listed in Table M.5.

Transmitter's reference accuracy expressed as a percentage of the measurement range is numerically equal to the reference accuracy expressed as a percentage of the output turndown (for transmitters with a linear transfer function of measurable value).

For transmitters with square root function, a reference accuracy is rated in percentage of URV. In that case, the reference accuracy expressed in percentage of output turndown is calculated by the formula given in Appendix 2 GOST 22520.

M.1.2.3 Variation of output signal γdoes not exceed an absolute value of allowable reference accuracy $|\gamma|$ as indicated in paragraph M.1.2.2.

M.1.2.4 The transmitters are manufactured in various versions specified in section M.7, depending on the materials of wetted parts.

Table M.1

Transmitter	Model	Range Code	Minimum Measurement Range or Upper Range Value, P_{min}		Maximum Upper Range Value, P_{max}		Maximum Measurement Range		Overpressure [1], MPa
			kPa	MPa	kPa	MPa	kPa	MPa	
Gage Pressure Transmitter	150CG	1T	0.125	–	6.30	–	-6.30 – 6.30	–	10
		2T	0.400	–	40.00	–	-40.00 – 40.00	–	16
		3T	2.500	–	250.00	–	-100.00 – 250.00	–	
		4T	–	0.01	–	1.00	–	-0.10 – 1.00	
		5T	–	0.03	–	3.00	–	-0.10 – 3.00	
		6T	–	0.10	–	10.00	–	-0.10 – 10.00	16

[1] For transmitters with S1 code, overpressure value is determined by the lowest value of remote seal flange nominal pressure and overpressure for the transmitter.

Table M.2

Transmitter	Model	Range Code	Minimum Measurement Range or Upper Range Value, P_{min}		Maximum Upper Range Value, P_{max}		Maximum Measurement Range	Overpressure [1], MPa
			kPa	MPa	kPa	MPa		
Gage Pressure Transmitter	150TG	0T	4.00	–	40.00	–	((-40.00)– 40.00) kPa	1
		1T	3.20	–	250.00	–	((-100.00) – 250.00) kPa	4
		2T	–	0.01	–	1.00	((-0.10) – 1.00) MPa	6
		3T	–	0.03	–	3.00	((-0.10) – 3.00) MPa	15
		4T	–	0.10	–	10.00	((-0.10) – 10.00) MPa	20
		5T	–	0.40	–	40.00	((-0.10) – 40.00) MPa	60
		6T	–	0.60	–	60.0	((-0.10) – 60.00) MPa	100

[1] For transmitters with S1 code, overpressure value is determined by the lowest value of remote seal flange nominal pressure and overpressure for the transmitter.

Table M.3

Transmitter	Model	Range Code	Minimum Measurement Range or Upper Range Value, P_{min}		Maximum Upper Range Value, P_{max}		Maximum Measurement Range	Maximum Allowable Operating Gage Pressure [1)], MPa
			kPa	MPa	kPa	MPa		
Differential Pressure Transmitter	150CD	1T	0.125	–	6.30	–	((-6.30) – 6.30) kPa	10
		2T	0.400	–	40.00	–	((-40.00) – 40.00) kPa	25
		3T	2.500	–	250.00	–	((-250.00) – 250.00) kPa	
		4T	–	0.01	–	1.00	((-1.00) – 1.00) MPa	
		5T	–	0.03	–	3.00	0 – 3.00 MPa	
		6T	–	0.10	–	10.00	0 – 10.00 MPa	

[1)] For transmitters with S1, S2 codes, maximum allowable gage pressure value is determined by the lowest value of remote seal flange nominal pressure and maximum allowable operating gage pressure for the transmitter.

Table M.4

Transmitter	Model	Range Code	Minimum Measurement Range or Upper Range Value, P_{min}		Maximum Upper Range Value, P_{max}		Maximum Measurement Range	Overpressure [1], MPa
			kPa	MPa	kPa	MPa		
Absolute Pressure Transmitter	150TA	0T	8.00	–	40.00	–	0 – 40.00 kPa	1
		1T	5.00	–	250.00	–	0 – 250.00 kPa	4
		2T	–	0.01	–	1.00	0 – 1.00 MPa	6
		3T	–	0.03	–	3.00	0 – 3.00 MPa	15
		4T	–	0.10	–	10.00	0 – 10.00 MPa	20
		5T	–	0.40		40.00	0 – 40.00 MPa	60

Notes: Lower range value is equal to absolute pressure zero.

[1] For transmitters with S1 code, overpressure value is determined by the lowest value of remote seal flange nominal pressure and overpressure for the transmitter.

Table M.5

Maximum Allowable Reference Accuracy of Transmitter Versions ±γ, %			
Reference Accuracy Code			
Range Code	Standard	PA (±0.2%)	PC (±0.5%)
150CD/150CG			
1T	0.1 for $P_u \geq P_{max}/15$ $0.025+0.005P_{max}/P_u$ for $P_u < P_{max}/15$	0.2 for $P_u \geq P_{max}/10$ $0.1+0.01P_{max}/P_u$ for $P_u < P_{max}/10$	0.5 for $P_u \geq P_{max}/10$ $0.25+0.025P_{max}/P_u$ for $P_u < P_{max}/10$
2T 3T 4T 5T 6T	0.075 for $P_u \geq P_{max}/10$ $0.025+0.005P_{max}/P_u$ for $P_u < P_{max}/10$	0.2 for $P_u \geq P_{max}/10$ $0.1+0.01P_{max}/P_u$ for $P_u < P_{max}/10$	0.5 for $P_u \geq P_{max}/10$ $0.25+0.025P_{max}/P_u$ for $P_u < P_{max}/10$

Table M.5 (Continued)

Maximum Allowable Reference Accuracy of Transmitter Versions ±γ, %			
Reference Accuracy Code			
Range Code	Standard	PA (±0.2%)	PC (±0.5%)
150TG/150TA			
0T	0.075 for $P_u \geq P_{max}/5$ $0.06+0.012P_{max}/P_u$ for 150TG and $P_{max}/10 \leq P_u < P_{max}/5$	0.2 for $P_u \geq P_{max}/5$ $0.06+0.03P_{max}/P_u$ for 150TG and $P_{max}/10 \leq P_u < P_{max}/5$	0.5 for 150TG and $P_u \geq P_{max}/10$ 0.5 for 150TA and $P_u \geq P_{max}/5$
1T	0.075 for $P_u \geq P_{max}/10$ $0.0075P_{max}/P_u$ for 150TG and $P_u < P_{max}/10$ $0.013P_{max}/P_u$ for 150TA and $P_u < P_{max}/10$	0.2 for $P_u \geq P_{max}/10$ $0.02P_{max}/P_u$ for 150TG and $P_u < P_{max}/10$ $0.025P_{max}/P_u$ for 150TA and $P_u < P_{max}/10$	0.5 for $P_u \geq P_{max}/10$ $0.05P_{max}/P_u$ for $P_u < P_{max}/10$
2T 3T 4T	0.075 for $P_u \geq P_{max}/10$ $0.0075P_{max}/P_u$ for $P_u < P_{max}/10$	0.2 for $P_u \geq P_{max}/10$ $0.02P_{max}/P_u$ for $P_u < P_{max}/10$	0.5 for $P_u \geq P_{max}/10$ $0.05P_{max}/P_u$ for $P_u < P_{max}/10$
5T	0.075 for $P_u \geq P_{max}/5$ $0.015P_{max}/P_u$ for $P_u < P_{max}/5$	0.2 for $P_u \geq P_{max}/10$ $0.02P_{max}/P_u$ for $P_u < P_{max}/10$	0.5 for $P_u \geq P_{max}/10$ $0.05P_{max}/P_u$ for $P_u < P_{max}/10$
6T*)	0.075 for $P_u \geq P_{max}/5$ $0.015P_{max}/P_u$ for $P_{max}/50 \leq P_u < P_{max}/5$ $0.065P_{max}/P_u - 2.5$ for $P_u < P_{max}/50$	0.2 for $P_u \geq P_{max}/15$ $0.015P_{max}/P_u$ for $P_{max}/50 \leq P_u < P_{max}/15$ $0.065P_{max}/P_u - 2.5$ for $P_u < P_{max}/50$	0.5 for $P_u \geq P_{max}/35$ $0.015P_{max}/P_u$ for $P_{max}/50 \leq P_u < P_{max}/35$ $0.065P_{max}/P_u - 2.5$ for $P_u < P_{max}/50$

Notes

1) P_{max} – maximum upper range value given in Tables M.1–M.4, P_u – measurement range the transmitter is set to.

2) Maximum allowable reference accuracy of transmitters verified in response to analog and HART outputs.

*) for 150TG only

M.1.2.5 The transmitter versions have a linearly increasing or linearly decreasing, or proportional to the square root dependence of analog output signal on the input value (pressure).

The nominal static characteristics of a transmitter with an analogue output signal must be of one of the following types:

$$I = I_l + \frac{I_u - I_l}{P_u} \cdot (P - P_l), \quad \text{(M.1)}$$

$$I = I_u - \frac{I_u - I_l}{P_u} \cdot (P - P_l), \quad \text{(M.2)}$$

$$I = I_l + (I_u - I_l) \cdot \sqrt{\frac{P - P_l}{P_u}} \quad \text{(M.3)}$$

Where I - is the current value of output signal;

I_u *and* I_l are the upper and the lower limits of output signal and equal to:

I_l*=4 mA,* I_u*=20 mA* – for transmitters with 4-20 mA output;

P is the value of measured quantity;

P_u is the measurement range;

P_l is lower range value for all transmitters (for standard version P_l=0).

The nominal static characteristics of a transmitter with a digital output signal must be of one of the following types:

$$N = P, \quad \text{(M.4)}$$

$$\%N = \frac{P}{P_u} \cdot 100\%, \quad \text{(M.5)}$$

$$Y = \sqrt{\%N} \cdot 10 \quad , \quad \text{(M.6)}$$

where N is current value of digital output signal;

$\%N$ - current value of the digital output signal in % of the measurement range;

P, P_u - the same as in formulas M.1 - M.3;

Y - current value of the output signal (corresponds to % of flowrate).

M.1.2.6 When calibrating the quadratic function of the analog output signal, specific low flow limits are established within the transmitters. These limits are determined as follows:

- the inlet pressure value at the cut-off is set at 4% of the measurement range, while the outlet pressure value of the cut-off is set at 5% of the measurement range (adjusted by the Manufacturer).

For a detailed representation of the square root law relationship between the output signal and input value, please refer to the graph provided in section M.8.

Note: The cut-off value is the pressure at which the transmitter stops measuring the flow. If the measured pressure is less than the cut-off value, the transmitter calculates the flow rate as zero;

- cut-off value is the pressure at which the transmitter starts to measure the flow rate. If the measured pressure exceeds the cut-off value, the transmitter starts flow measurement.

M.1.2.7 The electrical power supply for both the general industrial version transmitters and the explosion-protected transmitters with the ‘flameproof enclosure’ classification is achieved using a DC power supply source with a voltage range of 12-42 V.

External wiring diagrams for transmitters are given in the Appendix D of SPGK.5225.000.00 RE.

The electrical power supply for transmitter of the explosion-proof version utilizing the ‘intrinsically safe electrical circuit’ Exia type is derived from intrinsically safe circuits provided by barriers (blocks) with the ‘intrinsically safe electrical circuit’ type of explosion protection. In this configuration, maximum output voltage of barriers U_0 should not exceed 30 V, the maximum output current I_0 should not exceed 120 mA, the maximum output power P_0 should not exceed 0.9 W.

External wiring diagrams for explosion-proof transmitters with ‘intrinsically safe electrical circuit’ are given in the Appendix F SPGK.5225.000.00 RE.

When employing transmitters designed for the explosion-protected ‘intrinsically safe electric circuit’ type outside of hazardous areas where the properties of explosion protection are not critical, the transmitters can be powered from a standard DC power supply source typically used for transmitters of the general industrial version.

M.1.2.8 When the supply voltage experiences a sudden increase of 1 V from the set value defined in M.1.2.7 for a duration no less than 0.5 ms, the analog output signal emission should not exceed 1% of the output signal variation range. This condition is permissible as long as the transient effect lasts no more than 5 ms.

Furthermore, when the supply voltage encounters a dip of 1 V, it must not fall below the minimum value as stated in M.1.2.7.

M.1.2.9 Transmitters withstand power interruption for 5 ms, while the time of current loop signal recovery (to the value ±5 % of the range) is not more than 17 ms.

M.1.2.10 Transmitters with analog output signal operate at a load resistance:

$$R_{min}=0 \text{ at } U \le 36 \text{ V}, \quad (M.7)$$

$$R_{min} \ge 50(U-36) \text{ at } U > 36 \text{ V}, \quad (M.8)$$

$$R_{max} \le 42(U-12). \quad (M.9)$$

Note: R_{min}=250 Ohms for HART communications at supply voltage from 18.5 to 41.0 V.

The limits of permissible load resistance (resistance of devices and communication lines) depend on preset supply voltage of transmitters and should not overrun an operating area given in Appendix E SPGK.5225.000.00 RE.

M.1.2.11 When the supply voltage smoothly transitions from its minimum to maximum value (as specified in M.1.2.7) at the designated load levels outlined in M.1.2.10, any additional error introduced in the transmitter should not surpass ±0.005% of the output signal change range for each 1 V alteration in the supply voltage.

M.1.2.12 Upon the connection of load resistance values falling within the confines delineated in H.1.2.10, the transmitter must meet the criteria laid out in M.1.2.2 and M.1.2.3.

M.1.2.13 The power consumption of the transmitter should not exceed 0.9 B·A.

M.1.2.14 The transmitters are safeguarded against reverse polarity in the supply voltage.

Altering the polarity of the power supply voltage should not result in any damage to the transmitter.

M.1.2.15 The transmitters have an external pushbutton located on the electronics module housing to offset the transmitter characteristics (zero calibration) from the on-site mounting position of the gage pressure transmitters, differential pressure transmitters or static pressure of differential pressure transmitters.

M.1.2.16 The permissible range of deviation in the transmitter characteristic during zero calibration does not exceed:

±10% of Pmax for 150CD/CG models with 1T range code;

±5% of Pmax for 150CD/CG models with 2T–6T range codes; for 150TG models with 0T–6T range codes.

M.1.2.17 Transmitters are available in a variant equipped with a built-in backlit liquid crystal display, identified by the code M5.

Note: Transmitters with a built-in display in their basic version have the display light on.

M.1.2.18 Transmitters featuring the indicator (code M5) can be conveniently configured using the built-in control interface (buttons) or via a control device that supports the HART protocol.

M.1.2.19 The parameters of transmitters with the integrated indicator (code M5) can be adjusted using the control buttons based on a menu structure outlined in section M.10.

M.1.2.20 Each transmitter can be configured and managed remotely using a control device that is compatible with HART protocol version 7, following the menu structure provided in section M.9.

M.1.2.21 Table M.7 outlines the digital output parameters of the process variables measured by the transmitters. These variables typically include pressure, sensor temperature, and board temperature, with additional derived variables also accounted for in the system.

The only measured parameter of the transmitter is the Pressure process variable.

Table M.7

Digital Output Parameters of Process Variables	
Primary Variable (PV)	- pressure* - flow rate [1)] - totalizer - level - volume
Secondary Variable (SV)	- pressure - sensor temperature* - flow rate - totalizer - level - volume - board temperature - sensor temperature gradient - board temperature gradient

Table M.7 (Continued)

Tertiary Variable (TV)	- pressure - sensor temperature* - flow rate - totalizer - level - volume - board temperature - sensor temperature gradient - board temperature gradient
Quaternary Variable (QV)	- pressure - sensor temperature* - flow rate - totalizer - level - volume - board temperature - sensor temperature gradient - board temperature gradient
_____ * factory default design [1)] uncompensated flow rate	

The process variable is responsible for controlling the analog output signal.

It is associated with the process variables listed in Table M.7, excluding variables such as sensor temperature, board temperature, sensor temperature gradient, and board temperature gradient.

Note: If any of derivative process variables, such as level, volume, flowrate, or flow meter, is assigned as primary variable, this transmitter cannot be used as a measuring instrument.

Temperature gradient is a derivative variable that describes the temperature change rate. The transmitter calculates the temperature gradient once every minute.

Note: Once the transmitter is powered on, the temperature gradient readings are always equal to NAN until 2 minutes pass to obtain two temperature samples.

M.1.2.22 The units of measurement for variables such as pressure, analog output, level, sensor temperature, board temperature, and volume in the transmitter are configured in accordance with the guidelines provided in section H.11.

In the case of transmitters used with flow rate and flow meters, the devices can be configured to utilize user-defined units for these specific measurements.

Units selected for each gradient are: C/min or F/min.

M.1.2.23 The transmitters calculate the variable flow rate using the following expression:

$$Y=\text{sign}\,(Pp)\cdot\frac{Y_p}{\sqrt{|Pp|}}\cdot\text{sign}\,(P)\cdot\sqrt{|P|}, \quad (M.10)$$

where Y is the variable flow rate at pressure P,

Y_P – user-entered value of flow rate at measuring point P_p,

P_p – user-entered pressure value at the measuring point, in kPa,

P - measured pressure, in kPa.

$$\text{sign}(Pp)=\begin{cases} Pp,\ for\ Pp>0,\\ -Pp,\ for\ Pp<0,\\ 0,\ for\ Pp=0,\end{cases}$$

$$\text{sign}(P)=\begin{cases} P,\ for\ P>0,\\ -P,\ for\ P<0,\\ 0,\ for\ P=0.\end{cases}$$

In Section M.8, a graphical representation interaction between the output signal and the input variable for the variable flow rate can be found.

Regarding variable flow, the transmitters offer several capabilities:

– Option to establish a low flow cut-off within a range spanning from 0% to 50% of the total flow rate;

– Flexibility to enable or disable the cut-off function as needed.

M.1.2.24 The variable flow rate counter transmitter fulfills the critical function of tracking the volume of flow that traverses the measurement location within a given period.

In terms of operational modes, users have the flexibility to configure the flow meter in one of the following modes based on their specific requirements:

– Forward Flow Only;

– Reverse Flow Only;

– Gross Flows (Forward Flow + Reverse Flow)

– Net Flow (Forward Flow – Reverse Flow).

For the flow meter, the user-defined flow time units are: seconds, minutes, hours, days.

M.1.2.25 The transmitter display in pressure measurement mode shows the following variables in this order: pressure, sensor temperature, flow rate, level, volume, totalizer, board temperature, % of range, and loop current.

The units of measurement of the variables are in accordance with M.1.2.22.

Note: The indicator does not display the sensor temperature gradient and board temperature gradient variables.

The selected variable can be set for display via the display menu or HART. If no variable is selected for display, the pressure value is displayed.

The display backlight is switched on and off by HART command.

M.1.2.26 The permissible value of the variable displayed on the display is from –19999 to 19999. If the variable is higher than 19999 or lower than –19999, the number is displayed in exponential form (for example, 51500 will be displayed in the numeric line of the indicator as 5.2E4).

M.1.2.27 The indicator displays bar graph segments in accordance with output range percentage.

M.1.2.28 In the measurement mode, the transmitter display alternates between the variable screens and the warning screens when they occur.

When an error occurs, only the error screen is displayed and the backlight flashes at the frequency of 0.5 Hz if it is on.

Transmitters with LCD have a custom configuration of the display backlight flashing at the frequency of 0.5 Hz via HART to show errors and warnings.

The diagnostic messages displayed on the indicator are given in section M.12.

M.1.2.29 The transmitters have user configurable two warning thresholds for any of the process variables specified in M.1.2.21.

Each threshold has its own setting of two boundaries—upper and lower, including the ability to enable/disable notifications.

The custom setting of the alert/warning thresholds includes setting the type of notification:

– HART notification;

– analogue signal failure mode;

– disabling the alert threshold.

M.1.2.30 The transmitters provide constant control of their work and form a message about the fault in the form of setting of the alarm output signal.

The transmitters have three configurable options for fault and saturation alarm parameters:

– Metran (basic);
– NAMUR;
– custom.
– Values of output signals for each option are given in Table M.8.

Table M.8

Option	Level	Saturation alarm level, mA	Alarm signal value, mA
Metran (code CT)	Low	3.84	3.6
Metran (factory default design)	High	21.6	23
NAMUR NE43 Standard (code CN)	Low	3.8	3.6
NAMUR NE43 Standard (code C4)	High	20.5	22.5
Custom (code CS)	Low	3.7–3.9	3.6–3.8
Custom (code CR)	High	20.1–22.9	20.2–23

The custom output levels are limited as follows:
– Low failure alarm level must be lower than the low saturation alarm level;
– High failure alarm level must be higher than the high saturation alarm level;
– Alarm and saturation levels must be separated by at least 0.1 mA.

M.1.2.31 Transmitters featuring the DA0 version code are equipped with HART diagnostics capabilities to ensure the integrity of the current loop. These devices detect deviations in the supply voltage at the transmitter terminals, comparing them to the user-set limit deviations.

When these deviations surpass the predefined thresholds, the transmitter triggers either an analog alarm or a HART warning.

Note: please be aware that the default limit deviation value stands at ±1.5 V, whereas the minimum limit deviation value is ±1 V.

M.1.2.32 These transmitters adhere to the specifications outlined in HART protocol version 7.

M.1.2.33 Transmitters are equipped with robust protection mechanisms for setting parameters, including:

– Software protection prevents modifications to settings through HART and the indicator interface.

– The indicator password feature restricts changes to settings via the indicator interface while allowing adjustments through HART interactions.

M.1.2.34 The installation and connection dimensions of the transmitters are in accordance with the specifications detailed in Appendix G SPGK.5225.000.00RE.

M.1.2.35 The transmitter weight specifications can be found in 1.2.31 SPGK.5225.000.00RE.

M. 1.2.36 Analog output ripple within the frequency range from 0.06 Hz to 5 Hz does not exceed $0.7|\gamma|$. Values γ are indicated in M.1.2.2.

The analogue output signal ripple is controlled in the frequency range from 5 to 10^6 Hz, the ripple is constrained to not exceed 0.5% of the output signal variation range.

Analog output ripple with the frequency over 10^6 Hz is not rated.

Output ripple is rated for load resistance of 250 Ohms in case of no HART communication with the transmitter.

Note–: the ripple is rated at a minimum time of measurement result averaging.

M.1.2.37 The transmitters are resistant to atmospheric pressure from 66.0 kPa to 106.7 kPa (group R2, GOST R 52931).

M.1.2.38 Transmitters are resistant to ambient temperature within the operating range:

–40 to 85 °C;

–55 to 85 °C - for code LT;

–60 to 85 °C - for code BR6.

Built-in LCD (code M5) operates under the influence of ambient temperature ranging from – 45 to 85 °C.

Influence of ambient temperature lower than –45 C does not cause LCD damage, but may cause illegible readings, decreased update rate and decreased backlight brightness.

Code MW1 transmitters are resistant to ambient temperature in accordance with the requirements of 2.1.1 of Part XV of the RS/K Regulation — from –25 to 55 °C.

Transmitters with option code MW2 are resistant to ambient temperatures from –50 °C to +55 °C.

M.1.2.39 Temperature effect caused by an ambient temperature change within the operating temperature range of –40 to 85 °C (M.1.2.38) expressed as a percentage of the measurement range per each 10 °C does not exceed γ_t values listed in Table M.9.

Within the operating range of temperatures from –60 to –40 °C, the temperature effect γ_t per 10 °C is 3 times more.

M.1.2.40 Transmitters are resistant to environmental relative humidity 100% at a temperature of 35 °C and lower temperatures with moisture condensation.

The transmitters with option codes MW1, MW2 are resistant to relative humidity in accordance with the requirements outlined in paragraph 2.1.2 of section XV of RS/K Rules.

M.1.2.41 Ingress protection degree of transmitters complies with IP66/IP68 group as per GOST 14254.

For transmitters equipped with plug connectors with option codes SC, SC1, SC2, SC6, SC7 the degree of protection against dust and water corresponds to the group IP 65 as per GOST 14254.

M.1.2.42 The transmitters correspond to vibration-resistant version V2 according to GOST R 52931 in terms of resistance to mechanical influences. Vibration directions are specified in Appendix G SPGK.5225.000.00 RE.

Table M.9

Range Code	Temperature Effect per 10 °C, ± γ_t, %							
	Transmitter Model							
	150CG/150CD			150TG			150TA	
	Standard	Reference Accuracy Code		Standard	Reference Accuracy Code		Standard	Reference Accuracy Code
		PA (±0.2%)	PC (±0.5%)		PA (±0.2%)	PC (±0.5%)		PA (±0.2%)	PC (±0.5%)
0T	–			$0.02+0.03P_{max}/P_u$	$0.02+0.05P_{max}/P_u$		$0.02+0.03P_{max}/P_u$	$0.02+0.05P_{max}/P_u$	
1T	Diaphragm: SST, SST+Au $0.05+0.06P_{max}/P_u$ Diaphragm: C-276 alloy $0.01+0.12P_{max}/P_u$	Diaphragm: SST, SST+Au $0.05+0.08P_{max}/P_u$ Diaphragm: C-276 alloy $0.15+0.18P_{max}/P_u$		$(0.02+0.03P_{max}/P_u)$ for $P_u \geq P_{max}/10$ $(0.06+0.03P_{max}/P_u)$ for $P_u < P_{max}/10$	$(0.02+0.05P_{max}/P_u)$ for $P_u \geq P_{max}/10$ $(0.06+0.05P_{max}/P_u)$ for $P_u < P_{max}/10$		$(0.02+0.03P_{max}/P_u)$ for $P_u \geq P_{max}/10$ $(0.06+0.03P_{max}/P_u)$ for $P_u < P_{max}/10$	$(0.02+0.05P_{max}/P_u)$ for $P_u \geq P_{max}/10$ $(0.06+0.05P_{max}/P_u)$ for $P_u < P_{max}/10$	
2T-4T	Diaphragm: SST, SST+Au $0.02+0.03P_{max}/P_u$ Diaphragm: C-276 alloy $0.02+0.05P_{max}/P_u$	Diaphragm: SST, SST+Au $0.02+0.04P_{max}/P_u$ Diaphragm: C-276 alloy $0.03+0.075P_{max}/P_u$		$0.02+0.03P_{max}/P_u$	$0.02+0.04P_{max}/P_u$		$0.02+0.03P_{max}/P_u$	$0.02+0.04P_{max}/P_u$	
5T				$0.05+0.05P_{max}/P_u$	$0.05+0.065P_{max}/P_u$		$0.05+0.05P_{max}/P_u$	$0.05+0.065P_{max}/P_u$	
6T				$0.05+0.05P_{max}/P_u$	$0.05+0.065P_{max}/P_u$		–		

Notes

1 P_{max} and P_u are the same as in the note to Table M.5.

2 For transmitters with remote seals (S1, S2 codes) temperature effect is calculated separately for each version of the remote seal, taking into account specific application conditions.

M.1.2.43 Additional error of transmitters caused by exposure to vibration (M.1.2.42) and expressed as a percentage of the output turndown does not exceed the values γ_f obtained by the formulae:

- for 150TG, 150TA models

$$\gamma_f = \pm 0.1 \cdot \left(\frac{P_{max}}{P_u}\right), \quad \text{(M.11)}$$

where P_{max} and P_u are the same as in the note to Table M.5;

- for other models

$$\gamma_f = \pm 0.25 \cdot \left(\frac{P_{max}}{P_u}\right), \quad \text{(M.12)}$$

where P_{max} and P_u – are the same as in the note to Table M.5.

M.1.2.44 Variation of the initial value of the output signal of the 150CD differential pressure transmitters caused by the change of the operating gauge pressure from zero to the maximum allowable pressure and from the maximum allowable pressure to zero (Table M.3), expressed as a percentage of the measurement range, does not exceed the values γ_p, determined by the formula

$$\gamma_p = K_p \cdot P_{op} \cdot \frac{P_{max}}{P_u}, \quad \text{(M.13)}$$

where P_{max} and P_u– are the same as in the note to Table M.5;

P_{op} is the change in operating gage pressure, MPa;

K_p values are listed in Table M.10.

Table M.10

Range Code	Diaphragm Seal Material	±K_p *%/1 MPa values depending on P_{op}	
		$P_{op} \leq 16$ MPa	$P_{op} > 16$ MPa
1T	SST or gold-plated SST	0.100	–
	C-276 Alloy	0.140	–
2T	SST or gold-plated SST	0.020	0.050
3T	SST or gold-plated SST	0.015	0.050
2T, 3T	C-276 Alloy	0.040	0.100
4T, 5T	SST or gold-plated SST	0.025	0.075
	C-276 Alloy	0.080	0.080
6T	SST or gold-plated SST	0.015	0.075
	C-276 Alloy	0.080	0.080

* For transmitters with PA and PC code, K_p values should be 1.5 times higher.

Adjusting the ‘zero’ of the transmitter through bilateral action on the measuring cavities of the operating overpressure (static) transmitter is an effective method to mitigate the impact of changes in operating overpressure on the output signal variation.

M.1.2.45 The transmitters are proof against external alternating magnetic field with 50Hz frequency and 400 A/m tensity or external permanent magnet field with 400 A/m tensity at most adverse phase and field direction.

Additional error of transmitters caused by exposure to external electromagnetic interference does not exceed ±0.1% of output signal variation range.

M.1.2.46 The dynamic characteristics of the analogue signal from transmitters are rated based on the time required for the transmitter output signal to stabilize following a sudden change in the measured parameter, specifically at 63.2% of the measurement range.

The typical settling times are as follows:

- 100 ms for models 150TG with range codes 0T-6T, 150TA with range codes 0T–5T;
- 130 ms for models 150CD, 150CG with range codes 1T-6T.

Note: Dynamic characteristics of the transmitter are rated at a temperature (23±5) ºC and at a minimum electronic damping of transmitter output set to zero.

M.1.2.47 Transmitter has electronic damping of output signal, which is characterized by averaging time of measurement results. The averaging time is any value (integer or fractional number) between 0 and 60 s and can be set by the user.

Note: the damping time increases the settling time of the transmitter smoothing variations in output readings caused by rapid input changes.

M.1.2.48 Transmitter turn-on time measured as the time from power-on to analog output settling with accuracy better than 5% of steady-state value does not exceed 2 s at minimum electronic damping of transmitter output signal.

M.1.2.49 The transmitters withstand overload for 1 min by the pressure specified in Table M.11.

Table M.11

Range Code	Overpressure, MPa				
	Transmitter Model				
	150CD		150CG	150TG	150TA
	high-pressure cavity ‘H’	low-pressure cavity ‘L’			
0T	-	-	-	1	1
1T	10	10	10	4	4
2T	16	16	16	6	6
3T	16	16	16	15	15
4T	16	16	16	20	20
5T	16	16	16	60	60
6T	16	4	16	100	-

[1)] For transmitters with S1, S2 codes, overpressure value is determined by the lowest value of remote seal flange nominal pressure and overpressure for the transmitter.
The table shows overpressure values for the transmitter.

In some cases, overpressure may result in small changes of the rated transmitter characteristics. To avoid this effect after an overload, the ‘zero’ correction must be performed.

M.1.2.50 The insulation between electrical circuits and transmitter enclosure is designed to withstand alternating current voltage of 500 V (effective) that is practically sinusoidal in shape at the temperature range of (15-35) °C and a relative humidity of 80%, for a duration of 1 minute within a frequency range of 45 to 65 Hz.

For devices with option codes MW1 and MW2, the insulation between the electric circuits and the enclosure withstands the alternating current voltage (effective) as outlined in para 3.2, Appendix 1, Section 12 that is practically sinusoidal in shape within the temperature range of (15–35) °C and 80% relative humidity for a duration of 1 minute within a frequency range of 45 to 65 Hz. (Section IV of the RS/TN Regulations.

The leakage current during the test does not exceed the effective value of 5 mA.

For transmitters with basic terminal block this requirement is fulfilled when the ground jumper of the terminal block is removed.

M.1.2.51 Electrical insulation resistance between electrical circuits and transmitter housing at ambient temperature (15–35) °C and relative humidity up to 80% is no less than:

for the basic terminal block:

– 5 megohms at 50 V DC.

– 20 megohms at 100 V DC - with the ground jumper of the terminal block removed;

for the terminal block option code T0:

– 20 megohms at 100 V DC.

For transmitters MW1, MW2 the minimum permissible insulation resistance at ambient air temperature (15–35) °C and relative humidity up to 80 % shall be in accordance with Table 3.1 of Appendix 1, Section 12, Part IV of the RS/TN Regulations.

M.1.2.52 The transmitters are resistant to electromagnetic interference, given in table M.12, quality criterion of functioning A meets GOST R IEC 61326-1.

The transmitters with option codes MW1, MW2 are resistant to electromagnetic interference according to the requirements of 2.1.8 of Part XV of the RS/Q Regulations.

M.1.2.53 Additional transmitter error caused by exposure to electromagnetic interference (H.1.2.52) does not exceed ±1% of P_{max}

M.1.2.54 Transmitters meet the interference emission rates established for Class B in accordance with CISPR11, i.e., field strength of 40 dB within the frequency range of 30 to 230 MHz and 47 dB within the frequency range of 230 to 1000 MHz at the distance of 3m.

Transmitter having option codes MW1, MW2 comply with the interference emission standards specified in requirement 2.1.8 of Part XV of the RS/K Regulations.

M.1.2.55 The terminal block of the transmitter basic version provides protection against lightning and other transient overvoltages according to IEEE C62.41, category B with the following parameters:

– ringing wave: maximum voltage value 6 kV, oscillation frequency 100 kHz, rise time 0.5 μs;

– combined wave: maximum voltage value 6 kV, voltage pulse 1.2/50 μs and maximum current value 3 kA, current pulse 8/20 μs.

Table M.12

Port	EMI		Electromagnetic Compatibility Standard	Value
Input/Output (signal/control)	Nano-second impulse interference		GOST 30804.4.4	1 kV
Housing	Radio-frequency electromagnetic field within frequency band, MHz	80–1000	GOST IEC 61000-4-3	10 V/m
		1400–2000		3 V/m
		2000–2700		1 V/m
Housing	Electrostatic discharges	Contact discharge	GOST 30804.4.2	4 kV
		Air discharge		8 kV
Input/Output (signal/control)	Conducted interference		GOST R 51317.4.6	3 V
Housing	Power frequency magnetic field	Long magnetic field	GOST IEC 61000-4-8	30 A/m
Input/Output (signal/control)	Microsecond high-energy impulse interference applied under	wire-ground scheme	GOST R 51317.4.5	1 kV

Note
1. During interference exposure, HF pulses level within frequency band over 5 kHz and output pulse height with duration of less than 100 ms are not rated.
2. A maximum of two messages may be lost when interference occurs in digital communications.

M.1.2.56 The transmitters with SM option code are earthquake resistant to 9 intensity degree on the MSK-64 scale provided that it is installed at a height of 70 m above the ground zero as per GOST 30546.1.

Seismic effect expressed as a percentage of the measurement range shall not exceed ±1 % of P_{max} (P_{max} – is the same as in the note to M.5.)

M.1.2.57 Following transmitter resetting to any measurement limits referred to in M.1.2.1, the transmitter meets the requirements of this Operation Manual, and the reference accuracy and variation are better than those stipulated for the respective measurement limits (M.1.2.2, M.1.2.3).

After reconfiguring the transmitter, it is recommended to recalibrate the ‘zero’ setting; adjusting the upper range value is unnecessary.

M.1.2.58 Transmitters in shipping containers can withstand ambient temperature from –60 to 60 °C.

M.1.2.59 Transmitters in shipping containers withstand ambient relative humidity of 100 % at temperature 35 °C with moisture condensation.

M.1.2.60 Transmitters in shipping containers withstand vibration conforming to F3 Group in accordance with GOST 52931 provided that vibration is applied in the direction marked on the containers with handling sign THIS SIDE UP.

M.1.2.61 These transmitters are resistant to mould fungi. The permissible score is 3 according to GOST 9.048.

M.1.2.62 Transmitters are resistant to the rain with an intensity of 5mm/min in accordance with GOST 15150.

M.1.2.63 Transmitters retain operability after exposure to solar radiation: integral radiation flux density - 1120 W⁄m^2, flux density of the ultraviolet part of the spectrum - 68 W⁄m^2 in accordance with GOST 15150.

M.1.2.64 Transmitters are corrosion-resistant to salt (sea) mist in accordance with GOST 15150.

M.1.2.65 Outer surfaces of transmitters are resistant to dynamic effects of dust in accordance with GOST 15150.

M.1.2.66 When explosion-proof transmitters are ordered with AR code, they are exposed to additional test for 360 hours.

M.1.2.67 Materials of the transmitters comply with GEST 79/82 for use in contact with chlorine.

M.1.2.68 Transmitters with QT version code meet the requirements of GOST R IEC 61508-1, GOST R IEC 61508-2, GOST IEC 61508-3, GOST R IEC 61508-4, GOST R IEC 61508-5, GOST R IEC 61508-6, GOST R IEC 61508-7 and ensure safety integrity level 2 (SIL 2) for random failures, at HFT = 0, safety integrity level 3 (SIL 3), for random failures at HFT = 1, safety integrity level 3 (SIL 3), for systematic failures.

M.1.2.69 Transmitters bearing codes MW1, MW2 are designed for all macroclimatic regions on land and at sea, for ships of unlimited sailing area and for installation on open deck or open premises, as well as in any confined premises.

M.1.2.70 Transmitters with option codes MW1, MW2 meet the requirements of 2.1.4 of Part XV of the RS/C Regulations in terms of resistance to rocking and prolonged roll.

M.1.2.71 Transmitters with codes MW1 and MW2, in terms of their resistance to vibration in all directions, comply with requirement 2.1.3 of Part XV of the PC/C Regulation, with the following specifications:

Frequency range: 2 to 100 Hz,

Displacement amplitude: ±1.0 mm within the frequency range of 2 to 13.2 Hz,

Acceleration amplitude: ±0.7g within the frequency range of 13.2 to 100 Hz.

The additional error of transmitters induced by vibration does not exceed ±0.1% of P_{max} (where P_{max} corresponds to the values in Table 1).

M.1.2.72 Transmitters with codes MW1 and MW2, in terms of their resistance to shock pulses in all directions, comply with requirement 2.1.3 of Part XV of the PC/K Regulation, with the following specifications:

acceleration amplitude: ±5g,

shock pulse duration: 6 – 30 ms,

20 shock pulses in each position,

repetition rate is 40 – 80 beats per minute.

Exposure to the shock load does not result in a fault signal according to M.1.2.30 or fault messages. After termination of the specified impact, the transmitters fulfil the requirements of M.1.2.2, M.1.2.3.

M.1.2.73 Transmitters with codes MW1, MW2 are compliant with the requirement 2.1.6 of Part XV of the RS/K Regulations in terms of resistance to deviation of the supply voltage from the nominal supply values.

Transmitters with codes MW1, MW2 do not affect the performance of automation systems in case of power supply interruption with parameters according to 2.1.6 of Part XV of the RS/K Regulations.

M.1.2.74 Transmitters bearing codes MW1 and MW2 are constructed using materials that comply with the standards outlined in requirement 2.1.11 of Part XV of the RS/K Regulation for resistance against marine atmospheres.

M.1.2.75 Transmitters with the MW1 and MW2 codes, designed to withstand frost and dew, meet the specifications detailed in item 3.13 of Appendix 1, Section 12, Part IV of RS/TN Regulations.

M.1.2.76 The average Mean Time Between Failures (MTBF) for the transmitters, considering the maintenance procedures outlined in this operational manual, is estimated at 200,000 hours.

M.1.2.77 The average service life of transmitters, excluding those operating with aggressive fluids (average life of such transmitters is subject to properties of aggressive fluid, operating conditions, and materials used) is not less than:

– 20 years

– 30 years for ML option.

M.1.2.78 The average time required to restore the transmitter to working condition is 36 hours or less.

M.1.2.79 The transmitters that meet the standards of GOST 27.003 are categorized as products designed for continuous, long-term use, with the capability to be restored, repaired, and maintained.

M.1.2.80 The designated service life of the transmitters used in hazardous industrial environments, provided that the materials are corrosion-resistant to contact media, is 20 years.

M.1.2.81 The designated storage lifespan of transmitters is 20 years.

Total storage and operation time should not exceed the technical lifetime.

M.1.3 Transmitter Design and Operating Principle

M.1.3.1 Transmitter design and operation principle complies with section 1.3 of SPGK.5225.000.00RE.

M.1.4 Marking and Sealing

M.1.4.1 The nameplate attached to the transmitter includes the following marks and data:

- trade mark and name of a company-manufacturer;
- type approval mark according to Order No.2905;
- EurAsian Conformity Mark;
- transmitter name;
- transmitter model string;
- protection rating in accordance with GOST 14254;
- measurement limit P_{max};
- serial number according to the Manufacturer numbering system;
- Pg – maximum allowable operating gage pressure, including the units for differential pressure transmitters; for transmitters with S1, S2 codes, it is determined by the lowest value of remote seal flange nominal pressure and maximum allowable operating gage pressure for the transmitter;
- year and month of manufacture;
- supply voltage;
- output, mA;
- text ‘Made in Russia’.

M.1.4.2 The marking is made on a separate nameplate attached to the explosion-proof transmitter and includes:

- special explosion-proof mark in accordance with Appendix 2 to CU TR 012/2011;
- name or label of certification center and certificate number;
- Explosion protection marking:
  a) for Exd/Ext transmitters (EM code):
  1Ex db IIC T6…T4 Gb X
  Ex tb IIIC T85°C… T135°C Db X
  T6 (T85°C) (–60 °C≤t_a≤70 °C), T5 (T100°C) (–60 °C≤t_a≤85 °C),
  T4 (T135°C) (–60 °C≤t_a≤85 °C);
  b) for Exd/Ext transmitters (EM and HS codes):
  1Ex db IIC T6…T4 Gb X
  Ex tb IIIC T85°C… T135°C Db X
  c) for Exia transmitters (IM code):
  0Ex ia IIC T6…T4 Ga X
  Ex ia IIIC T_{200}85°C… T_{200}135°C Da X
  T6 (T85°C) (–60 °C≤t_a≤70 °C), T5 (T100°C) (–60 °C≤t_a≤85 °C),
  T4 (T135°C) (–60 °C≤t_a≤85 °C);
  U_i≤30 V, I_i≤120 mA, P_i≤0.9 W, L_i=70 µH, C_i=0.01 µF

d) for Exia transmitters (IM and HS codes):
0Ex ia IIC T6…T4 Ga X
Ex ia IIIC T_{200}85°C… T_{200}135°C Da X
U_i≤30 V, I_i≤120 mA, P_i≤0.9 W, L_i=70 µH, C_i=0.01 µF
e) for Exd/ Ext or Exia transmitters (KM code):
0Ex ia IIC T6…T4 Ga X
Ex ia IIIC T_{200}85°C… T_{200}135°C Da X
U_i≤30 V, I_i≤120 mA, P_i≤0.9 W, L_i=70 µH, C_i=0.01 µF
1Ex db IIC T6…T4 Gb X
Ex tb IIIC T85°C… T135°C Db X
T6 (T85°C) (–60 °C≤t_a≤70 °C), T5 (T100°C) (–60 °C≤t_a≤85 °C),
T4 (T135°C) (–60 °C≤t_a≤85 °C)
f) for Exd or Exia transmitters (KM and HS codes):
0Ex ia IIC T6…T4 Ga X
Ex ia IIIC T_{200}85°C… T_{200}135°C Da X
U_i≤30 V, I_i≤120 mA, P_i≤0.9 W, L_i=70 µH, C_i=0.01 µF
1Ex db IIC T6…T4 Gb X
Ex tb IIIC T85°C… T135°C Db X
g) for Exd mining transmitters (EC code):
PB Ex db I Mb X;
h) for Exia mining transmitters (IC code):
PO Ex ia I Ma X,
U_i≤30 V, I_i≤120 mA, P_i≤0.9 W, L_i=70 µH, C_i=0.01 µF;
i) for Exd and (or) Exia mining transmitters (KC code):
PB Ex db I Mb X
PO Ex ia I Ma X
PB Ex db ia I Mb X
U_i≤30 V, I_i≤120 mA, P_i≤0.9 W, L_i=70 µH, C_i=0.01 µF;
j) for Exd and Exia mining transmitters (TC code):
PB Ex db ia I Mb X,
U_i≤30 V, I_i≤120 mA, P_i≤0.9 W, L_i=70 µH, C_i=0.01 µF,

where U_i, I_i, and P_i are the maximum input voltage, current and power values respectively;
t_a is the range of ambient temperature values;
L_i and C_i are the maximum internal inductance and capacitance values respectively.

M.1.4.3 The points where higher and lower pressures are supplied are identified by the symbols ‘H’ and ‘L’. The symbol ‘H’ corresponds to the location where the measured pressure is equal to or higher than the measured pressure, while the symbol ‘L’ corresponds to the location where the static pressure is equal to or lower than the measured pressure.

On the electronics module covers of transmitters with a ‘flameproof enclosure’ designation label, you will find the instruction ‘Disconnect from the mains before opening’.

For transmitters with S1, S2 codes, remote seal flange is marked with flange nominal pressure.

For transmitters with S1, S2 codes, an additional nameplate with remote seal / seals order line is attached to the transmitter.

M.1.4.4 Transmitters bearing the code QT are equipped with a yellow-colored identification plate.

M.1.4.5 An embossed grounding symbol is located on the interior and exterior surfaces of the electronic transmitter body near the grounding clamp.

M.1.4.6 There is a QR code on the electronics module housing, packaging and Technical Data Sheet. By scanning this code, the user may access electronic versions of transmitter documentation (PDF format): Technical Data Sheet, Operation Manual, certificates and other documents per order.

M.1.5 Packaging

M.1.5.1 Packaging conforms to section 1.5 of SPGK.5225.000.00 RE.

M.1.6 Explosion Protection

M.1.6.1 Explosion protection of transmitters with Explosion-Proof Enclosure protection type (Exd, for EC, KC, TC codes), as well as Explosion-Proof Enclosure (Exd) and Dust Ignition Protection by Enclosures “t” (for EM, KM codes).

M.1.6.1.1 Explosion protection of transmitters with Explosion-Proof Enclosure and Dust Ignition Protection by Enclosures “t” protection type is ensured by placing their electrical parts in explosion-proof enclosure that complies with GOST IEC 60079-1 and GOST IEC 60079-31. Explosion protection of transmitters with Explosion-Proof Enclosure protection type is ensured by placing their electrical parts in explosion-proof enclosure that complies with GOST IEC 60079-1. The enclosure features a high mechanical strength degree. Specified explosion protection type precludes the transfer of an explosion inside the transmitter to the surrounding explosive atmosphere.

M.1.6.1.2 Explosion-proof enclosure of explosion-proof transmitters and its fastening element may withstand pressure tests inside an enclosure, equal to 4-fold explosion pressure.

Explosion protection of an enclosure is provided by manufacturing of its parts and their junction in compliance with the explosion protection parameters as per GOST IEC 60079-1 and GOST IEC 60079-31.

M.1.6.1.3 Explosion protection of an enclosure is provided by Explosion-Proof Enclosure (d) and Dust Ignition Protection by Enclosures “t” protection type.

Threaded explosion-proof connections are locked.

Threaded explosion-proof connections have at least 5 complete continuous non-damaged turns in the engagement.

M.1.6.1.4 Maximum temperature of the outer transmitter surface considering ambient temperature does not exceed permissible values provided for the temperature class and the surface temperature specified in the marking.

M.1.6.1.5 The nameplate attached to the transmitter housing bears the following explosion protection markings as per M.1.4.2.

X sign, which follows Ex marking of pressure transmitters with Explosion-Proof Enclosure protection type, means it is required to observe the following special conditions during operation:

– External electric circuits shall be connected to pressure transmitters through cable entries. Used Ex cable entries shall have valid certificates of conformity to CU TR 012/2011 for the relevant application and explosion protection type, as well as safety characteristics that do not adversely impact pressure transmitter safety parameters. Acceptable ambient temperature ranges (operating temperatures) of used Ex cable entries and cables shall correspond to acceptable ambient temperature range of pressure transmitters;

– Unused holes in pressure transmitter housings must be sealed with plugs having a valid certificate of conformity to CU TR 012/2011 for the relevant application and explosion protection type. Plugs shall have characteristics that do not adversely impact pressure transmitter safety parameters. Plugs must be protected from self-unfastening when installed into pressure transmitters;

– Explosion-proof joints of pressure transmitters are not subject to repair;

– It is prohibited to use pressure transmitters with aluminum alloy enclosures in underground shafts, mines and their above-ground structures, including those hazardous for mine gas (methane) and/or combustible dust;

– Mechanical strength of light-transmitting elements in inspection windows corresponds to a low risk of mechanical damage; when pressure transmitters with inspection windows are used in underground shafts, mines and their above-ground structures, including those hazardous for mine gas (methane) and/or combustible dust, inspection windows shall be protected from shocks and other mechanical impact;

– Dependence of the temperature class on the ambient temperature and the process temperature is given in Table M.12a:

Table M.12a

Ex Marking	Temperature Class (Surface Temperature)	Ambient (Process) Temperature Range, °C
1Ex db IIC T6…T4 Gb X Ex tb IIIC T85°C… T135°C Db X	T4 (135 °C)	–60 to 85 (–60 to 120)
	T5 (100 °C)	–60 to 85 (–60 to 85)
	T6 (85 °C)	–60 to 70 (–60 to 70)
PB Ex db I Mb X, PB Ex db ia I Mb X	-	–60 to 85 (–60 to 120)

Transmitters with Explosion-Proof Enclosure and Dust Ignition Protection by Enclosures “t” protection type (for EM, KM codes) are designed for operation in explosive areas where explosive mixtures of gases and steam with air (IIA, IIB, IIC category as per GOST 31610.20-1) and explosive dust atmospheres (IIIA, IIIB, IIIC categories as per GOST 31610.0) may be formed.

Transmitters with Explosion-Proof Enclosure protection type (for EC, KC, TC codes) are designed for operation in underground mines and their above-ground structures hazardous for mine gas (methane) and/or combustible dust

M.1.6.1.6 The detachable covers are labeled with a warning message stating: ‘Disconnect from Mains before Opening’.

M.1.6.2 Explosion protection of transmitters with Intrinsically Safe Electrical Circuit protection type (Exia, for IM, KM, IC, KC, TC codes).

M.1.6.2.1 Explosion protection of the transmitters with Exia protection type is ensured due to:

– Limitation of maximum input current (I_i=120mA), maximum input voltage (U_i=30V) and maximum input power (P_i=0.9W) in electrical circuits of secondary instruments operating together with the transmitter up to intrinsically safe values;

– Power load on intrinsically safe circuit elements does not exceed 2/3 of their rated values;

– Compliance of transmitter design with GOST 31610.11.

– Internal capacitance and inductance of electrical circuit do not accumulate energy hazardous for spark ignition of gas mixtures under IIA, IIB, IIC category as per GOST 31610.20-1 (for EM, KM codes), explosive dust atmospheres under IIIA, IIIB, IIIC category as per GOST 31610.0, as well as gas and dust under I group as per GOST 31610.0 (for EC, KC, TC codes).

M.1.6.2.2 Limitation of current, voltage and power in electrical circuits of transmitters up to intrinsically safe values is achieved through usage of the transmitter together with units/barriers having intrinsically safe electrical circuit of “ia” protection type for explosive mixtures of IIA, IIB, IIC subgroup, explosive dust atmospheres of IIIA, IIIB, IIIC category as per GOST 31610.0 (for IM, KM codes), as well as gas and dust under I group as per GOST 31610.0 (for IC, KC, TC codes) when voltage, current and power values of intrinsically safe electrical circuits do not exceed 30 V, 120 mA and 0.9 W respectively.

M.1.6.2.3 The transmitter bears the explosion protection marking in accordance with H.1.4.2.

X sign, which follows Ex marking of pressure transmitters with Intrinsically Safe Electrical Circuit protection type, means it is required to observe the following special conditions during operation:

− Pressure transmitters must be powered from intrinsic safety barriers (intrinsically safe power supplies) having a valid certificate of conformity to CU TR 012/2011;

− Total capacity and inductance of the transmitter intrinsically safe circuits, connected intrinsically safe equipment and cables shall not exceed maximum values stated in intrinsic safety barrier or intrinsically safe power supply on the side of explosion hazard zone;

− Dependence of the temperature class on the ambient temperature and the process temperature is given in Table M.12b:

Table M.12b

Ex Marking	Temperature Class (Surface Temperature)	Ambient (Process) Temperature Range, °C
0Ex ia IIC T6…T4 Ga X Ex ia IIIC T_{200}85°C… T_{200}135°C Da X	T4 (135 °C)	–60 to 85 (–60 to 120)
	T5 (100 °C)	–60 to 85 (–60 to 85)
	T6 (85 °C)	–60 to 70 (–60 to 70)
PO Ex ia I Ma X, PB Ex db ia I Mb X	-	–60 to 85 (–60 to 120)

− For transmitters with standard terminal block, insulation strength test with RMS voltage of 500 VAC as per GOST 31610.11 is not carried out (protection is triggered), which must be taken into account;

− Electronics module enclosure may be made of aluminum alloy with a polyurethane paint finish which may constitute a potential electrostatic ignition risk; care should be taken to protect it from impact or abrasion that may cause sparking when located in Zone 0;

− Unused holes in pressure transmitter housings must be sealed with plugs having a valid certificate of conformity to CU TR 012/2011 for the relevant application and explosion protection type. Plugs shall have characteristics that do not adversely impact pressure transmitter safety parameters. Plugs must be protected from self-unfastening when installed into pressure transmitters;

− External electric circuits shall be connected to pressure transmitters through cable entries or the manufacturer's plug and socket connector. Used Ex cable entries shall have valid certificates of conformity to CU TR 012/2011 for the relevant application and explosion protection type, as well as safety characteristics that do not adversely impact pressure transmitter safety parameters. Acceptable ambient temperature ranges (operating temperatures) of used Ex cable entries and cables shall correspond to acceptable ambient temperature range of pressure transmitters;

− It is prohibited to use pressure transmitters with aluminum alloy enclosures in underground shafts, mines and their above-ground structures, including those hazardous for mine gas (methane) and/or combustible dust;

− Mechanical strength of light-transmitting elements in inspection windows corresponds to a low risk of mechanical damage; when pressure transmitters with inspection windows are used in underground shafts, mines and their above-ground structures, including those hazardous for mine gas (methane) and/or combustible dust, inspection windows shall be protected from shocks and other mechanical impact.

Transmitters with Intrinsically Safe Electrical Circuit protection type (for IM, KM codes) are designed for operation in explosive areas where explosive mixtures of gases and steam with air (IIA, IIB, IIC category as per GOST 31610.20-1, Class T1–T6) may be formed, as well as in explosive dust atmospheres (IIIA, IIIB, IIIC categories as per GOST 31610.0).

Transmitters with Intrinsically Safe Electrical Circuit protection type (for IC, KC, TC codes) are designed for operation in underground mines and their above-ground structures hazardous for mine gas (methane) and/or combustible dust as per GOST 31610.0.

M.1.6.3 Exd/Ext or Exia transmitters (KM code), Exd and (or) Exia transmitters (KC code) may be installed at customer's discretion considering requirements to the implemented protection type. The customer must ensure the identification marking to comply with the selected Ex marking.

M.1.6.4 Explosion-proof transmitters shall comply with the requirements of CU TR 012/2011 and GOST 31610.0 at the process temperature in the transmitter operating area as per Tables M.12a and M.12b.

M.2 Operation

M.2.1 General instructions - see section 2.1 SPGK.5225.000.00 RE.

M.2.2 Safety measures.

M.2.2.1 To ensure electrical safety at facilities where transmitters are installed it is required to:

– Perform wiring in accordance with Appendix D, SPGK.5225.000.00 RE;

– Ensure that transmitter wiring is performed by personnel who have been authorized to work at electrical installations with voltage up to 1000 V and have read this manual;

– Ground the transmitter housing;

– During hipot testing, consider safety requirements set for the equipment.

Transmitters have the following electrical safety characteristics:

– Transmitters are classified in Class 01 in accordance with GOST 12.2.007.0 by electric shock protection method;

– Insulation resistance and strength comply with M.1.2.51, M.1.2.50;

– The transmitter should be connected and disconnected at power off.

M.2.2.2 To connect transmitters to or to disconnect them from main pipes supplying measured fluid, first close the valve upstream. The transmitter should be disconnected when pressure in the transmitter is decreased down to atmospheric pressure.

M.2.2.3 Do not use transmitters that have modules filled with silicone fluid in processes where such fluid shall not be mixed with measured medium for safety reasons.

M.2.2.4 Do not use 150CD transmitters in systems where operating gage pressure may exceed the limiting values specified in Table M.3.

Do not use 150CG/150TG/150TA transmitters in systems where pressure may exceed the maximum limiting values given in Tables M.1, M.2, M.4.

Do not use 150CD transmitters with remote seals (S1, S2 codes) in systems where operating gage pressure may exceed the lowest value of remote seal nominal pressure (specified on the flange) and maximum allowable gage pressure of the transmitter (Table M.3).

Do not use 150CG/150TG/150TA transmitters with remote seal (S1 code) in systems where pressure may exceed the lowest value of remote seal nominal pressure (specified on the flange) and maximum upper range value of the transmitter (Tables M.1, M.2, M.4).

M.2.2.5 Explosion-proof transmitters are to be installed in hazardous areas and outdoor installations in compliance with GOST IEC 60079-14 and other documents regulating the use of electrical equipment in explosive environments.

M.2.2.6 Transmitters meet safety requirements as per GOST 12.2.091.

M.2.3 Explosion protection of transmitters during installation - section 2.3 SPGK.5225.000.00 RE.

M.2.4 Installation procedure - section 2.4 SPGK.5225.000.00 RE.

M.2.5 Preparation for operation - section 2.5 SPGK.5225.000.00 RE.

M.2.6 Measurement, adjustment and calibration of transmitters

M.2.6.1 Setup tools

Configuration of the transmitters with the output signal code (4-20 mA / HART) is carried out via the digital communication channel using control devices that support HART protocol version 7. To configure, a HART modem is required, and the latest version of the device driver (DD) needs to be downloaded from the website.

The DD menu tree is provided in section M.9.

Note: The DD screen examples provided in this manual may vary with the customer’s host system.

Setting up of transmitters complete with an indicator (code M5) shall be done using buttons located under the cover of the electronic converter. The indicator menu structure can be found in section M.10.

The transmitters can be calibrated to zero by an external pushbutton located on the electronic transmitter enclosure. A Zero Trim is completed with the external button when the transmitter is at zero pressure. The limits of permissible offset during zero trim of the transmitter depending on the set measurement range are listed in section M.1.2.16

M.2.6.2 Setting of basic parameters for transmitter operation.

M.2.6.2.1 Setting the loop to manual control mode.

Whenever sending or requesting data that would disrupt the loop or change the output of the transmitter, set the process application loop to manual.

If necessary, the setting tool outputs a message to switch the loop to manual mode. The message is only a reminder and its acknowledgement does not mean that the loop has been set to manual mode.

A separate operation must be performed to set the loop to manual mode.

M.2.6.2.2 Checking the settings

It is recommended to check the following setup parameters before installing in the process:

– Alarm and Saturation Levels;

– Damping;

– Process variables

– URL and LRL values;

– Tag;

– Conversion Function;

– Units of measurement.

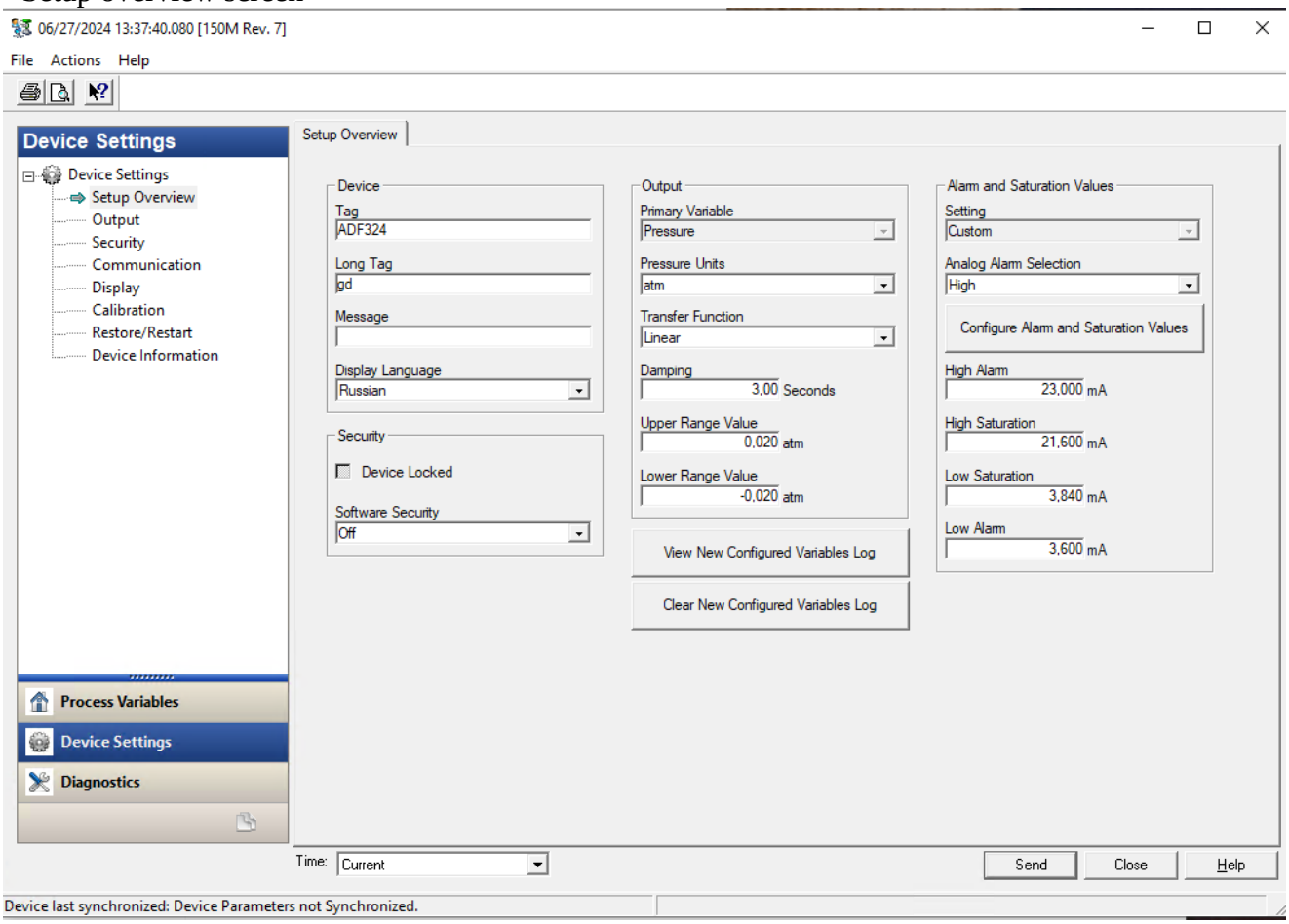
Reviewing the configuration settings using the communication device.

Procedure:

1. Navigate to ‘Device Settings → Setup Overview → Alarm and Saturation Values’ to adjust the alarm and saturation levels.

2. Access ‘Device Settings → Setup Overview→ Output’ to configure the damping.

Setup overview screen



3. Adjust the process variables as follows:

a) To adjust the primary variable, navigate to ‘Device Settings → Output → Analog Output → PV Setup’;

b) To adjust other process variables, navigate to ‘Device Settings → Communication → HART → Variable Mapping’.

4. To set the range values, go to ‘Device Settings → Output → Analog Output → PV Setup’.

5. To set the tag, go to ‘Device Settings → Setup Overview → Device’.

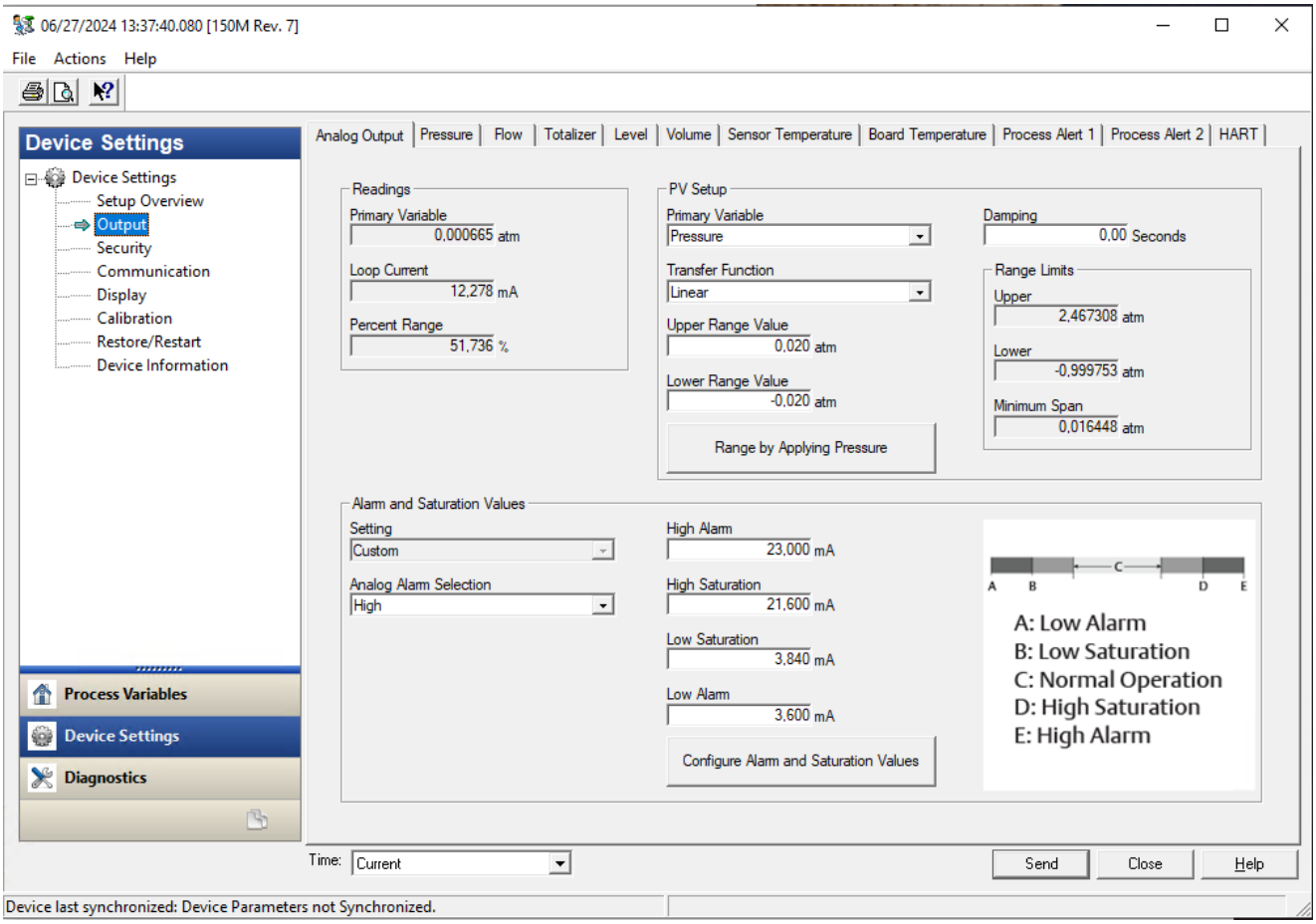
6. To set the transfer function, go to ‘Device Settings → Output → Analog Output → PV Setup’.

7. Set the measurement units:

a) to set the pressure units, go to ‘Device Settings → Output → Pressure → Setup’;

b) to set other measurement units, go to ‘Device Settings → Output → Pressure/Flow/ Totalizer/Level/Volume/Sensor Temperature/Board Temperature → Setup’.

Output Setup Screen



Reviewing the setting parameters using the buttons and indicator.

Procedure:

1 Keep pressed the setting button ‘1’ for 2 seconds to enable the indicator.

2 Use the menu structure, section H.10, to check the setting parameters.

M.2.6.2.3 Setting the pressure units

The command ‘pressure units’ sets the units of the pressure to be measured.

The procedure is the same for the other variables:

– Flow rate;

– Totalizer;

– Level;

– Volume;

– Sensor temperature;

– Board temperature.

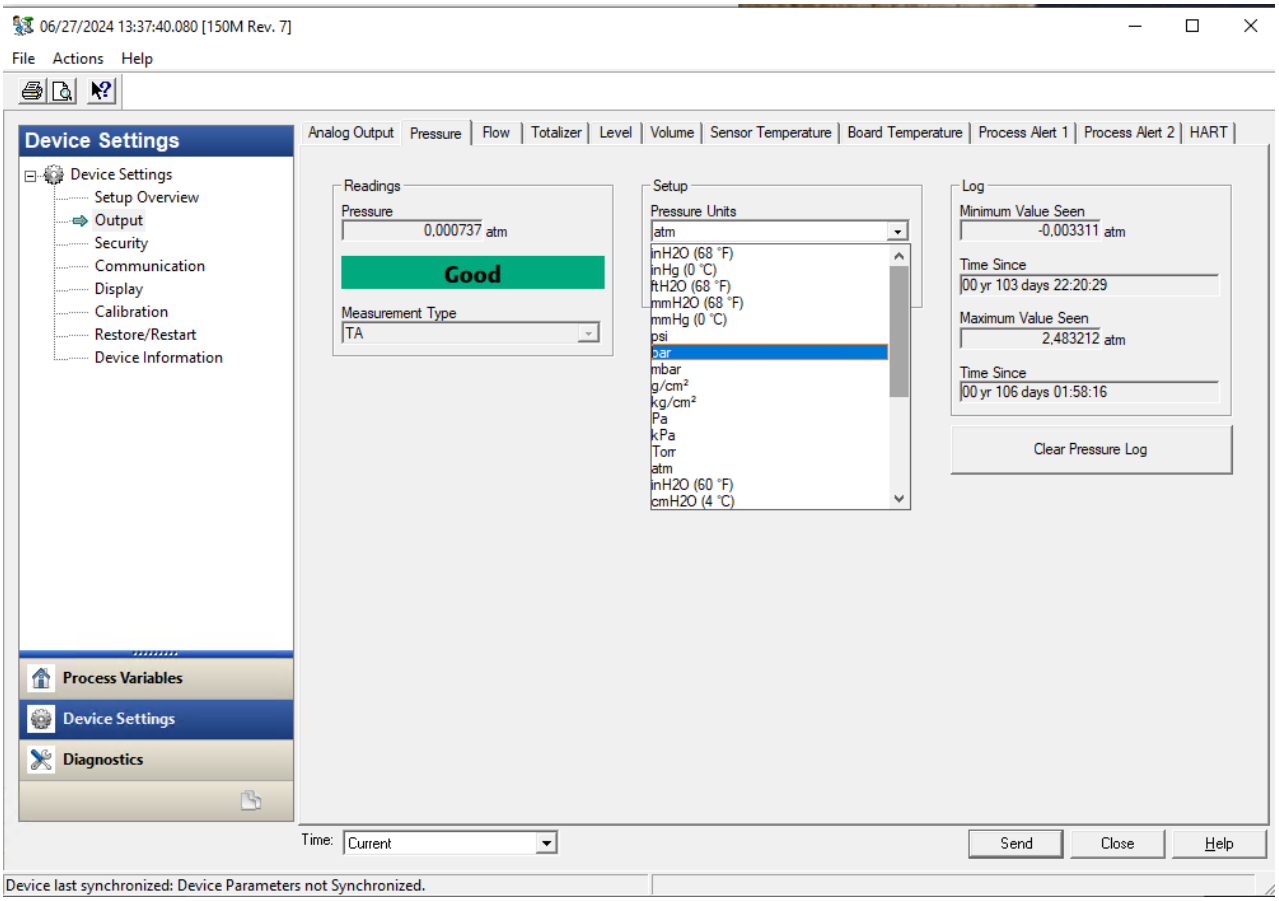
Select the desired variable and then follow the procedure below, using the desired variable instead of the pressure unit.

Set the pressure units using a communication device.

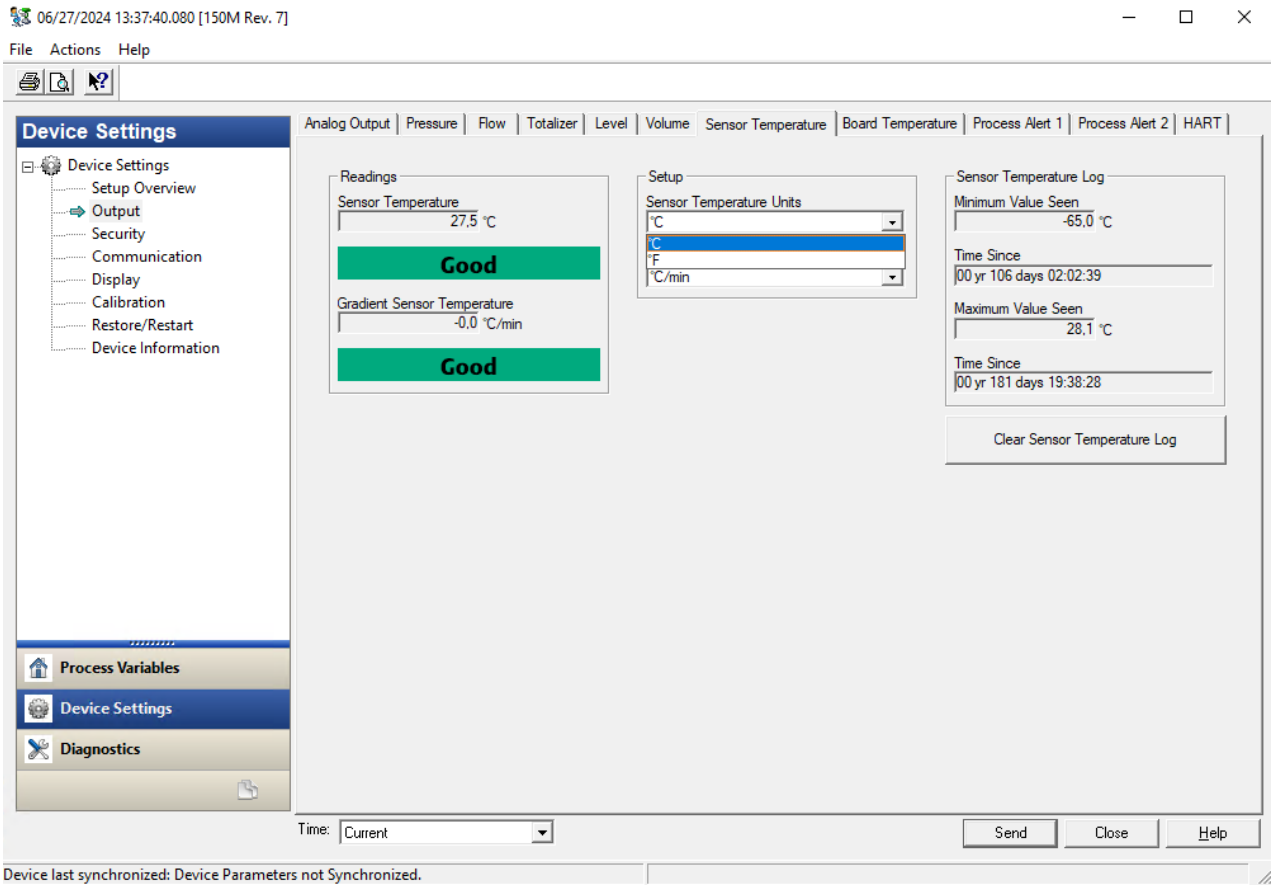
Procedure:

Go to ‘Device Settings → Output → Pressure → Setup’.

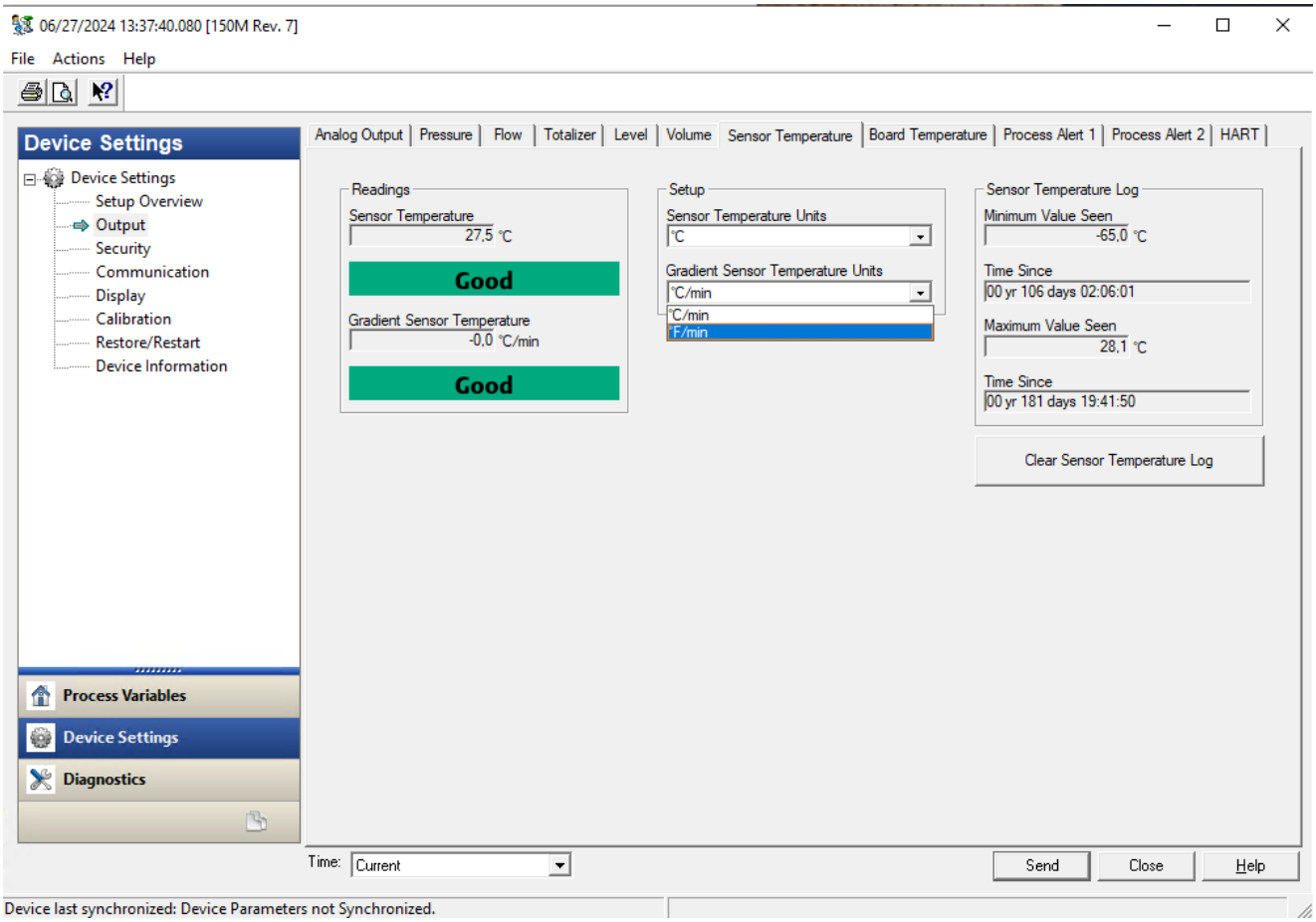
Pressure Unit Setup Screen



Sensor Temperature Unit Setup Screen



Sensor Temperature Gradient Unit Setup Screen



Temperature gradient is a derivative variable that describes the temperature change rate. The transmitter calculates the temperature gradient once every minute.

Note: Once the transmitter is powered on, the sensor/board temperature gradient readings are always equal to NAN until 2 minutes pass to obtain two temperature samples.

Set the pressure measurement units using the pushbuttons and indicator.

Procedure:

1 Keep pressed the setting button ‘1’ for 2 seconds to enable the indicator.

2 Select the ‘UNITS’ menu.

M.2.6.2.4 Setting the transfer function

The transmitters have two output settings: linear and square root.

The square root setting makes the analogue output signal proportional to the flow rate and includes a fixed low flow cut-off of four percent (entering the cut-off) and a low flow cut-off of five percent (leaving the cut-off) of the analogue output square root range.

It is recommended that a special setting be used to adjust the flow rate for differential pressures. When flow rate is assigned to the primary variable, the transfer function is automatically set to the square root of the pressure. The analogue output signal will be linear with respect to the flow rate.

Setting the transfer function using a communication device.
Procedure:
Go to ‘Device Settings → Output → Analog Output → PV Setup → Transfer Function’.

Setting the output transfer function using the buttons and indicator.
Procedure:
1 Keep pressed the setting button ‘1’ for 2 seconds to enable the indicator.
2 Go to ‘TR FNC → LINEAR → S ROOT’.

M.2.6.2.5 Measurement range readjustment

The range value command allows each of the lower and upper analogue range values (4 and 20 mA) to be set to the required pressure values. The lower range value represents 0% of the range and the upper range value represents 100% of the range.

The range can be changed:
– without pressure;
– with a pressure supply source.

Range reconfiguration using a communication device.
Procedure
1. Go to ‘Device Settings → Output → Analog Output → PV Setup’.
2. Do one of the following:
– Manually enter the range points.
– Select ‘Range by applying pressure’ and follow the instructions.

Range reconfiguration using the buttons and indicator.
Procedure:
1 Keep pressed the setting button ‘1’ for 2 seconds to enable the indicator.
2 Select the ‘RANGE’ menu.
3 Do one of the following:
• Select ‘20 MA’, ‘4 MA’ to manually enter the range points.
• Select the ‘APPLY’ menu and follow the instructions to use the input pressure source.

M.2.6.2.6 Damping setting

The damping command changes the response time of the transmitter, higher values can smooth out output fluctuations caused by rapid changes in input pressure.

Determine the appropriate damping setting based on the necessary response time, signal stability, and other requirements of the loop dynamics of the system. The damping command uses a floating point setting that allows you to enter any damping value between 0 and 60 seconds.

Configure Damping Using a Communication Device
Procedure:
Go to ‘Device Settings → Output → (select the output for which you want to set damping (e.g., Pressure or Level) → Setup → Damping’.

Setting the damping using the buttons and indicator.

Procedure:

1 Keep pressed the setting button ‘1’ for 2 seconds to enable the indicator.

2 Go to the ‘DAMPNG’ menu.

M.2.6.2.7 Setting the display

Set the display according to the requirements of your application. The display will alternately show the selected items:

- Pressure
- Sensor Temperature;
- Board Temperature;
- Percent of Range;
- Analog Output;
- Level;
- Volume;
- Flow rate;
- Totalized Flow .

On the display, you can adjust the screensaver displayed during the transmitter start-up, the display language, backlight turning on and off.

When setting the screensaver on the display upon transmitter activation: all segments are lit → all segments are off → the symbol string displays ‘METRAN’, the digital string shows ‘150’ → the measured value of the variable configured for display on the indicator. When the screensaver is off, upon transmitter activation, the measured value of the variable configured for display on the display will be shown.

The display may be set for backlight flashing to indicate errors and warning (refer to Display Setup Screen).

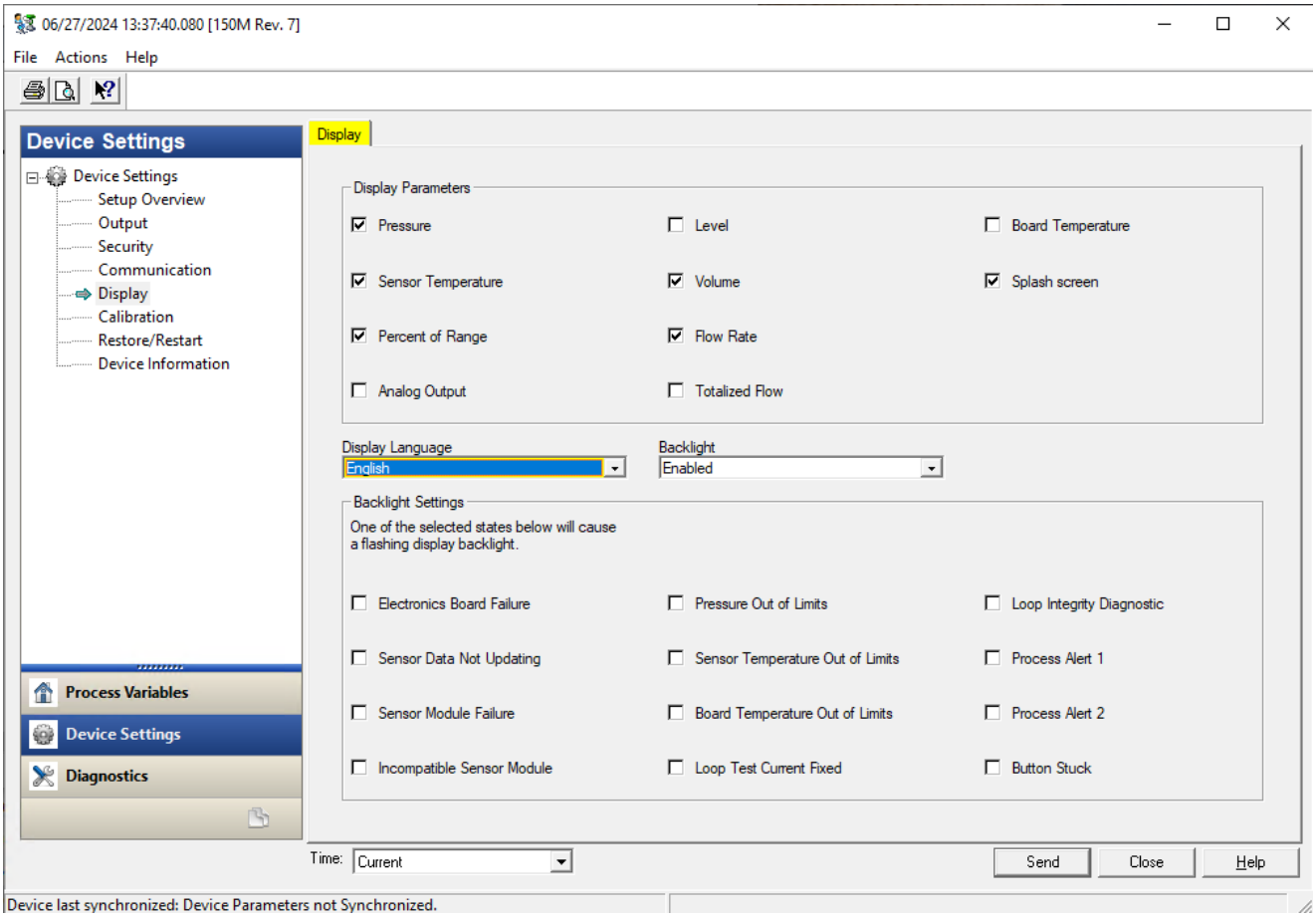
Note: By default (without selected states), the backlight flashes when “Circuit Board Failure” and “Sensor Failure” errors occur.

Setting the display using a communication device.

Procedure:

Go to ‘Device Settings → Display → Display → Display Parameters’.

Display Setup Screen



Setting the display using the display buttons.

Procedure:

1 Keep pressed the setting button ‘1’ for 2 seconds to enable the display.

2 Select the ‘DISPLY’ menu.

Note: Display backlight is not adjusted with buttons.

M.2.6.3 Setting the transmitter special parameters.

M.2.6.3.1 Flow setting

Flow rate is not a significant measured parameter.

With the flow rate setting you can create a relationship between pressure units and user-defined flow units. By determining the pressure at a given flow rate, the transmitter will perform a square root extraction to convert the pressure reading into a linear flow output.

The flow rate settings include the following parameters:

• Flow Rate Units: user-defined flow units.

• Entered Flow Rate: user defined flow rate.

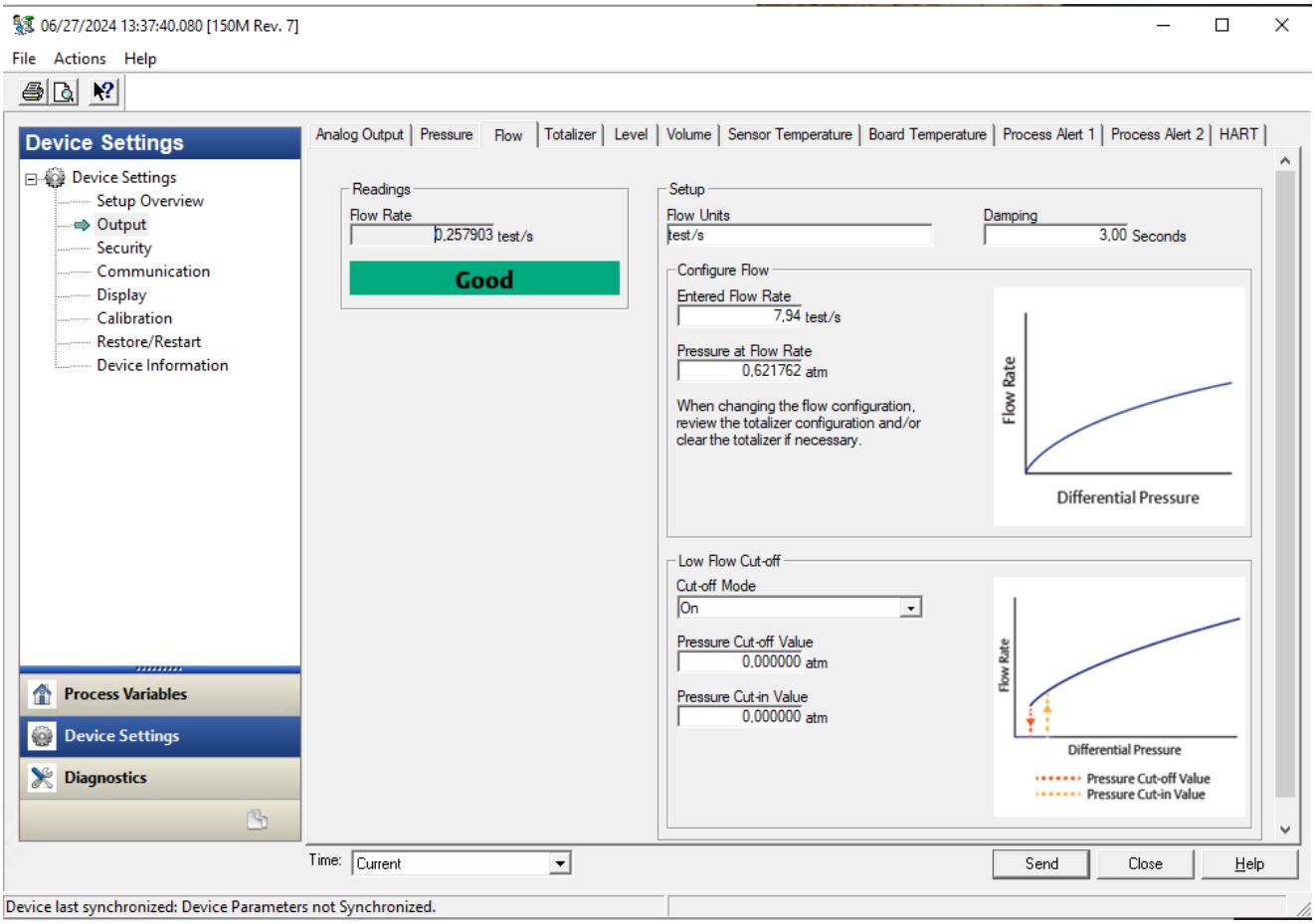
• Flow Pressure: user-defined pressure at the preset flow rate.

Setting the flow rate using a communication device.

Procedure:

Go to ‘Device settings → Output → Flow rate → Setup → Configure Flow’.

Flow Rate Setup Screen



Setting Low Flow Cut-Off.

It is advisable to utilize this setting to maintain stable output values and to prevent issues related to process noise, low or no flow.

Two crucial definitions can aid in grasping the concept of low flow cut-off:

– Pressure Cut-off Value: this refers to the pressure at which the transmitter will cease flow measurement. If the measured pressure drops below the cut-off pressure, the transmitter will interpret the flow rate as zero.

– Pressure Cut-in Value: this represents the pressure at which the transmitter will resume flow measurement. When the measured pressure exceeds the cut-in value, the transmitter will begin measuring flow.

Setting the cut-off point using a communication device.

Procedure:

Go to ‘Device settings → Output → Flow rate → Setup → Low flow Cut-off’.

M.2.6.3.2 Setting Up the Totalizer

Totalizer is not a significant measured parameter.

When setting up the flow meter, it will monitor the volume of flow that has moved through the measurement point within a specific timeframe. The total flow output is linked to the defined flow rate and necessitates the following input information:

Totalizer units.

This pertains to the unit of measure associated with the flow rate mass or volume aspect, with a maximum of six characters.

Flow rate time units.

This refers to the unit of measure linked to the flow rate time component.

Example:

For m^3/h flow rate, the flow meter unit is m^3 and the flow time unit is hour.

The flow rate unit is displayed on the communication device for convenience when setting the flow meter on the communication device.

Direction.

The totalizer can be configured to support the following flow directions:

– Forward Flow Only – only monitors flow in the forward direction (positive pressure drop);

– Reverse Flow Only – only tracks flow in the reverse direction (negative pressure drop);

– Gross Flows = Forward Flow + Reverse Flow;

– Net Flow = Forward Flow – Reverse Flow.

Maximum value.

The maximum value that the totalizer can measure is displayed.

Unit conversion factor.

Used to determine the specific unit of measurement.

Example: When the unit entered is liters and the target totalizer value is 1 m^3, a conversion factor of 0.001 can be applied to convert liters to m^3.

If the desired flow meter value is in liters, you would use a unit conversion factor of 1.

Setting the totalizer using a communication device.

Procedure:

1. Go to ‘Device Settings → Output → Totalizer → Setup’.

2. After the totalizer is configured and you are ready to start summing up, perform the following:

a) go to ‘Device Settings → Output → Totalizer → Control’;

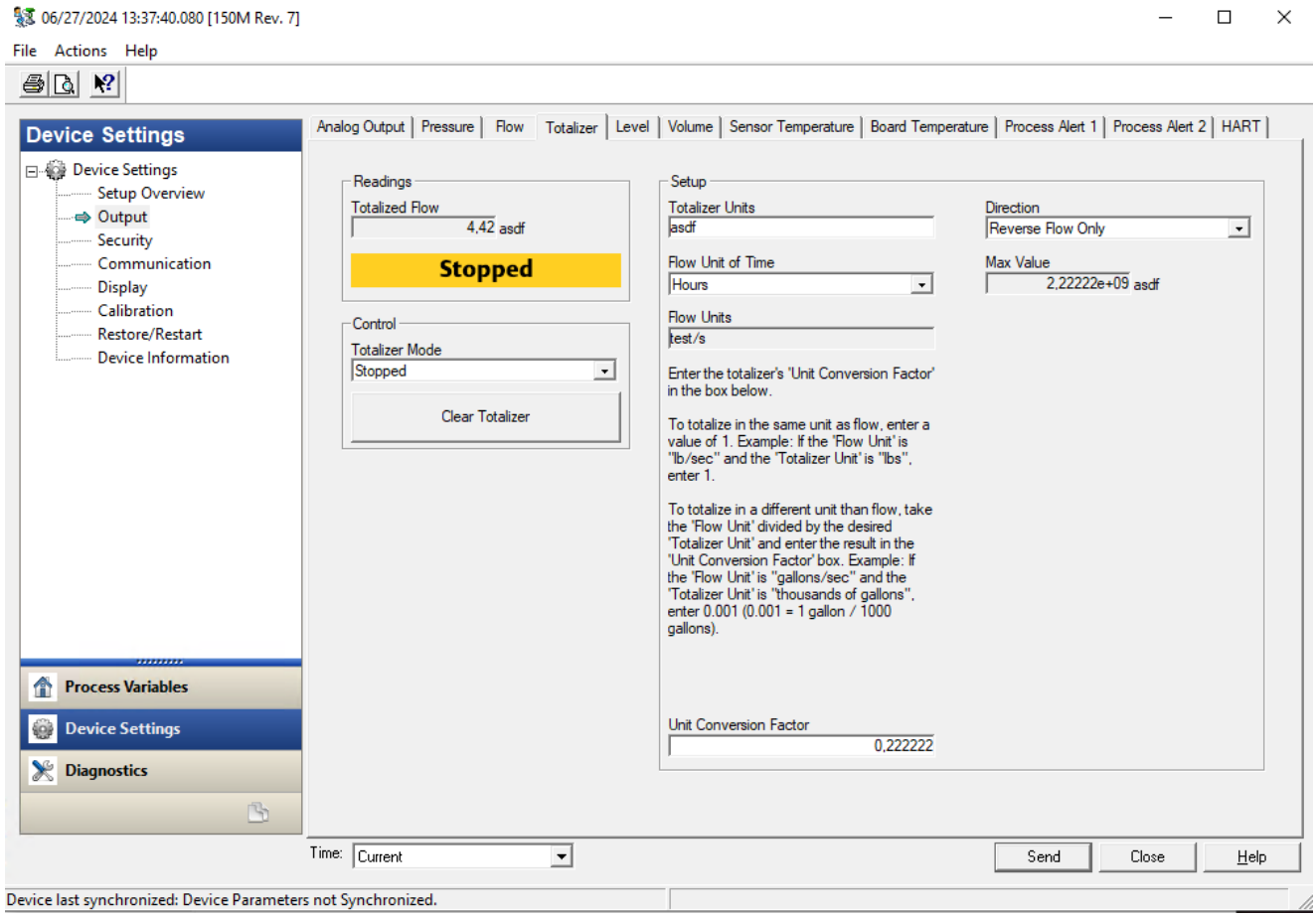
b) set the ‘Totalizer Mode’ parameter to ‘Stopped’;

c) run the ‘Clear Totalizer’ method;

d) set the ‘Totalizer Mode’ parameter for the summing operation.

Note: If software protection is enabled, it is not possible to clear the totalizer.

Totalizer Setup Screen



M.2.6.3.3 Level setup

Level is not a significant measured parameter.

Pressure created by the liquid column in the tank depends on three factors:

- Liquid level;
- Liquid surface pressure;
- Liquid density.

Using these variables, the level can be calculated based on pressure.

Pressure at a point under the liquid surface increases as the liquid head above the measuring point rises.

Since the liquid pressure depends directly on the liquid level in the tank, pressure measurement can be used to determine the level.

The pressure depends on the liquid head. Hydrostatic pressure can be calculated by multiplication of the liquid head by specific gravity.

Liquid surface pressure is a pressure applied above the column of the measured liquid. In an open tank, atmospheric pressure acts on the surface. If a tank is closed or pressurized, correct measurement of the head pressure can be ensured by taking into account the effect of the surface pressure. This compensation can be made when measuring differential pressure. To measure particularly the liquid column pressure during level measurement, the measured surface pressure should be deducted from the total pressure.

As the liquid is heated or cooled, the liquid volume is increased or decreased, which leads to changes in liquid density (weight to volume ration). Thus, temperature has a significant effect on liquid

density. Temperature changes will have an effect on level. Though changes in density can be temperature compensated, density is the factor that can introduce a significant error to the level value based on density.

If the pressure transmitter is installed with impulse tubing (dry and wet legs), the transmitter functioning will depend on ambient temperature changes, since they will lead to changes in density of fill fluid in wet leg or accumulated condensate in dry leg. Closed capillary systems can reduce the effect of some of these factors and can be selected to reduce additional error.

Level setup

With the level setup function, you can convert the transmitter into output data in the level units by creating a relationship between the measured pressure units and the desired level units.

To define this relationship directly, set the maximum pressure at the max. level and the minimum pressure at the min. level.

Level setting parameters.

When setting the level, the relationship between pressure and level will be obtained using the following parameters:

- level units:
  user-selectable level units;
- tank configuration:
  tank is Pressurized Tank or Vented Tank;
- measurement technology:
  selection depends on the tank configuration:
  • Transmitter with Capillary,
  • Direct Mount Transmitter,
  • Impulse Piping (liquid-filled (wet "leg") or dry (dry "leg");
- Maximum Level – the maximum level that can be measured;
- Minimum Level – the minimum level that can be measured;
- Process Fluid Specific Gravity.

If necessary:

– Vertical Distance – the vertical distance between the process connection on the high-pressure side and the transmitter;

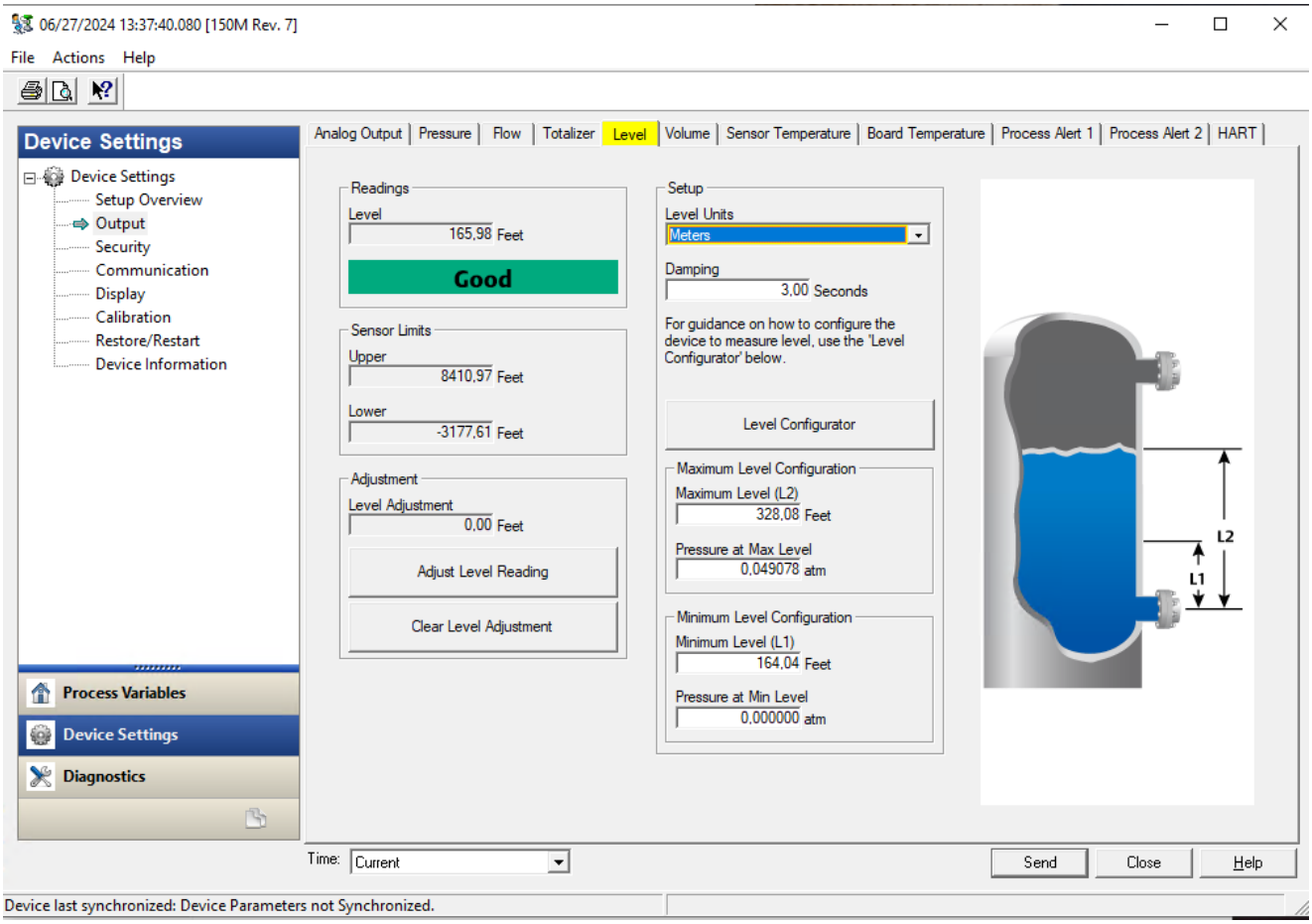
- Fill Fluid – the fill fluid used in a capillary system with remote diaphragms;
- Wet Leg – the height of the Impulse Piping side sensing line filled with liquid;
- Specific Gravity of the liquid filling the low-pressure side sensing line.

Level setup.

Procedure:

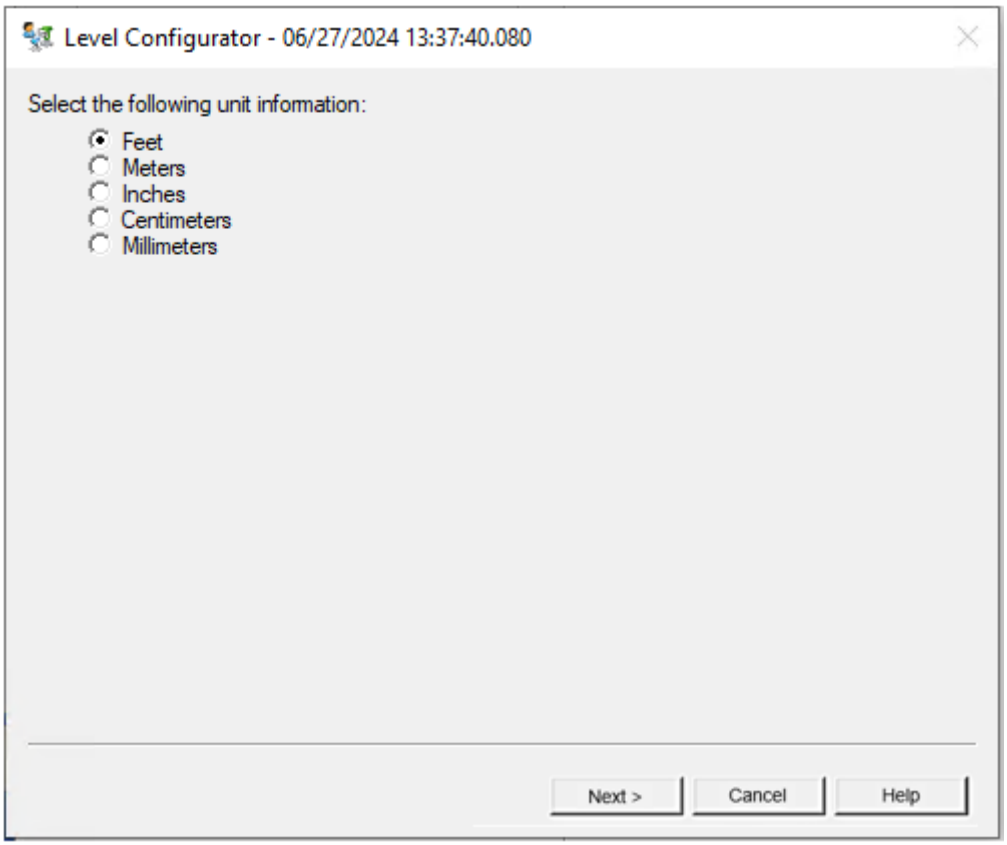
Go to ‘Device Settings → Output → Level → Setup’.

Level Setup Screen

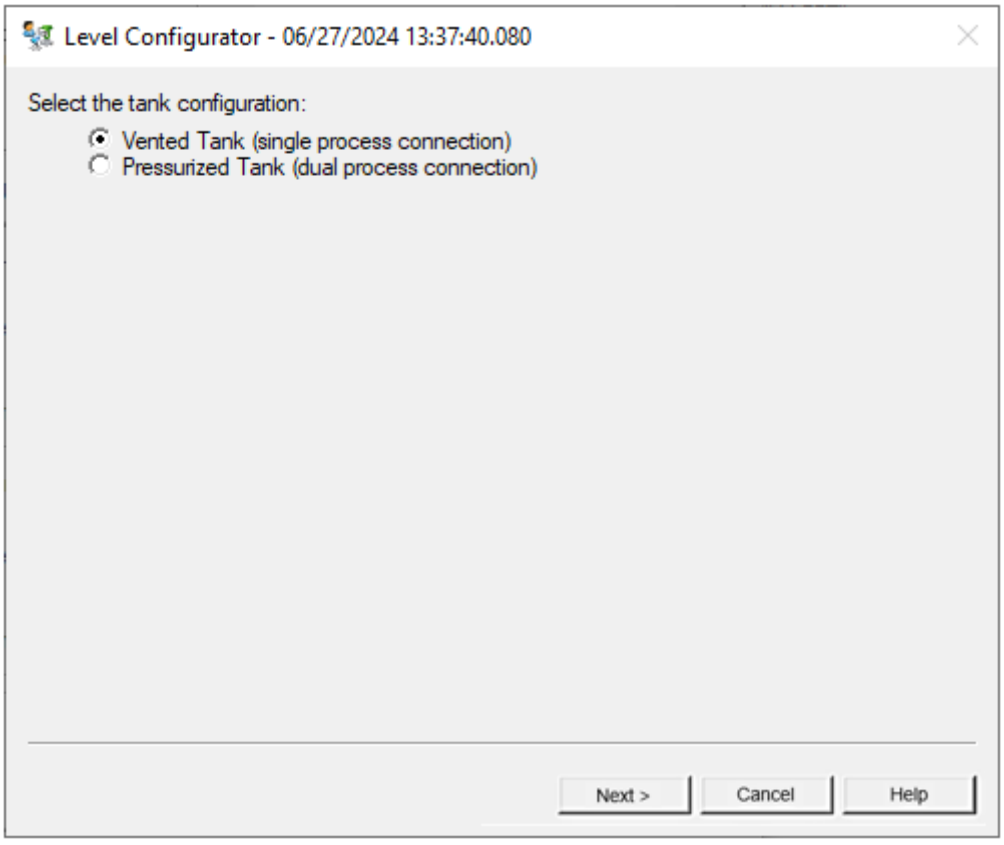


Level Setup screens:

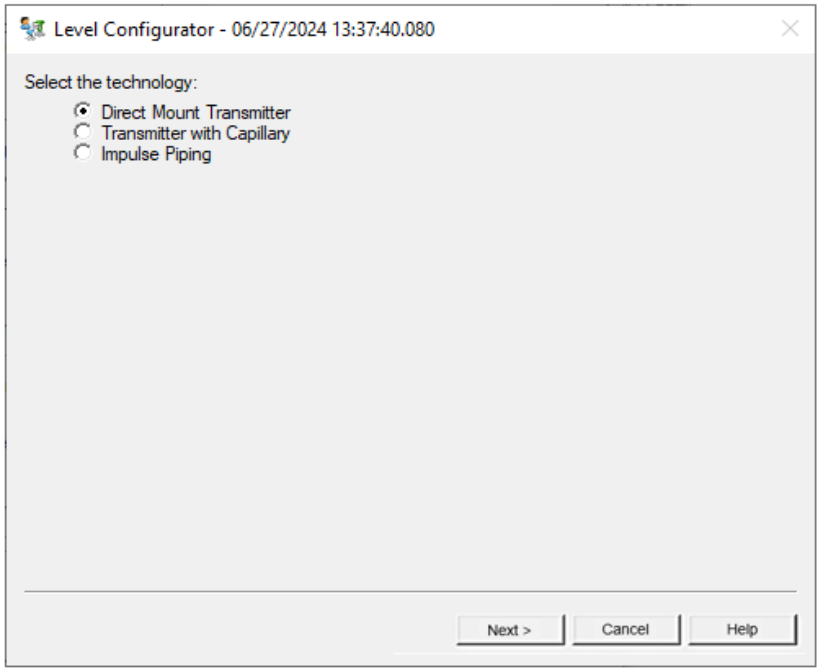
Engineering Unit Setup screen



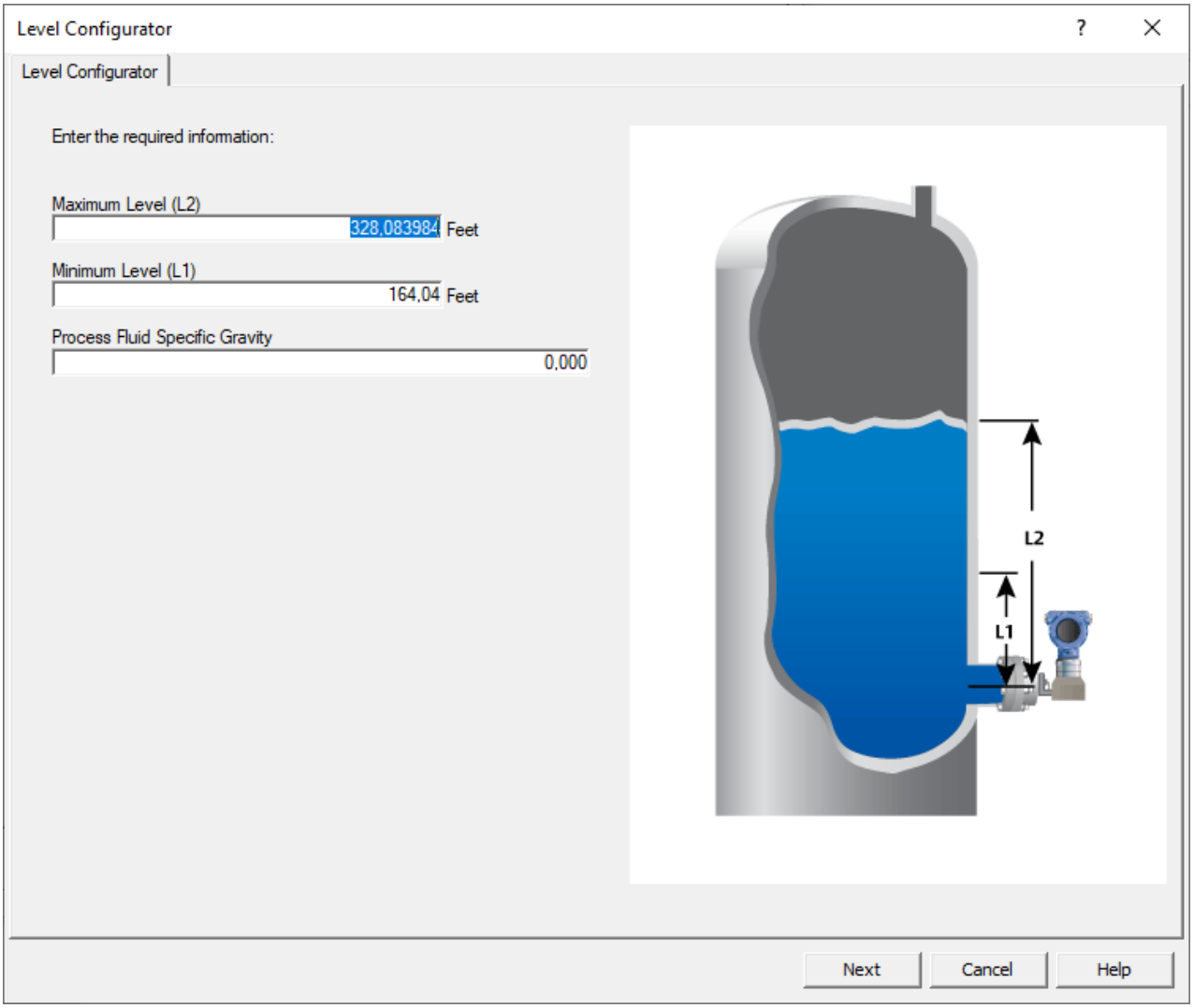
Tank Configuration Screen (open tank)



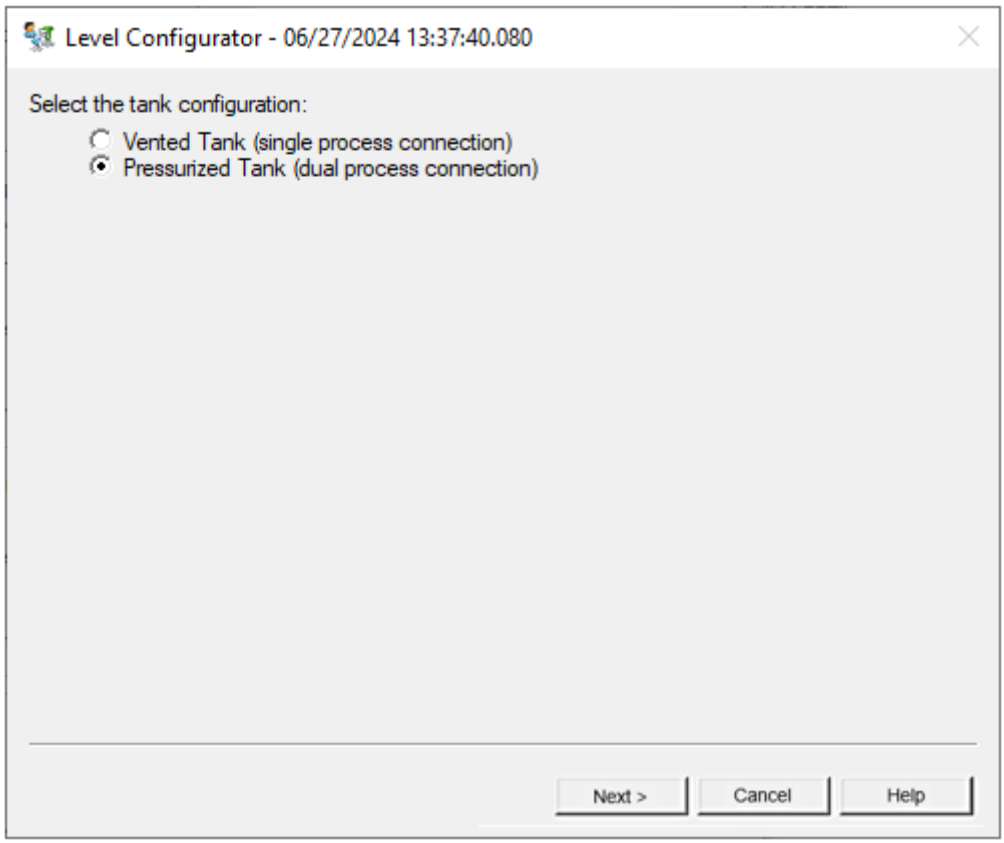
Measurement Method Screen (direct mounting)



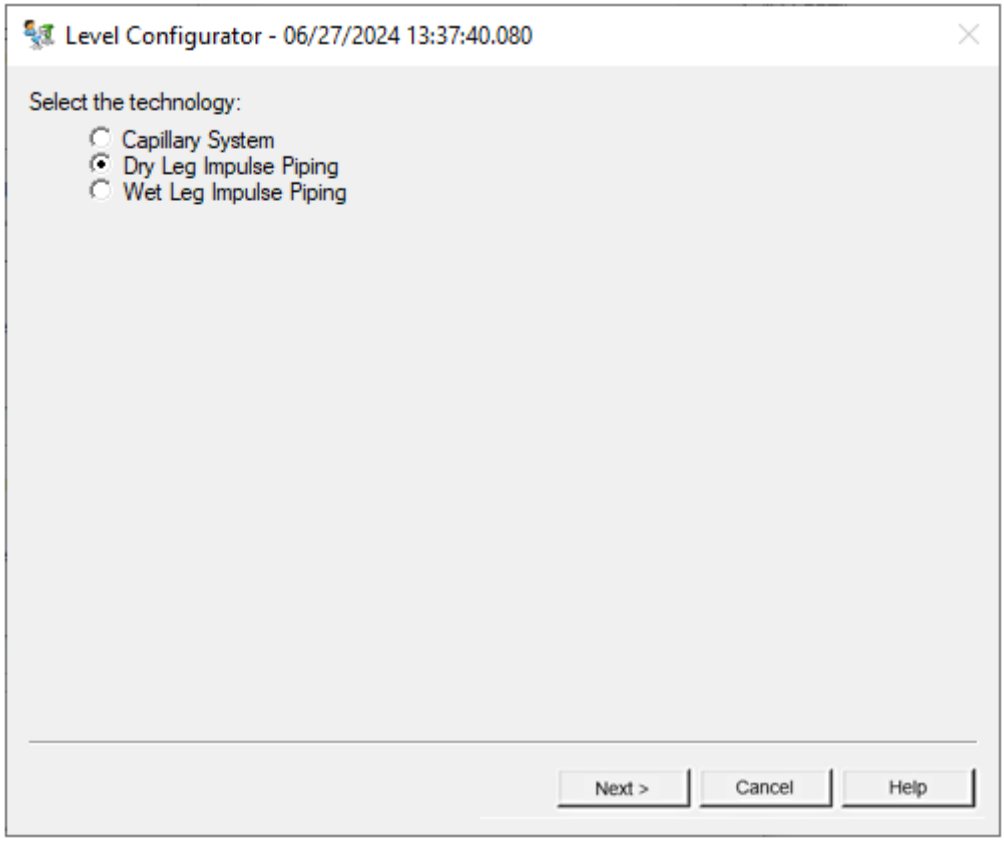
Required Information screen



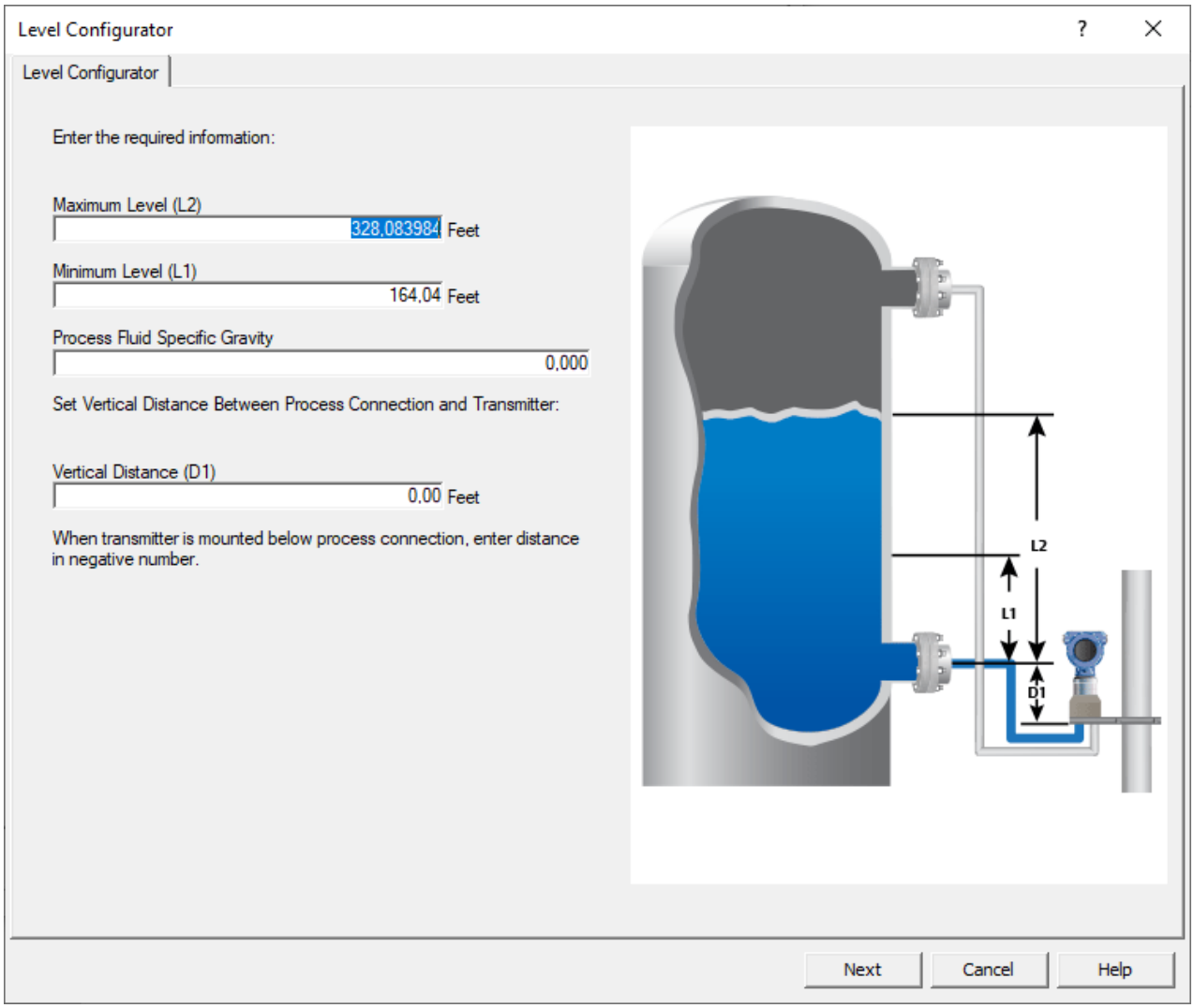
Tank Configuration screen - closed tank



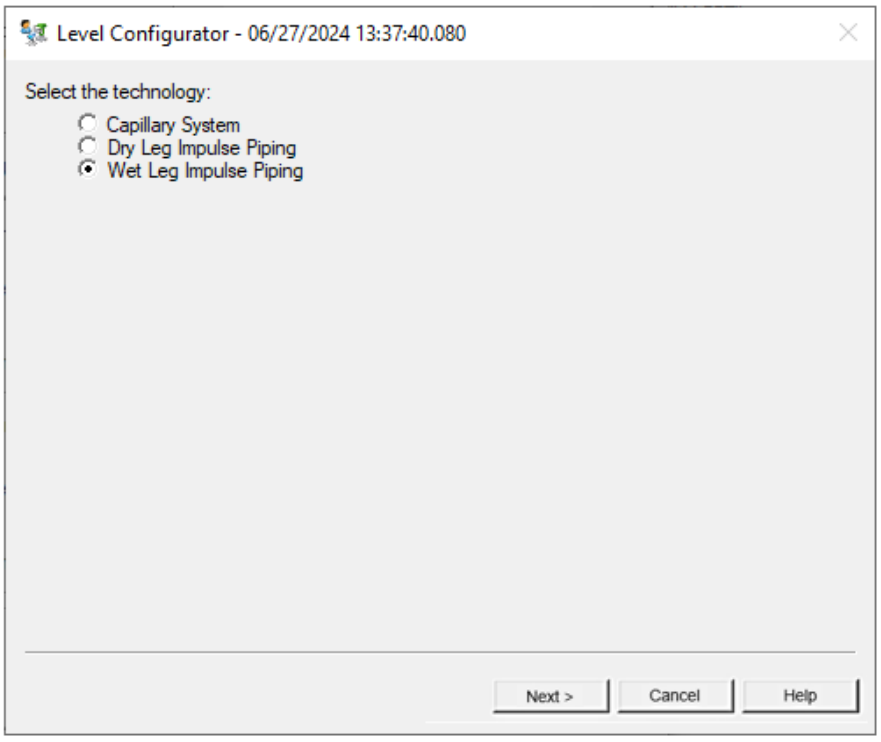
Measurement Method Screen - Dry leg impulse line



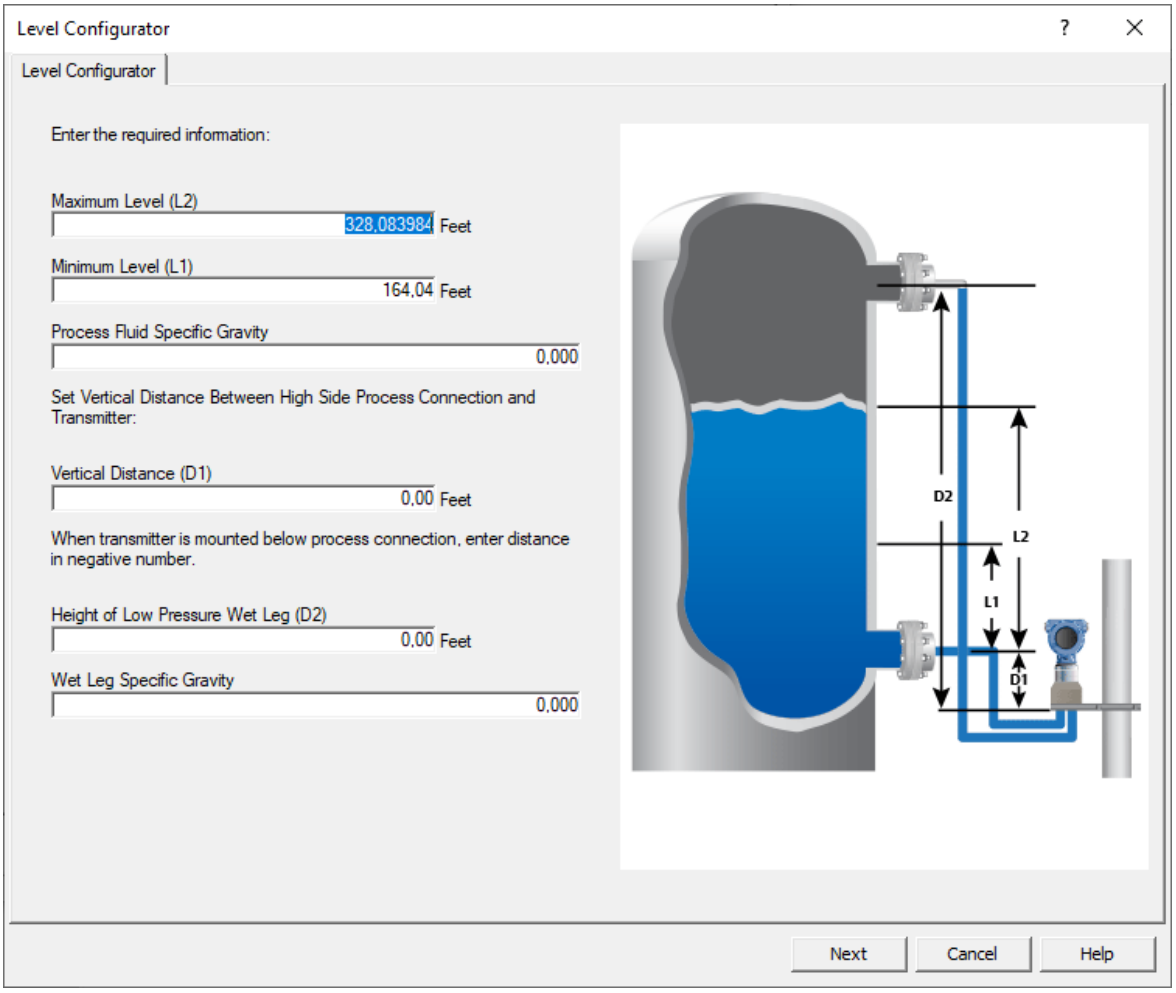
Required Information for Dry Leg Measuring Method Screen



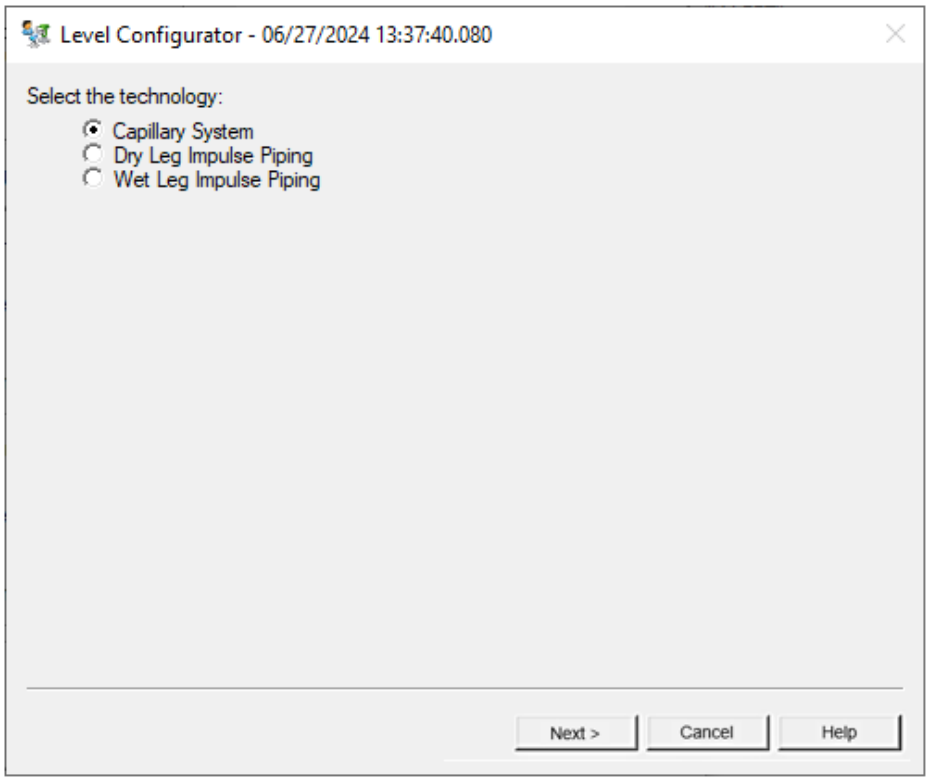
Measuring Technique screen - Wet leg impulse line



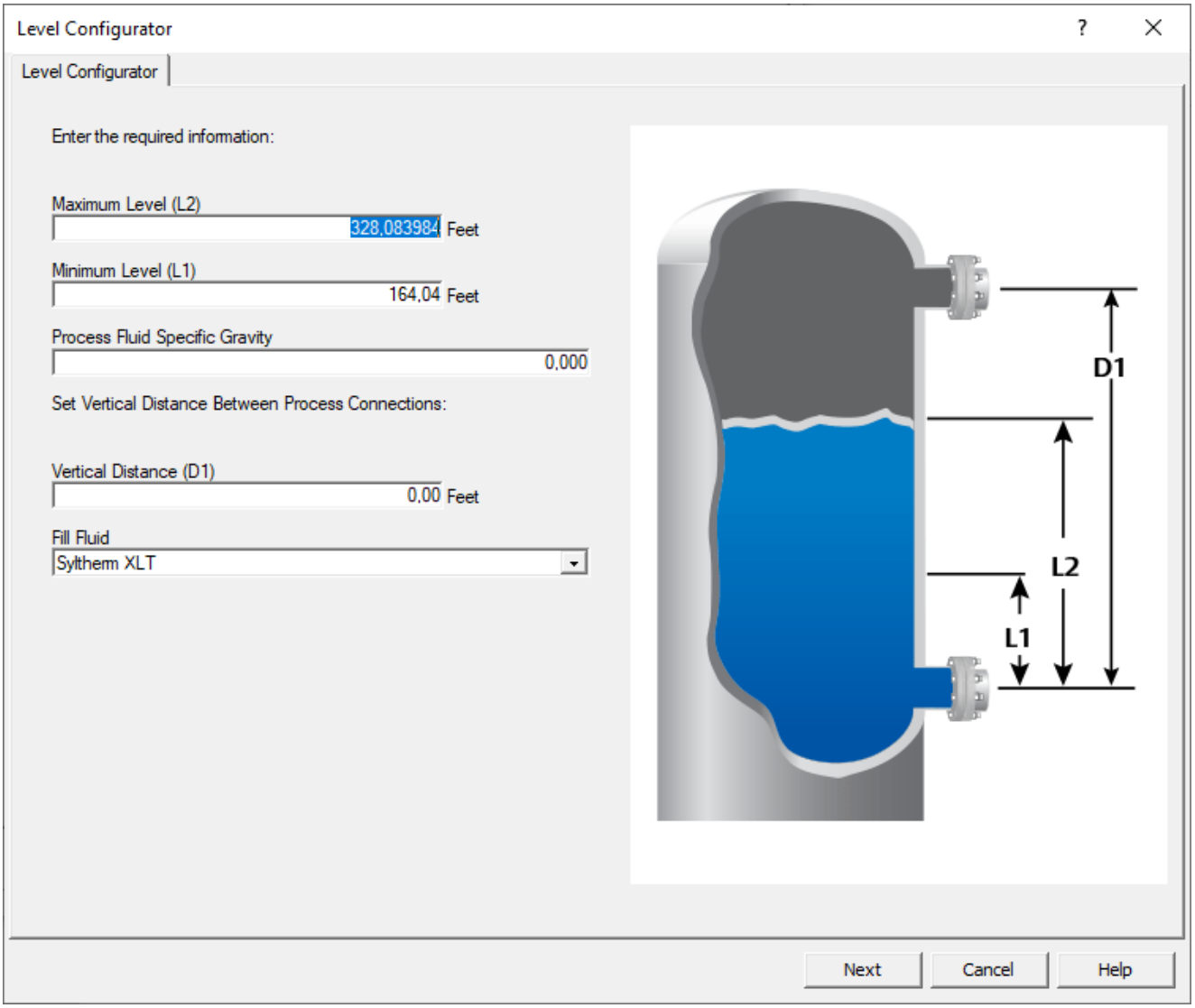
Required Information for Wet Leg Screen



Measuring Technique screen - Capillary system for closed tank



Required Information for Capillary System screen



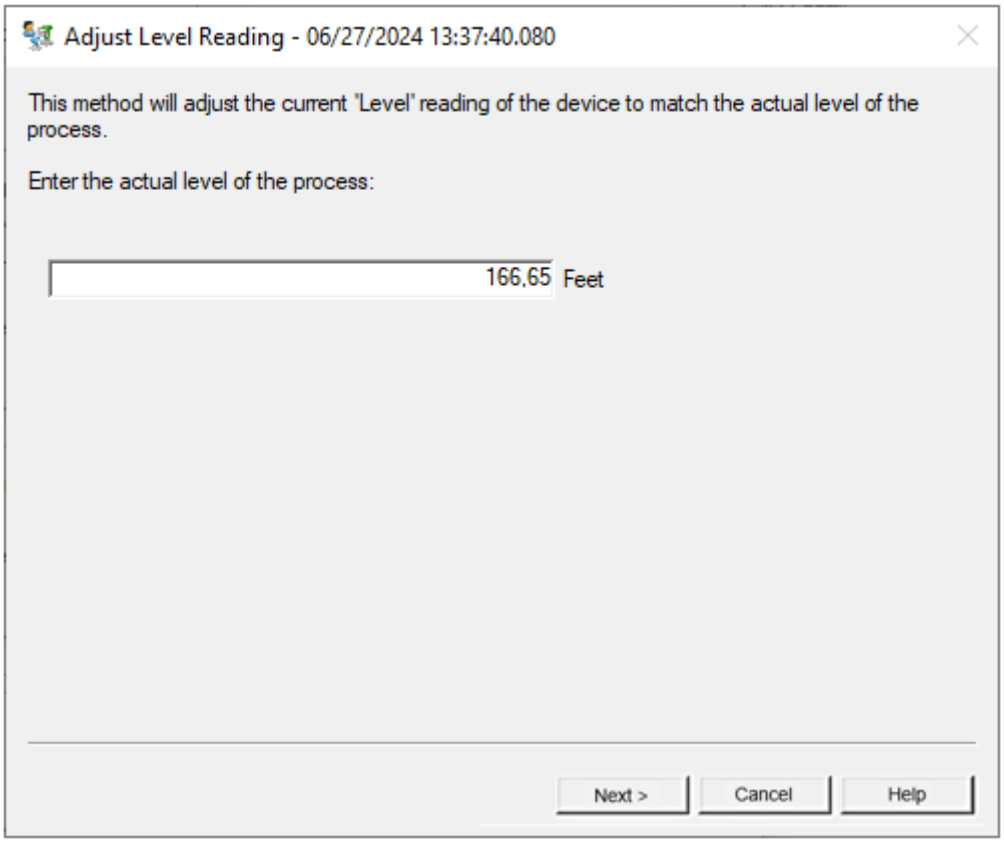
When the level setup is completed, you can view the level output screen to ensure that the values are set as expected.

Fine-tuning of level readings.

After setting the level, you can use the level fine-tuning function to change the transmitter level readings according to the desired level. This setting can be used to eliminate the impact of various installation variables, such as the influence of ambient temperature or distance measurement errors. For further adjustment, you will need to manually update the minimum level and/or maximum level to adjust the output data to the desired value.

Note: The level fine-tuning range does not exceed ± (0.05• (level at P_{max} – level at P_l)), where (P_{max} – P_l) is the maximum measurement range of transmitter model.

Adjust Level Fine-tuning Screen



M.2.6.3.4 Volume setup

Volume is not a significant measured parameter.

Volume is a space occupied be a given amount of the product; the volume is often calculated based on level. Volume is generally expressed in liters, cubic centimeters, cubic meters, gallons, or barrels.

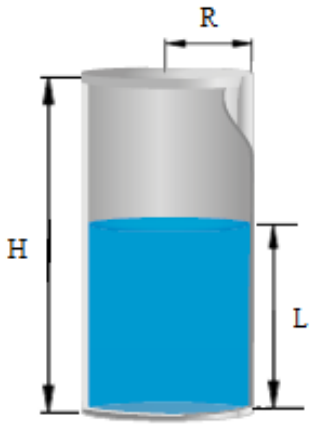
Volume can be calculated based on level.

Generally, tank level is measured first, and then the volume is calculated based on the tank geometry.

The transmitters store the geometries of common tank types which enables obtaining the output signal in volume units.

The transmitters contain the following level to volume ratios for some common tank shapes:

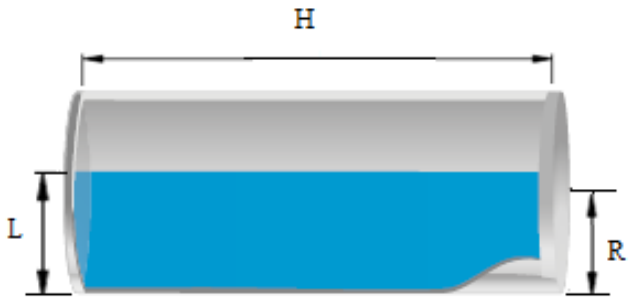
a) Vertical cylindrical tank: $Vcv=\pi R^2L$



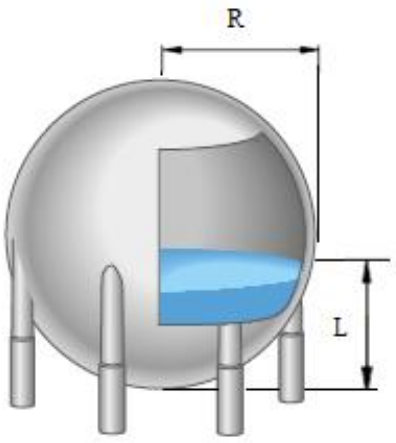
V = tank volume
R = tank radius
H = tank height
L = liquid level

b) Horizontal cylindrical tank:

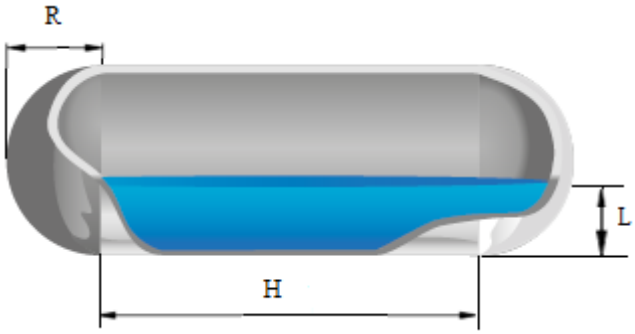
$V = HR^2 \arccos\left(\frac{R-L}{R}\right) - H(R\text{-}L)\sqrt{L(2R-L)}$



c) Sphere: $V=\frac{\pi L^2}{3}(3R-L)$



d) Horizontal bullet: $V = HR^2 \arccos\left(\frac{R-L}{R}\right) - H(R-L)\sqrt{L(2R-L)} + \frac{\pi L^2}{3}(3R-L)$

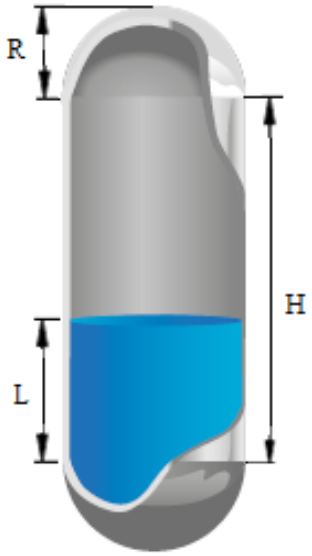


e) Vertical bullet:

$V = \frac{\pi L^2 (3R-L)}{3}$, if $L \leq R$;

$V = \frac{\pi R^2 (3L-R)}{3}$, if $R < L \leq (H+R)$;

$V = \pi R^2 H + \frac{\pi (L-H)^2}{3}(3R-(L-H))$, if $(H+R) < L$.

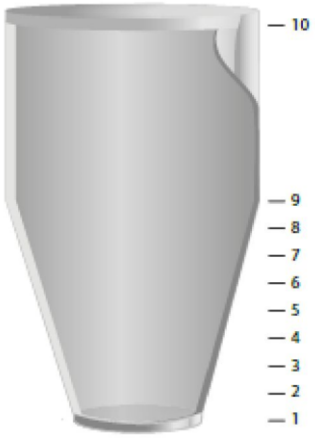


Volume calculation based on level and tank geometry ensures sufficient accuracy of volume measurement that can meet the requirements of the most of users. However, in some cases the tank geometry can be non-typical, which prevents from mathematical simulation of the relationship between level and volume. In such cases, volume should be determined based on level readings, using calibration tables.

The calibration table is a reference table that sets relation between level and volume based on several different points in the tank. These tables are usually obtained by adding a known volume of product to the tank and then measuring the product level corresponding to that volume (manual calibration).

The volume and level measurement results are recorded to the table. Then, when volume measurement is required, measure the level and find volume that is related to this level in the calibration table.

Calibration table example



Point	Level (inches)	Volume (gallons)
1	0	0
2	5	10
3	10	32
4	15	6S
5	20	115
b	25	173
7	30	230
8	35	313
9	40	394
10	100	957

Setup for volume

Use the Configure Tank method to configure the pressure transmitter to output data in volume units.

This method allows you to select one of five standard tank geometries or, for non-standard geometries, configure the unit using a level/volume relationship calibration table.

Volume setting parameters.

You can configure the volume to use any of the five standard tank geometries to calculate volume as a function of level.

Standard tank geometry assumes that the zero level is at the geometric bottom of the tank to accurately calculate the volume of the entire tank. If your zero point is above the tank geometric bottom, you can adjust the volume reading in one of the following ways:

• Adjust the level readings in the “Adjust Level Reading” meth;

• Use the level/volume calibration chart.

The “Configure Tank” method creates a relationship between level and volume using the following parameters:

- Tank Type

  user-selectable tank geometry:

  • sphere,

  • vertical bullet,

  • horizontal bullet,

  • vertical cylinder,

  • horizontal cylinder,

  • custom;

- volume units;
- level units;
- tank length (L);
- tank radius (R).

Custom tank type parameters.

The measured volume and level values are recorded in the calibration table. Subsequently, if it is necessary to obtain the liquid volume, the level measurement is performed and the corresponding volume value is determined from the calibration table.

The number of level/volume value points entered by the user in the calibration table can range from 2 to 50.

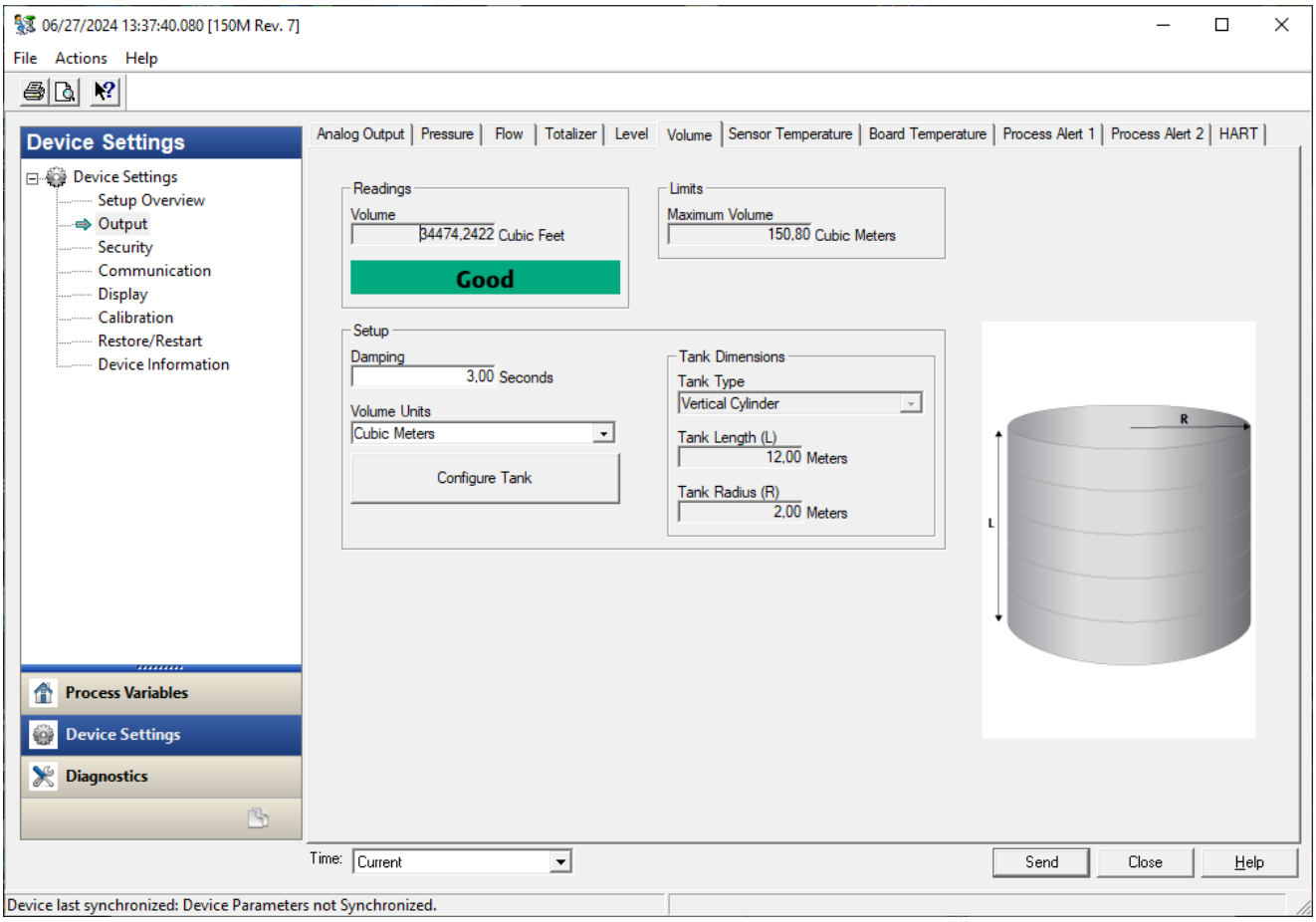
If the level measurement falls between two points in the table, the volume is determined by interpolating between the two points.

Setting the volume using a communication device.

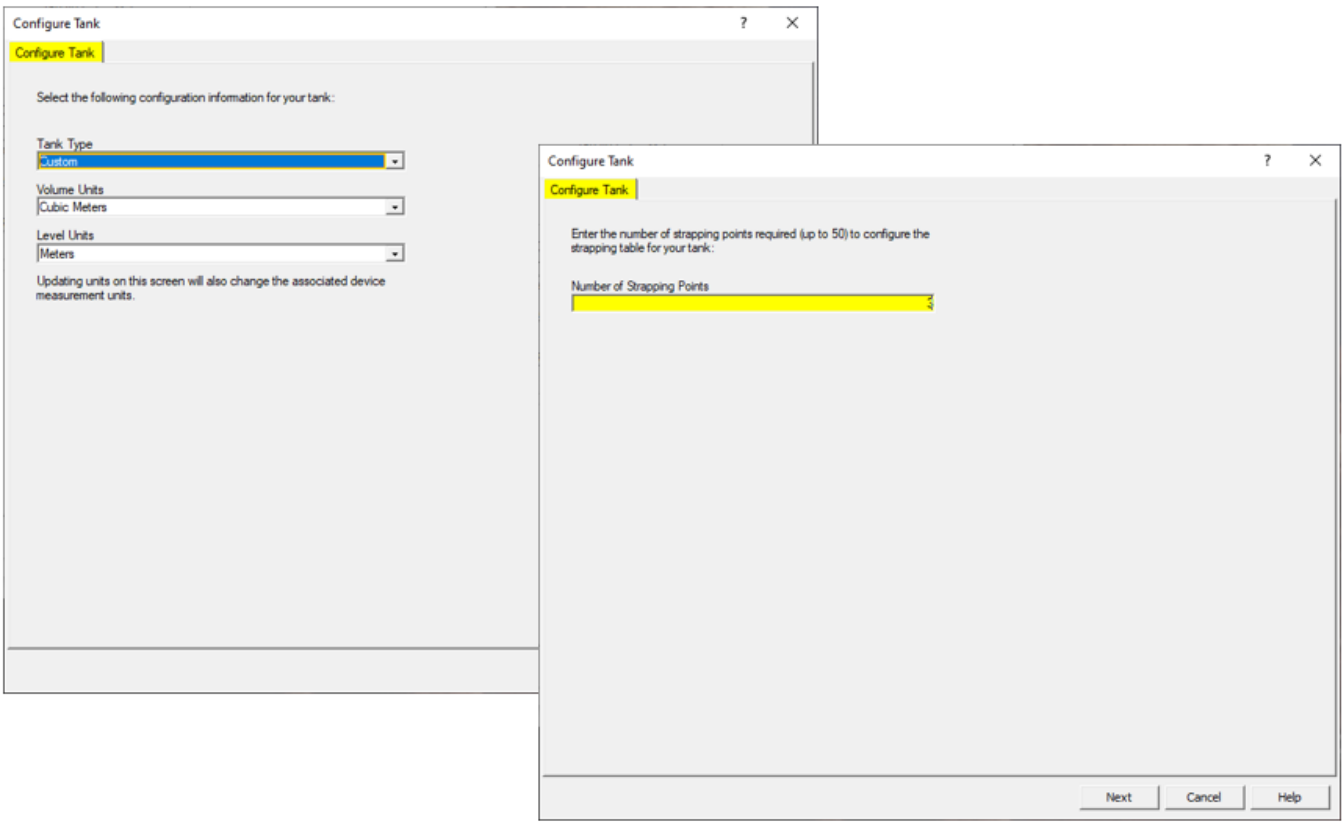
Procedure:

Go to ‘Device settings → Output → Volume → Setup →Configure Tank’.

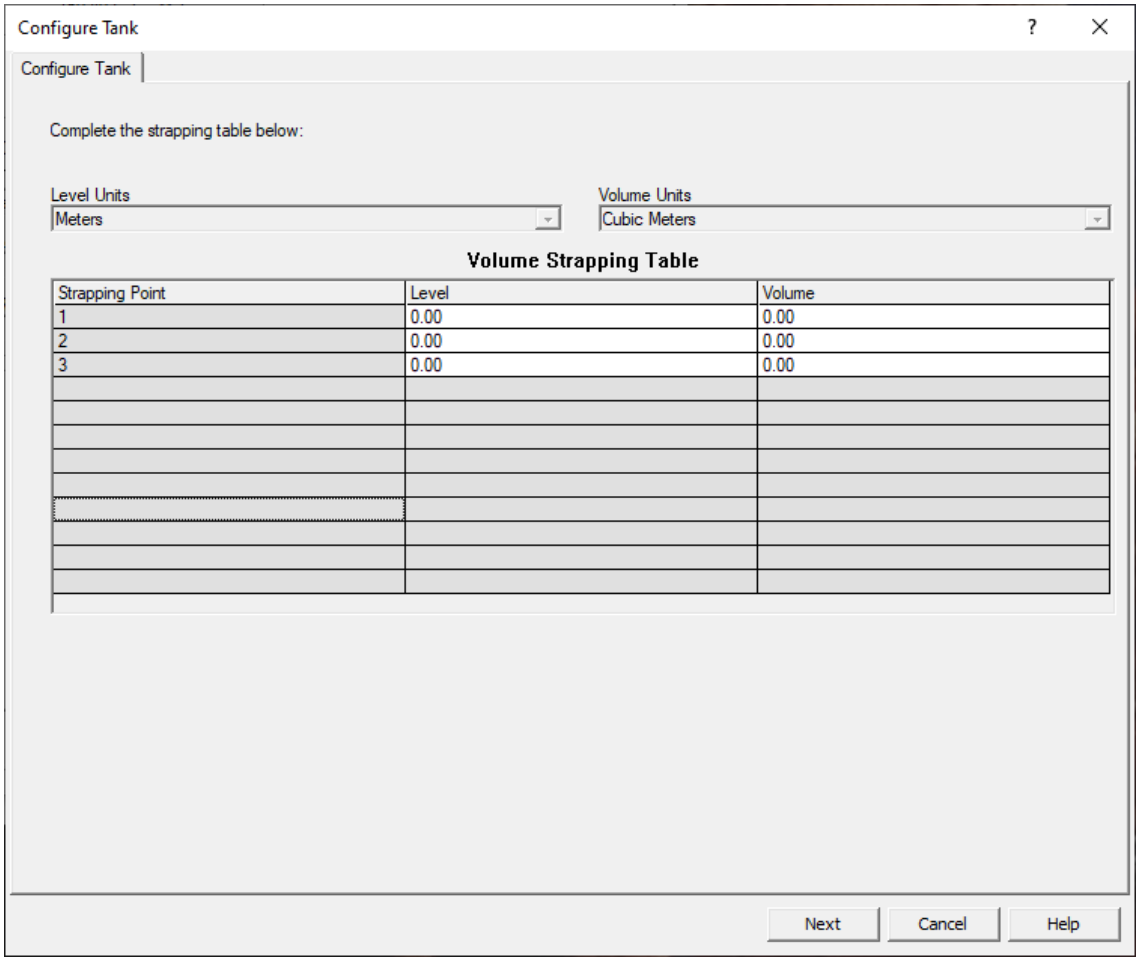
Volume Setup Screen



Tank Configuration Screen



Volume Strapping Table Screen



M.2.6.4 Detailed Transmitter Setting

M.2.6.4.1 Setting of alarm and saturation levels

During standard operation, the transmitter continuously performs a self-test. If the self-diagnostic routines detect a failure, the transmitter drives the output to configured alarm values.

The transmitter will also drive the output to configured saturation values if the applied pressure goes outside the 4-20 mA range values.

The alarm and saturation levels and values that can be set are given in M.1.2.30.

Setting the alarm and saturation levels using a communication device.

Procedure:

Go to 'Device Settings → Setup Overview → Alarm and Saturation Values→ Configure Alarm and Saturation Values".

Setting the alarm and saturation level signals using the buttons and indicator.

Procedure:

1 Keep pressed the setting button '1' for 2 seconds to enable the indicator.

2 Select the 'ALRSAT' menu.

M.2.6.4.2 Setting Process Alarm Thresholds

Process alarm thresholds allow the transmitter to indicate that the specified media parameters have been exceeded.

Two separate user-defined alarm thresholds are supported: threshold 1 and threshold 2. The process alarm thresholds are independent of each other. Each threshold has its own setting: upper and lower threshold limits, and the ability to individually enable/disable notifications. You can use these alarm thresholds to receive status notifications via HART or through an emergency analog output signal. Process alarms can be activated for any dynamic variable, regardless of the HART variable assignments. This means that the analog output signal can be activated for any of the process dynamic variables listed in M.1.2.21, even if they are not assigned as the primary HART variable.

Note: The upper limit of the alarm threshold must exceed the lower limit of the threshold. These alarm values must fall within the dynamic process variable range.

Parameters for setting up process alarm thresholds.

You can set the following parameters:

1 Alert name

The custom alarm threshold name.

2 Notification method.

Sets the notification method or disables the process alarms:

– Disable Alert;

– HART Status Alert;

– Analog Output Alarm.

3 Monitored process variable.

Dynamic variable that the process warning monitors.

4 Selecting the alarm threshold operating mode.

Operation modes of the process alert thresholds:

- Above High Side - activation of alert when the variable value is above the upper threshold limit;
- Below Low Side - activation of alert when the variable value is below the lower threshold limit;
- Inside Window - activation of alert when the variable value is within the threshold limits;
- Outside Window - activation of alert when the variable value is outside the threshold.

5. High Alert Value:

Once the monitored variable surpasses this upper limit, a process alarm will trigger the configured action (not applicable for activation when the value falls below the lower threshold).

6 Lower Alert Value:

When the monitored variable falls below this lower limit, the process alarm will activate the configured action (not applicable for activation when the value exceeds the upper threshold).

7 Method for reducing sporadic alert.

The transmitter implements two different approaches to prevent the activation of process alarms and deactivation of process warnings when the process variable fluctuates near one of the alarm thresholds.

Deadband.

A user-defined range, entered in the same units as the monitored variable, beyond the warning value when a process warning will not be issued

Time Delay.

A user-defined period of time (maximum 30 seconds) after an alarm is detected during which the process alarm will not be issued.

Disabling the processing of accidental alarms.

Setting the process alarm thresholds using a communication device

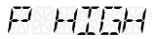
Procedure

Go to “Device settings → Output → Process Alert (1 or 2) → Alert Settings.

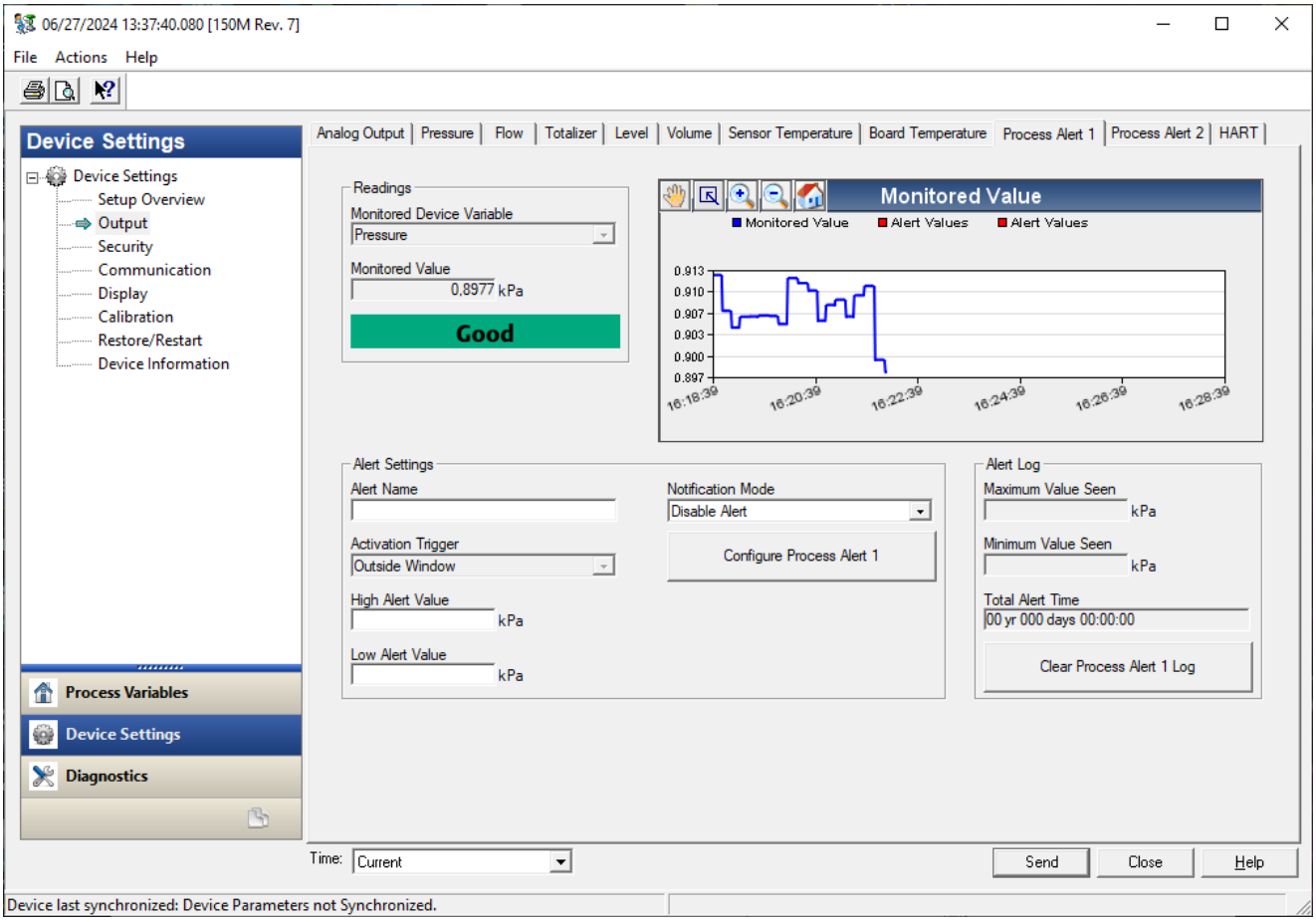
Process warning on the indicator.

Name of the process warning defined by user during the warning setup is displayed in the character line using the first 6 characters, and the digit line of the indicator will not display anything.

For example, if user defines the name as ‘P HIGH ALERT’, the indicator displays:



Process Alert Setting Screen



M.2.6.4.3 Re-mapping process variables

Use the re-mapping function to set the primary, secondary, tertiary and quaternary transmitter variables (PV, SV, TV and QV).

Re-mapping variables using a communication device.

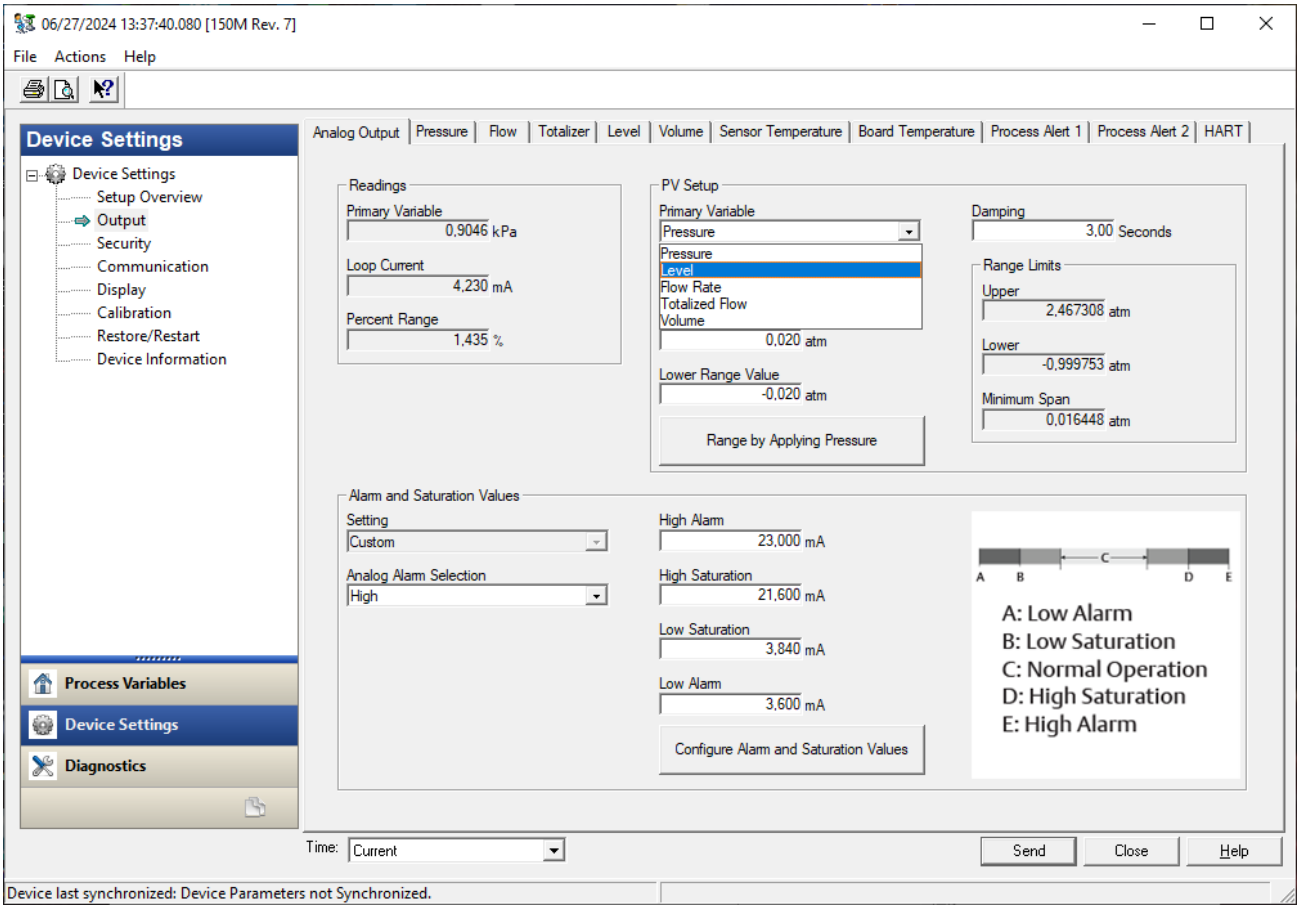
Procedure:

1 Select a primary variable: “Device Settings → Output → Analog Output → PV Setup”.

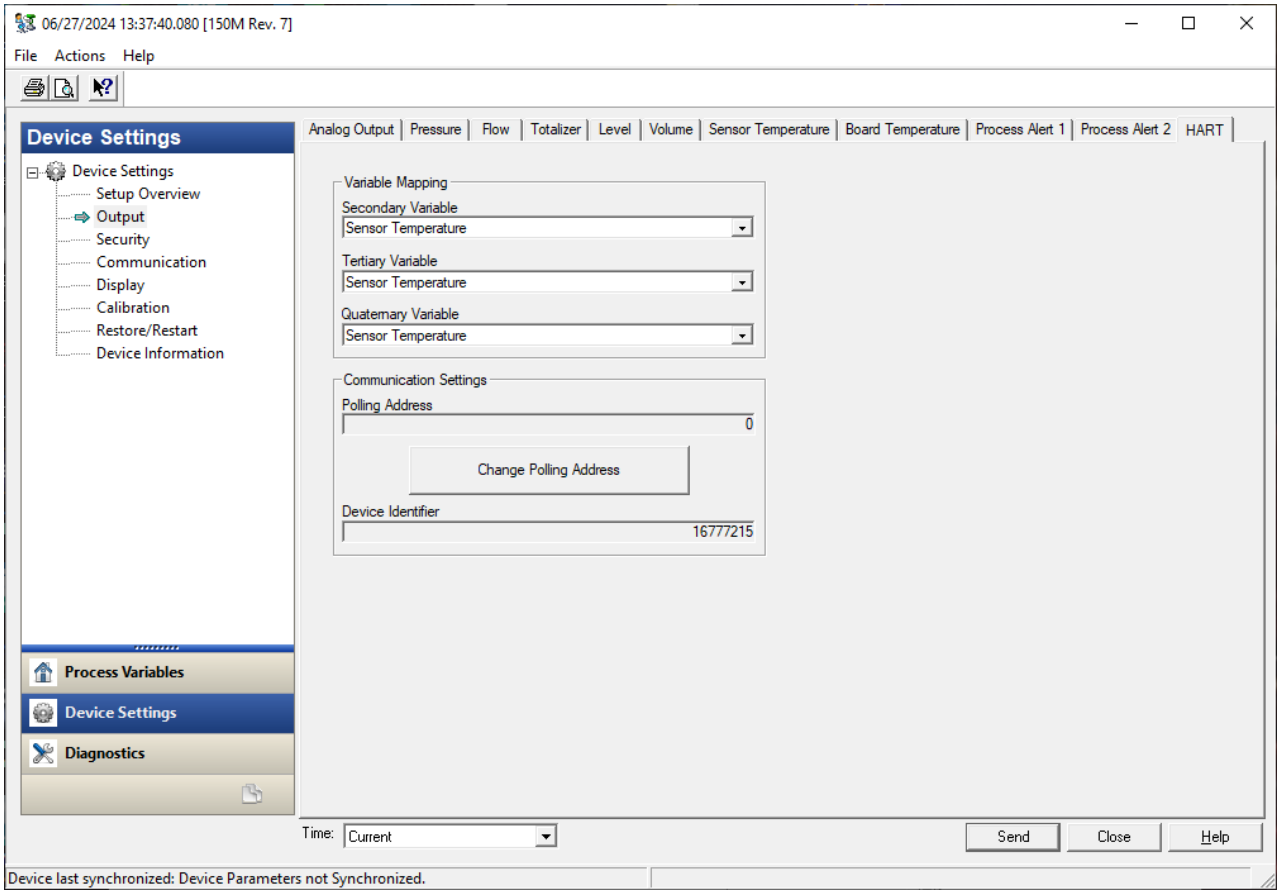
2 Match the secondary variable, tertiary variable and quaternary variable: “Device Settings → Communication → HART → Variable Mapping”.

Note: For process variables, refer to M.1.2.21.

Primary Variable Remapping Screen



Secondary Variable, Tertiary Variable and Quaternary Variable Mapping Screen



M.2.6.5 Setting the current loop continuity diagnostics

The diagnostic and maintenance features described in this section are mainly designed for post-field installation use.

The Transmitter Loop Integrity Diagnostics function (option code DA0) enables detection of alterations in the electrical loop attributes that could impact loop integrity. Instances include the presence of water on terminals, unstable power supply, or considerable corrosion at terminal points.

This function is based on the assumption that if the transmitter is installed and powered, the electrical loop has the basic characteristics of a correct installation. If the voltage at the transmitter terminals deviates from the baseline and exceeds user-defined tolerance limits, the transmitter may transmit a HART warning or analogue alarm.

To utilize this diagnostic function, it is necessary to establish a baseline characteristic of the electrical loop subsequent to transducer installation. The loop characteristic is generated automatically upon pressing the “Configure Loop Integrity” button displayed on the screen. This action establishes a linear correlation between the anticipated terminal voltages throughout the 4 to 20 mA operational span (refer to Figure M.1).

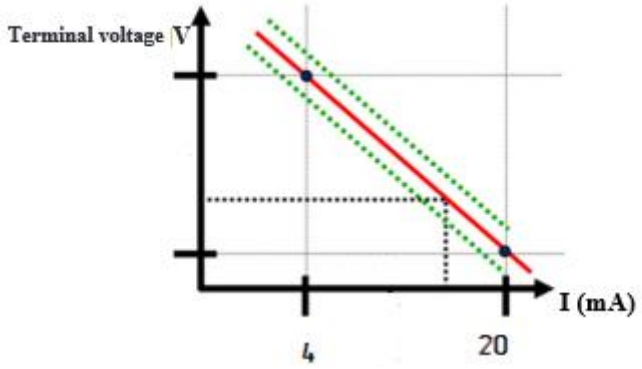


Figure M.1. Baseline Operational Range

The code DA0 transmitter is supplied with the loop integrity diagnostic function disabled and without the loop characteristic defined. After installing and powering on the transmitter, it is necessary to determine the loop characteristic for the loop integrity diagnostic function.

When the user initiates a loop characterization, the transmitter will check to see if the loop has sufficient power for proper operation. Then the transmitter will drive the analog output to both 4mA and 20mA to establish a baseline and determine the maximum allowable terminal voltage deviation. After completing this procedure, the user needs to enter a threshold sensitivity value, referred to as the maximum allowable voltage deviation at the terminals. Subsequently, a check is performed to verify the accuracy of the provided value.

After all of the above settings have been made, the loop integrity diagnostics function starts to monitor for deviations of the loop characteristics from the baseline characteristics. In case of a significant change in terminal voltage from the set reference value exceeding the maximum permissible deviation, the transmitter generates a warning or alarm signal.

Note: The Transmitter Loop Integrity Diagnostic function monitors and detects terminal voltage deviations from the expected value to identify common faults. It is not possible to predict and detect all types of loop faults using the 4-20 mA output. Therefore, it cannot be absolutely guaranteed that the diagnostic function will accurately detect all specific conditions under all circumstances.

The Loop Integrity Diagnostics setup screen allows the user to perform loop characterization, set the maximum allowable terminal voltage deviation from design values and the appropriate operation. The loop characteristic is recorded and displayed in two fields on the screen: baseline data and previous baseline data. Baseline represents values from the most recent loop characterization whereas Previous Baseline represents values recorded prior to the most recent characterization.

Terminal voltage.

This field shows the current terminal voltage value in Volts. The terminal voltage is a dynamic value and is directly related to the output current signal value (mA).

The maximum permissible deviation of the terminal voltage.

This value must be great enough to ensure that possible changes in voltage do not lead to false tripping of the protection function.

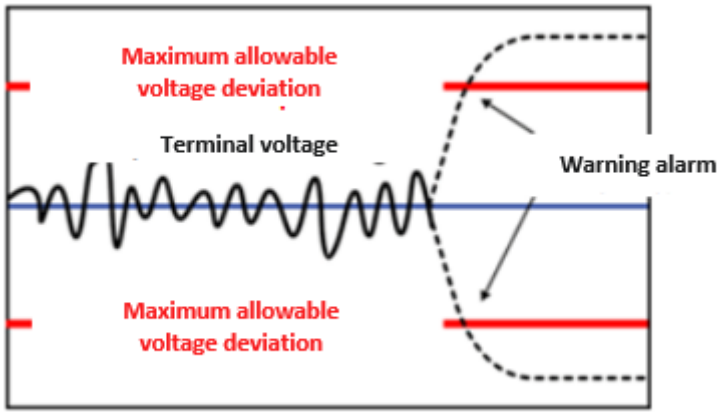


Figure M.2. Maximum Allowable Voltage Deviation

Note: Significant changes in the electrical loop may prevent HART communication or the ability to reach alarm values. Therefore, the Manufacturer cannot absolutely guarantee that the correct failure alarm level (high or low) can be read by the host system during alarming.

Resistance.

This value represents the estimated loop resistance (ohms) measured during the loop characterization procedure. Changes in resistance can occur due to changes in the installed loop physical condition. You can compare the baseline and previous baselines to see how much the resistance has changed over time.

Supply voltage.

This value represents the estimated loop supply voltage (V) measured during the loop characterization procedure. Changes in this value may occur due to power supply degradation. You can compare the baseline and previous baseline values to evaluate how much the power supply voltage has changed over time.

Loop characteristic.

You should initiate the loop characteristic determination after the initial installation of the transmitter or after intentionally changing the characteristics of the current loop.

Examples of such changes include:

– altering the power supply voltage or loop resistance;

– replacing the transmitter terminal block.

Note: Utilizing the loop integrity diagnostic function for the transmitters operating in multipoint mode is not recommended.

Loop integrity diagnostic function.

When the voltage deviation exceeds the set limit, three notification modes can be configured to notify of an unacceptable supply voltage deviation:

– no notification;

– HART status warning mode;

– current alarm mode.

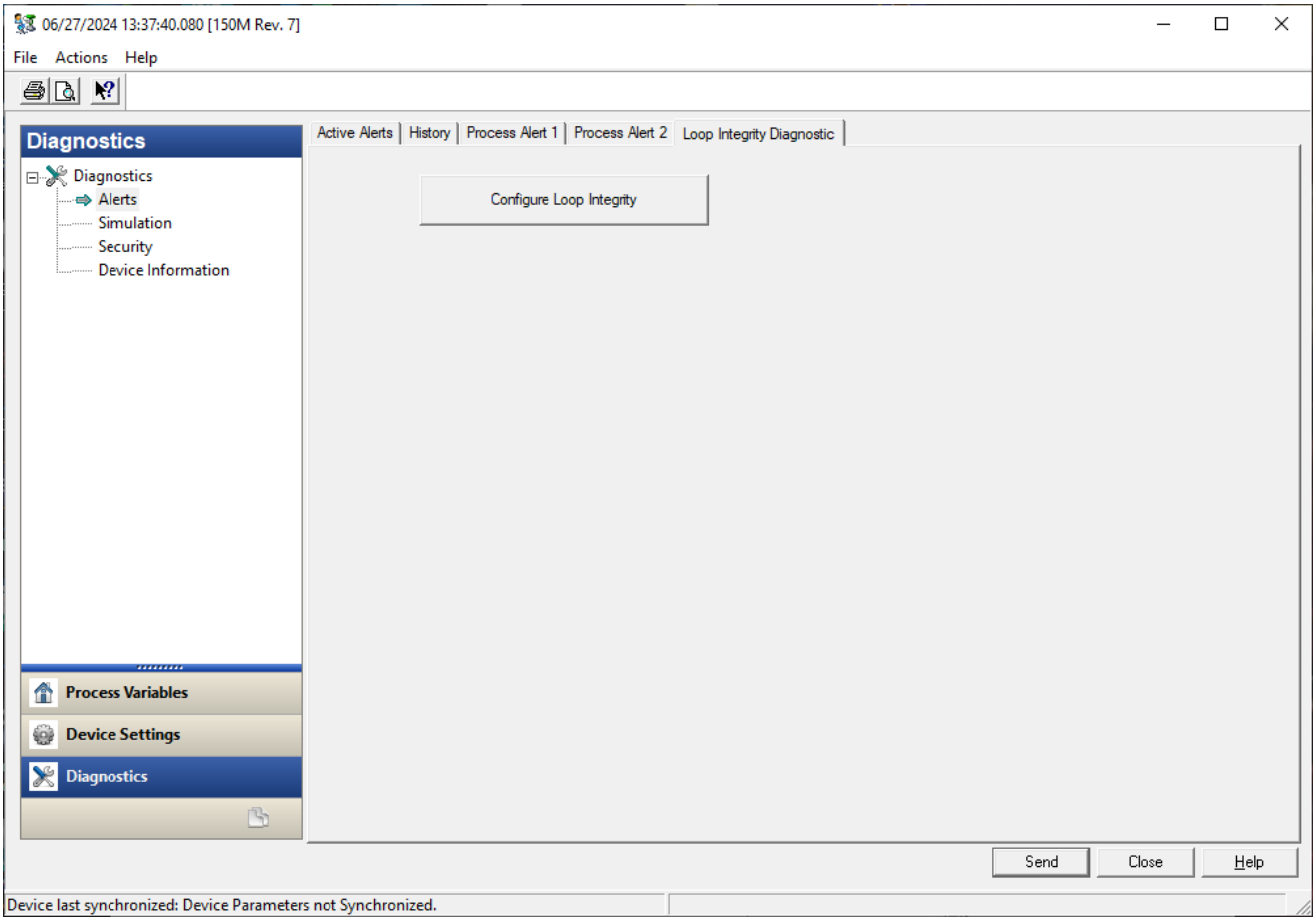
If the voltage deviation returns to the acceptable range as a result of changes in loop characteristics, the active alarm will be cleared, but it will continue to appear in the diagnostic log.

Setting the current loop integrity diagnostics using a communication device:

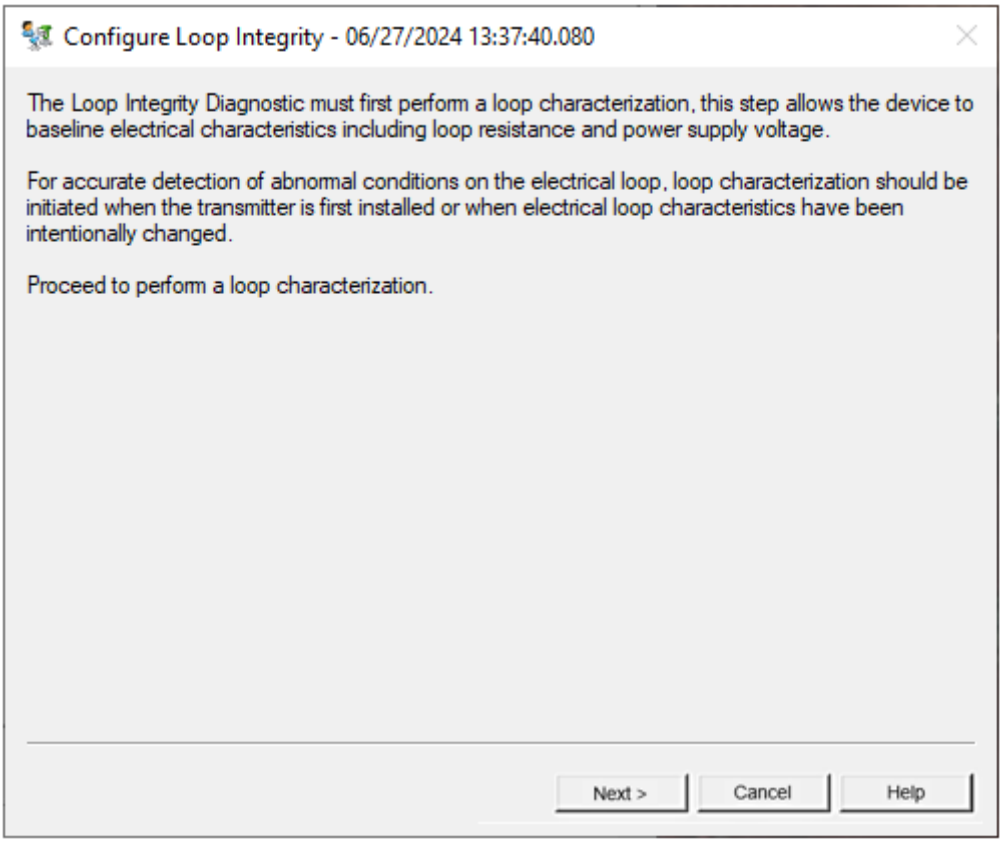
Procedure:

Go to ‘Diagnostics → Alerts → Loop Integrity Diagnostics → Configure Loop Integrity’.

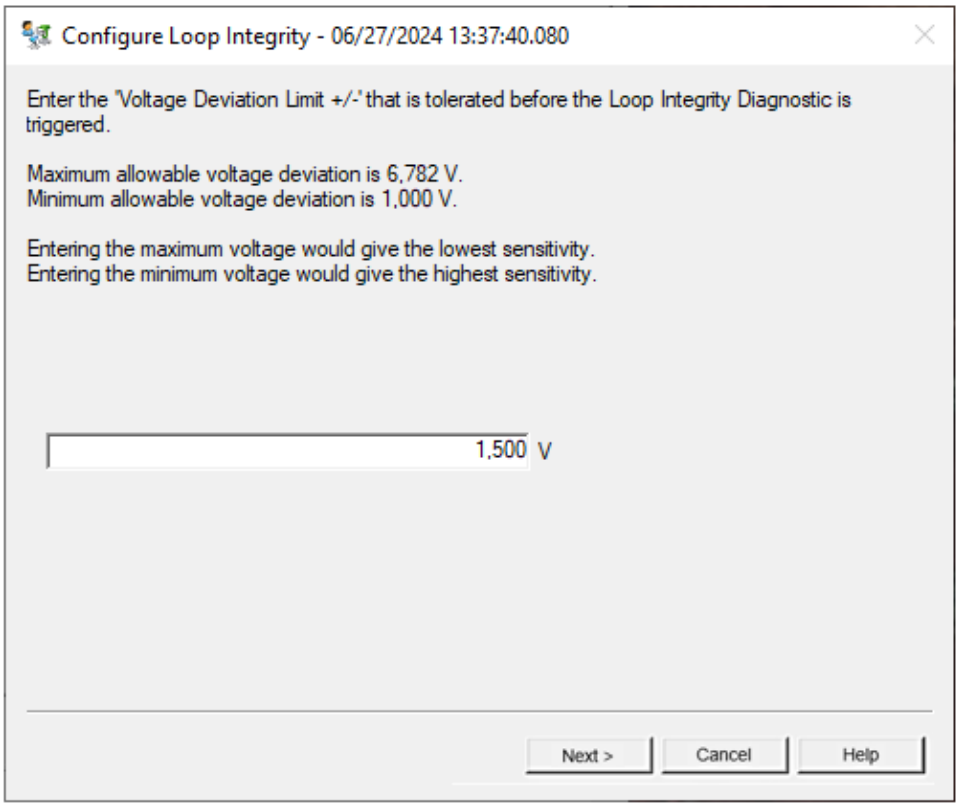
Loop Diagnostics Screen



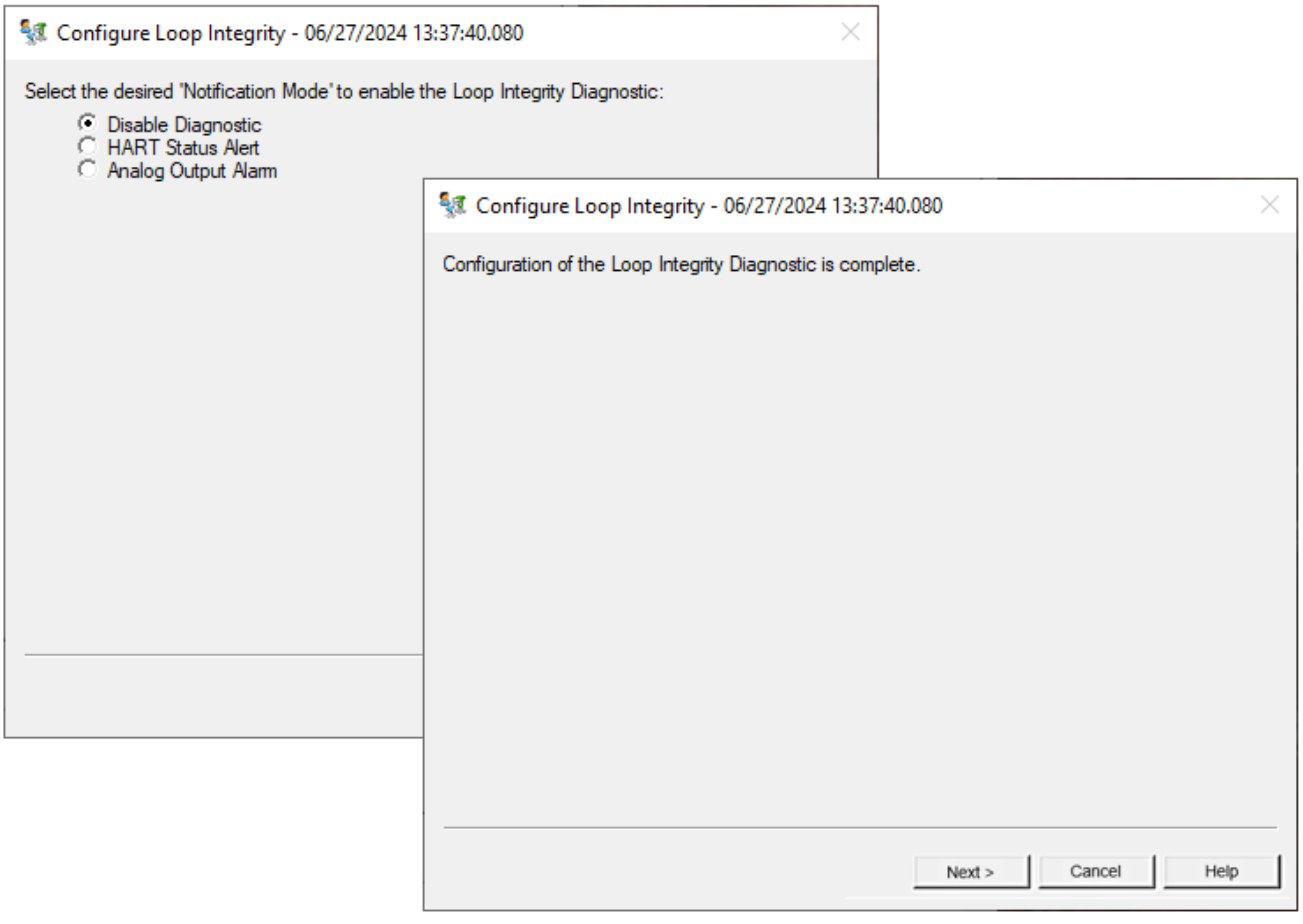
Configure Loop Integrity Screen



Enter Voltage Deviation Limit Screen



Select Notification Mode Screen and Loop Integrity Configuration Completed Screen



M.2.6.6 Transmitter Testing

M.2.6.6.1 Checking the fault level

After repairing or replacing the electronics board of the transmitter, sensor module, indicator, check the alarm level before putting the transmitter back into operation. This feature is also useful in testing the reaction of control system to a transmitter in an alarm state. The test ensures that the control system detects an alarm when it occurs. To check the alarm level values, the loop test (M.2.6.6.2) is carried out and the transmitter output is set to the alarm value (M.1.2.30).

M.2.6.6.2 Testing Current Loop

The command allows to check the transmitter output signal, the integrity of the current loop and the functioning of all installed recording devices.

Upon installation, repair, or replacement of the transmitter, it is advisable to verify the current limits of 4 and 20 mA.

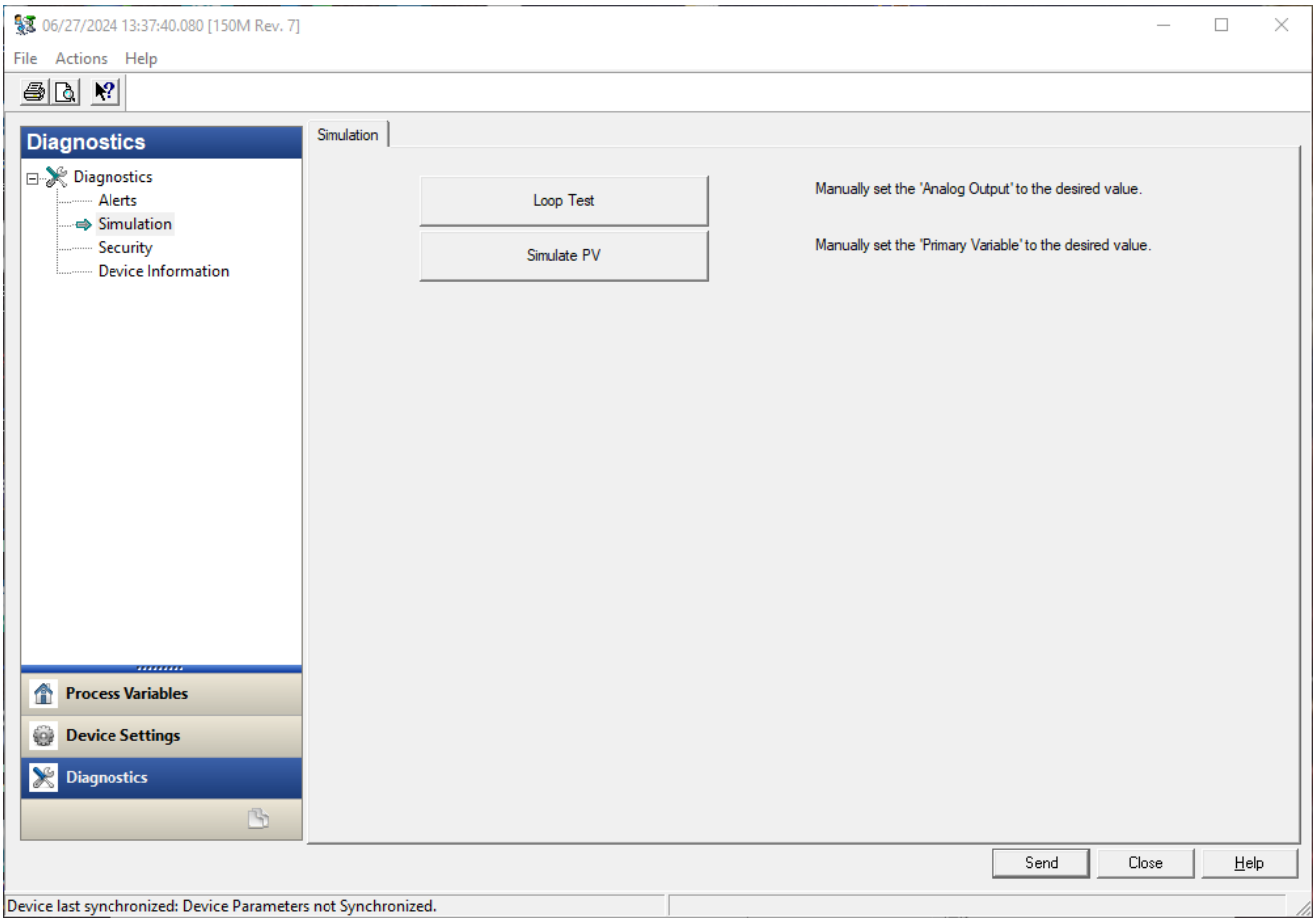
The host system may offer current measurement capabilities for the 4-20 mA HART output. In cases where this capability is not available, you can connect a reference milliammeter to the test terminals on the terminal block of the transmitter's electronic transmitter, or alternatively, connect the power supply and the milliammeter in parallel for measurement purposes.

Testing the current loop using a communication device.

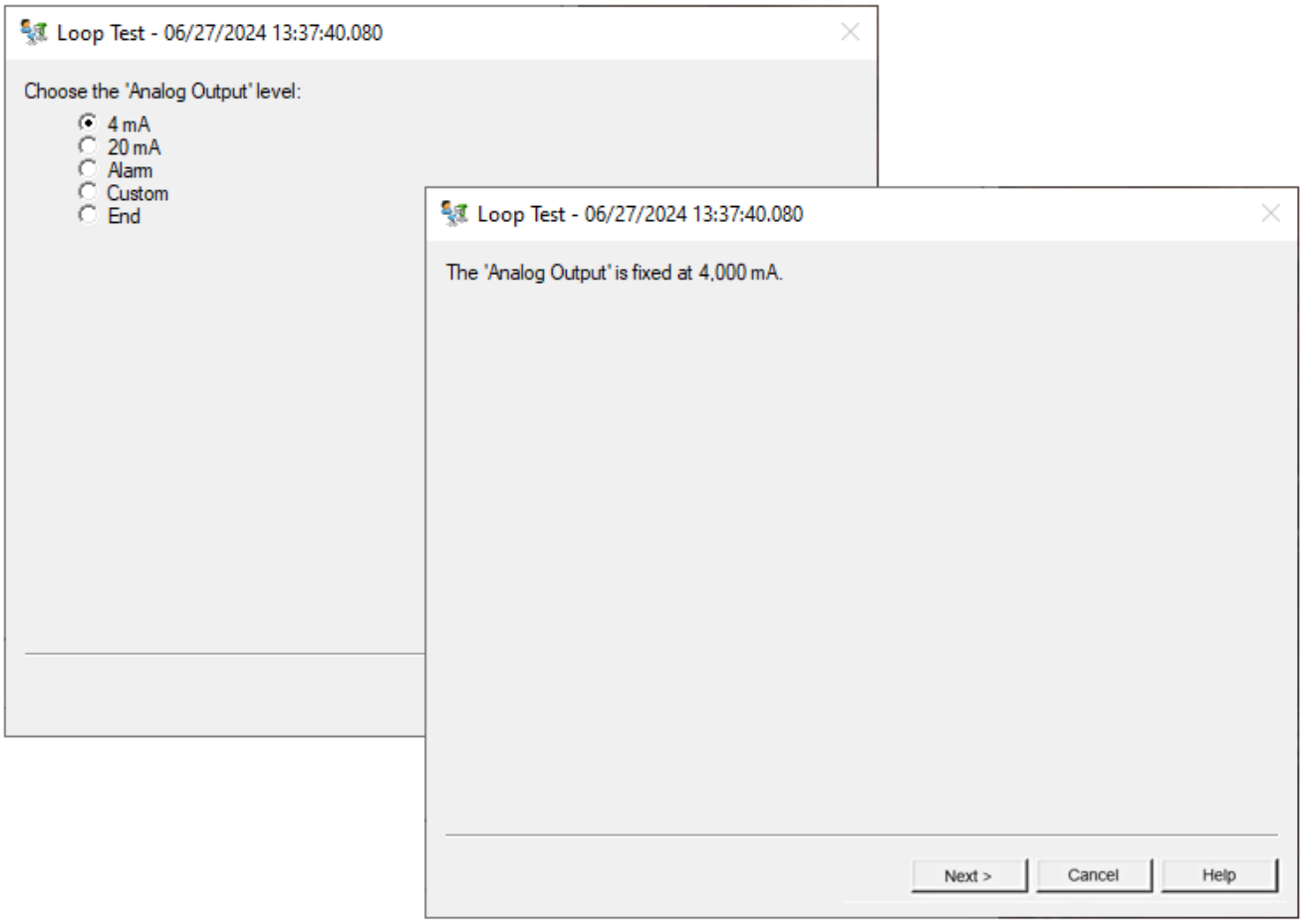
Procedure:

Go to ‘Diagnostics → Simulation → Loop test’.

Loop Test Screen



Select Analog Signal Level screen and Analog Signal Fixed screen



Testing the current loop using buttons and indicator.

Procedure:

1 Keep pressed the setting button ‘1’ for 2 seconds to enable the indicator.

2 Select the ‘LPTEST’ menu.

M.2.6.6.3 Variable modelling (simulation).

Modelling of the primary variable.

To conduct a transmitter test, users can choose to assign fixed values to the primary variable. When simulating the primary variable, the digital readings and analog output signal align with the user-defined value. Upon exiting the simulation mode, the primary process variable seamlessly reverts to reflecting the actual measurement.

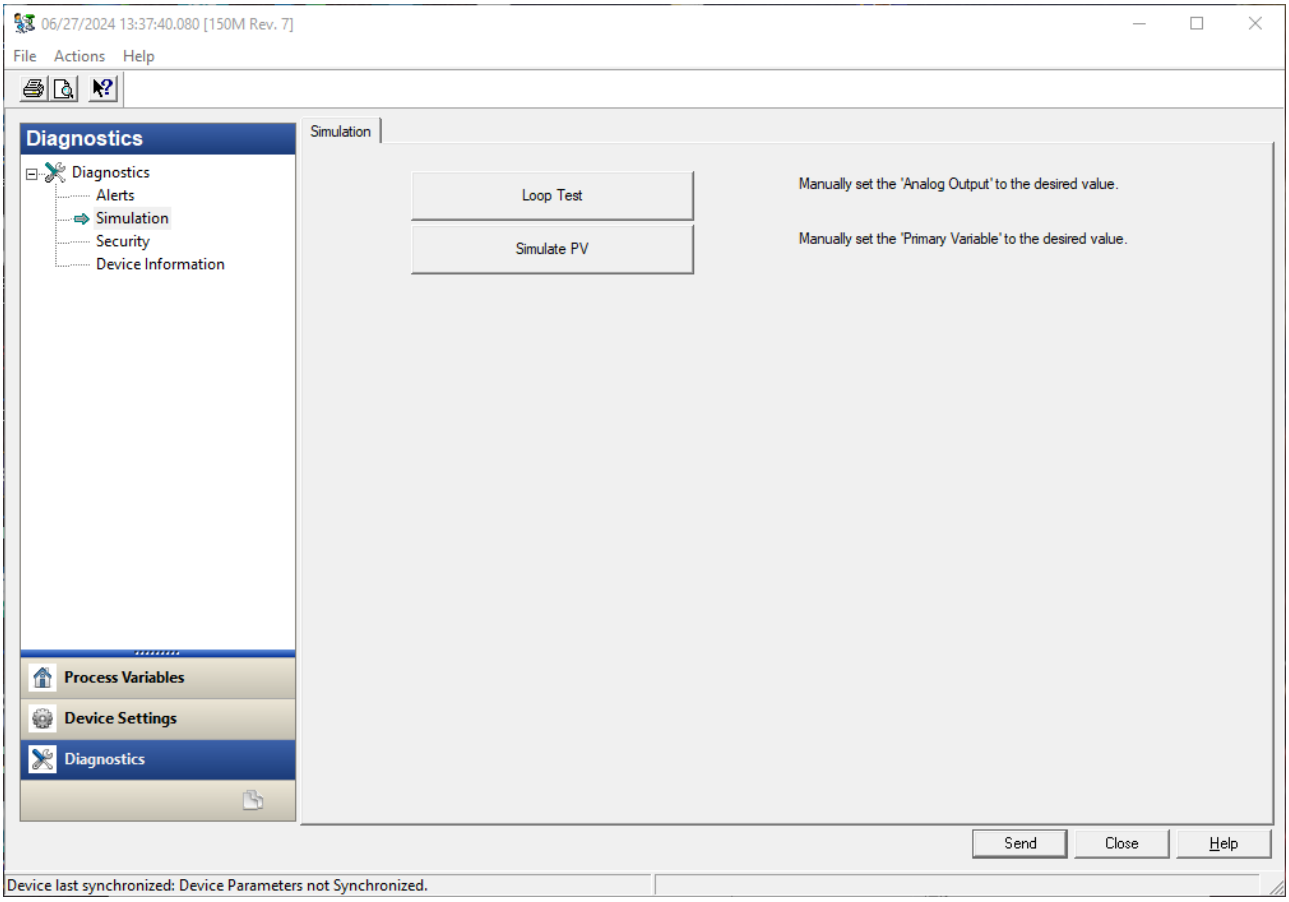
You can set any of the output variables specified in M.1.2.21 as the primary variable.

Simulation of primary variable with the use of communication device.

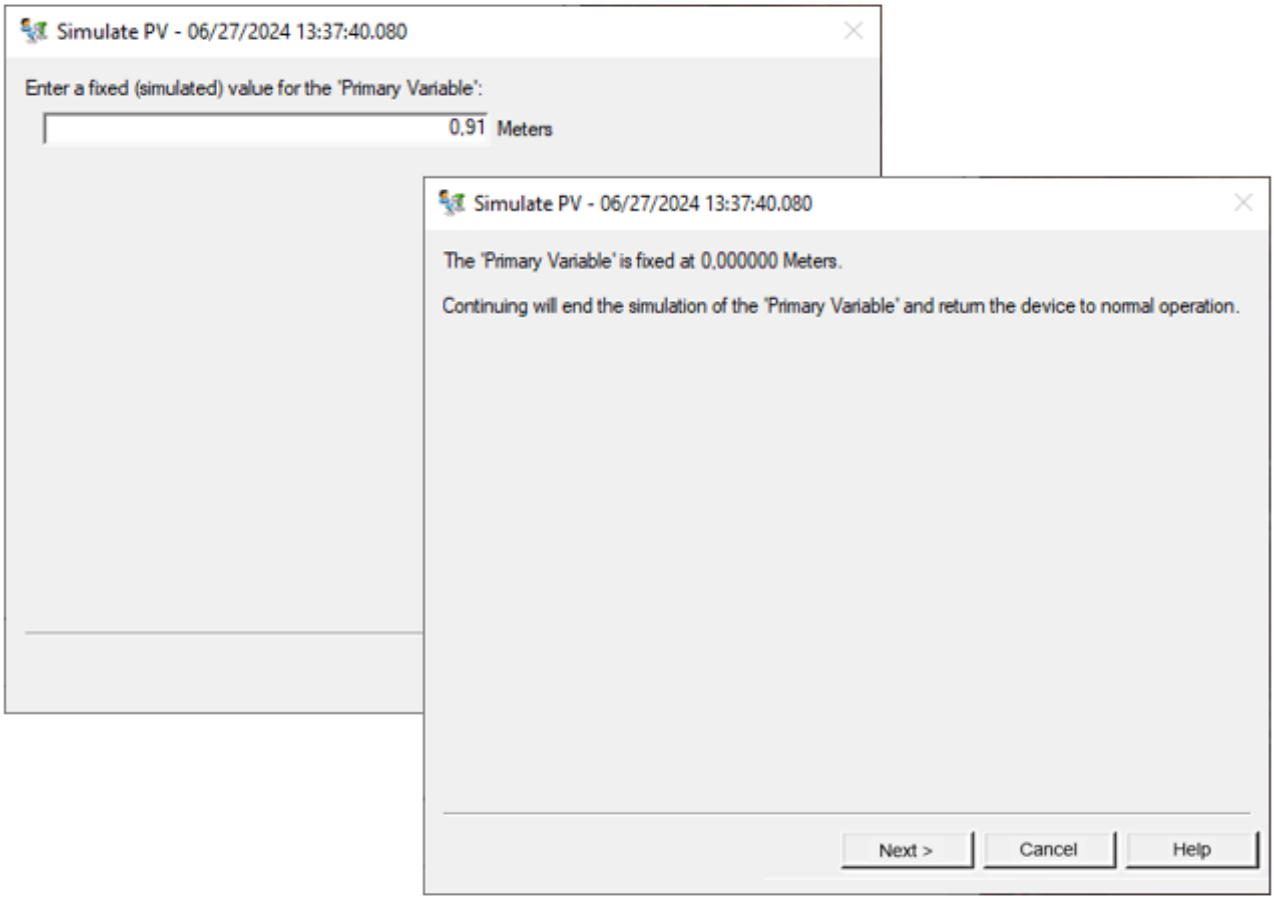
Procedure:

Go to ‘Diagnostics → Simulation → Simulation PV’.

Simulation PV Screen



Enter Fixed Value Screen



M.2.6.7 Setting multipoint connections

In multipoint connection mode, the transmitter operates with digital output signal only. The analog output signal automatically sets to 4 mA and is not dependent on input pressure. Pressure data can be read via HART protocol.

When configuring a multipoint connection, it is important to consider the required update frequency from each transmitter, the combination of transmitter models, and the length of the transmission line.

Each transmitter operating in multipoint mode is identified by a unique address from 1 to 63. The transmitter is set to address zero (0) in normal operation; if an address is assigned, the transmitter automatically switches to multidrop mode and sets 4 mA output. It also disables the failure mode alarm signal. Failure signals in multichannel transmitters are communicated through HART messages.

The transmitter is set to address zero (0) at the factory, which allows operation in the standard point-to-point manner.

Typical wiring diagram for multipoint transmitters is given in Figure D.3 SPGK.5225.000.00 RE.

M.2.6.7.1 Changing Transmitter Address.

To enable multipoint communication, a number between 1 and 63 must be assigned to the transmitter polling address.

Each transmitter in a multipoint loop must have a unique polling address.

Changing the transmitter address using a communication device.

Procedure:

Go to ‘Device settings → Output → HART → Communication settings → Change Polling Address”.

M.2.6.7.2 Communicating with Multipoint Transmitters

To communicate with multipoint devices, the communication device must be set to the polling mode.

M.2.6.8 Protecting of Setup Parameters against Unauthorized Changes

The transmitters are protected against unauthorized modification of the setup parameters through:

– Software protection

– Indicator password

Software protection prevents modifications to settings through HART and the indicator interface. Use the communication device to enable or disable the software protection. The software protection does not prevent the zero adjustment with an external push button.

The indicator password feature restricts changes to settings via the indicator interface while allowing adjustments through HART interactions. The indicator password does not prevent zero adjustment with an external push button.

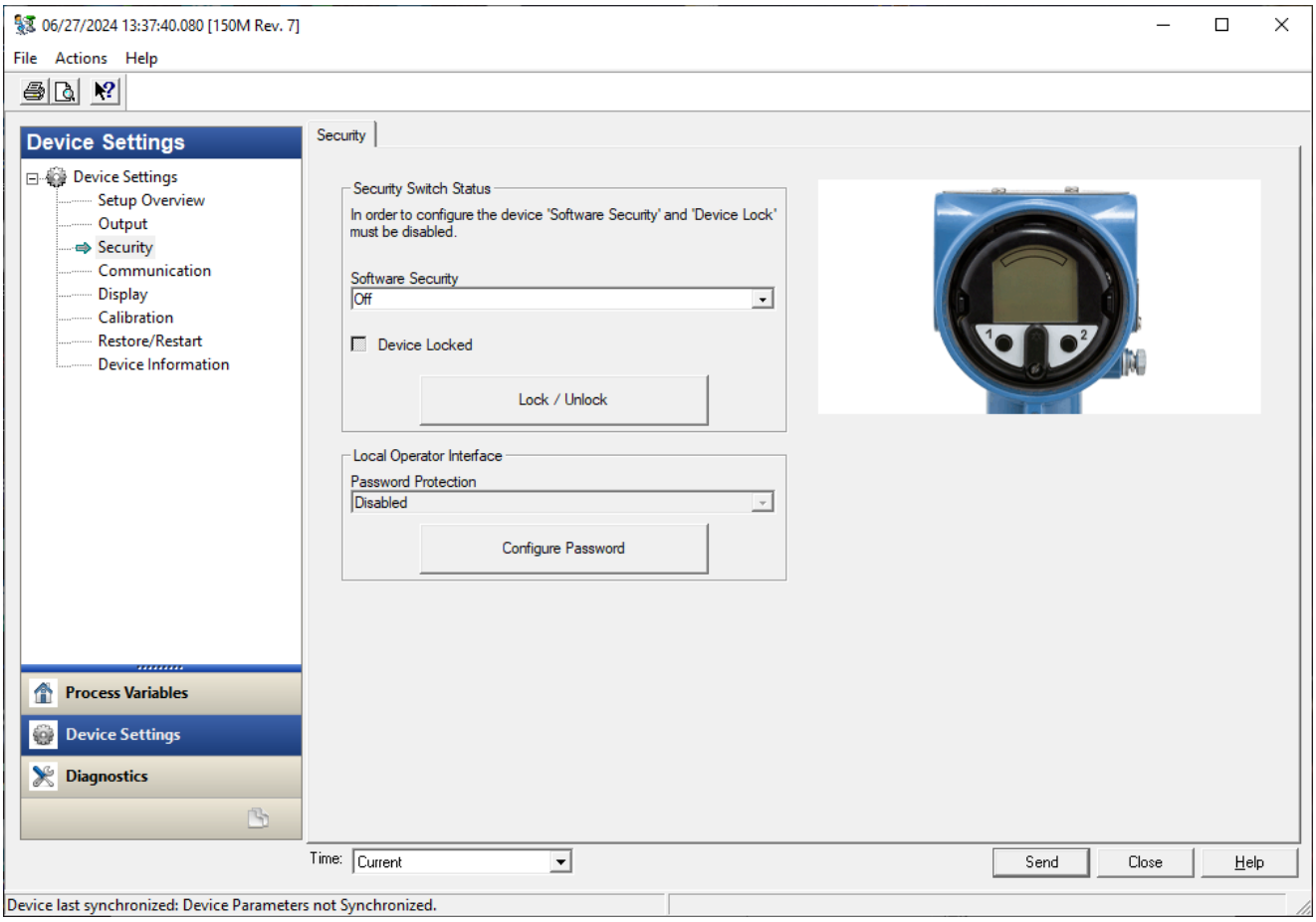
The indicator password is a four-digit code set by the user. If the password is lost or forgotten, use the master password 9307.

You can set, enable or disable the indicator password using HART communication or the indicator.

Protecting the transmitter parameters using a communication device.

Procedure:
Go to ‘Device settings → Security→ Local Operator Interface→ Configure Password”.

Security Screen



Setting the protection parameters using the buttons and indicator.
Procedure:
1 Keep pressed the setting button ‘1’ for 2 seconds to enable the indicator.
2 Enter the ‘PASSWD’ mode.

M.2.6.9 Recommended Calibration Tasks

Complete calibration of transmitter can be split into three stages: Sensor Calibration, Analog Output Trim, and Recall Factory Trim.

Sensor calibration:
– Full Calibration
– Zero Sensor Trim
Analog calibration 4-20 mA.

M.2.6.9.1 Full sensor calibration.
Full sensor calibration provides the lower and upper value trimming.

A lower trim is to adjust the pressure reading to match the applied pressure. The lower trim provides parallel offset of the characterization curve, but its slope does not change.

An upper trim is to adjust the pressure reading to match the applied pressure. The upper trim helps adjust the slope of the characterization curve.

Always adjust the lower trim value first to establish the correct offset. Adjustment of the upper trim value provides a slope correction to the characterization curve based on the lower trim value.

Select pressure input values so that lower and upper trim values are equal to or outside the 4 and 20 mA points.

The trim values help optimize performance over a specific measurement range.

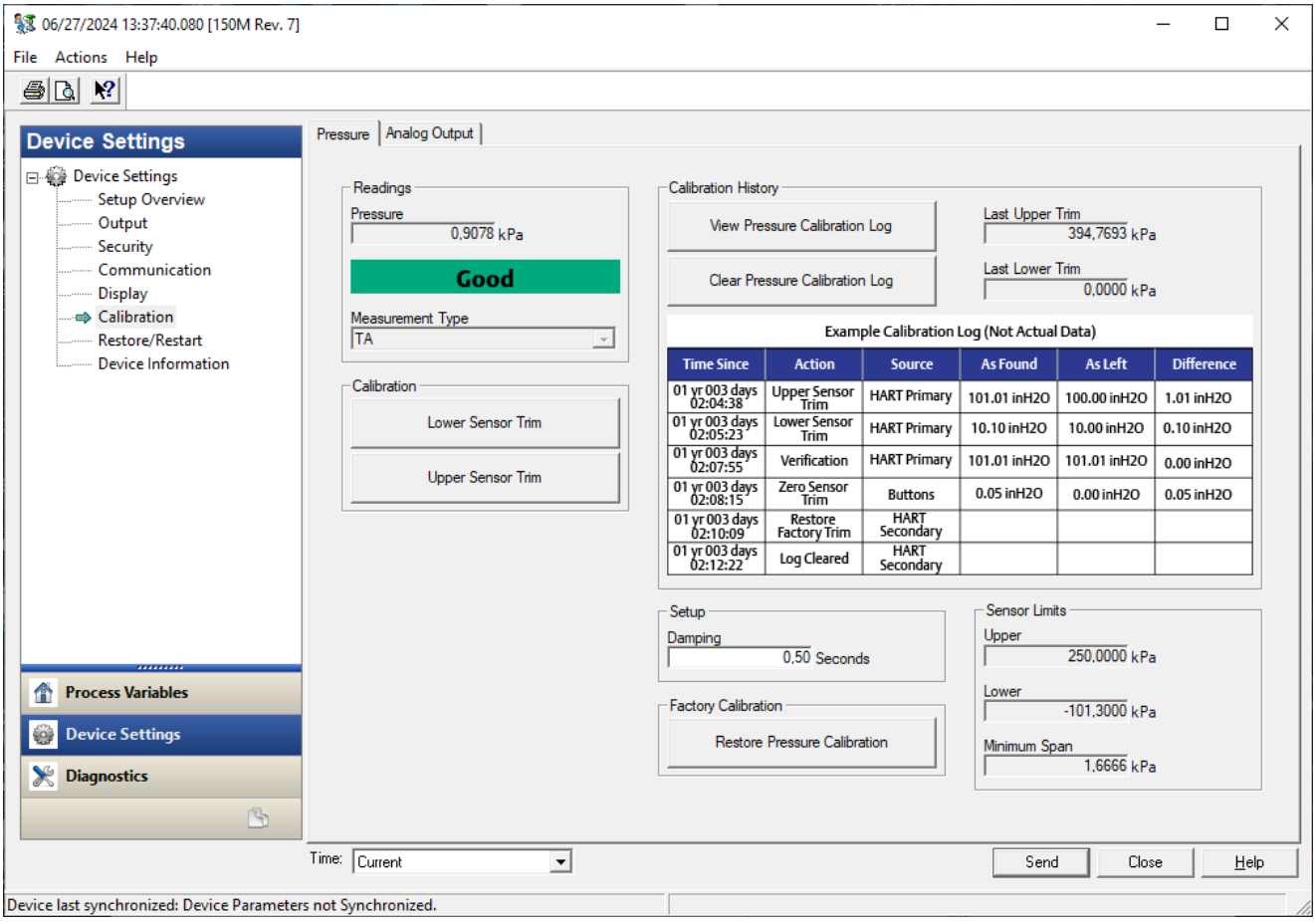
The user determines whether the sensor needs trimming depending on process conditions and accuracy requirements.

Sensor calibration using a communication device.

Procedure:

Go to ‘Device Settings → Calibration → Pressure → Calibration → Lower Sensor Trim → Upper Sensor Trim’.

Sensor Calibration Screen



Sensor calibration with buttons and indicator

Procedure:

1 Keep pressed the setting button ‘1’ for 2 seconds to enable the indicator.

2 Enter the mode: ‘TRIM’ → ‘LOWER’ → ‘UPPER’.

M.2.6.9.2 Sensor Zero Trim

A Zero Trim is completed when the transmitter is at zero pressure. This operation compensates an effect of mounting position or eliminates static pressure effect.

Zero trim (calibration) can be executed using an external button, an indicator with setting buttons, or via HART through a communication device.

When initiating the zero calibration procedure using an external push button, the button should be pressed and held for a minimum of 2 seconds. In instances where the zero offset surpasses the limit outlined in M.1.2.16 during transmitter installation, the transmitter program restricts the zero trim/calibration via the external push button. The transmitter is to be reinstalled in such a position that provides permissible zero trim limits.

Sensor zero calibration using a communication device.

Procedure:

Go to ‘Device settings → Calibration → Pressure → Calibration → Sensor zero trim’.

Sensor zero trim / calibration using buttons and indicator.

Procedure:

1 Keep pressed the setting button ‘1’ for 2 seconds to enable the indicator.

2 Enter mode: ‘TRIM’ → ‘ZERO’.

M.2.6.9.3 Analog Output Calibration

Analog Output Calibration provides:

– DAC ‘zero’ calibration - operation establishes an exact match (using standard models) of initial DAC output current signal value to the nominal value.

The DAC characterization curve is shifted in parallel, but its slope does not change when the trim is performed.

– Digital-to-Analog Trim - this command allows you to adjust the upper DAC analog output (with an accurate reference meter) to match the rated value. DAC characterization curve slope is adjusted when the trim is performed.

Analog Output Calibration command allows you to adjust the transmitter analog signal at the 4 and 20 mA points.

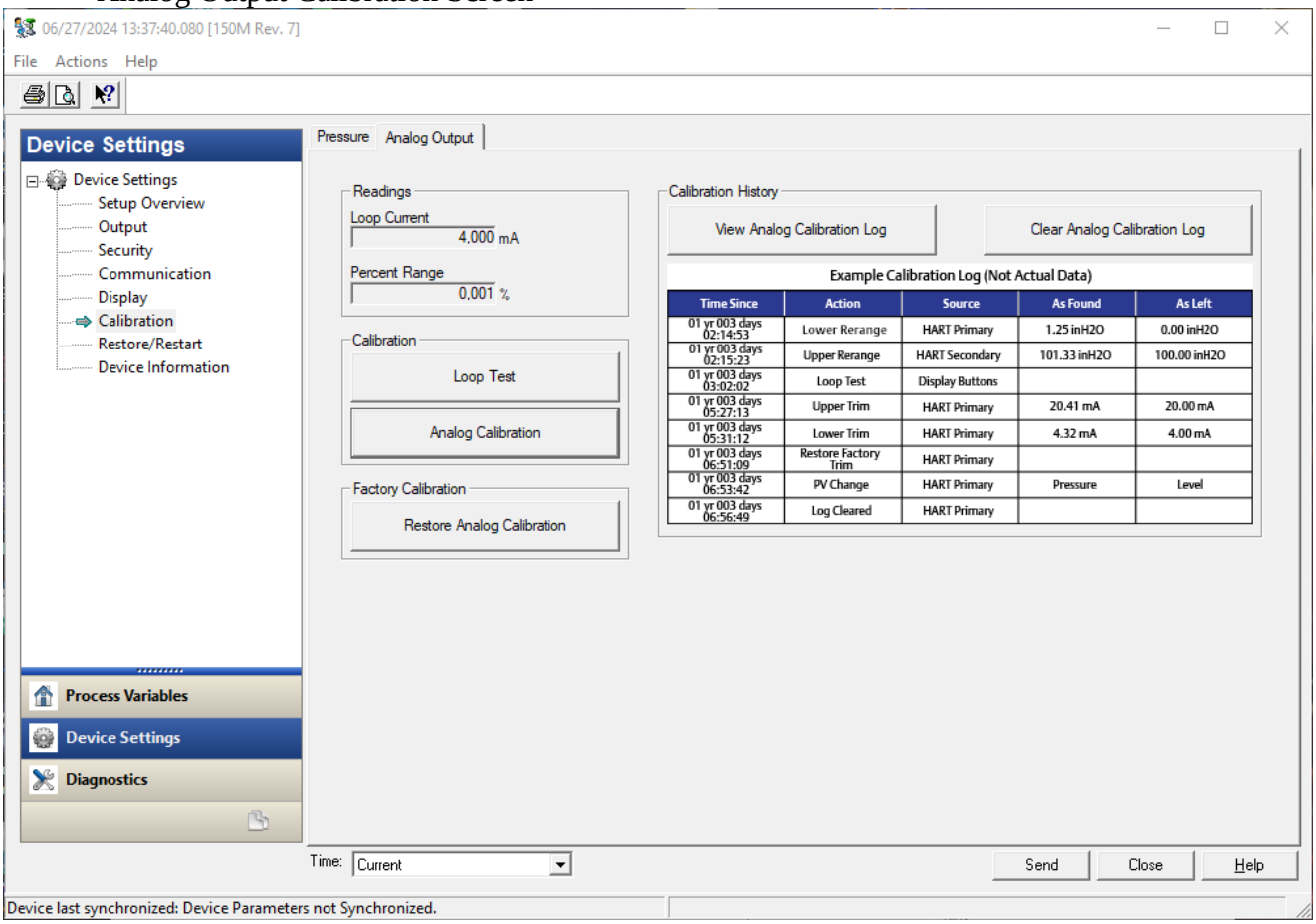
When calibrating the sensor trim, analogue signal, follow the instructions on the indicator or communication device screen.

Calibrating the analogue output using a communication device.

Procedure:

Go to ‘Device Settings → Calibration → Analog Output → Calibration → Analog Calibration’.

Analog Output Calibration Screen



Setting the indicator using buttons.

Procedure:

1 Keep pressed the setting button ‘1’ for 2 seconds to enable the indicator.

2 Enter the mode: ‘TRIM’ → ‘4 MA’ → ‘20 MA’.

M.2.6.9.4 Restore Factory Default Settings

The Restore Factory Default Settings command allows the restoration of the as-shipped factory settings of the sensor and analog output trim.

Restoring the sensor factory-default settings using a communication device.

Procedure:

Go to ‘Device settings → Calibration → Pressure → Factory calibration → Restore Pressure Calibration’.

Restoring the analog output signal factory settings using a communication device.

Procedure:

Go to ‘Device Settings → Calibration → Analog Output → Factory calibration → Restore Analog calibration’.

Setting the indicator using buttons.

Procedure:

1 Keep pressed the setting button ‘1’ for 2 seconds to enable the indicator.

2 Enter the mode: ‘TRIM’ → ‘DEFLT’ → ‘SENSOR’ → ‘CURRNT’.

M.2.6.9.5 The transmitters equipped with indicator support the device search function. This function can be used to find a transmitter using a special signal on the indicator screen. The search command can be sent via HART.

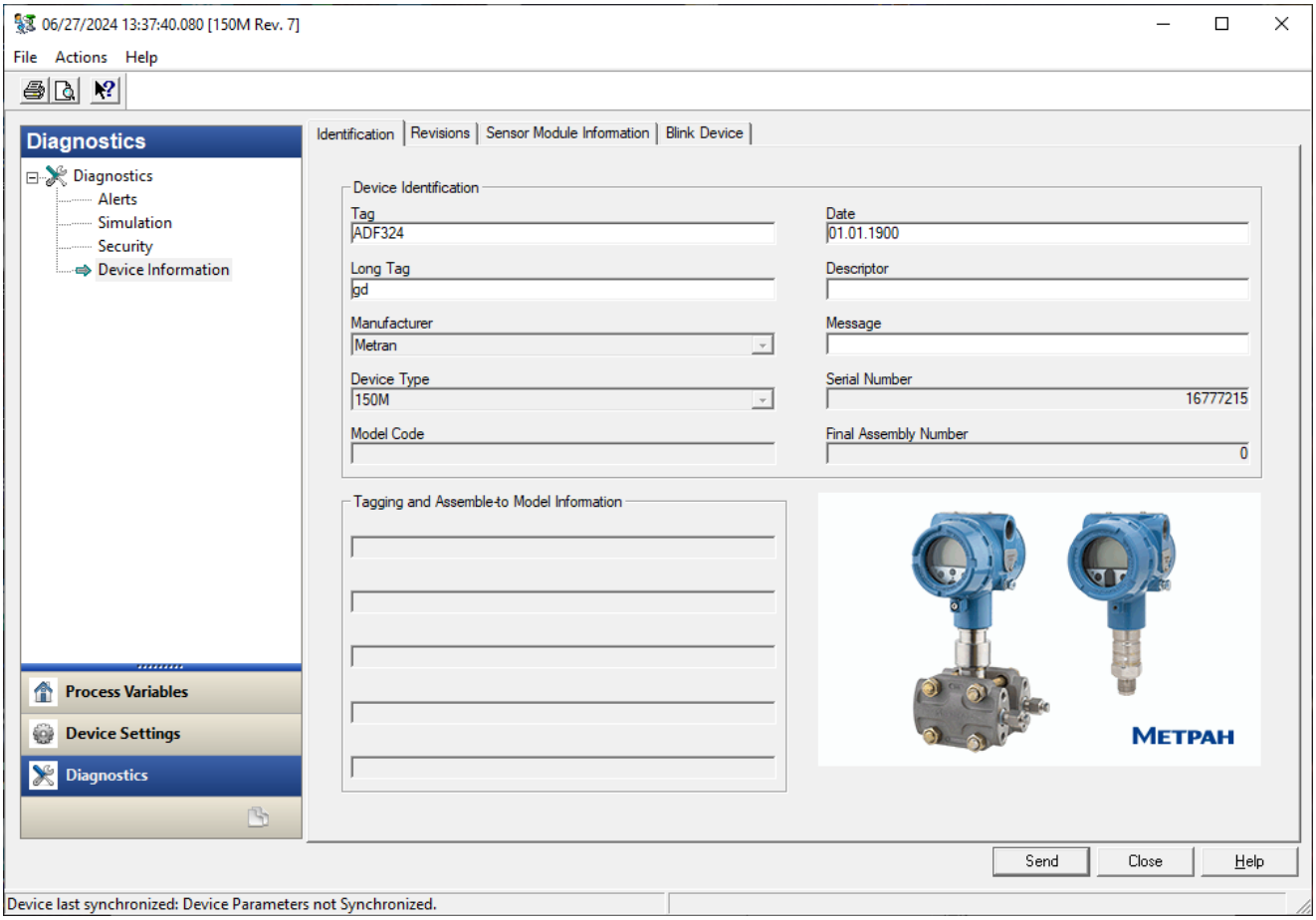
The device search can be used in two modes:

- active for 60 seconds,
- active until user sends a disabling command.

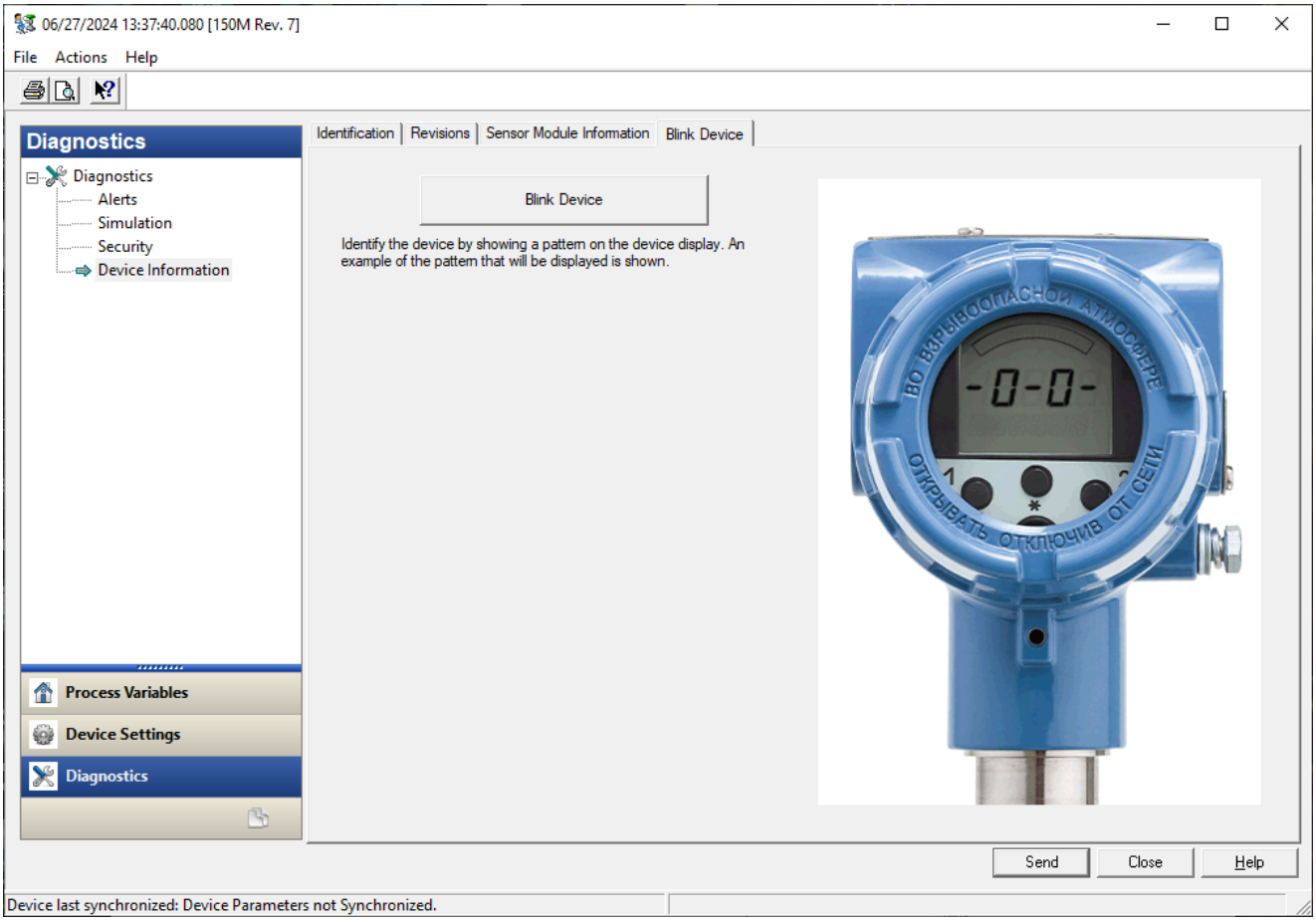
Procedure:

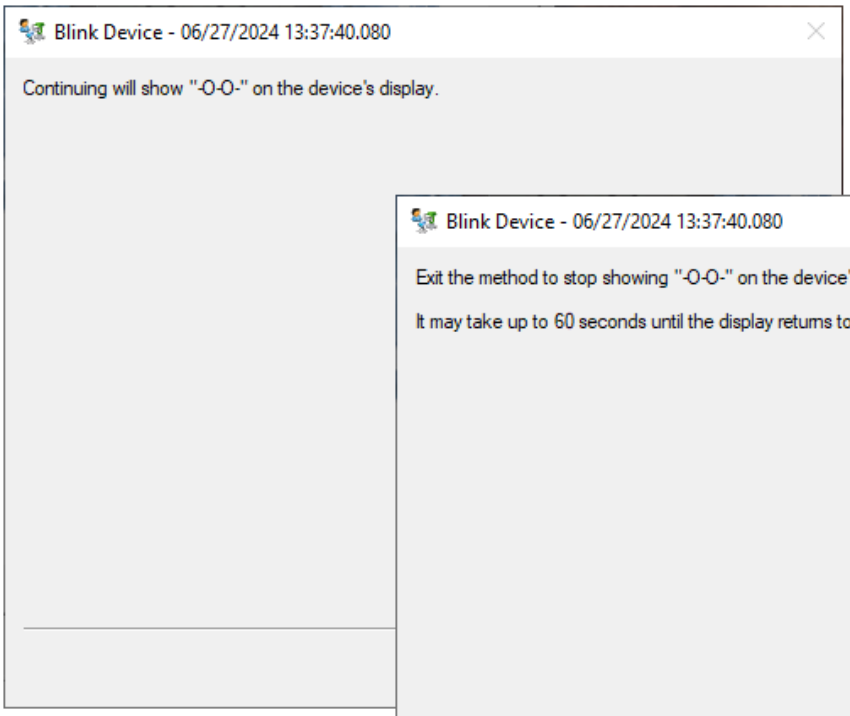
Navigate to ‘Diagnostics → Device Information → Blink Device’

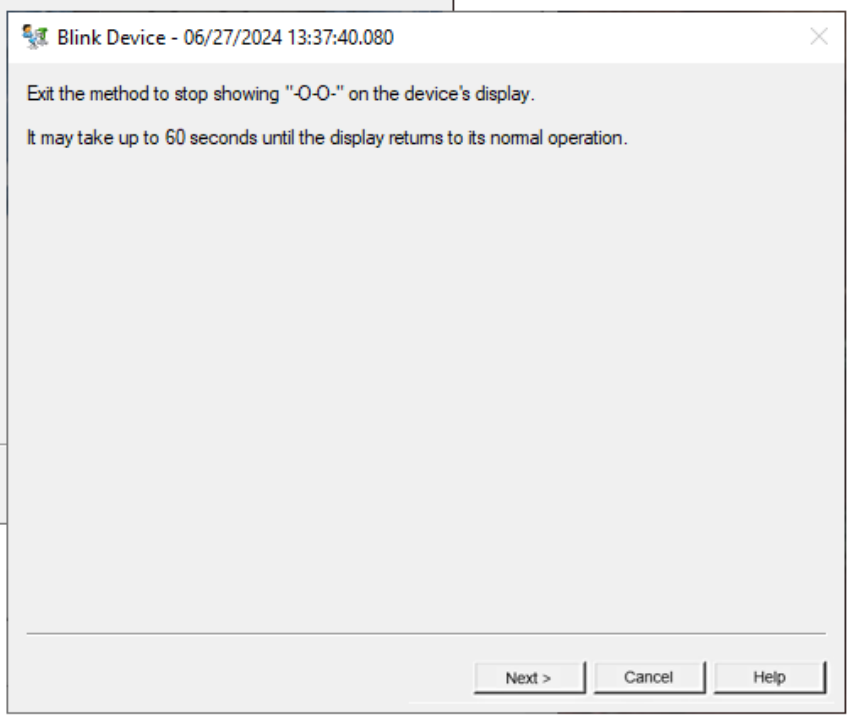
Device Information Screen



Blink Device Screens







M.2.7 Maintenance check

Maintenance check shall be performed in accordance with section 2.7 of SPGK.5225.000.00RE.

M.3 Maintenance and Repair

M.3.1 Maintenance procedure shall conform to section 3.1 SPGK.5225.000.00RE.

M.3.2 Troubleshooting

Table M.13 provides troubleshooting information for most failures that arise during operation.

If you suspect a malfunction even without diagnostic messages displayed on the screen or on the HART communication device, follow the procedures outlined here to verify the operational status of the hardware and process connections.

Table M.13

Failure	Remedial Action
1	2
1 No output signal	Test the voltage at the terminals. Check power supply polarity. Check the diode connected in parallel to the test terminals for proper functioning.
2 The transmitter does not communicate with the communication device	Check loop resistance (at least 250 Ohms). Test the voltage at the terminals. Verify the output is between 4-20 mA or saturation levels. Check DC supply voltage stability for the transmitter. Use the communication device to poll all addresses.
3 Milliamp reading is low or high	Check the applied pressure. Check if the output signal is in alarm condition. Check the 4 and 20 mA range limit points.
4 Transmitter does not respond to changes in applied pressure	Check test equipment. Check that the impulse line and valve block are not blocked. Check that applied pressure corresponds to the calibrated range. Verify applied pressure is between the 4 and 20 mA set points. Verify transmitter is not in Loop Test mode.
5. Digital Pressure Variable reading is low or high	Check that the impulse line is not blocked. Check that the transmitter is calibrated properly. Check metering equipment (verify accuracy). Verify calculations for this specific application.
6 Digital Pressure Variable reading is erratic	Check if the pipeline equipment is in serviceable. Verify damping is set properly for the application.

Table M.13 (Continued)

7 Milliamp reading is erratic	Check that the transmitter power supply provides the required voltage and current levels. Check for external electrical interference. Check that the transmitter is properly grounded. Check that the twisted-pair shield is grounded at one end only.
8 Output is unstable, transmitter accuracy is less than the permissible value	Pressure supply line is leaky. Find and eliminate the leakage. Mounting flange or transmitter nipple is leaky. Replace O-ring or gasket. Module flange plug is leaky. Tighten the plugs.
9 Leakage	Leakage between the manifold and the transmitter or between the manifold and the mounting flange or nipple. Reassemble or replace the O-ring.

M.3.3 Diagnostic Messages

If a transmitter malfunction is detected, diagnostic messages are generated on the indicator or communication device. Use them to diagnose the causes of particular transmitter status messages.

The transmitter diagnostics complies with the recommendations of Namur NE107 standard.

Standard status signals in accordance with Namur NE107 standard:

- Failure;
- Function Check;
- Maintenance Required;
- Out of Specification.

M.3.3.1 Diagnostic message: **Failure**.

Electronics Board Failure

Electronics board failure is detected.

The indicator displays: EL_ERR.

Recommended action:

Replace the electronics board.

Sensor failure

Transmitter module failure or incompatibility of circuit board and sensor module or no pressure data update or no sensor temperature data update.

The indicator displays: SN_ERR.

Recommended action:
1 Replace sensor.
2 Replace incompatible sensor.

M.3.3.2 Diagnostic message: **Function Check**.

Transmitter primary variable in simulation mode

Transmitter primary variable is in simulation mode and is not used for measuring the process.

The indicator displays: PV_SIM.

Recommended action:
Reset the Transmitter.

Fixed current output

Analog output is fixed and does not show the process measurement. This may be caused by analog trim in the transmitter, or because the transmitter has been set to loop test or multidrop mode.

The indicator displays: I_FIX.

Recommended actions:
1. Verify that loop test is no longer required.
2. Disable the test mode or restart the transmitter.

M.3.3.3 Diagnostic message: **Maintenance Required**.

Stuck buttons

At least one indicator button or transmitter external button is stuck.

The indicator displays: BN_STK.

Recommended actions:
1. Check if the external button on the housing is pressed;
2. Remove the front cover from the housing (considering the hazardous area requirements) and check that the indicator buttons are not pressed;
3. Replace the indicator;
4. Replace the electronics board.

Loop integrity diagnostics

Loop integrity diagnostics has detected voltage deviation on the transmitter terminals beyond the set limits. This may indicate that the loop integrity is deteriorated.

The indicator displays: _LOOP.

Recommended actions

1. Check the DC power supply to ensure that the power supply is correct, stable and has minimized ripple;
2. Check the circuit wiring for deterioration and proper grounding;
3. Remove the housing cover (considering the hazardous area requirements) and check for water or corrosion on the terminal block;
4. Repeat the circuit characterization and adjust the deviation limits, if required.

Process Alert 1

The transmitter has identified a deviation in the monitored variable that exceeds the predefined thresholds for process alert 1.

The indicator displays: The first 6 characters of the identifier for Process Alert 1.

Recommended actions:

1. Confirm the monitored variable exceeds the warning values;
2. Change or disable the warning settings.

Process Alert 2

The transmitter has identified a deviation in the monitored variable that exceeds the predefined thresholds for process alert 2.

The indicator displays: The first 6 characters of the identifier for Process Alert 2.

Recommended actions:

1. Confirm the monitored variable exceeds the warning values;
2. Change or disable the warning settings.

M.3.3.4 Diagnostic message: **Out of Specification**.

Pressure exceeds the allowable limits

The measured pressure is outside of the sensor module limits.

The indicator displays: _P_SAT.

Recommended actions

1. Check the process conditions for the installed transmitter.
2. Verify the pressure transmitter connection to the system to confirm there are no obstructions or damage to the isolating diaphragms.
3. Replace the sensor module.

Sensor temperature out of limits

The sensor module temperature is outside of the safe operating range.

The error does not affect the transmitter output.

The indicator displays: _T_SAT.

Recommended actions:

1. Check if the process temperature and ambient temperature are within the range of –65 to 90 °C.
2. Replace the sensor module.

Board temperature out of limits

Board temperature exceeds the safe operating range.

The error does not affect the sensor output.

The indicator displays: TE_SAT.

Recommended actions:

1. Check if the electronics temperature is within the range of –65 to 90 °C.
2. Replace the electronics board.

Current output is saturated

The analog output is restricted (saturated). Measured pressure is outside of the specified range.

The indicator displays: _I_SAT.

Recommended actions:

1. Inspect the status of the transmitter.
2. Check the range value settings for 4 mA and 20 mA, reconfigure if necessary.
3. Verify the pressure transmitter connection to the system to confirm there are no obstructions or damage to the isolating diaphragms;
4. Replace the sensor module.

M.3.4 Logs.

The transmitters store the logs where the transmitter operating data with time stamp is recorded.

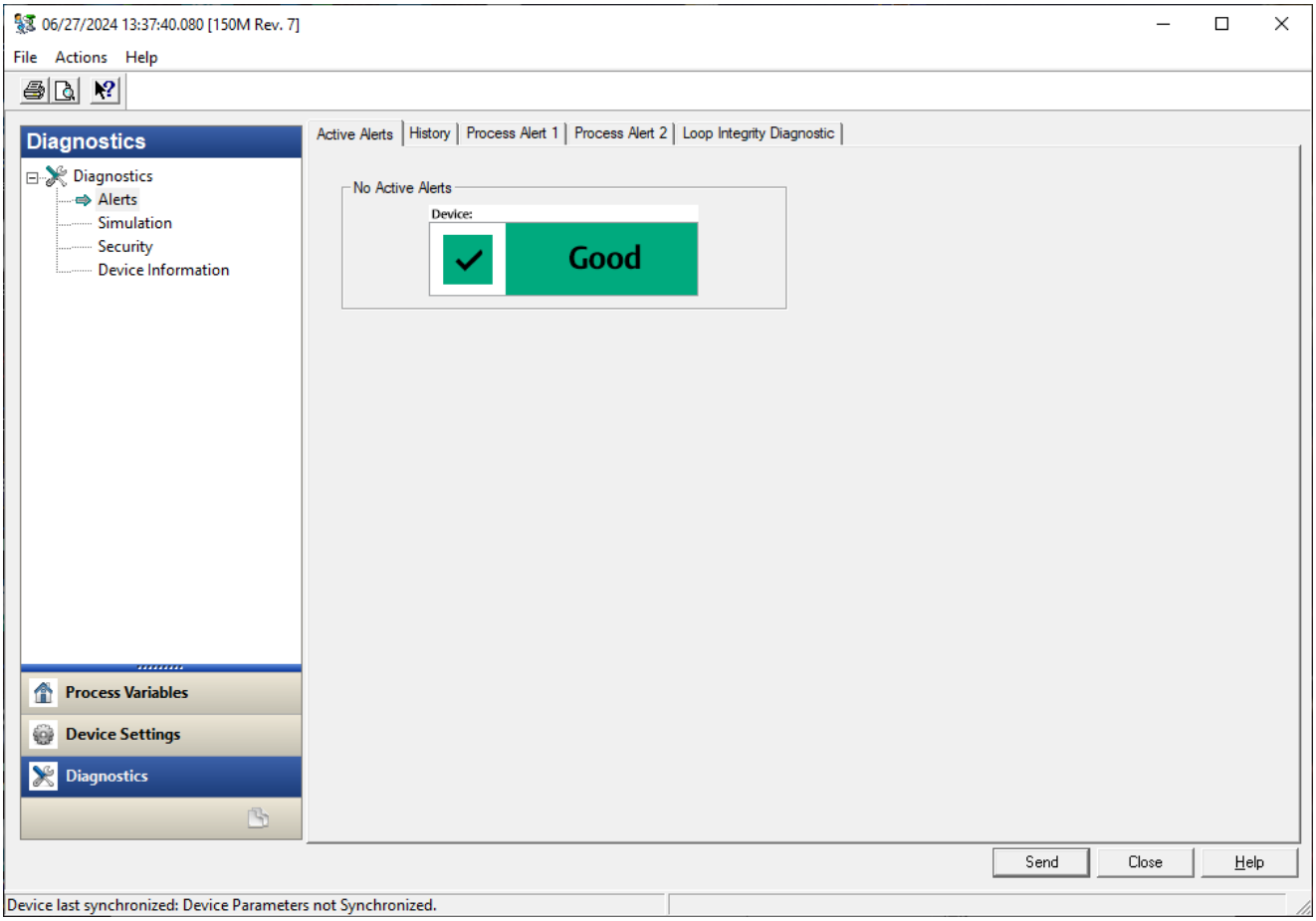
M.3.4.1 The transmitter stores a diagnostic message log that contains 100 failure/malfunction records.

Viewing the diagnostic message log using a communication device

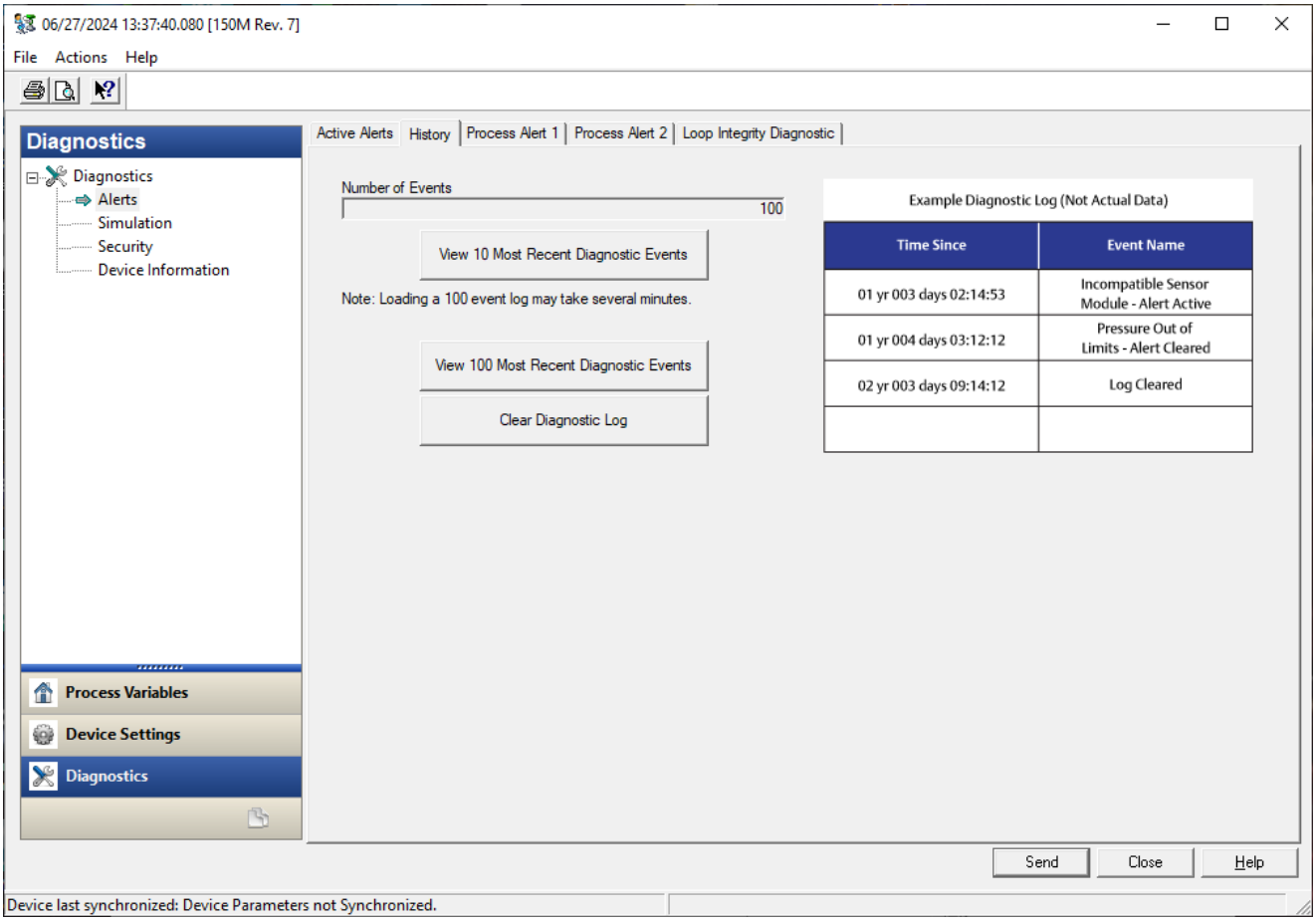
Procedure:

‘Diagnostics → Alerts → History.’

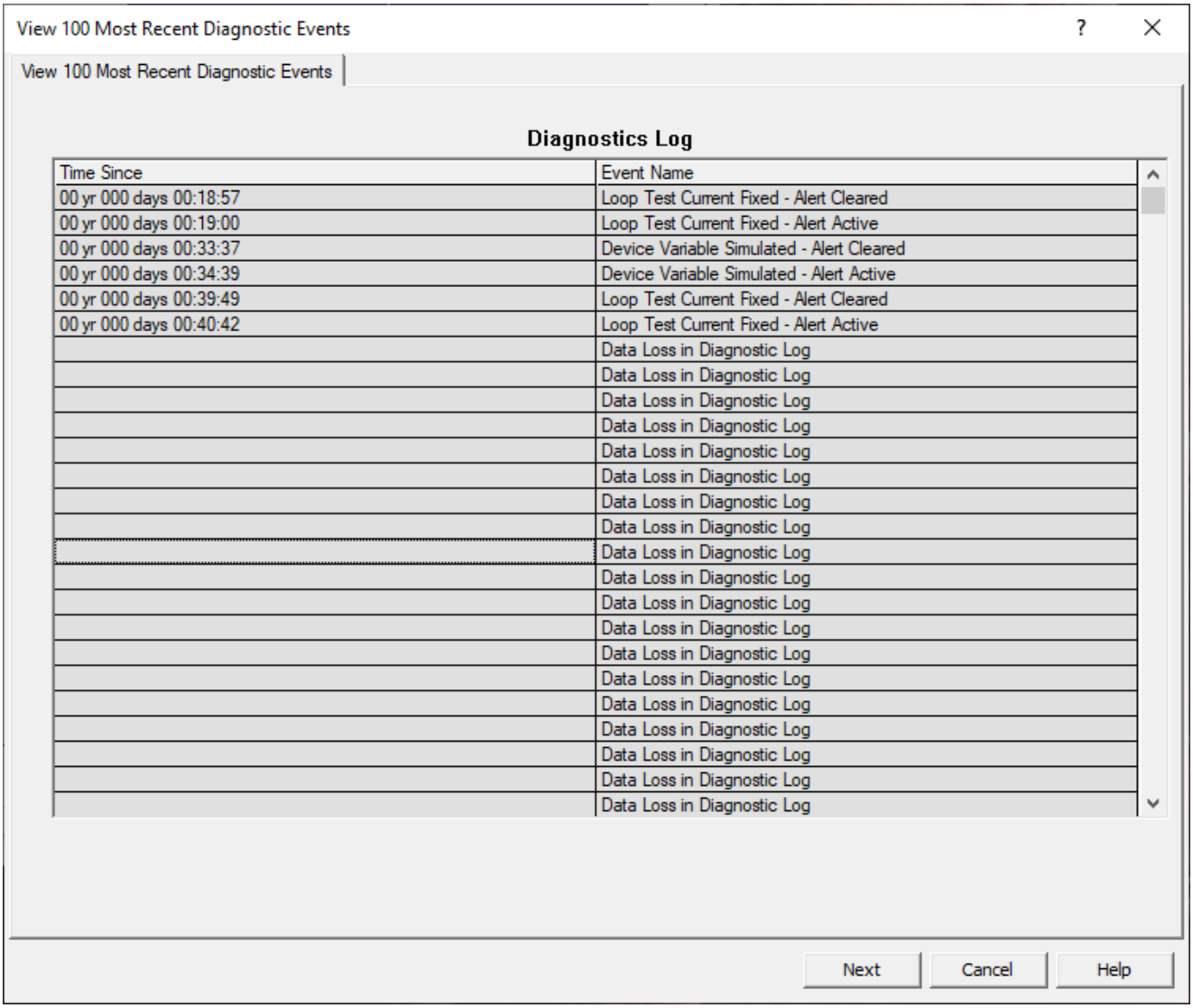
Alerts Screen



History Screen



100 Most Recent Diagnostic Events Log Screen



M.3.4.2 Additional Variable Log

The following events are recorded to the log:

– Modified settings of the Level variable;

– Modified settings of the Volume variable;

– Modified settings of the Flow variable;

– Modified low flow cut-off setpoint.

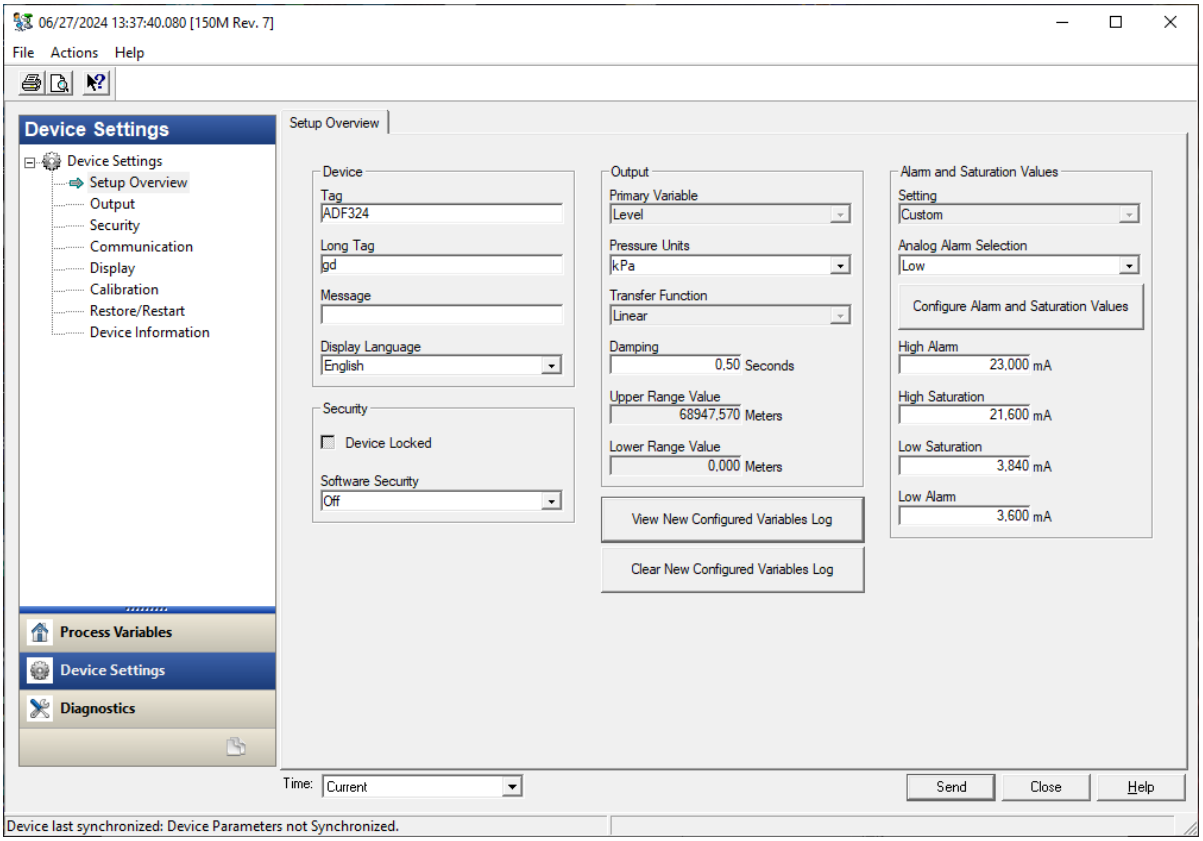
The log is used to record event type and event occurrence time since the beginning of transmitter operation.

Viewing the additional variable log using a communication device.

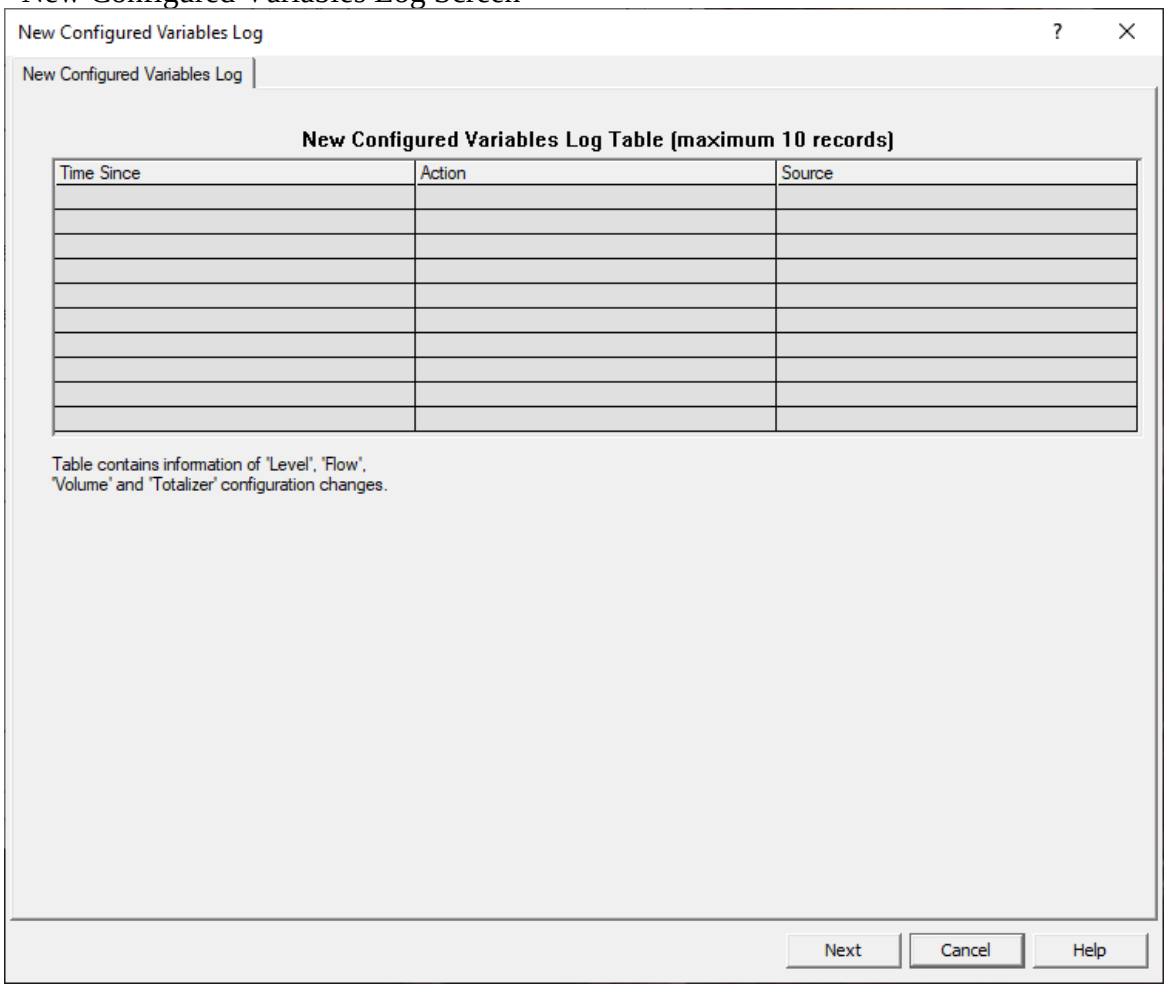
Procedure:

‘Device Settings → Setup overview → View New Configured Variables Log’.

Setup Overview Screen



New Configured Variables Log Screen



M.3.4.3 Analog Output Calibration Log.

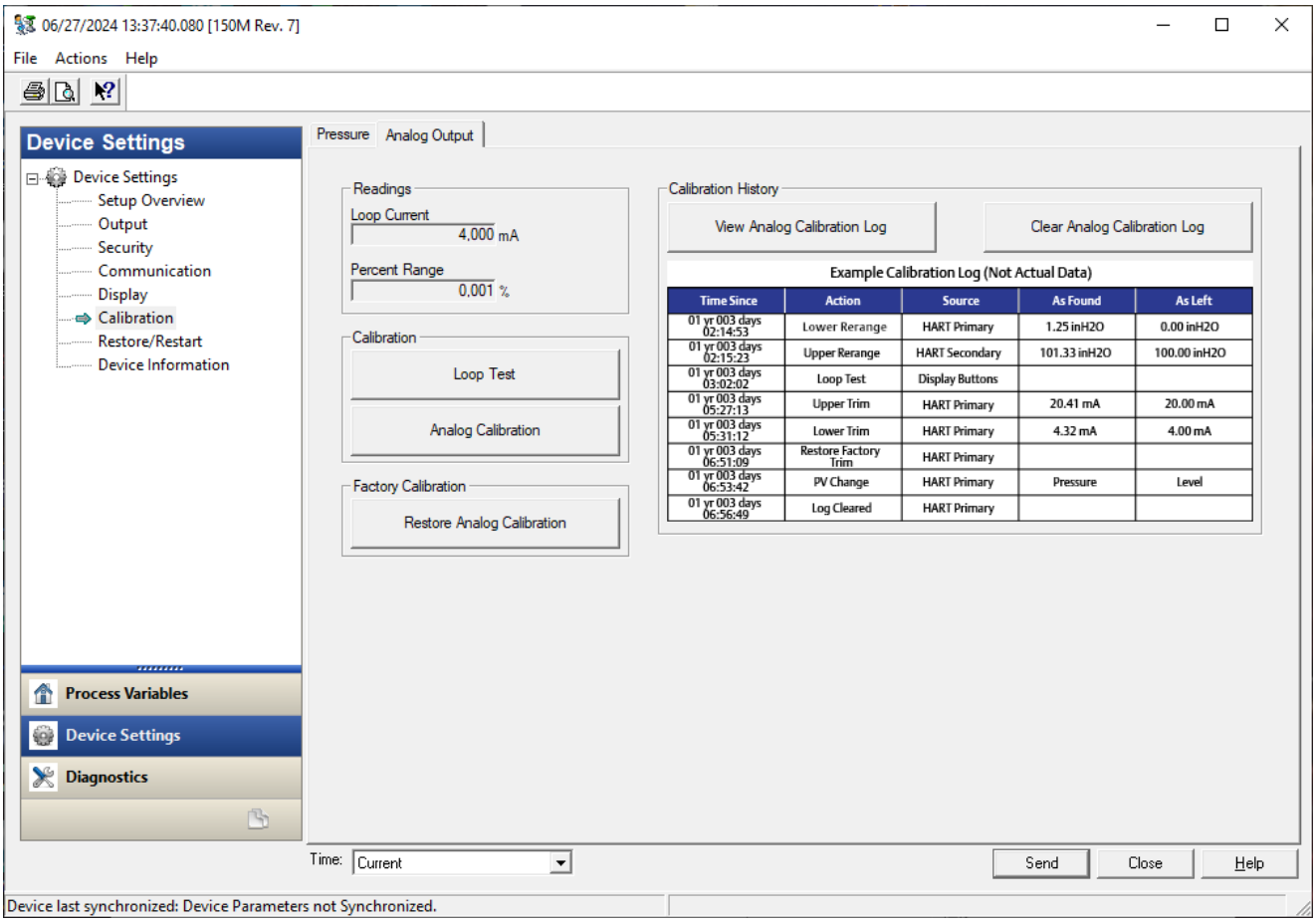
The transmitter contains an analog output calibration log for 20 records. The log is used to record the following events: 4mA and 20 mA trim, reset to factory defaults, fixed current setting, change in primary variable purpose, reranging, change in alarm and saturation current, change in analog signal conversion function.

Viewing the analog output calibration log using a communication device.

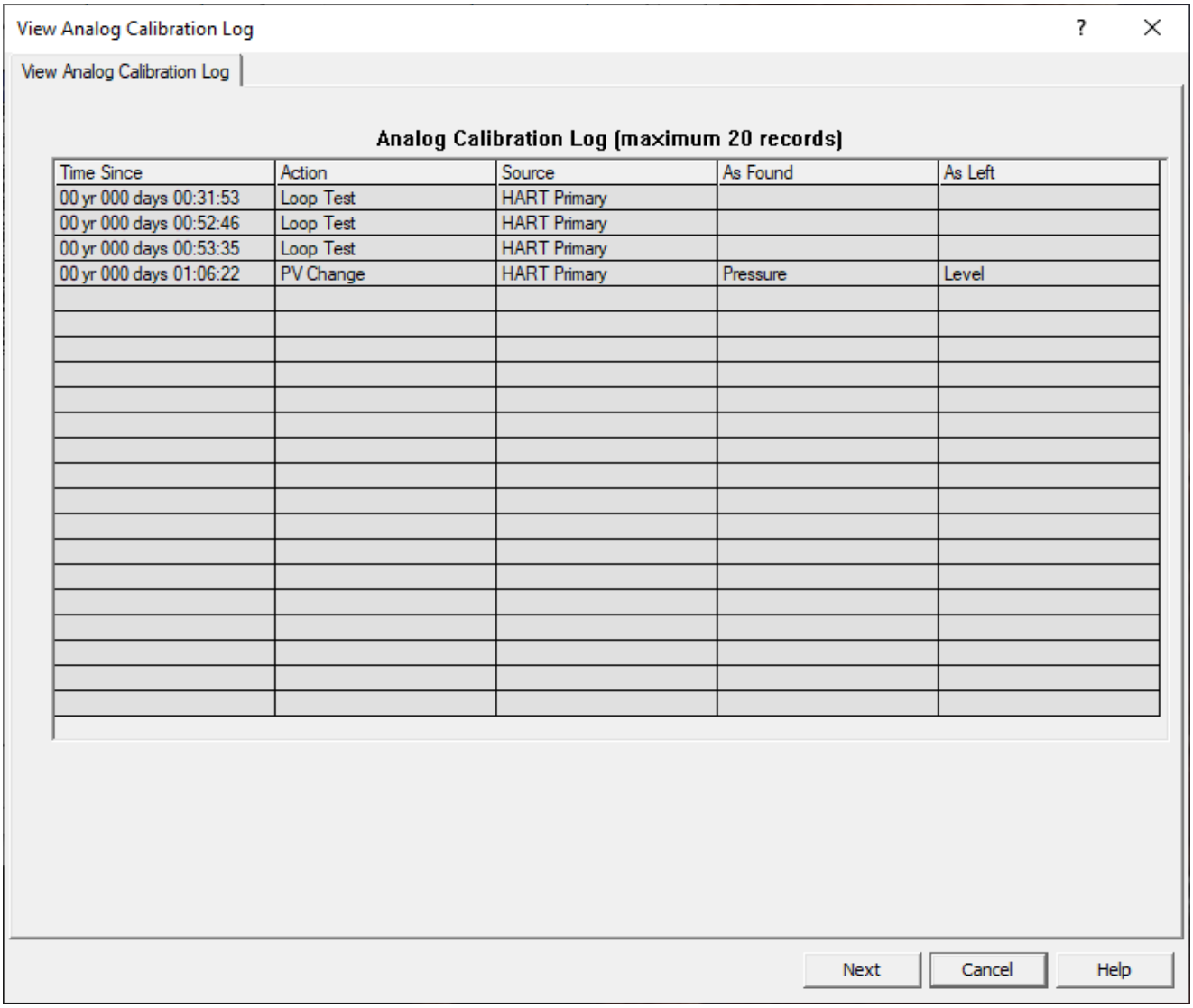
Procedure:

'Device Settings → Calibration → Analog Output → Calibration History → View Analog Calibration Log.'

Analog Output Calibration screen



Analog Calibration Log Screen



M.3.4.4 Sensor calibration log.

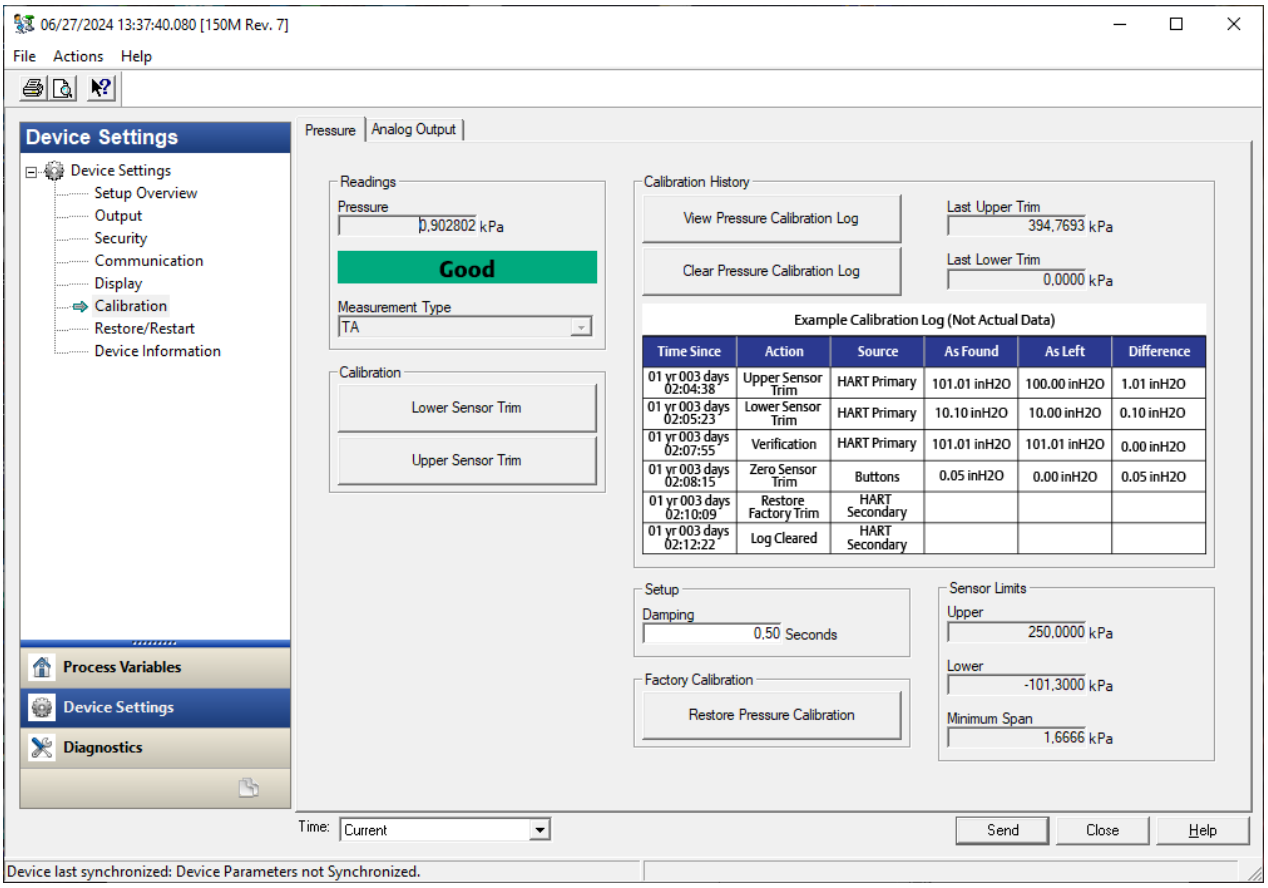
The transmitter contains a sensor calibration log for 20 records. The log is used to record the following events: lower and upper range value calibration, zero calibration, reset to factory defaults.

Viewing the sensor calibration log using a communication device.

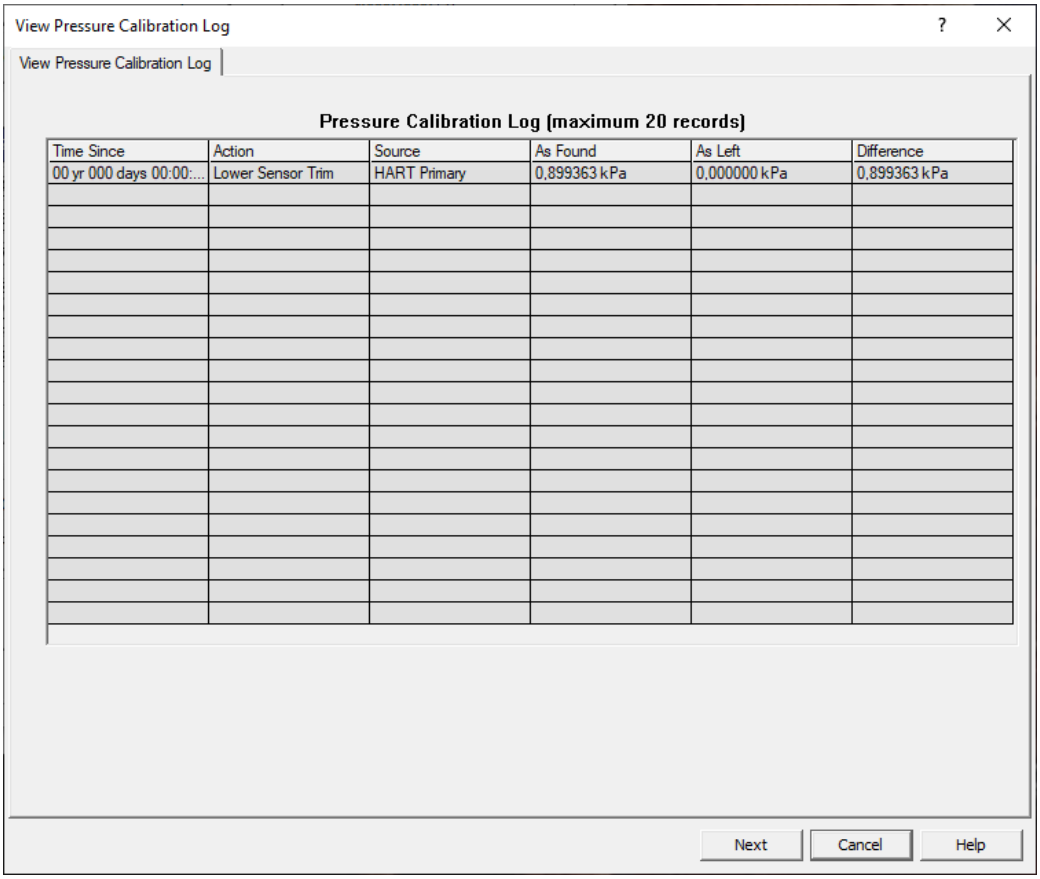
Procedure:

'Device Settings → Calibration → Pressure → Calibration History → View Pressure Calibration Log.'

Sensor Calibration Screen



Sensor Calibration Pressure Log Screen



M.3.4.5 Minimum and Maximum Value Log.

The transmitter contains a minimum and maximum value log.

The software saves minimum and maximum values of the following process variables with their occurrence times:

– pressure;

– sensor temperature;

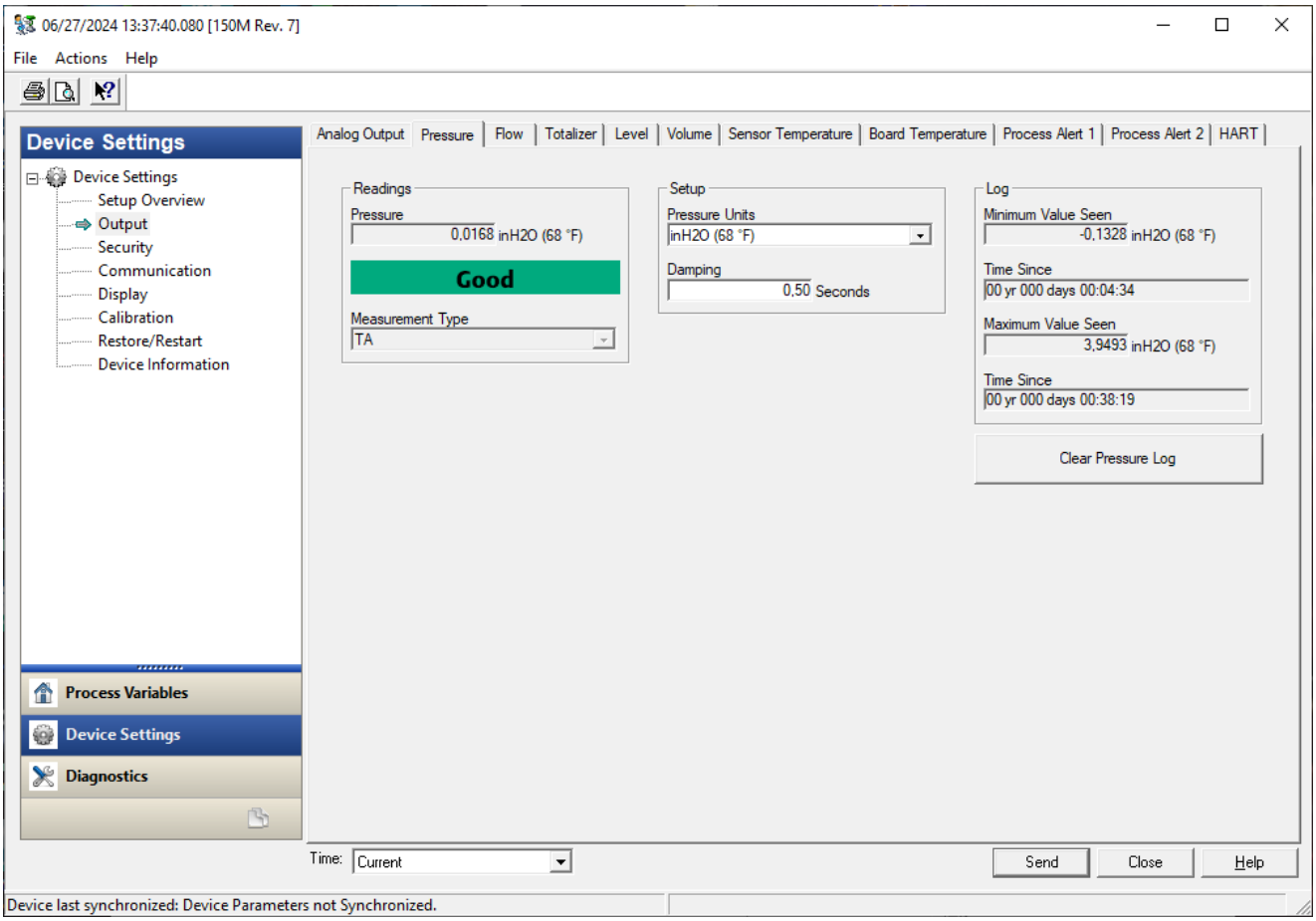
– electronics board temperature.

Viewing the maximum/minimum value log using a communication device.

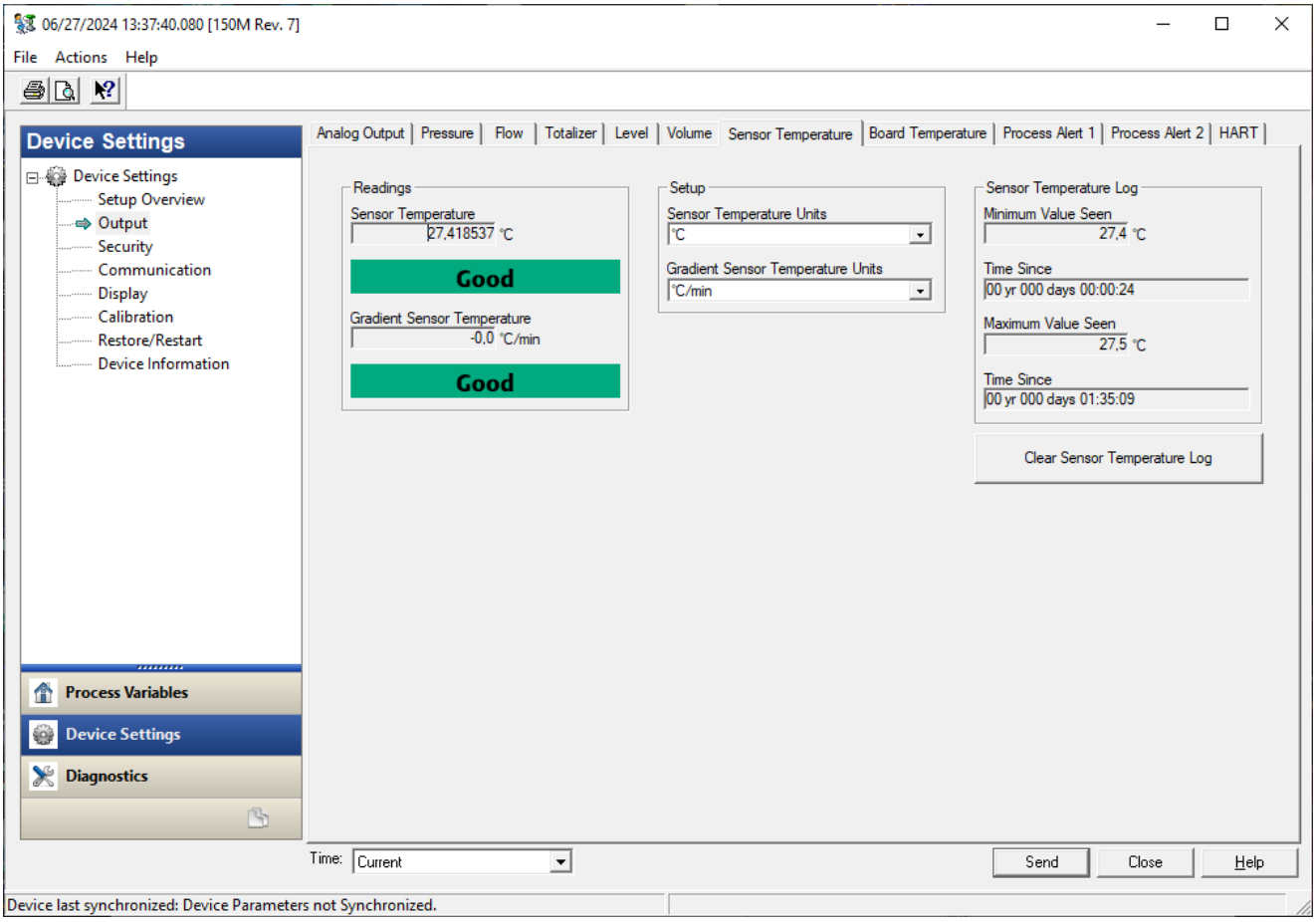
Procedure:

‘Device Settings → Output → Pressure/Sensor Temperature/Board Temperature.’

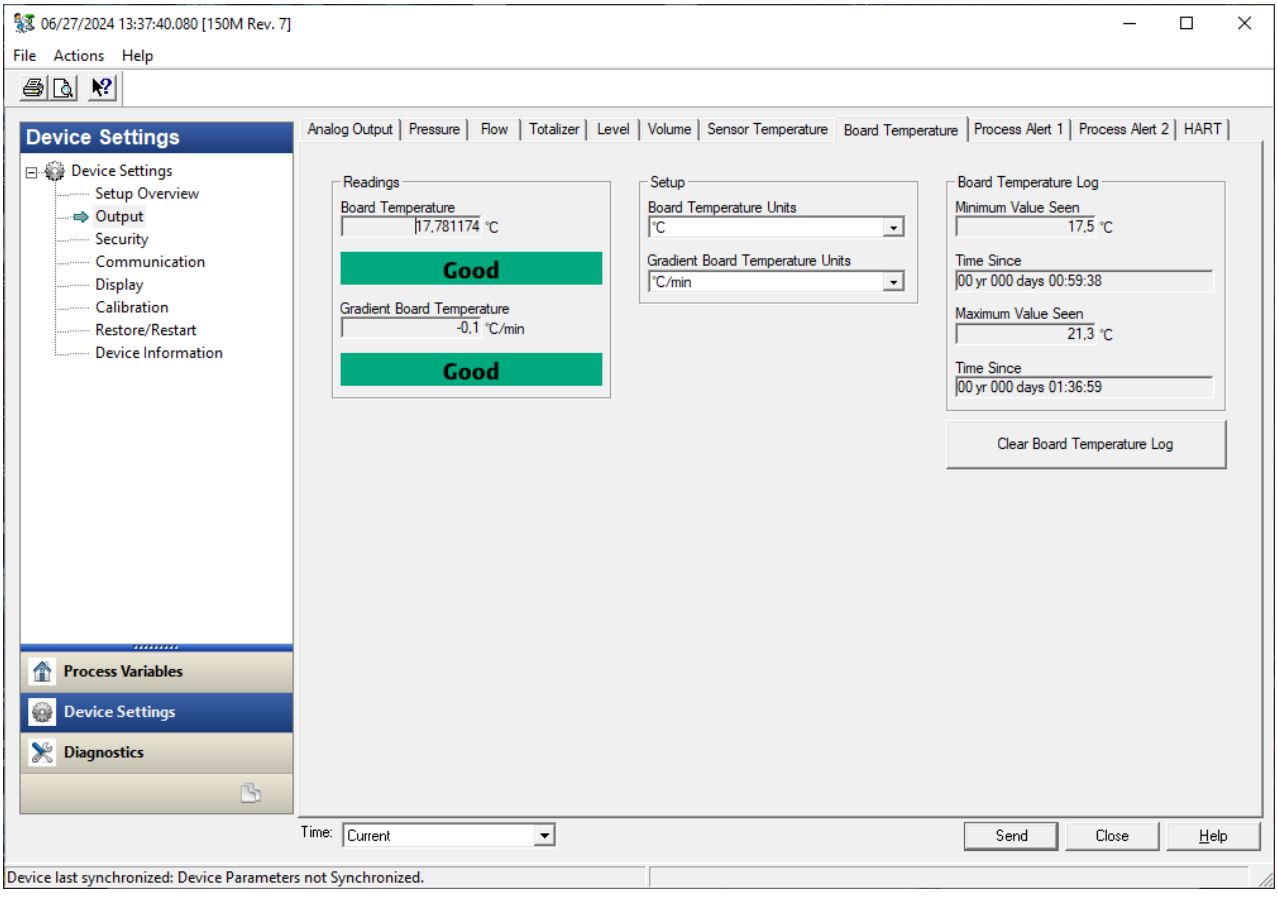
Maximum and Minimum Pressure Log Screen



Maximum and Minimum Sensor Temperature Log Screen



Maximum and Minimum Board Temperature Log Screen



M.3.5 Critical Failures

Critical failure that appears during operation means there is an external leakage in the transmitter. Critical failure may cause injury, environment and property.

External leak may result from:

- Sealing gasket damage or leak in flanged connection;
- Diaphragm corrosion.

Potential human errors that result in an incident or accident:

- incorrect installation of relevant sealing gaskets of mounting flanges, incorrect selection of sealing gaskets;
- incorrect installation or operation of manifolds;
- applying the operating pressure that significantly exceeds the maximum permissible value;
- the material selected is not corrosion-resistant to the process.

Staff actions in the event of critical failure, incident or accident.

The transmitters with critical failures are not allowed for operating.

In case of an accident, stop applying the operating media to the failed transmitter, turn the power off. Dismantle the transmitter and replace it with the new one.

M.3.6 Critical State Criteria.

Critical state criterion is part failure caused by corrosion, flow accelerated corrosion of materials, which is caused by operating fluid impact.

M.4 Safety Instrumented Systems (SIS) Requirements

M.4.1 Transmitter are devices that meet the GOST R IEC 61508 requirements when used in emergency protection systems.

Safety Instrumented Systems (SIS) consist of several Safety Instrumented Functions (SIF).

Each safety instrumented function has a specific Safety Integrity Level (SIL) that is required to achieve a functional safety level. Each SIF is a separate or interconnected circuit consisting of transmitters, logic solvers or control systems, and an executive control monitoring element.

The transmitters are two-wire pressure measuring instruments. The measured pressure is converted into a 4 to 20 mA output signal. A safety control system monitors the signal to perform a specific action based on the pressure measurement. If the safety control system detects a transmitter failure, it generates a signal that drives the actuator to the specified safe position.

GOST R IEC 61508 defines four safety integrity levels (SIL). Each level corresponds to a range of probability of failure of a safety function.

The higher the safety integrity level of a safety-related system, the lower the probability that the safety-related system will fail to fulfil the required safety function.

The available Safety Integrity Level (SIL) is defined by the following safety characteristics:

– The average probability of dangerous failures of the safety function when required (PFDavg);

– Hardware fault tolerance (HFT);

– Safe Failure Fraction (SFF).

The average probability of failure for the entire emergency protection system (PFDavg) is typically shared between three subsystems: the pressure transmitter, the control system or logic solver, and the actuating control element.

As per GOST R IEC 61508-2, the transmitters are categorized as type B elements that operate in low request frequency and high request frequency modes and have a zero hardware fault tolerance.

The transmitter resistance to systematic failures corresponds to SC3.

It is suitable for the safety function of Safety Integrity Level 2 (SIL 2) with hardware fault tolerance HFT=0, and for Safety Integrity Level 3 (SIL 3) with hardware fault tolerance HFT=1. Architectural restrictions on hardware safety conform to the 1n method. These transmitters are suitable for operation in both the low frequency and the high frequency of requests.

The measured pressure is the transmitter safety function. The 4-20 mA analog output signal can be used as part of the Safety Instrumented Function (SIF). The transmitter has a self-diagnostic function and is programmed to set the output signal to fault mode when an internal error is detected.

The self-diagnostic interval is at least once every 60 minutes.

The acceptable deviation for the functional safety signal is within ±2% of the output signal range.

Note: Functional safety system output is 4-20 mA analog signal.

In the event that the transmitter detects a failure through its diagnostics, the system must be promptly switched to a safe state, and the transmitter itself must undergo repairs.

When a failure is detected, the transmitters are programmed to trigger an alarm current. The specific alarm options and their associated values can be found in section M.1.2.30.

The failure intensities are outlined in the safety certificate.

M.4.2 Putting the transmitter into operation considering the operation as part of the Safety Instrumented Function (SIF).

To initiate the transmitter for use within the Safety Instrumented Function (SIF), trained personnel must commission the transmitters following the procedure outlined in section 2.2 of SPGK.5225.000.00. Several key requirements must be considered during this process:

– Prior to operation, the transmitter covers must be engaged metal-to-metal to ensure a proper seal;

– The current loop must deliver a voltage at the transmitter's power supply terminals of no less than 12 V, corresponding to a transmitter output signal value of 23 mA.

– Throughout operation, it is imperative to activate the protective mode for transmitter parameter settings to maintain operational integrity.

M.4.3 Setting the transmitter considering the operation as part of the Safety Instrumented Function (SIF).

A HART-compatible device may be used to connect with the transmitter and check its settings.

Note. Transmitter output is not safety-rated during: configuration changes and 4 – 20 mA loop test. Alternative means should be used to ensure process safety during transmitter configuration and maintenance activities: either disable the transmitter safety function to avoid a false trip, or undertake scheduled maintenance as part of the turnaround maintenance.

M.4.3.1 Damping.

User-selected damping will affect the transmitter's ability to respond to changes in the applied process. The damping value + settling time should not exceed the values determined as safety time to respond to unsafe change of a measurement variable.

M.4.3.2 Levels of Interlock and Safety Actuation in Case of Fault.

The logic solver or the control system of the emergency protection system shall be configured to match the transmitter settings. The failure and saturation levels and their signal values are given in M.1.2.30.

M.4.4 Transmitter Operation and Maintenance

According to Section 7.4.5.2 f) of GOST R IEC 61508-2, proof tests shall be carried out to reveal hazardous faults that cannot be detected by diagnostic tests. All steps included in the control tests shall be carried out by qualified personnel.

In most cases, the safety function should either be locked out during the routine test to avoid false triggering of the safety system, or routine maintenance procedure should be carried out during the shutdown.

M.4.4.1 Proof Test

Use the HART communicator for testing of the communication loop, calibration of the analog output signal or sensor calibration. During the test, switch off the transmitter protection parameters.

Once the test is complete, enable the transmitter protection parameters.

M.4.4.2 Simple Proof Test

The simple suggested proof test consists of a power cycle (transmitter turning on) plus reasonability checks of the transmitter output.

A communicator and a milliammeter are required for this test.

Simple proof test procedure is given in Table M.14.

Table M.14

Stage	Action
1	Block the safety function and perform the necessary actions to prevent a false actuation
2	Use HART communications to retrieve any diagnostics and take appropriate action.
3	Send a HART command to the transmitter to switch to a high fault level current output signal and check that the analog current reaches this value*. Check the fault level according to M.2.6.6.1.
4	Send a HART command to the transmitter to switch to a low fault level current output signal and check that the analog current reaches this value**. Check the fault level according to M.2.6.6.1.
5	Inspect the transmitter for any leaks, visible damage or contamination.
6	Activate the safety function and resume normal operation of the transmitter.
7	Enable the transmitter protection configuration mode

_____

* This tests for compliance voltage problems such as a low loop power supply voltage or increased wiring distance. This also tests for other possible failures.

** This tests for possible quiescent current related failures.

During this test, 60% of possible dangerous undetected failures can be identified.

M.4.4.3 Full Proof Test

The comprehensive proof test consists of performing the same steps as the simple suggested proof test but with a two point calibration of the pressure sensor.

This test requires a communication device and reference equipment for pressure calibration.

The operations included in the full proof test are given in Table M.15.

Table M.15

Stage	Action
1	Block the safety function and perform the necessary actions to prevent a false actuation
2	Use HART communications to retrieve any diagnostics and take appropriate action.
3	Send a HART command to the transmitter to switch to a high fault level current output signal and check that the analog current reaches this value*. Check the fault level according to M.2.6.6.1.
4	Send a HART command to the transmitter to switch to a low fault level current output signal and check that the analog current reaches this value**. Check the fault level according to M.2.6.6.1.
5	Inspect the transmitter for any leaks, visible damage or contamination.
6	Perform a calibration of the sensor at two distinct points located within the operational range.
7	Activate the safety function and resume normal operation of the transmitter.
8	Enable the transmitter protection configuration mode

_____

* This check reveals low supply voltage or increased wire resistance, as well as other possible malfunctions;

** This tests for possible quiescent current related failures.

During this test, 90% of possible dangerous undetected failures can be identified.

Notes:

1. Tailoring the frequency and type of verification tests is crucial for every unique Safety Instrumented Function (SIF) within the system, carefully considering factors such as the Safety Integrity Level (SIL), loop design, and the feasibility of conducting these tests in an operational plant environment.

2. It is the user's responsibility to establish and uphold the routine test prerequisites for pulse lines, including ensuring their cleanliness is maintained to the required standards.

3. It is important to note that automatic internal diagnostics are unable to identify potentially hazardous undetectable failures. They could be detected with proof tests only.

M.4.5 Safety Metrics

M.4.5.1 The transmitter failure rate in compliance with GOST R IEC 61508-2 is documented in the safety certificate, which is established based on the functional safety assessment.

M.4.5.2 Determination of the average probability of hazardous failure on demand (PFDavg)

When assessing the Safety Integrity Level (SIL) of a safety instrumented function (SIF), it is essential to calculate the PFDavg for the entire system. This calculation considers various factors such as redundant architectures, intervals and effectiveness of verification tests, automatic diagnostics, average repair durations, and specific failure rates of all system components integrated into the SIF. Each individual element must conform to the Hardware Fault Tolerance (HFT) specifications to ensure the overall integrity of the system.

M.5 Storage and Transportation Rules

Storage and transport rules conform to section 4 SPGK.5225.000.00 RE.

M.6 Disposal

Disposal procedures are in accordance with section 5 SPGK.5225.000.00 RE.

M.7 Metran-150/Code HR7 Transmitter Model String

M.7.1 — 150CD Differential Pressure Transmitter and 150CG Gage Pressure Transmitter Model String

Table M.16

Model	Product Description			CD	CG
150CD	Differential Pressure Transmitter			•	–
150CG	Gage Pressure Transmitter			–	•
Mandatory Options					
Code	**Measurement Range**[1] **150CD model**	**150CG model**		**CD**	**CG**
1T	((–6.3) – 6.3) kPa	((–6.3) – 6.3) kPa		•	•
2T	((–40) – 40) kPa	((–40) – 40) kPa		•	•
3T	((–250) – 250) kPa	((–100) – 250) kPa		•	•
4T	((–1.0) – 1.0) MPa	(–100) kPa – 1.0 MPa		•	•
5T	0 – 3.0 MPa	(–100) kPa – 3.0 MPa		•	•
6T	0 – 10.0 MPa	(–100) kPa – 10.0 MPa		•	•
Code	**Wetted Part Material**			**CD**	**CG**
	Flange	**Drain Valve, valve seat**	**Other Parts**		
2	316 SST	316 SST	316L SST	•	•
6	316 SST	Alloy C-276	316L SST	•	•
Code	**Diaphragm Seal Material**			**CD**	**CG**
2	316L SST			•	•
3	Alloy C-276			•	•
7	316L SST with golden coating			•	•
Code	**O-ring Material**			**CD**	**CG**
1	Rubber NO-68-1			•	•
2	Glass-filled PTFE			•	•
3	Fluorosilicone rubber			•	•
4	Graphite-filled PTFE			•	•
Code	**Fill Fluid**			**CD**	**CG**
1	Silicone			•	•
Code	**Fasteners**			**CD**	**CG**
L3	35KhGSA (35ХГСА) or 30KhGSA (30ХГСА) steel parts			•	•
L4	09Cr16Ni4Nb (09Х16Н4Б) or 14Cr17Ni2 (14Х17Н2) steel parts			•	•
Code	**Output**			**CD**	**CG**
A	4...20 mA digital HART			•	•
Code	**HART Version**			**CD**	**CG**
HR7	HART Version 7			•	•
Other Options					
Code	**Functional diagnostics**			**CD**	**CG**
DA0	Loop Integrity Diagnostic			•	•
Code	**Indication**			**CD**	**CG**
M5[2]	Built-in LCD			•	•

Table M.16 (Continued)

Code	Application-specific Certification	CD	CG
IM	0Ex ia/Ex ia Intrinsic Safety	•	•
EM	1Ex db/Ex tb Explosion Safety	•	•
KM	1Ex db/Ex tb Explosion Safety or 0Ex ia/Ex ia Intrinsic Safety	•	•
IC[13)14)]	PO Ex ia Intrinsic Safety	•	•
EC[13)14)]	PB Ex db Explosion Safety	•	•
KC[13)14)]	PB Ex db Explosion Safety or PO Ex ia Intrinsic Safety or PB Ex db ia Explosion and Intrinsic Safety	•	•
TC[13)14)]	PB Ex db ia Explosion and Intrinsic Safety	•	•
Code	**Integral Manifolds**	**CD**	**CG**
S5[3)]	Available with manifold installed	•	•
Code	**Diaphragm Seal Assembly** [4)]	**CD**	**CG**
S1	Assembly with a single diaphragm seal (pertaining specifically to the diaphragm seal code 2, material code 2, 6 for wetted parts, material code 2 for O-rings, fastener code L4; is not compatible with range code 1T, assembly part codes D1-D8, DA for 150CG, codes LT, BR6, MW2, RS).	•	•
S2	Assembly with two diaphragm seals (pertaining specifically to the diaphragm seal code 2, material code 2, 6 for wetted parts, material code 2 for O-rings, fastener code L4; and is not compatible with range code 1T, assembly part codes D1-D8, DA, codes LT, BR6, MW2, RS).	•	–
Code	**Connection hardware**[5)]	**CD**	**CG**
D1	Stainless steel mounting flange with K1/4 threaded hole″	•	•
D2	Stainless steel mounting flange with K1/2 threaded hole″	•	•
D3	Stainless steel mounting flange with 1/4 NPT threaded hole	•	•
D4	Stainless steel mounting flange with 1/2 NPT threaded hole	•	•
D5	Stainless steel mounting flange with nipple and coupling nut M20.1,5 for 14 mm OD pipe connection (ID ∅10)	•	•
D6	Carbon steel mounting flange with nipple for 14 mm OD pipe connection	•	•
D7	Stainless steel mounting flange with 1/4 NPT threaded fitting	•	•
D8	Stainless steel mounting flange with 1/2 NPT threaded fitting	•	•
DA	Stainless steel mounting flange with nipple and coupling nut M20.1,5 for 14 mm OD pipe connection (ID ∅8)	•	•

Code	Nipple material (for mounting part codes D5, D6, DA only)			CD	CG
	Nipple material	**Gasket material (for codes D5, DA)**	**Nipple Coupling Nut Material (for codes D5, DA)**		
2	12X18H10T or 316L SST	Steel 12X18H10T	Stainless Steel	•	•
4	Carbon steel coated	Copper M3	Carbon steel coated	•	•
5	09G2S coated carbon steel (for codes D5 and D6 only)	Copper M3	Carbon steel coated	•	•

Code	Mounting Brackets	CD	CG
B1	Mounting bracket to mount the transmitter on OD 50 mm diameter pipe (material – coated carbon steel)	•	•
B4	Mounting bracket to mount the transmitter on OD 50 mm diameter pipe (material – steel 12X18H10T)	•	•
Code	**Guaranteed Service Life**	**CD**	**CG**
WR5	Transmitter guaranteed service life is 5 years	•	•

Table M.16 (Continued)

Code	Calibration Certificate	CD	CG
Q4	Calibration Certificate	•	•
Code	**Level and Flowrate**	**CD**	**CG**
CF	Configuration of transmitter to display flowrate units (sheet C1 must be filled in)	•	•
CL	Configuration of transmitter to display level units (sheet C1 must be filled in)	•	•
Code	**Alarm signal levels**	**CD**	**CG**
CR	Custom failure and saturation alarm levels, High Alarm (requires option code C1 and configuration data sheet)	•	•
CS	Custom failure and saturation alarm levels, Low Alarm (requires option code C1 and configuration data sheet)	•	•
C4	NAMUR analog output signal levels, high alarm level	•	•
CN	NAMUR analog output signal levels, low alarm level	•	•
CT	Low alarm (standard Rosemount alarm and saturation levels)	•	•
Code	**Customization**	**CD**	**CG**
C1	Custom configuration (requires configuration data sheet)	•	•
Code	**Assembly error calculation for the option c/w diaphragm seal**	**CD**	**CG**
QZ	Remote Seal System Performance Calculation Report	•	•
Code	**Nameplate**[12)]	**CD**	**CG**
ST	Additional nameplate on a stainless steel wire (filled in as required by the customer)	•	•
SX	Additional nameplate on a stainless steel chain (filled in as required by the customer)	•	•
Code	**Plug and Socket Connector**	**CD**	**CG**
SC	Plug and socket connector: plug 2РМГ14Б4Ш1Е2Б and socket 2РМ14КПН4Г1В1 (not applicable for code EM, KM, HS transmitters, basic position according to Figure G.24 SPGK.5225.000.00 RE)	•	•
SC1	Plug and socket connector DIN 43650 (basic position - Figure G.24 SPGK.5225.000.00 RE, not applicable for transmitters bearing ordering codes EM, KM, HS, MW1, MW2)	•	•
SC2	Plug and socket connector: plug 2РМ22Б4Ш3В1 and socket 2РМ22КПН4Г3В1 (not applicable for code EM, KM, HS transmitters, basic position according to Figure G.24 SPGK.5225.000.00 RE)	•	•
SC6	Plug and socket connector: plug 2РМГ14Б4Ш1Е2Б (socket is not suppled) (not applicable for code EM, KM, HS transmitters, basic position according to Figure G.24 SPGK.5225.000.00 RE)	•	•
SC7	Plug and socket connector: plug 2РМ22Б4Ш3В1 (socket is not suppled) (not applicable for code EM, KM, HS transmitters, basic position according to Figure G.24 SPGK.5225.000.00 RE)	•	•
Code	**Plug and socket connector position**	**CD**	**CG**
OS	Alternative location of the plug and socket connector according to Operating Manual	•	•

Table M.16 (Continued)

Code	Basic Accuracy	CD	CG
PA	Reference accuracy: ±0.2 %	•	•
PC	Reference accuracy: ±0.5 %	•	•
Code	**Electronics Module Housing Color**	**CD**	**CG**
RH	Red electronics module housing	•	•
Code	**Electronics Module Housing Material**	**CD**	**CG**
HS[15)]	316 SST electronics module housing	●	●
Code	**Terminal Bock**	**CD**	**CG**
T0	Terminal block for industrial electromagnetic environment as per GOST R IEC 61326-1	•	•
Code	**Plate for configuration parameters protection**	**CD**	**CG**
J5	Plate for configuration protection (available for transmitters with code M5)	•	•
Code	**Ambient Temperature**	**CD**	**CG**
LT	Low-temperature version for ambient temperatures from –55 °C (suitable for O-ring code 2, 3, 4 and fastener material code L4)	•	•
BR6	Low-temperature version for ambient temperatures from –60 °C (suitable for O-ring code 2, 4 and fastener material code L4)	•	•
Code	**Service life**	**CD**	**CG**
ML	Average service life: 30 years	•	•
Code	**Process testing**	**CD**	**CG**
AR	Additional 360-hour process testing (only applicable for transmitters with codes IM, EM, KM, IC, EC, KC, TC)	•	•
Code	**Drain Valve Location**	**CD**	**CG**
RS[6)]	Alternative location of the drain/vent valve according to Operating Manual	•	•
Code	**Pressure Test**	**CD**	**CG**
P1	Pressure test with test report issued	•	•
Code	**Verification Certificate**	**CD**	**CG**
QM	Drawing up a Verification Certificate	•	•
Code	**Verification Report**	**CD**	**CG**
QP	Drawing up a Verification Report	•	•
Code	**Functional safety certificate**	**CD**	**CG**
QT	Functional Safety: GOST R IEC 61508 certified	•	•
Code	**Material Traceability Certificate**	**CD**	**CG**
Q8	Material Traceability Certificate as per EN 10204 3.1B	•	•
Code	**PMI verification and certificate**	**CD**	**CG**
Q76	Positive Material Identification Certificate (only applicable with option Q8)	•	•
Code	**NACE Declaration of Conformity**	**CD**	**CG**
Q15[7)]	Declaration of Conformity with NACE MR0175/ISO 15156:2015, NACE MR0103/ISO 17945:2015 (applies only to the material code for parts in contact with process medium and drain valve material 6)	•	•
Code	**For Application at Gazprom Sites**	**CD**	**CG**
OR	Gazprom Dobycha Orenburg sites (available with Q15 code only, without mounting parts)	•	•
AT	Gazprom Dobycha Astrakhan sites (available with Q15 code only, without mounting parts)	•	•
Code	**INTERGAZCERT Certificate**	**CD**	**CG**
IG[8)]	INTERGAZCERT Certificate	•	•

Table M.16 (Continued)

Code	Seismic	CD	CG
SM	Seismic Certificate	•	•
Code	**Marine Register of Shipping Certification**	**CD**	**CG**
MW1	Technical supervision by the Russian Maritime Register of Shipping (not applicable with codes LT and BR6)	•	•
MW2	Technical supervision by the Russian Maritime Register of Shipping for use with the additional WINTERIZATION(–50) mark (only applicable for transmitters with isolating diaphragm material code 2 and 7, O-ring material code 2, 4, fastener code L4, not used for codes LT, BR6).	•	•
Code	**Cable Entry**	**CD**	**CG**
KXX[9)]	Cable gland (not applicable with SC, SC1, SC2, SC6, SC7 plug codes)	•	•
Code	**Conduit plug**	**CD**	**CG**
D0[10)]	Stainless steel conduit plug (not used with IM, EM, KM, HS codes)	•	•

Notes

1 '–' – not applicable, '•' – applicable.

2. The manifold (unless S5 code is specified) is available as a separate product in accordance with Metran manifold documentation:

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[1)]Upon customer request, the transmitter can be tailored to accommodate any measurement range within the extreme values permitted for the model, code C1 shall not be stated in the order.

[2)] HART device should be used for configuration of transmitter with 4-20 mA signal and without built-in display.

[3)] The manifold is specified in a separate order line, ordering information shall comply with TU 3742-057-51453097-2009. When ordering the transmitter with S5 code, mounting parts are not specified in the transmitter model string. Mounting parts and bracket for manifold mounting are specified in the manifold order line.

[4)] Specify in a separate line in accordance with diaphragm seal documentation.

[5)] O-ring material for mounting flanges D1, D2, D3, D4, D5, D7, D8, DA and nipple for code D6 rubber NO-68-1.

[6)] Not applicable with 0104MT2 Metran manifold, TU 3742-057-51453097-2009.

[7)] Applicable only for code D1, D2, D3, D4 mounting parts , with material code for parts in contact with operating medium 6. When ordering code S5, specify Q15 in Manifold order line. When ordering codes S1 or S2, specify option Q15 or Q25 in diaphragm seal order line.

[8)] Certificate number shall be specified in the Technical Data Sheet.

[9)] Cable entry model is in accordance with Pressure Catalog.

[11)] If the D0 code is not specified, the transmitter is supplied with a plastic conduit plug (except for IM, EM, KM, HS codes).

[12)] The size of the nameplate is 65×35 mm. Text parameters: text height 5 mm, GOST type A font, left alignment of the text.

[13)] For mining version.

[14)] Available with HS housing material code only.

[15)] Available with: fastener code L4, mounting part codes D1-D5, D7, D8, DA, nipple material code 2, stainless steel plug; not available with: plug and socket connector codes SC, SC1, SC2, SC6, SC7, RH code, cable entry plug code D0.

Typical Model String 150CD2 (0 – 40) kPa[1)] 2 2 1 1 L3 A HR7 M5 D5 2 B1 CR C1 K02

[1)] Measurement range and measuring unit

M.7.2 150TG gage pressure transmitters and 150TA absolute pressure transmitters

Table M.17

Model	**Product Description**	
150TG 150TA	Gage Pressure Transmitter Absolute Pressure Transmitter	
Mandatory Options		
	Measurement Range[1)]	
Code	**Model 150TG**	**Model 150TA**
0T	(–40) – 40 kPa	0 – 40 kPa
1T	(–100) – 250 kPa	0 – 250 kPa
2T	(–100) – 1 MPa	0 – 1 MPa
3T	(–100) – 3 MPa	0 – 3 MPa
4T	(–100) – 10 MPa	0 – 10 MPa
5T	(–100) – 40 MPa	0 – 40 MPa
6T	(–100) – 60 MPa	–
Code	**Process Connection**	
2G	M20×1.5	
2B	½ NPT, female thread	
2N	½ NPT, male thread	
2C	G½, male thread (not applicable with material code of parts in contact with the working environment, 4)	
Code	**Diaphragm Seal Material**	**Wetted Part Material**
2	316L SST	316L SST
3	Alloy C-276 (not available with range code 6T)	316L SST
4	Alloy C-276	Alloy C-276
7	316L SST with golden coating (only for range codes 0T-5T)	316L SST
Code	**Fill Fluid**	
1	Silicone	
Code	**Output**	
A	4–20 mA HART Output	
Code	**HART Version**	
HR7	HART Version 7	
Other Options		
Code	**Functional diagnostics**	
DA0	Loop Integrity Diagnostic	
Code	**Indication**	
M5[2)]	Built-in LCD	
Code	**Application-specific Certification**	
IM	0Ex ia/Ex ia Intrinsic Safety	
EM	1Ex db/Ex tb Explosion Safety	
KM	1Ex db/Ex tb Explosion Safety or 0Ex ia/Ex ia Intrinsic Safety	
IC[11)12)]	PO Ex ia Intrinsic Safety	
EC[11)12)]	PB Ex db Explosion Safety	
KC[11)12)]	PB Ex db Explosion Safety or PO Ex ia Intrinsic Safety or PB Ex db ia Explosion and Intrinsic Safety	
TC[11)12)]	PB Ex db ia Explosion and Intrinsic Safety	
Code	**Integral Manifolds**	
S5[3)]	Available with manifold installed	
Code	**Diaphragm Seal Assembly** [4)]	
S1	Assembly with one isolating diaphragm (only applicable with process connection code 2B, isolating diaphragm material code 2, not applicable with range code 6T, codes LT, BR6, MW2, assembly part codes 2A-2H, integrated valve block code S5)	

Table M.17 (Continued)

Code	Mounting Parts (for Process Connection Code 2G only)		
2A	1/4 NPT female adapters		
2D	1/4 NPT male adapters		
2E	1/2 NPT male adapters		
2F	Nipple for 14 mm OD pipe connection (ID Ø10) with coupling nut M20×1.5		
2H	Nipple for 14 mm OD pipe connection (ID Ø8) with coupling nut M20×1.5		
	Nipple and Adapter Materials		
Code	**Nipple and Adapter Materials**	**Gasket Material**	**Nipple Coupling Nut Material (for codes 2F and 2H only)**
2	Steel 12X18H10T or 316L SST	Steel 12X18H10T	Stainless Steel
4	Carbon steel coated	Copper M3	Carbon steel coated
5	Plated 09G2S carbon steel (for code 2F only)	Copper M3	Carbon steel coated
Code	**Mounting Brackets**		
B1	Mounting bracket to mount the transmitter on OD 50 mm pipe and panel (material – coated carbon steel)		
B4	Mounting bracket for installation to 50 mm OD pipe or panel (material: steel 12X18H10T)		
Code	**Guaranteed Service Life**		
WR5	Transmitter guaranteed service life is 5 years		
Code	**Calibration Certificate**		
Q4	Calibration Certificate		
Code	**Level**		
CL	Configuration of transmitter to display level units (sheet C1 must be filled in)		
Code	**Alarm signal levels**		
CR	Custom failure and saturation alarm levels, High Alarm (requires option code C1 and configuration data sheet)		
CS	Custom failure and saturation alarm levels, Low Alarm (requires option code C1 and configuration data sheet)		
C4	NAMUR analog output signal levels, high alarm level		
CN	NAMUR analog output signal levels, low alarm level		
CT	Low alarm (standard Rosemount alarm and saturation levels)		
Code	**Customization**		
C1	Custom configuration (requires configuration data sheet)		
Code	**Assembly error calculation for the option c/w diaphragm seal**		
QZ	Remote Seal System Performance Calculation Report		
Code	**Nameplate**[10)]		
ST	Additional nameplate on a stainless steel wire (filled in as required by the customer)		
SX	Additional nameplate on a stainless steel chain (filled in as required by the customer)		

Table M.17 (Continued)

Code	Plug and Socket Connector
SC	Plug and socket connector: plug 2RMG14B4SH1E2B and socket 2RM14KPN4G1V1 (not applicable for code EM, KM, HS transmitters, basic position according to Figure G.24 SPGK.5225.000.00 RE)
SC1	Plug and socket connector DIN 43650 (basic position - Figure G.24 SPGK.5225.000.00 RE, not applicable for transmitters bearing ordering codes EM, KM, , HS, MW1, MW2)
SC2	Plug and socket connector: plug 2RM22B4SH3V1 and socket 2RM22KPN4G3V1 (not applicable for code EM, KM, HS transmitters, basic position according to Figure G.24 SPGK.5225.000.00 RE)
SC6	Plug and socket connector: plug 2RMG14B4SH1E2B (socket is not suppled) (not applicable for code EM, KM, HS transmitters, basic position according to Figure G.24 SPGK.5225.000.00 RE)
SC7	Plug and socket connector: plug 2RM22B4SH3V1 (socket is not suppled) (not applicable for code EM, KM, HS transmitters, basic position according to Figure G.24 SPGK.5225.000.00 RE)
Code	**Plug and socket connector position**
OS	Alternative location of the plug and socket connector according to Operating Manual
Code	**Basic Accuracy**
PA	Reference accuracy: ±0.2 %
PC	Reference accuracy: ±0.5 %
Code	**Electronics Module Housing Color**
RH	Red electronics module housing
Code	**Electronics Module Housing Material**
HS[13)]	316 SST electronics module housing
Code	**Terminal Bock**
T0	Terminal block for industrial electromagnetic environment as per GOST R MEK 61326-1
Code	**Plate for configuration parameters protection**
J5	Plate for configuration protection (available for transmitters with code M5)
Code	**Ambient Temperature**
LT	Low-temperature version for ambient temperatures from –55 °C
BR6	Low-temperature version for ambient temperatures from –60 °C
Code	**Service life**
ML	Average service life: 30 years (not applicable for codes OP, AT)
Code	**Process testing**
AR	Additional 360-hour process testing (only applicable for transmitters with codes IM, EM, KM, IC, EC, KC, TC)
Code	**Pressure Test**
P1	Pressure test with test report issued
Code	**Verification Certificates**
QM	Drawing up a Verification Certificate
Code	**Verification Report**
QP	Drawing up a Verification Report
Code	**Functional safety certificate**
QT	Functional Safety: GOST R IEC 61508 certified
Code	**Material Traceability Certificate**
Q8	Material Traceability Certificate as per EN 10204 3.1B
Code	**PMI verification and certificate**
Q76	Positive Material Identification Certificate (only applicable with option code Q8)
Code	**NACE Declaration of Conformity**
Q15[6)]	NACE Declaration of Conformity MR0175/ISO 15156:2015, NACE MR0103/ISO 17945:2015 (not applicable with range code 6T, not applicable with 2A-2H mounting part codes)

Table M.17 (Continued)

Code	For application at Gazprom sites
OP	Gazprom Dobycha Orenburg (applicable with Q15 code, mounting parts are not included, not applicable with range code 6T)
AT	Gazprom Dobycha Astrakhan (applicable with Q15 code, mounting parts are not included, not applicable with range code 6T)
Code	**INTERGAZCERT Certificate**
IG[7)]	INTERGAZCERT Certificate
Seismic Code	
SM	Seismic Certificate
Code	**Marine Register of Shipping Certification**
MW1	Technical supervision by the Russian Maritime Register of Shipping (not applicable with codes LT and BR6)
MW2	Technical supervision by the Russian Maritime Register of Shipping for use with the additional WINTERIZATION(−50) mark (only applicable for transmitters with diaphragm seal material code 2 and 7, not used for code LT, BR6 parts)
Code	**Cable Entry**
KXX[8)]	Cable gland (not applicable with SC, SC1, SC2, SC6, SC7 plug codes)
Code	**Conduit plug**
D0[9)]	Stainless steel conduit plug (not used with IM, EM, KM, HS codes)

Note: The manifold (unless S5 code is specified) is available as a separate product.

[1)]Upon customer request, the transmitter can be tailored to accommodate any measurement range within the extreme values permitted for the model, code C1 shall not be stated in the order.

[2)] 4-20 mA transmitters w/o built-in display must be set using a HART communicator or HART modem and configuration programmer.

[3)] The manifold is specified in a separate order line, ordering information shall comply with TU 3742-057-51453097-2009.

When ordering the transmitter with S5 code, mounting parts are not specified in the transmitter model string. Mounting parts are specified in the manifold order line.

[4)] Specify in a separate line in accordance with diaphragm seal documentation.

[6)] Not applicable for mounting part codes 2A - 2H. When ordering code S5, specify Q15 in Manifold order line. When ordering code S1, specify option Q15 or Q25 in diaphragm seal order line.

[7)] Cable entry model is in accordance with Pressure Catalog.

[8)] Certificate number shall be specified in the Technical Data Sheet.

[9)] If the D0 code is not specified, the transmitter is supplied with a plastic conduit plug (except for IM, EM, KM, HS codes)

[10)] The size of the nameplate is 65×35 mm. Text parameters: text height 5 mm, GOST type A font, left alignment of the text.

[11)] For mining version.

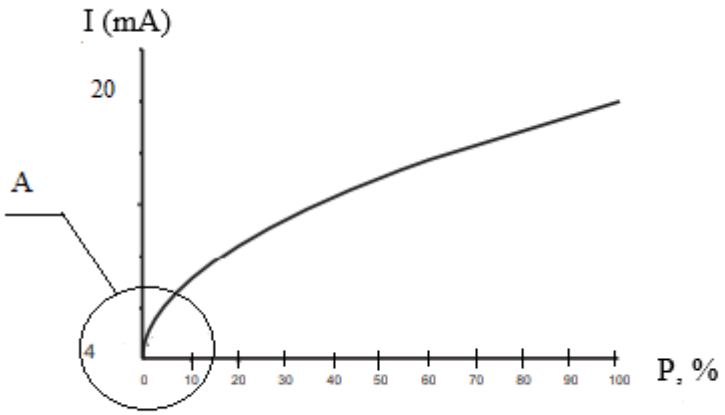
[12)] Available with HS housing material code only.

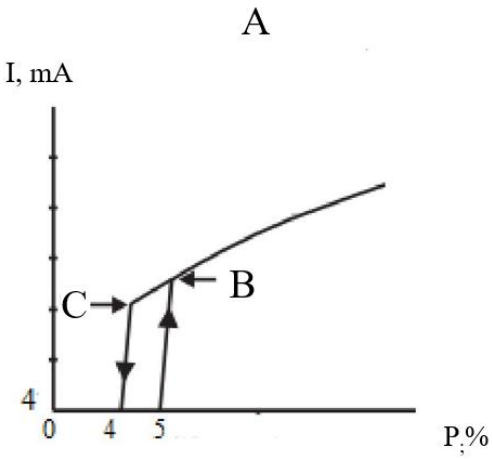
[13)] Available with: nipple and adapter material code 2, stainless steel plug; not available with: plug and socket connector codes SC, SC1, SC2, SC6, SC7, RH code, cable entry plug code D0.

Typical Model Number 150TG3 (0 – 4) MPa[1)] 2G 2 1 A HR7 M5 IM 2F 2 B4 CR C1 K02

[1)] Measurement range and measuring unit

M.8 Output signal vs measured input value in accordance with the square root law





C - represents the inlet pressure value for the flow cut-off;

B - indicates the outlet pressure value from the flow cut-off.

Figure M.3. Analog Output Signal Representation

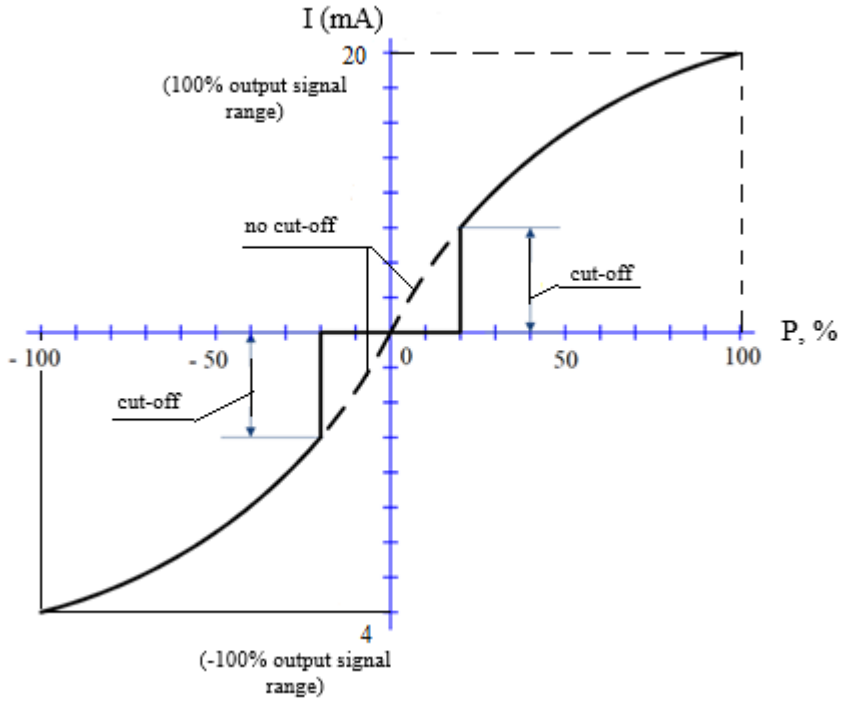


Figure M.4. Flowrate Variable (defined as primary)

M.9 Device Driver (DD) Menu Tree

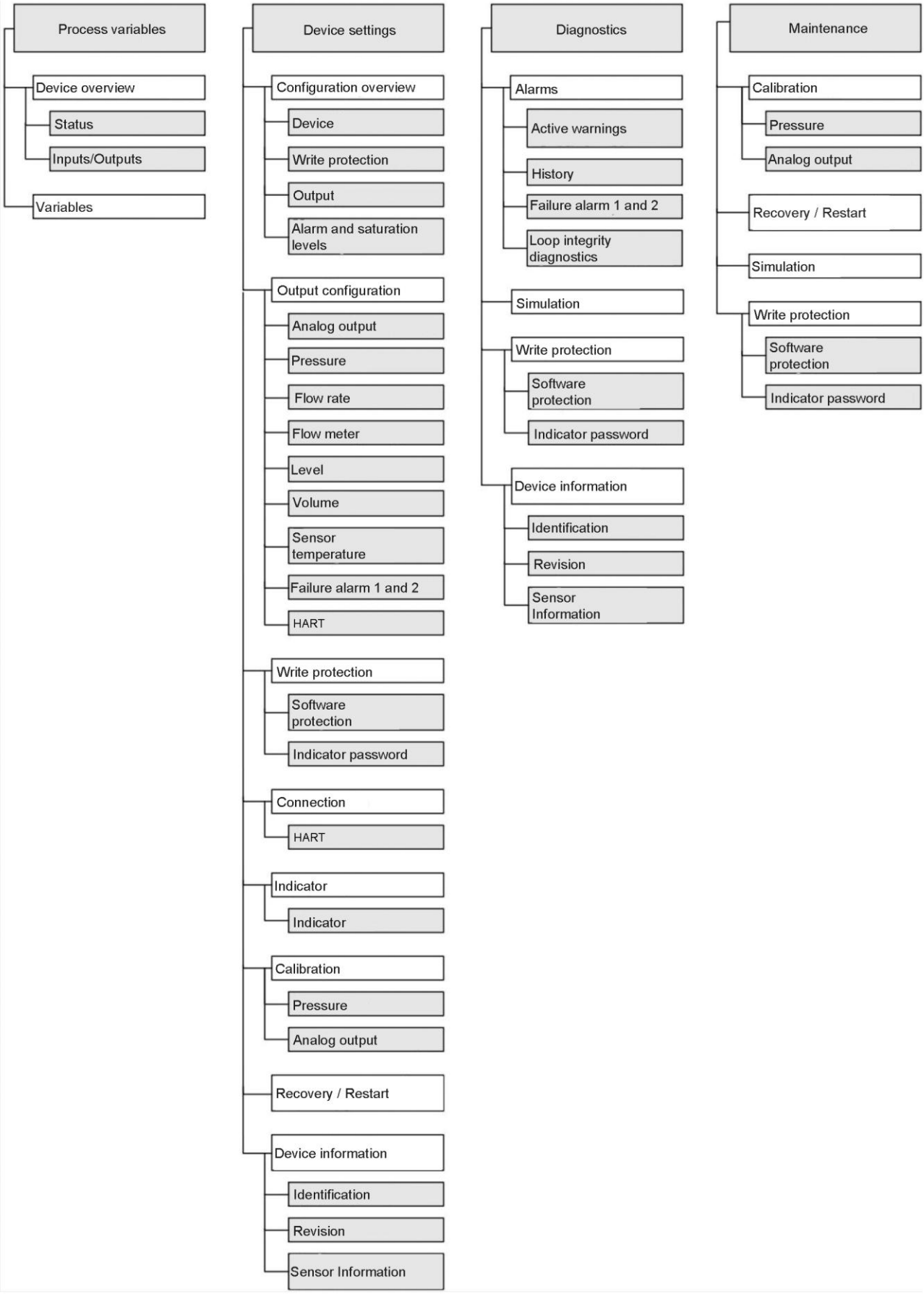


Figure M.5. Menu Level 1

M.10 Indicator Menu Structure

This section presents the menu structure for monitoring and adjusting the transmitter equipped with indicator (code M5). The indicator shall be adjusted using the buttons located on the indicator housing. Control operation does not affect an output signal of the transmitter.

The monitored parameter can be selected by continuously pressing the button 2. Press and hold button 1 for at least 2 seconds to enter the menu.

The transmitter will exit the menu mode automatically if no buttons are pressed within 60 seconds.

Symbols used in the figures:

UL – pressure value corresponding to the current 20 mA;

LL – pressure value corresponding to the current 4 mA;

LOWER — sensor lower point;

UPPER — sensor upper point;

MENU_TIMEOUT — time of displaying information screens (e.g., about successful saving) in the menu.

Table M.18

Configuration Buttons	Buttons designation on the layout	Purpose
	1	- Enter menu; - Exit menu/submenu; - Modify selected (flashing) digit;
	*	- Enter submenu; - Activate edit item; - Confirm entered value;
	2	- Move down the menu; - Modify selected (flashing) digit or letter;

M.10.1 Entering Numbers

1. Button 1 adjusts the value as follows:
   - For the first character: 1, -1, -, or space;
   - For subsequent characters: 0 to 9.

Space value for the first character is the same as zero for other characters. The upper and lower halves of digit 1 are displayed alternately. The switching period of these halves is defined in step 5.

2. Button 2 cycles to the next digit. When reaching the last character, it loops back to the first one.

a) If a decimal point is active but not yet entered (refer to point 2, subpoint b)), the input mode switches to decimal point (point 4).

b) The decimal point input mode can only be initiated once while moving from the first to the last character position. Once you return to the first character position, you can reinitiate the decimal point input mode (refer to point 2, subpoint a)).

3. The * button stores the adjusted value.

4. When in the decimal point input mode, use button 1 to adjust the position of the decimal point. Press button 2 to switch to the next digit.

5. The active character or decimal point (if it is entered) flashes with a period of:

- 0.5 seconds at temperatures above -10 °C,
- 1 second at temperature from -10 to -20 °C,
- 3 seconds at temperatures below -20 °C

6. If the initial value of the number to input is too large to be displayed in decimal format (showing in exponential notation or being unable to display at all), the default initial value will be '000.0'.

Limitation of this input method:

- Entering an exponent is not possible.
- The entered number must always contain a period.
- You can enter numbers from 0.0001 to 1999.0. The same is true for negative numbers.

Password Entry:

When entering a password, the method is similar to entering numbers as described above, with the following differences:

– The first character is not used for input.
– There is no decimal point input.
– The default initial value for password entry is '0000'.

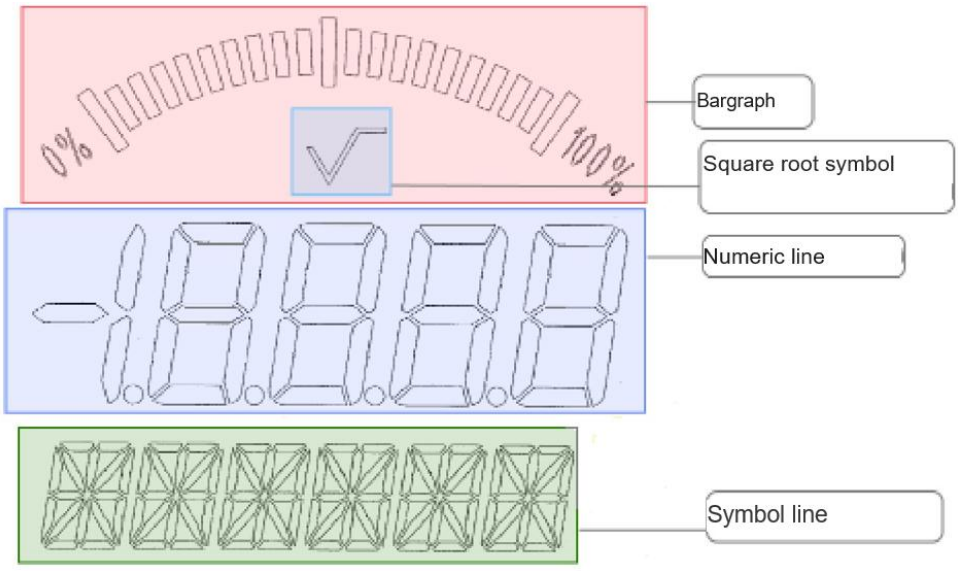


Figure M.6. Indicator display

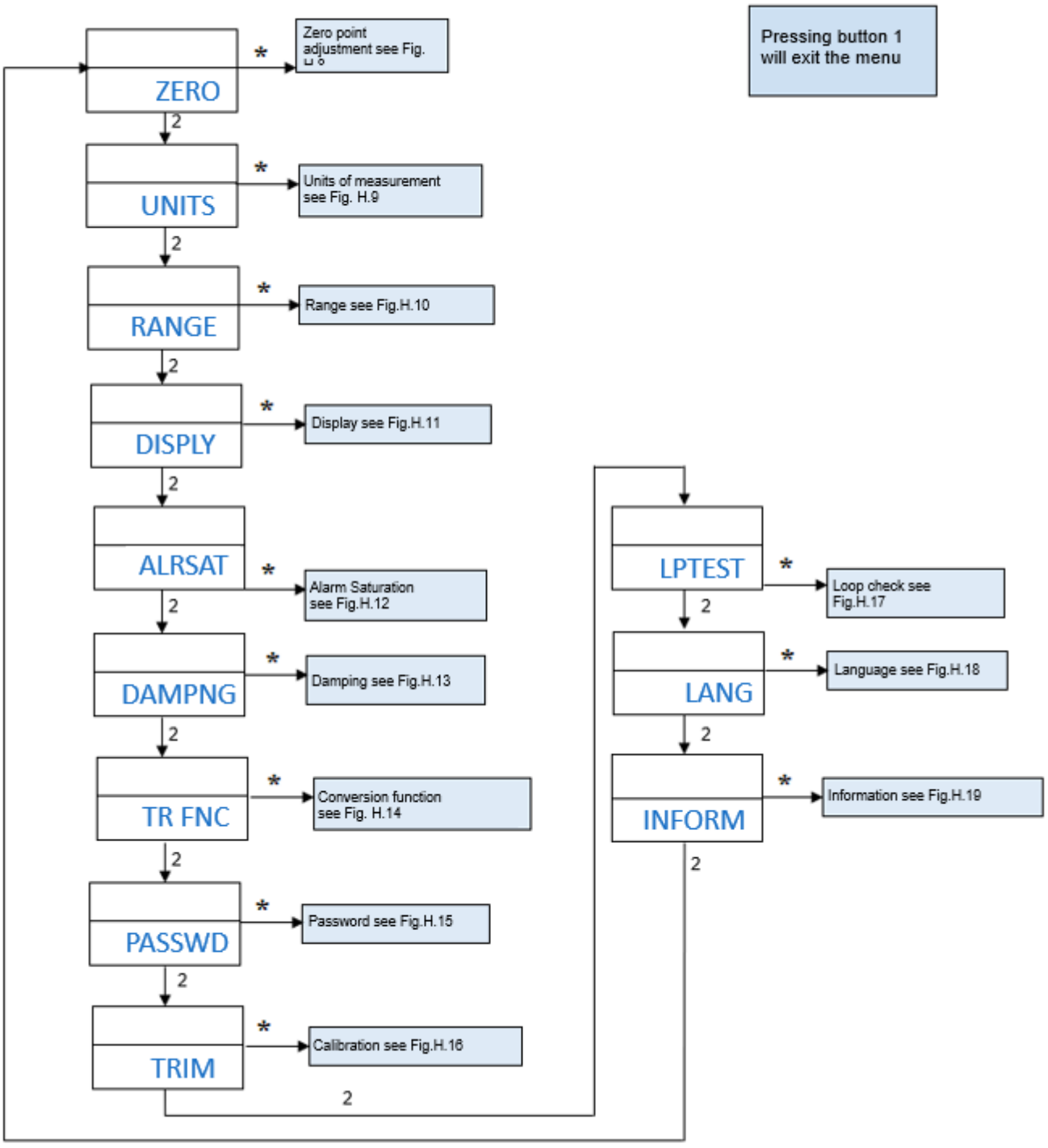


Figure M.7. Indicator Menu Structure

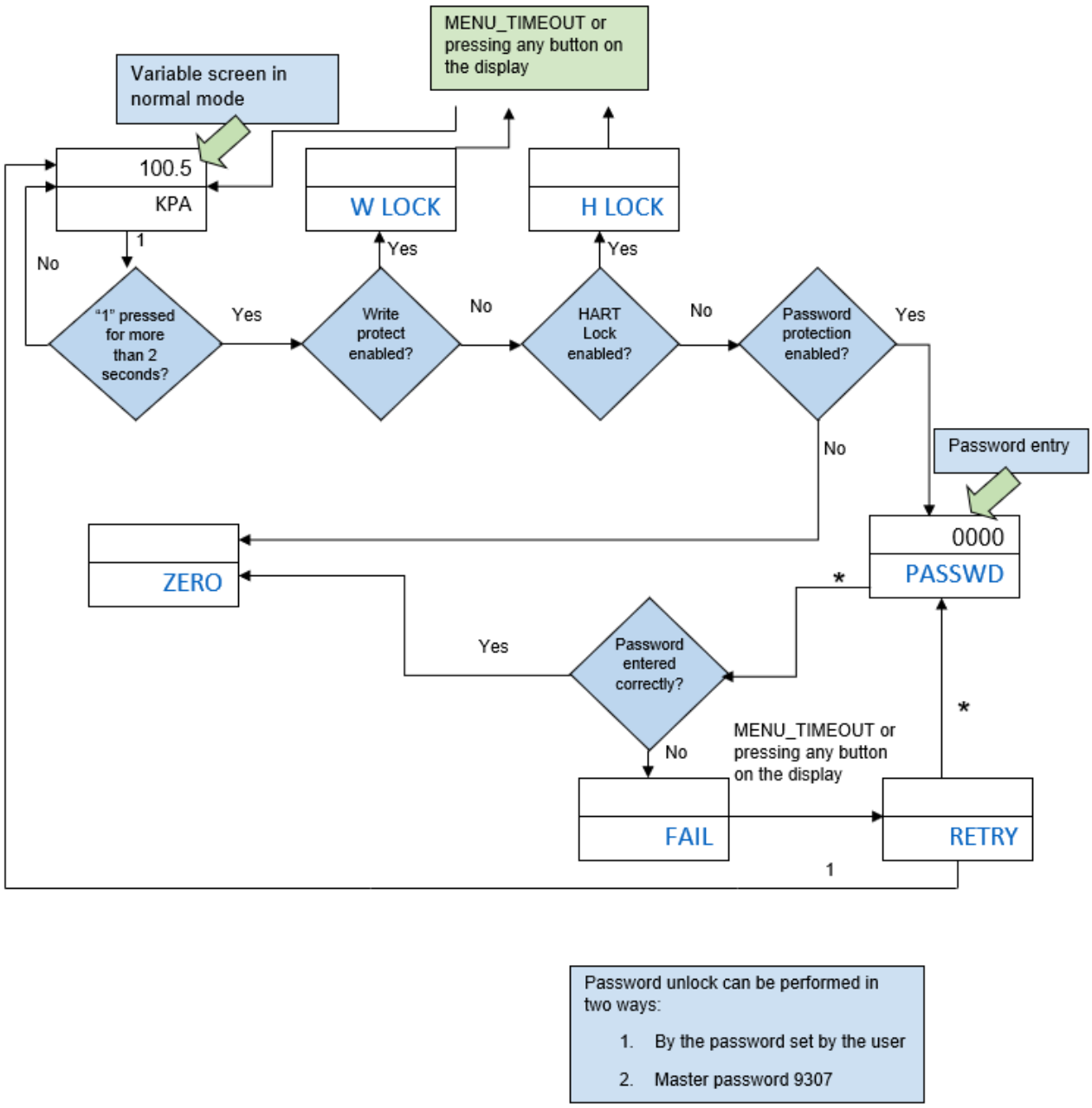
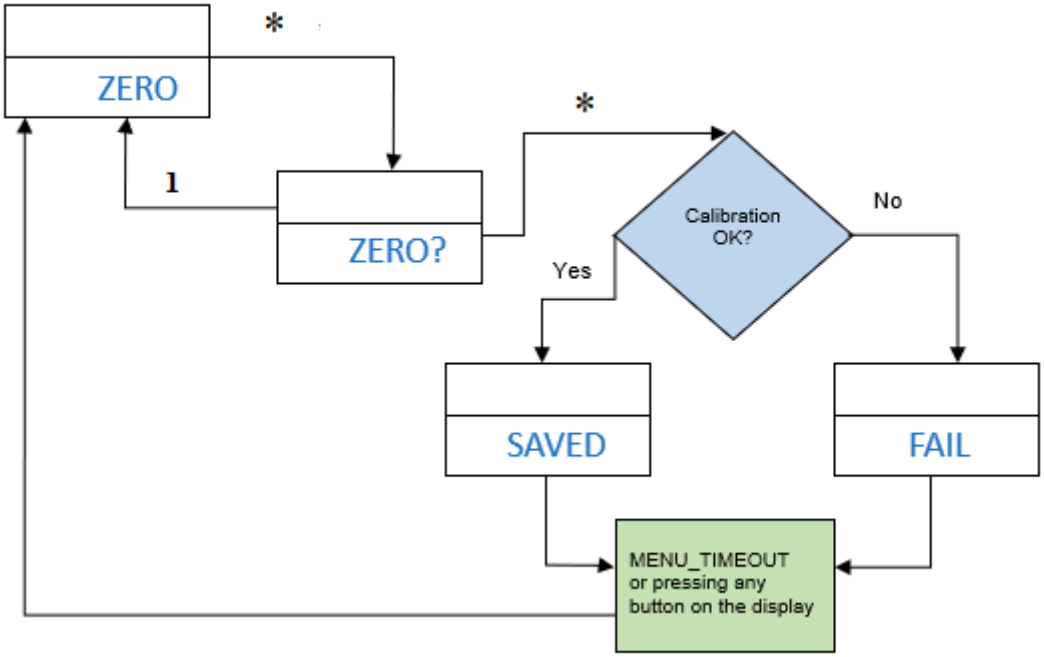


Figure M.7.1. Menu Access



Note: Keep pressed the button on the transmitter housing for at least 2 seconds to initiate calibration of the zero point.

This menu mode is hidden for 150TA absolute pressure transmitters.

Figure M.8. Automatic Zero Calibration Mode

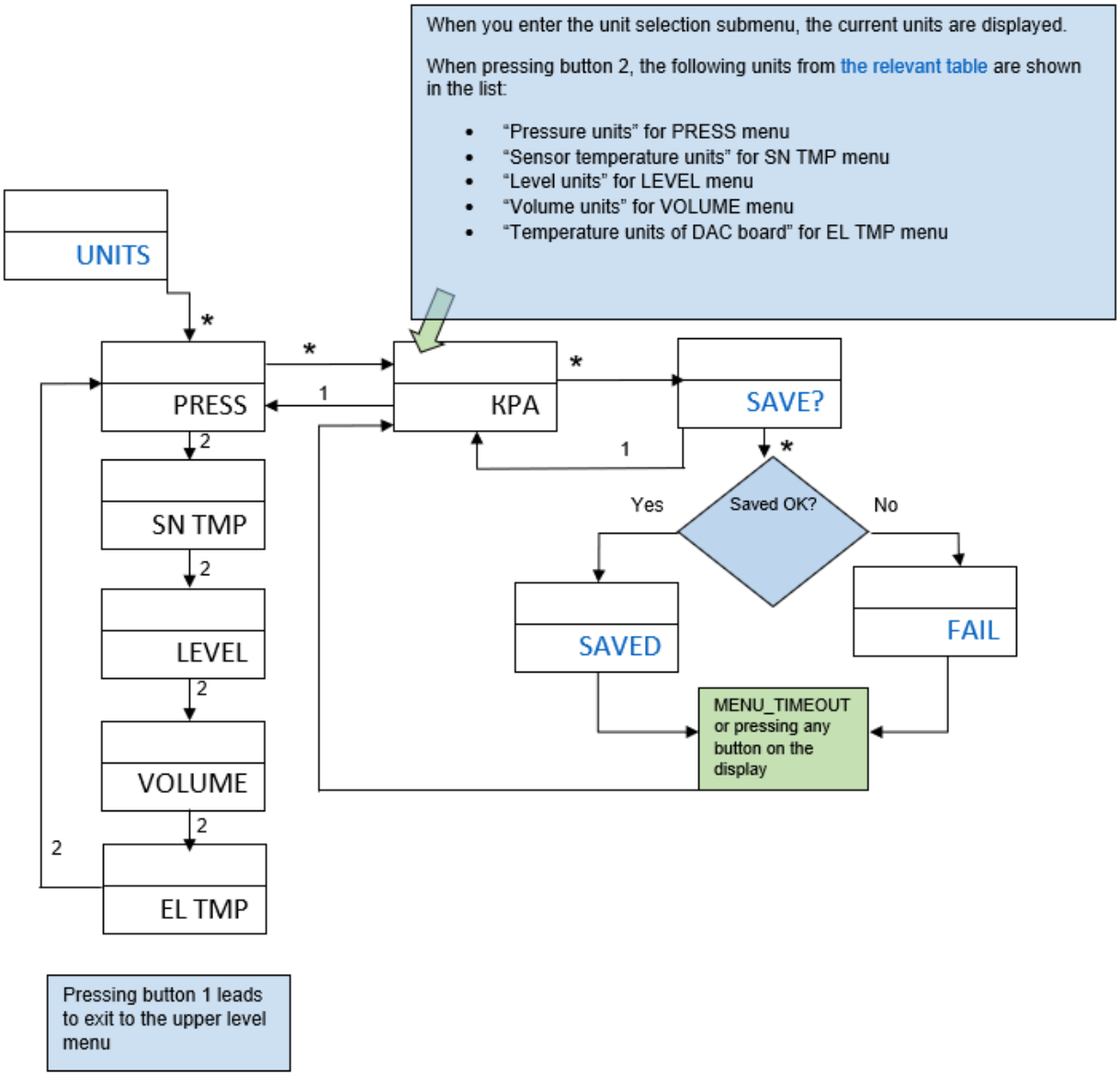


Figure M.9. Unit Selection Mode

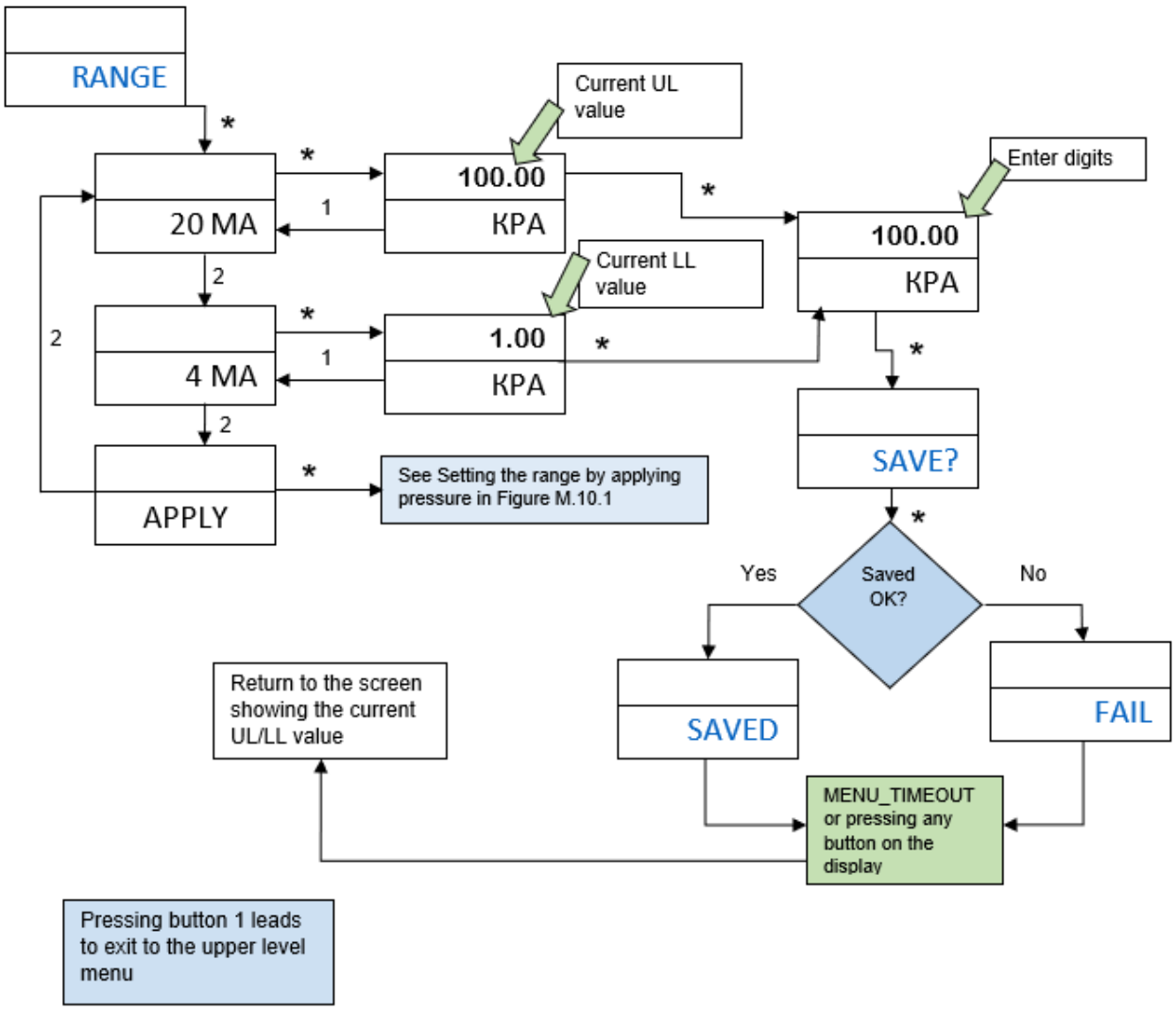


Figure M.10. Measurement Range Setting Mode - Setting of Values UL and LL (without pressure supply)

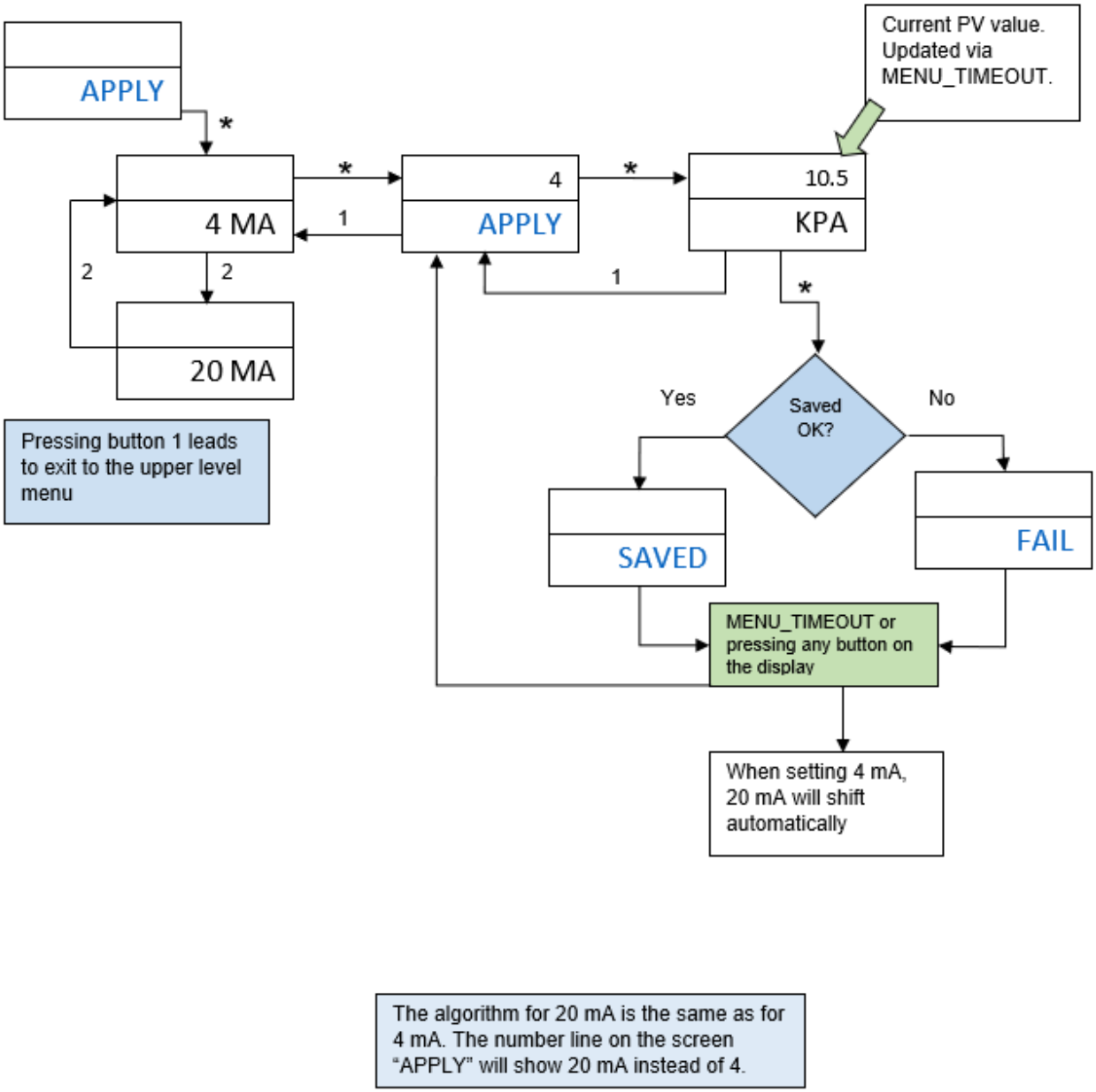


Figure M.10.1. Measurement Range Setting Mode - Setting of Values UL and LL (pressure is supplied)

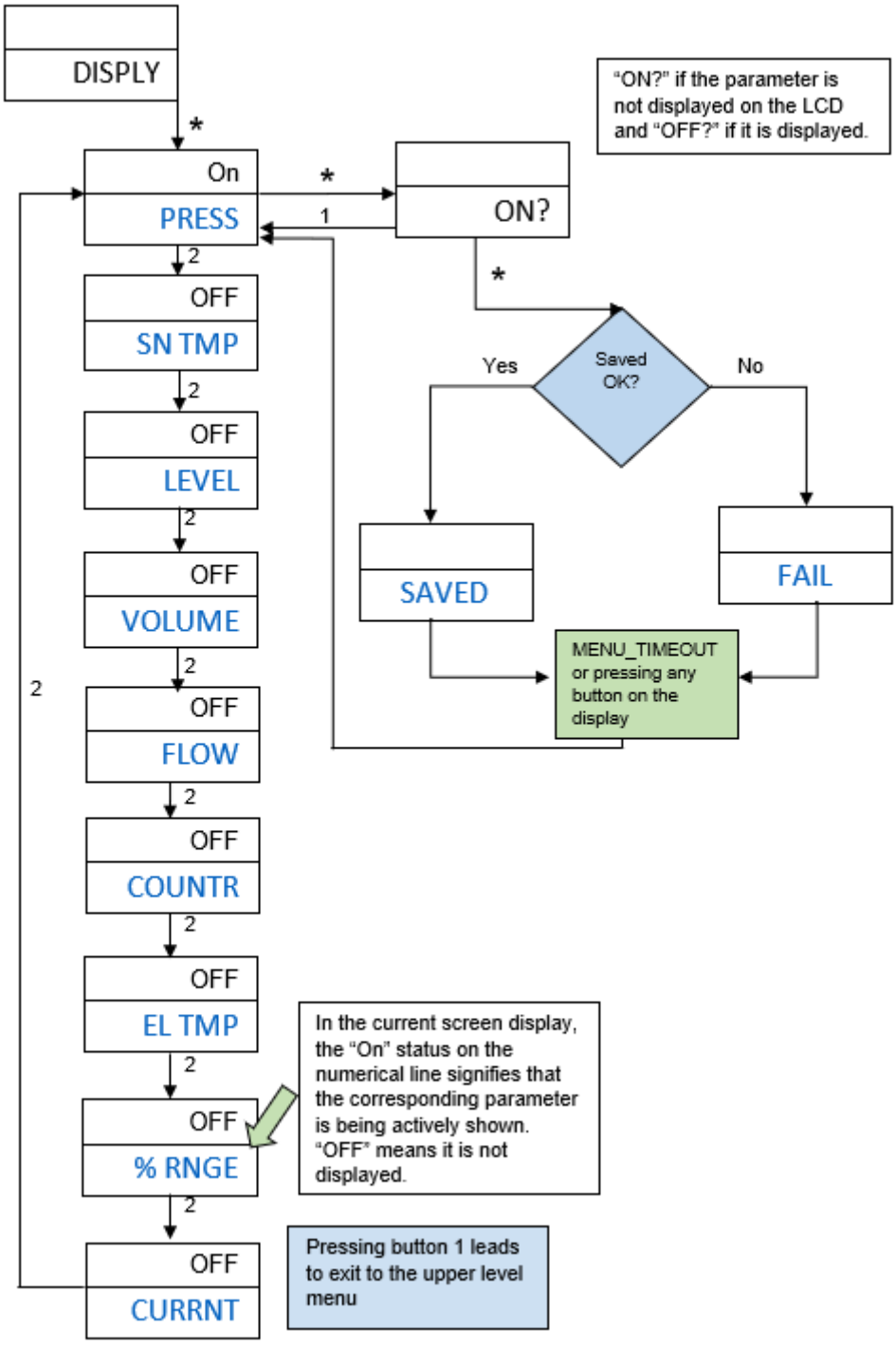


Figure M.11. Indicator Customization Mode

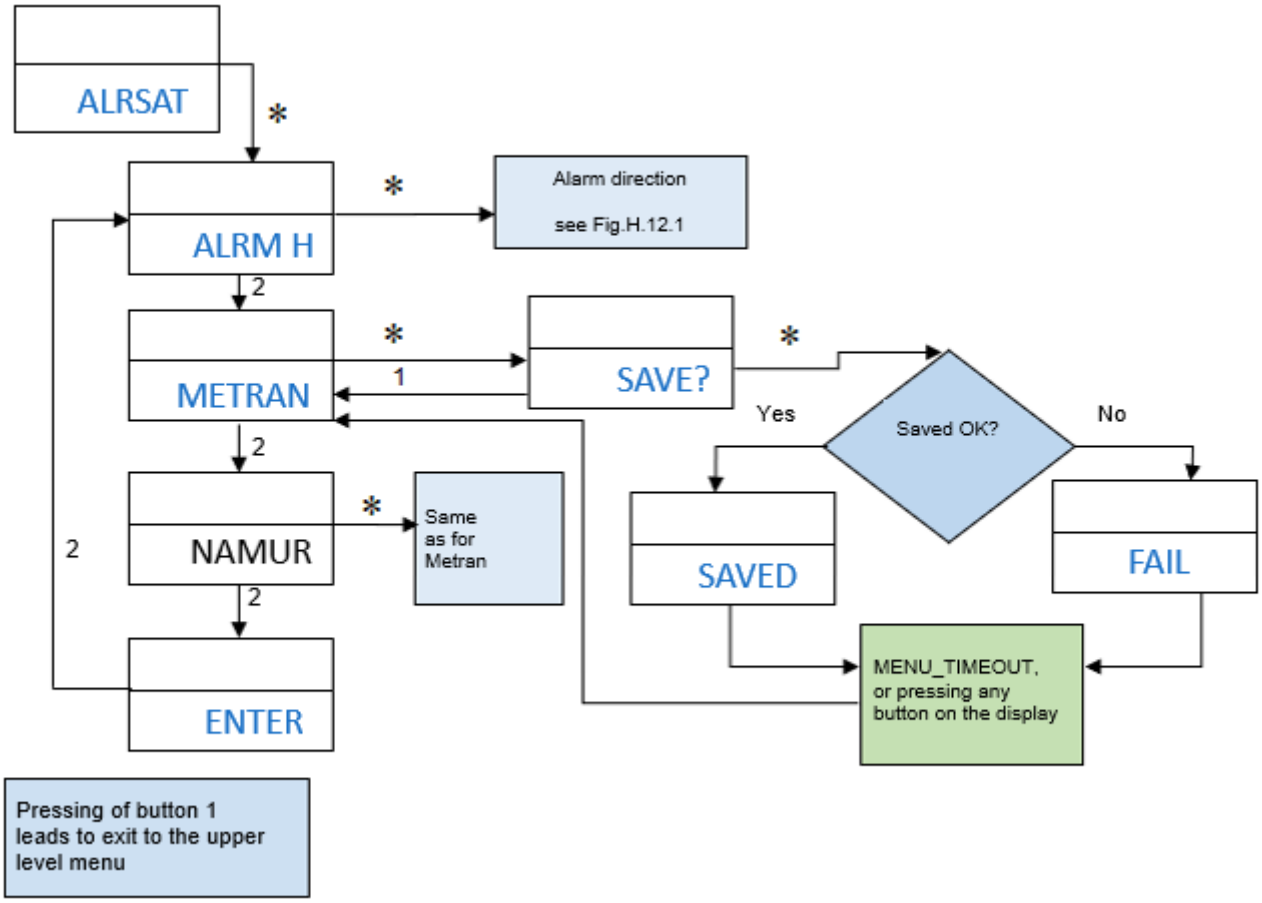


Figure M.12. Setting of alarm/saturation signal option

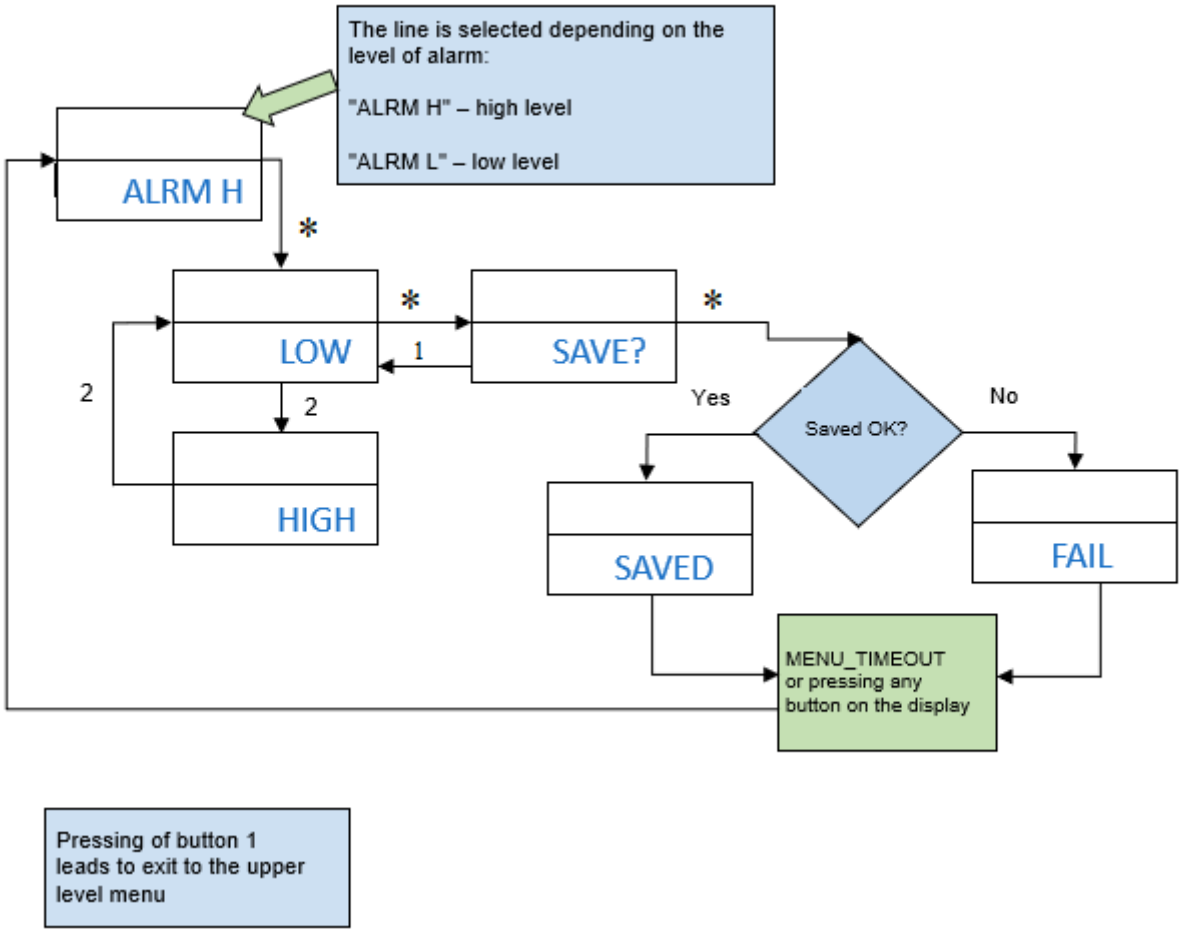


Figure M.12.1. Setting of Alarm/Saturation Signal Level (High/Low)

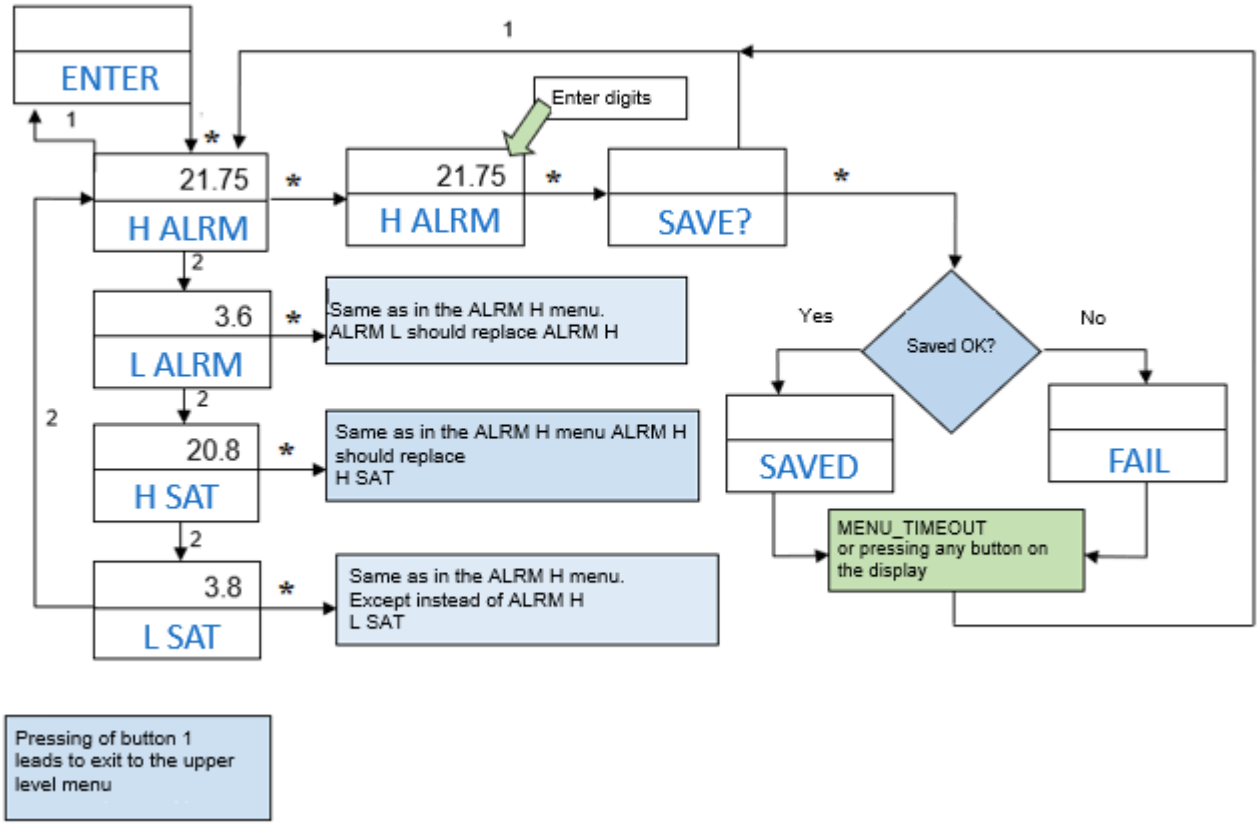


Figure M.12.2. Custom Setting of Alarm/Saturation Signal

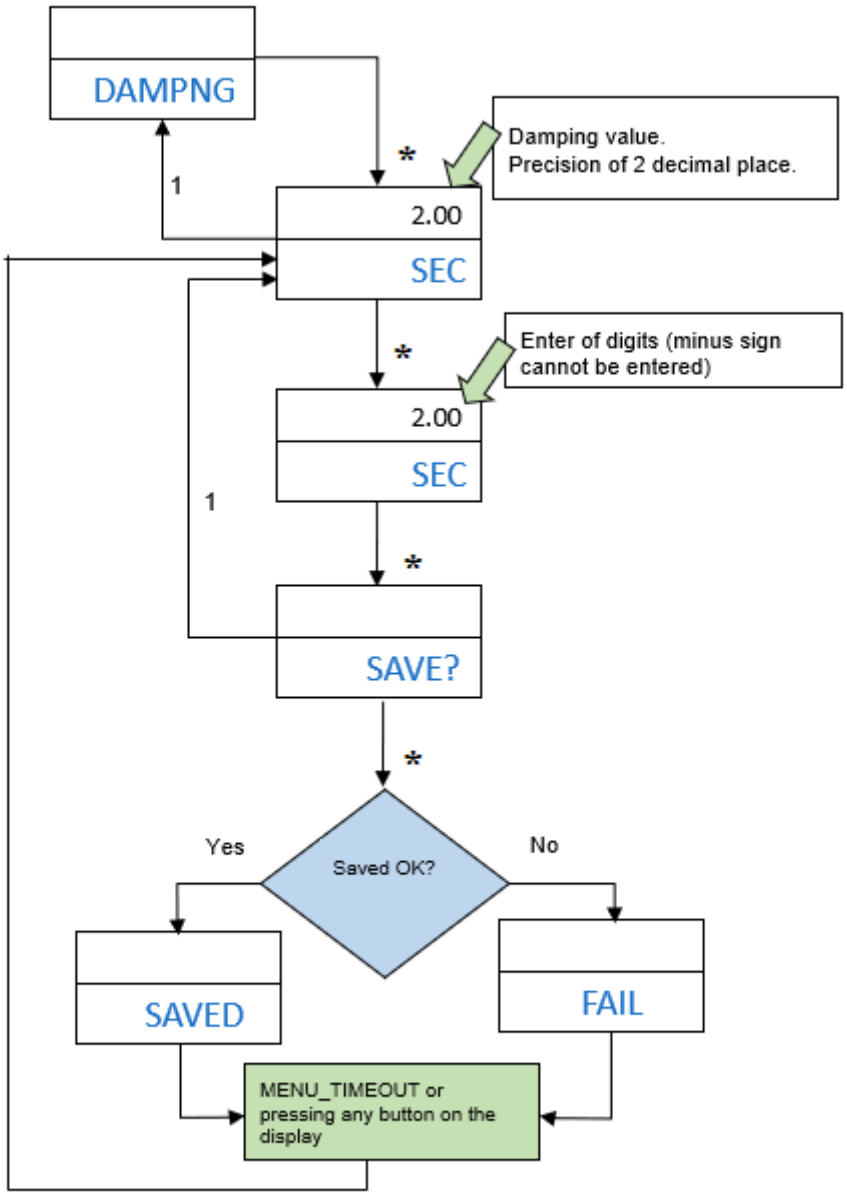


Figure M.13. Setting of Damping

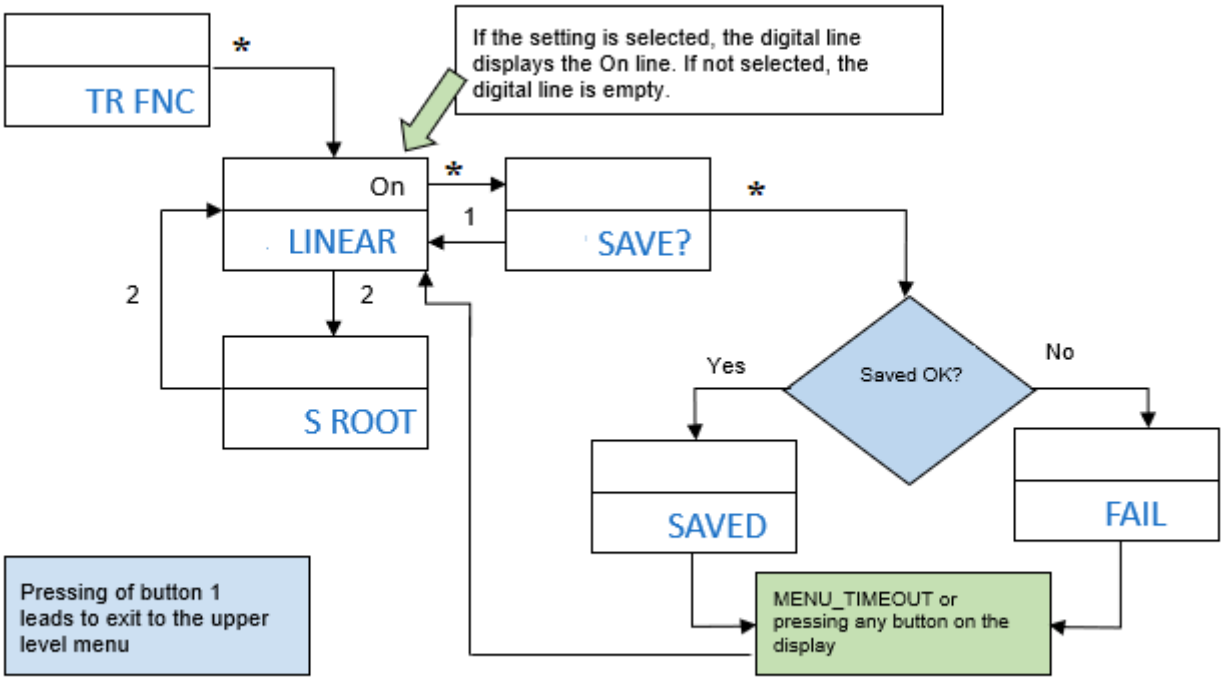


Figure M.14. Conversion Function Selection Mode

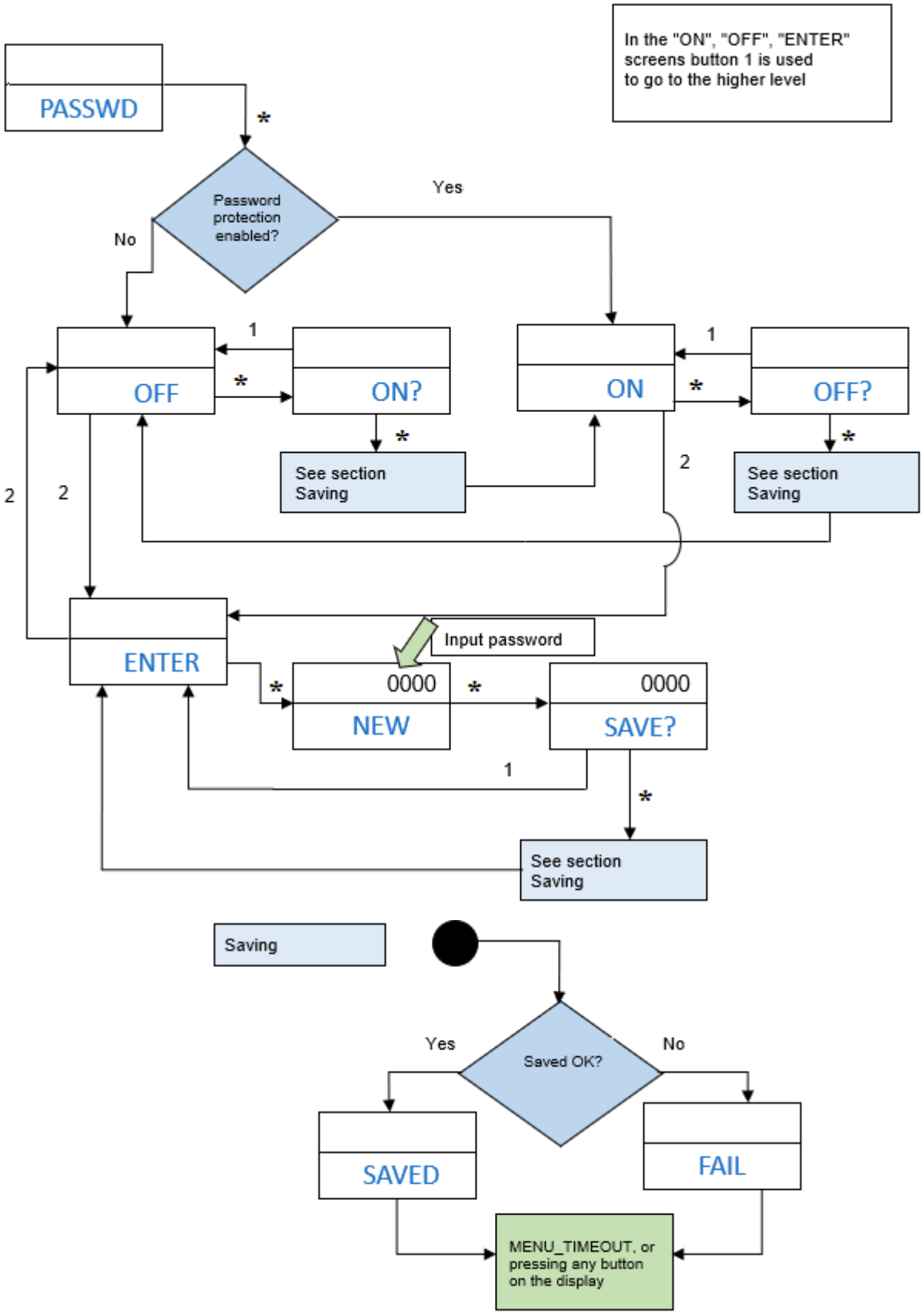


Figure M.15. Password Setting Mode

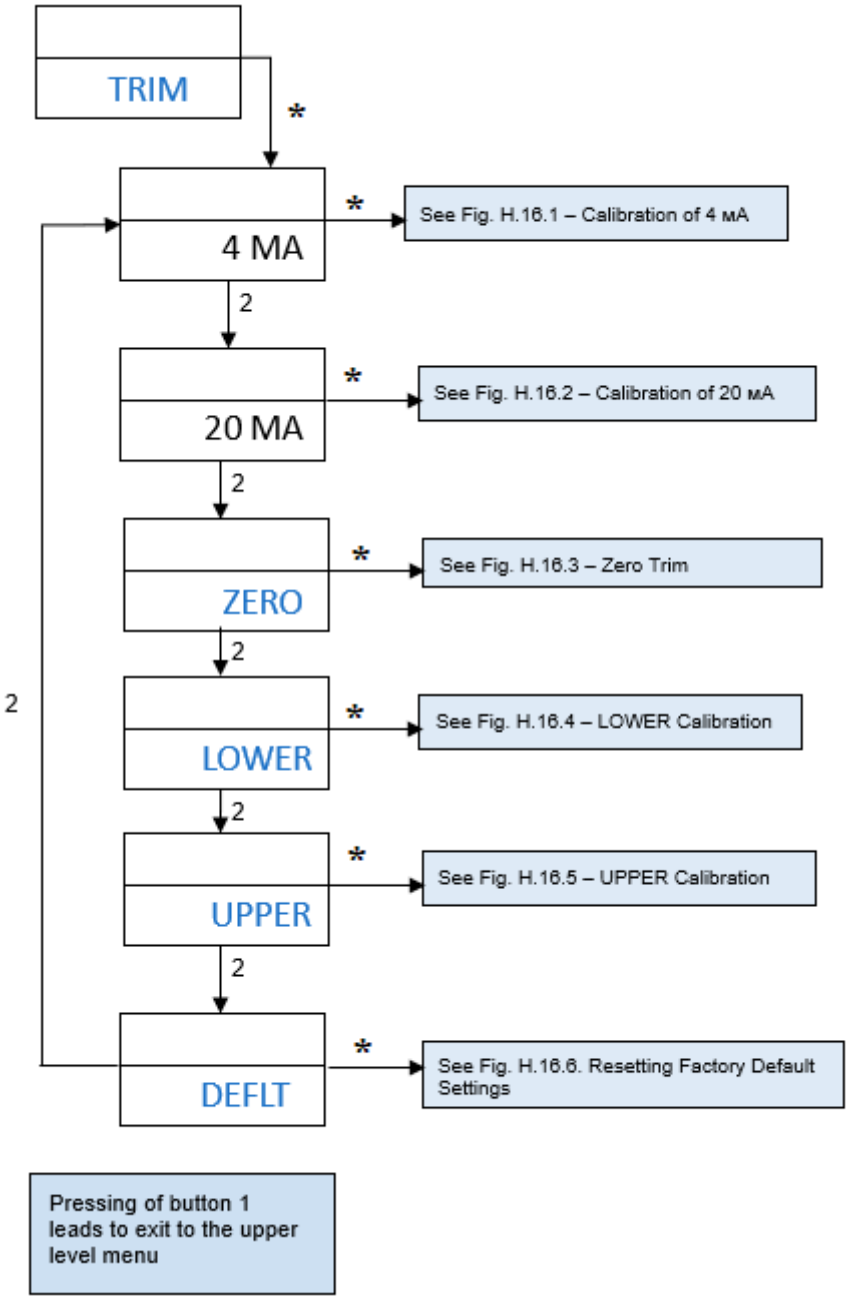


Figure M.16. Calibration Mode

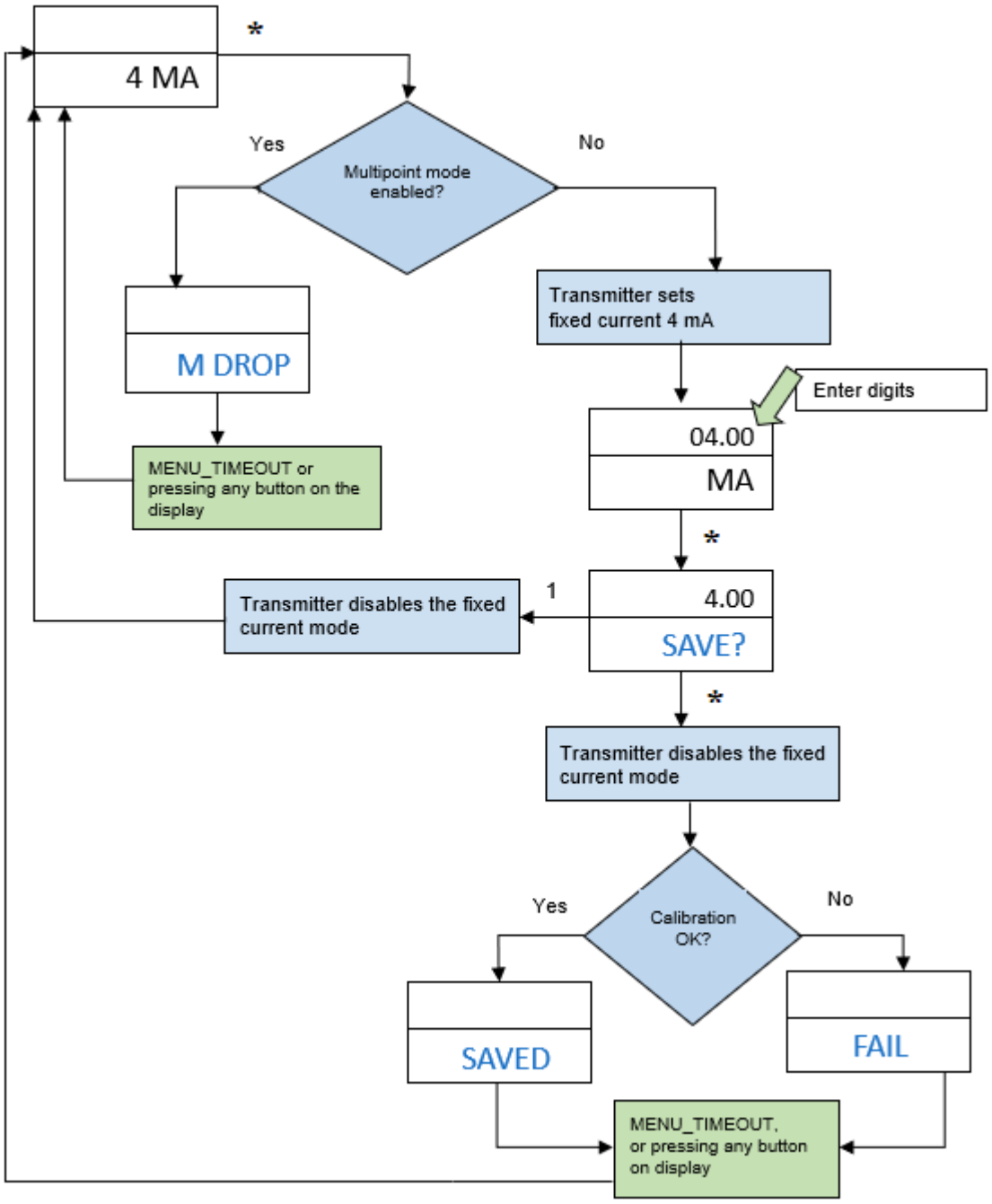


Figure M.16.1. 4 mA Calibration Mode

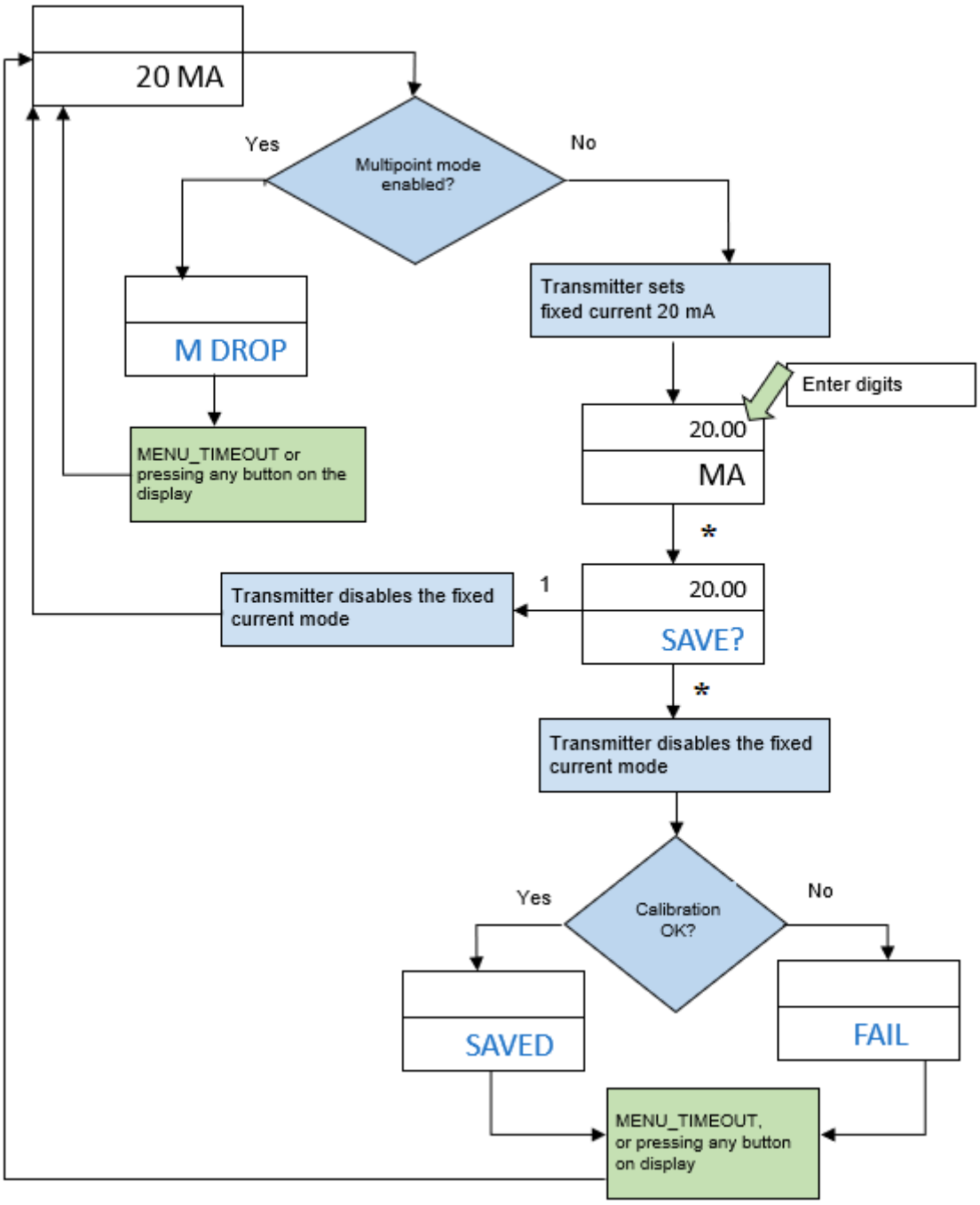


Figure M.16.2. 20 mA Calibration Mode

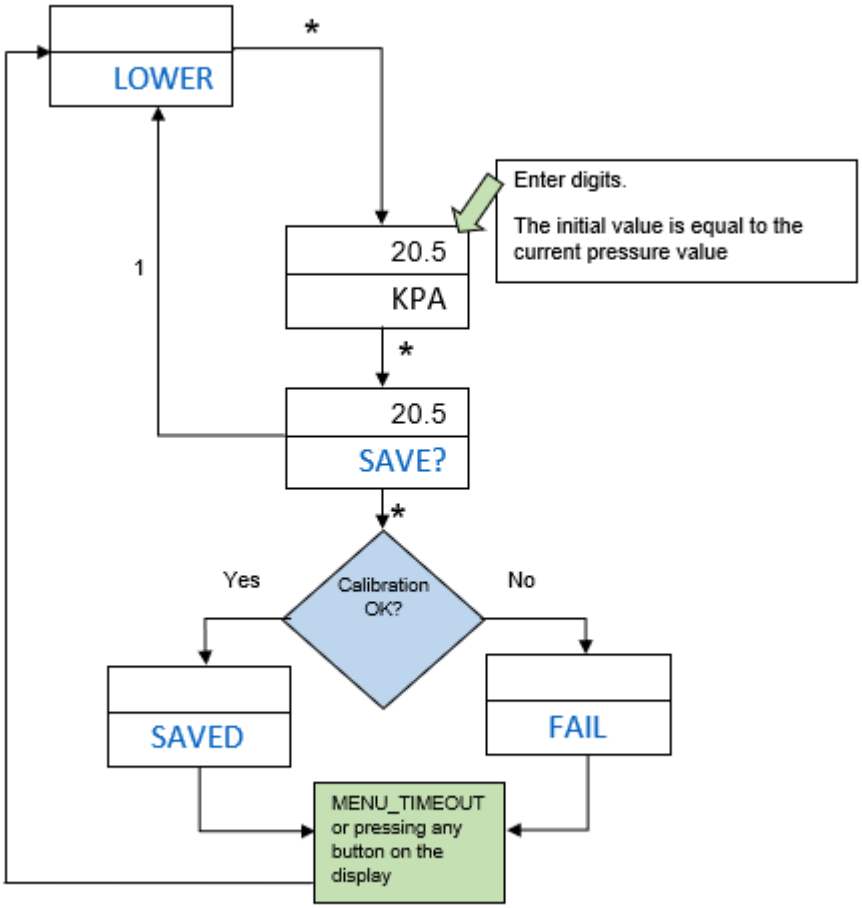


Figure M.16.3. LOWER Calibration Mode

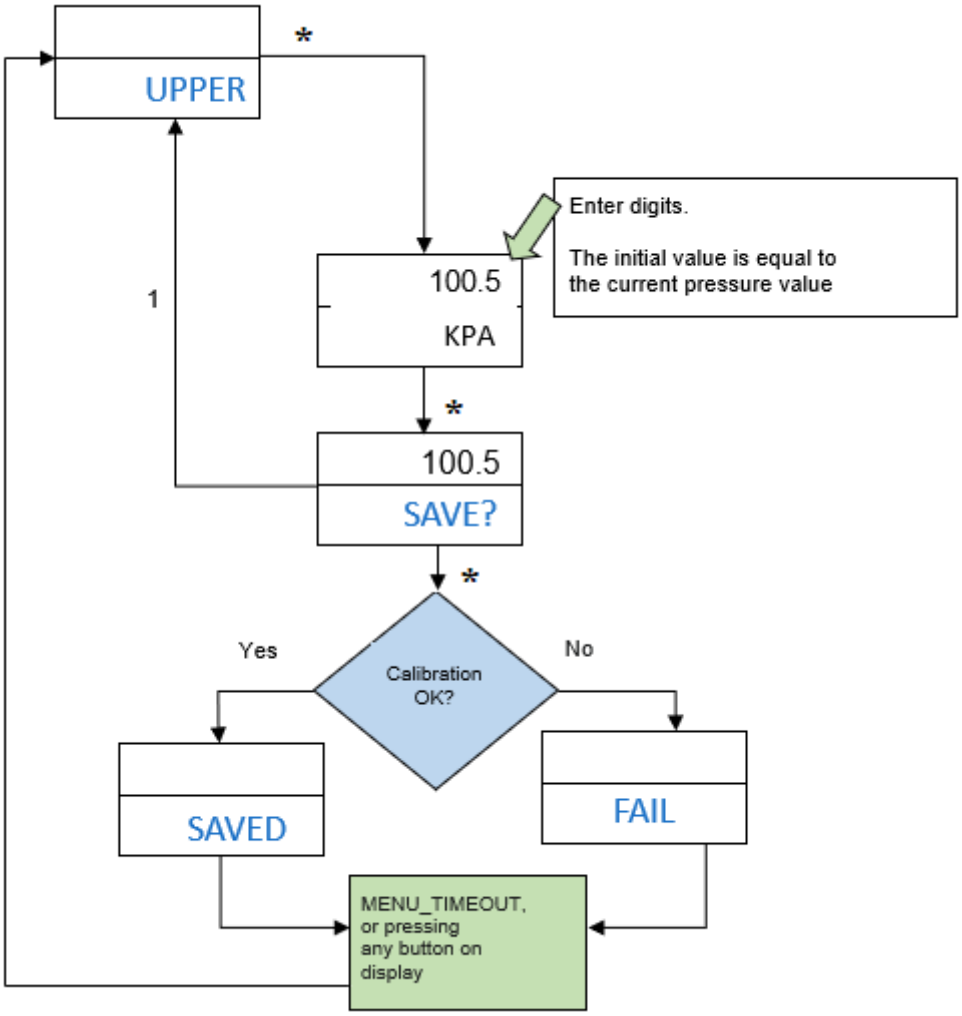


Figure M.16.4. UPPER Calibration Mode

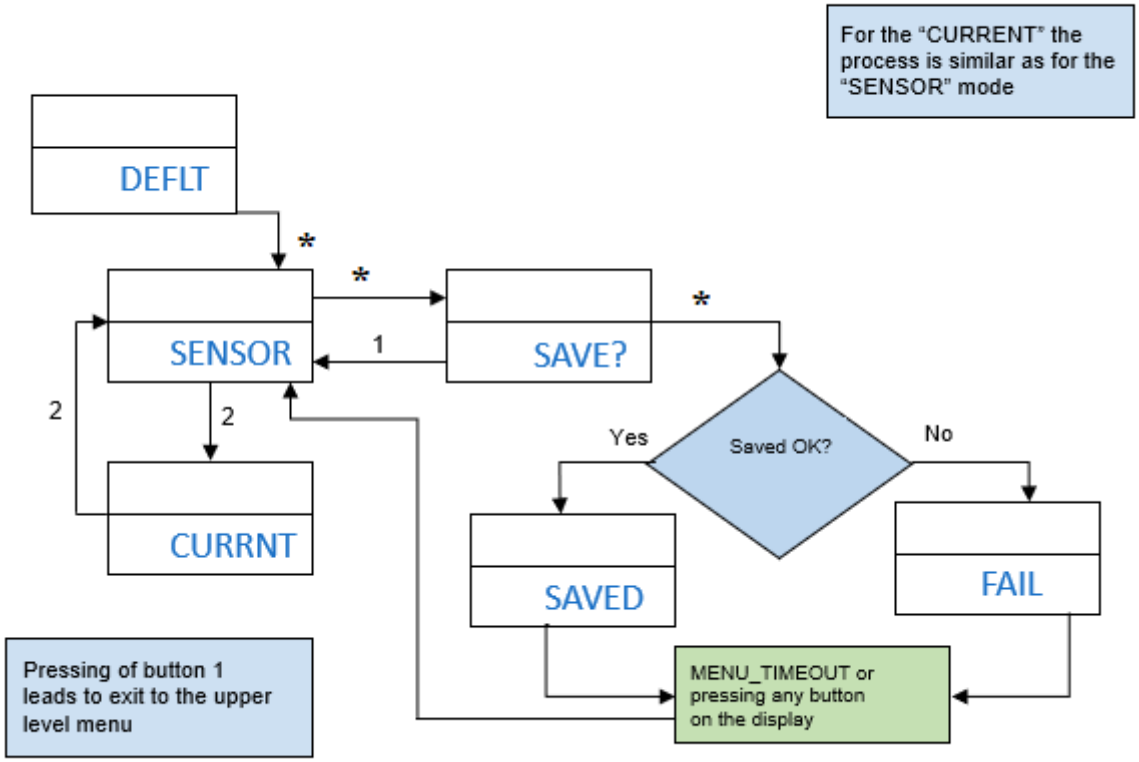


Figure M.16.5. Recall Factory Configuration Mode

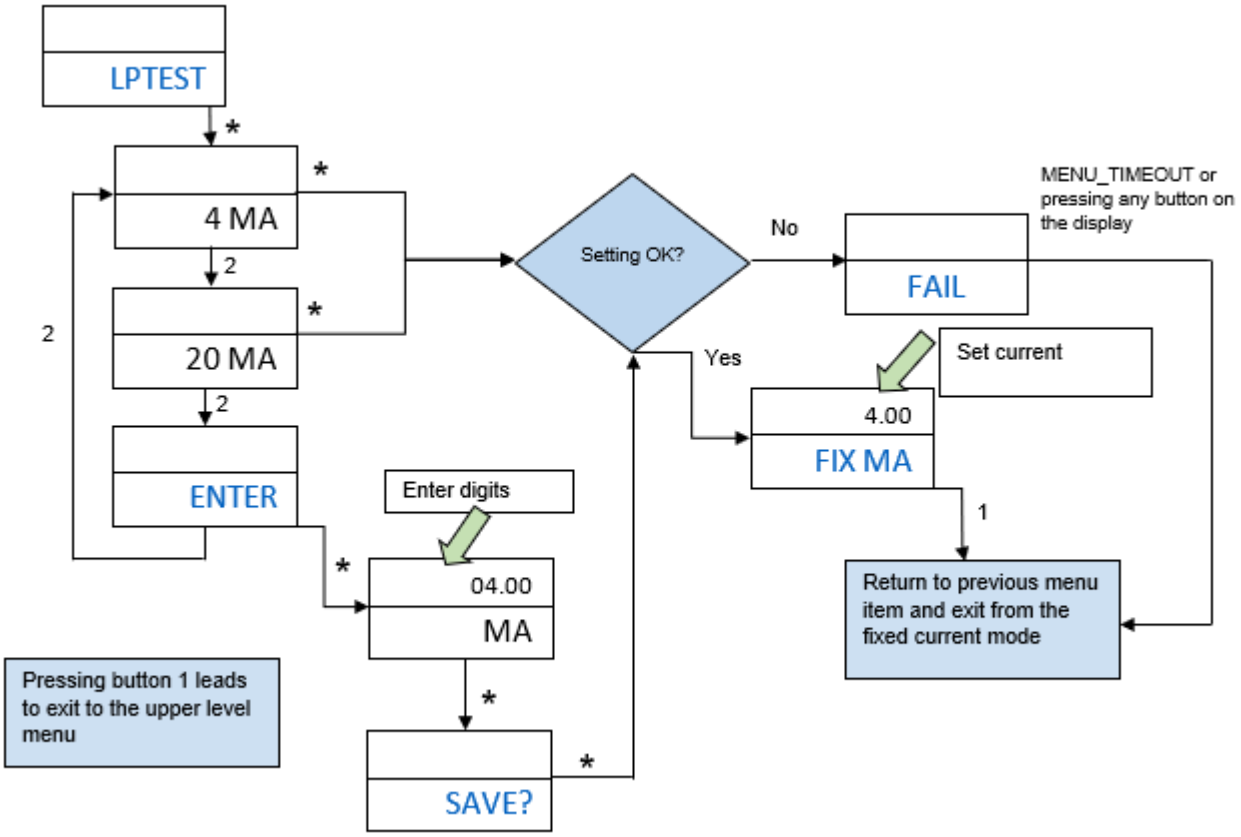


Figure M.17. Loop Test Mode

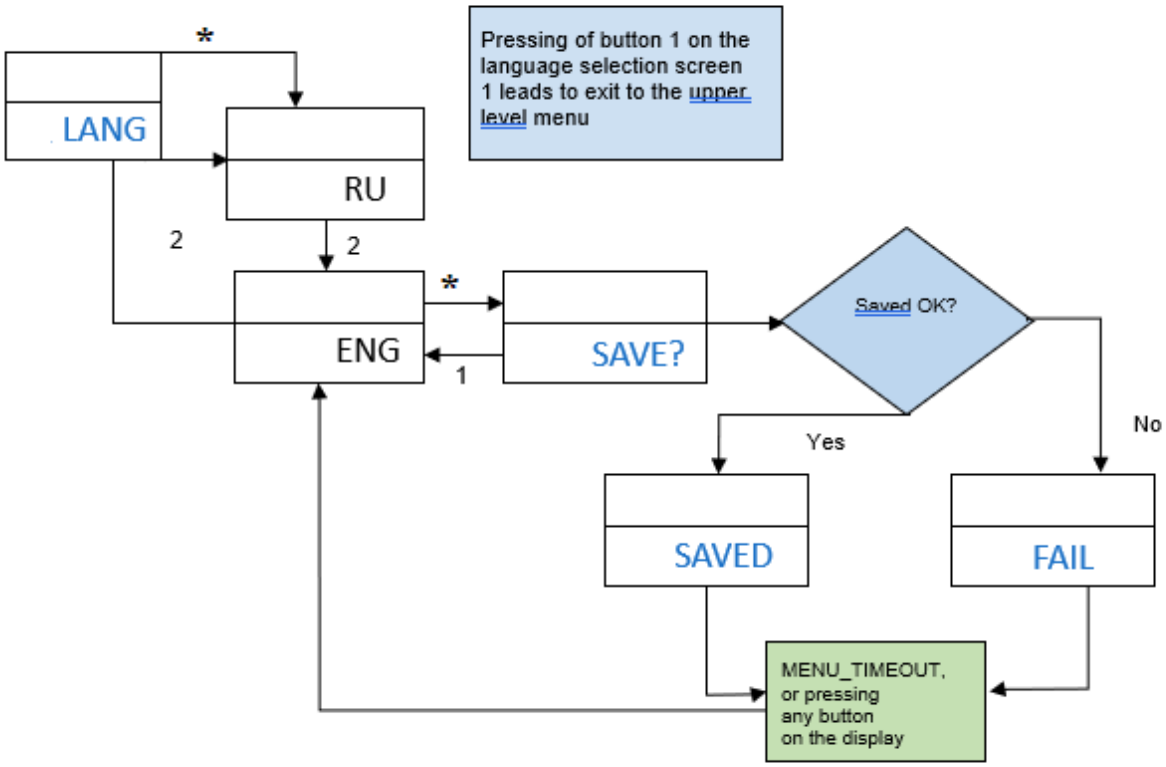


Figure M.18. Message Language Selection Mode

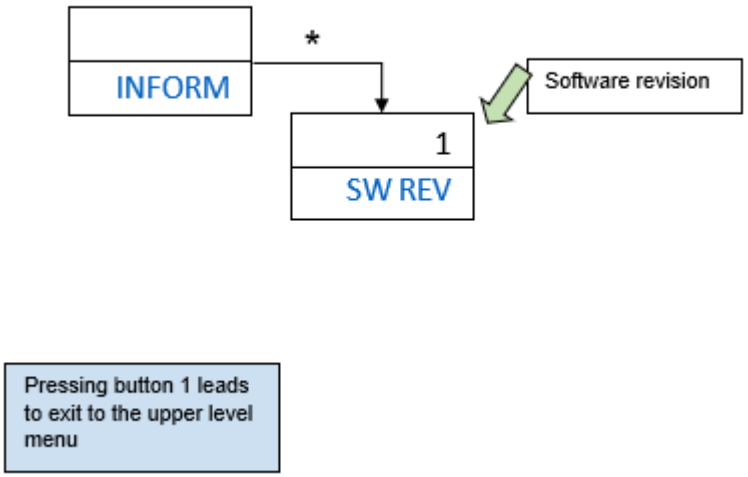


Figure M.19. Information Selection Mode

M.11 Units of measurement

Table M.19 - Pressure Units

Units of measurement	Indicator display		Conversion Factor to kPa
	English	Russian	
Inches of water gage at 4 °C	INWC4C	INWC4C	$2.4908192 \cdot 10^{-1}$
Inches of water gage at 60 °F	INWF60	INWF60	$2.4884283 \cdot 10^{-1}$
Inches of water gage at 68 °F	INH20	INH20	$2.4864101 \cdot 10^{-1}$
Feet of Water Gage at 4 °C	FTWC4C	FTWC4C	2.9889831
Feet of Water Gage at 60 °C	FTWF60	FTWF60	2.9861139
Feet of Water Gage at 68 °C	FTH20	FTH20	2.9836921
Millimeters of Water Gage at 4 °C	MMWC4C	MMWC4C	$9.8063749 \cdot 10^{-3}$
Millimeters of Water Gage at 68 °F	MMH20	ММВДСТ	$9.7890162 \cdot 10^{-3}$
Centimeters of Water Gage at 4 °C	CMWC4C	CMWC4C	$9.8063749 \cdot 10^{-2}$
meters of Water Gage at 4 °C	MWC4C	MWC4C	9.8063749
Inches of Mercury at 0 °C	INHG	INHG	3.3863890
Millimeters of Mercury at 0 °C	MMHG	ММРТСТ	$1.3332240 \cdot 10^{-1}$
Centimeters of Mercury at 0 °C	CMHGOC	CMHGOC	1.3332240
Meters of Mercury at 0 °C	MHGOC	MHGOC	$1.3332240 \cdot 10^{2}$
Pounds per Square Inch	PSI	PSI	6.8947570
Pounds per Square Foot	PSF	PSF	$4.7880260 \cdot 10^{-2}$
Atmosphere	ATM	АТМ	$1.0132500 \cdot 10^{2}$
Torr	TORR	ТОРР	$1.3332240 \cdot 10^{-1}$
Pascal	PA	ПА	$1.0000000 \cdot 10^{-3}$
Hectopascal	HPA	ГПА	$1.0000000 \cdot 10^{-1}$
Kilopascal	KPA	КПА	1.0000000
Megapascal	MPA	МПА	$1.0000000 \cdot 10^{3}$
Bar	BAR	БАР	$1.0000000 \cdot 10^{2}$
Millibar	MBAR	МВАР	$1.0000000 \cdot 10^{-1}$
g/cm^2	G/CM2	Г/СМ2	$9.8066500 \cdot 10^{-2}$
kg/cm^2	KG/CM2	КГ/СМ2	$9.8066500 \cdot 10$
kg/m^2	KG/M2	КГ/М2	$9.8066500 \cdot 10^{-3}$

Table M.20 — Analog Signal Engineering Units

Units of measurement	Indicator display	
	English	Russian
mA	MA	MA
%	%	%

Table M.21 - Level Units

Units of measurement	Indicator display	
	English	Russian
meters	M	M
centimeters	CM	CM
millimeters	MM	MM
foot	FT	ФУТ
inches	IN	ДЮЙМ

Table M.22 — Sensor Temperature Units

Units of measurement	Indicator display	
	English	Russian
Celsius	SENS°C	СЕНС°C
Fahrenheit	SENS°F	СЕНС°F

Table M.23 — Board Temperature Units

Units of measurement	Indicator display	
	English	Russian
Celsius	ELEC°C	ЭЛЕК°C
Fahrenheit	ELEC°F	ЭЛЕК°F

M.12 Configuration Data Sheet (code C1)

◉ – Select only one of the items provided,
☒ – One or more of the listed items can be selected.
∗ – Default

Customer information			
Customer:		Contact name:	
Phone no:		Fax no./email:	
P.O./reference no.:		P.O. line item:	
Quote no.:		Model no.:	
Customer sign-off:			

Tagging	
Hardware tag: 56 characters	
Tag	
The above Tag will be recorded in the product datasheet (in one line without whitespaces) *When ordering ST or SX option, the above Tag will also be shown on an additional plate (Tag on wire marking) in 4 lines, 14 characters each.*	
Software tag: *(English characters only)*	(8 characters)[1)]
Long software tag: *(English characters only)*	(32 characters) [1)]

Информация о выходном сигнале (Output information)							
Pressure units:	◯ in H_2O at 68 °F	◯ ft H_2O at 68 °F	◯ in Hg at 0 °C	◯ Atm	◯ MPa	◯ g/cm^2	
	◯ in H_2O at 4 °C	◯ mm H_2O at 4 °C	◯ mm Hg at 0 °C	Torr	Bar	kg/cm^2	
	◯ °F mm H_2O at 60 °F	◯ mm H_2O at 68 °F	◯ cm Hg at 0 °C	◯ Pa	◯ mBar	kg/m^2	
	◯ ft H_2O at 4 °C	◯ cm H_2O at 4 °C	◯ m Hg at 0 °C	◯ hPa		lb/ft^2	
	◯ ft H_2O at 60 °F	◯ m H_2O at 4 °C	◯ Psi	kPa			
Conversion Function:	◉ Linear*	◯ Square root					
Range points [2)]:	4 mA =	(0*)	20 mA =	(URL*)			

Transmitter information		
Descriptor)		(16 characters)
Message:		(32 characters)
Date:		date of calibration*

[1)] Software tag and long tag shall include English characters only (Russian is not supported by HART)
[2)] Also specify the units of measurement for set points (e.g., kPa)

Output information				
Sensor Temperature units: [1]	◉ °C*	○ °F	Damping:(1)	(0-60 sec): _____ (0.4 sec.*)
Elect.board Temperature units: [1]	◉ °C*	○ °F		

Информация на индикаторе (Display Parameters)			
☒ Pressure	☐ % of range	☐ Level	☐ Volume
☐ Flow rate	☐ Totalized flow	☐ Elect.board temp.	
☐ Startup display	☐ Analog output	☐ Temp.sens	

Process variable output assignments										
Primary Variable:	◉ Pressure	When leaving production, the primary variable of the transmitter is always Pressure. Setting the primary variable to another parameter is possible at the customer Site.								
Secondary Variable:	○ Pressure	○ Flow Rate	○ Totalized Flow	○ Level	○ Volume	◉ Sensor Temp	○ Gradient Sensor Temp	○ Elect. Temp	○ Gradient Elect. Temp	
Tertiary Variable:	○ Pressure	○ Flow Rate	○ Totalized Flow	○ Level	○ Volume	◉ Sensor Temp	○ Gradient Sensor Temp	○ Elect. Temp	○ Gradient Elect. Temp	
Четвертичная переменная (Quaternary Variable):	○ Pressure	○ Flow Rate	○ Totalized Flow	○ Level	○ Volume	◉ Sensor Temp	○ Gradient Sensor Temp	○ Elect. Temp	○ Gradient Elect. Temp	

Security information		
Local Operator Interface Password: Password (4 digits):	Enable ○	Disabled ◉
Write protection (via HART):	Enable ○	Disabled ◉
Lock/Unlock Device (Hart Lock)	Enable ○	Disabled ◉

Custom Alarm and Saturation Signal Levels		
Alarm: Transmitter output current (in mA) if a serious failure is found. **Saturation signal**: Transmitter output current (in mA) if transmitter inlet pressure exceeds the measurement range.		
Alarm and saturation levels are defined by option codes:	Alarm:	Saturation signal:
No option = Metran level, High	23,00 мА (23.00 mA)	= 21.60 mA
CT = Metran level, Low	3.6 mA	= 3.84 mA
C4 = NAMUR, High	22.50 mA	= 20.50 mA
CN = NAMUR, Low	3.6 mA	= 3.80 mA
CR = User-defined, High	enter the value (20.20 to 23.00) _____ (mA)[1]	(20.10 to 22.90) _____ (mA) [1]
CS = User-defined, Low	enter the value (3.60 to 3.80) _____ (mA)[2]	(3.70 to 3.90) _____ (mA)[2]

[1] High alarm must be 0,1 mA greater than high saturation value.
[2] Low alarm must be 0,1 mA less than low saturation value.

Process Alert 1									
The units of measurement will be set automatically in accordance with the previous settings of the monitored variables. Pressure and any warnings on expected process variables will be limited by transmitter range. Temperature warnings are limited by the range from –65 to 90 °C, and the minimum difference between high and low alarm levels is 0.1 °C.									
Monitored variable:									
○ *Pressure	○ Flow Rate	○ Totalized Flow	○ Level	○ Volume	● Sensor Temp	○ Gradient Sensor Temp	○ Elect. Temp	○ Gradient Elect. Temp	
Warning name (English characters only)									(14 characters)
Enabling condition (select one option):	○ Higher than URL	○ Lower than LRL	○ Withing the range	● Outside of the range*					
The warning thresholds define the warning actuation limits. The warnings can be set in accordance with the range. If the high level is exceeded, only a high level alarm setpoint is required, and if the low level is exceeded, only a low level alarm setpoint is required. Specifying the high and low levels is required for actuation within and outside of the range.									
Upper warning threshold				Lower warning threshold					
The warning values are limited by the transmitter range and have units defined by the selected variable.									

Notification mode:	○ Output current alarm level	○ HART warning	● Disabled*
Warning actuation limit[1]:	● Not defined*	○ Delay time seconds	○ Tolerance

[1] Two methods can be used to decrease the number of accidental actuations of warning thresholds:
- The warning threshold tolerance defines the interval from the warning threshold where no notifications occur. The units of measurement will be set automatically in accordance with the previous settings of the monitored device variable.
- The delay time defines the time period during which the warning threshold is already active, but no notification occurs.

Process Alert 2									
The units of measurement will be set automatically in accordance with the previous settings of the monitored variables. Pressure and any warnings on expected process variables will be limited by transmitter range. Temperature warnings are limited by the range from –65 to 90 °C, and the minimum difference between high and low alarm levels is 0.1 °C.									
Monitored variable:									
○ Pressure	○ Flow Rate	○ Totalized Flow	○ Level	○ Volume	● *Sensor Temp	○ Gradient Sensor Temp	○ Elect. Temp	○ Gradient Elect. Temp	
Warning name (English characters only)									(14 characters)
Enabling condition (select one option):	○ Higher than upper limit	○ Lower that lower limit	○ Within the range	● Outside of the range*					
The warning thresholds define the warning actuation limits. The warnings can be set in accordance with the range. If the high level is exceeded, only a high level alarm setpoint is required, and if the low level is exceeded, only a low level alarm setpoint is required. Specifying the high and low levels is required for actuation within and outside of the range.									
Upper warning threshold				Lower warning threshold					
The warning values are limited by the transmitter range and have units defined by the selected variable.									

Notification mode:	○ Output current alarm level	○ HART warning	● Disabled*
Warning actuation limit[1]	● Not defined*	○ Delay time seconds	○ Tolerance

[1] Two methods can be used to decrease the number of accidental actuations of warning thresholds:
- The warning threshold tolerance defines the interval from the warning threshold where no notifications occur. The units of measurement will be set automatically in accordance with the previous settings of the monitored device variable.
- The delay time defines the time period during which the warning threshold is already active, but no notification occurs

Setting for special applications
Requires C1 option code in order line of transmitter

Setting for special applications (options CF, CL) can be used to convert the measured pressures to the output signals for variables indirectly related with pressure—flowrate or level. Provide configuration details for any variable that will be displayed or set as output variable. The flowrate configuration is required to support functioning of flow totalizer, and the level configuration is required to support the volume calculation.

Flowrate (CF option in transmitter order line)

Units of measurement _____ (6 characters)

Pressure at flowrate: _____ (Pressure units)

Flowrate value: _____ (Flowrate units)

Low flow cut-off: _____ (Pressure units)

Resuming flowrate calculation: _____ (Единицы Давления) (Pressure units)

If the measured pressure is lower than the cut-off value, the device will calculate zero flowrate.
If the measured pressure exceeds the resuming value, the device will start measuring flowrate.

Flow meter (To be filled-in if calculation of accumulated flow is required, the Flowrate section must be filled-in)

Totalizer operating mode ○ Totalizing ◉ Stopped *

Totalizer direction : ◉ Direct flow measurement | ○ Reverse flow measurement
○ Sum of flows (forward + reverse) | ○ Flow difference (forward – reverse)

Totalizer units: _____ (6 characters , this value must be in accordance with the Flowrate units)

Flowrate measurement time units ◉ Seconds * | ○ Minutes | ○ Hours | ○ Days

(time units related to Flowrate units)

Unit conversion factor _____

Example: if the flowrate unit is 'kg/sec' and totalizer unit is 'kg', enter 1.

To totalize in the units other than Flowrate units, divide the flowrate unit by the desired totalizer unit and enter the division result to the 'Unit Conversion Factor' box.

Example: If the flowrate unit is 'liter/sec', and the totalizer unit is 'thousand liters', enter 0.001 (0.001 = 1 liter/1000 liters).

Setting for special applications
Requires C1 option code in order line of transmitter

Level (CL option in transmitter order line)

Units of measurement: (•) Meters* ( ) Inches ( ) Feet ( ) Centimeters ( ) Millimeters

Maximum level:		Level units
Pressure at maximum level:		Pressure units
Minimum level:		Level units
Pressure at minimum level:		Pressure units

Volume (Fill in if volume calculation is required, the Level section and piping table must be filled-in) (**Volume** (Fill in if volume calculation is required, the Level section and piping table must be filled-in))

Volume units: (•) *Cubic feet ( ) Liters ( ) Cubic inches ( ) Cubic meters

Tank Type	
Tank Length	
Tank Radius	

Calibration table

The level and volume units for the values entered below are defined in the Level and Volume sections above. Records must be higher than 0; with steadily growing values of both level and volume.
The table must include at least 2 data rows. Factory configuration is limited to 10 points, the device can be configured for up to 50 points in the field.

Calibration point	Level	Volume
0		
1		
2		
3		
4		
5		
6		
7		
8		
9		

M.13 Diagnostic Messages

Table M.24 — Diagnostic Messages

Message description	Display on the indicator character line	Problem and Recommended Action
Alarms		
Pressure exceeds the allowable limits	^P^SAT	The measured pressure is outside of the sensor module limits. 1. Check the environment where the transmitter is installed. 2. Verify the pressure transmitter connection to the system to confirm there are no obstructions or damage to the isolating diaphragms. 3. Replace the sensor module.
Sensor temperature out of limits	^T^SAT	The sensor module temperature is outside of the safe operating range. The error does not affect the transmitter output. Recommended action: 1. Check if the process temperature and ambient temperature are within the range of –65 ºC to 90 °C. 2. Replace the sensor module.
Board temperature out of limits	TE^SAT	Board temperature exceeds the safe operating range. The error does not affect the transmitter output. 1. Check if the electronics temperature is within the range of –65 to 90 °C. 2. Replace the electronics board.
Loop integrity diagnostic	LOOP	Power supply diagnostics. The voltage at the transmitter does not correspond to the set limits. Recommended action: 1. Check that the power source provides the correct and stable power, with minimal fluctuations. 2. Remove the cover of the electronic converter on the terminal block side to check for water or corrosion. 3. Check the condition of the wires and the grounding connection.
Stuck buttons	BN^STK	At least one button on the display or an external button is stuck. 1. Verify that the buttons located on the housing are not stuck. 2. Safely remove the front cover of the housing to inspect the indicator buttons (if equipped) to ensure they are not stuck. 3. If the buttons are unnecessary, deactivate them. 4. If the indicator has buttons, consider replacing it. 5. Replace the electronics board.

Table M.24 (Continued)

Process Alert 1	The initial 6 characters of the identifier for Process Alert 1.	The transmitter has identified a deviation in the monitored variable that exceeds the predefined thresholds for process warning 1. 1. Confirm that the monitored parameter exceeds the boundaries of the warning thresholds. 2. Adjust the warning threshold settings or deactivate them.
Process Alert 2	The initial 6 characters of the identifier for Process Alert 2.	The transmitter has identified a deviation in the monitored variable that exceeds the predefined thresholds for process warning 2. 1. Confirm that the monitored parameter exceeds the boundaries of the warning thresholds. 2. Adjust the warning threshold settings or deactivate them.
Primary variable in simulation mode	PV^SIM	Primary or transmitter variable is in simulation mode and is not used for measuring the process. Reset the transmitter.
Current output is saturated	^I^SAT	The analog output is restricted (saturated). Measured pressure is outside of the specified range. 1. Inspect the status of the transmitter. 2. Check the range value settings for 4 mA and 20 mA, reconfigure if necessary. 3. Verify the pressure transmitter connection to the system to confirm there are no obstructions or damage to the isolating diaphragms. 4. Replace the sensor module.
Fixed current output	^I^FIX	The analog output signal is currently set in fixed mode. Analog output does not depend on input pressure. This may be caused by analog trim in the transmitter, or because the transmitter has been set to loop test or multidrop mode. 1. Verify that loop test is no longer required. 2. Disable the loop test function or restart the transmitter.
Faults		
Circuit board failure	EL^ERR	Circuit board failure is detected. Replace the circuit board.
Sensor failure	SN^ERR	Sensor module failure or incompatibility of circuit board and sensor module or no pressure data update or no sensor temperature data update. 1 Replace sensor. 2 Replace incompatible sensor.

M.14 List of Reference Documents

Table M.25

Document ID	Number of section, subsection, or paragraph that contains reference
1	*2*
GOST 27.003-2016	M.1.2.79
GOST 14254-2015	M.1.2.4.1, M.1.4.1
GOST 15150-69	M.1.2.62, M.1.2.63, M.1.2.64, M.1.2.65
GOST 22520-85	M.1.2.2
GOST 30546.1	M.1.2.56
GOST 30804.4.2-2013	M.1.2.55
GOST 30804.4.4-2013	M.1.2.55
GOST 31610.0-2019 (IEC 60079-0:2017)	M.1.1.1, M.1.6.1.5, M.1.6.2.1, M.1.6.2.2, M.1.6.2.3, M.1.6.4
GOST 31610.11-2014 (IEC 60079-11:2011)	M.1.1.1, M.1.6.2.1, M.1.6.2.3
GOST 31610.20-1-2020 (ISO/IEC 80079-20-1:2017)	M.1.6.1.5, M.1.6.2.1, M.1.6.2.3
GOST R 51317.4.5-99	M.1.2.55
GOST R 51317.4.6-99	
GOST R 52931-2008	M.1.2.37, M.1.2.42, M.1.2.60
GOST IEC 60079-1-2013	M.1.1.1, M.1.6.1.1, M.1.6.1.2, M.1.6.1.5
GOST IEC 60079-14-2013	M.1.1.1
GOST IEC 60079-31-2013	M.1.1.1, M.1.6.1.1, M.1.6.1.2
GOST IEC 61000-4-3-2016	M.1.2.55
GOST IEC 61000-4-8-2013	
GOST R IEC 61326-1-2014	M.1.2.52, M.7.1, M.7.2
GOST R IEC 61508-2012	M.1.2.68, M.4.1, M.4.4, M.4.5.1, M.7.1, M.7.2
TU 4212-022-51453097-2006 Metran-150 Pressure Transmitters. Specification	M.1.1.2
TU 3742-057-514097-2009 Valve Manifolds. Specification	M.7.1, M.7.2

Table M.25 (Continued)

1	*2*
Order No. 2905 of the Ministry of Industry and Trade of the Russian Federation dated August 28, 2020, 'On approval of type approval test procedures for standard samples or measuring instruments, type approval procedures for standard samples or measuring instruments, amendments to respective records, type approval certification procedure for standard samples or measuring instruments, certificate forms for type approval of standard samples or measuring instruments, requirements for type approval marks for standard samples or measuring instruments with the respective application procedure.	M.1.4.1
TRCU 012/2011 Technical Regulation of the Customs Union. On Safety of Equipment for Operation in Explosive Environments.	M.1.1.1, M.1.4.2, M.1.6.1.5, M.1.6.2.3, M.1.6.4
Technical Regulations of the Customs Union (CU TR) 020/2011 On Electromagnetic Compatibility of Technical Equipment	M.1.1.1
Guidelines for the Categorization and Design of Naval Vessels, Section XV	M.1.1.1, M.1.2.38, M.1.2.40, M.1.2.52, M.1.2.54, M.1.2.70, M.1.2.71, M.1.2.72, M.1.2.73 M.1.2.74, M.1.2.75
Guidelines for the Categorization and Design of Naval Vessels, Section XVII	M.1.1.1
Rules for Technical Supervision of Ship Construction and Manufacturing of Materials and Products for Ships, Part IV	M.1.1.1, M.1.2.50, M.1.2.51, M.1.2.75
Regulations for the Classification, Fabrication, and Equipment of Floating Drilling Rigs and Offshore Fixed Platforms	M.1.1.1
Regulations for the Classification, Fabrication, and Equipment of Floating Oil and Gas Complexes	M.1.1.1
IEEE C62.41-1991	M.1.2.55
CISPR11	M.1.2.54
NACE MR0175/ISO 15156-2015	M.7.1, M.7.2
NACE MR0103/ISO 17945-2015	
EN 10204 3.1B	