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Fail-Safe Shutdown of the ET 200SP F-Motor Starter with 3SK

Safety Integrated, SIRIUS Industrial Controls

https://support.industry.siemens.com/cs/ww/en/view/109748128

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Table of Contents

1 Task

A machine is operated with different actuators. During operation, these actuators are controlled by a standard PLC. To protect the operating staff, these actuators are shut down through technical safety functions (e.g., emergency stop command device) in the event of danger. Monitoring the safety-related sensors/command devices and safely shutting down the actuators are implemented by a local solution.

This application example shows you how to safely shut down one or more actuators with the ET 200SP F-motor starter in combination with the 3SK1 and 3SK2 safety relays. The application examples described in this document meet the requirements of IEC 62061 (SIL 3) and ISO 13849-1 (PL e).

2 Shutdown Options

Depending on the application example, the ET 200SP motor starter can be safely shut down in different ways, for example

- with a 3SK safety relay,
- an ET 200SP F-DQ fail-safe digital output module or
- an ET 200SP F-PM-E fail-safe power module.

The below selection matrix illustrates the different shutdown options.

Table 2-1 Shutdown options

ET 200SP F-motor starter shutdown principle		Application example with 3SK safety relay	Application example with F-DQ fail-safe digital output	Application example with F-PM-E fail-safe power module
Hardware diversity	Suitable for group shutdown	Yes	Yes	Yes
	Suitable for single shutdown	Yes	Yes	No
Use for cyclically requested safety functions (e.g., safety door, light curtain)		Yes	Yes	No
Use for acyclically requested safety functions (e.g., emergency stop)		Yes	Yes	Yes
Motor starter can still be accessed by the CPU after fail-safe shutdown		Yes	Yes	No
Suitable for immediate ready for operation again		Yes	Yes	No (recovery time: >= 2.2s)
External wiring overhead		Yes	Yes	No
Standard and safety technology		Separate	Integrated in one device	Integrated in one device

3 Solution with 3SK1

3.1 Overview

Single shutdown is the shutdown of a single actuator with a single shutdown signal. Fail-safe single shutdown means that the shutdown signal is triggered by a technical safety function (e.g., emergency stop).

This application example describes a safety function that is evaluated locally. This means that the safety-related and functional switching of the actuators is separated and therefore performed by different evaluation units.
In this application example, this separation is implemented by using a non-fail-safe (standard) CPU that is responsible for the functional switching of the actuator. The evaluation of the safety function is performed by a 3SK1 safety relay.

Figure 3-1 Configuration with 3SK1
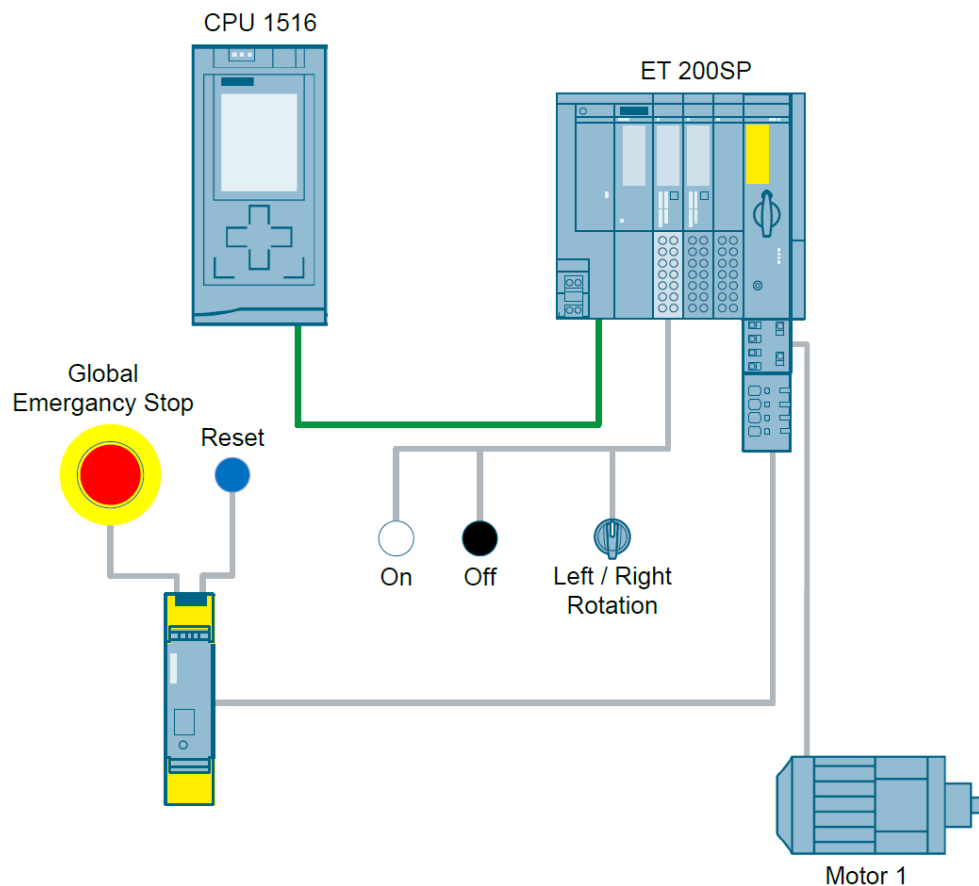
Required knowledge

The following knowledge is required:

- Basics of functional safety
- Basics of STEP 7 programming

3.2 Hardware and software components

3.2.1 Validity

This application example is valid for:
- All SIMATIC controllers
- STEP 7 Professional V14 or higher

3.2.2 Components used

The application example was created with the following components:

Table 3-1 Hardware components

Component	No.	Article no.	Note
3SK1 safety relay	1	3SK1122-2AB40	3SK1 Advanced, 3 F-DI, 3 F-DQ, spring-loaded terminal
Power supply	1	6EP1332-4BA00	PM 70W
Standard S7 CPU	1	6ES7516-3AN01-0AB0	CPU 1516-3 PN/DP
SIMATIC Memory Card	1	6ES7954-8LC02-0AA0	SMC 4MB
Interface module for ET 200SP	1	6ES7155-6AU00-0CN0	IM155-6PN HF (or ST or higher)
Digital input module	1	6ES7131-6BF00-0CA0	DI 8X24VDC HF
Base unit	1	6ES7193-6BP00-0DA0	New load group (bright base unit)
Empty module cover	1	6ES7133-6CV15-1AM0	15mm base unit cover
Base unit empty module	1	6ES7193-6BP00-0BA0	Bridged to left (dark BU)
ET 200SP fail-safe motor starter	1	3RK1308-0DB00-0CP0	F-reversing starter 0.3-1A
MS5 base unit	1	3RK1908-0AP00-0EP0	BU for ET 200SP motor starter with 400V infeed, with F-DI
Server module	1	6ES7193-6PA00-0AA0	ET 200SP, server module
Emergency stop command device, complete unit	1	3SU1150-1HB20-1CH0	Mushroom pushbutton with one normally closed contact
Contact module, 1 NC	1	3SU1400-2AA10-1CA0	Additional contact for emergency stop
Reset pushbutton, complete unit	1	3SU1150-0AB50-1BA0	Pushbutton, blue, one normally open contact
On pushbutton, complete unit	1	3SU1150-0AB50-1BA0	Pushbutton, white, one normally open contact
Off pushbutton, complete unit	1	3SU1150-0AB10-1BA0	Pushbutton, black, one normally open contact
Selector switch, left/right, complete unit	1	3SU1150-2BL60-1NA0	Selector switch, white, three switch positions I-O-II, latching, two normally open contacts

Table 3-2 Software components

Component	No.	Article number	Note
STEP 7 Professional	1	6ES7822-1AE04-0YA5	V15.1
Hardware Support Package	1	HSP0195 – SIMATIC ET 200SP motor starter (not required for V15 and higher)	https://support.industry.siemens.com/cs/ww/en/view/72341852

3.2.3 Sample files and projects

The following list contains all files and projects that are used in this application example.

Table 3-3 Files and projects

Component	Note
109748128_ET200SP-3SK_DOC_v10_en.docx	This document
109748128_ET_200SP_with_3SK1_PROG.zip	3SK1 TIA Portal project

3.3 Hardware configuration

3.3.1 Mode of operation

The following example explains safe single shutdown with a 3SK1 safety relay and an S7-1500 CPU in conjunction with a distributed ET 200SP station. Fail-safe single shutdown is implemented combining the 3SK1 safety relay and the ET 200SP F-motor starter. Safe shutdown is triggered by the emergency stop command device.

Unlike base units MS1-4, the two base units of the ET 200SP motor starter, MS5 and MS6, feature an F-DI terminal with an associated frame terminal. The base units have no additional 24 V terminal to supply the motor starters. The motor starters use the existing supply voltage of the upstream modules of the ET 200SP station (bright standard base unit). In the following example, safety-related shutdown takes place via the signal of the 3SK1 safety relay at the F-DI terminal.

The advantage of the single shutdown via the F-DI terminal shown in this application example is that, in the event of a safe shutdown operation, the motor starter continues to be supplied with 24 V and can still communicate with the ET 200SP interface module and therefore the higher-level controller.

This example implements the single shutdown of a fail-safe motor starter, in this case a reversing starter. The use of more motor starters or the maximum configuration depends on the load voltage conditions. Follow the instructions provided in the "Manual – SIMATIC ET 200SP Motor Starter":

https://support.industry.siemens.com/cs/ww/en/view/109479973

Slot rules

Trouble-free use of the ET 200SP motor starter requires that you use an empty module in front of the first motor starter.

For more information about setting up a plant with the ET 200SP motor starter, please refer to the "SIMATIC ET 200SP Distributed I/O System" system manual:

https://support.industry.siemens.com/cs/ww/en/view/58649293

Monitoring the feedback circuit

For the ET 200SP fail-safe motor starter 3RK1308-0**00-0CP0, the OFF state is defined as a safe state. The motor starters are self-monitoring in compliance with SILCL 3 / PL e; therefore, it is not necessary to monitor them in the feedback circuit of the upstream evaluation unit.

If an error occurs, the motor starter itself prevents a restart.

ET 200SP motor starter base units

Different base unit types (BU30 MS1 to MS10) are available for the ET 200SP motor starter. In this application example, the single shutdown is implemented with the MS5 type (3RK1908-0AP00-0EP0). The motor starter is supplied by the 24 V DC infeed of the upstream ET 200SP standard base unit (bright base unit). The 400 V infeed of the actuators is connected to the MS5 base unit of the motor starter.

Alternative: Shutdown via the 24V terminal

In addition, it is possible to shut down the ET 200SP fail-safe motor starter with a 3SK1 safety relay at the 24 V terminal of the MS1 or MS3 base unit. This design allows group shutdown with downstream MS2 or MS4 base units; the maximum output current of the 3SK1 semiconductor output must be considered. Based on the data of the "3SK1 Manual"
https://support.industry.siemens.com/cs/ww/en/view/67585885

and the "ET 200SP Motor Starter Manual"
https://support.industry.siemens.com/cs/ww/en/view/109479973,

this results in a maximum number of ET 200SP F-motor starters that can be shut down in a group (depending on the maximum output current of the 3SK1 semiconductor output and the maximum input current of the 24 V supply of the base unit). Shutdown via the 24V supply voltage (group shutdown) is not discussed in this application example.

For group shutdown via the 24V terminal of the ET 200SP F-motor starter base unit, please note the following: After voltage recovery, the modules in the potential group require a restart time to be ready for operation again. To ensure that this delay time does not affect the operational process, it is advisable to use this group shutdown for shutdown functions with low switching frequencies, for example for the emergency stop safety function. The emergency stop safety function is regarded as a complementary protective measure and does not affect the process. Actuating an emergency stop command device stops all actuators. Once the hazardous situation has been eliminated and the safety function has been acknowledged, the process can start again.

Note	Protecting the lines from the infeed to the motor starter requires additional measures such as a 3RV circuit breaker. As this is not part of functional safety, this is not included in the overviews and connection diagrams.
	It is also possible to implement an application with the ET 200SP F-motor starter according to the requirements of SIL 1 to SIL 2 (according to IEC 62061) or PL a to PL d (according to ISO 13849-1).

3.3.2 Wiring example

Figure 3-2 Wiring example with 3SK1
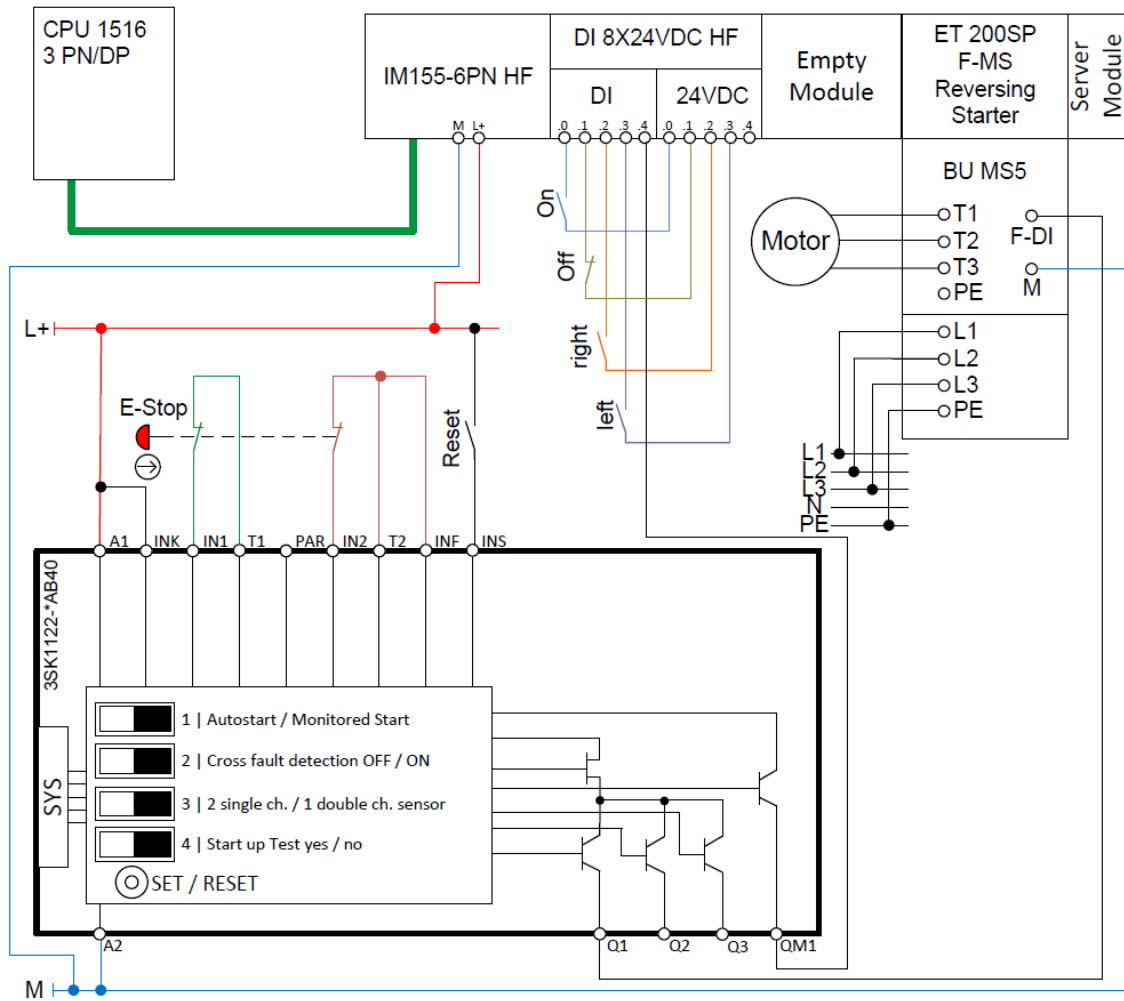
Note	The 3SK1 safety relay must have the same frame potential as the ET 200SP station and the motor starter base unit.

3.4 TIA Portal: Configuration and project engineering

3.4.1 Hardware configuration

The supplied project does not require any further configuration. If you reproduce the application example with other components, this chapter shows the most important settings.

The DIP switches of the 3SK1 safety relay must be set as shown in the above wiring example. For configuration and wiring examples customized to the specific application – that may have different requirements (e.g., SIL1, automatic restart) –, please refer to the "Safety Application Manual"

https://support.industry.siemens.com/cs/ww/en/view/81366718

and the "3SK1 Manual"

https://support.industry.siemens.com/cs/ww/en/view/67585885.

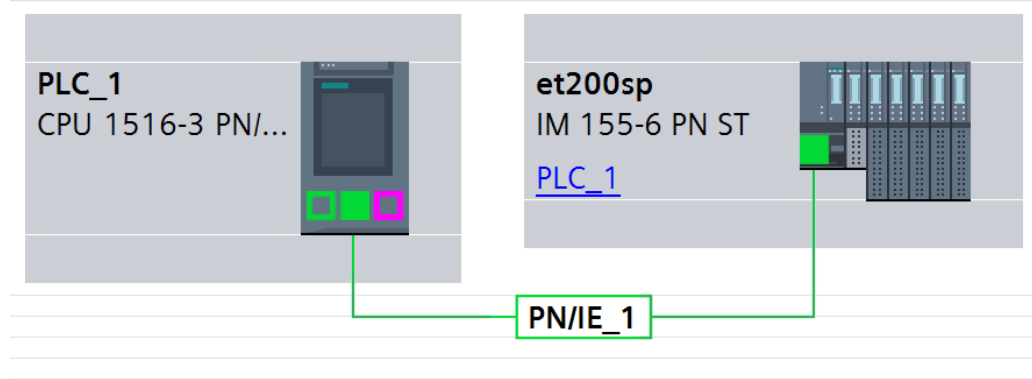| Notice	The settings shown below help meet PL e / SIL 3. Changes to the settings can reduce the achievable PL / SIL or lead to a loss of the safety function.
	The defaults used in the sample projects may differ from your specific requirements.

Figure 3-3 Hardware configuration

Figure 3-4 ET 200SP station
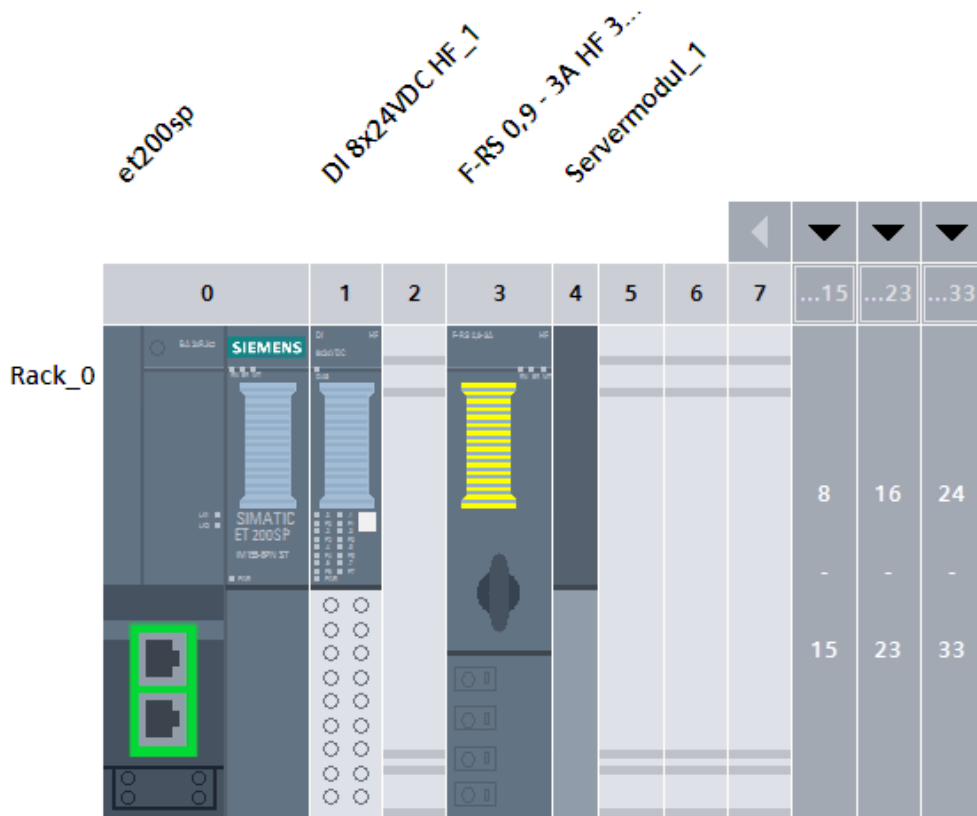
F-motor starter settings

For fail-safe operation of the motor starter, no other parameters need to be set in the motor starter's properties.

For correct operation of the motor, set the specific requirements of your application in the properties (e.g., rated normal current, current limits, shutdown class, etc.).

Note	Implementing the application described in this document with the ET 200SP F-motor starter in conjunction with a 3SK1 safety relay requires that the controller, including the distributed I/O, and the safety relay be installed in the same control cabinet. If this is not done, protected routing (e.g., armored conduit) must be used when connecting the devices.

3.4.2   Programming

Complete overview

The following figure shows the standard user program.
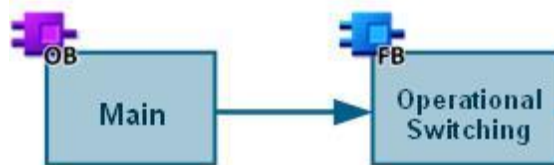
Figure 3-5 TIA Portal block overview

Table 3-4 TIA Portal blocks

Block	Function
OperationalSwitching	The standard user program is processed in this block.
Main	In this block, the "OperationalSwitching" function block is called and interconnected with the inputs and outputs.

Operational switching of the motor starter

Operational switching of the motor starter is implemented in the standard user program. When the 3SK1 safety relay is active and communicates this to the controller via the QM1 signaling contact, the motor starter can be started via the "commandOn" signal. The motor starter is operationally switched off via the "commandOff" signal. In addition, the reversing starter's direction of rotation can be selected using "commandRight" and "commandLeft".

Program description

The operational signals of the motor starter are controlled in the standard user program (OperationalSwitching [FB2]).

- Network 1 defines the conditions for switching on and off and buffers the result to a static tag for further processing.

  During fail-safe shutdown using the emergency stop command device, no automatic restart must be performed; therefore, the inverse #safetyEnable signal is included as a reset condition. If no safety enable has been given by the 3SK1 (QM1), the plant cannot be switched on.
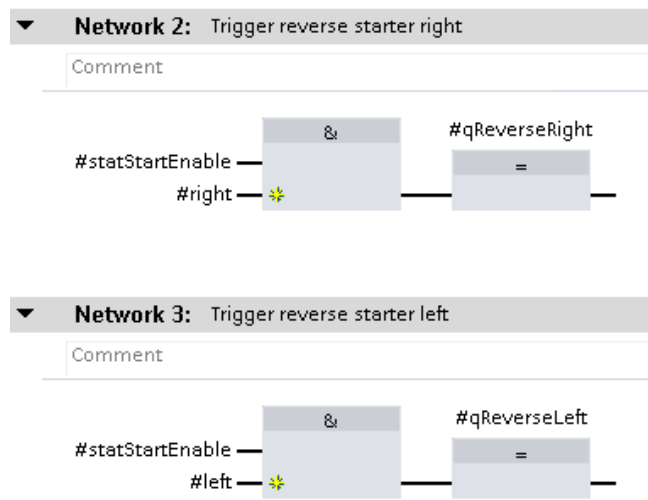
Figure 3-6 Network 1
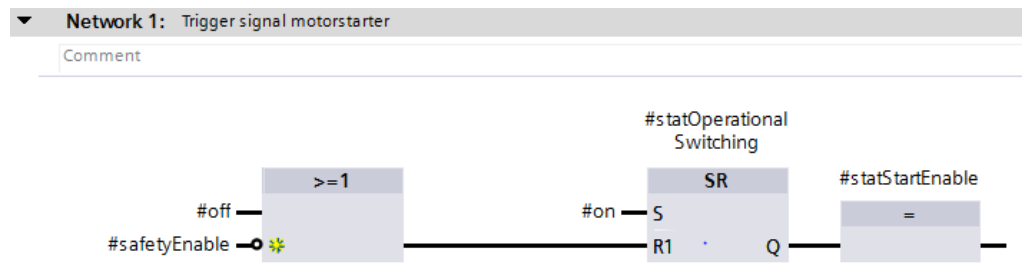
Network 1: Trigger signal motorstarter

Comment

- Network 2 controls the reversing starter's direction of rotation right.
- Network 3 controls the reversing starter's direction of rotation left.

Figure 3-7 Network 2 and 3

Network 2: Trigger reverse starter right

Comment

Network 3: Trigger reverse starter left

Comment

The standard program is configured by the call in the "Main [OB1]".

Figure 3-8 Main[OB1] – network 1
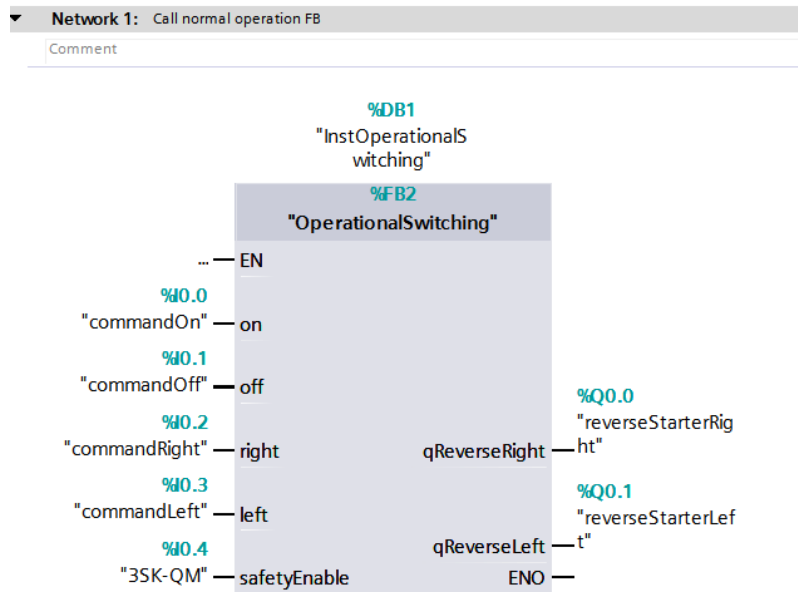
3.4.3 First commissioning

First commissioning of the ET 200SP motor starter requires that safety-related parameters be acknowledged. Confirm the relevant parameters by pressing the reset button on the motor starter front twice.

For more information about commissioning the fail-safe motor starter, please refer to the "Manual – SIMATIC ET 200SP Motor Starter":

https://support.industry.siemens.com/cs/ww/en/view/109479973

3.5   Diagnostics

Due to the fail-safe shutdown by the 3SK1 safety relay via the F-DI terminal, the 24 V DC supply voltage is not removed on the ET 200SP fail-safe motor starter. As a result, the module can still be accessed by the controller after the shutdown and diagnostic messages can be output to higher-level modules.

In contrast to the shutdown via the 24 V supply, an additional advantage is that there is no restart time after voltage recovery. Once the safety-related shutdown has been acknowledged, the motor starter can be immediately switched back on via the F-DI terminal.

In addition, the evaluation of a fail-safe shutdown operation can be performed by interconnecting signaling outputs of the safety relay with the higher-level controller (see QM1 with DI).

The diagnostics concept has to be verified for the custom application and is therefore not included in the user program.

4 Solution with 3SK2

4.1 Overview

Single shutdown is the shutdown of a single actuator with a single shutdown signal. Fail-safe single shutdown means that the shutdown signal is triggered by a technical safety function (e.g., emergency stop).

This application example describes a safety function that is evaluated locally. This means that the safety-related and functional switching of the actuators is separated and therefore performed by different evaluation units.
In the following application example, this separation is implemented by using a non-fail-safe (standard) CPU that is responsible for the functional switching of the actuator. The evaluation of the safety function is performed by a 3SK2 safety relay.

Figure 4-1 Configuration with 3SK2
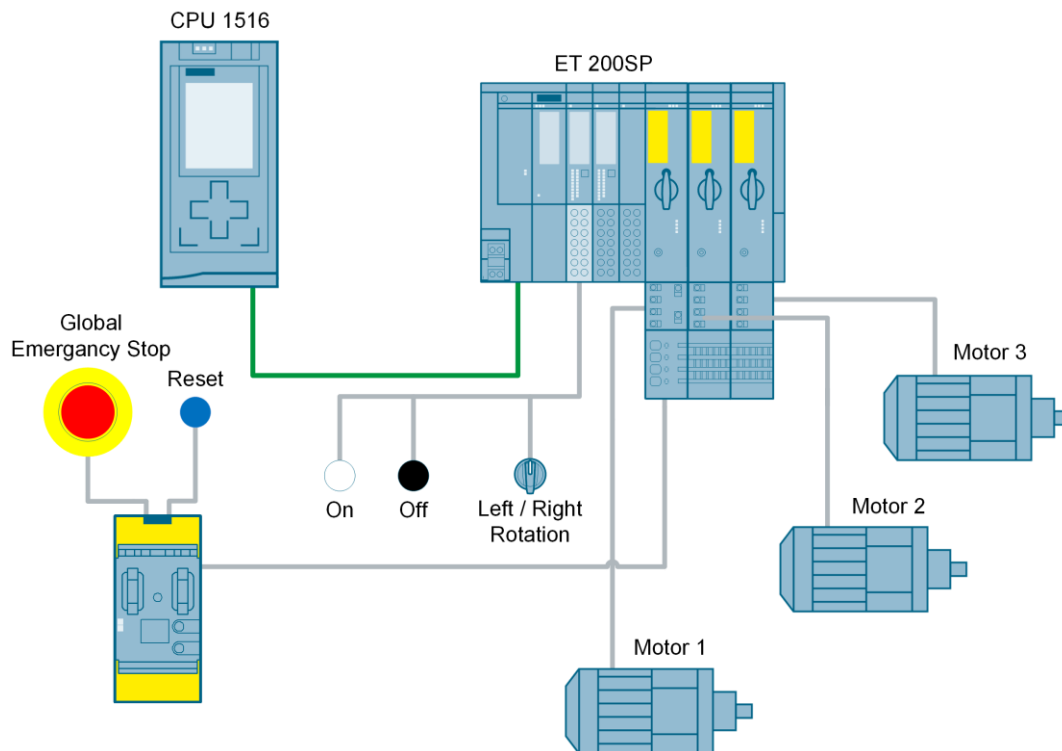
Required knowledge

The following knowledge is required:
- Basics of functional safety
- Basics of STEP 7 programming

4.2 Hardware and software components

4.2.1 Validity

This application example is valid for:

- All SIMATIC controllers
- STEP 7 Professional V14 or higher
- Safety ES V1.0 + SP1

4.2.2 Components used

The application example was created with the following components:

Table 4-1 Hardware components

Component	No.	Article no.	Note
3SK2 safety relay	1	3SK2122-2AA10	3SK2 45mm, spring-loaded terminal
Power supply	1	6EP1332-4BA00	PM 70W
Standard S7 CPU	1	6ES7516-3AN01-0AB0	CPU 1516-3 PN/DP
SIMATIC Memory Card	1	6ES7954-8LC02-0AA0	SMC 4MB
Interface module for ET 200SP	1	6ES7155-6AU00-0CN0	IM155-6PN HF
Digital input module	1	6ES7131-6BF00-0CA0	DI 8X24VDC HF
Base unit	1	6ES7193-6BP00-0DA0	New load group (bright base unit)
Empty module cover	1	6ES7133-6CV15-1AM0	15mm base unit cover
Base unit empty module	1	6ES7193-6BP00-0BA0	Bridged to left (dark base unit)
ET 200SP fail-safe motor starter	1	3RK1308-0DB00-0CP0	F-reversing starter 0.3-1A
ET 200SP fail-safe motor starter	1	3RK1308-0CC00-0CP0	F-direct-on-line starter 0.9-3A
ET 200SP fail-safe motor starter	1	3RK1308-0CB00-0CP0	F-direct-on-line starter 0.3-1A
MS7 base unit	1	3RK1908-0AP00-0GP0	BU for ET 200SP motor starter with 400V infeed, with F-DI infeed
MS9 base unit	2	3RK1908-0AP00-0JP0	BU for ET 200SP motor starter without 400V infeed, with F-DI forwarding
Server module	1	6ES7193-6PA00-0AA0	ET 200SP, server module
Emergency stop command device, complete unit	1	3SU1150-1HB20-1CH0	Mushroom pushbutton with one normally closed contact
Contact module, one NC	1	3SU1400-2AA10-1CA0	Additional contact for emergency stop
Reset pushbutton, complete unit	1	3SU1150-0AB50-1BA0	Pushbutton, blue, one normally open contact
On pushbutton, complete unit	1	3SU1150-0AB50-1BA0	Pushbutton, white, one normally open contact
Off pushbutton, complete unit	1	3SU1150-0AB10-1BA0	Pushbutton, black, one normally open contact
Selector switch, left/right, complete unit	1	3SU1150-2BL60-1NA0	Selector switch, white, three switch positions I-O-II, latching, two normally open contacts

Table 4-2 Software components

Component	No.	Article no.	Note
STEP 7 Professional	1	6ES7822-1AE04-0YA5	V15.1
Safety ES	1	3ZS1316-6CC10-0YA5	V1.0 + SP3
Hardware Support Package	1	HSP0195 – SIMATIC ET 200SP motor starter (not required for V15 and higher)	https://support.industry.siemens.com/cs/ww/en/view/72341852

4.2.3 Sample files and projects

The following list contains all files and projects that are used in this application example.

Table 4-3 Files and projects

Component	Note
109748128_ET200SP-3SK_DOC_v10_en.docx	This document
109748128_ET_200SP_with_3SK2_PROG.zip	3SK2 TIA Portal project
109748128_3SK2_Safety_ES_PROJ.zip	Safety ES project

4.3 Hardware configuration

4.3.1 Mode of operation

The following example explains safe single shutdown with a 3SK2 safety relay and an S7-1500 CPU in conjunction with a distributed ET 200SP station. Fail-safe single shutdown is implemented combining the 3SK2 safety relay and the ET 200SP F-motor starters. Safe shutdown is triggered by the emergency stop command device.

The single shutdown with a single emergency stop command device that shuts down all motor starters in a safety-related manner shown in this example is kept very simple. For your specific application, you can implement other safety functions that possibly act only on single motor starters (e.g., door monitoring using position switches).

The base unit MS7 of the ET 200SP F-motor starter feature an F-DI terminal with an associated frame terminal. The base unit MS9 of the ET 200SP F-motor starter is bridged to the F-DI terminal of a left placed base unit MS7. The base units have no additional 24V terminal to supply the motor starters. The motor starters use the existing supply voltage of the upstream modules of the ET 200SP station (bright standard base unit). In the following application example, safety-related shutdown takes place via the signal of the 3SK2 safety relay at the F-DI terminal.

The advantage of the single shutdown via the F-DI terminal shown in this application example is that, in the event of a safe shutdown operation, the motor starter continues to be supplied with 24 V and can still communicate with the ET 200SP interface module and therefore the higher-level controller.

This example implements the single shutdown of three fail-safe motor starters, in this case one reversing starter and two direct-on-line starters. The use of more motor starters or the maximum configuration depends on the load voltage conditions. Follow the instructions provided in the "SIMATIC ET 200SP Motor Starter Manual":

https://support.industry.siemens.com/cs/ww/en/view/109479973

Slot rules

Trouble-free use of the ET 200SP motor starter requires that you use an empty module in front of the first motor starter.

For more information about setting up a plant with the ET 200SP F-motor starter, please refer to the "SIMATIC ET 200SP Distributed I/O System" system manual:

https://support.industry.siemens.com/cs/ww/en/view/58649293

Monitoring the feedback circuit

For the ET 200SP fail-safe motor starter 3RK1308-0**00-0CP0, the OFF state is defined as a safe state. The motor starters are self-monitoring in compliance with SIL CL 3 / PL e; therefore, it is not necessary to monitor them in the feedback circuit of the upstream evaluation unit.

If an error occurs, the motor starter itself prevents a restart.

ET 200SP motor starter base units

Different base unit types (BU30 MS1 to MS10) are available for the ET 200SP motor starter. In this example, shutdown is implemented with the MS7 and MS9

types. The motor starters are supplied by the 24 V DC infeed of the left modules. The 400 V infeed of the actuators is connected to the MS7 base unit of the motor starter inserted first. Due to the use of the MS9 base unit, the 400 V infeed is bridged by MS7 and does not need to be reconnected. The base unit MS7 feature an F-DI that is connected, for example, to an F-DQ. Due to the use of the MS9 base unit, the F-DI infeed is bridged by MS7 and does not need to be reconnected.

Alternative: Shutdown via the 24V terminal

In addition, it is possible to shut down the ET 200SP fail-safe motor starters with a 3SK2 safety relay at the 24 V terminal of the MS1 or MS3 base unit. This design allows group shutdown with downstream MS2 or MS4 base units; the maximum output current of the 3SK2 semiconductor output must be considered. Based on the data of the "3SK2 Manual"
https://support.industry.siemens.com/cs/ww/en/view/109444336

and the "ET 200SP Motor Starter Manual"
https://support.industry.siemens.com/cs/ww/en/view/109479973

this results in a maximum number of ET 200SP F-motor starters that can be shut down in a group (depending on the maximum output current of the 3SK2 semiconductor output and the maximum input current of the 24V supply of the base unit). Shutdown via the 24 V supply voltage (group shutdown) is not discussed in this application example.

For group shutdown via the 24V terminal of the ET 200SP F-motor starter base unit, please note the following: After voltage recovery, the modules in the potential group require a restart time to be ready for operation again. To ensure that this delay time does not affect the operational process, it is advisable to use this group shutdown for shutdown functions with low switching frequencies, for example for the emergency stop safety function. The emergency stop safety function is regarded as a complementary protective measure and does not affect the process. In an emergency situation, actuating the emergency stop command device immediately stops the actuators. Once the hazardous situation has been eliminated and the safety function has been acknowledged, the process can start again.

Note	Protecting the lines from the infeed to the motor starter requires additional measures such as a 3RV circuit breaker. As this is not part of functional safety, this is not included in the overviews and connection diagrams.
	It is also possible to implement an application with the ET 200SP F-motor starter according to the requirements of SIL 1 to SIL 2 (according to IEC 62061) or PL a to PL d (according to ISO 13849-1).

4.3.2 Wiring example

Figure 4-2 Wiring

4.4 TIA Portal: Configuration and project engineering

4.4.1 Hardware configuration

The supplied project does not require any further configuration. If you reproduce the application example with other components, this chapter shows the most important settings.

Notice	The settings shown below help meet PL e / SIL 3. Changes to the settings can reduce the achievable PL / SIL or lead to a loss of the safety function.
	The defaults used in the sample projects may differ from your specific requirements.

Figure 4-3 Hardware configuration

Figure 4-4 ET 200SP station

F-motor starter settings

For fail-safe operation of the motor starters, no other parameters need to be set in the motor starters' properties.

For correct operation of the motor, set the specific requirements of your application in the properties (e.g., rated normal current, current limits, shutdown class, etc.).

Note	Implementing the application described in this document with the ET 200SP F-motor starter in conjunction with a 3SK2 safety relay requires that the controller, including the distributed I/O, and the safety relay be installed in the same control cabinet. If this is not done, protected routing (e.g., armored conduit) must be used when connecting the devices.

4.4.2 Programming

Complete overview

The following figure shows the standard user program.

Figure 4-5 TIA Portal block overview

Table 4-4 TIA Portal blocks

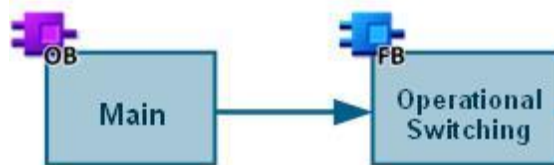| Block	Function
OperationalSwitching	The standard user program is processed in this block.
Main	In this block, the "OperationalSwitching" function block is called and interconnected with the inputs and outputs.

Operational switching of the motor starters

Operational switching of the motor starters is implemented in the standard user program. When the 3SK2 safety relay is active and communicates this to the controller via the QM1 signaling contact, the motor starter can be started via the "commandOn" signal. The motor starters are operationally switched off via the "commandOff" signal. In addition, the reversing starter's direction of rotation can be selected using "commandRight" and "commandLeft".

Program description

The operational signals of the motor starters are controlled in the standard user program (OperationalSwitching [FB2]).

- Network 1 defines the conditions for switching on and off and buffers the result for further processing in a static tag.

  During fail-safe shutdown using the emergency stop command device, no automatic restart must be performed; therefore, the inverse #safetyEnable signal is included as a reset condition. If no safety enable has been given by the 3SK2 (QM1), the plant cannot be switched (back) on.

Figure 4-6 Network 1
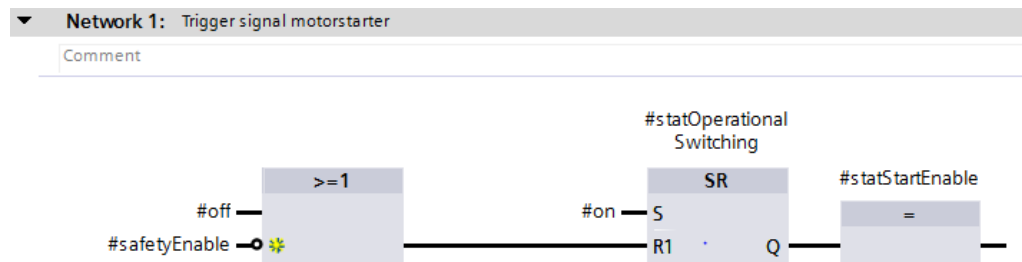
Network 1: Trigger signal motorstarter

Comment

- Network 2 controls the reversing starter's direction of rotation right.
- Network 3 controls the reversing starter's direction of rotation left.

Figure 4-7: Network 2 and 3

Network 2: Trigger reverse starter right

Comment

Network 3: Trigger reverse starter left

Comment

- Network 4 controls the output of the first direct-on-line starter.
- Network 5 controls the output of the second direct-on-line starter.

Figure 4-8 Network 4 and 5
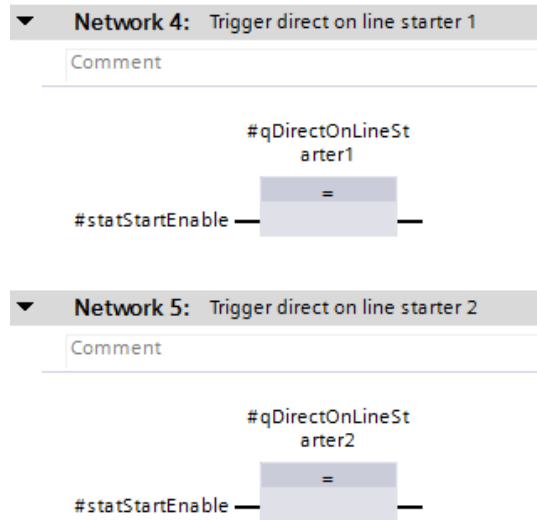
The standard program is configured by the call in the "Main [OB1]".

Figure 4-9: Main[OB1] – network 1
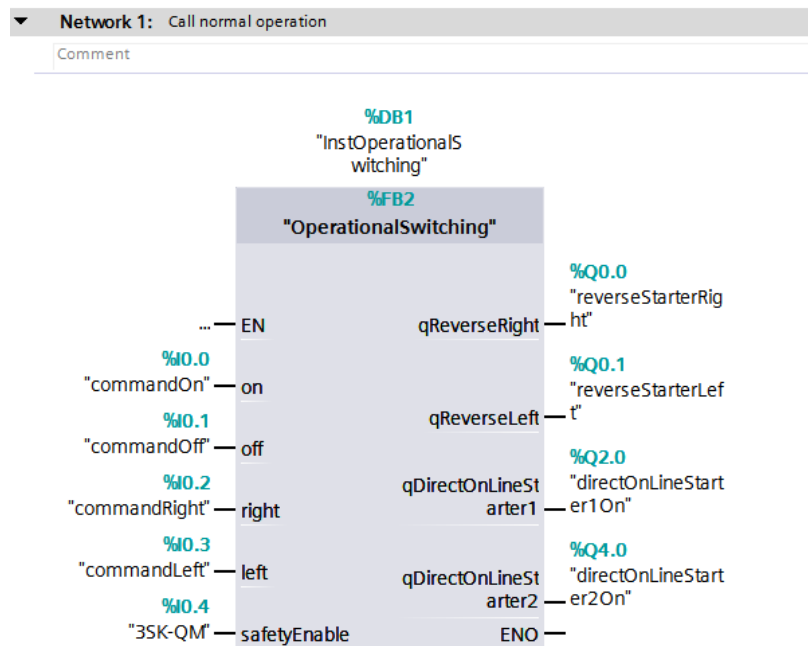
4.4.3 First commissioning

First commissioning of the ET 200SP F-motor starters requires that safety-related parameters be acknowledged. Confirm the relevant parameters by pressing the reset button on the front of the motor starters twice.

For more information about commissioning the fail-safe motor starter, please refer to the "Manual – SIMATIC ET 200SP Motor Starter":

https://support.industry.siemens.com/cs/ww/en/view/109479973

4.5 Safety ES: Configuration and project engineering

4.5.1 Hardware configuration

The supplied project does not require any further configuration. If you reproduce the application example with other components, this chapter shows the most important settings.

NOTICE	The settings shown below help meet PL e and SIL 3. Changes to the settings can lead to a reduction or loss of the safety function.

NOTICE	The defaults used in the sample projects may differ from your specific requirements.

Figure 4-10 Safety ES configuration
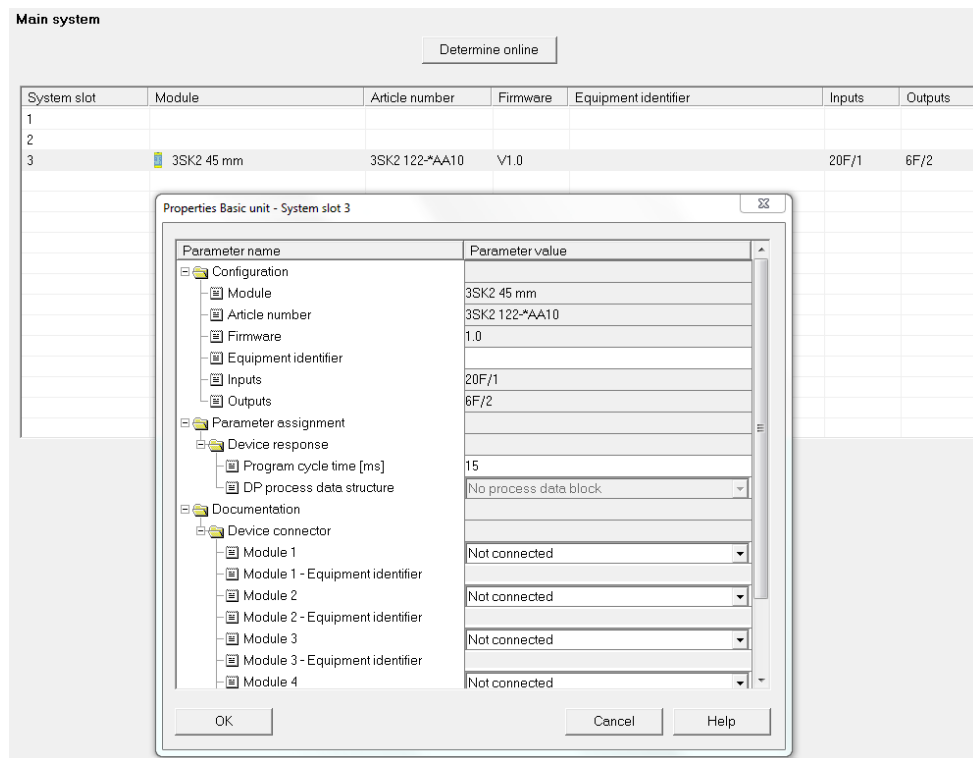
You can customize the configuration of the 3SK2 safety relay to the specific requirements of your application. For example, you could also use a narrow 3SK2 basic unit (22.5 mm: 3SK2112-2AA10) instead of the wide 3SK2 basic unit (45 mm: 3SK2122-2AA10) shown here. In addition, the 3SK2 basic unit can be expanded on the output side to control more than four motors.

4.5.2 Configuration

The Safety ES configuration of the 3SK2 safety relay shown here is designed for simultaneous shutdown of the three motors when the emergency stop command device is actuated. If other safety functions are integrated in your application (e.g., safety door monitoring using position switches), these functions can selectively act on single motor starters. You can customize the configuration shown here to your specific application.

Program description

The following diagram shows the fail-safe shutdown using the emergency stop command device with monitored start. The F-output on the right-hand side safely shuts down the fail-safe motor starters when the emergency stop command device is actuated (base unit MS9 of the two right-handed motor starters with bridged F-DI coming from the left motor starter with MS7). As no automatic restart must be performed, the QM1 signaling output of the 3SK2 is interconnected in addition to the F-Q1 fail-safe output. This signal is passed to the higher-level controller, where it is included in the standard user program as a reset condition (#safetyEnable). If no safety enable has been given by the 3SK2 (QM1), the plant cannot be switched (back) on.

Figure 4-11 Safety ES configuration

4.5.3 First commissioning

First commissioning of the 3SK2 safety relay requires that a specified procedure for achieving safety mode be followed. For detailed instructions and more information about commissioning, please refer to the "3SK2 Manual"

https://support.industry.siemens.com/cs/ww/en/view/109479973

and to the "Safety ES Operating Manual"

https://support.industry.siemens.com/cs/ww/en/view/109444445

4.6 Diagnostics

Due to the fail-safe shutdown by the 3SK2 safety relay via the F-DI terminal, the 24 V DC supply voltage is not removed on the ET 200SP fail-safe motor starters. As a result, the module can still be accessed by the controller after the shutdown and diagnostic messages can be output to higher-level modules.

In contrast to the shutdown via the 24 V supply, an additional advantage is that there is no restart time after voltage recovery. Once the safety-related shutdown has been acknowledged, the motor starter can be immediately switched back on via the F-DI terminal.

In addition, the evaluation of a fail-safe shutdown operation can be performed by interconnecting signaling outputs of the safety relay with the higher-level controller (see QM1 with DI).

Detailed diagnostics of the 3SK2 safety relay can be performed using the Safety ES software and the diagnostic display (3SK2611-3AA00).

The diagnostics concept has to be verified for the custom application and is therefore not included in the user program.

5 Appendix

5.1 Service and Support

Industry Online Support

Do you have any questions or do you need support?

With Industry Online Support, our complete service and support know-how and services are available to you 24/7.

Industry Online Support is the place to go to for information about our products, solutions and services.

Product Information, Manuals, Downloads, FAQs and Application Examples – all the information can be accessed with just a few clicks:
https://support.industry.siemens.com

Technical Support

Siemens Industry's Technical Support offers you fast and competent support for any technical queries you may have, including numerous tailor-made offerings ranging from basic support to custom support contracts.

You can use the web form below to send queries to Technical Support:
www.siemens.com/industry/supportrequest.

Service offer

Our service offer includes the following services:

- Product Training

- Plant Data Services

- Spare Part Services

- Repair Services

- Field & Maintenance Services

- Retrofit & Modernization Services

- Service Programs & Agreements

For detailed information about our service offer, please refer to the Service Catalog:
https://support.industry.siemens.com/cs/sc

Industry Online Support app

The "Siemens Industry Online Support" app provides you with optimum support while on the go. The app is available for Apple iOS, Android and Windows Phone:
https://support.industry.siemens.com/cs/ww/en/sc/2067

5.2 Links and literature

Table 5-1

No.	Topic
\1\	Siemens Industry Online Support https://support.industry.siemens.com
\2\	Link to the entry page of the application example https://support.industry.siemens.com/cs/ww/en/view/109748128
\3\	

5.3 Change documentation

Table 5-2

Version	Date	Modifications
V1.0	06/2017	First version
V1.1	09/2019	Update with new base units MS7/9 with bridged F-DI