S1-ExB CIRCUIT SEPARATOR self-powered

1 or 2 channels in rail housing with 22,5mm width

- "Group I", "category (M1)" and "group II and III", "category (1)" accompanying device
- Intrinsically safe output circuit with safety level of ia – consistent with ATEX
- EC-Type Examination Certificate: KDB 10ATEX129

FEATURE I (M1) [Ex ia Ma] I, II (1)G [Ex ia Ga] IIC, II (1)D [Ex ia Da] IIIC
Housing protection level IP20 Range of working temperature -25..+70°C
Feature basing on conformity assessment procedure according to ATEX module A:
II 3G Ex ec II T4, "group II", "category 3" device

- Intrinsically safe output circuit can operate with intrinsically safe circuit with ia or ib protection level of a device installed in hazardous zone "0, 1, 2, 20, 21, 22" of any explosive mixtures. Safety parameters of the output circuit Uo, Io, Po should be selected from five options according to the order code.
- Input circuit can operate with non-intrinsically safe circuits of devices with voltage **Um=253V** e.g. supplied from 230Vac network.
- The separator 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 separator.
- The separator 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:

The separator provides galvanic separation of the output circuit cooperating with hazardous zone from the input circuit.
The separator does not use any auxiliary power source (no auxiliary power). It is supplied with input measurement current.
The input signal is current. The output current is equal to the input current.
Output signal 0/4÷20mA can be converted to voltage signal 0/2÷10V by applying an external reference resistor 500Ω (fig. 2).
The separator S1-ExB transfers active current signal from safe zone to hazardous zone e.g. to indicator, solenoid valve, positioner, two-wire transmitter 4÷20mA etc. The separator S1-ExB2 ensures the cooperation of fire detectors installed in hazardous zone with the control unit installed in safe zone – fig. 3.
A valuable application of the separators S1-ExB3, S1-ExB4, S1-ExB5 to cooperate with two-wire transmitter shows fig. 1.

Order code

S1-ExB ---- Intrinsically safe output circuit
S1-ExB1 U=24±1,2V ⇒ Uo=25.2V, Io=121mA,
S1-ExB2 U=24±1,2V ⇒ Uo=25.2V, Io=39.3mA,
S1-ExB3 U=24±1,2V ⇒ Uo=25.2V, Io=89mA,
S1-ExB4 U=22±1,1V ⇒ Uo=23.1V, Io=98mA,
S1-ExB5 U=16.4±0.8V ⇒ Uo=17.2V, Io=91mA,
S1-ExB6 U=9.1±0.46V ⇒ Uo=9.56V, Io=139.8mA
S1-ExB7 U=24±1.2V ⇒ Uo=25.2V, Io=61.7mA
-1 1-channel version
-2 2-channel version
-f pulse operation only, without 4…20mA, frequency band increased to 3000Hz (to 6000Hz on request)

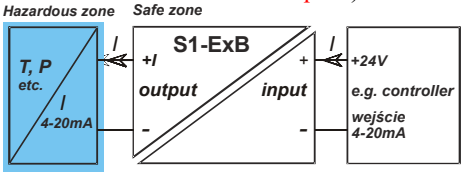

Fig. 1. S1-ExB3 or S1ExB4 – supply and separation for two-wire transmitter 4÷20mA.

Input signal - DC current 0 ÷ 100mA
input voltage drop at current 20mA:
$U_{IN} = 3.2V + (R_{SERIAL} \cdot 0.02A)$
where R_{SERIAL} depends on the S1-ExB version:
(for version "-f" sum up additional 100Ω)
S1-ExB1 ⇒ $R_{SERIAL} = 230\Omega + R_{LOAD}$
S1-ExB2 ⇒ $R_{SERIAL} = 690\Omega + R_{LOAD}$
S1-ExB3 ⇒ $R_{SERIAL} = 310\Omega + R_{LOAD}$
S1-ExB4 ⇒ $R_{SERIAL} = 260\Omega + R_{LOAD}$
S1-ExB5 ⇒ $R_{SERIAL} = 210\Omega + R_{LOAD}$
S1-ExB6 ⇒ $R_{SERIAL} = 82\Omega + R_{LOAD}$
S1-ExB7 ⇒ $R_{SERIAL} = 440\Omega + R_{LOAD}$
Each time, select the required version by estimating the maximum R_{LOAD} and I_{OUT}.
max input voltage - 30V
Output signal - DC current $I_{OUT} = I_{IN}$
voltage output for input 0/4÷20mA - external resistor connected to output terminals:
50Ω ⇒ 0/0.2 ÷ 1V
250 Ω ⇒ 0/1 ÷ 5V
500 Ω ⇒ 0/2 ÷ 10V
Class (used as in fig. 2) - 0.1% - 0,05% · (R_{SERIAL}/100Ω)
Temperature drift - ±0.005%/°C
Time constant - min 5ms
after agreement more e.g. 0,1s
Isolation test voltage - **2,5 kV, 50 Hz** or equivalent
Housing dimensions: width x height x depth
22,5 mm x 79 mm x 74 mm

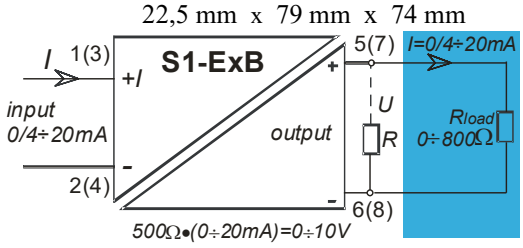

Fig. 2. Typical application – current circuits separation.

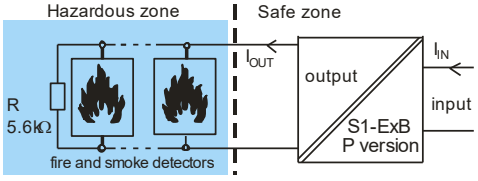

Fig. 3. S1-ExB2 or S1-ExB3 – cooperation with smoke and fire detectors.

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tel. +48 22 610 71 80, +48 22 610 89 45 Poland, 04-218 Warsaw, ul. Czechowicka 19

Application of separator S1-ExB for two-wire transmitter installed in explosion hazardous zone

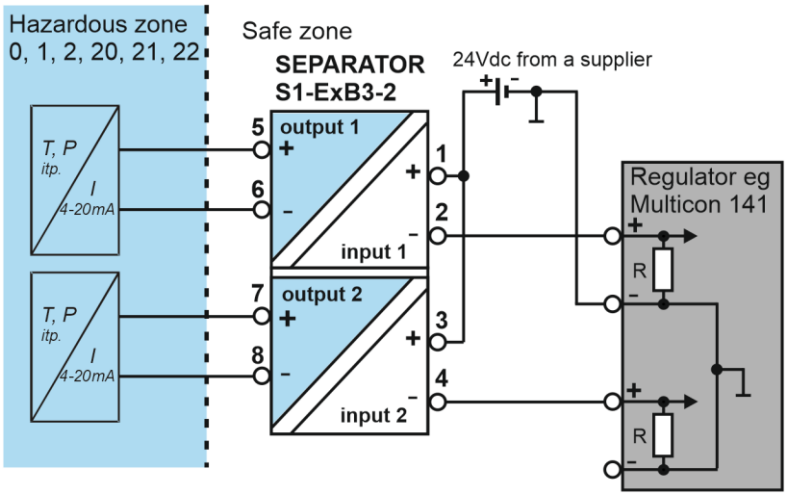


Fig. 4. Example of use of two-channel separator type S1-ExB3 for connection of two-wire transmitters installed in hazardous zone to a regulator (e.g. Multicon 141), which has passive inputs (for active current signals), with external 24Vdc power supplier.

Voltage drop on the input for application from fig. 1 and fig. 4 when two-wire 4-20mA transmitter is connected to intrinsically safe output of separator S1-ExB (version with 20Hz frequency band):

S1-ExB1 $\Rightarrow U_{IN} = 3{,}2V + 230\Omega \cdot 0{,}02A$ + voltage necessary on the terminals of two-wire 4-20mA transmitter
S1-ExB2 $\Rightarrow U_{IN} = 3{,}2V + 690\Omega \cdot 0{,}02A$ + voltage necessary on the terminals of two-wire 4-20mA transmitter
S1-ExB3 $\Rightarrow U_{IN} = 3{,}2V + 310\Omega \cdot 0{,}02A$ + voltage necessary on the terminals of two-wire 4-20mA transmitter
S1-ExB4 $\Rightarrow U_{IN} = 3{,}2V + 260\Omega \cdot 0{,}02A$ + voltage necessary on the terminals of two-wire 4-20mA transmitter
S1-ExB5 $\Rightarrow U_{IN} = 3{,}2V + 210\Omega \cdot 0{,}02A$ + voltage necessary on the terminals of two-wire 4-20mA transmitter
S1-ExB6 $\Rightarrow U_{IN} = 3{,}2V + 82\Omega \cdot 0{,}02A$ + voltage necessary on the terminals of two-wire 4-20mA transmitter
S1-ExB7 $\Rightarrow U_{IN} = 3{,}2V + 440\Omega \cdot 0{,}02A$ + voltage necessary on the terminals of two-wire 4-20mA transmitter

Correct version of the separator must be chosen by estimating necessary max Iout and max Rload.
In addition safety parameters Uo, Io, Po of the separator must be selected comparing to the parameters Ui, Ii, Pi of connected two-wire 4-20mA transmitter.

Note:

Class for application from fig. 2 — **0.1% typically for Rload ≤ 250Ω**
for any load resistance **±0,05% - 0,05%•(RLOAD/100Ω)**

Class for application from fig. 1 and fig. 4 — **+0.3%**

Second limitation of this application is requirement: (Uo-10%)+3,2V>Uin.

Example:

1) Two-wire transmitter on hazardous zone which requires Umin=13V at 20mA. Using above equations there are the following requirements on minimal Uin voltage depending on the version of S1-ExB separator:
   - S1-ExB1 $\Rightarrow U_{IN} = 3{,}2V + 230\Omega \cdot 0{,}02A + 13V = 20{,}8V$
   - S1-ExB2 $\Rightarrow U_{IN} = 3{,}2V + 690\Omega \cdot 0{,}02A + 13V = 30V$
   - S1-ExB3 $\Rightarrow U_{IN} = 3{,}2V + 310\Omega \cdot 0{,}02A + 13V = 22{,}4V$
   - S1-ExB4 $\Rightarrow U_{IN} = 3{,}2V + 260\Omega \cdot 0{,}02A + 13V = 21{,}4V$
   - S1-ExB5 $\Rightarrow U_{IN} = 3{,}2V + 210\Omega \cdot 0{,}02A + 13V = 20{,}4V$
   - S1-ExB6 $\Rightarrow U_{IN} = 3{,}2V + 82\Omega \cdot 0{,}02A + 13V = 17{,}8\ V$
   - S1-ExB7 $\Rightarrow U_{IN} = 3{,}2V + 440\Omega \cdot 0{,}02A + 13V = 25V$

   a) Having Uin=24Vdc (e.g. in DCS) suitable will be versions which require less voltage than Uin so in this case: S1-ExB1, S1-ExB3. Versions S1-ExB2, S1-ExB7 require higher supply voltage and will not be good in this application. Versions S1-ExB4, S1-ExB5, S1-ExB6 do not meet the requirement (Uo-10%)+3,2V>Uin.

   b) Having Uwe=18Vdc (e.g. in DCS) suitable will be versions which require less voltage than Uin so in this case it would be only S1-ExB6 but S1-ExB6 does not meet the requirement (Uo-10%)+3,2V>Uin. Other versions require higher supply voltage and will not be good in this application so for two-wire transmitter with Umin=13V and having 18V from DCS each version is not suitable.

2) Two-wire transmitter on hazardous zone which requires Umin=10V at 20mA.:
   - S1-ExB1 $\Rightarrow U_{IN} = 3{,}2V + 230\Omega \cdot 0{,}02A + 10V = 17{,}8V$
   - S1-ExB2 $\Rightarrow U_{IN} = 3{,}2V + 690\Omega \cdot 0{,}02A + 10V = 27V$
   - S1-ExB3 $\Rightarrow U_{IN} = 3{,}2V + 310\Omega \cdot 0{,}02A + 10V = 19{,}4V$
   - S1-ExB4 $\Rightarrow U_{IN} = 3{,}2V + 260\Omega \cdot 0{,}02A + 10V = 18{,}4V$
   - S1-ExB5 $\Rightarrow U_{IN} = 3{,}2V + 210\Omega \cdot 0{,}02A + 10V = 17{,}4V$
   - S1-ExB6 $\Rightarrow U_{IN} = 3{,}2V + 82\Omega \cdot 0{,}02A + 10V = 14{,}8\ V$
   - S1-ExB7 $\Rightarrow U_{IN} = 3{,}2V + 440\Omega \cdot 0{,}02A + 10V = 22V$

   a) Having Uin=18Vdc (e.g. in DCS) suitable versions would be S1-ExB1, S1-ExB5. Versions S1-ExB2, S1-ExB3, S1-ExB4 oraz S1-ExB7 require higher supply voltage and will not be good in this application. Version S1-ExB6 does not meet the requirement (Uo-10%)+3,2V>Uin.

Application of separator type S1-ExB2 or S1-ExB3 for pulser e.g. NI-3 operating with gasmeters e.g. UG G1,6; UG G2,5; UG G4.

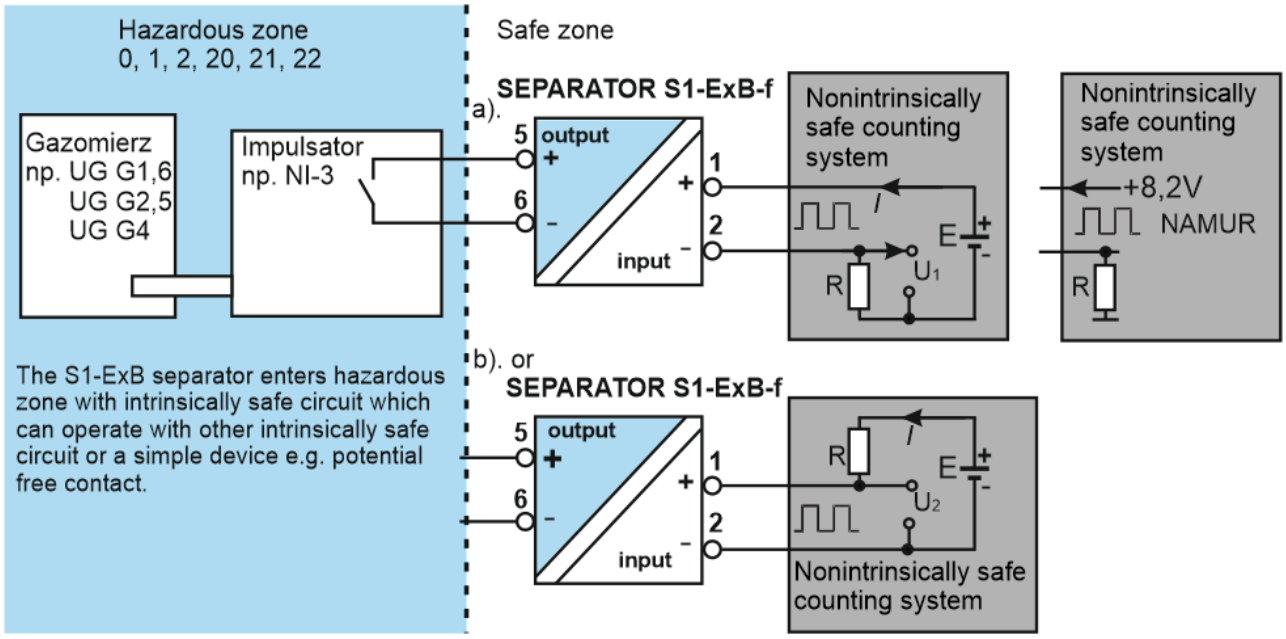


Fig. 5. Separator type S1-ExB2-f or S1-ExB3-f in one-channel version to operate with gasmeter pulser e.g. NI-3. Correct operational up to 3000Hz (to 6000Hz on request).

Choosing resistance R and supply voltage E.

Depending on the needs voltage E can have value from range: $3V_{DC} < E < 24V_{DC}$

Depending on the needs resistance R can have value from range: $1\ k\Omega < R < 51\ k\Omega$

Example 1: E=5V, R=24 kΩ

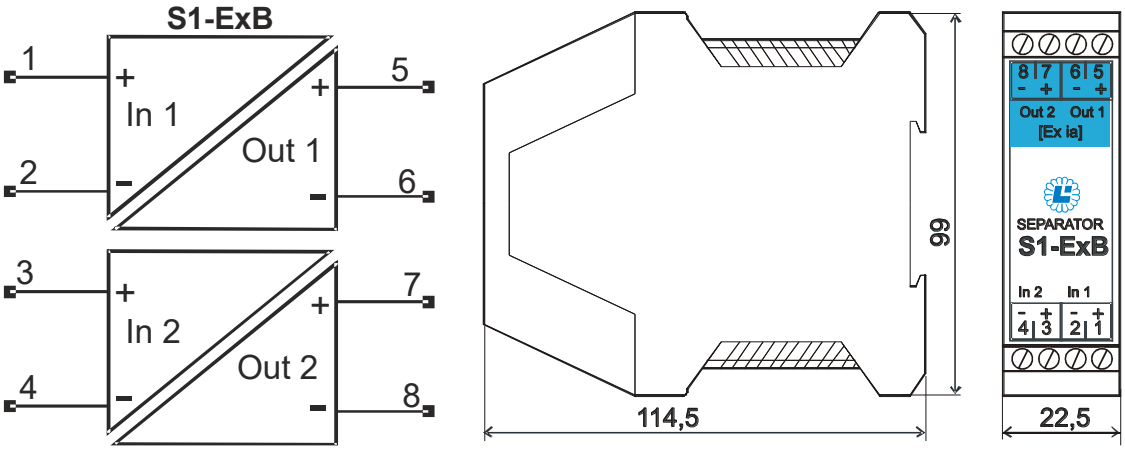
- pulser contact opened ⇒ I=25 µA; U_1=0,6 V; U_2=4,4 V
- pulser contact shorted ⇒ I=140 µA; U_1=3,3 V; U_2=1,7 V

Example 2: E=8,2V, R=1 kΩ

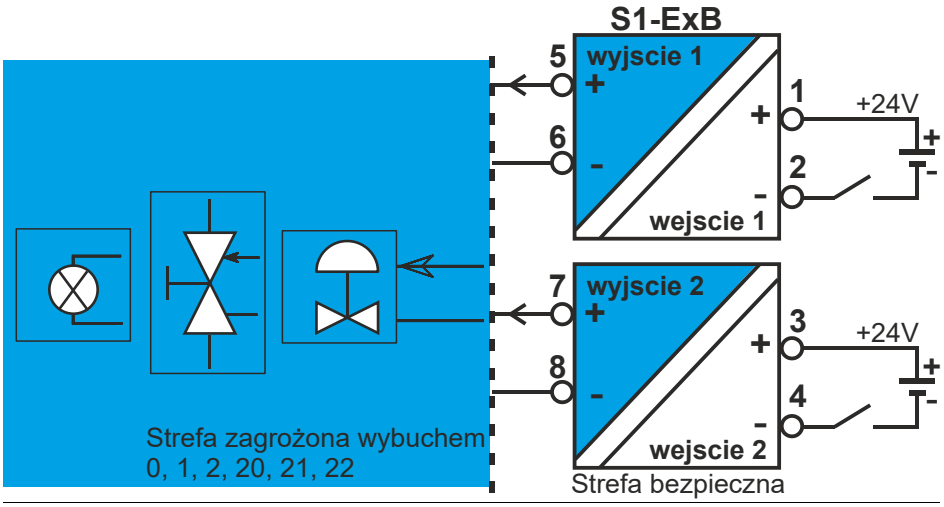
- pulser contact opened ⇒ I=40 µA; U_1=0,04 V; U_2=8,16 V
- pulser contact shorted ⇒ I=4,1 mA; U_1=4,1 V; U_2=4,1 V

Example 3: E=24V, R=10 kΩ

- pulser contact opened ⇒ I=225 µA; U_1=2,25 V; U_2=21,75 V
- pulser contact shorted ⇒ I=2,1 mA; U_1=21,1 V; U_2=2,9 V



Application of separator type S1-ExB to control coil valve, light or sound alarm indicators, signaling devices installed in explosion hazardous zone

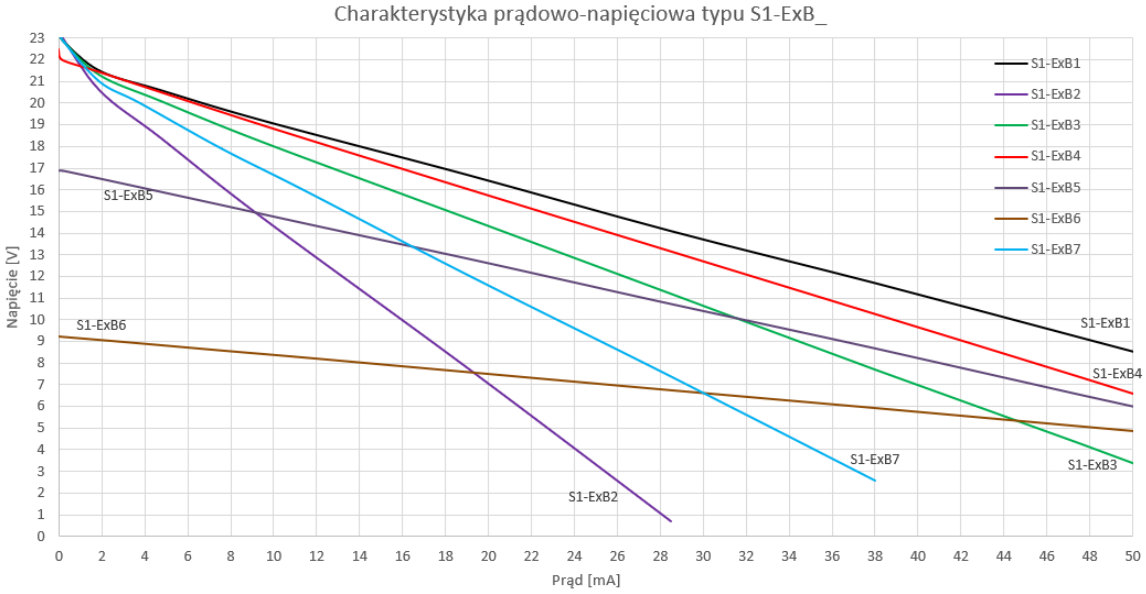


If there is a two-state valve with an induction coil with the explosion-proof design marking "Ex ia", "Ex ib", "Ex ic" with known Ui, Ii, Pi parameters in the hazardous area, then the S1-ExB version option should be selected from the table on the next page with Uo, Io, Po parameters as close as possible but not greater.

1) FOR VALVE

Known are: coil resistance Rc, necessary valve switching current Iz and switching control voltage on the safe side e.g. E=24V. If the inequality $E > 3.2V + (Rw + Rc) \cdot Iz$ is met, the selected separator option S1-ExB will work with this type of valve. Rw means the internal resistance of the separator. This data should be sent to us to tune the entire system with the internal resistor Rx so that $E \approx 3.2V + (Rw + Rc + Rx) \cdot Iz$.

Typ S1-ExB	S1-ExB1	S1-ExB2	S1-ExB3	S1-ExB4	S1-ExB5	S1-ExB6	S1-ExB7
Rw [Ω]	230	690	310	260	210	82	440



2) FOR INDICATOR

The following are known: voltage Us, necessary current Is for correct operation of the signaling device and switching control voltage on the safe side, e.g. E=24V. If the inequality $E > 3.2V + Us + Rw \cdot Iz$ is met, the selected separator option S1-ExB will work with this type of signaling device. This data should be sent to us to tune the entire system with the internal resistor Rx so that $E \approx 3.2V + Us + (Rw + Rx) \cdot Iz$

Example:

We assume that the S1-ExB3 separator option has been selected because its Uo, Io, Po parameters are not greater than the Ui, Ii, Pi parameters of the valve or signaling device. The valve requires a current of Iz=40mA to switch and has a resistance of Rc=200Ω. On the safe side, the voltage for switching is E=24V.

$3,2V + (Rw + Rc) \cdot Iz = 3,2 + (310 + 200) \cdot 0,04 = 3,2 + 20,4 = 23,6V < 24V$

Conclusion: The S1-ExB3 separator can be used to control such a valve.

Intrinsically safe parameters for S1-ExB – output circuit with "ia" protection level:

Terminals "5,6" in channel 1 and terminals "7, 8" in channel 2 are individual intrinsically safe circuits galvanically separated. For simultaneous connection of two circuits, you can use one multicore cable type A or B according IEC 60079-14 or separate cables.

a) Intrinsically safe output circuits:

channel **1 "out1" – terminals "5, 6",** channel 2 **"out2" – terminals "7, 8"** with "ia" protection level:

Values of Lo, Co and L/R connection cable parameters should be adopted according to the table shown below:

Type	Uo [V]	Io [mA]	Po [W]	L/R [µH/Ω]			Lo [mH]			Co [µF]		
				I and IIA	IIB	IIC	I and IIA	IIB	IIC	I and IIA	IIB	IIC
S1-ExB1	25,2	121	0,76	374	187	46	14	8,4	0,64	0,55	0,35	0,067
							0,5	1	0,2	0,7	0,41	0,1
							0,05	0,1	0,1	2,9	0,81	0,107
S1-ExB2	25,2	39,3	0,25	1149	574	143	100	100	21	0,46	0,26	0,067
							20	20	1	0,65	0,42	0,078
							0,02	0,1	0,2	1,8	0,82	0,107
S1-ExB3	25,2	89	0,56	510	255	63	29	17	2,6	0,45	0,38	0,047
							10	1	1	0,72	0,43	0,064
							0,02	0,1	0,2	1,8	0,82	0,107
S1-ExB4	23,1	98	0,57	506	253	63	24	15	2,5	0,54	0,45	0,062
							10	1	0,5	0,8	0,52	0,093
							0,05	0,05	0,1	1,6	1,02	0,14
S1-ExB5	17,2	91	0,39	730	365	91	32	21	4,3	0,83	0,65	0,17
							5	5	2	1,9	1,3	0,29
							0,02	0,02	0,02	3,7	2,11	0,36
S1-ExB6	9,56	139,8	0,334	851	425	106	15	10	2,4	2,7	2,2	0,51
							1	1	1	7,9	5,7	0,87
							0,2	0,2	0,2	13	9,4	1,60
S1-ExB7	25,2	61,7	0,389	732	366	91	64	39	7,1	0,38	0,31	0,054
							1	1	1	0,65	0,45	0,071
							0,2	0,2	0,2	0,93	0,68	0,107
Liniowa charakterystyka obwodów.												

Note: In case of clustered elements half of given Lo, Co values should be taken.

b) Non-intrinsically safe parameters of the input circuits: channel 1 **"in1"- terminals „1, 2"**, channel 2 **"in2"- terminals „3-4"**: **Um=253V**

Conditions of use:

Maximal values of capacitance and inductance connected to intrinsically safe terminals "5-6" or "7-8" of the separator " should be selected taking into account the safety parameters of the connected circuits (given in conditions of use of the device which will be powered with the output of the S1-ExB separator). However, they cannot exceed the values given in the table above.

Intrinsically safe measuring-supplying output circuit of the separator type S1-ExB with "ia" protection level can cooperate with circuits with "ia" or "ib" protection level installed in zone 0, 1, 2 of explosive mixtures with air classified to explosive group IIA, IIB, IIC and in zone 20, 21 and 22 of explosive mixtures with dust.

Input terminals "1-2" or "3-4" can operate with non-intrinsically safe circuits of devices with voltage **Um=253V** e.g. supplied from 230Vac network.

The separator is designed to be used outside of the hazardous zone or in the hazardous zone in the flameproof enclosure. Installation in a flameproof enclosure in explosive group "I" without restrictions. When in explosive group "IIG" and "IID" opening the flameproof enclosure can occur after 10 minutes after the power is turned off.

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 2,5mm^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 Uo, Io, Po, Co, Lo, Ui, Ii, Pi, Ci, Li (L, C of the cable and Li, Ci of the device installed in the hazardous area).

If the L, C clustered parameters in the connected circuit (and this is how the Li, Ci parameters of the connected device should be treated) exceed 1% of the Lo, Co value, for the calculation should be taken of the Lo, Co parameters given in the certificate for the clustered values. If such parameters are not provided, then half of the Co, Lo value from the certificate should be taken for calculations with the assumption that the Co value cannot exceed 1 µF for groups I, IIA, IIB and III and 0.6 µF 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 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 1, 2, 3, 4 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 1, 2, 3, 4 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.

The separator is placed in the housing of self-extinguishing plastic (poliamid PA 6.6) designed for mounting on T35 rail. Housing and terminals protection level is IP20.
External connections should be lead with wires of a cross section 0,5 ÷ 2.5 mm2.

ATEX conformity - directive 2014/34/UE:	PN-EN 60079-0, PN-EN 60079-11, PN-EN 60079-7
EMC conformity - directive 2014/30/UE:	PN-EN 61326-1

Operating conditions:

Ambient temperature – storage	-	-30 ÷ +70°C
Ambient temperature - operating	-	-25 ÷ +70°C
Relative humidity	-	max 90%
Ambient atmosphere	-	no dust and aggressive gases
Operating position	-	any