SIEMENS

SINAMICS

SINAMICS G130/G150/S120 Chassis/S120 Cabinet Modules/S150

Safety Integrated

Function Manual

Edition 07/2016

SIEMENS

SINAMICS

G130, G150, S120 Chassis, S120 Cabinet Modules, S150 Safety Integrated

Function Manual

Firmware version 4.8

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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

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.

Siemens AG
Division Process Industries and Drives
Postfach 48 48
90026 NÜRNBERG
GERMANY

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Preface

Target group

This documentation is intended for machine manufacturers, commissioning engineers, and service personnel who use the SINAMICS drive system.

Standard version

The scope of the functionality described in this document can differ from that of the actually supplied drive system.

- Other functions not described in this documentation might be able to be executed in the drive system. This does not, however, represent an obligation to supply such functions with a new controller or when servicing.
- The documentation can also contain descriptions of functions that are not available in a particular product version of the drive system. The functionalities of the supplied drive system should only be taken from the ordering documentation.
- Extensions or changes made by the machine manufacturer must be documented by the machine manufacturer.

For reasons of clarity, this documentation does not contain all of the detailed information on all of the product types. This documentation cannot take into consideration every conceivable type of installation, operation and service/maintenance.

Technical Support

In case of questions, please contact us through the following hotline:

Time zone Europe / Africa	
Phone	+49 911 895 7222
Fax	+49 911 895 7223
Internet	https://support.industry.siemens.com/sc/ww/en/sc/2090

Time zone Americas	
Phone	+1 423 262 2522
Fax	+1 423 262 2200
E-mail	techsupport.sea@siemens.com

Time zone Asia/Pacific	
Phone	+86 1064 757 575
Fax	+86 1064 747 474
E-mail	support.asia.automation@siemens.com

Note

Country-specific telephone numbers for technical support are provided under the following Internet address:

https://www.automation.siemens.com/aspa_app

Spare parts

You can find spare parts on the Internet at:
https://support.industry.siemens.com/sc/de/en/sc/2110

Internet address for SINAMICS

http://www.siemens.com/sinamics.

Internet address for Safety Integrated

http://www.siemens.com/safety

This address contains detailed application examples for Safety Integrated.

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Safety information

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Safety notices

⚠WARNING

Risk of death if the safety instructions and remaining risks are not carefully observed

If the safety instructions and residual risks are not observed in the associated documentation, accidents involving severe injuries or death can occur.

- Observe the safety instructions given in the associated documentation.
- When assessing the risk, take into account residual risks.

⚠WARNING

Danger to life or malfunctions of the machine as a result of incorrect or changed parameter assignment

Machines can malfunction as a result of incorrect or changed parameter assignment, which in turn can lead to injuries or death.

- Protect the parameterization (parameter assignments) against unauthorized access.
- Respond to possible malfunctions by applying suitable measures (e.g. EMERGENCY STOP or EMERGENCY OFF).

1.1 Industrial security

Note

Industrial security

Siemens provides products and solutions with industrial security functions that support the secure operation of plants, solutions, machines, devices, and/or networks. They are important components in a holistic industrial security concept. With this in mind, Siemens products and solutions undergo continuous development. Siemens recommends strongly that you regularly check for product updates.

For the secure operation of Siemens products and solutions, it is necessary to take suitable preventive action (e.g. cell protection concept) and integrate each component into a holistic, state-of-the-art industrial security concept. Any third-party products that may be in use must also be taken into account. For more information about industrial security, visit Hotspot-Text (http://www.siemens.com/industrialsecurity).

To receive information about product updates on a regular basis, register for our product newsletter. For more information, visit Hotspot-Text (https://support.industry.siemens.com).

⚠WARNING

Danger due to unsafe operating states caused by software manipulation

Software manipulations (e.g. viruses, trojans, malware, worms) can cause unsafe operating states in your system that may lead to death, serious injury, and property damage.

- Update your software regularly.

  You will find relevant information and newsletters at this address (http://www.siemens.com/industrialsecurity).
- Integrate the automation and drive components into a holistic, state-of-the-art industrial security concept for the plant or machine.

  You will find further information at this address (https://support.industry.siemens.com).
- Make sure that you include all installed products into the holistic industrial security concept.

Note

Industrial Security Configuration Manual

You can find a Configuration Manual on the topic of Industrial Security at this address (https://support.industry.siemens.com/cs/ww/en/view/108862708).

Note

Malfunctions as a result of withdrawing and inserting components

Malfunctions can occur by withdrawing and inserting components that are used for Safety Integrated without having to exit the fail-safe state. For example, PROFIsafe communication is not reestablished after this event.

- Withdrawing and inserting components used for Safety Integrated (power units, Sensor Modules, TM54F) in operation **and** in the deactivated state is **not** permissible. Activating the components always requires a POWER ON.

Note

Approval of option K82

Only circuits that have been manufactured by the OEM or by certified factories or that have been installed by the authorized service for option K82, possess an approval. Possible plant-side reproductions by non-certified manufacturers do not possess this approval!

An up-to-date list of authorized factories is available on request from your local Siemens office.

Introduction

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This document is a supplement to the "SINAMICS S120 Safety Integrated Function Manual" which serves as the basis for the functional scope of the Safety Integrated functions.

The "SINAMICS S120 Safety Integrated Function Manual" is available on the Internet at the following address (https://support.industry.siemens.com/cs/ww/en/ps/13231/man).

This document contains additional information on the use of the Safety Integrated functions with the following SINAMICS converters:

- SINAMICS G130
- SINAMICS G150
- SINAMICS S120 Chassis
- SINAMICS S120 Cabinet Modules
- SINAMICS S150

General information about SINAMICS Safety Integrated

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3.1 Supported functions

All of the Safety Integrated functions available under SINAMICS are listed in this section. SINAMICS makes a distinction between Safety Integrated Basic Functions and Safety Integrated Extended Functions.

The safety functions listed here are in conformance with:

- Safety Integrity Level (SIL) 2 according to IEC 61508
- Category 3 according to DIN EN ISO 13849-1
- Performance Level (PL) d according to DIN EN ISO 13849-1

The safety functions correspond to the functions according to DIN EN 61800-5-2 (under the assumption that they are defined there).

The following Safety Integrated functions (SI functions) are available:

- Safety Integrated Basic Functions

  These functions are part of the standard scope of the drive and can be used without requiring an additional license. These functions are always available, and do not require an encoder and/or do not place any special requirements on the encoder used.

  – Safe Torque Off (STO)

    Safe Torque Off is a safety function to avoid unexpected startup in accordance with EN 60204-1. STO prevents the supply of energy to the motor which can generate a torque and corresponds to Stop Category 0.

  – Safe Stop 1 (SS1, time-controlled)

    Safe Stop 1 is based on the "Safe Torque Off" function. This means that a Category 1 stop according to EN 60204-1 can be implemented.

  – Safe Brake Control (SBC)

    Safe Brake Control safely controls a holding brake.[1)]

- **Safety Integrated Extended Functions**

  These functions require an additional safety license. Extended Functions with encoder require an encoder with safety capability.

  – Safe Torque Off (STO)

    Safe Torque Off is a safety function that prevents the drive from restarting unexpectedly according to EN- 60204-1.

  – Safe Stop 1 (SS1, time- and acceleration-controlled)

    Safe Stop 1 is based on the "Safe Torque Off" function. This means that a Category 1 stop according to EN 60204-1 can be implemented.

  – Safe Brake Control (SBC)

    Safe Brake Control safely controls a holding brake.[1)]

  – Safe Operating Stop (SOS)

    Safe Operating Stop protects against unintentional movement. The drive is in closed-loop control mode and is not disconnected from the power supply.

  – Safe Stop 2 (SS2)

    Safe Stop 2 safely brakes the motor with a subsequent transition into the "Safe Operating Stop" state (SOS). This means that a Category 2 stop according to EN 60204-1 can be implemented.

  – Safely-Limited Speed (SLS)

    Safely Limited Speed monitors that the drive does not exceed a preset speed/velocity limit.

  – Safe Speed Monitor (SSM)

    Safe Speed Monitor safely identifies when a speed limit is undershot in both directions of motion, e.g. to identify zero speed. A fail-safe output signal is available for further processing.

  – Safe Direction (SDI)

    Safe Direction is used to safely monitor the direction of motion.

  – Safely-Limited Position (SLP)

    Safely-Limited Position ensures that a freely definable traversing range is not left.

  – Transferring safe position values (SP)

    The "Transfer safe position values (SP)" function enables you to transfer a safe position to a higher-level controller via PROFIsafe.

  – Safe gearbox stage switchover

    The "Safe gearbox stage switchover" function facilitates reliable switching between different gearbox stages. The switchover is only possible via PROFIsafe.

  – Safe Brake Test (SBT)

    The diagnostic function "Safe Brake Test" function (SBT) checks the required holding torque of a brake (operating or holding brake).

[1)] Note on Power/Motor Modules with chassis format:
For chassis format, SBC is only supported by Power/Motor Modules with article number ...3 or higher. A Safe Brake Adapter is also required for this design.

Note

Parallel use of Safety Integrated Functions

All Safety Integrated Functions can be used simultaneously.

Exception:

If SOS and SLS are activated simultaneously, SOS has higher priority and overrides the SLS reaction.

Invalid operating modes for Safety Integrated Extended Functions "without encoder"

- Current controller clock cycles 31.25 µs and 62.5 µs (for Double Motor Modules with two configured safety drives) are not permissible.
- For the independent setting of current controller clock cycle and pulse frequency in conjunction with Safety Integrated "without encoder", the following system clock cycles are not permissible:
  - Double Motor Modules <125 µs
  - All other components: <62.5 µs
  - p9589 must be set = 3300 to allow the current controller clock cycle and pulse frequency to be independently set.
- For chassis format devices, the following also applies:
  - For chassis format devices, operation without encoder is only permissible for induction motors, however **not** for synchronous motors.
  - No operation involving parallel connections
  - Optimized pulse patterns cannot be selected for SIMOTICS FD
  - Only using parameter p1810 = factory setting, this includes:
    - No wobbling
    - No fine setting of the pulse frequency
- No "shaft generator" functionality
- Induction motors up to a maximum of 1000 kW; for extremely large machines, it is necessary to adapt parameter p9585

3.1.1 SINAMICS G130

3.1.1.1 Basic functions

Requirements

The Safety Integrated Basic Functions are part of the standard scope of the drive and can be used without an additional license.

Supported Safety Integrated Basic Functions

Safety function	Abbreviation	
Safe Torque Off	STO	Yes
Safe Stop 1	SS1	Yes
Safe Brake Control	SBC	Using Safe Brake Adapter

Control options

- Control Unit and terminal (on the power unit)
- PROFIsafe and terminal (on the power unit)

3.1.1.2 Extended Functions

Requirements

- Option **F01**: Safety license for one axis

  Note

  The term "axes" should also be interpreted as "drives".

- For Extended Functions with encoder:
  Two SMC30 Sensor Modules (HTL/TTL encoders)

Supported Safety Integrated Extended Functions

Safety function	Abbreviation	With encoder [1]	Without encoder
Safe Torque Off	STO	Yes	Yes [2]
Safe Stop 1	SS1	Yes	Yes[2]
Safe Brake Control	SBC	Yes	Yes[2]
Safe Operating Stop	SOS	Yes	No
Safe Stop 2	SS2	Yes	No
Safely-Limited Speed	SLS	Yes	Yes[2]
Safe Speed Monitor	SSM	Yes	Yes[2]
Safe Direction	SDI	Yes	Yes[2]
Safely-Limited Position	SLP	Yes	No
Safe referencing/homing	SR	Yes	No
Transferring safe position values	SP	Yes	Yes[2]
Safe Brake Test	SBT	Yes	No
Safe Acceleration Monitor	SAM	Yes	Yes[2]
Safe Brake Ramp	SBR	No	Yes[2]
Safe gearbox stage switchover	--	Yes	No

1) Two SMC30 Sensor Modules (HTL/TTL encoders)

2) The use of this safety function without an encoder is permitted only for induction motors.

3) Using Safe Brake Adapter.

Control options

- Terminal Module TM54F
- PROFIsafe

3.1.2 SINAMICS G150

3.1.2.1 Basic functions

Requirements

The Safety Integrated Basic Functions are part of the standard scope of the drive and can be used without an additional license.

Supported Safety Integrated Basic Functions

Safety function	Abbreviation	
Safe Torque Off	STO	Yes
Safe Stop 1	SS1	Yes
Safe Brake Control	SBC	Via option K88

Control options

- With option **K82**: Terminal Module for controlling safety functions "STO" and "SS1"
- Control Unit and terminal (on the power unit)
- PROFIsafe and terminal (on the power unit)

3.1.2.2 Extended Functions

Requirements

- Option **K01**: Safety license for one axis

  Note

  The term "axes" should also be interpreted as "drives".

- For Extended Functions with encoder:
  Options **K50 and K52**: Two SMC30 Sensor Modules (HTL/TTL encoders)

Supported Safety Integrated Extended Functions

Safety function	Abbreviation	With encoder [1]	Without encoder
Safe Torque Off	STO	Yes	Yes[2]
Safe Stop 1	SS1	Yes	Yes[2]
Safe Brake Control [3]	SBC	Yes	Yes[2]
Safe Operating Stop	SOS	Yes	No
Safe Stop 2	SS2	Yes	No
Safely-Limited Speed	SLS	Yes	Yes[2]
Safe Speed Monitor	SSM	Yes	Yes[2]
Safe Direction	SDI	Yes	Yes[2]
Safely-Limited Position	SLP	Yes	No
Safe referencing/homing	SR	Yes	No
Transferring safe position values	SP	Yes	Yes[2]
Safe Brake Test	SBT	Yes	No
Safe Acceleration Monitor	SAM	Yes	Yes[2]
Safe Brake Ramp	SBR	No	Yes[2]
Safe gearbox stage switchover	--	Yes	No

1) Options **K50 and K52**: Two SMC30 Sensor Modules (HTL/TTL encoders)

2) The use of this safety function without an encoder is permitted only for induction motors.

3) Using Safe Brake Adapter (option **K88**).

Control options

- Option **K87**: Terminal Module TM54F
- PROFIsafe

3.1.3 SINAMICS S120 chassis

3.1.3.1 Basic functions

Requirements

The Safety Integrated Basic Functions are part of the standard scope of the drive and can be used without an additional license.

Supported Safety Integrated Basic Functions

Safety function	Abbreviation	
Safe Torque Off	STO	Yes
Safe Stop 1	SS1	Yes
Safe Brake Control	SBC	Using Safe Brake Adapter

Control options

- Control Unit and terminal (on the power unit)
- PROFIsafe and terminal (on the power unit)

3.1.3.2 Extended Functions

Requirements

- Option **F01 to F05**: Safety license for one to five axes

  Note

  The term "axes" should also be interpreted as "drives".

- For Extended Functions with encoder:
  - Sin/cos sensor evaluation (SMC20, SME20/25/120/125, SMI20 Sensor Modules) or
  - Two SMC30 Sensor Modules (HTL/TTL encoders)

Supported Safety Integrated Extended Functions

Safety function	Abbreviation	With encoder [1]	Without encoder
Safe Torque Off	STO	Yes	Yes[2]
Safe Stop 1	SS1	Yes	Yes[2]
Safe Brake Control [3]	SBC	Yes	Yes[2]
Safe Operating Stop	SOS	Yes	No
Safe Stop 2	SS2	Yes	No
Safely-Limited Speed	SLS	Yes	Yes[2]
Safe Speed Monitor	SSM	Yes	Yes[2]
Safe Direction	SDI	Yes	Yes[2]
Safely-Limited Position	SLP	Yes	No
Safe referencing/homing	SR	Yes	No
Transferring safe position values	SP	Yes	Yes[2]
Safe Brake Test	SBT	Yes	No
Safe Acceleration Monitor	SAM	Yes	Yes[2]
Safe Brake Ramp	SBR	No	Yes[2]
Safe gearbox stage switchover	--	Yes	No

1) Sin/cos sensor evaluation or 2 SMC30 Sensor Modules (HTL/TTL encoders)

2) The use of this safety function without an encoder is permitted only for induction motors.

3) Using Safe Brake Adapter.

Control options

- Terminal (TM54F)
- PROFIsafe

3.1.4 SINAMICS S120 Cabinet Modules, booksize format

3.1.4.1 Basic functions

Requirements

The Safety Integrated Basic Functions are part of the standard scope of the drive and can be used without an additional license.

Supported Safety Integrated Basic Functions

Safety function	Abbreviation	
Safe Torque Off	STO	Yes
Safe Stop 1	SS1	Yes
Safe Brake Control	SBC	Using Safe Brake Adapter

Control options

- With option K82: Terminal Module for controlling safety functions "STO" and "SS1"
- Control Unit and terminal (on the power unit)
- PROFIsafe and terminal (on the power unit)

3.1.4.2 Extended Functions

Requirements

- Option K01 to K05: Safety license for one to five axes

  Note

  The term "axes" should also be interpreted as "drives".

- For Extended Functions with encoder
  - Option K48: SMC20 Sensor Module (sin/cos encoder) or
  - Options K50 and K52: Two SMC30 Sensor Modules (HTL/TTL encoders)

Supported Safety Integrated Extended Functions

Safety function	Abbreviation	With encoder [1]	Without encoder
Safe Torque Off	STO	Yes	Yes[2]
Safe Stop 1	SS1	Yes	Yes[2]
Safe Brake Control	SBC	Yes	Yes[2]
Safe Operating Stop	SOS	Yes	No
Safe Stop 2	SS2	Yes	No
Safely-Limited Speed	SLS	Yes	Yes[2]
Safe Speed Monitor	SSM	Yes	Yes[2]
Safe Direction	SDI	Yes	Yes[2]
Safely-Limited Position	SLP	Yes	No
Safe referencing/homing	SR	Yes	No
Transferring safe position values	SP	Yes	Yes[2]
Safe Brake Test	SBT	Yes	No
Safe Acceleration Monitor	SAM	Yes	Yes[2]
Safe Brake Ramp	SBR	No	Yes[2]
Safe gearbox stage switchover	--	Yes	No

1) Option **K48**: SMC20 Sensor Module (sin/cos encoder) or
options **K50 and K52**: Two SMC30 Sensor Modules (HTL/TTL encoders)

2) The use of this safety function without encoder is permitted only for induction motors or synchronous motors of the SIEMOSYN series.

Control options

- Option **K87**: Terminal Module TM54F
- PROFIsafe

3.1.5 SINAMICS S120 Cabinet Modules, chassis format

3.1.5.1 Basic functions

Requirements

The Safety Integrated Basic Functions are part of the standard scope of the drive and can be used without an additional license.

Supported Safety Integrated Basic Functions

Safety function	Abbreviation	
Safe Torque Off	STO	Yes
Safe Stop 1	SS1	Yes
Safe Brake Control	SBC	Via option K88

Control options

- With option **K82**: Terminal Module for controlling safety functions "STO" and "SS1"
- Control Unit and terminal (on the power unit)
- PROFIsafe and terminal (on the power unit)

3.1.5.2 Extended Functions

Requirements

- Option **K01 to K05**: Safety license for one to five axes

  Note

  The term "axes" should also be interpreted as "drives".

- For Extended Functions with encoder:
  - Option **K48**: SMC20 Sensor Module (sin/cos encoder) or
  - Options **K50 and K52**: Two SMC30 Sensor Modules (HTL/TTL encoders)

Supported Safety Integrated Extended Functions

Safety function	Abbreviation	With encoder [1]	Without encoder
Safe Torque Off	STO	Yes	Yes[2]
Safe Stop 1	SS1	Yes	Yes[2]
Safe Brake Control [3]	SBC	Yes	Yes[2]
Safe Operating Stop	SOS	Yes	No
Safe Stop 2	SS2	Yes	No
Safely-Limited Speed	SLS	Yes	Yes[2]
Safe Speed Monitor	SSM	Yes	Yes[2]
Safe Direction	SDI	Yes	Yes[2]
Safely-Limited Position	SLP	Yes	No
Safe referencing/homing	SR	Yes	No
Transferring safe position values	SP	Yes	Yes[2]
Safe Brake Test	SBT	Yes	No
Safe Acceleration Monitor	SAM	Yes	Yes[2]
Safe Brake Ramp	SBR	No	Yes[2]
Safe gearbox stage switchover	--	Yes	No

1) Option **K48**: SMC20 Sensor Module (sin/cos encoder) or
options **K50 and K52**: Two SMC30 Sensor Modules (HTL/TTL encoders)

2) The use of this safety function without an encoder is permitted only for induction motors.

3) Using Safe Brake Adapter (option **K88**).

Control options

- Option **K87**: TM54F Terminal Module
- PROFIsafe

3.1.6 SINAMICS S150

3.1.6.1 Basic functions

Requirements

The Safety Integrated Basic Functions are part of the standard scope of the drive and can be used without an additional license.

Supported Safety Integrated Basic Functions

Safety function	Abbreviation	
Safe Torque Off	STO	Yes
Safe Stop 1	SS1	Yes
Safe Brake Control	SBC	Via option K88

Control options

- With option **K82**: Terminal Module for controlling safety functions "STO" and "SS1"
- Control Unit and terminal (on the power unit)
- PROFIsafe and terminal (on the power unit)

3.1.6.2 Extended Functions

Requirements

- Option **K01**: Safety license for one axis

  Note

  The term "axes" should also be interpreted as "drives".

- For Extended Functions with encoder:
  - Option **K48**: SMC20 Sensor Module (sin/cos encoder) or
  - Options **K50 and K52**: Two SMC30 Sensor Modules (HTL/TTL encoders)

Supported Safety Integrated Extended Functions

Safety function	Abbreviation	With encoder [1]	Without encoder
Safe Torque Off	STO	Yes	Yes[2]
Safe Stop 1	SS1	Yes	Yes[2]
Safe Brake Control [3]	SBC	Yes	Yes[2]
Safe Operating Stop	SOS	Yes	No
Safe Stop 2	SS2	Yes	No
Safely-Limited Speed	SLS	Yes	Yes[2]
Safe Speed Monitor	SSM	Yes	Yes[2]
Safe Direction	SDI	Yes	Yes[2]
Safely-Limited Position	SLP	Yes	No
Safe referencing/homing	SR	Yes	No
Transferring safe position values	SP	Yes	Yes[2]
Safe Brake Test	SBT	Yes	No
Safe Acceleration Monitor	SAM	Yes	Yes[2]
Safe Brake Ramp	SBR	No	Yes[2]
Safe gearbox stage switchover	--	Yes	No

1) Option **K48**: SMC20 Sensor Module (sin/cos encoder) or
options **K50 and K52**: Two SMC30 Sensor Modules (HTL/TTL encoders)

2) The use of this safety function without an encoder is permitted only for induction motors.

3) Using Safe Brake Adapter (option **K88**).

Control options

- Option **K87**: TM54F Terminal Module
- PROFIsafe

3.2 Drive monitoring with or without encoder

If motors without a (safety-capable) encoder are being used, not all Safety Integrated functions are available.

Note

Definition: "Without encoder"

When "without encoder" is used in this manual, then this always means that either no encoder or no safety-capable encoder is being used.

In operation without encoder, the actual speed values are calculated from the measured electrical actual values. Therefore, speed monitoring is also possible during operation without encoder.

Table 3- 1 Overview of Safety Integrated functions

	Functions	Abbr.	With encoder	Without encoder	Brief description
Basic Functions	Safe Torque Off	STO	Yes	Yes	Safe Torque Off
	Safe Stop 1	SS1	Yes	Yes	Safe stop according to stop category 1
	Safe Brake Control	SBC	Yes	Yes	Safe Brake Control
Extended Functions	Safe Torque Off	STO	Yes	Yes[1)]	Safe Torque Off
	Safe Stop 1	SS1	Yes	Yes[1)]	Safe stop according to stop category 1
	Safe Brake Control	SBC	Yes	Yes[1)]	Safe Brake Control
	Safe Operating Stop	SOS	Yes	No	Safe monitoring of the standstill position
	Safe Stop 2	SS2	Yes	No	Safe stop according to stop category 2
	Safely-Limited Speed	SLS	Yes	Yes[1)]	Safe monitoring of the maximum speed
	Safe Speed Monitor	SSM	Yes	Yes[1)]	Safe monitoring of the minimum speed
	Safe Direction	SDI	Yes	Yes[1)]	Safe monitoring of the direction of motion
	Safely-Limited Position	SLP	Yes	No	Safely-limited position
	Safe referencing/homing	SR	Yes	No	Safe referencing/homing
	Transferring safe position values	SP	Yes	Yes[1)]	Transferring safe position values
	Safe Brake Test	SBT	Yes	No	Safe test of the required holding torque of a brake
	Safe Acceleration Monitor	SAM	Yes	Yes[1)]	Safe monitoring of drive acceleration
	Safe Brake Ramp	SBR	No	Yes[1)]	Safe braking ramp
	Safe gearbox stage switch-over	–	Yes	No	–

[1)] The use of this safety function without encoder is permitted only for induction motors or synchronous motors of the SIEMOSYN series.

The configuration of the Safety Integrated functions and the selection of monitoring with or without encoder is realized in the Safety screens of the STARTER or SCOUT tools.

Description of Safety Integrated functions 4

Safety Integrated Basic Functions and Safety Integrated Extended Functions are described in detail in the "SINAMICS S120 Safety Integrated Function Manual".

The "SINAMICS S120 Safety Integrated Function Manual" is available on the Internet at the following address (https://support.industry.siemens.com/cs/ww/en/ps/13231/man).

4.1 Preconditions for Safety Integrated Basic Functions

The following prerequisites apply for operation of the Safety Integrated Basic Functions:

- For G150, S120 Cabinet Modules and S150:
  Option K82 (Terminal Module for activation of the safety functions "Safe Torque Off" and "Safe Stop 1"), for activation signals of 230 V and/or cable lengths of more than 30 m
- An activated current controller in the drive
- For the safe brake control:
  - For G150, S120 Cabinet Modules and S150:
    Option K88 (Safe Brake Adapter 230 VAC)
  - For the G130 and S120 Chassis units:
    Option SBA (Safe Brake Adapter)

4.2 Preconditions for Safety Integrated Extended Functions

- For operation of the Safety Integrated Extended Functions, **one** license is required for **each** axis.
- Control possible via
  - PROFIsafe
  - TM54F
  - Active functions without control (SLS, SDI)
- An activated current controller in the drive
- Overview of hardware components that support the Extended Functions:
  - Motor Modules booksize with an article number ending: -xxx3 or higher
  - Motor Modules chassis with an article number ending: -xxx3 or higher
  - Motor Modules cabinet with an article number ending: -xxx2 or higher
  - Control Unit Adapter CUA31 as of article number: 6SL3040-0PA00-0AA1
  - Control Unit Adapter CUA32 as of article number: 6SL3040-0PA01-0AA0
  - For the Extended Functions with encoder:

    Motors with sin/cos encoder and encoder evaluation with DRIVE-CLiQ interface or via Sensor Module SMC20, SME20/25/120/125

    Motors with two independent HTL/TTL encoders or a special double HTL/TTL encoder

    The list of approved encoders can be found on the Internet at:

    https://support.industry.siemens.com

    Enter the number **33512621** there as search term or contact your local Siemens office.

Controlling the safety functions

5

5.1 Control possibilities

The following options for controlling Safety Integrated functions are available:

Table 5- 1 Controlling the Safety Integrated functions

	Terminals (on the Control Unit and Motor/Power Module)	PROFIsafe based on PROFIBUS or PROFINET	TM545F	Control without selection
Basic Functions	Yes	Yes	No	No
Extended Functions	No	Yes	Yes	SLS, SDI

Note

PROFIsafe or TM54F

Using a Control Unit, control is possible either via PROFIsafe or TM54F. Mixed operation is not permissible.

The safety-related input and output terminals (F-DI and F-DO) act as an interface between the SINAMICS Safety Integrated functionality and the process.

A dual-channel signal applied to an F-DI (Fail-safe Digital Input, safety-oriented digital input = safe input terminal pair) controls the active monitoring of the activation/deactivation of safety functions.

An F-DO (Fail-safe Digital Output, safety-oriented digital output = safe output terminal pair) delivers a dual channel signal representing feedback from the safety functions.

Dual-channel processing of I/O signals

A dual-channel structure is realized for data input/output and for processing fail-safe I/O signals. All requests and feedback signals for fail-safe functions should be entered or picked off using both channels.

5.2 Control of "STO" and "SS1" via terminal module for option K82

5.2.1 Terminal module for control of "STO" and "SS1" for SINAMICS G150

Description

Option K82 (Terminal Module for activating "Safe Torque Off" and "Safe Stop 1") is used for isolated activation of the Safety Integrated Basic Functions over a wide voltage range.

Note

Refer to the circuit diagrams enclosed for the interconnections of your device.

Note

The Safety functions must be activated prior to use via parameter assignment. An acceptance test must be performed and an acceptance log must be created.

Option K82 is used to activate the following Safety Integrated Basic Functions (terms and definitions according to IEC 61800-5-2):

- Safe Torque Off (STO)
- Safe Stop 1 (SS1) (time-controlled)

Note

The integrated safety functions, starting from the Safety Integrated (SI) input terminals of the SINAMICS components (Control Unit, Power Module), satisfy the requirements of EN 61800-5-2, EN 60204-1 and DIN EN ISO 13849-1 category 3 (formerly EN 954-1), as well as the requirements for Performance Level (PL) d and IEC 61508 SIL2.

In combination with the option K82, the requirements specified in EN 61800-5-2, EN 60204-1, as well as in DIN EN ISO 13849-1 category 3 (formerly EN954-1) are satisfied for Performance Level (PL) d and IEC 61508 SIL2.

In addition, most of the SINAMICS safety functions have been certified by independent institutes. A list of currently certified components is available on request from your local Siemens office.

Recommended application

This option is used when the following requirements apply:

- Activation will be executed isolated in a voltage range of 24 VDC - 230 VAC.
- Using non-shielded control lines which are longer than 30 m.
- The devices are deployed in plants dispersed over a wide area (no ideal equipotential bonding).

Principle of operation

Two independent channels of the integrated safety function are controlled via relays (K41, K42).

Relay K41 controls the signal at the Control Unit that is necessary for the safety function and relay K42, the corresponding signal at the Power Module.

The selection and deselection must be simultaneous. The time delay that is unavoidable due to mechanical switching processes, for example, can be adapted via parameters. p9650 specifies the tolerance time within which the selection/deselection of the two monitoring channels must occur in order to be considered as "simultaneous".

The circuit is structured so that it is protected against wire break, i.e. if the relay's control voltage fails then the safety function is active.

A checkback signal can be derived for information, diagnostics or troubleshooting from the normally-closed contacts of the relay switched in series. Wiring of the checkback signal can be performed optionally and is not part of the safety concept.

Note

The feedback signal is not necessary to comply with standard DIN EN ISO 13849-1 (formerly EN 954-1) Cat. 3 PL d and DIN EN 61508 SIL2.

The selection of the safety function must be performed in two channels. A switch according to ISO 13850/ EN 418, positive opening according to EC 60947-5-1, or a certified safety controller must be used as actuating element.

⚠WARNING

Danger to life as a result of failure of the safety functions through unsuitable selection of the actuating element

An unsuitable actuating element may cause the safety function to fail which can result in death or serious injury.

- Select the correct actuating element for the purpose of compliance of the overall system with the required standard (DIN EN ISO 13849-1 (formerly EN954-1) Cat. 3 PL d or DIN EN 61508 SIL2).

Forced checking procedure

The maximum value for the forced checking procedure interval when using option K82 is 6 months (4380 h).

Customer interface -X41

Table 5- 2 Terminal strip -X41

Terminal	Meaning	Technical data
-X41:1	Control of -K41:A1	Connection for actuating element at channel 1 "+"
-X41:2	Connected to -X41:1	
-X41:3	Control of -K41:A2, -K42:A2 , N conductor or ground	Connection of reference potential for actuating elements at channel 1 and channel 2
-X41:4	Connected to -X41:3	
-X41:5	Feedback signal, status -K41, -K42	Connection of supply voltage for optional feedback signal
-X41:6	Feedback signal, status -K41, -K42	Connection of optional checkback signal
-X41:7	Control of -K42:A1	Connection for actuating element at channel 2 "+"
-X41:8	Connected to -X41:7	
-X41:9	Not assigned	
-X41:10	Output -K41: Permanently wired with CU320-2: -X132:4 (DI 7)	

Control circuit:

Rated voltage: 24 VDC to 230 VAC (0.85 ... 1.1 x Us)

Max. line length (applies to the sum of the outgoing and return lines):

- AC (line capacity: 300 pF/m):
  - 24 V: 5000 m
  - 110 V: 800 m
  - 230 V: 200 m

    The values apply for 50 Hz, at 60 Hz the line lengths must be reduced by 20%.

    ⚠WARNING

    Danger to life as a result of exceeding the permissible cable lengths and/or the permissible cable capacitances

    When the permissible cable lengths and/or the permissible cable capacitances are exceeded, the relay can remain energized as a result of the coupling capacitances of the cable and the associated residual current, in spite of the fact that the actuating elements are open. Death and serious injury can result in the event of an error.

    - Do not exceed the maximum permissible cable lengths and cable capacitances.
- DC (min. cross-section 0.75 mm²): 1500 m

Max. connectable cross-section: 2.5 mm²

Fuse: Max. 4 A

Load side:

Switching voltage: Max. 250 VDC/AC

Rated operating currents:

- AC-15 (according to IEC 60947-5-1): 24 ... 230 V = 3 A
- DC-13 (according to IEC 60947-5-1):
  - 24 V = 1 A
  - 110 V = 0.2 A
  - 230 V = 0.1 A

Min. contact load: 5 VDC, 1 mA at 1 ppm error

Fuse: Max. 4 A (fuse weld-free, duty category gL/gG with Ik ≥ 1 kA)

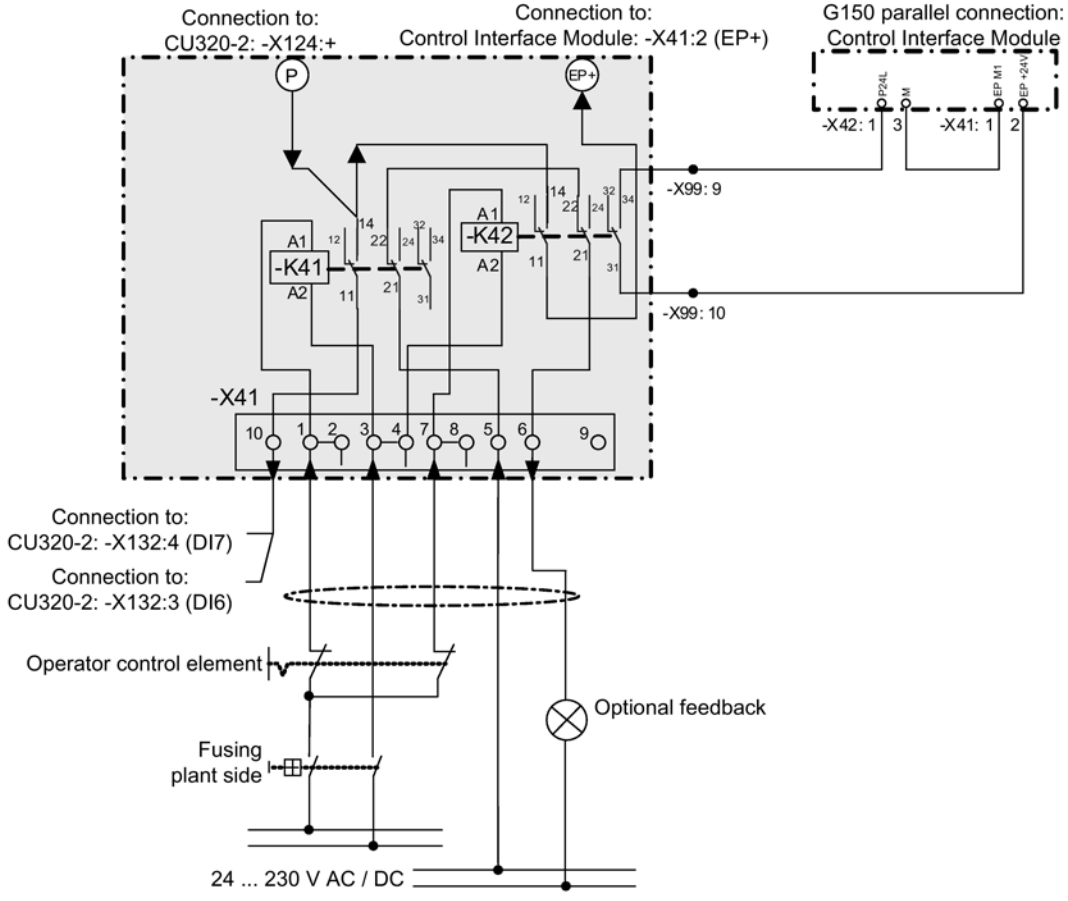


Figure 5-1 Circuit Terminal Module for option K82

A switch according to ISO 13850/ EN 418, positive opening according to EC 60947-5-1, or a certified safety controller must be used as actuating element.

Note

Terminal -X41:10 is permanently connected to the digital input DI 7 of the Control Unit.

Note

For the following cabinet units (parallel switchgear), digital input DI 6 of the Control Unit is also assigned:

- For 380 to 480 V 3 AC:
  6SL3710-2GE41-1AAx, 6SL3710-2GE41-4AAx, 6SL3710-2GE41-6AAx
- For 500 to 600 V 3 AC:
  6SL3710-2GF38-6AAx, 6SL3710-2GF41-1AAx, 6SL3710-2GF41-4AAx
- For 660 to 690 V 3 AC:
  6SL3710-2GH41-1AAx, 6SL3710-2GH41-4AAx, 6SL3710-2GH41-5AAx

Interconnection in groups

When using a single actuating element for multiple cabinet units, the following terminals have to be used on terminal strip -X41:

- -X41:2: Interconnection to the next cabinet unit, terminal -X41:1
- -X41:4: Interconnection to the next cabinet unit, terminal -X41:3
- -X41:6: Interconnection to the next cabinet unit, terminal -X41:5
- -X41:8: Interconnection to the next cabinet unit, terminal -X41:7
- -X41:9: Interconnection to the next cabinet unit, terminal -X41:6
- Connection of the optional checkback signal to terminal -X41:9

Wiring

The control cables should be permanently routed (e.g. cable duct, retained using cable ties).

Signal cables and encoder cables should be installed separated from one another.

The shields of the control cables should be grounded through the largest possible surface area immediately after they enter the control cabinet.

Outside the control cabinet, the cables must be routed in such a way that they are safe to walk on (e.g. as specified in IEC 60204-1).

5.2.2 Terminal module for control of "STO" and "SS1" for SINAMICS S120 Cabinet Modules

5.2.2.1 General information

Availability of the option

This option is available for the following S120 Cabinet Modules:

- Motor Module in chassis format
- Booksize Cabinet Kit

Description

Option K82 (Terminal Module for activating "Safe Torque Off" and "Safe Stop 1") is used for isolated activation of the Safety Integrated Basic Functions over a wide voltage range.

Note

Refer to the circuit diagrams enclosed for the interconnections of your device.

Note

The Safety functions must be activated prior to use via parameter assignment. An acceptance test must be performed and an acceptance log must be created.

Option K82 is used to activate the following Safety Integrated Basic Functions (terms and definitions according to IEC 61800-5-2):

- Safe Torque Off (STO)
- Safe Stop 1 (SS1) (time-controlled)

Note

The integrated safety functions, starting from the Safety Integrated (SI) input terminals of the SINAMICS components (Control Unit, Motor Module), satisfy the requirements of EN 61800-5-2, EN 60204-1 and DIN EN ISO 13849-1 category 3 (formerly EN 954-1), as well as the requirements for Performance Level (PL) d and IEC 61508 SIL2.

In combination with the option K82, the requirements specified in EN 61800-5-2, EN 60204-1, as well as in DIN EN ISO 13849-1 category 3 (formerly EN954-1) are satisfied for Performance Level (PL) d and IEC 61508 SIL2.

In addition, most of the SINAMICS safety functions have been certified by independent institutes. A list of currently certified components is available on request from your local Siemens office.

Recommended application

This option is used when the following requirements apply:

- Activation will be executed isolated in a voltage range of 24 VDC - 230 VAC.
- Using non-shielded control lines which are longer than 30 m.
- The devices are deployed in plants dispersed over a wide area (no ideal equipotential bonding).

Principle of operation

Two independent channels of the integrated safety function are controlled via relays (K41, K42).

Relay K41 controls the signal at the Control Unit that is necessary for the safety function and relay K42, the corresponding signal at the Motor Module.

The selection and deselection must be simultaneous. The time delay that is unavoidable due to mechanical switching processes, for example, can be adapted via parameters. p9650 specifies the tolerance time within which the selection/deselection of the two monitoring channels must occur in order to be considered as "simultaneous".

The circuit is structured so that it is protected against wire break, i.e. if the relay's control voltage fails then the safety function is active.

A checkback signal can be derived for information, diagnostics or troubleshooting from the normally-closed contacts of the relay switched in series.

Wiring of the checkback signal can be performed optionally and is not part of the safety concept.

Note

The checkback signal is not necessary for compliance with the standard DIN EN ISO 13849-1 (formerly EN954-1) cat. 3 PL d and DIN EN 61508 SIL2.

The selection of the safety function must be performed in two channels. A switch according to ISO 13850/ EN 418, positive opening according to EC 60947-5-1, or a certified safety controller must be used as actuating element.

⚠WARNING

Danger to life as a result of failure of the safety functions through unsuitable selection of the actuating element

An unsuitable actuating element may cause the safety function to fail which can result in death or serious injury.

- Select the correct actuating element for the purpose of compliance of the overall system with the required standard (DIN EN ISO 13849-1 (formerly EN954-1) Cat. 3 PL d or DIN EN 61508 SIL2).

Forced checking procedure

The maximum value for the forced checking procedure interval when using option K82 is 6 months (4380 h).

Customer interface -X41

Table 5- 3 Terminal strip -X41

Terminal	Meaning	Technical data
-X41:1	Control of -K41:A1	Connection for actuating element at channel 1 "+"
-X41:2	Connected to -X41:1	Connection for actuating element at channel 1 "+", for interconnecting Motor Modules in groups
-X41:3	Control of -K41:A2, -K42:A2 , N conductor or ground	Connection of reference potential for actuating elements at channel 1 and channel 2
-X41:4	Connected to -X41:3	Connection of reference potential for actuating elements at channel 1 and channel 2, for interconnecting Motor Modules in groups
-X41:5	Feedback signal, status -K41, -K42	Connection of supply voltage for optional feedback signal
-X41:6	Feedback signal, status -K41, -K42	Connection for optional checkback signal, for interconnecting Motor Modules in groups
-X41:7	Control of -K42:A1	Connection for actuating element at channel 2 "+"
-X41:8	Connected to -X41:7	Connection for actuating element at channel 2 "+", for interconnecting Motor Modules in groups
-X41:9	Connection of optional checkback	For the option of connecting other checkback signals in series when Motor Modules are grouped
-X41:10	Output -K41: Permanently wired with CU320-2: -X132:4 (DI 7)	Output -K41: For connecting to a digital input according to the Safety settings on the CU320-2 (already wired in option K90)

Control circuit:

Rated voltage: 24 VDC to 230 VAC (0.85 ... 1.1 x Us)

Max. line length (applies to the sum of the outgoing and return lines):

- AC (line capacity: 300 pF/m):
  - 24 V: 5000 m
  - 110 V: 800 m
  - 230 V: 200 m

    The values apply for 50 Hz, at 60 Hz the line lengths must be reduced by 20%.

    ⚠WARNING

    Danger to life as a result of exceeding the permissible cable lengths and/or the permissible cable capacitances

    When the permissible cable lengths and/or the permissible cable capacitances are exceeded, the relay can remain energized as a result of the coupling capacitances of the cable and the associated residual current, in spite of the fact that the actuating elements are open. Death and serious injury can result in the event of an error.

    - Do not exceed the maximum permissible cable lengths and cable capacitances.

- DC (min. cross-section 0.75 mm^2): 1500 m

Max. connectable cross-section: 2.5 mm^2

Fuse: Max. 4 A

Load side:

Switching voltage: Max. 250 VDC/AC

Rated operating currents:

- AC-15 (according to IEC 60947-5-1): 24 ... 230 V = 3 A
- DC-13 (according to IEC 60947-5-1):
  - 24 V = 1 A
  - 110 V = 0.2 A
  - 230 V = 0.1 A

Min. contact load: 5 VDC, 1 mA at 1 ppm error

Fuse: Max. 4 A (fuse weld-free, duty category gL/gG with Ik ≥ 1 kA)

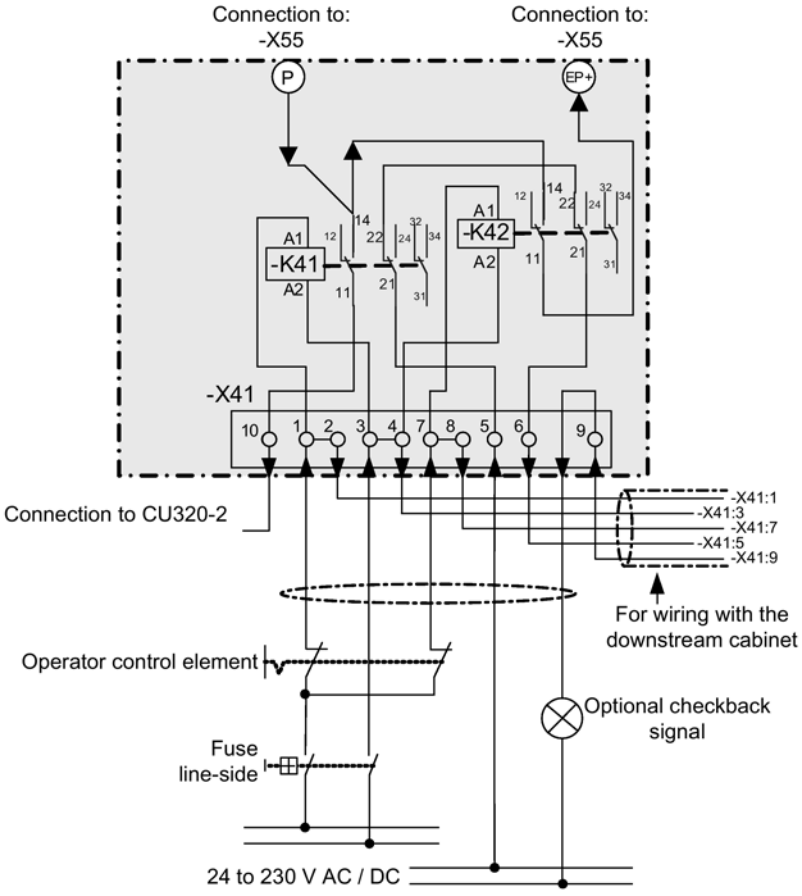


Figure 5-2 Circuit Terminal Module for option K82

A switch according to ISO 13850/ EN 418, positive opening according to EC 60947-5-1, or a certified safety controller must be used as actuating element.

5.2.2.2 Use of the K82 option with Control Unit CU320-2

In conjunction with option K90 or K95 (CU320-2 DP or CU320-2 PN), terminal -X41:10 is already connected inside the cabinet with digital input DI 7 of the CU320-2.

In the Double Motor Module, digital input DI 6 is also wired on the CU320-2.

These interconnections have to be taken into account when Safety function parameters are assigned.

5.2.2.3 Use of the K82 option with Control Unit CU320-2

If option K90 or K95 is not available, -X41:10 should be connected to the particular Control Unit associated with the Motor Module. Digital inputs DI 0 to DI 7, DI 16, DI 17, DI 20, DI 21 are available for this purpose.

These interconnections have to be taken into account when Safety function parameters are assigned.

If the cable is routed to the Control Unit outside the cabinet, then the cable may not be longer than 30 m. For longer cable lengths, suitable protective circuitry must be provided for overvoltage protection (Weidmüller, type: MCZ OVP TAZ, order no.: 8449160000).

Note

Terminal -X41:10 can only be connected with digital inputs DI 0 to DI 7, DI 16, DI 17, DI 20, DI 21 of the Control Unit, other digital inputs cannot be interconnected.

5.2.2.4 Wiring

The control cables should be permanently routed (e.g. cable duct, retained using cable ties).

Signal cables and encoder cables should be installed separated from one another.

The shields of the control cables should be grounded through the largest possible surface area immediately after they enter the control cabinet.

Outside the control cabinet, the cables must be routed in such a way that they are safe to walk on (e.g. as specified in IEC 60204-1).

5.2.3 Terminal module for control of "STO" and "SS1" for SINAMICS S150

Description

Option K82 (Terminal Module for activating "Safe Torque Off" and "Safe Stop 1") is used for isolated activation of the Safety Integrated Basic Functions over a wide voltage range.

Note

Refer to the circuit diagrams enclosed for the interconnections of your device.

Note

The Safety functions must be activated prior to use via parameter assignment. An acceptance test must be performed and an acceptance log must be created.

Option K82 is used to activate the following Safety Integrated Basic Functions (terms and definitions according to IEC 61800-5-2):

- Safe Torque Off (STO)
- Safe Stop 1 (SS1) (time-controlled)

Note

The integrated safety functions, starting from the Safety Integrated (SI) input terminals of the SINAMICS components (Control Unit, Motor Module), satisfy the requirements of EN 61800-5-2, EN 60204-1 and DIN EN ISO 13849-1 category 3 (formerly EN 954-1), as well as the requirements for Performance Level (PL) d and IEC 61508 SIL2.

In combination with the option K82, the requirements specified in EN 61800-5-2, EN 60204-1, as well as in DIN EN ISO 13849-1 category 3 (formerly EN954-1) are satisfied for Performance Level (PL) d and IEC 61508 SIL2.

In addition, most of the SINAMICS safety functions have been certified by independent institutes. A list of currently certified components is available on request from your local Siemens office.

Recommended application

This option is used when the following requirements apply:

- Activation will be executed isolated in a voltage range of 24 VDC - 230 VAC.
- Using non-shielded control lines which are longer than 30 m.
- The devices are deployed in plants dispersed over a wide area (no ideal equipotential bonding).

Principle of operation

Two independent channels of the integrated safety function are controlled via relays (K41, K42).

Relay K41 controls the signal at the Control Unit that is necessary for the safety function and relay K42, the corresponding signal at the Motor Module.

The selection and deselection must be simultaneous. The time delay that is unavoidable due to mechanical switching processes, for example, can be adapted via parameters. p9650 specifies the tolerance time within which the selection/deselection of the two monitoring channels must occur in order to be considered as "simultaneous".

The circuit is structured so that it is protected against wire break, i.e. if the relay's control voltage fails then the safety function is active.

A checkback signal can be derived for information, diagnostics or troubleshooting from the normally-closed contacts of the relay switched in series. Wiring of the checkback signal can be performed optionally and is not part of the safety concept.

Note

The checkback signal is not necessary for compliance with the standard DIN EN ISO 13849-1 (formerly EN954-1) cat. 3 PL d and DIN EN 61508 SIL2.

The selection of the safety function must be performed in two channels. A switch according to ISO 13850/ EN 418, positive opening according to EC 60947-5-1, or a certified safety controller must be used as actuating element.

⚠WARNING

Danger to life as a result of failure of the safety functions through unsuitable selection of the actuating element

An unsuitable actuating element may cause the safety function to fail which can result in death or serious injury.

- Select the correct actuating element for the purpose of compliance of the overall system with the required standard (DIN EN ISO 13849-1 (formerly EN954-1) Cat. 3 PL d or DIN EN 61508 SIL2).

Forced checking procedure

The maximum value for the forced checking procedure interval when using option K82 is 6 months (4380 h).

Customer interface -X41

Table 5- 4 Terminal strip –X41

Terminal	Meaning	Technical data
-X41:1	Control of -K41:A1	Connection for actuating element at channel 1 "+"
-X41:2	Connected to -X41:1	
-X41:3	Control of -K41:A2, -K42:A2 , N conductor or ground	Connection of reference potential for actuating elements at channel 1 and channel 2
-X41:4	Connected to -X41:3	
-X41:5	Feedback signal, status -K41, -K42	Connection of supply voltage for optional feedback signal
-X41:6	Feedback signal, status -K41, -K42	Connection of optional checkback signal
-X41:7	Control of -K42:A1	Connection for actuating element at channel 2 "+"
-X41:8	Connected to -X41:7	
-X41:9	Not assigned	
-X41:10	Output -K41: Permanently wired with CU320-2: -X132:4 (DI 7)	

Control circuit:

Rated voltage: 24 VDC to 230 VAC (0.85 … 1.1 x U_{Rated})

Max. line length (applies to the sum of the outgoing and return lines):

- AC (line capacity: 300 pF/m):
  - 24 V: 5000 m
  - 110 V: 800 m
  - 230 V: 200 m

    The values apply for 50 Hz, at 60 Hz, the line lengths must be reduced by 20%.

    ⚠ WARNING

    Danger to life as a result of exceeding the permissible cable lengths and/or the permissible cable capacitances

    When the permissible cable lengths and/or the permissible cable capacitances are exceeded, the relay can remain energized as a result of the coupling capacitances of the cable and the associated residual current, in spite of the fact that the actuating elements are open. Death and serious injury can result in the event of an error.

    - Do not exceed the maximum permissible cable lengths and cable capacitances.

- DC (min. cross-section 0.75 mm²): 1500 m

Max. connectable cross-section: 2,5 mm²

Fuse: Max. 4 A

Load side:

Switching voltage: Max. 250 VDC/AC

Rated operating currents:

- AC-15 (according to IEC 60947-5-1): 24 ... 230 V = 3 A
- DC-13 (according to IEC 60947-5-1):
  - 24 V = 1 A
  - 110 V = 0.2 A
  - 230 V = 0.1 A

Min. contact load: 5 VDC, 1 mA at 1 ppm error

Fuse: Max. 4 A (fuse weld-free, duty category gL/gG with Ik ≥ 1 kA)

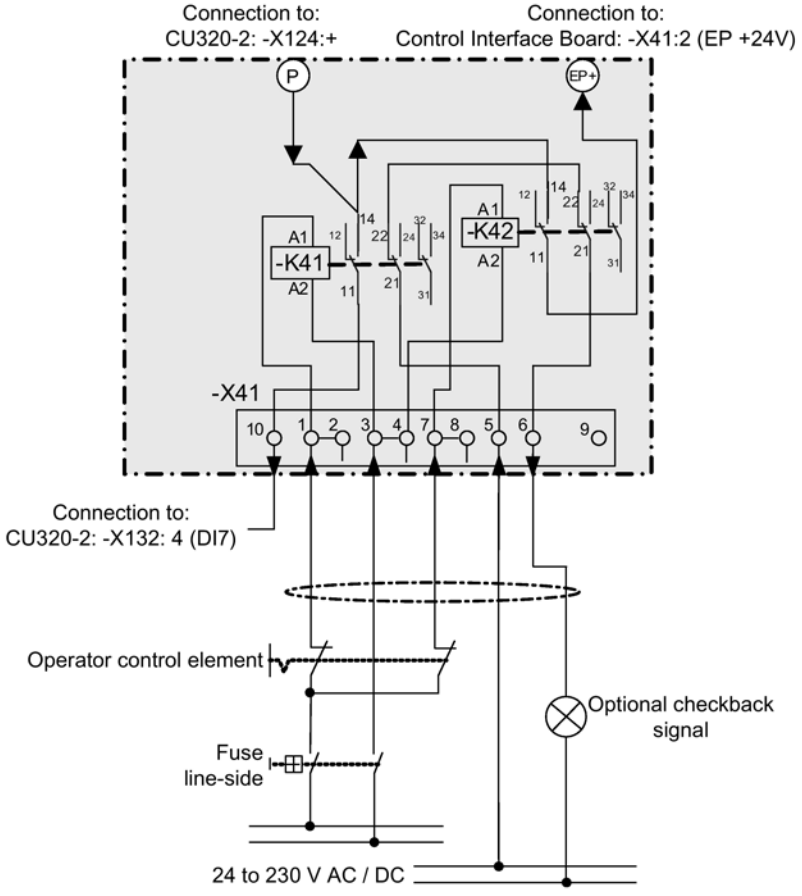


Figure 5-3 Circuit Terminal Module for option K82

A switch according to ISO 13850/ EN 418, positive opening according to EC 60947-5-1, or a certified safety controller must be used as actuating element.

Note

Terminal -X41:10 is permanently connected to the digital input DI 7 of the Control Unit.

Interconnection in groups

When using a single actuating element for multiple cabinet units, the following terminals have to be used on terminal strip -X41:

- -X41:2: Interconnection to the next cabinet unit, terminal -X41:1
- -X41:4: Interconnection to the next cabinet unit, terminal -X41:3
- -X41:6: Interconnection to the next cabinet unit, terminal -X41:5
- -X41:8: Interconnection to the next cabinet unit, terminal -X41:7
- -X41:9: Interconnection to the next cabinet unit, terminal -X41:6
- Connection of the optional checkback signal to terminal -X41:9

Wiring

The control cables should be permanently routed (e.g. cable duct, retained using cable ties).

Signal cables and encoder cables should be installed separated from one another.

The shields of the control cables should be grounded through the largest possible surface area immediately after they enter the control cabinet.

Outside the control cabinet, the cables must be routed in such a way that they are safe to walk on (e.g. as specified in IEC 60204-1).

5.3 Control of "STO" and "SS1" via terminals on the Control Unit and the Motor/Power Module

Features

- Only for the Basic Functions.
- Dual-channel structure via two digital inputs (Control Unit / power unit).
- A debounce function can be applied to the terminals of the Control Unit and the Motor Module to prevent incorrect trips due to signal disturbances or test signals. The filter times are set via parameters p9651 and p9851.
- Different terminal blocks depending on the format.
- Automatic AND operation of up to eight digital inputs (p9620[0..7]) on the Control Unit for chassis format power units connected parallel switching.

Overview of the terminals for safety functions

The different power unit formats have different terminal designations for the inputs of the safety functions. These are shown in the following table.

Table 5- 5 Inputs for safety functions

Module	1st switch-off signal path (p9620[0])	2nd switch-off signal path (EP terminals)
Control Unit CU320-2	X122.1....6 / X132.1…6 DI 0...7/16/17/20/21	
Single Motor Module Booksize	(see CU320-2)	X21.3 and X21.4 (on the Motor Module)
Single Motor Module/ Power Module Chassis	(see CU320-2)	X41.1 and X41.2
For further information about the terminals, see the Equipment Manuals.		

Terminals for STO, SS1 (time-controlled), SBC

The functions are separately selected/deselected for each drive using two terminals.

1. **Switch-off signal path, Control Unit**

   The desired input terminal is selected via BICO interconnection (BI: p9620[0]).

2. **Switch-off signal path Motor Module / Power Module**

   The input terminal is the "EP" terminal ("Enable Pulses")

   The EP terminal is periodically interrogated with a sampling time which is rounded off to an integer multiple of the current controller cycle; however, it is a minimum of 1 ms. (example: t_i = 400 µs, t_{EP} => 3 x t_i = 1.2 ms)

Both terminals must be energized within the tolerance time p9650, otherwise a fault will be output.

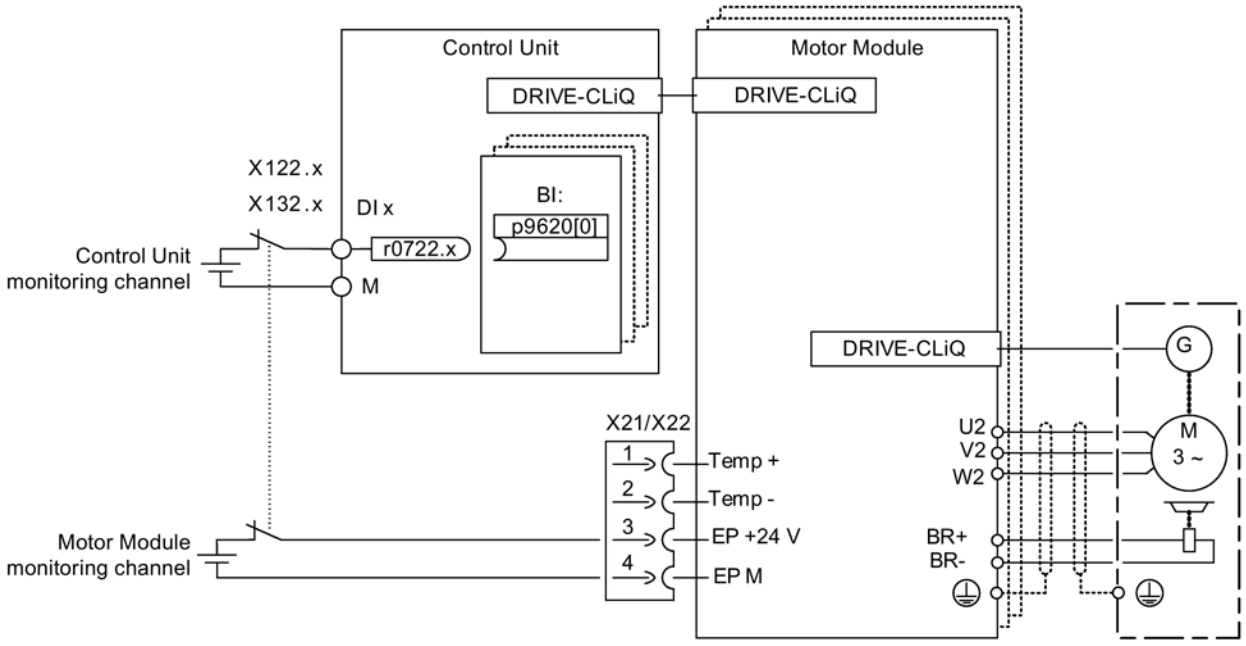


Figure 5-4 Example: Terminals for "Safe Torque Off": Example of Motor Modules Booksize and CU320-2

Grouping drives

To ensure that the function works for more than one drive at the same time, the terminals for the corresponding drives must be grouped together as follows:

1. Switch-off signal path

   By appropriately interconnecting the binector input to a joint input terminal for the drives to be combined to form a group.

2. Switch-off signal path (Motor Module / Power Module)

   By appropriately wiring the terminals for the individual Motor Modules / Power Modules belonging to the group.

Note

Parameterization of the grouping

The grouping must be configured (DI on Control Unit) and wired (EP terminals) identically in both monitoring channels.

Note

Response of STO for grouping

If a fault in a drive results in a "Safe Torque Off" (STO), this does not automatically mean that the other drives in the same group also switch to "Safe Torque Off" (STO).

The assignment is checked during the test for the switch-off signal paths. The operator selects "Safe Torque Off" for each group. The check is drive-specific.

Example: Terminal groups

It must be possible to select/deselect "Safe Torque Off" separately for group 1 (drives 1 and 2) and group 2 (drives 3 and 4).

For this purpose, the same grouping for "Safe Torque Off" must be realized both for the Control Unit and the Motor Modules.

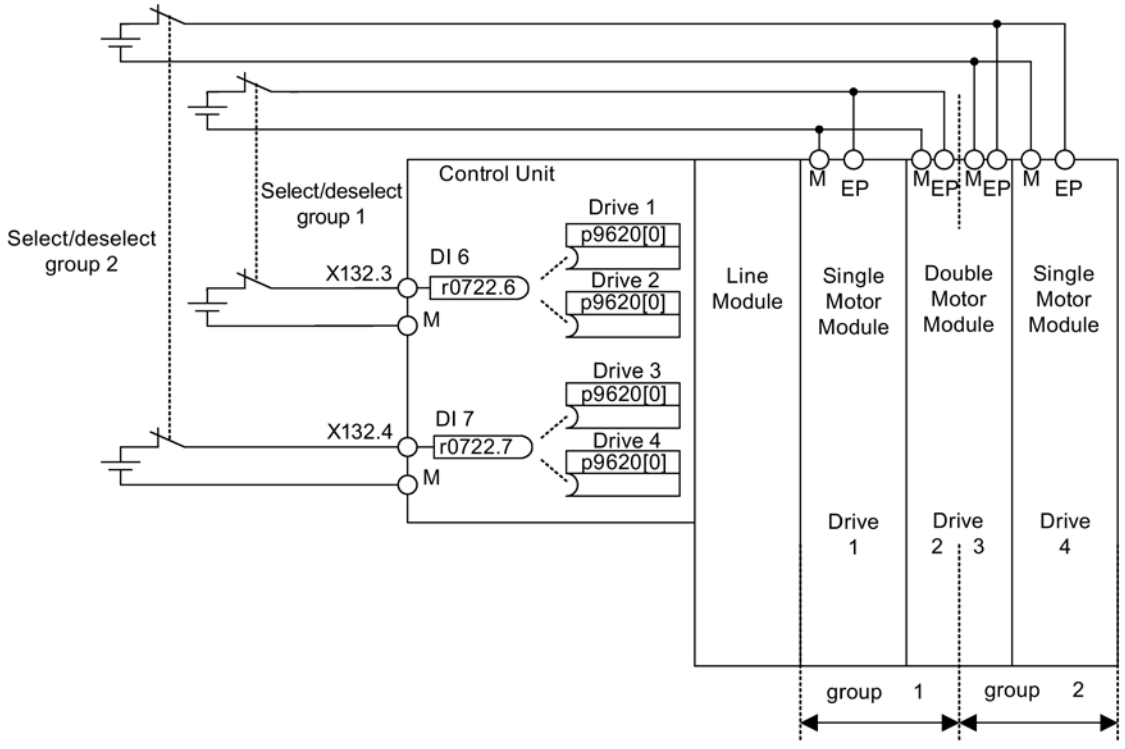


Figure 5-5 Example: Grouping terminals with Motor Modules Booksize and CU320-2

Information on the parallel connection of chassis type Motor Modules

When chassis format Motor Modules are connected in parallel, a safe AND element is created on the parallel drive object. The number of indexes in p9620 corresponds to the number of parallel chassis components in p0120.

5.3.1 Simultaneity and tolerance time of the two monitoring channels

The "Safe Torque Off" function must be selected/deselected simultaneously in both monitoring channels using the input terminals and is only effective for the associated drive.

- 1 signal: Deselecting the function
- 0 signal: Selecting the function

The time delay that is unavoidable due to mechanical switching operations, for example, can be adapted via parameters. The tolerance time, within which selection/deselection in the two monitoring channels must occur if they are to be considered "simultaneous," is set in the following parameters:

- p9650 (Basic Functions)
- p10002 (Extended Functions)

Note

Parameterization of the tolerance time

In order to avoid that faults are incorrectly initiated, at these inputs the tolerance time must always be set shorter than the shortest time between two switching events (ON/OFF, OFF/ON).

- If the monitoring functions are not selected/deselected within the tolerance time, this is detected by the cross-check, and the following fault (STOP F) is output.
  - F01611 (Basic Functions)
  - C01770 (Extended Functions)

  For STO the following applies: In this case, the pulses have already been canceled as a result of the selection of "Safe Torque Off" on one channel.

  Note

  Timing between the switching operations for Basic Functions

  Message F01611 with fault value 1000 is output if switching operations occur too frequently. The cause depends on the type of control:
  - The signals are continually changing at the F-DI.
  - STO is being permanently initiated via PROFIsafe (also as subsequent response).

  Within the time 5 × p9650, there must be at least two switching operations at the terminals or via PROFIsafe with a minimum time between them of p9650.

- If the "Safe Stop 1" of the Basic Functions is not selected within the tolerance time in two channels, this is detected by the cross-check, and fault F01611 (STOP F) is output. After the set "SI Safe Stop 1 delay time" (p9652), the pulses are suppressed.

  Note

  To enable the drive to brake to standstill even when selected through one channel, the time in p9652 must be shorter than the sum of the parameters for the data cross-check (p9650 and p9658). Otherwise, the drive will coast down after the time p9650 + p9658 has elapsed.

Further notes for setting the discrepancy time are contained in the List Manual for the following messages

- F01611 (Basic Functions)
- C01770 (Extended Functions)

Overview of important parameters

- p9650 SI SGE switchover discrepancy time (Control Unit)
- p9652 SI Safe Stop 1 delay time (Control Unit)
- p9658 SI transition time STOP F to STOP A (Control Unit)
- p10002 SI Motion F-DI switchover discrepancy time (processor 1)

5.3.2 Bit pattern test

Bit pattern test of fail-safe outputs

The converter normally responds immediately to signal changes in its fail-safe inputs. This is not desired in the following case: Several control modules test their fail-safe outputs using bit pattern tests (light/darkness tests) to identify faults due to either short-circuiting or cross circuiting. When you interconnect a fail-safe input of the converter with a fail-safe output of a control module, the converter responds to these test signals.

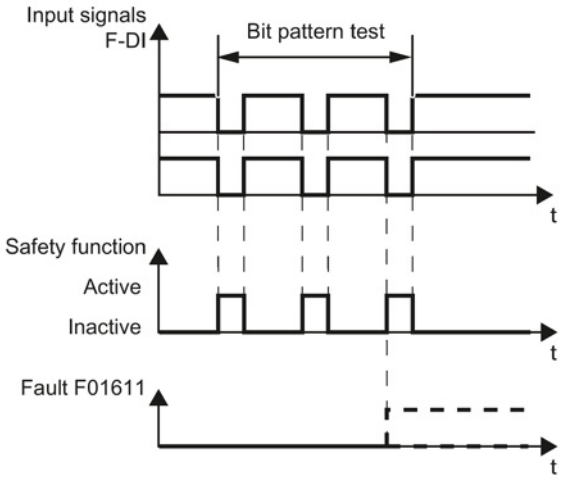


Figure 5-6 Converter response to a bit pattern test

Note

Debounce time for unwanted triggering of Safety Integrated functions

If the test pulses cause an unwanted triggering of the Safety Integrated functions, these test pulses can be suppressed using the F-DI input filter (p9651 for Basic Functions or p10017 for Extended Functions). To do this, a value that is greater than the duration of a test pulse must be entered in p9651 or p10017.

Overview of important parameters

- p9651 SI STO/SBC/SS1 debounce time (Control Unit)
- p10017 SI Motion digital inputs debounce time (processor 1)

5.3.3 Control of "STO" and "SS1" for SINAMICS G130

Description

The safety functions contained in the standard ("Safe Torque Off" and "Safe Stop 1") can be used with the Power Module.

Note

Refer to the circuit diagrams enclosed for the interconnections of your device.

Note

The Safety functions must be activated prior to use via parameter assignment. An acceptance test must be performed and an acceptance log must be created.

The following Safety Integrated Basic Functions (terms according to DIN EN 61800-5-2) can be activated:

- Safe Torque Off (STO)
- Safe Stop 1 (SS1) (time-controlled)

Note

The integrated safety functions, starting from the Safety Integrated (SI) input terminals of the SINAMICS components (Control Unit, Power Module), satisfy the requirements of EN 61800-5-2, EN 60204-1 and DIN EN ISO 13849-1 category 3 (formerly EN 954-1), as well as the requirements for Performance Level (PL) d and IEC 61508 SIL2.

In addition, most of the SINAMICS safety functions have been certified by independent institutes. A list of currently certified components is available on request from your local Siemens office.

Recommended application

This variant is used when:

- Activation will be executed optically isolated with a voltage of 24 VDC.
- Working with control lines that are shorter than 30 m.
- Devices are deployed in plants with low spatial elongation (observe the drop in voltage at 24 VDC!).

Principle of operation

The first shutdown path for the integrated safety functions is activated via a digital input on the Control Unit. Digital inputs DI 0 to DI 7, DI 16, DI 17, DI 20 and DI 21 are available for this purpose.

The second shutdown path for the integrated safety functions is activated via the terminals (-X41:1, -X42:2) on the Control Interface Module of the Power Module.

The selection and deselection must be simultaneous. The time delay that is unavoidable due to mechanical switching processes, for example, can be adapted via parameters. p9650 specifies the tolerance time within which the selection/deselection of the two monitoring channels must occur in order to be considered as "simultaneous".

The selection of the safety function on the Control Unit and on the Control Interface Module of the Power Module must be performed in two channels. A switch according to ISO 13850/ EN 418, positive opening according to EC 60947-5-1, or a certified safety controller must be used as actuating element.

⚠WARNING

Danger to life as a result of failure of the safety functions through unsuitable selection of the actuating element

An unsuitable actuating element may cause the safety function to fail which can result in death or serious injury.

- Select the correct actuating element for the purpose of compliance of the overall system with the required standard (DIN EN ISO 13849-1 (formerly EN954-1) Cat. 3 PL d or DIN EN 61508 SIL2).

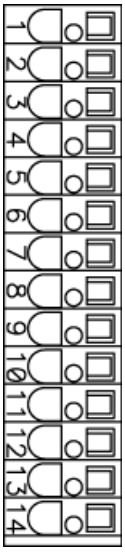
Terminal strip –X41 on the Control Interface Module of the Power Module

Table 5- 6 Terminal strip –X41 on the Control Interface Module of the Power Module

Terminal	Function	Technical data
-X41:2	EP +24 V (enable pulses)	Supply voltage: 24 VDC (20.4 ... 28.8 V) Power consumption: 10 mA
-X41:1	EP M1 (enable pulses)	

Terminal strip –X122 on the CU320-2 Control Unit

Table 5- 7 Terminal strip –X122 on the CU320-2 Control Unit

	Terminal	Designation [1]	Technical data
	1	DI 0	Voltage: -30 ... +30 VDC Typical power consumption: 9 mA at 24 V Electrical isolation: Reference potential is terminal M1 Level (incl. ripple) High level: 15 … 30 V Low-level: -30 … +5 V Input delay (typ.): For "0" → "1": 50 µs For "1" → "0": 150 µs
	2	DI 1	
	3	DI 2	
	4	DI 3	
	5	DI 16	
	6	DI 17	
	7	M1	Reference potential for terminals 1 ... 6
	8	M	Ground
	9	DI/DO 8	**As input**: Voltage: -30 ... +30 VDC Typical power consumption: 9 mA at 24 V Level (incl. ripple) High level: 15 … 30 V Low-level: -30 … +5 V DI/DO 8, 9, 10, and 11 are "rapid inputs" [2] Input delay (typ.): For "0" → "1": 5 µs For "1" → "0": 50 µs **As output**: Voltage: 24 V DC Max. load current per output: 500 mA Continuous short-circuit proof Output delay (typ./max.) [3]: For "0" → "1": 150 µs / 400 µs For "1" → "0": 75 µs / 100 µs Switching frequency: For resistive load: Max. 100 Hz For inductive load: Max. 0.5 Hz For lamp load: Max. 10 Hz Maximum lamp load: 5 W
	10	DI/DO 9	
	11	M	
	12	DI/DO 10	
	13	DI/DO 11	
	14	M	
Max. connectable cross-section: 1.5 mm^2			

[1] DI: Digital input; DI/DO: Bidirectional digital input/output; M: Electronics ground; M1: Reference ground

[2] The rapid inputs can be used as probe inputs or as inputs for the external zero mark

[3] Data for: V_{cc} = 24 V; Load 48 Ω; High ("1") = 90% V_{out}; Low ("0") = 10% V_{out}

Note

An open input is interpreted as "low".

To enable the digital inputs (DI) to function, terminal M1 must be connected.

This is achieved by:

1. Providing the ground reference of the digital inputs, or
2. A jumper to terminal M.

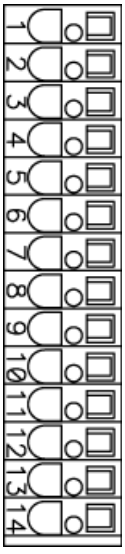
This removes isolation for these digital inputs.

Note

If the 24 V supply is briefly interrupted, the digital outputs are deactivated for this time.

Terminal strip –X132 on the CU320-2 Control Unit

Table 5- 8 Terminal strip –X132 on the CU320-2 Control Unit

	Terminal	Designation [1]	Technical data
	1	DI 4	Voltage: -30 ... +30 VDC Typical power consumption: 9 mA at 24 V Electrical isolation: Reference potential is terminal M2 Level (incl. ripple) High level: 15 … 30 V Low-level: -30 … +5 V Input delay (typ.): For "0" → "1": 50 µs For "1" → "0": 150 µs
	2	DI 5	
	3	DI 6	
	4	DI 7	
	5	DI 20	
	6	DI 21	
	7	M2	Reference potential for terminals 1 ... 6
	8	M	Ground
	9	DI/DO 12	**As input**: Voltage: -30 ... +30 VDC Typical power consumption: 9 mA at 24 V Level (incl. ripple) High level: 15 … 30 V Low-level: -30 … +5 V DI/DO 12, 13, 14, and 15 are "rapid inputs" [2] Input delay (typ.): For "0" → "1": 5 µs For "1" → "0": 50 µs **As output**: Voltage: 24 V DC Max. load current per output: 500 mA Continuous short-circuit proof Output delay (typ./max.) [3]: For "0" → "1": 150 µs / 400 µs For "1" → "0": 75 µs / 100 µs Switching frequency: For resistive load: Max. 100 Hz For inductive load: Max. 0.5 Hz For lamp load: Max. 10 Hz Maximum lamp load: 5 W
	10	DI/DO 13	
	11	M	
	12	DI/DO 14	
	13	DI/DO 15	
	14	M	
Max. connectable cross-section: 1.5 mm^2			

[1] DI: Digital input; DI/DO: Bidirectional digital input/output; M: Electronics ground; M2: Reference ground

[2] The rapid inputs can be used as probe inputs or as inputs for the external zero mark

[3] Data for: V_{cc} = 24 V; Load 48 Ω; High ("1") = 90% V_{out}; Low ("0") = 10% V_{out}

Note

An open input is interpreted as "low".

To enable the digital inputs (DI) to function, terminal M2 must be connected.

This is achieved by:

1. Providing the ground reference of the digital inputs, or
2. A jumper to terminal M.

This removes isolation for these digital inputs.

Note

If the 24 V supply is briefly interrupted, the digital outputs are deactivated for this time.

Wiring

The control cables should be permanently routed (e.g. cable duct, retained using cable ties).

Signal cables and encoder cables should be installed separated from one another.

The shields of the control cables should be grounded through the largest possible surface area immediately after they enter the control cabinet.

Outside the control cabinet, the cables must be routed in such a way that they are safe to walk on (e.g. as specified in IEC 60204-1).

5.3.4 Control of "STO" and "SS1" for SINAMICS G150

Description

The safety functions contained in the standard ("Safe Torque Off" and "Safe Stop 1") can also be used without option K82.

Note

Refer to the circuit diagrams enclosed for the interconnections of your device.

Note

The Safety functions must be activated prior to use via parameter assignment. An acceptance test must be performed and an acceptance log must be created.

The following Safety Integrated Basic Functions (terms and definitions according to IEC 61800-5-2) can be activated:

- Safe Torque Off (STO)
- Safe Stop 1 (SS1) (time-controlled)

Note

The integrated safety functions, starting from the Safety Integrated (SI) input terminals of the SINAMICS components (Control Unit, Power Module), satisfy the requirements of EN 61800-5-2, EN 60204-1 and DIN EN ISO 13849-1 category 3 (formerly EN 954-1), as well as the requirements for Performance Level (PL) d and IEC 61508 SIL2.

In addition, most of the SINAMICS safety functions have been certified by independent institutes. A list of currently certified components is available on request from your local Siemens office.

Recommended application

This variant is used when:

- Activation will be executed optically isolated with a voltage of 24 VDC.
- Working with control lines that are shorter than 30 m.
- Devices are deployed in plants with low spatial elongation (observe the drop in voltage at 24 VDC!).

Principle of operation

The first shutdown path for the integrated safety functions is activated via a digital input on the Control Unit. Digital inputs DI 0 to DI 7, DI 16, DI 17, DI 20 and DI 21 are available for this purpose.

The second shutdown path for the integrated safety functions is activated via the terminals (-X41:1, -X42:2) on the Control Interface Module of the Power Module.

Note

Additional inputs must be activated for the following cabinet units (synchronizers):

- An additional digital input on the CU320-2 and
- The terminals (-X41:1, -X42:2) on the Control Interface Module of the second Power Module connected in parallel.

Synchronizers:

- For 380 to 480 V 3 AC:
  6SL3710-2GE41-1AAx, 6SL3710-2GE41-4AAx, 6SL3710-2GE41-6AAx
- For 500 to 600 V 3 AC:
  6SL3710-2GF38-6AAx, 6SL3710-2GF41-1AAx, 6SL3710-2GF41-4AAx
- For 660 to 690 V 3 AC:
  6SL3710-2GH41-1AAx, 6SL3710-2GH41-4AAx, 6SL3710-2GH41-5AAx

The selection and deselection must be simultaneous. The time delay that is unavoidable due to mechanical switching processes, for example, can be adapted via parameters. p9650 specifies the tolerance time within which the selection/deselection of the two monitoring channels must occur in order to be considered as "simultaneous".

The selection of the safety function on the Control Unit and on the Control Interface Module of the Power Module must be executed over two channels. A switch according to ISO 13850/ EN 418, positive opening according to EC 60947-5-1, or a certified safety controller must be used as actuating element.

⚠ WARNING

Danger to life as a result of failure of the safety functions through unsuitable selection of the actuating element

An unsuitable actuating element may cause the safety function to fail which can result in death or serious injury.

- Select the correct actuating element for the purpose of compliance of the overall system with the required standard (DIN EN ISO 13849-1 (formerly EN954-1) Cat. 3 PL d or DIN EN 61508 SIL2).

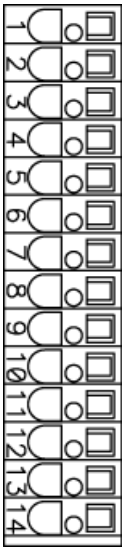
Terminal strip –X41 on the Control Interface Module of the Power Module

Table 5- 9 Terminal strip –X41 on the Control Interface Module of the Power Module

Terminal	Function	Technical data
-X41:2	EP +24 V (enable pulses)	Supply voltage: 24 VDC (20.4 ... 28.8 V) Power consumption: 10 mA
-X41:1	EP M1 (enable pulses)	

Terminal strip –X122 on the CU320-2 Control Unit

Table 5- 10 Terminal strip –X122 on the CU320-2 Control Unit

	Terminal	Designation [1]	Technical data
	1	DI 0	Voltage: -30 ... +30 VDC Typical power consumption: 9 mA at 24 V Electrical isolation: Reference potential is terminal M1 Level (incl. ripple) High level: 15 … 30 V Low-level: -30 … +5 V Input delay (typ.): For "0" → "1": 50 µs For "1" → "0": 150 µs
	2	DI 1	
	3	DI 2	
	4	DI 3	
	5	DI 16	
	6	DI 17	
	7	M1	Reference potential for terminals 1 ... 6
	8	M	Ground
	9	DI/DO 8	**As input**: Voltage: -30 ... +30 VDC Typical power consumption: 9 mA at 24 V Level (incl. ripple) High level: 15 … 30 V Low-level: -30 … +5 V DI/DO 8, 9, 10, and 11 are "rapid inputs" [2] Input delay (typ.): For "0" → "1": 5 µs For "1" → "0": 50 µs **As output**: Voltage: 24 V DC Max. load current per output: 500 mA Continuous short-circuit proof Output delay (typ./max.) [3]: For "0" → "1": 150 µs / 400 µs For "1" → "0": 75 µs / 100 µs Switching frequency: For resistive load: Max. 100 Hz For inductive load: Max. 0.5 Hz For lamp load: Max. 10 Hz Maximum lamp load: 5 W
	10	DI/DO 9	
	11	M	
	12	DI/DO 10	
	13	DI/DO 11	
	14	M	
Max. connectable cross-section: 1.5 mm^2			

[1] DI: Digital input; DI/DO: Bidirectional digital input/output; M: Electronics ground; M1: Reference ground

[2] The rapid inputs can be used as probe inputs or as inputs for the external zero mark

[3] Data for: V_{cc} = 24 V; Load 48 Ω; High ("1") = 90% V_{out}; Low ("0") = 10% V_{out}

Note

An open input is interpreted as "low".

To enable the digital inputs (DI) to function, terminal M1 must be connected.

This is achieved by:

1. Providing the ground reference of the digital inputs, or
2. A jumper to terminal M.

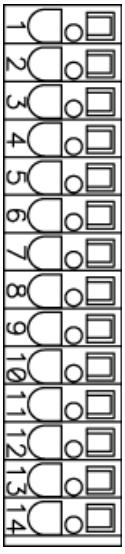
This removes isolation for these digital inputs.

Note

If the 24 V supply is briefly interrupted, the digital outputs are deactivated for this time.

Terminal strip –X132 on the CU320-2 Control Unit

Table 5- 11 Terminal strip –X132 on the CU320-2 Control Unit

	Terminal	Designation [1]	Technical data
	1	DI 4	Voltage: -30 ... +30 VDC Typical power consumption: 9 mA at 24 V Electrical isolation: Reference potential is terminal M2 Level (incl. ripple) High level: 15 … 30 V Low-level: -30 … +5 V Input delay (typ.): For "0" → "1": 50 µs For "1" → "0": 150 µs
	2	DI 5	
	3	DI 6	
	4	DI 7	
	5	DI 20	
	6	DI 21	
	7	M2	Reference potential for terminals 1 ... 6
	8	M	Ground
	9	DI/DO 12	**As input**: Voltage: -30 ... +30 VDC Typical power consumption: 9 mA at 24 V Level (incl. ripple) High level: 15 … 30 V Low-level: -30 … +5 V DI/DO 12, 13, 14, and 15 are "rapid inputs" [2] Input delay (typ.): For "0" → "1": 5 µs For "1" → "0": 50 µs **As output**: Voltage: 24 V DC Max. load current per output: 500 mA Continuous short-circuit proof Output delay (typ./max.) [3]: For "0" → "1": 150 µs / 400 µs For "1" → "0": 75 µs / 100 µs Switching frequency: For resistive load: Max. 100 Hz For inductive load: Max. 0.5 Hz For lamp load: Max. 10 Hz Maximum lamp load: 5 W
	10	DI/DO 13	
	11	M	
	12	DI/DO 14	
	13	DI/DO 15	
	14	M	
Max. connectable cross-section: 1.5 mm^2			

[1] DI: Digital input; DI/DO: Bidirectional digital input/output; M: Electronics ground; M2: Reference ground

[2] The rapid inputs can be used as probe inputs or as inputs for the external zero mark

[3] Data for: V_{cc} = 24 V; Load 48 Ω; High ("1") = 90% V_{out}; Low ("0") = 10% V_{out}

Note

An open input is interpreted as "low".

To enable the digital inputs (DI) to function, terminal M2 must be connected.

This is achieved by:

1. Providing the ground reference of the digital inputs, or
2. A jumper to terminal M.

This removes isolation for these digital inputs.

Note

If the 24 V supply is briefly interrupted, the digital outputs are deactivated for this time.

Wiring

The control cables should be permanently routed (e.g. cable duct, retained using cable ties).

Signal cables and encoder cables should be installed separated from one another.

The shields of the control cables should be grounded through the largest possible surface area immediately after they enter the control cabinet.

Outside the control cabinet, the cables must be routed in such a way that they are safe to walk on (e.g. as specified in IEC 60204-1).

5.3.5 Control of "STO" and "SS1" for SINAMICS S120 Chassis

Description

The safety functions contained in the standard ("Safe Torque Off" and "Safe Stop 1") can be used with the Motor Module.

Note

Refer to the circuit diagrams enclosed for the interconnections of your device.

Note

The Safety functions must be activated prior to use via parameter assignment. An acceptance test must be performed and an acceptance log must be created.

The following Safety Integrated Basic Functions (terms according to DIN EN 61800-5-2) can be activated:

- Safe Torque Off (STO)
- Safe Stop 1 (SS1) (time-controlled)

Note

The integrated safety functions, starting from the Safety Integrated (SI) input terminals of the SINAMICS components (Control Unit, Motor Module), satisfy the requirements of EN 61800-5-2, EN 60204-1, and DIN EN ISO 13849-1 category 3 (formerly EN 954-1), as well as the requirements for Performance Level (PL) d and IEC 61508 SIL2.

In addition, most of the SINAMICS safety functions have been certified by independent institutes. A list of currently certified components is available on request from your local Siemens office.

Recommended application

This variant is used when:

- Activation will be executed optically isolated with a voltage of 24 VDC.
- Working with control lines that are shorter than 30 m.
- Devices are deployed in plants with low spatial elongation (observe the drop in voltage at 24 VDC!).

Principle of operation

The first shutdown path for the integrated safety functions is activated via a digital input on the Control Unit. Digital inputs DI 0 to DI 7, DI 16, DI 17, DI 20 and DI 21 are available for this purpose.

The second shutdown path for the integrated safety functions is activated using the terminals (-X41:1, -X42:2) on the Control Interface Module of the Motor Module.

The selection and deselection must be simultaneous. The time delay that is unavoidable due to mechanical switching processes, for example, can be adapted via parameters. p9650 specifies the tolerance time within which the selection/deselection of the two monitoring channels must occur in order to be considered as "simultaneous".

The selection of the safety function on the Control Unit and on the Motor Module must be executed over two channels. A switch according to ISO 13850/ EN 418, positive opening according to EC 60947-5-1, or a certified safety controller must be used as actuating element.

⚠WARNING

Danger to life as a result of failure of the safety functions through unsuitable selection of the actuating element

An unsuitable actuating element may cause the safety function to fail which can result in death or serious injury.

- Select the correct actuating element for the purpose of compliance of the overall system with the required standard (DIN EN ISO 13849-1 (formerly EN954-1) Cat. 3 PL d or DIN EN 61508 SIL2).

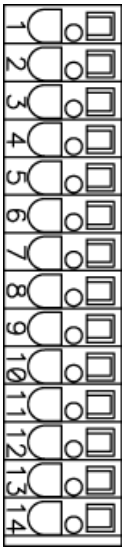
Terminal strip –X41 on the Control Interface Module of the chassis Motor Module

Table 5- 12 Terminal strip –X41 on the Control Interface Module of the chassis Motor Module

Terminal	Function	Technical data
-X41:2	EP +24 V (enable pulses)	Supply voltage: 24 VDC (20.4 ... 28.8 V) Power consumption: 10 mA
-X41:1	EP M1 (enable pulses)	

Terminal strip –X122 on the CU320-2 Control Unit

Table 5- 13 Terminal strip –X122 on the CU320-2 Control Unit

	Terminal	Designation [1]	Technical data
	1	DI 0	Voltage: -30 ... +30 VDC Typical power consumption: 9 mA at 24 V Electrical isolation: Reference potential is terminal M1 Level (incl. ripple) High level: 15 … 30 V Low-level: -30 … +5 V Input delay (typ.): For "0" → "1": 50 µs For "1" → "0": 150 µs
	2	DI 1	
	3	DI 2	
	4	DI 3	
	5	DI 16	
	6	DI 17	
	7	M1	Reference potential for terminals 1 ... 6
	8	M	Ground
	9	DI/DO 8	**As input**: Voltage: -30 ... +30 VDC Typical power consumption: 9 mA at 24 V Level (incl. ripple) High level: 15 … 30 V Low-level: -30 … +5 V DI/DO 8, 9, 10, and 11 are "rapid inputs" [2] Input delay (typ.): For "0" → "1": 5 µs For "1" → "0": 50 µs **As output**: Voltage: 24 V DC Max. load current per output: 500 mA Continuous short-circuit proof Output delay (typ./max.) [3]: For "0" → "1": 150 µs / 400 µs For "1" → "0": 75 µs / 100 µs Switching frequency: For resistive load: Max. 100 Hz For inductive load: Max. 0.5 Hz For lamp load: Max. 10 Hz Maximum lamp load: 5 W
	10	DI/DO 9	
	11	M	
	12	DI/DO 10	
	13	DI/DO 11	
	14	M	
Max. connectable cross-section: 1.5 mm^2			

[1] DI: Digital input; DI/DO: Bidirectional digital input/output; M: Electronics ground; M1: Reference ground

[2] The rapid inputs can be used as probe inputs or as inputs for the external zero mark

[3] Data for: V_{cc} = 24 V; Load 48 Ω; High ("1") = 90% V_{out}; Low ("0") = 10% V_{out}

Note

An open input is interpreted as "low".

To enable the digital inputs (DI) to function, terminal M1 must be connected.

This is achieved by:

1. Providing the ground reference of the digital inputs, or
2. A jumper to terminal M.

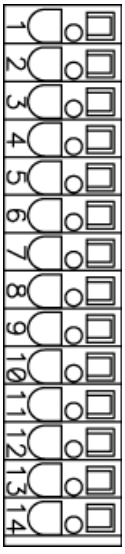
This removes isolation for these digital inputs.

Note

If the 24 V supply is briefly interrupted, the digital outputs are deactivated for this time.

Terminal strip –X132 on the CU320-2 Control Unit

Table 5- 14 Terminal strip –X132 on the CU320-2 Control Unit

	Terminal	Designation [1]	Technical data
	1	DI 4	Voltage: -30 ... +30 VDC Typical power consumption: 9 mA at 24 V Electrical isolation: Reference potential is terminal M2 Level (incl. ripple) High level: 15 … 30 V Low-level: -30 … +5 V Input delay (typ.): For "0" → "1": 50 µs For "1" → "0": 150 µs
	2	DI 5	
	3	DI 6	
	4	DI 7	
	5	DI 20	
	6	DI 21	
	7	M2	Reference potential for terminals 1 ... 6
	8	M	Ground
	9	DI/DO 12	**As input**: Voltage: -30 ... +30 VDC Typical power consumption: 9 mA at 24 V Level (incl. ripple) High level: 15 … 30 V Low-level: -30 … +5 V DI/DO 12, 13, 14, and 15 are "rapid inputs" [2] Input delay (typ.): For "0" → "1": 5 µs For "1" → "0": 50 µs **As output**: Voltage: 24 V DC Max. load current per output: 500 mA Continuous short-circuit proof Output delay (typ./max.) [3]: For "0" → "1": 150 µs / 400 µs For "1" → "0": 75 µs / 100 µs Switching frequency: For resistive load: Max. 100 Hz For inductive load: Max. 0.5 Hz For lamp load: Max. 10 Hz Maximum lamp load: 5 W
	10	DI/DO 13	
	11	M	
	12	DI/DO 14	
	13	DI/DO 15	
	14	M	
Max. connectable cross-section: 1.5 mm^2			

[1] DI: Digital input; DI/DO: Bidirectional digital input/output; M: Electronics ground; M2: Reference ground

[2] The rapid inputs can be used as probe inputs or as inputs for the external zero mark

[3] Data for: V_{cc} = 24 V; Load 48 Ω; High ("1") = 90% V_{out}; Low ("0") = 10% V_{out}

Note

An open input is interpreted as "low".

To enable the digital inputs (DI) to function, terminal M2 must be connected.

This is achieved by:

1. Providing the ground reference of the digital inputs, or
2. A jumper to terminal M.

This removes isolation for these digital inputs.

Note

If the 24 V supply is briefly interrupted, the digital outputs are deactivated for this time.

Wiring

The control cables should be permanently routed (e.g. cable duct, retained using cable ties).

Signal cables and encoder cables should be installed separated from one another.

The shields of the control cables should be grounded through the largest possible surface area immediately after they enter the control cabinet.

Outside the control cabinet, the cables must be routed in such a way that they are safe to walk on (e.g. as specified in IEC 60204-1).

5.3.6 Control of "STO" and "SS1" for SINAMICS S120 Cabinet Modules

Description

The safety functions contained in the standard ("Safe Torque Off" and "Safe Stop 1") can also be used without option K82.

Note

Refer to the circuit diagrams enclosed for the interconnections of your device.

Note

The Safety functions must be activated prior to use via parameter assignment. An acceptance test must be performed and an acceptance log must be created.

The following Safety Integrated Basic Functions (terms according to DIN EN 61800-5-2) can be activated:

- Safe Torque Off (STO)
- Safe Stop 1 (SS1) (time-controlled)

Note

The integrated safety functions, starting from the Safety Integrated (SI) input terminals of the SINAMICS components (Control Unit, Motor Module), satisfy the requirements of EN 61800-5-2, EN 60204-1, and DIN EN ISO 13849-1 category 3 (formerly EN 954-1), as well as the requirements for Performance Level (PL) d and IEC 61508 SIL2.

In addition, most of the SINAMICS safety functions have been certified by independent institutes. A list of currently certified components is available on request from your local Siemens office.

Recommended application

This variant is used when:

- Activation will be executed optically isolated with a voltage of 24 VDC.
- Working with control lines that are shorter than 30 m.
- Devices are deployed in plants with low spatial elongation (observe the drop in voltage at 24 VDC!).

Principle of operation

The first shutdown path for the integrated safety functions is activated via a digital input on the Control Unit. Digital inputs DI 0 to DI 7, DI 16, DI 17, DI 20 and DI 21 are available for this purpose.

Chassis Motor Module

- The second shutdown path for the integrated safety functions is activated using the terminals (-X41:1, -X42:2) on the Control Interface Module of the Motor Module.

Booksize Cabinet Kit

- The second shutdown path for the integrated safety functions is activated using the terminals (-X21:3, -X21:4) on the Motor Module Booksize.

The selection and deselection must be simultaneous. The time delay that is unavoidable due to mechanical switching processes, for example, can be adapted via parameters. p9650 specifies the tolerance time within which the selection/deselection of the two monitoring channels must occur in order to be considered as "simultaneous".

The selection of the safety function on the Control Unit and on the Motor Module must be executed over two channels. A switch according to ISO 13850/ EN 418, positive opening according to EC 60947-5-1, or a certified safety controller must be used as actuating element.

⚠WARNING

Danger to life as a result of failure of the safety functions through unsuitable selection of the actuating element

An unsuitable actuating element may cause the safety function to fail which can result in death or serious injury.

- Select the correct actuating element for the purpose of compliance of the overall system with the required standard (DIN EN ISO 13849-1 (formerly EN954-1) Cat. 3 PL d or DIN EN 61508 SIL2).

Terminal strip –X41 on the Control Interface Module of the chassis Motor Module

Table 5- 15 Terminal strip –X41 on the Control Interface Module of the chassis Motor Module

Terminal	Function	Technical data
-X41:2	EP +24 V (enable pulses)	Supply voltage: 24 VDC (20.4 ... 28.8 V) Power consumption: 10 mA
-X41:1	EP M1 (enable pulses)	

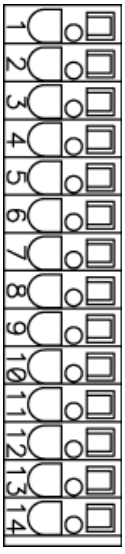
Terminal strip –X21/–X22 on the Motor Module Booksize

Table 5- 16 Terminal strip –X21/–X22 on the Motor Module Booksize

Terminal	Function	Technical data
-X21:3 -X22:3	EP +24 V (enable pulses)	Supply voltage: 24 VDC (20.4 ... 28.8 V) Power consumption: 10 mA
-X21:4 -X22:4	EP M1 (enable pulses)	Signal propagation times: L → H: 100 µs H → L: 1000 µs

Terminal strip –X122 on the CU320-2 Control Unit

Table 5- 17 Terminal strip –X122 on the CU320-2 Control Unit

	Terminal	Designation [1]	Technical data
	1	DI 0	Voltage: -30 ... +30 VDC Typical power consumption: 9 mA at 24 V Electrical isolation: Reference potential is terminal M1 Level (incl. ripple) High level: 15 … 30 V Low-level: -30 … +5 V Input delay (typ.): For "0" → "1": 50 µs For "1" → "0": 150 µs
	2	DI 1	
	3	DI 2	
	4	DI 3	
	5	DI 16	
	6	DI 17	
	7	M1	Reference potential for terminals 1 ... 6
	8	M	Ground
	9	DI/DO 8	**As input**: Voltage: -30 ... +30 VDC Typical power consumption: 9 mA at 24 V Level (incl. ripple) High level: 15 … 30 V Low-level: -30 … +5 V DI/DO 8, 9, 10, and 11 are "rapid inputs" [2] Input delay (typ.): For "0" → "1": 5 µs For "1" → "0": 50 µs **As output**: Voltage: 24 V DC Max. load current per output: 500 mA Continuous short-circuit proof Output delay (typ./max.) [3]: For "0" → "1": 150 µs / 400 µs For "1" → "0": 75 µs / 100 µs Switching frequency: For resistive load: Max. 100 Hz For inductive load: Max. 0.5 Hz For lamp load: Max. 10 Hz Maximum lamp load: 5 W
	10	DI/DO 9	
	11	M	
	12	DI/DO 10	
	13	DI/DO 11	
	14	M	
Max. connectable cross-section: 1.5 mm^2			

[1] DI: Digital input; DI/DO: Bidirectional digital input/output; M: Electronics ground; M1: Reference ground

[2] The rapid inputs can be used as probe inputs or as inputs for the external zero mark

[3] Data for: V_{cc} = 24 V; Load 48 Ω; High ("1") = 90% V_{out}; Low ("0") = 10% V_{out}

Note

An open input is interpreted as "low".

To enable the digital inputs (DI) to function, terminal M1 must be connected.

This is achieved by:

1. Providing the ground reference of the digital inputs, or
2. A jumper to terminal M.

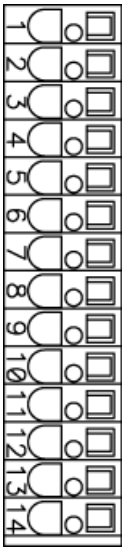
This removes isolation for these digital inputs.

Note

If the 24 V supply is briefly interrupted, the digital outputs are deactivated for this time.

Terminal strip –X132 on the CU320-2 Control Unit

Table 5- 18 Terminal strip –X132 on the CU320-2 Control Unit

	Terminal	Designation [1]	Technical data
	1	DI 4	Voltage: -30 ... +30 VDC Typical power consumption: 9 mA at 24 V Electrical isolation: Reference potential is terminal M2 Level (incl. ripple) High level: 15 … 30 V Low-level: -30 … +5 V Input delay (typ.): For "0" → "1": 50 µs For "1" → "0": 150 µs
	2	DI 5	
	3	DI 6	
	4	DI 7	
	5	DI 20	
	6	DI 21	
	7	M2	Reference potential for terminals 1 ... 6
	8	M	Ground
	9	DI/DO 12	**As input**: Voltage: -30 ... +30 VDC Typical power consumption: 9 mA at 24 V Level (incl. ripple) High level: 15 … 30 V Low-level: -30 … +5 V DI/DO 12, 13, 14, and 15 are "rapid inputs" [2] Input delay (typ.): For "0" → "1": 5 µs For "1" → "0": 50 µs **As output**: Voltage: 24 V DC Max. load current per output: 500 mA Continuous short-circuit proof Output delay (typ./max.) [3]: For "0" → "1": 150 µs / 400 µs For "1" → "0": 75 µs / 100 µs Switching frequency: For resistive load: Max. 100 Hz For inductive load: Max. 0.5 Hz For lamp load: Max. 10 Hz Maximum lamp load: 5 W
	10	DI/DO 13	
	11	M	
	12	DI/DO 14	
	13	DI/DO 15	
	14	M	
Max. connectable cross-section: 1.5 mm^2			

[1] DI: Digital input; DI/DO: Bidirectional digital input/output; M: Electronics ground; M2: Reference ground

[2] The rapid inputs can be used as probe inputs or as inputs for the external zero mark

[3] Data for: V_{cc} = 24 V; Load 48 Ω; High ("1") = 90% V_{out}; Low ("0") = 10% V_{out}

Note

An open input is interpreted as "low".

To enable the digital inputs (DI) to function, terminal M2 must be connected.

This is achieved by:

1. Providing the ground reference of the digital inputs, or
2. A jumper to terminal M.

This removes isolation for these digital inputs.

Note

If the 24 V supply is briefly interrupted, the digital outputs are deactivated for this time.

Wiring

The control cables should be permanently routed (e.g. cable duct, retained using cable ties).

Signal cables and encoder cables should be installed separated from one another.

The shields of the control cables should be grounded through the largest possible surface area immediately after they enter the control cabinet.

Outside the control cabinet the cables must be routed in such a way that they are safe to walk on (e.g. as specified in IEC 60204-1).

5.3.7 Control of "STO" and "SS1" for SINAMICS S150

Description

The safety functions contained in the standard ("Safe Torque Off" and "Safe Stop 1") can also be used without option K82.

Note

Refer to the circuit diagrams enclosed for the interconnections of your device.

Note

The Safety functions must be activated prior to use via parameter assignment. An acceptance test must be performed and an acceptance log must be created.

The following Safety Integrated Basic Functions (terms according to DIN EN 61800-5-2) can be activated:

- Safe Torque Off (STO)
- Safe Stop 1 (SS1) (time-controlled)

Note

The integrated safety functions, starting from the Safety Integrated (SI) input terminals of the SINAMICS components (Control Unit, Motor Module), satisfy the requirements of EN 61800-5-2, EN 60204-1 and DIN EN ISO 13849-1 category 3 (formerly EN 954-1), as well as the requirements for Performance Level (PL) d and IEC 61508 SIL2.

In addition, most of the SINAMICS safety functions have been certified by independent institutes. A list of currently certified components is available on request from your local Siemens office.

Recommended application

This variant is used when:

- Activation will be executed optically isolated with a voltage of 24 VDC.
- Working with control lines that are shorter than 30 m.
- Devices are deployed in plants with low spatial elongation (observe the drop in voltage at 24 VDC!).

Principle of operation

The first shutdown path for the integrated safety functions is activated via a digital input on the Control Unit. Digital inputs DI 0 to DI 7, DI 16, DI 17, DI 20 and DI 21 are available for this purpose.

The second shutdown path for the integrated safety functions is activated using the terminals (-X41:1, -X42:2) on the Control Interface Module of the Motor Module.

The selection and deselection must be simultaneous. The time delay that is unavoidable due to mechanical switching processes, for example, can be adapted via parameters. p9650 specifies the tolerance time within which the selection/deselection of the two monitoring channels must occur in order to be considered as "simultaneous".

The selection of the safety function on the Control Unit and on the Control Interface Module of the Motor Module must be executed over two channels. A switch according to ISO 13850/ EN 418, positive opening according to EC 60947-5-1, or a certified safety controller must be used as actuating element.

⚠WARNING

Danger to life as a result of failure of the safety functions through unsuitable selection of the actuating element

An unsuitable actuating element may cause the safety function to fail which can result in death or serious injury.

- Select the correct actuating element for the purpose of compliance of the overall system with the required standard (DIN EN ISO 13849-1 (formerly EN954-1) Cat. 3 PL d or DIN EN 61508 SIL2).

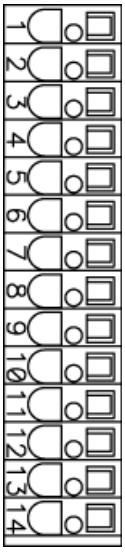
Terminal strip –X41 on the Control Interface Module of the Motor Module

Table 5- 19 Terminal strip –X41 on the Control Interface Module of the Motor Module

Terminal	Function	Technical data
-X41:2	EP +24 V (enable pulses)	Supply voltage: 24 VDC (20.4 ... 28.8 V) Power consumption: 10 mA
-X41:1	EP M1 (enable pulses)	

Terminal strip –X122 on the CU320-2 Control Unit

Table 5- 20 Terminal strip –X122 on the CU320-2 Control Unit

	Terminal	Designation [1]	Technical data
	1	DI 0	Voltage: -30 ... +30 VDC Typical power consumption: 9 mA at 24 V Electrical isolation: Reference potential is terminal M1 Level (incl. ripple) High level: 15 … 30 V Low-level: -30 … +5 V Input delay (typ.): For "0" → "1": 50 µs For "1" → "0": 150 µs
	2	DI 1	
	3	DI 2	
	4	DI 3	
	5	DI 16	
	6	DI 17	
	7	M1	Reference potential for terminals 1 ... 6
	8	M	Ground
	9	DI/DO 8	**As input**: Voltage: -30 ... +30 VDC Typical power consumption: 9 mA at 24 V Level (incl. ripple) High level: 15 … 30 V Low-level: -30 … +5 V DI/DO 8, 9, 10, and 11 are "rapid inputs" [2] Input delay (typ.): For "0" → "1": 5 µs For "1" → "0": 50 µs **As output**: Voltage: 24 V DC Max. load current per output: 500 mA Continuous short-circuit proof Output delay (typ./max.) [3]: For "0" → "1": 150 µs / 400 µs For "1" → "0": 75 µs / 100 µs Switching frequency: For resistive load: Max. 100 Hz For inductive load: Max. 0.5 Hz For lamp load: Max. 10 Hz Maximum lamp load: 5 W
	10	DI/DO 9	
	11	M	
	12	DI/DO 10	
	13	DI/DO 11	
	14	M	
Max. connectable cross-section: 1.5 mm^2			

[1] DI: Digital input; DI/DO: Bidirectional digital input/output; M: Electronics ground; M1: Reference ground

[2] The rapid inputs can be used as probe inputs or as inputs for the external zero mark

[3] Data for: V_{cc} = 24 V; Load 48 Ω; High ("1") = 90% V_{out}; Low ("0") = 10% V_{out}

Note

An open input is interpreted as "low".

To enable the digital inputs (DI) to function, terminal M1 must be connected.

This is achieved by:

1. Providing the ground reference of the digital inputs, or
2. A jumper to terminal M.

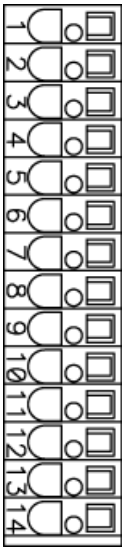
This removes isolation for these digital inputs.

Note

If the 24 V supply is briefly interrupted, the digital outputs are deactivated for this time.

Terminal strip –X132 on the CU320-2 Control Unit

Table 5- 21 Terminal strip –X132 on the CU320-2 Control Unit

	Terminal	Designation [1]	Technical data
	1	DI 4	Voltage: -30 ... +30 VDC Typical power consumption: 9 mA at 24 V Electrical isolation: Reference potential is terminal M2 Level (incl. ripple) High level: 15 … 30 V Low-level: -30 … +5 V Input delay (typ.): For "0" → "1": 50 µs For "1" → "0": 150 µs
	2	DI 5	
	3	DI 6	
	4	DI 7	
	5	DI 20	
	6	DI 21	
	7	M2	Reference potential for terminals 1 ... 6
	8	M	Ground
	9	DI/DO 12	**As input**: Voltage: -30 ... +30 VDC Typical power consumption: 9 mA at 24 V Level (incl. ripple) High level: 15 … 30 V Low-level: -30 … +5 V DI/DO 12, 13, 14, and 15 are "rapid inputs" [2] Input delay (typ.): For "0" → "1": 5 µs For "1" → "0": 50 µs **As output**: Voltage: 24 V DC Max. load current per output: 500 mA Continuous short-circuit proof Output delay (typ./max.) [3]: For "0" → "1": 150 µs / 400 µs For "1" → "0": 75 µs / 100 µs Switching frequency: For resistive load: Max. 100 Hz For inductive load: Max. 0.5 Hz For lamp load: Max. 10 Hz Maximum lamp load: 5 W
	10	DI/DO 13	
	11	M	
	12	DI/DO 14	
	13	DI/DO 15	
	14	M	
Max. connectable cross-section: 1.5 mm^2			

[1] DI: Digital input; DI/DO: Bidirectional digital input/output; M: Electronics ground; M2: Reference ground

[2] The rapid inputs can be used as probe inputs or as inputs for the external zero mark

[3] Data for: V_{cc} = 24 V; Load 48 Ω; High ("1") = 90% V_{out}; Low ("0") = 10% V_{out}

Note

An open input is interpreted as "low".

To enable the digital inputs (DI) to function, terminal M2 must be connected.

This is achieved by:

1. Providing the ground reference of the digital inputs, or
2. A jumper to terminal M.

This removes isolation for these digital inputs.

Note

If the 24 V supply is briefly interrupted, the digital outputs are deactivated for this time.

Wiring

The control cables should be permanently routed (e.g. cable duct, retained using cable ties).

Signal cables and encoder cables should be installed separated from one another.

The shields of the control cables should be grounded through the largest possible surface area immediately after they enter the control cabinet.

Outside the control cabinet, the cables must be routed in such a way that they are safe to walk on (e.g. as specified in IEC 60204-1).

5.4 Activating "SBC" via the Safe Brake Adapter

5.4.1 Activating "SBC" via the Safe Brake Adapter for option K88 (230 V AC)

Description

The Safe Brake Control (SBC) is a safety function which is used in safety-related applications, e.g. in presses or in rolling mills. In the no-current state, the brake acts on the motor of the drive using spring force. The brake is released when current flows (=low active).

The Safe Brake Adapter 230 VAC is installed in the factory in the cabinet unit. Power is connected to terminal -X12 on the Safe Brake Adapter. A connection between the Safe Brake Adapter and the Control Interface Module is established in the factory so that the Safe Brake Adapter can be controlled.

For controlling the brake, a connection must be established on site between terminal -X14 on the Safe Brake Adapter and the rectifier of the brake. Direct connection of AC brakes is not permissible.

Fast de-energization

Some brake rectifier types feature two additional connections for switching the brake load on the DC side. This allows the brake coil to be quickly de-energized, i.e. the braking effect starts earlier.

The Safe Brake Adapter supports such a fast de-energization using the two additional connections -X15:1 and -X15:2. This function is not part of the safe brake control.

Note

Determination of the time until the brake engages without fast de-energization

As the fast de-energization is not part of the safety function, this functionality is not monitored. The fast de-energization can therefore fail during operation without being noticed.

Therefore, to determine the time until the brake engages for a machine acceptance, the fast de-energization must be bypassed by short-circuiting the terminals at X15:1, 2.

Safety instructions

Note

The integrated safety functions, starting from the Safety Integrated (SI) input terminals of the SINAMICS components (Control Unit, Motor Module), satisfy the requirements of EN 61800-5-2, EN 60204-1 and DIN EN ISO 13849-1 category 3 (formerly EN 954-1), as well as the requirements for Performance Level (PL) d and IEC 61508 SIL2.

With the Safe Brake Adapter (option K89), the requirements specified in EN 61800-5-2, EN 60204-1, DIN EN ISO 13849-1 Category 3 (formerly EN954-1) as well as for Performance Level (PL) d and IEC 61508 SIL 2 are fulfilled.

NOTICE

Equipment fault caused by connection of a 24 VDC brake

If a 24 VDC brake is connected to option K88, Safe Brake Adapter 230 VAC on the system side, then this can cause damage to the Safe Brake Adapter.
This can result in the following undesirable effects:

1. Closing the brake is not displayed on the LEDS.
2. The fuse is ruptured.
3. The contact service life of the relay is reduced.

- Do not connect a 24 VDC brake to the 230 VAC Safe Brake Adapter.

Interfaces

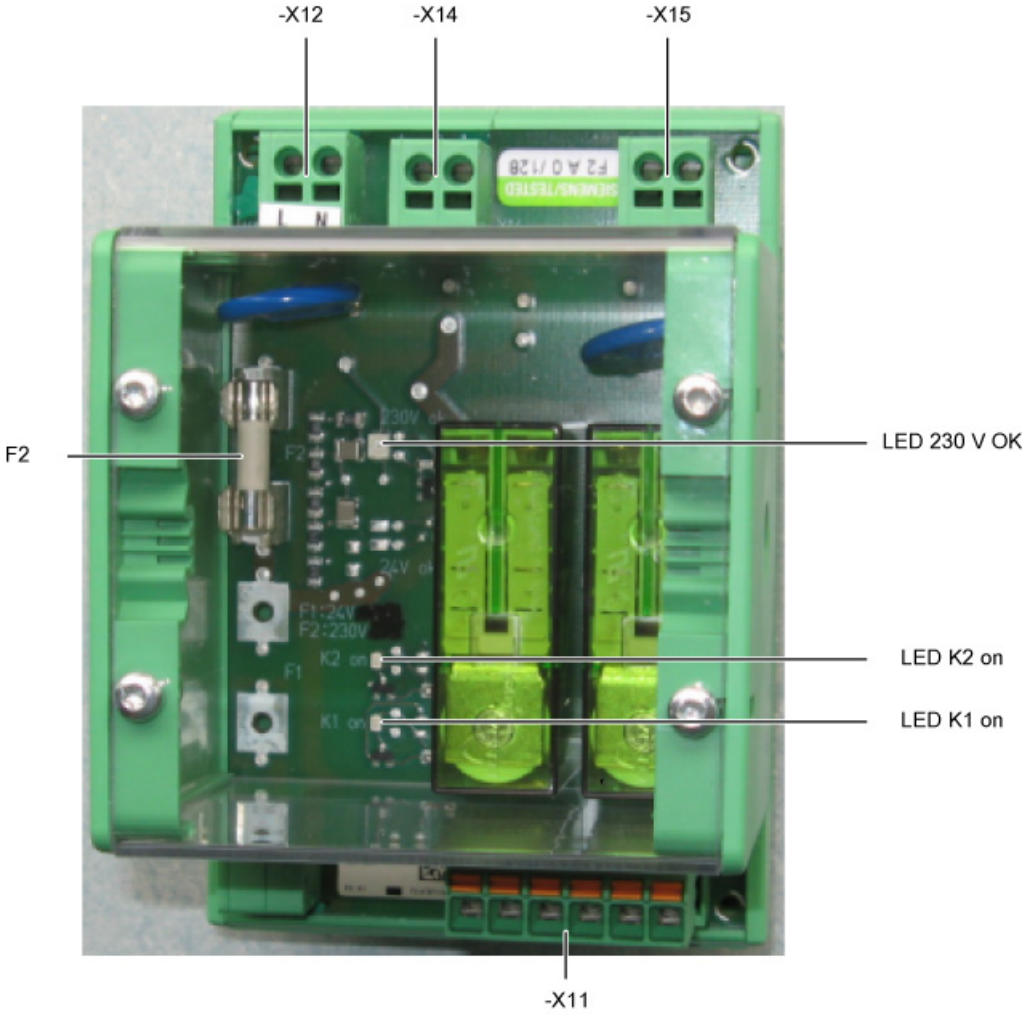


Figure 5-7 Safe Brake Adapter interface overview 230 VAC

Table 5- 22 Terminal strip X12, 230 VAC power supply

Connection	Signal	Description
X12.1	L	Supply voltage: 230 VAC Current consumption: 2 A Protection according to IEC 60269-1, operating class gG
X12.2	N	
Max. connectable cross-section 2.5 mm^2		

Table 5- 23 Terminal block X14, interface to the load

Connection	Signal	Description
X14.1	BR L	Supply voltage: 230 VAC
X14.2	BR N	Current consumption: 2 A, only for brakes with brake rectifier
Max. connectable cross-section 2.5 mm²		

⚠WARNING

Danger to life if the permissible cable length of the brake control is exceeded

If the permissible cable length of the brake control is exceeded this can result in death or serious injury in the event of an error.

- The maximum permissible cable length of 300 m between the 230 VAC Safe Brake Adapter and the brake must be carefully maintained.
- To accurately calculate the maximum cable length, see the SINAMICS Low Voltage Configuration Manual on the customer DVD supplied with the device.

Table 5- 24 Terminal block X15, fast de-energization

Connection	Signal	Description
X15.1	AUX1	Supply voltage: 230 VAC
X15.2	AUX2	Current consumption: 2 A
Max. connectable cross-section 2.5 mm²		

Spare fuse

The type of spare fuse is as follows: 2 A, time-lag.

Note

Correctly mounting the housing cover after replacing a fuse

An adhesive label is provided on the housing cover indicating the position of the connector. Mount the cover in the correct position so that the inscription of the label matches the actual connectors.

5.4.2 Safe Brake Adapter SBA 230 V AC for SINAMICS G130/SINAMICS S120 Chassis

Description

The Safe Brake Control (SBC) is a safety function which is used in safety-related applications, e.g. in presses or in rolling mills. In the no-current state, the brake acts on the motor of the drive using spring force. The brake is released when current flows (=low active).

Power must be connected to terminal -X12 on the Safe Brake Adapter.

For controlling the brake, a connection must be established between terminal -X14 on the Safe Brake Adapter and the rectifier of the brake.

For the control, a connection must be established between the Safe Brake Adapter and the Control Interface Module.
The cable harness with article number 6SL3060-4DX04-0AA0 can be used.

Fast de-energization

Some brake rectifier types feature two additional connections for switching the brake load on the DC side. This allows the brake coil to be quickly de-energized, i.e. the braking effect starts earlier.

The Safe Brake Adapter supports such fast de-energizing using the two additional connections -X15:1 and -X15:2. This function does not belong to safe brake control.

Note

Determination of the time until the brake engages without fast de-energization

As the fast de-energization is not part of the safety function, this functionality is not monitored. The fast de-energization can therefore fail during operation without being noticed.

Therefore, to determine the time until the brake engages for a machine acceptance, the fast de-energization must be bypassed by short-circuiting the terminals at X15:1, 2.

Safety instructions

Note

The integrated safety functions, starting from the Safety Integrated (SI) input terminals of the SINAMICS components (Control Unit, Motor Module), satisfy the requirements of EN 61800-5-2, EN 60204-1 and DIN EN ISO 13849-1 category 3 (formerly EN 954-1), as well as the requirements for Performance Level (PL) d and IEC 61508 SIL2.

With the Safe Brake Adapter, the requirements specified in EN 61800-5-2, EN 60204-1, as well as in DIN EN ISO 13849-1 Category 3 (formerly EN954-1) are satisfied for Performance Level (PL) d and IEC 61508 SIL 2.

NOTICE

Equipment fault caused by connection of a 24 VDC brake

If a 24 VDC brake is connected to option K88, Safe Brake Adapter 230 VAC on the system side, then this can cause damage to the Safe Brake Adapter.
This can result in the following undesirable effects:

1. Closing the brake is not displayed on the LEDS.
2. The fuse is ruptured.
3. The contact service life of the relay is reduced.

- Do not connect a 24 VDC brake to the 230 VAC Safe Brake Adapter.

Interfaces

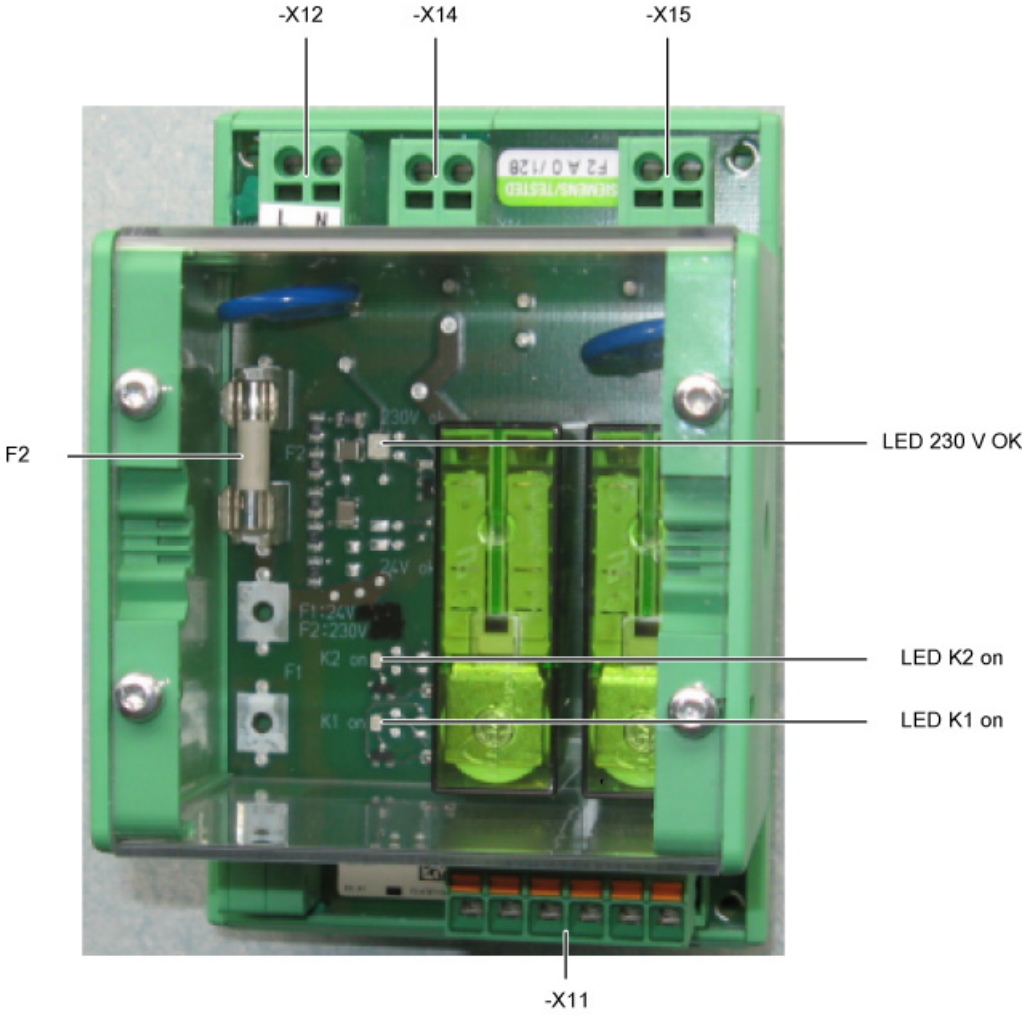


Figure 5-8 Safe Brake Adapter interface overview 230 VAC

Table 5- 25 Terminal block X11, interface to the Control Interface Module

Connection	Signal	Description	Technical data
X11.1	BR+	Control channel 1	Connection to the Control Interface Module, X46:1
X11.2	BR-	Control channel 2	Connection to the Control Interface Module, X46:2
X11.3	FB+	Relay feedback signal	Connection to the Control Interface Module, X46:3
X11.4	FB-	Ground of the relay feedback signal	Connection to the Control Interface Module, X46:4
X11.5	P24	P24 of the auxiliary voltage to supply the feedback signal	Connection to the Control Interface Module, X42:2
X11.6	M	Ground of the auxiliary voltage	Connection to the Control Interface Module, X42:3
Max. connectable cross-section 2.5 mm^2			

⚠WARNING

Danger to life if the maximum permissible cable length between the Safe Brake Adapter and the Control Interface Module is exceeded

If the permissible cable length between the Safe Brake Adapter and the Control Interface Module is exceeded this can result in death or serious injury in the event of an error.

- The maximum permissible cable length of 10 m between the 230 VAC Safe Brake Adapter and the brake must be carefully maintained.
- The cable must be routed according to ISO 13849-2, Table D.4.
- It is recommended that the cable harness (length 4 m) with article number 6SL3060-4DX04-0AA0 is used.

Table 5- 26 Terminal strip X12, 230 VAC power supply

Connection	Signal	Description
X12.1	L	Supply voltage: 230 VAC
X12.2	N	Current consumption: 2 A Protection according to IEC 60269-1, operating class gG
Max. connectable cross-section 2.5 mm²		

Table 5- 27 Terminal block X14, interface to the load

Connection	Signal	Description
X14.1	BR L	Supply voltage: 230 VAC
X14.2	BR N	Current consumption: 2 A, only for brakes with brake rectifier
Max. connectable cross-section 2.5 mm²		

⚠WARNING

Danger to life if the permissible cable length of the brake control is exceeded

If the permissible cable length of the brake control is exceeded this can result in death or serious injury in the event of an error.

- The maximum permissible cable length of 300 m between the 230 VAC Safe Brake Adapter and the brake must be carefully maintained.
- To accurately calculate the maximum cable length, see the SINAMICS Low Voltage Configuration Manual on the customer DVD supplied with the device.

Table 5- 28 Terminal block X15, fast de-energization

Connection	Signal	Description
X15.1	AUX1	Supply voltage: 230 VAC
X15.2	AUX2	Current consumption: 2 A
Max. connectable cross-section 2.5 mm^2		

Spare fuse

The type of spare fuse is as follows: 2 A, time-lag.

Note

Correctly mounting the housing cover after replacing a fuse

An adhesive label is provided on the housing cover indicating the position of the connector. Mount the cover in the correct position so that the inscription of the label matches the actual connectors.

Mounting

The Safe Brake Adapter is designed for mounting on a rail according to EN 60715

The dimensions are shown in the following dimension drawing.

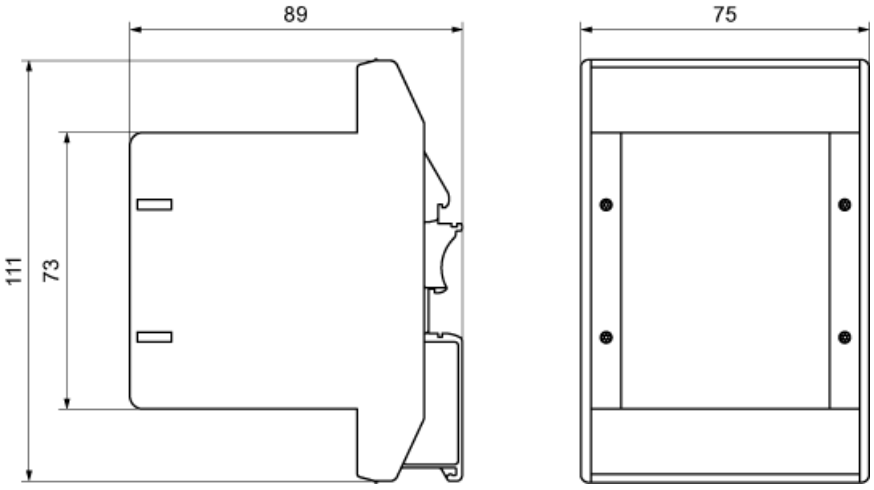


Figure 5-9 Dimension drawing of the Safe Brake Adapter (data in mm)

Technical data

Table 5- 29 Technical data

6SL3355-2DX00-1AA0	
Electronic power supply Power supply voltage (via the Control Interface Module)	 24 VDC (20.4 ... 28.8)
Power supply of the motor holding brake	230 VAC
Max. permissible current drain of the motor holding brake	2 A
Max. permissible current drain of the fast de-energization	2 A
Weight	0.250 kg

5.5 Control by way of PROFIsafe

The activation via PROFIsafe is described in detail in the SINAMICS S120 Safety Integrated Function Manual.

The "SINAMICS S120 Safety Integrated Function Manual" is available on the Internet at the following address (https://support.industry.siemens.com/cs/ww/en/ps/13231/man).

5.6 Control via TM54F

The activation via TM54F is described in detail in the SINAMICS S120 Safety Integrated Function Manual.

The "SINAMICS S120 Safety Integrated Function Manual" is available on the Internet at the following address (https://support.industry.siemens.com/cs/ww/en/ps/13231/man).

5.6.1 Control via TM54F for SINAMICS G130, S120 Chassis

The TM54F Terminal Module must be supplied with 24 VDC and connected to the Control Unit via DRIVE-CLiQ.

⚠ WARNING

Fire hazard due to overheating because of inadequate ventilation clearances

Insufficient ventilation clearances result in overheating with danger to persons as a result of smoke and fire. This can also result in more downtimes and reduced service lives of the Terminal Module.

- For this reason, it is imperative that you maintain the 50 mm clearances above and below the Terminal Module.

5.6.2 Control via option K87 for SINAMICS S120 Cabinet Modules

With option K87 the Terminal Module TM54F is integrated in the cabinet unit (-A70) and connected with the Control Unit via DRIVE-CLiQ.

5.6.3 Control via K87 for SINAMICS S150

With option K87 the Terminal Module TM54F is integrated in the cabinet unit (-A70) and connected with the Control Unit via DRIVE-CLiQ.

5.7 Motion monitoring without selection

As an alternative to controlling via terminals and/or PROFIsafe, there is also the option to parameterize several safety functions without selection. For this mode, after parameterization and a POWER ON, these functions are permanently selected.

Example

"SLS without selection" can be used, for example, to monitor the maximum velocity to prevent that the drive exceeds a mechanical speed limit. For this purpose, using the "without selection" function, an F-DI does not have to be used; an F-CPU is also not required.

Features

- The function "Motion monitoring without selection" is available in the following versions:

p9601	Meaning	Functionality	Comment
0024 hex	Drive-integrated motion monitoring functions without selection are enabled	• SLS • SDI	• p9501.0 = 1 • p9501.17 = 1
0025 hex	Drive-integrated motion monitoring functions without selection with STO via terminals are enabled	• SLS • SDI • STO • SS1 • SBC	• p9501.0 = 1 • p9501.17 = 1 • Basic Functions • Basic Functions • Basic Functions

- The functions "SLS without selection" and "SDI without selection positive/negative" are selected with p9512.
- The functions without selection are available in the versions "with encoder" and "without encoder" (selection via p9506).
- The functions without selection are parameterized and enabled in the same way as the versions with control via PROFIsafe/terminals.

Acknowledging safety faults

For acknowledging safety faults, a distinction should be made between the following cases:

- Drive-integrated motion monitoring functions without selection

  Acknowledging safety faults is only possible with POWER ON.

- Drive-integrated motion monitoring functions without selection and Basic Functions via onboard terminals

  Acknowledging Safety faults is possible with POWER ON or selecting/deselecting STO or SS1.

Differences

Differences in the behavior of the functions to the versions with control via PROFIsafe/terminals are described in the sections for commissioning the individual functions.

Overview of important parameters

- p9501.0 SI Motion enable safety functions (Control Unit)
- p9512 SI Motion enable safety functions without selection (Control Unit)
- p9601 SI enable functions integrated in the drive (Control Unit)

Commissioning and acceptance test

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The commissioning of the Safety Integrated functions and the acceptance test are described in detail in the SINAMICS S120 Safety Integrated Function Manual.

The "SINAMICS S120 Safety Integrated Function Manual" is available on the Internet at the following address (https://support.industry.siemens.com/cs/ww/en/ps/13231/man).

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Siemens AG
Process Industries and Drives
Large Drives
Postfach 4743
90025 NÜRNBERG
GERMANY

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