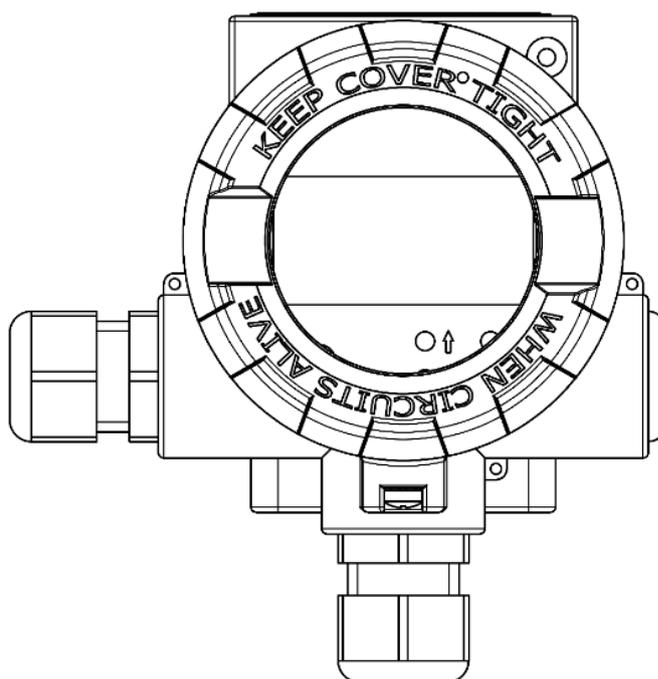




USER'S MANUAL
SMART TEMPERATURE TRANSMITTER
LI-24ALW Safety



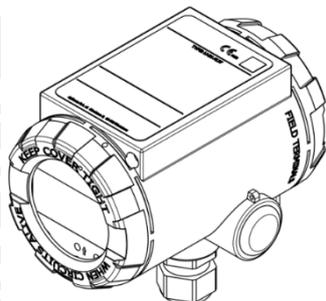
PRODUCT CODE – see → [5.2. Transmitter identification.](#)

The QR code or ID number identifies the transmitter and provides quick access to the following documentation on the manufacturer's website: user's manual, SIL safety manual, explosion-proof device user manual, declarations of conformity and copies of certificates.

LI-24ALW Safety

ID:0027 0001 0001 0001 0000 0001 0001 87

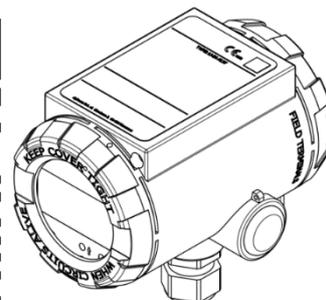
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LI-24ALW Safety (Exi)

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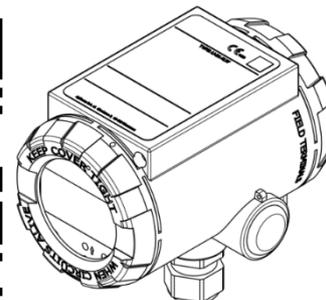
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LI-24ALW Safety (Exd)

ID:0027 0001 0001 0001 0000 0003 0001 86

<https://www.aplisens.pl/ID/002700010001000100000003000186/en.php>



Symbols used

Symbol	Description
	Warning to proceed strictly in accordance with the information contained in the documentation in order to ensure the safety and full functionality of the device.
	Information particularly useful during installation and operation of the device.
	Information particularly useful during installation and operation of an Ex type device.
	Information on disposal of used equipment.

BASIC REQUIREMENTS AND SAFE USE



The manufacturer will not be liable for damage resulting from incorrect installation, failure to maintain a suitable technical condition of the device or use of the device other than for its intended purpose.

Installation should be carried out by qualified staff having the required authorizations to install electrical and I&C equipment. The installer is responsible for performing the installation in accordance with manual as well as with the electromagnetic compatibility and safety regulations and standards applicable to the type of installation.

All safety and protection requirements must be observed during installation, operation and inspections.

If a malfunction occurs, the device should be disconnected and handed over to the manufacturer for repair.



In order to minimize the risk of malfunction and associated risks to staff, the device is not to be installed or used in particularly unfavourable conditions, where the following hazards occur:

- possible mechanical impacts, excessive shocks and vibration;
- excessive temperature fluctuation;
- water vapour condensation, dusting, icing.

Changes made to the manufacturing of products may be introduced before the paper version of the manual is updated. The up-to-date manuals are available on the manufacturer's website: www.aplisens.com.

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1. INTRODUCTION

1.1. Purpose of the document

The subject of manual are smart temperature transmitters **LI-24ALW Safety**, designed to work with a distance or direct sensor. The manual applies to the following versions: standard, intrinsically safe Exi and flameproof Exd.

The manual contains data, tips and general recommendations for safe installation and operation of the transmitters, as well as troubleshooting in case of possible failure.

The manual does not cover explosion protection issues.

Reading the SIL EN.IB.LI.24.ALW.SFT safety manual is mandatory, as it contains detailed data about the transmitter operation in the functional safety loop.



The use of the equipment in hazardous zones without appropriate approvals is forbidden.

It is mandatory to read EN.IX.LI.24.ALW Explosion-proof Device User Manual, containing important information related to the installation of intrinsically safe and flameproof versions of the transmitters.

1.2. Registered trademarks

HART® is a registered trademark of FieldComm Group.

Windows® is a registered trademark of Microsoft Corporation.

Google Play® is a service registered and managed by Google® Inc.

1.3. Definitions and abbreviations

Table 1. Definitions and abbreviations

Item no.	Abbr.	Meaning
1	LRV	“Lower Range Value” – the value of the set range expressed in the units of temperature, resistance or voltage corresponding to the current of 4,000 mA, i.e. 0% of the output setpoint. The set range must not exceed limits which depend on the selected measurement type. The minimum width of the set voltage range [(URV-LRV)] is limited by software to 10°C for resistive sensors (10 Ω for resistance measurement) or 50°C for voltage type sensors (10 mV for voltage measurement).
2	URV	“Upper Range Value” — the value of the set range expressed in the units of temperature, resistance or voltages corresponding to the current of 20,000 mA, i.e. 100% of the output setpoint. The set range must not exceed the set range limits which depend on the selected measurement type. The minimum width of the set voltage range [(URV-LRV)] is limited by software to 10°C for resistive sensors (10 Ω for resistance measurement) or 50°C for voltage type sensors (10 mV for voltage measurement).
3	LRL LSL	“Lower Range Limit” or “Lower Sensor Limit” – the lower limit of the set range expressed in the units of temperature, resistance or voltage. Value (URL-LRL) or (USL-LSL) is referred to as the transmitter base range and depends on the selected measurement type.
4	URL USL	“Upper Range Limit” or “Upper Sensor Limit” – the upper limit of the set range expressed in the units of temperature, resistance or voltage. Value (URL-LRL) or (USL-LSL) is referred to as the transmitter base range and depends on the selected measurement type.
5	LPL	“Lower Processing Limit” – the lower limit of digital processing of the measured value. The transmitter digitally processes the measurement below the lower limit of the LRL set range. When LPL is reached, the transmitter freezes digital value measurement refreshing and the diagnostic alarm mode I_AL < 3,600 mA is activated. In addition, collective statuses of the transmitter will be set: “Sensor error”, “First Process Variable Calculation Error”, “First Process Variable out of Range” and “Second or Subsequent Process Variables out of Range”. These can be read out in the diagnostic tab via the HART communication.
6	UPL	“Upper Processing Limit” – the upper limit of digital processing of the measured value. The transmitter digitally processes the measurement up to the upper limit of the URL set range. When UPL is reached, the transmitter freezes digital value measurement refreshing and the diagnostic alarm mode I_AL < 3,600 mA is activated. In addition, collective statuses of the transmitter will be set: “Sensor error”, “First Process Variable Calculation Error”, “First Process Variable out of Range” and “Second or Subsequent Process Variables out of Range”. These can be read out in the diagnostic tab via the HART communication.

1.4. Transmitter set range

The figure below shows the transmitter set range, limits related to the permissible set range, digital processing range of the A/D measuring converter. As standard, current values of 4 mA / 20 mA are assigned to LRV/URV points. In order to obtain reverse characteristics, it is possible to reverse the assignment so that the LRV/URV points are assigned to 20 mA / 4 mA values of currents.

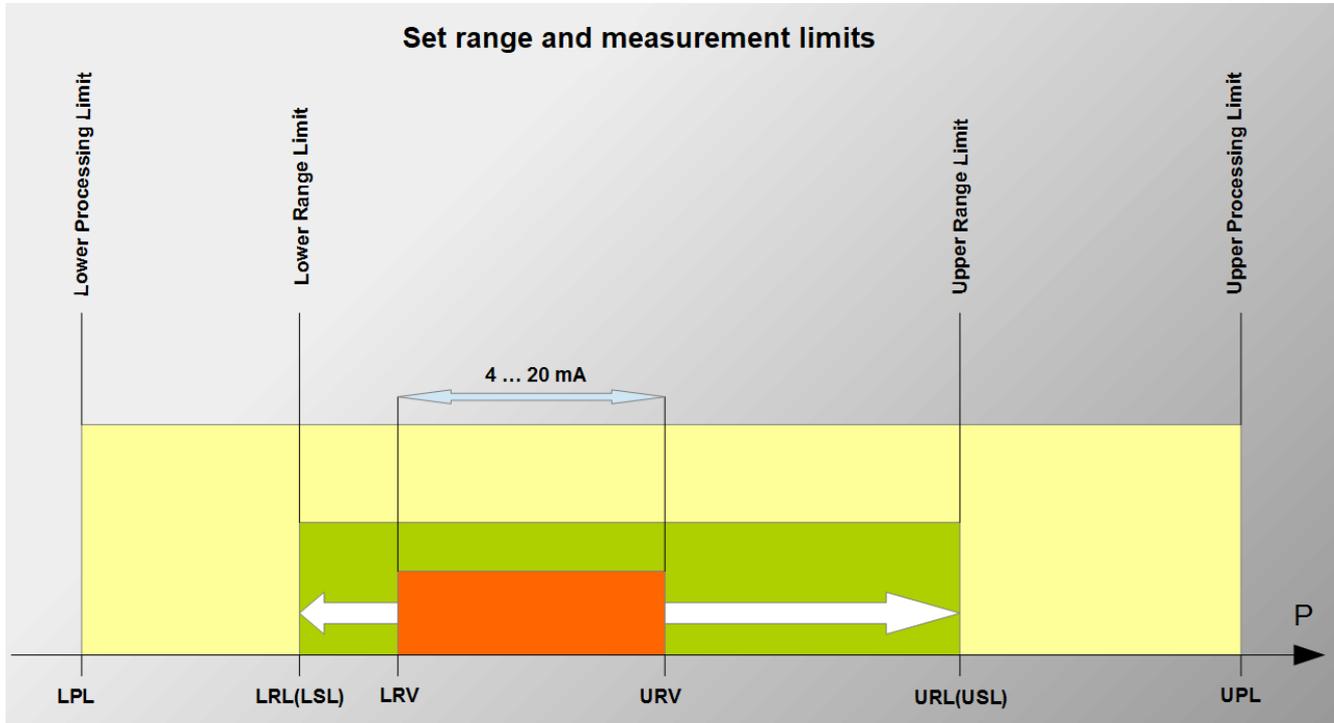


Figure 1. Set range and measurement limits

2. SAFETY



- The installation and start-up of the device and any activities related to operation shall be carried out after thorough examination of the contents of user's manual and the instructions related thereto.
- Installation and maintenance should be carried out by qualified staff having the required authorizations to install electrical and measuring devices.
- The device shall be used according to its intended purpose in line with the permissible parameters specified on the nameplate (→ 5.2. Transmitter identification).
- The protection elements used by the manufacturer to ensure transmitter safety may be less effective if the device is operated in a manner not consistent with its intended purpose.
- Before installing or disassembling the device, it is absolutely necessary to disconnect it from the power source.
- No repairs or alterations to the transmitter electronic system are permitted. Assessment of damages and possible repair may only be performed by the manufacturer or authorized representative.
- Do not use instruments if damaged. In case of malfunction, the device must be put out of operation.

3. TRANSPORT AND STORAGE

3.1. Delivery check

After receiving the delivery of the equipment, it is necessary to:

- make sure that the packaging and its contents were not damaged during transport;
- check the completeness and correctness of the received order, and make sure no parts are missing.

3.2. Transport

Transport of transmitters shall be carried out with the use of covered means of transport, in original packages. The packaging shall be protected against movement and direct impact of atmospheric factors.

3.3. Storage

Transmitters shall be stored in a factory packaging, in an indoor room without vapours and aggressive substances, protected against mechanical impact, at an air temperature and relative humidity not exceeding the permissible ambient parameters in accordance with data sheet.

4. GUARANTEE

General terms and conditions of guarantee are available on the manufacturer's website:

www.aplisens.com/ogolne_warunki_gwarancji



The guarantee shall be repealed if the device is used against its intended use, failure to comply with user's manual or interference with the structure of the device.

5. IDENTIFICATION

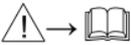
5.1. Manufacturer's address

APLISENS S.A.
03-192 Warsaw
Morelowa 7 St
Poland

5.2. Transmitter identification

Depending on the version of the transmitter, the nameplates may differ in the amount of information and parameters.

Table 2. Symbols occurring on the transmitter nameplate

	Logo and name of manufacturer
	CE mark
	CE mark with the number of notified body
	QR code
TYPE:	Transmitter type
ID	Transmitter model ID
	Type of measurement input
 U	Supply voltage values
 T _{amb}	Permissible range of ambient temperature
 I	Output signal
El. connection:	Type of electrical connection
Ser.- No.	Transmitter serial number
Year of production	Year of production
IP	IP range value
//lower part of the nameplate//	Special execution
	Note about the read the manual
Aplicens S.A. ul. Morelowa 7, 03-192 Warszawa	Manufacturer address

5.3. CE mark, declaration of conformity

The device has been designed to meet the highest safety requirements, it has been tested and has left the factory in a condition that is safe for operation. The device complies with the applicable standards and regulations listed in the EU Declaration of Conformity and has CE marking on nameplate.

6. INSTALLATION

6.1. General recommendations

Temperature transmitter LI-24ALW Safety can be mounted in any position.

The housing of the transmitter should be protected against hot air streams by appropriate location of the transducer or by installing thermal screens so that the transmitter does not heat up to a temperature higher than the permissible one.

The transmitter housing allows for wall and pipe mounting. For this purpose, use the AL handle by Aplisens S.A.

7. ELECTRICAL CONNECTION



All connection and installation operations must be performed with disconnected supply voltage and other external voltages, if used.



Failure to provide proper connection of the transmitter may result in danger. Risk of electric shock and/or ignition in potentially explosive atmospheres.

7.1. Cable connection to transmitter terminals

In order to perform correct connection of the cables, the following steps shall be performed:

- disconnect power supply;
- unscrew the rear cover of the transmitter body in order to gain access to the terminals of power supply and measurement and the internal ground terminal;
- pull the cable through the cable gland;
- power supply and signal cables of the 4 ... 20 mA current loop should be properly connected to the "+", "-" terminals;
- connect the transmitter in accordance with figures below and section → 7.1.1. [Options for connecting sensors, potentiometers and voltage sources to the transmitter](#), paying attention to the correct tightening of the screws fixing the conductor core to the terminal;
- depending on the type of installation grounding adopted, connect the shield of the cable to the earth screw terminal of the body;
- leaving a slight slack in the cable inside the body, tighten the gland nut so that the gland seal tightens on the cable.

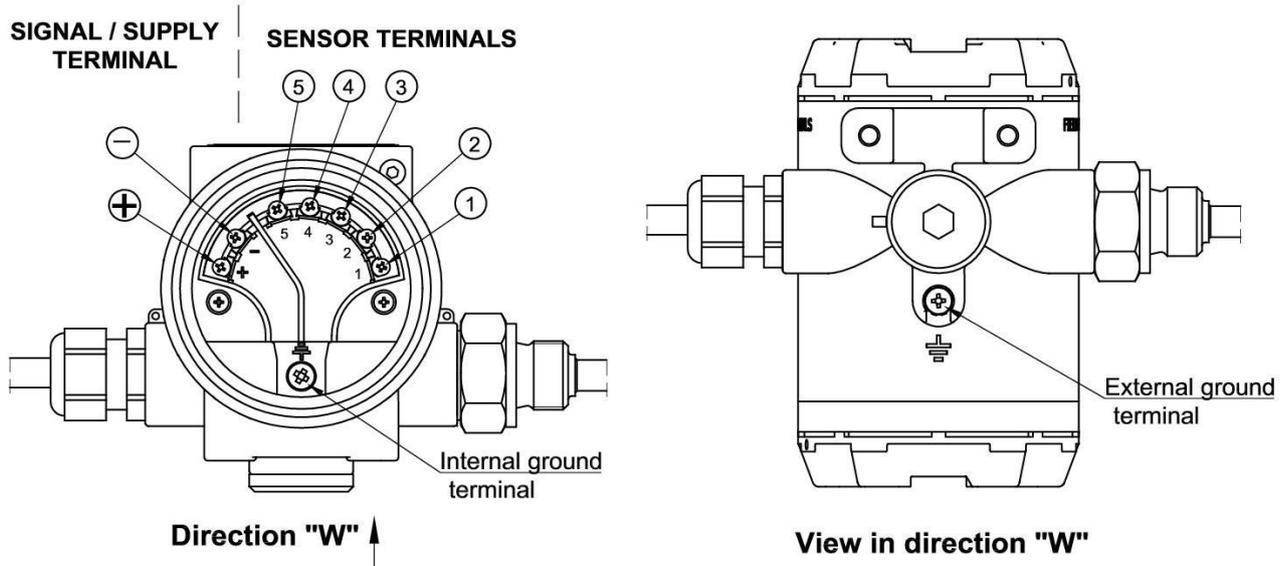


Figure 2. Marking of the LI-24ALW Safety terminals

7.1.1. Options for connecting sensors, potentiometers and voltage sources to the transmitter

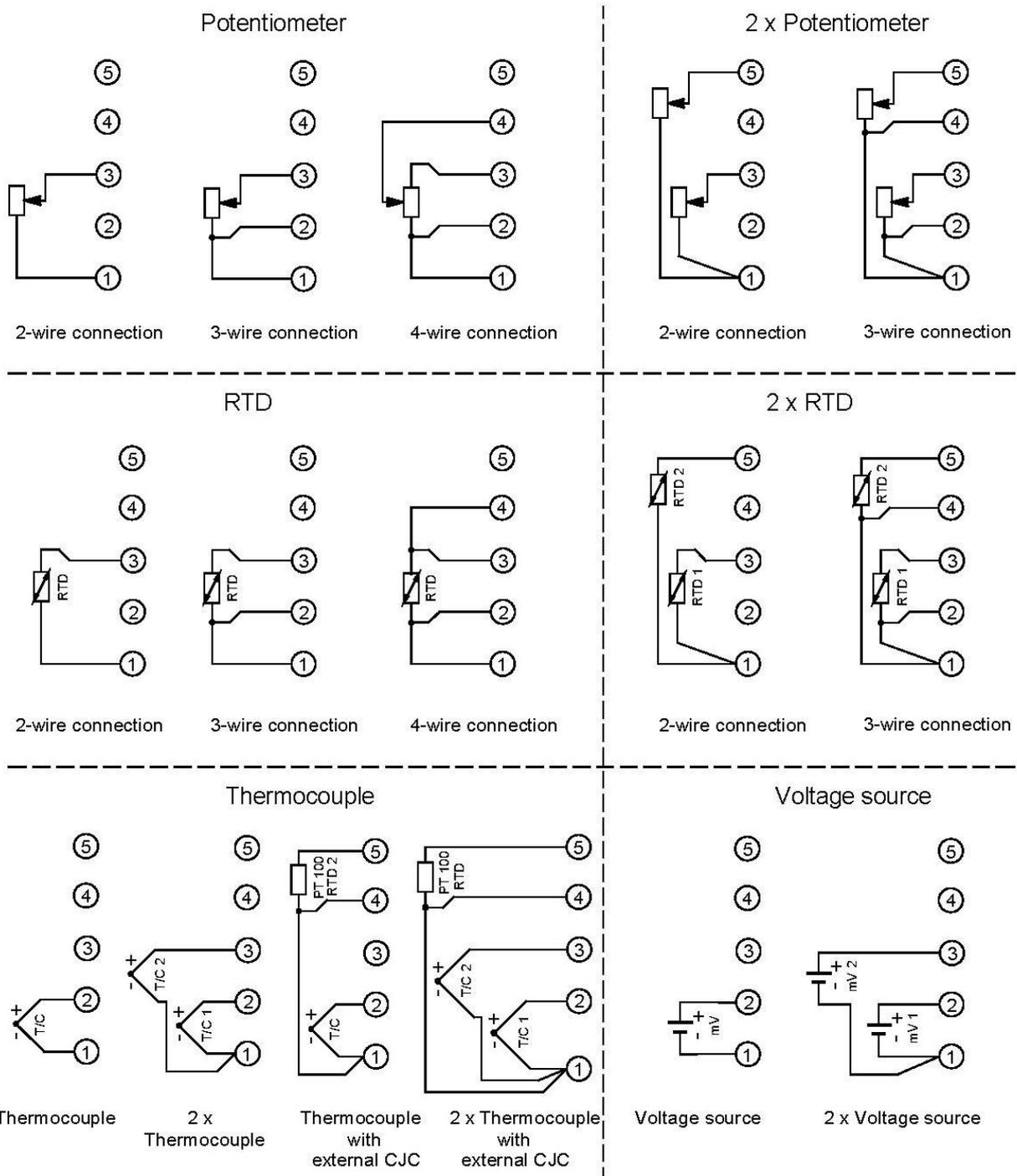


Figure 3. Methods of connecting sensors, potentiometers and voltage sources

7.1.2. Connection of transmitters with the option of using HART communication

The method of connecting a modem to transmitter for HART communication is shown in the figures below.



In order to communicate using connected HART modem to the “+” and “-” of transmitter terminals, make sure that the R_{Lmax} resistance viewed from the side of transmitter terminals towards power source is in the range of $240\ \Omega \leq R_{Lmax} \leq 1100\ \Omega$.

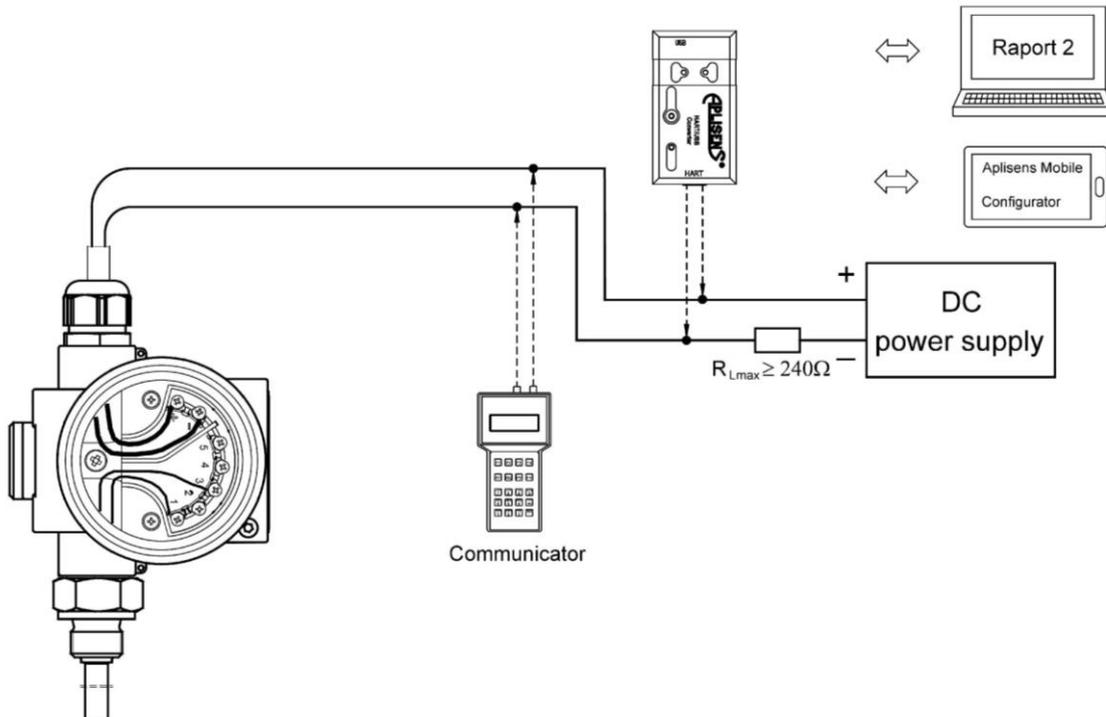


Figure 4. Electrical connection 4 ... 20 mA of HART to transmitters in standard version

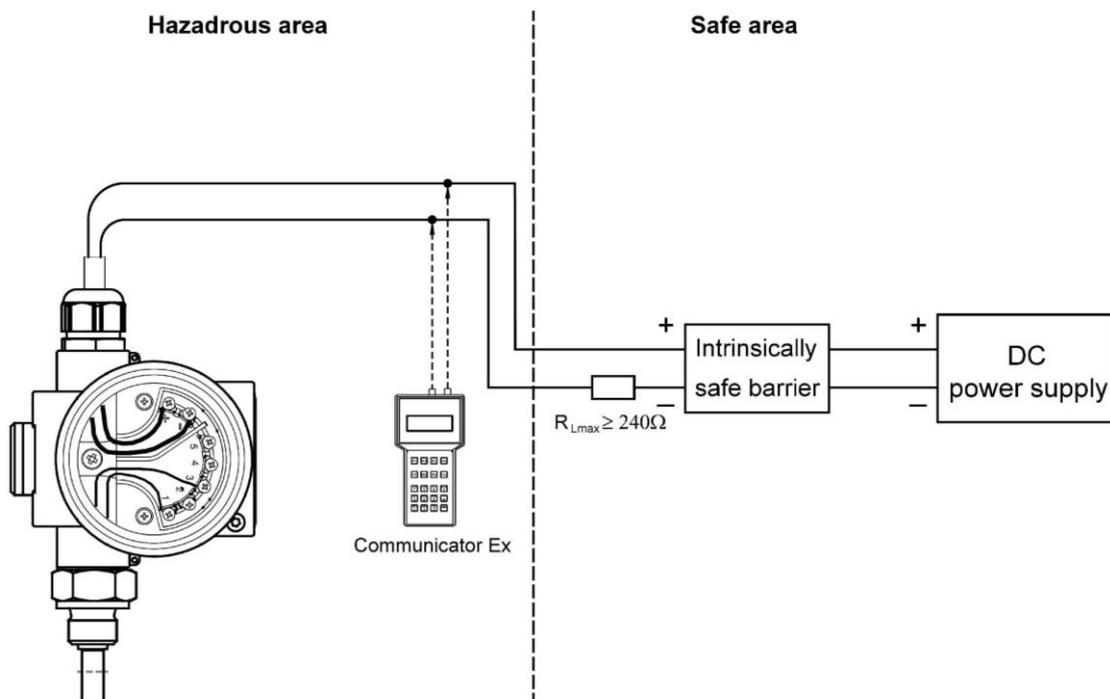


Figure 5. Electrical connection 4 ... 20 mA of HART to transmitters in Exi version

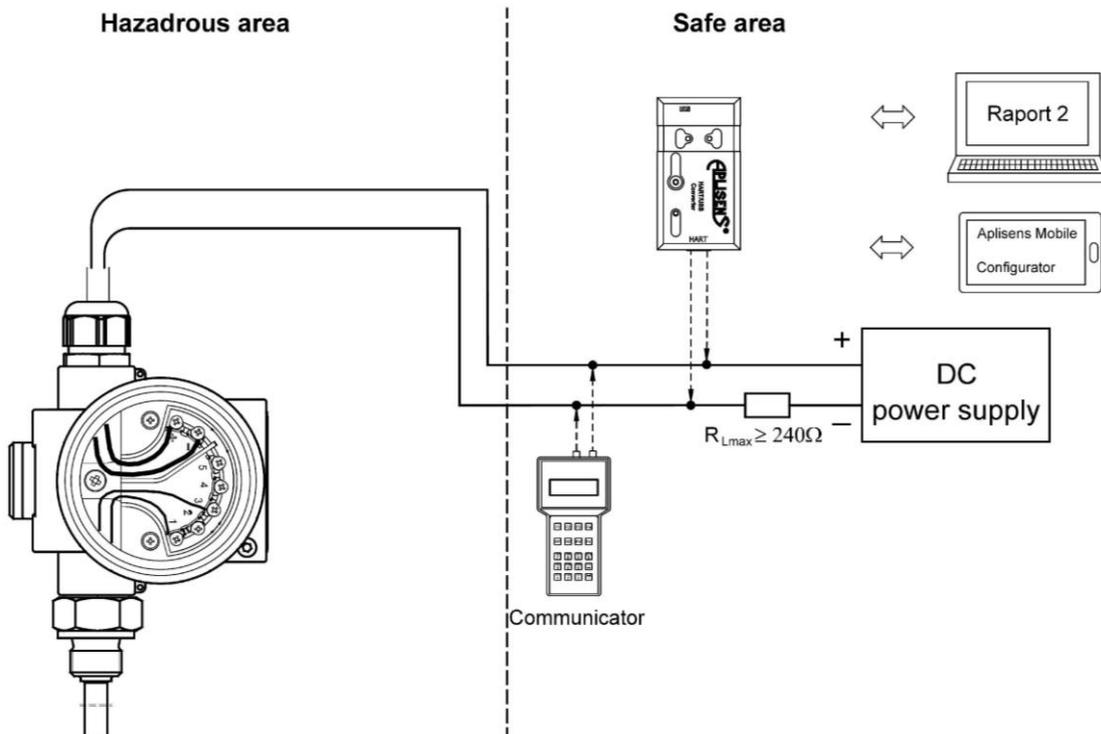


Figure 6. Electrical connection 4 ... 20 mA of HART to transmitters in Exd version



It is mandatory to read EN.IX.LI.24.ALW Explosion-proof Device User Manual, containing important information related to the installation of transmitters in intrinsically safe and flameproof versions.

The HART/USB converter by Aplisens S.A. may also be operated using **Aplisens Mobile Configurator** installed on smartphones with Android system and connected using wireless communication. The software is available on Google Play®:

<https://play.google.com/store/apps/details?id=com.aplisens.mobile.amc>.

7.2. Transmitter power supply

7.2.1. Transmitter supply voltage



Power cables may be live. In case of incorrect connection there is a risk of electric shock and/or explosion.



Installation of the transmitter in explosion-risk atmospheres must comply with the requirements of relevant instructions and national standards and regulations.

Table 3. Permissible transmitter supply voltages

Version	Minimum supply voltage	Maximum supply voltage
Standard, Exd*	12,5 V DC	36 V DC
Exi*	12,5 V DC	30 V DC

* For details on the intrinsically safe and flameproof versions, see manual EN.IX.LI.24.ALW.

7.2.2. Specifications of electrical switching terminals

The internal electrical connection terminals accept wires with a cross section of 0,5 to 1,75 mm². Internal and external electrical terminal of the body ground accepts wires with a cross-section from 0,5 to 4 mm².

Possible cables to be used:

- unshielded when using the analogue signal only;
- shielded, approved for the HART communication;
- shielded on the sensor(s) side for a cable length greater than 30 m.

7.2.3. Resistance load in power supply line

The power line resistance, power source resistance and other additional resistances connected in series increase the voltage drops between the power source and the transmitter terminals. The maximum transmitter current under normal operation conditions is defined as $I_{max} = 20,500 \text{ mA} + E$, where E is the permissible safe error equal to $\pm 0,320 \text{ mA}$.

The maximum resistance value in the power circuit (along with the power cables resistances) is defined by the formula:

$$R_{Lmax} \leq \frac{(U_{sup} - 12,5)[V]}{0,02082[A]}$$

where:

R_{Lmax} – maximum power line resistance [Ω],

U_{sup} – voltage at the supply terminals of 4 ... 20 mA current loop [V].

7.2.4. Shielding, equipotential bonding

Optimal protection against interference is provided by the earthing of the screen on both sides. In case of electrical potential difference between earthing points of devices which may result in the flow of equipotential currents, the screen shall be earthed on one side.

7.3. Final inspection of cabling

After completing the electrical installation of the transmitter, it is necessary to check the following:

- Does the supply voltage measured at the transmitter terminals at maximum set current match the range of supply voltage specified on the transmitter nameplate?
- Is the transmitter connected according to the information given in section [7.1. Cable connection to transmitter terminals](#)?
- Are all the screws tightened?
- Are the transmitter covers tightened?
- Is the cable gland tightened?

8. START-UP

Upon request, the customer receives a transmitter configured according to the setpoints specified in the order. The current base range and the basic unit of the transmitter can be read out from the device via the HART communication.

8.1. Alarm configuration

The LI-24ALW Safety transmitter features an advanced internal diagnostics resulting from the requirements of PN-EN 61508 standard. The internal diagnostics of the transmitter monitors the operation of its electronic circuits, process parameters and environmental parameters, thus ensuring an required level of functional safety. Diagnosed dangerous conditions or malfunctions of the internal transmitter systems result in setting alarm current $I_{AL} < 3,600$ mA. The user cannot disable diagnostics or change the alarm current value. The figure below shows the normal operation ranges of the transmitter process output as well as saturation and alarm current ranges.

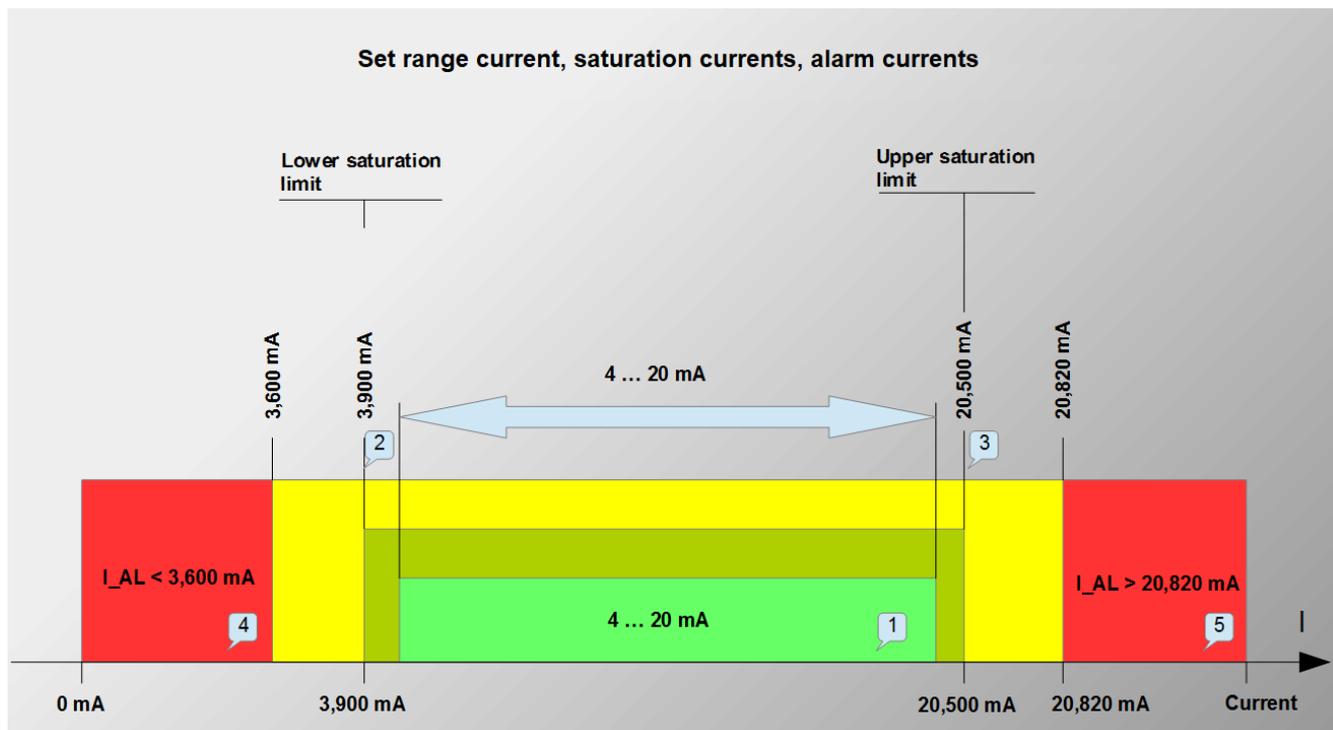


Figure 7. Set range current, saturation currents, alarm currents

- 1 – Set range current area 4 ... 20 mA corresponding to setpoint 0 ... 100% of the process output.
- 2 – Lower saturation current 3,900 mA.
- 3 – Upper saturation current 20,500 mA.
- 4 – Alarm current area $I_{AL} < 3,600$ mA for internal diagnostic alarms.
- 5 – Alarm current area $I_{AL} > 20,820$ mA for alarms related to safe failures with external diagnostics.



Temperature transmitters LI-24ALW Safety manufactured by Aplisens S.A. meet the alarm requirements Namur NE 89 and Namur NE 43.

The transmitter diagnostics continually tests the environmental parameters:

- temperature of the ADC converter that transforms the electric signal from the temperature sensor to the digital value of measurement;
- temperature of the CPU unit (transmitter's main microcontroller).

If the transmitter operating temperature limits are exceeded, the diagnostics will trigger alarm $I_{AL} < 3,600$ mA. The return of the temperature to permissible operating range of the transmitter will result in deactivation of the diagnostic alarm mode and return to its normal operation.

The transmitter diagnostics continually tests the process parameters of temperature measurement:

- if the value of measured process variable increases above the upper value of the base range URL, reaching UPL point, the diagnostics will trigger alarm $I_{AL} < 3,600$ mA;
- if the value of measured process variable decreases below the lower value of the base range LRL, reaching LRL point, the diagnostics will trigger alarm $I_{AL} < 3,600$ mA.

The return of the temperature into area between point LPL and point UPL will result in deactivation of the diagnostic alarm mode and return to its normal operation.

The transmitter diagnostics continually tests electric parameters and software resources of the transmitter:

- If the internal diagnostics detects malfunctions or failures of the transmitter that are not critical for integrity of hardware and software, the transmitter software will trigger alarm $I_{AL} < 3,600$ mA. The diagnostic alarm condition will persist until the malfunction or failure is resolved.
- If the internal diagnostics detects 20 unauthorised access attempts to protection codes of write operation or password change, the transmitter will trigger alarm $I_{AL} < 3,600$ mA. This state will persist until the transmitter software reset is performed or until power supply is disconnected and then reconnected.

Critical diagnostics:

- it detects RAM, FLASH, CPU errors and current mismatch in the current loop in alarm mode. The detected errors stop internal SIL watchdog refreshing, disable the internal transmitter power supply and trigger alarm current $I_{AL} \ll 3,600$ mA (nominal $I_{AL} < 0,300$ mA). To restore the operation of the transmitter after a critical alarm, it is required to disconnect the transmitter from its power supply temporarily and then reconnect it. The occurrence of a critical alarm with correct power supply parameters at the transmitter terminals usually indicates a serious malfunction of the transmitter. During a critical alarm, the transmitter LCD display is blank.

8.2. Configuration of the operating mode

Before starting the work with the transmitter, the following parameters must be configured:

- basic unit of the transmitter process variable;
- measurement input type (voltage/resistance);
- processing characteristics of measurement sensor (selection of sensor linearization characteristics);
- measurement sensitivity range (100 mV / 1000 mV or 400 Ω / 2000 Ω);
- type of sensor connections, number of terminals, CJC configuration (internal, external or none);
- type of the mathematical function processing the signal from two sensors (2x RTD 2-wire connection, 2x RTD 3-wire connection, 2x thermocouple, 2x thermocouple with external CJC (see [→ Figure 3. Methods of connecting sensors, potentiometers and voltage sources](#))):
 - difference of measurements from channels: Ch1-Ch2 or Ch2-Ch1;
 - measurement average: $0,5 \cdot (Ch1+Ch2)$;
 - minimum value of the two measurements: $\min (Ch1, Ch2)$;
 - maximum value of the two measurements: $\max (Ch1, Ch2)$.



In case of using the configuration with linearization, shorting one of the sensors results in triggering an alarm. This is due to the measurement going beyond the linearization table. In non-linearization configurations with resistance sensors, short circuits are undetectable.

- additional parameters such as offset of measuring channels or external compensation of sensor lead resistance;
- start point of the set range (LRV) in the basic unit;
- end point of the set range (URV) in the basic unit;
- damping time constant;
- analogue output processing characteristic mode;
- transmitter tag (TAG);
- setting the password for changing settings;
- setting the write lock after performing the configuration actions.

8.3. Metrological parameters, types of sensors, measuring ranges and errors

- User's processing characteristics.
- Input impedance, thermocouple or voltage input: > 10 MΩ.
- Additional error due to supply voltage changes: ± 0,002 %/V.
- Temperature impact compensation: 50-point at operating temperature range, segmental with linear approximation between points.
- Output updates time (calculation cycle): 0,74 ÷ 1,8 s.
- Additional electronic damping: 0 ÷ 30 s.

Table 4. Metrological parameters of RTD sensors

RTD sensor connected with 2, 3 or 4 wires						
Input – RTD						
Thermal resistance sensors:			2, 3 or 4 wires connection			
Sensor current:			~420 µA			
Maximum wires resistance:			25 Ω			
Sensor type	Standard	Basic range	Min. range span	Processing error Δp	Temperature processing error Δtp	Analogue output error
		[°C]	[°C]	[K]	[K/K]	[%]
1	2	3	4	5	6	7
Pt10 (α=0,003850)	PN-EN 60751+A2, IEC751, DIN43760, JISC 1604-97, BS 1904	-200÷850	10	±0,8	±0,035	Analogue output error is 0,05% FSO (Full Scale Output) over the operating temperature range.
Pt50 (α=0,003850)		-200÷850	10	±0,2	±0,0070	
Pt100 (α=0,003850)		-200÷850	10	±0,07	±0,0035	
Pt200 (α=0,003850)		-200÷850	10	±0,2	±0,0020	
Pt500 (α=0,003850)		-200÷850	10	±0,05	±0,0007	
Pt1000 (α=0,003850)		-200÷266	10	±0,03	±0,0003	
Pt98 (α=0,003923)	SAMA RC-4-1966	-200÷650	10	±0,07	±0,0035	
Ni100 (W100=1,617)	PN-83/M-53952	-60÷180	10	±0,07	±0,0030	
Cu100 (W100=1,426)		-50÷180	10	±0,07	±0,0030	
Pt10 (α=0,003916)	JIS C1604-81	-200÷630	10	±0,8	±0,035	
Pt50 (α=0,003916)		-200÷630	10	±0,2	±0,0070	
Pt100 (α=0,003916)		-200÷630	10	±0,07	±0,0035	
Pt10 (W100=1,3910)	GOST 6651-94	-200÷1100	10	±0,8	±0,035	
Pt50 (W100=1,3910)		-200÷1100	10	±0,2	±0,0070	
Pt100 (W100=1,3910)		-200÷1100	10	±0,07	±0,0035	
Pt500 (W100=1,3910)		-200÷900	10	±0,05	±0,00070	
Cu50 (W100=1,426)		-50÷200	10	±0,2	±0,0070	
Cu100 (W100=1,426)		-50÷200	10	±0,07	±0,0030	
Cu50 (W100=1,428)		-185÷200	10	±0,2	±0,0070	
Cu100 (W100=1,428)		-185÷200	10	±0,07	±0,0030	
Ni100 (W100=1,617)		-60÷180	10	±0,07	±0,0030	
Resistance (resistor, potentiometer)						
		[Ω]	[Ω]	[mΩ]	[mΩ/K]	As above
Measuring range 1		0 ... 400	10	±30	±2	
Measuring range 2		0 ... 2000	10	±120	±2	
1	2	3	4	5	6	7

Table 5. Metrological parameters of thermocouples

Thermocouples						
Input – Thermocouples						
Input impedance:		> 10 MΩ				
Maximum wires resistance:		500 Ω (wires + thermocouple)				
Cold junctions compensation:		internal sensor, external sensor Pt100, temperature constant of the cold junctions				
Sensor type	Standard	Basic range	Min. range span	Processing error Δp	Temperature processing error Δtp	Analogue output error
		[°C]	[°C]	[K]	[K/K]	[%]
1	2	3	4	5	6	7
B (Pt30Rh-Pt6Rh)	PN-EN 60751+A2, IEC584, NIST MN175, DIN43710, BS4937, ANSI MC96.1, JIS C1602, NF C42-321	500+1820	50	±0,55	< ±0,001	Analogue output error is 0,05% FSO (Full Scale Output) over the operating temperature range
E (Ni10Cr-Cu45Ni)		-150+1000	50	±0,15	< ±0,001	
J (Fe-Cu45Ni)		-210+1200	50	±0,20	< ±0,001	
K (Ni10Cr-Ni5)		-150+1372	50	±0,30	< ±0,001	
N (Ni14CrSi-NiSi)		-150+1300	50	±0,25	< ±0,001	
R (Pt13Rh-Pt)		50+1768	50	±0,35	< ±0,001	
S (Pt10Rh-Pt)		50+1768	50	±0,40	< ±0,001	
T (Cu-Cu45Ni)		-150+400	50	±0,15	< ±0,001	
TC Type L	GOST P 8.585-2001	-200+800	50	±0,20	< ±0,001	
Internal CJC sensor	-	-40+80	-	±[0,35+0,007 (T-273)]	< ±0,009	
Voltage						
		[mV]	[mV]	[μV]	[μV/K]	
Measuring range 1		-10 ... 100	10	±6	< ±0,06	As above
Measuring range 2		-100 ... 1000	10	±50	< ±0,5	
1	2	3	4	5	6	7

$$\Delta G[K] = \Delta p[K] + \Delta tp \left[\frac{K}{K} \right] \cdot TO[K] + TN[K] \cdot \frac{0,05[\%]}{100[\%]}$$

$$\Delta G[\%] = \frac{\Delta P[K] \cdot 100[\%]}{TN[K]} + \frac{\Delta tp \left[\frac{K}{K} \right] \cdot TO[K] \cdot 100[\%]}{TN[K]} + 0,05[\%]$$

ΔG – limiting error [K] or [%]

TN [K] – span of the measured temperature set range, algebraical difference between the upper and lower limit of the set range.

TO [K] – span of the transmitter ambient temperature range, algebraical difference between the upper and lower ambient temperatures (accepted as the boundary operating temperatures).

Table 6. Types of measurements, linearization and mathematical operations

Voltage measurements, TC type sensors Voltage measurement range: 0 ... 100 mV or 0 ... 1000 mV	
Linearization type / base range	Sensor type and CJC configurations
Linear / 0 ... 100 mV or 0 ... 1000 mV	1 x TC (voltage measurement)
Customised multi-section linear, 21 points / 0 ... 100 mV or 0 ... 1000 mV	2 x TC (voltage measurements)
Type B (IEC 584) / 250 ... 1820°C	1 x TC (without CJC)
Type E (IEC 584) / -200 ... 1000°C	1 x TC (internal CJC – PT100)
Type J (IEC 584) / -210 ... 1200°C	1 x TC (external CJC – PT100, 3-wire)
Type K (IEC 584) / -200 ... 1372°C	2 x TC (without CJC)
Type N (IEC 584) / -200 ... 1300°C	2 x TC (internal CJC – PT100)
Type R (IEC 584) / -20 ... 1768,1°C	2 x TC (external CJC – PT100, 3-wire)
Type S (IEC 584) / -30 ... 1768,1°C	
Type T (IEC 584) / -200 ... 400°C	
Type L (GOST P 8.585-2001) / -200 ... 800°C	
Resistance measurements, RTD type sensors Resistance measurement range: 0 ... 400 Ω or 0 ... 2000 Ω	
Linearization type/base range	Sensor type configurations
Linear / 0 ... 400 Ω or 0 ... 2000 Ω	1 x RTD 2 x Wire
Custom multi-section linear, 21 points / 0 ... 400 Ω or 0 ... 2000 Ω	1 x RTD 3 x Wire
PT10 α=0,003850 (IEC 751) / -200 ... 850°C	1 x RTD 4 x Wire
PT10 α=0,003916 (JIS C 1604-81) / -200 ... 630°C	2 x RTD 2 x Wire
PT10 W100=1,3910 (GOST 6651-94) / -200 ... 1100°C	2 x RTD 3 x Wire
PT50 α=0,003850 (IEC 751) / -200 ... 850°C	
PT50 α=0,003916 (JIS C 1604-81) / -200 ... 630°C	
PT50 W100=1,3910 (GOST 6651-94) / -200 ... 1100°C	
PT100 α=0,003850 (IEC 751) / -200 ... 850°C	
PT100 α=0,003916 (JIS C 1604-81) / -200 ... 630°C	
PT100 W100=1,3910 (GOST 6651-94) / -200 ... 1100°C	
PT200 α=0,003850 (IEC 751) / -200 ... 850°C	
PT500 α=0,003850 (IEC 751) / -200 ... 850°C	
PT500 W100=1,3910 (GOST 6651-94) / -200 ... 900°C	
PT1000 α=0,003850 (IEC 751) / -200 ... 266°C	
PT98 α=0,003923 (SAMA RC-4-1966) / -200 ... 650°C	
NI100 W100=1,617 (GOST 6651-94) / -60 ... 180°C	
NI100 W100=1,617 (PN-83/M-53952) / -60 ... 180,5°C	
CU50 W100=1,426 (GOST 6651-94) / -50 ... 200°C	
CU50 W100=1,428 (GOST 6651-94) / -185 ... 200°C	
CU100 W100=1,426 (GOST 6651-94) / -50 ... 200°C	
CU100 W100=1,428 (GOST 6651-94) / -185 ... 200°C	
CU100 W100=1,426 (PN-83/M-53952) / -50 ... 180,5°C	
Mathematical operations to be set for CH1 and CH2 channels	
PV – first process variable mapped in the process current value of the 4 ... 20 mA current loop PV = CH1 PV = CH2 PV = CH1-CH2 PV = CH2-CH1 PV = (CH1+CH2)/2 PV = min(CH1,CH2) PV = max(CH1,CH2)	

9. OPERATION

The transmitter has the ability to adjust the display position to the mounting position of the body. The module can be rotated by an angle of $\pm 180^\circ$ with 90° step. To do this, unscrew the cover (with the glass) of the transmitter body, unscrew the two fastening screws, pull the module towards you by the fastening screws. Rotate the extended display module and slide it back into the lower housing of the display electronics assembly, then tighten the fastening screws.

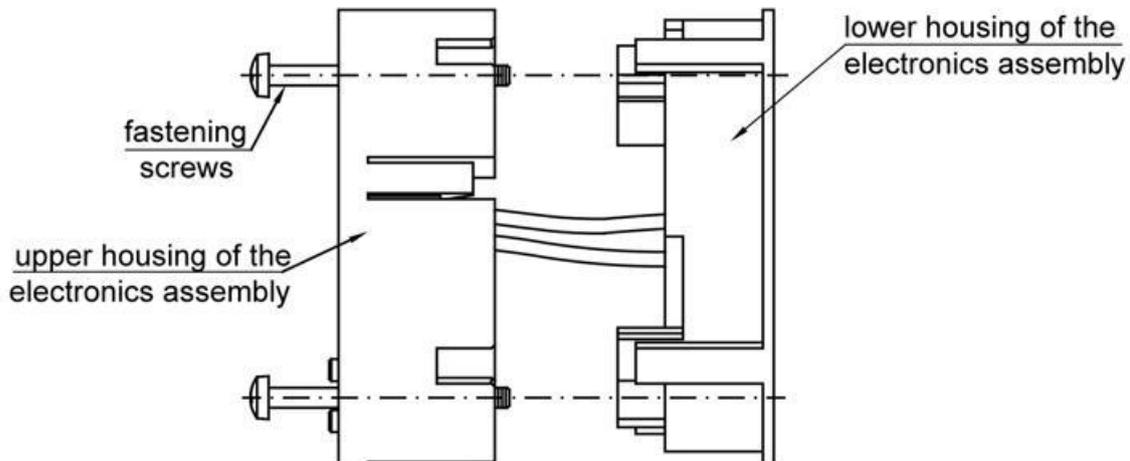


Figure 8. View of disassembled display unit

The programmable display is intended to illustrate the quantities measured during the measurement process. These can be process variables of the measured temperature, current in the current loop or other quantities converted from the process variable of current to user units. The display indication is based on the measurement of the regulated current in the 4 ... 20 mA current loop by the LI-24ALW Safety transmitter.

Features of the LI-24ALW Safety display:

- serial operation in the loop of the transmitter output signal 4 ... 20 mA;
- digital signal processing (filtering, readout rounding);
- displaying values in units of the measured quantity or current;
- linear dependence of the indication value on the current in current loop.

9.1. Display configuration

The user can change the display settings using the buttons below the display. The buttons can be accessed by unscrewing the display cover. The buttons are marked with symbols: [\downarrow], [\uparrow] and [\bullet].

The buttons [\downarrow], [\uparrow] are used to move up and down the MENU structure, and the button [\bullet] confirms and executes the selected option. Pressing and holding any button for about 4 seconds will cause enter to the local setting mode, and the following message "EXIT" appears on the display in the field LCD3. No activity in the MENU area for longer than 2 minutes automatically exits the local setting mode and goes to display process variable. After confirming the selected parameter, the display will confirm the acceptance of the command with a "DONE" message. The " \leftarrow BACK" button allows to move up a level higher in the MENU structure.

The way of navigating in the MENU structure of the local display is shown in the diagram below.

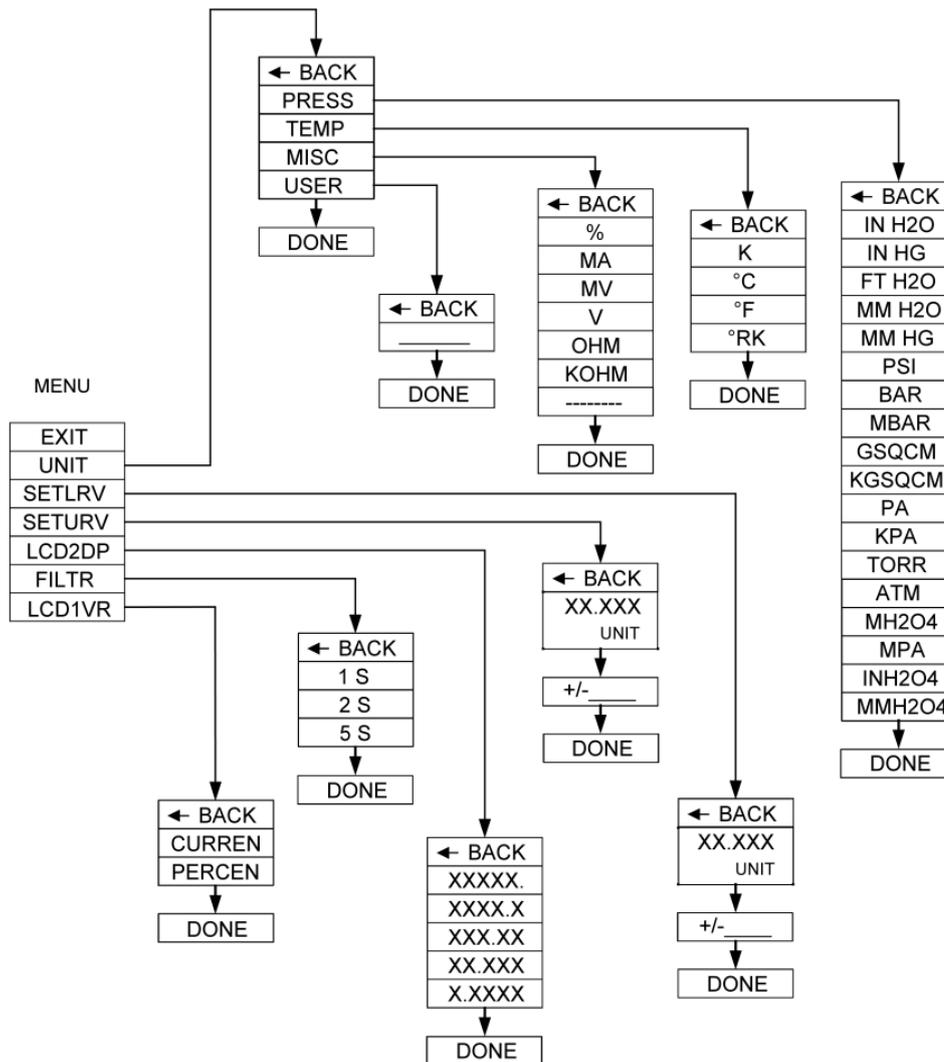


Figure 9. Structure of the local setpoints MENU

Table 7. Structure of the local setpoints MENU

Local MENU		Description
EXIT		Return from local MENU to display the process variable.
UNIT		Set up of units.
	PRESS	Switching to the selection of pressure units.
	TEMP	Switching to the selection of temperature units.
	MISC	Switching to the selection of different units.
	USER	Switching to the user's units entry.
	_____	Enter the user's unit name (six alphanumeric characters). Buttons "↑" or "↓" are used to select alphanumeric character of the entered unit. Selection of successive character comes after confirmation of the previous character (by pressing [●] button). After confirmation of the last (6th) character, the device will confirm the command with "DONE" message or report an error number.
SET LRV / SET URV		<p>Function allows to assign the given values corresponding to the output signals 4 and 20 [mA]. Value after linear scaling is displayed in the LCD2 field. User can set any value of start and end of the range. By default, the LCD2 field displays the percentage of the measured range.</p>

		Table. Exemplary settings LRV, URV			
		Unit	LRV	URV	LCD2
		mA	4	20	Current in current loop
		%	0	100	Setpoint percentage of output – default set
		Measurement range unit (e.g. °C)	Range beginning (e.g. 0)	Range end (e.g. 100)	Measured physical value (e.g. temperature)
	XX.XXX UNIT	Actual value of start and end of the displayed range will be presented. Confirmation of this option allows to assign the given value to the start and end of the displayed range.			
	+/- _____	Entering value of set range. Buttons “↑” or “↓” are used to select sign (“+” or “-”). Selection of successive digit comes after confirmation of the previous one (by pressing [●] button). Changing the digit or setting a comma is made using button “↑” or “↓”. After confirmation of the last (6th) character, the device will confirm the command with “DONE” message or report an error number. Parameter is entered in UNIT units.			
LCD2DP		Change the position of the decimal point of variable presented in the LCD2 field of the display.			
FILTR		Selection of averaging time of displayed process variable.			
LCD1VR		Type of process variable presented in the LCD1 field of the display.			
	CURREN	Value of current in current loop will be presented in the LCD1 field of display.			
	PERCEN	Percentage value of input setpoint will be presented in the LCD1 field of display.			

The LI-24ALW Safety display should be configured after changing the measuring range or the basic unit of the LI-24ALW Safety transmitter via HART communication.



The LI-24ALW Safety display works correctly for the transmitter current output set in the linear processing characteristic mode. Otherwise, the indication on the display may not be correct.

The LI-24ALW Safety display is factory set to the unit and set range of the transmitter in accordance with the customer's order. In the absence of these parameters in the order specification, the display is factory set to indicate the value of the current measured in the current loop in milliamperes.

9.2. Local MENU, error messages

During the execution of some functions in the local MENU, the EXXXX error message (letter “E” and 4 digits of the error code) may be displayed on the LCD2 field. Displaying an error means that the local MENU command was not carried out. The persistence of the error message for a long time proves the display is damaged or not working properly. Errors in the display or incorrect configuration of the display do not affect the value of the current process variable in current loop.

9.3. View of local LCD display

Display options can be changed in local MENU using buttons. The display is shown in the figure below.

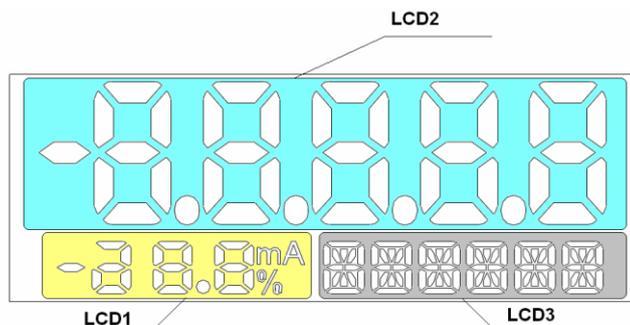


Figure 10. Display information fields

There are three basic fields on the display:

- **LCD1** – field used to display value of current or setpoint percentage of preset range. Depending on the display configuration, it will be displayed the current value in the current line 4 ... 20 mA with a resolution of 0,1 mA or setpoint percentage of the preset range with an indication resolution of 1%.
- **LCD2** – field used to display the measured digital value, the value rescaled by user's units and error codes. The position of the decimal point can be set in the local MENU or remotely.
- **LCD3** – information field. During normal operation it is designed for continuous display of the base unit or the user's units. In the MENU of local setup it displays the setting options. It is also used to display errors related to the execution of commands in the local setup MENU.

9.4. Basic technical parameter of the display

Electrical parameter: input signal: 4 ... 20 mA
 Metrological parameters: indication error: 0,2 % ± 1 digit

9.5. Operating temperature

Standard version	Exi, Exd version
-40 ... 85°C (-40 ... 185°F)	-40 ... 75°C (-40 ... 167°F)

9.6. Remote configuration of setpoints (HART)

The transmitter allows to read and configure parameters via HART communication using a 4 ... 20 mA loop as the physical layer for FSK BELL 202 modulation.

9.6.1. Compatible devices

The following devices may be used to communicate with the transmitter:

- HART/USB converter by Aplisens S.A. or converter HART/RS232;
- PC computers equipped with HART modem (e.g. HART/USB converter by Aplisens S.A.) with Windows 7 or Windows 10 operating system with installed Raport 2 software;
- PC computers equipped with HART modem using software from other companies, accepting DDL and DTM libraries;
- smartphones with Android system, using a converter providing wireless communication (e.g. HART/USB converter by Aplisens S.A.) using Aplisens Mobile Configurator software. The software is available on Google Play under the link:

<https://play.google.com/store/apps/details?id=com.aplisens.mobile.amc>.

9.6.2. Compatible configuration software

- Raport 2 Aplisens under control of Windows 7 or Windows 10;
- Aplisens Mobile Configurator under control of the Android system;
- every software from other companies accepting DDL and DTM libraries.

9.6.3. Method of connecting communication devices

The method of connecting communication devices to the transmitter is described in chapter → 7.1.2. [Connection of transmitters with the option of using HART communication](#). When using remote communication, the HART modem must be connected in parallel to the 4 ... 20 mA line. A resistance of ≥ 240 Ω is required between the power supply and the modem connection point. Also follow the guidelines for maximum load resistance R_{Lmax} described in section → 7.2.3. [Resistance load in power supply line](#). When using measuring cards with an integrated HART master, the card manufacturer's regulations must be followed.

10. MAINTENANCE

10.1. Periodic inspections

Periodic inspections shall be carried out in accordance with applicable standards. During the inspection, check the condition of electrical terminal connections (reliability of the connections) and the stability of transmitter mounting.

10.2. Non-periodic inspections

If the transmitter at the installation site has been exposed to mechanical damage, overvoltage or incorrect operation of the transmitter is detected, the device shall be inspected.



If there is no signal in the transmission line or its value is improper, check the supply line, connection status on terminal blocks, connectors, etc. Check if the supply voltage and load resistance are correct.

10.3. Spare parts

Parts of the transmitter that may be worn or damaged and thus replaced: cover gaskets.



Other parts in case of SIL, ATEX types of transmitters may be replaced only by the manufacturer or an authorized representative.

10.4. Repair

Faulty or non-operational transmitter shall be provided to the manufacturer.

10.5. Returns

In the following cases, the transmitter should be returned directly to the manufacturer:

- need for repair;
- need for factory calibration;
- replacement of improperly selected/shipped transmitter.

11. SCRAPPING, DISPOSAL



Worn or damaged devices shall be scrapped in accordance with WEEE Directive (2012/19/EU) on waste electrical and electronic equipment or returned to the manufacturer.

12. HISTORY OF REVISIONS

Revision No.	Document revision	Description of changes
-	01.A.001/2021.04	First version of the document. Prepared by DBFD.