

The Siemens logo is displayed in a white rectangular box with a thin black border. The word "SIEMENS" is written in a bold, teal, sans-serif font. The background of the entire page is a blurred industrial setting with a man in a light blue shirt looking at a tablet. Overlaid on the image are various blue and white digital icons, including a circular arrow with "24/7", a document icon, a "NEWS" header with a profile picture, a "Home" button, and a network diagram with three nodes and connecting lines. There are also floating binary digits (0s and 1s) and a stylized wrench icon.

SIEMENS

Safety Integrated functions – Probability of failure

SINAMICS / SIMOTION / SINUMERIK / SIMOTICS /
SIMATIC Drive Controller / V2.1

<https://support.industry.siemens.com/cs/ww/en/view/76254308>

Siemens
Industry
Online
Support



Legal information

Use of application examples

Application examples illustrate the solution of automation tasks through an interaction of several components in the form of text, graphics and/or software modules. The application examples are a free service by Siemens AG and/or a subsidiary of Siemens AG ("Siemens"). They are non-binding and make no claim to completeness or functionality regarding configuration and equipment. The application examples merely offer help with typical tasks; they do not constitute customer-specific solutions. You yourself are responsible for the proper and safe operation of the products in accordance with applicable regulations and must also check the function of the respective application example and customize it for your system.

Siemens grants you the non-exclusive, non-sublicensable and non-transferable right to have the application examples used by technically trained personnel. Any change to the application examples is your responsibility. Sharing the application examples with third parties or copying the application examples or excerpts thereof is permitted only in combination with your own products. The application examples are not required to undergo the customary tests and quality inspections of a chargeable product; they may have functional and performance defects as well as errors. It is your responsibility to use them in such a manner that any malfunctions that may occur do not result in property damage or injury to persons.

Disclaimer of liability

Siemens shall not assume any liability, for any legal reason whatsoever, including, without limitation, liability for the usability, availability, completeness and freedom from defects of the application examples as well as for related information, configuration and performance data and any damage caused thereby. This shall not apply in cases of mandatory liability, for example under the German Product Liability Act, or in cases of intent, gross negligence, or culpable loss of life, bodily injury or damage to health, non-compliance with a guarantee, fraudulent non-disclosure of a defect, or culpable breach of material contractual obligations. Claims for damages arising from a breach of material contractual obligations shall however be limited to the foreseeable damage typical of the type of agreement, unless liability arises from intent or gross negligence or is based on loss of life, bodily injury or damage to health. The foregoing provisions do not imply any change in the burden of proof to your detriment. You shall indemnify Siemens against existing or future claims of third parties in this connection except where Siemens is mandatorily liable.

By using the application examples you acknowledge that Siemens cannot be held liable for any damage beyond the liability provisions described.

Other information

Siemens reserves the right to make changes to the application examples at any time without notice. In case of discrepancies between the suggestions in the application examples and other Siemens publications such as catalogs, the content of the other documentation shall have precedence.

The Siemens terms of use (<https://support.industry.siemens.com>) shall also apply.

Security information

Siemens provides products and solutions with industrial security functions that support the secure operation of plants, systems, machines and networks.

In order to protect plants, systems, machines and networks against cyber threats, it is necessary to implement – and continuously maintain – a holistic, state-of-the-art industrial security concept. Siemens' products and solutions constitute one element of such a concept.

Customers are responsible for preventing unauthorized access to their plants, systems, machines and networks. Such systems, machines and components should only be connected to an enterprise network or the internet if and to the extent such a connection is necessary and only when appropriate security measures (e.g. firewalls and/or network segmentation) are in place.

For additional information on industrial security measures that may be implemented, please visit <https://www.siemens.com/industrialsecurity>.

Siemens' products and solutions undergo continuous development to make them more secure. Siemens strongly recommends that product updates are applied as soon as they are available and that the latest product versions are used. Use of product versions that are no longer supported, and failure to apply the latest updates may increase customer's exposure to cyber threats.

To stay informed about product updates, subscribe to the Siemens Industrial Security RSS Feed under <https://www.siemens.com/cert>.

Table of contents

Legal information	2
1 Introduction	5
2 Probability of failure	6
2.1 Fundamentals	6
2.2 Definitions	7
2.3 Calculating subsystem PFH or PFD values	7
2.4 Supplementary conditions	8
3 Safety-related parameters SINAMICS	9
3.1 SIMATIC ET 200pro FC-2	9
3.2 SINAMICS G110M.....	9
3.3 SINAMICS G115D	10
3.4 SINAMICS G120 modular	11
3.5 SINAMICS G120C	13
3.6 SINAMICS G120D	14
3.7 SINAMICS G120P	15
3.8 SINAMICS G120X	18
3.9 SINAMICS G130.....	21
3.10 SINAMICS G150.....	23
3.11 SINAMICS G180.....	24
3.12 SINAMICS G220.....	26
3.13 SINAMICS S110	28
3.14 SINAMICS S120 AC/AC	29
3.15 SINAMICS S120 Cabinet Modules	31
3.16 SINAMICS S120 Built-In Units	34
3.17 SINAMICS S150	38
3.18 SINAMICS S200	39
3.19 SINAMICS S210	40
3.20 SINAMICS S210 (New)	42
3.21 SINAMICS V90	43
4 Safety-related parameters motors, encoders & holding brakes	45
4.1 External rotary encoders	45
4.2 Motors with encoder connection.....	45
4.3 Motors with holding brake.....	46
5 Safety-related parameters Drive Controller and SIMOTION	48
6 Safety-related parameters SINUMERIK	51
6.1 SINUMERIK 828D	51
6.2 SINUMERIK 840D with SIMODRIVE 611D	52
6.3 SINUMERIK 840D sl	53

Table of contents

6.4	SINUMERIK handheld units	57
6.5	SINUMERIK machine control panel	58
6.6	SINUMERIK ONE	59
7	Calculation using the function Safety Evaluation at TIA Selection Tool	60
8	Terminology / abbreviations	60
9	Appendix.....	61
9.1	Service and support.....	61
9.2	Industry Mall	62
9.3	Links and literature	62
9.4	Change documentation	62

1 Introduction

This document is not independent; it may only be used as a supplement to the following Function Manuals or Operating Instructions:

- "SINUMERIK 828D / SINAMICS S120 Safety Integrated"
- "SINUMERIK 840D sl / SINAMICS S120 Safety Integrated"
- „SINUMERIK ONE Safety Integrated“
- "SINAMICS S120 Safety Integrated"
- "SINAMICS G120 Safety Integrated"
- "SINAMICS S210 servo drive system"
- "SINAMICS S200 servo drive system"
- "SINAMICS V90 servo drive system"
- Inverter SINAMICS G120X
- Inverter SINAMICS G220

"Safety Integrated" functions are used to reduce risks dependent on the application. Functional safety means that safety is achieved by the safety function operating as it should. The products are intended for installation in machines. The manuals can be downloaded from the Internet as PDF <https://support.industry.siemens.com/cs/ww/en/>

The danger notices must be observed.

In particular, the general lists of components, including those from different device families, must not be used to draw conclusions about permissible combinations of such components. Information about permissible component combinations can only be taken from the device-specific documentation. The most recent version of this document must always be used to calculate the PFH value of a (sub)system.

Further information concerning SINAMICS Safety Integrated you will find at:
<http://www.siemens.com/safety-drives>

NOTE

The specified PFH values are guaranteed product properties.

The calculation examples serve to understand the correct application of the PFH values and may differ in each safety function.

2 Probability of failure

2.1 Fundamentals

The safety-related parameters for Safety Functions integrated in the SINAMICS, SIMOTION, SINUMERIK, SIMATIC Drive Controller and SIMOTICS systems are described in this document.

The systems have the following general properties:

- according to IEC 61508 and IEC 61800-5-2, the following properties are complied with:
 - Safety integrity level SIL 2 or SIL 3
 - Operating mode: "high demand/continuous mode" or
 - Operating mode "low demand mode"
- according to ISO 13849-1, the following properties are complied with:
 - Category 3 or 4
 - Performance Level PL d or PL e

The detailed properties are described in the manufacturer's declarations or certificates. These are available on the Internet: <http://www.siemens.com/automation/service&support>

The defined safety category (SIL, PL) determines the level of the accepted residual risk and thus the required reliability of the safety system. Within the scope of the risk analysis, the required safety category is determined for the (sub-) systems under consideration.

For verification, the calculated PFH values of the considered (sub-) system must be smaller than the failure limit values. The operating mode in which the safety function is operated must be considered. A brief overview is given below for this purpose. The procedures and detailed values can be found in IEC 61508, EN 62061 and IEC 13849.

Table 2-1

Safety category	Operating mode	Failure limits
SIL 2	low demand mode	$PFD \geq 10^{-3}$ bis $< 10^{-2}$
SIL 2	high demand/continuous mode	$PFH \geq 10^{-7}$ 1/h bis $< 10^{-6}$ 1/h
SIL 3	low demand mode	$PFD \geq 10^{-4}$ bis $< 10^{-3}$
SIL 3	high demand/continuous mode	$PFH \geq 10^{-8}$ 1/h bis $< 10^{-7}$ 1/h
PL d	./.	$PFH_D \geq 10^{-7}$ 1/h bis $< 10^{-6}$ 1/h
PL e	./.	$PFH_D \geq 10^{-8}$ 1/h bis $< 10^{-7}$ 1/h

The safety-related parameters of the individual components are specified in the following chapters. These represent a proportion of the total PFH or PFD value of the safety functions of a machine or system.

The following time data are prerequisites for these values (valid for PFH and PFD):

- Mission time 20 years
- maximum diagnostic test interval (maximum diagnostic test interval) 1 year
- Scope up to 2000m installation altitude¹⁾

¹⁾ greater installation heights on request

In the examples, the safety-relevant peripherals and the safety-relevant sensors and actuators are not considered. The calculations only refer to the SINAMICS / SINUMERIK / SIMOTION / SIMOTICS / Drive Controller components contained in the images.

The following chapter [7](#) deals with safety evaluation in the TIA Selection Tool (TST). This allows the safety functions of machines / systems to be evaluated quickly and safely.

2.2 Definitions

PFH

Probability of failures per hour. The PFH value according to IEC 61800-5-2 and IEC 61508 corresponds to the PFH_D value according to IEC 62061.

The PFH value is used for high demand rates or continuous demand.

PFD

Mean probability of failure on demand of the safety function corresponds to the PFD value according to IEC 61508 and IEC 61800-5-2.

The PFD value is used for low demand rates.

B_{10d}

Number of cycles up until 10% of the components have failed dangerously according to ISO 13849-1

2.3 Calculating subsystem PFH or PFD values

For a drive system, all safety-related axes controlled by a Control Unit must be identified first. If more than one Control Unit is in use, the safety-relevant axes must be identified separately and the calculation for each Control Unit must be made separately.

For each safety-related axis, the controlling Motor Module/Power Module is relevant from the point of view of safety. In the case of Double Motor Modules, whether the safety functions have been configured for both axes or just for one axis is also important for the PFH/PFD calculation.

Where encoderless motion monitoring is concerned, the PFH/PFD value listed in the table must also be considered.

For safety systems with 1 encoder, the corresponding PFH/PFD value must be applied as appropriate for the Sensor Module (SMC, SME, or the DRIVE-CLiQ motor being used).

For 2-encoder safety systems, the specified PFH/PFD value applies to both Sensor Modules involved.

The PFH/PFD values of all safety-related components must be added together for the subsystem under consideration (based on their actual number).

Further, for SIMOTION and SINUMERIK the following also applies:

A CX32 or NX is safety relevant, if at least one of the associated Motor Modules is safety relevant.

The NCU is safety relevant if system/drive-integrated safety components according to Chapter 5/6 of the "SINUMERIK Safety Integrated" Function Module are used on at least one of the directly assigned Motor Modules or controlled via NX. If the subsystem being considered only uses the drive-integrated safety functions according to Chapter 4 of the "SINUMERIK 840D sl /SINAMICS S120 Safety Integrated" Function Manual (only drive-integrated STO/SBC/SS1 via terminals), then the NCU is only relevant, if at least one of the associated Motor Modules (i.e.

assigned to the internal control of the NCU) is safety relevant. Both application cases have different PFH values.

2.4 Supplementary conditions

The specified failure probabilities only apply under the precondition that the secondary conditions for the diagnostic test (see the Function Manuals), including the diagnostic test interval, are maintained.

The PFH/PFD values are only valid up to the specified mission time.

The PFH/PFD values are only valid under the precondition that the responses initiated by Safety Integrated in the event of an error (triggering a stop, activation of safe torque off STO, etc.) bring the process into a safe state or maintain the process in a safe state.

Please refer to the corresponding manuals for the components used for information about the properties of additional safety-relevant components, such as control systems, sensors, and actuators (e.g. Emergency Stop buttons, protective door switches).

The PFH/PFD value calculated here only takes the risks posed by the components of the SINAMICS, SIMOTION, SINUMERIK and SIMOTICS systems into account. Where other components are directly related to the safety functions of the SINAMICS drives, these are considered using the example of SIRIUS safety relays or SIMATIC failsafe controllers. The sensor technology is shown in the example illustrations, but is not considered in the calculations, since the concrete wiring is very application specific.

3 Safety-related parameters SINAMICS

Only the drive components are considered in the following configuration examples. These are shown in boxes in the following diagrams.

The corresponding manufacturer's data should be used as basis to evaluate additional components.

The compact inverters are represented below by a total PFH value. The evaluation of the failure probability is differentiated between applications with only basic functions (emergency stop via STO, SS1; incl. SBC) and applications that use extended Safety Integrated functions with motion monitoring (Extended). The contribution for emergency stop is included (Extended includes Basic).

The other drive systems, which are described by individual PFH values, distinguish the contributions for the different applications.

3.1 SIMATIC ET 200pro FC-2

The following values can be applied to the complete converter. ET 200pro FC-2 supports applications with STO.

Table 3-1: SIMATIC ET 200pro FC-2

Product	Order number	PFH [10 ⁻⁹ /h]	PFD [10 ⁻⁵]
ET 200pro FC-2	6SL3514-1KE13-5AE0	28	28

3.2 SINAMICS G110M

The following values can be applied to the complete motor-mounted converter. G110M supports applications with STO.

Table 3-2: SINAMICS G110M

Product	Order number	PFH [10 ⁻⁹ /h]	PFD [10 ⁻⁵]
CU240M USS/Modbus RTU	6SL3544-xxxxx-xBxx	50	50
CU240M DP	6SL3544-xxxxx-xPxx	50	50
CU240M PN	6SL3544-xxxxx-xFxx	50	50
CU240M AS-i	6SL3544-xxxxx-xMxx	50	50

Example configuration

In this example, the pushbutton is connected directly to the F-DI of the converter. Alternatively, this can be connected to decentralized periphery, the signals are then transmitted via PROFIsafe.

Emergency Stop button
STO

F-DI

CU

PM

M
3~

Safety relevant

Nicht Safety relevant

Table 3-3: Subsystem function "Emergency Stop" STO (without Emergency Stop button)

Component	Description	PFH [$10^{-9}/h$]
CU	Control Unit CU240M PN	50
PM	Power Module PM240M	
PFH value of the sub or total system		50

This system example has a PFH value of $25 \cdot 10^{-9}/h$ and fulfills the criteria for SIL 2 and PL d ($< 10^{-6}/h$).

3.3 SINAMICS G115D

The following values are applicable for the complete inverter. G115D supports applications with STO and SLS.

Product	Order number	Additional information	PFH [10 ⁻⁹ /h]	PFD [10 ⁻⁵]
G115D	6SL352x-xXxxx-xAB0	Wall mounted – STO	25	25
G115D	6SL352x-xXxxx-xAB0	Wall mounted – SLS, STO	30	30
G115D	2KJ8xxx-xxxxx-xBxx	Motor mounted – STO	50	50
G115D	2KJ8xxx-xxxxx-xBxx	Motor mounted – SLS, STO	60	60
G115D	2KJ8xxx-xxxxx-xCxx	Motor mounted – STO	50	50
G115D	2KJ8xxx-xxxxx-xCxx	Motor mounted – SLS, STO	60	60
G115D AS-i	6SL352x-xXxxx-xAA0	Wall mounted – STO	25	25
G115D AS-i	6SL352x-xXxxx-xAA0	Wall mounted – SLS, STO	30	30
G115D AS-i	2KJ8xxx-xxxxx-xDxx	Motor mounted – STO	50	50
G115D AS-i	2KJ8xxx-xxxxx-xDxx	Motor mounted – SLS, STO	60	60
G115D AS-i	2KJ8xxx-xxxxx-xExx	Motor mounted – STO	50	50
G115D AS-i	2KJ8xxx-xxxxx-xExx	Motor mounted – SLS, STO	60	60
G115D PN	6SL352x-xXxxx-xAF0	Wall mounted – STO	25	25
G115D PN	6SL352x-xXxxx-xAF0	Wall mounted – SLS, STO	30	30
G115D PN	2KJ8xxx-xxxxx-xFxx	Motor mounted – STO	50	50

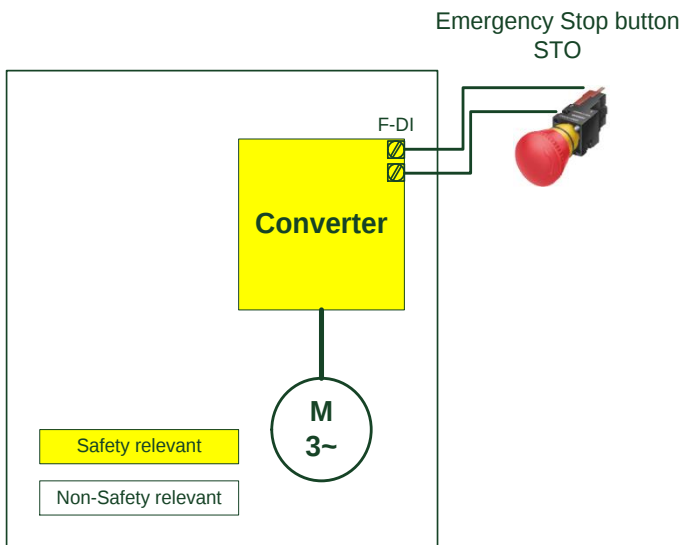
3 Safety-related parameters SINAMICS

Product	Order number	Additional information	PFH [10 ⁻⁹ /h]	PFD [10 ⁻⁵]
G115D PN	2KJ8xxx-xxxxx-xFxx	Motor mounted – SLS, STO	60	60
G115D PN	2KJ8xxx-xxxxx-xGxx	Motor mounted – STO	50	50
G115D PN	2KJ8xxx-xxxxx-xGxx	Motor mounted – SLS, STO	60	60

Example configuration

In this example, the pushbutton is connected directly to the F-DI of the converter. Alternatively, this can be connected to decentralized periphery, the signals are then transmitted via PROFIsafe.

Figure 3-2



Assessment of safety relevance of components and allocation of PFH values:

Table 3-5: **Subsystem function "Emergency Stop" STO** (without Emergency Stop button)

Component	Description	PFH [10 ⁻⁹ /h]
Converter	G115D PN wall mounted	25
PFH value of the sub or total system		25

This system example has a PFH value of 25*10⁻⁹/h and fulfills the criteria for SIL 2 and PL d (< 10⁻⁶/h).

3.4 SINAMICS G120 modular

The following values are applicable for Basic Functions and Extended Functions.

Table 3-6: SINAMICS G120 modular

Product	Order number	Additional information	PFH[10 ⁻⁹ /h]	PFD [10 ⁻⁵]
CU240E-2	6SL3244-0BB12-xxxx	STO	10	10
CU240E-2 F	6SL3244-0BB13-xxxx	STO	10	10
CU240E-2 F	6SL3244-0BB13-xxxx	Extended Functions ¹⁾	15	15
CU240S F	6SL3244-0BA21-xxxx	STO	10	10
CU240S F	6SL3244-0BA21-xxxx	Extended Functions ¹⁾	15	15
CU250S-2	6SL3246-0BA22-xxxx	STO	10	10
CU250S-2	6SL3246-0BA22-xxxx	Extended Functions ¹⁾	15	15

3 Safety-related parameters SINAMICS

Product	Order number	Additional information	PFH [10 ⁻⁹ /h]	PFD [10 ⁻⁵]
Power Module PM240-2 1AC/3AC 200 - 240V	6SL3210-1PBxx-xxLx 6SL3211-1PBxx-xxLx 6SL3210-1PCxx-xxLx	without SBC	18	18
Power Module PM240-2 1AC/3AC 200 - 240V	6SL3210-1PBxx-xxLx 6SL3211-1PBxx-xxLx 6SL3210-1PCxx-xxLx	with SBC, including Safe Brake Relay ²⁾	22	22
Power Module PM240-2 3AC 380 - 480V	6SL3210-1PExx-xxLx 6SL3211-1PExx-xxLx	without SBC	18	18
Power Module PM240-2 3AC 380 - 480V	6SL3210-1PExx-xxLx 6SL3211-1PExx-xxLx	with SBC, including Safe Brake Relay ²⁾	22	22
Power Module PM240-2 3AC 500 - 690V	6SL3210-1PHxx-xxLx	without SBC	18	18
Power Module PM240-2 3AC 500 - 690V	6SL3210-1PHxx-xxLx	with SBC, including Safe Brake Relay ²⁾	22	22
Power Module PM240-2 STO SIL 3 / PL e Framesize D to G ³⁾	without	STO	5	5
Power Module PM250 3AC 380 - 480V	6SL3225-0BExx-xxAx	without SBC	18	18
Power Module PM250 3AC 380 - 480V	6SL3225-0BExx-xxAx	with SBC, including Safe Brake Relay ²⁾	22	22

¹⁾ With ecoderless motion monitoring

²⁾ With Safe Brake Relay – The Safe Brake Relay (6SL3252-0BB01-0AA0) is rated PFH = 4*10⁻⁹/h.

The Power Module based STO can be used in connection with the above-mentioned Control Units 2nd generation (product labeling with “-2”) and from firmware version V4.7 SP3. This PM-STO and the CU-based functions can be used in the following use cases:

- Using exclusively the PM-STO, the value with the footnote ³⁾ must be considered.
- Using the Control Unit based Safety Functions, the CU-based value in [Table 3-6](#) must be considered.
- Using the Control Unit based Safety Functions and the PM-STO, both values must be considered, the CU-based value and the value with the footnote ³⁾.

Supplementary to the general basics according to [2.1](#), the PM-STO has the following properties:

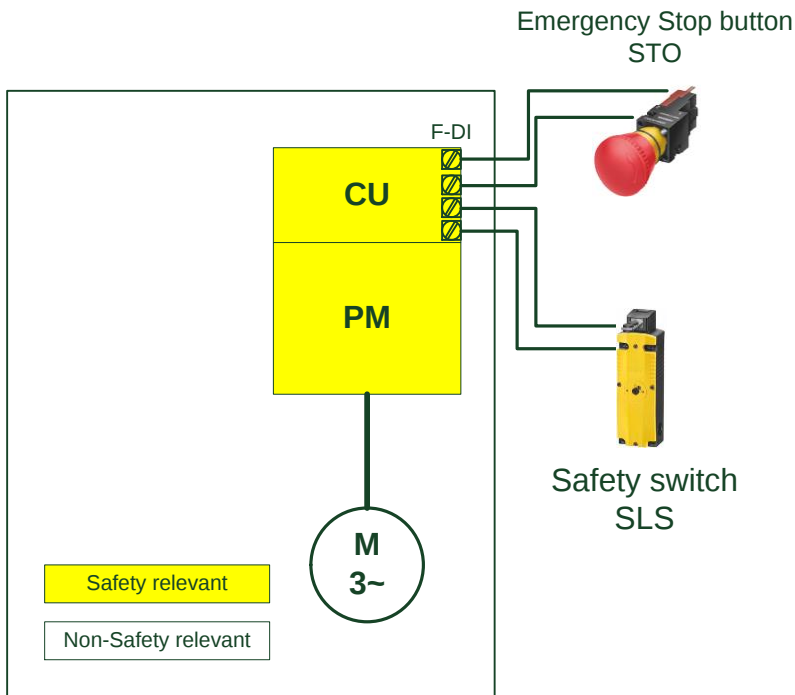
- According to IEC 61508:
 - Safety integrity level (SIL) 3
- According to ISO 13849-1:
 - Category 3
 - Performance Level (PL) e
 - maximum diagnostic test interval: 3 months

Example configuration

The two buttons in this example are directly connected to the fail-safe digital inputs (F-DI) of the converter. Alternatively, they can be connected to the distributed I/O. The signals are then transferred via PROFIsafe. In this case, the PFH values in the subsystems shown below, should be evaluated in the same way.

For standard CUs (not the F-version), applications with STO are supported. The subsystem Emergency Stop is evaluated in the same way as shown in this example.

Figure 3-3



Assessment of safety relevance of components and allocation of PFH values:

Table 3-7: Subsystem function "Emergency Stop" STO (without Emergency Stop button)

Component	Description	PFH [10 ⁻⁹ /h]
CU	CU250S-2 STO	10
PM	Power Module PM240-2 without SBC	18
PFH value of the sub or total system		28

This system example has a PFH value of 28*10⁻⁹/h and fulfills the criteria for SIL 2 and PL d (< 10⁻⁶/h).

Table 3-8: Subsystem function "Setting up operation with limited speed" SLS without encoder (without safety switch)

Component	Description	PFH [10 ⁻⁹ /h]
CU	CU250S-2 Extended Functions	15
PM	Power Module PM240-2 with SBC	22
PFH value of the sub or total system		37

This system example has a PFH value of 37*10⁻⁹/h and fulfills the criteria for SIL 2 and PL d (< 10⁻⁶/h).

3.5 SINAMICS G120C

The following values can be applied to the complete converter. G120C supports applications with STO.

Table 3-9: SINAMICS G120C

Product	Order number	PFH [10 ⁻⁹ /h]	PFD [10 ⁻⁵]
G120C USS/Modbus RTU	6SL3210-xxxxx-xxBx	25	25
G120C DP	6SL3210-xxxxx-xxPx	25	25
G120C PN	6SL3210-xxxxx-xxFx	25	25

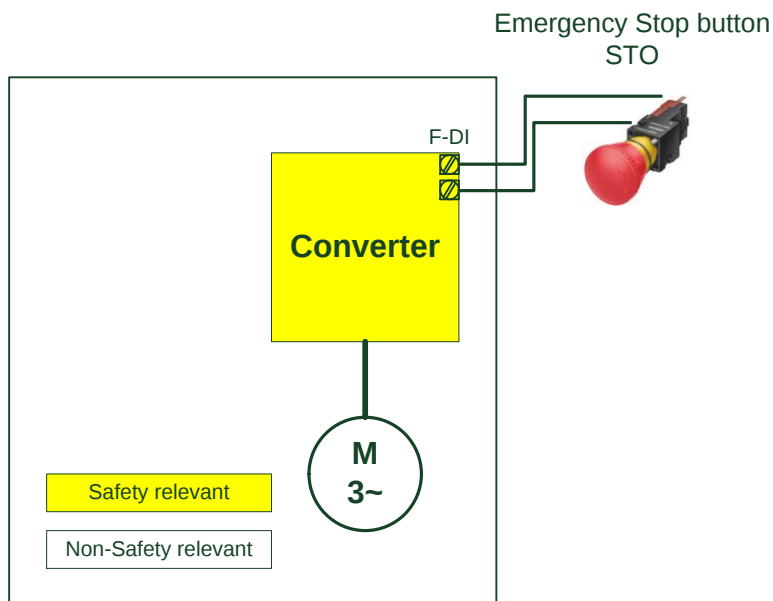
3 Safety-related parameters SINAMICS

Product	Order number	PFH [10 ⁻⁹ /h]	PFD [10 ⁻⁵]
G120C CAN	6SL3210-xxxxx-xxCx	25	25

Example configuration

The button in this example is directly connected to the F-DI of the converter. Alternatively, this can be connected to the distributed I/O; the signals are then transferred via PROFIsafe.

Figure 3-4



Assessment of safety relevance of components and allocation of PFH values:

Table 3-10: Subsystem function "Emergency Stop" STO (without Emergency Stop button)

Component	Description	PFH [10 ⁻⁹ /h]
Converter	G120C	25
PFH value of the sub or total system		25

This system example has a PFH value of 25*10⁻⁹/h and fulfills the criteria for SIL 2 and PL d (< 10⁻⁶/h).

3.6 SINAMICS G120D

The following values are for a complete drive train, comprising the Control Unit and Power Module.

Table 3-11: SINAMICS G120D

Product	Order number	Additional information	PFH [10 ⁻⁹ /h]	PFD [10 ⁻⁵]
CU240D -F	6SL3544-0FA21-xxxx	STO	10	10
CU240D -F	6SL3544-0FA21-xxxx	Extended Functions ¹⁾	15	15
CU240D-2	6SL3544-0FB20-xxxx	STO	10	10
CU240D-2 -F	6SL3544-0FB21-xxxx	STO	10	10
CU240D-2 -F	6SL3544-0FB21-xxxx	Extended Functions ¹⁾	15	15
CU250D-2 -F	6SL3546-0FB21-xxxx	STO	10	10
CU250D-2 -F	6SL3546-0FB21-xxxx	Extended Functions ¹⁾	15	15
Power Module Framesize Blocksize 3AC 380 - 500V	6SL3525-0PExx-xAA1	--	18	18

¹⁾ With encoderless motion monitoring

For a configuration example, see chapter [3.4](#) The structure shown there with the CU and PM components, should be used in the same way for G120D.

For standard CUs (not the F-version), applications with STO are supported. The Emergency Stop subsystem is evaluated in the same way as shown in this example.

3.7 SINAMICS G120P

The power modules PM240P-2 size D to F and PM330 (from function state FS: 04) have the shut-off paths for a hardware STO. The safety (partial) functions evaluation, diagnosis of the sensors, control and diagnosis of the shutdown paths are carried out by external components, e.g. a safety switching device or an F-PLC.

The following values apply to the power module alone and do not include any upstream system components, as these can be freely selected by the user according to the required safety (partial) function. The STO switch-off is implemented completely in hardware in the PM240P-2 and PM330.

Table 3-12: SINAMICS G120P

Product	Order number	PFH [10 ⁻⁹ /h]	PFD [10 ⁻⁵]
PM240P-2	6SL3210-1Rxxx-xxL0	5	5
PM330	6SL3310-1Pxxx-xAA0	5	5
PM330L	6SL3310-1Cxxx-xAA0	5	5

The correct use of the external component mentioned above must be considered in the application.

Requirements for SIL 2/PL d

- Suitable higher-level controls
 - SIRIUS 3SK1: Single-channel static feedback loop
 - SIRIUS 3SK2: Two-channel dynamic feedback loop
 - SIMATIC: Feedback loop monitoring in the safety program
- Forced checking procedure (test stop) once a year

Requirements for SIL 3/PL e

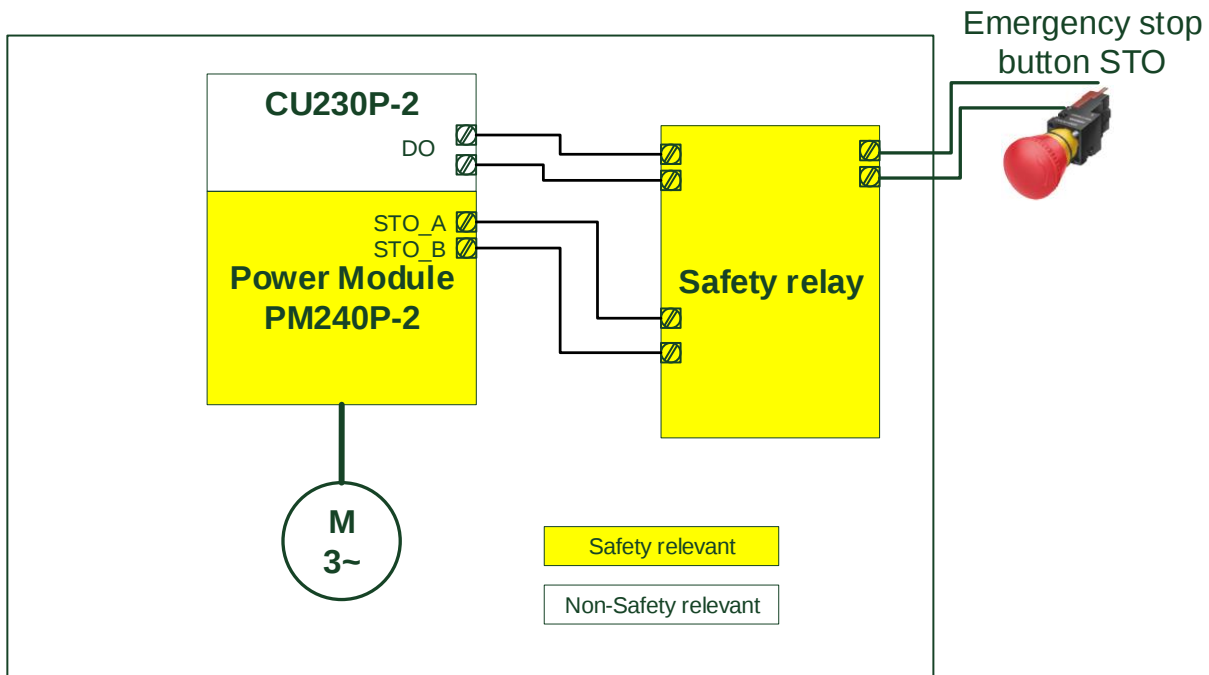
- Suitable higher-level controls
 - SIRIUS 3SK1: Single-channel static feedback loop (permissible for inverters FSH and FSJ, not permissible for FSA ... FSG)
 - SIRIUS 3SK2: Two-channel dynamic feedback loop
 - SIMATIC: Feedback loop monitoring in the safety program
- Forced checking procedure (test stop) every 3 months

The Power Module STO can be used in connection with the Control Unit CU230P-2 from firmware version V4.7 SP6.

Example configuration 1:

In this example, the safety relay controls the shutdown paths of the PM240P-2 framesize D. The feedback for diagnosis is fed back from the Control Unit to the safety relay via two connected digital outputs. The requirements for the safety function are SIL 2. A safety relay with static feedback loop (single-channel feedback) is used.

Figure 3-5



Assessment of safety relevance of components and allocation of PFH values:

Table 3-13: Subsystem function "Emergency Stop" STO (without Emergency Stop button)

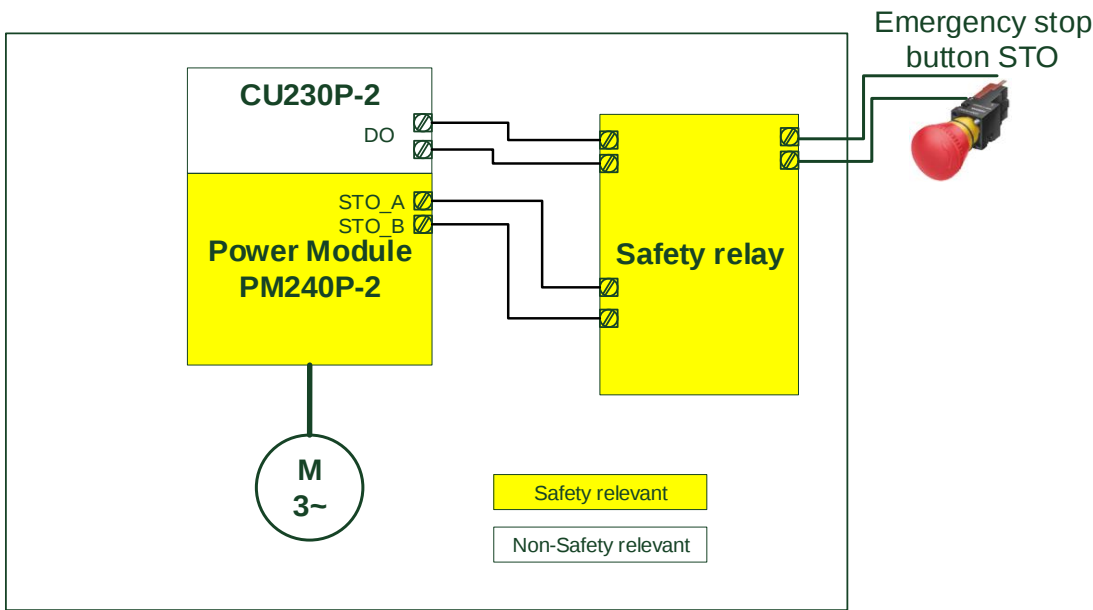
Component	Description	PFH [$10^{-9}/h$]
Converter	Power Module PM240P-2	5
Safety relay	e.g. 3SK1111-2AB30	1.7
PFH value of the sub or total system		6.7

This system example has a PFH value of $6.7 \cdot 10^{-9}/h$ and fulfills the criteria for SIL 2 and PL d ($< 10^{-6}/h$).

Example configuration 2:

In this example, the safety relay controls the shutdown paths of the PM240P-2 framesize D. The feedback for diagnosis is fed back from the Control Unit to the safety relay via two connected digital outputs. The requirements for the safety function are SIL3. A safety relay with dynamic feedback loop (two-channel feedback) is used.

Figure 3-6



Assessment of safety relevance of components and allocation of PFH values:

Table 3-14: Subsystem function "Emergency Stop" STO (without Emergency Stop button)

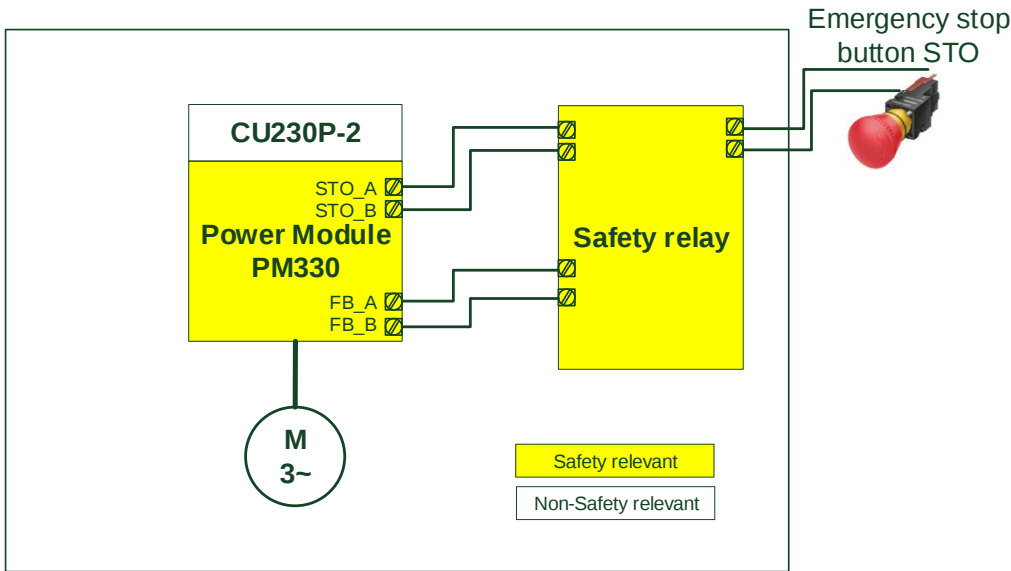
Component	Description	PFH [10 ⁻⁹ /h]
Converter	Power Module PM240P-2	5
Safety relay	e.g. 3SK2112-2AA10	10
PFH value of the sub or total system		15

This system example has a PFH value of 15.0*10⁻⁹/h and fulfills the criteria for SIL 3 and PL e (< 10⁻⁷/h).

Example configuration 3:

In this example, the safety relay controls the shutdown paths of the PM330. The feedback for diagnosis is fed back from the Power Module to the safety relay via the feedback signals. The requirements for the safety function are SIL3. A safety relay with static feedback loop (single-channel feedback) is used.

Figure 3-7



Assessment of safety relevance of components and allocation of PFH values:

Table 3-15: **Subsystem function "Emergency Stop" STO** (without Emergency Stop button)

Component	Description	PFH [$10^{-9}/h$]
Converter	Power Module PM330	5
Safety relay	e.g. 3SK1111-2AB30	1.7
PFH value of the sub or total system		6.7

This system example has a PFH value of $6.7 \cdot 10^{-9}/h$ and fulfills the criteria for SIL 3 and PL e ($< 10^{-7}/h$).

3.8 SINAMICS G120X

The G120X has the shutdown paths for a hardware STO. The safety (part) functions evaluation, diagnosis of the sensors, control and diagnosis of the shutdown paths are performed by external components, e.g., a safety relay or an F-PLC.

The following values apply to the G120X inverter. These values do not include any upstream system components, as these can be freely selected by the user according to the required safety (part) function. The STO switch-off of the G120X is completely implemented in hardware.

Table 3-16

Product	Order number	PFH [$10^{-9}/h$]	PFD [10^{-5}]
G120X	6SL32x0-xYxxx-xUx0	5	5

The correct use of the external component mentioned above must be considered in the application.

Requirements for SIL 2 / PL d

- Suitable higher-level controls
 - SIRIUS 3SK1: Single-channel static feedback loop
 - SIRIUS 3SK2: Two-channel dynamic feedback loop
 - SIMATIC: Feedback loop monitoring in the safety program
- Forced checking procedure (test stop) once a year

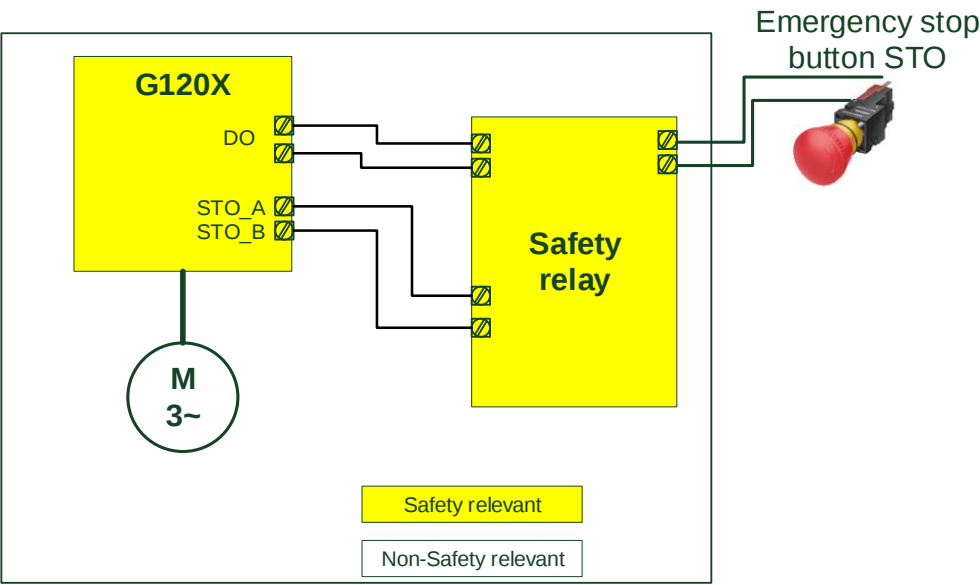
Requirements for SIL 3/PL e

- Suitable higher-level controls
 - SIRIUS 3SK1: Single-channel static feedback loop (permissible for inverters FSH and FSJ, not permissible for FSA ... FSG)
 - SIRIUS 3SK2: Two-channel dynamic feedback loop
 - SIMATIC: Feedback loop monitoring in the safety program
- Forced checking procedure (test stop) every 3 months

Example configuration 1:

In this example, the safety relay controls the shutdown paths of the G120X FSB. The feedback for diagnosis is fed back from the inverter to the safety relay via two connected digital outputs. The requirements for the safety function are SIL 2. A safety relay with static feedback loop (single-channel feedback) is used.

Figure 3-8



Assessment of safety relevance of components and allocation of PFH values:

Table 3-17: Subsystem function "Emergency Stop" STO (without Emergency Stop button)

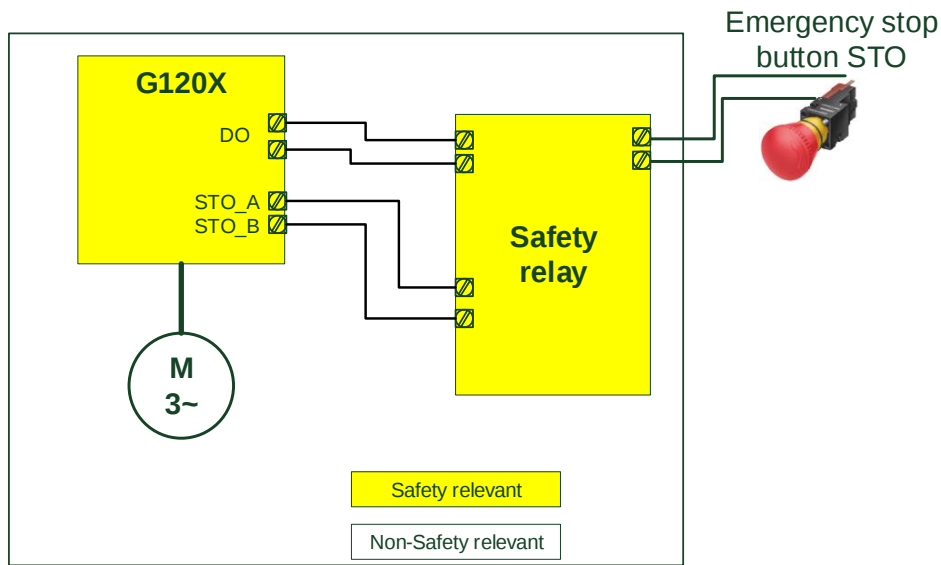
Component	Description	PFH [10 ⁻⁹ /h]
Converter	G120X FSA ... FSG	5
Safety relay	e.g. 3SK1111-2AB30	1.7
PFH value of the sub or total system		6.7

This system example has a PFH value of $6.7 \cdot 10^{-9}/h$ and fulfills the criteria for SIL 2 and PL d ($< 10^{-6}/h$).

Example configuration 2:

In this example, the safety relay controls the shutdown paths of the G120X FSB. The feedback for diagnosis is fed back from the inverter to the safety relay via two connected digital outputs. The requirements for the safety function are SIL 3. A safety relay with dynamic feedback loop (two-channel feedback) is used.

Figure 3-9



Assessment of safety relevance of components and allocation of PFH values:

Table 3-18: **Subsystem function “Emergency Stop” STO** (without Emergency Stop button)

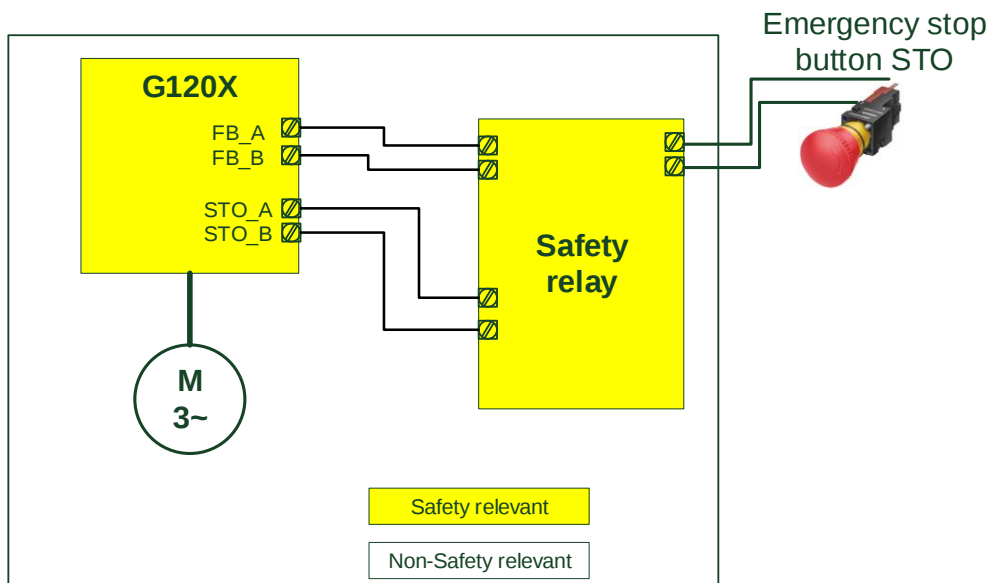
Component	Description	PFH [$10^{-9}/h$]
Converter	G120X FSA ... FSG	5
Safety relay	e.g. 3SK2112-2AA10	10
PFH value of the sub or total system		15

This system example has a PFH value of $15 \cdot 10^{-9}/h$ and fulfills the criteria for SIL 3 and PL e ($< 10^{-7}/h$).

Example configuration 3:

In this example, the safety relay controls the shutdown paths of the G120X FSH. The feedback for diagnosis is fed back from the inverter to the safety relay via two connected digital outputs. The requirements for the safety function are SIL 3. A safety relay with static feedback loop (single-channel feedback) is used.

Figure 3-10



Assessment of safety relevance of components and allocation of PFH values:

Table 3-19: Subsystem function "Emergency Stop" STO (without Emergency Stop button)

Component	Description	PFH [$10^{-9}/h$]
Converter	G120X FSH ... FSJ	5
Safety relay	e.g. 3SK1111-2AB30	1.7
PFH value of the sub or total system		6.7

This system example has a PFH value of $6.7 \cdot 10^{-9}/h$ and fulfills the criteria for SIL 3 and PL e ($< 10^{-7}/h$).

3.9 SINAMICS G130

The following values can be used for Basic Functions and Extended Functions.

Table 3-20: SINAMICS G130

Product	Order number	Additional information	PFH [$10^{-9}/h$]	PFD [10^{-5}]
Control Unit CU320-2 DP	6SL3040-1MA00-0AA0	--	10	10
Control Unit CU320-2 PN	6SL3040-1MA01-0AA0	--	10	10
Power Module Chassis	6SL3310-1Gxxx-xxx3	without SBC	14	14
Power Module Chassis	6SL3310-1Gxxx-xxx3	with SBC	15	15
Encoderless motion monitoring	without	--	20	20
Sensor Module SMC30	3SL3055-0AA00-5CAx	2-encoder system (value is valid for both Sensor Modules)	100	100
Terminal Module TM54F	6SL3055-0AA00-3BA0	--	38	38
Safe Brake Adapter 230V AC Actuation 1/h	6SL3355-2DX00-1AA0	for using SBC	2	2
Safe Brake Adapter 230V AC Actuation 1/min	6SL3355-2DX00-1AA0	for using SBC	120	120

The failure rates of the Safe Brake Adapter are dependent on the frequency of actuation. Interpolation proportional to n_{op} is possible between the specified PFH values:

NOTE

$$PFH_{SBA}(n_{op}) = \frac{n_{op}}{\frac{1}{h}} * PFH_{SBA}\left(\frac{1}{h}\right) \text{ for } 1/h \leq n_{op} \leq 1/\text{min}$$

For infrequent actuation, $PFH_{SBA}(1/h)$ is also valid.

The interpolation is also analogously applicable for the PFD value.

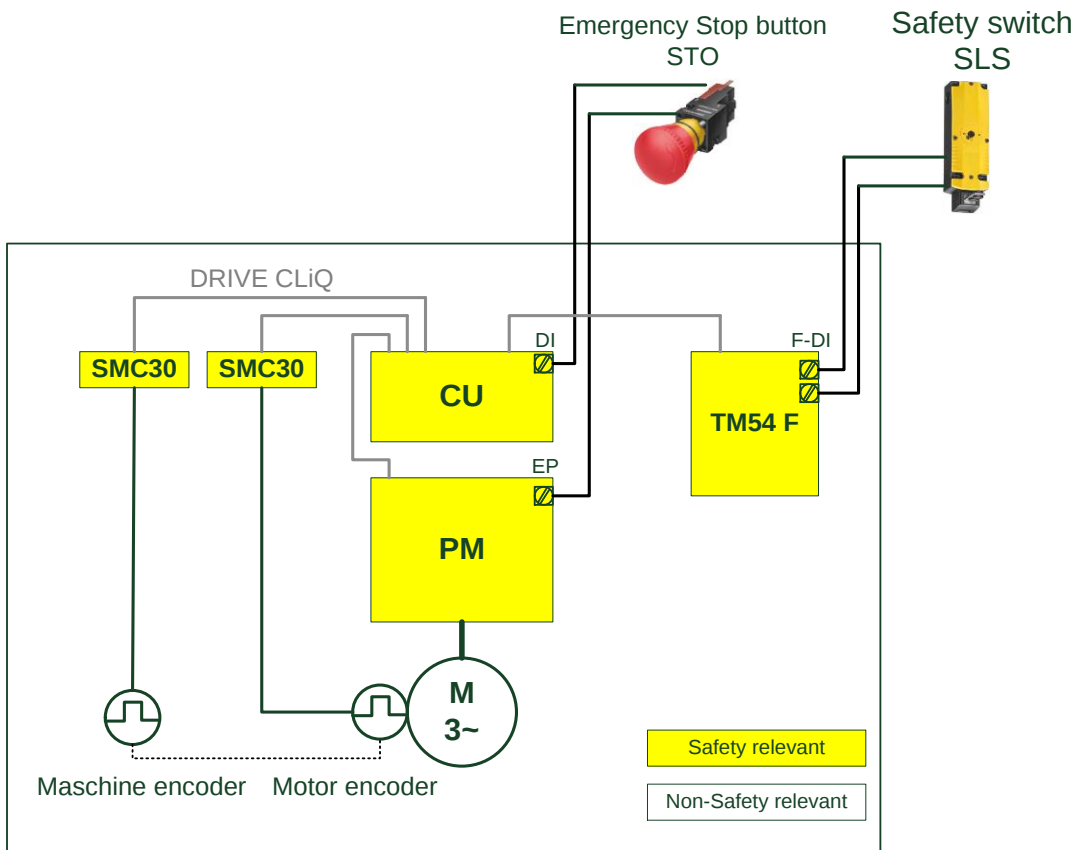
Example configuration:

The two command devices in this example are directly connected to the (F-DI) of the converter system. Alternatively, they can be connected to the distributed I/O, and the signals are transferred to the drive via PROFIsafe. In this case, the PFH values in the subsystems shown below, should be evaluated in the same way.

NOTE

2-encoder systems: In addition to the motor encoder, a machine encoder or a second motor encoder can be used as second encoder.

Figure 3-11



Assessment of safety relevance of components and allocation of PFH values:

Table 3-21: Subsystem function "Emergency Stop" STO (without Emergency Stop button)

Component	Description	PFH [10 ⁻⁹ /h]
CU	Control Unit CU320-2	10
PM	G130 Power Module Chassis without SBC	14

3 Safety-related parameters SINAMICS

Component	Description	PFH [10 ⁻⁹ /h]
PFH value of the sub or total system		24

This system example has a PFH value of 24*10⁻⁹/h and fulfills the criteria for SIL 2 and PL d (< 10⁻⁶/h).

Table 3-22: Subsystem function "Setting up operation with limited speed" SLS (without safety switch)

Component	Description	PFH [10 ⁻⁹ /h]
CU	Control Unit CU320-2	10
PM	G130 Power Module Chassis without SBC	14
TM54 F	Terminal Module TM54F	38
HTL / TTL encoders	2-encoder system with Sensor Modules SMC30	100
PFH value of the sub or total system		162

This system example has a PFH value of 162*10⁻⁹/h and fulfills the criteria for SIL 2 and PL d (< 10⁻⁶/h).

3.10 SINAMICS G150

The following values can be used for Basic Functions and Extended Functions.

Table 3-23: SINAMICS G150

Product	Order number	Additional information	PFH [10 ⁻⁹ /h]	PFD [10 ⁻⁵]
Converter (CU320-2 DP + PM/MM)	6SL3710-1Gxxx-xxx3	without SBC	24	24
Converter, 2-fold parallel connection (CU320-2 DP + 2 PM/MM)	6SL3710-2Gxxx-xxx3	without SBC	38	38
Converter (CU320-2 DP + PM/MM)	6SL3710-1Gxxx-xxx3	with SBC	25	25
Converter, 2-fold parallel connection (CU320-2 DP + 2 PM/MM)	6SL3710-2Gxxx-xxx3	with SBC	40	40
Converter (CU320-2 PN + PM/MM)	6SL3710-1Gxxx-xxx3-Z K95	without SBC	24	24
Converter, 2-fold parallel connection (CU320-2 PN + 2 PM/MM)	6SL3710-2Gxxx-xxx3-Z K95	without SBC	38	38
Converter (CU320-2 PN + PM/MM)	6SL3710-1Gxxx-xxx3-Z K95	with SBC	25	25
Converter, 2-fold parallel connection (CU320-2 PN + 2 PM/MM)	6SL3710-2Gxxx-xxx3-Z K95	with SBC	40	40
Encoderless motion monitoring	without	Not for 2-fold parallel connection	20	20
SMC30 Sensor Modules for HTL / TTL encoders	Options K50 and K52	2 encoder system (value applies to both Sensor Modules)	100	100
Terminal Module for STO, SS1	Option K82 ¹⁾	--	0.5	5
Terminal Module TM54F	Option K87	--	38	38
Safe Brake Adapter 230V AC Actuation 1/h	Option K88	for using SBC	2	2
Safe Brake Adapter 230V AC Actuation 1/min	Option K88	for using SBC	120	120

¹⁾ maximum diagnostic test interval = 12 months

NOTE

The Control Unit is included in the values for the G150 converter.

NOTE

The failure rates of the Safe Brake Adapter are dependent on the frequency of actuation. Interpolation proportional to n_{op} is possible between the specified PFH values:

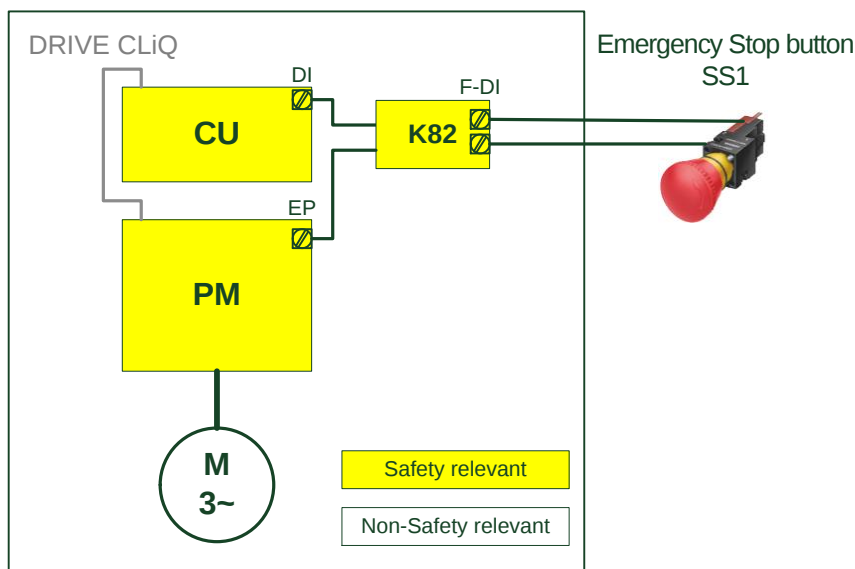
$$PFH_{SBA}(n_{op}) = \frac{n_{op}}{\frac{1}{h}} * PFH_{SBA}\left(\frac{1}{h}\right) \text{ for } 1/h \leq n_{op} \leq 1/min$$

For infrequent actuation, $PFH_{SBA}(1/h)$ is also valid.

The interpolation is also analogously applicable for the PFD value.

Example configuration:

Figure 3-12



Assessment of safety relevance of components and allocation of PFH values:

Table 3-24: **Subsystem function "Emergency Stop" SS1 time controlled** (without Emergency Stop button)

Component	Description	PFH [$10^{-9}/h$]
CU + PM	G150 (CU320-2 + Power Module Chassis)	24
Terminal module	Option K82	0.5
PFH value of the sub or total system		24.5

This system example has a PFH value of $24.5 \cdot 10^{-9}/h$ and fulfills the criteria for SIL 2 and PL d ($< 10^{-6}/h$).

3.11 SINAMICS G180

The following values can be applied to the complete converter. G180 supports applications with STO.

G180 supports the following specifications:

- Shutdown with STO (single channel and double channel)

3 Safety-related parameters SINAMICS

- Shutdown with PTC (single channel) Thermistor monitoring by a converter integrated unit.
The shutdown is executed via STO shutdown path.

Table 3-25

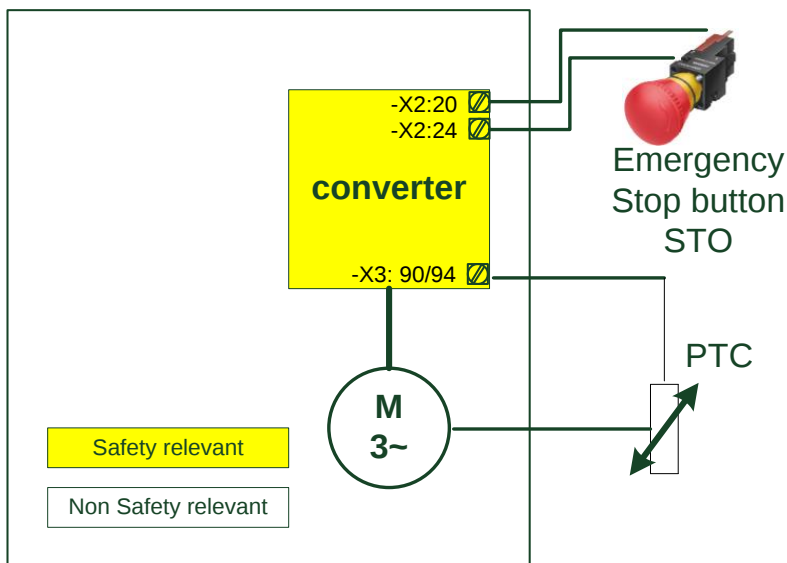
Product	Order number	Number key for inverter type	PFH [10 ⁻⁹ /h]	PFD [10 ⁻⁵]
G180 STO single channel	6SE010/4x-xxxxx-xxxx	2Txx-07 / 27xxx-xxx 2Xxx-87xxx-xxx	93,3	580
G180 STO single channel	6SE017/8x-xxxxx-xxxx	2Txx-77 / 87xxx-xxx	266	743
G180 STO double channel	6SE010/4x-xxxxx-xxxx	2Txx-07 / 27xxx-xxx 2Xxx-87xxx-xxx	50,6	128
G180 STO double channel	6SE017/8x-xxxxx-xxxx	2Txx-77 / 87xxx-xxx	224	290
G180 with PTC single channel	6SE010/4x-xxxxx-xxxx	2Txx-07 / 27xxx-xxx 2Xxx-87xxx-xxx	149	1067
G180 with PTC single channel	6SE017/8x-xxxxx-xxxx	2Txx-77 / 87xxx-xxx	313	1150

G180 has the following properties:

- according to IEC 61508, the following properties are complied with:
 - STO with Safety integrity level (SIL) 2
 - PTC with Safety integrity level (SIL) 1
 - Operating mode: "high demand/continuous mode" or
 - Operating mode "low demand mode"
- according to ISO 13849-1, the following properties are complied with:
 - STO with Category 3 and Performance Level (PL) d
 - PTC with Category 2 and Performance Level (PL) c

Example configuration:

Figure 3-13



Assessment of safety relevance of components and allocation of PFH values:

Table 3-26: Subsystem function "Emergency Stop" STO (without Emergency Stop button)

Component	Description	PFH [10 ⁻⁹ /h]
Converter	G180 double channel	50.6
PFH value of the sub or total system		50.6

This system example has a PFH value of $50.6 \cdot 10^{-9}/h$ and conforms with the criteria for SIL 2 and PL d ($< 10^{-6}/h$).

Table 3-27: Subsystem function "Thermal motor protection" PTC (without Emergency Stop button)

Component	Description	PFH [10 ⁻⁹ /h]
Converter	G180 single channel	149
PFH value of the sub or total system		149

This system example has a PFH value of $149 \cdot 10^{-9}/h$ and conforms with the criteria for SIL 2 and PL d ($< 10^{-6}/h$).

3.12 SINAMICS G220

The following values are applicable for Basic Functions and Extended Functions.

Table 3-28

Product	Order number	Additional information	PFH [10 ⁻⁹ /h]	PFD [10 ⁻⁵]
G220 (Order number: a = A; B; E; G; H; L; M)	6SL411x-xxxxx-xaxx	without SMT	12	12
G220	6SL411x-xxxxx-xFxx	with SMT; incl. OM SMT ¹⁾	27	27
Sensor Module SMC 20	6SL3055-0AA00-5BAx	1-encoder system	26	26

¹⁾ with OM SMT – The OM SMT (6SL4950-0AL00-0FA0) is rated PFH = $15 \cdot 10^{-9}/h$.

The motors with DRIVE-CLiQ interface can be used according to the information in chapter [4.2](#).

Requirements for SIL 2 / PL d

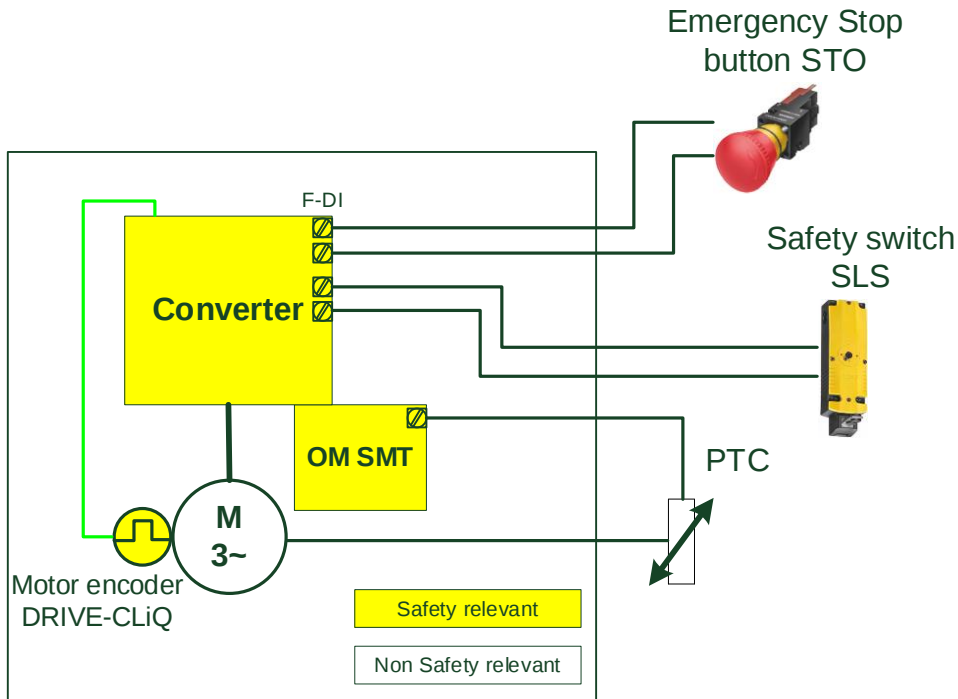
- Extended Safety Functions
 - Encoder system suitable for SIL 2 / PL d
- SMT
 - The function SMT is certified according to SIL 2 / PL d

Requirements for SIL 3/PL e

- Basic Safety Functions
 - The Basic Safety Functions fulfill SIL 3 / PL e
- Extended Safety Functions
 - Encoder system suitable for SIL 3 / PL e

Example configuration:

Figure 3-14



Assessment of safety relevance of components and allocation of PFH values:

Table 3-29: Subsystem function "Emergency Stop" STO (without Emergency Stop button)

Component	Description	PFH [$10^{-9}/h$]
Converter	G220	12
PFH value of the sub or total system		12

This system example has a PFH value of $12 \cdot 10^{-9}/h$ and fulfills the criteria for SIL 3 and PL e ($< 10^{-7}/h$).

Table 3-30: Subsystem function "Setting up operation with limited speed" SLS (without safety switch)

Component	Description	PFH [$10^{-9}/h$]
Converter	G220	12
Encoder	Asynchronous motor 1PH8 (1PH8xxx-xFxxx-xxxx) according to chapter 4.2	26
PFH value of the sub or total system		38

This system example has a PFH value of $38 \cdot 10^{-9}/h$ and fulfills the criteria for SIL 2 and PL d ($< 10^{-6}/h$).

Table 3-31: Subsystem function "Thermal motor protection" PTC (without Emergency Stop button)

Component	Description	PFH [$10^{-9}/h$]
Converter	G220 incl. OM SMT	27
PFH value of the sub or total system		27

This system example has a PFH value of $27 \cdot 10^{-9}/h$ and fulfills the criteria for SIL 2 and PL d ($< 10^{-6}/h$).

3.13 SINAMICS S110

The following values can be used for Basic Functions and Extended Functions.

Table 3-32

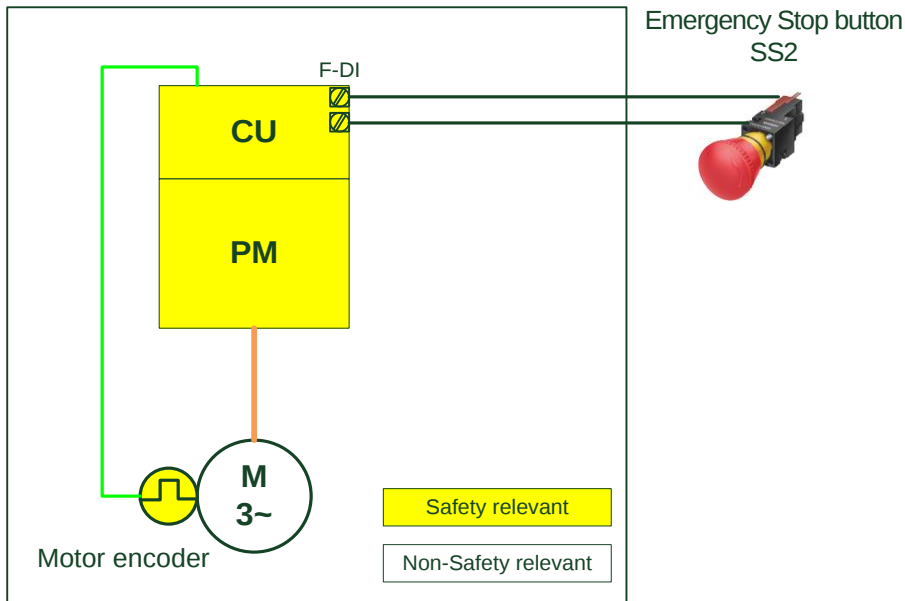
Product	Order number	Additional information	PFH [10 ⁻⁹ /h]	PFD [10 ⁻⁵]
CU305 DP Control Unit	6SL3040-0JA00-0AA0	--	10	10
Control Unit CU305 PN	6SL3040-0JA01-0AA0	--	10	10
Control Unit CU305 CAN	6SL3040-0JA02-0AA0	--	10	10
Encoderless motion monitoring	without	--	5	5
Sensor Module SMC 20	6SL3055-0AA00-5BAx	1-encoder system	26	26
Sensor Module SME 20	6SL3055-0AA00-5EAx	1-encoder system	26	26
Sensor Module SME 25	6SL3055-0AA00-5HAX	1-encoder system	26	26
Sensor Module SME 120	6SL3055-0AA00-5JAX	1-encoder system	26	26
Sensor Module SME 125	6SL3055-0AA00-5KAX	1-encoder system	26	26
Power Module PM240-2 1AC/3AC 200 - 240V	6SL3210-1PBxx-xxLx 6SL3211-1PBxx-xxLx 6SL3210-1PCxx-xxLx	without SBC	18	18
Power Module PM240-2 1AC/3AC 200 - 240V	6SL3210-1PBxx-xxLx 6SL3211-1PBxx-xxLx 6SL3210-1PCxx-xxLx	with SBC, including Safe Brake Relay ¹⁾	22	22
Power Module PM240-2 3AC 380 - 480V	6SL3210-1PExx-xxLx 6SL3211-1PExx-xxLx 6SL3210-1PHxx-xxLx	without SBC	18	18
Power Module PM240-2 3AC 380 - 480V	6SL3210-1PExx-xxLx 6SL3211-1PExx-xxLx 6SL3210-1PHxx-xxLx	with SBC, including Safe Brake Relay ¹⁾	22	22
Power Module PM240-2 3AC 500 - 690V	6SL3210-1PHxx-xxLx	without SBC	18	18
Power Module PM240-2 3AC 500 - 690V	6SL3210-1PHxx-xxLx	with SBC, including Safe Brake Relay ¹⁾	22	22

¹⁾ With Safe Brake Relay – The Safe Brake Relay (6SL3252-0BB01-0AA0) is rated PFH = 4* 10⁻⁹/h.

The motors with DRIVE-CLiQ interface can be used according to the information in chapter [4.2](#).
Motors with holding brake are applicable according to the information in chapter [4.3](#).

Example configuration:

Figure 3-15



Assessment of safety relevance of components and allocation of PFH values:

Table 3-33: **Subsystem function "Emergency Stop" SS2** (without Emergency Stop button)

Component	Description	PFH [$10^{-9}/h$]
CU	CU305	10
PM	Power Modules PM240-2 3AC 380 - 480V without SBC	18
Motor and encoder	Servomotor 1FT7 (1FT7xxx-xxxxx-xBxx) according to chapter 4.2	30
PFH value of the sub or total system		58

This system example has a PFH value of $58 \cdot 10^{-9}/h$ and conforms with the criteria for SIL 2 and PL d ($< 10^{-6}/h$).

3.14 SINAMICS S120 AC/AC

The following values can be used for Basic Functions and Extended/Advanced Functions.

Table 3-34

Product	Order number	Additional information	PFH [$10^{-9}/h$]	PFD [10^{-5}]
Control Unit CU310-2 DP	6SL3040-1LA00-0AA0	--	10	10
Control Unit CU310- 2 PN	6SL3040-1LA01-0AA0	--	10	10
Encoderless motion monitoring Blocksize	without	--	5	5
Encoderless motion monitoring Chassis	without	--	20	20
Sensor Module SMC 20	6SL3055-0AA00-5BAx	1-encoder system	26	26
Sensor Module SMC 20	6SL3055-0AA00-5BAx	2-encoder system (value is valid for both Sensor Modules)	7	7
Sensor Module SMC 30	6SL3055-0AA00-5CAx	2-encoder system (value is valid for both Sensor Modules).	100	100
Sensor Module SMC 40	6SL3055-0AA00-5DAx	1-Gebersystem	26	26
Sensor Module SMC 40	6SL3055-0AA00-5DAx	2- Gebersystem (Wert gilt für beide Sensor Modules)	7	7

3 Safety-related parameters SINAMICS

Product	Order number	Additional information	PFH [10 ⁻⁹ /h]	PFD [10 ⁻⁵]
Sensor Module SME 20	6SL3055-0AA00-5EAx	1-encoder system	26	26
Sensor Module SME 20	6SL3055-0AA00-5EAx	2-encoder system (value is valid for both Sensor Modules)	7	7
Sensor Module SME 25	6SL3055-0AA00-5HAx	1-encoder system	26	26
Sensor Module SME 25	6SL3055-0AA00-5HAx	2-encoder system (value is valid for both Sensor Modules)	7	7
Sensor Module SME 120	6SL3055-0AA00-5JAx	1-encoder system	26	26
Sensor Module SME 120	6SL3055-0AA00-5JAx	2-encoder system (value is valid for both Sensor Modules)	7	7
Sensor Module SME 125	6SL3055-0AA00-5KAx	1-encoder system	26	26
Sensor Module SME 125	6SL3055-0AA00-5KAx	2-encoder system (value is valid for both Sensor Modules)	7	7
Power Module PM240-2 1AC/3AC 200 - 240V	6SL3210-1PBxx-xxLx 6SL3211-1PBxx-xxLx 6SL3210-1PCxx-xxLx	without SBC	18	18
Power Module PM240-2 1AC/3AC 200 - 240V	6SL3210-1PBxx-xxLx 6SL3211-1PBxx-xxLx 6SL3210-1PCxx-xxLx	with SBC, including Safe Brake Relay ¹⁾	22	22
Power Modules PM240-2 3AC 380 - 480V	6SL3210-1PExx-xxLx 6SL3211-1PExx-xxLx	without SBC	18	18
Power Modules PM240-2 3AC 380 - 480V	6SL3210-1PExx-xxLx 6SL3211-1PExx-xxLx	with SBC, including Safe Brake Relay ¹⁾	22	22
Power Module PM240-2 3AC 500 - 690V	6SL3210-1PHxx-xxLx	without SBC	18	18
Power Module PM240-2 3AC 500 - 690V	6SL3210-1PHxx-xxLx	with SBC, including Safe Brake Relay ¹⁾	22	22
Power Module Chassis	6SL331x-1TExx-xxx3 6SL331x-1TExx-xxx7 6SL331x-1TGxx-xxx3 6SL331x-1TGxx-xxx7	without SBC	14	14
Power Module Chassis	6SL331x-1TExx-xxx3 6SL331x-1TExx-xxx7 6SL331x-1TGxx-xxx3 6SL331x-1TGxx-xxx7	with SBC	15	15
Safe Brake Adapter 230V AC; Actuation 1/h	6SL3355-2DX00-1AA0	for using SBC	2	2
Safe Brake Adapter 230V AC; Actuation 1/min	6SL3355-2DX00-1AA0	for using SBC	120	120

¹⁾ With Safe Brake Relay – The Safe Brake Relay (6SL3252-0BB01-0AA0) is rated PFH = 4*10⁻⁹/h.

The motors with DRIVE-CLiQ interface can be used according to the information in chapter [4.2](#).
Motors with holding brake are applicable according to the information in chapter [4.3](#).

NOTE

The failure rates of the Safe Brake Adapter are dependent on the frequency of actuation. Interpolation proportional to n_{op} is possible between the specified PFH values:

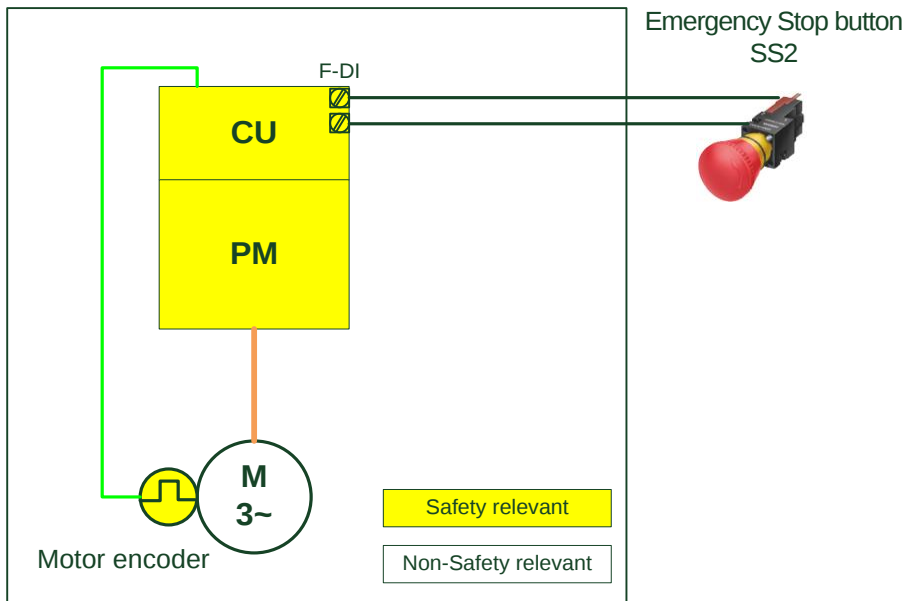
$$PFH_{SBA}(n_{op}) = \frac{n_{op}}{1} * PFH_{SBA}\left(\frac{1}{h}\right) \text{ for } 1/h \leq n_{op} \leq 1/min$$

For infrequent actuation, $PFH_{SBA}(1/h)$ is also valid.

The interpolation is also analogously applicable for the PFD value.

Example configuration

Figure 3-16



Assessment of safety relevance of components and allocation of PFH values:

Table 3-35: **Subsystem function "Emergency Stop" SS1** (without Emergency Stop button)

Component	Description	PFH [$10^{-9}/h$]
CU	CU310-2 PN	10
PM	Power Module PM240-2 3AC 380 - 480V without SBC	18
Motor with encoder	Servomotor 1FT7 (1FT7xxx-xxxxx-xBxx) according to chapter 4.2	30
PFH value of the sub or total system		58

This system example has a PFH value of $58 \cdot 10^{-9}/h$ and fulfills the criteria for SIL 2 and PL d ($< 10^{-6}/h$).

3.15 SINAMICS S120 Cabinet Modules

The following values can be used for Basic Functions and Extended/Advanced Functions.

Table 3-36

Product	Order number	Additional information	PFH [$10^{-9}/h$]	PFD [10^{-5}]
Cabinet Modules with chassis (CIM)	6SL3720-1Txxx-xxx3 6SL3721-1Txxx-xxx0 6SL3725-1Txxx-xxx3	without SBC; without CU320-2 (see option K90/95)	14	14
Cabinet Modules with chassis (CIM)	6SL3720-1Txxx-xxx3 6SL3721-1Txxx-xxx0 6SL3725-1Txxx-xxx3	with SBC; without CU320-2 (see option K90/95)	15	15
Cabinet Modules with Single Motor Module Booksize	6SL3720-1TExx-xxx3	without SBC; without CU320-2 (see option K90/95)	10	10
Cabinet Modules with Single Motor Module Booksize	6SL3720-1TExx-xxx3	with SBC; without CU320-2 (see option K90/95)	14	14

3 Safety-related parameters SINAMICS

Product	Order number	Additional information	PFH [10 ⁻⁹ /h]	PFD [10 ⁻⁵]
Cabinet Modules with Double Motor Module Booksize	6SL3720-2TExx-xxx3	without SBC; 1 axis used	10	10
Cabinet Modules with Double Motor Module Booksize	6SL3720-2TExx-xxx3	with SBC; 1 axis used	14	14
Cabinet Modules with Double Motor Module Booksize	6SL3720-2TExx-xxx3	without SBC; 2 axes used	12	12
Cabinet Modules with Double Motor Module Booksize	6SL3720-2TExx-xxx3	with SBC; 2 axes used	20	20
Cabinet Modules with Double Motor Module Booksize	6SL3720-2TExx-xxx3	1 axis with SBC; 2 axes used	16	16
Control Unit CU320-2 DP	Option K90	--	10	10
Control Unit CU320-2 PN	Option K95	--	10	10
Encoderless motion monitoring Booksize	without	--	5	5
Encoderless motion monitoring Chassis	without	--	20	20
Encoder evaluation SMC20 for sin/cos encoders	Option K48	--	26	26
SMC30 Sensor Module HTL/TTL encoders	Options K50 and K52	2-encoder system (value is valid for both Sensor Modules).	100	100
Terminal Module for STO, SS1	Option K82 ¹⁾	--	0.5	5
Terminal Module TM54F	Option K87	--	38	38
Safe Brake Adapter 230V AC; Actuated 1/h	Option K88	for using SBC	2	2
Safe Brake Adapter 230V AC; Actuated 1/min	Option K88	for using SBC	120	120

¹⁾ maximum diagnostic test interval = 6 months

The motors with DRIVE-CLiQ interface can be used according to the information in chapter [4.2](#).
Motors with holding brake are applicable according to the information in chapter [4.3](#).

NOTE

The failure rates of the Safe Brake Adapter are dependent on the frequency of actuation. Interpolation proportional to n_{op} is possible between the specified PFH values:

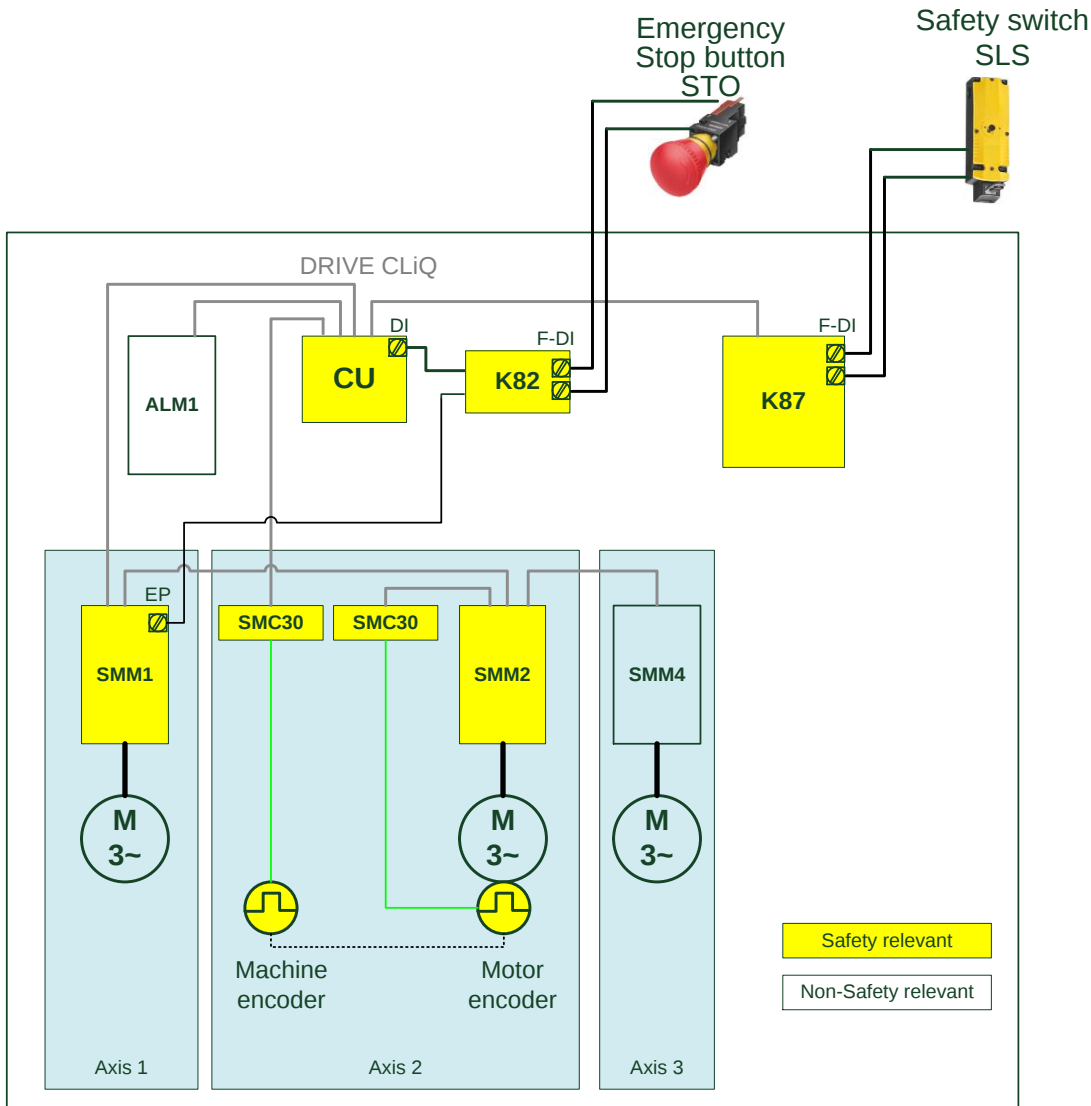
$$PFH_{SBA}(n_{op}) = \frac{n_{op}}{\frac{1}{h}} * PFH_{SBA}\left(\frac{1}{h}\right) \text{ for } 1/h \leq n_{op} \leq 1/min$$

For infrequent actuation, $PFH_{SBA}(1/h)$ is also valid.

The interpolation is also analogously applicable for the PFD value.

Example configuration:

Figure 3-17



Assessment of safety relevance of components and allocation of PFH values:

Table 3-37: **Subsystem function "Emergency Stop" STO acts on axis1** (without Emergency Stop button)

Component	Description	PFH [10 ⁻⁹ /h]
CU	CU320-2 DP (option K90)	10
Terminal module	K82	0.5
SMM1	Single Motor Module Cabinet without SBC	14
PFH value of the sub or total system		24.5

This system example has a PFH value of 24.5*10⁻⁹/h and fulfills the criteria for SIL 2 and PL d (< 10⁻⁶/h).

Table 3-38: **Subsystem function "Setting up operation with limited speed" SLS** (without safety switch)

Component	Description	PFH [10 ⁻⁹ /h]
CU	CU320-2 DP (option K90)	10
TM54F	K87	38
SMM1	Axis 1: Single Motor Module Cabinet Chassis without SBC	14

Component	Description	PFH [$10^{-9}/h$]
	Encoderless motion monitoring	20
SMM2	Axis 2: Single Motor Module Cabinet Chassis without SBC	14
HTL/TTL encoders Axis 2	2-encoder system with motor encoder via SMC30 and machine encoder via SMC30	100
PFH value of the sub or total system		196

This system example has a PFH value of $196 \cdot 10^{-9}/h$ and fulfills the criteria for SIL 2 and PL d ($< 10^{-6}/h$).

3.16 SINAMICS S120 Built-In Units

The following values can be used for Basic Functions and Extended/Advanced Functions.

Table 3-39

Product	Order number	Additional information	PFH [$10^{-9}/h$]	PFD [10^{-5}]
Control Unit CU320-2 DP	6SL3040-1MA00-0AA0	--	10	10
Control Unit CU320-2 PN	6SL3040-1MA01-0AA0	--	10	10
Encoderless motion monitoring Booksize / Blocksize	without	--	5	5
Encoderless motion monitoring Chassis	without	--	20	20
Sensor Module SMC 20	6SL3055-0AA00-5BAx	1-encoder system	26	26
Sensor Module SMC 20	6SL3055-0AA00-5BAx	2-encoder system (value is valid for both Sensor Modules)	7	7
Sensor Module SMC 30	6SL3055-0AA00-5CAx	2-encoder system (value is valid for both Sensor Modules).	100	100
Sensor Module SMC 40	6SL3055-0AA00-5DAx	1-encoder system	26	26
Sensor Module SMC 40	6SL3055-0AA00-5DAx	2-encoder system (value is valid for both Sensor Modules)	7	7
Sensor Module SME 20	6SL3055-0AA00-5EAx	1-encoder system	26	26
Sensor Module SME 20	6SL3055-0AA00-5EAx	2-encoder system (value is valid for both Sensor Modules)	7	7
Sensor Module SME 25	6SL3055-0AA00-5HAX	1-encoder system	26	26
Sensor Module SME 25	6SL3055-0AA00-5HAX	2-encoder system (value is valid for both Sensor Modules)	7	7
Sensor Module SME 120	6SL3055-0AA00-5JAX	1-encoder system	26	26
Sensor Module SME 120	6SL3055-0AA00-5JAX	2-encoder system (value is valid for both Sensor Modules)	7	7
Sensor Module SME 125	6SL3055-0AA00-5KAX	1-encoder system	26	26
Sensor Module SME 125	6SL3055-0AA00-5KAX	2-encoder system (value is valid for both Sensor Modules)	7	7
Single Motor Module Booksize (Order number: a = 3; 4) / Compact (Order number: b = 0; 1)	6SL312x-1xExx-xAXa 6SL3420-1TExx-xAAb 6SL3120-1TExx-xAC0 6SL3120-1TExx-xAD0	without SBC	10	10

3 Safety-related parameters SINAMICS

Product	Order number	Additional information	PFH [10 ⁻⁹ /h]	PFD [10 ⁻⁵]
Single Motor Module Booksize (Order number: a = 3; 4) / Compact (Order number: b = 0; 1)	6SL312x-1xExx-xAxa 6SL3420-1TExx-xAAb 6SL3120-1TExx-xAC0 6SL3120-1TExx-xAD0	with SBC	14	14
Double Motor Module Booksize (Order number: a = 3; 4) / Compact (Order number: b = 0; 1)	6SL312x-2TExx-xAxa 6SL3420-2TExx-xAAb 6SL3120-2TExx-xAC0 6SL3120-2TExx-xAD0	without SBC; 1 axis used	10	10
Double Motor Module Booksize (Order number: a = 3; 4) / Compact (Order number: b = 0; 1)	6SL312x-2TExx-xAxa 6SL3420-2TExx-xAAb 6SL3120-2TExx-xAC0 6SL3120-2TExx-xAD0	with SBC; 1 axis used	14	14
Double Motor Module Booksize (Order number: a = 3; 4) / Compact (Order number: b = 0; 1)	6SL312x-2TExx-xAxa 6SL3420-2TExx-xAAb 6SL3120-2TExx-xAC0 6SL3120-2TExx-xAD0	without SBC; 2 axes used	12	12
Double Motor Module Booksize (Order number: a = 3; 4) / Compact (Order number: b = 0; 1)	6SL312x-2TExx-xAxa 6SL3420-2TExx-xAAb 6SL3120-2TExx-xAC0 6SL3120-2TExx-xAD0	with SBC; 2 axes used	20	20
Double Motor Module Booksize (Order number: a = 3; 4) / Compact (Order number: b = 0; 1)	6SL312x-2TExx-xAxa 6SL3420-2TExx-xAAb 6SL3120-2TExx-xAC0 6SL3120-2TExx-xAD0	1 axis with SBC; 2 axes used	16	16
Motor Module Chassis	6SL3320-1Txxx-xxx3 6SL3325-1Txxx-xxx3 6SL3325-1Txxx-xxx7 6SL3321-1Txxx-xxx0	without SBC	14	14
Motor Module Chassis	6SL3320-1Txxx-xxx3 6SL3325-1Txxx-xxx3 6SL3325-1Txxx-xxx7 6SL3321-1Txxx-xxx0	with SBC	15	15
Power Modules PM240-2 1AC/3AC 200 - 240V	6SL3210-1PBxx-xxLx 6SL3211-1PBxx-xxLx 6SL3210-1PCxx-xxLx	without SBC; incl. CUA31/32	18	18
Power Modules PM240-2 1AC/3AC 200 - 240V	6SL3210-1PBxx-xxLx 6SL3211-1PBxx-xxLx 6SL3210-1PCxx-xxLx	with SBC, including Safe Brake Relay ¹⁾ ; incl. CUA31/32	22	22
Power Modules PM240-2 3AC 380 - 480V	6SL3210-1PExx-xxLx 6SL3211-1PExx-xxLx 6SL3210-1PHxx-xxLx	without SBC; incl. CUA31/32	18	18
Power Modules PM240-2 3AC 380 - 480V	6SL3210-1PExx-xxLx 6SL3211-1PExx-xxLx 6SL3210-1PHxx-xxLx	with SBC, including Safe Brake Relay ¹⁾ ; incl. CUA31/32	22	22
Power Module PM240-2 3AC 500 - 690V	6SL3210-1PHxx-xxLx	without SBC; incl. CUA31/32	18	18
Power Module PM240-2 3AC 500 - 690V	6SL3210-1PHxx-xxLx	with SBC, incl. Safe Brake Relay ¹⁾ ; incl. CUA31/32	22	22
Power Module Chassis	6SL331x-1TExx-xxx3 6SL331x-1TExx-xxx7 6SL331x-1TGxx-xxx3 6SL331x-1TGxx-xxx7	without SBC	14	14

3 Safety-related parameters SINAMICS

Product	Order number	Additional information	PFH [10 ⁻⁹ /h]	PFD [10 ⁻⁵]
Power Module Chassis	6SL331x-1TExx-xxx3 6SL331x-1TExx-xxx7 6SL331x-1TGxx-xxx3 6SL331x-1TGxx-xxx7	with SBC	15	15
Combi Motor Module	6SL3111-3VE2x-xxA0	1 axis with SBC; 3 axes used	34	34
Combi Motor Module	6SL3111-4VE2x-xxA0	1 axis with SBC; 4 axes used	44	44
Hydraulic Linear Actor	6SL3420-2HX00-0AA0	1 hydraulic axis used	14	14
Hydraulic Linear Actor	6SL3420-2HX00-0AA0	2 hydraulic axes used	20	20
Distributed drive unit	6SL35xx-6DF71-0Rxx	without SBC, Basic Functions	50	50
Distributed drive unit	6SL35xx-6DF71-0Rxx	with SBC, Basic Functions	60	60
Distributed drive unit	6SL35xx-6DF71-0Rxx	without SBC, Extended Functions	80	80
Distributed drive unit	6SL35xx-6DF71-0Rxx	with SBC, Extended Functions	90	90
Adapter Module AM600	6SL3555-2BC10-0AA0	--	10	10
Terminal Module TM54F	6SL3055-0AA00-3BA0	--	38	38
Safe Brake Adapter 230V AC; Actuated 1/h	6SL3355-2DX00-1AA0	for using SBC	2	2
Safe Brake Adapter 230V AC; Actuated 1/min	6SL3355-2DX00-1AA0	for using SBC	120	120

¹⁾ with Safe Brake Relay – The Safe Brake Relay (6SL3252-0BB01-0AA0) is rated PFH = 4*10⁻⁹/h.

The motors with DRIVE-CLiQ interface can be used according to the information in chapter [4.2](#).
Motors with holding brake are applicable according to the information in chapter [4.3](#).

NOTE

The failure rates of the Safe Brake Adapter are dependent on the frequency of actuation. Interpolation proportional to n_{op} is possible between the specified PFH values:

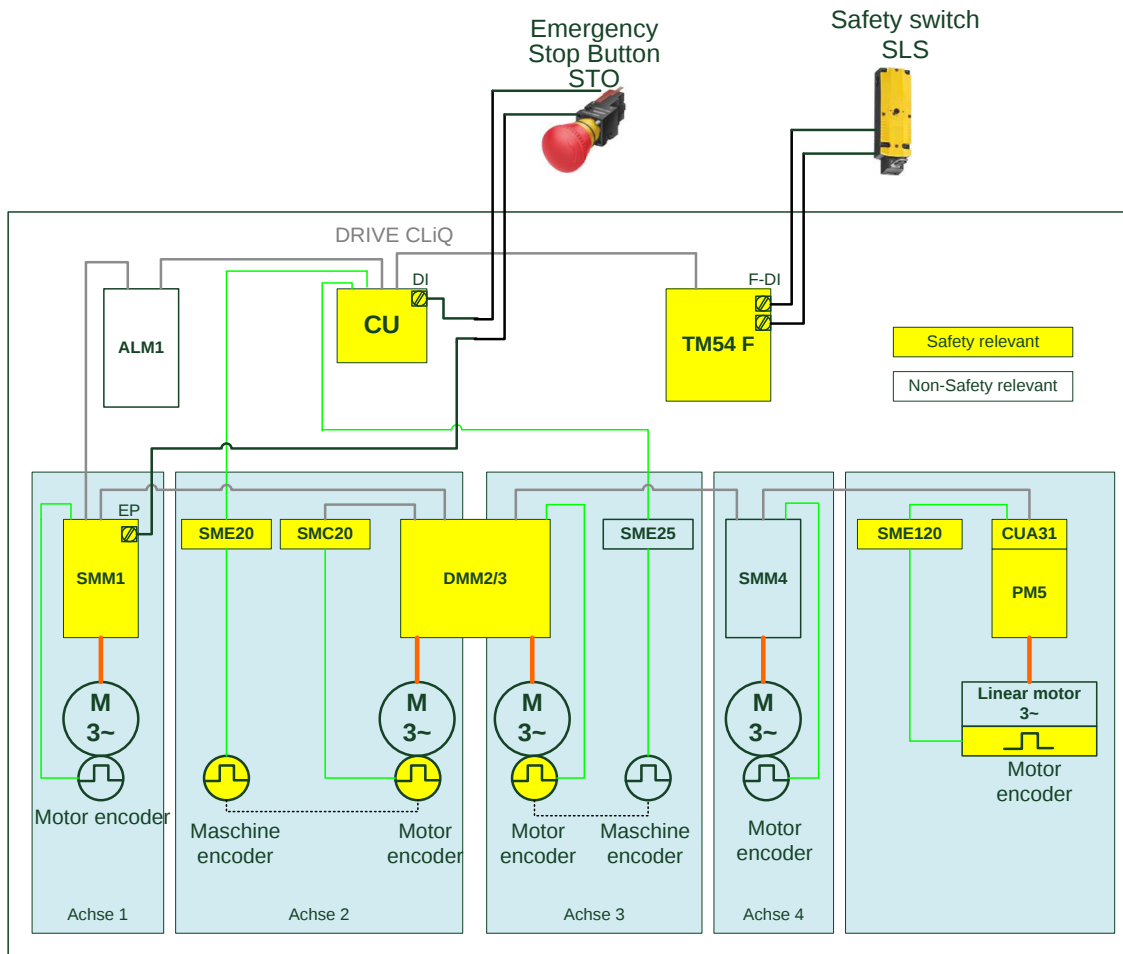
$$PFH_{SBA}(n_{op}) = \frac{n_{op}}{\frac{1}{h}} * PFH_{SBA}\left(\frac{1}{h}\right) \text{ for } 1/h \leq n_{op} \leq 1/min$$

For infrequent actuation, $PFH_{SBA}(1/h)$ is also valid.

The interpolation is also analogously applicable for the PFD value.

Example configuration

Figure 3-18



Assessment of safety relevance of components and allocation of PFH values:

Table 3-40: Subsystem function "Emergency Stop" STO acts on axis1 (without Emergency Stop button)

Component	Description	PFH [10 ⁻⁹ /h]
CU	CU320-2 PN	10
SMM1	Single Motor Module Booksize without SBC	10
PFH value of the sub or total system		20

This system example has a PFH value of $20 \cdot 10^{-9}/h$ and fulfills the criteria for SIL 2 and PL d ($< 10^{-6}/h$).

Table 3-41: Subsystem function "Setting up operation with limited speed" SLS (without safety switch)

Component	Description	PFH [10 ⁻⁹ /h]
CU	CU320-2 PN	10
TM54F	Terminal Module with F-IO	38
SMM1	Axis 1: Single Motor Module Booksize without SBC	10
	Encoderless motion monitoring	5
DMM2/3	Axis 2 and axis 3: Double Motor Module Booksize, 2 axes without SBC	12
Encoder axis 2	2-encoder system with motor encoder via SMC20 and machine encoder via SME20	7

3 Safety-related parameters SINAMICS

Component	Description	PFH [10 ⁻⁹ /h]
Motor with encoder axis 3	Servomotor 1FT7 (1FT7xxx-xxxxx-xBxx) according to chapter 4.2	30
PM5	Axis 5: Power Module Blocksize without SBC	18
Encoder axis 5	1-encoder system with motor encoder via SME120	26
PFH value of the sub or total system		156

This system example has a PFH value of 156*10⁻⁹/h and fulfills the criteria for SIL 2 and PL d (< 10⁻⁶/h)

3.17 SINAMICS S150

The following values can be used for Basic Functions and Extended/Advanced Functions.

Table 3-42

Product	Order number	Additional information	PFH [10 ⁻⁹ /h]	PFD [10 ⁻⁵]
Converter (CU320-2 DP + PM)	6SL3710-7Lxxx-xxx3	without SBC	24	24
Converter (CU320-2 DP + PM)	6SL3710-7Lxxx-xxx3	with SBC	25	25
Converter (CU320-2 PN + PM)	6SL3710-7Lxxx-xxx3-Z K95	without SBC	24	24
Converter (CU320-2 PN + PM)	6SL3710-7Lxxx-xxx3-Z K95	with SBC	25	25
Encoderless motion monitoring	without	--	20	20
Encoder evaluation SMC20 for sin/cos encoders	Option K48	1-encoder system	26	26
SMC30 Sensor Modules for HTL/TTL encoders	Options K50 and K52	2-encoder system (value is valid for both Sensor Modules)	100	100
Terminal Module for STO, SS1	Option K82 ¹⁾	--	0.5	5
Terminal Module TM54F	Option K87	--	38	38
Safe Brake Adapter 230V AC Actuated 1/h	Option K88	for using SBC	2	2
Safe Brake Adapter 230V AC Actuated 1/min	Option K88	for using SBC	120	120

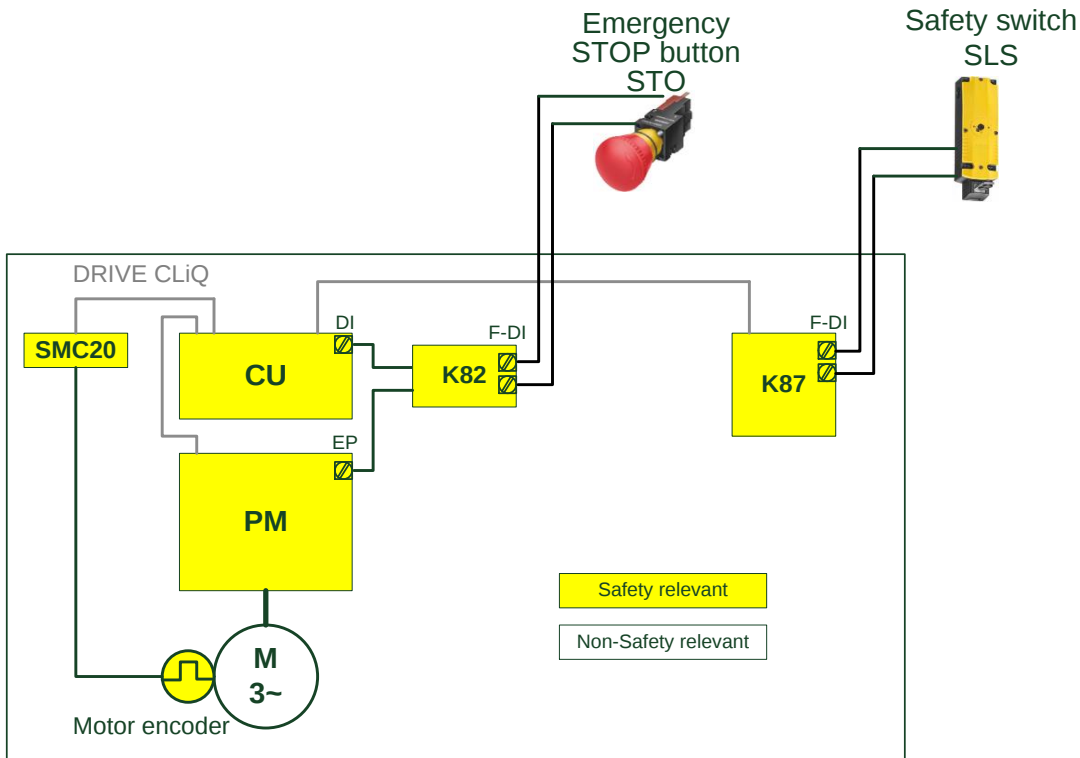
¹⁾ maximum diagnostic test interval = 12 months

NOTE

The Control Unit is included in the values for the S150 converter.

Example configuration:

Figure 3-19



Assessment of safety relevance of components and allocation of PFH values:

Table 3-43: **Subsystem function "Emergency Stop" SS1 time controlled** (without Emergency Stop button)

Component	Description	PFH [$10^{-9}/h$]
CU + PM	S150 (CU320-2 + Power Module Chassis) without SBC	24
Terminal module	Option K82	0.5
PFH value of the sub or total system		24.5

This system example has a PFH value of $24.5 \cdot 10^{-9}/h$ and fulfills the criteria for SIL 2 and PL d ($< 10^{-6}/h$).

Table 3-44

Component	Description	PFH [$10^{-9}/h$]
CU + PM	S150 (CU320-2 + Power Module Chassis) without SBC	24
TM54F	Option K87	38
Encoder	1-encoder system with Sensor Modules SMC20	26
PFH value of the sub or total system		88

This system example has a PFH value of $88 \cdot 10^{-9}/h$ and fulfills the criteria for SIL 2 and PL d ($< 10^{-6}/h$).

3.18 SINAMICS S200

The following values can be applied to the complete converter. S200 supports applications with STO via terminals.

3 Safety-related parameters SINAMICS

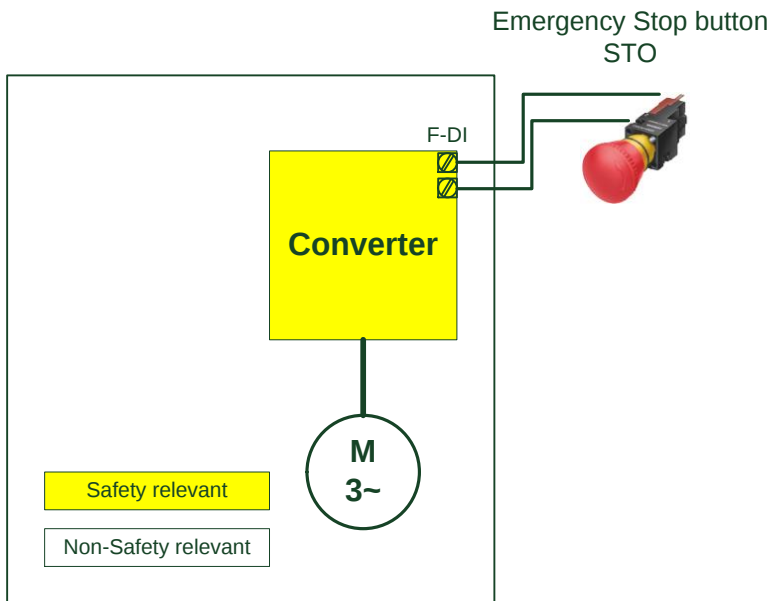
Table 3-45: SINAMICS S200

Product	Order number	PFH [10 ⁻⁹ /h]	PFD [10 ⁻⁵]
S200	6SL5510-xxxxx-xxxx	9	9

Example configuration:

The emergency stop button is directly connected to the F-DI of the converter.

Figure 3-20



Assessment of safety relevance of components and allocation of PFH values:

Table 3-46: Subsystem function "Emergency Stop" STO (without Emergency Stop button)

Component	Description	PFH [10 ⁻⁹ /h]
Converter	S200	7
PFH value of the sub or total system		7

This system example has a PFH value of $9 \cdot 10^{-9}/h$ and fulfills the criteria for SIL 3 and PL e ($< 10^{-7}/h$).

3.19 SINAMICS S210

The following values can be used for Basic Functions (STO, SS1, SBC) and Extended Functions (Motion monitoring with encoder) incl. Basic. The evaluation for the Extended Functions includes the encoders of the 1FK2, 1FT2 and 1FS2 motors with one-cable technology.

NOTE

Other motor types are not supported on the SINAMICS S210.

Table 3-47

Product	Order number	Additional information	PFH [10 ⁻⁹ /h]	PFD [10 ⁻⁵]
S210	6SL3210-5HBxx-xUFx	Basic	25	25
S210	6SL3210-5HBxx-xUFx	Extended	50	50
S210	6SL3210-5HExx-xUFx	Basic	25	25

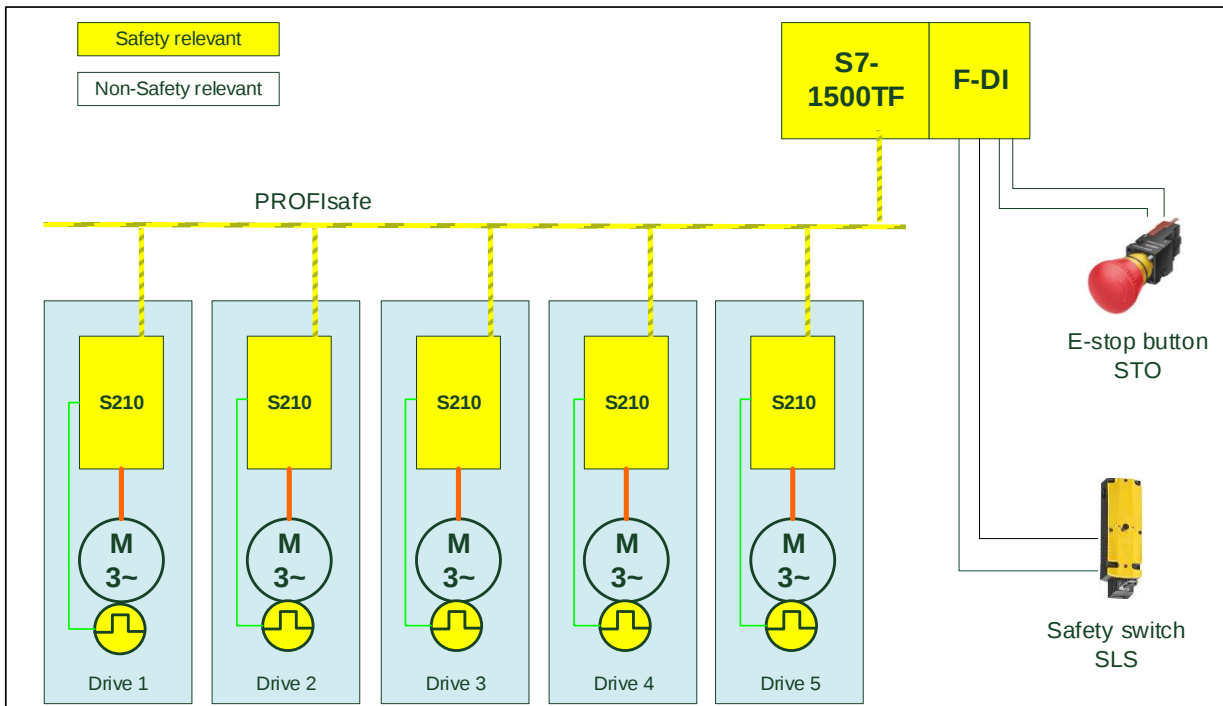
3 Safety-related parameters SINAMICS

Product	Order number	Additional information	PFH [10 ⁻⁹ /h]	PFD [10 ⁻⁵]
S210	6SL3210-5HExx-xUFx	Extended	50	50

Motors with holding brake are applicable according to the information in chapter [4.3](#).

Example configuration:

Figure 3-21



Assessment of safety relevance of components and allocation of PFH values:

Table 3-48: **Subsystem function "Emergency Stop" STO** (without Emergency Stop button)

Component	Description	PFH [10 ⁻⁹ /h]
S7 F-PLC incl. PROFIsafe	S7 1515TF-2PN	2
ET200MP SM526	F-DI	1
Drive 1	S210	25
Drive 2	S210	25
Drive 3	S210	25
Drive 4	S210	25
Drive 5	S210	25
PFH value of the sub or total system		128

This system example has a PFH value of 128*10⁻⁹/h and fulfills the criteria for SIL 2 and PL d (< 10⁻⁶/h).

Table 3-49: **Subsystem function "Setting up operation with limited speed" SLS** (without safety switch)

Component	Description	PFH [10 ⁻⁹ /h]
S7 F-CPU incl. PROFIsafe	S7 1515TF-2PN	2
ET200MP SM526	F-DI	1
Drive 1	S210 + 1FK2	50
Drive 2	S210 + 1FK2	50

3 Safety-related parameters SINAMICS

Component	Description	PFH [10 ⁻⁹ /h]
Drive 3	S210 + 1FK2	50
Drive 4	S210 + 1FK2	50
Drive 5	S210 + 1FK2	50
PFH value of the sub or total system		253

This system example has a PFH value of 253*10⁻⁹/h and fulfills the criteria for SIL 2 and PL d (< 10⁻⁶/h).

3.20 SINAMICS S210 (New)

The following values can be used for Basic Functions (STO, SS1, SBC) and Extended Functions (Motion monitoring with encoder) incl. Basic. The evaluation for the Extended Functions includes the encoders of the 1FK2, 1FT2 and 1FS2 motors with one-cable technology.

Hinweis

Other motor types are not supported on the SINAMICS S210.

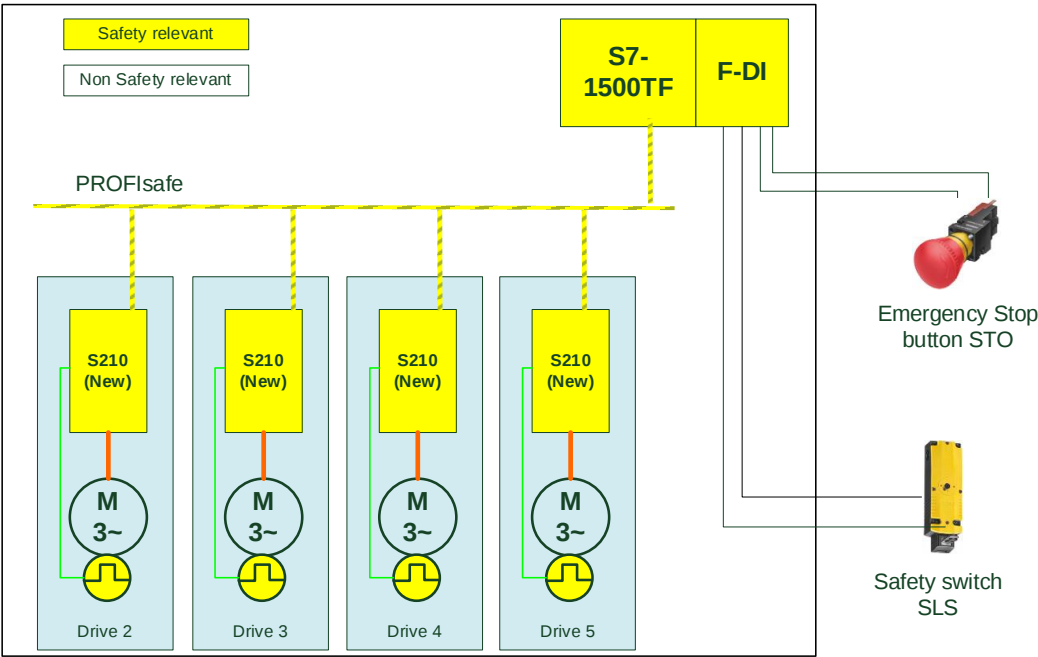
Table 3-50

Product	Order number	Additional information	PFH[10 ⁻⁹ /h]	PFD [10 ⁻⁵]
S210 (New)	6SL5310-1Bxxx-xxxx	Basic Functions, without SBC	7	7
S210 (New)	6SL5310-1Bxxx-xxxx	Basic Functions, with SBC	11	11
S210 (New)	6SL5310-1Bxxx-xxxx	Extended Functions, without SBC	20	20
S210 (New)	6SL5310-1Bxxx-xxxx	Extended Functions, with SBC	24	24

Motors with holding brake are applicable according to the information in chapter 4.3.

Example configuration:

Figure 3-22



Assessment of safety relevance of components and allocation of PFH values:

Table 3-51: **Subsystem function "Emergency Stop" STO** (without Emergency Stop button)

Component	Description	PFH [$10^{-9}/h$]
S7 F-PLC incl. PROFIsafe	S7 1515TF-2PN	2
ET200MP SM526	F-DI	1
Drive 1	S210 (New)	7
Drive 2	S210 (New)	7
Drive 3	S210 (New)	7
Drive 4	S210 (New)	7
PFH value of the sub or total system		31

This system example has a PFH value of $31 \cdot 10^{-9}/h$ and fulfills the criteria for SIL 3 and PL e ($< 10^{-7}/h$).

Table 3-52: **Subsystem function "Setting up operation with limited speed" SLS** (without safety switch)

Component	Description	PFH [$10^{-9}/h$]
S7 F-CPU incl. PROFIsafe	S7 1515TF-2PN	2
ET200MP SM526	F-DI	1
Drive 1	S210 (New) + 1FK2	20
Drive 2	S210 (New) + 1FK2	20
Drive 3	S210 (New) + 1FK2	20
Drive 4	S210 (New) + 1FK2	20
PFH value of the sub or total system		83

This system example has a PFH value of $83 \cdot 10^{-9}/h$ and fulfills the criteria for SIL 3 and PL e ($< 10^{-7}/h$).

3.21 SINAMICS V90

The following values can be applied to the complete converter. V90 supports applications with STO via terminals.

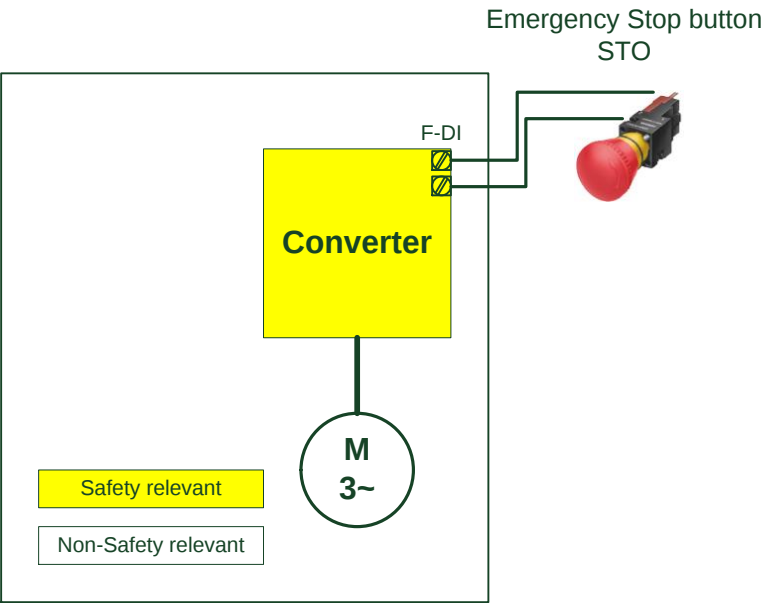
Table 3-53

Product	Order number	PFH [$10^{-9}/h$]	PFD [10^{-5}]
V90 PN	6SL3210-5Fxxx-xUFx	25	25
V90 USS	6SL3210-5Fxxx-xUAx	25	25

Example configuration:

The emergency stop button is directly connected to the F-DI of the converter.

Figure 3-23



Assessment of safety relevance of components and allocation of PFH values:

Table 3-54: **Subsystem function "Emergency Stop" STO** (without Emergency Stop button)

Component	Description	PFH [10 ⁻⁹ /h]
Converter	V90	25
PFH value of the sub or total system		25

This system example has a PFH value of 25*10⁻⁹/h and fulfills the criteria for SIL 2 and PL d (< 10⁻⁶/h).

4 Safety-related parameters motors, encoders & holding brakes

4.1 External rotary encoders

All of the encoders listed here have a DRIVE-CLiQ interface. The subsequently listed PFH values are valid for 1-encoder systems.

Table 4-1

Product	Order number	Additional Information	PFH [10 ⁻⁹ /h]
Absolute encoder with DRIVE-CLiQ	6FX2001-5xD13-1AA0	Singleturn 24 bit	27
Absolute encoder with DRIVE-CLiQ	6FX2001-5xD25-1AA0	Multiturn 36 bit	27

Further information on Siemens encoders that can be used without DRIVE-CLiQ can be found in chapter [3](#).

4.2 Motors with encoder connection

All of the motors listed here have a DRIVE-CLiQ interface. The subsequently listed PFH values are valid for 1-encoder systems.

Table 4-2

Product	Order number	Additional Information	PFH [10 ⁻⁹ /h]
1FT6	1FT6xxx-xxxxx-xDxx	DRIVE-CLiQ	26
1FT6	1FT6xxx-xxxxx-xLxx	DRIVE-CLiQ	26
1FT6	1FT6xxx-xxxxx-xFxx	DRIVE-CLiQ	26
1FT7	1FT7xxx-xxxxx-xBxx	highly integrated DRIVE-CLiQ interface (DQI)	30
1FT7	1FT7xxx-xxxxx-xCxx	highly integrated DRIVE-CLiQ interface (DQI)	30
1FT7	1FT7xxx-xxxxx-xKxx	highly integrated DRIVE-CLiQ interface (DQI)	30
1FT7	1FT7xxx-xxxxx-xLxx	highly integrated DRIVE-CLiQ interface (DQI)	30
1FT7	1FT7xxx-xxxxx-xDxx	integrated DRIVE-CLiQ interface (SMI)	26
1FT7	1FT7xxx-xxxxx-xFxx	integrated DRIVE-CLiQ interface (SMI)	26
1FK2	1FK2xxx-xxxxx-xSB0	integrated DRIVE-CLiQ interface (DQCon)	26
1FK2	1FK2xxx-xxxxx-xMB0	Integrated DRIVE-CLiQ interface (DQCon)	26
1FS2	1FS2xxx-xxxxx-xSxx	integrated DRIVE-CLiQ interface (DQCon)	26
1FS2	1FS2xxx-xxxxx-xMxx	integrated DRIVE-CLiQ interface (DQCon)	26
1FT2	1FS2xxx-xxxxx-xSxx	integrated DRIVE-CLiQ interface (DQCon)	26
1FT2	1FS2xxx-xxxxx-xMxx	integrated DRIVE-CLiQ interface (DQCon)	26
1FK7 (order number: a = 5; 7)	1FK7xxx-axxxx-xDxx	integrated DRIVE-CLiQ interface (SMI)	26

4 Safety-related parameters motors, encoders & holding brakes

Product	Order number	Additional Information	PFH [10 ⁻⁹ /h]
1FK7 (order number: a = 5; 7)	1FK7xxx-axxxx-xFxx	integrated DRIVE-CliQ interface (SMI)	26
1FK7 (order number: a = 5; 7)	1FK7xxx-axxxx-xLxx	integrated DRIVE-CliQ interface (SMI)	26
1FK7 (order number: a = 2; 3; 4)	1FK7xxx-axxxx-xDxx	integrated DRIVE-CliQ interface (SMI)	26
1FK7 (order number: a = 2; 3; 4)	1FK7xxx-axxxx-xFxx	integrated DRIVE-CliQ interface (SMI)	26
1FK7 (order number: a = 2; 3; 4)	1FK7xxx-axxxx-xLxx	integrated DRIVE-CliQ interface (SMI)	26
1FK7 (order number: a = 2; 3; 4)	1FK7xxx-axxxx-xBxx	highly integrated DRIVE-CliQ interface (DQI)	30
1FK7 (order number: a = 2; 3; 4)	1FK7xxx-axxxx-xCxx	highly integrated DRIVE-CliQ interface (DQI)	30
1FK7 (order number: a = 2; 3; 4)	1FK7xxx-axxxx-xQxx	highly integrated DRIVE-CliQ interface (DQI)	30
1FK7 (order number: a = 2; 3; 4)	1FK7xxx-axxxx-xRxx	highly integrated DRIVE-CliQ interface (DQI)	30
1FG1	1FG1xxx-xQxxx-xxxx	highly integrated DRIVE-CliQ interface (DQI)	30
1FG1	1FG1xxx-xRxxx-xxxx	highly integrated DRIVE-CliQ interface (DQI)	30
1FW3	1FW3xxx-xBx6x-xxxx	highly integrated DRIVE-CliQ interface (DQI)	30
1FW3	1FW3xxx-xCx6x-xxxx	highly integrated DRIVE-CliQ interface (DQI)	30
1PH8	1PH8xxx-xDxxx-xxxx	DRIVE-CLiQ	26
1PH8	1PH8xxx-xFxxx-xxxx	DRIVE-CLiQ	26
1PH8	1PH8xxx-xVxxx-xxxx	DRIVE-CLiQ	26
1PH8	1PH8xxx-xUxxx-xxxx	DRIVE-CLiQ	26
1PH7	1PH7xxx-xDxxx-xxxx	DRIVE-CLiQ	26
1PH7	1PH7xxx-xFxxx-xxxx	DRIVE-CLiQ	26
1PH7	1PH7xxx-xQxxx-xxxx	DRIVE-CLiQ	26
1PH7	1PH7xxx-xVxxx-xxxx	DRIVE-CLiQ	26
1PL6	1PL6xxx-xDxxx-xxxx	DRIVE-CLiQ	26
1PL6	1PL6xxx-xFxxx-xxxx	DRIVE-CLiQ	26
1PL6	1PL6xxx-xQxxx-xxxx	DRIVE-CLiQ	26
2KJ3	2KJ3*-Z Q22/Q23	highly integrated DRIVE-CliQ interface (DQI)	26

More information about useable Siemens motors without DRIVE-CliQ interface and –encoder you will find under [3.1](#).

4.3 Motors with holding brake

For the calculation of the PFH_d values of the motor holding brake the B_{10d} values are used.

Table 4-3

Order number		B _{10d}
1FG1 SH36 to SH80	Standard holding brake option N23	20.000.000

4 Safety-related parameters motors, encoders & holding brakes

Order number		B _{10d}
1FG1 SH36 to SH63	Reinforced brake option N24	20.000.000
1FG1 SH80 to SH100	Reinforced brake option N24	16.000.000
1FG1 SH100	Standard holding brake option N23	16.000.000
1FG1	Holding brake option N30 - N34	10.000.000
1FK2x02 to 1FK2x08	Standard holding brake	20.000.000
1FK2x10	Standard holding brake	16.000.000
1FS2x02 bis 1FS2x08	Standard holding brake	20.000.000
1FS2x10	Standard holding brake	16.000.000
1FT2x02 bis 1FT2x08	Standard holding brake	20.000.000
1FT2x10	Standard holding brake	16.000.000
1FK702x to 1FK708x	Standard holding brake	20.000.000
1FK702x to 1FK706x	Reinforced brake option N24	20.000.000
1FK708x to 1FK710x	Reinforced brake option N24	16.000.000
1FK710x	Standard holding brake	16.000.000
1FT703x to 1FT708x	Standard holding brake	20.000.000
1FT710x	Standard holding brake	16.000.000
1PH808x	Mounted holding brake	8.000.000
1PH810x	Mounted holding brake	7.000.000
1PH813x	Mounted holding brake	6.000.000
1PH816x	Mounted holding brake	5.000.000
2KJ3 BG63 bis BG225	Brake option Bxx + C09	6.000.000

The brakes listed in [Table 4-3](#) are proven in use components. They are assigned to category 1 according to ISO 13849-1. This means that PL c can be achieved without any further measures. To achieve PL d, further measures (brake test) are required.

NOTE

The failure rate of the holding brakes depends on the frequency of the operation.

According to ISO 13849-1 the constant dangerous failure rate (λ_d) during this service life is:

$$\lambda_d = \frac{0,1 * n_{op}}{B_{10d}}$$

With IEC 62061: $PFH_d = \lambda_d * 1h$

Further information on Safe Brake Control can be found in the manuals and in the application example [14](#).

As additional information for handling holding brakes, calculation examples for suspended/hanging (i.e. subject to gravity) axes are listed in the following document [15](#).

5 Safety-related parameters Drive Controller and SIMOTION

Table 5-1

Product	Order number	Additional Information	PFH [$10^{-9}/h$]
SIMOTION D410-2 DP	6AU1410-2AA00-0AA0		10
SIMOTION D410-2 DP/PN	6AU1410-2AD00-0AA0		10
SIMOTION D425-2 DP	6AU1425-2AA00-0AA0		10
SIMOTION D425-2 DP/PN	6AU1425-2AD00-0AA0		10
SIMOTION D435-2 DP	6AU1435-2AA00-0AA0		10
SIMOTION D435-2 DP/PN	6AU1435-2AD00-0AA0		10
SIMOTION D445-2 DP/PN	6AU1445-2AD00-0AA0 6AU1445-2AD00-0AA1		10
SIMOTION D455-2 DP/PN	6AU1455-2AD00-0AA0		10
SIMOTION CX32-2	6AU1432-2AA00-0AA0		10
CPU 1504D TF	6ES7615-4DF10-0AB0		14 ^{1), 2)}
CPU 1504D TF	6ES7615-4DF10-0AB0	with exclusive use of the F-CPU	1 ^{1), 2)}
CPU 1507D TF	6ES7615-7DF10-0AB0		14 ^{1), 2)}
CPU 1507D TF	6ES7615-7DF10-0AB0	with exclusive use of the F-CPU	1 ^{1), 2)}

¹⁾ The integrated F-PLC meets the requirements up to SIL 3 / PL e.

²⁾ incl. $1 \times 10^{-09}/h$ for PROFIsafe

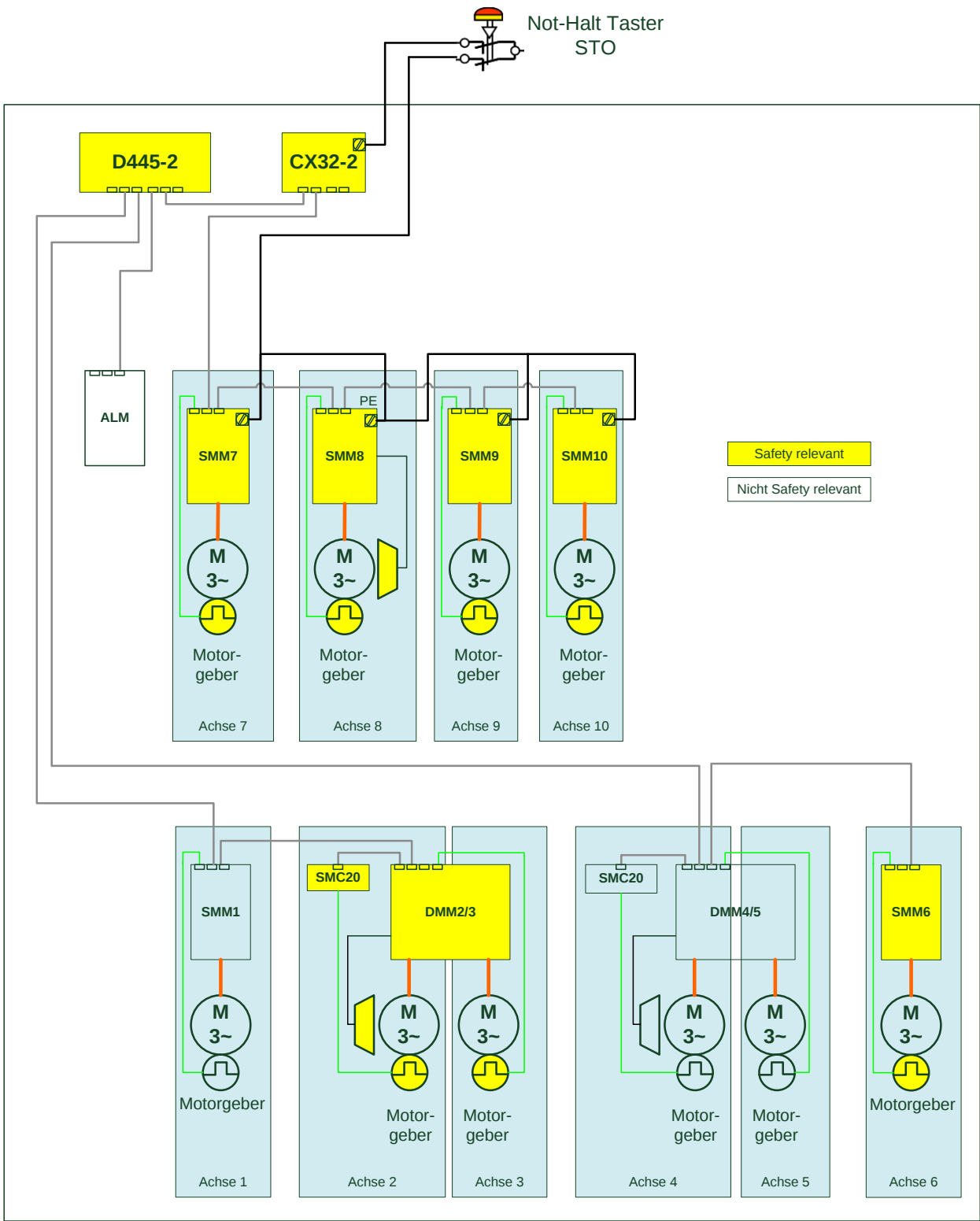
The SINAMICS S120 drive components are listed in chapter [3.16](#).

Motors with DRIVE-CLiQ interface can be used according to the information in chapter [4.2](#).

Motors with holding brake are applicable according to the information in chapter [4.3](#).

Example configuration:

Figure 5-1



Assessment of safety relevance of components and allocation of PFH values:

Table 5-2: **Subsystem function "Emergency Stop" STO via Onboard terminals** (without Emergency Stop button)

Component	Description	PFH [10 ⁻⁹ /h]
CX32-2	SIMOTION Controller Extension	10
SMM7	Single Motor Module Booksize without SBC	10

Component	Description	PFH [$10^{-9}/h$]
SMM8	Single Motor Module Booksize without SBC	10
SMM9	Single Motor Module Booksize without SBC	10
SMM10	Single Motor Module Booksize without SBC	10
PFH value of the sub or total system		50

This system example has a PFH value of $50 \cdot 10^{-9}/h$ and fulfills the criteria for SIL 2 and PL d ($< 10^{-6}/h$).

Table 5-3: **Subsystem function "Set-up operation with SLS"** (Activation via PROFIsafe, without F-CPU and Sensorik)

Component	Description	PFH [$10^{-9}/h$]
D445-2	Control Unit SIMOTION D445-2	10
CX32-2	SIMOTION Controller Extension	10
DMM2/3	Double Motor Module Booksize, 1x without SBC, 1x with SBC	14
Encoder axis 2	Sensor Module Cabinet-Mounted SMC20	26
Motor and encoder axis 3	Servomotor with integrated DRIVE-CliQ interface (SMI)	26
SMM6	Single Motor Module Booksize without SBC	10
Motor and encoder axis 6	Servomotor with highly integrated DRIVE-CliQ interface (DQI)	30
SMM7	Single Motor Module Booksize without SBC	10
Motor and encoder axis 7	Servomotor with highly integrated DRIVE-CliQ interface (DQI)	30
SMM8	Single Motor Module Booksize with SBC	14
Motor and encoder axis 8	Servomotor with integrated DRIVE-CliQ interface (SMI)	26
SMM9	Single Motor Module Booksize without SBC	10
Motor and encoder axis 9	Servomotor with highly integrated DRIVE-CliQ interface (DQI)	30
SMM10	Single Motor Module Booksize without SBC	10
Motor and encoder axis 10	Servomotor with highly integrated DRIVE-CliQ interface (DQI)	30
PFH value of the sub or total system		286

This system example has a PFH value of $286 \cdot 10^{-9}/h$ and fulfills the criteria for SIL 2 and PL d ($< 10^{-6}/h$).

6 Safety-related parameters SINUMERIK

6.1 SINUMERIK 828D

Table 6-1: SINUMERIK 828D

Product	Order number	PFH [$10^{-9}/h$]
PU 272.5 modular	6FC5370-7AA50-0AA0	10
PPU 240.2 BASIC M	6FC5370-4AM20-0AA0	10
PPU 240.2 BASIC T	6FC5370-4AT20-0AA0	10
PPU 240.3 BASIC vertical	6FC5370-4AA30-0AA0	10
PPU 240.3 BASIC vertical	6FC5370-4AA30-0AA1	10
PPU 241.2 BASIC M	6FC5370-3AM20-0AA0	10
PPU 241.2 BASIC T	6FC5370-3AT20-0AA0	10
PPU 241.3 BASIC horizontal	6FC5370-3AA30-0AA0	10
PPU 241.3 BASIC horizontal	6FC5370-3AA30-0AA1	10
PPU 260.1	6FC5370-6AA00-0AA0	10
PPU 260.2	6FC5370-6AA20-0AA0	10
PPU 260.3 vertical	6FC5370-6AA30-0AA0	10
PPU 260.3 vertical	6FC5370-6AA30-0AA1	10
PPU 261.1	6FC5370-5AA00-0AA0	10
PPU 261.2	6FC5370-5AA20-0AA0	10
PPU 261.3 horizontal	6FC5370-5AA30-0AA0	10
PPU 261.3 horizontal	6FC5370-5AA30-0AA1	10
PPU 280.1	6FC5370-8AA00-0AA0	10
PPU 280.2	6FC5370-8AA20-0AA0	10
PPU 280.3 vertical	6FC5370-8AA30-0AA0	10
PPU 280.3 vertical	6FC5370-8AA30-0AA1	10
PPU 281.1	6FC5370-7AA00-0AA0	10
PPU 281.2	6FC5370-7AA20-0AA0	10
PPU 281.3 horizontal	6FC5370-7AA30-0AA0	10
PPU 281.3 horizontal	6FC5370-7AA30-0AA1	10
PPU 290.3 vertical	6FC5370-8AA30-0BA0	10
NUMERIC CONTROL EXTENSION NX10	6SL3040-0NC00-0AA0	10
NUMERICAL CONTROL EXTENSION NX10.3	6SI3040-1NC00-0AA0	10
NUMERICAL CONTROL EXTENSION NX15.3	6SI3040-1NB00-0AA0	10

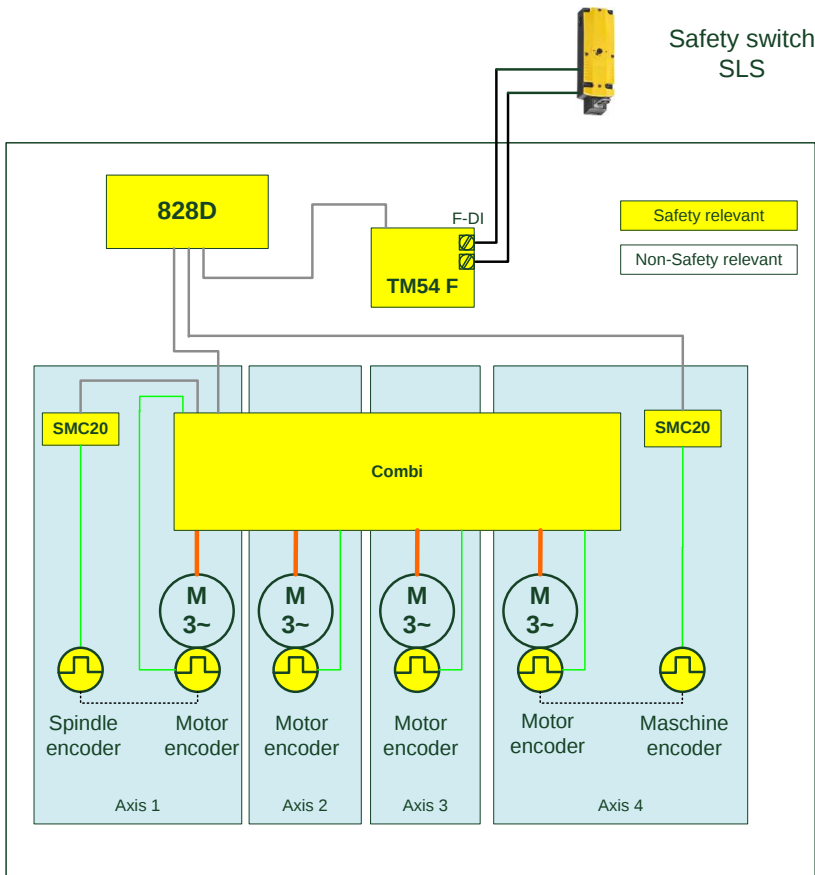
The SINAMICS S120 drive components are listed in chapter [3.16](#).

Motors with DRIVE-CLiQ interface can be used according to the information in chapter [4.2](#).

Motors with holding brake are applicable according to the information in chapter [4.3](#).

Example configuration:

Figure 6-1



Assessment of safety relevance of components and allocation of PFH values:

Table 6-2: **Subsystem function "Setting up operation with limited speed" SLS** (without safety switch)

Component	Description	PFH [10 ⁻⁹ /h]
828D	SINUMERIK PPU	10
Combi	Power Module with 4 integrated power units	44
Encoder axis 1	2-encoder system with DRIVE-CLiQ motor encoder and machine encoder via SMC20	7
Motor and encoder axis 2	Servomotor 1FT7 (1FT7xxx-xxxxx-xBxx) according to Chapter 4.2	30
Motor and encoder axis 3	Servomotor 1FT7 (1FT7xxx-xxxxx-xBxx) according to Chapter 4.2	30
Encoder axis 4	2-encoder system with DRIVE-CLiQ motor encoder and machine encoder via SMC20	7
TM54F	Terminal Module with F-IO	38
PFH value of the sub or total system		166

This system example has a PFH value of $166 \cdot 10^{-9}/h$ and fulfills the criteria for SIL 2 and PL d ($< 10^{-6}/h$).

6.2 SINUMERIK 840D with SIMODRIVE 611D

Table 6-3: SINUMERIK 840D with SIMODRIVE 611D

Product	Order number	PFH [10 ⁻⁹ /h]
NCU 561.4	6FC5356-0BB14-0AA0	25

Product	Order number	PFH [10 ⁻⁹ /h]
NCU 561.5	6FC5356-0BB15-0AA0	25
NCU 561.5B	6FC5356-0BB15-0AB0	25
NCU 571.4	6FC5357-0BB14-0AA0	25
NCU 571.5	6FC5357-0BB15-0AA0	25
NCU 571.5B	6FC5357-0BB15-0AB0	25
NCU 572.4	6FC5357-0BB24-0AA0	25
NCU 572.5	6FC5357-0BB25-0AA0	25
NCU 572.5B	6FC5357-0BB25-0AB0	25
NCU 573.4	6FC5357-0BB34-0AA0	25
NCU 573.5	6FC5357-0BB35-0AA0	25
NCU 573.5B	6FC5357-0BB35-0AB0	25
1-axis control board High Performance	6SN1118-0DJ23-0AA0	45
1-axis control board High Performance	6SN1118-0DJ23-0AA1	45
1-axis control board High Performance	6SN1118-0DJ23-0AA2	45
2-axes control board High Performance	6SN1118-0DK23-0AA0	60
2-axes control board High Performance	6SN1118-0DK23-0AA1	60
2-axes control board High Performance	6SN1118-0DK23-0AA2	60
2-axes control board High Standard	6SN1118-0DM33-0AA0	60
2-axes control board High Standard	6SN1118-0DM33-0AA1	60
2-axes control board High Standard	6SN1118-0DM33-0AA2	60

6.3 SINUMERIK 840D sl

Table 6-4: SINUMERIK 840D sl

Product	Order number	Additional Information	PFH [10 ⁻⁹ /h]
NCU 710.1 with PLC 317-2DP	6FC5371-0AA10-0AA0	SINUMERIK Safety Integrated	66 ¹⁾
NCU 710.1 with PLC 317-2DP	6FC5371-0AA10-0AA0	SINAMICS Safety Integrated Basic Functions	10
NCU 710.2 with PLC 317-2DP	6FC5371-0AA10-0AA1	SINUMERIK Safety Integrated	66 ¹⁾
NCU 710.2 with PLC 317-2DP	6FC5371-0AA10-0AA1	SINAMICS Safety Integrated Basic Functions	10
NCU 710.2 with PLC 317-2DP	6FC5371-0AA10-0AA2	SINUMERIK Safety Integrated	66 ¹⁾
NCU 710.2 with PLC 317-2DP	6FC5371-0AA10-0AA2	SINAMICS Safety Integrated Basic Functions	10
NCU 710.3 PN with PLC 317-3PN/DP	6FC5371-0AA30-0AA0	SINUMERIK Safety Integrated	66 ¹⁾
NCU 710.3 PN with PLC 317-3PN/DP	6FC5371-0AA30-0AA0	SINAMICS Safety Integrated Basic Functions	10
NCU 710.3 PN with PLC 317-3PN/DP	6FC5371-0AA30-0AA1	SINUMERIK Safety Integrated	66 ¹⁾
NCU 710.3 PN with PLC 317-3PN/DP	6FC5371-0AA30-0AA1	SINAMICS Safety Integrated Basic Functions	10
NCU 710.3B PN with PLC 317-3PN/DP	6FC5371-0AA30-0AB0	SINUMERIK Safety Integrated	66 ¹⁾
NCU 710.3B PN with PLC 317-3PN/DP	6FC5371-0AA30-0AB0	SINAMICS Safety Integrated Basic Functions	10
NCU 710.3B PN with PLC 317-3PN/DP	6FC5371-0AA30-0AB0	SINUMERIK Safety Integrated plus	14 ¹⁾

6 Safety-related parameters SINUMERIK

Product	Order number	Additional Information	PFH [10 ⁻⁹ /h]
NCU 720.1 with PLC 317-2DP	6FC5372-0AA00-0AA0	SINUMERIK Safety Integrated	66 ¹⁾
NCU 720.1 with PLC 317-2DP	6FC5372-0AA00-0AA0	SINAMICS Safety Integrated Basic Functions	10
NCU 720.2 with PLC 317-2DP	6FC5372-0AA00-0AA1	SINUMERIK Safety Integrated	66 ¹⁾
NCU 720.2 with PLC 317-2DP	6FC5372-0AA00-0AA1	SINAMICS Safety Integrated Basic Functions	10
NCU 720.2 with PLC 317-2DP	6FC5372-0AA00-0AA2	SINUMERIK Safety Integrated	66 ¹⁾
NCU 720.2 with PLC 317-2DP	6FC5372-0AA00-0AA2	SINAMICS Safety Integrated Basic Functions	10
NCU 720.2 PN with PLC 317-3PN/DP	6FC5372-0AA01-0AA1	SINUMERIK Safety Integrated	66 ¹⁾
NCU 720.2 PN with PLC 317-3PN/DP	6FC5372-0AA01-0AA1	SINAMICS Safety Integrated Basic Functions	10
NCU 720.2 PN with PLC 317-3PN/DP	6FC5372-0AA01-0AA2	SINUMERIK Safety Integrated	66 ¹⁾
NCU 720.2 PN with PLC 317-3PN/DP	6FC5372-0AA01-0AA2	SINAMICS Safety Integrated Basic Functions	10
NCU 720.3 PN with PLC 317-3PN/DP	6FC5372-0AA30-0AA0	SINUMERIK Safety Integrated	66 ¹⁾
NCU 720.3 PN with PLC 317-3PN/DP	6FC5372-0AA30-0AA0	SINAMICS Safety Integrated Basic Functions	10
NCU 720.3 PN with PLC 317-3PN/DP	6FC5372-0AA30-0AA1	SINUMERIK Safety Integrated	66 ¹⁾
NCU 720.3 PN with PLC 317-3PN/DP	6FC5372-0AA30-0AA1	SINAMICS Safety Integrated Basic Functions	10
NCU 720.3B PN with PLC 317-3PN/DP	6FC5372-0AA30-0AB0	SINUMERIK Safety Integrated	66 ¹⁾
NCU 720.3B PN with PLC 317-3PN/DP	6FC5372-0AA30-0AB0	SINAMICS Safety Integrated Basic Functions	10
NCU 720.3B PN with PLC 317-3PN/DP	6FC5372-0AA30-0AB0	SINUMERIK Safety Integrated plus	14 ¹⁾
NCU 730.1 with PLC 317-2DP	6FC5373-0AA00-0AA0	SINUMERIK Safety Integrated	66 ¹⁾
NCU 730.1 with PLC 317-2DP	6FC5373-0AA00-0AA0	SINAMICS Safety Integrated Basic Functions	10
NCU 730.2 with PLC 317-2DP	6FC5373-0AA00-0AA1	SINUMERIK Safety Integrated	66 ¹⁾
NCU 730.2 with PLC 317-2DP	6FC5373-0AA00-0AA1	SINAMICS Safety Integrated Basic Functions	10
NCU 730.2 with PLC 317-2DP	6FC5373-0AA00-0AA2	SINUMERIK Safety Integrated	66 ¹⁾
NCU 730.2 with PLC 317-2DP	6FC5373-0AA00-0AA2	SINAMICS Safety Integrated Basic Functions	10
NCU 730.2 PN with PLC 319-3PN/DP	6FC5373-0AA01-0AA1	SINUMERIK Safety Integrated	66 ¹⁾
NCU 730.2 PN with PLC 319-3PN/DP	6FC5373-0AA01-0AA1	SINAMICS Safety Integrated Basic Functions	10
NCU 730.2 PN with PLC 319-3PN/DP	6FC5373-0AA01-0AA2	SINUMERIK Safety Integrated	66 ¹⁾
NCU 730.2 PN with PLC 319-3PN/DP	6FC5373-0AA01-0AA2	SINAMICS Safety Integrated Basic Functions	10
NCU 730.3 PN with PLC 317-3PN/DP	6FC5373-0AA30-0AA0	SINUMERIK Safety Integrated	66 ¹⁾
NCU 730.3 PN with PLC 317-3PN/DP	6FC5373-0AA30-0AA0	SINAMICS Safety Integrated Basic Functions	10
NCU 730.3 PN with PLC 317-3PN/DP	6FC5373-0AA30-0AA1	SINUMERIK Safety Integrated	66 ¹⁾
NCU 730.3 PN with PLC 317-3PN/DP	6FC5373-0AA30-0AA1	SINAMICS Safety Integrated Basic Functions	10
NCU 730.3 PN with PLC 317-3PN/DP	6FC5373-0AA30-0AB0	SINUMERIK Safety Integrated	66 ¹⁾
NCU 730.3 PN with PLC 317-3PN/DP	6FC5373-0AA30-0AB0	SINAMICS Safety Integrated Basic Functions	10

6 Safety-related parameters SINUMERIK

Product	Order number	Additional Information	PFH [$10^{-9}/h$]
NCU 730.3B PN with PLC 317-3PN/DP	6FC5373-0AA31-0AB0	SINUMERIK Safety Integrated	66 ¹⁾
NCU 730.3B PN with PLC 317-3PN/DP	6FC5373-0AA31-0AB0	SINAMICS Safety Integrated Basic Functions	10
NCU 730.3B PN with PLC 317-3PN/DP	6FC5373-0AA31-0AB0	SINUMERIK Safety Integrated plus	14 ¹⁾
NUMERIC CONTROL EXTENSION NX10	6SL3040-0NC00-0AA0	--	10
NUMERIC CONTROL EXTENSION NX15	6SL3040-0NB00-0AA0	--	10
NUMERICAL CONTROL EXTENSION NX10.3	6SL3040-1NC00-0AA0	--	10
NUMERICAL CONTROL EXTENSION NX15.3	6SL3040-1NB00-0AA0	--	10

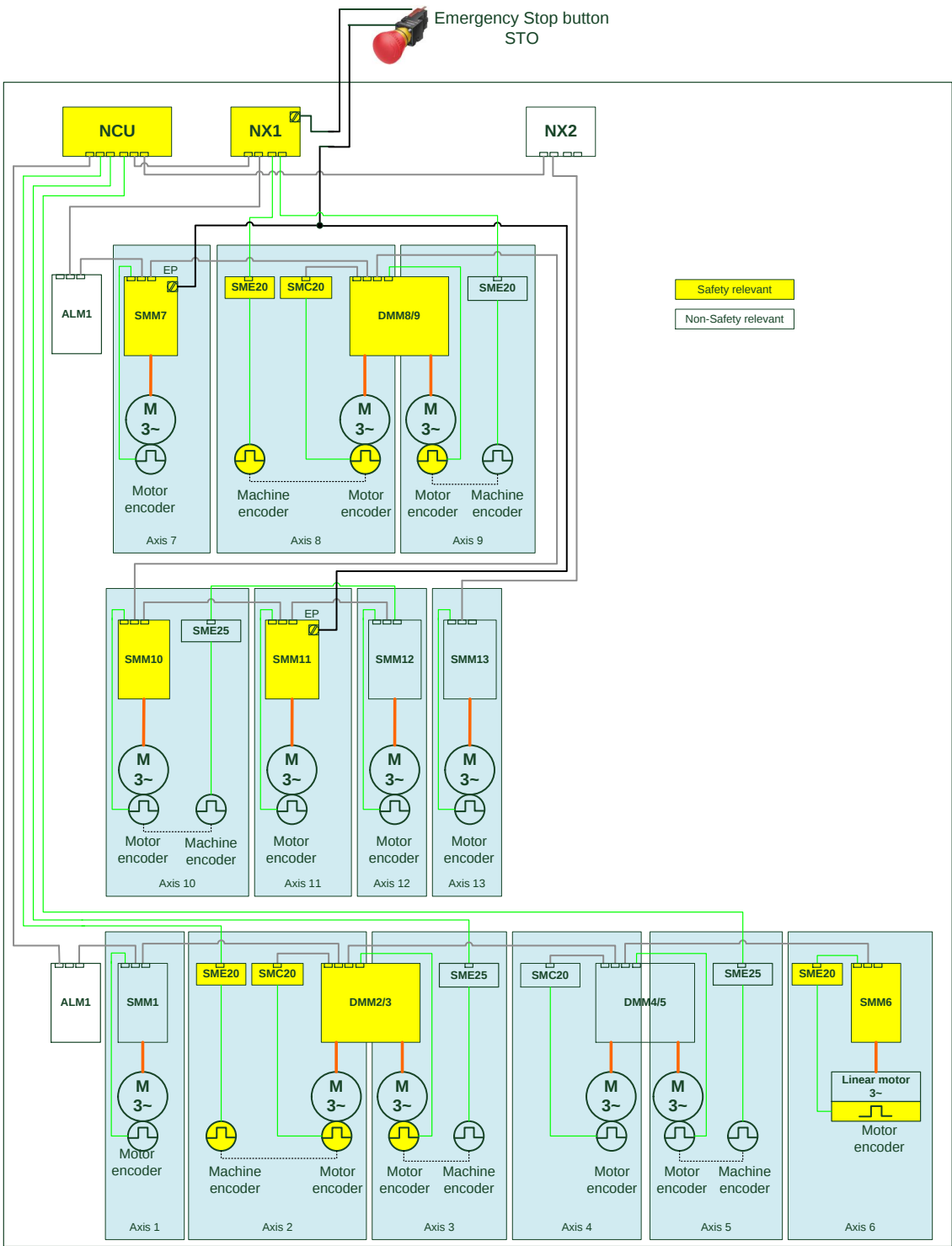
¹⁾ incl. $1 \times 10^{-09}/h$ for PROFIsafe

The SINAMICS S120 drive components are listed in chapter [3.16](#).

Motors with DRIVE-CLiQ interface can be used according to the information in chapter [4.2](#).

Motors with holding brake are applicable according to the information in chapter [4.3](#).

Figure 6-2



Assessment of safety relevance of components and allocation of PFH values:

Table 6-5: Subsystem function "Emergency Stop" STO (without Emergency Stop button)

Component	Description	PFH [10 ⁻⁹ /h]
NCU	SINUMERIK Safety Integrated	66
NX1	Numeric Control Extension NX10	10
DMM2/3	Axis 2 and axis 3: Double Motor Module Booksize, both axes without SBC	12

Component	Description	PFH [$10^{-9}/h$]
Encoder axis 2	2-encoder system with motor encoder via SMC20 and machine encoder via SME20	7
Motor and encoder axis 3	Servomotor 1FT7 (1FT7xxx-xxxxx-xBxx) according to Chapter 4	30
SMM6	Single Motor Module Booksize without SBC	10
Encoder axis 6	1-encoder system with motor encoder via SME20	26
SMM7	Single Motor Module Booksize without SBC	10
DMM8/9	Axis 8 and axis 9: Double Motor Module Booksize, both axes without SBC	12
Encoder axis 8	2-encoder system with motor encoder via SMC20 and machine encoder via SME20	7
Motor and encoder axis 9	Servomotor 1FT7 (1FT7xxx-xxxxx-xBxx) according to Chapter 4	30
SMM10	Single Motor Module Booksize without SBC	10
SMM11	Single Motor Module Booksize without SBC	10
PFH value of the sub or total system		240

This system example has a PFH value of $240 \cdot 10^{-9}/h$ and fulfills the criteria for SIL 2 and PL d ($< 10^{-6}/h$).

6.4 SINUMERIK handheld units

Table 6-6: SINUMERIK handheld units

Product	Order number	PFH [$10^{-9}/h$]	B _{10d}
HT 10, Emergency Stop command device	6FC5403-0AA21-0AA1	--	250.000
HT 10, enable button	6FC5403-0AA21-0AA1	--	1.000.000
HT 10H with handwheel, Emergency Stop command device	6FC5403-0AA21-1AA1	--	250.000
HT 10H with handwheel, enable button	6FC5403-0AA21-1AA1	--	1.000.000
HT 2, Emergency Stop command device (with connection box/module PN Basic)	6FC5303-0AA00-2AA0	--	100.000
HT 2, Emergency Stop command device (with connection box PN Plus)	6FC5303-0AA00-2AA0	101	--
HT 2, enable button	6FC5303-0AA00-2AA0	135	--
HT 8, Emergency Stop command device (with connection box/module PN Basic)	6FC5403-0AA20-0AA0	--	100.000
HT 8, Emergency Stop command device (with connection box/module PN Basic)	6FC5403-0AA20-1AA0	--	100.000
HT 8, Emergency Stop command device (with connection box PN Plus)	6FC5403-0AA20-0AA0	101	--
HT 8, Emergency Stop command device (with connection box PN Plus)	6FC5403-0AA20-1AA0	101	--
HT 8, enable button	6FC5403-0AA20-0AA0	135	--
HT 8, enable button	6FC5403-0AA20-1AA0	135	--
HT 8, Emergency Stop command device (with connection box/module PN Basic)	6FC5403-0AA20-0AA1	--	100.000
HT 8, Emergency Stop command device (with connection box/module PN Basic)	6FC5403-0AA20-1AA1	--	100.000
HT 8, Emergency Stop command device (with connection box PN Plus)	6FC5403-0AA20-0AA1	101	--
HT 8, Emergency Stop command device (with connection box PN Plus)	6FC5403-0AA20-1AA1	101	--

Product	Order number	PFH [10 ⁻⁹ /h]	B _{10d}
HT 8, enable button	6FC5403-0AA20-0AA1	5,07	--
HT 8, enable button	6FC5403-0AA20-1AA1	5,07	--
Mini handheld unit, Emergency Stop command device	6FX2007-1AD03	--	100.000
Mini handheld unit, Emergency Stop command device	6FX2007-1AD13	--	100.000
Mini handheld unit, enable button	6FX2007-1AD03	--	100.000
Mini handheld unit, enable button	6FX2007-1AD13	--	100.000
Type B-MPI, Emergency Stop command device	6FX2007-1AC04	--	100.000
Type B-MPI, Emergency Stop command device	6FX2007-1AC14	--	100.000
Type B-MPI, Emergency Stop command device	6FX2007-1AE04	--	100.000
Type B-MPI, Emergency Stop command device	6FX2007-1AE14	--	100.000
Type B-MPI, enable button	6FX2007-1AC04	--	100.000
Type B-MPI, enable button	6FX2007-1AC14	--	100.000
Type B-MPI, enable button	6FX2007-1AE04	--	100.000
Type B-MPI, enable button	6FX2007-1AE14	--	100.000

6.5 SINUMERIK machine control panel

Table 6-7: SINUMERIK machine control panel

Product	Order number	PFH [10 ⁻⁹ /h]	B _{10d}
SINUMERIK ONE MCP 1500 Industrial Ethernet / PROFINET mechanical keys	6FC5303-0AP01-0AA0	--	500.000
SINUMERIK ONE MCP 1900 Industrial Ethernet / PROFINET mechanical keys	6FC5303-0AP02-0AA0	--	500.000
SINUMERIK ONE MCP 2400.c Industrial Ethernet / PROFINET mechanical keys	6FC5303-0AP51-0BA0	--	500.000
SINUMERIK ONE MCP 2200c, Emergency Stop command device	6FC5303-0AP51-0DA0	--	202.500
SINUMERIK ONE MCP 2400.2c, Emergency Stop command device	6FC5303-0AP51-0CA0	--	202.500
SINUMERIK ONE MCP 2400, Emergency Stop command device	6FC5303-0AP04-0AA0	--	500.000
SINUMERIK ONE MCP 2200, Emergency Stop command device	6FC5303-0AP03-0AA0	--	500.000
MPP 464 IEH, Emergency Stop command device	6FC5303-1AF60-8AA0	--	500.000
MPP 464 IEH, bypass button	6FC5303-1AF60-8AA0	--	500.000
MPP398 IEH, Emergency Stop command device	6FC5303-1AF50-8AA0	--	500.000
MPP398 IEH, bypass button	6FC5303-1AF50-8AA0	--	500.000
MPP1500E, Emergency Stop command device	6FC5303-1AF31-0AA0	--	500.000
MPP1500E, bypass button	6FC5303-1AF31-0AA0	--	500.000
MPP1500D, Emergency Stop command device	6FC5303-1AF30-0AA0	--	500.000
MPP1500D, bypass button	6FC5303-1AF30-0AA0	--	500.000
MCP 398C, Emergency Stop command device	6FC5303-0AF25-0AA0	--	500.000
MCP 483, Emergency Stop command device	6FC5303-0AF22-0AA1	--	500.000
MCP 483, Emergency Stop command device	6FC5303-0AF22-1AA1	--	500.000
MCP 483, Emergency Stop command device	6FC5203-0AF22-1AA2	--	500.000
MCP 483, Emergency Stop command device	6FC5203-0AF22-0AA2	--	500.000
MPP 310 IEH, Emergency Stop command device	6FC5303-1AF2x-xxxx	--	500.000

Product	Order number	PFH [$10^{-9}/h$]	B _{10d}
MPP 310 IEH, bypass button	6FC5303-1AF2x-xxxx	--	500.000
MPP 483, Emergency Stop command device	6FC5303-1AFxx-xxxx	--	500.000
MPP 483, bypass button	6FC5303-1AFxx-xxxx	--	500.000
PP 012, Emergency Stop command device	6FC5203-0AFxx-xxxx	--	500.000
PP 012, bypass button	6FC5203-0AFxx-xxxx	--	500.000

6.6 SINUMERIK ONE

Table 6-8: SINUMERIK ONE

Product	Order number	Additional Information	PFH [$10^{-9}/h$]
NCU 1740 with PLC 1500F	6FC5317-4AA00-0AA0	SINUMERIK Safety Integrated	14 ^{1), 2)}
NCU 1760 with PLC 1500F	6FC5317-6AA00-0AA0	SINUMERIK Safety Integrated	14 ^{1), 2)}
NCU 1750 with PLC 1500F	6FC5317-5AA00-0AA0	SINUMERIK Safety Integrated	14 ^{1), 2)}
NCU 1750 with PLC 1500F	6FC5317-5AA00-0AA1	SINUMERIK Safety Integrated	14 ^{1), 2)}
PPU 1740-1500 with PLC 1500F	6FC5317-4AA00-0CA0	SINUMERIK Safety Integrated	14 ^{1), 2)}
PPU 1740-1900 with PLC 1500F	6FC5317-4AA00-0DA0	SINUMERIK Safety Integrated	14 ^{1), 2)}
MCU 1720 with PLC 1500F	6FC5222-1AA00-0AA0	SINUMERIK Safety Integrated	14 ^{1), 2)}

¹⁾ The integrated F-PLC meets the requirements up to SIL 3 / PL e.

²⁾ incl. $1 \times 10^{-9}/h$ for PROFIsafe

The SINAMICS S120 drive components are listed in chapter [3.16](#).

Motors with DRIVE-CLiQ interface can be used according to the information in chapter [4.2](#).

Motors with holding brake are applicable according to the information in chapter [4.3](#).

7 Calculation using the function Safety Evaluation at TIA Selection Tool

The configuration examples listed in this document can be created very easily using the Safety Evaluation function in the TIA Selection Tool. You can find more information here:

<https://www.siemens.com/global/en/products/automation/topic-areas/safety-integrated/factory-automation/support/tia-safety-evaluation-tool.html>

With the Safety Evaluation in the TIA Selection Tool you can import safety characteristic values of products of other manufacturers in the VDMA 66413 XML format and use them for the calculation. The safety characteristic values of Siemens products in XML format for import into other tools can be found under the following link:

<https://support.industry.siemens.com/cs/ww/en/view/109750403>

NOTE

The characteristic safety values of this document version are contained in the VDMA 66413 characteristic value library V1.25.0.

8 Terminology / abbreviations

EN	European Standard
IEC	International Electrotechnical Commission
ISO	International Organization for Standardization
Motor Module	Inverter, 1-axis or 2-axis version
PFD	Probability of Failure on Demand
PFH	Probability of Failure per Hour
PL	Performance Level
PM	Power Module (power unit)
SIL	Safety Integrity Level
Converter	Complete unit with power unit and Control Unit

9 Appendix

9.1 Service and support

Industry Online Support

Do you have any questions or need assistance?

Siemens Industry Online Support offers round the clock access to our entire service and support know-how and portfolio.

The Industry Online Support is the central address for information about our products, solutions and services.

Product information, manuals, downloads, FAQs, application examples and videos – all information is accessible with just a few mouse clicks:

support.industry.siemens.com

Technical Support

The Technical Support of Siemens Industry provides you fast and competent support regarding all technical queries with numerous tailor-made offers

– ranging from basic support to individual support contracts. Please send queries to Technical Support via Web form:

siemens.com/SupportRequest

SITRAIN – Digital Industry Academy

We support you with our globally available training courses for industry with practical experience, innovative learning methods and a concept that's tailored to the customer's specific needs.

For more information on our offered trainings and courses, as well as their locations and dates, refer to our web page:

siemens.com/sitrain

Service offer

Our range of services includes the following:

- Plant data services
- Spare parts services
- Repair services
- On-site and maintenance services
- Retrofitting and modernization services
- Service programs and contracts

You can find detailed information on our range of services in the service catalog web page:

support.industry.siemens.com/cs/sc

Industry Online Support app

You will receive optimum support wherever you are with the "Siemens Industry Online Support" app. The app is available for iOS and Android:

support.industry.siemens.com/cs/www/en/sc/2067

9.2 Industry Mall



The Siemens Industry Mall is the platform on which the entire Siemens Industry product portfolio is accessible. From the selection of products to the order and the delivery tracking, the Industry Mall enables the complete purchasing processing – directly and independently of time and location:

mall.industry.siemens.com

9.3 Links and literature

Table 9-1

Nr.	Thema
\1\	Siemens Industry Online Support https://support.industry.siemens.com
\2\	Link to this entry page of this application example https://support.industry.siemens.com/cs/ww/en/view/76254308
\3\	Suitable motors and encoders https://support.industry.siemens.com/cs/ww/en/view/33512621
\4\	SINAMICS Options for Safe Brake Control https://support.industry.siemens.com/cs/ww/en/view/109810528
\5\	Calculation examples for an axis subject to gravitational force https://support.industry.siemens.com/cs/ww/en/view/69870640

9.4 Change documentation

Table 9-2

Version	Date	Modifications
V1.0	06/2013	First edition
V1.1	08/2014	Extension of devices
V1.2	02/2015	Extension of devices
V1.2.1	02/2015	Clarification G120
V1.3	04/2016	Extension of devices
V1.4	03/2017	Extension of devices
V1.5	06/2017	Extension of devices
V1.6	01/2018	Extension of devices
V1.7	05/2019	Extension of devices
V1.8	03/2020	Extension of devices; update PFH values
V1.9	06/2021	Extension of devices; update PFH values
V1.10	04/2022	Extension of devices; update PFH values
V2.0	05/2023	Extension of devices; update PFH values

Version	Date	Modifications
V2.1	04/2024	• Extension devices • Update PFH values • Update layout