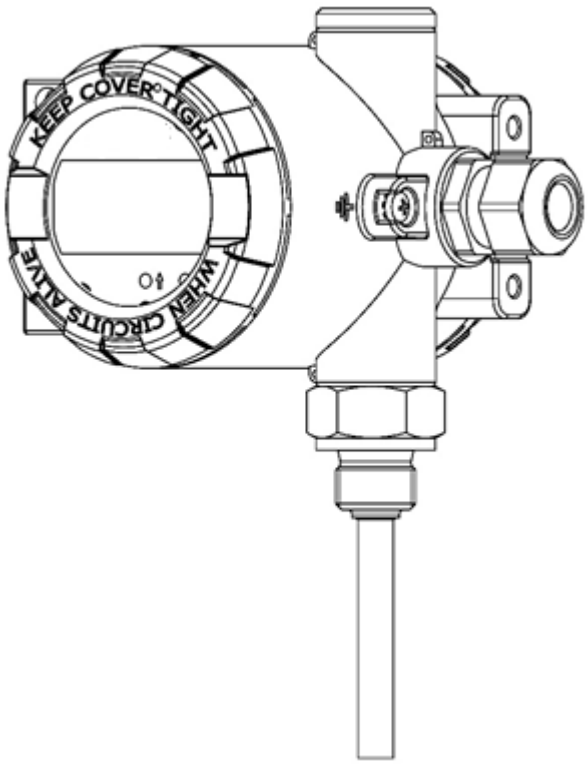
USER'S MANUAL

TEMPERATURE TRANSMITTER

LI-24ALW



APLISENS S.A., 03-192 Warsaw, Morelowa 7 St,
tel. +48 22 814 07 77; fax +48 22 814 07 78
www.aplisens.com, e-mail: export@aplisens.com

PRODUCT CODE – see (➔ 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, explosion-proof device user manual, declarations of conformity and copies of certificates.

LI-24ALW

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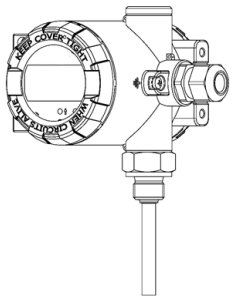

LI-24ALW (Exi)

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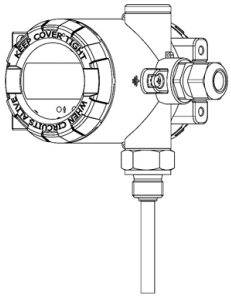

LI-24ALW (Exd)

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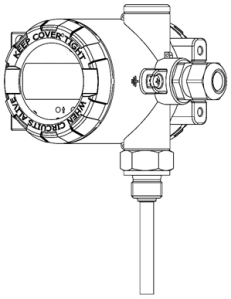

Symbols used

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 rail-mounted smart temperature transmitters **LI-24ALW,** 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.

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 version 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.

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 (➔ 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 of transmitters 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;
- It is not allowed to tear or damage the protective seal on the housing.

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 a room without vapours and aggressive substances, protected against mechanical impact.

Allowable range of storage temperature:
-40…80°C (-40...176°F).

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 1. Symbols occurring on the transmitter nameplate.

APLISENS S.A.	**Logo and name of manufacturer**
CE	CE mark
CE 1453	CE mark with the number of notified body
	QR code
TYPE:	Transmitter type
ID	Transmitter model ID
	Types of measurement input
U	Supply voltage values
Tamb	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
Aplisens 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 standards, 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. CONSTRUCTION

6.1. Construction

The basic transducer assemblies are the housing and the electronic assembly converting the signal from the measuring sensor into a unified output signal. The electronics main board with display is placed in a polycarbonate cover. This assembly is located in a larger housing chamber, where it can be rotated ±180° every 90°. This allows you to change the position of the display. In the second chamber there is a connecting plate, also protected by a polycarbonate-nu cover, with connection terminals.

6.2. Measurement principle

Signal from the measuring sensor, i.e. thermometric resistor or measuring junction of the thermocouple, corresponding to the measured temperature of the medium, is sent to the input of the analogue-digital transmitter and converted to digital signal. The digital signal is sent via the optoelectronic galvanic barrier to the main board. Microcontroller of the main board reads the measured values and uses the incorporated algorithms to calculate the precise temperature. The resulting value is displayed on the integrated LCD display which can be configured according to the user's needs . Digital value of the measured temperature is converted to analogue signal of 4...20 [mA]. The integrated modem BELL 202 and the implemented communication stack, HART rev 5.1, enable communication with the transmitter via converter connected to a PC computer and appropriate software or via communicator. The transmitter is provided with an output interference filter and overvoltage protection components. Fig. 1 shows the block diagram of the transmitter. LI-24ALW transmitter monitors its hardware resources and calculation accuracy. In case of a failure the transmitter specifies an error code on the LCD display and generates alarm current in the current loop. Measuring signal from the sensor is isolated galvanically from the current line. As a result the transmitter is less susceptible to interference and provides better safety of work in intrinsically safe applications.

7. INSTALLATION

7.1. General recommendations

Temperature transmitter LI-24ALW 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.

8. ELECTRICAL CONNECTION

8.1. Cable connection to transmitter terminals

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.

8.1.1. Cable connection

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

- disconnect power supply of the supply cable line before connecting the transmitter cabling;
- unscrew the rear cover of the transducer body in order to gain access to the power supply, measurement terminals and the internal ground terminal;
- 4...20 mA current loop power supply and signal cables should be properly connected to the "+", "-" terminals;
- connect the transmitter in accordance with figures below and section ➔8.1.2, 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 glands nut so that the gland seal tightens on the power cable.

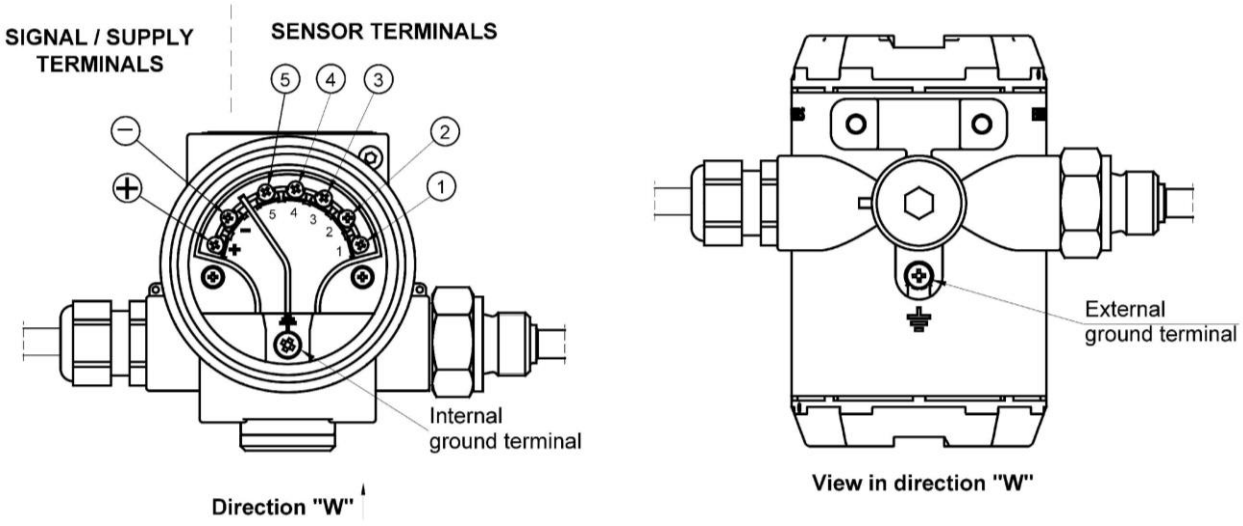


Figure 1. Marking of the LI-24ALW terminals.

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

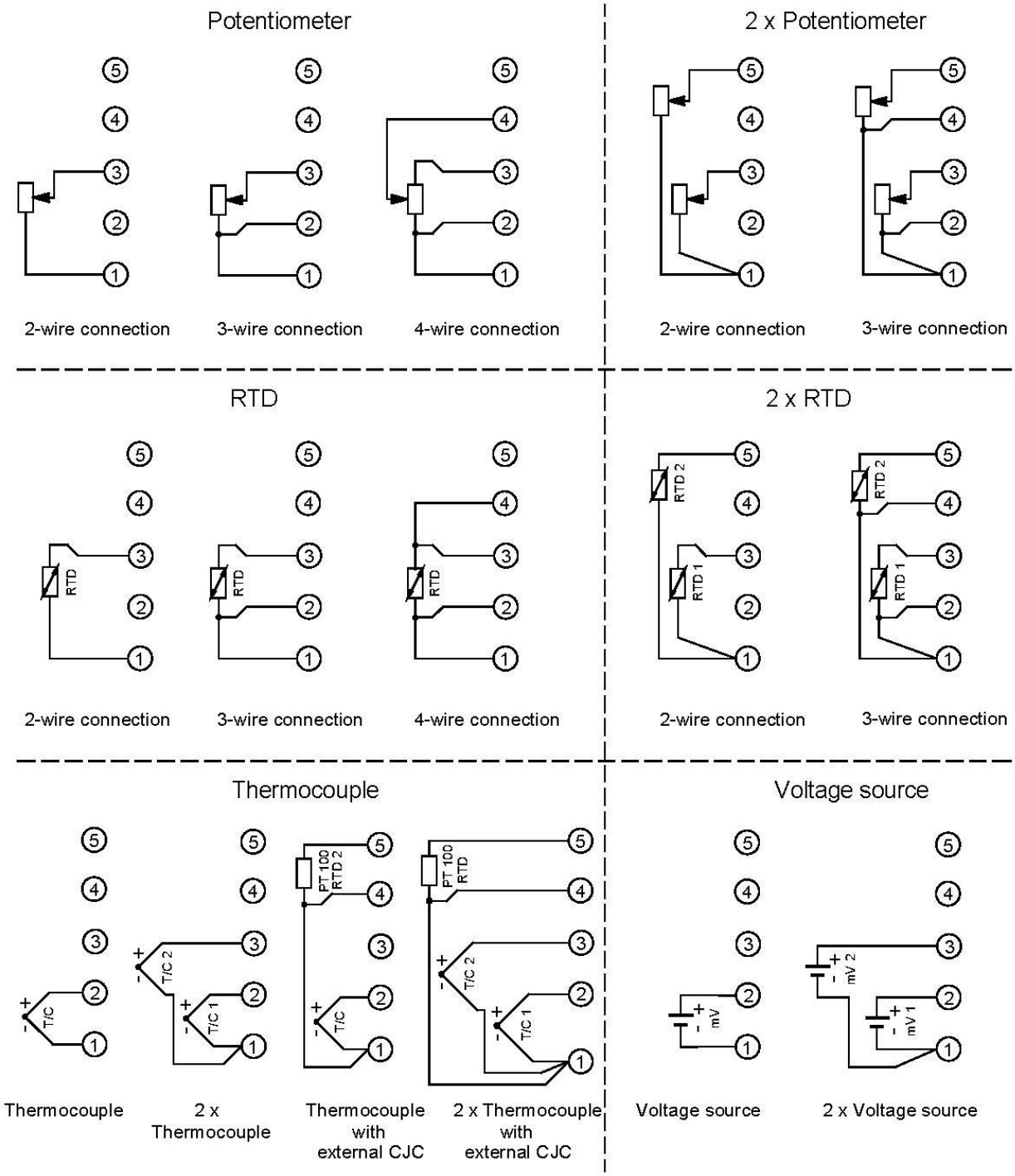


Figure 2. Methods of connecting sensors, potentiometers and voltage sources.

8.2. 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 transmitter ''+'' and ''-'' terminals, make sure that the R_{Lmax} resistance viewed from the side of transmitter terminals towards power source is in the range of 240 Ω ≤ R_{Lmax} ≤ 1100 Ω.

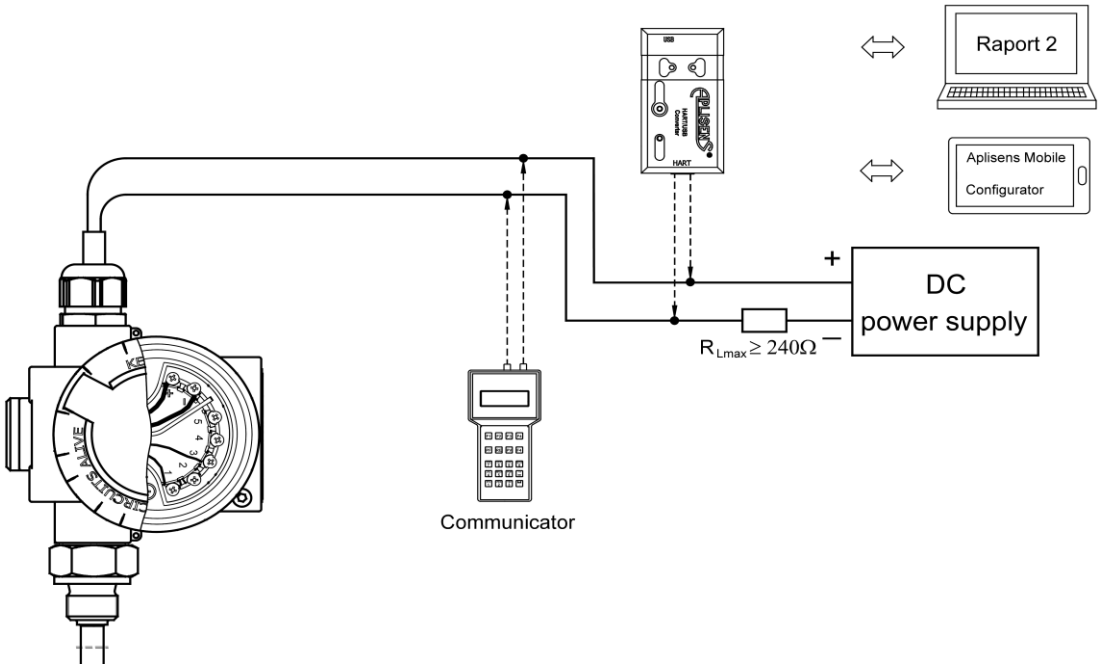


Figure 3. Electrical connection 4…20 mA of HART to transmitters in standard version.

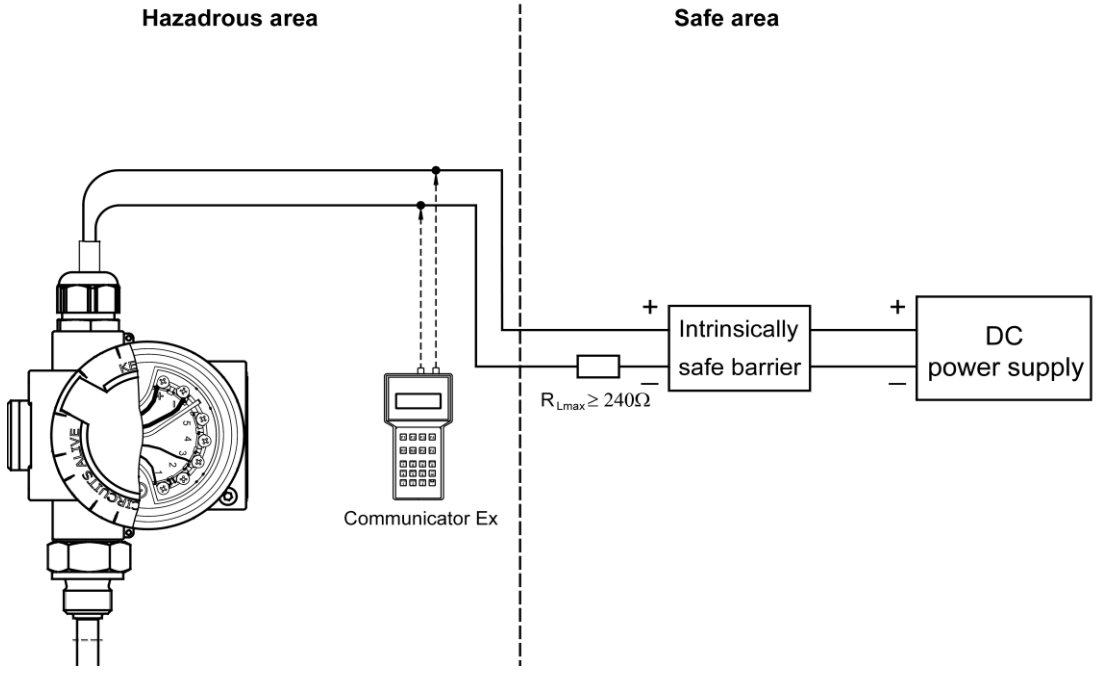


Figure 4. Electrical connection 4...20 mA of HART to transmitters in Exi version.

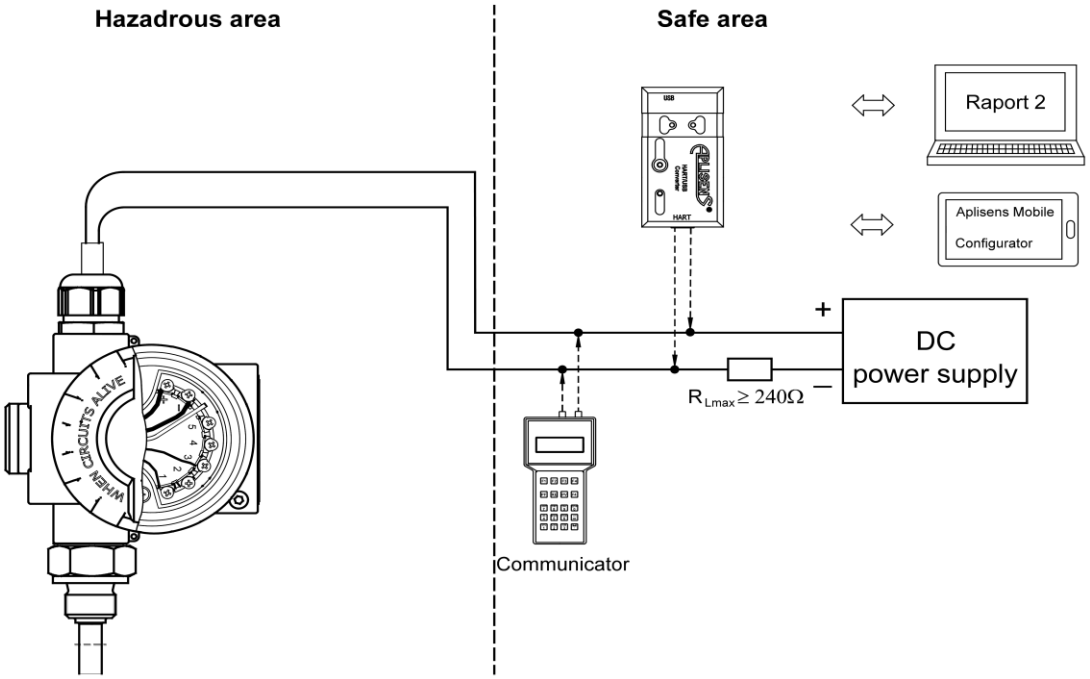


Figure 5. Electrical connection 4...20 mA of HART to transmitters in Exd version.

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 version.

The converter 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

8.3. Transmitter power supply

8.3.1. 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 2. Permissible transmitter supply voltages.

Version	Minimum supply voltage	Maximum supply voltage
Standard	**13,5 V DC**	**55 V DC**
	16,5* V DC	**55 V DC**
Exi	**13,5 V DC**	**30 V DC**
	16,5* V DC	**30 V DC**
Exd	**13,5 V DC**	**45 V DC**
	16,5* V DC	**45 V DC**
* Minimum supply voltage with backlight on. The backlight can only be switched on at the production stage of the transducer.		

8.3.2. Specifications of electrical switching terminals

The internal electrical connection terminals accept wires with a cross section of 0.5 to 1.75 mm^2. Internal and external electrical terminal of the body ground accepts wires with a cross-section from 0.5 to 4 mm^2 .

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 or over-normative radio interference.

8.3.3. 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 = 21,600 mA (the maximum possible current value issued by the user is 23,00 mA).
The maximum resistance value in the power circuit (along with the power cables resistances) is defined by the formula:

$$R_{Lmax} \leq \frac{(Usup - Umin\ )\ [V]}{0{,}0235\ [A]}$$

where:
U_{sup} – voltage at the supply terminals of 4…20 mA current loop [V].
U_{min} – minimum supply voltage.
R_{Lmax} – maximum power line resistance [Ω].

8.3.4. Shielding, equipotential bonding

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

8.4. 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 (➔Cable connection to transmitter terminals);
- Are all the screws tightened;
- Are the cable terminals tightened;
- Is the cable gland tightened.

9. 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.

9.1. Alarms

The alarms signal hardware faults, calculation errors or exceeding the permissible operating ranges of the transmitter. Internal hardware faults include e.g. RAM and FLASH memory failures, damage to the internal oscillator, opto-isolation interface, ADC measurement converter, internal HART modem. External malfunctions are related to damage or improper connection of measurement sensors to the transmitter. Transmitter operating temperature ranges are exceeded.
The errors are manifested by the transmitter issuing an alarm current in the line and signalling an error code on the display. The alarm current values can be set using the program Raport 2 or by ordering an appropriate alarm configuration in the transmitter from the supplier.

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

Table 3. Type and level of alarms.

Type of alarm	Value of the alarm current
NORMAL LOW	3,75 mA
NORMAL HIGH	21,6 mA
NAMUR LOW	3,6 mA
NAMUR HIGH	21,0 mA

Type of alarm	Value of the alarm current
CUSTOM (user's alarm current value).	Alarm current value in the range from 3.6 mA to 23 mA.
LAST VALUE (no analogue output update).	The value of the alarm current shall be equal to the value of the current at the moment preceding the triggering event.

9.2. 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);
- measurement sensor processing characteristics (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 (2 x RTD 2-wire connection, 2 x RTD 3-wire connection, 2 x thermocouple, 2 x thermocouple with external CJC (see ➔**Figure 2**. Methods of connecting sensors, potentiometers and voltage sources.)):
  - difference of measurements from channels: Ch1-Ch2 or Ch2-Ch1;
  - measurement average: 0,5 (Ch1+Ch2);
  - measurement average with redundancy: 0,5 · (Ch1+Ch2) or Ch2 or Ch1, when one of the sensors is damaged. Redundancy corresponds to the following variants of the sensors connection: 2 x RTD 2-wire connection, 2 x RTD 3-wire connection, 2 x thermocouple, 2 x thermocouple with external CJC (alarm deactivation is required);
  - 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 compensation of sensor lead resistance;
- start point of the set LRV range in the basic unit;
- end point of the set URV range in the basic unit;
- damping time constant;
- analogue output processing characteristic mode;
- transmitter tag (TAG);
- setting of the password for the settings change lock;
- setting of the write lock after performing the configuration actions.

9.3. 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 points 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	
Pt 98 (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 Maximum wires resistance Cold junctions compensation				>10 MΩ 500 Ω (wires + thermocouple) 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 Typ 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]	As above
Measuring range 1		-10…100	10	±6	<±0.06	
Measuring range 2		-100…1000	10	±50	<±0.5	
1	2	3	4	5	6	7

ΔG – limiting error [K] or [%]

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

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

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.

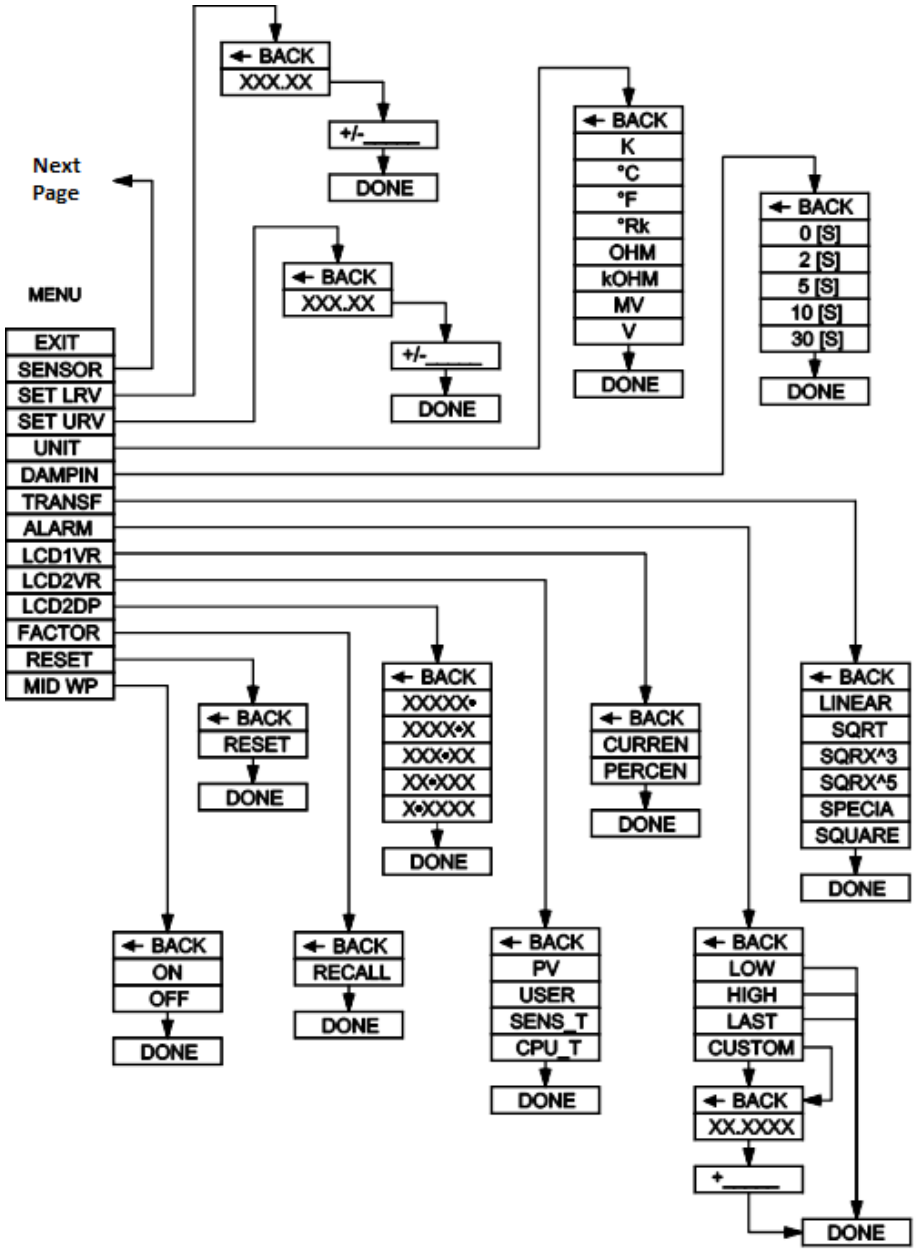
Voltage measurements, TC type sensors. Voltage measurement range 0...100 mV or 0...1000 mV	
Linearization type/base range	Sensor type and CJC configurations
Linear/0...100 mV or 0...1000 mV	1 x TC (voltage measurement); 2 x TC (voltage measurements); 1 x TC (without CJC); 1 x TC (internal CJC – PT100); 1 x TC (external CJC – PT100, 3-wire); 2 x TC (without CJC); 2 x TC (internal CJC – PT100); 2 x TC (external CJC – PT100, 3-wire)
Customised multi-section linear, 21 points/0...100 mV or 0...1000 mV	
Type B (IEC 584)/250... 1820 °C	
Type E (IEC 584)/-200... 1000 °C	
Type J (IEC 584)/-210... 1200 °C	
Type K (IEC 584)/-200... 1372 °C	
Type N (IEC 584)/-200... 1300 °C	
Type R (IEC 584)/-20... 1768.1 °C	
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 1 x RTD 3 x Wire 1 x RTD 4 x Wire 2 x RTD 2 x Wire 2 x RTD 3 x Wire
Custom multi-section linear, 21 points/0...400 Ω or 0...2000 Ω	
PT10 α = 0.003850 (IEC 751)/-200... 850 °C	
PT10 α = 0.003916 (JIS C 1604-81)/-200... 630 °C	
PT10 W100 = 1.3910 (GOST 6651-94)/-200... 1100 °C	
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=(CH1+CH2)/2 or CH1 if CH2 fails or CH2 if CH1 fails; PV = min(CH1, CH2); PV = max(CH1, CH2).	

10. OPERATION

The programmable display is designed to shows the values measured during the measurement process. These can be process variables of the measured temperature, current in the current loop or other values converted from the process current variable to the user's units.

10.1. Display configuration

The user can change some transmitter settings, including the display using the buttons below the display. The buttons can be accessed by unscrewing the display cover. The buttons are marked with symbols: [↓], [↑] and [●].
The buttons [↓], [↑] are used to move up and down the MENU structure, and the button [●] 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 "← 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.



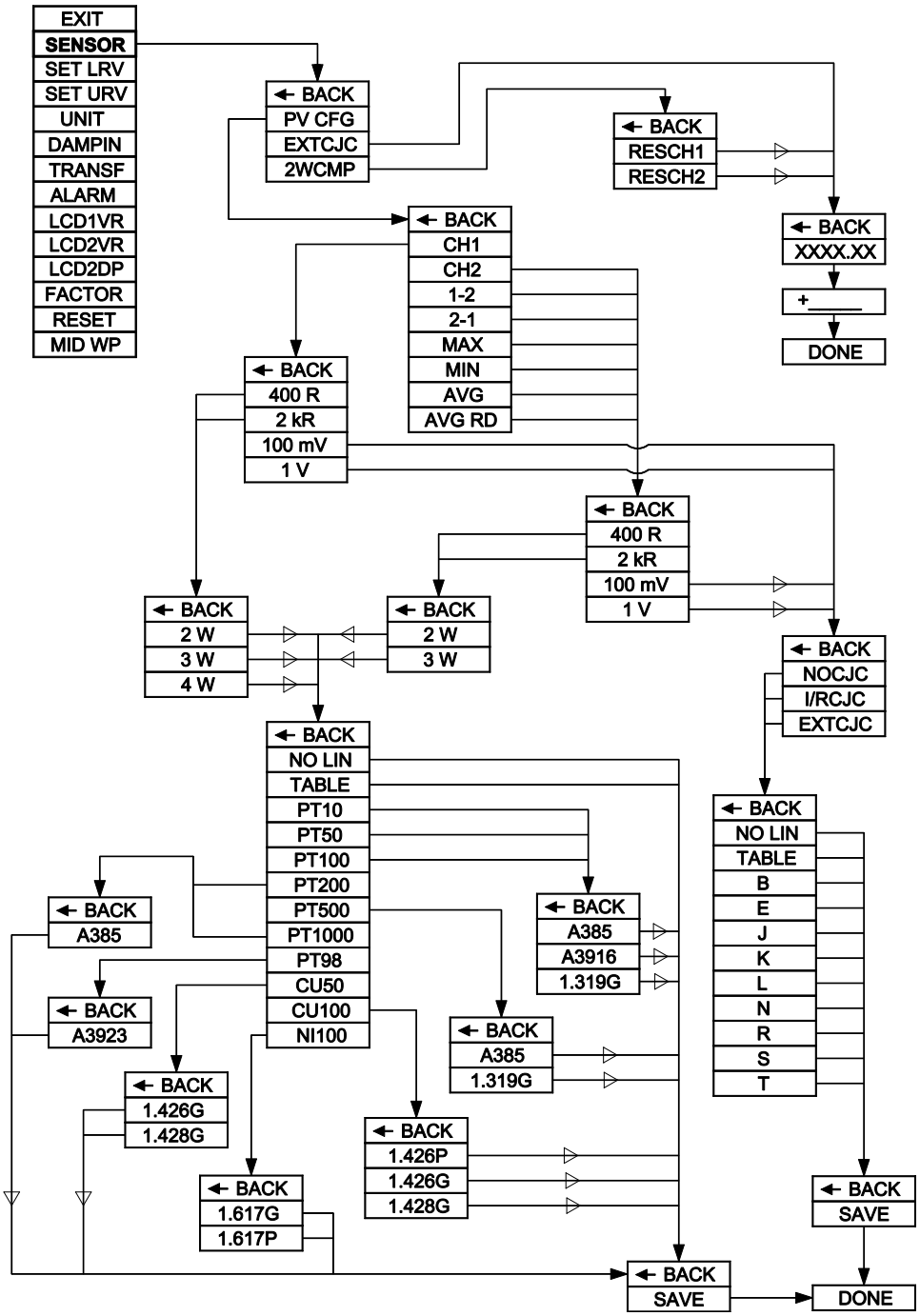


Figure 6. Structure of the local setpoints MENU.

Local Menu	Submenu	Description
EXIT		Return from the Local Menu to display the process variable
SET LRV / SET URV		Setting the start of the range set to LRV / Setting the finish of the range set to URV
	XXX.XX	The current LRV/URV value is displayed
	+/-_____	Select and confirm the sign of the parameter to be entered; enter digit by digit, 5-digit number with or without a dot; after confirming the last 5 digits of the parameter, the transmitter will confirm acceptance of the command with "DONE" or will report an error number; the parameter is entered in "UNIT" units"
UNIT		Setting of temperature units
DAMPIN		Setting of the constant time damping of the process variable

TRANSF			Setting the linearization type of current processing characteristics
	LINEAR		Linear characteristics
	SQRT		Square root function
	SQRX^3		Square root function of x^3
	SQRX^5		Square root function of x^5
	SPECIA		Linearisation of the user board output
	SQUARE		Square function
ALARM			Setting the transmitter alarm current value
	LOW		Low alarm current
	HIGH		High alarm current
	LAST		Last value
	CUSTOM		Alarm current value set by user
LCD1VR			Type of process variable displayed on LCD1
	CURREN		The LCD1 displays the current value in the current loop
	PERCEN		The LCD1 displays the percentage of output control
LCD2VR			Type of variable displayed on LCD2
	PV		The LCD2 displays process variable
	USER		LCD2 will display the scaled value in user units
	SENS_T		The LCD2 display temperature value of ADC transmitter
	CPU_T		The LCD2 display temperature value of microcontroller
LCD2DP			Position of the decimal dot of the variable displayed on LCD2
FACTORY			Removes user's calibration coefficients Returns to factory settings
RESET			Transmitter metrological parameters reset override
MID WP			Sets write lock parameters
SENSOR			Configuration of the measuring sensor
	PV CFG		Configuration of the first process variable
	EXTCJC		External cold junctions compensation for thermocouples
	2WCMP		Compensation of wire resistance thermocouple
	RESCH1 / RE-SCH2		Resistance of Chanel 1 / Chanel 2 wires
	Value of the process variable PV	*CH1*	Chanel 1
		CH2	Chanel 2
		1-2	Measurement difference: Ch1 - Ch2
		2-1	Measurement difference: Ch2 - Ch1
		MAX	Maximum value of the two measurements: max (Ch1, Ch2);
		MIN	Minimum value of the two measurements: max (Ch1, Ch2);
		AVG	Measurement average: 0,5 * (Ch1 + Ch2)
		AVG RD	Measurement average with redundancy: 0,5 · (Ch1+Ch2) or Ch2 or Ch1, when one of the sensors is damaged
SENSOR	*400R / 2kR*		Resistance input
	100mV / 1V		Voltage input
	2W / 3W / 4W		Connection method of RTD sensor (number of wires)
	NOCJC / I/RCJC / EXTCJC		Compensation cold junctions thermocouple
			Resistance inputs
			Voltage inputs

10.2. Local MENU, error messages

During the execution of some functions in the local Menu, may be displayed on the LCD2 screen. Displaying an error means that the local Menu command was not carried out. Errors in the display or incorrect configuration of the display do not affect the value of the loop current process variable.

10.3. View of local LCD display

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

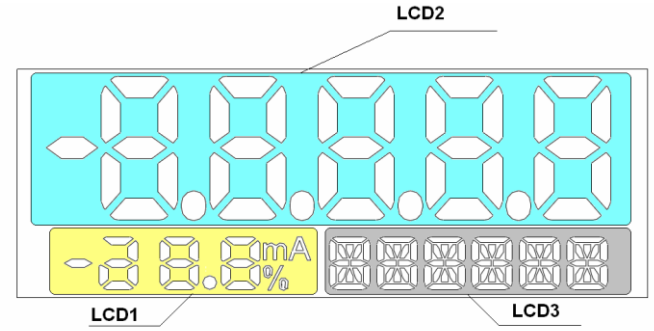


Figure 7. Display information fields.

There are three basic fields on the display:

- **LCD1** – value of current or guidance percent preset range display. Depending on the display configuration will be displayed the current value of the current line 4…20 mA with a resolution of 0.1 mA, or percent guidance the preset range with a resolution of indications 1%.
- **LCD2** – display field for the digital value measured by display, the value rescaled by user's units, and error codes. The position of the decimal point can be set in the local MENU.
- **LCD3** – information field. During normal operation it is designed for continuous display of the base unit or the user units. In the MENU operation mode it displays the setting options. It is also used to display errors related to the execution of commands in the local setup MENU.

10.4. Operating temperature

Standard version	Exi, Exd
-40…80°C (-40…176°F)	-40…75°C (-40…167°F)

10.5. Remote configuration of setpoints (HART 5)

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

10.5.1. Compatible devices

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

- converter Aplisens HART/USB Converter or converter HART/RS232;
- PC computers equipped with HART modem (e.g. HART/USB converter by Aplisens S.A.) with Windows7 or Windows10 operating system with installed Raport 2;
- 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. The software is available on Google Play under the link: https://play.google.com/store/apps/details?id=com.aplisens.mobile.amc

10.5.2. 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.

10.5.3. Method of connecting communication devices

The method of connection of communication devices to the transducer is described in chapter ➔ Connection of transmitters with the option of using HART communication. When using remote communication, the HART modem must be connected in parallel to a 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 minimum load resistance R_{Lmax} described in section ➔ Resistance load in power supply line. When using measuring cards with an integrated HART master, the card manufacturer's regulations must be followed.

11. MAINTENANCE

11.1. 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.

11.2. 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.

11.3. Spare parts

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

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

11.4. Repair

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

11.5. 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.

12. 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.

13. HISTORY OF REVISIONS

Revision No.	Document revision	Description of changes
-	01_A1_2014-11	First version of the document. Prepared by DKD.
1	01_02.B.003_2018	Documentation update. Prepared by DKD
2	01_02.C.004_2018	New certification, documentation update. Prepared by DKD.
3	01.A.001/2021.05	New version. Prepared by DBFD.