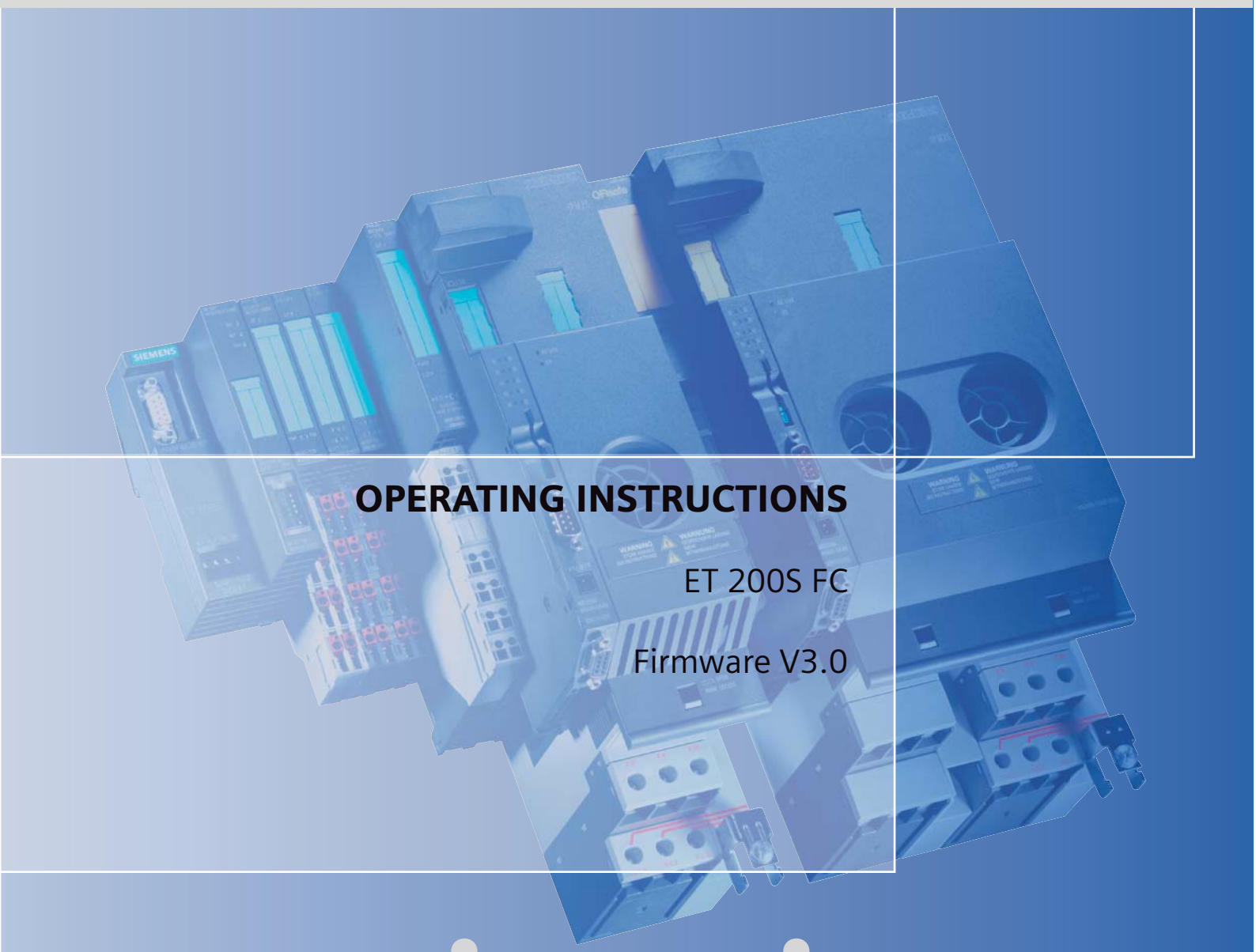
Operating Instructions · 06/2007



OPERATING INSTRUCTIONS

ET 200S FC

Firmware V3.0

simatic

ET 200S FC

SIEMENS

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Product Information

SIMATIC ET 200S FC
SIMATIC ET 200pro FC

Edition 06/2007

This product information sheet describes the behavior of the above mentioned inverters (Firmware version V3.0), that is not described in the associated documentation, edition 06/2007, Firmware version 3.0.

All inverters

If in sensorless vector control (SLVC) one of the following problems appears

- motor does not ramp up
- setpoint jumps at low frequencies at ramp down
- motor does not ramp down to 0 Hz even if torque limit is set to 0
- the calculated motor temperature (P0621 > 0) shown in r0035 is implausible

this can be caused by faulty values for both, stator and motor cable resistance.

Try the following to solve the problem:

- disconnect the motor from the feeder cable,
- measure the stator resistance and the motor cable resistance with an ohmmeter or better with a wheatstone bridge
- put the values in P0350 (stator resistance) and P0352 (cable resistance),
- then perform "calculation of motor parameters" again with P0340 = 3.

If you don' not get feasible values measuring the stator resistance, use the equivalent circuit data of the motor (this can be can be provided by the motor manufacturer) and write it into the respective parameters (fig 6.1 in Function Manual) or reduce the stator resistance in 5 % steps and perform "calculation of motor parameters" again with P0340 = 3.

Fail-safe inverters

If activating SS1 or SLS, this triggers the STO signal as a pulse. This STO pulse has no influence on the SS1 or SLS function and can be ignored.

Parameterization

The parameter length for an ET 200 station is 244 Bytes; when this limit is exceeded the module diagnosis of the ET 200 Frequency converter will not work.

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Frequency converter ET 200S FC

Operating Instructions

Firmware version V3.0

06/2007
A5E01100755B AA

Preface (*** NO TRANSLATION IN THIS VERSION! ***)

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Interfaces 3

Assembly 4

Planning/Configuring 5

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Safety Guidelines

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

⚠DANGER
indicates that death or severe personal injury **will** result if proper precautions are not taken.

⚠WARNING
indicates that death or severe personal injury **may** result if proper precautions are not taken.

⚠CAUTION
with a safety alert symbol, indicates that minor personal injury can result if proper precautions are not taken.

CAUTION
without a safety alert symbol, indicates that property damage can result if proper precautions are not taken.

NOTICE
indicates that an unintended result or situation can occur if the corresponding information is not taken into account.

If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

Qualified Personnel

The device/system may only be set up and used in conjunction with this documentation. Commissioning and operation of a device/system may only be performed by **qualified personnel**. Within the context of the safety notes in this documentation qualified persons are defined as persons who are authorized to commission, ground and label devices, systems and circuits in accordance with established safety practices and standards.

Prescribed Usage

Note the following:

⚠WARNING
This device may only be used for the applications described in the catalog or the technical description and only in connection with devices or components from other manufacturers which have been approved or recommended by Siemens. Correct, reliable operation of the product requires proper transport, storage, positioning and assembly as well as careful operation and maintenance.

Trademarks

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Disclaimer of Liability

We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

Siemens AG
Automation and Drives
Postfach 48 48
90327 NÜRNBERG
GERMANY

Ordernumber: A5E01100755B AA
℗ 08/2007

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Preface

SIMATIC documentation

A wide variety of manuals is available for SIMATIC hardware and software.

You can access an overview of available documentation and languages, which is updated on a regular basis, by visiting us on the Internet at:
http://www.automation.siemens.com/simatic/portal/html_76/techdoku.htm.

The online catalog and ordering system are available at:
https://mall.automation.siemens.com/de/guest/guiRegionSelector.asp?lang=en/

Siemens offers various courses to get you started with the ET 200 and the SIMATIC S7 automation system. Information about our training courses is available on the Internet at:
http://www.sitrain.com/index_en.html

Information about FAQs (frequently asked questions) is available on the Internet at:
http://www.automation.siemens.com/simatic (under "Support" > "FAQ").

Internet address for SIMATIC

http://www.siemens.com/simatic

Target group

This publication is intended for project engineers, commissioners, machine operators, and service and maintenance personnel.

Purpose of the manual

The operating instructions impart knowledge about the components and allow the addressed target groups to properly and safely install, set up, test, and commission the SIMATIC ET 200.

Validity of the manual

This manual is valid for the specified components of the ET 200 decentralized I/O device.

The manual describes the components based on the data valid at the time of its release. We reserve the right to issue a Product Information which contains up-to-date information about new components and new versions of components.

For the sake of simplicity, this documentation does not contain all detailed information about all types of the product and cannot cover every conceivable case of installation, operation, or maintenance.

Experience required

General knowledge in the field of automation engineering and drive technology is required to understand this manual.

Recycling and disposal

Thanks to the fact that it is low in contaminants, the ET 200 is recyclable. For environmentally-compliant recycling and disposal of your electronic waste, please contact a company certified for the disposal of electronic waste.

Guide

You can quickly access specific information in the manual by using the following aids:

- At the beginning of the manual you will find a complete table of contents.
- Important terms are explained in the glossary.
- Navigate to the most important topics in this document using the index.

Special notes

In addition to this manual, you also need the manual for your DP master or I/O controller.

Overview

The components of ET 200S are described in various manuals. The following examples illustrate possible constructions of ET 200S and the manuals you will need in this context.

Table 1 ET 200S without fail-safe components

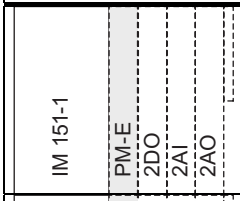
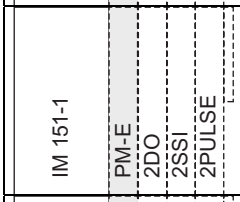
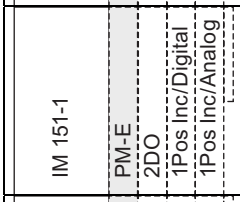
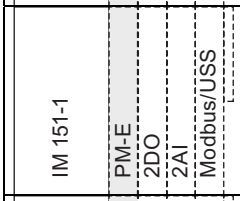
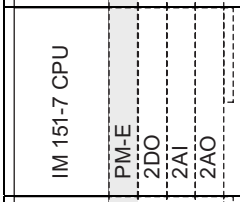
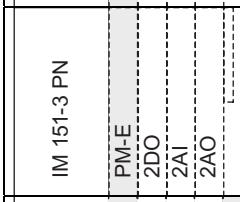
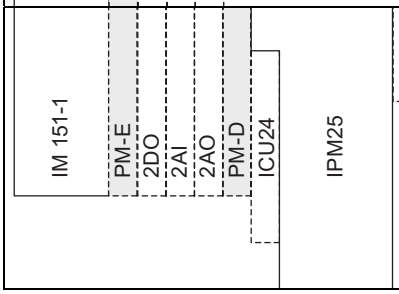
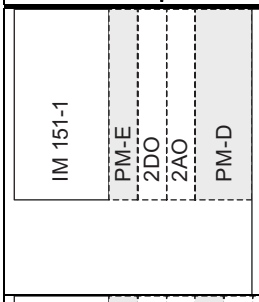
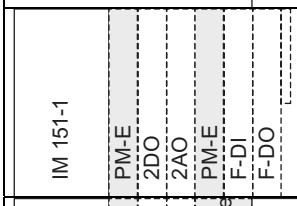
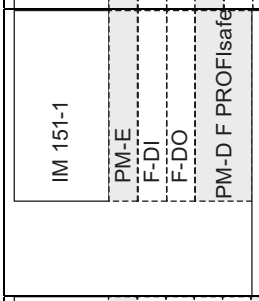
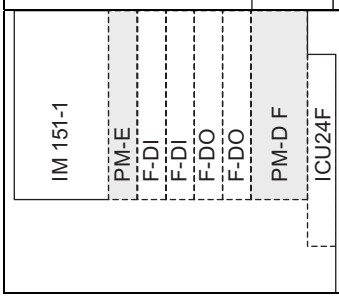
ET 200S comprises:	Manuals required:
	• ET 200S Decentralized Peripherals System
	• ET 200S Decentralized Peripherals System • ET 200S Technological Functions
	• ET 200S Decentralized Peripherals System • ET 200S Positioning
	• ET 200S Decentralized Peripherals System • ET 200S Serial Interface Module
	• ET 200S Decentralized Peripherals System • IM151-7 CPU Interface Module
	• ET 200S Decentralized Peripherals System • PROFINET System Documentation
	• ET 200S Decentralized Peripherals System • ET 200S FC Frequency Converter – Operating Instructions – Parameter Manual

Table 2 ET 200S with fail-safe components

ET 200S comprises:	Manuals required:
	• ET 200S Decentralized Peripherals System • ET 200S Motor Starter, Fail-Safe Motor Starters, SIGUARD Safety Systems
	• ET 200S Decentralized Peripherals System • ET 200S Decentralized Peripherals System Fail-Safe Modules
	• ET 200S Decentralized Peripherals System • ET 200S Motor Starter, Fail-Safe Motor Starters, SIGUARD Safety Systems • ET 200S Decentralized Peripherals System Fail-Safe Modules
	• ET 200S Decentralized Peripherals System • ET 200S FC Frequency Converter – Operating Instructions – Parameter Manual

Where do you find what information?

The table below will help you get your bearings and find the information you need quickly. It indicates which manual you need to refer to.

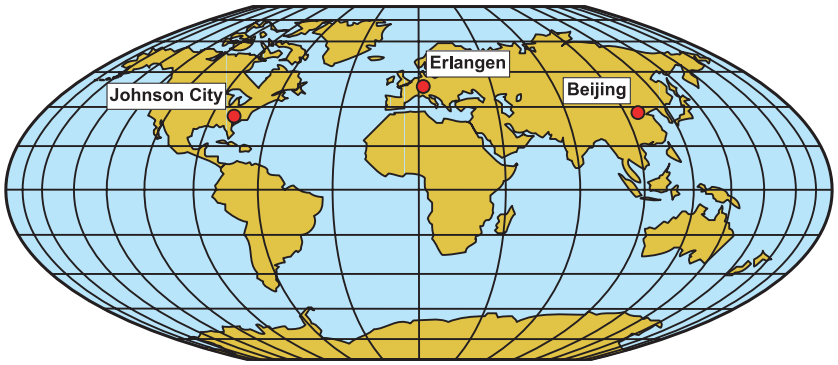
ET 200S manuals:

(1) ET 200S FC Frequency Converter Operating Instructions
(2) ET 200S FC Frequency Converter List Manual
(3) G120, G120D, ET 200S FC, ET 200pro FC Converter Functions Function Manual
(4) ET 200S Decentralized Peripherals System
(5) ET 200S Motor Starter, Fail-Safe Motor Starters
(6) IM151-7 CPU Interface Module
(7) ET 200S Technological Functions
(8) ET 200S Positioning
(9) ET 200S Serial Interface Module
(10) ET 200S Decentralized Peripherals System, Fail-Safe Modules
(11) Safety Engineering in S7 System Description
(12) S7 Distributed Safety Configuration and Programming

Subject	Manual											
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
ET 200S components	x			x	x	x				x	x	x
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Communication	x										x	
Configuration	x				x						x	x
Addressing	x			x		x				x		
Assembly	x			x	x					x		
Electrical configuration and wiring of the ET 200S				x						x		
Programming and parameterization	x	x									x	x
Commissioning and diagnosis	x	x		x	x	x				x		
Functions			x			x						
Function diagrams		x										
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Technical data	x					x	x	x	x			
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Electronic modules				x								
Positioning modules								x				
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Fail-safe modules	x				x					x		
Monitoring, cycle and response times						x				x	x	
Dimension drawings	x			x	x					x		
Applications				x	x							

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Comprehensive information and support tools are available from the Service and Support internet site at:

http://support.automation.siemens.com

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Automation & Drives
A&D SD SPA PM4
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D-91050 Erlangen
Germany

Email: documentation.sd@siemens.com

Regional contacts

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Safety information

1

Safety instructions

The warnings, safety information and remarks that follow are intended to be used as both safety measures for users and measures that can be put in place to avoid damage to the product or to components of the connected machines. The following section provides an overview of warnings, safety information and remarks that are generally applicable to any work involving the ET 200S FC product: these are divided into general instructions and instructions for transportation and storage, commissioning, operation, repair, disassembly, and disposal.

Particular warnings and danger notices, as well as remarks on certain actions, will be given at the beginning of each relevant chapter of these Operating Instructions. In all sections, these will be repeated or expanded upon at key points.

Please read this information carefully: it has been included with your own personal safety in mind and in order to help you extend the service life of both your ET 200S FC product and the machines that are connected to it.

General

⚠ WARNING

This equipment contains dangerous voltages and controls potentially dangerous rotating mechanical parts. Non-compliance with the warnings or failure to follow the instructions contained in this manual can result in loss of life, severe personal injury or serious damage to property.

Protection in case of direct contact by means of SELV / PELV is only permissible in areas with equipotential bonding and in dry indoor rooms. If these conditions are not fulfilled, other protective measures against electric shock must be applied e.g. protective insulation.

Only suitably qualified personnel should work on this equipment, and only after becoming familiar with all safety notices, installation, operation and maintenance procedures contained in this manual. The successful and safe operation of this equipment is dependent upon its proper handling, installation, operation and maintenance.

As the earth leakage for this product can be greater than 3.5 mA a.c., a fixed earth connection is required and the minimum size of the protective earth conductor shall comply with the local safety regulations for high leakage current equipment.

If an RCD (also referred to as an ELCB or a RCCB) is fitted, the Power Module will operate without nuisance tripping provided that:

- A type B RCD is used.
- The trip limit of the RCD is 300 mA.
- The neutral of the supply is grounded.
- Only one Power Module is supplied from each RCD.
- The output cables are less than 15 m screened or 30 m unscreened.

The power supply, DC and motor terminals, the brake and thermistor cables can carry dangerous voltages even if the inverter is inoperative. Wait at least five minutes to allow the unit to discharge after switching off the line supply before carrying out any installation work.

It is strictly prohibited for any mains disconnection to be performed on the motor-side of the system; any disconnection of the mains must be performed on the mains-side of the Inverter.

When connecting the line supply to the Inverter, make sure that the terminal case of the motor is closed.

This equipment is capable of providing internal motor overload protection according to UL508C. Refer to P0610 and P0335, i^2t is ON by default.

When changing from the ON to OFF-state of an operation if an LED or other similar display is not lit or active; this does not indicate that the unit is switched-off or powered-down.

The inverter must always be grounded.

Isolate the line supply before making or changing connections to the unit.

Ensure that the inverter is configured for the correct supply voltage. The inverter must not be connected to a higher voltage supply.



Static discharges on surfaces or interfaces that are not generally accessible (e.g. terminal or connector pins) can cause malfunctions or defects. Therefore, when working with inverters or inverter components, ESD protective measures should be observed.

Take particular notice of the general and regional installation and safety regulations regarding work on dangerous voltage installations (e.g. EN 50178) as well as the relevant regulations regarding the correct use of tools and personal protective equipment (PPE).

⚠ CAUTION

Children and the general public must be prevented from accessing or approaching the equipment!

This equipment may only be used for the purpose specified by the manufacturer. Unauthorized modifications and the use of spare parts and accessories that are not sold or recommended by the manufacturer of the equipment can cause fires, electric shocks and injuries.

NOTICE

Keep this manual within easy reach of the equipment and make it available to all users.

Whenever measuring or testing has to be performed on live equipment, the regulations of Safety Code BGV A2 must be observed, in particular § 8 "Permissible Deviations when Working on Live Parts". Suitable electronic tools should be used.

Before installing and commissioning, please read these safety instructions and warnings carefully and all the warning labels attached to the equipment. Make sure that the warning labels are kept in a legible condition and replace missing or damaged labels.

Transport and storage

⚠ WARNING

Correct transport, storage as well as careful operation and maintenance are essential for the proper and safe operation of the equipment.

⚠ CAUTION

Protect the equipment against physical shocks and vibration during transport and storage. It is important that the equipment is protected from water (rainfall) and excessive temperatures.

Description

2

2.1 The frequency converter

Description

The ET 200S FC is a modular frequency converter that is completely embedded in the decentralized peripherals system of the ET 200S. The individual components can be configured in STEP 7 HW Config or integrated into other configuration systems using a GSD (device master file). The frequency converter itself consists of a Control Unit and a power unit.

The Control Units are available in two versions:

- ICU24 Standard
- ICU24F Fail-safe design

The power unit is available in the following versions:

- IPM25 FSA 750 W
- IPM25 FSB 2.2 kW
- IPM25 FSB 4 kW

The frequency converter works with an input voltage of 3-ph. 400 V AC, 50/60 Hz.

Note

No particular power units are required for ET 200S FC fail-safe frequency converters.

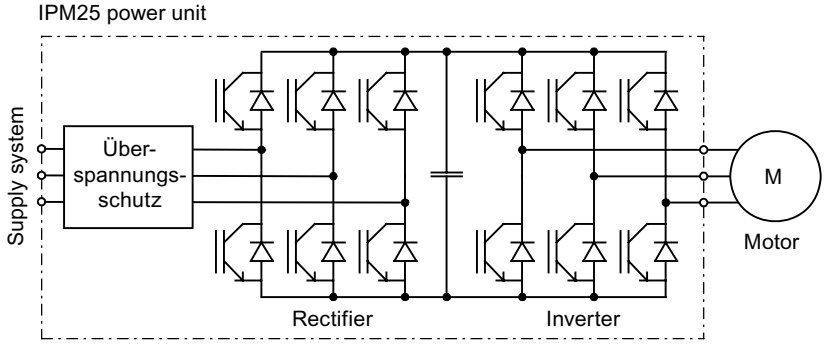


Figure 2-1 Block diagram

Special features of the frequency converter

The power unit of the frequency converter feeds the braking energy from the motor back into the line supply system. A braking resistor, which transforms energy accumulated during regenerative operation into heat, is not necessary.

The frequency converter can be operated without a line reactor.

Commissioning and operation

The commissioning software STARTER is used for commissioning. It is available for download on the Siemens homepage, or can be ordered on a data carrier. It parameterizes the frequency converter via a fieldbus or a point-to-point connection. You have the option of reading the parameters for operating the frequency converter from the EEPROM of the frequency converter or from a Micro Memory Card (MMC) that is inserted in the frequency converter. A higher-level controller (e.g., SIMATIC S7) program is used to control the frequency converter.

Features

- Modular frequency converter in SIMATIC ET 200S system.
- Easy installation
- Simple commissioning
- Interconnection of signals using BICO technology
- Selectable data sets
- Fast current limitation (FCL) for trip-free operation
- Energy recovery into line supply system
- No braking resistor required
- Power unit or Control Unit can be easily swapped during operation (hot swapping)
- Robust EMC design
- Can be configured for a wide range of applications
- Powerfail-proof storage of parameter settings on either EEPROM or MMC parameter memory (MMC-PS).
- Control and diagnostics via a higher-level controller (e.g., SIMATIC S7)
- Diagnostics via LED on the Control Unit
- High pulse frequencies for low-noise motor operation
  Factory setting: 8 kHz; can be set between 2 kHz and 16 kHz
- Commissioning using STARTER via fieldbus or RS232 interface (USS protocol)

Commissioning functions

- Quick commissioning
- Calculating the motor/controller data
- Motor data identification
- Application commissioning
- Standard commissioning

- Parameter reset to factory settings

Operating functions

- Adjustable setpoint channel
- Adjustable ramp function generator (RFG)
- Jog mode
- Free function blocks (FFB)
- Positioning ramp down
- Automatic restart (AR) function
- Flying restart
- Current limit
- Slip compensation
- Motor holding brake (MHB)
- Regenerative braking

Additional features of fail-safe frequency converters:

- Safe Torque Off (STO)
- Safe Stop 1 (SS1)
- Safely Limited Speed (SLS)

Function modules

- Vector control (speed and torque control) with or without encoder
- V/f control with different characteristics

Protective functions

- Motor protection functions
- Converter protection functions
- System protection functions

Interfaces

- PROFIBUS or PROFINET via backplane bus
- MMC parameter memory (MMC)
- RS232 interface with USS protocol
- Motor temperature sensor, KTY84 or PTC
- Encoder interface

Additional features for fail-safe frequency converters:

- Fail-safe inputs on shutdown groups G1 - G6

Block diagram

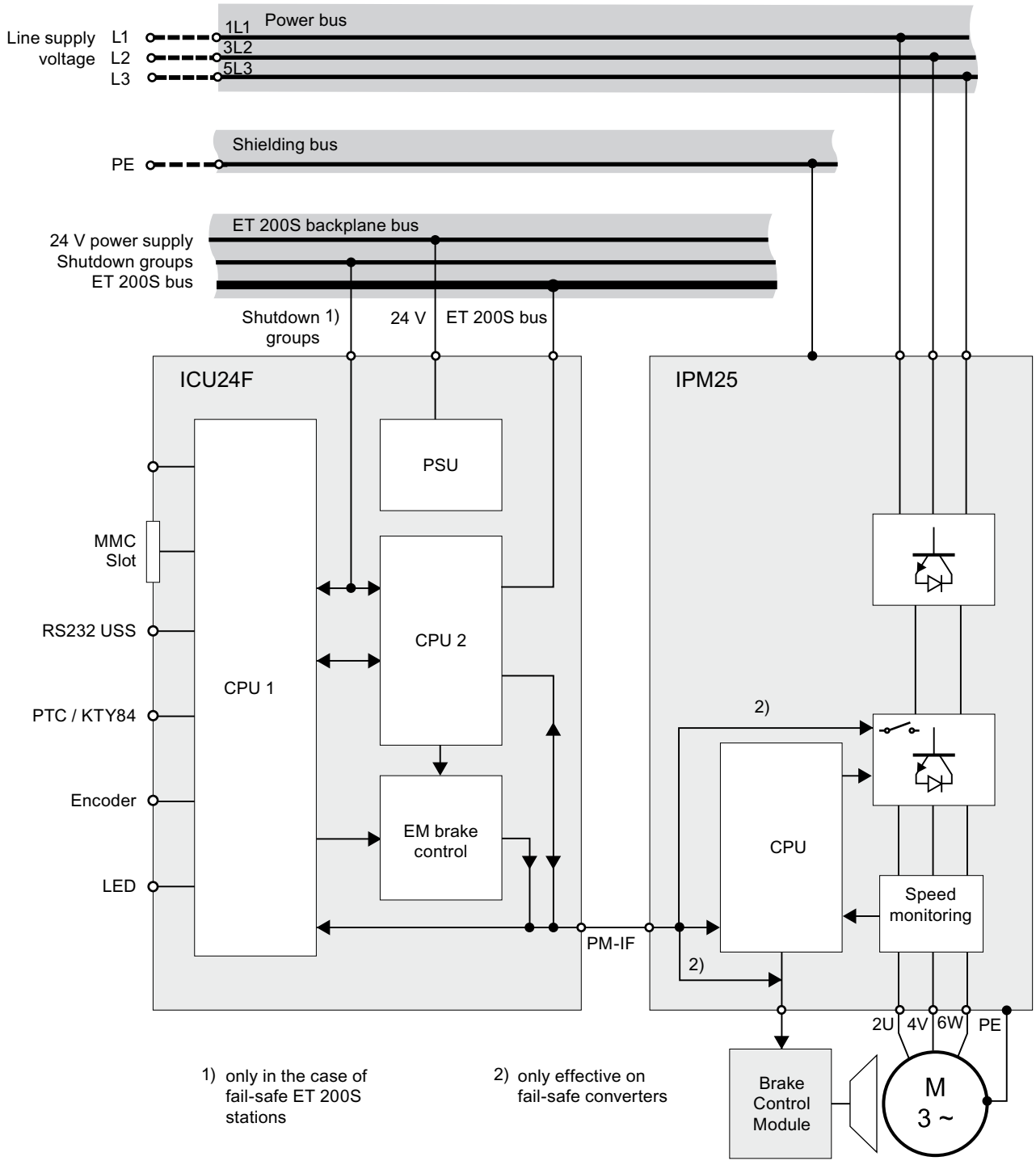


Figure 2-2 Fail-safe ET 200S FC: block diagram

2.2 Components for constructing a frequency converter

General

The following section provides an overview of configuration options for the frequency converter in the ET 200S decentralized peripherals system.

Other general information on the ET 200S decentralized peripherals system can be found in the manual entitled "ET 200S Decentralized Peripherals System".

For the purpose of selecting the components of an ET 200S decentralized peripherals system, we recommend the "SIMATIC ET 200 Configurator" tool.

2.2.1 Components for constructing an ET 200S FC frequency converter

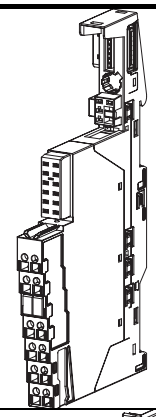
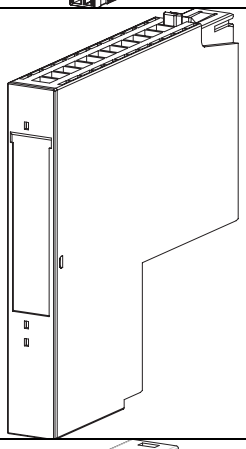
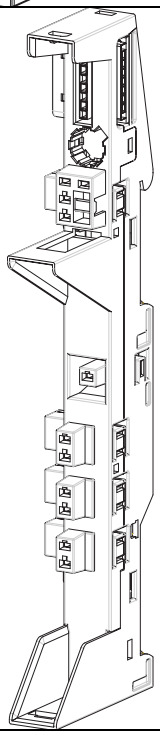
Components for the frequency converter

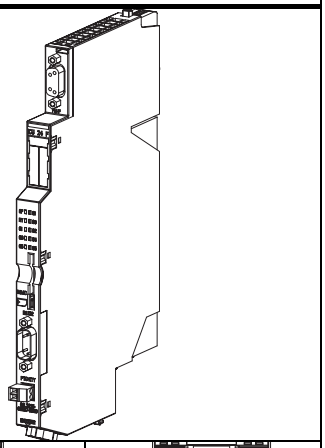
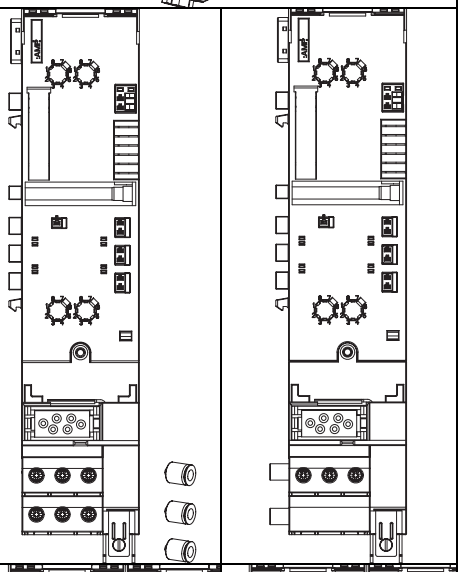
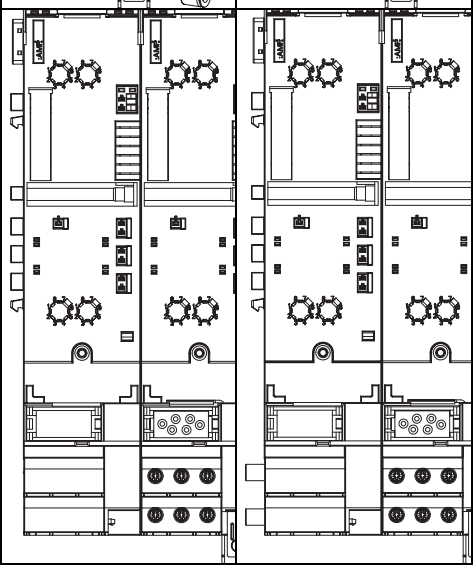
The following table lists the components required (in addition to the DIN rail and interface module) to construct a frequency converter with the ET 200S decentralized peripherals system.

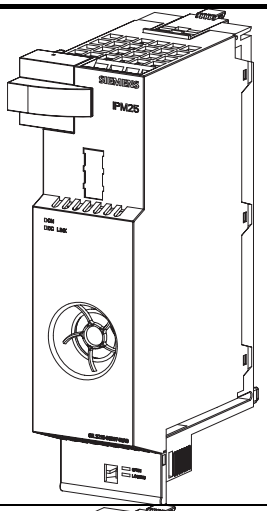
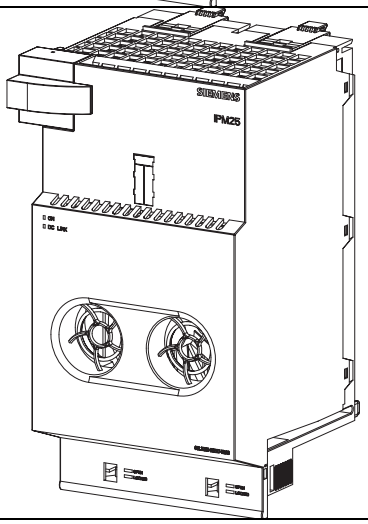
Table 2-1 Components used to construct a frequency converter potential group

Components	ET 200S FC	Fail-safe ET 200S FC
TM-PFX30 or TM-PF30 terminal module		X
PM-D FX1 or PM-D F PROFIsafe power/expansion module		X
TM-P15 S27-01 terminal module	X	
PM-D power module	X	
TM-ICU15 terminal module	X	X
ICU24 Control Unit	X	
ICU24F Control Unit		X
TM-IPM65 terminal module for FSA or TM-IPM130 terminal module for FSB	X	X
IPM25 FSA or IPM25 FSB power unit	X	X

Table 2-2 Components for an ET 200S FC frequency converter

Components	Function	Illustration
TM-P15 S27-01 terminal module	Contains the wiring and houses the PM-D power module. The cover plate is included in the scope of delivery. It ensures touch protection for shutdown groups G1 to G6 and protects them from dirt at the same time.	
PM-D power module	The module monitors the electronic voltage for a group of frequency converters (= potential group).	
TM-ICU15 terminal module	Houses the ICU24/ICU24F Control Unit and establishes any necessary connections.	

Components	Function	Illustration
ICU24 Control Unit	The IPM25 power unit of the ET 200S FC is controlled via the ICU24 Control Unit.	
TM-IPM65 terminal module for FSA	The terminal module houses an IPM25 FSA power unit and supplies it with supply voltage L1, L2, L3. Versions: • S32: With power bus infeed for a new load group (left-hand image), incl. 3 caps • S31: With power bus bushing (right-hand image) as an expansion of a load group	
TM-IPM130 terminal module for FSB	The terminal module houses an IPM25 FSB power unit and supplies it with supply voltage L1, L2, L3. Versions: • S32: With power bus infeed for a new load group (left-hand image), incl. 3 caps • S31: With power bus bushing (right-hand image) as an expansion of a load group	

Components	Function	Illustration
IPM25 FSA power unit for motors up to 750 W	Supplies current, voltage and frequency to the motor. During regenerative operation, this module feeds energy into the line supply system. A brake control module can be connected to the power unit.	
IPM25 FSB power unit for 2.2 kW and 4 kW motors	Supplies current, voltage and frequency to the motor. During regenerative operation, this module feeds energy into the line supply system. A brake control module can be connected to the power unit.	

Fail-safe components

The following table lists the components required to construct a fail-safe ET 200S FC frequency converter.

Note

The following fail-safe components are necessary in order to construct a fail-safe ET 200S potential group with a frequency converter:

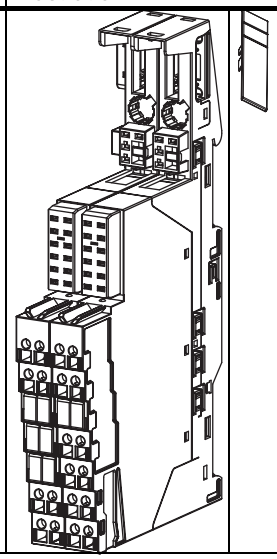
- Fail-safe power module (PM-D F PROFIsafe or PM-D FX1) with corresponding terminal module (TM-PF30/TM-PFX30)
- Fail-safe Control Unit (ICU24F)

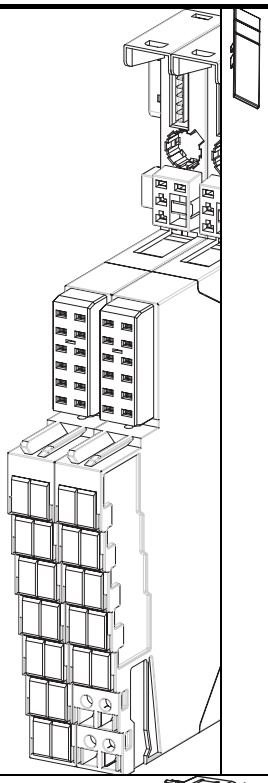
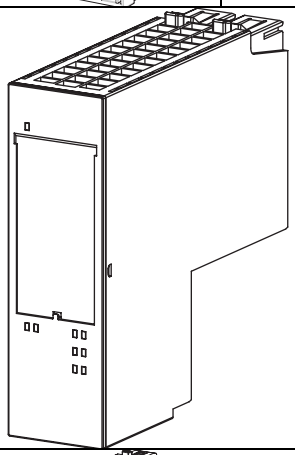
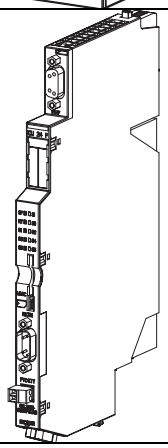
If additional ET 200S components are being used, they must be the fail-safe versions.

Combining fail-safe and standard components in a potential group is not permitted.

If both fail-safe components and the Safety Integrated functionality are being used, the ET 200S system must be constructed in a cabinet with IP54 degree of protection.

Table 2-3 Components for constructing a fail-safe ET 200S FC frequency converter

Components	Function	Illustration
TM-PFX30 terminal module	Contains the wiring and houses the fail-safe PM-D FX1 power module. Versions available: • With infeed from the left for the purpose of expanding a load group for PM-D FX1 power modules • Without infeed from the left as a power module for beginning a new potential group for PM-D FX1 power modules The cover plate is included in the scope of delivery. It ensures touch protection for shutdown groups G1 to G6 and protects them from dirt at the same time.	

Components	Function	Illustration
TM-PF30 terminal module	Houses a fail-safe PROFIsafe PM-DF power module. The cover plate is included in the scope of delivery. It ensures touch protection for shutdown groups G1 to G6 and protects them from dirt at the same time.	
PM-D F PROFIsafe PM-D FX1 power/expansion module	Monitors the electronic voltage for a group of frequency converts, feeds energy to external safety relays and loops through the signals for shutdown groups G1 to G6. Detailed descriptions of the PM-D F PROFIsafe power module can be found in the manual entitled "ET 200S Decentralized Peripherals System - Fail-Safe Modules".	
ICU24F Control Unit	In addition to the functions of the ICU24, the ICU24F Control Unit evaluates the signals of shutdown groups G1 to G6 and uses them to realize the following fail-safe functions: • Safe Torque Off (STO) • Safe Stop 1 (SS1) • Safely Limited Speed (SLS) The TM-ICU15 terminal module is required for both the ICU24F and ICU24.	

2.2.2 ET 200S stations with ET 200S FC frequency converters

ET 200S station with frequency converter – Minimum configuration

The following example shows the construction of and parts list for the minimum configuration of an ET 200S station with a frequency converter.

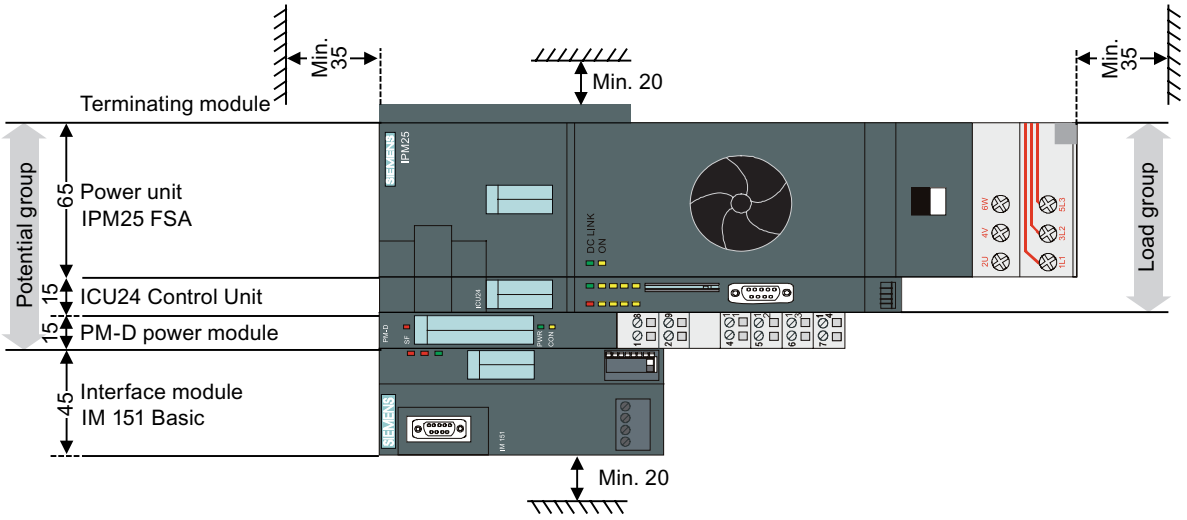


Figure 2-3 ET 200S station with frequency converter – Minimum configuration

Table 2-4 Parts list for ET 200S station pictured above

Designation	Quantity
Terminal module for power module	1
PM-D power module for motor starter	1
Terminal module for ICU24/ICU24F Control Unit	1
Terminal module for 0.75 kW IPM25 with incoming-feeder connection	1
IM 151 Basic for connection of the ET 200S to PROFIBUS DP	1
Frequency converter EMC filter, Class A, 25 A	1
Frequency converter IPM25 power unit, 0.75 kW	1
Frequency converter ICU24 Control Unit	1

ET 200S station with motor starters and frequency converters, with standard and fail-safe components

The following example shows the construction of and parts list for an ET 200S station with both standard and fail-safe frequency converters as well as motor starters.

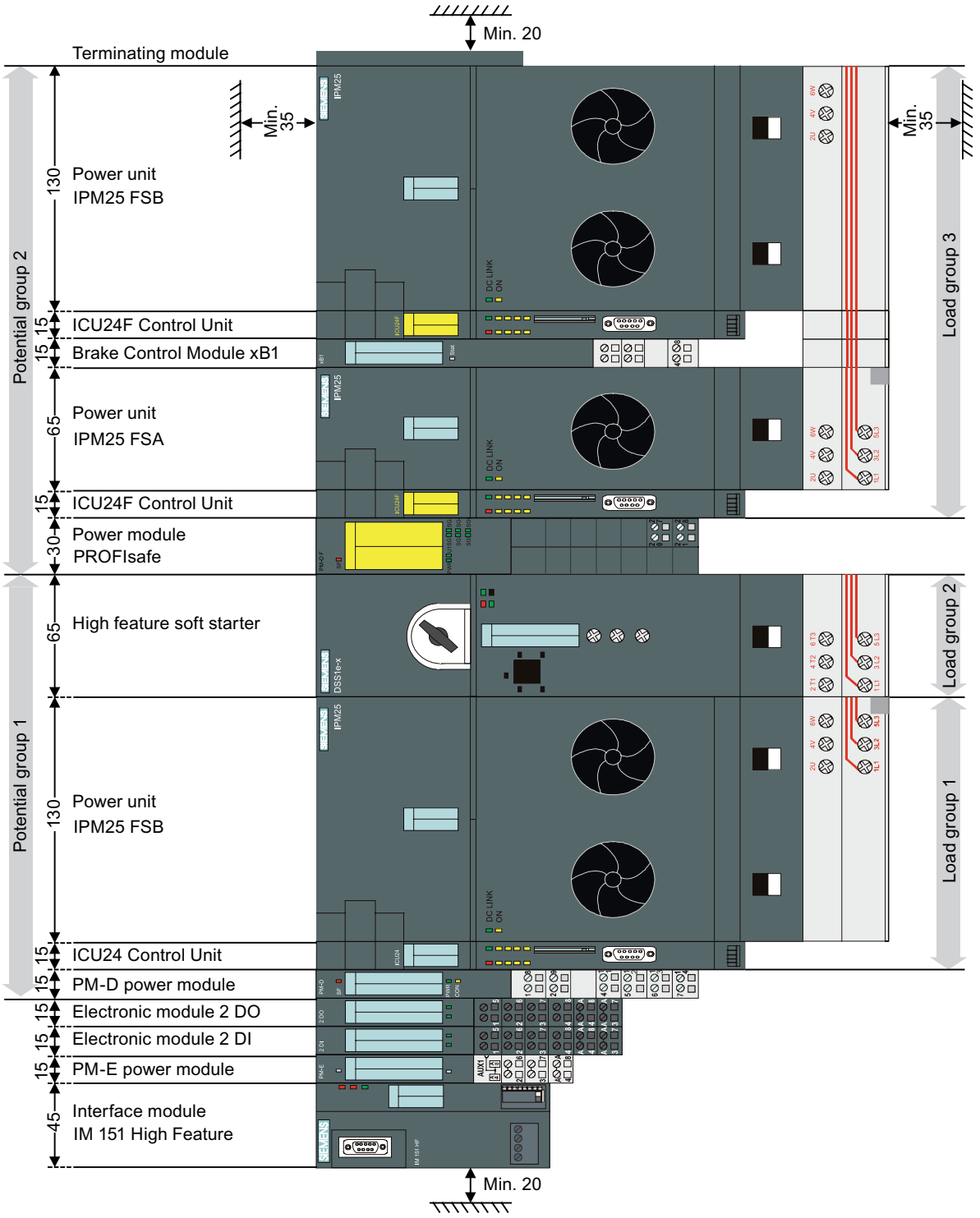


Figure 2-4 Example: Construction of an ET 200S station

Note

The IPM25 power units are the same for both standard and fail-safe frequency converters.

Table 2-5 Parts list for ET 200S station pictured above

Designation	Quantity
High feature soft starter with switch SST, 0.3 to 3 A	1
Terminal module for power module	1
15 mm jumper module L1/L2/L3	2
Terminal module for xB1/2 expansion modules	1
Terminal module for direct/soft starter with incoming-feeder conn.	1
PM-D power module for motor starter	1
xB1 brake control module, 24 V DC/4 A	
Terminal module for PM-D F power module	1
Power module PM-D F PROFIsafe	1
Terminal module for ICU24/ICU24F Control Unit	3
Terminal module for 0.75 kW IPM25 with incoming-feeder connection	1
Terminal module for 2.2/4.0 kW IPM25 with incoming-feeder connection	1
Terminal module for 2.2/4.0 kW IPM25 without incoming-feeder connection	1
Electronic module, 2 DIs, 24 V DC, standard (5 units)	0,2
Electronic module, 2 DOs, 24 V/2 A, standard (5 units)	0,2
PM-E 24 V DC power module for electronic modules; with diagnostics	1
High feature IM151 for connecting the ET 200S to PROFIBUS DP	1
Universal terminal module; screw connection (5 units)	0,4
Terminal module to AUX1 infeed; screw connection	1
Frequency converter EMC filter, Class A, 25 A	2
Frequency converter IPM25 power unit, 0.75 kW	1
Frequency converter IPM25 power unit, 4.0 kW	2
Frequency converter ICU24 Control Unit	1
Frequency converter ICU24F Control Unit	2

2.3 Restrictions/Maximum configuration of connectable ET 200S modules

Maximum configuration per IM 151 interface module

The maximum configuration of an ET 200S station is determined by a number of restrictions. These restrictions depend on the IM 151 interface module being used:

- Maximum station width
- Maximum number of modules
- Maximum parameters
- Maximum address space.

The aspects that affect the maximum configuration of the frequency converters are:

- Maximum width of the ET 200S station: 2 meters (depending on IM 151)
- Maximum current carrying capacity of load group: 50 A
- Maximum current carrying capacity of PM-D power modules: 6 A … 10 A (depending on PM-D).

Under optimum conditions, i.e., a suitable IM 151 interface module has been selected and only FSA power units (0.75 kW) are being used, the maximum number of frequency converters per station is as follows:

- 24 converters (standard)
- 23 converters (fail-safe).

Note

The power unit, EMC filter and brake control modules (xB1 and xB2) are integrated into the ET 200S system via the ICU24/ICU24F Control Unit of the corresponding frequency converter.

STEP 7 HW Config is not used to configure these components.

Whatever the number of parameters in an ET 200S station, they contain a maximum of 244 bytes. This limit does not apply to DPV1 mode for IM151-1 HF.

Address space of the frequency converter

The address space is 4 bytes.

Current carrying capacity of the ET 200S power modules and the maximum number of Control Units that can be connected

The following table lists the maximum current carrying capacity for the ET 200S power modules and the maximum permissible number of ICU24/ICU24F Control Units.

Table 2-6 Current carrying capacity of power modules

Power module		Maximum number of ICU24/ICU24F Control Units that can be connected
Type	Maximum current carrying capacity	
PM-D	10 A	12
PM-D F X1	6 A	7
PM-D F PROFIsafe	Inrush current: 10 A Continuous current: 5 A	6

The number of modules that can be connected depends on the total current of all modules in the potential group. This must not exceed the maximum current carrying capacity of each module.

Note

The maximum current consumption of an ICU24/ICU24F Control Unit is 0.8 A.

If other components belong to a potential group, e.g., motor starters, the current consumption of each of these components must be taken into account individually.

Current carrying capacity of a load group

The derated loading of a load group (sum of the current of all consumers in a load group) is 50 A. If this value is exceeded, a new load group is required.

2.4 Overview of the LEDs

Status display via LEDs

The SIMATIC ET 200S FC frequency converter has a number of functions and statuses that can be displayed by means of the LEDs located on the front plate of the ICU24/ICU24F.

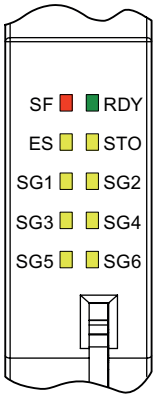


Figure 2-5 ICU24/ICU24F LEDs

The LEDs ES, STO and SG1 to SG6 are only relevant to the ICU24F.

Colors

The frequency converter status is displayed by means of the following range of LED colors and statuses:

Meaning	Color	Status		
		On	Off	Transitional status (Flashing: 0.5 Hz)
Fault LED • SF	Red			
Standby LED • RDY	Green			
Fail-safe LED • ES • STO, SG1 … SG6	Yellow			

Description of the LEDs

LED	Meaning
System failure (SF)	The "System failure" LED indicates a general system error in either the software or hardware.
Ready (RDY)	The "Ready" LED indicates whether the frequency converter is ready to run. It does not show whether the drive is running or not.
Final state (ES)	The "Final state" LED shows whether the final state of a safety function that has been triggered has been reached.
Safe torque off (STO)	The STO LED displays the safety function "Safe Torque Off".
Safety group 1 (SG1) to Safety group 6 (SG6)	The SG1 to SG6 LEDs show the safety group that has been assigned.

You can find safety function information in the Function Manual.

Interfaces

3

3.1 Communications interfaces

Overview

The Control Unit of the ET 200S FC converter has 3 communications interfaces.

Specifically, these are:

- RS232 interface
  For commissioning ET 200S FC using a PC
- Field bus connection
  Via ET 200S backplane bus, for communicating with a master controller
- MMC slot
  for a special Micro Memory Card (MMC) The MMC can be used as parameter memory.

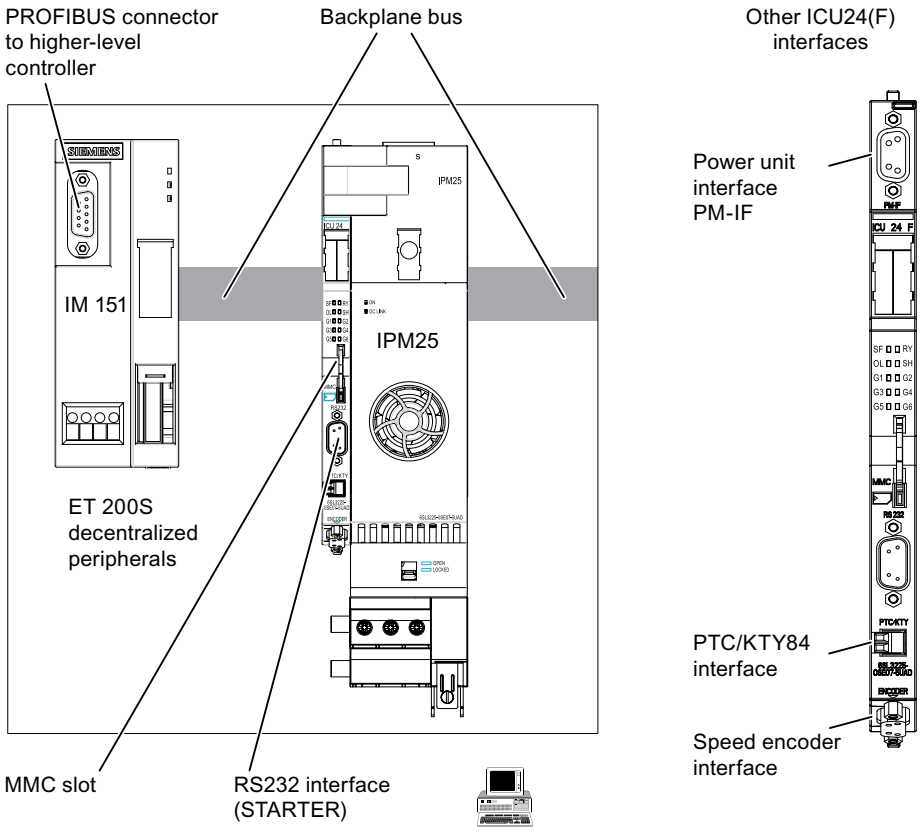


Figure 3-1 Interfaces on the ET 200S FC

The ICU24 Control Unit/ICU24F fail-safe Control Unit are necessary components of the ET 200S FC frequency converter. All of the control processes used for controlling the IPM25 power unit and the brake control module (optional) run on this module. It assumes responsibility for communicating with the higher-level controller via the IM151 interface module.

3.1.1 RS232 interface

Description

The ET 200S FC converter has a serial RS232 communications interface with USS protocol, which is used for the purpose of commissioning with a PC via STARTER commissioning software.

The following components are required:

- PC with Windows 2000/Windows NT4, SP6/Windows XP Professional
- STARTER commissioning software
- Null modem cable

3.1.2 Fieldbus interface (backplane bus)

Description

Communication between an ET 200S station and the corresponding master controller (e.g. SIMATIC S7) is based on the standardized PROFIBUS DP or PROFINET I/O communication protocol. The internal communication of the ET 200S system is routed across the ET 200S backplane bus. The ET 200S IM151 interface module creates the interface between the two bus systems.

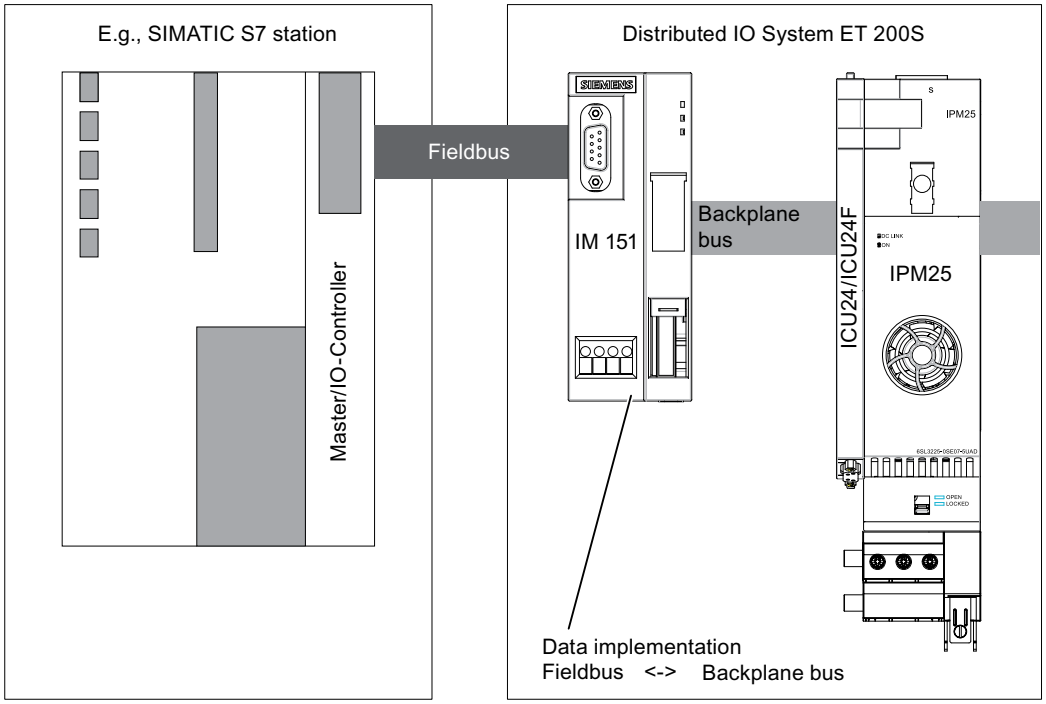


Figure 3-2 Fieldbus connection for ET 200S

Communication data

The ET 200S FC converter is operated and controlled normal process mode by means of PROFIdrive profile 4.0 with standard telegram 1.

The PROFIdrive profile with standard telegram 1 offers the following functionality:

- Sending control words and setpoints with a fixed length to the drive
- Receiving status words and actual values with a fixed length from the drive
- Displaying drive faults via data set 47
- Reading/writing parameters using data set 47.

Note

Parameter values are transferred in non-cyclic data exchange mode by means of data record 47.

Default diagnostics

The frequency converter can be included in the default diagnosis of the S7.

A channel-specific diagnostic message is output to IM 151 if the frequency converter generates a fault message. This diagnostic message triggers a fault display on IM 151 (SF LED). At the same time, an entry corresponding to this is made in the diagnostic buffer of the higher-level SIMATIC PLC and the OB82 is started via a diagnostic interrupt. In the OB82, appropriate responses can be triggered by the user.

3.1.3 MMC interface (Micro Memory Card)

Description

The MMC interface can be used to back up frequency converter parameters on an external MMC and, if required, download them back onto the frequency converter.

Possible fields of application for the MMC

The MMC can be used as a parameter memory:

- Uploading a parameter set onto an MMC
- Transferring parameters from an MMC when exchanging the frequency converter
- Automatic download of a parameter set from an MMC.

Note

Several parameter sets can be stored on an MMC. The file name clone00.bin is used in the default setting. Other names can be set via P0804 (e.g., clone00.bin to clone99.bin).

Inserting the MMC



The label must be facing right when the chamfered edge of the MMC is pointing downwards.

The MMC must be pushed into the MMC slot as far as it will go; it can only then be removed by pressing the eject button.

3.2 Power unit interface (PM-IF)

Description

The power unit interface (PM-IF) connects the ICU24/ICU24F Control Unit of the frequency converter with the IPM25 power unit.

All of the necessary open-loop and closed-loop control signals, as well as monitoring and diagnostic messages, are transferred via this interface.

See also

- IPM25 power unit (Page 60)

3.3 PTC/KTY84 interface

Description

The ICU24/ICU24F has a connector for connecting a PTC/KTY84 sensor for motor temperature monitoring with the following assignment:

Table 3-1 Pin assignment of the PTC/KTY connector

	ICU24/ ICU24-F	KTY84 motor connection		PTC motor connection
	Pin	Connecting terminals	Signal	Connecting terminals
	1	21 amber	KTY + (anode)	3 blue
	2	22 green	KTY - (cathode)	4 black

Note

In the case of the KTY84 temperature sensor, the cathode must be connected to pin 2 of the connector.

The terminal markings on the motor only apply to Siemens motors.

3.4 Speed encoder interface

Description

The speed encoder interface is implemented as a 9-pin sub D socket on the ICU24/ICU24F Control Unit. It is designed in such a way that only single-ended HTL incremental encoders can be connected. Single-ended incremental encoders have only one cable per channel. A channel can be used to detect the speed, but not the direction of rotation. To detect the speed and direction of rotation of a motor, it is, therefore, necessary to use a two-track speed encoder (channel A and B).

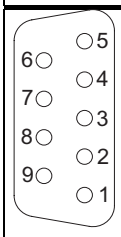
The ICU24/ICU24F Control Unit provides the speed encoder with a non-stabilized 24 V power supply via the sub D socket. It is not possible to use a second (external) power supply with the speed encoder.

Compared with encoderless vector control and V/f operation, connecting a speed encoder offers the following advantages:

- Full torque and speed control until speed is at zero
- Precise speed control
- Stable control response throughout the entire speed range
- Greater speed and torque dynamics

The pin assignment is outlined in the following table.

Table 3-2 Pin assignment of the speed encoder interface

	Pin	Signal	Description
	1	A	Channel A, non-inverted input
	2	B	Channel B, non-inverted input
	3	Z	Channel Z, non-inverted input
	4	0 V	0 V, power supply for speed encoder
	5	24 V	24 V, power supply for speed encoder
	6, 7, 8, 9		Not used
	Shield	GND	Grounding

CAUTION

The transfer direction of the speed encoder and motor must be the same as that of the encoder when using vector control. If you do not observe this regulation, it is not guaranteed that vector control with the encoder will function properly. For this reason, extreme care should be taken when connecting the motor to the converter and wiring the encoder (power cables/encoder signal cables must not be twisted).

3.5 Brake control module interface

Description

An ET 200S brake control module can be controlled via the ET 200S FC.

The electrical connection between the brake control module and the frequency converter is established when the IPM25 power unit is connected via the terminal module of the brake control module.

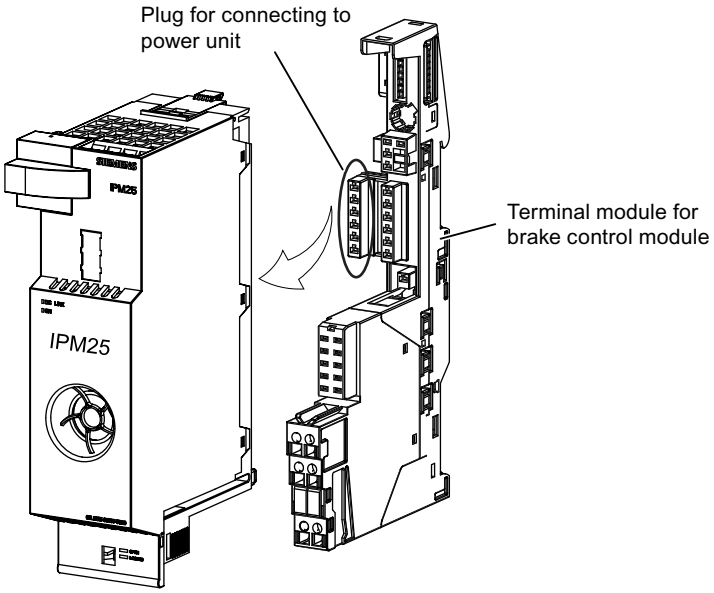


Figure 3-3 Brake control module interface - Power unit

Assembly

4

4.1 Slot rules

ET 200S FC frequency converter slot rules

In order to operate an ET 200S system safely and correctly, the individual components must be inserted according to specific rules. The following section provides an overview of the rules that must be observed when constructing an ET 200S station with ET 200S FC frequency converters.

- A power module is always located to the right of an IM151 module.
- Each potential group begins with a power module.
- An IPM25 power unit must always be connected to the right of an ICU24/ICU24F Control Unit.
- An ICU24F fail-safe Control Unit must only be connected to a potential group with a fail-safe power module (PM-D F PROFIsafe or PM-D FX1).
- An ICU24 Control Unit must only be connected to a potential group with a standard power module (PM-D).
- The ET 200S FC and high feature motor starter must not be operated in the same load group.

4.2 Assembly rules

DIN rail

The ET 200S decentralized peripherals system is assembled on DIN rails in accordance with EN 50022 (35 mm x 7.5 mm or 35 mm x 15 mm). To construct an ET 200S station with ET 200S FC frequency converters, you need two DIN rails that have been assembled with a center-line spacing of 100 mm.

Note

We recommend screwing the DIN rails onto the mounting plane with a distance of 200 mm between them.

Simple assembly

The ET 200S decentralized peripherals system is designed for simple assembly. When constructing an ET 200S station with ET 200S FC frequency converters, the terminal modules are assembled first; the power modules and frequency converter components can then be connected to these.

Assembly rules for constructing an ET 200S station with ET 200S FC frequency converters

Please observe the following rules for assembly:

- Construction is carried out in single-row groups.
- Each row begins with an IM151 interface module on the left.
- A power module comes after the interface module or at the beginning of each potential group. The following power modules are permissible for ET 200S FC frequency converters:
  - Standard version

    PM-D
  - Fail-safe version

    PM-D F X1

    PM-D F PROFIsafe.
- The ET 200S decentralized peripherals system ends with the terminating module. ET 200S FC frequency converters also have a cover plate and cover caps for the power bus on the end.
- The maximum configuration per IM151 interface module consists of 63 modules to be configured.
- A maximum of 24 frequency converters can be connected to an ET 200S station. The maximum station width of an ET 200S rail must not exceed 2 m.

Mounting position

Both vertical and horizontal mounting positions are permitted on DIN rails, whereas the DIN rails themselves must be assembled on a vertical wall. Any derating that may be necessary should be observed.

4.3 Assembling the terminal modules

Features

Terminal modules replace the control wiring in the control cabinet and act as the mechanical support for function modules such as the power modules, converter components, Control Unit, and power unit.

With the terminal modules, the control cabinet can be completely pre-wired even before power modules and frequency converters have been installed. If they are being used, the encoder cable and/or PTC/KTY must be connected to separate connectors.

Requirements

- Both DIN rails have been assembled (with 100 mm center-line spacing between them).
- Space has been set aside for the IM151 interface module.

Mechanical coding of the modules

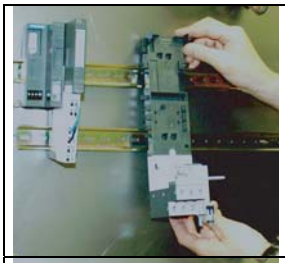
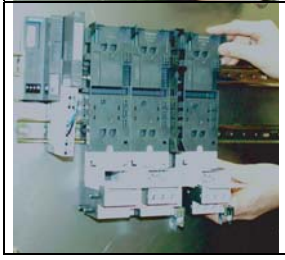
When the module is first connected, the terminal module is mechanically coded in such a way that, in the event of an error, it is only possible to replace the module with one that has identical functions.

For this reason, during assembly take note of the construction that has been configured and label the terminal modules with the ET 200S slot number plates.

Assembling terminal modules for ET 200S FC

The following example demonstrates how to assemble terminal modules with a 65 mm installation width.

Table 4-1 Example: Assembling a TM-DS65 terminal module

	Attach the terminal module to the upper DIN rail and push it onto the lower mounting rail until you hear it latch into place.
	Using both hands, push the terminal module toward the modules that have already been assembled on the left (without tilting it) until you hear it latch onto the neighboring module.

Disassembling terminal modules for ET 200S FC

⚠ WARNING
Switch off all active power supplies!

You can then disassemble a terminal module if no other modules are connected on the right-hand side. You may need to remove all modules on the right-hand side beforehand or move them to one side.

The following example demonstrates how to disassemble terminal modules with a 65 mm installation width.

Table 4-2 Example: Disassembling a TM-IPM65 terminal module

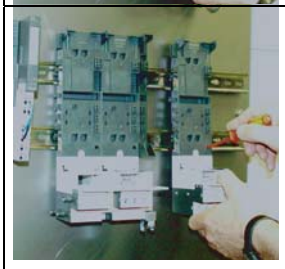
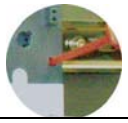
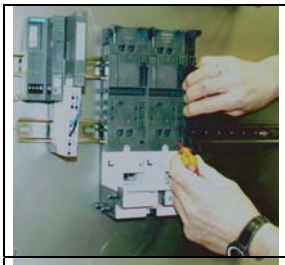
	Using a screwdriver (5 mm), press down the locking slide of the module immediately to the **left** and, with this module's lock open, pull the module that you want to disassemble to the right, moving parallel to the DIN rails. 
	Unlatch the module by inserting the screwdriver in the release opening and pressing the slide switch down. By doing this you will also unlatch the upper and lower DIN rails. Keeping the the slide switch pressed down, remove the module from the lower DIN rail. You can then detach the module from the upper DIN rail. 

Table 4-3 Example: Disassembling a TM-ICU15 terminal module

	Using a screwdriver (5 mm), press down the locking slide of the module immediately to the **left** and, with this module's lock open, pull the module that you want to disassemble to the right, moving parallel to the DIN rails. 
	Unlatch the module by inserting the screwdriver in the release opening and pressing the slide switch down. By doing this you will also unlatch the upper and lower DIN rails. Keeping the the slide switch pressed down, remove the module from the lower DIN rail. You can then detach the module from the upper DIN rail. 

See also

- Assembly rules (Page 52)

4.4 Assembling the converter components

Prerequisites

- The DIN rails have been assembled.
- The terminal modules have been assembled.

Note

When all of the modules are connected, the corresponding terminal module is mechanically coded (two coding keys) in such a way that, in the event of an error, it is only possible to replace the module with one that has identical functions.

You should, therefore, take note of the ET 200S construction when connecting the modules.

Brand new modules are supplied with coding keys for both the power module and the terminal module.

This means that, before the new module can be connected to a terminal module that has already been coded, the coding key for the terminal module must be removed from the new module.

Coding keys that have been incorrectly connected can be removed from the terminal module using a 3 mm screwdriver.

Assembly sequence

1. Connect the power module
2. Connect the ICU24/ICU24F Control Unit
3. Connect the brake control module (if available)
4. Connect the power unit
5. Connect the terminating module, cover plate and caps

NOTICE
If a brake control module has been configured, it is imperative that it is connected upstream of the converter power unit. If the converter power unit has already been connected, it must be removed again before the brake control module can be connected.

4.4.1 Power module

Connecting the power module

Connect the power module to the assembled, pre-wired terminal module. Regardless of the coding key, power modules can only be connected to the terminal modules designed for them.

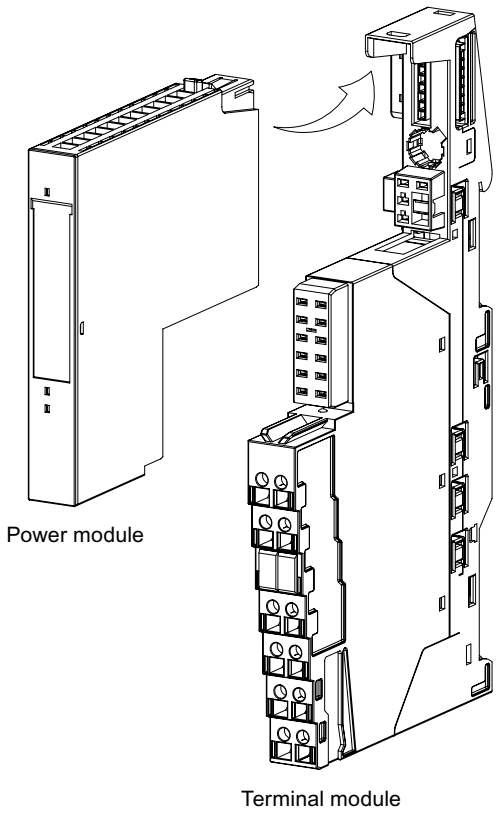


Figure 4-1 Connecting the power module

4.4.2 ICU24/ICU24F Control Unit

Connecting the Control Unit

Note

When the Control Unit is connected, the corresponding terminal module is mechanically coded (two coding keys) in such a way that, in the event of an error, it is only possible to replace the module with one that has identical functions.

You should, therefore, take note of the ET 200S construction when connecting the modules.

Brand new modules are supplied with coding keys for both the ICU24/ICU24F and the terminal module.

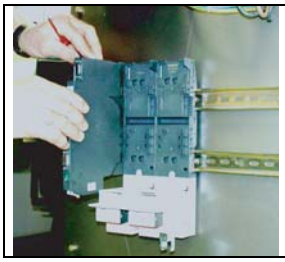
This means that, before the new module can be connected to a terminal module that has already been coded, the coding key for the terminal module must be removed from the new module.

Coding keys that have been incorrectly connected can be removed from the terminal module using a 3 mm screwdriver.

When connecting the Control Unit, check that the latches are correctly engaged.

Connect the ICU24/ICU24F to the assembled terminal module. ICU24/ICU24F Control Units can only be connected to the corresponding TM-ICU15 terminal modules, regardless of the coding key. However, the codings for the ICU24 and ICU24F Control Units are different.

Table 4-4 Connecting the Control Unit

	Push the ICU24/ICU24F Control Unit onto the terminal module, moving parallel to the guide rails, until the upper and lower locking springs latch into place.

Removing the Control Unit

To be able to remove the Control Unit, the power unit must be removed first.

Table 4-5 Disassembling the ICU24/ICU24F

	 Unlatch the module by pressing latches 1 and 2, then remove the Control Unit from the terminal module by pulling it toward you. 

4.4.3 Connecting the brake control module

Prerequisite

The terminal module for the brake control module (optional) has been assembled.

Note

When the brake control module is connected, the terminal modules are mechanically coded in such a way that it is only possibly to replace the brake control module with one that has identical functions.

You should, therefore, take note of the ET 200S construction when connecting the modules.

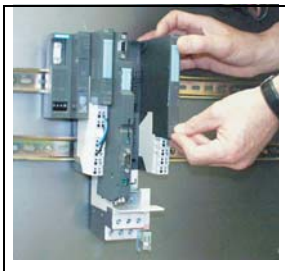
Brand new modules are supplied with coding keys for both the brake control module and the terminal module.

This means that, before the new brake control module can be connected to a terminal module that has already been coded, the coding key for the terminal module must be removed from the new brake control module.

Coding keys that have been incorrectly connected can be removed from the terminal module using a 3 mm screwdriver.

Connecting the brake control module

Table 4-6 Connecting the brake control module

	Once you have customized the coding (if necessary), connect the brake control module to the assembled, pre-wired terminal module. Regardless of the coding key, brake control modules can only be connected to the terminal modules designed for them. **Notice** It is imperative that a brake control module be connected upstream of the converter power unit. If the converter power unit has already been connected, it must be removed again before the brake control module can be connected.

Removing the brake control module

The brake control module can only be removed if the corresponding converter power unit has been removed.

Unlatch the module by pressing the latch at the top of the module, then remove the module from the terminal module by pulling it toward you.

4.4.4 IPM25 power unit

Connecting the power unit

Note

When the power unit is connected, the corresponding terminal module is mechanically coded (two coding keys) in such a way that, in the event of an error, it is only possible to replace the module with one that has identical functions.

You should, therefore, take note of the ET 200S construction when connecting the modules.

Brand new modules are supplied with coding keys for both the power unit and the terminal module.

This means that, before the new module can be connected to a terminal module that has already been coded, the coding key for the terminal module must be removed from the new module.

Coding keys that have been incorrectly connected can be removed from the terminal module using a 3 mm screwdriver.

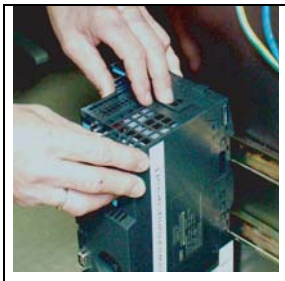
When connecting the power unit, check that the latches are correctly engaged.

Once the ICU24/ICU24F (and, if necessary, the brake control module) have been connected, connect the power unit to the assembled terminal modules. When doing this, two "detent positions" must be observed. Depending on the position, electrical connections are either established or are interrupted during disassembly.

The following table describes how the IPM25 is assembled.

Table 4-7 Assembling the IPM25 power unit

<table>
<tr><td>
Position 1</td><td>
Position 2</td><td colspan="2">Set the IM-PF connector on the power unit to position 2</td></tr>
<tr><td colspan="2" rowspan="2"></td><td rowspan="2">With the IPM25 power unit tilted slightly (see image), push it away from you onto the terminal module. Then push firmly on the lower part until contact with the power bus is established.
• The IPM25 power unit remains slightly tilted and the latch is not engaged.
• In this position, the IPM25 power unit is mechanically unstable and only connected to the power bus.</td><td>
Latch</td></tr>
<tr><td>
Locking spring</td></tr>
</table>

	Push the latch and move the power unit in the direction of the DIN rail until the latch engages twice. Set the IM-PF connector on the power unit to position 1; by doing this you establish the connection between the Control Unit and the power unit. **Engage once: Parking position** • The connection to the ICU24/ICU24F has not yet been established, i.e., no power is being supplied to the power unit electronics yet. • The connection to the power bus has been established, but it is not yet possible to operate the converter. • The connection to the brake control module (if available) has not yet been established. **Engage twice: Operating position** • The connection to the backplane bus is established via the ICU24/ICU24F. • The connection between the Control Unit and power unit is established via the PM-IF connector. • The connection between the power unit and brake control module (if available) has been established. • The locking spring is engaged.

Removing the IPM25 power unit

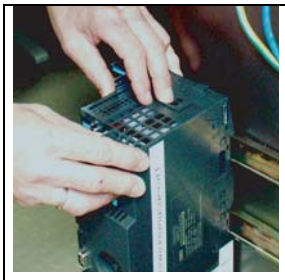
The power unit can be removed while under voltage.

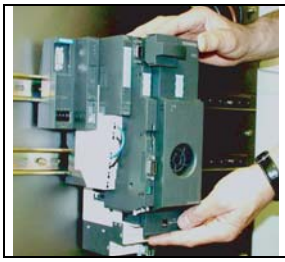
- The motor coasts to a standstill without the brake control module as soon as the PM-IF connector has been removed.
- The motor is braked with the brake control module as soon as the PM-IF connector has been removed and, therefore, the brake control is interrupted.

The other components of the ET 200S station continue to run unaffected.

The following table describes how the IPM25 is disassembled.

Table 4-8 Disassembling the IPM25

	• Set the IM-PF connector on the power unit to position 2' by doing this you interrupt the connection to the ICU24/ICU24F. • Press the latch(es) (one for the ET 200S FC FSA, two for the ET 200S FC FSB) down. • Guide the latch beyond the first detent position. The power unit will now be in the parking position and the module will (still) be mechanically stable (also see previous table). As soon as you have guided the latch beyond the second detent position, the power unit will be in the unlatch position. Unlatching the locking spring will mean that the power unit is no longer mechanically stable.

	Using both hands, grip the upper and lower recessed grip and pull the power unit out. Applying a consistent amount of tension (approx. 30 N tensile force), pull the module in its tilted position to remove it from the terminal module.

Note

We recommend that you provide maintenance and service engineers with detailed information on how to correctly handle the ET 200S FC frequency converter before it is handed over, so that, in the event that a part needs to be replaced, they can take full advantage of the ET 200S system from the outset.

4.4.5 Connecting the terminating module, cover plate and caps

Terminating module

The terminating module must be assembled as the final module in the ET 200S decentralized peripheral device. The ET 200S can only be operated if the terminating module is connected. The terminating module is included in the scope of delivery for the IM151 interface module. You can find more information on this in the manual entitled "SIMATIC ET 200S Decentralized Peripherals System".

Cover plate

With ET 200S FC frequency converters, a cover plate must be attached to the final terminal module in a potential group (if there is a PM-E or terminating module following it) to protect exposed contacts from dirt and to seal off the ET 200S so that it is "touch-proof".

The cover plate is included in the scope of delivery for terminal modules TM-P15 S27-01, TM-PF30 S47-F1 and TM-PFX30 S47-G1 for the power modules.

Caps

⚠ WARNING
Before commissioning at the power bus (L1, L2, L3, N, PE) can take place, the exposed contacts of the final terminal module in an ET 200S FC frequency converter load group must be made finger-safe by covering them with caps (pushed on firmly), which will prevent both the contacts from being touched and the risk of electric shock (400 V AC).

The caps must be removed if the ET 200S station is being expanded. To do this, use a 1 mm screwdriver. Then re-attach them to the power bus of the new final ET 200S FC frequency converter.

The caps are included in the scope of delivery of the terminal module for the ET 200S FC frequency converter with power bus infeed and of the terminal block with PE/N infeed.

Ending a row of the ET 200S construction

Finish the construction of the ET 200S decentralized peripherals device with frequency converters by connecting the following components:

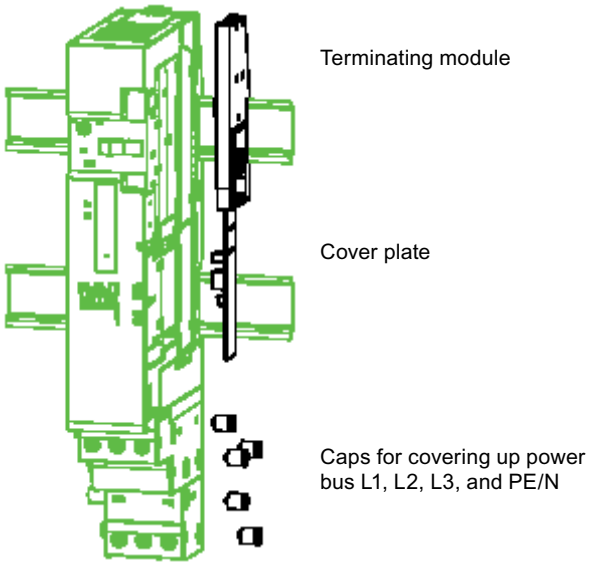


Figure 4-2 Connecting the cover plate and caps

Assembling the terminating module

1. Attach the terminating module to the upper DIN rail.
2. Pivot the terminating module backwards onto the DIN rail until you hear it latch into place.
3. Move the terminating module to the left until you hear it latch onto the last terminal module.

Disassembling the terminating module

1. Use a screwdriver (5 mm) to push the slide switch on the last terminal module down until the mechanism stops, and move the terminating module to the right.
2. Swivel the terminating module out of the mounting rail.

4.5 Wiring in the ET 200S system

Description

The IPM25 power unit of the ET 200S FC frequency converter is rated for direct operation on TN and TT line supply systems with a grounded PEN conductor with a rated voltage of 3-ph. 380 V to 3-ph. 480 V AC.

In the case of systems where CE/EMC requirements are to be fulfilled, the prescribed EMC filters and shielded cables must be used. Standard SY cables are recommended for this purpose. The shield must also be grounded on both sides.

Installation guideline for ET 200S FC frequency converter with EMC filter

- Operation with an EMC filter is only permitted for TN line supply systems.
- The Class A EMC filter is connected directly upstream of the power bus infeed into the main supply conductor of the ET 200S FC frequency converter.
- The converter must be assembled on a grounded plate with a large surface.
- Only shielded cables are permitted downstream of the EMC filter.
- In general, shielded cables should be used for converters with safety-related functions.
- The power bus for the frequency converter must be separate from the other power buses.
- The entire ET 200S system with frequency converters must be installed in a metal control cabinet.
- The maximum length of the power cables is 350 meters. This must also incorporate all of the power cables for all of the converters that are connected to a single power bus.
- The maximum length per frequency converter of the shielded power cable is 50 m.
- Connection cross-section
  - 25 A: 4 mm^2 (AWG 11)
  - 50 A: 10 mm^2 (AWG 7)

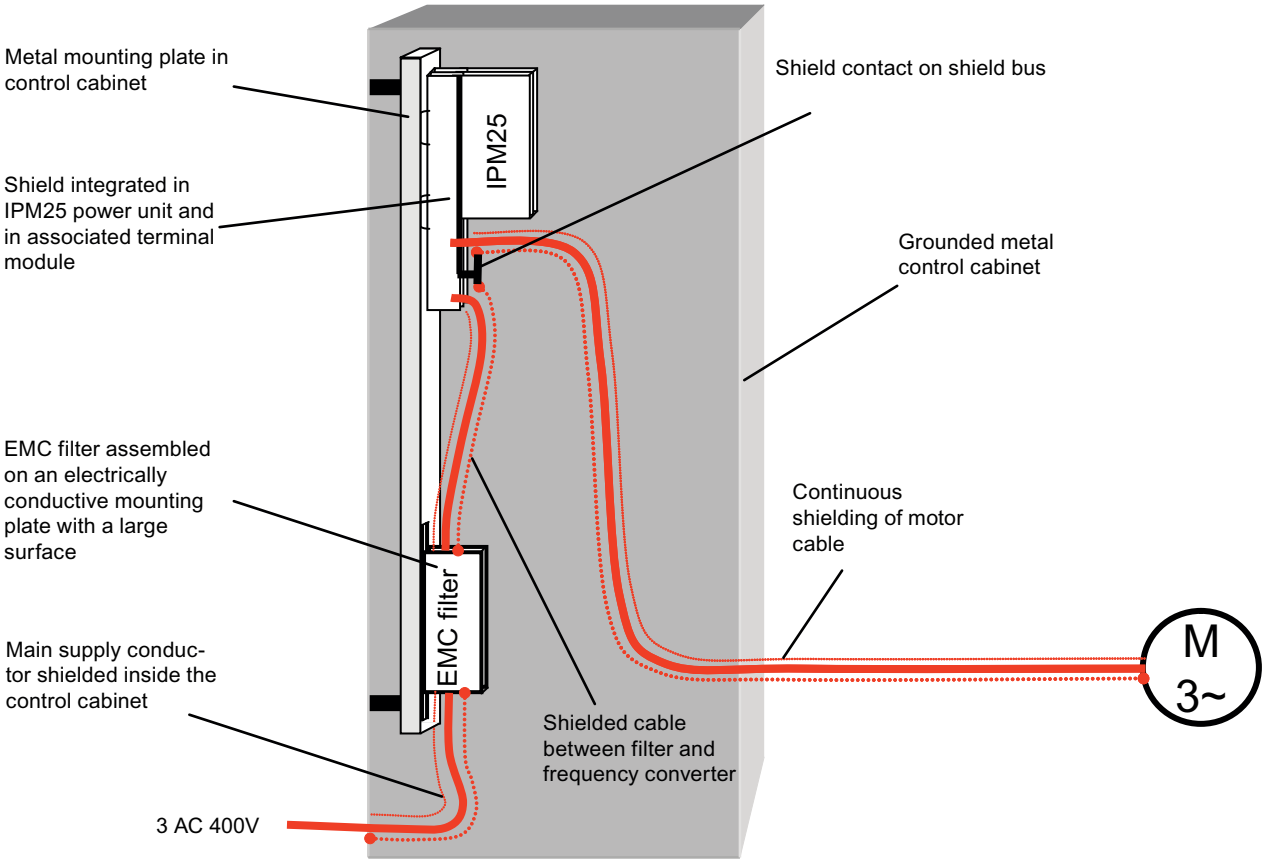


Figure 4-3 EMC-compliant design: Overview

4.6 Shield connections

Description

On the underside of the TM-IPM terminal modules for ET 200S FC power units, there is a metal clamp with a fixing screw for a rail (integrated shield connecting element). After the rail has been assembled, the clamp can be used for the converter in the following ways:

- PA between several converters
- Outgoing cable from HF interference pulses
- Connecting cable shields
- Connecting to the ground bus

The following accessories are required for assembling the rail:

- Shield terminal
- Grounding terminal
- Rail (1 m, 3 x 10 mm)

Procedure

1. Saw off the correct length of rail.
2. Push the rail into the metal clamp.
3. Attach the shield terminals to the rail.
4. Attach the grounding terminal to the rail.
5. Screw the rail tightly using the fixing screw (0.8 Nm).
6. Pull the cable through the shield terminal so that the shield rests between the rail and screw of the shield terminal.
7. Tighten the shield terminal screw.
8. Establish a connection with the ground bus using the shortest route possible and a cable with a minimum cross-section of 16 mm^2.

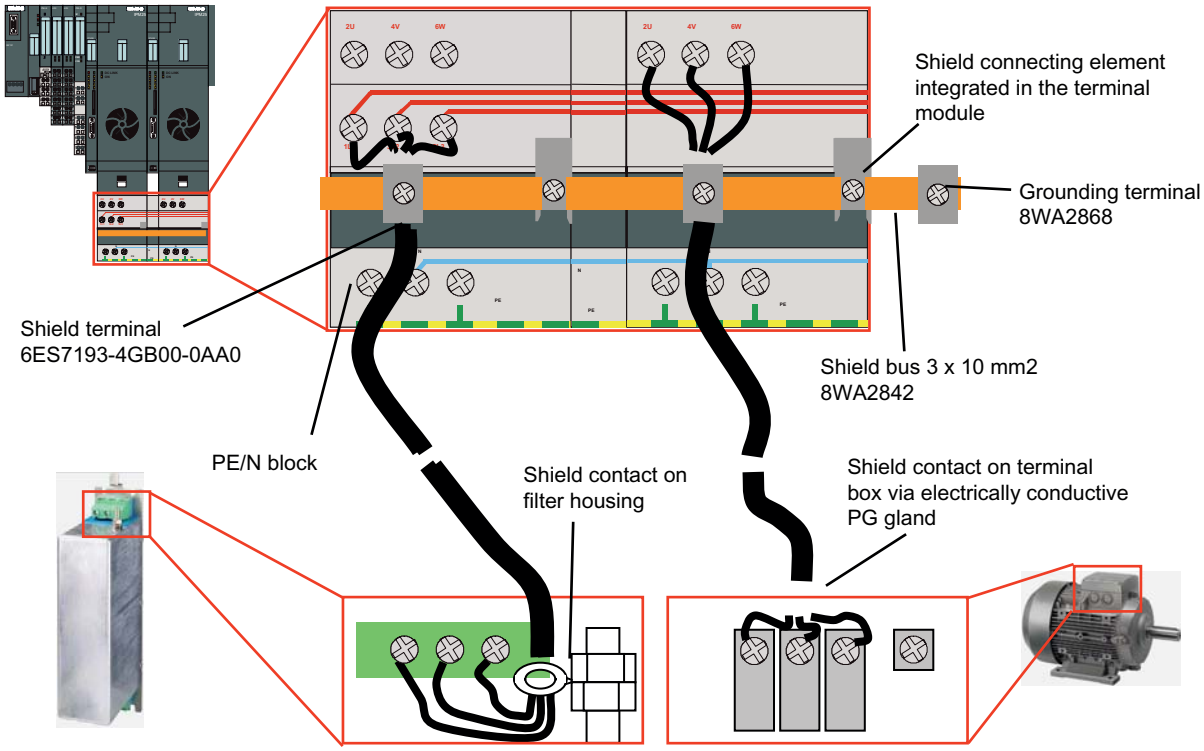


Figure 4-4 EMC-compliant design: Details

Planning/Configuring

5

5.1 Integrating ET 200 frequency converters into automation systems using STEP 7

General information on STEP 7

STEP 7 is the basic package for configuring and programming SIMATIC automation systems. It forms part of the SIMATIC industrial software. There are several versions of the basic STEP 7 package. "STEP 7 for SIMATIC S7-300/400 applications" is required for integrating frequency converters into the ET 200S. You can find more information on STEP 7 in the STEP 7 manuals.

Integrating frequency converters into SIMATIC S7

STEP 7 is used to integrate frequency converters into the line supply system of a SIMATIC S7 controller. Communication takes place via either the standard PROFIBUS DP communication protocol or PROFINET IO. Within the PROFIBUS system the SIMATIC automation device represents the master, whereas the ET 200S station with the PROFIBUS interface module and other components such as frequency converters or I/O modules represents the slave. In PROFINET IO, the SIMATIC automation system is designated as the I/O controller and the ET 200S station with the PROFINET interface module and other components (such as frequency converters or I/O modules) is designated as the field device. Within the ET 200S decentralized peripherals system, the frequency converter is accessed via the ET 200S backplane bus.

Hardware components (SIMATIC and ET 200S)

- SIMATIC S7-300 or SIMATIC S7-400 with integrated PROFIBUS DP/PROFINET IO interface.
- ET 200S with interface module
- ET 200S FC frequency converter.

Software components (SIMATIC and ET 200S)

- STEP 7 Version 5.2 or higher, Service Pack 1 or higher plus the Hardware Support Package (HSP). This can be downloaded directly from HW Config in STEP 7, where the correct link is preset.
- Drive ES block library.

5.2 Installing the hardware information in the SIMATIC Manager

5.2.1 Installing a hardware support package (HSP)

The HSP (hardware support package) file defines the system environment of an ET 200S station. To be able to configure an ET 200S with the HW Config tool, the relevant HSP file must be installed first.

- To do this, open the SIMATIC tool HW Config and go to "Install HW updates" in the "Options" menu.
- In the upper part of the window, select the source of the file (Internet or data carrier) and click "Execute". A new window opens. The HSP files found are displayed in a drop-down list box. Select the "ET 200S ICU24/ICU24F" HSP and click "Copy" or "Download". You can then close this window.
- The copied HSP files will now be available in the drop-down list box of the window that you initially opened. Select the HSP files to be installed from the list of available files in the archive folder and click "Install". All STEP 7 applications will be closed automatically and the selected HSP files installed.

The next time you open the HW Config tool, the ET 200S station will be able to be found in the hardware catalog under PROFIBUS DP/PROFINET IO.

5.2.2 Installation of a master device file (GSD)

The device description for the frequency converter is declared to HW Config in STEP 7 by installing the GSD (master device file) for use with PROFIBUS and the GSDML for use with PROFINET. If no HSP is installed for the frequency converter in the STEP 7 pack, or if the frequency converter is operated with a third party master, the device description for operation on PROFIBUS can be implemented by installing the GSD file. In this case the masks and the designation of the frequency converters differ from the S7 standard as described on the following page.

The following example demonstrates how the GSD can be input into HW Config of the SIMATIC.

- Open the program "HW Config".

  Close any projects which may be open there.
- Then select Options > Install GSD files in order to open the dialog box for installing GSD files and click "Browse" to select the location of the GSD file.
- Then select the file you want from the list and click on the button "Install".

  After the dialog is closed, the hardware configuration catalog is updated automatically and you can open your project.
- Install the GSD file in the required language (English, French, German, Italian, or Spanish) from the folder containing the relevant data.
- Selection of the telegram in the frequency converter is set using the parameter P0922 while the drive is commissioned. The receive telegram is in r2050[8] and the send telegram is set using the P2051[8] parameter.

5.3 Configuring the communication (*** NO TRANSLATION IN THIS VERSION! ***)

The frequency converter is operated by means of PROFIdrive profile.

Table 5-1 Operation with standard telegram 1

Usable PLC	Any PLC
Possible fieldbus	PROFIBUS DP or PROFINET IO
Required blocks	None [1]
Communication between frequency converter and STARTER commissioning software	Optional on the field bus [2] [3] or across the RS232 port of the frequency converter
Cyclic communication between higher-level PLC and frequency converter	4 bytes For details, refer to the "Standard telegram 1" table
Acyclic communication with a higher-level PLC	DS 47 for transferring several parameters [2]
Default diagnostics	Channel-specific diagnostics (diagnostics number, slot number) with OB82 called in higher-level SIMATIC CPU in the event of a frequency converter fault

1 Optional: Drive ES block package
2 Only in PROFINET IO and PROFIBUS DPV1
3 Routing across one or several SIMATIC CPUs is not supported

Table 5-2 Standard telegram 1

	SIMATIC PLC → frequency converter		Frequency converter → SIMATIC PLC	
	Signal	Remark	Signal	Remark
PZD1	STW1	Control word 1	ZSW1	Status word 1
PZD2	NSET_A	Speed setpoint, 16 bit	NACT_A	Speed actual value, 16 bit

5.3.1 Generating a hardware configuration for PROFIBUS in the SIMATIC Manager

Description

The following example of an ET 200S FC frequency converter with "IM 151-1 Standard" interface module demonstrates the three steps in creating a PROFIBUS configuration in HW Config of SIMATIC Manager.

- Parameterizing the PROFIBUS DP interface in SIMATIC S7
- Populating the ET 200S station
- Settings for the frequency converter

Note

Please refer to the "Interface modules" chapter in the manual entitled "ET 200S Decentralized Peripherals System" for information on the interface modules.

Parameterizing the PROFIBUS DP interface in SIMATIC S7

The hardware configuration is used to parameterize the PROFIBUS DP interface. When a CPU with an integrated DP interface or a DP communications processor is selected from the hardware catalog, a PROFIBUS DP system is made available in the hardware configuration. Once the parameters for the master have been set, the slave - in this case, the ET 200S station - must be selected from the hardware catalog and positioned at the PROFIBUS train. Insert an IM 151 accordingly and set the PROFIBUS address for the ET 200S station in the IM 151.

Insert a master system via the context menu of the CPU DP interface.

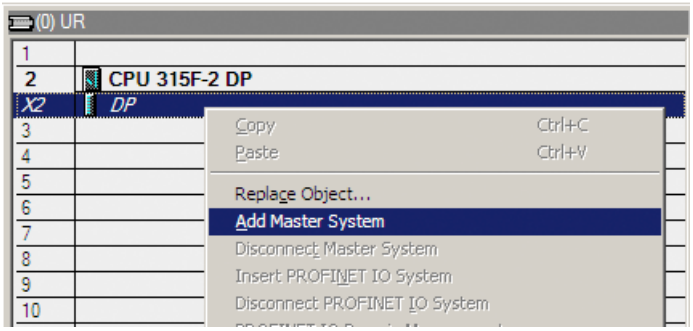


Figure 5-1 Master system

Inserting the ET 200S system into the master system and setting the PROFIBUS address

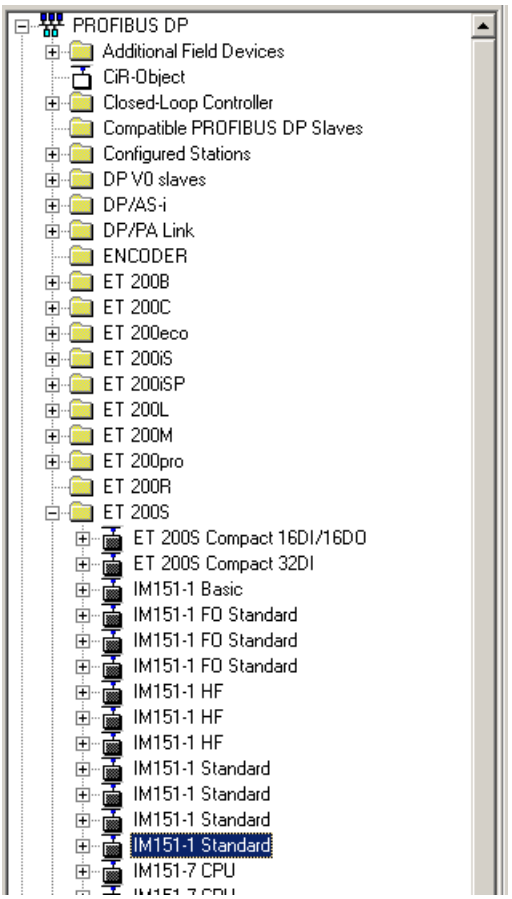


Figure 5-2 Selecting the ET 200S from the hardware catalog

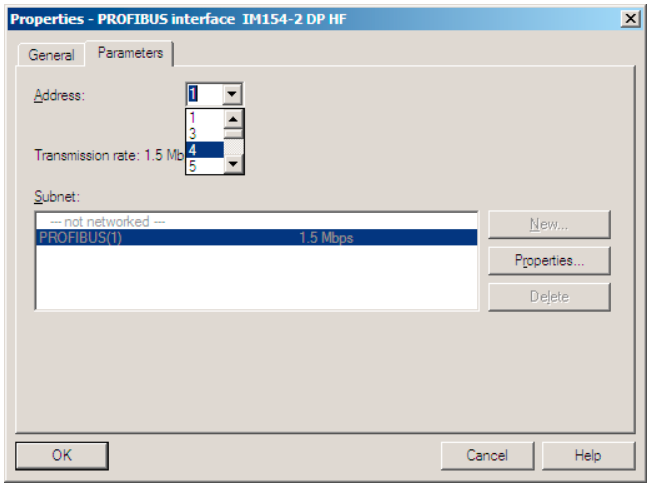


Figure 5-3 Assigning the slave address on PROFIBUS DP

The configuration should now appear as follows:

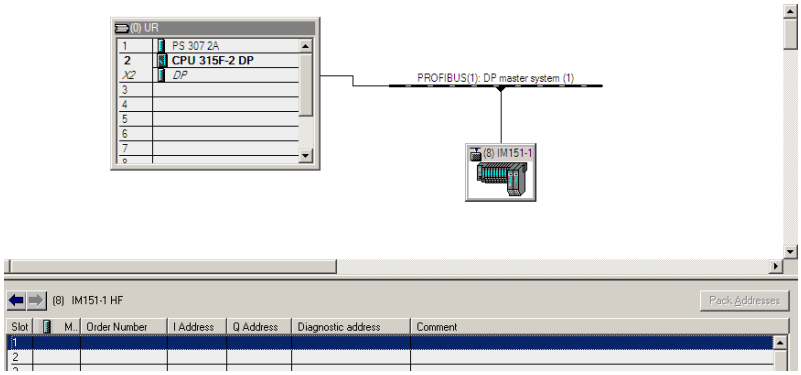


Figure 5-4 Configuration

Inserting a converter into an "ET 200S slot"

Drag-and-drop "ICU24; standard telegram 1" from the hardware catalog to the slot.

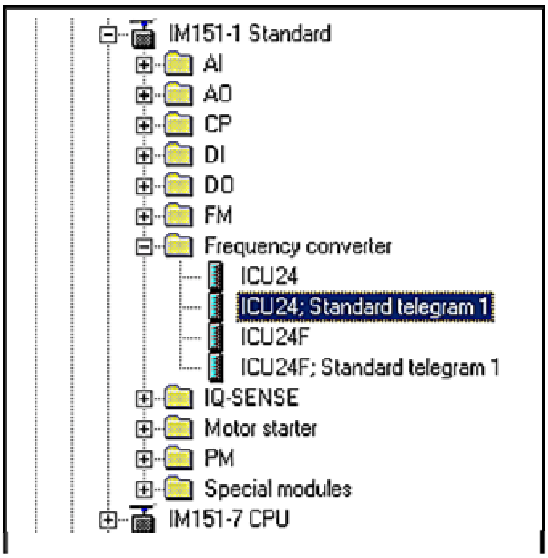


Figure 5-5 Selecting the frequency converter

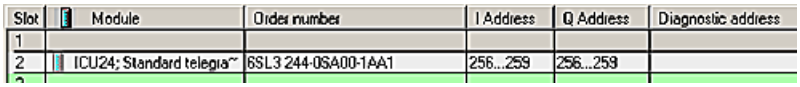


Figure 5-6 Frequency converter in slot

By this selection the user determines whether to use a standard or a fail-safe frequency converter.

Note

A fail-safe PM-D F X1 or PM-D F PROFIsafe power/expansion module must be inserted upstream of the frequency converter if a fail-safe application is installed.

Settings for the frequency converter

Double-click the frequency converter to open the property view with the following tabs:

- General
- Address
- Parameters.

Address/ID

Setting the address in the I/O image
The start address configured in this tab is activated in the user program as "LADDR" input parameter for the blocks in the user program.

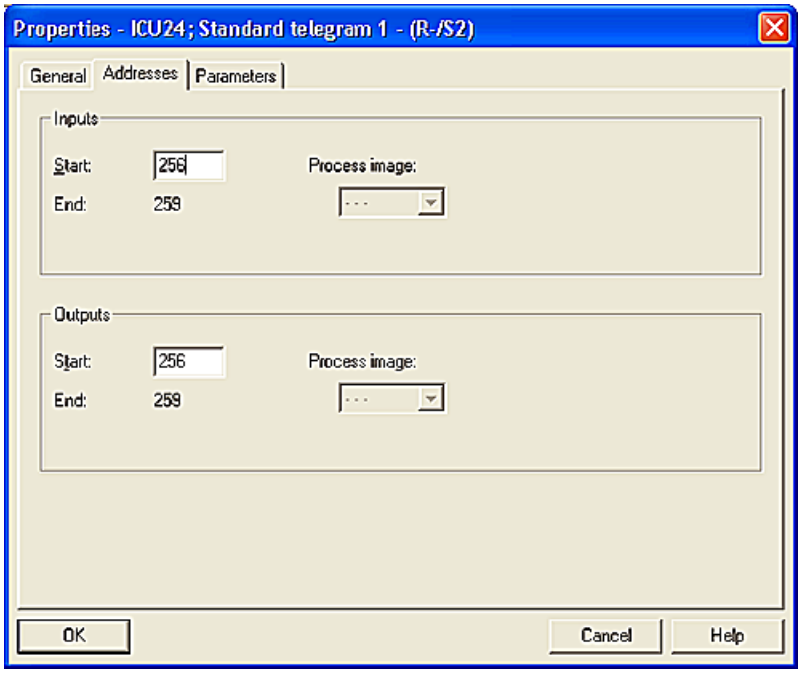


Figure 5-7 Setting the address in the I/O image

Note

The input and output address range for the frequency converter must be identical.

Parameters

The application ID assigned by the user safely prevents interchanging.

Note

If the same application ID is entered for several frequency converters, they can be used interchangeably. Frequency converters with the same application ID must have the same parameter settings. Only frequency converters with the same parameter settings may be interchanged.

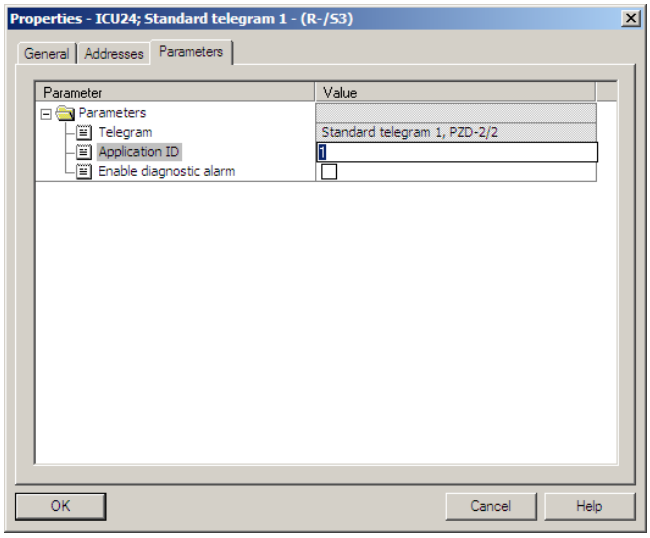


Figure 5-8 Parameters

Points to note when using the PROFIdrive profile

The DPV1 alarm mode must be set at the ET 200S slave.

- Double-click the ET 200S system
- Select the Operating parameters tab.

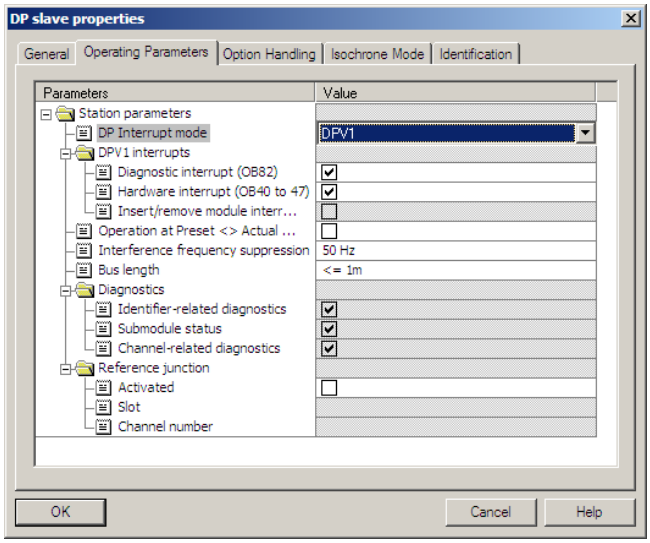


Figure 5-9 Operating parameters

- The diagnostic interrupt parameter of the frequency converter enables the S7 system diagnostics in PROFIdrive mode.
  - No diagnostic messages: 0
  - Diagnostic messages: 1.

Note

Enabled diagnostic messages require troubleshooting in the OB82 of the user program. (If there is no OB82 in the user program, the S7 enters the "STOP" state in the event of an error.)

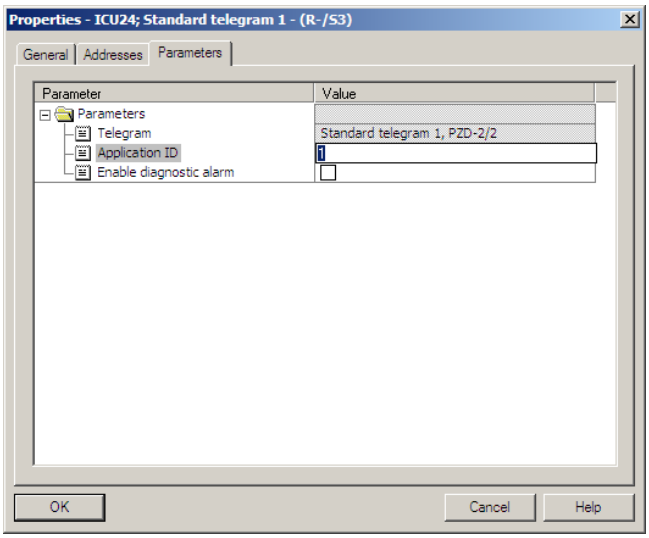


Figure 5-10 Setting of the device-specific parameters

5.3.2 Generating a hardware configuration for PROFINET in the SIMATIC Manager

Description

The following example of an ET 200S FC frequency converter with an "IM151-1 Standard" interface module will be used to demonstrate how to generate a PROFINET configuration with HW Config in the SIMATIC Manager. This will take place in three steps:

- Parameterizing the PROFINET IO interface in SIMATIC S7
- Populating the ET 200S station
- Settings for the frequency converter

Note

Please refer to the "Interface modules" chapter in the manual entitled "ET 200S Decentralized Peripherals System" for information on the interface modules.

Parameterizing the PROFINET IO interface in SIMATIC S7

The hardware configuration is used to parameterize the PROFINET IO interface. When a CPU with an integrated PROFINET IO interface or a PROFINET IO communications processor is selected from the hardware catalog, a PROFINET IO system is made available in the hardware configuration. Once the parameters for the IO Controller have been set, the device - in this case, the ET 200S station - must be selected from the hardware catalog and

positioned at the PROFINET train. Insert an IM 151 accordingly and set the PROFINET address for the ET 200S station in the IM 151.

Inserting an IO controller using the shortcut menu of the PROFINET IO interface of the CPU

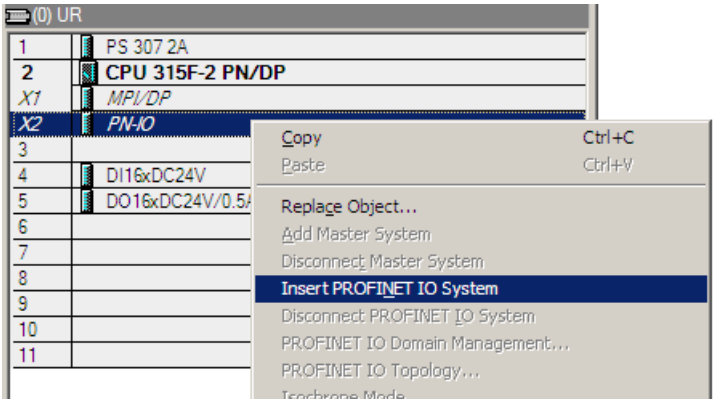


Figure 5-11 Inserting an IO Controller

Insert the ET 200S system in the IO Controller.

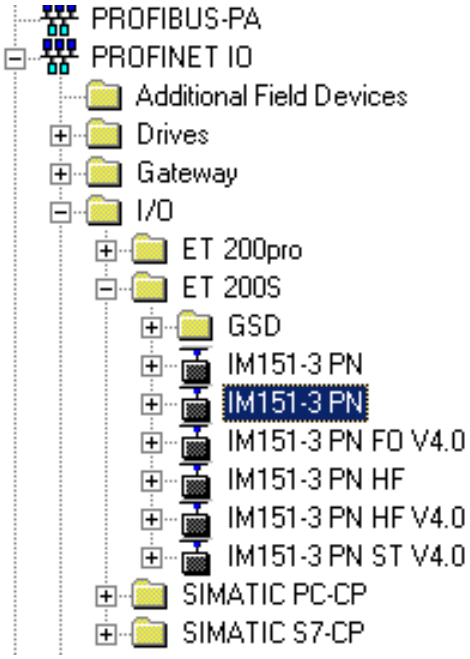


Figure 5-12 Selecting the ET 200S from the hardware catalog

Specify the device name.

In the PROFINET version, the address of the peripherals is assigned via their device names. To do this, click the ET 200S station in the HW Config tool to open its properties. You can then enter any unique device name you like.

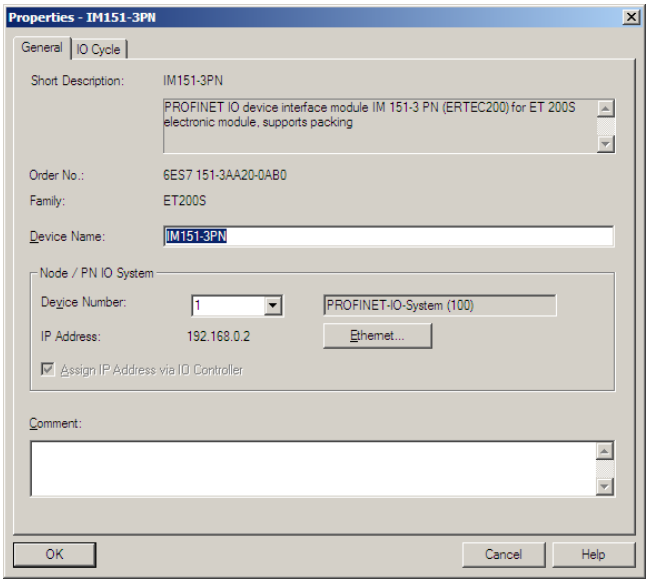


Figure 5-13 Specifying device names

The ET 200S must then declare the name that has been selected. This can be performed in 2 different ways:

- Direct route --> The NameOfStation is written via PROFINET to the MMC of the IM in the ET 200S:

  The prerequisite for this is a PC with PG functionality, which can establish an Ethernet connection with the ET 200S. An MMC must also be inserted in the IM. The name is assigned in the SIMATIC Manager. To do this, select the station to which a name is to be assigned via the "Target system > Edit Ethernet nodes" menu entries in the window that appears. Use the "Browse" button in the "Ethernet nodes" field to do this. With an online connection to the station, all of the stations in the network that can be accessed appear in the window that opens. The relevant ET 200S is selected by means of the MAC address and confirmed with "OK". In the "Assign device name" field, a name can be edited and assigned using the "Assign name" button. The NameOfStation can then be found on the MMC of the IM in the ET 200S.

- Indirect route --> Written to the memory card with "Prommer":

  If no PC with PG functionality is available, or an online connection to the ET 200S cannot be established, the device name can also be written to the MMC of the IM with the "Prommer" device. To do this, insert the MMC of the IM in the Prommer. Enable the ET 200S in the HW Config tool and go to "Store device name on memory card" in the "Target system" menu. The prerequisite for this is that the desired "Device name" has been edited previously via the "Edit > Object properties" menu entries.

  After the name has been successfully written to the MMC of the IM, this can then be inserted in the IM of the ET 200S station.

The configuration should now appear as follows:

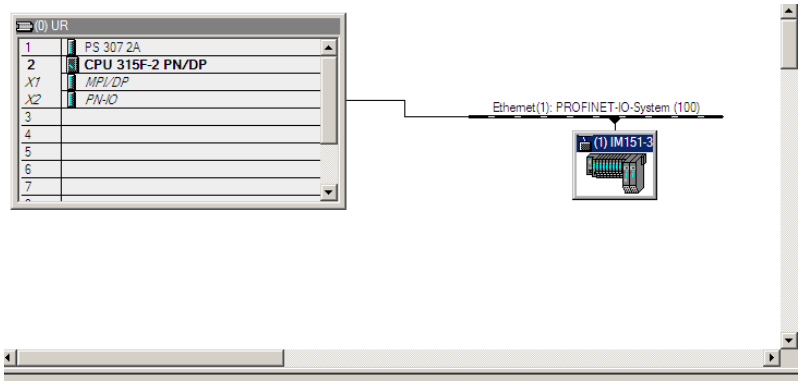


Figure 5-14 Configuration

Inserting a converter into an "ET 200S slot"

Drag-and-drop "ICU24; standard telegram 1" from the hardware catalog to the slot.

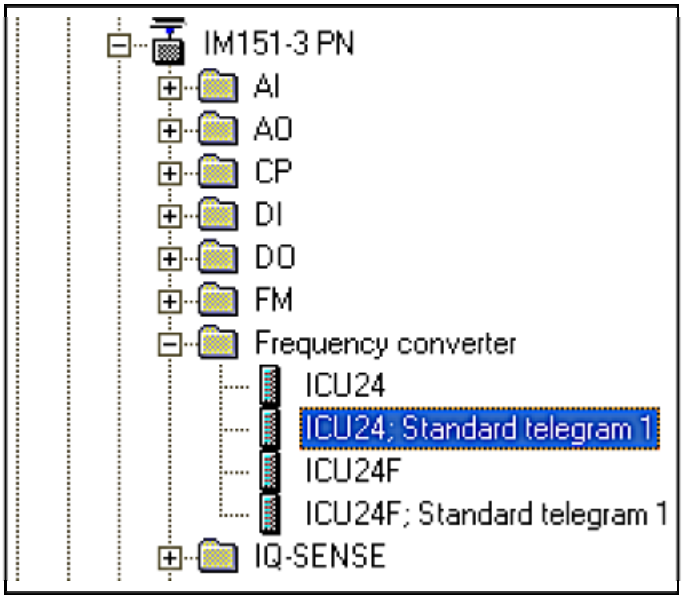


Figure 5-15 Selecting the frequency converter

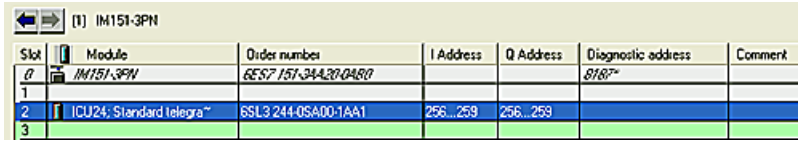


Figure 5-16 Frequency converter in slot

By this selection the user determines whether to use a standard or a fail-safe frequency converter.

Note

A fail-safe PM-D F X1 or PM-D F PROFIsafe power/expansion module must be inserted upstream of the frequency converter if a fail-safe application is installed.

Settings for the frequency converter

Double-click the frequency converter to open the property view with the following tabs:

- General
- Address
- Parameters.

Address/ID

Setting the address in the I/O image
The start address configured in this tab is activated in the user program as "LADDR" input parameter for the blocks in the user program.

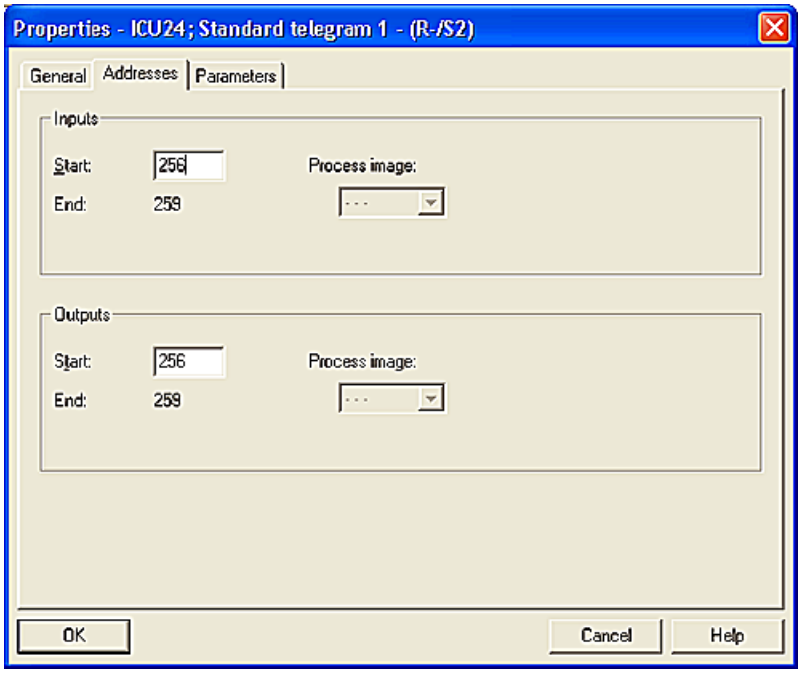


Figure 5-17 Setting the address in the I/O image

Note

The input and output address range for the frequency converter must be identical.

Parameters

The application ID assigned by the user safely prevents interchanging.

Note

If the same application ID is entered for several frequency converters, they can be used interchangeably. Frequency converters with the same application ID must have the same parameter settings. Only frequency converters with the same parameter settings may be interchanged.

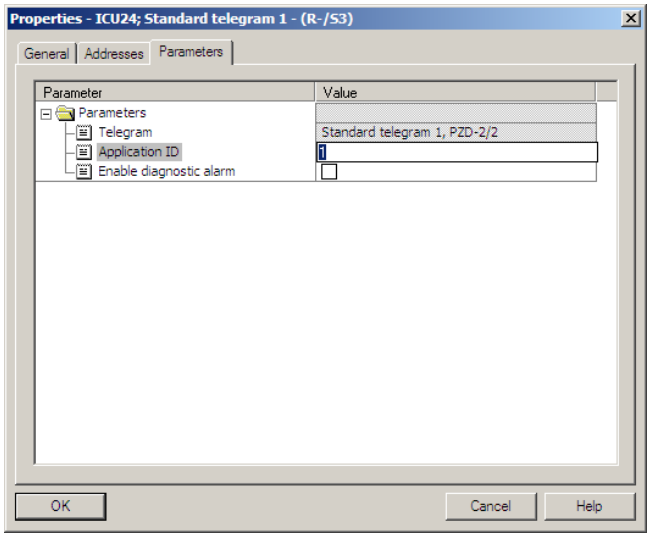


Figure 5-18 Parameters

Points to note when using the PROFIdrive profile

The DPV1 alarm mode must be set at the ET 200S slave.

- Double-click the ET 200S system
- Select the Operating parameters tab.

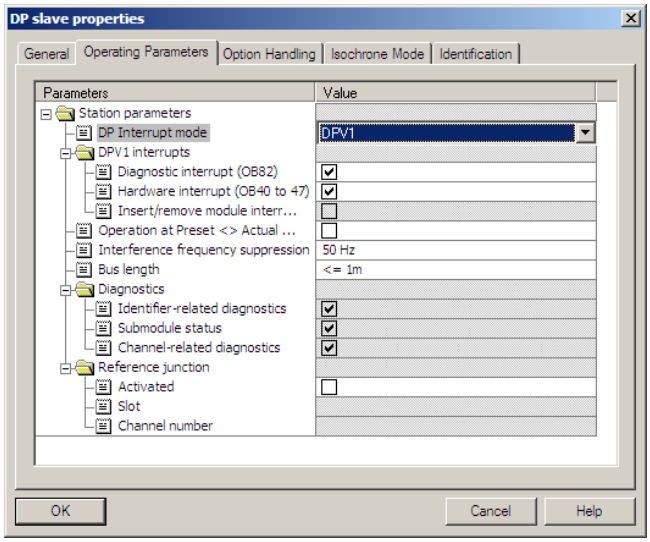


Figure 5-19 Operating parameters

- The diagnostic interrupt parameter of the frequency converter enables the S7 system diagnostics in PROFIdrive mode.
  - No diagnostic messages: 0
  - Diagnostic messages: 1.

Note

Enabled diagnostic messages require troubleshooting in the OB82 of the user program. (If there is no OB82 in the user program, the S7 enters the "STOP" state in the event of an error.)

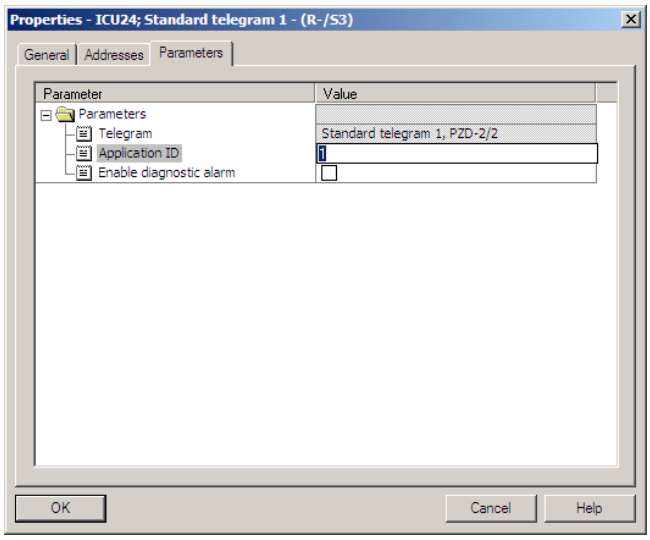


Figure 5-20 Setting of the device-specific parameters

5.3.3 Generating a fail-safe configuration in the SIMATIC Manager

Description

Configuration is carried out using the fail-safe PM-D FX1 or PM-D F PROFIsafe power/expansion module on PROFIBUS DP. The procedure for PROFINET IO is similar to this and will not be described separately.

With the PM-D FX1, the frequency converter is incorporated into a safety local solution; with the PM-D F PROFIsafe, it is incorporated into a safety solution where the shutdown groups are operated using the fail-safe PROFIsafe.

Technical functions and the PM-D FX1 and PM-D F PROFIsafe circuitry are described in the manual entitled
"SIMATIC ET 200S Motor Starter, Fail-Safe Motor Starters, SIGUARD Safety Systems".

Prerequisite

The following are prerequisites for configuring and parameterizing ET 200S fail-safe modules:

- STEP 7, version V5.3 SP3 or higher
- S7 Distributed Safety V5.4 or higher (F Configuration Pack V5.5 SP1 or higher)
- S7 F systems V5.2 SP2 or higher

You can download the F Configuration Pack on the Internet at:
http://www.siemens.com/automation/service&support

Procedure for a safety local solution with PM-D FX1

Once the IM151-1 HF has been positioned and parameterized in the master system, a module that can control the safety functions of the frequency converter via switch-off signals in the backplane bus is positioned to the left of the frequency converter.

The fail-safe module (PM-D FX1) is then connected.

Follow the usual procedure with STEP 7 HW Config to configure fail-safe modules (in the same way as standard ET 200S modules).

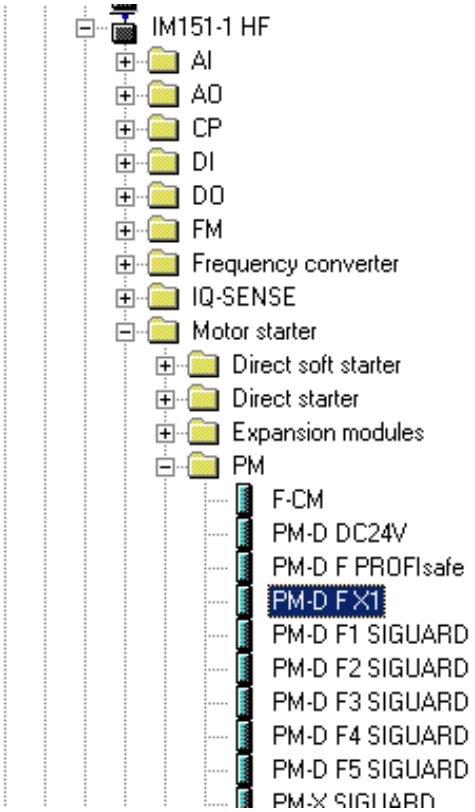


Figure 5-21 Selecting PM-D FX1

The PM-D XF1 has no process image, but rather a diagnostics address; its I/O functions are only related to shutdown groups G1 - G6.

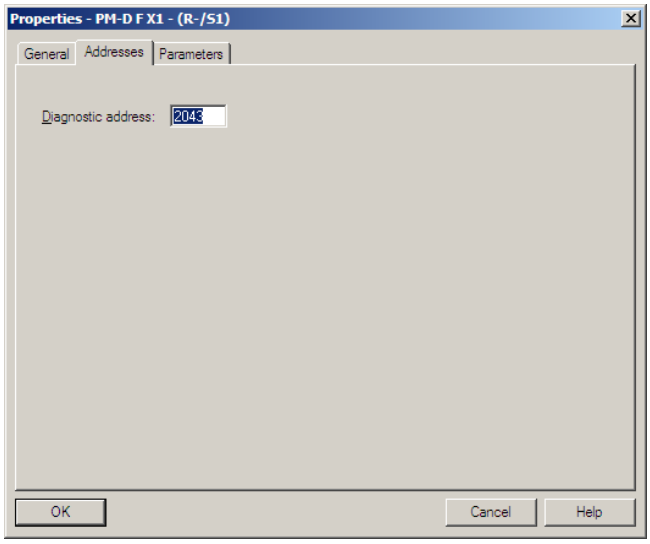


Figure 5-22 Specifying the diagnostics address

Group diagnostics can be activated or deactivated.

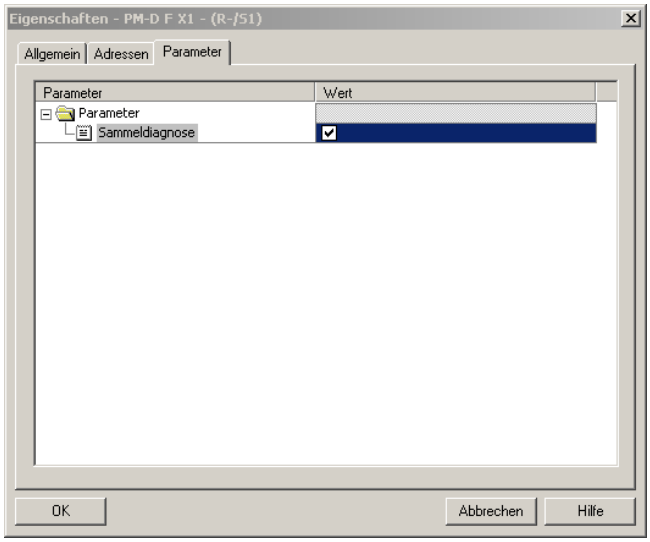


Figure 5-23 Specifying the diagnostics properties

You can use drag-and-drop to position the fail-safe frequency converter to the right of the fail-safe power/expansion module. The configuration sequence is identical to the one used when generating a PROFIBUS configuration in the SIMATIC Manager.

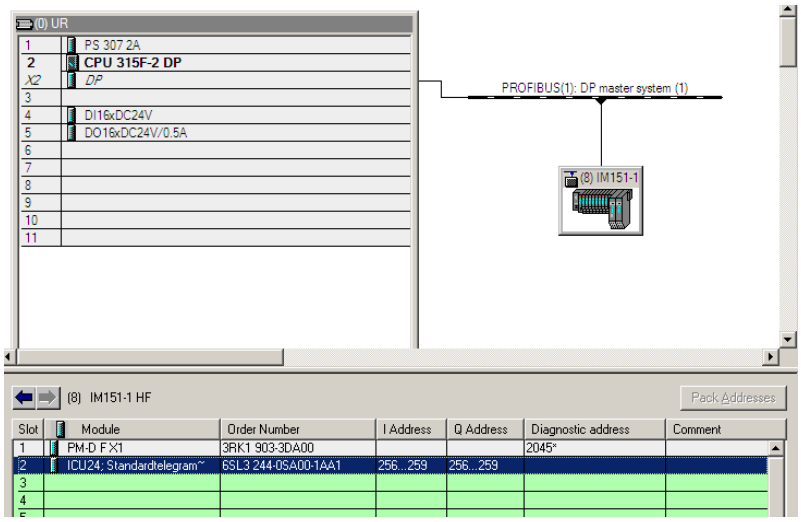


Figure 5-24 Configuring a frequency converter in a safety local environment

Procedure for a PROFIsafe solution

Once the IM151-1 HF has been positioned and parameterized in the master system, a power module that can use PROFIdrive telegrams to control the switch-off signals in the backplane bus via PROFIsafe, and can, therefore, enable the safety functions in the frequency converter, is positioned to the left of the frequency converter.

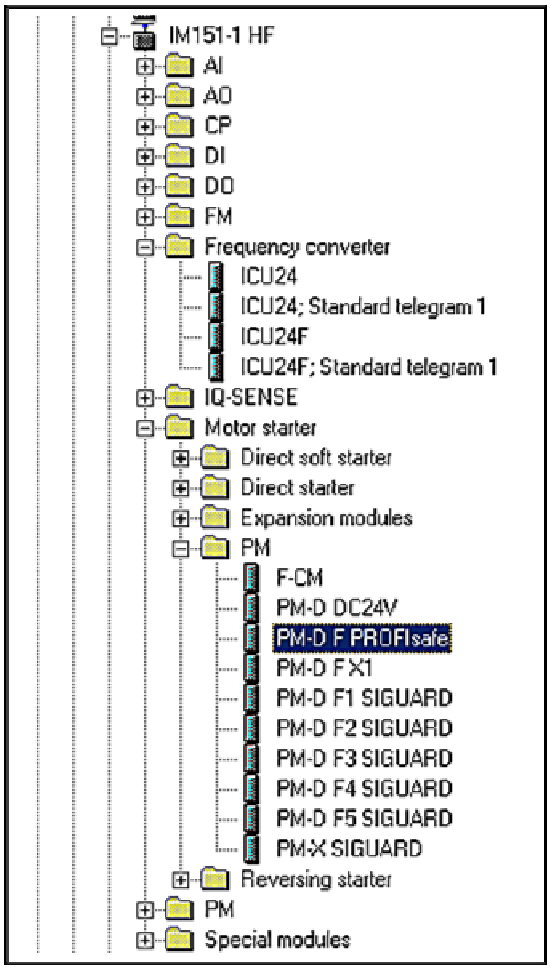


Figure 5-25 Selecting the power module for PROFIsafe operation

The length of the process image of the power module for PROFIsafe operation is 5 bytes. The start address in the PI must be set.

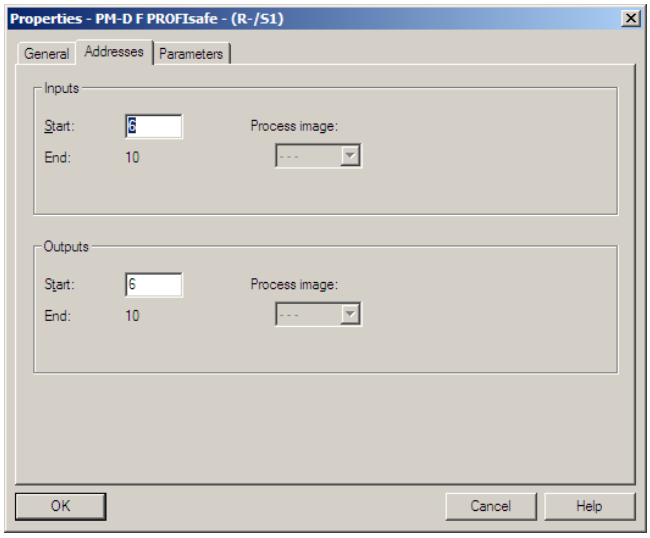


Figure 5-26 Setting the address in the PI

A start address must also be set in the process image for fail-safe data, as well as a monitoring time for communication.

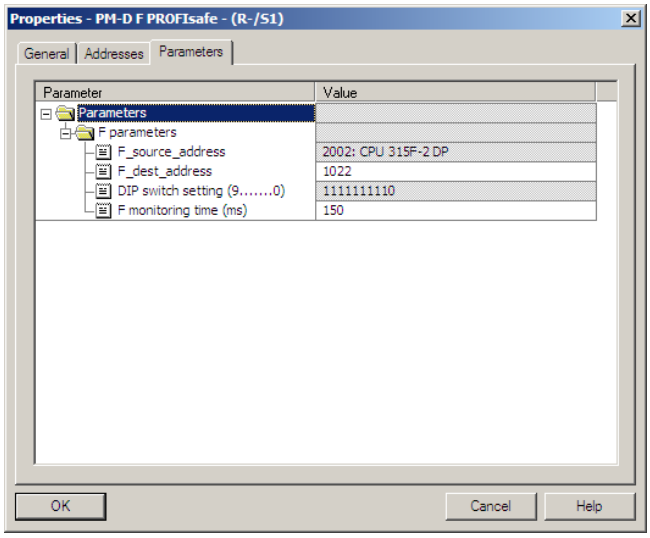


Figure 5-27 Setting the F target address and the monitoring time

You can use drag-and-drop to position the fail-safe frequency converter to the right of the PROFIsafe module.

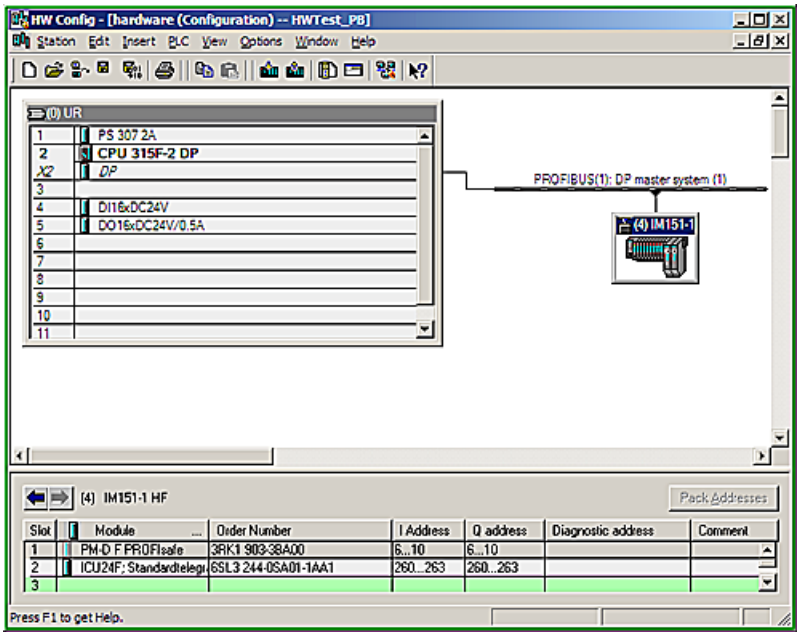


Figure 5-28 Configuring a frequency converter on PROFIsafe

Neither frequency converter configuration nor operation makes a distinction in terms of which power module is used to enable the switch-off signals on the backplane bus.

However, for the user there are differences in the way in which the fail-safe power modules are treated:

- In a safety local application, inputs/outputs of the PM-D FX1 are connected physically.
- Via PROFIsafe, the safety library from STEP 7 is used to generate a fail-safe application on the S7 CPU.

Parameterizing module properties

To parameterize fail-safe module properties, select the module in STEP 7 HW Config and select the menu command "Edit > Object properties".

Parameters are downloaded from the programming device to the F-CPU, where they are stored and then transferred to the fail-safe module.

Parameter description

You can find the fail-safe module parameters that can be set in the manual entitled "SIMATIC ET 200S Motor Starter, Fail-Safe Motor Starters, SIGUARD Safety Systems".

PROFIsafe address and address assignment

The PS address is set via a 10-pin DIP switch on the left-hand side of the module housing. When carrying out parameterization via the PG, the user must specify the PS address selected for the module in binary code format. This corresponds to the DIP switch setting and the module PS address.

Commissioning (hardware)

6

Introduction

Hardware commissioning involves the ET 200S station and the drive components.

The following section uses an example to describe the commissioning of a minimum configuration on PROFIBUS DP, with an S7 controller as the master and STARTER directly on the RS232 interface of the frequency converter.

It is assumed that the user possesses the requisite knowledge of STARTER to generate a drive configuration and use the operating panel.

Prerequisites

Table 6-1 Prerequisites for commissioning

Actions	Reference
ET 200S assembled	Chap. *Assembling*
PROFIBUS address set at interface module and IM wired	Interface module manual
ET 200S configured	Chap. *Planning/Configuring*
Motor connected	Chap. *Assembling*
Power supply to the DP master is switched on	Manual for the DP master
The DP master is set to RUN mode	Manual for the DP master

6.1 Starting up the ET 200S

Procedure

Switch on power to the ET 200S station (electronic/encoder supply 1L+ for ET 200S).

Mode of operation

The image below illustrates the startup routine of the ET 200S with frequency converter.

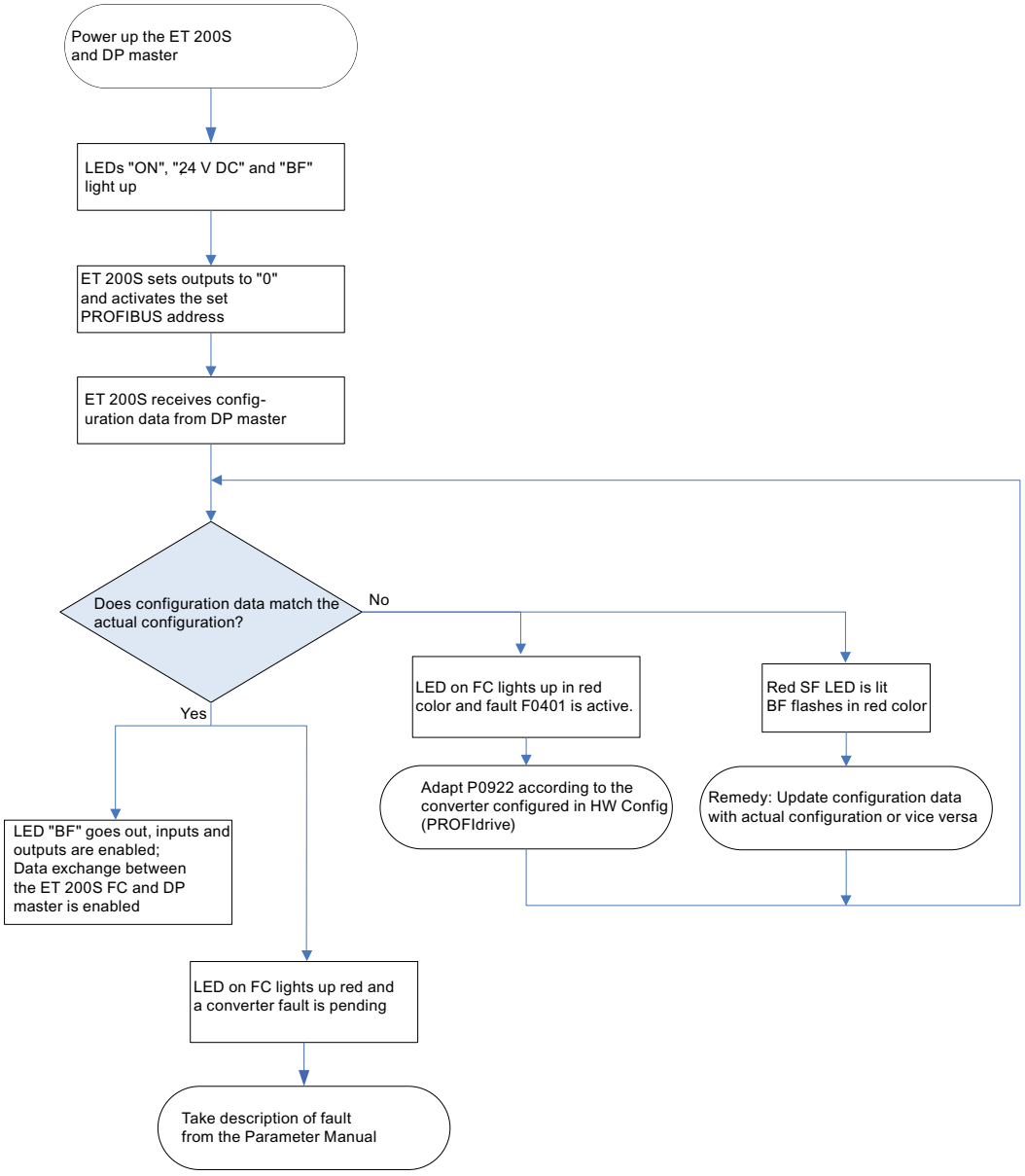


Figure 6-1 Startup of an ET 200S with frequency converter

Note

The SF LED on the S7 will not necessarily light up if a fault occurs in the ET 200S FC. The S7 only receives notification of a fault if diagnostic messages are enabled in the converter. This is done by means of parameterization in HW Config. Converter faults can only be indicated by the red LED on the converter if diagnostic messages are disabled.

6.2 Commissioning via the RS232 interface

Prerequisites for commissioning via the RS232 interface

- ET 200S station is supplying power
- ICU24/ICU24F connected to PC via null modem cable
- STARTER commissioning software installed on PC

Commissioning via the RS232 interface

Note

The fail-safe parameters can only be set and changed online via the RS232 interface and using the STARTER commissioning software.

Note

It is recommended that all converters within a station/system be configured with the USS address 0. The USS address suggested by STARTER can be overwritten manually. This guarantees that, as soon as the connecting cable is connected, STARTER can incorporate each converter within the station connection.

1. Start the STARTER commissioning software.
2. Using your PC's Control Panel, set "PC COM port (USS)" as the PG/PC interface, with a baud rate of 38,400.

   Note

   If the baud rate is to be changed, the parameter P2010 must always be changed first, followed by the PG/PC interface.
3. Create a new project or open an existing one (if applicable).
4. Insert an ET 200S FC frequency converter:
   - Automatic:

     Via "Project/Integrate accessible nodes into project".

     STARTER searches for the converter connected via the null modem cable and sets all necessary settings to the correct values.
   - Manual:

     "Insert single drive" via the project navigator. 

     Select the ET 200S FC frequency converter via an interactive screen.
5. You can now parameterize the ET 200S FC online or offline.
   - Online:

     Press the  button. All parameter changes are made directly in the RAM of the ET 200S FC. The changes are stored in the EEPROM using  ("Copy RAM to ROM").
   - Offline:

To do this, you need to store a parameter set on the PC by uploading it from the relevant Control Unit. Changes to the parameters are then made in this parameter set on the PC. If you have made all of the parameter changes, use to switch the converter to online mode. The changes are stored in the EEPROM using the ("Download to target device") button.

Notice

This will overwrite all parameter settings in the converter.

6. If you have made all the necessary parameter settings and stored them in the EEPROM, you can use to exit online mode and close STARTER.

Note

There are two methods of parameterization:

- Interactive, via the project navigator (STARTER V3.2 and higher)
- List-oriented, via an expert list (ET_200S_FC/Experts/Expert list)

For commissioning purposes, setpoints and commands can be entered via STARTER in order to traverse the drive. To do this, the operating panel in the detailed view of STARTER must be enabled via the project navigator "ET_200S_FC/ET_200S_FC/Operating panel".

- To assume control priority: Click the "Assume control priority" button → Control priority is transferred to STARTER and the button changes to "Return ...".
- To return control priority: Click the "Return ..." button → Control priority is returned to the higher-level controller and the button changes to "Assume control priority".

Parameter	Setting/description (default settings are in BOLD)		Your own settings
P2010 = 8	**USI baud rate** Sets the baud rate for USI data transfer (default setting: **8**).		
	Possible settings		
	4	2400 baud	
	5	4800 baud	
	6	9600 baud	
	7	19200 baud	
	8	38400 baud	
	9	57600 baud	
	10	76800 baud	
	11	93750 baud	
	12	115200 baud	
P2012 = 2	**USI PSD length** Defines the total number of 16-bit words in the PSD section of the USI telegram (default setting: **2**).		
P2013 = 127	**USI PIV length** Defines the number of 16-bit words in the PIV section of the USI telegram (default setting: **127**).		

6.3 Creating a drive configuration with STARTER

Procedure

- Connect STARTER to the to the RS232 interface of the frequency converter.
- Generate a drive configuration; in doing so, check the motor data and take into account the power derating in relation to the ambient temperature of the frequency converter.

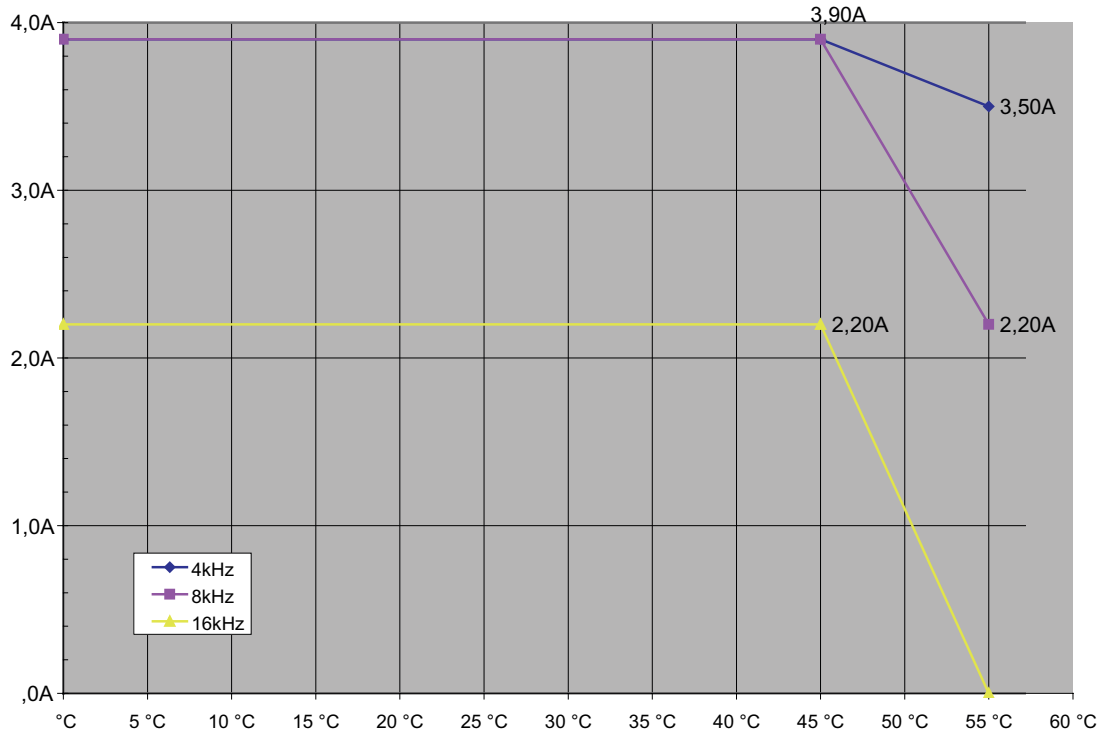


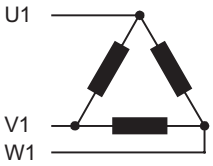
Figure 6-2 Power derating in relation to the ambient temperature

Checking the motor terminal box (IEC/NEMA motor)

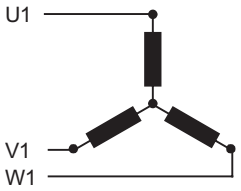
For commissioning to be successful, it is important that the interconnection in the motor terminal box (see image below) corresponds to the entry for the rated motor voltage (P0304)/rated motor current (P0305).

IEC motor





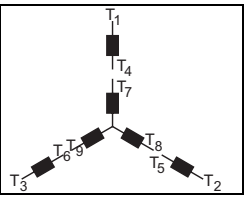
Delta connection



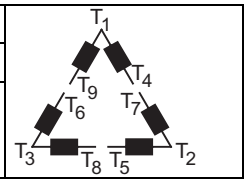
Star circuit configuration

E.g.: Voltage of 230 V (delta connection)/400 V (star connection)

NEMA motor

Voltage	U	V	W	Connected to one another			Circuit	
Low	T_1-T_7	T_2-T_8	T_3-T_9	T_4-T_5-T_6			Y Y	
High	T_1	T_2	T_3	T_1-T_7	T_2-T_8	T_3-T_9	Y	

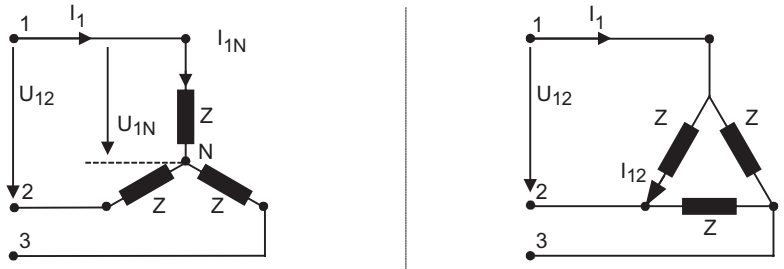
E.g.: Voltage of 230 V YY (low)/460 V Y (high)

Voltage	U	V	W	Connected to one another			Circuit	
Low	T_1-T6-T7	T_2-T_4-T_8	T_3-T_5-T_9	-			Δ Δ	
High	T_1	T_2	T_3	T_4-T_7	T_5-T_8	T_6-T_9	Δ	

Entering the type plate data

The following should be noted when entering the type plate data/ESB data:

- The phase-to-phase voltage (voltage U_{12} between external lines L1 and L2) and/or phase-to-phase current I_1 is always specified on the type plate.
- The rated motor voltage (P0304)/rated motor current (P0305) must always be entered according to the motor circuitry (delta/star).
- If the available rated motor data (P0304, P0305) are not consistent with the motor circuitry, they should be converted before they are entered.
- If ESB data (P0350, P0354, P0356, P0358, P0360) is available, this should be entered according to the motor circuitry. If the ESB data is not consistent with the motor circuitry, the ESB data should be converted before it is entered, in the same way as the data on the type plate (P0304, P0305).



$I_1 = I_2 = I_3$

$U_{12} = U_{23} = U_{31} = \sqrt{3} \cdot U_{1N}$

$\frac{U_{12}}{I_1} = 2 \cdot Z$

$I_{1,\Delta} = \frac{1}{\sqrt{3}} I_{1,Y}$

$U_{12,\Delta} = \frac{1}{\sqrt{3}} U_{12,Y}$

$Z_{12,\Delta} = \frac{Z_{12,Y}}{3}$

$I_{12} = I_{23} = I_{31} = \frac{1}{\sqrt{3}} \cdot I_1$

$U_{12} = U_{23} = U_{31}$

$\frac{U_{12}}{I_1} = \frac{2}{3} \cdot Z$

Figure 6-3 Star connection/Delta connection conversion

Note

The following formula can be used to check the accuracy of the motor type plate data:

$P_N = \sqrt{3} \cdot U_{NY} \cdot I_{NY} \cdot \cos\varphi \cdot \eta \approx \sqrt{3} \cdot U_{N\Delta} \cdot I_{N\Delta} \cdot \cos\varphi \cdot \eta$

mit	P_N	Motornennleistung	P0303
	U_{NY}, $U_{N\Delta}$	Motornennspannung (Stern / Dreieck)	P0304
	I_{NY}, $I_{N\Delta}$	Motornennstrom (Stern / Dreieck)	P0305
	$\cos\varphi$	Leistungsfaktor	P0308
	η	Wirkungsgrad	P0309

First commissioning and optimization (software) 7

7.1 Commissioning sequence

The sequence in which the software of a frequency converter in an ET 200 station is commissioned depends on how complex the drive application is, and on the automation structure.

The basic drive functions and the higher-level controller are commissioned first and are then specialized, optimized and the drive application generated.

The parameters and settings that are located during this process can be used for standard commissioning, if required.

Prerequisites

A prerequisite for software commissioning is functional hardware that has been commissioned according to the chapter entitled "Commissioning (hardware)".

A drive configuration has been generated for the converter and the motor has been commissioned with the factory settings.

Procedure

1. First commissioning and optimization
   - Frequency converter/motor combination
   - Drive application
   - Communication between the S7 CPU and frequency converter
   - Fail-safe functions
2. Standard commissioning

   Transferring the parameters and settings to other frequency converters

Table 7-1 First commissioning and optimization

Steps		Description	Tool
1	Commissioning and optimizing the frequency converter/motor combination	Basic parameterization has already been carried out when commissioning the hardware (quick commissioning). The motor type plate data and the frequency converter factory settings form the basis for this. Motor data are entered; Motor identification Motor data measurement Setting the V/f control (I-max controller, slip compensation, adaptation of the V/f characteristic) Setting the frequency control (pre-control, closed-loop PI controller) Torque limits	STARTER at the RS232 interface
2	Commissioning and optimizing the drive application	Frequency setpoint Frequency limitation (skip frequency bands, minimum and maximum limitation) Ramp function generator Motor temperature monitoring Brake control Flying restart Automatic restart Load torque monitoring	STARTER at the RS232 interface
3	Commissioning the communication between the S7 CPU and frequency converter: • PROFIdrive • FB100	Fieldbus parameters Telegram failure time Integrating the S7 program for the cyclic parameters into the S7 CPU	STEP 7 via fieldbus on the PLC STARTER at the RS232 interface
4	Commissioning fail-safe functions	Parameters Password protection	STARTER at the RS232 interface

Table 7-2 Standard commissioning

Steps	Description	Tool
Transferring the parameters and settings to other frequency converters	With STARTER	STARTER at the RS232 interface
	With MMC	MMC

7.2 Commissioning and optimizing the frequency converter/motor combination

Description

If there is still no matching parameter set for the drive, then quick commissioning including a motor data identification routine must be carried out - both for the closed-loop vector control and the V/f control. A PC with the STARTER commissioning software can be used for the quick commissioning.

Once the quick commissioning has been completed, the frequency converter can put into operation. Before starting the quick commissioning, the following data must be queried, changed or entered:

- Enter the line frequency
- Enter the rating plate data
- Min./max. frequency or ramp-up/ramp-down time
- Control mode
- Motor data acquisition

7.2.1 General

The frequency converter can be adapted to different applications by changing the parameter values.

Upload and download

Upload is understood to mean the saving of parameters from the EEPROM of a frequency converter to a PC (using STARTER) or to an MMC. Download is understood to mean the transferring of a parameter set saved on a PC or an MMC into the RAM or EEPROM memory of a frequency converter.

The commissioning procedure using STARTER is interactive and will not, therefore, be described in more detail here.

STARTER can be connected locally to the frequency converter, or can access the fieldbus via the frequency converter.

Table 7-3 STARTER connection options

Type	USS to RS232	Fieldbus
PC connected to frequency converter via	RS232 interface cable	Fieldbus cable
Restrictions	Peer-to-peer	Routing via SIMATIC CPU not possible

STARTER projects

STARTER can be used to either create a new project or open an existing one. To create a new project in STARTER, any of the following procedures can be used:

- Find frequency converter
- Wizard
- Select frequency converter

When an existing project is opened or a new one created, STARTER will be in offline mode. To go online, press the  ("Connect to target system") button.

Changing parameters with STARTER

Parameters can be changed online or offline (but preferably online). Parameter changes made online are stored in the RAM of the frequency converter. Transferring from RAM to the EEPROM can be triggered manually by pressing the  ("Copy RAM to ROM") button. If the content of the RAM and EEPROM are different when the user closes STARTER, he/she will be asked if he/she wishes to transfer the data from the RAM to the EEPROM.

Note

The storage method can be changed by means of P0014:

- P0014=0: Parameter changes stored in RAM (default)
- P0014=1: Parameter changes stored in EEPROM.

Parameter sets that have been changed offline can be transferred to the frequency converter using the download function  ("Download project to target system").

CAUTION
Parameters for safety functions can only be changed in online mode. Parameters for safety functions are not downloaded when parameters are downloaded using STARTER.

7.2.2 Calculating the motor and controller data

The internal motor and controller data are calculated using the parameter P0340, or indirectly with the help of the parameter P3900 or P1910. The function of the parameter P0340 can be used, for example, if the data of the replacement circuit or the values of the moments of inertia are known.

Table 7-4 Settings for P0340

P0340	Meaning
0	No calculation
1	Complete parameterization
2	Calculation of the replacement circuit data
3	Calculation of V/f and the closed-loop vector control
4	Calculation of the controller settings

For complete parameterization (P0340=1), not only the motor and controller parameters are assigned in advance but also the parameters which are related to the rated motor data (e.g. torque limit values and reference quantities for interface signals). The List Manual contains a full list of all parameters depending on P0340. For calculation of the motor and controller data with P0340 there are various scenarios which can be called up as a function of the known data.

7.2.3 Motor Data Identification

Description

The Inverter has a measuring technique which is used to determine the motor parameters:

Equivalent circuit diagram (ECD)	→	P1900 = 2
Measures Equivalent circuit diagram (ECD) + Magnetizing characteristic (includes P1900 = 2)	→	P1900 = 3

For control-related reasons, it is essential that the motor data identification is performed. Without performing the motor data identification it is only possible to estimate ECD data using information from the motor rating plate. For example, the stator resistance is extremely important for the stability of the closed-loop Vector control and for the voltage boost of the V/f characteristic. The motor data identification routine should be executed, especially if long feeder cables or if third-party motors are being used.

If the motor data identification routine is being started for the first time, then the following data is determined, starting from the rating plate data (rated [nominal] data) with P1900 = 2:

- ECD data
- Motor cable resistance
- IGBT on-state voltage and compensation of IGBT gating dead times.

The rating plate data represents the initialization values for the identification. This is the reason that it is necessary to have the correct input from the rating plate data when determining the data specified above.

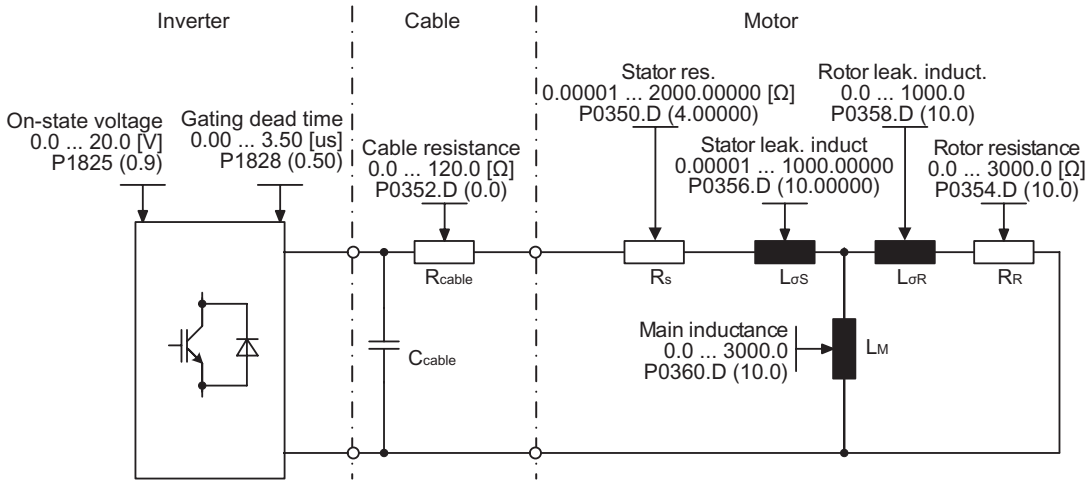


Figure 7-1 Equivalent circuit diagram (ECD)

In addition to the ECD data, the motor magnetizing characteristic (see the figure above) can be determined using the motor data identification (P1900 = 3). If the motor-inverter combination is operated in the field-weakening range (which is above the nominal frequency of the motor), then this characteristic should be determined, especially when Vector control is being used. As a result of this magnetizing characteristic, the Inverter can, in the field-weakening range, accurately calculate the current which is generated in the field and in-turn achieve a higher torque accuracy.

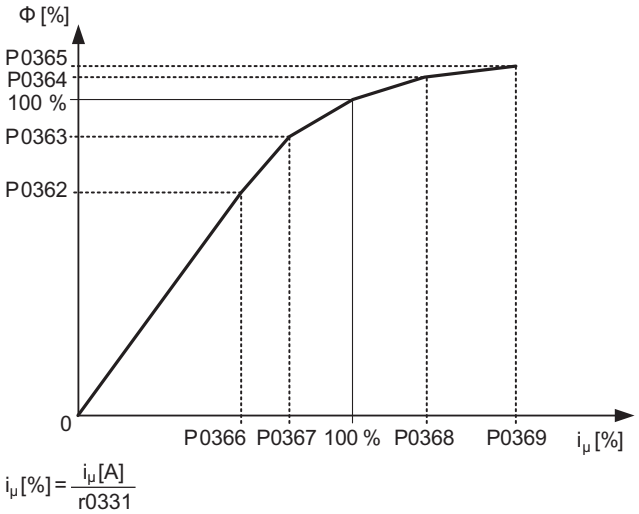


Figure 7-2 Magnetizing characteristic

The motor data identification is carried-out with the motor at a standstill and it takes, including the data calculation per selection (P1900 = 2 or 3), between 20 seconds and 4 minutes to complete. While the motor data identification is active A0541 is displayed. The identification time depends on the motor and increases with its size (this takes approx. 4 min. for a 200 kW motor).

The motor data identification routine must be carried-out with the motor in the **cold** condition so that the motor resistance values saved can be assigned to the parameter of the ambient temperature P0625. Only then is the correct temperature adaptation of the resistances possible during operation.

The motor data identification routine operates with the results of the "Complete parameterization" P0340 = 1 or the motor equivalent diagram data which was last saved. The results become increasingly better the more times that the identification routine is executed (up to 3 times).

⚠ WARNING

It is not permissible to carry-out the motor identification routine for loads which are potentially hazardous (e.g. suspended loads for crane applications). Before starting the motor data identification routine, the potentially hazardous load must be secured (e.g. by lowering the load to the floor or clamping the load using the motor holding brake).

When starting the motor data identification routine, the rotor can move into a preferred position. This is more significant for larger motors.

Note

The equivalent circuit data (P0350, P0354, P0356, P0358, P0360) and the motor cable resistance (P0352) are entered as phase values.

During the motor identification routine, the sum of the stator resistance (P0350) and the motor cable resistance (P0352) are determined. To get a correct stator resistance the cable resistance has to be set before the motor identification has been started.

If the motor cable resistance is known, it should be entered into parameter P0352 before the motor data identification. The value of P0350 then will be changed in dependenccy of P0352 and is more precisely as the calculated value.

It is not necessary to lock the motor rotor for the motor data identification routine. However, if it is possible to lock the motor rotor during the identification routine (i.e. by closing the motor holding brake), then this should be used to determine the equivalent circuit diagram data.

The following formula can be applied to check the correctness of the motor rating plate data:

$P_N = \sqrt{3} * V_{NY} * I_{NY} * \cos\phi * \eta \approx \sqrt{3} * V_{N\Delta} * I_{N\Delta} * \cos\phi * \eta$

Where:

P_N	rated motor power
$V_{N\,Y}$, $V_{N\,\Delta}$	rated motor voltage (star/delta)
$I_{N\,Y}$, $I_{N\,\Delta}$	rated motor current (star/delta)
cosϕ	power factor
η	efficiency

Before starting the motor identification, the correct ambient temp value should be entered in P0625 (default 20°C).

If Problems occur during the identification run, for example, the current controller oscillates, then the rating plate data should be re-checked and an approximately correct magnetizing current P0320 entered. The motor data identification routine should then be re-started by calling P1900 = 2 or P1900 = 3.

A step-by-step description is given in section "Quick Commissioning".

Parameter settings

> **⚠ WARNING**
>
> The motor data identification routine MUST not be used for loads which are potentially hazardous (for example, suspended loads for crane applications). Before the motor data identification routine is started, the potentially hazardous load must be carefully secured (for example, by lowering the load to the floor or by clamping the load using the motor holding brake).

Parameter	Description
P0625 = …	**Ambient motor temperature** (entered in °C) The motor ambient temperature is entered at the instant that motor data is being determined (factory setting: **20 °C**). The difference between the motor temperature and the motor ambient temperature P0625 must lie in the tolerance range of approx. ± 5 °C.
If not the motor must be allowed to cool down.	
P0010 = 0	**Commissioning parameter filter*** Check if P0010 = 0 (Ready)
P1900 = 3	**Select motor data identification*** 0: Disabled (default) 2: Identification of all parameters in standstill. 3: Identification of all parameters in standstill including saturation curve
ON command	**Start motor data identification** Once P1900 ≠ 0, alarm A0541 is generated that states, the next ON command will initiate the motor data identification. When the ON Command is given, current flows through the motor and the rotor aligns itself. Note: When motor data identification is complete A0541 will be cleared and P1900 will be set to zero.
OFF1	In order to set the inverter into a defined state, an OFF1 command must be issued before the next step. With the OFF1 command the motor data identification is finished.

7.3 Commissioning and optimizing the drive application

After the motor and converter combination is commissioned by quick commissioning, parameters must be adapted and set to suit the requirements of the specific application.

Note

According to the factory setting, parameter changes are saved in the volatile memory (RAM) of the converter. One of the following options can be used for saving the changes to EEPROM:

- Set P0014 = 1: all changes are then saved immediately to EEPROM
- Trigger transfer from RAM to EEPROM via P0971 = 1
  or via the STARTER button.

The duration of the data transfer depends on the number of parameters changed. In some cases it can take up to 3 minutes.

When using STARTER, the transfer is indicated by a progress bar. A dialog field announces when transfer is successful.

The *List Manual* contains detailed parameter descriptions.

General settings

Parameters	Description (parameter name and factory setting in bold)	Setting
P0290 = 2	**Converter overload behavior** Specifies the converter's response to internal overheating. 0: Reduce output frequency 1: Shut down (F00004) 2: Reduce pulse frequency and output frequency 3: Reduce pulse frequency, then shut down (F00004)	
P0335 = 0	**Motor cooling** (enter the motor's cooling system) **0: Self-cooling using fan attached to the motor, mounted on the shaft** 1: Separate cooling by means of a separately-driven cooling fan 2: Self-cooling and internal fan 3: Separate cooling and internal fan	

Temperature encoder

Parameters	Description (parameters and factory settings in bold)	Setting
P0601 = 0 or P0601 = …	**Motor temperature encoder** 0: No encoder (→ P0610) 1: PTC thermistor (→ P0604) 2: KTY84 (→ P0604)	
P0604 = 130°	**Motor temperature limit** Enter the alarm limit value of the motor overtemperature protection. The shutdown temperature (limit) is the value at which the converter will either shut down or I_{max} will be reduced (P0610); this always happens at 10% above the alarm limit value.	
P0610 = 2	**I2t temperature behavior of the motor** (This defines the behavior of the motor if the temperature has reached the alarm limit value.) 0: No response, alarm only 1: Alarm and reduction of Imax (this results in a reduced output frequency) 2: Alarm and shutdown (F00011)	

Temperature calculation without encoder

Temperature calculation without a temperature encoder is possible in all operating modes. In vector mode the current temperature is determined automatically when the converter is switched on and the motor is hot. In V/f mode the motor temperature is set to an average value in this case.

Parameters	Description (parameters and factory settings in bold)	Setting
P0621 = 1	**Motor temperature measurement after restarting** 0: No measurement. 1: Temperature measurement upon first power-up after an OFF/ON switching operation? 2: Temperature measurement after each power-up.	
P0622 = …	**Motor remagnetizing time for temperature measurement after ON signal** Length of a measuring cycle time for motor temperature measurement after ON signal Several measuring cycles are required to increase accuracy. This measuring cycle is pre-assigned the magnetizing time from the Mot ID (r0384)t.	

Selecting the command source

The command sources that are available depend on the CU being used. Depending on that Control Unit, the command source is preset to different values by default.

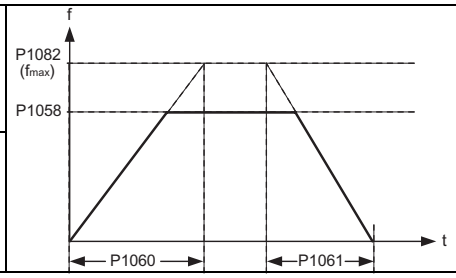
Parameters	Description (parameter name and factory setting in bold)	Setting
P0700 = 4/6	**Command source selection** Select digital command source from this option. 0: Factory default setting 4: USI to RS232 6: Fieldbus (P2050 … P02091)	

Setting the frequency setpoint

Parameters	Description (parameter name and factory setting in bold)	Setting
P1000 = …	Selecting the frequency setpoint 0: No master setpoint 6: **Fieldbus** (P2050 … P02091)	

JOG frequency

Parameter	Description	Setting
P1057 = 1	**JOG Enable** P1057 = 0 JOG-function disabled P1057 = 1 JOG-function enabled (default)	
P1058 = 5	**JOG frequency right** Frequency in Hz when the motor is being jogged in the clockwise direction.	
P1059 = 5	**JOG frequency left** Frequency in Hz when the motor is being jogged in the counter-clockwise direction.	
P1060 = 45	**JOG ramp-up time** Ramp-up time in seconds from 0 to the maximum frequency (P1082). The JOG ramp-up is limited by P1058 or P1059.	
P1061 = 50	**JOG ramp-down time** Ramp-down time in seconds from the maximum frequency (P1082) to 0.	

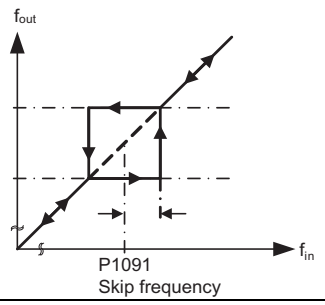


Additional setpoints

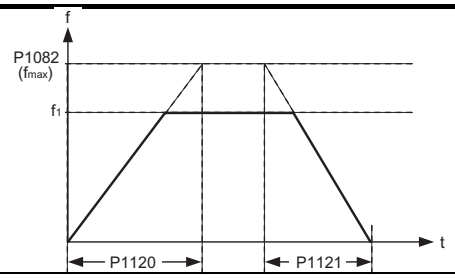
Parameters	Description (parameter name and factory setting in bold)	Setting
P1074 = 1.0	**BI: Disable additional setpoint**	
P1075 = 775	**CI: Additional setpoint** Specifies the source of the additional setpoint, which is added to the main setpoint.	
P1076 = 1.0	**CI: Additional setpoint scaling** Defines the source for scaling the additional setpoint. **General settings**: 1: Scaling 1.0 (100%) 755: Analog input setpoint 1024: Fixed frequency setpoint 1050: MOP setpoint	

Skip Frequency

Parameter	Description	Setting
P1091 = 7.5	**Skip frequency 1** (entered in Hz) Avoids mechanical resonance effects and suppresses (skips) frequencies in the range around the skip frequency ± P1101 (skip frequency bandwidth).	
P1092 = 0.0	**Skip frequency 2**	
P1093 = 0.0	**Skip frequency 3**	
P1094 = 0.0	**Skip frequency 4**	
P1101 = 1.0	**Skip frequency bandwidth** (entered in Hz)	



Ramp times

Parameter	Description		Setting
P1120 = 10	**Ramp-up time** Enter the acceleration time in seconds.		
P1121 = 10	**Ramp-down time** Enter the deceleration time in seconds.		

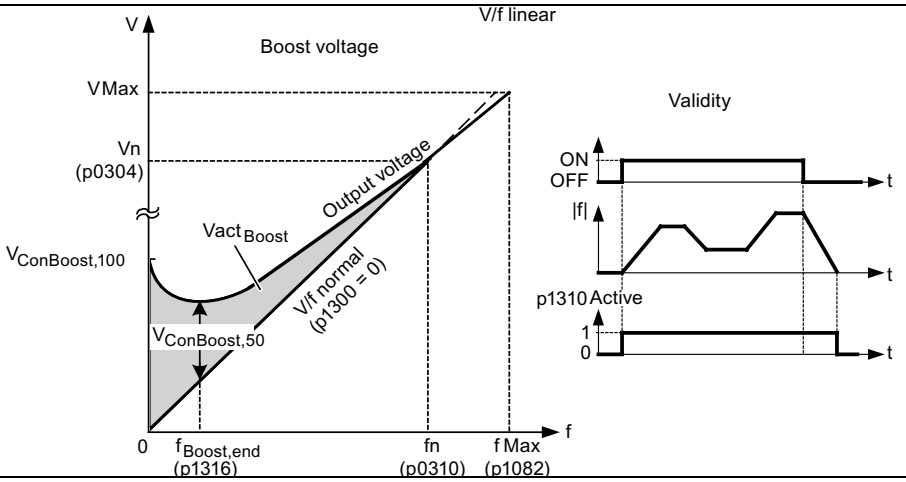
Rounding

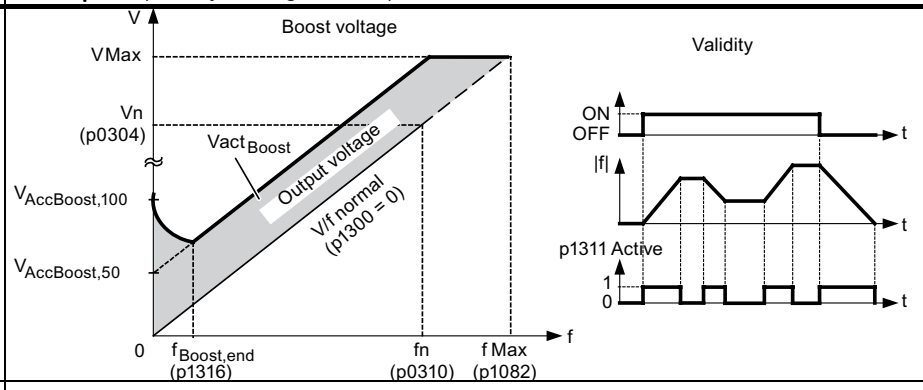
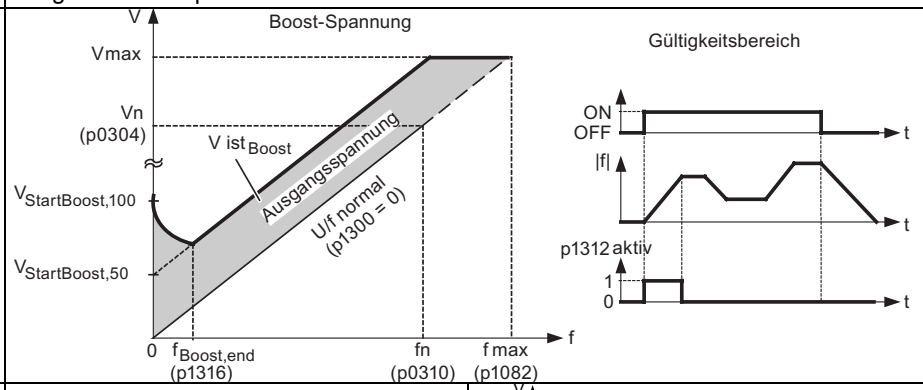
Parameter	Description		Setting
P1130 = 5.0	**Ramp-up initial rounding time** (in seconds)	The rounding times are recommended, to avoid abrupt responses and so to minimize stress to the mechanical system. The ramp-up and ramp-down times are extended by the component of the rounding ramps.	
P1131 = 5.0	**Ramp-up final rounding time** (in seconds)		
P1132 = 5.0	**Ramp-down initial rounding time** (in seconds)		
P1133 = 5.0	**Ramp-down final rounding time** (in seconds)		
P1134 = 0	**Rounding type** **0: continuous smoothing** (jerk-free) 1: Discontinuous smoothing **NOTE**: for discontinuous rounding (P1134 = 1), after the setpoint is reduced or an OFF1 command, the final rounding at ramp-up (P1131) and the initial rounding at ramp-down (P1132) are not executed.		

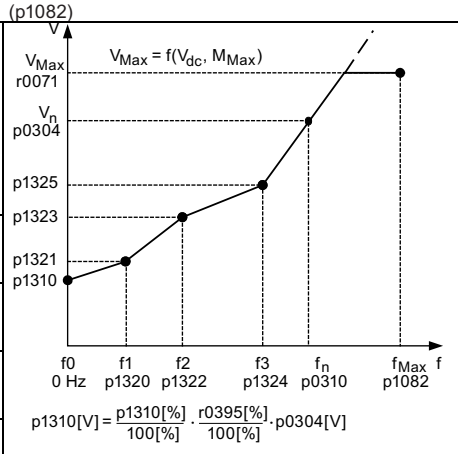
Reference/Limiting frequencies

Parameter	Description	Settings
P1080 = 0.00	**Minimum frequency** (entry in Hz) Sets the minimum motor frequency [Hz] with which the motor works independently of the frequency setpoint. If the setpoint undershoots the value of P1080 the output frequency is set to P1080 in accordance with the sign.	
P1082 = 50.00	**Max. frequency** (entry in Hz) Sets the maximum motor frequency [Hz]. The output frequency will be limited if the setpoint overshoots the P1082 value. The set value here is valid for both directions of rotation.	
P2000 = 50.00	**Reference frequency** (entry in Hz) The reference frequency in Hz is equivalent to a value of 100%. The setting is automatically changed to 60 Hz if the standard frequency of 60 Hz has been selected by means of P0100. **Note** This reference frequency affects the target frequency as the frequency setpoints derived from USI and fieldbus are also referenced to this value (4000 hex ≙ 100% ≙ P2000).	

Motor control

Parameter	Description (factory settings in bold)	Settings
P1300 = 0	**Control mode** This parameter is used to select the control mode. The ratio between the converter output voltage and the converter output frequency must be defined for the "V/f characteristic" control mode: **0: V/f with linear characteristic** 1: V/f with FCC 2: V/f with quadratic characteristic 3: V/f with programmable characteristic (→ P1320 – P1325) 5: V/f for textile applications 6: V/f with FCC for textile applications 19: V/f control with independent voltage setpoint 20: Vector control – speed without encoder 21: Vector control – speed with encoder 22: Vector control – torque without encoder 23: Vector control – torque with encoder	
P1310 = 50.0	**Continuous boost** (in %) Voltage boost in % relative to P0305 (rated motor current) or P0350 (stator resistance). P1310 is valid for all V/f variants (see P1300). With low output frequencies, the ohmic winding resistances must no longer be disregarded in order to maintain the motor flux.	
		
P1311 = 0.0	**Voltage boost during acceleration** (in %) Voltage boost for acceleration/deceleration in % relative to P0305 or P0350. P1311 only results in a voltage boost during ramping (change of setpoint) and generates additional torque for accelerating/decelerating. By contrast to parameter P1312 which is only active during initial acceleration after the ON command, parameter P1311 is active in all acceleration/deceleration operations.	

Parameter	Description (factory settings in bold)	Settings
		
P1312 = 0.0	**Continuous boost during startup** (in %) Voltage boost at startup (after ON command) if a linear or quadratic V/f characteristic is used, in % relative to P0305 (rated motor current) or P0350 (stator resistance). Voltage boost remains enabled until • The setpoint is reached for the first time, or • The setpoint is reduced to a value that is smaller than the current ramp function generator output.	
		
P1320 = 0.00	**Programmable** **V/f freq. coord. 1** (in Hz) Sets V/f coordinates (P1320/1321 to P1324/1325) in order to define the V/f characteristic.	
P1321 = 0.0	**Programmable** **V/f volt. coord. 1** (in V)	
P1322 = 0.00	**Programmable** **V/f freq. coord. 2** (in Hz)	
P1323 = 0.0	**Programmable** **V/f volt. coord. 2** (in V)	
P1324 = 0.00	**Programmable** **V/f freq. coord. 3** (in Hz)	
P1325 = 0.0	**Programmable** **V/f volt. coord. 3** (in V)	
P1335 = 0.0	**Slip compensation** (in %) Adapts the converter's output frequency dynamically so that the motor speed is held constant, regardless of the motor load.	



Parameter	Description (factory settings in bold)	Settings
P1338 = 0.00	**Resonance damping gain V/f** Defines the controller gain for resonance damping for operation with a V/f characteristic.	

Converter / motor protection

Parameter	Description (factory settings in bold)	Settings
P0290 = 2	**Converter overload response** Specifies the converter's response to internal overheating. 0: Reducing the starting frequency 1: Shutdown (F00004) **2: Reduce pulse frequency and output frequency** 3: Reduce pulse frequency, then shut down (F00004)	
P0292 = 5	**Inverter overload warning** (in °C) Specifies the temperature difference between the converter's overtemperature shutdown threshold and the overtemperature warning level. The shutdown threshold is stored on the converter and cannot be changed by the user.	
P0335 = 0	**Motor cooling** (entered by motor cooling system) **0 Self-cooling through the fan impeller on the engine shaft** 1: Auxiliary cooled with separately driven fan 2: Self-ventilated and internal fan 3: Auxiliary cooling and internal fan	
P0610 = 2	**Response to motor overtemperature I^2t** Specifies the response when the warning level for the motor temperature is reached. 0: No response, only alarm 1: Alarm and reduction of I_{max} (reduces the output frequency) **2: Alarm and fault (F00011)**	
P0640 = 150.0	**Motor overload factor** (in %) Defines the motor overload factor in [%] relative to P0305 (rated motor current). Limited to the maximum converter current, or to 400% of the rated motor current (P0305) whichever is lower. $p0640_{max} = \frac{\min(r0209,4 \cdot p0305)}{p0305} \cdot 100$	

Parameterizing the speed encoder

For the speed encoder to adapt to the Control Unit without any problems, the following parameters must be set:

<table>
<tr><th>Parameter</th><th>Description (factory settings in bold)</th><th>Settings</th></tr>
<tr><td>P0400 = 0</td><td>Encoder type selection
0 Disabled
1: Single-track pulse encoder (only channel A)
2: Dual-track pulse encoder (channel A and B)
12: Dual-track pulse encoder with zero pulse (channel A + B + Z)
<table><tr><td>Parameters</td><td>Channel</td><td>Track</td></tr><tr><td>P0400 = 1</td><td>A</td><td></td></tr><tr><td>P0400 = 2</td><td>A
B</td><td></td></tr></table></td><td></td></tr>
<tr><td>P0405 = …</td><td>Pulse pattern enable
Enable for the selection of different pulse types. Bit 00 to bit 03 and bit 06 to bit 08 are not used.
<table><tr><td>Bit 04</td><td>Zero pulse inverted</td><td>0</td><td>No</td><td>1</td><td>Yes</td></tr><tr><td>Bit 05</td><td>Zero pulse = Z + A + B</td><td>0</td><td>No</td><td>1</td><td>Yes</td></tr></table></td><td></td></tr>
<tr><td>P0408 = 1024</td><td>Number of encoder pulses
Defines the number of encoder pulses per revolution. This value is specified by the manufacturer of the speed encoder. The usual values are 360, 500 or 1024. (Default setting: 1024)
The number of encoder pulses per rotation (P0408) is limited by the max. pulse frequency of the incremental encoder input (f_{max} = 300 kHz). The equation below demonstrates the relationship between the speed (rpm), the number of encoder pulses per rotation and the resultant incremental encoder frequency. The incremental encoder frequency must be less than the max. pulse frequency of the incremental encoder input.
$f_{max} > f = \frac{p0408 \times U/min}{60}$</td><td></td></tr>
<tr><td>P0410 = …</td><td>Inv. int. direction of rotation signal
Internal reversal of the direction of rotation. This effect of this parameter is similar to that of a changeover of channels A and B.
0: Standard direction of rotation of the speed encoder
1: Reverse direction of rotation of the speed encoder
Note
If P0400 = 1 (single-track pulse encoder), P0410 = 1 must be set in order to invert the actual speed value.</td><td></td></tr>
<tr><td>P0491 = 0</td><td>Response to speed signal loss
0: No transition (converter shuts down (OFF2))
1: Transition to SLVC (operation continues with vector control without encoder)</td><td></td></tr>
</table>

Parameter	Description (factory settings in bold)	Settings
P0492 = 10.00	**Valid speed difference** P0492 defines the frequency threshold for encoder signal loss (fault F0090). The threshold is applied to low and high frequencies. 1. Signal loss at high frequencies: Fault F0090 is output if the actual frequency and the frequency difference between two sampling cycles (t_A) is greater than parameter P0492: (actual frequency f_{act} > P0492 and $f(t_{A2}) - f(t_{A1})$ > P0492) **Note** A fixed delay time of 40 ms is stored in the converter. If the encoder signal is lost at high frequency fault F00090 is only activated if this delay time has expired. 2. **Signal loss at low frequencies:** Fault F00090 is output if all of the conditions for either case 1 or case 2 have been met simultaneously: • Case 1 – Actual frequency < P0492 – r0061 = 0 and torque limited – r0061 = 0 with frequency setpoint f_{set} > 0 active during the time > P0494. • Case 2 – Actual frequency < P0492 – $f(t_{A2})$ < P0492 and a fault is detected at channel B. **Note** P0492 is updated after the motor startup time P0345 was changed or after the speed was optimized (P1960 = 1). **Caution** P0492 = 0 (no monitoring): The setting P0492 = 0 disables the detection of encoder signal loss at high frequency and at low frequency. That is, encoder signal loss is not monitored. If encoder signal loss detection is disabled and this fault occurs, the motor control may become unstable.	
P0494 = 10	**Delay in response to speed signal loss** P0494 defines the delay time which expires from detecting speed signal loss to triggering the corresponding response. **Note** This parameter is updated after the motor startup time P0345 was changed or the speed was optimized (P1960 = 1). **Caution** P0494 = 0 (no monitoring): The setting P0494 = 0 deactivates monitoring for encoder signal loss at low frequencies. That is, any encoder signal loss is not detected at these frequencies (monitoring for encoder signal loss at high frequency remains active as long as parameter P0492 > 0). If encoder signal loss monitoring is disabled and this fault occurs the motor control may become unstable.	
P1300 = …	**Control mode** 21: Vector control with encoder 23: Vector torque control with encoder	

Display parameters

Parameters r0061, r0090 and r0403 are available as display parameters:

Parameters	Setting/Description (Default settings: BOLD)				Your own settings
r0061	CO: Rotor speed Displays the actual speed detected by the speed encoder.				
r0061	CO: Rotor speed Displays the actual speed detected by the speed encoder.				
r0090	CO: Rotor angle Displays the actual position detected by the encoder. This function is not available if single-track speed encoders are used.				
r0403	CO/BO: Curr. encoder status word Displays the status word of the speed encoder in bit format.				
	Bit 00	Encoder enabled	0: No	1: Yes	
	Bit 01	Encoder error	0: No	1: Yes	
	Bit 02	Signal OK	0: No	1: Yes	
	Bit 03	Encoder signal loss	0: No	1: Yes	
	Bit 04	Use of a speed encoder pulse edge	0: No	1: Yes	

Note

Start by activating the converter with V/f control (P1300 = 0) when commissioning the vector control with encoder (VC). The following variables must match at parameters r0061 and r0021 while the motor is rotating and a speed encoder is connected (activated by means of P0400):

- Sign
- Value (may deviate by a few percent)

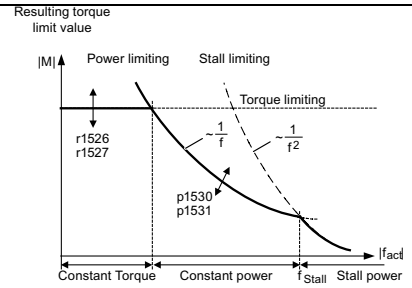
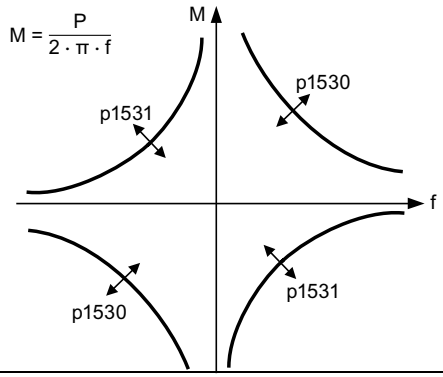
The vector control with encoder (P1300 = 21 or 23) may only be enabled if both conditions are met.

NOTICE

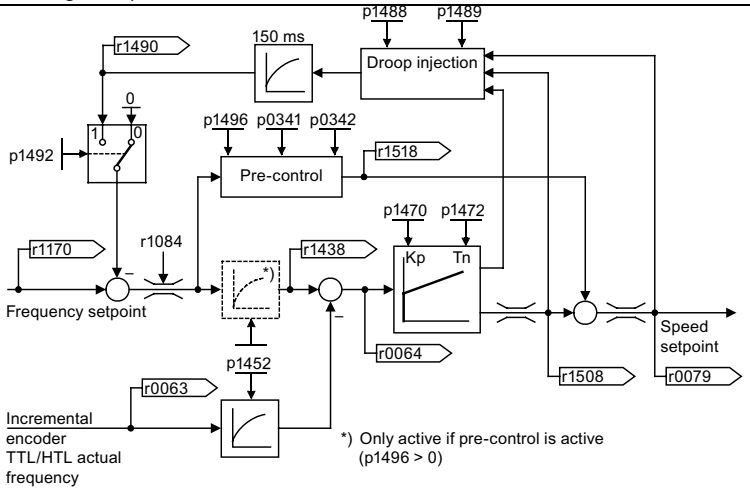
The speed values indicated at r0061, r0063, r0021, and r0022 will be incorrect if the encoder is not properly connected.

7.3.1 Speed controller

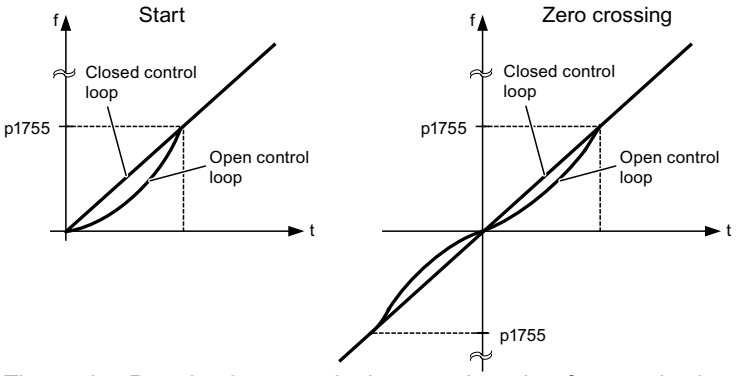
Limits

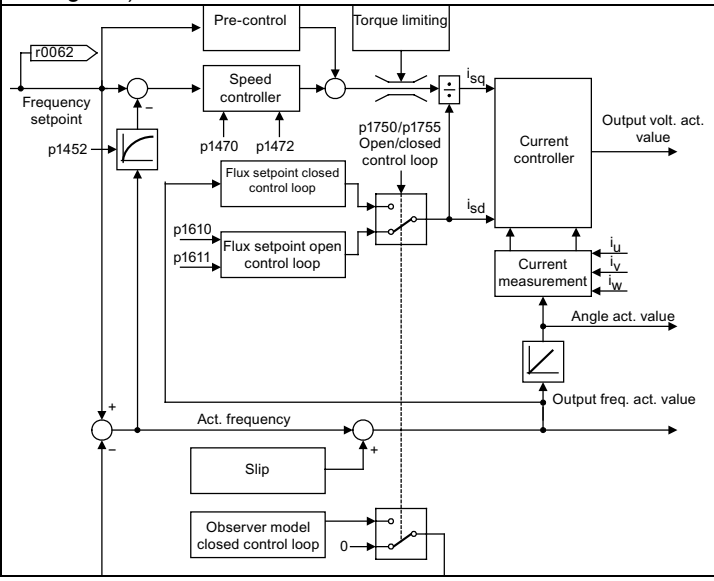
<table>
<tr><th>Parameter</th><th>Description (factory settings in bold)</th><th></th><th>Settings</th></tr>
<tr><td>P0640 = 150.0</td><td colspan="2">Motor overload factor(in %)
Determines the motor overload factor in [%] relative to P0305 (rated motor current). Limited to the maximum converter current, or to 400% of the rated motor current (P0305) whichever is lower.</td><td></td></tr>
<tr><td>P1520 = …</td><td>CO: Upper torque limit
Specifies the upper torque limit.
P1520_{max} = ± r0333</td><td rowspan="2">
</td><td></td></tr>
<tr><td>P1521 = …</td><td>CO: Lower torque limit
Specifies the lower torque limit.
P1521_{max} = ± 4 · r0333</td><td></td></tr>
<tr><td>P1530 = …</td><td>Motoring power limitation
Specifies the maximum permissible power during motor operation.
P1530_{max} = 3 · P0307</td><td rowspan="2">Power limiting (motor, regenerative)

</td><td></td></tr>
<tr><td>P1531 = …</td><td>Regenerative power limitation
Specifies the maximum permissible power during regenerative operation.
P1531_{max} = 3 · P0307</td><td></td></tr>
</table>

Encoderless vector control

Parameters	Description (factory settings in bold)	Settings
P1300 = 20	**Control mode** **0: default setting** 20: Vector control – speed without encoder Encoderless vector control can offer a higher performance level in the following types of applications: • Applications that require high torques to be used. • Applications that require a quick response to sudden loading. • Applications where the torque must be controlled when passing through 0 Hz. • Applications where the speed must be extremely closely adhered to. • Applications that require motor stalling protection.	
P1452 = 4	**Filter time. f. act. frequency (SLVC)** (in ms) Sets the PT1 filter time constant to filter the control deviation of the speed controller in SLVC mode. Reducing this value causes a higher dynamic response of the speed control. There is, however, a risk of instability where values that are too small (or too large) are concerned. The setting P1452 = 2 ms is suitable for most applications (default setting: **4)**.	
P1470 = 3.0	**Gain speed controller (SLVC)** Enters the gain of the speed controller (default setting: **3.0**).	
P1472 = 400	**Integral time n-ctrl. (SLVC)** (in ms) Enters the integral time constant of the speed controller (default setting: **400**).	
		
P1610 = 50.0	**Continuous torque boost (SLVC)** (in %) Sets a continuous torque boost in the lower SLVC speed range. Value entered as a [%] relative to the rated motor torque r0333 (default setting: **50.0**). P1610 is only effective in the open control loop between 0 Hz and approx. ±P1755.	

Parameters	Description (factory settings in bold)	Settings
P1611 = 0.0	**Acc. torque boost (SLVC)** (in %) Sets a torque boost when acceleration occurs in the lower SLVC speed range. Value entered as a [%] relative to the rated motor torque r0333. P1611 is only effective in an open control loop between 0 Hz and approx. ±P1755 (default setting: **0.0**). By contrast to P1610, P1611 is only activated if the setpoint has changed and is deactivated again after the setpoint is reached.	

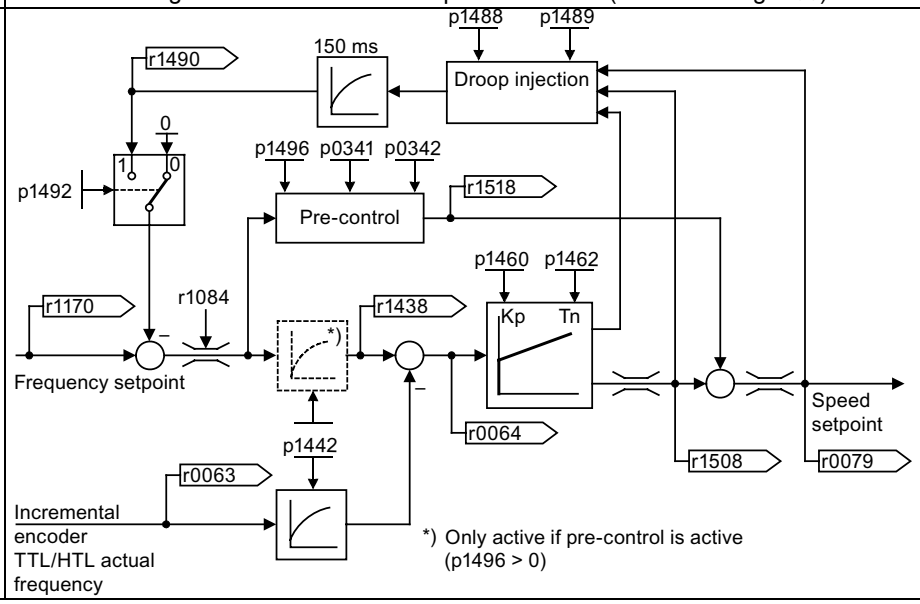
P1750 = 1	**Control word of motor model**
	This parameter is used to specify the response at 0 Hz:
	`Bit00: SLVC controlled start, 0 = NO, 1 = YES`
	(operation directly following ON command)
	`Bit01: SLVC controlled zero crossover, 0 = NO, 1 = YES`
	(transition from 0 Hz)
	
	The setting P1750 = 0 returns the best results at low frequencies in most applications (default setting: **1**)	

P1755 = 5	**Motor model start freq. (SLVC)** (in Hz) Specifies the frequency at which encoderless vector control switches from open-loop controlled to closed-loop controlled operation (default setting: **5.0**)	
		

Vector control (VC)

- First step: Parameterizing the speed encoder (see section "Speed encoder interface" in chapter entitled "Interfaces")
- Start by activating the converter with V/f control (P1300 = 0) when commissioning the vector control with encoder (VC). The following variables must match at parameters r0061 and r0021 while the motor is rotating and a speed encoder is connected (activated by means of P0400):
  - Sign
  - Magnitude (may deviate by a few percent)

    The vector control with encoder (P1300 = 21 or 23) may only be enabled if both conditions are met.
- Speed signal loss monitoring must be disabled (P0492 = 0) if torque is limited externally.

Parameter	Description (factory settings in bold)	Settings
P1300 = 21	**Mode of operation** **0: default setting** 21: Vector control with encoder	
P1442 = 4	**Filter time for act. speed** (in ms) Sets the PT1 filter time constant in order to smooth control errors of the speed controller. Reducing this value causes a higher dynamic response of the speed control. There is, however, a risk of instability where values that are too small are concerned. The setting P1442 = 2 ms is suitable for most applications (default setting: **4**).	
P1460 = 3.0	**Gain factor speed controller** Specifies the gain of the speed controller (default setting: **3.0**).	
P1462 = 400	**Integral time n-ctrl** (in ms) Enters the integral time constant of the speed controller (default setting: **400**).	
		

7.3.2 Converter-specific functions

Overview

You can find more detailed information on converter-specific functions in the section entitled "Operating functions".

Flying restart

Parameter	Description (factory settings in bold)	Settings
P1200 = 0	**Flying restart selection** The flying restart allows the converter to be powered up while the motor is still rotating. **0: Flying restart is disabled** 1: Flying restart is always active 2: Flying restart is active, with power ON, error, OFF2, 3: Flying restart is active, with error, OFF2, 4: Flying restart is always active, in direction of setpoint only 5: Flying restart is active, with line ON, error, OFF2, in direction of setpoint only 6: Flying restart is active, with error, OFF2, in direction of setpoint only	
P1202 = 100	**Motor current: Flying restart** (in %) Defines the detection current used during the flying restart (factory setting: **100**).	
P1203 = 100	**Search speed: Flying restart** (in %) Sets the factor by which the output frequency is changed during the flying restart in order to synchronize with the running motor (factory setting: **100**).	

Automatic restart

Parameter	Description (factory settings in bold)	Settings
P1210 = 1	**Automatic restart** Configures the automatic restart. 0: Disabled **1: Fault acknowledgment after ON** 2: Restart after power failure 3: Restart after undervoltage or error 4: Restart after undervoltage 5: Restart after power failure and error 6: Restart after undervoltage/power failure or error	

Motor holding brake

Parameter	Description (factory settings in bold)	Settings
P1215 = 0	**Holding brake enable** Enables/disables motor holding brake (MHB). **0: Motor holding brake is disabled** 1: Motor holding brake released	
P1216 = 1	**Holding brake release delay** (in s) Defines the time interval during which the converter operates at min. frequency P1080 after magnetization before it is ramped (factory setting: **1.0**).	
P1217 = 1.0	**Holding time after ramp down** (in s) Defines the time during which the converter operates at minimum frequency (P1080) after it was ramped down to this frequency (factory setting: **1.0**).	

Note

The motor holding brake will always be triggered for fail-safe applications by way of the configured shutdown group as soon as a "safe standstill 1" signal is active. Triggering by "safe standstill 1" signal has higher priority compared to the signal output by the brake control module.

Imax controller during regenerative operation

Parameter	Setting/Description The factory settings are highlighted in BOLD.	Your own settings
P1253 = …	**Limit V_{DC} or Imax during regenerative operation** Restricts the maximum effects of the DC link controller (only with V/f control and SLVC) or of the I_{max} controller (V/f control only) during regenerative operation. During regenerative operation at the rated or maximum frequency, the output frequency could exceed the value of P1082 by the amount set at this parameter. If this is not acceptable, you should take one of the following actions: • Reduce the maximum frequency (P1082) accordingly. • Set P1253 to 0 • Take suitable measures to prevent regeneration at maximum frequency.	

Conclusion

Parameter	Setting/Description The factory settings are highlighted in BOLD.	Your own settings
 END	If parameterization is carried out using the STARTER commissioning software, the settings will not automatically be stored in the EEPROM. The data is only transferred from the RAM to the ROM when this button on the STARTER screen is pressed. If "MMC required" has been configured, the parameter set must also be written to the MMC-PS by means of P0802.	

Note

During the transfer of parameter P0340 (see section entitled "Calculating motor/control data") the ET 200S FC is busy computing internal data and communication (on USI and on PROFIBUS DP) is interrupted for the duration of these calculations. This can lead to the following fault codes on the connected SIMATIC S7 controller (communication via PROFIBUS DP):

- Parameterization error 30
- Drive error 70

During commissioning via STARTER (USS), no entries can be made when the calculations are being carried out. The errors can be acknowledged as soon as the converter has completed its calculations.

7.3.3 Completing the application settings

Parameters which must be set before ending the application settings

The following parameters must be configured for every application.

Parameters	Description (parameter name and factory setting (if non-variable) in bold print)	Setting
P1800 = 4	**Pulse frequency** (kHz) The pulse frequency can be changed in steps of 2 kHz. The range extends from 2 kHz to 16 kHz. The full output current of the converter at 55 °C is 4 kHz. The highest output frequency is limited by the pulse frequency. With a pulse frequency of 2 kHz, operation up to 133 Hz is possible. If a higher output frequency is required, the pulse frequency should also be increased (10 kHz pulse frequency - maximum output frequency of 650 Hz). If no low-noise operation is required, then the converter losses and the high-frequency interference transmitted by the converter can be reduced by selecting a lower pulse frequency.	
P2000 = 50	**Reference frequency** (Hz) The reference frequency in Hertz corresponds to a value of 100 %. This setting should be changed if a maximum frequency greater than 50 Hz is required. Comments: This scaling has an effect on the maximum frequency of the analog setpoints. Fixed frequencies and standardization processes of the motor potentiometer are related to 100 %.	
P2001 = 1000	**Reference voltage** (V) The reference voltage in Volt (output voltage) corresponds to a value of 100 %. Comments: This setting should only be changed if the power must be output with a different scaling.	
P2002 = ?	**Reference current** (A) The reference current in Ampere (output current) corresponds to a value of 100 %. The factory setting equals 200 % of the rated motor current (P0305). Comments: This setting should only be changed if the current must be output with a different scaling.	

P2003 = ?	**Reference torque** (Nm) The reference torque in Newton meter corresponds to a value of 100 %. The factory setting equals 200 % of the rated motor torque which is determined from the motor data for a constant motor torque. Comments: This setting should only be changed if the torque must be output with a different scaling.	
P2004 = ?	**Reference power** (kW or hp) The reference power in kW or hp corresponds to a value of 100 %. The factory setting is 200 % of the rated motor torque at constant motor torque. This setting should only be changed if the power must be output with a different scaling.	

Ending the application settings

Parameters	**Description** (parameter name and factory setting (if non-variable) in bold print)	**Setting**
P0971 = 1	**Adopting data from RAM into EEPROM** **0: Inhibited** 1: All parameter changes are transferred from RAM into EEPROM, i.e. the data are not lost if there is a power failure.	

7.4 Commissioning the communication between the S7 CPU and frequency converter

7.4.1 Parameter settings for communication

The frequency converter is operated by means of PROFIdrive profile.

Table 7-5 Standard telegram 1

Telegram	Function in the drive	PZD1	PZD2	PZD3	PZD4
1 (PROFIdrive)	Speed control 2 words	STW1	NSOLL_A	← Receive telegram from fieldbus → Send telegram to fieldbus	
		ZSW1	NIST_A		

STW 1	Control word 1
ZSW 1	Status word 1
NSET_A (P1070)	Speed setpoint A (16-bit)
NIST_A (r0021)	Speed setpoint A (16-bit)

Fieldbus parameter

The following parameters must be set in order to put the fieldbus interface into operation:

Table 7-6 Fieldbus parameters

Parameter	Contents
P0700	Fast selection of command source
P1000	Fast selection of frequency setpoint
P2051	Actual values for process data (BICO)
P2040	Failure time of process data telegram
P0927	Parameter change source

P0700 and P1000 fast selection

The control word and setpoint sources can be selected quickly in parameters P0700 (Select command source) and P1000 (Select frequency setpoint).

r2050 and P2051 BICO

- If process data is interconnected by means of binectors/connectors, much greater flexibility is offered.
- The precise connection of setpoints and actual values from/to the fieldbus interface is parameterized in r2050 and P2051.
- The table below shows the parameters used to transfer process data in PROFIdrive mode.

Table 7-7 Parameters for flexibly interconnecting process data in the PROFIdrive profile

Telegram	PZD1 STW/ZSW	PZD2 HSW/HIW
Connection values for setpoints, master to converter	r2050.00	r2050.01
Connection parameters for actual values, converter to master	P2051.00	P2051.01

Note

r2050 also acts as a display parameter, by means of which the setpoint received from the fieldbus can be checked.

CAUTION

The watchdog function must not be disabled. If this monitoring function is disabled and a fault occurs at the fieldbus interface, the converter cannot detect a fault condition and, therefore, continues to run even in the event of a fault.

Process data monitoring

The telegram failure time is monitored in the converter using parameter P2040.

P2040 telegram failure time

Parameter P2040 specifies the time after which a fault code (F0070) is generated if no telegram is received via the fieldbus.

- P2040 = 0 means: No monitoring
- P2040 > 0 means: The time in milliseconds after which a fault condition is generated if no setpoint telegram has been received.

CAUTION

Faults can only trigger a shutdown if both monitoring functions are active.

If communication is taking place via the fieldbus, parameter P2040 should also be set to a value > 0. This enables/disables the process data monitoring function if the watchdog function is used on its own. The monitoring time corresponds to the watchdog time setting value, plus the time set in P2040.

Note

Process data for which the complete control word (PZD1) is set to zero are not transferred to the converter via the fieldbus. Result: Fault F00070 may occur.

P0927 parameter change source

Bit	Description	Value	
0	Fieldbus	0: No	1: Yes
2	Local interface	0: No	1: Yes

The factory setting for all bits is 1, i.e., the parameters can be changed from all sources.

7.4.2 Process data transfer in the PROFIdrive profile

7.4.2.1 Control and status words

Control word 1 (STW1)

(Bits 0 to 10 according to PROFIdrive profile; bits 11 to 15 specifically for SIMATIC ET 200S FC and ET 200pro FC).

Table 7-8 Preassignment, control word 1

Bit	Value	Meaning	Remarks
0	1	ON	Puts the frequency converter into the "Ready to run" state. The direction of rotation must be specified with bit 11.
	0	OFF1	Shutdown, deceleration of ramp function generator ramp, pulse tripping when $f < f_{min}$.
1	1	Do not run down to standstill	All "Run down to standstill" (OFF2) commands are canceled.
	0	Run down to standstill (OFF2)	Immediate pulse tripping; drive runs down to a standstill.
2	1	No rapid standstill	All "Rapid standstill" (OFF3) commands are canceled.
	0	Rapid standstill (OFF3)	Rapid stop: Shut down with the quickest possible delay rate.
3	1	Enable operation	CL-control and frequency converter pulses are enabled.
	0	Disable operation	CL-control and frequency converter pulses are disabled.
4	1	Enable ramp function generator	--
	0	Reset ramp function generator	Ramp function generator output set to 0 (quickest possible deceleration); frequency converter remains in ON state.

Bit	Value	Meaning	Remarks
5	1	Enable ramp function generator	--
	0	"Freeze" ramp function generator	The setpoint currently provided by the ramp function generator is "frozen".
6	1	Enable setpoint	The value selected on the ramp function generator input is enabled.
	0	Inhibit setpoint	The value selected on the ramp function generator input is set to 0 (zero).
7	1	Acknowledge error	Error acknowledged with a positive pulse edge; frequency converter then switches to the "Begin interlocking" state.
	0	Not relevant	--
8	1	JOG 1 ON	The drive runs up to the setpoint for jog mode as quickly as possible (direction of rotation: clockwise).
	0	JOG 1 OFF	Drive brakes as quickly as possible.
9	1	JOG 2 ON	The drive runs up to the setpoint for jog mode as quickly as possible (direction of rotation: counter-clockwise).
	0	JOG 2 OFF	Drive brakes as quickly as possible.
10	1	Open-loop control with PLC	Open-loop control via interface; process data valid
	0	No open-loop control with PLC	Process data invalid except for "sign of life"
11	1	Setpoint inversion	Motor runs counter-clockwise as a response to a positive setpoint.
	0	No setpoint inversion	Motor runs clockwise as a response to a positive setpoint.
12	-	Not used	--
13	-	Not used	--
14	-	Not used	--
15	1	Command data set bit 0	--

Status word 1 (ZSW1)

(Bits 0 to 10 according to PROFIdrive profile; bits 11 to 15 specifically for SINAMICS frequency converters).

Table 7-9 Preassignment, status word 1

Bit	Value	Meaning	Remarks
0	1	Ready to start	Power supply switched on; electronics initialized; pulses disabled.
	0	Not ready to start	--
1	1	Ready	Frequency converter is switched on (ON command is present); no fault enabled; frequency converter can run as soon as the "Enable operation" command is issued. See control word 1, bit 0
	0	Not ready to start	--

Bit	Value	Meaning	Remarks
2	1	Operation enabled	Drive follows setpoint. See control word 1, bit 3
	0	Operation inhibited	--
3	1	Fault present	Drive is faulty. A fault is present in the drive; it is, therefore, not operating and will switch back to the "Begin start interlock" state once the fault has been successfully eliminated and acknowledged.
	0	No fault	--
4	1	"Run down to standstill" not enabled	--
	0	"Run down to standstill" enabled	"Run down to standstill" (OFF2) command present.
5	1	"Rapid stop" not enabled	--
	0	"Rapid stop" enabled	"Rapid stop" (OFF3) command present.
6	1	Switch-on disabled	The drive is then only transferred to the "Switched on" state when the "Do not run down to standstill" AND "No rapid stop" commands, followed by "ON", are issued.
	0	Switch-on not disabled	
7	1	Warning present	Drive still in operation; warning in service/maintenance parameters; no acknowledgement; see interrupt parameter r2110.
	0	No warning	No warning is present, or the warning has disappeared.
8	1	Speed deviation within tolerance range	Setpoint/actual value deviation within tolerance range.
	0	Speed deviation outside of tolerance range	--
9	1	Master control requested	The automation system is requested to assume control.
	0	No control requested	The master is not currently the master control.
10	1	Maximum frequency reached or exceeded	Frequency converter output frequency is greater than or equal to the maximum frequency.
	0	Maximum frequency not reached	--
11	1	--	--
	0	Warning: Motor current/torque limit reached	--
12	1	Motor holding brake enabled	Signal can be used to control a holding brake.
	0	--	--
13	1	--	Motor data display overload status.
	0	Motor overload	--
14	1	Clockwise rotation	--
	0	Counter-clockwise rotation	--
15	1	--	--

Bit	Value	Meaning	Remarks
	0	Converter overload	For example, current or temperature

7.4.2.2 Block call

On PROFIBUS DP and PROFINET IO cyclic data is read (from the frequency converter to the S7-CPU) by calling SFC14 and written using SFC15 (from the S7-CPU to the frequency converter). A call is generated for each module.

Table 7-10 Table: Call parameters for SFC15

Parameters	Declaration	Data type	Memory area	Description
LADDR	INPUT	WORD	I, Q, M, D, L, const.	Configured start address from the PIO range of the module to which data is to be written. **Note:** The address must be in hexadecimal format, e.g., the start address 100 means: LADDR:=W#16#64.
RECORD	INPUT	ANY	I, Q, M, D, L	Source area for the net data to be written. It must be the same length as the length configured for the module with STEP 7. Only the data type BYTE is permissible.
RET_VAL	OUTPUT INT	INT	I, Q, M, D, L	The system outputs a return value with error code if an error occurs while it executes the function.

Error information

Note

Slave error information can be passed to the SFC by the DP master/IO Controller.

Error code (W#16#...)	Explanation
0000	No error has occurred.
808x	System error at external DP interface
8090	• You have not configured a module for the logical base address specified, or • You have exceeded the limit for the consistent data length, or • You have not entered the start address in the LADDR parameter in hexadecimal format.
8092	A type other than BYTE has been specified in an ANY reference.
8093	For the logical address specified under LADDR, no DP module/PROFINET IO device exists to which you can write consistent data.
80A1	The system has detected a peripherals access error.
80B0	Slave failure at external DP interface
80B1	The declared length of the source area is not equal to the length of user data configured in STEP 7.
80B2	System error at external DP interface
80B3	System error at external DP interface
80C1	The module has not yet processed the data of a previous write job.
80C2	System error at external DP interface
80Fx	System error at external DP interface
85xy	System error at external DP interface
8xyy	General error information, see error analysis with the output parameter RET VAL

7.4.2.3 Examples

Writing PROFIdrive process data

In this example, the control word 1 and the setpoint frequency are written in PROFIdrive mode. The inputs E0.0 and E0.6 are linked to the Start/Stop bit or to the Acknowledge Fault bit of the control word STW1.

The process data are written with the help of SFC15 onto the logic address 256 of the FC.

The SFC15 is called up in the cyclic time slot of the S7 (e.g. OB1).

Note

It should be noted that the interpretation of the cyclic data depends on the parameterization of the ET 200pro FC.

Network 1 : Title:

```
Controlword 1: 0x47e
FREQ         : 0x2500

      L     W#16#47E
      T     MW     1
      L     W#16#2500
      T     MW     3
```

Network 2 : Title:

```
error acknowledgement

      U     E      0.6
      =     M      2.7
```

Network 3 : Title:

```
START / STOP

      U     E      0.0
      =     M      2.0
```

Network 4 : Title:

```
write process data

      CALL  "DPWR_DAT"
       LADDR  :=W#16#100
       RECORD :=MD1
       RET_VAL:=MW12
```

Figure 7-3 Writing PROFIdrive process data (only for S7-300)

Reading PROFIdrive process data

In this example, status word 1 and the instantaneous frequency are read in PROFIdrive mode. The process data are read from FC logical address 256 using SFC14.

SFC14 is called in the S7 cyclic time slice (e.g., OB1).

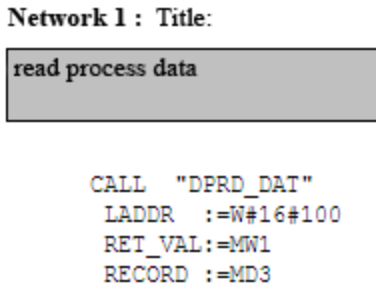


Figure 7-4 Reading PROFIdrive process data (only for S7-300)

Note

Please note that the way cyclic data are interpreted depends on how the frequency converter is parameterized (P2051, P1000).

7.4.3 Parameter transfer in the PROFIdrive profile

7.4.3.1 Block call

Acyclic data transfer can take place parallel to cyclic data transfer. The acyclic data transfer mode allows:

- Large quantities of user data (on PROFIBUS up to 240 bytes) to be exchanged
- Access through other PROFINET hosts (Class 2 masters, or in the case of PROFINET IO by other IO controllers, e.g. commissioning tools) is possible.

Use of the expanded bus functions

There are suitable channels available in the frequency converters for the different masters and IO controllers and for the different data transmission rates:

- Acyclic data exchange with the same master class of Class 1 or the same IO controller: Use of the READ and WRITE functions. In this case, the content of the transferred data block corresponds to the structure of the non-cyclic parameter channel in accordance with the PROFIdrive profile, V4.0 (with data block 47 (DS47)).
- Acyclic data exchange with the help of a SIEMENS startup tool (master of Class 2 or supervisor) (e.g. STARTER). The startup tool can acyclically access parameters and process data in the frequency converter.
- Acyclic data exchange with a SIMATIC HMI (Human Machine Interface) (second master of Class 2 or second supervisor). The SIMATIC HMI can acyclically access parameters in the frequency converter.
- Instead of a SIEMENS commissioning tool or a SIMATIC HMI it is also possible for an external master (master of Class 2) or an external supervisor, as defined in the acyclic parameter channel according to the PROFIdrive profile, Version 4.0 (with DS47), to access the frequency converter.

Properties of the parameter channel

- One 16-bit address for each parameter number and subindex.
- Transfer of different parameters in one access (multiple request).
- Entire fields or parts of fields can be transferred.
- Only one parameter request is processed at a time (no pipelining).
- A parameter request/response must fit into a data set (on PROFIBUS: max. 240 bytes).
- The header of the task or the response are user data.
- Only 1 master or 1 supervisor on a frequency converter can be cyclically accessed at a time.

Structure of parameter request and parameter response

Each parameter request consists of three parts:

Request header:

ID for the request and number of parameters being accessed.

Parameter address:

Addressing a parameter. If multiple parameters are being accessed there will be a corresponding number of parameter addresses. The parameter address appears in the request and not in the response.

Parameter value:

For each parameter addressed there is a segment for the parameter values. Depending on the request ID, the parameter values appear either only in the request or in the response.

Table 7-11 Parameter request

	Word	
	Byte	**Byte**
Request header	Request reference	Request ID
	Drive object ID	Qty Parameters
1. Parameter address	Attribute	Qty of elements
	Parameter number (PNU)	
	Subindex	
…		
n. parameter address	Attribute	Qty of elements
	Parameter number (PNU)	
	Subindex	
1. parameter value(s) (only in the case of "change parameters" request)	Format	Qty Values
	Values	
	…	
…		
n. parameter value(s)	Format	Qty Values
	Values	
	…	

Table 7-12 Parameter response

	Word	
	Byte	Byte
Response header	Request reference mirrored	Request ID
	Drive object ID mirrored	Qty Parameters
1. parameter value(s) (only after a "request")	Format	Qty Values
	Values or error values	
	…	
…		
n. parameter value(s)	Format	Qty Values
	Values or error values	
	…	

Description of the fields for a parameter request and response

Table 7-13 Description of the fields for parameter requests

Field	Data type	Values	Remark
Request reference	Unsigned 8	0x01 … 0xFF	
	Unambiguous identification of the request/response pair for the master. The master changes the request reference with each new request. The slave mirrors the request reference in its response.		
Request ID	Unsigned 8	0x01 0x02	Read request, write request
	Specifies the request type. In the event of a write request the changes are saved to volatile memory (RAM). A save operation is required in order to transfer the data to non-volatile memory (P0971).		
Drive object ID	Unsigned 8	0x00 … 0xFF	Number
	Setting for the drive object number with a drive unit with more than one drive object. Different drive objects with separate parameter number ranges can be accessed at the same DPV1 connection.		
Qty Parameters	Unsigned 8	0x01 … 0x27	No. 1 ... 39 Limited by the length of the DPV1 telegram
	In the case of multiple requests, defines the number of adjacent areas for the parameter address and/or the parameter value for multiple parameter requests. The number of parameters = 1 for individual requests.		
Attribute	Unsigned 8	0x10 0x20 0x30	Value Description Text (not implemented)
	Type of parameter element being accessed.		
Qty of elements	Unsigned 8	0x00 0x01 … 0x75	Special function no. 1 ... 117 Limited by the length of the DPV1 telegram
	Number of field elements being accessed.		
Parameter number	Unsigned 16	0x0001 … 0xFFFF	No. 1 … 65535
	Number of parameter being accessed.		
Subindex	Unsigned 16	0x0001 … 0xFFFF	No. 0 … 65535

Field	Data type	Values	Remark
	Addresses the first field element of the parameter to be accessed.		
Format	Unsigned 8	0x02 0x03 0x04 0x05 0x06 0x07 0x08 Other values 0x40 0x41 0x42 0x43 0x44	Data type: integer 8 Data type: integer 16 Data type: integer 32 Data type: unsigned 8 Data type: unsigned 16 Data type: unsigned 32 Data type: floating point See PROFIdrive profile Zero (without values as positive sub-response to a write request) Byte Word Doubleword Faults
	Format and number specify the correlated areas in the telegram which contain values. Data types conforming to the PROFIdrive profile should be preferred for write access. Bytes, words and doublewords may also be used as alternatives		
Qty Values	Unsigned 8	0x00 … 0xEA	No. 0 ... 234 Limited by the length of the DPV1 telegram
	Specifies the number of successive values.		
Values	Unsigned 16	0x0000 … 0x00FF	
	The values of the parameters for read or write access. A zero byte is appended if the values result in an odd number of bytes. This ensures integrity of the word structure in the telegram.		

Table 7-14 Description of the fields for parameter requests

Field	Data type	Values	Remark	
Request ID	Unsigned 8	0x01 0x02 0x81 0x82	Read request (+) Write request (+) Read request (–) Write request (–)	Request positive, status ok Request negative, error state
	Mirrors the request ID and indicates whether the execution of the request has been positive or negative. Negative means: part of the - or the entire request cannot be executed. The error values are transferred in place of the values for every sub-response.			
Drive object ID	See the table above			
Qty Parameters	See the table above			
Format	See the table above			
Qty Values	See the table above			
Values	See the table above			
Error values	Unsigned 16	0x0000 … 0x00FF	Meaning of the error values: See the next table	
	The error values in the event of a negative response. A zero byte is appended if the values result in an odd number of bytes. This ensures integrity of the word structure in the telegram.			

Note

The DRIVE-ES SIMATIC block package provides function blocks within the standard block libraries for writing/reading parameters, including a few examples.

Error values in parameter responses

Table 7-15 Error values in parameter responses

Error value	Meaning	Remark	Additional inf.
0x00	Invalid parameter number	Access to a non-existent parameter.	–
0x01	Parameter value cannot be modified.	Attempt to modify a read-only parameter.	Subindex
0x02	Low or high limit exceeded	Attempted modification with value outside limits.	Subindex
0x03	Invalid subindex	Access to non-existing subindex.	Subindex
0x04	No field	Access with subindex to non-indexed parameter.	–
0x05	Incorrect data type	Attempt to modify with a value which is incompatible with the data type of the parameter.	–
0x06	Invalid "Set" action (only reset is allowed)	Attempt to modify with a value unequal 0 in a situation where this is not allowed.	Subindex

Error value	Meaning	Remark	Additional inf.
0x07	The descriptive element cannot be modified.	Attempt to modify a read-only descriptive element.	Subindex
0x09	No descriptive data	Access to a non-existent description (parameter value exists).	–
0x0B	No priority active	Attempted modification without active priority.	–
0x0F	No text field available	Attempt to access a non-existent text field (parameter value exists).	–
0x11	Request cannot be executed on account of the operating state	Access is temporarily disabled for unspecified reasons.	–
0x14	Invalid value	Attempt to modify with a value which lies within the limits, however, is invalid for other permanently valid reasons (parameters with permanently defined values).	Subindex
0x15	Response too long	The length of the present response exceeds the maximum transfer length.	–
0x16	Invalid parameter address	Invalid or unsupported value for attribute, number of elements, parameter number, subindex, or a combination of these.	–
0x17	Invalid format	Write request for an invalid or unsupported parameter data format.	–
0x18	Inconsistent qty. of values	Write request - The number of values in parameter data and the number of elements in the parameter address do not match.	–
0x19	Drive object is not present	Access to a drive object which is not present.	–
0x20	The parameter text element cannot be modified.	Attempt to modify a read only parameter text element.	Subindex

7.4.3.2 Examples

Writing PROFIdrive parameters

In order to make use of DS47, a data block first needs to be created in Simatic Manager. This implements the data set structure using the parameter request table as a template. In this example, a data set is stored in DB47 for the purpose of changing P1082 (maximum frequency).

P1082 is to be changed to 100 Hz.

Adresse	Name	Typ	Anfangswer	Kommentar
0.0		STRUCT		
+0.0	Request_Reference	BYTE	B#16#1	
+1.0	Request_ID	BYTE	B#16#2	writing Request
+2.0	AxisNo	BYTE	B#16#1	
+3.0	Number_of_Parameterss	BYTE	B#16#1	1 Parameter
+4.0	Attribute	BYTE	B#16#10	Value of Parameter
+5.0	Number_of_Elements	BYTE	B#16#1	1 Element
+6.0	Parameter_Number	WORD	W#16#43A	P1082
+8.0	Subindex	WORD	W#16#0	Index 0
+10.0	Format	BYTE	B#16#8	Format = Float
+11.0	Number_of_Values	BYTE	B#16#1	1 Value
+12.0	Valuee	REAL	1.000000e+	Value=1.0
=16.0		END_STRUCT		

Figure 7-5 DB47 (DS47 write job)

This data set is then sent to the FC in the context of cyclic program execution (e.g., OB1) using SFC58.

In order to be able to read the reply data set from the FC, an additional data block again needs to be created. For this purpose, DB1 is added to the project. To ensure as flexible a response as possible, DB1 is created as a data field with a length of 240 bytes and no defined structure. The response must then be evaluated on a request-specific basis.

Adresse	Name	Typ	Anfangswer	Kommentar
0.0		STRUCT		
+0.0	Request_Reference	BYTE	B#16#0	
+1.0	Request_ID	BYTE	B#16#0	
+2.0	AxisNo	BYTE	B#16#0	
+3.0	Number_of_Parameterss	BYTE	B#16#0	
+4.0	buffer	ARRAY[0..234]		
*1.0		BYTE		
=240.0		END_STRUCT		

Figure 7-6 DB1 (DS47 response)

Once the data blocks have been created, a parameter request is written via data set DS47 using S7 function SFC58. Then, a reply data set is read with SFC59 and stored in DB1. In this example, the start of this process is triggered by a positive edge at input In0.0.

Network 1 : Title:

on positive edge of In0.0 M8.0 is set

```
U     E      0.0
FP    M      1.0
S     M      8.0
```

Network 2 : Title:

On positive edge of M8.0 the first 16 Byte portion of DB47 is being transfered as dataset 47 to logical address 256.
On negative edge of „busy“ M8.2 is set.

```
CALL  "WR_REC"
 REQ     :=M8.0
 IOID    :=B#16#54
 LADDR   :=W#16#100
 RECNUM  :=B#16#2F
 RECORD  :=P#DB47.DBX0.0 BYTE 16
 RET_VAL:=MW10
 BUSY    :=M8.1

U     M      8.1
R     M      8.0

U     M      8.1
FN    M      1.1
S     M      8.2
```

Network 3 : Title:

With M8.2=1 the reply data set is read from the logical address 256.

```
CALL  "RD_REC"
 REQ     :=M8.2
 IOID    :=B#16#54
 LADDR   :=W#16#100
 RECNUM  :=B#16#2F
 RET_VAL:=MW12
 BUSY    :=M8.3
 RECORD  :=P#DB1.DBX0.0 BYTE 240

U     M      8.3
R     M      8.2
```

Figure 7-7 Request processing in OB1

Once the parameter request has been executed successfully, the request header (defined in DB47) must be mirrored in DB1 (requestID does not indicate any errors).

To view the data currently stored in DB1, open DB1 in Simatic Manager and click the glasses icon.

The parameter response table provides information about the structure of the reply data set.

Reading PROFIdrive parameters (example)

In order to make use of DS47, a data block first needs to be created in SIMATIC Manager. The structure of the data set will then be implemented in it. In this example, a data set is stored in DB48 for the purpose of reading P0947 (error buffer).

Adresse	Name	Typ	Anfangswer	Kommentar
0.0		STRUCT		
+0.0	Request_Reference	BYTE	B#16#1	
+1.0	Request_ID	BYTE	B#16#1	reading Request
+2.0	AxisNo	BYTE	B#16#1	
+3.0	Number_of_Parameterss	BYTE	B#16#1	1 Parameter
+4.0	Attribute	BYTE	B#16#10	Value of Parameter
+5.0	Number_of_Elements	BYTE	B#16#8	8 Elements
+6.0	Parameter_Number	WORD	W#16#3B3	P947
+8.0	Subindex	WORD	W#16#0	Index 0
=10.0		END_STRUCT		

Figure 7-8 DB48 (DS47 read job)

This data set is then sent to the FC in the context of cyclic program execution (e.g., OB1) using SFC58.

In order to be able to read the reply data set from the FC, an additional data block needs to be created. For this purpose, DB1 is added to the project. To ensure as flexible a response as possible, DB1 is created as a data field with a length of 240 bytes and no defined structure. The response must then be evaluated on a request-specific basis.

Adresse	Name	Typ	Anfangswer	Kommentar
0.0		STRUCT		
+0.0	Request_Reference	BYTE	B#16#0	
+1.0	Request_ID	BYTE	B#16#0	
+2.0	AxisNo	BYTE	B#16#0	
+3.0	Number_of_Parameterss	BYTE	B#16#0	
+4.0	buffer	ARRAY[0..234]		
*1.0		BYTE		
=240.0		END_STRUCT		

Figure 7-9 DB1 (DS47 response)

Once the data blocks have been created, a parameter request is written via data set DS47 using S7 function SFC58. Then, a reply data set is read with SFC59 and stored in DB1. In this example, the start of this process is triggered by a positive edge at input In0.0.

on positive edge of In0.0 M8.0 is set

```
U     E      0.0
FP    M      1.0
S     M      8.0
```

Network 2 : Title:

On positive edge of M8.0 the first 16 Byte portion of DB47 is being transfered as dataset 47 to logical address 256.
On negative edge of „busy“ M8.2 is set.

```
CALL  "WR_REC"
 REQ    :=M8.0
 IOID   :=B#16#54
 LADDR  :=W#16#100
 RECNUM :=B#16#2F
 RECORD :=P#DB48.DBX0.0 BYTE 10
 RET_VAL:=MW10
 BUSY   :=M8.1

U     M      8.1
R     M      8.0

U     M      8.1
FN    M      1.1
S     M      8.2
```

Network 3 : Title:

With M8 The reply data set will be read from the logical address 256.

```
CALL  "RD_REC"
 REQ    :=M8.2
 IOID   :=B#16#54
 LADDR  :=W#16#100
 RECNUM :=B#16#2F
 RET_VAL:=MW12
 BUSY   :=M8.3
 RECORD :=P#DB1.DBX0.0 BYTE 240

U     M      8.3
R     M      8.2
```

Adress	Name	Typ	Anfangswert	Aktualwert
0.0	Request_Refer	BYTE	B#16#0	B#16#01
1.0	Request_ID	BYTE	B#16#0	B#16#01
2.0	AxisNo	BYTE	B#16#0	B#16#01
3.0	Number_of_Par	BYTE	B#16#0	B#16#01
4.0	buffer[0]	BYTE	B#16#0	B#16#42
5.0	buffer[1]	BYTE	B#16#0	B#16#08
6.0	buffer[2]	BYTE	B#16#0	B#16#00
7.0	buffer[3]	BYTE	B#16#0	B#16#46
8.0	buffer[4]	BYTE	B#16#0	B#16#00
9.0	buffer[5]	BYTE	B#16#0	B#16#00
10.0	buffer[6]	BYTE	B#16#0	B#16#00
11.0	buffer[7]	BYTE	B#16#0	B#16#00
12.0	buffer[8]	BYTE	B#16#0	B#16#00
13.0	buffer[9]	BYTE	B#16#0	B#16#00
14.0	buffer[10]	BYTE	B#16#0	B#16#00
15.0	buffer[11]	BYTE	B#16#0	B#16#00
16.0	buffer[12]	BYTE	B#16#0	B#16#00
17.0	buffer[13]	BYTE	B#16#0	B#16#00
18.0	buffer[14]	BYTE	B#16#0	B#16#00
19.0	buffer[15]	BYTE	B#16#0	B#16#00
20.0	buffer[16]	BYTE	B#16#0	B#16#00
21.0	buffer[17]	BYTE	B#16#0	B#16#00
22.0	buffer[18]	BYTE	B#16#0	B#16#00
23.0	buffer[19]	BYTE	B#16#0	B#16#00
24.0	buffer[20]	BYTE	B#16#0	B#16#00
25.0	buffer[21]	BYTE	B#16#0	B#16#00

Figure 7-10 Example DB1 after P947 has been read out successfully with F70 pending (P947.0=70)

7.5 Commissioning fail-safe functions

General steps

Those parameters that are marked with an asterisk ("*") offer a wider variety of setting options than the ones listed here. For information on additional setting options, please refer to the List Manual.

When making changes to fail-safe functions, the following steps are mandatory:

Parameter	Description	Unit	Standard value	Min.	Max.
P0010 = 95	**Commissioning parameter*** 95: Commissioning of fail-safe functions		0	0	95
P9761	**SI password input** These parameters are used to enter the security password necessary for accessing and changing fail-safe function parameters.	-	0	1000	99999
Change the required fail-safe parameters and then follow the steps below to exit parameterization:					
P9799	**Checksum for SI parameters** Checksum of fail-safe function parameters. Enter the value from r9798.	-	0000h	0000h	FFFFh
P9899	**Checksum for SI parameters** Checksum of fail-safe function parameters. Enter the value from r9898.	-	0000h	0000h	FFFFh
P3900 = 10	**End of safety commissioning*** 10: Accept changes to fail-safe function parameters. 11: Reject changes to fail-safe function parameters.		0	0	11

Parameters for fail-safe functions

The table below provides an overview of all the fail-safe function parameters. Access level 3 applies in respect of the fail-safe parameters (P0003 = 3). The values of fail-safe parameters can only be changed with a password (P9761). For a more detailed description, please refer to the List Manual.

CUs with integrated fail-safe functions are equipped with two processors. To distinguish between them, they shall be referred to as follows:

- P1 denotes processor 1.
- P2 denotes processor 2.

Table 7-16 Parameters for fail-safe functions

Parameter	Description	Unit	Standard value	Min.	Max.
Processor 1 (drive processor)					
P9601	SI enable parameter	-	2	0	2
P9603	SI selection of safety source	-	0	0	48
P9659	SI maximum time until test stop	h	8.0	0.1	8760.0
r9660	SI time remaining until test stop	h	-	-	-
P9680	SI braking ramp deceleration	ms	250	10	99000
P9681	SI braking ramp coasting down time	ms	10000	100	99000
P9682	SI minimum speed for detecting standstill	Hz	5.0	2.0	20.0
P9690	SI setpoint for SLS	Hz	10.0	1.0	300.0
P9691	SI tolerance for SLS	Hz	13.0	5.0	302.0
P9692	SI response to SLS selection	-	1	0	2
r9760	SI internal password	-	12345	1000	99999
P9761	SI password input	-	0	1000	99999
P9762	SI password change	-	0	1000	99999
P9763	SI confirmation of password change	-	0	1000	99999
r9770	SI FW version	-	-	-	-
r9771	SI hardware functions	-	-	-	-
r9772	SI status word	-	-	-	-
r9798	SI display checksum	-	0000h	0000h	FFFFh
P9799	SI parameter checksum	-	0000h	0000h	FFFFh
Processor 2 (communications processor)					
P9801	SI enable parameter	-	2	0	2
P9803	SI selection of safety source	-	0	0	48
P9880	SI braking ramp deceleration	s	0.250	0.010	99.000
P9881	SI braking ramp coasting down time	s	10.000	0.100	99.000
P9882	SI minimum speed for detecting standstill	kHz	0.005	0.002	0.020
P9890	SI setpoint for SLS	kHz	0.010	0.001	0.300
P9891	SI tolerance for SLS	kHz	0.013	0.005	0.302
P9892	SI response to SLS selection	-	1	0	2
r9898	SI display checksum	-	0000h	0000h	FFFFh
P9899	SI parameter checksum	-	0000h	0000h	FFFFh

7.5.1 Password for fail-safe functions

Password for fail-safe functions

Four parameters are assigned to the password protection system:

- r9760 - Shows the currently valid password for fail-safe function parameters.
- P9761 - Used to enter the password.
- P9762 - Used to enter a new password (5 digits without leading zeros (0)).
- P9763 - Used to confirm a new password.

When a password is entered (5 digits without leading zeros), it is compared to the password stored in r9760.

If it is correct, i.e., if the two passwords match, access is granted.

If the password is incorrect, the parameters for fail-safe functions are disabled and the user has to exit the commissioning mode for fail-safe functions manually using parameter P3900 = 11. Parameter P3900 = 11 clears all previous changes that have been made to the parameters for fail-safe functions.

Checksums

All parameters for fail-safe functions are verified with the aid of checksums, which guarantee the integrity of the data stored in the drive processor's memory.

There are four checksums, two for each processor:

- r9798 - Current checksum for P1
- P9799 - Reference checksum for P1
- r9898 - Current checksum for P2
- P9899 - Reference checksum for P2

7.5.2 General information on acceptance tests

Description

In order to check the safety function parameters, an acceptance test must be carried out after commissioning, after a reset and also whenever changes are made to a fail-safe parameter data set associated with safety functions (e.g., via MMC). The acceptance test must be logged and documented using appropriate means. This section contains an example of a duly completed acceptance report. Acceptance reports must be archived using appropriate means.

Acceptance test

An acceptance test must be carried out by the machine manufacturer in respect of any safety functions that are enabled on the system.

Authorized person, acceptance certificate

Each of the safety functions must be checked by the relevant authorized personnel. Each check must be documented/logged in an acceptance report and then signed off. The acceptance report must be enclosed with or attached to the system's log book.

In this context, the term "authorized personnel" refers to any member of the machine manufacturer's personnel with the requisite training and knowledge to carry out a safety function acceptance test correctly.

Note

It is essential for personnel to adhere precisely to the information/instructions and descriptive information regarding commissioning provided in the section of this manual entitled "Commissioning fail-safe functions".

Whenever changes are made to safety function parameters, a new acceptance test must be carried out and the results included in the form of an acceptance report.

The official acceptance report form can be found in the Appendix to these Operating Instructions.

What the results of a completed acceptance test must include

System documentation including details of fail-safe functions

- Description of the system and synopsis/block diagram
- Safety functions for each drive
- Description of fail-safe devices/equipment

Functional test

Used to check the individual safety functions that are implemented.

- "Safe Torque Off" (STO)
- "Safe Stop 1" (SS1)

- "Safely Limited Speed" (SLS)

Completing the report

Document/log the commissioning time and then sign.

- Check the safety function parameters.
- Document/log the checksums.
- Provide evidence to show that the data have been saved/archived.
- Sign.

Appendix

Records/printouts of measurements associated with the functional test.

- Alarm logs
- Printouts of curve characteristics

Note

The official acceptance report form can be found in the Appendix to these Operating Instructions.

7.6 Performing a reset to factory settings

Overview

All converter parameters can be restored to a defined original state by performing a reset to factory settings.

The original state can be restored by resetting the parameters to factory default by means of P0970. These factory-set values are indicated in the parameter list by means of the abbreviation "Def".

After a reset to factory settings, the following default settings will apply to the converter:

- Command and setpoint sources reset to fieldbus communication
- Control mode: basic V/f characteristic (P1300 = 0)
- Induction motor (P0300 = 1)

To facilitate the process of performing a reset to factory settings, the STARTER software offers self-explanatory buttons and operator dialogs for both the standard and fail-safe parameters.

Note

When the parameters are reset to the factory settings, the data transfer memory is reinitialized. As a result, data transfer will be suspended while the reset process is being performed.

⚠ WARNING

Fail-safe parameters

If standard frequency converters are used only the reset to factory defaults by means of P0970 = 1 is of relevance.

If using frequency converters with fail-safe functions you have two reset options:

- P0970 = 1 only resets parameters which are irrelevant to fail-safe functions (application parameters).
  If P0970 = 1 is used to reset factory defaults on a frequency converter with fail-safe functions all application parameters will be reset, however, any parameter settings relating to fail-safe functions will be retained. That is, it is not necessary to carry out an acceptance test.
- P0970 = 10 (password protected) only resets parameters which relate to fail-safe functions.
  An acceptance test must be carried out if parameters relating to fail-safe functions have to be changed.

Factory default settings

After the frequency converter is reset to the factory settings, it can be operated without any additional parameterization provided the default settings of the frequency converter match the following data of a 4-pole motor:

Default line frequency	50 Hz
Rated motor voltage	P0304
Rated motor current	P0305
Rated motor output	P0307
Rated motor frequency	P0310
Rated speed	P0311
(We recommend a Siemens standard motor.)	
The following conditions must also be fulfilled:	
Control (ON/OFF command) through fieldbus	P0700=6
Asynchronous motor	P0300=1
Self-cooled motor	P0335=0
Motor overload factor	P0640=150 %
Setpoint input through fieldbus	P1000=6
Minimum frequency	P1080=0 Hz
Maximum frequency	P1082=50 Hz
Ramp-up time	P1120=10 s
Ramp-down time	P1121=10 s
Linear V/f characteristic	P1300=0

NOTICE
If the settings made go beyond the factory settings, then careful attention must be paid - depending on the complexity of the application - to the description of special functions and to the parameter list plus function diagrams when commissioning the frequency converter.

7.6.1 Resetting fail-safe parameters to default values

Description

Safe resetting to factory settings causes all fail-safe parameters to revert to their default values. Exceptions:

- r9760 SI internal password
- P9761 SI password input
- P9762 SI password change
- P9763 SI confirmation of password change

Required parameter settings

Parameter	Description (parameter name and factory setting (if this does not vary) in bold)
P0003 = 3	User access level* 1: Standard: Facilitates access to the most frequently used parameters. 2: Extended: Facilitates extended access, e.g., to converter I/O functions. 3: Expert level: Only to be used by experts.
P0004 = 0	Parameter filter* 0: All parameters
P0010 = 30	Commissioning parameter* 0: Ready 30: Factory setting, parameter transfer
P9761	SI password input Enter security password
P0970 = 10	Reset to factory settings* 0: Disabled 1: Reset application parameters 10: Reset parameters for fail-safe functions
BUSY	Once the reset to factory settings has been completed, P0970 and P0010 are set to 0.

Standard commissioning and operation

8

Overview

The operating and startup characteristics depend on the settings of the converter during commissioning.

The following special operating characteristics are covered in this section:

- Transfer of frequency converter parameters to external storage media
- Simple standard commissioning of several frequency converters and the response when a frequency converter is replaced
- Normal frequency converter operating conditions

Requirements

The software user functions require functional hardware and software which have been put into operation.

8.1 Transfer of frequency converter parameters

The mechanisms by means of which parameters are transferred to external storage media play an important role both under normal frequency converter operating conditions and during standard commissioning and device replacement. For this reason, the different media and their associated transfer methods are explained below.

8.1.1 Storage media for frequency converter parameters

Internal memory

All frequency converter parameter values are stored in a ROM block and are transferred to the RAM once the device has powered up. Changes to factory settings can be saved in an EEPROM so that they are powerfail-proof.

External memory

The frequency converter parameter values can be transferred to external storage media and saved there. Options are:

- PC hard disk
- PLC memory
- MMC

Note

The file format for the MMC is FAT. Other file formats, such as FAT32 or NTFS, are not compatible with uploading or downloading parameter sets from/to the converter.

Formatting is performed via the following DOS command line:

C:\>format volume /FS:FAT, where "volume" must be replaced by the drive name of the MMC (e.g., A).

Please note that formatting causes all data to be deleted from the MMC.

8.1.2 Parameter transfer - Terms

Upload

"Upload" refers to the transfer of parameters from the internal memory to an external storage medium (e.g., MMC).

Download

"Download" refers to the transfer of parameters from an external storage medium to the frequency converter's internal memory.

Supplementary conditions

The following supplementary conditions must be observed in respect of uploads/downloads:

- Once the upload/download procedure is under way, there is no way of stopping it again.
- If the data being downloaded are incompatible with the frequency converter, the relevant parameters in the converter will revert to their default values.
- All the LEDs will flash during the upload/download process. On successful completion of the process, the "RY/RDY" LED will light up.

⚠ CAUTION

Downloading parameters between different frequency converters or firmware versions is not recommended.

It is possible to download parameter sets between different frequency converters, but the user bears full responsibility for the consistency of the downloaded parameter set, as the sets may differ from one another.

8.1.3 Parameter transfer with MMC

Upload from frequency converter to an MMC

The frequency converter features an MMC slot, into which a memory card can be inserted. An upload of parameters from EEPROM to the MMC can only be triggered manually.

Prerequisites:

- The upload frequency converter's power supply must be connected.
- The upload frequency converter must be in the "Ready" state.
- You must have an MMC, type 6SL3254-0AM00-0AA0, at your disposal.

Procedure

Parameter	**Description** (parameter name and factory setting (if this does not vary) in bold)	**Setting**
	Insert MMC in the CU - perform the following steps for the parameter set to be uploaded:	
P0010 = 30	**Commissioning parameter*** **0: Ready** 1: Quick comm. 2: Frequency converter 30: Factory setting, parameter transfer 95: Commissioning of fail-safe functions	
P0804 = …	**Select clone file** **0: clone00.bin** … 99: clone99.bin **Remark**: You can use P0804 to select the name of the clone file. In theory, up to a maximum of 100 (0 ... 99) parameter sets can be stored on one MMC.	

P0802 = 2	**Transfer data from EEPROM** **0: Disabled** 2: Start MMC transfer	
	If the upload procedure has been completed successfully, P0010 and P0802 will be set to 0 and the "RDY" LED will light up.	

A fault code indicates an unsuccessful upload.

Download from an MMC to the frequency converter

The transfer of parameters from the MMC to the frequency converter's EEPROM can be triggered manually or performed automatically.

Note

When making use of this download procedure, you must bear in mind the following important constraints:

- During the download procedure, the frequency converter will not be able to respond to any commands.
- Once the download procedure is under way, there is no way of stopping it again.
- If the data being downloaded are incompatible with the frequency converter, the relevant parameters in the frequency converter's memory will revert to their default values.
- In the event of an unsuccessful download, the frequency converter will not function as it should.

The LEDs should flash when parameters are downloaded from an MMC to the frequency converter's EEPROM. However, if the frequency converter is in fault status, this will be afforded higher signaling priority by the LEDs than the download process. In such an event, there is no way of knowing whether or not the parameter set has been downloaded correctly.

Manual download

In the case of a manual download, all the necessary parameters (with the exception of fail-safe parameters) will be downloaded to the frequency converter.

Prerequisites

- The download frequency converter's power supply must be connected.
- The download frequency converter must be in the "Ready" state.
- You must have an MMC, type 6SL3254-0AM00-0AA0, at your disposal.

Procedure

Parameter	**Description** (parameter name and factory setting in bold)	**Setting**
	Insert MMC in the CU and perform a manual download.	
P0010 = 30	**Commissioning parameter*** **0: Ready** 1: Quick comm. 2: Frequency converter 30: Factory setting, parameter transfer 95: Commissioning of fail-safe functions	
P0804 = …	**Select clone file (for download)** **0: clone00.bin** … 99: clone99.bin	
P0803 = 2	Transfer data to EEPROM 0: Disabled 2: Start MMC transfer	
	If the upload procedure has been completed successfully, P0010 and P0803 will be set to 0 and the "RDY" LED will light up.	

Remark: It is possible to transfer data from one MMC to another using a commercially available card reader.

A fault code indicates an unsuccessful download.

Automatic download

In the case of an automatic download, all parameters are transferred to the frequency converter, including the fail-safe parameters.

P8458 is the parameter responsible for controlling the automatic download procedure on power-up. Irrespective of this, an automatic download is always performed after frequency converter components have been replaced.

Note

MMC for "automatic download"

The file clone00.bin is always used for an automatic download.

The user must ensure that clone00.bin (saved as "clone00.bin" on the PC with the STARTER software) is available on the MMC that is being used for downloading parameters automatically on power-up. Otherwise, the automatic download will not be performed.

Possible settings for P8458 and its functions are specified below.

P8458 = 0	Automatic parameter downloads from MMC disabled.
P8458 = 1	Parameters automatically downloaded from the MMC once (when frequency converter next powers up (factory setting)). After the download, P8458 will be set to 0.
P8458 = 2	Parameters automatically downloaded from the MMC each time the frequency converter powers up.

Note

Parameter P8458 does not have any function once a module has been replaced. After a frequency converter is replaced, an automatic download is always performed once.

The converter will be ready to operate following a successful automatic download. A successful automatic download means:

- All parameters on the MMC have been written to the converter's EEPROM.
- The application ID on the MMC matches the configured application ID for this slot.

Fault codes indicate an unsuccessful download.

P8458 after an automatic download

The table below shows how parameter P8458 is affected by the value that may be stored on the MMC.

Table 8-1 P8458 settings after an automatic parameter download from the MMC

P8458 settings in the frequency converter's EEPROM	P8458 settings in the MMC	P8458 setting after startup	Remark
0	0	0	Only possible in the case of a replacement
0	1	0	
0	2	2	
1	0	0	--
1	1	0	--
1	2	2	--
2	0	0	--
2	1	0	--
2	2	2	--

8.1.4 Parameter transfer with PC (STARTER)

Upload from frequency converter to the PC

Parameters are uploaded from the frequency converter's RAM to a project file on a PC's hard disk using STARTER. STARTER can be connected via a fieldbus or directly to the frequency converter's RS232 interface.

Prerequisites

- You must have a converter with a suitable parameter set at your disposal (upload converter).
- STARTER must be installed on the PC used for standard commissioning.
- The upload converter's power supply must be connected.
- The upload converter is in the "Ready to run" state.

Connect the STARTER PC to the upload frequency converter via RS232 (point-to-point connection, appropriate connecting cable required) or via fieldbus, press the online button  ("Connect to target system") and perform the upload using the  button.

Remark

An online connection can only be established between the PC and frequency converter via fieldbus if the following conditions are met:

- The interface module of the ET 200 station is running in DPV1 mode.
- There is no CPU between the PC and the frequency converter (also applies to the

Download from PC to the frequency converter

In the case of a manual download, all parameters (with the exception of fail-safe parameters) will be transferred to the frequency converter.

The parameter download is triggered via STARTER, from the project file in the frequency converter's RAM.

Note

When making use of this download procedure, you must bear in mind the following important constraints:

- During the download process, the frequency converter will not be able to respond to any commands.
- Once the download procedure is under way, there is no way of stopping it again.
- If the data being downloaded are incompatible with the frequency converter, the relevant parameters in the frequency converter's memory will revert to their default values.
- In the event of an unsuccessful download, the frequency converter will not function as it should.

When parameters are being downloaded from the PC to the frequency converter's EEPROM, the LEDs will flash. If the frequency converter experiences a fault condition, the fault is indicated by the LEDs (SF on, RY/RDY off). The download will be carried out regardless.

Prerequisites

- The download converter's power supply must be connected.
- The download converter is in the "Ready to run" state.

Connect the STARTER PC to the download frequency converter via RS232 (point-to-point connection, appropriate connecting cable required) or via fieldbus, press the online button and perform the download using the ("Download project to target system") button.

The transferred parameters must then be saved in the frequency converter so that they are powerfail-proof by pressing the ("RAM to ROM") button.

Remark

An online connection can only be established between the PC and frequency converter via fieldbus if the following conditions are met:

- The interface module of the ET 200 station is running in DPV1 mode.
- The PC must be connected to the fieldbus directly.

See also

- Standard commissioning (Page 159)

8.1.5 Parameter transfer with PLC

Parameters can be uploaded and downloaded via fieldbus using the transfer mechanisms of data set 47. For detailed information, refer to "Commissioning and Optimization".

8.1.6 Fault codes during upload and download

Fault codes

If a fault occurs during an automatic download procedure, the frequency converter returns to the parameter set that was previously stored in the EEPROM and the following fault codes are generated:

Error	Cause	Remedy/Test
F00061	No MMC inserted	• MMC faulty? • Insert an MMC and attempt the upload/download again.
F00062	MMC contents invalid	• MMC faulty? • Parameter valid for this frequency converter?
F00063	MMC contents incompatible	• MMC faulty? • Parameter set clone00.bin available on the MMC • Parameter valid for this frequency converter?
F00395	Different application ID after download	See below

NOTICE

Once parameters have been uploaded from and downloaded to different frequency converters, the parameter settings must be checked.

Downloading parameters from another frequency converter may cause a fault to occur with F00063 output, if there are parameters that cannot be downloaded (check P0949 regarding the (first) parameter number that cannot be downloaded).

If fault code F00061 or F00063 occurs during startup, it can only be cleared by shutting down and restarting.

Remedy for F00395

If fault F00395 occurs, the loaded parameter set must be checked and confirmed by clearing code F00395. The procedures are different for standard and fail-safe frequency converters.

F00395 for standard frequency converter

For a frequency converter without fail-safe functions, code F00395 can be cleared by means of:

- Setting P7844 = 0 (confirmation of parameter download) or
- Setting P7844 = 2 (rejection of parameter download)
  → The frequency converter must be commissioned.
- Fault F00395 is acknowledged automatically by both P7844 settings.

> **⚠ WARNING**
>
> In acknowledging fault F00395, the user assumes full responsibility for the parameters saved in the frequency converter. In the "Ready to run" state, the frequency converter can be started after acknowledgement by means of an OFF1/ON command.

F00395 for fail-safe frequency converter

In the case of frequency converters with integrated fail-safe functions, it is necessary to perform an acceptance test. To clear F00395 on a frequency converter with integrated fail-safe functions, proceed as follows:

- P0010 = 30
- P9761 = Fail-safe password
- Setting P7844 = 0 (confirmation of parameter download) or
- Setting P7844 = 2 (rejection of parameter download)
  → The frequency converter must be commissioned.
- Fault F00395 is acknowledged automatically by both P7844 settings.
- Perform an acceptance test.

> **⚠ WARNING**
>
> In acknowledging fault F00395, the user assumes full responsibility for performing the acceptance test. The frequency converter must not be switched on before an acceptance test is properly completed. In the "Ready to run" state, the frequency converter can be started by means of an OFF1/ON command.

8.2 Frequency converter standard commissioning and replacement

8.2.1 Application ID

The application ID is an important parameter for frequency converter standard commissioning and replacement. It is specified in HW Config when the frequency converter is configured (see Planning/Configuring) and saved in the PLC.

The application ID is designed to uniquely identify the frequency converter's parameter assignment and to prevent frequency converters being swapped incorrectly.

Saving the application ID in the frequency converter

The very first time a connection is established between the PLC and frequency converter, the application ID is accepted into the frequency converter and saved so that it is powerfail-proof.

The frequency converter's application ID is also transferred and saved when the frequency converter parameters are uploaded to an MMC or in STARTER.

Application ID during standard commissioning or replacement

When the frequency converter is replaced or after it has been parameterized by means of a parameter download, the frequency converter receives the application ID from the PLC and compares this value with the one saved in the frequency converter. If both values are identical, the frequency converter is ready to run. If the values differ, the frequency converter outputs fault F00395. In this case, you must check why the application IDs do not match.

Options for changing the application ID

There are two options for changing the application ID in the frequency converter:

- Rejection of the parameter download
- Acceptance of the parameter download

See "Fault codes during upload and download".

The application ID can, of course, be changed in the PLC too. Once the PLC has been restarted, the modified application ID is transferred to the frequency converter.

8.2.2 Standard commissioning

Overview

The term standard commissioning refers to the process of transferring the parameter set from one frequency converter to a number of other frequency converters in order to carry out quick commissioning of identical applications (e.g., series machines or groups of converters).

Standard commissioning is divided into the following steps:

- Creating a valid parameter set
- Uploading this parameter set
- Downloading the parameter set you have just uploaded to the new frequency converter

The prerequisite for carrying out standard commissioning is that there must be a suitable parameter set available. This parameter set can be created by using the STARTER software for frequency converter parameterization.

⚠ CAUTION

Downloading parameters between different firmware versions may lead to incorrect parameter settings.

The LEDs should flash when parameters are downloaded from an MMC to the frequency converter's EEPROM (e.g., during standard commissioning). Check the parameters following download.

As soon as you have a frequency converter with a suitable parameter set at your disposal, you are ready to upload the parameter set. The next step after that is to download it to the new frequency converter using the STARTER software or MMC. The various interfaces are shown in the figure below.

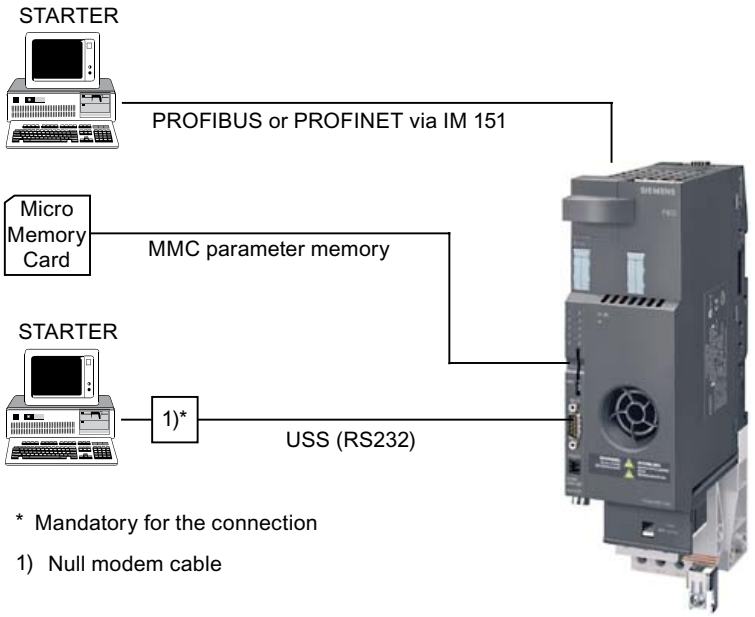


Figure 8-1 Standard commissioning interfaces

⚠ WARNING

All the data interfaces are reinitialized for the purpose of standard commissioning as are the digital and analog interfaces. This will either interfere temporarily with data transfer or will result in a switchover of the digital outputs.

Before embarking on standard commissioning, care must be taken to secure any dangerous loads.

To do this, proceed as follows:

- Lower the load to the ground or
- Secure the load using the motor holding brake.

See also

- Diagnostics via LEDs (Page 168)

Standard commissioning sequence with STARTER

1. Configure all frequency converters to be involved in standard commissioning with the same application ID.
2. Commission the first frequency converter.
3. Upload from frequency converter to the PC: Frequency converter parameters are saved on the PC.
4. Download from PC to the frequency converter: The saved parameters are transferred to other frequency converters.

Note

In the case of a download with STARTER, all the necessary parameters (with the exception of fail-safe parameters) will be downloaded to the frequency converter.

See also

- Parameter transfer with PC (STARTER) (Page 155)

Standard commissioning sequence with MMC

1. Configure all frequency converters to be involved in standard commissioning with the same application ID.
2. Commission the first frequency converter.
3. Upload from frequency converter to an MMC: Frequency converter parameters are saved on an MMC.
4. Download from an MMC to the frequency converter: The saved parameters are transferred to other frequency converters. The download can be performed manually or automatically.

Note

In the case of a manual download, all the necessary parameters (with the exception of fail-safe parameters) will be downloaded to the frequency converter.

See also

- Parameter transfer with MMC (Page 151)

8.2.3 Replacing frequency converter components

Overview

This section describes how converter components, power modules or Control Units can be replaced and includes descriptions of the steps that have to be carried out to do so.

Replacement options:

1. Replacement of PM (CU power supply is on)
2. Replacement of PM (CU power supply is off)
3. Replacement of CU

For cases 2 and 3, the operational performance of the frequency converter is exactly the same after a component has been replaced. The only difference will relate to whether or not an MMC is inserted in the CU.

Removing and reinserting the CU or PM in the same position does not constitute module replacement.

Operational performance following replacement of PM (CU power supply is on)

CU without MMC

Once the CU and PM have been inserted and connected, the CU detects that its power unit has been replaced. The CU reinitializes by reloading all parameter changes saved from the EEPROM. The frequency converter is then ready to run.

Note

After a PM has been replaced without an MMC, the parameter settings, which are only saved in the RAM, are lost.

CU with MMC

Once the CU and PM have been inserted and connected, the CU detects that its power unit has been replaced. The CU performs an automatic download from the MMC to the frequency converter (see "Transfer of parameters"). The frequency converter is then ready to run.

Operational performance following replacement of CU or PM (CU power supply is off)

CU without MMC

Once the CU and PM have been inserted and connected or the PM has been inserted and the power supply switched on, the CU detects that its power unit has been replaced. The CU reinitializes by reloading all parameter changes saved from the EEPROM.

Note

After a PM has been replaced without an MMC, the parameter settings, which are only saved in the RAM, are lost.

If the CU has been replaced, the frequency converter outputs fault F00395 – unless the application ID for this slot matches the application ID of the slot from which the CU originates.

CU with MMC

Once the CU and PM have been inserted and connected, the CU detects that its power unit has been replaced. The CU performs an automatic download from the MMC to the frequency converter (see "Transfer of parameters").

If the CU has been replaced, the frequency converter outputs fault F00395 – unless the application ID for this slot matches the application ID of the slot from which the CU originates.

Replacement provisions and replacement during operation

There are various scenarios in which a replacement, or a replacement during operation, may be performed and for which distinct requirements must be met.

⚠DANGER

Do not replace a power module (PM) during operation

A PM must be completely disconnected from its power supply before it can be replaced. Any attempt to replace a live PM may cause fatal injury, serious material damage or damage to the equipment.

⚠WARNING

Replacement constraints

The following must be taken into account prior to replacement:

- The user is responsible for ensuring that a CU is replaced by one of the same type.
- The user is responsible for ensuring that the MMC contains the correct parameter set.
- The user is responsible for ensuring that a PM is replaced by one of the same type and the same rated power.
- The user is responsible for ensuring that the application is in a safe state before performing a replacement during operation.

Instructions on how to replace a CU correctly

⚠ CAUTION

Parameter compatibility

In order to ensure full parameter compatibility, we recommend uploading the parameters from the CU to a new MMC prior to replacing the CU.

The following must be taken into account prior to replacing a CU:

1. Open the PM-IF connection between the CU and PM.
2. Remove the CU.
3. Remove the MMC.

The following must be taken into account when inserting the CU:

1. Push the MMC into the MMC slot on the CU before inserting the CU.
2. Insert the new CU.
3. Close the PM-IF connection between the CU and PM.

Instructions on how to replace a PM correctly

⚠ CAUTION

Parameter compatibility

In order to ensure full parameter compatibility, we recommend that you check that all parameters are saved in the CU's EEPROM (see P0014 or P0971) prior to replacing the PM.

The following must be taken into account prior to replacing a PM:

1. Open the PM-IF connection between the CU and PM.
2. Remove the PM.

The following must be taken into account when inserting the PM:

1. Insert the new PM.
2. Close the PM-IF connection between the CU and PM.

8.3 Operational performance of the converter

Description

A normal power-up procedure refers to the converter starting up after it has been switched off and on again, or after a power failure. It can be performed with or without an MMC.

Normal startup without MMC

Following a load cycle or a power failure, the frequency converter reads the parameters from the EEPROM into the RAM.

Normal startup with MMC

The frequency converters have been designed so that they can automatically detect whether an MMC is available. The level of interaction between the frequency converter and the MMC is controlled by parameter P8458.

Possible settings for P8458 and its functions are specified below.

P8458 = 0:	Parameters not automatically downloaded from the MMC.
P8458 = 1:	Parameters automatically downloaded from the MMC once (when frequency converter next powers up (factory setting)). After the download, P8458 will be set to 0.
P8458 = 2:	Parameters automatically downloaded from the MMC (if available) each time the frequency converter powers up.

Once the automatic download is complete, parameter P8458 will be set to 0 (provided that it had the value 1 before the download), thereby disabling any other automatic parameter downloads.

If parameter P8458 is set to 1 or 2 and no MMC is available, the converter begins with the EEPROM parameters without messages or fault codes.

Hot swapping of the MMC during operation

Inserting an MMC in a CU during operation elicits the following response as a function of P8458:

P8458 = 0	No response
P8458 = 1 or P8458 = 2	Alarm A00564

Removing an MMC from a CU during operation does not have any direct effect.

Cyclic data exchange during operation

The frequency converter is controlled via the fieldbus by means of cyclic data traffic. The frequency converter receives control commands and the frequency setpoint by way of standard telegram 1.

Parameter change during operation

A frequency converter which is controlled via fieldbus also handles the transfer of parameters via fieldbus in PROFIdrive mode using data set 47.

The transfer is described in the chapter entitled "Commissioning and Optimization":

- Parameter transfer to the frequency converter
- Parameter transfer from the converter
- Programming error.

Messages, fault codes and system messages 9

9.1 Fault codes and interrupts

Interrupts

An interrupt does not shut down the frequency converter. The interrupt number is displayed and transferred via STARTER and the fieldbus. Interrupt numbers are stored in parameter r2110 under their code number (e.g., A0503 = 503) and can be read out from here. Interrupts cannot be acknowledged; they will clear of their own accord, provided that the cause has been removed.

Fault codes

In the event of a fault, the converter shuts down and the red "SF" LED lights up. The error code is displayed and transferred via STARTER and the fieldbus.

Fault codes are stored in parameter r0947 under their code number (e.g., F0003 = 3). The associated error value can be found in parameter r0949. If no error value is assigned to a fault, the value 0 is entered. The point in time at which the fault occurred can be read out (r0948), as can the number of the fault code (P0952) that is stored in parameter r0947.

The following sections describe the LED display of fault conditions.

Note

A group fault is only output if it has been enabled via parameter P8452 or the GSD.

Resetting fault codes

To reset the error code, one of the procedures listed below can be used:

- Switch the converter power supply off and on again via the main power supply to the ET 200 station (depending on P1210).
- Set bit 7 in control word 1 (r0054).
- Reset via STARTER.

Description of interrupts and fault codes

For detailed information on alarms and error messages, refer to the *SIMATIC ET 200 List Manual*.

9.2 Diagnostics via LEDs

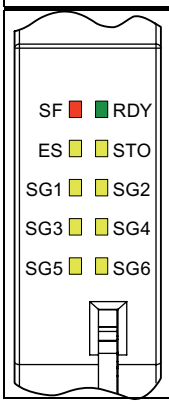
Description

Ten status LEDs are located on the front panel of the ICU24/ICU24F Control Unit of the ET 200S FC frequency converter.

Status LEDs on the ICU24

The status of the frequency converter is displayed on the front panel of the ET 200S FC frequency converter's ICU24 by means of three LEDs (SF, RDY and ES). The LEDs STO and SG1 to SG6 are not relevant to the ICU24:

Table 9-1 Status LEDs on the front panel of the ICU24

	SF (red)	RDY (green)	ES (yellow)	Meaning
	On	Off	Off	General fault (OFF1/OFF2)
	On	Off	On	Switched off with fault overload
	Off	On	Off	Ready to run
	Off	Off	On	Overload operation
	STO (yellow)		Not relevant	
	SG1 to SG6 (yellow)		Not relevant	

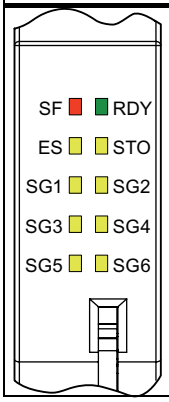
Other ICU24 status LEDs

SF	Flashes (0.5 Hz)	After a firmware upgrade is complete, to indicate that a system reset is required.
RDY	Flashes	While the converter is undertaking quick commissioning
RDY	Flashes	If there are no converter faults; communication with the higher-level controller has not yet been established but power is being supplied to the ET 200S station
All LEDs	Light up	During a firmware upgrade
	OFF	While parameter sets are being uploaded and downloaded when the ICU(F) Control Unit is powering up

Status LEDs on the ICU24F

The status of the frequency converter is displayed on the front panel of the ET 200S FC frequency converter's ICU24F by means of 10 LEDs (SF, RDY, STO, ES, and SG1 - SG6).

Table 9-2 Status LEDs on the front panel of the ICU24F

	SF (red)	RDY (green)	STO (yellow)	ES (yellow)	Meaning
	On	Off	Off	Off	General fault (OFF1/OFF2)
	On	Off	Off	On	Switched off with fault overload
	On	Off	On	Off	Fault shutdown with safe standstill
	Off	On	Off	Off	Ready to run
	Off	Off	Off	On	Overload operation
	Off	Off	On	Off	Safe standstill (SH) status reached
	Off	Off	On	On	Safely reduced speed (SG) status reached
	SG1 to SG6 (yellow) on Flashes		Display the assigned converter safety group Flash while the assigned safety-related function is enabled		

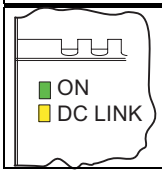
Other ICU24F status LEDs

SF	Flashes (0.5 Hz)	After a firmware upgrade is complete, to indicate that a system reset is required.
RDY	Flashes	While the converter is undertaking quick commissioning
RDY	Flashes	If there are no converter faults; communication with the higher-level controller has not yet been established but power is being supplied to the ET 200S station Gx is the selected shutdown group; x = 1 to 5
SGx and SG6	On	
All LEDs	OFF	While parameter sets are being uploaded and downloaded when the ICU(F) Control Unit is powering up
	Light up	During a firmware upgrade
SG1 to SG6	Flash (2 Hz)	Synchronously while the safety-related functions are being commissioned

Status LEDs on the IPM25 power units

The power unit status is displayed by means of two LEDs.

Table 9-3 Power unit status LED

	LED	Status	Meaning
	ON (green)	On	Converter output enabled (pulse enable)
		Off	Converter output disabled (pulse disable)
	DC LINK (yellow)	On	DC voltage connection available
		Off	DC voltage connection not available

In any state where it makes no difference whether the LED is off, on or flashing, it is listed as "Not relevant".

STO status LEDs for fail-safe functions

LED						Description
SF	RY/RDY	ES	STO	SS1	SLS	
Red	Green	Yellow				
Not relevant	Not relevant			Not relevant	Not relevant	STO parameterized
Not relevant	Not relevant			Not relevant	Not relevant	STO initiated
Not relevant	Not relevant			Not relevant	Not relevant	STO reached
Not relevant	Not relevant					Passivation of frequency converter initiated

SS1 status LEDs for fail-safe functions

LED						Description
SF	RY/RDY	ES	STO	SS1	SLS	
Red	Green	Yellow				
Not relevant	Not relevant					SS1 parameterized
Not relevant	Not relevant		Not relevant		Not relevant	SS1 initiated
Not relevant	Not relevant		Not relevant		Not relevant	SS1 reached

SLS status LEDs for fail-safe functions

LED						Description
SF	RY/RDY	ES	STO	SS1	SLS	
Red	Green	Yellow				
Not relevant	Not relevant					SLS parameterized
Not relevant	Not relevant		Not relevant	Not relevant		SLS initiated
Not relevant	Not relevant		Not relevant	Not relevant		SLS reached

Additional states indicated by LEDs

LED						Description
SF	RY/RDY	ES	STO	SS1	SLS	
Red	Green	Yellow				
						Safety commissioning
						Parameter download from MMC

9.3 Diagnostics through STARTER

In STARTER, fault messages and alarms are presented in the detailed display in the lower part of the workbench. Additional information on each fault message can be called up through the help function.

The frequency converter has an alarm history in which all alarms and fault messages are recorded. You can read out this alarm history in STARTER in ONLINE mode.

9.4 Diagnostics via fieldbus

9.4.1 Diagnostics through the user program

The drive's fault condition is indicated in the cyclic program via status word 1 in bit 3 (ZSW1/bit 3). The PLC program can read this bit and in the event of any faults it can investigate their cause with the help of the function "Reading parameters": Parameter P0944 contains the quantity of active faults and r0947 the fault number (the meaning can be found in the list manual).

Interrupts are displayed in bit 7 of the status word (ZSW1/bit 7). Once this bit has been evaluated, if any interrupts exist their cause can be investigated with the help of the function "Reading parameters". Parameter P2111 contains all pending interrupts and r2110 contains the interrupt numbers, whose meanings can be found in the List Manual.

The user can then initiate suitable action:

- Display
- Reactions in the user program
- Fault acknowledgment via the cyclic program (STW1/bit 7)

The parameters are read in PROFIdrive mode by calling SFC 59.

Note

The fault bit (ZSW1/bit 3) can also be evaluated by means of system diagnostics.

See also

- Parameter transfer in the PROFIdrive profile (Page 131)

9.4.2 System diagnostics by means of standardized functions

Prerequisites

1. Diagnostics must be set in the interface module; this setting is made in the interface module's property view during configuration.
2. Diagnostics must be set in the frequency converter; this setting is made when the frequency converter is configured by selecting the parameter value "Enable diagnostics" in the frequency converter's property view.

Evaluating

The user program (e.g., SIMATIC S7) has organization blocks OB82, OB86 and OB122 at its disposal for the purpose of evaluating diagnostic errors in the ET 200 station.

- OB82 for diagnostic interrupts on drive errors
- OB86 for diagnostic interrupts for IM slave (ET 200 station failed)
- OB122 for diagnostic interrupts upon I/O access errors.

A specific response to errors can be programmed in these organization blocks. If the OB in question is not available, the control enters a STOP state in the event of an error. The frequency converter's response to the CPU stop is defined by parameter P2040.

Depending on the CPU being used, other organization blocks can be integrated for diagnostics purposes.

If an error occurs in the frequency converter, a diagnosis is reported and OB82 called. Error code 27 is always reported. Detailed error diagnostics is only possible by reading out parameters P0947 to P0949 with SFC59.

9.5 Device diagnostics

Parameter P8820 (1 - 31) contains information about the product version for the current frequency converter which can be read via

- STARTER
- PLC using the "Read parameters" function (PROFIdrive mode)
- PC on the fieldbus using the I&M0 function.

The parameter is assigned as follows:

I&M function	Byte length	Format	Example	Related parameter (Index)
MANUFACTURER_ID	2	U16	42	P8820[5]
ORDER_ID	20	VS	6SL3235-0TEpp-pRB0	P8820[6-15]
SERIAL_NUMBER	16	VS	12345	P8820[16-23]
HARDWARE _REVISION	2	U16	1	P8820[24]
SOFTWARE_REVISION	4	1 Char 3 U8	V123	P8820[25-26]
REVISION_COUNTER	2	U16	0x0001	P8820[27]
PROFILE_ID	2	U16	0x3A00	P8820[28]
PROFILE_SPECIFIC_TYPE	2	U16	0x0003	P8820[29]
IM_VERSION	2	2 U8	11	P8820[30]
IM_SUPPORTED	2	U16	0x0000	P8820[31]

9.6 Fault clearance

Fault clearance depends on locating the cause of the fault exactly. Details of the possible causes of faults and measures for eliminating them can be found in the list manual and in STARTER (using the help function).

Technical data

10

10.1 Technical data

Technical data

You can find general technical data in the manual entitled "SIMATIC ET 200S Decentralized Peripherals System".

Note

Aside from the general technical data, the following also applies to ET 200S FC components:

Drop test (in original package) ≤ 0.35 m

Table 10-1 Technical data

Type 6SL3225-…		**0SE17-5AA1**	**0SE22-2AA1**	**0SE24-0AA1**
Construction type		A	B	B
Cooling type		Fans	Fans	Fans
Degree of protection		IP20	IP20	IP20
Rated input voltage, AC	V	400	400	400
Permissible voltage range min.	V	380	380	380
Permissible voltage range max.	V	480	480	480
Output permissible voltage range				
AC max.	V	480	480	480
AC min.	V	0	0	0
Rated output current				
Constant torque	A	2.1	5.9	10.2
• At overload (150% for 60 s)	A	3.1	8.8	15.3
• At overload (200% for 3 s)	A	4.2	11.8	20.4
• Without overload capability	A	2.3	6.5	11.2
Rated current I_r				
Peak output current	A	4.2	11.8	20.4
Rated input current, 3-ph. AC				
Constant torque	A	1.9	5.7	9.6
Rated power	W	750	2,200	4,000

Type 6SL3225-…		0SE17-5AA1	0SE22-2AA1	0SE24-0AA1
	hp	1	3	5
At overload (150% for 60 s)	W	1,125	3,300	6,000
At overload (200% for 3 s)	W	1,500	4,400	8,000
Without overload capability	W	830	2,400	4,400
Pulse frequency (factory setting)	Hz	8,000	8,000	8,000
Installation altitude above sea level	m	1,000	1,000	1,000
Efficiency η		95	95	95
Power factor		0.9	0.9	0.9
Gating factor		0.87	0.87	0.87
Width	m	0.065	0.13	0.13
Depth	m	0.15	0.15	0.15
Height	m	0.25	0.25	0.25
Weight	kg	1	1.8	1.8
Ambient conditions				
Operation	°C	-10 (0 for fail-safe version) … +50 (HO)		
Relative atmospheric humidity	%	95 (non-condensing)		
Temperature: transportation, storage	°C	-40 … +70		
Filter (Class A; 3-ph. AC)		6SL3203-0BE22-5AA0	6SL3203-0BE22-5AA0	6SL3203-0BE25-0AA0
Type of overload capability		150% for 60 s every 300 s, 200% for 3 s every 300 s		
Cable cross-sectional area				
Motor cable max.	mm^2	10	10	10
EM brake control module				
24 V		3RK1903-0CB00		
500 V		3RK1903-0CC00		

Ambient conditions

For information on the mechanical and climatic ambient conditions of the ET 200S system, please refer to the manual entitled "SIMATIC ET 200S Decentralized Peripherals System".

Special ambient conditions for the ET 200S FC frequency converter are described in the relevant sections.

10.2 Installation dimensions and clearances

Overview

The table below shows the mounting and spacing dimensions for an ET 200S FC system. The dimensions for the Control Unit and the IPM25 power units can be found in the Appendix, in the section titled "Dimension drawings".

Table 10-2 Installation dimensions and clearances for ET 200S FC components

	Module	Dimensions [mm]
Installation widths	PM-D power module	15
	PM-D F PROFIsafe power module	30
	PM-D FX1 power module	30
	ICU24	15
	ICU24F	15
	IPM25 FSA	65
	IPM25 FSB	130
	Brake control module	15
Installation heights, including terminal modules	With three-pole power bus (L1, L2, L3)	290
	With five-pole power bus (including PE/N)	332
Minimum installation and wiring clearances	Above and below the terminal modules	35
	To the left, adjacent to the interface module	20
	To the right, adjacent to the ET 200S terminating module	20
	Below the shield bus	15
	Between the front of the converter and the control cabinet door/wall	35

10.3 General ambient conditions

The following conditions must be taken into account when installing a frequency converter:

Shocks and vibrations

The frequency converter must not be dropped, exposed to sudden shocks or installed in surroundings where it might be exposed to regular vibrations.

Air pollution/water

The frequency converter must not be installed in areas where there are corrosive gases and air pollution; however, it can be exposed to dust and splashwater (degree of protection IP65).

Installation and cooling

Make sure that convection can take place freely in front of the frequency converter. In this area there must be no devices which could obstruct or affect the convection.

A clearance of 35 mm must be kept above and below the components of the frequency converter from other devices or components in order to ensure that convection can take place unhindered.

10.4 Special ambient conditions

What are special ambient conditions?

The ET 200S FC frequency converter is designed to be operated at an ambient temperature of 40°C and an installation altitude of up to 1000 m. The frequency converter can be operated without derating within these limits.

If the ambient conditions during operation deviate from these values, this is referred to as "special ambient conditions". In such cases, the converter must not be operated at full power.

Derating factors

With ET 200S FC frequency converters, derating may be necessary for the following reasons:

- Ambient temperature > 40°C.
- Pulse frequency > 8 kHz
- Installation altitudes > 1000 m
  The low air pressure means that the amount of cooling air conveyed by the fan will not be sufficient.

10.5 Technical data of the modules

10.5.1 Terminal modules

10.5.1.1 TM-P15 S27-01 terminal module for PM-D power module

Features

The TM-P15 S27-01 terminal module is required for the PM-D power module. It consists of an adapter and a terminal block.

1. Connection via screw terminal
2. Basic wiring of the terminal module

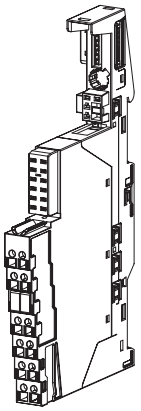
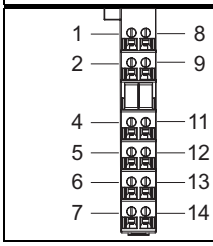


Figure 10-1 TM-P15 S27-01 terminal module

Terminal assignment

The terminal assignment of the TM-P15 S27-01 terminal module can be found in the table below:

Table 10-3 TM-P15 S27-01 terminal assignment

View	Terminal	Meaning	
	1/8 2/9	L+ M	U1: Electronics power supply URATED = 24 V DC
	4/11 5/12	A1 A2-	U2: Power supply URATED = 24 V DC
	6/13 7/14 -	AUX2 AUX3 AUX1	Not relevant Not relevant Not relevant

Looping-through of the potentials

Terminals 1/8, 2/9, 4/11, 5/12, 6/13, and 7/14 are jumpered in the terminal module and can be used for the purpose of looping through the potentials.

Technical data

Table 10-4 Technical data - TM-P15 S27-01

Technical data		
Dimensions and weight		
Mounting dimensions W x H x D	mm	15 x 196.5 x 102
	inch	3.81 x 49.66 x 25.91
Mounting depth with PM-D power module	mm	117.5
	inch	29.84
Weight	g	Approx. 175
	lbs	Approx. 0.39
Insulating voltages and rated currents		
Insulating voltage	V	500
Rated operational voltage	V	DC 24
Rated operational current	A	10
Conductor cross-sections		
Single-core	mm^2	1 x (0.14 to 2.5), acc. to IEC 60947 1 x 2.5
Finely stranded with end sleeve	mm^2	1 x (0.14 to 1.5), acc. to IEC 60947
AWG conductors, solid or stranded	AWG	1 x (18 to 22)
Wiring		
Tools required		Standard screwdriver size 1
Tightening torque	Nm	0.4 to 0.7
	lbf.in	3.5 to 6.2

10.5.1.2 TM-PF30 S47-F1 terminal module for PM-D F PROFIsafe power module

Features

The TM-PF30 S47-F1 terminal module is required for the fail-safe PM-D F PROFISAFE power module. It consists of an adapter and a terminal block.

- Connection via screw terminal
- Basic wiring of the terminal module
- Fail-safe modules identified by yellow labels

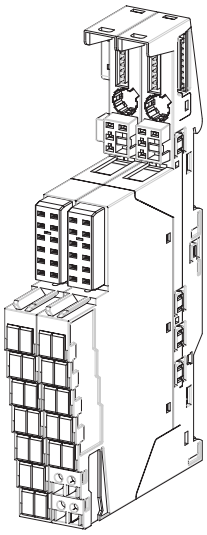
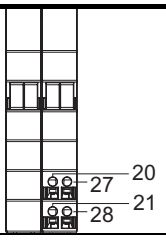


Figure 10-2 TM-PF30 S47-F1 terminal module

Terminal assignment

The terminal assignment of the TM-PF30 S47-F1 terminal module can be found in the table below:

Table 10-5 TM-PF30 S47-F1 terminal assignment

Terminal	Meaning		View
20/27 21/28	L+ M	Uin: For connecting an external 24 V DC PELV power supply unit	

Looping-through of the potentials

Terminals 20/27 and 21/28 are jumpered in the terminal module and can be used for the purpose of looping through the potentials.

Technical data

Table 10-6 Technical data - TM-PF30 S47-F1

Technical data		
Dimensions and weight		
Mounting dimensions W x H x D	mm	30 x 196.5 x 102
	inch	7.62 x 49.66 x 25.91
Mounting depth with power module	mm	117.5
	inch	29.84
Weight	g	Approx. 350
	lbs	Approx. 0.77
Insulating voltages and rated currents		
Insulating voltage	V	500
Rated operational voltage	V	DC 24
Rated operational current	A	10
Conductor cross-sections		
Single-core	mm^2	1 x (0.14 to 2.5), acc. to IEC 60947 1 x 2.5
Finely stranded with end sleeve	mm^2	1 x (0.14 to 1.5), acc. to IEC 60947
AWG conductors, solid or stranded	AWG	1 x (18 to 22)
Wiring		
Tools required		Standard screwdriver size 1
Tightening torque	Nm	0.4 to 0.7
	lbf.in	3.5 to 6.2

10.5.1.3 TM-PFX30 S47 terminal module for PM-D FX1 power module

Features

The TM-PFX30 S47 terminal module is required for the fail-safe PM-D FX1 power module. It consists of an adapter and a terminal block.

- Connection via screw terminal
- Basic wiring of the terminal module
- Fail-safe modules identified by yellow labels

The following variants are available:

- TM-PFX30 S47-G0 with infeed from the left for conveying U1 and M as well as G1 to G6
- TM-PFX30 S47-G1 without infeed from the left for the beginning of a new group

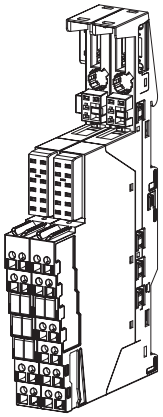
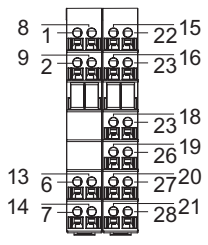


Figure 10-3 TM-PFX30 S47 terminal module

Terminal assignment

The terminal assignment of the TM-PFX30 S47 terminal module can be found in the table below:

Table 10-7 TM-PFX30 S47 terminal assignment

Terminal	Meaning		View	Terminal	Meaning	
1/8 2/9	+ IN/OUT M IN/OUT	U1: Safe 24 V DC limited to SIMATIC range		15/22	G1	G1 – G5: freely selectable shutdown groups
				16/23	G2	
				18/25	G3	
				19/26	G4	
6/13 7/14	L+ M	Uin: For connecting an external 24 V DC PELV power supply unit		20/27	G5	
				21/28	G6	Safely reduced speed
-	AUX1	Not relevant				

Looping-through of the potentials

Terminals 1/8, 2/9, 6/13, 7/14, 15/22, 16/23, 18/25, 19/26, 20/27, and 21/28 are jumpered in the terminal module and can be used for the purpose of looping through the potentials.

Technical data

Table 10-8 Technical data - TM- PFX30 S47

Technical data		
Dimensions and weight		
Mounting dimensions W x H x D	mm	30 x 196.5 x 102
	inch	7.62 x 49.66 x 25.91
Mounting depth with PM-D FX1 power module	mm	117.5
	inch	29.84
Weight	g	Approx. 375
	lbs	Approx. 0.83
Insulating voltages and rated currents		
Insulating voltage	V	500
Rated operational voltage	V	DC 24
Rated operational current	A	10
Conductor cross-sections		
Single-core	mm^2	1 x (0.14 to 2.5), acc. to IEC 60947 1 x 2.5
Finely stranded with end sleeve	mm^2	1 x (0.14 to 1.5), acc. to IEC 60947
AWG conductors, solid or stranded	AWG	1 x (18 to 22)
Wiring		
Tools required		Standard screwdriver size 1
Tightening torque	Nm	0.4 to 0.7
	lbf.in	3.5 to 6.2

10.5.1.4 TM-ICU15 terminal module for ICU24(F) Control Unit

Features

The TM-ICU15 terminal module is required for the ICU24(F) Control Unit.

- It has no input terminals.
- All necessary voltages and signals are transferred via a connector to the ICU24(F).

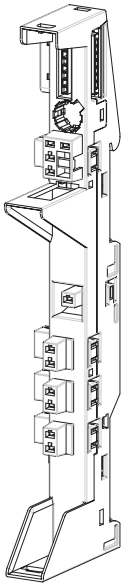


Figure 10-4 TM-ICU15 terminal module

Technical data

Table 10-9 Technical data - TM-ICU15

Technical data		
Dimensions and weight		
Mounting dimensions W x H x D	mm	15 x 196.5 x 52
	inch	3.81 x 49.66 x 13.21
Mounting depth with Control Unit	mm	150
	inch	38.1
Weight	g	Approx. 52
	lbs	Approx. 0.11
Insulating voltages and rated currents		
Insulating voltage	V	500
Rated operational voltage	V	DC 24
Rated operational current	A	10

10.5.1.5 TM-IPM terminal modules for IPM25 power units

Features

The TM-IPM terminal module is required for the ET 200S FC frequency converter power unit. It consists of an adapter and a terminal block L1/L2/L3 for the power bus, with a fixing screw for connecting the shield to the rail.

- The power bus distributes power within a load group.
- The maximum current carrying capacity is 50 A at 60°C.
- Wiring is carried out automatically when the terminal modules are assembled.
- Power bus: 3-pin (L1, L2, L3); can be expanded to 5 pins using PE/N terminal block
- There are 4 types of the TM-IPM terminal modules:
  - TM-IPM65-S31 for IPM25 FSA power units
    (without power bus infeed)
  - TM-IPM65-S32 for IPM25 FSA power units
    (with power bus infeed)
  - TM-IPM130-S31 for IPM25 FSB power units
    (without power bus infeed)
  - TM-IPM130-S32 for IPM25 FSB power units
    (with power bus infeed)

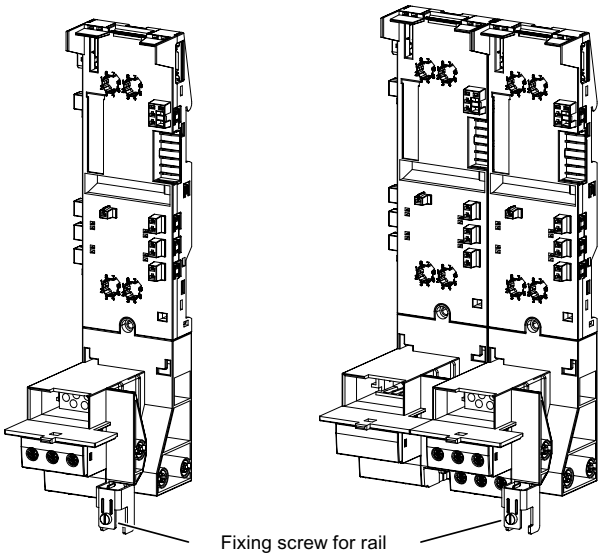


Figure 10-5 TM-IPM65 and TM-IPM130 terminal modules

In addition to terminals for the power supply cables, the TM-IPM terminal modules have a fixing screw for a rail. This rail can be used to connect several converters with ground potential. Shields on power supply cables (e.g., motor cables) can be connected to the rail via shield terminals (see "Overview").

⚠ WARNING

Before commissioning can take place, the exposed contacts at the power bus (L1, L2, L3, N, PE) of the final terminal module in an ET 200S FC power unit load group must be made finger-safe by covering them with caps (pushed on firmly). This will prevent both the contacts from being touched and the risk of electric shock (400 V AC).

Technical data

Table 10-10 Technical data - TM-IPM terminal module

Technical data			
Dimensions and weight			
		TM-IPM65	TM-IPM130
Mounting dimensions W x H x D	mm	65 x 290 x 102	130 x 290 x 102
	inch	16.51 x 73.66 x 25.91	33.02 x 73.66 x 25.91
Mounting depth with power unit	mm	151	151
	inch	38.35	38.35
Weight	g	Approx. 455	Approx. 728
	lbs	Approx. 1	Approx. 1.6
Rated voltages, currents and frequencies for the power bus			
Rated insulating voltage Ui	V	690	
Rated operational voltage Ue	V	500	
Rated impulse withstand voltage Uimp	kV	6	
Rated operational current Ie	A	50	
Rated frequency	Hz	50/60	
Conductor cross-sections			
Single-core	mm^2	2 x (1 to 2.5) or 2 x (2.5 to 6)	
Finely stranded with end sleeve	mm^2	1 x 10 or 2 x (1 to 2.5) or 2 x (2.5 to 6) acc. to IEC 60947	
AWG conductors, solid or stranded	AWG	2 x (14 to 10)	
Wiring			
Tools required		Screwdriver size 2 and Pozidrive 2	
Tightening torque	Nm	2.0 to 2.5	
	lbf.in	17.7 to 22.1	

NOTICE

IP20 degree of protection can only be reached if insulated fork-type cable lugs (e.g., Thomas & Betts KV10-10F-D or KV14-10F-M, or equivalent) are used to connect the electric power cable.

10.5.1.6 TM-xB15 S24-01 terminal module for brake control module

Features

The TM-xB15 S24-01 terminal module is required for the xB1 or xB2 brake control module. It consists of an adapter and a terminal block. Screw terminals are used to connect it.

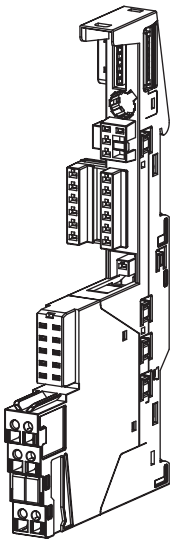
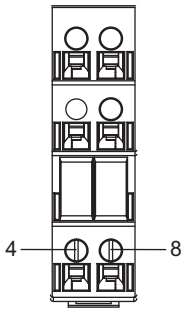
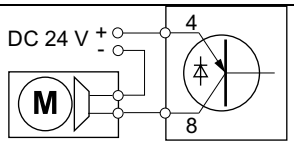
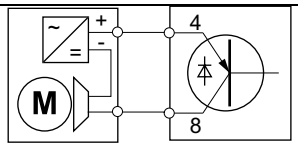
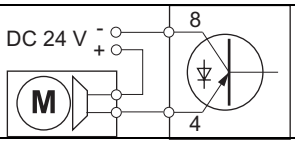
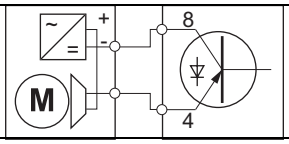


Figure 10-6 TM-xB15 S24-01 terminal module

Terminal assignment

The terminal assignment of the TM-xB15 S24-01 terminal module can be found in the table below:

Table 10-11 TM-xB15 S24-01 terminal assignment

View	Terminal	Block diagram		
	4 8	Wiring options		
			xB1 brake control module	xB2 brake control module
		Current sourcing:	 Motor with brake Brake Control	 Motor with brake Brake Control
		Current sinking:		

Technical data

Table 10-12 Technical data - TM-xB15 S24-01

Technical data		
Dimensions and weight		
Mounting dimensions W x H x D	mm	15 x 196.5 x 95
	inch	3.81 x 49.66 x 25.91
Mounting depth with brake control module	mm	117.5
	inch	29.84
Weight	g	Approx. 120
	lbs	Approx. 0.26
Rated currents		
Inputs (terminals 1 and 2, 5 and 6) - only with TM-xB215 S24-01 brake control (terminals 4 and 8)		
Conductor cross-sections		
Single-core	mm^2	1 x (0.14 to 2.5), acc. to IEC 60947 1 x 2.5
Finely stranded with end sleeve	mm^2	1 x (0.14 to 1.5), acc. to IEC 60947
AWG conductors, solid or stranded	AWG	1 x (18 to 22)
Wiring		
Tools required		Standard screwdriver size 1
Tightening torque	Nm	0.4 to 0.7
	lbf.in	3.5 to 6.2

10.5.2 Power/Expansion modules

10.5.2.1 PM-D power module for ET 200S FC

Features

- A new potential group begins with each power module (along with its corresponding terminal module). In a potential group, the ET 200S FC frequency converter is connected to the right of the power module.
- The power module conducts the voltages for the electronics power supply to the voltage buses of the terminal modules - and, in fact, does so for all ET 200S FC frequency converters in a potential group.
- The PM-D monitors voltages U1 (PWR) - the electronics power supply - and U2 (CON) - the power supply (not relevant for ET 200S FC). Power failures are displayed and reported.

CAUTION
The power modules must not be connected or disconnected during operation.

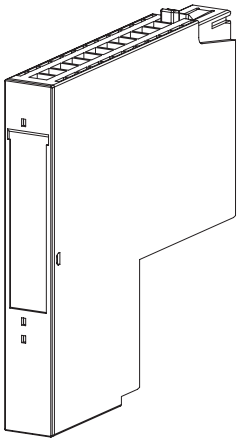
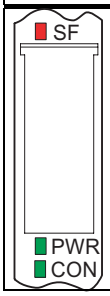


Figure 10-7 PM-D power module

Status LEDs

Table 10-13 Status LEDs for PM-D power module

	SF (red)	PWR (green)	CON (green)	Meaning
	Off	On	On	Standard operation
	On	On	On	Group fault
	On	On	Off	Power supply U2 for contactors not available **Note**: Only required for motor starters.
	On	Off	On	Electronics power supply U1 not available
	On	Off	Off	Power supplies U1 and U2 not available

Technical data

Table 10-14 Technical data - PM-D power module

Technical data		
Dimensions and weight		
Mounting dimensions W x H x D	mm	15 x 196.5 x 117.5
with terminal module	inch	3.81 x 49.66 x 29.84
Weight	g	Approx. 65
	lbs	Approx. 0.14
Voltages, currents, potentials		
Rated control supply voltage Us	V	20.4 to 28.8 DC, up to 60°C
Rated operational current Ie	A	10
Recommended upstream short-circuit protection:		
• Fuse	A	gL/gG 10
• Miniature circuit breaker	A	10, release characteristic B
Isolation between U1 and U2 checked with	V	500
Current consumption from backplane bus	mA	≤ 10
Status, interrupts, diagnostics		
Interrupts		None
Diagnostic functions:		Yes
• Group fault/device fault		Red LED "SF"
• Monitoring of the electronics power supply U1 (PWR)		Green LED "PWR"
• Monitoring of power supply U2 (CON)		Green LED "CON"
• Diagnostic information can be read out		Yes

10.5.2.2 Fail-safe PM-D FX1 power/expansion module

General note on fail-safe ET 200S modules

NOTICE
Fail-safe modules **cannot** be used in conjunction with the SIGUARD power modules PM-D F1/F2/F3/F4/F5.

Features

- A new fail-safe potential group begins with each power/expansion module (along with the corresponding terminal module). The fail-safe components of a fail-safe potential group are connected to the right of the power/expansion module.
- The PM-D FX1 has redundant overvoltage protection that triggers the internal fuse above the SIMATIC voltage range and, therefore, makes the entire series-connected system (24 V) voltage-free.
- The PM-D FX1 conducts the safe voltage (U1) for both the electronics power supply and shutdown groups G1 to G6 to the voltage buses of the terminal modules - and, in fact, does so for all fail-safe components in a fail-safe potential group.
- Safe voltage U1 of the PM-D FX1 can provide the power supply for external safety relays. This ensures that no overvoltages can occur in the system (there must be an absence of adverse effects).
- Infeeding for the 6 shutdown groups, G1 to G6, as well as for U1 and M.
- An LED displays the state of each shutdown group, G1 to G6.
- Transfer of diagnostic messages to the higher-level controller.
- The fail-safe potential group can be connected to another ET 200S row.
- Fail-safe modules identified by yellow labels.

CAUTION
The power/expansion modules must not be connected or disconnected during operation.

LED states

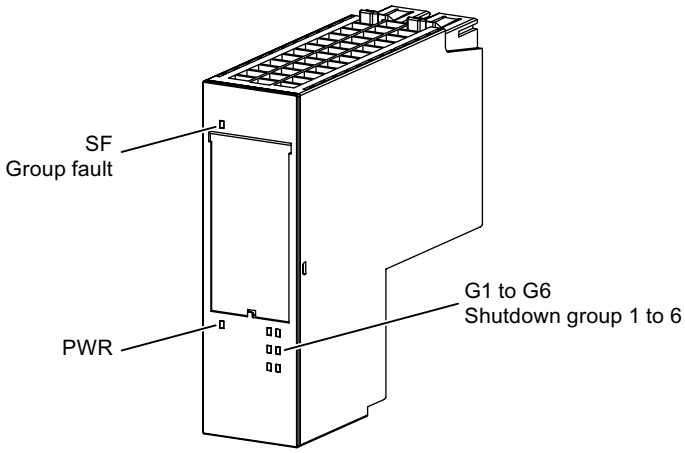
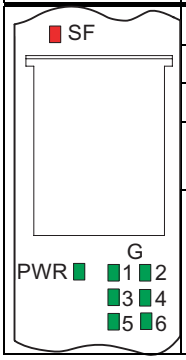


Figure 10-8 PM-D FX1 power/expansion module

Status LEDs

Table 10-15 Status LEDs on the PM-D FX1

	SF (red)	PWR (green)	G1 - G6 (green)	Meaning
	Off	On	On	Standard operation
	On	On	Not relevant	Bus fault
	On	Off	Not relevant	Electronics power supply U1 not available
	Not relevant	Not relevant	Off	EMERGENCY STOP on shutdown group Gx, wire break at input Gx or shutdown group unused
	G1 - G6 display the operation of the six shutdown groups.			

Electrical design

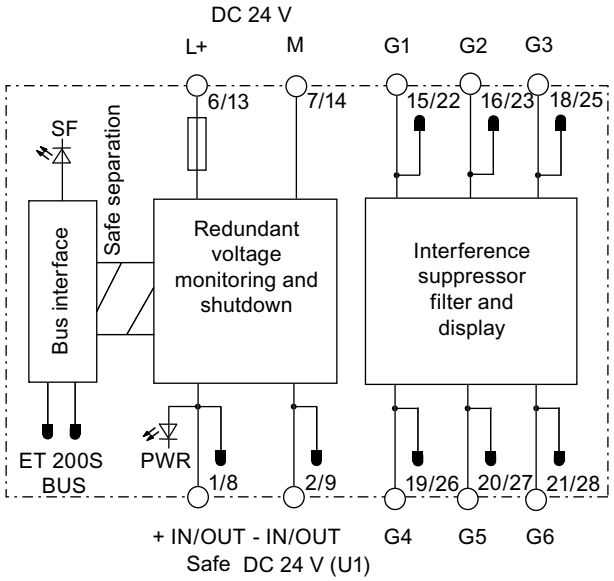


Figure 10-9 PM-D FX1 block diagram

Explanation

The PM-D FX1 is integrated at the beginning of a potential group or a new row (TM-PFX30 S47-G1), or is connected for the purpose of looping-through a potential group (TM-PFX30 S47-G0).

You can connect a voltage (Uin) to terminals 6/13 and 7/14 on the PM-D FX1.

A safe voltage of 24 V DC (U1) can be fed in and out at terminals 1/8 and 2/9.

Shutdown groups G1 to G6 can be fed in and out at terminals 15/22, 16/23, 18/25, 19/26, 20/27, and 21/28.

The PM-D FX1 module consists of the following system components:

- Non-safety-related system components:
  - Bus connection with communication
  - Diagnostic messages via the BUS
  - Display of switching states and fault conditions
- Safety-related system components:
  - Overvoltage monitoring of voltage U1
  - Tripping of voltage U1 in the event of overvoltage (< 100 ms)

NOTICE
It is the user's responsibility to monitor the shutdown groups for cross-circuits and short-circuits.

Cable laying regulations

NOTICE
The user should employ cable-laying measures that eliminate the possibility of cross-circuits occurring between the individual shutdown groups G1 to G6, as well as U1/Uin or other cables (see EN 60204-1 and EN 13849-2).

Safety regulations

NOTICE
If power is supplied to the PM-D FX1 power/expansion module by means of Uin, a PELV power supply unit (which also outputs a maximum of 60 V DC in the event of an error) should be used. An external protective circuit (surge filter) between the load voltage supply (power supply unit) and load voltage input (Uin) of the terminal module is required for surge protection; this can be, for example, a lightning protection unit VT (order no. 918 402, Dehn + Söhne).

NOTICE
If power is supplied to the PM-D FX1 power/expansion module by means of Uin, a PELV power supply unit (which also outputs a maximum of 60 V DC in the event of an error) should be used. An external protective circuit (surge filter) between the load voltage supply (power supply unit) and load voltage input (Uin) of the terminal module is required for surge protection; this can be, for example, a lightning protection unit VT (order no. 918 402, Dehn + Söhne).

NOTICE
PM-D FX1, F-CM and fail-safe ET 200S FC components that belong to a potential group must all be installed in the same control cabinet. Cable laying for G1 to G6, U1 and Uin is only permissible within this control cabinet.

NOTICE
If external safety relays (not ET 200S; e.g.,.SIGUARD 3TK28, AS-i safety monitor) are connected to the PM-D FX1, you should ensure that they have **no repercussions** for the potential group. The external safety relays then switch U1+ (terminal 1/8) over to the shutdown groups (EMERGENCY STOP signal). A safety relay that is suitable for the required category/SIL should be chosen. Please observe the regulations for the safety relay being used.

Module change

If a PM-D FX1 module is changed, there is no need for repeat approval by an inspector.

Technical data

Table 10-16 Technical data - PM-D FX1 power/expansion module

Technical data		
Dimensions and weight		
Mounting dimensions W x H x D	mm inch	30 x 196.5 x 102 7.62 x 49.66 x 25.91
Mounting depth with terminal module	mm inch	117.5 29.84
Weight	g lbs	Approx. 100 Approx. 0.22
Data for specific modules		
Ambient temperature	°C	0 to 60
Degree of protection		IP20
Maximum achievable safety classes:		
IEC 61508 DIN V 19250 EN 954-1		SIL 3 Tripping class 5 and 6 Category 4
Safety characteristics:		
Low demand PFDavg (10a) High demand/continuous mode PFH 1/h No. of years in proof-test interval		2.5*10-6 5.7*10-11 10
Voltages, currents, potentials		
Rated control supply voltage Us	V	21.6 to 26.4 V DC, up to 60°C
Rated operational current Ie Internal fuse protection	A A	6 7 (quick-response)
Recommended upstream short-circuit protection: Fuse	 A	 gL/gG 6.3 [1)]
Current consumption: From the backplane bus From U1 From Gx	 mA mA mA	 ≤ 10 ≤ 35 ≤ 15
Status, interrupts, diagnostics		
Interrupts		None
Diagnostic functions: Group fault/device fault Monitoring of the electronics power supply U1 (PWR) Monitoring of 6 shutdown groups Diagnostic information can be read out		Yes Red LED "SF" Green LED "PWR" Green LED G1 to G6 Yes
Standards, approvals		
TÜV		Yes
UL, CSA certification		Yes

1) The fuse is designed in such a way that the connected power supply unit can provide the required current if the fuse is tripped.

10.5.2.3 Fail-safe PM-D F PROFIsafe power module

General note on fail-safe ET 200S modules

NOTICE
Fail-safe modules **cannot** be used in conjunction with the SIGUARD power modules PM-D F1/F2/F3/F4/F5.

Features

- 6 shutdown groups, G1 to G6
- 3 A output current for each group, G1 to G6 (aggregate current 5 A)
- 24 V DC rated load voltage per shutdown group
- Suitable for supplying:
  - Fail-safe ET 200S FC frequency converters
  - Fail-safe F-DS1e-x and F-RS1e-x motor starters
  - Fail-safe F-CM contact multipliers
  - Fail-safe PM-D FX1 power/expansion modules
  - Expansion modules for xB1 and xB2 brake control module
- Group fault display (SF; red LED)
- Status LED for each shutdown group (SG1 to SG6, green LED)
- Status LED for load current power supply (PWR; green LED)
- Status LED for electronics power supply (U1; green LED)
- Achievable safety class (safety integrity level) AK6/SIL3/Category 4

CAUTION
The power modules must not be connected or disconnected during operation.

Switching the voltage buses G1 to G6 and U1

The power module can shut down voltage buses G1 to G6 in a fail-safe manner via 6 digital outputs complying with safety class AK4/SIL2/Category 3 or AK6/SIL3/Category 4. The outputs are implemented with two P switches. There is a main power switch for all 6 shutdown groups and 6 series-connected individual switches for each shutdown group.

The voltage bus U1 (electronics power supply) is supplied with 24 V DC. **When overvoltage or undervoltage occurs,** U1 is switched off by two P switches and the series-connected frequency converters are passivated. **In the event of a safety shutdown** of frequency converters, U1 is not switched off.

Achievable safety classes:

The integrated safety functions of the fail-safe ET 200S FC frequency converter meet the requirements of Category 3 in accordance with EN 954-1 and SIL 2 in accordance with IEC 61508.

LED states

LED states

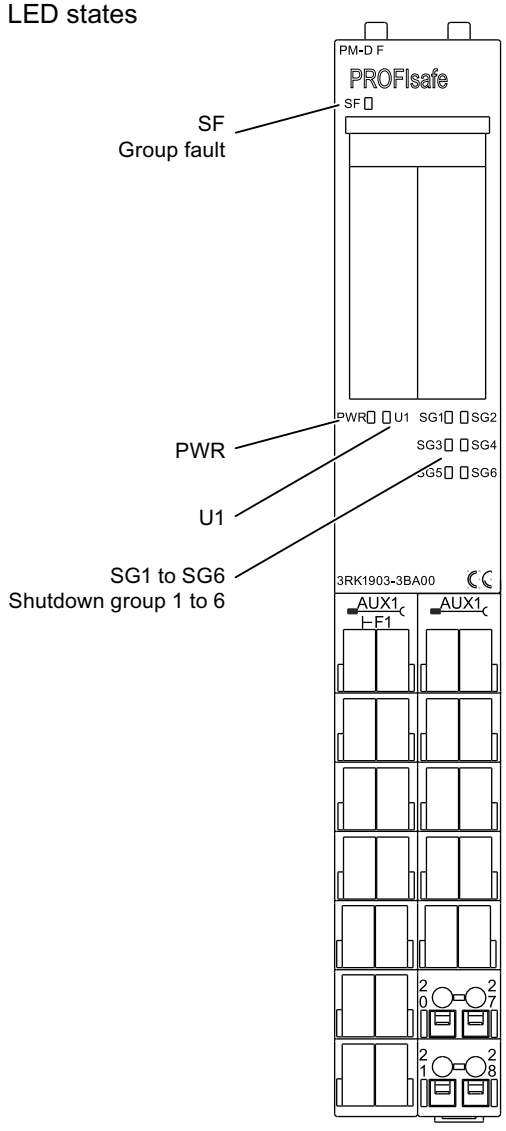


Figure 10-10 PM-D F PROFIsafe power module

⚠ WARNING

The group fault LED and the status LEDs for the outputs must not be evaluated for safety-related activities.

Terminal assignment

On the PM-D F PROFIsafe, you connect only the 24 V DC load voltage supply and reference potential. Wire the power module using the special terminal module.

The terminal assignment of the PM-D F PROFIsafe for the supported TM-PF30 S47-F1 terminal module can be found in the table below.

Table 10-17 TM-PF30 S47-F1 terminal assignment

Terminal		Designation
20	24 V DC	24 V DC rated load voltage for: • Connected power module and • Voltage buses G1 to G6 and U1
21	M	Ground
27	24 V DC	24 V DC rated load voltage for: • Connected power module and • Voltage buses G1 to G6 and U1
28	M	Ground

Electrical design

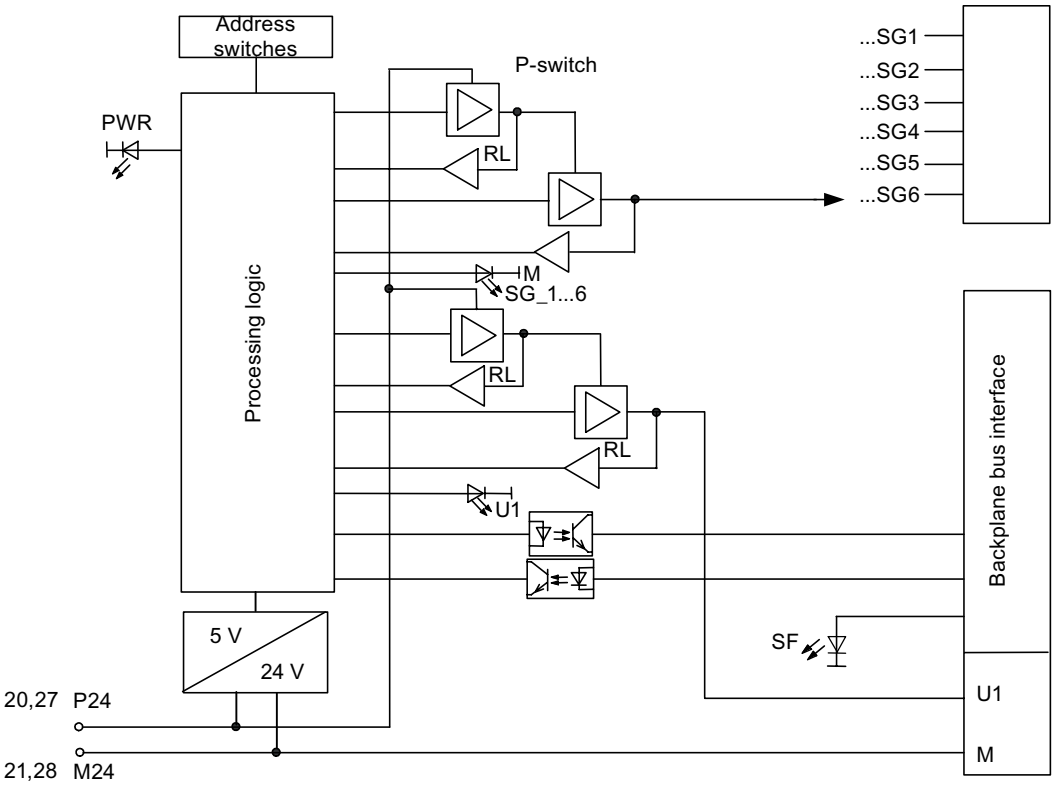


Figure 10-11 PM-D F PROFIsafe block diagram

Parameters in STEP 7

The table below lists the parameters that can be set for the PM-D F PROFIsafe.

Table 10-18 Parameters of the PM-D F PROFIsafe

Parameters	Range of values	Default setting	Type of parameter	Efficiency range
F parameters:				
F_target_address	1 to 1022	Assigned by STEP 7	Static	Module
F monitoring time	10 to 10000 ms	150 ms	Static	Module

Behavior in the event of power supply failure

A load current power supply failure in the PM-D F PROFIsafe is always indicated by the PWR LED on the module (light switches off). An electronics power supply failure is indicated by the U1 LED on the module (light switches off). This information is also provided on the module (entry in diagnostics data). All of the module's shutdown groups (G1 to G6) are passivated.

A dip in the load current supply is indicated by the off state of the PWR LED and the supplied shutdown groups are passivated. When the power supply later recovers, the PWR LED remains in the off state and the shutdown groups remain passivated. The PWR LED only lights up and the shutdown groups are only enabled again when you restart the ET 200S (turn the ET 200S power supply off and on again, or disconnect and reconnect the power module with the load voltage switched off).

Diagnostic functions

The table below provides an overview of the PM-D F PROFIsafe diagnostic functions. The diagnostic functions are assigned either to one channel or to the entire module.

Table 10-19 Diagnostic functions of the PM-D F PROFIsafe

Diagnostic function	Fault Number	LED	Scope of diagnostics	Parameterizable
Short-circuit	1H	SF	Channel	no
Overtemperature	5H	SF	Module	no
Internal fault	9H	SF	Module	no
Parameter assignment error	10H	SF	Module	no
External auxiliary voltage missing	11H	PWR	Module	no
Communication fault	13H	SF	Module	no

Causes of faults and corrective measures

The table below lists the possible causes of faults and corrective measures for the individual diagnostic messages of the PM-D F PROFIsafe.

Table 10-20 Causes of faults and corrective measures for diagnostic messages of the PM-D F PROFIsafe

Diagnostic message	Error detection	Possible causes of faults	Remedial measures
Short-circuit	always	Short-circuit in the actuator	Eliminate short-circuit/cross-circuit. After the fault has been corrected, the module must be removed and reconnected or switched off and on.
		Cross-circuit in the actuator	
		Internal fault	Replace module.
Overtemperature	always	Shutdown due to temperature limit in module housing being exceeded	Check load wiring, check ambient temperature. Once the fault has been corrected, the module must be removed and reconnected or switched off and on.
Internal fault	always	Internal module fault has occurred.	Replace module.
Parameter assignment error	always	Connected module does not match configuration. Parameter assignment faulty	Correct the configuration (compare actual and preset configuration), and check communication paths. Correct the parameterization.
		PROFIsafe address set incorrectly in the F-module	Check whether the PROFIsafe address on the module matches the configuration in *STEP 7 HW Config*.
External auxiliary voltage missing	always	No power supply, or power supply is too low.	Check module for correct contact. Once the fault has been corrected, the module must be removed and reconnected, or switched off and on.
Communication fault	always	Fault in communication between F-CPU and module due to defective PROFIBUS connection or higher than permissible EMI, for example.	Check the PROFIBUS connection. Eliminate the faults.
		PROFIsafe monitoring time set too low	Set a higher value for the "F monitoring time" parameter for the module in *STEP 7 HW Config*.

Technical specifications

Table 10-21 Technical data - PM-D F PROFIsafe

Technical specifications		
Dimensions and weight		
Mounting dimensions W x H x D	mm	30 x 196.5 x 102
	inch	7.62 x 49.66 x 25.91
Mounting depth with terminal module	mm	117,5
	inch	29,84
Weight	g	approx. 112
	lbs	approx. 0,25
Data for specific modules		
Ambient temperature	°C	0 to 60
Degree of protection		IP20

Technical specifications		
Number of outputs (P/P switching)		6 shutdown groups (G1 to G6)
Internal power supply		U1
Assigned address area		
• In the I/O area for inputs		5 bytes
• In the I/O area for outputs		5 bytes
Maximum achievable safety classes:		
• IEC 61508		SIL 3
• DIN V 19250		Tripping class 6
• EN 954-1		Category 4
Safety characteristics:		
• Low demand mode		<< 1.00E-05
• High demand/continuous mode		<< 1.00E-10
Voltages, currents, potentials		
Power supply L+	V	21.6 to 26.4 DC, up to 60°C
L+ mains buffering		None
Internal P5 mains buffering		5 ms
Reverse polarity protection		No
Current consumption:		
• From the backplane bus	mA	≤ 28
• from load voltage L+ (no-load)	mA	Typical: 100
Galvanic isolation		
• Between channels and backplane bus		Yes
• Between channels and power supply		No
• between channels		no
• Between channels/power supply and shield		Yes
Permissible potential difference between		
• Shield and ET 200S bus connection		75 V DC/60 V AC
• Shield and peripherals (G, U1 bus)		75 V DC/60 V AC
• ET 200S bus connection and peripherals (G, U1 bus)		250 V AC
Status, alarms, diagnostics		
Interrupts		None
Diagnostic functions:		Yes
Group error		Red LED "SF"
Status LEDs:		
• For electronics power supply		Green LED U1
• Monitoring of 6 shutdown groups		Green LED SG1 to SG6
• For load voltage		Green LED "PWR"
Diagnostic information can be read out		Yes

10.5.3 ICU24 and IC24F Control Units

Description

The ICU24 Control Units/ICU24F fail-safe Control Units are necessary components of the ET 200S FC frequency converter. All of the control processes used for controlling the IPM25 power unit and the brake control module (optional) run on this module. It assumes responsibility for communicating with the higher-level controller via the IM151 interface module.

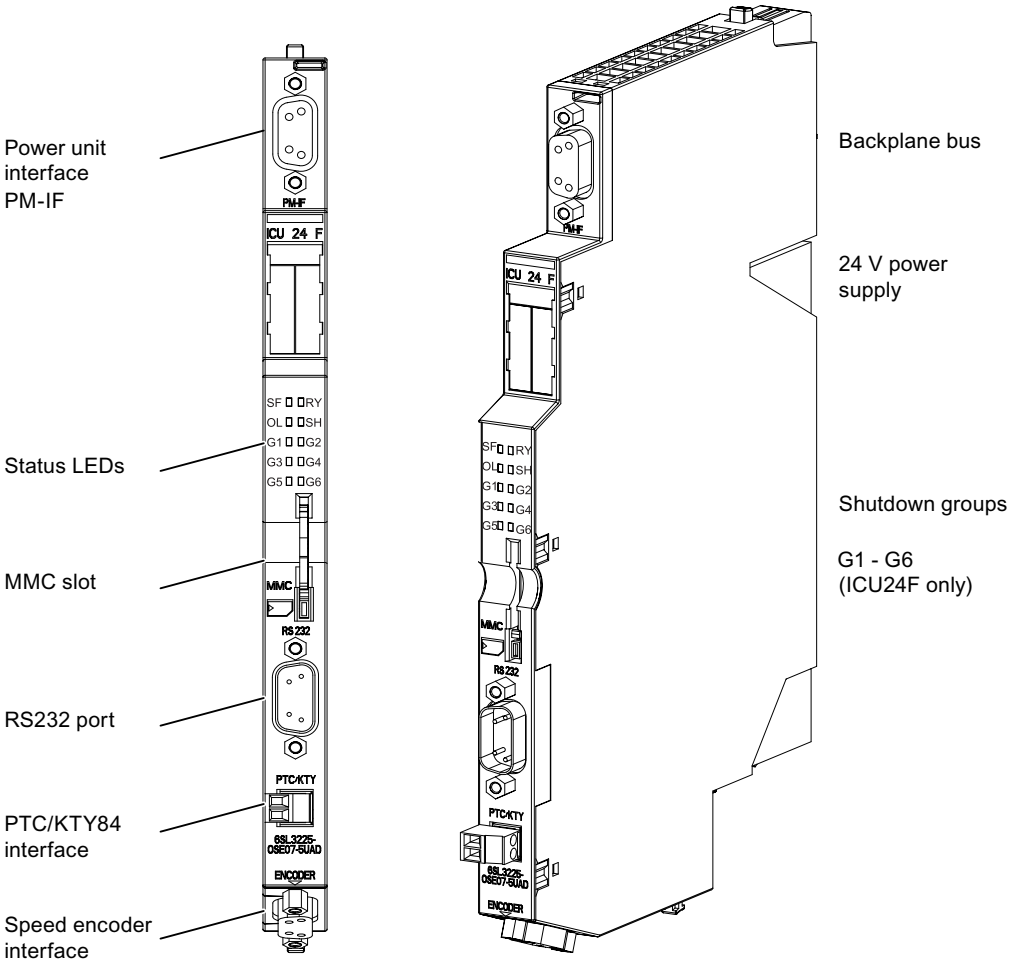


Figure 10-12 ICU24(F) Control Unit and its components

Function modules

V/f characteristic open-loop control (V/f characteristic) and field-oriented closed-loop control (vector control) are the most important processes in controlling the speed and torque of synchronous and asynchronous machines. The following processes are supported by the ICU24(F) Control Unit:

V/f characteristic

- Linear V/f control
- Linear V/f control with flux current control (FCC)
- Parabolic V/f control
- Multi-point V/f control

Vector control

- Speed control with/without encoder
- Torque control with/without encoder

Protective functions

The ICU24(F) is used to implement a number of protective functions, which protect the IPM25 power unit of the ET 200S FC, its associated motor and the system.

Converter protection

- Ground fault
- Short-circuit
- Overcurrent
- Overvoltage
- Undervoltage
- Thermal monitoring
  - I^2t
  - Heat-sink temperature
  - Chip temperature

Motor protection

- Stall protection
- Motor blocking protection
- Thermal monitoring
  - I^2t
  - Temperature sensor

System protection

- Load torque monitoring

Braking functions

- Regenerative braking
- Control of an external mechanical motor holding brake

Exchanging the Control Unit

The Control Units are easy to install and can be exchanged while still under voltage (hot swapping). However, an ICU24F Control Unit **mustnot** be exchanged for an ICU24.

NOTICE
When the connection between the ICU24(F) and IPM25 is interrupted (by removing the PM-IF), the converter will be in an undefined state, which may result in the faults listed below: F0001, F0004, F0005, F0025, F0052, F0060, F0100, F1601, F1611, F1625. The converter temperature may also be incorrectly displayed in r0037. Once the connection has been re-established, these fault codes can be acknowledged (depending on the setting of P1210, the faults will be acknowledged automatically).

Technical data

Table 10-22 Technical data - ICU24(F) Control Unit

Technical data		
Dimensions and weight		
Mounting dimensions W x H x D	mm	15 x 220 x 156
(Mounting depth with terminal module)	inch	3.8 x 55.9 x 39.6
Weight	g	Approx. 220 (ICU24F approx. 250)
	lbs	Approx. 0.49 (ICU24F approx. 0.56)
Data for specific modules		
Ambient temperature	°C	-10 – 60 for horizontal construction -10 – 40 for vertical construction
Degree of protection		IP20
Max. achievable safety classes (ICU24F only)		
IEC 61508		SIL 2
EN 954-1		Category 3
PFH value		$1.46 . 10^{-7}$
Duration of use	Years	10
Electrical data		
Setpoint resolution		0.01 Hz digital, 0.01 Hz serial
Output frequency resolution		0.01 Hz digital, 0.01 Hz serial
Current consumption	A	0.8 max. 0.4 typ.

10.5.4 IPM25 FSA/FSB power units

Overview

The following power units are available for the ET 200S FC frequency converter:

Table 10-23 Power units for the ET 200S FC frequency converter

Designation	Current carrying capacity	Frame size (width)
IPM25 FSA	0.75 kW	65 mm
IPM25 FSB	2.2 kW	130 mm
IPM25 FSB	4.0 kW	130 mm

Frame sizes

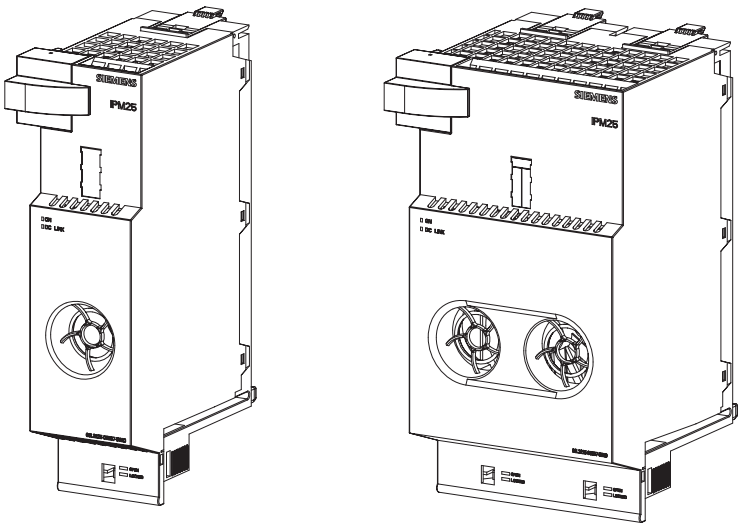


Figure 10-13 IPM25 FSA power unit (left) and IPM25 FSB power units (right)

Description

The IPM25 FSA or IPM25 FSB power units are components of ET 200S FC frequency converters, which operate using an input voltage of 3-ph. 400 V AC, 50/60 Hz, and cover a performance range of between 0.75 kW and 4 kW.

They have an AC/AC power range with control electronics and are connected to the ICU24(F) Control Unit via the PM-IF connector. The Control Unit then provides the ET 200S with the actual motor control, plus the necessary interfaces.

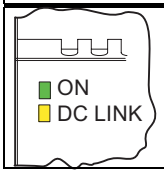
The electrical connection with the motor is established via the terminal module of the power unit. The brake control module is connected via its terminal module.

A brake control module from the ET 200S system can be controlled via the power unit, for the purpose of enabling/disabling a motor holding brake. The connection to the power unit is established via the terminal modules, by snapping on the components.

Status LEDs

The power unit status is displayed by means of two LEDs.

Table 10-24 Power unit status LED

	LED	Status	Meaning
	ON (green)	On	Converter output enabled (pulse enable)
		Off	Converter output disabled (pulse disable)
	DC LINK (yellow)	On	DC voltage connection available
		Off	DC voltage connection not available

Note

You can find the ET 200S system diagnostics for the IPM25 in the chapter entitled "Protective and monitoring functions".

Technical data

Table 10-25 Power-related technical data - IPM25

Designation	Power rating		Input current	Output current
	kW	hp	A	A
IPM25 FSA	0.75	1.0	1.9	2.1
IPM25 FSB	2.2	3.0	5.7	5.9
IPM25 FSB	4.0	5.0	9.6	10.2

The frequency converters have internal fuse protection. An external fuse is required for the power bus supply line. The size of the supply line cross-section depends on the maximum converter current expected at the power bus. The supply line fuse depends on the cable cross-section.

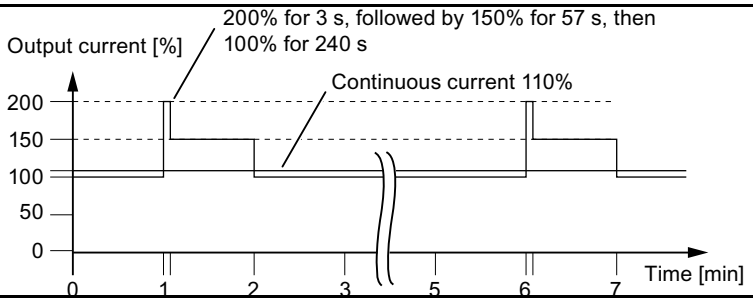
Table 10-26 General technical data - IPM25 FSA/FSB power units

Technical data			
Dimensions and weight			
		FSA	**FSB**
Mounting dimensions W x H x D	mm	65 x 290 x 156	130 x 290 x 156
(with terminal module)	inch	16.5 x 73.7 x 39.6	33.0 x 73.7 x 39.6
Weight	g	Approx. 1000	Approx. 1800
	lbs	Approx. 2.2	Approx. 4.0
Electrical data			
Rated voltage	V	3-ph. AC 380 – 480, +10%/-10%	
Overvoltage category		2	
Line frequency	Hz	47– 63	
Power factor		≥ 0.7	
Efficiency	%	96 – 97	

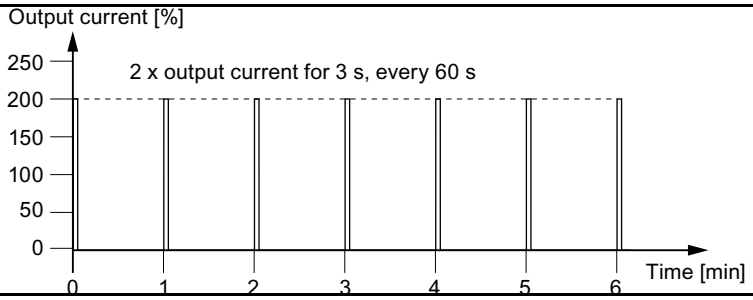
Technical data				
Making current	A	< Rated current		
Pulse frequency	kHz	2 - 16, can be set in 2 kHz increments		
Output current rating in relation to the pulse frequency		A	≤ 8 kHz	10 - 16 kHz
(The current data apply to an ambient temperature of 50°C and a horizontal construction.)		6SL3225-0SE07-5UA0	2.1	1.05
		6SL3225-0SE12-2UA0	5.9	5.3
		6SL3225-0SE14-0UA0	10.2	5.1

Overload capability

(The diagrams opposite only apply to motor operation. Energy regeneration is limited to the rated power of the IPM25.)

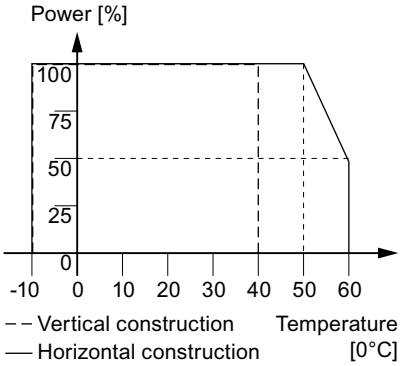


or

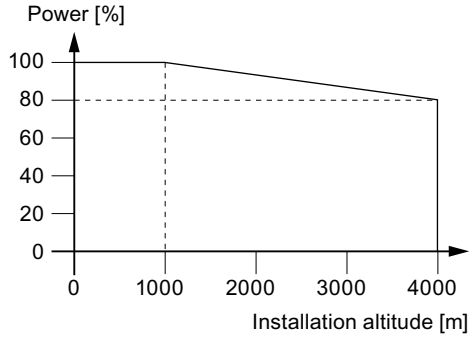


Data for specific modules			
Degree of protection		IP20	
Electromagnetic compatibility		EMC filter in accordance with EN 55011, Class A (accessories)	
Maximum cable length (motor)	m	50 (shielded), 100 (unshielded)	

Ambient temperature [°C]



Installation altitude [m]



10.5.5 xB1 and xB2 brake control modules

Description

The function of the brake control modules is to control the integrated DC spring-loaded brake (motor holding brake). An electromagnet is used to operate the brake: when the electric circuit is closed, it holds the brake open. When the current is switched off, the magnet drops out and the brake is enabled by the spring force, thereby blocking the motor.

Another application of the module is the possibility of integrating external actuators, e.g., DC valves (particularly those whose function depends on the motor).

The brake control module can be used in conjunction with motor starters and ET 200S FC frequency converters.

The brake control module is always installed to the right of the ET 200S FC frequency converter. The electrical connection to the ET 200S FC is established when the power unit is connected to the terminal module.

Note

The brake control module must be connected upstream of the ET 200S FC frequency converter's power unit. In addition, the power unit must be disconnected before the brake control module can be disconnected.

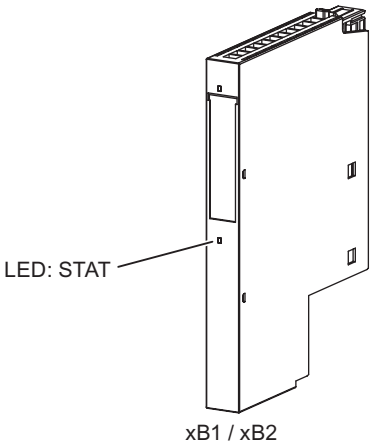
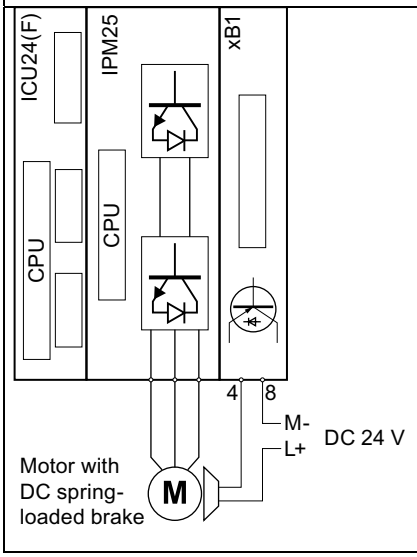
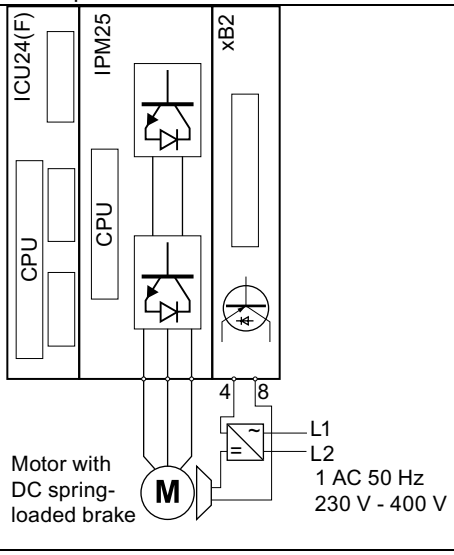


Figure 10-14 xB1/xB2 brake control modules

Common features of the xB1 and xB2

- The brake control module has a single-pole electronic switch, which can be used to control a DC spring-loaded brake (motor holding brake) integrated in electric motors.
- At the left-hand side of the brake control module there is a clip that ensures that the brake control module can only be disconnected or connected when its associated converter power unit has been disconnected. This means that it is impossible to disconnect or connect a module that is under voltage.
- A coding key is attached to the brake control module housing. This makes it possible to mechanically distinguish different modules.
- The frequency converter power unit is used to control the brake control module. The ET 200S FC has internal braking logic that can be enabled and set by means of parameters P1215 to P1217.
- The brake is triggered when voltage is applied.

Distinguishing features of the xB1 and xB2

xB1 brake control module	xB2 brake control module
• 3RK1903-0CB00 • 24 V DC external power supply required.	• 3RK1903-0CC00 • 1-ph. 230 to 400 V AC external power supply required.
	

Note

£In safety-related applications, the motor holding brake will always be triggered via the configured shutdown group, provided that a "safe standstill" function is available. Triggering by "safe standstill" has a higher priority than the signal via the brake control module.

⚠ WARNING

If the motor holding brake on a brake control module is open and the motor voltage is interrupted, the motor holding brake remains open and only message A0922 is output.

Status LEDs

The following statuses are displayed on the brake control module by means of LEDs:

Table 10-27 Brake control module status LEDs

LED	Status	Meaning
Yellow	On Off	Brake triggered Brake enabled

Note

The response of the overload or short-circuit protection is not shown.

Technical data

Table 10-28 Technical data - xB1 and xB2 brake control module

Technical data			
Dimensions and weight		**xB1**	**XB2**
Mounting dimensions W x H x D	mm	15 x 195.6 x 95	15 x 195.6 x 95
	inch	3.8 x 49.6 x 24.1	3.8 x 49.6 x 24.1
Mounting depth with terminal module	mm	117.5	117.5
	inch	29.82	29.8
Weight	g	Approx. 120	Approx. 120
	lbs	Approx. 0.265	Approx. 0.265
Data for specific modules			
Ambient temperature			
Operation	°C	0 to 60	0 to 60
Storage	°C	-40 to 80	-40 to 80
Degree of protection		IP20	IP20
Isolation			
Between control and braking circuit Surge capacity	V kV	500 AC 8	500 AC 8
Brake control module contact block (terminals 4 - 8)			
Rated operational voltage	V	24 DC	500 DC
Peak voltage (recurring)	V	< 35 DC	< 710
Continuous current [1]	A	≤ 4	≤ 0.7
Inrush current at t < 120 ms	A	≤ 8	≤ 5
13 DC breaking current, at 24 V (with ext. inductive interference protection)	A	≤ 4	-
13 DC breaking current, at 220 V_{rms} [2] (with ext. inductive interference protection)	A	-	≤ 0.7
Residual current	mA	< 10	< 1
Voltage drop at I_{load} < 0.7 A	V	< 0.3	< 1.4
Permissible braking (examples) with half-wave rectification on			
230 V AC produces 100 Vrms, T < 40°C	W	-	≤ 70
400 V AC produces 170 Vrms	W	-	≤ 100
500 V AC produces 220 Vrms	W	-	≤ 135
Permissible braking power at 24 V	W	≤ 95	-
Fault code with non-controlled brake		No	No

1) During installation, please take note of the special ambient conditions in the manual entitled "ET 200S Motor Starter/Fail-Safe Motor Starters".

2) With half-wave rectification on a 500 V AC line supply system

Technical data		
Protective measures	**xB1**	**XB2**
Overload protection 3)	Current limitation integrated	Current limitation integrated
Short-circuit protection acc. to EN 60947-5-1 3)	Yes, with 24 V/1 kA	Yes, with 230 V/1 kA
Reverse polarity protection 4)	No	No
Inductive interference protection (internal)	Protective diode	Varistor
External protective circuit with inductive load 5)	≤ 40 W recommended > 40 W required	≤ 40 W recommended > 40 W required

3) Electronic switch-off (switching back on only possible following switch-off via the frequency converter)

4) Module generates a short-circuit without current limitation, the brake is triggered and the overload and short-circuit protection has no effect.

5) Circuitry with RC element or protective diode on brake coil or varistor on brake rectifier

10.5.6 EMC filter

Description

ET 200S FC frequency converters can be fitted with Class A EMC filters. Using an optional group EMC filter and an EMC-compliant construction ensures conformity with the EMC directive in accordance with EN 55011, Class A.

NOTICE
Operation with an EMC filter is only permitted for TN line supply systems.

There are two external EMC filters for the ET 200S FC:

25 A rated current: Order no. 6SL3203-0BE22-5AA0

50 A rated current: Order no. 6SL3203-0BE25-0AA0

11 Dimension drawings

11.1 ET 200S modules

Dimension drawings for the following ET 200S modules can be found in the manual entitled *SIMATIC ET 200S Decentralized Peripherals System*:

- PM-D power module
- PM-D F power module
- xB1 and xB2 brake control module

11.2 ET 200S FC frequency converter

ICU24/ICU24F Control Unit

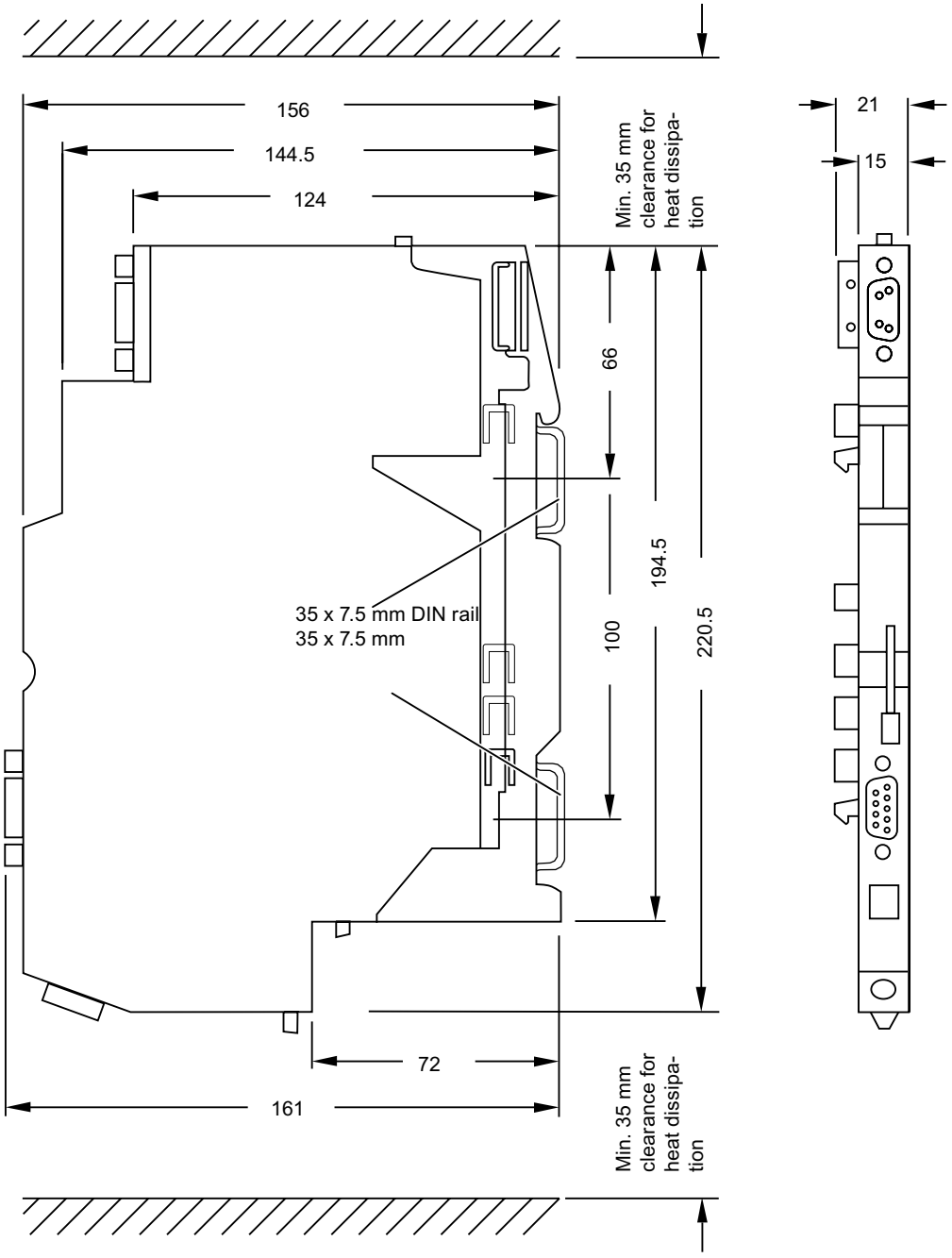


Figure 11-1 ICU24/ICU24F with terminal module dimension drawing

IPM25 FSA power unit

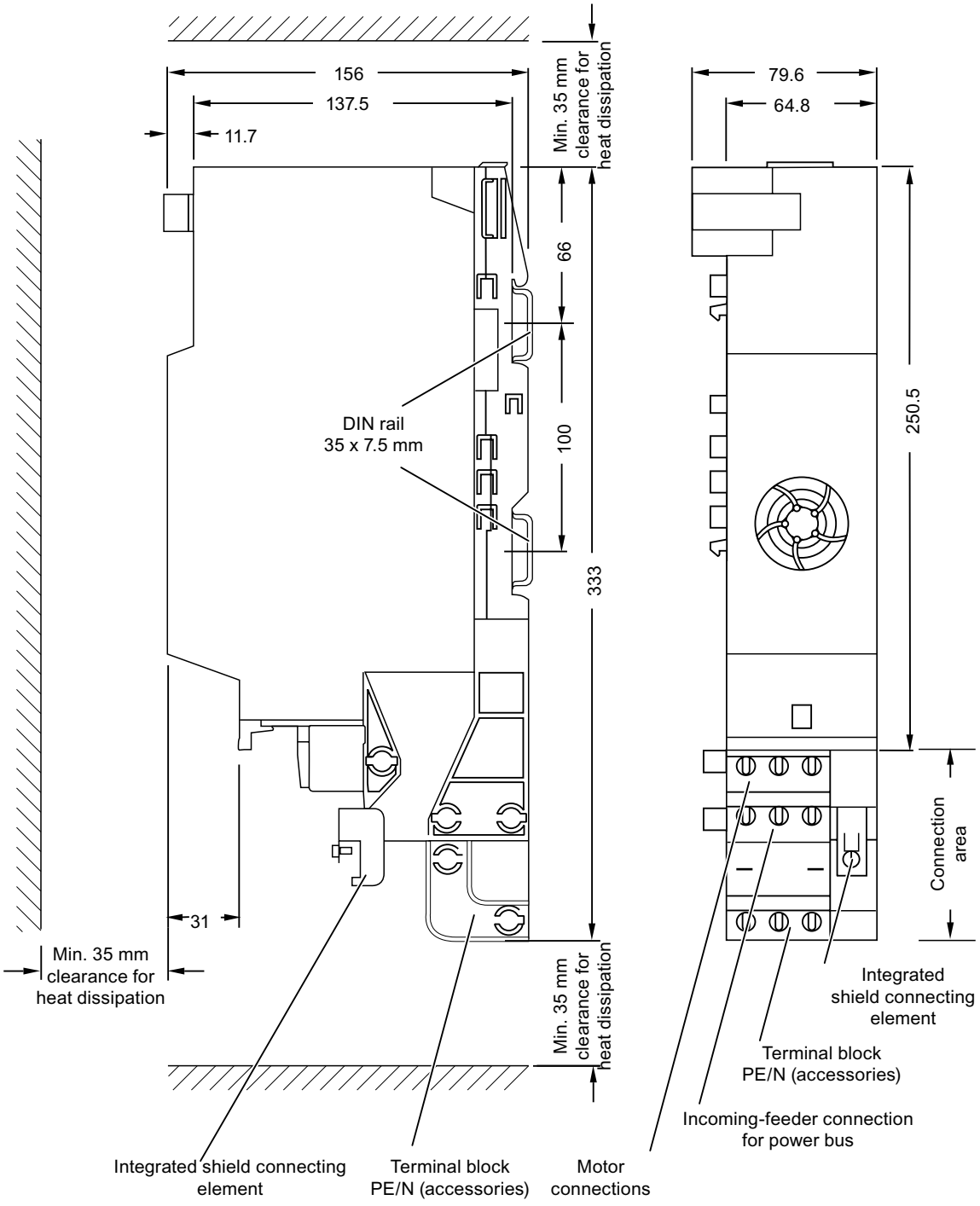


Figure 11-2 IPM25 FSA with terminal module dimension drawing

IPM25 FSB power unit

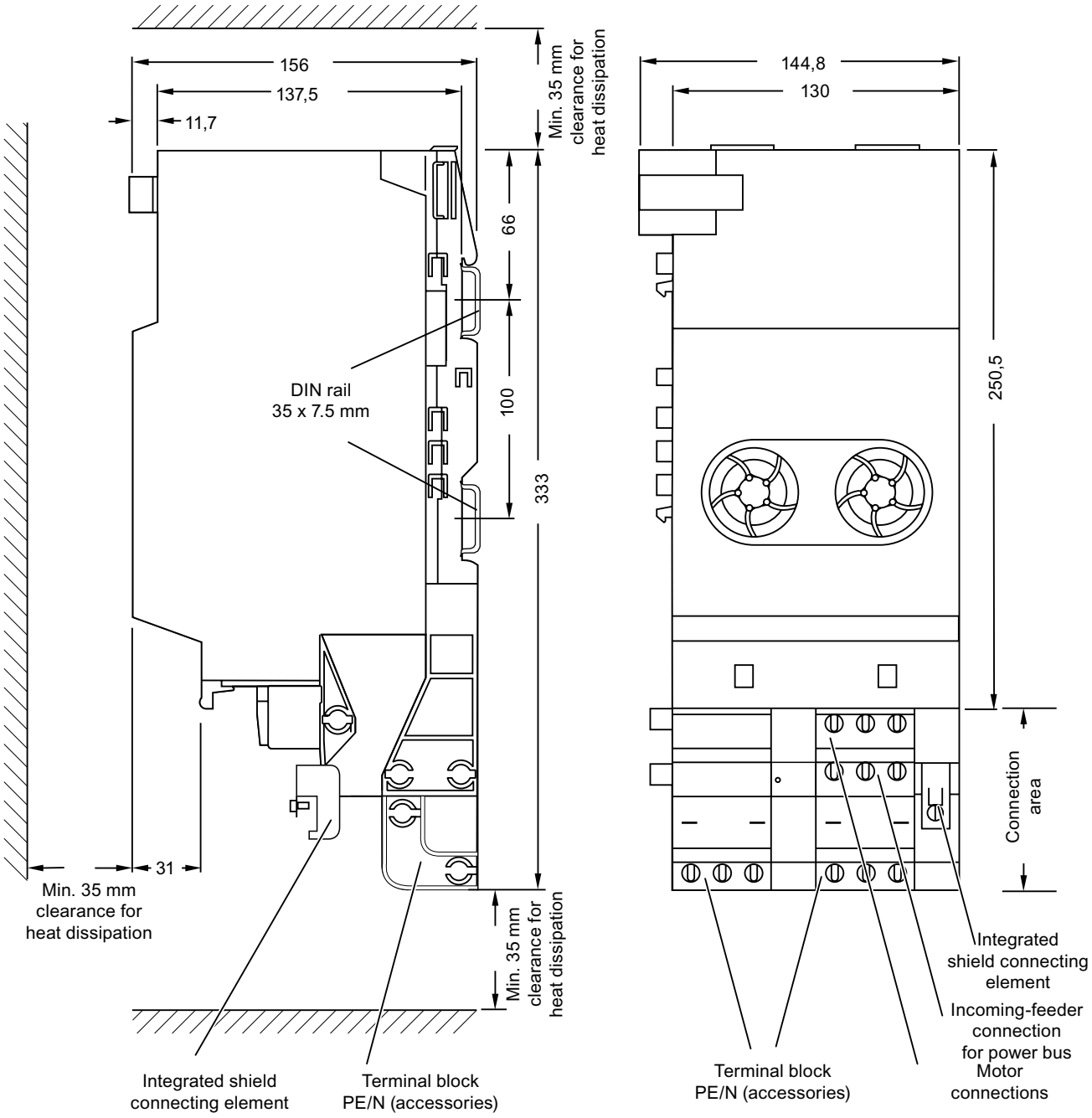


Figure 11-3 IPM25 FSB with terminal module dimension drawing

11.3 EMC filter (option)

EMC filter (25 A)

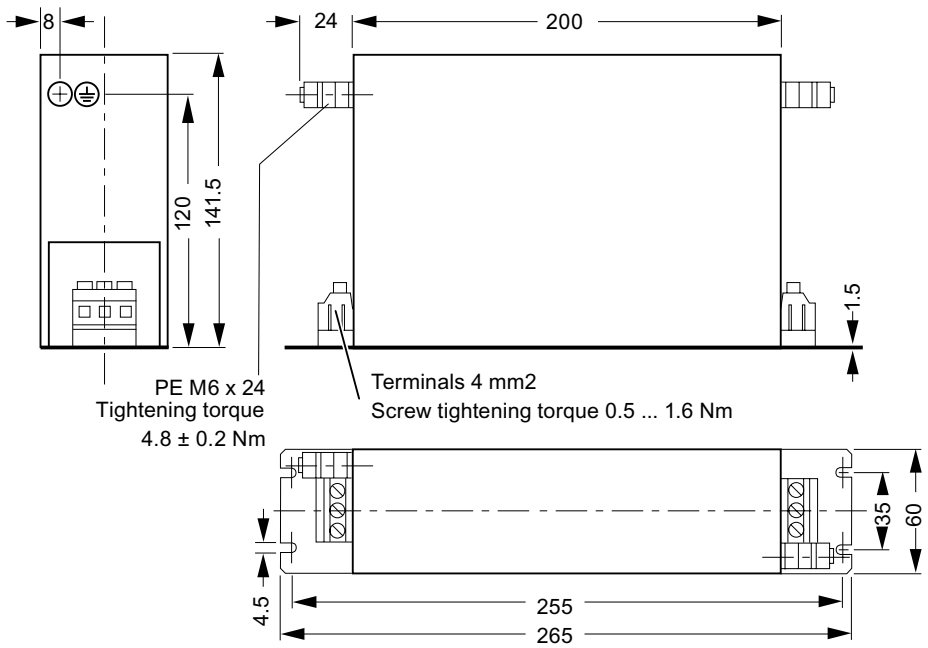


Figure 11-4 EMC filter (25 A) dimension drawing

EMC filter (50 A)

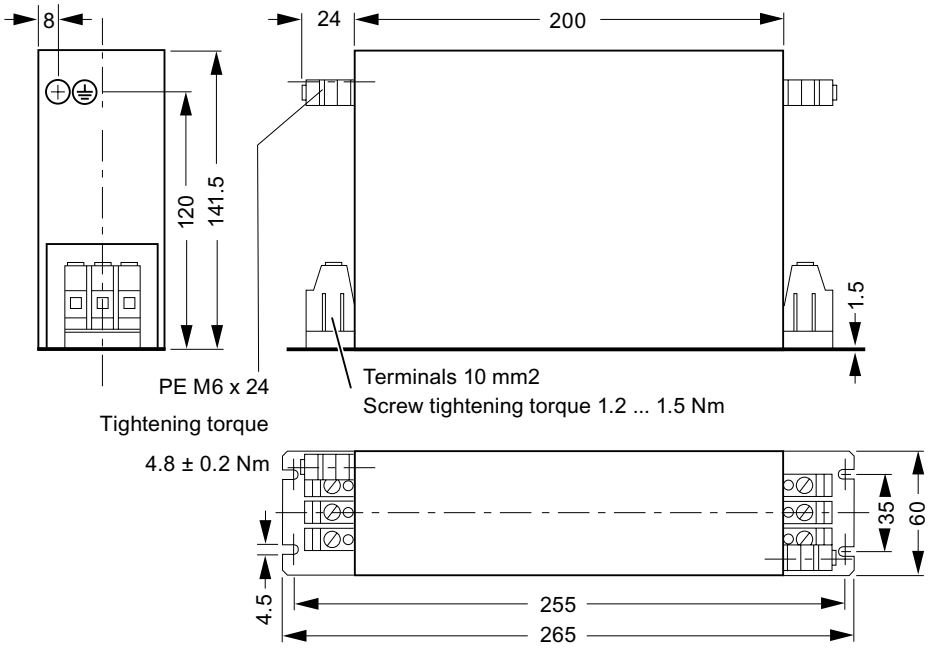


Figure 11-5 EMC filter (50 A) dimension drawing

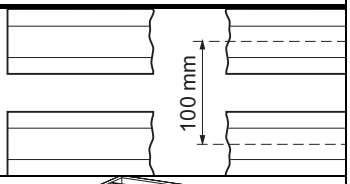
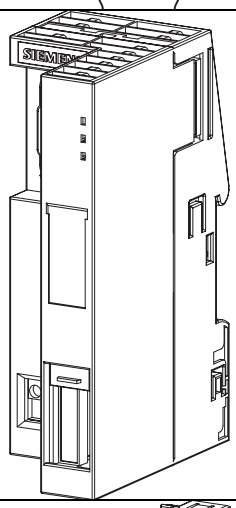
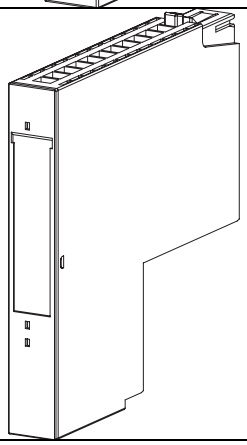
Spare parts/accessories

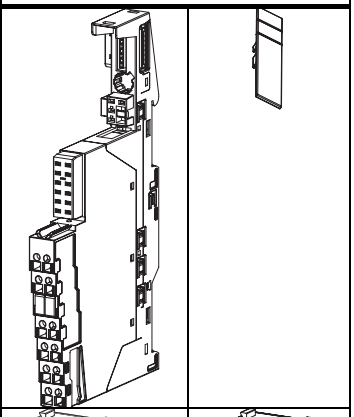
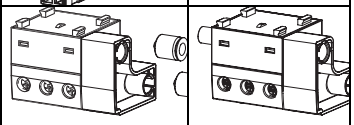
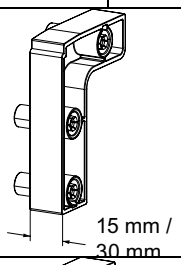
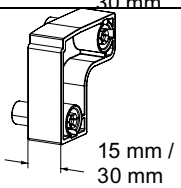
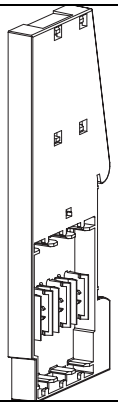
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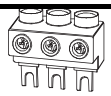
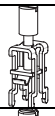
General ET 200S components

The following table lists the general ET 200S components required to construct an ET 200S FC frequency converter.

Table 12-1 ET 200S components

Components	Function	Illustration
DIN rails	Mechanical supports onto which the terminal modules of the ET 200S are snapped.	
Interface module IM151	Connects the ET 200S system with the PROFIBUS DP master and prepares the data for the electronic modules and frequency converters. (See *ET 200S Decentralized Peripherals System* manual.)	
PM-D power module	Monitors the electronics voltage for a group of frequency converters (= potential group) (see section entitled "Terms and definitions for ET 200S").	

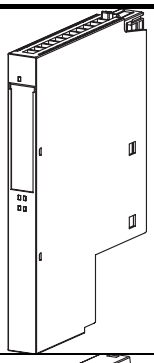
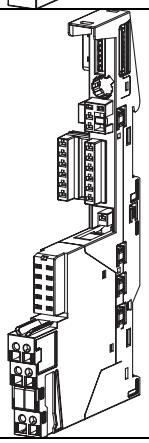
Components	Function	Illustration
TM-P15 S27-01 terminal module	Contains the wiring and houses the PM-D power module. The cover plate is included in the scope of delivery. It ensures touch protection for shutdown groups G1 to G6 and protects them from dirt at the same time.	
PE/N M65-PEN terminal block	Expands the power bus to include a protective earth (PE) conductor and a neutral conductor (N). It acts as an incoming feeder (left-hand image) or bushing (right-hand image) for the protective and neutral conductors. **Note** There is no cable connection to the power unit with PE included. It is snapped onto the terminal block L1/L2/L3 of the terminal module from below.	
Jumper module L1/L2/L3	Loops-through L1, L2, L3 and closes gaps in the power bus between two power units, where there are several ET 200S FCs connected in succession, or where expansion modules are being used. Available versions with L1/L2/L3 bushing: • 15 mm • 30 mm	
PE/N jumper module	Expands the power bus to include a neutral (N) and protective earth (PE) conductor and closes gaps in the power bus between two power units, where there are several ET 200S FCs connected in succession, or where expansion modules are being used. Available versions with PE/N bushing: • 15 mm • 30 mm	
Terminating module	Electrically terminates the internal data bus of the ET 200S system while simultaneously protecting it from dirt; see the chapter entitled "Assembling", section "Connecting the terminating module, cover plate and caps" and the manual entitled *ET 200S Decentralized Peripherals System*. The terminating module is included in the scope of delivery of the interface module.	

Components	Function	Illustration
3-phase feed-in terminal	Expands the conductor cross-section at the power supply (if required) by: • 2.5 to 25 mm²: Solid, stranded or finely stranded with end sleeve • AWG 12 to 4: Solid or stranded:	
Shield connection	Shield terminal (x5) for mounting shields on the rail	
	Grounding terminal for connecting the cable to the grounding power bus	
	Rail (1 m, 3 x 10 mm)	

Optional expansion modules for the ET 200S FC

The following table lists the expansion modules for constructing an ET 200S FC frequency converter.

Table 12-2 Optional ET 200S FC components

Components	Function	Illustration
Brake control module	The brake control module can be used with all ET 200S FC frequency converters. The following variants are available: xB1: Mechanical brake (24 V DC/4 A) xB2: Mechanical brake (500 V DC/0.7 A)	
TM-xB15 S24-01 terminal module	Contains the wiring and houses an xB1 or xB2 brake control module.	

Appendix

A

A.1 Acceptance reports

A.1.1 Documentation of acceptance test

Overview

Acceptance test No.	
Date	
Person carrying-out	

Table A-1 Machine description and overview/block diagram

Designation	
Type	
Serial No.	
Manufacturer	
End customer	
Block/overview diagram of the machine	

Table A-2 Fail-safe functions for each drive

Drive No.	FW version	SI version	Fail-safe function
	r0018 =	r9770 =	
	r0018 =	r9770 =	
	r0018 =	r9770 =	
	r0018 =	r9770 =	
	r0018 =	r9770 =	
	r0018 =	r9770 =	
	r0018 =	r9770 =	
	r0018 =	r9770 =	
	r0018 =	r9770 =	
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	r0018 =	r9770 =	
	r0018 =	r9770 =	
	r0018 =	r9770 =	
	r0018 =	r9770 =	

Table A-3 Description of the fail-safe equipment/devices

Drive No.	**Example:** Wiring of the STO terminals (protective door, EMERGENCY STOP), grouping of the STO terminals, etc.

A.1.2 Function test of the acceptance test

Description

The function test must be carried-out separately for each individual drive (assuming that the machine permits this to be done).

Executing the test

First commissioning	Please mark	
Series commissioning		

Function test "Safe Torque Off" (STO)

This test comprises the following steps:

Table A-4 "Safe Torque Off" function (STO)

No.	Description	Status
1.	Initial state • Drive is "Ready to Run" (P0010 = 0) • No safety faults and alarms • r9772.0 = r9772.1 = 0 (STO de-selected and inactive) • P9659 = time intervals for the forced checking procedure correctly set	
2.	Operate the drive	
3.	Check that the expected drive operates	
4.	Select STO while issuing the command to operate	
5.	Check the following: • The drive coasts-down • The drive is braked by the mechanical brake and held if a brake is being used • No safety faults • r9772.0 = r9772.1 = 1 (STO selected and active), r9772.14 = 1 if Safe Brake Control is enabled	
6.	De-select STO	
7.	Check the following: • No safety faults • r9772.0 = r9772.1 = 0 (STO de-selected and inactive) , r9772.14 = 0	
8.	Check that the expected drive operates if so the following is tested: • That the wiring between the control unit and power module is correct • Correct assignment, drive No. – inverter power module – motor • That the hardware is correctly functioning • That the shutdown paths have been correctly wired • Correct assignment of the STO terminals on the control unit • Correct parameterization of the STO function • Routine for the forced checking procedure of the shutdown paths	

Function test "Safe Stop 1" (SS1)

This test comprises the following steps:

Table A-5 "Safe Stop 1" function (SS1)

No.	Description	Status
1.	Initial state • Drive is "Ready to Run" (P0010 = 0) • No safety faults and alarms • r9772.0 = r9772.1 = 0 (STO de-selected and inactive) • r9772.2 = r9772.3 = 0 (SS1 de-selected and inactive)	
2.	Operate the drive	
3.	Check that the expected drive operates	
4.	Select SS1 while issuing the traversing command	
5.	Check the following: • Drive speed decreases corresponding to the selected ramp time (if required, use a stop watch) • After the parameterized minimum speed has been fallen below, the drive coasts-down • The drive is braked and held by the mechanical brake if a brake is being used • No safety faults • r9772.1 = 1 (STO active) • r9772.2 = 1 (SS1 selected) • r9772.14 = 1 if safe brake monitoring is enabled	
6.	De-select SS1	
7.	Check the following: • No safety faults • r9772.1 = 0 (STO inactive) • r9772.2 = 0 (SS1 de-selected) • r9772.14 = 0	
8.	Check that the expected drive operates if so the following is tested: • The wiring between the control unit and power module is correct • Correct assignment, drive No. – inverter power module – motor • Correct functioning of the hardware • Correct wiring of the shutdown paths • Correct assignment, STO terminals on the control unit • Correct parameterization of the SS1 function	

Function test "Safely-Limited Speed" (SLS)

This test comprises the following steps:

Table A-6 "Safely-Limited Speed" function (SLS)

No.	Description	Status
1.	Initial state • Drive is "Ready to Run" (P0010 = 0) • No safety faults and alarms • r9772.4 = r9772.5 = 0 (SLS de-selected and inactive)	
2.	Operate the drive (if the machine permits it, at a higher speed than the parameterized safely-limited speed)	
3.	Check that the expected drive operates	
4.	Select SLS while issuing the traversing command	
5.	Check the following: • r9772.4 = 1 (SLS selected) • Drive speed decreases corresponding to the selected ramp time or SLS mode (if required, use an oscilloscope) • After the parameterized safely-limited speed has been fallen below, the speed remains below this limit – In SLS mode 1 à correct, must be no fault – In SLS mode 0 à LSTO (safety fault at ramping end) – In SLS mode 2 à LSTO (immediately) • r9772.5 = 1 (SLS active)	
6.	De-select SLS	
7.	Check the following: • No safety faults • r9772.4 = r9772.5 = 0 (SLS de-selected and inactive)	
8.	Check that the expected drive operates if so the following is tested: • The wiring between the control unit and power module is correct • Correct assignment, drive No. – inverter power module – motor • Correct functioning of the hardware • Correct wiring of the shutdown paths • Correct parameterization of the SLS function	

A.1.3 Completing the acceptance log

Parameters of the fail-safe functions

	Specified value checked?	
	Yes	No
Control unit		

Checksums

Drive		Checksums	
Name	Drive No.	Control unit (r9798)	Control unit (r9898)

Data back-up/archiving

	Memory medium			Saved where
	Type	Designation	Date	
Parameters				
PLC program				
Circuit diagrams				

Signatures

Commissioning engineer

Confirms that the above listed tests and checks have been correctly carried-out.

Date	Name	Company/department	Signature

Machinery construction OEM

Confirms the correctness of the parameterization documented above.

Date	Name	Company/department	Signature

ESD guidelines

B

B.1 Electromagnetic compatibility

Electromagnetic compatibility (EMC)

All manufacturers/assemblers of electrical units which "perform an essentially complete function and are marketed as a single unit designed for the end-user", must comply with the EMC Directive 89/336/EEC.

There are three ways for the manufacturer/assembler to verify compliance:

Self-certification

The manufacturer declares that the European standards applicable to the electrical environment for which the unit is intended are satisfied. Only standards which have been officially published in the official journal of the European Union are allowed to be cited in the manufacturer's declaration.

Description of technical design

A description of the unit's technical design covering its EMC properties may be drawn up. Such a description must be approved by a "competent body" appointed by the responsible European authority. This method enables the use of standards which are still being prepared.

EMC standards

The drives were tested according to the EMC product standard EN 61800-3:2004.

Classification of EMC behavior

The EMC environment and the EMC classes are defined in the EMC product standard EN 61800-3 as follows:

Environment 1

An environment in which there are residential estates and facilities which are connected directly to a public low-voltage supply network without the use of an intermediate transformer.

Note

Example: Houses, apartments, commercial units or office rooms within a residential building.

Environment 2

An environment in which there are commercial estates and facilities which are not connected directly to a public low-voltage supply network.

Note

Example: Developed commercial sites and other sites which are supplied by a transformer provided specially for the purpose.

Class C1

Power drive system (PDS) with a rated voltage of less than 1000 V for use in residential buildings.

Class C2

Power drive system (PDS) with a rated voltage of less than 1000 V, which is neither fitted with a plug connector nor intended for (easy) transport and which, when used in residential buildings, is designed solely for installation and commissioning by a specialist.

Note

A specialist is a person or organization with the necessary skills to install and/or commission a power drive system (PDS) including its EMC aspects.

EMC emitted interference

The frequency converters were tested in accordance with the requirements regarding emitted interference for environments of Class C3 (commercial).

Table B-1 Conductor-related and radiated emitted interference

EMC impact	Standard	Step
Conductor-related emissions	EN 55011	Class A
Radiated emissions	EN 55011	Class A

Note

To comply with this behavior, the factory-set switching frequency must not be exceeded.

Harmonic currents

No connection approval is required for units which are installed in an environment of Class C3 (commercial).

EMC immunity

The frequency converters were tested in accordance with the interference immunity requirements for environments of Class C3 (commercial).

Table B-2 EMC immunity

EMC impact	Standard	Step	Power criterion
Electrostatic discharge (ESD)	EN 61000-4-2	4 kV discharge by contact	A
		8 kV discharge in air	
Electromagnetic high frequency field	EN 61000-4-3	0.15 MHz … 80 MHz 10 V/m	A
Amplitude modulated		80 % AM at 1 kHz	
Transient overvoltages	EN 61000-4-4	2 kV at 5 kHz	A
Voltage surge	EN 61000-4-5	1 kV inverse mode (L-L)	A
1.2/50 µs		2 kV common mode (L-E)	
Wired	EN 61000-4-6	0.15 MHz … 80 MHz 10 V/rms	A
High frequency common mode		80 % AM at 1 kHz	
System interruptions and voltage dips	EN 61000-4-11	100 % voltage dip for 3 ms	A
		30 % voltage dip for 10 ms	B
		60 % voltage dip for 100 ms	C
		95 % voltage dip for 5000 ms	D
Voltage distortion	EN 61000-2-4 Class 3	10 % THD	A
Voltage asymmetry	EN 61000-2-4 Class 3	3 % inverse reactance	A
Frequency fluctuation	EN 61000-2-4 Class 3	Rated value 50 Hz or 60 Hz (± 4 %)	A
Commutation notches	EN 60146-1-1 Class B	Depth = 40 %	A
		Area = 250 % x degrees	

B.2 ET 200S FC frequency converter in the industrial environment

ET 200S FC frequency converters with Class A filters are designed for use in the industrial environment, provided that the permissible cable lengths are used.

Table B-3 Use in the industrial environment

Fields of application	Requirement for	
	Emitted noise	Interference immunity
Industry	EN61000-6-4, with Class A filter	EN61000-6-2

Installation guideline for ET 200S FC frequency converter with EMC filter

- Operation with an EMC filter is only permitted for TN line supply systems.
- The Class A EMC filter is connected directly upstream of the power bus infeed into the main supply conductor of the ET 200S FC frequency converter.
- The converter must be assembled on a grounded plate with a large surface.
- Only shielded cables are permitted downstream of the EMC filter.
- In general, shielded cables should be used for converters with safety-related functions.
- The power bus for the frequency converter must be separate from the other power buses.
- The entire ET 200S system with frequency converters must be installed in a metal control cabinet.
- The maximum length of the power cables is 350 meters. This must also incorporate all of the power cables for all of the converters that are connected to a single power bus.
- The maximum length per frequency converter of the shielded power cable is 50 m.
- Connection cross-section
  - 25 A: 4 mm^2 (AWG 11)
  - 50 A: 10 mm^2 (AWG 7)

B.2.1 ET 200S FC frequency converter in a drive system in accordance with EN 61800-3

Explanatory notes for EN 61800-3+A11

The EN 61800-3+A11 product standard for "Adjustable speed electrical power drive systems, Part 3: EMC requirements and specific test methods" specifies limit values for noise radiation and interference immunity. The EMC product standard EN 61800-3+A11 does not apply directly to a frequency converter but to a complete drive system, which comprises the complete circuitry, motor and cables in addition to the converter.

Limit values for compliance with EN 61800-3 Category C3

The following table lists the key limit values for compliance with EN 61800-3 on devices with **restricted availability** for a drive system in accordance with Category C3 (Category C3: Power drive system (PDS) with rated voltage < 1000 V. For use in second environment), i.e., **use in second environment** (industrial) with commissioning and installation carried out by an EMC expert.

Table B-4 Limit values for noise radiation for a drive system compliant with Category C3

EMC phenomena	Basic standard for test procedures	Limit value
Radiated emissions	EN 55011	Class A, Group 1
Conducted emissions	EN 55011	Class A, Group 2

Table B-5 Limit values for interference immunity for a drive system compliant with Category C3

EMC phenomena		Basic standard for test procedures	Level				Evaluation criterion
Voltage dips		EN 61800-3-A11	30%, 10 ms 1) 60%, 100 ms 1) 95%, 5 s 3)				B C C
Voltage interruptions		EN 61800-3-A11	100%, 230 ms 3) 100%, 120 ms (regenerative feedback) 2)				C C
Harmonics at rated load		EN 61800-3-A11	5.	7.	11.	13.	–
			22.7 %	20.7 %	9.6 %	9.7 %	
	Regenerative feedback	EN 61800-3-A11	19.2 %	14.7 %	12.9 %	11.6 %	
Electrostatic discharge		EN 61000-4-2	8 kV, air discharge (housing)				B
Interference pulses	Burst	EN 61000-4-4	2 kV/5 kHz (electric power cable)				B
	Voltage surge	EN 61000-4-5	2 kV, phase – ground (electric power cable) 1 kV, phase – phase (electric power cable)				B B
High-frequency electromagnetic field, amplitude-modulated		EN 61000-4-3	80 MHz – 1000 MHz, 10 V/m, 80% AM				A
Ground leakage current		EN 61800-5-1	See the two tables below.				

1) Reduction of motor speed

2) Shutdown on fault F0002 "Overvoltage"

3) Shutdown on fault F0003 "Undervoltage"

With the exception of conducted emissions, the requirements of the product standard for a drive system compliant with C3 are met. An external filter is necessary to meet the requirements for conducted emissions.

The use of ET 200S FC frequency converters without filters in a drive system compliant with Category C3 is only permitted if the entire drive system is fitted with additional line filters on the incoming supply side.

Table B-6 Ground leakage currents (mA) to EN 61800-5-1 with 50 m CY shielded cable

IPM25 power unit	Output frequency	Ground leakage currents (mA) at pulse frequency			
		2 kHz	4 kHz	8 kHz	16 kHz
	50 Hz	8.21	7.87	7.39	7.22
	20 Hz	12.63	10.69	8.04	6.72
FSA, 0.75 kW	10 Hz	13.79	11.58	8.57	6.88
	5 Hz	14.21	11.85	8.76	6.95
	Ready	5.01			
	50 Hz	9.92	9.12	8.04	7.80
	20 Hz	16.44	13.46	9.66	7.18
FSB, 2.2 kW	10 Hz	18.10	14.76	10.32	7.46
	5 Hz	18.64	15.08	10.50	7.60
	Ready	4.97			
	50 Hz	11.03	9.68	8.42	8.32
	20 Hz	18.36	14.25	10.32	7.79
FSB, 4.0 kW	10 Hz	20.21	15.58	11.09	8.00
	5 Hz	20.72	16.63	11.43	8.27
	Ready	5.05			
FSB, 4.0 kW with external filter	50 Hz	1.94	2.06	2.02	2.08
	20 Hz	2.06	2.00	1.98	1.96
	10 Hz	2.10	1.98	1.92	1.92
	5 Hz	2.10	1.98	1.92	1.88
	Ready	1.84			

Table B-7 Ground leakage currents (mA) to EN 61800-5-1 with 3 m YY unshielded cable

IPM25 power unit	Output frequency	Ground leakage currents (mA) at pulse frequency			
		2 kHz	4 kHz	8 kHz	16 kHz
	50 Hz	5.12	5.12	5.12	5.09
	20 Hz	5.09	5.07	2.97	5.05
FSA, 0.75 kW	10 Hz	5.12	5.09	5.07	5.05
	5 Hz	5.12	5.09	5.08	5.05
	Ready	5.03			
	50 Hz	5.16	5.25	5.36	5.39
	20 Hz	5.47	5.46	5.36	5.32
FSB, 2.2 kW	10 Hz	5.56	5.48	5.38	5.12
	5 Hz	5.68	5.49	5.38	5.18
	Ready	5.02			
	50 Hz	5.26	5.37	5.35	5.33
	20 Hz	5.56	5.47	5.31	5.22
FSB, 4.0 kW	10 Hz	5.68	5.52	5.33	5.22
	5 Hz	5.71	5.54	5.33	5.22
	Ready	5.05			
FSB, 4.0 kW with external filter	50 Hz	1.76	1.90	1.90	1.88
	20 Hz	1.78	1.86	1.88	1.88
	10 Hz	1.84	1.84	1.86	1.88
	5 Hz	1.78	1.84	1.86	1.86
	Ready	1.86			

B.2.2 ET 200S FC frequency converter in general industrial application

Explanatory notes for general industrial application

In this EMC application, the manufacturer/assembler must certify the devices used as compliant with the EMC directive for industrial environments. The limit values are in line with the generic standards EN 61000-6-4 for generic emissions (noise radiation) and EN 61000-6-2 interference immunity in the second environment (industrial).

Limit values for general industrial application

The following tables contain the key limit values for compliance with the generic standards.

Table B-8 Limit values for noise radiation for general industrial application to EN 61000-6-4

EMC phenomena	Basic standard for test procedures	Limit value
Radiated emissions	EN 55011	Class A, Group 1
Conducted emissions	EN 55011	Class A, Group 1

Table B-9 Limit values for interference immunity for general industrial application to EN 61000-6-2

EMC phenomena		Basic standard for test procedures	Level	Evaluation criterion
Voltage dips		EN 61000-4-11	30% reduction, 0.5 periods	B
Voltage interruptions		EN 61000-4-11	> 95% reduction, 250 periods	C
Electrostatic discharge		EN 61000-4-2	8 kV, air discharge 4 kV, contact discharge	B B
Interference pulses	Burst	EN 61000-4-4	2 kV electric power cable 1 kV control cable	B B
	Voltage surge	EN 61000-4-5	2 kV electric power cable (phase - ground) 1 kV electric power cable (phase - phase) 1 kV control cable (cable - ground)	B B B
High-frequency electromagnetic field, amplitude-modulated		EN 61000-4-3	80 MHz – 1000 MHz, 10 V/m, 80% AM	A

The requirements of the generic standards in respect of interference immunity are met. The required values for noise radiation are met by using an external EMC filter (Class A) and with installation in accordance with the EMC Installation Guideline.

The use of ET 200S FC frequency converters without filters in general industrial application is only permitted if the entire system is fitted with additional line filters on the incoming supply side.

B.3 Standards

Standards and directives

CE	**European Low-Voltage Directive** The SINAMICS product series meets the requirements of the Low Voltage Directive 73/23/EEC, including the amendment by Directive 98/68/EEC. The devices are certified as complying with the following standards: EN 61800-5-1 - Semiconductor - General Requirements and Line Commutated Converters EN 60204-1 - Safety of Machinery - Electrical Equipment of Machinery
	European Machinery Directive The converter series does not fall within the area covered by the machinery directive. However, the use of the products in a typical machine application has been fully assessed for compliance with the main regulations in this directive concerning health and safety. A declaration regarding the general acceptance is available upon request.
	European EMC Directive When installed in accordance with the recommendations specified in this manual, the frequency converter complies with all regulations of the EMC directive according to the definition provided by EN 61800-3 "EMC Product Standard for Power Drive Systems".
c UL us LISTED	**Underwriters Laboratories** The device is listed by UL and CUL for power conversion in an environment the pollution degree 2. Comment: UL certification is being processed.
	ISO 9001 Siemens AG uses a quality management system that meets the requirements of ISO 9001.
	EC Machinery Directive 98/37/EG This directive defines basic protection goals for safety technology
	EN 292-1 Basic terminology and general principles for design
	EN 954-1 Safety-related parts of control systems
	EN 1050 Risk assessment
	DKE 226.03 Safety-related functions of electrical drive systems in machinery
	EN 61800-3 EMC product standard including special test procedures
	EN 61800-5-1 Requirements for the safety of electrical power drive systems with adjustable speed
	IEC 61508 Functional safety of electrical and electronic systems

List of abbreviations

C

C.1 Abbreviations

Abbreviations

Abbreviations	German	English
A		
A...	Warnung	alarm
AC	Wechselstrom	alternating current
AD	Analog-Digital-Konverter	analog digital converter
ADC	Analog-Digital-Konverter	analog digital converter
ADR	Adresse	address
AFM	Frequenzmodifikation	frequency modification
AFM	Zusätzliche Frequenzmodulation	additional frequency modulation
AG	Automatisierungsgerät	programmable controller
AI	Analog-Eingang	analog input
AIN	Analog-Eingang	analog input
AK	Anforderungsidentifizierung	request identification
ALM	Active Line Module	active line module
AO	Analog output	analog output
AOP	Advanced Operator Panel	advanced operator panel
AOUT	Analog-Ausgang	analog output
APC	Advanced Positioning Control	advanced positioning control
ASC	Ankerkurzschluss	armature short-circuit
ASCII	Amerikanische Code-Norm für den Informationsaustausch	American standard code for information interchange
ASIC	Anwendungsspezifischer integrierter Schaltkreis	application specific integrated circuit
ASM	Asynchronmotor	induction motor
ASP	Analog-Sollwert	analog setpoint
ASVM	Asymmetrische Raumvektormodulation	asymmetrical space vector modulation
B		
BB	Betriebsbedingung	operating condition
BCC	Block-Prüfzeichen	unit mark of conformity
BCD	Binär codierter Dezimalcode	binary conversion code

Abbreviations	German	English
BERO	Firmenname für einen Näherungsschalter	trade name for a type of proximity switch
BI	Binektor-Eingang	binector input
BIA	Berufsgenossenschaftliches Institut für Arbeitssicherheit	German institute for occupational safety
BICO	Binektor-Konnektor-Technologie	binector connector technology
BIST	Testprogramm	debugger
BLM	Basic Line Module	basic line module
BO	Binektor-Ausgang	binector output
BOP	Basic Operator Panel	basic operator panel
C		
C	Kapazität	capacitance
C...	Safety-Meldung	safety message
CAN	Serielles Bussystem	controller area network
CB	Kommunikationsbaugruppe	communication board
CBC	Kommunikationsbaugruppe CAN	communication board CAN
CCW	gegen den Uhrzeigersinn	counter-clockwise
CD	Compact Disc	compact disc
CDS	Befehlsdatensatz	command data set
CI	Konnektor-Eingang	connector input
CM	Konfigurierungs-Management	configuration management
CMD	Befehl	command
CNC	Computerunterstützte numerische Steuerung	computer numerical control
CO	Konnektor-Ausgang	connector output
CO/BO	Konnektor-Ausgang/Binektor-Ausgang	connector output/binector output
COB-ID	CAN Object-Identification	can object-identification
COM	Mittelkontakt eines Wechslerkontaktes	common contact of a change-over relay
CP	Kommunikationsprozessor	communications processor
CPU	Zentralbaugruppe	central processing unit
CRC	Checksummenprüfung	cyclic redundancy check
CSM	Control Supply Module	control supply module
CT	Konstantes Drehmoment; hohe Überlast	constant torque
CU	Control Unit	Control Unit
CW	im Uhrzeigersinn	clockwise
D		
DA	Digital-Analog-Konverter	digital analog converter
DAC	Digital-Analog-Konverter	digital analog converter
DC	Gleichstrom	direct current
DCN	Gleichstrom negativ	direct current negative
DCP	Gleichstrom positiv	direct current positive
DDS	Antriebsdatensatz	drive data set
DI, DIN	Digital-Eingang	digital input

Abbreviations	German	English
DI/DO	Digitaleingang/-ausgang bidirektional	bidirectional digital input/output
DIP	DIP-Schalter	dip switch
DMC	DRIVE-CLiQ Module Cabinet (Hub)	drive-cliq module cabinet (hub)
DO	Digital-Ausgang	digital output
DOUT	Digital-Ausgang	digital output
DP	Dezentrale Peripherie (verteilte E/As)	decentralized peripherals
DPRAM	Speicher mit beidseitigem Zugriff	dual ported random access memory
DRAM	Dynamischer Speicher	dynamic random access memory
DRIVE-CLiQ	Drive Component Link with IQ	drive component link with iq
DS	Antriebs-Zustand	drive state
DSC	Dynamic Servo Control	dynamic servo control
E		
ECD	Ersatzschaltbild	equivalent circuit diagram
EDS	Geberdatensatz	encoder data set
EEC	Europäische Wirtschaftsgemeinschaft	European economy community
EEPROM	Elektrisch löschbarer, programmierbarer Festwertspeicher	erasable programmable read-only memory
EGB	Elektrostatisch gefährdete Baugruppen	electrostatic sensitive devices (esd)
ELCB	Erdschluss-Schutzschalter; Fehlerstrom-Schutzschalter (FI)	earth leakage circuit-breaker
ELP	Erdschlussüberwachung	earth leakage protection
EMC	Elektromagnetische Verträglichkeit (EMV)	electromagnetic compatibility
EMI	Elektomagnetische Störung	electromagnetic interference
EMF	Elektromagnetische Kraft	electromagnetic force (EMF)
EMK	Elektromagnetische Kraft	electromagnetic force (EMF)
EMV	Elektromagnetische Verträglichkeit	electromagnetic compatibility (EMC)
EN	Europäische Norm	European standard
EnDat	Geber-Schnittstelle	encoder-data-interface
EP	Impulsfreigabe	enable pulses
EPOS	Einfachpositionierer	basic positioner
ES	Technisches System	engineering system
ESB	Ersatzschaltbild	equivalent circuit diagram
ESR	Erweitertes Stillsetzen und Rückziehen	extended stop and retract
F		
F...	Störung	fault
FAQ	Häufig gestellte Fragen	frequently asked questions
FCC	Flussstromregelung	flux current control
FCC	Steuerfunktionsablauf	function control chart
FCL	Schnelle Strombegrenzung	fast current limiting
FEM	Fremderregter Synchronmotor	separately excited synchronous motor
FEPROM	Schreib- und Lesespeicher nichtflüchtig	flash eprom
FF	Festfrequenz	fixed frequency

Abbreviations	German	English
FFB	Freier Funktionsbaustein	free function block
FG	Funktionsgenerator	function generator
FI	Fehlerstrom-Schutzschalter	earth leakage circuit-breaker (elcb)
FOC	Feldorientierte Regelung	field-oriented control
FP	Funktionsplan	function diagram
FREQ	Frequenz	frequency
FSA	Baugröße A	frame size A
FSB	Baugröße B	frame size B
FSC	Baugröße C	frame size C
FSD	Baugröße D	frame size D
FSE	Baugröße E	frame size E
FSF	Baugröße F	frame size F
FW	Firmware	firmware
G		
GB	Gigabyte	gigabyte
GC	Global-Control-Telegramm (Broadcast-Telegramm)	global control telegram (broadcast telegram)
GSD	Gerätestammdatei: beschreibt die Merkmale eines PROFIBUS-Slaves	device master file: describes the features of a profibus slave
GSG	Inbetriebnahme-Anleitung	getting started guide
GSV	Gate Supply Voltage	gate supply voltage
GUI ID	Eindeutige globale Kennung	graphical user interface
H		
HF	Hochfrequenz	high frequency
HFD	Hochfrequenzdrossel	high frequency reactor
HIW	Haupt-Istwert	main actual value
HLG	Hochlaufgeber	ramp-function generator
HMI	Mensch-Maschine-Schnittstelle	human machine interface
HO	Konstantes Drehmoment; hohe Überlast	constant torque
HSW	Haupt-Sollwert	main setpoint
HTL	Logik mit hoher Störschwelle, Hochspannungs-Transistor-Logik	high-threshold logic
HW	Hardware	hardware
I		
i. V.	In Vorbereitung: diese Eigenschaft steht zur Zeit nicht zur Verfügung	in preparation: this feature is currently not available
I/O	Eingang/Ausgang	input/output
IBN	Inbetriebnahme	commissioning
ID	Identifizierung	identifier
IEC	Internationale Norm in der Elektrotechnik	international electrotechnical commission
IGBT	Bipolartransistor mit isolierter Steuerelektrode	insulated gate bipolar transistor
IL	Impulslöschung	pulse suppression

Abbreviations	German	English
IND	Unter-Index	sub index
IP65	Schutzgrad 65	grade of protection 65
IT	Drehstromversorgungsnetz ungeerdet	Insulated three-phase supply network
IVP	Interner Spannungsschutz	internal voltage protection
J		
JOG	Tippen, JOG-Betrieb	jogging
K		
KDV	Kreuzweiser Datenvergleich	data cross-checking
KIB	Kinetische Pufferung	
KIP	Kinetische Pufferung	kinetic buffering
Kp	Proportionalverstärkung	proportional gain
KTY	Spezieller Temperatursensor	special temperature sensor
L		
L	Induktivität	inductance
LCD	Flüssigkristallanzeige	liquid-crystal display
LED	Leuchtdiode	light emitting diode
LGE	Länge	length
LIN	Linearmotor	linear motor
LO	Leichte Überlast (Veränderbares Drehmoment)	light overload
LR	Lageregler	position controller
LSB	Niederstwertiges Bit	least significant bit
LSS	Netzschalter	line side switch
LU	Längeneinheit	length unit
LWL	Lichtwellenleiter	optical fibre
M		
M	Masse	reference potential, zero potential
MB	Megabyte	megabyte
MCC	Motion Control Chart	motion control chart
MDS	Motordatensatz	motor data set
MHB	Motor-Haltebremse	motor holding brake
MLFB	Maschinenlesbare Fabrikatebezeichnung	machine-readable product designation
MLP	Mehrsprachen-Paket	multi language package
MMC	Mensch-Maschine-Kommunikation	man-machine communication
MMC	Micro Memory Card kompakte Speicherkarte für SIMATIC	Micro Memory Card Compact memory card for SIMATIC
MOP	Motorpotentiometer	motor potentiometer
MSB	Höchstwertiges Bit	most significant bit
MSCY_C1	Zyklische Kommunikation zwischen Master (Klasse 1) und Slave	master slave cycle class 1
MT	Messtaster	measuring probe
N		

Abbreviations	German	English
N. C.	Nicht angeschlossen	not connected
N...	Keine Meldung oder Interne Meldung	no report
NAMUR	Normenarbeitsgemeinschaft für Mess- und Regeltechnik in der chemischen Industrie	standardization association for measurement and control in chemical industries
NC	Numerische Steuerung	numerical control
NC	Ruhekontakt; Öffner	normally closed (contact)
NEMA	Normengremium in USA (United States of America)	national electrical manufacturers association
NM	Nullmarke	zero mark
NO	Arbeitskontakt; Schließer	normally open (contact)
NPN	Negativ positiv negativ	negative positive negative
O		
OA	Open Architecture	open architecture
OEM	Original Equipment Manufacturer	original equipment manufacturer
OLM	Optische Koppelbaugruppe	
OLP	Stecker für optische Verbindung	optical link plug
OMI	Option Module Interface	option module interface
OP	Bedienfeld	operator panel
OPI	Betriebsanleitung	operating instruction
P		
P...	Einstellparameter	adjustable parameter
PcCtrl	Steuerungshoheit	master control
PDS	Leistungsteildatensatz, Antriebssystem	power unit data set
PE	Schutzerde	protective earth
PELV	Schutzkleinspannung	protective extra low voltage
PEM	Permanenterregter Synchronmotor	permanent-magnet synchronous motor
PG	Programmiergerät	programming terminal
PI	Proportional Integral	proportional integral
PID	Proportional Integral Differential	proportional integral differential
PID	Proportional-Integral-Differential-Regler	proportional integral differential controller
PKE	Parameterkennung	parameter ID
PKW	Parameterkennung Wert	parameter ID value
PLC	Speicherprogrammierbare Steuerung (SPS)	programmable logical controller (PLC)
PLI	Listenhandbuch	parameter list
PLL	Baustein zur Synchronisierung	phase locked loop
PM	Netzteil	power module
PM-IF	Leistungsteil Schnittstelle	power module interface
PNO	PROFIBUS Nutzerorganisation	profibus user organisation
PNP	Positiv negativ positiv	positive negative positive
PNU	Parameternummer	parameter number
POT	Potentiometer	potentiometer

Abbreviations	German	English
PPI	Punkt zu Punkt Schnittstelle	point to point interface
PPO	Parameter-Prozessdatenobjekt	parameter process data object
PRBS	Weißes Rauschen	pseudo random binary signal
PROFIBUS	Serieller Datenbus	process field bus
PROFIdrive	Antriebsstandard	drive standard
PROFINET	Serieller Datenbus	process field network
PS	Stromversorgung	power supply
PSA	Power Stack Adapter	power stack adapter
PTC	Positiver Temperaturkoeffizient	positive temperature coefficient
PTP	Punkt zu Punkt	point to point
PWE	Parameterwert	parameter value
PWM	Pulsweitenmodulation	pulse width modulation
PX	Leistungserweiterung	power extension
PZD	PROFIBUS Prozessdaten	profibus process data
Q		
QC	Schnellinbetriebnahme	quick commissioning
R		
r...	Beobachtungsparameter (nur lesbar)	display parameter (read only)
RAM	Speicher zum Lesen und Schreiben	random access memory
RCCB	Fehlerstrom-Schutzschalter	residual current circuit-breaker
RCD	Fehlerstrom-Schutzschalter	residual current device
RFG	Hochlaufgeber	ramp-function generator
RFI	Hochfrequenzstörung	radio frequency interference
RJ45	Norm. Beschreibt eine 8-polige Steckverbindung mit Twisted-Pair Ethernet.	standard. Describes an 8-pole plug connector with twisted pair ethernet.
RKA	Rückkühlanlage	recooling system
RO	Nur lesbar	read only
ROM	Festwertspeicher	read-only memory
RPDO	Receive Process Data Object	receive process data object
RPM	Umdrehungen pro Minute	revolutions per minute
RS232	Serielle Schnittstelle	serial interface
RS485	Norm. Beschreibt die Physik einer digitalen seriellen Schnittstelle.	standard. Describes the physical characteristics of a digital serial interface.
RTC	Echtzeituhr	real time clock
RTOS	Echtzeitbetriebssystem	real time operating system
S		
S1	Dauerbetrieb	continuous operation
S3	Aussetzbetrieb	periodic duty
SBC	Sichere Bremsenansteuerung	safe brake control
SBH	Sicherer Betriebshalt	safe operating stop
SBR	Sichere Bremsrampe	safe braking ramp

Abbreviations	German	English
SBT	Sicherer Bremsentest	safe brake test
SCL	Skalierung	scale
SDI	Sichere Richtung	safe direction
SDP	Statusanzeigeeinheit	staus display unit
SE	Sicherer Software-Endschalter	safe software limit switch
SFC	Systemfunktion	System function
SG	Sicher reduzierte Geschwindigkeit	safely reduced speed
SGA	Sicherheitsgerichteter Ausgang	safety-related output
SGE	Sicherheitsgerichteter Eingang	safety-related input
SH	Sicherer Halt	safe standstill
SI	Safety Integrated	safety integrated
SIL	Sicherheitsintegritätsgrad	safety integrity level
SLI	Sicheres Schrittmaß	safely limited increment
SLM	Smart Line Module	smart line module
SLP	Sichere Endlage	safely limited position
SLS	Sicher begrenzte Geschwindigkeit	safely limited speed
SLVC	Geberlose Vektorregelung	sensorless vector control
SM	Sensor Module	sensor module
SMC	Sensor Module Cabinet	sensor module cabinet
SME	Sensor Module External	sensor module external
SN	Sicherer Software-Nocken	safe software cam
SOL	Serielle Verbindung als Option	serial option link
SOS	Sicherer Betriebshalt	safe operational stop
SPC	Sollwertkanal	setpoint channel
SPS	Speicherprogrammierbare Steuerung	programmable logic controller (plc)
SS1	Sicherer Stopp 1	safe stop 1
SSI	Synchron Serielle Schnittstelle	synchronous serial interface
SSM	Sichere Geschwindigkeitsanzeige n < nx	safe speed monitoring n < nx
SSR	Sichere Bremsrampe	safe stop ramp
STO	Sicher abgeschaltetes Moment	safe torque off
STW	PROFIBUS Steuerwort	profibus control byte
STW	Steuerwort	control word
STX	Textanfang	text start
SVM	Raumvektormodulation	space vector modulation
T		
TB	Terminal Board	terminal board
TIA	Totally Integrated Automation	totally integrated automation
TM	Terminal Module	terminal module
TN	Drehstromversorgungsnetz geerdet	grounded three-phase supply network
Tn	Nachstellzeit	integral time
TPDO	Transmit Process Data Object	transmit process data object
TT	Drehstromversorgungsnetz geerdet	grounded three-phase supply network

Abbreviations	German	English
TTL	Transistor-Transistor-Logik	transistor-transistor-logic
U		
U/f	Spannung/Frequenz	voltage/frequency
UL	Underwriters Laboratories Inc.	underwriters laboratories inc.
USS	Universelle serielle Schnittstelle	universal serial interface
USV	Unterbrechungsfreie Stromversorgung	uninterruptible power supply
V		
VC	Vektorregelung	vector control
Vdc	Zwischenkreisspannung	dc link voltage
VdcN	Teilzwischenkreisspannung negativ	partial dc link voltage negative
VdcP	Teilzwischenkreisspannung positiv	partial dc link voltage positive
VDE	Verband Deutscher Elektrotechniker	association of german electrical engineers
VDI	Verein Deutscher Ingenieure	association of german engineers
Vpp	Volt Spitze zu Spitze	volt peak to peak
VSM	Voltage Sensing Module	voltage sensing module
VT	Variables Drehmoment	variable torque
W		
WEA	Wiedereinschaltautomatik	automatic restart
WZM	Werkzeugmaschine	machine tool
X		
XML	Erweiterbare Auszeichnungssprache (Standardsprache für Web-Publishing und Dokumentenmanagement)	extensible markup language
Z		
ZK	Zwischenkreis	dc link
ZSW	PROFIBUS Zustandswort	profibus status byte
ZSW	Zustandswort	status byte
ZUSW	Zusatz-Sollwert	supplementary setpoint

Glossary

Duty cycle

Electrical machines run in one of the modes of operation described below. This results in the machine being subjected to different thermal loads during a duty cycle (S1 to S9).

- S1: Continuous operation
- S2: Short-time operation
- S3: Intermittent operation without startup procedure
- S4: Intermittent operation with startup procedure
- S5: Intermittent operation with startup procedure and electrical braking
- S6: Continuous operation with intermittent load
- S7: Uninterrupted operation (with startup and electrical braking)
- S8: Uninterrupted operation with periodic speed variations
- S9: Uninterrupted operation with non-periodic load and speed variations

ET 200S decentralized peripherals system

The ET 200S decentralized peripherals system is a highly modular and very flexible DP slave with IP20 degree of protection.

The interface with PROFIBUS is always provided by an IM151 interface module. Implementations vary from one application to the next.

Expectations

The monitoring functions in each monitoring channel work on the principle that a defined status must prevail before each action is carried out and a specific acknowledgement must follow each action. If these expectations of a monitoring channel are not fulfilled, the drive coasts to a standstill (two-channel) and an appropriate message is output.

General installation guidelines

Safety-related motor starters and frequency converters can be operated in tandem downstream of a module able to switch safe switch-off signals on the ET200 backplane bus. The F switch supplies two switch-off signals, F0 and F1; the repair switch module F-RSM only supplies F0.

The STARTER software can be used to assign switch-off signals at will if a different application ID is selected for the frequency converters.

Load groups

A load group contains a frequency converter with power supply and all frequency converters located to the right of it as far as the next frequency converter/motor starter with power supply.
All ET 200S FCs sharing **one** incoming power bus supply are designated as a "load group". A load group can differ from a potential group. An additional incoming power bus supply may be needed within a group of frequency converters supplied by the same power module, in order to avoid exceeding the rated operational current (aggregate current) of the terminal modules. The aggregate current of the power bus must not exceed 50 A.

Monitoring cycle

The safety-related monitoring functions for the drives are executed cyclically in ms.

Monitoring parameters

Parameters which can only be monitored are identified by the prefix "r".

These parameters are used to display internal variables, e.g., statuses or actual values.

Examples of notation:

r0002	Monitoring parameter 2
r0052.3	Monitoring parameter 52, bit 03
r0947[2]	Monitoring parameter 947 index 2
r0964[0 ... 4]	Monitoring parameter 964 with 5 indices (indices 0 to 4)

Parameter attributes

In the parameter list, the header for each parameter shows all attributes and groups associated with it.

Index

The index is used to define a parameter (e.g., P0013[20]) with a number of following elements (in this case, 20). Each individual index is defined using a numerical value. In relation to a parameter, this means that one indexed parameter can exhibit a number of values. The values are addressed using the parameter number and index value (e.g. P0013[0], P0013[1], P0013[2], P0013[3], P0013[4]). Indexed parameters are used, for example, for:

- Drive data sets (DDS)
- Command data sets (CDS)
- Subfunctions

BICO

The following types of interconnectable parameter are available. The function manual contains a description of the BICO technology.

Table 12-10 BICO parameter attributes

BICO	Description
BI	Binector input
BO	Binector output
CI	Connector input
CO	Connector output
CO/BO	Connector output/Binector output

Changeable in

"P" parameters can only be changed dependent upon the status of the frequency converter. The parameter value will not be applied unless the current status is listed in the "changeable" parameter attribute. For example, the parameter for quick commissioning P0010 with the attribute "CT" can only be changed in quick commissioning "C" or standby status "T" and not in motor mode "U".

Table 12-11 Changeable parameter attributes

Status	Description
C	Quick commissioning
U	Running (drive running)
T	Drive ready to start

Data types

The data type associated with a parameter defines the widest possible range of values. Five data types are used on the frequency converter. They represent either an unsigned integer value (U16, U32) or a floating point value. The range of values is frequently limited by a minimum and a maximum value (min., max.) or using variables associated with the frequency converter/motor.

Table 12-12 Data type of parameter attributes

Data type	Description
U16	16-bit unsigned integer value
U32	32-bit unsigned integer value
I16	16-bit signed integer value
I32	32-bit signed integer value
Float	A simple-accuracy floating point value compliant with IEEE standard format Max. range of values: -3.39e+38 – +3.39e+38

Unit

On the frequency converter, the units associated with a specific parameter contain the physical variable (e.g., m, s, A). Variables are measurable properties/features of physical objects, procedures and statuses; they are represented by the terms of a formula (e.g., V = 9 V).

Table 12-13 Data type of parameter attributes

Unit	Description
-	Without dimension
%	Percent
A	Ampere
V	Volt
Ohms	Ohms
us	Microseconds
ms	Milliseconds
s	Seconds
Hz	Hertz
kHz	Kilo Hertz
rpm	Revolutions per minute (rpm)
m/n	Meters per second
Nm	Newton meter
W	Watt
kW	Kilowatt
hp	Horse power
kWh	Kilowatt hours
°C	Degrees Centigrade
m	Meter
kg	Kilogram
°	Degrees (angular degrees)

Quick commissioning

This parameter attribute indicates whether the parameter is part of quick commissioning (QC) (P0010 = 1).

Table 12-14 Quick commissioning parameter attributes

QC	Description
No	The parameter is not part of quick commissioning.
Yes	The parameter is part of quick commissioning.

Range of values

The range of values specified by the data type is limited by the minimum and maximum value (min., max.) and by the variables associated with the frequency converter/motor. Quick commissioning is dependent upon the parameters being set to default values. These values (min., max., def.) are permanently stored in the frequency converter and cannot be changed by the user.

Table 12-15 Range of values of parameter attributes

Range of values	Description
-	No value entered (e.g. "r-parameter")
Min	Minimum value
Max	Maximum value
Def	Default value

Data sets

You will find a more detailed description of the data sets in the corresponding section.

Table 12-16 Changeable parameter attributes

BICO	Description
CDS	Command data set
DDS	Drive data set

Potential groups

A potential group contains a power module and all modules located to the right of it as far as an ET 200S terminating module or the next power module.

Note

Frequency converters and motor starters can be operated together in the same potential group.

Switch-off signal paths

The fail-safe frequency converter has two separate switch-off signal paths for the power electronics. All switch-off signal paths are low active, thereby ensuring that the system is always switched to a safe state if a component fails or in the event of an open circuit. If a fault is detected on the switch-off signal paths, the frequency converter is passivated. In this case, passivation cannot simply be acknowledged.

Two-channel monitoring structure

All the main safety-related hardware and software functions are implemented in two independent monitoring channels (e.g., switch-off signal paths, data management, data comparison).

Upload and download

Upload is understood to mean the saving of parameters from the EEPROM of a frequency converter to a PC (using STARTER) or to an MMC. Download is understood to mean the transferring of a parameter set saved on a PC or an MMC into the RAM or EEPROM memory of a frequency converter.

Writable parameters

Parameters that can be written and displayed are identified by the prefix "P".

These parameters have a direct impact on the behavior of a function. Their values are written to a non-volatile memory (EEPROM) if the corresponding option has been selected (non-volatile data storage). Otherwise, these values are written to the processor's volatile memory (RAM) and will be lost in the event of a power failure or restart.

Examples of the standard notation we always use in our manuals appear below.

Examples of notation:	
P0970	Parameter 970
P0748.1	Parameter 748, bit 01
P0819[1]	Parameter 819 index 1
P0013[0 ... 19]	Parameter 13 with 20 indices (indices 0 … 19)

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