

ESR5-VE3-42

Contact expansion for safety relay



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Original operating manual

The German-language edition of this document is the original operating manual.

Translation of the original operating manual

All editions of this document other than those in German language are translations of the original operating manual.

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See revision protocol in the "About this manual" chapter.

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Editor: René Wiegand

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Subject to alteration.



Danger! **Dangerous electrical voltage!**

Before commencing the installation

- Disconnect the power supply of the device.
- Ensure that devices cannot be accidentally restarted.
- Verify isolation from the supply.
- Earth and short circuit.
- Cover or enclose neighbouring units that are live.
- Follow the engineering instructions (AWA/IL) of the device concerned.
- Only suitably qualified personnel in accordance with EN 50110-1/-2 (VDE 0105 Part 100) may work on this device/system.
- Before installation and before touching the device ensure that you are free of electrostatic charge.
- The functional earth (FE) must be connected to the protective earth (PE) or to the potential equalisation. The system installer is responsible for implementing this connection.
- Connecting cables and signal lines should be installed so that inductive or capacitive interference does not impair the automation functions.
- Install automation devices and related operating elements in such a way that they are well protected against unintentional operation.
- Suitable safety hardware and software measures should be implemented for the I/O interface so that a line or wire breakage on the signal side does not result in undefined states in the automation devices.
- Ensure a reliable electrical isolation of the low voltage for the 24 volt supply. Only use power supply units complying with IEC 60364-4-41 (VDE 0100 Part 410) or HD 384.4.41 S2.
- Deviations of the mains voltage from the rated value must not exceed the tolerance limits given in the specifications, otherwise this may cause malfunction and dangerous operation.
- Emergency stop devices complying with IEC/EN 60204-1 must be effective in all operating modes of the automation devices. Unlatching the emergency-stop devices must not cause restart.
- Devices that are designed for mounting in housings or control cabinets must only be operated and controlled after they have been installed with the housing closed. Desktop or portable units must only be operated and controlled in enclosed housings.
- Measures should be taken to ensure the proper restart of programs interrupted after a voltage dip or failure. This should not cause dangerous operating states even for a short time. If necessary, emergency-stop devices should be implemented.
- Wherever faults in the automation system may cause damage to persons or property, external measures must be implemented to ensure a safe operating state in the event of a fault or malfunction (for example, by means of separate limit switches, mechanical interlocks etc.).

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0 About This Manual

This manual applies to the ESR5-VE3-42 safety relay.



Against the background that we do not know your application in detail, the information and examples in this document can only serve as incomplete support for you as a user of safety-related control technology for the implementation of the standards and directives.

The information and examples in this document do not claim to be legally binding or complete.

For detailed information, please refer to the standards and directives that apply to your application.

0.1 List of revisions

The following significant amendments have been introduced since previous issues:

Publication date	Page	Keyword	new	modified	deleted
12/19		First edition	–	–	–
07/20	3,8,18.	Update	–	✓	–
11/25	7,19,20	Re-certification EN IEC 62061 SII, CLaim Limit removed	–	–	✓

0.2 Target group

This manual is particularly aimed at planners, developers and Operators in electrical, control and mechanical engineering who use the device Use ESR5-VE3-42 for safe operation of a machine.

An ESR5-VE3-42 may only be operated by a qualified electrician or a person who is familiar with electrotechnical installation, mounted and connected become



CAUTION

Installation requires a qualified electrician

0.3 Additional documents

For further information, see the following documentation:

- Instruction leaflet IL05013034Z
- Safety relay data sheet ESR5-VE3-42, article no. 118706

WARNING

Make sure you always use the latest documentation.
It can be downloaded from the product at: Eaton.com/esr5

0.4 Abbreviations and symbols

The symbols used in this manual have the following meanings:

- ▶ indicates actions to be taken.

0.4.1 Risk of material damage

WARNING

Warns about the possibility of material damage.

0.4.2 Hazard warnings of personal injury



CAUTION

Warns of the possibility of hazardous situations that may possibly cause slight injury.



WARNING

Warns of the possibility of hazardous situations that could result in serious injury or even death.



DANGER

Warns of hazardous situations that result in serious injury or death.

0.4.3 Tips



Indicates useful tips.

1 Safety notes



WARNING

Risk of electric shock

During operation, parts of electrical switching devices carry hazardous voltages.

Before working on the switching device, disconnect the power. Please observe the safety regulations of electrical engineering and industrial safety and liability associations!

Disregarding these safety regulations may result in death, serious personal injury or damage to equipment.

Startup, mounting, modifications, and upgrades should only be carried out by a skilled electrical engineer!



WARNING

Risk of automatic machine restart!

For emergency stop applications, the machine must be prevented from restarting automatically by a higher-level control system.

Protective covers must not be removed when operating electrical switching devices.



WARNING

Danger due to faulty devices!

The devices may be damaged following an error and correct operation can no longer be ensured.

In the event of an error, replace the device immediately.

Repairs to the device, especially if the housing must be opened, may only be carried out by the manufacturer or authorized persons. Otherwise the warranty is invalidated.

CAUTION

Risk of damage to equipment due to incorrect installation

For reliable operation, the safety relay must be installed in housing protected from dust and humidity (IP54).

Carry out wiring according to the application.

Refer to the "Application examples" section for this.

CAUTION

Risk of damage to equipment due to noise emissions

When operating relay modules the operator must meet the requirements for noise emission for electrical and electronic equipment (EN 61000-6-4) on the contact side and, if required, take appropriate measures.

2 Description

The safety relay ESR5-VE3-42 is used as a contact extension for safety relays for Emergency stop and safety door monitoring.

The relay has four enabling current paths, one signalling current path and a feedback path.

Depending on the set time, the contacts drop out with a delay of 0.3 s - 3 s, corresponding to of stop category 1 according to DIN EN 60204-1/VDE 0113-1.

In combination with a suitable evaluation unit, which uses the feedback contacts monitored, the device can be used as a contact expansion block with adjustable Contact delay in safety applications up to SIL 3 according to IEC 61508 / EN 62061 and meets the requirements up to category 3 and PL e according to EN ISO 13849-1.

The device can be controlled via a single-channel contact of the base unit.

Features

- Contact extension block
- Suitable up to category 3, PL e (EN ISO 13849-1), SIL 3 (EN 62061) in conjunction with a suitable evaluation unit
- Single-channel wiring
- Safe isolation
- Housing width 22.5 mm
- Four enable contacts, one alarm contact, and one confirmation contact
- Plug-in screw connection terminal blocks

3 Operating and indication elements

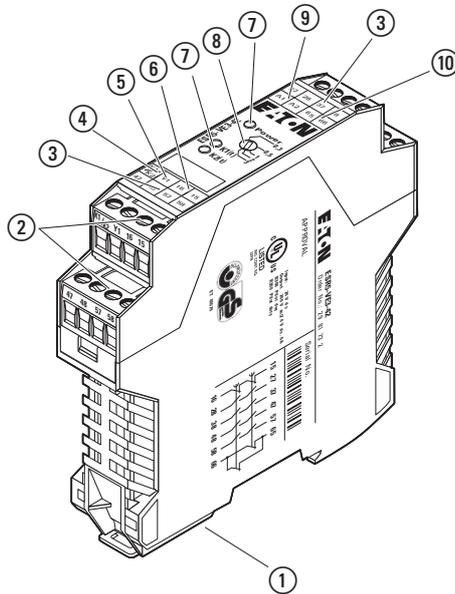


Figure 1: ESR5-VE3-42

- ① Metal lock for mounting on the DIN rail
- ② COMBICON plug-in screw terminal blocks
- ③ 27-28, 37-38, 47-48, 57-58 - Enabling current paths
- ④ K1/K2 - Input
- ⑤ Y1
- ⑥ 15-16 - Confirmation contacts
- ⑦ K1(t), K2(t), Power - LED status indicators
- ⑧ Off delay setting
- ⑨ A1, A2 - Supply voltage connection
- ⑩ 65-66 - Alarm contacts

3.1 Connection Notes



- Before working on the device, disconnect the power.
- Check the set time following installation.
- Devices may only be mounted on/removed when the power is switched off.



In order to comply with UL approval, use copper cables that are designed for operating temperatures $> 75^{\circ}\text{C}$.



For reliable and safe-to-touch contacts, strip the cable ends.

4 Mounting and removing

- ▶ Mount the device on a 35 mm DIN rail according to EN 60715.
- ▶ To remove the device, use a screwdriver to release the snap-on foot.

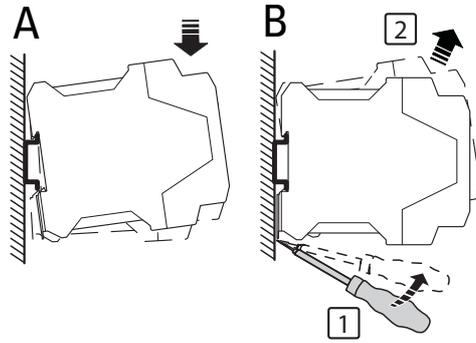


Figure 2: Mounting and removing

5 Wiring

- ▶ Connect the cables to the connection terminal blocks using a screwdriver.

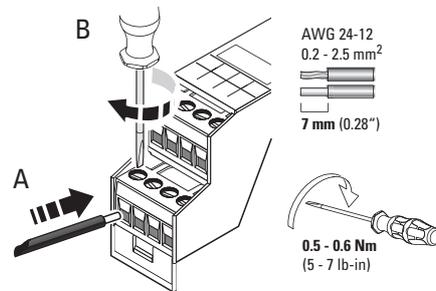


Figure 3: Connecting the cables

6 Configuration

- ▶ Disconnect the safety relay from the supply voltage.
- ▶ Set the delay time at the rotary switch.
- ▶ Restore the power supply.



WARNING

Danger due to incorrect delay time

Check the set delay time following installation!



If the rotary switch is modified during operation, the safety relay switches to configuration mode and the LEDs flash. The safety relay is only ready for operation again once the supply voltage has been switched off and on again and configuration has been carried out.

7 Startup

- ▶ Apply the nominal input voltage U_N (24 V DC) at terminal blocks A1/A2. → The **Power** LED lights up.
- ▶ Apply a 24 V DC voltage at input K1/K2.
 - Both relays are activated.
 - The LEDs light up and the contacts for enabling current paths 27-28, 37-38, 47-48, and 57-58 close.
 - Alarm contacts 15-16 and 65-66 open.
- ▶ Switch off the voltage at input K1/K2.
 - The enable contacts open and the alarm contacts close after the set time has elapsed.



For additional connection examples, see → section 12, “Connection Example”, page 16.

8 Protection against manipulation

Once the time has been set, the rotary switch can be protected against manipulation by covering with the label provided.

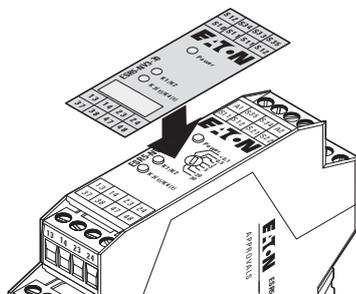


Figure 4: Applying the label

9 Block Diagram

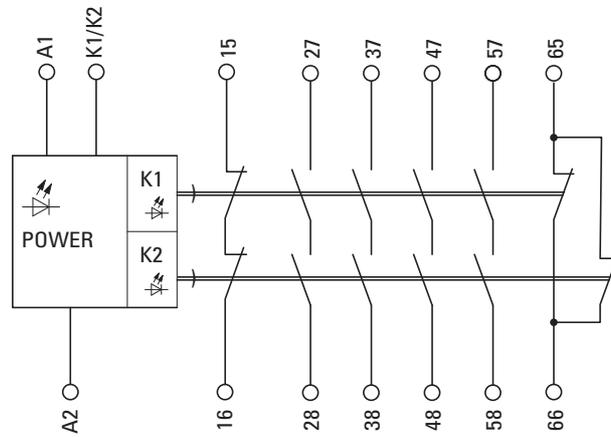


Figure 5: Block diagram

10 Derating Curve

10 Derating Curve

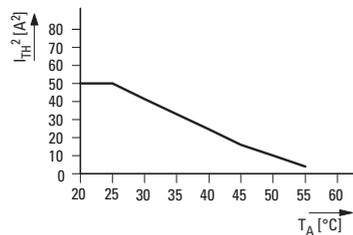


Figure 6: Derating curve

11 Diagnostics

○ – LED off

● – LED on

Table 1: Diagnostic description

	Power	K1(t)	K2(t)	Fault	Remedy
Connection/ voltage error	○	○	○	Supply voltage not present.	Apply supply voltage.
	●	○	○	Supply voltage too low.	Adjust supply voltage.
	○	○	○	The input circuit is connected incorrectly or not connected at all.	Check the connection of the input circuit.
Short circuit	○	○	○	Fault between contact points A1 and A2.	Remove short circuit.
Fault with internal cause	●	○	○	Checkback contacts 15 and 16 faulty.	Replace safety relays.
	●	○	●	Enable contact of K1(t) faulty.	
	●	●	○	Enable contact of K2(t) faulty.	

12 Connection Example

Single-Channel connection with confirmation path 15-16 integrated in the basic device, suitable for up to safety category 3

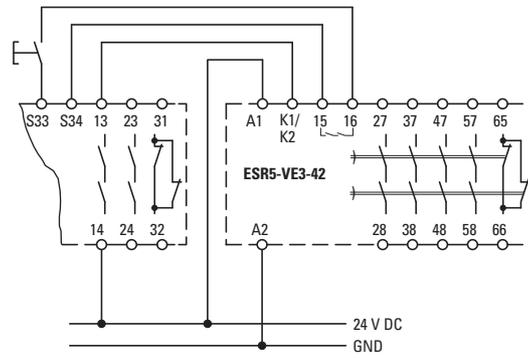


Figure 7: Wiring via connection terminal blocks

13 Functional test / Proof-Test

To prove the function of the device, proceed as follows:

- Request the safety function by actuating the corresponding protective device.
- Check whether the safety function has been performed correctly by reactivating the base unit and thus the contact extension. If the device does not switch on again, the proof test failed.



WARNING

Loss of functional safety due to malfunction!

If the proof test failed, the device will no longer function properly.

- Replace the device.

14 Technical data

Input data	
Nominal input voltage U_N	24 V DC
Input voltage range (factor)	0.85 - 1.1
Typical current consumption at U_N	94 mA
Typical response time (K1, K2)	20 ms
Typical Release time (K1, K2)	0.3 s - 3 s + 50 %
Recovery time	~ 1 s
Status display	LEDs (K1, K2, Power), green
Surge protection	Suppressor diode
Output data	
Contact type	4 enabling current paths 1 signaling current path 1 confirmation path
Contact material	AgSnO ₂
Minimum switching voltage	15 V AC/DC
Maximum switching voltage	250 V AC/DC
Limiting continuous current	6 A (N/O contact) 3 A (N/C contact 65/66)
Maximum inrush current	6 A (N/O contact) 3 A (N/C contact 65/66)
Switching current, minimum	25 mA
Sq. Total current $(I_{TH})^2 = (I_1)^2 + (I_2)^2 + \dots + (I_n)^2$	50 A ² (see derating curve, → Figure 6, page 14)
Interrupting rating (ohmic load) maximum	144 W (24 V DC, $\tau = 0$ ms), N/C contact (65/66): 72 W 288 W (48 V DC, $\tau = 0$ ms), N/C contact (65/66): 144 W 77 W (110 V DC, $\tau = 0$ ms) 88 W (220 V DC, $\tau = 0$ ms) 1500 VA (250 V AC, $\tau = 0$ ms), N/C contact (65/66): 750 VA
Maximum interrupting rating (inductive load)	48 W (24 V DC, $\tau = 40$ ms) 40 W (48 V DC, $\tau = 40$ ms) 35 W (110 V DC, $\tau = 40$ ms) 33 W (220 V DC, $\tau = 40$ ms)
Switching capacity minimum	0.4 W
Mechanical service life	~ 10 ⁷ cycles
Switching capacity (360 cycles/h)	6 A (24 V DC) 5 A (230 V AC)
Switching capacity (3600 cycles/h)	3 A (24 V (DC-13)) 3 A (230 V (AC-15))
Output fuse	10 A gL/gG NEOZED (N/O contact) 6 A gL/gG NEOZED (N/C contact)

General data	
Nominal operating mode	100 % operating factor
Ambient temperature (operation)	-20 °C - 55 °C
Ambient temperature (storage/transport)	-40 °C - 70 °C
Degree of protection	IP20
Min. degree of protection of inst. location	IP54
Mounting position	any
Mounting type	DIN rail mounting
Air and creepage distances between the power circuits	according to DIN EN 50178:1998-04
Rated surge voltage / insulation	Basic insulation 4 kV: between all current paths and housing Safe isolation, reinforced insulation 6 kV
Pollution degree	2
Surge voltage category	III
Dimensions	
W x H x D	22.5 x 99 x 114.5 mm
Connection data	
Conductor cross section, solid	0.2 mm ² - 2.5 mm ²
Conductor cross section, stranded	0.2 mm ² - 2.5 mm ²
Conductor cross section AWG/kcmil	24 - 12
Stripping length	7 mm
Housing material	Polyamide PA, not reinforced
Tests / Approvals	
BG/TÜV	  
UL/CUL	 <p>LISTED IND. CONT. EQ. 32FB</p>

Technical safety data	
Stop category according to IEC 60204	1
Safety parameters for IEC 61508 - High demand	
SIL	3 (in conjunction with suitable evaluating device)
PFH _d	1.35×10^{-9} per hour
Requirement rate	< 12 months
Proof test interval	240 months
Duration of use	240 months
The specifications apply assuming the following calculation basis:	
B _{10d}	300000 (at 5 A DC-13)
Cycles	8760 per year
Safety parameters for IEC 61508 - Low demand	
SIL	3 (in conjunction with suitable evaluating device)
PFD _{avg}	1.49×10^{-4}
Proof test interval	67 months
Duration of use	240 months
Safety characteristic data according to EN ISO 13849	
Category	3 (in conjunction with suitable evaluating device)
Performance Level	e (in conjunction with suitable evaluating device)
Duration of use	240 months
For applications in PL e, the required demand rate for the safety function is once per month. The specifications apply assuming the following calculation basis:	
B _{10d}	300000 (at 5 A DC-13)
Cycles	8760 per year
Safety parameters for EN 62061	
SIL	3 (in conjunction with suitable evaluating device)
For SIL 3 applications the required demand rate for the safety function is once per month..	

15 Glossary

Abbreviation	Description
AC-15, DC-13	Standardized utilization categories and load cases from standard IEC 60947-5-1 that are used to test switching elements, i.e., switching on and off with defined voltages, currents, and loads (electromagnetic loads in particular in this case).
AOPD	Active Opto-electronic Protective Device Device with a sensor function that is implemented with optoelectronic transmission and reception elements that detect when an opaque object in the defined area of protection (or in the way of the light beam axis in the case of light barriers) is blocking the beams generated by the device. AOS is used as an abbreviation synonymous with AOPD in DIN EN 692 ("Machine tools - Mechanical presses - Safety"), DIN EN 693 ("Machine tools - Safety - Hydraulic presses"), and EN 12622 ("Safety of machine tools - Hydraulic press brakes").
AOPDDR	Active Opto-electronic Protective Device responsive to Diffuse Reflection Device with a sensor function that is implemented with optoelectronic transmission and reception elements that detect when an object in the area of protection defined with two dimensions diffusely reflects the beam generated by the device.
ESPE	Electro-sensitive protective equipment
CCF	Common Cause Failure Common cause failure
DC	Diagnostic Coverage Diagnostic coverage
ESR	Electronic safety relay
DF	Duty factor
PL	Performance Level Classification of safety functions used to meet a safety requirement.
HFT	Hardware Fault Tolerance
Cat. / category	Classification of resistance to errors as defined in EN ISO 13849-1
Mission Time T_M	Lifetime
MTTF / $MTTF_d$	Mean Time To Failure Mean time to failure / mean time to dangerous failure
NC	Normally Closed contact, break contact An NC breaks a circuit when it is energized.
NO	Normally-Open contact An NO closes when it is energized.
PFD	Probability Failure on Demand (Low-Demand) Probability of failure relative to the number of requests
PFH_d	Probability of a Dangerous Failure per Hour Probability of dangerous Failures per Hour
SIL	Safety Integrity Level Safety integrity level
SRCF	Safety-Related Control Function Safety-related control function
SRECS	Safety-Related Electrical Control System Safety related electrical, electronic, programmable electronic control system
SRP	Safety-Related Part Safety-related part
SRP/CS	Safety-Related Parts of Control System Safety-related part of a control system

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