

The background of the cover is a complex, layered digital illustration. It features a large, semi-transparent image of a SIMATIC MICRO-DRIVE servo drive unit, which is a black and silver industrial component with various ports and a display. To the left of the drive is a SIMATIC HMI (Human Machine Interface) panel with a color screen and a numeric keypad. Below the drive, there are two industrial servomotors: a larger one with a black frame and a smaller one with a silver frame. To the right of the servomotors is a coiled black cable with a multi-pin connector. The entire scene is overlaid with a blue grid pattern and floating binary code (0s and 1s). Several semi-transparent rectangular boxes contain text and icons, such as 'PLC_1 CPU 1515T-2 PN', 'Drive_1 SIMATIC MI...', 'PLC_1.PROFINET IO-System...', 'Show all devices', 'Configure networks', and 'Totally Integrated Automation PORTAL'. A line graph with the label 'Current' and a value of '14.3' is also visible on the right side.

SIEMENS

System Manual

SIMATIC

MICRO-DRIVE Servo Drive System

Drive controller PDC

Edition

10/2020

support.industry.siemens.com

SIMATIC

MICRO-DRIVE Drive controller PDC

System Manual

Preface

Guide to documentation

1

Description

2

Application planning

3

Installation

4

Connecting

5

Safety functions integrated
in the drive

6

Configuring

7

Commissioning

8

Programming motion
control instructions

9

Maintenance

10

Interrupts, diagnostics
alarms, error messages and
system alarms

11

Technical specifications

12

Parameters

13

Faults and warnings

14

Dimension drawings

A

Accessories/spare parts

B

Symbols

C

Legal information

Warning notice system

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

DANGER

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

WARNING

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

CAUTION

indicates that minor personal injury can result if proper precautions are not taken.

NOTICE

indicates that property damage can result if proper precautions are not taken.

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Qualified Personnel

The product/system described in this documentation may be operated only by **personnel qualified** for the specific task in accordance with the relevant documentation, in particular its warning notices and safety instructions. Qualified personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with these products/systems.

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Note the following:

WARNING

Siemens products may only be used for the applications described in the catalog and in the relevant technical documentation. If products and components from other manufacturers are used, these must be recommended or approved by Siemens. Proper transport, storage, installation, assembly, commissioning, operation and maintenance are required to ensure that the products operate safely and without any problems. The permissible ambient conditions must be complied with. The information in the relevant documentation must be observed.

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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.

Preface

Purpose of the documentation

This documentation provides important information for configuring, installing, connecting and commissioning the PDC drive controller of the SIMATIC MICRO-DRIVE drive system.

Basic knowledge required

A basic knowledge of automation engineering is required to understand the documentation.

Scope of the documentation

This documentation applies to all PDC drive controller products.

Conventions

PDC (stands for "ProfiDriveControl"): The descriptions "PDC drive controller", "PDC" and "drive controller" are used in this documentation as synonyms for "PDC drive controller of the SIMATIC MICRO-DRIVE drive system".

The description "drive" means the combination of motor, encoder and additional built-on accessories such as a gearbox and holding brake.

STEP 7: In this documentation, "STEP 7" is used as a synonym for all versions of the configuration and programming software "STEP 7 (TIA Portal)".

The terms "safety technology" and "F-technology" are used synonymously in this documentation. The same applies to the terms "fail-safe" and "F-".

The term "safety program" describes the fail-safe part of the user program and is used instead of "fail-safe user program", "F-program", etc. By way of distinction, the non-safety-oriented part of the user program is referred to as the "standard user program".

To distinguish them from blocks and instructions of the standard user program, all fail-safe blocks and instructions have a yellow background in the software user interface (e.g. in the project tree). The fail-safe parameters of F-CPU's and F-I/O also have a yellow background in the hardware configuration.

Also observe notes marked as follows:

Note

A note contains important information on the product described in the documentation, on the handling of the product or on the section of the documentation to which particular attention should be paid.

Special information

Note

Important note for maintaining the operational safety of your system

Systems with safety-oriented variants are subject to special operational safety requirements on the part of the operator. Even suppliers are required to observe special product monitoring measures. For this reason, we notify you personally about product developments and features that are (or could be) relevant to operation of systems from a safety perspective.

By subscribing to the appropriate notifications, you will ensure that you are always up-to-date and able to make changes to your system, when necessary.

Register at the Industry Online Support site. Follow the links below, and click on "email on update" located on the right side:

- SIMATIC S7-1500/SIMATIC S7-1500F (<https://support.industry.siemens.com/cs/ww/en/ps/13716>)
- SIMATIC S7-1200/SIMATIC S7-1200F (<https://support.industry.siemens.com/cs/ww/en/ps/13883>)
- STEP 7 (TIA Portal) (<https://support.industry.siemens.com/cs/ww/en/ps/14340>)

Note

When using F-CPU's in safety mode and fail-safe PDC drive controllers, observe the description of the F-system in the programming and operating manual SIMATIC Safety - Configuring and Programming (<https://support.industry.siemens.com/cs/ww/en/view/54110126>).

Recycling and disposal

For environmentally friendly recycling and disposal of your old equipment, contact a certified electronic waste disposal company and dispose of the equipment according to the applicable regulations in your country.

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

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

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

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

Siemens' products and solutions undergo continuous development to make them more secure. Siemens strongly recommends that product updates are applied as soon as they are available and that the latest product versions are used. Use of product versions that are no longer

supported, and failure to apply the latest updates may increase customers' exposure to cyber threats.

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

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You can find current information on the following topics quickly and easily here:

- **Product support**
All the information and extensive know-how on your product, technical specifications, FAQs, certificates, downloads, and manuals.
- **Application examples**
Tools and examples to solve your automation tasks – as well as function blocks, performance information and videos.
- **Services**
Information about Industry Services, Field Services, Technical Support, spare parts and training offers.
- **Forums**
For answers and solutions concerning automation technology.
- **mySupport**
Your personal working area in Industry Online Support for messages, support queries, and configurable documents.

This information is provided by the Siemens Industry Online Support in the Internet (<https://support.industry.siemens.com>).

Industry Mall

The Industry Mall is the catalog and order system of Siemens AG for automation and drive solutions on the basis of Totally Integrated Automation (TIA) and Totally Integrated Power (TIP).

You can find catalogs for all automation and drive products on the Internet (<https://mall.industry.siemens.com>) and in the Information and Download Center.

Table of contents

	Preface	3
1	Guide to documentation.....	13
2	Description.....	17
2.1	System overview	17
2.2	Application range	20
2.3	Product overview	21
2.4	PROFIdrive	25
2.5	PROFINET.....	25
3	Application planning	27
3.1	Shipping	27
3.2	Storage.....	27
3.3	Scope of delivery	27
3.4	Installation location	28
3.5	Power supply	29
3.6	Battery operation.....	32
4	Installation.....	35
4.1	Basics	35
4.2	Installation rules	36
4.3	Installing the PDC in a control cabinet	38
4.3.1	Installing the PDC on a mounting rail.....	38
4.3.2	Installing the PDC on a mounting plate.....	39
4.4	Removing the PDC	41
4.5	Mounting the shield bracket.....	41
5	Connecting	45
5.1	Rules and regulations for operation	45
5.2	Connecting the supply voltages.....	46
5.3	Connecting the PROFINET interface	47
5.4	Connecting the cable shield	47
5.5	Connecting to functional ground.....	50
5.6	Connecting the motor	51
5.7	Removing/inserting microSD memory card	51
5.8	Connecting the digital inputs/outputs.....	53

5.9	Connecting an encoder	54
5.9.1	Connecting an incremental encoder	54
5.9.2	Connecting a Hall sensor	58
5.9.3	Connecting an SSI encoder	58
5.10	Connecting Hardware STO	60
5.11	Connecting a braking resistor	61
6	Safety functions integrated in the drive	63
6.1	Fundamental safety instructions	63
6.1.1	General safety instructions	63
6.1.2	Warranty and liability for application examples	63
6.1.3	Industrial security	64
6.2	Fundamental safety instructions for Safety Integrated	64
6.3	Residual risk	66
6.4	Overview of the Safety Integrated functions	66
6.5	Supported safety functions	67
6.6	Examples of use of the safety functions	68
6.7	Safety concept	69
6.8	Safety Integrated functions	70
6.8.1	Safe Torque Off (STO)	70
6.8.2	Safe Stop 1 (SS1, time-controlled)	73
6.8.3	Safely-Limited Speed (SLS)	75
6.8.4	Safe Speed Monitor (SSM)	77
6.8.5	Safely-Limited Torque (SLT)	78
6.9	PROFIsafe communication	82
6.9.1	Monitoring times	82
6.9.2	Telegram structure	83
6.9.3	Process data	83
6.10	Acceptance of the safety functions	86
6.11	System features	86
6.11.1	Current information	86
6.11.2	Certifications	86
6.11.3	Failure probability of the safety functions	87
6.11.4	Response times	87
6.12	Emergency Off and Emergency Stop	87
7	Configuring	89
7.1	Inserting PDC from the hardware catalog	90
7.2	Networking the PDC	90
7.3	Configuring the PDC	91
7.3.1	Device configuration	91
7.3.2	Drive telegram	91
7.3.3	Identification and maintenance data	92
7.3.4	Assignment of device name	93

7.3.5	Assignment of an IP address	93
7.3.6	Module parameters	94
7.3.7	Shared device	94
7.3.8	Isochronous communication	95
7.3.9	MAC addresses	95
7.3.10	Fail-safe communication	96
7.3.11	Digital inputs and outputs	96
7.4	LED flash test	96
7.5	Media redundancy	97
7.6	Communication telegrams	97
8	Commissioning	101
8.1	Basics	102
8.1.1	Engineering	102
8.1.2	Going online	106
8.1.3	Toolbar	108
8.1.4	Saving parameters in power-independent storage	108
8.1.5	Drive parameters	109
8.1.6	Drive control panel	112
8.1.7	Drive trace	114
8.1.8	Calling help information	118
8.2	Requirements for the commissioning	118
8.3	Commissioning procedure	120
8.4	Drive data sets	121
8.4.1	Using the drive data set	124
8.4.2	Using the drive data set of the IQ encoder	125
8.4.3	Using preconfigured drive data sets	126
8.4.4	Using a user-defined drive data set	127
8.5	Controller settings	128
8.5.1	Open-loop/closed-loop control	128
8.5.2	Speed setpoint filter	132
8.5.3	Optimization	132
8.5.4	Rotating measurement run	133
8.5.5	Suspended axis	135
8.5.6	Flying restart	136
8.5.7	OFF responses	136
8.6	Setpoint channel	137
8.6.1	Reference values	138
8.6.2	Limit values	139
8.6.3	Ramp generator	141
8.7	Power unit	144
8.7.1	Energy recovery	144
8.7.2	Overload protection	144
8.8	Drive functions	145
8.8.1	Blockage detection	145
8.8.2	Thermal monitoring	146
8.8.3	Travel to fixed stop	149

8.8.4	Dynamic torque reduction.....	150
8.8.5	SSI interface	151
8.8.6	Encoder assignment.....	152
8.9	Commissioning Safety Integrated functions	153
8.9.1	Safety instructions for commissioning	153
8.9.2	Safety Integrated in the engineering system	154
8.9.3	Guidelines for safety commissioning	156
8.9.4	Selecting safety functions	157
8.9.5	Setting up the safety functions	158
8.9.6	Completing safety commissioning	165
8.9.7	Safety change tracking.....	166
8.9.8	Safety password.....	167
9	Programming motion control instructions	171
10	Maintenance	175
10.1	Introduction.....	175
10.2	Maintenance and repair	175
10.3	Warranty.....	175
10.4	Using the service button	175
10.5	Resetting to factory settings.....	176
10.6	Resetting interface parameters.....	178
10.7	Replacing the PDC as a replacement part	178
10.7.1	Replacing the PDC with a parameter backup	179
10.7.2	Replacing the PDC with an engineering tool	179
10.8	Series commissioning	180
10.9	Creating a parameter backup	181
10.10	Loading the parameter backup	183
10.11	Copying service data to the memory card	184
10.12	Firmware update.....	185
10.13	Formatting the memory card	187
10.14	Safely removing the memory card	188
10.15	Restarting the drive.....	188
11	Interrupts, diagnostics alarms, error messages and system alarms.....	189
11.1	Status and error displays	189
11.2	Actual values	195
11.3	System time.....	196
11.4	Messages.....	196
11.5	Standard PROFIdrive alarms.....	199
12	Technical specifications	201
12.1	Standards, approvals and safety instructions.....	201

12.2	Electromagnetic compatibility	204
12.3	Transport and storage conditions	205
12.4	Mechanical and climatic ambient conditions	206
12.5	Information on insulation tests, protection class, degree of protection and rated voltage...	208
13	Parameters.....	211
13.1	Overview of the parameters	211
13.2	Parameter list.....	213
14	Faults and warnings.....	267
14.1	Overview of messages	267
14.2	List of faults and alarms	267
A	Dimension drawings	281
B	Accessories/spare parts	283
C	Symbols	285
	Glossary	287
	Index	293

Guide to documentation

PDC drive controller of the SIMATIC MICRO-DRIVE drive system

This system manual covers the variants of the PDC drive controller.

The PDC drive controller is the drive controller equipped with closed-loop control circuits for the SIMATIC MICRO-DRIVE drive system.

The PDC drive controller system manual contains information, for example, on properties, installation, connection, configuration and parameter assignment, alarms and diagnostics and technical specifications of the PDC drive controller.

Changes and supplements to the system manual are documented in a Product Information.

This Product Information supplements the documentation for the SIMATIC MICRO-DRIVE drive system and takes precedence over the system manual. You can download the Product Information free of charge from the Internet (<https://support.industry.siemens.com/cs/ww/en/ps/25460>).

The product manuals of the respective PDC device versions contain a compact description of the device-specific information, such as properties, interfaces, wiring diagrams, display and operator control elements and technical specifications.

General information

The PDC drive controller is integrated in the engineering system of the SIMATIC S7-1200 and S7-1500 automation systems (STEP 7 TIA Portal).

The SIMATIC S7-1200 and S7-1500 automation systems and STEP 7 offer a wide variety of documentation and other sources with technical information.

SIMATIC S7-1500

You can download general information about the SIMATIC S7-1500/ET 200MP systems free of charge from the Internet (<https://support.industry.siemens.com/cs/ww/en/view/109742691>).

Changes and supplements to the manuals are documented in a Product Information. You can download the Product Information free of charge from the Internet (<https://support.industry.siemens.com/cs/us/en/view/68052815>).

SIMATIC S7-1200

The system manual S7-1200 Programmable Controller (<https://support.industry.siemens.com/cs/ww/en/view/109741593>) provides information on the entire S7-1200 product family. In addition to the system manual, the S7-1200 Easy Book provides a general overview of the capabilities of the S7-1200 family. You can download or view the electronic manuals on the Siemens Industry Online Support (<https://support.industry.siemens.com>) website.

The Update to the S7-1200 System Manual (<https://support.industry.siemens.com/cs/ww/en/view/109743003>) contains updates to the system manual "SIMATIC S7-1200 Programmable Controller" that occurred after its publication.

Safety Integrated

Through use of fail-safe S7-1500 or S7-1200 CPUs and fail-safe PDCxxxF drive controllers, you implement applications for safety engineering. You configure and program your safety program in STEP 7 (TIA Portal) too.

You can find further information on creating a safety program and accessing PROFI-safe user data in the safety program in the programming and operating manual SIMATIC Safety - Configuring and Programming (<https://support.industry.siemens.com/cs/ww/en/view/54110126>).

"mySupport"

With "mySupport", your personal work area, you make the most of your Industry Online Support.

In "mySupport" you can store filters, favorites and tags, request CAx data and compile your own personal library in the Documentation area. Furthermore, your data is automatically filled in for support requests and you can get a quick overview of your current requests.

You need to register once to use the full functionality of "mySupport".

You can find "mySupport" on the Internet (<https://support.industry.siemens.com/My/ww/en>).

"mySupport" - Documentation

In the Documentation area of "mySupport", you have the possibility to combine complete manuals or parts of them to make your own manual.

You can export the manual in PDF format or in an editable format.

You can find "mySupport" - Documentation on the Internet (<https://support.industry.siemens.com/My/ww/en/documentation>).

"mySupport" - CAx Data

In the CAx Data area of "mySupport", you can access the latest product data for your CAx or CAe system.

You configure your own download package with a few clicks.

In doing so you can select:

- Product images, 2D dimension drawings, 3D models, internal circuit diagrams, EPLAN macro files
- Manuals, characteristics, operating instructions, certificates
- Product master data

You can find "mySupport" - CAx Data on the Internet (<https://support.industry.siemens.com/my/ww/en/CAxOnline>).

Application examples

The application examples support you with various tools and examples for solving your automation tasks. Here, solutions involving the interaction of multiple components in the system are shown, thus departing from the focus on individual products.

You can find the application examples on the Internet (<https://support.industry.siemens.com/cs/ww/en/sc/2054>).

TIA Selection Tool

With the TIA Selection Tool, you can select, configure and order devices for Totally Integrated Automation (TIA).

This tool is the successor of the SIMATIC Selection Tool and combines the known configurators for automation technology into one tool.

An integral component of the TIA Selection Tool is the calculation tool for the design and component selection of the SIMATIC MICRO-DRIVE drive system.

With the TIA Selection Tool, you generate a complete order list from your product selection or product configuration.

You can find the TIA Selection Tool on the Internet (<https://new.siemens.com/global/en/product-services/automation/topics/tia/tia-selection-tool.html>).

SIMATIC Automation Tool

You can use the SIMATIC Automation Tool to perform commissioning and maintenance activities simultaneously on various SIMATIC S7 stations and PROFINET devices as a bulk operation independent of the TIA Portal. For example:

- Searching of the network and creation of a table showing the accessible devices in the network.
- Flashing of device LEDs or HMI displays to locate a device
- Downloading of addresses (IP, subnet, gateway) to a device
- Downloading of the PROFINET name (station name) to a device
- Resetting of devices to factory settings (resetting interface parameters)
- Downloading of a firmware update to a device

You can find the SIMATIC Automation Tool on the Internet (<https://support.industry.siemens.com/cs/ww/en/view/98161300>).

PRONETA

With SIEMENS PRONETA (PROFINET network analysis), you analyze the plant network during commissioning. PRONETA features two core functions:

- The topology overview independently scans PROFINET and all connected components.
- PRONETA also scans: configuration of the station name, IP subnet mask and identification and maintenance data (I&M1..3)

You can find SIEMENS PRONETA on the Internet (<https://support.industry.siemens.com/cs/ww/en/view/67460624>).

Description

2.1 System overview

The components described in this manual - motors, converters and associated connecting cables - are optimally matched to one another, thus allowing installation and commissioning in just a few steps. You perform commissioning as well as diagnostics with a PG/PC or notebook (commissioning device) using the TIA Portal (Hardware Support Package HSP0198 needed).

The SIMATIC MICRO-DRIVE drive systems are safety-related single-axis devices with integrated infeed in the protective extra low voltage range. They feature a compact design and a versatile and system-integrated range of applications.

SIMATIC MICRO-DRIVE drive system

The SIMATIC MICRO-DRIVE drive system is made up of the following coordinated components:

- PDC drive controller servo drive system
- Encoder systems (e.g. IQ encoder with electronic rating plate, Hall sensors, incremental encoder and SSI encoder)
- Motors (Dunkermotoren, ebmpapst) and connecting cables (Harting, KnorrTec) of proven product partners of Siemens as well as individual motors
- Integrated engineering system in the TIA Portal (as of V14 SP1 with Hardware Support Package HSP0198)
- TIA Selection Tool configuration management

The SIMATIC MICRO-DRIVE drive system is intended for use with a higher-level controller (CPU). The drive system is connected to the controller via PROFINET.

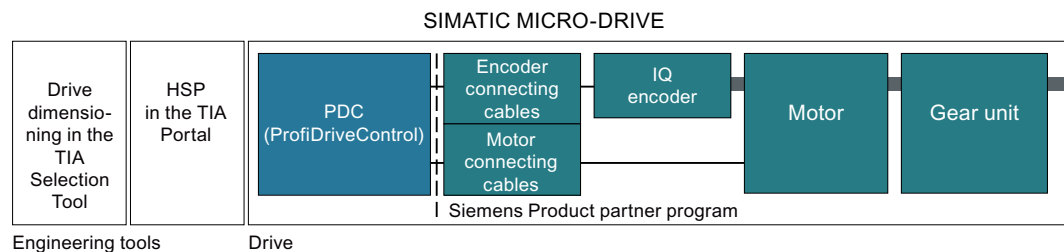


Figure 2-1 SIMATIC MICRO-DRIVE components

2.1 System overview

You can use the SIMATIC MICRO-DRIVE drive system with Siemens controllers.

- Standard CPU or F-CPU, e.g.:
 - S7-1500, S7-1500F (standard, F-, compact or technology CPU) CPU Firmware Version V1.8 or higher
 - PC-based controller SIMATIC S7-1500 (F) Software Controller
 - S7-1200, S7-1200F CPU Firmware Version V2.0 or higher
 - SIMATIC ET 200SP Distributed Controller
 - SIMATIC ET 200pro Distributed Controller

What is the PDC drive controller?

The PDC drive controller is a motor controller for three-phase motors (EC) with supply voltages to 48 V DC and permanent magnets. Various performance classes and fail-safe variants of the PDC drive controller are available (F: Functional Safety).

Specific PDC device versions support the connection of permanent magnet DC motors with mechanical commutator.

The device-specific information on the respective PDC device versions is available in the corresponding manuals.

The device profile for communication via PROFINET for motor control is PROFIdrive.

The PDC drive controller is integrated in the engineering system of STEP 7 (TIA Portal) via HSP0198. The integrated engineering system allows you to easily make use of the motion control functionality in the CPU.

Reference

Additional information can be found on the Internet for the following:

- SIMATIC MICRO-DRIVE (<https://support.industry.siemens.com/cs/ww/en/ps/25460>) drive system
- Siemens Product Partner Program (<https://new.siemens.com/global/en/company/topic-areas/partners/product-partners-industry.html>).

Standard variants of the PDC drive controller

The standard variants of the SIMATIC MICRO-DRIVE family support the "Hardware STO" (Safe Torque Off) safety function – safe torque off via onboard terminal (STO+ and STO-).

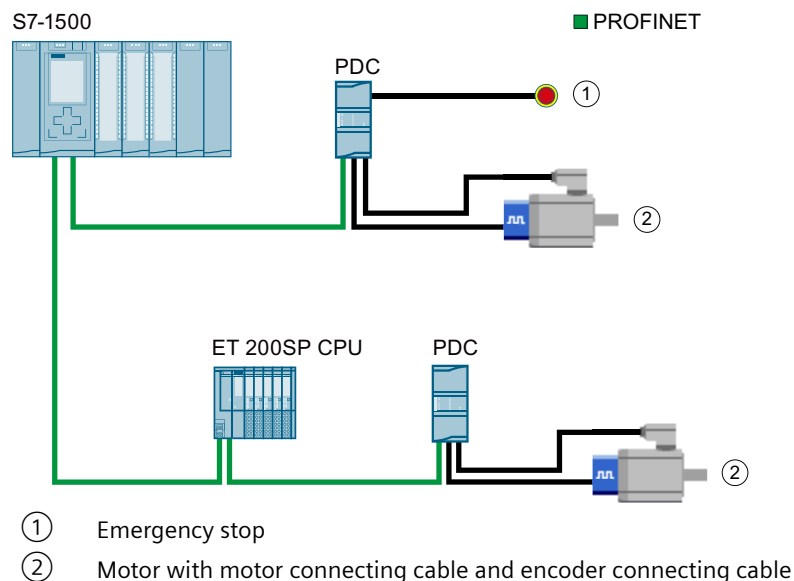


Figure 2-2 Overview: Standard variant with standard CPU (example)

Fail-safe variants of the PDC drive controller

Depending on the device version, the fail-safe PDC-"F" device versions of the SIMATIC MICRO-DRIVE family support the following drive-integrated safety functions.

- Stop functions "Hardware STO" (Safe Torque Off)
Safe torque off via onboard terminal (STO+ and STO-)
- Stop functions STO (Safe Torque Off)
Safe Torque Off, controllable via PROFIsafe
- Stop functions SS1 (Safe Stop 1)
Stop function according to Stop Category 1 (time-monitored), controllable via PROFIsafe
- Motion monitoring SSM (Safe Speed Monitor)
Safe Speed Monitor, controllable via PROFIsafe
- Motion monitoring SLS (Safely Limited Speed)
Safely Limited Speed, controllable via PROFIsafe
- Motion monitoring SLT (Safely Limited Torque)
Safely Limited Torque, controllable via PROFIsafe

Note

Some safety functions are only supported by specific PDC device versions. You can find information on this in the Equipment Manual of the respective PDC device version.

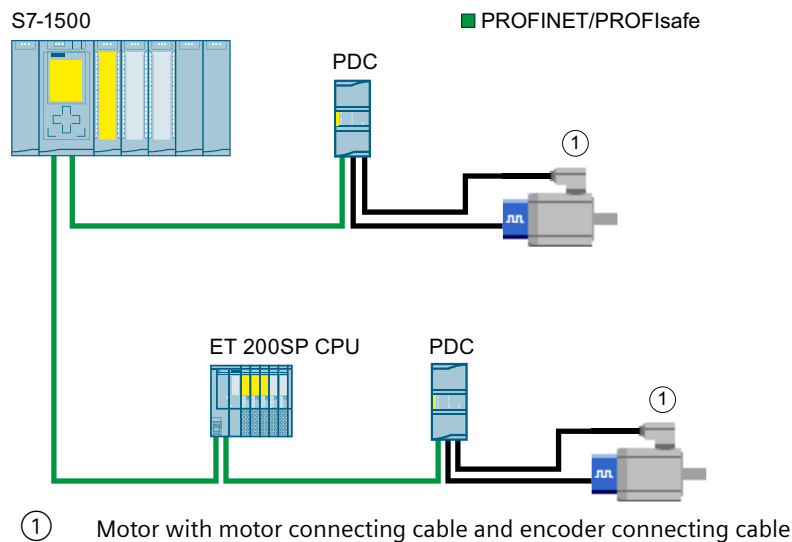


Figure 2-3 Overview: F-variant with F-CPU (example)

**WARNING****Personal injury and damage to property may occur.**

As a component of plants and systems, the PDC drive controller must observe specific standards and regulations depending on the application. Observe the applicable safety and accident prevention regulations such as IEC 60204-1 (general machine safety requirements).

The programming and operating manual SIMATIC Safety - Configuring and Programming (<https://support.industry.siemens.com/cs/ww/en/view/54110126>) provides information that enables you to configure and program fail-safe systems with SIMATIC Safety. In addition, you receive information about acceptance testing of a fail-safe SIMATIC Safety system.

Before you commission the fail-safe system, we urge you to read the current version of the manual SIMATIC Safety - Configuring and Programming (<https://support.industry.siemens.com/cs/ww/en/view/54110126>). The warnings and other information there must be observed, even if they are not repeated in this manual!

Failure to observe this information may result in serious injuries and damage to machinery and facilities.

2.2 Application range

Broad range of control applications

The SIMATIC MICRO-DRIVE drive system with the S7-1200(F)/S7-1500(F) automation system provides the required flexibility and performance for a wide range of control applications:

- Simple positioning tasks with S7-1200 and safety function "Hardware STO"
- Simple positioning tasks with S7-1200F and safety functions via PROFIsafe

- More complex positioning tasks with S7-1500 and safety function "Hardware STO"
- More complex positioning tasks with S7-1500F and safety functions via PROFIsafe

Areas of application

You can use the SIMATIC MICRO-DRIVE drive system in different industry sectors that require powerful positioning drives. SIMATIC MICRO-DRIVE has proven to be an ideal drive in numerous applications. The system excels in dynamic positioning tasks in production and manufacturing and in innovative application areas.

Examples of applications:

- Packaging machines
- Automatic assembly machines
- Metal forming machines
- Printing and labeling machines
- Winders/unwinders, e.g. in the textile, packing and printing industries and in electronics manufacturing
- Driving of shuttles for storage and retrieval machines and storage rack systems
- Automated guided vehicle systems (battery operation)
- Medical applications such as safe movement of MRI tables and exact automated alignment of ceiling-mounted X-ray devices.

2.3 Product overview

Properties of the PDC drive controller

Through the integration of numerous performance features, the PDC offers you good operability and the highest performance:

- Speed-controlled single-axis drive with PROFINET IRT connection and PROFIdrive profiles
- Motor voltage supply in the protective extra low voltage range (< DC 60 V) of 24 to 48 V DC
- Support of IQ encoder technology for easy commissioning using electronic rating plates and with motor temperature measurement
- Four discrete digital inputs and two discrete digital outputs directly on the drive
- Second encoder system for evaluating absolute encoders with SSI interface
- Support of individually configurable motors
- Automatic controller tuning and auto-tuning with measurement run
- Internal braking resistor (where applicable, depends on variant) which can be replaced by an external braking resistor if required
- Integrated ramp generator and thermal monitoring of motor, internal brake resistance (where applicable) and power output stage

2.3 Product overview

- Integrated energy recovery protection, which can be deactivated via the engineering system, thereby making the drive capable of energy recovery.
- Cyclic overload capability
- Service button and optional commercially available microSD memory card for series commissioning and for various maintenance activities, such as parameter backup and resetting to factory settings without engineering tool
- F-variants with PROFI-safe and Safety Integrated functions STO, SS1, SLS, SLT, SSM
- Easy control via motion control technology objects with position control in the higher-level CPU (central motion control)
- Integrated engineering in STEP 7 (TIA Portal) via Hardware Support Package HSP0198
- Support for commissioning through drive control panel, message buffer and trace function in the engineering tool

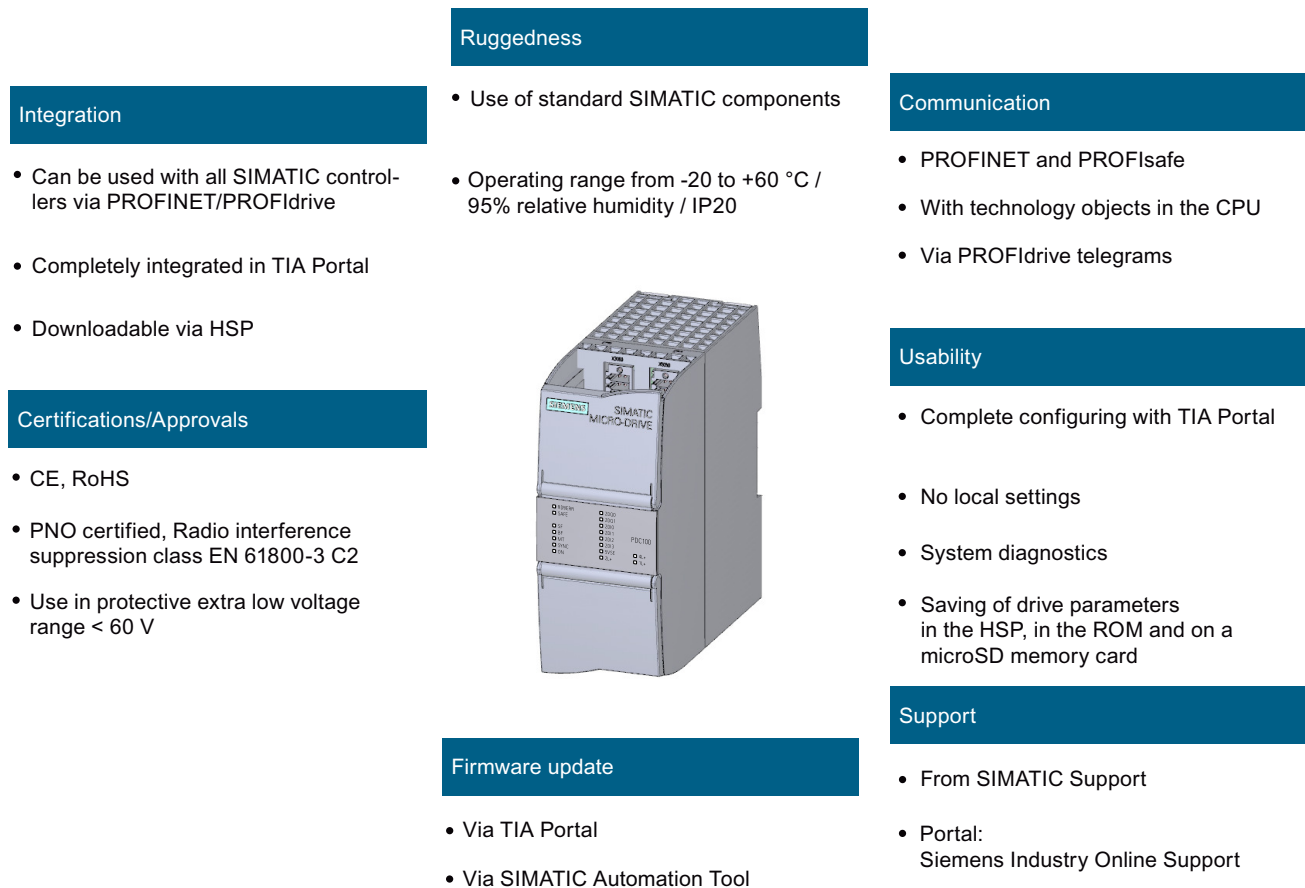


Figure 2-4 Properties and functions of PDC drive controller (example)

Achievable safety classes

You achieve the safety classes of the table below through the following:

- Appropriate parameter assignment of the safety functions in STEP 7
- Specific combination of fail-safe and non-fail-safe I/O modules
- Specific arrangement and wiring of the sensors and actuators

Table 2-1 Achievable safety classes in safety mode with PDC

Safety class in safety mode		
According to IEC 61508	According to ISO 13849-1	
SIL2	Category 3	(PL) Performance Level d

Supply voltage

Use in protective extra low voltage range < 42.4 V/60 V (SELV/PELV):

- Supply voltage:
 - 24 V DC for the logic unit (1L+, 2L+)
 - 24 V DC to 48 V DC for the power unit (4L+)
- Maximum voltage of the supplying power supplies under fault conditions:
 - < 42.4 V DC for the logic unit (1L+, 2L+)
 - < 60 V DC for the power unit (4L+)

You can find further information on the power supply in section Power supply (Page 29).

Installation

The PDC drive controller has IP20 degree of protection and is intended for use in a dry environment and installation in a control cabinet (IP54). For functional safety reasons, you must install the PDC with degree of protection IP54. The control cabinet must guarantee protection against electric shock and spread of fire.

Communication interface

The PDC drive controller has one PROFINET interface with two ports. You connect PROFINET IO to the PDC drive controller using RJ45 bus cable connectors.

User interface in the engineering system

The engineering system of a PDC drive controller is integrated in STEP 7 (TIA Portal). You install it with the Hardware Support Package HSP0198.

The graphic user interface supports you in the configuration, parameter assignment and commissioning of the Safety Integrated drive functions of the PDC:

- You select the PDC variant in the hardware catalog.
- You interconnect the PDC with a higher-level CPU and configure the communication via PROFINET IRT in the "Network view".
- You define the desired communication frames in the device configuration.
- You monitor the current status of the drive in "Online & diagnostics".
- You configure the drive and commission the Safety Integrated functions in the "Parameters" window.
- You move the drive with the drive control panel in the "Commissioning" window.
- You can configure, manage and save recordings in the "Traces" window.

You will find the HSP for download on the Siemens Industry Online Support website using keyword "Hardware Support Packages".

Motion control

The SIMATIC MICRO-DRIVE drive system operates with the standard Motion Control functions of the technology objects:

- Speed-controlled axis for controlling a drive with speed specification
- Positioning axis for positioning a drive with closed-loop position control
- Motion Control instructions based on PLCopen are available for programming the technology objects.
- Communication between technology objects (TOs) and drive takes place via PROFINET with PROFIdrive telegrams.

Technology objects

Technology objects are software objects in the CPU that represent the mechanical components and encapsulate the technological functionality.

You can find a detailed description of the use of Motion Control in the following:

- Function manual S7-1500 Motion Control in the TIA Portal (<https://support.industry.siemens.com/cs/ww/en/view/109481326>) or S7-1200 Motion Control in the TIA Portal (<https://support.industry.siemens.com/cs/ww/en/view/109741731>)
- Online help of STEP 7 under "Using technology functions > Motion Control (S7-1200, S7-1500)"

You use the configuring tool for the SIMATIC MICRO-DRIVE drive system in the TIA Selection Tool (<http://w3.siemens.com/mcms/topics/en/simatic/tia-selection-tool>) for selecting and sizing the axes.

See also

PROFIdrive (Page 25)

2.4 PROFIdrive

PROFIdrive application classes

PROFIdrive is the standardized standard profile for drive technology for the connection of drives and encoders via PROFINET IO. Drives and encoders that support the PROFIdrive profile are connected according to the PROFIdrive profile.

The SIMATIC MICRO-DRIVE drive system supports Application Classes 1 and 4 of the PROFIdrive profile as of V4.2.

- Class 1 (AC1)
The drive is controlled via a speed setpoint using PROFINET.
The closed-loop speed control takes place entirely in the drive.
Typical applications are, for example, simple frequency converters for pump and fan control.
- Class 4 (AC4)
This PROFIdrive application class defines a speed setpoint interface with the closed-loop speed control taking place in the drive and the closed-loop position control taking place in the CPU, as is required for robot and machine tool applications with coordinated motion sequences on multiple drives.
The motion control is implemented predominantly with a central numerical control (NC). The position control loop is closed via the bus, i.e. communication between the controller (CPU) and drive (PDC) must be isochronous.

CPU and drive/encoder communicate via various PROFIdrive telegrams. Each of the telegrams has a defined structure. You select the appropriate telegram according to the application. PROFIdrive telegrams transfer setpoints and actual values, control and status words and other parameters between the CPU and drive/encoder.

Note

PROFIdrive for drive technology is standardized and described in the following:

- PROFIdrive – Profile Drive Technology,
PROFIBUS User Organization e. V.
Haid-und-Neu-Straße 7, D-76131 Karlsruhe
PROFIBUS User Organization (<https://www.profibus.com>)
 - IEC 61800-7
-

2.5 PROFINET

PROFINET functions

In PROFINET IO mode, the PDC supports the following functionalities of conformance classes A, B and C (CC-A, CC-B, CC-C).

- PROFINET switch (2 x RJ45)
- Cyclic data exchange (RT)
- Isochronous data exchange (IRT)

- Acyclic parameter data (read/write record)
- Device diagnostics, alarms (alarm handling)
- Device identification (I&M0)
- Extended device identification (I&M1 to 4)
- Topology information (LLDP)
- Network diagnostics (SNMP)
- Port-specific statistics (PDEV)
- Automatic addressing (DCP)
- Media redundancy (MRP client)
- PROFI-safe
- Automatic telegram selection
- Shared device
- Device replacement without exchangeable medium

You can find information on "PROFINET Conformance Class C" in "PROFINET IO Conformance Classes, Guideline for PROFINET IO", Version 1.1 – dated March 2011. Order No.: 7.042.

You can find information on "Isochronous mode", "Media redundancy", "Device replacement without exchangeable medium" and "Shared device" in the PROFINET (<https://support.industry.siemens.com/cs/ww/en/view/49948856>) function manual.

You can use the Simple Network Management Protocol (SNMP) to support network diagnostics. The drive supports MIB-II for TCP/IP according to RFC1213.

Note

Communication protocols and used port numbers

The following port numbers are used with communication via the PROFINET interface:

- PROFINET Context Manager, port 34964 (UDP)
- SNMP (Simple Network Management Protocol), port 161 (UDP)
- ISO-on-TCP (according to RFC 1006), port 102 (TCP)

Use this information to match the security measures for protection of the system to the used protocols (for example, firewall).

Application planning

3.1 Shipping

NOTICE
Damage to the device The device can be damaged by inappropriate shipping. Transport the device, therefore, only in the original packaging. This will give it the necessary protection against shock and impact.

3.2 Storage

You must adhere to the storage conditions described in section Mechanical and climatic ambient conditions (Page 206) for storage of the PDC. If contamination, penetration of liquid, formation of condensation, damage and/or any other breach of the storage conditions occurs, commissioning is only permitted after agreement with Siemens AG on further measures.

3.3 Scope of delivery

Unpacking and checking the delivery

1. Unpack the device.
2. Make sure that the package is complete.
3. Check the device for transport damage by visual inspection.

Accessories for the PDC are not included in the scope of delivery. You can order (Page 283) accessories separately.

NOTICE
Damage to the system Damaged parts can result in damage to the system. Do not use any parts that show evidence of damage!

3.4 Installation location

The product is designed for use in an industrial environment and for indoor use only.

Note

Installation in control cabinet/device connection box

The PDC drive controller is intended for installation in a control cabinet or in a device connection box.

- In these cases, the LEDs on the front of the device will remain visible and usable only during commissioning. Please take this into consideration for subsequent operation of the device.
 - Note that installation in a control cabinet or device connection box is essential for compliance with regulations for electrical safety!
 - For functional safety reasons, you must install the PDC in a control cabinet with a degree of protection corresponding to the environmental conditions, but at least IP54.
 - The control cabinet/device connection box must guarantee protection against spread of fire.
 - Ensure that all cables and leads that protrude externally are equipped with adequate strain relief.
-

Also observe the installation guidelines in the S7-1200 (<https://support.industry.siemens.com/cs/ww/en/view/109741593>) and S7-1500/ET 200MP (<https://support.industry.siemens.com/cs/ww/en/view/59191792>) system manuals.

Electromagnetic compatibility (EMC)

NOTICE
Damage to the device Inadequately dimensioned overvoltage protection can result in severe damage to the device and loss of functional safety. Therefore, you must ensure sufficient overvoltage protection (see section Technical specifications (Page 201)). For this purpose, use the shield bracket set (see section Accessories/spare parts (Page 283)) or take comparable measures.

Reference

You can find further information on selection of the installation location, mounting position, minimum clearances, etc. in section Installation (Page 35).

3.5 Power supply

Supply voltage concept

The PDC provides the option of connecting the supply of the logic unit (low voltage) and the power unit separately.

Supply voltage of PDC

The PDC operates with 24 V DC nominal voltage for the logic unit and 24 to 48 V DC nominal voltage for the power unit.



WARNING

Maximum voltage under fault conditions of the supplying power supplies:

- 42.4 V DC for the logic unit (1L+, 2L+)
- 60 V DC for the power unit (4L+)

The supplying power supply must comply with the maximum voltages under fault conditions. Voltages above that may lead to malfunction of safety-relevant functions.

Damage to the device may occur at voltages above the specified supply voltages.

The supplying power supplies must also comply with the insulation requirements according to IEC 60364-4-41 SELV/PELV. The power supply must not be made up of two individual SELV power supplies connected in series.

Overvoltage category of the input power supply of the feeding power supply: II.

When PELV is used, the negative pole of the source must always be grounded. Grounding of the positive pole is never permitted.



WARNING

Use separate power supply units to supply the logic unit and the power unit or a filter between the shared power supply unit and the power supply.

Grounding of the SELV at the negative pole of the source in order to implement a PELV supply is permitted but not required. Interconnection of the ground of the logic supply 1M with the ground of the power supply 4M for the power unit is permitted. Please also observe the specifications regarding the fusing of the logic supply in the corresponding Equipment Manual.

NOTICE

The potential 4M is directly electrically connected to the potential 1M. The negative wires 1M and 4M must always be properly wired up to the source.

Logic supply voltages 1L+, 2L+

The logic supply voltages 1L+, 2L+ with associated ground potentials 1M, 2M are electrically isolated from one another.

Given the total current load of the wiring and the supplying power supply, you can connect the logic supply voltages in parallel.

If the power supply terminals 1L+, 2L+ (with 1M, 2M) on the PDC are used for through-wiring, the line protection on the installation side must be rated in such a way that the terminals are protected under short-circuit conditions.

If the STO-1VS and STO-1M terminals are used, this also corresponds to a through-wiring.

The following rated currents apply to the terminals:

- 12 A according to IEC 60664-1, IEC 61984:
- 9.5 A according to UL 1059

Power supply for the power unit

You must feed the power supply for the power unit via terminals 4L+ and 4M at the X5050 interface.

NOTICE

A two-pole miniature circuit breaker according to UL category DIVQ (UL 498) must be inserted in the 4L+ and 4M feed line. You can find the article numbers of the miniature circuit breakers to be used in section Accessories/spare parts (Page 283).
--

The miniature circuit breaker must be implemented with two poles even when using PELV.
--

In order for the DC link capacitors to be charged slowly when 4L+ is switched on, we recommend a primary-switched electronic power supply with current limitation. Only the required miniature circuit breaker has to be installed between the power supply and PDC, and not an operational switch.

NOTICE

The 4L+ input has no switch-on current limitation. Do not connect the terminals while live. This must also be observed for any upstream switching devices or miniature circuit breakers.
--

If, for operational reasons, the supply of 4L+ must be switched, we recommend implementing a pre-charging input circuit on the installation side. After pre-charging is finished, the pre-charging resistor must be bypassed by a suitable circuit before normal operation is started.

Note

Ensure that the voltage 4L+ is constantly available for at least 2s before you switch on the motor output stage. Otherwise, this may result in the alarm message F61055 Bit 2 (HW short-circuit identification).

**WARNING****Operation above the voltage setting range**

Under the given application conditions, ensure that the motor is not operated above the voltage setting range by selecting the appropriate motor and gear unit; otherwise, the DC-link voltage can increase above 60 V DC with inactive control.

References

Note the device-specific information on the characteristic values and the general information on dimensioning the power supply in the manual of the respective PDC device version.

For battery operation, observe the information in section Battery operation (Page 32).

See also

Power supply (Page 29)

Energy recovery (Page 144)

Supply of 5 V rotary encoders (encoders, Hall sensors)

The PDC provides a short-circuit-proof 5 V DC supply with 150 mA. You can use this to supply 5 V rotary encoders.

This sensor supply (5VSE, 5VSH) has the potential of the sensor inputs 5M and is supplied electrically isolated from 1L+.

Note

The rotary encoder supply at terminals 5VSE, 5VSH complies with the electrical safety requirements of the following standards:

- EN 61010-1 Section 9.4 Limited-energy circuit
- UL 61800-5-1 DVC.1.5 Limited voltage/current circuit requirements (LVLC)

NOTICE

The potential 5M must not be connected to other potentials (FE, PE or other supplies). It is used exclusively for connecting the encoder and Hall sensor.

Supply of an SSI encoder

For the supply of an SSI encoder, the supply of the logic unit of the PDC (nominal voltage of 24 V DC) is looped through and connected to terminals 1VS+ und 1VS- via a protective and noise suppression circuit.

The output voltage between terminals 1VS+ and 1VS- is approximately 1L+ - 1.2 V.

The maximum current consumption of the SSI sensor must not exceed 200 mA.

Note

The SSI sensor supply at terminals 1VS+, 1VS- complies with the electrical safety requirements of the following standards:

- EN 61010-1 Section 9.4 Limited-energy circuit
- UL 61800-5-1 DVC.1.5 Limited voltage/current circuit requirements (LVLC)

NOTICE

The external SSI sensor must always be supplied with the designated terminal 1VS+ and 1VS- of PDC. This also applies to the ground cable. Meshing with other potentials is not permitted!

See also

Energy recovery (Page 144)

Accessories/spare parts (Page 283)

3.6 Battery operation

For battery operation, we recommend that energy recovery be permitted in order to avoid possible operational disturbances.

Use the engineering tool to configure energy recovery for the drive. It is essential that you observe the information on recovery in section Energy recovery (Page 144).

Operating conditions of power unit

When energy recovery is permitted, the monitoring of the DC link voltage is suppressed in the drive. When energy recovery is activated, the supply voltage of the 4L+ power unit can therefore also be above the specified value.

In this case, use a suitable bi-directional supply to ensure that the voltage at 4L+ (power unit) does not exceed 60 V DC even under fault conditions. Use suitable external voltage monitoring (e.g. via a battery management system).

Operating conditions of logic unit

With battery operation, ensure that the requirements on the supply voltage of the logic unit (1L+ and 2L+) are met as described in section Power supply (Page 29).

Braking resistor

When energy recovery is permitted, the control of the internal and external braking resistance is deactivated by the drive.

Inrush current

With battery operation, take suitable measures to allow the DC link capacitors to be charged slowly when 4L+ is switched on.

Charging voltage

The max. charging voltage is typically defined by a setting on the battery management system. You need to ensure that the no-load voltage of the battery, i.e. the maximum battery voltage, adheres to the specified limit ranges.

Battery management system

Some battery management systems require a changeover time between charging and discharging. To ensure that the energy recovered during this time does not result in an impermissible increase of the infeed voltage, we recommend providing a suitable brake chopper on the battery management system. A brake chopper is also necessary if a completely charged battery can no longer take in recovered brake energy.

Installation

4.1 Basics

WARNING

Hazardous Voltage Can Cause Death, Serious Injury, or Property Damage.

Hazardous electrical voltage can cause electric shock, burns and property damage.

Disconnect your system and devices from the power supply before starting any installation work.

The PDC drive controllers are open equipment. This means they may only be installed in enclosures, cabinets or electrical equipment rooms. The enclosures, cabinets and electrical equipment rooms must guarantee protection against electric shock and spread of fire. The requirements regarding mechanical strength must also be observed. The enclosures, cabinets, and electrical equipment rooms must only be accessible with a key or tool. Access must only be possible for personnel instructed or authorized to work with such equipment.

Choose a dry environment for the PDC drive controller for the installation. SELV/PELV circuits are meant to provide protection from electric shock in dry environments.

The installation must provide the required mechanical strength, fire class and stability according the applicable electrotechnical and building regulations for open equipment in your specific location category.

NOTICE

Damage due to overheating

You must comply with the instructions regarding the Installation location (Page 28) and mounting position. Otherwise the device may malfunction or incur permanent damage as a result of overheating.

Contamination of conductive parts by dust, moisture and air pollution can lead to operational errors and electrical faults in the PDC.

WARNING

Protection from conductive contamination

Taking into consideration the environmental conditions, the devices must be protected from conductive contamination.

For functional safety reasons, you must install the PDC in a control cabinet with a degree of protection corresponding to the environmental conditions, but at least IP54!

Mounting position

You can mount a PDC drive controller on a standard mounting rail or directly in a control panel. The PDC can be mounted horizontally or vertically. The compact size allows efficient space utilization.

You can use the PDC drive controller as follows:

- In horizontal and vertical mounting position in ambient temperatures from -20 °C to +60 °C

**CAUTION**

Note the information on derating as a function of environmental conditions (e.g. temperature, mounting position) in the manual of the respective PDC device version.

More information can be found in section Mechanical and climatic ambient conditions (Page 206).

4.2 Installation rules

Heat, high voltage and electrical interferences

General rule for arranging devices in your system: Keep devices that generate high voltage or high electrical interferences away from low-voltage electronic devices such as the PDC drive controller.

Take into account heat-generating devices and arrange the electronic devices in the cooler parts of your control cabinet. The less an electronic device is exposed to high-temperature environments, the longer its service life will be.

Also take into account the manner in which you install the wiring of the devices in the control panel. Do not install the low-voltage signal lines and communication cables in the same cable run as AC supply lines and fast-switching DC power lines.

Clearance for cooling and wiring

The PDC drive controllers are designed for natural heat dissipation by convection. To guarantee the heat dissipation, keep at least 50 mm space free all around the device. The PDCs can be arranged in series with horizontal and with vertical installation of the mounting rail. Therefore, 50 mm clearance must be allowed below the bottom PDC and above the top PDC. With installation on a vertical DIN rail, a clearance of 50 mm must be observed on the right and the left. Also make sure that a depth of at least 50 mm remains clear between the front of the PDC and the inner surface of the enclosure.

**CAUTION**

Note the information on derating as a function of environmental conditions (e.g. temperature, mounting position) in the manual of the respective PDC device version.

Leave sufficient space for the wiring and communication cable connections.

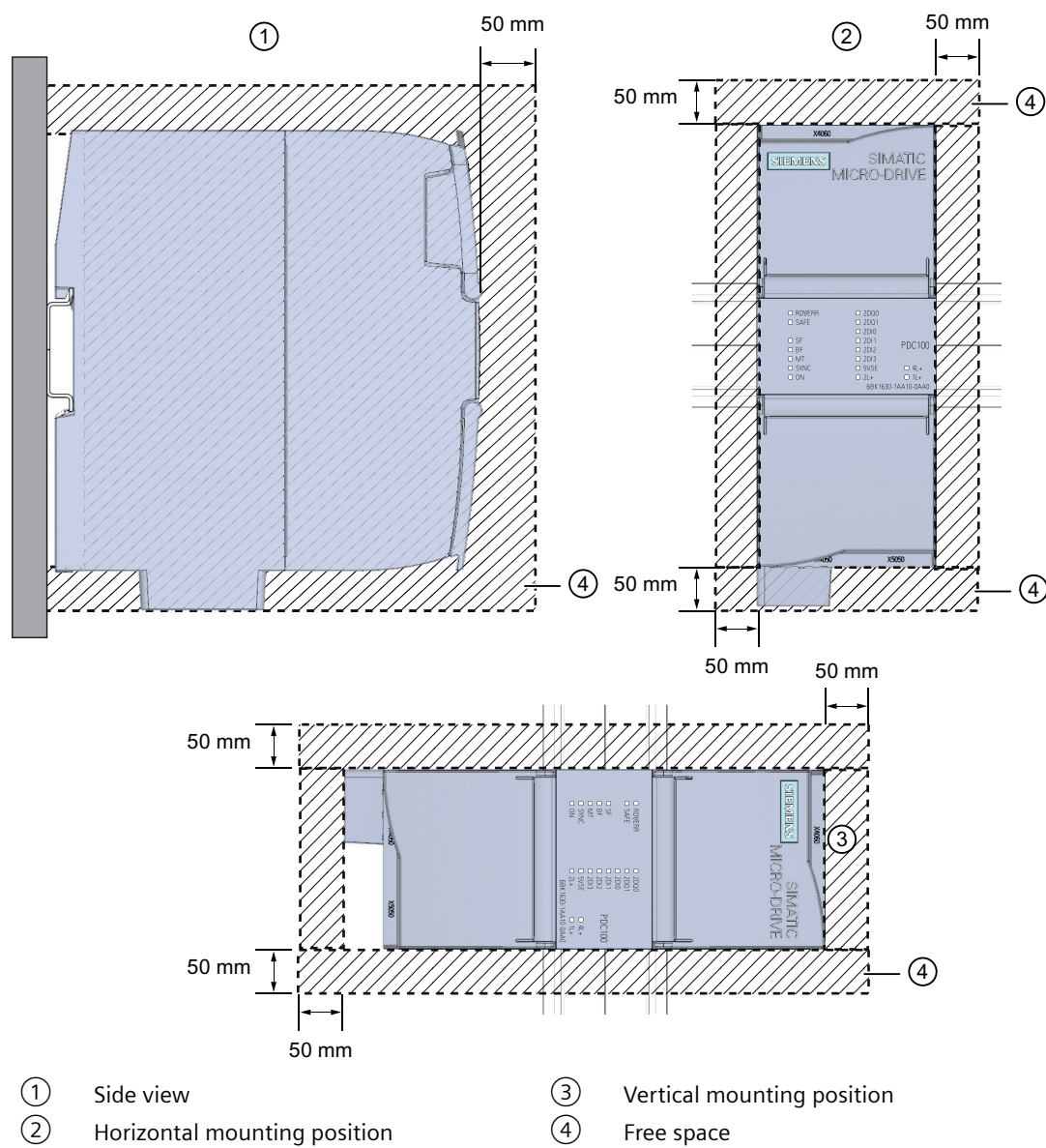


Figure 4-1 Mounting positions on 35 mm standard mounting rail, minimum clearances (example)

Installation and removal of the PDC drive controller

Before you install or remove a PDC, you must ensure that the voltage supply of the device is switched off. Also ensure that all connected devices are switched off. If there is a second power supply for the motor, it must also be switched off.



WARNING

Dangerous voltage

If you install or remove a PDC drive controller or devices connected to it while in switched-on state, you may suffer an electric shock or the devices may operate unexpectedly.

Take all necessary safety precautions. Make certain that the voltage supplies are switched off before installing or removing a device.

NOTICE

Property damage from insertion or removal of connectors under voltage

Switch off the supply before you install or remove the PDC.

4.3 Installing the PDC in a control cabinet

4.3.1 Installing the PDC on a mounting rail

Mounting on a standard mounting rail

You mount the PDC drive controller easily on a standard mounting rail (35 mm). The profile rail interlock is integrated in the PDC for mounting the device on the mounting rail.

Requirement

Before you install or remove an electrical device, you must ensure that the voltage supply of the devices is switched off. Also ensure that all connected devices are switched off.

Observe the rules and warnings in section Installation rules (Page 36).

Installing the mounting rail

Install the mounting rail in such a way that sufficient space remains for installation and removal and heat dissipation of the modules. Refer to section Installation rules (Page 36).

Screw the mounting rail onto the mounting surface.

Installing the PDC drive controller on a mounting rail

1. Hook the tabs on the back of the PDC onto the top of the mounting rail.

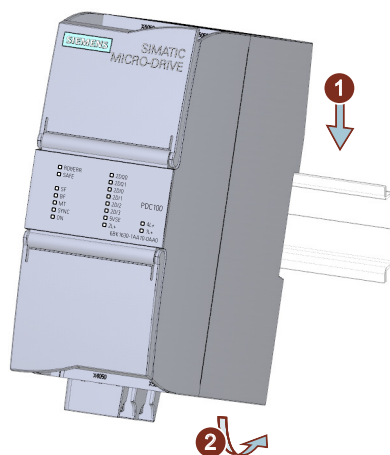


Figure 4-2 Mounting rail installation (example)

2. Pivot the PDC rearward until the mounting rail locking mechanism engages and the PDC is firmly seated on the rail.

4.3.2 Installing the PDC on a mounting plate

Mounting on a mounting plate

As an alternative to mounting on a mounting rail, you can mount a PDC drive controller directly on a mounting plate.

Install the PDC drive controller in such a way that sufficient space remains for installation and heat dissipation of any other devices. Refer to section Installation rules (Page 36).

Requirement

Before you install or remove an electrical device, you must ensure that the voltage supply of the devices is switched off. Also ensure that all connected devices are switched off.

Observe the rules and warnings in section Installation rules (Page 36).

Mounting the PDC drive controller on a mounting plate

1. Drill the required holes (M4).
2. Pull out the mounting rail locking mechanism(s) (depending on the device version) at the bottom on the back of the PDC.

4.3 Installing the PDC in a control cabinet

3. Pull out the mounting tabs at the top of the back of the PDC and reinsert them upside down.

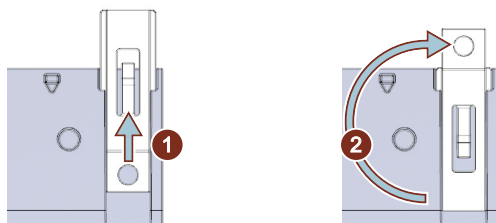
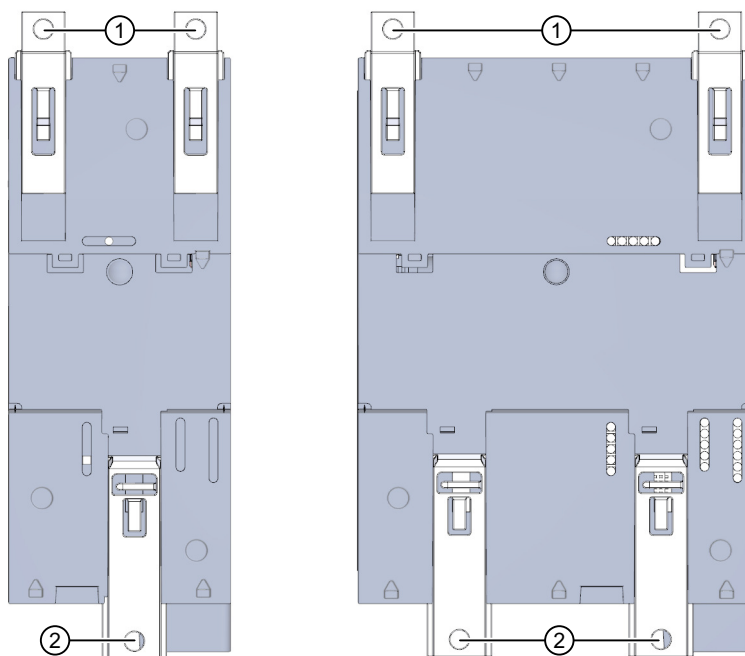


Figure 4-3 Wall mounting of PDC

4. Screw the PDC to the mounting plate with screws.



- ① Holes for wall mounting
- ② Mounting rail locking mechanism(s)

Figure 4-4 Control panel installation (examples)

4.4 Removing the PDC

Requirement

The PDC is wired.

NOTICE

Property damage may occur

If you install or remove a PDC drive controller while the voltage is switched on, this can lead to undefined states in your plant.

The PDC may be damaged as a result.

Therefore, only install/remove PDC drive controllers when the voltage is switched off.

When configuring a system, always comply with the requisite relevant standards and safety guidelines.

Removing the PDC drive controller

To remove the PDC, follow these steps:

1. Switch off all fed supply voltages.
2. Unplug the connectors for the supply voltages.
3. Unscrew the PROFINET bus cable connector(s), using a screwdriver if necessary.
4. Remove the PROFINET bus cable connector(s) from the PDC.
5. Disconnect and remove the plug connectors from the PDC.
6. Swing the PDC off of the mounting rail.

4.5 Mounting the shield bracket

Shield bracket set for the PDC drive controller

The shield bracket set is used for EMC-compliant connection of signal, encoder and power cables to the PDC.

The set contains shield brackets, terminal clamps and hardware installation instructions (compact). It can be ordered as an accessory (Page 283).

- Shield bracket at top: Grounding of the cable shield for Hardware STO, SSI encoder, digital inputs and outputs (e.g. motor brake), power supply units
- Shield bracket at bottom: Grounding of the cable shields for the motor cable, encoder and Hall sensor cable and, if applicable, for the PROFINET cable
- Flexible HF grounding strap for installation between PDC grounding screw and shield bracket

Note

Do not use the terminal clamps as strain relief!

Procedure

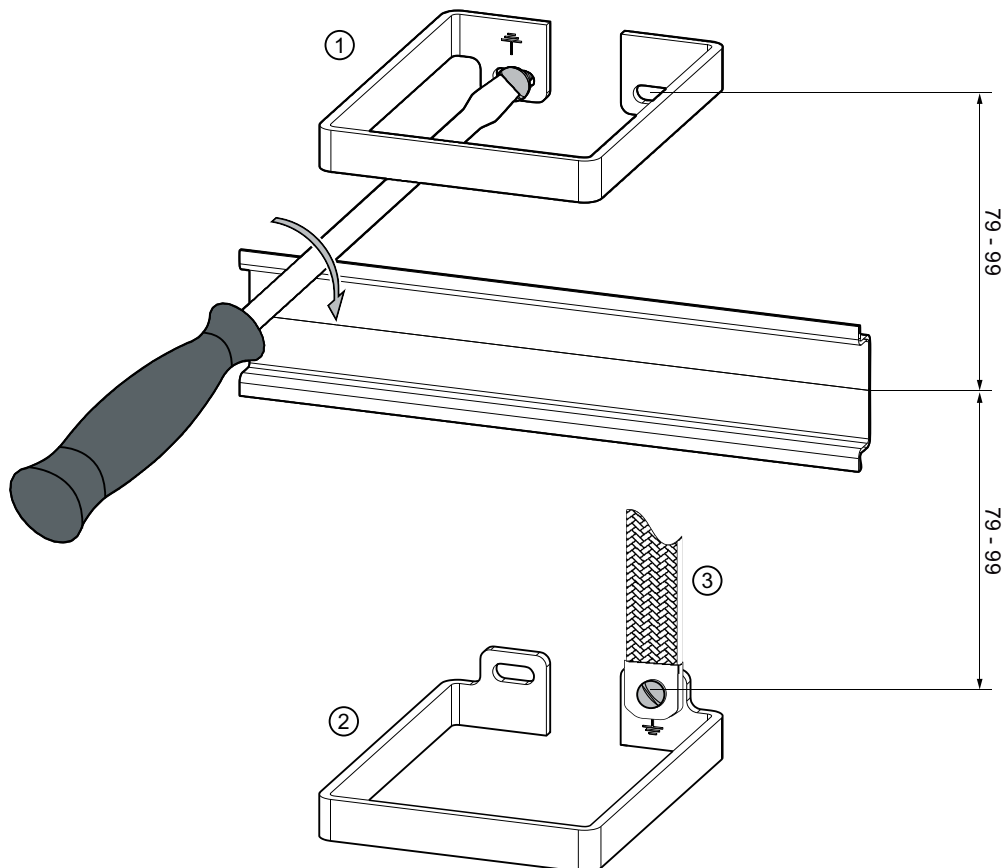
1. Screw the shield brackets to the mounting plate above and below the mounting rail. Take suitable measures to ensure a continuous, low-impedance connection of the shield bracket to the grounded mounting plate.

Note

You need two shield bracket sets.

Observe the permitted clearances between the PDC and shield bracket:

- Minimum clearance: 30 mm
- Maximum clearance: 50 mm



- ① Shield bracket at top for terminal clamp for Hardware STO, SSI encoder, digital inputs and outputs (e.g. motor brake), power supply units
- ② Shield bracket at bottom for clamp terminal for motor cable, encoder and Hall sensor cable
- ③ Grounding strap

Figure 4-5 Mounting the shield bracket

See also

Connecting the cable shield (Page 47)

Connecting to functional ground (Page 50)

4.5 Mounting the shield bracket

Connecting

5.1 Rules and regulations for operation

Specific application

Follow the safety and accident prevention regulations applicable to specific applications, e.g. Machinery Directive.

Emergency off devices

Emergency off devices pursuant to IEC 60204 (corresponds to DIN VDE 0113) must remain effective in all operating modes of the plant or system.

Excluding hazardous plant states

Hazardous operating states must not occur when

- The plant restarts up after a voltage dip or voltage failure
- Bus communication resumes after a disruption

If necessary, the emergency off must be forced.

An uncontrolled or undefined startup must not occur after the emergency off device is unlocked.



WARNING

Be sure to observe the voltage supply specifications in section Power supply (Page 29)!

Protection from external electrical effects

Below is a description of what you must consider for protection against electrical influences and/or faults:

- For all systems with an SIMATIC S7-1500 or SIMATIC S7-1200 automation system, ensure that the system is connected to a protective conductor with sufficient cross section for discharge of electromagnetic interferences.
- For supply, signal and bus cables, you must ensure that the cables are correctly routed and installed.
- For signal and bus cables, you must ensure that a wire/strand break or a cross-circuit does not lead to undefined states of the plant or system.
- You can find further information on interference-proof design in function manual Designing interference-free controllers (<https://support.industry.siemens.com/cs/ww/en/view/59193566>).

DC motors

Please note: DC motors are only supported by specific PDC device versions. You can find information on this in the manual of the respective PDC device version.

Permanent-magnet DC motors with mechanical commutator generally only have one incremental encoder for speed determination. In contrast to permanent-magnet three-phase EC motors, with DC motors, faults in the motor encoder system or interchanged motors phases with the PDC motor controller can still lead to rotating of the motor at this time (permanently exceeding the set speed limiting or wrong direction of rotation).

When planning and commissioning a plant with DC motors, you must take this behavior into consideration.

Overload

The PDC drive controllers are overloadable. The overload is cyclically permitted, with an overload duration of 3 s followed by a recovery time of 17 s. During operation with cyclic overload, the time-averaged power (rms) must not exceed the rated current. The drive has an overload protection (Page 144).

Derating

Note the information on derating as a function of environmental conditions (e.g. temperature, mounting position) in the manual of the respective PDC device version.

5.2 Connecting the supply voltages

Overview

You connect the 24 V DC supply voltage for the PDC logic unit and the inputs/outputs to terminal connectors X5060 (1L+ and 1M) and X4060 (2L+ and 2M).

Pins 3/4 (2L+) and Pins 1/2 (2M) of interface X4060 are electrically connected to one another. If you connect the supply voltage to Pin 3 (2L+) and Pin 1 (2M), you can use terminals 4 (2L+) and 2 (2M) to loop through the potential to Pins 3 (1L+) and 1 (1M) of interface X5060.

You connect the 24 V DC to 48 V DC supply voltage for the power unit to connector X5050 (4L+ and 4M).

Requirements

- Only wire the connection plug when the supply voltage is turned off.
- Observe the Rules and regulations for operation (Page 45).
- Observe the rules and regulations described in section Power supply (Page 29).
- Observe the information on terminal assignment and wiring rules for the interfaces in the manual of the respective PDC device version.

5.3 Connecting the PROFINET interface

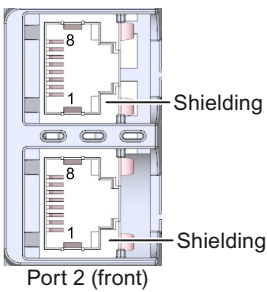
PROFINET IO with RJ45

You connect the PDC to the PROFINET network with a standard RJ45 socket.

The PDC provides two PROFINET ports on the bottom of the housing.

- On Port 1 the signals are connected with crossover (assignment corresponds to switch assignment, MDI-X).
- On Port 2 the signals are connected straight-through (assignment corresponds to the standard for terminal devices, MDI).

Table 5-1 Pin assignment for PROFINET IO with RJ45

View	Signal name		Type	Designation
 Port 1 (rear) Port 2 (front) Shielding Shielding Connection of PROFINET IO with RJ45	PROFINET Port 1 (X2050)			
	1	RXP	O	Receive Data +
	2	RXN	O	Receive Data -
	3	TXP	I	Transmit Data +
	4	TERM		Ground
	5	TERM		Ground
	6	TXN	I	Transmit Data -
	7	TERM		Ground
	8	TERM		Ground
	PROFINET Port 2 (X2060)			
	1	TXP	O	Transmit Data +
	2	TXN	O	Transmit Data -
	3	RXP	I	Receive Data +
	4	TERM		Ground
	5	TERM		Ground
	6	RXN	I	Receive Data -
	7	TERM		Ground
	8	TERM		Ground

5.4 Connecting the cable shield

Overview

You must connect the following process signals of the PDC drive controller using shielded cables:

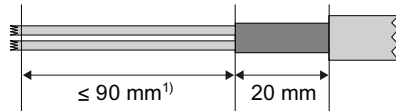
- Encoder signals
- Hall sensor signals
- Process signals and power supply units

To do this, apply the shields of the cables to the upper and lower shield bracket with the help of the terminal clamps. The shield bracket set can be ordered as an accessory (see section Accessories/spare parts (Page 283)).

Procedure

Proceed as follows:

1. Strip the cable.



- ① Length depends on the distance between the shield bracket and device

Figure 5-1 Stripping the cable

2. Press the terminal clamps onto the protective braided shield of the cable.

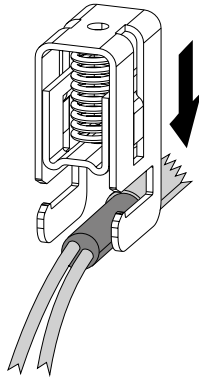


Figure 5-2 Pressing the terminal clamps onto the protective braided shield.

3. Slide the terminal clamps with cable onto the shield bracket.

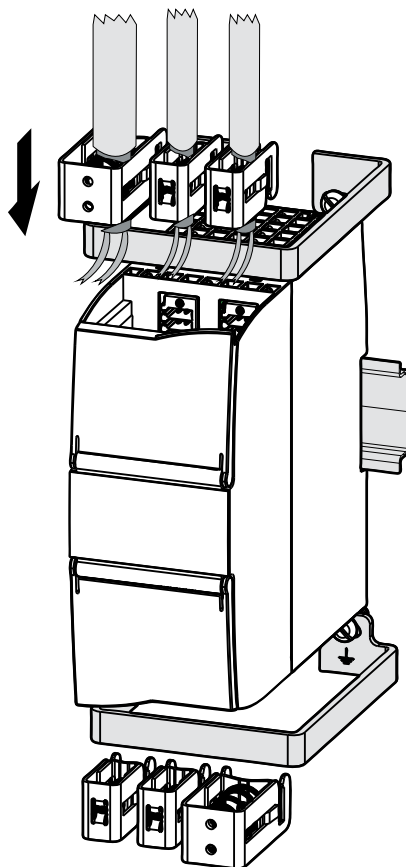


Figure 5-3 Sliding the terminal clamps with cable onto the shield bracket (schematic representation)

4. The result should look like this:

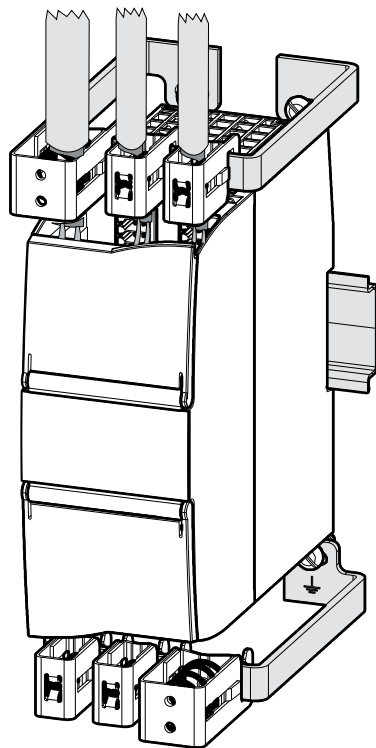


Figure 5-4 Connected cable shield (schematic representation)

Configuration with several PDC drive controllers

If you use more than one PDC drive controller in your configuration, an equivalent grounding of the cable shields, e.g. via a ground bus, is also permitted.

5.5 Connecting to functional ground

Requirements

- The mounting plate must not be painted in the contact area of the shield bracket and must be connected to the cabinet ground with low-impedance.
- The conductor cross-section must be 4 mm² (AWG11).
- Ensure that the functional grounding conductor is as short as possible (≤ 10 cm).

Procedure

Connect all terminals with the symbol  to the screw connections of the shield brackets.

Use the grounding strap for the connection of the functional ground of the PDC (available for order as accessories/spare parts (Page 283)).

1. Screw the grounding strap to the ground connection provided for this purpose on the bottom of the housing.
2. Attach the other end of the grounding strap to ground, e.g. to the shield bracket or housing.

5.6 Connecting the motor

Overview

You can connect permanent-magnet three-phase motors (EC) with suitable sensors to the PDC drive controller.

Specific PDC device versions support the connection of permanent magnet DC motors with mechanical commutator.



WARNING

Operation above the voltage setting range

Under the given application conditions, ensure that the motor is not operated above the voltage setting range by selecting the appropriate motor and gear unit; otherwise, the DC-link voltage can increase above 60 V DC with inactive control.

Reference

Connection diagrams for the connection of the motor phases and the power supply for the power unit as well as the associated pin assignment of the interface can be found in the manual of the respective PDC device version.

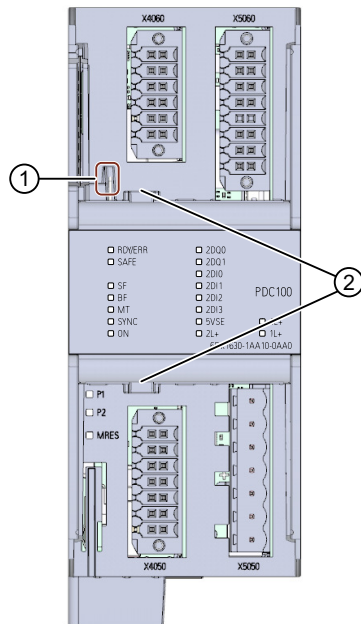
5.7 Removing/inserting microSD memory card

Introduction

The PDC supports commercially available microSD memory cards. Before using the microSD memory card, delete all previously stored data if necessary.

Slot for the microSD memory card

The slot for the microSD memory card is located behind the upper front cover of the PDC, to the left of the wiring duct for connection cables.



- ① Slot for microSD memory card (with inserted memory card)
- ② Wiring duct for connection cables

Figure 5-5 Position of the slot for the microSD memory card (example)

Inserting the microSD memory card

To insert a microSD memory card, follow these steps:

1. Open the upper front cover of the PDC.
2. Insert the microSD memory card into the slot for the memory card. In so doing, ensure that the contacts of the memory card are positioned at the bottom left.
3. Gently press the microSD memory card into the PDC as far as it will go.

Removing the microSD memory card

To remove a microSD memory card, follow these steps:

1. Open the upper front cover of the PDC.
2. Remove the microSD memory card.

5.8 Connecting the digital inputs/outputs

Electrical properties

Electrical properties of the digital inputs

The PDC drive controllers have four discrete digital inputs with a shared reference potential 2M.

The inputs are designed according to EN 61131-2 Type 1. The rated voltage is 24 V DC and the limiting frequency is at least 100 Hz.

Electrical properties of the digital outputs

The PDC drive controllers have two discrete digital outputs that have a shared ground (2M) with the discrete digital inputs.

The digital outputs are designed for a rated voltage of 24 V DC. The rated current according to EN 61131-2 is 1 A DC, current-sourcing type.

The outputs surpass the requirements of EN 61131-2 regarding leakage current. The leakage current is < 0.5 mA. The outputs are thus also compatible with Type 1 inputs.

The digital outputs can switch both resistive loads and inductive loads. The maximum permissible inductance depends on the number of starting operations

Table 5-2 Load and number of starting operations

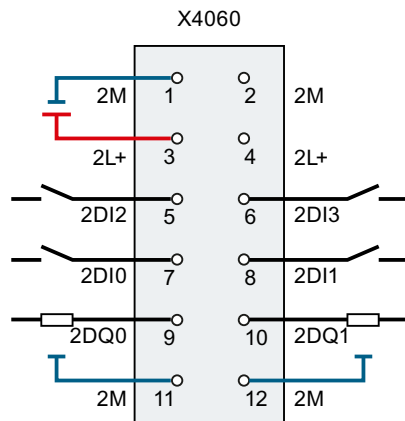
Type of load	f[Hz] max.
Resistive load	100
Inductive load ≤ 3 mH	100
Inductive load ≤ 30 mH	10
Inductive load ≤ 300 mH	1
Inductive load > 300 mH	Not permitted

Connection for digital inputs/outputs

Inputs DI0, DI1, DI2, DI3

You can use these inputs freely, e.g. as end stops or reference switches.

Connecting of the digital inputs/outputs



2M Reference potential of supply of DI/DQ

2L+ Supply of DI/DQ

2DIx Digital inputs

2DQx Digital outputs

Figure 5-6 Connection of digital inputs/outputs

The logic supply voltages 1L+, 2L+ with associated ground potentials 1M, 2M are electrically isolated from one another. However, they can be connected in parallel (the total current-carrying capacity of the wiring and the supplying power supply required).

Derating

Note the information on the permissible coincidence factors of the inputs/outputs and the corresponding deratings as a function of environmental conditions (e.g. temperature, mounting position) in the manual of the respective PDC device version.

5.9 Connecting an encoder

5.9.1 Connecting an incremental encoder

Incremental encoder

The incremental encoders and IQ encoders are used for closed-loop speed control of the drive.

The PDC drive controllers have inputs for connecting an encoder with differential inputs A+, A-, B+, B-, Z+ and Z-.

Differential signals with RS422 level (A&nA, B&nB) are supported as are discrete signals (A, B). The Z track is not evaluated by the drive firmware.

The inputs function for 5 V level.

The maximum detectable frequency of the encoder per channel (A and B shifted 90°) is 200 kHz. The encoder signal is evaluated using the hardware quadrature interface of the PDC. These are two rectangular signals ("A" and "B") which show a phase offset of 90° to each other. The direction of rotation can be clearly assigned at the state changes of the signals. The following four states repeat cyclically in a direction of rotation: HL, HH, LH, LL.

Legend:

- HL: "A" = High level, "B" = Low level
- HH: "A" = High level, "B" = High level
- LH: "A" = Low level, "B" = High level
- LL: "A" = Low level, "B" = Low level

These states change through an edge at one of the signals "A" or "B". For example, 100 pulses per revolution (p0408) results in 400 edges per revolution.



WARNING

An interruption or short-circuit of the Hall and AB sensor inputs at terminal X4050 can mean that the reference to the motor rotor angle is lost. Because this cannot be clearly detected and assigned by the PDC drive controller, we recommend restarting the PDC drive controller after changes to the motor encoder system (e.g. pulling/plugging of terminal X4050) and after a fault is resolved at the sensor inputs. The loss of the rotary angle relation can result in the following faults:

- F61009 "Motor blocked"
- F64640 "SI speed"

If a fault was clearly detected in the motor encoder system F61056 (A) "Motor encoder", the relation to the rotary angle of the motor is automatically restored by the PDC drive controller.

Requirements

- For reasons of interference immunity, we recommend that only encoders with differential outputs be used.
- However, single-ended encoders are also possible in principle, if they contain a push-pull output stage.
- Please note: The use of open collector outputs is not permitted.

Connecting IQ encoders

Motors from the SIMATIC MICRO-DRIVE Product Partner Program have an IQ encoder that provides the respective motor, gearbox and rotary encoder parameters (electronic rating plate).

5.9 Connecting an encoder

You connect the IQ encoder interface to the PDC connection for incremental encoder/Hall sensor using connecting cables.

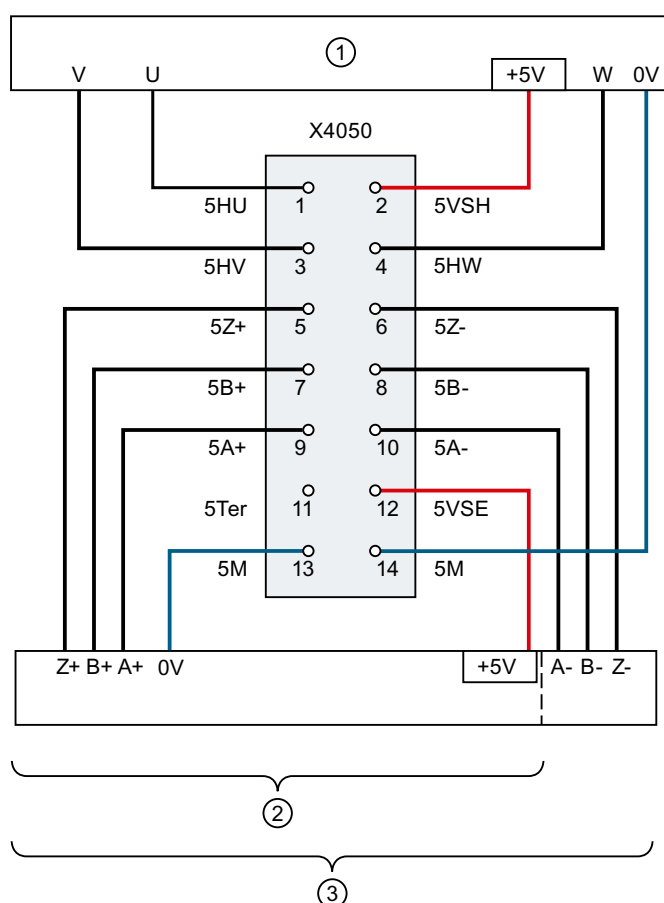
Note

The IQ encoder has an integrated wire test that arranges for all four possible states of the A/B signals to occur at least once every 25 ms. For a stalled or slowly rotating motor, additional pulses are generated to achieve these states. The logic integrated in the IQ encoder ensures that these pulses add up to zero in order to prevent falsification of the position. If the required A/B states are not detected every 25 ms, fault F61056 is reported.

Connecting of Hall sensor and incremental encoder

The figure below shows the connection of a Hall sensor and an incremental encoder to encoder interface X4050.

For information on Hall sensors, see section Connecting a Hall sensor (Page 58).



①	Hall sensor	5M	Reference potential of sensor supply
②	Incremental encoder with single-ended signals (informative)	5VSH	Supply voltage of 5 V Hall sensor
③	Incremental encoder with differential signals (recommended)	5HU, 5HV, 5HW	Hall signals U, V, W
		5VSE	Supply voltage of 5 V incremental encoder
5Ter	Not used	5A+/5A-, 5B+/5B-, 5Z+/5Z-	Discrete/differential incremental encoder signals

Figure 5-7 Connection of Hall sensor/incremental encoder

The logic supply voltages 1L+, 2L+ with associated ground potentials 1M, 2M are electrically isolated from 5M.

Note

Do not connect the signals present at X4050 and voltages at potential 5M to other signals or potentials.

5.9.2 Connecting a Hall sensor

Hall sensor

The PDC drive controllers have inputs for connecting a Hall sensor to the Hall_U, Hall_V and Hall_W signals. Only single-ended signals are supported.

The inputs function for 5 V level. Both sensor-side push-pull outputs and open collector outputs are supported. The maximum detectable frequency is 1 kHz.

Connecting the Hall sensor

For connection diagram, see Figure 5-7 Connection of Hall sensor/incremental encoder (Page 57).

The logic supply voltages 1L+, 2L+ with associated ground potentials 1M, 2M are electrically isolated from 5M and must not be connected with one another.

See also

Connecting an incremental encoder (Page 54)

5.9.3 Connecting an SSI encoder

SSI absolute encoder

Both the signal output CLK and signal input DAT are differential signals (RS422).

For the supply of the SSI encoder, the supply of the logic unit of the PDC (nominal voltage of 24 V DC) is looped through and connected to terminals 1VS+ und 1VS- via a protective and noise suppression circuit.

Connecting the SSI encoder

The figure below shows the connection of an SSI encoder to encoder interface X5060 for an absolute encoder (SSI):

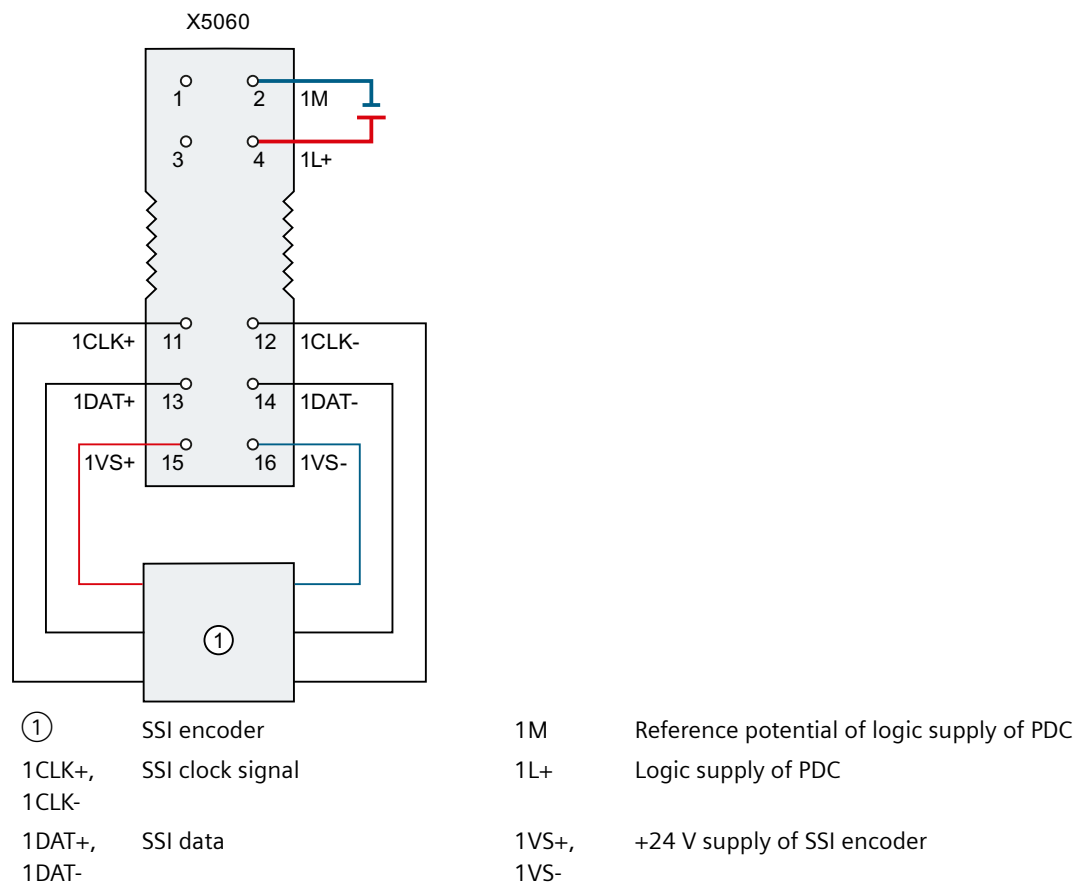


Figure 5-8 SSI encoder connection

Note

Only connect the SSI sensor (supply/signals) as indicated in the figure. Always supply the sensor from terminals 1VS+ and 1VS-. Do not connect any other supplies, potentials or signals to terminals 11 to 16!

The logic supply voltages 1L+, 2L+ with the associated ground potentials 1M, 2M are electrically isolated from one another.

Given the total current load of the wiring and the supplying power supply, you can connect the logic supply voltages in parallel.

5.10 Connecting Hardware STO

Safe Torque Off (STO)

The safety function Hardware STO is activated via an exclusive safe input (STO+ and STO-). The drive controller safely switches off the energy supply of the motor. As long as Hardware STO is active, the motor does not generate any torque.

The safe state "Safe Torque Off" corresponds to the de-energized state at STO+/STO- (closed-circuit current principle).

The Hardware STO function meets the specification of a digital input according to EN 61131-2 Type 1 without limitation. In addition, this input has an increased leakage current resistance of 2 mA. That is, at leakage currents below 2 mA, the safe state is always selected.

Connecting the Hardware STO

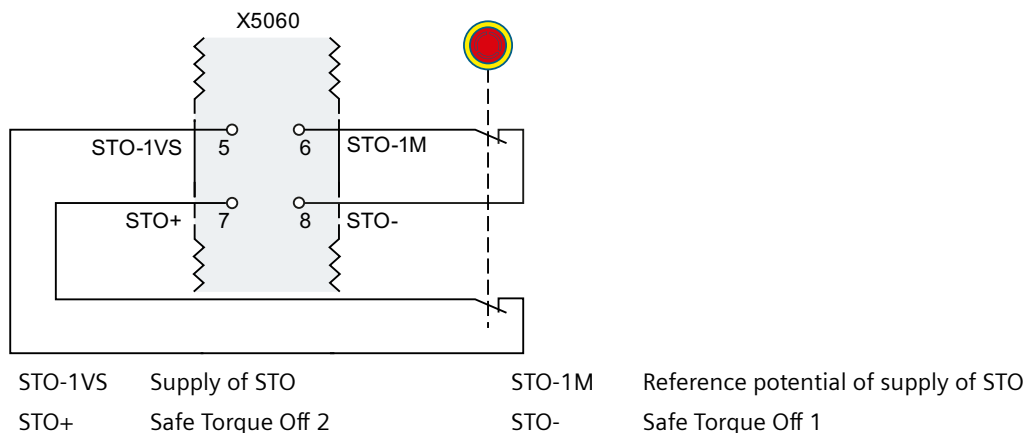


Figure 5-9 Connection of Hardware STO

WARNING

If terminals STO-1VS and STO-1M are used for supplying the encoder, this corresponds to a through-wiring of 1L+ or 1M. Observe the corresponding instructions for protection of the power supply of the PDC in section Power supply (Page 29), as well as the requirements for protection of the encoder for safe operation.

WARNING

To achieve SIL2/Cat.3/PLd with this wiring, a correspondingly qualified encoder is required.

5.11 Connecting a braking resistor

Internal braking resistor

Specific PDC device versions have an internal braking resistor to absorb the generating energy of the motor.

To use the internal braking resistor, terminals 4R+ and 4R- must remain unconnected.

External braking resistor

For PDC device versions without internal braking resistor or if the internal braking resistor cannot fulfill the brake requirements (e.g. if an alarm is output), you can connect an external braking resistor.

A connected external braking resistor is detected and the internal braking resistor (where applicable) is electronically disabled.

NOTICE
Damage caused by overheating
When an external braking resistor is used, you can provide overtemperature monitoring that prevents further operational overheating.
For electrical safety, however, this function is not a substitute for use of an intrinsically safe braking resistor.

You can connect an external braking resistor to all variants of the PDC drive controller.

More information can be found in the appropriate Equipment Manual.

Connecting a non-Siemens external braking resistor**WARNING****Damage to braking resistor - Risk of fire!**

If you use a non-Siemens external braking resistor, you can connect an overtemperature detection device to a digital input (e.g. a bimetallic switch that opens when the temperature is too high). You must perform the monitoring and evaluation of this digital input in the user program in the CPU.

For electrical safety, however, this function is not a substitute for use of an intrinsically safe braking resistor.

For example, the following must always be anticipated:

- Failure of the switch for the brake circuit
- Overvoltage
- Undervoltage (e.g. through a resulting source current limitation)

Allow for these circumstances by using suitable braking resistors with corresponding fuse elements and other measures.

You must implement fire prevention measures for the external braking resistor (e.g. fire protection housing, temperature fuse). The resistance of the externally connectable braking resistor must be $3\ \Omega \pm 10\%$.

Likewise, you must select the required power as a function of the braking energy to be converted.

External braking resistors must provide a basic insulation (at least 0.8 mm clearance and creepage distance, at least 1570 V DC test voltage) between the electrical circuit of the resistor element and the bimetallic switch even under fault conditions. That is required to exclude a potential threat to electrical and functional safety in the area of the digital inputs. (Background: up to 60 V on the brake circuit under fault conditions exceeds the requirements for LVLC circuits and the fault exclusions regarding functional safety in the 2M circuit and, if applicable, other circuits.)

Reference

Connection diagrams for the connection of an external braking resistor as well as the associated pin assignment of the interface can be found in the manual of the respective PDC device version.

Safety functions integrated in the drive

6.1 Fundamental safety instructions

6.1.1 General safety instructions

 WARNING

Danger to life if the safety instructions and residual risks are not observed

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

- Observe the safety instructions given in the hardware documentation.
- Consider the residual risks for the risk evaluation.

 WARNING

Malfunctions of the machine as a result of incorrect or changed parameter settings

As a result of incorrect or changed parameterization, machines can malfunction, which in turn can lead to injuries or death.

- Protect the parameterization against unauthorized access.
- Handle possible malfunctions by taking suitable measures, e.g. emergency stop or emergency off.

6.1.2 Warranty and liability for application examples

Application examples are not binding and do not claim to be complete regarding configuration, equipment or any eventuality which may arise. Application examples do not represent specific customer solutions, but are only intended to provide support for typical tasks.

As the user you yourself are responsible for ensuring that the products described are operated correctly. Application examples do not relieve you of your responsibility for safe handling when using, installing, operating and maintaining the equipment.

6.1.3 Industrial security

WARNING

Risk of unsafe operating states due to manipulation of the software

Software manipulations (e.g. viruses, Trojans, malware and worms) can cause unsafe operating states in your plant, which may result in death, serious injury and property damage.

- Keep the software up-to-date.
- Integrate the automation and drive components into a comprehensive, state-of-the-art industrial security concept of the plant or machine.
- Take into account all of your utilized products in your comprehensive industrial security concept.
- Protect files stored on removable media from malware with appropriate protective measures, e.g. virus scanner.
- Protect the drive from unauthorized changes by using a suitable safety password.

6.2 Fundamental safety instructions for Safety Integrated

Additional safety instructions and residual risks are presented outside of this section at the relevant points of this system manual.

DANGER

Risk minimization through Safety Integrated

Safety Integrated can be used to minimize the level of risk associated with machines and plants. However, safe operation of the machine or system with Safety Integrated is only possible if the machine manufacturer:

- knows and complies with this technical user documentation, including the documented constraints, safety instructions and residual risks.
- carefully constructs and configures the machine/plant and verifies it through a carefully implemented and documented acceptance test by qualified personnel.
- implements and validates all the measures required in accordance with the system/machine risk analysis by means of the programmed and configured Safety Integrated functions or by other means.

The use of Safety Integrated does not replace the machine/plant risk assessment carried out by the machine manufacturer as required by the EC Machinery Directive.

In addition to using Safety Integrated functions, further risk reduction measures must be implemented.

 WARNING

Danger to life as a result of undesirable motor movement when automatically restarting

The Emergency Stop function must bring the machine to a standstill according to Stop Category 0 or 1 (STO or SS1) (EN 60204-1).

It is not permissible that the motor automatically restarts after an Emergency Stop, as this represents danger to life as a result of the associated undesirable motor motion.

If individual safety functions are deactivated, an automatic restart is permitted under certain circumstances depending on the risk analysis (except when Emergency Stop is reset). An automatic start is permitted when a protective door is closed, for example.

- Ensure that no automatic restart takes place in the indicated cases.

 WARNING

Danger to life as a result of undesirable motor motion when the system powers up and the drives are activated after changing or replacing hardware and/or software

After hardware and/or software components have been modified or replaced, or after drive parameters are changed or parameter backups are loaded, it is only permissible for the system to run up and the drives to be activated with the protective devices closed. Personnel shall not be present within the danger zone.

- It may be necessary to carry out a partial or complete acceptance test or a simplified functional test after having made certain changes or replacements.
- Before personnel may re-enter the hazardous area, all of the drives should be tested to ensure that they exhibit stable control behavior by briefly moving them in both the plus and minus directions (+/-).
- **When switching on carefully observed the following:**
The Safety Integrated functions are only available for selection after a complete system startup.

 WARNING

Parameterizing the encoder system

Encoder faults are detected using different hardware and software monitoring functions.

- These monitoring functions (i.e. encoder monitoring) must be carefully configured. Depending on the type of fault and the responding monitoring function, the Category 0 or Category 1 stop function according to the EN 60204-1 (fault reaction functions STOP_STO or STOP_SS1 according to Safety Integrated) is selected.

 WARNING

Converter operation despite active messages

With activated safety functions, there are a number of system messages that still permit the drive to be traversed. In these cases, you must ensure that the causes of the messages are corrected immediately.

6.3 Residual risk

The fault analysis enables machine manufacturers to determine the residual risk at their machine with regard to the drive unit. The following residual risks are known:

WARNING

Danger due to short, limited movements in PMSM motors

The simultaneous failure of the rotary encoder may cause a brief, limited movement.

For rotary three-phase permanent-magnet synchronous motors (PMSM), the maximum movement is $180^\circ / \text{Pole pair number}$ ($180^\circ / p0314$).

WARNING

Danger due to unlimited movements in DC motors

The failure of the rotary encoder can cause permanent, unlimited movement. The SLT and STO functions are independent of this and remain available without restriction.

Please note: The SLS and SSM safety functions are not available for operation with DC motors.

NOTICE

Property damage from overshooting of the speed or position with brief limit violation

When a limit violation occurs, from the time of its detection to the corresponding reaction, speeds greater than the speed setting may occur briefly or the specified position may be overrun to a greater or lesser extent, depending on the dynamic response of the drive and on parameter settings.

- Design your machine and application accordingly.
- Observe the specified response times.

NOTICE

Property damage from overshooting of the torque or force with brief limit violation

When a limit violation occurs, from the time of its detection to the corresponding reaction, torques greater than the torque setting may occur briefly or the specified force may be exceeded to a greater or lesser extent, depending on the dynamic response of the drive and on parameter settings.

- Design your machine and application accordingly.
- Observe the specified response times.

6.4 Overview of the Safety Integrated functions

Compared to standard drive functions, safety functions have an especially low error rate. Performance Level (PL) and Safety Integrity Level (SIL) as defined in their corresponding standards are a measure for the error rate.

For this reason, safety functions are suitable for use and for risk reduction in safety-related applications. An application is safety-related when the risk analysis of the machine or plant has identified a particular risk potential in the application.

Safety Integrated means that the safety functions are integrated in the drive and can be executed without additional external components.

You make the settings for these Safety Integrated functions via the integrated engineering system in the TIA Portal with Hardware Support Package HSP0198. To do this, follow the instructions in section Commissioning Safety Integrated functions (Page 153).

Conformity of Safety Integrated functions

The Safety Integrated functions comply with:

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

For functional safety of variable-speed drives, IEC 61800-5-2, in which the Safety Integrated functions are defined, applies.

Function groups

For the PDC drive controller, the safety functions are divided into the following function groups:

- Safety Integrated stop function
- Safety Integrated motion monitoring
- Safety Integrated communication

Fail-safe variants of the PDC drive controller

The fail-safe PDC-"F" device variants support all listed safety functions, including Hardware STO, as well as PROFIsafe communication.

Standard variants of the PDC drive controller

The standard device variants only support the Hardware STO safety function.

6.5 Supported safety functions

The supported safety functions are included in the standard scope of the PDC drive controller and can be used without an additional license.

Note

Parallel use of Safety Integrated functions

You can use all listed Safety Integrated functions of the drive simultaneously.

Stop functions

The stop functions do not impose any special requirements on the utilized sensor and do not need actual value acquisition. The stop functions include the following Safety Integrated functions:

- **Safe Torque Off (STO)**
Safe Torque Off is a safety function for prevention of unexpected startup according to EN 60204-1. STO prevents torque-producing energy from being supplied to the motor and corresponds to Stop Category 0.
- **Safe Stop 1 (SS1, time-controlled)**
Safe Stop 1 complements the "Safe Torque Off" function. It can be used to implement a Category 1 stop according to EN 60204-1.

Motion monitoring

Some safety functions for motion monitoring require an encoder concept suitable for safety and are not appropriate for all motor types. Observe the respective description for the listed safety functions.

- **Safely-Limited Speed (SLS)**
Safely Limited Speed monitors the drive to ensure that it does not exceed a preset rotational speed or velocity limit
- **Safe Speed Monitor (SSM)**
Safe Speed Monitor is used to safely detect when the speed falls below a speed limit in both motion directions, e.g. for standstill detection. A safe output signal is available for further processing.
- **Safely-Limited Torque (SLT)**
Safely Limited Speed monitors the drive to ensure that it does not exceed a preset torque or force limit.

PROFIsafe communication

In addition to control of the Safety Integrated function STO via terminals, the stop and motion monitoring functions can also be controlled via PROFIsafe. You use PROFINET telegram 30 or 31 for communication via PROFIsafe.

6.6 Examples of use of the safety functions

Table 6-1 Examples of use of the safety functions

Safety function	Application examples	Possible solution	See section ...
Safe Torque Off (STO)	It is only permissible to open a protective door if the motor torque has been switched off.	Select STO in the drive controller via a terminal or via PROFIsafe. The pulses are suppressed and the motor coasts to a standstill.	Safe Torque Off (STO) (Page 70)
	A central Emergency Stop button ensures that several drives cannot unintentionally start.	Evaluate the Emergency Stop button in a central controller, select STO in the drive controller via PROFIsafe	

Safety function	Application examples	Possible solution	See section ...
Safe Stop 1 (SS1)	The drive must brake as quickly as possible after the Emergency Stop button has been pressed. It is not permissible that the stationary motor undesirably accelerates.	Select SS1 in the drive controller via PROFI-safe .	Safe Stop 1 (SS1, time-controlled) (Page 73)
Safely Limited Speed (SLS)	The machine operator must be able to enter the machine after the protective door has been opened and slowly move a horizontal conveyor with an acknowledgment button in the danger zone.	Select SLS in the drive controller via PROFI-safe. The drive controller limits and monitors the speed of the horizontal conveyor.	Safely-Limited Speed (SLS) (Page 75)
	A spindle drive, depending on the selection of the cutting tool, must not exceed a specific maximum speed.	Select SLS and the corresponding SLS stage in the drive controller via PROFI-safe.	
Safe Speed Monitor (SSM)	A centrifuge may only be filled when the speed falls below a user-defined speed.	The drive controller safely monitors the centrifuge speed and enables the process to advance to the next step with the "SSM status" status bit.	Safe Speed Monitor (SSM) (Page 77)
Safely Limited Torque (SLT)	The force limiting for opening and closing of a machine protective door must be maintained.	Select SLT and the corresponding SLT stage in the drive controller via PROFI-safe.	Safely-Limited Torque (SLT) (Page 78)

6.7 Safety concept

The safety concept of the drive controller is based on a 2-channel system structure. The safety-relevant components are distributed between two independent processors (also referred to hereinafter as channel A and channel B). Each channel has the possibility of bringing about the safe state, and the two channels monitor each other through a corresponding cross-comparison. A cyclic (r9780), synchronous exchange of a process input image and process output image of the safety functions of the drive controller as well as a parameter checksum of the safety-relevant drive parameters takes place.

The drive parameters are retentively stored on channel A. During startup, channel B reads all needed parameters from channel A. For new parameter assignments to become effective, the safety program must always be reinitialized. See section Completing safety commissioning (Page 165).

Safe state

The safe state of the system exists when the motor bridge is **de-energized**.

The safe state is achieved in the following cases:

- Disconnection or failure of the logic supply 1L+, 1M (depending on the status of the other voltage supplies)
- RESET status of channel A or B
- Detection of an internal HW fault or SW error
- Failure or falsification of the bus communication (PROFINET with PROFI-safe)
- Following (detected) sporadic errors (e.g. soft error or EMC influences)

Safe state of Safety Integrated functions

The safe state of the STO input terminal is reached when at least one of the two STO supply terminals is disconnected from the energy supply.

The safe state exists when:

- for a three-phase motor, at least two phases of the motor are disconnected from the DC link.
- for a DC motor, at least one of the two terminals is disconnected from the DC link.

Note

The safe state means the absence of torque in the sense of functional safety but not necessarily the absence of voltage in the sense of electrical safety.

6.8 Safety Integrated functions

This section gives you a quick insight into the functioning of the safety functions.

The description of the safety functions starts with the definition in IEC/EN 61800-5-2 and simple examples of the use of the function.

The description of the functions is simplified as far as possible so that the essential properties and setting options are made clear.

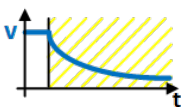
Parameter assignment

You can find additional information on the safety functions and information for their parameter assignment in section Commissioning Safety Integrated functions (Page 153).

Response time

You can find additional information on the response time of the listed safety functions on the Internet (<https://support.industry.siemens.com/cs/ww/en/ps/25460>).

6.8.1 Safe Torque Off (STO)



Safe Torque Off (STO) is a safety function that directly stops torque- or force-producing energy from being supplied to the motor. This function corresponds to Stop Category 0 according to EN 60204-1.

The PDC drive controller complies with the definition of the STO function in IEC/EN 61800-5-2: "The STO function prevents torque-producing energy from being supplied to the motor."

If the motor is still rotating when STO is selected, the motor will coast to a standstill.

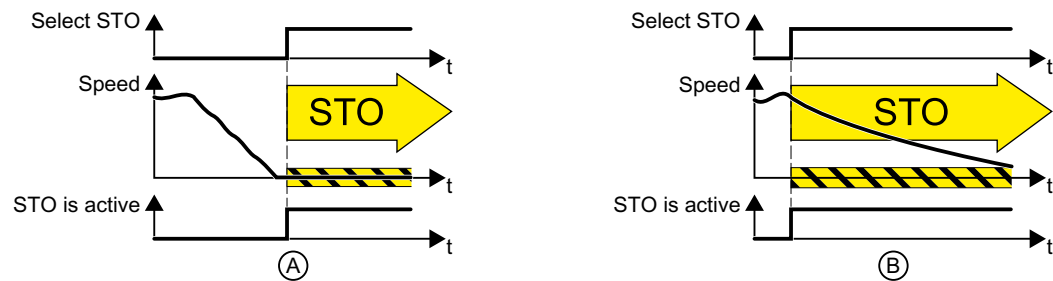


Figure 6-1 Functioning of STO (A) when motor is at stopped and (B) when motor is rotating

Functional characteristics

Switching On Inhibited prevents an automatic restart after deselection of STO and thus fulfills the requirements of EN 60204-1. As a result, the STO function prevents unwanted restart of an electrically driven machine component.



WARNING

Danger to life due to coasting down of the drive with STO

The Category 0 stop function according to EN 60204-1 (STO according to Safety Integrated) means that the drives are not braked but instead coast down for an amount of time corresponding to the kinetic energy.

- You must take this behavior into account, for example, in the logic for the protective door interlock.

STO is a drive-specific function and must be individually commissioned for each drive.

The following applies when the "Safe Torque Off" function is selected:

- An unwanted startup of the motor cannot take place.
- The torque-producing energy supply to the motor is safely interrupted.
- An electrical isolation between the power unit and motor does not occur.

The status of the STO function is indicated with a parameter (r9790).

Selection

The STO safety function is always enabled and cannot be disabled via parameter assignment.

You can select the STO function via PROFIsafe and/or the fail-safe digital input at terminals STO + and STO- of interface X5060. You can configure the STOP_STO stop response as a response to safety messages (e.g. in case of a detected defect in a monitoring channel, limit violation or failure of the PROFIsafe communication). The STOP_STO stop response directly triggers selection of the STO function.

Range of application

You can use the STO safety function in all control types and with single- and three-phase motors (DC and EC motors) without limitations. A special encoder concept suitable for safety is not required.

Applications

Application areas are all machines or systems with moving axes (e.g. conveyor systems, handling systems).

The STO function suits applications in which the motor is already stopped or will safely come to a stop in a brief amount of time due to friction.

STO allows safe working while a protective door is open. A conventional Emergency Stop with electromechanical unlocking is not required. The converter remains connected to the supply system and has full diagnostics capability.

Note

Difference between Emergency Off and Emergency Stop

"Emergency Off" and "Emergency Stop" are commands that mitigate different risks in the machine or plant. The STO function is suitable for implementing an Emergency Stop, but not an Emergency Off.

You can find details on the distinction between Emergency Off and Emergency Stop in the section "Emergency Off and Emergency Stop (Page 87)".

Hardware STO

The fail-safe digital input at terminals STO+ und STO- of interface X5060 is monitored for chattering and internally for discrepancy.

Discrepancy monitoring

Due to the design of the Hardware STO circuit, a discrepancy cannot occur at terminals STO+ and STO- of interface X5060. As long as the STO terminal is de-energized, STO is selected. The Hardware STO signal is read internally via two channels. If a discrepancy occurs, e.g. due to a hardware defect, the alarm F64610.23 "SI Power" is reported.

Chatter monitoring

In addition, the signal at terminals STO+ and STO- are monitored for chattering. Chatter monitoring is a control function for the digital input signal of Hardware STO. It detects and reports unusual signal sequences, such as an input signal that fluctuates too frequently between "0" and "1". The occurrence of such signal sequences is a sign of faulty sensors. Signal chattering at the Hardware STO input is reported with alarm F64610.22 "SI Power".

Diagnostics and dynamization

The drive controller uses an integrated diagnostics device to cyclically check the fail-safe digital input Hardware STO. The fault F64610.9 "SI power" is signaled in the event of an error at the digital input for hardware STO.

To comply with the requirements for timely error detection from ISO 13849-1, the switch-off signal paths of the output stage in both monitoring channels are also cyclically tested. An error while testing the shutdown paths of the output stage is signaled with fault F64610.10 "SI power". Faults F64610.16 "SI power" and/or F64610.17 "SI power" are signaled in the event of implausible readback signals of the shutdown paths of the output stage. A manual forced

checking procedure (test stop) for testing the switch-off signal paths of the PDC drive controller is therefore not needed.

WARNING

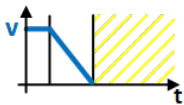
Forced checking procedure

You should nevertheless examine its necessity for diagnosing the utilized sensors or for performing a test stop in the context of the overall system.

Extended message acknowledgment

It is also possible to acknowledge safety messages through selection/deselection of Hardware STO. The "Extended message acknowledgment via HW-STO" in parameter p9501 must be enabled for this, see section Setting up the safety functions (Page 158).

6.8.2 Safe Stop 1 (SS1, time-controlled)



The "Safe Stop 1" (SS1) function can be used to implement a Category 1 stop according to EN 60204-1. After selection of "Safe Stop 1", the drive brakes according to the OFF3 ramp (p1135, p1136, p1137) and goes to "Safe Torque Off" (STO) state after the delay time (p9556) elapses.

The PDC drive controller complies with the definition of the SS1-t function in IEC/EN 61800-5-2: "[...] [2] Initiation of motor deceleration and, after an application-specific time delay, initiation of the STO function."

If the motor is still rotating after the delay time (p9556), the motor will coast to a standstill.

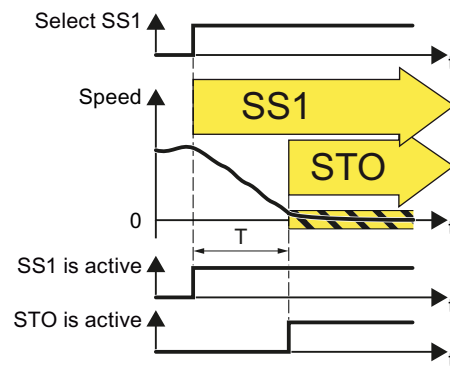


Figure 6-2 Functioning of SS1-t

Note

The braking according to the OFF3 ramp is not monitored!

Functional characteristics

When SS1 is selected, the drive is braked according to the OFF3 ramp (see section OFF responses (Page 136)) and, after the delay time (p9556) elapses, STO is initiated automatically. After selection of the function, the delay time elapses, even if the function is deselected during this time. In this case, after the delay time elapses, the STO function is selected and then deselected again immediately.

Note

SS1 cannot be interrupted.

SS1 cannot be deselected during the delay time by revoking the control command. It therefore fulfills the requirements of EN 60204-1 for an Emergency Stop function.

Note

Setting the delay time

Select the SS1 delay time in such a way that the drive completes the OFF3 ramp and a motor holding brake, if present, can be applied before the torque is safely turned off. In addition, the value for the OFF3 ramp-down time must be geared to the actual braking capacity of the system or machine.

The timer for the delay time that, when it elapses, initiates the STO function, is implemented with two channels. The braking according to the OFF3 ramp, however, is implemented with only one channel.

SS1 is a drive-specific function and must be individually commissioned for each drive.

The status of the SS1 function is indicated with a parameter (r9791).

Selection

The SS1 safety function must be enabled with parameter p9501, see section Selecting safety functions (Page 157).

You select the SS1 function via PROFIsafe. You can configure the STOP_SS1 stop response as a response to certain safety messages (e.g. in case of a limit violation or failure of the PROFIsafe communication). The STOP_SS1 stop response directly triggers selection of the SS1 function.

Range of application

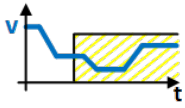
You can use the SS1 safety function in all control types and with single- and three-phase motors (DC and EC motors) without limitations. A special encoder concept suitable for safety is not required.

Applications

You can use SS1 in the following cases:

- The load torque cannot bring the motor to a standstill through friction in a sufficiently short amount of time.
- A coasting down of the drive (STO) results in safety risks.

6.8.3 Safely-Limited Speed (SLS)



The Safely-Limited Speed (SLS) function is used to protect against undesired high speed/velocity of a drive in both directions of rotation. This is achieved by load-side, two-channel monitoring of the current drive speed for a speed limit. Safely Limited Speed prevents the configured limit from being exceeded. The limits must be specified based on results of the risk analysis.

Up to four different SLS limit values can be set with parameter p9531, and it is possible to dynamically switch between these limit values even when SLS is active.

The PDC drive controller complies with the definition of the SLS function in IEC/EN 61800-5-2: "The SLS function prevents the motor from exceeding the specified speed limit."

The SLS function allows the operation of an electrically driven machine component at temporarily reduced safe speed or velocity.

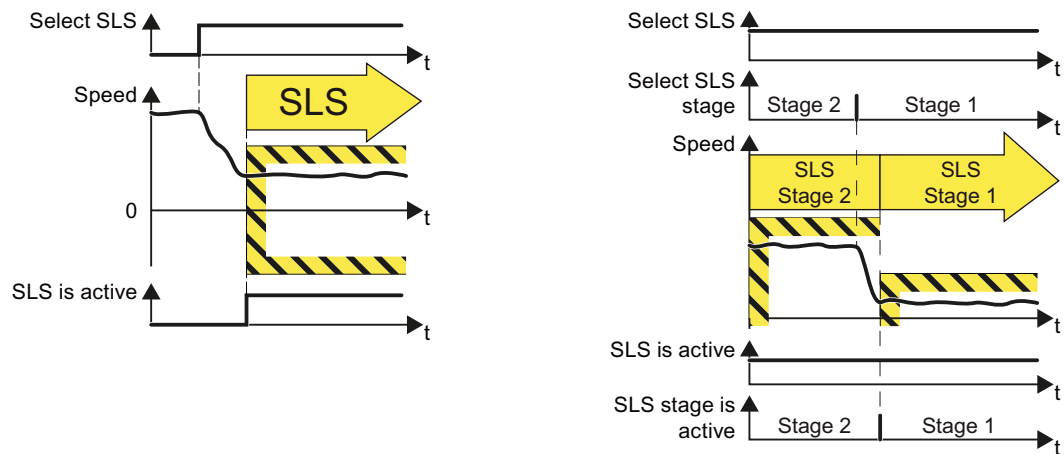


Figure 6-3 Functioning of SLS/SLS stages (example)

Functional characteristics

When SLS is selected, the monitoring is only active after the delay time (p9551) expires. Within this time, the actual velocity must be below the (selected) limit value. The delay time is not active when SLS is deselected.

After a switchover to a lower limit value (p9531), the actual speed of the drive must have dropped below the new limit value within the delay time (p9551). The existing limit value remains active during the delay time. The lower limit value is active after the delay time has expired.

If, after the delay time elapses, the actual speed of the motor is higher than the new SLS limit value, a message regarding the limit violation with the parameterized stop response is generated. The Stop response (STOP_STO or STOP_SS1) is configured with parameter p9561.

On switchover to a higher limit value, the delay time is not active and the higher limit value becomes active immediately.

A total of four limit values can be set in p9531.

You have the option of setting up a drive-internal speed setpoint limiting (p9533) during parameter assignment of SLS.

Selection

The SLS safety function must be enabled with parameter p9501, see section Selecting safety functions (Page 157).

You select the SLS function via PROFIsafe. Only SLS stage 1 is available with PROFIsafe telegram 30. A switchover between the SLS stages is possible with PROFIsafe telegram 31.

As an alternative to control via PROFIsafe, there is also the option of configuring the SLS function without selection. In this case, the SLS function is permanently active after POWER ON. You will find details regarding SLS without PROFIsafe in section Setting up the safety functions (Page 158).

Range of application

The use of the SLS safety function is based on the safe determination of the actual speed. The SI speed acquisition is an integral component of the actual value acquisition and is used for safe determination of the current motor speed.

You can use the SLS safety function only with three-phase permanent-magnet synchronous motors (PMSM) and an encoder concept suitable for safety. The SLS safety function is implemented according to the requirements of ISO 13849-1 as a Cat.3 element and requires the use of two independent sensors.

- The A/B tracks of the encoder provide direction information as well as (incremental) position information. A direct monitoring is not possible, because no redundancy or plausibility information is available. For the safety-relevant speed monitoring, comparison with the Hall signal is therefore needed. The A/B tracks and Hall signals must always come from independent sensors. The sensor signals are evaluated in the drive via two channels.

The SLS function of the SIMATIC MICRO-DRIVE drive system is only permitted for use with drives from the Siemens Product Partner Program with IQ encoder and Hall signals. Drives permitted to use SLS are defined via the Drive ID component of the drive identifier.

The drives permitted to use SLS are listed in the table below.

Table 6-2 Drives permitted to use SLS

Manufacturer	Drive ID
ebm-papst	10000 to 14999
Dunkermotoren	20000 to 24999

You can find the list of approved drives on the Internet at (<https://support.industry.siemens.com/cs/ww/en/ps/25460>) or contact the Siemens branch in your region.

Applications

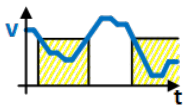
SLS is suitable for machines that can pose a hazard when a speed is exceeded and that require work to be performed on them while:

- in operation
- in setup mode
- undergoing maintenance

Example application:

- A circular saw must not exceed a certain maximum speed, depending on the diameter of the saw blade.
- The machine operator must be able to enter the machine after the protective door has been opened and slowly move a horizontal conveyor with an acknowledgment button in the danger zone.
- A spindle drive must not exceed a certain maximum velocity, depending on the machining tool selection.

6.8.4 Safe Speed Monitor (SSM)



The "Safe Speed Monitor" (SSM) function is used for safe detection of speeds below a speed limit (p9546) in both directions of rotation, e.g. for standstill detection. A safe output signal is available for further processing.

The PDC drive controller complies with the definition of the SSM function in IEC/EN 61800-5-2: "The SSM function supplies a safe output signal to indicate whether the motor speed is below a specified limit value."

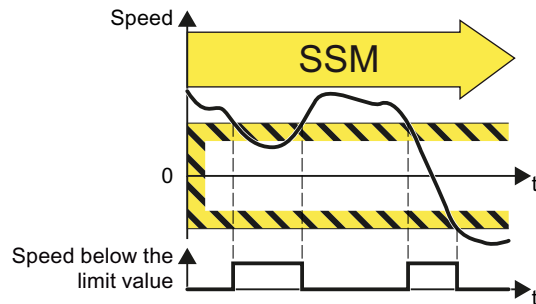


Figure 6-4 Functioning of SSM

Note

SSM is a pure signaling function

Unlike other Safety Integrated functions, exceeding the SSM limit value does not trigger a drive-autonomous stop response.

Functional characteristics

You set the speed limit for SSM with parameter p9546. If the speed limit for the SSM feedback is fallen below, the "Speed below SSM limit" signal is set.

Parameterizable hysteresis

The parameterizable hysteresis ensures that the SSM output signal does not jump between the values "0" and "1" in the limit range.

Selection

The SSM safety function must be enabled with parameter p9501, see section Selecting safety functions (Page 157).

The SSM safety function cannot be selected or deselected by external control signals. SSM is always active if you have enabled the function in parameter p9501, see section Setting up the safety functions (Page 158).

The SSM function provides a safe output signal in PROFIsafe for further processing.

Range of application

The "Speed below limit value SSM" signal is only available in PROFIsafe telegram 31.

The SSM monitoring function needs a safe speed as an input signal and uses the same preprocessing as for the SLS speed monitoring for this. As a result, SSM is subject to the same limitations regarding sensor and motor types as the SLS safety function. See section Safely-Limited Speed (SLS) (Page 75).

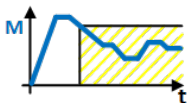
Applications

SSM is suitable for implementing a release for machine entry through a safe SSM feedback.

Example application:

- A protective door may only be unlocked when the speed falls below a critical speed.
- A centrifuge may only be filled when the speed falls below a user-defined speed.

6.8.5 Safely-Limited Torque (SLT)



The Safely Limited Torque (SLT) function is used to protect against undesired high torque or force of a drive in both directions of rotation. This is achieved by two-channel monitoring of the current motor torque for a torque limit. Safely Limited Torque prevents the configured limit from being exceeded. The limits must be specified based on results of the risk analysis.

Up to four different SLT limit values can be set with parameter p9532, and it is possible to dynamically switch between these limit values even when SLT is active.

The PDC drive controller complies with the definition of the SLT function in IEC 61800-5-2: "This function prevents the motor from exceeding the specified torque (or, when using a linear motor, the specified force)."

The SLT function allows the operation of an electrically driven machine component at temporarily reduced safe torque or force.

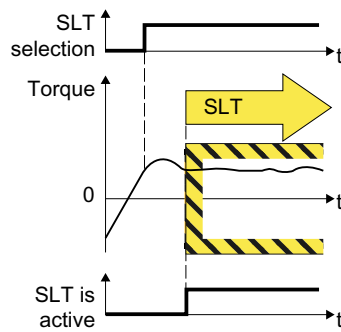


Figure 6-5 Functioning of SLT (when motor is rotating)

Functional characteristics

When SLT is selected, the monitoring becomes active only after a configurable delay time elapses (p9552). Within this time, the actual torque must lie below the (selected) limit value. The delay time is not active when SLT is deselected.

After a switchover to a lower limit value (p9532), the actual torque of the drive must have fallen below the new limit value within the delay time (p9552). The existing limit value remains active during the delay time. The lower limit value is active after the delay time has expired.

If, after the delay time elapses, the actual torque of the motor is higher than the new SLS limit value, a message regarding the limit violation with the stop response STOP_STO is generated.

On switchover to a higher limit value, the delay time is not active and the higher limit value becomes active immediately.

A total of four limit values can be set in p9532.

You have the option of setting up a drive-internal torque limiting (p9533) during parameter assignment of SLT.

Selection

The SLT function can be selected via PROFIsafe. Only SLT stage 1 is available with PROFIsafe telegram 30. A switchover between the SLT stages is possible with PROFIsafe telegram 31.

As an alternative to control via PROFIsafe, there is also the option of configuring the SLT function without selection. In this case, the SLT function is permanently active after POWER ON. You will find details regarding SLT without PROFIsafe in section Setting up the safety functions (Page 158).

Range of application

You can use the SLT safety function with single- and three-phase motors (DC and EC motors). There are no special requirements on the used encoder system of the motor for the use of the SLT safety function.

The Safely Limited Torque safety function operates on the basis of the current motor current (r0068) and the motor constant (p9504). The torque generated on the motor shaft is assumed to be proportional to the motor current. The proportionality is expressed via the motor constant

(p9504). The SI torque acquisition is an integral component of the actual value acquisition and is used for safe determination of the current torque.

Impacts of the PDC drive controller on the accuracy of torque acquisition

With consideration of the operating range of the SLT safety function, the following impacts on secure torque acquisition result from the drive-internal current measurement:

Measuring device

The drive-internal current measuring device may show a measurement error due to component tolerances. However, the circuit principle enables high repeatability. We recommend checking the actual torque during commissioning.

Connection inductance

Take into account that the drive-internal current measurement only works correctly if the motor winding has sufficiently high inductance. Otherwise, the utilized measuring principle will be fulfilled only to an insufficient extent and currents will be measured incorrectly. A minimum inductance of 0.5 mH is required.

The minimum inductance is composed of the motor connection inductance (p0377) and the motor series inductance (p0353). If the minimum inductance is not adhered to, alarm A61052.5 is signaled.

Note

Series inductance

If the connection inductance of the motor (p0377) is below the required minimum inductance of 0.5 mH, you must provide a series inductance and specify the value in the controller parameter (p0353).

Impacts of the plant on the accuracy of torque acquisition

Take the following influence factors of the plant into account for the operating range of the SLT safety function:

Effects of specimen distribution

All specified motor variables are subject to manufacturing-related tolerances (specimen distribution).

Effects of friction

The PDC drive system operates with the ideal motor constant (p9504). The ideal motor constant (p9504) determines the internal torque of the motor. The torque available at the motor shaft is reduced by the internal motor friction and remagnetization losses.

When observing the actually active torque or the power on the drive train, take into account not only the internal motor friction but also other plant components, such as gears, mechanical components and other friction points.

Note

Each form of friction can be dependent on temperature and on speed.

Effects of the temperature

The magnetic flow of the permanent magnets installed in the motor depends on the temperature. The magnetic flow and thus the torque decrease when the temperature increases.

Effects of saturation

At currents above the rated current, saturation effects can occur in the magnetic circuit. This causes the effective motor constant and thus also the output torque to decrease.

Effect of a phase displacement in three-phase PMSM motors

The phase displacement is only relevant for EC motors. It describes the deviation of the acquired rotor position from the actual rotor position. The effect of a phase displacement is typically very low and is usually much less than the other tolerances.

In isolated cases, the increase in torque due to a phase displacement effect is not negligible. For this reason, the impact of a phase displacement on the torque limit must be taken into account:

- In motors with symmetrical inductances (L_d and L_q in p0377 are less than 10% apart), the phase displacement does not play a safety-relevant role. Any phase displacement that occurs decreases the torque that is effectively delivered at the motor shaft, which always acts in the direction of greater safety.
- In motors with asymmetrical inductances, a relevant increase in torque is possible. The lower the flux linkage of the motor and the higher the load current, the greater the torque increase will be.

Note

We recommend checking the actual torque during commissioning to take the influence of the listed factors into account accordingly.

Applications

SLT is suitable for machines that can pose a hazard when a torque or force is exceeded and that require work to be performed directly on them while:

- in operation
- in setup mode
- undergoing maintenance

Example application:

- The force limiting for opening and closing of a machine protective door must be maintained.

6.9 PROFIsafe communication

The PROFIsafe communication of the PDC takes place via the integrated PROFINET interface. Each PDC with configured PROFIsafe represents a PROFIsafe slave (F-slave or F-device) with fail-safe communication with the F-host via PROFINET and is assigned its own PROFIsafe telegram. PROFIsafe telegrams are received, processed and sent within the configured PROFINET communication cycle. The minimum communication cycle for PROFIsafe telegrams in the drive is calculated from: $2 \times r9780$ (SI monitoring clock cycle).

Requirements for PROFIsafe communication

The communication driver of the drive controller supports fail-safe communication according to PROFIsafe profile specification V2.6.1 via PROFINET.

Note

You can find additional information on the requirements for PROFIsafe data security in the "PROFIsafe – Environmental Requirements – Guideline V2.5 Ch. 6", section "Data security".

PROFIsafe telegrams

The following table provides an overview of which Safety Integrated function you can control with which PROFIsafe telegram.

Table 6-3 Safety functions of the PROFIsafe telegrams

Safety function	PROFIsafe telegram	
	30	31
STO	x	x
SS1	x	x
SLS (stage 1)	x	x
SLS with stage switchover	-	x
SSM	-	x
SLT (stage 1)	x	x
SLT with stage switchover	-	x

6.9.1 Monitoring times

When configuring the monitoring and cycles times in the F-host, you need to consider both the availability and the safety of the F-system:

- **Availability:**
Sufficiently large monitoring times should be selected so that time monitoring is not activated in an error-free scenario.
- **Safety:**
Sufficiently small monitoring times must be selected so that the process safety time of the process is not exceeded.

**WARNING**

It can only be ensured fail-safe that a signal state to be transferred is detected on the sender side and transferred to the receiver if it is present for at least as long as the configured F-monitoring time.

Rules for configuration of the monitoring times in the F-host

The following rules result for the monitoring time in the F-host:

- The monitoring time must be greater than the configured PROFINET communication cycle
- The monitoring time must be greater than the minimum communication cycle for PROFIsafe telegrams in the PDC:
Monitoring time F-host > $2 \times r9780$ (SI monitoring clock cycle).

6.9.2 Telegram structure

Structure of PROFIsafe telegram 30

PROFIsafe telegram 30 transfers the safety control word 1 (S_STW1) and the safety status word 1 (S_ZSW1) as user data.

It has the following structure:

Table 6-4 Structure of PROFIsafe telegram 30

	Output data	Input data
PZD1 (16 bits)	S_STW1	S_ZSW1

Structure of PROFIsafe telegram 31

PROFIsafe telegram 31 transfers the safety control word 2 (S_STW2) and the safety status word 2 (S_ZSW2) as user data.

It has the following structure:

Table 6-5 Structure of PROFIsafe telegram 31

	Output data	Input data
PZD1 (16 bits)	S_STW2	S_ZSW2
PZD2 (16 bits)		

6.9.3 Process data

Control words or setpoints are process data that is sent from the controller to the drive.

Status words or actual values are process data that is sent from the drive to the controller.

Note

Control and status bits assigned to non-enabled safety functions are not relevant. Non-relevant signals and reserved signals should be set to "0" in the control word and must not be evaluated in the status word.

Note

Take into consideration the information and application examples on the "LDrvSafe" fail-safe library on the Siemens Industry Online Support (<https://support.industry.siemens.com>) website.

Safety control word 1 (S_STW1)

Table 6-6 Description of safety control word 1 (S_STW1)

Byte	Bit	Meaning	Comments	
0	0	STO	1 = Deselect STO	0 = Select STO
0	1	SS1	1 = Deselect SS1	0 = Select SS1
0	2	Reserved	-	
0	3	Reserved	-	
0	4	SLS	1 = Deselect SLS	0 = Select SLS
0	5	SLT	1 = Deselect SLT	0 = Select SLT
0	6	Reserved	-	
0	7	Internal Event ACK	1 → 0 = F-acknowledgment	0 = No F-acknowledgment
1	0..7	Reserved	-	

Safety status word 1 (S_ZSW1)

Table 6-7 Description of safety status word 1 (S_ZSW1)

Byte	Bit	Meaning	Comments	
0	0	STO	1 = STO active	0 = STO not active
0	1	SS1	1 = SS1 active	0 = SS1 not active
0	2	Reserved	-	
0	3	Reserved	-	
0	4	SLS	1 = SLS active	0 = SLS not active
0	5	SLT	1 = SLT active	0 = SLT not active
0	6	Reserved	-	
0	7	Internal Event ACK	1 = Internal event	0 = No internal event
1	0..7	Reserved	-	

Safety control word 2 (S_STW2)

Table 6-8 Description of safety control word 2 (S_STW2)

Byte	Bit	Meaning	Comments	
0	0	STO	1 = Deselect STO	0 = Select STO
0	1	SS1	1 = Deselect SS1	0 = Select SS1
0	2	Reserved	-	
0	3	Reserved	-	
0	4	SLS	1 = Deselect SLS	0 = Select SLS
0	5	SLT	1 = Deselect SLT	0 = Select SLT
0	6	Reserved	-	
0	7	Internal Event ACK	1 → 0 = F-acknowledgment	0 = No F-acknowledgment
1	0	Reserved	-	
1	1	Select SLS Bit 0	Selection of SLS stage (2 bits)	
1	2	Select SLS Bit 1		
1	3..7	Reserved	-	
2	0	Select SLT Bit 0	Selection of SLT stage (2 bits)	
2	1	Select SLT Bit 1		
2	2..7	Reserved	-	
3	0..7	Reserved	-	

Safety status word 2 (S_ZSW2)

Table 6-9 Description of safety status word 2 (S_ZSW2)

Byte	Bit	Meaning	Comments	
0	0	STO	1 = STO active	0 = STO not active
0	1	SS1	1 = SS1 active	0 = SS1 not active
0	2	Reserved	-	
0	3	Reserved	-	
0	4	SLS	1 = SLS active	0 = SLS not active
0	5	SLT	1 = SLT active	0 = SLT not active
0	6	Reserved	-	
0	7	Internal Event ACK	1 = Internal event	0 = No internal event
1	0	Reserved	-	
1	1	Active SLS level Bit 0	Display of active SLS stage (2 bits)	
1	2	Active SLS stage Bit 1		
1	3..6	Reserved	-	
1	7	SSM (speed)	1 = SSM (speed below limit)	0 = SSM (speed above or equal to limit)
2	0	Active SLT stage Bit 0	Display of active SLT stage (2 bits)	
2	1	Active SLT stage Bit 1		
2	2..7	Reserved	-	
3	0..7	Reserved	-	

6.10 Acceptance of the safety functions

The machine manufacturer must carry out an acceptance test of the selected Safety Integrated Functions for the machine (SI functions). To check or prove correct functioning, the acceptance test must cause all entered limit values of the enabled SI functions to be exceeded.

In the following entry, you will find a recommendation with examples and templates for how to perform and document the acceptance tests for the individual safety functions of the PFC/PDC-F drive controller.

SIMATIC MICRO-DRIVE PDC/PDC-F: Template for acceptance test or acceptance report for Safety applications (<https://support.industry.siemens.com/cs/ww/en/view/109780463>)

6.11 System features

6.11.1 Current information

Important note for maintaining the operational safety of your system:

NOTICE

Operational safety risk from unwanted motions

Systems with safety-oriented variants are subject to special operational safety requirements on the part of the operator. If information becomes known in the course of product monitoring indicating insufficient product safety, this information will be disclosed in various ways. For this reason, we publish a special newsletter containing information on product developments and features that are (or could be) relevant to operation of systems from a safety perspective.

To ensure that you are always up-to-date and able to make changes to your system, when necessary, we recommend that you catch up on the latest information on the device at SIMATIC MICRO-DRIVE (<https://support.industry.siemens.com/cs/ww/en/ps/25460>).

6.11.2 Certifications

The safety functions of the SIMATIC MICRO-DRIVE drive system fulfill the following requirements:

- Safety Integrity Level (SIL) 2 according to IEC 61508 Part 1-3 and IEC 61800-5-2
- Category 3 according to ISO 13849-1
- Performance Level (PL) d according to ISO 13849-1

In addition, the safety functions of the drive are generally certified by independent institutes. A list of the components that are currently already certified in each case is available on request from your Siemens branch.

6.11.3 Failure probability of the safety functions

The probability of failure of safety functions must be specified in the form of a PFH value (Probability of Failure per Hour) or a PFD value (Probability of Failure on Demand) according to IEC 61508, IEC 62061 and ISO 13849-1. The PFH/PFD values of a safety function depend on the safety concept of the drive device, its hardware configuration and the PFH/PFD values of the other components used for the safety function. For the SIMATIC MICRO-DRIVE drive system, PFH/PFD values are provided as a function of the hardware configuration.

Note**PFH/PFD values**

You will find the PFH/PFD values of the individual safety components of the SIMATIC MICRO-DRIVE drive system on the Internet (<https://support.industry.siemens.com/cs/ww/en/view/109777254>).

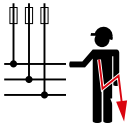
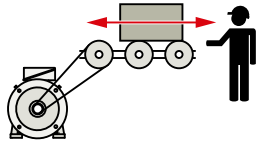
6.11.4 Response times

The response time is the time between the detection of an input signal and the change of a linked output signal. You will find the response times of the SIMATIC MICRO-DRIVE drive system on the Internet (<https://support.industry.siemens.com/cs/ww/en/view/109777254>). The response times of the drive enter into the calculation of the response time of the F-system.

6.12 Emergency Off and Emergency Stop

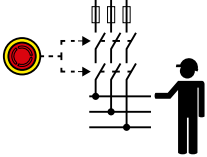
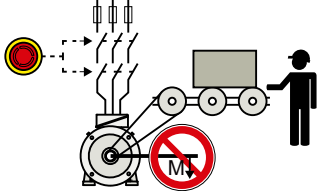
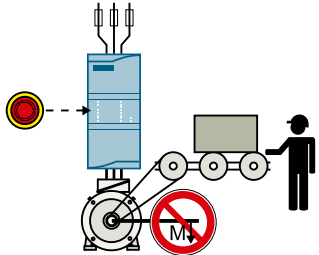
Difference between Emergency Off and Emergency Stop

"Emergency Off" and "Emergency Stop" are commands that mitigate different risks in the machine or plant.

Emergency Off Risk of electric shock 	Emergency Stop Risk of unexpected motion 
---	---

6.12 Emergency Off and Emergency Stop

Table 6-10 Measures and solutions

Command	Emergency Off	Emergency Stop
Measure to minimize risk	Safe switch off Switching off the electric power supply for the installation, either completely or partially.	Safely stop and safely prevent re-starting Stopping or preventing the dangerous movement
Classic solution	Switch off the power supply. 	Switch off the drive power supply. 
Solution with the STO safety function integrated in the drive	STO is not suitable for safely switching off a voltage.	Select STO.  You may also switch off the power supply of the drive controller. However, switching off the voltage is not required as a risk-reduction measure.

Configuring

Configuration and parameter assignment

STEP 7 (TIA Portal) is available for configuring a PDC.

With STEP 7 (TIA Portal) and SIMATIC MICRO-DRIVE, you perform the following tasks, for example:

- You configure the PDC (insert PDC in the project and interconnect it with the higher-level CPU; configure the communication telegram, I/O addresses, PROFINET interface).
- You specify the desired hardware parameters for operation of the PDC.
- You create a technology object for motion control functions.

Requirements

Hardware

- You have completed installation and wiring of the hardware.
- You have connected the PG/PC to the PROFINET interface of the PDC.

Software

- You have installed the HSP0198 ("Other_DriveCtrl").
- You have installed the latest firmware of the PDC.
- For fail-safe applications:
 - You have installed the optional package STEP 7 Safety Advanced V14 SP1 or higher.
 - You have created a project with an F-CPU S7-1200/S7-1500 in STEP 7.

As soon as the configuration and hardware parameter assignment have been successfully completed, you can create your user program/safety program and commission the drive.

WARNING

The configuration of F-CPU and F-I/O and the programming of F-blocks must be carried out in STEP 7 (TIA Portal) as described in the programming and operating manual SIMATIC Safety - Configuring and Programming (<http://support.automation.siemens.com/WW/view/en/54110126>).

As soon as a safety program has been created, you must perform a complete function test based on your automation task.

For acceptance of the system, you must use the safety summary created according to the above manual.

7.1 Inserting PDC from the hardware catalog

To add a device to the hardware configuration from the hardware catalog, proceed as follows:

1. Open the network view or the topology view.
2. Open the "Hardware Catalog" task card.
3. Navigate in the catalog to the "Drivers & starters" folder.
4. Under "SIMATIC Micro-Drives", click the desired PDC drive controller to select it. (F-components have a yellow marking.)

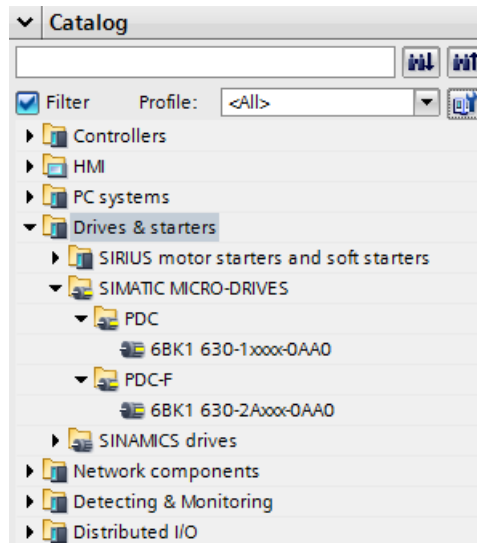


Figure 7-1 Selecting the PDC

5. If necessary, set the firmware version in the "Information" pane using the drop-down list of the hardware catalog.
6. Using drag-and-drop, move the PDC into the network view or topology view. This inserts the PDC in the "Ungrouped devices" folder of the project tree.

7.2 Networking the PDC

The drive supports star, line, tree and ring topologies. The PDC has an integrated switch for line and ring topologies.

Connecting the PDC drive controller to the CPU

After the PDC is added to a project, you must connect it to the CPU:

1. Open the network view.
2. Configure the PROFINET connection to the PDC.

After assigning the PDC to a PROFINET subnet, a sync domain and a PROFINET IO system are created automatically. The IP addresses of the devices are automatically adapted so that a valid combination is created.

7.3 Configuring the PDC

7.3.1 Device configuration

To enable communication between the CPU and drive, configure the drive(s) in the CPU and, optionally, enable assignment of a device name by the IO controller based on the topology. As a result of this, the PDC obtains its PROFINET device name and IP address from the CPU.

Procedure

To configure a drive, follow these steps:

1. Select the PDC under "Ungrouped devices" in the project tree.

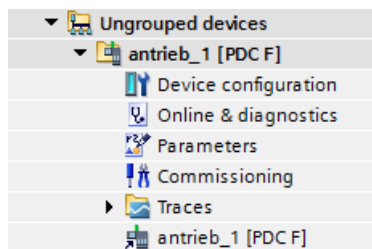


Figure 7-2 PDC in the project tree under "Ungrouped devices"

2. Double-click "Device configuration" to open the device view of the PDC.

7.3.2 Drive telegram

The PDC automatically adopts the specified drive telegram from the hardware configuration of the CPU.

The following drive telegrams are supported:

- Standard telegram 1/2
- Standard telegram 3/4
- Siemens telegram 102/103

You can find an overview of the telegrams in section Communication telegrams (Page 97).

Procedure

To configure the drive telegram for the PDC, follow these steps:

1. Double-click "Device configuration" to open the device view of the PDC.
2. Using drag-and-drop, move the desired drive telegram from the catalog "SIMATIC MICRO-DRIVES" > "Submodules" to the selected submodule slot in the device overview of the PDC.

Table 7-2 Supported communication telegrams (Page 98) shows which telegrams are supported in which slot and which telegrams support isochronous mode.

7.3.3 Identification and maintenance data

Identification and maintenance data (I&M data) is information for standardized and simplified identification and maintenance of PROFINET devices. You can set the I&M data records 1 to 3 with STEP 7 (HW Config).

I&M data

I&M data records contain information that is stored on the device/module either as read-only data (I-data) or read/write data (M-data).

Identification data (I&M 0): Manufacturer information about the device/module that can only be read and is in part also printed on the housing of the device/module, for example, article number and serial number.

You will find the I&M0-Daten data in STEP 7 (TIA Portal) as catalog data both in the information field of the hardware catalog as well as in the device overview of the PDC in the Inspector window, tab "Properties" > "General".

Maintenance data (I&M 1, 2, 3): Plant-dependent information, e.g. installation location. You create the maintenance data during configuration and download it to the automation system.

All PDC drive controllers support identification data (I&M 0 to I&M 4).

The I&M identification data supports you in the following activities:

- Checking the plant configuration
- Locating hardware changes in a plant
- Correcting errors in a plant

Devices/modules can be clearly identified online using the I&M identification data.

Table 7-1 I&M data records

I&M data record	Fields (standardized)	Access authorization
I&M 0	MANUFACTURER_ID ORDER_ID SERIAL_NUMBER HARDWARE_REVISION SOFTWARE_REVISION REV_COUNTER PROFILE_ID PROFILE_SPECIFIC_TYPE IM_VERSION IM_SUPPORTED	Read
I&M 1	TAG_FUNCTION TAG_LOCATION	Read and write (to Device Access Point, DAP)
I&M 2	INSTALLATION_DATE	
I&M 3	DESCRIPTOR	
I&M 4	SIGNATURE	

You can read out the identification data with STEP 7 (see online help for STEP 7).

Procedure for entering maintenance data via STEP 7

You can enter the following information:

- Plant designation (I&M 1)
- Location identifier (I&M 1)
- Installation date (I&M 2)
- Additional information (I&M 3)

To enter maintenance data via STEP 7, follow these steps:

1. Select the PDC in the device view of STEP 7.
2. Select the "Identification & Maintenance" area under "General" in the Inspector window, "Properties" tab, and enter the data.

The I&M data is downloaded to the drive via the CPU. If the I&M data is to be stored retentively in the PDC, you must enable download of I&M data in STEP 7 (TIA Portal) in menu "Options > Settings > Hardware configuration > Compile & download", and download the project.

During the loading of the hardware configuration, the maintenance data (I&M 1, 2, 3) are also loaded.

7.3.4 Assignment of device name

PROFINET uses the device name in addition to the MAC address and IP address for identification of PROFINET devices.

This device name must be unique within the PROFINET network.

A device name is assigned by the engineering tool to each PROFINET device during commissioning. In so doing, the device name is written to the IO device via an IO supervisor with the help of the Discovery and Configuration Protocol (DCP). The device name is stored retentively on the PDC.

When the device is replaced, this process has to be repeated with the replacement device if no data backup exists.

Assignment of device name by the IO controller

The IO controller can also assign the device name to the IO device based on the topology. The precondition for this is that the configured target topology matches the actual topology and all devices involved meet at least the requirements for Class B (support of LLDP (Link Layer Discovery Protocol) and SNMP (Simple Network Management Protocol)).

7.3.5 Assignment of an IP address

In order to establish an application relationship, each PROFINET device must have an IP address. To ensure online access to the correct device, it is recommended that an IP address be assigned to each PROFINET device at the beginning of commissioning.

During configuration of the IO system, the engineering tool assigns an IP address to both the IO controller and IO devices. The IO controller obtains an IP assignment list via the system configuration. The IP addresses are assigned to the IO devices during initialization of the application relationships.

The PDC provides the option of having the IP address assigned by the IO controller. For this, a PROFINET connection must exist between the IO device and the IO controller and the device name of the IO device must match the configured device name. If this function is used, a communication connection must be established to the IO controller so that an IP address can be assigned to the IO device and so that TCP services of the drive (e.g. firmware update) are available.

7.3.6 Module parameters

General settings

You can set up the diagnostics for the drive using standard PROFIdrive alarms.

1. Open the device configuration of the PDC.
2. You can adapt the diagnostics in the Inspector window, tab "Properties > General" under "Module parameters > General settings".

TCP/IP services

The ISO-TCP server of the PDC allows the establishment of an S7 online connection to the drive. This S7 connection is based on TCP/IP and is provided for commissioning and diagnostics. The ISO-TCP server of the PDC is activated by default.

Note the information regarding industrial security on the Internet (<https://www.siemens.com/industrialsecurity>). If necessary, such as after commissioning the drive, deactivate the ISO-TCP server of the drive.

1. Open the device configuration of the PDC.
2. You can deactivate the ISO-TCP server of the PDC in the Inspector window, tab "Properties > General" under "Module parameters > TCP/IP services".

Note

The setting for the ISO-TCP server of the PDC can only be changed in the hardware configuration and is stored retentively in the drive. The setting is therefore retained even when the PROFINET connection is disconnected.

7.3.7 Shared device

The PDC allows the simultaneous connection of two IO controllers via PROFINET, e.g. an automation controller (standard CPU) and a safety controller (F-CPU).

Reference

You can find additional information on configuring with HW Config in the online help of STEP 7 and in function manual PROFINET (<https://support.industry.siemens.com/cs/ww/en/view/49948856>).

7.3.8 Isochronous communication

PROFINET IO with IRT (Isochronous Real Time)

Isochronous Real Time: Real-time property of PROFINET IO, in which IRT telegrams are transmitted deterministically over planned communication paths in a specified order so that the best possible synchronicity and performance between IO controller and IO device (drive device) can be achieved.

IRT is also referred to as scheduled communication that uses knowledge about the network structure (topology).

IRT requires special network components that support scheduled data transmission. SIMATIC MICRO-DRIVE achieves cycle times down to 1 ms and a jitter accuracy below 1 µs with this method.

Procedure

You can select or deselect the PROFINET interface and edit its settings in the Inspector window of the PDC, tab "Properties" > "General" under "PROFINET interface" > "Advanced options". In addition, you can select or deselect isochronous mode for the submodules.

Note

For the IRT-capable drive telegrams, you can set a minimum cycle time of 1 ms in intervals of 0.5 ms for the PDC.

Note

If isochronous mode is set for the PROFINET interface, then isochronous mode must be set for at least one submodule.

If isochronous mode is set for at least one submodule, then isochronous mode must be set for the interface.

7.3.9 MAC addresses

The PDC uses a total of three MAC addresses:

- As an IO device, the drive itself uses the MAC address that is laser-printed on the side of the PDC housing.
- The two PROFINET ports (Port 1: X2050, Port 2: X2060) each use one 1 incremental MAC address.

See the following example:

IO device	00-1B-1B-65-AC-6 1
Port 1	00-1B-1B-65-AC-6 2
Port 2	00-1B-1B-65-AC-6 3

7.3.10 Fail-safe communication

PROFIsafe offers the possibility of fail-safe communication (F-communication) between the fail-safe CPU and fail-safe PDC-F drive controller. PROFIsafe is a vendor-neutral, open standard and overlays the PROFINET protocol.

Note the information in section PROFIsafe communication (Page 82) for commissioning and use of PROFIsafe.

Note

Fail-safe communication according to PROFIsafe is supported only by the fail-safe PDC-F variants. For this reason, the PROFIsafe configuration is relevant only for the fail-safe PDC-F variants.

7.3.11 Digital inputs and outputs

You can link and use the four digital inputs and two digital outputs of the PDC freely via the process image of the CPU.

Procedure

To incorporate and configure the digital inputs and outputs of the PDC in the process image of the CPU, proceed as follows:

1. Double-click "Device configuration" to open the device view of the PDC.
2. Using drag-and-drop, move the desired submodule "DI 24VDC" or "DQ 24VDC" from the catalog "SIMATIC MICRO-DRIVES" > "Submodules" to the selected submodule slot in the device overview of the PDC.

7.4 LED flash test

This function is used to check the correct assignment for a device and its interface. Identification takes place through a DCP flash test. You start the flash test with the engineering tool.

In this test, the following LEDs on the PDC flash at a frequency of 2 Hz:

SF LED	
BF LED	
MT LED	
SYNC LED	
P1/P2	

7.5 Media redundancy

To increase the availability of PROFINET, you can set up a ring topology. If the ring is interrupted at one point, the data paths between the devices are automatically reconfigured. After the reconfiguration the devices are once again accessible in the newly created topology.

To set up a ring topology with media redundancy, you join the two ends of a PROFINET line topology in a switch that acts as a redundancy manager (e.g. a suitable SCALANCE switch). The line topology is joined via 2 ports (ring ports) of the SCALANCE redundancy manager, which monitors the data telegrams in the PROFINET ring.

All other connected PROFINET nodes are redundancy clients. The Media Redundancy Protocol (MRP) is the standard protocol for the media redundancy. A maximum of 50 devices per ring can participate with this protocol. In the event of a line interruption, a brief interruption of data transmission may occur until communication switches over to the redundant data path.

The PDC can be used as an MRP client and not as a redundancy manager (MRP manager). The MRP manager must be provided separately in the network.

7.6 Communication telegrams

Selection of a communication telegram

The selection of a communication telegram determines the process data of the drive that will be transmitted between the drive and CPU.

The following table shows the supported telegram types for the drive and sensor assignment.

Please note:

- Standard telegrams 1 and 2 can only be used for RT mode.
- Standard telegrams 3 and 4 and Siemens telegrams 102 and 103 can be used for RT mode or IRT mode, irrespective of the IO controller.

Table 7-2 Supported communication telegrams

Slot (slot.sub slot)	Supported telegrams	Brief description	User data	Isochronous mode	
				Required	Supported
1.2	PROFIsafe telegram 30	Telegram for fail-safe communication	Safety control word 1 (S_STW1), Safety status word 1 (S_ZSW1)	No	No
	PROFIsafe telegram 31	Telegram for fail-safe communication	Safety control word 2 (S_STW2), Safety status word 2 (S_ZSW2)	No	No

Slot (slot.sub slot)	Supported telegrams	Brief description	User data	Isochronous mode	
				Required	Supported
1.3	PROFIdrive standard telegram 1 PZD-2/2	Speed setpoint 16 bits, without sensor	- Control word STW1, status word ZSW1 - Speed setpoint 16 bits (NSET), actual speed value 16 bits (NACT)	No	No
	PROFIdrive standard telegram 2 PZD-4/4	Speed setpoint 32 bits, without position encoder	- Control words STW1 and STW2, status words ZSW1 and ZSW2 - Speed setpoint 32 bits (NSET), actual speed value 32 bits (NACT)	No	No
	PROFIdrive standard telegram 3 PZD-9/5	Speed setpoint, 32 bits with one position encoder	- Control words STW1 and STW2, status words ZSW1 and ZSW2 - Speed setpoint 32 bits (NSET), actual speed value 32 bits (NACT) - Encoder control word 1 (G1_STW), encoder status word 1 (G1_ZSW) - Actual encoder position value 1 (G1_XIST1, G1_XIST2)	No	Yes
	PROFIdrive standard telegram 4 PZD-14/6	Speed setpoint, 32 bits with two position encoders	- Control words STW1 and STW2, status words ZSW1 and ZSW2 - Speed setpoint 32 bits (NSET), actual speed value 32 bits (NACT) - Encoder control word 1 (G1_STW), encoder status word 1 (G1_ZSW) - Encoder control word 2 (G2_STW), encoder status word 2 (G2_ZSW) - Actual encoder position value 1 (G1_XIST1, G1_XIST2) - Actual encoder position value 2 (G2_XIST1, G2_XIST2)	No	Yes

Slot (slot.sub slot)	Supported telegrams	Brief description	User data	Isochronous mode	
				Required	Supported
	Siemens telegram 102 PZD-10/6	Speed setpoint 32 bits with one position encoder and torque reduction	- Control words STW1 and STW2, status words ZSW1 and ZSW2 - Speed setpoint 32 bits (NSET), actual speed value 32 bits (NACT) - Encoder control word 1 (G1_STW), encoder status word 1 (G1_ZSW) - Actual encoder position value 1 (G1_XIST1, G1_XIST2) (motor encoder) - Dynamic torque reduction (MOMRED)	No	Yes
	Siemens telegram 103 PZD-15/7	Speed setpoint 32 bits with two position encoders and torque reduction	- Control words STW1 and STW2, status words ZSW1 and ZSW2 - Speed setpoint 32 bits (NSET), actual speed value 32 bits (NACT) - Encoder control word 1 (G1_STW), encoder status word 1 (G1_ZSW) - Encoder control word 2 (G2_STW), encoder status word 2 (G2_ZSW) - Actual encoder position value 1 (G1_XIST1, G1_XIST2) (motor encoder) - Actual encoder position value 2 (G2_XIST1, G2_XIST2) - Dynamic torque reduction (MOMRED)	No	Yes
1.5	DI DC 24 V	Mapping of digital inputs of the drive	Input data	No	No
1.6	DQ DC 24 V	Mapping of digital outputs of the drive	Output data	No	No

A PZD (process data word) corresponds to a 16-bit word.

Commissioning

The PDC drive controller engineering is integrated in STEP 7 (TIA Portal). You install it with the Hardware Support Package HSP0198. The graphic user interface supports you in the configuration, parameter assignment and commissioning of the drive functions and Safety Integrated functions of the PDC.

In this section you will find information on various topics including:

- Check before powering on for the first time
- Commissioning a SIMATIC MICRO-DRIVE drive system
- Operating test with drive control panel
- Automatic drive controller tuning
- Rotating measurement for drive optimization
- Use of the drive trace function



CAUTION

Failure to comply with the instructions for Safety Integrated poses a risk of injury

Failure to comply with the instructions may result in serious injuries. Carefully read through the safety instructions in section Fundamental safety instructions for Safety Integrated (Page 64) before commissioning and before operation.



WARNING

Personal injury and property damage from the falling down of a suspended axis

If the servo system is used as a suspended axis, the axis will fall down if the positive and negative poles of the 24 V power supply are interchanged during connection. An unexpected falling down of a hanging axis can result in personal injury and property damage.

Before commissioning, it must be ensured that a cross brace is fitted to hold the suspended axis in place and prevent it from falling down unexpectedly. Also ensure that the 24 V power supply is connected properly.

Note

Performing tests

You must ensure the safety of your plant. You therefore need to perform a complete functional test and the necessary safety checks before the final commissioning of a plant.

Also allow for any possible foreseeable errors in the tests. This avoids endangering persons or equipment during operation.

8.1 Basics

For commissioning the drive with STEP 7, you need an Ethernet or PROFINET connection to the drive. For this purpose, you must be able to establish an IP connection to the drive.

You can access the PDC online and commission the drive in the TIA Portal independent of a STEP 7 project via "Online access" > "Accessible devices". This commissioning is a purely online commissioning without offline data. This means you cannot save, duplicate or archive the drive settings in your project (offline).

We therefore recommend that commissioning be carried out in the context of a STEP 7 project.

Creating a project

In order to carry out commissioning in the project context, perform the following steps:

1. Create a STEP 7 project.
2. Create your devices in the project, and configure the drive(s), see section Configuring (Page 89).

8.1.1 Engineering

You perform commissioning as well as diagnostics of a PDC with a PG/PC or notebook (commissioning device) using the TIA Portal (Hardware Support Package HSP0198 needed).

Overview

This drive engineering is divided into the following areas:

- Online & diagnostics
- Parameters
- Commissioning
- Traces

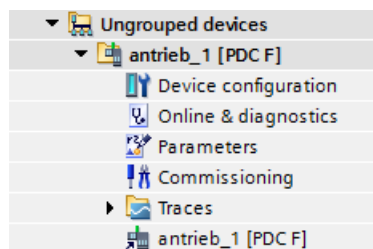


Figure 8-1 PDC in the project tree under "Ungrouped devices"

Online & diagnostics area

Online & diagnostics area of the PDC engineering:

- General (module information):
Order number, firmware and hardware version, I&M data, serial number
- Diagnostic status (display of status information)
- Active messages:
Pending faults and alarms
- Message history:
Acknowledged/eliminated faults and alarms
- Actual values:
Power unit, control/status words, operating values, sensors, temperatures, inputs/outputs, firmware signatures, service and maintenance data
- Safety diagnostics:
Safety change tracking, drive safety status, status of safety functions, PROFIsafe diagnostics
- PROFINET interface:
Current PROFINET configuration
- Functions:
Assign IP address, assign PROFINET device names, reset interface parameters, firmware update
- Save/reset:
Save and reset (save RAM to ROM), parameter backup, service and maintenance

Parameters area

Contents in the "Parameters" area of the PDC engineering:

- Drive:
Drive data set, drive identification, motor, encoder, thermal motor model, electronic motor rating plate
- Setpoint channel:
Reference values, limit values, speed ramp generator, OFF3 braking ramp, torque ramp generator
- Open-loop/closed-loop control:
Control type, controller settings, speed controller, current controller, additional torques
- Power unit:
Energy recovery, overload protection
- Communication:
Communication settings (assignment drive encoder - telegram, isochronous communication - IRT)
- SSI encoder:
Settings of the SSI interface

- Drive functions:
Blockage detection, messages/monitoring (motor (thermal motor model), internal braking resistance (load), power output stage (utilization))
- Safety Integrated:
Selection of safety functions, STO, SS1, SLS, SSM, SLT, PROFIsafe, actual value acquisition

Commissioning area

Contents in the "Commissioning" area of the PDC engineering:

- Optimization:
Measurement run, optimize controller settings
- Drive control panel

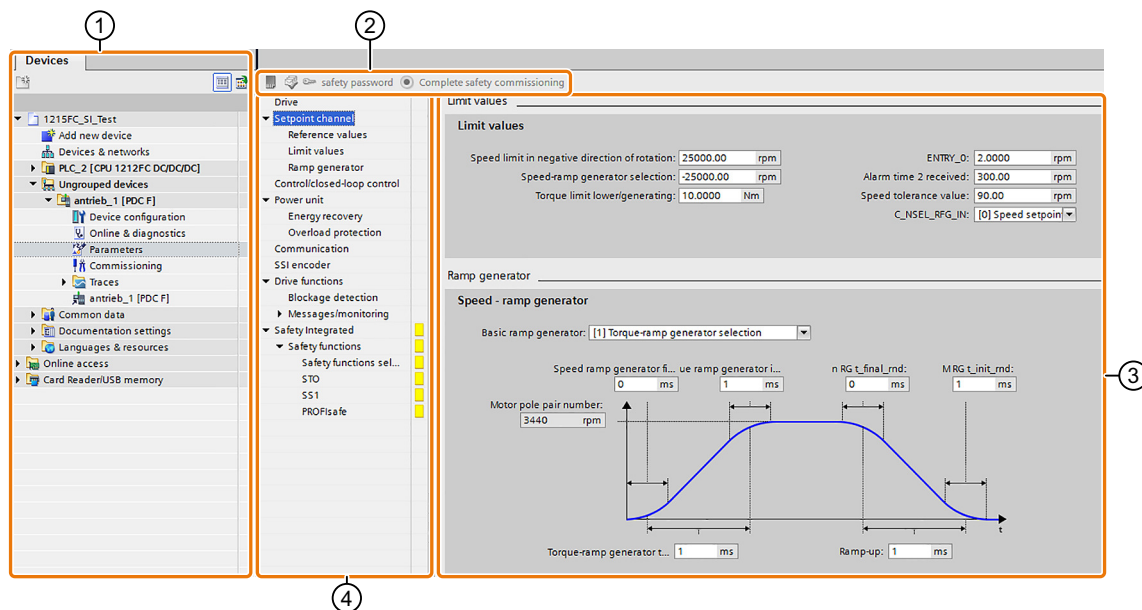
Traces area

Contents in the "Traces" area of the PDC engineering:

- Add new trace
- Configuration:
Select signals, defining recording conditions
- Measurements:
List of saved measurements
- Combined measurements:
List of combined measurements

Window layout of the PDC engineering

The following contents are integrated in the TIA Portal with the Hardware Support Package HSP0198. The figure below shows the basic layout of the PDC engineering.



- ① Project tree
- ② Toolbar
- ③ Work area (navigation-dependent window selection)
- ④ Area navigation

Figure 8-2 Layout of the PDC engineering

8.1.2 Going online

You can establish an online connection to the PDC drive controller with STEP 7 in order to monitor and modify the online settings of the drive in the project context of the drive. In online mode, there is an S7 online connection between your PG/PC and one or more PDCs. Depending on the properties of a device, you have certain diagnostics options in online mode, and certain functions are available.

NOTICE**Use of the S7 online connection**

Only one S7 online connection at a time per PDC is supported. The S7 online connection is provided for commissioning and diagnostics and is enabled by default in the module parameters (Page 94).

The S7 protocol (ISO-on-TCP) transfers data unencrypted. This may ultimately result in damage in the event of data manipulation by third parties. If necessary, deactivate the S7 protocol of the drive after commissioning. See Module parameters (Page 94)

Note the following restrictions for the S7 online connection:

- Only local access is permitted
- No networking or only local networking in a closed control cabinet is permitted.

If remote access to the control cabinet is needed, you must take additional safety measures to prevent misuse through sabotage, unqualified data manipulation and eavesdropping on confidential data.

Note the information regarding industrial security on the Internet (<https://www.siemens.com/industrialsecurity>).

Requirement

To establish an online connection, at least one PG/PC interface that is physically connected to a device, e.g. via a PROFINET cable, must be installed.

In addition, you must have assigned the PDC the PROFINET settings "Device name" or "IP address", e.g. in the Inspector window of the PDC, tab "Properties" > "PROFINET interface" under "Ethernet addresses" or with the SIMATIC Automation Tool. You can find more information on configuration an IP connection in section Configuring the PDC (Page 91).

Note**Security measures with communication via the PROFINET interface X2050 and X2060**

In accordance with the "Defense in Depth" concept, the PROFINET interface must be isolated from the remaining plant network (see Industrial Security (<https://www.siemens.com/industrialsecurity>)). Protection must be provided against access to the cables and possible open connections, for example, by installing in a control cabinet.

Online mode

The current online status of a device is indicated by a symbol to the right of the device in the project tree.

Note

Symbols and their meaning

You can find a legend with the meaning of the diagnostics symbols for modules and devices and the symbols for the comparison status in function manual Diagnostics (<https://support.industry.siemens.com/cs/ww/en/view/59192926>) and in the online help for STEP 7.

Connecting to the PDC online

You can connect to the PDC online within a project context or independent of a project context.

1. Select the PDC in the project tree, e.g. under "Ungrouped devices".
2. Select menu command "Go online" in the shortcut menu or click the "Go online" button in the toolbar.
3. If you had not already established an online connection to this device, the "Go online" dialog opens where you can search for the drive in the network.
 - Select the PG/PC interface used.
 - Select the interface/subnet used.
 - Start the search.
 - Use the "LED flashing" function to visually identify the selected drive.
 - Click "Connect" to establish the online connection to the PDC.
4. If an online connection exists, diagnostic data and the module status are determined by the TIA Portal. Check the current online status of the drive with the symbol next to the device in the project tree.

Result: You have established a direct online connection to the PDC.

Online diagnostics views

There are generally two views for the online diagnostics of devices/modules in STEP 7:

- Diagnostics view of the CPU and its associated I/O
- Diagnostics view of a device with a direct online connection to the device itself

Diagnostics view of the CPU and its associated I/O

If you go online to the CPU and establish an online connection via the CPU to the PDC, this occurs within the project context.

The direct online connection to the CPU gives you access to the standard PROFIdrive alarms, the I&M data and the diagnostic status of the drive as well as to the diagnostics of the PROFINET interface with all available port and domain information of PROFINET.

- To display alarms in STEP 7, enable the "Receive alarms" option in the shortcut menu of the CPU
- Enable the standard PROFIdrive alarms as described in section Standard PROFIdrive alarms (Page 199).

Diagnostics view of a device with a direct online connection to the device itself

If you establish a direct connection to the PDC via "Online access" > "Accessible devices", this happens independent of a project context via an S7 connection.

A direct online connection to the PDC gives you access to drive-specific diagnostics, such as active alarms, actual values or safety diagnostics.

8.1.3 Toolbar

The toolbar is available in the "Parameters" and "Commissioning" areas. The content of the toolbar varies depending on the PDC drive controller variant.

You have direct access to the following online functions of the drive:

- Save RAM to ROM (Page 108)
- Acknowledge faults
- Safety password (Page 167)
- Complete safety commissioning (Page 165)

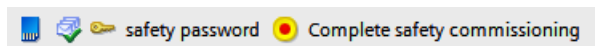


Figure 8-3 Toolbar

Note

The toolbar functions are only available online.

8.1.4 Saving parameters in power-independent storage

Save RAM to ROM

Changed parameters values are kept in the volatile memory of the PDC. They are lost when the PDC is switched off. For this reason, it is important that you regularly save changes to the drive parameter values to non-volatile memory.

To save parameter values to non-volatile memory (retentively) in the PDC, copy the data from the volatile memory (RAM) to the non-volatile drive memory (ROM) ("Save RAM to ROM").

You can save the settings for each individual commissioning step or save all the settings made and the optimization results at the end of commissioning at the latest.

Procedure

To save the data to non-volatile memory, follow these steps:

1. Open "Online & diagnostics" in the context of the drive.
2. Select the "Save/reset" group.
3. Click on "Save RAM to ROM" in the "Save and Reset" area to save all drive parameters retentively in the PDC.

Note

You can also start the "Save RAM to ROM" function with the memory button in the toolbar of the "Parameters" and "Commissioning" windows.

8.1.5 Drive parameters

Parameter tooltips

All drive parameters displayed in the PDC drive engineering of STEP 7 are linked to tooltips. You will find detailed information on the parameter in the tooltips, e.g. parameter name, properties, factory setting, value range, descriptions, notes and dependencies.

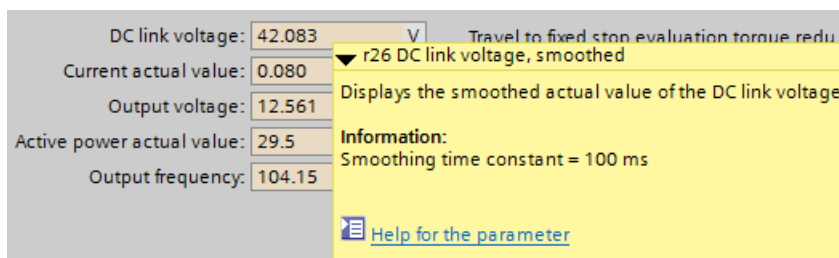


Figure 8-4 DC link voltage tooltip

Changing a parameter

You can directly change the values of the writable adjustable parameters (p-parameters) in STEP 7.

You have the following options for this:

- You overwrite the current parameter value with the new value.
Or
- You select a value via the drop-down list.

Invalid values are rejected.

Note

Some p-parameters cannot be changed online while the drive is in operation. In this case, the corresponding entry field is automatically disabled.

The following overview shows the display of an entry field, depending on the context and the properties of the drive parameter:

	Project (offline)	Parameter value can be changed and stored in the project.
	Project (offline)	The parameter value is write-protected.
	Drive (online)	Parameter value can be directly changed in the drive (RAM).
	Drive (online)	Parameter value is write-protected or disabled due to the drive status.

Offline/online comparison of parameters

The comparison of the offline values in the project with the online values in the drive is displayed for all p-parameters when an online connection exists within a project context. Here, you can directly see differences between the settings in the project and the online values of the drive and you can adapt the values as appropriate.

The following overview shows the representation of the offline/online comparison of the drive parameters:

	Project value (offline) same as drive value (online)
	Project value same as drive value, write-protected
	Project value (offline) different than drive value (online)
	Project value different than drive value, write-protected

You can synchronize all parameter values using the "Download to device" or "Upload from device" function in the project context of the drive, see Drive parameters (Page 109).

You can also change individual parameter values directly in your project. To do so, click the arrow of the comparison indicator to open the parameter comparison view. Change the project parameter value in the comparison view and then save your project.

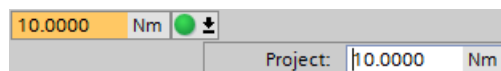
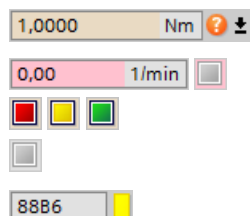


Figure 8-5 Parameter comparison view

Parameter symbols and operator controls

The following overview explains additional symbols and operator controls in the PDC engineering:



Drive value (online) could not be compared

Drive value (online) could not be determined

Bit parameter active (1-signal)

Bit parameter inactive (0-signal)

Safety Integrated parameters

Loading drive parameters

You can synchronize all p-parameter values of your project (offline) with the drive values (online) using the "Download to device" or "Upload from device" function.

Note

The safety password is neither saved in the STEP 7 project nor transferred to/from the device during loading. It must be individually assigned to the drive, see section Safety password (Page 167).

"Download to device" function for drive parameters

You can use the "Download to device" function to transfer parameter values from your project (offline) to the drive (online).

NOTICE

The Safety Integrated parameter checksums in p9799 cannot be downloaded to the device. The expected checksums must be generated and stored in the drive using the "Complete safety commissioning" function.

Procedure

1. Select the drive in the project tree.
2. Click on "Download to device"  in the menu bar.

Or

1. Select "Download to device" > "Software" in the shortcut menu.
2. In the "Load results" dialog, you can select the "Save RAM to ROM" option to save the parameter values in non-volatile memory in the drive.

You have transferred the current parameter values of your project to the drive.

"Upload from device" function for drive parameters

You can use the "Upload from device" function to transfer the parameter values from the drive (online) to your project (offline).

Procedure

1. Select the drive in the project tree.
2. Click on "Upload from device"  in the menu bar.

Or

1. Select "Upload from device" > "Software" in the shortcut menu.
2. In the "Upload preview" dialog, you must confirm that all parameter values will be transferred from the drive to the current project (offline) and that all existing parameter values in the project will be overwritten.
3. Save your project with "Project" > "Save".

You have transferred the current parameter values of the drive to your project.

8.1.6 Drive control panel

The control panel is used for control and monitoring of the drive during commissioning. Comply with the required safety measures when using the control panel.

The control panel offers the following options:

- Testing drive movements or manually moving the drive
- Monitoring drive movements

You move the drive by specifying speed setpoints and the torque limitation. You use the drive control panel to perform an initial function test of your drive.

Note

You can only use the drive control panel if an online connection to the PDC exists.

Opening the drive control panel

To open the drive control panel of the PDC, proceed as follows.

1. Select the PDC in the project tree.
2. Open the "Commissioning" area.
3. Select the "Drive control panel" in the page navigation.

The control panel is started in monitoring mode. All control elements except for the "Master control: Activate" button are grayed-out in monitoring mode. The remaining control elements become active only after you have taken over the master control.

Taking over master control



WARNING

The control panel may be used only when the associated safety instructions are observed! Failure to comply with these instructions can result in injury or material damage!

The function is released exclusively for commissioning, diagnostic and service purposes.

The function may only be used by authorized personnel.

The "Stop with the space key" function cannot be guaranteed for all operating situations of the drive. Consequently, it is important to implement a hardware solution for Emergency Stop. You must take the required measures.

You activate the drive control panel by taking over the master control of the drive. When you take over the control, you can test drive movements or manually move the drive.

To activate the drive control panel, follow these steps:

1. Click the "Master control: Activate" button in the drive control panel.
2. Read the warning carefully and check the value for the monitoring time. The monitoring time indicates the interval at which the connection from the PG/PC to the PDC is cyclically monitored.

Note

Keep in mind the performance capability of your PG/PC system and, in case of problems with the control panel, select a sufficiently long monitoring time in parameter p8984.

3. Confirm the dialog with "OK".
The control panel is now activated, and the master control has been changed. This is indicated by a broken orange line around the window of the drive control panel. All other control sources are now disconnected.
4. To hand over the master control again, click on "Master control: Deactivate". The drive control panel changes over to monitoring mode.

Note

The master control can only be taken over when the PDC is not in operation and the master control has not already been handed over.

Controlling the drive

Once you have successfully taken over the master control, you can manually move the drive to test the drive movements:

1. Enter a suitable value for the torque limiting and the desired actual speed value in the "Setpoints" area.
2. Check the status of the current enables in the "Drive status" area.

3. Switch on the motor and move the motor in jog mode or with a speed setting.
Jog mode: Movement is activated only as long as you press the button. As soon as the button is no longer pressed, the movement stops
Speed setting: Movement is activated until the drive is stopped. Click "Stop" to decelerate the motor to speed 0.
4. Switch the motor off via a stop response:
 - Ramp stop (switch off)
 - Rapid stop (OFF3)
 - Coast down (OFF2)

Note

Test the motor response, check the drive status and monitor the actual values of the drive via the display fields. In addition, check the direction of rotation of the motor shaft.

Handing over master control

You deactivate the drive control panel by handing over the master control again. You can hand over the master control at any time.

To hand over the master control, proceed as follows:

1. Click "Master control: Deactivate".
The control elements of the drive control panel are grayed out again.

8.1.7 Drive trace

For efficient commissioning and optimization of the motor and closed-loop controls, the PDC drive controller has an integrated real-time trace function. The drive trace is used to record and evaluate parameter values within the PDC in real-time. The trace function is integrated in the PDC drive controller. It records parameter values according to the adjustable trigger conditions and saves them in volatile memory of the drive controller.

You can display, evaluate and save the recorded data with STEP 7.

By visualizing the entire process with real-time trace, you identify, for example, sporadic events in the system during commissioning and service.

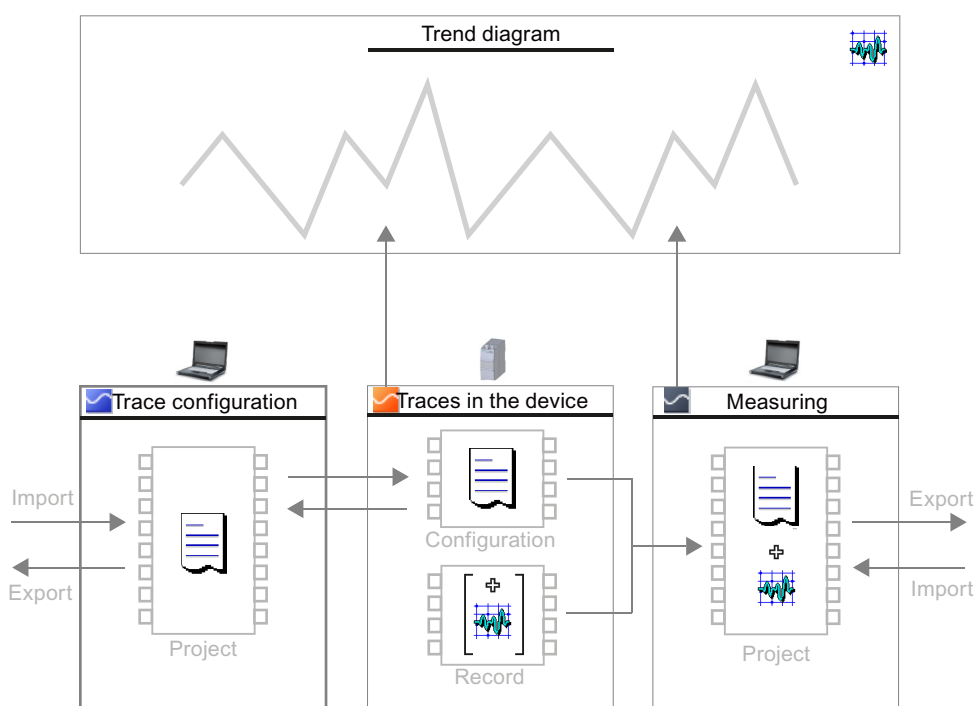


Figure 8-6 Schematic overview

Advantages

The trace function provides you with the following advantages:

- Recording independent of the engineering, trace data are kept in the drive and can be evaluated at a later time
- Monitoring of highly dynamic processes in real-time
- Simultaneous recording of up to 6 parameters
- Pretrigger for recording before actual trigger point
- Smart trigger, such as trigger on alarm or fault
- Zoom, cursor and interpolation functions for evaluation
- Import and export of trace configurations

Procedure

You call up the trace function in the "Traces" folder in the project context of the drive.

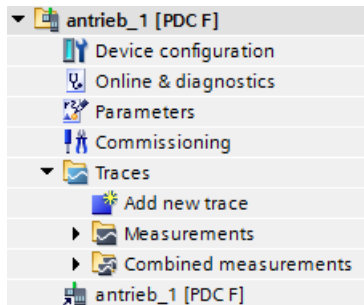


Figure 8-7 "Traces" folder

1. Create a new trace configuration or open an existing trace configuration.
2. Select the signals to be recorded and specify recording and trigger conditions.
3. Download your trace configuration to the device with .
4. Start the monitoring and activate the recording with .
5. The recording starts as soon as the trigger condition is satisfied.
6. Note the current status of the recording.

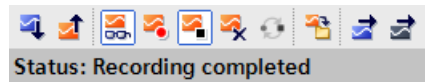


Figure 8-8 Status of the recording

7. To load a completed recording to the engineering system and evaluate it, open the "Diagram" tab.

Note

The recorded data remains on the PDC until a new recording is started or the drive is restarted.

8. Add the recording to the measurements. Measurements are stored in your engineering project and can also be evaluated offline.

Note

To repeat a recording, you can generate a trace configuration from a stored measurement. To do so, open a measurement and click on "Create trace function" in the toolbar of the drive trace.

Symbols and operator controls of the drive trace

Symbols in the "Traces" folder

Trace configurations and installed traces are shown in the "Traces" folder 



Add trace configuration.
Double-click the symbol to add a new trace configuration.



Trace configuration (offline)
Double-click the symbol to open the "Configuration" tab.



Installed trace (online)
The symbol is only displayed when an identically-named offline trace configuration does not exist for the installed trace.
Double-click the symbol to open the "Diagram" tab.



Trace configuration with identically-named installed trace
If the  button is not selected, the trace configuration from the project is displayed. The trace corresponds to a trace configuration.
If the  button is selected, the trace configuration from the device is displayed. The trace corresponds to an installed trace.
Double-click the symbol to open the "Diagram" tab of the installed trace.

Status

When there is an online connection, the status is displayed in the right-hand column of the project tree. The status is also displayed as a tooltip above the respective symbol.

The following table shows the meaning of the symbols:



Online and offline trace configuration are identical



Online and offline configuration are different



Trace configuration only exists online

Trace toolbar

Tools for using the trace are available via buttons.



The selected trace configuration is transferred to the PDC.



The selected trace configuration is transferred from the PDC to the project.



Activate (start) the recording.
If the recording of an installed trace is repeated, then the settings relevant for the display (curve diagram and signal table) are also retained for the new recording.



Add the recording to the measurements.
Measurements are stored in the engineering project and can also be evaluated offline.



Activate/deactivate monitoring.
Toggle of the display between online and offline



Delete the selected trace from the device.



Deactivate the recording.



Export a trace configuration as a file with file extension "*.ttcfgx".



Create a new trace configuration from the measurement.



Export a measurement as a file with file extension "*.ttrecx" or "*.csv".



Import a measurement from a file with file extension "*.ttrecx".

Reference

You can find additional information on the "Trace" function in function manual Using the trace and logic analyzer function (<https://support.industry.siemens.com/cs/ww/en/view/64897128>).

8.1.8 Calling help information

To obtain information on parameters and alarms (messages) of the drive, open the information system via "Help" > "Show help" and search for "SIMATIC MICRO-DRIVE".

You can also directly open the information system for a parameter or a message. To do so, click the online help link in the tooltip of a parameter or message .

8.2 Requirements for the commissioning

Requirements

- The PDC was installed according to the information in the following sections:
 - Installation (Page 35)
 - Connecting (Page 45)
 - Configuring (Page 89)
- The motor is installed in the drive train to be operated in accordance with the plant/device construction planning.

Note

Further information concerning the requirements

You can find further information concerning technology objects and motion control in the online help of STEP 7 under "Using technology functions" > "Motion Control".

Before powering on for the first time

Before the first power-on, check the installation and the wiring of the PDC drive controller, including connector assignment.

Items to be checked

The following checklist provide guidance for the check of your PDC drive controller.

Rack

- Is the mounting rail securely mounted to the wall, in the frame or in the cabinet?
- Are the cable ducts correctly installed?
- Have the minimum clearances been observed?

Grounding concept

- Is the mounting rail connected to the protective conductor?
- Is the connection between the ground reference and ground properly established for the mounting rail?
- Are the required equipotential bonding cables connected to the relevant parts of the system with low impedance?

Module installation and wiring

- Is the PDC plugged in/installed in accordance with the mounting diagram and corresponding to the configuration with STEP 7 and securely connected or screwed (to the mounting rail)?
- Are all connectors wired/assigned according to the circuit diagram?
- Is the PDC connected to the CPU and the STEP 7 (TIA Portal) engineering tool via PROFINET cable?
- Is the input for Hardware STO (STO+/STO-) connected or bridged?
- Are the cables (power cable, encoder cable) between the PDC drive controller and the motor properly connected?
- If a motor holding brake is being used, is it connected correctly?
- Are the digital inputs and outputs connected?
- Was a second encoder optionally connected to the SSI interface?
- Was an external braking resistor optionally connected to the PDC?

Power supply

- Are all power supplies switched off?
- Is the power plug connector correctly wired/assigned?
- Has the connection to the line voltage been established?
- Is the power supply for the power unit properly connected to 4L+?
When energy recovery (Page 144) is activated, the supply voltage can also be above the specified value. Use a suitable bi-directional supply to ensure that the voltage at 4L+ never exceeds 60 V DC during operation or under fault conditions.
- Are the logic supply voltages (24 V DC at 1L+, 2L+) properly connected?

**WARNING****Operation above the voltage setting range**

Under the given application conditions, ensure that the motor is not operated above the voltage setting range by selecting the appropriate motor and gear unit; otherwise, the DC-link voltage can increase above 60 V DC with inactive control.

8.3 Commissioning procedure

Requirements

The following preconditions are assumed in the description of the commissioning procedure in this section:

- The PDC is in "Factory settings" state or has been reset to factory settings (see Resetting to factory settings (Page 176)).
- The microSD memory card is empty and formatted to FAT32.
- The PROFINET interface of the PDC is configured (IP address and device name are set) and connected to the PG/PC commissioning device.

Procedure for commissioning with STEP 7

Commissioning is performed according to the steps listed below. The individual commissioning steps are optional and are to be performed as required. We recommend the following procedure for the first commissioning of a PDC drive controller.

Table 8-1 Commissioning procedure

Step	Procedure	Comments	See section ...
1	Configure drive data set	Use one of the following options in the "Configure drive data set" dialog under "Parameters > Drive": • Read drive data set from the connected motor with IQ encoder (online) • Select preconfigured drive data set from list • Edit drive data set user-defined	Drive data sets (Page 121)
2	Perform controller optimization	Under "Commissioning" > "Optimization", perform a rotating measurement run and adapt the settings for the automatic controller calculation.	Optimization (Page 132), Rotating measurement run (Page 133)

Step	Procedure	Comments	See section ...
3	Make additional settings	• Setpoint channel • Open-loop/closed-loop control • Power unit • Communication • SSI encoder • Drive functions	• Setpoint channel (Page 137) • Open-loop/closed-loop control (Page 128) • Power unit (Page 144) • Communication (Page 91) • SSI encoder (Page 151) • Drive functions (Page 145)
4	Commission Safety Integrated	Only when fail-safe functions are required.	Commissioning Safety Integrated functions (Page 153)
5	Save parameters	Save parameter settings and, optionally, create an external parameter backup. Note: You can also save the parameters after each commissioning step. We recommend saving parameters before starting the safety commissioning.	Saving parameters in power-independent storage (Page 108), Creating a parameter backup (Page 181)

8.4 Drive data sets

Introduction

So that you can optimally handle the requirements of drive technology, the SIMATIC MICRO-DRIVE drive system is compatible with motors (Dunkermotoren, ebm-papst) and connecting cables (Harting, KnorrTec) of proven product partners of Siemens. This allows you to optimally combine suitable products from proven product partners for your individual application.

You can find more information about the Siemens Product Partner Program on the Internet (<https://new.siemens.com/global/en/company/topic-areas/partners/product-partners-industry.html>).

Drive data set

The motor or drive of the SIMATIC MICRO-DRIVE drive system is configured using a drive data set (DDS). A drive data set contains the settings and information for the following drive components:

- Motor
- Motor encoder
- Thermal motor model

8.4 Drive data sets

- Motor gearbox
- Motor holding brake

Note

The description "drive" means the combination of motor, encoder and additional built-on accessories such as a gearbox and holding brake.

Motor

You can find the settings for the motor in the "Parameters" > "Drive" > "Motor" area of the PDC engineering.

You specify the motor type (p0300) in this area: The SIMATIC MICRO-DRIVE drive system supports DC and EC motors.

Please note: DC motors are only supported by specific PDC device versions. You can find information on this in the manual of the respective PDC device version.

You specify important basic data and reference data of the motor.

Observe the information and notes in the help or in the tooltips of the individual parameters.

You will also find detailed information and descriptions for the drive parameters in section Parameters (Page 211).

Note

The information on the d-component of the motor connection inductance (p0377[1]) as well as the motor pole pair number (p0314) is not required for DC motors (p0300).

Motor encoder

You configure the motor encoder in the "Parameters" > "Drive" > "Encoder" area of the PDC engineering.

The motor encoder is used for the closed-loop speed control of the drive. You can assign it to the drive telegram, depending on the parameter assignment as encoder 1 (G1_XIST1, G1_XIST2) or encoder 2 (G2_XIST1, G2_XIST2), see section Encoder assignment (Page 152).

Fine resolution

The hardware interface of the incremental encoder and IQ encoder on the PDC is a quadrature interface, and the fine resolution of the incremental encoder and IQ encoder is therefore always "2". Example: 100 pulses or pulses per revolution (p0408) corresponds to 400 signal edges.

Note

IQ encoder

The IQ encoder is a single-turn absolute encoder and is connected to the connection for an incremental encode like a standard incremental encoder. The angular synchronization of the motor can therefore take place without a Hall sensor. However, you should consider the necessity of Hall sensors for safety-oriented applications, see section Safety Integrated functions (Page 70).

Encoderless operation is **not** supported. Angular synchronization is not necessary with DC motors.

Note

Configuration - Data exchange with encoder in the technology object of the CPU

Configure the data exchange with the encoder in the "Data exchange with encoder" configuration window. Select the "Automatic transfer of encoder parameter values in the device" option if you want necessary data, such as "Measuring system", "Increments per revolution", "Number of revolutions" and "Fine resolution" to be automatically transferred to the CPU as a value from the configuration of the drive. The settings are transferred from the drive after (re-)initialization of the technology object and (re)start of the drive and the CPU.

Thermal motor model

The motor can be protected from thermal overload. Take section Thermal monitoring (Page 146) into consideration for this.

You define the thermal properties of the motor in the "Parameters" > "Drive" > "Thermal motor model" area.

Motor gearbox and holding break

All additional information available from the drive, such as information for the gearbox and holding brake, is displayed in the "Electronic motor rating plate" area.

NOTICE
Gearbox and holding break
The information in the "Electronic motor rating plate" area is purely informative in nature and is not used in the PDC. For this reason, all speed and torque values and settings are also always directly referenced to the motor shaft without the gearbox. This is true even if the gearbox is already permanently installed on the motor. Always consider gearboxes and brakes independent of one another, e.g. in the higher-level closed-loop position control of a CPU.

NOTICE**Motor holding brake**

Check the operability of the mechanical motor holding brake or parking brake at regular intervals.

**WARNING****Unpredictable movements due to insufficient braking effect**

If you use a holding brake improperly, e.g. as an operating brake, or if you disregard the permissible operating energy of the brake, the brake will be subject to excessive wear (guaranteed service lives no longer apply). This may reduce or cancel the braking effect. Unpredictable movements of the machine or system as a result of this may cause death or severe injuries.

- Adhere to the permissible switching cycles and Emergency Stop properties.
- Only operate the motor with an intact brake.
- Avoid repeated brief motor starts with the brake applied.

Breakaway torque (holding torque)

The holding torque is the maximum permissible torque for the applied brake in static operation without slip (holding function when motor is at standstill). The data applies to the holding brake at operating temperature.

Braking torque (dynamic)

The dynamic braking torque is the lowest averaged dynamic braking torque that can occur during Emergency Stop operation.

Opening time and closing time

These are the delay times that arise when operating the brake.

8.4.1 Using the drive data set

To configure a drive, you have the following three options:

- For motors of Siemens product partners (e.g. Dunkermotoren and ebm-papst) with IQ encoder, you can load the drive data set directly from the electronic rating plate of the motor and use it.
- Download preconfigured drive data sets as a file for selected motors from Siemens Industry Online Support (<https://support.industry.siemens.com/cs/ww/en/ps/25460>).
- Create a user-defined drive data set and configure your motor manually.

Note

In the PDC engineering, the drive parameters can only be edited in the "Parameters" > "Drive" area if you are using a user-defined drive data set.



WARNING

After a change of the drive data set, you must adapt or optimize the parameters for the current and speed controllers, if necessary. You must also perform a safety commissioning, if necessary, so that the safety-relevant motor parameters are applied, see section Commissioning Safety Integrated functions (Page 153).

In case of manual controller tuning (p1301.0), always check the controller settings after a change of the drive data set. In case of automatic controller tuning, the settings for the current and speed controllers are automatically calculated by the drive according to the specifications for controller response (p1371) and load fluctuations (p1372), see section Open-loop/closed-loop control (Page 128).

8.4.2 Using the drive data set of the IQ encoder

The motors with IQ encoder from the Siemens Product Partner Program have an electronic rating plate.

You can read out the drive data set from the electronic rating plate of the motor with the help of the engineering tool. In this case, the data is transferred to the PDC drive controller via the encoder connection cable. Connect the motor encoder to the PDC for this, see section Connecting an encoder (Page 54). No additional connections are required.

Note

The current drive configuration of the PDC is not changed by the connection of a motor with IQ encoder. Use the "Read drive data set from the connected motor with IQ encoder" function during commissioning to set up the connected motor with IQ encoder.

Requirements

- Make certain that you have connected the motor with IQ encoder from which you want read the drive data set to the PDC, see section Connecting an encoder (Page 54).
- Establish an online connection to the PDC, see section Going online (Page 106).
- Ensure that the drive is not in operation.

Procedure

1. Open "Parameters" > "Drive" in the context of the drive.
2. Start the configuration wizard with the "Configure drive data set..." button in the "Drive data set" area.
3. Select the "Read drive data set from the connected motor with IQ encoder" option.
4. Click "Upload from IQ encoder".
The loaded drive data set is displayed in the report area and you can check the data.

5. Accept the configuration with "Yes".
6. Confirm that you are changing the drive data set.
The current setting for the controller tuning is displayed.
To then change directly to the commissioning area, select the "Display commissioning" option.

You have read out and set up the drive data set from the IQ encoder.

8.4.3 Using preconfigured drive data sets

You have the option of using preconfigured drive data sets for configuring your motor. You can obtain preconfigured drive data sets for selected motors from Siemens Industry Online Support (<https://support.industry.siemens.com/cs/ww/en/ps/25460>) or product partners.

Installing the drive data set

Preconfigured drive data sets are provided as a file (pdc-*.mpk) and must be installed in the STEP 7 engineering. A drive data set file can contain the configuration of one or more motors.

Expand the list of drives by installing new drive data sets from the file system:

1. Open "Parameters" > "Drive" in the context of the drive.
2. Start the configuration wizard with the "Configure drive data set..." button in the "Drive data set" area.
3. Select the "Select preconfigured drive data set from list" option.
4. Click "Install drive data set"  and select one or more drive data set files that you want to install.

You have installed a drive data set and can now use it.

Note

An installed drive data set is installed locally on the PG/PC only for the current STEP 7 version. To open the local installation folder, click the "Locally installed drives" link in the "Configure drive data set" wizard.

Using a preconfigured drive data set

You can search for the desired drive in the list of all locally installed drives and filter using specific properties.

1. Open "Parameters" > "Drive" in the context of the drive.
2. Start the configuration wizard with the "Configure drive data set..." button in the "Drive data set" area.
3. Select the "Select preconfigured drive data set from list" option.

4. Use the smart search and select the desired drive from the list. For example, enter "24V 1:1" in the search to filter for motors with 24 V rated voltage and without gearbox.

Note

Use a space character to separate various filters in the search. Filter by manufacturer, motor name, order number, rated voltage, gear speed, brake, drive ID or identifier and revision.

5. The selected drive data set is displayed in the report area and you can check the data.
6. Accept the configuration with "Yes".
7. Confirm that you are changing the drive data set.
The current setting for the controller tuning is displayed.
To then change directly to the commissioning area, select the "Display commissioning" option.

You have selected and set up a preconfigured drive data set.

Note

You can pass on a saved engineering project with preconfigured drive data set or use it on a different PG/PC on which the utilized drive is not installed. In this case, no optional additional information on the drive is displayed, e.g. manufacturer or order number. This is displayed as soon as you have installed the utilized drive.

8.4.4 Using a user-defined drive data set

Create a user-defined drive data set and configure your motor manually.

You can also use this function to edit an existing drive data set.

**WARNING****Avoiding incorrect parameter assignments**

Note that incorrect or modified parameter assignments can result in drive malfunctions and damage to the drive.

Procedure

To freely configure the current drive data, follow these steps:

1. Open "Parameters" > "Drive" in the context of the drive.
2. Start the configuration wizard with the "Configure drive data set..." button in the "Drive data set" area.
3. Select the "Edit drive data set by user" option.
4. Accept the configuration with "Yes".

5. Confirm that you are changing the drive data set.
The current setting for the controller tuning is displayed.
To then change directly to the commissioning area, select the "Display commissioning" option.
6. Assign a drive name (p0303) and adapt the settings for motor, motor encoder and thermal motor model for your drive.
Observe the information and notes in the help or in the tooltips of the individual parameters. You will also find detailed information and descriptions for the drive parameters in section Parameters (Page 211).

You have selected user-defined editing of the drive and adapted the settings.

Note

No additional information on the drive is displayed in user-defined mode. You do not have to set the "Drive identifier" (p0302), "Drive data set signature" (p0143) and "Drive data set signature extension" (p0142) parameters. For example, enter the value "0".

8.5 Controller settings

8.5.1 Open-loop/closed-loop control

Under "Parameters" > "Open-loop/closed-loop control", you specify the general controller settings and the settings for speed and current controllers.

- Controller settings and load description
- Speed controller
- Current controller
- Supplementary torques, see section Suspended axis (Page 135)

Control type

The drive supports cascade speed controllers. Speed and current controllers operate in the drive with a sampling time of 62.5 μ s.

Controller setting

You can tune the speed and current controllers manually or use the automatic controller calculation.

You can optimally tune speed and current controllers if you specify the properties of the load in the machine due to mechanical systems and the electrical properties of the motor connection.

- Important properties of the load in the machine due to mechanical systems:
 - Load frictional torque (p1395)
 - Moment of inertia of the load (p1398)
 - Static torque of the load (p1396)

Note

To have the load due to mechanical systems of the drive measured, you perform a rotating measurement run, see section Rotating measurement run (Page 133). To do so, open the "Commissioning" > "Optimization" > "Measurement run" area.

- Important electrical properties of the motor connection:
 - Motor cable resistance (p0352)
 - Motor series inductance (p0353)

Precontrol of closed-loop controller

If the load mechanics (Frictional torque p1395, Moment of inertia p1398 and Load torque p1396) are configured optimally, a significantly improved controller result can be achieved by means of precontrol.

For this purpose, open the advanced settings in the "Controller settings" area and adapt the following points:

- Speed precontrol (p1375)
- Moment of inertia precontrol (p1376)
- Frictional torque precontrol (p1377)
- Efficiency when motoring (p1391)
- Efficiency when generating (p1390)

For the precontrol, values between 60% and 80% generally represent a good compromise between occurring fluctuations and the control result.

If the efficiency is unknown and cannot be estimated, you can leave the values at 100%. If only one efficiency is specified, this usually relates to the efficiency when motoring (p1391). In this case, enter the same value for the efficiency when generating (p1390).

Automatic controller optimization

You can have the controller settings of the drive calculated automatically by the PDC during commissioning.

The advantage of automatic controller optimization is that the speed and current controllers are automatically re-tuned when you:

- modify the drive data set or change to another drive data set; see section Drive data sets (Page 121)
- change the description of the load properties; see section Rotating measurement run (Page 133)
- change the connection properties such as the motor series inductance (p0353) or the motor cable resistance (p0352).

With automatic controller tuning, the settings for the speed and current controllers are automatically calculated and updated in the drive.

Tuning the current controller

The current controller is preset to match the motor and corresponding to the connection properties of the motor in the drive. As a consequence, it is adequately optimized for most applications.

Tuning the speed controller

With automatic controller tuning, the optimal settings for the speed controller are calculated corresponding to what has been specified for the controller response (p1371) and load fluctuation (p1372) and updated.

Automatic synchronization of the speed controller takes place according to the principle of symmetrical optimum, where the selection of the phase reserve is variable based on the setting for load fluctuations.

1. Set the tuning type for the controller parameters (p1301.0) to the value "[1] Automatic".
2. Specify the desired settings for controller response (p1371) and load fluctuations (p1372).

Select the controller response (p1371) and the load fluctuations (p1372) according to the mechanical system of your machine:

Table 8-2 Different values of the controller response (p1371)

0	very soft	Slow speed control and low mechanical load.
50	normal	Compromise between fast speed control and low mechanical load.
100	aggressive	Fast speed control – increased mechanical load.

Note

If there are elastic transmission elements in the drive train (e.g. belts or toothed belts), you should generally set a smaller value; if the drive train is adequately inelastic, larger values are also recommended.

Table 8-3 Different values of the load fluctuations (p1372):

0	normal	Fastest speed control without change of load behavior.
50	high tolerance	Slow speed control on change of load behavior.
100	very high tolerance	Very slow speed control on large and dynamic change of load behavior (e.g. elastic mechanics).

Note

If the motor vibrates or whistles at certain speeds, adapt the settings for controller response (p1371) and fluctuations (p1372) as appropriate and check the control behavior again.

Manual controller tuning

WARNING

Only experienced drive technicians should manually enter integral times and gain factors for speed and current controllers!

1. Set the tuning type for the controller parameters (p1301.0) to the value "[0] Manual".
2. Enter the values for speed and current controllers as desired.

Use the online function "Calculate controller settings" to assign the optimum speed and current controller settings based on the specifications in the "Controller settings" area.

Then, perform the desired fine-tuning of the parameters for speed and current controllers.

1. Specify the desired settings for controller response (p1371) and load fluctuations (p1372).
2. Click the "Calculate controller settings" button and wait while the settings are calculated in the drive.
The speed and current controller settings are updated in the drive. You can apply the results directly to your project in the dialog.
3. Tune the values for the speed and current controllers as desired.

Note

As a rule, you can apply the current controller settings from automatic mode without changing them because they are not dependent on the load.

You have manually tuned the drive controllers.

Commutation

The PDC drive controller works in connection with three-phase (ES) motors with sine commutation and field-based control. In DC motors, commutation takes place mechanically by means of a scrub system.

Note

With sine commutation, only a reduced DC link voltage can be forwarded to the motor

If the supply voltage of the power unit (4L+) is the same as the rated motor voltage (p0304), the motor only reaches about 80% of the specified rated motor speed (p0311) due to the sine commutation. To be able to operate the motor at rated speed (p0311), the DC link voltage (4L+) must be about 20% above the specified rated motor voltage (p0304).

However, make sure to consider the given DC link voltage limit, see section Power supply (Page 29).

8.5.2 Speed setpoint filter

The drive has a first-order time-delay element (low pass PT1) as a speed setpoint filter. The filter time constant can be set with p1416.

The speed setpoint filter is able to attenuate harmonic components of the setpoint and thus to reduce any overshooting of the controller.

The speed setpoint filter has no effect on the stability of the speed controller because it is in the setpoint channel before the control loop. The dynamics of the response to setpoint changes is reduced by smoothing.

As a rule, the speed setpoint filter can be set to a small value or zero because the upstream ramp generator ensures adequate limiting of the setpoint signal. If the speed setpoint filter is used nevertheless, you typically select a value equal to or greater than the integral time of the speed controller (p1462).

8.5.3 Optimization

Overview

The optimization consists of three phases:

- Determination of the load properties
- Determination of the connection properties
- Optimization of controller settings

Determination of the load properties

If you know the load properties of the machine, enter the values in the following parameters:

1. Frictional torque of the load (p1395)
2. Static torque of the load (p1396)
3. Moment of inertia of the load (p1398)

This completes the determination of the load properties.

If you do not know or only partially know the load properties, the rotating measurement run is a useful tool for determining the missing data.

1. Perform a rotating measurement run (Page 133).

Determination of the connection properties

This step can be skipped in most cases, but should be performed if, for example, very long motor cables are used.

Determine the connection properties of the motor to further optimize the control properties of the motor. Determine the following values for this:

1. Motor series inductance (p0353)
2. Motor cable resistance (p0352)

This completes the determination of the connection properties.

Optimization of controller settings

Optimize your controller settings with the automatic or manual controller tuning as described in section Open-loop/closed-loop control (Page 128).

Note

If you use the rotating measurement run to determine the load properties, you can tune the controller settings in the same navigation area under "Optimize controller settings". The recommended sequence of steps for the controller optimization is clearly represented in this window.

8.5.4 Rotating measurement run

Introduction

If you do not know or only partially know the load properties, the rotating measurement run can be a useful tool for determining the missing data. Perform the rotating measurement run with coupled load in order to optimize the closed-loop control properties of the motor through determination of the load properties.

Load properties of the machine are:

- Frictional torque of the load (p1395)
- Static torque of the load (p1396)
- Moment of inertia of the load (p1398)

Note

You can only use this function if an online connection to the PDC exists.

The large number of possible load cases can have the result that the measurement run fails or no optimum parameter values are determined. In these cases, you need to perform a manual adaptation as described in section Open-loop/closed-loop control (Page 128).

We recommend deactivation of the safety functions SLS, SSM and SLT for motion monitoring during the measurement run.

Procedure

To perform a rotating measurement, follow these steps:

1. Open the "Measurement run" area in the context of the drive via "Commissioning" > "Optimization".
2. Take over the master control.
3. Configure the settings for the parameters:
 - Dynamic response factor (p8990)
 - Revolutions limit (p8991)
 - Torque limiting (p1520)

Note

The "Dynamic response factor" influences the acceleration ramps during the rotating measurement run. A high value is suitable for stiff systems and a low value for elastic systems. Generally, a high dynamic response factor provides better results for the rotating measurement run.

For the "Revolutions limit", you set the maximum number of revolutions in each direction that is permissible for the rotating measurement run.

The "Torque limiting" acts only during the rotating measurement run.

4. To apply valid results of the measurement run directly to the controller settings, select the "Automatically apply valid measured values" check box.

WARNING
--

Risk to humans and machinery from a rotating motor

The motor must be free-running within the specified range.
--

The machine may be damaged if the travel range is not appropriately limited. You must provide a sufficiently large measuring range that is suitable for the load!

5. Click the "Start rotating measurement run now" button.
The rotating measurement is performed.
6. Note the information on the status of the rotating measurement (r8999).
7. Hand over the master control after the successful measurement run.
8. Transfer the load properties from the drive (online) to your project (offline) with the "Upload from device" function.
9. Copy the parameters from RAM to ROM to save the settings in non-volatile memory in the drive.

Note

Under "Referenced", the measured load properties are displayed referenced to the motor:

- Measurement run frictional torque load (r8395) referenced to rated motor torque (p0312)
 - Measurement run static load torque (r8396) referenced to rated motor torque (p0312)
 - Measurement run load moment of inertia (r8398) referenced to Motor rotor moment of inertia (p0341)
-

8.5.5 Suspended axis

The supplementary torque (p1511) is used to set an additional load torque. The supplementary torque (p1511) and the static torque of the load (p1396) have the same effect and are summed in the drive.

To prevent a suspended axis without mechanical weight compensation from sagging after the holding brake is released, you can set up an electronic weight compensation via a supplementary torque (p1511).

This reduces the compensation action after the release of a holding brake and specifies the holding torque directly after switch-on of the motor.

NOTICE

Note the necessity of a motor holding brake in conjunction with suspended axes.

When holding brakes are used, the special technological and machine-specific regulations and standards for protection of personnel and machinery must be complied with. In addition the risks associated with suspended axes must be assessed.

Note

Set the torque limitation in p1520 appropriately.

8.5.6 Flying restart

After switching on to a rotating motor, the "Flying restart" function autonomously starts the motor. This allows you to avoid sudden loads on the entire mechanical system.

When the motor is switched on to a rotating motor, the current speed setpoint in the ramp generator is set to the current actual speed value. The ramp-up to the final speed setpoint takes place from this value.

The "flying restart" function is always active in the PDC drive controller.

Note

During the flying restart, not only the speed ramp generator but also the torque ramp generator, the speed setpoint filter and the integral-action components of the speed controller and current controller are initialized in such a way that the transition to the current speed is as jerk-free as possible.

Following a reconfiguration of the actual value processing, this is also executed as jerk-free as possible to prevent step changes in the actual values (e.g. speed, torque).

8.5.7 OFF responses

OFF1 (Switch off)

When the ON command is withdrawn, OFF1 is activated and the drive is braked to 0 in a speed-controlled manner according to the ramp generator ramp-down (p1120[1], p1130[1], p1131[1]). If the actual speed falls below the value of the "Zero speed detection" (p1226) parameter, the pulses become inhibited and the motor is in free-running state and coasts down.

"Switching on inhibited" is activated.

OFF2 (Coast down)

The OFF2 command inhibits the pulses immediately. The motor is in free-running state and coasts down.

"Switching on inhibited" is activated.

OFF3 (Quick stop)

The drive is braked to 0 in a speed-controlled manner according to the OFF3 braking ramp (p1135, p1136, p1137). If the actual speed falls below the value of the "Zero speed detection" (p1226) parameter, the pulses become inhibited and the motor is in free-running state and coasts down.

"Switching on inhibited" is activated.

Note

The setting of the OFF3 braking ramp should be geared to the actual braking capacity of the drive/motor.

Prioritization

The OFF responses are prioritized as follows:

- OFF2 (Coast down) > OFF3 (Quick stop) > OFF1 (Switch off)

8.6 Setpoint channel

Overview

Setpoints from the respective setpoint source are prepared for the motor control in the setpoint channel of the drive.

The following options are available for the setpoint setting:

- Fieldbus (PROFINET drive telegrams according to PROFIdrive)
- Drive control panel

You can find the settings for the setpoint channel in the context of the drive under "Parameters" > "Setpoint channel".

Under "Setpoint channel" you configure the following:

- Reference values (Page 138)
- Limit values (Page 139)
- Ramp generator (Page 141)

The figure below shows the processing of the speed setpoint in the drive controller.

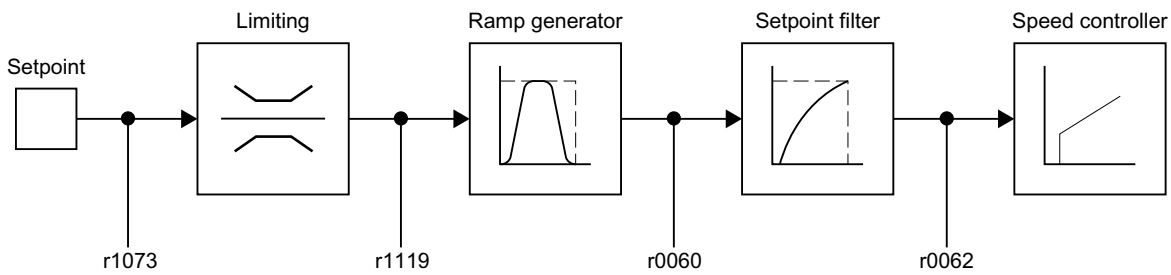


Figure 8-9 Setpoint channel

The speed setpoint from the drive telegram (r1073) is limited in the setpoint channel according to the specified values, see section Limit values (Page 139).

The limited speed setpoint (r1119) is fed to the ramp generator as an input signal, see section Ramp generator (Page 141).

The output of the ramp generator (r0060) is fed to the speed controller (r0062) via the speed setpoint filter, see section Speed setpoint filter (Page 132).

8.6.1 Reference values

The physical values speed and torque are transferred to the drive telegrams as referenced values.

- Speeds are normalized to the reference speed (p2000) in the drive telegram.
- Torques are normalized to the reference torque (p2003) in the drive telegram.

Parameters p2000 and p2003 are definitive as reference values (telegram content = 4000 hex or 4000 0000 hex for double words, if the input value has the value p2000 or p2003).

Example of the normalization of the speed:

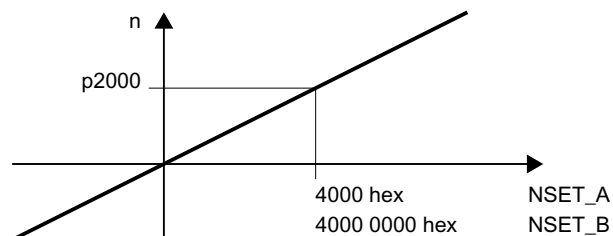


Figure 8-10 Example of normalization of the speed

Note

The speed and torque are specified in the drive telegram as a percentage of the reference speed in the range -200% to 200%.

Therefore, set the reference variables in such a way that the desired maximum value falls within the value range of the control from -200% to +200%.

Procedure

1. Configure the reference values in the context of the drive under:
"Parameters" > "Setpoint channel" > "Reference values".



WARNING

Uncontrolled drive behavior

Note that the specification of reference values in the CPU and the drive must always match. Otherwise, uncontrolled drive behavior and rotating of the motor might occur. We therefore recommend that commissioning of the drive and thus specification of the reference values be completed first before you commission the CPU and, for example, a technology object.

Note

Configuration - Data exchange with drive in the technology object of the CPU

Configure the data exchange with the drive in the "Data exchange with the drive" configuration window. Select the "Automatic transfer of drive parameters in the device" option if you want the drive parameters "Reference speed", "Maximum speed" and "Reference torque" to be transferred to the CPU as a value from the drive configuration. The drive parameters are transferred from the drive after (re-)initialization of the technology object and (re)start of the drive and the CPU.

8.6.2 Limit values

In the "Parameters" > "Setpoint channel" > "Limit values" area, you can configure limitations for the speed and torque of the drive if required and adapt them to the requirements of your mechanical system.

Speed limiting

If you need a direction-dependent speed limiting, you can define speed limits for each direction.

Torque limiting

You can specify the torque limiting as an absolute value. The limiting acts both when motoring as well as generating.



WARNING

Danger to life due to uncontrolled movement of the drive as a result of incorrect parameter assignment

Incorrect parameterization of the torque limiting can result in uncontrolled movement of the drives if there is no counter-torque, and cause death or serious injury.

- Ensure the correct parameterization.

Zero speed detection

Specify the speed threshold for the zero speed detection of the motor. For braking with OFF1 or OFF3, the zero speed is detected when this threshold is fallen below.

Speed threshold values for message

Also specify the speed threshold values for the following messages of the drive status word:

- "n comparison value reached or exceeded" in the ZSW1 (bit 10).
Set the signal source for this message in parameter p2141.
- "Speed setpoint - actual value deviation within tolerance" in ZSW1 (bit 8).
Set the signal source for this message in parameter p2151.

Speed limitation through incremental encoder frequency

In this section we explain the correlation between maximum incremental encoder frequency and speed.

The frequency of the A/B signal of the incremental encoder can be converted into a speed using the number of encoder pulses.

The following correlation exists for an encoder fine resolution of 2 (hardware quadrature interface):

$$n_{Mot} = \frac{60}{4} \times \frac{f_{AB}}{k_{Enc}}$$

with

- n_{Mot} Motor speed without gear unit in rpm
- f_{AB} Frequency quadrature interface in Hz (combination of A/B signal)
- k_{Enc} Encoder pulse count

The maximum frequency that can be measured at the incremental encoder input (terminal X4050 of the PDC drive controller) is 200 kHz per A or B signal. The frequency quadrature interface therefore is $200 \text{ kHz} \times 4 = 800 \text{ kHz}$. With a pulse number (p0408) of 1000 this results in a maximum speed of:

$$n_{Mot} = \frac{60}{4} \times \frac{800,000 \text{ Hz}}{1000} = 12,000 \text{ 1/min}$$

The IQ encoder generates an incremental signal with a maximum frequency of 36 kHz. With a pulse number (p0408) of 100 this results in a maximum speed of:

$$n_{Mot} = \frac{60}{4} \times \frac{36,000 \text{ Hz}}{100} = 5,400 \text{ 1/min}$$

Note**Speed limitation through incremental encoder frequency**

In the PDC drive controller the maximum speed is limited automatically depending on the set sensor type (p0404) according to the permissible A/B frequency.

System limitation

The maximum motor speed is limited automatically by the PDC drive controller based on the following system limits:

- Speed max. 25000 rpm
- Motor current max. = $3.9 \times p0305$ (rated motor current)
- Motor speed max. = $3.9 \times p0311$ (rated motor speed)
- Electrical rotary field frequency maximum = 500 Hz
- Maximum modulation factor = ca. 80% (with sine commutation)

8.6.3 Ramp generator

The PDC drive controller has the following ramp generators:

- Speed ramp generator
- Torque ramp generator

Procedure

1. Configure speed and torque ramp generators in the context of the drive under:
"Parameters" > "Setpoint channel" > "Ramp generator".

Speed ramp generator

The speed ramp generator is used to limit the acceleration at sudden setpoint changes and helps to prevent drive train shock loads.

An acceleration ramp and a deceleration ramp can be set independently of each other with the ramp-up time p1120[0] and ramp-down time p1120[1]. This enables a controlled transition at setpoint changes.

The reference value for calculation of the ramps from the ramp-up and ramp-down times of the ramp generator is the rated motor speed (p0311).

There is a special ramp for quick stop (OFF3), which can be adjusted using the ramp-down time p1135.

Note

On principle, the ramp-up and ramp-down times of the ramp generator in the setpoint channel of the drive should be set only so fast that, in case of accelerations and decelerations, the motor speed can track the setpoint without damaging the machine. This ensures optimal functioning of the speed controller precontrol.

There are 2 types of ramp generators (p1115):

- Basic ramp generator with ramp-up and ramp-down ramps
- Extended ramp generator with additional initial rounding-off and final rounding-off

Properties of the basic ramp generator:

- Speed-ramp generator ramp-up time T_{up} - p1120[0]
- Speed-ramp generator ramp-down time T_{dn} - p1120[1]

Properties of the extended ramp generator:

- Speed-ramp generator ramp-up time T_{up} - p1120[0]
- Speed ramp generator initial rounding-off time (ramp-up) IR_{up} - p1130[0]
- Speed ramp generator final rounding-off time (ramp-up) FR_{up} - p1131[0]
- Speed-ramp generator ramp-down time T_{dn} - p1120[1]
- Speed ramp generator initial rounding-off time (ramp-down) IR_{dn} - p1130[1]
- Speed ramp generator final rounding-off time (ramp-down) FR_{dn} - p1131[1]

For the extended ramp generator, this yields:

- Effective ramp-up time: $T_{up_eff} = T_{up} + (IR_{up}/2 + FR_{up}/2)$
- Effective ramp-down time: $T_{dn_eff} = T_{dn} + (IR_{dn}/2 + FR_{dn}/2)$

Properties of the OFF3 braking ramp:

- OFF3 ramp generator ramp-down time T_{dn} - p1135
- OFF3 ramp generator initial rounding-off time IR - p1136
- OFF3 ramp generator final rounding-off time FR - p1137

For the OFF3 braking ramp, this yields:

- Effective ramp-down time: $T_{dn_eff} = T_{dn} + (IR/2 + FR/2)$

Braking of the motor with the OFF3 braking ramp

During "quick stop", the drive controller brakes the motor with the OFF3 ramp-down time. The drive controller switches off the motor once standstill has been reached. The command is often used for exceptional operating situations where it is necessary to brake the motor very quickly, e.g. for collision protection.

Torque ramp generator

Like for the speed ramp generator, an extended ramp generator and initial and final rounding-off times are also available for the torque ramp generator.

The reference value for calculation of the ramps from the ramp-up and ramp-down times of the ramp generator is the rated motor torque (p0312).

Properties of the basic ramp generator:

- Torque-ramp generator ramp-up time T_{up} - p1125[0]
- Torque-ramp generator ramp-down time T_{dn} - p1125[1]

Properties of the extended ramp generator:

- Torque-ramp generator ramp-up time T_{up} - p1125[0]
- Torque ramp generator initial rounding-off time (ramp-up) IR_{up} - p1132[0]
- Torque ramp generator final rounding-off time (ramp-up) FR_{up} - p1133[0]
- Torque-ramp generator ramp-down time T_{dn} - p1125[1]
- Torque ramp generator initial rounding-off time (ramp-down) IR_{dn} - p1132[1]
- Torque ramp generator final rounding-off time (ramp-down) FR_{dn} - p1133[1]

For the extended ramp generator, this yields:

- Effective ramp-up time: $T_{up_eff} = T_{up} + (IR_{up}/2 + FR_{up}/2)$
- Effective ramp-down time: $T_{dn_eff} = T_{dn} + (IR_{dn}/2 + FR_{dn}/2)$

Speed and torque ramp generators

Speed and torque ramp generators are connected. The limiting effect originates from the weakest element. Example: The speed acceleration ramp is set steep enough that the torque resulting from the acceleration and inertia of the mass to be moved would exceed the torque of the set torque acceleration ramp. If you now enter a setpoint at the PDC, the axis is accelerated based on the torque acceleration ramp and not the speed acceleration ramp.

Note

Special case: The axis is blocked or is pressing against a fixed stop with a set torque

You now want to reduce the pressure-exerting torque using the deceleration ramp of the torque ramp generator and initiate a change of direction. For this purpose, you first need to control the torque deceleration using the torque reduction with the "MOMRED (Page 150)" signal (setpoint 0 Nm). You then initiate the change of direction with a drive task and cancel the torque reduction of 0 Nm again or reset it.

8.7 Power unit

You set up various applications for the power unit of the drive:

- Energy recovery (Page 144)
- Overload protection (Page 144)

Procedure

1. Configure the power unit of the drive under:
"Parameters" > "Power unit".

Note

You can read out the type and the properties of the power unit online in the context of the drive under "Online & diagnostics" > "Diagnostics" > "Actual values" > "Power unit".

8.7.1 Energy recovery

You can activate or deactivate energy recovery of the drive using parameter p0205.0.

When energy recovery is permitted, the control of the internal and external brake resistance is deactivated. Further, the DC link voltage monitoring is set to a trip value for voltages >60 V. The user is responsible for ensuring compliance with the permissible voltage limits.

For battery operation, we recommend that energy recovery be permitted in order to avoid possible operational disturbances.

NOTICE
Maximum DC link voltage with energy recovery
When energy recovery is activated, use a suitable bi-directional supply to ensure that the voltage at 4L+ does not exceed 60 V DC even under fault conditions. Refer to section Power supply (Page 29).



WARNING
Operation above the voltage setting range
Under the given application conditions, ensure that the motor is not operated above the voltage setting range by selecting the appropriate motor and gear unit; otherwise, the DC-link voltage can increase above 60 V DC with inactive control.

8.7.2 Overload protection

You can have the load of the power output stage automatically limited by the drive. To do so, configure the automatic overload limiting (p0205.1) as desired.

Automatic overload limiting

With automatic overload limiting, the output current (r0027) is automatically reduced on reaching the rated load of the power output stage (r0036 = 100%) to effectively prevent an overload of the power unit.

Temporary violation of the warning limit cannot be ruled out here.

Please note: For automatic overload limiting (p0205.1) the thermal overload alarm of the power end stage (r2135.9) is suppressed.

Note

Overload capability of the power unit

Operation with peak current (r0209) is possible for a short time if the average rms output current does not exceed the rated current of the power unit (r0208).

Calculation

See the information on the relationship between overload and recovery of the power unit in the manual of the respective PDC device version.

8.8 Drive functions

8.8.1 Blockage detection

Configure the blockage detection of the motor corresponding to your mechanical system and application.

Description

A motor is detected as being blocked when the current speed (r0063) is less than the speed threshold value (p2175) for longer than the delay time (p2177) and the torque limit has been reached. The drive signals that the torque limit has still not been reached in status bit "Torque limit not reached" in ZSW1 (Bit 11) (r0968.11 or r0899.11).

For a blocked motor, message F61009 "Motor blocked" is output.

Note

Message F61009 "Motor blocked" can also be triggered when the actual speed value oscillates and the speed controller output reaches the stop.

The blockage detection of the motor is inactive in "Travel to fixed stop" mode, see section Travel to fixed stop (Page 149).

Procedure

1. You configure the blockage detection of the motor in the context of the drive under:
"Parameters" > "Drive functions" > "Blockage detection".

NOTICE
When blockage detection is disabled, the drive is continuously in "Travel to fixed stop" mode, see section Travel to fixed stop (Page 149).

8.8.2 Thermal monitoring

Overview

The purpose of thermal monitoring is to detect critical states. Parameterizable warning thresholds are available that allow further operation of the drive (e.g. with reduced power) and prevent an immediate shutdown. However, the parameter assignment options are only interventions below the shutdown thresholds.

The shutdown thresholds of the internal braking resistor and the power output stage are fixed and cannot be changed. The shutdown threshold of the thermal motor monitoring is defined by means of the drive data set in the "Maximum temperature" parameter (p0325).

The following thermal monitoring options are available:

- Motor
 - Basis model (I^2t relative)
 - IQ encoder (absolute)
- Internal braking resistor
 - Energy model
 - Temperature sensor
- Power output stage
 - Overload protection
 - Temperature sensor
- Operating temperature

When an overload is detected by one of these monitoring functions, a warning is output first. The respective warning thresholds (p0291) are parameterizable. The current status of the monitoring functions is displayed in status word thermal monitoring (r2135). When an alarm

limit or fault limit is exceeded, message F61059(A) "Temperature and energy monitoring" is output.

Note

All alarm and fault limits are provided with a corresponding hysteresis. The corresponding alarm or fault messages therefore remain until the threshold including hysteresis has been fallen below.

Motor

The thermal motor monitoring is carried out using a parameterizable temperature model. Two types of thermal models (p0601) are available: The thermal motor model type (p0601) is selected during configuration of the drive data set, see section Drive data sets (Page 121).

**WARNING****Thermal motor utilization cannot be immediately determined after initialization**

The thermal model is reinitialized after changing the drive data set and when switching on the device.

After initialization, the thermal motor utilization cannot be immediately determined as the model must first settle. As a consequence, an initial utilization of 50% is used as basis. The settling phase duration depends on the given thermal time constants; the accuracy depends on to what extent the specific installation situation deviates from the model.

During the settling time it is possible that the set alarm and/or interference threshold is reached with some delay. For the installation situation simulated in the model, a comparatively unfavorable installation was selected so that generally deviations occur on the safe side.

You can specify the warning threshold (p0291[0]) relative to the respective shutdown threshold.

Procedure

1. Configure the drive data set in the "Drive" area in the context of the drive under "Parameters".
2. Open the "Motor" area in the context of the drive under "Parameters" > "Drive functions" > "Messages/Monitoring functions".
3. Configure the warning threshold p0291[0].

Basis model (I²t monitoring with relative values)

The I²t monitoring operates with the relative motor power loss (r0042), and in addition to the rated motor current (p0305) as reference value, only requires the thermal time constant winding - environment (p0611[0]) to calculate the limiting integral. The 100% shutdown threshold for the basis model corresponds to the maximum continuous power loss of the motor, i.e. to the square of the rated motor current (p0305).

IQ encoder (Pt monitoring two-loop with absolute values)

The extended monitoring with IQ encoder provides critical advantages over the basis model with I²t:

- Protection from pulsed overload
- Consideration of additional temperature effects
- Determination of absolute temperatures

The additional time constant prevents a pulsed overload of the winding. In addition, temperature effects owing to a cold or hot motor are taken into account by the power measurement. By determining the absolute temperature of the motor winding and enclosure, it is also possible to fully utilize the temperature range, i.e. a higher motor load is possible at room temperature than at, for example, 40 °C.

The Pt monitoring with absolute values operates with the relative motor power loss (r0042) and current IQ encoder temperature (r0035[0]). In addition, the values for the thermal time constants (p0611), thermal resistances (p0613) and intrinsic temperature rise of the IQ encoder (p0617) are needed.

Note

The values for the thermal time constants (p0611), thermal resistances (p0613) and intrinsic temperature rise of the IQ encoder (p0617) are included on the electronic rating plate of a motor with IQ encoder and are provided by the motor manufacturers of the Siemens Product Partner Program.

The 100% shutdown threshold for the IQ encoder model corresponds to the maximum continuous power loss of the motor, calculated using:

$$\begin{aligned}\text{Shutdown threshold} &= \text{Rated voltage} \times \text{Rated current} - (\text{Rated speed}/60 \times 2\pi \times \text{Rated torque}) \\ &= p0304 \times p0305 - (p0311 \times 2\pi \times p0312)\end{aligned}$$

Power output stage

The power output stage is monitored with a temperature sensor. You can specify the warning threshold (p0291[1]) relative to the shutdown threshold "System maximum temperature power end stage" (r3692).

Procedure

1. Open the "Power output stage" area in the context of the drive under "Parameters" > "Drive functions" > "Messages/Monitoring functions".
2. Configure the warning threshold p0291[1].

Besides the temperature monitoring, the current load is also monitored. The current load of the power unit is decisive for the temperature rise. The relative load of the power end stage (r0036) is calculated based on the square of the output current (r0027), referenced to the rated value of the power unit (r0208) according to the I²t method.

You can have the current load of the power output stage automatically limited by the drive. To do so, configure the automatic overload limiting, see section Overload protection (Page 144).

Internal braking resistor

Specific PDC device versions have an internal braking resistor to absorb the generating energy of the motor. The current internal brake resistance utilization from an energy perspective (r0034[2]) is calculated using the amount of energy absorbed.

The internal brake resistance is monitored based on a two-loop temperature model so that the pulse load as well as the continuous load is monitored. After the module is switched on, an initial load of 50% is assumed (initial value of r0034[2] is 50%).

You can specify the warning threshold (p0291[2]) relative to the shutdown threshold "System maximum energy brake resistance" (r3690).

Note

At each braking operation, the drive checks whether an external braking resistor is present. If this is the case, the internal braking resistor is electrically disconnected.

The internal braking resistor is also monitoring with a temperature sensor. You can specify the warning threshold (p0291[3]) relative to the shutdown threshold "System maximum temperature brake resistance" (r3691).

Procedure

1. Open the "Internal braking resistor" area in the context of the drive under "Parameters" > "Drive functions" > "Messages/Monitoring functions".
2. Configure the warning thresholds p0291[2] or p0291[3]

Operating temperature

Note that the specified ambient temperature range for the drive must always be adhered to. The technical specifications of the individual PDC drive controllers are available in the manual of the respective PDC device version.

When the maximum permissible operating temperature is exceeded, the drive outputs alarm F61059(A) "Temperature and energy monitoring".

8.8.3 Travel to fixed stop

With the "Travel to fixed stop" function, the motor can be moved to a fixed stop with a specified torque without a fault being signaled. When the stop is reached, the specified torque builds up and is continuously applied. The desired torque reduction is effected by a corresponding scaling of the torque limit.

Application examples

- Screwing of parts with defined torque
- Travel to mechanical reference point

Activation and status display of "Travel to fixed stop" function is by means of the "STW2" or "ZSW2" signal of the drive telegram. The PROFIdrive telegrams 2, 3, 4, 102 and 103 are suitable for this; see Table 7-2 Supported communication telegrams (Page 98).

When the "Travel to fixed stop" function is activated, the absolute value of the torque setpoint after limiting (r1503) is approached.

When PROFIdrive telegrams 2 to 4 are used, no torque reduction is transferred. The absolute value of the torque limit (p1520) is therefore approached.

In the case of dynamic torque reduction via the "MOMRED" signal, the torque setpoint in r1503 is reduced accordingly.

Note

When you deactivate blockage detection of the motor (p1545.0), the drive is continuously in "Travel to fixed stop" mode.

Procedure

For commissioning the "Travel to fixed stop" function, follow these steps:

1. Set the torque limit (p1520) as required.
2. Activate "Travel to fixed stop" in control word STW2 (Bit 8).
3. Have the motor travel to the stop.

The motor travels with the set torque and, on reaching the stop, operates against the stop until the torque limit is reached. This can be detected at status bit "Torque limit not reached" in r0968.11 and/or r0899.11.

See also

Communication telegrams (Page 97)

8.8.4 Dynamic torque reduction

MOMRED (torque reduction)

If dynamic torque reduction is required, this can be realized using the MOMRED signal with drive telegrams 102 and 103.

This setpoint is used to reduce the torque limit that is currently active in the drive. The percent by which the torque limit is to be reduced is specified with MOMRED. This value is internally converted to the absolute value to which the torque limit is reduced. The percentage of available torque is displayed in parameter p1543.

Parameter r1503 indicates the absolute value of the active torque setpoint after limiting (p1520) and reduction (MOMRED).

Note

The MOMRED signal is scaled to 4000 hex (16384 dec), see parameter r1544. The value 4000 hex (16384 dec) in the MOMRED control word corresponds to a reduction by 100% of the set reference torque p2003.

8.8.5 SSI interface

Introduction

The PDC drive controller has an SSI interface (Synchronous Serial Interface) for connecting an absolute encoder. In this case, the drive is the interface between the absolute encoder (SSI) and the higher level controller. You process the cyclically acquired encoder value in your user program in the CPU.

Note

The speed control in the drive always takes place via the motor encoder.

Properties

The SSI interface of the drive has the following properties or options:

- Isochronous mode
- Standardization of the encoder value, i.e. pushing aside of trailing, irrelevant bits in the encoder value.
- Gray/dual converter
- Absolute encoder (SSI) with up to 32 bits
- Optional signal monitoring

Procedure

1. You configure the SSI interface in the context of the drive under:
"Parameters" > "SSI encoder".

Note

You can place the acquired SSI position data in the drive telegram as an encoder signal and use it in the CPU, e.g. for homing. You will find the procedure for assigning an encoder to the drive telegram in section Encoder assignment (Page 152).

You will find the procedure for connecting an SSI encoder in section Connecting an SSI encoder (Page 58).

8.8.6 Encoder assignment

Introduction

You have 0 to 2 encoders available depending on the drive telegram used. You will find the number of encoders supported by the respective drive telegram in Table 7-2 Supported communication telegrams (Page 98).

Procedure

1. Open the "Parameters" > "Communication" area in the context of the drive.
2. Select which drive encoder is to be assigned to the drive telegram as encoder 1 and encoder 2.

Note

You must activate and configure the motor encoder and/or SSI encoder independent of one another. See sections Drive data sets (Page 121) and SSI interface (Page 151).

See also

Communication telegrams (Page 97)

8.9 Commissioning Safety Integrated functions

8.9.1 Safety instructions for commissioning

Safety instructions for the Safety Integrated functions

** WARNING****Unexpected movement of machines due to inactive safety functions**

Safety functions that are inactive or that have not been adjusted can cause unexpected movements on machines that may lead to serious injury or death. If you insert a memory card without safety functions instead of a card with active safety functions, the safety functions will be deactivated on a memory reset of the drive.

- Only insert cards with suitable settings in the drive.
- Prevent unauthorized persons from having access to the drive.
- Use passwords to protect configurations with active safety functions from being changed.

** WARNING****Unwanted movement due to incorrect parameter changes**

Incorrect parameter changes for SI functions can result in unwanted movements leading to death or severe injury.

- After making a change to a parameter for Safety Integrated functions, always perform an acceptance test for the function in question.
- Document the values determined in the acceptance test in an acceptance report.

Note**Faulty safety functions in case of non-EMC-compliant installation**

A non-EMC-compliant installation of your system/machine can result in sporadic safety function faults. Install the drive in an EMC-compliant manner according to the specifications in section Electromagnetic compatibility (Page 204).

**WARNING****Unsafe operating states due to manipulation of the Safety Integrated parameters after the acceptance test**

Incorrect parameter changes to Safety Integrated functions after an acceptance test can result in unwanted movements with subsequent severe injury or death.

- To prevent access to your machines and systems by unauthorized persons, implement access restrictions and take the precautions described in the security instructions in section Security information (Page 4).
- To prevent improper configuration changes and incorrect parameter changes of the Safety Integrated functions, take the precautions described in this manual
- Check the safety log book of the drive controller at regular intervals, see section Safety change tracking (Page 166). Make certain that no changes have been made to the parameters after the last successfully completed acceptance test.
- If intentional changes have been made, repeat the acceptance test for the Safety Integrated functions affected. The purpose of the acceptance test is to ensure and document safe operation of the system. Correct any unintentional changes back to the original values and repeat the acceptance test.

Reference

Note

- Observe the information in the following sections and in section Safety Integrated functions (Page 70).
 - In section Acceptance of the safety functions (Page 86), you will find recommendations on how to perform and document the acceptance tests for the individual safety functions.
-

8.9.2 Safety Integrated in the engineering system

Safety-relevant areas and Safety Integrated parameters and messages are marked in yellow in the engineering system of the STEP 7 (TIA Portal).

Safety messages

You will find faults and alarms from the Safety Integrated area in the general message window, see section Messages (Page 196).

Faults and alarms from the Safety Integrated area are marked in yellow in the message buffer.

Note

Fail-safe acknowledgment

Stop responses triggered by internal events are indicated by safety faults, which require safe acknowledgment followed by a standard acknowledgment.

You have the following options for the safe acknowledgment (Internal Event Acknowledge):

- POWER ON by switching the supply voltage off and then on again.
- Selection/deselection of HW STO. Requirement: "Extended message acknowledgment via HW-STO" function is enabled (p9501.5 = 1)
- PROFIsafe telegram (S_STWx Byte 0 Bit 7)

Safety Integrated

In the "Parameters" > "Safety Integrated" area, you select the safety functions of the drive and set the Safety Integrated drive parameters.

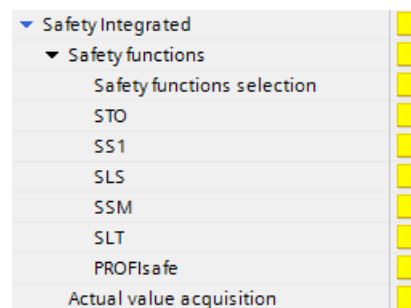


Figure 8-11 Safety Integrated area

You can check the current safety settings in read mode at any time.

Safety diagnostics

The safety diagnostics shows the most important online information on the safety states of the drive.

1. Open "Online & diagnostics" in the context of the drive.
2. Select the "Safety diagnostics" group.

You receive the following information in separate display areas:

Safety change tracking

Safety change tracking is used to detect changes to safety parameters, see section Safety change tracking (Page 166).

Drive safety status

Information on the status of the drive. The display area provides information on:

- Status of STO terminal (X5060)
- Signaled limit violations
- Internal events
- Internal stop responses

Safety functions

Displays which safety functions are activated in the drive.

PROFIsafe diagnostics

Displays the status of the PROFIsafe communication as well as current requests from the PROFIsafe telegram.

Note

The contents in the safety diagnostics area are only available online.

8.9.3 Guidelines for safety commissioning

The procedure for commissioning a PDC drive controller with integrated safety functions is described below. The commissioning of the safety functions is part of the overall commissioning of the drive.

Procedure

1. Connect the fieldbus to the PDC and configure the communication in the higher-level CPU.
2. If necessary, configure the PROFIsafe communication in the higher-level CPU.
3. Perform the basic commissioning of the drive.
See section Commissioning procedure (Page 120).
4. Enable the desired safety functions of the drive.
See section Selecting safety functions (Page 157).
5. Set the enabled safety functions of the drive.
See section Setting up the safety functions (Page 158).
6. Complete the safety commissioning to activate the settings.
See section Completing safety commissioning (Page 165).
7. Perform the acceptance test of the safety functions.
See section Acceptance of the safety functions (Page 86).

You have commissioned the PDC drive controller with integrated safety functions.

8.9.4 Selecting safety functions

Basis of safety functions

You can find detailed information on utilized safety functions in section Safety functions integrated in the drive (Page 63).

Overview

The safety functions are sorted into groups by functionality, but can be set up independent of one another.

Table 8-4 Grouping of the safety functions

Group	Safety function	Description	Drive controller
Communication	PROFIsafe	Communication driver for PROFIsafe Profile Specification V.2.6.1 via PROFINET	PDC-F
Stop function	STO	Hardware STO, STO via PROFIsafe and STOP_STO	PDC-F, PDC
	SS1t	SS1 via PROFIsafe and STOP_SS1	PDC-F
Motion monitoring	SLS	SLS via PROFIsafe and SLS statically without PROFIsafe	PDC-F
	SSM	SSM via PROFIsafe	PDC-F
	SLT	SLT via PROFIsafe and SLT statically without PROFIsafe	PDC-F

Enabling safety functions

Start the safety commissioning by enabling the desired safety functions. When a Safety Integrated safety function is enabled, the corresponding settings for this function are activated and included in the calculated checksum of the SI parameters (p9799).

Note

The entries in the menu tree under "Parameters" > "Safety Integrated" > "Safety functions" are dynamically displayed and hidden depending on the safety functions enabled in each case.

Procedure

1. Open the "Select safety functions" area in the context of the drive under "Parameters" > "Safety Integrated" > "Safety functions".
2. Enable the needed safety functions and disable the unnecessary ones.

Note

The STO safety function is always enabled for the PDC drive controllers in the "Stop functions" area and cannot be disabled.

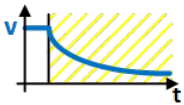
8.9.5 Setting up the safety functions

This section describes the settings for the individual safety functions of the drive controller.

Note

The input windows for the individual Safety Integrated functions are only displayed in the PDC engineering if the corresponding safety function was enabled in parameter p9501.

Safe Torque Off (STO)



Safe Torque Off (STO) is a safety function that directly stops torque- or force-producing energy from being supplied to the motor.

You can select the STO function via PROFIsafe and/or the fail-safe terminal X5060.

The STO safety function can be selected as follows:

- Fail-safe STO terminal at X5060
- Via PROFIsafe
- As a consequence of SS1
- Internal stop response STOP_STO (e.g. as response to messages)
 - In parameter assignment mode (on completion of safety commissioning)
 - Change of safety-relevant drive parameters outside of parameter assignment mode

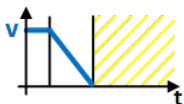
Procedure

1. Open the "STO" area in the context of the drive under "Parameters" > "Safety Integrated" > "Safety functions".
2. Make the desired settings.

Extended message acknowledgment via HW-STO

To perform a safe acknowledgment through selection and deselection of HW STO, activate the "Extended message acknowledgment via HW-STO" option in p9501.5 The messages in the fault buffer must additionally be reset by the general acknowledgment mechanism.

Safe Stop 1 (SS1)



After selection of "Safe Stop 1", the drive functionally brakes according to the OFF3 ramp (see section OFF responses (Page 136)) and goes to "Safe Torque Off" (STO) state after the delay time (p9556) elapses.

The SS1 safety function can be selected via PROFIsafe and/or via the internal stop response STOP_SS1 (e.g. as response to messages)

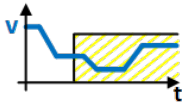
Procedure

1. Open the "SS1" area in the context of the drive under "Parameters" > "Safety Integrated" > "Safety functions".
2. Make the desired settings.

Setting the SS1 delay time

After selection of the function, the delay time elapses. The delay time in p9556 must be appropriately set so that the drive can complete the OFF3 ramp and a motor holding brake, if present, can be applied before the pulses are safely inhibited.

Safely-Limited Speed (SLS)



Safely-Limited Speed prevents a parameterized speed limit value from being exceeded.

You can select the SLS function via PROFIsafe.

Procedure

1. Open the "SLS" area in the context of the drive under "Parameters" > "Safety Integrated" > "Safety functions".
2. Make the desired settings.

SLS without PROFIsafe

If you enable the SLS function but not PROFIsafe in parameter p9501, SLS is requested statically and SLS stage 1 becomes active.

Setting the limit values of the SLS stages

Up to four different SLS speed limit values can be set with parameter p9531, and it is possible to switch between these limit values even when SLS is active.

Note

Only SLS stage 1 is available with PROFIsafe telegram 30. A switchover between the SLS stages is possible with PROFIsafe telegram 31.

Setting the SLS switchover delay time

When SLS is selected, the monitoring is only active after the delay time (p9551) expires. Within this time, the actual speed must lie below the (selected) limit value. The delay time is not active when SLS is deselected.

After switching over to a lower limit value (p9531), the actual drive speed must have fallen below the new limit value within the delay time (p9551). The existing limit value remains active during the delay time. The lower limit value is active after the delay time has expired. If the actual drive speed is higher than the new SLS limit value after the delay time has expired, then a limit value violation is signaled and the parameterized stop response (p9561) requested. At a limit violation, fault F64640.19 "SI speed" is signaled.

On switchover to a higher limit value, the delay time is not active and the higher limit value becomes active immediately.

Setting the SLS stop response

You can set the stop response STOP_STO or STOP_SS1 in parameter p9561.

Note

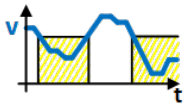
If you set STOP_SS1 as the stop function, the safety function SS1 must be enabled using p9501.6. Otherwise, fault F64605.4 "SI parameters" is signaled.

Setting the speed limiting

You have the option of setting a drive-internal speed setpoint limiting during parameter assignment of SLS. The active SLS limit value is evaluated with factor p9533 and becomes active as the speed limiting. The limiting acts before the ramp generator in the setpoint channel and as an absolute value for both directions of rotation.

Example: Speed limiting = $p9531[x] \times p9533$

Safe Speed Monitor (SSM)



The "Safe Speed Monitor" (SSM) function is used for safe detection of speeds below a speed limit (p9546) in both directions of rotation, e.g. for standstill detection.

The SSM function provides a safe output signal in PROFIsafe for further processing.

Note

The "Speed below limit value SSM" signal is only available in PROFIsafe telegram 31.

Procedure

1. Open the "SSM" area in the context of the drive under "Parameters" > "Safety Integrated" > "Safety functions".
2. Make the desired settings.

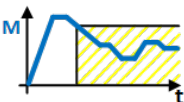
Setting the SSM limit value

If the speed falls below the speed limit (p9546), the "SSM feedback active" signal is set. Unlike other Safety Integrated functions, exceeding the SSM limit value does not trigger a drive-autonomous stop response.

Setting SSM with hysteresis

You can activate a hysteresis for the SSM function using parameter p9550.0. The hysteresis (p9547) allows a more stable signal sequence of SSM to be achieved at speeds near the monitoring threshold (p9546).

Safely-Limited Torque (SLT)



Safely-Limited Torque prevents a parameterized torque limit value from being exceeded.

You can select the SLT function via PROFIsafe.

Procedure

1. Open the "SLT" area in the context of the drive under "Parameters" > "Safety Integrated" > "Safety functions".
2. Make the desired settings.

SLT without PROFIsafe

If you enable the SLT function but not PROFIsafe in parameter p9501, SLT is requested statically and SLT stage 1 becomes active.

Setting the limit values of the SLT stages

Up to four different SLT torque limit values can be set with parameter p9532, and it is possible to dynamically switch between these limit values even when SLT is active.

Note

Only SLT stage 1 is available with PROFIsafe telegram 30. A switchover between the SLT stages is possible with PROFIsafe telegram 31.

Setting the SLT switchover delay time

When SLT is selected, the monitoring is activated only after a configurable delay time (p9552) elapses. Within this time, the actual torque must lie below the (selected) limit value. The delay time is not active when SLT is deselected.

After a switchover to a lower limit value (p9532), the actual torque of the drive must have fallen below the new limit value within the delay time (p9552). The existing limit value remains active during the delay time. The lower limit value is active after the delay time has expired. If the actual torque of the drive is higher than the new SLT limit value after the delay time elapses, a limit violation is signaled and the non-adjustable stop response "STOP_STO" (p9563) is requested. At a limit violation, fault F64630.20 "SI torque" is signaled.

On switchover to a higher limit value, the delay time is not active and the higher limit value becomes active immediately.

SLT stop response

The stop response STOP_STO is permanently set in parameter p9563.

Setting the torque limiting

You have the option of setting a drive-internal torque limiting during parameter assignment of SLT. The active SLT limit value is evaluated with factor p9633 and becomes active as the torque limiting. The limiting acts before the ramp generator in the setpoint channel and as an absolute value in motoring and generating operation.

Example: Torque limiting = p9532[x] × p9633

PROFIsafe communication

When PROFIsafe communication is enabled (p9501.0), the PROFIsafe driver and thus the safety subslot 1.2 is activated in the drive controller, see section Communication telegrams (Page 97).

The control of the Safety Integrated functions is then possible via the PROFIsafe telegrams 30 and 31. You can find the description of the telegrams and the structure of the associated control and status words in section PROFIsafe communication (Page 82).

NOTICE

You must configure the PROFIsafe communication both in the hardware configuration of the fail-safe CPU and in the drive parameter assignment.

Procedure - step 1: PROFIsafe drive parameters

As the first step, we recommend enabling the PROFIsafe communication in the drive (p9501.0) and setting the PROFIsafe drive parameters in the "Parameters" > "Safety Integrated" > "Security functions" > "PROFIsafe" area.

1. Enable PROFIsafe communication (p9501.0)
Enable the PROFIsafe communication driver in the drive controller, thereby activating the safety subslot 1.2 of the drive in the PROFINET system.
2. PROFIsafe telegram selection (p9611)
Specify the PROFIsafe telegram you want to use to control the Safety Integrated functions of the drive.
3. F-destination address (p9610[0]) and F-source address (p9610[1])
For control of the safety functions via PROFIsafe, a unique assignment of PROFIsafe addresses in the network is necessary.
4. PROFIsafe failure response (p9615)
Set the desired stop response to a failure of the PROFIsafe communication.
5. Download the parameter settings to the drive and activate them by completing the safety commissioning, see section Completing safety commissioning (Page 165).

Procedure - step 2: PROFIsafe hardware configuration

In the second step, adapt the hardware configuration of the system according to the drive parameter assignment.

NOTICE

The PROFIsafe telegram inserted in the HW configuration and the set F-source address and F-destination address must match the Safety Integrated drive parameter assignment of the PDC-F.

1. Select the desired PROFIsafe telegram from the HW catalog. The PROFIsafe telegrams 30 and 31 are available, see section Communication telegrams (Page 97).
2. Set the F-source address and F-destination address in the hardware configuration of the PDC-F in the Inspector window of the PROFIsafe telegram, tab "Properties" > "General" > "F-parameters".

Note**F-source address and F-destination address**

The uniqueness of the PROFIsafe address is ensured through the combination of F-source address and F-destination address.

The PROFIsafe address must be unique throughout the network and the CPU. You achieve this when both of the following conditions are met:

- The F-source address (parameter "Central F-source address") of the F-CPU is unique network-wide. Keep this in mind also when making changes.
- The F-destination address of the PDC-F is unique CPU-wide.

You specify the F-source address with the "Central F-source address" parameter in the F-CPU. As long as you configure only supported configurations, this parameter is automatically applied as the F-source address and the F-destination address is assigned uniquely CPU-wide (generally in descending order from 65534).

If you change the F-destination address, the CPU-wide uniqueness of the F-destination address is automatically checked for supported configurations.

Further information is available in the programming and operating manual SIMATIC Safety - Configuring and Programming (<https://support.industry.siemens.com/cs/ww/en/view/54110126>).

3. You can individually change the F-monitoring time in the Inspector window of the PDC-F, tab "Properties" > "General" > "F-parameters". This can be necessary to prevent the time monitoring from responding under error-free conditions when the PDC-F needs a longer F-monitoring time or when an assignment using the standard F-monitoring time in the properties of the F-CPU is not possible. For this, you select the "Manual assignment of F-monitoring time" check box and assign an F-monitoring time.

Note

If you change the F-monitoring time for central or distributed F-I/O on the F-CPU, the safety program will be changed after recompilation and may therefore have to undergo acceptance testing again.

 WARNING

The acquisition of a signal state to be transferred by the sender and its transfer to the receiver is only ensured (in a fail-safe manner) if the signal state is present at least as long as the parameterized monitoring time.

Failure of PROFIsafe communication

Set the desired stop response to a failure of the PROFIsafe communication in parameter p9615.

Actual value acquisition

The actual value acquisition is used for configuration of safe speed acquisition and safe torque acquisition and is dependent on the enabled safety functions for motion monitoring.

Procedure

1. Open the "Actual value acquisition" area in the context of the drive under "Parameters" > "Safety Integrated" > "Safety functions".
2. Make the desired settings.

For parameter assignment of the actual value acquisition, only the parameters necessary for your configuration are offered to you.

Table 8-5 SI speed acquisition and SI torque acquisition

	SSM	SLS	SLT
SI speed acquisition	x	x	
SI torque acquisition			x

The settings for SI speed acquisition and SI torque acquisition are automatically taken from the drive data set. The parameter values are applied in the device when you complete safety commissioning (Page 165).

The following parameter values are synchronized by the drive data set:

Table 8-6 Synchronized parameter values

Acquisition	Drive data set	⇒	SI actual value acquisition	Description
Speed acquisition	p0300	⇒	p9502	Motor type configuration
	p0314	⇒	p9503	Motor pole pair number
	p0408	⇒	p9518	Encoder incremental pulse number
	p0404	⇒	p9516	Encoder type configuration
	p0410	⇒	p9520	Encoder incremental configuration
	p0420	⇒	p9523	Encoder Hall angle setting
Torque acquisition	p0316	⇒	p9504	Motor inner constant

Setting the SI speed acquisition

The safe actual speed determined by the SI speed acquisition forms the input signal for the SLS and SSM safety functions. You have the option of smoothing the safe actual speed. To do so, set the filter time for speed actual value smoothing (p9545) as desired.

Note

When the speed input signal is filtered, there is a corresponding time delay of the output signals of the SLS and SSM safety functions. This is a property of the filtering.

Setting the SI torque acquisition

The safe actual torque determined by the SI torque acquisition forms the input signal for the SLT safety function. You have the option of smoothing the safe actual torque. To do so, set the filter time for torque actual value smoothing (p9539) as desired.

Note

When the torque input signal is filtered, there is a corresponding time delay of the output signals of the SLT safety function. This is a property of the filtering.

8.9.6 Completing safety commissioning

Changes to the SI parameter settings do not take effect immediately. To confirm changes to the SI parameters and to activate the current SI settings, use the "Complete safety commissioning" function.

Depending on the enabled safety functions for motion monitoring, the settings of the Safety Integrated actual value acquisition are synchronized with the current settings of the drive data set on completion of the safety commissioning.

Note

Changes to SI parameters that are not activated or not confirmed are signaled with alarm A64606.0 "SI information".

Requirement

- You have completed all settings for the commissioning of the drive-integrated safety functions.
- If you have not yet changed the default safety password, you can still change the password in this step (see section Safety password (Page 167)).

Procedure

1. Start the "Complete safety commissioning" function via the toolbar (Page 108).
2. Enter the assigned safety password.
The "SI parameter copy function" (p9700) creates a redundant image of the safety-relevant parameters on the drive. This updates the actual checksum of the SI parameters in r9798.
3. Check the report of the safety-relevant parameters in the "Activate safety parameters" dialog.

4. Confirm the changes of the safety-relevant parameters in the drive by selecting the check box.

NOTICE

If you confirm the "Activate safety parameters" dialog with "Yes", the following will occur:

- The "Reference checksum of SI parameters" in parameter p9799 is updated.
- The safety program of the drive is re-initialized with p9701.
- Any existing PROFINET connection is restarted.
- A new acceptance checksum is generated in r9781[0].

This operation cannot be undone.

5. Save the settings in non-volatile memory in the drive, see section Saving parameters in power-independent storage (Page 108).

You have completed the safety commissioning.

Note

Observe the information in the sections for Acceptance of the safety functions (Page 86).

8.9.7 Safety change tracking

To detect and log safety-relevant changes to the drive, the PDC drive controller has a safety change tracking function ("Safety log book").

The safety change tracking is used to detect the following changes to the PDC.

- Change of SI drive parameters (r9799)
- Modification of safety settings of the drive (r9781[0])
- Replacement of the device hardware (r9781[1])
- Update of the safety-relevant firmware of the drive (r9781[2])

SI parameters checksum

The SI parameters checksum (r9799) specifies the checksum of all setting values of the SI parameters of the drive. The parameter settings of a safety function are only included in the calculated checksum (r9799) if the corresponding safety function is enabled in parameter p9501.

Note

The checksums in safety channels A and B are determined differently, and the values therefore always differ even when settings are synchronized.

Note

The assigned safety password has no effect on the SI parameters checksum.

Safety change tracking hardware

Hardware-specific changes after device replacement are detected in checksum r9781[1]. This pertains only to the drive controller itself. Components such as the memory card, motor, external braking resistor, IQ encoder or SSI encoder have no effect on the hardware change tracking r9781[1] in the safety log book.

Safety change tracking firmware

Changes to the safety-relevant area of the drive controller firmware, e.g. due to firmware updates of the device, are detected in checksum r9781[2]. Changes of the functional firmware of the drive controller are independent of the safety program and do not change the checksum r9781[2].

Safety change tracking acceptance

Each modification of the safety settings of the drive controller, e.g. due to loading of factory settings, resetting to factory settings, restoring a parameter backup or completing the safety commissioning, is detected in the acceptance checksum r9781[0].

Note

The logging of the acceptance checksum allows even temporary modifications of the safety-relevant settings of the drive controller to be detected.

NOTICE
The acceptance checksum r9781[0] is automatically changed by the following actions and cannot be undone: • Completing safety commissioning • Loading of factory settings • Resetting to factory settings (memory reset) • Restoring or loading a parameter backup

8.9.8 Safety password

With the safety password, you protect the settings of the drive-integrated safety functions from changes by unauthorized users.

The safety password is a normatively prescribed protection against incorrect operation by unauthorized users.

Note that the safety password does not provide write protection for the Safety Integrated drive parameters or the STEP 7 project settings. You need the safety password to start the safety commissioning mode of the drive. Only in this mode can you apply and activate the safety settings in the drive with the "Complete safety commissioning" function.

You can assign the safety password at the start or end of safety commissioning.

Note

In the delivery condition of the drive controller, the safety password is set to "0" by default.

The commissioning engineer must decide whether a different password is required. The failure probabilities (PFH) and the certification of the safety functions also apply with the standard password.

If you do not change the default safety password, any user can change and activate the settings of the drive-integrated safety functions. For this reason, we recommend that a new safety password always be assigned.

Note

The safety password is not saved in the STEP 7 project.

The safety password is stored as a hash value and not in plain text.

Safety commissioning mode

Certain SI parameters of the drive controller can only be changed when safety commissioning mode of the drive is active. Entering the assigned safety password activates the safety commissioning mode.

The following SI parameters are protected accordingly:

- SI reference checksum of SI parameters (p9799)
- SI parameter copy function (p9700)
- SI parameter, confirm data change (p9701)
- SI password new (p9762)
- SI password acknowledgment (p9763)

As long as safety commissioning mode is active, the drive is in STOP_STO state and alarm A64606.5 "SI information" is output.

Safety commissioning mode is exited by completing safety commissioning, see section Completing safety commissioning (Page 165), or automatically after 5 min.

Parameter backup

In the case of series commissioning or for device replacement with a replacement part with parameter backup, the following applies:

- Information on the assigned safety password is contained in the parameter backup of the drive and can therefore be passed on using a microSD memory card.

Changing the safety password

To change the current safety password, follow these steps:

1. Click "Safety password" in the toolbar, see section Toolbar (Page 108).
The "Password input" dialog appears.
2. Enter the current password in the "Password input" dialog, select the "Change password" option, enter the new password and then enter the new password again.
3. Confirm with OK.
4. Save the settings in non-volatile memory with "Copy RAM to ROM", see section Saving parameters in power-independent storage (Page 108).

Note

For better protection against unauthorized access, e.g. by an attacker, the password should also contain the following:

- At least 8 characters
- Upper and lower case letters
- Numbers and special characters (e.g.: ?!%+ etc.)

The safety password must not be used anywhere else.

Check of password

The password is not checked for length, special characters or upper and lower case letters!

Lost password

If the safety password is lost, you have the following options:

- Reset to factory settings (Page 176)
- Restore a parameter backup with known safety password.

To avoid losing drive settings, follow these steps:

1. Open your existing STEP 7 project or create a new one.
2. Upload the drive parameters from the device, see "Upload from device" in section Drive parameters (Page 109), and save the project.
3. Load the factory settings or reset the drive controller to factory settings, see section Resetting to factory settings (Page 176).
4. Download the drive parameters to the device, see "Download to device" in section Drive parameters (Page 109).
5. The safety password has been reset to "0" – change the default safety password and save the drive settings to non-volatile memory, see section Saving parameters in power-independent storage (Page 108).
6. If necessary, perform an acceptance test for the safety functions, see section Acceptance of the safety functions (Page 86).

Note

If the described methods are not possible for you, contact Technical Support (<https://support.industry.siemens.com>).

Programming motion control instructions

Overview

You need a user program to control motion sequences. STEP 7 provides various motion control instructions for this. These instructions pass the commands to the technology object. The technology object in the CPU executes the individual commands and sends the control signals to the PDC.

As soon as you have configured and parameterized your project, you can program your user program/safety program.

Configuring with technology objects

The properties of real objects (e.g. drives) are configured by means of the technology objects and saved in a technology data block. STEP 7 (TIA Portal) generates the technology data block automatically when creating the technology object. The technology data block contains all configuration data, setpoint and actual values, and status information of the technology object. You access the data of the technology data block (read/write access) with your user program.

Note

Use the "Automatic transfer of drive parameters in the device" option if you want to automatically transfer necessary information, e.g. "Reference speed", "Maximum speed" and "Reference torque" from the PDC.

You can find more information on data exchange with the drive in section Reference values (Page 138).

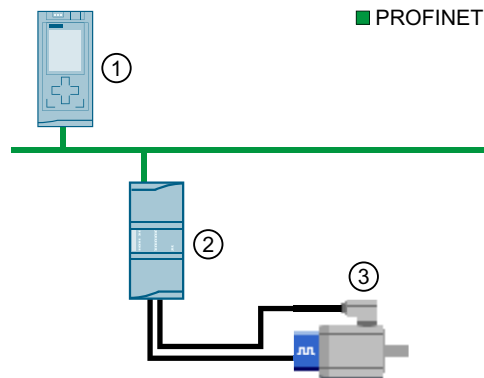
Note

Use the "Automatic transfer of encoder parameters in the device" option if you want to automatically transfer necessary data, e.g. "Measuring system", "Increments per revolution", "Number of revolutions" and "Fine resolution", from the PDC.

You can find more information on data exchange with the encoder under "Motor encoder" in section Drive data sets (Page 121).

Positioning axis with position control in the higher-level CPU

The following figure shows the basic hardware structure of a central motion control application with the SIMATIC MICRO-DRIVE.



- ① S7-CPU
 - Control and monitoring of the drive system and thus the motor of the motion control application
- ② PDC drive controller
 - Control of the motor
 - Supply of the necessary motor current for moving the connected motor
 - Position detection of the motor axis (incremental or absolute)
- ③ Motor from the Siemens Product Partner Program
 - Execution of the desired rotary motion
 - The motor forms the interface to the mechanical components of the motion control application.

Figure 9-1 Basic hardware structure

The following figure shows the basic structure of a positioning axis in the SIMATIC MICRO-DRIVE drive system with position control by the technology object (TO) in the SIMATIC CPU.

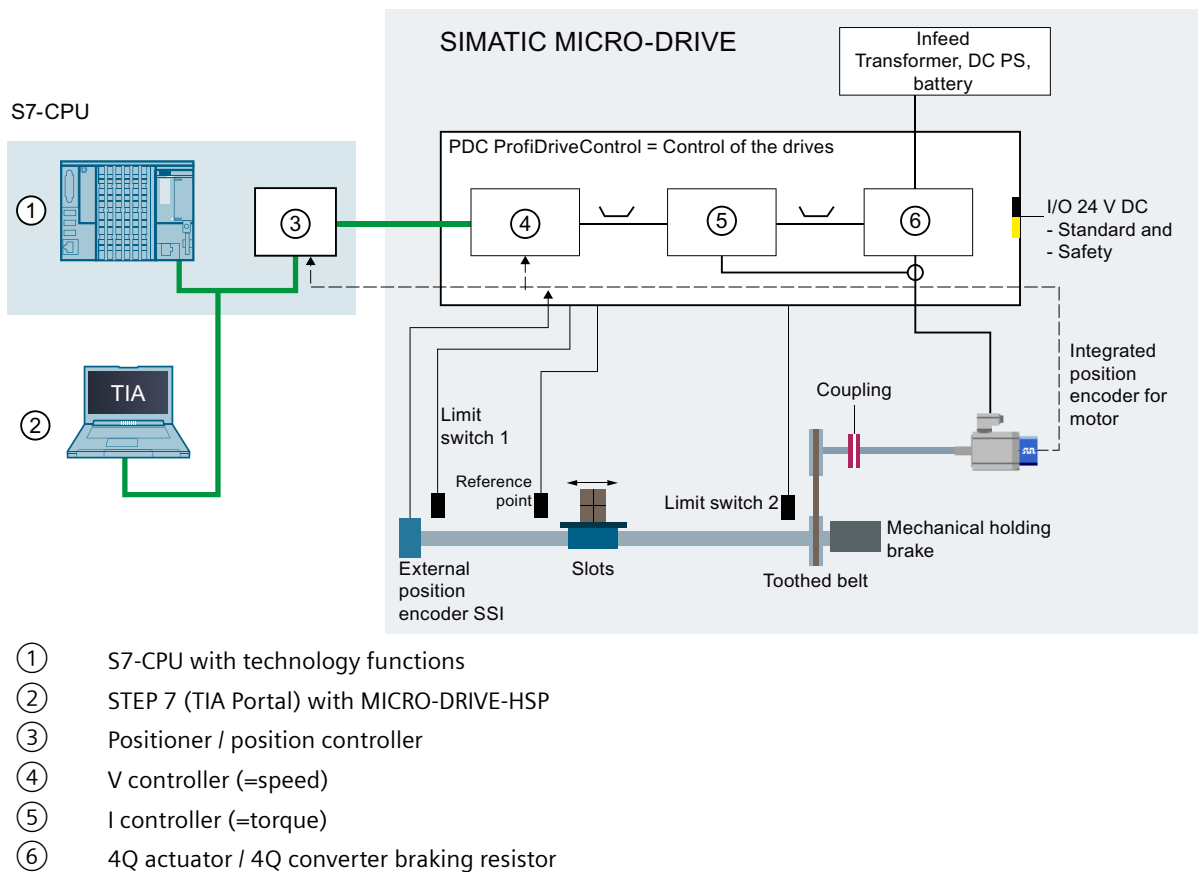


Figure 9-2 Basic structure of a positioning axis

The slide travels between the two limit switches. The reference point is approached after switching on the machine in order to explicitly set the machine coordinate system to zero again. With absolute (SSI) encoders, the reference point approach is omitted since the absolute measured value is available immediately after switch-on without homing.

Controlling with motion control instructions

You control the technology axis from the user program using motion control instructions. The instructions start motion control commands that execute the desired functions.

The status of the motion control commands and any errors that occur during their execution can be obtained from the output parameters of the motion control instructions.

You will find the available motion control instructions in STEP 7 in the "Instructions" task card, category "Technology", folder "Motion Control", for example:

- MC_Power: Enable, disable axes
- MC_Reset: Acknowledge errors
- MC_Home: Home axes, set reference point
- MC_Halt: Halt axes
- MC_MoveAbsolute: Position axis absolutely
- MC_MoveRelative: Position axis relatively

- MC_MoveVelocity: Move axes at preset speed
- MC_MoveJog Move axes in jog mode

Reference

You can find detailed information on the motion control instructions, including descriptions and override response, as well as a list and description of the technology object tags in function manual S7-1500 Motion Control in the TIA Portal (<https://support.industry.siemens.com/cs/ww/en/view/109481326>) or S7-1200 Motion Control in the TIA Portal (<https://support.industry.siemens.com/cs/ww/en/view/109741731>).

Axis control panel of the technology object

You move individual axes with the axis control panel. With the axis control panel, you take over master control for a technology object and control the movements of the axis. You can find more information on the axis control panel of the technology object in:

- Function manual S7-1500 Motion Control in the TIA Portal (<https://support.industry.siemens.com/cs/ww/en/view/109481326>) or S7-1200 Motion Control in the TIA Portal (<https://support.industry.siemens.com/cs/ww/en/view/109741731>)
- Online help of STEP 7 under "Using technology functions > Motion Control (S7-1200, S7-1500)"

Maintenance

10.1 Introduction

The PDC drive controllers are designed to be maintenance-free. They contain no moving mechanical parts.

The PDC drive controller displays a detected malfunction with LEDs.

You can find information on the status displays of the PDC drive controller in section Interrupts, diagnostics alarms, error messages and system alarms (Page 189).

10.2 Maintenance and repair

The PDC drive controllers are maintenance-free. They contain no wear parts (fans, brushes, carbon, etc.). The internal fuses are protected from application errors by electronic protective circuits, serve as the last resort and are not intended to be changed by the user.

Note

Repairs to a PDC drive controller may only be carried out by the manufacturer.

10.3 Warranty

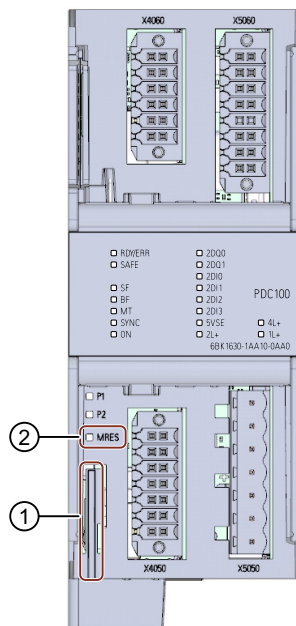
To meet the conditions of the warranty, you must observe the safety and commissioning instructions.

10.4 Using the service button

Position of the service button

The service button is located behind the lower front cover of the PDC, below the LEDs on the left.

The bottommost green LED of the LED bar (MRES) is assigned to the service button.



- ① Service button
- ② Service function status LED

Figure 10-1 Position of the service button (example)

Actuating the service button

We recommend using a screwdriver for actuating the service button.

Gently press the service button of the PDC inwards with the screwdriver.

Functions of the service button

You can use the service button for the following work:

- Copying service data to the memory card (Page 184)
- Creating a parameter backup (Page 181) and Loading the parameter backup (Page 183)
- Series commissioning (Page 180)
- Resetting to factory settings (Page 176)

10.5 Resetting to factory settings

For the following applications, you have the option of resetting the drive to factory settings (memory reset):

- You would like to delete the complete parameter assignment.
- You have forgotten the Safety Integrated password.

- You want to restore the delivery condition of the device.
- You want to delete the communication settings of the drive.

The I&M data is not deleted during the reset.

To delete I&M data of the drive, use the "Reset interface parameters" (Page 178) function.

Procedure

You reset the drive to factory settings (memory reset) using the service button on the device.

1. Press and hold down the service button on the PDC for 7 s.
2. After 7 s the "MRES" LED flashes very rapidly.
3. Release the service button and press the service button again within 5 s to confirm and start the reset.

All user data in the drive will be deleted.

- During the reset, the "MRES" LED flashes slowly (this operation can take a few seconds).
- After the reset is complete, the drive restarts automatically.

NOTICE

If all parameters have been successfully deleted, the drive signals fault F61100.0 after the restart and automatically attempts to load a parameter backup from the memory card. If no memory card is inserted or no valid backup is available on the memory card, the drive also signals fault F61101.14 or F61101.8.

Note

When you reset the PDC to factory settings, the IP address and the PROFINET device name are also deleted.

If you have reset the PDC to factory settings and want to operate it in the system again, you must first commission the PDC.

Loading factory settings

You also have the option of loading the factory settings to the RAM of the PDC.

If you then save the parameter settings in non-volatile memory (Page 108), the operation corresponds to a reset to factory settings.

Note

In this case, fault F61100 is not signaled and the drive also does not attempt to load a parameter backup from the memory card on restart.

Procedure

To load the factory settings, follow these steps:

1. Open "Online & diagnostics" in the context of the drive.
2. Select the "Save/reset" group.
3. Click "Load factory settings...".

Note

You can only use this function if an online connection to the PDC exists.

10.6 Resetting interface parameters

To delete the PROFINET interface parameters "IP address" and "Device name" as well as the I&M data of the drive, use the PRONETA network analysis tool or the TIA Portal.

Procedure

In the TIA Portal, you can delete the interface parameters of the drive under "Online & diagnostics" > "Functions" > "Reset interface parameters".

Requirement: An online connection must exist.

The function deletes the previously assigned settings and restores the default values.

- IP address: 0.0.0.0
- Device name: (empty)

You can optionally delete the I&M data records 1 to 3.

10.7 Replacing the PDC as a replacement part

To easily replace a PDC as a replacement part, we recommend creating a parameter backup on the microSD memory card after a completed commissioning. After replacing the drive, you can restore the parameters from the microSD memory card without an engineering tool.

All replacement options are described in detail below.

**WARNING****Risk of injury due to uncontrolled movement of the drive**

The replacement of a PDC with a PDC of another performance class can result in uncontrolled movements of the drive.

In this case, you must commission the drive again after the replacement.

PROFINET functionality "Device replacement without exchangeable medium"

The PDC supports the PROFINET functionality "Device replacement without exchangeable medium": After device replacement, the PDC automatically obtains its device name from the IO controller.

Independent of that, you must transfer the drive settings of the old PDC to the new PDC after the replacement.

You can find information on the procedure and other instructions for device replacement without exchangeable medium in function manual PROFINET (<https://support.industry.siemens.com/cs/ww/en/view/49948856>).

10.7.1 Replacing the PDC with a parameter backup

Requirement

To replace the PDC without an engineering tool, you need a microSD memory card with a valid parameter backup of the drive.

Note

If you have archived parameter backup files of the drive on a PC, you can copy them to the "PDC" folder on a microSD memory card.

Procedure

1. Switch off the old PDC.
2. Remove the microSD memory card with the parameter backup from the old PDC.
3. Disconnect all connections of the old PDC, replace the PDC and re-establish the connections on the new PDC.
See sections Installation (Page 35) and Connecting (Page 45).
4. Insert the memory card into the PDC and switch on the PDC.
5. Use the service button to perform a reset to factory settings (Page 176).
6. After the successful reset, the PDC restarts automatically, loads the parameter backup from the memory card and saves the settings in non-volatile memory in the ROM.

You have now replaced the PDC.

10.7.2 Replacing the PDC with an engineering tool

Procedure with existing drive project

You have created a project with the drive parameters of the PDC in the TIA Portal.

The engineering tool can then be used to replace a PDC as a replacement part without a memory card.

Observe the basics for commissioning in section Commissioning (Page 101).

1. Switch off the old PDC.
2. Disconnect all connections of the old PDC, replace the PDC and re-establish the connections on the new PDC.
See sections Installation (Page 35) and Connecting (Page 45).
3. Switch on the PDC.
4. Open the drive project in the project tree of the TIA Portal.
5. Establish an online connection to the drive. In addition, assign an IP address and the provided device name to the PDC if necessary.
6. To download the parameter settings from the drive project to the drive, click the "Download to device" button in the TIA Portal in the context of the drive, see Drive parameters (Page 109).
7. Complete the safety commissioning, see Completing safety commissioning (Page 165).
8. Copy the parameters from RAM to ROM of the PDC to save the settings in non-volatile memory.

You have now replaced the PDC.

Procedure without a parameter backup or drive project

Observe the basics for commissioning in section Commissioning (Page 101).

1. Switch off the old PDC.
2. Disconnect all connections of the old PDC, replace the PDC and re-establish the connections on the new PDC.
See sections Installation (Page 35) and Connecting (Page 45).
3. Switch on the PDC.
4. Perform a full commissioning, see section Commissioning (Page 101).

You have now replaced the PDC.

10.8 Series commissioning

If you need the same settings for multiple machines – with identical application, drive and motor – you can perform a series commissioning.

The drive provides the option of series commissioning using the microSD memory card.

The PDC also supports the PROFINET functionality "Device replacement without exchangeable medium". If this function is activated in the CPU, the device name is assigned to the drive by the IO controller after a replacement.

You can find information on the procedure and other instructions for device replacement without exchangeable medium in function manual PROFINET (<https://support.industry.siemens.com/cs/ww/en/view/49948856>).

Series commissioning via memory card

In the case of a series commissioning using a memory card, all settings/parameters that you can save retentively and/or change on a PDC (including safety password) are transferred to any number of other PDCs.

You need a microSD memory card for the series commissioning. You do not need an engineering tool to transfer the settings/parameters to other drives.

1. Insert an empty microSD memory card in the PDC.
2. Commission the drive, see section Commissioning (Page 101).
3. Save your drive settings on the PDC, see section Saving parameters in power-independent storage (Page 108).
4. Create a parameter backup on the memory card, see section Creating a parameter backup (Page 181).
The IP address and the PROFINET device name are typically not transferred in a series commissioning. Create a backup without IP address and PROFINET device name for this case.
5. Switch off the drive or remove the memory card safely, see section Safely removing the memory card (Page 188).
6. Insert the memory card in the next PDC and load the parameter backup by resetting the drive to factory settings using the service button, see section Resetting to factory settings (Page 176).

Repeat steps 5 and 6 for all PDC drives to which you want to transfer these settings.

You have now performed a series commissioning for multiple PDCs using a memory card.

10.9 Creating a parameter backup

You have the option of creating a backup of all PDC drive parameters on the microSD memory card and saving it externally.

You can use the parameter backup to commission other systems or, in the case of a device replacement, to restore the settings of the PDC or transfer them to other PDCs.

Parameter backup

The backup of the PDC drive parameters on the microSD memory card contains all settings/parameters that you can save retentively and/or change on the PDC. The backup contains both non-safety-relevant and safety-relevant parameters including the safety password but no configuration or user data of your CPU project.

You can perform a data backup at any time. We recommend creating a data backup after commissioning the drive.

The data backup is stored on the memory card under the "PDC" folder depending on the device type. The backup is stored in the files "pdc_cfg.ini" and "pdc_cfg.ini.xrol" for a PDC and in the files "pdc_f_cfg.ini" and "pdc_f_cfg.ini.xrol" for a PDC-F.

The ".xrol" file is used for checking the data integrity of the parameter backup.

10.9 Creating a parameter backup

A PDC parameter backup always consists of two files. Include both files when you archive or send the data backup.

NOTICE**Loss of data backup**

If a data backup already exists on the memory card when a backup is created, it is overwritten. To prevent data loss, you must not change the content of the parameter backup files. The backup files are stored in a readable format and can therefore be checked.

Note**Archiving of the parameter backup**

We recommend archiving the parameter backup under a defined name so that you can confidently identify and assign the desired data backup based on the name.

You can create a parameter backup with or without an engineering tool.

Creating a parameter backup without an engineering tool.

Procedure

Insert an empty microSD memory card (memory card does not contain a PDC parameter backup) into a commissioned PDC, and restart the PDC. The PDC automatically creates a parameter backup including the PROFINET settings "Device name" and "IP address" on the memory card.



While the backup is being created, the "MRES" LED flashes slowly (this operation can take a few seconds).

Using the service button

If you use the service button directly on the PDC to copy the service data of the drive to the microSD memory card, a parameter backup including the PROFINET settings "Device name" and "IP address" is additionally created on the memory card.

Procedure

1. Insert the microSD memory card into the PDC.
2. Press the service button on the PDC twice in quick succession.
3. While the service data is being copied and the backup data is being created, the "MRES" LED flashes slowly (this operation can take a few seconds).

You can find more information on copying the service data in section Copying service data to the memory card (Page 184).

Creating a parameter backup with an engineering tool

To save the settings/parameters on a memory card, proceed as follows:

1. Insert the microSD memory card into the PDC.
2. Open "Online & diagnostics" in the context of the drive.
3. Select the "Save/reset" group.
4. Click "Create backup" in the "Parameter backup" area.
5. Select the desired backup type in the subsequent dialog.
You can select whether or not the parameter backup is created with PROFINET settings "Device name" and "IP address".
 - Parameter backup with PROFINET settings:
With this backup type you create a complete copy of the PDC drive parameters, which you can use, for example, for a 1:1 device replacement.
 - Parameter backup without PROFINET settings:
This backup type is suitable, for example, for series commissioning in which you individually assign the "Device name" and "IP address", e.g. using the SIMATIC automation tool. You will find other options for assigning IP addresses and device names in function manual PROFINET (<https://support.industry.siemens.com/cs/ww/en/view/49948856>).
6. Confirm your selection with "OK".

The parameter backup is created on the memory card.

Note

You can only use this function if an online connection to the PDC exists.

10.10 Loading the parameter backup

Loading the drive parameters backed up on the microSD memory card onto the PDC again restores the drive state at the time of the data backup. You can also use the backed up parameter data to perform a series commissioning (Page 180).

You can load a parameter backup onto the PDC with or without an engineering tool.

Loading a parameter backup without an engineering tool

Procedure

1. Insert the microSD memory card with a valid parameter backup into a PDC that has been reset to factory settings and not yet commissioned.
2. Restart the PDC.

The PDC automatically loads the parameter backup from the memory card to the RAM and then saves it in non-volatile memory in the internal ROM.

The drive is considered as not commissioned as long as no parameter settings have been copied or saved to the ROM. The internal ROM is erased on a reset to factory settings (Page 176).

10.11 Copying service data to the memory card

Using the service button

Use the service button to reset the drive to factory settings or to erase the internal ROM (memory reset).

Procedure

1. Insert the microSD memory card with the parameter backup into the PDC.
2. Use the service button to reset the PDC to factory settings.

After the automatic restart resulting from the reset operation, the parameter backup is loaded from the memory card and automatically copied to the ROM.

Loading a parameter backup with an engineering tool

To load a parameter backup from the memory card, follow these steps:

1. Insert the microSD memory card with the parameter backup into the PDC.
2. Open "Online & diagnostics" in the context of the drive.
3. Select the "Save/reset" group.
4. Click "Load backup" in the "Parameter backup" area.
5. The parameter backup is loaded into the RAM of the drive. Optionally, you can copy this directly to the non-volatile ROM.

The parameter backup is now loaded into the drive.

Note

You can only use this function if an online connection to the PDC exists.

10.11 Copying service data to the memory card

For diagnostics or maintenance purposes, you have the option of copying service data of the drive to the microSD memory card and, for example, evaluating it with a PC. The service data contains diagnostic buffer data, statistical data and service data of the drive at the time of copying.

The service data is stored as an .ini file on the memory card under the folder "PDC" > "maint" with the serial number as the file name. If the memory card contains previously copied service data, it is overwritten.

You can use the service button directly on the PDC or the engineering tool to copy the service data to the microSD memory card.

Copying service data with the service button

To copy the service data to the microSD memory card with the service button, proceed as follows:

1. Insert the microSD memory card into the PDC.
2. Press the service button on the PDC twice in quick succession.
3. While the service data is being copied to the memory card, the "MRES" LED flashes slowly (this operation can take a few seconds).

NOTICE
Unwanted data loss
When you use the service button to copy the service data to the memory card, a parameter backup is additionally created. If the memory card already contains service data, it is overwritten.

Copying service data with the engineering tool

To copy the service data to the microSD memory card with the engineering tool, proceed as follows:

1. Insert the microSD memory card into the PDC.
2. Open "Online & diagnostics" in the context of the drive.
3. Select the "Save/reset" group.
4. Click "Export service data".

Note

You can only use this function if an online connection to the PDC exists.

To safely remove the microSD memory card from the PDC, use the Safely removing the memory card (Page 188) function.

10.12 Firmware update

During operation, it may be necessary to update the firmware (e.g. due to function extensions).

You have to option of upgrading your PDC to a newer firmware version. However, you can also downgrade to an older firmware version, e.g. to supply identical machine configurations every time.

When the firmware is upgraded, the saved drive settings are retained (unless otherwise specified in the update description).

A firmware update is only possible online via a firmware update file (.upd file).

NOTICE**Malfunctions due to voltage supply interruption during firmware update**

When a firmware update is active, an interruption of the voltage supply can result in defects or malfunctions of the drive.

Observe the descriptions of the LED displays.

You can find the latest firmware files and information on firmware updates on the Product Support (<https://support.industry.siemens.com/cs/ww/en/ps>) site on the Internet.

Options for the firmware update

The options for performing a firmware update are as follows:

- Online in STEP 7 (TIA Portal) via Online & Diagnostics
- Online using the SIMATIC Automation Tool

Requirement

Save the files of the desired firmware update. Before installing the firmware update, verify that the PDC is not in use.

The PDC can be accessed online via PROFINET IO, i.e. an IP address has been assigned.

Installing the firmware update

**WARNING****Risk of impermissible system states**

Installation of the firmware update causes the PDC to switch to "Firmware update" state. This may affect the operation of an online process or machine. Unexpected operation of a process or a machine can lead to fatal or severe injuries and/or property damage.

Before installing the firmware update, verify that the CPU is not executing any active process.

Online procedure in STEP 7 via Online & Diagnostics

Proceed as follows to perform a firmware update online using STEP 7:

1. Open "Online & diagnostics" in the context of the drive.
2. Select "Firmware update" in the "Functions" group.
3. Select the appropriate firmware file. The table in the "Firmware update" area lists all devices for which an update is possible with the selected firmware file.

4. Start the firmware update with the "Start update" button.
The "BF" and "SF" LEDs flash slowly during the update.
5. If the "Run firmware after update" option is active, the drive automatically restarts after the firmware update. To prevent disconnection of the network connection for other devices connected to the selected drive, deselect this option. In this case, you must manually restart the drive at a suitable time to complete the firmware update.

Note

If a firmware update was unexpectedly interrupted, switch the PDC off and on again. Wait approximately 5 minutes after restarting the device. Then restart the firmware update.

Online procedure using the SIMATIC Automation Tool

The procedure is described in manual SIMATIC Automation Tool (<https://support.industry.siemens.com/cs/ww/en/view/98161300>).

Completion of the firmware update

After the firmware update, check the following under "Online & diagnostics" in the context of the drive:

- The firmware version of the PDC in the "General" area
- The firmware signatures of the drive controller component and the communication in the "Firmware signatures" area, group "Actual values".
- Review the necessary steps for safety acceptance after a firmware update. Note the checksums in the "Safety change tracking" area, group "Safety diagnostics" for this.

10.13 Formatting the memory card

You can use a commercially available microSD memory card with the following FAT file systems and up to 32 GB memory capacity as the memory card in the PDC:

- FAT32

If your microSD memory card has a different file system (e.g. exFAT), you must first format the memory card and create a PDC-compatible file system. Only then can you use the memory card in the PDC.

Procedure

To format the microSD memory card, follow these steps:

1. Insert the microSD memory card into the PDC.
2. Open "Online & diagnostics" in the context of the drive.

10.15 Restarting the drive

3. Select the "Save/reset" group.
4. Click "Format memory card".

The microSD memory card will be suitably formatted.

Note

You can only use this function if an online connection to the PDC exists.

10.14 Safely removing the memory card

Procedure

To ensure that no access to the memory card is currently taking place and that the card can be safely removed without risk of data loss, follow these steps:

1. Open "Online & diagnostics" in the context of the drive.
2. Select the "Save/reset" group.
3. Click "Safely remove card".
4. Then, remove the microSD memory card from the PDC.

Note

You can only use this function if an online connection to the PDC exists.

10.15 Restarting the drive

For certain operations or operator control actions, you would like to restart the drive without disconnecting the supply voltage.

Procedure

To restart the drive, proceed as follows:

1. Open "Online & diagnostics" in the context of the drive.
2. Select the "Save/reset" group.
3. Click "Restart drive".

Note

You can only use this function if an online connection to the PDC exists.

Interrupts, diagnostics alarms, error messages and system alarms

11

The status and error displays of the PDCs are described below.

You can find detailed information and descriptions for the individual fault and alarm messages in section Faults and warnings (Page 267).

You can find additional information on the topic of "Interrupts" in the STEP 7 online help.

You can find additional information on the topic of "Diagnostics" and "System alarms" in function manual Diagnostics (<https://support.industry.siemens.com/cs/ww/en/view/59192926>).

11.1 Status and error displays

LED displays for the current operating state and diagnostics status of the PDC

The PDC has LED displays for indicating the current operating state and the diagnostics status.

The drive is ready for operation when the "RDY/ERR" is off. A steady green "RDY/ERR" LED indicates that the drive is in operation.

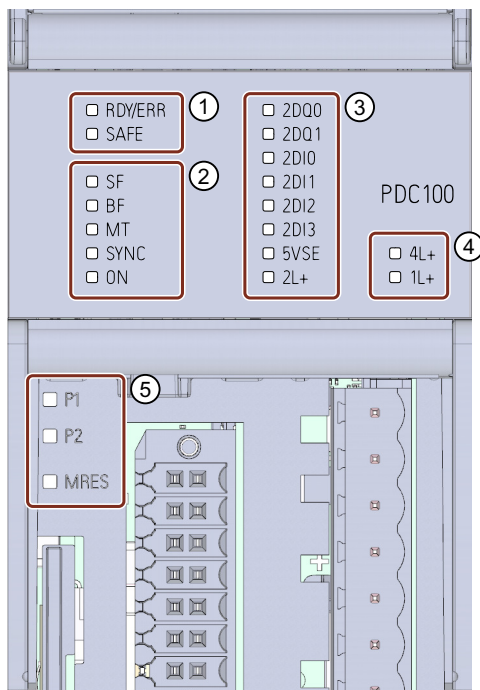
The "SAFE" LED indicates the status of the Safety Integrated functions.

The LEDs assume different statuses during startup. The displays of the LEDs operate independent of one except during firmware update.

You can find the arrangement of the LED displays of specific PDC device versions in the manual of the respective PDC device version.

The figure below shows an example of the various LED displays on the PDC.

11.1 Status and error displays

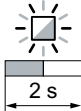
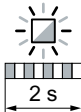


- ① Diagnostic LEDs for the drive controller:
 - RDY/ERR = Drive status
 - SAFE = Safety function status
- ② Diagnostic LEDs for the PROFINET communication:
 - SF = PROFINET group error
 - BF = PROFINET bus error
 - MT = PROFINET maintenance request
 - SYNC = PROFINET isochronous mode (IRT)
 - ON = PROFINET communication started
- ③ Diagnostic LEDs for the sensor unit:
 - DQ/DI = Status of digital inputs/outputs
 - 5VSE = Output of supply voltage of motor encoder
 - 2L+ = Infeed of supply voltage for the sensor unit
- ④ Diagnostic LEDs for power unit and logic unit:
 - 4L+ = Infeed of supply voltage of power unit
 - 1L+ = Infeed of supply voltage of logic unit
- ⑤ Diagnostic LEDs PROFINET ports and service (behind the lower front cover):
 - P1/P2 = Status information of PROFINET port
 - MRES = Service function status

Figure 11-1 LED displays (example)

Status display via LEDs

Table 11-1 Explanation of symbols for the tables below

	LED is on
	LED is off
	LED flashes slowly
	LED flashes rapidly
	LED flashes at variable frequency

The following tables show the meaning of the various "LED patterns" of the PDC (slow flashing $\approx$ 0.5 Hz, rapid flashing $\approx$ 2 Hz).

Meaning of the LEDs for the status of the drive controller

Table 11-2 Meaning of the RDY/ERR LED

RDY/ERR LED	Meaning
	The drive is not in operation, no faults are present.
	The drive is switched on and in operation (status S4 operation).
	A fault is present, the drive is not ready for operation.
 (flickers red/green)	Consistency of safety channel B is being checked.
 (flickers red at 8 Hz)	A firmware update is being performed.

11.1 Status and error displays

Table 11-3 Meaning of the SAFE LED

SAFE LED	Meaning
	Safety channel B not available. Solution: Check the power supply and restart the drive.
	One or more safety functions are enabled but not active.
	One or more safety functions are active, no error of the safety functions present.
	The PDC has detected an error of the safety functions and initiated a STOP response.

Meaning of the LEDs for the PROFINET communication

Table 11-4 Meaning of the SF LED

SF LED	Meaning
	The PROFINET configuration/parameter assignment is okay and no diagnostics alarms exist.
	Firmware update is being performed. The "LED flashing test" is being performed.
	A PROFINET group error message exists. Solution: Take notice of the diagnostics alarm and check the device. Missing or incorrect PROFINET configuration Solution: Check the configuration of the system and the drive.

Table 11-5 Meaning of the BF LED

BF LED	Meaning
	Bus connection is OK
	Firmware update is being performed. The "LED flashing test" is being performed.
	No bus connection Solution: Ensure that the bus cables are connected and not damaged.

Table 11-6 Meaning of the MT LED

MT LED	Meaning
	No PROFINET maintenance request.
	The "LED flashing test" is being performed.
	A PROFINET maintenance request exists. Solution: Take notice of the diagnostics alarm and check the device.

Table 11-7 Meaning of the SYNC LED

SYNC LED	Meaning
	Isochronous mode (IRT) is not active.
	Isochronous mode (IRT) is active.
	The "LED flashing test" is being performed.

Table 11-8 Meaning of the ON LED

ON LED	Meaning
	ISO-TCP server is not started.
	ISO-TCP server is started.

Meaning of the LEDs for the sensor unit

Table 11-9 Meaning of the LEDs for the sensor unit

DQ/DI LEDs	Meaning
	Digital input/output is inactive.
	Digital input/output is active.

Table 11-10 Meaning of the 5VSE LED

5VSE LED	Meaning
	Supply voltage output of motor encoder is switched off.
	Supply voltage output of motor encoder is switched on.

11.1 Status and error displays

Table 11-11 Meaning of the 2L+ LED

2L+ LED	Meaning
	Infeed of supply voltage for the sensor unit is missing or is outside the permissible tolerance range.
	Infeed of supply voltage for the sensor unit is OK.

Meaning of the LEDs for power unit and logic unit

Table 11-12 Meaning of the 4L+ LED

4L+ LED	Meaning
	Infeed of supply voltage of power unit is missing or is outside the permissible tolerance range.
	Infeed of supply voltage of power unit is OK.

Table 11-13 Meaning of the 1L+ LED

1L+ LED	Meaning
	Infeed of supply voltage of logic unit is missing or is outside the permissible tolerance range.
	Infeed of supply voltage of logic unit is OK.

Meaning of the LED displays of the PROFINET ports

Each PROFINET port has two LEDs (green/yellow) for signaling whether a connection is present and data transfer is active:

- P1
- P2

The following table shows the meaning of the various color combinations of the P1/P2 LEDs.

Table 11-14 Meaning of the LED displays of the PROFINET ports

P1/P2	Meaning
	No Ethernet connection. No data is currently being sent/received via the Ethernet interface.
	The "LED flashing test" is being performed.

P1/P2	Meaning
	Ethernet connection established (Link).
 (flickers)	Data exchange with communication partner (Activity).

Meaning of the service LED displays

Table 11-15 Meaning of the MRES LED

MRES LED	Meaning
	No microSD memory card inserted.
	microSD memory card inserted.
	Service action is being executed (maintenance data and parameter backup is being written to the memory card or a reset to factory settings is being performed).
	Ready for memory reset (deletion of user data, resetting to factory settings and restart) You must confirm this action by briefly pressing the service button.

11.2 Actual values

You can find online information on important current operating data, actual data and service data of the drive in the "Actual values" area under "Online & diagnostics" in the context of the drive.

Note

All actual values are only available online. They are automatically updated in the user interface.

You will find diagnostic information on the following in the "Actual values" area:

- Type of power unit
- Control and status words
- Actual values and setpoints of motor and drive controller
- Encoder information
- Temperatures
- Digital inputs and outputs
- Firmware signatures
- Service and maintenance data

11.4 Messages

Procedure

To display the diagnostic information of the drive, follow these steps:

1. Select the PDC in the project tree and go to "Online & diagnostics".
2. Select the desired area in the "Diagnostics" folder under "Actual values".

Reference

All displayed parameters are provided with a tooltip that provides you with information and descriptions for the parameter as well as access to the online help.

You can find additional information on the parameters in section Parameters (Page 211).

11.3 System time

Time and date information is not available for the PDC and must therefore also not be synchronized, e.g. via NTP (= Network Time Protocol). The system time of the drive is mapped in parameter r3102. It is made up of the number of system starts and the current running time of the system.

The current system time is displayed in the "Service and maintenance data" area, among other places.

1. Open "Online & diagnostics" in the context of the drive.
2. Select the "Service and maintenance data" group under "Actual values".

The following displays are used in the PDC engineering:

"RST-0, 0d 00:00:00" or "Reset-19, 0d 00:00:02.249", where:

- "RST" or "Reset" = Number of system starts
- Current system running time in "d" = days and "Hours:Minutes:Seconds".
- The time stamp for the alarms also contains milliseconds.

11.4 Messages

The messages of the drive are subdivided into faults and alarms. You will find a list of the faults and alarms in section Faults and warnings (Page 267).

Faults

Fault messages or faults have the following properties:

- A fault usually results in the motor being switched off.
- Faults must be eliminated and acknowledged.

What happens when a fault occurs?

- The appropriate fault response is initiated.
- Status signal ZSW1.3 is set.
- The fault is entered in the fault buffer.

How do you eliminate faults?

- Eliminate the cause of the fault.
- Acknowledge the fault.

Faults are indicated as follows:

- In the CPU corresponding to the PROFIdrive message class (alarm message)
- On the drive controller via the "RDY/ERR" LED.
- In the context of the drive under "Online & diagnostics > Active messages".

Acknowledging fault messages

Before you can acknowledge a fault message, you must eliminate the cause of the fault.

You have several options for acknowledging:

- Acknowledge via the CPU
- Switch the voltage supply of the drive controller off and back on
- Acknowledge using the engineering tool

With enabled function "Extended message acknowledgment via HW-STO" (p9501.5), a safe acknowledgment (Internal Event Acknowledge) can be performed by selecting/deselecting HW STO. Any pending messages of other safety functions are simultaneously acknowledged through the extended message acknowledgment. In addition, you must also execute the standard acknowledgment mechanism.

Faults due to drive-internal monitoring of hardware and firmware can only be acknowledged by switching the supply voltage off and on again. In the list of faults, you will find information on any acknowledgment restrictions for the corresponding fault codes.

After acknowledgment, faults and alarms are moved to the message history, see below.

Procedure

To acknowledge faults using the engineering tool, follow these steps:

1. Select the PDC in the project tree.
2. Double-click "Online & diagnostics".
3. Select the "Active messages" group.
4. Click "Acknowledge faults" to acknowledge all fault messages.

11.4 Messages

Note

You can also start the "Acknowledge faults" function directly from the toolbar of the "Parameters" and "Commissioning" windows.

Alarms

Alarm messages or alarms have the following properties:

- Alarms have no direct effect in the drive.
- Alarms go out again when the cause is eliminated.
- Alarms cannot be acknowledged.

What happens when an alarm occurs?

- Status signal ZSW1.7 is set.
- The alarm is entered in the alarm buffer.

How are alarms corrected?

- Alarms are self-acknowledging.
- When the cause is no longer present, alarms automatically reset themselves.

Alarms are indicated as follows:

- In the CPU corresponding to the PROFIdrive message class.
- In the context of the drive under "Online & diagnostics > Active messages".

Alarm code and alarm value describe the cause of the alarm.

Evaluating messages

Information on possible causes as well as suggestions for eliminating a message are provided in the tooltip of the message.

Messages can be subdivided into as many as 32 individual messages by a mask. The mask is mapped in the message value. Each bit set in the mask displays an active single message. Each single message has an individual cause and, if applicable, information on how to eliminate it. All available information on the active single messages is displayed in the tooltip of the message.

Note

You can find additional information on faults and alarms in section Faults and warnings (Page 267) and in the online help of the drive.

Message history

The PDC has a message history in which all faults and alarms are recorded. You read out this message history in online mode.

To display the message history, follow these steps:

1. Select the "Message history" area in the context of the drive under "Online & diagnostics".

Deleting the message history

To delete the message history of faults or alarms, click the "Delete fault buffer" or "Delete alarm buffer" button.

Exporting the message history

To export the fault buffer and alarm buffer to a CSV file, click the "Export message history" button.

Note

You can find additional information on faults and alarms in section Faults and warnings (Page 267) and in the online help of the drive.

11.5 Standard PROFIdrive alarms

With the PDC drive controller, it is possible to use the standardized diagnostics for PROFINET. This allows the alarms and faults of the drive to be integrated into the system diagnostics of a higher-level controller and automatically displayed on an HMI. This function is certified for PROFIdrive on PROFINET.

Display of standard PROFIdrive alarms

The transferred information is stored in parameters r0947[0..7] for faults and r2110[0..7] for alarms. The messages entered here are combined to create PROFIdrive message classes for diagnostics.

The standard PROFIdrive alarms are activated by default in the PDC. To deactivate the standard PROFIdrive alarms, change the diagnostics settings in the module parameters of the drive, see section Module parameters (Page 94).

Note

Displaying alarms in STEP 7

When channel diagnostics are activated, the error texts are displayed in the CPU.

To display alarms in STEP 7, select the "Receive alarms" option in the CPU, for example, under "Online & diagnostics" > "Online access".

11.5 Standard PROFIdrive alarms

The time stamps are generated by the higher-level CPU when the alarms arrive. The alarms are compatible with PROFINET controllers. Alarms or faults are acknowledged using the already known means of acknowledgment.

Note

If shared device is activated, only one of the controllers can receive diagnostics.

Technical specifications

Introduction

The technical specifications of the drive system are found in this section:

- The standards and test values that the PDC drive controllers comply with and fulfill.
- The test criteria according to which the PDC drive controllers were tested.

Technical specifications for the PDC variants

The technical specifications of the individual PDC drive controllers are available in the manual of the respective PDC device version. If there are discrepancies between the statements in this document and the product manuals, the statements in the product manuals take priority.

12.1 Standards, approvals and safety instructions

Currently valid markings and approvals

Note

Information on the PDC housing

The valid markings and approvals are printed on the housing of the PDC.

Safety instructions



WARNING

Range of application

This device is only suitable for use in non-hazardous areas.

5 safety rules for working in and on electrical installations

A set of rules, which are summarized in DIN VDE 0105 as the "five safety rules", are defined for work in or on electrical installations as a preventative measure against electrical accidents:

1. De-energize
2. Secure to prevent reconnection
3. Verify safe isolation from the supply

12.1 Standards, approvals and safety instructions

4. Connect to ground and short-circuit
5. Cover or provide barriers from adjacent live parts

These five safety rules must be applied in the above-indicated order before starting work on electrical equipment. After completing the work, proceed in the reverse order.

It is assumed that every electrician is familiar with these rules.

CE marking



The PDC drive controller meets the requirements and safety objectives of the following guidelines and complies with the following standards:

- 2006/42/EC "Directive on machinery" (Machinery Directive)
ISO 13849-1:2015 (Cat. 3, PL d)
IEC 62061:2005
- 2014/30/EU "Electromagnetic Compatibility" (EMC Directive)
EN 61000-6-2:2019
EN 61000-6-4:2007
EN 61800-3:2018
- 2011/65/EU "Restriction of the use of certain hazardous substances in electrical and electronic equipment" (RoHS Directive)
EN 50581:2012

The EU conformity declaration certificates are available for the responsible authorities and are kept at the following address:

Siemens AG
Digital Factory

Factory Automation
DF FA APS
Breslauer Str. 5
D-90766 Fürth

They are also available for download on the Siemens Industry Online Support website, under the keyword "Declaration of Conformity".

IEC 61131

The PDC drive controller meets the requirements and criteria of IEC 61131-2:2017 (Programmable logic controllers, Part 2: Equipment requirements and tests).

PROFINET standard

The PDC drive controller is based on IEC 61158

EMC - Use in industrial environments

The PDC drive controller is designed for use in industrial environments. It meets the following EMC standards for this type of use:

- Requirements on interference emission EN 61000-6-4
- Requirements on immunity EN 61000-6-2
- Requirements on interference emission and immunity EN 61800-3



WARNING

PDC1000 und PDC600(F) in residential environments

In a residential environment, this product can cause high-frequency interference that can make radio interference suppression measures necessary.

Have the installation and commissioning performed by experts using appropriate radio interference suppression measures.

A filter (such as Schaffner FN2410-45-33) can be used on the 4L+ and 4M power supplies to reduce conducted interference. This means that the following limit values are observed:

- 0.15 - 0.5 MHz: 79 dB (μV) Q, 66 dB (μV) M
- 0.5 - 30 MHz: 73 dB (μV) Q, 60 dB (μV) M

EMC - Use in residential environments (only PDC100(F))

The PDC drive controller meets the requirements for radiated interference emission according to EN 61000-6-3:2007 Electromagnetic compatibility (EMC) - Part 6-3: Generic standards – Emission standard for residential, commercial and light-industrial environments.

The following requirements apply to this:

- All components (inputs, motors, encoders, outputs, voltage supply) are connected with professionally shielded cables if appropriate based on length and requirements. The wiring rules for the interfaces in the manual of the respective PDC device version still apply.
- The utilized components are intended for an appropriate shield connection and their design also allows this objective to be met.
- The control system is mounted on a grounded ground plane.

Note

The PDC controller is not intended for use in residential environments without additional measures.

If you want to use the PDC drive controller in residential environments, use an appropriate installation and additional filter measures at the supply inputs to ensure compliance with EN 61000-6-3.

The following limits are complied with at the supply inputs without additional measures:

- 0.15 - 0.5 MHz: 89 dB (μV) Q, 76 dB (μV) M
- 0.5 - 30 MHz: 83 dB (μV) Q, 70 dB (μV) M

Reference

The certificates for the markings and approvals can be found on the Internet (<https://support.industry.siemens.com/cs/ww/en/ps/25460/cert>).

12.2 Electromagnetic compatibility

Note

Only items in need of explanation are explained in this section. All other items correspond to the normative requirements.

Definition

Electromagnetic compatibility (EMC) is the ability of an electrical installation to function satisfactorily in its electromagnetic environment without interfering with that environment.

The PDC drive controller also meets, among other things, the requirements of the EMC law of the European Single Market. The precondition for this is that the PDC drive controller complies with the requirements and guidelines for the electrical installation.

EMC in accordance with NE21

The PDC drive controller meets the EMC requirements according to NAMUR Recommendation NE21.

High-energy single pulse (surge)

The following table shows the electromagnetic compatibility of the PDC drive controller with regard to pulse-shaped disturbances.

Table 12-1 Pulse-shaped disturbances

Pulse-shaped disturbance	Tested with	Corresponds with degree of severity
High-energy single pulse (surge) in accordance with IEC 61000-4-5. An external protective circuit is required for the DC power supply connections 1L+, 2L+, 4L+ for achieving degree of severity 3. The PDC has been successfully tested with the following protective element: Phoenix Contact GmbH & Co. KG, Type 3 surge protection device - PT 2+1-S-48DC/FM - 2817958		
Asymmetrical coupling	±1 kV (power supply lines) ¹⁾ DC voltage without additional protective elements	2
	±2 kV (power supply lines) ¹⁾ DC voltage with protective elements	3
	±2 kV (signal line/data line on shield for cables >30 m) without additional protective elements	3
Symmetrical coupling	±0.5 kV (power supply lines) ¹⁾ DC voltage without additional protective elements	2
	±1 kV (power supply lines) ¹⁾ DC voltage with protective elements	3

¹⁾ Only applies to PDC100(F)

12.3 Transport and storage conditions

Transport and storage conditions for the PDC

Table 12-2 Transport and storage conditions

Type of condition	Permissible range
Free fall (in shipping package)	≤750 mm
Temperature	-20 °C to +70 °C
Barometric pressure	1060 to 620 hPa (corresponds to an altitude of -1000 to +4000 m)
Relative humidity	10 to 95%, without condensation
Sinusoidal vibrations in accordance with IEC 60068-2-6	5 - 9 Hz: 3.5 mm 9 - 500 Hz: 9.8 m/s ²
Shock in accordance with IEC 60068-2-27	250 m/s ² , 6 ms, 1000 shocks

12.4 Mechanical and climatic ambient conditions

Operating conditions

The PDC drive controller is designed for stationary use in weather-proof locations.

Average operating time

For the total operating time, the following temperature spectrum is assumed:

Air temperatures outside the PDC	Percentage of operating hours
-20 °C	5%
+25 °C	20%
+40 °C	65%
+60 °C	10%

The MTBF value is calculated for an ambient temperature of 40 °C and a typical load and can be obtained from the technical specifications.

The module is designed for a t_m (mission time) of 20 years.

Test of mechanical ambient conditions

The table below provides important information with respect to the type and scope of the test of ambient mechanical conditions.

Table 12-3 Test of mechanical ambient conditions

Condition tested	Test Standard	Comment
Vibrations (with wall mounting)	IEC 60068-2-6	Type of vibration: Sinusoidal, frequency sweeps with a rate of change of 1 octave/minute. 9 Hz ≤ f ≤ 29 Hz, 1.5 mm constant amplitude 29 Hz ≤ f ≤ 200 Hz, 5 g constant acceleration Duration of vibration: 1 octave/minute, 10 frequency sweeps per axis in each of three perpendicular axes
Vibrations (with mounting rail mounting)	IEC 60068-2-6	Type of vibration: Frequency sweeps with a rate of change of 1 octave/minute. 5 Hz ≤ f ≤ 8.4 Hz, 3.5 mm constant amplitude 8.4 Hz ≤ f ≤ 150 Hz, 1 g constant acceleration Duration of vibration: 1 octave/minute, 10 frequency sweeps per axis in each of three perpendicular axes
Shock (with wall mounting)	IEC 60068-2-27	Type of shock: Half-sine Shock intensity: 100 m/s ² peak value, 30 ms duration Direction and number of shocks: 1000 shocks each in +/- direction in each of three perpendicular axes

Condition tested	Test Standard	Comment
Shock (with wall mounting)	IEC 60068-2-27	Type of shock: Half-sine Shock intensity: 250 m/s ² peak value, 6 ms duration Direction and number of shocks: 1000 shocks each in +/- direction in each of three perpendicular axes
Shock (with mounting rail mounting)	IEC 60068-2-27	Type of shock: Half-sine Shock intensity: 150 m/s ² peak value, 11 ms duration Direction of shock: 3 shocks each in +/- direction in each of three perpendicular axes

Reduction of vibrations

If the automation system is exposed to greater shocks or vibrations, you must take appropriate measures to reduce the acceleration or the amplitude.

We recommend mounting the automation system on damping materials (for example, rubber-bonded-to-metal mounting).

Climatic ambient conditions

The following table shows the permissible climatic ambient conditions for the PDC:

Table 12-4 Climatic ambient conditions

Ambient conditions	Permissible range	Comments
Temperature	from -20 to 60 °C	- PDC100: - Horizontal mounting position: from -20 to 60 °C - Vertical mounting position: from -20 to 40 °C - PDC1000: - For temperatures above 40 °C, observe the notes on derating in the PDC1000 (https://support.industry.siemens.com/cs/ww/en/view/109774127) manual.
Temperature variation	10 K/h	-
Relative humidity	10 to 95%	Without condensation, corresponds to relative humidity (RH) degree 2 in accordance with IEC 61131 part 2
Barometric pressure	1060 to 620 hPa	Corresponds to an altitude of -1000 to +4000 m; starting from 1000 m, observe notes on derating in the manual of the respective PDC device version.

12.5 Information on insulation tests, protection class, degree of protection and rated voltage

Insulation

Before testing, all signals must be conductively connected to one another with the same potential.

A routine test is not performed. It is not required according to EN 61010 or UL 61800 because there are no "HAZARDOUS LIVE parts" at any point.

The test voltages for the possible field test are specified in Table 12-5 Test voltages on the PDC for possible field and production tests (Page 209). The tests can be conducted with AC or DC. If necessary, the insulation resistance between the potential groups can be measured. A test with an insulation tester and a DC test voltage of 500 V DC is suggested. The measured resistance should be greater than 2 MΩ.

See also

Information on insulation tests, protection class, degree of protection and rated voltage (Page 208)

Voltage potentials on the PDC

- PROFINET Port 1
 - X2050 Interface
 - Field side P1
- PROFINET Port 2
 - X2060 Interface
 - Field side P2
- Digital inputs/outputs
 - X4060 Interface
 - 2M
- Sensor
 - X4050 Interface
 - 5M
- Hardware STO
 - X5060 Interface
 - Field side STO

12.5 Information on insulation tests, protection class, degree of protection and rated voltage

- Controller
 - X5050, X5060 Interfaces
 - 4M, 1M
- Functional ground
 - Screw terminal, functional ground pin on X5050

Table 12-5 Test voltages on the PDC for possible field and production tests

	PROFINET Port 2	Digital inputs/ outputs	Sensor	Hardware STO	Controller	Functional ground
PROFINET Port 1	500 V DC 350 V AC 1 s	500 V DC 350 V AC 1 s	500 V DC 350 V AC 1 s	500 V DC 350 V AC 1 s	500 V DC 350 V AC 1 s	500 V DC 350 V AC 1 s
PROFINET Port 2	-	500 V DC 350 V AC 1 s	500 V DC 350 V AC 1 s	500 V DC 350 V AC 1 s	500 V DC 350 V AC 1 s	500 V DC 350 V AC 1 s
Digital inputs/ outputs	-	-	500 V DC 350 V AC 1 s	500 V DC 350 V AC 1 s	500 V DC 350 V AC 1 s	500 V DC 350 V AC 1 s
Sensor	-	-	-	500 V DC 350 V AC 1 s	500 V DC 350 V AC 1 s	500 V DC 350 V AC 1 s
Hardware STO	-	-	-	-	500 V DC 350 V AC 1 s	500 V DC 350 V AC 1 s
Controller	-	-	-	-	-	500 V DC 350 V AC 1 s

Pollution degree/overvoltage category according to IEC 61131-2: 2007

- Pollution degree 2
- Overvoltage category: II

Degree of protection IP20

Degree of protection IP20 according to IEC 60529 for all variants of the PDC drive controller, i.e.:

- Protection against contact with standard test finger
- Protection against foreign objects with diameters in excess of 12.5 mm
- No protection against water

12.5 Information on insulation tests, protection class, degree of protection and rated voltage

Note

Degree of protection IP20 applies only to the housing of the drive controller and not to the connections.

Rated voltage for operation

See the specifications in section Power supply (Page 29).

Parameters

13.1 Overview of the parameters

Parameters are used to represent some variables and settings of the drive controller. There are adjustable parameters and display parameters.

The representations of the adjustable and display parameters as well as the components of the parameter description are described in more detail below.

Parameter number

The parameter number is made up of "p" or "r", followed by the parameter number and, optionally, the index or bit field.

- Parameter numbers preceded with the letter "p" designate adjustable parameters.
- Parameter numbers preceded with the letter "r" indicate write-protected parameters.

Examples of representation in the parameter list:

- p... Adjustable parameter (read/write)
- r... Display parameters (read only)
- p0300 Adjustable parameter 0300
- p0420[0...5] Adjustable parameter 0420 index 0 to 5
- r0944 Display parameter 0944
- r0051.0...04 Display parameter 0051 with bit field from bit 0 (lowest bit) to bit 04 (highest bit)

Other examples of notation in the documentation:

- p0142[1] Adjustable parameter 0142 index 1
- r0480[1].3 Display parameter 0480 index 1 bit 3
- r0947[2](3) Display parameter 0947 index 2 of drive object 3
- p9501.4 Adjustable parameter 9501 bit 4

Changeable

- The information "-" means:
A change of the parameter is possible in any state and becomes active immediately.
- The information "C2(95)" means:
The change of the parameter must be confirmed by completing the safety commissioning.
- The information "U" (operation) means:
A change of the parameter is possible in operation if pulses are enabled ("RDY/ERR" LED lit green).
- The information "T" (ready for operation) means:
A change of the parameter is not possible in operation if pulses are enabled.

Data types of parameters

Each parameter corresponds to one of the following data types. The relevant data type is specified in the parameter header.

Data type	Abbreviation	Description
Integer16	I16	16-bit integer
Integer32	I32	32-bit integer
Unsigned8	U8	8-bit without sign
Unsigned16	U16	16-bit integer without sign
Unsigned32	U32	32-bit integer without sign
FloatingPoint32	Float	32-bit floating-point number

Parameter values

Min	Minimum value of parameter [unit]
Max	Maximum value of parameter [unit]
Def	Value in delivery condition [unit]

Index

For parameters with index, the name and the meaning of each individual index is specified.

For the parameter values (Min, Max, Def), the following applies to indexed adjustable parameters:

- Min, Max:
The setting range and the unit applies to all indices.
- Def:
If the factory setting of the indices differs, all indices are individually listed.

Bit field

For parameters with bit fields, the following is specified for each bit:

- Bit number and signal name
- Meaning when signal state is 1 and 0

Safety information

The safety information contains:

- Important information that must be observed to prevent physical injury or property damage.
- Information that must be observed to avoid problems.
- Information that can be helpful to users.

You can find a description of the warning concept of the safety information in the legal information at the beginning of the manual.

13.2 Parameter list

List of parameters of the PDC drive controller

Product: sim_pdc, Version: 1001700

r0024	Output rotating field frequency smoothed
	Data type: FloatingPoint32 Unit: [Hz]
Description:	Displays the smoothed output rotating field frequency with which the motor is controlled. For EC motors, this value is higher than the mechanical speed in revolutions per second by the pole pair number factor.
	Note Smoothing time constant = 100 ms
r0025	Output voltage, smoothed
	Data type: FloatingPoint32 Unit: [V]
Description:	Displays the smoothed output voltage of the power unit.
Dependency:	See also: r0072
	Note Smoothing time constant = 100 ms
r0026	DC link voltage, smoothed
	Data type: FloatingPoint32 Unit: [V]
Description:	Displays the smoothed actual value of the DC link voltage.
	Note Smoothing time constant = 100 ms
r0027	Current actual value, smoothed
	Data type: FloatingPoint32 Unit: [A]
Description:	Displays the smoothed current actual value.
Dependency:	See also: r0068
	Note Smoothing time constant = 100 ms
r0031	Torque actual value, smoothed
	Data type: FloatingPoint32 Unit: [Nm]
Description:	Displays the smoothed torque actual value.
Dependency:	See also: r0080
	Note Smoothing time constant = 100 ms
r0034[0...3]	Thermal monitoring, utilization
	Data type: FloatingPoint32 Unit: [%]
Description:	Displays the currently calculated thermal utilization levels of the system.

13.2 Parameter list

Index:

- [0] = Thermal motor utilization
- [1] = Thermal utilization, power end stage
- [2] = Internal brake resistance utilization from an energy perspective
- [3] = Thermal utilization, internal brake resistance

⚠ WARNING

After initialization, the thermal motor utilization cannot be immediately determined as the model must first settle. As a consequence, an initial utilization of 50% is used as basis.

r0035[0...1]**Encoder temperature**

Data type: FloatingPoint32 **Unit:** [°C]

Description: IQ-Encoder temperature display.

Index:

- [0] = IQ-Encoder housing actual
- [1] = IQ-Encoder housing maximum

Dependency: The value is only supplied for motors equipped with IQ-Encoder.

r0036**Power unit, relative load**

Data type: FloatingPoint32 **Unit:** [%]

Description: Displays the currently calculated relative load of the power unit.

Recommendation: See also: r0027, r0208

Note

The relative load of the power end stage is calculated based on the square of the output current r0027, referred to the rated value of the power unit r0208.

r0037[0...5]**Temperatures**

Data type: Integer16 **Unit:** [°C]

Description: Display of the drive temperatures.

Index:

- [0] = Actual microcontroller temperature
- [1] = Maximum microcontroller temperature
- [2] = Actual brake resistance temperature
- [3] = Maximum brake resistance temperature
- [4] = Actual power end stage temperature
- [5] = Maximum power end stage temperature

Note

The displayed temperature of the power end stage and internal braking resistor are measured using sensors installed in the vicinity. As a consequence, the actual temperature of the power transistors or the internal braking resistor can lie above this value.

r0051**Active drive data set DDS**

Data type: Unsigned8 **Unit:** -

Description: Displays the active drive data set (DDS).

Bit field:	Bit	Signal name	1 signal	0 signal
	00	DDS active bit 0	On	Off
	01	DDS active bit 1	On	Off
	02	DDS active bit 2	On	Off
	03	DDS active bit 3	On	Off
	04	DDS active bit 4	On	Off

r0060**Speed setpoint before the setpoint filter**

Data type: FloatingPoint32 **Unit:** [rpm]

Description: Displays the active speed setpoint before the setpoint filter.

Note

The setpoint channel comprises the following blocks:

Setpoint -- limiting -- ramp-function generator -(r0060)- setpoint filter -- speed controller

r0061 Speed actual value

Data type: FloatingPoint32 **Unit:** [rpm]

Description: Displays the speed actual value.

r0062 Speed setpoint before the speed controller

Data type: FloatingPoint32 **Unit:** [rpm]

Description: Displays the active speed setpoint before the speed controller.

Note

The setpoint channel comprises the following blocks:

Setpoint -- limiting -- ramp-function generator -- setpoint filter -(r0062)- speed controller

r0063 Speed actual value smoothed

Data type: FloatingPoint32 **Unit:** [rpm]

Description: Displays the smoothed speed actual value for the speed control.

Dependency: See also: r0061

Note

Smoothing time constant = 100 ms

r0068 Current actual value

Data type: FloatingPoint32 **Unit:** [A]

Description: Displays the current actual value.

r0072 Output voltage

Data type: FloatingPoint32 **Unit:** [V]

Description: Displays the actual power unit output voltage (Motor Module).

Note

The value is not smoothed.

r0073 Modulation depth

Data type: FloatingPoint32 **Unit:** [%]

Description: Displays the modulation depth.

r0080 Torque actual value

Data type: FloatingPoint32 **Unit:** [Nm]

Description: Displays the actual torque value.

r0082[0...2] Active power actual value

Data type: FloatingPoint32 **Unit:** [W]

Description: Displays the instantaneous drive power data.

Index: [0] = Power drawn by the drive (motor winding + load)

[1] = Mechanical power drawn (load)

[2] = Electrical power loss (motor winding)

13.2 Parameter list

Note

The power is split up into 2 components. Electrical losses that occur in the motor winding and mechanical power that is output at the motor shaft.

r0093	Rotor angle electrical			
	Data type: FloatingPoint32	Unit: [°]		
Description:	Displays the electrical rotor angle			
	NOTICE			
	Only available for EC motors, a value of 0 is output for a DC motor.			
r0107	Drive object type			
	Data type: Integer16	Unit: -		
Description:	Type of the existing drive object.			
Value:	0: - 11: SERVO 12: VECTOR 17: DC_CTRL			
r0108	Drive objects function module			
	Data type: Unsigned32	Unit: -		
Description:	Displays the activated function module for the particular drive object.			
Bit field:	Bit	Signal name	1 signal	0 signal
	02	Speed/torque control / n/M		
	03	Position control / Pos ctrl		
	04	Basic positioner / EPOS		
	08	Extended setpoint channel / Ext setp		
	13	Safety rotary axis /		
	14	Extended brake control /		
	15	Parallel connection /		
	16	Technology controller /		
	17	Extended messages /		
	18	Free function blocks / FBLOCKS		
	20	Software gating unit /		
	28	Cooling unit /		
	31	PROFINET / PROFINET		
r0115	Sampling time control loops			
	Data type: FloatingPoint32	Unit: [µs]		
Description:	Displays the controller sampling times.			
p0141	Drive data set configuration procedure			
	Can be changed: T	Data type: Integer16		
	Min: 0	Max: 2	Def: 2	
Description:	Sets the procedure to configure the drive data set.			
Value:	0: IQ-Encoder drive data set 1: Preconfigured drive data set 2: User-defined drive data set			

Note

IQ-Encoder drive data set:

Drives from the Siemens product partner program equipped with IQ-Encoder have an electronic rating plate, from which the drive data set can be loaded.

Preconfigured drive data set:

Source the preconfigured drive data sets as file for the selected drive from Siemens Industry Online Support.

User-defined drive data set:

Create a user-defined drive data set and manually configure the drive.

p0142[0...2]	Drive data set signature extension
	Can be changed: T Data type: Unsigned32 Min: 0 Max: 4294967295 Def: 0
Description:	Sets the extended signatures (rating plate).
Recommendation:	Extended signatures should only be used if explicitly specified by the manufacturer.
Index:	[0] = Signature extension 1 [1] = Signature extension 2 [2] = Signature extension 3
	Note These checksums are used to support old drives.
p0143	Drive data set signature
	Can be changed: T Data type: Unsigned32 Min: 0 Max: 4294967295 Def: 0
Description:	Sets the signature of the drive data set (rating plate).
Recommendation:	The manufacturer provides the signature for a drive data set.
	Note This checksum is used to sign the data set, and is used to secure consistency. A value of 0 must be set if it involves an unsigned data set.
r0200[0...2]	Firmware signatures
	Data type: Unsigned32 Unit: -
Description:	Displays the unique firmware signatures within the drive.
Index:	[0] = Motor controller [1] = Communication [2] = Revision
r0203	Power unit type
	Data type: Integer16 Unit: [W]
Description:	Displays the power unit type installed.
p0205	Power unit configuration
	Can be changed: T Data type: Unsigned16 Min: - Max: - Def: 0010 bin

13.2 Parameter list

Description: Sets various power unit applications.

For bit 1 (overload protection):

In the automatic mode, when reaching the rated load of the power end stage (r0036 = 100%) output current r0027 is automatically reduced in order to prevent an overload condition. Operation with peak current r0209 is possible for a short time if the average rms current does not exceed rated current r0208.

Bit field:	Bit	Signal name	1 signal	0 signal
	00	Energy recovery	On	Off
	01	Automatic overload limiting	On (automatic)	Off

⚠ WARNING

For bit 0 (energy recovery):

When energy recovery is permitted, the control of the internal and external brake resistance is deactivated. Further, the DC link voltage monitoring is also deactivated. An external voltage monitoring function must be provided. For battery operation, it is recommended that energy recovery is permitted in order to avoid possible operational disturbances.

r0208 Rated power unit current

Data type: FloatingPoint32 **Unit:** [A]

Description: Displays the rated current of the power unit.

r0209 Peak power unit current

Data type: FloatingPoint32 **Unit:** [A]

Description: Displays the maximum output current of the power unit.

The maximum output current can be briefly reached. The available duration depends on the actual load state of the end stage. The maximum output current varies depending on the power unit being used.

Note

The peak current is available every 20s for at least 3s, assuming that the current load in the remaining time is adequately low.

p0291[0...1] Thermal monitoring alarm threshold utilization

Can be changed: T **Data type:** FloatingPoint32

Min: 60.0 [%] **Max:** 100.0 [%] **Def:** 85.0 [%]

Description: Sets the alarm threshold for the thermal system monitoring.

Index:
[0] = Alarm threshold thermal motor utilization
[1] = Alarm threshold energy utilization internal brake resistance

p0292[0...2] Thermal monitoring alarm threshold utilization temperature

Can be changed: T **Data type:** FloatingPoint32

Min: 0.0 [K] **Max:** 100.0 [K] **Def:** 15.0 [K]

Description: Sets the alarm threshold for the thermal system monitoring.

Index:
[0] = Alarm threshold thermal motor utilization
[1] = Alarm threshold thermal utilization power end stage
[2] = Alarm threshold thermal utilization internal brake resistance

Dependency: See fault thresholds: r3692, r3691, r0325

Note

The alarm thresholds are specified as temperature difference with respect to the specified maximum value.

r0293[0...1] Power unit threshold values load

Data type: FloatingPoint32 **Unit:** [%]

Description: Displays the threshold value for the power unit load.

Index: [0] = Alarm threshold load
[1] = Interference threshold load

Dependency: See also: r0036, p0205.

p0300 Motor type configuration

Can be changed: T

Data type: Integer16

Min: 0

Max: 26

Def: 0

Description: Sets the motor type (rating plate).

Value: 0: Not configured
21: Motor - DC (DC motor)
26: PMSM motor (permanent magnet synchronous motor)

p0302 Drive identifier

Can be changed: T

Data type: Unsigned32

Min: 0

Max: 4294967295

Def: 0

Description: Sets the primary drive identifier (rating plate).

Note

This identifier is used to uniquely identify the drive, and is provided by the manufacturer. A drive identifier of 0 can be set if it involves a freely configured drive.

p0303[0...27] Drive name

Can be changed: T

Data type: Unsigned8

Min: -

Max: -

Def: -

Description: Sets the drive name to electronically identify and assign the drive (rating plate).

p0304 Rated motor voltage

Can be changed: T

Data type: FloatingPoint32

Min: 3.0 [V]

Max: 100.0 [V]

Def: 3.0 [V]

Description: Sets the rated motor voltage (rating plate).

Note

The rated motor voltage should be taken from the motor data sheet. This involves the voltage that must be connected at the rated operating point of the motor to supply the power unit (4L+) for a modulation depth of 100% (for block commutation).

p0305 Rated motor current

Can be changed: T

Data type: FloatingPoint32

Min: 0.01 [A]

Max: 100.00 [A]

Def: 0.01 [A]

Description: Sets the rated motor current (rating plate).

Note

This involves the DC link current at the rated operating point. The rated motor current should be taken from the motor data sheet.

p0311 Rated motor speed

Can be changed: T

Data type: FloatingPoint32

Min: 10 [rpm]

Max: 25000 [rpm]

Def: 10 [rpm]

Description: Sets the rated motor speed (rating plate).

13.2 Parameter list

Note Motor speed at the rated operating point. The rated motor speed should be taken from the motor data sheet.	
p0312	Rated motor torque
	Can be changed: T Data type: FloatingPoint32 Min: 0.0010 [Nm] Max: 1000.0000 [Nm] Def: 0.0010 [Nm]
Description:	Sets the rated motor torque (rating plate).
	Note Motor torque at the rated operating point. The rated motor torque should be taken from the motor data sheet.
p0314	Motor pole pair number
	Can be changed: T Data type: Unsigned16 Min: 0 Max: 16 Def: 0
Description:	Sets the number of motor pole pairs (rating plate).
Dependency:	It is not necessary to specify the pole pair number for DC motors (p0300).
	Note Example: p0314=2 => 4-pole motor.
p0316	Motor inner constant
	Can be changed: T Data type: FloatingPoint32 Min: 1.0 [mNm/A] Max: 100000.0 [mNm/A] Def: 1.0 [mNm/A]
Description:	Sets the inner motor constant (rating plate).
	Note The ideal or inner motor constant k_m is obtained from the ideal transfer response of a motor (i.e. without losses). The inner motor constant is determined by externally driving the motor at a defined speed and then measuring the induced rms voltage. The measured rms voltage * root (3/2) is taken and divided by the angular velocity ((speed [rpm] * 2 * pi) / 60). Inner motor constant [Vs/rad] = rms voltage [V] * root (3/2) / angular velocity [rad/s] As the ideal torque constant is the same as the ideal speed constant, the following is obtained: Inner ideal torque constant [Nm/A] = inner ideal speed constant [Vs/rad] Remark: The real motor constants do not correspond to the inner motor constant. The real torque constant and the real speed constant are referred to variables that can be measured outside, and therefore include the losses that occur in the motor.
p0318	Motor stall current
	Can be changed: T Data type: FloatingPoint32 Min: 0.01 [A] Max: 100.00 [A] Def: 0.01 [A]
Description:	Sets the motor stall current (rating plate).
Dependency:	See p0305.
	Note At 20 °C it is permissible that the stall current flows through the stationary motor without thermally overloading the motor. Typically, the motor stall current is the same as the rated motor current.
p0322	Maximum motor speed
	Can be changed: T Data type: FloatingPoint32 Min: 10 [rpm] Max: 25000 [rpm] Def: 10 [rpm]
Description:	Sets the maximum motor speed (rating plate).

Note

For EC motors it is possible that the set maximum speed cannot be reached for all pole pair numbers, as the maximum rotating field frequency is limited.

For example, if the maximum rotating field frequency is 450 Hz, then the following maximum speeds that can be reached are obtained.

Example a: $(450 \text{ Hz} / 1 \text{ pole pair}) * 60 = 27000 \text{ rpm}$

Example b: $(450 \text{ Hz} / 7 \text{ pole pair}) * 60 = 3857 \text{ rpm}$

Speed limiting as a result of the maximum rotating field frequency is not relevant for DC motors.

p0323	Maximum motor current
	Can be changed: T Data type: FloatingPoint32 Min: 0.01 [A] Max: 100.00 [A] Def: 0.01 [A]
Description:	Sets the maximum permissible motor current (rating plate).
	Note The motor can be briefly operated up to this current without incurring any damage; however, continuous operation is only permissible up to a maximum of the rated current (p0305). Operation with the maximum current causes the thermal monitoring to respond (temperature model, see p0601).
p0325	Maximum motor winding temperature
	Can be changed: T Data type: FloatingPoint32 Min: 0 [°C] Max: 250 [°C] Def: 0 [°C]
Description:	Sets the maximum permissible motor winding temperature (rating plate).
p0341	Motor rotor moment of inertia
	Can be changed: T Data type: FloatingPoint32 Min: 0.010 [kgcm ²] Max: 1000.000 [kgcm ²] Def: 0.010 [kgcm ²]
Description:	Sets the rotor moment of inertia (rating plate).
p0352	Motor cable resistance
	Can be changed: T Data type: FloatingPoint32 Min: 0.000 [ohm] Max: 100.000 [ohm] Def: 0.000 [ohm]
Description:	Sets the resistance of the power cable between the drive controller and motor.
p0353	Motor series inductance
	Can be changed: T Data type: FloatingPoint32 Min: 0.000 [mH] Max: 1000.000 [mH] Def: 0.000 [mH]
Description:	Sets the motor series inductance
p0372	Motor connection resistance
	Can be changed: T Data type: FloatingPoint32 Min: 0.001 [ohm] Max: 100.000 [ohm] Def: 0.001 [ohm]
Description:	Sets the connection resistance (rating plate).
	Note The connection resistance that is measured at 20 °C between two winding connections.

13.2 Parameter list

p0377[0...1]	Motor connection inductance
	Can be changed: T Min: 0.010 [mH] Data type: FloatingPoint32 Max: 1000.000 [mH] Def: 0.010 [mH]
Description:	Sets the motor connection inductance (rating plate).
Index:	[0] = Connection inductance (q component) [1] = Connection inductance (q component)
Dependency:	It is not necessary to specify the connection inductance (d component) for DC motors (p0300).
	Note The connection inductance that is measured at 20 °C between two winding connections for a sinusoidal measurement frequency of 1 kHz. For motors with embedded magnets, generally, the higher value corresponds to connection component L_q and the lower value corresponds to connection component L_d. The measured values are approximately the same for motors with surface-mounted magnets.
p0389	Motor no-load current
	Can be changed: T Min: 0.01 [A] Data type: FloatingPoint32 Max: 100.00 [A] Def: 0.01 [A]
Description:	Sets the no-load current (rating plate).
	Note The no-load current is obtained at the rated voltage and when the motor has no load. It is decisively influenced by the bearing friction.
p0400[0...1]	Assignment encoder signals G_x
	Can be changed: T Min: 0 Data type: Integer16 Max: 2 Def: [0] 1 , [1] 2
Description:	Selects the drive encoder from the list of supported encoder types.
Value:	0: inactive (no encoder) 1: Motor encoder 2: SSI encoder
Index:	[0] = Encoder 1 (G1) [1] = Encoder 2 (G2)
	NOTICE You must additionally set the individual parameterization of the selected drive encoder.
	Note Depending on the drive telegram used (process image), 0 to 2 encoders are available. The assignment of the encoder types using this parameter is independent of the telegram used. For the configuration, the list index refers to the encoder number.
p0404	Encoder type configuration
	Can be changed: T Min: 0 Data type: Integer16 Max: 7 Def: 0
Description:	Selects a motor encoder from the list of supported encoder types (rating plate).
Value:	0: Not configured 1: Incremental encoder (AB track) 3: Incremental encoder (AB track) and Hall sensors 5: IQ-Encoder with incremental encoder (AB track) 7: IQ-Encoder with incremental encoder (AB track) and Hall sensors

NOTICE
The individual parameterization of the selected encoder must be taken into consideration.

Note

An IQ-Encoder always involves a single turn absolute encoder.

p0408	Encoder incremental pulse number
	Can be changed: T Data type: Unsigned32
	Min: 1 Max: 65536 Def: 1
Description:	Sets the pulse number (number of pulses per revolution) of the incremental encoder (rating plate).
	Note
	The hardware interface of the incremental encoder is a quadrature interface, therefore the encoder fine resolution is always two. Example: 100 pulses or pulses per revolution (p0408) corresponds to 400 signal edges.

p0410	Encoder incremental configuration			
	Can be changed: T		Data type: Unsigned8	
	Min: -		Max: -	Def: 0000 bin
Description:	Sets the phase position between the motor rotating field and count direction of the incremental encoder (rating plate).			
Bit field:	Bit	Signal name	1 signal	0 signal
	00	Invert count direction of incr. encoder and/or phase position	negative	positive
 WARNING An incorrectly configured phase position can cause the motor to accelerate uncontrollably.				
Note For the speed controller it is important that the phase position between the motor rotating field and the count direction of the incremental encoder is the same; this is the reason that the count direction must be configured so that a positive rotating field results in an incrementing encoder actual value. To realize this, the count direction of the incremental encoder can be inverted using this parameter.				

p0420[0...5]	Encoder Hall angle setting
	Can be changed: T Data type: Unsigned16
	Min: 0 [°] Max: 300 [°] Def: [0] 0 [°], [1] 60 [°], [2] 120 [°], [3] 180 [°], [4] 240 [°], [5] 300 [°]
Description:	Sets the sectors of the Hall encoder as electrical angle (rating plate).
Index:	[0] = Hall U [1] = Hall V [2] = Hall U+V [3] = Hall W [4] = Hall W+U [5] = Hall W+V

r0440[0...1]	SSI encoder position actual values
	Data type: Unsigned16 Unit: -
Description:	Displays the actual position information of the SSI encoder being used.
Index:	[0] = Singleturn [1] = Multiturn

r0441	SSI encoder angle
	Data type: FloatingPoint32 Unit: [°]
Description:	Displays the actual absolute angle setting of the SSI encoder.

13.2 Parameter list

p0446[0...3]	SSI encoder telegram configuration			
	Can be changed: T		Data type: Unsigned8	
	Min: 0		Max: 32	
	Def: [0] 25 , [1] 13 , [2] 12 , [3] 0			
Description:	Sets the telegram structure for the SSI encoder being used.			
Index:	[0] = Telegram length in bits [1] = Number of measurement steps per revolution [2] = Number of rotations that can be resolved [3] = Number of bits before position value (number of following bits)			
	Note SSI: Synchronous Serial Interface			

p0447	SSI encoder monoflop time			
	Can be changed: T		Data type: Unsigned16	
	Min: 10 [µs]		Max: 10000 [µs]	
	Def: 60 [µs]			
Description:	Sets the minimum wait time between two transfers of the absolute value for an SSI encoder.			
	Note SSI: Synchronous Serial Interface			

p0448	SSI encoder baud rate			
	Can be changed: T		Data type: Unsigned16	
	Min: 350 [kHz]		Max: 350 [kHz]	
	Def: 350 [kHz]			
Description:	Sets the baud rate of the SSI interface.			
	The output frequency of the SSI interface can deviate from the set value. It is ensured that the output frequency does not exceed the specified value.			
	Note SSI: Synchronous Serial Interface			

p0449	SSI encoder options			
	Can be changed: T		Data type: Unsigned16	
	Min: -		Max: -	
	Def: 0010 1010 bin			
Description:	Sets the options for an SSI encoder.			
Bit field:	Bit	Signal name	1 signal	0 signal
	00	SSI interface	Activated	Deactivated
	01	Transfer code	Gray	Dual
	02	Data line during the monoflop time	High level	Low level
	03	Sampling	Isochronous	Cyclic
	05	Diagnostics message	Activated	Deactivated
	Note SSI: Synchronous Serial Interface			

r0480[0...1]	Encoder control word Gn_STW			
	Data type: Unsigned16		Unit: -	
Description:	Displays the encoder control word Gn_STW according to PROFIdrive.			
Index:	[0] = Encoder 1 (G1) [1] = Encoder 2 (G2)			
Bit field:	Bit	Signal name	1 signal	0 signal
	00	Request function 1	Yes	No

01	Request function 2	Yes	No
02	Request function 3	Yes	No
03	Request function 4	Yes	No
04	Request command bit 0	Yes	No
05	Request command bit 1	Yes	No
06	Request command bit 2	Yes	No
07	Mode flying measurement/search for reference mark	Flying measurement	Reference marks
13	Request absolute value cyclic	Yes	No
14	Request parking encoder	Yes	No
15	Request acknowledge encoder error	Yes	No

r0481[0...1]**Encoder status word Gn_ZSW****Data type:** Unsigned16**Unit:** -**Description:** Displays the encoder status word Gn_ZSW according to PROFIdrive.**Index:** [0] = Encoder 1 (G1)

[1] = Encoder 2 (G2)

Bit field:

Bit	Signal name	1 signal	0 signal
00	Function 1 active	Yes	No
01	Function 2 active	Yes	No
02	Function 3 active	Yes	No
03	Function 4 active	Yes	No
04	Value 1	Displayed in r0483	Not present
05	Value 2	Displayed in r0483	Not present
06	Value 3	Displayed in r0483	Not present
07	Value 4	Displayed in r0483	Not present
11	Encoder error acknowledgment active	Yes	No
13	Absolute value cyclic	Displayed in r0483	No
14	Parking encoder active	Yes	No
15	Encoder error	Displayed in r0483	None

r0482[0...1]**Encoder position actual value Gn_XIST1****Data type:** Unsigned32**Unit:** -**Description:** Displays the encoder position actual value Gn_XIST1 according to PROFIdrive.**Index:** [0] = Encoder 1 (G1)

[1] = Encoder 2 (G2)

r0483[0...1]**Encoder position actual value Gn_XIST2****Data type:** Unsigned32**Unit:** -**Description:** Displays the encoder position actual value Gn_XIST2 according to PROFIdrive.**Index:** [0] = Encoder 1 (G1)

[1] = Encoder 2 (G2)

Note

The encoder position actual value must be requested using the encoder control word Gn_STW.13.

r0505**Selects the system of units****Data type:** Integer16**Unit:** -**Description:** Displays the actual system of units.**Value:** 1: SI system of units

13.2 Parameter list

- 2: System of units referred/SI
 3: US system of units
 4: System of units referred/US

p0601**Thermal motor model type configuration**

Can be changed: T **Data type:** Integer16
Min: 0 **Max:** 2 **Def:** 0
Description: Sets the type of thermal model (rating plate).
Value: 0: Basis model (I2t relative)
 2: IQ-Encoder (absolute)

⚠ DANGER

The thermal model is reinitialized after changing the drive data set and when switching on the device. After initialization, the thermal motor utilization cannot be immediately determined as the model must first settle. As a consequence, an initial utilization of 50% is used as basis. The settling phase duration depends on the given thermal time constants; the accuracy depends on to what extent the specific installation situation deviates from the model. During the settling time it is possible that the set alarm and/or interference threshold is reached with some delay. For the installation situation simulated in the model, a comparatively unfavorable installation was selected so that generally deviations occur on the safe side.

Note

Basis model (I2t monitoring with relative values):

The I2t monitoring operates with the relative motor power loss (r0042), and in addition to the rated motor current (p0305) as reference value, only requires the thermal time constant winding - environment (p0611[0]) to calculate the limiting integral. The 100% shutdown threshold for the basis model corresponds to the maximum continuous power loss of the motor, i.e. to the square of the rated motor current (p0305).

p0611[0...3]**Thermal motor model time constants**

Can be changed: T **Data type:** Unsigned16
Min: 0 [s] **Max:** 10000 [s] **Def:** 0 [s]
Description: Sets the thermal time constants (rating plate).
Index: [0] = Winding - environment
 [1] = Winding - enclosure
 [2] = Wicklung - sensor IQ-Encoder
 [3] = Intrinsic temperature rise of the IQ-Encoder

p0613[0...2]**Thermal motor model resistances**

Can be changed: T **Data type:** FloatingPoint32
Min: 0.00 [K/W] **Max:** 100.00 [K/W] **Def:** 0.00 [K/W]
Description: Sets the thermal resistances (rating plate).
Index: [0] = Winding - environment
 [1] = Winding - enclosure
 [2] = Wicklung - sensor IQ-Encoder

p0617**Thermal motor model intrinsic temperature rise of the IQ-Encoder**

Can be changed: T **Data type:** FloatingPoint32
Min: 0.0 [K] **Max:** 20.0 [K] **Def:** 0.0 [K]
Description: Sets the thermal intrinsic temperature rise of the IQ-Encoder (rating plate).

r0632**Motor temperature model winding temperature**

Data type: FloatingPoint32 **Unit:** [°C]
Description: Displays the winding temperature calculated by the motor temperature model.

r0650	Operating hours			
	Data type: Unsigned32	Unit: [h]		
Description:	Displays the operating hours of the drive.			
r0721	Digital Hall signal inputs			
	Data type: Unsigned32	Unit: -		
Description:	Displays the actual state of the digital Hall signal inputs.			
Bit field:	Bit	Signal name	1 signal	0 signal
	00	Hall U	High	Low
	01	Hall V	High	Low
	02	Hall W	High	Low
r0722	Digital inputs status			
	Data type: Unsigned8	Unit: -		
Description:	Displays the status of the digital inputs.			
Bit field:	Bit	Signal name	1 signal	0 signal
	00	Digital input DI0 (X4060.7)	High	Low
	01	Digital input DI1 (X4060.8)	High	Low
	02	Digital input DI2 (X4060.5)	High	Low
	03	Digital input DI3 (X4060.6)	High	Low
	Note			
	DI: Digital Input			
r0747	Digital outputs status			
	Data type: Unsigned8	Unit: -		
Description:	Displays the status of the digital outputs.			
Bit field:	Bit	Signal name	1 signal	0 signal
	00	Digital output DQ0 (X4060.9)	High	Low
	01	Digital output DQ1 (X4060.10)	High	Low
	Note			
	DQ: Digital Output			
r0881	Control word 2 sequence control			
	Data type: Unsigned16	Unit: -		
Description:	Display for control word 2 (STW2) of the sequence control.			
Bit field:	Bit	Signal name	1 signal	0 signal
	08	Activates travel to a fixed stop	Yes	No
	12	Master sign-of-life bit 0	Yes	No
	13	Master sign-of-life bit 1	Yes	No
	14	Master sign-of-life bit 2	Yes	No
	15	Master sign-of-life bit 3	Yes	No
Dependency:	PROFIdrive signal STW2.			
	Note			
	The higher-level control cyclically sends control word 2 to the drive.			
	For bit 8:			
	With command bit 8 (travel to fixed stop), the blockage monitoring of the drive is deactivated, see p1545.0.			

13.2 Parameter list

r0882	Status word 2 sequence control			
	Data type: Unsigned16		Unit: -	
Description:	Display for the status word (ZSW2) of the sequence control.			
Bit field:	Bit	Signal name	1 signal	0 signal
	08	Travel to fixed stop active	Yes	No
	12	Slave sign-of-life bit 0	Yes	No
	13	Slave sign-of-life bit 1	Yes	No
	14	Slave sign-of-life bit 2	Yes	No
	15	Slave sign-of-life bit 3	Yes	No
Dependency:	PROFIdrive signal ZSW2.			
Note				
Status word 2 is cyclically sent from the drive to the higher-level control.				
For bit 8:				
When the blockage monitoring is deactivated (see p1545.0), the drive is permanently in the travel to fixed stop mode.				

r0899	Status word 1 sequence control			
	Data type: Unsigned16		Unit: -	
Description:	Displays the status word (ZSW1) of the sequence control.			
Bit field:	Bit	Signal name	1 signal	0 signal
	00	Ready for switching on	Yes	No
	01	Ready	Yes	No
	02	Operation enabled	Yes	No
	03	Drive fault active (acknowledgment required)	Yes	No
	04	Coast down active	OFF2 inactive	OFF2 active
	05	Quick stop inactive	OFF3 inactive	OFF3 active
	06	Switching on inhibited active	Yes	No
	07	Alarm active	Yes	No
	08	Speed setpoint - actual value deviation within tolerance	Yes	No
	09	Master control by PLC requested	Yes	No
	10	Speed threshold value 1 reached or exceeded	Yes	No
	11	Torque limit not reached	Yes	No
	12	Motor holding brake open	Yes	No
	13	Drive trace available	Yes	No
	14	Safe state active	Yes	No
	15	Safety message active (safety acknowledgment required)	Yes	No
Dependency:	PROFIdrive signal ZSW1.			
Note				
Status word 1 is cyclically sent from the drive to the higher-level control.				

r0922	PROFIdrive telegram configured			
	Data type: Integer16		Unit: -	
Description:	Displays the configured PROFIdrive send and receive telegram.			
Value:	0:	No telegram		
	1:	Standard telegram 1, PZD 2/2		
	2:	Standard telegram 2, PZD 4/4		
	3:	Standard telegram 3, PZD 5/9		
	4:	Standard telegram 4, PZD 6/14		

5:	Standard telegram 5, PZD 9/9
6:	Standard telegram 6, PZD 10/14
102:	SIEMENS telegram 102, PZD-10/6
103:	SIEMENS telegram 103, PZD-15/7
105:	SIEMENS telegram 105, PZD 10/10
106:	SIEMENS telegram 106, PZD-15/11

Note

In the hardware configuration, the PROFIdrive telegram is set using the configuration tool, and does not have to be additionally configured in the device itself.

p0925	PROFIdrive isochronous synchronous sign-of-life tolerance
	Can be changed: T, U Data type: Unsigned16
	Min: 0 Max: 65535 Def: 5
Description:	Sets the number of tolerated consecutive sign-of-life errors of the isochronous PROFIdrive master. The sign-of-life signal is normally received in PZD4 (control word 2) from the master.

Note

The sign-of-life monitoring is deactivated for p0925 = 65535.

r0930	PROFIdrive operating mode
	Data type: Integer16 Unit: -
Description:	Displays the operating mode.
Value:	1: Closed-loop speed controlled operation with ramp generator 2: Closed-loop position controlled operation 3: Closed-loop speed controlled operation without ramp generator

r0944	Counter for fault buffer changes
	Data type: Unsigned16 Unit: -
Description:	Displays fault buffer changes. This counter is incremented every time the fault buffer changes.
Recommendation:	Used to check whether the fault buffer has been read out consistently.

r0947[0...63]	Fault number
	Data type: Unsigned16 Unit: -
Description:	Displays the numbers of faults that have occurred.
	Note
	The buffer parameters are cyclically updated in the background.
	Fault buffer structure (general principle):
	r0947[0], r0949[0], r3120[0], r0948/r2130[0], r2109/r2136[0] --> actual fault case, fault 1
	...
	r0947[7], r0949[7], r3120[7], r0948/r2130[7], r2109/r2136[7] --> actual fault case, fault 8
	r0947[8], r0949[8], r3120[8], r0948/r2130[8], r2109/r2136[8] --> 1st acknowledged fault, fault 1
	...
	r0947[15], r0949[15], r3120[15], r0948/r2130[15], r2109/r2136[15] --> 1st acknowledged fault, fault 8
	...
	r0947[56], r0949[56], r3120[56], r0948/r2130[56], r2109/r2136[56] --> 7th acknowledged fault, fault 1
	...
	r0947[63], r0949[63], r3120[63], r0948/r2130[63], r2109/r2136[63] --> 7th acknowledged fault, fault 8

13.2 Parameter list

r0948[0...63]	Fault time 1 received Data type: Unsigned32 Unit: [ms] Description: Displays the system runtime in milliseconds of a day on which the fault occurred. Note The buffer parameters are cyclically updated in the background.
r0949[0...63]	Fault value Data type: Unsigned32 Unit: - Description: Displays additional information about the fault that occurred. Note The buffer parameters are cyclically updated in the background. The structure of the fault buffer and the assignment of the indices is shown in r0945.
r0950[0...1]	Fault buffer scaling Data type: Unsigned16 Unit: - Description: Displays the scaling or the length of the fault buffer. Index: [0] = Number of fault cases [1] = Number of fault messages per fault case
p0952	Fault case counter Can be changed: T, U Data type: Unsigned16 Min: 0 Max: 65535 Def: 0 Description: Number of fault cases that have occurred since the last reset. The complete fault buffer is cleared by setting p0952=0.
r0964[0...4]	Device identification Data type: Unsigned16 Unit: - Description: Displays the device identification of the drive object. Index: [0] = Company (Siemens = 42) [1] = Device type [2] = Firmware version [3] = Firmware date (year) [4] = Firmware date (day/month) Note Example: r0964[0] = 42 -> SIEMENS r0964[1] = 6999 -> SIMATIC MICRO-DRIVE r0964[2] = 102 --> first part of the firmware version V01.02 (second part, refer to index 6) r0964[3] = 2018 --> year 2018 r0964[4] = 2508 -> August 25
r0965[0...1]	PROFIdrive profile number Data type: Unsigned8 Unit: - Description: Displays the PROFIdrive profile number and profile version. Constant value = 032A hex. Byte 1: Profile number = 03 hex = PROFIdrive profile Byte 2: Profile version = 2A hex = Version 4.2 Note When the parameter is read via PROFIdrive, the Octet String 2 data type applies.

r0967

Control word 1 PROFIdrive

Data type: Unsigned16

Unit: -

Description:

Displays control word 1 (STW1) of the sequence control.

Bit field:

Bit	Signal name	1 signal	0 signal
00	ON - switch on	ON	OFF1
01	OFF 2 - coast down (low active)	Oper condition	OFF2
02	OFF 3 - Quick Stop (low active)	Oper condition	OFF3
03	Operation enabled	Yes	No
04	Enable ramp generator	Yes	No (reset)
05	Start ramp generator	Yes	No (frozen)
06	Enable setpoints	Yes	No
07	Acknowledge fault	Yes	No
10	Control requested	Yes	No

Dependency:

PROFIdrive signal STW1.

Note

The higher-level control cyclically sends control word 1 to the drive. Master control can be taken over via the drive control panel.

For bit 10 "Control requested":
If control is not requested, then the control data from the drive telegram is not updated. This is not applicable for the master sign of life in STW2.

r0968	Status word 1 PROFIdrive			
	Data type: Unsigned16		Unit: -	
Description:	Displays the status word (ZSW1) of the sequence control.			
Bit field:	Bit	Signal name	1 signal	0 signal
	00	Ready for switching on	Yes	No
	01	Ready	Yes	No
	02	Operation enabled	Yes	No
	03	Drive fault active (acknowledgment required)	Yes	No
	04	Coast down active	OFF2 inactive	OFF2 active
	05	Quick stop inactive	OFF3 inactive	OFF3 active
	06	Switching on inhibited active	Yes	No
	07	Alarm active	Yes	No
	08	Speed setpoint - actual value deviation within tolerance	Yes	No
	09	Master control by PLC requested	Yes	No
	10	Speed threshold value 1 reached or exceeded	Yes	No
	11	Torque limit not reached	Yes	No
	12	Motor holding brake open	Yes	No
	13	Drive trace available	Yes	No
	14	Safe state active	Yes	No
	15	Safety message active (safety acknowledgment required)	Yes	No
Dependency:	PROFIdrive signal ZSW1.			
Note				
Status word 1 is cyclically sent from the drive to the higher-level control.				

p0972	Drive unit reset			
	Can be changed: T		Data type: Integer16	
	Min: 0		Max: 2	Def: 0

13.2 Parameter list

Description: Sets the required procedure to execute a hardware reset for the drive unit.

Value:

0:	Inactive
1:	Reboot/reset immediately
2:	Reboot/reset preparation

⚠ WARNING

You must carefully ensure that the system is in a safe condition. The memory card/device memory of the drive should not be accessed.

Note

For value = 1:

Reset is immediately executed and communications interrupted. After communication has been established, check the reset operation.

For value = 2:

Help setting to check the reset operation. Firstly, set p0972=2 and then read back. Secondly, set p0972=1 (it is possible that this task is no longer acknowledged). Communications are then interrupted. After communication has been established, check the reset operation.

r0974[0...2] Base access service parameter

Data type: Unsigned16 **Unit:** -

Description: Displays the properties of the base access service for parameters.

Index:

[0]	= Maximum block length
[1]	= Maximum number of parameter requests per multiparameter task
[2]	= Maximum latency time per task (in 10ms)

r0975[0...7] Drive object identification

Data type: Unsigned16 **Unit:** -

Description: Displays the identification of the drive object.

Index:

[0]	= Manufacturer
[1]	= DO type
[2]	= Version (Software)
[3]	= Firmware date (year)
[4]	= Firmware date (day/month)
[5]	= PROFIdrive DO type class (structure)
[6]	= PROFIdrive DO sub class 1
[7]	= Drive Object ID (DO-ID)

Note

Example:

r0975[0] = 42 --> SIEMENS

r0975[1] = 11 --> SERVO drive object type

r0975[2] = 102 -> firmware version V01.02

r0975[3] = 2018 --> year 2018

r0975[4] = 1401 -> August 25

r0975[5] = 1 -> PROFIdrive drive object, type class

r0975[6] = 9 -> PROFIdrive drive object sub-type class 1

r0975[7] = 1 -> drive object number = 1

p0976 Load and reset parameter

Can be changed: T

Data type: Unsigned16

Min: 0

Max: 65535

Def: 0

Description: Setting to reset or load drive parameters from the non-volatile memory.

Available values:

0: Inactive

6: Load parameter backup from the memory card to RAM

7: Load factory settings into the RAM

8: Load user settings into the RAM

100: Error

NOTICE

Parameters are loaded to the work memory (RAM) of the drive. For a restart they are lost, and must therefore be backed up. They are copied to a non-volatile memory (ROM). Set p977=1 to save all of the drive system parameters.

Note

The parameter indicates the processing status of the task. Once execution has been completed, the parameter is automatically set to inactive (0) or error (100).

p0977

Save parameters

Can be changed: T, U

Data type: Unsigned16

Min: 0

Max: 65535

Def: 0

Description:

Setting to retentively save drive parameters in the non-volatile memory.

Available values:

0: Inactive

1: Retentively save drive parameters (RAM-ROM backup)

3: Make a parameter backup on the memory card

4: Make a parameter backup without PROFINET settings on the memory card

5: Export maintenance data to the memory card

100: Error

Note

The parameter indicates the processing status of the task. Once execution has been completed, the parameter is automatically set to inactive (0) or error (100).

r0978[0...2]

List of drive objects

Data type: Unsigned8

Unit: -

Description:

This parameter contains the drive object IDs for all drive objects in the PROFIdrive drive unit. Drive object IDs can be assigned to drive objects independent of the slot. The drive object ID can be a number from 1 to 254. The value 255 means that no drive object is assigned; 0 is used as separator.

Entries after the first 0 entry specify drive object IDs for drive objects that do not contain any IO data. The second 0 entry marks the end of the list. A valid drive object ID list always contains at least two 0 entries.

r0979[0...20]

PROFIdrive encoder format

Data type: Unsigned32

Unit: -

Description:

Displays the actual position encoder used according to PROFIdrive.

13.2 Parameter list

Index:	[0] = Header
	[1] = Type encoder 1
	[2] = Resolution encoder 1
	[3] = Shift factor G1_XIST1
	[4] = Shift factor G1_XIST2
	[5] = Distinguishable revolutions encoder 1
	[6...10] = Reserved
	[11] = Type encoder 2
	[12] = Resolution encoder 2
	[13] = Shift factor G2_XIST1
	[14] = Shift factor G2_XIST2
	[15] = Distinguishable revolutions encoder 2
	[16...20] = Reserved

Note

Information about the individual indices can be taken from the following literature:
PROFIdrive Profile Drive Technology

r0980[0...99] List of existing parameters section 1

Data type: Unsigned16 **Unit:** -

Description: Displays the parameters that exist for this drive.

Note

All of the parameter numbers defined in the unit are saved under sub-indices (manufacture-specific and profile parameters). They are sorted consecutively in ascending order. If a sub-index contains the value 0, then the list of the defined parameters ends here. If a sub-index contains the parameter number of the following parameter list, then the list is continued there.

r0981[0...99] List of existing parameters section 2

Data type: Unsigned16 **Unit:** -

Description: Displays the parameters that exist for this drive.

Note

All of the parameter numbers defined in the unit are saved under sub-indices (manufacture-specific and profile parameters). They are sorted consecutively in ascending order. If a sub-index contains the value 0, then the list of the defined parameters ends here. If a sub-index contains the parameter number of the following parameter list, then the list is continued there.

r0982[0...99] List of existing parameters section 3

Data type: Unsigned16 **Unit:** -

Description: Displays the parameters that exist for this drive.

Note

All of the parameter numbers defined in the unit are saved under sub-indices (manufacture-specific and profile parameters). They are sorted consecutively in ascending order. If a sub-index contains the value 0, then the list of the defined parameters ends here. If a sub-index contains the parameter number of the following parameter list, then the list is continued there.

r0983[0...99] List of existing parameters section 4

Data type: Unsigned16 **Unit:** -

Description: Displays the parameters that exist for this drive.

Note

All of the parameter numbers defined in the unit are saved under sub-indices (manufacture-specific and profile parameters). They are sorted consecutively in ascending order. If a sub-index contains the value 0, then the list of the defined parameters ends here. If a sub-index contains the parameter number of the following parameter list, then the list is continued there.

r1045	Speed setpoint after limiting	Data type: FloatingPoint32	Unit: [rpm]
Description:	Displays the active speed setpoint after limiting in the setpoint channel.		
r1073	Speed setpoint before limiting	Data type: FloatingPoint32	Unit: [rpm]
Description:	Displays the active speed setpoint before limiting.		
	Note	The setpoint channel comprises the following blocks: Setpoint -(r1073)- limiting -- ramp-function generator -- setpoint filter -- speed controller	
r1082	Maximum speed	Data type: FloatingPoint32	Unit: -
Description:	Displays the highest possible speed of the configured motor. The parameter is the reference quantity for all ramp-up and ramp-down times (e.g. down ramps, ramp generator).		
	Note	The parameter applies for both motor directions of rotation.	
p1083	Speed limit in positive direction of rotation	Can be changed: T, U	Data type: FloatingPoint32
	Min: 0.00 [rpm]	Max: 25000.00 [rpm]	Def: 25000.00 [rpm]
Description:	Sets the maximum speed for the positive direction.		
p1086	Speed limit in negative direction of rotation	Can be changed: T, U	Data type: FloatingPoint32
	Min: -25000.00 [rpm]	Max: 0.00 [rpm]	Def: -25000.00 [rpm]
Description:	Sets the maximum speed for the negative direction of rotation.		
p1115	Speed-ramp generator selection	Can be changed: T	Data type: Integer16
	Min: 0	Max: 1	Def: 1
Description:	Sets the speed ramp generator type.		
Value:	0: Basic ramp generator 1: Extended ramp generator		
	Note	Another ramp generator type can only be selected when the motor is at a standstill.	
p1116	Torque-ramp generator selection	Can be changed: T	Data type: Integer16
	Min: 0	Max: 1	Def: 0
Description:	Sets the torque ramp generator type.		
Value:	0: Basic ramp generator		

13.2 Parameter list

1: Extended ramp generator

Note

Another ramp generator type can only be selected when the motor is at a standstill.

r1119**Speed setpoint in front of the ramp generator**

Data type: FloatingPoint32 **Unit:** [rpm]

Description:

Displays the active speed setpoint before the ramp-function generator.

Note

The setpoint channel comprises the following blocks:

Setpoint -- limiting -(r1119)- ramp-function generator -- setpoint filter -- speed controller

p1120[0...1]**Speed-ramp generator times**

Can be changed: T

Data type: Unsigned32

Min: 1 [ms]

Max: 60000 [ms]

Def: 1 [ms]

Description:

Ramp-up time:

The ramp generator ramps-up the speed setpoint from standstill (setpoint = 0) up to the rated motor speed (p0311) in this time.

Ramp-down time:

The ramp generator ramps-down the speed setpoint from the rated motor speed (p0311) down to standstill (setpoint = 0) in this time. Further, the ramp-down time is always effective for OFF1.

Index:

[0] = Ramp-up

[1] = Ramp-down

p1125[0...1]**Torque-ramp generator times**

Can be changed: T

Data type: Unsigned32

Min: 1 [ms]

Max: 60000 [ms]

Def: 1 [ms]

Description:

Ramp-up time:

The ramp generator ramps-up the torque setpoint from 0 up to the rated motor torque (p0312) in this time.

Ramp-down time:

The ramp generator ramps-down the torque setpoint from the rated motor torque (p0312) down to 0 in this time.

Index:

[0] = Ramp-up

[1] = Ramp-down

p1130[0...1]**Speed ramp generator initial rounding-off time**

Can be changed: T

Data type: Unsigned32

Min: 0 [ms]

Max: 30000 [ms]

Def: 0 [ms]

Description:

Sets the initial rounding-off time for the extended ramp generator.

Index:

[0] = Initial rounding-off (ramp-up)

[1] = Initial rounding-off (ramp-down)

Note

Rounding-off times avoid an abrupt response and prevent damage to the mechanical system.

p1131[0...1]**Speed ramp generator final rounding-off time**

Can be changed: T

Data type: Unsigned32

Min: 0 [ms]

Max: 30000 [ms]

Def: 1 [ms]

Description:

Sets the final rounding-off time for the extended ramp generator.

Index: [0] = Final rounding-off (ramp-up)
[1] = Final rounding-off (ramp-down)

Note

Rounding-off times avoid an abrupt response and prevent damage to the mechanical system.

p1132[0...1] Torque ramp generator initial rounding-off time

Can be changed: T **Data type:** Unsigned32
Min: 0 [ms] **Max:** 30000 [ms] **Def:** 0 [ms]

Description: Sets the initial rounding-off time for the extended ramp generator.

Index: [0] = Initial rounding-off (ramp-up)
[1] = Initial rounding-off (ramp-down)

Note

Rounding-off times avoid an abrupt response and prevent damage to the mechanical system.

p1133[0...1] Torque ramp generator final rounding-off time

Can be changed: T **Data type:** Unsigned32
Min: 0 [ms] **Max:** 30000 [ms] **Def:** 0 [ms]

Description: Sets the final rounding-off time for the extended ramp generator.

Index: [0] = Final rounding-off (ramp-up)
[1] = Final rounding-off (ramp-down)

Note

Rounding-off times avoid an abrupt response and prevent damage to the mechanical system.

p1135 OFF 3 ramp generator ramp-down time

Can be changed: T **Data type:** Unsigned32
Min: 1 [ms] **Max:** 60000 [ms] **Def:** 250 [ms]

Description: Sets the ramp-down time from the rated speed down to zero speed for the OFF3 command (Quick Stop).

Note

This time can be exceeded if the DC link voltage reaches its maximum value.

p1136 OFF3 ramp generator initial rounding-off time

Can be changed: T **Data type:** Unsigned32
Min: 0 [ms] **Max:** 30000 [ms] **Def:** 0 [ms]

Description: Sets the initial rounding-off time for OFF3 (Quick Stop) for the extended ramp generator.

p1137 OFF3 ramp generator final rounding-off time

Can be changed: T **Data type:** Unsigned32
Min: 0 [ms] **Max:** 30000 [ms] **Def:** 25 [ms]

Description: Sets the final rounding-off time for OFF3 (Quick Stop) for the extended ramp generator.

p1215 Motor holding brake type configuration

Can be changed: T **Data type:** Integer16
Min: 0 **Max:** 2 **Def:** 0

Description: Displays the holding brake configuration (rating plate).

Value: 0: No motor holding brake
1: Open-circuit brake
2: Closed-circuit brake

13.2 Parameter list

Note

Open-circuit brake: braking when there is no voltage

Closed-circuit brake: braking when voltage is applied

p1216[0...1]**Motor holding brake time response****Can be changed:** T**Data type:** Unsigned16**Min:** 0 [ms]**Max:** 65535 [ms]**Def:** 0 [ms]**Description:**

Displays the time response of the motor holding brake (rating plate).

Recommendation:

Opening time (release time):

The delay time used in the application should be longer than the actual brake opening time; this ensures that the drive cannot accelerate when the brake is still closed.

Index:

[0] = Closing and pull-in time of the motor holding brake

[1] = Opening and drop-out time of the motor holding brake

NOTICE

Closing time (application time):

If the holding time used in the application is too short with respect to the actual closing time of the brake, then the load can sag. If the holding time is selected to be too long with respect to the actual closing time of the brake, the control works against the brake and therefore reduces its service life.

p1217[0...1]**Motor holding brake torque****Can be changed:** T**Data type:** FloatingPoint32**Min:** 0.00 [Nm]**Max:** 340.28235E36 [Nm]**Def:** 0.00 [Nm]**Description:**

Displays the motor holding brake torque (rating plate).

Index:

[0] = Breakaway torque (static)

[1] = Braking torque (when moving)

p1226**Threshold for zero speed detection****Can be changed:** T**Data type:** FloatingPoint32**Min:** 0.0000 [rpm]**Max:** 10000.0000 [rpm]**Def:** 2.0000 [rpm]**Description:**

Sets the speed threshold for the standstill identification.

When braking with OFF1 or OFF3, when the threshold is undershot, standstill is identified.

Note

Acts on the actual value and setpoint monitoring.

r1300**Open-loop/closed-loop control operating mode****Data type:** Integer16**Unit:** -**Description:**

Sets the open-loop and closed-loop control type of a drive.

Value:

0: U/f

100: Speed controller (cascade)

101: Closed loop speed controller

102: Adaptive disturbance rejection control (ADRC)

p1301**Open-loop/closed-loop control configuration****Can be changed:** T**Data type:** Unsigned16**Min:** -**Max:** -**Def:** 0001 bin**Description:**

Settings for the open-loop or closed-loop control configuration of a drive.

Bit field:**Bit** **Signal name**

00 Tuning type for the controller parameters

1 signal

Automatic

0 signal

Manual

⚠ WARNING

Manual controller tuning: Only experienced drive technicians should manually enter integral times and gain factors for speed and current controllers!

Note

With automatic controller tuning, the settings for the speed and current controllers are automatically calculated in the drive and updated.

Tuning the current controller:

The current controller is preset to match the motor and corresponding to the connection properties of the motor in the drive; as a consequence, it is adequately optimized for most applications.

Tuning the speed controller:

With automatic controller tuning, the optimum settings for the speed controller are automatically calculated in the drive corresponding to what has been specified for the controller response p1371 and load fluctuation p1372 and updated.

p1370	Controller calculation		
	Can be changed: T	Data type: Unsigned8	
	Min: 0	Max: 1	Def: 0
Description:	Start controller calculation		
	Note		
	The controller calculation is started by setting p1370=1. Is automatically reset to 0 as soon as the operation has been completed.		
	With the controller calculation, the optimum settings for the speed and current controllers are calculated in the drive and updated.		
	Calculating the current controller:		
	The current controller is calculated to match the motor and corresponding to the connection properties of the motor in the drive.		
	Calculating the speed controller:		
	With the controller calculation, the optimum settings for the speed controller are automatically calculated in the drive corresponding to what has been specified for the controller response p1371 and load fluctuation p1372 and updated.		
p1371	Controller response		
	Can be changed: T	Data type: Unsigned8	
	Min: 0 [%]	Max: 100 [%]	Def: 80 [%]
Description:	Sets the control response for the automatic controller calculation.		
	Classification of the values:		
	0 = very soft		
	50 = normal		
	100 = aggressive		
Dependency:	See p1301		
	Note		
	The setting of this value defines the loop gain and the time response (prefilter, integrating and differentiating elements).		
p1372	Load fluctuations		
	Can be changed: T	Data type: Unsigned8	
	Min: 0 [%]	Max: 100 [%]	Def: 20 [%]

13.2 Parameter list

Description: Sets the load fluctuations for the automatic controller calculation.

Classification of the values:

0 = normal

50 = high tolerance

100 = very high tolerance

Dependency: See p1301

Note

The tendency for the control loop to oscillate results from the phase reserve at the zero crossing. The speed control loop has two integrators; they cause the 180° phase rotation and therefore the tendency to oscillate. This tendency can only be weakened range by range (with the ratio between the controller time constant and the measuring element time constant). Load fluctuations influence the position of the zero crossing; as a consequence, in case of doubt, it makes sense to incorporate a somewhat higher phase reserve.

p1375**Speed precontrol**

Can be changed: T

Data type: Unsigned8

Min: 0 [%]

Max: 200 [%]

Def: 66 [%]

Description:

Sets the speed precontrol.

0 no precontrol

100 rated value is precontrolled

200 double precontrol

Note

The current controller response can be improved by precontrolling the counter EMF.

p1376**Moment of inertia precontrol**

Can be changed: T

Data type: Unsigned8

Min: 0 [%]

Max: 200 [%]

Def: 85 [%]

Description:

Sets the precontrol of the moment of inertia

0 no precontrol

100 rated value is precontrolled

200 double precontrol

Note

The speed controller response can be improved by precontrolling the moment of inertia.

p1377**Frictional torque precontrol**

Can be changed: T

Data type: Unsigned8

Min: 0 [%]

Max: 200 [%]

Def: 0 [%]

Description:

Sets the precontrol of the frictional torque

0% no precontrol

100% rated value is precontrolled

200% double precontrol

Note

The speed controller response can be improved by precontrolling the friction.

p1390**Efficiency when generating**

Can be changed: T

Data type: Unsigned8

Min: 1 [%]

Max: 100 [%]

Def: 100 [%]

Description:

Sets the efficiency between the load and motor axis when in the generating mode.

p1391	Efficiency when motoring Can be changed: T Min: 1 [%] Data type: Unsigned8 Max: 100 [%] Def: 100 [%]
Description:	Sets the efficiency between the motor axis and load when in the motoring mode.
p1395	Frictional torque of the load Can be changed: T Min: 0.000 [Nm] Data type: FloatingPoint32 Max: 1000.000 [Nm] Def: 0.000 [Nm]
Description:	Sets the load frictional torque.
	Note Negative values can occur for suspended loads.
p1396	Static torque of the load Can be changed: T Min: -1000.000 [Nm] Data type: FloatingPoint32 Max: 1000.000 [Nm] Def: 0.000 [Nm]
Description:	Sets the static load torque.
	Note The static load torque describes an external superimposed force or direction-dependent friction. For example, this occurs for suspended loads or gearboxes with direction-dependent friction components.
p1398	Moment of inertia of the load Can be changed: T Min: 0.000 [kgcm ²] Data type: FloatingPoint32 Max: 10000.000 [kgcm ²] Def: 0.000 [kgcm ²]
Description:	Sets the load moment of inertia referred to the rotating axis.
	Note It is specified as [kgcm ²]
p1416	Speed controller speed setpoint filter Can be changed: T Min: 0 [ms] Data type: Unsigned16 Max: 10000 [ms] Def: 250 [ms]
Description:	Sets the time constant for the speed setpoint filter.
Dependency:	The parameter is influenced by the automatic controller calculation (see p1301 or p1300), and depends on the controller settings.
	Note Time constant for the speed prefilter. The prefilter is used to reduce oscillations for fast setpoint changes. Typically, it is set to the same value as the integration time constant.
p1441	Speed controller speed actual value filter Can be changed: T Min: 1 [ms] Data type: Unsigned16 Max: 1000 [ms] Def: 4 [ms]
Description:	Sets the time constant for the speed actual value filter.
Dependency:	The parameter is influenced by the automatic controller calculation (see p1301 or p1300), and depends on the controller settings.
	Note For the cascade controller, the actual value filter must be appropriately set in relation to the integral time so that sufficient phase reserve is ensured in the range of the gain crossover frequency. The measured value filter cannot be deactivated.

13.2 Parameter list

p1460	Speed controller proportional gain Can be changed: T Data type: FloatingPoint32 Min: 0.000000 [Nms/rad] Max: 10000.000000 [Nms/rad] Def: 0.050000 [Nms/rad]
Description:	Sets the proportional gain for the speed controller.
Dependency:	The parameter is influenced by the automatic controller calculation (see p1301 or p1300), and depends on the controller settings, see: p1371 controller response p1372 load fluctuation p1398 moment of inertia of the load p0353 motor series inductance
	Note A value of 0 means that the P component is "off".
p1462	Speed controller integral time Can be changed: T Data type: FloatingPoint32 Min: 0.000 [ms] Max: 10000.000 [ms] Def: 250.000 [ms]
Description:	Sets the integral time for the speed controller.
Dependency:	The parameter is influenced by the automatic controller calculation (see p1301 or p1300), and depends on the controller settings, see: p1371 controller response p1372 load fluctuation p0353 motor series inductance
	Note A value of 0 means that the I component is "off".
p1467	Speed controller downslope integration exponent Can be changed: T Data type: Unsigned8 Min: 1 Max: 16 Def: 6
Description:	Sets the downslope integration exponents for the speed controller.
Dependency:	The parameter is influenced by the automatic controller calculation (see p1301 or p1300), and depends on the controller settings.
	Note The downslope integration exponent becomes active when the modulation limits are reached and then reduces the I component by the factor 2^x per cycle (e.g. because the current controller is at the current limit or the DC link voltage is not sufficient to achieve the specified speed).
r1503	Torque setpoint after limiting Data type: FloatingPoint32 Unit: [Nm]
Description:	Displays the active maximum torque setpoint absolute value after limiting (p1520) and reduction (MOMRED).
Dependency:	See p1520 and signal MOMRED.
	Note If the dynamic torque reduction is required, then this can be realized using the MOMRED signal with drive telegrams 102 and 103.
p1511	Supplementary torque Can be changed: T Data type: FloatingPoint32 Min: -1000.0000 [Nm] Max: 1000.0000 [Nm] Def: 0.0000 [Nm]
Description:	Sets the supplementary torque to compensate active load torques.

p1520	Torque limiting Can be changed: T, U Min: 0.0000 [Nm] Data type: FloatingPoint32 Max: 1000.0000 [Nm] Def: 10.0000 [Nm]
Description:	Sets the torque limiting. The limit is active both when motoring as well as generating and is specified as absolute value.
r1521	Torque limit lower/generating Data type: FloatingPoint32 Unit: [Nm]
Description:	Displays the lower torque limit or the torque limit when generating.
r1543	Torque available Data type: FloatingPoint32 Unit: [%]
Description:	Displays the available torque after torque reduction via signal MOMRED.
	Note If the dynamic torque reduction is required, then this can be realized using the MOMRED signal with drive telegrams 102 and 103. 4000 hex (16384 dec) in control word MOMRED corresponds to a reduction by 100% of the set reference torque p2003.
r1544	Travel to fixed stop evaluation torque reduction Data type: FloatingPoint32 Unit: [%]
Description:	Displays the evaluation for the torque reduction when traveling to a fixed stop.
	Note Evaluates the transferred value for torque reduction in the drive. 4000 hex (16384 dec) in the MOMRED control word corresponds to a reduction by the percentage specified in this parameter.
p1715	Current controller Iq proportional gain Can be changed: T Min: 0.000 [V/A] Data type: FloatingPoint32 Max: 10000.000 [V/A] Def: 7.000 [V/A]
Description:	Sets the proportional gain for the Iq current controller.
Dependency:	The parameter is influenced by the automatic controller calculation (see p1301 or p1300), and depends on the controller settings, see: p0353 motor series inductance p0352 motor cable resistance
p1717	Current controller Iq integral time Can be changed: T Min: 0.000 [ms] Data type: FloatingPoint32 Max: 10000.000 [ms] Def: 1.000 [ms]
Description:	Sets the integral time for the Iq current controller.
Dependency:	The parameter is influenced by the automatic controller calculation (see p1301 or p1300), and depends on the controller settings, see: p0353 motor series inductance p0352 motor cable resistance
p1720	Current controller Iq downslope integration exponent Can be changed: T Min: 1 Data type: Unsigned8 Max: 16 Def: 7
Description:	Sets the downslope integration exponents for the Iq current controller.
Dependency:	The parameter is influenced by the automatic controller calculation (see p1301 or p1300), and depends on the controller settings.

13.2 Parameter list

Note

The downslope integration exponent becomes active when the modulation limits are reached and then it reduces the I component by the factor 2^x per cycle (e.g. because the DC link voltage is not sufficient to reach the specified current).

p1726**Current controller decoupling Id-Iq****Can be changed:** T**Data type:** Unsigned8**Min:** 0 [%]**Max:** 200 [%]**Def:** 67 [%]**Description:**

Sets the Id-Iq decoupling for the current controller.

Dependency:

The parameter is influenced by the automatic controller calculation (see p1301 or p1300), and depends on the controller settings.

Note

As a result of the inherent physics of an EC motor, Id and Iq are coupled with one another through the speed. For low speeds that slowly change and low inductances, this coupling phenomena can already be adequately handled by the Id and/or Iq controllers. However, the control quality can be increased by implementing decoupling.

p1735**Current controller Id proportional gain****Can be changed:** T**Data type:** FloatingPoint32**Min:** 0.000 [V/A]**Max:** 10000.000 [V/A]**Def:** 7.000 [V/A]**Description:**

Sets the proportional gain for the Id current controller.

Dependency:

The parameter is influenced by the automatic controller calculation (see p1301 or p1300), and depends on the controller settings, see:
 p0353 motor series inductance
 p0352 motor cable resistance

p1736**Current controller Id integral time****Can be changed:** T**Data type:** FloatingPoint32**Min:** 0.000 [ms]**Max:** 10000.000 [ms]**Def:** 1.000 [ms]**Description:**

Sets the integral time for the Id current controller.

Dependency:

The parameter is influenced by the automatic controller calculation (see p1301 or p1300), and depends on the controller settings, see:
 p0353 motor series inductance
 p0352 motor cable resistance

p1737**Current controller Id downslope integration exponent****Can be changed:** T**Data type:** Unsigned8**Min:** 1**Max:** 16**Def:** 7**Description:**

Sets the downslope integration exponents for the Id current controller.

Dependency:

The parameter is influenced by the automatic controller calculation (see p1301 or p1300), and depends on the controller settings.

Note

The downslope integration exponent becomes active when the modulation limits are reached and then it reduces the I component by the factor 2^x per cycle (e.g. because the DC link voltage is not sufficient to reach the specified current).

p2000**Reference speed****Can be changed:** T**Data type:** FloatingPoint32**Min:** 0.01 [rpm]**Max:** 25000.00 [rpm]**Def:** 3000.00 [rpm]**Description:**

Sets the reference quantity for speed.

All speeds specified as relative values refer to this reference quantity.

The reference quantity corresponds to 100% or 4000 hex (word) or 4000 0000 hex (double word).

p2003	Reference torque		
	Can be changed: T	Data type: FloatingPoint32	
	Min: 0.0001 [Nm]	Max: 1000.0000 [Nm]	Def: 1.0000 [Nm]
Description:	Sets the reference quantity for torque.		
	All torques specified as relative value are referred to this reference quantity. The reference quantity corresponds to 100% or 4000 hex (word) or 4000 0000 hex (double word).		
r2109[0...63]	Fault time 1 resolved		
	Data type: Unsigned32	Unit: [ms]	
Description:	Displays the system runtime in milliseconds of a day on which the fault was resolved.		
	Note The buffer parameters are cyclically updated in the background. The structure of the fault buffer and the assignment of the indices is shown in r0945.		
r2110[0...63]	Alarm number		
	Data type: Unsigned16	Unit: -	
Description:	Displays the numbers of the alarms that have occurred.		
	Note The buffer parameters are cyclically updated in the background.		
p2111	Delete alarm buffer		
	Can be changed: T, U	Data type: Integer16	
	Min: 0	Max: 1	Def: 0
Description:	Setting to delete the alarm buffer.		
Value:	0: Inactive 1: Start to delete the buffer		
	Note p2111 is automatically set to 0 after execution.		
r2121	Counter alarm buffer changes		
	Data type: Unsigned16	Unit: -	
Description:	Displays changes to the alarm buffer This counter is incremented every time the alarm buffer changes.		
Recommendation:	Used to check whether the fault buffer has been read out consistently.		
r2123[0...63]	Alarm time 1 received		
	Data type: Unsigned32	Unit: -	
Description:	Displays the system runtime in milliseconds of a day on which the alarm occurred.		
	Note The buffer parameters are cyclically updated in the background.		
r2124[0...63]	Alarm value		
	Data type: Unsigned32	Unit: -	
Description:	Displays additional information about the alarm that occurred.		
	Note The buffer parameters are cyclically updated in the background.		

13.2 Parameter list

r2125[0...63]	Alarm time 1 resolved		
	Data type: Unsigned32	Unit: -	
Description:	Displays the system runtime in milliseconds of a day on which the alarm was resolved.		
	Note The buffer parameters are cyclically updated in the background.		
r2130[0...63]	Fault time 2 received		
	Data type: Unsigned32	Unit: -	
Description:	Displays the system runtime when the fault occurred.		
	Lower 16 bits: system runtime in days Upper 16 bits: number of new starts (POWER ON resets)		
	Note The buffer parameters are cyclically updated in the background. The structure of the fault buffer and the assignment of the indices is shown in r0945.		
r2135	Status word thermal monitoring		
	Data type: Unsigned32	Unit: -	
Description:	Displays the status word of the thermal monitoring.		
Bit field:	Bit	Signal name	1 signal 0 signal
	00	Thermal overload internal brake resistance	Yes No
	01	Energy limit internal brake resistance	Yes No
	02	Alarm threshold thermal overload internal brake resistance	Yes No
	03	Alarm threshold energy limit internal brake resistance	Yes No
	04	Thermal overload power end stage	Yes No
	05	Alarm threshold thermal overload power end stage	Yes No
	06	Thermal motor overload	Yes No
	07	Alarm threshold thermal motor overload	Yes No
	08	Overload power end stage	Yes No
	09	Alarm threshold overload power end stage	Yes No
Dependency:	Message F61059(A) "Temperature and energy monitoring".		
	Note For automatic overload limiting (p0205.1) the thermal overload alarm of the power end stage (r2135.9) is suppressed.		
r2136[0...63]	Fault time 2 resolved		
	Data type: Unsigned32	Unit: -	
Description:	Displays the system runtime when the fault was resolved.		
	Lower 16 bits: system runtime in days Upper 16 bits: number of new starts (POWER ON resets)		
	Note The buffer parameters are cyclically updated in the background. The structure of the fault buffer and the assignment of the indices is shown in r0945.		
p2141	Speed threshold 1		
	Can be changed: T, U	Data type: FloatingPoint32	
	Min: 0.00 [rpm]	Max: 25000.00 [rpm]	Def: 300.00 [rpm]
Description:	Sets the speed threshold value for message "n comparison value reached or exceeded" in the ZSW 1 (bit 10).		

r2145[0...63]	Alarm time 2 received	Data type: Unsigned32	Unit: -
Description:	Displays the system runtime when the alarm occurred.		
	Lower 16 bits: system runtime in days Upper 16 bits: number of new starts (POWER ON resets)		
	Note The buffer parameters are cyclically updated in the background.		
r2146[0...63]	Alarm time 2 resolved	Data type: Unsigned32	Unit: -
Description:	Displays the runtime when the fault was resolved.		
	Lower 16 bits: system runtime in days Upper 16 bits: number of new starts (POWER ON resets)		
	Note The buffer parameters are cyclically updated in the background.		
p2147	Delete fault buffer	Data type: Integer16	
	Can be changed: T, U	Min: 0	Max: 1
			Def: 0
Description:	Setting to delete the fault buffer.		
Value:	0: Inactive 1: Start to delete the buffer		
	Note p2147 is automatically set to 0 after execution.		
p2151	Speed setpoint for messages/signals	Data type: Integer16	
	Can be changed: T, U	Min: 0	Max: 1
			Def: 0
Description:	Sets the signal source for the speed setpoint for message "Speed setpoint-actual value deviation in tolerance" ZSW 1 (bit 8).		
Value:	0: Speed setpoint RG input 1: Speed setpoint RG output		
p2163	Speed threshold 4	Data type: FloatingPoint32	
	Can be changed: T, U	Min: 0.00 [rpm]	Max: 1000.00 [rpm]
			Def: 90.00 [rpm]
Description:	Sets the speed threshold value for message "Speed setpoint-actual value deviation in tolerance" ZSW1 (bit 8).		
p2175	Motor blocked speed threshold	Data type: FloatingPoint32	
	Can be changed: T	Min: 0.00 [rpm]	Max: 25000.00 [rpm]
			Def: 50.00 [rpm]
Description:	Sets the speed threshold for the blockage detection of the motor.		
Dependency:	The drive signals that the torque limit has still not been reached in status bit "Torque limit not reached" in ZSW1 bit 11 (r0968.11 or r0899.11). For a blocked motor, message "F61009 motor blocked" is output.		

13.2 Parameter list

	Note The motor is detected as being blocked if the actual speed (r0063) is less than the speed threshold value (p2175) for longer than the delay time (p2177) and the torque limit has been reached.
p2177	Motor blocked delay time Can be changed: T Min: 25 [ms] Data type: Unsigned16 Max: 65000 [ms] Def: 2000 [ms] Description: Sets the delay time for blockage detection of the motor. Dependency: The drive signals that the torque limit has still not been reached in status bit "Torque limit not reached" in ZSW1 bit 11 (r0968.11 or r0899.11). For a blocked motor, message "F61009 motor blocked" is output. Note The motor is detected as being blocked if the actual speed (r0063) is less than the speed threshold value (p2175) for longer than the delay time (p2177) and the torque limit has been reached.
p2710[0...1]	Gearbox ratio Can be changed: T Min: 0 Data type: FloatingPoint32 Max: 100000 Def: 1 Description: Displays the gearbox ratio (rating plate). Index: [0] = Input speed (motor speed) [1] = Output speed (load speed) Note The gearbox ratio is the ratio between the input and output speed. The gearbox ratio is specified as motor revolutions/load revolutions.
p2715[0...1]	Gearbox efficiency Can be changed: T Min: 0.0 Data type: FloatingPoint32 Max: 100.0 Def: 0.0 Description: Displays the gearbox efficiency (rating plate). Index: [0] = Forward direction (motoring) [1] = Backward direction (generating)
p2725	Gearbox moment of inertia Can be changed: T Min: 0.000 [kgcm²] Data type: FloatingPoint32 Max: 100.000 [kgcm²] Def: 0.000 [kgcm²] Description: Displays the gearbox moment of inertia at the input side (rating plate). Note It is specified as [kgcm²]
p2726[0...1]	Gearbox torque Can be changed: T Min: 0.000 [Nm] Data type: FloatingPoint32 Max: 1000.000 [Nm] Def: 0.000 [Nm] Description: Displays the gearbox torque properties (rating plate). Index: [0] = Gearbox rated torque [1] = Gearbox peak torque
r3102[0...4]	System time Data type: Unsigned16 Unit: - Description: Displays the actual system time drive.

Index:

- [0] = System start
- [1] = Days
- [2] = Hours
- [3] = Minutes
- [4] = Seconds

r3120[0...63]	Fault component
	Data type: Unsigned32 Unit: -
Description:	Displays the component number of the fault that has occurred (supplementary information).
	Note The buffer parameters are cyclically updated in the background. The structure of the fault buffer and the assignment of the indices is shown in r0945.
r3121[0...63]	Alarm component
	Data type: Unsigned32 Unit: -
Description:	Displays the component number of the alarm that has occurred (supplementary information).
	Note The buffer parameters are cyclically updated in the background.
r3690	System maximum energy brake resistance
	Data type: FloatingPoint32 Unit: [Ws]
Description:	Displays the maximum permissible energy that the internal brake resistance can absorb.
r3691	System maximum temperature brake resistance
	Data type: FloatingPoint32 Unit: [°C]
Description:	Displays the maximum permissible temperature of the internal brake resistance.
r3692	System maximum temperature power end stage
	Data type: FloatingPoint32 Unit: [°C]
Description:	Displays the maximum permissible temperature of the power end stage.
p3981	Acknowledges drive object faults
	Can be changed: T, U Data type: Unsigned8
	Min: 0 Max: 1 Def: 0
Description:	Setting to acknowledge all active faults of a drive object.
	Note Parameter should be set from 0 to 1 to acknowledge. After acknowledgment, the parameter is automatically reset to 0. Safety messages cannot be acknowledged using this parameter.
p7771	Safely remove memory card
	Can be changed: T, U Data type: Unsigned16
	Min: 0 Max: 65535 Def: 0
Description:	Setting to safely remove the microSD memory card.
	Available values: 0: Inactive 1: Safely remove the memory card 100: Error

13.2 Parameter list

Note

The parameter indicates the processing status of the task. Once execution has been completed, the parameter is automatically set to inactive (0) or error (100).

p7772**Format memory card****Can be changed:** T, U**Data type:** Unsigned16**Min:** 0**Max:** 65535**Def:** 0**Description:**

Setting to format the microSD memory card.

Available values:

0: Inactive

1: Format the memory card

100: Error

⚠ CAUTION

All data on the memory card are lost and cannot be recovered.

Note

The parameter indicates the processing status of the task. Once execution has been completed, the parameter is automatically set to inactive (0) or error (100).

r7810[0...1]**IQ-Encoder position actual values****Data type:** Unsigned16**Unit:** -**Description:**

Displays the actual position information of the IQ-Encoder being used.

Index:

[0] = Singleturn

[1] = Multiturn

r7811**IQ-Encoder angle****Data type:** FloatingPoint32**Unit:** [°]**Description:**

Displays the actual absolute angle setting of the IQ-Encoder.

r7824**IQ-Encoder status****Data type:** Unsigned16**Unit:** -**Description:**

Displays the IQ-Encoder status register. The status information is only available if an IQ-Encoder is connected and parameterized in the drive.

Bit field:

Bit	Signal name	1 signal	0 signal
00	Magnet sensor	Valid	Invalid
01	Temperature sensor	Valid	Invalid
02	Parameter memory	Valid	Invalid
03	Normal operation	Active	Inactive

r8395**Measurement run frictional torque load****Data type:** FloatingPoint32**Unit:** [Nm]**Description:**

Displays the measured frictional torque of the load

Note

Negative values can occur for suspended loads.

r8396**Measurement run static load torque****Data type:** FloatingPoint32**Unit:** [Nm]**Description:**

Displays the static load torque determined for the measurement run.

Note

The static load torque describes an external superimposed force or direction-dependent friction. For example, this occurs for suspended loads or gearboxes with direction-dependent friction components.

r8398 Measurement run load moment of inertia

Data type: FloatingPoint32 **Unit:** [kgcm²]

Description: Displays the measured load moment of inertia.

r8855 Internal drive status

Data type: Integer16 **Unit:** -

Description: Displays the internal drive status.

Value:

- 0: Initialization
- 1: No current
- 2: Parameter accepted
- 3: Switch-test successful
- 4: Ready

r8856 Internal encoder status

Data type: Integer16 **Unit:** -

Description: Displays the internal encoder status (motor encoder).

Value:

- 0: Initialization
- 1: Start procedure
- 2: Parameterization
- 3: Angle synchronization
- 4: Normal operation
- 5: Encoder error

r8930[0...239] PROFINET station name

Data type: Unsigned8 **Unit:** -

Description: Displays the active station name for the onboard PROFINET interface on the drive.

r8931[0...3] PROFINET IP address

Data type: Unsigned8 **Unit:** -

Description: Displays the active IP address for the onboard PROFINET interface on the drive.

r8932[0...3] PROFINET default gateway

Data type: Unsigned8 **Unit:** -

Description: Displays the active default gateway for the onboard PROFINET interface

r8933[0...3] PROFINET subnet mask

Data type: Unsigned8 **Unit:** -

Description: Displays the active subnet mask for the onboard PROFINET interface

r8935[0...5] PROFINET MAC address

Data type: Unsigned8 **Unit:** -

Description: Displays the MAC address for the onboard PROFINET interface

13.2 Parameter list

r8940[0...31]	Product name			
	Data type: Unsigned8	Unit: -		
Description:	Displays the product name.			
p9501	SI enable safety functions			
	Can be changed: T	Data type: Unsigned32		
	Min: -	Max: -	Def: 0000 0000 bin	
Description:	Sets the enable signals for the safe motion monitoring.			
Bit field:	Bit	Signal name	1 signal	0 signal
	00	Enable PROFIsafe communication	Enable	Inhibited
	01	Enable SBC function	Enable	Inhibited
	02	Enable SLS via PROFIsafe	Enable	Inhibited
	03	Enable SSM via PROFIsafe	Enable	Inhibited
	04	Enable SLT via PROFIsafe	Enable	Inhibited
	05	Extended message acknowledgment via HW-STO	Enable	Inhibited
	06	Enable SS1t function	Enable	Inhibited
NOTICE				
Safety functions SLS and SSM can only be used for motors with Hall sensors and incremental encoders (generally, DC motors are not suitable as they have no Hall sensors). The SBC safety function can only be used in conjunction with a safety-related digital output. SBC can only be used for PDC-FIO drives.				
Note				
A parameter change only becomes effective after the safety functions have been commissioned or the safety functions have been reinitialized.				
SS1t: Safe Stop 1 (Safe Stop 1 time-controlled)				
SLS: Safely-Limited Speed				
SSM: Safe Speed Monitor (safety-relevant feedback signal of the speed monitoring)				
SBC: Safe Brake Control				
SLT: Safely-Limited Torque				
Extended message acknowledgment via HW-STO (p9501.5):				
When the function is enabled, a safety-related acknowledgment (internal event acknowledge) can be performed by selecting/deselecting the HW-STO.				
r9502	SI motor type configuration			
	Data type: Integer16	Unit: -		
Description:	Sets the motor type for function channel B.			
Value:	0:	Not configured		
	21:	Motor - DC (DC motor)		
	26:	PMSM motor (permanent magnet synchronous motor)		
Dependency:	This setting is automatically taken from function parameter p0300, and is only active when the SLS or SSM safety function is enabled (p9501.2 = 1 or p9501.3 = 1).			
r9503	SI motor pole pair number			
	Data type: Unsigned16	Unit: -		
Description:	Sets the pole pair number for safety channel B.			
Dependency:	This setting is automatically taken from function parameter p0314, and is only active when the SLS or SSM safety function is enabled (p9501.2 = 1 or p9501.3 = 1).			
Note				
This parameter is used to determine the safety-related speed in safety channel B.				

r9504	SI motor inner constant										
	Data type: FloatingPoint32	Unit: [mNm/A]									
Description:	Sets the inner motor constant for determining the torque in a safety-related fashion.										
Dependency:	The setting is automatically taken from function parameter p0316, and is only active when the SLT safety function is enabled (p9501.4 = 1).										
	Note										
	This parameter is used to determine the safety-related torque in safety channels A and B.										
r9516	SI encoder type configuration										
	Data type: Integer16	Unit: -									
Description:	Sets the motor encoder type for function channel B.										
Value:	0: Not configured 1: Incremental encoder (AB track) 3: Incremental encoder (AB track) and Hall sensors 5: IQ-Encoder with incremental encoder (AB track) 7: IQ-Encoder with incremental encoder (AB track) and Hall sensors										
Dependency:	The setting is automatically taken from function parameter p0404, and is only active when the SLS or SSM safety function is enabled (p9501.2 = 1 or p9501.3 = 1).										
r9518	SI encoder incremental pulse number										
	Data type: Unsigned32	Unit: -									
Description:	Sets the pulse number (number of pulses per revolution) of the incremental encoder to determine the speed in a safety-related fashion										
Dependency:	The setting is automatically taken from function parameter p0408, and is only active when the SLS or SSM safety function is enabled (p9501.2 = 1 or p9501.3 = 1).										
	Note										
	This parameter is used to determine the safety-related speed in safety channel A.										
r9520	SI encoder incremental configuration										
	Data type: Unsigned8	Unit: -									
Description:	Sets the phase position between the motor rotating field and count direction of the incremental encoder.										
Bit field:	<table border="1"> <thead> <tr> <th>Bit</th> <th>Signal name</th> <th>1 signal</th> <th>0 signal</th> </tr> </thead> <tbody> <tr> <td>00</td> <td>Invert count direction of incr. encoder and/or phase position</td> <td>negative</td> <td>positive</td> </tr> </tbody> </table>	Bit	Signal name	1 signal	0 signal	00	Invert count direction of incr. encoder and/or phase position	negative	positive		
Bit	Signal name	1 signal	0 signal								
00	Invert count direction of incr. encoder and/or phase position	negative	positive								
Dependency:	The setting is automatically taken from function parameter p0410, and is only active when the SLS or SSM safety function is enabled (p9501.2 = 1 or p9501.3 = 1).										
	Note										
	This parameter is used to determine the direction of rotation information within the sensor evaluation and diagnostics.										
r9523[0...5]	SI encoder Hall angle setting										
	Data type: Unsigned16	Unit: [°]									
Description:	Sets the angle of the Hall encoder.										
Index:	[0] = Hall U [1] = Hall V [2] = Hall U+V [3] = Hall W [4] = Hall W+U [5] = Hall W+V										
Dependency:	The setting is automatically taken from function parameter p0420, and is only active when the SLS or SSM safety function is enabled (p9501.2 = 1 or p9501.3 = 1).										

13.2 Parameter list

Note

This parameter is used to determine the direction of rotation and speed information within the sensor evaluation and diagnostics.

p9531[0...3]**SI SLS limit values****Can be changed:** T**Data type:** FloatingPoint32**Min:** 0.00 [rpm]**Max:** 25000.00 [rpm]**Def:** 2000.00 [rpm]**Description:**

Sets the limit values for the SLS function.

Index:

[0] = Limit value SLS stage 1

[1] = Limit value SLS stage 2

[2] = Limit value SLS stage 3

[3] = Limit value SLS stage 4

Dependency:

The setting is only active if safety function SLS is enabled (p9501.2 = 1).

⚠ WARNING

For PROFIsafe telegram 30, only SLS stage 1 is available. Switchover between SLS levels 1-4 is possible with PROFIsafe telegram 31.

Note

A parameter change only becomes effective after the safety functions have been commissioned or the safety functions have been reinitialized.

SLS: Safely-Limited Speed

p9532[0...3]**SI SLT limit values****Can be changed:** T**Data type:** FloatingPoint32**Min:** 0.0000 [Nm]**Max:** 100.0000 [Nm]**Def:** 2.0000 [Nm]**Description:**

Sets the limit values for the SLT function.

Index:

[0] = Limit value SLT stage 1

[1] = Limit value SLT stage 2

[2] = Limit value SLT stage 3

[3] = Limit value SLT stage 4

Dependency:

The setting is only active if safety function SLT is enabled (p9501.4 = 1).

⚠ WARNING

For PROFIsafe telegram 30, only stage 1 is available. Switchover between levels 1-4 is only possible with PROFIsafe telegram 31.

Note

A parameter change only becomes effective after the safety functions have been commissioned or the safety functions have been reinitialized.

SLT: Safely-Limited Torque

p9533**SLS speed limiting****Can be changed:** T**Data type:** Unsigned8**Min:** 0 [%]**Max:** 100 [%]**Def:** 90 [%]**Description:**

Sets the evaluation factor to determine the speed limiting from the selected SLS level.

Speed limiting can be deactivated with value p9533 = 0.

Note

The active SLS limit value is evaluated with this factor, and is active as speed limiting. The limit acts in front of the ramp generator and as absolute value for both directions of rotation. The limiting is only active when safety function SLS is enabled and also requested.

Speed limiting = $p9531[x] \cdot p9533$

[x] = selected SLS stage

p9533 = 0 no limiting

p9539	SI filter time torque actual value smoothing
	Can be changed: T Data type: Unsigned16 Min: 0 [ms] Max: 1000 [ms] Def: 100 [ms]
Description:	Sets the filter time of the safety-related torque actual smoothing in safety channels A and B.
Dependency:	The setting is only active if safety function SLT is enabled (p9501.4 = 1).
	Note A parameter change only becomes effective after the safety functions have been commissioned or the safety functions have been reinitialized.
p9545	SI filter time speed actual value smoothing
	Can be changed: T Data type: Unsigned16 Min: 0 [ms] Max: 1000 [ms] Def: 100 [ms]
Description:	Sets the filter time of the safety-related speed actual smoothing in safety channels A and B.
Dependency:	This setting is only active when the SLS or SSM safety function is enabled (p9501.2 = 1 or p9501.3 = 1).
	Note A parameter change only becomes effective after the safety functions have been commissioned or the safety functions have been reinitialized.
p9546	SI SSM speed limit
	Can be changed: T Data type: FloatingPoint32 Min: 0.00 [rpm] Max: 25000.00 [rpm] Def: 1000.00 [rpm]
Description:	Sets the speed limit for the SSM feedback signal. When this limit value is fallen below, signal "SSM feedback signal active" is set.
Dependency:	The setting is only active if safety function SSM is enabled (p9501.3 = 1).
	Note A parameter change only becomes effective after the safety functions have been commissioned or the safety functions have been reinitialized.
	SSM: Safe Speed Monitor (safety-relevant feedback signal of the speed monitoring)
p9547	SI SSM speed hysteresis
	Can be changed: T Data type: FloatingPoint32 Min: 0.00 [rpm] Max: 2000.00 [rpm] Def: 10.00 [rpm]
Description:	Sets the speed hysteresis for the SSM feedback signal.
Dependency:	The speed hysteresis is only effective if the SSM safety function is enabled (p9501.3 = 1 and p9550 = 1).
	Note A parameter change only becomes effective after the safety functions have been commissioned or the safety functions have been reinitialized.
	SSM: Safe Speed Monitor (safety-relevant feedback signal of the speed monitoring)

13.2 Parameter list

p9550	SI SSM enable speed hysteresis			
	Can be changed: T		Data type: Unsigned8	
	Min: -	Max: -	Def: 0000 bin	
Description:	Sets the enable signal for the speed hysteresis of the SSM function.			
Bit field:	Bit	Signal name	1 signal	0 signal
	00	Enable hysteresis SSM	Activated	Deactivated
Dependency:	The setting is only active if safety function SSM is enabled (p9501.3 = 1).			
Note				
A parameter change only becomes effective after the safety functions have been commissioned or the safety functions have been reinitialized.				
SSM: Safe Speed Monitor (safety-related feedback signal of the speed monitoring)				

p9551	SI SLS switchover delay time			
	Can be changed: T		Data type: Unsigned16	
	Min: 0 [ms]	Max: 60000 [ms]	Def: 0 [ms]	
Description:	Sets the delay time for the SLS switchover for the SLS function. The set time is rounded internally to an integer multiple of the monitoring clock cycle.			
Dependency:	The setting is only active if safety function SLS is enabled (p9501.2 = 1).			
Note				
A parameter change only becomes effective after the safety functions have been commissioned or the safety functions have been reinitialized.				
When selecting SLS, the monitoring is only active after the delay time (p9551) expires. Within this time, the actual speed must lie below the (selected) limit value. The delay time is not active when SLS is deselected. After switching over to a lower limit value (p9531), the actual drive speed must have fallen below the new limit value within the delay time (p9551). The existing limit value remains active during the delay time. The lower limit value is active after the delay time has expired. If the actual drive speed is higher than the new Safely-Limited Speed limit value after the delay time has expired, then a limit value violation is signaled and the parameterized stop response (p9563) requested.				
SLS: Safely-Limited Speed				

p9552	SI SLT switchover delay time			
	Can be changed: T		Data type: Unsigned16	
	Min: 0 [ms]	Max: 60000 [ms]	Def: 0 [ms]	
Description:	Sets the delay time for the SLT switchover for the SLT function.			
	When transitioning from a higher to a lower safely-limited torque stage, the "old" torque stage remains active within this delay time. This delay is still applied even if SLT is activated from the state "SLT inactive". The set time is rounded internally to an integer multiple of the monitoring clock cycle.			
Dependency:	The setting is only active if safety function SLT is enabled (p9501.4 = 1).			
Note				
A parameter change only becomes effective after the safety functions have been commissioned or the safety functions have been reinitialized.				
SLT: Safely-Limited Torque				

p9556	SI SS1 delay time			
	Can be changed: T		Data type: Unsigned16	
	Min: 0 [ms]	Max: 30000 [ms]	Def: 0 [ms]	
Description:	Sets the delay time of the pulse cancellation for the SS1t function to brake along the OFF3 down ramp (p1135).			
	The set time is rounded internally to an integer multiple of the monitoring clock cycle.			

Recommendation:	In order that the drive can completely ramp-down along the OFF3 ramp and a motor holding brake that is possibly available can close, then the delay time should be set as follows: Motor holding brake parameterized: delay time >= p1135 + motor holding brake closing time Motor holding brake not parameterized: delay time >= p1135		
Dependency:	The setting is only active if safety function SS1 is enabled (p9501.6 = 1).		
Note A parameter change only becomes effective after the safety functions have been commissioned or the safety functions have been reinitialized.			
SS1t: Safe Stop 1 (Safe Stop 1 time-controlled)			

p9561	SI SLS stop response		
	Can be changed: T	Data type: Integer16	
	Min: 0	Max: 1	Def: 0
Description:	Sets the stop response for the SLS function.		
Value:	0: Stop response STO 1: Stop response SS1		
Dependency:	The setting is only active if safety function SLS is enabled (p9501.2 = 1).		
⚠ WARNING			
For stop function STOP_SS1, safety function SS1 must be enabled via p9501.6.			
Note A parameter change only becomes effective after the safety functions have been commissioned or the safety functions have been reinitialized. This setting applies for all SLS limit values.			
SLS: Safely-Limited Speed			

r9563	SI SLT stop response		
	Data type: Integer16	Unit: -	
Description:	Sets the stop response for the SLT function. This setting applies for all SLT limit values.		
Value:	0: Stop response STO 1: Stop response SS1		
Dependency:	The setting is only active if safety function SLT is enabled (p9501.4 = 1).		
Note A parameter change only becomes effective after the safety functions have been commissioned or the safety functions have been reinitialized.			
SLT: Safely-Limited Torque			

p9603	SI SBC to STO delay time		
	Can be changed: T	Data type: Unsigned16	
	Min: 0 [ms]	Max: 2000 [ms]	Def: 0 [ms]
Description:	Sets the delay time for STO after an SBC. The set time is rounded internally to an integer multiple of the monitoring clock cycle.		
Dependency:	The setting is only active if safety function SBC is enabled (p9501.1 = 1).		

13.2 Parameter list

Note

A parameter change only becomes effective after the safety functions have been commissioned or the safety functions have been reinitialized.

STO: Safe Torque Off

SBC: Safe Brake Control

p9610[0...1]**SI PROFIsafe address**

Can be changed: T

Data type: Unsigned16

Min: 1

Max: 65534

Def: 1

Description:

Sets the PROFIsafe address in the drive.

Index:

[0] = PROFIsafe F-destination address

[1] = PROFIsafe F-source address

Dependency:

The setting is only active if safety function PROFIsafe is enabled (p9501.0 = 1).

⚠ WARNING

The setting in the drive and in the control system must be identical.

Note

A parameter change only becomes effective after the safety functions have been commissioned or the safety functions have been reinitialized.

p9611**SI PROFIsafe telegram selection**

Can be changed: T

Data type: Integer16

Min: 30

Max: 31

Def: 31

Description:

Sets the PROFIsafe telegram in the drive.

Value:

30: PROFIsafe standard telegram 30, PZD-1/1

31: PROFIsafe standard telegram 31, PZD-2/2

Dependency:

The setting is only active if safety function PROFIsafe is enabled (p9501.0 = 1).

⚠ WARNING

The setting in the drive and in the control system must be identical.

Note

A parameter change only becomes effective after the safety functions have been commissioned or the safety functions have been reinitialized.

r9612**SI PROFIsafe status**

Data type: Integer16

Unit: -

Description:

Displays the actual status of the PROFIsafe driver.

Value:

0: Inactive

50: No data exchange

105: Error

181: Data exchange

211: Initialization

r9613**SI PROFIsafe driver signature**

Data type: Unsigned32

Unit: -

Description:

Displays the version signature of the PROFIsafe driver.

r9614**SI PROFIsafe F-parameters status**

Data type: Integer16

Unit: -

Description:	Displays the actual status of the PROFIsafe F-parameters.		
Value:	0:	F-parameters and telegram configuration unknown	
	84:	F-parameters OK	
	134:	F-parameters not OK	
	151:	F-parameters and telegram configuration not OK	
	152:	F-parameters and telegram configuration OK	
	181:	F-parameters and telegram configuration not available	
	211:	Initialization F-parameters and telegram configuration	

Note

PROFIsafe F-parameters are the start parameters of the PROFIsafe submodule of the drive. They are set via the hardware configuration of the control system and transferred to the drive.

p9615	SI PROFIsafe failure response		
	Can be changed: T	Data type: Integer16	
	Min: 0	Max: 1	Def: 0
Description:	Sets the stop response when PROFIsafe communication fails.		
Value:	0: Stop response STO		
	1: Stop response SS1		
Dependency:	The setting is only active if safety function PROFIsafe is enabled (p9501.0 = 1).		
	Note		
	A parameter change only becomes effective after the safety functions have been commissioned or the safety functions have been reinitialized.		

p9633	SLT torque limiting		
	Can be changed: T	Data type: Unsigned8	
	Min: 0 [%]	Max: 100 [%]	Def: 80 [%]
Description:	Sets the evaluation factor to determine the torque limiting from the selected SLT level.		
	Torque limiting can be deactivated with value p9633 = 0.		
	Note		
	The active SLT limit value is evaluated with this factor, and is active as torque limiting. The limiting acts in front of the ramp generator. The limiting is only active when safety function SLT is enabled and also requested.		
	Torque limiting = 9532[x] * p9633		
	[x] = selected SLT stage		
	p9633 = 0 no limiting		

p9700	SI parameter copy function		
	Can be changed: C2(95)	Data type: Unsigned8	
	Min: 0000 hex	Max: 00FF hex	Def: 0000 hex
Description:	Setting to start the copy function of the SI parameters.		
	Available requests (set p9700):		
	(1) Start copy function SI parameters		
	Task status (read p9700):		
	(0) Inactive or copy function completed		
	After copying, the parameter value is automatically reset to 0.		

13.2 Parameter list

NOTICE
Write access to this parameter is protected using the Safety Integrated commissioning mode. A Safety Integrated password must be entered.

Note

Using the SI parameter copy function, the relevant SI parameters are transferred from safety monitoring channel A to safety monitoring channel B.

p9701**SI parameter, confirm data change****Can be changed:** C2(95)**Data type:** Unsigned8**Min:** 0000 hex**Max:** 00FF hex**Def:** 0000 hex**Description:**

Setting to transfer the reference checksums from the associated actual checksums after changes (SI parameters, hardware).

Available requests (set p9701):

(1) Acknowledge SI data change

Task status (read p9700):

(0) Inactive or data change completed

After transferring the reference checksums, the parameter value is automatically reset to zero.

NOTICE

Write access to this parameter is protected using the Safety Integrated commissioning mode. A Safety Integrated password must be entered.

r9714[0...2]**SI diagnostics speed****Data type:** FloatingPoint32**Unit:** [rpm]**Description:**

Displays the actual speed values for motion monitoring functions.

Index:

[0] = Load-side speed actual value in safety channel A

[1] = Load-side speed actual value in safety channel B

[2] = Actual SLS speed limit

Dependency:

The display is only updated when the SLS or SSM safety function is enabled (p9501.2 = 1 or p9501.3 = 1).

Note

The display is updated in the safety monitoring clock cycle.

r9715[0...2]**SI diagnostics torque****Data type:** FloatingPoint32**Unit:** [Nm]**Description:**

Displays the actual torque values for motion monitoring functions.

Index:

[0] = Load-side torque actual value in safety channel A

[1] = Load-side torque actual value in safety channel B

[2] = Actual SLT torque limit

Dependency:

The display is only updated when the SLT safety function is enabled (p9501.4 = 1).

Note

The display is updated in the safety monitoring clock cycle.

p9761[0...9]**SI password input****Can be changed:** -**Data type:** Unsigned8**Min:** -**Max:** -**Def:** -**Description:**

Enters the Safety Integrated password.

Dependency:

It is not possible to change Safety Integrated parameters until the Safety Integrated password has been entered.

Note

The safety password protects safety parameters from unintentional or unauthorized access.

p9762[0...9]	SI password new
	Can be changed: C2(95) Data type: Unsigned8
	Min: - Max: - Def: -
Description:	Enters a new Safety Integrated password.
Dependency:	Write access to this parameter is protected using the Safety Integrated commissioning mode. A Safety Integrated password must be entered.
	Note
	A change made to the Safety Integrated password must be acknowledged in parameter p9763.

p9763[0...9]	SI password acknowledgment
	Can be changed: C2(95) Data type: Unsigned8
	Min: - Max: - Def: -
Description:	Acknowledges the new Safety Integrated password.
Dependency:	Write access to this parameter is protected using the Safety Integrated commissioning mode. A Safety Integrated password must be entered.
	Note
	The new password entered in p9762 must be re-entered in order to acknowledge. p9762 = p9763 = 0 is automatically set after the new Safety Integrated password has been successfully acknowledged.

r9776[0...1]	SI diagnostics alarms			
	Data type: Unsigned32		Unit: -	
Description:	Displays the active alarms of the safety function for the relevant safety channel			
	For bit 0 safety parameter changed: At least one safety parameter was changed, which only becomes active after the safety functions have been commissioned or the safety functions have been reinitialized.			
Index:	[0] = Safety channel A [1] = Safety channel B			
Bit field:	Bit	Signal name	1 signal	0 signal
	00	Safety parameter changed	Yes	No
	03	PROFIsafe passivated	Yes	No
	04	PROFIsafe no data exchange	Yes	No
	05	Safety commissioning activated	Yes	No

r9777[0...1]	SI diagnostics faults			
	Data type: Unsigned32		Unit: -	
Description:	Displays the active faults of the safety function for the relevant safety channel			
Index:	[0] = Safety channel A [1] = Safety channel B			
Bit field:	Bit	Signal name	1 signal	0 signal
	03	Missing safety diagnostics	Yes	No
	04	Safety Integrated parameter invalid	Yes	No
	05	Watchdog for status synchronization	Yes	No
	06	Error in the safety application	Yes	No
	07	Status synchronization error	Yes	No
	08	PROFIsafe error	Yes	No

13.2 Parameter list

09	Diagnostics STO HW error	Yes	No
10	End stage shutdown unsuccessful	Yes	No
11	Error, crosswise comparison of the safety channels	Yes	No
12	Error, time monitoring of the safety channels	Yes	No
13	Timeout in a safety channel	Yes	No
14	Error, factory CRC across Safety Integrated parameters	Yes	No
15	Error, setup CRC across Safety Integrated parameters	Yes	No
16	End stage read-back signal in safety channel A not plausible	Yes	No
17	End stage read-back signal in safety channel B not plausible	Yes	No
18	Hall sensor connection error	Yes	No
19	SLS limit value violation	Yes	No
20	SLT limit value violation	Yes	No
21	PROFIsafe telegram different HW config/SI parameters	Yes	No
22	Chatter monitoring STO HW error	Yes	No
23	Discrepancy error STO HW	Yes	No
24	Error in the safety application	Yes	No
25	Torque monitoring diff between safety channels above limit value	Yes	No
26	Current summing error	Yes	No
28	ROM memory error	Yes	No
29	Speed sensor monitoring error	Yes	No

r9780**SI monitoring clock cycle****Data type:** Unsigned16 **Unit:** [ms]**Description:**

Displays the clock cycle time in which the safety functions are executed in the drive.

Note

You can find information regarding the relationship between monitoring clock cycle and response times in the manual.

r9781[0...2]**SI checksum to check changes****Data type:** Unsigned16 **Unit:** -**Description:**

Displays the checksum to track changes for safety functions.

Index:

[0] = Safety change tracking acceptance
 [1] = Safety change tracking hardware
 [2] = Safety change tracking firmware

Dependency:

The acceptance checksum is automatically generated after setting the SI reference checksum (p9799) and saved.

Note

The hardware checksum is automatically generated depending on the drive hardware, and only changes after the drive hardware has been replaced.

The firmware checksum is automatically generated depending on the safety program of the drive firmware, and only changes after the drive firmware has been updated.

r9790**SI diagnostics STO****Data type:** Unsigned32 **Unit:** -**Description:**

Displays the diagnostics information of function STO.

Bit field:

Bit	Signal name	1 signal	0 signal
00	STO active	Yes	No
01	SBC active	Yes	No
02	STO request via HW terminal (X5060)	Yes	No
03	STO request as a result of SS1 function	Yes	No
04	STO request via PROFIsafe telegram	Yes	No

05	STO request as a result of a STOP_STO	Yes	No
----	---------------------------------------	-----	----

Note

STO: Safe Torque Off

r9791**SI diagnostics SS1****Data type:** Unsigned32 **Unit:** -**Description:** Displays the diagnostics information of function SS1t.

Bit field:	Bit	Signal name	1 signal	0 signal
	00	SS1 active	Yes	No
	01	SS1 request as a result of a STOP_SS1	Yes	No
	02	SS1 request via PROFIsafe telegram	Yes	No
	03	STO request via SS1 function	Yes	No

Dependency: The display is only updated when the SS1 safety function is enabled (p9501.6 = 1).**Note**

SS1t: Safe Stop 1 (Safe Stop 1 time-controlled)

r9792**SI diagnostics SLS****Data type:** Unsigned32 **Unit:** -**Description:** Displays the diagnostics information of function SLS.

Bit field:	Bit	Signal name	1 signal	0 signal
	00	SLS active	Yes	No
	01	SLS request via PROFIsafe telegram	Yes	No
	04	SLS stage 1 active	Yes	No
	05	SLS stage 2 active	Yes	No
	06	SLS stage 3 active	Yes	No
	07	SLS stage 4 active	Yes	No
	08	SLS stage selection bit 0 via PROFIsafe	Active	Inactive
	09	SLS stage selection bit 1 via PROFIsafe	Active	Inactive
	10	SLS limit value violation	Active	Inactive
	11	STO request due to an SLS limit value violation	Yes	No
	12	SS1 request due to an SLS limit value violation	Yes	No

Dependency: The display is only updated when the SLS safety function is enabled (p9501.2 = 1).**NOTICE**

For bit 1 "SLS request via PROFIsafe telegram":

If PROFIsafe communication was not enabled (p9501.0 = 0), then the SLS request via PROFIsafe telegram is internally active.

Note

SLS: Safely-Limited Speed

r9793**SI diagnostics SSM****Data type:** Unsigned32 **Unit:** -**Description:** Displays the diagnostics information of function SSM.

Bit field:	Bit	Signal name	1 signal	0 signal
	00	Speed below limit value SSM	Yes	No
	01	SSM active	Yes	No

Dependency: The display is only updated when the SSM safety function is enabled (p9501.3 = 1).**⚠ WARNING**

Signal "Speed below limit value SSM" is only available in PROFIsafe telegram 31.

13.2 Parameter list

Note

SSM: Safe Speed Monitor (safety-relevant feedback signal of the speed monitoring)

r9794**SI diagnostics SLT****Data type:** Unsigned32**Unit:** -**Description:**

Displays the diagnostics information of function SLT.

Bit field:

Bit	Signal name	1 signal	0 signal
00	SLT active	Yes	No
01	SLT request via PROFIsafe telegram	Yes	No
04	SLT stage 1 active	Yes	No
05	SLT stage 2 active	Yes	No
06	SLT stage 3 active	Yes	No
07	SLT stage 4 active	Yes	No
08	SLT stage selection bit 0 via PROFIsafe	Active	Inactive
09	SLT stage selection bit 1 via PROFIsafe	Active	Inactive
10	SLT limit value violation	Active	Inactive
11	STO request due to an SLT limit value violation	Yes	No

Dependency:

The display is only updated when the SLT safety function is enabled (p9501.4 = 1).

NOTICE

For bit 1 "SLT request via PROFIsafe telegram":

If PROFIsafe communication was not enabled (p9501.0 = 0), then the SLT request via PROFIsafe telegram is internally active.

Note

SLT: Safely-Limited Torque

r9795**SI diagnostics PSD****Data type:** Unsigned32**Unit:** -**Description:**

Displays the PROFIsafe diagnostics information of the drive.

Bit field:

Bit	Signal name	1 signal	0 signal
01	Reintegration after passivation (OA_Req)	Requested	Not requested

Dependency:

The display is only updated when the PROFIsafe safety function is enabled (p9501.0 = 1).

r9798[0...1]**SI actual checksum of the SI parameters****Data type:** Unsigned16**Unit:** -**Description:**

Displays the checksum across the safety-relevant parameters of the particular safety channel (actual checksum).

Index:

[0] = Safety parameter channel A

[1] = Safety parameter channel B

p9799[0...1]**SI reference checksum of SI parameters****Can be changed:** C2(95)**Data type:** Unsigned16**Min:** 0000 hex**Max:** FFFF hex**Def:** 0000 hex**Description:**

Sets the checksum across the safety-relevant parameters of the particular safety channel (reference checksum).

Index:

[0] = Safety parameter channel A

[1] = Safety parameter channel B

Dependency:

Write access to this parameter is protected using the Safety Integrated commissioning mode. A Safety Integrated password must be entered.

⚠ WARNING

When the parameter is changed, a new acceptance checksum is automatically generated in the change check r9781[0]. This operation cannot be undone. An appropriate acceptance test is required after changing the Safety Integrated checksum.

r9950	Cold restart counter	Data type: Unsigned32	Unit: -
Description:	Displays the number of system cold restarts.		
r9951	Restart counter	Data type: Unsigned32	Unit: -
Description:	Displays the number of system restarts.		
p60000	Reference speed	Data type: FloatingPoint32	
	Can be changed: T	Min: 0.01 [rpm]	Max: 25000.00 [rpm] Def: 3000.00 [rpm]
Description:	Sets the reference quantity for speed.		
	All speeds specified as relative values refer to this reference quantity. The reference quantity corresponds to 100% or 4000 hex (word) or 4000 0000 hex (double word).		
r60022	SI PROFIsafe telegram HW configuration	Data type: Unsigned16	Unit: -
Description:	Displays the PROFIsafe send and receive telegrams from the currently transferred HW configuration.		
Dependency:	The display is only updated when the PROFIsafe safety function is enabled (p9501.0 = 1).		
r60122	SI PROFIsafe telegram HW configuration	Data type: Unsigned16	Unit: -
Description:	Displays the PROFIsafe send and receive telegrams from the currently transferred HW configuration.		
Dependency:	The display is only updated when the PROFIsafe safety function is enabled (p9501.0 = 1).		

Faults and warnings

14.1 Overview of messages

A message is made up of a letter followed by the respective number.

The letters have the following meaning

- "A" means alarm
- "F" means fault

Detailed examples:

- Axxxxx: Alarm xxxxx
- Fxxxxx: Fault xxxxx

Acknowledgment (of faults)

In the list of faults and alarms, the method that must be used to acknowledge each fault after the cause has been eliminated is specified.

- POWER ON
The fault is acknowledged by switching the drive unit off and on again.
- IMMEDIATELY
The fault can be acknowledged directly after elimination of the cause (e.g. using STW1.7 or p3981).

Reference

Observe the information in section Messages (Page 196).

You can find additional information on the fault reactions in section OFF responses (Page 136).

14.2 List of faults and alarms

List of faults and alarms of the PDC drive controller

Product: sim_pdc, Version: 1001700, Language: eng
Objects:

F61000	RAM-ROM-CPU test
Message value:	Value: %1
Reaction:	NONE
Acknowledge:	IMMEDIATELY (POWER ON)
Cause:	An error was detected during the RAM-ROM-CPU test.

14.2 List of faults and alarms

Remedy: Attempt to restart the device or replace the drive controller. Contact the hotline.

F61001 Trace

Message value: Mask: %1

To %1

Bit	Cause	Remedy
0	Access to trigger parameter unsuccessful	
1	Access to trace parameter unsuccessful	
8	Trigger parameter is invalid	
9	Trace parameter is invalid	

Reaction: NONE

Acknowledge: IMMEDIATELY

Cause: An error has occurred in the trace data or in the trace configuration.

Remedy:

- Check or update the trace configuration.
- In this firmware version, the configured parameter has not been released for tracing.

F61009 Motor blocked

Message value: -

Reaction: NONE

Acknowledge: IMMEDIATELY (POWER ON)

Cause: The motor has been operating at the torque limit longer than the delay time (p2177) and below the speed threshold (p2175). This signal can also be initiated if the speed actual value is oscillating and the speed controller output goes to its limit.

Remedy:

See also: p2175, p2177, p1545, r0968

- Check the motor shaft to see if it is blocked.
- Check the torque limit in p1520.
- Check the parameter of the message "Motor blocked", and if required, correct (p2175, p2177).
- Check the inversion of the actual value (p0410.0).
- Check the encoder pulse number (p0408).
- Check the motor encoder at terminal X4050.
- Check the connection sequence of the motor phases at terminal X5050.

An interruption or short-circuit of the Hall and AB sensor inputs at terminal X4050 can mean that the reference to the motor rotor angle is lost. In this case, restart the drive device.

F61018 PN isochronous - sign-of-life failure

Message value: Error limit: %1 (p0925)

Reaction: NONE

Acknowledge: IMMEDIATELY

Cause: The maximum permissible number of errors in the controller sign-of-life (isochronous operation) has been exceeded in cyclic operation.

Remedy:

- Check the topology saved in the controller
- Physically check the bus (cables, connectors, terminating resistor, shielding, etc.).
- Check the permissible telegram failure rate (p0925).
- Check the bus and controller for utilization level (e.g. bus cycle time was set too short).

F61019 (A) SSI sensor failure

Message value: -

Reaction: NONE

Acknowledge: IMMEDIATELY
Cause: SSI sensor failed or faulted. The internal signal evaluation was interrupted.
Remedy: - Check the SSI encoder at terminal X5060.

F61052 (A) Drive settings

Message value: Mask: %1
 To %1

Bit	Cause	Remedy
0	No motor type selected or selection is not supported	Check p0300
1	Motor resistance R outside the permissible range	Check p0372
2	Motor inductance Ld outside the permissible range	Check p0377
3	Motor inductance Lq outside the permissible range	Check p0377
4	Motor current Iref outside the permissible range	Check p0305
5	Rated motor current outside the permissible range	Check p0311
6	Motor current Imax outside the permissible range	Check p0323
7	Motor speed limiting value outside the permissible range	Check p0322
10	Inner motor constant outside the permissible range	Check p0316
11	Rotor moment of inertia outside the permissible range	Check p0341
12	Number of pole pairs outside the permissible range	Check p0314
13	Time constant Ld/R outside the permissible range	Check p0377, p0372
14	Time constant Lq/R outside the permissible range	Check p0377, p0372
24	No motor type selected or selection is not supported	Check p0404
25	Motor encoder pulse number outside the permissible range	Check p0408
26	Parameter assignment of the Hall sensor not plausible	Check p0420
27	Parameter assignment of the Hall sensor missing	Check p0420, p404
30	Parameter assignment of the efficiency when motoring outside the permissible range	Check p1390 (controller parameter)
31	Parameter assignment of the efficiency when generating outside the permissible range	Check p1391 (controller parameter)

Reaction: NONE
Acknowledge: IMMEDIATELY
Cause: Invalid settings were found when checking the drive settings. Parameters in the "Drive" area are invalid or inconsistent.
Remedy: Check the parameterization in the "Drive" area or use the "Configure drive data set" function in order to select a preconfigured motor data set. When using a motor equipped with IQ-Encoder, you can also load the electronic rating plate directly from the motor.

F61053 (A) Controller settings

Message value: Mask: %1
 To %1

14.2 List of faults and alarms

Bit	Cause	Remedy
0	P gain speed controller outside the permissible range	Check p1460
1	Integral time speed controller outside the permissible range	Check p1462
2	Downslope integration exponent speed controller outside the permissible range	Check p1467
3	Internal sequence error when setting up the speed controller	Contact the hotline
4	Time constant series filter speed controller outside the permissible range	Check p1416
5	Time constant speed measured value filter outside the permissible range	Check p1441
8	P gain current controller Id outside the permissible range	Check p1735
9	Integral time current controller Id outside the permissible range	Check p1736
10	Downslope integration exponent current controller Id outside the permissible range	Check p1737
11	Internal sequence error when setting up the current controller Id	Contact the hotline
16	P gain current controller Iq outside the permissible range	Check p1715
17	Integral time current controller Iq outside the permissible range	Check p1717
18	Downslope integration exponent current controller Iq outside the permissible range	Check p1720
19	Internal sequence error when setting up the current controller Iq	Contact the hotline
Reaction:	NONE	
Acknowledge:	IMMEDIATELY	
Cause:	The controller settings for the configured drive data set are invalid.	
Remedy:	- Adapt the controller settings for the actual drive data set - Perform automatic controller calculation - Reset load properties, see p1395, p1398, p1396 - Controller tuning using a measurement run	

F61054 (A) Ramp generator settings

Message value: Mask: %1
To %1

Bit	Cause	Remedy
0	Speed ramp generator 0 parameterization is internally adapted	Check p1130, p1131, p1120
1	Speed ramp generator 1 parameterization is internally adapted	Check p1136, p1137, p1135
2	Speed ramp generator 2 parameterization is internally adapted	Check the parameterization
3	Speed ramp generator 3 parameterization is internally adapted	Check the parameterization
4	Torque ramp generator 0 parameterization is internally adapted	Check p1125, p1132, p1133
5	Torque ramp generator 1 parameterization is internally adapted	Check the parameterization
6	Torque ramp generator 2 parameterization is internally adapted	Check the parameterization
7	Torque ramp generator 3 parameterization is internally adapted	Check the parameterization
8	Speed ramp generator 0 internal processing error	Contact the hotline
9	Speed ramp generator 1 internal processing error	Contact the hotline
10	Speed ramp generator 2 internal processing error	Contact the hotline
11	Speed ramp generator 3 internal processing error	Contact the hotline
12	Torque ramp generator 0 internal processing error	Contact the hotline
13	Torque ramp generator 1 internal processing error	Contact the hotline
14	Torque ramp generator 2 internal processing error	Contact the hotline
15	Torque ramp generator 3 internal processing error	Contact the hotline
16	Reference value in the speed ramp generator is outside the permissible range	Adapt the parameterization
17	Reference value in the torque ramp generator is outside the permissible range	Adapt the parameterization

Reaction: NONE

Acknowledge: IMMEDIATELY

Cause: The actual settings for the torque or speed ramp generator are invalid.

Remedy: Check the ramp generator settings and adapt the parameters (observe the error bit).

F61055 (A) Operating messages

Message value: Mask: %1

To %1

14.2 List of faults and alarms

Bit	Cause	Remedy
0	Undervoltage in the DC link	Check the cabling and value of the brake resistance, infeed 4L+ at terminal X5050
1	Undervoltage in the DC link	Check the infeed 4L+ at terminal X5050 for sufficient voltage and load capability
2	Shutdown due to HW short-circuit detection	Check the cabling and motor (possible insulation loss)
3	Shutdown due to overcurrent trip, phase U	Check the cabling and motor (possible insulation loss)
4	Shutdown due to overcurrent trip, phase V	Check the cabling and motor (possible insulation loss)
5	Shutdown due to overcurrent trip, phase W	Check the cabling and motor (possible insulation loss)
6	Shutdown due to STO request	Check the correct functioning of the safety equipment
9	Alarm: DC link voltage close to overvoltage shutdown	Check the cabling and value of the brake resistance, infeed 4L+ at terminal X5050
10	Alarm: DC link voltage close to undervoltage shutdown	Check the infeed 4L+ at terminal X5050 for sufficient voltage and load capability
14	Controller manifests implausible response (e.g. unexpected tendency to oscillate)	Check the cabling and controller parameterization
16	Motor model manifests excessively high deviations	Check the motor parameters and if required, adapt
30	Alarm: motor end stage load in critical range	Reduce the end stage load and/or activate the automatic mode
31	Motor final stage was shut down due to overload	Reduce the end stage load and/or activate the automatic mode
Reaction:	NONE	
Acknowledge:	IMMEDIATELY	
Cause:	A diagnostics unit in the drive has signaled an operating event.	
Remedy:	Observe the relevant information for the active signaling bit.	

F61056 (A) Motor encoder

Message value: Mask: %1
To %1

Bit	Cause	Remedy
7	Speed sensor frequency limit exceeded	Check the system design
17	Group message speed sensor error and Hall error	
18	Speed sensor and Hall sensor operate in different directions	Check the parameterization and cabling
20	Speed sensor-A/B monitoring signals an error	Check the cabling
21	Hall signals not plausible	Check the parameterization and Hall signal cabling
22	Hall sector too small	Check the incremental encoder cabling
23	Hall sector too large	Check Hall signal cabling
24	Hall sector assignment incorrect	Check the Hall signal cabling, check the parameterization of the Hall angle
25	Encoder parameter processing takes too long or unsuccessful	Check the encoder parameterization
26	Synchronization of the actual position takes too long or unsuccessful	Check the parameterization and encoder cabling
27	Speed sensor supplies too many edges	Check the parameterization, improve the shielding
28	Hall sensor supplies an unstable signal	Check Hall signal shielding

Reaction: NONE
Acknowledge: IMMEDIATELY
Cause: A problem was identified in conjunction with the motor encoder.
Remedy: - Check the motor encoder parameterization (p0404, p0408, p0410, p0420)
- Check the motor encoder at terminal X4050.

F61057 (A) Drive data set

Message value: Signature: %1 (p0143)

Reaction: NONE

Acknowledge: IMMEDIATELY

Cause: The configured and/or selected drive data set is not consistent. The signature set in p0143 deviates from the actual drive data set.

Remedy:

- Use a user-defined drive data set.
- Check or update the drive data set.
- Use a newer drive data set.
- Contact the Hotline.

F61058 Start-up test

Message value: Mask: %1

To %1

Bit	Cause	Remedy
0	Brake resistance control error	Replace the drive controller; contact the hotline
1	External brake resistance too low	Check the cabling and brake resistance; use a permissible brake resistance
2	Motor end stage control, phase U error	Replace the drive controller; contact the hotline
3	Motor end stage control, phase V error	Replace the drive controller; contact the hotline
4	Motor end stage control, phase W error	Replace the drive controller; contact the hotline
5	Current measurement device, phase U error	Replace the drive controller; contact the hotline
6	Current measurement device, phase V error	Replace the drive controller; contact the hotline
7	Current measurement device, phase W error	Replace the drive controller; contact the hotline
8	Motor connection: phase U not connected	Check the cabling and parameterized motor type (DC/EC)
9	Motor connection: phase V not connected	Check the cabling and parameterized motor type (DC/EC)
10	Motor connection: phase W not connected	Check the cabling and parameterized motor type (DC/EC)
11	Motor connection: one or more phases not connected	Check the cabling and parameterized motor type (DC/EC)
12	Motor connection: phases incorrectly connected	Check the cabling and parameterized motor type (DC/EC)

Reaction: NONE

Acknowledge: IMMEDIATELY

Cause: An error has occurred in the start-up test (SUT)

Remedy:

F61059 (A) Temperature and energy monitoring

Message value: Mask: %1

To %1

14.2 List of faults and alarms

Bit	Cause	Remedy
0	Temperature monitoring internal brake resistance limit value exceeded	Use an external brake module
1	I2t monitoring internal brake resistance limit value exceeded	Use an external brake module
2	Temperature monitoring internal brake resistance alarm threshold exceeded	Use an external brake module
3	I2t monitoring internal brake resistance alarm threshold exceeded	Use an external brake module
4	Temperature monitoring motor end stage limit value exceeded	Reduce the load
5	Temperature monitoring motor end stage alarm threshold reached	Reduce the load
6	Temperature monitoring motor winding limit value exceeded	Reduce the load
7	Temperature monitoring motor winding alarm threshold reached	Reduce the load
8	I2t monitoring motor end stage limit value exceeded	Reduce the load
9	I2t monitoring motor end stage alarm threshold reached	Reduce the load
10	Temperature monitoring MCU A alarm threshold reached	Reduce the load, improve the cooling

Reaction: NONE
Acknowledge: IMMEDIATELY
Cause: Temperature or energy limit value exceeded.
Remedy:

- Reduce load or load duration
- Use external brake resistance
- Adapt the alarm thresholds, see p0291

F61060 (A) IQ-Encoder

Message value: Mask: %1
 To %1

Bit	Cause	Remedy
0	Different drive ID detected	Check drive data set p0302 or connect the drive that has been set
1	Connection to the IQ-Encoder interrupted	Check terminal X4050
2	IQ-Encoder system found but not set	Check the drive data set
3	IQ-Encoder drive data set is inconsistent or out of date	Use a newer drive or adapt the drive data set

Reaction: NONE
Acknowledge: IMMEDIATELY
Cause: A problem involving the configuration or connection to the IQ-Encoder was identified.
Remedy:

- Check that the drive used has a compatible IQ-Encoder.
- Check the parameterization of the motor encoder type, see p0404.
- Check the IQ-Encoder connection at terminal X4050.

F61100 NVM - parameter memory

Message value: Mask: %1
 To %1

Bit	Cause	Remedy
0	Drive parameters were not able to be loaded	Restart the device, check the parameterization in the commissioning tool and if necessary save again
1	Drive parameter backup unsuccessful	Repeat the save operation (e.g. save RAM to ROM using p0977)
2	Diagnostic parameters were not able to be loaded	Restart the device, check the parameterization in the commissioning tool and if necessary save again
3	Diagnostic parameter save unsuccessful	Repeat the save operation (e.g. save RAM to ROM using p0977)
4	Statistics parameters were not able to be loaded	Restart the device, check the parameterization in the commissioning tool and if necessary save again
5	Statistics parameter save unsuccessful	Repeat the save operation (e.g. save RAM to ROM using p0977)
6	Communication parameters were not able to be loaded	Restart the device, check the parameterization in the commissioning tool and if necessary save again
7	Communication parameter backup unsuccessful	Repeat the save operation (e.g. save RAM to ROM using p0977)
10	Factory parameters were not able to be loaded	Contact the hotline
11	Firmware parameters were not able to be loaded	Contact the hotline
15	General reset of the memory system unsuccessful	Perform a general reset of the device using the service button, contact the hotline
16	Error while initializing the memory system	Perform a general reset of the device using the service button, contact the hotline
17	Journaling was not able to be activated in the memory system	Perform a general reset of the device using the service button, contact the hotline
18	After the test, the file system had to be repaired	Perform a general reset of the device using the service button and restart the device
20	Error while setting up the memory system	Perform a general reset of the device using the service button, contact the hotline
21	Safety logbook was not able to be loaded	Restart the device, check the parameterization in the commissioning tool and if necessary save again
22	Safety logbook backup unsuccessful	Repeat the save operation (e.g. save RAM to ROM using p0977)

Reaction: NONE

Acknowledge: IMMEDIATELY

Cause: Parameter data were not able to be completely loaded or backed up. Defective or missing data were identified in the internal parameter memory (ROM) of the drive.

Remedy:

- Perform a POWER ON to restart the device.
- Backup the parameters.
- Reload the project or the backup into the drive device.

For errors in the memory system, attempt to restore the factory settings of the device using the service button (general reset). If the problem reoccurs then contact the hotline.

F61101 MMC memory card

Message value: Mask: %1
To %1

14.2 List of faults and alarms

	Bit	Cause	Remedy
	8	Parameter backup not found	
	9	Parameter backup was not able to be created	
	12	Parameter backup not available or inconsistent	
	13	Maintenance data was not able to be exported	
	14	No memory card inserted	
	19	Memory card was not able to be formatted	
Reaction:	NONE		
Acknowledge:	IMMEDIATELY		
Cause:	Parameters were not able to be backed up or loaded. An error occurred when accessing the external microSD memory card (MMC).		
Remedy:	- Check whether the memory card is inserted and the memory medium functions - Memory cards up to and including 32 Gbyte can be read - The memory card must be formatted with FAT32 - Format the memory card via the PDC - Check the memory card for mechanical deformation and/or wear - Ensure that the memory card is correctly inserted in the card holder - Check the housing and mechanics of the card holder for any damage.		

F61200 (A) PROFINET system

Message value:	-
Reaction:	NONE
Acknowledge:	IMMEDIATELY
Cause:	The PROFINET system was restarted after a problem.
Remedy:	Ensure that a valid PROFINET name and IP address have been assigned.

Check the following settings:

- I&M data of the drive
- Shared device configuration
- Network topology of the PROFINET controller
- Configuration of the PROFINET controller

Possible causes:

- IP address, subnet mask or default gateway is not correct
- IP address or station name used twice in the network
- Station name contains invalid characters, etc.

F64600 SI general

Message value:	Mask: %1
	To %1

Bit	Cause	Remedy
5	Watchdog for status synchronization	Safety program error Contact the hotline and if necessary replace the device.
6	Safety program is in an error state	Safety program error Contact the hotline and if necessary replace the device.
7	Status synchronization error	Safety program error Contact the hotline and if necessary replace the device.
8	PROFIsafe error	PROFIsafe driver error. Check the HW configuration and if necessary restart the device.
11	Error, crosswise comparison of the safety channels	Check the safety functions, motor and encoder.
12	Error, time monitoring of the safety channels	Safety program error Contact the hotline and if necessary replace the device.
13	Timeout in a safety channel	Safety program error Contact the hotline and if necessary replace the device.
21	Difference between PROFIsafe telegram HW config and SI parameterization	Check or adapt the HW configuration and drive configuration.
24	Safety function is in an error state	Safety program error Contact the hotline and if necessary replace the device.
28	ROM memory error	Safety program error Contact the hotline and if necessary replace the device.

Reaction: NONE

Acknowledge: IMMEDIATELY (POWER ON)

Cause: A general problem in the drive safety circuit has occurred.

Remedy:

- Check the parameterization of the safety functions in the drive.
- Check the configuration used.
- Attempt to restart the device.

F64605 SI parameters

Message value: Mask: %1
To %1

Bit	Cause	Remedy
4	Safety Integrated parameter invalid	Check release signals for the safety functions (e.g. stop response SS1) and motor and encoder type.
14	Error, factory CRC across Safety Integrated parameters	Contact the hotline and if necessary replace the device.
15	Error, setup CRC across Safety Integrated parameters	Perform safety commissioning or load a valid parameter set.

Reaction: NONE

Acknowledge: IMMEDIATELY (POWER ON)

Cause: A parameter problem has occurred in the drive safety program.

Remedy:

- Check the Safety Integrated parameters.
- If necessary, commission the safety functions.
- Ensure that a valid parameter set was loaded.
- It is possible that a corrupted backup was loaded from the memory card.

A64606 SI information

Message value: Mask: %1
To %1

14.2 List of faults and alarms

	Bit	Cause	Remedy
	0	SI parameter changed, safety commissioning required	Complete safety commissioning.
	3	PROFIsafe passivated	Perform PROFIsafe reintegration.
	4	PROFIsafe no data exchange	Start PROFIsafe data exchange
	5	Safety commissioning mode active	Complete safety commissioning.
Reaction:	NONE		
Acknowledge:	NONE		
Cause:	Information about the drive safety program is available.		
	Note: regarding the safety commissioning mode:		
	- Is activated by entering the safety password		
	- Drive is in the STOP_STO state		
Remedy:	Regarding the safety commissioning mode:		
	- Is automatically exited after 5 minutes		
	- Is deactivated when the safety functions have been commissioned		

F64610 SI power

Message value: Mask: %1
To %1

	Bit	Cause	Remedy
	3	Missing safety diagnostics request from STO-HW or end stage shutdown test	Contact the hotline and if necessary replace the device.
	9	STO HW input test unsuccessful	Contact the hotline and if necessary replace the device.
	10	End stage shutdown test unsuccessful	Contact the hotline and if necessary replace the device.
	16	End stage read-back signal in safety channel A not plausible	Error cannot be acknowledged. Restart the device or replace.
	17	End stage read-back signal in safety channel B not plausible	Error cannot be acknowledged. Restart the device or replace.
	22	Chatter at the STO HW input detected	Check input STO HW terminal X5060.
	23	Discrepancy at the STO HW input detected	Check input STO HW terminal X5060.
	26	Current summing error	Contact the hotline and if necessary replace the device.
Reaction:	NONE		
Acknowledge:	IMMEDIATELY (POWER ON)		
Cause:	The drive safety program detected a hardware problem.		
Remedy:			

F64630 SI torque

Message value: Mask: %1
To %1

	Bit	Cause	Remedy
	20	SLT limit value violation	Check the torque limit and setpoint values.
	25	Torque monitoring error	Contact the hotline and if necessary replace the device.
	31	SLT level request incorrect	SLT level request between the safety channels not plausible.
Reaction:	NONE		
Acknowledge:	IMMEDIATELY (POWER ON)		
Cause:	The safety-related drive torque monitoring has detected a problem.		

Remedy: Safety function SLT does not automatically limit the torque setpoint.

- Check the SLT limit values in p9532.
- Check the torque setpoint input, see r1503.
- check the motor parameterization.

F64640 SI speed

Message value: Mask: %1
To %1

Bit	Cause	Remedy
18	Error, Hall sensor inputs	Check the Hall sensor inputs at terminal X4050.
19	SLS limit value violation	Check the speed limit and setpoint values.
29	Error, speed sensor monitoring	Check the Hall and AB sensor inputs (terminal X4050) and the sensor parameterization.
30	SLS level request incorrect	SLS level request between the safety channels not plausible.

Reaction: NONE

Acknowledge: IMMEDIATELY (POWER ON)

Cause: The safety-related drive speed monitoring has detected a problem.

Remedy: Automatically limiting the velocity setpoint using the SLS safety function can be set in parameter p9533.

- Check the SLS limit values in p9531.
- Check the speed setpoint input, see r1045.
- Check the sensor parameterization
- Check the Hall and AB sensor inputs at terminal X4050.

An interruption or short-circuit of the Hall and AB sensor inputs at terminal X4050 can mean that the reference to the motor rotor angle is lost. In this case, restart the drive device.

F64700 SI PROFIsafe driver

Message value: Mask: %1
To %1

Bit	Cause	Remedy
0	Discrepancy of the F-destination address	
1	Invalid F-destination address	
2	Invalid or discrepancy of the F-source address	
3	F-monitoring time is 0 ms	
4	F_SIL exceeds SIL of the device application	
5	Data length does not match the length of the F-CRC used	
6	F-parameter version is not correct	
7	F-parameter data block not consistent (CRC1 error)	
8	Device-specific or unknown error	
9	iParameter not consistent (iParCRC error)	
10	F_Block_ID is not supported	
11	Transfer error: data not consistent (CRC2 error)	
12	Transfer error: F-monitoring time expired (F_WD_Time)	

Reaction: NONE

Acknowledge: IMMEDIATELY (POWER ON)

Cause: An error from the PROFIsafe driver was signaled in the drive.

14.2 List of faults and alarms

Remedy:

- Check the hardware configuration and configuration of the PROFINET controller
- Check the PROFIsafe parameterization in the drive.
- Attempt to restart the device.

Dimension drawings

In this appendix you will find the dimension drawings of the shield clamp. You must take into account the dimensions for installation in cabinets, control rooms, etc.

You can find the dimension drawings of the MICRO-DRIVE PDC device versions in the manual of the respective PDC device version.

Dimension drawings of shield brackets

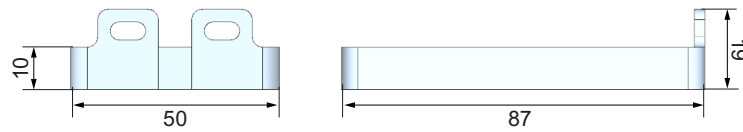


Figure A-1 Dimension drawing of the shield clamp 50 mm

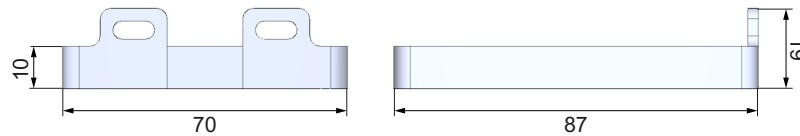


Figure A-2 Dimension drawing of the shield clamp 70 mm

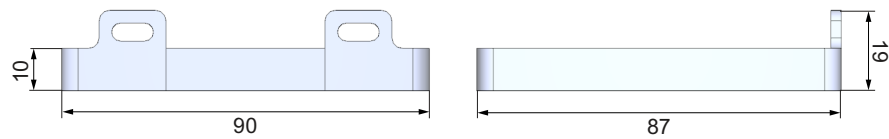


Figure A-3 Dimension drawing of the shield clamp 90 mm

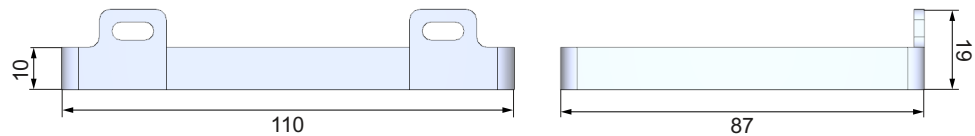


Figure A-4 Dimension drawing of the shield clamp 110 mm

Accessories/spare parts

Accessories for SIMATIC MICRO-DRIVE PDC drive controller

Table B-1 General accessories

Designation	Article number
Shield bracket set	
Shield bracket set SBS1-50, consisting of 1 x shield bracket 50 mm 3 x terminal clamps 1 x grounding strap with 2 x fixing screws - Compact Hardware Installation Instructions	6BK1638-0XA50-0AA0
Shield clamp set SBS1-70, consisting of 1 x shield clamp 70 mm 4 x terminal clamps 1 x grounding strap with 2 x fixing screws - Compact Hardware Installation Instructions	6BK1638-0XA70-0AA0
Shield clamp set SBS1-90, consisting of 1 x shield clamp 90 mm 5 x terminal clamps 1 x grounding strap with 2 x fixing screws - Compact Hardware Installation Instructions	6BK1638-0XA80-0AA0
Shield clamp set SBS1-110, consisting of 1 x shield clamp 110 mm 4 x terminal clamps 1 x grounding strap with 2 x fixing screws - Compact Hardware Installation Instructions	6BK1638-0XA10-0AA0
Bus cable connector	
Industrial Ethernet FastConnect RJ45 plug 180 degrees, 10 units	6GK1901-1BB10-2AB0
Industrial Ethernet FastConnect RJ45 plug 180 degrees, 10 units	6GK1901-1BB11-2AA0
Industrial Ethernet FastConnect RJ45 plug 90 degrees, 1 unit	6GK1901-1BB20-2AA0
Industrial Ethernet FastConnect RJ45 plug 90 degrees, 10 units	6GK1901-1BB20-2AB0

Table B-2 Miniature circuit breaker accessories

Description	Article number
Miniature circuit breaker for PDC100(F)	
Miniature circuit breaker 2P, 240 V AC, class C tripping characteristic, rated current 3A, UL 489, EN 60947-2 (Note: for 4L+ - and 4M feed line)	5SJ4203-7HG41
Miniature circuit breaker for PDC1000	
Miniature circuit breaker 2P, 240 V AC, class C tripping characteristic, rated current 25 A, UL 489, EN 60947-2 (Note: for 4L+ - and 4M feed line)	5SJ4225-7HG41
Miniature circuit breaker for PDC600(F)	
Miniature circuit breaker 2P, 240 V AC, class C tripping characteristic, rated current 3 A, UL 489, EN 60947-2 (Note: for 1L+ - and 1M feed line for PELV or for SELV supply of 1L+ and 4L+ with joint negative pole)	5SJ4203-7HG41
Miniature circuit breaker 2P, 240 V AC, class C tripping characteristic, rated current 25A, UL 489, EN 60947-2 (Note: for 4L+ - and 4M feed line)	5SJ4225-7HG41

Connecting cables, motors

The configuration tool for the SIMATIC MICRO-DRIVE drive system in the TIA Selection Tool and the STEP 7 HSP provide motor configuration data via a motor library.

You can order motors and gearboxes as well as connecting cables for the motor, encoder and holding brake via the Siemens Product Partner Program on the Internet (<https://new.siemens.com/global/en/company/topic-areas/partners/product-partners-industry.html>).

The plug-in cables on the SSI interface must be specified for the SSI encoder used. These SSI plug-in tables can be requested from the encoder manufacturers.

microSD memory card

You can use a commercially available microSD memory card with the PDC drive controller.

FAT file system:

- FAT32 with maximum 32 GB memory

Online catalog

You can find further article numbers for the SIMATIC MICRO-DRIVE drive system and the S7-1200/ S7-1500 automation systems on the Internet (<https://mall.industry.siemens.com>) in the online catalog and online ordering system.

Symbols

The following table contains an explanation of the symbols located on your SIMATIC device, its packaging or the accompanying documentation.

Symbol	Meaning
	General warning sign Caution/Notice You must read the product documentation. The product documentation contains information about the type of potential hazard and enables you to recognize risks and take countermeasures.
	Read the information contained in the product documentation.
	Ensure the device is only installed by an electrically skilled person.
 CABLE SPEC.	Note that connected mains lines must be designed according to the expected minimum and maximum ambient temperature.
 EMC	Note that the device must be constructed and connected in accordance with EMC regulations.
 INDOOR USE ONLY INDUSTRIAL USE ONLY	Be aware that the device is only approved for the industrial field and only for indoor use.
	Note that a housing is required for installing the device. The following are considered housings: • Standing control cabinet • Series control cabinet • Terminal box • Wall enclosure

Glossary

Absolute encoder

Absolute encoders output the position value as an absolute numerical value. Because this numerical value is unique over the resolution range of an absolute encoder, an initial reference point approach is not required like it is for incremental encoders. For absolute rotary encoders, a differentiation is made between those that can resolve only one revolution and then restart at 0 again (single-turn), and those that can resolve several revolutions (multi-turn).

Automation system

Programmable logic controller for the open-loop and closed-loop control of process chains in the process engineering industry and in manufacturing technology. The automation system consists of different components and integrated system functions according to the automation task.

Axis control panel

The axis control panel allows you to move the technology axis in manual mode, optimize the axis settings in the technology object and test the operation of the axis in your system.

Bus

Shared transmission path to which all devices in a fieldbus system are connected.

Code block

In SIMATIC S7, a code block is a block that contains a section of the STEP 7 user program. (in contrast to a data block, which contains only data)

Configuration

Systematic arrangement (setup) of the individual modules (HW Config).

CPU

The CPU uses the integrated system power supply to supply the electronics of the modules via the backplane bus. The CPU contains the operating system and executes the user program. The user program is located on the SIMATIC memory card and is processed in the work memory of the CPU. The PROFINET interfaces on the CPU allow simultaneous communication with PROFINET devices, PROFINET controllers, HMI devices, programming devices, other controllers and other systems.

Crimping

Procedure whereby two components joined together, e.g. wire end sleeve and cable, are connected with one another through plastic strain.

Data block

Data blocks (DBs) are data areas in the user program that contain user data. There are global data blocks, which can be accessed from all code blocks, and instance data blocks, which are assigned to a specific FB call.

Device names

Before an IO device can be addressed by an IO controller, it must have a device name.

In its delivery state, an IO device has no device name. An IO device can only be addressed by an IO controller - e.g., for transferring configuration data (including the IP address) during startup, or for user data exchange during cyclic operation - after it has been assigned a device name with the programming device/PC.

Diagnostics

Monitoring functions for the detection, localization, classification, display, and further evaluation of errors, faults, and alarms. They run automatically while the system is in operation. This increases the availability of systems by reducing commissioning times and downtimes.

Distributed I/O system

System with I/O modules that is configured on a distributed basis at a distance from the CPU controlling it.

Drive control panel

The drive control panel (= control panel of the PDC) is used for the control and monitoring of a drive during commissioning. With the control panel, you move the drive by specifying speed setpoints and the torque limitation.

Firmware update

Updating the firmware of modules (interface modules, I/O modules, etc.), for example after functional expansions, to the latest firmware version (update).

Following error

The following error is the difference between the position setpoint and the actual position value.

The time required to transfer the setpoint to the drive and the actual position value to the controller are taken into account in the calculation of the following error.

Function

A function (FC) is a code block with no static data. A function allows you to pass parameters in the user program. Functions are thus suited for programming frequently recurring complex functions, such as calculations.

Function block

A function block (FB) is a code block with static data. An FB allows you to pass parameters in the user program. Function blocks are thus suited for programming frequently recurring complex functions, such as closed-loop controls or operating mode selection.

GSD file

This generic station description file contains all the properties of a PROFINET or PROFIBUS device that are necessary for its configuration.

Hardware limit switch

Mechanical limit switch that limits the maximum permissible traversing range of the axis.

Homing

With homing, you establish the relationship between the position in the technology object and the mechanical position of the axis. The actual position value in the technology object is thereby assigned to a reference mark. This reference mark represents a known mechanical position.

I/O modules

All modules that can be operated with a CPU or an interface module.

Identification data

Information that is saved in modules, and that supports the user in reviewing the system configuration and locating hardware changes.

Incremental encoder

Incremental encoders supply a defined number of pulses per revolution and, optionally, a so-called zero pulse per revolution.

The relationship between the position of an axis and its mechanical position must be established for an incremental encoder by homing.

Instance data block

Each call of a function block in the STEP 7 user program is assigned a data block, which is automatically generated. Values of the input, output and in/out parameters, as well as local block data, are stored in the instance data block.

IP address

The IP address is made up of four decimal numbers with a range of values from 0 through 255. The decimal numbers are separated by a dot (e.g. 192.162.0.0).

The IP address consists of the following:

- Address of the network
- Address of the device (PROFINET interface of the IO controller/IO device)

Motion control instruction

You use motion control instructions to start motion control jobs (PLCopen) on technology objects in your user program and thus execute the desired functionality on the technology objects. You track the status of running jobs via the output parameters of the motion control instructions.

Organization block

Organization blocks (OBs) form the interface between the operating system of the CPU and the user program. The organization blocks determine the order in which the user program is executed.

PELV

Protective Extra Low Voltage = grounded extra low voltage with safe isolation

PROFIdrive

PROFIdrive is a profile specified by the PNO (PROFIBUS) for PROFIBUS DP and PROFINET IO for speed- and position-controlled drives.

Four communication types are defined in the PROFIdrive profile:

- Cyclic data exchange via a cyclic data channel
- Acyclic data exchange via an acyclic data channel
- Alarm channel
- Isochronous mode

PROFIdrive drive telegram

Telegram for communication according to PROFIdrive.

PROFINET

PROcess Field NETwork, open industrial Ethernet standard which further develops PROFIBUS and industrial Ethernet. A cross-manufacturer communication, automation, and engineering model defined by PROFIBUS International e.V. as an automation standard.

PROFINET IO

Communication concept for the realization of modular, distributed applications within the scope of PROFINET.

PROFINET IO controller

Device used to address connected I/O devices (e.g. distributed I/O systems). This means that: The IO controller exchanges input and output signals with assigned I/O devices. Often, the IO controller is the CPU on which the automation program runs.

PROFINET IO device

Distributed field device that can be assigned to one or more IO controllers (e.g. distributed I/O system, valve terminals, frequency converters, switches).

PROFIsafe

Safety-oriented bus profile of PROFIBUS DP and PROFINET IO for communication between the safety program and the F-I/O in an F-system. See IEC 61784-3-3:2010 or PROFIsafe – Profile for Safety Technology on PROFIBUS DP and PROFINET IO; Order No: 3.192 (V2.6.1).

Proximity switch

Position switch that is actuated with the moving part without any mechanical contact.

Reference potential

Potential from which the voltages of the circuits involved are observed and/or measured.

SELV

Safety Extra Low Voltage = Safety extra-low voltage

Software limit switch

A programmable position that limits the traversing range of an axis.

Technology alarm

If a technology object error occurs (e.g. a hardware limit switch is reached), a technology alarm is triggered and indicated.

The effects of a technology alarm on the technology object is specified by the alarm reaction (e.g. remove enable). The alarm reaction is specified by the system.

Technology data block

The technology data block represents the technology object and contains all configuration data, setpoints and actual values and status information of the technology object.

Technology object

A technology object supports you in the configuration and commissioning of a technological function.

The properties of real objects are represented by technology objects in the controller. Examples of real objects are controlled systems and drives.

The technology object contains all data of the real object required for its open-loop or closed-loop control, and it signals back status information.

TIA Portal

Totally Integrated Automation Portal

The TIA Portal is the key to the full performance capability of Totally Integrated Automation. The software optimizes operating, machine and process sequences.

User program

SIMATIC differentiates between the operating system of the CPU and user programs. The user program contains all instructions and declarations as well as data for the signal processing that enable a plant or process to be controlled. The user program is assigned to a programmable module (e.g. CPU) and can be structured in smaller units.

The user program comprises the standard user program and the safety program of the CPU.

Index

A

- Accuracy of the torque acquisition, 80
- Activating standard PROFIdrive alarms, 94
- Activating the diagnostics, 94
- Actual encoder position value, 97
- Actual value acquisition
 - Setting, 164
- Adjustable parameters, 109, 211
- Air flow, 36
- Alarms
 - Display, 267
- Alert
 - A64606, 277
 - F61000, 267
 - F61001, 268
 - F61009, 268
 - F61018, 268
 - F61019 (A), 268
 - F61052 (A), 269
 - F61053 (A), 269
 - F61054 (A), 270
 - F61055 (A), 271
 - F61056 (A), 272
 - F61057 (A), 273
 - F61058, 273
 - F61059 (A), 273
 - F61060 (A), 274
 - F61100, 274
 - F61101, 275
 - F61200 (A), 276
 - F64600, 276
 - F64605, 277
 - F64610, 278
 - F64630, 278
 - F64640, 279
 - F64700, 279
- Ambient condition
 - Climatic, 207
 - Mechanical, 206
 - Operating conditions, 206
- Approvals, 201
- Article numbers
 - Accessories, 283
 - Spare parts, 283
- Automatic overload limiting, 145
- Automatically apply measured values, 135
- Axis control panel technology object, 174

B

- Battery management system, 32
- Blockage monitoring, 146
- Braking resistor, 61
- Braking torque (dynamic), 124
- Breakaway torque, 124

C

- Cable shield, 47
- Changing
 - Password, 169
- Chatter monitoring, 72
- Climatic ambient conditions, 207
- Closing time, 124
- Coasting down, 137
- Commissioning, 101
 - Check before power-on, 119
 - Identification data, 92
 - Procedure, 120
- Communication
 - Actual encoder position value, 97
 - Drive and sensor assignment, 97
 - IRT, 97
 - Isochronous mode, 25, 97
- Configuring
 - Overview, 89
- Control panel
 - Drive control panel, 112
- Control panel of the PDC
 - Drive control panel, 112
- Controller tuning
 - Automatic, 129
 - Manual, 131
- Copying service data
 - With engineering tool, 185
- Cross-comparison, 69

D

- Date, 196
- Degree of protection IP20, 23, 209
- Degree of protection IP54, 23, 28, 35
- Delivery
 - Unpacking, 27
- Determining the connection properties, 133

Determining the load properties, 133
 Rotating measurement run, 133

Device replacement
 With engineering tool, 179
 Without drive project, 180
 Without engineering tool, 179
 Without exchangeable medium, 179
 Without parameter backup, 180

Diagnostics and dynamization, 72

Digital inputs
 Connecting, 54

Digital outputs
 Connecting, 54

Discrepancy monitoring, 72

Display parameters, 211

Download to device, 111, 169

Drive data set
 Drive components, 121
 Editing, 127
 from IQ encoder, 125
 Options, 124
 Preconfigured, 126
 User-defined, 127

Drive parameters
 Formatting the memory card, 187
 Offline/online comparison, 110
 Optimization, 132
 Saving, 109
 Synchronizing, 110

Dynamic torque reduction, 100, 150

E

EDS, (see Electronic data sheet)
Electromagnetic compatibility (EMC), 204
Electronic data sheet, 55
Electronic rating plate, 55
EMC (Electromagnetic compatibility), 204
 Disturbances, 205
Emergency off devices, 45
Excluding hazardous plant states, 45
Extended message acknowledgment, 73, 158
External braking resistor, 61
 Connecting, 61
 Pin assignment, 62
 Third-party manufacturer, 62

F

Factory settings
 Loading, 177
 Resetting to, 177
Failure probability, 87
Faults
 Acknowledging, 267
 DC motors, 46
 Display, 267
F-monitoring time, 163
F-monitoring time, 83
Format
 microSD memory card, 187
F-parameters
 F-monitoring time, 163
Functional characteristics
 SLS, 75
 SLT, 79
 SS1-t, 74
 SSM, 77
 STO, 71
Functional grounding, 50

G

Gearbox, 123
Grounding, 50
Guidelines
 Installation procedure, 38

H

Hall sensor
 Connecting, 56, 58
Hardware STO
 Chatter monitoring, 72
 Connecting, 60
 Diagnostics and dynamization, 72
 Discrepancy monitoring, 72
 Extended message acknowledgment, 72, 158
 Forced checking procedure, 73
High-energy single pulse, 205
Holding brake, 123
Holding torque, 124

I

I2t monitoring, 147

Identification data, 92
 Identification flashing, (see LED flash test)
 Incremental encoder
 Connecting, 56
 Installation, 35
 Air flow, 36
 Basics, 35
 Clearance, 36
 Cooling, 36
 Mounting rail, 38
 Overview, 38
 Insulation, 208
 Internal braking resistor, 61
 IQ encoder
 Connecting, 55
 IRT, 95
 Isochronous Real Time, 95

J

Jog mode
 Drive control panel, 114

L

LED flash test, 96, 192

M

Maintenance measures with engineering tool
 Copying service data, 185
 Creating a parameter backup, 183
 Loading the parameter backup, 184
 Maintenance measures without engineering tool
 Copying service data, 185
 Creating a parameter backup, 182
 Device replacement, 179
 Loading the parameter backup, 183
 Maximum DC link voltage, 144
 Mechanical environmental conditions, 206
 Memory card, (see microSD memory card)
 microSD memory card
 Copying service data, 185
 Device replacement, 179
 File system, 187
 Formatting, 187
 Safely removing, 188
 Miniature circuit breaker, 30, 284
 Minimum clearances, 36
 MOMRED, 100, 143, 150
 Motion monitoring, 19, 68, 157

Motor
 Connecting, 51
 Motor holding brake, 124
 Motor phases
 Pin assignment, 51
 Mounting
 Shield bracket set, 41
 Shield support, 42
 Mounting position, 36
 Mounting rail
 Installation, 38
 MTBF, 206

N

Network topologies, 90
 Note
 Shipping, 27
 Number of system starts, 196

O

OFF1, 140
 OFF1 (Switch off), 136
 OFF2 (Coast down), 137
 OFF3, 140, 142
 OFF3 (Quick stop), 73, 137
 Online diagnostics views, 107
 Online mode, 107
 Opening time, 124
 Operating time, 206
 Optimization, 132
 Optimizing the controller settings, 133
 Overload, 46

P

Password
 Changing, 169
 PDC
 Properties, 21
 Variants, 19
 PFH/PFD values, 87
 Pin assignment
 Digital inputs, 54
 Digital outputs, 54
 External braking resistor, 62
 Hall sensor, 56
 Incremental encoder, 56
 Motor phases, 51
 SSI encoder, 59

PLC

- Installation, 38
- Pollution degree, 209
- Precontrol of closed-loop controller, 129
- PROFIdrive application classes, 25
- PROFIdrive communication, 25
- PROFIsafe communication, 68
 - Setting, 161
- PROFIsafe telegram 30, 83, 98
- PROFIsafe telegram 31, 83, 98
- PROFIsafe telegrams, 82, 83, 98
- Protection class, 209
- Protection from external electrical effects, 45
- Protection of the power supply, 30, 60
- Pt monitoring, 148

Q

- Quick stop, 137

R

- Radio interference, 203
- Ramp generator
 - Properties, 141
- rated voltage, 210
- Real-time trace, 114
- Reference values, 138
- Removing
 - PDC, 41
- Residual risk, 66
- Restart, 188
- Restarting the PDC, 188
- Rotating measurement, 134
- Rotating measurement run, 134

S

- S7 connection, 94
- Safe state, 69
- Safety classes
 - Achievable, 23
- Safety control words, 84
- Safety functions
 - Conformity, 67
 - Function groups, 67
 - Grouping, 157
 - Motion monitoring, 68
 - PROFIsafe communication, 68
 - Stop functions, 68

Safety Integrated

- Actual value acquisition, 164
- Password, 167
- PROFIsafe communication, 161
- SLS, 159
- SLT, 160
- SS1, 158
- SSM, 160
- STO, 158
- Safety Integrated parameters
 - PROFIsafe communication, 157
- Safety Integrated password, 167
- Safety log book, 154, 166
- Safety password, 167
- Safety rules, 201
- Safety status words, 84
- Save RAM to ROM, 109, 135
- Scope of delivery, 27
- Shield bracket, 47
- Shield bracket set, 283
- Shield support
 - Mounting, 42
- Shielding
 - Shield bracket, 47
 - Shield bracket set, 283
 - Terminal clamp, 47
- Shipping
 - Note, 27
- Signal states, 191
- SIMATIC MICRO-DRIVE
 - Configuration, 17
- SLS
 - Horizontal conveyors, 69
 - Permitted drives, 76
 - Setting, 159
 - Spindle drive, 69
- SLT
 - Connection inductance, 80
 - Machine protective door, 69
 - Measuring device, 80
 - Phase displacement, 81
 - Saturation effects, 81
 - Setting, 160
 - Temperature effects, 81
- Spare parts, 283
- Specific application, 45
- Speed, 138
- Speed limiting, 139
- Speed ramp generator, 141
- Speed setting
 - Drive control panel, 114
- Speed threshold values for message, 140

SS1

- Example, 69
- Setting, 158

SSI encoder

- Connecting, 59

SSM

- Centrifuge, 69
- Setting, 160

Standard mounting rail, 38**Standards, 201**

- EN 60204, 68

STO

- Emergency Stop button, 68
- Setting, 158

STO hardwired, (see Hardware STO)**Stop functions, 19, 68, 157****STOP_SS1, 65, 74, 75, 160****STOP_STO, 65, 71, 75, 79, 160, 161****Storage, 27****Storage conditions, 27, 205****Supplementary torque, 135****Supply**

- 5 V rotary encoder, 31
- SSI encoder, 31

Supply voltage, 29**Surge, 205****Switch off, 136****System running time, 196****System structure, 69****T****TCP/IP services, 94****Technical specifications**

- Climatic ambient conditions, 207
- Electromagnetic compatibility (EMC), 204
- Mechanical environmental conditions, 206
- Standards and approvals, 201
- Transport and storage conditions, 205

Technology data block

- Basics, 171

Terminal clamp, 47**Test voltage, 208****Through-wiring, 30, 60****Time of day, 196****Toolbar**

- Save RAM to ROM, 109

Torque, 138**Torque limiting, 139****Torque ramp generator, 143****Trace, 114****Transport conditions, 205****U****Upload from device, 111, 169****Use**

- in industrial environments, 203
- in residential environments, 203

W**Wall mounting, 39****Wiring guidelines**

- Clearance for air flow and cooling, 36

Writable parameters, (see adjustable parameters)**X****X4050**

- Encoder interfaces, 56

X4060

- Digital inputs, 54
- Digital outputs, 54

X5060

- SSI encoder, 59

Z**Zero speed detection, 140**

