Safety Relays



40.10 Safety Relays

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Note: Supplement to Volume 7—Motor Controls, Logic and Connectivity, CA08100008E, Tab 40.

Safety Relays



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Product Description

Safety relays are intended to reliably monitor the signals from safety devices at all times and switch off quickly and reliably in an emergency. Single-channel and dual channel versions are available for the construction of safety applications. The internal logic of the safety relays monitors the safety circuits (emergency stop, guard door, and so on) and activates the enable paths in a fault-free condition. Upon actuation of the safety device or in the even of a fault, the enable paths are switched off. Any faults that occur in the control circuit, such as ground fault, cross connection fault or wire breakage are also detected.

Application Description

Eaton's ESR5 safety relays provide optimal safety and a high degree of reliability on plant machinery. Applications that meet the highest safety requirements in accordance with EN 954-1, EN ISO 13849-1 up to PL e and accordance with IEC 62061 up to SILCL 3 can be realized with the ESR5 safety relay.

Compatible with a wide variety of safety devices:

- Emergency stops
- Rope pulls
- Two-hand control stations
- Light curtain (OSSD)
- Gate enable device
- Safety switches

Features

- Use for the highest safety requirements in accordance with EN 954-1 EN ISO 13849-1, IEC 62061 and EC 61508
- Suitable for the world market with UL, cUL certifications and TÜV Rhineland functional safety certifications
- Applicable for EN 60204 stop categories 0 or 1
- Plug-in screw terminals for fast and fault-free replacement
- Multi-voltage versions (24–230 Vac/Vdc) for a flexible range of application
- Delayed and non-delayed contact expansions accommodate a wide variety of applications

Standards and Certifications

- UL 508; CSA-C22.2 No 14-95; CE Marked
- UL/cUL file number: E29184
- Degree of protection: IP20
- TÜV Rhineland certified
- UL/cULus listed

Listed

Product Selection

Safety Relays



Technical Overview

Single Channel	Dual Channel	Safety Output (NO)	Safety Output (NO) (Delayed)	Output Delay	Signal Output (NC)	Feedback Output	Control Voltage	Removable Terminal Blocks	Type of Unit	Catalog Number
■	—	4	—	—	1	—	24 Vac/Vdc	■	Main	**ESR5-NO-41-24VAC-DC**
■	■	2	—	—	1	—	24 Vac/Vdc	■	Main	**ESR5-NO-21-24VAC-DC**
■	■	3	—	—	1	—	24 Vac/Vdc	■	Main	**ESR5-NO-31-24VAC-DC**
■	■	3	—	—	1	—	230 Vac	■	Main	**ESR5-NO-31-230VAC**
■	■	3	—	—	1	—	24–230 Vac/Vdc	■	Main	**ESR5-NO-31-AC-DC**
■	■	2	2	0.1–30s	—	—	24 Vdc	■	Main	**ESR5-NV3-30**
—	■	2	—	—	1	—	24 Vac/Vdc	■	Main	**ESR5-NZ-21-24VAC-DC**
■	—	5	—	—	1	1	24 Vac/Vdc	■	Expansion	**ESR5-NE-51-24VAC-DC**
■	—	—	4	0.3–3s	1	1	24 Vdc	■	Expansion	**ESR5-VE3-42**

Application Overview

Emergency Stop	Safety Switches	Light Curtain/ OSSD ①	Two-Hand Control (EN 574 Type III C)	Contact Expansion	Off-Delayed	Cross Circuit Recognition	Monitored Manual Reset ②	Catalog Number
■	■	—	—	—	—	—	—	**ESR5-NO-41-24VAC-DC**
■	■	—	—	—	—	■	—	**ESR5-NO-21-24VAC-DC**
■	■	—	—	—	—	■	—	**ESR5-NO-31-24VAC-DC**
■	■	—	—	—	—	■	■	**ESR5-NO-31-230VAC**
■	■	—	—	—	—	■	■	**ESR5-NO-31-AC-DC**
■	■	■	—	—	■	■	■	**ESR5-NV3-30**
—	■	—	■	—	—	■	—	**ESR5-NZ-21-24VAC-DC**
—	—	—	—	■	—	—	—	**ESR5-NE-51-24VAC-DC**
—	—	—	—	■	■	—	—	**ESR5-VE3-42**

Application Overview, continued

Single Channel	Dual Channel	Stop Category EN 60204	Control Category to EN 954-1	Achievable PL per ISO 13849-1	Achievable SIL per EN IEC 62061	Catalog Number
■	—	0	2	PL d	SIL 3	**ESR5-NO-41-24VAC-DC**
■	■	0	4	PL e	SIL 3	**ESR5-NO-21-24VAC-DC**
■	■	0	4	PL e	SIL 3	**ESR5-NO-31-24VAC-DC**
■	■	0	4	PL e	SIL 3	**ESR5-NO-31-230VAC**
■	■	0	4	PL e	SIL 3	**ESR5-NO-31-AC-DC**
■	■	0/1	4	PL e	SIL 3	**ESR5-NV3-30**
—	■	0	4	PL e	SIL 3	**ESR5-NZ-21-24VAC-DC**
■	—	0	4	PL e	SIL 3	**ESR5-NE-51-24VAC-DC**
■	—	1	3	PL d	SIL 2	**ESR5-VE3-42**

Notes

① Laser scanners or light curtains with OSSD outputs.

② All main units can also be reset automatically or manually.

Technical Data and Specifications

Safety Relay

Description	Unit	ESR5-NO-21_	ESR5-NO-41_	ESR5-NO-31-24VAC-DC	ESR5-NZ-21_
General					
Standards		EN ISO 13849-1, IEC 62061, IEC 61508, DIN EN 50178, UL/CUL listed	EN ISO 13849-1, IEC 62061, IEC 61508, DIN EN 50178, UL/CUL listed	EN ISO 13849-1, IEC 62061, IEC 61508, DIN EN 50178, UL/CUL listed	EN ISO 13849-1, IEC 62061, IEC 61508, DIN EN 50178, UL/CUL listed
Type-dependent standards		—	—	—	EN 574 Part no. IIIC
Lifespan, mechanical—c (contacts)	x 10^6	10	10	10	10
Maximum operating frequency	Ops/h	3600	3600	3600	3600
Climatic proofing		Cold according to EN 60068-2-1, dry heat according to EN60068-2-2, damp heat according to EN 60068-2-3	Dry heat according to EN60068-2-2, damp heat according to EN 60068-2-3	Cold according to EN 60068-2-1, dry heat according to EN60068-2-2, damp heat according to EN 60068-2-3	Dry heat according to EN60068-2-2, damp heat according to EN 60068-2-3
Ambient temperature	°F (°C)	–4° to 131° (–20° to 55°)	–4° to 131° (–20° to 55°)	–4° to 131° (–20° to 55°)	–4° to 131° (–20° to 55°)
Ambient temperature storage	°F (°C)	–13° to 167° (–25° to 75°)	–13° to 167° (–25° to 75°)	–13° to 167° (–25° to 75°)	–13° to 167° (–25° to 75°)
Mounting position		Any	Any	Any	Any
Vibration resistance (IEC/EN 60068-2-6)		2g, frequency: 10–150 Hz, amplitude: 0.15 mm	2g, frequency: 10–150 Hz, amplitude: 0.15 mm	2g, frequency: 10–150 Hz, amplitude: 0.15 mm	2 g, frequency: 10–150 Hz, amplitude: 0.15 mm
Shock resistance (IEC 60068-2-27)		—	—	—	—
Protection type					
Housing		IP20	IP20	IP20	IP20
Terminals		IP20	IP20	IP20	IP20
Protection against direct contact when actuated from front (IEC 0106 Part 100)		Finger- and back-of-hand proof	Finger- and back-of-hand proof	Finger- and back-of-hand proof	Finger- and back-of-hand proof
Weight	kg	0.17	0.22	0.17	0.22
Terminal capacity					
Solid or flexible	mm^2	1 x (0.2–2.5) 2 x (0.2–1)	1 x (0.2–2.5) 2 x (0.2–1)	1 x (0.2–2.5) 2 x (0.2–1)	1 x (0.2–2.5) 2 x (0.2–1)
Flexible with ferrule	mm^2	1 x (0.25–2.5) 2 x (0.25–1)	1 x (0.25–2.5) 2 x (0.25–1)	1 x (0.25–2.5) 2 x (0.25–1)	1 x (0.25–2.5) 2 x (0.25–1)
Solid or stranded	AWG	24–12	24–12	24–12	24–12
Terminal screw					
Pozidriv screwdriver	Size	2	2	2	2
Flat-blade screwdriver	mm	0.6 x 3.5	0.6 x 3.5	0.6 x 3.5	0.6 x 3.5
Max. tightening torque	Nm	0.6	0.6	0.6	0.6
Main Contacts					
Rated impulse withstand voltage—U_{imp}	Vac	6000	4000	4000	6000
Overvoltage category/pollution degree					
Outside		III/2	III/2	III/2	III/2
Inside		—	—	—	—
Rated insulation voltage—U_i	Vac	250	250	250	250
Rated operating voltage—U_e	Vac	230	230	230	230
Rated operation current					
AC-15					
230V (360 ops./h)—I_e	A	5	4	5	4
230V (3600 ops./h)—I_e	A	3	3	3	3
DC-13					
24V (360 ops./h)—I_e	A	6	4	6	4
24V (3600 ops./h)—I_e	A	3	2.5	3	2.5
Max. summation current of all poles					
24 Vac/Vdc devices	A	72	72	72	72
230 Vac devices	A	—	—	—	—
Square of the total current (and total current) of all current paths		72 A^2 (6 + 6)	72 A^2 (4.2 + 4.2 + 4.2 + 4.2)	72 A^2 (4.9 + 4.9 + 4.9)	72 A^2 (6 + 6)
Short-circuit protection					
Max. fuse	A gG/gL	10	6	10	6

Safety Relay, continued

Description	Unit	ESR5-NO-21_	ESR5-NO-41_	ESR5-NO-31-24VAC-DC	ESR5-NZ-21_
Power Supply Circuit					
Actuating voltage 50/60 Hz	Vac	24	24	24	24
Actuating voltage—U_s	Vdc	24	24	24	24
Voltage tolerance pick-up voltage	x_e	0.85–1.1	0.85–1.1	0.85–1.1	0.85–1.1
Power consumption					
AC operated 50/60 Hz	VA	—	—	—	—
AC operated 50/60 Hz	W	3.4	3.4	3.4	3
DC operated	W	1.6	1.6	1.6	1.5
Fuse for control circuit supply					
24V		Short-circuit proof	Short-circuit proof	Short-circuit proof	Short-circuit proof
115/230V		—	—	—	—
Control Circuit					
Rated output voltage	Vdc	24	24	24	24
Rated operational current	mA	S12, S22: 30, S34: 45	S12: 65, S34: 40	S12, S22: 30, S34: 45	S11, S21: 60, Y2: 45
Resistance—R		50	22	50	22
Short-circuit current	A	2.3	2.3	2.3	2.3
Response time	ms	100	65	100	50
Recovery time	ms	—	—	—	—
Response time with reset monitoring—t_{A1}	ms	—	—	—	—
Response time without reset monitoring—t_{A2}	ms	100	65	100	50
Reset time—t_R/t_{R1}	ms	Single-channel 45; dual-channel 10	45	Single-channel 45; dual-channel 10	20
Minimum on duration—t_M	ms	—	—	—	—
Recovery time—t_W	ms	Approx. 1000	Approx. 1000	Approx. 1000	Approx. 1000
Synchronous monitoring time—t_S	ms	—	—	—	500
Electromagnetic Compatibility (EMC)					
Emitted interference		EN 61000-6-4	EN 61000-6-4	EN 61000-6-4	EN 61000-6-4
Interference immunity		According to EN 61000-6-2, EN 62061	According to EN 61000-6-2	According to EN 61000-6-2, EN 62061	According to EN 61000-6-2

Safety Relay, continued

Description	Unit	ESR5-NO-31-230VAC	ESR5-NO-31-24V-230VAC-DC	ESR5-NV3_	ESR5-VE3_	ESR5-NE-51_
General						
Standards		EN ISO 13849-1, IEC 62061, IEC 61508, DIN EN 50178, UL/CUL listed	EN ISO 13849-1, IEC 62061, IEC 61508, DIN EN 50178, UL/CUL listed	EN ISO 13849-1, IEC 62061, IEC 61508, DIN EN 50178, UL/CUL listed	EN ISO 13849-1, IEC 62061, IEC 61508, DIN EN 50178, UL/CUL listed	EN ISO 13849-1, IEC 62061, IEC 61508, DIN EN 50178, UL/CUL listed
Type-dependent standards		EN 60204 (if applicable)	EN 60204 (if applicable)	EN 60204 (if applicable)	—	—
Lifespan, mechanical—c (contacts)	x 10^6	10	10	10	10	10
Maximum operating frequency	Ops/h	3600	3600	3600	900	3600
Climatic proofing		Dry heat according to EN60068-2-2, damp heat according to EN 60068-2-3	Dry heat according to EN60068-2-2, damp heat according to EN 60068-2-3	Cold in accordance with: EN 60068-2-1, dry heat in accordance with EN 60068-2-2, humidity storage test in accordance with 60068-2-78	Dry heat according to EN60068-2-2, damp heat according to EN 60068-2-3	Dry heat according to EN60068-2-2, damp heat according to EN 60068-2-3
Ambient temperature	°F (°C)	–4° to 131° (–20° to 55°)	–4° to 131° (–20° to 55°)	–4° to 113° (–20° to 45°)	–4° to 131° (–20° to 55°)	–4° to 131° (–20° to 55°)
Ambient temperature storage	°F (°C)	–13° to 167° (–25° to 75°)	–13° to 167° (–25° to 75°)	–13° to 167° (–25° to 75°)	–13° to 167° (–25° to 75°)	–13° to 167° (–25° to 75°)
Mounting position		Any	Any	Any	Any	Any
Vibration resistance (IEC/EN 60068-2-6)		2g, frequency: 10–150 Hz, amplitude: 0.15 mm	2g, frequency: 10–150 Hz, amplitude: 0.15 mm	2g, frequency: 10–150 Hz, amplitude: 0.15 mm	2g, frequency: 10–150 Hz, amplitude: 0.15 mm	2g, frequency: 10–150 Hz, amplitude: 0.15 mm
Shock resistance (IEC 60068-2-27)		—	—	—	—	—
Protection type						
Housing		IP40	IP40	IP20	IP20	IP20
Terminals		IP20	IP20	IP20	IP20	IP20
Protection against direct contact when actuated from front (IEC 0106 Part 100)		Finger- and back-of-hand proof	Finger- and back-of-hand proof	Finger- and back-of-hand proof	Finger- and back-of-hand proof	Finger- and back-of-hand proof
Weight	kg	0.3	0.3	0.17	0.17	0.22
Terminal capacity						
Solid or flexible	mm^2	1 x (0.2–2.5) 2 x (0.2–1)	1 x (0.2–2.5) 2 x (0.2–1)	1 x (0.2–2.5) 2 x (0.2–1)	1 x (0.2–2.5) 2 x (0.2–1)	1 x (0.2–2.5) 2 x (0.2–1)
Flexible with ferrule	mm^2	1 x (0.25–2.5) 2 x (0.25–1)	1 x (0.25–2.5) 2 x (0.25–1)	1 x (0.25–2.5) 2 x (0.25–1)	1 x (0.25–2.5) 2 x (0.25–1)	1 x (0.25–2.5) 2 x (0.25–1)
Solid or stranded	AWG	24–12	24–12	24–12	24–12	24–12
Terminal screw						
Pozidriv screwdriver	Size	2	2	2	2	2
Flat-blade screwdriver	mm	0.6 x 3.5	0.6 x 3.5	0.6 x 3.5	0.6 x 3.5	0.6 x 3.5
Max. tightening torque	Nm	0.6	0.6	0.6	0.6	0.6
Main Contacts						
Rated impulse withstand voltage—U_{imp}	Vac	6000	6000	4000	4000	4000
Overvoltage category/pollution degree						
Outside		III/2	III/2	III/2	III/2	III/2
Inside		—	—	—	—	—
Rated insulation voltage—U_i	Vac	250	250	250	250	250
Rated operating voltage—U_e	Vac	230	230	230	230	230
Rated operation current						
AC-15						
230V (360 ops./h)—I_e	A	4	4	—	5	4
230V (3600 ops./h)—I_e	A	3	3	3	3	3
DC-13						
24V (360 ops./h)—I_e	A	4	4	—	6	4
24V (3600 ops./h)—I_e	A	2.5	2.5	3	3	2.5
Max. summation current of all poles						
24 Vac/Vdc devices	A	50	50	49	50	50
230 Vac devices	A	50	50	—	—	—
Square of the total current (and total current) of all current paths		50 A^2 (4 + 4 + 4)	50 A^2 (4 + 4 + 4)	50 A^2 (4 + 4 + 4)	49 A^2 (3.5 + 3.5 + 3.5 + 3.5)	50 A^2 (3.7 + 3.7 + 3.7 + 3.7 + 3.7)
Short-circuit protection						
Max. fuse	A gG/gL	6	6	10	10	6

Safety Relay, continued

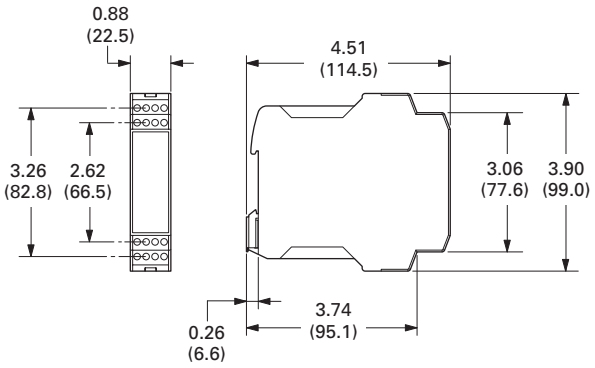
Description	Unit	ESR5-NO-31-230VAC	ESR5-NO-31-24V-230VAC-DC	ESR5-NV3_	ESR5-VE3_	ESR5-NE-51_
Power Supply Circuit						
Actuating voltage 50/60 Hz	Vac	230	24–230	—	—	24
Actuating voltage—U_s	Vdc	—	230	24	24	24
Voltage tolerance pick-up voltage	x_e	0.85–1.1	0.85–1.1	0.85–1.1	0.85–1.1	0.8–1.1
Power consumption						
AC operated 50/60 Hz	VA	—	—	—	—	—
AC operated 50/60 Hz	W	5.8	5.8	—	—	2.2
DC operated	W	2.9	2.9	1.8	2	2.2
Fuse for control circuit supply						
24V		—	Short-circuit proof	—	—	—
115/230V		Short-circuit proof	Short-circuit proof	—	—	—
Control Circuit						
Rated output voltage	Vdc	24	24	24	24	24
Rated operational current	mA	S10, S12, S22: 35, S34, S35: 45	S10, S12, S22: 35, S34, S35: 45	S12, S22: 3.5, S34, S35: 7	A1, A2: 84, K1/K2: 5	A1, A2: 92
Resistance—R		11	11	500	—	—
Short-circuit current	A	0.7	0.7	0.1	—	—
Response time	ms	250	250	150	20	20
Recovery time	ms	—	—	—	—	—
Response time with reset monitoring—t_{A1}	ms	60	60	150	20	20
Response time without reset monitoring—t_{A2}	ms	250	250	150	20	20
Reset time—t_R/t_{R1}	ms	20	20	20 (non-delayed enable paths); 100 (min. delayed enable paths)	0.3–3 s (+50%) adjustable	20
Minimum on duration—t_M	ms	—	—	—	—	—
Recovery time—t_W	ms	Approx. 1000	Approx. 1000	Approx. 330	Approx. 1000	—
Synchronous monitoring time—t_S	ms	—	—	—	—	—
Electromagnetic Compatibility (EMC)						
Emitted interference		EN 61000-6-4	EN 61000-6-4	EN 61000-6-4	EN 61000-6-4	EN 61000-6-4
Interference immunity		According to EN 61000-6-2	According to EN 61000-6-2	According to EN 61000-6-2, EN 62061	According to EN 61000-6-2	According to EN 61000-6-2

Dimensions

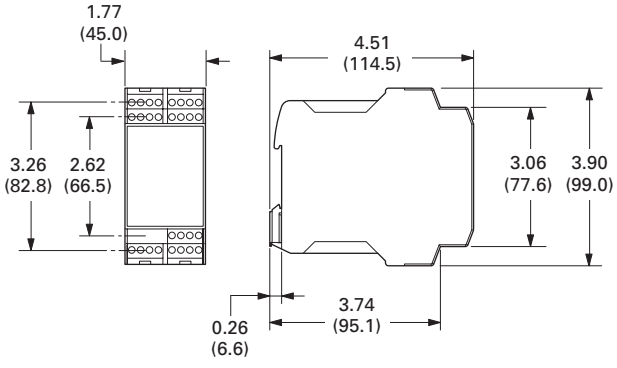
Approximate Dimensions in Inches (mm)

Safety Relays, Contact Expansion Modules

ESR5_ 24 Vac/Vdc



ESR5_ 230 Vac



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