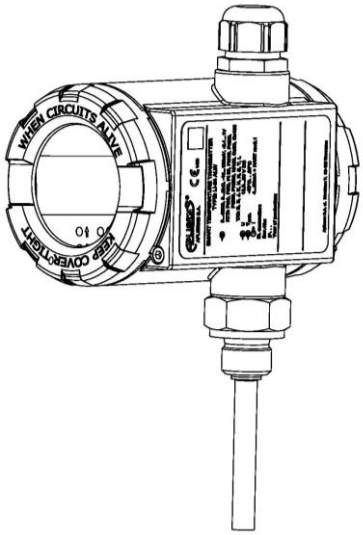
USER'S MANUAL

SMART TEMPERATURE TRANSMITTER

LI-24ALW

LI-24ALW/C



APLISENS S.A., 03-192 Warszawa, ul. Morelowa 7
tel. +48 22 814 07 77; fax +48 22 814 07 78
www.aplisens.pl, e-mail: aplisens@aplisens.pl

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 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 the device in a suitably functional condition, or use of the device other than for its intended purpose.**
- Installation should be carried out by qualified personnel having the necessary authorisation to install electrical and pressure measuring devices. The installer is responsible for performing the installation in accordance with these instructions and with the electromagnetic compatibility and safety regulations and standards applicable to the type of installation.
- The device should be configured appropriately for the purpose for which it is to be used. Incorrect configuration may cause erroneous functioning, leading to damage to the device or an accident.
- In systems with pressure transmitters there exists, in case of leakage, a risk to personnel on the side where the medium is under pressure. All safety and protection requirements must be observed during installation, operation and inspections.
- If a device is not functioning correctly, disconnect it and send it for repair to the manufacturer or to a firm authorised by the manufacturer.

In order to minimise the risk of malfunction and associated risks to personnel, the device is not to be installed or used in particularly hostile conditions, where the following risks occur:

- Possibility of mechanical impacts, excessive shocks and vibration;
- Excessive temperature fluctuation;
- Condensation of water vapour, dust, icing.

Installation of intrinsically safe versions should be performed with particular care, in accordance with the regulations and standards applicable to that type of installation.

Changes in the production of transmitters may precede a paper updating for the user. The current user manuals are available at http www.aplisens.pl

CONTENTS

APPENDIX.LI-24ALW.Exi.ATEX

CE 1453 LI-24ALW and LI-24ALW/C TEMPERATURE TRANSMITTERS
Ex VERSION IN ACCORDANCE WITH ATEX DIRECTIVE

1. Introduction

1.1. This Appendix.LI-24ALW.Exi.ATEX only applies to the intrinsically safe (Exi) transmitters designed in accordance with ATEX Directive, provided with the rating plate as specified in sections 2 and 3, and information about Exi design in the Product Certificate.

1.2. The Appendix.LI-24ALW.Exi.ATEX concerns intrinsically safe transmitters (Exi) which are marked:

- LI-24ALW- transmitter without temperature sensor: direct or cable temperature sensor, owned or provided by "Aplisens" should be installed by user;
- LI-24ALW/C- transmitter equipped with sensor.

The LI-24ALW intrinsically safe transmitters (Exi) should be installed and used in accordance with the User Manual **IO.LI24.ALW.01*(ENG)* and Appendix.LI-24ALW.Exi.ATEX.**

2. Use of the LI-24ALW and LI-24ALW/C transmitters in hazardous areas

2.1. The transmitters are designed and manufactured in accordance with requirements of the following standards: EN 60079-0:2012 + A11:2013, EN 60079-11:2012, EN 50303:2000.

2.2. The transmitters may be used in potentially explosive atmospheres in accordance with the following explosion-proof designations:

I M1 Ex ia I Ma	(with 1.4401 (316) enclosure only)
II 1D Ex ia IIIC T105°C Da	
II 1/2G Ex ia IIC T4-T6 Ga/Gb	(for LI-24ALW/C transmitters)
II 2(1)G Ex ia [ia Ga] IIC T4/T5/T6 Gb	(for LI-24ALW transmitters)
FTZÚ 13 ATEX 0205X	

The temperature class of the transmitter for the gases and the maximum surface temperature in the presence of combustible dust depends of the medium temperature; see section 5.

2.3. Transmitters category and hazardous areas

The category designation means that transmitter may be installed in hazardous zones 1 or 2. The shield of the measuring insert may be installed in a zone 0 (as shown below).

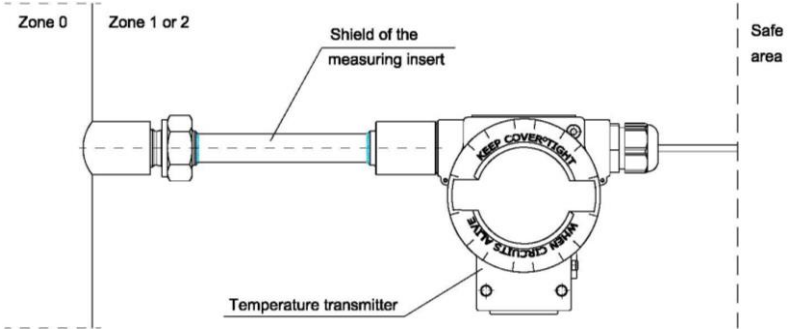


Fig. 1. Determination of hazardous zones - transmitter installation example.

3. Identifying marks

Intrinsically safe transmitters are provided with a rating plate containing specifications referred to section 4.1 of IO.LI24.ALW.01*(ENG)* and additionally:

- CE marking and notified body number;
- "Ex" mark, type of explosion protection design and certificate number;
- Values of such parameters as Ui, Ii, Ci, Li;
- Year of production;
- „SA" mark for device with additional overvoltage protection that does not meet the 500V AC test.

4. User documents

Together with the intrinsically safe transmitters, user receives the following documents:

a) Product Certificate (which is also a warranty card);
b) Declaration of conformity;
c) Copy of the certificate (on request);
d) User manual, ref. No. IO.LI24.ALW.01*(ENG)*.

Items b), c) and d) are accessed at www.aplisens.pl.

5. Permissible input parameters (based on the certificate FTZÚ 13 ATEX 0205X and validation documents)

5.1. The temperature class of transmitter depends on the input power, ambient and measured medium temperature.
For transmitters used with media temperature that is no higher than permitted environmental temperature values Tm≤Ta the temperature class should be taken according to and section 5.4. In this case, the maximum surface temperature of the transmitter for combustible dusts is 105°C.

5.2. For transmitters that measure temperature greater than permitted Ta value, the effect of heat transfer from the medium temperature whose temperature is measured to the transmitter should be taken into account by measuring the increase in the transmitter's temperature due to the higher temperature of the medium. The method of determining the temperature class for gases and the maximum surface temperature for combustible dusts for the temperature of medium Tm>Ta is described in section 7: Operating temperature measurement.

5.3. Input capacity and inductance: Ci = 2.5 nF, Li = 18 µH

5.4. Supply from a power source and the transmitter's temperature class measuring the temperature of medium Tm and not greater than Ta. The maximum permissible surface temperature of the transmitter for combustible dusts is 105°C

a) linear output characteristic

Ui=30V, Ii=0.1A, Pi=0.75W, Ta=80°C and T4, Ta=70°C and T5,
Pi=0.5W, Ta=40°C and T6,

b) trapezoidal output characteristic

Ui=24V, U_Q = 48V, Ii=50mA, Pi=0.6W, Ta≤80°C and T5,
Pi=0.5W, Ta≤40°C and T6,

c) rectangular output characteristic

Ui=24V, Ii=25mA, Pi=0.6W, Ta≤80°C and T5,

Tm – the temperature of measured medium;

The temperature of the temperature class of the transmitter T** equipped with gas sensor and the maximum surface temperature in the presence of combustible dust T*, when Tm>Ta, which is determined by the so-called operating temperature Tp based on way of measuring determined in section 7.

5.5.. The permissible output parameters for LI-24ALW transmitters in sensor circuit:

Uo=6.6V, Io=9.8mA, Po=16.2mW, Lo=400mH, Co=3.5µF (for IIC), Co=480µF (for IIB), Co=1000µF (for IIA)

5.6. If the temperature of the medium exceeds the ambient temperature, the temperature class of the sensor or the maximum surface temperature can be taken as the maximum temperature of the medium (Tp) specified for the technological process. In this case it is not necessary to Tp measure.

5.7. In case of measurements for non-explosive media, the temperature of the medium can be greater than the temperature of the temperature class or the maximum surface temperature for a given outside explosive mixture, provided that the heat of the medium will not be transferred to any surface of the sensor installed in potentially explosive atmosphere due to the risk of explosion of gases or vapours (in contact with the explosive mixture) above the maximum permissible temperature (Tp) (see section 7.2.).

6. Power supply examples

The transmitters should be supplied from supply - measuring devices provided with relevant safety certificates, which output parameters to the hazardous area should not exceed the power input parameters for transmitters as specified below.

6.1. Supply from a power source with linear output characteristic

Ui = 30V, Ii = 0.1A, Pi = 0.75W

Example of linear power supply, e.g. a typical barrier with the following parameters:

Uo = 28V, Io = 0.093A, Rw = 300Ω

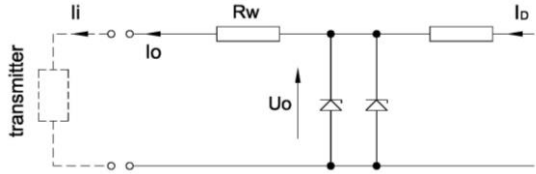


Fig. 2. Linear power supply configuration

6.2. Supply from a power source with trapezoidal output characteristic

Ui = 24V, Ii = 50mA, Pi = 0.6W

An example of trapezoidal power supply is shown in Fig. 3.

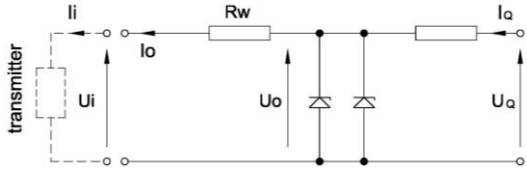


Fig. 3. Trapezoidal power supply configuration

If $U_o < \frac{U_Q}{2}$, then U_Q, I_0, P_0 are related as follows:

$$U_Q < \frac{4P_0}{I_0},\ R_w = \frac{U_Q}{I_o},\ P_0 = \frac{U_0(U_Q - U_o)}{Rw} \quad \text{for } U_0 \le 1/2U_Q$$

6.3. Supply from a power source with rectangular output characteristic

Ui = 24V, Ii = 25mA, Pi = 0.6W

The supply from a power source with rectangular output characteristic means that the voltage of an intrinsically safe power supply unit remains constant until a current limiter is activated.

The level of protection of power supply with rectangular output characteristic units is usually 'ib'. Transmitters supplied from such supply units are also intrinsically safe devices with safety level 'ib'.

Practical example of rectangular supply:

stabilised power supply unit with Uo = 24V and protection level 'ib', value of the current limited to Io = 25mA.

6.4. Minimum supply voltage: 10.5VDC **

6.5. Load resistance – examples:

- for linear power supply source, from 28V barrier

$$\text{Ro max } [\Omega] = \frac{(28V \times 0{,}95) - 10.5V^{**} - (300\Omega^{*} \cdot 0.0235A)}{0.0235A}$$ for transmitters without backlighting

- for trapezoidal or rectangular power supply source

$$\text{Ro max } [\Omega] = \frac{Usup - 10.5V^{**}}{0.0235A}$$

**) Barrier resistance. **) 13.5V for transmitters with backlighting.*

7. Measurement of transmitter operating temperature (Tp) with mounted sensor (LI-24ALW/C or LI-24ALW with user's direct sensor)

7.1. In the case of transmitters used for measure the temperature of the medium that is greater than the permissible ambient temperature values at Tm>Ta the temperature of the hottest spot on the connection surface (Tpp) which might be in contact with an explosive atmosphere and the temperature of the enclosure (Tpo) should be measured. The Tpp and Tpo temperatures should be determined for the maximum medium and ambient temperature. When calculating Tpo, ΔTe=20K should be added to account for the effect of additional heat transfer due to the input power (Pi=0.75W) in case of malfunction. **The higher value of Tpp and Tpo+20K should be taken as the operating temperature of the transmitter (Tp).**

7.2. The transmitter temperature of the temperature class (T**) for gases and the maximum surface temperature (T*) for combustible dusts should be based on Tp determined in section 7.1 and 5.6.

1. The temperature of the transmitter temperature class T** for gases should be determined from the following equation:

   T** ≥ Tp+5K for temperature classes T5…T6

   T** ≥ Tp+10K for temperature classes T1…T4

2. The maximum temperature T* of the transmitter's surface which might be in contact with dust cloud must not exceed 2/3 of the minimum ignition temperature of the dust cloud $T_{CL.}$

   T* ≥ Tp T* = 2/3T_{CL}

3. The maximum surface temperature T* of the transmitter, for a dust layer of 5 mm thickness, is T*≥Tp, where T*=T_{5mm}-75K, T_{5mm}– minimum ignition temperature of a dust layer of 5 mm thickness.

4. The maximum surface temperature of the transmitter in the case of coal dust deposition must not exceed 150°C.

5. The temperature of the enclosure Tpo during operation must not exceed 80 ºC.

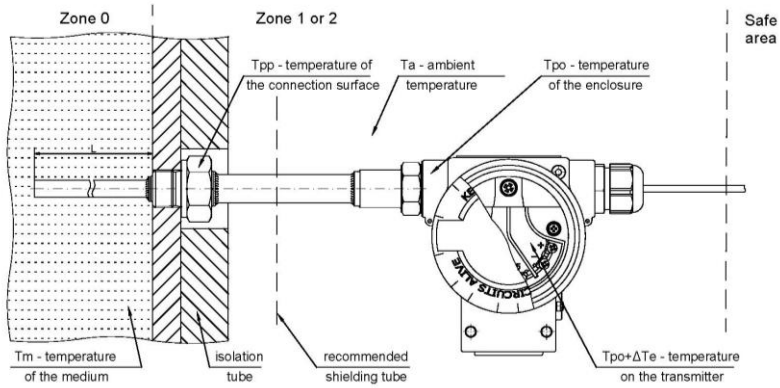


Fig. 4. Determination of the temperature of transmitter.

System designer is responsible for selecting the sensor and the method of its installation so that the temperature of the hottest surfaces of the sensor under extreme operating conditions is less than the temperature of the temperature class for a given substance (gas, mist, vapour) and the maximum surface temperature for combustible dusts.

8. Connection procedure for LI-24ALW intrinsically safe (Exi) transmitters

8.1. Connections between the transmitter and other devices in the measuring loop of the transmitter should be made in accordance with the requirements of intrinsic safety standards and instructions for use in hazard areas. Non-compliance with the intrinsic safety requirements may cause the transmitter to explode and pose a hazard to human safety or health.

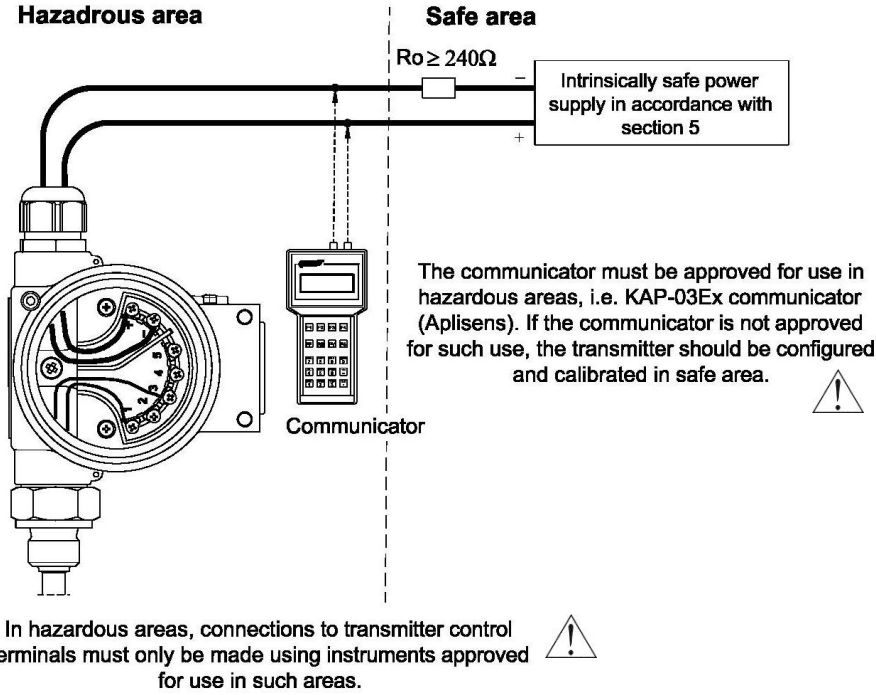


Fig. 5. Connection of the transmitter LI-24ALW in Exi version.

Electrical connections of the transmitter should be made in accordance with the installation requirements of the applicable standards.

External devices are connected to transmitter internal terminals via cable glands which are type-approved in versions designed for use in hazardous areas by the presence of combustible dust (Fig. 7. on page 45.)

Under no circumstances may the electrical system of the transmitter be repaired or otherwise handled by the user. Damage assessments and repairs may only be carried out by the manufacturer or its authorised dealer.

8.2. Special conditions for safe use:

- This Operating Instructions must be taken into account during installation.
- Version of device with surge arrester, marked as "SA", does not meet the 500V rms test required by EN 60079-11:2012. This must be taken into account when device is installing.
- For the medium temperature Tm>Ta temperature of the temperature class T* and the maximum surface temperature T* should be set according to the section 7.2.
- In explosion hazardous areas, transmitters in lacquered aluminium casing, as well as transmitters fitted with plastic tags, should be installed in a manner that prevents electrostatic charging in accordance with IO.LI24.ALW.01*(ENG)* clause 7.

APPENDIX.LI-24ALW.Exi.IECEx

LI-24ALW and LI-24ALW/C TEMPERATURE TRANSMITTERS

Ex VERSION IN ACCORDANCE WITH IECEx CERTIFICATE

1. Introduction

1.1. This Appendix.LI-24ALW.Exi.IECEx only applies to the intrinsically safe (Exi) transmitters designed in accordance with IECEx Certificate, provided with the rating plate as specified in sections 2 and 3, and information about Exi design in the Product Certificate.

1.2. The Appendix.LI-24ALW.Exi.IECEx concerns intrinsically safe transmitters (Exi) which are marked:

- LI-24ALW- transmitter without temperature sensor: direct or cable temperature sensor, owned or provided by "Aplisens" should be installed by user;
- LI-24ALW/C- transmitter equipped with a sensor..

The Li-24ALW and LI-24ALW/C intrinsically safe transmitters (Exi) should be installed and used in accordance with the User Manual **IO.LI24.ALW.01*(ENG)* and Appendix.LI-24ALW.Exi.IECEx.**

2. Use of the LI-24ALW and LI-24ALW/C transmitters in hazardous areas

2.1. The transmitters are designed and manufactured in accordance with requirements of the following standards: IEC 60079-0:2011 Ed.6, IEC 60079-11:2011 Ed.6.

2.2. The transmitters may be used in potentially explosive atmospheres in accordance with the following explosion-proof designations:

Ex ia I Ma	(with 1.4401 (316) enclosure only)
Ex ia IIIC T105°C Da	
Ex ia IIC T4-T6 Ga/Gb	(for LI-24ALW/C transmitters)
Ex ia [ia Ga] IIC T4/T5/T6 Gb	(for LI-24ALW transmitters)
IECEx FTZÚ 13.0028X	

The temperature class of the transmitter for the gases and the maximum surface temperature in the presence of combustible dust depends of the medium temperature; see section 5.

2.3. Transmitters category and hazardous areas

The transmitters intended as EPL Ga/Gb equipment shall be installed into the zones 1 or 2. The shield of the measuring insert may be installed in a zone 0 (as shown below).

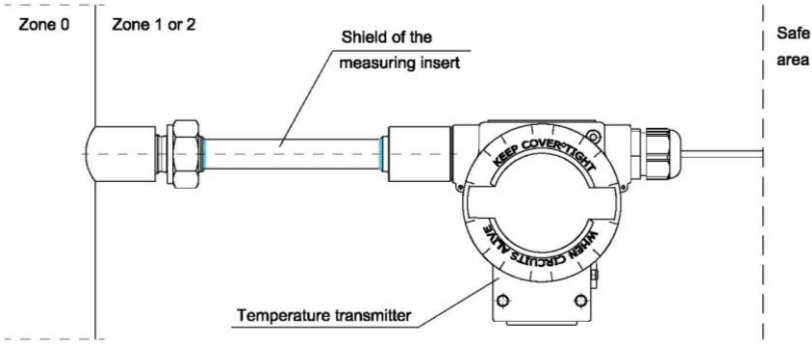


Fig. 1. Determination of hazardous zones - transmitter installation example.

3. Identifying marks

Intrinsically safe transmitters are provided with a rating plate containing specifications referred to section 4.1 of IO.LI24.ALW.01*(ENG)* and additionally:

- Type of explosion protection design and certificate number;
- Values of such parameters as Ui, Ii, Ci, Li;
- Year of production;
- „SA" mark for device with additional overvoltage protection that does not meet the 500V AC test.

4. User documents

Together with the intrinsically safe transmitters, user receives the following documents:

e) Product Certificate (which is also a warranty card);
f) Declaration of conformity (on request);
g) Copy of the certificate (on request);
h) User manual, ref. No. IO.LI24.ALW.01*(ENG)*.

Items b), c) and d) are accessed at www.aplisens.pl.

5. Permissible input parameters (based on the certificate IECEx FTZÚ 13.0028X and validation documents)

5.1. The temperature class of transmitter depends on the input power, ambient and measured medium temperature.
For transmitters used with media temperature that is no higher than permitted environmental temperature values Tm≤Ta the temperature class should be taken according to and section 5.4. In this case, the maximum surface temperature of the transmitter for combustible dusts is 105°C.

5.2. For transmitters that measure temperature greater than permitted TA value, the effect of heat transfer from the medium temperature whose temperature is measured to the transmitter should be taken into account by measuring the increase in the transmitter's temperature due to the higher temperature of the medium. The method of determining the temperature class for gases and the maximum surface temperature for combustible dusts for the temperature of medium Tm>TA is described in section 7: Operating temperature measurement.

5.3. Input capacity and inductance: Ci = 2.5 nF, Li = 18 µH

5.4. Supply from a power source and the transmitter's temperature class measuring the temperature of medium Tm and not greater than Ta. The maximum permissible surface temperature of the transmitter for combustible dusts is 105°C

a) linear output characteristic

Ui=30V, Ii=0.1A, Pi=0.75W, Ta=80°C and T4, Ta=70°C and T5,
Pi=0.5W, Ta=40°C and T6,

b) trapezoidal output characteristic

Ui=24V, U_Q = 48V, Ii=50mA, Pi=0.6W, Ta≤80°C and T5,
Pi=0.5W, Ta≤40°C and T6,

c) rectangular output characteristic

Ui=24V, Ii=25mA, Pi=0.6W, Ta≤80°C and T5,

Tm – the temperature of measured medium;

The temperature of the temperature class of the transmitter T** equipped with gas sensor and the maximum surface temperature in the presence of combustible dust T*, when Tm>Ta, which is determined by the so-called operating temperature Tp based on way of measuring determined in section 7.

5.5.. The permissible output parameters for LI-24ALW transmitters in sensor circuit:

Uo=6.6V, Io=9.8mA, Po=16.2mW, Lo=400mH, Co=3.5µF (for IIC), Co=480µF (for IIB), Co=1000µF (for IIA)

5.6. If the temperature of the medium exceeds the ambient temperature, the temperature class of the sensor or the maximum surface temperature can be taken as the maximum temperature of the medium (Tp) specified for the technological process. In this case it is not necessary to Tp measure.

5.7. In case of measurements for non-explosive media, the temperature of the medium can be greater than the temperature of the temperature class or the maximum surface temperature for a given outside explosive mixture, provided that the heat of the medium will not be transferred to any surface of the sensor installed in potentially explosive atmosphere due to the risk of explosion of gases or vapours (in contact with the explosive mixture) above the maximum permissible temperature (Tp) (see section 7.2.).

6. Power supply examples

The transmitters should be supplied from supply - measuring devices provided with relevant safety certificates, which output parameters to the hazardous area should not exceed the power input parameters for transmitters as specified below.

6.1. Supply from a power source with linear output characteristic

Ui = 30V, Ii = 0.1A, Pi = 0.75W

Example of linear power supply, e.g. a typical barrier with the following parameters:

Uo = 28V, Io = 0.093A, Rw = 300Ω

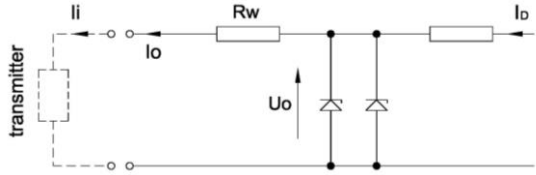


Fig. 2. Linear power supply configuration

6.2. Supply from a power source with trapezoidal output characteristic

Ui = 24V, Ii = 50mA, Pi = 0.6W

An example of trapezoidal power supply is shown in Fig. 3.

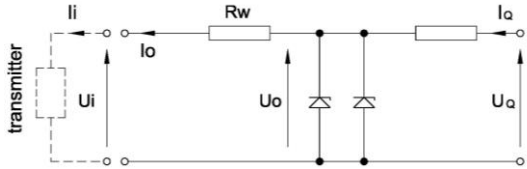


Fig. 3. Trapezoidal power supply configuration

If $U_o < \frac{U_Q}{2}$, then U_Q, I_0, P_0 are related as follows:

$$U_Q < \frac{4P_0}{I_0}, \quad R_w = \frac{U_Q}{I_o}, \quad P_0 = \frac{U_0(U_Q - U_o)}{Rw} \quad \text{for } U_0 \le 1/2U_Q$$

6.3. Supply from a power source with rectangular output characteristic

Ui = 24V, Ii = 25mA, Pi = 0.6W

The supply from a power source with rectangular output characteristic means that the voltage of an intrinsically safe power supply unit remains constant until a current limiter is activated.

The level of protection of power supply with rectangular output characteristic units is usually 'ib'. Transmitters supplied from such supply units are also intrinsically safe devices with safety level 'ib'.

Practical example of rectangular supply:

stabilised power supply unit with Uo = 24V and protection level 'ib', value of the current limited to Io = 25mA.

6.4. Minimum supply voltage: 10.5VDC **

6.5. Load resistance – examples:

- for linear power supply source, from 28V barrier

$$\text{Ro max } [\Omega] = \frac{(28V \times 0{,}95) - 10.5V^{**} - (300\Omega^{*} \cdot 0.0235A)}{0.0235A}$$ for transmitters without backlighting

- for trapezoidal or rectangular power supply source

$$\text{Ro max } [\Omega] = \frac{Usup - 10.5V^{**}}{0.0235A}$$

**) Barrier resistance. **) 13.5V for transmitters with backlighting.*

7. Operating temperature measurement (Tp)

7.1. In the case of transmitters used for measure the temperature of the medium that is greater than the permissible ambient temperature values at Tm>Ta the temperature of the hottest spot on the connection surface (Tpp) which might be in contact with an explosive atmosphere and the temperature of the enclosure (Tpo) should be measured. The Tpp and Tpo temperatures should be determined for the maximum medium and ambient temperature. When calculating Tpo, ΔTe=20K should be added to account for the effect of additional heat transfer due to the input power (Pi=0.75W) in case of malfunction. **The higher value of Tpp and Tpo+20K should be taken as the operating temperature of the transmitter (Tp).**

7.2. The transmitter temperature of the temperature class (T**) for gases and the maximum surface temperature (T*) for combustible dusts should be based on Tp determined in section 7.1 and 5.6.

1. The temperature of the transmitter temperature class T** for gases should be determined from the following equation:

   T** ≥ Tp+5K for temperature classes T5…T6

   T** ≥ Tp+10K for temperature classes T1…T4

2. The maximum temperature T* of the transmitter's surface which might be in contact with dust cloud must not exceed 2/3 of the minimum ignition temperature of the dust cloud T_{CL}.

   T* ≥ Tp T* = 2/3T_{CL}

3. The maximum surface temperature T* of the transmitter, for a dust layer of 5 mm thickness, is T* ≥ Tp, where T* = T_{5mm}-75K, T_{5mm} – minimum ignition temperature of a dust layer of 5 mm thickness.

4. The maximum surface temperature of the transmitter in the case of coal dust deposition must not exceed 150°C.

5. The temperature of the enclosure Tpo during operation must not exceed 80 °C.

Determination of the temperature of transmitter at fig.4 p.7.2 Appendix.LI-24ALW.Exi.ATEX.

System designer is responsible for selecting the sensor and the method of its installation so that the temperature of the hottest surfaces of the sensor under extreme operating conditions is less than the temperature of the temperature class for a given substance (gas, mist, vapour) and the maximum surface temperature for combustible dusts..

8. Connection procedure for LI-24ALW intrinsically safe (Exi) transmitters

According to the p.8.1 Appendix.LI-24ALW.Exi.ATEX.

Under no circumstances may the electrical system of the transmitter be repaired or otherwise handled by the user. Damage assessments and repairs may only be carried out by the manufacturer or its authorised dealer.

Special conditions for safe use:

- This Operating Instructions must be taken into account during installation.
- Version of device with surge arrester, marked as "SA", does not meet the 500V rms test required by IEC 60079-11:2011. This must be taken into account when device is installing.
- For the medium temperature Tm>Ta temperature class T* and the maximum surface temperature T* should be set according to the section 7.2.
- In explosion hazardous areas, transmitters in lacquered aluminium casing, as well as transmitters fitted with plastic tags, should be installed in a manner that prevents electrostatic charging in accordance with IO.LI24.ALW.01*(ENG)* clause 7.

APPENDIX.LI-24ALW.Exd.ATEX

CE 1453

LI-24ALW TEMPERATURE TRANSMITTERS
Exd VERSION IN ACCORDANCE WITH ATEX DIRECTIVE

1. Introduction

1.1. This Appendix.LI-24ALW.Exd.ATEX only applies to LI-24ALW transmitters in flameproof (Exd) versions certified in accordance with ATEX Directive, provided with rating plates as shown in sections 2 and 3 and information about Exd design in Product certificates.

1.2. This appendix contains additional information regarding flameproof design of the transmitters. The **LI-24ALW** transmitters certified to be flameproof (Exd) in accordance with ATEX Directive should be used in accordance with the User Manual **IO.LI24.ALW.01*(ENG)*** and **Appendix.LI-24ALW.Exd.ATEX.**

2. Use of the LI-24ALW transmitters in hazardous areas

2.1. The LI-24ALW transmitters are designed and manufactured in accordance with requirements of the following standards:
EN 60079-0:2012+A11:2013, EN 60079-11:2012, EN 60079-26:2007, PN-EN 60079-1:2007, EN 60079-31:2009.

2.2. The transmitters designed for use with a cable temperature sensor may be used in potentially explosive atmospheres in accordance with the type of explosion-proof designations:

II 2(1)G Ex d [ia Ga] IIC T4/T5/T6 Gb
II 2(1)D Ex t [ia Da] IIIC T105°C Db
I M2 Ex d [ia Ma] I Mb (with 1.4401 (316) enclosure only)
KDB 14 ATEX0118X

Transmitter Category 2(1) in ATEX code means it may be installed in a hazardous area 1 (21) or 2 22) and cable temperature sensor, supplied together with the transmitter, may be installed in an area 0(20) (Fig.1).
The transmitters designed for M2 mines must be turn off if there is a risk of explosion.

The temperature class of the transmitter for the gases and the maximum permissible surface temperature in the presence of combustible dust is specified in accordance with the specifications (shown in the User Manual) of the temperature sensor.

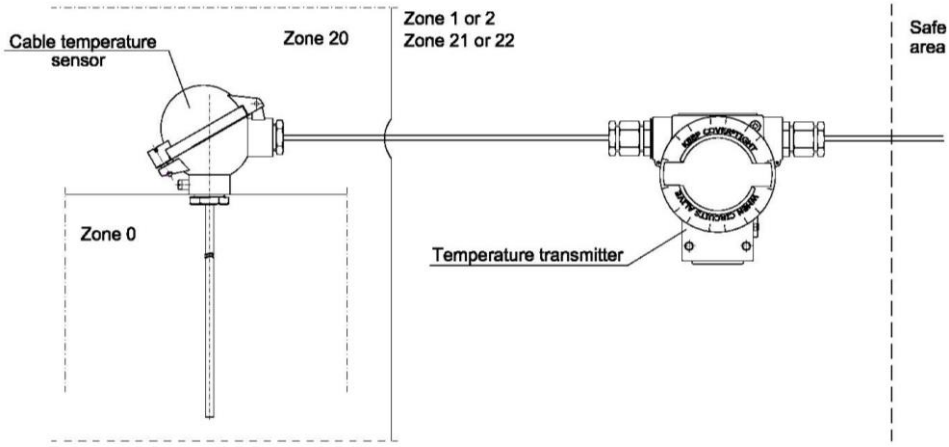


Fig. 1. LI-24ALW temperature transmitter with a cable temperature sensor.

The transmitters designed for use with a cable temperature sensor are provided with an intrinsically safe output on the sensor's side.
Sensors installed in the zone '0' should meet the following requirements:

- for a "simple apparatus" – according to section 6.7 in EN 60079-11;
- the requirements relating to the operating parameters, e.g. resistance to operating pressure, temperature, resistance to chemical and mechanical stress.

A cable temperature sensor that meets the above requirements can be purchased either from Aplisens or another manufacturer.

2.3. The transmitters with a sensor screwed into the enclosure may be used in potentially explosive atmospheres in accordance with the following explosion-proof designations:

II 2G Ex d IIC T* Gb
II 2D Ex t IIIC T* Db
I M2 Ex d I Mb (with 1.4401 (316) enclosure only)
KDB14 ATEX0118X

If a sensor screwed into the enclosure is installed, a flameproof transmitter plus the sensor is a Category 2 (Fig.2).
Transmitters designed for M2 mines must be switched off in the event of an explosion risk.

The temperature class T* of the transmitter for gases and the maximum surface temperature T* in the presence of combustible dust depends on the temperature of the medium (see section 5).

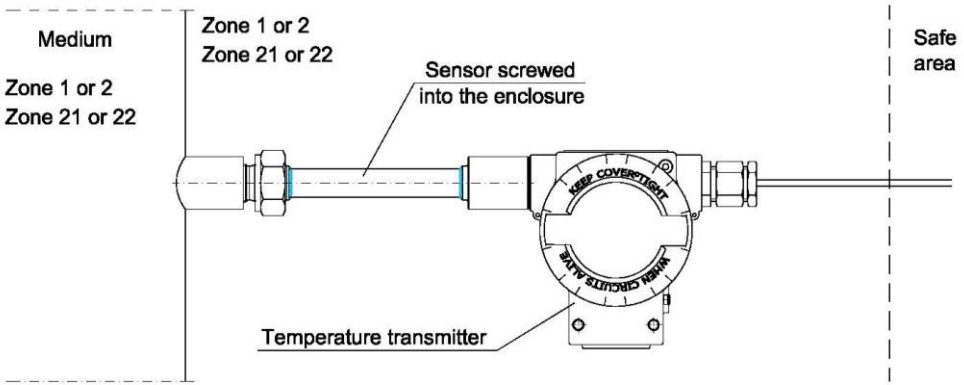


Fig. 2. LI-24ALW temperature transmitter with a sensor screwed into the enclosure.

3. Identifying marks

Exd transmitters are provided with a rating plate containing specifications referred to section 4.1 of IO.LI24.ALW.01*(ENG)* and additionally:

- CE marking and notified body number ;
- "Ex" mark, type of explosion protection design and certificate number;
- Process connection;
- Year of production.

4. User documents

Together with the Exd transmitters, user receives the following documents:

a) Product Certificate (which is also a warranty card);
b) Declaration of conformity;
c) Copy of the certificate (on request);
d) User manual, ref. No. IO.LI24.ALW.01*(ENG)*.

Items b), c) and d) are accessed at www.aplisens.pl.

5. Permissible input parameters (based on the certificate KDB 14 ATEX 0118X and validation documents)

5.1. The temperature class of transmitter depends on the input power, ambient and measured medium temperature.
For transmitters used with media temperature Tm ≤ 80°C the temperature class should be taken according to Table Z1 and section 5.3. The maximum permissible temperature of the medium must not be greater than the ambient temperature Ta. In this case, the maximum surface temperature of the transmitter is 105°C.

5.2. The permissible output parameters for the transmitters with a cable temperature sensor:
Uo=6,6V; Io=9,8mA; Po=14,5mW; Lo=400mH; Co=3,5µF dla IIC, Co=480µF dla IIB, Co=1000µF dla IIA

5.3. Temperature class and maximum surface temperature
The transmitter's temperature class for standard use of a transmitter supplied in accordance with section 8 is as specified in Table Z1. The maximum permissible surface temperature of the transmitter is 105°C.

Table Z1

Ta [°C]	Temperature class
40	T6
75	T5, T4, group III 105°C

5.4. For transmitters provided with a sensor screwed into the enclosure for measuring temperatures greater than 75°C, the effects of heat transfer from the medium whose temperature is measured to the transmitter should be taken into account by measuring the increase in the transmitter's temperature due to the higher temperature of the medium. A system designer and system user are responsible for ensuring that after installation in the facility, the temperature of the hottest parts of the transmitter, so-called operating temperature, does not exceed the temperature specified for a given temperature class and the maximum permissible surface temperature due to the presence of combustible dust. The method for defining the temperature class for gases and the maximum surface temperature for combustible dust for the temperature of the medium Tm>75^{o}C is described in section 7 'Operating temperature measurement for transmitters with sensor screwed into the enclosure'.

6. Installation and use

6.1. User should read and understand this User Manual before attempting to connect and use the transmitter. The transmitter should be connected in accordance with the wiring diagram shown in section 8 of Appendix.LI-24ALW.Exd.ATEX. In potentially explosive atmosphere the transmitter must only be installed by qualified personnel who are familiar with the national and international laws, directives and standards that apply to this area. Transmitters should be grounded via a ground terminal. If the transmitter is in contact with metal structural parts or pipes connected to a system of equalization cables, no additional earthing of the transmitter is required.

6.2. On account of the material of the enclosure (a light alloy with a high percentage of aluminium) user is required to ensure that the transmitter is not exposed to mechanical damage of the enclosure at the place of installation. If the transmitter is to be used for measurements in the presence of strong chemical agents, an enclosure made of steel 1.4401 (*316*) is recommended.

6.3. The transmitter's enclosure is provided with two openings for threaded (M20x1.5 or 1/2 NPT).

6.4. Upon consulting with the manufacturer, customer may purchase a transmitter with or without a cable gland. Typically, transmitters supplied to customers are not provided with cable glands. If a transmitter without a cable gland is purchased, customer is responsible for providing a cable gland in accordance with Table 1 Appendix.LI-24ALW.Exd.ATEX. Cable glands from other manufacturers may also be used (Exd IIC (Cat. II)). They should provide the degree of safety IP 67÷68 and their operating temperature should correspond to the transmitter's expected operating range. If a cable gland is installed by the user, the thread M20x1.5 in the cable gland should be lubricated with LOCTITE 243 before installation to protect it against coming loose. With cable glands ½" NPT, use LOCTITE 577.

6.5. For sensors WRGB and WOGB (fig.4 in the IO.LI24.ALW.01*(ENG)*) from Aplisens, provided only with a measuring insert protection with walls >0.5 mm thick, additional process shields (Fig. 8 in the IO.LI24.ALW.01*(ENG)*) or an additional user shield with walls ≥1 mm thick should be installed.
The need to install an additional user shield is indicated in an information label.

6.6. The general rules for connecting and using Exd transmitters should conform to the rules and standards for equipment with flameproof enclosures as specified in section 2.1., including:

EN 60079-14: Explosive atmospheres. Electrical installations design, selection and erection.

EN 60079-17: Explosive atmospheres. Electrical installations inspection and maintenance.

6.7. During routine inspections it should be checked that covers, cable glands and cable connectors are properly tightened. It should be checked if the enclosure and cable show no sign of mechanical damage and if the rating plate is legible. The condition of the sensor and cover should also be checked on a regular basis and it must not show any sign of damage. During maintenance the threads in covers should be lubricated using acid-free vaseline.

Data on the flameproof joints are given in Fig.10 in the IO.LI24.ALW.01*(ENG).*

Due to the risk of damage, the transmitter must be protected against heating to temperatures above 75°C, also if there is no explosion risk.

7. Operating temperature measurement (Tp) transmitters with sensor screwed into the enclosure.

7.1. In the case of transmitters used for the medium temperature measuring at Tm>75°C the temperature of the hottest spot on the connection surface (Tpp) which might be in contact with an explosive atmosphere and the temperature of the enclosure (Tpo) should be measured. The Tpp and Tpo temperatures should be determined for the maximum medium and ambient temperature. When calculating Tpo, ΔTe=20K should be added to account for the effect of additional heat transfer due to the input power in case of malfunction. **The higher value of Tpp and Tpo+20K should be taken as the operating temperature of the transmitter (Tp).**

7.2. The transmitter temperature of the temperature class (T*) for gases and the maximum surface temperature (T*) for combustible dusts should be based on Tp determined in section 7.1 and Note 1.

1. The temperature of the transmitter temperature class T* for gases should be determined from the following equation:

   $T^* \geq Tp+5K$ for temperature classes T5..T6

   $T^* \geq Tp+10K$ for temperature classes T1..T4

2. The maximum temperature T* of the transmitter's surface which might be in contact with dust cloud must not exceed 2/3 of the minimum ignition temperature of the dust cloud T_{CL}.

   $T^* \geq Tp \quad T^* = 2/3T_{CL}$

3. The maximum surface temperature T* of the transmitter, for a dust layer of 5 mm thickness, is $T^* \geq Tp$, where $T^* = T_{5mm}-75K$, T_{5mm} – minimum ignition temperature of a dust layer of 5 mm thickness.

4. The maximum surface temperature of the transmitter in the case of coal dust deposition must not exceed 150°C.

5. The temperature of the enclosure Tpo during operation must not exceed 80 ºC

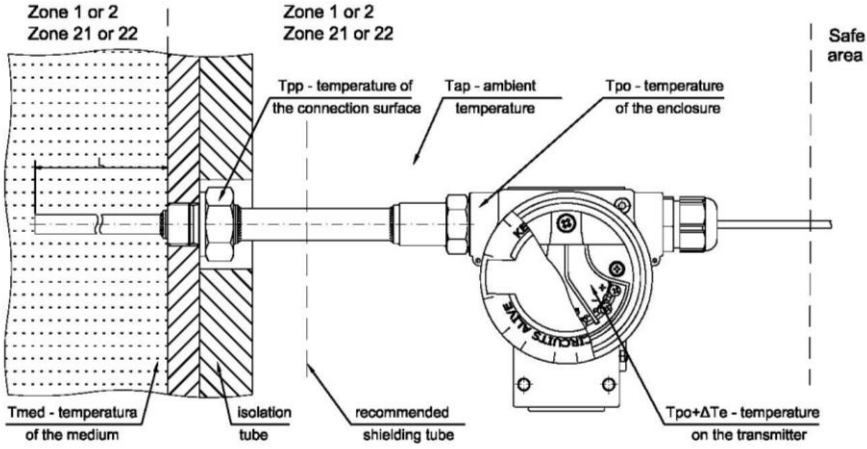


Fig.3. Determination of the temperature of transmitter with sensor screwed into the enclosure.

Note 1:

If the temperature of the medium exceeds the ambient temperature, the temperature class of the sensor or the maximum surface temperature can be taken as the maximum temperature of the medium (Tp) specified for the technological process. In this case it is not necessary to Tp measure.

Note 2:

In case of measurements for non-explosive media, the temperature of the medium can be greater than the temperature of the temperature class or the maximum surface temperature for a given outside explosive mixture, provided that the heat of the medium will not be transferred to any surface of the sensor installed in potentially explosive atmosphere due to the risk of explosion of gases or vapours (in contact with the explosive mixture) above the maximum permissible temperature (Tp) (see section 7.1).

System designer is responsible for selecting the sensor and the method of its installation so that the temperature of the hottest surfaces of the transmitter under extreme operating conditions is less than the temperature of the temperature class for a given substance (gas, mist, vapour).

8. Power supply and connecting procedure for Exd transmitters LI-24ALW

Connections between the transmitter and other devices in the measuring loop of the transmitter should be made in accordance with the requirements of intrinsic safety standards and instructions for use in hazard areas. Non-compliance with requirements may cause the transmitter to explode and pose a hazard to human safety or health.

8.1. Transmitters should be supplied with voltage up to 45 VDC (nominal voltage 24 VDC) from a transformer-based PSU or other devices ensuring at least reinforced insulation between primary and secondary winding where the maximum voltage does not exceed 250 VAC. The responsibility to ensure power supply in accordance with the above requirements lies with the user.

8.2. Minimum supply voltage: 13,5VDC **

***) 16,5V for transmitters with backlight.*

8.3. When connecting the transmitter to the electrical system, the type and diameter of the connection cable should correspond to the cable gland installed.

8.4. Compact cables of circular cross-section, shielded or non-shielded, with or without a protective layer, in tubes from non-absorbent elastomer such as soft PVC should be used, e.g. YKSLY 2*1, YnTKSYekw 1*2*1, LIYCY 2*1. If a different cable needs to be used, it should be agreed with the transmitter's manufacturer so that an appropriate cable entry is installed.
Cables should be laid in e.g. cable trays, protective tubes, cable ducts, firmly attached, etc. to protect them from mechanical damage.

8.5. Connecting procedure for the transmitter LI-24ALW

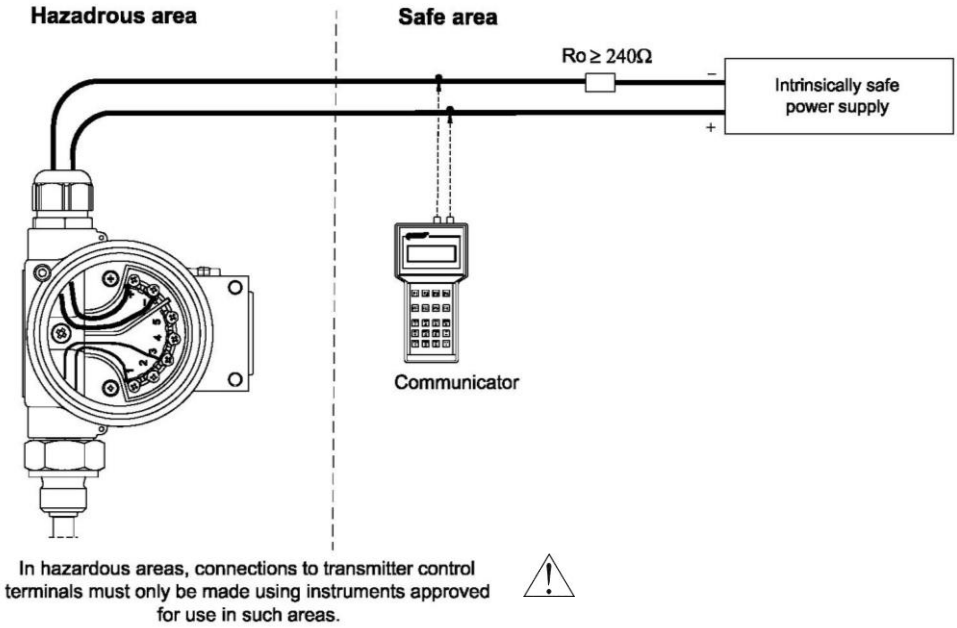


Fig. 4. Connection of the transmitter LI-24ALW in Exd version.

Electrical connections of the transmitter should be made in accordance with the installation requirements of the applicable standards.

Under no circumstances may the electrical system of the transmitter be repaired or otherwise handled by the user. Damage assessments and repairs may only be carried out by the manufacturer or its authorised dealer.

Special conditions for safe use:

- The temperature class T* and the maximum surface temperature T* for the temperature of the medium Tm > 75^{o}C should be determined in accordance with section 7.2.
- The permissible clearance of the flameproof cylindrical connection, designated L1 in the documentation, is smaller compared to the requirements of EN 60079-1:2007 and it must not exceed the values shown in Fig. 10 IO.LI24.ALW.01*(ENG)*.

Table 1. Permitted cable glands.

Type of packing glands	Producer	Screw	Feature	Other marking	No of certificate	Note
501/423	HAWKE	M20x1.5 ½"NPT	Exd IIC	dimension OS, O, A	Baseefa 06 ATEX 0056X	
501/421	HAWKE	M20x1.5 ½"NPT	Exd IIC	dimension OS, O, A	Baseefa 06 ATEX 0056X	
ICG 623	HAWKE	M20x1.5 ½"NPT	Exd IIC	dimension OS, O, A	Baseefa 06 ATEX 0058X	
501/453	HAWKE	M20x1.5 ½"NPT	Exd IIC	dimension OS, O, A	Baseefa 06 ATEX 0056X	*
501/453/RAC	HAWKE	M20x1.5 ½"NPT	Exd IIC	dimension OS, O, A	Baseefa 06 ATEX 0056X	*
501/453/Universal	HAWKE	M20x1.5 ½"NPT	Exd IIC	dimension OS, O, A	Baseefa 06 ATEX 0057X	*
ICG 653	HAWKE	M20x1.5 ½"NPT	Exd IIC	dimension OS, O, A	Baseefa 06 ATEX 0058X	*
8163/2-A2F	STAHL	M20x1.5	Exd IIC		SIRA06ATEX1188X	
A2F, A2FRC, SS2K	CMP-Products	M20x1.5	Exd IIC		SIRA06ATEX1097X	
E1FW, E1FX/Z, E2FW, E2FX/Z	CMP-Products	M20x1.5	Exd IIC		SIRA06ATEX1097X	*
T3CDS, T3CDSPB	CMP-Products	M20x1.5	Exd IIC		SIRA06ATEX1283X	*
PX2K, PXSS2K, PX2KX, PXB2KX	CMP-Products	M20x1.5	Exd IIC		SIRA06ATEX1097X	*

Table 2. Permitted plugs.

Type of plug	Producer	Screw	Feature	Other marking	No certificate	Note
	AGRO AG	M20x1.5	Exd IIC	No cat.		
475	HAWKE	M20x1.5	Exd IIC			
477	HAWKE	M20x1.5	Exd IIC			

**) for special cable only.*

APPENDIX.LI-24ALW.Exd.IECEx

LI-24ALW TEMPERATURE TRANSMITTERS

Exd VERSION IN ACCORDANCE WITH IECEx CERTIFICATE

1. Introduction

1.1. This Appendix.LI-24ALW.Exd.IECEx only applies to LI-24ALW transmitters in flameproof (Exd) versions certified in accordance with IECEx Certificate, provided with rating plates as shown in sections 2 and 3 and information about Exd design in Product certificates.

1.2. This appendix contains additional information regarding flameproof design of the transmitters. The **LI-24ALW** transmitters certified to be flameproof (Exd) in accordance with IECEx Certificate should be used in accordance with the User Manual **IO.LI24.ALW.01*(ENG)*** and **Appendix. LI-24ALW.Exd.IECEx.**

2. Use of the LI-24ALW transmitters in hazardous areas

2.1. The LI-24ALW transmitters are designed and manufactured in accordance with requirements of the following standards:
IEC 60079-0:2011 Ed.6.0, IEC 60079-11:2011 Ed.6.0, IEC 60079-1:2007-04 Ed.6,
IEC 60079-31:2008 Ed.1, IEC 60079-26:2006 Ed.2.

2.2. The transmitters designed for use with a cable temperature sensor may be used in potentially explosive atmospheres in accordance with the type of explosion-proof designations:

Ex d [ia Ga] IIC T4/T5/T6 Gb
Ex t [ia Da] IIIC T105°C Db
Ex d [ia Ma] I Mb (with 1.4401 (316) enclosure only)
IECEx KDB 15.0005X

The transmitter with the above designation may be installed in zones 1 (21) or 2 (22), while cable temperature sensor may be installed in zone 0 (20) (Fig.1).
The transmitters designed for mines must be turn off if there is a risk of explosion.

The temperature class of the transmitter for the gases and the maximum permissible surface temperature in the presence of combustible dust is specified in accordance with the specifications (shown in the User Manual) of the temperature sensor.

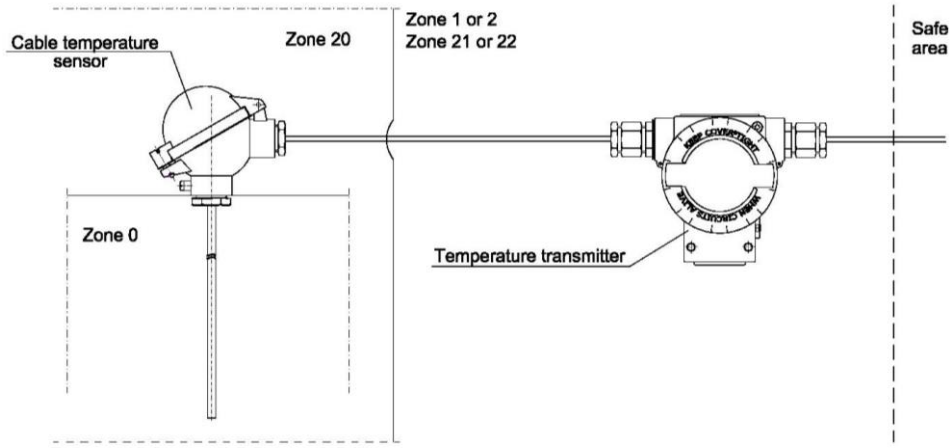


Fig. 1. LI-24ALW temperature transmitter with a cable temperature sensor.

The transmitters designed for use with a cable temperature sensor are provided with an intrinsically safe output on the sensor's side.
Sensors installed in the zone 0 should meet the following requirements:

- for a "simple apparatus" - according to section 5.7 in IEC 60079-11:2011 Ed.6;
- the requirements relating to the operating parameters, e.g. resistance to operating pressure, temperature, resistance to chemical and mechanical stress.

A cable temperature sensor that meets the above requirements can be purchased either from Aplisens or another manufacturer.

2.3. The transmitters with a sensor screwed into the enclosure may be used in potentially explosive atmospheres in accordance with the following explosion-proof designations:

Ex d IIC T* Gb
Ex t IIIC T* Db
Ex d I Mb (with 1.4401 (316) enclosure only)
IECEx KDB 15.0005X

If a sensor screwed into the enclosure is installed, a flameproof transmitter plus the sensor may be installed in zones 1 (21) or 2 (22) (Fig.2).
Transmitters designed for mines must be switched off in the event of an explosion risk.

The temperature class T* of the transmitter for gases and the maximum surface temperature T* in the presence of combustible dust depends on the temperature of the medium (see section 5).

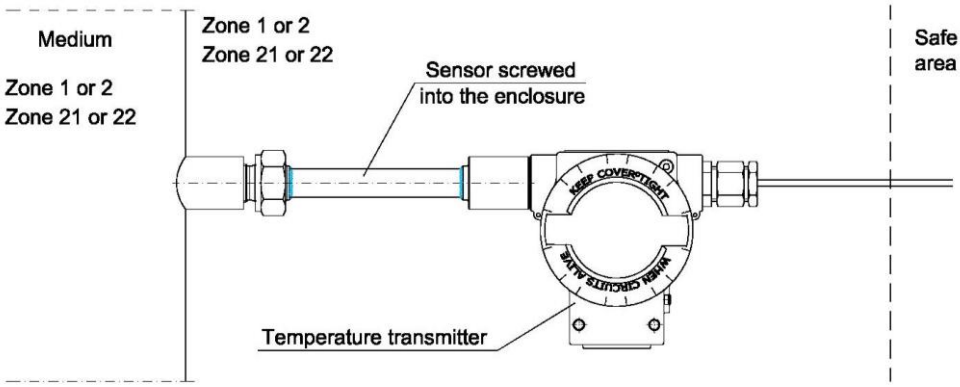


Fig. 2. LI-24ALW temperature transmitter with a sensor screwed into the enclosure.

3. Identifying marks

Exd transmitters are provided with a rating plate containing specifications referred to section 4.1 of IO.LI24.ALW.01*(ENG)* and additionally:

- Type of explosion protection design and certificate number;
- Process connection;
- Year of production.

4. User documents

Together with the Exd transmitters, user receives the following documents:

a) Product Certificate (which is also a warranty card);
b) Declaration of conformity (on request);
c) Copy of the certificate (on request);
d) User manual, ref. No. IO.LI24.ALW.01*(ENG)*.

Items b), c) and d) are accessed at www.aplisens.pl.

5. Permissible input parameters (based on the certificate IECEx KDB 15.0005X and validation documents)

5.1. The temperature class of transmitter depends on the input power, ambient and measured medium temperature.
For transmitters used with media temperature Tm ≤ 80°C the temperature class should be taken according to Table Z1 and section 5.3. The maximum permissible temperature of the medium must not be greater than the ambient temperature Ta. In this case, the maximum surface temperature of the transmitter is 105°C.

5.2. The permissible output parameters for the transmitters with a cable temperature sensor:
Uo=6,6V; Io=9,8mA; Po=14,5mW; Lo=400mH; Co=3,5µF dla IIC, Co=480µF dla IIB, Co=1000µF dla IIA

5.3. Temperature class and maximum surface temperature
The transmitter's temperature class for standard use of a transmitter supplied in accordance with section 8 is as specified in Table Z1. The maximum permissible surface temperature of the transmitter is 105°C.

Table Z1

Ta [°C]	Temperature class
40	T6
75	T5, T4, group III 105°C

5.4. For transmitters provided with a sensor screwed into the enclosure for measuring temperatures greater than 75°C, the effects of heat transfer from the medium whose temperature is measured to the transmitter should be taken into account by measuring the increase in the transmitter's temperature due to the higher temperature of the medium. A system designer and system user are responsible for ensuring that after installation in the facility, the temperature of the hottest parts of the transmitter, so-called operating temperature, does not exceed the temperature specified for a given temperature class and the maximum permissible surface temperature due to the presence of combustible dust. The method for defining the temperature class for gases and the maximum surface temperature for combustible dust for the temperature of the medium Tm>75^{o}C is described in section 7 'Operating temperature measurement for transmitters with sensor screwed into the enclosure'.

6. Installation and use

6.1. User should read and understand this User Manual before attempting to connect and use the transmitter. The transmitter should be connected in accordance with the wiring diagram shown in section 8 of Appendix.LI-24ALW.Exd.IECEx. In potentially explosive atmosphere the transmitter must only be installed by qualified personnel who are familiar with the national and international laws, directives and standards that apply to this area. Transmitters should be grounded via a ground terminal. If the transmitter is in contact with metal structural parts or pipes connected to a system of equalization cables, no additional earthing of the transmitter is required.

6.2. On account of the material of the enclosure (a light alloy with a high percentage of aluminium) user is required to ensure that the transmitter is not exposed to mechanical damage of the enclosure at the place of installation. If the transmitter is to be used for measurements in the presence of strong chemical agents, an enclosure made of steel 1.4401 (*316*) is recommended.

6.3. The transmitter's enclosure is provided with two openings for threaded (M20x1.5 or 1/2 NPT).

6.4. Upon consulting with the manufacturer, customer may purchase a transmitter with or without a cable gland. Typically, transmitters supplied to customers are not provided with cable glands. If a transmitter without a cable gland is purchased, customer is responsible for providing a cable gland in accordance with Table 1 Appendix.LI-24ALW.Exd.ATEX. Cable glands from other manufacturers may also be used (Exd IIC (Cat. II)). They should provide the degree of safety IP 67÷68 and their operating temperature should correspond to the transmitter's expected operating range. If a cable gland is installed by the user, the thread M20x1.5 in the cable gland should be lubricated with LOCTITE 243 before installation to protect it against coming loose. With cable glands ½" NPT, use LOCTITE 577.

6.5. For sensors WRGB and WOGB (fig.4 in the IO.LI24.ALW*(ENG)*) from Aplisens, provided only with a measuring insert protection with walls >0.5 mm thick, additional process shields (Fig. 8 in the IO.LI24.ALW.01*(ENG)*) or an additional user shield with walls ≥1 mm thick should be installed.
The need to install an additional user shield is indicated in an information label.

6.6. The general rules for connecting and using Exd transmitters should conform to the rules and standards for equipment with flameproof enclosures as specified in section 2.1., including:

IEC 60079-14: Explosive atmospheres. Electrical installations design, selection and erection.

IEC 60079-17: Explosive atmospheres. Electrical installations inspection and maintenance.

6.7. During routine inspections it should be checked that covers, cable glands and cable connectors are properly tightened. It should be checked if the enclosure and cable show no sign of mechanical damage and if the rating plate is legible. The condition of the sensor and cover should also be checked on a regular basis and it must not show any sign of damage. During maintenance the threads in covers should be lubricated using acid-free vaseline.

Data on the flameproof joints are given in Fig.10 in the IO.LI24.ALW.01*(ENG).*

Due to the risk of damage, the transmitter must be protected against heating to temperatures above 75°C, also if there is no explosion risk.

7. Operating temperature measurement (Tp) transmitters with sensor screwed into the enclosure

7.1. In the case of transmitters used for the medium temperature measuring at Tm>75°C the temperature of the hottest spot on the connection surface (Tpp) which might be in contact with an explosive atmosphere and the temperature of the enclosure (Tpo) should be measured. The Tpp and Tpo temperatures should be determined for the maximum medium and ambient temperature. When calculating Tpo, ΔTe=20K should be added to account for the effect of additional heat transfer due to the input power in case of malfunction. **The higher value of Tpp and Tpo+20K should be taken as the operating temperature of the transmitter (Tp).**

7.2. The transmitter temperature of the temperature class (T*) for gases and the maximum surface temperature (T*) for combustible dusts should be based on Tp determined in section 7.1 and Note 1.

1. The temperature of the transmitter temperature class T* for gases should be determined from the following equation:

   $T^* \geq Tp+5K$ for temperature classes T5..T6

   $T^* \geq Tp+10K$ for temperature classes T1..T4

2. The maximum temperature T* of the transmitter's surface which might be in contact with dust cloud must not exceed 2/3 of the minimum ignition temperature of the dust cloud T_{CL}.

   $T^* \geq Tp \qquad T^* = 2/3T_{CL}$

3. The maximum surface temperature T* of the transmitter, for a dust layer of 5 mm thickness, is $T^* \geq Tp$, where $T^* = T_{5mm}-75K$, T_{5mm} – minimum ignition temperature of a dust layer of 5 mm thickness.
4. The maximum surface temperature of the transmitter in the case of coal dust deposition must not exceed 150°C.
5. The temperature of the enclosure Tpo during operation must not exceed 80ºC

Determination of the temperature of transmitter is shown in the figure 3 p.7.4 Appendix.LI-24ALW.Exd.ATEX.

Note 1:

If the temperature of the medium exceeds the ambient temperature, the temperature class of the sensor or the maximum surface temperature can be taken as the maximum temperature of the medium (Tp) specified for the technological process. In this case it is not necessary to Tp measure.

Note 2:

In case of measurements for non-explosive media, the temperature of the medium can be greater than the temperature of the temperature class or the maximum surface temperature for a given outside explosive mixture, provided that the heat of the medium will not be transferred to any surface of the sensor installed in potentially explosive atmosphere due to the risk of explosion of gases or vapours (in contact with the explosive mixture) above the maximum permissible temperature (Tp) (see section 7.1).

System designer is responsible for selecting the sensor and the method of its installation so that the temperature of the hottest surfaces of the transmitter under extreme operating conditions is less than the temperature of the temperature class for a given substance (gas, mist, vapour).

8. Power supply and connecting procedure for Exd transmitters LI-24ALW

Connections between the transmitter and other devices in the measuring loop of the transmitter should be made in accordance with the requirements of intrinsic safety standards and instructions for use in hazard areas. Non-compliance with requirements may cause the transmitter to explode and pose a hazard to human safety or health.

8.1. Transmitters should be supplied with voltage up to 45 VDC (nominal voltage 24 VDC) from a transformer-based PSU or other devices ensuring at least reinforced insulation between primary and secondary winding where the maximum voltage does not exceed 250 VAC. The responsibility to ensure power supply in accordance with the above requirements lies with the user.

8.2. Minimum supply voltage: 13,5VDC **
***) 16,5V for transmitters with backlight.*

8.3. When connecting the transmitter to the electrical system, the type and diameter of the connection cable should correspond to the cable gland installed.

8.4. Compact cables of circular cross-section, shielded or non-shielded, with or without a protective layer, in tubes from non-absorbent elastomer such as soft PVC should be used, e.g. YKSLY 2*1, YnTKSYekw 1*2*1, LIYCY 2*1. If a different cable needs to be used, it should be agreed with the transmitter's manufacturer so that an appropriate cable entry is installed.
Cables should be laid in e.g. cable trays, protective tubes, cable ducts, firmly attached, etc. to protect them from mechanical damage.

8.5. Connecting procedure for the transmitter LI-24ALW

According to the p.8.5. Appendix.LI-24ALW.Exd.ATEX.

Electrical connections of the transmitter should be made in accordance with the installation requirements of the applicable standards.

Under no circumstances may the electrical system of the transmitter be repaired or otherwise handled by the user. Damage assessments and repairs may only be carried out by the manufacturer or its authorised dealer.

Special conditions for safe use:

- The temperature class T* and the maximum surface temperature T* for the temperature of the medium Tm > 75°C should be determined in accordance with section 7.2.
- The permissible clearance of the flameproof cylindrical connection, designated L1 in the documentation, is smaller compared to the requirements of IEC 60079-1:2014 Ed.7 and it must not exceed the values shown in Fig. 10 IO.LI24.ALW.01*(ENG)*.

FEATURES, INSTALLATION AND MAINTENANCE OF TRANSMITTERS

1. INTRODUCTION

1.1. This instruction concerns the LI-24ALW intelligent temperature transmitters in standard and intrinsically safe versions. The instruction contains information and recommendations for installation and operation of intelligent temperature transmitters and troubleshooting procedures for all transmitter models.

1.2. Additional information for intrinsically safe (Exi) **LI–24ALW** transmitters, provided with a common EC type approval certificate **No. FTZÚ 13ATEX 0205X** are specified in **Appendix.LI-24ALW.Exi.ATEX**.

When installing and using intrinsically safe (Exi) transmitters, you should comply with the instruction No. **IO.LI24.ALW.01*(ENG)*** and **Appendix.LI-24ALW.Exi.ATEX**.

1.3. Additional information for flameproof (Exd) **LI–24ALW** transmitters, compliant with the ATEX directive, are specified in **Appendix.LI-24ALW.Exd.ATEX**.

When installing and using flameproof (Exd) transmitters, you should comply with the instruction ref. No. **IO.LI24.ALW.01*(ENG)*** and **Appendix.LI-24ALW.Exd.ATEX.**

1.4. Additional information for intrinsically safe (Exi) **LI–24ALW** transmitters, compliant with the IECEx certificate, are specified in **Appendix.LI-24ALW.Exi.IECEx.**

When installing and using intrinsically safe (Exi) transmitters, you should comply with the instruction ref. No. **IO.LI24.ALW.01*(ENG)*** and **Appendix.LI-24ALW.Exi.IECEx.**

1.5. Additional information for flameproof (Exd) **LI–24ALW** transmitters, compliant with the IECEx certificate, are specified in **Appendix.LI-24ALW.Exd.IECEx.**

When installing and using flameproof (Exd) transmitters, you should comply with the instruction ref. No. **IO.LI24.ALW.01*(ENG)*** and **Appendix.LI-24ALW.Exd.IECEx.**

2. USER DOCUMENTS

Transmitters are supplied in multi-unit and/or single-unit packaging, together with the following documents:

a) Product Certificate (which is also a warranty card);
b) Declaration of conformity (on request);
c) Copy of the certificate (on request);
d) User Manual ref. No. IO.LI24.ALW.01*(ENG)*.

Items b), c) and d) are accessed at www.aplisens.pl

3. INTENDED USE AND FUNCTIONS

3.1. LI-24ALW temperature transmitters are designed for temperature measuring in various industrial applications related to measurements, control and regulation in normal conditions as well as in conditions of danger gas or dust explosion.

3.2. LI-24ALW transmitters can be provided with replaceable temperature sensors:

- installed directly to the transmitter enclosure;
- installed with the connection cable.

3.3. Main features of **LI-24ALW** transmitters:

a) Two wires power supply (4...20 mA current loop);
b) Digital signal processing (filtration, linearization, compensation);
c) Possibility of local configuration from the display panel or remote configuration (based on HART protocol);
d) Auto diagnostic system of correctness of sensor connections and functions of transmitter components;
e) Ability to operate with resistive and thermoelectric sensors;
f) Ambient temperature effects compensation;
g) Sensor/output galvanic isolation.

4. IDENTIFICATION

4.1. Identification marking

All transmitters are provided with rating plates containing the following information

a) Manufacturer;
b) CE marking;
c) Transmitter type designation;
d) Sensor type;
a) Supply voltage;
b) Ambient temperature range;
c) Output signal;
d) Sensor connection type;
e) Year of production and serial number

4.1.1. Intrinsically safe (Exi) **LI-24ALW** transmitters, in accordance with ATEX Directive, are provided with additional marking as specified in **Appendix.LI-24ALW.Exi.ATEX.**

4.1.2. Intrinsically safe(Exi) **LI-24ALW** transmitters, in accordance with IECEx Certificate, are provided with additional marking as specified in **Appendix.LI-24ALW.Exi.IECEx.**

4.1.3. Flameproof (Exd) **LI-24ALW** transmitters, in accordance with ATEX Directive, are provided with additional marking as specified in **Appendix.LI-24ALW.Exd.ATEX.**

4.1.4. Flameproof (Exd) **LI-24ALW** transmitters, in accordance with IECEx Certificate, are provided with additional marking as specified in **Appendix.LI-24ALW.Exd.IECEx.**

5. TECHNICAL SPECIFICATIONS

5.1. Electrical parameters

Power supply voltage (Usup):

- standard version — 13.5* ÷ 55V DC
- intrinsically safe version (Exi) — 13.5* ÷ 30V DC (see **Appendices Exi**)
- flameproof version (Exd) — 13.5* ÷ 45V DC (see **Appendices Exd**)

Output signal — 4 ÷ 20 mA + HART Rev. 5.1

Communication with the transmitter to check its configuration parameters is carried out via HART transmission protocol and signal of 4÷20mA. For this purpose: KAP-03, KAP-03Ex communicator, HART/RS232 converter or HART/USB/ Converter (APLISENS) or another HART converters, PC computer and Raport 2 Programme can be used.

Resistance to communication (HART) — 250 ÷ 1100Ω, min. 240Ω

Maximum load resistance for supply voltage Usup (V):

$$Ro[\Omega] = \frac{Usup[V] - 13.5V *}{0{,}0235A}$$

**) When backlighting is ON, the minimum supply voltage is increased by 3V in all cases (see section 9.2.6).*

Normally, intrinsically safe (Exi) transmitters are supplied with display backlighting switched off. User may switch on the backlighting (see Fig. 6).

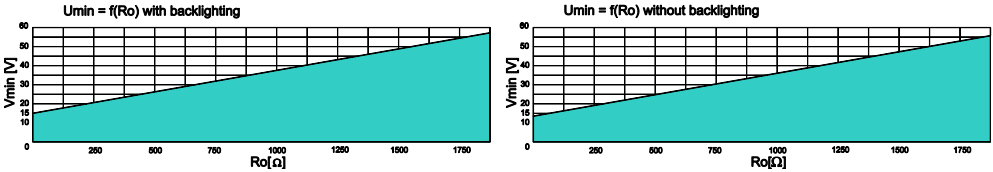
Maximum length of the connection cable — 1500m - for standard version

Minimum voltage from the power supply unit to the measuring line with a standard transmitter should be calculated as follows:

Umin = 13.5 + 0.0235·Ro [V] or see the figure below *for transmitters without LCD display backlighting*

Umin = 16.5 + 0.0235·Ro [V] or see the figure below *for transmitters with LCD display backlighting*

Ro is the total resistance of the measuring line (current loop).



Correlation between supply voltage and resistance in the current loop

Area of correct operation of the transmitter (cross-hatched area) is above the shaded area.

List of current 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 (alarm current level defined by the user)	Alarm current level in the range from 3.6 mA to 23 mA
LAST VALUE (no analogue output update)	The alarm current level is equal to the current value preceding the alarm-generating event.

5.2. Metrological parameters

Input type, measurement range and accuracy	according to Table 1 or Table 2 (section 5.3)
User's processing characteristics	up to 60 measuring points
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

5.3. Measuring ranges

Input – with two sensors:

– Difference	output value: Ch1 – Ch2 or Ch2 – Ch1
– Average	output value: 0.5 · (Ch1 + Ch2)
– Average with redundancy	output value: 0.5 · (Ch1 + Ch2) or Ch2 or Ch1 if the other one is damaged
– Minimum	output value: min (Ch1, Ch2)
– Maximum	output value: max (Ch1, Ch2)

5.3.1. RTD sensors

Table 1. Types of sensors, measuring ranges and errors

RTD sensor connected with 2, 3 or 4 wires

Input – RTD

Thermal resistance sensors	2, 3 or 4 wires connection
Sensor current	~420uA
Maximum wires resistance	25Ω

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)	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÷1100	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 No.1		0…400	10	±30	±2	
Measuring range No.2		0…2000	10	±120	±2	
1	2	3	4	5	6	7

5.3.2. Thermocouples

Table 2. Types of sensors, measuring ranges and errors

Thermocouples						
Input – Thermocouples Input impedance Maximum wires resistance Cold junctions compensation				>10MΩ 500Ω (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)	EN 60751+A2, IEC584, NIST MN175, DIN43710, BS4937, ANSI MC96.1, JIS C1602, NF C42-321	250 ÷ 1820	10	±0.55	<±0.001	Analogue output error is 0.05% FSO (Full Scale Output) over the operating temperature range.
E (Ni10Cr-Cu45Ni)		-200 ÷ 1000	10	±0.15	<±0.001	
J (Fe-Cu45Ni)		-210 ÷ 1200	10	±0.20	<±0.001	
K (Ni10Cr-Ni5)		-200 ÷ 1372	10	±0.30	<±0.001	
N(Ni14CrSi-NISi)		-200 ÷ 1300	10	±0.25	<±0.001	
R(Pt13Rh-Pt)		-20 ÷ 1768.1	10	±0.35	<±0.001	
S(Pt10Rh-Pt)		-30 ÷ 1768.1	10	±0.40	<±0.001	
T(Cu-Cu45Ni)		-200 ÷ 400	10	±0.15	<±0.001	
TC Type L	EN 60751+A2, GOST P 8.585-2001	-200 ÷ 800	10	±0.20	<±0.001	

Voltage						
		mV	mV	µV	µV/K	As above
Measuring range No.1		-10…100	10	±6	<±0.06	
Measuring range No.2		-100…1000	10	±50	<±0.5	
1	2	3	4	5	6	7

ΔG – limiting error [K] or [%] calculated according to Tables 1 and 2.

$$\Delta G\,[K] = \Delta p\,[K] + \Delta tp\,\frac{[K]}{[K]} \cdot TO\,[K] + TN\,[K] \cdot \frac{0.05\,[\%]}{100\,[\%]} \quad ;$$

$$\Delta G\,[\%] = \frac{\Delta p\,[K] \cdot 100\%}{TN\,[K]} + \frac{\Delta tp\,[K] \cdot TO\,[K] \cdot 100\%}{TN\,[K]\ [K]} + 0.05\% \ ;$$

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).

5.4. Permitted environmental

Ambient temperature range (enclosure operating temp.) -40°C ÷ 80°C
- intrinsically safe version (Exi) according to **Appendices Exi**
- flameproof version (Exd) according to **Appendices Exd**

Relative humidity 10 ÷ 98% with condensation

Range of the measured temperatures according to Table 1 or Table 2 (section 5.3)
- intrinsically safe version (Exi) according to **Appendices Exi**
- flameproof version (Exd) according to **Appendices Exd**

5.4.1. Electromagnetic compatibility (EMC), immunity

rating according to EN 61326-1,2 for industrial applications:

Electrostatic Discharge Immunity (ESD):
EN 61000-4-2; S3 Level: contact ±6kV, air ±8kV; criterion A

Conducted Radio Frequency:
EN 61000-4-6; 0.15…80MHz, 10V; criterion A

Radiated Electromagnetic Field:
EN 61000-4-3; 80…2,000MHz – 10V/m, 2,000 …2,700MHz – 1V/m; criterion A

Electrical Fast Transient (Burst Immunity):
EN 61000-4-4; ± 2kV power supply port/earth, ± 1kV signal port/earth; criterion A

Electrical Slow Transient (Surge Immunity):
EN 61000-4-5; ±0.5kV (±1kV) differentia mode, ±1kV (±2kV) common mode; criterion B

5.4.2. Electromagnetic Compatibility, emission

according to CISPR16-1, CISPR 16-2, class B, distance to antenna: 3m, quasi-peak measurements:

Radiation: 0.15 … 30MHz, 80-52dBµV/m;
30 … 2,000MHz, <54dBµV/m

Induction: 0.01 … 0.150MHz, 96-50dBµV/m;
0.150 … 0.350MHz, 60-50dBµV/m;
0.35 … 30MHz, <50dBµV/m;

5.4.3. Climatic immunity: dry heat, cold, humidity

Dry heat:
EN 60068-2-2, test B; T = 70^{o}C,
RH = max 55%

Cold:
EN 60068-2-1, test A; T = -25^{o}C,

Cyclic condensation:
EN 60068-2-30, test D; (T = 55^{o}C, RH = min95%, 24h)x2

5.4.4. Mechanical resistance

Shock:
EN 60068-2-27; 50g/11ms

Sinusoidal vibrations:
PN-EN 60068-2-6, Fc test; up to 1.6mm,
0 … 25Hz, up to 4g for 25 … 100Hz

5.4.5. Insulation resistance

>100 MΩ @110V DC transmitters with gas arresters
>100 MΩ @750V DC transmitters without gas arresters (Exi)

5.4.6. High Voltage Test

500V AC, or 750V DC, 1 min., transmitters without gas arresters (Exi)
75V AC, or 110V DC, 1 min., transmitters with gas arresters

5.4.7. Degree of protection of the enclosure

IP66/67 according to EN 60529:2003

5.5. Materials

Electronics enclosure — High pressure die-cast aluminium alloy with chemical-resistant epoxy coating (yellow - RAL 1003) or 1.4401 (316) steel – no coating.

Table 3. Sensors – materials, diameters, etc.

Type of sensors	Sensor		Material of the sensor	Connector
	Diameter F (mm)	Length L (mm)		
WO	∅3, ∅6	100, 160, 250, 400	1.4301 (304)	M20x1.5, G1/2”
WR	∅3, ∅6	depending on the selected shield	1.4301 (304)	M20x1.5, G1/2”

Table 4. Shields – materials, diameters, etc. (Fig.8)

Type of shields	Shield					Material of the shield	Connector
	Diameter F (mm)	Length L (mm)		Length of the conical part l (mm)			
OG2.9	∅9x1	100, 160, 250, 400		–		1.4404 (316L)	M20x1.5, M27x2, G1/2”, G3/4”, 1/2”NPT
OG2.11	∅11x2	100, 160, 250, 400		–		1.4404 (316L)	M20x1.5, M27x2, G1/2”, G3/4”, 1/2”NPT
T1	∅11x2	100, 160, 250, 400		–		1.4404 (316L)	PN, DIN, ANSI flange
SW1/SW2	∅18h7/∅24h7	100 140 200	140 200	35 65 65	65 65	13CrMo4-5 (15HM) 11CrMo9-10(10H2M) 1.4404 (316L)	–
SW1T/SW2T	∅18h7/∅24h7	100 140 200	140 200	35 65 65	65 65	13CrMo4-5 (15HM) 11CrMo9-10(10H2M) 1.4404 (316L)	PN, DIN, ANSI flange

6. CONSTRUCTION

6.1. Principle of measurement

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 (see section 9.2.5).

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 (depending on the configuration – see section 5.1).

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.

6.2. Construction

The transmitter consists of the following basic components: enclosure and logic unit converting signal form the measuring sensor to unified output signal.

6.2.1. Transmitter enclosure

Enclosure of the **LI-24ALW** transmitter is made of high pressure die-cast aluminium alloy or stainless steel 1.4401 (316). It is composed of the dual-chamber housing body and two screw-on covers (for the display and electrical connection terminal). Cover for the display has a window. The enclosure is provided with two openings with M20x1.5 or ½" NPT thread; one for the sensor assembly and the other to screw the cable gland output. The enclosure is provided with an external and internal earth clamp.

6.2.2. Main electronic board with display and switching board

The main electronic board with the display which is placed in separate polycarbonate housing is assembled to the housing body by screws. This module is installed in the larger compartment in the enclosure and it can be rotated by ±180° every 90° to change position of the display. A board of the connection terminals is placed (Fig. 2) in the second housing body chamber.

6.2.3. Types of measuring sensors. Types of shields

The following types of temperature sensors are available:

- WR – sensors with a sliding measuring insert;
- WO – sensors with a welded shield;

} the first part of desigantion

The WO and WR types are available in two versions:

- GB – sensors to be assembled with transmitter without temperature distance;
- GN – sensors to be assembled with transmitter with temperature distance.

} the second part

Transmitters with WR sensors (with sliding measuring insert) should be placed in the shields (see Fig.8) or user shields that meet the design requirements of installation. Direct mounting (without shields) is dangerous for the environment; it may cause unsealing of installation and explosion.

Sensor shields offered by APLISENS:

- SW1 and SW2 shields are high-pressure casings designed to welding installations;
- OG2.9, OG2.11 shields are provided with threaded connection and designed for screwed installations;
- T1, SW1T, SW2T shields are provided with flanged connection.

Cable temperature sensors offered by APLISENS use according to their User's Manuals:

- Industrial Temperature Sensors-head with Replaceable Measuring Inserts;
- Industrial Cable Temperature Sensors;

Above are available at www.aplisens.pl

7. INSTALLATION

The **LI-24ALW** temperature transmitters can be installed at any working position, while taking into account that the enclosure of the electronic processing systems should not exceed the maximum permissible temperature. The enclosure must be protected against hot air streams from hot pipeline by proper placement of the transmitter or installation of thermal screens.

It is not allowed to install transmitters with WR sensors directly (without shields). Direct mounting may cause in explosion of transmitters in installation.

LI-24ALW transmitters can be assembled in any position using a universal APLISENS "AL Handle" to the support rack, or on a vertical or horizontal pipe (see Figure 9). The display position in the transmitter should be set in most convenient position for read (see p. 6.2.2. and Figure 5).

If transmitters are installed in potentially explosive atmospheres, heat conductivity of the sensors metal casing and the ambient temperature should be taken into account in order to ensure appropriate temperature class of the transmitters.

Requirements for intrinsically safe designs are given in Appendices Exi.
Requirements for flameproof designs are given in Appendices Exd.

8. ELECTRICAL CONNECTIONS

8.1. General recommendations

8.1.1. It is recommended that twisted-pair cables should be used for signal lines or shielded twisted-pair cables in case of significant electromagnetic interference. Avoid putting the transmitter measuring cables next to leads that could generate a lot of interfering signals, for example near cables of large energy consumers.

Devices connected to the transmitter should be resistant to electromagnetic interference from the other transmission line in accordance with electromagnetic compatibility requirements.

It is also recommended that interference filters be used on the primary side of transformers, power supply units used to supply transmitters and equipment connected to them.

8.1.2. **Make sure that the cable diameter corresponds to the cable gland. Place and anchor the cable so that it is subject to no mechanical stress. Tighten particularly carefully cable glands and cover electrical terminals. Analyse the transmitter earthing; the transmitter can be earthed via the process connection external or internal earth clamps. Do not earth the transmitter via the screen of the transmitter connecting cable to the supply and measuring system.**

The section of the signal cable leading to the cable gland should be formed as a protective loop which the lowest point will lower than the input cable to the gland to prevent a condensed water of running down towards the gland.

8.2. Electrical connections

The **LI-24ALW** transmitter should be connected to the supply and measuring system as shown in Fig. 2a ÷ 2b.

8.3. Overvoltage protection

8.3.1. The transmitters are protected against switching or lightning overvoltage. Overvoltage protection between the wires of the connecting line is provided by transient voltage suppression diodes TVS installed in all transmitter types (see column 2 in the table below).

8.3.2. Additionally, the transmitter is protected against overvoltage between the wires of connecting line and the earth or the enclosure by gas tube arresters (see column 3 in the table below).

In difficult, exposed to interference, environments should be apply additional external protection devices, e.g. Aplisens UZ-2 system. With long power transmission lines, is preferable to use one protection in proximity to the transmitter (or in its inside) and the other one in the entry of the connected devices.

Overvoltage protection:

1	2	3
Transmitter type	Transient voltage suppression diodes between wires – nominal voltage	Protection between the wires and the earth and/or enclosure – type of protection – nominal voltage
LI-24ALW (standard version)	68 VDC	Gas arrester – 230 VDC
LI-24ALW (Exi version)	68 VDC	Gas arrester – 230 VDC for 'Version SA' only
LI-24ALW (Exd version)	68 VDC	Gas arrester - 230 VDC for special version only.

8.3.3. The maximum permissible voltage on protection components must not exceed the values given in columns 2 and 3 of the above table.

The insulation test voltage of 500 VAC or 750 VDC, as specified in section 5.1.1, applies to transmitters without gas tube arresters.

8.4. Earthing

Transmitters are provided with internal and external earth terminals.

8.5. Possible ways of sensor connection to the LI-24ALW transmitter

Various configurations of sensor connection to the **LI-24ALW** transmitter are shown in Fig. 7.

9. CONFIGURATION AND CALIBRATION

9.1. Measuring ranges, identify

9.1.1. Basic range

The maximum temperature range which can be processed by the transmitter is called the "**basic range**" (see p. 5.3). Difference between the upper and lower sensor limit of the basic range is called width of the basic range (Full Scale Output - FSO).

An internal processing characteristic covering the basic range of the transmitter is encoded in its memory. It is used as reference characteristics in making any adjustments that affect on the transmitter's output signal.

9.1.2. Set range

Set range is used during transmitter operation. Set range is the range whose lower end-point corresponds to an output current of 4mA and whose upper end-point corresponds to a current of 20mA (or 20mA and 4mA when the conversion characteristic is inverted). The set range can correspond to the basic range or its part only.
The width of the set range is defined as the difference between the upper and the lower range value of the set range. The transmitter can be set to any temperature range of within the basic range, however, taking into account the limits due to the minimum width of the measuring range.

9.2. Configuration and calibration

9.2.1. Metrological and identification parameters can be set via the configuration of digital HART. The metrological parameters which can be set by the user are as below:

a. Type of the measuring sensor;
b. Characteristic of sensor linearization;
c. Lower end-point of the set range;
d. Upper end-point of the set range;
e. User measuring unit;
f. Electronic damping;
g. Type of output characteristic set by the user, e.g. linear, root-square, user's special;
h. Decimal point.

9.2.2. The other identification parameters which do not affect the output signal are as follows: polling address, device type code, manufacturer identification code, manufacturer's device type code, number of preambles (3÷20), UCR (Universal Command Revision), Transmitter–specific Command Revision, software revision, hardware reversion, device function flags, device ID number, tag, descriptor - tag, date – tag, message, final assembly number, sensor serial number.
The process of setting the parameters referred to in sections 9.2.1 and 9.2.2 is called CONFIGURATION.

9.2.3. Remote transmitter configuration

The transmitters are configured and calibrated via the KAP-03, KAP-03Ex communicator (APLISENS), Raport2 programme or software using EDDL libraries (PC software) with HART convener and PC. Features of the KAP communicator are described in the User Manual No. IO.KAP-03.02*(ENG)*, specifications of the HART/RS232 converter are listed in the data sheet 'HART/RS232/01 CONVERTER', and specifications of the HART/USB/ Converter are in the User Manual No. DTR.HB.01*(ENG)*.
In order to enable remote calibration, the network should be set up as shown in Fig. 2a, 2b.

9.2.4. Local transmitter configuration

If the local configuration option is active, the operator can change settings using buttons below the display. In order to access the buttons, unscrew the cover of the display (see Fig. 5).
Press and hold any of the three buttons for about 4s to access the local settings change mode. The error code **ERR_L16** appears on the display when the local configuration mode is locked. In this case the settings entered via the communicator or computer override the settings entered via the Local Menu. The local configuration mode must be first unlocked via the communicator or computer (see → HART command 132, 133).

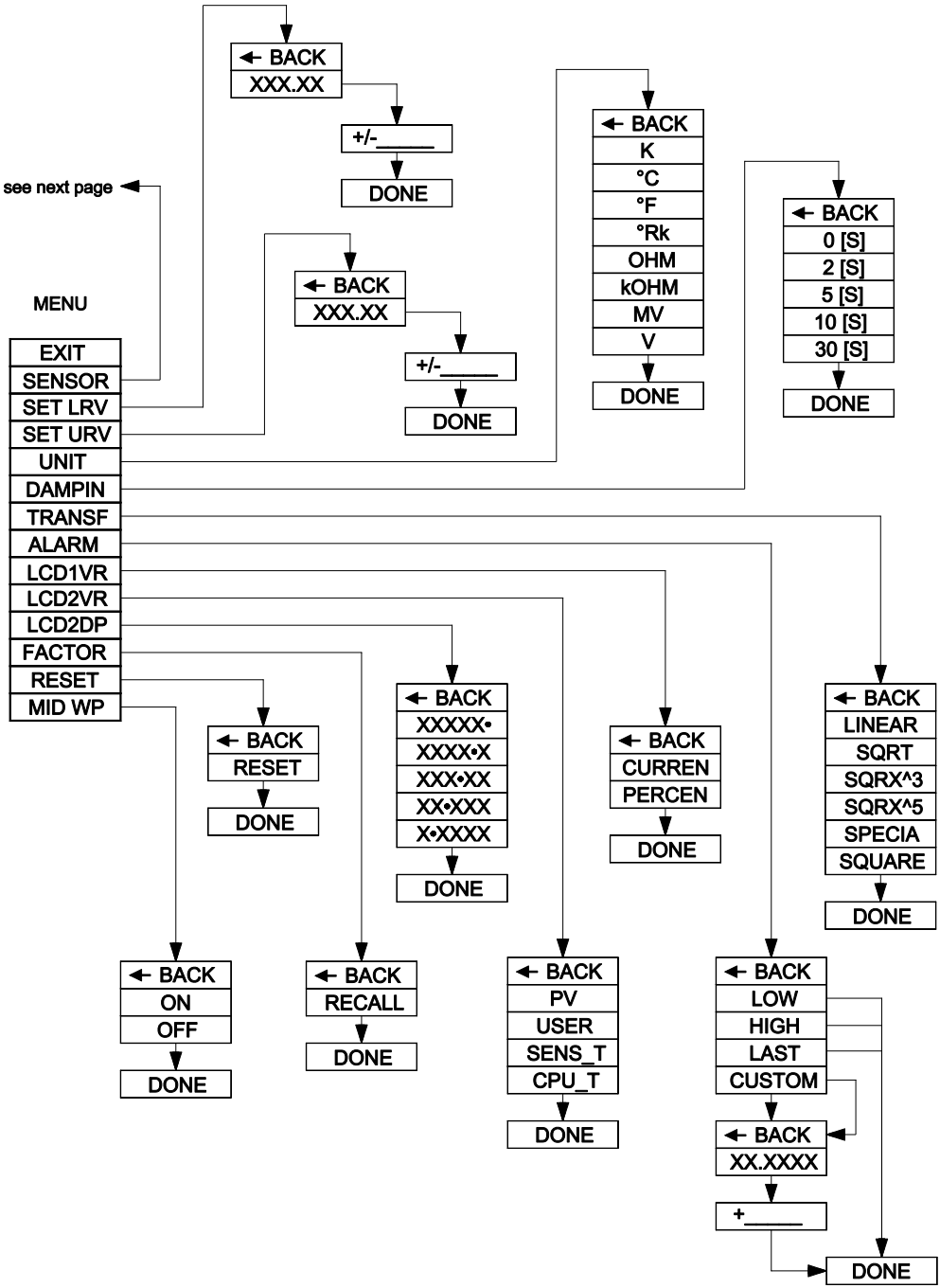
Buttons are marked with the following symbols: [↑] [↓] [◙]

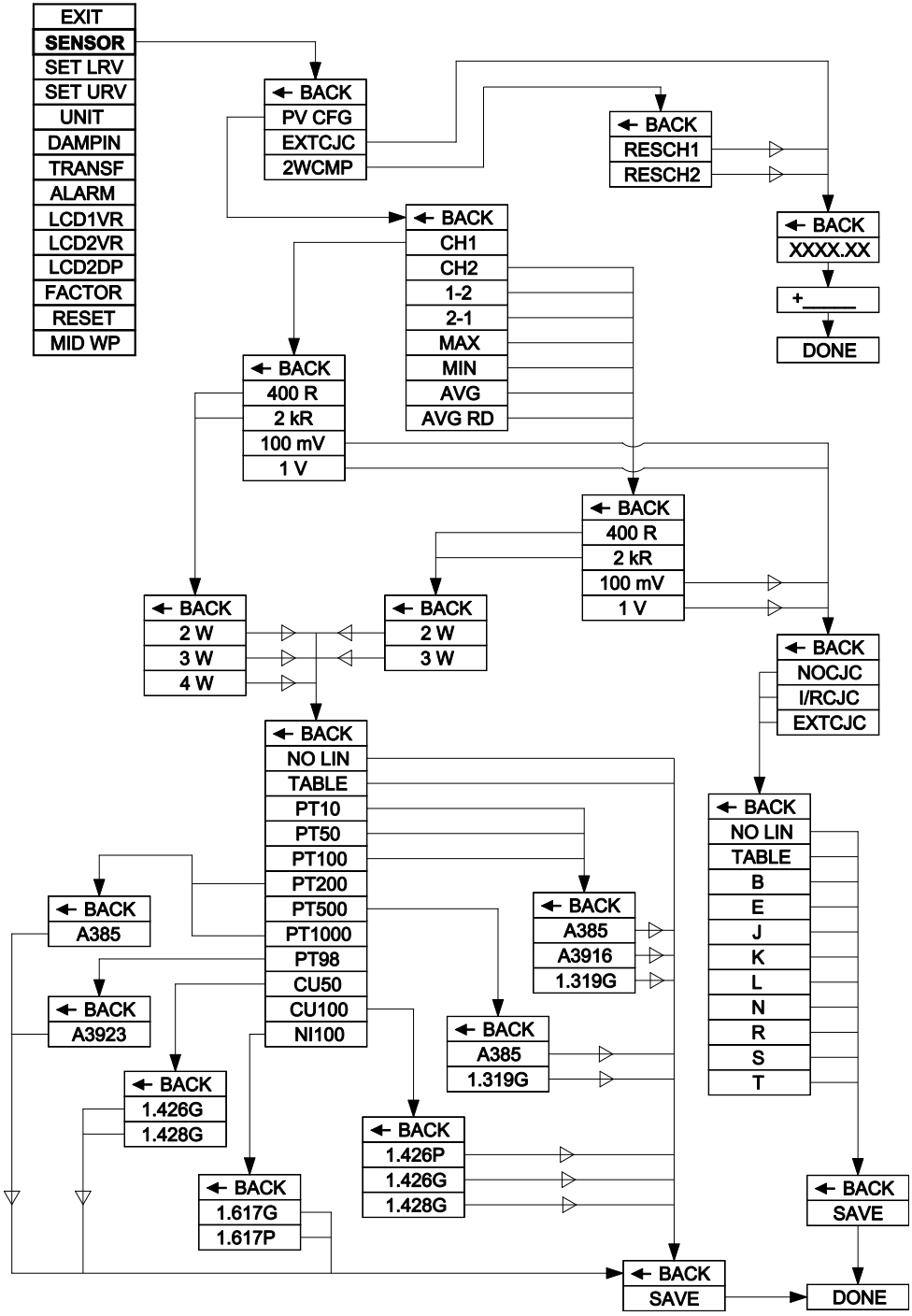
When any of the 3 buttons is pressed and held for 4 seconds, the **EXIT** message appears on the display.
Press and hold the button [◙] to confirm the message or exit the local configuration MENU. Otherwise you can navigate the MENU, select and confirm parameters of interest. If the button [↑] or [↓] is pressed and held for a longer period, the MENU will be navigated at an interval of 0.33 s.

Press button [↑] to move up the MENU structure.
Press button [↓] to move down the MENU structure.
Press button [◙] to enter and confirm your selection.

At no activity in MENU for more than 2 min. the MENU mode is ended and the process variable modifications are entered to temperature measuring.

The diagram in the next page shows how to navigate the commands in the Local Menu structure of the **LI-24ALW** temperature transmitter.


see next page
MENU
EXIT
SENSOR
SET LRV
SET URV
UNIT
DAMPIN
TRANSF
ALARM
LCD1VR
LCD2VR
LCD2DP
FACTOR
RESET
MID WP
BACK
XXX.XX
+/-_____
DONE
BACK
XXX.XX
+/-_____
DONE
BACK
K
°C
°F
°Rk
OHM
kOHM
MV
V
DONE
BACK
0 [S]
2 [S]
5 [S]
10 [S]
30 [S]
DONE
BACK
RESET
DONE
BACK
XXXXX•
XXXX•X
XXX•XX
XX•XXX
X•XXXX
DONE
BACK
CURREN
PERCEN
DONE
BACK
LINEAR
SQRT
SQRX^3
SQRX^5
SPECIA
SQUARE
DONE
BACK
ON
OFF
DONE
BACK
RECALL
DONE
BACK
PV
USER
SENS_T
CPU_T
DONE
BACK
LOW
HIGH
LAST
CUSTOM
BACK
XX.XXXX
+_____
DONE


EXIT
SENSOR
SET LRV
SET URV
UNIT
DAMPIN
TRANSF
ALARM
LCD1VR
LCD2VR
LCD2DP
FACTOR
RESET
MID WP
BACK
PV CFG
EXTCJC
2WCMP
BACK
RESCH1
RESCH2
BACK
XXXX.XX
+
DONE
BACK
CH1
CH2
1-2
2-1
MAX
MIN
AVG
AVG RD
BACK
400 R
2 kR
100 mV
1 V
BACK
400 R
2 kR
100 mV
1 V
BACK
2 W
3 W
4 W
BACK
2 W
3 W
BACK
NOCJC
I/RCJC
EXTCJC
BACK
NO LIN
TABLE
PT10
PT50
PT100
PT200
PT500
PT1000
PT98
CU50
CU100
NI100
BACK
A385
BACK
A3923
BACK
1.426G
1.428G
BACK
1.617G
1.617P
BACK
A385
A3916
1.319G
BACK
A385
1.319G
BACK
1.426P
1.426G
1.428G
BACK
NO LIN
TABLE
B
E
J
K
L
N
R
S
T
BACK
SAVE
BACK
SAVE
DONE

Menu entry confirm by pushing the button [◙]. After the parameter is confirmed, the transmitter displays 'DONE' to confirm acceptance of the command. In order to move one level up, select '←BACK'.

Legend:

Local Menu	Submenu		Description
EXIT			Returns from the Local Menu to a process variable.
SET LRV / SET URV			Specifies the lower range value of the LRV range set by the user / Specifies the upper range value of the URV range set by the user.
	XXX.XX		Displays the current value of LRV/URV
	+/-_____		Selects the sign of the parameter. Enter one by one a 5-digit number with or without a decimal point. After the last digit of the parameter is confirmed, the transmitter displays 'DONE' to confirm acceptance of the command or returns an appropriate error code. The parameter is entered in the units specified in the 'UNIT' menu.
UNIT			Specifies the temperature units.
DAMPIN			Specifies the time constant for the process variable damping.
TRANSF			Specifies the type of linearization of the output current.
	LINEAR		Linear processing.
	SQRT		Square root.
	SQRX^3		Square root of x^3.
	SQRX^5		Square root of x^5.
	SPECIA		Linearization of the output from the user's table.
	SQUARE		Square root.
ALARM			Sets value of the alarm current.
	LOW		Low alarm current.
	HIGH		High alarm current.
	LAST		The last value.
	CUSTOM		Value of the alarm current set by the user.
LCD1VR			Type of the variable displayed on LCD1.
	CURREN		Sets the process value of the current in the current loop to be displayed on LCD1.
	PERCEN		Sets the output control percentage to be displayed on LCD1.
LCD2VR			Type of the variable displayed on LCD2.
	PV		Sets the process variable to be displayed on LCD2.
	USER		Sets the value re-calculated in the user's units to be displayed on LCD2.
	SENS_T		Sets the temperature of the ADC converter to be displayed on LCD2.
	CPU_T		Sets the temperature of the microcontroller to be displayed on LCD2.
LCD2DP			Sets the decimal point 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 to 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.
	RESCH1 / RESCH2		Resistance of the Channel 1 / Channel 2 wires.
	Value of the process variable (PV)	*CH1*	Channel 1.
		CH2	Channel 2.
		1-2	Difference output value: Channel 1 – Channel 2.
		2-1	Difference output value: Channel 2 – Channel 1.
		MAX	Maximum output value: Max (Channel 1, Channel 2).
		MIN	Minimum output value: Min (Channel 1, Channel 2).
		AVG	Average output value: 0.5 • (Channel 1 + Channel 2).
		AVG RD	Average with redundancy output value: 0.5•(Channel 1 + Channel 2) or Channel 1 or Channel 2, if the other one is damaged.

SENSOR	*400R / 2kR*	Resistance ranges.
	100mV / 1V	Voltage ranges.
	2W / 3W / 4W	RTD sensor connection configuration (number of wires).
	NOCJC / I/RCJC / EXTCJC	Type of cold junctions compensation in thermocouples.

9.2.5. Local Menu, error messages

When performing some functions in the Local Menu, the error message could appear on the LCD2 display. Display the error indicates that the Local Menu command has not been performed.
A short description of the most common error messages is given below.

ERR_L07 Error [in_write_protected_mode]. If the transmitter is write-protected, the error will appear at the attempt to change settings in the Local Menu. In order to change settings via the Local Menu, turn on the service of Local Menu mode and remove the write protection. These parameters can be modified via the KAP-03 communicator, Raport 2 programme or software based on EDDL libraries.

- Default settings: Local Menu mode is ON.
  Write protection is OFF.

ERR_L09 Error [applied_process_too_high]. The error message will appear if the parameter setting exceeds the maximum permissible value.

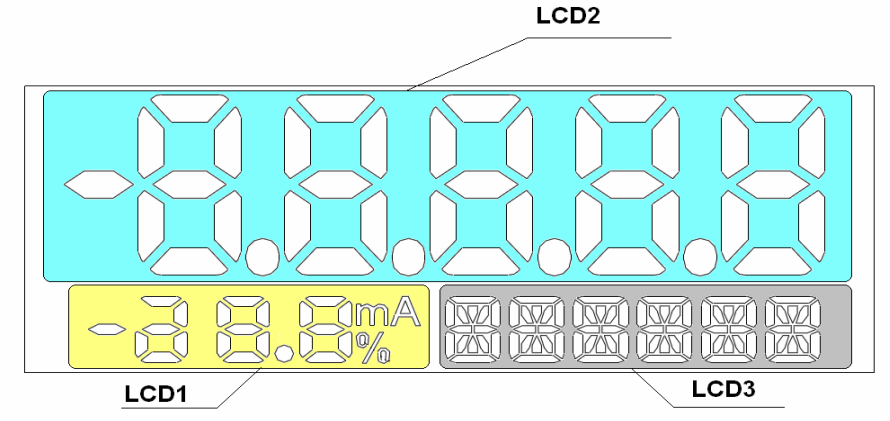
ERR_L09 Error [applied_process_too_low]. The error message will appear if the parameter setting is less than the minimum permissible value.

ERR_L14 Error [span_too_small]. The error message will appear if the range set by the user is less than the permissible range.

ERR_L16 Error [acces_restricted]. The error message will appear if the Local Menu mode is OFF and the user attempts to change settings in the Local Menu. Turn on the Local Menu mode via the KAP-03 communicator, Raport 2 programme or software based on EDDL libraries.

9.2.6. Local LCD display configuration

Optional settings of the display can be changed in the local MENU using buttons, via the communicator or PC software. If necessary, the display can also be turned off. This feature is accessible only via the communicator or PC software. The local display of the **LI-24ALW** transmitter is shown in the figure below.



The display contains the following 3 fields:

- **LCD1** – value of current or control percentage for the set range. Depending on the display configuration, this field can contain the value of the current at the current line 4-20 mA with a resolution of 0.1mA as the processing variable or control percentage of the set range with a resolution of 1%.
- **LCD2** – digital value of the temperature measured by the transmitter, value of the temperature recalculated according to the user's units or the error code. The position of the decimal point can be defined in the local MENU or remotely. If the temperature is above or below the permissible limit values, the message **'OVER'** or **'UNDER'**, respectively, will appear on the display.
- **LCD3** – information field. During normal operation this field shows the basic unit of the transmitter or the user's unit. In the local settings change MENU mode, it shows the available options. It also shows errors related to execution of commands in the local settings change MENU.

Display backlighting – local display is provided with a backlighting which can be turned on or off as needed. Backlight setting of indicates increases the minimum supply voltage for all versions by 3V. The display backlighting should be operated as shown in Fig. 6.

Fig. 5 shows how the display can be rotated to change its position.

To verify the proper work of all segments of the display on the transmitter, disconnect and turn on again the power supply or use the RESET command. After connecting power to the transmitter for 3 seconds will light up all segments of the display, a similar function fulfills RESET command.

When the configuration is completed, use the appropriate HART [247] command to protect the transmitter. The transmitter should be write-protected at all times during operation in order to prevent accidental or intentional modifications of its configuration settings.

The write-protected settings can be accessed via the KAP-03 communicator or via the computer PC with 'Raport 2' or DD/DTM libraries.

9.3. Calibration

The transmitter can be calibrated by comparing benchmark temperature acting on the transmitter's sensor to its measuring: to the output current of 4...20 (20...4) mA or to user's output signal. The taken values calibration points need not be equal to the upper and lower limit of the basic range but cannot exceed them
The calibration range must not be less than the minimum set range by the user. In order to achieve better accuracy, the calibration points should correspond or be similar to the lower and the upper limits of the user's set range.
The transmitter setting can be change using the PC computer and Raport 2 programme in accordance with the procedure described in APLISENS 'User Manual' No. IO.RAPORT2*(ENG)* or other instruments as specified in section 9.2.3.

9.4. Alerts

Alerts indicate that the limit values for proper operation of the transmitter have been exceeded or its components are not functional. Alerts generated by the **LI-24ALW** transmitter indicate: no sensor, sensor error, HART Modem error, CRC error, flash memory CRC error, error of the oscillator, calculation error of the first process variable, first process variable out of range, second process variable out of range, opto-isolation interface error. Errors are indicated by generating current in the line and an error code displayed on the display. Values of the alarm current in the line can be set using the 'Raport 2' configuration software or an appropriate configuration of the transmitter's alert messages can be ordered from the supplier.

10. INSPECTIONS AND SPARE PARTS

10.1. Scheduled inspections

Scheduled inspections should be carried out in accordance with the user's maintenance requirements.
Inspections should include checks of the shield of the measuring insert (tightening's and leaks) and electrical components (condition of connections, cable and cable gland seals).
If necessary, calibrate and configure the transmitter to check the processing parameters (section 9).

10.2. Unscheduled inspections

If the transmitter could have been exposed to mechanical damage, overvoltage or works improperly, inspections should be carried out as necessary, including checks of the processing parameters.

If there is no signal in the transmission line or its value is out of range, check the cable, connections to the terminals, connection points, etc. Check the supply voltage and load resistance. If the communicator is connected to the transmitter's supply line, the messages "No response" or "Check connections" may indicate that the line has been damaged. If the line is in working order, check if the transmitter works properly.

10.3. Spare parts

Components of the transmitter which may be subject to wear and tear, damage and replacement: seals of the covers and cable glands.

The other components of explosion-proof transmitters may only be replaced by the manufacturer or its authorised dealer.

11. PACKAGING, STORAGE AND TRANSPORT

The transmitters should be packed so as to protect them against damage during transport in multi-unit and/or single-unit packaging.
The transmitters should be kept in bulk packaging in covered areas, away from corrosive substances and vapours, with the ambient temperature and relative humidity in accordance with the permissible values as specified in section 5.4.
They should be transported in packaging protected against displacement. Transport can be carried out by land, sea or air, provided that the transmitters are not exposed to weathering. Transport conditions according to PN-81/M-42009.

12. WARRANTY

Manufacturer warrants under the conditions specified in the Product Certificate which is also a guarantee card.

13. SCRAPPING, DISPOSAL

Waste or damaged **LI-24ALW** temperature transmitters should be dismantled and disposed of in accordance with Directive (2012/19/UE) on waste electrical and electronic equipment (WEEE) or returned to the manufacturer.

14. ADDITIONAL INFORMATION

The manufacturer reserves the right to make constructional and technological changes in such a way that not lower the quality of the transmitters.

15. DRAWINGS

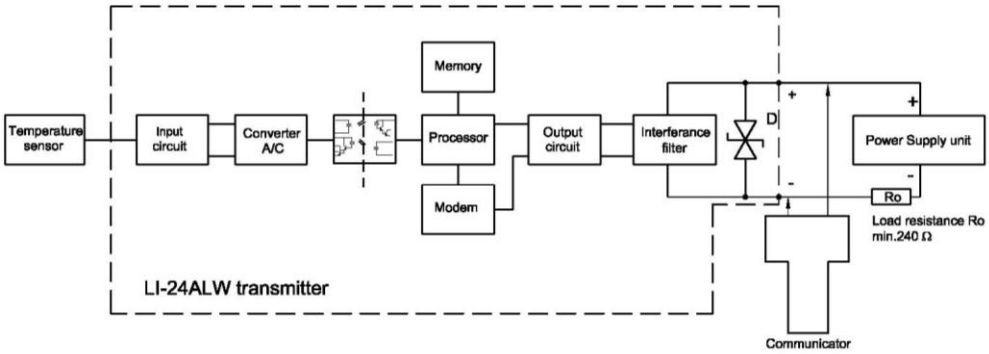


Fig. 1. Block diagram of LI-24ALW transmitter.

Before increasing resistance in the current loop to enable communication make sure that the voltage drop for the total resistance Ro included in the current loop will not cause the voltage at the transmitter's terminals to drop below the minimum permissible supply voltage! (see the figure in section 5.1).

Connection of the LI-24ALW transmitter

Connect the **LI-24ALW** as shown in Fig. 2a. If it is necessary to enable communication with the transmitter, a communicator or converter can also be connected.
Optional connection configurations to communication devices are shown below.

Communicator or converter connection near to a switch box

In order to enable communication with a transmitter at a distant location via connection near to a switch box, make sure that the resistance Ro from the point of connection of the communicator to the power supply source lies within the range of 250÷1100 Ω. If necessary, an additional resistance can be integrated into the line. Connect the communicator or converter as shown in Fig. 2a.

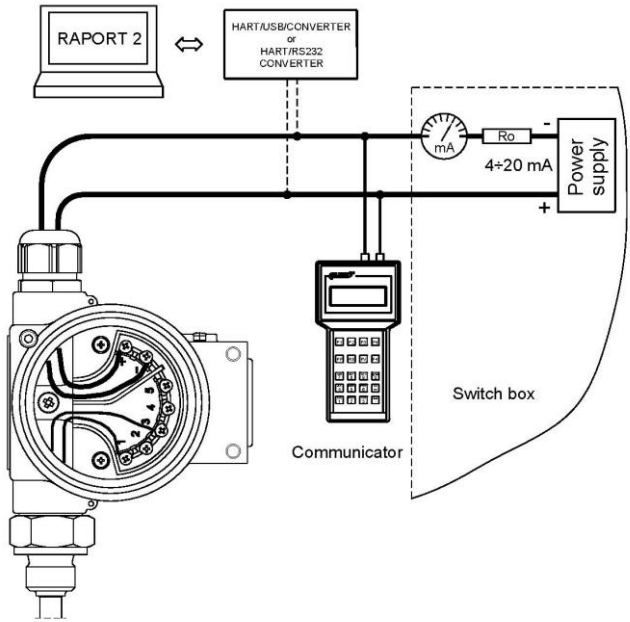


Fig. 2a. Electrical connection between LI-24ALW transmitter and the communicator or converter near to switch box.

Communicator or converter connection to the transmitter's terminals

In order to enable local communication by connecting a communicator or converter to the transmitter's terminals, make sure that the resistance Ro from the transmitter's terminals to the power supply source lies within the range of 250÷1100 Ω. If so, connect the communicator or converter to the terminals <+> <-> as shown in Fig. 2b.

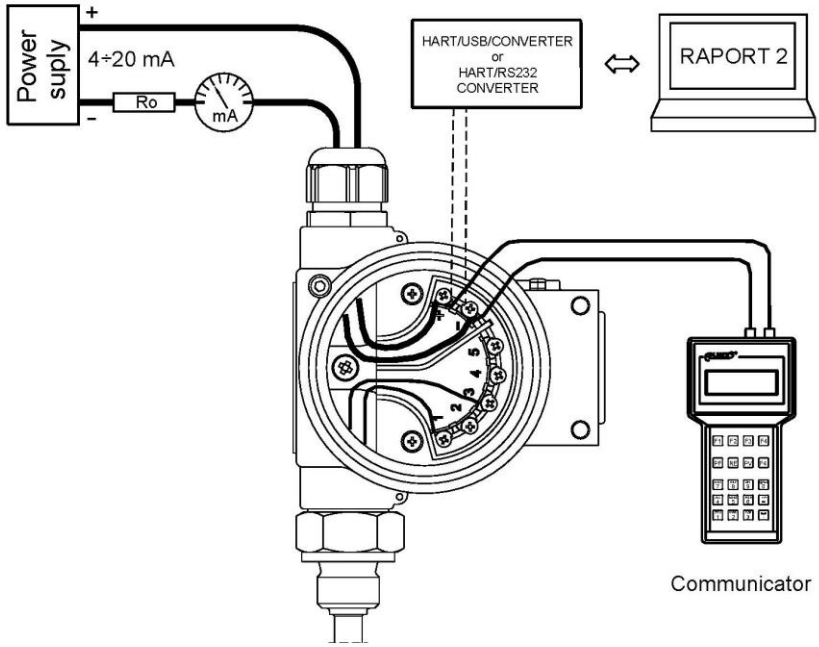


Fig. 2b. Communicator or converter connection to the transmitter's terminals <+> <->

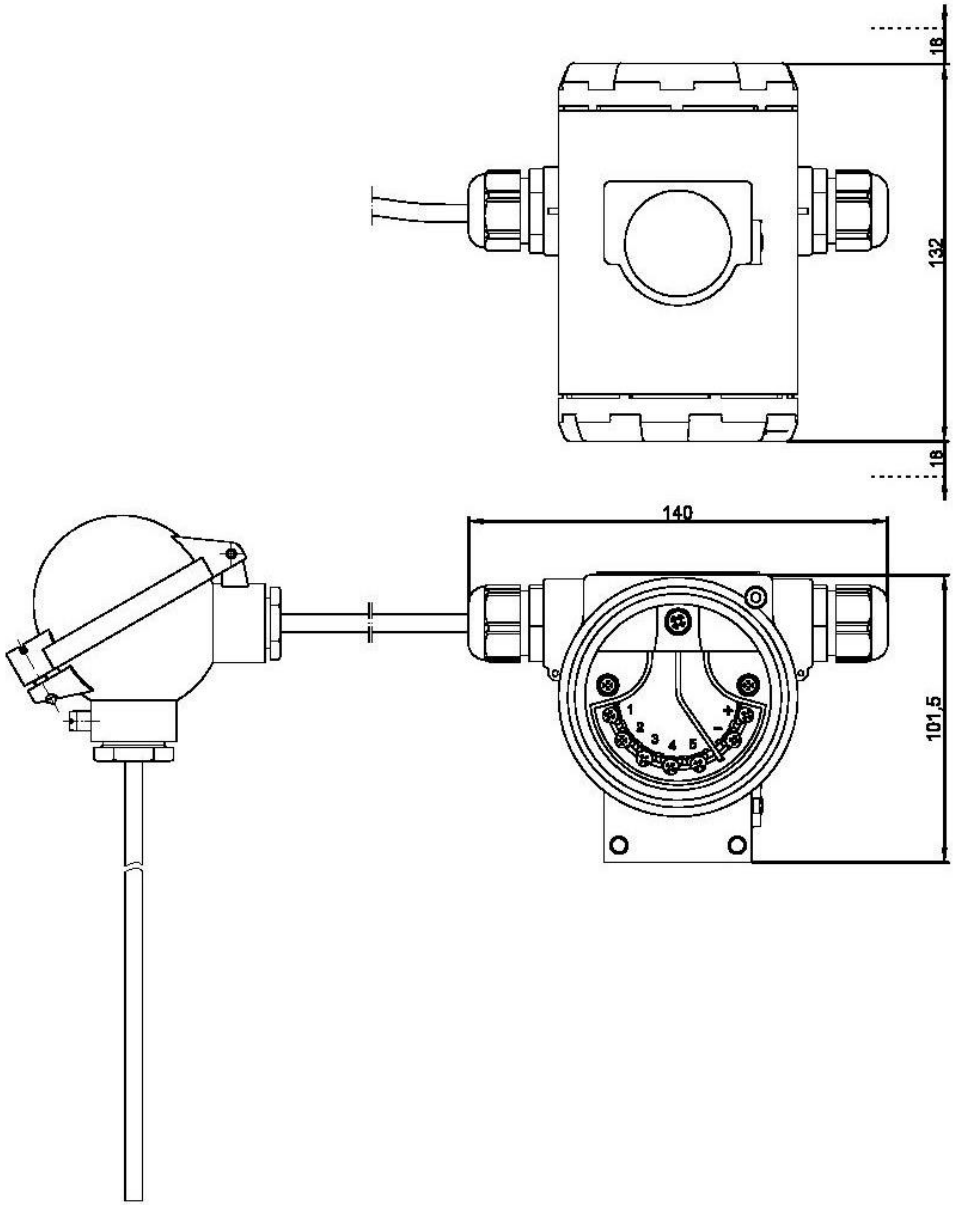


Fig. 3. LI-24ALW temperature transmitter with cable temperature sensor (example). Dimensions.

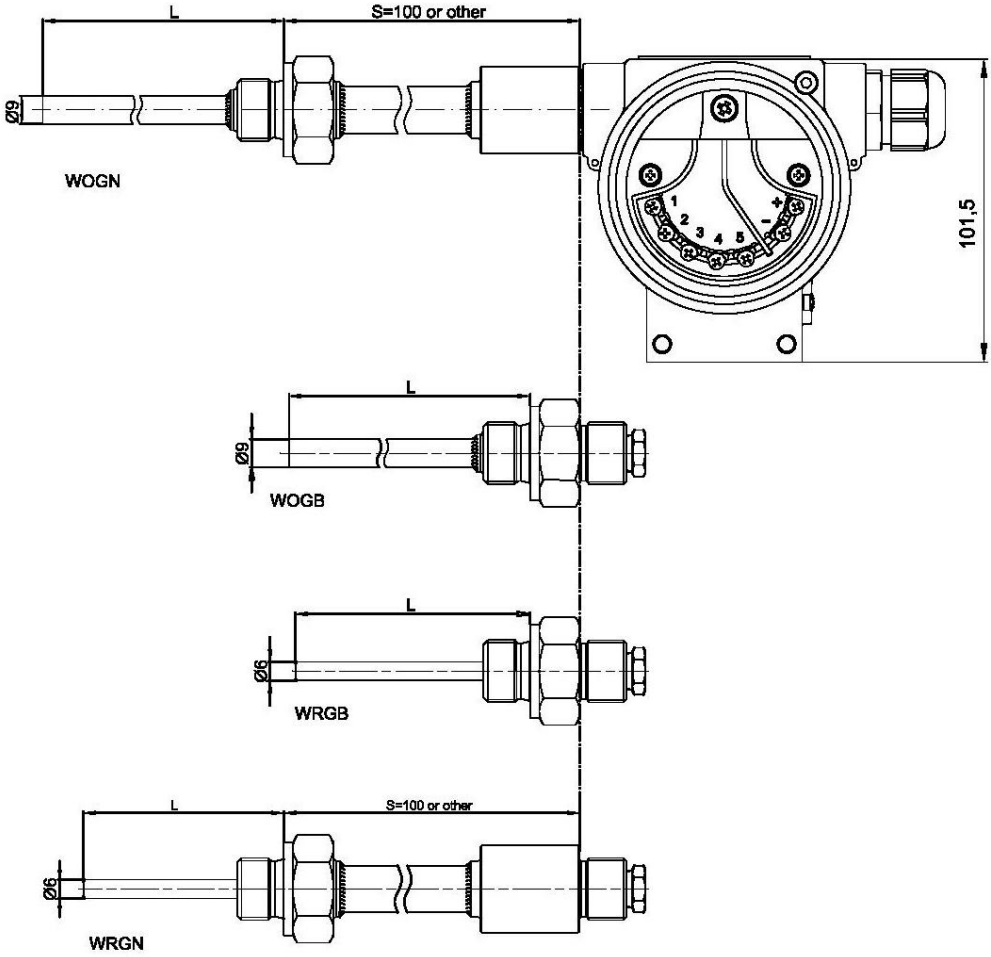
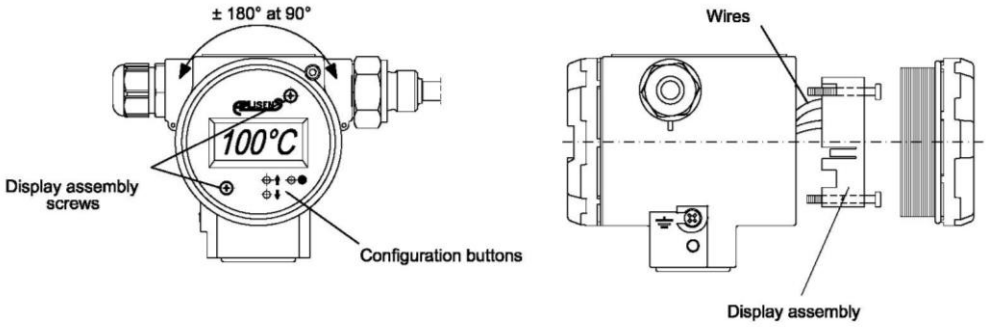


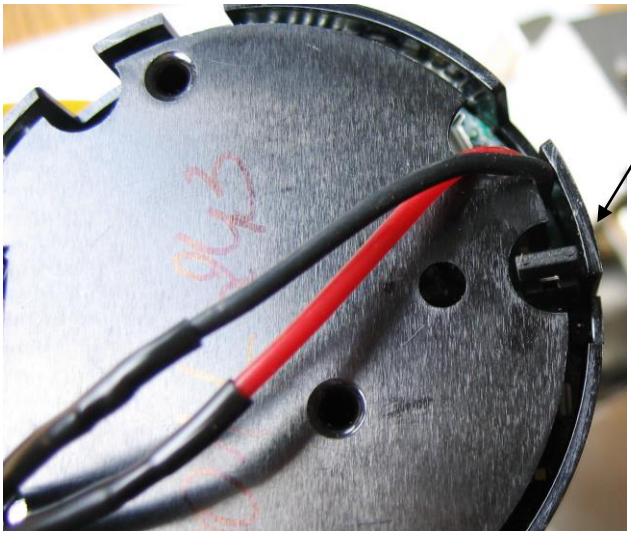
Fig. 4. LI-24ALW temperature transmitter with temperature sensor screwed into the enclosure (examples).



To adjust the display position proceed as follows:

1. Unscrew the display cover.
2. Unscrew display assembly screws.
3. Carefully pull the LCD display.
4. Carefully insert the LCD display in required position (possibility rotation ±180° at 90° step).
5. Screw the display assembly screws back on.
6. Screw the display cover.

Fig. 5. Transmitter without the cover for display position changing.



Jumper in radial position (as at photo) – back lighting off; jumper in circular position – back lighting on.

Fig. 6. Jumper of the display backlight unit in the transmitter electronics module (back side of the display).

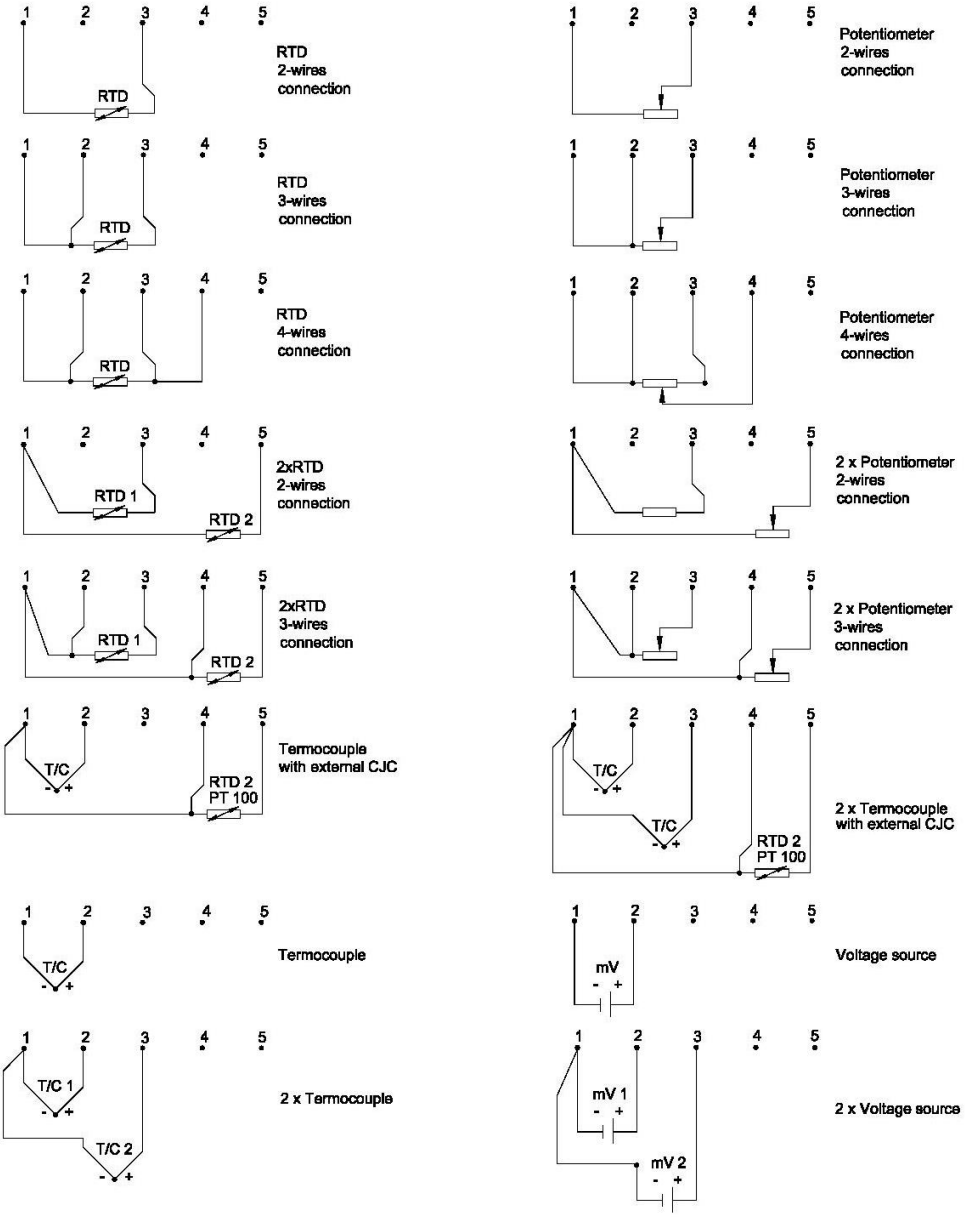


Fig. 7. Various possibilities of sensor connections to LI-24ALW transmitter.

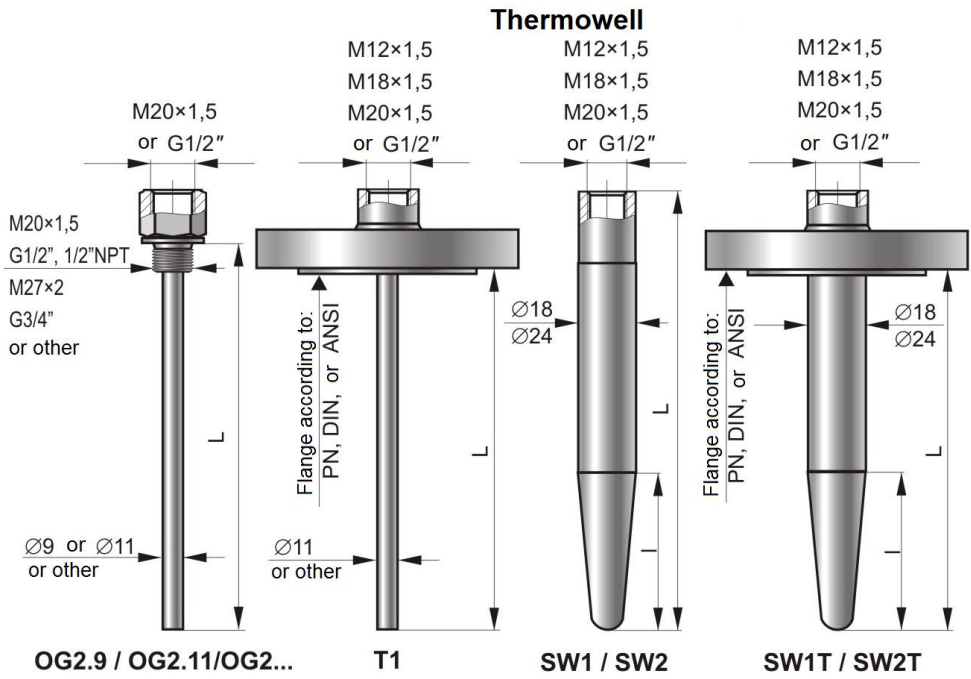


Fig. 8. APLISENS mounting shields for temperature sensors.

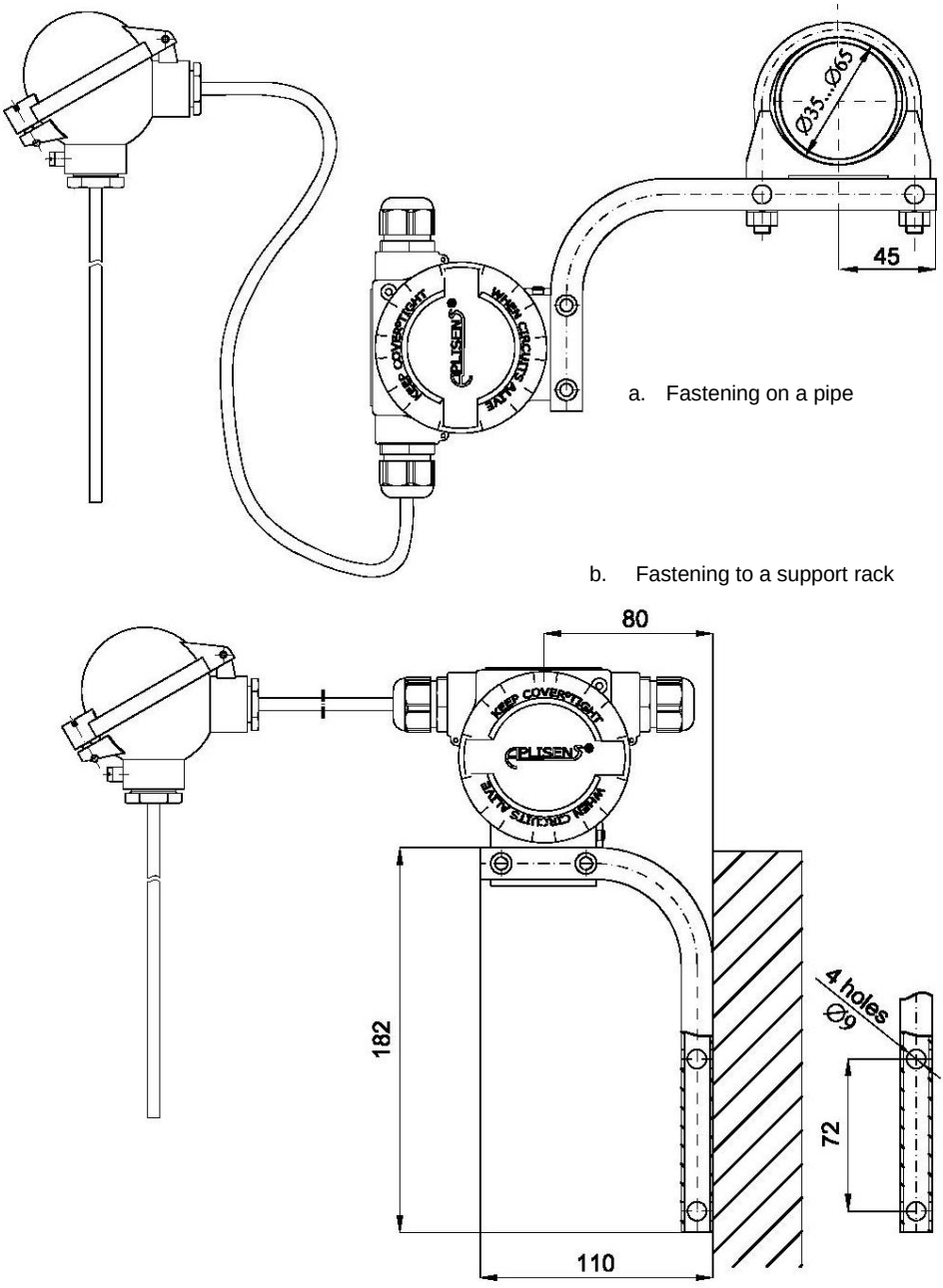
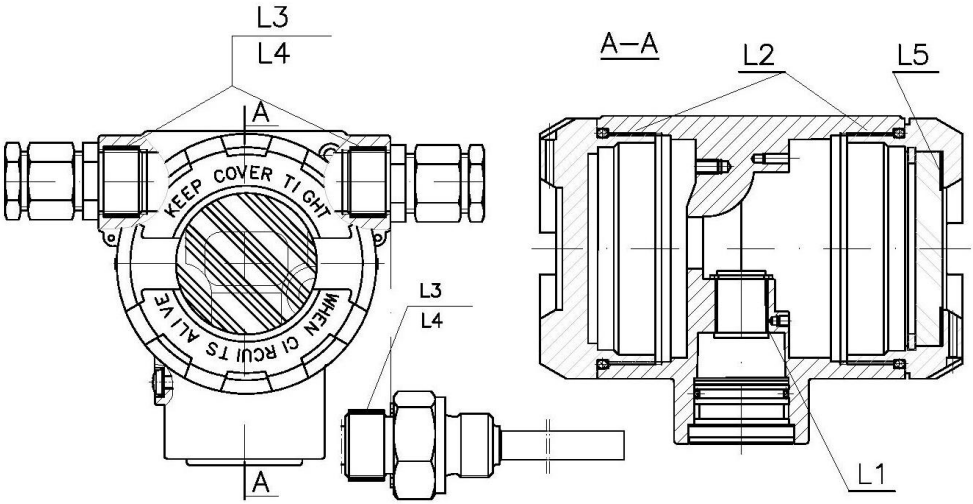


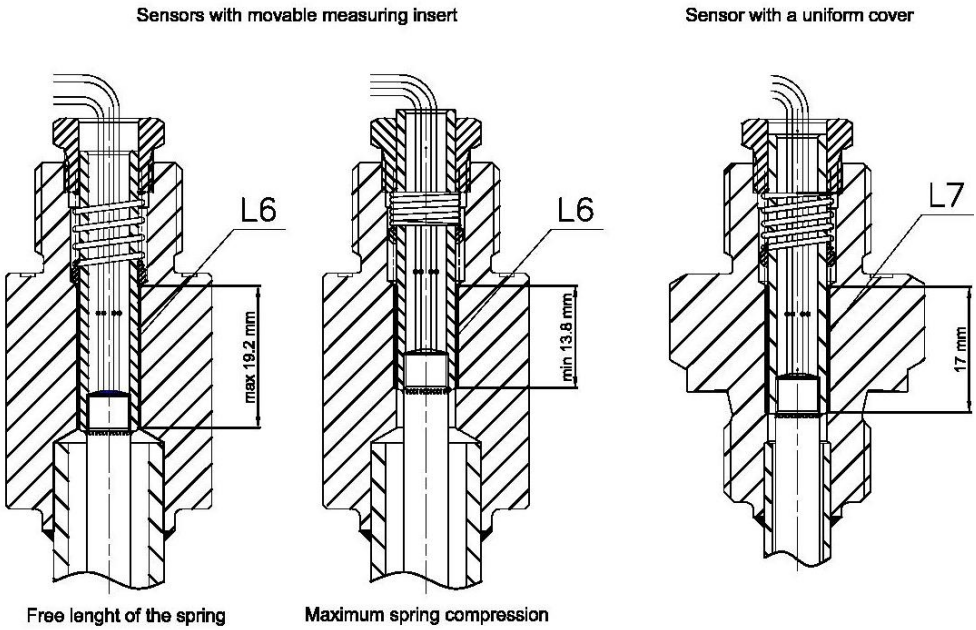
Fig. 9 Example: how to install LI-24ALW

a. Fastening on a pipe - transmitter with sensor screwed into the enclosure;
b. Fastening to a support rack - transmitter with cable temperature sensor.



MINIMUM WIDTH OF JOINT AND MAXIMUM GAP FOR GRUP IIC ENCLOSURES						
No	Width of joint (min. real) L [mm]	Diameter D [mm]	Diameter d [mm]	D–d [mm]	Quality of joint	Note (min value according to EN 60079–1:2007)
L1	13,2	$\phi 15^{+0,027}$	$\phi 15^{-0,040}_{-0,090}$	0,117	1	width of joint min 12,5
L2	12	M72x1,5	M72x1,5		2	min 5 threads enganged (8)
L3	9	M20x1,5	M20x1,5		2	min 5 threads enganged (6)
L4	12,7	1/2NPT	1/2NPT		2	min 6 threads enganged
L5	10				1	cemented joints width of joint min 10

Fig. 10. The explosion-proof joints of LI-24ALW transmitter.



LIST OF THE FLAME–PROOF JOINTS					
No	Width of joint (min real) L [mm]	Diameter D [mm]	Diameter d [mm]	D–d [mm]	Note (min value according to EN 60079–1:2007)
L6	min 13,8 max 19,2	ø8 +0,058	ø8 −0,040 −0,076	0,134	width of joint min 12.5mm / / max gap 0.15mm
L7	16,2	ø8 +0,058	ø8 −0,076	0,134	width of joint min 12.5mm / / max gap 0.15mm

Note:
When the spring is entirely compressed, the minimum length of the flameproof joints occur for a sensor with a movable measuring insert.

Fig. 11. The explosion-proof joints of the temperature sensors.