

Industrial controls

Safety technology 3TK28 safety relays




Manual

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Legal information

Warning notice system

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

 DANGER
indicates that death or severe personal injury will result if proper precautions are not taken.
 WARNING
indicates that death or severe personal injury may result if proper precautions are not taken.
 CAUTION
indicates that minor personal injury can result if proper precautions are not taken.
NOTICE
indicates that property damage can result if proper precautions are not taken.


If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

Qualified Personnel

The product/system described in this documentation may be operated only by **personnel qualified** for the specific task in accordance with the relevant documentation, in particular its warning notices and safety instructions. Qualified personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with these products/systems.

Proper use of Siemens products

Note the following:

 WARNING
Siemens products may only be used for the applications described in the catalog and in the relevant technical documentation. If products and components from other manufacturers are used, these must be recommended or approved by Siemens. Proper transport, storage, installation, assembly, commissioning, operation and maintenance are required to ensure that the products operate safely and without any problems. The permissible ambient conditions must be complied with. The information in the relevant documentation must be observed.

Trademarks

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Disclaimer of Liability

We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

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Introduction

1.1 Purpose of this manual

Note

Original manual

The manual for the 3TK28 safety relays described below is the original manual.

This manual contains a detailed description of the 3TK28 safety relays. This manual provides you with the information you require to configure, commission, and use 3TK28 safety relays. Typical application examples provide you with a clear and practice-oriented introduction.

Furthermore, the manual contains dimension drawings, circuit diagrams, and technical data of the 3TK28 safety relays to facilitate configuration.

1.2 Required basic knowledge

A general knowledge of the following areas is needed in order to understand this manual:

- Low-voltage switchgear
- Digital circuit logic
- Automation systems
- Safety systems

1.3 Validity range

The manual is valid for the available 3TK28 safety relays. It describes the components that are valid at the time of publication.

SIEMENS reserves the right of including a Product Information for each new component, and for each component of a later version.

1.4 Definitions

"3TK28" always applies to all variants of the 3TK28 safety relays.

1.5 Correction sheet

The appendix to this manual contains a correction sheet for evaluation and feedback. Please use it to record your suggestions for improvements, additions and corrections, and return the sheet to us. This will help us to improve the next edition of the manual.

Thank you.

1.6 User responsibility for system design and function

The products described here were developed to perform safety-related functions as part of an overall installation or machine.

A complete, safety-related system is generally equipped with sensors, evaluation units, and signaling units, and uses reliable shutdown concepts.


It is the responsibility of the manufacturer of a system or machine to ensure that the product functions properly.

Siemens AG, its regional offices, and associated companies (hereinafter referred to as "Siemens") cannot guarantee all the properties of an entire plant, system or machine that has not been designed by Siemens.

Nor can Siemens assume liability for recommendations that appear or are implied in the following description. No new guarantee, warranty, or liability claims beyond the scope of the Siemens general terms of supply are to be derived or inferred from the following description.


Product-specific safety information

2.1 Intended use

 WARNING
<p>Hazardous Voltage. Can Cause Death, Serious Injury, or Property Damage.</p> <p>Proper use of hardware products</p> <p>This equipment is only allowed to be used for the applications described in the catalog and in the technical description, and only in conjunction with non-Siemens equipment and components recommended by Siemens.</p> <p>Correct transport, storage, installation and assembly, as well as careful operation and maintenance, are required to ensure that the product operates safely and without faults.</p> <p>Before you run any sample programs or programs you have written yourself, make sure that running the plant cannot cause injury to anyone else or damage to the machine itself.</p> <p>EU note: Commissioning is absolutely prohibited until it has been ensured that the machine in which the component described here is to be installed complies with the stipulations of the Directive 2006/42/EC.</p>

2.2 Current information about operational safety

Important note for maintaining operational safety of your system

 WARNING
<p>Hazardous Voltage. Can Cause Death, Serious Injury, or Property Damage. Please take note of our latest information</p> <p>Systems with safety-related characteristics are subject to special operational safety requirements on the part of the operator. The supplier is also obliged to comply with special product monitoring measures. For this reason, we publish a special newsletter containing information on product developments and features that are (or could be) relevant to operation of safety-related systems. By subscribing to the appropriate newsletter, you will ensure that you are always up-to-date and able to make changes to your system, when necessary:</p> <p>SIEMENS newsletter</p> <p>Sign on to the following newsletter under "Products & Solutions":</p> <ul style="list-style-type: none">• Control Components and System Engineering News• Safety Integrated Newsletter

2.3 Declaration of conformity

The manufacturer declares that the safety components of the SIRIUS 3TK series in the designs marketed by us comply with the applicable basic safety and health requirements of the EC Directives* stated (including amendments) and that the stated standards* were applied in their design and construction.

* You can download the complete EC Declaration of Conformity as a PDF.

2.4 General safety notes

Note

Safety category 4 per DIN EN 954-1 / SIL 3 per IEC 61508 / PL e per DIN EN ISO 13849-1

The 3TK28 safety relays have been designed such that applications up to category 4 per DIN EN 954-1 / SIL 3 per IEC 61508 / PL e per DIN EN ISO 13849-1 can be implemented.

 CAUTION**Protection against electrostatic charge**

When handling and installing the 3TK safety relays, ensure that the components are protected from being electrostatically charged. Changes to the system configuration and wiring are only permissible while the supply voltage is switched off.

Connection of 3TK safety relays is only permissible when the power supply units (PELV and SELV) are switched off.

 WARNING**Hazardous voltage**

Will Cause Death, Serious Injury or Property Damage

Installing devices in control cabinets

Taking the ambient conditions into account, you must install the devices in control cabinets with the IP32, IP43 or IP54 degree of protection.

 CAUTION**Noise immunity/grounding**

The following must be grounded in accordance with the regulations to ensure noise immunity of the 3TK28 safety relays:

- PELV / SELV power supplies (please also observe the documentation of the respective power supply).

Note**Operational faults and malfunctions in communication**

If the EMC Directive 2004/108/EC is not complied with when plants and devices are installed, communication breaks may occur.

Note

The 3TK28 devices are products for environment A. These devices can cause unwanted radio interference in residential environments. The user may be required to implement appropriate measures in this case.

2.5 Safety information for hazardous areas

 **WARNING**

Hazardous Voltage.

Can Cause Death, Serious Injury, or Property Damage.

Installation of the 3TK28 safety relays in hazardous areas

The components of the 3TK28 are **not** suitable for installation in hazardous areas.
Please contact your ATEX specialist.

Description of the individual safety relays

3.1 Introduction

SIRIUS 3TK28 safety relays are mainly used in autonomous safety applications that are not connected to a safety-related bus system. Here they are used to evaluate sensors and ensure safety-related shutdown in case of a hazard. They also check and monitor the sensors, actuators, and the safety-related functions of the safety relay.

Applications

Depending on the version of the device and the external wiring with sensors and actuators, applications up to Category 4 in accordance with DIN EN 954-1 or SILCL 3 in accordance with IEC 62061 / PL_e as specified in DIN EN ISO 13849-1 can be implemented.

In these applications, 3TK28 safety relays perform the following functions:

- Monitoring the safety functions of the sensors
- Monitoring of the sensor lines
- Monitoring of correct functioning of the safety relay
- Monitoring of actuators for standstill
- Safety-related shutdown in case of hazards

3.2 Overview

Overview of 3TK28 safety relays

The following tables provide an overview of the 3TK28 safety relays.

3TK28 safety relays with relay enabling circuits

3TK28..	20	21	22	23	24	25	27	28	30	34
SENSORS										
Electromechanical	X	X	X	X	X	X	X	X	-	X
Solid-state	-	-	-	-	-	-	-	-	-	-
Magnetically-operated switches	X	-	-	-	-	-	-	-	-	-
START TYPE										
Auto	X	X	X	-	X	X	-	X	-	-
Monitored	X	X	-	X	X	X	X	-	-	-
ENABLING CIRCUITS										
Instantaneous	3 NO	3 NO	2 NO	2 NO	2 NO	3 NO	2 NO	2 NO	4 NO	2 NO + 2 NC
Delayed	-	-	-	-	-	-	2 NO	2 NO	-	-
SIGNALING CIRCUITS										
Relay	1 NC	1 NC	-	-	-	2 NC	1 NC	1 NC	-	2 NC
Solid-state	-	-	-	-	-	-	-	-	-	-
Performance Indicators										
Max. achievable SIL acc. to IEC 61508 / IEC 62061	3	2	3	3	2	3	3 / 2 (tv)	3 / 2 (tv)	as BU	3
Max. achievable PL acc. to EN ISO 13849-1	e	d	e	e	d	e	e / d (tv)	e / d (tv)	as BU	e

3TK28 safety relays with solid-state enabling circuits

3TK28..	40	41	42
SENSORS			
Electromechanical	X	X	X
Solid-state	-	X	X
Magnetically-operated switches	X	X	X
START TYPE			
Auto	X	X	X
Monitored	X	X	X
ENABLING CIRCUITS			
Instantaneous	2	2	1
Delayed	-	-	1
SIGNALING CIRCUITS			
Relay	-	-	-
Solid-state	-	-	-
Performance			
Max. achievable SIL acc. to IEC 61508 / IEC 62061	2	3	3
Max. achievable PL acc. to EN ISO 13849-1	d	e	e

3.2 Overview

3TK28 safety relays with contactor relay enabling circuits

3TK28..	05	06	50	51	52	53	56	57
SENSORS								
Electromechanical	X	X	X	X	X	X	-	-
Solid-state	-	-	-	-	-	X	-	-
Magnetically-operated switches	-	-	X	X	X	X	-	-
START TYPE								
Auto	-	X	X	X	X	X	-	-
Monitored	-	-	X	X	X	X	-	-
ENABLING CIRCUITS								
Instantaneous	5 NO	5 NO	3 NO	2 NO	6 NO	3 NO+1 SS	6 NO+1 SS	1 SS
Delayed	-	-	-	-	-	-	-	3 NO
SIGNALING CIRCUITS								
Relay	1 NC	1 NC	-	1 NC	1 NC	-	1 NC	-
Solid-state	-	-	-	-	-	-	-	-
PERFORMANCE RATINGS								
Max. achievable SIL acc. to IEC 61508 / IEC 62061	3	3	2	2	2	3	as BU	as BU
Max. achievable PL acc. to EN ISO 13849-1	e	e	d	d	d	e	as BU	as BU

NO = normally-open; SS = solid-state; NC = normally-closed; as BU = as basic unit

3TK28 speed/standstill monitoring

3TK28..	10-0	10-1
SENSORS		
Electromechanical	X	X
Solid-state	-	X
Magnetically-operated switches	-	X
START TYPE		
Auto	X	X
Monitored	-	X
ENABLING CIRCUITS		
Instantaneous	3 NO + 1 NC	2 NO
Delayed	-	-
SIGNALING CIRCUITS		
Relay	1 CO	
Solid-state	2	2
Achievable SIL / PL		
Max. achievable SIL acc. to IEC 61508 / IEC 62061	3	3
Max. achievable PL acc. to EN ISO 13849-1	e	e
SENSORS		
Without sensors	X	-
Sensors	-	PNP, NPN, HTL, TTL, SIN/COS, NAMUR

NO = normally-open; SS = solid-state; NC = normally-closed; CO = changeover

You will find further information on 3TK2810-1 speed/standstill monitors in Manual 3TK2810-1 safety-related speed monitor

(<http://support.automation.siemens.com/WW/view/en/43707376>)

3TK28 multifunctional devices

3TK28..	26	45
SENSORS		
Electromechanical	X	X
Solid-state	X	X
Magnetically-operated switches	X	X
START TYPE		
Auto	X	X
Monitored	X	X
ENABLING CIRCUITS		
Instantaneous	See manual 3TK2826	See manual 3TK2845
Delayed		
SIGNALING CIRCUITS		
Relay	See manual 3TK2826	See manual 3TK2845
Solid-state		
Max. achievable SIL acc. to IEC 61508 / IEC 62061	3	3
Max. achievable PL acc. to EN ISO 13849-1	e	e

You will find further information on 3TK2826 in Manual 3TK2826 (<http://support.automation.siemens.com/WW/view/en/24044904>)

You will find further information on 3TK2845 in Manual 3TK2845 (<http://support.automation.siemens.com/WW/view/en/25613330>)

You will find comprehensive help with selecting products in Catalog IC10 (<http://www.siemens.com/industrial-controls/catalogs>)

3.3 General technical data

Technical data valid for all 3TK28 products in this manual.

Product brand name		SIRIUS	
Product designation		Safety relay	
Version of the product		for EMERGENCY STOP and protective doors	
Installation environment with respect to EMC		The 3TK products are only suitable for Class A environments. These devices can cause unwanted radio interference in residential environments. The user is required to implement appropriate measures in this case.	
IP degree of protection of the housing		IP40	
IP degree of protection of the terminal		IP20	
Touch protection against electric shock	V	Safe from finger-touch	
Hardware failure tolerance / according to IEC 61508		1	
Ambient temperature • during storage • during operation	°C	-40 ... +80 -25 ... +60	
Atmospheric pressure • according to SN 31205	hPa	900 ... 1060	
Relative air humidity • during operation	%	10 ... 95	
Maximum operating altitude above MSL	m	2000	
Vibration resistance according to IEC 60068-2-6		5 ... 500 Hz: 0.75 mm	
Shock resistance		15g / 11 ms	
Rated impulse strength	V	4000	
Mounting position		Any	
Type of fixing		Snap-on mounting	
Type of electrical connection		3TK28..-1.... screw-type	3TK28..-2.... spring-loaded
Certificate of suitability • TÜV / BG approval • UL certification		Yes Yes	

You will find further technical data in the Technical Data chapters of each product and in the Dimension Drawings chapter.

3.4 Cable lengths

3.4 Cable lengths

The cable lengths specified in the table are valid for a cable cross-section of 1.5 mm².

Sensor - evaluation unit distance for 3TK28 devices		
	Sensor - evaluation unit distance in meters (1-channel)	Sensor - evaluation unit distance in meters (2-channel)
3TK2805	150	150
3TK2806	150	150
3TK2820 (DC)	1000	1000
3TK2820 (AC)	1000	1000
3TK2821	1000	500
3TK2822 / 23	-	500
3TK2824 (DC)	1000	500
3TK2824 (AC)	1000	500
3TK2825	1000	500
3TK2827 / 28	1000	500
3TK2830-.CB30	1000 *	500
3TK2830-.AJ20	300 *	150
3TK2830-.AL20	80 *	40
3TK2834	-	500
3TK2840	2000	2000
3TK2841	2000	2000
3TK2842	2000	2000
3TK2850 / 51 / 52	2000	2000
3TK2853	2000	2000
3TK2856 / 57	1000*	-

* only for protected installation if not in the same switchboard as the basic unit

3.5 General information about enabling and signaling circuits

Relay enabling circuits:

When a safety function is requested or a fault detected, the 3TK28 safety relays enter the safe state. This means:

Relay enabling circuits with NO function OPEN

Relay enabling circuits with NC function CLOSE

Relay signaling circuits:

Relay signaling circuits always have NC functionality with 3TK28 devices.

Relay signaling circuits thus always operate inversely with respect to the relay enabling circuits with NO functionality.

Solid-state enabling circuits:

Solid-state enabling circuits in 3TK28 safety-related devices always operate according to the NO principle.

When a safety function is requested or a fault detected, the 3TK28 safety relays enter the safe state. This means:

Solid-state enabling circuits switch to the inactive state.

Solid-state signaling circuits:

Solid-state signaling circuits in 3TK28 safety relays signal the state of the enabling circuits (==> functioning synchronously with the solid-state enabling circuits).

When a safety function is requested or a fault detected, the 3TK28 safety relays enter the safe state. This means:

Solid-state signaling circuits switch to the inactive state.

Contactor enabling circuits:

When a safety function is requested or a fault detected, the 3TK28 safety relays enter the safe state. This means:

Contactor enabling circuits with NO function OPEN

Contactor enabling circuits with NC function CLOSE

Contactor signaling circuits:

Contactor signaling circuits always have NC functionality with 3TK28 devices.

Contactor signaling circuits thus always operate inversely with respect to the contactor enabling circuits with NO functionality.

3.6 3TK28 safety relays with relay enabling circuits

3.6.1 3TK2810-0 safety relay

3.6.1.1 Applications

Applications of the 3TK2810-0 safety relay

You can use the 3TK2810-0 safety relays for safety standstill detection on 3-phase and 1-phase induction motors, e.g. to disengage protective door release mechanisms on machine tools or to activate stopping brakes.

3.6.1.2 Description of function and connection information

The 3TK2810-0 safe stillstand monitor measures a voltage of the coasting motor induced by remanent magnetization at 3 terminals of the stator winding.

If the induction voltage approaches 0, this means motor standstill for the device and the output relay is activated.

To enable adaptation of the device to the most varied types of motors and applications, the voltage threshold U_{an} , below which the 3TK2810-0 detects standstill, can be set. The duration for which U_{an} must be undershot to detect standstill definitively and enable the output circuit can also be set (standstill time t_s).

The device also detects wire break between the measurement inputs L1 / L2 / L3. If a wire break is detected, the output relay goes into the safe position (as it does when the motor is running). This state is stored and can be cleared by (briefly) jumpering terminals X2 - X3. X1 - X2: Feedback circuit for connecting external contactors (NC contact). If the feedback circuit is not required, terminals X1 - X2 must be jumpered; otherwise a fault will be signaled.

Device properties

- PL_e per EN ISO 13849-1; SIL 3 per IEC 61508 / IEC 62061
- Wire-break detection in the measurement circuit
- Positive-action safe output contacts: 3 NO contacts, 1 NC contact for 250 V AC
- 2 semiconductor signaling outputs
- 1 changeover signaling output
- Settable voltage threshold U_{an}
- Settable standstill time t_s
- LED displays for motor standstill, wire break, and operating voltage
- Suitable for use with frequency converters

Practical note

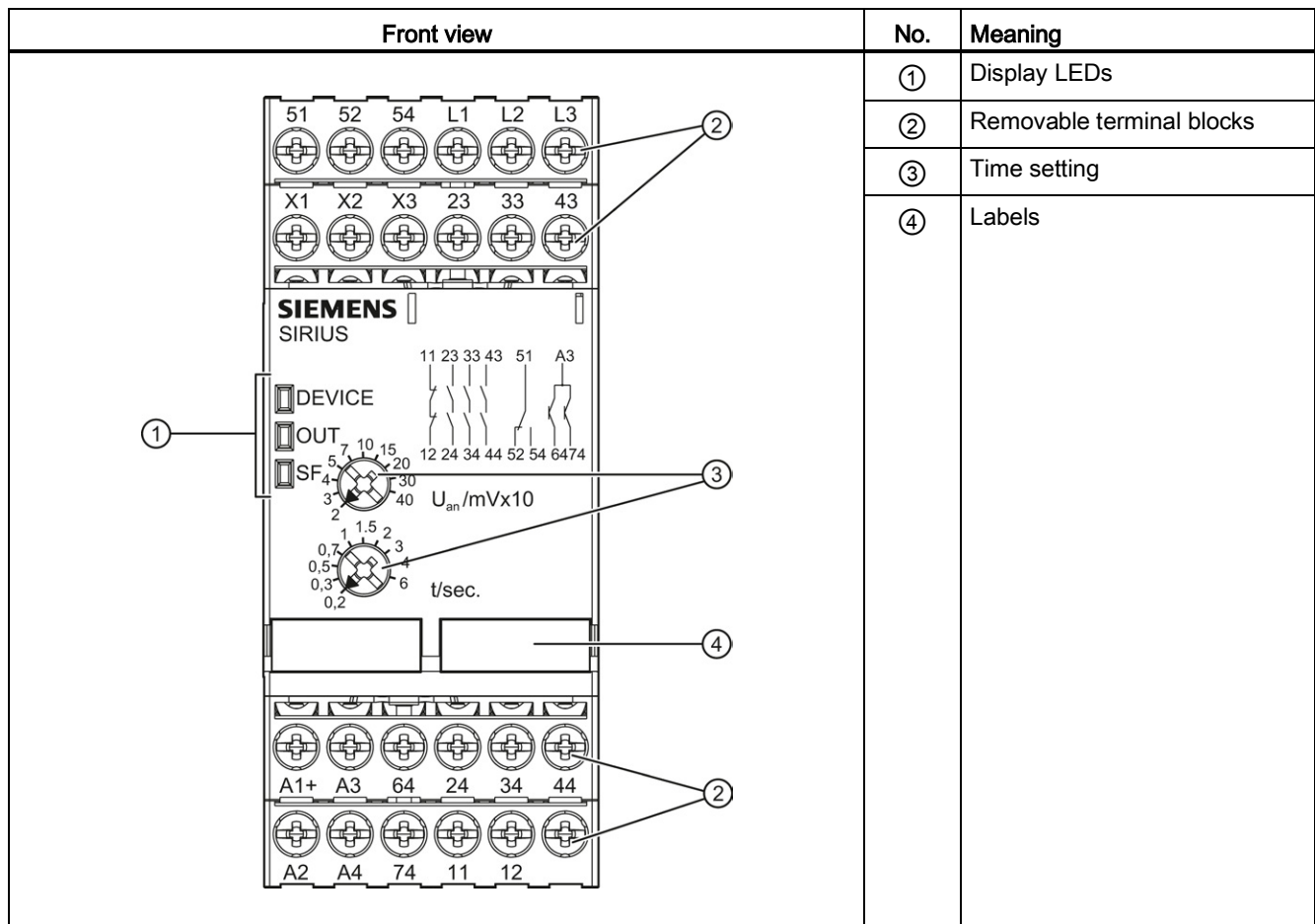
A frequency converter generates an offset during braking (DC component). This can be detected as a wire break and stored by the standstill monitor. The same operation also occurs during DC braking.

The enabling circuits are only released when:

- braking has ended, i.e. the standstill monitor no longer detects a DC component (-> motor stopped) and control terminals X2 - X3 are jumpered.
- or a manual reset is performed via these terminals.

If the 3TK2810 is used with a frequency converter, terminals X2 - X3 must be jumpered or a manual reset must be performed before restart.

3.6.1.3 Structure of the 3TK2810-0



3.6.1.4 Terminal assignment

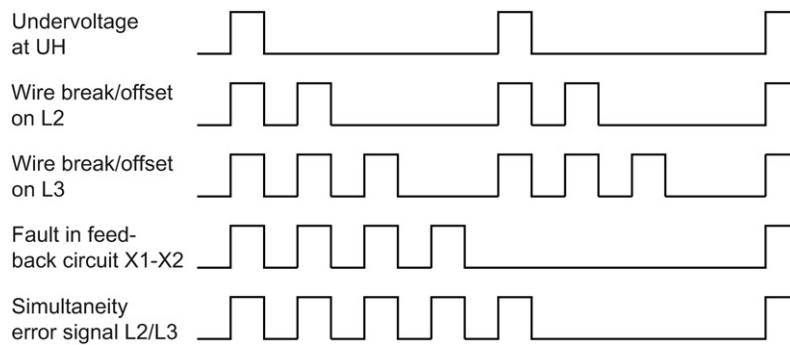
Terminal	Description
A1	L/+
A2	L/-
A3	24 V DC power supply to signaling outputs
A4	Ground for signaling outputs
L1, L2, L3	Signal inputs
X1, X2, X3	Control terminals
11, 12	NC contact, positive-action, enabling circuit
23, 24; 33, 34; 43, 44	NO contact, positive-action, enabling circuit
51, 52, 54	Signaling output, changeover contact
64	Signaling output "enable"
74	Signaling output "fault"

3.6.1.5 Display of the operating state

The operating state and functioning of the device are indicated by three LEDs:

- DEVICE
 - lights up green during operation
 - lights up red on internal device faults
- OUT
 - lights up yellow on $EMF > U_{an}$
 - flashes green when t_s elapses
 - green steady light on enabling the output contacts
- SF
 - flashes on faults in the measurement and feedback circuit and on insufficient auxiliary voltage U_H (see flashing code)

LED flashing codes of the red LEDs "SF" in order of priority



3.6.1.6 State diagram 3TK2810-0

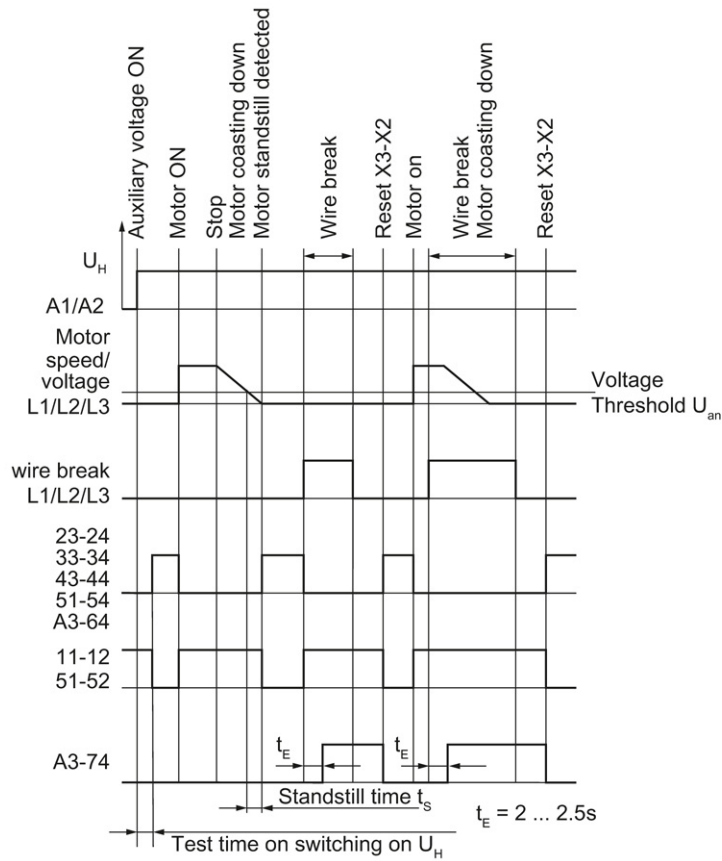


Figure 3-1 t_E : Detection time after wire break

3.6.1.7 Technical data 3TK2810-0

	3TK2810-0G...	3TK2810-0B...
EMC emitted interference	IEC 61000-6-2, IEC 61000-6-3	
Item designation		
<ul style="list-style-type: none"> • according to DIN 40719 extendable after IEC 204-2 according to IEC 750 	KT	
<ul style="list-style-type: none"> • according to DIN EN 61346-2 	F	
Number of sensor inputs 1-channel or 2-channel	1	
Design of the cascading	none	
Type of the safety-related wiring of the inputs	measuring inputs	
Product feature transverse contact-secure	No	
Safety Integrity Level (SIL) according to IEC 61508	SIL3	
SIL claim limit (for a subsystem) according to EN 62061	3	
Safety integrity level (SIL) for delayed release circuit according to IEC 61508	SIL3	
Performance Level (PL)		
<ul style="list-style-type: none"> • according to ISO 13849-1 	e	
<ul style="list-style-type: none"> • for delayed release circuit according to ISO 13849-1 	e	
Category		
<ul style="list-style-type: none"> • according to EN 954-1 	4	
<ul style="list-style-type: none"> • according to ISO 13849-1 	4	
Safety device type according to IEC 61508-2	Type B	
Probability of dangerous failure per hour (PFHD) with high demand rate according to EN 62061	1/h	1.5 ⁻⁹
T1 value for proof test interval or service life according to IEC 61508	a	20

3.6 3TK28 safety relays with relay enabling circuits

	3TK2810-0G...	3TK2810-0B...
Number of outputs as contact-affected switching element as NO contact safety-related		
• as contact-affected switching element as NC contact for reporting function instantaneous switching	2	
• as contact-affected switching element as NO contact safety-related instantaneous switching	4	
• as contact-affected switching element as NO contact safety-related delayed switching	0	
• as contact-less semiconductor switching element		
– for reporting function		
– non-delayed	2	
– delayed switching	0	
– safety-related		
– non-delayed	0	
– delayed switching	0	
Stop category according to DIN EN 60204-1	0	
Design of the input		
• cascading-input/functional switching	No	
• feedback input	Yes	
• start input	No	
Design of the electrical connection jumper socket	Yes	
Switching capacity current		
• at AC-15 at 24 V	A	—
• of the NO contacts of the relay outputs		
– at AC-15 at 230 V	A	3
– at DC-13 at 24 V	A	2
• of the NC contacts of the relay outputs at AC-15		
– at 115 V	A	2
– at 230 V	A	2
Thermal current of the contact-affected switching element maximum	A	5

	3TK2810-0G...	3TK2810-0B...
Electrical operating cycles as operating time typical	200 000	
Mechanical operating cycles as operating time typical	50 000 000	
Design of the fuse link for short-circuit protection of the NO contacts of the relay outputs required	quick: 5 A	
Type of voltage of the controlled supply voltage	AC	DC
Control supply voltage frequency 1 rated Hz value	50	—
Control supply voltage frequency 2 rated Hz value	60	—
Control supply voltage 1 for DC final rated value		
• for DC rated value	V —	24
Operating range factor control supply voltage rated value of the magnet coil		
• at 50 Hz for AC		
– initial value	0.8	—
– final value	1.1	—
• at 60 Hz for AC		
– initial value	0.8	—
– final value	1.1	—
• for DC	—	0.9
	—	1.2

3.6 3TK28 safety relays with relay enabling circuits

	3TK2810-0G...	3TK2810-0B...
Product function		
• automatic start	No	
• rotation speed monitoring	No	
• laser scanner monitoring	No	
• light grid monitoring	No	
• light barrier monitoring	No	
• magnetic switch monitoring Normally closed contact-Normally open contact	No	
• magnetic switch monitoring Normally closed contact-Normally closed contact	No	
• emergency stop function	No	
• protective door monitoring	No	
• standstill monitoring	Yes	
• step mat monitoring	No	
• monitored start-up	No	
Acceptability for application		
• safety-related circuits	Yes	
• safety cut-out switch	Yes	
• magnetically operated switches monitoring	No	
• EMERGENCY-OFF circuit monitoring	No	
• proximity switches monitoring	No	
• opto-electronical protection device monitoring	No	
• position switch monitoring	No	
• tactile sensor monitoring	No	
• valve monitoring	No	

Input data (L1-L2-L3)

Measurement/motor voltage	V	max. 690 V AC
Input resistances	kΩ	Approx. 400
Reponse value Uan	mV	approx. 20 ... 400; settable
Standstill time ts	s	0.2 ... 6; settable

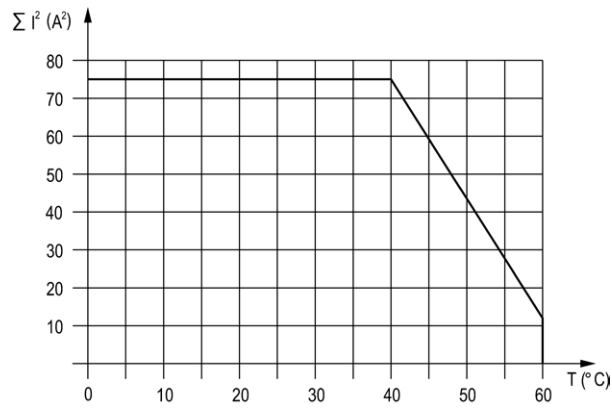
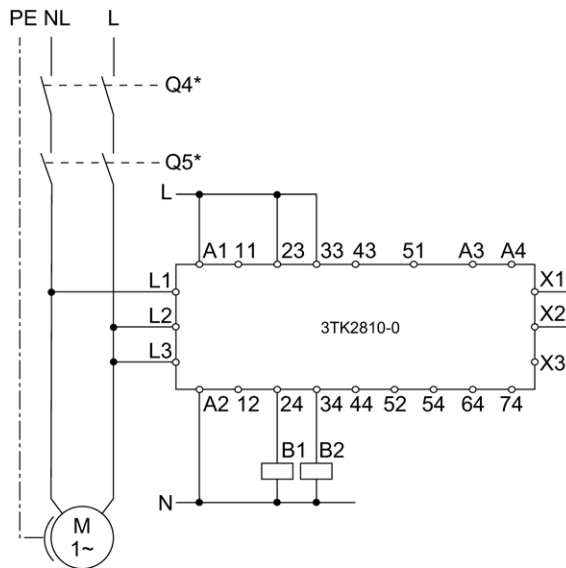


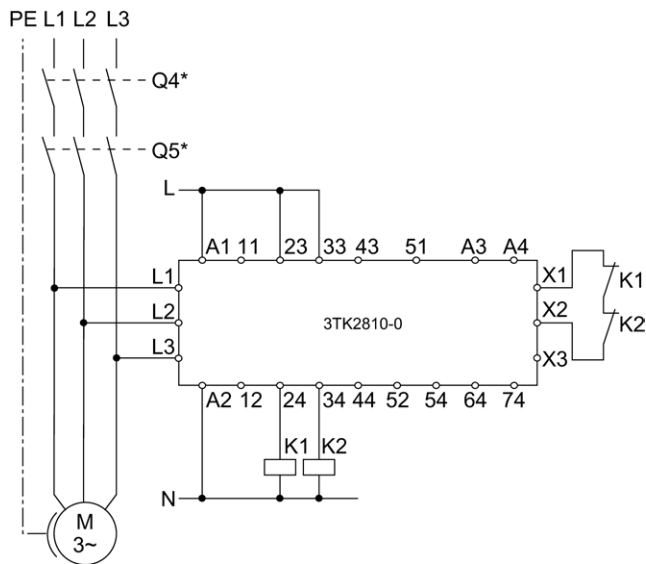
Figure 3-2 Derating table

3.6.1.8 Connection examples 3TK2810-0



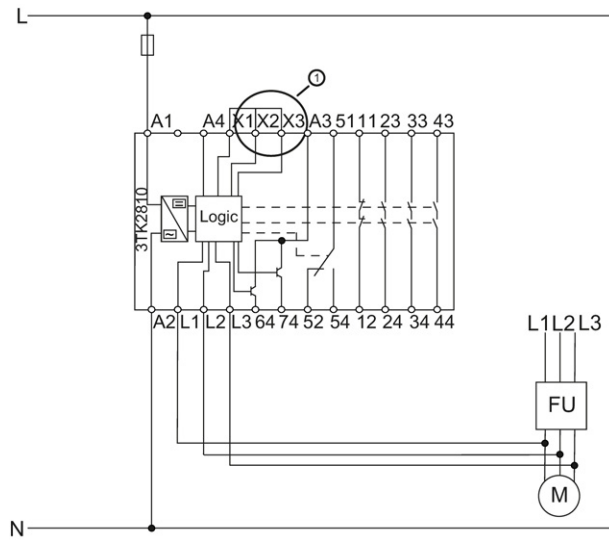
* Motor contactors

Figure 3-3 Without evaluation of the feedback circuit



* Motor contactors

Figure 3-4 With evaluation of the feedback circuit



① With jumper between X2-X3 for automatic acknowledgment of open-circuit detection

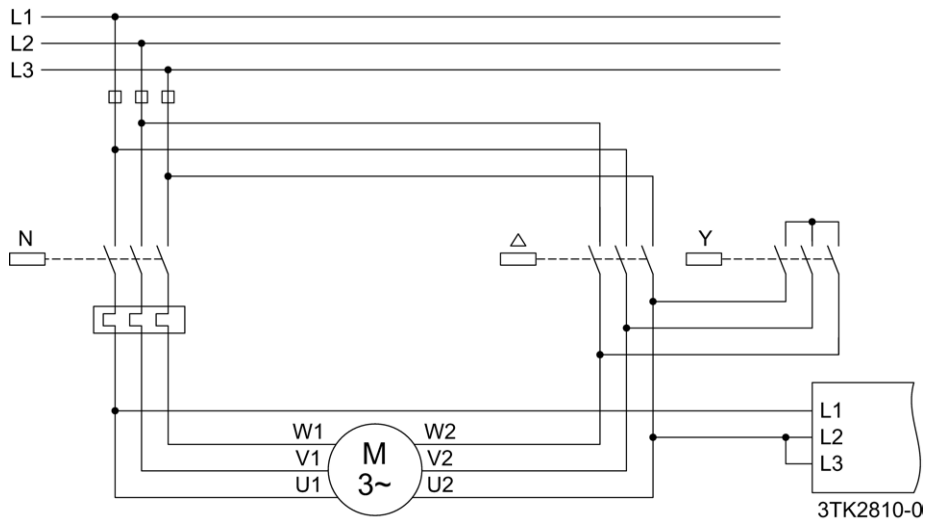


Figure 3-5 Use of the 3TK2810-0 standstill monitor in a wye-delta connection

3.6.2 3TK2820 safety relay

3.6.2.1 Applications

Applications of the 3TK2820 safety relay

You can use the 3TK2820 safety relay in EMERGENCY STOP devices according to DIN EN ISO 13850 and in safety circuits according to VDE 0113-1 or DIN EN 60204-1, e.g. for movable guards and protective doors.

Depending on the external circuitry, SILCL 3 in accordance with IEC 62061 or PL_e in accordance with EN 13849-1 can be achieved. Depending on the hazard assessment, additional measures may be necessary in the sensor circuit (e.g. protected cable installation).

When the safety relay is used in "automatic start" mode, automatic restart (acc. to EN 60204-1, section 9.2.5.4) after shutdown in an emergency (EMERGENCY STOP) must be prevented by suitable means.

3.6.2.2 Description of function and connection information

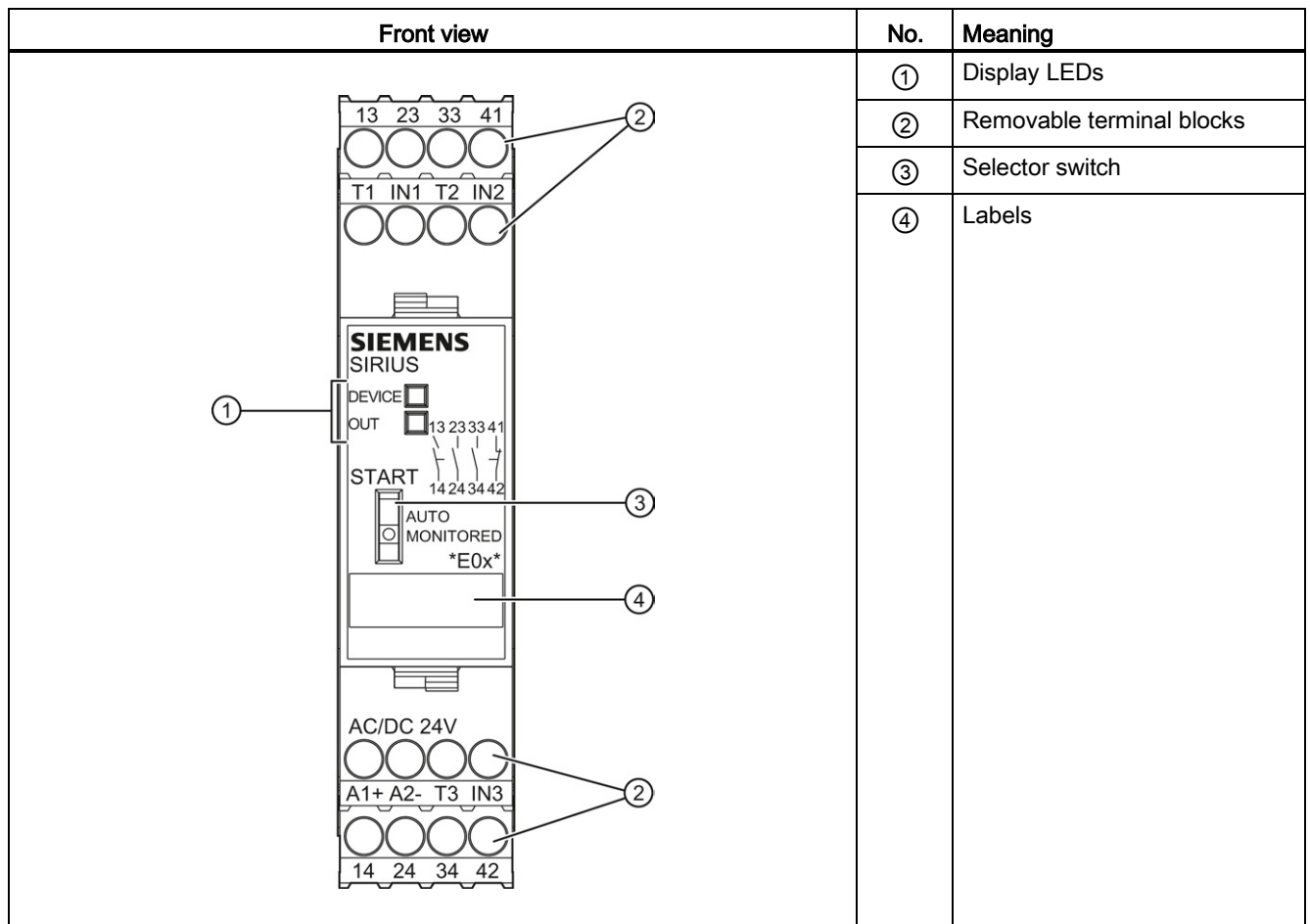
The 3TK2820 safety relay has three enabling circuits (safe circuits, NO) and one signaling circuit (non-safe, NC). The number of enabling circuits can be increased by adding one or more 3TK2830 expansion blocks. Two LEDs indicate the operating state of the device.

The devices also monitor the sensor circuits for cross-circuits. This is done based on various potentials in the sensor circuits.

When the EMERGENCY STOP buttons or limit switches are released and the ON button is pressed, the internal circuit of the safety relay and the external contactors are monitored to ensure that they are functioning correctly.

Connect the EMERGENCY STOP button or the limit switch at terminals T1/IN1 and T2/IN2. The ON button is connected in series with the NC contacts of the external contactors (feedback circuit) at terminals T3/IN3.

3.6.2.3 Structure 3TK2820



3.6.2.4 Terminal assignment

Terminal	Description
A1	L/+
A2	N/-
IN1	Sensor channel 1
IN2	Sensor channel 2
IN3	ON button, feedback circuit
T1	Test output 1 (for IN1)
T2	Test output 2 (for IN2)
T3	Test output 3 (for IN3)
13 - 14	Enabling circuit 1 (NO, relay contact)
23 - 24	Enabling circuit 2 (NO, relay contact)
33 - 34	Enabling circuit 3 (NO, relay contact)
41 - 42	Signaling circuit (NC, relay contact)

3.6.2.5 Display of the operating state

Two LEDs and a slide switch indicate the operating state and functioning of the device:

- DEVICE
- OUT

Operating state of 3TK2820


LED		Operation			
DEVICE	OUT	Line supply	EMERGENCY STOP	ON	Enabling circuit
		On	Not pressed	Pressed	Closed
			Pressed	Not pressed	Open
			Not pressed	Not pressed	Open
		Fault			
		Fault in sensor circuit			Open
= off	= on				

Selector switch		
Start	Up	Automatic start
<input type="checkbox"/> AUTO <input checked="" type="checkbox"/> MONITORED	Down	Monitored start

3.6.2.6 Installation 3TK2820

Warning notices

Warning notices before installation, wiring, and commissioning

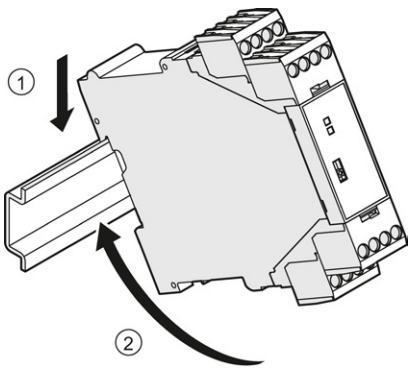
 WARNING
Hazardous voltage! Can cause electric shock and burns. Turn off and lock out all power supplying this device before working on this device.

Mounting the device on a DIN rail


Requirements

- At the installation location, a horizontal 35 mm mounting rail in accordance with DIN EN 60715 is properly secured
- Please observe the information about the mounting position in Chapter "General technical data (Page 19)"

DIN rail mounting procedure

Step	Operating instruction	Figure
1	Hang the back of the device onto the upper edge of the DIN rail	
2	Press the lower half of the device against the DIN rail until the device engages	

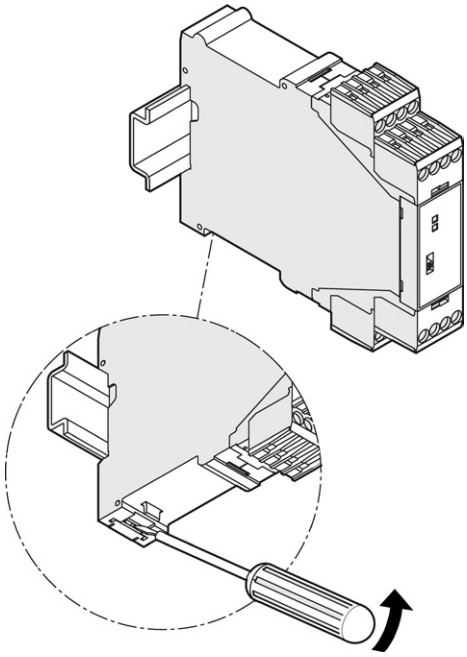
Disassembling the device

 WARNING
<p>Hazardous Voltage. Can Cause Death, Serious Injury, or Property Damage.</p> <p>Before starting work, therefore, disconnect the system and devices from the power supply.</p>

Requirements

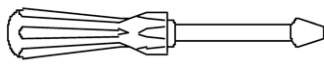
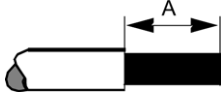
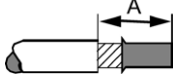
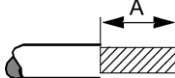
- All system interface connections are terminated.
- The terminal blocks have been removed or disconnected.

Disassembling the device from a DIN rail


Step	Operating instruction	Figure
1	Unlock the device using a screwdriver	
2	Pull the lower half of the device away from the DIN rail.	
3	Lift the device from the upper edge of the DIN rail.	

3.6.2.7 Connection 3TK2820

Connection data for terminal blocks

	Specification and value in the case of removable terminal blocks with screw- type terminals	Specification and value in the case of removable terminal blocks with spring-loaded terminals	
Screwdriver 	Cross-tip screwdriver Size: PZ 1 (ø 4 mm) Torque: 0.8 ... 1.2 N	Screwdriver Size: 0 or 1 (width to 3 mm) for raising the terminal springs DIN 5264-A; 0.5 x 3	
Rigid cable 	A = 8 mm 1 x 0.5 ... 2.5 mm ² 1 x AWG 20 to 14 2 x 0.5 ... 1.5 mm ² 2 x AWG 20 to 16	A = 10 mm 1 x 0.5 ... 2.5 mm ² 1 x AWG 20 to 14	A = 12 mm 1 x 0.5 ... 4 mm ² 1 x AWG 20 to 12
Flexible cable with end sleeve/cable lug 	A = 8 mm 1 x 0.5 ... 2.5 mm ² 1 x AWG 20 to 14 2 x 0.5 ... 1.0 mm ² 2 x AWG 20 to 18	A = 10 mm 1 x 0.5 ... 1.5 mm ² 1 x AWG 20 to 16	A = 12 mm 1 x 0.5 ... 2.5 mm ² 1 x AWG 20 to 14
Flexible cable 	A = 8 mm 1 x 0.5 ... 2.5 mm ² 1 x AWG 20 to 14 2 x 0.5 ... 1.5 mm ² 2 x AWG 20 to 16	A = 10 mm 1 x 0.5 ... 2.5 mm ² 1 x AWG 20 to 14	A = 12 mm 1 x 0.5 ... 4 mm ² 1 x AWG 20 to 12

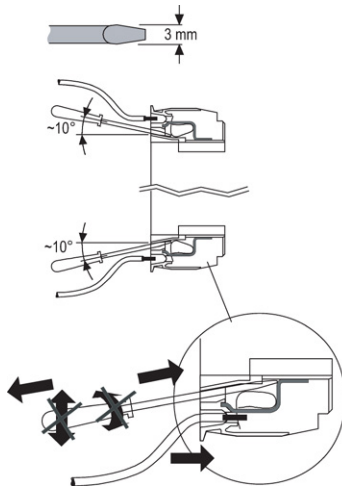
Connecting terminal blocks

 WARNING
<p>Hazardous Voltage. Can Cause Death, Serious Injury, or Property Damage.</p> <p>Before starting work, therefore, disconnect the system and devices from the power supply.</p>

Procedure for screw-type terminal blocks

Step	Operating instruction
1	Insert the relevant cable into square on the screw-type terminal until it engages.
2	Hold the cable in the screw-type terminal.
3	Tighten the screw of the terminal in which the cable is inserted.
4	Pull on the cable to ensure it is screwed tight.

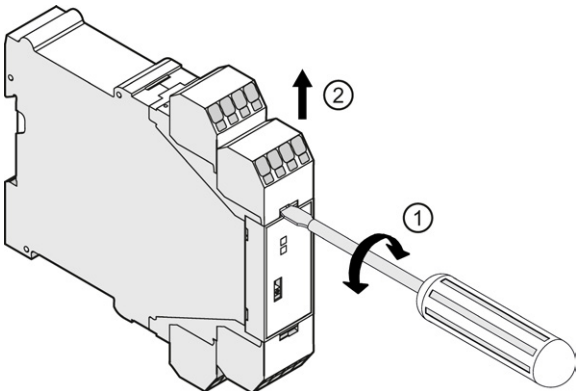
Procedure for spring-loaded terminal blocks

Step	Operating instruction	Figure
1	To release the clamping springs, insert the flat-head screwdriver as far as it will go into the square opening of the spring-loaded terminal. Please observe a 10° horizontal angular deviation of the screwdriver to the oval opening.	
2	Insert the cable into the oval opening as far as it will go.	
3	Hold the cable in the spring-loaded terminal.	
4	Remove the screwdriver.	
5	Pull on the cable to ensure it is tight.	

Disconnecting

⚠ WARNING
Hazardous Voltage. Can Cause Death, Serious Injury, or Property Damage.
Before starting work, therefore, disconnect the system and devices from the power supply.

Removing terminal blocks from the device

Step	Operating instruction	Figure
1	Insert a flat-head screwdriver between the clip of the terminal block and the front panel ①.	
2	Lift the terminal block out of the guiderail of the device ②	


Disconnecting screw-type terminals

Step	Operating instruction
1	Unscrew the screw of the screw-type terminal.
2	Remove the cable from the unscrewed screw-type terminal.

Disconnecting spring-loaded terminals

Step	Operating instruction
1	Insert the flat-head screwdriver into the square opening of the spring-loaded terminal until it engages. Please observe a 10° horizontal angular deviation of the screwdriver to the oval opening.
2	Remove the cable from the oval opening.
3	Remove the screwdriver.

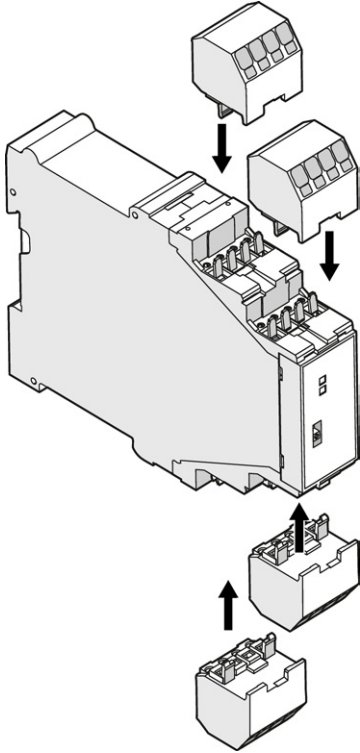
Plugging in terminal blocks

 WARNING
<p>Hazardous Voltage. Can Cause Death, Serious Injury, or Property Damage.</p> <p>Before starting work, therefore, disconnect the system and devices from the power supply.</p>

Requirements

You must have removed the terminal blocks, for the purpose of replacing a device, for example.

Procedure when plugging in the terminal blocks

Step	Operating instruction	Figure
1	Insert the removable terminal block into the guiderail of the device.	
2	Check that the clip of the removable terminal block closes flush with the front panel.	

3.6.2.8 Technical data 3TK2820

	3TK2820-.AJ..	3TK2820-.AL..	3TK2820-.CB..
EMC emitted interference	IEC 60947-5-1, IEC 61000		
Item designation			
<ul style="list-style-type: none"> • according to DIN 40719 extendable after IEC 204-2 according to IEC 750 	—		
<ul style="list-style-type: none"> • according to DIN EN 61346-2 	F		
Number of sensor inputs 1-channel or 2-channel	1		
Design of the cascading	—		
Type of the safety-related wiring of the inputs	single-channel and two-channel		
Product feature transverse contact-secure	Yes		
Safety Integrity Level (SIL) according to IEC 61508	SIL3		
SIL claim limit (for a subsystem) according to EN 62061	3		
Safety integrity level (SIL) for delayed release circuit according to IEC 61508	—		
Performance Level (PL)			
<ul style="list-style-type: none"> • according to ISO 13849-1 	e		
<ul style="list-style-type: none"> • for delayed release circuit according to ISO 13849-1 	—		
Category			
<ul style="list-style-type: none"> • according to EN 954-1 	—		
<ul style="list-style-type: none"> • according to ISO 13849-1 	4		
Safety device type according to IEC 61508-2	Type A		
Probability of dangerous failure per hour (PFHD) with high demand rate according to EN 62061	1/h	9.4 ⁻¹⁰	
T1 value for proof test interval or service life according to IEC 61508	a	20	

3.6 3TK28 safety relays with relay enabling circuits

	3TK2820-.AJ..	3TK2820-.AL..	3TK2820-.CB..
Number of outputs as contact-affected switching element as NO contact safety-related			
• as NC contact for reporting function instantaneous switching	1		
• as NO contact safety-related instantaneous switching	3		
• as NO contact safety-related delayed switching	0		
Stop category according to DIN EN 60204-1	0		
Design of the input			
• cascading-input/functional switching	—		
• feedback input	Yes		
• start input	Yes		
Design of the electrical connection jumper socket	No		
Switching capacity current			
• at AC-15 at 24 V	A 4		
• of the NO contacts of the relay outputs			
– at AC-15 at 230 V	A 4		
– at DC-13 at 24 V	A 4		
• of the NC contacts of the relay outputs at AC-15			
– at 115 V	A 4		
– at 230 V	A 4		
Thermal current of the contact-affected switching element maximum	A 5		
Electrical operating cycles as operating time typical	200 000		
Mechanical operating cycles as operating time typical	10 000 000		
Design of the fuse link for short-circuit protection of the NO contacts of the relay outputs required	gL/gG: 10 A or quick-response: 10 A or MCB type B: 2 A or MCB type C: 1.6 A or SITOP select diagnostics module (order No.: 6EP1961-2BA00)		

Description of the individual safety relays
3.6 3TK28 safety relays with relay enabling circuits

		3TK2820-.AJ..	3TK2820-.AL..	3TK2820-.CB..
Type of voltage of the controlled supply voltage		AC		AC/DC
Control supply voltage frequency 1 rated value	Hz	50		
Control supply voltage frequency 2 rated value	Hz	60		
Control supply voltage 1 for DC final rated value				
• for DC rated value	V	—		24
Operating range factor control supply voltage rated value of the magnet coil				
• at 50 Hz for AC		0.85		
		1.1		
• at 60 Hz for AC		0.85		
		1.1		
• for DC		—		0.85
		—		1.2

3.6 3TK28 safety relays with relay enabling circuits

	3TK2820-.AJ..	3TK2820-.AL..	3TK2820-.CB..
Product function			
• automatic start	Yes		
• rotation speed monitoring	No		
• laser scanner monitoring	No		
• light grid monitoring	No		
• light barrier monitoring	No		
• magnetic switch monitoring Normally closed contact- Normally open contact	No		
• magnetic switch monitoring Normally closed contact- Normally closed contact	Yes		
• emergency stop function	Yes		
• protective door monitoring	Yes		
• standstill monitoring	No		
• step mat monitoring	No		
• monitored start-up	Yes		
Acceptability for application			
• safety-related circuits	Yes		
• safety cut-out switch	Yes		
• magnetically operated switches monitoring	Yes		
• EMERGENCY-OFF circuit monitoring	Yes		
• proximity switches monitoring	No		
• opto-electronical protection device monitoring	No		
• position switch monitoring	Yes		
• tactile sensor monitoring	No		
• valve monitoring	No		

3.6.2.9 Connection examples 3TK2820

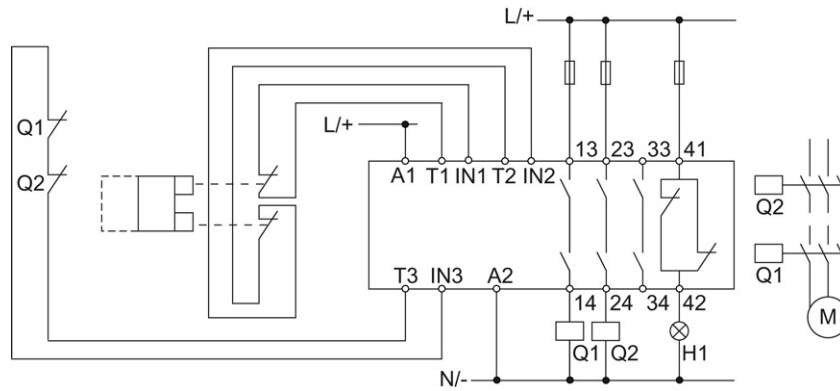


Figure 3-6 Autostart (2-channel)

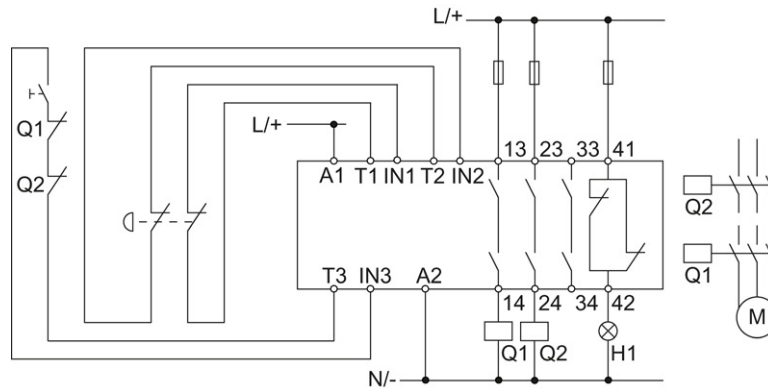


Figure 3-7 Monitored start (2-channel)

3.6 3TK28 safety relays with relay enabling circuits

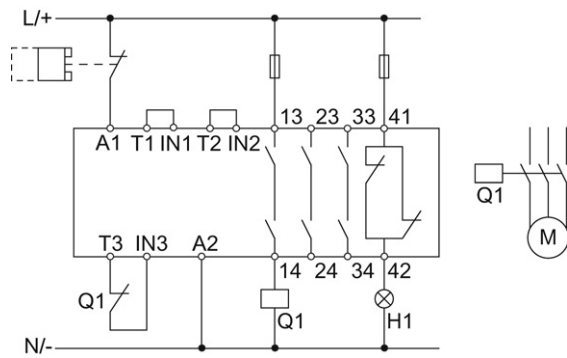


Figure 3-8 Autostart (1-channel)

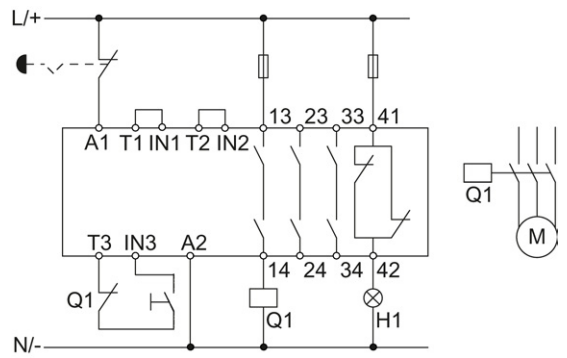


Figure 3-9 Monitored start (1-channel)

3.6.3 3TK2822 / 3TK2823 safety relays

3.6.3.1 Applications

Applications of the 3TK2822/23 safety relay

You can use the 3TK2822 safety relay in safety circuits according to DIN EN / IEC 60204-1, e.g. on movable guards and protective doors.

You can use the 3TK2823 safety relay in EMERGENCY STOP devices according to DIN EN / IEC 60947-5-5. Depending on the external circuitry, a maximum performance level PL_e/Cat. 4 in accordance with DIN EN ISO 13849-1 or SILCL 3 in accordance with DIN EN/IEC 62061 can be achieved with this device.

3.6.3.2 Description of function

The 3TK2822/23 safety relays have two instantaneous redundant enabling circuits with NO functions. The enabling circuits are for the safety-related deactivation of actuators.

Diagnostics is performed using three LEDs.

The 3TK2822/23 safety relays are suitable for monitoring actuator and sensor circuits according to DIN EN / IEC 60204-1 in "Autostart" or "Monitored start" mode (depending on device variant).

When the EMERGENCY STOP buttons are released or position switches operated and the ON button is pressed, the internal circuit of the safety relay and the external contactors are monitored to ensure that they are functioning correctly.

If monitoring results in a fault-free state, it is possible to start the device using the ON button (in "monitored start" mode). This closes the enabling circuits. In "Autostart" mode, starting and therefore closing the enabling circuits is initiated directly after closure of the sensor contacts upon detection of the fault-free state.

The number of enabling circuits can be increased by adding one or more 3TK2830 expansion blocks.

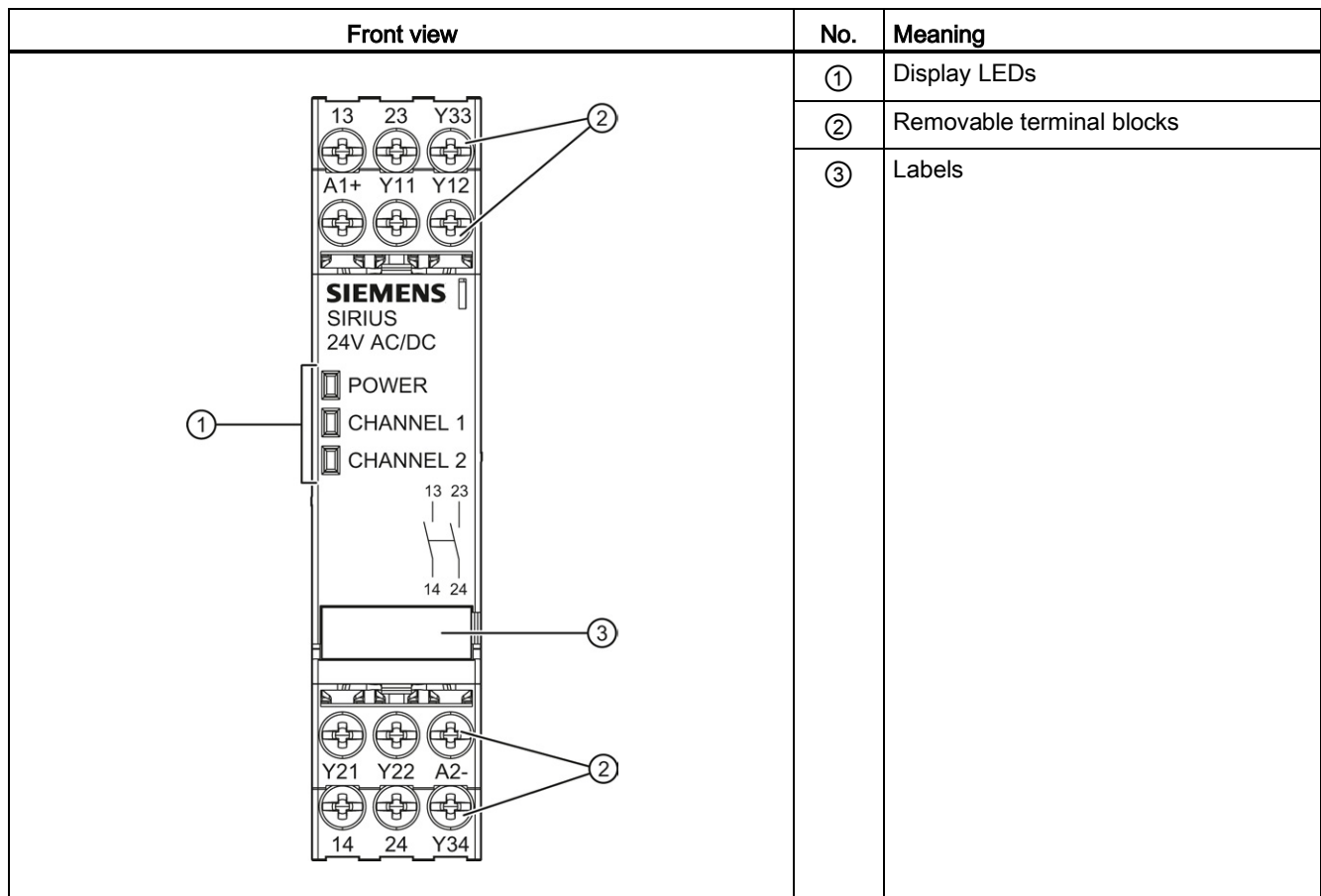
With the safety relays, the ON circuit Y33/34 is checked for short-circuit. That means it is identified as a fault if Y33/34 is closed before the EMERGENCY STOP button is reset.

The devices also monitor the sensor circuits for cross-circuits. This is done based on various potentials in the sensor circuits.

3.6.3.3 Connection advice

Connect the EMERGENCY STOP button or the limit switch to terminals Y11, Y12, Y21, and Y22. Connect the ON button in series with the NC contacts of the external contactors (feedback circuit) to terminals Y33, Y34. (See Chapter Connection examples 3TK2822 / 3TK2823 (Page 57)).

3.6.3.4 Structure 3TK2822/23



3.6.3.5 Terminal assignment

Terminal	Description
A1	L/+
A2	N/-
Y11; Y12	Channel 1, EMERGENCY STOP or limit switch
Y21; Y22	Channel 2, EMERGENCY STOP or limit switch
Y33; Y34	On button, feedback circuit
13 - 14	Enabling circuit 1, (NO)
23 - 24	Enabling circuit 2, (NO)

3.6.3.6 Display of the operating state

The operating state and functioning of the device are indicated by three LEDs:

- POWER
- CHANNEL 1
- CHANNEL 2

Operating states of 3TK2822/23

● = off

☼ = on

LED			Operation			
POWER	CHANNEL 1	CHANNEL 2	Line supply	EMERGENCY STOP	ON	Enabling circuit
☼	☼	☼	On	Not pressed	Pressed	Closed
☼	●	●		Pressed	Not pressed	Open
☼	●	●		Not pressed	Not pressed	Open
			Fault			
☼	☼	●	<ul style="list-style-type: none"> • Relay welded • Motor contactor welded • Fault in electronics • Short-circuit in ON circuit (on 3TK2823 only) 			Open
☼	●	☼				
☼	●	●				
●	●	●	Cross-circuit in EMERGENCY STOP circuit (minimum fault current $I_{kmin} = 0.5 \text{ A}$; PTC fuse responds) or no supply voltage			

3.6.3.7 State diagrams 3TK2822 / 3TK2823

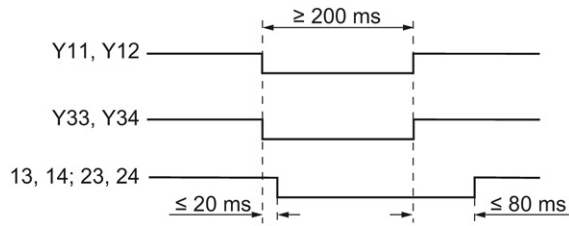


Figure 3-10 State diagram 3TK2822

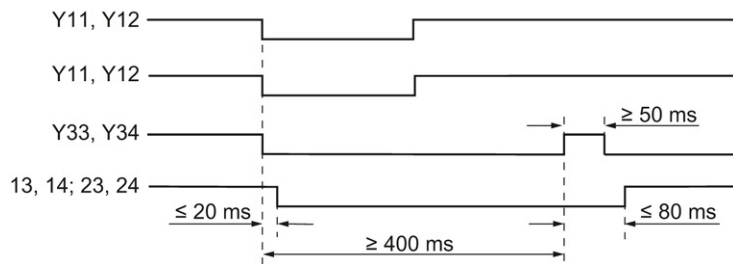


Figure 3-11 State diagram 3TK2823

3.6.3.8 Technical data 3TK2822 / 3TK2823

	3TK2822-.....	3TK2823-.....
EMC emitted interference	EN 60947-5-1	
Item designation	KT	
<ul style="list-style-type: none"> according to DIN 40719 extendable after IEC 204-2 according to IEC 750 	KT	
<ul style="list-style-type: none"> according to DIN EN 61346-2 	F	
Number of sensor inputs 1-channel or 2-channel	—	
Design of the cascading	none	
Type of the safety-related wiring of the inputs	two-channel	
Product feature transverse contact-secure	Yes	
Safety Integrity Level (SIL) according to IEC 61508	SIL3	
SIL claim limit (for a subsystem) according to EN 62061	3	
Safety integrity level (SIL) for delayed release circuit according to IEC 61508	—	
Performance Level (PL)	e	
<ul style="list-style-type: none"> according to ISO 13849-1 	e	
<ul style="list-style-type: none"> for delayed release circuit according to ISO 13849-1 	—	
Category	4	
<ul style="list-style-type: none"> according to EN 954-1 	4	
<ul style="list-style-type: none"> according to ISO 13849-1 	4	
Safety device type according to IEC 61508-2	Type A	
Probability of dangerous failure per hour (PFHD) with high demand rate according to EN 62061	1/h	1.3 ⁻⁹
T1 value for proof test interval or service life according to IEC 61508	a	20
Number of outputs as contact-affected switching element as NO contact safety-related	0	
<ul style="list-style-type: none"> as NC contact for reporting function instantaneous switching 	0	
<ul style="list-style-type: none"> as NO contact safety-related instantaneous switching 	2	
<ul style="list-style-type: none"> as NO contact safety-related delayed switching 	0	

3.6 3TK28 safety relays with relay enabling circuits

	3TK2822-.....	3TK2823-.....
Stop category according to DIN EN 60204-1	0	
Design of the input		
• cascading-input/functional switching	No	
• feedback input	Yes	
• start input	Yes	
Design of the electrical connection jumper socket	Yes	
Switching capacity current		
• at AC-15 at 24 V	A	—
• of the NO contacts of the relay outputs		
– at AC-15 at 230 V	A	5
– at DC-13 at 24 V	A	5
• of the NC contacts of the relay outputs at AC-15		
– at 115 V	A	—
– at 230 V	A	—
Thermal current of the contact-affected switching element maximum	A	5
Electrical operating cycles as operating time typical	100 000	
Mechanical operating cycles as operating time typical	10 000 000	
Design of the fuse link for short-circuit protection of the NO contacts of the relay outputs required	gL/gG: 6 A, or quick: 10 A	
Type of voltage of the controlled supply voltage	AC/DC	
Control supply voltage frequency 1 rated value	Hz	50
Control supply voltage frequency 2 rated value	Hz	60
Control supply voltage 1 for DC final rated value		
• for DC rated value	V	24

	3TK2822-.....	3TK2823-.....
Operating range factor control supply voltage rated value of the magnet coil <ul style="list-style-type: none"> • at 50 Hz <ul style="list-style-type: none"> – for AC • at 60 Hz <ul style="list-style-type: none"> – for AC • for DC 	0.85 1.1 0.85 1.1 0.85 1.2	
Product function <ul style="list-style-type: none"> • automatic start • rotation speed monitoring • laser scanner monitoring • light grid monitoring • light barrier monitoring • magnetic switch monitoring Normally closed contact-Normally open contact • magnetic switch monitoring Normally closed contact-Normally closed contact • emergency stop function • protective door monitoring • standstill monitoring • step mat monitoring • monitored start-up 	Yes No No No No No No No Yes Yes No Yes No	No Yes No Yes
Acceptability for application <ul style="list-style-type: none"> • safety-related circuits • safety cut-out switch • magnetically operated switches monitoring • EMERGENCY-OFF circuit monitoring • proximity switches monitoring • opto-electronical protection device monitoring • position switch monitoring • tactile sensor monitoring • valve monitoring 	Yes Yes No No No No Yes No No	Yes

Utilization category acc. to VDE0660-200, DIN EN / IEC 60947-5-1	Rated operational voltage U_o [V]	Rated operational current I_o [A] if all enabling circuits are loaded		
		50 °C	60 °C	70 °C
AC-15	230	5	4.5	4
DC-13	24	5	4.5	4
	115	0.2	0.2	0.2
	230	0.1	0.1	0.1
Continuous current I_{th}		5	4.5	4

3.6.3.9 Connection examples 3TK2822 / 3TK2823

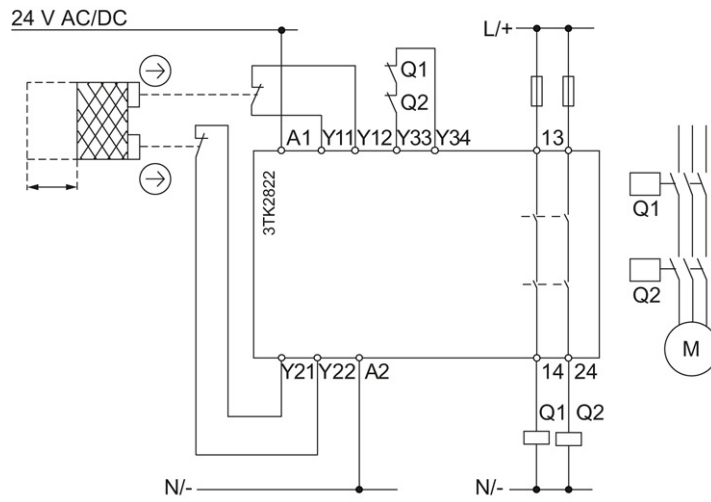


Figure 3-12 Autostart (2-channel)

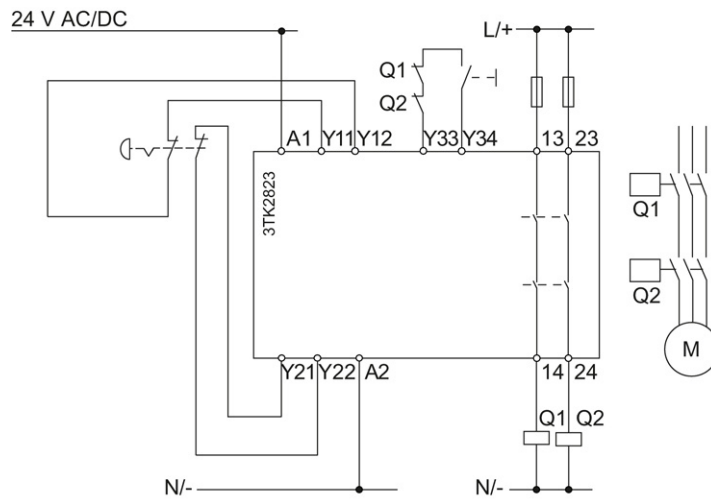


Figure 3-13 Monitored start (2-channel)

3.6.4 3TK2821 / 3TK2824 safety relays

3.6.4.1 Applications

Applications of the 3TK2821/24 safety relay

You can use the 3TK2821/24 safety relays in EMERGENCY STOP devices according to DIN EN / IEC 60947-5-5 and in safety circuits according to DIN EN / IEC 60204-1, as a basic unit or contact extension.

With the device, a maximum performance level PL_e/Cat. 4 in accordance with DIN EN ISO 13849-1 or SILCL 3 in accordance with DIN EN/IEC 62061 can be achieved. Depending on the hazard assessment, additional measures may be necessary in the sensor circuit (e.g. protected cable installation). If the 3TK2821/24 is used as a contact extension, the achievable PL / Cat. / SIL is equivalent to that of the basic unit.

Table 3- 1 Achievable SIL CL/PL/Cat. in applications

	1-channel	2-channel	Contact extension
SIL (DIN EN / IEC 61508)	1	1 (2)*	3
PL (DIN EN ISO 13849)	c	c (d)*	e
Cat. (DIN EN ISO 13849)	1	1	4

* PL d or Cat 4 can only be achieved if faults can be ruled out for the positive opening contacts (to IEC 60947-5-1 Annex K) and for the mechanical system. In the sensor circuit, DC = 0.

3.6.4.2 Description of function and connection information

The 3TK2821 safety relay has three enabling circuits (safe circuits) as NO circuits and a signaling circuit as an NC circuit.

The 3TK2824 safety relay has two enabling circuits (safe circuits) as NO circuits.

The number of enabling circuits can be increased by adding one or more 3TK2830 expansion blocks.

The operating state and functioning are indicated by three LEDs.

When the EMERGENCY STOP buttons or limit switches are released and the ON button is pressed, the internal circuit of the safety relay and the external contactors are monitored to ensure that they are functioning correctly.

Connect the EMERGENCY STOP button or the limit switch in the supply cable between A1 and +24 V or in the supply cable of the A1 terminal (L/+24 V DC). If evaluation is to take place via two channels, then connect channel 2 between A2 and 0 V or N. Connect the ON button in series with the NC contacts of the external contactors (feedback circuit) to the terminals Y1, Y2.

3.6.4.3 Structure 3TK2821/24

Front view	No.	Meaning
	①	Display LEDs
	②	Removable terminal blocks
	③	Labels

3.6.4.4 Terminal assignment

Terminal	Description
A1	L/+
A2	N/-
Y1; Y1	On button, feedback circuit
13; 14	Enabling circuit 1, (NO)
23; 24	Enabling circuit 1, (NO)
33; 34	Enabling circuit 1, (NO) (3TK2821 only)
41; 42	Signaling circuit 1, (NC) (3TK2821 only)

3.6.4.5 Display of the operating state

The operating state and functioning of the device are indicated by three LEDs:

- POWER
- CHANNEL 1
- CHANNEL 2

Operating states of 3TK2821/24

● = off

☼ = on

LED			Operation			
POWER	CHANNEL 1	CHANNEL 2	Line supply	EMERGENCY STOP	ON	Enabling circuit
☼	☼	☼	On	Not pressed	Pressed	Closed
☼	●	●		Pressed	Not pressed	Open
☼	●	●		Not pressed	Not pressed	Open
			Fault			Open
☼	☼	●	<ul style="list-style-type: none"> • Relay welded • Motor contactor welded • Fault in electronics 			
☼	●	☼				
☼	●	●				
●	●	●	Cross-circuit or ground fault in EMERGENCY STOP circuit (minimum fault current $I_{Kmin} = 0.5 \text{ A}$; PTC fuse responds) or no supply voltage			

3.6.4.6 State diagrams 3TK2821 / 3TK2824

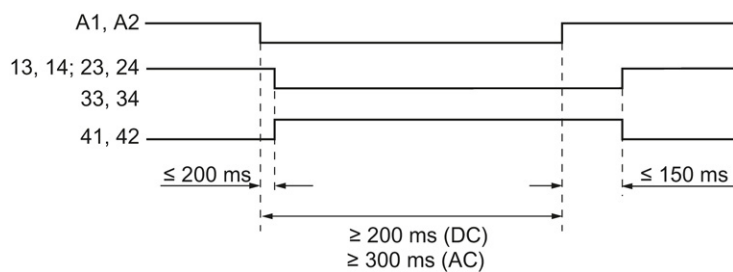


Figure 3-14 State diagram 3TK2821/24

3.6.4.7 Technical data 3TK2821 / 3TK2824

		3TK2821-.C...	3TK2824-.B...	3TK2824-.C...
EMC emitted interference		EN 60947-5-1		
Item designation		KT		
<ul style="list-style-type: none"> according to DIN 40719 extendable after IEC 204-2 according to IEC 750 		F		
<ul style="list-style-type: none"> according to DIN EN 61346-2 				
Number of sensor inputs 1-channel or 2-channel		1		
Design of the cascading		none		
Type of the safety-related wiring of the inputs		single-channel or single-channel and two-channel		
Product feature transverse contact-secure		No		
Safety Integrity Level (SIL) according to IEC 61508		SIL3		
SIL claim limit (for a subsystem) according to EN 62061		1		
Safety integrity level (SIL) for delayed release circuit according to IEC 61508		—		
Performance Level (PL)		e		
<ul style="list-style-type: none"> according to ISO 13849-1 for delayed release circuit according to ISO 13849-1 		—		
Category		3		
<ul style="list-style-type: none"> according to EN 954-1 according to ISO 13849-1 		3	2	
Safety device type according to IEC 61508-2		Type A		
Probability of dangerous failure per hour (PFHD) with high demand rate according to EN 62061	1/h	1.1 ⁻⁹	8.7 ⁻¹⁰	
T1 value for proof test interval or service life according to IEC 61508	a	20		

3.6 3TK28 safety relays with relay enabling circuits

	3TK2821-.C...	3TK2824-.B...	3TK2824-.C...
Number of outputs as contact-affected switching element as NO contact safety-related			
• as NC contact for reporting function instantaneous switching	1	0	
• as NO contact safety-related instantaneous switching	3	2	
• as NO contact safety-related delayed switching	0		
Stop category according to DIN EN 60204-1	0		
Design of the input			
• cascading-input/functional switching	No		
• feedback input	Yes		
• start input	Yes		
Design of the electrical connection jumper socket	Yes		
Switching capacity current			
• at AC-15 at 24 V	A —		
• of the NO contacts of the relay outputs			
– at AC-15 at 230 V	A 5	6	
– at DC-13 at 24 V	A 5	6	
• of the NC contacts of the relay outputs at AC-15			
– at 115 V	A 5	—	
– at 230 V	A 5	—	
Thermal current of the contact-affected switching element maximum	A 5		
Electrical operating cycles as operating time typical	100 000		
Mechanical operating cycles as operating time typical	10 000 000		
Design of the fuse link for short-circuit protection of the NO contacts of the relay outputs required	gL/gG: 6 A, or quick: 10 A		

		3TK2821-.C...	3TK2824-.B...	3TK2824-.C...
Type of voltage of the controlled supply voltage		AC/DC	DC	AC/DC
Control supply voltage frequency 1 rated value	Hz	50	—	50
Control supply voltage frequency 2 rated value	Hz	60	—	60
Control supply voltage 1 for DC final rated value				
• for DC rated value	V	24		
Operating range factor control supply voltage rated value of the magnet coil				
• at 50 Hz				
– for AC		0.85		
		1.1		
• at 60 Hz				
– for AC		0.85		
		1.1		
• for DC		0.85		
		1.2		

3.6 3TK28 safety relays with relay enabling circuits

	3TK2821-.C...	3TK2824-.B...	3TK2824-.C...
Product function			
• automatic start	Yes		
• rotation speed monitoring	No		
• laser scanner monitoring	No		
• light grid monitoring	No		
• light barrier monitoring	No		
• magnetic switch monitoring Normally closed contact- Normally open contact	No		
• magnetic switch monitoring Normally closed contact- Normally closed contact	No		
• emergency stop function	Yes		
• protective door monitoring	Yes		
• standstill monitoring	No		
• step mat monitoring	No		
• monitored start-up	No		
Acceptability for application			
• safety-related circuits	Yes		
• safety cut-out switch	Yes		
• magnetically operated switches monitoring	No		
• EMERGENCY-OFF circuit monitoring	Yes		
• proximity switches monitoring	No		
• opto-electronical protection device monitoring	No		
• position switch monitoring	Yes		
• tactile sensor monitoring	No		
• valve monitoring	No		

Utilization category acc. to VDE0660-200, DIN EN / IEC 60947-5-1	Rated operational voltage U_e [V]	Rated operational current I_e [A] if all enabling circuits are loaded		
		50 °C	60 °C	70 °C
AC-15	230	5	4.5	4
DC-13	24	5	4.5	4
	115	0.2	0.2	0.2
	230	0.1	0.1	0.1
Continuous current I_{th}		5	4.5	4

3.6.4.8 Connection examples 3TK2821 / 3TK2824

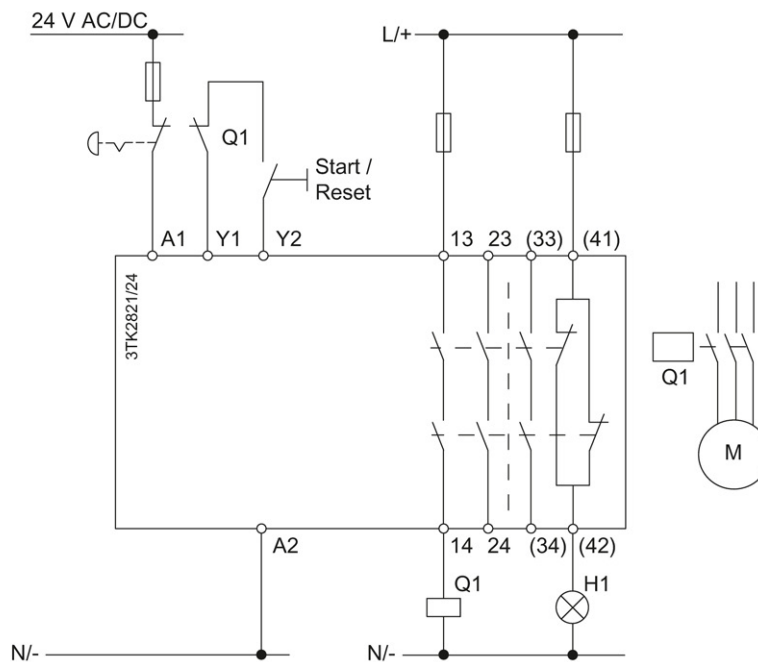


Figure 3-15 EMERGENCY STOP (1-channel)

3.6 3TK28 safety relays with relay enabling circuits

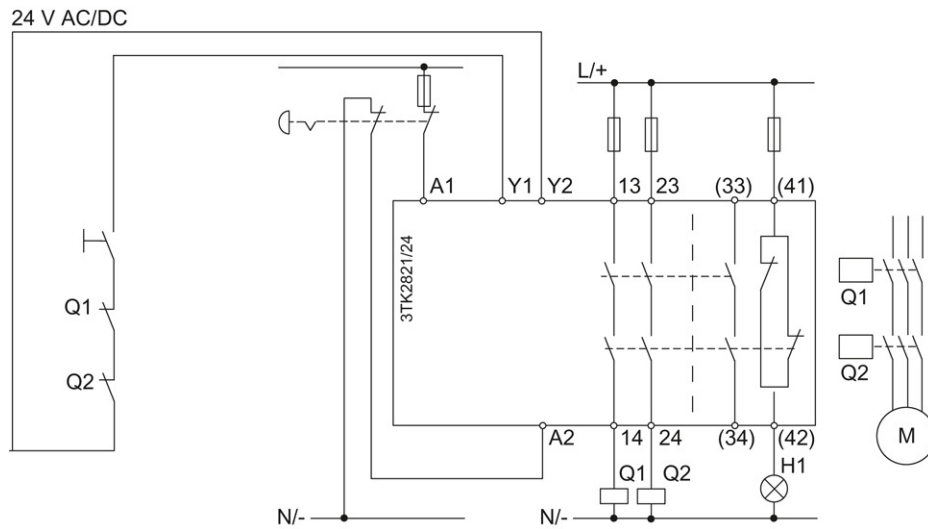


Figure 3-16 EMERGENCY STOP (2-channel)

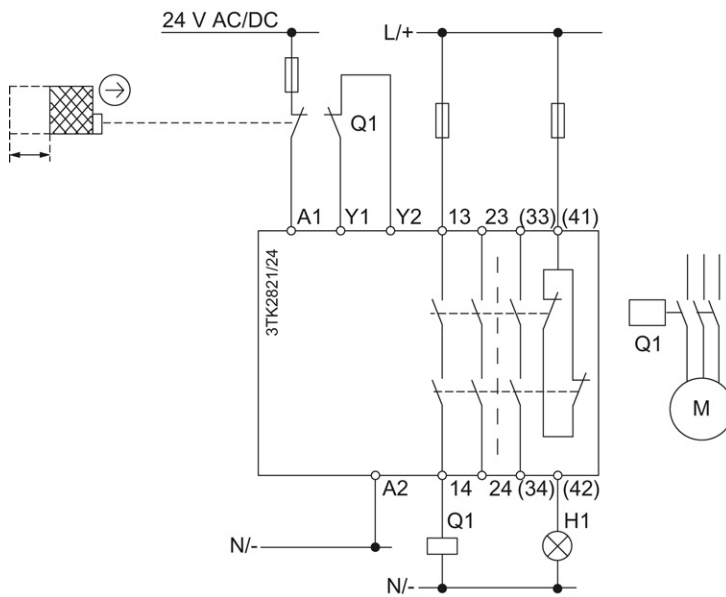


Figure 3-17 Protective door monitoring (1-channel)

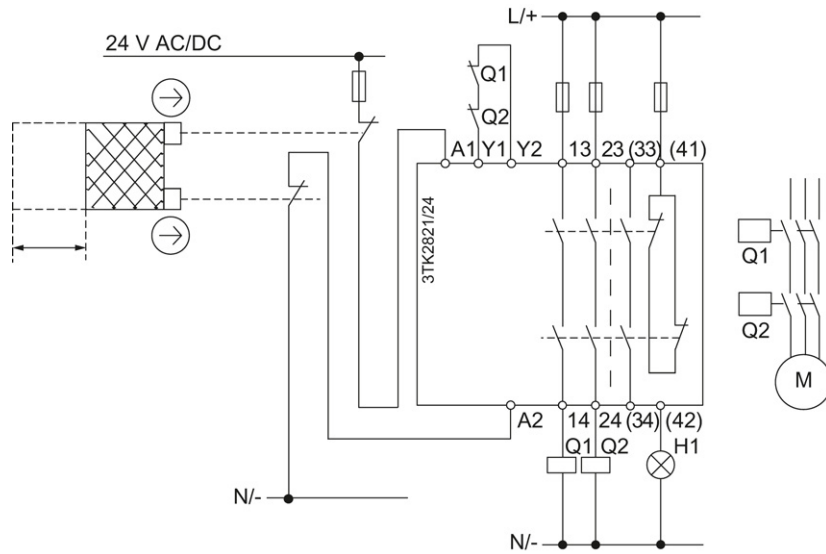


Figure 3-18 Protective door monitoring (2-channel)

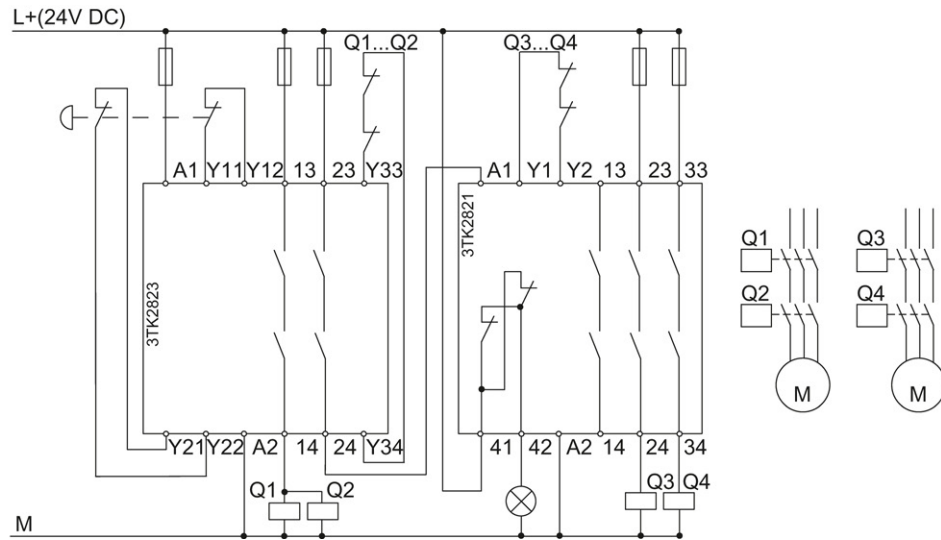


Figure 3-19 3TK2821 as contact extension

3.6.5 3TK2824-.A.20 safety relay

3.6.5.1 Applications

Applications of 3TK2824-.A.20 safety relay

You can use the 3TK2824-.A.20 safety relay in EMERGENCY STOP devices according to DIN EN ISO 60947-5-5 and in safety circuits according to DIN EN IEC 60204-1, e.g. for movable guards and protective doors. With the device, a maximum performance level PL_d/Cat. 1 in accordance with DIN EN ISO 13849-1 or SILCL 1 in accordance with DIN EN/IEC 62061 can be achieved. Depending on the hazard assessment, additional measures may be necessary in the sensor circuit (e.g. protected cable installation). When the safety relay is used in "automatic start" mode, automatic restart (acc. to DIN EN IEC 60204-1, Sections 9.2.5.4.2 and 10.8.3) after shutdown in an emergency (EMERGENCY STOP) must be prevented by the higher-level control.

Table 3-2 Achievable SIL CL/PL as an evaluation unit

	1-channel	2-channel
SILCL (in accordance with IEC 62061)	1	1
PL (DIN EN ISO 13849)	c	c
Cat. (DIN EN ISO 13849)	1	1

3.6.5.2 Description of function and connection information

The 3TK2824 safety relay has two enabling circuits (safe circuits) as NO circuits. The number of enabling circuits can be increased by adding one or more 3TK2830 expansion blocks. The operating state and functioning are indicated by three LEDs.

When the EMERGENCY STOP buttons or limit switches are released and the ON button is pressed, the internal circuit of the safety relay and the external contactors are monitored to ensure that they are functioning correctly.

Connect the EMERGENCY STOP button or the limit switch to terminals Y11, Y12 and Y21, Y22. The ON button is connected in series with the NC contacts of the external contactors (feedback circuit) at terminals Y33, Y34.

3.6.5.3 Structure 3TK2824-.A.20

Front view	No.	Meaning
	①	Display LEDs
	②	Removable terminal blocks
	③	Labels

3.6.5.4 Terminal assignment

Terminal	Description
A1	L/+
A2	N/-
Y11; Y12	Channel 1, EMERGENCY STOP or limit switch
Y21; Y22	Channel 2, EMERGENCY STOP or limit switch
Y33; Y34	On button, feedback circuit
13 - 14	Enabling circuit 1, (NO)
23 - 24	Enabling circuit 2, (NO)

3.6.5.5 Display of the operating state

The operating state and functioning of the device are indicated by three LEDs:

- POWER
- CHANNEL 1
- CHANNEL 2

Operating states of 3TK2824-.A.20

● = off

☼ = on

LED			Operation			
POWER	CHANNEL 1	CHANNEL 2	Line supply	EMERGENCY STOP	ON	Enabling circuit
☼	☼	☼	On	Not pressed	Pressed	Closed
☼	●	●		Pressed	Not pressed	Open
☼	●	●		Not pressed	Not pressed	Open
			Fault			
☼	●	●	<ul style="list-style-type: none"> • Relay welded • Motor contactor welded • Fault in electronics 			Open
●	●	●	Cross-circuit in EMERGENCY STOP circuit or no supply voltage			

3.6.5.6 State diagrams 3TK2824-.A.20

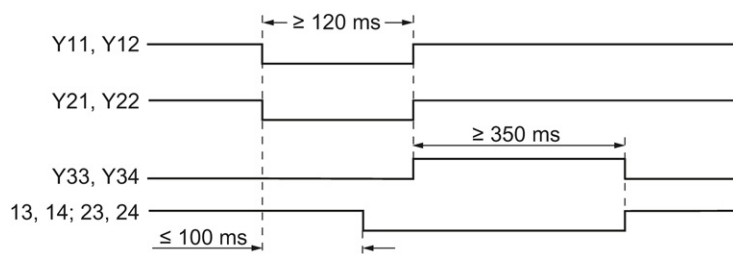


Figure 3-20 State diagram 3TK2824-.A.

3.6.5.7 Technical data 3TK2824-.A.20

		3TK2824-.A...
EMC emitted interference		EN 60947-5-1
Item designation		
<ul style="list-style-type: none"> • according to DIN 40719 extendable after IEC 204-2 according to IEC 750 		KT
<ul style="list-style-type: none"> • according to DIN EN 61346-2 		F
Number of sensor inputs 1-channel or 2-channel		1
Design of the cascading		none
Type of the safety-related wiring of the inputs		single-channel or single-channel and two-channel
Product feature transverse contact-secure		No
Safety Integrity Level (SIL) according to IEC 61508		SIL2
SIL claim limit (for a subsystem) according to EN 62061		1
Safety integrity level (SIL) for delayed release circuit according to IEC 61508		—
Performance Level (PL)		
<ul style="list-style-type: none"> • according to ISO 13849-1 		d
<ul style="list-style-type: none"> • for delayed release circuit according to ISO 13849-1 		—
Category		
<ul style="list-style-type: none"> • according to EN 954-1 		3
<ul style="list-style-type: none"> • according to ISO 13849-1 		2
Safety device type according to IEC 61508-2		Type A
Probability of dangerous failure per hour (PFHD) with high demand rate according to EN 62061	1/h	8.7 ⁻¹⁰
T1 value for proof test interval or service life according to IEC 61508	a	20
Number of outputs as contact-affected switching element as NO contact safety-related		
<ul style="list-style-type: none"> • as NC contact for reporting function instantaneous switching 		0
<ul style="list-style-type: none"> • as NO contact safety-related instantaneous switching 		2
<ul style="list-style-type: none"> • as NO contact safety-related delayed switching 		0
Stop category according to DIN EN 60204-1		0
Design of the input		
<ul style="list-style-type: none"> • cascading-input/functional switching 		No
<ul style="list-style-type: none"> • feedback input 		Yes
<ul style="list-style-type: none"> • start input 		Yes
Design of the electrical connection jumper socket		Yes

	3TK2824-A...	
Switching capacity current		
• at AC-15 at 24 V	A	—
• of the NO contacts of the relay outputs		
– at AC-15 at 230 V	A	6
– at DC-13 at 24 V	A	6
• of the NC contacts of the relay outputs at AC-15		
– at 115 V	A	—
– at 230 V	A	—
Thermal current of the contact-affected switching element maximum	A	5
Electrical operating cycles as operating time typical		100 000
Mechanical operating cycles as operating time typical		10 000 000
Design of the fuse link for short-circuit protection of the NO contacts of the relay outputs required		gL/gG: 6 A, or quick: 10 A
Type of voltage of the controlled supply voltage		AC
Control supply voltage frequency 1 rated value	Hz	50
Control supply voltage frequency 2 rated value	Hz	60
Control supply voltage 1 for DC final rated value		
• for DC rated value	V	—
Operating range factor control supply voltage rated value of the magnet coil		
• at 50 Hz		
– for AC		0.85 1.1
• at 60 Hz		
– for AC		0.85 1.1
• for DC		— —

	3TK2824-.A...
Product function	
• automatic start	Yes
• rotation speed monitoring	No
• laser scanner monitoring	No
• light grid monitoring	No
• light barrier monitoring	No
• magnetic switch monitoring Normally closed contact- Normally open contact	No
• magnetic switch monitoring Normally closed contact- Normally closed contact	No
• emergency stop function	Yes
• protective door monitoring	Yes
• standstill monitoring	No
• step mat monitoring	No
• monitored start-up	No
Acceptability for application	
• safety-related circuits	Yes
• safety cut-out switch	Yes
• magnetically operated switches monitoring	No
• EMERGENCY-OFF circuit monitoring	Yes
• proximity switches monitoring	No
• opto-electronical protection device monitoring	No
• position switch monitoring	Yes
• tactile sensor monitoring	No
• valve monitoring	No

3.6.5.8 Connection examples 3TK2824-.A.20

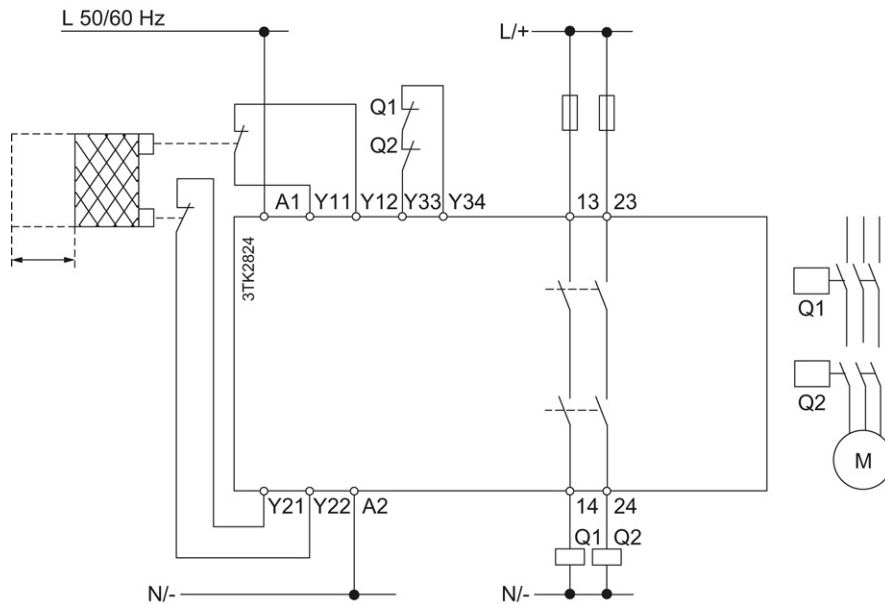


Figure 3-21 Protective door monitoring autostart (2-channel)

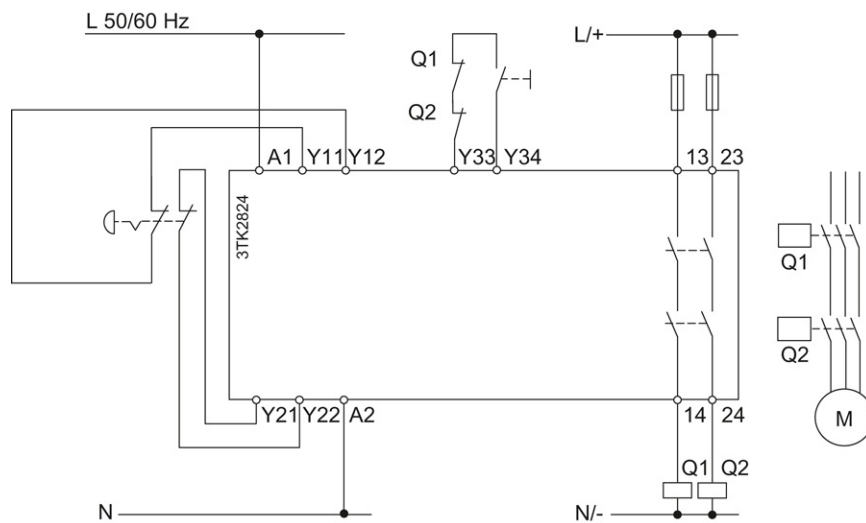


Figure 3-22 EMERGENCY STOP (2-channel) with additional ON button

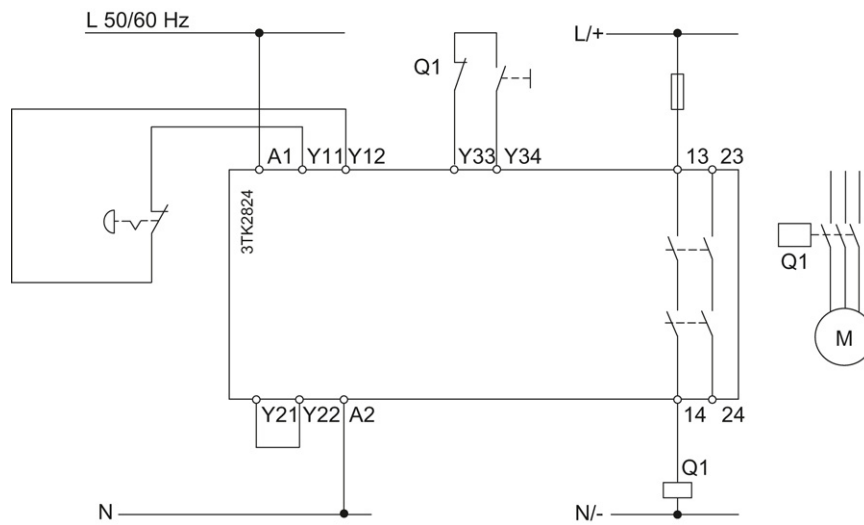


Figure 3-23 EMERGENCY STOP (1-channel) with additional ON button

3.6.6 3TK2825 safety relay

3.6.6.1 Applications

Applications of the 3TK2825 safety relay

You can use the 3TK2825 safety relay in EMERGENCY STOP devices according to DIN EN / IEC 60947-5-5 and in safety circuits according to DIN EN / IEC 60204-1, e.g. for movable guards and protective doors.

Depending on the external circuitry, a maximum performance level PL_e /Cat. 4 in accordance with DIN EN ISO 13849-1 or SILCL 3 in accordance with DIN EN/IEC 62061 can be achieved with this device.

3.6.6.2 Description of function and connection information

The 3TK2825 safety relays have three instantaneous redundant enabling circuits with NO functions and two instantaneous one-channel signaling circuits. The enabling circuits are used for safety-related shutdown of actuators; the signaling contacts are used for a non-safety-related signaling function.

Diagnostics is performed using three LEDs.

The 3TK2825 is suitable for monitoring actuator and sensor circuits according to DIN EN / IEC 60204-1 in "Autostart" or "Monitored start" mode.

When the EMERGENCY STOP buttons are released or position switches operated and the ON button is pressed, the redundant safety relays, the electronics, and the external contactors are monitored to ensure that they are functioning correctly.

If monitoring results in a fault-free state, it is possible to start the device using the ON button (in "monitored start" mode). This closes the enabling circuits. In autostart mode, starting and therefore closing the enabling circuits is initiated directly after closure of the sensor contacts on detection of the fault-free state.

With 3TK2825, the ON circuit Y33/34 is checked for short-circuit. That means it is identified as a fault if Y33/34 is closed before the EMERGENCY STOP button is reset.

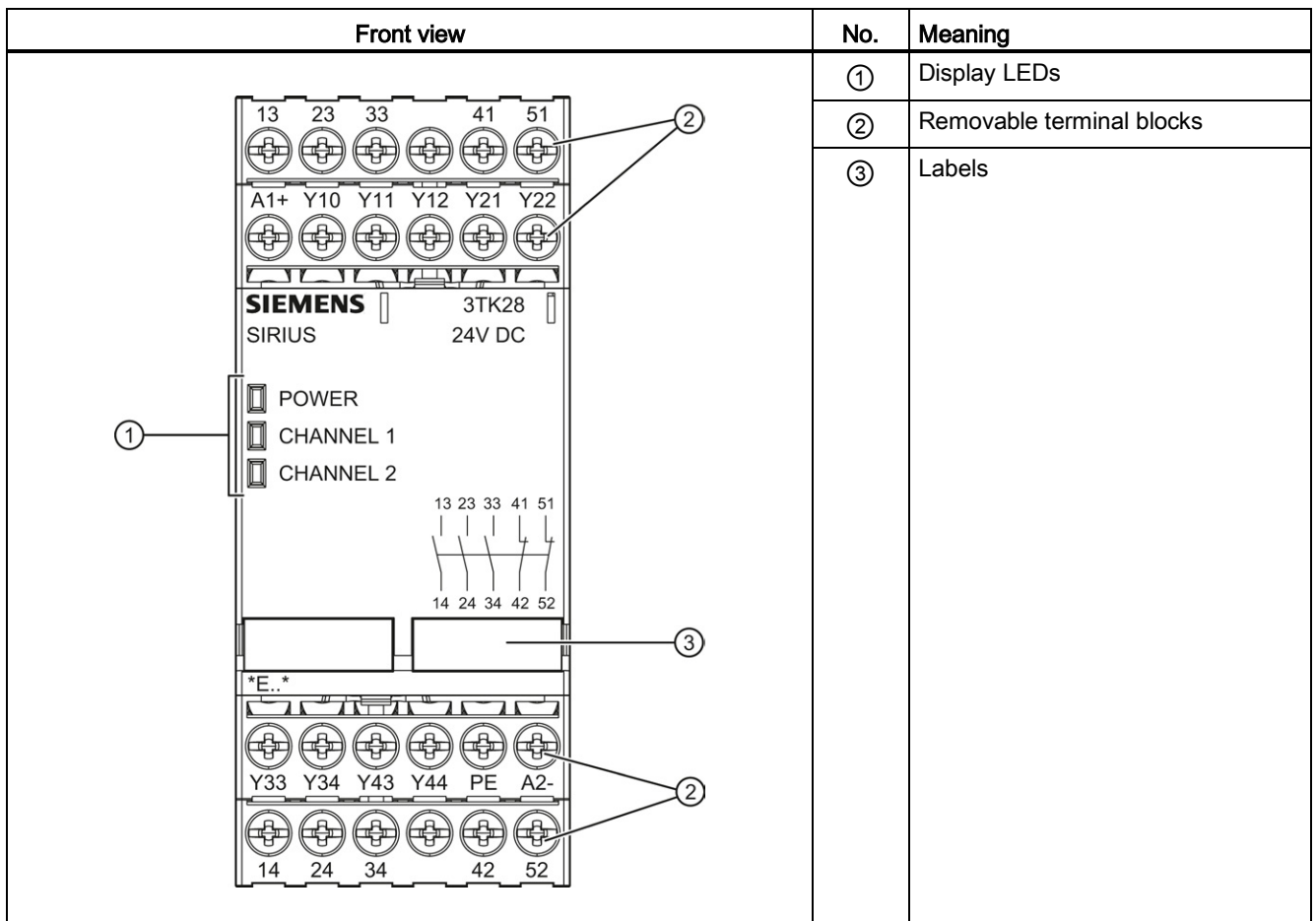
The device also monitors the sensor circuits for cross-circuits. This is done based on various potentials in the sensor circuits.

3.6.6.3 Commissioning

After the supply voltage is applied to terminals A1 and A2, the 3TK2825 safety relay is ready for operation. The internal parts of the circuit are constantly monitored for faults during operation.

If any sensor is operated, or a fault is detected, the safety relay disconnects without delay.

3.6.6.4 Structure 3TK2825



3.6.6.5 Terminal assignment

Terminal	Description
A1	L/+
A2	N/-
Y10; Y11	Channel 1, (1-channel)
Y11; Y12	Channel 1, (2-channel)
Y21; Y22	Channel 2, (2-channel)
Y33; Y34	On button, feedback circuit
Y43; Y44	Switchover between automatic start and monitored start
13 - 14	Enabling circuits, (NO)
23 - 24	
33 - 34	
41 - 42	Enabling circuits, (NC contacts)
51 - 52	

3.6.6.6 Display of the operating state

The operating state and functioning of the device are indicated by three LEDs:

- POWER
- CHANNEL 1
- CHANNEL 2

Operating states of 3TK2825

● = off

☼ = on

LED			Operation			
POWER	CHANNEL 1	CHANNEL 2	Line supply	EMERGENCY STOP	ON	Enabling circuit
☼	☼	☼	On	Not pressed	Pressed	Closed
☼	●	●		Pressed	Not pressed	Open
☼	●	●		Not pressed	Not pressed	Open
			Fault			Open
☼	☼	●	<ul style="list-style-type: none"> • Relay welded 			
☼	●	☼	<ul style="list-style-type: none"> • Motor contactor welded 			
☼	●	●	<ul style="list-style-type: none"> • Fault in electronics • Short-circuit in ON circuit 			
●	●	●	Cross-circuit in EMERGENCY STOP circuit (minimum fault current $I_{Kmin} = 0.5 \text{ A}$; PTC fuse responds)			

3.6.6.7 State diagrams 3TK2825

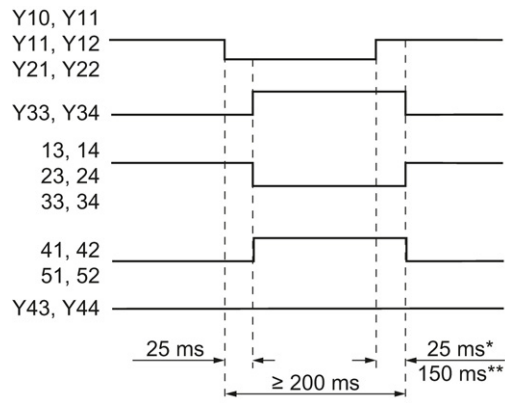


Figure 3-24 State diagram 3TK2825

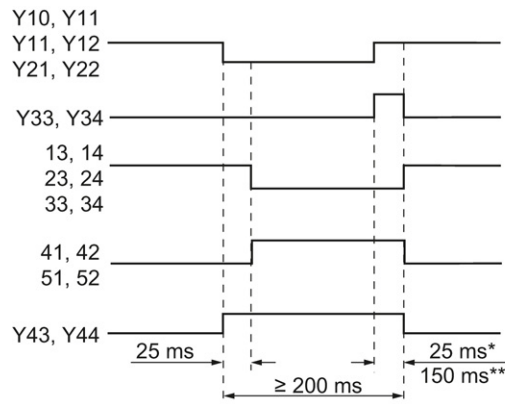


Figure 3-25 State diagram 3TK2825

*) = monitored start

**) = autostart

3.6.6.8 Technical data 3TK2825

	3TK2825-A...	3TK2825-B...
EMC emitted interference	EN 60947-5-1	
Item designation		
<ul style="list-style-type: none"> according to DIN 40719 extendable after IEC 204-2 according to IEC 750 	KT	
<ul style="list-style-type: none"> according to DIN EN 61346-2 	F	
Number of sensor inputs 1-channel or 2-channel	1	
Design of the cascading	none	
Type of the safety-related wiring of the inputs	single-channel and two-channel	
Product feature transverse contact-secure	Yes	
Safety Integrity Level (SIL) according to IEC 61508	SIL3	
SIL claim limit (for a subsystem) according to EN 62061	3	
Safety integrity level (SIL) for delayed release circuit according to IEC 61508	—	
Performance Level (PL)		
<ul style="list-style-type: none"> according to ISO 13849-1 	e	
<ul style="list-style-type: none"> for delayed release circuit according to ISO 13849-1 	—	
Category		
<ul style="list-style-type: none"> according to EN 954-1 	4	
<ul style="list-style-type: none"> according to ISO 13849-1 	4	
Safety device type according to IEC 61508-2	Type A	
Probability of dangerous failure per hour (PFHD) with high demand rate according to EN 62061	1/h	1.5 ⁻⁹
T1 value for proof test interval or service life according to IEC 61508	a	20
Number of outputs as contact-affected switching element as NO contact safety-related		
<ul style="list-style-type: none"> as NC contact for reporting function instantaneous switching 	2	
<ul style="list-style-type: none"> as NO contact safety-related instantaneous switching 	3	
<ul style="list-style-type: none"> as NO contact safety-related delayed switching 	0	

	3TK2825-A...	3TK2825-B...
Stop category according to DIN EN 60204-1	0	
Design of the input		
• cascading-input/functional switching	No	
• feedback input	Yes	
• start input	Yes	
Design of the electrical connection jumper socket	Yes	
Switching capacity current		
• at AC-15 at 24 V	A	—
• of the NO contacts of the relay outputs		
– at AC-15 at 230 V	A	6
– at DC-13 at 24 V	A	6
• of the NC contacts of the relay outputs at AC-15		
– at 115 V	A	6
– at 230 V	A	6
Thermal current of the contact-affected switching element maximum	A	6
Electrical operating cycles as operating time typical	100 000	
Mechanical operating cycles as operating time typical	10 000 000	
Design of the fuse link for short-circuit protection of the NO contacts of the relay outputs required	gL/gG: 6 A, or quick: 10 A	
Type of voltage of the controlled supply voltage	AC	DC
Control supply voltage frequency		
• 1 rated value	Hz	50
• 2 rated value	Hz	60
Control supply voltage 1 for DC final rated value		
• for DC rated value	V	—
		24

3.6 3TK28 safety relays with relay enabling circuits

	3TK2825-A...	3TK2825-B...
Operating range factor control supply voltage rated value of the magnet coil <ul style="list-style-type: none"> • at 50 Hz <ul style="list-style-type: none"> – for AC • at 60 Hz <ul style="list-style-type: none"> – for AC • for DC 	0.85 1.1 0.85 1.1 0.85 1.1	
Product function <ul style="list-style-type: none"> • automatic start • rotation speed monitoring • laser scanner monitoring • light grid monitoring • light barrier monitoring • magnetic switch monitoring Normally closed contact-Normally open contact • magnetic switch monitoring Normally closed contact-Normally closed contact • emergency stop function • protective door monitoring • standstill monitoring • step mat monitoring • monitored start-up 	Yes No No No No No No Yes Yes No Yes Yes	
Acceptability for application <ul style="list-style-type: none"> • safety-related circuits • safety cut-out switch • magnetically operated switches monitoring • EMERGENCY-OFF circuit monitoring • proximity switches monitoring • opto-electronical protection device monitoring • position switch monitoring • tactile sensor monitoring • valve monitoring 	Yes Yes No Yes No No Yes No No	

Utilization category DIN EN / IEC 60947-5-1	Rated operational voltage U_e [V]	Rated operational current I_e [A] if all enabling circuits are loaded	
		60 °C	70 °C
AC-15	230	6	4
DC-13	24	6	4
	115	0.2	0.2
	230	0.1	0.1
Continuous current I_{th}		6	4

3.6.6.9 Connection examples 3TK2825

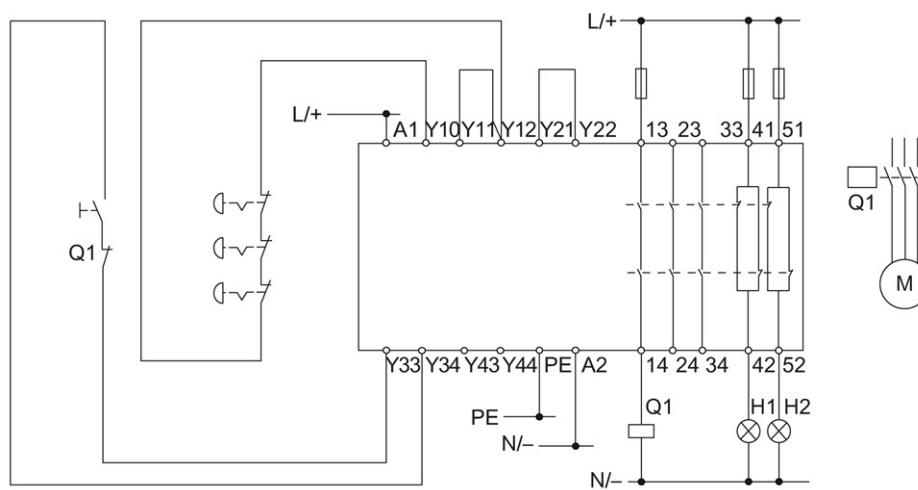


Figure 3-26 Monitored start (1-channel)

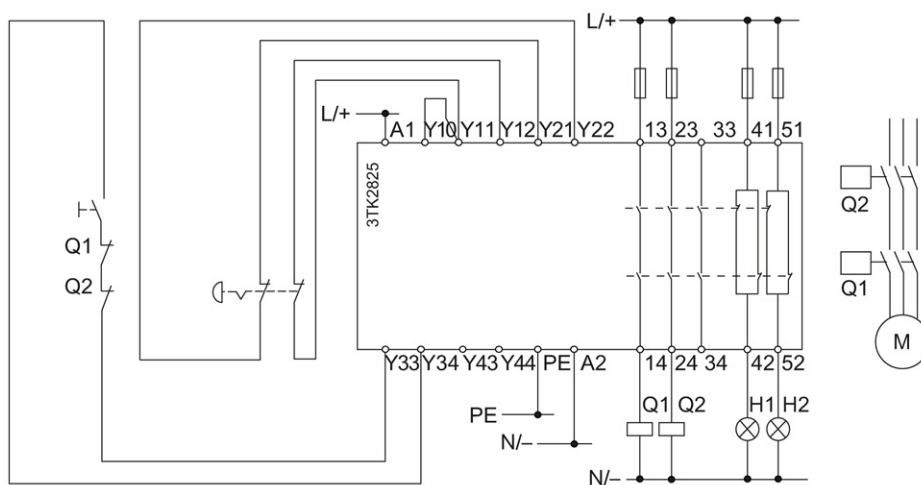


Figure 3-27 Monitored start (2-channel)

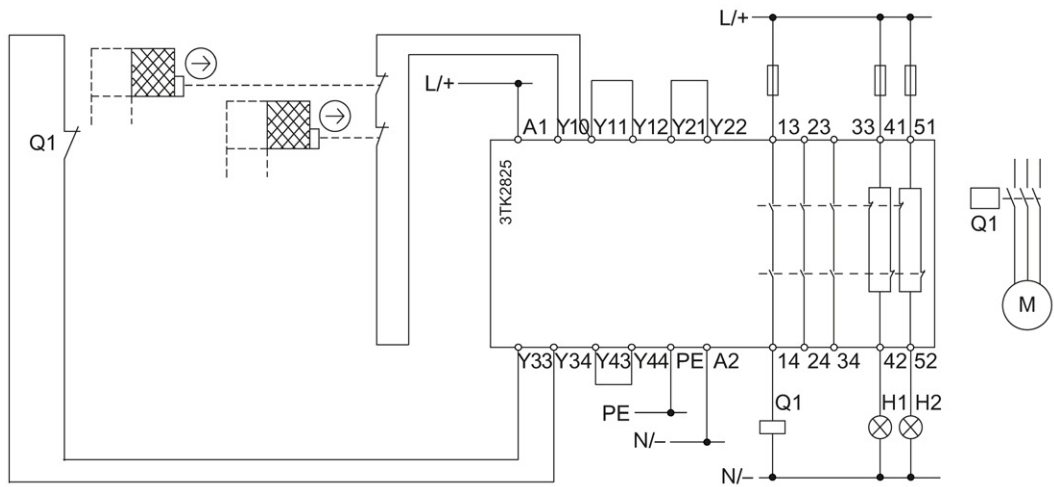


Figure 3-28 Autostart (1-channel)

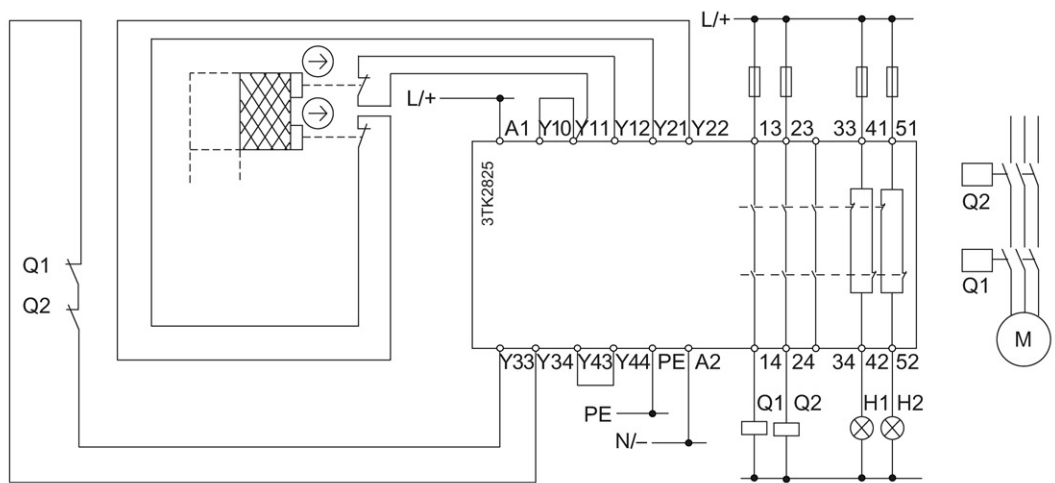


Figure 3-29 Autostart (2-channel)

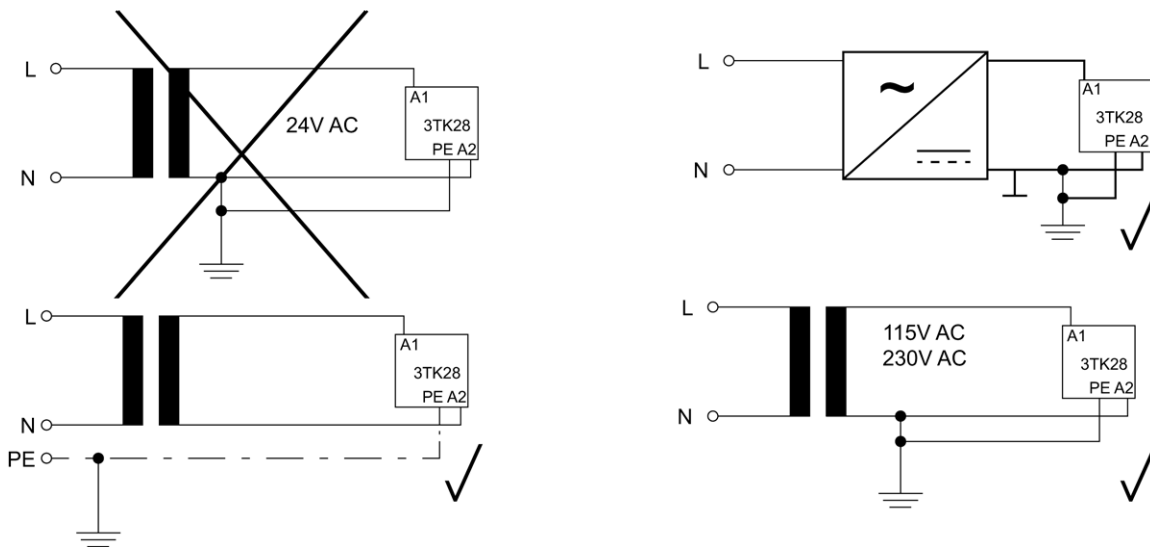


Figure 3-30 Grounding

Note

It is not necessary to connect the PE terminal for the device to function. For this reason, we recommend that you do not wire this terminal.

3.6.7 3TK2827 / 3TK2828 safety relays

3.6.7.1 Applications

Applications of the 3TK2827/28 safety relay

You can use 3TK2827/28 safety relays in:

- EMERGENCY STOP devices acc. to DIN EN / IEC 60947-5-5
- Safety circuits acc. to DIN EN / IEC 60204-1, e.g. for monitoring safety guards
- Circuits in which controlled shutdown, STOP category 1 is necessary.

Depending on the external circuitry, you can achieve maximum performance level PL_e /Cat. 4/SIL 3 for instantaneous enabling circuits and maximum performance level PL_d /Cat. 3/SILCL 2 acc. to DIN EN ISO 13849-1/IEC 62061 for time-delayed enabling circuits with this device.

3.6.7.2 Description of function and connection information

The 3TK2827/28 safety relays have two time-delayed and two instantaneous enabling circuits as NO circuits and one instantaneous signaling circuit as an NC circuit. The operating state and functioning are indicated by five LEDs.

When the EMERGENCY STOP buttons or the limit switch are released, when the ON circuit Y33, Y34 is closed, the redundant safety relay, the electronics, and the controlled motor contactors are checked for correct functioning.

With the 3TK2827 (monitored start), the ON circuit Y33, Y34 is checked for a short-circuit, that is, it is identified as a fault if Y33, Y34 is closed before the EMERGENCY STOP button is closed.

OFF-delay times

The table below provides an overview of the OFF-delay times t_v

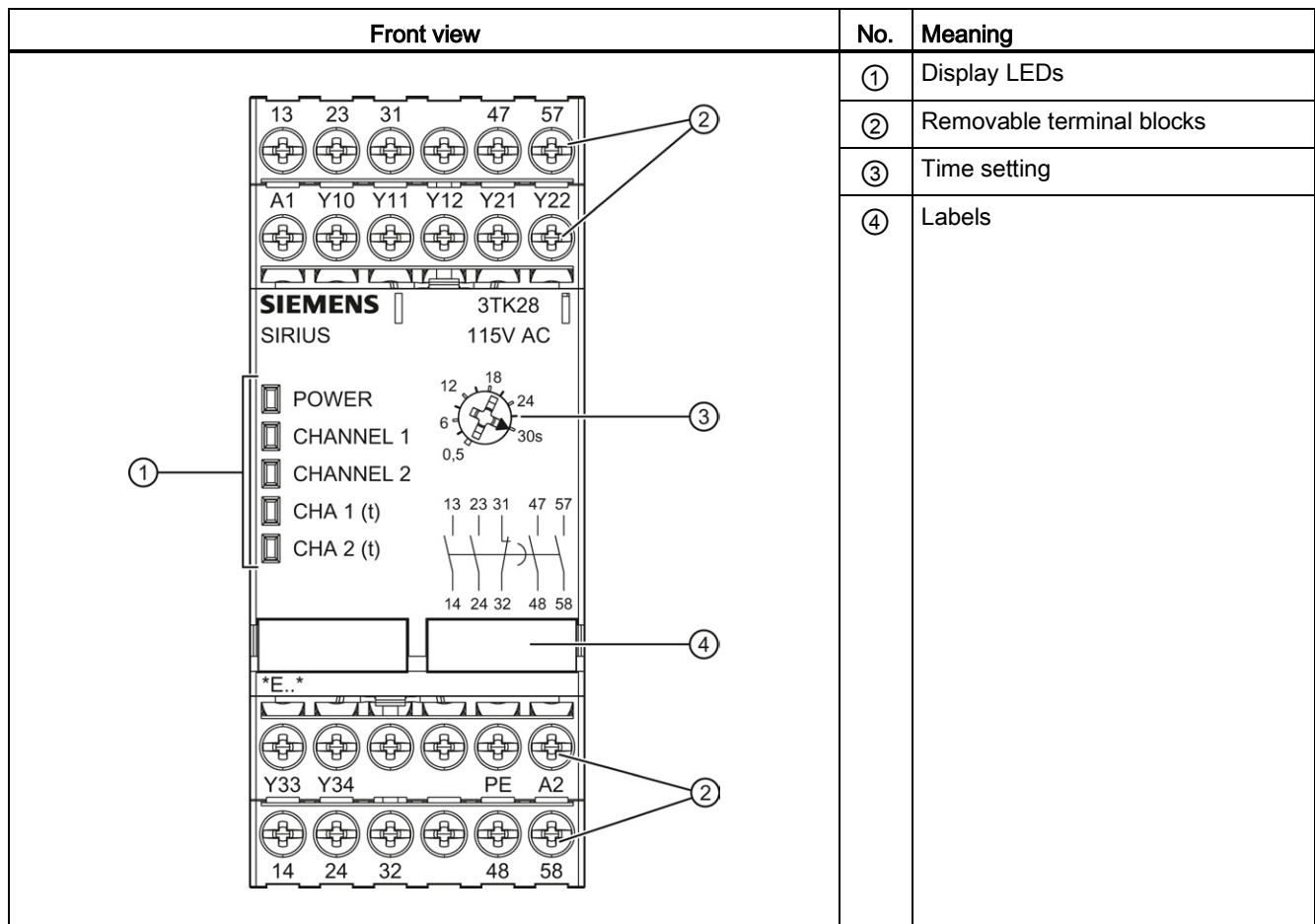
Table 3- 3 3TK2827

Rated control supply voltage U_s [V]	Start type	OFF delay t_v [s]	Article No. Screw-type	Article No. Spring-loaded
24 V DC	Monitored	0,05 ... 3	3TK2827-1BB41	3TK2827-2BB41
24 V AC	Monitored	0,05 ... 3	3TK2827-1AB21	3TK2827-2AB21
115 V AC	Monitored	0,05 ... 3	3TK2827-1AJ21	3TK2827-2AJ21
230 V AC	Monitored	0,05 ... 3	3TK2827-1AL21	3TK2827-2AL21
24 V DC	Monitored	0,05 ... 30	3TK2827-1BB40	3TK2827-2BB40
24 V AC	Monitored	0,05 ... 30	3TK2827-1AB20	3TK2827-2AB20
115 V AC	Monitored	0,05 ... 30	3TK2827-1AJ20	3TK2827-2AJ20
230 V AC	Monitored	0,05 ... 30	3TK2827-1AL20	3TK2827-2AL20

Table 3- 4 3TK2828

Rated control supply voltage U_s [V]	Start type	OFF delay t_v [s]	Article No. Screw-type	Article No. Spring-loaded
24 V DC	Auto	0,05 ... 3	3TK2828-1BB41	3TK2828-2BB41
24 V AC	Auto	0,05 ... 3	3TK2828-1AB21	3TK2828-2AB21
115 V AC	Auto	0,05 ... 3	3TK2828-1AJ21	3TK2828-2AJ21
230 V AC	Auto	0,05 ... 3	3TK2828-1AL21	3TK2828-2AL21
24 V DC	Auto	0,05 ... 30	3TK2828-1BB40	3TK2828-2BB40
24 V AC	Auto	0,05 ... 30	3TK2828-1AB20	3TK2828-2AB20
115 V AC	Auto	0,05 ... 30	3TK2828-1AJ20	3TK2828-2AJ20
230 V AC	Auto	0,05 ... 30	3TK2828-1AL20	3TK2828-2AL20

3.6.7.3 Structure 3TK2827/28



3.6.7.4 Terminal assignment

Terminal	Description
A1	L/+
A2	N/-
Y10; Y11	Channel 1, (1-channel)
Y11; Y12	Channel 1, (2-channel)
Y21; Y22	Channel 2, (2-channel)
Y33; Y34	On button, feedback circuit
13 - 14	Enabling circuits, (NO)
23 - 24	
31 - 32	Enabling circuit, (NC)
47 - 48	Enabling circuits (NO), time-delayed
57 - 58	

3.6.7.5 Display of the operating state

The operating state and functioning of the device are indicated by five LEDs:

- POWER
- CHANNEL 1
- CHANNEL 2
- CH 1 (t)
- CH 2 (t)

Operating states of 3TK2827/28

● = off

☼ = on

LED					Operation			
POWER	Ch 1	Ch 2	Ch 1 (t)	Ch 2 (t)	Line supply	EMERGENCY STOP	ON	Enabling circuit
☼	☼	☼	☼	☼	On	Not pressed	Pressed	Closed
☼	●	●	☼	☼		Pressed, delay time running	Not pressed	FK1 & FK2 open, FK1 (t) & FK2 (t) closed
☼	●	●	●	●		Pressed	Not pressed	Open
☼	●	●	●	●		Not pressed	Not pressed	Open
					Fault			
☼	☼	●	☼	●	<ul style="list-style-type: none"> • Relay welded • Motor contactor welded • Fault in electronics • Short-circuit in ON circuit 			Open
☼	●	☼	●	☼				
●	●	●	●	●				

Ch1 = Channel 1

Ch2 = Channel 2

FK1 = enabling circuit 1, instantaneous

FK2 = enabling circuit 2, instantaneous

FK1 (t) = enabling circuit 1, time-delayed

FK2 (t) = enabling circuit 2, time-delayed

3.6.7.6 State diagrams 3TK2827 / 3TK2828

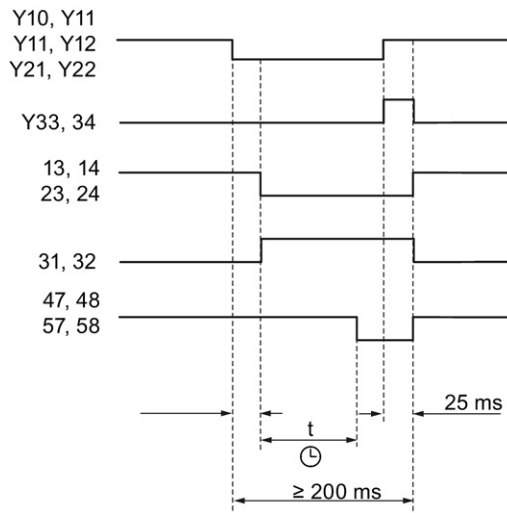


Figure 3-31 State diagram 3TK2827 (monitored start)

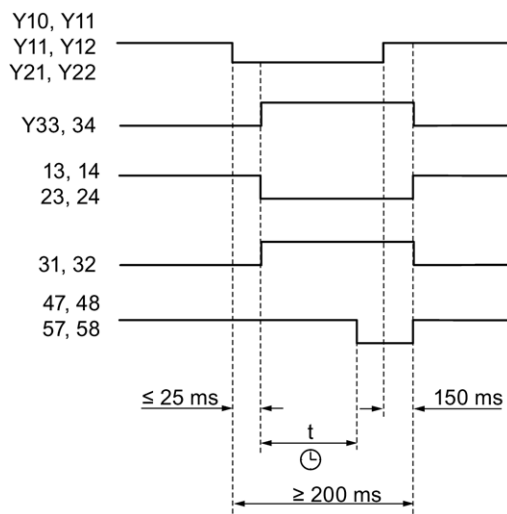


Figure 3-32 State diagram 3TK2828 (Autostart)

3.6.7.7 Technical data 3TK2827 / 3TK2828

Technical data 3TK2827

	3TK2827-.A...	3TK2827-.B...
EMC emitted interference	EN 60947-5-1	
Item designation	KT	
<ul style="list-style-type: none"> • according to DIN 40719 extendable after IEC 204-2 according to IEC 750 	KT	
<ul style="list-style-type: none"> • according to DIN EN 61346-2 	F	
Number of sensor inputs 1-channel or 2-channel	1	
Design of the cascading	none	
Type of the safety-related wiring of the inputs	single-channel and two-channel	
Product feature transverse contact-secure	Yes	
Safety Integrity Level (SIL) according to IEC 61508	SIL3	
SIL claim limit (for a subsystem) according to EN 62061	3	
Safety integrity level (SIL) for delayed release circuit according to IEC 61508	SIL2	
Performance Level (PL)	e	
<ul style="list-style-type: none"> • according to ISO 13849-1 	e	
<ul style="list-style-type: none"> • for delayed release circuit according to ISO 13849-1 	d	
Category	4	
<ul style="list-style-type: none"> • according to EN 954-1 	4	
<ul style="list-style-type: none"> • according to ISO 13849-1 	4	
Safety device type according to IEC 61508-2	Type A	
Probability of dangerous failure per hour 1/h (PFHD) with high demand rate according to EN 62061	2.7 ⁻⁹	
T1 value for proof test interval or service life according to IEC 61508	a	20

3.6 3TK28 safety relays with relay enabling circuits

	3TK2827-A...	3TK2827-B...
Number of outputs as contact-affected switching element as NO contact safety-related		
• as NC contact for reporting function instantaneous switching	1	
• as NO contact safety-related instantaneous switching	2	
• as NO contact safety-related delayed switching	2	
Stop category according to DIN EN 60204-1	0 + 1	
Design of the input		
• cascading-input/functional switching	No	
• feedback input	Yes	
• start input	Yes	
Design of the electrical connection jumper socket	Yes	
Switching capacity current		
• at AC-15 at 24 V	A —	
• of the NO contacts of the relay outputs		
– at AC-15 at 230 V	A 5	
– at DC-13 at 24 V	A 5	
• of the NC contacts of the relay outputs at AC-15		
– at 115 V	A 5	
– at 230 V	A 5	
Thermal current of the contact-affected switching element maximum	A 5	
Electrical operating cycles as operating time typical	100 000	
Mechanical operating cycles as operating time typical	10 000 000	
Design of the fuse link for short-circuit protection of the NO contacts of the relay outputs required	gL/gG: 6 A, or quick: 10 A	

		3TK2827-A...	3TK2827-B...
Type of voltage of the controlled supply voltage		AC	DC
Control supply voltage frequency 1 rated value	Hz	50	—
Control supply voltage frequency 2 rated value	Hz	60	—
Control supply voltage 1 for DC final rated value			
• for DC rated value	V	—	24
Operating range factor control supply voltage rated value of the magnet coil			
• at 50 Hz			
– for AC		0.85	1.1
• at 60 Hz			
– for AC		0.85	1.1
• for DC		0.85	1.1

3.6 3TK28 safety relays with relay enabling circuits

	3TK2827-A...	3TK2827-B...
Product function		
• automatic start	No	
• rotation speed monitoring	No	
• laser scanner monitoring	No	
• light grid monitoring	No	
• light barrier monitoring	No	
• magnetic switch monitoring Normally closed contact-Normally open contact	No	
• magnetic switch monitoring Normally closed contact-Normally closed contact	No	
• emergency stop function	Yes	
• protective door monitoring	No	
• standstill monitoring	No	
• step mat monitoring	Yes	
• monitored start-up	Yes	
Acceptability for application		
• safety-related circuits	Yes	
• safety cut-out switch	Yes	
• magnetically operated switches monitoring	No	
• EMERGENCY-OFF circuit monitoring	Yes	
• proximity switches monitoring	No	
• opto-electronical protection device monitoring	No	
• position switch monitoring	Yes	
• tactile sensor monitoring	No	
• valve monitoring	No	

Technical data 3TK2828

	3TK2828-A...	3TK2828-B...
EMC emitted interference	EN 60947-5-1	
Item designation		
<ul style="list-style-type: none"> according to DIN 40719 extendable after IEC 204-2 according to IEC 750 	KT	
<ul style="list-style-type: none"> according to DIN EN 61346-2 	F	
Number of sensor inputs 1-channel or 2-channel	1	
Design of the cascading	none	
Type of the safety-related wiring of the inputs	single-channel and two-channel	
Product feature transverse contact-secure	Yes	
Safety Integrity Level (SIL) according to IEC 61508	SIL3	
SIL claim limit (for a subsystem) according to EN 62061	3	
Safety integrity level (SIL) for delayed release circuit according to IEC 61508	SIL2	
Performance level (PL) according to ISO 13849-1	e	
Performance Level (PL) for delayed release circuit according to ISO 13849-1	d	
Category		
<ul style="list-style-type: none"> according to EN 954-1 	4	
<ul style="list-style-type: none"> according to ISO 13849-1 	4	
Safety device type according to IEC 61508-2	Type A	
Probability of dangerous failure per hour (PFHD) with high demand rate according to EN 62061	1/h	2.7 ⁻⁹
T1 value for proof test interval or service life according to IEC 61508	a	20
Number of outputs as contact-affected switching element as NO contact safety-related		
<ul style="list-style-type: none"> as NC contact for reporting function instantaneous switching 	1	
<ul style="list-style-type: none"> as NO contact safety-related instantaneous switching 	2	
<ul style="list-style-type: none"> as NO contact safety-related delayed switching 	2	
Stop category according to DIN EN 60204-1	0 + 1	

3.6 3TK28 safety relays with relay enabling circuits

		3TK2828-A...	3TK2828-B...
Design of the input			
• cascading-input/functional switching		No	
• feedback input		Yes	
• start input		Yes	
Design of the electrical connection jumper socket		Yes	
Switching capacity current			
• at AC-15 at 24 V	A	—	
• of the NO contacts of the relay outputs			
– at AC-15 at 230 V	A	5	
– at DC-13 at 24 V	A	5	
• of the NC contacts of the relay outputs at AC-15			
– at 115 V	A	5	
– at 230 V	A	5	
Thermal current of the contact-affected switching element maximum	A	5	
Electrical operating cycles as operating time typical		100 000	
Mechanical operating cycles as operating time typical		10 000 000	
Design of the fuse link for short-circuit protection of the NO contacts of the relay outputs required		gL/gG: 6 A, or quick: 10 A	
Type of voltage of the controlled supply voltage		AC	DC
Control supply voltage frequency 1 rated value	Hz	50	—
Control supply voltage frequency 2 rated value	Hz	60	—
Control supply voltage 1 for DC final rated value			
• for DC rated value	V	—	24

	3TK2828-A...	3TK2828-B...
Operating range factor control supply voltage rated value of the magnet coil <ul style="list-style-type: none"> • at 50 Hz <ul style="list-style-type: none"> – for AC • at 60 Hz <ul style="list-style-type: none"> – for AC • for DC 	0.85 1.1 0.85 1.1 0.85 1.1	
Product function <ul style="list-style-type: none"> • automatic start • rotation speed monitoring • laser scanner monitoring • light grid monitoring • light barrier monitoring • magnetic switch monitoring Normally closed contact-Normally open contact • magnetic switch monitoring Normally closed contact-Normally closed contact • emergency stop function • protective door monitoring • standstill monitoring • step mat monitoring • monitored start-up 	Yes No No No No No No No Yes No Yes No	
Acceptability for application <ul style="list-style-type: none"> • safety-related circuits • safety cut-out switch • magnetically operated switches monitoring • EMERGENCY-OFF circuit monitoring • proximity switches monitoring • opto-electronical protection device monitoring • position switch monitoring • tactile sensor monitoring • valve monitoring 	Yes Yes No No No No Yes No No	

Utilization category DIN EN / IEC 60947-5-1	Rated operational voltage U_e [V]	Rated operational current I_e [A] if all instantaneous / time-delayed enabling circuits are loaded	
		60 °C	70 °C
AC-15	230	5 / 3	4 / 3
DC-13	24	5 / 2	4 / 3
	115	0.2 / 0.2	0.2 / 0.2
	230	0.1 / 0,1	0.1 / 0.1
Continuous current I_{th}		5 / 5	4 / 4

3.6.7.8 Connection examples 3TK2827 / 3TK2828

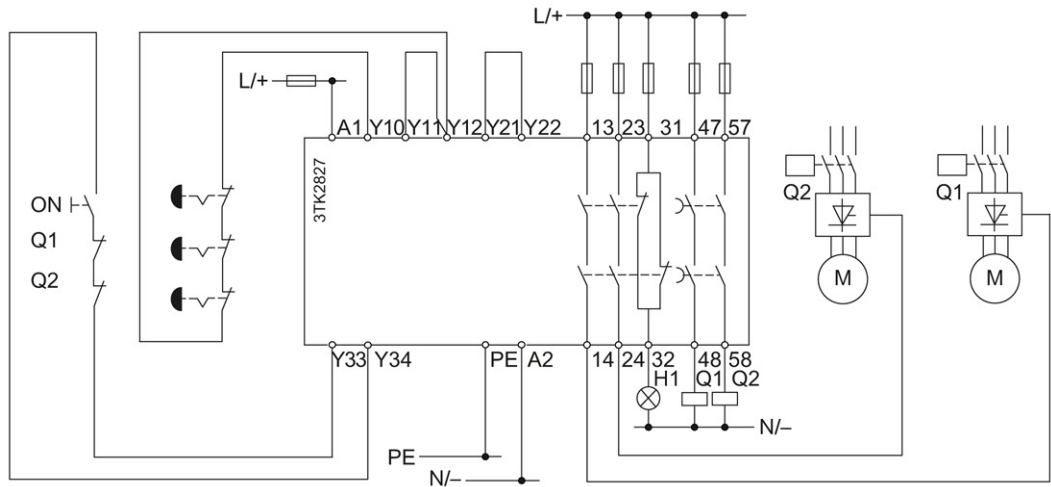


Figure 3-33 Monitored start (1-channel)

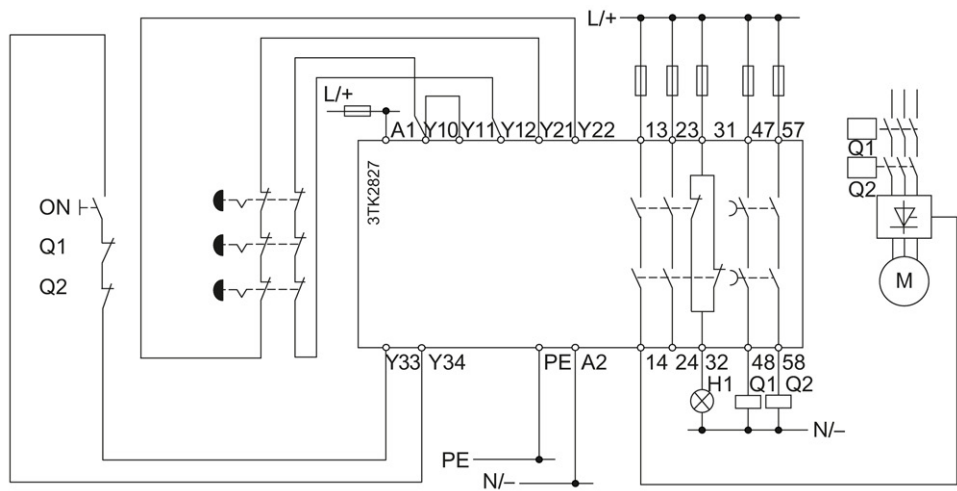


Figure 3-34 Monitored start (2-channel)

3.6 3TK28 safety relays with relay enabling circuits

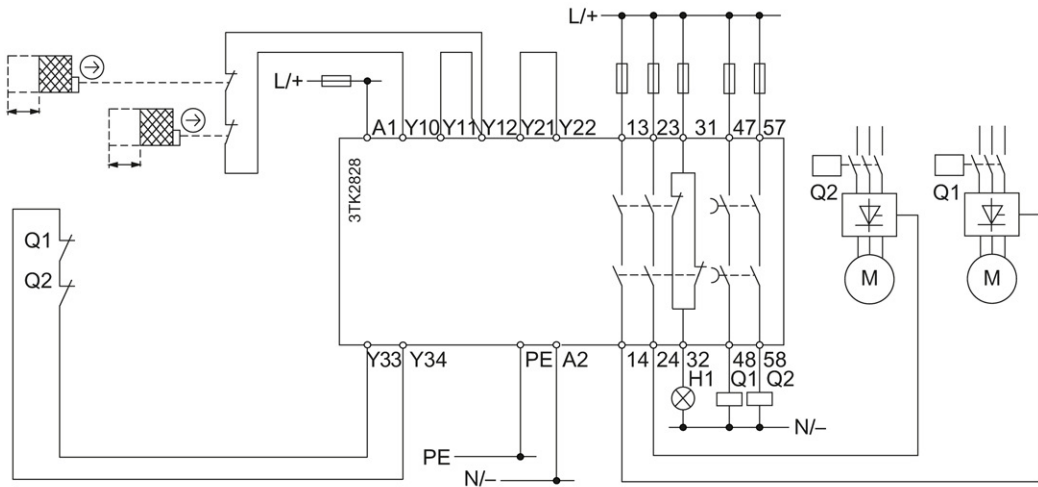


Figure 3-35 Autostart (1-channel)

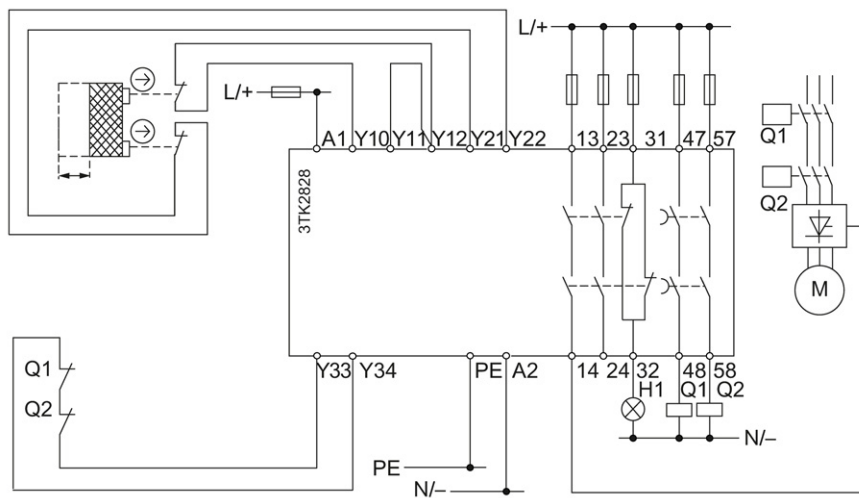


Figure 3-36 Autostart (2-channel)

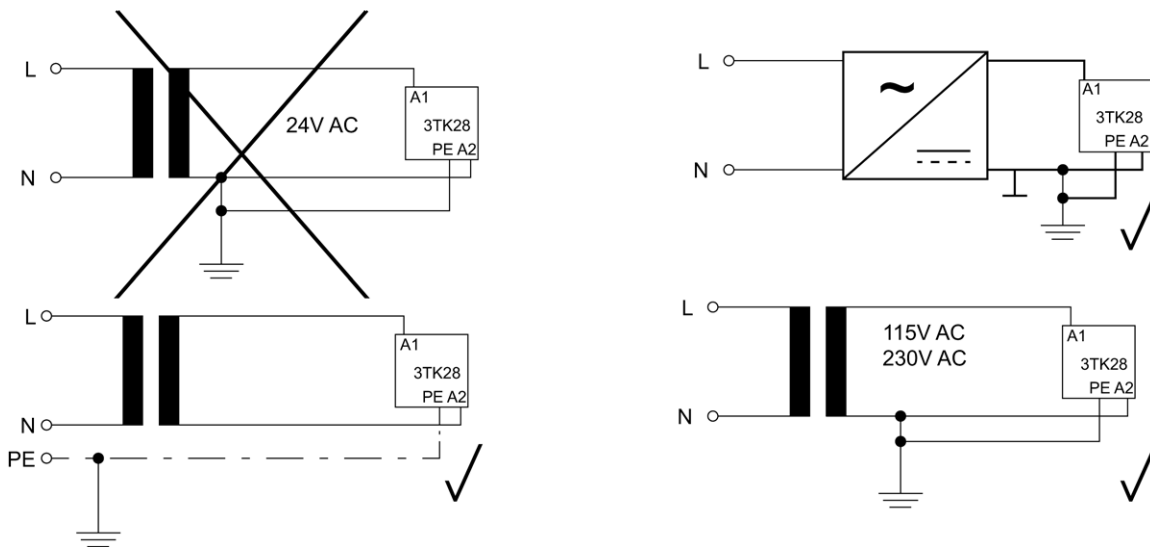


Figure 3-37 Grounding

Note

It is not necessary to connect the PE terminal for the device to function. For this reason, we recommend that you do not wire this terminal.

3.6.8 3TK2830 expansion unit

3.6.8.1 Applications

Applications of 3TK2830 expansion unit

The 3TK2830 is used to expand the enabling circuits. You can use it together with all 3TK28 basic units. The maximum achievable performance level PL / Cat. in accordance with DIN EN ISO 13849-1, or SILCL in accordance with IEC 62061 is equivalent to the performance level PL / Cat. / SIL of the basic unit if the external circuitry (cable connection between basic unit and expansion unit) is failsafe.

3.6.8.2 Description of function and connection information

The 3TK2830 has four safe enabling circuits as NO circuits and one positive-action NC circuit. Two LEDs indicate the operating state.

The 3TK2830 is controlled via any enabling circuit of the basic unit. The NC circuit 51/52 of the 3TK2830 is looped into the feedback circuit of the basic unit.

The 3TK2830 expansion unit is checked for correct functioning by means of the feedback circuit of the connected basic unit.

3.6.8.3 Structure 3TK2830

Front view	No.	Meaning
	①	Display LEDs
	②	Removable terminal blocks
	③	Labels

3.6.8.4 Terminal assignment

Terminal	Description
A1	L/+
A2	N/-
13 - 14	Enabling circuit 1, (NO)
23 - 24	Enabling circuit 2, (NO)
33 - 34	Enabling circuit 3, (NO)
43 - 44	Enabling circuit 4, (NO)
51 - 52	Monitoring of the 3TK2830 (NC)

3.6.8.5 Display of the operating state

The operating state and functioning of the device are indicated by two LEDs:

- CHANNEL 1
- CHANNEL 2

Operating states of 3TK2830

● = off

☼ = on

LED		Operation	
Channel 1	Channel 2	Line supply	Enabling circuit
☼	☼	On	Closed
●	●		Open
		Fault	
●	●	<ul style="list-style-type: none"> • Relay jammed • Motor contactor jammed • Fault in electronics • Supply voltage missing 	

3.6.8.6 State diagrams 3TK2830

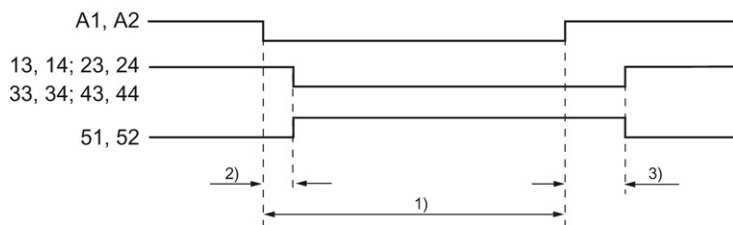


Figure 3-38 State diagrams 3TK2830

	.CB30	.A.20
1)	50 ms	100 ms
2)	25 ms	80 ms
3)	30 ms	200 ms

3.6.8.7 Technical data 3TK2830

	3TK2830-.A...	3TK2830-.C...
EMC emitted interference	EN 60947-5-1	
Item designation		
<ul style="list-style-type: none"> according to DIN 40719 extendable after IEC 204-2 according to IEC 750 	KT	
<ul style="list-style-type: none"> according to DIN EN 61346-2 	F	
Number of sensor inputs 1-channel or 2-channel	—	
Design of the cascading	none	
Type of the safety-related wiring of the inputs	—	
Product feature transverse contact-secure	No	
Safety Integrity Level (SIL) according to IEC 61508	SIL3	
SIL claim limit (for a subsystem) according to EN 62061	3	
Safety integrity level (SIL) for delayed release circuit according to IEC 61508	—	
Performance Level (PL)		
<ul style="list-style-type: none"> according to ISO 13849-1 	e	
<ul style="list-style-type: none"> for delayed release circuit according to ISO 13849-1 	—	
Category		
<ul style="list-style-type: none"> according to EN 954-1 	corresponds to basic unit	
<ul style="list-style-type: none"> according to ISO 13849-1 	4	
Safety device type according to IEC 61508-2	Type A	
Probability of dangerous failure per hour (PFHD) with high demand rate according to EN 62061	1/h	1.2 ⁻⁹
T1 value for proof test interval or service life according to IEC 61508	a	20
Number of outputs as contact-affected switching element as NO contact safety-related		
<ul style="list-style-type: none"> as NC contact for reporting function instantaneous switching 	0	
<ul style="list-style-type: none"> as NO contact safety-related instantaneous switching 	4	
<ul style="list-style-type: none"> as NO contact safety-related delayed switching 	0	

3.6 3TK28 safety relays with relay enabling circuits

		3TK2830-A...	3TK2830-C...
Stop category according to DIN EN 60204-1		0	
Design of the input			
• cascading-input/functional switching		No	
• feedback input		Yes	
• start input		No	
Design of the electrical connection jumper socket		Yes	
Switching capacity current			
• at AC-15 at 24 V	A	—	
• of the NO contacts of the relay outputs			
– at AC-15 at 230 V	A	5	
– at DC-13 at 24 V	A	5	
• of the NC contacts of the relay outputs at AC-15			
– at 115 V	A	5	
– at 230 V	A	5	
Thermal current of the contact-affected switching element maximum	A	5	
Electrical operating cycles as operating time typical		100 000	
Mechanical operating cycles as operating time typical		10 000 000	
Design of the fuse link for short-circuit protection of the NO contacts of the relay outputs required		gL/gG: 6 A, or quick: 10 A	
Type of voltage of the controlled supply voltage		AC	AC/DC
Control supply voltage frequency 1 rated value	Hz	50	
Control supply voltage frequency 2 rated value	Hz	60	
Control supply voltage 1 for DC final rated value			
• for DC rated value	V	—	24

	3TK2830-A...	3TK2830-C...
Operating range factor control supply voltage rated value of the magnet coil		
<ul style="list-style-type: none"> • at 50 Hz <ul style="list-style-type: none"> – for AC 	0.85 1.1	
<ul style="list-style-type: none"> • at 60 Hz <ul style="list-style-type: none"> – for AC 	0.85 1.1	
<ul style="list-style-type: none"> • for DC 	— —	0.85 1.2
Product function		
<ul style="list-style-type: none"> • automatic start • rotation speed monitoring • laser scanner monitoring • light grid monitoring • light barrier monitoring • magnetic switch monitoring Normally closed contact-Normally open contact • magnetic switch monitoring Normally closed contact-Normally closed contact • emergency stop function • protective door monitoring • standstill monitoring • step mat monitoring • monitored start-up 	No No No No No No No No No No No No No	
Acceptability for application		
<ul style="list-style-type: none"> • safety-related circuits • safety cut-out switch • magnetically operated switches monitoring • EMERGENCY-OFF circuit monitoring • proximity switches monitoring • opto-electronical protection device monitoring • position switch monitoring • tactile sensor monitoring • valve monitoring 	No Yes No No No No No No No	

Utilization category acc. to DIN EN / IEC 60947-5-1	Rated operational voltage U_o [V]	Rated operational current I_o [A] if all enabling circuits are loaded			
		40 °C	50 °C	60 °C	70 °C
AC-15	230	5	4	3.5	3
DC-13	24	5	4	3.5	3
	115	0.2	0.2	0.2	0.2
	230	0.1	0.1	0.1	0.1
Continuous current I_{th}		5	4	3.5	3

3.6.8.8 Connection examples 3TK2830

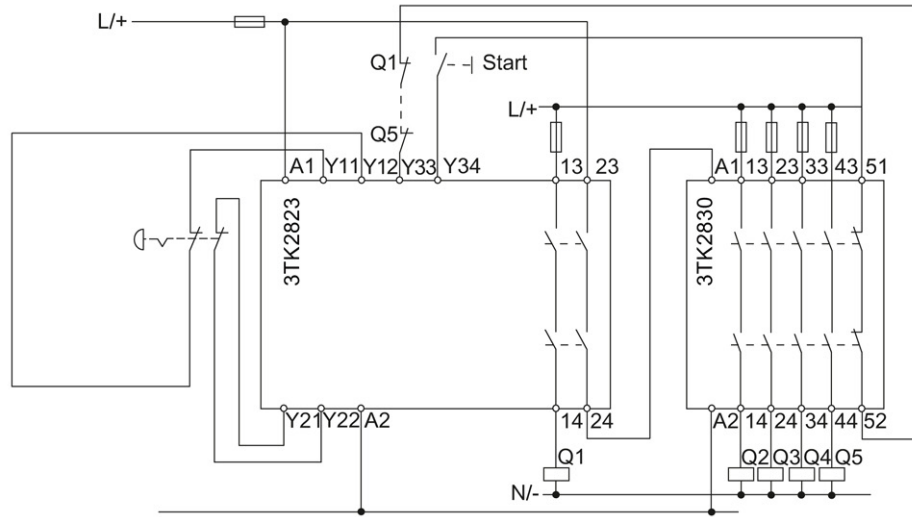


Figure 3-39 EMERGENCY STOP

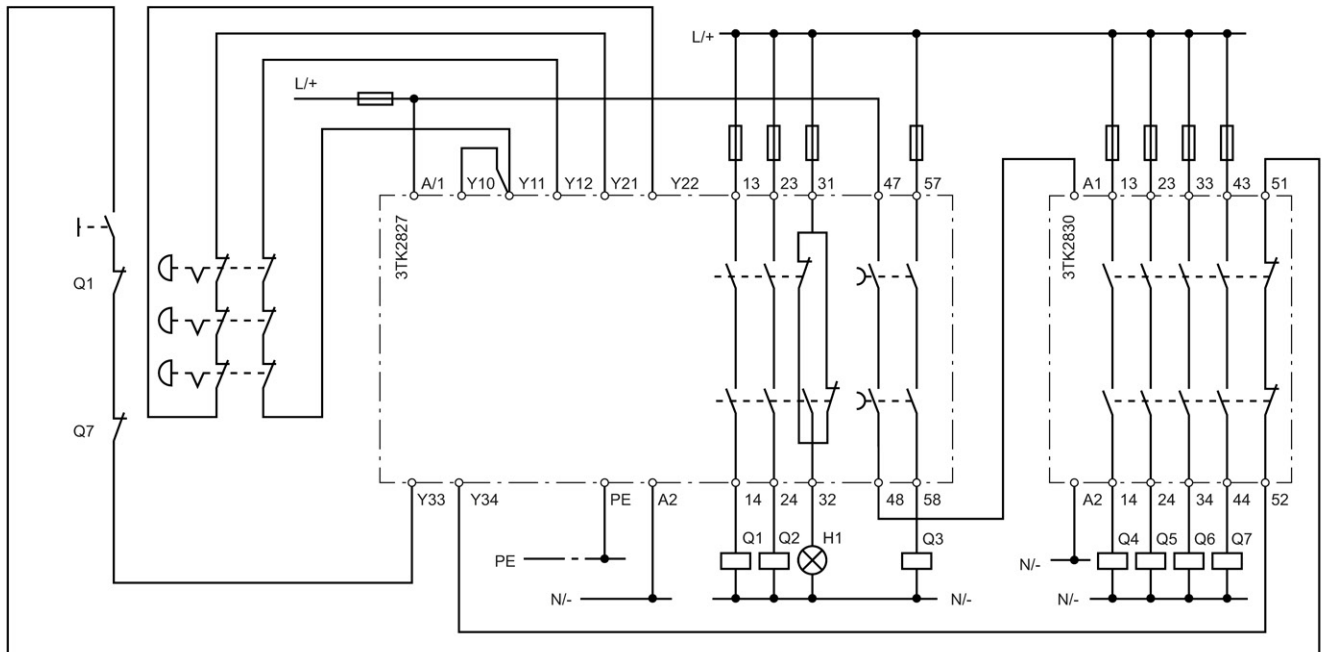


Figure 3-40 EMERGENCY STOP with time delay

3.6.9 3TK2834 two-hand control device

3.6.9.1 Applications

Applications of the 3TK2834 two-hand control device

The 3TK2834 two-hand control device is suitable for installation in controllers for the following presses:

- Hydraulic presses DIN EN 693,
- Eccentric presses and similar presses DIN EN 692,
- Screw presses DIN EN 692,

A maximum performance level PL_e /Cat. 4 in accordance with DIN EN ISO 13849-1/SILCL 3 in accordance with IEC 62061 or Category III C acc. to DIN EN 574 can be achieved with this device.

3.6.9.2 Description of function and connection information

The 3TK2834 two-hand control device has two enabling circuits as NO circuits and two signaling circuits as NC circuits. The operating state and functioning are indicated by five LEDs.

Pressing buttons S1 and S2 simultaneously (< 0.5 s) closes the enabling circuits. Releasing one button, opens the enabling circuits. They will only close again when both buttons are released and pressed again.

1. Apply operating voltage to terminals A1 and A2. The operating voltage must be disconnected at the same time as the driving energy of the press.
2. Closing the feedback circuit: Connect a jumper to Y11, Y12 or NC contacts of external contactors.
3. Connecting the input circuit:
Connect button S1 to terminals Y21, Y22, Y23 and
button S2 to terminals Y31, Y32, Y33

3.6.9.3 Structure 3TK2834

Front view	No.	Meaning
	①	Display LEDs
	②	Removable terminal blocks
	③	Labels

3.6.9.4 Terminal assignment

Terminal	Description
A1	L/+
A2	N/-
13; 14	Enabling circuit 1, (NO)
23; 24	Enabling circuit 2, (NO)
31; 32	Signaling circuit 1, (NC)
41; 42	Signaling circuit 2, (NC)
Y11, Y12	Feedback circuit
Y21; Y22; Y23	Button S1
Y31; Y32; Y33	Button S2

3.6.9.5 Display of the operating state

The operating state and functioning of the device are indicated by five LEDs:

- POWER
- S 1 ON
- S 2 ON
- CHANNEL 1
- CHANNEL 2

Operating states of 3TK2834

● = off

☀ = on

LED					Operation
POWER	S 1 ON	S 2 ON	Channel 1	Channel 2	Button
☀	●	●	●	●	Not pressed
☀	☀	●	●	●	Only S1 pressed
☀	●	☀	●	●	Only S2 pressed
☀	☀	☀	☀	☀	S1 and S2 pressed

The device cannot start with the following faults:

- Short-circuit, e.g. between the buttons
- Defective relay coils
- Wire break
- Jammed contacts

The output relays do not pick up if

- simultaneity (< 0.5 s) is not achieved
- only one button is pressed
- feedback circuit Y11, Y12 is open.

3.6.9.6 Technical data 3TK2834

	3TK2834-.A...	3TK2834-.B...
EMC emitted interference	EN 60947-5-1	
Item designation	KT	
<ul style="list-style-type: none"> • according to DIN 40719 extendable after IEC 204-2 according to IEC 750 	KT	
<ul style="list-style-type: none"> • according to DIN EN 61346-2 	F	
Number of sensor inputs 1-channel or 2-channel	—	
Design of the cascading	none	
Type of the safety-related wiring of the inputs	two-channel	
Product feature transverse contact-secure	Yes	
Safety Integrity Level (SIL) according to IEC 61508	SIL3	
SIL claim limit (for a subsystem) according to EN 62061	3	
Safety integrity level (SIL) for delayed release circuit according to IEC 61508	—	
Performance Level (PL)	e	
<ul style="list-style-type: none"> • according to ISO 13849-1 	e	
<ul style="list-style-type: none"> • for delayed release circuit according to ISO 13849-1 	—	
Category	4	
<ul style="list-style-type: none"> • according to EN 954-1 	4	
<ul style="list-style-type: none"> • according to ISO 13849-1 	4	
Safety device type according to IEC 61508-2	Type A	
Probability of dangerous failure per hour 1/h (PFHD) with high demand rate according to EN 62061	1.4 ⁻⁹	
T1 value for proof test interval or service life according to IEC 61508	a	20
Number of outputs as contact-affected switching element as NO contact safety-related	0	
<ul style="list-style-type: none"> • as NC contact for reporting function instantaneous switching 	0	
<ul style="list-style-type: none"> • as NO contact safety-related instantaneous switching 	4	
<ul style="list-style-type: none"> • as NO contact safety-related delayed switching 	0	

3.6 3TK28 safety relays with relay enabling circuits

	3TK2834-A...	3TK2834-B...
Stop category according to DIN EN 60204-1	0	
Design of the input		
• cascading-input/functional switching	No	
• feedback input	Yes	
• start input	No	
Design of the electrical connection jumper socket	Yes	
Breaking capacity current at AC-15 at 24 V	A	—
Switching capacity current of the NO contacts of the relay outputs		
• at AC-15 at 230 V	A	5
• at DC-13		
– at 24 V	A	6
– at 115 V	A	0.2
– at 230 V	A	0.1
Switching capacity current of the NC contacts of the relay outputs		
• at AC-15		
– at 115 V	A	5
– at 230 V	A	5
• at DC-13		
– at 115 V	A	0.2
– at 230 V	A	0.1
Thermal current of the contact-affected switching element maximum	A	6
Electrical operating cycles as operating time typical	100 000	
Mechanical operating cycles as operating time typical	10 000 000	
Design of the fuse link for short-circuit protection of the NO contacts of the relay outputs required	gL/gG: 6 A, or quick: 10 A	
Type of voltage of the controlled supply voltage	AC	DC
Control supply voltage frequency 1 rated Hz value	50	—
Control supply voltage frequency 2 rated Hz value	60	—
Control supply voltage 1 for DC final rated value		
• for DC rated value	V	— 24

	3TK2834-A...	3TK2834-B...
Operating range factor control supply voltage rated value of the magnet coil		
<ul style="list-style-type: none"> • at 50 Hz <ul style="list-style-type: none"> – for AC 	0.85 1.1	
<ul style="list-style-type: none"> • at 60 Hz <ul style="list-style-type: none"> – for AC 	0.85 1.1	
<ul style="list-style-type: none"> • for DC 	0.85 1.1	
Product function		
<ul style="list-style-type: none"> • automatic start 	No	
<ul style="list-style-type: none"> • rotation speed monitoring 	No	
<ul style="list-style-type: none"> • laser scanner monitoring 	No	
<ul style="list-style-type: none"> • light grid monitoring 	No	
<ul style="list-style-type: none"> • light barrier monitoring 	No	
<ul style="list-style-type: none"> • magnetic switch monitoring Normally closed contact-Normally open contact 	No	
<ul style="list-style-type: none"> • magnetic switch monitoring Normally closed contact-Normally closed contact 	No	
<ul style="list-style-type: none"> • emergency stop function 	No	
<ul style="list-style-type: none"> • protective door monitoring 	No	
<ul style="list-style-type: none"> • standstill monitoring 	No	
<ul style="list-style-type: none"> • step mat monitoring 	No	
<ul style="list-style-type: none"> • monitored start-up 	No	
Acceptability for application		
<ul style="list-style-type: none"> • safety-related circuits 	Yes	
<ul style="list-style-type: none"> • safety cut-out switch 	Yes	
<ul style="list-style-type: none"> • magnetically operated switches monitoring 	No	
<ul style="list-style-type: none"> • EMERGENCY-OFF circuit monitoring 	No	
<ul style="list-style-type: none"> • proximity switches monitoring 	No	
<ul style="list-style-type: none"> • opto-electronical protection device monitoring 	No	
<ul style="list-style-type: none"> • position switch monitoring 	Yes	
<ul style="list-style-type: none"> • tactile sensor monitoring 	No	
<ul style="list-style-type: none"> • valve monitoring 	No	

Utilization category acc. to VDE 0660 Part 200, DIN EN / IEC 60947-5-1	Rated operational voltage U_e [V]	Rated operational current I_e [A] if all instantaneous / time-delayed enabling circuits are loaded	
		60 °C	70 °C
AC-15	230	6	4
DC-13	24	6	4
	115	0.2	0.2
	230	0.1	0.1
Continuous current I_{th}		6	4

3.6.9.7 Connection example

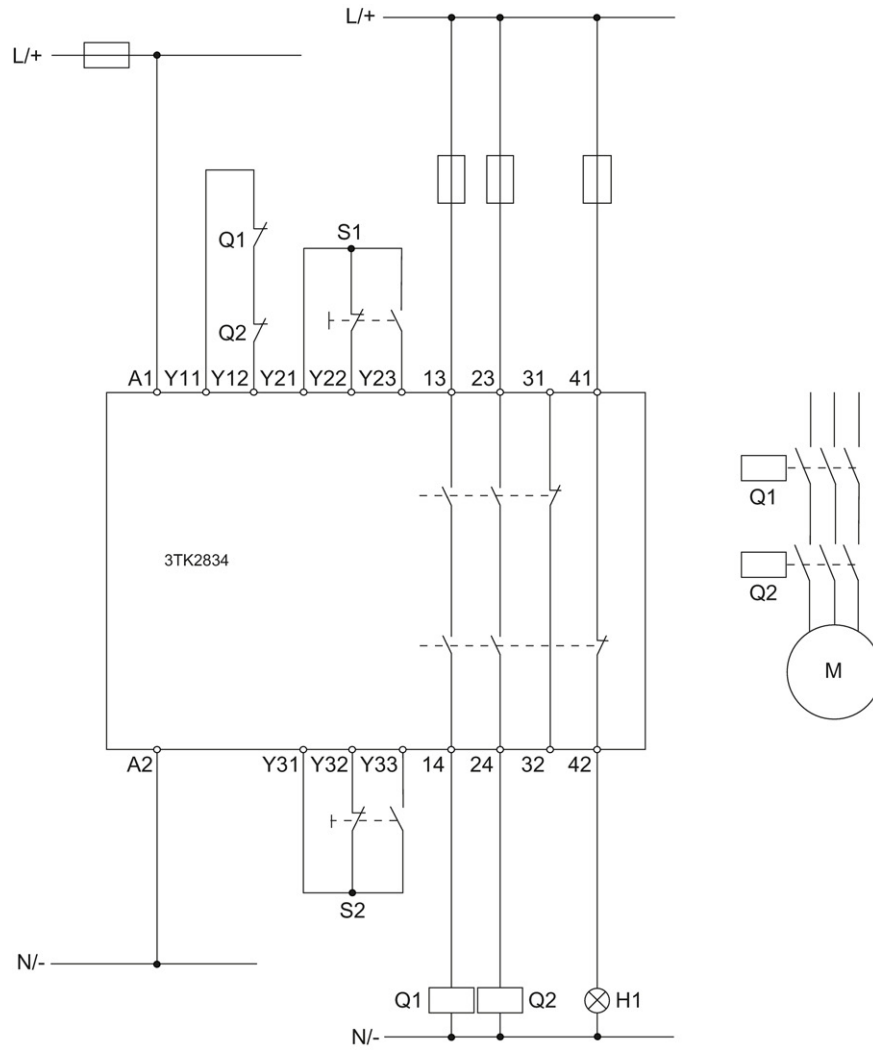


Figure 3-41 Two-hand

3.7 3TK28 safety relays with solid-state enabling circuits

3.7.1 3TK2840 safety relay

3.7.1.1 Applications

Applications of the 3TK2840 safety relay

You can use the 3TK2840 safety relay in EMERGENCY STOP devices according to DIN EN / IEC 60947-5-5 and in safety circuits according to DIN EN / IEC 60204-1, e.g. for movable guards and protective doors. Depending on the external circuitry, a maximum performance level PL_d / Cat. 3 in accordance with DIN EN ISO 13849-1 or SILCL 2 in accordance with IEC 62061 can be achieved.

3.7.1.2 Description of function and connection information

The 3TK2840 safety relay has two solid-state outputs. The operating state and functioning are indicated by three LEDs.

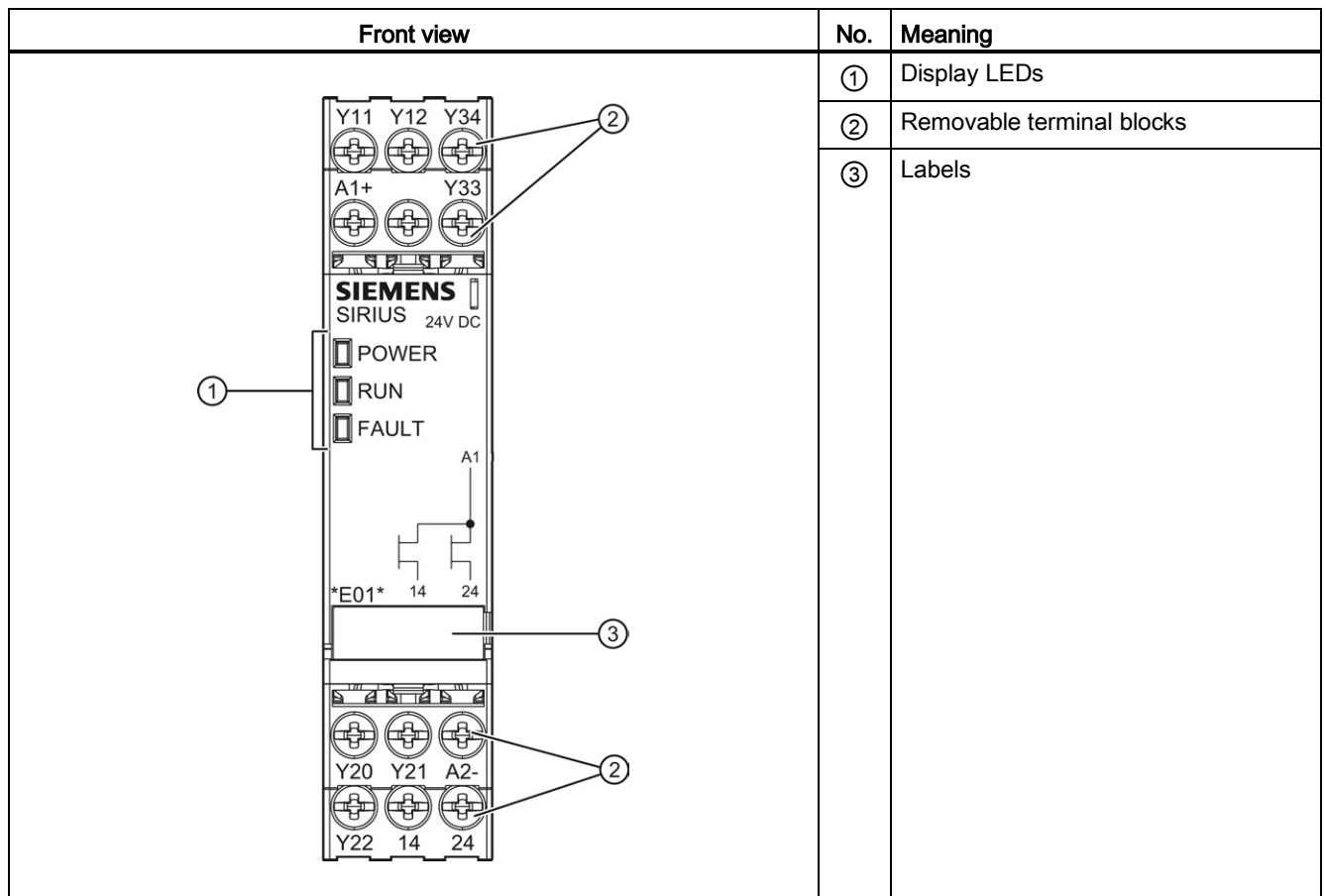
All internal parts of the circuit are cyclically monitored for faults during operation.

Connect the EMERGENCY STOP button or the position switch to terminals Y11, Y12, and Y21, Y22. The ON button is connected in series with the NC contacts of the external actuators (feedback circuit) at terminals Y33, Y34.

The 3TK2840 safety relay and the controlled contractors Q1 and Q2 require the same ground potential.

Performance level PL_d in accordance with DIN EN ISO 13849-1 or SILCL 2 in accordance with IEC 62061 is only achieved in conjunction with 2 external actuators with positive-action feedback contacts.

3.7.1.3 Structure 3TK2840



3.7.1.4 Terminal assignment

Terminal	Description
A1	L/+
A2	N/-
Y11; Y12	Channel 1, EMERGENCY STOP or position switch
Y21; Y22	Channel 2, EMERGENCY STOP or position switch
Y20	Parameterization "single-channel sensor connection"
Y33; Y34	ON button, feedback circuit
14; 24	Solid-state outputs

3.7.1.5 Display of the operating state

The operating state and functioning of the device are indicated by three LEDs:

- POWER
- RUN
- FAULT

Operating states of 3TK2840

● = off

☼ = on

LED			Operation			
POWER	RUN	FAULT	Line supply	EMERGENCY STOP	ON	Outputs
☼	☼	●	On	Not pressed	Pressed	On
☼	●	☼		Pressed	Not pressed	Off
☼	●	●		Not pressed	Not pressed	Off
Fault						
☼	●	☼	<ul style="list-style-type: none"> • Fault in electronics • Cross-circuit in EMERGENCY STOP circuits 			Off
●	●	●	Supply voltage missing			

3.7.1.6 State diagrams 3TK2840

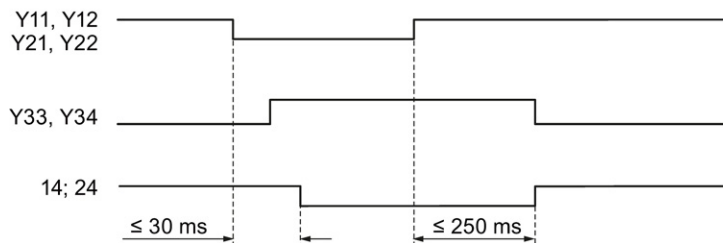


Figure 3-42 State diagram 3TK2840 autostart

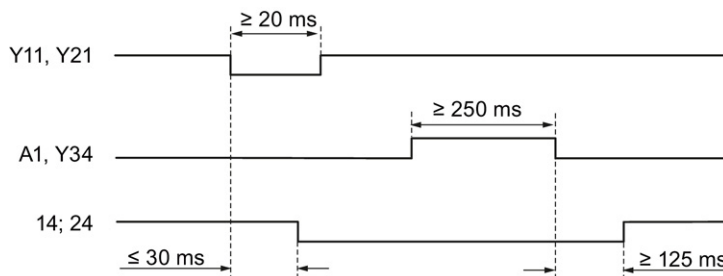


Figure 3-43 State diagram 3TK2840 monitored start

3.7.1.7 Technical data 3TK2840

	3TK2840-1B...	3TK2840-2B...
EMC emitted interference	EN 60947-5-1, EN 61000-6-2, EN 61000-6-4	
Item designation		
<ul style="list-style-type: none"> according to DIN 40719 extendable after IEC 204-2 according to IEC 750 	KT	
<ul style="list-style-type: none"> according to DIN EN 61346-2 	F	
Number of sensor inputs 1-channel or 2-channel	1	
Design of the cascading	none	
Type of the safety-related wiring of the inputs	single-channel and two-channel	
Product feature transverse contact-secure	Yes	
Safety Integrity Level (SIL) according to IEC 61508	SIL2	
SIL claim limit (for a subsystem) according to EN 62061	2	
Safety integrity level (SIL) for delayed release circuit according to IEC 61508	—	
Performance Level (PL)		
<ul style="list-style-type: none"> according to ISO 13849-1 	d	
<ul style="list-style-type: none"> for delayed release circuit according to ISO 13849-1 	—	
Category		
<ul style="list-style-type: none"> according to EN 954-1 	3	
<ul style="list-style-type: none"> according to ISO 13849-1 	3	
Safety device type according to IEC 61508-2	Type B	
Probability of dangerous failure per hour (PFHD) with high demand rate according to EN 62061	1/h	1.1 ⁻⁸
T1 value for proof test interval or service life according to IEC 61508	a	20

3.7 3TK28 safety relays with solid-state enabling circuits

	3TK2840-1B...	3TK2840-2B...
Number of outputs as contact-less semiconductor switching element		
• for reporting function		
– non-delayed	0	
– delayed switching	0	
• safety-related		
– non-delayed	2	
– delayed switching	0	
Stop category according to DIN EN 60204-1	0	
Design of the input		
• cascading-input/functional switching	No	
• feedback input	Yes	
• start input	Yes	
Design of the electrical connection jumper socket	Yes	
Switching capacity current of semiconductor outputs for enabling circuit for DC-13 at 24 V	A 0.5	
Type of voltage of the controlled supply voltage	DC	
Control supply voltage 1 for DC final rated value		
• for DC rated value	V 24	
Operating range factor control supply voltage rated value of the magnet coil for DC	0.9 1.15	

	3TK2840-1B...	3TK2840-2B...
Product function		
• automatic start	Yes	
• rotation speed monitoring	No	
• laser scanner monitoring	No	
• light grid monitoring	No	
• light barrier monitoring	No	
• magnetic switch monitoring Normally closed contact-Normally open contact	No	
• magnetic switch monitoring Normally closed contact-Normally closed contact	Yes	
• emergency stop function	Yes	
• protective door monitoring	Yes	
• standstill monitoring	No	
• step mat monitoring	No	
• monitored start-up	Yes	
Acceptability for application		
• safety-related circuits	Yes	
• safety cut-out switch	Yes	
• magnetically operated switches monitoring	Yes	
• EMERGENCY-OFF circuit monitoring	Yes	
• proximity switches monitoring	No	
• opto-electronical protection device monitoring	Yes	
• position switch monitoring	Yes	
• tactile sensor monitoring	No	
• valve monitoring	No	

3.7.1.8 Connection examples 3TK2840

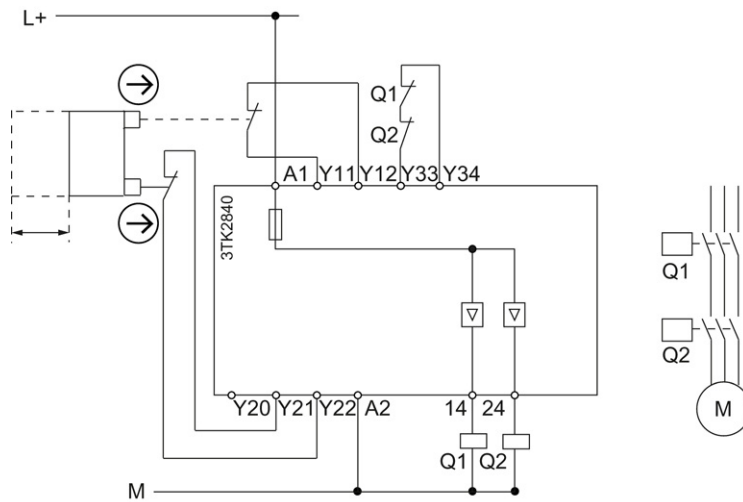


Figure 3-44 Autostart (2-channel)

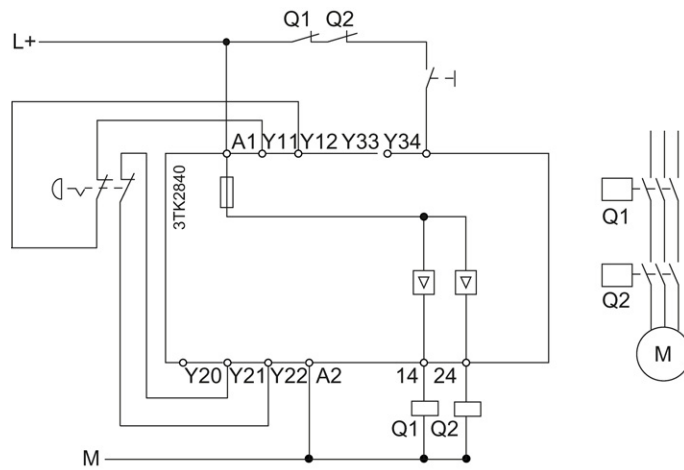


Figure 3-45 Monitored start (2-channel)

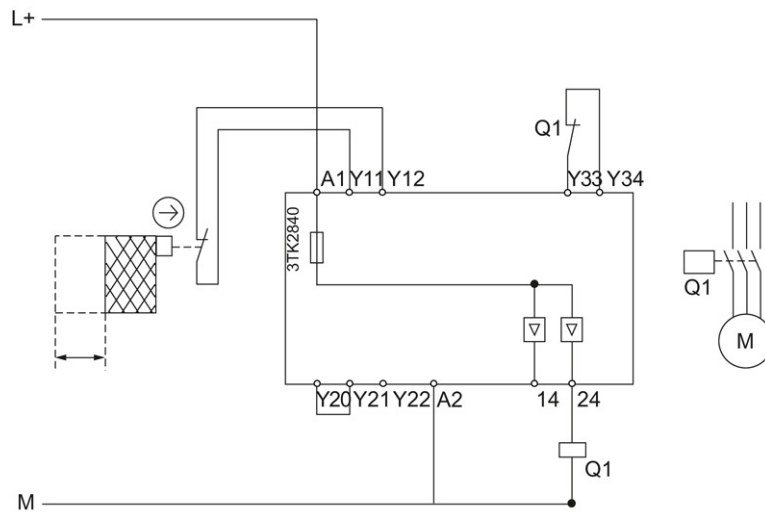


Figure 3-46 Autostart (1-channel)

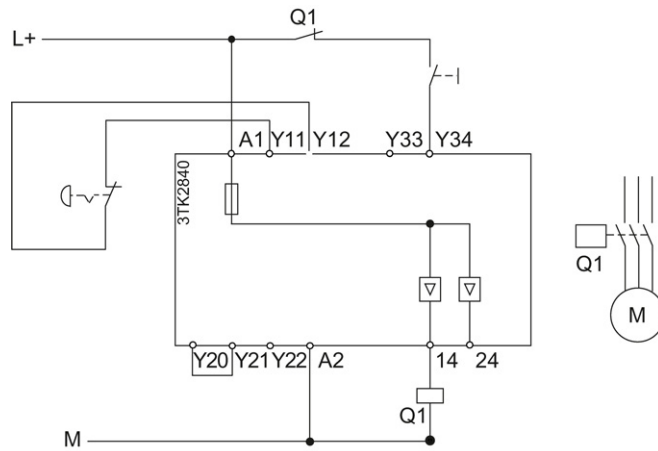


Figure 3-47 Monitored start (1-channel)

3.7.2 3TK2841 safety relay

3.7.2.1 Applications

Applications of the 3TK2841 safety relay

You can use the 3TK2841 safety relay in EMERGENCY STOP devices according to DIN EN / IEC 60947-5-5 and in safety circuits according to DIN EN / IEC 60204-1, e.g. with movable guards and protective doors or with contactless protective equipment according to DIN EN / IEC 61496-1, electrical equipment of furnaces according to VDE 0116 and automatic gas burner control systems for gas burners according to DIN EN 298. Depending on the external circuitry, a max. performance level PL_e / Cat. 4 per DIN EN ISO 13849-1 or SIL 3 per DIN EN / IEC 62061 can be achieved with this device.

The device can monitor safety shutdown mats with evaluation according to the cross-circuit principle (see Figure 3-54 Safety shutdown mat (Page 135))

3.7.2.2 Description of function and connection information

The solid-state 3TK2841 safety relay has two safe solid-state outputs. The operating state and functioning are indicated by three LEDs. On startup, the device runs a self-test in which the internal electronics are checked for correct functioning. All internal parts of the circuit are cyclically monitored for faults during operation.

Connect the EMERGENCY STOP button or the position switches or light array to terminals Y11, Y12, and Y21, Y22. Connect the ON button in series with the NC contacts of the external actuators to the supply voltage L+ (24 V DC) and to terminal Y34. The cascade input 1 must either be routed via a safe output or directly to supply voltage L+ (24 V DC).

External actuators or loads can be connected to safe outputs 14, 24. Make sure that the actuators or loads and the 3TK2841 solid-state safety relay have the same ground potential. Parallel connection of outputs 14 and 24 to increase the load current is not permissible.

If solid-state sensors are used (light array monitoring, etc.) and in single-channel operation, Y35 must be connected to L+ (24 V DC). For autostart operation, Y32 must be routed directly and Y34 via NC contacts of the external actuators to L+ (24 V DC).

3.7.2.3 Structure 3TK2841

Front view	No.	Meaning
	①	Display LEDs
	②	Removable terminal blocks
	③	Labels

3.7.2.4 Terminal assignment

Terminal	Description
A1	L/+
A2	N/-
Y11; Y12	Channel 1, EMERGENCY STOP or position switch
Y21; Y22	Channel 2, EMERGENCY STOP or position switch
Y35	with / without cross-circuit detection
Y32	Parameterization "single-channel sensor connection"
Y34	ON button, feedback circuit
1	Cascade input
14; 24	Safe solid-state outputs

3.7.2.5 Display of the operating state

The operating state and functioning of the device are indicated by three LEDs:

- POWER
- RUN
- FAULT

Operating states of 3TK2841

● = off

☼ = on

◐ = flashing

LED			Operation			
POWER	RUN	FAULT	Line supply	EMERGENCY STOP	ON	Outputs
☼	☼	●	On	Not pressed	Pressed	On
☼	●	☼		Pressed ¹⁾	Not pressed	Off
☼	●	●		Not pressed	Not pressed	Off
☼	●	◐	Self-test on startup approx. 7 s			
			Fault			
☼	●	◐	<ul style="list-style-type: none"> • Fault in electronics • Change of pin assignment during operation • Short-circuit to 24 V²⁾ 			Off
●	●	●	Supply voltage missing			

1) Sensor circuits open; cross-circuit between sensors; short-circuit of sensors to ground.

2) Only on circuit variant with "cross-circuit detection"

3.7.2.6 State diagrams 3TK2841

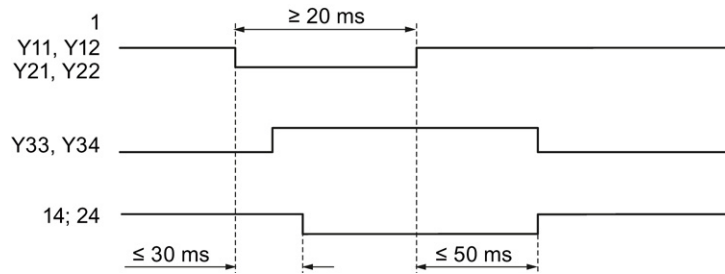


Figure 3-48 State diagram 3TK2841 autostart

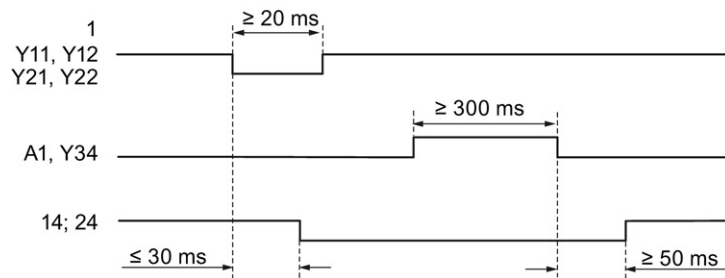


Figure 3-49 State diagram 3TK2841 monitored start

3.7.2.7 Technical data 3TK2841

	3TK2841-1B...	3TK2841-2B...
EMC emitted interference	IEC 60947-5-1, IEC 60000-4-3, IEC 60000-4-5, IEC 60000-4-6	
Item designation		
<ul style="list-style-type: none"> according to DIN 40719 extendable after IEC 204-2 according to IEC 750 	KT	
<ul style="list-style-type: none"> according to DIN EN 61346-2 	F	
Number of sensor inputs 1-channel or 2-channel	1	
Design of the cascading	cascading or in-service switching	
Type of the safety-related wiring of the inputs	single-channel and two-channel	
Product feature transverse contact-secure	Yes	
Safety Integrity Level (SIL) according to IEC 61508	SIL3	
SIL claim limit (for a subsystem) according to EN 62061	3	
Safety integrity level (SIL) for delayed release circuit according to IEC 61508	—	
Performance Level (PL)		
<ul style="list-style-type: none"> according to ISO 13849-1 	e	
<ul style="list-style-type: none"> for delayed release circuit according to ISO 13849-1 	—	
Category		
<ul style="list-style-type: none"> according to EN 954-1 	4	
<ul style="list-style-type: none"> according to ISO 13849-1 	4	
Safety device type according to IEC 61508-2	Type B	
Probability of dangerous failure per hour (PFHD) with high demand rate according to EN 62061	0.5 ⁻¹⁰	
T1 value for proof test interval or service life according to IEC 61508	a	20

	3TK2841-1B...	3TK2841-2B...
Number of outputs as contact-less semiconductor switching element		
• for reporting function		
– non-delayed	0	
– delayed switching	0	
• safety-related		
– non-delayed	2	
– delayed switching	0	
Stop category according to DIN EN 60204-1	0	
Design of the input		
• cascading-input/functional switching	Yes	
• feedback input	Yes	
• start input	Yes	
Design of the electrical connection jumper socket	Yes	
Switching capacity current of semiconductor outputs for enabling circuit for DC-13 at 24 V	A 1.5	
Type of voltage of the controlled supply voltage	DC	
Control supply voltage 1 for DC final rated value		
• for DC rated value	V 24	
Operating range factor control supply voltage rated value of the magnet coil for DC	0.9 1.15	

3.7 3TK28 safety relays with solid-state enabling circuits

	3TK2841-1B...	3TK2841-2B...
Product function		
• automatic start	Yes	
• rotation speed monitoring	No	
• laser scanner monitoring	Yes	
• light grid monitoring	Yes	
• light barrier monitoring	Yes	
• magnetic switch monitoring Normally closed contact-Normally open contact	No	
• magnetic switch monitoring Normally closed contact-Normally closed contact	Yes	
• emergency stop function	Yes	
• protective door monitoring	Yes	
• standstill monitoring	No	
• step mat monitoring	Yes	
• monitored start-up	Yes	
Acceptability for application		
• safety-related circuits	Yes	
• safety cut-out switch	Yes	
• magnetically operated switches monitoring	Yes	
• EMERGENCY-OFF circuit monitoring	Yes	
• proximity switches monitoring	No	
• opto-electronical protection device monitoring	Yes	
• position switch monitoring	Yes	
• tactile sensor monitoring	Yes	
• valve monitoring	No	

3.7.2.8 Connection examples 3TK2841

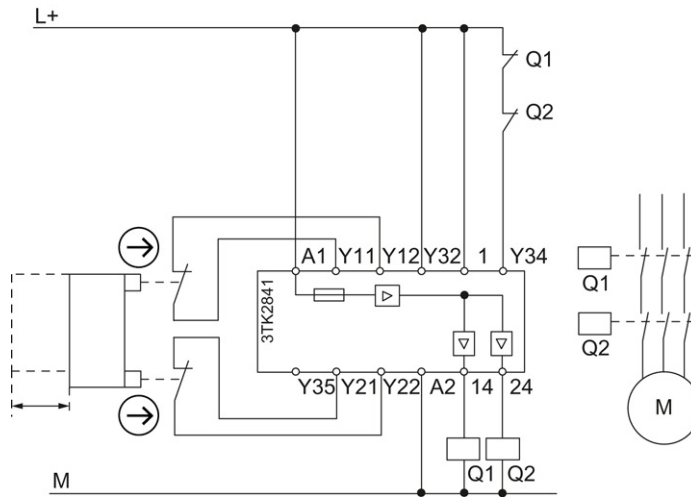


Figure 3-50 Autostart (2-channel)

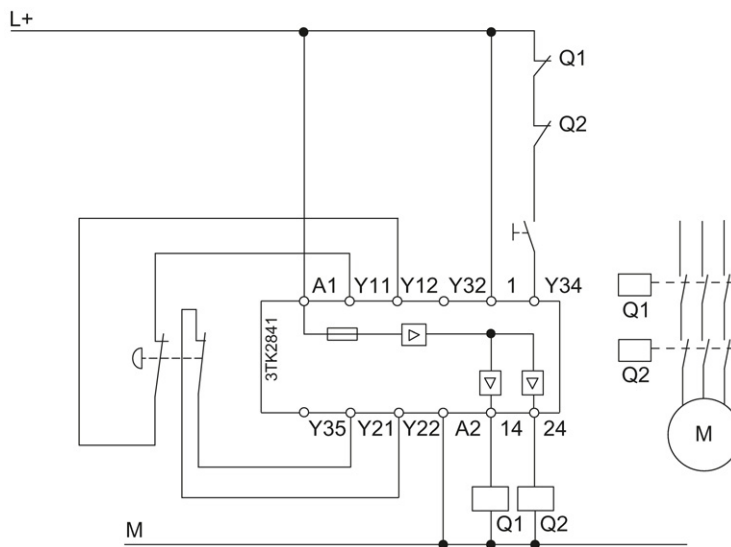


Figure 3-51 Monitored start (2-channel)

3.7 3TK28 safety relays with solid-state enabling circuits

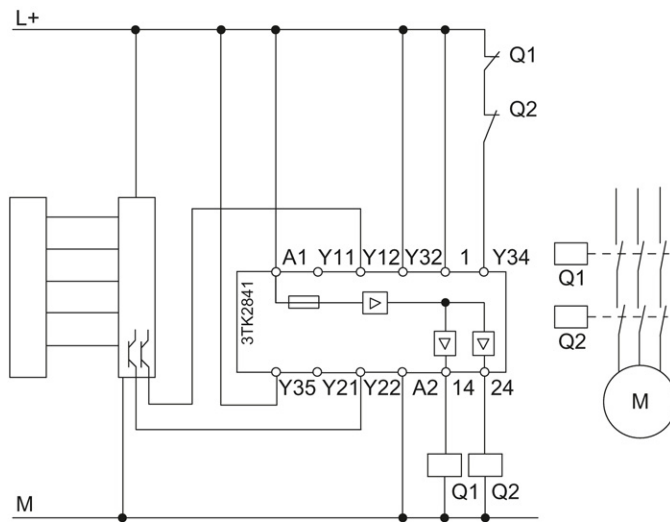


Figure 3-52 Autostart (2-channel) without cross-circuit detection

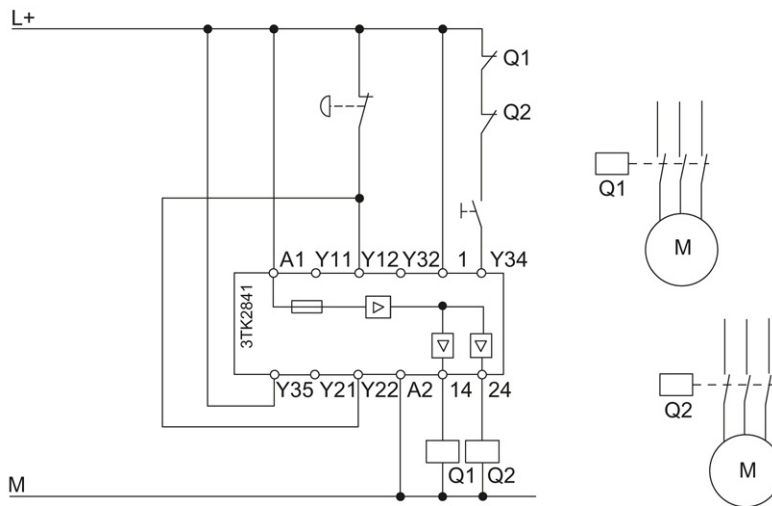


Figure 3-53 Monitored start (1-channel)

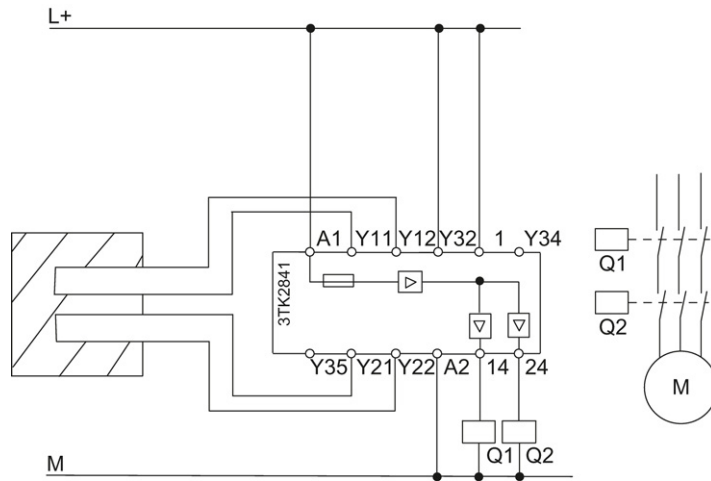


Figure 3-54 Safety shutdown mat

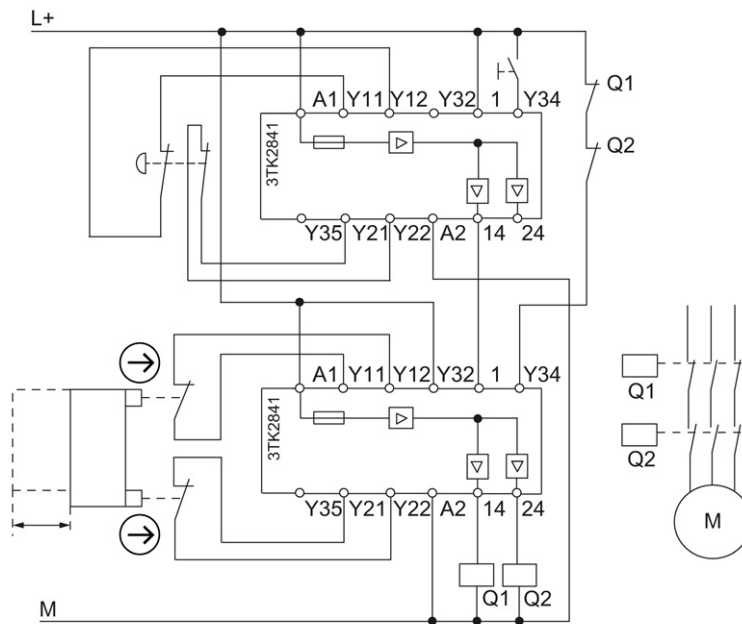


Figure 3-55 Cascading

3.7.3 3TK2842 safety relay

3.7.3.1 Applications

Applications of the 3TK2842 safety relay

You can use the 3TK2842 safety relay in EMERGENCY STOP devices according to DIN EN / IEC 60947-5-5 and in safety circuits according to DIN EN / IEC 60204-1, e.g. with movable guards and protective doors or with contactless protective equipment according to DIN EN / IEC 61496-1, electrical equipment of furnaces according to DIN EN 50156-1 and automatic gas burner control systems for gas burners according to DIN EN 298.

Depending on the external circuitry, a max. performance level PL_e / Cat. 4 per DIN EN ISO 13849-1 or SIL 3 per DIN EN / IEC 62061 can be achieved with this device.

The device can monitor safety shutdown mats with evaluation according to the cross-circuit principle (see Figure 3-62 Safety shutdown mat, autostart (2-channel) (Page 146))

3.7.3.2 Description of function and connection information

The solid-state 3TK2842 safety relay has a safe solid-state output and a time-delayed safe solid-state output.

The operating state and functioning are indicated by three LEDs.

On startup, the device runs a self-test in which the internal electronics are checked for correct functioning. All internal parts of the circuit are cyclically monitored for faults during operation.

Connect the EMERGENCY STOP button or the position switches or light array to terminals Y11, Y12, and Y21, Y22. Connect the ON button in series with the NC contacts of the external actuators to the supply voltage L+ (24 V DC) and to terminal Y34. The cascade input 1 must either be routed via a safe output or directly to supply voltage L+ (24 V DC).

External actuators or loads can be connected to safe outputs 14, 28. Make sure that the actuators or loads and the 3TK2842 solid-state safety relay have the same ground potential.

If solid-state sensors are used (light array monitoring, etc.) and in single-channel operation, Y35 must be connected to L+ (24 V DC). For autostart operation, Y32 must be routed directly and Y34 via NC contacts of the external actuators to L+ (24 V DC).

Correct functioning of the sensor circuits is checked by means of a clocked signal.

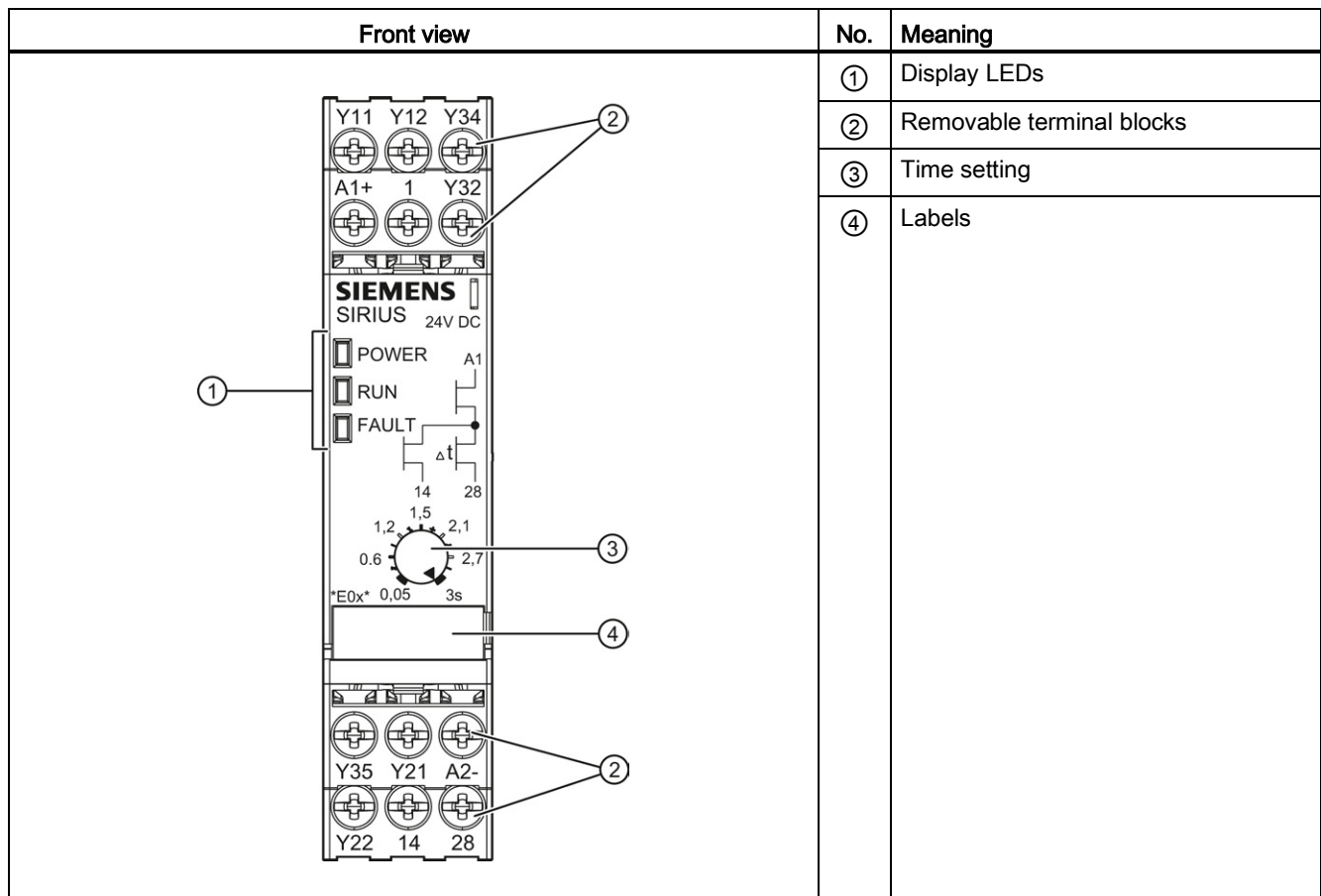
OFF-delay times

The table below provides an overview of the OFF-delay times t_v

Table 3- 5 3TK2842

Rated control supply voltage U_s [V]	Start type	OFF delay t_v [s]	Article No. Screw-type	Article No. Spring-type
24 V DC	Auto/ monitored	0,05 ... 3	3TK2842-1BB41	3TK2842-2BB41
		0,05 ... 30	3TK2842-1BB42	3TK2842-2BB42
		5 ... 300	3TK2842-1BB44	3TK2842-2BB44

3.7.3.3 Structure 3TK2842



3.7.3.4 Terminal assignment

Terminal	Description
A1	L/+
A2	N/-
Y11; Y12	Channel 1, EMERGENCY STOP or position switch
Y21; Y22	Channel 2, EMERGENCY STOP or position switch
Y35	with / without cross-circuit detection
Y32	Parameterization "single-channel sensor connection"
Y34	ON button, feedback circuit
1	Cascade input
14	Safe solid-state output
28	Safe solid-state output, delayed

3.7.3.5 Display of the operating state

The operating state and functioning of the device are indicated by three LEDs:

- POWER
- RUN
- FAULT

Operating states of 3TK2842

- = off
- ☼ = on
- ◐ = flashing

LED			Operation			
POWER	RUN	FAULT	Line supply	EMERGENCY STOP	ON	Outputs
☼	☼	●	On	Not pressed	Pressed	On
☼	●	☼		Pressed ¹⁾	Not pressed	Off
☼	●	●		Not pressed	Not pressed	Off
☼	◐ ³⁾	☼		Pressed	Not pressed	On / Off
☼	●	☼	Self-test on startup approx. 7 s			
			Fault			
☼	●	◐	<ul style="list-style-type: none"> • Fault in electronics • Change of pin assignment during operation • Short-circuit to 24 V²⁾ 			Off
●	●	●	Supply voltage missing			

¹⁾ Sensor circuits open; cross-circuit between sensors; short-circuit of sensors to ground.

²⁾ Only on circuit variant with "cross-circuit detection"

³⁾ Delay time running

3.7.3.6 State diagrams 3TK2842

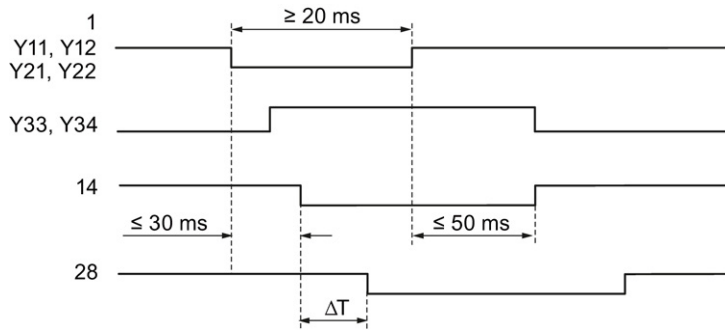


Figure 3-56 State diagram 3TK2842 autostart

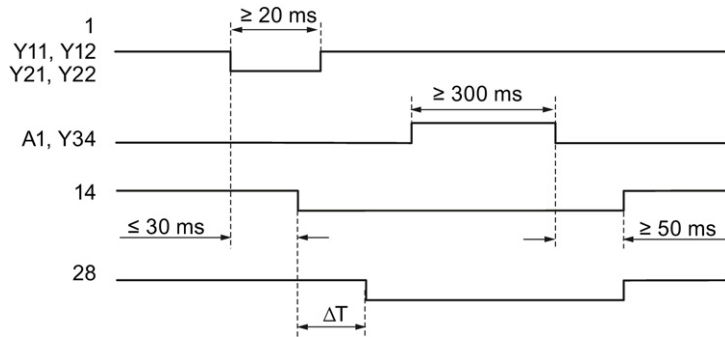


Figure 3-57 State diagram 3TK2842 monitored start

3.7.3.7 Technical data 3TK2842

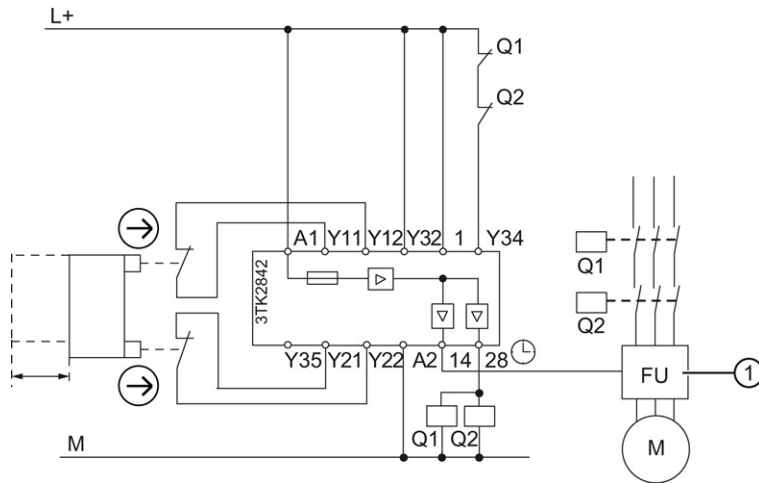
	3TK2842-1B...	3TK2842-2B...
EMC emitted interference	IEC 60947-5-1, IEC 60000-4-3, IEC 60000-4-5, IEC 60000-4-6	
Item designation	<ul style="list-style-type: none"> according to DIN 40719 extendable after IEC 204-2 according to IEC 750 according to DIN EN 61346-2 	
Number of sensor inputs 1-channel or 2-channel	KT	
Design of the cascading	F	
Type of the safety-related wiring of the inputs	1	
Product feature transverse contact-secure	cascading or in-service switching	
Safety Integrity Level (SIL) according to IEC 61508	single-channel and two-channel	
SIL claim limit (for a subsystem) according to EN 62061	Yes	
Safety integrity level (SIL) for delayed release circuit according to IEC 61508	SIL3	
Performance Level (PL)	3	
<ul style="list-style-type: none"> according to ISO 13849-1 for delayed release circuit according to ISO 13849-1 	SIL3	
Category	<ul style="list-style-type: none"> according to ISO 13849-1 for delayed release circuit according to ISO 13849-1 	
<ul style="list-style-type: none"> according to EN 954-1 according to ISO 13849-1 	e	
Safety device type according to IEC 61508-2	4	
Probability of dangerous failure per hour (PFHD) with high demand rate according to EN 62061	4	
T1 value for proof test interval or service life according to IEC 61508	Type B	
Number of outputs as contact-less semiconductor switching element	0.5 ⁻¹⁰	
<ul style="list-style-type: none"> for reporting function <ul style="list-style-type: none"> non-delayed delayed switching safety-related <ul style="list-style-type: none"> non-delayed delayed switching 	a 20	
<ul style="list-style-type: none"> for reporting function <ul style="list-style-type: none"> non-delayed delayed switching safety-related <ul style="list-style-type: none"> non-delayed delayed switching 	0	
	0	
	1	
	1	

3.7 3TK28 safety relays with solid-state enabling circuits

	3TK2842-1B...	3TK2842-2B...
Stop category according to DIN EN 60204-1	0 + 1	
Design of the input		
• cascading-input/functional switching	Yes	
• feedback input	Yes	
• start input	Yes	
Design of the electrical connection jumper socket	Yes	
Switching capacity current of semiconductor outputs for enabling circuit for DC-13 at 24 V	A	1.5
Type of voltage of the controlled supply voltage	DC	
Control supply voltage 1 for DC final rated value		
• for DC rated value	V	24
Operating range factor control supply voltage rated value of the magnet coil for DC	0.9 1.15	

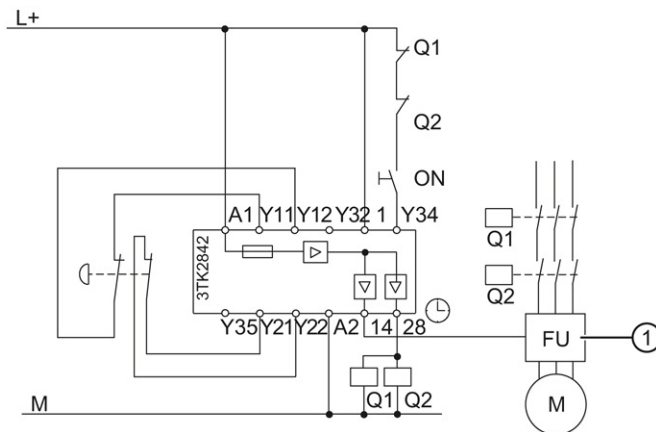
	3TK2842-1B...	3TK2842-2B...
Product function		
• automatic start	Yes	
• rotation speed monitoring	No	
• laser scanner monitoring	Yes	
• light grid monitoring	Yes	
• light barrier monitoring	Yes	
• magnetic switch monitoring Normally closed contact-Normally open contact	No	
• magnetic switch monitoring Normally closed contact-Normally closed contact	Yes	
• emergency stop function	Yes	
• protective door monitoring	Yes	
• standstill monitoring	No	
• step mat monitoring	Yes	
• monitored start-up	Yes	
Acceptability for application		
• safety-related circuits	Yes	
• safety cut-out switch	Yes	
• magnetically operated switches monitoring	Yes	
• EMERGENCY-OFF circuit monitoring	Yes	
• proximity switches monitoring	No	
• opto-electronical protection device monitoring	Yes	
• position switch monitoring	Yes	
• tactile sensor monitoring	Yes	
• valve monitoring	No	

3.7.3.8 Connection examples 3TK2842



① Converter

Figure 3-58 Protective door monitoring, autostart (2-channel)



① Converter

Figure 3-59 EMERGENCY STOP, monitored start (2-channel)

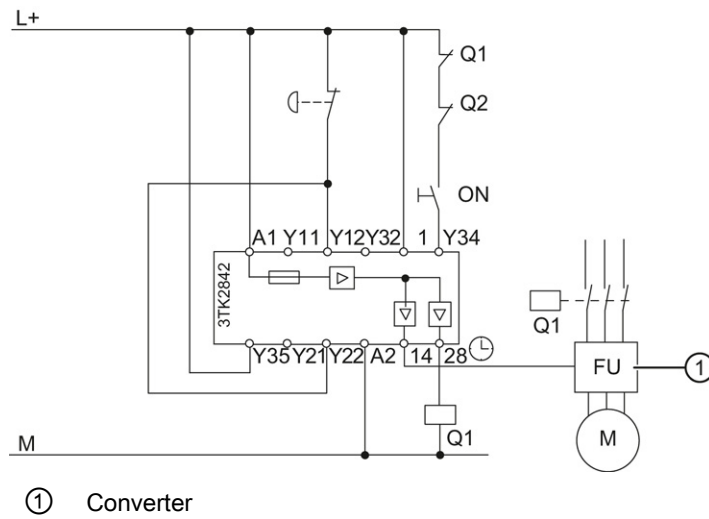


Figure 3-60 EMERGENCY STOP, monitored start (1-channel)

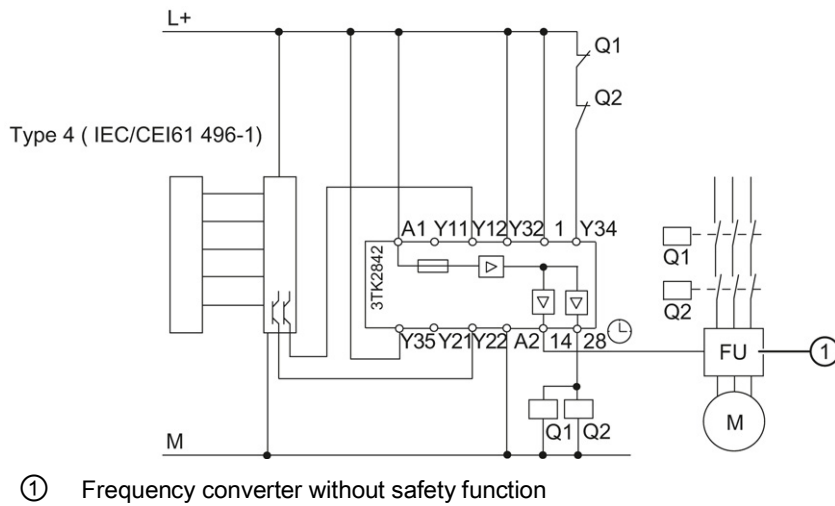


Figure 3-61 Light array monitoring, (2-channel) without cross-circuit detection

3.7 3TK28 safety relays with solid-state enabling circuits

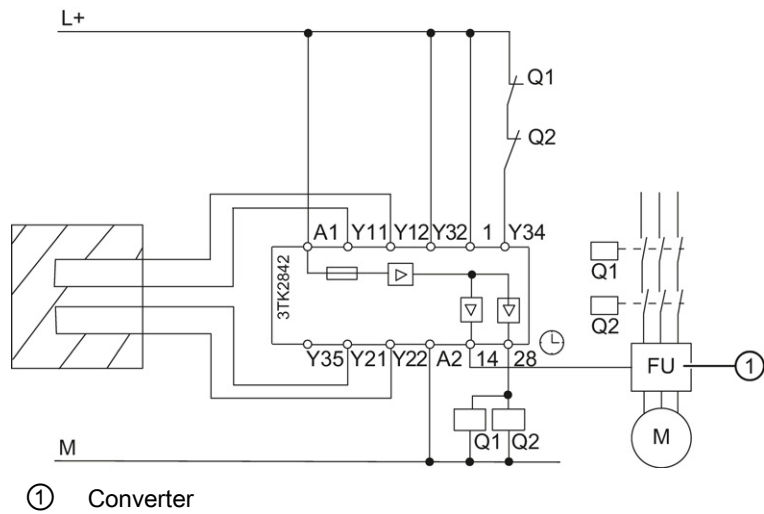


Figure 3-62 Safety shutdown mat, autostart (2-channel)

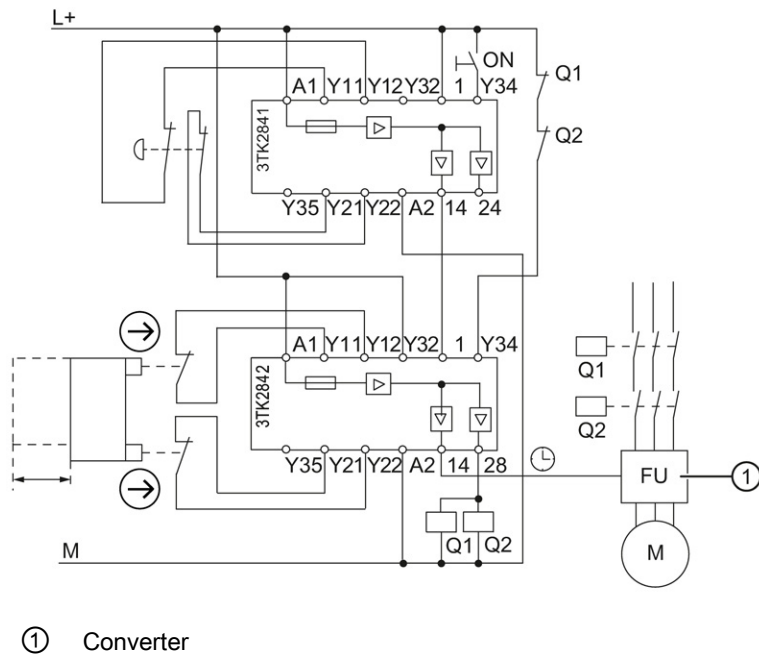


Figure 3-63 Cascading, EMERGENCY STOP + protective door monitoring, (2-channel)

3.8 3TK28 safety relays with contactor relay enabling circuits

3.8.1 3TK2805 / 3TK2806 safety relays

3.8.1.1 Applications

The 3TK2805 / 3TK2806 contactor safety combinations are used in EMERGENCY STOP circuits and in circuits for monitoring protective equipment, such as safety guards.

3.8.1.2 Description of function and connection information

Internal control of the contactor safety combination is implemented according to DIN EN / IEC 60204-1, paragraph 9.4.2.2 so that the function of the safety circuit is retained in case of a fault in the contactor relay. The supply voltage must meet the requirements of DIN EN / IEC 60204-1. (Terminal "A2" must be connected to the side of the control circuit that is connected to the protective circuit.) On each ON and OFF cycle of the machine to be switched, the contacts of the contactor relays are checked for correct opening and closure. This is achieved, for example, by:

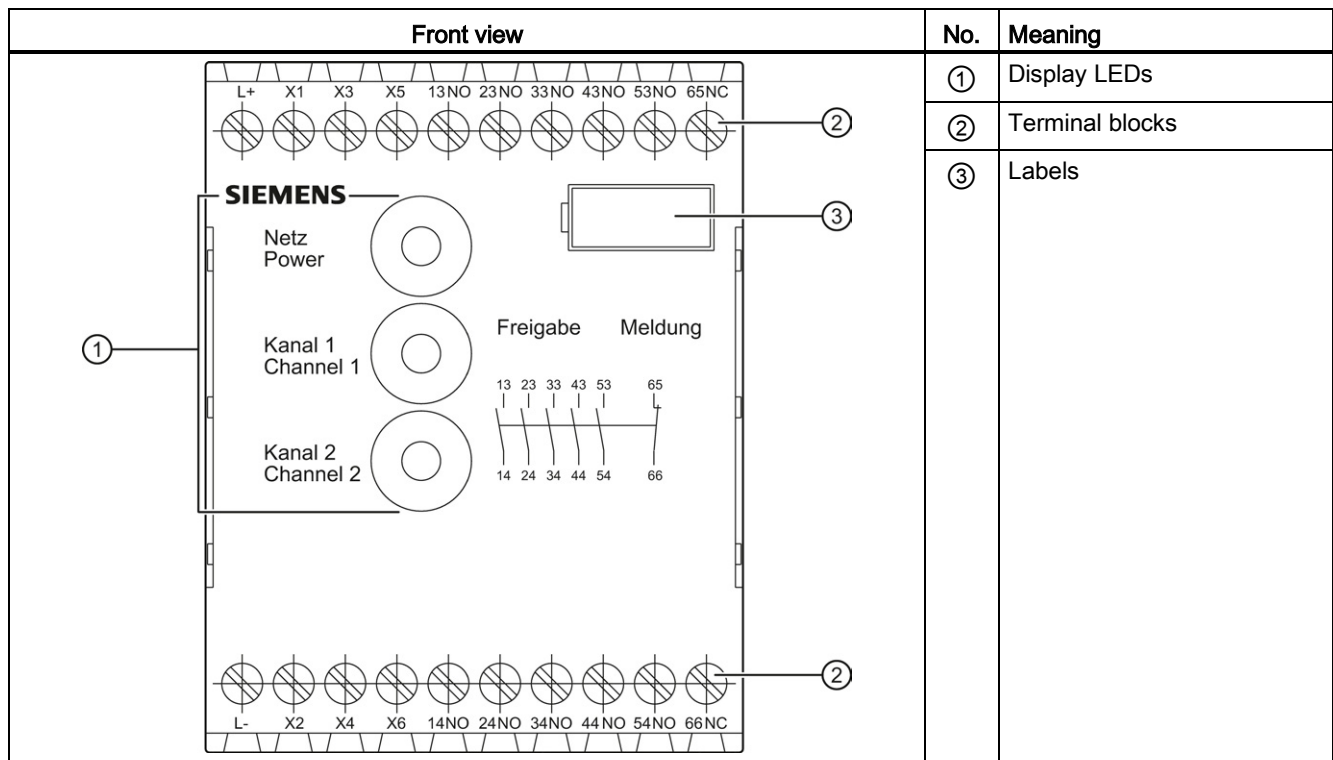
- Disconnecting and reconnecting the control voltage at the main switch
- Operating and releasing the EMERGENCY STOP device
- Opening and closing the safety guard.

Note

1-channel sensor connection

A 1-channel control of the contactor safety combination can be implemented by connecting terminal X6 directly to "A2" and connecting the EMERGENCY STOP device between terminal X1 and the connected terminals X3; X5.

3.8.1.3 Structure 3TK2805/06



3.8.1.4 Terminal assignment

Terminal	Description
A1	L/+
A2	N/-
X1 ... X6	Control connections
13 - 14 23 - 24 33 - 34 43 - 44 53 - 54	Enabling circuits (NO)
65 - 66	Signaling circuits / feedback circuit

3.8.1.5 Display of the operating states

Operating states of 3TK2805/06

"POWER" indicates that the device is energized.

"CHANNEL 1" and "CHANNEL 2" light up if the ON button has been operated and the contacts of the EMERGENCY STOP button or the position switch are closed.

3.8.1.6 State diagrams 3TK2805 / 3TK2806

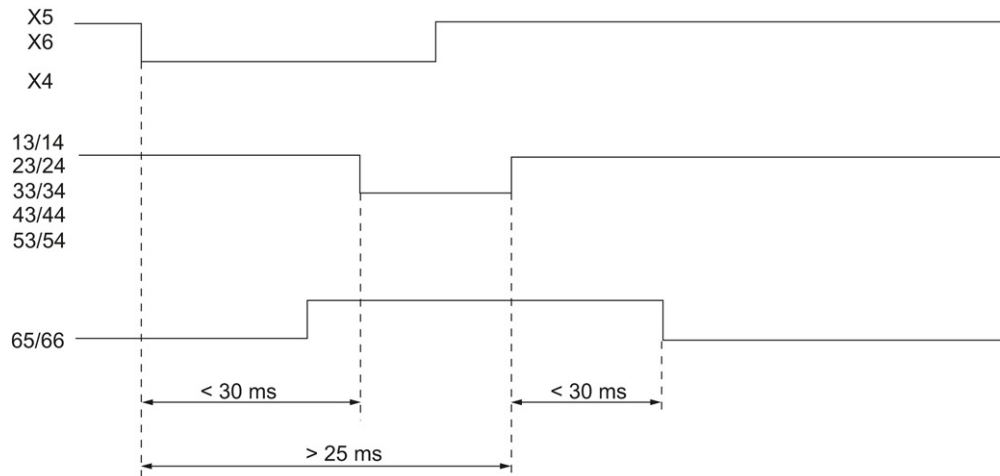


Figure 3-64 Automatic start

3.8.1.7 Technical specifications 3TK2805/ 3TK2806

Ambient temperature • during storage • during operation	°C	-55 ... +80 -25 ... +55
HFT		1
Classification		Type A
Rated control supply voltage		24 V AC/DC; 110 V AC; 230 V AC
Rated insulation voltage • for control circuit	V	U _i = 400 U _i = 250
Rated impulse withstand voltage • for control circuit	kV	U _{imp} = 4 U _{imp} = 1.5
Short-circuit protection		Fuse-links LV HBC, NEOZED, and DIAZED
No-weld fuse protection at • for enabling circuit • and signaling circuit		IK ≥ 1 kA Operational class gL(gG) 6 A / fast 10 A Operational class gL(gG) 6 A / fast 6 A

Utilization category acc. to VDE0660-200, DIN EN / IEC 60947-5-1	Rated operational voltage U _e [V]	Rated operational current I _e [A] if all enabling circuits are loaded	
		50 °C	55 °C
AC-1 / AC-12		6	6
AC-15	24	4	4
	230	4	3
	400	3	3
DC-13	24	6	6
	230	0,5	0,5
		Rated power	
AC-3	230	0.55 kW	0.55 kW
	400	1.1 kW	1.1 kW
Continuous current I _{th} Breaking capacity at cosφ = 0.7 ... 1 ohmic	230 V AC 24 V DC	10	8
		10	8
		Σ max 30	Σ max 24

In case of fault, outputs 13/14, 23/24, 33/34, 43/44, and 53/54 switch off. Signaling contact 65/66 switches on.

You can obtain further technical data of the 3TK2805/06 safety relays on request from:
Technical Assistance (<http://www.siemens.com/industrial-controls/technical-assistance>)

3.8.1.8 Connection examples 3TK2805/ 3TK2806

Connection examples 3TK2805

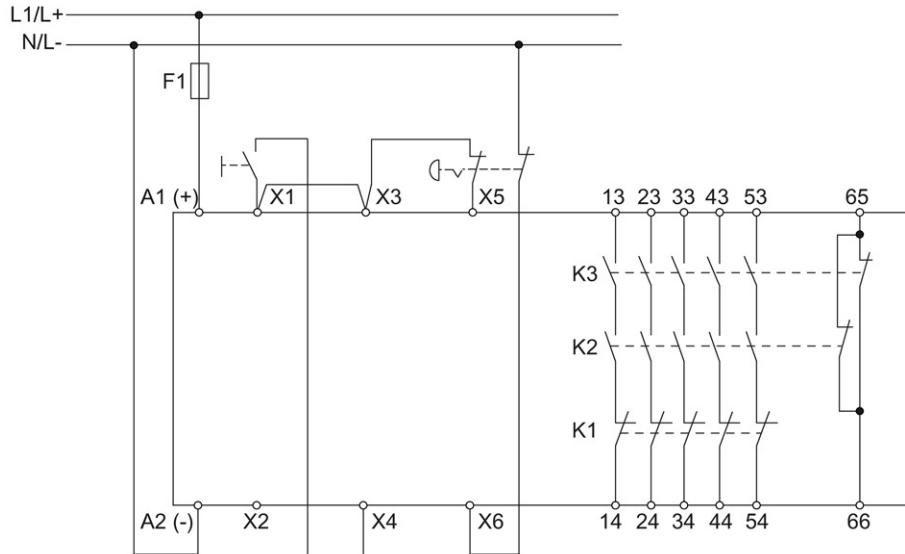


Figure 3-65 Monitored start; EMERGENCY STOP (2-channel)

Connection examples 3TK2806

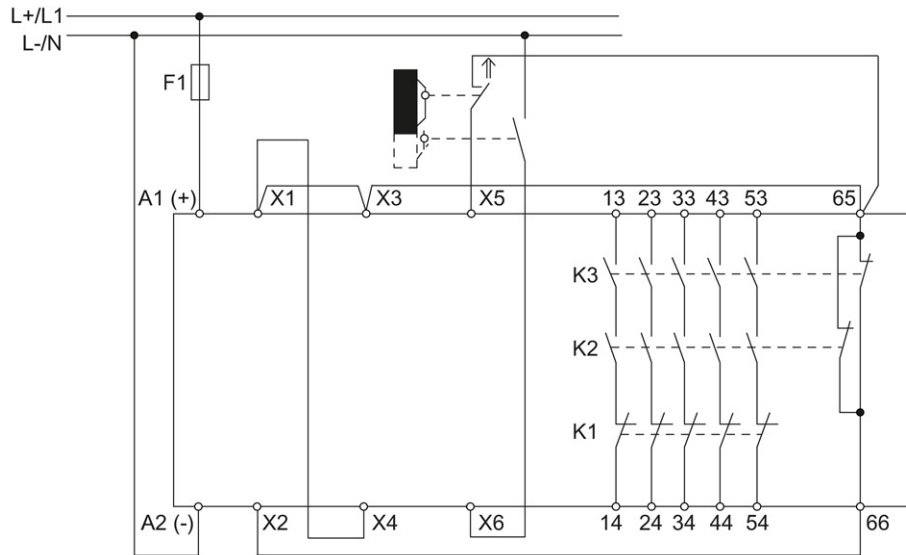


Figure 3-66 Autostart; protective door (2-channel)

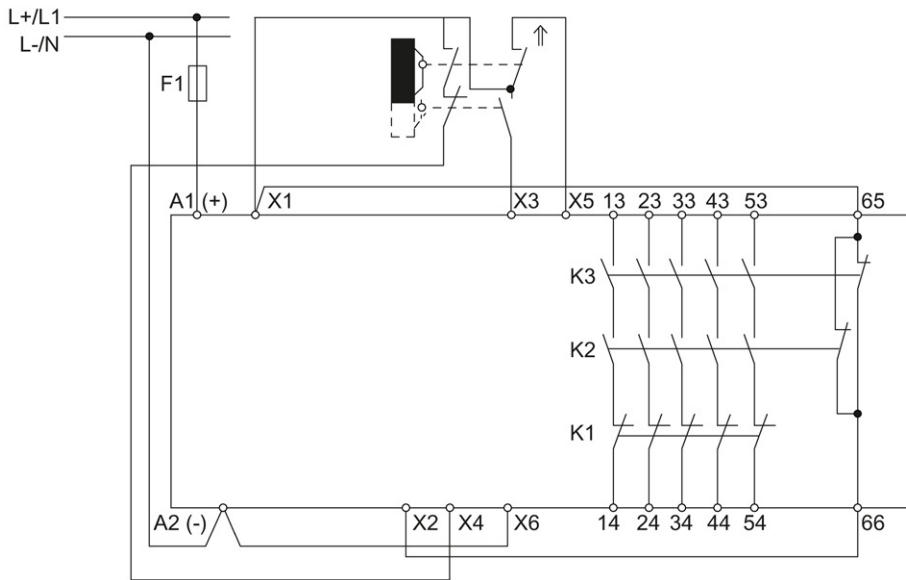


Figure 3-67 Autostart; protective door (1-channel)

3.8.2 3TK2850 / 3TK2851 / 3TK2852 safety relay

3.8.2.1 Applications

Applications of the 3TK285 safety combination

You can use the 3TK285 safety combination in EMERGENCY STOP devices according to DIN EN / IEC 60947-5-5 and in safety circuits according to DIN EN / IEC 60204-1, e.g. for movable guards and protective doors. Depending on the external circuitry, a maximum performance level PL_d / Cat. 3 in accordance with DIN EN ISO 13849-1 or SILCL 2 in accordance with IEC 62061 can be achieved with this device.

3.8.2.2 Description of function and connection information

The solid-state 3TK285 safety combination has two contactor relays. The operating state and functioning are indicated by three LEDs.

All internal parts of the circuit are cyclically monitored for faults during operation.

Connect the EMERGENCY STOP button or the position switch to terminals Y11, Y12, and Y21, Y22.

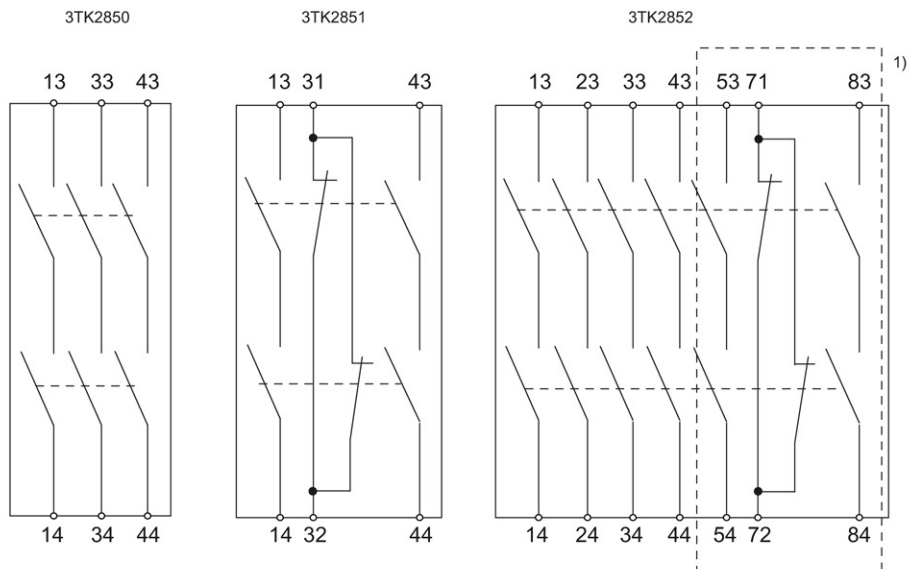
The ON button is connected to Y34 and L+ (24 DC). Terminals Y33, Y34 are jumpered during autostart operation. Y20 and Y21 are jumpered during 1-channel operation.

3.8.2.3 Structure 3TK285

Front view	No.	Meaning
	①	Removable terminal block
	②	Display LEDs
	③	Terminal blocks
	④	Labels

3.8.2.4 Terminal assignment

Terminal	Description
A1	L/+
A2	N/-
Y11; Y12	Channel 1, EMERGENCY STOP or position switch
Y21; Y22	Channel 2, EMERGENCY STOP or position switch
Y20	Parameterization "single-channel sensor connection"
Y33; Y34	ON button feedback circuit
13 - 14	Contact units (see contact units graphic)



1) Auxiliary contact units

Figure 3-68 Contact units

3.8.2.5 Display of the operating state

The operating state and functioning of the device are indicated by three LEDs:

- POWER
- RUN
- FAULT

Operating state of 3TK285

● = off

☼ = on

LED			Operation			
POWER	RUN	FAULT	EMERGENCY STOP	ON	Outputs	Cause
☼	☼	●	Not pressed	Pressed	On	Normal operation
☼	●	☼	Pressed	No function	Off	EMERGENCY STOP (protective door) pressed
☼	●	●	Not pressed	Not pressed		Contactors opened; press ON button to start
			Fault			
☼	●	☼	<ul style="list-style-type: none"> • Fault in electronics • Change of pin assignment during operation • Short-circuit to 24 V 		Off	EMERGENCY STOP (protective door) not pressed ⇒ device errors
●	●	●	No supply voltage			

3.8.2.6 State diagrams 3TK2850 / 3TK2851 / 3TK2852

2) For contact units, see Chapter: Terminal assignment (Page 154)

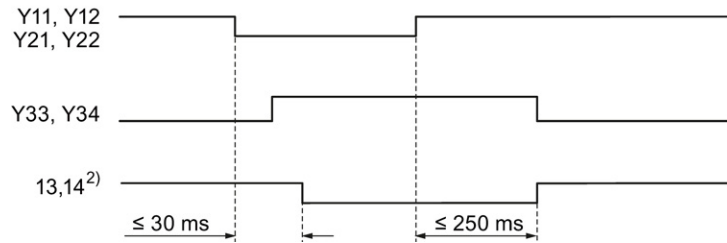


Figure 3-69 State diagram 3TK2850 / 3TK2851 / 3TK2852 autostart

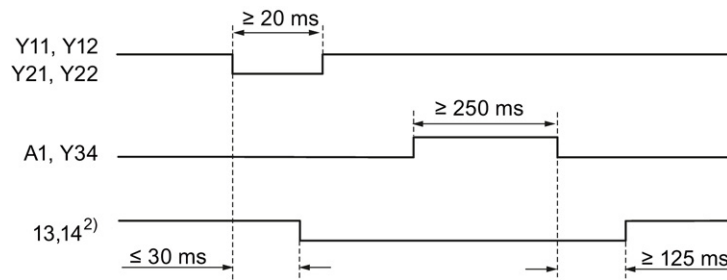


Figure 3-70 State diagram 3TK2850 / 3TK2851 / 3TK2852 monitored start

3.8.2.7 Technical data 3TK2850 / 3TK2851 / 3TK2852

Technical data 3TK2850

	3TK2850-.A...	3TK2850-.B...
EMC emitted interference	IEC 60947-5-1, IEC 60000-4-3, IEC 60000-4-5, IEC 60000-4-6	
Item designation	KT	
<ul style="list-style-type: none"> according to DIN 40719 extendable after IEC 204-2 according to IEC 750 	KT	
<ul style="list-style-type: none"> according to DIN EN 61346-2 	F	
Number of sensor inputs 1-channel or 2-channel	1	
Design of the cascading	none	
Type of the safety-related wiring of the inputs	single-channel and two-channel	
Product feature transverse contact-secure	Yes	
Safety Integrity Level (SIL) according to IEC 61508	SIL2	
SIL claim limit (for a subsystem) according to EN 62061	2	
Safety integrity level (SIL) for delayed release circuit according to IEC 61508	—	
Performance Level (PL)	d	
<ul style="list-style-type: none"> according to ISO 13849-1 	d	
<ul style="list-style-type: none"> for delayed release circuit according to ISO 13849-1 	—	
Category	3	
<ul style="list-style-type: none"> according to EN 954-1 	3	
<ul style="list-style-type: none"> according to ISO 13849-1 	3	
Safety device type according to IEC 61508-2	Type B	
Probability of dangerous failure per hour (PFHD) with high demand rate according to EN 62061	1/h	1.2 ⁻⁸
T1 value for proof test interval or service life according to IEC 61508	a	20

	3TK2850-A...	3TK2850-B...
Number of outputs as contact-affected switching element as NO contact safety-related		
• as NC contact for reporting function instantaneous switching	0	
• as NO contact safety-related instantaneous switching	3	
• as NO contact safety-related delayed switching	0	
Stop category according to DIN EN 60204-1	0	
Design of the input		
• cascading-input/functional switching	No	
• feedback input	Yes	
• start input	Yes	
Design of the electrical connection jumper socket	Yes	
Switching capacity current		
• at AC-15 at 24 V	A —	
• of the NO contacts of the relay outputs		
– at AC-15 at 230 V	A 6	
– at DC-13 at 24 V	A 10	
• of the NC contacts of the relay outputs at AC-15		
– at 115 V	A 6	
– at 230 V	A 6	
Thermal current of the contact-affected switching element maximum	A —	
Electrical operating cycles as operating time typical	—	
Mechanical operating cycles as operating time typical	30 000 000	
Design of the fuse link for short-circuit protection of the NO contacts of the relay outputs required	gL/gG: 10 A	

		3TK2850-A...	3TK2850-B...
Type of voltage of the controlled supply voltage		AC	DC
Control supply voltage frequency 1 rated value	Hz	50	—
Control supply voltage frequency 2 rated value	Hz	60	—
Control supply voltage 1 for DC final rated value			
• for DC rated value	V	—	24
Operating range factor control supply voltage rated value of the magnet coil			
• at 50 Hz			
– for AC		0.9 1.15	— —
• at 60 Hz			
– for AC		0.9 1.15	— —
• for DC		— —	0.85 1.1

	3TK2850-A...	3TK2850-B...
Product function		
• automatic start	Yes	
• rotation speed monitoring	No	
• laser scanner monitoring	No	
• light grid monitoring	No	
• light barrier monitoring	No	
• magnetic switch monitoring Normally closed contact-Normally open contact	No	
• magnetic switch monitoring Normally closed contact-Normally closed contact	Yes	
• emergency stop function	Yes	
• protective door monitoring	Yes	
• standstill monitoring	No	
• step mat monitoring	No	
• monitored start-up	Yes	
Acceptability for application		
• safety-related circuits	Yes	
• safety cut-out switch	Yes	
• magnetically operated switches monitoring	No	
• EMERGENCY-OFF circuit monitoring	Yes	
• proximity switches monitoring	No	
• opto-electronical protection device monitoring	No	
• position switch monitoring	Yes	
• tactile sensor monitoring	No	
• valve monitoring	No	

Technical data 3TK2851

	3TK2851-A...	3TK2851-B...
EMC emitted interference	IEC 60947-5-1, IEC 60000-4-3, IEC 60000-4-5, IEC 60000-4-6	
Item designation	KT	
<ul style="list-style-type: none"> according to DIN 40719 extendable after IEC 204-2 according to IEC 750 	KT	
<ul style="list-style-type: none"> according to DIN EN 61346-2 	F	
Number of sensor inputs 1-channel or 2-channel	1	
Design of the cascading	none	
Type of the safety-related wiring of the inputs	single-channel and two-channel	
Product feature transverse contact-secure	Yes	
Safety Integrity Level (SIL) according to IEC 61508	SIL2	
SIL claim limit (for a subsystem) according to EN 62061	2	
Safety integrity level (SIL) for delayed release circuit according to IEC 61508	—	
Performance Level (PL)	d	
<ul style="list-style-type: none"> according to ISO 13849-1 	d	
<ul style="list-style-type: none"> for delayed release circuit according to ISO 13849-1 	—	
Category	3	
<ul style="list-style-type: none"> according to EN 954-1 	3	
<ul style="list-style-type: none"> according to ISO 13849-1 	3	
Safety device type according to IEC 61508-2	Type B	
Probability of dangerous failure per hour 1/h (PFHD) with high demand rate according to EN 62061	1.1 ⁻⁸	
T1 value for proof test interval or service life according to IEC 61508	a	20
Number of outputs as contact-affected switching element as NC contact for reporting function instantaneous switching	1	
Number of outputs as contact-affected switching element as NO contact safety-related instantaneous switching	2	
Number of outputs as contact-affected switching element as NO contact safety-related delayed switching	0	

3.8 3TK28 safety relays with contactor relay enabling circuits

		3TK2851-A...	3TK2851-B...
Stop category according to DIN EN 60204-1		0	
Design of the input			
• cascading-input/functional switching		No	
• feedback input		Yes	
• start input		Yes	
Design of the electrical connection jumper socket		Yes	
Switching capacity current			
• at AC-15 at 24 V	A	—	
• of the NO contacts of the relay outputs			
– at AC-15 at 230 V	A	6	
– at DC-13 at 24 V	A	10	
• of the NC contacts of the relay outputs at AC-15			
– at 115 V	A	6	
– at 230 V	A	6	
Thermal current of the contact-affected switching element maximum	A	—	
Electrical operating cycles as operating time typical		—	
Mechanical operating cycles as operating time typical		30 000 000	
Design of the fuse link for short-circuit protection of the NO contacts of the relay outputs required		gL/gG: 10 A	
Type of voltage of the controlled supply voltage		AC	DC
Control supply voltage frequency 1 rated value	Hz	50	—
Control supply voltage frequency 2 rated value	Hz	60	—
Control supply voltage 1 for DC final rated value			
• for DC rated value	V	—	24

	3TK2851-A...	3TK2851-B...
Operating range factor control supply voltage rated value of the magnet coil		
<ul style="list-style-type: none"> • at 50 Hz <ul style="list-style-type: none"> – for AC 	0.9 1.15	— —
<ul style="list-style-type: none"> • at 60 Hz <ul style="list-style-type: none"> – for AC 	0.9 1.15	— —
<ul style="list-style-type: none"> • for DC 	— —	0.85 1.1
Product function		
<ul style="list-style-type: none"> • automatic start 	Yes	
<ul style="list-style-type: none"> • rotation speed monitoring 	No	
<ul style="list-style-type: none"> • laser scanner monitoring 	No	
<ul style="list-style-type: none"> • light grid monitoring 	No	
<ul style="list-style-type: none"> • light barrier monitoring 	No	
<ul style="list-style-type: none"> • magnetic switch monitoring Normally closed contact-Normally open contact 	No	
<ul style="list-style-type: none"> • magnetic switch monitoring Normally closed contact-Normally closed contact 	Yes	
<ul style="list-style-type: none"> • emergency stop function 	Yes	
<ul style="list-style-type: none"> • protective door monitoring 	Yes	
<ul style="list-style-type: none"> • standstill monitoring 	No	
<ul style="list-style-type: none"> • step mat monitoring 	No	
<ul style="list-style-type: none"> • monitored start-up 	Yes	
Acceptability for application		
<ul style="list-style-type: none"> • safety-related circuits 	Yes	
<ul style="list-style-type: none"> • safety cut-out switch 	Yes	
<ul style="list-style-type: none"> • magnetically operated switches monitoring 	No	
<ul style="list-style-type: none"> • EMERGENCY-OFF circuit monitoring 	Yes	
<ul style="list-style-type: none"> • proximity switches monitoring 	No	
<ul style="list-style-type: none"> • opto-electronical protection device monitoring 	No	
<ul style="list-style-type: none"> • position switch monitoring 	Yes	
<ul style="list-style-type: none"> • tactile sensor monitoring 	No	
<ul style="list-style-type: none"> • valve monitoring 	No	

Technical data 3TK2852

	3TK2852-A...	3TK2852-B...
EMC emitted interference	IEC 60947-5-1, IEC 60000-4-3, IEC 60000-4-5, IEC 60000-4-6	
Item designation	KT	
<ul style="list-style-type: none"> according to DIN 40719 extendable after IEC 204-2 according to IEC 750 	KT	
<ul style="list-style-type: none"> according to DIN EN 61346-2 	F	
Number of sensor inputs 1-channel or 2-channel	1	
Design of the cascading	none	
Type of the safety-related wiring of the inputs	single-channel and two-channel	
Product feature transverse contact-secure	Yes	
Safety Integrity Level (SIL) according to IEC 61508	SIL2	
SIL claim limit (for a subsystem) according to EN 62061	2	
Safety integrity level (SIL) for delayed release circuit according to IEC 61508	—	
Performance Level (PL)	d	
<ul style="list-style-type: none"> according to ISO 13849-1 	d	
<ul style="list-style-type: none"> for delayed release circuit according to ISO 13849-1 	—	
Category	3	
<ul style="list-style-type: none"> according to EN 954-1 	3	
<ul style="list-style-type: none"> according to ISO 13849-1 	3	
Safety device type according to IEC 61508-2	Type B	
Probability of dangerous failure per hour (PFHD) with high demand rate according to EN 62061	1.1 ⁻⁸	
T1 value for proof test interval or service life according to IEC 61508	a	20
Number of outputs as contact-affected switching element as NO contact safety-related	1	
<ul style="list-style-type: none"> as NC contact for reporting function instantaneous switching 	1	
<ul style="list-style-type: none"> as NO contact safety-related instantaneous switching 	6	
<ul style="list-style-type: none"> as NO contact safety-related delayed switching 	0	

	3TK2852-A...	3TK2852-B...
Stop category according to DIN EN 60204-1	0	
Design of the input		
• cascading-input/functional switching	No	
• feedback input	Yes	
• start input	Yes	
Design of the electrical connection jumper socket	Yes	
Switching capacity current		
• at AC-15 at 24 V	A	—
• of the NO contacts of the relay outputs		
– at AC-15 at 230 V	A	6
– at DC-13 at 24 V	A	10
• of the NC contacts of the relay outputs at AC-15		
– at 115 V	A	6
– at 230 V	A	6
Thermal current of the contact-affected switching element maximum	A	—
Electrical operating cycles as operating time typical	—	
Mechanical operating cycles as operating time typical	30 000 000	
Design of the fuse link for short-circuit protection of the NO contacts of the relay outputs required	gL/gG: 10 A	

3.8 3TK28 safety relays with contactor relay enabling circuits

		3TK2852-A...	3TK2852-B...
Type of voltage of the controlled supply voltage		AC	DC
Control supply voltage frequency 1 rated value	Hz	50	—
Control supply voltage frequency 2 rated value	Hz	60	—
Control supply voltage 1 for DC final rated value			
• for DC rated value	V	—	24
Operating range factor control supply voltage rated value of the magnet coil			
• at 50 Hz			
– for AC		0.9 1.15	— —
• at 60 Hz			
– for AC		0.9 1.15	— —
• for DC		— —	0.85 1.1

	3TK2852-A...	3TK2852-B...
Product function		
• automatic start	Yes	
• rotation speed monitoring	No	
• laser scanner monitoring	No	
• light grid monitoring	No	
• light barrier monitoring	No	
• magnetic switch monitoring Normally closed contact-Normally open contact	No	
• magnetic switch monitoring Normally closed contact-Normally closed contact	Yes	
• emergency stop function	Yes	
• protective door monitoring	Yes	
• standstill monitoring	No	
• step mat monitoring	No	
• monitored start-up	Yes	
Acceptability for application		
• safety-related circuits	Yes	
• safety cut-out switch	Yes	
• magnetically operated switches monitoring	No	
• EMERGENCY-OFF circuit monitoring	Yes	
• proximity switches monitoring	No	
• opto-electronical protection device monitoring	No	
• position switch monitoring	Yes	
• tactile sensor monitoring	No	
• valve monitoring	No	

3.8.2.8 Connection examples 3TK2850 / 3TK2851 / 3TK2852

2) For contact units, see Chapter: Terminal assignment (Page 154)

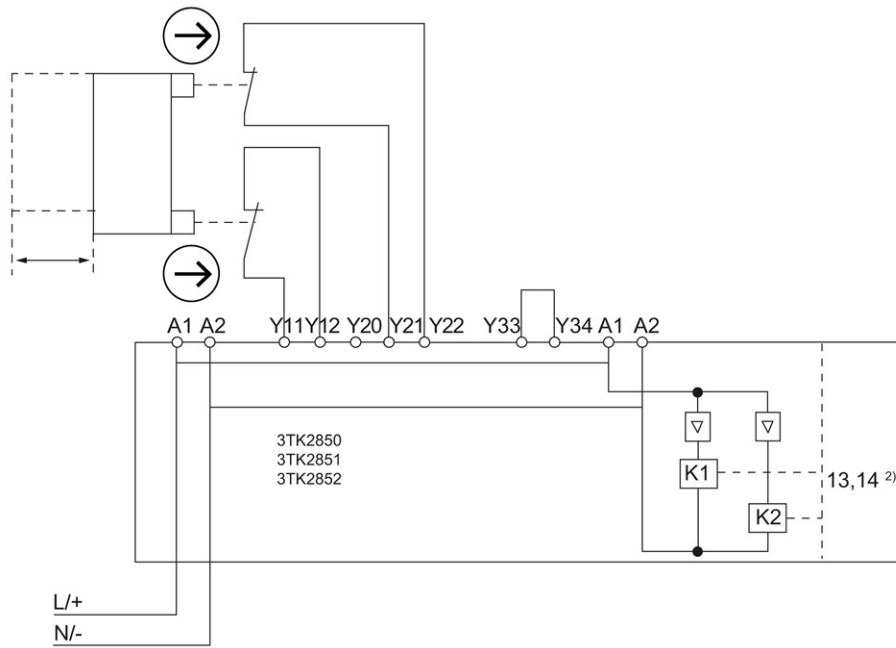


Figure 3-71 Autostart (2-channel)

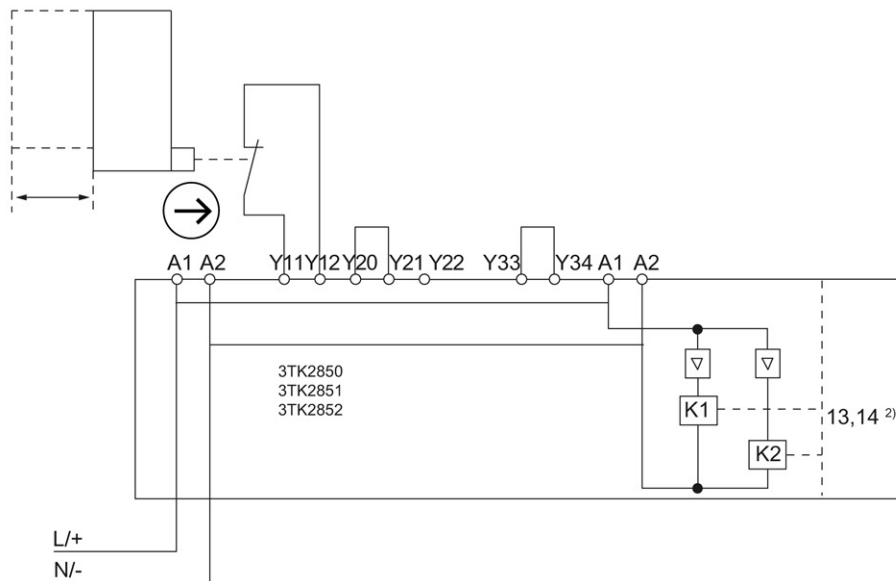


Figure 3-72 Autostart (1-channel)

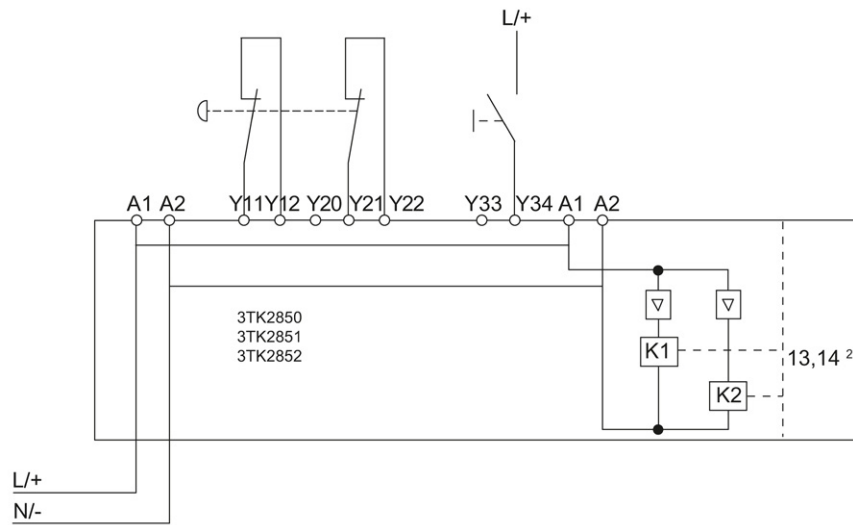


Figure 3-73 Monitored start (2-channel)

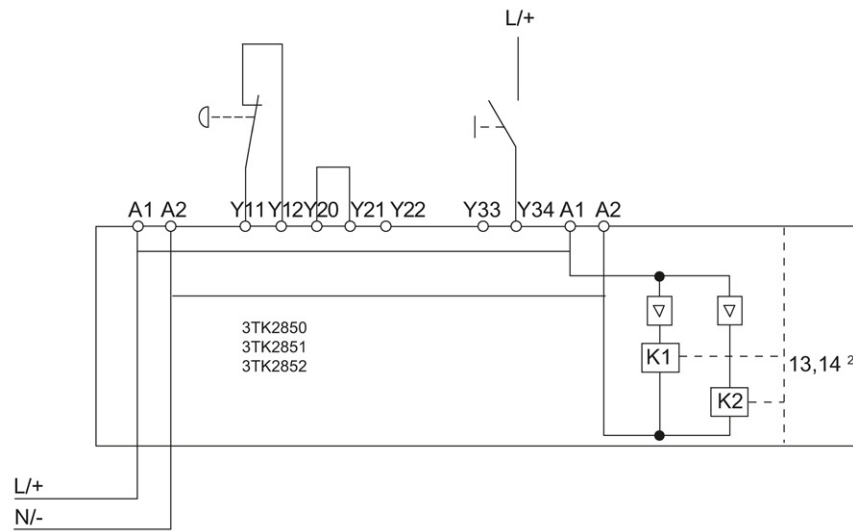


Figure 3-74 Monitored start (1-channel)

3.8.3 3TK2853 safety relay

3.8.3.1 Applications

Applications of the 3TK2853 safety combination

You can use the 3TK2853 safety combination in EMERGENCY STOP devices according to DIN EN / IEC 60947-5-5 and in safety circuits according to DIN EN / IEC 60204-1, e.g. for movable guards and protective doors and contactless protective equipment. Depending on the external circuitry, a maximum performance level PL_e / Cat. 4 in accordance with DIN EN ISO 13849-1 or SILCL 3 in accordance with IEC 62061 can be achieved.

3.8.3.2 Description of function and connection information

The 3TK2853 solid-state safety combination has two contactor relays as switching elements, one safe solid-state output, one safe input for cascading and one input for functional switching.

The operating state and functioning are indicated by three LEDs.

On startup, the device runs a self-test in which the internal electronics are checked for correct functioning.

All internal parts of the circuit are cyclically monitored for faults during operation.

With safe output 2, expansion units, such as 3TK2830/56/57 and external actuators or loads, can be switched. Also, cascading with units 3TK2841/42/45/53 is possible via safe output 2. In the case of $PL_{d/e}$ or SILCL 2/3, single-channel cascading is only possible within one cabinet.

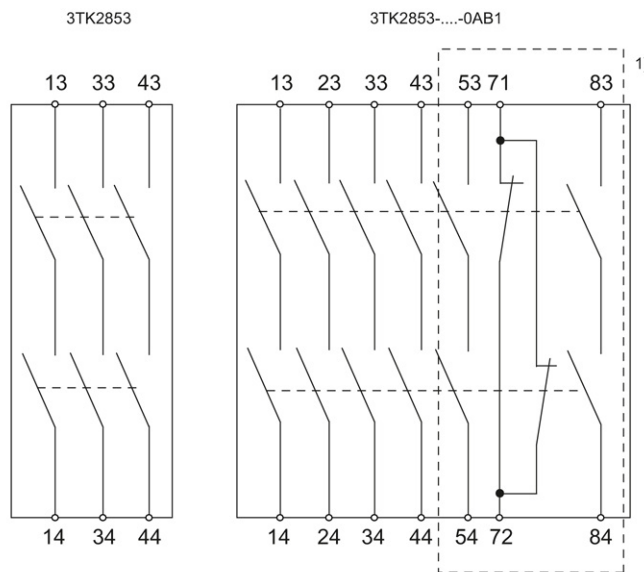
Make sure that the actuator/load and the 3TK2853 safety combination have the same ground potential.

3.8.3.3 Structure 3TK2853

Front view	No.	Meaning
	①	Removable terminal block
	②	Display LEDs
	③	Terminal blocks
	④	Labels

3.8.3.4 Terminal assignment

Terminal	Description
A1	L/+
A2	N/-
Y11; Y12	Channel 1, EMERGENCY STOP or position switch
Y21; Y22	Channel 2, EMERGENCY STOP or position switch
Y35	with / without cross-circuit detection
Y32	Parameterization "single-channel sensor connection"
Y33; Y34	ON button, feedback circuit
1	Cascade input
2	Safe solid-state output (24V DC / 1A)
3	Power supply for external switches
4	Input for functional switching
13, 14	Contact units



1) Auxiliary contact units




Figure 3-75 Contact units
















3.8.3.5 Display of the operating state

The operating state and functioning of the device are indicated by three LEDs:

- POWER
- RUN
- FAULT

Operating states of 3TK2853

-  = off
-  = on
-  = flashing

LED			Operation			
POWER	RUN	FAULT	EMERGENCY STOP	ON	Outputs	Cause
			Not pressed	Pressed	On	Normal operation
			Pressed	no function	Off	EMERGENCY STOP (protective door) pressed
			Not pressed	Not pressed		Contactors opened; press ON button to start
			Fault			
			<ul style="list-style-type: none"> • Fault in electronics • Change of pin assignment during operation • Short-circuit to 24 V 		Off	-
			No supply voltage			

3.8.3.6 State diagrams 3TK2853

2) For contact units, see Chapter: Terminal assignment (Page 172)

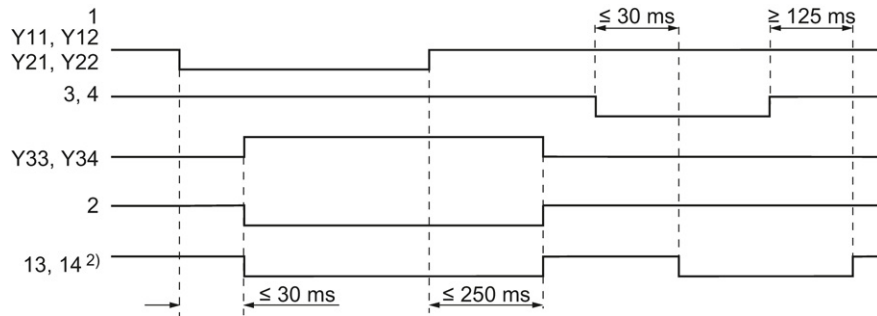


Figure 3-76 State diagram 3TK2853 autostart

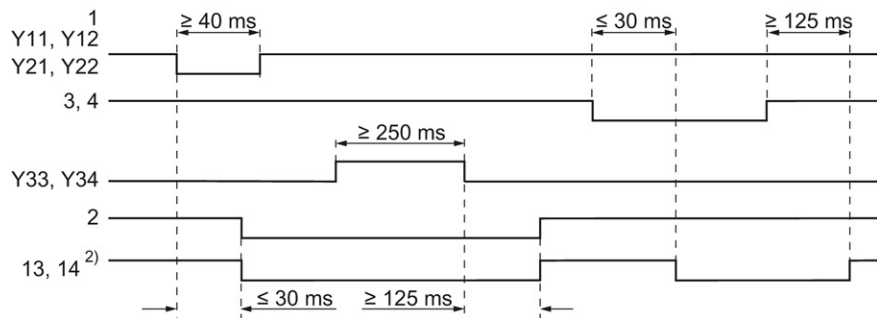


Figure 3-77 State diagram 3TK2853 monitored start

3.8.3.7 Technical data 3TK2853

	3TK2853-2B...	3TK2853-1B...
EMC emitted interference	IEC 60947-5-1, IEC 60000-4-3, IEC 60000-4-5, IEC 60000-4-6	
Item designation	KT	
<ul style="list-style-type: none"> according to DIN 40719 extendable after IEC 204-2 according to IEC 750 	KT	
<ul style="list-style-type: none"> according to DIN EN 61346-2 	F	
Number of sensor inputs 1-channel or 2-channel	1	
Design of the cascading	cascading and in-service switching	
Type of the safety-related wiring of the inputs	single-channel and two-channel	
Product feature transverse contact-secure	Yes	
Safety Integrity Level (SIL) according to IEC 61508	SIL3	
SIL claim limit (for a subsystem) according to EN 62061	3	
Safety integrity level (SIL) for delayed release circuit according to IEC 61508	—	
Performance Level (PL)	e	
<ul style="list-style-type: none"> according to ISO 13849-1 	e	
<ul style="list-style-type: none"> for delayed release circuit according to ISO 13849-1 	—	
Category	4	
<ul style="list-style-type: none"> according to EN 954-1 	4	
<ul style="list-style-type: none"> according to ISO 13849-1 	4	
Safety device type according to IEC 61508-2	Type B	
Probability of dangerous failure per hour (PFHD) with high demand rate according to EN 62061	1/h	1.1 ⁻⁸
T1 value for proof test interval or service life according to IEC 61508	a	20

	3TK2853-2B...	3TK2853-1B...
Number of outputs as contact-affected switching element as NO contact safety-related		
• as contact-affected switching element as NC contact for reporting function instantaneous switching	0	
• as contact-affected switching element as NO contact safety-related instantaneous switching	3	
• as contact-affected switching element as NO contact safety-related delayed switching	0	
• as contact-less semiconductor switching element		
– for reporting function		
– non-delayed	0	
– delayed switching	0	
– safety-related		
– non-delayed	1	
– delayed switching	0	
Stop category according to DIN EN 60204-1	0	
Design of the input		
• cascading-input/functional switching	Yes	
• feedback input	Yes	
• start input	Yes	
Design of the electrical connection jumper socket	Yes	
Switching capacity current		
• at AC-15 at 24 V	A	—
• of the NO contacts of the relay outputs		
– at AC-15 at 230 V	A	6
– at DC-13 at 24 V	A	10
• of the NC contacts of the relay outputs at AC-15		
– at 115 V	A	6
– at 230 V	A	6

		3TK2853-2B...	3TK2853-1B...
Thermal current of the contact-affected switching element maximum	A	—	
Electrical operating cycles as operating time typical		—	
Mechanical operating cycles as operating time typical		30 000 000	
Design of the fuse link for short-circuit protection of the NO contacts of the relay outputs required		gL/gG: 10 A	
Type of voltage of the controlled supply voltage		DC	
Control supply voltage frequency 1 rated value	Hz	—	
Control supply voltage frequency 2 rated value	Hz	—	
Control supply voltage 1 for DC final rated value			
• for DC rated value	V	24	
Operating range factor control supply voltage rated value of the magnet coil			
• at 50 Hz			
– for AC		—	
		—	
• at 60 Hz			
– for AC		—	
		—	
• for DC		0.85	
		1.1	

	3TK2853-2B...	3TK2853-1B...
Product function		
• automatic start	Yes	
• rotation speed monitoring	No	
• laser scanner monitoring	Yes	
• light grid monitoring	Yes	
• light barrier monitoring	Yes	
• magnetic switch monitoring Normally closed contact-Normally open contact	No	
• magnetic switch monitoring Normally closed contact-Normally closed contact	Yes	
• emergency stop function	Yes	
• protective door monitoring	Yes	
• standstill monitoring	No	
• step mat monitoring	Yes	
• monitored start-up	Yes	
Acceptability for application		
• safety-related circuits	Yes	
• safety cut-out switch	Yes	
• magnetically operated switches monitoring	No	
• EMERGENCY-OFF circuit monitoring	Yes	
• proximity switches monitoring	No	
• opto-electronical protection device monitoring	Yes	
• position switch monitoring	Yes	
• tactile sensor monitoring	Yes	
• valve monitoring	No	

3.8.3.8 Connection examples 3TK2853

²⁾ For contact units, see Chapter: Terminal assignment (Page 172)

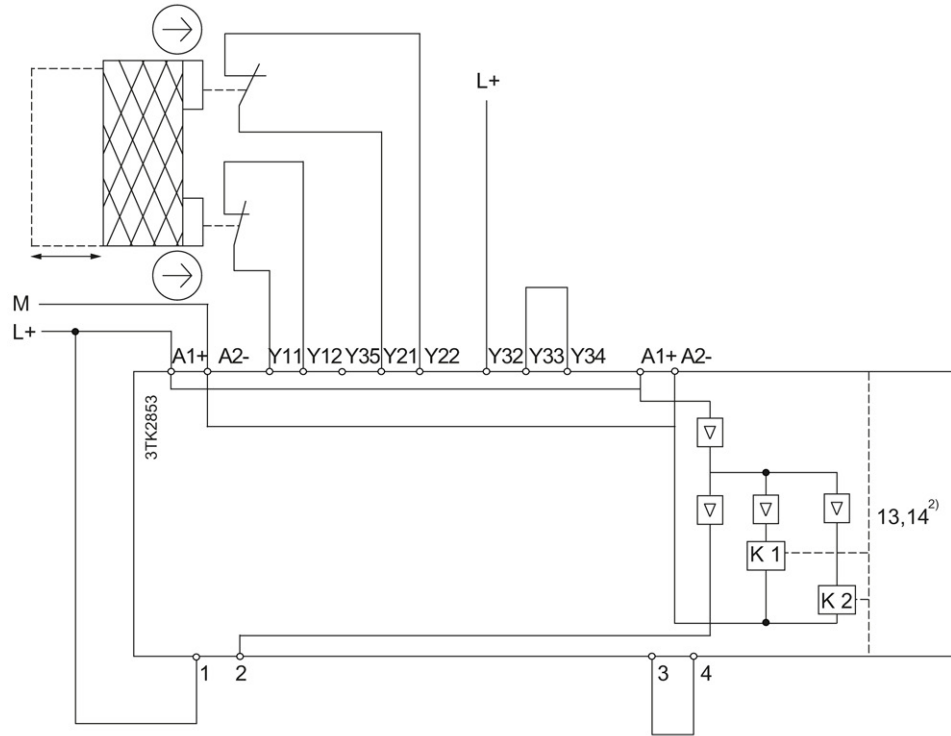


Figure 3-78 Autostart (2-channel)

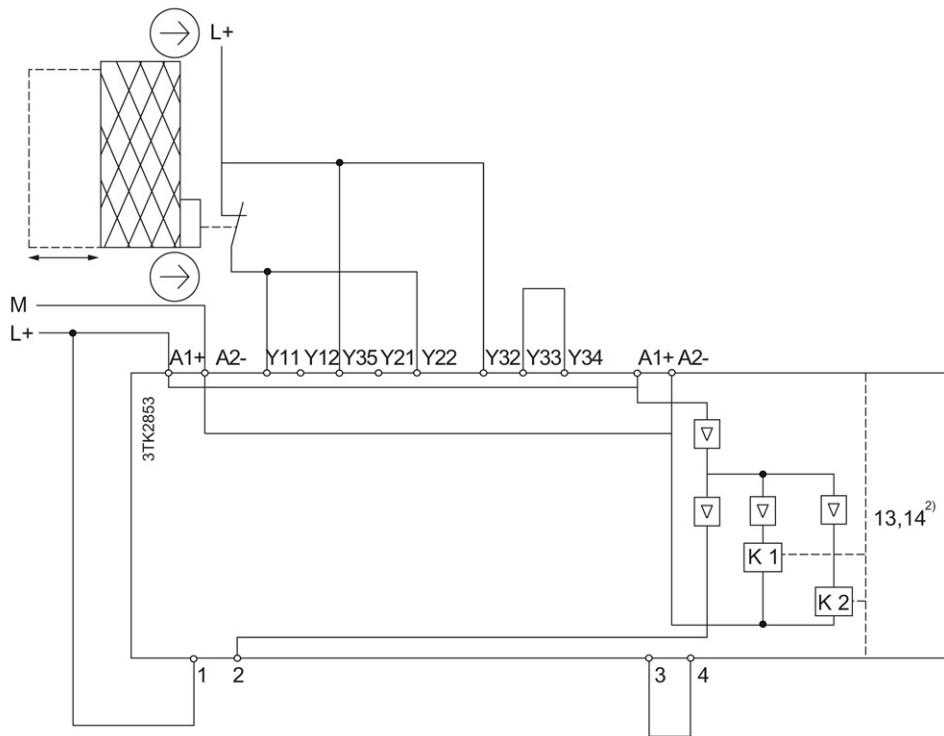


Figure 3-79 Autostart (1-channel)

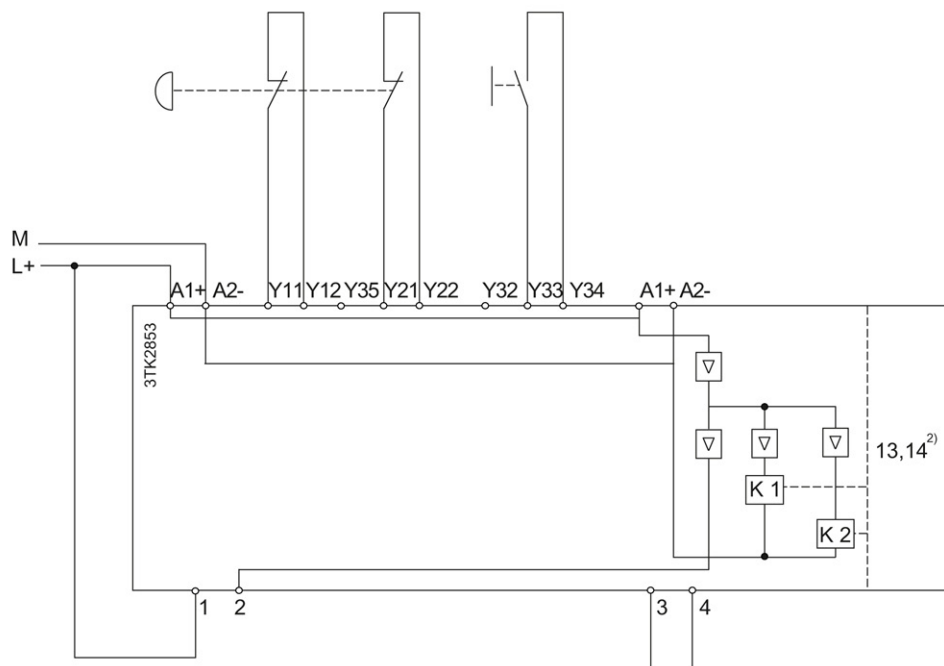


Figure 3-80 Monitored start (2-channel)

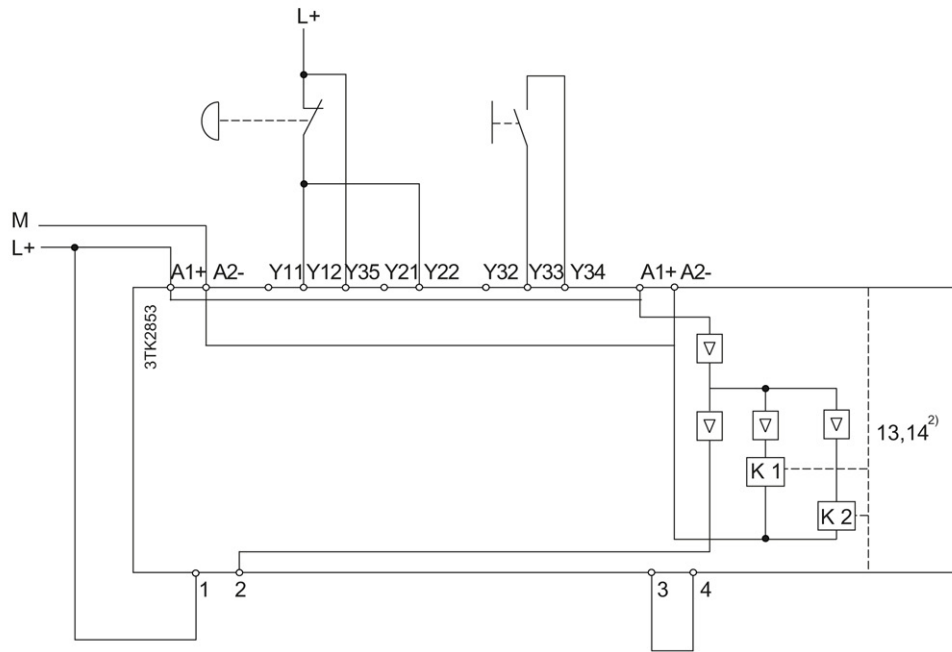


Figure 3-81 Monitored start (1-channel)

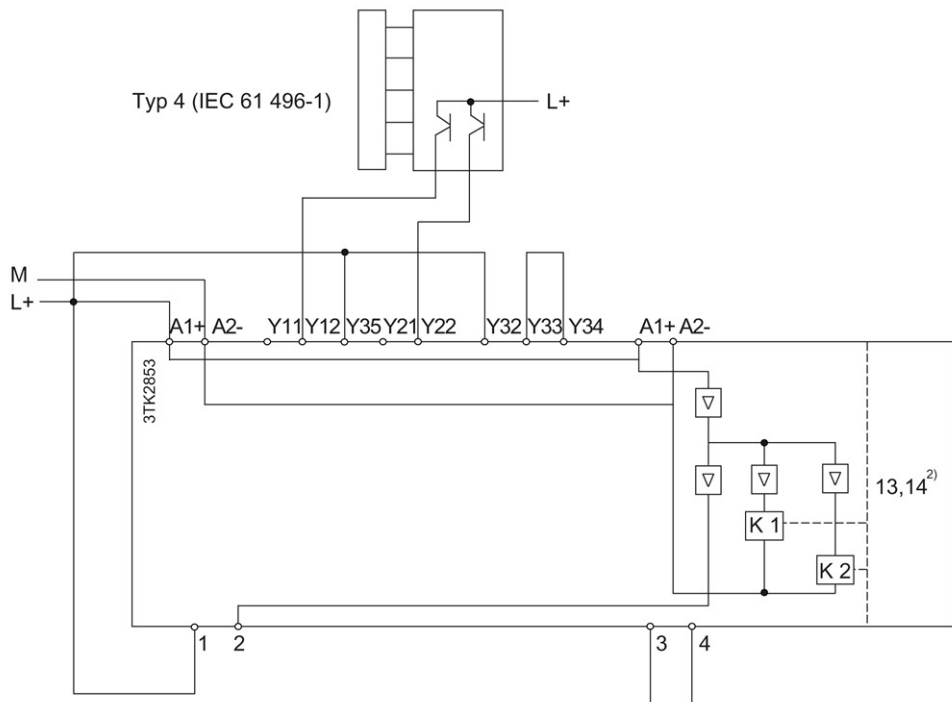


Figure 3-82 Light array monitoring (2-channel) without cross-circuit detection

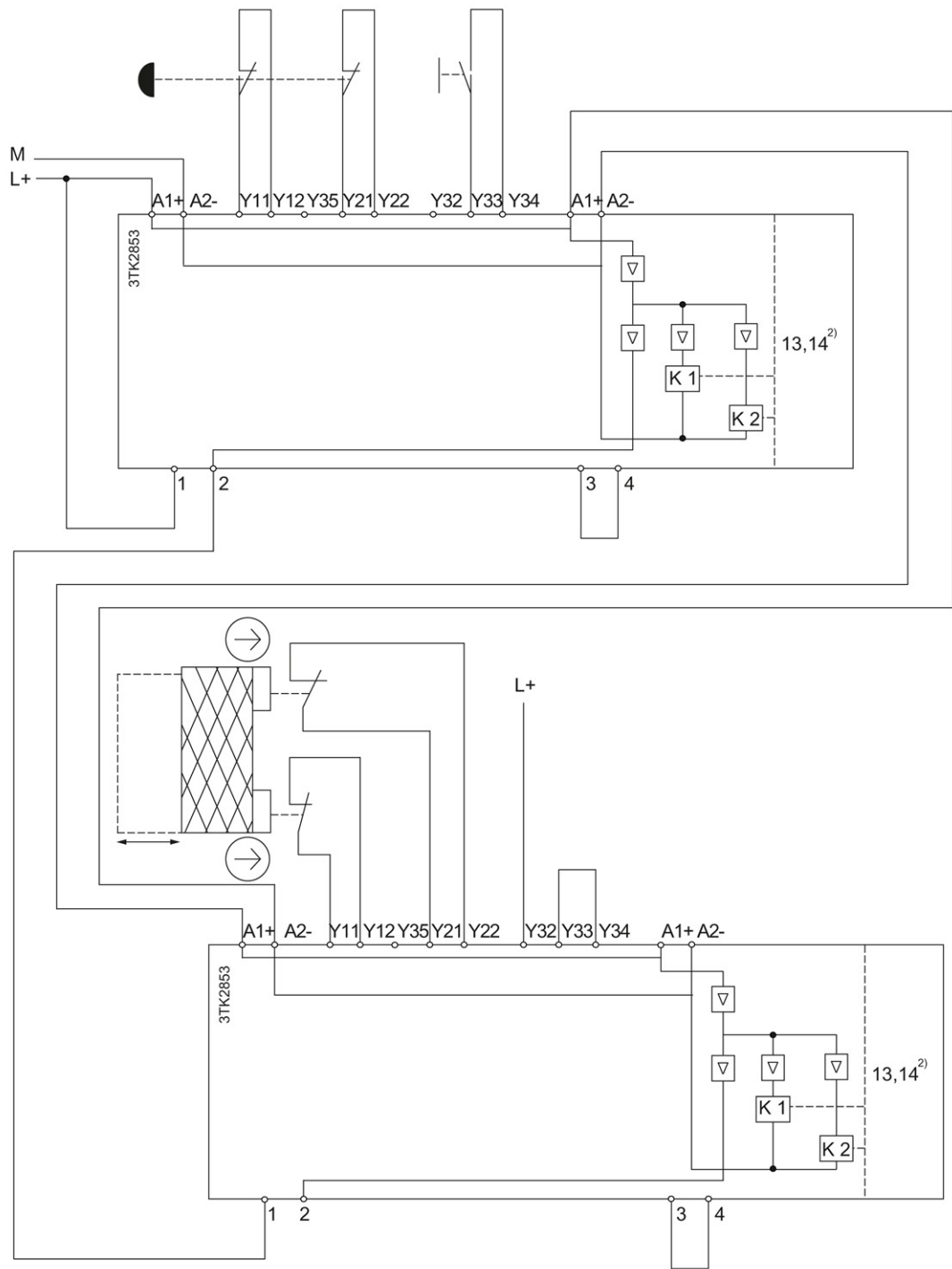


Figure 3-83 Cascading

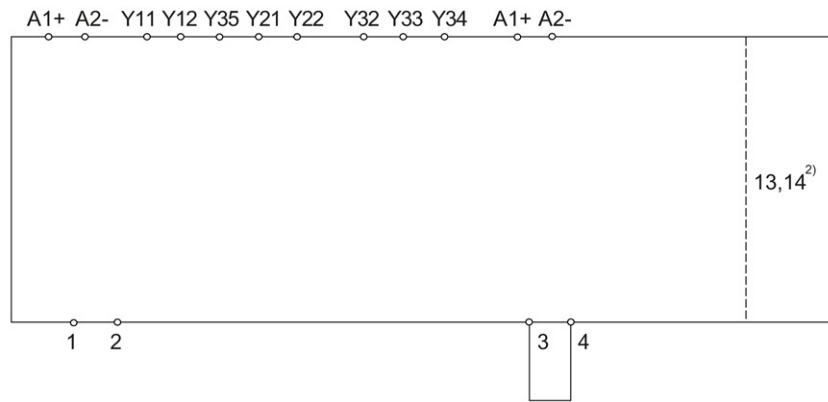


Figure 3-84 without functional operation

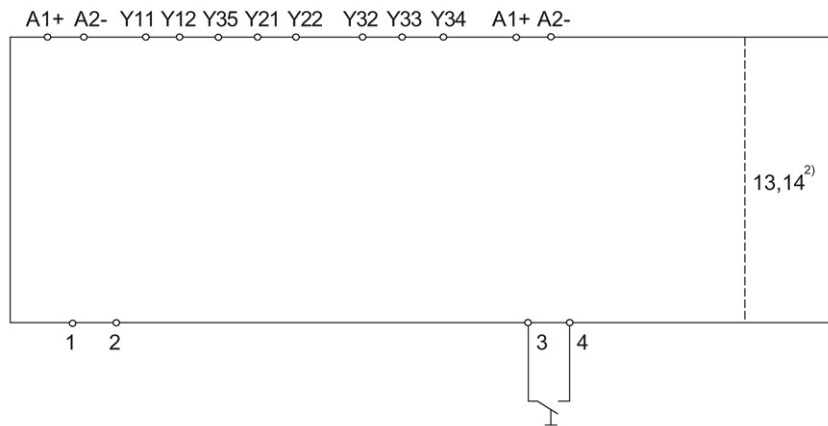


Figure 3-85 with isolated contact, functionally operated

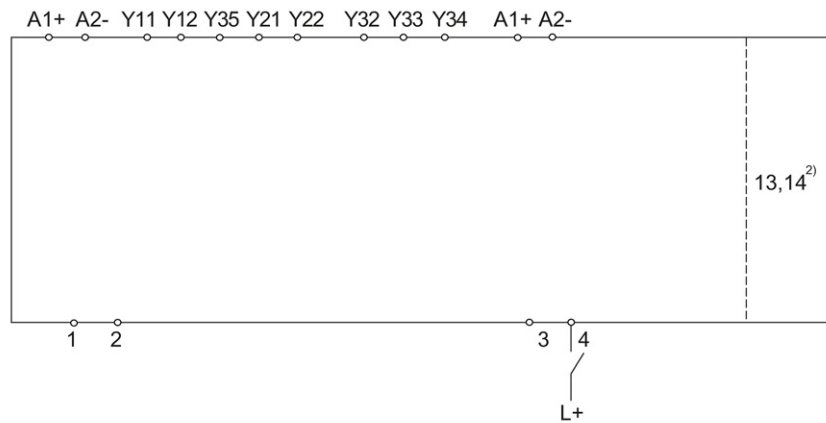


Figure 3-86 with non-isolated contact, functionally operated

3.8.4 3TK2856 / 3TK2857 safety relays

3.8.4.1 Applications

Applications of 3TK2856/57 expansion units

You can use the 3TK2856/57 expansion units in conjunction with all 3TK28/3RA7 basic units. It is used to expand the enabling circuits.

The maximum achievable performance level PL / Cat. in accordance with DIN EN ISO 13849-1, or SILCL in accordance with IEC 62061 is equivalent to the PL / Cat. / SILCL of the basic unit if the external circuitry (connection between basic unit and expansion unit) is failsafe.

3.8.4.2 Description of function and connection information

The 3TK2856/57 expansion units have two contactor relays as switching elements, one safe solid-state output, one safe input for cascading and one input for functional switching.

The operating state and functioning are indicated by three LEDs.

On startup, the device runs a self-test in which the internal electronics are checked for correct functioning.

All internal parts of the circuit are cyclically monitored for faults during operation.

With safe output 2, additional expansion units, such as 3TK2830/56/57 and external actuators or loads, can be switched.

Also, cascading with units 3TK2841/42/45/53 is possible via safe output 2. In the case of PL_{d/e} or SILCL 2/3, single-channel cascading is only possible within one cabinet.

Make sure that the actuator/load and the 3TK2856/57 expansion unit have the same ground potential.

OFF-delay times

The table below provides an overview of the OFF-delay times t_v .

Table 3- 6 3TK2856

Rated control supply voltage U_s [V]	Start type	OFF delay t_v [s]	Article No. Screw-type	Article No. Spring-loaded
24 V DC	-	-	3TK2856-1BB40	3TK2856-2BB40

Table 3- 7 3TK2857

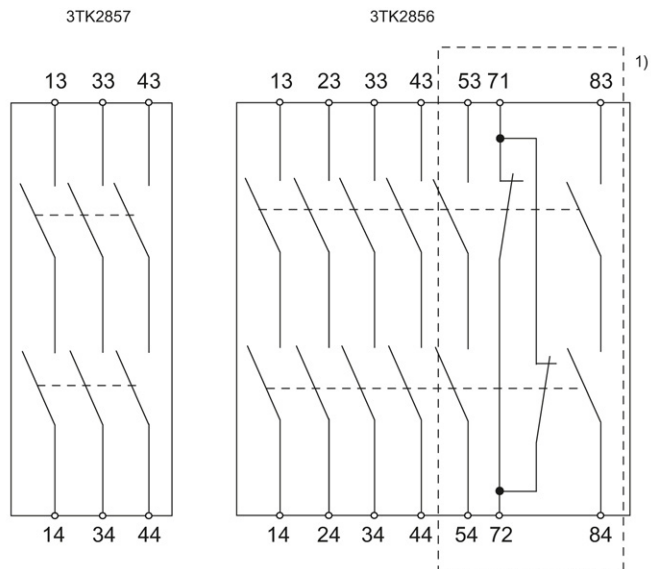
Rated control supply voltage U_s [V]	Start type	OFF delay t_v [s]	Article No. Screw-type	Article No. Spring-loaded
24 V DC	-	0,05 ... 3	3TK2857-1BB41	3TK2857-2BB41
		0,05 ... 30	3TK2857-1BB42	3TK2857-2BB42
		5 ... 300	3TK2857-1BB44	3TK2857-2BB44

3.8.4.3 Structure 3TK2856/57

Front view	No.	Meaning
	①	Removable terminal block
	②	Display LEDs
	③	Terminal blocks
	④	Labels

3.8.4.4 Terminal assignment

Terminal	Description
A1	L/+
A2	N/-
1	Cascade input
2	Safe solid-state output (24V DC / 1A)
3	Power supply for external switches
4	Input for functional switching
13; 14	Contact units (see contact units graphic)



1) Auxiliary contact units

Figure 3-87 Contact units

3.8.4.5 Display of the operating state

The operating state and functioning of the device are indicated by three LEDs:

- POWER
- RUN
- FAULT

Operating state of 3TK2856/57

● = off

☀ = on

◐ = flashing

LED			Operation				
POWER	RUN	FAULT	EMERGENCY STOP	Op. switching	Contactors	Output 2	Cause
☀	☀	☀	Self-test on startup approx. 7 s				
☀	☀	●	Closed	Closed	On	On	Normal operation
				Open	Off		Contactors off
☀	●	☀	Open		Off		Open EMERGENCY STOP
			For 3TK2857 only				
☀	◐	☀	Open	-	On	Off	Time elapsed
			Fault				
☀	●	◐	<ul style="list-style-type: none"> • Fault in electronics • Contactor welded 		Off		-
●	●	●	Supply voltage missing				

3.8.4.6 State diagrams 3TK2856 / 3TK2857

2) For contact units, see Chapter: Terminal assignment (Page 186)

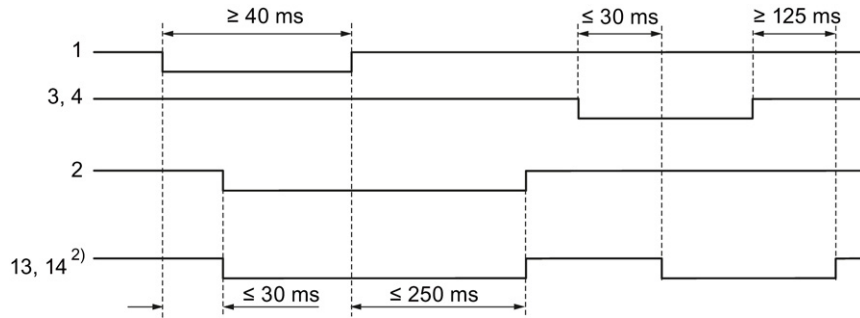


Figure 3-88 State diagram 3TK2856

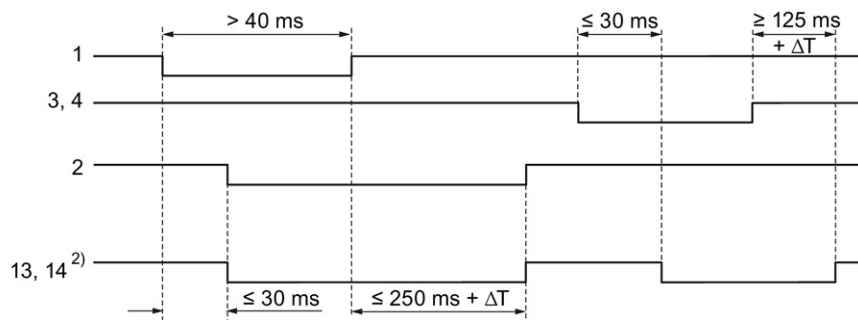


Figure 3-89 State diagram 3TK2857

3.8.4.7 Technical data 3TK2856 / 3TK2857

	3TK2856-B...	3TK2857-B...
EMC emitted interference	IEC 60947-5-1, IEC 60000-4-3, IEC 60000-4-5, IEC 60000-4-6	
Item designation	KT	
<ul style="list-style-type: none"> according to DIN 40719 extendable after IEC 204-2 according to IEC 750 according to DIN EN 61346-2 	F	
Number of sensor inputs 1-channel or 2-channel	—	
Design of the cascading	cascading and in-service switching	
Type of the safety-related wiring of the inputs	—	
Product feature transverse contact-secure	No	
Safety Integrity Level (SIL) according to IEC 61508	SIL3	
SIL claim limit (for a subsystem) according to EN 62061	3	
Safety integrity level (SIL) for delayed release circuit according to IEC 61508	—	SIL3
Performance Level (PL)	e	
<ul style="list-style-type: none"> according to ISO 13849-1 for delayed release circuit according to ISO 13849-1 	—	e
Category	corresponds to basic unit	
<ul style="list-style-type: none"> according to EN 954-1 according to ISO 13849-1 	4	
Safety device type according to IEC 61508-2	Type B	
Probability of dangerous failure per hour (PFHD) with high demand rate according to EN 62061	1/h	1.1 ⁻⁸
T1 value for proof test interval or service life according to IEC 61508	a	20

3.8 3TK28 safety relays with contactor relay enabling circuits

	3TK2856-.B...	3TK2857-.B...
Number of outputs as contact-affected switching element as NO contact safety-related		
• as contact-affected switching element as NC contact for reporting function instantaneous switching	1	0
• as contact-affected switching element as NO contact safety-related instantaneous switching	6	0
• as contact-affected switching element as NO contact safety-related delayed switching	0	3
• as contact-less semiconductor switching element		
– for reporting function		
– non-delayed	0	
– delayed switching	0	
– safety-related		
– non-delayed	1	
– delayed switching	0	
Stop category according to DIN EN 60204-1	0	1
Design of the input		
• cascading-input/functional switching	Yes	
• feedback input	Yes	
• start input	Yes	
Design of the electrical connection jumper socket	Yes	
Switching capacity current		
• at AC-15 at 24 V	A 4	—
• of the NO contacts of the relay outputs		
– at AC-15 at 230 V	A 6	
– at DC-13 at 24 V	A 10	
• of the NC contacts of the relay outputs at AC-15		
– at 115 V	A 6	
– at 230 V	A 6	

		3TK2856-B...	3TK2857-B...
Thermal current of the contact-affected switching element maximum	A	—	—
Electrical operating cycles as operating time typical		—	—
Mechanical operating cycles as operating time typical		30 000 000	—
Design of the fuse link for short-circuit protection of the NO contacts of the relay outputs required		gL/gG: 10 A	—
Type of voltage of the controlled supply voltage		DC	—
Control supply voltage frequency 1 rated value	Hz	—	—
Control supply voltage frequency 2 rated value	Hz	—	—
Control supply voltage 1 for DC final rated value			
• for DC rated value	V	24	—
Operating range factor control supply voltage rated value of the magnet coil			
• at 50 Hz			
– for AC		—	—
• at 60 Hz			
– for AC		—	—
• for DC		0.85	1.1

3.8 3TK28 safety relays with contactor relay enabling circuits

	3TK2856-.B...	3TK2857-.B...
Product function		
• automatic start	No	
• rotation speed monitoring	No	
• laser scanner monitoring	No	
• light grid monitoring	No	
• light barrier monitoring	No	
• magnetic switch monitoring Normally closed contact-Normally open contact	No	
• magnetic switch monitoring Normally closed contact-Normally closed contact	Yes	
• emergency stop function	Yes	
• protective door monitoring	No	
• standstill monitoring	No	
• step mat monitoring	No	
• monitored start-up	No	
Acceptability for application		
• safety-related circuits	Yes	
• safety cut-out switch	Yes	
• magnetically operated switches monitoring	No	
• EMERGENCY-OFF circuit monitoring	Yes	
• proximity switches monitoring	No	
• opto-electronical protection device monitoring	No	
• position switch monitoring	Yes	
• tactile sensor monitoring	No	
• valve monitoring	No	

3.8.4.8 Connection examples 3TK2856 / 3TK2857

²⁾ For contact units, see Chapter: Terminal assignment (Page 186)

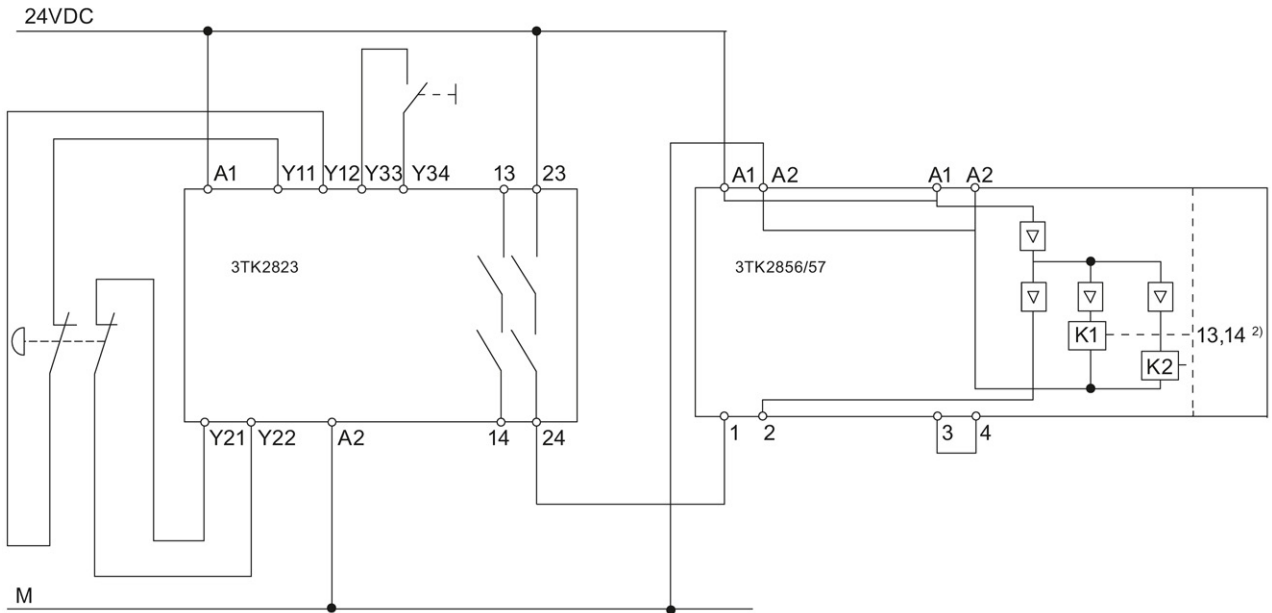


Figure 3-90 3TK2823 expanded with 3TK2856/57

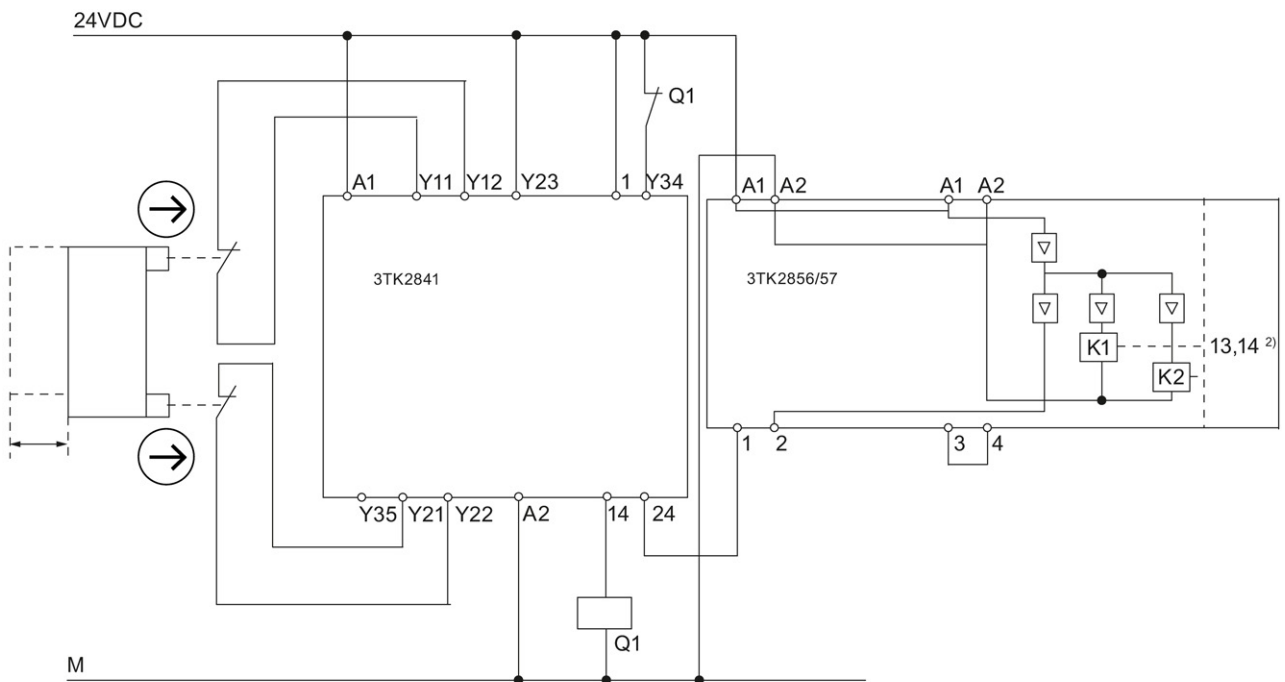


Figure 3-91 3TK2841 expanded with 3TK2856/57

3.8 3TK28 safety relays with contactor relay enabling circuits

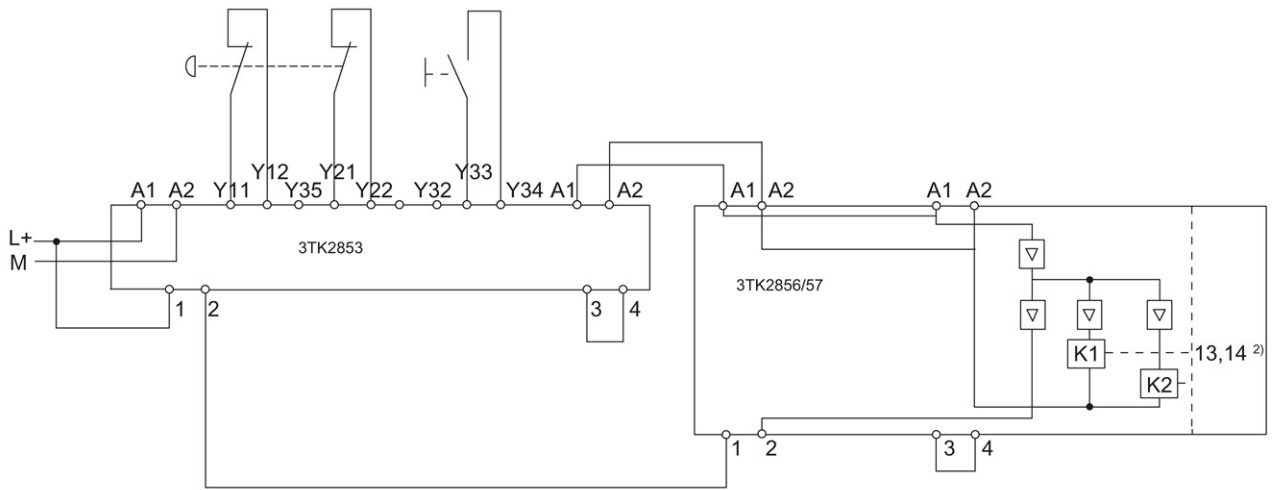


Figure 3-92 3TK2853 expanded with 3TK2856/57

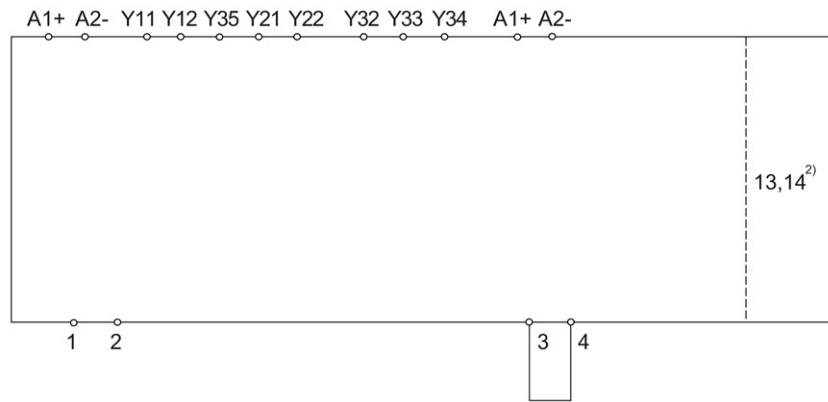


Figure 3-93 without functional operation

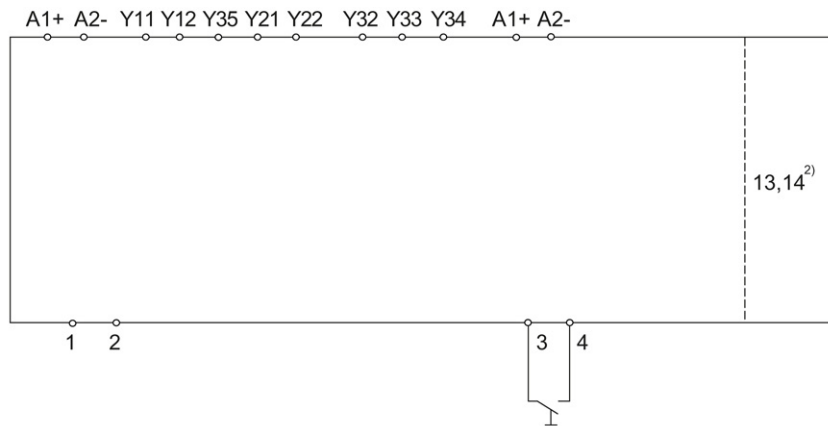


Figure 3-94 with isolated contact, functionally operated

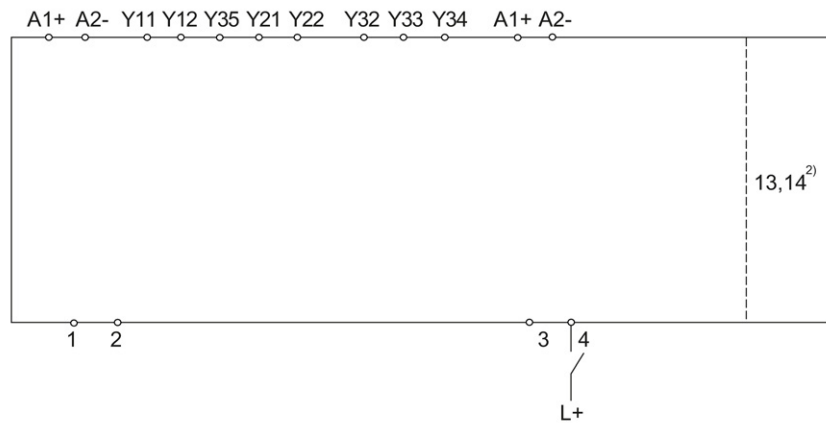


Figure 3-95 with non-isolated contact, functionally operated

Mounting

4.1 Warning notices

Warning notices before installation, wiring, and commissioning

 WARNING
Hazardous voltage! Can cause electric shock and burns. Turn off and lock out all power supplying this device before working on this device.

4.2 Mounting the device on a DIN rail

Requirements

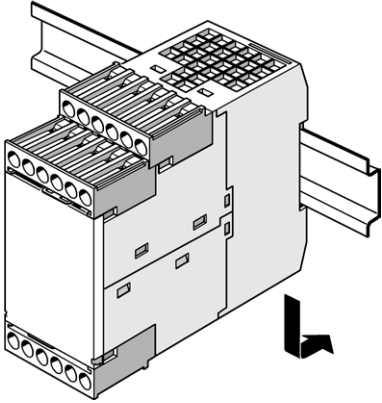
- At the installation location, a horizontal 35 mm mounting rail in accordance with DIN EN 60715 is properly secured
- Please observe the information about the mounting position in chapter "General technical data (Page 19)"

DIN rail mounting procedure

Note

The procedure is shown applied to the 45 mm housing. The procedure for 22.5 mm devices is analogous.

For installation of the 3TK2820, see Section: Mounting the device on a DIN rail (Page 37)

Step	Operating instruction	Figure
1	Hang the back of the device onto the upper edge of the DIN rail	
2	Press the lower half of the device against the DIN rail until the device engages	

4.3 Mounting the device on a level surface

Requirements

Please note the following requirements for mounting on a level surface:

- Please observe the information about the mounting position in the chapter "General technical data (Page 19)".
- Two properly executed drill holes with thread or plug on the level surface

For details of the distances between the drilled holes, please refer to the relevant dimension drawings in the chapter "Dimension drawings 3TK28 (Page 209)".

- Two screws with a maximum thread diameter of 4.8 mm
- Two plastic securing brackets

Please refer to the accessories list for the relevant article number in the chapter "Accessories (Page 219)".

Note

The procedure is shown applied to the 45 mm housing. The procedure for 22.5 mm devices is analogous.

Procedure for mounting on a level surface

Step	Operating instruction	Figure
1	Insert the securing brackets into the openings provided on the device until they engage.	
2	Hold the device up to the surface prepared for screw fastening.	
3	Insert the screws through the oblong holes in the securing brackets.	
4	Screw the device onto the level surface so that it is secure.	

4.4 Disassembling the device

⚠ WARNING
Hazardous voltage
Can Cause Death, Serious Injury, or Property Damage.
Before starting work, therefore, disconnect the system and devices from the power supply.

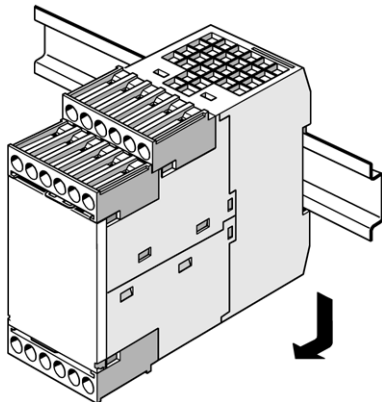
Requirements

- All system interface connections are terminated.
- The terminal blocks have been removed or disconnected.

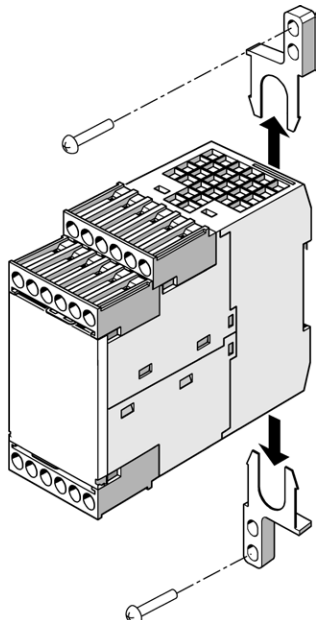
Note

The procedure is shown applied to the 45 mm housing. The procedure for 22.5 mm devices is analogous.

Disassembling the device from a DIN rail

Step	Operating instruction	Figure
1	Pull the device down until the lower half can be pulled away from the DIN rail.	
2	Pull the lower half of the device away from the DIN rail.	
3	Lift the device from the upper edge of the DIN rail.	

Disassembling the device from a level surface

Step	Operating instruction	Figure
1	Hold the device firmly.	
2	Unscrew the cap screws.	
3	Lift the device from the level surface.	
4	Remove the securing brackets from the device.	

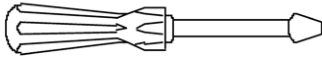
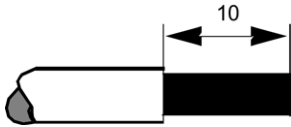
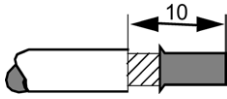
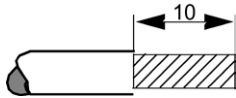
See also

Disassembling the device (Page 38)

Connection

5.1 Connection data for terminal blocks

The following connection data apply dependent on the removable terminal block:

	Specification and value in the case of removable terminal blocks with screw-type terminals	Specification and value in the case of removable terminal blocks with spring- loaded terminals
Screwdriver 	Cross-tip screwdriver Size: PZ 2 (ø 5 ... 6 mm) Torque: 0.8 ... 1.2 Nm Article No.: 8WA2803	Screwdriver Size: 0 or 1 (width to 3 mm) for raising the terminal springs Article No.: 8WH9200-0AA0
Rigid cable 	Maximum number of cables x cable cross-section: 1 x 0.5 ... 4.0 mm ² or 2 x 0.5 ... 2.5 mm ²	Maximum number of cables x cable cross-section: 2 x 0.25 ... 1.5 mm ²
Flexible cable with end sleeve/cable lug 	Maximum number of cables x cable cross-section: 1 x 0.5 ... 2.5 mm ² or 2 x 0.5 ... 1.5 mm ²	Maximum number of cables x cable cross-section: 2 x 0.25 ... 1.5 mm ²
Flexible cable 	Not allowed	Maximum number of cables x cable cross-section: 2 x 0.25 ... 1.5 mm ²

5.2 Connecting terminal blocks

⚠ WARNING

Hazardous voltage

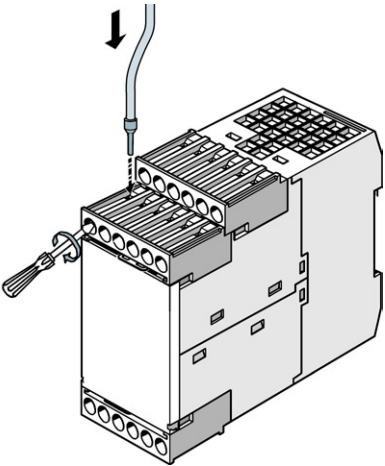
Can Cause Death, Serious Injury, or Property Damage.

Before starting work, therefore, disconnect the system and devices from the power supply.

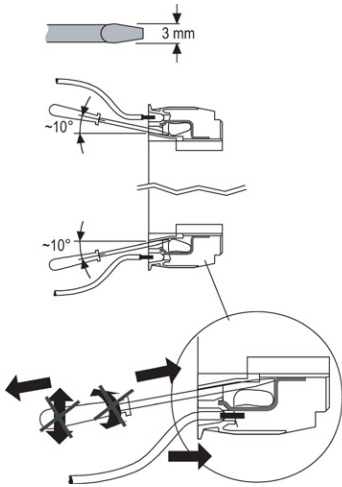
Procedure for screw-type terminal blocks

Note

The procedure is shown applied to the 45 mm housing. The procedure for 22.5 mm devices is analogous.

Step	Operating instruction	Figure
1	Insert the relevant cable into square on the screw-type terminal until it engages.	
2	Hold the cable in the screw-type terminal.	
3	Tighten the screw of the terminal in which the cable is inserted.	
4	Pull on the cable to ensure it is screwed tight.	

Procedure for spring-loaded terminal blocks

Step	Operating instruction	Figure
1	To release the terminal spring, insert the 3-mm flat-head screwdriver into the square opening of the spring-loaded terminal until it engages. Please observe a 10° horizontal angular deviation of the screwdriver to the oval opening.	
2	Insert the cable into the oval opening as far as it will go.	
3	Hold the cable in the spring-loaded terminal.	
4	Remove the screwdriver.	
5	Pull on the cable to ensure it is tight.	

See also

Connecting terminal blocks (Page 40)

5.3 Disconnecting

⚠ WARNING

Hazardous voltage

Can Cause Death, Serious Injury, or Property Damage.

Before starting work, therefore, disconnect the system and devices from the power supply.

Removing terminal blocks from the device

Note

Order of removal

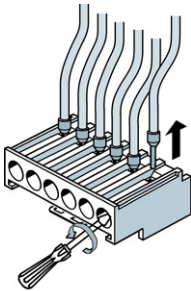
Remove terminal block A before terminal block B, and C before D.

Note

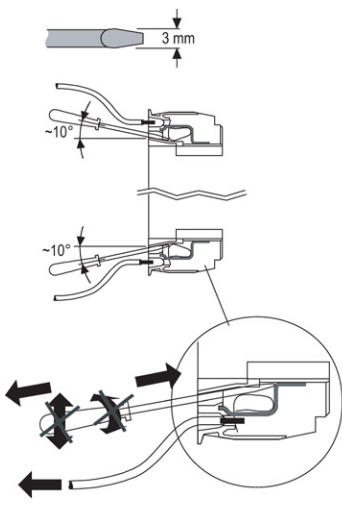
The procedure is shown applied to the 45 mm housing. The procedure for 22.5 mm devices is analogous.

Step	Operating instruction	Figure
1	Insert a flat-head screwdriver between the clip of the terminal block and the front panel ①.	
2	Pull the terminal block out to the front ②.	
3	Lift the terminal block out of the mechanically coded guiderail of the device ③.	

Disconnecting screw-type terminals

Step	Operating instruction	Figure
1	Unscrew the screw of the screw-type terminal.	
2	Remove the cable from the unscrewed screw-type terminal.	

Disconnecting spring-loaded terminals

Step	Operating instruction	Figure
1	Insert the flat-head screwdriver into the square opening of the spring-loaded terminal until it engages. Please observe a 10° horizontal angular deviation of the screwdriver to the oval opening.	
2	Remove the cable from the oval opening.	
3	Remove the screwdriver.	

5.4 Plugging in terminal blocks

⚠ WARNING

Hazardous voltage

Can Cause Death, Serious Injury, or Property Damage.

Before starting work, therefore, disconnect the system and devices from the power supply.

Requirements

You must have removed the terminal blocks, for the purpose of replacing a device, for example.

Procedure when plugging in the terminal blocks

Note

Removable terminal blocks are mechanically coded to prevent polarity reversal

The removable terminal blocks are mechanically coded to prevent polarity reversal and are labeled with A, B, C or D on the inside. Only use the slots shown in the diagram below.

Note

Plug-in sequence

Connect terminal block B before terminal block A, and D before C.

Note

The procedure is shown applied to the 45 mm housing. The procedure for 22.5 mm devices is analogous.

Step	Operating instruction	Figure
1	Insert the removable terminal block into the mechanically coded guiderail of the device ①.	
2	Slide the removable terminal block back until it audibly engages.	
3	Check that the clip of the removable terminal block closes flush with the front panel ②.	

Dimension drawings

6.1 Dimension drawings 3TK28

All dimensions in mm

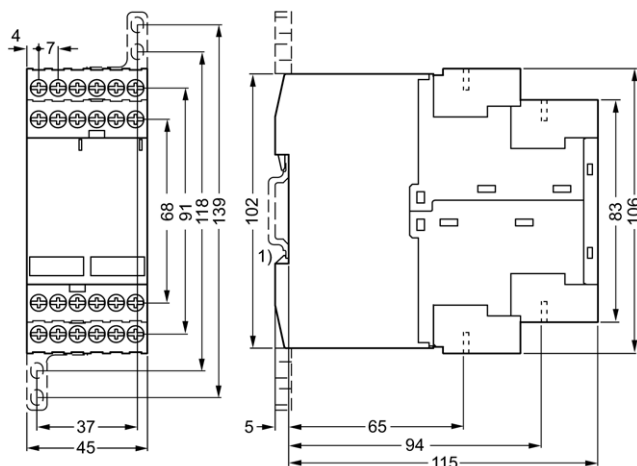


Figure 6-1 3TK2810/25/26/27/28/34/45 screw-type

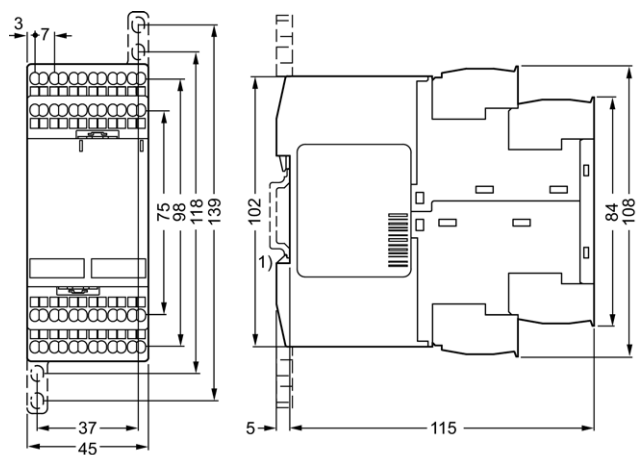


Figure 6-2 3TK2810/25/26/27/28/34/45 spring-loaded

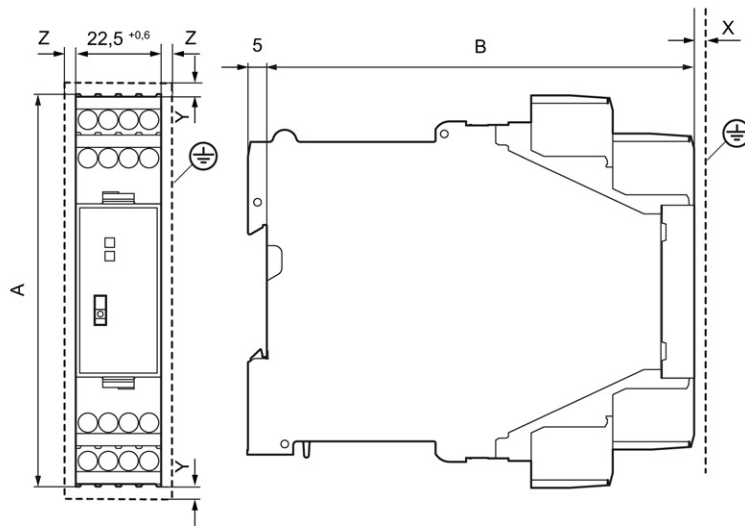


Figure 6-3 3TK2820

3TK2820-1...	
A	103,6
B	113
3TK2820-2...	
A	111,2
B	113
X	≥ 5
Y	≥ 5
Z	≥ 5

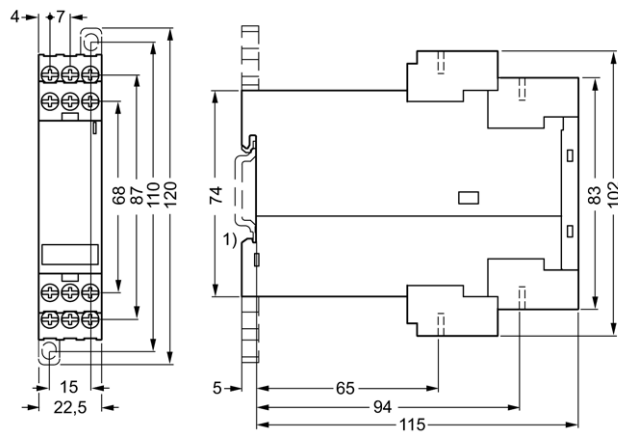


Figure 6-4 3TK2821/22/23/24/30 screw-type

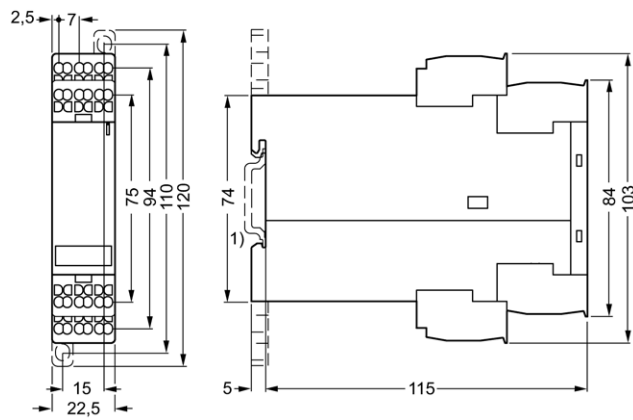


Figure 6-5 3TK2821/22/23/24/30 spring-loaded

6.1 Dimension drawings 3TK28

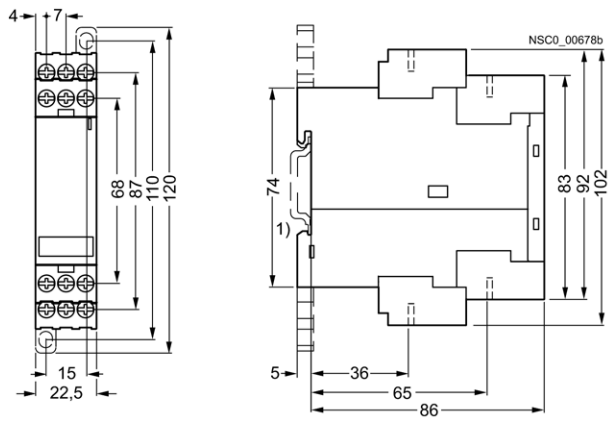


Figure 6-6 3TK2840/41/42 screw-type

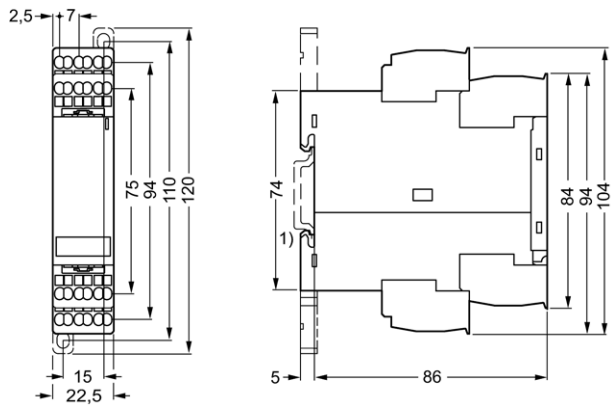


Figure 6-7 3TK2840/41/42 spring-loaded

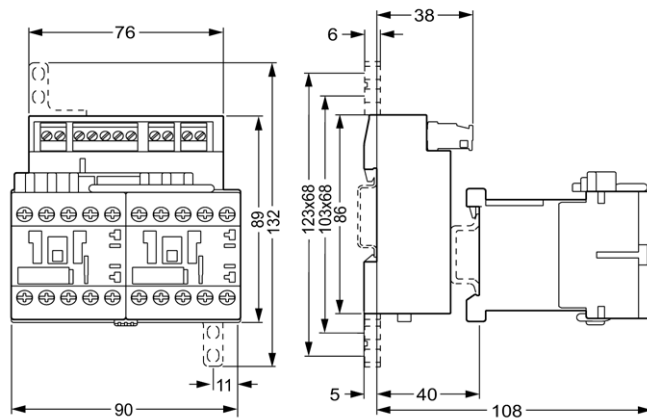


Figure 6-8 3TK2850/51 screw-type

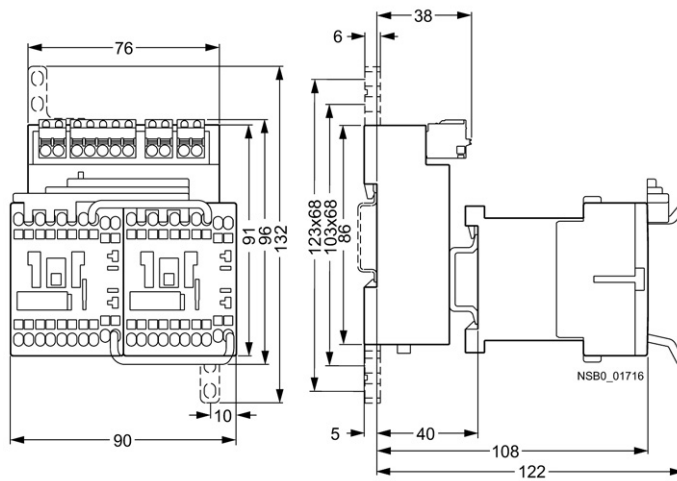


Figure 6-9 3TK2850/51 spring-loaded

6.1 Dimension drawings 3TK28

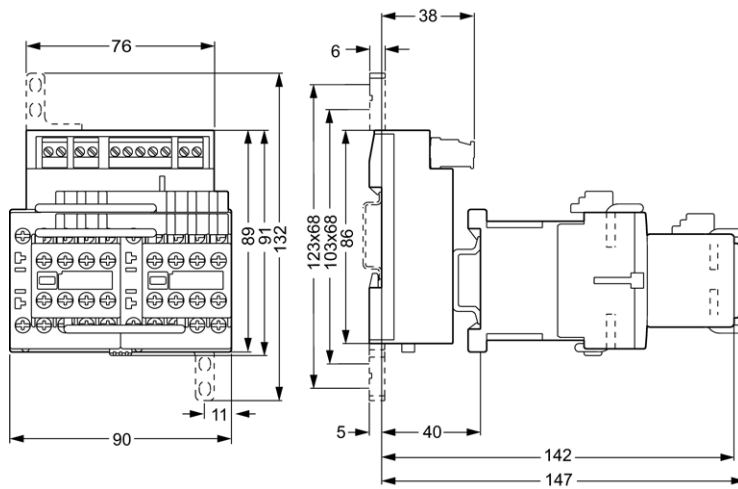


Figure 6-10 3TK2852 screw-type

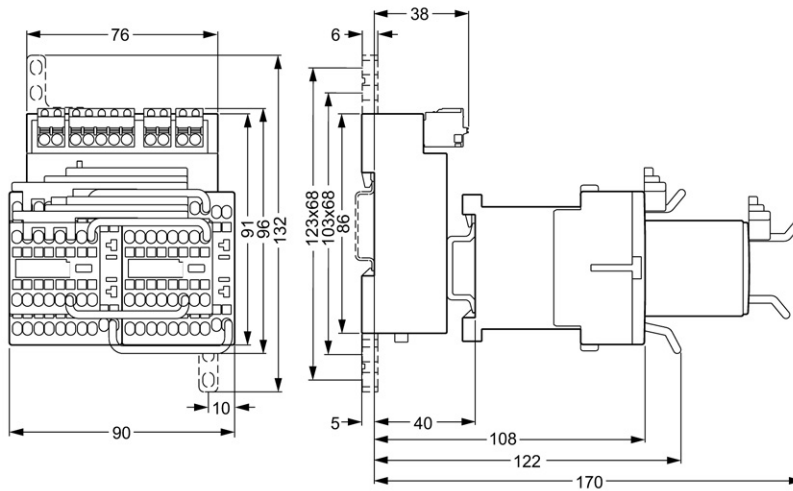


Figure 6-11 3TK2852 spring-loaded

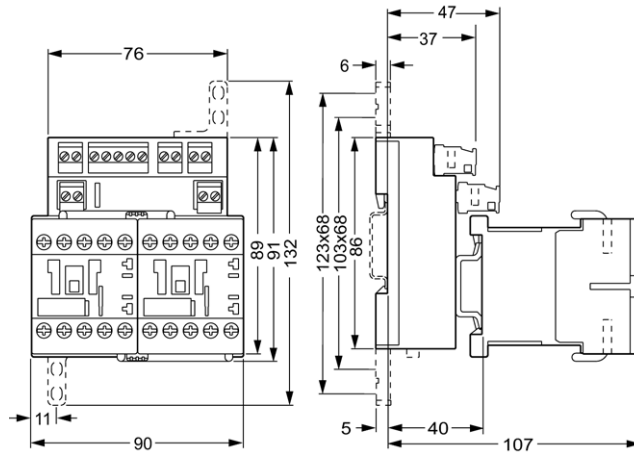


Figure 6-12 3TK2853 screw-type

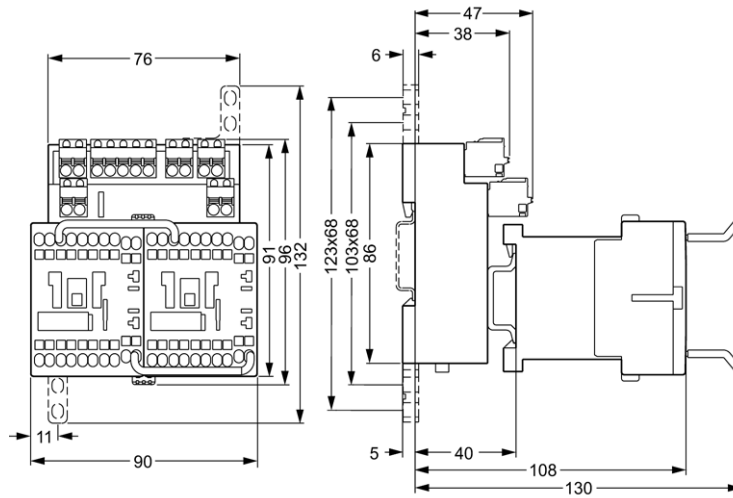


Figure 6-13 3TK2853 spring-loaded

6.1 Dimension drawings 3TK28

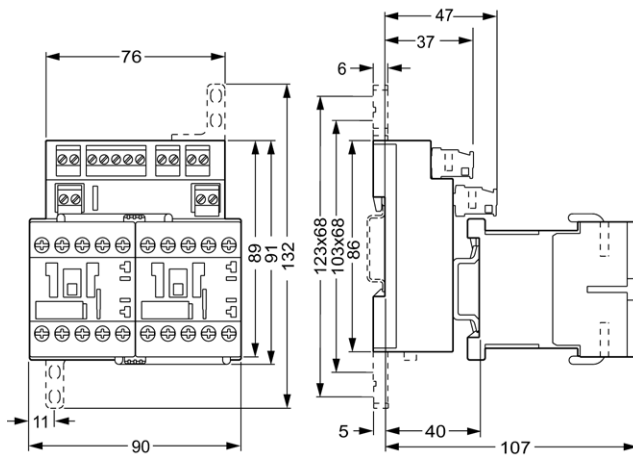


Figure 6-14 3TK2856 screw-type

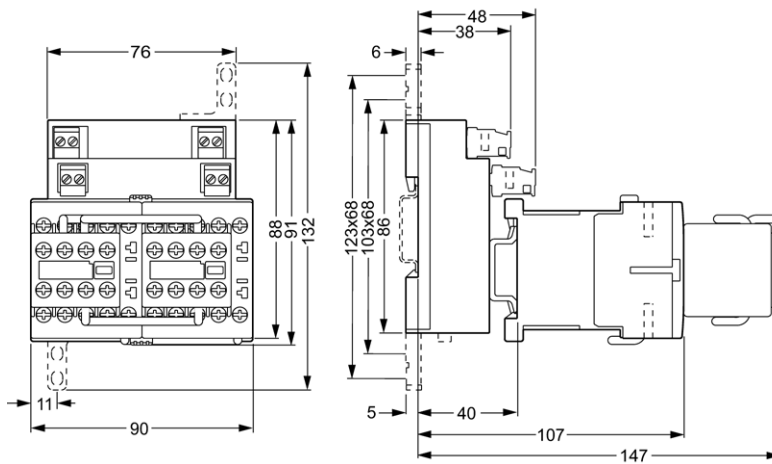


Figure 6-15 3TK2856 spring-loaded

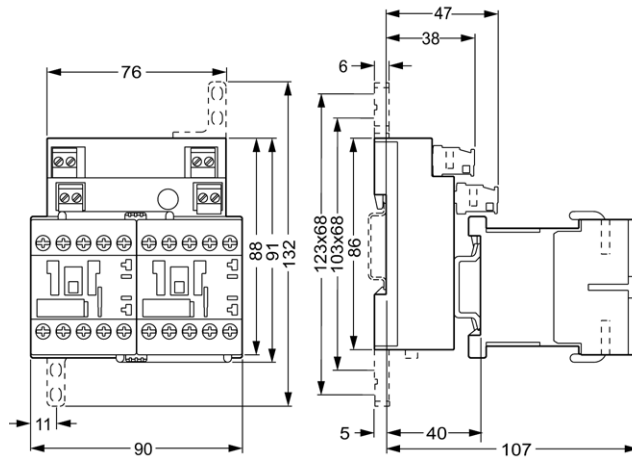


Figure 6-16 3TK2857 screw-type

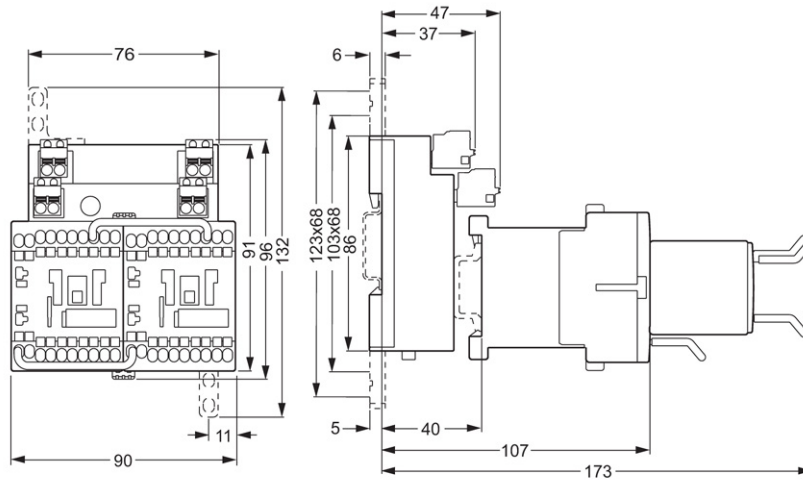


Figure 6-17 3TK2857 spring-loaded

Accessories

Accessories for 3TK28

The following accessories are available for the 3TK28 devices.

Designation	Article number	Suitable for:
Device identification labels 20 mm x 7 mm, pastel turquoise	3RT1900-1SB20	3TK28
Labels 19 mm x 6 mm, pastel turquoise	3RT1900-1SB60	3TK28
Labels 19 mm x 6 mm, zinc yellow	3RT1900-1DB60	3TK28
Push-in lugs (for screw fastening; 2 are required for each device)	3RP1903	3TK28
Sealable cover (to secure against unauthorized operation of the setting elements)	3RP1902	3TK2827; 3TK2828
Sealable cover (to secure against unauthorized operation of the setting elements)	3TK2826-0DA00-0HA0	3TK2826
Sealable membrane (to secure against operation of the setting elements)	3TK2820-0AA00	3TK2820
Screwdriver for all devices with spring-loaded terminals 3.0 mm x 0.5 mm	3RA2908-1A	3TK28 (with spring-loaded terminals)

