S3Ex-R

ATEX

TWO-WIRE RESISTANCE TRANSMITTER

(temperature, position, potentiometer) with separation

- "group I", "category M1" and "group II", "category 1" accompanying device,
- Intrinsically safe input circuit of level „ia" – ATEX compliance,
- EC type examination certificate: KDB 10ATEX129
FEATURE: I (M1) [Ex ia] I, II (1)G [Ex ia] IIC, II (1)D [Ex iaD] 20
Protection Level IP20 Operating temperature range -25..+70°C
Designation based on the ATEX conformity assessment procedure of module A:
II 3G Ex ec II T4, group "II" category "3" device

- Intrinsically safe input circuit can operate with a sensor installed in zone „0, 1, 2" of explosive mixtures with air belonging to explosion group IIA, IIB, IIC and in zone „20, 21 and 22"of explosive dust – including a temperature or position sensor.
- Output circuit can work with non-intrinsically safe circuits of devices with voltage **Um=253V**, e.g. supplied from 230Vac network.
- Transmitter can be installed only in a safe room in terms of explosion or in explosion hazardous zone in enclosure of a device with explosion-proof construction (see page 3). The surroundings should be dry, dust-free and protected against access of people not trained in maintenance and operation of the converter.
- Transmitter as accompanying device can be installed in any explosion hazardous zone in enclosure with explosion-proof construction e.g. in flameproof housing or in zone 2 in other enclosure according to applicable rules. Basing on the marking Ex ec II T4 (device of category 3) converter can be installed in accordance with the rules given on page 3.

Purpose

S3Ex-R transmitter is designed to convert the resistance increment of the sensors to 4÷20mA current signal in two-wire current loop. Output circuit is galvanically isolated from input circuit which is cooperating with sensor. Converter allows linearization for platinum sensors Pt.

Transmitter can be used as :
-linear converter of resistance increments: $f = k * \Delta R$,
-linear converter of temperature changes for sensors Pt (PN-EN-60751); $f = k * \Delta T$,
-converter of potentiometer position (fig.1).

When using a three-wire, homogenous (all three strands the same) connection line (or four-line at customer's request), S3Ex-R converter provides total compensation of changes in the sensor connection line parameters. This also means no necessity to adjust ″zero″ and ″range″ when the line is changed in length. Using separation can reduce the influence of the object interference to the center part working.

Technical parameters:

Input signal:	**- resistance changes**
	- ΔR_{min}=1Ω, ΔR_{max}=10 000Ω
-Pt100 , Ni100	**- ΔT_{min}=20°C**
-Pt500, Pt1000 etc.	**- negotiable**
-potentiometer position	**- ΔR_{min}=10Ω**
Output signal:	**- 4÷20mA**
supply voltage Uz	- 10V ÷ 27V
output load resistance	- R=(Uz-10V)/20mA [kΩ]
Note: for supply voltage >29V burning of the protection barrier fuse may occur – to be repaired by the producer	
Galvanic separation	**- between input and output**
insulation test voltage	- **2 kV, 50Hz** or equivalent
Class	- 0.1%
Nonlinearity error:	
f=k∗ΔR	- ±0.05%
f=k∗ΔT sensor after linearization.	- ±0.1%
Supply voltage change error Uz	- ±0.02%
Ambient temperature change error	- 0.01 % / °C ; ΔR≥10Ω - 0.02 % / °C ; ΔR<10Ω
Zero and range regulation	- ±7.5% by potentiometers
Sensor-converter connection	- S3Ex-R three-wire line - S3Ex-R-(4) four-wire line
Maximum resistance of the sensor connection line	- fig.1
- two-wire	- ≤ 10 Ω
- three- or four-wire	- ≤ 30Ω
Time constant	- < 0.2 s, after arrangement 0.001÷1sec

Ordering code:

S3Ex-R - --------	resistance transmitter (three-wire)
S3Ex-R-(4) - ----	resistance transmitter (four-wire)
P1÷P23 ----	measurement range in table 1
N1÷N11----	measurement range in table 2
R_{min} /R_{max}---	resistance potentiometer min/max value
L -	with linearization
BL -	without linearization

Note: For other than table 1 or 2 ranges please provide minimum and maximum value of the temperature and sensor type.

Order example:

S3Ex-R-(4) resistance transmitter (four-wire sensor connection), rail housing, Pt1000 sensor, range 0 ÷ 15°C, with linearization: S3Ex-R-(4) - (Pt1000, 0÷15°C) - L

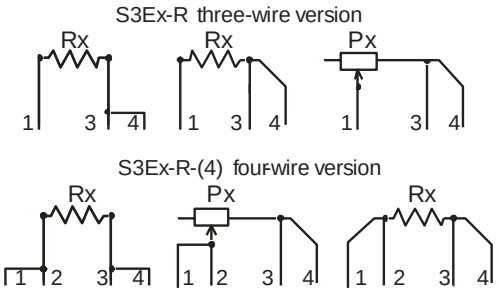

Fig.1. Resistance sensors Rx and potentiometers P connection

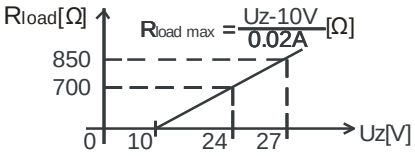

Fig.2 Method of determining the load resistance

LABOR-ASTER www.labor-automatyka.pl , biuro@labor-automatyka.pl Edition 02/2022
tel. +48 22 610 71 80, 610 89 45, fax 22 610 89 48; Poland, 04-218 Warsaw, ul. Czechowicka 19

Measurement ranges:

Table 1. Pt100

Range number	Range °C	Nonlinearity of the sensor [%]
P1	0.....25	+0.11
P2	0.....40	+0.12
P3	0.....60	+0.22
P4	0...100	+0.39
P5	0...120	+0.46
P6	0...150	+0.57
P7	0...200	+0.76
P8	0...250	+0.96
P9	0...300	+1.16
P10	0...400	+1.58
P11	0...550	+2.22
P12	50...150	+0.38
P13	100...320	+0.87
P14	100...400	+1.2
P15	200...320	+0.49
P16	200...400	+0.81
P17	300...550	+1.06
P18	-10... +40	+0.18
P19	-20... +20	+0.16
P20	-30... +60	+0.34
P21	-30.. +150	+0.69
P22	-100...+50	+0.62
P23	-220...+50	+1.37
Other ranges according to the order		

Table 2. Ni100

Range number	Range °C	Nonlinearity of the sensor [%]
N 1	0.....25	-0.67
N 2	0.....40	-1.1
N 3	0.....60	-1.6
N 4	0...100	-2.8
N 5	0...120	-3.5
N 6	0...150	-4.5
N 7	50...150	-3.0
N 8	-10... +40	-1.4
N 9	-20... +20	-1.15
N 10	-30... +60	-2.5
N 11	-30.. +150	-5.2
Other ranges according to the order		

Transmitter is enclosed in self-extinguishing plastic (polyamide PA 6.6) intended for mounting on TS 35 rail. The degree of housing and terminals protection is IP20.

ATEX compliance - directive 2014/34/UE: PN-EN 60079-0:2013, PN-EN 60079-11:2012, PN-EN 60079-7:2016

EMC requirements 2004/108/WE - PN-EN 61326-1:2013

Intrinsically safe parameters for S3Ex-R – input circuit with „ia" protection level:

a) Intrinsically safe input circuit: **„Input" – terminals „1, 2, 3, 4"**: with „ia" protection level:
Uo=5,4V, Io= 9,9mA, Po=17mW, Li=0,1mH, Ci≅ 33nF,
Lo, Co values and L/R connection cable parameters should be according to the table below:

Explosion group	Lo [mH]	Co [µF]	L/R [mH/Ω]
I and IIA	100	10	17
	5	18	
	0,05	67	
IIB	100	5,6	8
	5	8,5	
	0,05	32	
IIC	100	1,1	2,2
	5	1,6	
	0,05	4,8	
Trapezoid characteristics of the circuits.			

b) Non-intrinsically safe parameters of the output circuit: **„Output" – terminals „5, 6, 7"**: **Um=253V**

In installations where parameters Ci and Li of a device operating with intrinsically safe circuit (excluding the connection cable) exceed 1% of the value of parameters Co and Lo given in the table above there shall:

- from 50% of the value Co, Lo subtract Ci, Li of cooperating device,
- received values remains for the connection cable parameters,
- if cable parameters are unknown, for calculation should be taken 200pF/m, 1,5µH/m.

Conditions of use:

Typically the transmitter should be installed in safe zone.

The transmitter can be installed in explosion hazardous zone in flameproof enclosure (or other according to the rules in force). Using it in explosion group I does not require putting a warning on the housing. After turning off the power supply it can be taken out from the housing without delay. In case of use the transmitter in explosion group II on the outter part of the housing should be warning "Do not open the enclosure within 10 minute after turning off the power supply".

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 safest to install the device in zone 2, both inside and outside of the building, in an explosion proof 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 5, 6, 7 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 ÷ 2.5 mm²,
   - 2 cables with the same cross-section of 0.5 ÷ 1.5 mm² type wire with a twisted tip placed in a common tube sleeve with plastic crushed 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).

8) If an explosive atmosphere is present or can occur, non-intrinsically safe terminals numbers 5, 6, 7 must not be connected to live cables. When the device is powered, you can disconnect / connect disconnectable connector blocks but do not disconnect / connect non-intrinsically safe circuits. If an explosive atmosphere is present or can occur during service work, disconnect all non-intrinsically safe connector blocks or disconnect these circuits in the safe area. If there is no explosive atmosphere during service work, the above-mentioned principles from point 8 are not required.

Operation conditions:

Ambient temperature - storage	-	-30 ÷ +70°C
Ambient temperature - operating	-	-25 ÷ +70ºC
Relative Humidity	-	max 90%
Environment	-	no dusts and aggressive gases
Operation position	-	any

Output can be connected between terminals „6,5” or „6,7”. By connecting output according to fig.3b output current value can be tested with a ammeter (R≤10Ω) without cables disconnecting.

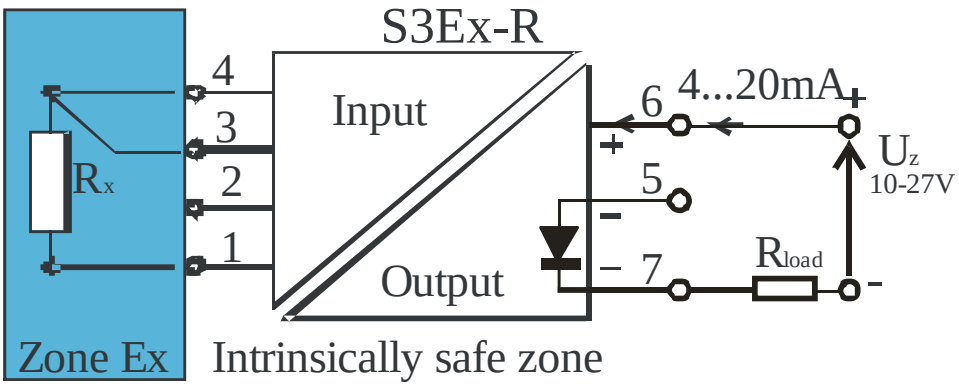

Fig 3a Load connection to the transmitter without output current control

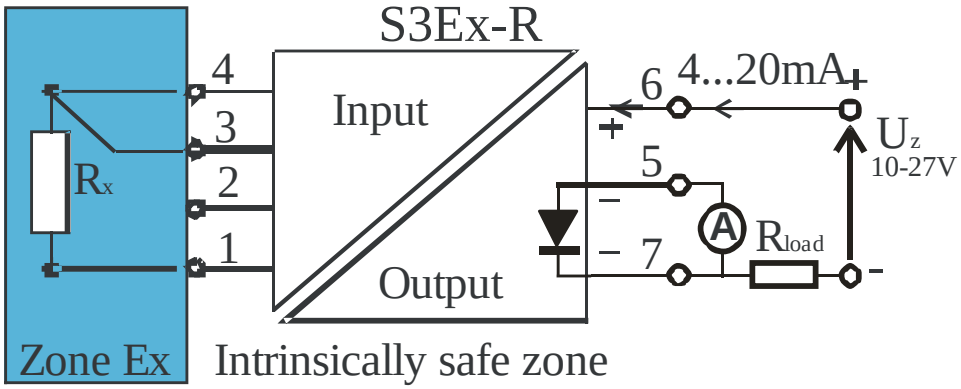

Fig. 3b Load connection to the transmitter with output current control