



Industrial Controls

Safety Systems

SIRIUS 3TK2810-1 Safety-related speed monitor

Manual

Edition

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Answers for industry.

SIRIUS industrial controls

Safety relays 3TK2810-1 safety-related speed monitor

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 system manual

The system manual of the 3TK2810-1 safety-related speed monitor described below is the original system manual.

This manual contains a detailed description of the 3TK2810-1 safety-related speed monitor and its components. The manual provides you with the information you require for configuring, commissioning and using the 3TK2810-1 safety-related speed monitor. 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 relay 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 present 3TK2810-1 safety-related speed monitor. It contains a description of the components 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 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.

1.5 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.

1.6 Product-specific information

Important note for maintaining the operational safety of your system

 WARNING
Hazardous Voltage. Can Cause Death, Serious Injury, or Property Damage. Please take note of our latest information. 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 certain actions when monitoring the product. 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: SIEMENS Newsletter (http://www.siemens.com/industrial-controls/newsletter) Register for the Newsletter by checking the appropriate box: • Controls and Distribution News

Safety notices

NOTICE
Observe the ESD guidelines When handling and installing the devices, observe the ESD guidelines. Connection is only permitted when the power adapters have been deactivated.

ESD guidelines

ESD components are destroyed by voltage and energy far below the limits of human perception. Voltages of this kind occur as soon as a device or an assembly is touched by a person who is not electrostatically discharged. ESD components which have been subject to such voltage are usually not recognized immediately as being defective, because the malfunction does not occur until after a longer period of operation.

NOTICE

Damage to the speed monitor from electrostatic charging!

The speed monitor contains electrostatically sensitive devices. These modules will be destroyed or damaged by improper handling.

- You must discharge your body electrostatically immediately before touching an electronic component. To do this, touch a conductive, grounded object, e.g., a bare metal part of a switch cabinet or the water pipe.
- Always hold the component by the plastic enclosure.
- Electronic modules should not be brought into contact with electrically insulating materials such as plastic film, plastic parts, insulating table supports or clothing made of synthetic fibers.
- Always place electrostatic sensitive devices on conductive bases.
- Always store and transport electronic modules or components in ESD-safe conductive packaging, e.g. metallized plastic or metal containers. Leave the component in its packaging until installation.

Note

In the case of capacitive or inductive load at the output contacts, sufficient suppressor circuits must be provided to protect against contact overload. A fuse must also be connected in series to protect against welding of the safety contacts (see Chapter "Technical data (Page 65)").

Note

Routing of the sensor cables

If EMC interference is to be expected, all initiator/encoder cables are to be shielded when laid. The shielding must be connected to PE at both ends.

Intended use

WARNING

Intended use

Can Cause Death, Serious Injury, or Property Damage.

The devices may only be used for the applications described in the catalog and the technical description (see Chapter "Application (Page 16)"), and only in conjunction with equipment or components from other manufacturers which have been approved or recommended by Siemens. You must also ensure that suitable and reliable sensors are used (see Chapter "Basic versions (Page 17)" and "Configuring (Page 50)").

This product can function correctly and reliably only if it is transported, stored, assembled, and mounted correctly, and operated and maintained as recommended.

Before you run any sample programs or programs that you have written yourself, make sure that running the plant cannot cause injury to anyone else or damage to the machine itself.

EU notice: Start-up/commissioning is absolutely prohibited until it has been ensured that the machine in which the component described here is to be installed fulfills the regulations/specifications of Machinery Directive 2006/42/EC.

Dormant error detection

Note

In the case of longer standstill times ($t \geq 24$ hrs), forced dormant error detection must be carried out before restarting the system (function test of the application).

Exception:

This forced dormant error detection procedure is not necessary when using NAMUR sensors.

Connection of the initiators

Note

If common sensor potentials are directly connected to the initiators and a common return wire is connected to the 3TK2810-1 device, the first error that occurs will result in a loss of the safety function. Thus the maximum achievable SIL = 1 and the PL = c.

A series connection of proximity switches is not permitted.

Encoder

NOTICE**Use of encoders**

In order to achieve the highest possible SIL / PL when using encoders, 2-channel encoders (4 tracks: A, A/, B, B/) with defined failure responses (high-resistance outputs > 170 kOhm) must be used.

If such information cannot be found on the encoder manufacturer's data sheet, then the failure response data must be requested from the encoder manufacturer.

No specific safety encoders have to be used on the 3TK2810-1 safety-related speed monitor.

If an encoder is used, the encoder's **FIT** value (Failure in Time) must be incorporated into the calculation of the safety chain.

Encoders that are operated on a 3TK2810-1 safety-related speed monitor must have the following properties:

- TTL/HTL encoders that provide two signal tracks with the respectively inverted signals.
- All sin/cos encoders that supply both the sine and the cosine tracks with the respectively inverted signals (sin, /sin and cos, /cos).
- The phase offset of the two signals A (or sin) and B (or cos) must be 90 °, between A and /A or B and /B it must be 180 ° in each case.
- The encoder's signals must have a high resistance in the event of failure. In other words: the corresponding track must supply a resistance of at least 170 kOhm.

The 3TK2810-1 speed monitor detects a disrupting offset of the signal track or mutual overtaking of the signals in the case of sin/cos encoders. Detection of the fault is independent of the set frequency. The 3TK2810-1 safety-related speed monitor assumes the safe state and issues a fault message.

It is the responsibility of the user to check whether a specific encoder and its pin assignments match the 3TK2810-1 safety-related speed monitor.

Actuator wiring up to PL e / Cat. 4 per ISO 13849-1, or SILCL 3 per IEC 62061

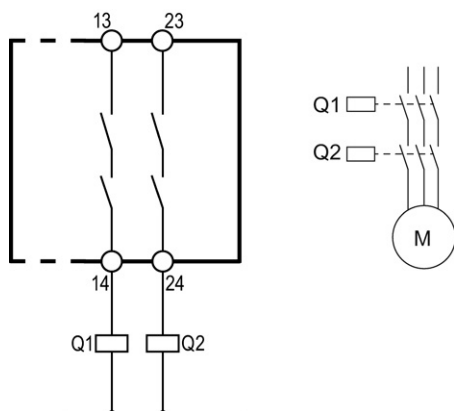


Figure 1-1 Dual-channel actuator wiring via two terminals

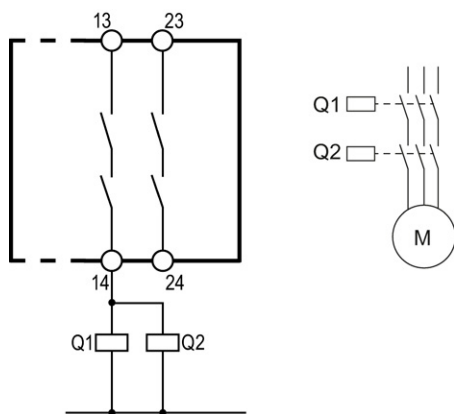


Figure 1-2 Dual-channel actuator wiring via one terminal

Note

To achieve SILCL 2/3 as per IEC 62061 or PL d/e as per EN ISO 13849-1, a fault exclusion such as a short-circuit to P or M is required. This can, for example, be implemented within a control cabinet or by installing the connection cables in such a way that they are protected. If this is not possible, the actuators must be wired via two safety-related outputs, see image "Dual-channel actuator wiring via **two** terminals". For this purpose, separate cables must be laid to actuators / contactors.

Product description

2.1 Overview

All key product features at a glance

General information:

- TÜV approval / UL approval
 - Suitable for use in applications to Level (SIL) 3 in accordance with IEC 61508
 - SIL claim limit (SIL CL) 3 in accordance with IEC 62061
 - Performance Level (PL) e in accordance with EN ISO 13849-1
 - in accordance with EN 60204
- Width 45 mm
- Frequencies from 1Hz to 400 kHz can be monitored depending on the sensor used.

Sensors:

- 1-channel or 2-channel protective door monitor
- Monitoring of a release magnet (spring-locked tumbler)
- PNP or NPN initiators adjustable
- Connection of different encoders possible (sin/cos, TTL, HTL)
Please note the signal shape in Chapter Technical data (Page 65).
- Connection of NAMUR initiators possible (note device versions)

Outputs:

- 2 enabling circuits with positively-driven contacts (2-channel configuration)
- 2 semiconductor signaling outputs

Times:

- Adjustable start override (0 to 999 s)
- Adjustable release delay time (0 to 999 s)
- Adjustable switch-off monitoring (0.5 to 999 s)

Adjustment/diagnostics:

- Device settings via menu-driven display or RJ45 (FCC Western Modular 8P8C) with connecting cable (copy function)
- Selectable modes:
 - Automatic mode: Monitoring of automatic speed window and standstill speed.
 - Setup mode: Monitoring of setup speed window. Standstill permanently enabled.
- Autostart/monitored start
- LED displays for status diagnostics
- Display for status diagnostics and device parameterization

Installation conditions:

- The devices must be installed in control cabinets with degree of protection IP54 or higher, taking account of the ambient conditions.

2.2 Application

The device is designed for use on machines and plants whose motions or moving parts can constitute a hazard to personnel or machinery.

The device continuously carries out standstill monitoring (output circuit 13/14) and speed monitoring (output circuit 23/24). For speed monitoring, there is a choice between automatic and setup mode.

With the corresponding circuitry and suitable additional components (such as drives, sensors and tripping elements), the 3TK2810-1 can be used to implement the safety functions STO (safe torque off), SOS (safe operating stop), SLS (safely limited speed), and SSM (safe speed monitor) from the EN 61800-5-2 standard.

Note

Routing of the sensor cables

If EMC interference is to be expected, all initiator/encoder cables are to be shielded when laid. The shielding must be connected to PE at both ends.

2.3 Basic versions

3TK2810-1 speed monitor

The speed monitor is the main component of safety-related speed monitoring and is necessary in every application. The terminals and the RJ45 interface are used for the outputs, and for supplying the device with power and signals. The device is parameterized using the keys and the display. The LEDs and the display show operating statuses, error messages and diagnostics data.

The device can be configured via the display and the keys on the front panel or via RJ45 with an appropriate connecting cable (see Chapter "Accessories (Page 23)") by means of the copy function.

The speed can be detected by the following measuring sensors:

- Two NPN or PNP proximity switches (design versions with NAMUR sensors) connected to inputs E1 and E2. The proximity switches (NAMUR sensors) are supplied with 24 V DC by the speed monitor at terminal U (design version NAMUR 8.2 V DC at terminal U1 and U2).
- Encoders (sin/cos, TTL, HTL) connected via cable adapters (available as accessories) to the RJ45 interface. The encoder is not supplied with power by the speed monitor. Absence of feedback must be observed. When selecting the encoders it must be ensured that the signal tracks A, B and their inverted tracks are present.
- A combination of encoder and proximity switch (or in the case of NAMUR sensor version).

Functional principle of the 3TK2810-1 speed monitor

The 3TK2810-1 speed monitor is used for safety-related detection or monitoring of a standstill (output 13/14), and additionally for monitoring a set speed window (lower and upper speed limit) in setup or automatic mode (output 23/24).

To detect the standstill or the speed of the motor, the speed (frequency) is measured using two NPN or PNP proximity switches (design version with NAMUR sensors) or using encoders (sin/cos, TTL, HTL) with two signal tracks and their inverted tracks. (See Fig. "Example of HTL level signal characteristics")

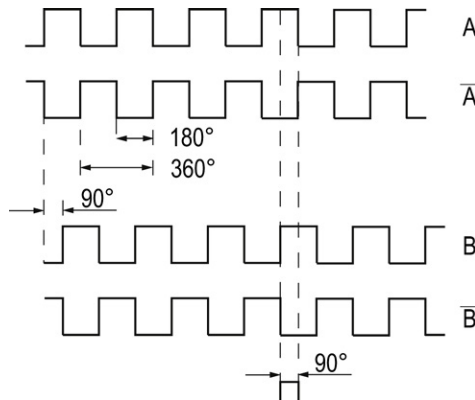


Figure 2-1 Example of HTL level signal characteristics

A combination of encoder and NPN or PNP proximity switch / Namur sensor is also possible.

Evaluation is carried out in two diversely redundant microcontrollers using the applied pulse trains. The measured frequency is compared here with the specified speed limit for standstill, and with the limits for setup or automatic mode (depending on the operating mode). The speed limits for the individual operating modes can be adjusted by the user to optimally adapt the speed monitor to the most diverse applications and motor types. If a motor standstill is detected, NO contact paths 13/14 are connected. If the speed is within the specified limits of setup or automatic mode, NO contact paths 23/24 are connected.

Power-up/self-test

Once the power supply has been applied, the device performs a self-test. During the self-test phase, all LEDs briefly light up (lamp test) and all the pixels on the display are energized for approximately 2 seconds.

After power-up, the LEDs light up according to the device status.

Functional principle in setup mode

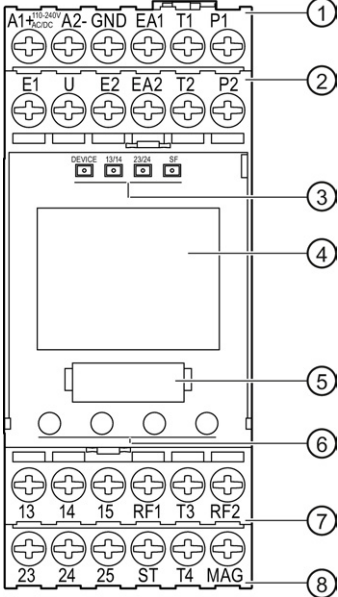
If the 3TK2810-1 safety-related speed monitor is switched to the setup mode (control of terminal EA1), the output contact 13/14 closes immediately. If the machine speed is also within the parameterized speed window, the output contact 23/24 closes.

If setup mode (control of terminal EA1) is selected, monitoring of the protective door contacts is deactivated (sensor circuits T1/P1 and T2/P2). The protective door can now be opened by an enabling command to the interlock magnets.

Versions and order numbers of the 3TK2810-1 speed monitor

MLFB	Designation
3TK2810-1BA41	Speed monitor 24 V DC screw-type terminal
3TK2810-1BA42	Speed monitor 24 V DC spring-loaded terminal
3TK2810-1KA41	Speed monitor 110 to 240 V AC/DC screw-type terminal
3TK2810-1KA42	Speed monitor 110 to 240 V AC/DC spring-loaded terminal
3TK2810-1BA41-0AA0	Speed monitor 24 V DC screw-type terminal; for use with Namur sensors
3TK2810-1BA42-0AA0	Speed monitor 24 V DC spring-loaded terminal; for use with Namur sensors
3TK2810-1KA41-0AA0	Speed monitor 110 to 240 V AC/DC screw-type terminal; for use with Namur sensors
3TK2810-1KA42-0AA0	Speed monitor 110 to 240 V AC/DC spring-loaded terminal; for use with Namur sensors

Design of the 3TK2810-1 speed monitor

Front view	No.	Meaning
	①	Removable terminal block D
	②	Removable terminal block C
	③	Display LEDs
	④	Display
	⑤	Label
	⑥	Buttons for menu navigation
	⑦	Removable terminal block A
	⑧	Removable terminal block B

Terminal designations of the 3TK2810-1 speed monitor

Terminal	Function
A1	24 V DC or 110 - 240 V AC/DC power supply
A2	Chassis ground/N
23/24	Safety-related output. Closed if speed is within permissible window or power-up override time is running
13/14	Safety-related output. Closed if speed < speed limit or setup mode has been selected (via EA1 and EA2)
15	Standstill signaling output
25	Speed signaling output
T1	Test signal channel 1
T2	Test signal channel 2
T3	Test signal channel 3
T4	Test signal channel 4
ST	Start of the drive
RF1	Feedback circuit 1 input
RF2	Feedback circuit 2 input
P1	Input for position switch channel 1
P2	Input for position switch channel 2
MAG	Input for magnet monitoring (contact closed/open when magnet attracted/repelled)
EA1	setup speed /automatic speed channel 1 switchover
EA2	Setup speed/ automatic speed channel 2 switchover
U 3TK2810-1.A4.-0AA0 only: U1	Connection of proximity switch channel 1+2
GND 3TK2810-1.A4.-0AA0 only: U2	Connection of proximity switch channel 1+2
E1	Proximity switch 1 signal input
E2	Proximity switch 2 signal input

Interfaces of the 3TK2810-1 speed monitor

Interface	Meaning
RJ45	Interface for connecting the encoder and for the copy function

Operator control elements of the 3TK2810-1 speed monitor

Element	Meaning
Keys	Navigation in the operator control menu / error acknowledgement

Display elements of the 3TK2810-1 speed monitor

Element	Display	Meaning
DEVICE	Green	Device OK
	Flashing green	Parameterizing mode
	Flashing red	Parameterization error
	Red	Device defective
13/14	Green	Output contact 13/14 closed
	Flashing green	Switch-off monitoring feedback circuit 2 failed
23/24	Green	Output contact 23/24 closed
	Flashing green	Switch-off monitoring feedback circuit 1 failed
SF	Off	No error
	Red	(External) error
Display		Diagnosis
		Error messages
		Status indicator, possibly parameterization

2.4 Accessories

The following accessories are available in addition to the main devices:

MLFB	Designation
3TK2810-0A	Cable for connecting with encoder/for copy function
3TK2810-1A	Adapter for connecting with Siemens/Heidenhain encoder 15-pin
3TK2810-1B	Adapter for connecting with Siemens/Heidenhain encoder 25-pin

The adapters (15-pin or 25-pin) are used as the connection between the encoder, the controller and the standstill/speed monitor. They are designed for Siemens/Heidenhain controllers with the following PIN assignments:

Signal	SUB D15/SUB D25	RJ45
VCC	1	2*
GND	2	1
A	3	3
$\bar{A}$	4	4
B	6	6
$\bar{B}$	7	8

* Connection not absolutely necessary (not evaluated by device)

Further accessories:

Fixing lugs for mounting the device on a level surface. Per device 2 units are required.

Order No.: 3RP1903



Functions

3.1 Terminals and their functions

Supply voltage A1, A2

Connection for device supply (see Chapter "Technical data (Page 65)").

Measuring inputs U, GND, (or U1, U2), E1, E2 and RJ45

The connections E1 and E2 are provided for NPN and PNP proximity switches (device version with NAMUR sensors). The switches are supplied by terminals U with 24 V DC (device version NAMUR $U1 = U2 = 8.2 \text{ V DC}$) and GND. The encoder type (NPN or PNP) must be selected in the menu.

The RJ45 interface is suitable for connecting encoders with sin/cos, TTL and HTL signals.

Output circuits (contacts) 13/14, 23/24

The device has two output circuits each implemented with two safety relays (standstill 13/14: K1, K2; setup or automatic speed monitoring 23/24: K3, K4) with positively-driven contacts switched in series.

- Automatic mode: Monitoring of automatic speed window and standstill speed.
- Setup mode: Monitoring of setup speed window. Standstill permanently enabled.
- Contact 13/14 switches in if the speed drops below the set standstill speed ($n < n_{\text{still}}$), in other words, if standstill is detected.
- Contact 23/24 switches in if the speed is within the set speed limits of setup or automatic mode ($n_{\text{min}} < n < n_{\text{max}}$).

Signaling outputs 15 and 25

The semiconductor signal outputs 15 and 25 are designed, for example, for connection to a PLC and not for use in safety-related functions.

They function as follows:

- The internal supply potential (U_{Rel} approx. 24 V) is output via terminal 15 when the speed drops below the set standstill speed ($n < n_{\text{still}}$), in other words, if standstill is detected.
- The internal supply potential (U_{Rel} approx. 24 V) is output via terminal 25 if the speed is within the set speed limits of setup and automatic mode ($n_{\text{min}} < n < n_{\text{max}}$).

Test signals T1, T2, T3, T4

To detect errors in the input circuit or in processing of the safety-related inputs ST, RF1, RF2, EA1, EA2, P1, P2 and MAG, a dynamic output signal is routed via the contact blocks, and via the start and feedback circuits. The output signals at the individual outputs T1, T2, T3 and T4 vary here so that cross-circuits between the output signals can thus also be detected.

Signal input ST (start circuit)

The start signal is applied at this input. ST is supplied by test signal T4. To start the motion connected at 23/24 as well as the monitor, the on pushbutton must be pressed in the case of manual start. The pushbutton is monitored for cross-circuit or short-circuit by scanning the falling edge (opening of the on pushbutton) at switch-on. For this reason, it must not be pressed for longer than 3 s. If a cross-circuit or short-circuit is detected, the device switches to the safe state and a diagnostics message is displayed.

After correction of the fault, it is necessary to perform a reset (see Chapter "Troubleshooting (Page 57)") or a restart by switching the supply voltage off and on.

At autostart, the test signal T4 must be applied at ST to start the device using a jumper.

Signal input MAG (interlock for protective door)

MAG is supplied by test signal T4. When the hazardous motion is started (output 23/24), the protective door must be interlocked. The interlock magnet is equipped with a contact that is read into the device via the MAG terminal. If the contact is closed, the device cannot be started or it goes immediately to a safe state (output contact 23/24 drops out). However, as soon as the contact is closed again, the device can be restarted. Acknowledgment of the error is not necessary.

The contact is permanently monitored. If this is not used, terminals T4 and MAG must be jumpered.

Signal input RF1 (feedback circuit for setup or automatic mode)

RF1 is supplied by test signal T3. The NC contacts of the external contactors connected at terminal 24 are read in via terminal RF1. Connection of output contact 23/24 is only possible if the feedback contacts are closed.

If contact extension or reinforcement is not used, terminals T3 and RF1 must be jumpered.

Signal input RF2 (feedback circuit for standstill)

RF2 is supplied by test signal T3. The NC contacts of the external contactors connected at terminal 14 are read in via terminal RF2. Connection of output contact 13/14 is only possible if the feedback contacts are closed. If output contact 13/14 is switched off, the feedback contacts must be closed 1 second afterwards, otherwise the relevant diagnostics message appears. After correction of the fault, it is necessary to perform a reset (see Chapter "Troubleshooting (Page 57)") or a restart by switching the supply voltage off and on.

If contact extension or reinforcement is not used, terminals T3 and RF2 must be jumpered.

Signal input P1 and P2 (position switches for protective door)

P1 is supplied by test signal T1, and P2 by test signal T2. These terminals are used to connect the position switches for the protective door with a tumbler. To achieve maximum fail-safety (Performance Level e in accordance with DIN EN ISO 13849-1 and SIL3 in accordance with IEC EN 61508), the position switches are connected with two channels.

The position switches are monitored for simultaneity. When the position switches are opened, contacts P1 and P2 must be opened within $t < 0.5$ s. If simultaneity is not satisfied, a diagnostics message appears on the display. After correction of the fault, it is necessary to perform a reset (see Chapter "Troubleshooting (Page 57)") or a restart by switching the supply voltage off and on.

Both position switches must be closed to start output contact 23/24. When connecting a single-channel position switch or two individual single-channel position switches for a lower category, detection of simultaneity must be disabled in the menu. Terminals T2 and P2 must be jumpered when using a single-channel position switch.

If no position switches are used, terminals T1 must be jumpered with P1, and terminals T2 with P2.

If setup mode (control of terminal EA1) is selected, monitoring of the protective door contacts is deactivated (sensor circuits T1/P1 and T2/P2). The protective door can now be opened by an enabling command to the interlock magnets.

Signal input EA1 and EA2 (operating mode selection)

The speed monitor is suitable for monitoring 2 operating modes (setup and automatic mode). The relevant speed limits for both operating modes are set in the menu using the pushbuttons. Safety-related selection of the operating mode, and thus the speed to be monitored, is carried out with an antivalent switch connected in a two-channel configuration to connections EA1 and EA2.

Monitoring of the setup speed is selected if EA1 is connected with T1 via the antivalent selector switch, and EA2 is disconnected from T2 by the antivalent switch. To monitor automatic speed, EA1 must be disconnected from T1 by the antivalent switch, and EA2 must be connected to T2 via the antivalent selector switch. The two channels of the switch are monitored for simultaneity ($t_{diff} < 0.5 \text{ s}$). If simultaneity is not satisfied, or a cross-circuit exists between EA1 and EA2, the device goes to a safe fault state. After correction of the fault, it is necessary to perform a reset (see Chapter "Troubleshooting (Page 57)") or a restart by switching the supply voltage off and on.

If the 3TK2810-1 safety-related speed monitor is switched to the setup mode (control of terminal EA1), the output contact 13/14 closes immediately. If the machine speed is also within the parameterized speed window, the output contact 23/24 closes.

3.2 Function diagram for setup and automatic mode

Requirements

- Start type: Automatic start
- Protective door closed and signal present at P1 and P2
- Magnet of the tumbler provides positive checkback signal (signal to MAG)

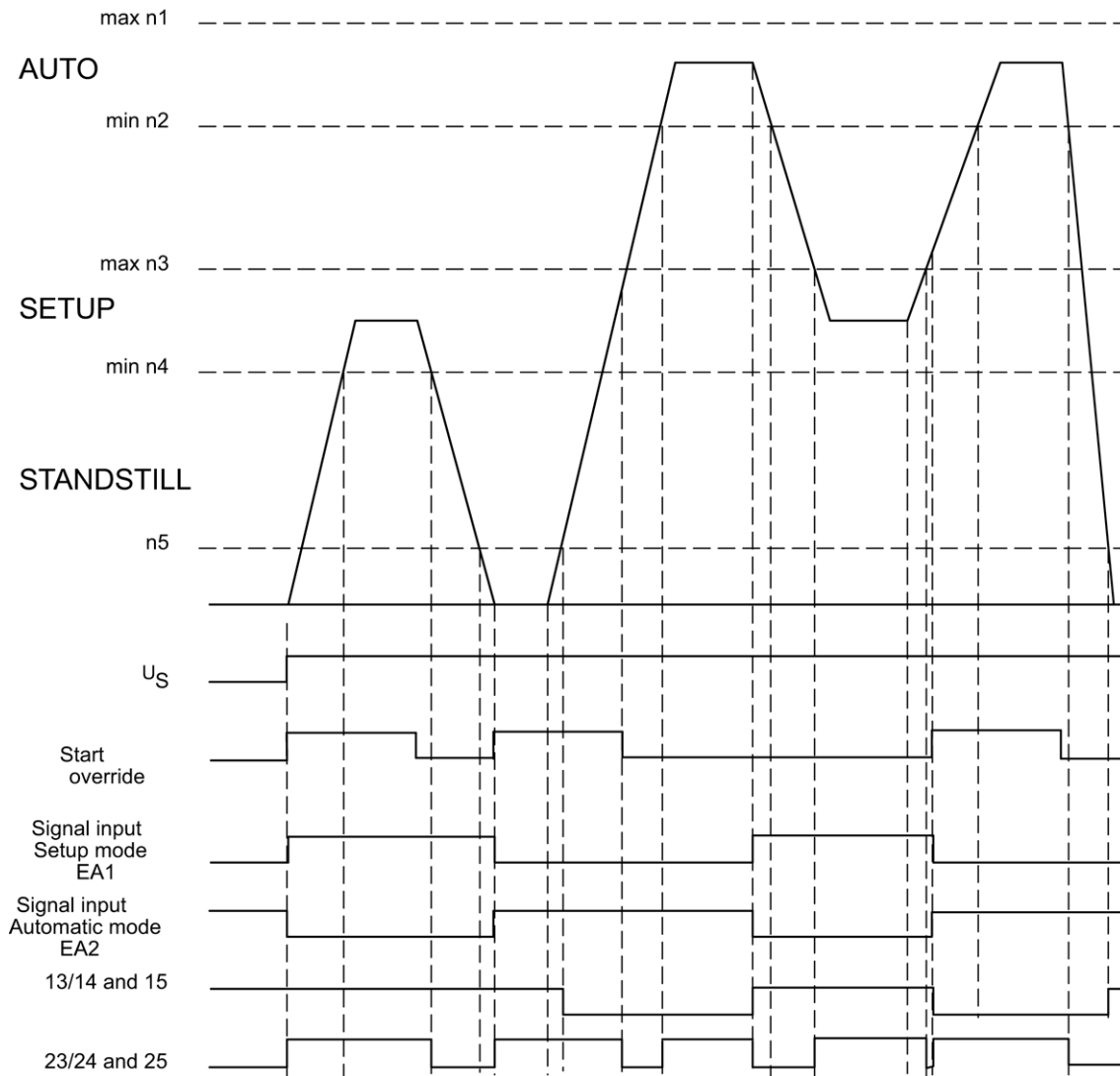
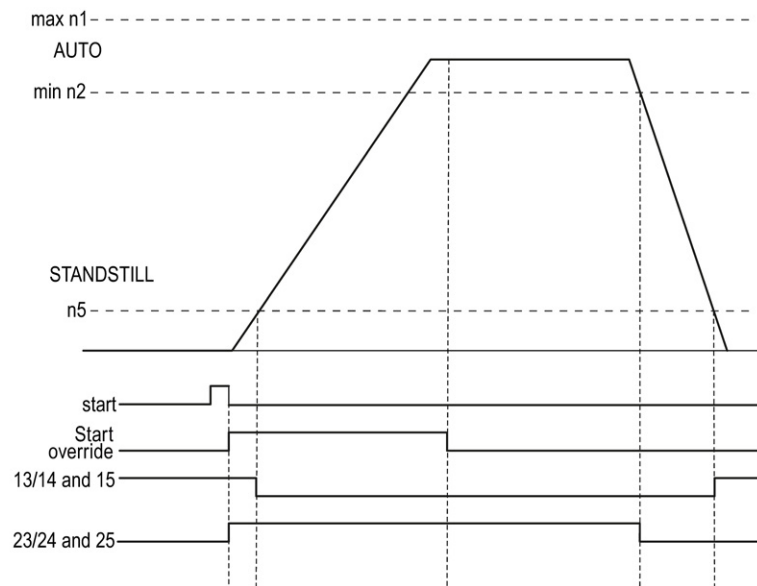


Figure 3-1 Function diagram for setup and automatic mode

3.3 Function diagram for automatic mode

Requirements

- Start type: Manual start
- Protective door closed and signal present at P1 and P2
- Magnet of the tumbler provides positive checkback signal (signal to MAG)
- "AUTOMATIC MODE" is selected (no signal at EA1 and signal at EA2)



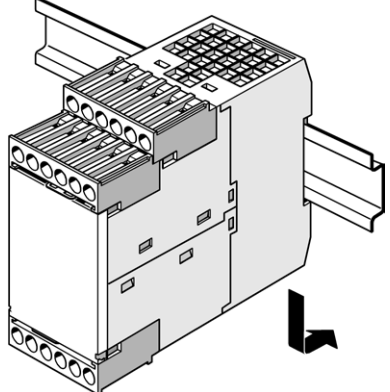
Assembling

4.1 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 "Technical data (Page 65)"

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	

4.2 Mounting the device on a level surface

Requirements

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

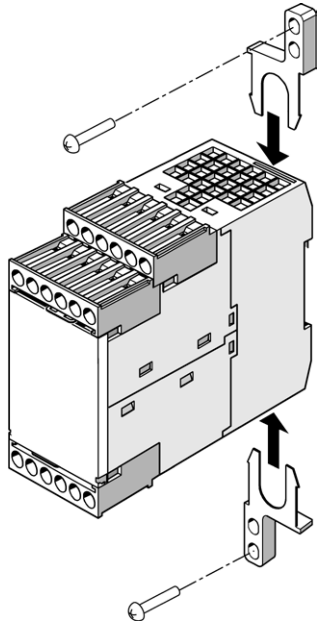
- Please observe the information about the mounting position in Chapter "Technical data (Page 65)".
- Two properly executed drill holes with thread or plug on the level surface

For details of the distances between the drilled holes, please refer to the relevant dimension drawings in Chapter "Dimension drawings (Page 73)".

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

Please refer to the accessories list for the relevant order number in Chapter "Accessories (Page 23)".

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.	

4.3 Disassembling the device

WARNING

Hazardous Voltage.

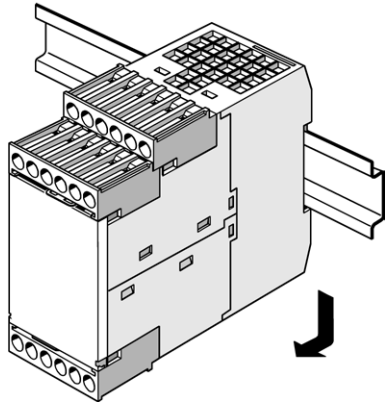
Can Cause Death, Serious Injury, or Property Damage.

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

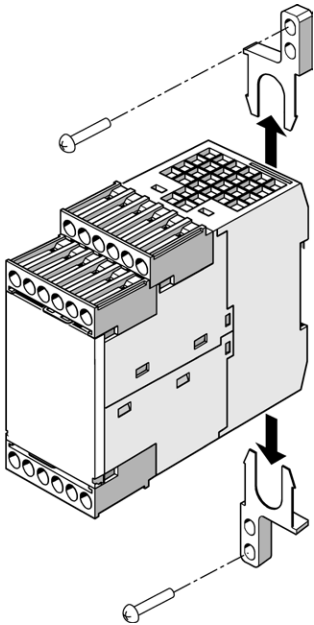
Requirements

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

Disassembling the device from a DIN rail

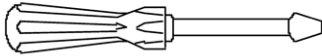
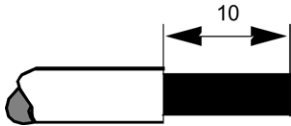
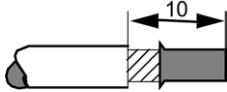
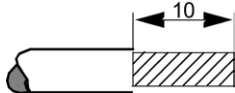
Step	Operating instruction	Figure
1	Pull the device down until the lower half can be pulled away from the DIN rail.	
2	Pull the lower half of the device away from the DIN rail.	
3	Lift the device from the upper edge of the DIN rail.	

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.	

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 Order No.: 8WA2803	Screwdriver Size: 0 or 1 (width to 3 mm) for raising the terminal springs Order 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

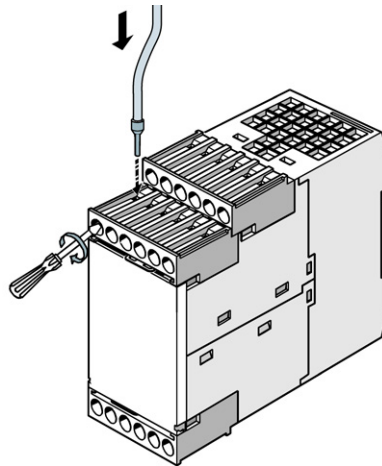
WARNING

Hazardous Voltage.

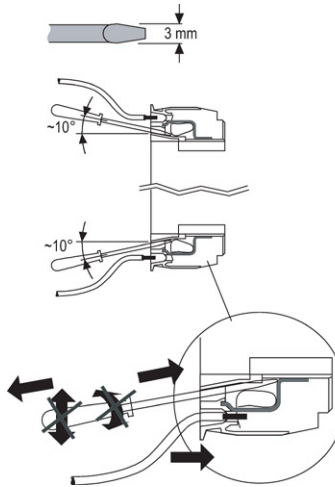
Can Cause Death, Serious Injury, or Property Damage.

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

Procedure for screw-type terminal blocks

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.	

5.3 Disconnecting

WARNING

Hazardous Voltage.

Can Cause Death, Serious Injury, or Property Damage.

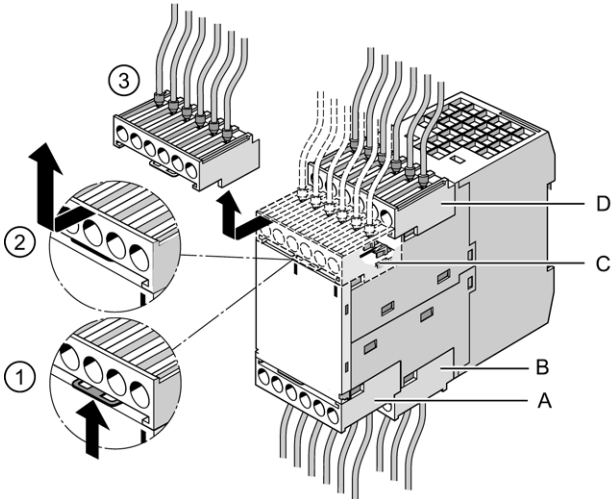
Before starting work, therefore, disconnect the system and devices from the power supply.

Removing terminal blocks from the device

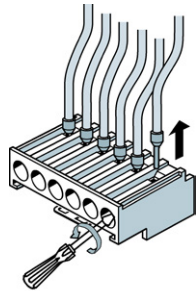
Note

Order of removal

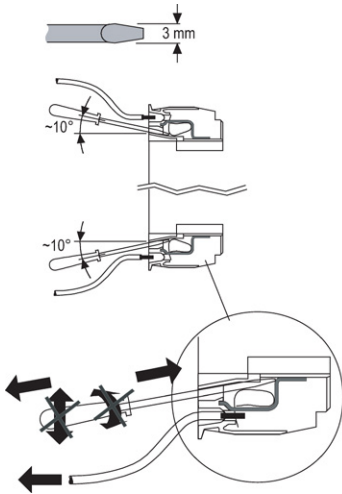
Remove terminal block A before terminal block B, and C before D.

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.

Requirement

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

Procedure when plugging in the terminal blocks

Note

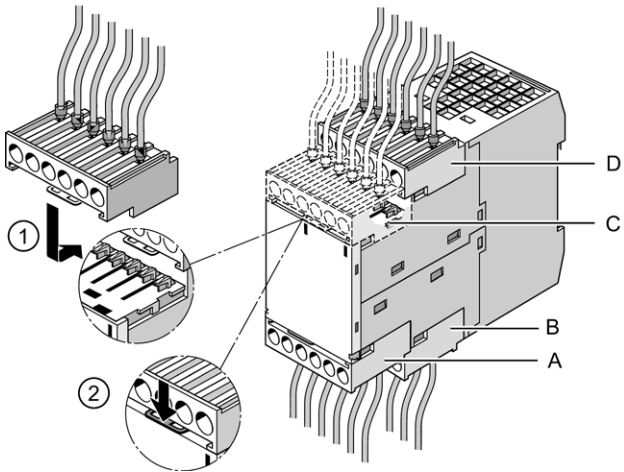
Removable terminal blocks are mechanically coded to prevent polarity reversal

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.

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.	

Operation

6.1 Times

Start override time t_a

The start override time is used, for example, to bridge the start time of a motor until it has reached a specific speed. If the parameterized min. setup or automatic speed is not reached within the parameterized start override time t_a , the device switches immediately to the safe state. Contacts 23/24 are opened and signaling output 25 switches off.

The start override executes at restart of the device, when changing from setup to automatic mode in autostart mode, and in manual start mode every time the on pushbutton is pressed. However, the requirement for this is always that before starting the start override time, all safety requirements (position switch, magnet switch, feedback circuit) must be satisfied, with the exception of the speed. During start override, output contact 23/24 is permanently connected provided the safety requirements such as position switch and magnet switch continue to be satisfied.

See also Chapter "Terminals and their functions (Page 25)" in this regard.

Release delay time t_v

The release delay time is the time that elapses until output contacts 13/14 and signaling contact 15 are switched through following a detected standstill.

See also Chapter "Terminals and their functions (Page 25)" in this regard.

Switch-off monitoring time t_r

The switch-off monitoring time is used to check the contactors connected to output contacts 23/24. If the feedback at RF1 is not available within the parameterized switch-off monitoring time t_r after switching off output 23/24, a blink code in the ratio 50/50 is output at signaling output 25. An error message is also displayed.

After correction of the fault, it is necessary to perform a reset (see Chapter "Troubleshooting (Page 57)") or a restart by switching the supply voltage off and on.

Verification of response times in the case of safety circuits

When safety equipment is commissioned, steps must be taken to verify that a safety-related output will switch off within a maximum permissible response time if the input signal changes at the relevant input.

To provide this verification, you must calculate the total response time of the application you have configured.

Note

Note that the results of calculating the response time affect the level of safety and affect the overall design of the system.

Response time up to the switch-off procedure after expiry of the set start override time

The maximum response time up to detection of a violation of the upper/lower limit depends on the selected parameters. The lower the set values, the longer the device requires to detect the pending fault.

To achieve a faster response time, encoders or gear wheels that supply several pulses per revolution can be used (e.g. encoders with 32 pulses). This reduces the time $1 / f_{\text{threshold}}$ by the factor of the number of pulses of the encoder or the number of teeth on the gear wheel.

The following applies in general: $t_{\text{Switch-off_max}} = 1 : f + t_{\text{Response}}$

e.g. under-speed in setup mode to be checked 120 rpm = 2 Hz

with initiators (1 pulse/rev.): $t_{\text{Switch-off_max}} = 1 : 2 \text{ Hz} + 150 \text{ ms} = 650 \text{ ms}$

with encoder with number of pulses = 32: $t_{\text{Switch-off_max}} = 1 : (2 \text{ Hz} \times 32) + 150 \text{ ms} = 166 \text{ ms}$

f = set frequency threshold or frequency of the applied measuring signal (e.g. under-frequency in setup mode)

t_{Response} = internal response time following detection of the switch-off frequency (max. 150 ms)

Indication on the display

In the normal operating mode, all set values can be checked at any time by pressing the "Up" or "Down" key.

In addition, the current speed is indicated by initiator 1 or by the encoder. However, this speed does not correspond to the accuracy of the device and is used exclusively for diagnostics purposes!

6.2 Parameterizing/configuring

6.2.1 Commissioning

Note

Since the commissioning and parameterization of the speed monitor are important safety-related steps, they must be carried out by qualified personnel.

Requirements

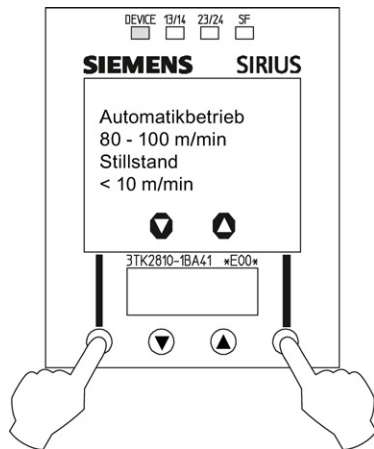
The following requirements must be met for commissioning:

- The device has been installed
For more information see: Chapter "Assembling (Page 31)"
- Check all the latches to ensure that they are properly engaged.
- The device has been wired
For more information see: Chapter "Connecting (Page 35)"
- The parameterization is available and consistent.
- The power supply for the device is connected.

6.2.2 Parameterization using the display

To enter the parameterization mode of the device, press the following button combinations:

- Press the right button and keep it pressed.
- Also press the left button (see below).
A display test follows
- After correct execution of the display test, confirm with the OK button (right button)
- The parameterization can then be modified.
- Before the device accepts the modified parameters, you must confirm the parameters again for security.



! WARNING

Hazardous Voltage.

Can Cause Death, Serious Injury, or Property Damage.

Carry out functional test of the system

To guarantee the safety of the system, a full functional test must be carried out and successfully concluded following parameterization.

Note

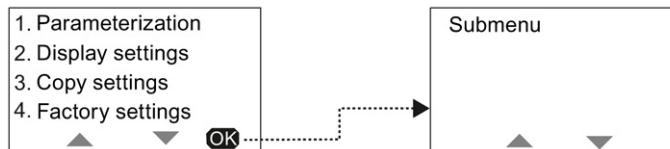
You must document the set parameters with the printed form (see Chapter "Appendix (Page 79)").

6.2.3 Change tracking of parameterization

The menu item "Change tracking" is available in order to be able to recognize any changes that have been made subsequently to the parameterization. In this menu a counter can be activated once. It is then incremented with every future change. Once the counter has been activated, it is no longer possible for the user to reset or deactivate the counter.

6.2.4 Parameterization menu

You can navigate the menu with the pushbuttons. Each menu option may have additional sub-menus. The menu structure and menu representation are in part directly dependent on the device parameterization and the hardware configuration.



1.	Parameterization		
	1.1	Monitored motion ¹⁾	
			Translational
			Rotational
		ESC	OK
	1.2	Encoder type ¹⁾	
			Lin. encoder
			Rot. encoder
		ESC	OK
	1.3	Encoder selection	
			RJ45: Encoder + E2
			RJ45: Encoder
			E1+ E2
		ESC	OK
	1.4	Lead/transmission	
			Transmission
			x: 1
			Lead
			xxxxx.xxx [mm]
		ESC	OK

1.	Parameterization		
	1.5	Encoder settings	
			Signal form
			sin/cos or TTL
			HTL
			Resolution
			xxxxxx or xxx.xx [pulses/rev. or mm]
		ESC	OK
	1.6	Initiator settings	
			Initiator type
			pnP
			npN
			Resolution E1
			xxxxx [pulses/rev. or mm]
			Resolution E2
			xxxxx [pulses/rev. or mm]
		ESC	OK
	1.7	Speed limits	
			Automatic max.
			xxxxx [rpm or m/min]
			Automatic min.
			xxxxx [rpm or m/min]
			Setting max.
			xxxxx [rpm or m/min]
			Setting min.
			xxxxx [rpm or m/min]
			Standstill
			xxxxx [rpm or m/min]
			ESC
		1.8	Times
			Start override
			xx.x [s]
			Release delay
xxx.x [s]			
Switch-off monitoring			
xxx.x [s]			
ESC	OK		

1.	Parameterization		
	1.9	Start type	
		☐	Manual start
		☐	Automatic start
		ESC	OK
	1.10	Protective door monitoring	
		☐	Simultaneity on
		☐	Simultaneity off
		ESC	OK

1) If this setting is changed, points 1.4, 1.5 and 1.7 are reset to the default values.

2.	Display settings		
	2.1	Languages	
		☐	english
		☐	deutsch
		☐	francais
		☐	espanol
		☐	italiano
		ESC	OK
	2.2	Contrast	
			xxx [%]
		ESC	OK
	2.3	Lighting	
		☐	Off
		☐	3 s
		☐	10 s
		☐	1 min
		☐	5 min
		☐	On
		ESC	OK
	2.4	Diagnosis	
		☐	Do not display
		☐	Display
		ESC	OK
	2.5	Error messages	
		☐	Do not display
		☐	Display
		ESC	OK

2.	Display settings		
	2.6	Status indicator	
			Manual
			3 s
			10 s
			1 min
			5 min
	ESC		OK

3.	Copy settings		
		Parameters	
		Display settings	
		Parameters + display settings	
	ESC		OK

4.	Factory settings		
		Parameters	
		Display settings	
		Parameters + display settings	
	ESC		OK

5.	Change tracking		
		Activate	
	ESC		OK

6.	About 3TK2810-1		
	ESC		OK

6.2.5 Parameterization and pin assignments of the RJ45 interface

The RJ45 interface is used for connecting an encoder to the device with the relevant configuration of the 3TK2810-1. With the appropriate transfer cable (see accessories), the interface can also be used to parameterize another device using the copy function. This is important if the speed monitor is to be used in a standard application, or if it has to be replaced in the event of a fault.

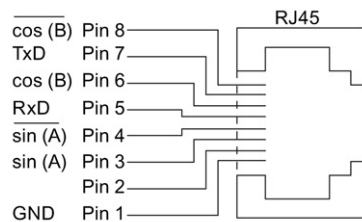


Figure 6-1 Pin assignments of the RJ45 interface

6.2.6 Copying parameters

The parameters can be copied by linking two speed monitors using the transfer cable.

Procedure:

1. Connect both speed monitors with the transfer cable
2. Connect both speed monitors to power supply
3. Select "Copy parameters" in the menu of the "Sending device".
4. Start the copy operation with "Send parameters"
5. The prompt "Receive parameters?" appears on the display of the "Receive device" As soon as this is acknowledged with "OK" (right softkey), transfer begins.
6. When transfer has been completed, the basic screens appear again on both devices.
7. Disconnect the cable (remove transfer cable).

WARNING

Hazardous Voltage.

Can Cause Death, Serious Injury, or Property Damage.

Carry out functional test of the system

To guarantee the safety of the system, a full functional test must be carried out and successfully concluded after copying the parameters.

6.3 Configuring

6.3.1 Configuration information

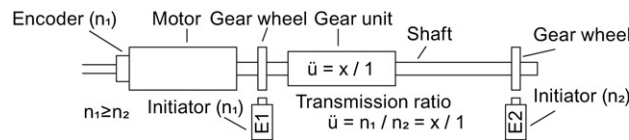
Mounting measuring sensors

Cross-circuits between the measuring sensors must be avoided by means of suitable cable installation.

Transmission ratio or shaft fracture monitoring

In certain applications, it can be necessary to set a transmission ratio. The following arrangement of the initiators or the encoder is necessary here:

- The speed to be monitored on the encoder or on initiator 1 (E1) must always be greater than or equal to the speed to be monitored on initiator 2 (E2).
- The set speed limits on the display always refer to the encoder or to initiator 1 (E1) when a transmission ratio is set.
- If the gear unit switched between E1 and E2 does not have an integer ratio, it can be adjusted appropriately by modifying the resolution settings E1/E2 (pulses/rev. or mm).



z.B.: $n = 1500 \text{ U/min}$; $n = 300 \text{ U/min}$

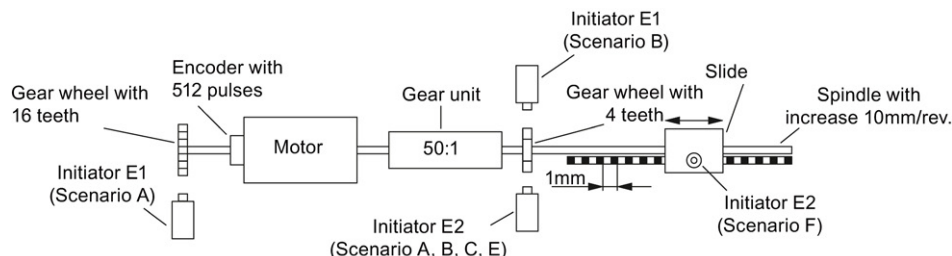
$$\ddot{u} = \frac{n_1}{n_2} = \frac{1500 \text{ U/min}}{300 \text{ U/min}}$$

➔ Input on display ratio = 5:1

This arrangement is also used to detect a shaft fracture. If the measuring signals of the measuring sensor do not agree with the measuring sensor on the shaft in accordance with the ratio, the device switches immediately to a safe fault state.

6.3.2 Configuration examples

6.3.2.1 Rotational motion, rotary encoder



Settings on the display using the example above:

Scenario A:

1. Parameterization:

- | | |
|-------------------------|----------------|
| 1.1 Monitored motion: | Rotational |
| 1.2 Encoder type: | Rot. encoder |
| 1.3 Encoder selection: | E1+E2 |
| 1.6 Initiator settings: | |
| Resolution E1 | 16 pulses/rev. |
| Resolution E2 | 4 pulses/rev. |
| 1.4 Lead//transmission: | |
| Transmission: | 50:1 |

The speed limits (rpm) to be set refer to the speed at initiator E1.

Scenario B:

1. Parameterization:

- | | |
|-------------------------|---|
| 1.1 Monitored motion: | Rotational |
| 1.2 Encoder type: | Rot. encoder |
| 1.3 Encoder selection: | E1+E2 |
| 1.6 Initiator settings: | |
| Resolution E1 | 4 pulses/rev. |
| Resolution E2 | 4 pulses/rev. |
| 1.4 Lead//transmission: | |
| Transmission: | 1:1 (since the measurement is made at the same point) |

The speed limits (rpm) to be set refer to the speed at initiator E1.

Scenario C:

- 1. Parameterization:
 - 1.1 Monitored motion: Rotational
 - 1.2 Encoder type: Rot. encoder
 - 1.3 Encoder selection: Encoder+E2
 - 1.5 Encoder resolution: 512 pulses/rev.
 - 1.6 Initiator settings:
 - Resolution E2 4 pulses/rev.
 - 1.4 Lead//transmission:
 - Transmission: 50:1
- The speed limits (rpm) to be set refer to the speed at the encoder.

Scenario D:

- 1. Parameterization:
 - 1.1 Monitored motion: Rotational
 - 1.2 Encoder type: Rot. encoder
 - 1.3 Encoder selection: Encoder
 - 1.5 Encoder resolution: 512 pulses/rev.
 - 1.4 Lead//transmission:
 - Transmission: not relevant since only one encoder has been selected.
- The speed limits (rpm) to be set refer to the speed at the encoder.

Scenario E: Monitoring the slide to, e.g. 3 m/min.

- 1. Parameterization:
 - 1.1 Monitored motion: Rotational
 - 1.2 Encoder type: Rot. encoder
 - 1.3 Encoder selection: Encoder+E2
 - 1.5 Encoder resolution: 512 pulses/rev.
 - 1.6 Initiator settings:
 - Resolution E2 4 pulses/rev.
 - 1.4 Lead//transmission:
 - Transmission: 50:1
- $$\begin{aligned}
 \text{Rotational monitoring threshold} &= \frac{\text{Translational monitoring threshold} \times \text{transmission ratio}}{\text{Lead}} \\
 &= \frac{3 \text{ m/min} \times 50}{10 \text{ mm/rev.}} = 15000 \text{ rpm}
 \end{aligned}$$

Scenario F: Monitoring the slide to, e.g. 3 m/min.

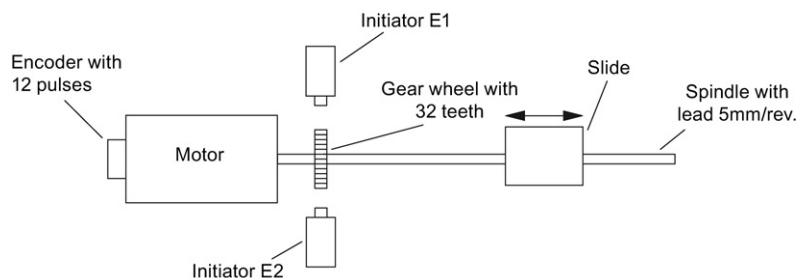
1. Parameterization:

1.1 Monitored motion:	Rotational
1.2 Encoder type:	Rot. encoder
1.3 Encoder selection:	Encoder+E2
1.5 Encoder resolution:	512 pulses/rev.
1.6 Initiator settings:	
Resolution E2	10 pulses/rev. (1 mm/pulse)
1.4 Lead//transmission:	
Transmission:	50:1

The speed limits (rpm) to be set refer to the speed at the encoder, so to monitor the slide as shown, the translational motion must first be converted to the corresponding rotational motion. The resolution of initiator E2 must also be calculated. This is done as follows:

$$\begin{aligned}
 \text{Rotational initiator resolution E2} &= \frac{\text{Lead}}{\text{Translational initiator resolution E2}} \\
 &= \frac{10 \text{ mm/rev.}}{1 \text{ mm/pulse}} = 10 \text{ pulses/rev.} \\
 \\
 \text{Rotational monitoring threshold} &= \frac{\text{Translational monitoring threshold x transmission ratio}}{\text{Lead}} \\
 &= \frac{3 \text{ m/min} \times 50}{10 \text{ mm/rev.}} = 15000 \text{ rpm}
 \end{aligned}$$

6.3.2.2 Translational motion, rotary encoder



Settings on the display using the example above:

Scenario A:

1. Parameterization:
 - 1.1 Monitored motion: Translational
 - 1.2 Encoder type: Rot. encoder
 - 1.3 Encoder selection: E1+E2
 - 1.6 Initiator settings:

Resolution E1	32 pulses/rev.
Resolution E2	32 pulses/rev.
 - 1.4 Lead//transmission:

Lead:	5 mm/rev.
-------	-----------

The speed limits (rpm) to be set refer to the speed at initiator E1.

Scenario B:

1. Parameterization:
 - 1.1 Monitored motion: Translational
 - 1.2 Encoder type: Rot. encoder
 - 1.3 Encoder selection: Encoder+E2
 - 1.5 Encoder resolution: 12 pulses/rev.
 - 1.6 Initiator settings:

Resolution E2	32 pulses/rev.
---------------	----------------
 - 1.4 Lead//transmission:

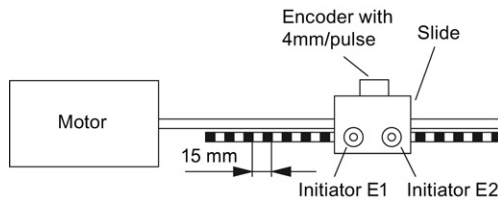
Lead:	5 mm/rev.
-------	-----------

The speed limits (rpm) to be set refer to the speed at the encoder.

Scenario C:

- 1. Parameterization:
 - 1.1 Monitored motion: Translational
 - 1.2 Encoder type: Rot. encoder
 - 1.3 Encoder selection: Encoder+E2
 - 1.5 Encoder resolution: 12 pulses/rev.
 - 1.6 Initiator settings:
 - Resolution E2 32 pulses/rev.
 - 1.4 Lead//transmission:
 - Lead: 5 mm/rev.
- The speed limits (rpm) to be set refer to the speed at the encoder.

6.3.2.3 Translational motion, linear encoder



Settings on the display using the example above:

Scenario A:

1. Parameterization:
 - 1.1 Monitored motion: Translational
 - 1.2 Encoder type: Lin. encoder
 - 1.3 Encoder selection: E1+E2
 - 1.6 Initiator settings:

Resolution E1	15 pulses/rev.
Resolution E2	15 pulses/rev.

The speed limits (rpm) to be set refer to the frequency at initiator E1.

Scenario B:

1. Parameterization:
 - 1.1 Monitored motion: Translational
 - 1.2 Encoder type: Lin. encoder
 - 1.3 Encoder selection: Encoder+E2
 - 1.5 Encoder resolution: 4 mm/pulse
 - 1.6 Initiator settings:

Resolution E2	15 pulses/rev.
---------------	----------------

The speed limits (rpm) to be set refer to the frequency at the encoder.

Scenario C:

1. Parameterization:
 - 1.1 Monitored motion: Translational
 - 1.2 Encoder type: Lin. encoder
 - 1.3 Encoder selection: Encoder
 - 1.5 Encoder resolution: 4 mm/pulse

The speed limits (rpm) to be set refer to the frequency at the encoder.

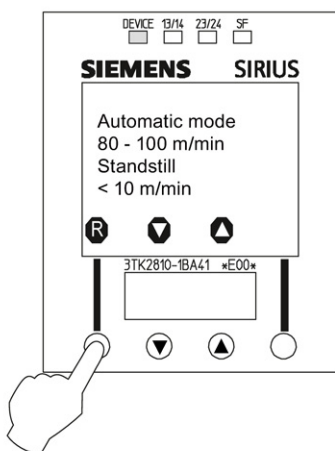
Diagnostics/troubleshooting

7.1 Reading the setting values during operation

The parameters set on the device during normal operation can be read using the "up/down" arrow keys.

7.2 Troubleshooting

If faults are detected on or in the device, these are indicated by the LEDs and on the display with the appropriate message. If the fault necessitates a reset of the device, the pending fault must first be corrected and the error/diagnostics message on the device must be acknowledged. The left button must then be pressed for approximately 3 seconds to trigger a reset of the device.



In the case of system faults, the device must be briefly switched off. If a system fault is detected again on switching on, the device must be returned to the manufacturer.

7.3 Corrective action

Error message	SF LED	Error	Diagnosis	Device response
Simultaneity of protective door not fulfilled	Red	Simultaneity was not fulfilled	Check position switch	Restart or reset
Speed sensor defective	Red	Parameterized speed sensor does not return a signal or returns an incorrect signal	• Check plug-in connection or terminal connection • Check signal cables • Check speed sensor	Restart or reset
Fault on external contactors (switch off)	Red	Device stopped and RF contacts do not close	• Check connection cables • Check contactors	Device switches to the safe state. Restart or reset following correction of the fault
Fault in the feedback circuit (RF)	Red	Impermissible signal on RF	• Check wiring (wire break or short-circuit)	Device switches to the safe state. A restart is necessary following correction of the fault
Fault at the position switch input (P1/P2)	Red	Impermissible signal at the position switch input	• Check wiring (wire break or short-circuit/cross-circuit)	Device switches to the safe state. A restart or reset is necessary following correction of the fault
Fault at the start input (ST)	Red	Impermissible signal at the start input	• Check wiring (wire break or short-circuit/cross-circuit)	Device switches to the safe state. A restart or reset is necessary following correction of the fault
Fault at the setup/automatic input (EA1/EA2)	Red	Impermissible signal at the setup/automatic input	• Check wiring (wire break or short-circuit/cross-circuit)	Device switches to the safe state. A restart is necessary following correction of the fault
Fault at the magnet contact input (MAG)	Red	Impermissible signal at the magnet contact input	• Check wiring (wire break or short-circuit/cross-circuit)	Device switches to the safe state. A restart or reset is necessary following correction of the fault
Fault in the cable connection to the adapter (3TK2810-1A, 3TK2810-1B)	Red	Fault in the cable connection to the adapter (3TK2810-1A, 3TK2810-1B)	• Check plug-in connectors of the connecting cable • Check connecting cable • Check power supply of the adapter	Device switches to the safe state. A restart or reset is necessary following correction of the fault
Feedback circuit 1 does not close in time	Red	Switch-off monitoring time exceeded	• Check wiring at the outputs (short-circuit) • Check external contactors	Device switches to the safe state. A restart or reset is necessary following correction of the fault

7.4 Behavior in the event of a fault

7.4.1 Power failure

After failure of the supply voltage, the device is switched off. When the supply returns, the device is ready for operation again. For more information on power-up please refer to Chapter "Basic versions (Page 17)", section "Power-up/self-test".

7.4.2 Internal error

The device LED shows a red light in the case of an internal fault in the device. The device must be replaced and repair is not possible.

Note

The device LED on the 3TK2810-1 devices can also show a continuous red light if a discrepancy is found between the two internal processors that monitor each other. Apart from an actual device defect, extreme EMC influences may cause this discrepancy. If this is the case, however, the display will indicate an error code at the same time. Please notify us of this error code if the problem occurs again. With a cold start, i.e. after the control supply voltage has been interrupted, the 3TK2810-1 device forgets this error again.

7.4.3 Sensor fault

7.4.3.1 Position switch protective door

When the position switches are opened, contacts P1 and P2 must be opened within $t < 0.5$ s. If simultaneity is not satisfied, a diagnostics message appears on the display. After correction of the fault, it is necessary to perform a reset (see Troubleshooting) or a restart by switching the supply voltage off and on.

Both position switches must be closed to start output contact 23/24.

If only single-channel or two individual single-channel position switches are to be connected for a lower category, detection of simultaneity must be disabled in the menu. Terminals T2 and P2 must be jumpered when using a single-channel position switch. If no position switches are used, terminals T1 must be jumpered with P1, and terminals T2 with P2.

7.4.3.2 Speed sensor

If the speed sensor fails (encoder or initiators defective), the device switches to the safe state (outputs are switched off).

A restart or reset is necessary following correction of the fault.

7.4.4 Fault in the feedback circuit

7.4.4.1 Contacts of the feedback circuit are not closed on starting

Connection of output contact 13/14 or 23/24 is only possible if the relevant feedback contact is closed.

A fault message is not displayed.

7.4.4.2 Contacts of the feedback circuit do not close after stopping

If the contacts of the feedback circuit do not close after the device is stopped, the contactors are still energized or defective. A message is displayed.

A restart or reset is necessary following correction of the fault.

7.4.5 Cross-circuit/short-circuit

If a cross-circuit or short-circuit is detected, the device switches to the safe state. An error message is generated and the diagnostics provides information on the location of the fault.

A restart or reset is necessary following correction of the fault.

7.4.6 Fault in the connection to the adapter

If an adapter module has been parameterized and the connection to the adapter is interrupted, or the adapter signals a fault, the device switches to the safe state. An error message is generated and the diagnostics provides information on the location of the fault.

A restart or reset is necessary following correction of the fault.

7.4.7 Violation of upper/lower parameterized speed limits

7.4.7.1 Automatic speed exceeded

If the parameterized maximum automatic speed is exceeded, the device switches immediately to the safe state. Contacts 23/24 are opened and when the lower parameterized standstill speed limit is violated, contacts 13/14 are closed. The corresponding signaling outputs are switched.

7.4.7.2 Automatic speed undershot

If the parameterized minimum automatic speed is undershot, the device switches immediately to the safe state. Contacts 23/24 are opened and when the lower parameterized standstill speed limit is violated, contacts 13/14 are closed. The corresponding signaling outputs are switched.

7.4.7.3 Setup speed exceeded

If the parameterized maximum setup speed is exceeded, the device switches immediately to the safe state. Contacts 23/24 are opened and when the lower parameterized standstill speed limit is violated, contacts 13/14 are closed. The corresponding signaling outputs are switched.

7.4.7.4 Setup speed undershot

If the parameterized minimum setup speed is undershot, the device switches immediately to the safe state. Contacts 23/24 are opened and when the lower parameterized standstill speed limit is violated, contacts 13/14 are closed. The corresponding signaling outputs are switched.

7.4.7.5 Standstill speed exceeded

If the parameterized maximum standstill speed is exceeded, the device switches immediately to the safe state. Contacts 13/14 are opened. The corresponding signaling outputs are switched.

7.4.7.6 Start override time exceeded

If the parameterized minimum setup or automatic speed (depending on the switch position) is not reached within the parameterized start override time t_a , the device switches immediately to the safe state. Contacts 23/24 are opened and when the lower parameterized standstill speed limit is violated, contacts 13/14 are closed. The corresponding signaling outputs are switched.

See also Chapter "Times (Page 41)"

7.4.8 Parameterized monitoring times exceeded/undershot

7.4.8.1 Release delay time undershot

If "unlocked" is indicated at the MAG input before expiry of the release delay time t_v , the device switches immediately to the safe state. The corresponding signaling outputs are switched.

See also Chapter "Times (Page 41)"

7.5 Device replacement

WARNING
--

Hazardous Voltage.

Can Cause Death, Serious Injury, or Property Damage.

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

Note

When replacing a device, you do not need to re-wire it. The terminal blocks can be disconnected from the defective device and then connected to the new device.

Replace device

1. Disconnect the defective device.
See also Chapter "Disconnecting (Page 37)".
2. De-install the defective device.
See also Chapter "Disassembling the device (Page 33)".
3. Install the new device.
See also Chapter "Mounting the device on a DIN rail (Page 31)" or Chapter "Mounting the device on a level surface (Page 32)".
4. Connect the device.
See also Chapter "Connecting terminal blocks (Page 36)".

The device is powered up after the supply voltage has been applied.

For more information on power-up please refer to Chapter "Basic versions (Page 17), section "Power-up/self-test".

Parameterization following device replacement

After the device has been replaced, transfer the parameterization from the existing speed monitor.

See also Chapter "Copying parameters (Page 49)"

or

parameterize your speed monitor using the data sheet you have completed.

See also Chapter "Parameterization using the display (Page 44)" and Chapter

"Parameterization menu (Page 45)"; or "Printed form for documenting the setting parameters (Page 79)".

WARNING

Hazardous Voltage.

Can Cause Death, Serious Injury, or Property Damage.

Carry out functional test of the system

To guarantee the safety of the system, a full functional test must be carried out and successfully concluded following parameterization.

Technical data

8.1 Technical data

		3TK2810-1BA41	3TK2810-1BA42	3TK2810-1KA41	3TK2810-1KA42
Product brand name		SIRIUS			
Product designation		safety relays			
Design of the product		standstill and speed monitoring			
Protection type IP of the enclosure		IP20			
Protection class IP of the terminal		IP20			
Protection against electrical shock		finger-safe			
Insulation voltage rated value	V	300			
Ambient temperature during storage	°C	-20 ... +70			
Ambient temperature during operating	°C	0 ... 60			
Air pressure according to SN 31205	hPa	900 ... 1 060			
Relative humidity					
• during operating phase	%	10 ... 95			
Installation altitude at a height over sea level maximum	m	2 000			
Resistance against vibration according to IEC 60068-2-6		10 ... 55 Hz: 0.35 mm			
Resistance against shock		8g / 10 ms			
Impulse voltage resistance rated value	V	4 000			
EMC emitted interference		EN 60947-5-1			
Item designation according to DIN 40719 extendable after IEC 204-2 according to IEC 750		KT			
Item designation according to DIN EN 61346-2		F			
Number of sensor inputs 1-channel or 2-channel		0			
Design of the cascading		none			
Type of the safety-related wiring of the inputs		single-channel or two-channel			

8.1 Technical data

		3TK2810-1BA41	3TK2810-1BA42	3TK2810-1KA41	3TK2810-1KA42
Product feature transverse contact-secure		Yes			
Safety Integrity Level (SIL) according to IEC 61508		3			
SIL claim limit (for a subsystem) according to EN 62061		3			
Performance level (PL) according to ISO 13849-1		e			
Category					
• according to EN 954-1		4			
• according to ISO 13849-1		4			
Probability of dangerous failure per hour (PFHD) with high demand rate according to EN 62061	1/h	3,38E-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 NC contact for reporting function instantaneous switching		0			
– as NO contact safety-related					
– instantaneous switching		1			
– delayed switching		1			
• as contact-less semiconductor switching element					
– for reporting function					
– non-delayed		1			
– delayed switching		1			
– safety-related					
– non-delayed		0			
– delayed switching		0			
Stop category according to DIN EN 60204-1		0			

		3TK2810-1BA41	3TK2810-1BA42	3TK2810-1KA41	3TK2810-1KA42
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			3	
• 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			3	
– at 230 V	A			2	
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				50 000 000	
Design of the fuse link for short-circuit protection of the NO contacts of the relay outputs required				gL/gG: 4 A	

8.1 Technical data

		3TK2810-1BA41	3TK2810-1BA42	3TK2810-1KA41	3TK2810-1KA42
Control circuit					
Type of voltage of the controlled supply voltage		DC		AC/DC	
Control supply voltage frequency					
• 1 rated value	Hz	—	—	50	50
• 2 rated value	Hz	—	—	60	60
Control supply voltage 1					
• at 50 Hz					
– for AC	V	—		110 ... 240	
• at 60 Hz					
– for AC	V	—		110 ... 240	
• for DC	V	—		110 ... 240	
• for DC rated value	V	24		—	
Operating range factor control supply voltage rated value of the magnet coil					
• at 50 Hz					
– for AC		—	—	0.8 ... 1,1	0.8 ... 1,1
• at 60 Hz					
– for AC		—	—	0.8 ... 1,1	0.8 ... 1,1
• for DC		0.9 ... 1.1	0.9 ... 1.1	0.8 ... 1,1	0.8 ... 1,1

		3TK2810-1BA41	3TK2810-1BA42	3TK2810-1KA41	3TK2810-1KA42
Built in / Fixing / Dimensions					
Mounting position		any			
Type of mounting		screw and snap-on mounting			
Width	mm	45			
Height	mm	105,9	107.7	105.9	107.7
Depth	mm	124.3			
Design of the electrical connection		screw-type terminals	spring-loaded terminals	screw-type terminals	spring-loaded terminals
Type of the connectable conductor cross-sections					
• solid	mm ²	1x (0,5 ... 4 mm ²)			
• finely stranded					
– with wire end processing	mm ²	1x (0,5 ... 2,5 mm ²), 2x (0,5 ... 1,5 mm ²)	2x (0,25 ... 1,5 mm ²)	1x (0,5 ... 2,5 mm ²), 2x (0,5 ... 1,5 mm ²)	2x (0,25 ... 1,5 mm ²)
– without wire end processing	mm ²	—	2x (0,25 ... 1,5 mm ²)	—	2x (0,25 ... 1,5 mm ²)
• for AWG conductors					
– solid		2x (20 ... 14)	2x (24 ... 16)	2x (20 ... 14)	2x (24 ... 16)
– stranded		2x (20 ... 14)	2x (24 ... 16)	2x (20 ... 14)	2x (20 ... 16)

8.1 Technical data

	3TK2810-1BA41	3TK2810-1BA42	3TK2810-1KA41	3TK2810-1KA42
Product function				
• automatic start			Yes	
• rotation speed monitoring			Yes	
• 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			Yes	
• 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			No	
• proximity switches monitoring			Yes	
• opto-electronical protection device monitoring			No	
• position switch monitoring			Yes	
• tactile sensor monitoring			No	
• valve monitoring			No	
Verification of suitability				
• TÜV (German technical inspectorate) certificate			Yes	
• UL-registration			Yes	

		3TK2810-1BA41	3TK2810-1BA42	3TK2810-1KA41	3TK2810-1KA42
Initiators					
Supply voltage	V	24 V DC (provided by device)			
Current consumption	mA	max. 30			
Output		optionally PNP or NPN			
Voltage at E1 and E2	V	min. DC 10			
Minimum pulse/break time	µs	75			
Setting range		1 Hz ... 2 kHz			
Encoder					
Design		with two signal tracks and their inverted signalsn			
Output		optionally TTL, HTL or sin/cos ($U_A = 1 V_{pp}$)			
Setting range		1 Hz ... 400 kHz			
Response to failure		High impedance > 170 kOhm			
Design version NAMUR					
Supply voltage	V	8.2 V DC (provided by device)			
Current consumption	mA	max. 10			
Switching thresholds					
Low:	mA	typ. 1.6			
High:	mA	typ. 1.8			
Wire break	mA	≤ 0.15			
Short-circuit:	mA	> 6.0			
Minimum pulse/break time:	µs	75			
Setting range:		1 Hz ... 2 kHz			

Dimension drawings

9.1 Dimension drawings

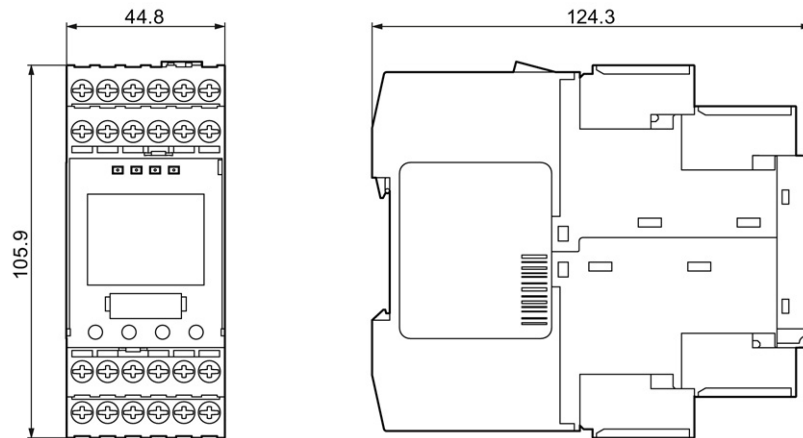


Figure 9-1 Dimension drawing: Enclosure with screw-type terminals

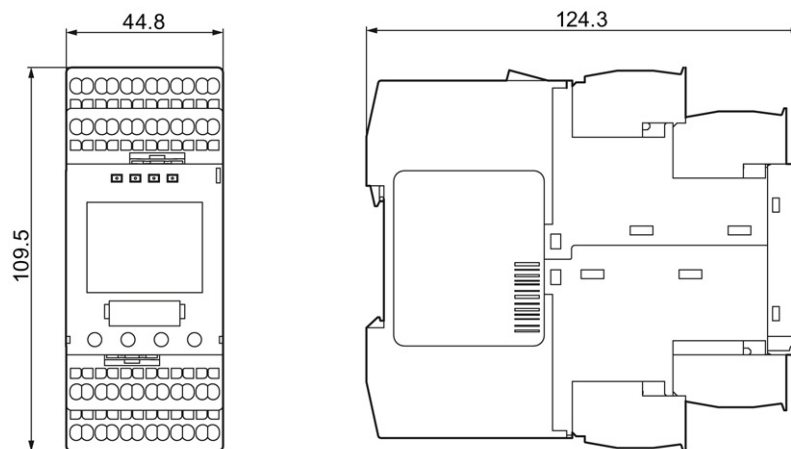


Figure 9-2 Dimension drawing: Enclosure with spring-loaded terminals

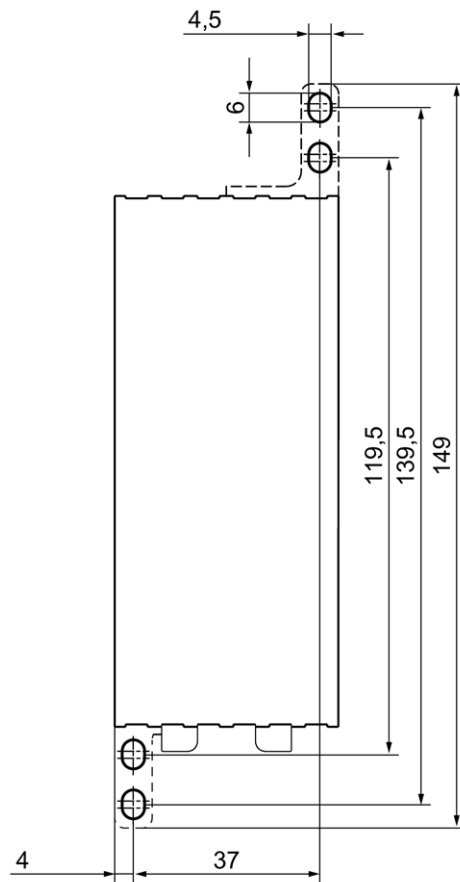


Figure 9-3 Drilling plan: Enclosure 45 mm

Circuit diagrams

10.1 Circuit diagram

Circuit diagrams

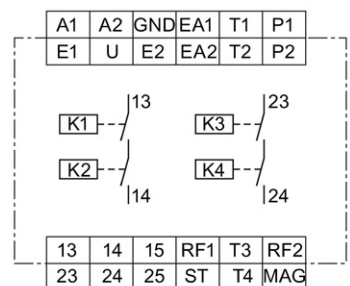


Figure 10-1 3TK2810-1.A4.

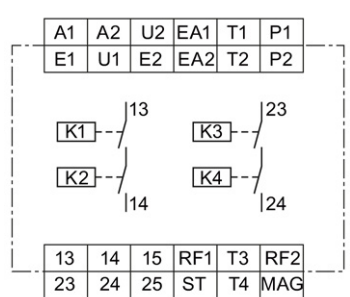
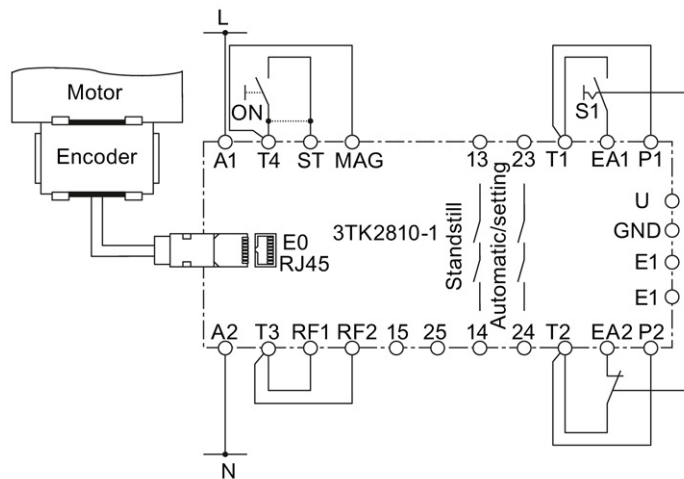
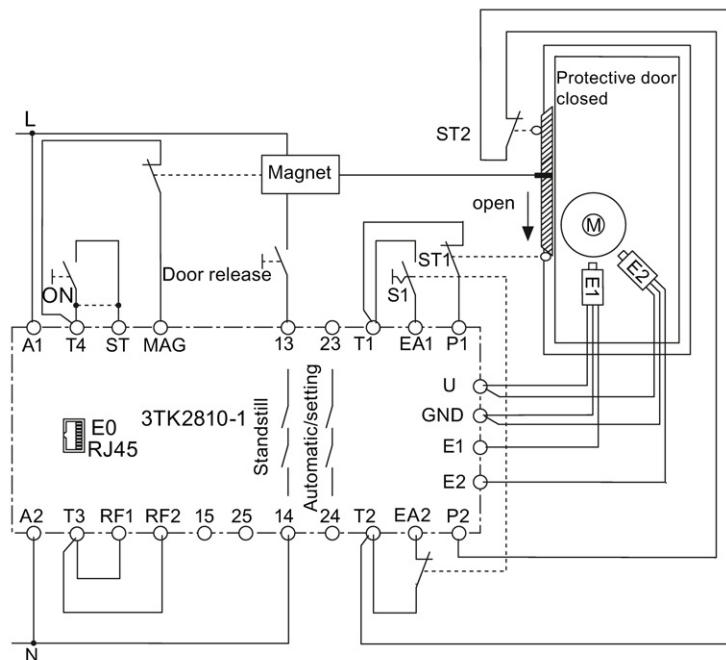


Figure 10-2 3TK2810-1.A4.-0AA0

Application examples

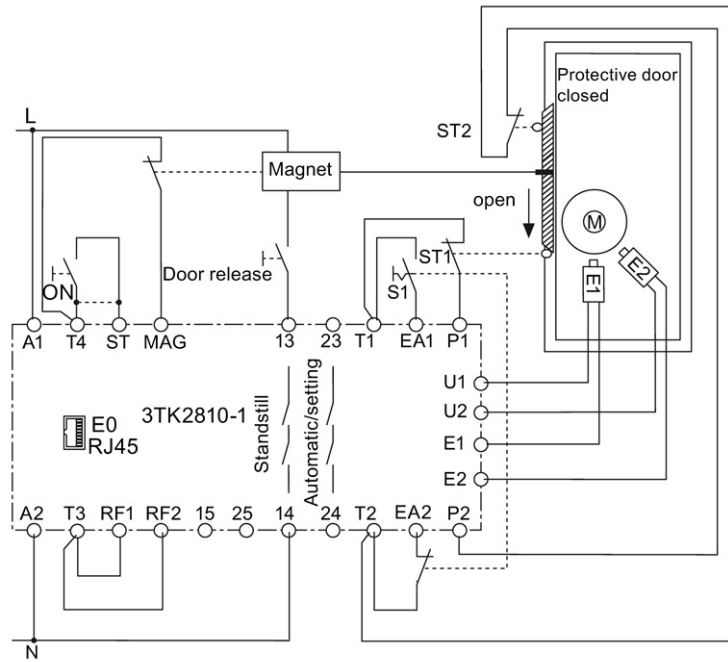


Speed and standstill monitoring using a suitable encoder, automatic mode; in the case of manual start, on pushbutton at T4/ST; in the case of autostart, jumper at T4/ST; suitable up to SIL 3, Performance Level e, SK 4 (a requirement for SK 4 is that in the case of longer standstill times, a forced dormant error detection procedure $t < 24$ hrs is carried out).

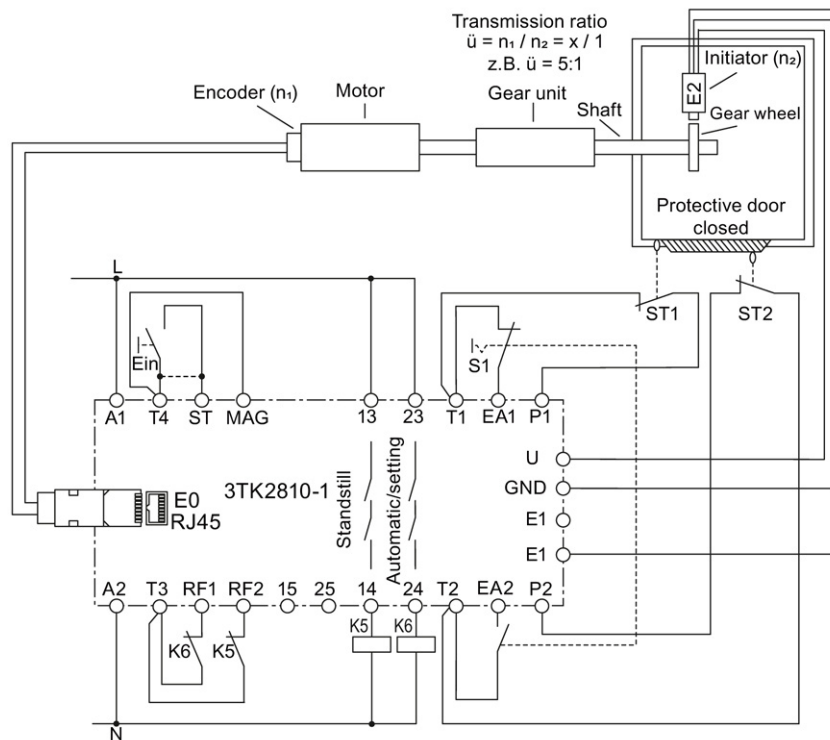


Two-channel speed and standstill monitoring using two NPN or PNP proximity switches, automatic mode; protective door monitoring active; in the case of manual start, on pushbutton at T4/ST; in the case of autostart, jumper at T4/ST; suitable up to SIL 3, Performance Level e, SK 4 (a requirement for SK 4 is that in the case of longer standstill times, a forced dormant error detection procedure $t < 24$ hrs is carried out).

Please read the note "Connecting the initiators" in chapter "Product-specific information (Page 9)".



Speed and standstill monitoring using two NAMUR sensors; automatic mode; protective door monitoring active; in the case of manual start, on pushbutton at T4/ST; in the case of autostart, jumper at T4/ST; suitable up to SIL 3, Performance Level e; SK 4



Speed and standstill monitoring using encoders and an NPN or PNP proximity switch; setup mode; transmission ratio set; protective door monitoring active; in the case of manual start, on pushbutton at T4/ST; in the case of autostart, jumper at T4/ST; suitable up to SIL 3, Performance Level e, SK 4 (a requirement for SK 4 is that in the case of longer standstill times, a forced dormant error detection procedure $t < 24$ hrs is carried out).

Appendix

A.1 Printed form for documenting the setting parameters

Device:	3TK2810-1
Device number:	
Configuration carried out by:	
Date:	

1.	Parameterization	
	1.1	Monitored motion
		Translational
		Rotational
	1.2	Encoder type
		Lin. encoder
		Rot. encoder
	1.3	Encoder selection
		RJ45: Encoder + E2
		RJ45: Encoder
		E1+ E2
	1.4	Lead/transmission
		Transmission
		Lead
	1.5	Encoder settings
		Signal form
		sin/cos or TTL
		HTL
		Resolution

1.	Parameterization	
	1.6	Initiator settings
		Initiator type
		pnp
		nnp
		Resolution E1
		Resolution E2
	1.7	Speed limits
		Automatic max.
		Automatic min.
		Setting max.
		Setting min.
		Standstill
	1.8	Times
		Start override
		Release delay
Switch-off monitoring		
1.9	Start type	
	Manual start	
	Automatic start	
1.10	Protective door monitoring	
	Simultaneity on	
	Simultaneity off	

Note

Please complete the printed form and keep it in a safe place!

A.2 Correction sheet

Have you noticed any errors while reading this manual? If so, please use this form to tell us about them. We welcome comments and suggestions for improvement.

Fax response

To	From (please complete):
SIEMENS AG	Name
I IA CE MK&ST 3	Company/Department
92220 Amberg / Germany	Address

Fax: +49 (0)9621-80-3337

Manual title:

Table A- 1 Errors, comments, and suggestions for improvements

Service & Support

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