



LABOR – ASTER

INDUSTRIAL AUTOMATION



Intrinsically safe barrier

PROGRAMMABLE TEMPERATURE TRANSDUCER type S2Ex-TP with separation



- “group I”, “category M1” and “group II and III”, “category 1” accompanying device
- Intrinsically safe input circuit of level “ia” – ATEX compliance
- EC-Type Examination Certificate: KDB 04ATEX120

FEATURE: II (1)G [Ex ia] IIC, II (1)D [Ex ia] IIIC, I (M1) [Ex ia] I

- “group II”, “category 3” accompanying device with feature based on the conformity assessment procedure acc. to module A of the ATEX directive: II 3G Ex ec II T4 Gc

Protection level IP20

Operating temperature range -30...+70°C

- Intrinsically safe input circuit can work with sensors installed in ex zone „0, 1, 2, 20, 21, 22” of any explosive mixtures.
- Output and supply circuit can work with non-intrinsically safe circuits of devices with voltage $U_m=253V$, e.g. supplied from 230Vac network.
- The transducer can be installed in an explosion safe, dry and dust free room that is protected against access of people not trained in maintenance and operation of the transducer.
- The transducer can be installed in any explosion hazardous zone in explosion-proof designed enclosure e.g. in a flameproof enclosure or another in accordance to the relevant standards. Basing on designation II 3G Ex ec II T4 (category 3 device) it can be installed basing on other rules – see pages 4.
- For Pt100, Ni100 temperature sensors and „J”, „K”, „S”, „N”, „T”, „B” thermocouples or according to the order (other sensors on request e.g. Pt50, Cu50, Cu53, other thermocouples etc.)
- Digital linearization of the sensors
- Automatic or constant cold junctions compensation for thermocouples
- Programmable standards of output analog signal: 0...20mA, 4...20mA, 0...10V. Output type (current or voltage) should be also chosen by switcher accessible on the PCB after opening the housing (check the drawing on the penultimate page)
- High accuracy with narrow measuring ranges
- Galvanic separation of input, output and supply circuits
- Setting parameters from by using AsSETUP program

PURPOSE

S2Ex-TP converts input signal from temperature sensors to standard analog signal 0÷20mA, 4÷20mA or 0÷10V. The input, output and supply circuits are mutually galvanically separated.

The transducer has high accuracy even with narrow measuring ranges through digital signal processing and high versatility. The transducer works with most temperature sensors used in the industry. For thermocouples it has an internal cold junctions compensation or constant compensation temperature.

The transducer is configured by AsSETUP program and RS232 serial port. To configure the transducer use any PC with Windows and RS232 serial port.



User can program the following parameters:

- type of sensor which transducer works with;
- lower and upper range of input signal;
- digital filter of input signal;
- standard of output signal directly or reverse;
- precise calibration of measuring range;
- enable automatic cold junctions calibration or enter a constant compensation temperature.

In the case of thermoresistance sensors it is recommended to connect the sensor with three-wire line.

BASIC TECHNICAL PARAMETERS

1. Dimensions - 22,5x99x114,5mm
2. Mounting - on TS35 rail
3. Supply voltage - 22V \pm 28Vdc / 80mA
4. Input signal:
 - Pt100 - -200 ... 850 °C
 - Ni100 - -60 ... 180 °C
 - Fe-CuNi „J” - -150 ... 1200 °C
 - NiCr-Ni „K” - -200 ... 1350 °C
 - Pt10Rh-Pt „S” - 0 ... 1750 °C
 - NiCrSi-NiSi „N” - -100 ... 1300 °C
 - Cu-CuNi „T” - -200 ... 400 °C
 - Pt30Rh-Pt6Rh „B” - 0 ... 1800 °C
 - other types of sensors - on request
5. Minimal span
 - for Pt, Ni - 50°C
 - for thermocouples - 200°C
6. Sensor current Pt100/Ni100 - 1,0 mA
7. Output signal
 - programmable
 - current - 0(4) \div 20mA / < 550 Ω
 - voltage - 0 \div 10V / >50k Ω
8. Output update time - 0,25 sec.
9. Class - 0,2%
10. Nonlinearity error - \pm 0,05%
11. Ambient temperature error - 0,005% / °C
12. Accuracy of cold junctions - 1 °C
- compensation in range -30...70 °C
13. Maximum output current - 22mA
14. Connection of object - 0,5 ...1,5mm²
15. Isolation test voltage - 2 kV
16. Operation conditions
 - a. ambient temperature - -30 \div +70°C
 - b. storage temperature - -30 \div +70°C
 - c. relative humidity without condensation - up to 85%
 - d. environment - no dusts and aggressive gases
 - e. working position - any

FUNCTIONAL DESCRIPTION

The transducer measures input signal and process it according to programmed parameters (sensor type, range, digital filtering, precise calibration of measuring channel). The controller of the transducer sets the gain and offset of the input amplifiers. On this basis, the temperature value is computed and with regard to input range analog output signal is calculated. Microcontroller sets the programmed output type and controls analog output of the transducer. User must also open the housing and manually change the switcher on the PCB to current or voltage (see the drawing on the penultimate page of this datasheet). The transducer is operating in 0,25 sec period which means that the analog output is updated four times per second.

Lit of the green LED indicates the power supply and correct operating of the internal processor.

To program the parameters of the transducer use any PC equipped with serial port with program AsSETUP installed. Connect computer's

RS232 port to transducer's COM connector (socket RJ11, cable sold separately: [Cable RS232 \(labor-automatyka.pl\)](http://www.labor-automatyka.pl)). Supply the transducer and launch AsSETUP program.

The program allows to read the currently programmed parameters and modify them. The program should have loaded the configuration for TP-S2 transducer.

Note: the transducer checks correctness of the sending parameters. If the upper range value is lower than the lower value + 50°C for Pt/Ni or + 200°C for thermocouples the transducer automatically enters the limit value.

The design of the transducer is adapted for mounting on TS25 rail in the control cabinet.

For small input signals to reduce the impact of object interference connection cable should be shielded.

PARAMETERS CONFIGURED IN AsSETUP PROGRAM

For S2Ex-TP-0 version

• Sensor type:

0 – Pt100	1 – Ni100
2 – Fe-CuNi „J”	3 – NiCr-Ni „K”
4 – Pt10Rh-Pt „S”	5 – NiCrSi-NiSi „N”
6 – Cu-CuNi „T”	7 – Pt30Rh-Pt6Rh „B”

- Upper temperature range: 0 ... 1800 °C
- Lower temperature range: -200 ... 1000 °C

• Choosing measuring signal filter (time constant)

0 – no filtration	1 – 0,5 sec.	2 – 1 sec.
3 – 2 sec.	4 – 4 sec.	5 – 8 sec.
6 – 16 sec.	7 – 32 sec.	

• Analog output type:

After programming the output standard user must also change the switcher according to the table on the last page of this datasheet.

- 1 – output 0...10V
- 2 – output 0...20mA
- 3 – output 4...20mA
- 4 – output 10...0V
- 5 – output 20...0mA
- 6 – output 20...4mA

- Top measuring signal calibration -10,0 ... 10,0 %
- Bottom measuring signal calibration -10,0 ... 10,0 %

• Cold junctions compensation:

- 0 – automatic internal cold junctions compensation turned ON
- 1...700 – constant cold junctions compensation temperature/0,1°C from range 0,1 ... 70,0°C

Intrinsically safe input circuit of the transducer type S2Ex-TP with “ia” protection level (terminals 1, 2, 3, 4) can cooperate with circuits with “ia”, “ib” or “ic” protection level of a device installed in zone “0, 1, 2” of explosion mixtures with air, counted as explosive groups IIA, IIB IIC and in zone “20, 21 and 22” of dust explosion hazard (group III), according to its terms of use.

The device has a plastic housing and is adapted for mounting on a DIN T35 rail.

Protection level of the housing and its terminals is IP20.

External connections should be led with cables of a wire core diameter 0,5 \div 2,5mm².

ATEX compliance – directive 94/9/WE: PN-EN 60079-0:2013, PN-EN 60079-11:2012. PN-EN 60079-7:2016-02

EMC requirements 2014/30/UE: PN-EN 61326-1:2013

INTRINSICALLY SAFE PARAMETERS:

a) intrinsically safe input circuit - terminals 1, 2, 3, 4. Resistance measure two- and three-wire:

$U_0=5,88V$, $I_0=9,9mA$, $P_0=36mW$, $L_i=0,02mH$, $C_i\cong 0,2\mu F$,

The values of L_0 , C_0 and L/R connection cable parameters should be adopted according to the table shown below

Explosive group	L_0 [mH]	C_0 [μF]	L/R [mH/ Ω]
I and IIA	100	43	1,0
IIB and III	100	43	4,0
IIC	100	43	8,0

Characteristic of the circuits is trapezoidal

b) Intrinsically safe input parameters: terminals „3-4”:

$U_i=10,6V$, I_i any, P_i any, $L_i=0,02mH$, $C_i=0,2\mu F$.

c) Nonintrinsically safe circuit parameters:

„input” - terminals „5-6” and „supply” - terminals „7-8”: $U_m=253V$

configuration connector „COM”: $U_m=14,3V$

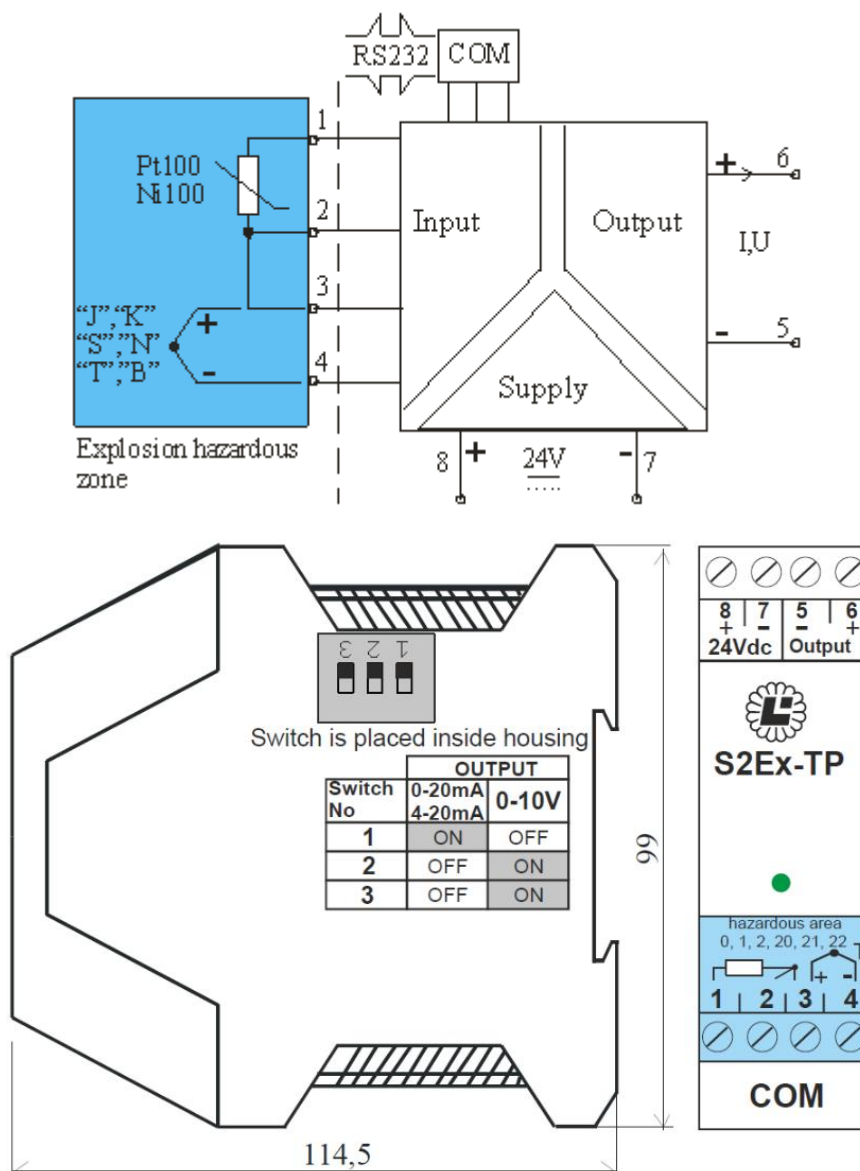
Safety parameters for group III (dusts) are the same as for group IIB.

In installations where parameters C_i and L_i of a device cooperating with intrinsically safe circuits (without connection cable) exceed 1% of the value of parameters C_0 and L_0 in the above table you should:

- subtract values C_i , L_i of the cooperating device from 50% of the values C_0 , L_0 ,
- the values remains for the parameters of the connection cable,
- if cable parameters are not known you can take for calculation values 200pF/m, 1 μH /m.

d) RS232 configuration connector circuit parameters: $U_m=14,28V$

The transducer S2Ex-TP can be configured only in safe zone with a computer type laptop with only battery supply while network supply is disconnected. Laptop's battery must have maximal voltage not greater then 14,28V. Typical batteries has $U=10,8V$ and 12,3V for short time when charged to maximum. After configuration is done one shall disconnect RS232 cable from the transducer.



Conditions of use:

Typically the device should be installed in a safe zone. Maximal values of capacity and inductance connected to intrinsically safe terminals "1, 2, 3, 4" of the transducer should be selected taking into consideration safety parameters of the connected circuits. They cannot exceed values given in the table above. External connections should be led with cables of a wire core diameter $0,5 \div 2,5 \text{ mm}^2$. The transducer can be installed in a hazardous zone in a flameproof enclosure (or other according to the applicable rules). Using the transducer in explosive group I does not require placing on the enclosure a warning and after the power supply is turned off it can be taken out of the housing without a delay. In case of using the transducer in explosive group II on the outside part of the enclosure should be placed a warning "Do not open the housing within 10 min. after turning off the power."

In general cables and wires of intrinsically safe circuits should be led separately regarding to non-intrinsically safe cables and wires. If intrinsically safe cable is shielded and is blue it can be in cable trays together with other non-intrinsically safe cables. Shield of the cable should be connected to the ground PE only from one side e.g. only in safe zone with a wire of $2,5 \text{ mm}^2$ diameter. Maintain a distance of 50mm from the end of the shield braid to the stripped ends of the cable cores in both the hazardous and safe zones. Put the crimping sleeves on the stripped ends of the cable cores. If in a multicore intrinsically safe cable are several intrinsically safe circuits the cables must be of A or B type with insulation test of 500V and the insulation cannot be thinner than 0.2mm. Cables and wires must be permanently fixed and protected against the possibility of mechanical damage. It is recommended to use blue cables. Compare the parameters $U_o, I_o, P_o, C_o, L_o, U_i, I_i, P_i, C_i, L_i$ (L, C of the cable and L_i, C_i of the device installed in the hazardous area).

If the L, C clustered parameters in the connected circuit (and this is how the L_i, C_i parameters of the connected device should be treated) exceed 1% of the L_o, C_o value, for the calculation should be taken of the L_o, C_o parameters given in the certificate for the clustered values. If such parameters are not provided, then half of the C_o, L_o value from the certificate should be taken for calculations with the assumption that the C_o value cannot exceed $1 \mu\text{F}$ for groups I, IIA, IIB and III and $0,6 \mu\text{F}$ for IIC.

If a "simple device" made of plastic is installed in the hazardous area, the risk of electrostatics should be assessed. In the case of cable routes with high energy (power grid) or interferences, cables with measurement signals susceptible to the impact of interferences, apart from the use of shielded twisted-pair cables, should be led at a distance, e.g. in a separate tray, and the routes crossing each other should be at right angles.

For installation in zone 2:

- 1) The housing provides a minimum degree of protection IP20. The device can be installed inside a building provided it is protected against dirt, dust, especially conductive dust, extreme mechanical exposures (eg vibrations, impacts, shocks), and thermal stress.
- 2) Installation outside the building requires an additional enclosure with a higher degree of protection minimum IP54 or higher, eg IP65, in accordance with the surrounding environment in which the installation operates. It may be an enclosure **without an explosion-proof designation**, but:
 - with the warning label "Caution: risk of electrostatic discharge" (see point 6).
 - provided that it will be mounted with protection against falls and mechanical impacts.
- 3) It is the safest to install the device in zone 2, both inside and outside of the building, in an explosion-proof designed enclosure (eg with an "Ex e" protection level) providing a minimum IP54 protection degree or higher (eg IP65) in accordance with the surrounding environment in which the installation operates.
- 4) Regardless of the place of installation, the devices must be protected against dirt, dust, especially conductive dusts, extreme mechanical infections (eg vibrations, impacts, shocks) and thermal stress.
- 5) In order to prevent self-loosing of cables in non-intrinsically safe screw terminals numbers 8, 7, 5, 6 one should place non-tinned cables in each of the clamp:
 - a single wire or cable with a twisted tip with a cross-section of $0,25 \div 2,5 \text{ mm}^2$. It is recommended to use a tube sleeve with plastic crimped by a specialized tool..
 - 2 cables with the same cross-section of $0,5 \div 1,5 \text{ mm}^2$ type wire with a twisted tip placed in a common tube sleeve with plastic crimped by a specialized tool.Tighten the terminal firmly with a torque of 0.5 Nm (typically 2 kfg force on the handle of a screwdriver with a diameter of 2.5 cm) with a flat screwdriver 3.0...3.5 mm wide. Every 6 months, check the tightening of the terminals by tightening with a torque of 0.5 Nm using a screwdriver with a width of 3...3.5 mm.
- 6) If the housing needs cleaning, use a cloth lightly moistened with a mixture of detergent and water.
Electrostatic hazard: to avoid the risk of electrostatic discharge, the casing of the device and / or the enclosure in which the device is installed should be cleaned only with a damp or antistatic cloth (soaked in antistatic liquid).
Avoid any penetration of cleaning liquid into the interior to prevent damage to the device.
- 7) Non-intrinsically safe circuits (including 24Vdc power supply) must be connected to power suppliers and devices galvanically separated from the power grid (SELV or SELV-E circuits) with a CE designation.
- 8) If an explosive atmosphere is present or can occur, non-intrinsically safe terminals numbers 8, 7, 5, 6 must not be connected/disconnected to/from cables of non-intrinsically safe circuits with voltage. If an explosive atmosphere is present or can occur during service work, disconnect non-intrinsically safe circuits only in the safe area. If there is no explosive atmosphere during service work, the above-mentioned principles from point 8 are not required.

ORDERING CODE:

TEMPERATURE CONVERTER type S2Ex-TP - X	
Programmable only resistance sensors (e.g. Pt100) - R	
Programmable only thermocouple sensors (e.g. „K”) - T	
Programmable resistance and thermocouple sensors - RT	

ORDER EXAMPLE: Programmable converter of thermocouple sensors, type: S2Ex-TP-T

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