Installation Guidelines

ET 200pro Distributed IOs

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1 Introduction

This document gives an overview of the modules of the ET 200pro and a summary of the guidelines and rules to be observed for the module structure of the ET 200pro in particular when using fail-safe modules.

1.1 ET 200pro Distributed IO System

Definition

The ET 200pro is a modular distributed IO system with a degree of protection up to IP67.

Field of application

The solid construction, the setup without control cabinet, and a degree of protection of up to IP67 make the ET 200pro Distributed IO System suitable in particular for use in rough industrial environments.

IP65, IP66 and IP67 mean that the ET 200pro is protected against the ingress of foreign bodies and water. The ET 200pro does not need an additional housing.

The ET 200pro can communicate with:

- All PROFIBUS DP masters that follow the standard IEC 61784-1:2002 Ed1 CP 3/1.
- All PROFINET IO controllers that follow the standard IEC 61158.

Setup

The ET 200pro is mounted on a rack and consists mainly of:

- An interface module in the versions below:
  - Interface module without CPU (IM) that transfers the data to the PROFIBUS DP master or to the PROFINET IO controller.
  - Interface module with CPU or F-CPU (IM 154-8(F/FX) PN/DP CPU), which can be either DP slave or DP master on the PROFIBUS DP.
    The IM 154-8(F/FX) PN/DP CPU can be used on PROFINET IO as IO controller, IO device or PROFINET CBA device.
    The CPU 1516PRO-2 PN and CPU 1516PRO F-2 PN can be used on PROFINET as IO controller or IO device.
- Up to 16 electronic modules with maximum 1 m or 1,2 m (with IM 154-3 PN HF) setup width (without rack).
- Connection modules of different types for
  - PROFIBUS DP
  - PROFINET IO
  - Supply voltages
  - Inputs and outputs
  - Pneumatic interface modules
  - RFID systems
- Motor starter, frequency converter, F switch and special modules

In this way you can tailor the setup precisely to meet the on-site requirements in each case. Simple handling means that the ET 200pro ensures fast commissioning and simple maintenance.

1.2 Overview of the ET 200pro Modules

Table 1-1

Module	Abbreviation	Function
Interface module without CPU	IM	The interface module connects the ET 200pro with the DP master or IO controller and prepares the data for the electronic modules. Version of the interface module: • Standard • High Feature
Interface module with CPU	IM 154-8 PN/DP CPU, CPU 1516PRO-2 PN	The interface module with integrated CPU makes it possible to decentralize control tasks. You can utilize the ET 200pro as DP master or as DP slave via the integrated PROFIBUS interface of the interface module. You can utilize the ET 200pro as IO controller or as IO device via the integrated PROFINET interface of the interface module.
Interface module with F-CPU	IM 154-8F PN/DP CPU, IM 154-8FX PN/DP CPU, CPU 1516PRO F-2 PN	The interface module with integrated fail-safe CPU makes it possible to decentralize control tasks and set up a fail-safe automation system for plants with higher safety requirements (PROFIsafe). You can utilize the ET 200pro as DP master or as DP slave via the integrated PROFIBUS interface of the interface module. You can utilize the ET 200pro as IO controller or as IO device via the integrated PROFINET interface of the interface module.
Pneumatic interface module	16 DO DC24V CPV10 16 DO DC24V CPV14	The pneumatic interface modules permit you to connect the FESTO valve islands CPV10 and CPV14.
RFID systems	RF170C	The RF170C is a communication module that is slotted in the ET 200pro to connect RFID and code reading devices.
Input and output modules	IO modules	The input and output modules are for connecting digital and analog sensors/encoders and actuators/loads.
Fail-safe input and output modules	IO F-modules	The fail-safe input and output modules can be used for fail-safe operation in the ET 200pro Distributed IO device (PROFIsafe). These modules have integrated test functions and are for connecting fail-safe digital sensors/encoders and actuators/loads.
Power module	PM-E	The power module opens a new potential group for the load power supply 2L+ and monitors the load voltage for all electronic modules in the potential group.
Outgoing module	PM-O	The outgoing module is a special power module that can be used to tap the electronics/encoder supply 1L+ and load power supply 2L+ of a potential group.

Module	Abbreviation	Function
F Switch PROFIsafe	F switch	The F switch permits fail-safe shutdown of output module, motor starters and fail-safe frequency converters via the 2L+, F0 or F1 busbars. Furthermore, fail-safe sensors/encoders can also be connected to the fail-safe inputs. The F switch captures the signal states of these fail-safe sensors/encoders and sends corresponding secure messages to the F-compatible CPU.
Frequency converter ET 200pro FC-2	ET 200pro FC-2	Frequency converters are used in drive technology to control the speed of motors. The frequency converter ET 200pro FC-2 can be used in Standard and Fail-safe applications.
Repair switch module	RSM	The repair switch module is for shutdown of the successive motor starter and frequency converter. It offers short circuit protection for the successive consumers with 25 A circuit-breakers.
Safety Local repair switch module	F-RSM	The Safety Local repair switch module is for shutdown of the successive motor starter and frequency converter. It offers short circuit protection for the successive consumers with 16 A circuit-breakers and has additional safety functions.
Shutdown module	ASM	The 400V shutdown module must only be used in conjunction with the Safety Local repair switch module for local safety applications or with an F switch. It is for fail-safe shutdown of the main power circuit.
Motor starter	MS	A motor starter determines the startup and rotation direction of a motor. They are offered as direct and reversing starters in the following version: • mechanical
Electronic motor starter	E-MS	A motor starter determines the startup and rotation direction of a motor. They are offered as direct and reversing starters in the following version: • electronic

1.3 Color Chart

The figures in this document show the ET 200pro modules in different colors.

Table 1-2 gives an overview of the colors used for the different ET 200pro modules in the figures.

Table 1-2

Description	Color Chart
The interface modules and PM-E power modules in gray open a new potential group.	
The F switch in yellow sets up the F0 and F1 busbars in a PROFIsafe safety application.	
The F-RSM in blue sets up the F0 busbar in a Safety Local safety application.	
The modules in green do not interrupt the F0 and F1 busbars.	
The modules in orange interrupt the F0 and F1 busbars.	

1.4 Configuration

Use the TIA Selection Tool to configure your ET 200pro station. This configuration tool guides you simply and easily through the configuration of an ET 200pro station and supports you in selecting the various components and matching accessories.

The TIA Selection Tool is in the configuration tool overview of the Industry Mall under Automation Technology.

Industry Mall

1.5 Safety Functions

Use one of two options below to set up a safety function.

- Safety Local
- PROFIsafe

1.5.1 Safety Local

Definition

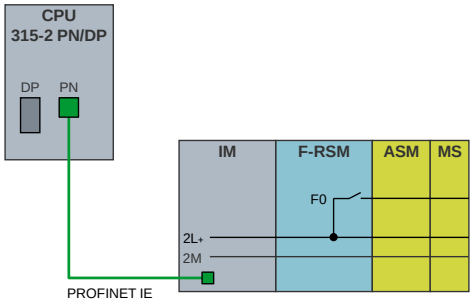
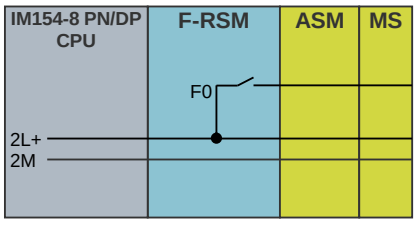
The Safety Local repair switch module (F-RSM) is used to set up local safety applications.

This solution is often used for locally limited safety applications. It works independently and does not depend on an F-CPU. Specific programming of the safety engineering is not required.

Setup of a Safety Local safety function

Table 1-3 shows an example of the decentralized and central setup of a local safety function with the Safety Local repair switch module (F-RSM).

Table 1-3

Decentralized setup	Central setup
The setup of a local safety function with the Safety Local repair switch module (F-RSM) can be done decentralized via PROFINET or PROFIBUS.	The setup of a local safety function with the Safety Local repair switch module (F-RSM) can be central in an ET 200pro with the IM154-8 PN/DP CPU or CPU 1516PRO-2 PN.
	

1.5.2 PROFIsafe

Definition

PROFIsafe is used for safe data communication between fail-safe IO modules and fail-safe controllers (F-CPU) via PROFIBUS and PROFINET.

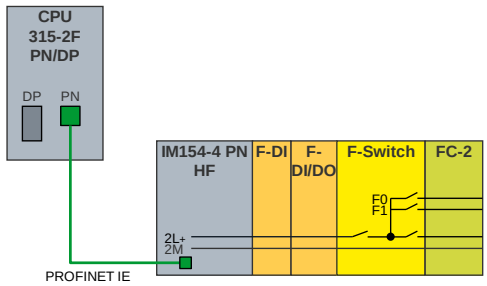
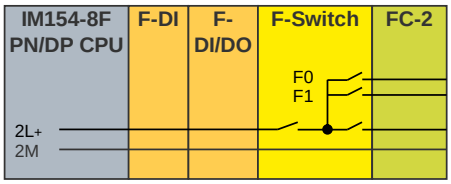
Standard and safe communication is via a single bus system whereby the safe communication is made with the PROFIsafe profile.

This solution is used for complex, flexible and networked safety applications.

Setup of a PROFIsafe safety application

Table 1-4 shows an example of the decentralized and central setup of a PROFIsafe safety function.

Table 1-4

Decentralized setup	Central setup
The setup of a PROFIsafe safety function can be done decentralized via PROFINET or PROFIBUS. You need an F-CPU for decentralized setup of a PROFIsafe safety application. You can use the interface modules below in the ET 200pro to set up a PROFIsafe safety application. • IM154-2 DP HF • IM 154-3 PN HF • IM154-4 PN HF • IM154-8F PN/DP CPU • CPU 1516PRO F-2 PN	The setup of a PROFIsafe safety function can be central in an ET 200pro with the IM154-8F PN/DP CPU or CPU 1516PRO F-2 PN.
	

2 Power Supply

2.1 Electronics/Encoder Supply 1L+

- The electronics/encoder supply 1L+ supplies the internal electronics of the ET 200pro modules and the externally connected encoders.
- The electronics/encoder supply 1L+ is isolated from the backplane bus of the ET 200pro, the load power supply 2L+ and PROFIBUS DP and PROFINET IO.

2.2 Load Power Supply 2L+

- Load power supply 2L+ supplies the externally connected actuators and the control elements for the main circuit of the motor starters.
- The load power supply 2L+ is isolated from the backplane bus of the ET 200pro, the electronics/encoder supply 1L+ and PROFIBUS DP and PROFINET IO.

3 Modules of the ET 200pro Distributed IO System

3.1 Setup of Potential Groups

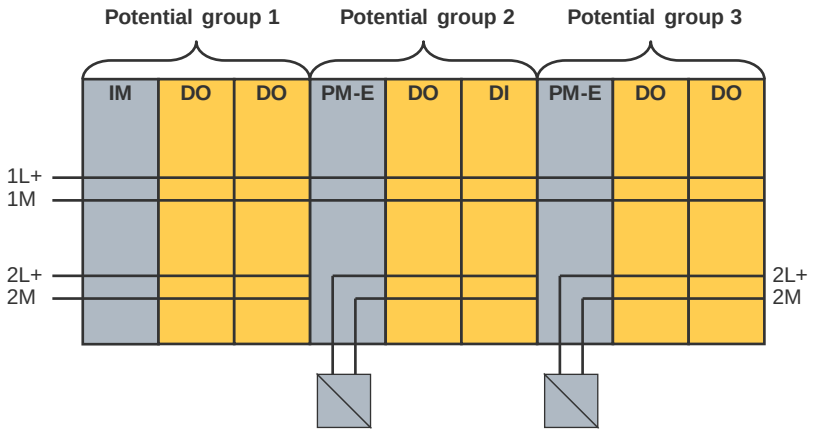
The first potential group is opened by the internal power supply of the interface module.

If the maximum current load of 10 A is reached on the load power supply 2L+ or a new potential group is to be opened, then you need a power module (PM-E).

The power module (PM-E) opens another potential group (supply root) for the load power supply 2L+. The power module (PM-E) supplies all the successive load supplies of the electronic modules. Each power module (PM-E) has a replaceable fuse as device protection. Externally all you have to provide in addition is a line protection in compliance with DIN VDE 0100.

The electronics/encoder supply 1L+ is not interrupted by the power module (PM-E).

Figure 3-1



Shutdown of the load power supply via external safety relay

You can shut down the load power supply 2L+ of a potential group via an external safety relay (e. g. 3TK1).

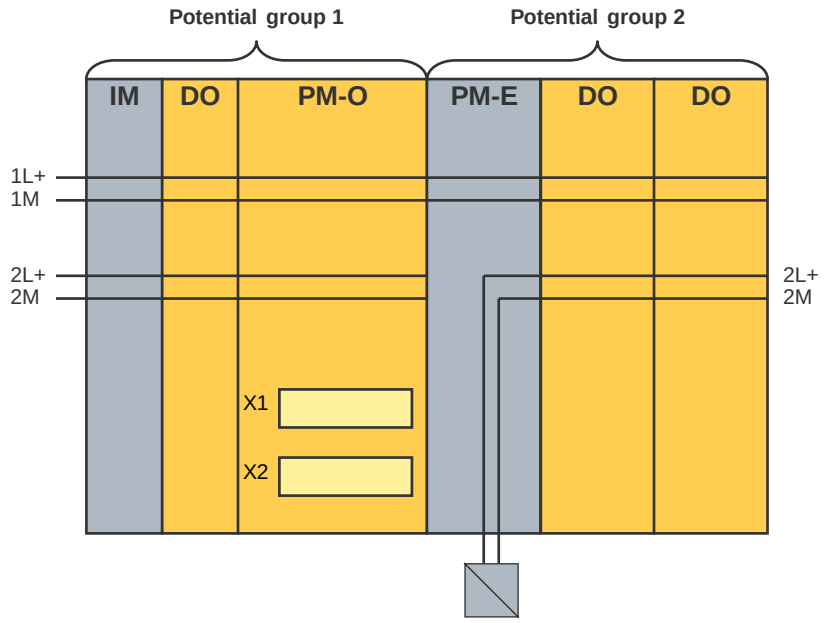
3.2 Tapping the Power Supply

You can use the outgoing module (PM-O) to tap the electronics/encoder supply 1L+ and load power supply 2L+ in a potential group.

The electronics/encoder supply 1L+ of the outgoing module (PM-O) is secured by an electronic switch and is short-circuit-proof.

The load power supply 2L+ is protected against short-circuiting by a replaceable fuse in the downstream power module (PM-E) or in the integrated power module of the interface module.

Figure 3-2



Note The output module (PM-O) must not be fed back.

3.3 Fail-safe Modules

In the ET 200pro Distributed IO System you can also use fail-safe ET 200pro modules in addition to the standard ET 200pro modules. You can use standard and fail-safe modules together in the ET 200pro.

The fail-safe modules communicate with the F-CPU via the PROFIsafe fail-safe bus profile.

3.3.1 Fail-safe Digital Input Modules

The fail-safe digital input modules capture the signal states of the fail-safe encoders and send corresponding safety messages to the F-CPU.

3.3.2 Fail-safe Digital Output Modules

The fail-safe digital output modules are for shutdown procedures with short-circuit and cross-circuit monitoring up to the actuator.

3.3.3 F Switch PROFIsafe

The PROFIsafe F switch makes fail-safe shutdown of modules possible. It sends a shutdown signal via the F0 and F1 busbars. In this way, all the modules in the potential group of the F switch are switched off in a fail-safe manner via the F0 busbar, F1 busbar or load power supply 2L+.

The PROFIsafe F switch captures the signal states of fail-safe encoders and sends corresponding safety messages to the F-CPU and is for connecting frequency converters, motors and output modules.

The PROFIsafe F switch has the following inputs and outputs:

- 2 fail-safe inputs
- 3 busbars (F0 busbar, F1 busbar and load power supply 2L+) as internal outputs for the fail-safe shutdown of:
  - Standard DOs including valve island CPV (via load power supply 2L+)
  - Mechanical motor starters (via load power supply 2L+)
  - Electronic motor starters (via load power supply 2L+) if the F switch is used together with an ASM
  - ASM (via F0 busbar) for shutdown of the 400V power supply for mechanical and electrical motor starters
  - Frequency converter (via F0 busbar)

The entry below gives a list of the modules that can be operated behind a F switch.

http://support.automation.siemens.com/WW/view/en/25371449

3.3.4 Setup Rules

The setup rules for the shutdown of fail-safe modules are described in section 4.2 .

The setup of a shutdown group with the PROFIsafe F switch and setup rules for fail-safe shutdown are described in sections 4.4.2 and 4.4.3.

3.4 Frequency Converters, Motor Starters and Special Modules

The frequency converter FC-2 has a width of 155 mm. You may mount a maximum of 5 frequency converters next to each other to keep within the permissible setup width of an ET 200pro Station (1 m).

Motor starters and special modules have a width of 110 mm. You may mount a maximum of 8 motor starters / special modules next to each other to keep within the permissible setup width of an ET 200pro Station (1 m).

The 400V power supply of the modules is provided via jumpers and looping within the modules. Note the following power bus current limit values.

Table 3-1

Module	Max. total current of the power bus
RSM	25 A
F-RSM	**16 A**
ASM	25 A
Motor starter (MS, E-MS)	25 A
FC-2	25 A

Note If an F-RSM is installed in an ET200pro station, the total current via the F-RSM must not exceed 16 A.

3.4.1 Special modules

Special modules are the repair switch module (RSM), the Safety Local repair switch module (F-RSM) and the shutdown module (ASM).

Special modules are used if you

• Require a shutdown of the successive motor starters.

• Require safety up to category 4, safety class SIL 3 or PL e.

Repair Switch Module (RSM)

The repair switch module (RSM) switches the 400V power supply for the successive motor starters, in other words, the motor starters can be isolated manually from the power supply with the repair switch module (RSM).

The RSM offers short circuit protection for the successive consumers with 25 A circuit-breakers.

The setup rules for placing a repair switch module are described in section 4.3.

Safety Local repair switch module (F-RSM)

The F-RSM has two slide switches for selecting the operating mode. You have a choice between the operating modes below.

- 1-channel or 2-channel operation
- Automatic start or monitored start

The front has M12 connection sockets for external transducers.

1-channel or 2-channel fail-safe encoders can be connected to the "IN" input of the F-RSM.

The "START" input is for connecting a button for the "Monitored Start" mode.

The signal statuses of the encoder are evaluated in the F-RSM. A fail-safe output signal is fed from the load power supply 2L+ to the F0 bus in the backplane module.

The setup of a shutdown group with the Safety Local repair switch module F-RSM and setup rules for fail-safe shutdown are described in sections 4.4.1 and 4.4.3.

Shutdown Module (ASM)

The 400V shutdown module can be used in conjunction with the Safety Local repair switch module (F-RSM) or F switch for safety applications up to

- Safety class SIL 3 (Safety Integrity Level)
- PL e (Performance Level) in compliance with ISO 13849

The ASM is designed for the functions below:

- 2-channel shutdown of the main circuit supply (400V power supply)
- Feedback of the module function status via bus
- Feedback of the switching status of the contactors via bus

The ASM includes two contactors connected in series for fail-safe shutdown of the main power circuit (400V power supply). Operational switching of the connected consumer must be made by a successive motor starter. The auxiliary circuit supply is provided via a safety busbar (F0 busbar) in the backplane bus module.

The setup rules for safe shutdown of the 400V power supply with the shutdown module are in section 4.5.

3.4.2 Motor Starter

Description

There are mechanical motor starters (MS) and electronic motor starters (E-MS). They determine the startup and rotation direction of a motor.

The motor starters are available as direct and reversing starters with a setting range of up to 5.5kW. They are designed with IP65 degree of protection and are available with an optional brake control.

Setup Rules

The setup rules for the shutdown of mechanical and electronic motor starters are in section 4.6.

3.4.3 Frequency Converter

Frequency converters are used in drive technology to control the speed of motors.

Versions

The frequency converter for ET 200pro can be used in standard and fail-safe applications.

For safety applications the ET 200pro FC-2 provides the safety function Safe Torque Off (STO). The STO function protects against active movements of the drive.

Description

ET 200pro FC-2 is a compact frequency converter which is embedded completely into the ET 200pro distributed IO system.

The individual components can be configured in the hardware configuration of or be integrated into another configuration system via a GSD (device master file).

The frequency converter works with an input voltage of 3 AC 400 V 50/60 Hz and can be used for 3-phase motors up to 1.1 KW with temperature derating up to 1.5 KW.
It is designed with IP65 degree of protection and has as standard an integrated brake control and temperature sensor evaluation (PTC/KTY).

Special Features

The power unit of the frequency converter feeds the braking energy of the motor back into the power network. No braking resistance is required which transforms the energy produced during generator operation into heat. The frequency converter works without line-side commutation reactor.

Setup Rules

The setup rules for shutdown of the ET 200pro FC-2 frequency converter are described in section 4.7.

4 Setup Rules

4.1 Maximum Setup

As soon as one of the following rules applies the maximum setup in ET 200pro has been reached.

Maximum mechanical setup

Table 4-1

Properties	Rule
Number of modules	Max. 16 electronic modules
	Max. 5 frequency converters
	Max. 8 special modules / motor starters
ET 200pro width	Max. 1 m or 1,2 m (with 154-3 PN HF) setup width (without rack)

Maximum electrical setup

Table 4-2

Properties	Rule
Electronics/Encoder Supply 1L+	Max. 5A per ET 200pro station
Load Power Supply 2L+	Max. 10A per potential group

4.2 Fail-safe Modules

You may use fail-safe digital input and output modules (IO modules) and a PROFIsafe F switch with the interface modules below:

- IM154-2 DP HF
- IM 154-3 PN HF
- IM154-4 PN HF
- IM154-8F PN/DP CPU
- CPU 1516PRO F-2 PN

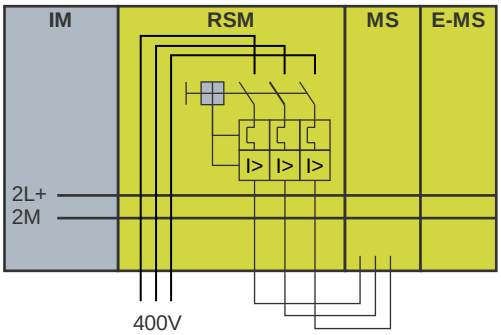
4.3 Repair Switch Module (RSM)

Place the repair switch module (RSM) to the left of the motor starter or frequency converter.

Standard application for shutdown of motor starters

Figure 4-1 shows the position of the repair switch module (RSM) in a standard application for the shutdown of motor starters.

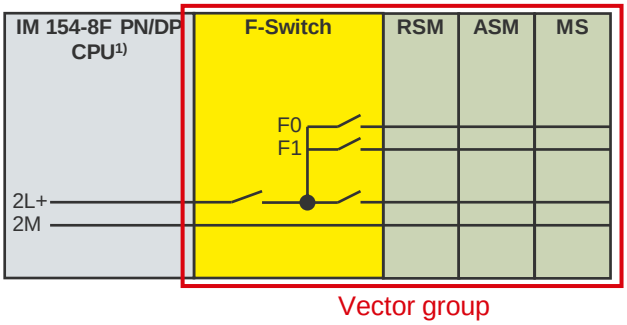
Figure 4-1



Fail-safe shutdown of motor starters

Figure 4-2 shows the position of the repair switch module (RSM) in a PROFIsafe safety application with fail-safe shutdown of the motor starters by the F switch and a shutdown module.

Figure 4-2



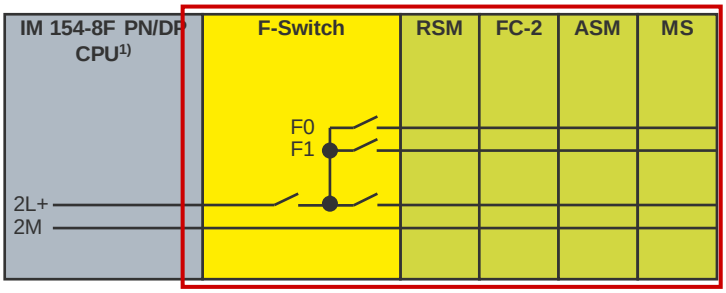
1) Alternatively you can use one of the following modules instead of IM 154-8F PN/DP CPU:

- IM 154-2 DP HF
- IM 154-3 PN HF
- IM 154-4 PN HF
- IM 154-6 PN IWLAN
- CPU 1516PRO F-2 PN

Safety application with frequency converter ET 200pro FC-2

Figure 4-3 shows the position of the repair switch module (RSM) in a PROFIsafe safety application with frequency converter ET 200pro FC-2.

Figure 4-3



1) Alternatively you can use one of the following modules instead of IM 154-8F PN/DP CPU:

- IM 154-2 DP HF
- IM 154-3 PN HF
- IM 154-4 PN HF
- IM 154-6 PN IWLAN
- CPU 1516PRO F-2 PN

4.4 Shutdown Group

A shutdown group is opened by the PROFIsafe F switch or the Safety Local repair switch module (F-RSM). The F switch and the F-RSM ensure a fail-safe shutdown of the modules in the shutdown group.

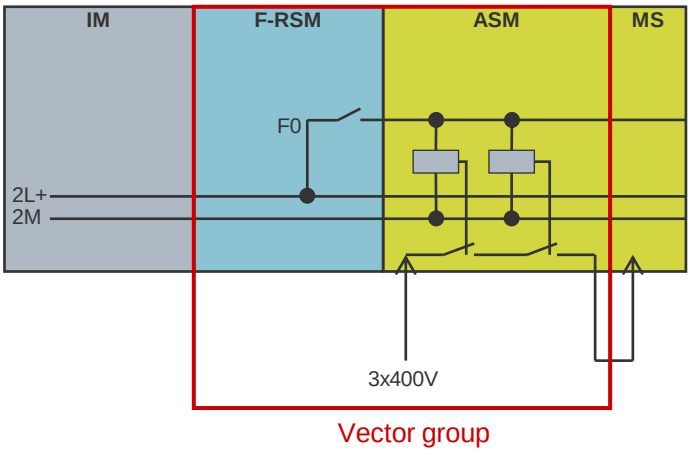
4.4.1 Shutdown Group with F-RSM

Sample setup

Figure 4-4 shows a sample setup of a shutdown group in a local safety application (Safety Local).

In a local safety application (Safety Local) the shutdown group is opened by a Safety Local repair switch module (F-RSM).

Figure 4-4



Description

The F-RSM only sets up the F0 busbar. It provides a shutdown signal via the F0 busbar so that the F0 busbar is shutdown. This ensures fail-safe shutdown of all the modules in the shutdown group.

The shutdown group in Figure 4-4 consists of the modules below.

Table 4-3

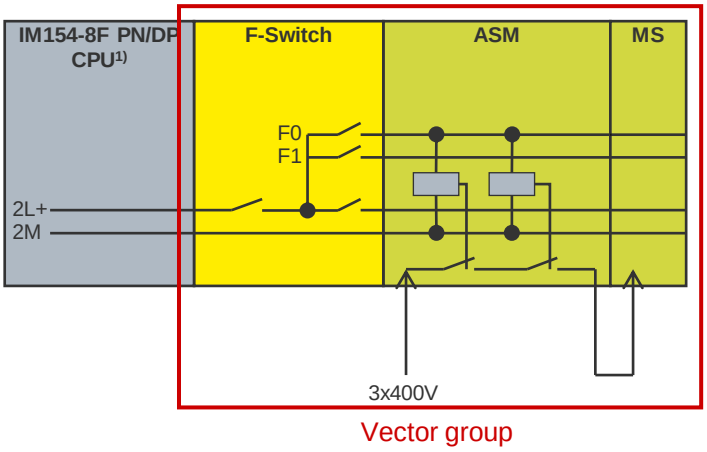
Module	Description
F-RSM	The F-RSM sets up the F0 busbar of the shutdown group. It sends a shutdown signal via the F0 busbar.
ASM	The ASM taps the F0 busbar. Shutdown is made via the F0 busbar. Thus, the ASM makes a two-fold shutdown of the 400V power supply.

4.4.2 Shutdown Group with F Switch

Figure 4-5 shows a sample setup of a shutdown group in a PROFIsafe safety application.

In a PROFIsafe safety application the shutdown group is opened by a PROFIsafe F switch.

Figure 4-5



1) Alternatively you can use one of the following modules instead of IM 154-8F PN/DP CPU:

- IM 154-2 DP HF
- IM 154-3 PN HF
- IM 154-4 PN HF
- IM 154-6 PN IWLAN
- CPU 1516PRO F-2 PN

Description

The F switch sets up the F0 and F1 busbars. It provides a shutdown signal via the F0 busbar so that the F0 busbar and the load power supply 2L+ are shutdown. This ensures fail-safe shutdown of all the modules in the shutdown group.

The shutdown group in Figure 4-5 consists of the modules below.

Table 4-4

Module	Description
F switch	The F switch sets up the F0 and F1 busbars of the shutdown group. It sends two shutdown signals, one each via the F0 and F1 busbars.
ASM	The ASM taps the F0 busbar. Shutdown is made via the F0 busbar. Thus, the ASM makes a two-fold shutdown of the 400V power supply.
Motor Starter	The motor starter is shut down via the load power supply 2L+.

4.4.3 Setup Rules for Fail-safe Shutdown

The following rules must be adhered to when setting up a shutdown group for fail-safe shutdown.

- The shutdown group is opened by the F switch or the F-RSM.
- Within a shutdown group, the F0 and F1 busbars must not be interrupted by modules that have no F0 and F1 busbars.
- Modules that interrupt the F0 and F1 busbars must be positioned completely to the right in the shutdown group; for example, for the fail-safe shutdown of DOs (digital output modules).

Table 4-5 gives an overview of the modules that set up, tap or interrupt the F0 and F1 busbars.

Table 4-5

Module	Set up F0 busbar	Set up F1 busbar	Interrupt F0/F1 busbars	Tap F0 busbar	Tap F1 busbar
F switch	**Yes**	**Yes**	No	No	No
F-RSM	**Yes**	No	No	No	No
RSM	No	No	No	No	No
ASM	No	No	No	**Yes**	No
MS	No	No	No	No	No
E-MS	No	No	No	No	No
FC-2	No	No	No	**Yes**	No
IO modules	No	No	**Yes**	No	No
IO F-modules	No	No	**Yes**	No	No
PM-E	No	No	**Yes**	No	No
PM-O	No	No	**Yes**	No	No
RFID systems	No	No	**Yes**	No	No
Valve island CPV10, CPV14	No	No	**Yes**	No	No

Table 4-6 gives an overview of the modules that can be given a fail-safe shutdown with the F-RSM or F switch via the F0 busbar or F1 busbar or via the load power supply 2L+.

Table 4-6

	Shutdown via		
	F0 busbar	**F1 busbar**	**Load Power Supply 2L+**
ASM	Yes	No	No
MS	No	No	Yes
E-MS	No	No	No
FC-2	Yes	No	No
Digital output module (DO)	No	No	Yes
Pneumatic interface module • 16 DO DC24V CPV10 • 16 DO DC24V CPV14	No	No	Yes
PM-O	No	No	Yes

Fail-safe shutdown via F0 busbar in a Safety Local safety application

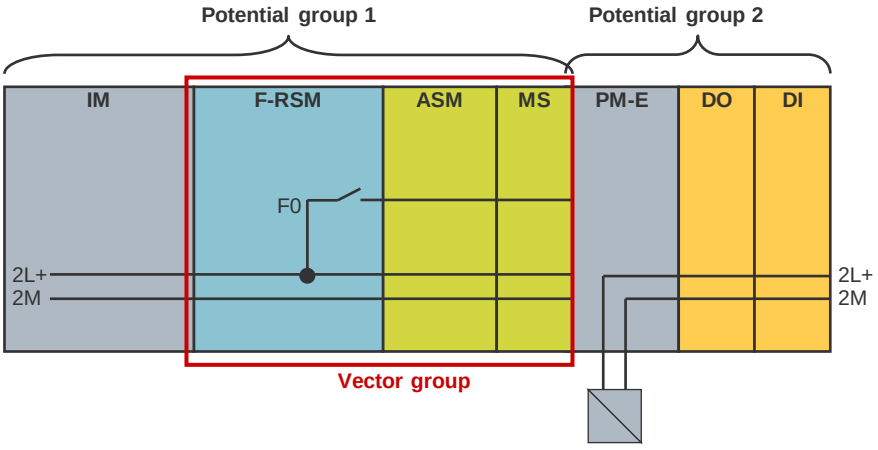
Figure 4-6 shows a sample setup of a shutdown group for fail-safe shutdown via the F0 busbar in a Safety Local safety application.

The F-RSM provides a shutdown signal via the F0 busbar for fail-safe shutdown of the modules in the shutdown group.

All the modules that do not interrupt the F0 and F1 busbars are slotted on the right next to the F-RSM in the shutdown group. Then those modules that interrupt the F0 and F1 busbars are slotted.

The F-RSM shuts down the F0 busbar so that the 400V power supply for the motor starters is also shut down by the ASM.

Figure 4-6



Note The Safety Local repair switch module (F-RSM) may only control up to a maximum of 3 shutdown modules (ASM).

Fail-safe shutdown via F0 and F1 busbars in a PROFIsafe safety application

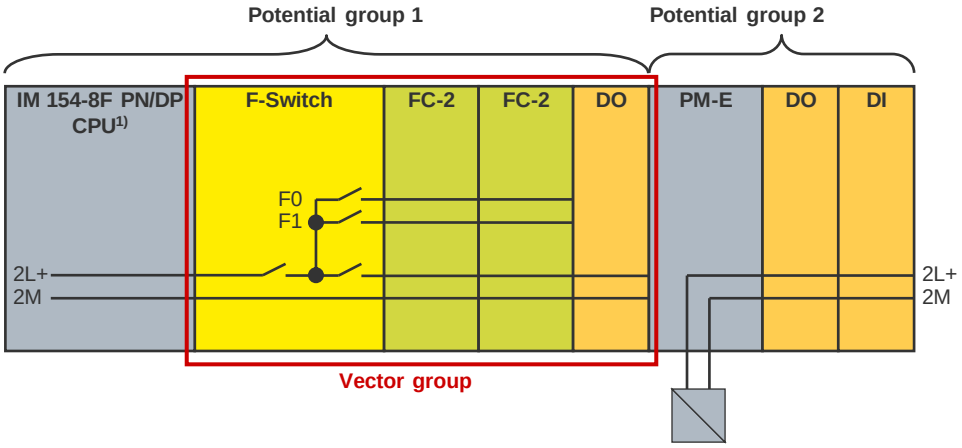
Figure 4-7 shows a sample setup of a shutdown group for fail-safe shutdown via the F0 and F1 busbars in a PROFIsafe safety application.

The F switch provides a shutdown signal via the F0 and F1 busbars for fail-safe shutdown of the modules in the shutdown group.

The modules that do not interrupt the F0 and F1 busbars are slotted on the right next to the F switch in the shutdown group. Then those modules that interrupt the F0 and F1 busbars are slotted.

If the load power supply 2L+ is shut down by the F switch, the DOs and motor starters (MS) are shutdown.
The F switch shuts down the F0 and F1 busbars in parallel to the load power supply 2L+ so that the 400V power supply for the motor starters is also shut down by the ASM.

Figure 4-7



1) Alternatively you can use one of the following modules instead of IM 154-8F PN/DP CPU:

- IM 154-2 DP HF
- IM 154-3 PN HF
- IM 154-4 PN HF
- IM 154-6 PN IWLAN
- CPU 1516PRO F-2 PN

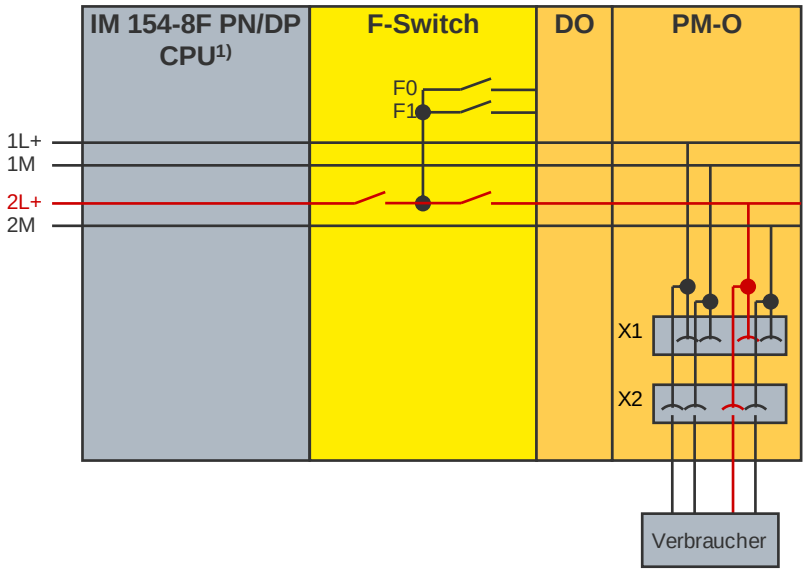
Fail-safe shutdown of PM-O and DO in a Safety Local safety application

Figure 4-8 shows a sample setup of a shutdown group for fail-safe shutdown of PM-O and DOs in a PROFIsafe safety application.

The digital output module and the PM-O are placed on the right next to the F switch.

If the load power supply 2L+ is shut down by the F switch, there is fail-safe shutdown of the DOs, the pneumatic interface modules or the consumers connected to the outgoing module (PM-O).

Figure 4-8



1) Alternatively you can use one of the following modules instead of IM 154-8F PN/DP CPU:

- IM 154-2 DP HF
- IM 154-3 PN HF
- IM 154-4 PN HF
- IM154-6 PN IWLAN
- CPU 1516PRO F-2 PN

4.5 Shutdown Module (ASM)

You use the shutdown module (ASM) for safe shutdown of the 400V power supply together with the Safety Local repair switch module (F-RSM) or F switch.

Place the shutdown module (ASM) on the right next to the F-RSM or F switch.

In this shutdown group an ET 200pro FC-2 frequency converter may not be placed on the right of the shutdown module (ASM).

Sample Safety Local safety function

In a Safety Local safety application, you use the ASM together with a Safety Local repair switch module (F-RSM). Place the ASM on the right next to the F-RSM.

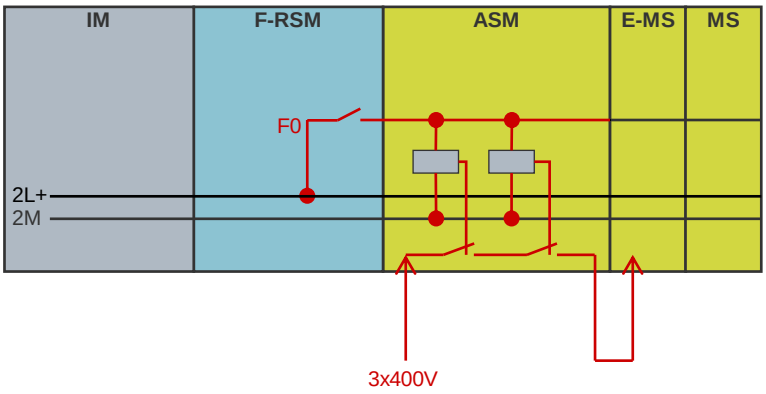
The F-RSM sends a shutdown signal via the F0 busbar. The shutdown signal shuts down the F0 busbar.

The ASM is shut down via the F0 busbar.

The ASM shuts down the 400V power supply of the motor starters to achieve the following in this Safety Local safety application:

- Safety class SIL 3 (Safety Integrity Level)
- PL e (Performance Level) in compliance with ISO 13849-1:2015

Figure 4-9



Sample PROFIsafe safety function

In a PROFIsafe safety application you use the ASM together with an F switch. Place the ASM on the right next to the F switch.

The F switch sends a shutdown signal via the F0 and F1 busbars. The shutdown signals shut down the F0 and F1 busbars and the load power supply 2L+.

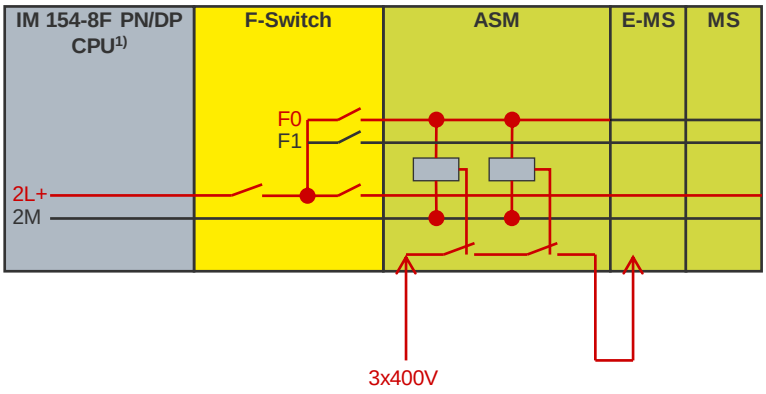
The ASM is shut down via the F0 busbar.

The motor starters are shut down via the load power supply 2L+.

The ASM also shuts down the 400V power supply of the motor starters to achieve the following in this PROFIsafe safety application:

- Safety class SIL 3 (Safety Integrity Level)
- PL e (Performance Level) in compliance with ISO 13849-1:2015

Figure 4-10



1) Alternatively you can use one of the following modules instead of IM 154-8F PN/DP CPU:

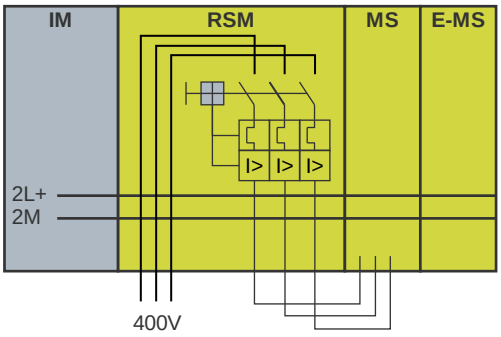
- IM 154-2 DP HF
- IM 154-3 PN HF
- IM 154-4 PN HF
- IM 154-6 PN IWLAN
- CPU 1516PRO F-2 PN

4.6 Motor Starters (MS and E-MS)

4.6.1 Shutdown of the 400V Power Supply with the Repair Switch Module RSM

The mechanical and electronic motor starters (MS and E-MS) can be isolated from the power supply with a repair switch module (RSM). Place the motor starters on the right directly next to the RSM.

Figure 4-11



4.6.2 Safe Shutdown of Mechanical Motor Starters (MS)

The mechanical motor starters (MS) can be shut down safely by the F switch.

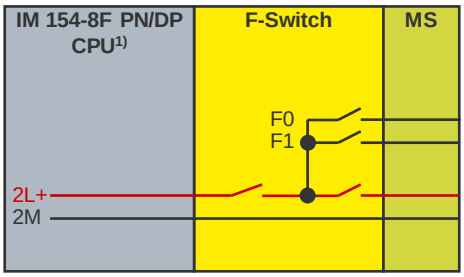
Place the mechanical motor starters (MS) directly on the right of the F switch.

Sample PROFIsafe safety function

In a PROFIsafe safety application the mechanical motor starters (MS) are shut down by the F switch. Place the mechanical motor starters (MS) directly on the right of the F switch.

The mechanical motor starters (MS) are shut down via the load power supply 2L+.

Figure 4-12



1) Alternatively you can use one of the following modules instead of IM 154-8F PN/DP CPU:

- IM 154-2 DP HF
- IM 154-3 PN HF
- IM 154-4 PN HF
- IM 154-6 PN IWLAN
- CPU 1516PRO F-2 PN

4.6.3 Safe Shutdown of Electronic Motor Starters (E-MS)

The electronic motor starters (E-MS) cannot be shut down directly by the Safety Local repair switch module (F-RSM) or the F switch.

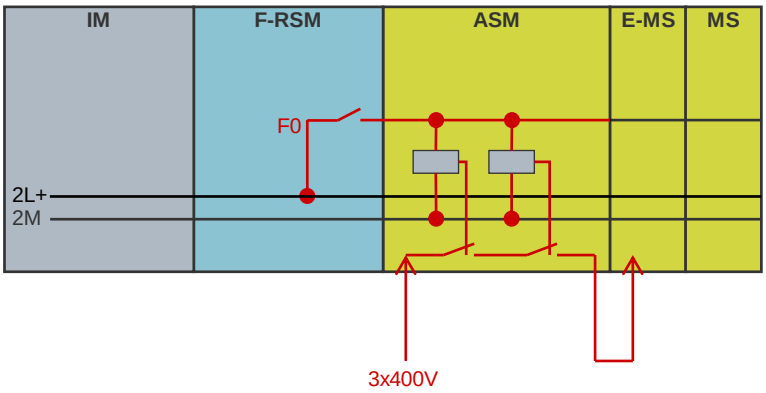
For safe shutdown of the electronic motor starters (E-MS) you must use the F-RSM or the F switch together with an ASM.

Sample Safety Local safety function

Figure 4-13 shows a sample setup of a Safety Local safety application for safe shutdown of mechanical and electronic motor starters (MS and E-MS).

Place the mechanical and electronic motor starters (MS and E-MS) on the right next to the shutdown module (ASM).

Figure 4-13

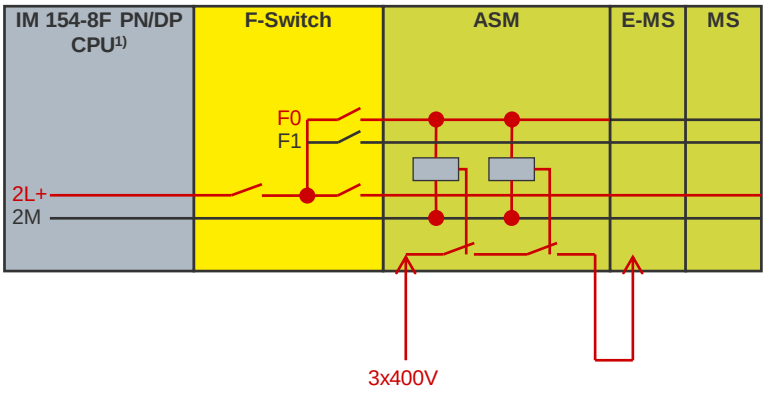


Sample PROFIsafe safety function

Figure 4-14 shows a sample setup of a PROFIsafe safety application for safe shutdown of mechanical and electronic motor starters (MS and E-MS).

Place the mechanical and electronic motor starters (MS and E-MS) on the right next to the shutdown module (ASM).

Figure 4-14



1) Alternatively you can use one of the following modules instead of IM 154-8F PN/DP CPU:

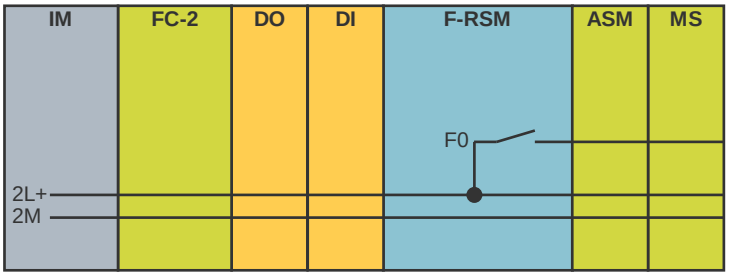
- IM 154-2 DP HF
- IM 154-3 PN HF
- IM 154-4 PN HF
- IM 154-6 PN IWLAN
- CPU 1516PRO F-2 PN

4.7 Frequency Converter

4.7.1 Standard Application with Frequency Converter ET 200pro FC-2

Figure 4-15 shows a sample setup of a standard application with the frequency converter FC-2.

Figure 4-15



The frequency converter FC-2 may also be shut down by the F switch or the F-RSM.

4.7.2 Safety Application with Frequency Converter ET 200pro FC-2

In a safety application a module must be slotted on the left next to the frequency converter ET 200pro FC-2, via which the safety functions of the frequency converter can be controlled, for example:

- A Safety Local repair switch module (F-RSM)
- An F switch

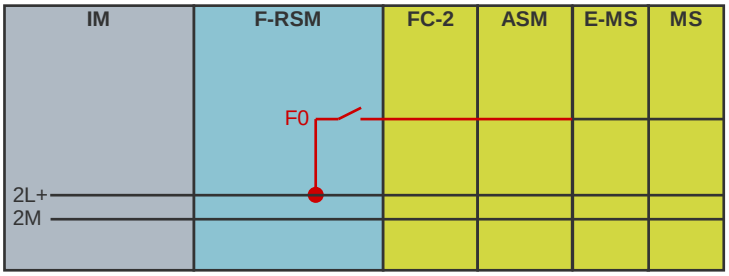
Sample Safety Local safety function

In a Safety Local safety application, you place the frequency converter ET 200pro FC-2 on the right next to the F-RSM. Fail-safe shutdown of the FC-2 is made by the F-RSM via the F0 busbar.

Only the safety function Safe Torque Off (STO) can be used.

The frequency converter ET 200pro FC-2 must not be shut down by the ASM. Therefore, the frequency converter ET 200pro FC-2 may only be placed on the left next to the shutdown module (ASM) in a potential group.

Figure 4-16



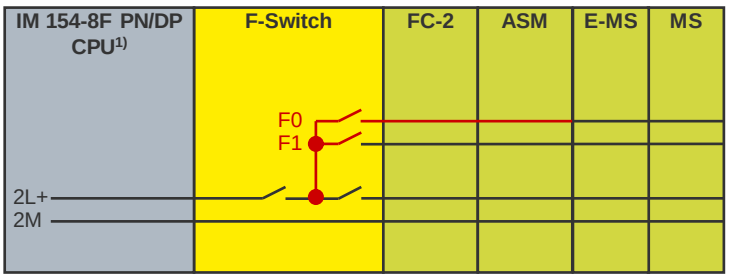
Sample PROFIsafe safety function

In a PROFIsafe safety application you place the frequency converter FC2 on the right next to the F switch. Fail-safe shutdown of the FC-2 is made by the F switch via the F0 busbars.

Only the safety function Safe Torque Off (STO) can be used.

The frequency converter ET 200pro FC-2 must not be shut down by the ASM. This is why the frequency converter ET 200pro FC-2 may only be placed on the left next to the shutdown module (ASM) in a potential group.

Figure 4-17



[1)] Alternatively you can use one of the following modules instead of IM 154-8F PN/DP CPU:

- IM 154-2 DP HF
- IM 154-3 PN HF
- IM 154-4 PN HF
- IM154-6 PN IWLAN
- CPU 1516PRO F-2 PN

5 Setup Versions for Safety Functions

5.1 Standards

Below are some of the standards used for the specification, design and operation of safety systems.

- IEC 61508 and IEC 62061
- ISO 13849-1:2015

Safety systems consist of active or passive plant components. They are used to make dangerous processes safe and reduce the risk of accidents.

5.1.1 IEC 61508

The IEC 61508 standard is applied worldwide as the basis for the specification, design and operation of safety systems.

The IEC 61508 standard categorizes the safety functions of a safety system in SIL safety classes (Safety Integrity Level). Here, the possible risks are considered which would be caused by failure of the safety functions.

The SIL safety class (Safety Integrity Level) is a measure for the required or achieved risk-reducing effectiveness of the safety functions.

5.1.2 ISO 13849-1:2015

The ISO 13849-1:2015 standard replaces the EN 954-1 standard.

By applying the ISO 13849-1:2015 standard you receive a performance level (PL) fitting to the risk against which is to be protected.

The PL value ranges from a (low contribution to reducing risk) to e (high contribution to reducing risk).

Other than the technical requirements of the EN 954-1 standard, the ISO 13849 1:2006 standard provides for several ways of achieving the required PL value. Users can therefore combine the measures they consider most suitable. The technical conditions and cost factors can play a role here. The defined safety structures are always to be applied as usual.

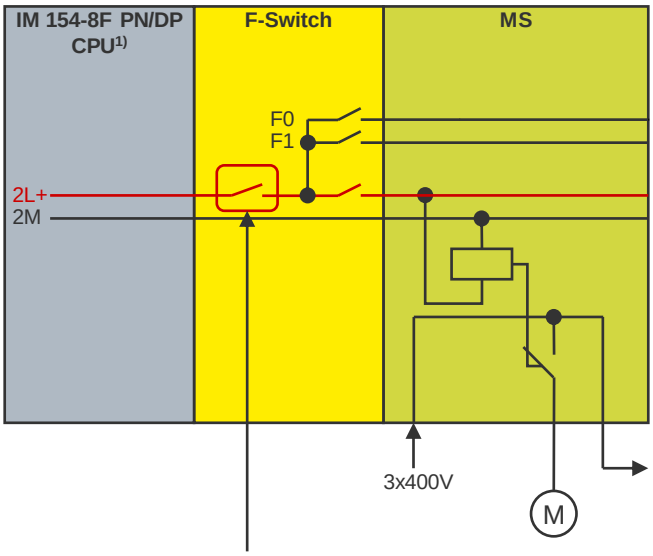
5.2 SIL 1/PL c with Motor Starters

PROFIsafe safety function

If the F switch shuts down a mechanical motor starter (MS) directly via the load power supply 2L+ (without shutdown module), this is a safety function meeting the requirements for

- Safety class SIL 1 (Safety Integrity Level)
- PL e (Performance Level) in compliance with ISO 13849-1:2015

Figure 5-1



Main switch for F0 bus, F1 bus and 2L+ load power supply. In case of internal failure the main switch is opened by the module independently.

1) Alternatively you can use one of the following modules instead of IM 154-8F PN/DP CPU:

- IM 154-2 DP HF
- IM 154-3 PN HF
- IM 154-4 PN HF
- IM 154-6 PN IWLAN
- CPU 1516PRO F-2 PN

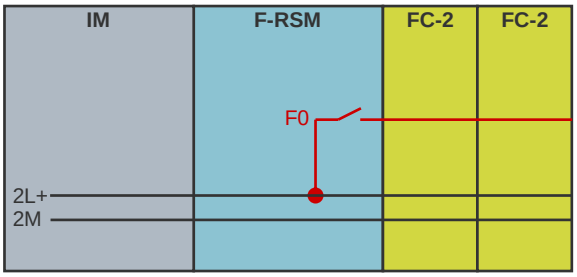
5.3 SIL 2/PL d

Safety Local safety functions

If the F-RSM shuts down the frequency converter ET 200pro FC-2 via the F0 busbar, this is a safety function meeting the requirements for

- Safety class SIL 2 (Safety Integrity Level)
- PL e (Performance Level) in compliance with ISO 13849-1:2015

Figure 5-2

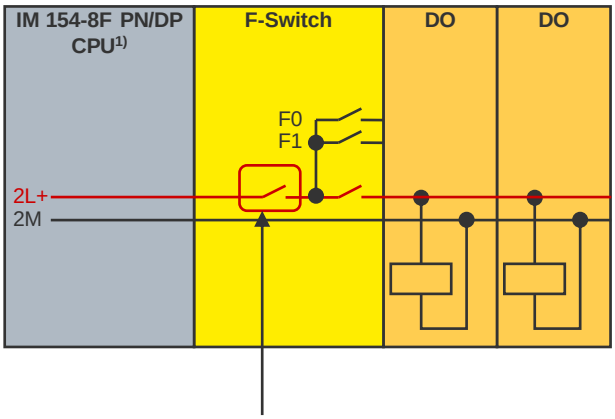


PROFIsafe safety function

If the F switch shuts down the digital output modules on 2 channels via the load power supply 2L+, this is a safety function meeting the requirements for

- Safety class SIL 2 (Safety Integrity Level)
- PL e (Performance Level) in compliance with ISO 13849-1:2015

Figure 5-3



Main switch for F0 bus, F1 bus and 2L+ load power supply. In case of internal failure the main switch is opened by the module independently.

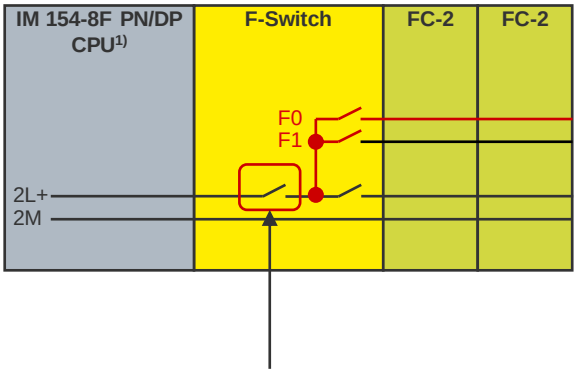
1) Alternatively you can use one of the following modules instead of IM 154-8F PN/DP CPU:

- IM 154-2 DP HF
- IM 154-3 PN HF
- IM 154-4 PN HF
- IM 154-6 PN IWLAN
- CPU 1516PRO F-2 PN

If the F switch shuts down the frequency converter FC-2 via the F0 busbar, this is a safety function meeting the requirements for

- Safety class SIL 2 (Safety Integrity Level)
- PL e (Performance Level) in compliance with ISO 13849-1:2015

Figure 5-4



Main switch for F0 bus, F1-bus and 2L+ load power supply. In case of internal failure the main switch is opened by the module independently.

1) Alternatively you can use one of the following modules instead of IM 154-8F PN/DP CPU:

- IM 154-2 DP HF
- IM 154-3 PN HF
- IM 154-4 PN HF
- IM 154-6 PN IWLAN
- CPU 1516PRO F-2 PN

5.4 SIL 3/PL e with Motor Starters

Using a shutdown module (ASM) you establish safety functions for shutting down motor starters, which meet the requirements for

- Safety class SIL 3 (Safety Integrity Level)
- PL e (Performance Level) in compliance with ISO 13849-1:2015

In these safety functions the F-RSM or the F switch shuts down a shutdown module (ASM) and a motor starter (MS and E-MS). In this shutdown group a frequency converter ET 200pro FC-2 may not be placed on the right of the shutdown module (ASM).

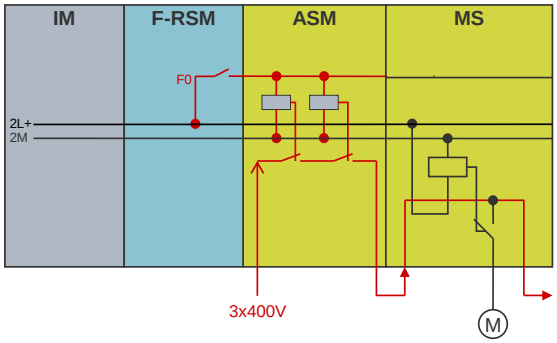
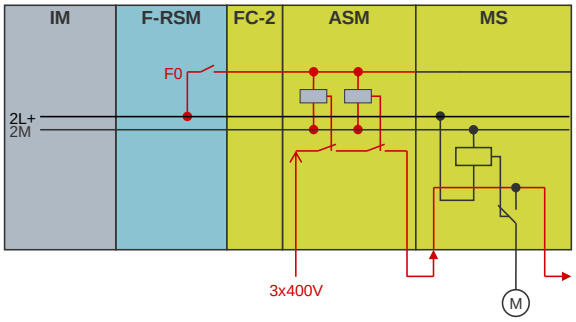
The shutdown module (ASM) is shut down by the F-RSM or the F switch via the F0 busbar. This shuts down the 400V power supply via the ASM.

Safety Local safety functions

The Safety Local safety functions below meet the requirements for

- Safety class SIL 3 (Safety Integrity Level)
- PL e (Performance Level) in compliance with ISO 13849-1:2015

Table 5-1

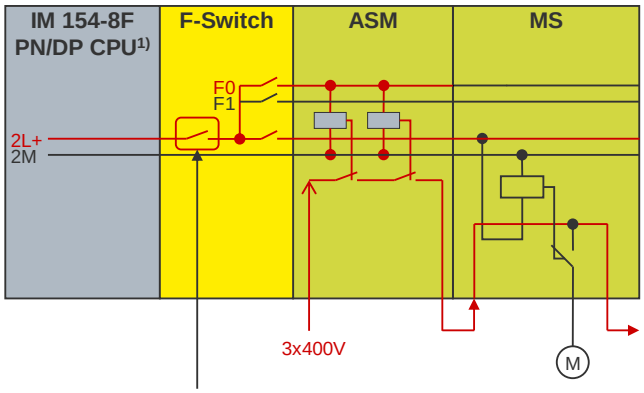
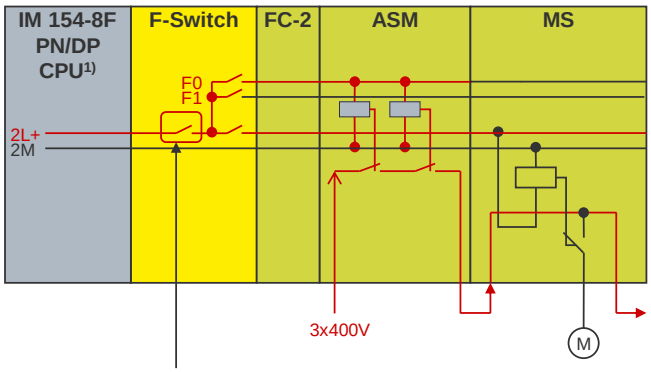
Safety Local safety functions	Note
Sample setup with F-RSM, ASM and motor starters (MS, E-MS)	
Sample setup with F-RSM, FC-2, ASM and motor starters (MS, E-MS)	

PROFIsafe safety function

The PROFIsafe safety functions below meet the requirements for

- Safety class SIL 3 (Safety Integrity Level)
- PL e (Performance Level) in compliance with ISO 13849-1:2015

Table 5-2

PROFIsafe safety function	Note
Sample setup with F switch, ASM and motor starters (MS, E-MS)	 Main switch for F0 bus, F1 bus and 2L+ load power supply. In case of internal failure the main switch is opened by the module independently. Alternatively you can use one of the following modules instead of IM 154-8F PN/DP CPU: • IM 154-3 PN • IM 154-4 PN HF • IM 154-6 PN • CPU 1516PRO F-2 PN
Sample setup with F switch, FC-2, ASM and motor starters (MS, E-MS)	 Main switch for F0 bus, F1 bus and 2L+ load power supply. In case of internal failure the main switch is opened by the module independently. 1) Alternatively you can use one of the following modules instead of IM 154-8F PN/DP CPU: • IM 154-2 DP HF • IM 154-3 PN HF • IM 154-4 PN HF • IM 154-6 PN IWLAN • CPU 1516PRO F-2 PN

6 Glossary

- ASM - Shutdown module
- E-MS - Electronic motor starter
- IO - Input/output module
- F-IO - Fail-safe digital inputs/outputs
- FC-2 - Fail-safe frequency converter
- F-RSM- Fail-safe repair switch
- MS - Motor Starter
- PM-E - Power module supply
- PM-O - Outgoing module
- RSM - Repair switch

7 History

Version	Date	Change
V1.0	24.10.2007	First edition
V1.1	20.10.2008	Complete revision or restructured document
V2.0	03.05.2011	Complete revision: • New modules added • New format template
V2.1	28.08.2013	• Correction of Figures 5-3 and 5-5 • Colors in all figures changed to current color values
V3.0	05.03.2015	Complete revision
V3.1	29.07.2015	Update of the document for frequency converter
V3.2	07.11.2018	The following modules are added: • CPU 1516PRO-2 PN • CPU 1516PRO F-2 PN • IM 154-3 PN HF
V3.3	06.05.2020	New norms have to be used: • IEC 62061:2005 + A2:2015 for SIL • ISO 13849-1:2015 for performance level (PL)