



SBEx-4 BISTATE SEPARATOR

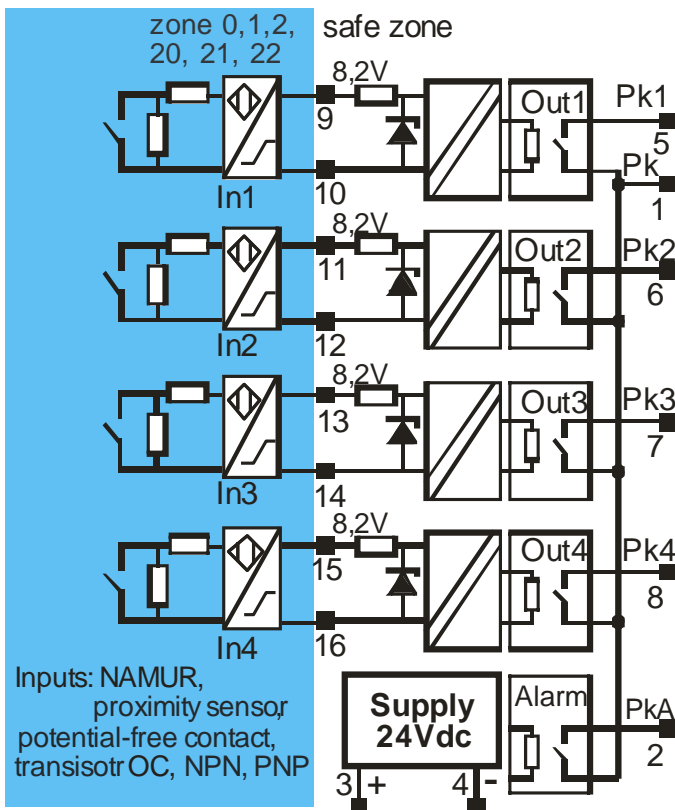
1, 2, 3 or 4 channels in rail housing (TS35, 22,5mm width)

- group I category (M1), group II and III category (1) accompanying device,
- intrinsically safe input circuits with "ia" protection level – compliance with ATEX,
- EC-Type Examination Certificate: KDB 04ATEX061/1

FEATURE: I (M1) [Ex ia] I; II (1) G [Ex ia] IIC; II (1) D [Ex ia] IIIC
 Protection level IP20 Operating temperature range -25..+70°C

- **Inputs: NAMUR proximity sensors, opto-relays, contacts, transistor switches etc.**
- **Can be used as resistance value comparator.**
- **Relay or opto-relay outputs.**
- **Version "SBEx-4 option Q".** Output of channel number 1 and 3, as well as 2 and 4 have a common terminal.
- **Version "SBEx-4 option D".** Output of channel number 1 and 3, as well as 2 and 4 have a common terminal.
- **Activation phase is settable with switchers accessible after opening the housing.**
- **Inputs, outputs and power supply are mutually galvanically separated.**
- Intrinsically safe input circuits can operate with intrinsically safe circuits with **ia** or **ib** protection level of a device installed in explosion hazardous zone group I and in zones "0, 1, 2, 20, 21, 22" of group II of any mixtures including e.g. proximity sensor, turbine flow sensor, contact etc.
- Output, ALARM indication and power supply circuits can operate with any non-intrinsically safe circuits of devices with voltage **Um=253V** e.g. supplied from 230Vac network.
- Separator can be installed in a room that is safe in terms of explosion and protected against access of persons not trained in maintenance and operating the transducer.
- Separator installed in a hazardous area can have a flameproof housing. Separator can be removed from the housing shortly after power in group I is turned off, because it does not contain any energy storage elements and do not become too hot. A 10 minutes delay is necessary in group II and III (gases and dusts).

SBEx-4 standard version



Inputs: NAMUR, proximity sensor, potential-free contact, transistor OC, NPN, PNP

Application:

Separator can be used to transfer a state of a contact or OC type transistor to galvanically separated side. It is designed to operate with NAMUR proximity sensors which switch current 1.2 / 2.1 mA (DIN 19234). It can also be used as resistor values comparator.

After agreement switching current can be adjusted as well as hysteresis width. These parameters should be specified in writing.

Note: for SBEx-4 all four outputs ("Out1", "Out2", "Out3", "Out4") together with Alarm output have common terminal number 1 ("Pk").

Ordering code for standard version:

- SBEx-4- binary separator, 1,2,3 or 4 channels
- SBEx-4-1- one channel
- SBEx-4-2- two channels
- SBEx-4-3- three channels
- SBEx-4-4- four channels
- PK PK1, PK2, PK3, PK4 relay outputs
- OPTO OP1, OP2, OP3, OP4 opto-relay outputs

Order example for standard version:

Binary separator, two channels, opto-relay outputs:
 type SBEx-4-2-OP1/OP2

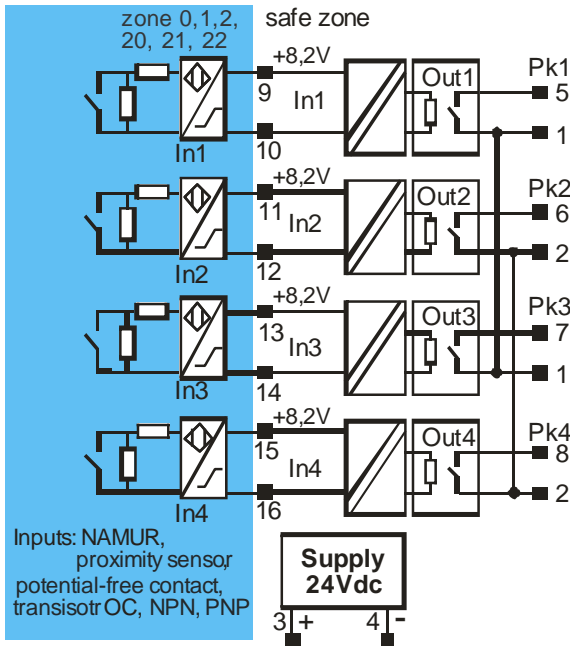
For atypical application switching resistance or current thresholds and hysteresis should be described.

Note: While the power is turned off output relay's contacts "Pk1 ; Pk", "Pk2 ; Pk", "Pk3 ; Pk", "Pk4 ; Pk" and alarm contacts "PkA ; Pk" are opened.

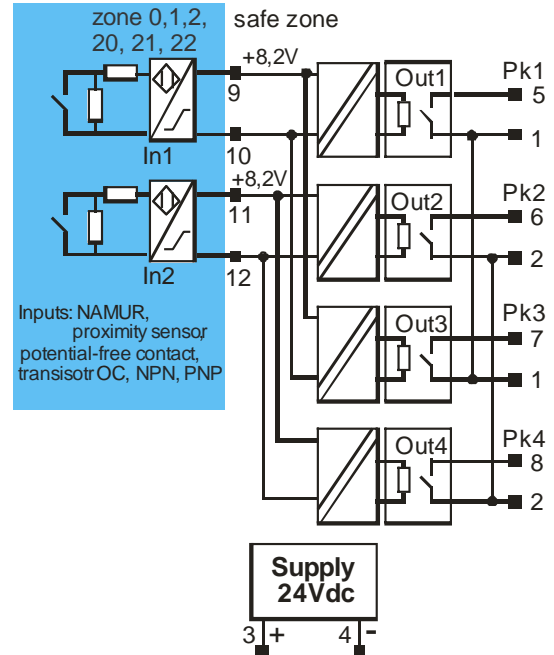
Version “SBEx-4 option Q”. Outputs of channel number 1 and 3, as well as 2 and 4 have a common terminal.

Version “SBEx-4 option D”. Outputs of channel number 1 and 3, as well as 2 and 4 have a common terminal.

SBEx-4 version Q



SBEx-4 version D



Application of SBEx-4 option Q:

There are four independent inputs. There is no ALARM opto-relay output. Detection of shorting or opening of connection line between separator’s terminals and set of two resistors installed on the end of the line from hazardous zone side can be indicated only by LEDs.

Outputs of channel 1 and 3 have a common terminal 1 and are galvanically separated from output set of channel 2 and 4 which have a common terminal number 2.

Similar as in standard version, output phase of each output can be set by switchers accessible after removing the housing.

Ordering code for version with option Q: is identical as for standard version.

Example: Binary separator, four channels, relay outputs: type SBEx-4-4-PK1/PK2/PK3/PK4 option Q

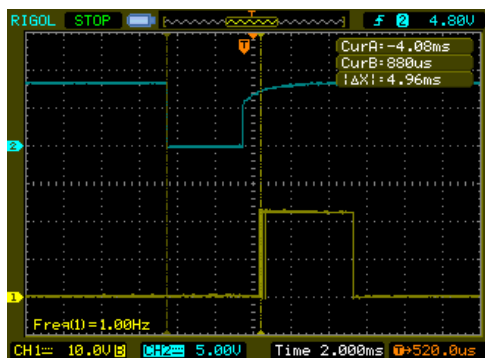


Fig. 1a Type PK output response.

Application of SBEx-4 option D:

There are two independent inputs. Input In1 controls outputs number 1 and 3. Input In2 controls outputs number 2 and 4.

There is no ALARM opto-relay output. Detection of shorting or opening of connection line between separator’s terminals and set of two resistors installed on the end of the line from hazardous zone side can be indicated only by LEDs.

Outputs of channel 1 and 3 have a common terminal number 1 and are galvanically separated from output set of channel 2 and 4 which have a common terminal number 2.

Similar as in standard version, output phase of each output can be set by switchers accessible after removing the housing.

Ordering code for version with option D: is identical as for standard version.

Example: Binary separator, four channels, relay outputs: type SBEx-4-4-PK1/PK2/PK3/PK4 option D

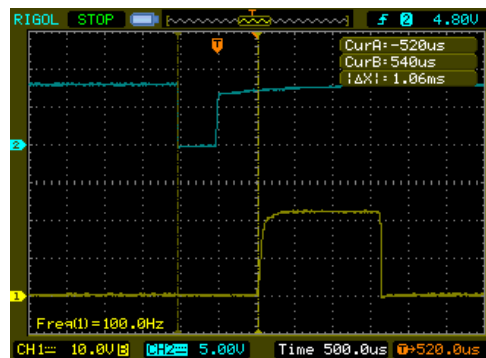


Fig. 1b Type OPTO output response.

Input signal – blue, output signal – yellow.

In above pictures is shown minimal required duration time of input pulse which gives response on the output. In case of relay version (Fig. 1a) it is about 4ms. For version optorelay (Fig. 1b) it is about 0.5ms. Cursors CurA and CurB show delay time between output response and input pulse. For relay it is about 5ms, and for optorelay about 1ms.

On the input terminals is voltage 8.2V. In case of driving the separator from NPN OC transistor terminals “In1+ 9”, “In2+ 11”, “In3+ 13”, “In4+ 15” should be connected to collector. A typical sensor operating with the input of the separator is a sensor with output type NAMUR 1.2/2.1mA e.g. inductive proximity sensor.

For atypical application values of resistance or current switching thresholds and hysteresis should be specified in the order.

Switchers SW1, SW2, SW3, SW4 (accessible after removing the housing) are used for inverting output relays state. Position “ON” means inversion operation of that channel.

If switchers SW5, SW6, SW7, SW8 (accessible after removing the housing) are set in “ON” positions detection of damage in input connection line is turned on. Position “OFF” means turning off damage line alarm in this channel.

For SW1, SW2, SW3, SW4 ⇒ OFF and for SW5, SW6, SW7, SW8 ⇒ ON output contacts and LED signalization is as follows:

- increase of input signal above value switching level + 0.5 • hysteresis

causes shorting of output relay’s contact (terminals “Pk1; Pk”, “Pk2; Pk”, “Pk3; Pk”, “Pk4; Pk”) and lighting up green LED (“Pk1”, “Pk2”, “Pk3”, “Pk4”). Lighting up red LED “Alarm and contact PkA; Pk shorting” means a break in connection line (I<0.25mA). Lighting up orange LED “Alarm and contact PkA; Pk shorting” means shorting in connection line (I>5mA). Contacts of alarm “PkA, Pk” are common signalization for all channels – the user should check which channel is damaged by looking at LEDs.

Note: to allow proper signalization of shorting/opening in sensor connection line in case of operating with contact or transistor, to the terminals of the sensor (in Ex zone) should be connected a parallel resistor 10÷13kΩ and a serial resistor 910÷1000 Ω. It is shown on the figure on page 1.

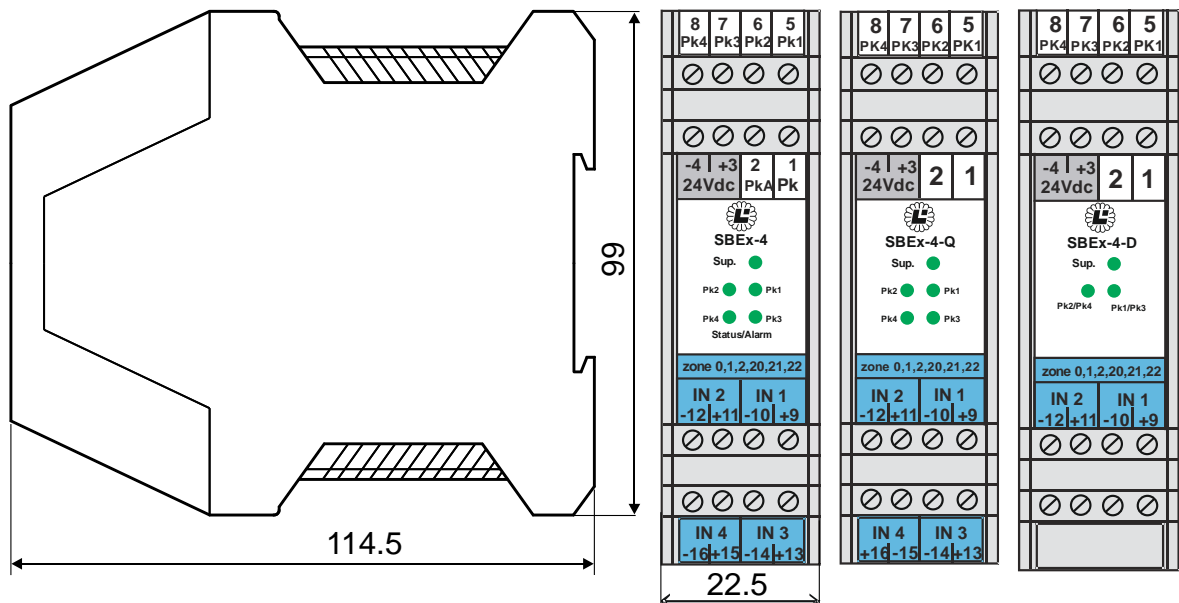
Technical data:

One, two, three or four channels with the following parameters.

- Input signal type - contact, transistor switch or NAMUR proximity sensor e.g. PCIN by SELS
- standard switching thresholds - 1.45 / 1.85 mA or according to the order
- sensor supply voltage - 8.2 V
- input resistance - 1 kΩ
- Opening in connection line - opened I < 0.25mA
signalization threshold - not opened I > 0.35mA
- Shorting in connection line - shorted I > 4.4mA
signalization threshold - not shorted I < 3.9mA
- Output – potential-free contact of relay PK1, PK2, PK3, PK4
 - switching time - max 20 ms
 - switching frequency - max 50 Hz
 - mechanical durability - 10⁷ (for 1Hz ⇒ 4 months)
 - switched power - max 5A / 250Vac or 30Vdc
- Opto-relay - 350V, 0.1A, 450 Hz, r=30Ω
- After agreement this opto-relay - 60V, 0.5A, 200 Hz
- Min. required time of input pulse: details in Fig. 1a and 1b
 - for output type PK - 4 ms
 - for output type OPTO - 0.5 ms
- In SBEx-4 all outputs have common terminals marked as “Pk”.
- Output ALARM – PKA
 - opto-relay - 350V, 0.1A, 300 Hz, r=30Ω
- Power supply voltage - 20 ÷ 30V DC
 - 70mA for four channels
 - 55mA for one channel

Note: If supply voltage exceeds 30V the fuse of the protection barrier may be burnt – repair only by the manufacturer.

- Galvani separation: isolation test voltage
 - between inputs - 2 kV
 - inputs/outputs/supply - 2 kV
- Connections - cables 0.5 ÷ 2.5 mm²
- TS35 rail housing - housing and terminals IP20
- housing material - self-extinguishing poliamid PA 6.6
- compliance with directive - PN-EN 61000-6-4,
EMC 2004/108/WE PN-EN 61000-6-2



Configuration:

Below table describes logic of output relays and respectively LEDs on the example of one channel.

state of relays and LEDs current (state of the input contact)	state of output contacts in channels 1, 2, 3, 4 respectively for SW1, SW2, SW3, SW4 in OFF state	state of output contacts in channels 1, 2, 3, 4 respectively for SW1, SW2, SW3, SW4 in ON state	LED in channel with active alarm SW5 or SW6 or SW7 or SW8 in ON state	LED in channel with inactive alarm SW5 or SW6 or SW7 or SW8 in OFF state	state of "PkA; Pk" ALARM contact with active alarm in channel SW5 or SW6 or SW7 or SW8 in ON state	state of "PkA; Pk" ALARM contact with inactive alarm in channel SW5 or SW6 or SW7 or SW8 in OFF state
	I > 5 mA ALARM (shorted line $R_L < 300\Omega$)	shorted	opened	orange	green	shorted
I > 1.85 mA (shorting contact)	green					
I < 1.45 mA (opening contact)	opened	shorted	off	off	opened if no alarms on other channels	
I < 0.25 mA ALARM (opened line $R_L > 40k\Omega$)			red		shorted	

In SBEx-4 all output contacts "Pk1; Pk", "Pk2; Pk", "Pk3; Pk", "Pk4; Pk" and alarm contact "PkA; Pk" have one common terminal "Pk". It means that output terminals are not galvanically separated from each other.

Safety parameters for SBEx-4 – input circuits with "ia" protection level:

Terminal sets "IN1", "IN2", "IN3", "IN4" for SBEx-4 are individual galvanically separated intrinsically safe circuits. For simultaneous connection of these circuits can be used one multi-wire cable type A or B compliant with IEC 60079-14 or separated cables.

a) Intrinsically safe input circuits:

"IN1"- terminals 9-10, "IN2"- terminals 11-12, "IN3"- terminals 13-14, "IN4"- terminals 15-16 for SBEx-4

Clustered parameters Lo, Co.

Clustered values Co, Lo and connection cable parameters L/R should be taken according to the table below.

Data refer to clustered values can also be applied to cables.

version	Uo [V]	Io [mA]	Po [mW]	L/R [mH/ Ω]			Lo [H]			Co [μ F]		
				I and IIA	IIB	IIC	I and IIA	IIB	IIC	I and IIA	IIB	IIC
SBEx-4	0÷9,6	10	24	12,3	6,1	1,5	0,1	0,1	0,1	4	2,7	0,5
							0,05	0,05	0,02	4,3	3	0,66
							0,02	0,02	0,005	4,9	3,4	0,83

Characteristic of circuits is linear.

Distributed parameters Lo, Co.

Distributed values Co, Lo for connection cable should be taken according to the table on the right. L/R connection cable parameters should be taken according to the table above.

version	Lo [mH]			Co [μ F]		
	I and IIA	IIB	IIC	I and IIA	IIB	IIC
SBEx-4	100	100	100	210	26	3,6

Characteristic of circuits is linear.

Safety parameters with serial galvanic connection of any of two out of four separated intrinsically safe input circuits for SBEx-4.

Sets (set is two serial connected circuits) of galvanically separated intrinsically safe input circuits are individual intrinsically safe circuits. For simultaneous connection of these circuits can be used one multi-wire cable type A or B compliant with IEC 60079-14 or separated cables.

Clustered parameters Lo, Co.

Clustered values Co, Lo and connection cable parameters L/R should be taken according to the table below. Data refer to clustered values can also be applied to cables.

version	Uo [V]	Io [mA]	Po [mW]	L/R [mH/Ω]			Lo [mH]			Co [μF]		
				I and IIA	IIB	IIC	I and IIA	IIB	IIC	I and IIA	IIB	IIC
SBEx-4	0÷19,2	10	48	6	3	0,76	20	20	20	1,1	0,78	0,15
							5	5	5	1,4	0,96	0,18
							1	1	1	1,8	1,1	0,18

Characteristic of circuits is linear.

Distributed parameters Lo, Co.

Distributed values Co, Lo for connection cable should be taken according to the table on the right. L/R connection cable parameters should be taken according to the table above.	version	Lo [mH]			Co [μF]		
	I and IIA	IIB	IIC	I and IIA	IIB	IIC	
	SBEx-4	100	100	100	6,11	1,54	0,24

Characteristic of circuits is linear.

Safety parameters with parallel galvanic connection of any of two out of four separated intrinsically safe input circuits for SBEx-4.

Sets (set is two parallel connected circuits) of galvanically separated intrinsically safe input circuits are individual intrinsically safe circuits. For simultaneous connection of these circuits can be used one multi-wire cable type A or B compliant with IEC 60079-14 or separated cables.

Clustered parameters Lo, Co.

Clustered values Co, Lo and connection cable parameters L/R should be taken according to the table below. Data refer to clustered values can also be applied to cables.

version	Uo [V]	Io [mA]	Po [mW]	L/R [mH/Ω]			Lo [H]			Co [μF]		
				I and IIA	IIB	IIC	I and IIA	IIB	IIC	I and IIA	IIB	IIC
SBEx-4	0÷9,6	20	48	6	3	0,76	50	50	20	3,9	2,6	0,55
							20	20	5	4,4	3,0	0,71
							5	5	1	5,5	3,8	0,97

Characteristic of circuits is linear.

Distributed parameters Lo, Co.

Distributed values Co, Lo for connection cable should be taken according to the table on the right. L/R connection cable parameters should be taken according to the table above.	version	Lo [mH]			Co [μF]		
	I and IIA	IIB	IIC	I and IIA	IIB	IIC	
	SBEx-4	100	100	100	210	26	3,6

Characteristic of circuits is linear.

b) Non-intrinsically safe circuit parameters:

version	terminals	Um
SBEx-4	“Pk1-Pk” – terminals “5-1”, “Pk2-Pk” – terminals “6-1”, “Pk3-Pk” – terminals “7-1”, “Pk4-Pk” – terminals “8-1”, “PkA-Pk” – terminals “2-1” and “Supply 24V” - terminals “3-4”	253 V

Application condition:

Maximal value of capacitance and inductance joined to intrinsically safe terminals “IN1”, “IN2”, “IN3”, “IN4” should be selected based on joining circuits safety parameters (given in conditions of use of devices which will be connected to the input of the separator SBEx-4) but cannot exceed the values given in the tables above.

ATEX compliance - directive 94/9/WE: PN-EN 60079-0:2009, PN-EN 60079-11:2012, PN-EN 50303:2004.

Operation condition :

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

Configuration – additional information:

Phase activation selection of output relays (does not concern alarm relay) and activation of connection line breaking detection alarm is made by switches SW1, SW2, SW3, SW4 accessible after opening the housing.

Table 1.

Channel	1	2	3	4
output contact "Pk1; Pk"	output contact "Pk2; Pk"	output contact "Pk3; Pk"	output contact "Pk4; Pk"	
input opened I < 1.45 mA	contact opened when SW1 OFF	contact opened when SW2 OFF	contact opened when SW3 OFF	contact opened when SW4 OFF
input opened I < 1.45 mA	contact closed when SW1 ON	contact closed when SW2 ON	contact closed when SW3 ON	contact closed when SW4 ON
input closed I > 1.85 mA	contact closed when SW1 OFF	contact closed when SW2 OFF	contact closed when SW3 OFF	contact closed when SW4 OFF
input closed I > 1.85 mA	contact opened when SW1 ON	contact opened when SW2 ON	contact opened when SW3 ON	contact opened when SW4 ON

Choosing of a channel from which detection of connection line damage is summed to the result of detection from other channels is selected with switches SW5, SW6, SW7, SW8 accessible after removing the housing.

Table 2.

Channel	1	2	3	4
detection of connection line damage				
alarm off	when SW5 OFF	when SW6 OFF	when SW7 OFF	when SW8 OFF
alarm on	when SW5 ON	when SW6 ON	when SW7 ON	when SW8 ON

Table 3 describes function of switches for setting output relays phase: "inversion" or "no inversion".

State "no inversion": $I_{in} > 1.85 \text{ mA}$

input contact closed \Rightarrow output contact closed

State "inversion": $I_{in} > 1.85 \text{ mA}$

input contact closed \Rightarrow output contact opened.

Switchers SW1, SW2, SW3, SW4 refers respectively to phase inversion of output relays' contacts PK1, PK2, PK3, PK4.

Table 3.

relays	switchers state	
	SW1, SW2, SW3, SW4 ON	OFF
PK1 channel 1 relay PK2 channel 2 relay PK3 channel 3 relay PK4 channel 4 relay	inversion	no inversion

Table 4 describes function of switcher for activation or blockade "ALARM" function for each channel. There is one common output terminal "PkA; Pk" for "ALARM" function. It operates as a logical sum – it is enough if alarm appears on only one of channels activated for alarm.

Switchers SW5, SW6, SW7, SW8 refers respectively for activation of detection of alarm states $I < 0.25 \text{ mA}$ or $I > 5 \text{ mA}$ in channels 1, 2, 3, 4. Contacts "PkA; Pk" us closed when $I < 0.25 \text{ mA}$ or $I > 5 \text{ mA}$ on at least one of channels activated for alarm.

Table 4.

LEDs "status/alarm" and ALARM relay	switchers state	
	SW5, SW6, SW7, SW8 ON	OFF
LEDs "Pk1", "Pk2", "Pk3", "Pk4"	- red $I < 0.2 \text{ mA}$ - orange $I > 5.5 \text{ mA}$	- off $I < 0.2 \text{ mA}$ - green $I > 5.5 \text{ mA}$
contacts "PkA; Pk" of ALARM relay	- closed When in one of channels activated for alarm $I < 0.25 \text{ mA}$ or $I > 5 \text{ mA}$	- opened All = OFF or in all channels activated for alarm $0.35 < I < 4 \text{ mA}$