Operating Instructions (Edition 03/2006)

sinamics

Converter Chassis Units
SINAMICS G130
315 kW to 800 kW

SIEMENS

SIEMENS

SINAMICS G130

Converter Chassis Units

Operating Instructions
User Documentation

Safety Information	**1**
Device Overview	**2**
Mechanical Installation	**3**
Electrical Installation	**4**
Commissioning	**5**
Operation	**6**
Setpoint Channel and Closed-Loop Control	**7**
Output Terminals	**8**
Functions, Monitoring, and Protective Functions	**9**
Diagnosis / Faults and Alarms	**10**
Maintenance and Servicing	**11**
Technical Specifications	**12**
List of abbreviations	
Index	
Parameter macros	

Valid for

Converter type	*Control version*
SINAMICS G130	V2.4

Edition 03/06

For further information please visit us at:
http://www.ad.siemens.de

We have conscientiously checked the contents of this manual to ensure that they coincide with the hardware and software described. Since deviations cannot be precluded entirely, we cannot guarantee complete conformance. However, the data in this manual is reviewed regularly and any necessary corrections included in subsequent editions. We are thankful for any recommendations or suggestions.

We reserve the right to make technical changes.

Siemens AG

Preface

User documentation

WARNING

Before installing and commissioning the converter, make sure that you read all the safety notes and warnings carefully, including all the warning labels on the components. The warning labels must always be legible. Missing or damaged labels must be replaced.

Further information is available from:

Technical support

Tel: +49 (0) 180 50 50 222

Fax: +49 (0) 180 50 50 223

Internet: http://www.siemens.de/automation/support-request

Internet address

Information about SINAMICS can be found on the Internet at the following address:
http://www.siemens.com/sinamics

Contents

1	**Safety information**	**1-1**
1.1	Definitions and warning information	1-1
1.2	Safety and operating instructions	1-3
2	**Device overview**	**2-1**
2.1	Chapter content	2-1
2.2	Overview of the chassis units	2-2
2.3	Overview of the Power Modules	2-3
2.4	Applications, features, and design	2-4
2.5	Wiring principle	2-5
2.6	Type plate	2-6
3	**Mechanical installation**	**3-1**
3.1	Chapter content	3-1
3.2	Transportation and storage	3-2
3.3	Installation	3-4
3.3.1	Required tools	3-5
3.4	Power Module	3-6
3.4.1	Dimension drawings	3-7
3.5	Control Unit CU320	3-10
3.6	TM31 Terminal Module	3-12
3.7	SMC30 Sensor Module	3-13
4	**Electrical installation**	**4-1**
4.1	Chapter content	4-1
4.2	Preparatory Steps	4-2
4.3	Important safety precautions	4-3
4.4	Introduction to EMC	4-4
4.5	EMC-compliant installation	4-6
4.6	Connection overview	4-8
4.7	Power connections	4-11
4.7.1	Connection cross-sections and cable lengths	4-11
4.7.2	Connecting the motor and power cables	4-12
4.7.3	DCPS, DCNS – connection for a du/dt filter	4-13
4.7.4	Adjusting the fan voltage	4-13
4.7.5	Removing the connection bracket for the interference-suppression capacitor with operation from an ungrounded supply	4-14
4.8	External 24 V DC supply	4-15
4.9	DRIVE-CLiQ cabling diagram	4-16
4.10	Signal connections	4-17
4.10.1	Power Module	4-17
4.10.2	Control Unit CU320	4-19
4.11	Terminal Module TM31	4-27
4.12	SMC30 Sensor Module for detecting the actual motor speed	4-34
4.12.1	Description	4-34
4.12.2	Connection	4-37
4.12.3	Connection examples	4-39

5 Commissioning **5-1**
5.1 Chapter content 5-1
5.2 The STARTER commissioning tool 5-2
5.2.1 Installing STARTER 5-2
5.2.2 The STARTER user interface 5-3
5.3 Commissioning using STARTER 5-4
5.3.1 Creating your project 5-4
5.3.2 Configuring the drive unit 5-11
5.3.3 Starting the drive project 5-29
5.3.4 Connection via serial interface 5-31
5.4 The AOP30 operator panel (optional) 5-33
5.5 First commissioning 5-34
5.5.1 Initial ramp-up 5-34
5.5.2 Initial commissioning 5-36
5.6 Status after commissioning 5-42
5.7 Resetting parameters to the factory settings 5-43

6 Operation **6-1**
6.1 Chapter content 6-1
6.2 General information about command and setpoint sources 6-2
6.3 Basic information about the drive system 6-3
6.3.1 Parameters 6-3
6.3.1.1 Parameter types 6-3
6.3.1.2 Parameter categories 6-4
6.3.2 Drive objects 6-6
6.3.3 Data sets 6-8
6.3.4 BICO technology: interconnecting signals 6-15
6.4 Command sources 6-20
6.4.1 "Profidrive" default setting 6-20
6.4.2 "TM31 Terminals" default setting 6-22
6.4.3 "CU Terminals" default setting 6-24
6.4.4 "Profidrive+TM31" default setting 6-26
6.5 Setpoint sources 6-28
6.5.1 TM31 analog inputs 6-28
6.5.2 Motorized potentiometer 6-30
6.5.3 Fixed speed setpoints 6-31
6.6 PROFIBUS 6-32
6.6.1 PROFIBUS connection 6-32
6.6.2 Control via PROFIBUS 6-32
6.6.2.1 General information 6-32
6.6.2.2 Setting the PROFIBUS Ident Number 6-33
6.6.3 Telegrams and process data 6-33
6.6.4 Description of control words and setpoints 6-35
6.6.5 Description of status words and actual values 6-40

7 Setpoint channel and closed-loop control **7-1**
7.1 Chapter content 7-1
7.2 Setpoint channel 7-3
7.2.1 Setpoint addition 7-3
7.2.2 Direction of rotation changeover 7-4
7.2.3 Suppression speed and minimum speed 7-5
7.2.4 Speed limitation 7-6
7.2.5 Ramp-function generator 7-7
7.3 V/f control 7-9
7.3.1 Voltage boost 7-12

7.3.2 Slip compensation 7-15
7.4 Vector speed / torque control with / without encoder 7-16
7.4.1 Vector control without encoder 7-17
7.4.2 Vector Control with Encoder 7-19
7.4.3 Speed controller 7-20
7.4.3.1 Speed controller pre-control (integrated pre-control with balancing) 7-24
7.4.3.2 Reference model 7-27
7.4.3.3 Speed controller adaptation 7-28
7.4.3.4 Droop function 7-30
7.4.4 Closed-loop torque control 7-32
7.4.5 Torque limiting 7-34
7.4.6 Permanent-magnet synchronous motors 7-36

8 Output terminals 8-1

8.1 Chapter content 8-1
8.2 TM31 analog outputs 8-2
8.2.1 Lists of signals for the analog outputs 8-3
8.3 TM31 digital outputs 8-6

9 Functions, protective functions, and monitoring functions 9-1

9.1 Chapter content 9-1
9.2 Drive functions 9-3
9.2.1 Motor identification and automatic speed controller optimization 9-3
9.2.1.1 Standstill measurement 9-4
9.2.1.2 Rotating measurement and speed controller optimization 9-5
9.2.2 Vdc control 9-8
9.2.3 Automatic restart function 9-13
9.2.4 Flying restart function 9-14
9.2.4.1 Flying restart without encoder 9-15
9.2.4.2 Flying restart with encoder 9-16
9.2.4.3 Parameters 9-16
9.2.5 Motor changeover 9-17
9.2.5.1 Description 9-17
9.2.5.2 Example of changing over between two motors 9-17
9.2.5.3 Function diagram 9-19
9.2.5.4 Parameters 9-19
9.2.6 Friction characteristic 9-20
9.2.7 Increasing the output frequency 9-22
9.2.7.1 Description 9-22
9.2.7.2 Default pulse frequencies 9-22
9.2.7.3 Increasing the pulse frequency 9-23
9.2.7.4 Maximum output frequencies achieved by increasing the pulse frequency 9-24
9.2.7.5 Parameters 9-24
9.2.8 Runtime (operating hours counter) 9-25
9.2.9 Simulation operation 9-26
9.2.10 Reversing 9-27
9.2.11 Unit changeover 9-28
9.3 Extended functions 9-31
9.3.1 Technology controller 9-31
9.3.1.1 Description 9-31
9.3.1.2 Commissioning 9-32
9.3.1.3 Example: liquid level control 9-33
9.3.2 Bypass function 9-34
9.3.2.1 Bypass with synchronizer with degree of overlapping (p1260 = 1) 9-35
9.3.2.2 Bypass with synchronizer without degree of overlapping (p1260 = 2) 9-38

9.3.2.3	Bypass without synchronizer (p1260 = 3)	9-39
9.3.2.4	Function diagram	9-42
9.3.2.5	Parameter	9-42
9.3.3	Extended braking control	9-43
9.3.3.1	Description	9-43
9.3.3.2	Commissioning	9-43
9.3.3.3	Examples	9-43
9.3.4	Extended monitoring functions	9-45
9.3.4.1	Description	9-45
9.3.4.2	Commissioning	9-46
9.4	Monitoring and protection functions	9-47
9.4.1	Protecting power components: general	9-47
9.4.2	Thermal monitoring and overload responses	9-48
9.4.3	Block protection	9-50
9.4.4	Stall protection (vector control only)	9-51
9.4.5	Thermal motor protection	9-52
10 Diagnosis / faults and alarms		**10-1**
10.1	Chapter content	10-1
10.2	Diagnosis	10-2
10.2.1	Diagnosis using LEDs	10-2
10.2.2	Diagnosis via parameters	10-6
10.2.3	Indicating and rectifying faults	10-10
10.3	Service and support	10-11
11 Maintenance and servicing		**11-1**
11.1	Chapter content	11-1
11.2	Maintenance	11-2
11.2.1	Cleaning	11-2
11.3	Servicing	11-3
11.3.1	Installation device	11-4
11.4	Replacing components	11-5
11.4.1	Replacing the power block (type GX)	11-6
11.4.2	Replacing the power block (type HX)	11-8
11.4.3	Replacing the power block (type JX)	11-12
11.4.4	Replacing the Control Interface Board (type GX)	11-16
11.4.5	Replacing the Control Interface Board (type HX)	11-18
11.4.6	Replacing the Control Interface Board (type JX)	11-20
11.4.7	Replacing the fan (type GX)	11-22
11.4.8	Replacing the fan (type HX)	11-24
11.4.9	Replacing the fan (type JX)	11-28
11.5	Reforming the DC link capacitors	11-32
11.6	Messages after replacing DRIVE-CLiQ components	11-33
11.7	Upgrading the chassis unit firmware	11-33
12 Technical specifications		**12-1**
12.1	Chapter content	12-1
12.2	General data	12-2
12.2.1	Derating data	12-3
12.2.2	Overload capacity	12-7
12.3	Technical data	12-8
12.3.1	Power Module	12-9
12.3.2	Control Unit CU320	12-15
12.3.3	TM31 Terminal Module	12-16
12.3.4	SMC30 Sensor Module	12-17

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Safety information

1

1.1 Definitions and warning information

Qualified personnel

For the purpose of this documentation and the product warning labels, a “qualified person” is someone who is familiar with the installation, mounting, start-up, operation and maintenance of the product. He or she must have the following qualifications:

- Trained or authorized to energize, de-energize, ground, and tag circuits and equipment in accordance with established safety procedures.
- Trained in the proper care and use of protective equipment in accordance with established safety procedures.
- First aid training.

DANGER

This symbol indicates that death, severe personal injury, or substantial property damage **will** result if proper precautions are not taken.

WARNING

This symbol indicates that death, severe personal injury, or substantial property damage **could** result if proper precautions are not taken.

CAUTION

This symbol indicates that minor personal injury or property damage **could** result if proper precautions are not taken.

CAUTION

"Caution" without a warning triangle indicates that material damage can result if proper precautions are not taken.

IMPORTANT

This indicates that an unwanted result or situation could result if the appropriate advice is not taken into account.

NOTE

This symbol always appears in this documentation where further, explanatory information is provided.

WARNING

Hazardous voltages are present in this electrical equipment during operation.
Non-observance of the warnings can result in severe personal injury or property damage.
Only qualified personnel should work on or around the equipment.
This personnel must be thoroughly familiar with all warning and maintenance procedures described in this documentation.
The successful and safe operation of this device is dependent on correct transport, proper storage and installation, as well as careful operation and maintenance.
National safety guidelines must be observed.

Certification

The following certificates can be found under "Safety and Operating Instructions" on the documentation CD:

- EU declaration of conformity
- Certificate of compliance with order
- EU manufacturer's declaration

1.2 Safety and operating instructions

DANGER

This equipment is used in industrial high-voltage installations. During operation, this equipment contains rotating and live, bare parts. For this reason, they could cause severe injury or significant material damage if the required covers are removed, if they are used or operated incorrectly, or have not been properly maintained.
When the machines are used in non-industrial areas, the installation location must be protected against unauthorized access (protective fencing, appropriate signs).

Prerequisites

Those responsible for protecting the plant must ensure the following:

- The basic planning work for the plant and the transport, assembly, installation, commissioning, maintenance, and repair work is carried out by qualified personnel and/or checked by experts responsible.
- The operating manual and machine documentation are always available.
- The technical data and specifications regarding the applicable installation, connection, environmental, and operating conditions are always observed.
- The plant-specific assembly and safety guidelines are observed and personal protection equipment is used.
- Unqualified personnel are forbidden from using these machines and working near them.

This operating manual is intended for qualified personnel and only contains information and notes relating to the intended purpose of the machines.

The operating manual and machine documentation are written in different languages as specified in the delivery contracts.

NOTE

The services and support provided by the SIEMENS service centers are recommended for planning, installation, commissioning, and servicing work.

Electrostatic sensitive devices (ESDs)

CAUTION

The board contains components that can be destroyed by electrostatic discharge. These components can be easily destroyed if not handled properly. If you do have to use electronic boards, however, please observe the following:

- You should only touch electronic boards if absolutely necessary.
- When you touch boards, however, your body must be electrically discharged beforehand.
- Boards must not come into contact with highly insulating materials (such as plastic parts, insulated desktops, articles of clothing manufactured from man-made fibers).
- Boards must only be placed on conductive surfaces.
- Boards and components should only be stored and transported in conductive packaging (such as metalized plastic boxes or metal containers).
- If the packaging material is not conductive, the boards must be wrapped with a conductive packaging material (such as conductive foam rubber or household aluminum foil).

The necessary ESD protective measures are clearly illustrated in the following diagram:

- a = conductive floor surface
- b = ESD table
- c = ESD shoes
- d = ESD overall
- e = ESD chain
- f = cabinet ground connection
- g = contact with conductive flooring

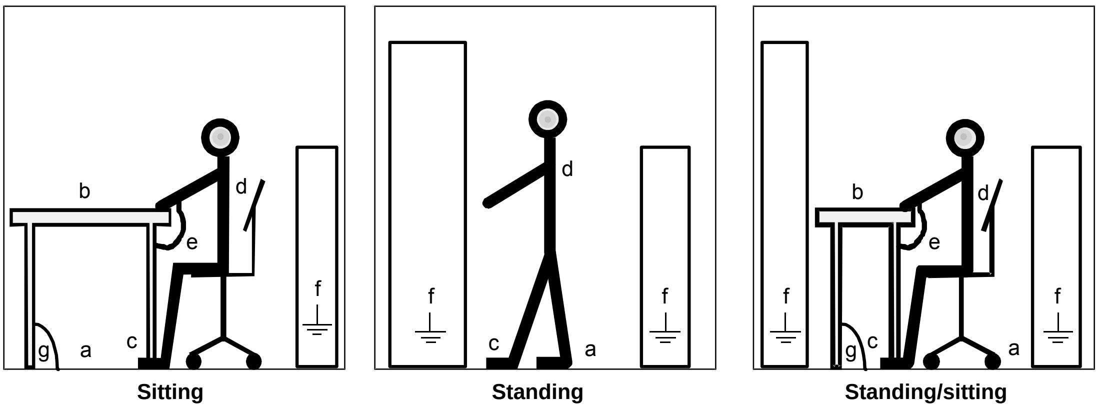

Fig. 1-1 ESD protective measures

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Device overview 2

2.1 Chapter content

This chapter provides information on the following:

- Introduction to the chassis units
- The main components and features of the chassis units
- The chassis unit wiring
- Explanation of the type plate

2.2 Overview of the chassis units

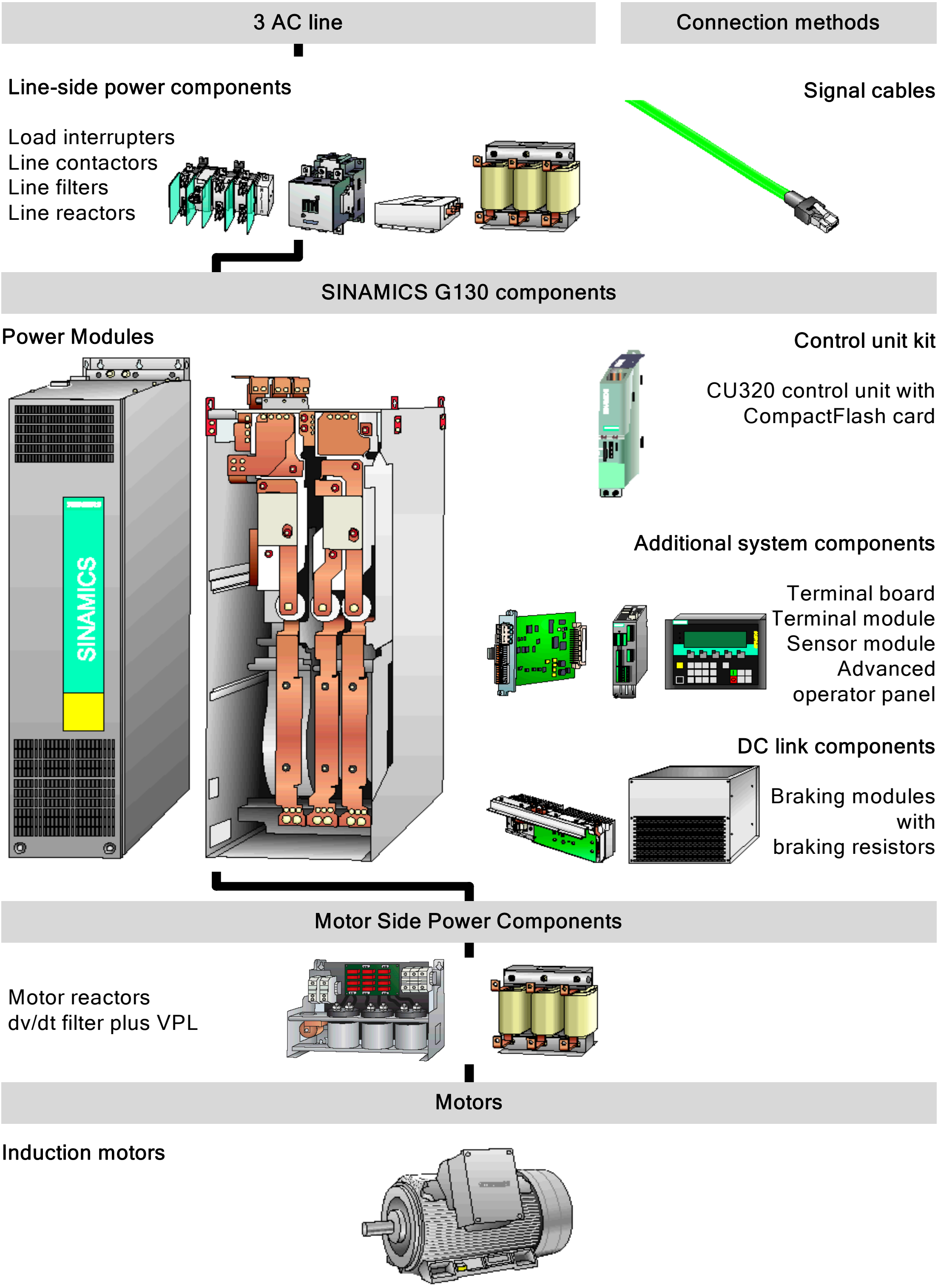


Fig. 2-1 Overview of the chassis units

2.3 Overview of the Power Modules

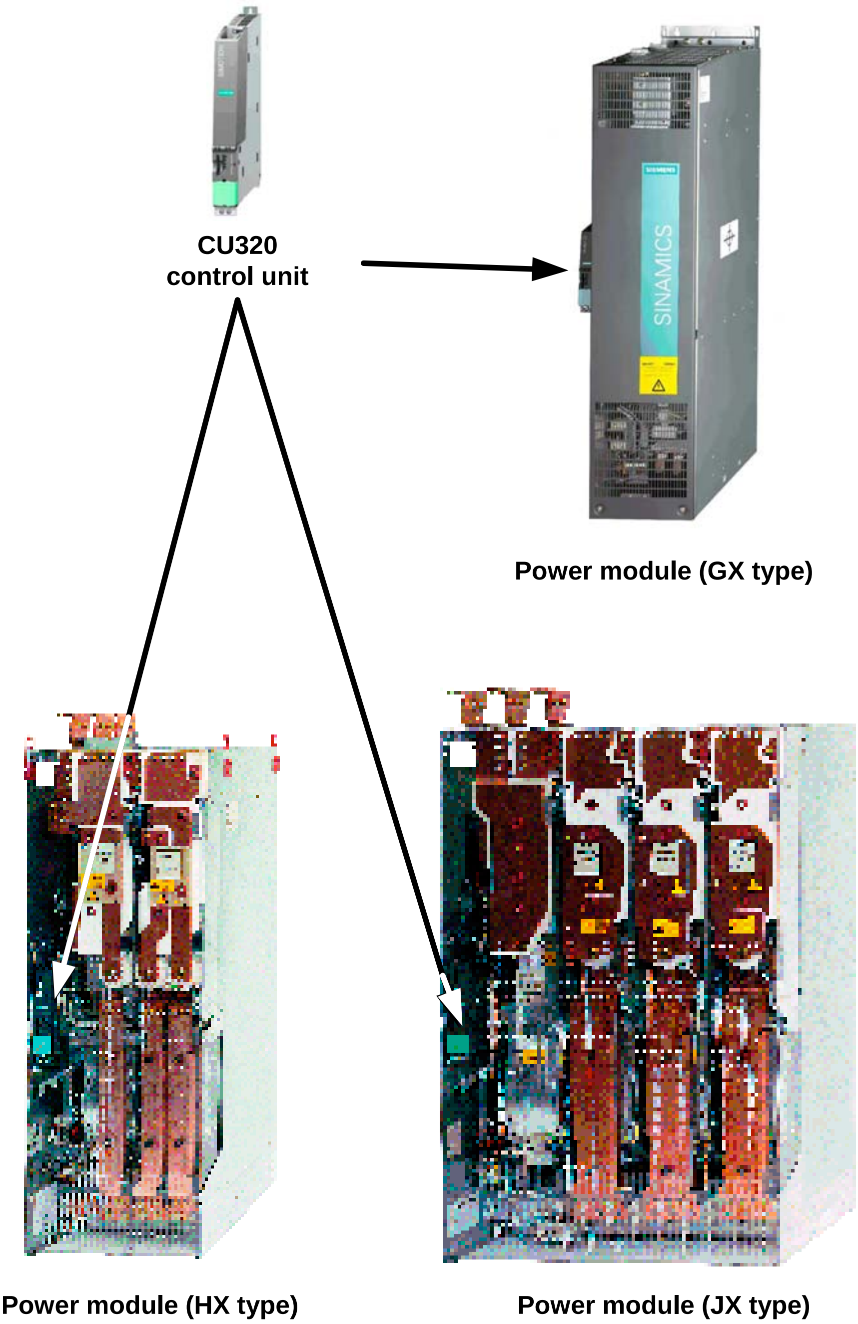


Fig. 2-2 Overview of the Power Modules

2.4 Applications, features, and design

Applications

SINAMICS G130 chassis units are specially designed to meet the requirements of variable-speed drives with a quadratic and constant load characteristic, medium performance requirements, and no regenerative feedback.

As a result, SINAMICS G130 chassis units represent a cost-effective drive solution for all types of industrial applications that involve moving, conveying, pumping, compressing, or extracting solids, liquids, or gasses.

Features

From configuration to operation, SINAMICS G130 chassis units are easy to use and offer the following benefits:

- Compact, modular, and service-friendly design
- Straightforward planning and design thanks to the Sizer and Starter tools
- Ready to connect to facilitate the installation process.
- Quick and easy commissioning thanks to practical menu guidance and integrated optimization routines.
- SINAMICS G130 chassis units are an integral part of Totally Integrated Automation (TIA). The TIA concept offers an optimized range of products for automation and drive technology. This concept is characterized by planning / design, communication, and data management procedures that are consistent throughout the product range. SINAMICS is totally integrated in the TIA concept.
  Separate S7/PCS7 blocks and faceplates for WinCC are available.
- A user-friendly graphical operator panel with measured values, messages, and a quasi-analog display for measured values is also available as an option.
- Integration in SIMATIC H systems is possible via a Y link.

Quality

SINAMICS G130 chassis units are manufactured to meet high standards of quality and exacting demands.

This results in a high level of reliability, availability, and functionality for our products.

The development, design, and manufacturing processes, as well as order processing and the logistics supply center have been independently certified to DIN ISO 9001.

Service

Our worldwide sales and service network offers our customers individual consultations, provides support with planning and design, and offers a range of training courses.

For detailed contact information and the current link to our Internet pages, see 10.3.

2.5 Wiring principle

Wiring principle for SINAMICS G130

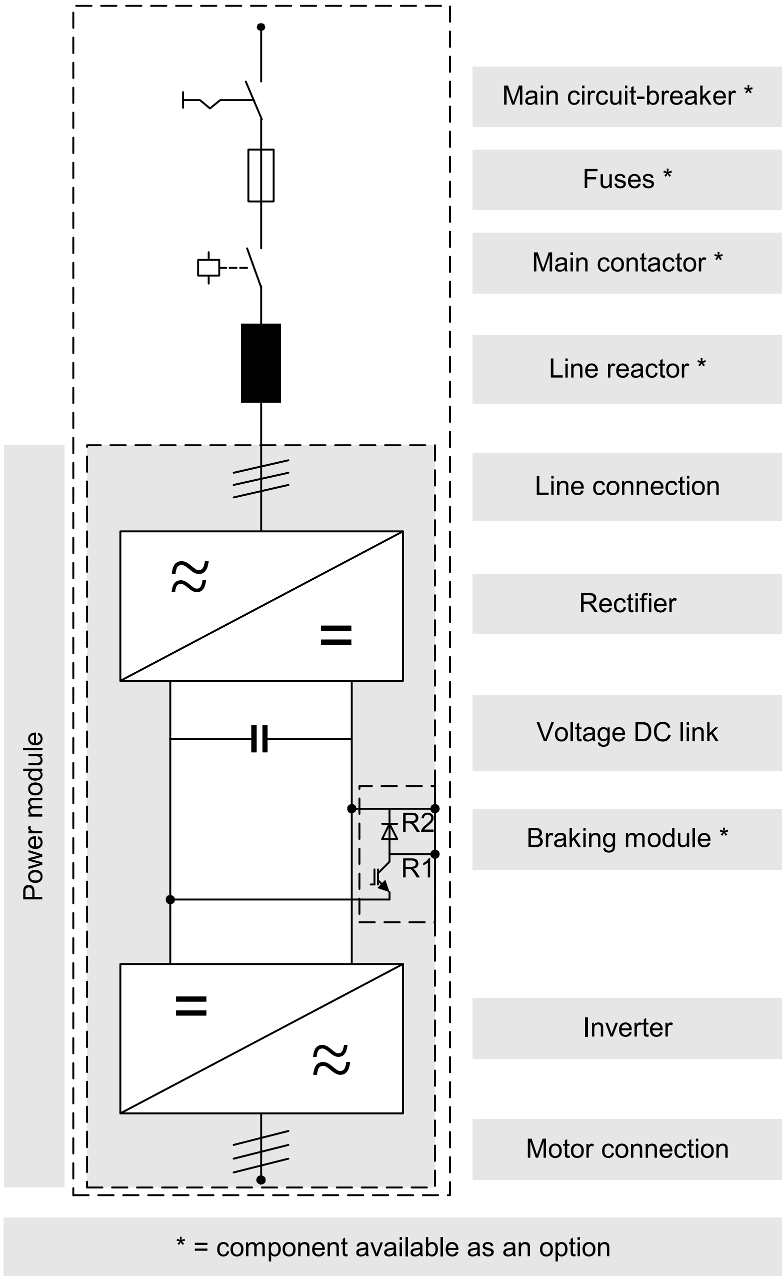


Fig. 2-3 Wiring principle for SINAMICS G130

2.6 Type plate

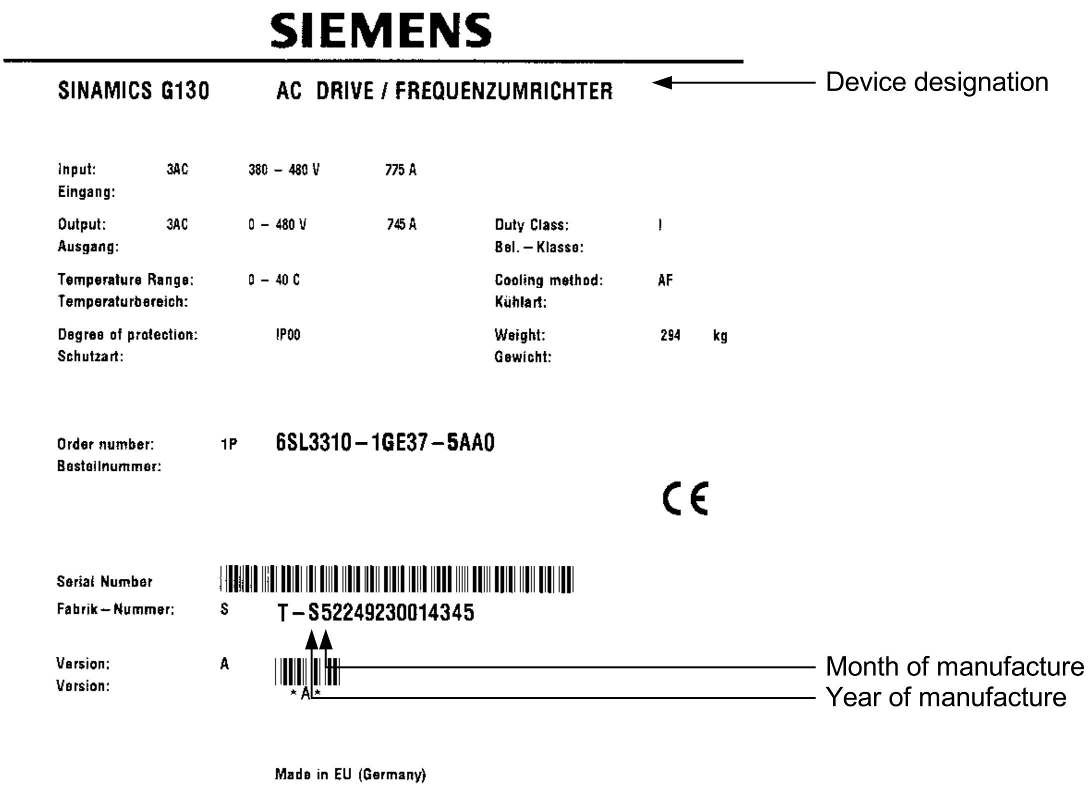


Fig. 2-4 Type plate for SINAMICS G130 chassis units

Date of manufacture

The date of manufacture can be ascertained as follows:

Table 2-1 Year and month of manufacture

Letter / number	Year of manufacture		Letter / number	Month of manufacture
T	2005		1 to 9	January to September
U	2006		O	October
V	2007		N	November
W	2008		D	December

Type plate data (from type plate on previous page)

Table 2-2 Type plate data

Specification	value	Explanation
Input	3AC 380 – 480 V 775 A	Three-phase connection Rated input voltage Rated input current
Output	3AC 0 – 480 V 745 A	Three-phase connection Rated output voltage Rated output current
Temperature range	0 -40 °C	Ambient temperature range within which the chassis unit can operate under 100% load
Degree of protection	IP20 IP00	Degree of protection
Duty class	I	I: Duty class I to EN 60146-1-1 = 100% (continuously) (the chassis unit can operate continuously under 100% load with the specified current values)
Cooling method	AF	A: coolant: air F: circulation method: forced cooling, drive unit (fan) in the device
Weight		Weight

■

Mechanical installation 3

3.1 Chapter content

This chapter provides information on the following:

- The conditions for installing the chassis units and optional components.
- The preparations for installing the chassis units and optional components.

3.2 Transportation and storage

Transportation

WARNING

- The devices are heavy. Their center of gravity is displaced, and they can be top heavy.
- Suitable hoisting gear operated by trained personnel is essential due to the weight of the devices.
- The devices must only be transported in the upright position indicated. The devices must not be transported upside down or horizontally.
- Serious injury or even death and substantial material damage can occur if the devices are not lifted or transported properly.

NOTES regarding transportation

- The devices are packaged by the manufacturers in accordance with the climatic conditions and stress encountered during transit and in the recipient country.
- The notes on the packaging for transportation, storage, and proper handling must be observed.
- The devices must be carried on a wooden palette when transported with fork-lift trucks.
- When the devices are unpacked, they can be transported using the transport eyebolts on the device. The load must be distributed evenly. Chains attached to the transport eyebolts must only be loaded vertically from above. Heavy blows or impacts must be avoided during transit and when the devices are being set down, for example.
- Permissible ambient temperatures:
  Ventilation: -25°C to +70°C, class 2K3 to IEC 60 721-3-2
  Up to -40°C for max. 24 hours

NOTES regarding built-in system-side components

If built-in system-side components are to be installed on the devices, you must take into account the following points:

- The degree of protection must not be reduced as a result.
- The electromagnetic compatibility of the device must not be adversely affected.

NOTES regarding damage in transit

- Carry out a thorough visual inspection of the device before accepting the delivery from the transportation company.
- Ensure that you have received all the items specified on the delivery note.
- Notify the transportation company immediately of any missing components or damage.
- If you identify any hidden deficiencies or damage, contact the transportation company immediately and ask them to examine the device.
- If you fail to contact them immediately, you may lose your right to claim compensation for the deficiencies and damage.
- If necessary, you can request the support of your local Siemens branch.

WARNING

Damage in transit indicates that the device was subject to unreasonable stress. The electrical safety can no longer be ensured. It must not be connected until a thorough high-voltage test has been carried out.

Death, serious injury, or substantial material damage can result if these factors are not taken into account.

Storage

The devices must be stored in clean, dry rooms. Permissible temperatures: between –25°C and +70°C. Temperature variations greater than 20 K per hour are not permitted.

If the device is stored for a prolonged period once it has been unpacked, cover it or take other appropriate measures to ensure that it does not become dirty and that it is protected against environmental influences. If such measures are not taken, the guarantee becomes invalid in the event of a claim for damages.

WARNING

The storage period should not exceed two years. If the device is stored for more than two years, the DC link capacitors of the devices must be reformed during commissioning.

The reforming procedure is described in "Maintenance and Servicing”.

3.3 Installation

WARNING

To ensure that the chassis units operate safely and reliably, they must be properly installed and put into operation by qualified personnel, taking into account the warning messages provided in this operating manual.

In particular, both the general and national installation and safety guidelines for high-voltage installations (e.g. VDE – the Union of German Technical Engineers) and the guidelines relating to the professional use of tools and the use of personal protective equipment must be observed.

Death, serious injury, or substantial material damage can result if these factors are not taken into account.

On-site requirements

The chassis units are suitable for installation in general operating areas (DIN VDE 0558 /Edition 7.87, Part 1 / Section 5.4.3.2.4).
The standard specifies the following:
When power conversion units are installed in general operating areas, live parts must be protected in such a way that they cannot be touched either directly or indirectly.
The operating areas must be dry and free of dust. The air supplied must not contain any electrically conductive gas, vapors, or dust, which could impair the function of the devices. It may be necessary to filter the air supplied to the installation room.

The ambient conditions for the units in the operating rooms must not exceed the values of code F in accordance with EN 60146. At temperatures > 40°C (104°F) and altitudes > 2000 m, the devices must be derated.

Type GX chassis units comply with degree of protection IP20; type HX and JX chassis units comply with degree of protection IP00 to EN 60529.

The cabinet units are installed in accordance with the dimension drawings supplied. The clearance between the top of the devices and the ceiling is also specified on the dimension drawings.

The cooling air for the power section is drawn from the lower part of the device. The warmed air is expelled through the heat sink. When installing the device in cabinet units, you must ensure that suitable barriers are in place to ensure that the warmed air is not drawn back into the suction area of the heat sink.

According to EN 61800-3, the chassis unit is not suitable for use in low-voltage public networks that supply residential buildings. High-frequency interference may occur if they are used in this type of network.

Unpacking the cabinet units

Check the delivery against the delivery note to ensure that all the items have been delivered. Check that the devices are intact. The packaging material must be discarded in accordance with the applicable country-specific guidelines and rules.

3.3.1 Required tools

To install the connections, you will require:

- Spanner or socket spanner (w/f 10)
- Spanner or socket spanner (w/f 13)
- Spanner or socket spanner (w/f 16/17)
- Spanner or socket spanner (w/f 18/19)
- Hexagon-socket spanner (size 8)
- Torque spanner, max. 50 Nm
- Screwdriver, size 2
- Screwdriver Torx T20
- Screwdriver Torx T30

3.4 Power Module

Description

The Power Module is the power section for an AC-AC converter. Line or motor-side components can be added to create a converter system. If required (e.g. for braking operation), a Braking Module can also be installed in the DC link of the converter. A mounting location in the Power Module is provided for this purpose.

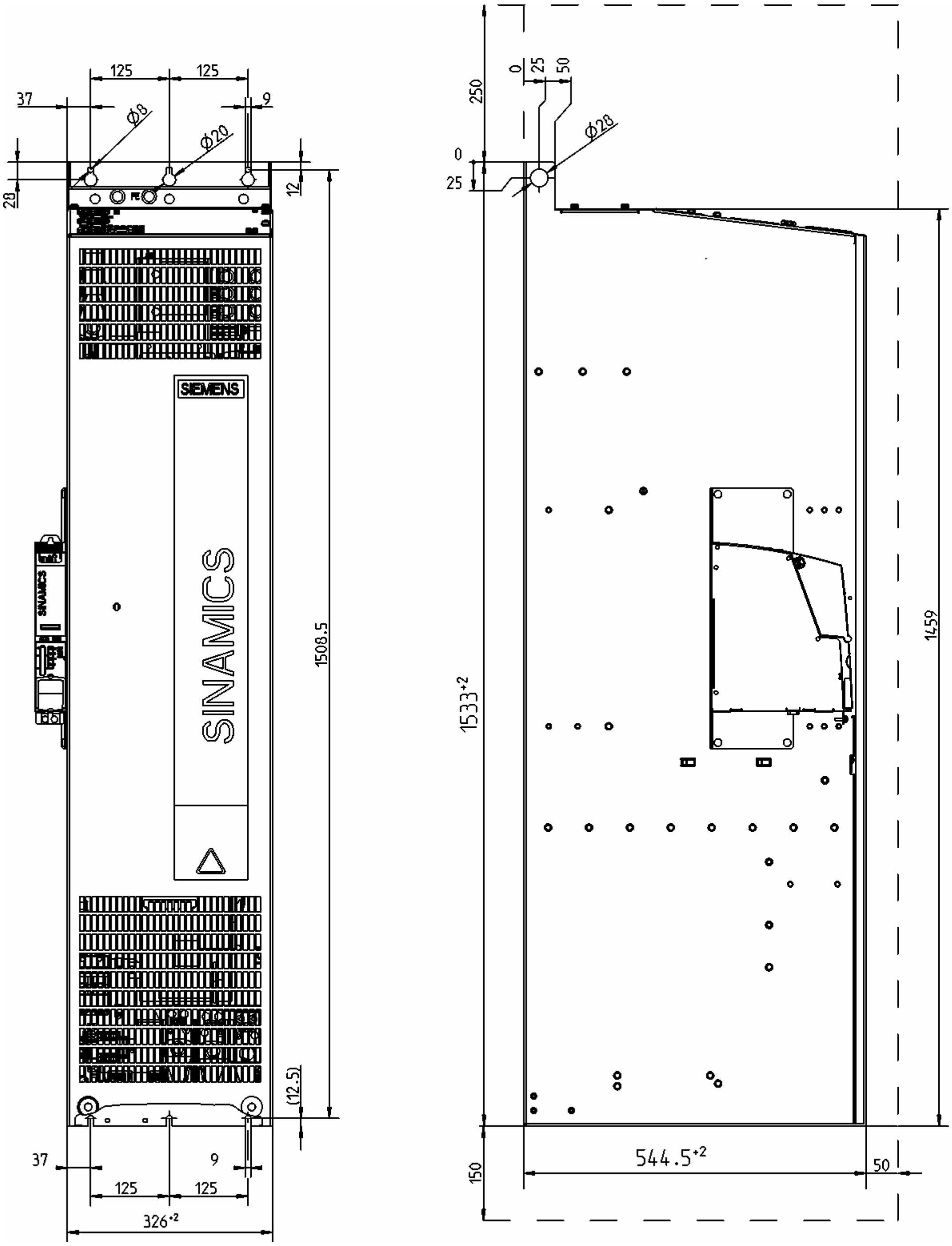
The Power Module creates an output voltage with variable amplitude and frequency from a supply voltage with constant amplitude and frequency.

IMPORTANT

The clearances above, below, and in front of the Power Module, which are specified in the dimension drawings, must be observed.

3.4.1 Dimension drawings

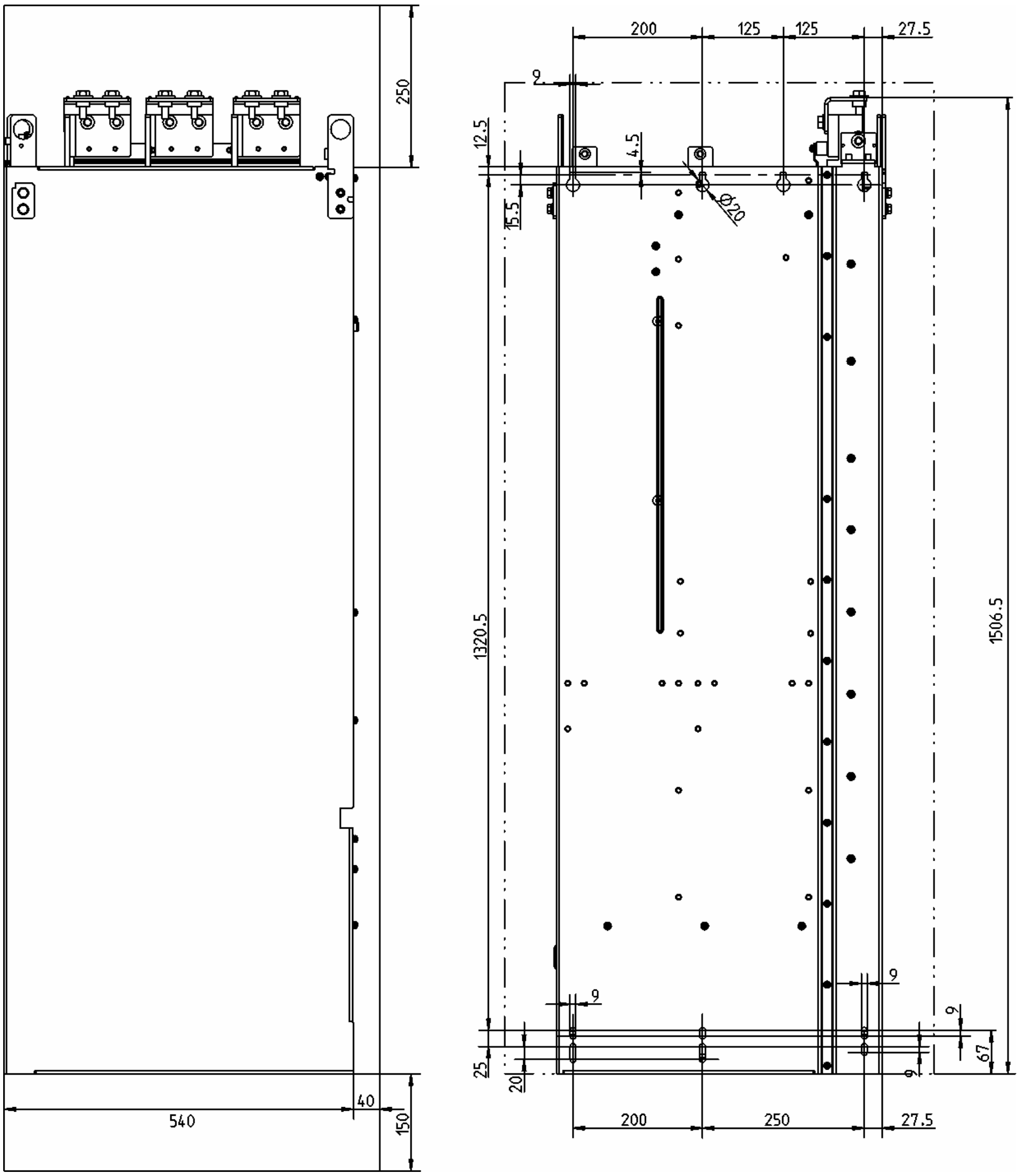
Dimension drawing: GX type



Front view Side view

Fig. 3-1 Dimension drawing: GX type

Dimension drawing: HX type



Side view Rear view

Fig. 3-2 Dimension drawing: HX type

Dimension drawing: JX type

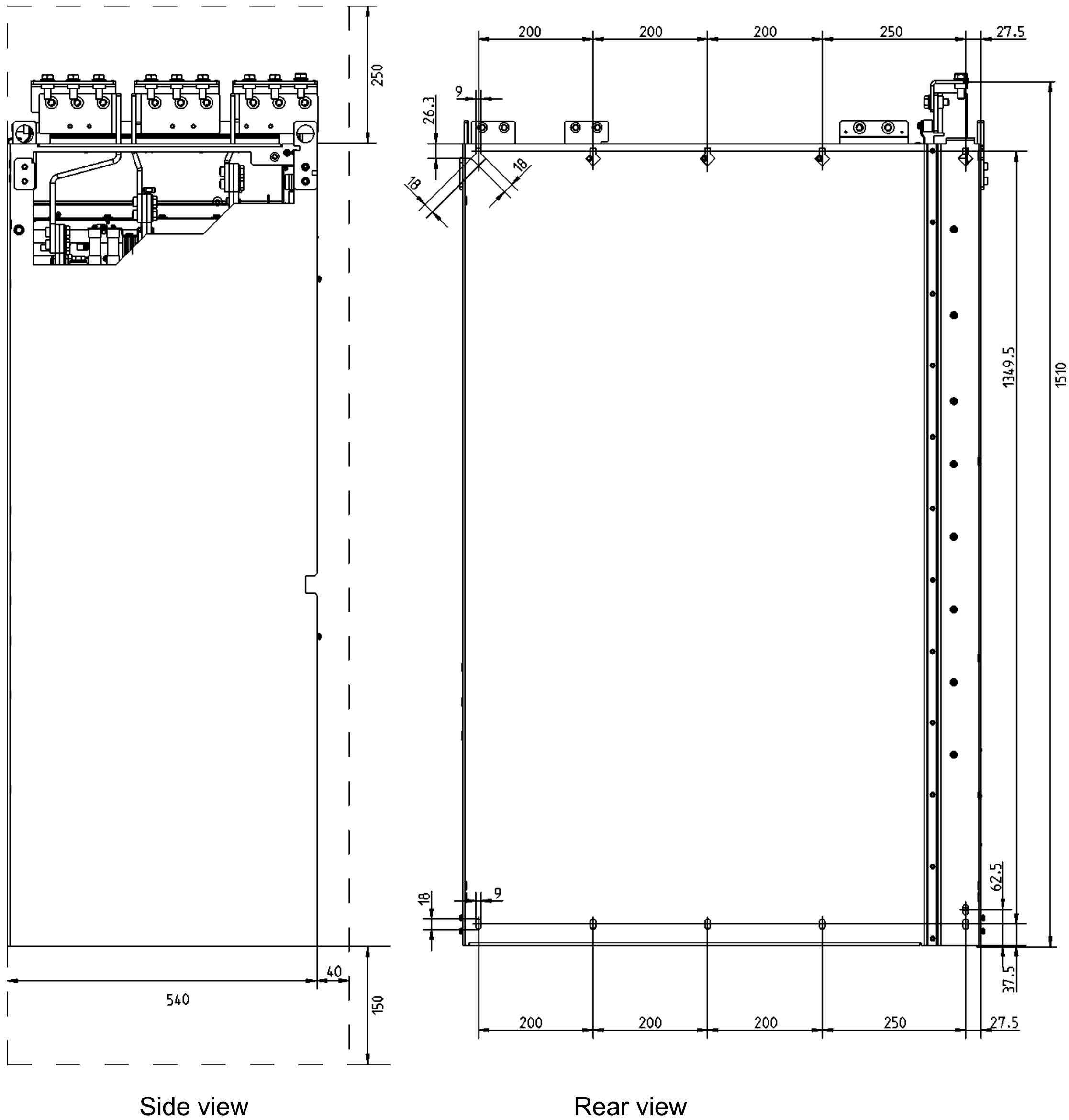


Fig. 3-3 Dimension drawing: JX type

WARNING

The Power Modules can be lifted up using the lifting eyebolts attached. A lifting harness with a vertical rope or chain must, however, be used. The device must not be lifted at an angle because this can damage the housing or displace the connections. Rope spreaders may have to be used.

WARNING

For Power Modules of type HX and JX, the hoists must be removed once the devices have been installed.

3.5 Control Unit CU320

Description

The CU320 is the central Control Unit in which the closed-loop and open-loop functions are implemented.

IMPORTANT

The 80 mm clearances above and below the Control Unit must be observed. If these clearances are not observed, this can result in a thermal overload of the Control Unit.

Dimension drawing

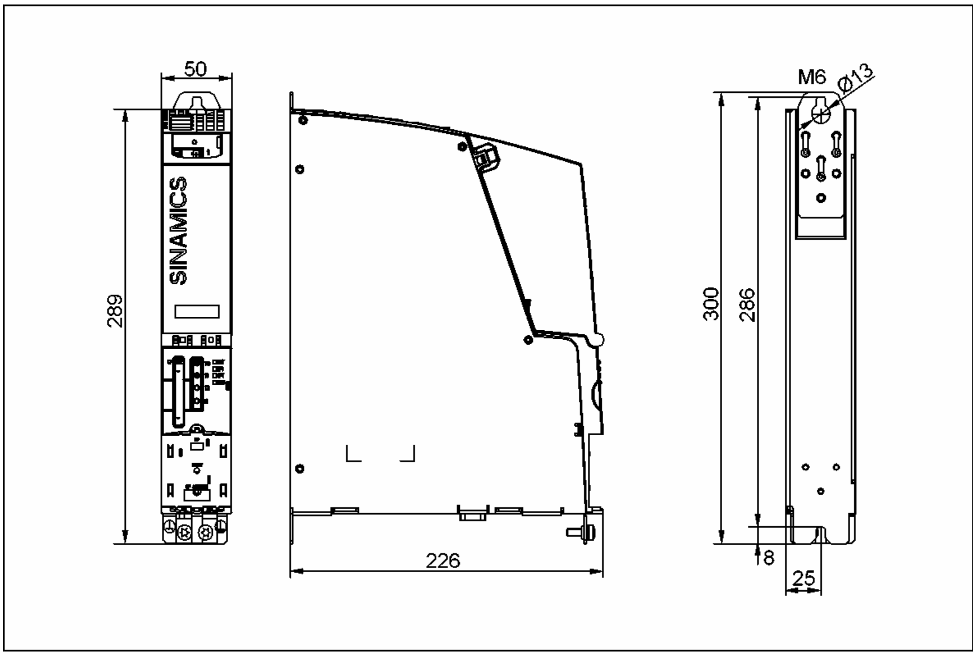


Fig. 3-4 Dimension drawing: CU320

NOTE

- With type GX, the CU320 is installed to the left of the Power Module. The required connection elements are supplied with the Power Module.
- With types HX and JX, the CU320 is installed in the Power Module.

CU320: CompactFlash card

The CompactFlash card contains the control software and parameters.

NOTE

The CompactFlash card may only be inserted and removed when the Control Unit is disconnected from the power supply.

If it is inserted and removed when the power supply is connected, this can damage the CompactFlash card and/or result in data being lost.

3.6 TM31 Terminal Module

Description

The TM31 Terminal Module is a terminal expansion board. It can be used to increase the number of digital inputs/outputs. Analog inputs and outputs are also available on the TM31.

IMPORTANT

The 80 mm clearances above and below the Terminal Module must be observed. If these clearances are not observed, this can result in a thermal overload of the Terminal Module.

Dimension drawing

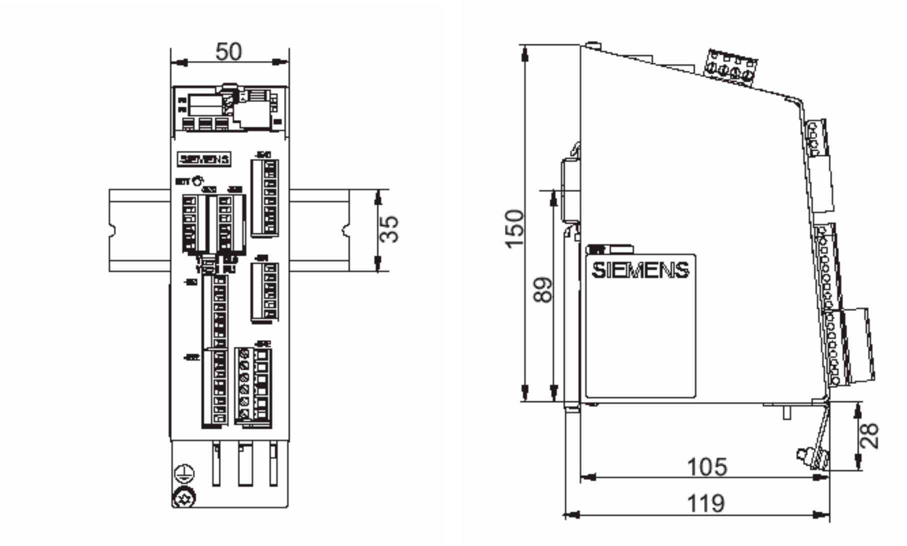


Fig. 3-5 Dimension drawing: TM31 Terminal Module

NOTE

The TM31 is installed near the Power Module on a mounting rail, which must be provided by the customer.

3.7 SMC30 Sensor Module

Description

The SMC30 Sensor Module is a module for evaluating encoder signals. TTL/HTL encoders (with or without open-circuit monitoring) can be connected to the SMC30. The motor temperature can also be recorded by means of thermistor KTY84-130.

IMPORTANT

The 80 mm clearances above and below the SMC30 Sensor Module must be observed. If these clearances are not observed, this can result in a thermal overload of the Sensor Module.

Dimension drawing

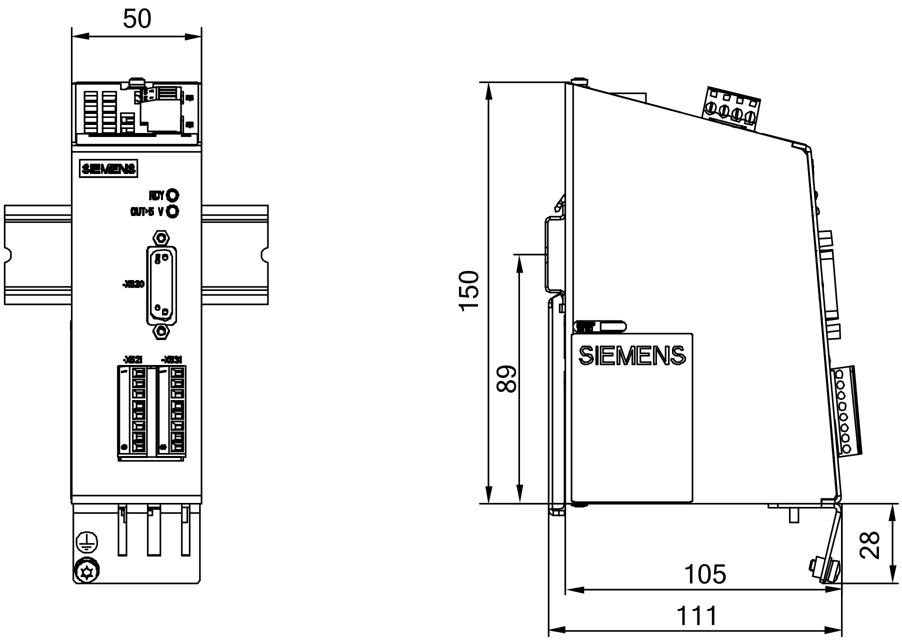


Fig. 3-6 Dimension drawing: SMC30 Sensor Module

NOTE

The SMC30 is installed near the Power Module on a mounting rail, which must be provided by the customer.

■

Electrical installation 4

4.1 Chapter content

This chapter provides information on the following:

- Establishing the electrical connections for the Power Module, the CU320 Control Unit, and the optional TM31 Terminal Module and SMC30 Sensor Module.
- Adjusting the fan voltage and the internal power supply to local conditions (supply voltage)
- The interfaces for the CU320 Control Unit, TM31 Terminal Module, and SMC30 Sensor Module.

4.2 Preparatory Steps

Required tools

To install the connections, you will require:

- Spanner or socket spanner (w/f 10)
- Spanner or socket spanner (w/f 13)
- Spanner or socket spanner (w/f 16/17)
- Spanner or socket spanner (w/f 18/19)
- Hexagon-socket spanner (size 8)
- Torque spanner, max. 50 Nm
- Screwdriver, size 2
- Screwdriver Torx T20
- Screwdriver Torx T30

4.3 Important safety precautions

WARNING

The chassis units are operated with high voltages.
All connection procedures must be carried out with the cabinet de-energized.
All work on the units must be carried out by trained personnel only.
Death, serious injury, or substantial material damage can result if these warnings are not taken into account.

Work on an open device must be carried out with extreme caution because external supply voltages may be present. The power and control terminals may be live even when the motor is not running.
Dangerously high voltage levels are still present in the cabinet up to five minutes after it has been disconnected due to the DC link capacitors. For this reason, the cabinet should not be opened until after a reasonable period of time has elapsed.

Reforming the DC link capacitors:
The storage period should not exceed two years. If the device is stored for more than two years, the DC link capacitors of the devices must be reformed during commissioning.
The reforming procedure is described in "Maintenance and Servicing”.

The operator is responsible for ensuring that the Power Module and other components are installed and connected in accordance with the recognized technical rules in the country of installation and applicable regional guidelines. Special attention should be paid to cable dimensioning, fuses, grounding, shutdown, disconnection, and overcurrent protection.

If an item of protective gear trips in a branch circuit, a leakage current may have been disconnected. To reduce the risk of fire or an electric shock, the current-carrying parts and other components in the cabinet unit should be inspected and damaged parts replaced. When an item of protective gear trips, the cause of the trip must be identified and rectified.

NOTE

The chassis units are equipped with shock-hazard protection in accordance with BGV A 3 to DIN 57 106, Part 100 / VDE 0106, Part 100.

4.4 Introduction to EMC

Electromagnetic compatibility (EMC) describes the capability of an electrical device to function satisfactorily in an electromagnetic environment without itself causing interference unacceptable for other devices in the environment.
EMC, therefore, represents a quality standard for the following:

- Internal noise immunity: resistance against internal electrical disturbances
- External noise immunity: resistance against external electromagnetic disturbances
- Noise emission level: environmental effects caused by electromagnetic emissions

To ensure that the chassis unit functions satisfactorily in the system, the environment subject to interference must also be taken into consideration. For this reason, special requirements exist regarding the structure and the EMC of the system.

Operational reliability and noise immunity

Measures must be taken by the converter manufacturer and the operator to ensure the greatest possible level of operational reliability and noise immunity within the entire system (converters, automation systems, drive motors, and so on). Only when all of these measures have been taken are the satisfactory function of the converter and compliance with the legal requirements (89/336/EEC) ensured.

Noise emissions

Product standard EN 61800 – 3 outlines the EMC requirements for variable-speed drive systems. It specifies requirements for converters with operating voltages of less than 1000 V. Different environments and categories are defined depending on where the drive system is installed.

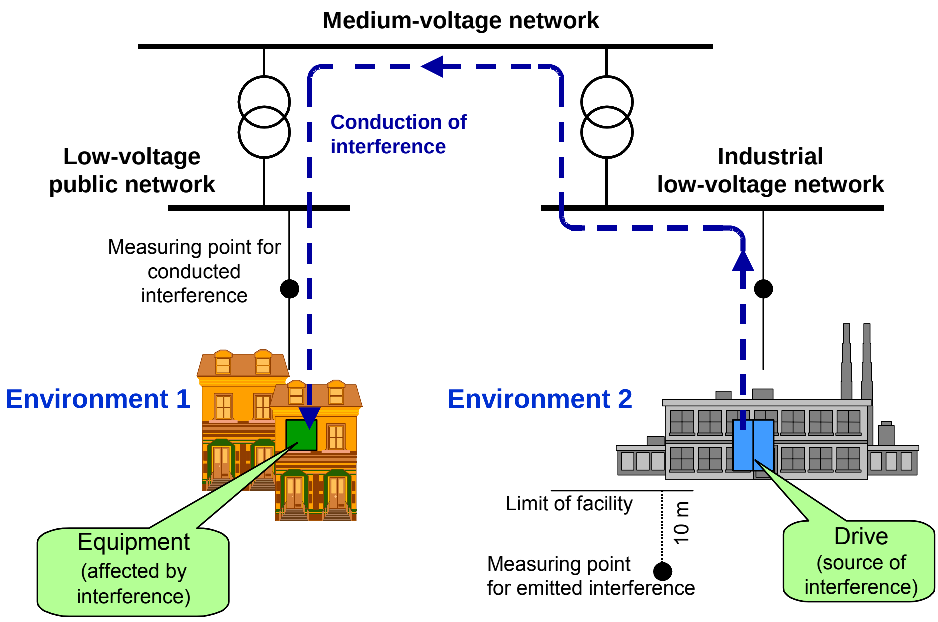


Fig. 4-1 Definition of environments 1 and 2

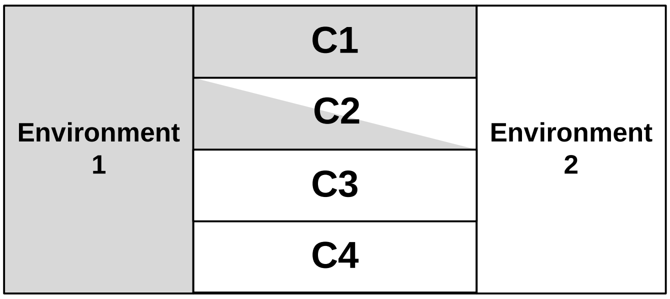


Fig. 4-2 Definition of categories C1 to C4

Definition of environments 1 and 2

- Environment 1:
  Residential buildings or locations at which the drive system is connected to a public low-voltage supply without a transformer.
- Environment 2:
  Industrial locations supplied by a medium-voltage network via a separate transformer.

Definition of categories C1 to C4

- Category C1:
  Rated voltage <1000 V; unrestricted use in environment 1
- Category C2:
  Rated voltage for stationary drive systems <1000 V; for use in environment 2
  For use in environment 1 only when sold and installed by skilled personnel.
- Category C3:
  Rated voltage <1000 V; use in environment 2 only
- Category C4:
  Rated voltage ≥1000 V or for rated currents ≥400 A in complex systems in environment 2

4.5 EMC-compliant installation

The following section provides some basic information and guidelines that will help you comply with the EMC and CE guidelines.

Installation

- Connect painted or anodized metal components using toothed self-locking screws or remove the insulating layer.
- Use unpainted, de-oiled mounting plates.
- Establish a central connection between ground and the protective conductor system (ground).

Shield gaps

- Bridge shield gaps (at terminals, circuit-breakers, contactors, and so on) with minimum impedance and the greatest possible surface area.

Using large cross-sections

- Use underground and grounding cables with large cross-sections or, better still, with litz wires or flexible cables.

Laying the motor supply cable separately

- The distance between the motor supply cable and signal cable should be > 20 cm. Do not lay power cables and motor supply cables in parallel to each other.

Securing the potential to ground between modules with widely differing interference potential

- Lay an equalizing cable parallel to the control cable (the cable cross-section must be at least 16 mm^2).
- If relays, contactors, and inductive or capacitive loads are connected, the switching relays or contactors must be provided with anti-interference elements.

Cable installation

- Cables that are subject to or sensitive to interference should be laid as far apart from each other as possible.
- Noise immunity increases when the cables are laid close to the ground potential. For this reason, you are advised to lay these cables in corners and on the ground potential.
- Ground the spare cables on at least one end.
- Long cables should be shortened or laid in noise resistant areas to avoid additional connecting points.

- Conductors or cables that carry signals of different classes must cross at right angles, especially if they carry sensitive signals that are subject to interference.
  - Class 1:
    unshielded cables for ≤ 60 V DC
    unshielded cables for ≤ 25 V AC
    shielded analog signal cables
    shielded bus and data cables
    operator panel interface, incremental/absolute encoder lines
  - Class 2:
    unshielded cables for > 60 V DC and ≤ 230 V DC
    unshielded cables for > 25 V AC and ≤ 230 V AC
  - Class 3:
    unshielded cables for > 230 V AC/DC and ≤ 1000 V AC/DC

Shield connection

- Shields must not be used to conduct electricity. In other words, they must not simultaneously act as neutral or PE conductors.
- Apply the shield so that it covers the greatest possible surface area. You can use ground clamps, ground terminals, or ground screw connections.
- Avoid extending the shield to the grounding point using a wire (pigtail) because this will reduce the effectiveness of the shield by up to 90%.
- Attach the shield to a shield bar directly after the line inlet into the cabinet. Insulate the entire shielded cable and route the shield up to the device connection, but do not connect it again.

I/O connection

- Create a low-impedance ground connection for additional cabinets, system components, and distributed devices with the largest possible cross-section (at least 16 mm²).
- Ground unused lines at one end in the cabinet.
- Choose the greatest possible clearance between the power and signal cables (at least 20 cm). The greater the distance over which the cables are routed in parallel, the greater the clearance must be. If a sufficient clearance cannot be maintained, you must install additional shields.
- Avoid unnecessarily long cable loops.

Filtering cables

- Line supply cables and power supply cables for devices and modules may have to be filtered in the cabinet to reduce incoming or outgoing disturbances.
- To reduce emissions, SINAMICS G130 is equipped with a radio interference suppression filter as standard (in accordance with the limit values defined in category C3). Optional filters, which are available on request, can be fitted for use in environment 1 (category C2).

4.6 Connection overview

Power Module: GX type

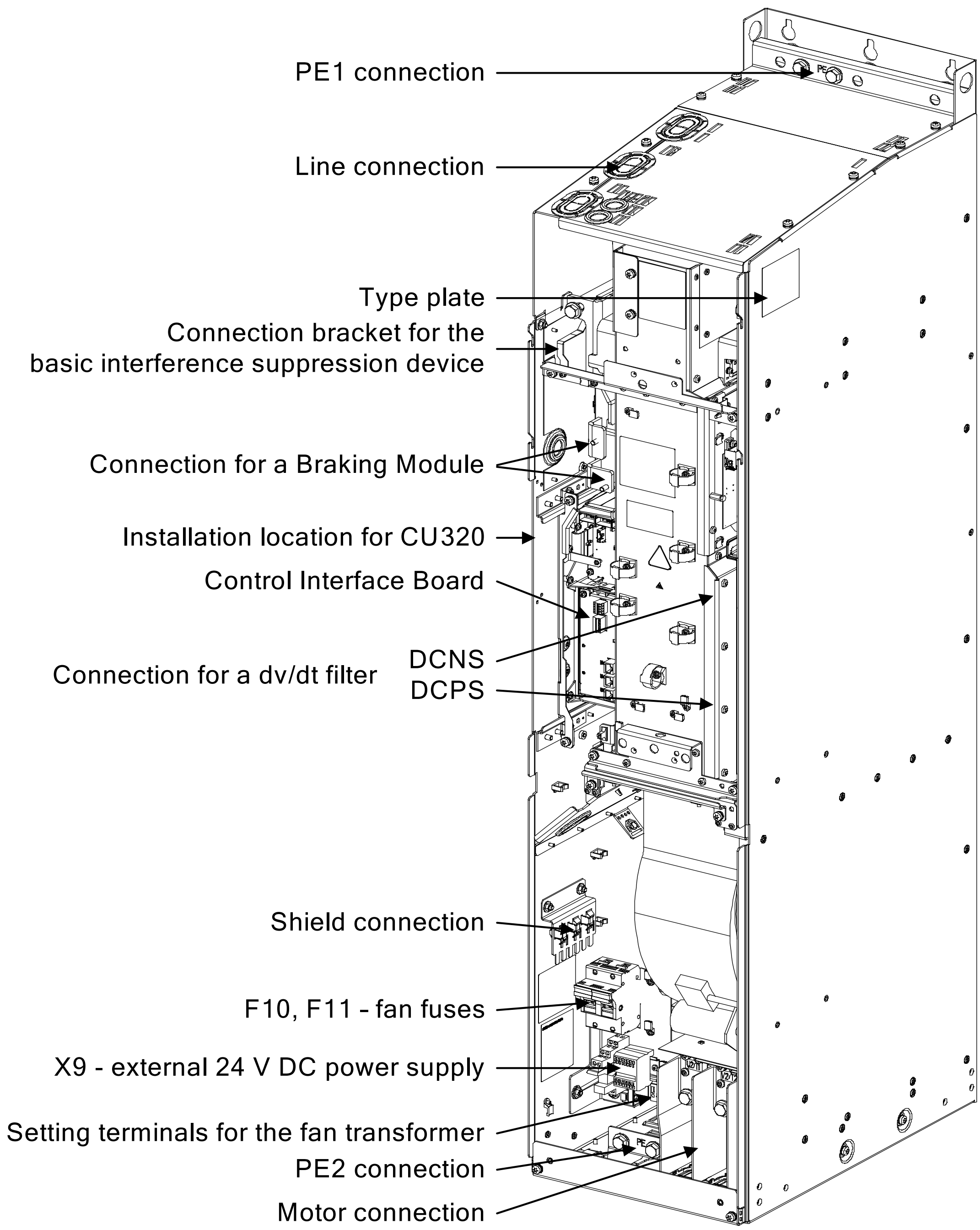


Fig. 4-3 Connection overview of Power Module, GX type (without front cover)

Power Module: HX type

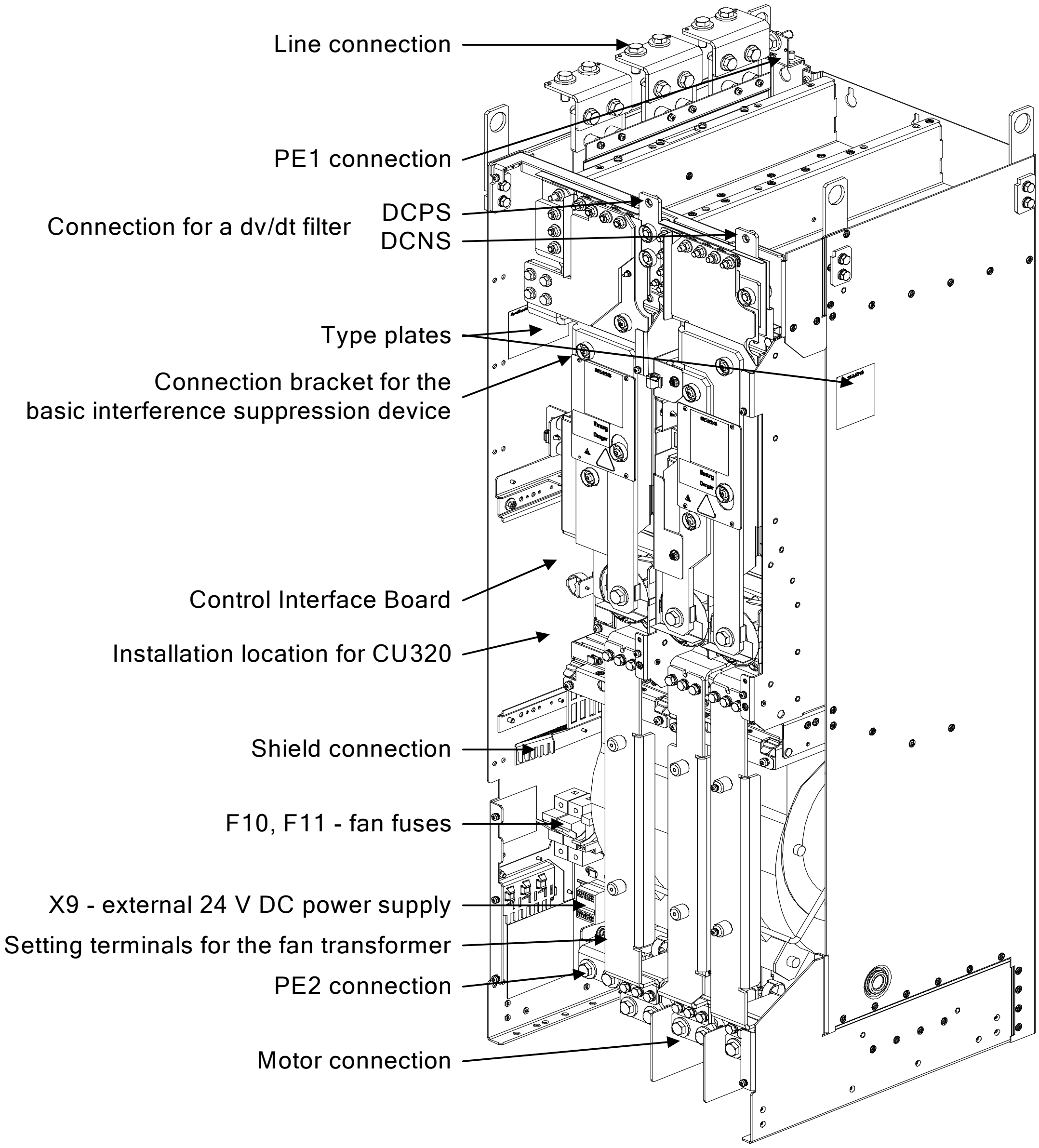


Fig. 4-4 Connection overview of Power Module, HX type (without front cover)

Power Module: JX type

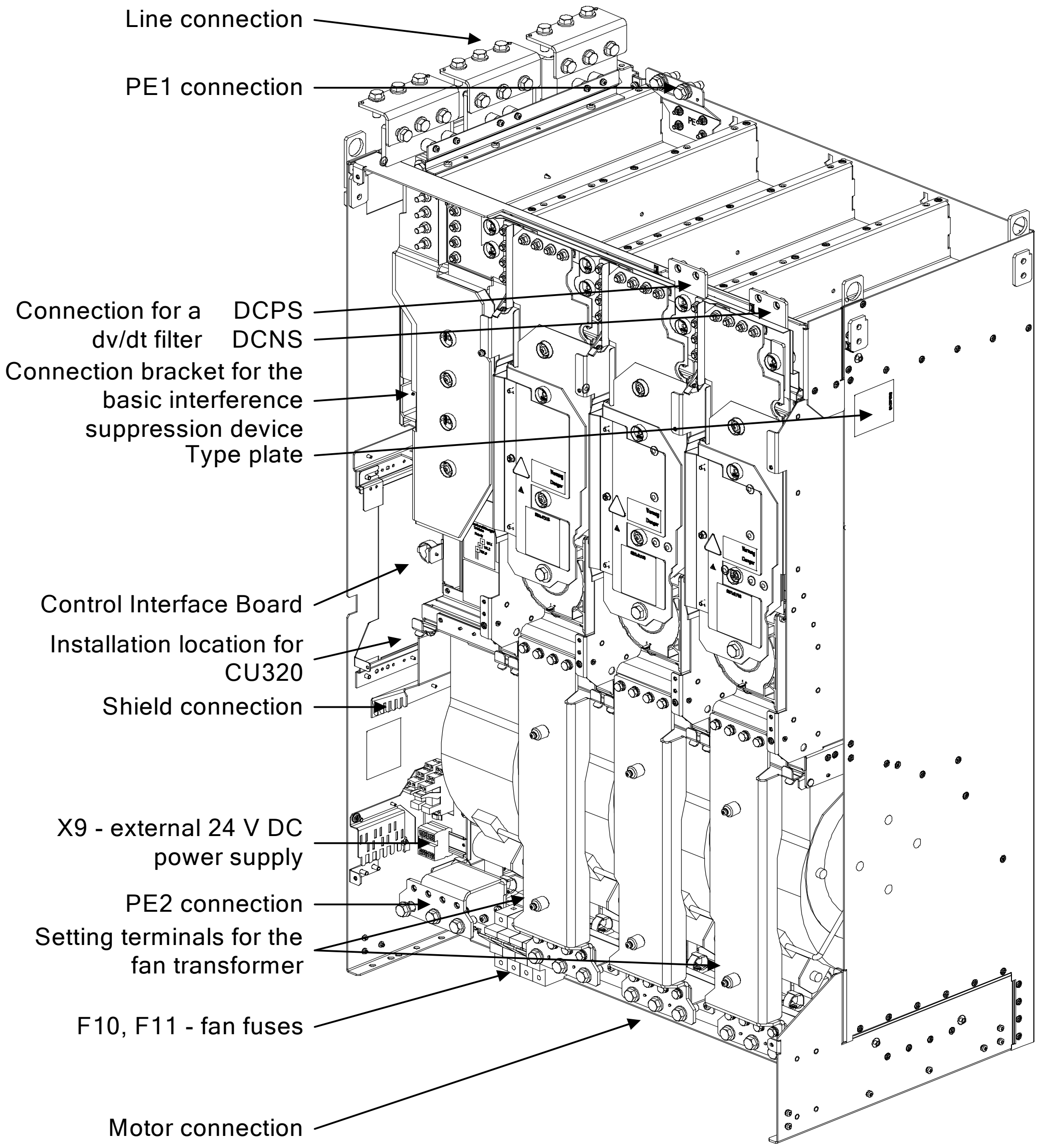


Fig. 4-5 Connection overview of Power Module, JX type (without front cover)

4.7 Power connections

WARNING

- Mixing up the input and output terminals can destroy the chassis unit.
- Short-circuiting the DC link terminals can destroy the chassis unit.
- The contactor and relay operating coils that are connected to the same supply network as the chassis unit or are located near the chassis units must be connected to overvoltage limiters (e.g. RC elements).
- The chassis unit must not be operated via a residual-current circuit-breaker (DIN VDE 0160).

4.7.1 Connection cross-sections and cable lengths

Connection cross-sections

The connection cross-sections for the line connection, motor connection, and ground connection for your chassis unit are specified in the tables provided in the "Technical Data" section.

Cable lengths

The maximum permissible cable lengths are specified for standard cable types or cable types recommended by SIEMENS. Longer cables can only be used after consultation.

The cable lengths specified represent the actual distance between the cabinet unit and the motor, taking into account parallel routing, current-carrying capacity, and the cable-laying factor.

- Unshielded cable (e.g. Protodur NYY): max. 450 m
- Shielded cable (e.g. Protodur NYCWY, Protoflex EMV 3 Plus): max. 300 m

NOTE

The PROTOFLEX-EMV-3 PLUS shielded cable recommended by Siemens is the protective conductor and comprises three symmetrically-arranged protective conductors. The individual protective conductors must each be provided with cable eyes and be connected to ground. The cable also has a concentric flexible braided copper shield. To comply with EN55011 regarding radio interference suppression, the shield must contact at both ends and with the greatest possible surface area.

On the motor side, cable glands that contact the shield with the greatest possible surface area are recommended for the terminal boxes.

4.7.2 Connecting the motor and power cables

Connecting the motor and power cables on the Power Module

1. If necessary, remove the covers or front covers in front of the connection panel for motor cables (terminals U2/T1, V2/T2, W2/T3; X2) and power cables (terminals U1/L1, V1/L2, W1/L3; X1).
2. Screw the protective earth (PE) into the appropriate terminal (with earth symbol) (50 Nm with M12) at the points provided in the cabinet.
3. Screw the motor cables into the terminals.
   Make sure that you connect the conductors in the correct sequence: U2/T1, V2/T2, W2/T3 and U1/L1, V1/L2, W1/L3.

CAUTION

Tighten the screws with the appropriate torque (50 Nm with M12), otherwise the terminal contacts could catch fire during operation.

NOTE

The motor ground must be fed back directly to the Power Module and connected.

Direction of motor rotation

With induction machines with a clockwise phase sequence (looking at the drive shaft), the motor must be connected to the Power Module as follows:

Table 4-1 Connection terminals on the Power Module and motor

Power Module (connection terminals)	Motor (connection terminals)
U2/T1	U
V2/T2	V
W2/T3	W

In contrast to the connection for the clockwise phase sequence, two phases have to be reversed with a counter-clockwise phase sequence (looking at the drive shaft).

NOTE

If an incorrect phase sequence was connected when the cables were routed, and the phase sequence cannot be corrected by subsequently swapping the motor cables, it can be corrected by means of a negative command value or by parameterizing the device.

With motors that can be operated in a star/delta configuration, the windings must be checked to ensure that they have been connected properly. Please refer to the relevant documentation for the motor and note the required insulation voltage for operating the device.

4.7.3 DCPS, DCNS – connection for a du/dt filter

Table 4-2 DCPS, DCNS

Type	Connectable cross-section	Terminal screw
GX	1 x 70 mm²	M8
HX	1 x 185 mm²	M10
JX	2 x 185 mm²	M10

With type GX, the connection cables are routed down through the Power Module and out.

4.7.4 Adjusting the fan voltage

The power supply for the device fan (230 V AC) in the Power Module is generated from the main supply system by means of a transformer.

The transformer is fitted with primary taps so that it can be fine-tuned to the line supply voltage. When delivered, the taps are always set to the highest level. With a low supply voltage, the appropriate transformer tap must be activated.

The connection overviews in Section 4.6 show the position of the setting terminals.

NOTE

One transformer is installed in types GX and HX; two transformers are installed in type JX. The two primary terminals on these devices must be set together.

The terminals must be connected to "0" and the supply voltage.

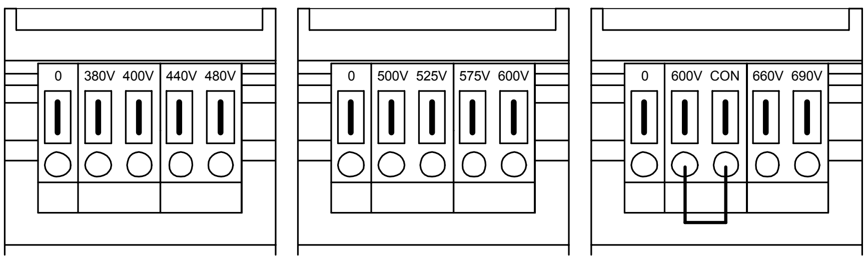


Fig. 4-6 Setting terminals for the fan transformer
(380 V – 480 V 3AC / 500 V – 600 V 3AC / 660 V – 690 V 3AC)

The supply voltage assignments for making the appropriate setting on the fan transformer are specified in Table 4-3 to Table 4-5.

NOTE

With the 660 V – 690 V fan transformer, a jumper is inserted between terminal “600 V” and terminal “CON”. Terminals "600V" and "CON" are for internal use.

CAUTION

If the terminals are not reconnected to the actual supply voltage:

- the required cooling capacity cannot be provided because the fan rotates too slowly
- the fan fuses may blow due to an overcurrent.

Table 4-3 Supply voltage assignments for setting the fan transformer (380 V – 480 V 3AC)

Line voltage	Fan transformer tap
380 V ± 10 %	380 V
400 V ± 10 %	400 V
440 V ± 10 %	440 V
480 V ± 10 %	480 V

Table 4-4 Supply voltage assignments for setting the fan transformer (500 V – 600 V 3AC)

Line voltage	Fan transformer tap
500 V ± 10 %	500 V
525 V ± 10 %	525 V
575 V ± 10 %	575 V
600 V ± 10 %	600 V

Table 4-5 Supply voltage assignments for setting the fan transformer (660 V – 690 V 3AC)

Line voltage	Fan transformer tap
660 V ± 10 %	660 V
690 V ± 10 %	690 V

4.7.5 Removing the connection bracket for the interference-suppression capacitor with operation from an ungrounded supply

If the chassis unit is operated from an ungrounded supply/IT supply, the connection bracket for the interference-suppression capacitor of the Power Module must be removed.

The connection overviews in Section 4.6 show the position of the connection bracket.

4.8 External 24 V DC supply

Description

An external supply of 24 V DC is always recommended if communication and closed-loop control are to be independent of the supply system. An external auxiliary supply is particularly recommended for low-power lines susceptible to short-time voltage dips or power failures.

With an external supply independent of the main supply, warnings and fault messages may still be displayed on the operator panel and internal protection and monitoring devices if the main supply fails.

The power requirement is 4 A.

Connection

Connect the external 24 V DC supply to terminals 1 (P 24 V) and 2 (M_{ext}) on terminal block –X9 on the Power Module.

4.9 DRIVE-CLiQ cabling diagram

The diagram below shows the specifications for the DRIVE-CLiQ connections between the components.

IMPORTANT

These specifications for the DRIVE-CLiQ connections should be observed, otherwise faults may occur during commissioning via STARTER or the AOP30 operator panel.

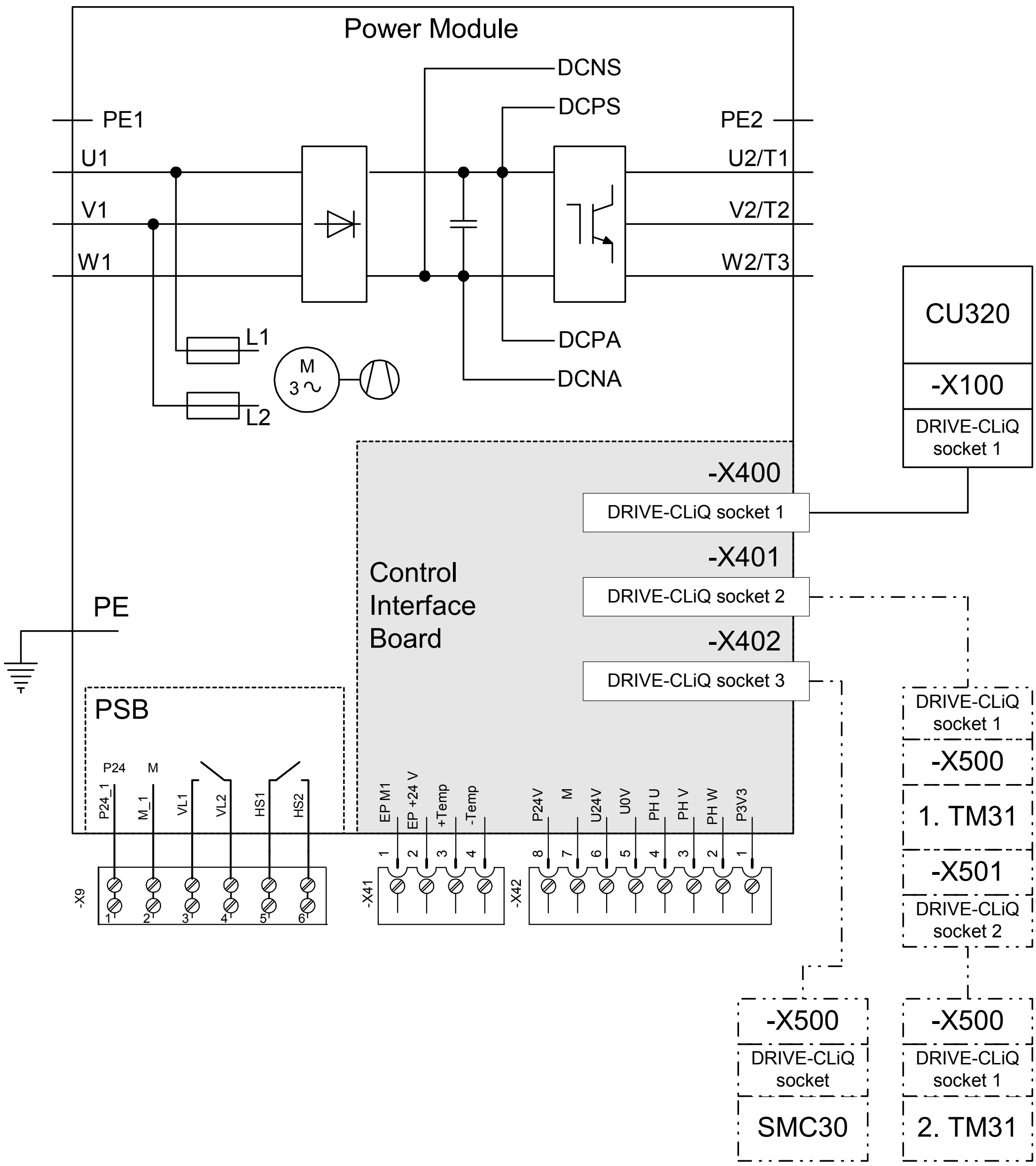


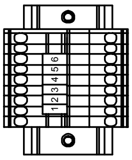
Fig. 4-7 DRIVE-CLiQ cabling diagram

4.10 Signal connections

4.10.1 Power Module

X9: Terminal block

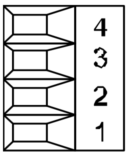
Table 4-6 Terminal block X9

	Terminal	Function	Technical data
	1	P24V	Voltage: 24 V DC (20.4 V – 28.8 V) Current input: max. 4 A
	2	M	
	3		
	4		
	5		
	6		

Max. connectable cross-section: 1.5 mm² (AWG 14)

X41: EP terminals / temperature sensor connection

Table 4-7 Terminal block X41

	Terminal	Function	Technical data
	4	+ Temp	Temperature sensor connection KTY84–1C130
	3	- Temp	
	2	EP +24 V (Enable Pulses)	Supply voltage: 24 V DC (20.4 V – 28.8 V) Current input: 10 mA Signal propagation times: L → H: 100 µs H → L: 1000 µs
	1	EP M1 (Enable Pulses)	

Max. connectable cross-section: 1.5 mm² (AWG 14)

NOTICE

The KTY temperature sensor must be connected with the correct polarity.

NOTE

The temperature sensor connection can be used for motors that are equipped with a KTY84-1C130 measurement sensor in the stator windings.

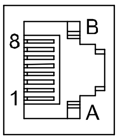
For operation, 24 V DC must be connected to terminal 2 and ground to terminal 1. Upon removal, pulse inhibit is activated.

X42: Terminal block

Reserved, do not use!

X400-X402: DRIVE-CLiQ interface

Table 4-8 DRIVE-CLiQ interface X400-X402: Power Module

	Pin	Signal name	Technical specifications
	1	TXP	Transmit data +
	2	TXN	Transmit data -
	3	RXP	Receive data +
	4	Reserved, do not use	
	5	Reserved, do not use	
	6	RXN	Receive data -
	7	Reserved, do not use	
	8	Reserved, do not use	
	A	+ (24 V)	Power supply
	B	GND (0 V)	Electronic ground

Blanking plate for DRIVE-CLiQ interface: Tyco (order no.: 969556-5)

4.10.2 Control Unit CU320

Connection overview

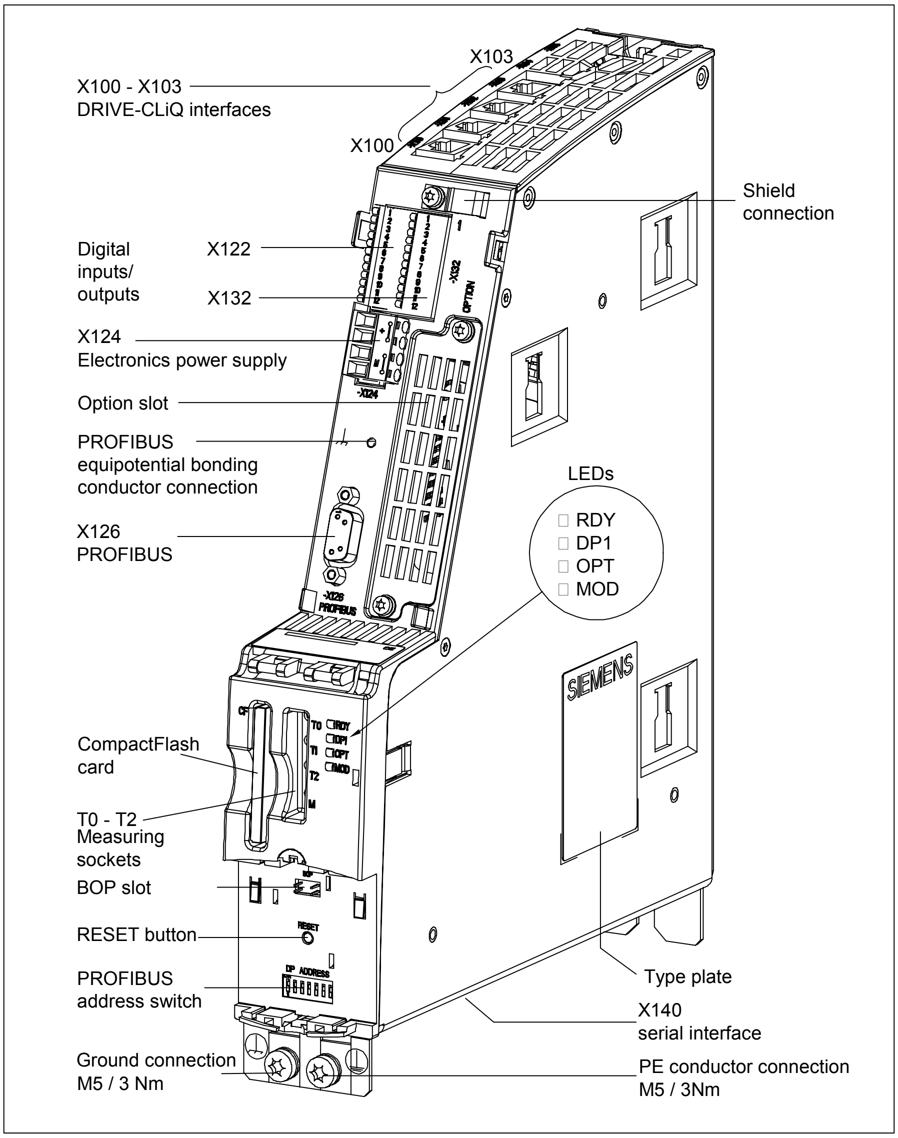


Fig. 4-8 Connection overview: Control Unit CU320 (without cover)

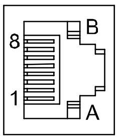
NOTE

The CompactFlash card may only be inserted and removed when the Control Unit is disconnected from the power supply.

If it is inserted and removed when the power supply is connected, this can result in data being lost.

X100 – X103: DRIVE-CLiQ interface

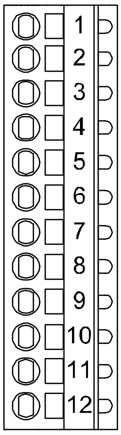
Table 4-9 DRIVE-CLiQ interface X100 - X503

	Pin	Signal name	Technical specifications
	1	TXP	Transmit data +
	2	TXN	Transmit data -
	3	RXP	Receive data +
	4	Reserved, do not use	
	5	Reserved, do not use	
	6	RXN	Receive data -
	7	Reserved, do not use	
	8	Reserved, do not use	
	A	+ (24 V)	Power supply
	B	GND (0 V)	Electronic ground

Blanking plate for DRIVE-CLiQ interface: Tyco (order no.: 969556-5)

X122: digital inputs/outputs

Table 4-10 Terminal block X122

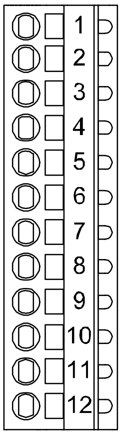
	Pin	Designation [1)]	Technical specifications
	1	DI 0	Voltage: -3 V to 30 V Typical current consumption: 10 mA at 24 V DC Isolation: The reference potential is terminal M1 Level (incl. ripple) High level: 15 V to 30 V Low level: -3 V to 5 V Signal propagation times: L → H: approx. 50 µs H → L: approx. 100 µs
	2	DI 1	
	3	DI 2	
	4	DI 3	
	5	M1	
	6	M	
	7	DI/DO 8	As input: Voltage: -3 V to 30 V Typical current consumption: 10 mA at 24 V DC Level (incl. ripple) High level: 15 V to 30 V Low level: -3 V to 5 V Terminal numbers 8, 10, and 11 are "fast inputs" Signal propagation times for inputs/"fast inputs": L → H: approx. 50 µs H → L: approx. 100 µs/50 µs As output: Voltage: 24 V DC Max. load current per output: 500 mA continued-short-circuit-proof
	8	DI/DO 9	
	9	M	
	10	DI/DO 10	
	11	DI/DO 11	
	12	M	

[1)] DI: digital input; DI/DO: bidirectional digital input/output; M: electronic ground, M1: Ground reference

Max. connectable cross-section: 0.5 mm²

X132: Digital inputs/outputs

Table 4-11 Terminal block X132

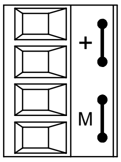
	Pin	Designation [1)]	Technical specifications
	1	DI 4	Voltage: -3 V to 30 V Typical current consumption: 10 mA at 24 V DC Isolation: The reference potential is terminal M2 Level (incl. ripple) High level: 15 V to 30 V Low level: -3 V to 5 V Signal propagation times: L → H: 50 µs H → L: 100 µs
	2	DI 5	
	3	DI 6	
	4	DI 7	
	5	M2	
	6	M	
	7	DI/DO 12	As input: Voltage: -3 V to 30 V Typical current consumption: 10 mA at 24 V DC Level (incl. ripple) High level: 15 V to 30 V Low level: -3 V to 5 V Terminal numbers 8, 10, and 11 are "fast inputs" Terminal numbers 8, 10, and 11 are "fast inputs" Signal propagation times for inputs/"fast inputs": L → H: 50 µs/5 µs H → L: 100 µs/50 µs As output: Voltage: 24 V DC Max. load current per output: 500 mA, continued-short-circuit-proof
	8	DI/DO 13	
	9	M	
	10	DI/DO 14	
	11	DI/DO 15	
	12	M	

1) DI: digital input; DI/DO: bidirectional digital input/output; M: electronic ground, M1: Ground reference

Max. connectable cross-section: 0.5 mm²

X124: Electronics power supply

Table 4-12 Terminal block X124

	Terminal	Function	Technical specifications
	+	Electronics power supply	Voltage: 24 V DC (20.4 V - 28.8 V) Current consumption: max. 0.8 A (without load) Max. current via jumper in connector: 20 A at 55 °C
	+	Electronics power supply	
	M	Electronic ground	
	M	Electronic ground	

DI: digital input; DI/DO: bidirectional digital input/output; M: electronic ground M1: Ground reference

Max. connectable cross-section: 2.5mm² (AWG 12)

NOTE

The two "+" and "M" terminals are jumpered in the connector and not in the unit. This ensures the supply voltage is looped through.

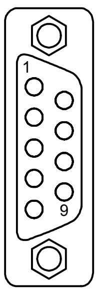
NOTE

The power can be supplied via terminals X41.1/2 on the Power Module.

X126: PROFIBUS connection

The PROFIBUS is connected by means of a 9-pin Sub-D socket (X126). The connections are electrically isolated.

Table 4-13 PROFIBUS interface X126

	Pin	Signal name	Meaning	Range
	1	SHIELD	Ground connection	
	2	M24_SERV	Power supply for teleservice, ground	0 V
	3	RxD/TxD–P	Receive/send data P (B/B')	RS485
	4	CNTR–P	Control signal	TTL
	5	DGND	PROFIBUS data reference potential (C/C')	
	6	VP	Supply voltage plus	5 V + -10 %
	7	P24_SERV	Power supply for teleservice, + (24 V)	24 V (20.4 V – 28.8 V)
	8	RxD/TxD–N	Receive/send data N (A/A')	RS485
	9	-	Not used	

NOTE

The power supply for the teleservice terminals 2 and 7 withstands a max. load and continued short-circuit current of 150 mA.

Connectors

The cables must be connected via PROFIBUS connectors as they contain the necessary terminating resistors.

The figure below shows suitable PROFIBUS connectors with/without a PG/PC connector.

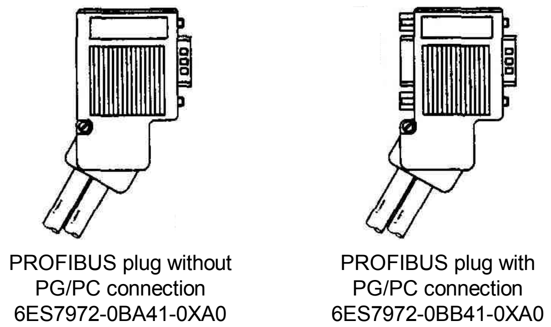


Fig. 4-9 PROFIBUS connectors

Bus terminating resistors

The first and last nodes in a bus must contain terminating resistors. Otherwise data transmission will not function correctly.

The cable shield must be connected at both ends over large-surface area contacts.

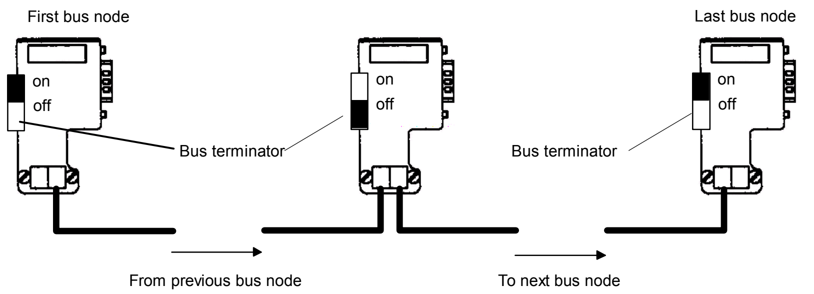
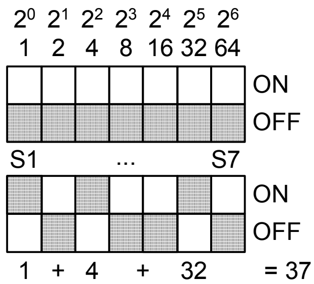


Fig. 4-10 Position of the bus terminating resistors

PROFIBUS address switches

Table 4-14 PROFIBUS address switches

Switch	Significance	Technical specifications
S1	$2^0 = 1$	Significance  Example
S2	$2^1 = 2$	
S3	$2^2 = 4$	
S4	$2^3 = 8$	
S5	$2^4 = 16$	
S6	$2^5 = 32$	
S7	$2^6 = 64$	

NOTE

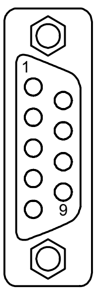
The factory settings are "ON" or "OFF" for all switches. With these two settings, the PROFIBUS address is set via parameters.

The address switch is behind the blanking plate.

X140: serial interface (RS232)

The AOP30 operator panel for operating/parameterizing the device can be connected via the serial interface. The interface is located on the underside of the Control Unit. A standard cable can be used for connecting the AOP30 operator panel to the RS232 interface.

Table 4-15 Serial interface (RS232) X140

	Pin	Designation	Technical specifications
	2	RxD	Receive data
	3	TxD	Transmit data
	5	Ground	Ground reference
Plug type:		9-pin SUB-D female	

Measurement sockets T0, T1, and T2

Table 4-16 Measurement sockets T0, T1, and T2

Socket	Function	Technical specifications
T0	Measurement socket 0	Voltage: 0 V to 5 V Resolution: 8 bits Load current: max. 3 mA Continued-short-circuit-proof
T1	Measurement socket 1	
T2	Measurement socket 2	
M	Ground	The reference potential is terminal M

Measuring sockets for bunch pin plugs d: 2 mm

NOTE

The measurement sockets are only for support during start-up.

Slot for the CompactFlash card

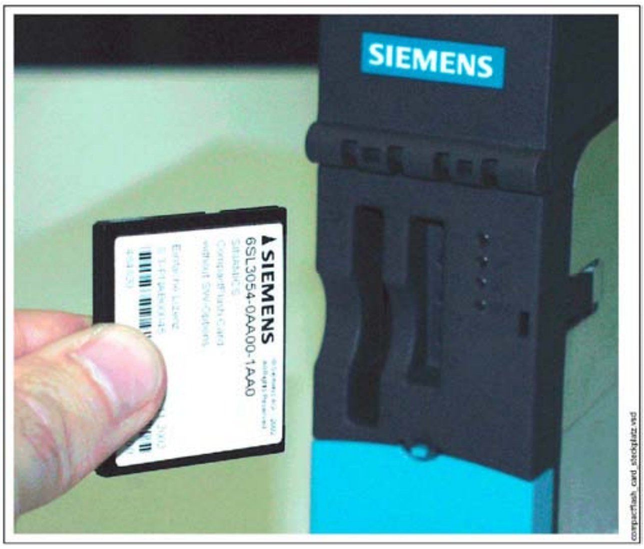


Fig. 4-11 Slot for the CompactFlash card

CAUTION

The CompactFlash card may only be inserted as shown in the figure (arrow top right).

The CompactFlash card may only be inserted or removed when the Control Unit is disconnected from the power supply.

When returning a defective unit, remove the CompactFlash card and keep it for insertion in the replacement unit.

If you do not do this, all the data on the CompactFlash card will be lost (parameters, software license, etc.).

Wiring diagram

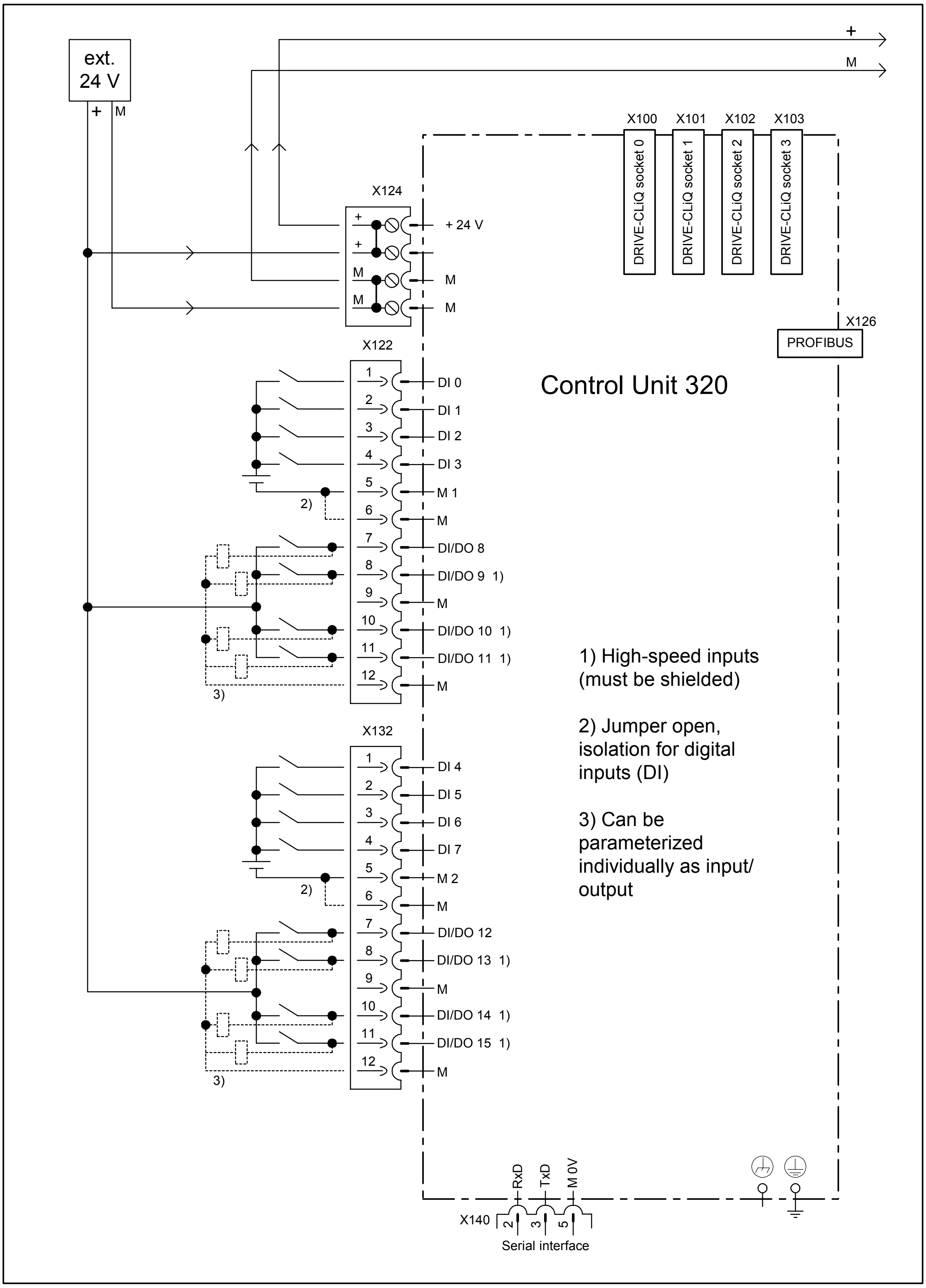


Fig. 4-12 Wiring diagram: CU320

4.11 Terminal Module TM31

Description

The TM31 Terminal Module (TM31) is a terminal expansion board. It can be used to increase the number of available digital/analog inputs/outputs within a drive system.

Connection overview

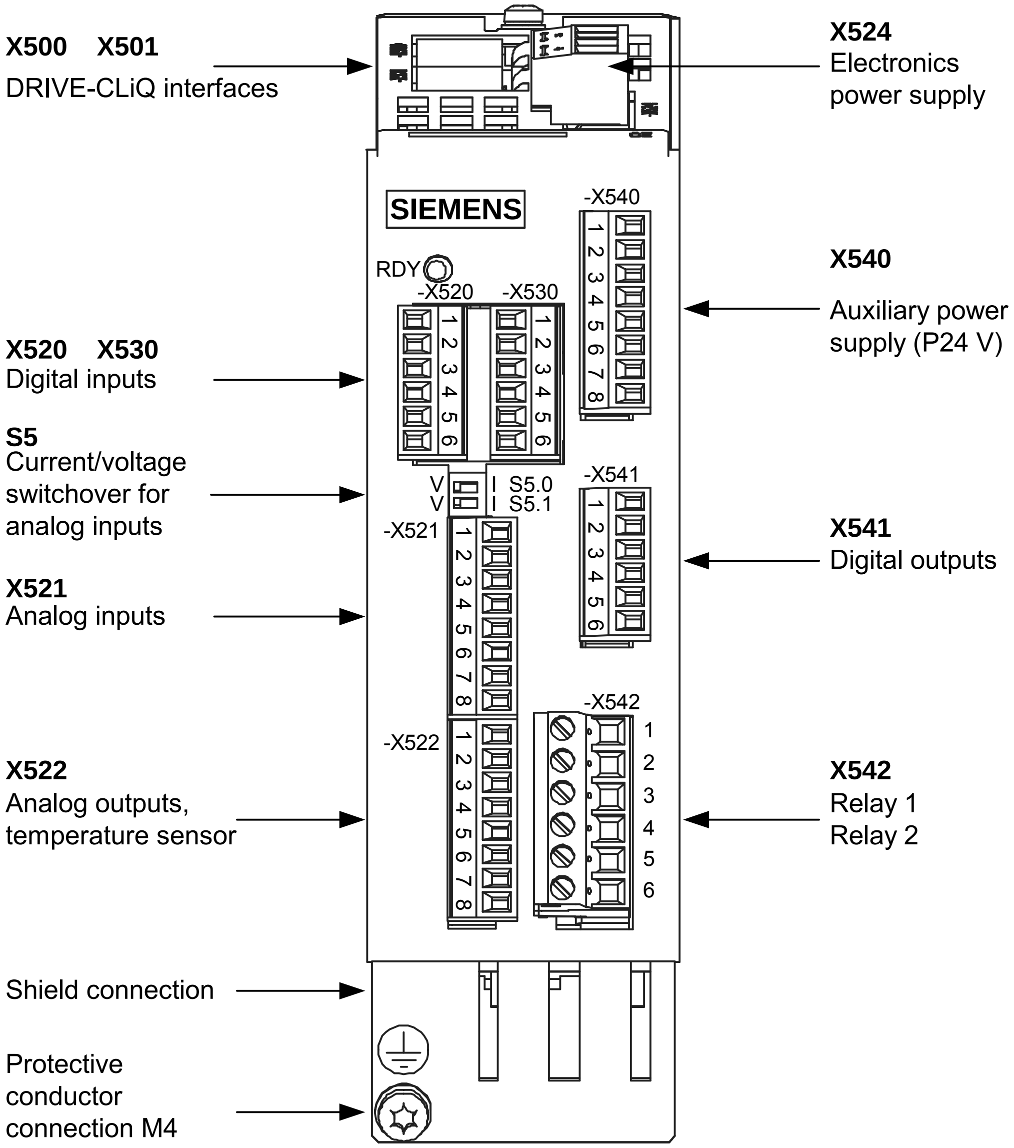


Fig. 4-13 TM31 Terminal Module

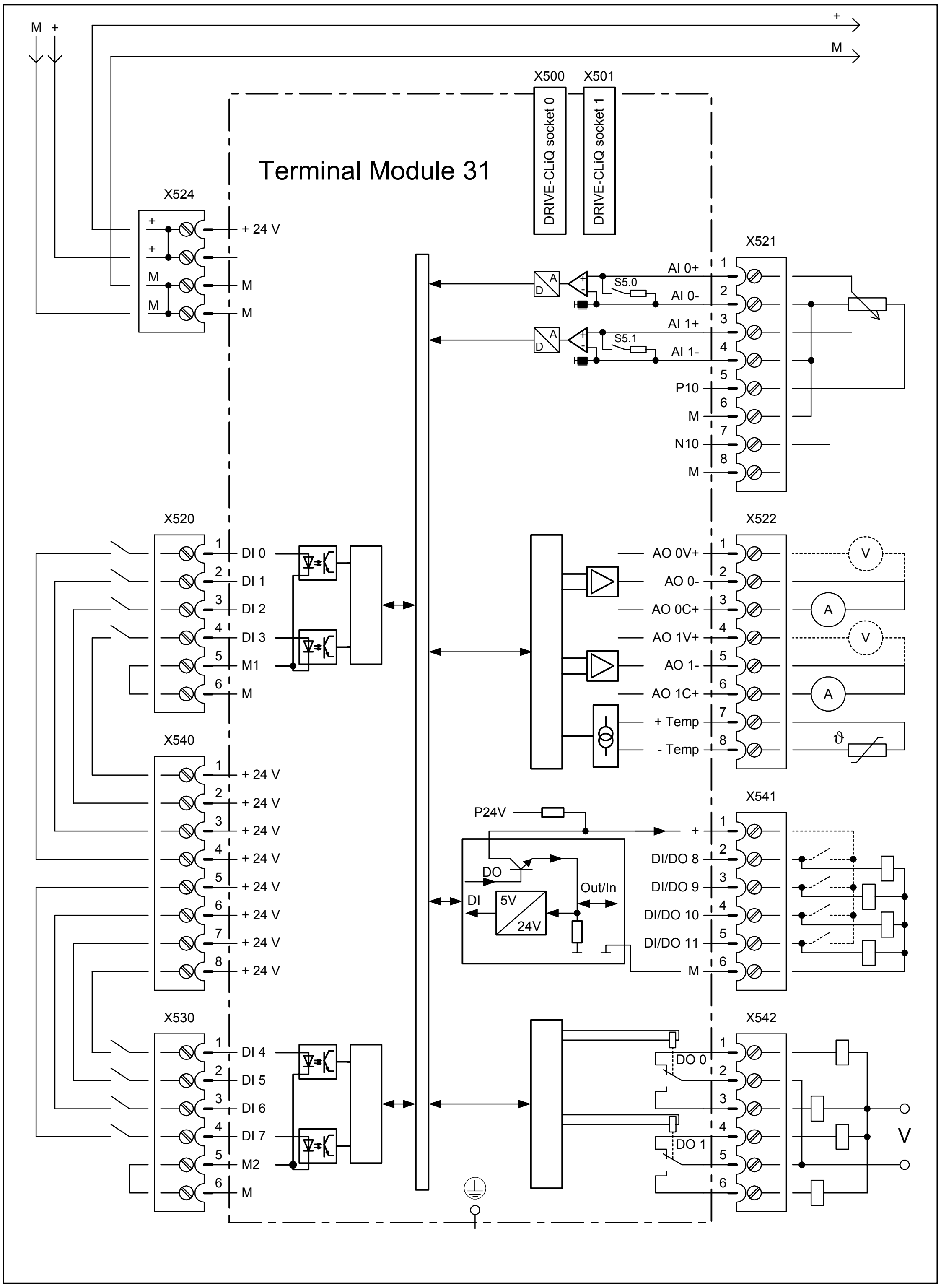


Fig. 4-14 Connection overview for the TM31 Terminal Module

NOTE

The diagram of the Terminal Module shows the factory setting. The digital inputs (terminals -X520 and -X530) in the example are powered by the internal 24 V supply of the Terminal Module (terminal -X540).

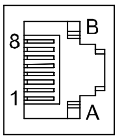
The two groups of digital inputs (optocoupler inputs) have a common reference potential (ground reference M1 or M2). In order to close the circuit when the internal 24 V supply is used, the ground references M1 / M2 must be connected to internal ground (M).

If the power is not supplied from the internal 24 V supply (terminal –X540), the jumper between ground M1 and M or M2 and M must be removed and M1 or M2 must be connected to the ground of the external 24 V DC supply.

If you do not do this, this can result in potential rounding.

X500, X501: DRIVE-CLiQ interface

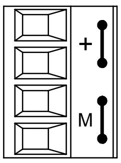
Table 4-17 DRIVE-CLiQ interface X500 and X501

	Pin	Signal name	Technical specifications
	1	TXP	Transmit data +
	2	TXN	Transmit data -
	3	RXP	Receive data +
	4	Reserved, do not use	
	5	Reserved, do not use	
	6	RXN	Receive data -
	7	Reserved, do not use	
	8	Reserved, do not use	
	A	+ (24 V)	Power supply
	B	GND (0 V)	Electronic ground

Blanking plate for DRIVE-CLiQ interface: Tyco (order no.: 969556-5)

X524: Electronics power supply

Table 4-18 Terminals for electronics power supply

	Terminal	Designation	Technical specifications
	+	Electronics power supply	Voltage: 24 V DC (20.4 V – 28.8 V) Current input: max. 0.5 A
	+	Not used	
	M	Electronic ground	Max. current via jumper in connector: 20 A at 55 °C
	M	Electronic ground	

Max. connectable cross-section: 2.5 mm^2 (AWG 12)

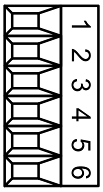
NOTE

The two “+” and “M” terminals are jumpered in the connector and not in the unit. This ensures the supply voltage is looped through.

The power can be supplied via terminals X41.1/2 on the Power Module.

X520: 4 digital inputs

Table 4-19 Terminal block X520

	Terminal	Designation [1)]	Technical specifications
	1	DI 0	Voltage: -3 V to 30 V Current input (typical): 10 mA at 24 V With electrical isolation: The reference potential is terminal M1 Level: High level: 15 V to 30 V Low level: -3 V to 5 V
	2	DI 1	
	3	DI 2	
	4	DI 3	
	5	M1	
	6	M	

1) DI: digital input; M1: ground reference; M: Electronic ground

Max. connectable cross-section: 1.5 mm^2 (AWG 14)

NOTE

An open input is interpreted as "low".

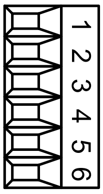
To enable the digital inputs to function, terminal M1 must be connected. This can be done as follows:

1) The provided ground reference of the digital inputs, or
2) A bridge to terminal M (important: this removes the electrical isolation for the digital inputs).

The digital inputs will not function if terminal M is not connected.

X530: 4 digital inputs

Table 4-20 Terminal block X530

	Terminal	Designation 1)	Technical specifications
	1	DI 4	Voltage: -3 V to 30 V Current input (typical): 10 mA at 24 V With electrical isolation: The reference potential is terminal M2 Level High level: 15 V to 30 V Low level: -3 V to 5 V
	2	DI 5	
	3	DI 6	
	4	DI 7	
	5	M2	
	6	M	

1) DI: digital input; M2: ground reference; M: Electronic ground

Max. connectable cross-section: 1.5 mm^2 (AWG 14)

NOTE

An open input is interpreted as "low".

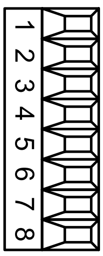
To enable the digital inputs to work, terminal M2 must be connected. This can be done as follows:

1) The provided ground reference of the digital inputs, or
2) A bridge to terminal M (important: this removes the electrical isolation for the digital inputs).

The digital inputs will not function if terminal M is not connected.

X521: 2 analog inputs (differential inputs)

Table 4-21 Terminal block X521

	Terminal	Designation 1)	Technical specifications
	1	AI 0+	-10 V - +10 V, R_i = 70 kΩ +4 mA - +20 mA -20 mA - +20 mA, R_i = 250 Ω 0 mA - +20 mA
	2	AI 0-	
	3	AI 1+	
	4	AI 1-	
	5	P10	+10 V ± 1 %, I_{max} 5 mA
	6	M	Reference potential for AI 0
	7	N10	-10 V ± 1 %, I_{max} 5 mA
	8	M	Reference potential for AI 1

1) AI: analog input; P10/N10: auxiliary voltage, M: Ground reference

Max. connectable cross-section: 1.5 mm^2 (AWG 14)

CAUTION

The input current of the analog inputs must not exceed 35 mA when current measurements are performed.

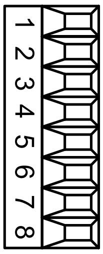
S5: Selector for voltage/current AI0, AI1

Table 4-22 Selector for voltage/current S5

Switch	Function	Technical specifications
S5.0	Selector voltage/current AI0	Voltage V I S5.0 V I S5.1 Current
S5.1	Selector voltage/current AI1	

X522: 2 analog outputs, temperature sensor connection

Table 4-23 Terminal block X522

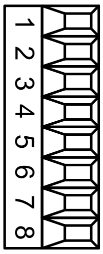
	Terminal	Designation [1)]	Technical specifications
	1	AO 0 V+	-10 V - +10 V +4 mA - +20 mA -20 mA - +20 mA 0 mA - +20 mA
	2	AO 0 ref.	
	3	AO 0 A+	
	4	AO 1 V+	
	5	AO 1 ref.	
	6	AO 1 A+	
	7	KTY+	KTY84: 0...200 °C PTC: $R_{PTC} \leq 1.5\ k\Omega$
	8	KTY-	

[1)] AO: analog output; KTY: temperature sensor connection

Max. connectable cross-section: 1.5 mm^2 (AWG 14)

X540: common auxiliary voltage for digital inputs

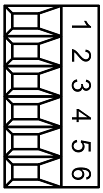
Table 4-24 Terminal block X540

	Terminal	Designation	Technical specifications
	1	P24	24 V DC Imax = 150 mA (total of all P24 terminals) Continued-short-circuit-proof
	2	P24	
	3	P24	
	4	P24	
	5	P24	
	6	P24	
	7	P24	
	8	P24	

Max. connectable cross-section: 1.5 mm^2 (AWG 14)

X541: 4 non-floating digital inputs/outputs

Table 4-25 Terminal block X541

	Terminal	Designation [1]	Technical specifications
	1	P24	As input:
	2	DI/DO 8	Voltage: -3 V to 30 V
	3	DI/DO 9	Current input (typical): 10 mA at 24 V DC
	4	DI/DO 10	As output:
	5	DI/DO 11	Max. load current per output: 20 mA
	6	M	Continued-short-circuit-proof

1) DI/DO: digital input/output; M: Electronic ground

Max. connectable cross-section: 1.5 mm^2 (AWG 14)

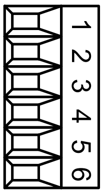
NOTE

An open input is interpreted as "low".

When externally-generated 24 V DC signals are connected, the ground must also be connected.

X542: 2 relay outputs (two-way contacts)

Table 4-26 Terminal block X542

	Terminal	Designation [1]	Technical specifications
	1	DO 0.NC	Max. load current: 8 A
	2	DO 0.COM	Max. switching voltage: 250 V AC, 30 V DC
	3	DO 0.NO	
	4	DO 1.NC	Max. switching capacity: at 250 V AC: 2000 VA at DC 30 V: 240 W (ohmic load)
	5	DO 1.COM	
	6	DO 1.NO	Required minimum load: 20 mA

1) NO: normally open contact, NC: normally-closed contact, COM: mid-position contact

Max. connectable cross-section: 2.5 mm^2 (AWG 12)

NOTE

If 230 V AC is applied to the relay outputs, the Terminal Module must also be grounded via a 6 mm² protective conductor.

4.12 SMC30 Sensor Module for detecting the actual motor speed

4.12.1 Description

The SMC30 Sensor Module is used for determining the actual motor speed. The signals emitted by the rotary pulse encoder are converted here and made available via the DRIVE-CLiQ interface of the closed-loop control for evaluation purposes.

The following encoders can be connected to the SMC30 Sensor Module:

- TTL encoder
- HTL encoder
- KTY temperature sensor

Table 4-27 Encoders that can be connected with supply voltage

Sensor type	Remote Sense	X520 (D-Sub)	X521 (terminal)	X531 (terminal)	Interrupted cable monitoring
HTL bipolar 24 V	No	No	Yes	Yes	No
HTL unipolar 24 V	No	No	Yes	Yes	No
TTL bipolar 24 V	No	Yes	Yes	Yes	ja
TTL bipolar 5 V	Only at X520	Yes	Yes	Yes	ja
TTL unipolar	Not possible				

Table 4-28 Max. signal cable lengths

Sensor type	Maximum signal cable length in m
TTL	100
HTL unipolar	100
HTL bipolar	300

NOTE

For HTL encoders, in order to reduce the effect of interference, a bipolar connection is recommended.

For encoders with a 5 V supply at X521/X531, the cable length is dependent on the encoder current (this applies cable cross-sections of 0.5 mm²):

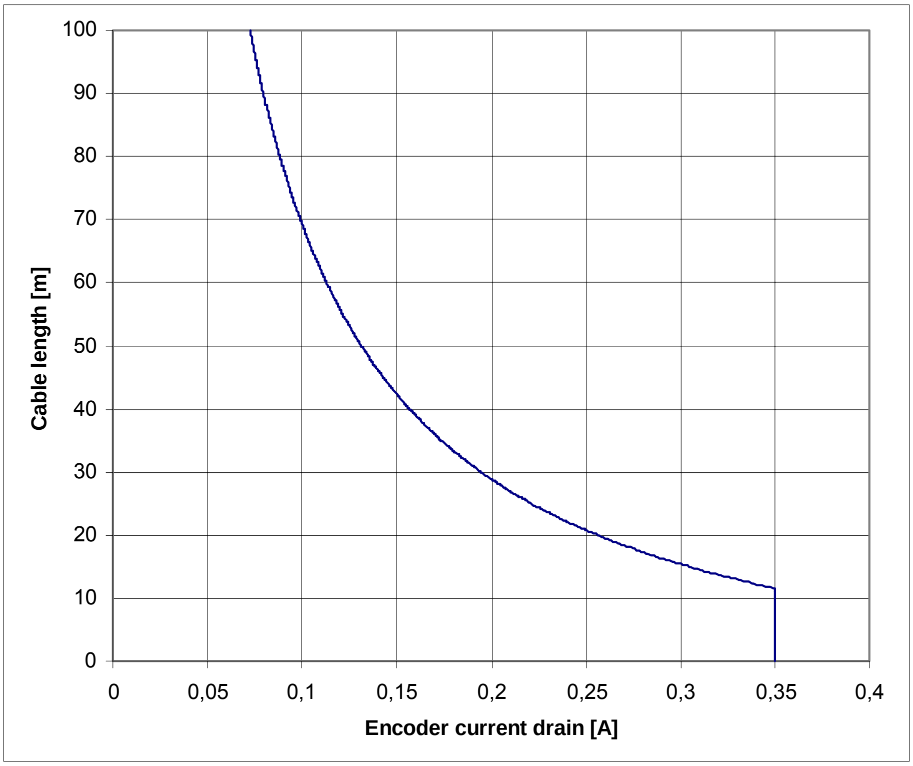


Fig. 4-15 Signal cable length as a function of the encoder current drain

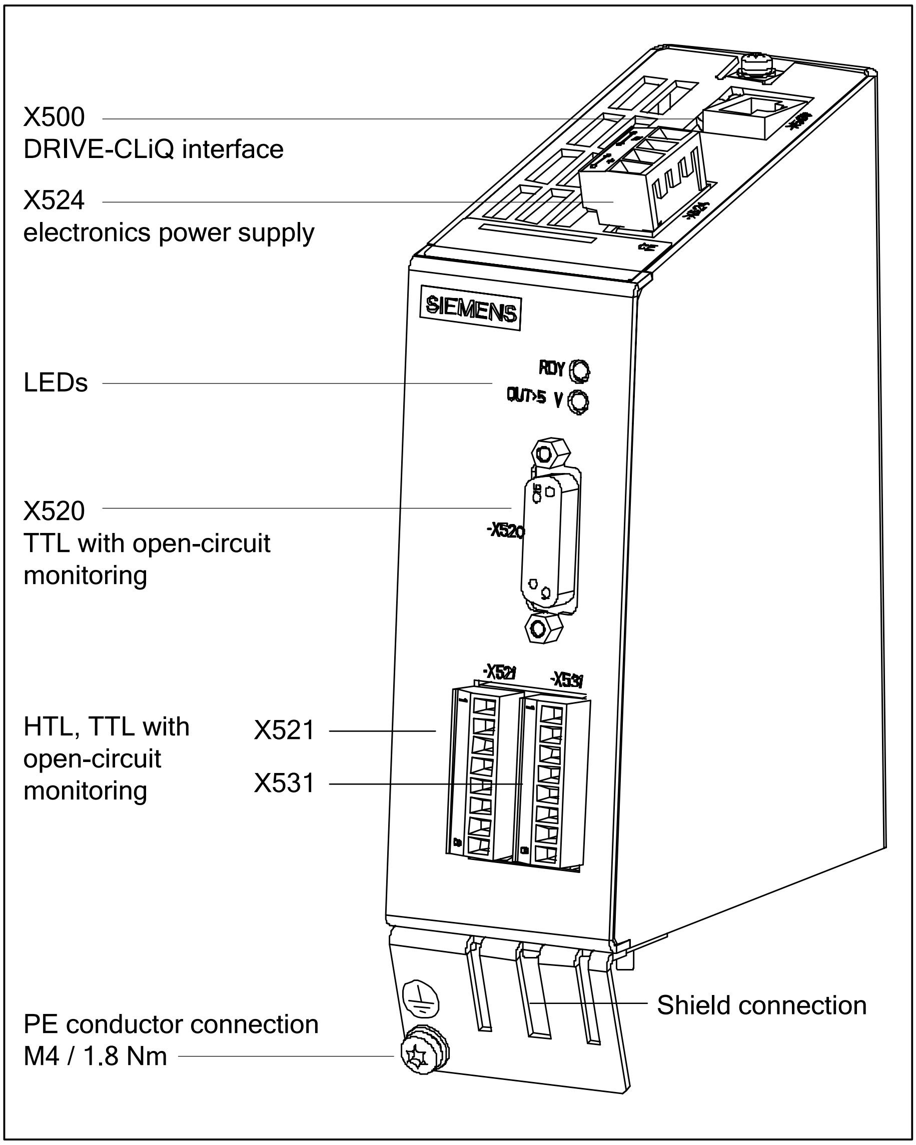
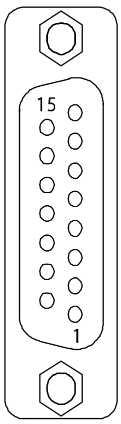


Fig. 4-16 SMC30 Sensor Module

4.12.2 Connection

X520: encoder connection 1 for TTL encoder with open-circuit monitoring

Table 4-29 Encoder connection X520



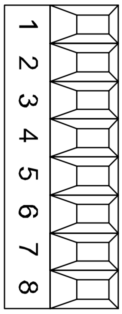
Pin	Signal name	Technical specifications
1	Reserved, do not use	
2	Reserved, do not use	
3	Reserved, do not use	
4	P_Encoder 5 V / 24 V	Sensor power supply
5	P_Encoder 5 V / 24 V	Sensor power supply
6	P_Sense	Sense input sensor power supply
7	M_Encoder (M)	Ground for sensor power supply
8	Reserved, do not use	
9	M_Sense	Ground for sense input
10	R	Reference signal R
11	R*	Inverted reference signal R
12	B*	Inverted incremental signal B
13	B	Incremental signal B
14	A*	Inverted incremental signal A
15	A	Incremental signal A

Plug type: 15-pin socket

CAUTION
The sensor power supply can be parameterized to 5 V or 24 V. The sensor may be destroyed if you enter the wrong parameters.

X521 / X531: encoder connection 2 for HTL/TTL encoder with open-circuit monitoring

Table 4-30 Encoder connection X521

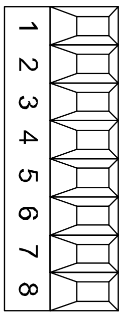
	Terminal	Signal name	Technical specifications
	1	A	Incremental signal A
	2	A*	Inverted incremental signal A
	3	B	Incremental signal B
	4	B*	Inverted incremental signal B
	5	R	Reference signal R
	6	R*	Inverted reference signal R
	7	CTRL	Control signal
	8	M	Ground via inductance

Max. connectable cross-section: 1.5 mm² (AWG 14)

NOTE

When unipolar HTL encoders are used, A*, B*, and R* on the terminal block must be jumpered with M_Encoder (X531).

Table 4-31 Encoder connection X531

	Terminal	Signal name	Technical specifications
	1	P_Encoder 5 V / 24 V	Sensor power supply
	2	M_Encoder	Ground for sensor power supply
	3	-Temp	Motor temperature sensing KTY84-1C130 Temperature sensor connection KTY84-1C130/PTC
	4	+Temp	
	5	Reserved, do not use	
	6	Reserved, do not use	
	7	Reserved, do not use	
	8	Reserved, do not use	

Max. connectable cross-section: 1.5 mm² (AWG 14)

NOTE

When the sensor is connected via terminals, make sure that the cable shield is placed on the module.

4.12.3 Connection examples

Connection example 1: HTL encoder, bipolar, without zero marker -> p0405 = 9 (hex)

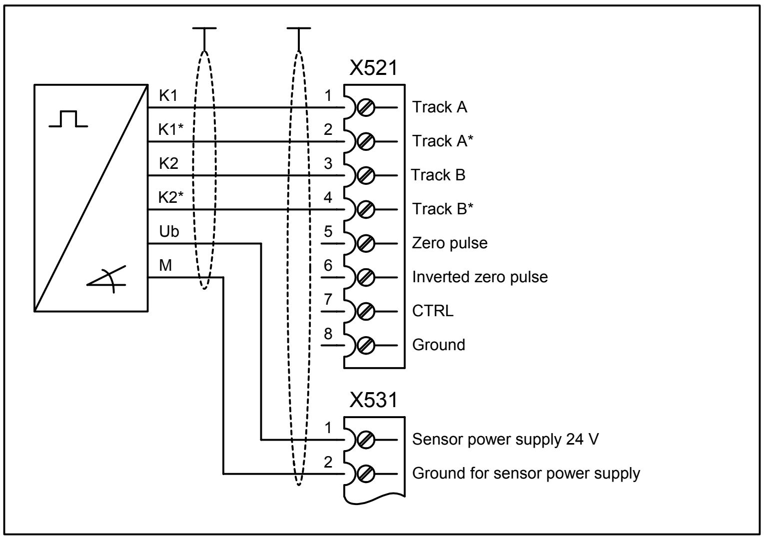


Fig. 4-17 Connection example 1: HTL encoder, bipolar, without zero marker

Connection example 2: TTL encoder, unipolar, without zero marker -> p0405 = A (hex)

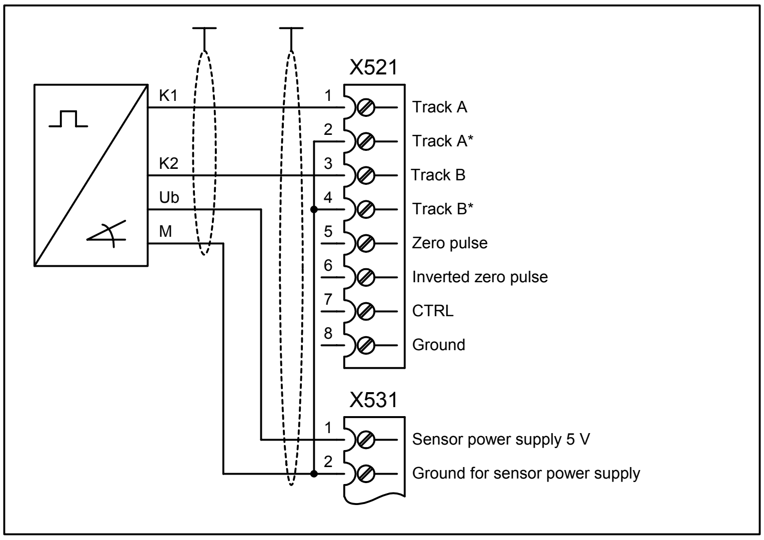


Fig. 4-18 Connection example 2: TTL encoder, unipolar, without zero marker

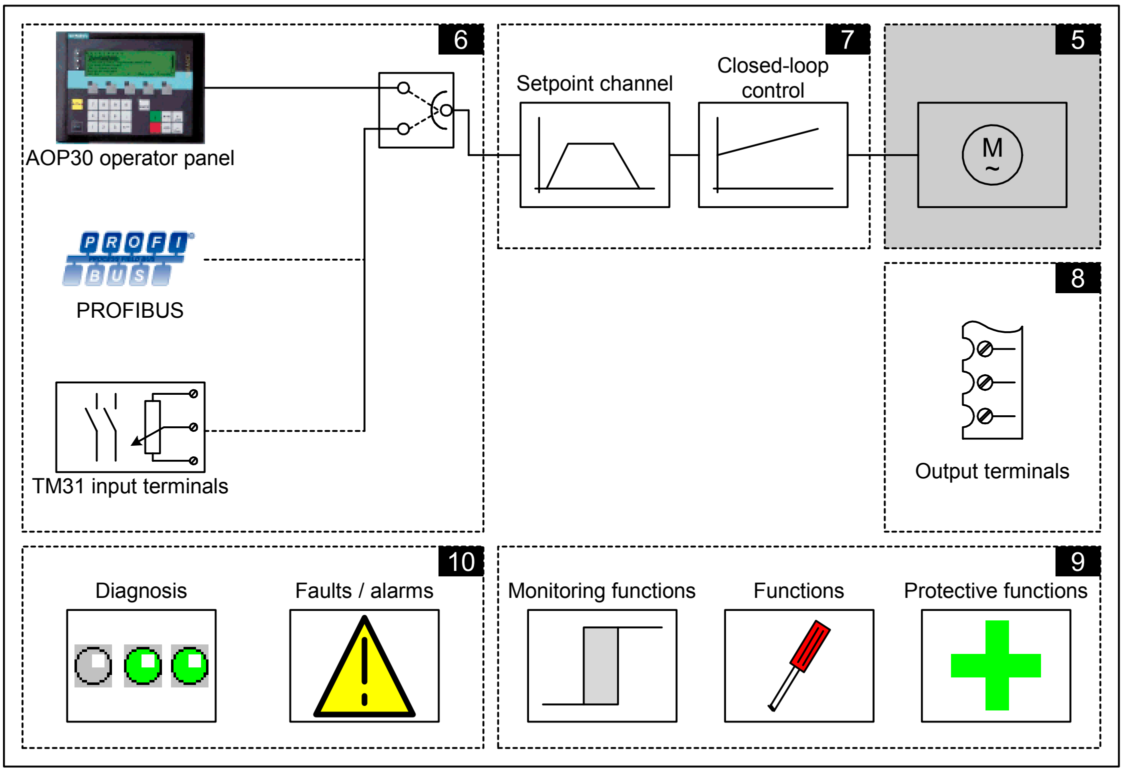
■

Commissioning 5

5.1 Chapter content

This chapter provides information on the following:

- Initial commissioning of the chassis units (initialization)
  - Entering the motor data (drive commissioning)
  - Entering the most important parameters (basic commissioning), concluding with the motor ID
- Data backup
- Resetting parameters to the factory setting



5.2 The STARTER commissioning tool

Description

You can use the **STARTER** commissioning tool to configure and commission SINAMICS drives and drive systems. The drive can be configured using the STARTER drive configuration Wizard.

NOTE

This chapter shows you how to carry out commissioning using STARTER.
STARTER features a comprehensive online help function, which provides detailed explanations of all the processes and available system settings.
This chapter will, therefore, only look at commissioning.

Prerequisites for installing STARTER

Minimum hardware requirements:

- PG or PC with:
- Pentium II 400 MHz (Windows NT/2000)
- Pentium III 500 MHz (Windows XP)
- 256 MB RAM (recommended 512 MB)
- 1024 x 768 pixel screen resolution

Minimum software requirements:

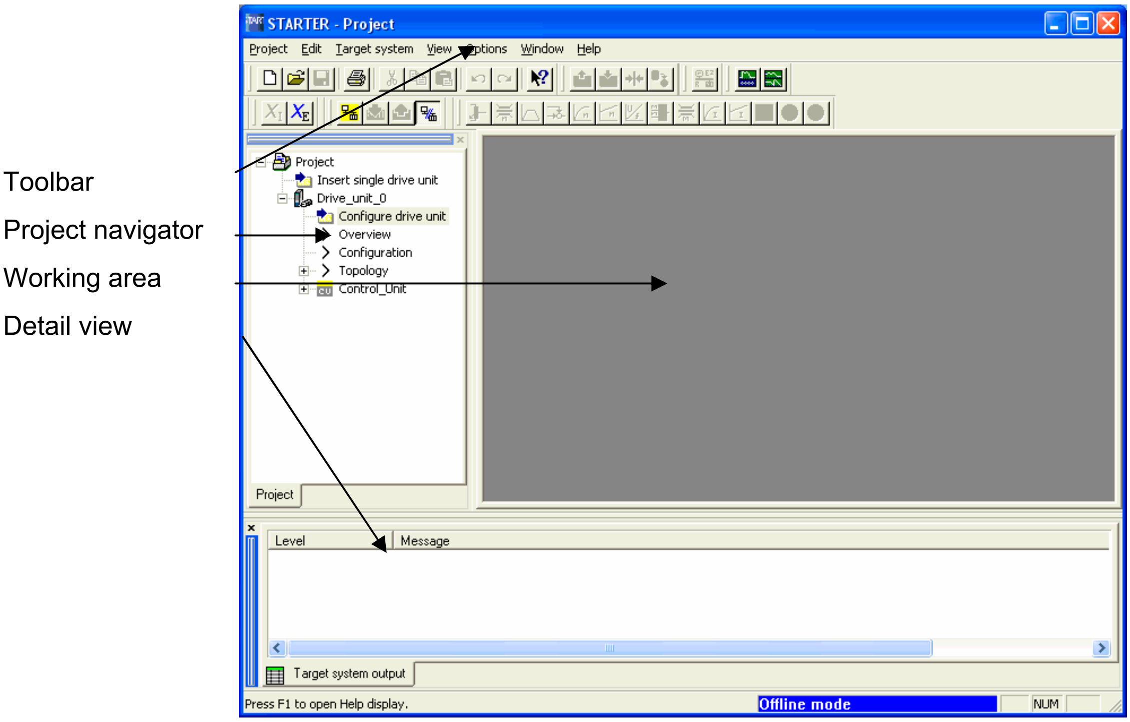
- Either Windows NT 4.0 SP6
- or Windows 2000 SP3
- or Windows XP Professional SP1
- and Internet Explorer V5.0.1

5.2.1 Installing STARTER

STARTER is installed using the “setup” file on the CD supplied. When you double-click the “setup” file, the installation Wizard guides you through the process of installing STARTER.

5.2.2 The STARTER user interface

STARTER features four operating areas:



Operating area	Explanation
Toolbar	In this area, you can access frequently used functions by clicking icons.
Project navigator	The elements and projects available in the project are displayed here.
Working area	In this area, you can change the settings for the drive units.
Detail view	Detailed information about faults and alarms, for example, is displayed this area.

5.3 Commissioning using STARTER

Basic procedure using STARTER

STARTER uses a sequence of dialog screens for entering the required drive unit data.

IMPORTANT

These dialog screens contain default settings, which you may have to change according to your application and configuration.

This is intentional!
Aim: By taking time to consider what configuration data you enter, you can prevent inconsistencies between the project data and drive unit data (identifiable in online mode).

5.3.1 Creating your project

Click the STARTER icon on your desktop or choose the following menu path in the Windows start menu to call up STARTER: Start > Simatic > STEP 7 > STARTER.

The first time you run the software, the main screen (shown below) appears with the following windows:

- STARTER Getting Started Drive Commissioning
- STARTER Project Wizard

The commissioning steps are listed below in numerical order.

Accessing the STARTER project Wizard

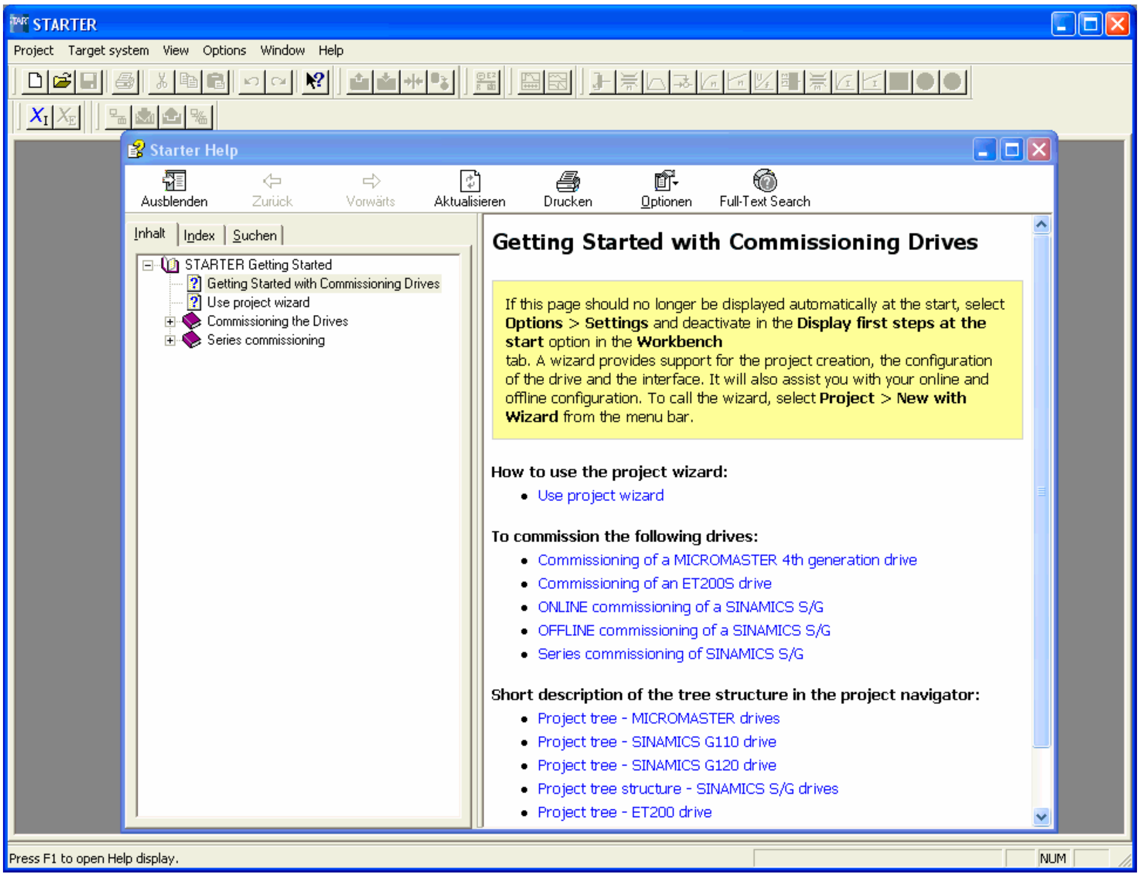


Fig. 5-1 Main screen for the STARTER parameterization and commissioning tool

1. Close the “STARTER Getting Started Drive Commissioning” screen by choosing **HTML Help > Close**.

NOTE

When you deactivate the **Display Wizard during start** checkbox, the project Wizard is no longer displayed the next time you start STARTER.

You can call up the project Wizard by choosing **Project > New with Wizard**.

To deactivate the online help for **Getting Started**, follow the instructions provided in Help.

You can call up the online help at any time by choosing **Help –> Getting Started**.

STARTER features a detailed online help function.

The STARTER project Wizard

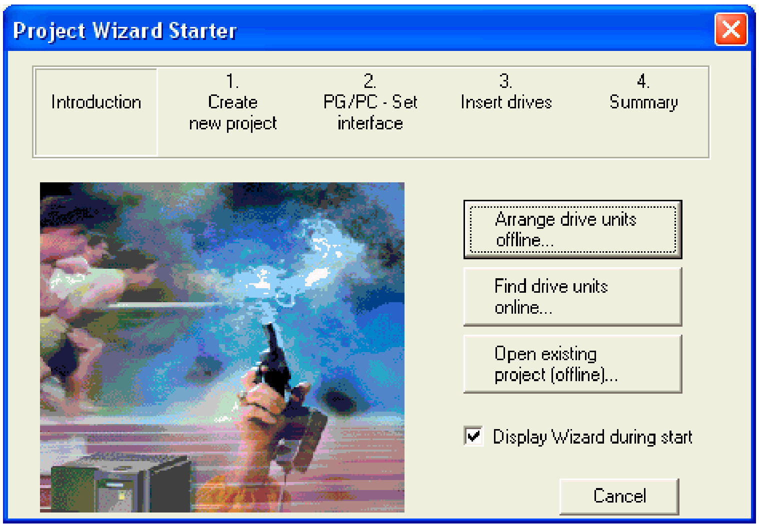


Fig. 5-2 The STARTER project Wizard

2. Click **Arrange drive units offline...** in the STARTER project Wizard.

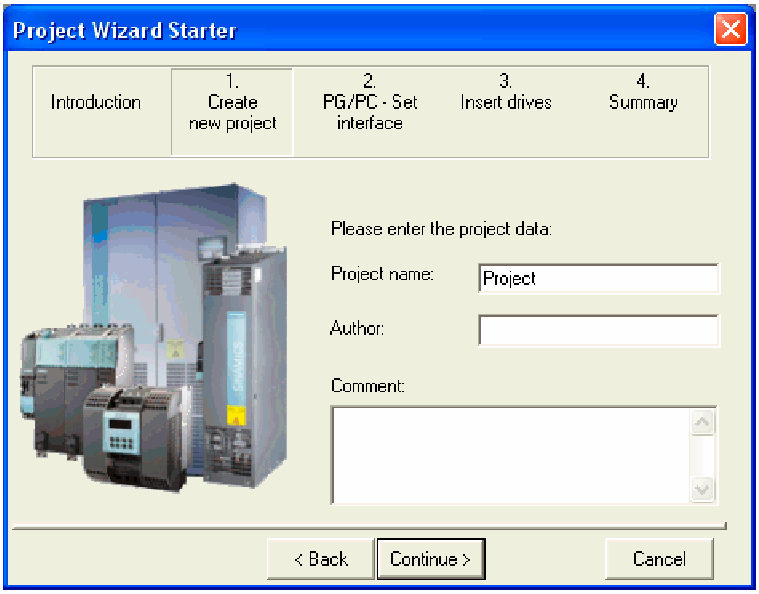


Fig. 5-3 Creating a new project

3. Enter the **project name** and, if necessary, the **author** and a **comment**.
4. Click **Continue >** to set up a PROFIBUS interface in the PG/PC.

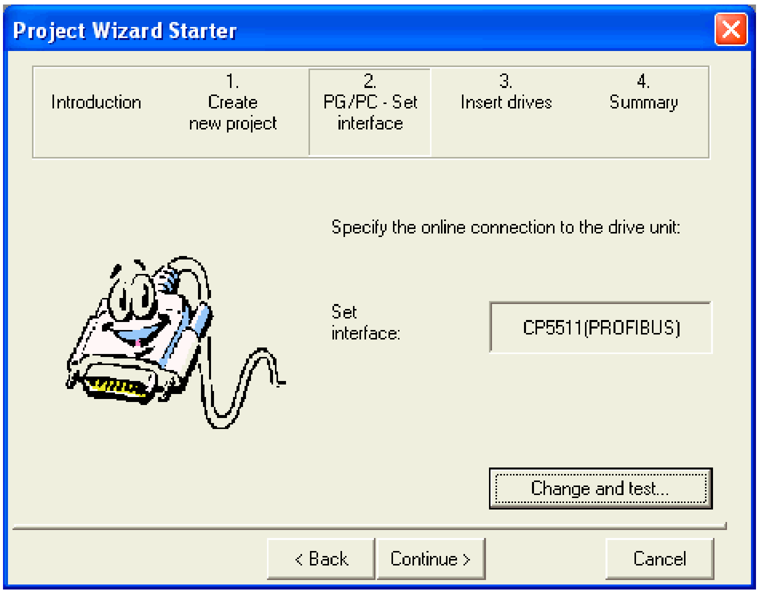


Fig. 5-4 Setting up the interface

NOTE

The online connection to the drive unit can only be established via PROFIBUS,

---

5. Click **Change and test...** and set up the interface in accordance with your device configuration.
   The **Properties...**, **Diagnostics...**, **Copy...**, and **Select...** pushbuttons are now active.

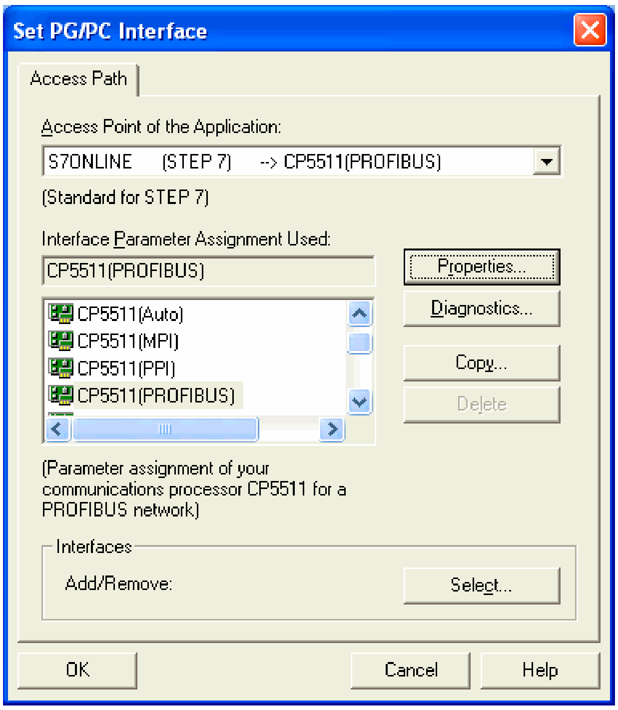


Fig. 5-5 Setting the interface

NOTE

To parameterize the interface, you must install the appropriate interface card (e.g.: CP5511).

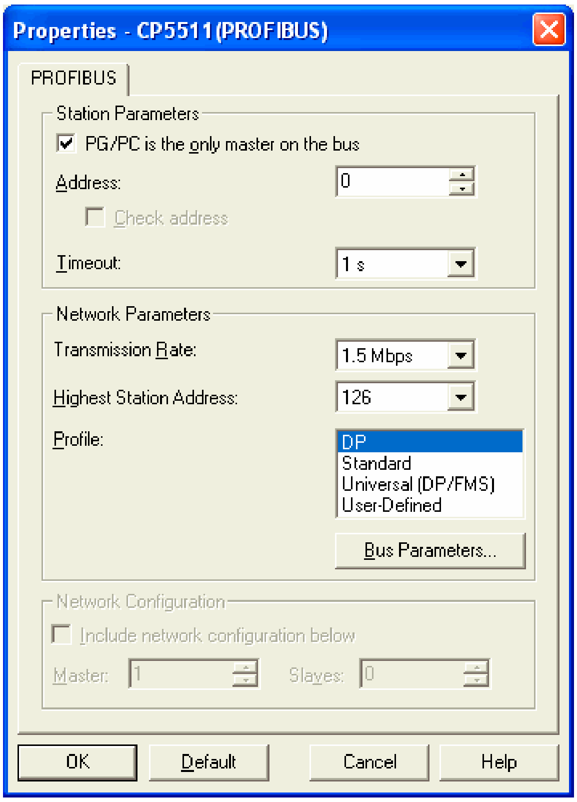


Fig. 5-6 Setting the interface properties

IMPORTANT

You must activate **PG/PC is the only master on bus** if no other master (PC, S7, etc.) is available on the bus.

NOTE

Projects can be created and PROFIBUS addresses for the drive objects assigned even if a PROFIBUS interface has not been installed on the PC.

To prevent bus addresses from being assigned more than once, only the bus addresses available in the project are proposed.

6. Once you have done this, click **OK** to confirm the settings and return to the project Wizard.

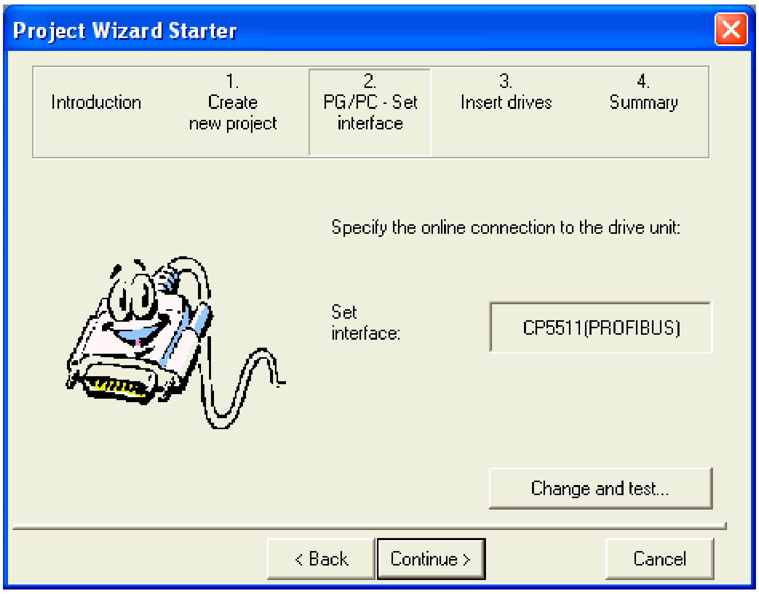


Fig. 5-7 Setting the interface

7. Click **Continue >** to set up a drive unit in the project Wizard.

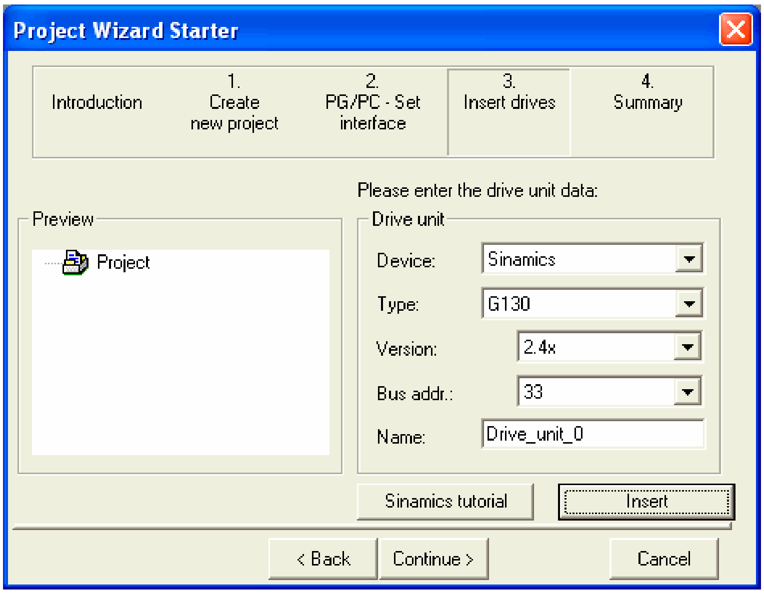


Fig. 5-8 Inserting a drive unit

8. Choose the following data from the list fields:

Device:	Sinamics
Type:	G130
Version:	v2.4
Bus address:	The corresponding bus address for your configuration
Entry in the **Name** field:	As required

9. Click **Insert**.
   The selected drive unit is displayed in a preview window in the project Wizard.

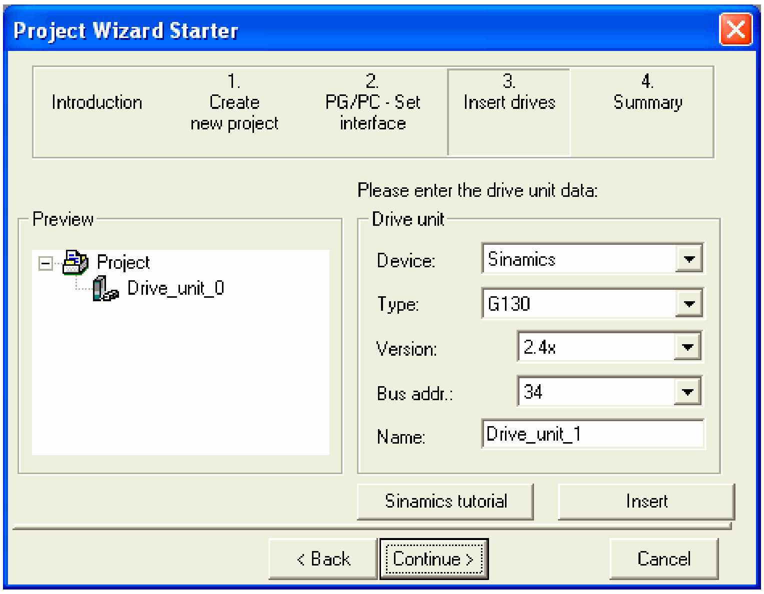


Fig. 5-9 Inserting a drive unit

10. Click **Continue >**.
    A project summary is displayed.

Fig. 5-10 Summary

11. Click **Complete** to finish creating a new drive unit project.

5.3.2 Configuring the drive unit

In the project navigator, open the component that contains your drive unit.

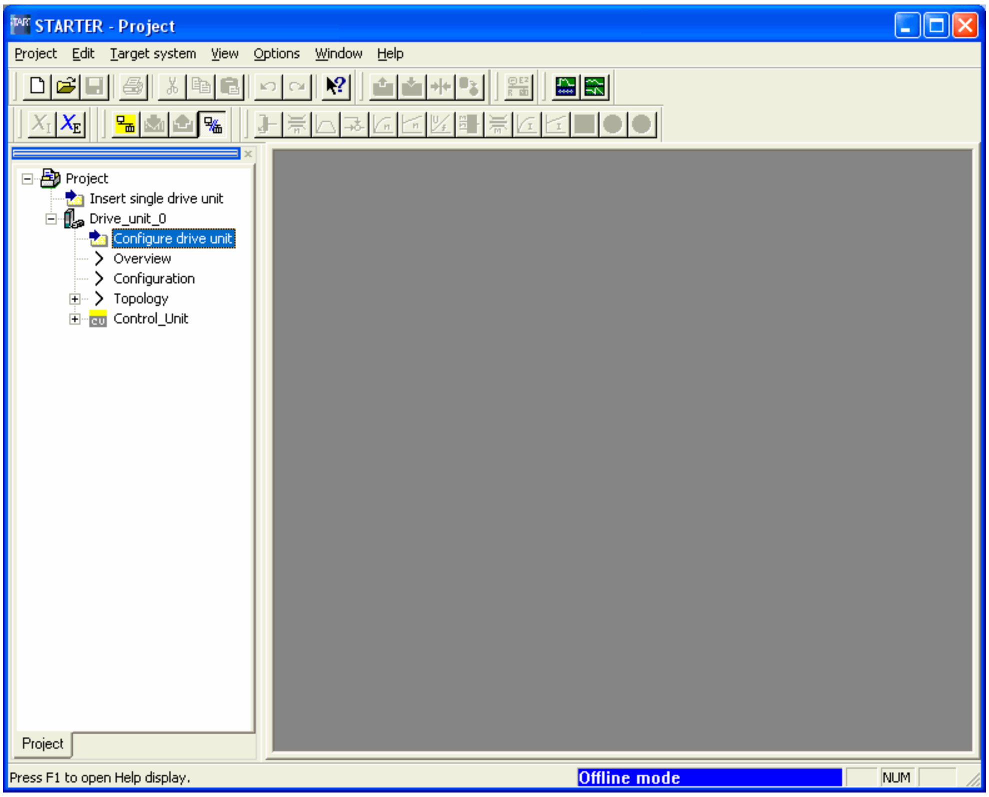


Fig. 5-11 Project navigator – configuring the drive unit

1. In the project navigator, click the plus sign next to the drive unit that you want to configure.
   The plus sign becomes a minus sign and the drive unit configuration options are displayed as a tree below the drive unit.
2. Double-click “Configure drive unit”.

Configuring the drive unit

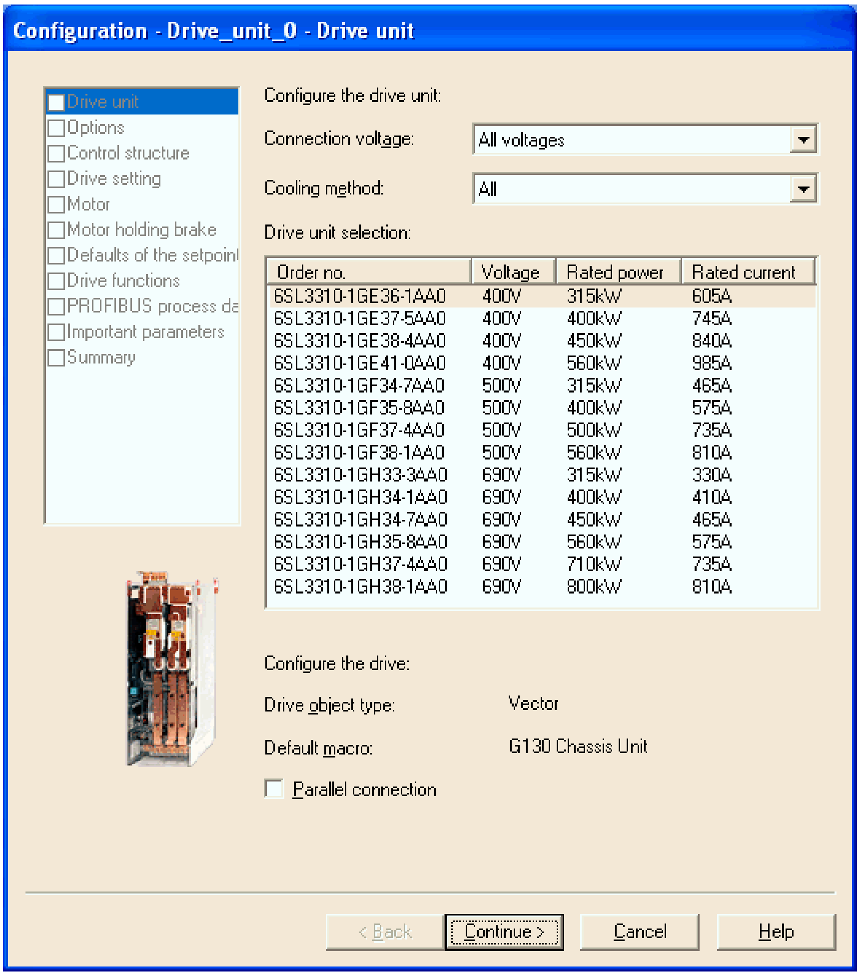


Fig. 5-12 Configuring the drive unit

3. In **Connection voltage:**, select the appropriate voltage and, in **Cooling method:**, the appropriate cooling method for your drive unit.

NOTE

In this step, you make a preliminary selection of the chassis units. You do not define the supply voltage yet.

---

4. A list is now displayed under **Drive unit selection:**. Choose the corresponding drive unit according to **type (order no.)** (see the type plate).
5. Click **Continue >**.

Choosing the options

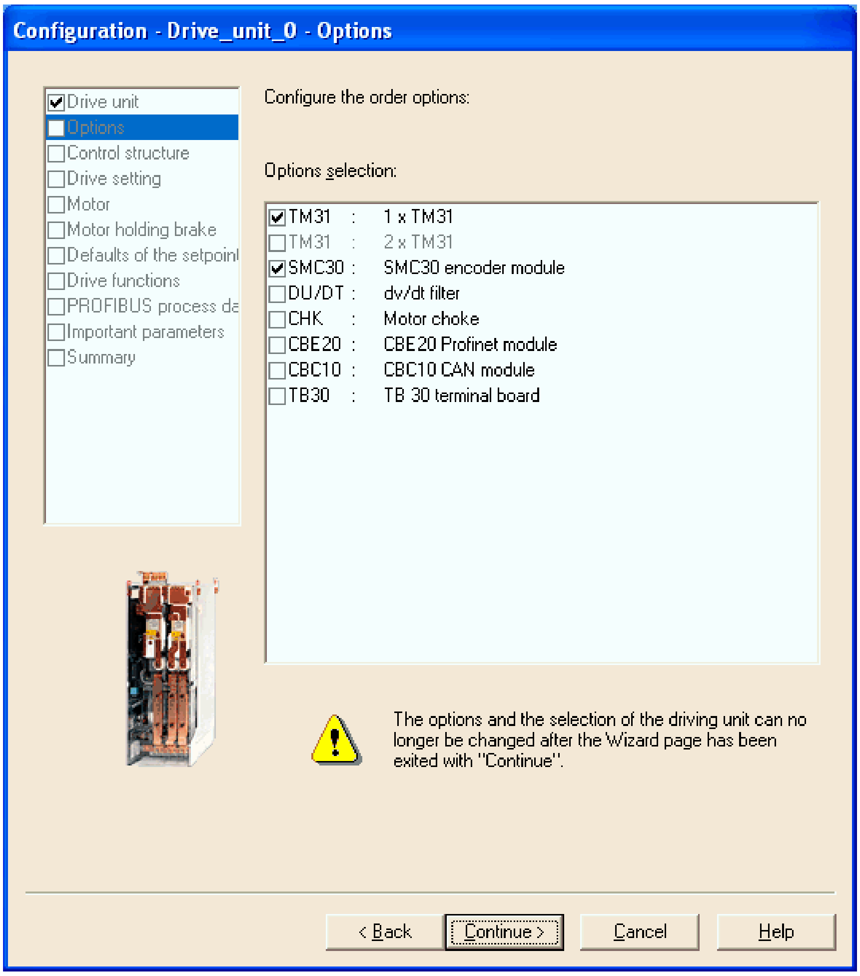


Fig. 5-13 Choosing the options

6. In the **Option selection:** combination field, choose the options that belong to your drive unit by clicking the appropriate checkboxes (see the type plate).

NOTE

Carefully check whether the selected options are connected to your chassis unit.

The Wizard makes internal connections on the basis of the options you have selected, which means that you can no longer change your options by pressing the **< Back** pushbutton.
If you have made an incorrect entry, you have to delete the entire drive unit from the project navigator and add a new one.

---

7. Carefully check your options and then click **Continue >**.

Selecting the control structure

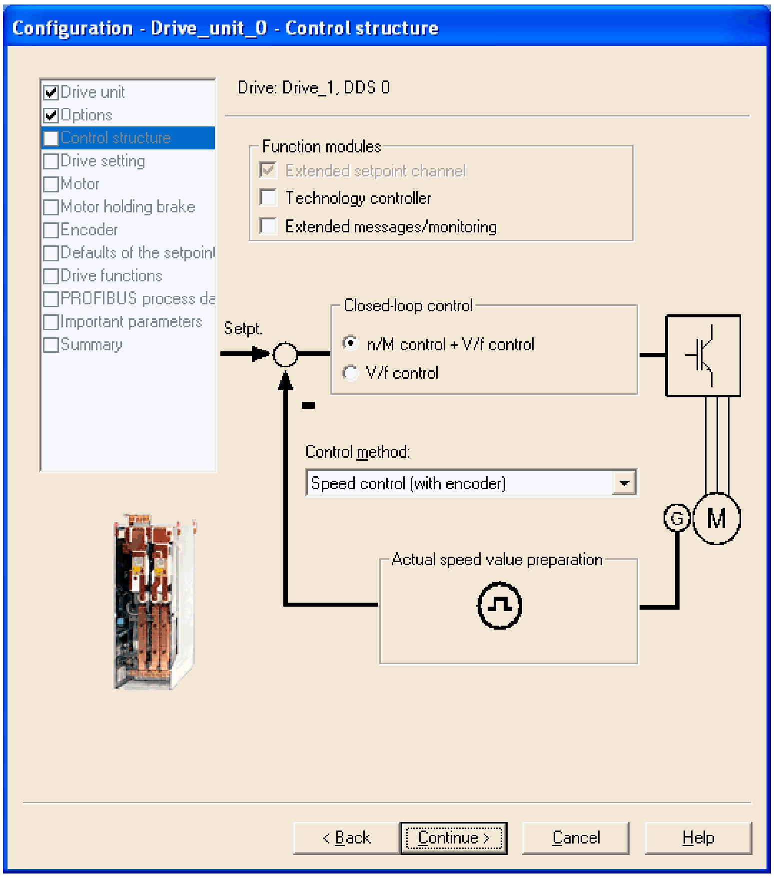


Fig. 5-14 Selecting the control structure

8. Select the required data:

   – **Function modules:**
   Select the function modules required in your application:
   - Technology controller
   - Extended messages/monitoring

   – **Control type:**
   Choose one of the following open-loop/closed-loop control types:
   - Torque control (sensorless)
   - Torque control (with encoder)
   - Speed control (sensorless)
   - Speed control (with encoder)
   - I/f control with fixed current
   - U/f control for drives requiring a precise frequency with FCC
   - U/f control for drives requiring a precise freq. (e.g. textiles)
   - U/f control with linear characteristic
   - U/f control with linear characteristic and FCC
   - U/f control with parabolic characteristic
   - U/f control with parameterizable characteristic
   - V/f control with independent voltage setpoint

9. Click **Continue >**.

Configuring the drive unit properties

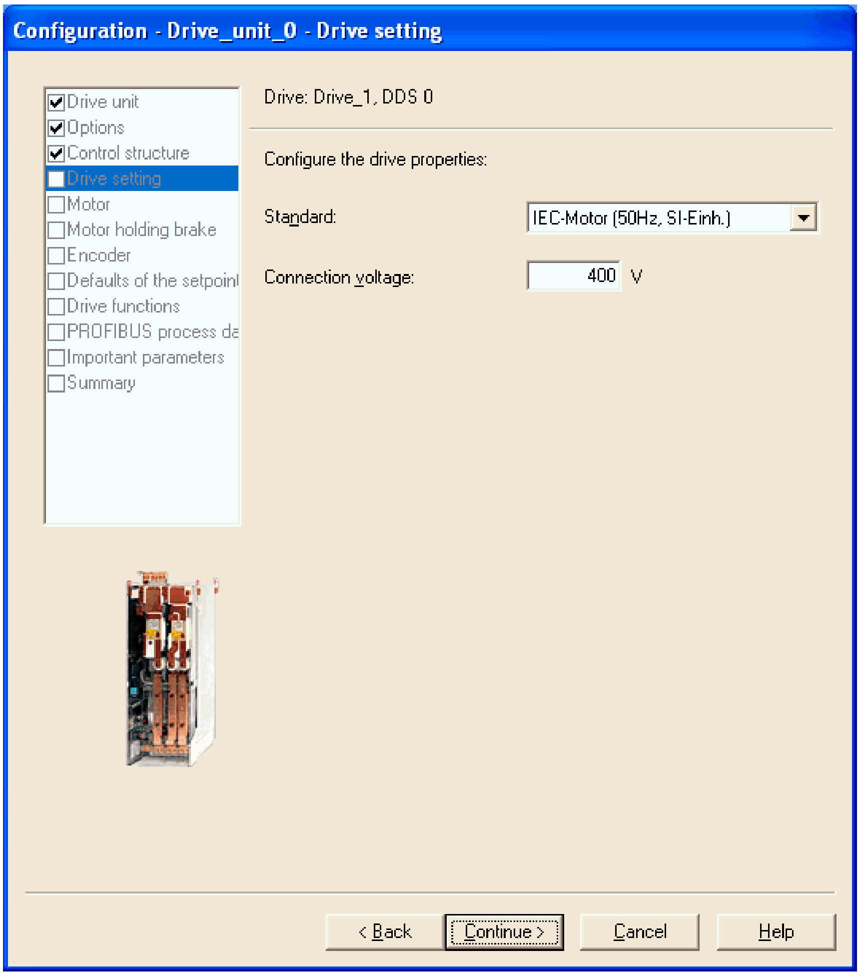


Fig. 5-15 Configuring the drive unit properties

10. In **Standard:**, choose the appropriate standard for your motor.
    The following standards are defined:
    IEC motor [50 Hz / SI-Einh.]: Line frequency 50 Hz, motor data in kW
    NEMA motor [60 Hz / US-Einh.]: Line frequency 60 Hz, motor data in hp
11. Under **Connection voltage:** enter the appropriate voltage of the cabinet unit.
12. Click **Continue >**.

Configuring the motor and selecting the motor type

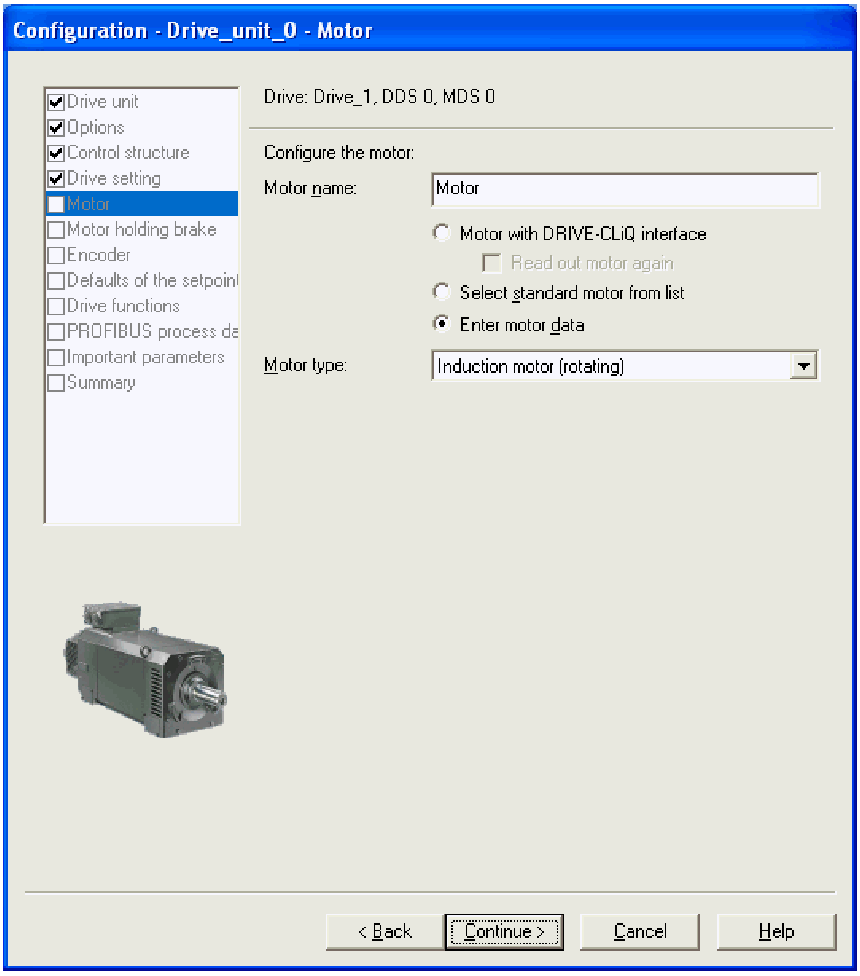


Fig. 5-16 Configuring the motor and selecting the motor type

13. In **Motor name:**, enter a name for the motor.
14. In the selection field next to **Motor type:**, select the appropriate motor for your application.

NOTE

The description provided for the following stages also applies to commissioning an asynchronous motor.

When commissioning a permanent-magnet synchronous motor, there are a few special conditions which are detailed in a separate chapter (chapter 7.4.6).

15. Click **Continue >**

Configuring the motor and entering motor data

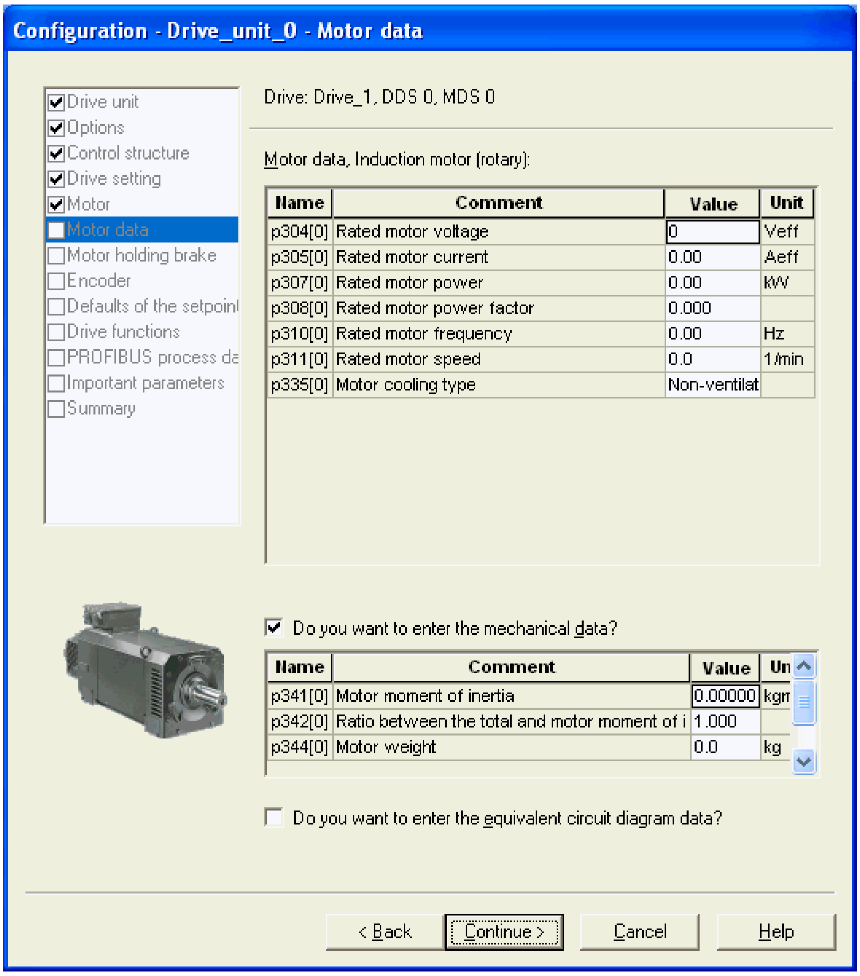


Fig. 5-17 Configuring the motor and entering motor data

16. Enter the motor data (see motor type plate).
17. If necessary, activate **Do you want to enter the mechanical data?**.
18. If necessary, activate **Do you want to enter the equivalent circuit diagram data?**.

IMPORTANT
This function should only be activated if the data sheet for equivalent circuit diagram data is available. If any data is missing, an error message will be output when the system attempts to load the drive project to the target system.

Configuring the motor and entering the equivalent circuit diagram data

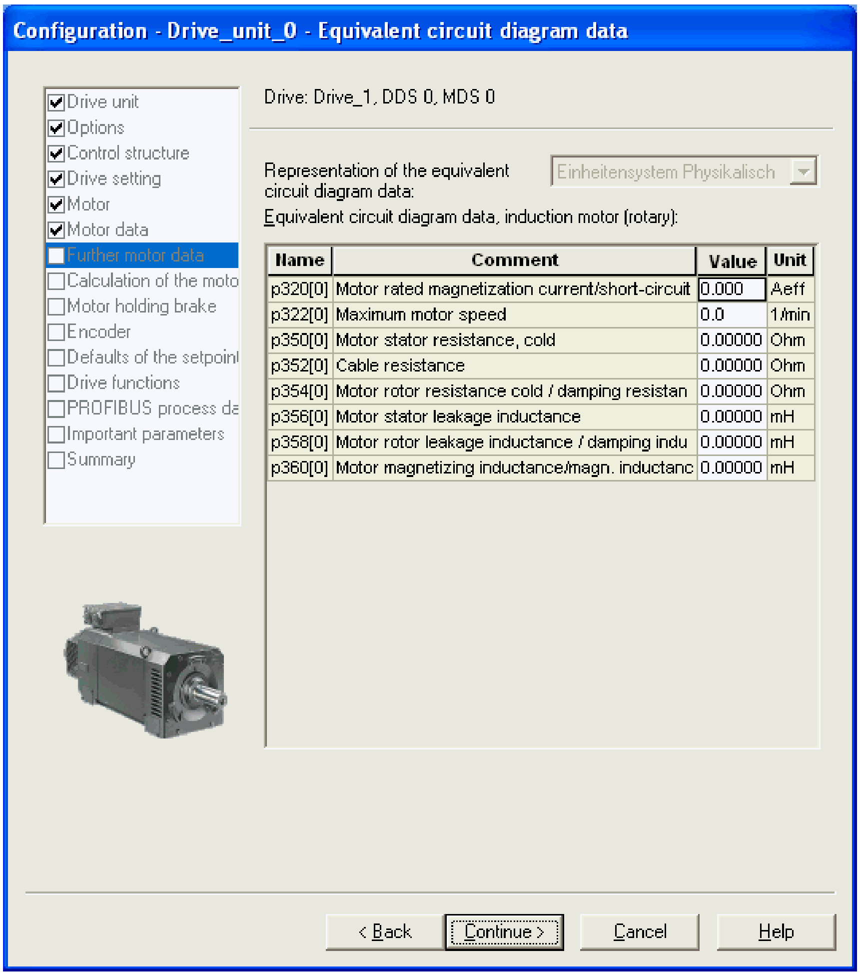


Fig. 5-18 Entering the equivalent circuit diagram data

19. If necessary, enter the equivalent circuit diagram data.
20. Click **Continue >**.

Calculating the motor/controller data

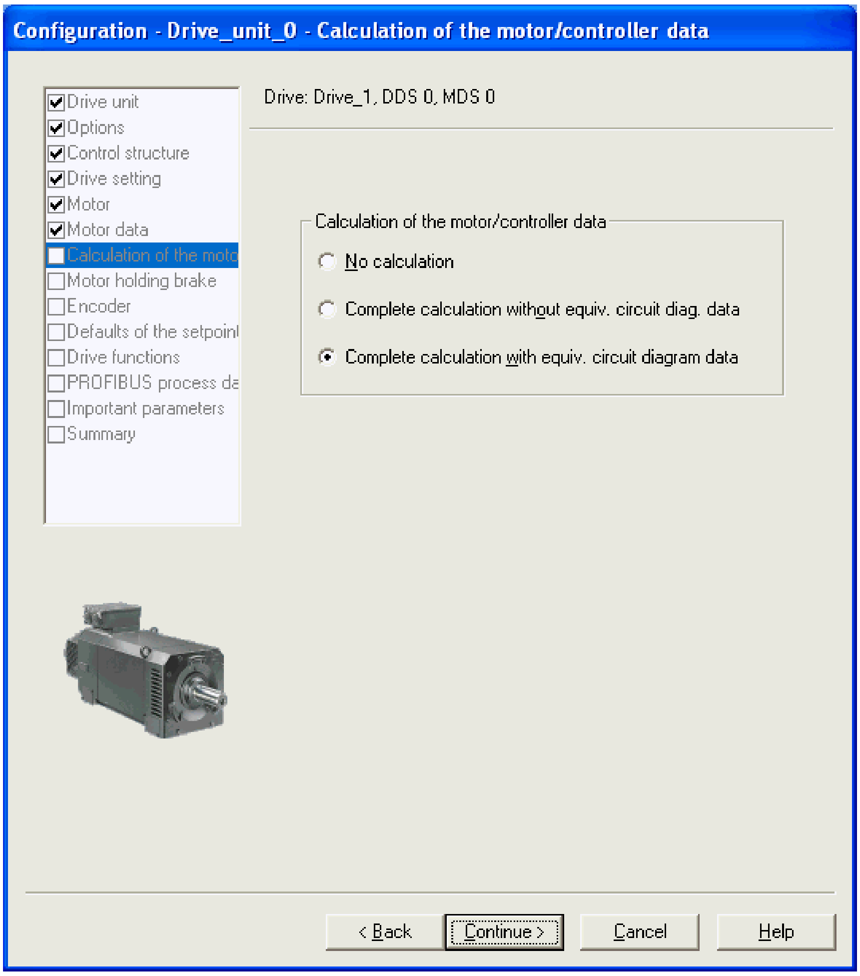


Fig. 5-19 Calculating the motor/controller data

21. In **Calculation of the motor/controller data**, choose the appropriate settings for your device configuration.

NOTE

If the equivalent circuit diagram data was entered manually (see Fig. 5-18), the motor/controller data should be calculated **without** calculating the equivalent circuit diagram data.

Configuring the motor holding brake

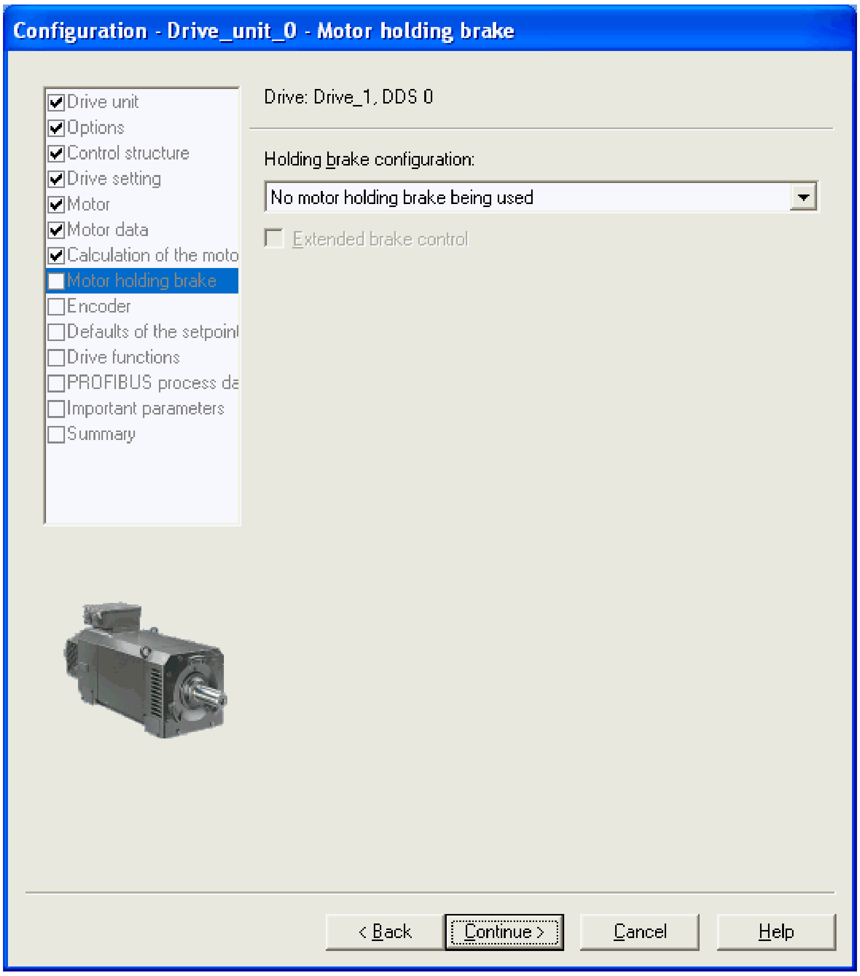


Fig. 5-20 Configuring the motor holding brake

22. In **Holding brake configuration:**, select the appropriate setting for your device configuration.

Entering the encoder data (option: SMC30 Sensor Module)

NOTE

If you have specified the option SMC30 Sensor Module, the following screen is displayed in which you can enter the encoder data.

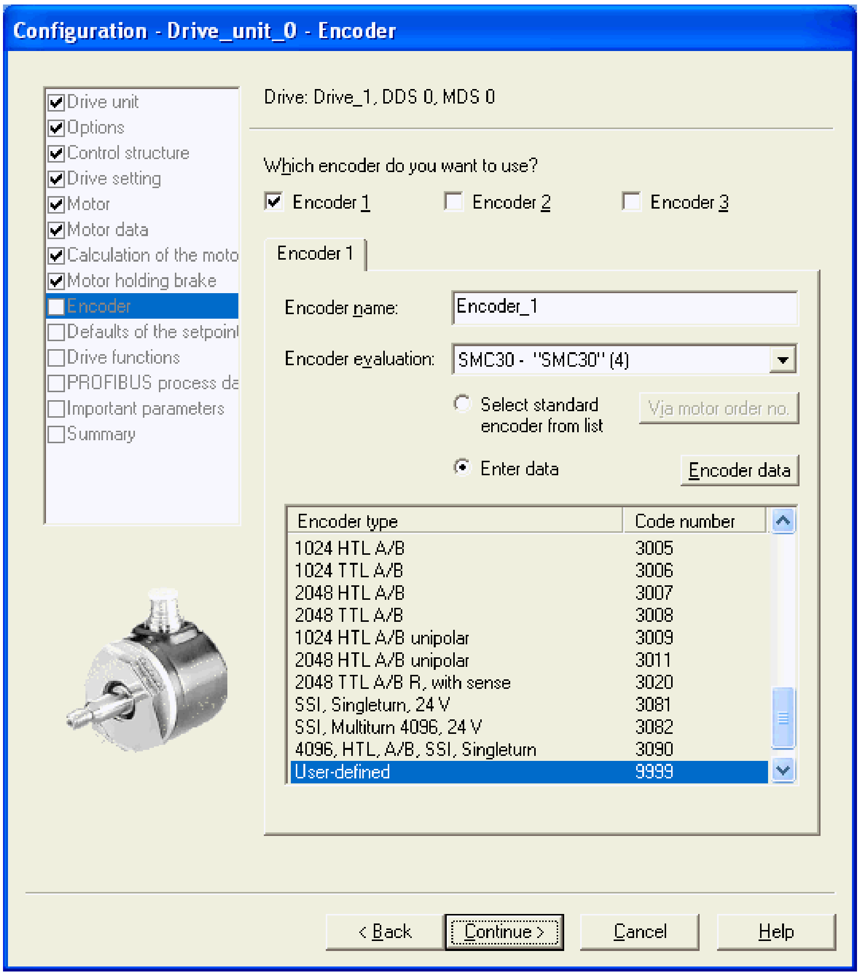


Fig. 5-21 Entering the encoder data

23. In **Encoder name:**, enter a name.

NOTE

In the factory setting, an HTL encoder is bipolar with 1024 pulses per revolution at terminal X521/X531 of the SMC30 Sensor Module.

24. Click the option field **Select standard encoder from list** and select one of the available encoders.

25. To enter special encoder configurations, click the option field **Enter data** and then **Encoder data**. The following screen is displayed in which you can enter the required data.

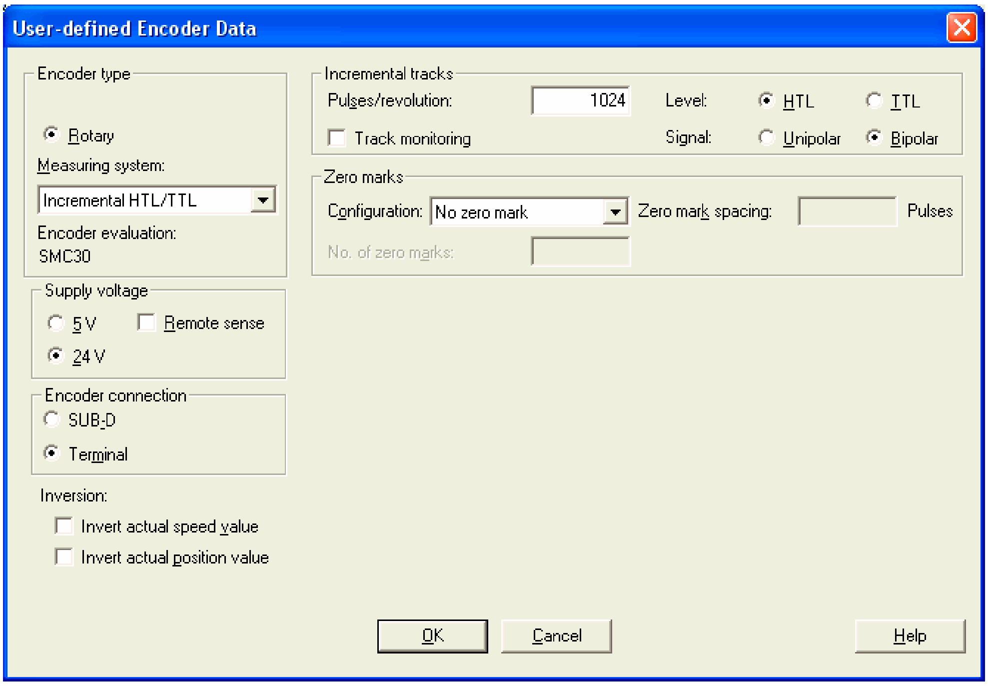


Fig. 5-22 Entering the encoder data – user-defined encoder data – HTL encoder

26. Select the **measuring system**.
    You can choose the following encoders:
    - HTL
    - TTL
27. Enter the required encoder data.
28. Click **OK**.

CAUTION

Once the encoder has been commissioned, the supply voltage (5/24 V) set for the encoder is activated on the SMC30 module. If a 5 V encoder is connected and the supply voltage has not been set correctly, the encoder may be damaged.

Default settings for setpoints / command sources

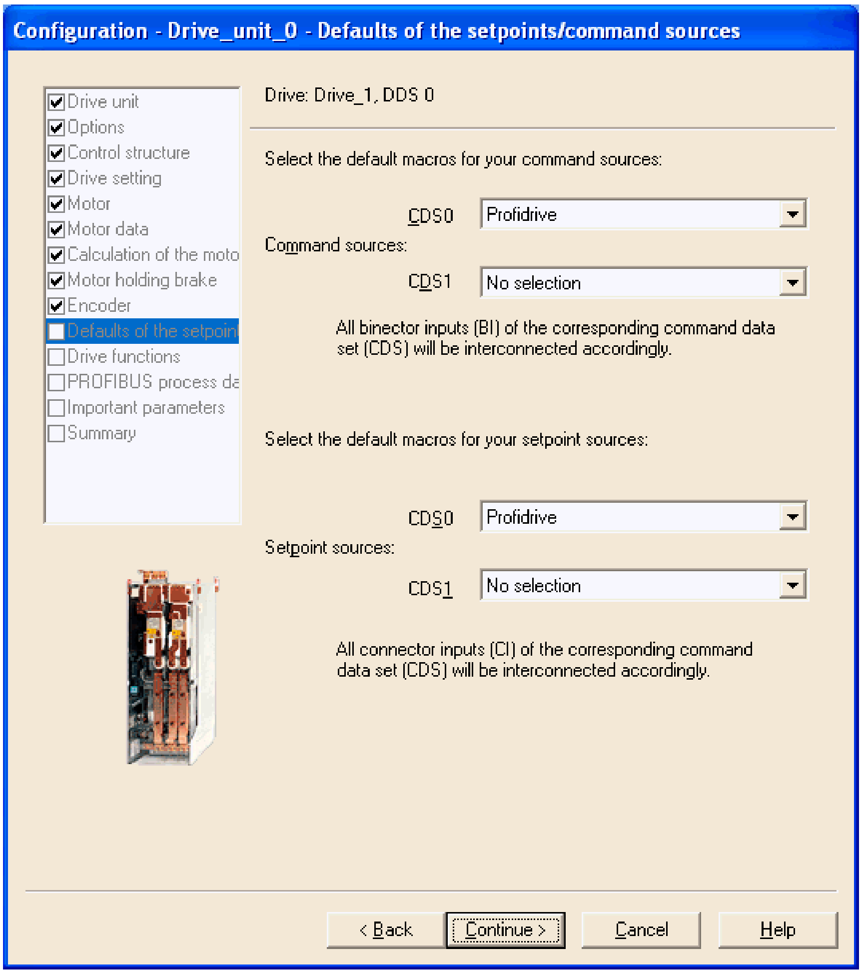


Fig. 5-23 Default settings for setpoints / command sources

29. In **Command sources:** and **Setpoint sources:**, choose the appropriate settings for your device configuration.
The following command and setpoint source options are available:

Command sources

- Profidrive
- TM31 terminals
- CU terminals
- Profidrive + TM31

Setpoint sources

- Profidrive
- TM31 terminals
- Motorized potentiometer
- Fixed setpoint

NOTE

With SINAMICS G130, only CDS0 is normally used as a default setting for the command and setpoint sources.

Make sure that the selected default settings are compatible with the actual system configuration.

You cannot use the **< Back** pushbutton if you want to change the default settings (unless **No selection** is displayed for the current value).
If you have made an incorrect entry, you have to delete the entire drive unit from the project navigator and add a new one.

30. Carefully check the default settings and then click **Continue >**.

Technological application / defining the motor identification

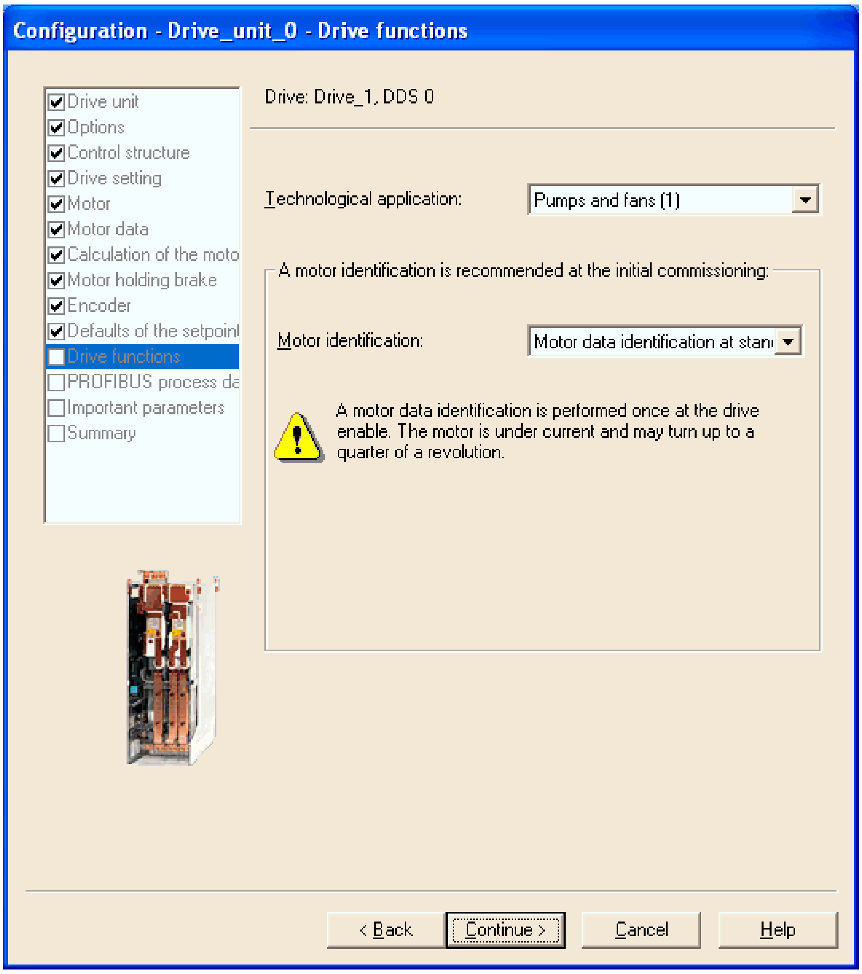


Fig. 5-24 Technological application / defining the motor identification

31. Select the required data.

   - **Technological application:**
     "Pumps and fans": edge modulation is enabled (default setting)
     "Standard drive (VECTOR)": edge modulation is not enabled.

   - **Motor identification:**
     In most cases, "Motor data identification at standstill" is the correct default setting for SINAMICS G130.

32. Click **Continue >**.

Selecting the PROFIBUS telegram

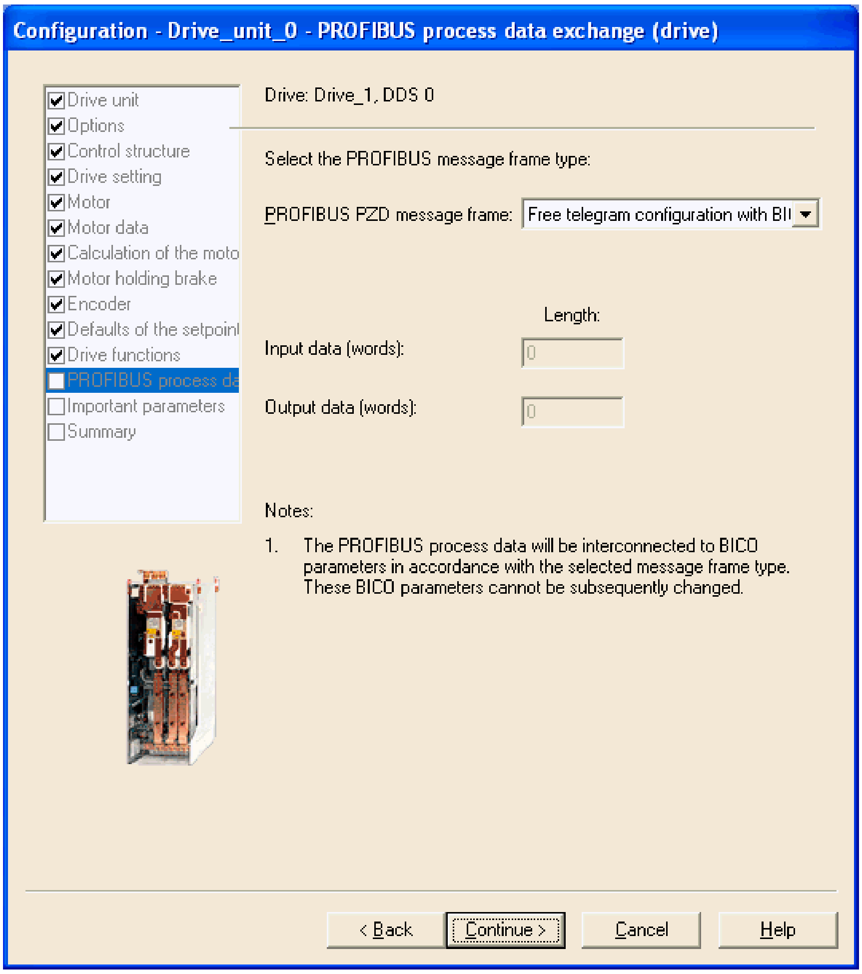


Fig. 5-25 Selecting the PROFIBUS telegram

33. Under **PROFIBUS PZD telegram, select:** the PROFIBUS telegram type.

Telegram types

- Standard telegram 1
- Standard telegram 2
- Standard telegram 3
- Standard telegram 4
- VIK-NAMUR telegram 20
- PCS7 telegram 352
- Free telegram configuration with BICO

34. Click **Continue >**.

Entering key parameters

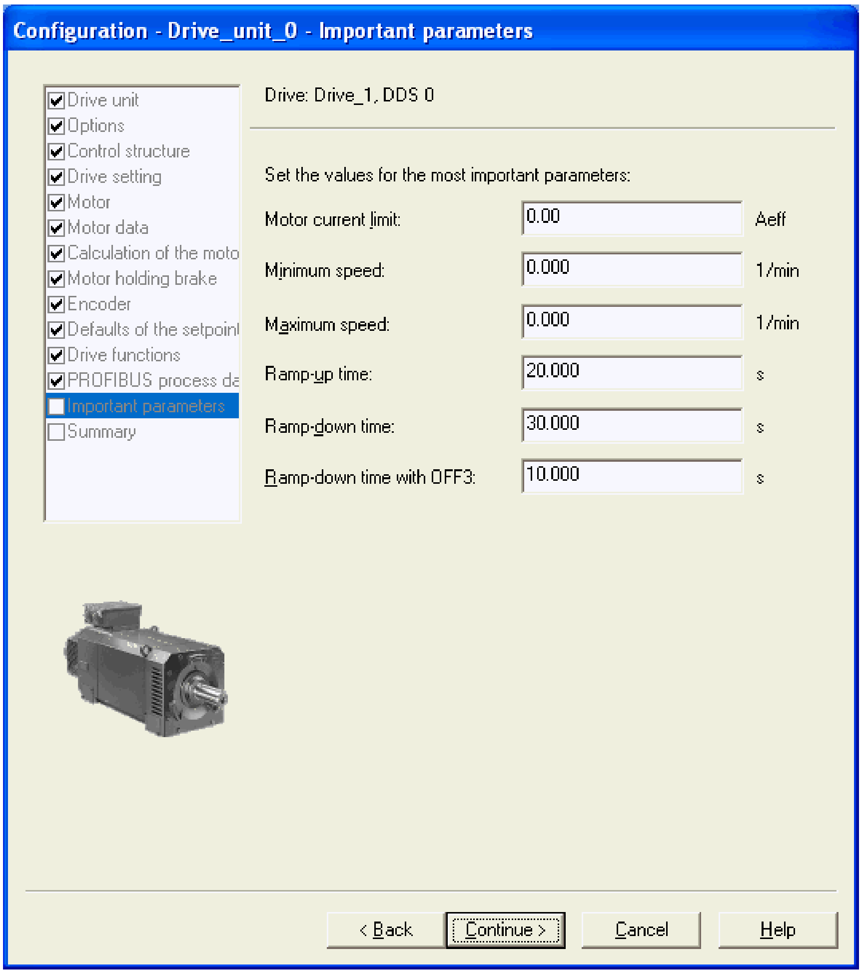


Fig. 5-26 Key parameters

35. Enter the required parameter values.

NOTE

STARTER provides tool tips if you position your cursor on the required field **without clicking in the field**.

---

36. Click **Continue >**.

Summary of the drive unit data

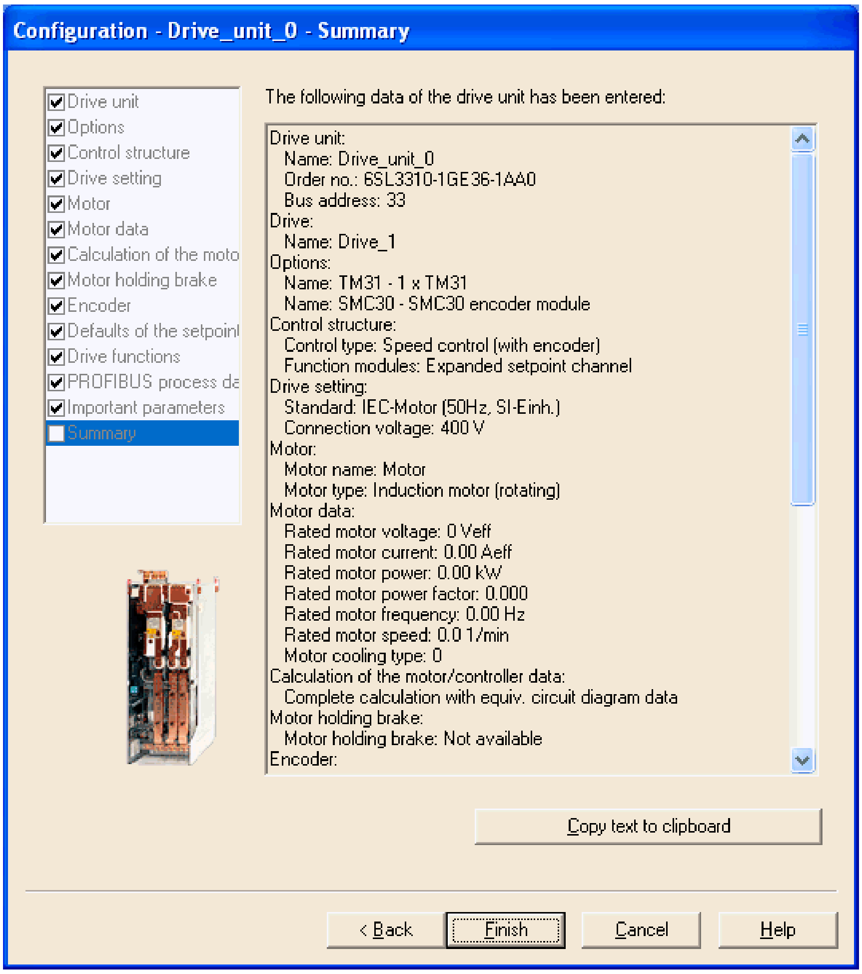


Fig. 5-27 Summary of the drive unit data

37. You can use the **Copy text to clipboard** function to copy the summary of the drive unit data displayed on the screen to a word processing program for subsequent use.

38. Click **Finish**.

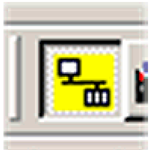
39. Save your project to the hard disk by choosing **Project > Save**.

5.3.3 Starting the drive project

You have created a project and saved it to your hard disk. You now have to transfer your project configuration data to the drive unit.

Transferring the STARTER project to the drive unit

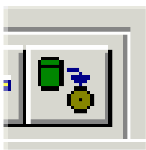
To transfer the STARTER project you created offline to the drive unit, carry out the following steps:

Step	Selection in toolbar
1. Choose **Project > Connect to target system**.	
2. Choose **Target system > Load project to target system**.	

IMPORTANT

The project has now been loaded to the drive unit. The data is currently only stored in the volatile memory of the drive unit and not on the CompactFlash card.

To store the project data on the CompactFlash card so that it is protected in the event of a power failure, carry out the following step.

Step	Selection in toolbar
3. Choose **Target system > Copy from RAM to ROM**.	

NOTE

The **Copy from RAM to ROM** icon is only active when the drive unit is selected in the project navigator.

Results of the previous steps

- You have created a drive unit project offline using STARTER.
- You have saved the project data to the hard disk on your PC.
- You have transferred the project data to the drive unit.
- You have saved the project data to the CompactFlash card so that it is protected in the event of a power failure.

NOTE

The STARTER commissioning tool supports complex drive system operations.

If you are confronted with any system conditions in online mode that are beyond your control, you are advised to delete the drive project from the project navigator and carefully create a new project in STARTER using the appropriate configuration data for your application.

5.3.4 Connection via serial interface

As well as the PROFIBUS connection, there is also the option of exchanging data via a serial interface.

Requirement

There must a serial interface (COM) on the PC from which the connection is to be made.

Settings

1. In STARTER, from **Project > Set PC/PG interface,** select the **Serial cable (PPI)** interface.
   If this is not available from the dropdown list, you first have to add it using **Select**.

NOTE

If the interface cannot be added to the selection menu, the driver for the serial interface has to be installed.
This can be found on the STARTER-CD using the following path:
\installation\starter\starter\Disk1\SerialCable_PPI\
The STARTER must not be active when installing the driver.

---

2. Enter the following settings. The "0" address and the transmission rate of 19.2 kbit/s are important here.

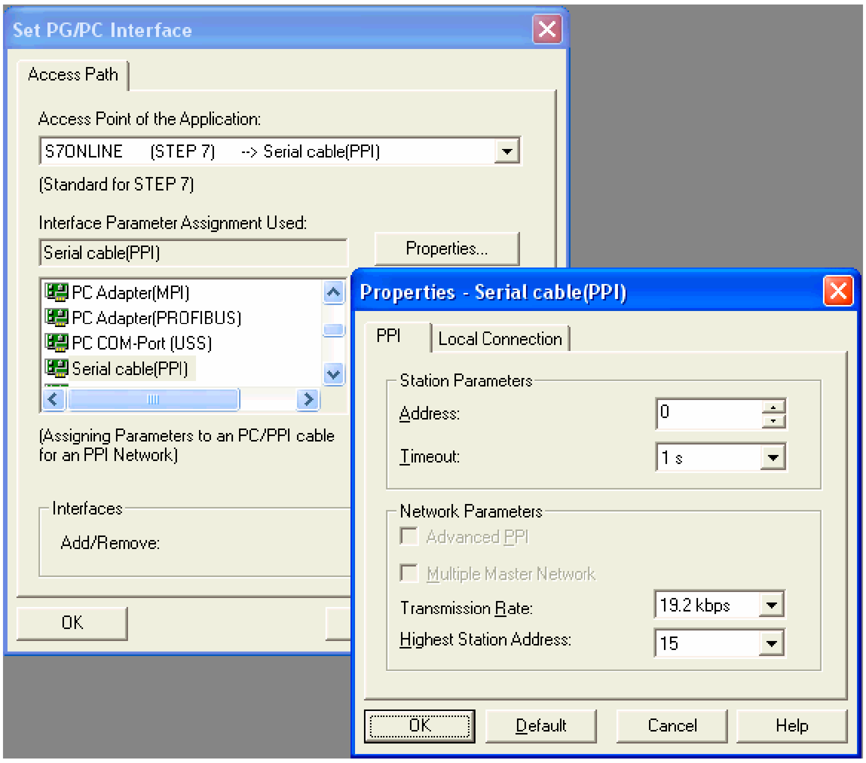


Fig. 5-28 Setting the interface

3. On CU320, set bus address "3" on the Profibus address switch.
4. When setting up the drive unit, also set bus address "3".

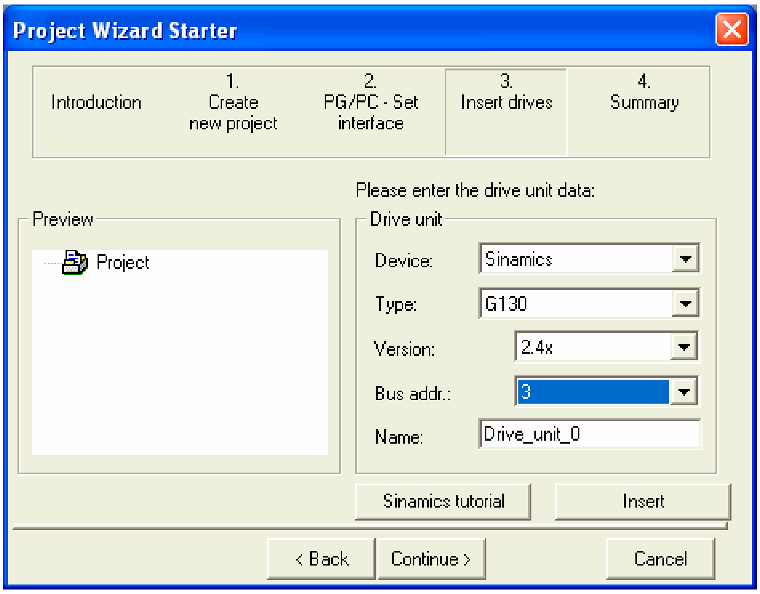


Fig. 5-29 Setting the bus address

NOTE

The bus addresses on CU320 and on the PC must not be set the same.

---

5. The connecting cable from CU320 to AOP30 must be ground off on CU320. A null modem cable must be connected up here as a link between the PC (COM interface) and CU320.
   This interface must not be changed.

5.4 The AOP30 operator panel (optional)

Description

An optional operator panel for operating, monitoring, and commissioning purposes is available. It has the following features:

- Graphical LCD with backlighting for plain-text display and a "bar display" of process variables
- LEDs for displaying the operational statuses
- Help function describing causes of and remedies for faults and alarms
- Keypad for controlling drives during operation
- LOCAL/REMOTE switchover for selecting the control terminal (master control assigned to operator panel or customer terminal block / PROFIBUS)
- Numeric keypad for entering setpoint or parameter values
- Function keys for prompted navigation through the menus
- Two-stage security concept to protect against accidental or unauthorized changes to settings
- Degree of protection IP 54 (when installed)

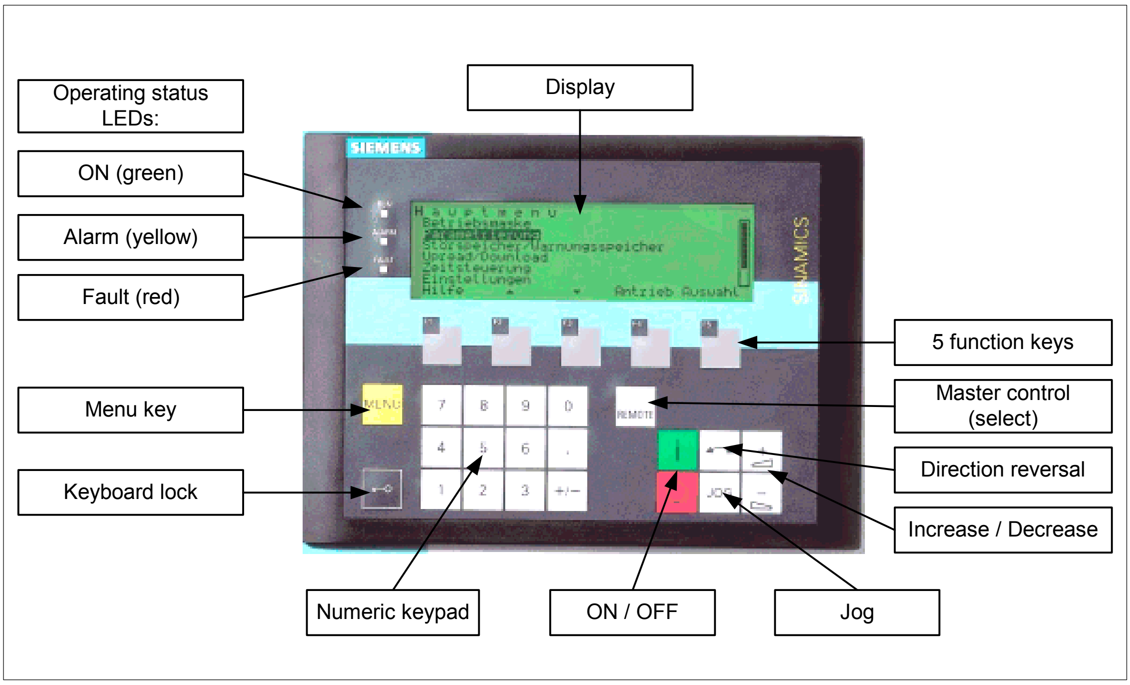


Fig. 5-30 Components of the chassis unit operator panel (AOP30)

5.5 First commissioning

5.5.1 Initial ramp-up

Start screen

When the system is switched on for the first time, the Control Unit (CPU) is initialized automatically. The following screen is displayed:

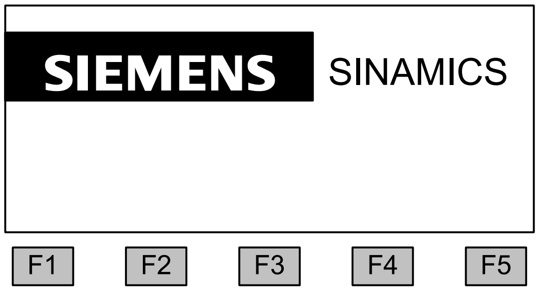


Fig. 5-31 Initial screen

When the system boots up, the parameter descriptions are loaded into the operating field from the CompactFlash card.

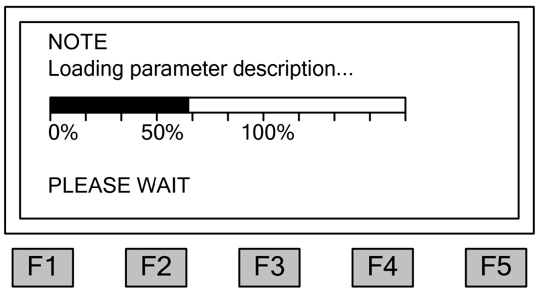
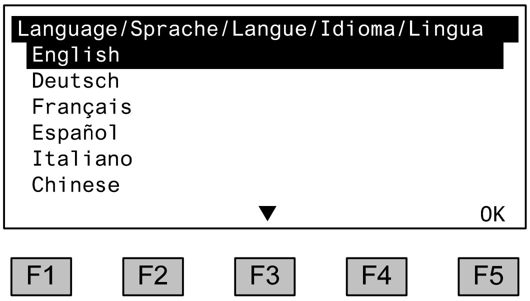


Fig. 5-32 Load the parameter descriptions while booting up the system

Selecting the language

When the system is first booted up, a screen for selecting the language appears.



The language should be selected in the interactive screen.

Use <F2> and <F3> to change language
Use <F5> to select language

Fig. 5-33 Language selection

Once the language has been selected, the booting up process continues.

Once the system has successfully ramped up, the drive has to be commissioned when the system is switched on for the first time after it has been delivered. The converter can then be switched on.

When the system is then ramped up again, it can be operated immediately.

Navigation within the interactive screens

Within an interactive screen, the selection boxes can usually be selected using the F2 and/or F3 keys. Selection boxes are usually texts set in frames which are highlighted (inverted) by selecting them (white font on black background).
The present value of a highlighted selection box can usually be changed by pressing F5 "OK" and/or "Change". Another entry box then appears and the value you want is entered directly using the numerical keypad or can be selected from a list.

You can change from an interactive screen to the next or previous screen by selecting the "Next" or "Previous" selection boxes and then confirming by pressing F5 "OK".
The "Next" selection box only appears at the end of the interactive screen on screens with particularly important parameters. This is because every single parameter in this interactive screen has to be checked and/or corrected thoroughly before the next interactive screen can be accessed.

5.5.2 Initial commissioning

Entering the motor data

During initial commissioning, you have to enter motor data using the operator panel. Use the data shown on the motor type plate.

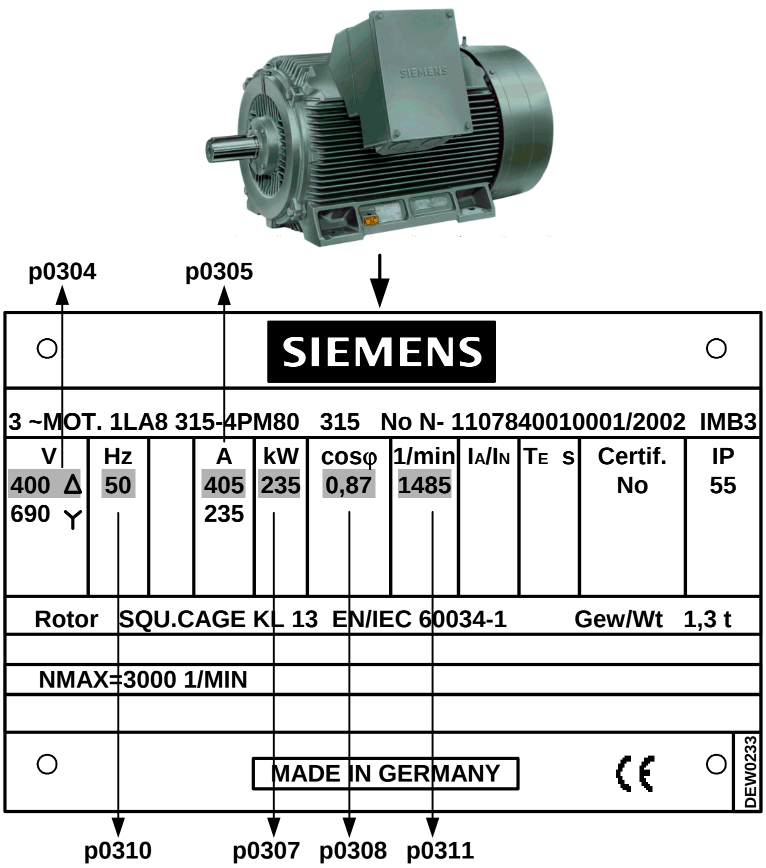
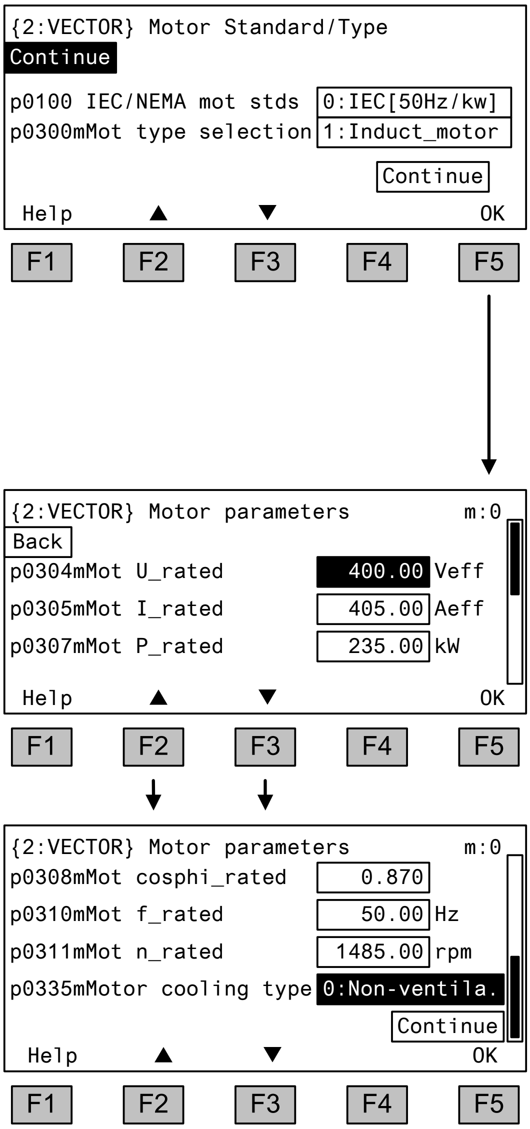


Fig. 5-34 Example of a motor type plate

Table 5-1 Motor data

	Parameter no.	Values	Unit
System of units for line frequency and entering motor data	p0100	0 1	IEC [50 Hz / kW] NEMA [60 Hz / hp]
Motor: Rated voltage Rated current Rated output Rated power factor Cos φ (at p0100 = 0 only) Rated efficiency η (at p0100 = 1 only) Rated frequency Rated speed	 p0304 p0305 p0307 p0308 p0309 p0310 p0311		 [V] [A] [kW] / [hp] [%] [Hz] [min-1] / [rpm]

Basic Commissioning: Selecting the Motor Type and Entering the Motor Data



The motor standard and motor type should be selected in the interactive screen.
The following is defined for motor standard:
0: mains frequency 50 Hz, motor data in kW
1: mains frequency 60 Hz, motor data in hp

The following selection options are permitted for motor type:
1: asynchronous motor
2: synchronous motor permanently excited
No other values are permitted.

Use <F2> and <F3> to navigate within the selection boxes
Use <F5> to activate the selection made by navigation

Input of motor data from the type plate

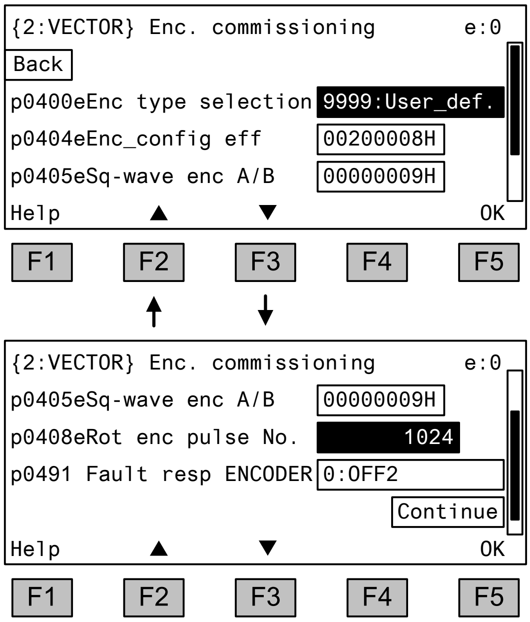
Use <F2> and <F3> to navigate within the selection boxes
Use <F5> to activate the selection made by navigation

Change a parameter value by going to the selection box required and pressing <F5> to activate the value.
Another entry box appears in which
- the value required can be entered directly or
- the value can be selected from a list.

The input of motor data is completed by selecting the \`next´ selection box under the last parameter value and activated by pressing <F5>.

Fig. 5-35 Selecting the motor type and entering the motor data

Basic commissioning: entering the encoder data (if available)



If the SMC30 module is connected up for encoder evaluation, this is rexognized by AOP30 and a screen displayed for entering the encoder data.

Use <F2> and <F3> to navigate within the selection boxes
Use <F5> to activate the selection made by navigation

Fig. 5-36 Entering the encoder data (if available)

Predefined encoders can be easily set by selecting parameter p0400 (encoder type selection):

- 3001: 1024 HTL A/B R at X521/X531
- 3002: 1024 TTL A/B R at X521/X531
- 3003: 2048 HTL A/B R at X521/X531
- 3005: 1024 HTL A/B at X521/X531
- 3006: 1024 TTL A/B at X521/X531
- 3007: 2048 HTL A/B at X521/X531
- 3008: 2048 TTL A/B at X521/X531
- 3009: 1024 HTL A/B unipolar at X521/X531
- 3011: 2048 HTL A/B unipolar at X521/X531
- 3020: 2048 TTL A/B R at X520

NOTE

In the factory setting, an HTL encoder is bipolar with 1024 pulses per revolution and a 24 V power supply.

Chapter 4 ("Electrical Installation") contains two connection examples for HTL and TTL encoders.

The significance of the bit settings for p0404 is as follows:

Bit	Meaning	Value 0	Value 1
20	Voltage 5 V	No	Yes
21	Voltage 24 V	No	Yes

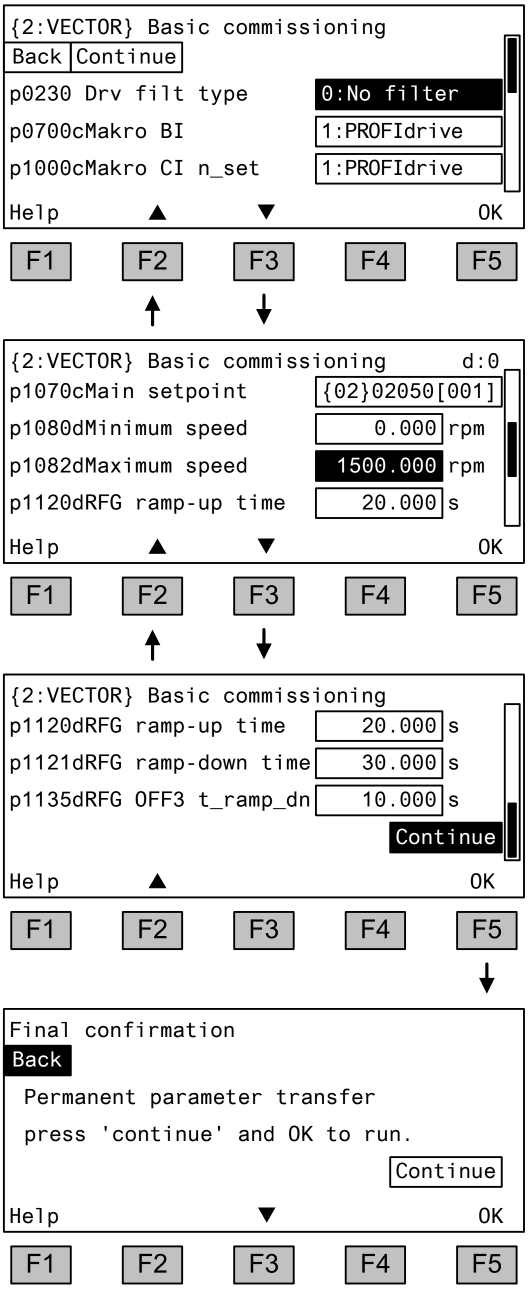
The significance of the bit settings for p0405 is as follows:

Bit	Meaning	Value 0	Value 1
0	Signal	Unipolar	Bipolar
1	Level	HTL	TTL
2	Track monitoring	None	A/B<> -A/B
3	Zero pulse	24 V unip.	Same as A/B track

CAUTION

Once the encoder has been commissioned, the supply voltage (5/24 V) set for the encoder is activated on the SMC30 module. If a 5 V encoder is connected and the supply voltage has not been set correctly via p0404 (bit 20 = "Yes", bit 21 = "No"), the encoder may be damaged.

Basic commissioning: entering the basic parameters



Entering basic commissioning parameters

If a sinusoidal filter is connected up, it MUST be activated in p0230 (p0230 = 3) because otherwise the filter may be destroyed!

p0700: Pre-assignment of command source
- 1: PROFIdrive
- 2: Terminals TM31
- 3: CU terminals
- 4: PROFIdrive+TM31

p1000: Pre-assignment of setpoint source
- 1: PROFIdrive
- 2: Terminals TM31
- 3: Motor potentiometer
- 4: Fixed setpoint

Once a setpoint source (p01000) has been selected, the main setpoint p1070 is preset accordingly.

Use <F2> and <F3> to navigate within the selection boxes
Use <F5> to activate the selection made by navigation

Change a parameter value by going to the selection box required and pressing <F5> to activate the value.
Another entry box appears in which
- the value required can be entered directly or
- the value can be selected from a list.

Final confirmation

Final confirmation is received to indicate that the basic parameters entered have been transferred.

Once you have pressed `next´ and activated by pressing <F5>, the basic parameters entered are saved permanently and the calculations needed for control undertaken.

Fig. 5-37 Basic commissioning – Entering the Basic Parameters

---

NOTICE

A filter at the motor end must be entered in p0230 (motor restrictor: p0230 = 1, dv/dt filter: p0230 = 2, external sinusoidal filter: p0230 = 4). Motor control cannot otherwise work perfectly.

Basic Commissioning: Motor Identification

```
{2:VECTOR} Motor ID
 Select ID type:
  Stat. + rotating
  Stationary only
  No ID

Help               ▼            OK
```

F1 F2 F3 F4 F5

```
{2:VECTOR} Motor ID
   NOTE
   Start the drive by
   pressing LOCAL and ON.

Help                      Cancel
```

F1 F2 F3 F4 F5

Selecting motor identification

Use <F2> and <F3> to navigate within the selection boxes
Use <F5> to activate the selection made by navigation

The stationary measurement increases the level of control quality because variations in teh electric characteristics are minimized as a result of scatter in the material characteristics and production tolerances

The rotary measurement calculates the data required (e.g. torque of inertia) for setting the speed controller. The motor´s magnetization characteristics curve and rated characteristics curve are also measured.

Press the LOCAL button (wait until the LED in the LOCAL button lights up) and the ON button to switch on.

If motor indentification is not undertaken, the motor control does not function using the values measured, instead it uses the motor characteristics calculated from the type plate data.

NOTE
Once motor identification is complete, the OFF button must be pressed to cancel the activation inhibit.

Fig. 5-38 Basic commissioning – Motor Identification

DANGER

During the rotating measurement, the drive triggers movements in the motor that can reach the maximum motor speed. The emergency OFF functions must be fully operational during commissioning. To protect the machines and personnel, the relevant safety regulations must be observed.

NOTE

If a fault is present when selecting the stationary or rotary measurement, motor identification cannot be carried out.
The "No identification" screen must be exited and the fault remedied in order to rectify the fault.
Motor identification can then be reselected via MENU - Commissioning/Service - Drive commissioning - Motor identification.

5.6 Status after commissioning

LOCAL mode (control via operator panel)

- You switch to LOCAL mode by pressing the "LOCAL/REMOTE" key.
- Control (ON/OFF) is carried out via the "ON" and "OFF" keys.
- You specify the setpoint using the "increase" and "decrease" keys or by entering the appropriate numbers using the numeric keypad.

Analog outputs (for version with TM31)

- The actual speed (r0063) is output as a voltage output in the range 0 to 10 V at analog output 0 (X522:1 and 2).
  10 V is equal to the maximum speed in p1082.
- The actual current value (r0068) is output as a voltage output in the range 0 to 10 V at analog output 1 (X522:4 and 5).
  10 V is equal to the current limit (p0640) set to 1.5 x rated motor current (p0305).

Digital outputs (for version with TM31)

- The "enable pulses" signal is output at digital output 0 (X542:2 and 3).
- The “no fault active” signal is output at digital output 1 (X542:5 and 6) (fail safe).
- The "ready to start" signal is output at digital output 8 (X541:2).

5.7 Resetting parameters to the factory settings

The factory settings represent the defined original status of the cabinet unit on delivery.

Resetting the parameters to the factory settings means that all the parameter settings made since the system was delivered are reset.

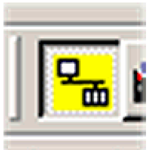
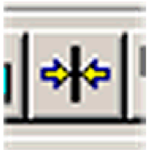
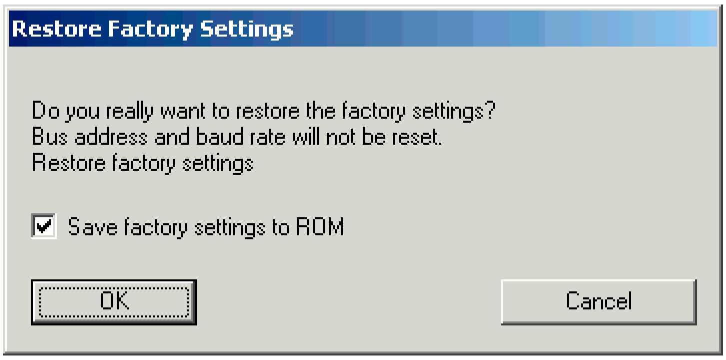
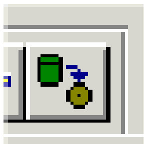
Resetting parameters via AOP30 (optional)

"Extended" access level	**Setting \`extended´ access level on operator panel** <Key button> <Access level> Set \`extended´
↓	
Select parameter reset	**Setting parameter filter to "parameter reset"** <MENU> <Commissioning/Service> <OK> <device commissioning> <OK> Select \`30: parameter reset´ <OK>
↓	
Press OK	**Resetting all parameters to factory setting** Al the cabinet parameters are reset to the SINAMICS G130 factory setting.

Fig. 5-39 Procedure for resetting parameters to the factory settings with AOP30

Resetting parameters via STARTER

With STARTER, the parameters are reset in online mode. The required steps are described below:

Step	Selection in toolbar
1. Choose **Project > Connect to target system**.	
2. Click the drive unit whose parameters you want to reset to the factory settings and click the **Restore factory settings** icon in the toolbar.	
3. Click **OK** to confirm this.  	
4. Choose **Target system > Copy from RAM to ROM**.	

NOTE

The **Copy from RAM to ROM** icon is only active when the drive unit is selected in the project navigator.

When the parameters have been reset to the factory settings, initial commissioning needs to be carried out.

■

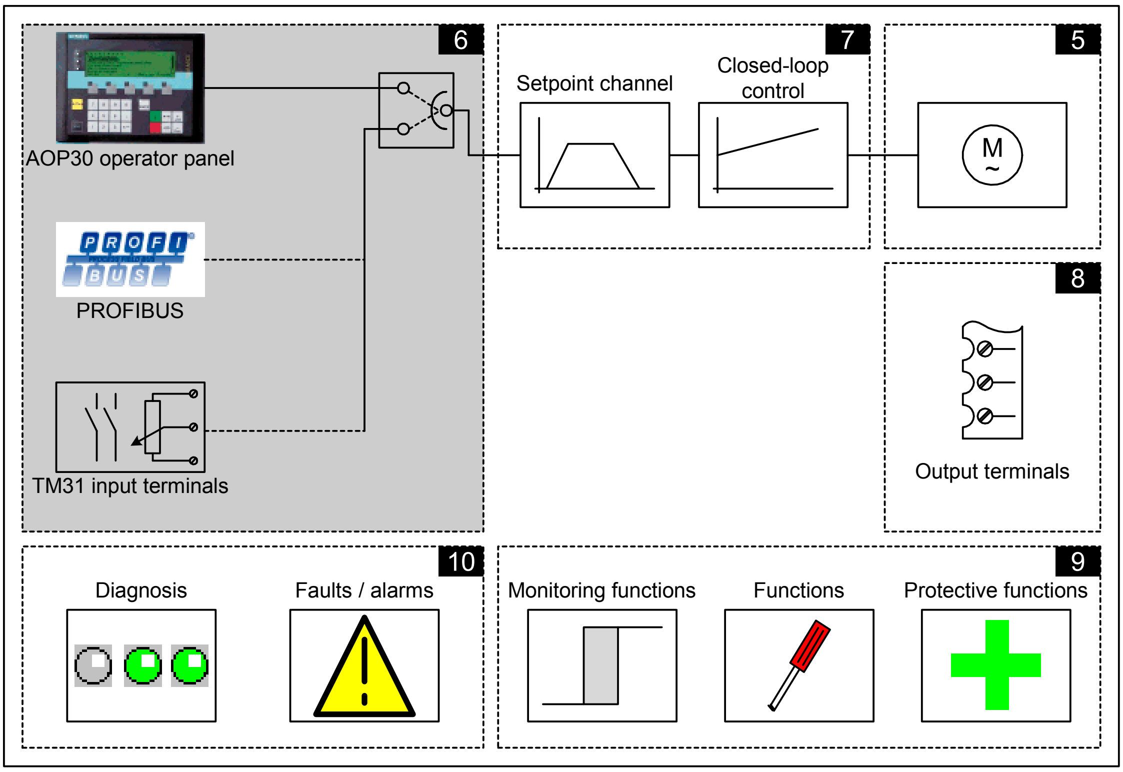
Operation

6

6.1 Chapter content

This chapter provides information on the following:

- Basic information about the drive system
- Selecting command sources via:
  - PROFIBUS
  - TM31 terminal block
  - CU320 terminal block
- Inputting setpoints via:
  - PROFIBUS
  - Analog inputs
  - Motorized potentiometer
  - Fixed setpoints



6.2 General information about command and setpoint sources

Description

Four default settings are available for selecting the command sources and four for selecting the setpoint sources for the SINAMICS G130.

Command sources

- Profidrive
- TM31 terminals
- CU terminals
- Profidrive+TM31

Setpoint sources

- Profidrive
- Analog inputs
- Motorized potentiometer
- Fixed setpoints

The various assignments are explained in the following sections.

NOTE

Make sure that the default settings you choose during commissioning are compatible with the system configuration (see "Commissioning", Chapter 5).

Function diagrams

To supplement this operating manual, the CD contains simplified function diagrams describing the operating principle of the SINAMICS S150.
The diagrams are arranged in accordance with the chapters in the operating manual. The page numbers (6xx) describe the functionality in the following chapter.

At certain points in this chapter, reference is made to function diagrams with a 4-digit number. These are stored on the CD in the "SINAMICS G List Manual", which provides experienced users with detailed descriptions of all the functions.

6.3 Basic information about the drive system

6.3.1 Parameters

Overview

The drive is adapted to the relevant drive task by means of parameters. Each parameter is identified by a unique parameter number and by specific attributes (e.g. read, write, BICO attribute, group attribute, and so on).

With SINAMICS G130, the parameters can be accessed by the following means:

- PC with the "STARTER" commissioning tool via PROFIBUS
- The user-friendly AOP30 Operator Panel

6.3.1.1 Parameter types

The following adjustable and visualization parameters are available:

- Adjustable parameters (write/read)

  These parameters have a direct impact on the behavior of a function.

  Example: Ramp-up and ramp-down time of a ramp-function generator
- Visualization parameter (read only)

  These parameters are used to display internal variables.

  Example: current motor current

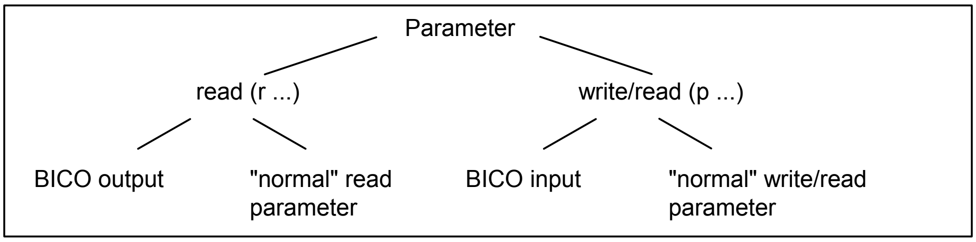


Fig. 6-1 Parameter types

All these drive parameters can be read and changed via PROFIBUS using the mechanisms defined in the PROFIdrive profile.

6.3.1.2 Parameter categories

The parameters for the individual drive objects (see 6.3.2) are categorized according to data sets as follows (see 6.3.3):

- Data-set-independent parameters

  These parameters exist only once per drive object.

- Data-set-dependent parameters

  These parameters can exist several times for each drive object and can be addressed via the parameter index for reading and writing. A distinction is made between various types of data set:

  - CDS: command data set (CDS)

    By parameterizing several command data sets and switching between them, the drive can be operated with different pre-configured signal sources.

  - DDS: drive data set

    The drive data set contains the parameters for switching between different drive control configurations.

  The CDS and DDS can be switched over during normal operation. Further types of data set also exist, however these can only be activated indirectly by means of a DDS switchover.

  - EDS: encoder data set
  - MDS: motor data set

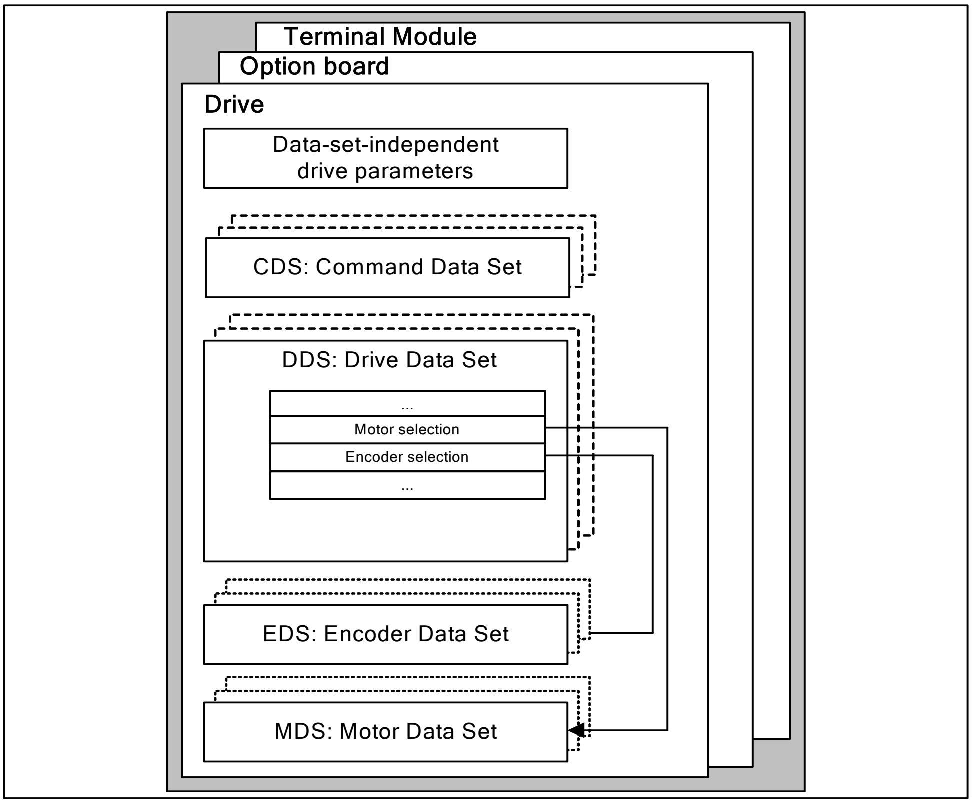


Fig. 6-2 Parameter categories

6.3.2 Drive objects

A drive object is a self-contained software function with its own parameters and, if necessary, its own faults and alarms. Drive objects can be provided as standard (e.g. I/O evaluation), or you can add single (e.g. option board) or multiple objects (e.g. drive control).

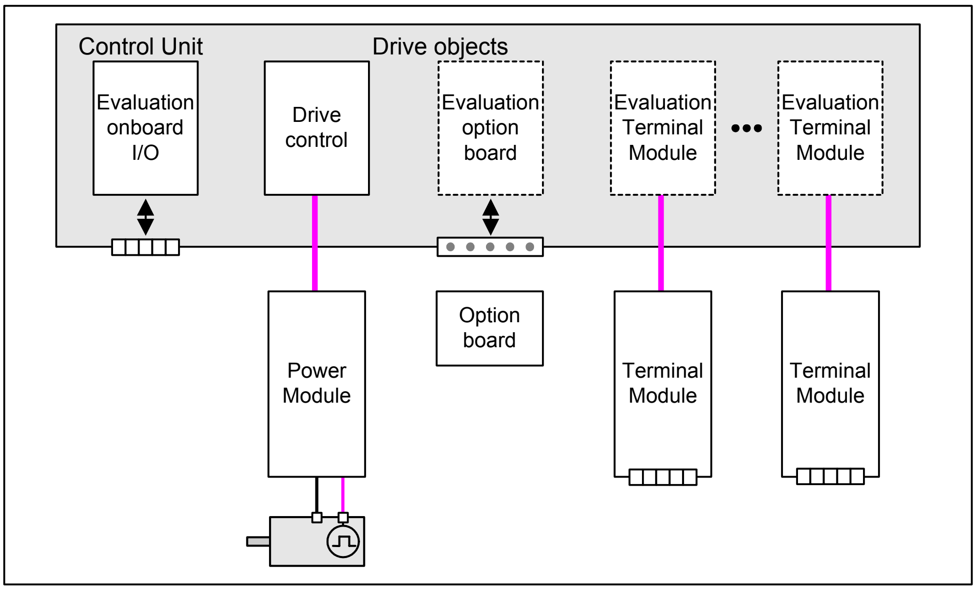


Fig. 6-3 Drive objects

Drive objects installed by default

- Drive control

  Drive control handles closed-loop control of the motor. One Power Module, at least one motor, and up to three sensors are assigned to drive control.

- Control Unit, inputs/outputs

  The I/Os on the Control Unit are evaluated within a drive object. High-speed inputs for probes are processed here in addition to bidirectional digital I/Os.

Properties of a drive object

- Separate parameter space
- Separate window in STARTER
- Separate fault/alarm system
- Separate PROFIBUS telegram for process data

Optionally installed drive objects

- Option board evaluation

  A further drive object handles evaluation of an installed option board. The specific method of operation depends on the type of option board installed.
- Terminal Module evaluation

  A separate drive object handles evaluation of the respective optional Terminal Modules.

Configuring drive objects

When you commission the system for the first time using the STARTER tool, you will use configuration parameters to set up the software-based "drive objects" which are processed on the Control Unit. Various drive objects can be created within a Control Unit.

The drive objects are configurable function blocks and are used to execute specific drive functions.

If you need to configure additional drive objects or delete existing ones after initial commissioning, the drive system must be switched to configuration mode.

The parameters of a drive object cannot be accessed until the drive object has been configured and you have switched from configuration mode to parameterization mode.

NOTE

Each installed drive object is allocated a number between 0 and 63 during initial commissioning for unique identification.

Parameters

- p0101 Drive object numbers
- r0102 Number of drive objects
- p0107 Drive object type
- p0108 Drive object configuration

6.3.3 Data sets

Description

For many applications, it is beneficial if more than one parameter can be changed simultaneously by means of one external signal during operation/when the system is ready for operation.

This can be carried out using indexed parameters, whereby the parameters are grouped together in a data set according to their functionality and indexed. Indexing allows several different settings, which can be activated by switching the data set, to be defined in each parameter.

NOTE

The command and drive data sets can be copied in STARTER (Drive -> Configuration -> "Command data sets" or "Drive data sets" tab).
The displayed command and drive data set can be selected in the appropriate STARTER screens.

CDS: command data set

The BICO parameters (binector and connector inputs) are grouped together in a command data set. These parameter are used to interconnect the signal sources of a drive (see 6.3.4).

By parameterizing several command data sets and switching between them, the drive can be operated with different pre-configured signal sources.

A command data set contains the following (examples):

- Binector inputs for control commands (digital signals)
  - ON/OFF, enable signals (p0844, etc.)
  - Jog (p1055, etc.)
- Connector inputs for setpoints (analog signals)
  - Voltage setpoint for V/f control (p1330)
  - Torque limits and scaling factors (p1522, p1523, p1528, p1529)

Two command data sets are available.

The following parameters are available for selecting command data sets and for displaying the currently selected command data set:

Table 6-1 Command data set: selection and display

	Selection	**Displays**	
	Bit 0	**Selected**	**Active**
CDS	**p0810**	**r0836**	**r0050**
0	0	0	0
1	1	1	1

If a command data set, which does not exist, is selected, the current data set remains active.

Example: Switching between command data set 0 and 1

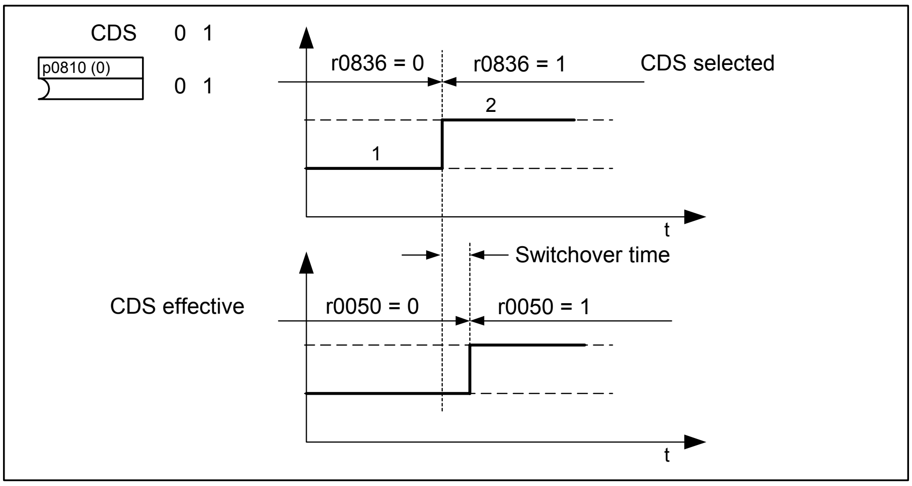


Fig. 6-4 Switching command data sets (example)

DDS: drive data set

A drive data set contains various adjustable parameters that are relevant with respect to open and closed-loop drive control:

- Numbers of the assigned motor and encoder data sets:
  - p0186: assigned motor data set (MDS)
  - p0187 to p0189: up to 3 assigned encoder data sets (EDS)
- Various control parameters, e.g.:
  - Fixed speed setpoints (p1001 to p1015)
  - Speed limits min./max. (p1080, p1082)
  - Characteristic data of ramp-function generator (p1120 ff)
  - Characteristic data of controller (p1240 ff)
  - ...

The parameters that are grouped together in the drive data set are identified in the SINAMICS parameter list by "Data Set DDS" and are assigned an index [0..n].

It is possible to parameterize several drive data sets. You can switch easily between different drive configurations (control type, motor, encoder) by selecting the corresponding drive data set.

One drive object can manage up to 32 drive data sets. The number of drive data sets is configured with p0180.

Binector inputs p0820 to p0823 are used to select a drive data set. They represent the number of the drive data set (0 to 31) in binary format (where p0823 is the most significant bit).

- p0820 BI: Drive data set selection DDS bit 0
- p0821 BI: Drive data set selection DDS bit 1
- p0822 BI: Drive data set selection DDS bit 2
- p0823 BI: Drive data set selection DDS bit 3

Supplementary conditions and recommendations

- Recommendation for the number of drive data sets for a drive

  The number of drive data sets for a drive should correspond to the options for switchover. The following must therefore apply:

  p0180 (DDS) ≥ p0130 (MDS)
- Max. number of DDS for one drive object = 32 DDS

EDS: encoder data set

An encoder data set contains various adjustable parameters describing the connected encoder for the purpose of configuring the drive.

- Adjustable parameters, e.g.:
  - Encoder interface component number (p0141)
  - Encoder component number (p0142)
  - Encoder type selection (p0400)

The parameters that are grouped together in the encoder data set are identified in the SINAMICS parameter list by "Data Set EDS" and are assigned an index [0..n].

A separate encoder data set is required for each encoder controlled by the Control Unit. Up to 3 encoder data sets are assigned to a drive data set via parameters p0187, p0188 and p0189.

An encoder data set can only be changed using a DDS changeover.

Each encoder may only be assigned to one drive and within a drive must - in each drive data set - either always be encoder 1, always encoder 2 or always encoder 3.

One application for the EDS changeover would be a power component with which several motors are operated in turn. These motors are switched between via a contactor circuit. Each of the motors can be fitted with an encoder or can be operated without encoders. Each encoder must be connected to its own SMx.

If encoder 1 (p0187) is changed over using DDS, an MDS must also be changed over.

One drive object can manage up to 16 encoder data sets. The number of encoder data sets configured is specified in p0140.

When a drive data set is selected, the assigned encoder data sets are selected automatically.

MDS: motor data set

A motor data set contains various adjustable parameters describing the connected motor for the purpose of configuring the drive. It also contains certain visualization parameters with calculated data.

- Adjustable parameters, e.g.:
  - Motor component number (p0131)
  - Motor type selection (p0300)
  - Rated motor data (p0304 ff)
  - ...
- Visualization parameters, e.g.:
  - Calculated rated data (p0330 ff)
  - ...

The parameters that are grouped together in the motor data set are identified in the SINAMICS parameter list by "Data Set MDS" and are assigned an index [0..n].

A separate motor data set is required for each motor that is controlled by the Control Unit via a Motor Module. The motor data set is assigned to a drive data set via parameter p0186.

A motor data set can only be changed using a DDS changeover.

The motor data set changeover is, for example, used for:

- Changing over between different motors
- Changing-over between different windings in a motor (e.g. star-delta changeover)
- Motor data adaptation

If several motors are operated alternately on one Power Module, a matching number of drive data sets must be created. Refer to Chapter 9.2 "Drive functions" for additional information and instructions on changing over motors.

A drive object can manage a max. of 16 motor data sets. The number of motor data sets in p0130 may not exceed the number of drive data sets in p0180.

Copying the command data set (CDS)

Set parameter p0809 as follows:

1. p0809[0] = number of the command data set to be copied (source)
2. p0809[1] = number of the command data to which the data is to be copied (target)
3. p0809[2] = 1

Start copying.

Copying is finished when p0809[2] = 0.

Copying the drive data set (DDS)

Set parameter p0819 as follows:

1. p0819[0] = Number of the drive data set to be copied (source)
2. p0819[1] = Number of the drive data set to which the data is to be copied (target)
3. p0819[2] = 1

Start copying.

Copying is finished when p0819[2] = 0.

Copying a motor data set (MDS)

Set parameter p0139 as follows:

1. p0139[0] = Number of the motor data set to be copied (source)
2. p0139[1] = Number of the motor data set which should be copied into (target)
3. p0139[2] = 1

Start copying.

Copying is finished when p0139[2] = 0.

Function diagrams

- 8560 Command data set (CDS)
- 8565 Drive data set (DDS)
- 8570 Encoder data set (EDS)
- 8575 Motor data set (MDS)

Parameters

- p0120 Power Module data sets (PDS) number
- p0130 Motor data sets (MDS) number
- p0139[0...2] Copy motor data set MDS
- p0140 Encoder data sets (EDS) number
- p0170 Command data set (CDS) number
- p0180 Drive data set (DDS) number
- p0187[0...n] Encoder 1 encoder data set number
- p0188[0...n] Encoder 2 encoder data set number
- p0189[0...n] Encoder 3 encoder data set number
- p0809[0...2] Copy command data set CDS
- p0810 BI: Command data set selection CDS bit 0
- p0811 BI: Command data set selection CDS bit 1
- p0812 BI: Command data set selection CDS bit 2
- p0813 BI: Command data set selection CDS bit 3
- p0819[0...2] Copy drive data set DDS
- p0820 BI: Drive data set selection, bit 0
- p0821 BI: Drive data set selection, bit 1
- p0822 BI: Drive data set selection, bit 2
- p0823 BI: Drive data set selection, bit 3
- p0824 BI: Drive data set selection, bit 4

6.3.4 BICO technology: interconnecting signals

Description

Every drive contains a large number of interconnectable input and output variables and internal control variables.

BICO technology (Binector Connector Technology) allows the drive to be adapted to a wide variety of conditions.

Digital and analog signals, which can be connected freely by means of BICO parameters, are identified by the prefix BI, BO, CI or CO in their parameter name. These parameters are identified accordingly in the parameter list or in the function diagrams.

NOTE

The STARTER parameterization and commissioning tool is recommended when using BICO technology.

Binectors, BI: binector input, BO: binector output

A binector is a digital (binary) signal without a unit which can assume the value 0 or 1.

Binectors are subdivided into binector inputs (signal sink) and binector outputs (signal source).

Table 6-2 Binectors

Abbreviation and symbol	Name	Description
BI	Binector input Binector input (signal sink)	Can be interconnected to a binector output as source. The number of the binector output must be entered as a parameter value.
BO	Binector output Binector output (signal source)	Can be used as a source for a binector input.

Connectors, CI: connector input, CO: connector output

A connector is a digital signal e.g. in 32–bit format. It can be used to form words (16 bits), double words (32 bits) or analog signals. Connectors are subdivided into connector inputs (signal sink) and connector outputs (signal source).

The options for interconnecting connectors are restricted to ensure that performance is not adversely affected.

Table 6-3 Connectors

Abbreviation and symbol	Name	Description
CI	Connector input Connector input (signal sink)	Can be interconnected to a connector output as source. The number of the connector output must be entered as a parameter value.
CO	Connector output Connector output (signal source)	Can be used as a source for a connector input.

Interconnecting signals with BICO technology

To interconnect two signals, a BICO input parameter (signal sink) must be assigned to the desired BICO output parameter (signal source).

The following information is required in order to connect a binector/connector input to a binector/connector output:

- Binectors: Parameter number, bit number, and drive object ID
- Connectors with no index: Parameter number and drive object ID
- Connectors with index: Parameter number, index, and drive object ID

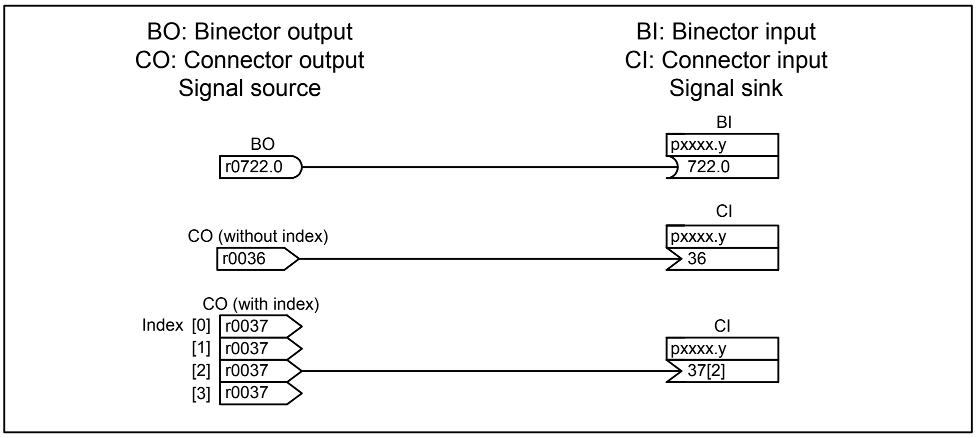


Fig. 6-5 Interconnecting signals using BICO technology

NOTE

A signal source (BO) can be connected to any number of signal sinks (BI).
A signal sink (BI) can only ever be connected to one signal source (BO).

The BICO parameter interconnection can be implemented in different command data sets (CDS). The different interconnections are activated by switching data sets. Interconnections across drive objects are also possible.

Internal encoding of the binector/connector output parameters

The internal codes are needed, for example, in order to write BICO input parameters via PROFIBUS.

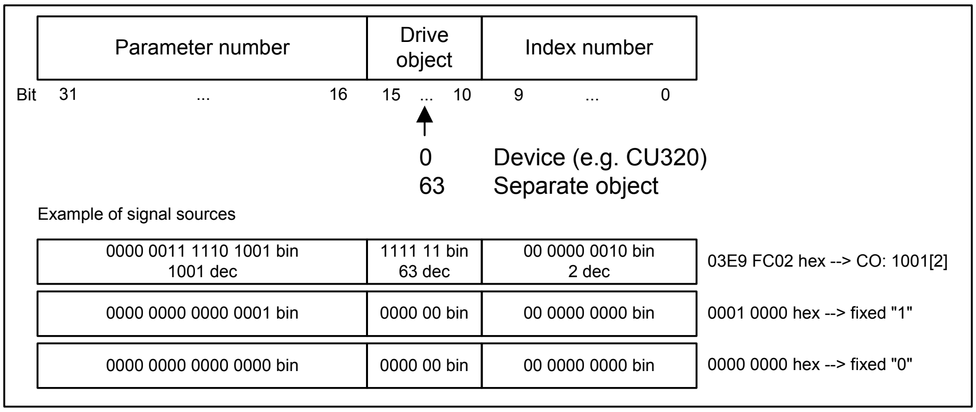


Fig. 6-6 Internal encoding of the binector/connector output parameters

Example 1: interconnecting digital signals

Suppose you want to operate a drive via terminals DI 0 and DI 1 on the Control Unit using jog 1 and jog 2.

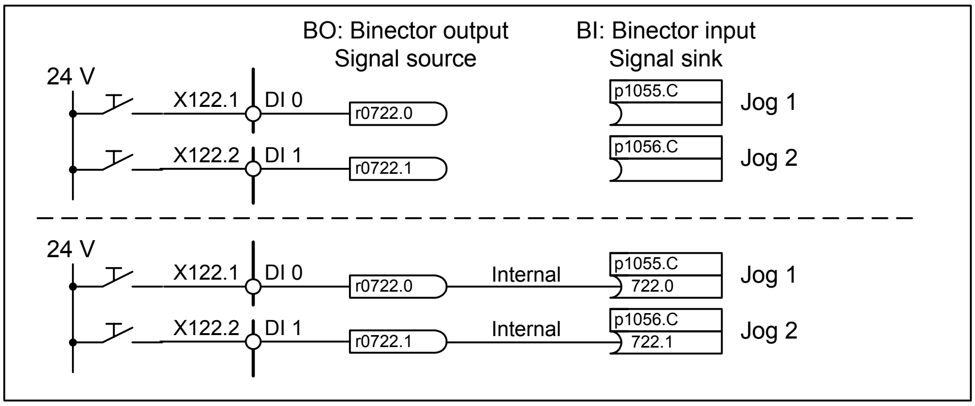


Fig. 6-7 Interconnecting digital signals (example)

Example 2: connection of OC/OFF3 to several drives

The OFF3 signal is to be connected to two drives via terminal DI 2 on the Control Unit.

Each drive has a binector input 1. OFF3 and 2. OFF3. The two signals are processed via an AND gate to STW1.2 (OFF3).

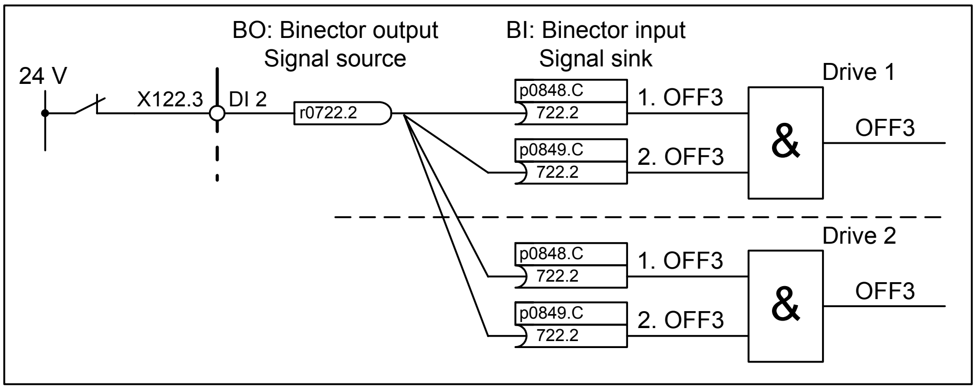


Fig. 6-8 Interconnecting OFF3 with more than one drive (example)

BICO interconnections to other drives

The following parameters are available for BICO interconnections to other drives:

- r9490 number BICO interconnections to other drives
- r9491[0...15] BI/CI of BICO interconnections to other drives
- r9492[0...15] BO/CO of BICO interconnections to other drives
- p9493[0...15] Reset BICO interconnections to other drives

Binector-connector converters and connector-binector converters

Binector-connector converter

- Several digital signals are converted to a 32-bit integer double word or to a 16-bit integer word.
- p2080[0...15] BI: PROFIBUS PZD send bit-serial

Connector-binector converter

- A 32-bit integer double word or a 16-bit integer word is converted to individual digital signals.
- p2099[0...1] CI: PROFIBUS PZD selection receive bit-serial

Fixed values for interconnection using BICO technology

The following connector outputs are available for interconnecting any fixed value settings:

- p2900[0...n] CO: Fixed value_%_1
- p2901[0...n] CO: Fixed value_%_2
- p2930[0...n] CO: Fixed Value_M_1

Example:

These parameters can be used to interconnect the scaling factor for the main setpoint or to interconnect an additional torque.

6.4 Command sources

6.4.1 "Profidrive" default setting

Requirements

- The Power Module and CU320 have been correctly installed.
- The "Profidrive" default setting was chosen during commissioning:
  - STARTER: "Profidrive"
  - AOP30: "1: Profidrive"

Command sources

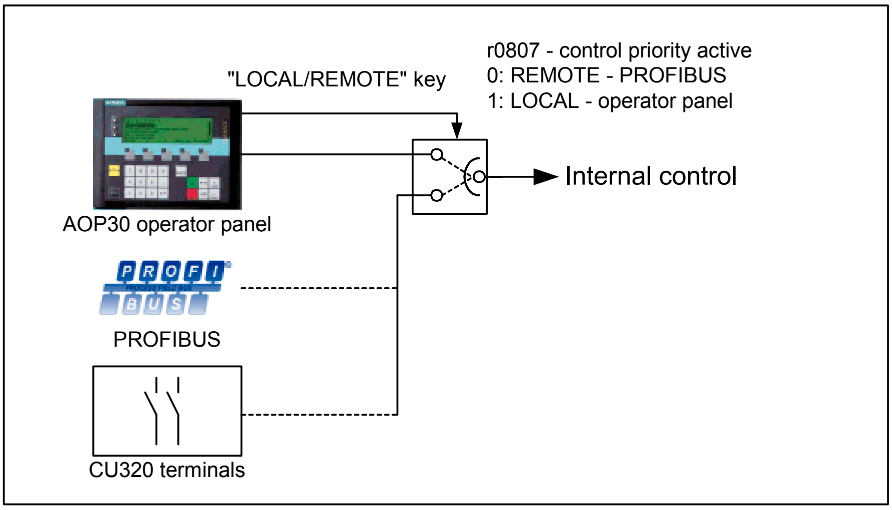


Fig. 6-9 Command sources – AOP30 ←→ Profidrive

Priority

The priority of the command sources is shown in Fig. 6-9.

NOTE

For LOCAL master control, all of the supplementary setpoints are de-activated.

CU320 terminal assignment with "Profidrive" default setting

When you choose the "Profidrive" default setting, use the following terminal assignment for CU320:

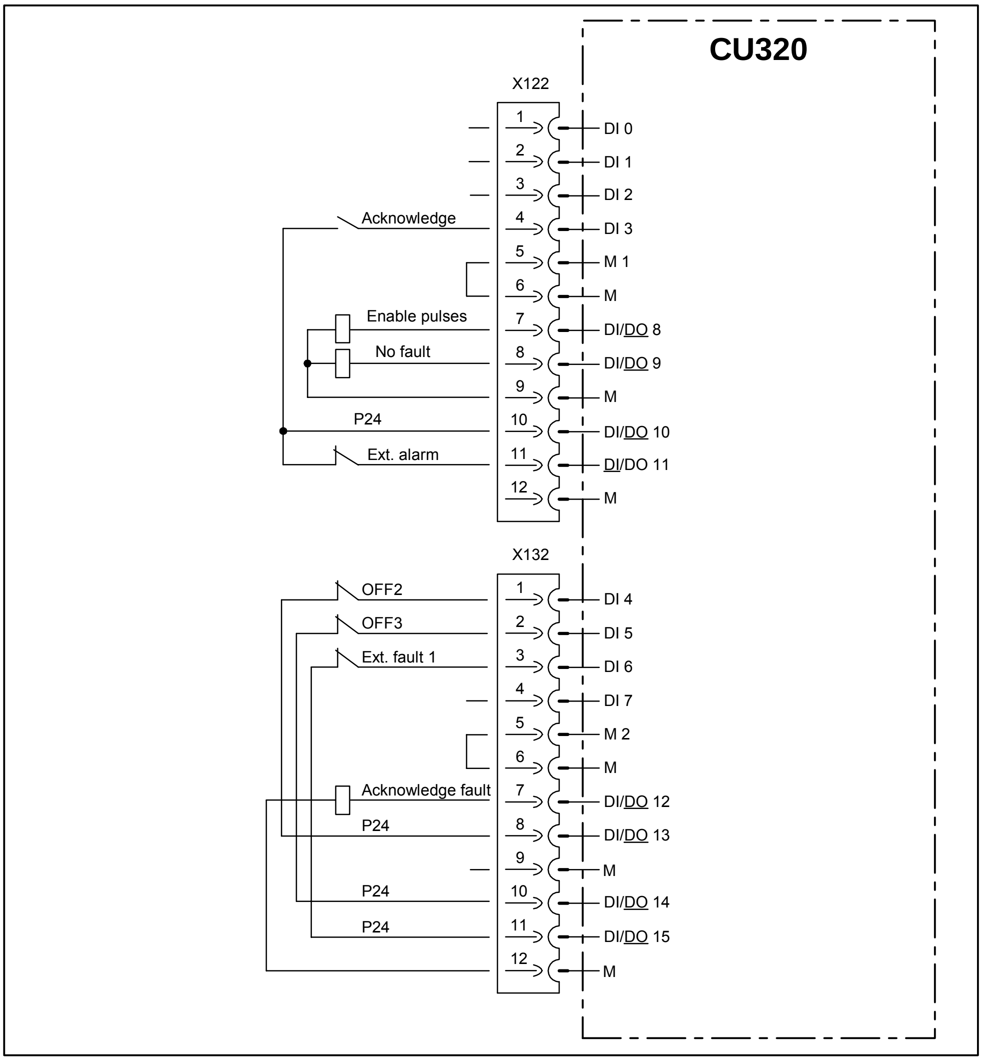


Fig. 6-10 CU320 terminal assignment with "Profidrive" default setting

Control word 1

The bit assignment for control word 1 is described in 6.6.4.

Status word 1

The bit assignment for status word 1 is described in 6.6.5.

Switching the command source

If necessary, the command source can be switched using the LOCAL/REMOTE key on the AOP30.

6.4.2 "TM31 Terminals" default setting

Requirements

- The Power Module, CU320, and TM31 have been correctly installed.
- The "TM31 Terminals" default setting was chosen during commissioning:
  - STARTER: "TM31 Terminals"
  - AOP30: "2: TM31 Terminals"

Command sources

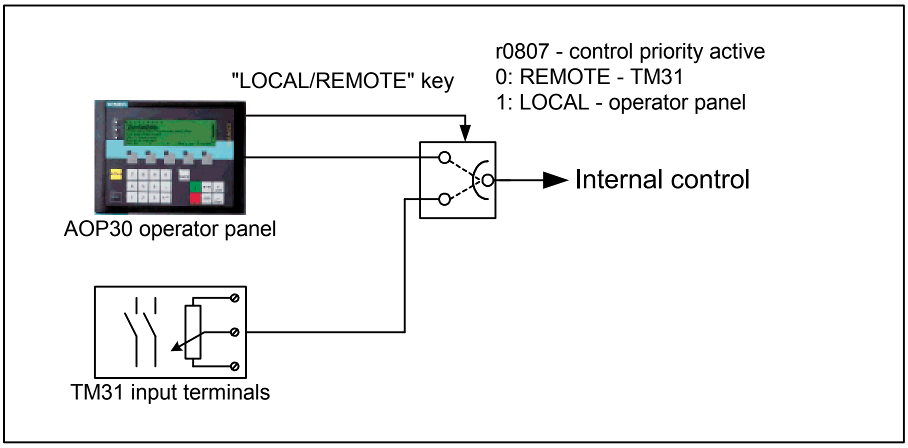


Fig. 6-11 Command sources AOP30 ←→ TM31 Terminals

Priority

The priority of the command sources is shown in Fig. 6-11.

NOTE

For LOCAL master control, all of the supplementary setpoints are de-activated.

TM31 terminal assignment with "TM31 Terminals" default setting

When you choose the "TM31 Terminals" G130 default setting, the terminal assignment for TM31 is as follows:

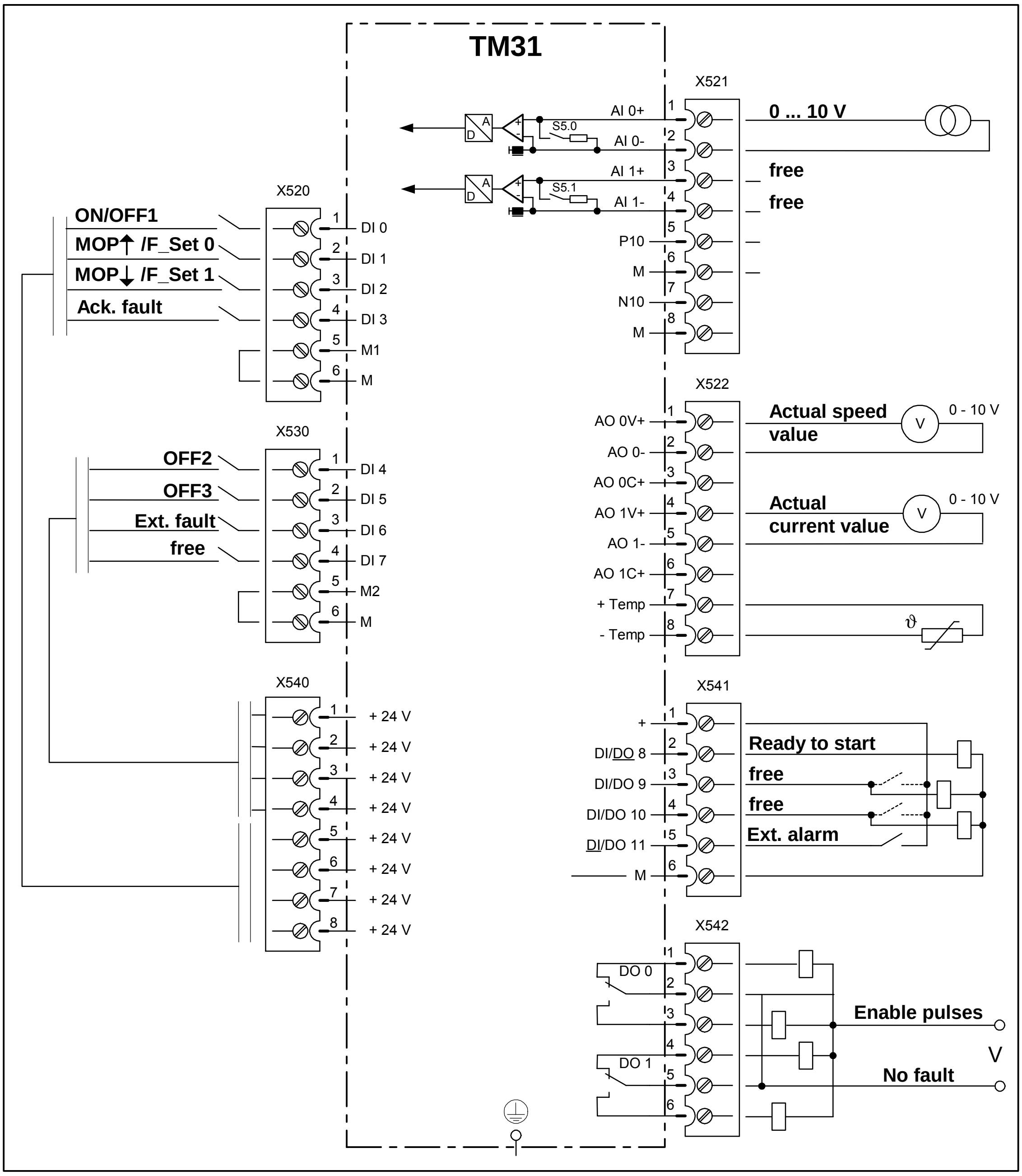


Fig. 6-12 TM31 terminal assignment with "TM31 Terminals" default setting

Switching the command source

If necessary, the command source can be switched using the LOCAL/REMOTE key on the AOP30.

6.4.3 "CU Terminals" default setting

Requirements

- The Power Module and CU320 have been correctly installed.
- The "CU Terminals" default setting was chosen during commissioning:
  - STARTER: "CU Terminals"
  - AOP30: "3: CU Terminals"

Command sources

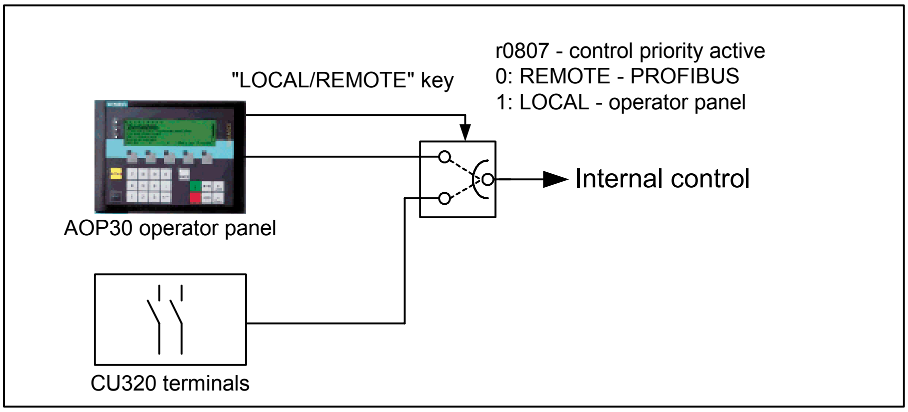


Fig. 6-13 Command sources AOP30 ←→ CU terminals

Priority

The priority of the command sources is shown in Fig. 6-13.

NOTE

For LOCAL master control, all of the supplementary setpoints are de-activated.

CU320 terminal assignment with "CU Terminals" default setting

When you choose the "CU Terminals" G130 default setting, the terminal assignment for CU320 is as follows:

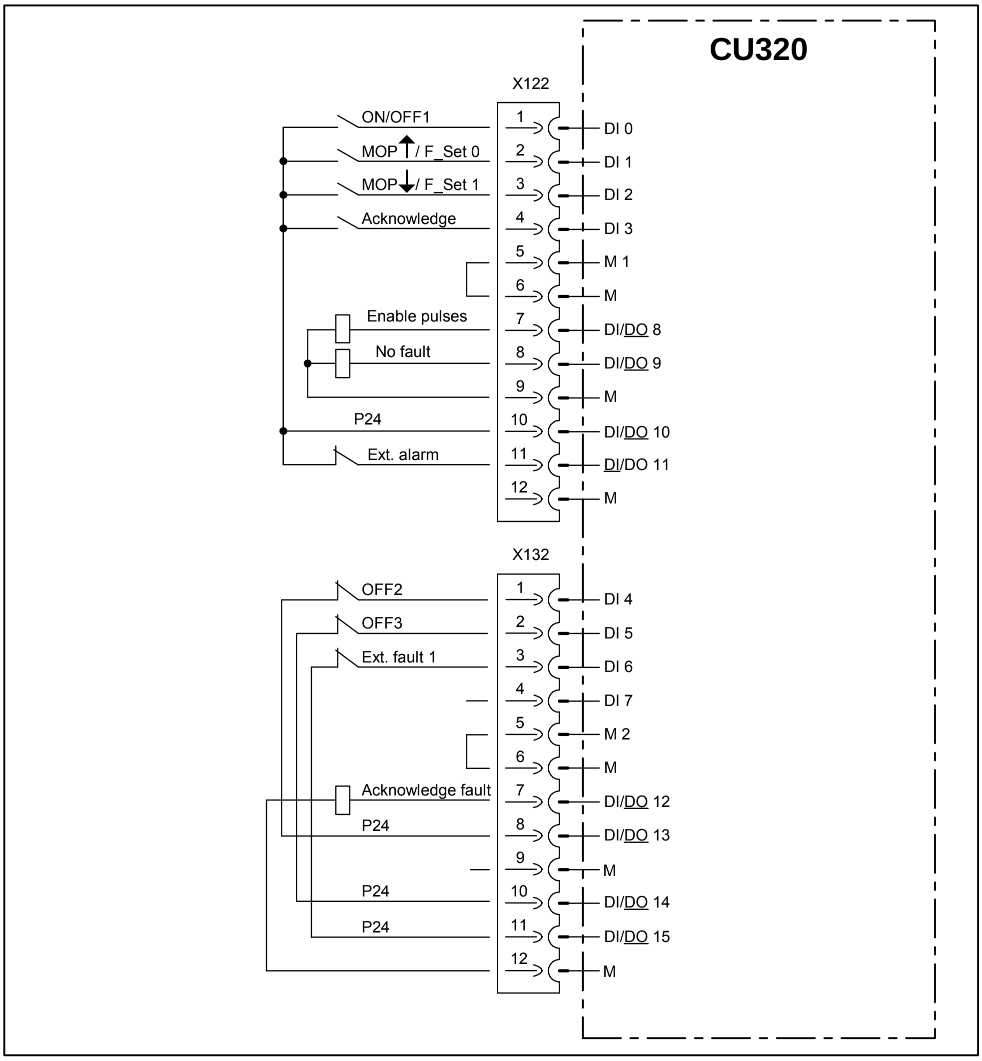


Fig. 6-14 CU320 terminal assignment with "CU Terminals" default setting

Switching the command source

If necessary, the command source can be switched using the LOCAL/REMOTE key on the AOP30.

6.4.4 "Profidrive+TM31" default setting

Requirements

- The Power Module, CU320, TM31, and PROFIBUS have been correctly installed.
- The "Profidrive+TM31" default setting was chosen during commissioning:
  - STARTER: "Profidrive+TM31"
  - AOP30: "4: Profidrive+TM31"

Command sources

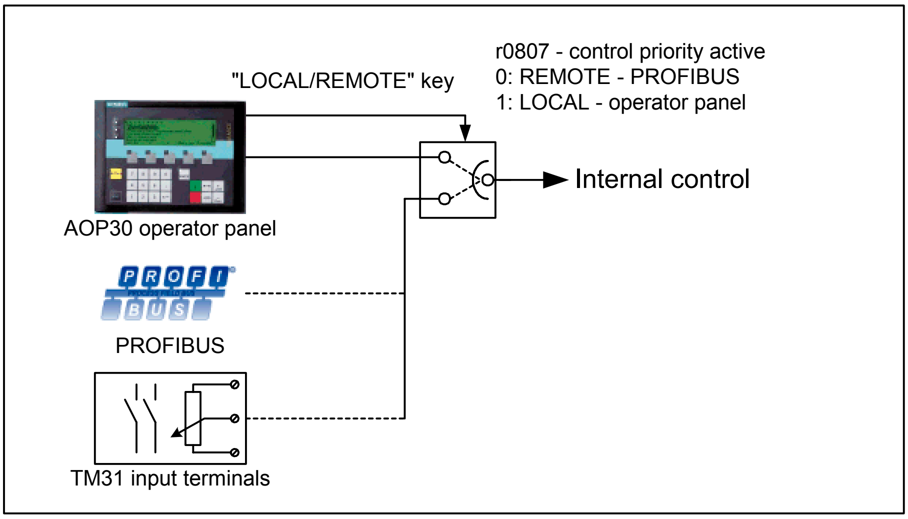


Fig. 6-15 Command sources – AOP30 ←→ Profidrive+TM31

Priority

The priority of the command sources is shown in Fig. 6-15.

NOTE

For LOCAL master control, all of the supplementary setpoints are de-activated.

TM31 terminal assignment with "Profidrive+TM31" default setting

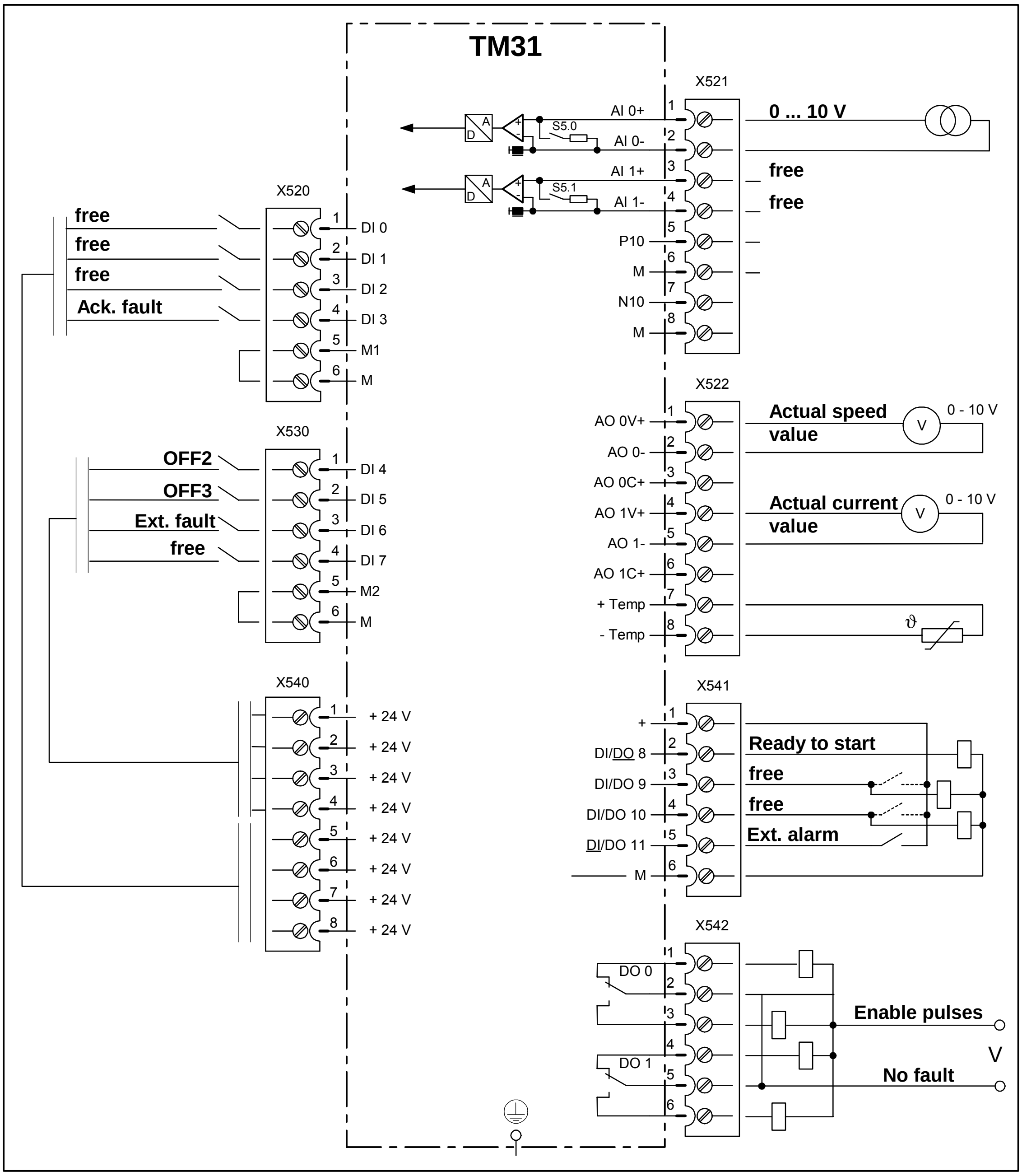


Fig. 6-16 TM31 terminal assignment with "Profidrive+TM31" default setting

Switching the command source

If necessary, the command source can be switched using the LOCAL/REMOTE key on the AOP30.

6.5 Setpoint sources

6.5.1 TM31 analog inputs

Description

The customer terminal block TM31 features two analog inputs for specifying setpoints for current or voltage signals.

In the factory setting, analog input 0 (terminal X521:1/2) is used as a voltage input in the range 0 ... 10 V.

Prerequisite

- The TM31 has been correctly installed.
- The default setting for analog inputs was chosen during commissioning:
  - STARTER: "TM31 Terminals"
  - AOP30: "2: TM31 Terminals"

Signal flow diagram

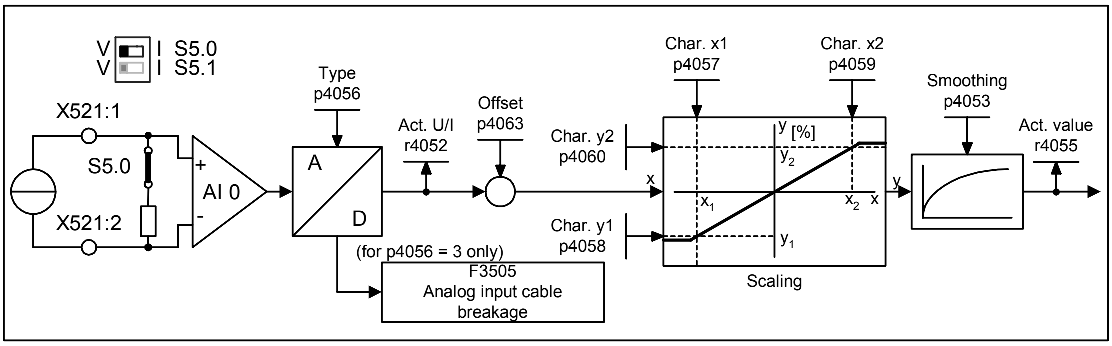


Fig. 6-17 Signal flow diagram: analog input 0

Function diagrams

FD 9566, 9568 TM31 – Analog Input 0 (AI 0), Analog Input 1 (AI 1)

Parameters

- r4052 Actual input voltage/current
- p4053 Analog inputs smoothing time constant
- r4055 Analog inputs, actual input value in percent
- p4056 Analog inputs type
- p4057 Analog inputs, characteristic value x1
- p4058 Analog inputs, characteristic value y1
- p4059 Analog inputs, characteristic value x2

- p4060 Analog inputs, characteristic value y2
- p4063 Analog inputs offset

NOTE

In the factory setting and after basic commissioning, an input voltage of 10 V is equal to the main setpoint 100 % reference speed (p2000), which has been set to the maximum speed (p1082).

Example: changing analog input 0 from voltage to current input 0 - 20 mA

S5.0 = "I"	**Current/voltage switchover** Set current/voltage selector to "Current" ("I").
↓	
p4056 = 2	Set analog input type 0 to 0...20 mA.

Fig. 6-18 Example: setting analog input 0

NOTE

The new analog input must then be stored on the CompactFlash card so that it is protected in the event of a power failure.

F3505 – Fault: "Analog input cable breakage"

The fault is triggered when analog input type (p4056) is set to 3 (4 ... 20 mA with open-circuit monitoring) and the input current of 2 mA has been undershot.

The fault value can be used to determine the analog input in question.

Example

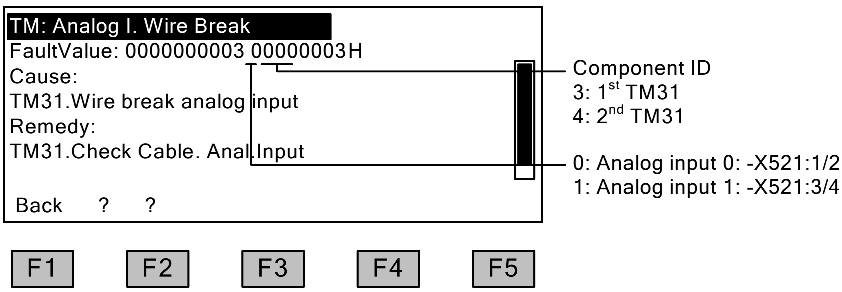


Fig. 6-19 Fault screen

6.5.2 Motorized potentiometer

Description

The digital motorized potentiometer enables you to set speeds remotely using switching signals (+/- keys). It is activated via terminals or PROFIBUS. As long as a logical 1 is present at signal input "MOP raise" (setpoint higher), the internal numerator integrates the setpoint. You can set the integration time (time taken for the setpoint to increase) using parameter p1047. In the same way, you can decrease the setpoint using signal input "MOP lower". The deceleration ramp can be set using parameter p1048.
Configuration parameter p1030.0 = 1 (default setting = 0) is used to activate that the actual motorized potentiometer is saved in a non-volatile fashion when powering-down the drive unit. When powering-up the drive unit, the starting (initial) value of the motorized potentiometer is set to the last, actual value that was present when the drive unit was powered-down.

Prerequisite

The default setting for the motorized potentiometer was chosen during commissioning:

- STARTER: "Motorized potentiometer"
- AOP30: "3: Motorized potentiometer "

Signal flow diagram

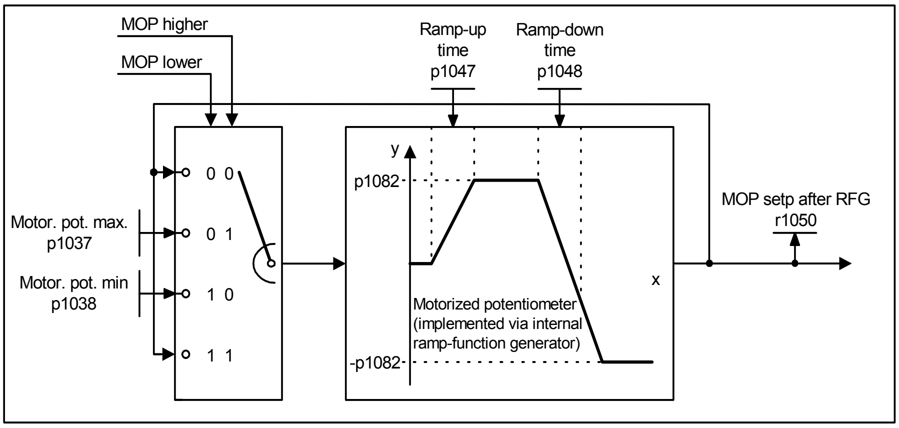


Fig. 6-20 Signal flow diagram: motorized potentiometer

Function diagram

FD 3020 Motorized potentiometer

Parameters

- p1030 Motorized potentiometer, configuration
- p1037 Motorized potentiometer, maximum speed
- p1038 Motorized potentiometer, minimum speed
- p1047 Motorized potentiometer, ramp-up time
- p1048 Motorized potentiometer, ramp-down time
- r1050 Motorized potentiometer, setpoint after the ramp-function generator

6.5.3 Fixed speed setpoints

Description

Three settable fixed speed setpoints are available. They can be selected via terminals or PROFIBUS.

Prerequisite

The default setting for the fixed speed setpoints was chosen during commissioning:

- STARTER: "Fixed setpoint"
- AOP30: "4: Fixed setpoint"

Signal flow diagram

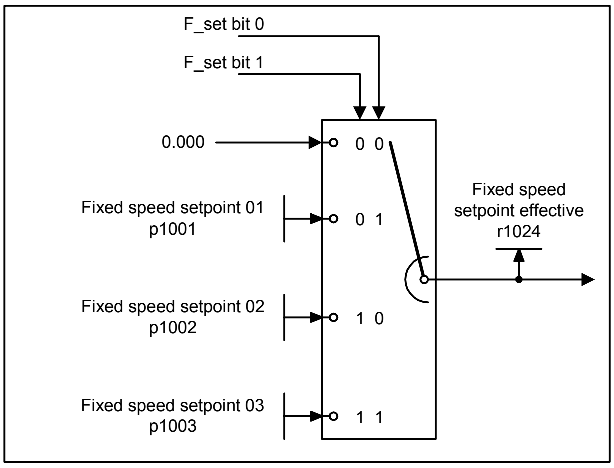


Fig. 6-21 Signal flow diagram: fixed speed setpoints

Function diagram

FD 3010 Fixed speed setpoints

Parameters

- p1001 Fixed speed setpoint 1
- p1002 Fixed speed setpoint 2
- p1003 Fixed speed setpoint 3
- r1024 Fixed speed setpoint effective

NOTE

Other fixed speed setpoints are available using p1004 to p1015. They can be selected using p1020 to p1023.

6.6 PROFIBUS

6.6.1 PROFIBUS connection

For information on connecting PROFIBUS, see Chapter 4 ("Electrical installation").

6.6.2 Control via PROFIBUS

6.6.2.1 General information

"DP1 (PROFIBUS)" Diagnostics LED

The PROFIBUS diagnostics LED is located on the front of the Control Unit. Its statuses are described in the following table.

Table 6-4 Description of the LEDs

Color	Status	Description
------	OFF	Cyclic communication has not (yet) taken place.
Green	Continuous	PROFIBUS is ready for communication and cyclic communication is running
Green	Flashing 0.5 Hz	Full cyclic communication is not yet taking place. Possible causes: • The master is not transmitting setpoints.
Red	Continuous	Cyclic communication has been interrupted.

6.6.2.2 Setting the PROFIBUS Ident Number

The PROFIBUS Ident Number (PNO-ID) can be set using p2042.

SINAMICS can be operated on PROFIBUS with various identities. This allows a PROFIBUS GSD that is independent of the device to be used (e.g. PROFIdrive VIK-NAMUR with Ident Number 3AA0 hex).

- 0: SINAMICS S/G
- 1: VIK-NAMUR

A new setting only becomes effective after POWER ON, reset or download.

NOTE

The advantages of Totally Integrated Automation (TIA) can only be utilized when selecting "0".

6.6.3 Telegrams and process data

General information

Selecting a telegram via CU parameter p0922 determines which process data is transferred between the master and slave.

From the perspective of the slave (SINAMICS G130), the received process data comprises the receive words and the process data to be sent the send words.

The receive and send words comprise the following elements:

- Receive words: Control words and setpoints
- Send words: Status words and actual values

"Profibus" default settings

When the "Profibus" default setting is chosen for command and setpoint selection (see Section 6.4.1), "Free telegram" (p0922 = 999) is selected.

The receive telegram is parameterized as follows as a result of the default setting (plan 622):

CTW 1	N_SETP

The send telegram is parameterized as follows (factory setting, plan 623):

STW 1	N_ACT	I_IST	M_ACT	P_ACT	Fault

You do not have to make any further settings in order to use these telegrams.

User-defined telegram selection

a. Standard telegrams

Standard telegrams are structured in accordance with PROFIdrive profile V3 or internal company specifications. The internal process data links are established automatically in accordance with the telegram number setting in CU parameter p0922.

The following standard telegrams can be set via parameter p0922:

- p0922 = 1 -> Speed control, 2 words
- p0922 = 2 -> Speed control, 4 words
- p0922 = 3 -> Speed control, 1 position encoder
- p0922 = 4 -> Speed control, 2 position encoder
- p0922 = 20 -> NAMUR telegram
- p0922 = 352 -> PCS7 telegram

Depending on the setting in p0922, the interface mode of the control and status word is automatically set:

- p0922 = 1, 352, 999:
  STW 1/ZSW 1: Interface Mode SINAMICS / MICROMASTER, p2038 = 0
- p0922 = 20:
  STW 1/ZSW 1: Interface Mode PROFIdrive VIK-NAMUR, p2038 = 2

b. Free telegrams (p0922 = 999)

Send and receive telegrams can be configured as required by using BICO technology to interconnect the send and receive words. The default process data assigned under a) is retained during the switchover to p0922 = 999, although it can be changed or supplemented at any time.

To maintain compliance with the PROFIdrive profile, however, the following assignments should be retained:

- Interconnect PZD receive word 1 as control word 1 (CTW 1)
- Interconnect PZD send word 1 as status word 1 (STW 1)

For more information about possible interconnections, see function diagrams FP2460 and FP2470 and the simplified diagrams 620 to 622.

Structure of the telegrams

Table 6-5 Structure of the telegrams

Telegr.	PZD 1	PZD 2	PZD 3	PZD 4	PZD 5	PZD 6	PZD 7	PZD 8	PZD 9	PZD 10
1	CTW 1	N_setp_A								
	STW 1	N_act_A								
2	CTW 1	N_set_B		CTW2						
	STW 1	N_act_B		STW2						
3	CTW 1	N_set_B		CTW2	G1_CTW					
	STW 1	N_act_B		STW2	G1_STW	G1_XACT1		G1_XACT2		
4	CTW 1	N_set_B		CTW2	G1_CTW					
	STW 1	N_act_B		STW2	G1_STW	Further allocation: see FP2420				
20	CTW 1	N_setp_A								
	STW 1	N_act_GLATT	Ia_act_GLATT	M_act_GLATT	P_act_GLATT	MELD_NAMUR				
352	CTW 1	N_setp_A	PCS7_3	PCS7_4	PCS7_5	PCS7_6				
	STW 1	N_act_GLATT	Ia_act_GLATT	M_act_GLATT	WARN_CODE	FAULT_CODE				
999	CTW 1	free	free	free	free	free	free	free	free	free
	STW 1	free	free	free	free	free	free	free	free	free

6.6.4 Description of control words and setpoints

Overview

Table 6-6 Overview of control words and setpoints

Abbreviation	Description	Parameters	Function diagram
CTW 1	Control word 1 (Interface Mode SINAMICS / MICROMASTER, p2038 = 0)	See Table 6-7	FD2442
CTW 1	Control word 1 (Interface Mode PROFIdrive VIK-NAMUR, p2038 = 2)	See Table 6-8	FD2441
CTW 2	Control word 2 (Interface Mode SINAMICS / MICROMASTER, p2038 = 0)		FD2444
N_setp_A	Speed setpoint A (16 bit)	p1070	FD3030
N_setp_B	Speed setpoint B (32 bit)	p1155	FD3080
PCS7_x	PCS7-specific setpoints		

Control Word 1 (CTW 1) (Interface Mode SINAMICS / MICROMASTER, p2038 = 0)

Table 6-7 Control word 1 (Interface Mode SINAMICS / MICROMASTER, p2038 = 0)

Bit	Meaning	Explanation	Operating condition	BICO
0	**0 = OFF1 (OFF1)**	0 : Deceleration on the deceleration ramp (p1121), then pulse block, main contactor (if fitted) is opened.	1	BI: p0840
	1 = ON			
1	**0 = Coast to stop (OFF2)**	0 : Pulse block, main contactor (if fitted) is opened	1	BI: p0844 BI: p0845
	1 = Do not coast to stop			
	Note: Control signal OFF2 is generated by ANDing BI: p0844 and BI: p0845.			
2	**0 = Fast stop (OFF3)**	0: Deceleration on the rapid-stop ramp (p1115), then pulse block, main contactor (if fitted) is opened.	1	BI: p0848
	1 = No emergency stop			
	Note: Control signal OFF3 is generated by ANDing BI: p0848 and BI: p0849.			
3	0 = Disable operation **1 = Enable operation**	1: Enable inverter, pulse enable, ramp-up with active setpoint 0: Pulse inhibit. The motor coasts down. The "Ready To Run" status remains set.	1	BI: p0852
4	**0 = Set ramp generator to zero** 1 = Enable ramp-function generator	0: The ramp generator output is set to setpoint "0".	1	BI: p1140
5	**0 = Freeze ramp generator** 1 = Restart ramp generator	0: The current setpoint is frozen at the ramp generator output.	1	BI: p1141
6	**1 = Enable speed setpoint** 0 = Inhibit speed setpoint	1: The speed setpoint at the input of the ramp-function generator is enabled. 0: The speed setpoint at the input of the ramp-function generator is set to zero. The drive brakes in accordance with the ramp-down time set in p1121.	1	BI: p1142
7	**0 -> 1 = Acknowledge error**	A positive signal transition acknowledges all the current faults	–	BI: p2103
	Note: The error is acknowledged at a 0/1 edge via BI: p2103, BI: p2104, or BI: p2105.			
8	Reserved		–	–
9	Reserved		–	–
10	**1 = Control via PLC**	1: PROFIBUS control words and setpoints are analyzed. 0: PROFIBUS control words and setpoints are not analyzed.	1	BI: p0854

<table>
<tr><th>Bit</th><th>Meaning</th><th>Explanation</th><th>Operating condition</th><th>BICO</th></tr>
<tr><td></td><td colspan="4">Note: This bit should not be set to "1" until the PROFIBUS slave has returned an appropriate status via STW1.9 = "1".</td></tr>
<tr><td rowspan="2">11</td><td rowspan="2">1 = Direction of rotation changeover</td><td>1: CCW phase sequence</td><td rowspan="2">–</td><td rowspan="2">BI: p1113</td></tr>
<tr><td>0: CW phase sequence</td></tr>
<tr><td>12</td><td>Reserved</td><td></td><td>–</td><td>–</td></tr>
<tr><td>13</td><td>1 = Increase motorized potentiometer</td><td></td><td>–</td><td>BI: p1035</td></tr>
<tr><td rowspan="2">14</td><td>1 = Decrease motorized potentiometer</td><td></td><td>–</td><td>BI: p1036</td></tr>
<tr><td colspan="4">Note:
If motorized potentiometer up and down are both 0 or 1 simultaneously, the momentary setpoint is frozen.</td></tr>
<tr><td>15</td><td>Reserved</td><td></td><td>–</td><td>–</td></tr>
</table>

Control Word 1 (CTW 1) (Interface Mode PROFIdrive VIK-NAMUR, p2038 = 2)

Table 6-8 Control word 1 (Interface Mode PROFIdrive VIK-NAMUR, p2038 = 2)

<table>
<tr><th>Bit</th><th>Meaning</th><th>Explanation</th><th>Operating condition</th><th>BICO</th></tr>
<tr><td rowspan="2">0</td><td>0 = OFF1 (OFF1)</td><td>0 : Deceleration on the deceleration ramp (p1121), then pulse block, main contactor (if fitted) is opened.</td><td rowspan="2">1</td><td rowspan="2">BI: p0840</td></tr>
<tr><td>1 = ON</td><td></td></tr>
<tr><td rowspan="3">1</td><td>0 = Coast to stop (OFF2)</td><td>0 : Pulse block, main contactor (if fitted) is opened</td><td rowspan="2">1</td><td rowspan="2">BI: p0844
BI: p0845</td></tr>
<tr><td>1 = Do not coast to stop</td><td></td></tr>
<tr><td colspan="4">Note: Control signal OFF2 is generated by ANDing BI: p0844 and BI: p0845.</td></tr>
<tr><td rowspan="3">2</td><td>0 = Fast stop (OFF3)</td><td>0: Deceleration on the rapid-stop ramp (p1115), then pulse block, main contactor (if fitted) is opened.</td><td rowspan="2">1</td><td rowspan="2">BI: p0848</td></tr>
<tr><td>1 = No emergency stop</td><td></td></tr>
<tr><td colspan="4">Note: Control signal OFF3 is generated by ANDing BI: p0848 and BI: p0849.</td></tr>
<tr><td rowspan="2">3</td><td rowspan="2">0 = Disable operation
1 = Enable operation</td><td>1: Enable inverter, pulse enable, ramp-up with active setpoint</td><td rowspan="2">1</td><td rowspan="2">BI: p0852</td></tr>
<tr><td>0: Pulse inhibit. The motor coasts down. The "Ready To Run" status remains set.</td></tr>
<tr><td rowspan="2">4</td><td rowspan="2">0 = Set ramp generator to zero
1 = Enable ramp-function generator</td><td>0: The ramp generator output is set to setpoint "0".</td><td rowspan="2">1</td><td rowspan="2">BI: p1140</td></tr>
<tr><td></td></tr>
<tr><td>5</td><td>0 = Freeze ramp generator</td><td>0: The current setpoint is frozen at the ramp generator output.</td><td>1</td><td>BI: p1141</td></tr>
</table>

Bit	Meaning	Explanation	Operating condition	BICO
	1 = Restart ramp generator			
6	**1 = Enable speed setpoint** 0 = Inhibit speed setpoint	1: The speed setpoint at the input of the ramp-function generator is enabled. 0: The speed setpoint at the input of the ramp-function generator is set to zero. The drive brakes in accordance with the ramp-down time set in p1121.	1	BI: p1142
7	**0 -> 1 = Acknowledge error**	A positive signal transition acknowledges all the current faults	–	BI: p2103
	Note: The error is acknowledged at a 0/1 edge via BI: p2103, BI: p2104, or BI: p2105.			
8	Reserved		–	–
9	Reserved		–	–
10	**1 = Control via PLC**	1: PROFIBUS control words and setpoints are analyzed. 0: PROFIBUS control words and setpoints are not analyzed.	1	BI: p0854
	Note: This bit should not be set to "1" until the PROFIBUS slave has returned an appropriate status via STW1.9 = "1".			
11	**1 = Direction of rotation changeover**	1: CCW phase sequence 0: CW phase sequence	–	BI: p1113
12	Reserved		–	–
13	Reserved		–	–
14	Reserved		–	–
15	**1 = Data set 2** 0 = Data set 1	1: Parameter data set changeover (DDS) data set 2 is active 0: Parameter data set changeover (DDS) data set 1 is active	–	BI: p0820

Speed Setpoint (N_Setp_A)

- Speed setpoint with 16-bit resolution incl. sign bit.
- Bit 15 determines the setpoint sign:
  - Bit = 0 → positive setpoint
  - Bit = 1 → negative setpoint
- The speed setpoint is normalized via parameter p2000.
  N_setp_A = 4000 hex or 16384 dec = speed in p2000

Speed Setpoint (N_Setp_B)

- Speed setpoint with 32-bit resolution incl. sign bit.
- Bit 32 determines the setpoint sign:
  - Bit = 0 → positive setpoint
  - Bit = 1 → negative setpoint
- The speed setpoint is normalized via parameter p2000.
  N_setp_B = 4000 0000 hex or 1073741824 dec = speed in p2000

PCS7-specific setpoints (PCS7 x)

Depending on the configuration, KP adaptation values for the speed controller and acceleration values or other setpoints, for example, are transferred here. Depending on their application, these variables are generally normalized via parameters p2000 to p2004.

6.6.5 Description of status words and actual values

Overview

Table 6-9 Overview of status words and actual values

Abbreviation	Description	Parameters	Function diagram
STW 1	Status word 1 (Interface Mode SINAMICS / MICROMASTER, p2038 = 0)	See Table 6-10	FD2452
STW 1	Status word 1 (Interface Mode SINAMICS / MICROMASTER, p2038 = 0)	See Table 6-11	FD2451
STW 2	Status word 2 (Interface Mode SINAMICS / MICROMASTER, p2038 = 0)		FD2454
N_act_A	Actual speed value A (16 bit)	r0063[0]	FD4715
N_act_B	Actual speed value B (32 bit)	r0063	FD4710
Ia_act	Actual current	r0068[0]	FD6714
M_act	Actual torque value	r0080[0]	FD6714
P_act	Actual power value	r0082[0]	FD6714
N_act_GLATT	Actual speed value smoothed	r0063[1]	FD4715
Ia_act_GLATT	Actual current smoothed	r0068[1]	FD6714
M_act_GLATT	Actual torque value smoothed	r0080[1]	FD6714
P_act_GLATT	Actual power value smoothed	r0082[1]	FD6714
MELD_NAMUR	VIK-NAMUR signaling bit bar	r3113, See Table 6-12	--
Alarm code	Alarm code	r2132	FD8065
Fault code	Error code	r2131	FD8060

Status Word 1 (Interface Mode SINAMICS / MICROMASTER, p2038 = 0)

Table 6-10 Status word 1 (Interface Mode SINAMICS / MICROMASTER, p2038 = 0)

<table>
<tr><th>Bit</th><th>Meaning</th><th colspan="2">Explanation</th><th>BICO</th></tr>
<tr><td rowspan="2">0</td><td rowspan="2">Ready to power up</td><td>1</td><td>Ready to power up
Power supply on, electronics initialized, line contactor released if necessary, pulses inhibited.</td><td rowspan="2">BO: r0899.0</td></tr>
<tr><td>0</td><td>Not ready to power up</td></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Ready to run</td><td>1</td><td>Ready to run
Voltage at line module (i.e. line contactor closed (if used)), field being built up.</td><td rowspan="2">BO: r0899.1</td></tr>
<tr><td>0</td><td>Not ready to run
Cause: No ON command has been issued.</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">Operation enabled</td><td>1</td><td>Operation enabled
Enable electronics and pulses, then ramp up to active setpoint.</td><td rowspan="2">BO: r0899.2</td></tr>
<tr><td>0</td><td>Operation inhibited</td></tr>
<tr><td rowspan="2">3</td><td rowspan="2">Fault present</td><td>1</td><td>Fault present
The drive is faulty and is, therefore, out of service. The drive switches to Power-on inhibit once the fault has been acknowledged and the cause has been remedied.
The active faults are stored in the fault buffer.</td><td rowspan="2">BO: r2139.3</td></tr>
<tr><td>0</td><td>No fault present
No active fault in the fault buffer.</td></tr>
<tr><td rowspan="2">4</td><td rowspan="2">No OFF2 active / coasting active (OFF2)</td><td>1</td><td>No OFF2 active</td><td rowspan="2">BO: r0899.4</td></tr>
<tr><td>0</td><td>Coasting active (OFF2)
An OFF2 command is present.</td></tr>
<tr><td rowspan="2">5</td><td rowspan="2">0 = Fast stop active (OFF3)</td><td>1</td><td>No OFF3 active</td><td rowspan="2">BO: r0899.5</td></tr>
<tr><td>0</td><td>Coasting active (OFF3)
An OFF3 command is present.</td></tr>
<tr><td rowspan="2">6</td><td rowspan="2">Power-on inhibit</td><td>1</td><td>Power-on inhibit
A restart is only possible through OFF1 followed by ON.</td><td rowspan="2">BO: r0899.6</td></tr>
<tr><td>0</td><td>No power-up inhibit
Power up is possible.</td></tr>
<tr><td rowspan="2">7</td><td rowspan="2">Alarm present</td><td>1</td><td>Alarm present
The drive is operational again. No acknowledgement necessary.
The active alarms are stored in the alarm buffer.</td><td rowspan="2">BO: r2139.7</td></tr>
<tr><td>0</td><td>No alarm present
No active alarm is present in the alarm buffer.</td></tr>
<tr><td rowspan="2">8</td><td rowspan="2">Speed setpoint/actual value deviation within tolerance bandwidth</td><td>1</td><td>Setpoint/actual value monitoring within tolerance bandwidth
Actual value within a tolerance bandwidth; dynamic overshoot or shortfall permitted for $t < t_{max}$, t_{max} can be parameterized. See FD8010</td><td rowspan="2">BO: r2197.7</td></tr>
<tr><td>0</td><td>Setpoint/actual value monitoring not within tolerance band</td></tr>
</table>

Bit	Meaning		Explanation	BICO
9	Control requested for PLC A "1" is always present	1	Control from the PLC	BO: r0899.9
		0	Local operation	
10	f or n comparison value reached or exceeded	1	f or n comparison value reached or exceeded	BO: r2199.1
		0	f or n comparison value not reached	
	Note: The message is parameterized as follows: p2141 Threshold value p2142 Hysteresis			
11	I, M, or P limit not reached / I, M, or P limit reached	1	I, M or P limit not reached	BO: r1407.7
		0	I, M or P limit reached	
12	Reserved			
13	Alarm, motor overtemperature	1	Motor overtemperature alarm active	BO: r2135.14
		0	Motor overtemperature alarm not active	
14	Motor rotates forwards (n_act >= 0)	1	Motor rotates forwards (n_act ≥ 0)	BO: r2197.3
		0	Motor not rotating forwards (n_act < 0)	
15	0 = Alarm, power module thermal overload	1	No alarm present	BO: r2135.15
		0	Alarm, power module thermal overload The overtemperature alarm for the power module is active.	

Status Word 1 (Interface Mode PROFIdrive VIK-NAMUR, p2038 = 2)

Table 6-11 Status word 1 (Interface Mode PROFIdrive VIK-NAMUR, p2038 = 2)

Bit	Meaning		Explanation	BICO
0	Ready to power up	1	Ready to power up Power supply on, electronics initialized, line contactor released if necessary, pulses inhibited.	BO: r0899.0
		0	Not ready to power up	
1	Ready to run	1	Ready to run Voltage at line module (i.e. line contactor closed (if used)), field being built up.	BO: r0899.1
		0	Not ready to run Cause: No ON command has been issued.	
2	Operation enabled	1	Operation enabled Enable electronics and pulses, then ramp up to active setpoint.	BO: r0899.2
		0	Operation inhibited	
3	Fault present	1	Fault present The drive is faulty and is, therefore, out of service. The drive switches to Power-on inhibit once the fault has been acknowledged and the cause has been remedied. The active faults are stored in the fault buffer.	BO: r2139.3
		0	No fault present No active fault in the fault buffer.	

Bit	Meaning	Explanation		BICO
4	No OFF2 active / coasting active (OFF2)	1	No OFF2 active	BO: r0899.4
		0	Coasting active (OFF2) An OFF2 command is present.	
5	0 = Fast stop active (OFF3)	1	No OFF3 active	BO: r0899.5
		0	Coasting active (OFF3) An OFF3 command is present.	
6	Power-on inhibit	1	Power-on inhibit A restart is only possible through OFF1 followed by ON.	BO: r0899.6
		0	No power-up inhibit Power up is possible.	
7	Alarm present	1	Alarm present The drive is operational again. No acknowledgement necessary. The active alarms are stored in the alarm buffer.	BO: r2139.7
		0	No alarm present No active alarm is present in the alarm buffer.	
8	Speed setpoint/actual value deviation within tolerance bandwidth	1	Setpoint/actual value monitoring within tolerance bandwidth Actual value within a tolerance bandwidth; dynamic overshoot or shortfall permitted for $t < t_{max}$, t_{max} can be parameterized. See FD8010	BO: r2197.7
		0	Setpoint/actual value monitoring not within tolerance band	
9	Control requested for PLC A "1" is always present	1	Control from the PLC	BO: r0899.9
		0	Local operation	
10	f or n comparison value reached or exceeded	1	f or n comparison value reached or exceeded	BO: r2199.1
		0	f or n comparison value not reached	
	Note: The message is parameterized as follows: p2141 Threshold value p2142 Hysteresis			
11	I, M, or P limit not reached / I, M, or P limit reached	1	I, M or P limit not reached	BO: r1407.7
		0	I, M or P limit reached	
12	Reserved			
13	Alarm, motor overtemperature	1	Motor overtemperature alarm active	BO: r2135.14
		0	Motor overtemperature alarm not active	
14	Motor rotates forwards (n_act >= 0)	1	Motor rotates forwards (n_act ≥ 0)	BO: r2197.3
		0	Motor not rotating forwards (n_act < 0)	
15	Reserved			

NAMUR signaling bit bar

Table 6-12 NAMUR signaling bit bar

Bit	Meaning	0-signal	1-signal
00	Fault, drive converter data electronics / SW error	No	Yes
01	Line supply fault	No	Yes
02	DC link overvoltage	No	Yes
03	Fault, drive converter power electronics	No	Yes
04	Overtemperature, drive converter	No	Yes
05	Ground fault	No	Yes
06	Motor overload	No	Yes
07	Bus error	No	Yes
08	External safety trip	No	Yes
09	Fault, motor encoder	No	Yes
10	Error, internal communications	No	Yes
11	Fault, infeed	No	Yes
15	Other faults/errors	No	Yes

Actual Speed Value (N_Act_A, N_Act_GLATT)

- Actual speed value with 16-bit resolution incl. sign bit.
- Bit 15 determines the actual value sign:
  - Bit = 0 → positive actual value
  - Bit = 1 → negative actual value
- The actual speed value is normalized via parameter p2000.
  N_act = 4000 hex or 16384 dec = speed in p2000

Actual Speed Value (N_Act_B)

- Actual speed value with 32-bit resolution incl. sign bit.
- Bit 32 determines the actual value sign:
  - Bit = 0 → positive actual value
  - Bit = 1 → negative actual value
- The actual speed value is normalized via parameter p2000.
  N_act_B = 4000 0000 hex or 1073741824 dec = speed in p2000

Actual Current Value (Ia_Act, Ia_Act_GLATT)

- Actual current value with 16-bit resolution
- The actual current value is normalized via parameter p2002.
  Ia_act = 4000 hex or 16384 dec = current in p2002

Actual Torque Value (M_Act, M_Act_GLATT)

- Actual torque value with 16-bit resolution incl. sign bit.
- Bit 15 determines the actual value sign:
  - Bit = 0 → positive actual value
  - Bit = 1 → negative actual value
- The actual torque value is normalized via parameter p2003.
  M_act = 4000 hex or 16384 dec = torque in p2003

Actual Power Value (P_Act, P_Act_GLATT)

- Actual power value with 16-bit resolution incl. sign bit.
- Bit 15 determines the actual value sign:
  - Bit = 0 → positive actual value
  - Bit = 1 → negative actual value
- The actual power value is normalized via parameter p2004.
  P_act = 4000 hex or 16384 dec = power in p2004

Alarm code (ALARM_CODE)

The number of the current alarm and the last alarm to occur are output here. Decimal notation is used (i.e. value 7910 dec = A07910 (motor overtemperature)).

Fault code (FAULT_CODE)

The number of the oldest fault still active is output here. Decimal notation is used (i.e. value 7860 dec = F07860 (external fault 1)).

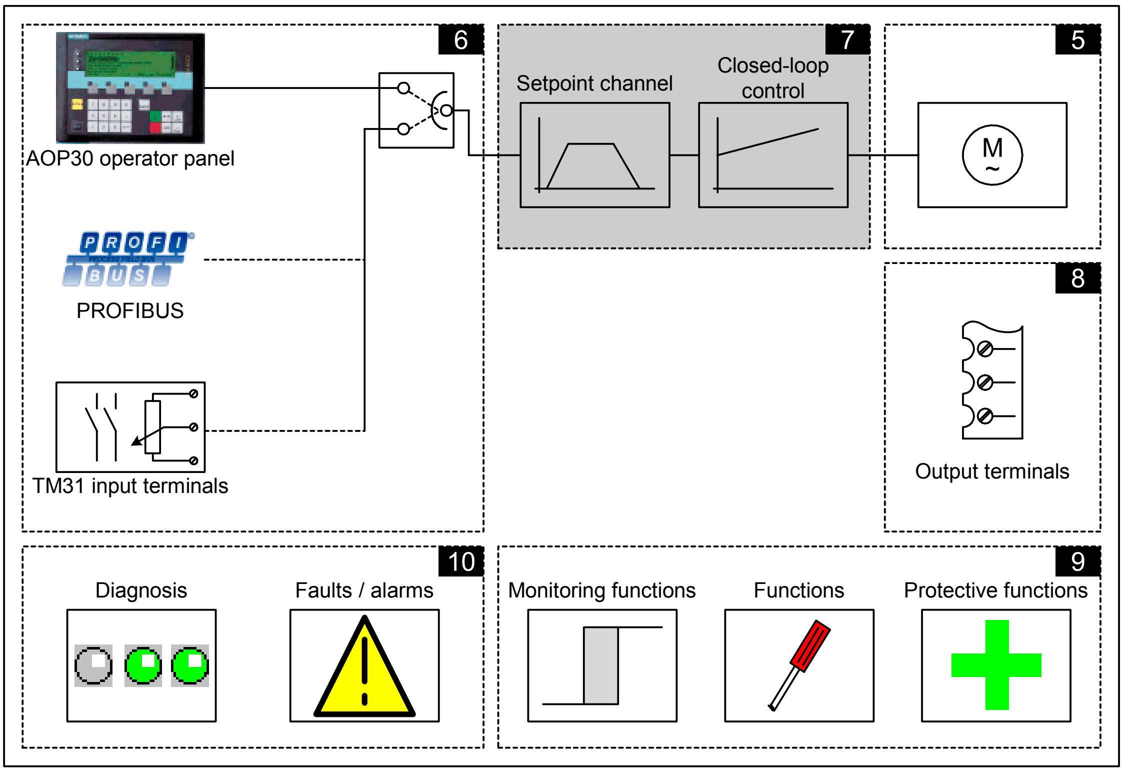
■

Setpoint channel and closed-loop control 7

7.1 Chapter content

This chapter provides information on the setpoint channel and closed-loop control functions.

- Setpoint channel
  - Direction of rotation changeover
  - Suppression speed
  - Minimum speed
  - Speed limitation
  - Ramp-function generator
- V/f control
- Speed control with / without encoder



Function diagrams

To supplement this operating manual, the CD contains simplified function diagrams describing the operating principle of the SINAMICS G130.
The diagrams are arranged in accordance with the chapters in the operating manual. The page numbers (7xx) describe the functionality in the following chapter.

At certain points in this chapter, reference is made to function diagrams with a 4-digit number. These are stored on the CD in the "SINAMICS G List Manual", which provides experienced users with detailed descriptions of all the functions.

7.2 Setpoint channel

7.2.1 Setpoint addition

Description

The supplementary setpoint can be used to enter correction values from higher-level closed-loop controls. This can be implemented using the summing point of the main/supplementary setpoint in the setpoint channel. Both variables are imported simultaneously via two separate or one setpoint source and added in the setpoint channel.

Function diagram

FD 3030 Main/supplementary setpoint, setpoint scaling, jogging

Parameters

- p1070 Main setpoint
- p1071 Main setpoint scaling
- r1073 Main setpoint effective
- p1075 Supplementary setpoint
- p1076 Supplementary setpoint scaling
- r1077 Supplementary setpoint effective
- r1078 Total setpoint effective

7.2.2 Direction of rotation changeover

Description

If an incorrect phase sequence was connected when the cables were installed, and the phase sequence cannot be corrected by swapping the motor cables, it can be corrected by means of a negative command value or by parameterizing the chassis units, thereby enabling the direction to be reversed.

This is mainly used for operating the drive in both directions of rotation.

Prerequisites

Direction of rotation changeover is triggered:

- via PROFIBUS by means of control word 1, bit 11
- via the operator panel (LOCAL mode) with the "direction of rotation changeover" key.

NOTE

Please note that when control takes place via AOP30 only one direction of rotation is enabled in the factory setting.

Function diagram

FD 3040 Direction of rotation limitation and direction of rotation reversal

Parameters

- p1110 Inhibit negative direction
- p1111 Inhibit positive direction
- p1113 Direction of rotation changeover

7.2.3 Suppression speed and minimum speed

Description

Variable-speed drives can generate critical whirling speeds within the control range of the entire drive train. This prevents steady-state operation in their proximity; in other words, although the drive can pass through this range, it must not remain within it because resonant oscillations may be excited. The suppression bandwidths allow this range to be blocked for steady-state operation. Because the points at which critical whirling speeds occur in a drive train can vary depending on age or thermal factors, a broader control range must be blocked. To ensure that the speed does not constantly increase and decrease in the suppression bandwidth (speeds), the bands are assigned a hysteresis.

Specifying a minimum speed allows a specific range to be disabled about speed 0 1/min for steady-state operation.

Signal flow diagram

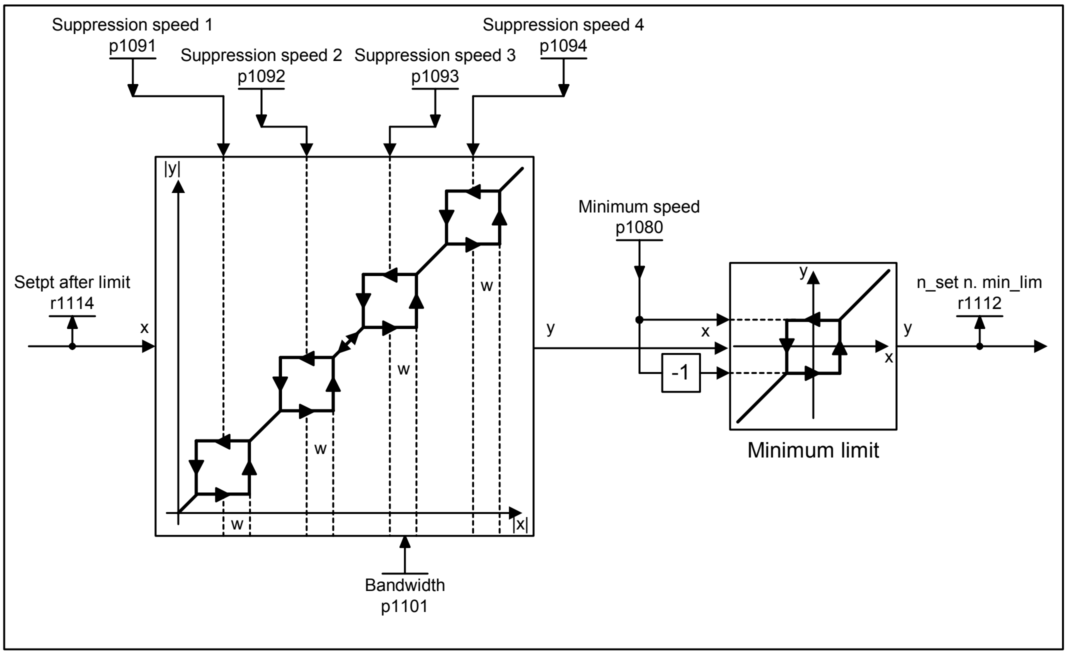


Fig. 7-1 Signal flow diagram: suppression speeds and minimum speeds

Function diagrams

FD 3050 Suppression bandwidth and speed limiting

Parameters

- p1091 Suppression speed 1
- p1092 Suppression speed 2
- p1093 Suppression speed 3
- p1094 Suppression speed 4
- p1101 Suppression speed bandwidth
- p1080 Minimum speed
- r1112 Speed setpoint after minimum limiting

7.2.4 Speed limitation

Description

Speed limitation aims to limit the maximum permissible speed of the entire drive train to protect the drive and load machine/process against damage caused by excessive speeds.

Signal flow diagram

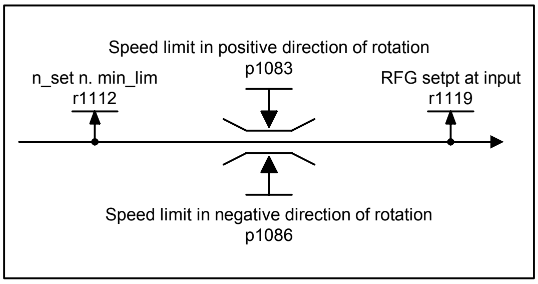


Fig. 7-2 Signal flow diagram: speed limitation

Function diagrams

FD 3050 Suppression bandwidth and speed limiting

Parameters

- p1082 Maximum speed
- p1083 Speed limit in positive direction of rotation
- p1086 Speed limit in negative direction of rotation

7.2.5 Ramp-function generator

Description

The ramp-function generator limits the rate at which the setpoint changes when the drive is accelerating or decelerating. This prevents excessive setpoint step changes from damaging the drive train. Additional rounding times can also be set in the lower and upper speed ranges to improve control quality and prevent load surges, thereby protecting mechanical components, such as shafts and couplings.

The ramp-up and ramp-down times each refer to the maximum speed (p1082). The rounding times that can be set can prevent the actual speed value from being overshot when the setpoint is approached, thereby improving control quality.

Notice: if rounding times are too long, this can cause the setpoint to be overshot if the setpoint is reduced abruptly during ramp-up. Rounding is also effective in the zero crossover; in other words, when the direction is reversed, the ramp-function generator output is reduced to zero via initial rounding, the ramp-down time, and final rounding before the new, inverted setpoint is approached via start rounding, the ramp-up time, and end rounding. Rounding times that can be set separately are active in the event of a fast stop (OFF3). The actual ramp-up/ramp-down times increase with active rounding.

The rounding type can be set using p1134 and separately activated/deactivated using p1151.00 in the zero passage.

Signal flow diagram

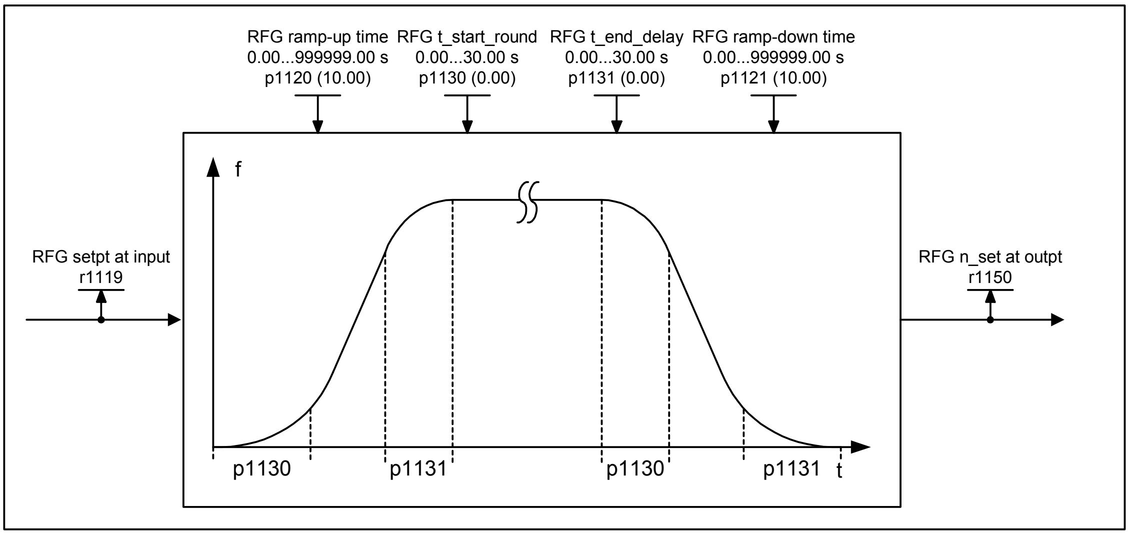


Fig. 7-3 Signal flow diagram: ramp-function generator

Function diagrams

FD 3060 Simple ramp-function generator

FD 3070 Expanded ramp-function generator

Parameters

- p1120 Ramp-function generator ramp-up time
- p1121 Ramp-function generator ramp-down time
- p1130 Ramp-function generator initial rounding-off time
- p1131 Ramp-function generator final rounding-off time
- p1134 Ramp-function generator rounding-off type
- p1135 OFF3 ramp-down time
- p1136 OFF3 initial rounding-off time
- p1137 OFF3 final rounding-off time
- p1151 Ramp-function generator configuration

NOTE

The effective ramp-up time increases when you enter an initial and final rounding-off time.

Effective ramp-up time = p1120 + (0.5 x p1130) + (0.5 x p1131)

7.3 V/f control

Description

The simplest solution for a control procedure is the V/f characteristic, whereby the stator voltage for the induction motor or synchronous motor is controlled proportionately to the stator frequency. This method has proved successful in a wide range of applications with low dynamic requirements, such as:

- Pumps and fans
- Belt drives
- Multi-motor drives

and other similar processes.

V/f control aims to maintain a constant flux Φ in the motor, whereby the flux is proportional to the magnetization current (Iμ) or the ratio of voltage (U) to frequency (f).

$\Phi \sim I\mu \sim U/f$

The torque (M) generated by the induction motors is, in turn, proportional to the product (or, more precisely, the vector product (Φ x I)) of the flux and current.

To generate as much torque as possible with a given current, the motor must function using the greatest possible constant flux. To maintain a constant flux (Φ), therefore, the voltage must be changed in proportion to the frequency (f) to ensure a constant magnetization current (Iμ). V/f characteristic control is derived from these basic premises.

The field-weakening range is above the rated motor frequency, where the maximum voltage is reached. The flux and maximum torque are reduced as the frequency increases (see Fig. 7-4).

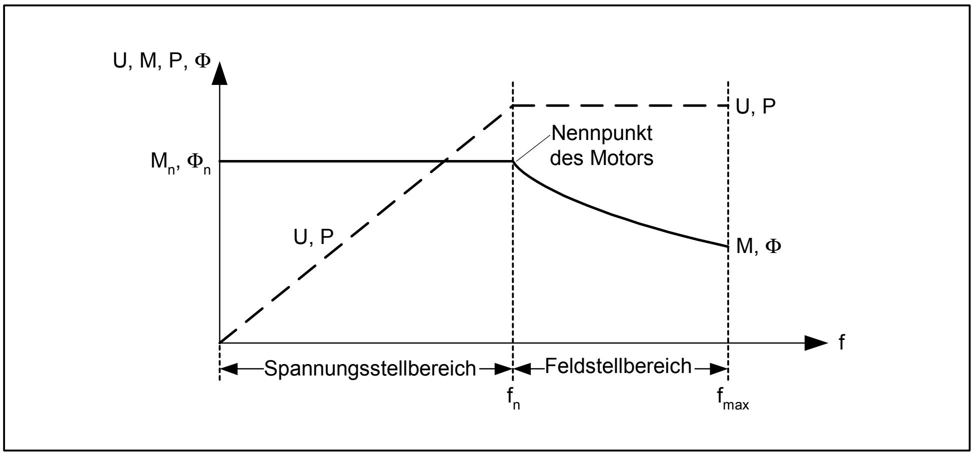
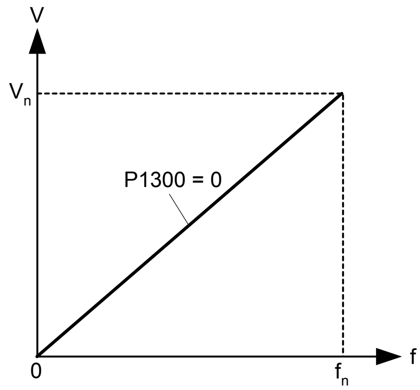
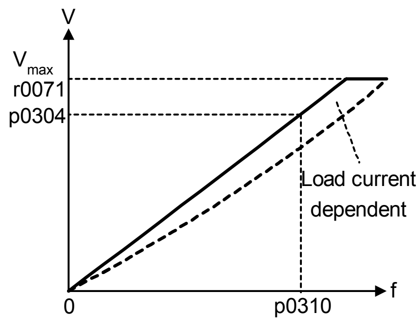
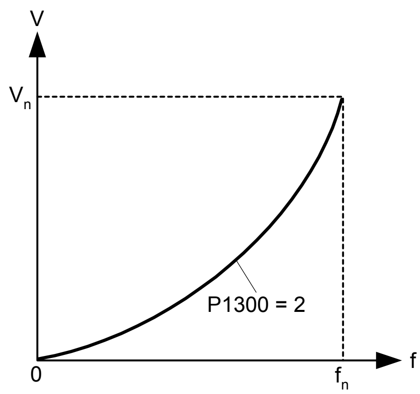
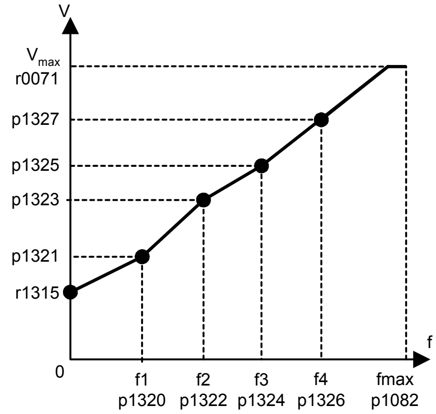


Fig. 7-4 Operating areas and characteristic curves for the induction motor with converter supply

Several variations of the V/f characteristic exist, which are listed in the following table.

Table 7-1 V/f characteristics

Parameter values	Meaning	Application / Property	
0	Linear characteristic	Standard with variable voltage boost	
1	Linear characteristic with flux current control (FCC)	Characteristic that compensates for voltage drops in the stator resistance for static / dynamic loads (flux current control FCC). This is particularly useful for small motors, since they have a relatively high stator resistance.	
2	Parabolic characteristic	Characteristic that takes into account the motor torque curve (e.g. fan/pump). • Quadratic characteristic (f^2 characteristic) • Energy saving because the low voltage also results in small currents and drops.	

Parameter values	Meaning	Application / Property
3	Programmable characteristic	Characteristic that takes into account the motor/machine torque characteristic. 
5	Precise frequency drives	Characteristic (see parameter value 0) that takes into account the technological particularity of an application (e.g. textile applications): • Whereby the current limitation (Imax controller) only affects the output voltage and not the output frequency. • By disabling slip compensation.
6	Precise frequency drives with flux current control (FCC)	Characteristic (see parameter value 1) that takes into account the technological particularity of an application (e.g. textile applications): • Whereby the current limitation (Imax controller) only affects the output voltage and not the output frequency. • By disabling slip compensation. In addition, this characteristic compensates for voltage drops in the stator resistance for static / dynamic loads (flux current control FCC). This is particularly useful for small motors, since they have a relatively high stator resistance.
19	Independent voltage setpoint	The user can define the output voltage of the Power Module independently of the frequency using BICO parameter p1330 via the interfaces (e.g. analog input AI0 of the TM31 –> p1330 = r4055[0]).

Function diagrams

FD 6300 V/f characteristic and voltage boost

Parameter

- p1300 Open-loop/closed-loop control operating mode

7.3.1 Voltage boost

Description

With low output frequencies, the V/f characteristics yield only a small output voltage.

With low frequencies, too, the ohmic resistance of the stator windings has an effect and can no longer be ignored vis-à-vis the machine reactance. With low frequencies, therefore, the magnetic flux is no longer proportional to the magnetization current or the V/f ratio.

The output voltage may, however, be too low to:

- Magnetize the induction motor.
- Maintain the load.
- Compensate for the voltage losses (ohmic losses in the winding resistors) in the system.
- Induce a breakaway / accelerating / braking torque.

You can choose whether the voltage boost is to be active permanently or only during acceleration.

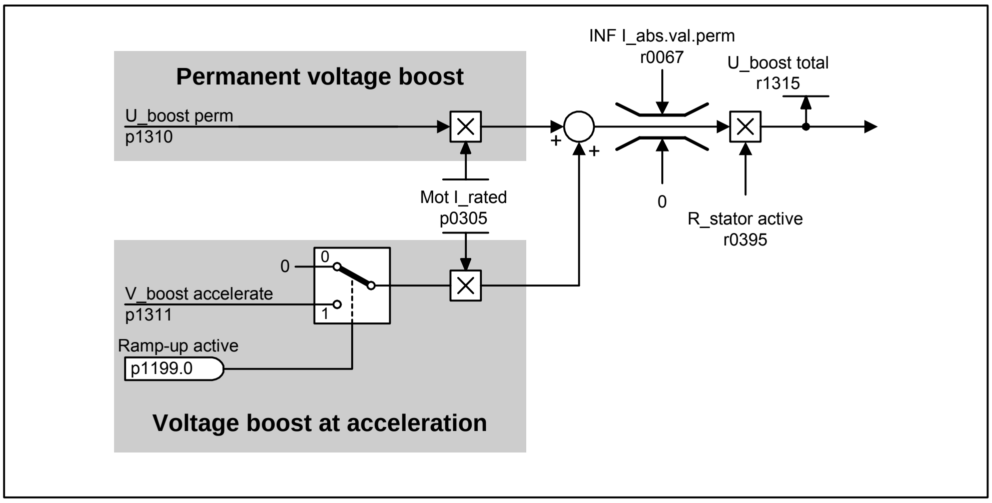


Fig. 7-5 Total voltage boost

NOTE

The voltage boost affects all V/f characteristics (p1300) from 0 to 6.

IMPORTANT

If the voltage boost value is too high, this can result in a thermal overload of the motor winding.

Permanent voltage boost (p1310)

The voltage boost is active across the entire frequency range, whereby the value decreases continuously at higher frequencies.

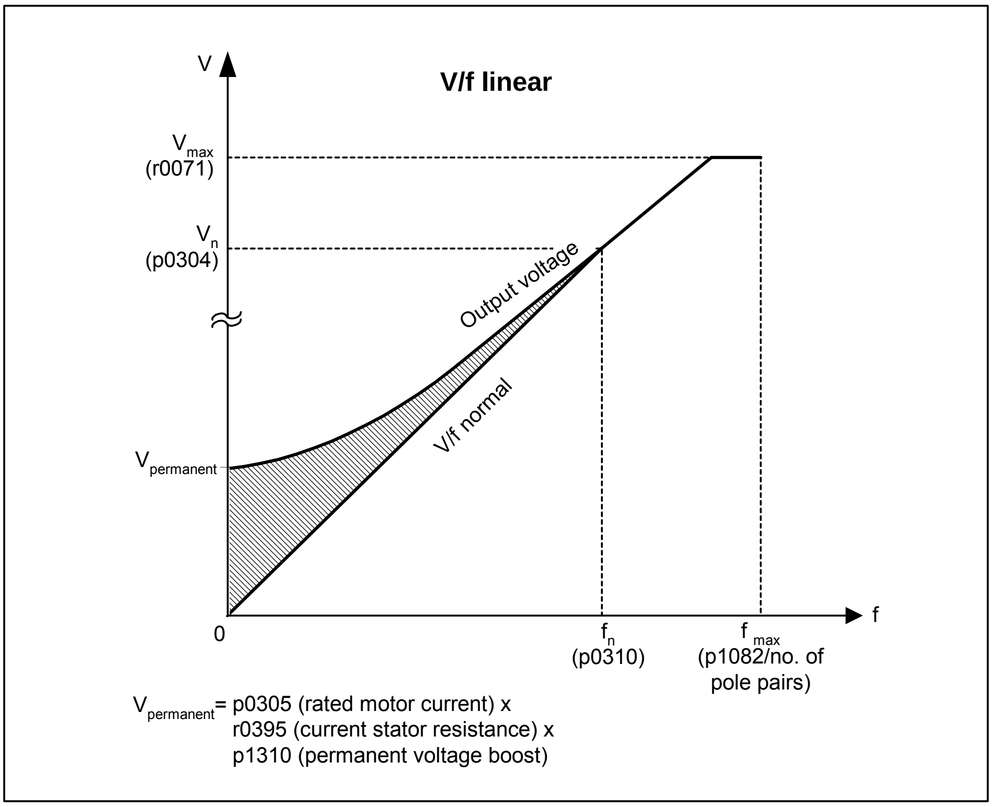


Fig. 7-6 Permanent voltage boost (e.g.: p1300 = 0 and p1311 = 0)

Voltage boost at acceleration (p1311)

The voltage boost is only active during acceleration/braking.

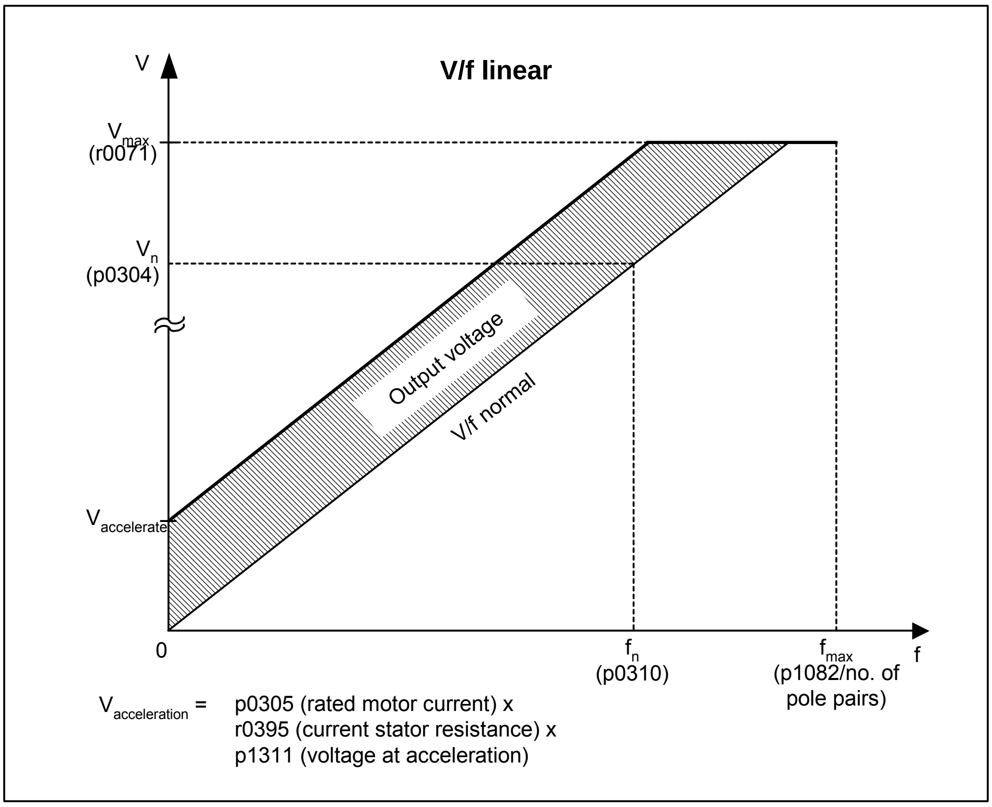


Fig. 7-7 Voltage boost at acceleration (e.g.: p1300 = 0 and p1310 = 0)

Function diagrams

FD 6300 V/f characteristic and voltage boost

Parameters

- p0305 Rated motor current
- p0395 Stator resistance, actual
- p1310 Voltage boost permanent
- p1311 Voltage boost at acceleration
- r1315 Voltage boost total

7.3.2 Slip compensation

Description

The slip compensation means that the speed of induction motors is essentially kept constant independent of the load.

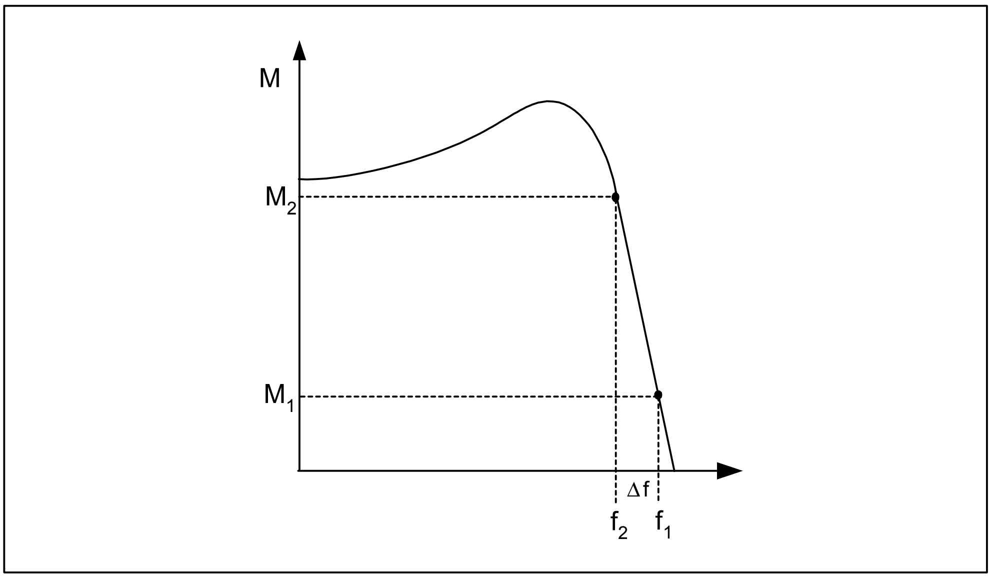


Fig. 7-8 Slip compensation

Function diagrams

FD 6310 Resonance damping and slip compensation

Parameters

- p1335 Slip compensation
  - – p1335 = 0.0 %: slip compensation is deactivated.
  - – p1335 = 100.0 %: slip is fully compensated.
- p1336 Slip compensation limit value
- r1337 Actual slip compensation

7.4 Vector speed / torque control with / without encoder

Description

Compared with V/f control, vector control offers the following benefits:

- Stability vis-à-vis load and setpoint changes
- Short rise times with setpoint changes (–> better command behavior)
- Short settling times with load changes (–> better disturbance characteristic)
- Acceleration and braking are possible with maximum available torque
- Motor protection due to variable torque limitation in motor and regenerative mode
- Drive and braking torque controlled independently of the speed

These benefits are available without speed feedback.

Vector control can be used with or without an encoder.

The following criteria indicate when an encoder is required:

- Maximum speed accuracy requirements
- Maximum dynamic response requirements
- Better command behavior
- Shortest settling times when disturbances occur
- Torque control in a range greater than 1:20 is required
- Allows a defined and/or variable torque for speeds below approx. 5 % of the rated motor frequency (p0310) to be maintained

With regard to setpoint input, vector control is divided into:

- Speed control
- Torque/current control (torque control)

7.4.1 Vector control without encoder

Description

In vector control without an encoder (SLVC: Sensorless Vector Control), the position of the flux and actual speed must be determined via the electric motor model. The model is buffered by the incoming currents and voltages. At low frequencies (approx. 0 Hz), the model cannot determine the speed.

For this reason and due to uncertainties in the model parameters or inaccurate measurements, the system is switched from closed-loop to open-loop operation in this range.

The switchover is governed by time and frequency conditions (p1755, p1756, p1758 and p1759). The system does not wait for the time condition to elapse when the setpoint frequency at the ramp-function generator input and the actual frequency are below p1755 x (1 - p1756) simultaneously.

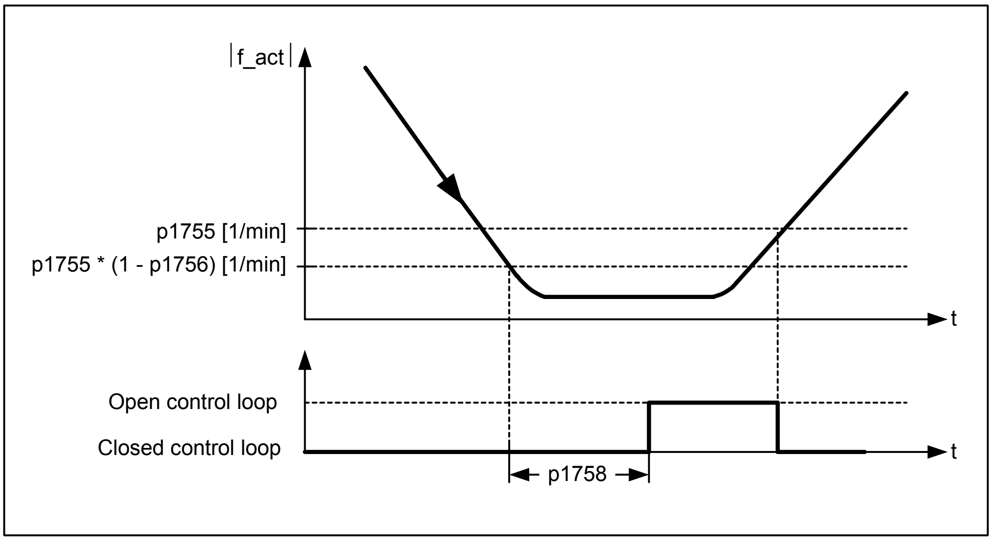


Fig. 7-9 Switchover conditions

In open-loop operation, the actual speed value is the same as the setpoint value. For vertical loads and acceleration, parameters p1610 (constant torque boost) and p1611 (acceleration torque boost) must be modified in order to generate the static or dynamic load torque of the drive. If p1610 is set to 0%, only the magnetizing current (r0331) is injected; when the value is 100%, the rated motor current (p0305) is injected. To ensure that the drive does not stall during acceleration, p1611 can be increased or acceleration pre-control for the speed controller can be used. This is also advisable to ensure that the motor is not subject to thermal overload at low speeds.

Vector control without a speed sensor has the following characteristics at low frequencies:

- Closed-loop operation up to approx. 1 Hz output frequency
- Start-up in closed-loop operation (directly after drive is energized)
- Passes through low frequency range (0 Hz) in closed-loop operation

---

NOTE

In this case, the speed setpoint upstream of the ramp-function generator must be greater than (p1755).

Closed-loop operation up to approx. 1 Hz (settable via parameter p1755) and the ability to start or reverse at 0 Hz directly in closed-loop operation (settable via parameter p1750) result in the following benefits:

- No switchover required within closed-loop control (smooth operation, no dips in frequency).
- Stationary speed–torque control up to approx. 1 Hz.

NOTE

When the motor is started or reversed in closed-loop control at 0 Hz, it is important to take into account that a switchover is made from closed-loop to open-loop control automatically if the system remains in the 0 Hz range for too long (> 2 s or > p1758).

Function Diagram

FD 6730 Interface to the motor module

Parameters

- p0305 Rated motor current
- r0331 Motor magnetizing current/short-circuit current
- p1610 Torque setpoint static (SLVC)
- p1611 Supplementary accelerating torque (SLVC)
- p1750 Motor model configuration
- p1755 Motor model changeover speed sensorless operation
- p1756 Motor model changeover speed hysteresis
- p1758 Motor model changeover delay time, closed/open-loop control
- p1759 Motor model changeover delay time, open/closed-loop control

7.4.2 Vector Control with Encoder

Description

Benefits of vector control with an encoder:

- The speed can be controlled right down to 0 Hz (standstill)
- Stable control response throughout the entire speed range
- Allows a defined and/or variable torque for speeds below approx. 10 % of the rated motor speed (p0310) to be maintained
- Compared with speed control without an encoder, the dynamic response of drives with an encoder is significantly better because the speed is measured directly and integrated in the model created for the current components.

Function diagrams

FD 4715	Speed actual value and pole position sensing for motor encoder
FD 6030	Speed setpoint, droop
FD 6040	Speed controller with/without encoder
FD 6050	Kp_n/Tn_n adaptation
FD 6060	Torque setpoint
FD 6490	Speed control configuration

7.4.3 Speed controller

Description

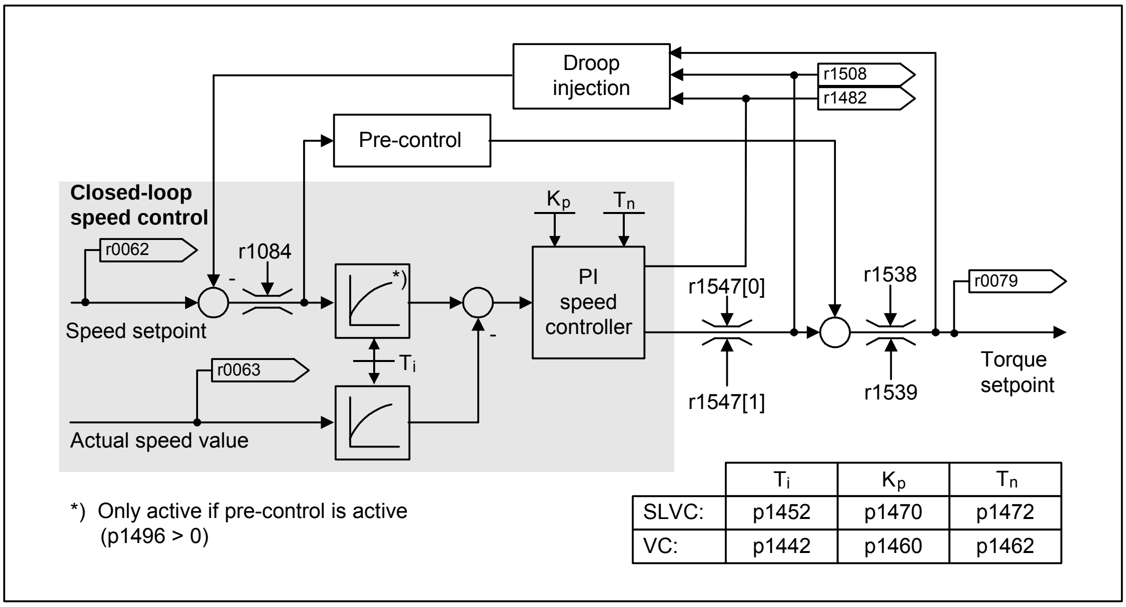
Both closed-loop control techniques with and without encoder (SLVC, VC) have the same speed controller structure that contains the following components as kernel:

- PI controller
- Speed controller pre-control
- Droop function

The total of the output variables result in the torque setpoint, which is reduced to the permissible magnitude by means of the torque setpoint limitation.

The speed controller receives its setpoint (r0062) from the setpoint channel and its actual value (r0063) either directly from the speed sensor (speed control with sensor) or indirectly via the motor model (speed control without sensor). The system difference is increased by the PI controller and, in conjunction with the pre-control, results in the torque setpoint.

When the load torque increases, the speed setpoint is reduced proportionately when the droop function is active, which means that the single drive within a group (two or more mechanically connected motors) is relieved when the torque becomes too great.



	T_i	K_p	T_n
SLVC:	p1452	p1470	p1472
VC:	p1442	p1460	p1462

Fig. 7-10 Speed controller

The optimum speed controller setting can be determined via the automatic speed controller optimization function (p1960).

If the inertia load has been specified, the speed controller (Kp, Tn) can be calculated by means of automatic parameterization (p0340 = 4). The controller parameters are defined in accordance with the symmetrical optimum as follows:

Tn = 4 x Ts

Kp = 0.5 x r0345 / Ts = 2 x r0345 / Tn

Ts = sum of the short delay times (includes p1442 and p1452).

If vibrations occur with these settings, the speed controller gain Kp must be reduced manually. Actual speed value smoothing can also be increased (standard procedure for gearless or high-frequency torsion vibrations) and the controller calculation performed again because this value is also used to calculate Kp and Tn.

The following relationships apply for optimization:

- If Kp is increased, the controller becomes faster, although overshoot is reduced. Signal ripples und vibrations in the speed control loop, however, increase.
- If Tn is decreased, the controller still becomes faster, although overshoot is increased.

When the speed control is set manually, it is easiest to define possible dynamic response via Kp (and actual speed value smoothing) first before reducing the integral time as much as possible. When doing so, closed-loop control must also remain stable in the field-weakening range.

To suppress any vibrations that occur in the speed controller, it is usually only necessary to increase the smoothing time in p1442 or p1452 or reduce the controller gain.

The integral output of the speed controller can be monitored via r1482 and the limited controller output via r1508 (torque setpoint).

NOTE

When compared to closed-loop speed control with encoder, the dynamic performance for sensorless drives is significantly lower. The actual speed is derived – using a model-based calculation – from the drive converter output quantities current and voltage. These current and voltage signals are noisy. This means that the actual speed must be filtered using appropriate filter algorithms in the software.

Examples of speed controller settings

A few examples of speed controller settings with vector control without encoders (p1300 = 20) are provided below. These should not be considered to be generally valid and must be checked in terms of the control response required.

Fans (large centrifugal masses) and pumps

Kp (p1470) = 2 … 10

Tn (p1472) = 250 … 500 ms

The Kp = 2 and Tn = 500 ms settings result in asymptotic approximation of the actual speed to the setpoint speed after a setpoint step change. During many simple control procedures, this is satisfactory for pumps and fans.

Stone mills, separators (large centrifugal masses)

Kp (p1470) = 12 … 20

Tn (p1472) = 500 … 1000 ms

Kneader drives

Kp (p1470) = 10

Tn (p1472) = 200 … 400 ms

NOTE

We recommend checking the effective speed control gain (r1468) during operation. If this value changes during operation, the Kp adaptation is being used (p1400.5 = 1). Kp adaptation can if necessary be deactivated or its behavior changed.

When operating with encoder (p1300 = 21):

A smoothing value for the actual speed value (p1442) = 5 … 20 ms ensures quieter operations for motors with gear units.

Function diagram

FD 6040 Speed controller with/without encoder

Parameters

- r0062 CO: Speed setpoint after filter
- r0063 CO: Actual speed smoothed
- p0340 Automatic calculation of motor/closed-loop control parameters
- r0345 CO: Nominal motor starting time
- p1442 Speed actual value smoothing time (VC)
- p1452 Speed actual value smoothing time (SLVC)
- p1460 Speed controller P gain adaptation speed, lower
- p1462 Speed controller integral action time adaptation speed, lower
- p1470 Speed controller sensorless operation P-gain
- p1472 Speed controller sensorless operation integral-action time
- r1482 CO: Torque output I speed controller
- r1508 CO: Torque setpoint before supplementary torque
- p1960 Speed controller optimization selection

7.4.3.1 Speed controller pre-control (integrated pre-control with balancing)

Description

The command behavior of the speed control loop can be improved by calculating the accelerating torque from the speed setpoint and connecting it on the line side of the speed controller. This torque setpoint mv is applied to the current controller/the current controller is pre-controlled using adaptation elements directly as additive reference variable (enabled via p1496).
The torque setpoint mv is calculated from:

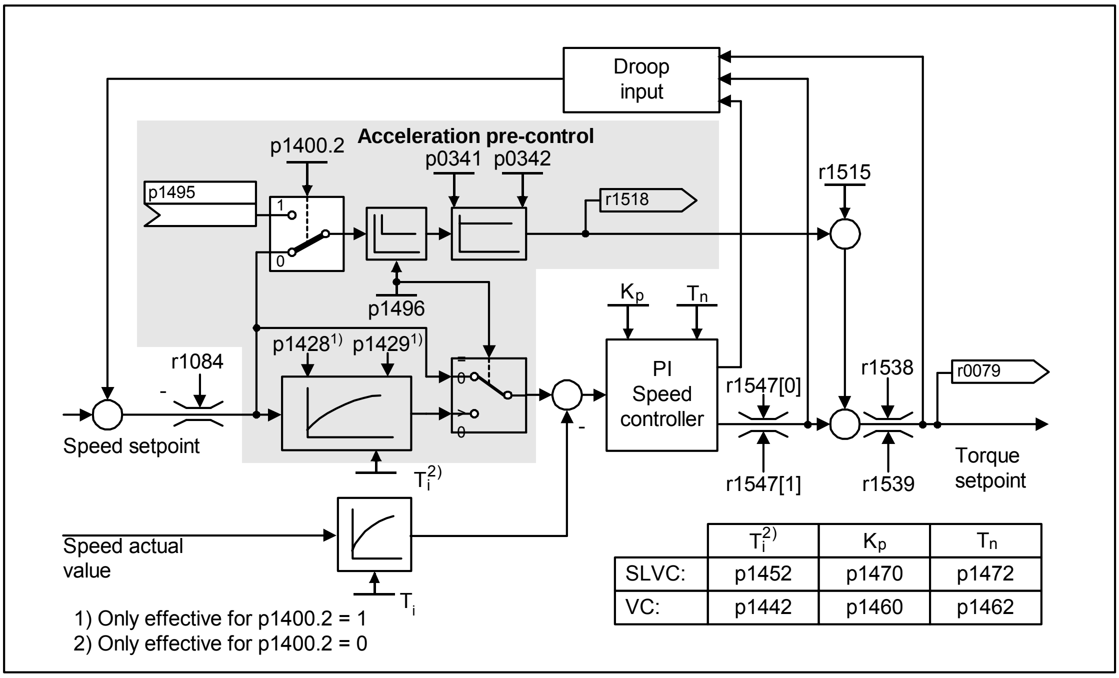
$$mv = p1496 \cdot J \cdot \frac{d\omega}{dt} = p1496 \cdot p0341 \cdot p0342 \cdot \frac{d\omega}{dt}, \omega = 2\pi f$$

The motor moment of inertia p0341 is calculated when commissioning the drive system. The factor p0342 between the total moment of inertia J and the motor moment of inertia must be determined manually or by optimizing the speed controller. The acceleration is calculated from the speed difference over the time dω/dt.

NOTE

When speed controller optimization is carried out, the ratio between the total moment of inertia and that of the motor (p0342) is determined and acceleration pre-control scaling (p1496) is set to 100 %.

If p1400.2 = p1400.3 = 0, then the pre-control balancing is automatically set.



	T_i 2)	K_p	T_n
SLVC:	p1452	p1470	p1472
VC:	p1442	p1460	p1462

Fig. 7-11 Speed controller with pre-control

When correctly adapted, when accelerating, the speed controller must compensate for disturbances in its control loop. This is achieved with a relatively low controlled variable change at the controller output. On the other hand, speed setpoint changes are routed past the speed controller and are therefore more quickly executed.

The effect of the pre-control variable can be adapted according to the application via the evaluation factor p1496. For p1496 = 100 %, the pre-control is calculated according to the motor and load moment of inertia (p0341, p0342). In order that the speed controller does not work against the entered torque setpoint, a balancing filter is automatically used. The time constant of the balancing filter corresponds to the equivalent delay time of the speed control loop. The speed controller pre-control is correctly set (p1496 = 100 %, calibration using p0342) if the I component of the speed controller (r1482) does not change while ramping-up or ramping-down in the range n > 20 % x p0310. Thus, the pre-control allows a new speed setpoint to be approached without overshoot (prerequisite: the torque limiting does not act and the moment of inertia remains constant).

If the speed controller is pre-controlled through injection, the speed setpoint (r0062) is delayed with the same smoothing time (p1442 or p1452) as the actual value (r1445). This ensures that no target/actual difference (r0064) occurs at the controller input during acceleration, which would be attributable solely to the signal propagation time.

When speed pre-control is activated, the speed setpoint must be specified continuously or without a higher interference level (avoids sudden torque changes). An appropriate signal can be generated by smoothing the setpoint or activating the rounding-off function of the ramp-function generator p1130 - p1131.

The starting time r0345 (T_{start}) is a measure for the total moment of inertia J of the motor and defines that time in which the unloaded drive can accelerate from standstill up to the rated motor speed p0311 ($M_{mot,rated}$) with the rated motor torque r0333 ($n_{mot,rated}$).

$$r0345 = T_{start} = J \cdot \frac{2\pi \cdot n_{mot,rated}}{60 \cdot M_{mot,rated}} = p0341 \cdot p0342 \cdot \frac{2\pi \cdot p0311}{60 \cdot r0333}$$

If these basic conditions are in line with the application, the starting time can be used as the lowest value for the ramp-up or ramp-down time.

NOTE

The ramp-up and ramp-down times (p1120; p1121) of the ramp-function generator in the setpoint channel should be set accordingly so that the motor speed can track the setpoint during acceleration and braking. This ensures that speed controller pre-control is functioning optimally.

The acceleration pre-control using a connector input (p1495) is activated by the parameter settings p1400.2 = 1 and p1400.3 = 0. p1428 (dead time) and p1429 (time constant) can be set for balancing purposes.

Function diagram

FP 6031 Pre-control balancing for reference/acceleration model

Parameters

- p0311 Rated motor speed
- r0333 Rated motor torque
- p0341 Motor moment of inertia
- p0342 Ratio between the total and motor moment of inertia
- r0345 Nominal motor starting time
- p1400.2 Acceleration pre-control source
- p1428 Speed pre-control balancing deadtime
- p1429 Speed pre-control balancing time constant
- p1496 Acceleration pre-control scaling
- r1518 Accelerating torque

7.4.3.2 Reference model

Description

The reference model becomes operative when p1400.3 = 1 and p1400.2 = 0.

The reference model is used to emulate the speed control loop with a P speed controller.

The loop emulation can be set in p1433 to p1435. It becomes effective if p1437 is connected to the output of the model r1436.

The reference model delays the setpoint-actual value deviation for the integral component of the speed controller so that settling (stabilizing) operations can be suppressed.

The reference model can also be externally emulated and the external signal entered via p1437.

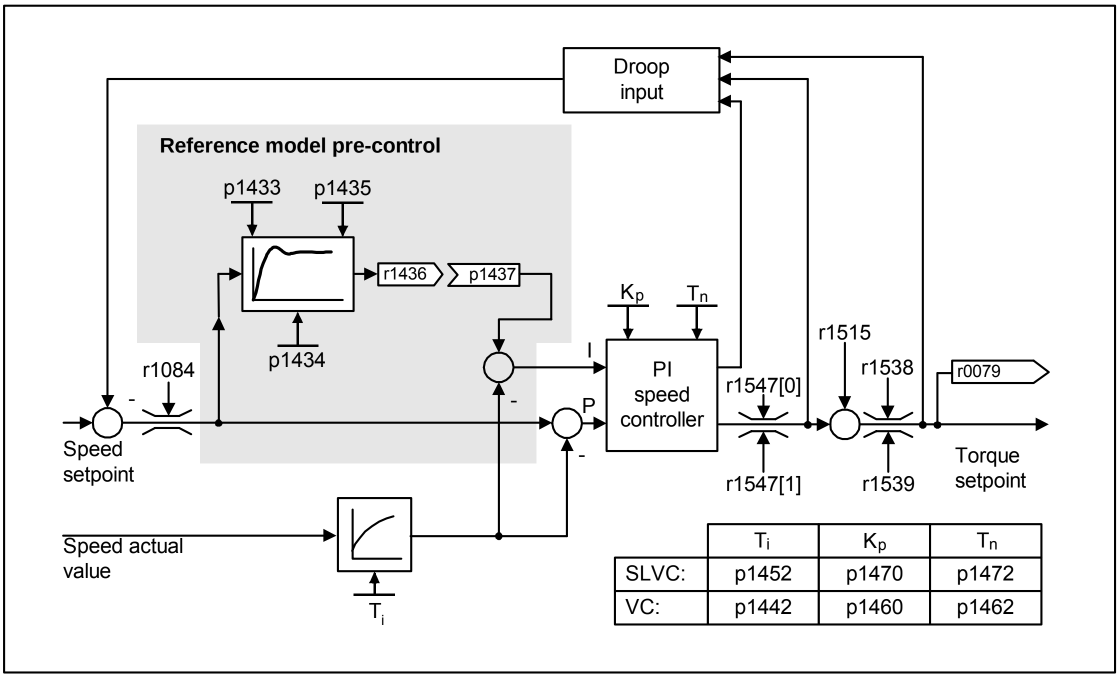


Fig. 7-12 Reference model

Function diagram

FD 6031 Pre-control balancing for reference/acceleration model

Parameters

- p1400.3 Reference model, speed setpoint, I component
- p1433 Speed controller reference model natural frequency
- p1434 Speed controller reference model damping
- p1435 Speed controller reference model deadtime
- p1436 Speed controller reference model speed setpoint output
- p1437 Speed controller, reference model I component input

7.4.3.3 Speed controller adaptation

Description

Two adaptation methods are available, namely free Kp_n adaptation and speed-dependent Kp_n/Tn_n adaptation.

Free Kp_n adaptation is also active in "operation without encoder" mode and is used in "operation with encoder" mode as an additional factor for speed-dependent Kp_n adaptation.

Speed-dependent Kp_n/Tn_n adaptation is only active in "operation with encoder" mode and also affects the Tn_n value.

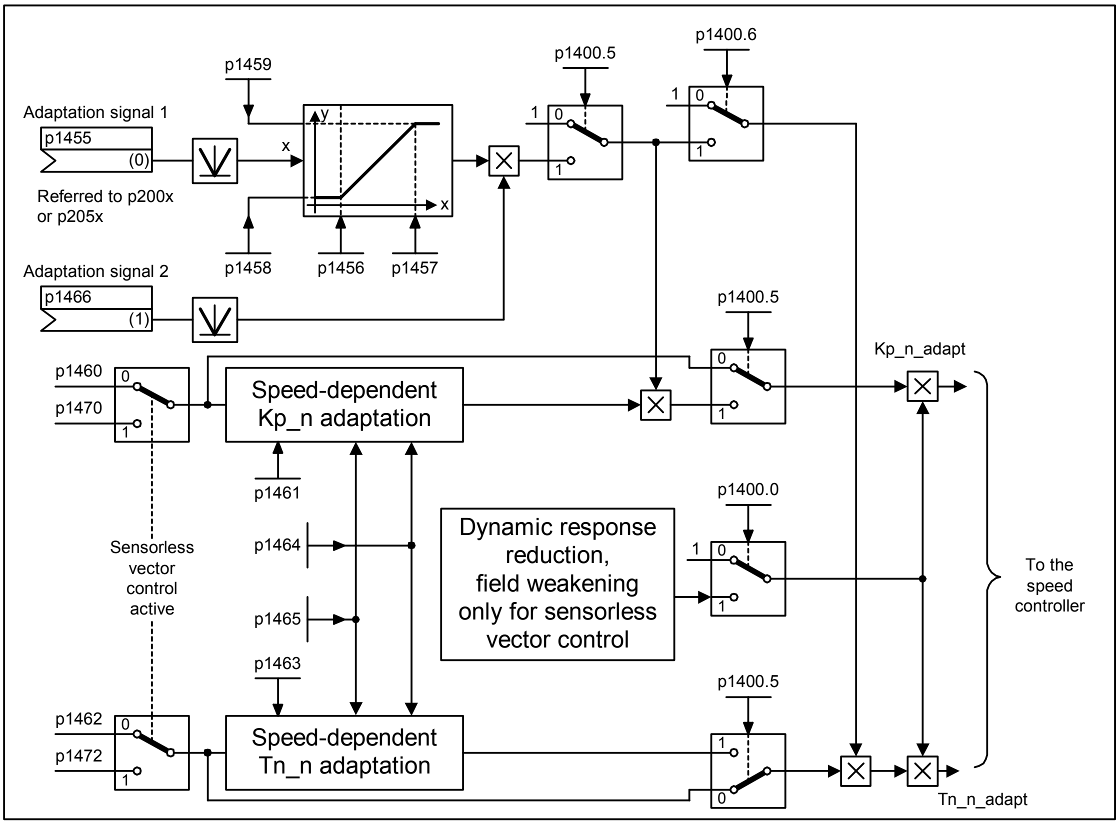


Fig. 7-13 Free Kp adaptation

A dynamic response reduction in the field-weakening range can be activated (p1400.0) in sensorless operation. This is activated when the speed controller is optimized in order to achieve a greater dynamic response in the basic speed range.

Example of speed-dependent adaptation

NOTE

This type of adaptation is only active in "operation with encoder" mode.

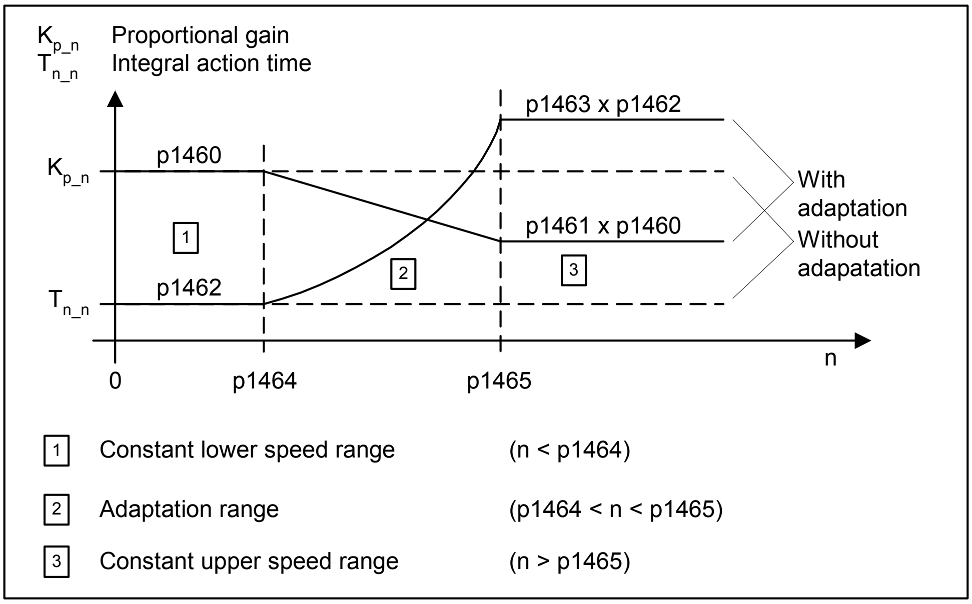


Fig. 7-14 Free Kp adaptation

Function diagram

FD 6050 Kp_n/Tn_n adaptation

Parameters

- p1400.5 Speed control configuration: Kp/Tn adaptation active

Free Kp_n adaptation

- p1455 Speed controller P gain adaptation signal
- p1456 Speed controller P gain adaptation lower starting point
- p1457 Speed amplifier, P gain adaptation upper starting point
- p1458 Adaptation factor, lower
- p1459 Adaptation factor, upper
- p1470 Speed controller sensorless operation P-gain

Speed-dependent Kp_n/Tn_n adaptation (VC only)

- p1460 Speed controller P gain adaptation speed, lower
- p1461 Speed controller P gain adaptation speed, upper
- p1462 Speed controller integral action time adaptation speed, lower
- p1463 Speed controller integral action time adaptation speed, upper
- p1464 Speed controller adaptation speed, lower
- p1465 Speed controller adaptation speed, upper
- p1466 Speed controller P-gain scaling

Dynamic response reduction field weakening (SLVC only)

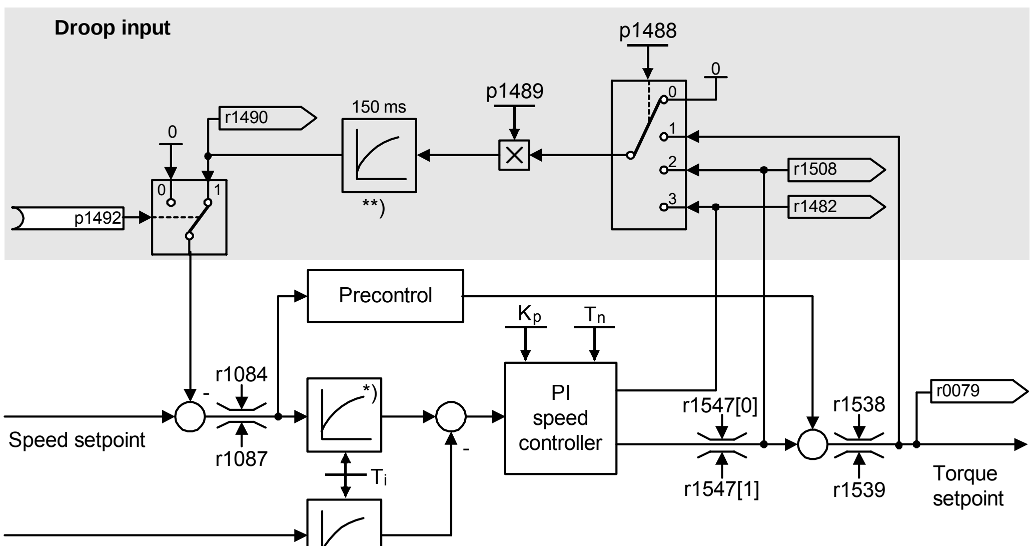
- p1400.0 Speed control configuration: Automatic Kp/Tn adaptation active

7.4.3.4 Droop function

Description

The droop function (enabled via p1488) ensures that the speed setpoint is reduced proportionately as the load torque increases.

Drooping is the most straightforward way of controlling load balancing. This type of control can only be applied, however, if the drives are operated in motor mode and the speed is more or less constant. This method is only suitable to a limited extent for drives that are accelerated and braked with significant changes in speed. This simple type of load balancing control is used, for example, in applications in which two or more motors are connected mechanically or operate with a common shaft and fulfill the above requirements. In this case, the droop compensates/corrects torque differences that can occur as a result of the mechanical coupling by appropriately modifying the speeds of the individual motors (individual drive is relieved when the torque becomes too great).



	T_i	K_p	T_n
SLVC:	p1452	p1470	p1472
VC:	p1442	p1460	p1462

Fig. 7-15 Speed controller with droop

Requirements

- All drives must be operated with vector control.
- The ramp-up/ramp-down times of the ramp-function generator must be identical for all drives.

Function diagram

FD 6030 Speed setpoint, droop

Parameters

- r0079 Total speed setpoint
- r1482 Speed controller I torque output
- p1488 Droop input source
- p1489 Droop feedback scaling
- r1490 Droop feedback speed reduction
- p1492 Enable droop
- r1508 Torque setpoint before supplementary torque

7.4.4 Closed-loop torque control

Description

For sensorless closed-loop speed control (p1300 = 20) or closed-loop speed control with encoder VC (p1300 = 21), it is possible to change over to closed-loop torque control using BICO parameter p1501. It is not possible to change over between closed-loop speed and torque control if closed-loop torque control is directly selected with p1300 = 22 or 23. The torque setpoint and/or supplementary setpoint can be entered using BICO parameter p1503 (CI: torque setpoint) or p1511 (CI: supplementary torque setpoint). The supplementary torque acts both for closed-loop torque as well as for the closed-loop speed control. As a result of this characteristic, a pre-control torque can be implemented for the closed-loop speed control using the supplementary torque setpoint.

NOTE

For safety reasons, assignments to fixed torque setpoints are currently not possible.

If energy is regenerated and cannot be injected back into the line supply, then a Braking Module with connected braking resistor must be used.

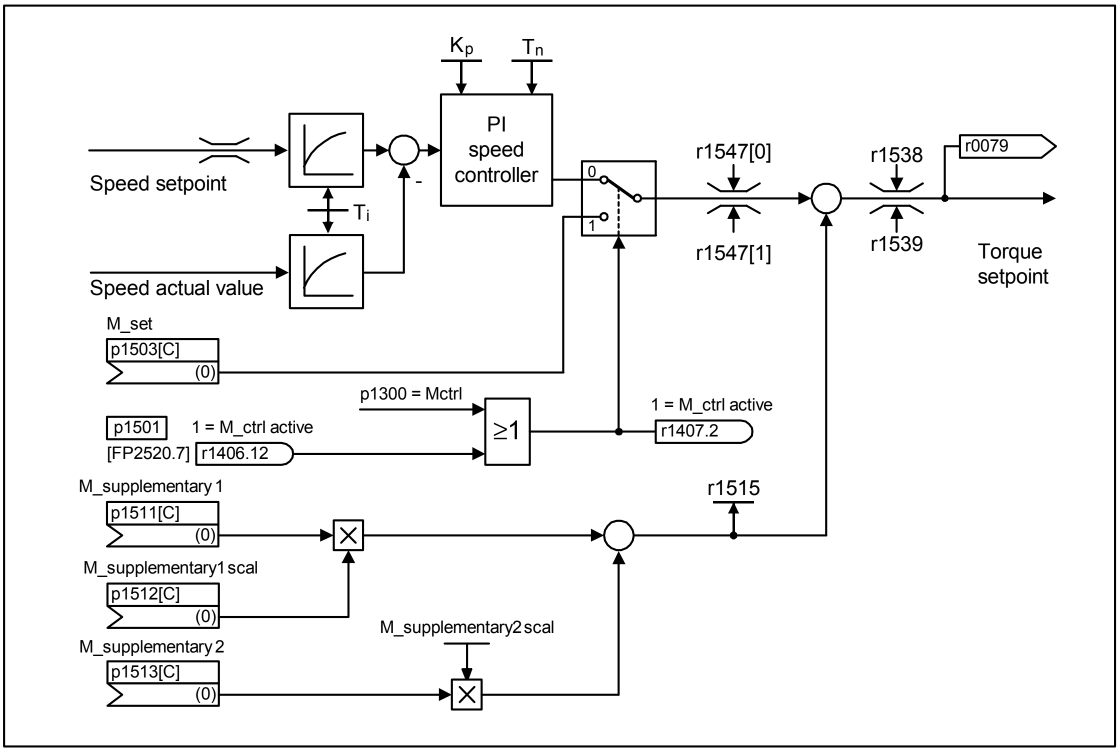


Fig. 7-16 Closed loop speed/torque control

The total of the two torque setpoints is limited in the same way as the speed control torque setpoint. Above the maximum speed (p1082), a speed limiting controller reduces the torque limits in order to prevent the drive from accelerating any further.

A "real" closed-loop torque control (with a speed that automatically sets itself) is only possible in the closed-loop control range but not in the open-loop control range of the sensorless closed-loop vector control. In the open-loop controlled range, the torque setpoint changes the setpoint speed via a ramp-up integrator (integrating time ~ p1499 x p0341 x p0342). This is the reason that sensorless closed-loop torque control close to standstill is only suitable for applications that require an accelerating torque there and no load torque (e.g. traversing drives). Closed-loop torque control with encoder does not have this restriction.

If a quick stop command (OFF3) is issued when torque control is active, a switchover is made automatically to speed control and the drive is decelerated. For closed-loop torque control (p1501 = 1), when a stop command is issued (OFF1) a changeover is not made. Instead, the system waits until a higher-level closed-loop control decelerates the drive to a standstill so that the pulses can be inhibited. This is necessary in order to allow master and slave drives to stop together in a coordinated fashion.

For p1300 = 22 or 23, when an OFF1 is issued, then the drive is drive is directly powered-down (the same as for OFF2).

Function diagram

FD 6060 Torque setpoint

Parameters

- p0341 Motor moment of inertia
- p0342 Ratio between the total and motor moment of inertia
- p1300 Open-loop/closed-loop control mode
- p1499 Accelerating for torque control, scaling
- p1501 Change over between closed-loop speed/torque control
- p1503 Torque setpoint
- p1511 Supplementary torque 1
- p1512 Supplementary torque 1 scaling
- p1513 Supplementary torque 2
- p1514 Supplementary torque 2 scaling
- r1515 Supplementary torque total

7.4.5 Torque limiting

Description

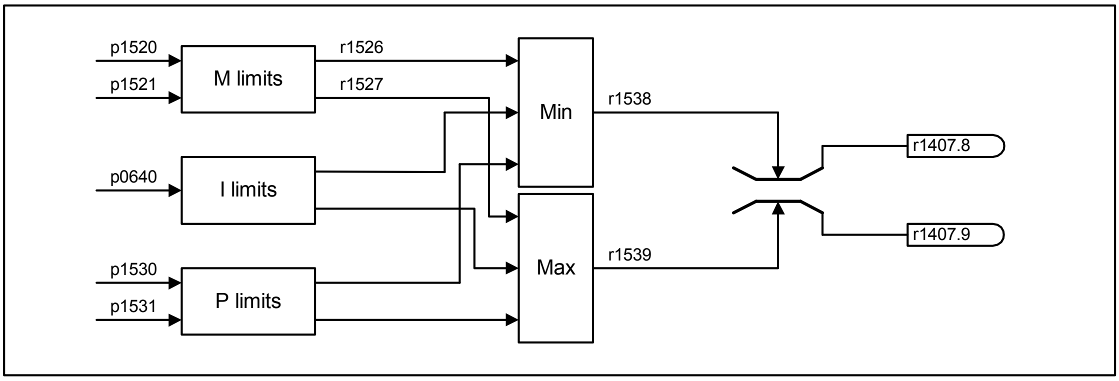


Fig. 7-17 Torque limiting

The value specifies the maximum permissible torque whereby different limits can be parameterized for motor and regenerative mode.

- p0640 Current limit
- p1520 Torque limit, upper/motoring
- p1521 Torque limit, lower/regenerative
- p1522 Torque limit, upper/motoring
- p1523 Torque limit, lower/regenerative
- p1524 Torque limit, upper/motoring, scaling
- p1525 Torque limit, lower/regenerating scaling
- p1530 Power limit, motoring
- p1531 Power limit, regenerating

The currently active torque limit values are displayed in the following parameters:

- r0067 Maximum drive output current
- r1526 Torque limit, upper/motoring without offset
- r1527 Torque limit, lower/regenerative without offset

All of the following limits act on the torque setpoint – that is either available at the speed controller output for closed-loop speed control or as torque input, for closed-loop torque control. The minimum or the maximum is used for the various limits. This minimum or maximum is cyclically calculated and is displayed in r1538 or r1539.

- r1538 Upper effective torque limit
- r1539 Lower effective torque limit

These cyclical values therefore limit the torque setpoint at the speed controller output/torque input or indicate the instantaneous max. possible torque. If the torque setpoint is limited, then this is displayed using parameter p1407.

- r1407.8 Upper torque limit active
- r1407.9 Lower torque limit active

Function diagram

FD 6060 Torque setpoint

FD 6630 Upper/lower torque limit

FD 6640 Current/power/torque limits

7.4.6 Permanent-magnet synchronous motors

Description

Permanent-magnet synchronous motors without encoders are supported during operations without encoders. Controlled operations are not possible when stationary.

Typical applications include direct drives with torque motors which are characterized by high torque at low speeds, e.g. Siemens complete torque motors of the 1FW3 series. When using these drives, gear units and therefore mechanical parts subject to wear can be dispensed with in such applications.

WARNING

A soon as the motor starts to run, a voltage is produced. When working on the converter, the motor must be safely disconnected. If this cannot be done, the motor must be locked e.g. by a holding brake.

Features

- Field weakening of up to approx. 1.2 x rated speed (depending on the supply voltage of the converter and motor data, also see supplementary conditions)
- Capture (only when using a VSM module to record the motor speed and phase angle)
- Speed and torque control vector
- V/f control for diagnostics vector
- Motor identification
- Speed controller optimization (rotary measurement)

Supplementary conditions

- Maximum speed or maximum torque depends on the converter output voltage available and the motor's back-EMF (calculation specifications: EMF must not exceed $U_{rated,\ converter}$).
- Maximum speed calculation:

$$n_{max} = V_{nom,AC} \times \frac{\sqrt{3} \times 30}{k_T \times \pi}$$

  For calculation of k_T, see commissioning paragraph
- Depending on terminal voltage and load cycle, the maximum torque can be taken from the motor data sheets / project design instructions.

- There is no thermal model for the closed-loop control of a permanent-magnet synchronous motor. The motor can only be protected against overheating using a temperature sensor (PTC). We recommend that the motor temperature is measured using a temperature sensor (KTY) in order to achieve a high torque accuracy.

Commissioning

The following order is recommended for commissioning:

- Configure the drive

  While commissioning the drive using STARTER or AOP30 operator panel, the permanent-magnet synchronous motor must be selected. The motor data, specified in Table 7-2, must then be entered. Finally, the motor identification routine and the speed optimization (p1900) are activated. The encoder adjustment is automatically activated together with the motor identification routine.
- Motor identification (standstill measurement, p1910)
- Speed controller optimization (rotary measurement, p1960)

Motor data for permanent-magnet synchronous motors

Table 7-2 Motor data type plate

Parameters	Description	Comment
p0304	Rated motor voltage	If this value is not known, then a value of "0" can also be entered. However, by entering the correct value, the stator leakage inductance (p0356, p0357) can be more precisely calculated.
p0305	Rated motor current	
p0307	Rated motor power	
p0310	Rated motor frequency	
p0311	Rated motor speed	
p0314	Motor pole pair number	If this value is not known, then a value of "0" can also be entered.
p0316	Motor torque constant	If this value is not known, then a value of "0" can also be entered.

If the details of the torque constant k_T are not provided on the type plate or in the data sheet, you can calculate them as follows from the rated motor data or from the zero-speed current I_0 and zero-speed torque M_0:

$$k_T = \frac{M_N}{I_N} = \frac{60 \frac{s}{min} \times P_N}{2\pi \times n_N \times I_N} \text{ or } k_T = \frac{M_0}{I_0}$$

The optional motor data can be entered if you know them. Otherwise, these are estimated from the type plate data or established through motor identification or speed controller optimization.

Table 7-3 Optional motor data

Parameters	Description	Note
p0320	Rated motor short-circuit current	This is used for the field weakening characteristic
p0322	Maximum motor speed	Maximum mechanical speed
p0323	Maximum motor current	De-magnetization protection
p0325	Rotor position identification current, 1st phase	-
p0327	Optional load angle	Optional otherwise leave at 90°
p0328	Reluctance torque constant	-
p0329	Rotor position identification current	-
p0341	Motor moment of inertia	For speed controller pre-control
p0344	Motor weight	-
p0350	Stator resistance, cold	-
p0356	Quadrature axis stator inductance Lq	-
p0357	In-line stator inductance Ld	-

Short-circuit protection

For a short-circuit that can occur in the drive converter or in the motor cable, the rotating machine would supply the short-circuit until it comes to a standstill. An output contactor can be used for protection. This should be located as close as possible to the motor. This is especially necessary if the motor can still be driven by the load when a fault develops. The contactor must be provided with a protective circuit against overvoltage on the motor side so that the motor winding is not damaged as a result of the shutdown.

Control signal r0863.1 is used to control the contactor via a freely available digital output; the feedback signal contact of the contactor is connected to parameter p0864 via a free digital input.

This means that if the drive converter develops a fault with a shutdown response, at the instant in time that the pulses are inhibited, the motor is isolated from the drive converter so that energy is not fed back to the fault location.

Function diagram

FD 6721 Current control - Id setpoint (PEM, p0300 = 2)

FD 6724 Current control - Field weakening controller (PEM, p0300 = 2)

FD 6731 Current control - Interface to the motor module (PEM, p0300 = 2)

■

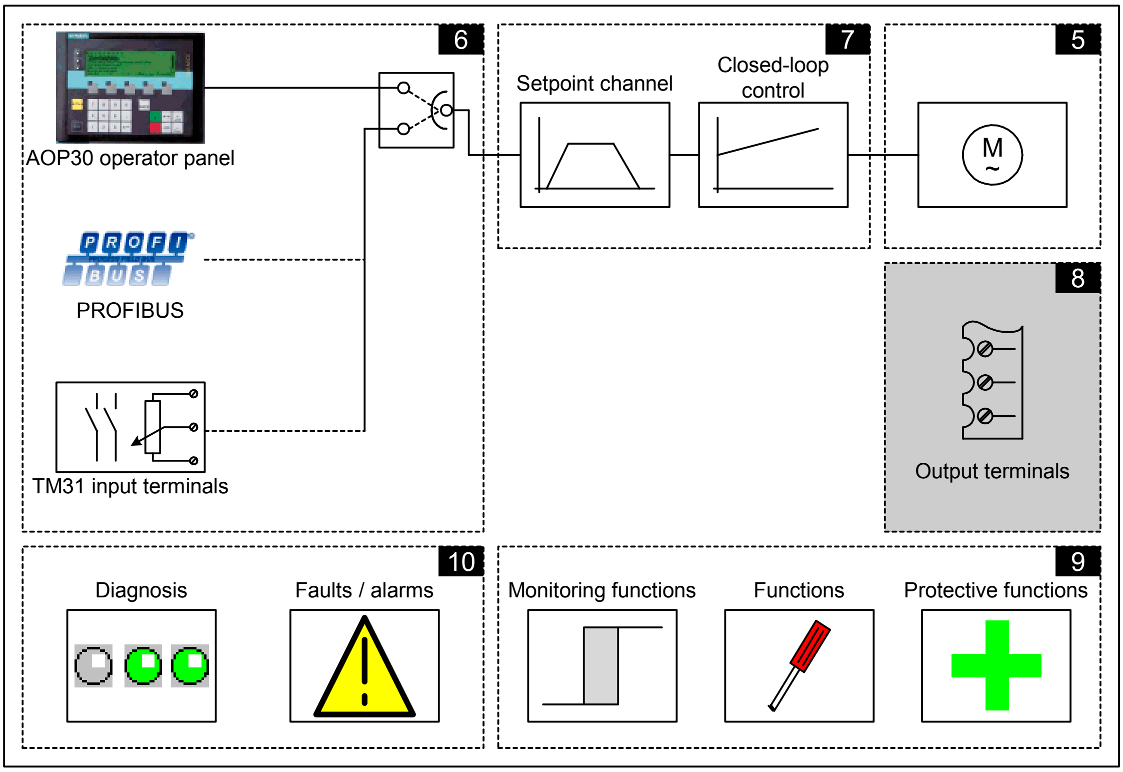
Output terminals

8

8.1 Chapter content

This chapter provides information on:

- Analog outputs
- Digital outputs



Function diagrams

To supplement this operating manual, the CD contains simplified function diagrams describing the operating principle of the SINAMICS G130.
The diagrams are arranged in accordance with the chapters in the operating manual. The page numbers (8xx) describe the functionality in the following chapter.

At certain points in this chapter, reference is made to function diagrams with a 4-digit number. These are stored on the CD in the "SINAMICS G List Manual", which provides experienced users with detailed descriptions of all the functions.

8.2 TM31 analog outputs

Description

The TM31 terminal block features two analog outputs for outputting setpoints via current or voltage signals.

Factory setting:

- AO0: Actual speed value: 0 – 10 V
- AO1: Actual motor current: 0 – 10 V

Prerequisites

- The Power Module, CU320, and TM31 are correctly installed.
- The "TM31 Terminals" or "Profidrive+TM31" default setting was chosen during commissioning:
  - STARTER: "TM31 Terminals" or "Profidrive +TM31"
  - AOP30: "2: TM31 Terminals" or "4: Profidrive+TM31"

Signal flow diagram

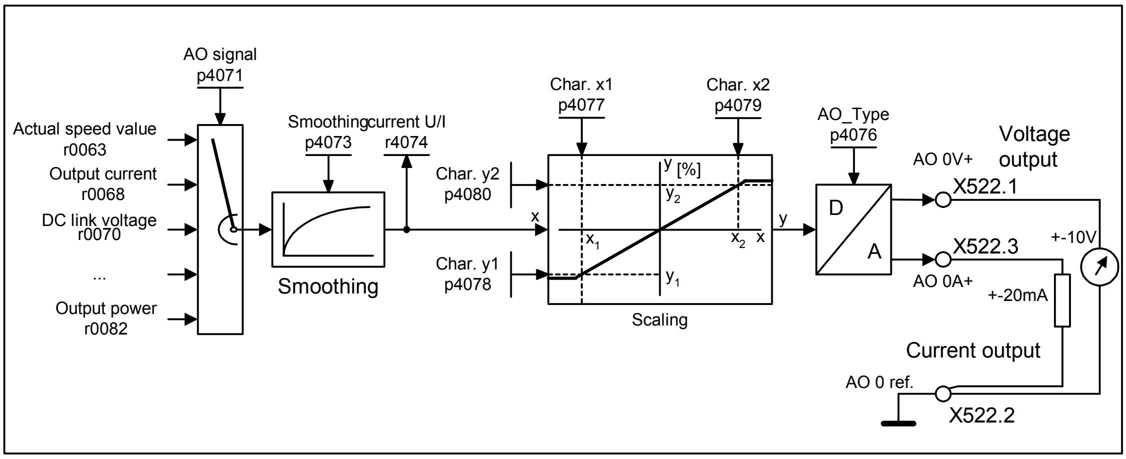


Fig. 8-1 Signal flow diagram: analog output 0

Function diagrams

FD 1840, 9572 TM31 – Analog outputs (AO 0 ... AO 1

Parameters

- p4071 Analog outputs, signal source
- p4073 Analog outputs, smoothing time constant
- r4074 Analog outputs, actual output voltage/current
- p4076 Analog outputs, type
- p4077 Analog outputs, characteristic value x1
- p4078 Analog outputs, characteristic value y1
- p4079 Analog outputs, characteristic value x2
- p4080 Analog outputs, characteristic value y2

8.2.1 Lists of signals for the analog outputs

Signals for the analog outputs

Signal	Parameters	Unit	Scaling (100 % = ...), see Table 8-1
Speed setpoint upstream of setpoint filter	r0060	rpm	p2000
Motor speed unsmoothed	r0061	rpm	p2000
Actual speed after smoothing	r0063	rpm	p2000
Output frequency	r0066	Hz	Reference frequency
Output current	r0068	Aeff	p2002
DC link voltage	r0070	V	p2001
Torque setpoint	r0079	Nm	p2003
Output power	r0082	kW	r2004
For diagnostic purposes			
Control deviation	r0064	rpm	p2000
Control factor	r0074	%	Reference control factor
Torque-generating current setpoint	r0077	A	p2002
Torque-generating actual current	r0078	A	p2002
Flux setpoint	r0083	%	Reference flux
Actual flux	r0084	%	Reference flux
For further diagnostic purposes			
Speed controller output	r1480	Nm	p2003
I component of speed controller	r1482	Nm	p2003

Scaling

Table 8-1 Scaling

Variable	Scaling parameter	Default for quick commissioning
Reference speed	100 % = p2000	p2000 = Maximum speed (p1082)
Reference voltage	100 % = p2001	p2001 = 1000 V
Reference current	100 % = p2002	p2002 = Current limit (p0640)
Reference torque	100 % = p2003	p2003 = 2 x rated motor torque
Reference power	100 % = r2004	$r2004 = \frac{p2003 \times p2000 \times \pi}{30}$
Reference frequency	$100\ \% = \frac{p2000}{60}$	
Reference control factor	100 % = Maximum output voltage without overload	
Reference flux	100 % = Rated motor flux	
Reference temperature	100% = 100 °C	

Example: changing analog output 0 from voltage to current output –0 ... 20 mA

X522: 3,2 — Current output present at terminal 3, ground is at terminal 2

↓

p4076 = 0 — Set analog output type 0 to 0...20 mA.

Fig: 8-2 Example: Setting analog output 0

Example: changing analog output 0 from voltage to current output 0 ... 20 mA and setting the characteristic

X522: 3,2	Current output present at terminal 3, ground is at terminal 2
↓	
p4076[0] = 0	Set TM31.AO_type [analog output 0] to 0...20 mA.
↓	
p4077[0] = 0.00	Set TM31.AO_char x1 to 0.00%.
↓	
p4078[0] = 0.000	Set TM31.AO_char y1 to 0 mA.
↓	
p4079[0] = 100.00	Set TM31.AO_char x2 to 100.00%.
↓	
p4080[0] = 20.000	Set TM31.AO_char y2 to 20 mA.

Fig: 8-3 Example: setting analog output 0 and the characteristic

8.3 TM31 digital outputs

Description

Four bi-directional digital outputs (terminal X541) and two relay outputs (terminal X542) are available on the optional TM31 terminal block. These outputs are, for the most part, freely parameterizable.

Prerequisites

- The Power Module, CU320, and TM31 are correctly installed.
- The "TM31 Terminals" or "Profidrive +TM31" default setting was chosen during commissioning:
  - STARTER: "TM31 Terminals" or "Profidrive +TM31"
  - AOP30: "2: TM31 Terminals" or "4: Profidrive +TM31"

Signal flow diagram

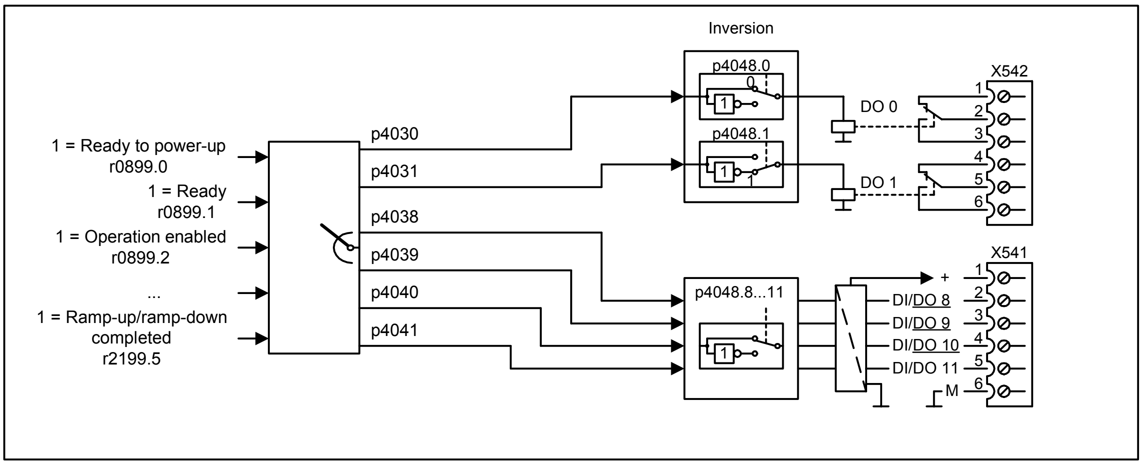


Fig. 8-4 Signal flow diagram: digital outputs

Factory setting

Digital output	Terminal	Factory setting
DO0	X542: 2,3	"Enable pulses"
DO1	X542: 5,6	"No fault"
DI/DO8	X541: 2	"Ready to start"
DI/DO9	X541: 3	
DI/DO10	X541: 4	
DI/DO11	X541: 5	

Selection of possible connections for the digital outputs

Signal	Bit in status word 1	Parameters
1 = Ready to start	0	r0889.0
1 = Ready to operate (DC link loaded, pulses blocked)	1	r0889.1
1 = Operation enabled (drive follows n_setp)	2	r0889.2
1 = Fault present	3	r2139.3
0 = Coast to stop active (OFF2)	4	r0889.4
0 = Fast stop active (OFF3)	5	r0889.5
1 = Power-on disable	6	r0889.6
1 = Alarm present	7	r2139.7
1 = Speed setpoint/actual deviation in the tolerance bandwidth (p2163, p2166)	8	r2197.7
1 = Control required to PLC	9	r0899.9
1 = f or n comparison value reached or exceeded (p2141, p2142)	10	r2199.1
1 = I, M, or P limit reached (p0640, p1520, p1521)	11	r1407.7
reserved	12	
0 = Alarm motor overtemperature (A7910)	13	r2129.14
reserved	14	
0 = Alarm thermal overload in power section (A5000)	15	r2129.15
1 = Pulses enabled (inverter is clocking, drive is carrying current)		r0899.11
1 = n_act ≤ p2155		r2197.1
1 = n_act > p2155		r2197.2
1 = Ramp-up/ramp-down completed		r2199.5
1 = n_act < p2161 (preferably as n_min or n=0 message)		r2199.0
1 = Torque setpoint < p2174		r2198.10
1 = LOCAL mode active (control via operator panel)		r0807.0
0 = Motor blocked		r2198.6

■

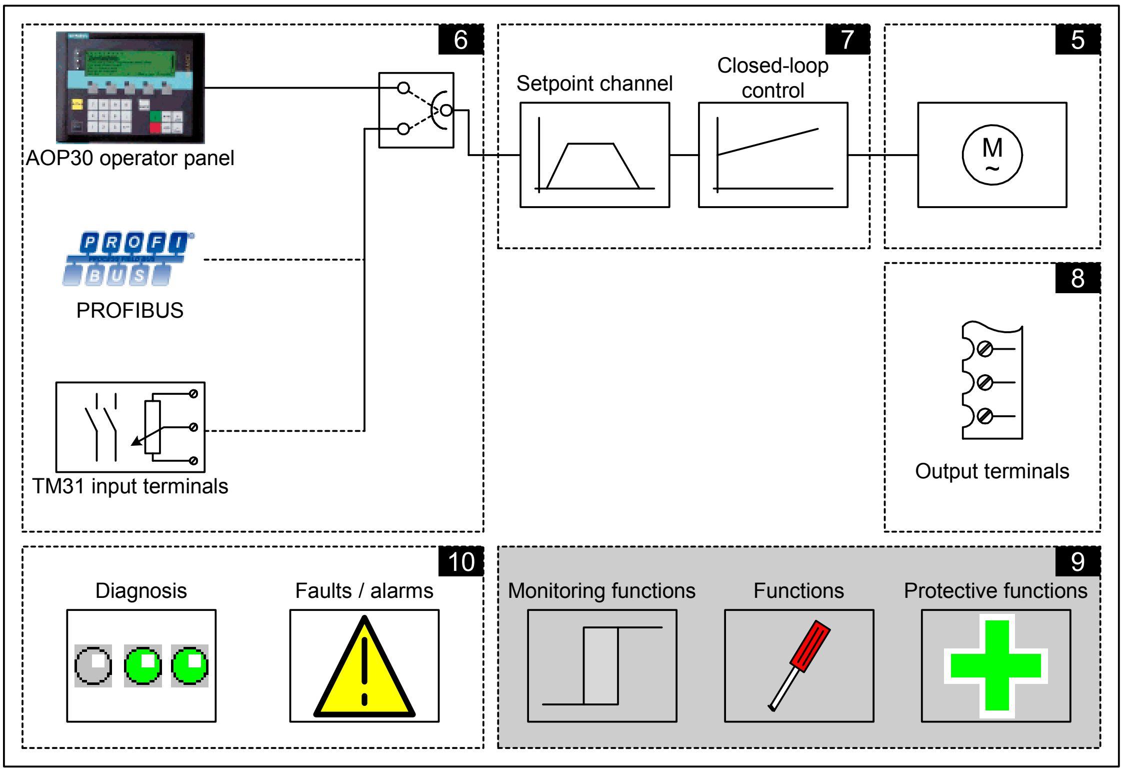
Functions, protective functions, and monitoring functions

9

9.1 Chapter content

This chapter provides information on:

- Drive functions:
  Motor identification routine, Vdc control, automatic restart, flying restart, motor changeover, friction characteristic, increase in the output frequency, runtime, simulation operation, direction of rotation reversal, unit changeover.
- Extended functions:
  Technology controller, Bypass function, Extended braking control, Extended monitoring functions
- Monitoring and protective functions:
  Power Module protection, thermal monitoring functions and overload responses, anti-stall protection, stall protection, thermal motor protection.



Function diagrams

To supplement this operating manual, the CD contains simplified function diagrams describing the operating principle of the SINAMICS G130.
The diagrams are arranged in accordance with the chapters in the operating manual. The page numbers (9xx) describe the functionality in the following chapter.

At certain points in this chapter, reference is made to function diagrams with a 4-digit number. These are stored on the CD in the "SINAMICS G List Manual", which provides experienced users with detailed descriptions of all the functions.

9.2 Drive functions

9.2.1 Motor identification and automatic speed controller optimization

Description

Two motor identification options, which are based on each other, are available:

- Standstill measurement with p1910 (motor identification)
- Rotating measurement with p1960 (speed controller optimization)

These can be selected more easily via p1900. p1900 = 2 selects the standstill measurement (motor not rotating). p1900 = 1 also activates the rotating measurement; p1900 = 1 sets p1910 = 1 and p1960 in accordance with the current control type (p1300).

Parameter p1960 is set depending on p1300:

- p1960 = 1, when p1300 = 20 or 22
- p1960 = 2, when p1300 = 21 or 23

Motor identification is not started until all the enable signals are set and the next switch-on command is issued. This is indicated using appropriate alarms (A07991 for the standstill measurement and A07980 for the rotating measurement).

When the standstill measurement is complete, the drive switches itself off automatically and p1910 is automatically reset to 0. To start the rotating measurement, the drive has to be switched on again. The drive also switches itself off automatically when this measurement is complete and p1960 (and p1900) is reset to 0.

The measurements can be aborted by canceling the enable signals (e.g. OFF) or by resetting the parameters.

NOTE

To set the new controller setting permanently, the data must be saved with p0977 or p0971 on the non-volatile CompactFlash card.

9.2.1.1 Standstill measurement

Description

Motor identification with p1910 is used for determining the motor parameters at standstill (see also p1960: speed controller optimization):

- Equivalent circuit diagram data p1910 = 1

For control engineering reasons, you are strongly advised to carry out motor identification because the equivalent circuit diagram data, motor cable resistance, IGBT on-state voltage, and compensation for the IGBT lockout time can only be estimated if you use the data on the type plate. For this reason, the stator resistance for the stability of sensorless vector control or for the voltage boost with the V/f characteristic is very important.

Motor identification is essential if long supply cables or third-party motors are used. When motor data identification is started for the first time, the following data is determined with p1910 = 1 on the basis of the data on the type plate (rated data):

- Equivalent circuit diagram data
- Total resistance of:
  - Power cable resistor (R_{cable})
  - Stator resistance (R_S)
- IGBT on-state voltage/compensation for the IGBT lockout time

Since the type plate data contains the initialization values for identification, you must ensure that it is entered correctly and consistently to enable the above data to be determined.

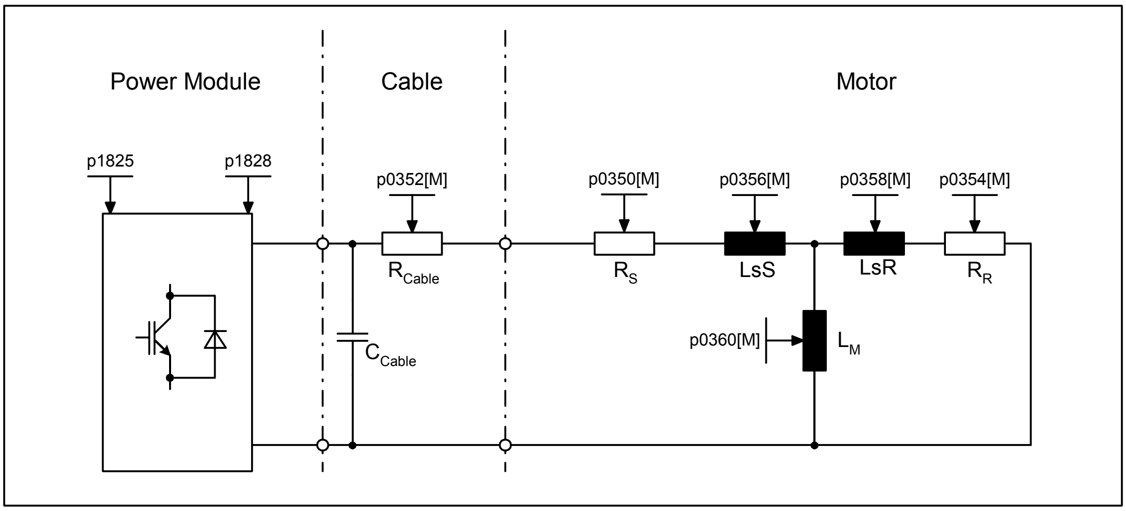


Fig. 9-1 Equivalent circuit diagram for induction motor and cable

Carrying out motor identification

- Enter p1910 > 0. Alarm A07991 is displayed.
- Identification starts when the motor is switched on.
- p1910 resets itself to "0" (successful identification) or fault F07990 is output.

NOTE

To set the new controller setting permanently, the data must be saved with p0977 or p0971 on the non-volatile CompactFlash card.

WARNING

During motor identification, the drive may cause the motor to move.

The emergency OFF functions must be fully operational during commissioning. To protect the machines and personnel, the relevant safety regulations must be observed.

The following parameters are determined by means of motor identification:

- p1910 = 1: p0350, p0354, p0356, p0358, p0360, p1825, p1828, p1829, p1830

9.2.1.2 Rotating measurement and speed controller optimization

Description

Speed controller optimization determines the data required (e.g. moment of inertia) for setting the speed controller. It also measures the magnetization characteristic and rated magnetization current of the motor.

Speed control can be optimized via p1960 or p1900 = 1.

If the rotating measurement is not to be carried out using the speed set in p1965, this parameter can be changed before the measurement is started.

The speed controller is set to the symmetrical optimum in accordance with dynamic factor p1967.

If any problems occur during the measurement, the dynamic response is reduced automatically and the result displayed in r1969. The drive must also be checked to ensure that it is stable across the entire range. If necessary, the dynamic response may have to be reduced or Kp/Tn adaptation for the speed controller parameterized accordingly (see FP 6050).

If the motor–Power Module combination is operated in the field-weakening range, this characteristic should be determined for vector control in particular. The magnetization characteristic can be used to calculate the field-generating current in the field-weakening range more accurately, thereby increasing torque accuracy.

NOTE

Speed controller optimization (p1960) allows the rated magnetization current and magnetization characteristic to be determined more accurately.

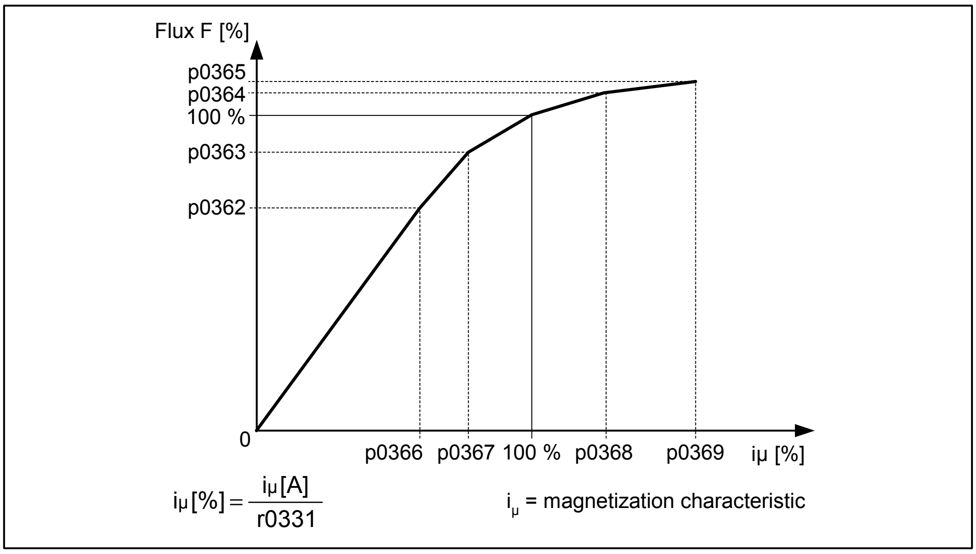


Fig. 9-2 Magnetization characteristic

Carrying out rotating measurement

The following measurements are carried out when the enable signals are set and a switch-on command is issued.

- Measurement of the saturation characteristic (p0362 to p0369)
- Measurement of the magnetization current (p0320)
- Speed controller optimization
  - p1470 and p1472
  - Kp adaptation switch-off
- Acceleration pre-control setting (p1496)
- Setting for ratio between the total moment of inertia and that of the motor (p0342)

NOTE

To set the new controller setting permanently, the data must be saved with p0977 or p0971 on the non-volatile CompactFlash card.

DANGER

During speed controller optimization, the drive triggers movements in the motor that can reach the maximum motor speed. The emergency OFF functions must be fully operational during commissioning. To protect the machines and personnel, the relevant safety regulations must be observed.

Parameters

- p1959 Speed controller optimization configuration
- p1960 Speed controller optimization selection
- p1961 Saturation characteristic speed for calculation
- p1965 Speed controller optimization speed
- p1967 Speed controller optimization dynamic factor
- r1969 Speed controller optimization inertia identified

9.2.2 Vdc control

Description

The "Vdc control" function can be activated using the appropriate measures if an overvoltage or undervoltage is present in the DC link.

- Overvoltage in the DC link
  - Typical cause:
    The drive is operating in regenerative mode and is supplying too much energy to the DC link.
  - Remedy:
    Reduce the regenerative torque to maintain the DC link voltage within permissible limits.

NOTE

When switching off or during rapid load changes, if failure often arises and fault F30002 "DC link overvoltage" is reported, you may be able to improve the situation by increasing the gain factor for the Vdc controller p1250 (p1290), e.g. from "1.00" to "2.00".

Undervoltage in the DC link
  - Typical cause:
    Failure of the supply voltage or supply for the DC link.
  - Remedy:
    Specify a regenerative torque for the rotating drive to compensate the existing losses, thereby stabilizing the voltage in the DC link (kinetic buffering).
    Kinetic buffering is only possible as long as energy is generated by the movement of the drive.

Properties

- Vdc control
  - This comprises Vdc_max control and Vdc_min control (kinetic buffering), which are independent of each other.
  - It contains a joint PI controller. The dynamic factor is used to set Vdc_min and Vdc_max control to a smoother or harder setting independently of each other.
- Vdc_min control (kinetic buffering)
  - With this function, the kinetic energy of the motor is used for buffering the DC link voltage in the event of a momentary power failure, thereby delaying the drive.
- Vdc_max closed-loop control
  - This function can be used to control a momentary regenerative load without shutdown with "overvoltage in DC link".
  - Vdc_max control is only recommended with a supply without active closed-loop control for the DC link and without feedback.

Description of Vdc_min control (kinetic buffering)

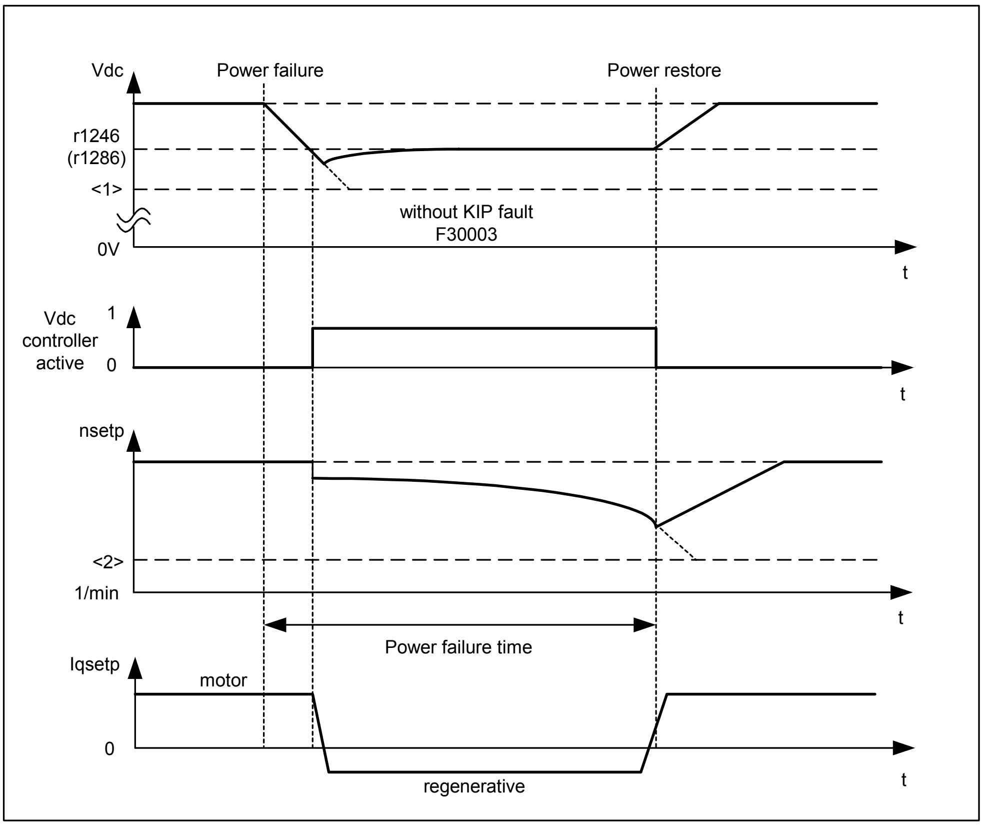


Fig. 9-3 Switching Vdc_min control on/off (kinetic buffering)

NOTE

The activation of kinetic buffering is only permissible if the optional components (TM31, SMC30, VSM, …) are supplied by external power supply.

When Vdc_min control is enabled with p1240 = 2,3 (p1280)[1] it is activated in the event of a power failure when the Vdc_min switch-in level (r1246 (r1286)) is undershot. In general, the regenerative power (braking energy) of the drive machine generated when the motor speed is reduced is used to support the DC link voltage of the converter; in other words, when Vdc_min control is active, the motor speed no longer follows the main setpoint and can be reduced to a standstill. The SINAMICS continues operating until the shutdown threshold of the DC link voltage (see Fig. 9-3 <1>) is undershot.

[1] All data in brackets apply for V/f open-loop control

- V/f control

  The Vdc_min controller acts on the speed setpoint path. When Vdc_min control is active, the drive setpoint speed is reduced so that the drive becomes regenerative.

- Speed control

  The Vdc_min controller acts on the speed controller output and affects the torque-generating current setpoint. When Vdc_min control is active, the torque-generating current setpoint is reduced so that the drive becomes regenerative.

In the event of a power failure, the DC link voltage decreases due to the lack of power from the supply system. When the DC link voltage threshold set via parameter p1245 (p1285) is reached, the Vdc_min controller is activated. Due to the PID properties of the controller, the motor speed is reduced to the extent that the regenerative drive energy maintains the DC link voltage at the level set in p1245 (p1285). The kinetic energy of the drive governs the dropout characteristic of the motor speed and, in turn, the buffering duration. In centrifugal mass drives (e.g. fans), buffering can last a few seconds. In drives with a low centrifugal mass (e.g. pumps), however, buffering can last just 100 – 200 ms. When the power is restored, the Vdc_min controller is deactivated and the drive is ramped up to its setpoint speed at the ramp-function generator ramp. Alarm A7402 (drive: DC link voltage minimum controller active) is present as long as the Vdc_min controller is active.

If the drive can no longer generate any regenerative energy because, for example, it is almost at a standstill, the DC link voltage continues to drop. If the minimum DC link voltage is undershot (see Fig. 9-3 <1>), the drive is switched off with fault F30003 (power section: DC link undervoltage).

If a speed threshold (see Fig. 9-3 <2>) set with parameter p1257 (p1297) is undershot when Vdc_min control is active, the drive is switched off with F7405 (drive: kinetic buffering minimum speed undershot).

If a shutdown with undervoltage in the DC link (F30003) occurs without the drive coming to a standstill despite the fact that Vdc_min control is active, the controller may have to be optimized via dynamic factor p1247 (p1287). Increasing the dynamic factor in p1247 (p1287) causes the controller to intervene more quickly. The default setting for this parameter, however, should be suitable for most applications.

Parameter P1256 = 1 (p1296) can be used to activate time monitoring for kinetic buffering. The monitoring time can be set in parameter p1255 (p1295). If buffering (i.e. the power failure) lasts longer than the time set here, the drive is switched off with fault F7406 (drive: maximum duration for kinetic buffering exceeded). The standard fault reaction for this fault is OFF3, which means that this function can be used for controlled drive deceleration in the event of a power failure. In this case, excess regenerative energy can only be dissipated via an additional braking resistor.

Description of Vdc_max control

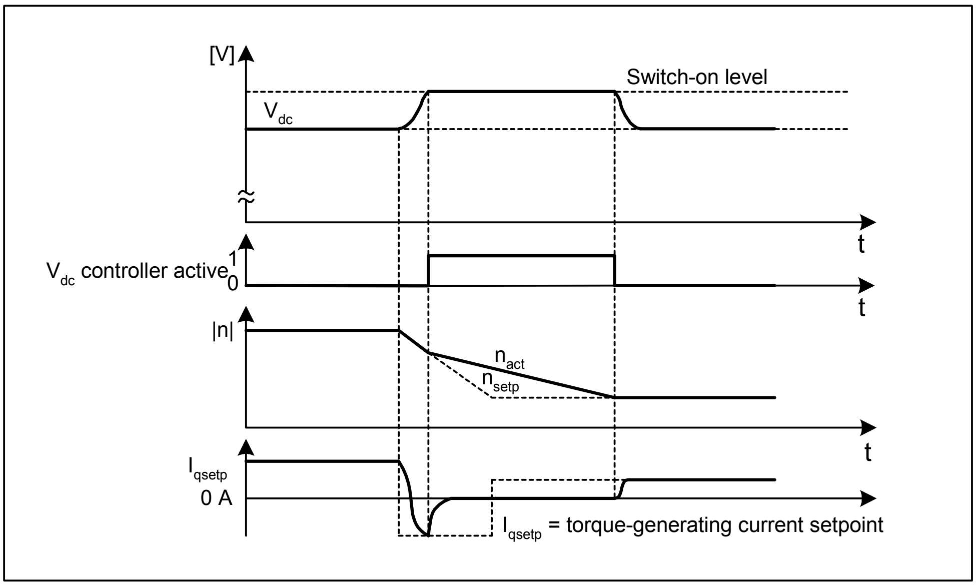


Fig. 9-4 Switching Vdc_max control on/off

The switch-on level of the Vdc_max control (r1242 or r1282) is calculated as follows:

- when the automatic switch-in level sensing is disabled (p1254 = 0)
  r1242 (r1282) = 1.15 x p0210 (unit supply voltage, DC link)
- when the automatic switch-on level sensing is enabled (p1254 = 1)
  r1242 (r128) = Vdc_max - 50 V (Vdc_max: overvoltage threshold of the Power Module)

Function diagram

FD 6220 (FD 6320) Vdc_max controller and Vdc_min controller

Parameters

- p1240 (p1280) Vdc controller configuration
- r1242 (r1282) Vdc_min controller switch-in level
- p1243 (p1283) Vdc_max controller dynamic factor
- p1245 (p1285) Vdc_min controller switch-in level
- p1246 (p1286) Vdc_min controller switch-in level
- p1247 (p1287) Vdc_min controller dynamic factor
- p1250 (p1290) Vdc controller proportional gain
- p1251 (p1291) Vdc controller integral action time
- p1252 (p1292) Vdc controller derivative-action time

- (p1293) Vdc_min controller output limit (V/f control)
- p1254 (p1294) Vdc_max controller automatic ON level detection
- p1255 (p1295) Vdc_min controller time threshold
- p1256 (p1296) Vdc_min controller response
- p1257 (p1297) Vdc_min controller speed threshold
- r1258 (r1298) Vdc controller output

9.2.3 Automatic restart function

Description

The automatic restart function automatically restarts the cabinet unit after an undervoltage or a power failure. The alarms present are acknowledged and the drive is restarted automatically.

The drive can be restarted using:

- The standard procedure starting from standstill, or
- The flying restart function. For drives with small inertia loads and load torques where the drive can be brought to a standstill within seconds (such as pump drives with water gauges), the start from standstill is recommended.

NOTE

The flying restart function can also be activated for drives with large inertia loads (such as fan drives). This enables you to switch to the motor that is still rotating.

WARNING

If p1210 is set to 2 or higher, the motor can be restarted automatically without the need to issue the ON command.

In the event of prolonged power failures and when the automatic restart function is activated (p1210 > 1), the drive may have been at a standstill for a long time and mistakenly considered to have been switched off.

For this reason, entering the area around the drive when it is in this condition can cause death, serious injury, or considerable material damage.

Parameters

- p1210 Automatic restart mode
- p1211 Automatic restart, start attempts
- p1212 Automatic restart waiting time first starting attempt
- p1213 Automatic restart waiting time increment

Settings

To prevent the motor from switching to phase opposition when the drive is being restarted, there is a delay while the motor demagnetizes (t = 2.3 x motor magnetization time constant). Once this time has elapsed, the inverter is enabled and the motor is supplied with power.

9.2.4 Flying restart function

Description

The "Flying restart" function (enabled via p1200) allows the converter to switch to a motor that is still rotating. Switching on the converter without the flying restart function would not allow any flux to build up in the motor while it is rotating. Since the motor cannot generate any torque without flux, this can cause it to switch off due to overcurrent (F07801).

The flying restart function first determines the speed of the drive with which V/f or vector control is initialized so that the converter and motor frequency can be synchronized.

During the standard start-up procedure for the converter, the motor must be at a standstill. The converter then accelerates the motor to the setpoint speed. In many cases, however, the motor is not at a standstill.

Two different situations are possible here:

a.) The drive rotates as a result of external influences, such as water (pump drives) or air (fan drives). In this case, the drive can also rotate against the direction of rotation.

b.) The drive rotates as a result of a previous shutdown (e.g. OFF 2 or a power failure). The drive slowly coasts to a standstill as a result of the kinetic energy stored in the drive train (example: induced-draft fan with a high inertia load and a steeply descending load characteristic in the lower speed range).

Depending on the setting chosen (p1200), the flying restart function is activated in the following situations:

- Once power has been restored and the automatic restart function is active.
- After a shutdown with the OFF2 command (pulse inhibit) when the automatic restart function is active.
- When the ON command is issued.

NOTE

The flying restart function must be used when the motor may still be running or is being driven by the load to prevent shutdowns due to overcurrent (F7801).

NOTE

- If the value set for parameter p1203 (search speed factor) is higher, the search curve is flatter and, as a result, the search time is longer. A lower value has the opposite effect.
- In motors with a low moment of inertia, the flying restart function can cause the drive to accelerate slightly.
- In group drives, the flying restart function should not be activated due to the different coasting properties of the individual motors.

9.2.4.1 Flying restart without encoder

Depending on parameter p1200, the flying restart function is started with the maximum search speed ($n_{search,max}$) once the de-excitation time (p0347) has elapsed (see Fig. 9-5).

$$n_{search,max} = 1.25 \cdot n_{max}(p1082)$$

The flying restart function behaves differently with V/f control and vector control:

- V/f characteristic (p1300 < 20):
  The search speed yielded from parameter p1203 reduces the search frequency in accordance with the motor current. The parameterizable search current (p1202) is injected here. If the search frequency is similar to the rotor frequency, a current minimum occurs. Once the frequency has been found, the motor is magnetized. The output voltage during the magnetization time (p0346) is increased to the voltage value yielded from the V/f characteristic (see Fig. 9-5).
- Vector control without encoder:
  The motor speed is determined using the speed adaptation control loop for the electric motor model. To begin with, the search current (p1202) is injected and then the controller is activated starting from the maximum search frequency. The dynamic response of the controller can be altered using the search speed factor (p1203). If the deviation of the speed adaptation controller is not too great, the motor continues to be magnetized for the duration parameterized in p0346.

Once the excitation build-up time (p0346) has elapsed, the ramp-function generator is set to the actual speed value and the motor ramped up to the current setpoint frequency.

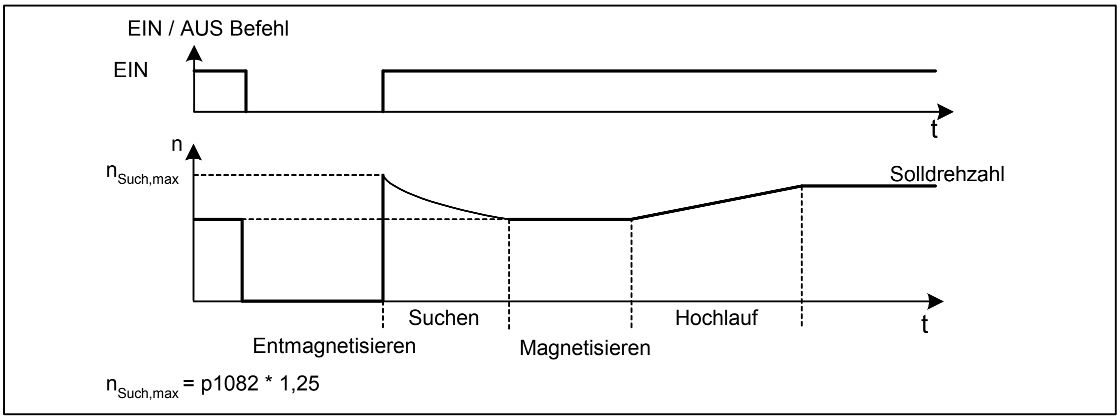


Fig. 9-5 Flying restart

WARNING

When the “Flying restart” (p1200) function is active, the drive may still be accelerated by the detection current despite the fact that it is at standstill and the setpoint is 0!

For this reason, entering the area around the drive when it is in this condition can cause death, serious injury, or considerable material damage.

9.2.4.2 Flying restart with encoder

The flying restart function behaves differently with V/f control and vector control:

- V/f characteristic (p1300 < 20):
  Refer to Section 9.2.4.1 (Flying Restart without Encoder).
- Vector control with encoder:
  Since the speed is known from the start, the motor can be magnetized immediately at the appropriate frequency. The duration of magnetization is specified in p0346. Once the excitation build-up time has elapsed, the ramp-function generator is set to the actual speed value and the motor ramped up to the current setpoint speed.

DANGER

When the flying restart (p1200) function is active, the drive may still be accelerated by the detection current despite the fact that it is at standstill and the setpoint is 0.

For this reason, entering the area around the drive when it is in this condition can cause death, serious injury, or considerable material damage.

9.2.4.3 Parameters

- p1200 Flying restart operating mode
  - 0: Flying restart inactive
  - 1: Flying restart is always active (start in the setpoint direction).
  - 2: Flying restart is active after: power-on, fault, OFF2 (start in the setpoint direction).
  - 3: Flying restart is active after: fault, OFF2. (start in the setpoint direction).
  - 4: Flying restart is always active (start only in the setpoint direction).
  - 5: Flying restart is active after: power-on, fault, OFF2
    (start only in the setpoint direction).
  - 6: Flying restart is active after: fault, OFF2 (start only in the setpoint direction).
- p1202 Flying restart search current
- p1203 Flying restart search rate factor
- r1204 Flying restart, V/f control status
- r1205 Flying restart, vector control status

9.2.5 Motor changeover

9.2.5.1 Description

The motor data set changeover is, for example, used for:

- Changing over between different motors
- Motor data adaptation

9.2.5.2 Example of changing over between two motors

Requirements

- The drive has been commissioned for the first time.
- 2 motor data sets (MDS), p0130 = 2
- 2 drive data sets (DDS), p0180 = 2
- 2 digital outputs to control the auxiliary contactors
- 2 digital inputs to monitor the auxiliary contactors
- 1 digital input to select the data set
- 2 auxiliary contactors with auxiliary switches (1 NO contact)
- 2 motor contactors with positively-driven auxiliary switches (1 NC contact, 1NO contact)

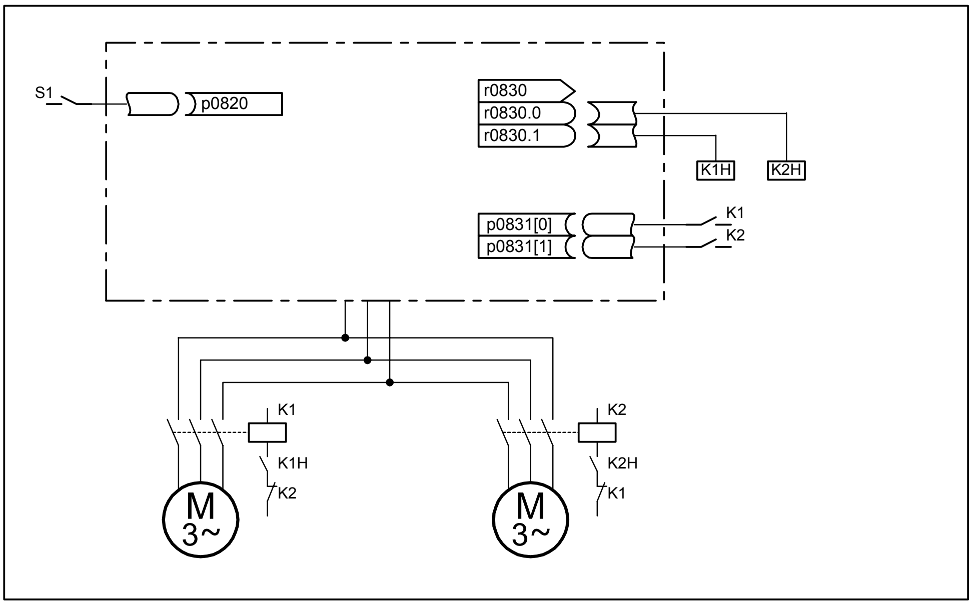


Fig. 9-6 Example, motor changeover

Table 9-1 Settings for the motor changeover example

Parameter	Settings	Comment
p0130	2	Configure 2 MDS
p0180	2	Configure 2 DDS
p0186[0..1]	0, 1	The MDS are assigned the DDS.
p0820	Digital input, DDS selection	The digital input to change over the motor is selected via DDS selection. Binary coding is used (p0820 = bit 0 etc.).
p0821 to p0824	0	
p0826[0..1]	1, 2	Different numbers mean different thermal models.
p0827[0..1]	0, 1	The bits from p0830 are assigned to the MDS. If e.g. p0827[0] = 0, then when selecting MDS0, bit p0830.0 is set via DDS0.
p0830.0 and p0830.1	Digital outputs, auxiliary contactors	The digital outputs for the auxiliary contactors are assigned bits.
p0831[0..1]	Digital inputs, auxiliary switches	The digital inputs for the feedback signal of the motor contactors are assigned.
p0833[0..1]	0, 0	The drive controls the contactors and the pulse cancellation.

Motor changeover sequence

1. Pulse cancellation:
   The pulses must be disabled before selecting a new drive data set using p0820 to p0824.
2. Open the motor contactor:
   Motor contactor 1 is opened r0830 = 0 and the status bit "Motor changeover active" (r0835.0) is set.
3. Change over the drive data set:
   The requested data set is activated (r0051 = data set currently effective, r0837 = requested data set).
4. Energize the motor contactor:
   After the feedback signal (motor contactor opened) for motor contactor 1, the appropriate bit of r0830 is set and motor contactor 2 is energized.
5. Enable the pulses:
   After the feedback signal (motor contactor closed) for motor contactor 2, the bit "motor data set changeover active" (r0835.0) is reset and the pulses are enabled. The motor has been changed over.

9.2.5.3 Function diagram

FD 8565 Drive data set (DDS)

FD 8575 Motor data sets (MDS)

9.2.5.4 Parameters

- r0051 Drive data set DDS effective
- p0130 Motor data sets (MDS) number
- p0180 Drive data set (DDS) number
- p0186 Motor data sets (MDS) number
- p0819[0...2] Copy drive data set DDS
- p0820 BI: Drive data set selection, bit 0
- p0821 BI: Drive data set selection, bit 1
- p0822 BI: Drive data set selection, bit 2
- p0823 BI: Drive data set selection, bit 3
- p0824 BI: Drive data set selection, bit 4
- p0826 Motor changeover, motor number
- p0827 Motor changeover, status bit number
- p0828 Motor changeover, feedback signal
- p0830 Motor changeover, status
- p0831 Motor changeover, contactor feedback signal
- p0833 Motor changeover, configuration

9.2.6 Friction characteristic

Description

The friction characteristic is used to compensate for the frictional torque of the motor and driven load. A friction characteristic allows the speed controller to be pre-controlled and improves the control behavior.

10 points along the characteristic are used for the friction characteristic. The coordinates of every point along the characteristic are defined by a speed parameter (p382x) and a torque parameter (p383x) (point 1 = p3820 and p3830).

Features

- There are 10 points along the characteristic to represent the friction characteristic.
- An automatic function supports the friction characteristic plot.
- A connector output (r3841) can be interconnected as friction torque (p1569).
- The friction characteristic can be activated and de-activated (p3842)

Commissioning

Speeds for making measurements as a function of the maximum speed p1082 are pre-assigned in p382x when commissioning the drive system for the first time. These can be appropriately changed corresponding to the actual requirements.

The automatic friction characteristic plot can be activated using p3845. The characteristic is then plotted the next time that it is enabled.

The following settings are possible:

- p3845 = 0 Friction characteristic plot de-activated
- p3845 = 1 Friction characteristic plot activated, all directions of rotation
  The friction characteristic is plotted in both directions of rotation. The result of the positive and negative measurement is averaged and entered into p383x.
- p3845 = 2 Friction characteristic plot activated, positive direction of rotation
- p3845 = 3 Friction characteristic plot activated, negative direction of rotation

---

DANGER

When plotting the friction characteristic, the drive causes the motor to move – the maximum motor speed can be reached.

When commissioning the drive, the EMERGENCY STOP functions must function perfectly. To protect the machines and personnel, the relevant safety regulations must be carefully observed.

Function diagram

FD 7010 Friction characteristic

Parameters

- p3820 Friction characteristic, value n0
- ...
- p3839 Friction characteristic, value M9
- r3840 Friction characteristic, status
- r3841 Friction characteristic, output
- p3842 Activate friction characteristic
- p3845 Activate friction characteristic plot

9.2.7 Increasing the output frequency

9.2.7.1 Description

In applications that require higher output frequencies, the pulse frequency of the Power Module may have to be increased.

It may also be necessary to change the pulse frequency to prevent resonance from occurring.

Since increasing the pulse frequency also increases the switching losses, a derating factor for the output current must be taken into account when the drive is configured.

Once the pulse frequency has been increased, the new output currents are automatically included in the calculation for power section protection.

NOTE

Use of a sinusoidal filter must be selected using p0230 = 4 when commissioning. This setting fixes the pulse frequency to 4 kHz or 2.5 kHz and it cannot be changed.

9.2.7.2 Default pulse frequencies

With the default pulse frequencies listed below, the specified maximum output frequencies can be achieved.

Table 9-2 Maximum output frequency with default pulse frequency

Converter rating [kW]	Default pulse frequency [kHz] [1)]	Maximum output frequency [Hz]
Supply voltage 380 – 480 V 3 AC		
315 – 560	1.25	100
Supply voltage 500 – 600 V 3 AC		
315 – 560	1.25	100
Supply voltage 660 – 690 V 3 AC		
315 – 800	1.25	100

The scanning times for the inputs and outputs of the customer terminal strip TM31 are set in the factory to 4000 µs. This is also the minimum limit.

[1)] The pulse frequencies set in the factory are also the minimum frequencies.

9.2.7.3 Increasing the pulse frequency

Description

The pulse frequency can be increased in a virtually continuously variable manner to between the value preassigned in the factory and the maximum pulse frequency which can be set.

Once the new pulse frequency required has been entered in p0113, a check is run to establish whether the pulse frequency requested can be set.

1. To do this, the value requested is entered in the following formula:
   $X = \frac{0.5}{p0113} \times 1000\,\mu s$.
   If the result "X" is an integral multiple of 1.25 µs, the value is accepted. If not, warning A1224 "Inconsistent pulse frequency" appears.
2. The following calculation will help obtain a permissible value for p0113:
   - The result "X" is divided by 1.25 µs and the result is rounded up to the next whole number.
   - This result is in turn multiplied by 1.25 µs and converted into a recommended pulse frequency by reversing the above formula.
   - The recommended pulse frequency must be rounded up to 3 digits after the decimal place and entered in parameter p0113.
3. The scanning time for the customer terminal strip TM31 (p4099[x]) must then be set to an integral multiple of the scanning time of p0115[0].
   The minimum limit for the setting range must be taken into account.

Example

Factory setting: 1.25 kHz, requested pulse frequency: 1.3 kHz.

1. $\frac{0.5}{1.3} \times 1000\,\mu s = 384.61538461\,\mu s$
   is not an integral multiple of 1.25 µs, is not accepted.
2. Calculation of p0113:
   - $\frac{384.61538461\,\mu s}{1.25\,\mu s} = 307.692307688 \Rightarrow 308$
   - $308 \times 1.25\,\mu s = 385\,\mu s \Rightarrow r0114[1] = \frac{0.5}{385} \times 1000\,kHz = 1.2987\,kHz$
   - $p0113 = 1.299\,kHz$
3. $p0115[0] = 385\,\mu s \Rightarrow p4099[0] = p4099[1] = p4099[2] = 11 \times 385\,\mu s = 4235\,\mu s$

Process for the setting in the above example

1. Set drive to pulse inhibit
2. DO1 (CU320): p0009 = 3 (basic drive configuration)
3. DO2 (VECTOR): p0112 = 0 (expert)
4. DO2 (VECTOR): p0113 = 1,299 kHz -> value is accepted
5. DO3 (TM31): p0112 = 0 (expert)
6. DO3 (TM31): p4099[0] = p4099[1] = p4099[2] = 4235 -> values are accepted
7. DO1 (CU320): p0009 = 0 -> calculations are undertaken, a warm start is then carried out.

NOTE

The example described only applies to a SINAMICS G130 without a second customer terminal strip TM31. When using a second customer terminal strip TM31, stages 5 and 6 also have to be run for DO4 (2nd TM31).

9.2.7.4 Maximum output frequencies achieved by increasing the pulse frequency

By multiplying the basis pulse frequency (with integers), the following output frequencies can be achieved (taking into account the derating factors):

Table 9-3 Maximum output frequencies achieved by increasing the pulse frequency

Pulse frequency [kHz]	Maximum output frequency [Hz]
1.25	100
2.5	200
5	400 [1)]

9.2.7.5 Parameters

- p0009 Device commissioning parameter filter
- p0112 Sampling times pre-setting p0115
- p0113 Pulse frequency, minimum selection
- p0115 Sampling times
- p1800 Pulse frequency
- p4099 TM31 inputs/outputs, sampling time

[1)] Due to the closed-loop control, the maximum output frequency is limited to 300 Hz.

9.2.8 Runtime (operating hours counter)

Total system runtime

The total system runtime is displayed in p2114. Index 0 indicates the system runtime in milliseconds after reaching 86.400.000 ms (24 hours), the value is reset. Index 1 indicates the system runtime in days.

The value is saved when the system is switched off.
After the drive unit is powered-up, the counter continues to run with the value that was saved the last time that the drive unit was powered-down.

Relative system runtime

The relative system runtime after the last POWER ON is displayed in p0969. The value is in milliseconds and the counter is reset to 0 after 49 days.

Actual motor runtime

The motor runtime is displayed in p0650 in hours. The counter is started when the pulses are enabled. When the pulse enable is withdrawn, the counter is stopped and the value saved.

The values can only be stored with a CU320 with order number 6SL3040-....-0AA1 and version C or higher.

The counter is deactivated with p0651 = 0.

If the maintenance interval set in p0651 is reached, fault F01590 is triggered. Once the motor has been maintained, the maintenance interval must be reset.

Operating hours counter for the fan

The operating hours of the fan in the power section are displayed in p0251.

The number of hours operated can only be reset to 0 in this parameter (e.g. after a fan has been replaced).

The service life of the fan is entered in p0252.

Alarm A30042 is output 500 hours before this figure is reached.

Monitoring is deactivated with p0252 = 0.

9.2.9 Simulation operation

Description

The simulation function is predominantly used to simulate the drive without a motor being connected and without a DC link voltage. In this case, it should be noted that the simulation mode can only be activated under an actual DC link voltage of 40 V. If the voltage lies above this threshold, the simulation mode is reset, and a fault message F07826 is issued.

Communications with a higher-level automation system can be tested using the simulation mode. If the drive is also to return actual values, then it must be ensured that during simulation operation, sensorless operation (V/f) should be selected. This means that large parts of the SINAMICS software – such as software channel, sequence control, communications, technology function, etc. – can be tested in advance without requiring a motor.

Another application is to test the correct functioning of the Power Module. Especially for drive units with higher power ratings 754 kW (690 V) and 110 kW (400 V), after repairs, it is necessary to test the gating of the power semiconductors. This is done by injecting a low DC voltage as DC link voltage (e.g. 12 V). The drive unit is then powered-up and the pulses enabled. It must be possible to run through all of the pulse patterns of the gating unit software.

This means that the software must allow the pulses to be switched-in and various frequencies approached. If a speed encoder is not being used, then this is generally implemented using V/f control or sensorless closed-loop speed control.

NOTE

The following functions are de-activated in the simulation mode:

- Motor data identification
- Motor data identification, rotating without encoder
- Pole position identification

No flying restart is carried-out for V/f control and sensorless closed-loop vector control.

Commissioning

Simulation is activated using p1272 = 1; the following pre-requisites must be fulfilled:

- The drive unit must have been commissioned for the first time (default: Standard induction motors).
- The DC link voltage must lie below 40 V (observe the tolerance of the DC link voltage sensing).

Alarm A07825 (simulation mode activated) must be output during simulation operation.

Parameter

- p1272 Simulation operation

9.2.10 Reversing

Description

Reversing is used to reverse the direction in which the connector motor turns and to leave the setpoint and actual speed values and setpoint and actual torque values unchanged.

Reversing can only be undertaken in the motor commissioning status.

Reversing can be set differently for each drive data set.

NOTE

When changing over the drive data set to differently set reversing and with pulse approval, fault F7434 is issued.

Reversing can be observed by checking parameters r0069 (phase currents) and r0089 (phase voltage).

Function diagram

FP 4704, 4715	Encoder evaluation
FP 6730, 6731	Cl-loop curr ctrl

Parameters

- r0069 Phase currents
- r0089 Phase voltage
- p1821 Direction reversal

9.2.11 Unit changeover

Description

Parameters and process variables for input and output can be changeover to a suitable units system (US units or referenced sizes (%)) with the help of unit changeover.

The following constraints apply to the unit changeover:

- Unit changeover is only possible for the "VECTOR" drive object.
- Type plate parameters of the converter and/or motor can be changed between SI/US units but not to a referenced form of depiction.
- Once the changeover parameters have been changed over, all parameters which are assigned to a group of dependent units are jointly changed over to the new unit.
- There is a parameter for selecting technological units (p0595) for depicting technological variables in the technology controller.
- If the unit changeover is changed over to referenced variables and the reference variable is then changed, the % value entered in a parameter is not changed.

  Example:

  - With a reference speed of 1500 rpm, a fixed speed of 80 % corresponds to a value of 1200 rpm.
  - If the reference speed is changed to 3000 rpm, the value of 80 % is retained and is now 2400 rpm.

Changing over the units

The units can be changed over via AOP30 and via the STARTER.

- Unit changeover via AOP30 is always undertaken immediately. Once the corresponding parameters have been changed, the values affected are displayed in the new selected unit.
- If operating using the STARTER, the unit changeover can only take place in offline mode in the configuration screen of the corresponding drive object. The new units are only displayed after the download ("Load project in target system") and subsequent upload ("Load project in PG").

Unit groups

Each parameter which can be changed over is assigned to a unit group which can be changed over within certain limits depending on the group.

This assignment can be seen for each parameter in the list of parameters in the Parameter Manual.

Table 9-4 Units groups: Changeover by p0100, can be changed over when p0010 = 1

Unit Group	**Unit when p0100 =**		**Reference variable for %**
	0	**1**	
14_2	W	HP	--
14_6	kW	HP	--

Table 9-5 Units groups: Changeover by p0349, can be changed over when p0010 = 5

Unit Group	**Unit when p0349 =**		**Reference variable for %**
	1	**2**	
15_1	mH	%	$\frac{1000 \times p0304}{2 \times \pi \times \sqrt{3} \times p0305 \times p0310}$
16_1	Ohm	%	$\frac{p0304}{\sqrt{3} \times p0305}$

Table 9-6 Units groups: Changeover by p0505, can be changed over when p0010 = 5

Unit Group	**Unit when p0505 =**				**Reference variable for %**
	1	**2**	**3**	**4**	
2_1	Hz	%	Hz	%	p2000
2_2	kHz	%	kHz	%	p2000
3_1	1/min	%	1/min	%	p2000
5_1	V	%	V	%	p2001
5_2	V	%	V	%	p2001
5_3	V	%	V	%	p2001
6_1	mA	%	mA	%	p2002
6_2	A	%	A	%	p2002
7_1	Nm	%	lbf * ft	%	p2003
7_2	Nm	Nm	lbf * ft	lbf * ft	--
14_1	W	%	HP	%	r2004
14_5	kW	%	HP	%	r2004
14_10	kW	kW	HP	HP	--
21_1	°C	°C	°F	°F	--
21_2	K	K	°F	°F	--
22_1	m/s^2	m/s^2	ft/s^2	ft/s^2	--
23_1	Vs/m	Vs/m	Vs/ft	Vs/ft	--
25_1	kgm^2	kgm^2	$lbft^2$	$lbft^2$	--
26_1	m/s^3	m/s^3	ft/s^3	ft/s^3	--
27_1	kg	kg	lb	lb	--
28_1	Nm/A	Nm/A	lbf * ft /A	lbf * ft /A	--

Parameters

- p0100 IEC/NEMA mot stds
- p0349 Selection of units system, motor equivalent circuit diagram data
- p0505 Selection of units system
- p0595 Selection of technological unit
- p0596 Reference variable of technological unit

9.3 Extended functions

9.3.1 Technology controller

9.3.1.1 Description

The "technology controller" function module allows simple control functions to be implemented, e.g.:

- Liquid level control
- Temperature control
- Dancer position control
- Pressure control
- Flow control
- Simple control without higher-level control
- Tension control

The technology controller is designed as a PID controller, whereby the differentiator can be switched to the control deviation channel or the actual value channel (factory setting). The P, I, and D components can be set separately.

A value of 0 deactivates the corresponding component. Setpoints can be specified via two connector inputs. The setpoints can be scaled via parameters p2255 and p2256.

A ramp-function generator in the setpoint channel can be used to set the setpoint ramp-up/ramp-down time via parameters p2257 and p2258. The setpoint and actual value channel each have a smoothing element. The smoothing time can be set via parameters p2261 and p2265.

The setpoints can be specified via separate fixed setpoints (p2201 to p2215), the motorized potentiometer, or via the field bus (e.g. PROFIBUS).

Pre-control can be integrated via a connector input.

The output can be scaled via parameter p2295 and the control direction reversed. It can be limited via parameters p2291 and p2292 and interconnected as required via a connector output (r2294).

The actual value can be integrated, for example, via an analog input on the TM31.

If a PID controller has to be used for control reasons, the D component is switched to the setpoint/actual value difference (p2263 = 1) unlike in the factory setting. This is always necessary when the D component is to be effective, even if the reference variable changes. The D component can only be activated when p2274 > 0.

9.3.1.2 Commissioning

The "technology controller" function module can be activated by running the commissioning Wizard. Parameter r0108.16 indicates whether the function module has been activated.

Function diagram

FD 7950 Technology controller – fixed values

FD 7954 Technology controller – motorized potentiometer

FD 7958 Technology controller – closed-loop controller

9.3.1.3 Example: liquid level control

The objective here is to maintain a constant level in the container.

This is carried out by means of a variable-speed pump in conjunction with a sensor for measuring the level.

The level is determined via an analog input (e.g. AI0 TM31) and sent to the technology controller. The level setpoint is defined in a fixed setpoint. The resulting controlled variable is used as the setpoint for the speed controller.

In this example, a Terminal Module (TM31) is used.

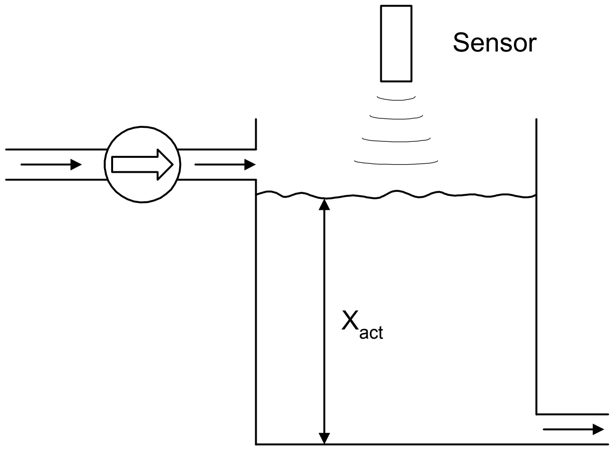


Fig. 9-7 Liquid level control: application

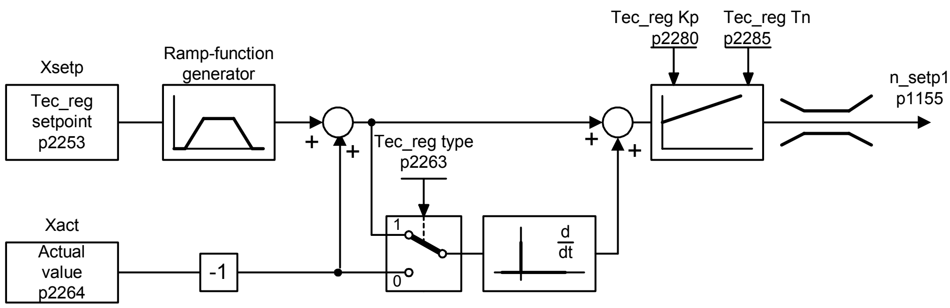


Fig. 9-8 Liquid level control: controller structure

Key control parameters:

- p1155 = r2294 n_setp1 downstream of RFG [FD 3080]
- p2253 = r2224 Technology controller setpoint effective via fixed setpoint [FD 7950]
- p2263 = 1 D component in fault signal [FD 7958]
- p2264 = r4055 Actual value signal Xactual via AI0 of TM31 [FD 9566]
- p2280 = Kp Determine by optimization
- p2285 = Tn Determine by optimization
- p2200 = 1 Technology controller enabled

9.3.2 Bypass function

Description

The bypass function uses digital converter outputs to activate two contactors and uses digital inputs to evaluate the contactor's feedback (e.g. via TM31). This circuit allows the motor to be operated using the converter or directly on the supply line. The contactors are activated by the converter. The feedback signals for the contactor positions have to be returned to the converter.

The bypass circuit can be implemented in two ways:

- without synchronizing the motor to the supply and
- with synchronizing the motor to the supply.

The following applies to all bypass versions:

- The bypass is also shut down when one of the "OFF2" or "OFF3" control word signals is canceled.
- Exception to this:
  If necessary, the bypass switch can be interlocked by a higher-level controller such that the converter can be shut down completely (i.e. including the controller electronics) while the motor is operated on the supply.
  The contactor interlock should be implemented on the line-side.
- When the converter is started up again after POWER OFF, the status of the bypass contactors is evaluated. After powering up, the converter can thereby change straight into "Ready to start and bypass" status. This is only possible if the bypass is activated by a control signal (p1267.0 = 1, p1267.1 = 0, p1267.2 = 0) and the control signal (p1266) is still active after powering up.
- Changing the converter into "Ready to start and bypass" status after powering up, is of a higher priority than switching back on automatically.
- Monitoring of the motor temperatures using temperature sensors is active while the converter is in one of two statuses "Ready to start and bypass" or "Ready to operate and bypass".
- The two motor contactors must be designed for switching under load.

NOTE

The examples contained in the following descriptions are only basic circuits designed to explain the basic function. The dimensions of specific circuit configurations (contactors, protective equipment) must be calculated for specific systems.

Requirements

The bypass function is only available for sped control without encoders (p1300 = 20) or V/f- control (p1300 = 0...19) and when using an asynchronous motor.

Establishing the bypass function

The bypass function is part of the "technology controller" function module that can be activated by running the commissioning Wizard. Parameter r0108.16 indicates whether the function module has been activated.

9.3.2.1 Bypass with synchronizer with degree of overlapping (p1260 = 1)

Description

When "Bypass with synchronizer with degree of overlapping (p1260 = 1)" is activated, the synchronized motor is transferred to the supply and retrieved again. During the changeover, both contactors K1 and K2 are closed at the same time for a period (phase lock synchronization).

A restrictor is used to disconnect the converter and supply voltage. The uk value for the restrictor is 10% ± 2%.

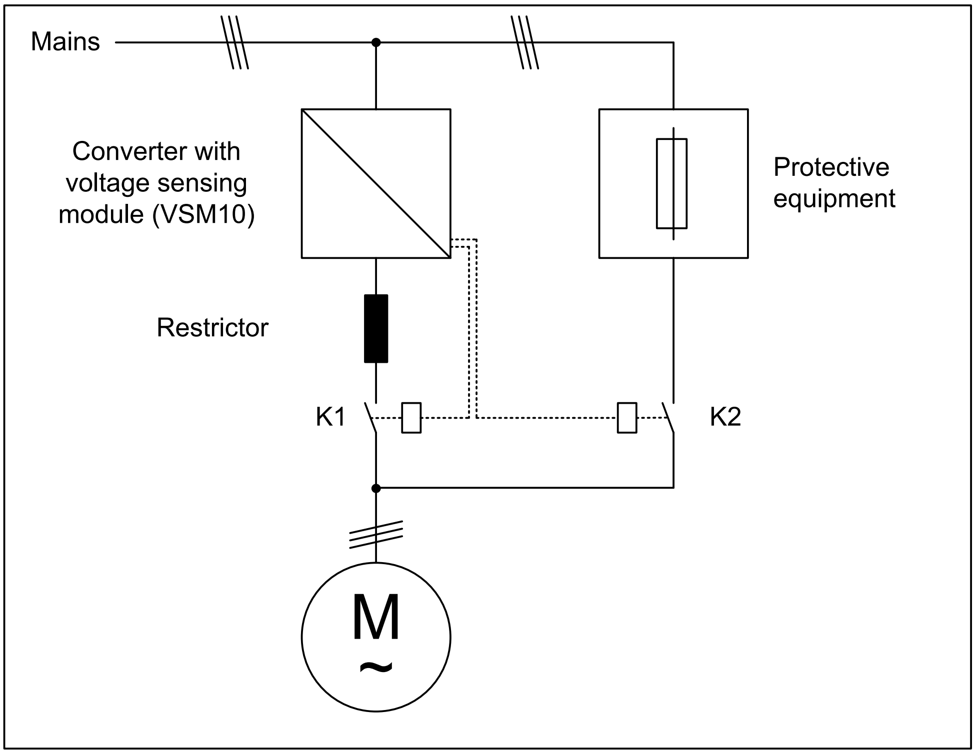


Fig. 9-9 Bypass circuit with synchronizer with degree of overlapping

Activating

The bypass with synchronizer with degree of overlapping (p1260 = 1) function can only be activated using a control signal. It cannot be activated using a speed threshold or a fault.

Parameterization

Once the bypass with synchronizer with degree of overlapping (p1260 = 1) function has been activated, the following parameters must be set:

Table 9-7 Parameter settings for bypass function with synchronizer with degree of overlapping

Parameters	Description
p1266 =	Control signal setting
p1269[0] =	Signal source for contactor K1 feedback
p1269[1] =	Signal source for contactor K2 feedback
p1273 = 1	The feedback for the "Close converter bypass switch" signal must be set to "1".
p3800 = 1	The internal voltages are used for synchronization.
p3802 = r1261.2	Synchronizer activation is triggered by the bypass function.

Transfer process

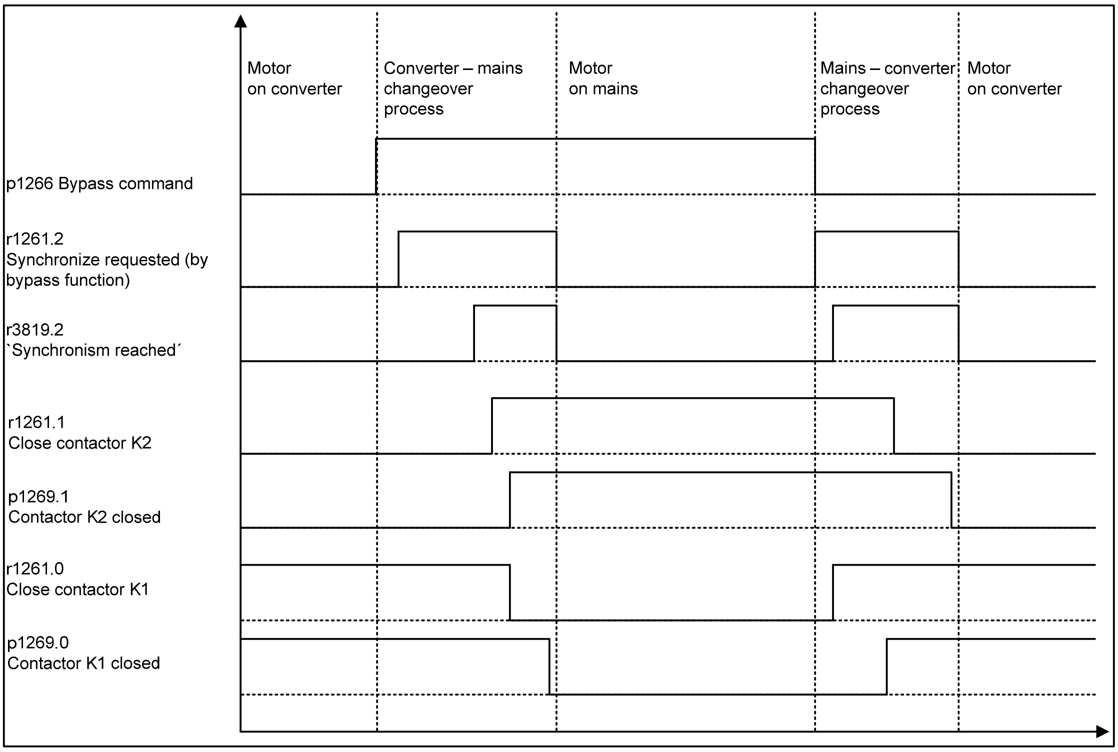


Fig. 9-10 Signal diagram for bypass with synchronizer with degree of overlapping

Transfer of motor to supply
(contactors K1 and K2 are activated by the converter):

- The output state is as follows: contactor K1 is closed, contactor K2 is opened and the motor is operated by the converter.
- The "Command bypass" control bit (p1266) is set (e.g. by the higher-level automation).
- The bypass function sets the "Synchronize" control word bit (r1261.2).
- Since the bit is set while the converter is running, the "Transfer motor to supply" synchronization process is started.
- Once motor synchronization to line frequency, voltage and phase angle is complete, the synchronization algorithm reports this state (r3819.2).
- The bypass mechanism evaluates this signal and closes the contactor K2 (r1261.1 = 1). The signal is evaluated internally, BICO wiring is not needed.
- Once contactor K2 has reported "closed" status (r1269[1] = 1), contactor K1 is opened and the converter blocks the pulse. The converter is in "Ready for operation and bypass" state.
- If the On command is cancelled in this phase, the converter changes to "Ready to start and bypass" status. If corresponding contactors are present, the converter is disconnected from the supply and the DC link unloaded.

Retrieving the motor from supply mode functions the same yet in reverse: At the start of the process, contactor K2 is closed and contactor K1 is opened.

- The "Command bypass" control bit is canceled (e.g. by the higher-level automation).
- The bypass function sets the "Synchronize" control word bit.
- Pulses are enabled. Since "Synchronize" is set before "Pulse enable", the converter interprets this as a command to retrieve a motor from the supply and to take it over.
- Once converter synchronization to mains frequency, voltage and phasing is complete, the synchronization algorithm reports this state.
- The bypass mechanism evaluates this signal and closes contactor K1. The signal is evaluated internally, BICO wiring is not needed.
- Once contactor K1 has reported "closed" status, contactor K2 is opened and the motor is operated again on the converter.

9.3.2.2 Bypass with synchronizer without degree of overlapping (p1260 = 2)

When "Bypass with synchronizer without degree of overlapping (p1260 = 2)" is activated, contactor K2 (to be closed) is only closed when contactor K1 is opened (anticipatory type synchronization). Phasing of the motor voltage before synchronization must be set such that there is an "initial jump" upstream of the supply to which synchronization should be carried out. This done by setting the synchronization setpoint (p3809). A phase and frequency difference of around zero is produced when closing contactor K2 by braking the motor in the brief period in which both contactors are open.

Due to the expense of determining the synchronization setpoint (p3809), the decoupling restrictor is not needed.

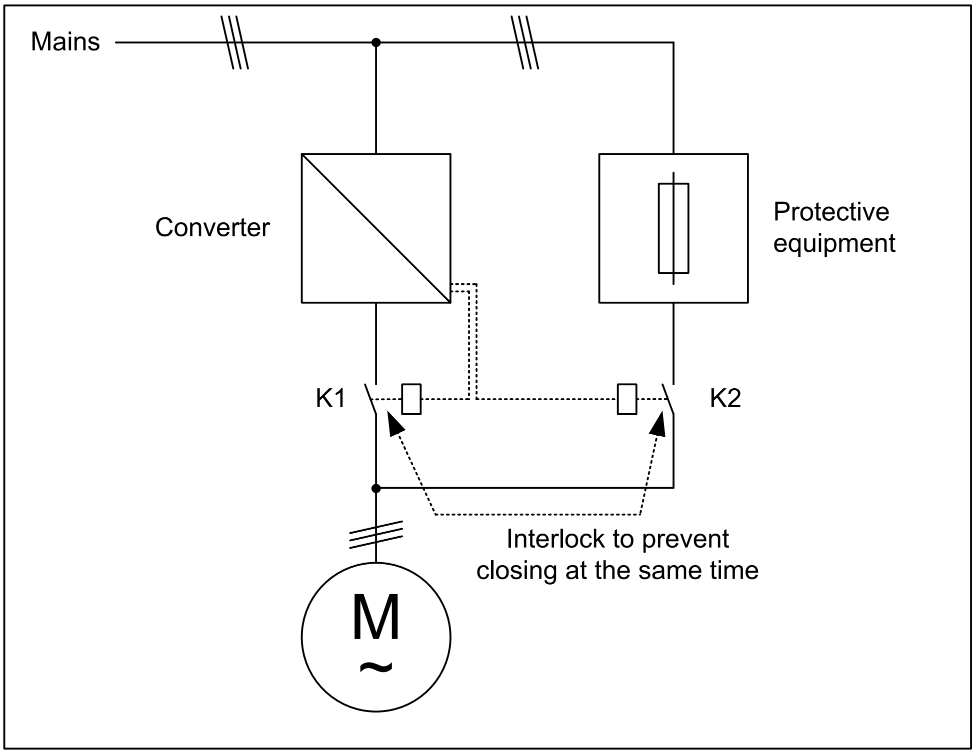


Fig. 9-11 Bypass circuit with synchronizer without degree of overlapping

Activating

The bypass with synchronizer without degree of overlapping (p1260 = 2) function can only be activated using a control signal. It cannot be activated using a speed threshold or a fault.

Parameterization

Once the bypass with synchronizer without degree of overlapping (p1260 = 2) function has been activated, the following parameters must be set:

Table 9-8 Parameter settings for bypass function with synchronizer without degree of overlapping

Parameters	Description
p1266 =	Control signal setting
p1269[0] =	Signal source for contactor K1 feedback
p1269[1] =	Signal source for contactor K2 feedback
p1273 = 1	The feedback for the "Close converter bypass switch" signal must be set to "1".
p3800 = 1	The internal voltages are used for synchronization.
p3802 = r1261.2	Synchronizer activation is triggered by the bypass function.

9.3.2.3 Bypass without synchronizer (p1260 = 3)

Description

When transferring the motor to the supply, contactor K1 is opened (following converter's pulse inhibit), then the system waits during the motor's excitation time and contactor K2 is then closed such that the motor is run directly on the supply. If the motor is switched on in a non-synchronized manner, when activated an equalizing current flows and this must be taken into account when designing the protective equipment (see Fig. 9-12).

When the motor is being transferred from the supply by the converter, initially contactor K2 is opened and after the excitation time, contactor K1 is closed. The converter then captures the rotating motor and the motor is operated on the converter.

Contactor K2 must be designed for switching under load.

Contactors K1 and K2 must be interlocked against closing at the same time.

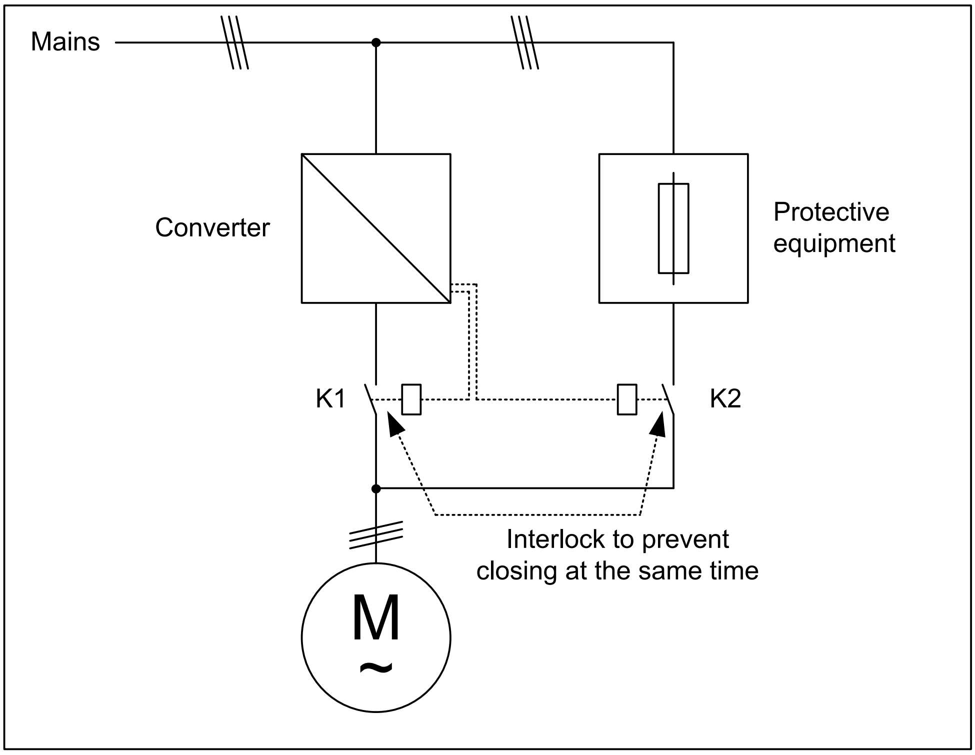


Fig. 9-12 Bypass circuit without synchronizer

Activating

The bypass with synchronizer (p1260 = 3) can be triggered by the following signals (p1267):

- Bypass using control signal (p1267.0 = 1):
  Activation of the bypass is triggered by a digital signal (p1266) e.g. from a higher-level automation. If the digital signal is canceled, once the debypass delay time (p1263) has expired, a changeover to converter operations is triggered.
- Bypass at speed threshold (p1267.1 = 1):
  Once a certain speed is reached, the system changes over to bypass, i.e. the converter is used as a start-up converter. The precondition for activating the bypass is that the speed setpoint is greater than the bypass speed threshold (p1265).
  Switching back to converter operations is initiated by the setpoint (at input of ramp generator, r1119) falling below the bypass speed threshold (p1265). The setpoint > comparison value condition prevents the bypass from being reactivated straight away if the actual speed is still above the bypass speed threshold (p1265) after switching back to converter operations.

The bypass time, debypass time, bypass speed variables and the command source for changing over are set using parameters.

Parameterization

Once the bypass without synchronizer (p1260 = 3) function has been activated, the following parameters must be set:

Table 9-9 Parameter settings for bypass function with synchronizer with degree of overlapping

Parameters	Description
p1262 =	Bypass dead time setting
p1263 =	Debypass dead time setting
p1264 =	Bypass delay time setting
p1265 =	Speed threshold setting when p1267.1 = 1
p1266 =	Control signal setting when p1267.0 = 1
p1267.0 = p1267.1 =	Trigger signal setting for bypass function
p1269[1] =	Signal source for contactor K2 feedback
p1273 = 1	The feedback for the "Close converter bypass switch" signal must be set to "1".
p3800 = 1	The internal voltages are used for synchronization.
p3802 = r1261.2	Synchronizer activation is triggered by the bypass function.

9.3.2.4 Function diagram

FP 7020 Synchronization

9.3.2.5 Parameter

Bypass function

- p1260 Bypass configuration
- r1261 CO/BO: Bypass control/status word
- p1262 Bypass dead time
- p1263 Debypass delay time
- p1264 Bypass delay time
- p1265 Bypass speed threshold
- p1266 BI: Bypass control signal
- p1267 Bypass source configuration
- p1268 BI: Bypass control signal
- p1269 BI: Bypass switch feedback signal source
- p1273 BI: Close converter bypass switch

Synchronization

- p3800 Sync–supply–drive activation
- p3801 Sync–supply–drive drive object number
- p3802 BI: Sync–supply–drive enable
- r3803 CO/BO: Sync–supply–drive control word
- r3804 CO: Sync–supply–drive target frequency
- r3805 CO: Sync–supply–drive frequency difference
- p3806 Sync–supply–drive frequency difference threshold
- r3808 CO: Sync–supply–drive phase difference
- p3809 Sync–supply–drive phase setpoint
- p3811 Sync–supply–drive frequency limitation
- r3812 CO: Sync–supply–drive correction frequency
- p3813 Sync–supply–drive phase synchronism threshold
- r3814 CO: Sync–supply–drive voltage difference
- p3815 Sync–supply–drive voltage difference threshold
- p3816 CI: Sync–supply–drive actual voltage value U12 = U1 – U2
- p3817 CI: Sync–supply–drive actual voltage value U23 = U2 – U3
- r3819 CO/BO: Sync–supply–drive status word

9.3.3 Extended braking control

9.3.3.1 Description

The "extended braking control" function module allows complex braking control for motor holding brakes and operational brakes.

The brake is controlled as follows (the sequence reflects the priority):

- Via parameter p1215
- Via binector parameters p1219[0..3] and p0855
- Via zero speed detection
- Via a connector interconnection threshold value

9.3.3.2 Commissioning

The "extended braking control" function module can be activated by running the commissioning Wizard. Parameter r0108.14 indicates whether the function module has been activated.

Parameter p1215 must be set to "3" and the brake activated via a digital output on customer terminal block TM31.

Function diagrams

FD 2704	Zero speed detection
FD 2707	Release/apply brake
FD 2711	Signal outputs

9.3.3.3 Examples

Starting against applied brake

When the device is switched on, the setpoint is enabled immediately (if other enable signals are issued), even if the brake has not yet been released (p1152 = 1). The factory setting p1152 = r0899.15 must be separated here. The drive first generates torque against the applied brake. The brake is not released until the motor torque or motor current (p1220) has exceeded braking threshold 1 (p1221).

This configuration is used, for example, when the drive is connected to a belt that is under tension (loop accumulator in the steel industry).

Emergency brake

If emergency braking is required, electrical and mechanical braking is to take place simultaneously. This can be achieved if OFF3 is used as a tripping signal for emergency braking:

p1219[0] = r0898.2 (OFF3 to "apply brake immediately").

This is often used, for example, in calendar stacks, cutting tools, running gears, and presses.

9.3.4 Extended monitoring functions

9.3.4.1 Description

The "extended monitoring functions" function module enables additional monitoring functions:

- Speed setpoint monitoring: |n_set| <= p2161
- Speed setpoint monitoring: n_set > 0
- Load monitoring

Load monitoring

This function monitors power transmission between the motor and the working machine. Typical applications include V-belts, flat belts, or chains that loop around the belt pulleys or cog wheels for drive and outgoing shafts and transfer the peripheral speeds and forces. Load monitoring can be used here to identify blockages in the working machine and interruptions to the power transmission. During load monitoring, the current speed/torque curve is compared with the programmed speed/torque curve (p2182 – p2190). If the current value is outside the programmed tolerance bandwidth, a fault or alarm is triggered depending on parameter p2181. The fault or alarm message can be delayed by means of parameter p2192 to prevent false alarms caused by brief transitional states.

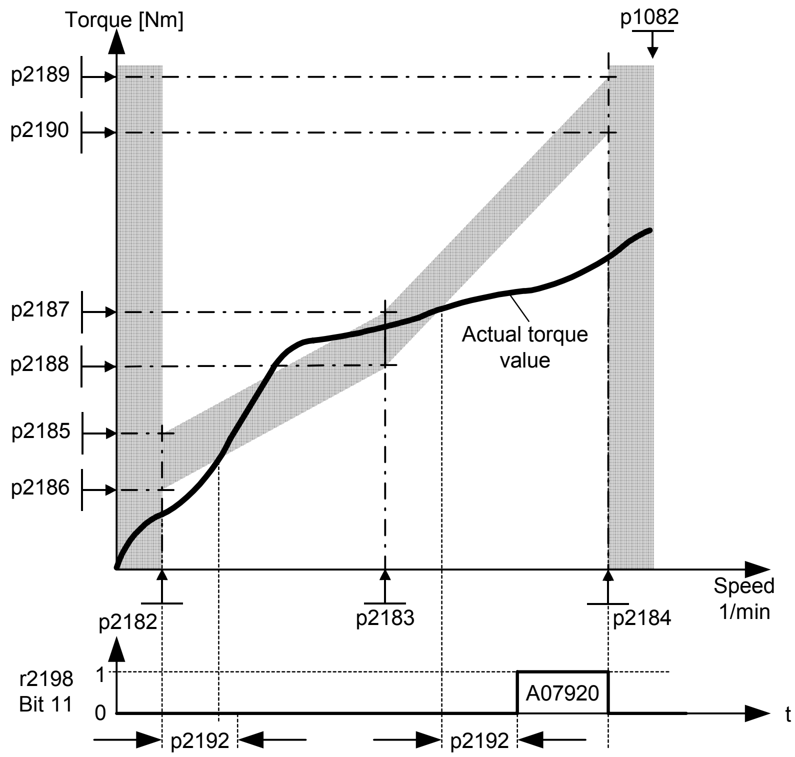


Fig. 9-13 Load monitoring (p2181 = 1)

9.3.4.2 Commissioning

The "extended monitoring functions" function module can be activated by running the commissioning Wizard. Parameter r0108.17 indicates whether the function module has been activated.

Function diagrams

FD 8010 Speed messages

FD 8013 Load monitoring

9.4 Monitoring and protection functions

9.4.1 Protecting power components: general

Description

SINAMICS power sections offer comprehensive functions for protecting power components.

Table 9-10 General protection for power components

Protection against:	Protective measure	Response
Overcurrent [1]	Monitoring with two thresholds: • First threshold exceeded • Second threshold exceeded	 A30031, A30032, A30033 Current limitation of phase activated. Pulsing in the phase in question is inhibited for one pulse period. F30017 -> OFF2 is triggered if the threshold is exceeded too often. F30001 "Overcurrent" -> OFF2
Overvoltage [1]	Comparison of DC link voltage with hardware shutdown threshold	F30002 "Overvoltage" -> OFF2
Overvoltage [1]	Comparison of DC link voltage with hardware shutdown threshold	F30003 "Undervoltage" -> OFF2
Short-circuit [1]	• Second monitoring threshold checked for overcurrent • U_{ce} monitoring for IGBT module	F30001 "Overcurrent" -> OFF2 F30022 "Monitoring U_{ce}" -> OFF2
Ground fault	Monitoring the sum of all phase currents	After threshold in p0287 is exceeded: F30021 "Power Module: ground fault" -> OFF2 Note: The sum of all phase currents is displayed in r0069[6]. For operation, the value in p0287[1] must be greater than the sum of the phase currents when the insulation is intact.
Line phase-failure detection [1]		F30011 "Line phase-failure in main circuit" -> OFF2

[1] The monitoring thresholds are permanently defined in the converter and cannot be changed by the user.

9.4.2 Thermal monitoring and overload responses

Description

The priority of thermal monitoring for power components is to identify critical situations. If alarm thresholds are exceeded, the user can set parameterizable response options that enable continued operation (e.g. with reduced power) and prevent immediate shutdown. The parameterization options, however, only enable intervention below the shutdown thresholds, which cannot be changed by the user.

The following thermal monitoring options are available:

- i^2t monitoring – A07805 – F30005
  i^2t monitoring is used to protect components that have a high thermal time constant compared with semi-conductors. Overload with regard to i^2t is present when the converter load (r0036) is greater than 100% (load in % in relation to rated operation).
- Heat-sink temperature – A05000 – F30004
  Monitoring of the heat-sink temperature (r0037) of the power semi-conductor (IGBT).
- Chip temperature – A05001 – F30025
  Significant temperature differences can occur between the IGBT barrier junction and the heat sink. These differences are taken into account and monitored by the chip temperature (r0037).

If an overload occurs with respect to any of these three monitoring functions, an alarm is first output. The alarm threshold p0294 (i^2t monitoring) can be parameterized relative to the shutdown (trip) values.

Example

The factory setting for the alarm threshold for chip temperature monitoring is 15°C. Temperature monitoring for the heat sink and inlet air is set to 5°C, that is, the "Overtemperature, overload" alarm is triggered at 15°C or 5°C below the shutdown threshold.

The parameterized responses are induced via p0290 simultaneously when the alarm is output. Possible responses include:

- Reduction in pulse frequency (p0290 = 2, 3)
  This is a highly effective method of reducing losses in the power section, since switching losses account for a high proportion of overall losses. In many applications, a temporary reduction in pulse frequency is tolerable in order to maintain the process.
  Disadvantage:
  Reducing the pulse frequency increases the current ripple which, in turn, can increase the torque ripple on the motor shaft (with low inertia load), thereby increasing the noise level. Reducing the pulse frequency does not affect the dynamic response of the current control circuit, since the sampling time for the current control circuit remains constant.

- Reducing the output frequency (p0290 = 0, 2)
  This variant is recommended when you do not need to reduce the pulse frequency or the pulse frequency has already been set to the lowest level. The load should also have a characteristic similar to a fan, that is, a quadratic torque characteristic with falling speed. Reducing the output frequency has the effect of significantly reducing the converter output current which, in turn, reduces losses in the power section.
- No reduction (p0290 = 1)
  You should choose this option when a reduction in neither pulse frequency nor output current is necessary. The converter does not change its operating point once an alarm threshold has been overshot, which means that the drive can be operated until it reaches its shutdown values. Once it reaches its shutdown threshold, the converter switches itself off and the "Overtemperature, overload" fault is output. The time until shutdown, however, is not defined and depends on the degree of overload. To ensure that an alarm can be output earlier or that the user can intervene, if necessary, in the drive process (e.g. reduce load/ambient temperature), only the alarm threshold can be changed.

Function diagram

FD 8014 Thermal monitoring, power unit

Parameters

- r0036 Power Module overload
- r0037 Power Module temperatures
- p0290 Power Module overload response
- p0294 Power Module alarm with i^2t overload

9.4.3 Block protection

Description

The error message "Motor blocked" is only triggered if the speed of the drive is below the variable speed threshold set in p2175. With vector control, it must also be ensured that the speed controller is at the limit. With V/f control, the current limit must already have been reached.
Once the ON delay (p2177) has elapsed, the message "Motor blocked" and fault F7900 are generated.

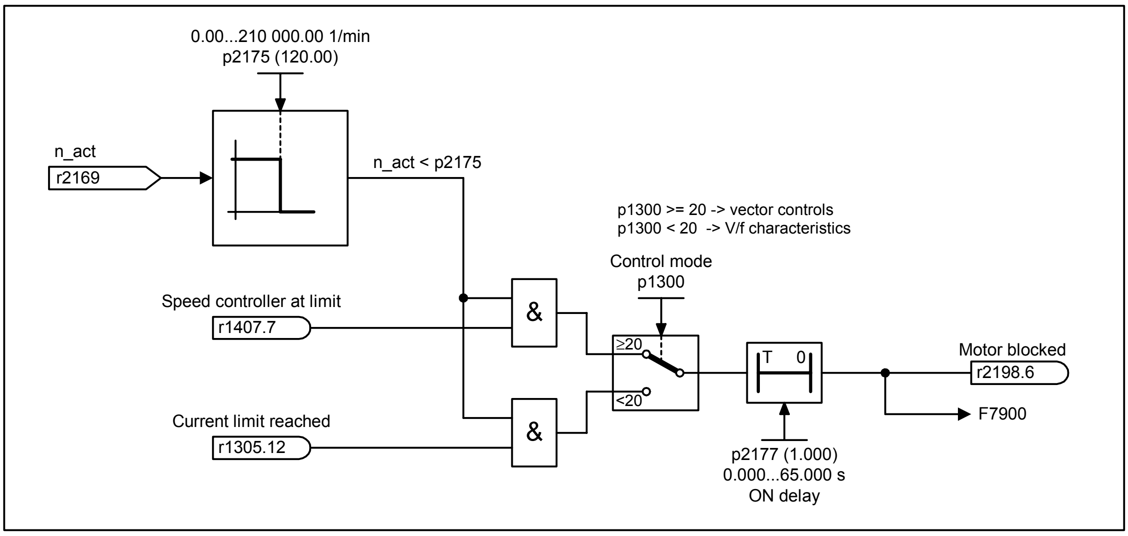


Fig. 9-14 Block protection

Function diagram

FD 8012 Torque messages/signals, motor locked/stalled

Parameters

- p2175 Motor blocked speed threshold
- p2177 Motor blocked delay time

9.4.4 Stall protection (vector control only)

Description

When using speed control with encoder, if the speed threshold set in p1744 for stall detection is exceeded, r1408.11 (speed adaptation speed variance) is set.

If the fault threshold value set in p1745 is exceeded when in the low speed range (less than p1755 x p1756), r1408.12 (motor stalled) is set.

If one of the two signals is set, fault F7902 (motor tilted) is triggered after the delay time in p2178.

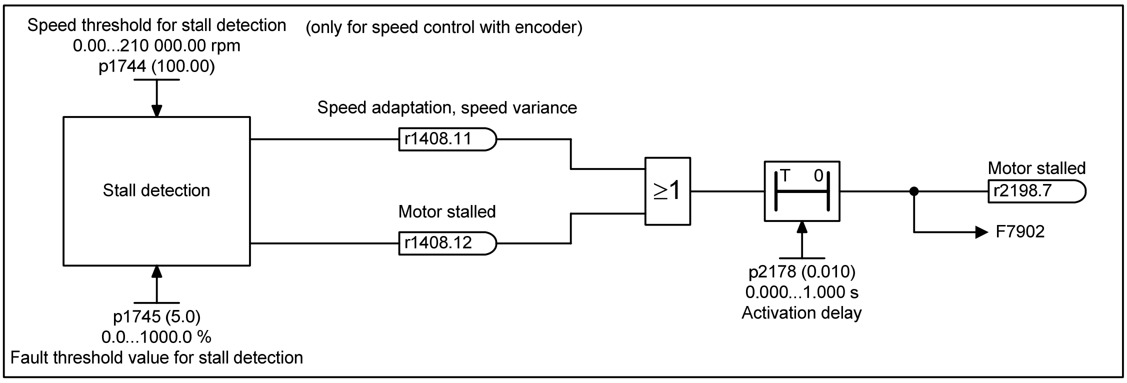


Fig. 9-15 Stall protection

Function diagram

FD 6730 Current control

FD 8012 Torque messages/signals, motor locked/stalled

Parameter

- r1408 CO/BO: Closed-loop control status word 3
- p1744 Motor model speed threshold stall detection
- p1745 Motor model error threshold stall detection
- p1755 Motor model changeover speed encoder-less operation
- p1756 Motor model changeover speed hysteresis
- p2178 Motor stalled delay time

9.4.5 Thermal motor protection

Description

The priority of thermal motor protection is to identify critical situations. If alarm thresholds are exceeded, the user can set parameterizable response options (p0610) that enable continued operation (e.g. with reduced power) and prevent immediate shutdown.

The signal characteristic is shown in plan 902.

- Effective protection is also possible without a temperature sensor (p4100 = 0). The temperatures of different motor components (stators, core, rotors) can be determined indirectly using a temperature model.
- Connecting temperature sensors (KTY84 or PTC100 to the customer terminal block (TM31) terminal X522:7(+)/8(-)) allows the motor temperature to be determined directly. In this way, accurate start temperatures are available immediately when the motor is switched on again or after a power failure.

Temperature measurement via KTY

The device is connected to terminals X522:7 (anode) and X522:8 (cathode) on the customer terminal block in the forward direction of the diode. The measured temperature is limited to between –48°C and +248°C and is made available for further evaluation.

- Set the KTY temperature sensor type: p4100 = 2
- Activate motor temperature measurement via the external sensor: p0600 = 10
- When the alarm threshold is reached (set via p0604; factory setting: 120°C), alarm A7910 is triggered.

  Parameter p0610 can be used to set how the drive responds to the alarm triggered:

  - 0: No response, only alarm, no reduction of I_max
  - 1: Alarm with reduction of I_max and fault (F7011)
  - 2: Alarm and fault (F7011), no reduction of I_max
- When the fault threshold is reached (set via p0605; factory setting: 155°C), fault F7011 is triggered in conjunction with the setting in p0610.

Temperature measurement via PTC

The device is connected to terminal X522:7/8 on the customer terminal block (TM31). The threshold for switching to an alarm or fault is 1650 Ω. If the threshold is exceeded, the system switches internally from an artificially-generated temperature value of –50°C to +250°C and makes it available for further evaluation.

- Set the KTY temperature sensor type: p4100 = 1
- Activate motor temperature measurement via the external sensor: p0600 = 10
- Alarm A7910 is triggered once the PTC responds.
- Fault F7011 is triggered once the waiting time defined in p0606 has elapsed.

Sensor monitoring for cable breakage / short-circuit

If the temperature of the motor temperature monitor is outside the range –50°C to +250°C, the sensor cable is broken or has short-circuited. Alarm A07915 ("Alarm: temperature sensor fault") is triggered. Fault F07016 (“Fault: temperature sensor fault”) is triggered once the waiting time defined in p0607 has elapsed.

Fault F07016 can be suppressed by p0607 = 0. If an induction motor is connected, the drive continues operating with the data calculated in the thermal motor model.

If the system detects that the motor temperature sensor set in p0600 is not connected, alarm A07820 ("Temperature sensor not connected") is triggered.

Function diagrams

FD 8016 Faults and alarms / Fault buffer

FD 9576 TM31 - Temperature evaluation KTY/PTC

FD 9577 TM31 - Sensor monitoring KTY/PTC

Parameters

- p0600 Motor temperature sensor for monitoring
- p0604 Motor overtemperature alarm threshold
- p0605 Motor overtemperature fault threshold
- p0606 Motor overtemperature timer
- p0607 Temperature sensor fault timer
- p0610 Response to motor overtemperature condition
- p4100 TM31 temperature evaluation sensor type

■

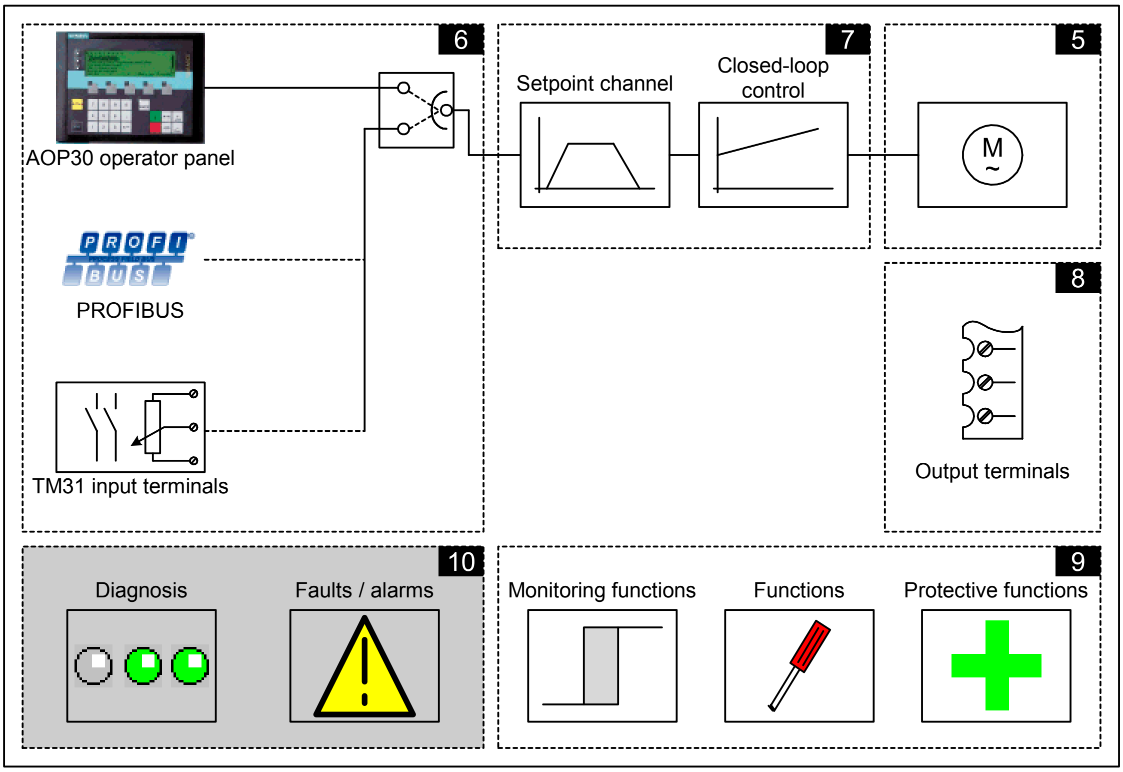
Diagnosis / faults and alarms

10

10.1 Chapter content

This chapter provides information on the following:

- Troubleshooting
- Service and support offered by Siemens AG



10.2 Diagnosis

Description

This section describes procedures for identifying the causes of problems and the measures you need to take to rectify them.

NOTE

If errors or malfunctions occur in the chassis unit, you must carefully check the possible causes and take the necessary steps to rectify them. If you cannot identify the cause of the problem or you discover that components are defective, your regional office or sales office should contact Siemens Service and describe the problem in more detail.

10.2.1 Diagnosis using LEDs

CU 320 Control Unit

Table 10-1 Description of the LEDs on the CU320

LED	Color	Status	Description
RDY (ready)	---	OFF	The electronics power supply is missing or lies outside permissible tolerance range.
	Green	Continuous	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place.
		Flashing 2 Hz	Writing to CompactFlash card.
	Red	Continuous	At least one fault is present in this component.
		Flashing 0.5 Hz	CompactFlash Card is not inserted. Boot error (e.g. firmware cannot be loaded to RAM).
	Green Red	Flashing 0.5 Hz	Control Unit 320 is ready. No software licenses for the device
	Orange	Continuous	DRIVE-CLiQ communication is being established.
		Flashing 0.5 Hz	Unable to load firmware to RAM.
		Flashing 2 Hz	Firmware CRC error

LED	Color	Status	Description
DP1 (PROFIBUS cyclic operation)	---	OFF	Cyclic communication has not (yet) taken place. Note: PROFIBUS is ready for communication when the Control Unit is ready (see LED RDY).
	Green	Continuous	Cyclic communication is taking place.
		Flashing 0.5 Hz	Full cyclic communication is not yet taking place. Possible causes: • The master is not transmitting setpoints. • No global control (GC) or master sign-of-life is transmitted during isochronous operation.
	Red	Continuous	Cyclic communication has been interrupted.
OPT (option)	---	OFF	The electronics power supply is missing or lies outside permissible tolerance range. The component is not ready for operation. Option board not installed or no associated drive object has been created.
	Green	Continuous	Option board is ready.
		Flashing 0.5 Hz	Depends on the option board used.
	Red	Continuous	At least one fault is present in this component. Option board not ready (e.g. after power-on).
MOD	---	OFF	Reserved
	Green	Continuous	Reserved

TM31 terminal block

Table 10-2 Description of the LEDs on the TM31

LED	Color	Status	Description
RDY	---	OFF	The electronics power supply is missing or lies outside permissible tolerance range.
	Green	Continuous	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place.
	Orange	Continuous	DRIVE-CLiQ communication is being established.
	Red	Continuous	At least one fault is present in this component.
	Green / red	Flashing 2 Hz	Firmware is being downloaded.
	Green / orange or Red / orange	Flashing 2 Hz	Component recognition via LED is activated (p0144). Note: Both options depend on the LED status when component recognition is activated via p0154 = 1.

Control Interface Board in the Power Module

Table 10-3 Description of the LEDs on the Control Interface Board

<table>
<tr><th colspan="2">LED state</th><th rowspan="2">Description</th></tr>
<tr><th>H200</th><th>H201</th></tr>
<tr><td>Off</td><td>Off</td><td>The electronics power supply is missing or lies outside permissible tolerance range.</td></tr>
<tr><td rowspan="3">Green</td><td>Off</td><td>The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place.</td></tr>
<tr><td>Orange</td><td>The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place.
The DC link voltage is present.</td></tr>
<tr><td>Red</td><td>The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place.
The DC link voltage is too high.</td></tr>
<tr><td>Orange</td><td>Orange</td><td>DRIVE-CLiQ communication is being established.</td></tr>
<tr><td>Red</td><td>---</td><td>At least one fault is present in this component.</td></tr>
<tr><td>2 Hz flashing light
Green / red</td><td>---</td><td>Firmware is being downloaded.</td></tr>
<tr><td>2 Hz flashing light
Green orange
or
red orange</td><td>---</td><td>Component detection using LED is activated (p0124).
Note:
Both options depend on the LED status when component recognition is activated via p0124 = 1.</td></tr>
</table>

WARNING

Independent of the state of LED "H201", hazardous DC link voltages can always be available.
The warning information on the components must be carefully observed!

SMC30 – encoder evaluation

Table 10-4 Description of the LEDs on the SMC30

LED	Color	Status	Description
RDY	---	OFF	The electronics power supply is missing or lies outside permissible tolerance range.
	Green	Steady light	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place.
	Orange	Steady light	DRIVE CLiQ communication is being established.
	Red	Steady light	At least one fault is present in this component.
	Green / red	2 Hz flashing light	Firmware is being downloaded.
	Green / orange or Red / orange	2 Hz flashing light	Component recognition via LED is activated (p0144). Note: Both options depend on the LED status when component recognition is activated via p0144 = 1.
OUT>5 V	---	OFF	The electronics power supply is missing or lies outside permissible tolerance range. Measuring system supply ≤ 5 V (only when ready for operation).
	Orange	Steady light	Electronics power supply for the measuring system is available. Measuring system supply > 5 V. **Notice:** It must be guaranteed that the connected encoder may be operated with a 24 V power supply. If an encoder designed for connection to 5 V is connected to 24 V, then this can destroy the encoder electronics.

10.2.2 Diagnosis via parameters

All objects: key diagnostic parameters (details in List Manual)

r0945	**Fault code**
Displays the fault number. Index 0 is the most recent fault (last fault to have occurred).	

r0949	**Fault value**
Displays additional information about the fault. This information is required for detailed fault diagnosis.	

r0948	**Time that the fault comes in milliseconds**
Displays the system runtime in ms at which the fault occurred.	

r2109	**Time that the fault has cleared in milliseconds**
Displays the system runtime in ms at which the fault was rectified.	

r2124	**Alarm value**
Displays additional information about the alarm. This information is required for detailed alarm diagnosis.	

r2123	**Time that the alarm comes in milliseconds**
Displays the system runtime in ms at which the alarm occurred.	

r2125	**Time that the alarm has been cleared in milliseconds**
Displays the system runtime in ms at which the alarm was rectified.	

CU320: key diagnostic parameters (details in List Manual)

r0002	**Control Unit Operating display**
Operating display for the Control Unit.	

r0018	**Control Unit Firmware Version**
Displays the firmware version of the Control Unit. For the display parameters for the firmware version of the other connected components, see the parameter description in the List Manual.	

r0721	**CU digital inputs terminal actual value**
Displays the actual value at the digital input terminals on the CU. This parameter shows the actual value, uninfluenced by simulation mode of the digital inputs.	

r0722	CU digital inputs status
Displays the status of the digital inputs on the CU. This parameter shows the status of the digital inputs under the influence of simulation mode of the digital inputs.	

r0747	CU digital outputs status
Display of the CU digital output status. This parameter shows the status of the digital inputs under the influence of simulation mode of the digital inputs.	

r2054	Profibus status
Displays the status of the Profibus interface.	

r9976[0..7]	System load
Displays the system load. The individual values (computation load and cyclic load) are measured over short time slices; from these values, the maximum, the minimum and the average value are generated and displayed in the appropriate indices. Further, the degree of memory utilization of the data and program memory is displayed.	

Vector: key diagnostic parameters (details in List Manual)

r0002	Operating display
The value provides information about the current operating status and the conditions necessary to reach the next status.	

r0020	Speed setpoint smoothed
Displays the actual smoothed speed/velocity setpoint at the input of the speed/velocity controller or V/f characteristic (after the interpolator).	

r0021	Actual speed smoothed
Displays the smoothed actual value of the motor speed/velocity.	

r0026	DC link voltage, smoothed
Displays the smoothed actual value of the DC link.	

r0027	Absolute actual current smoothed
Displays the smoothed actual value of the current.	

r0031	Actual torque smoothed
Displays the smoothed actual torque.	

r0035	Motor temperature

If r0035 does not equal -200.0 °C, the following applies:

- This temperature indicator is valid.
- An KTY sensor is connected.
- If using an asynchronous motor, the thermal motor model is activated (p0600 = 0 or p0601 = 0).

If r0035 equals -200.0 °C, the following applies:

- This temperature indicator is invalid (temperature sensor fault).
- An PTC sensor is connected.
- If using a synchronous motor, the thermal motor model is activated (p0600 = 0 or p0601 = 0).

r0037	Power Module temperatures

Displays the measured temperatures in the Power Module.

r0046	Missing drive enable signals

Displays missing enable signals that are preventing the closed-loop drive control from being commissioned.

r0050	Active command data set (CDS)

Displays the active command data set (CDS)

r0051	Drive data set (DDS) effective

Effective drive data set (DDS) display.

r0206	Rated Power Module power

Displays the rated Power Module power for various load duty cycles.

r0207	Rated Power Module current

Displays the rated Power Module current for various load duty cycles.

r0208	Rated line supply voltage of Power Module

Displays the rated line supply voltage of the Power Module.

TM31: key diagnostic parameters (details in List Manual)

r0002	TM31 Operating display
Operating display for the Terminal Module 31 (TM31).	

r4021	Digital inputs terminal actual value
Displays the actual value at the digital input terminals on the TM31. This parameter shows the actual value, uninfluenced by simulation mode of the digital inputs.	

r4022	TM31 digital inputs status
Displays the status of the digital inputs on the TM31. This parameter shows the status of the digital inputs under the influence of simulation mode of the digital inputs.	

r4047	Digital outputs status
Displays the status of the TM31 digital outputs. Inversion via p4048 is taken into account.	

10.2.3 Indicating and rectifying faults

The chassis unit features a wide range of functions that protect the drive against damage if a fault occurs (faults and alarms).

Indicating faults and alarms

If a fault occurs, the drive displays the fault and/or alarm on the AOP30 operator panel. Faults are indicated by the red "FAULT" LED and a fault screen is automatically displayed. You can use the F1 Help function to call up information about the cause of the fault and how to remedy it. You can use F5 Ack. to acknowledge a stored fault.

Any alarms are displayed by the yellow flashing "ALARM" LED. The system also displays a note in the status bar providing information on the cause.

Every fault and alarm is entered in the fault/alarm buffer along with time the error occurred and the time it was rectified. The time stamp relates to the relative system time in milliseconds (r0969).

What is a fault?

A fault is a message from the drive indicating an error or other exceptional (unwanted) status. This could be caused by a fault within the converter or an external fault triggered, for example, from the winding temperature monitor for the asynchronous motor. The faults are displayed and can be reported to a higher-level control system via PROFIBUS. In the factory default setting, the message "converter fault" is also sent to a relay output. Once you have rectified the cause of the fault, you have to acknowledge the fault message.

What is an alarm?

An alarm is the response to a fault condition identified by the drive. It does not result in the drive being switched off and does not have to be acknowledged. Alarms are "self acknowledging", that is, they are reset automatically when the cause of the alarm has been eliminated.

10.3 Service and support

Service and support helpline

If you need help and do not know who to contact, we make sure that you receive all the help you need as quickly as possible.

The helpline ensures that a specialist in your area can provide you with professional support. The helpline (in Germany, for example) is available 24 hours a day, 365 days a year. German and English are spoken.

Tel.: 0180 50 50 111

Online support

Our round-the-clock, worldwide online support service provides quick and efficient support in five languages. The comprehensive Internet-based information system, which is available round the clock, provides product support, services, and support tools in the shop.

Online support provides a wide range of technical information:

- FAQs, tips and tricks, downloads, current news
- Manuals
- Helpful programs and software products

http://www.siemens.de/automation/service&support

Field service

If your plant is down and you need fast, on-site help, we can provide the specialists with the required expertise wherever you are.

With our comprehensive service network, we offer professional and reliable expertise to get your plant up and running again as quickly as possible.

Experts are available 24 hours a day, 365 days a year.

Tel.: 0180 50 50 444

Of course, we can also arrange special service contracts tailored to your specific requirements. For details, please contact your Siemens office.

Spare parts and repairs

Our global network of regional spare parts warehouses and repair centers enables us to respond quickly and reliably with modern logistics procedures.

During the operational phase of your machinery, we provide a comprehensive repairs and spare parts service to ensure maximum operational reliability. Our service includes expert advice with technical problems, and a wide range of product and system support services tailored to your needs.

For more information about repairs or spare parts, please call the following number (in Germany):

Tel.: 0180 50 50 448

You can call this number outside office hours and at the weekend to contact our emergency spare parts service.

Technical support

We offer technical support in both German and English for deploying products, systems, and solutions in drive and automation technology.

In special cases, help is available from professional, trained, and experienced specialists via teleservice and video conferencing.

Free Contact – providing you with free technical support

- In Europe / Africa
  Tel.: +49 (0)180 50 50 222
  Fax: +49 (0)180 50 50 223
  Internet: http://www.siemens.de/automation/support-request
- in America
  Tel.: +14232622522
  Fax: +14232622289
  E-mail: simatic.hotline@sea.siemens.com
- Asia / Pacific region
  Tel.: +86 1064 757575
  Fax: +86 1064 747474
  E-mail: adsupport.asia@siemens.com

■

Maintenance and servicing 11

11.1 Chapter content

This chapter provides information on the following:

- Maintenance and servicing procedures that have to be carried out on a regular basis to ensure the availability of the chassis units.
- Exchanging device components when the unit is serviced
- Reforming the DC link capacitors
- Upgrading the chassis unit firmware

DANGER

Before carrying out any maintenance or repair work on the de-energized chassis unit, wait for 5 minutes after switching off the supply voltage. This allows the capacitors to discharge to a harmless level (< 25 V) after the supply voltage has been switched off.

Before starting work, you should also measure the voltage after the 5 minutes have elapsed!

11.2 Maintenance

The chassis unit comprises mostly electronic components. Apart from the fan(s), the unit, therefore, contains hardly any components that are subject to wear or that require maintenance or servicing. The purpose of maintenance is to preserve the specified condition of the chassis unit. Dirt and contamination must be removed regularly and parts subject to wear replaced.
The following points must generally be observed.

11.2.1 Cleaning

Dust deposits

Dust deposits inside the chassis unit must be removed at regular intervals (or at least once a year) by qualified personnel in line with the relevant safety regulations. The unit must be cleaned using a brush and vacuum cleaner, and dry compressed air (max. 1 bar) for areas that cannot be easily reached.

Ventilation

When installing the devices in a cabinet, make sure that the cabinet ventilation slots are not obstructed. The fan must be checked to make sure that it is functioning correctly.

Cable and screw terminals

Cable and screw terminals must be checked regularly to ensure that they are secure in position, and if necessary, retightened. Cabling must be checked for defects. Defective parts must be replaced immediately.

NOTE

The actual intervals at which maintenance procedures are to be performed depend on the installation conditions and the operating conditions.

Siemens offers its customers support in the form of a service contract. For further details, contact your regional office or sales office.

11.3 Servicing

Servicing involves activities and procedures for maintaining and restoring the operating condition of the chassis unit.

Required tools

The following tools are required for replacing components:

- Spanner or socket spanner (w/f 10)
- Spanner or socket spanner (w/f 13)
- Spanner or socket spanner (w/f 16/17)
- Spanner or socket spanner (w/f 18/19)
- Hexagon-socket spanner (size 8)
- Torque spanner, max. 50 Nm
- Screwdriver size 1 / 2
- Screwdriver Torx T20
- Screwdriver Torx T30

Tightening torques for current-carrying parts

When securing connections for current-carrying parts (DC link, motor connections, busbars), you must observe the following tightening torques.

Table 11-1 Tightening torques for connecting current-carrying parts

Screw	Torque
M6	6 Nm
M8	13 Nm
M10	25 Nm
M12	50 Nm

11.3.1 Installation device

Description

The installation device is used for installing and removing the power blocks.

It is used as an installation aid, which is placed in front of and secured to the module. The telescopic guide support allows the withdrawable device to be adjusted according to the height at which the power blocks are installed. Once the mechanical and electrical connections have been removed, the power block can be removed from the module, whereby the power block is guided and supported by the guide rails on the withdrawable devices.

Fig. 11-1 Installation device

Order number

Order number for the installation device: 6SL3766-1FA00-0AA0.

11.4 Replacing components

WARNING

The following must be taken into account when the devices are transported:

Some of the devices are heavy or top heavy.

Due to their weight, the devices must be handled with care by trained personnel.

Serious injury or even death and substantial material damage can occur if the devices are not lifted or transported properly.

WARNING

The chassis units are operated with high voltages.
All connection procedures must be carried out with the cabinet de-energized.
All work on the units must be carried out by trained personnel only. Death, serious injury, or substantial material damage can result if these warnings are not taken into account.
Work on an open device must be carried out with extreme caution because external supply voltages may be present. The power and control terminals may be live even when the motor is not running.
Dangerously high voltage levels are still present in the cabinet up to five minutes after it has been disconnected due to the DC link capacitors. For this reason, the cabinet should not be opened until after a reasonable period of time has elapsed.

11.4.1 Replacing the power block (type GX)

Replacing the power block

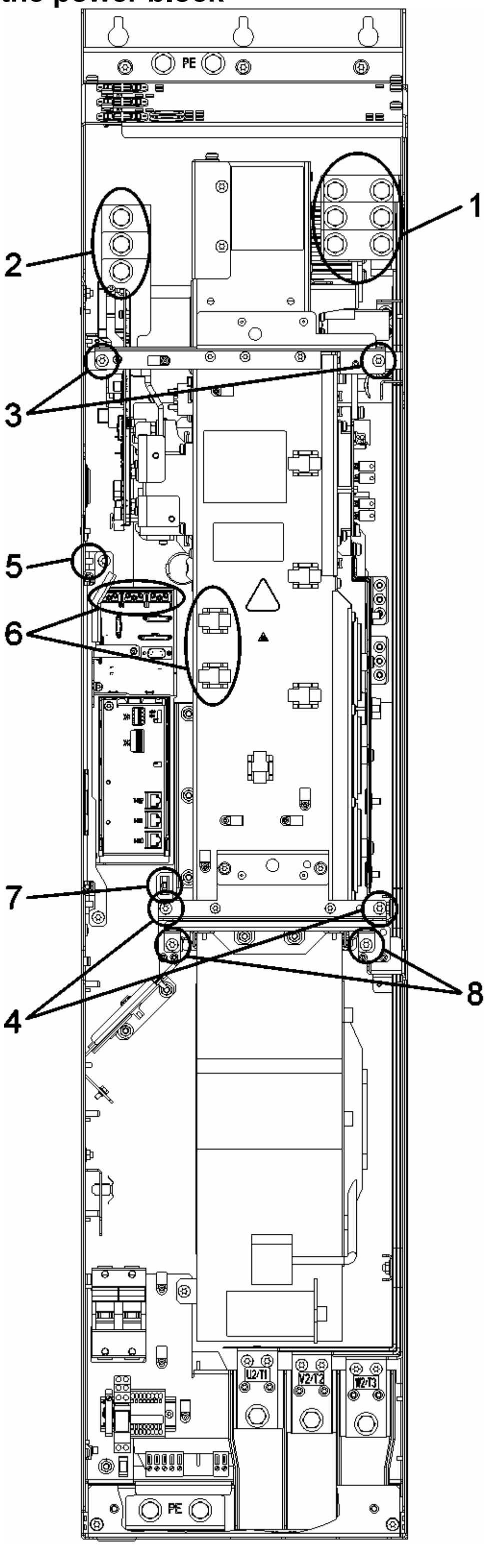


Fig. 11-2 Replacing the power block (type GX)

Preparatory steps

- Disconnect the chassis unit from the power supply.
- Allow unimpeded access to the power block.
- Remove the protective cover.

Removal

The steps for the removal procedure are numbered in accordance with Fig. 11-2.

1. Unscrew the connection to the outgoing motor section (3 screws).
2. Unscrew the connection to the mains supply (3 screws).
3. Remove the retaining screws at the top (2 screws).
4. Remove the retaining screws at the bottom (2 screws).
5. Remove the CU320 mount (1 nut). If necessary, remove the PROFIBUS plug and connection to the operator panel (-X140 on the CU320) and carefully remove the CU320.
6. Disconnect the plugs for the fiber optic cables (5 plugs) and release the cable connection for the signal cables (2 connectors).
7. Disconnect the plug for the thermocouple.
8. Unscrew the two retaining screws for the fan and attach the tool for de-installing the power block at this position.

You can now remove the power block.

CAUTION

When removing the power block, ensure that you do not damage any signal cables.

Installation

To re-install the fan, carry out the above steps in reverse order.

CAUTION

The tightening torques specified in Table 11-1 must be observed.

Carefully re-establish the plug connections and ensure that they are secure.

The screwed connections for the protective covers must only be tightened by hand.

11.4.2 Replacing the power block (type HX)

Replacing the left-hand power block

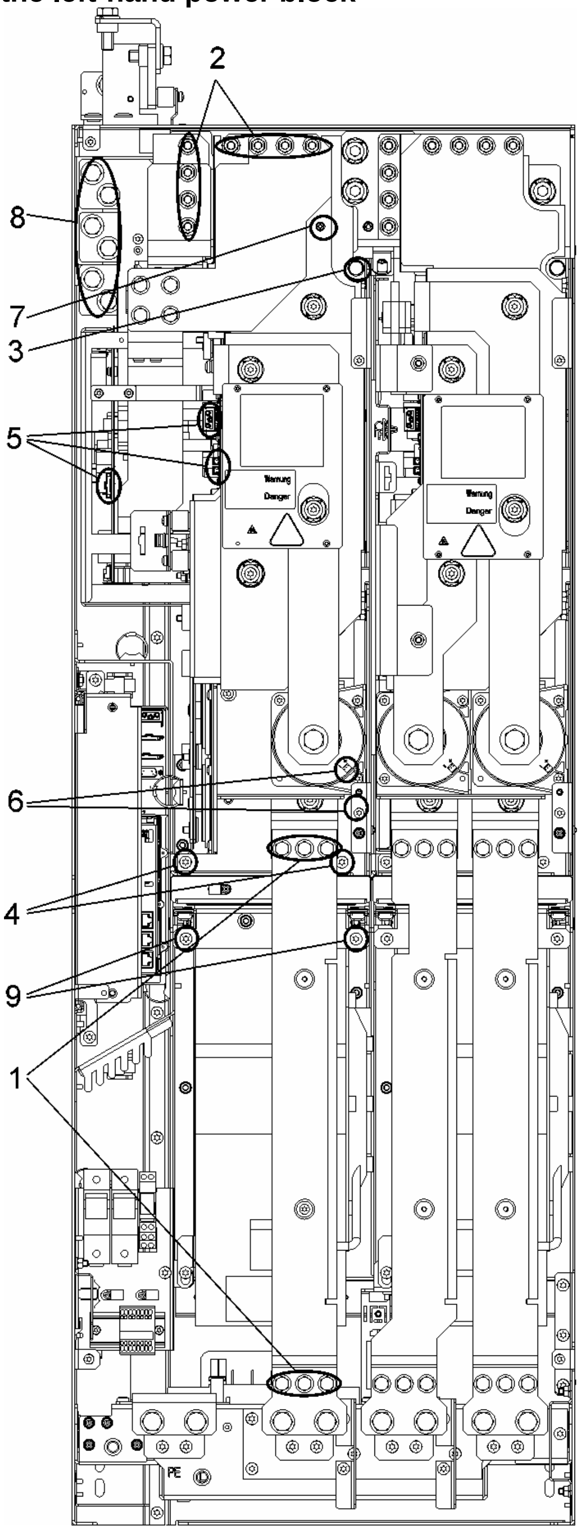


Fig. 11-3 Replacing the power block (type HX) (left-hand power block)

Preparatory steps

- Disconnect the chassis unit from the power supply.
- Allow unimpeded access to the power block.
- Remove the protective cover.

Removal

The steps for the removal procedure are numbered in accordance with Fig. 11-3.

1. Remove the busbar (6 screws).
2. Unscrew the connection to the DC link (8 nuts).
3. Remove the retaining screw at the top (1 screw).
4. Remove the retaining screws at the bottom (2 screws).
5. Disconnect the plugs for the fiber optic cables and signal cables (3 plugs).
6. Remove the connection for the current transformer and associated PE connection (1 plug).
7. Remove the connection for the DC link sensor (1 nut).
8. Remove the power connections (6 screws).
9. Unscrew the two retaining screws for the fan and attach the tool for de-installing the power block at this position.

You can now remove the power block.

CAUTION

When removing the power block, ensure that you do not damage any signal cables.

Installation

To re-install the fan, carry out the above steps in reverse order.

CAUTION

The tightening torques specified in Table 11-1 must be observed.

Carefully re-establish the plug connections and ensure that they are secure.

The screwed connections for the protective covers must only be tightened by hand.

Replacing the right-hand power block

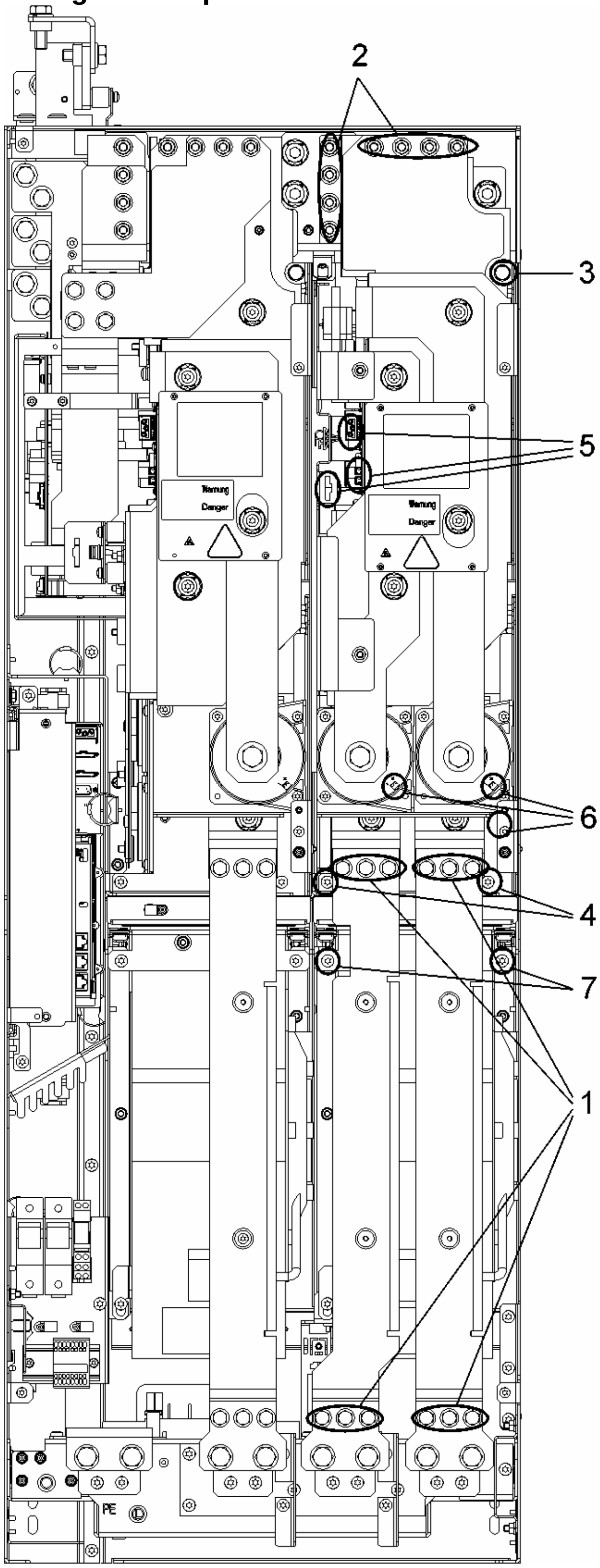


Fig. 11-4 Replacing the power block (type HX) (right-hand power block)

Preparatory steps

- Disconnect the chassis unit from the power supply.
- Allow unimpeded access to the power block.
- Remove the protective cover.

Removal

The steps for the removal procedure are numbered in accordance with Fig. 11-4.

1. Remove the busbars (12 screws).
2. Unscrew the connection to the DC link (8 nuts).
3. Remove the retaining screw at the top (1 screw).
4. Remove the retaining screws at the bottom (2 screws).
5. Disconnect the plugs for the fiber optic cables and signal cables (3 plugs).
6. Remove the connection for the current transformer and associated PE connection (2 plug).
7. Unscrew the two retaining screws for the fan and attach the tool for de-installing the power block at this position.

You can now remove the power block.

CAUTION

When removing the power block, ensure that you do not damage any signal cables.

Installation

To re-install the fan, carry out the above steps in reverse order.

CAUTION

The tightening torques specified in Table 11-1 must be observed.

Carefully re-establish the plug connections and ensure that they are secure.

The screwed connections for the protective covers must only be tightened by hand.

11.4.3 Replacing the power block (type JX)

Replacing the left-hand power block

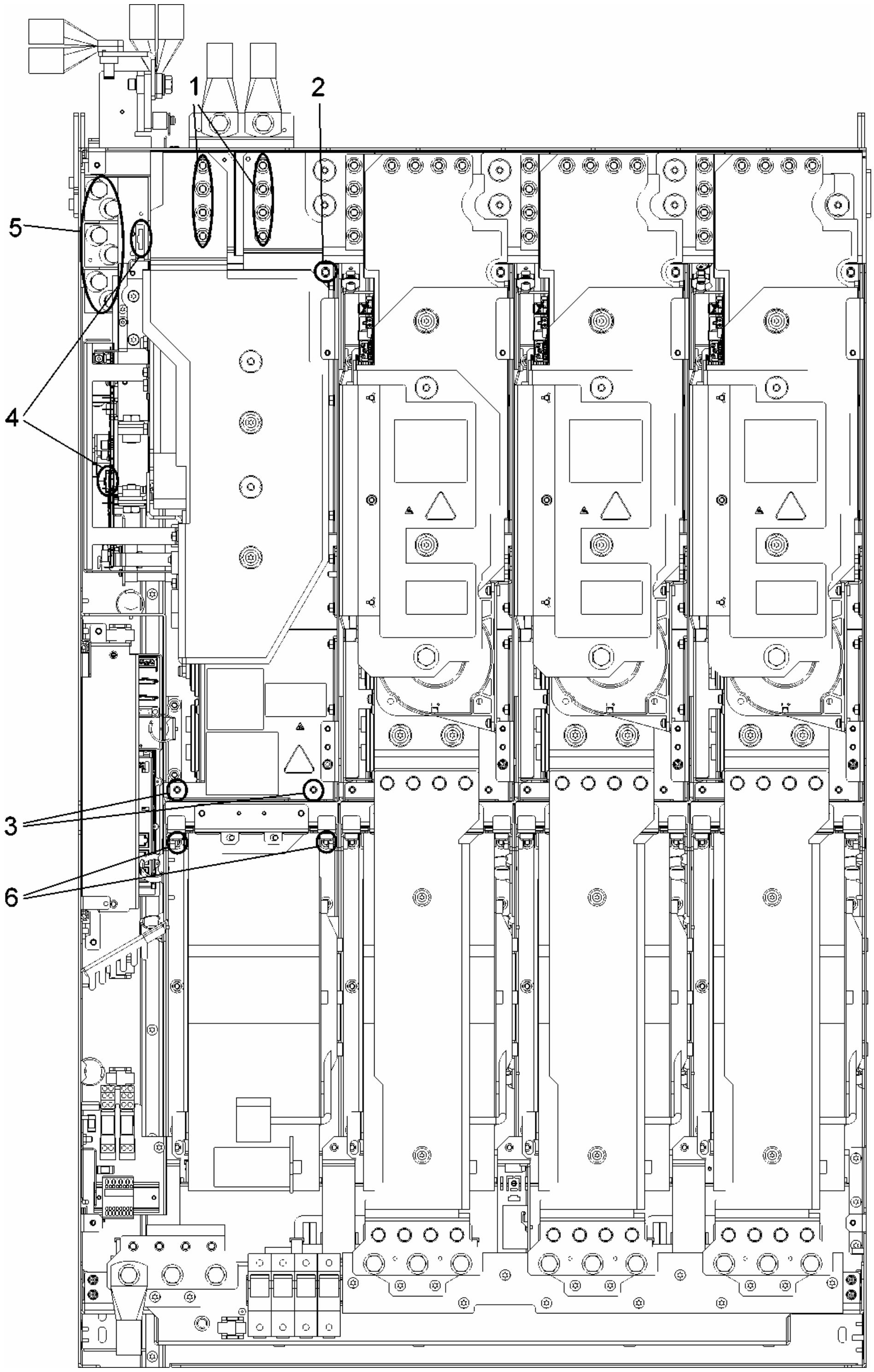


Fig. 11-5 Replacing the power block (type JX) (left-hand power block)

Preparatory steps

- Disconnect the chassis unit from the power supply.
- Allow unimpeded access to the power block.
- Remove the protective cover.

Removal

The steps for the removal procedure are numbered in accordance with Fig. 11-5.

1. Unscrew the connection to the DC link (8 nuts).
2. Remove the retaining screw at the top (1 screw).
3. Remove the retaining screws at the bottom (2 screws).
4. Disconnect the plugs for the fiber optic cables and signal cables (2 plugs).
5. Remove the power connections (6 screws).
6. Unscrew the two retaining screws for the fan and attach the tool for de-installing the power block at this position.

You can now remove the power block.

CAUTION

When removing the power block, ensure that you do not damage any signal cables.

Installation

To re-install the fan, carry out the above steps in reverse order.

CAUTION

The tightening torques specified in Table 11-1 must be observed.

Carefully re-establish the plug connections and ensure that they are secure.

The screwed connections for the protective covers must only be tightened by hand.

Replacing the right-hand power block

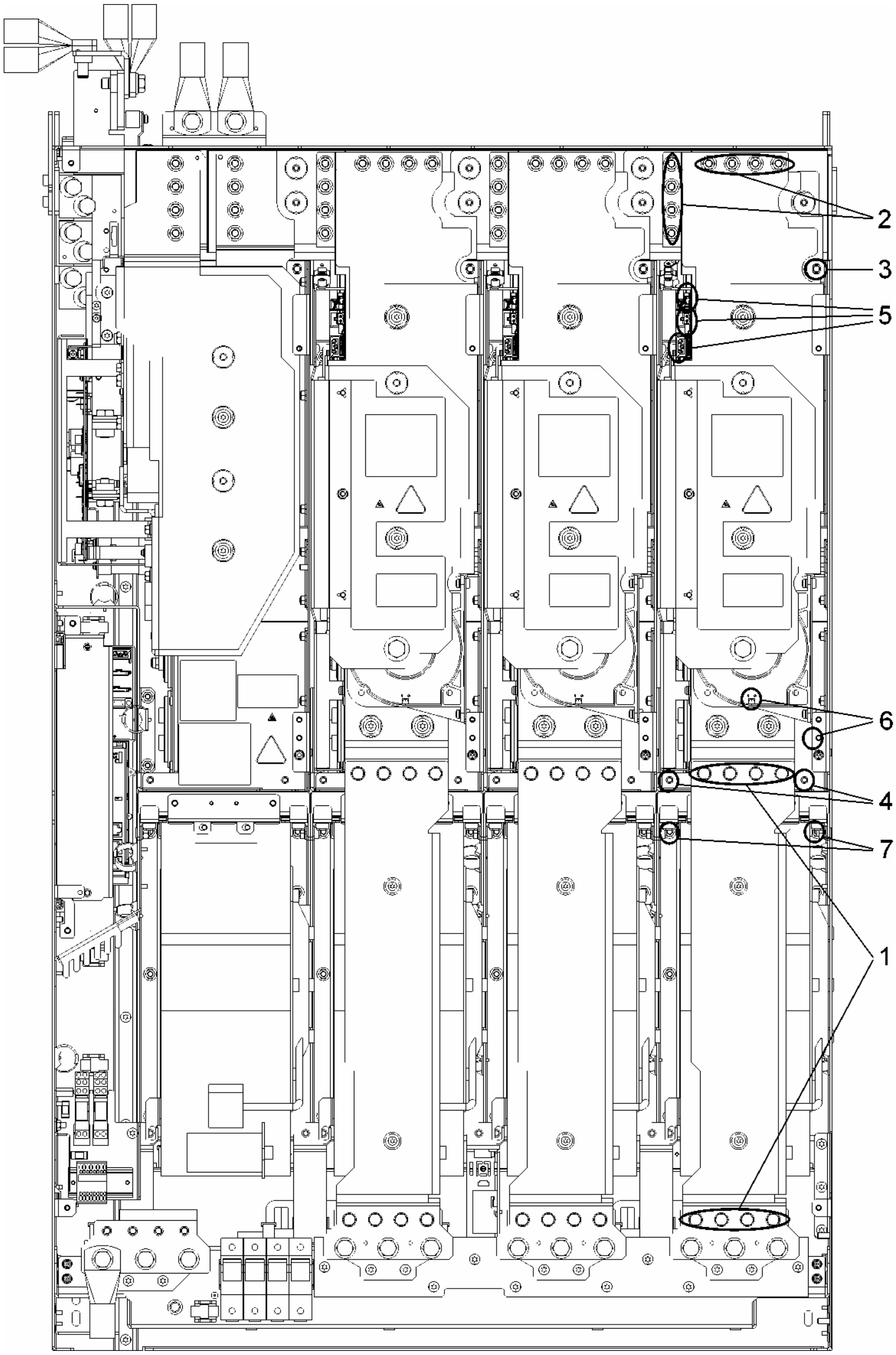


Fig. 11-6 Replacing the power block (type JX) (right-hand power block)

Preparatory steps

- Disconnect the chassis unit from the power supply.
- Allow unimpeded access to the power block.
- Remove the protective cover.

Removal

The steps for the removal procedure are numbered in accordance with Fig. 11-6.

1. Remove the busbar (8 screws).
2. Unscrew the connection to the DC link (8 nuts).
3. Remove the retaining screw at the top (1 screw).
4. Remove the retaining screws at the bottom (2 screws).
5. Disconnect the plugs for the fiber optic cables and signal cables (2 plugs).
6. Remove the connection for the current transformer and associated PE connection (1 plug).
7. Unscrew the two retaining screws for the fan and attach the tool for de-installing the power block at this position.

You can now remove the power block.

CAUTION

When removing the power block, ensure that you do not damage any signal cables.

Installation

To re-install the fan, carry out the above steps in reverse order.

CAUTION

The tightening torques specified in Table 11-1 must be observed.

Carefully re-establish the plug connections and ensure that they are secure.

The screwed connections for the protective covers must only be tightened by hand.

11.4.4 Replacing the Control Interface Board (type GX)

Replacing the Control Interface Board

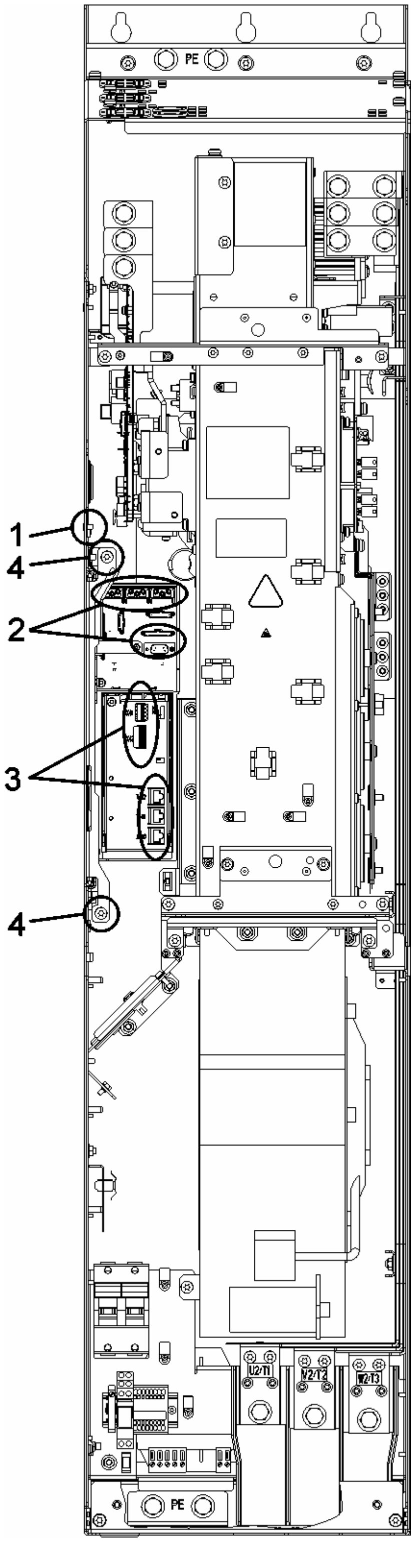


Fig. 11-7 Replacing the Control Interface Board (type GX)

Preparatory steps

- Disconnect the chassis unit from the power supply.
- Allow unimpeded access to the fan.
- Remove the protective cover.

Removal

The steps for the removal procedure are numbered in accordance with Fig. 11-7.

1. Remove the CU320 mount (1 nut). If necessary, remove the PROFIBUS plug and connection to the operator panel (-X140 on the CU320) and carefully remove the CU320.
2. Disconnect the plugs for the fiber optic cables and signal cables (5 plugs).
3. Remove the DRIVE-CLiQ cables and connections to the CU320 (5 plugs).
4. Remove the retaining screws for the slide-in electronics unit (2 screws). When removing the slide-in electronics unit, you have to disconnect 5 further plugs one after the other (2 at the top, 3 below).

CAUTION

When removing the Control Interface Board, ensure that you do not damage any signal cables.

The Control Interface Board can then be removed from the slide-in electronics unit.

Installation

To re-install the fan, carry out the above steps in reverse order.

CAUTION

The tightening torques specified in Table 11-1 must be observed.

Carefully re-establish the plug connections and ensure that they are secure.

The screwed connections for the protective covers must only be tightened by hand.

11.4.5 Replacing the Control Interface Board (type HX)

Replacing the Control Interface Board

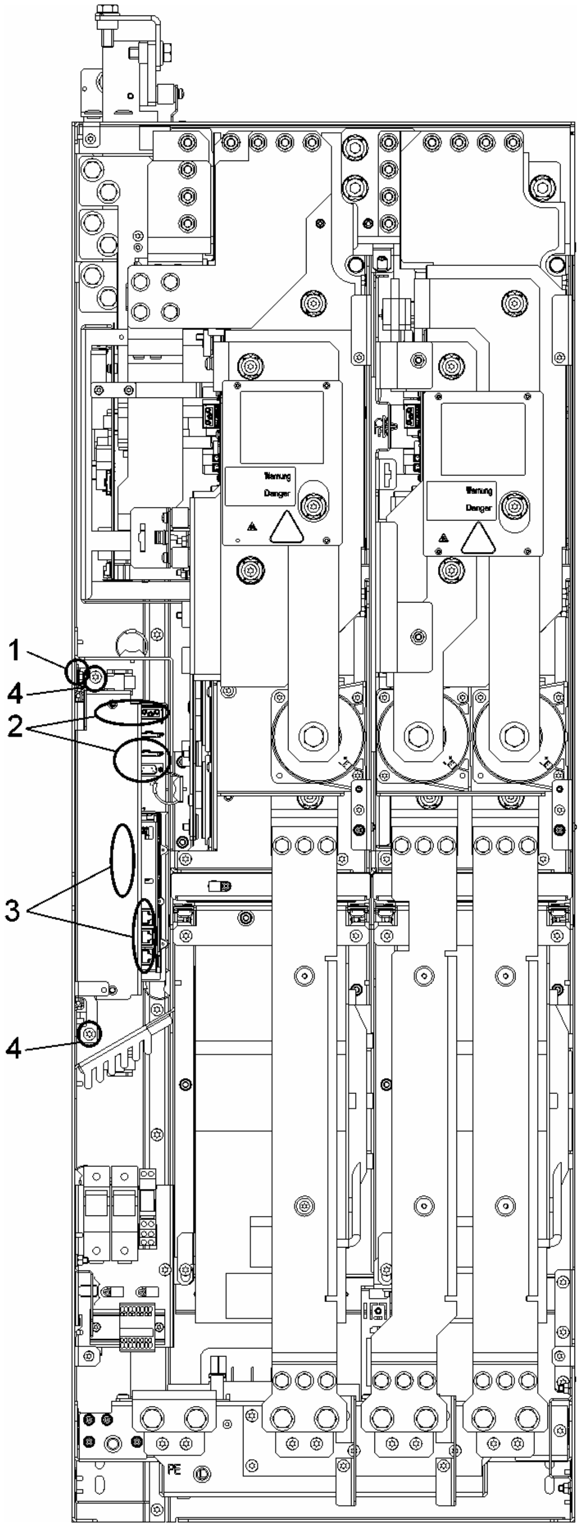


Fig. 11-8 Replacing the Control Interface Board (type HX)

Preparatory steps

- Disconnect the chassis unit from the power supply.
- Allow unimpeded access to the fan.
- Remove the protective cover.

Removal

The steps for the removal procedure are numbered in accordance with Fig. 11-8.

1. Remove the CU320 mount (1 nut). If necessary, remove the PROFIBUS plug and connection to the operator panel (-X140 on the CU320) and carefully remove the CU320.
2. Disconnect the plugs for the fiber optic cables and signal cables (5 plugs).
3. Remove the DRIVE-CLiQ cables and connections to the CU320 (5 plugs).
4. Remove the retaining screws for the slide-in electronics unit (2 screws). When removing the slide-in electronics unit, you have to disconnect 5 further plugs one after the other (2 at the top, 3 below).

CAUTION

When removing the Control Interface Board, ensure that you do not damage any signal cables.

The Control Interface Board can then be removed from the slide-in electronics unit.

Installation

To re-install the fan, carry out the above steps in reverse order.

CAUTION

The tightening torques specified in Table 11-1 must be observed.

Carefully re-establish the plug connections and ensure that they are secure.

The screwed connections for the protective covers must only be tightened by hand.

11.4.6 Replacing the Control Interface Board (type JX)

Replacing the Control Interface Board

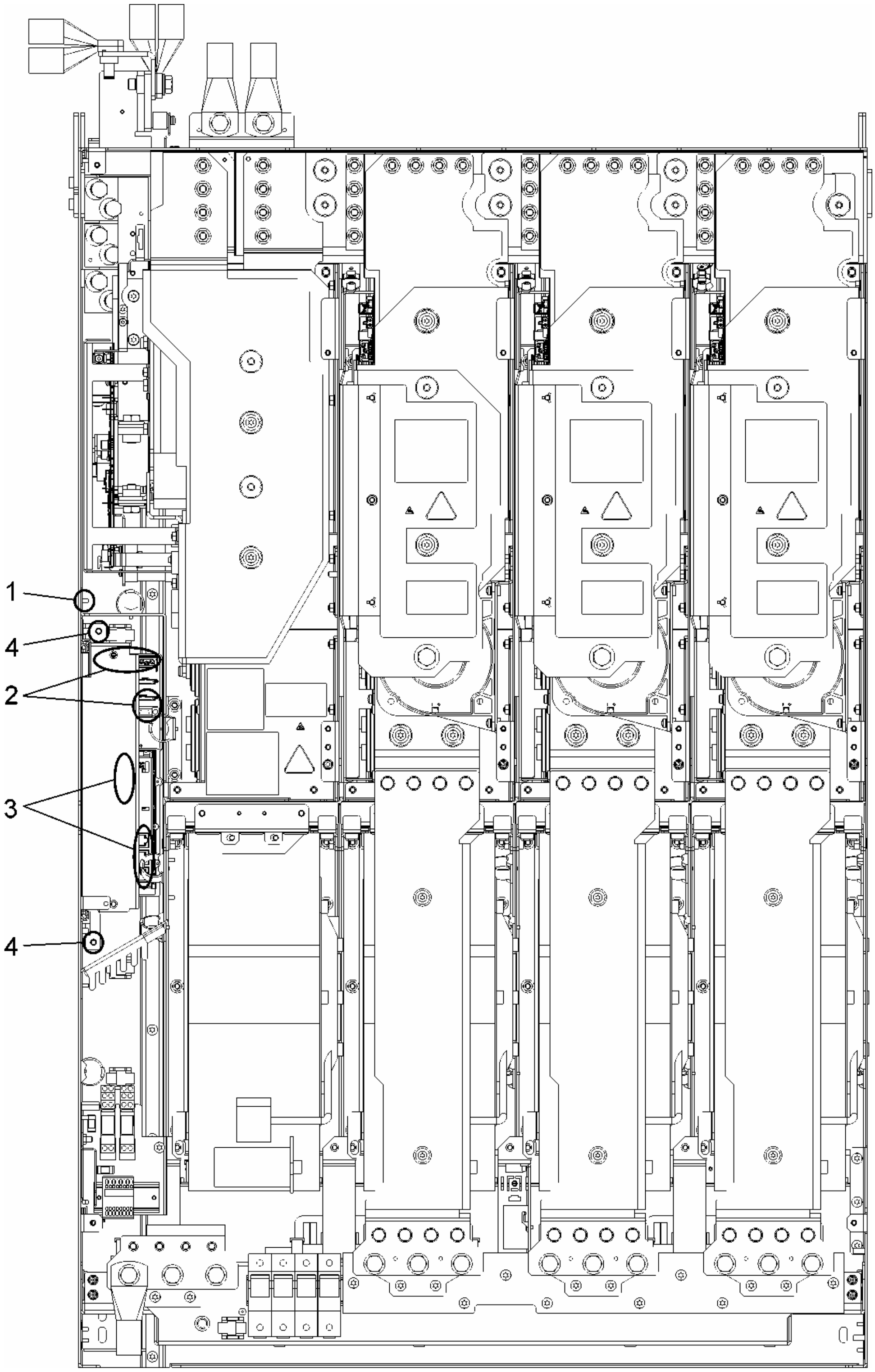


Fig. 11-9 Replacing the Control Interface Board (type JX)

Preparatory steps

- Disconnect the chassis unit from the power supply.
- Allow unimpeded access to the fan.
- Remove the protective cover.

Removal

The steps for the removal procedure are numbered in accordance with Fig. 11-9.

1. Remove the CU320 mount (1 nut). If necessary, remove the PROFIBUS plug and connection to the operator panel (-X140 on the CU320) and carefully remove the CU320.
2. Disconnect the plugs for the fiber optic cables and signal cables (5 plugs).
3. Remove the DRIVE-CLiQ cables and connections to the CU320 (5 plugs).
4. Remove the retaining screws for the slide-in electronics unit (2 screws). When removing the slide-in electronics unit, you have to disconnect 5 further plugs one after the other (2 at the top, 3 below).

CAUTION

When removing the Control Interface Board, ensure that you do not damage any signal cables.

The Control Interface Board can then be removed from the slide-in electronics unit.

Installation

To re-install the fan, carry out the above steps in reverse order.

CAUTION

The tightening torques specified in Table 11-1 must be observed.

Carefully re-establish the plug connections and ensure that they are secure.

The screwed connections for the protective covers must only be tightened by hand.

11.4.7 Replacing the fan (type GX)

Replacing the fan

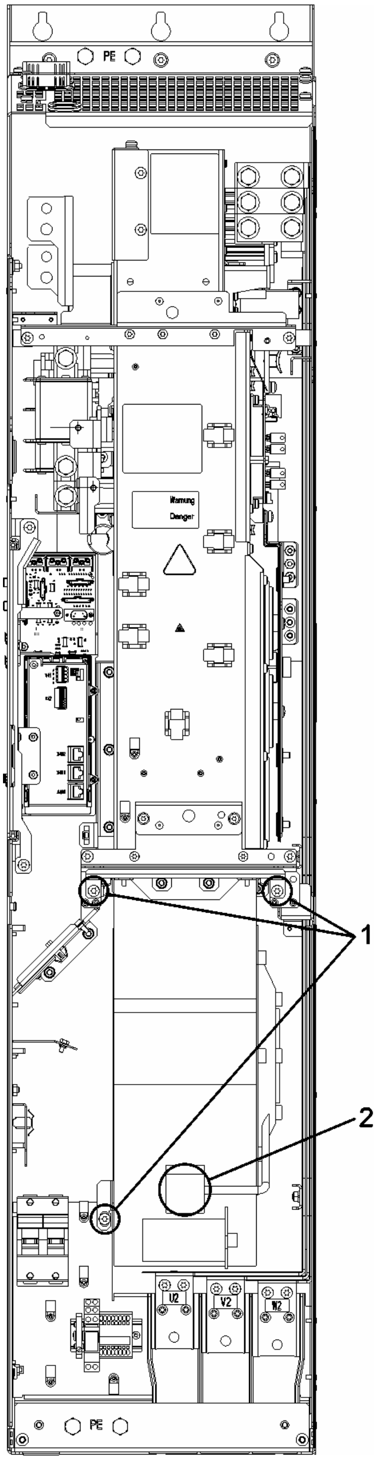


Fig. 11-10 Replacing the fan (type GX)

Description

The average service life of the device fans is 50,000 hours. In practice, however, the service life depends on other variables, including ambient temperature and the degree of cabinet protection and, therefore, may deviate from this value.

The fans must be replaced in good time to ensure that the chassis unit is available.

Preparatory steps

- Disconnect the chassis unit from the power supply.
- Allow unimpeded access to the fan.
- Remove the protective cover.

Removal

The steps for the removal procedure are numbered in accordance with Fig. 11-10.

1. Remove the retaining screws for the fan (3 screws).
2. Disconnect the supply cables (1 x "L", 1 x "N").

You can now carefully remove the fan.

CAUTION

When removing the fan, ensure that you do not damage any signal cables.

Installation

To re-install the fan, carry out the above steps in reverse order.

CAUTION

The tightening torques specified in Table 11-1 must be observed.

Carefully re-establish the plug connections and ensure that they are secure.

The screwed connections for the protective covers must only be tightened by hand.

11.4.8 Replacing the fan (type HX)

Replacing the fan (left-hand power block)

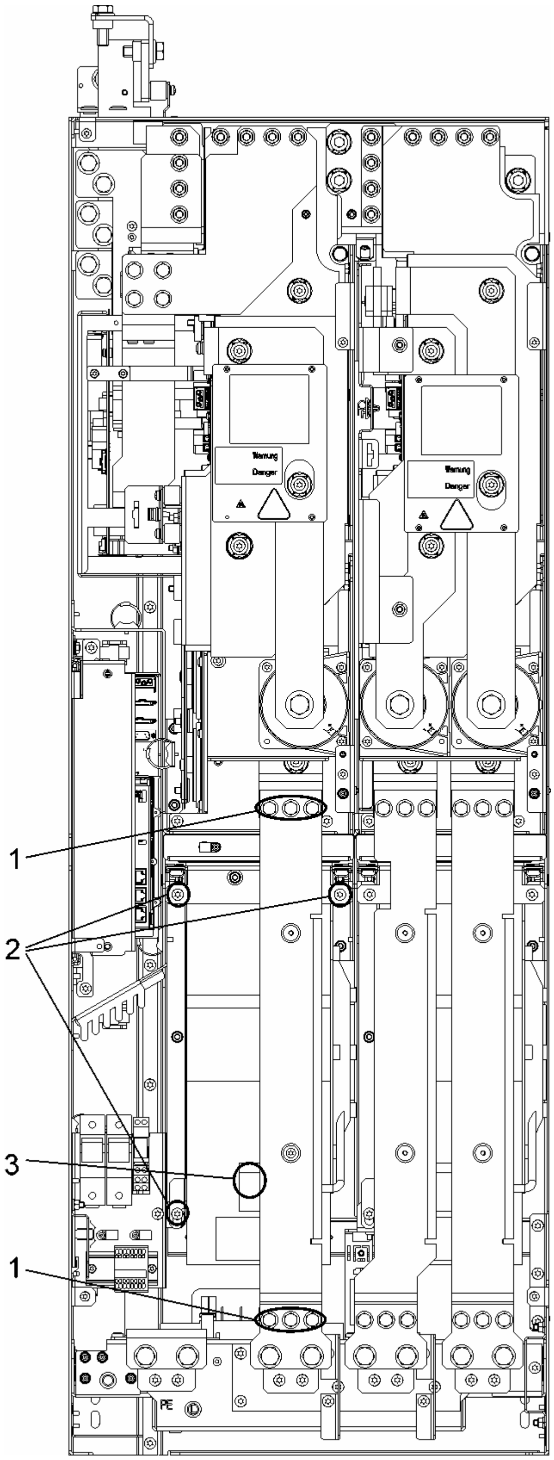


Fig. 11-11 Replacing the fan (type HX) (left-hand power block)

Description

The average service life of the device fans is 50,000 hours. In practice, however, the service life depends on other variables, including ambient temperature and the degree of cabinet protection and, therefore, may deviate from this value.

The fans must be replaced in good time to ensure that the chassis unit is available.

Preparatory steps

- Disconnect the chassis unit from the power supply.
- Allow unimpeded access to the fan.
- Remove the protective cover.

Removal

The steps for the removal procedure are numbered in accordance with Fig. 11-11.

1. Remove the copper bars (6 screws).
2. Remove the retaining screws for the fan (3 screws).
3. Disconnect the supply cables (1 x "L", 1 x "N").

You can now carefully remove the fan.

CAUTION

When removing the fan, ensure that you do not damage any signal cables.

Installation

To re-install the fan, carry out the above steps in reverse order.

CAUTION

The tightening torques specified in Table 11-1 must be observed.

Carefully re-establish the plug connections and ensure that they are secure.

The screwed connections for the protective covers must only be tightened by hand.

Replacing the fan (right-hand power block)

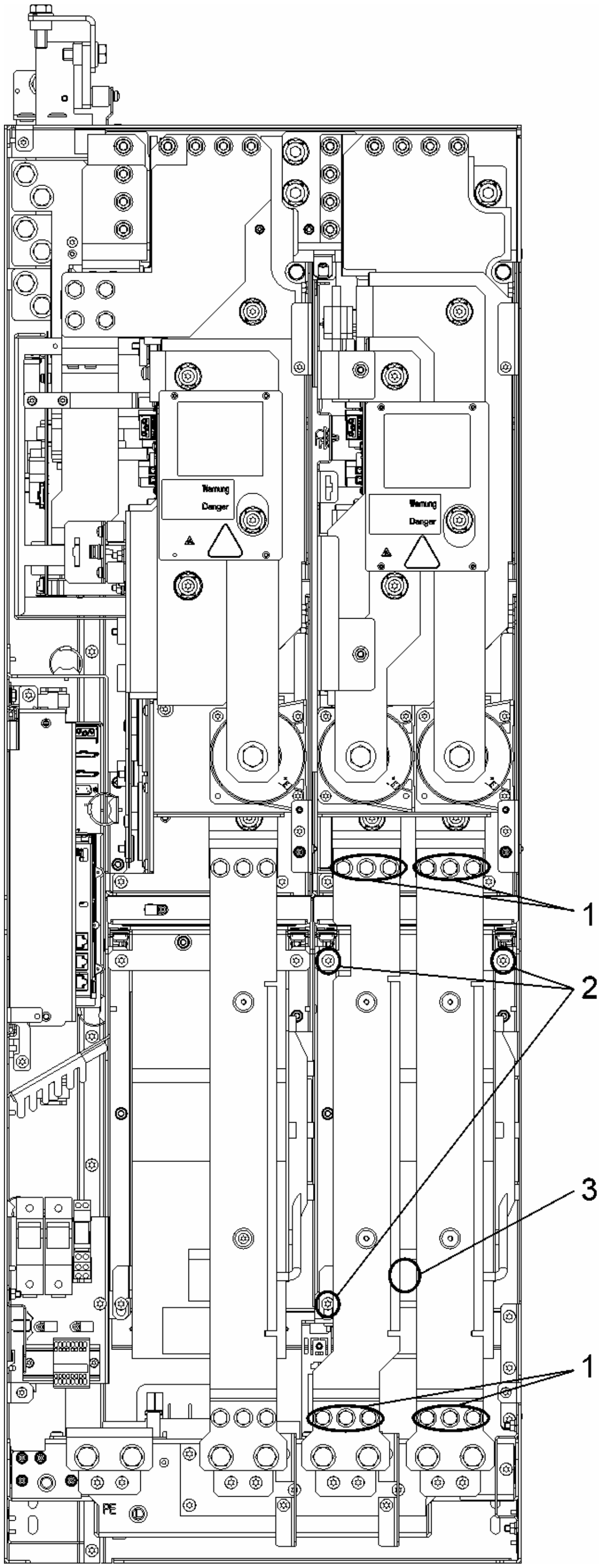


Fig. 11-12 Replacing the fan (type HX) (right-hand power block)

Description

The average service life of the device fans is 50,000 hours. In practice, however, the service life depends on other variables, including ambient temperature and the degree of cabinet protection and, therefore, may deviate from this value.

The fans must be replaced in good time to ensure that the chassis unit is available.

Preparatory steps

- Disconnect the chassis unit from the power supply.
- Allow unimpeded access to the fan.
- Remove the protective cover.

Removal

The steps for the removal procedure are numbered in accordance with Fig. 11-12.

1. Remove the copper bars (12 screws).
2. Remove the retaining screws for the fan (3 screws).
3. Disconnect the supply cables (1 x "L", 1 x "N").

You can now carefully remove the fan.

CAUTION

When removing the fan, ensure that you do not damage any signal cables.

Installation

To re-install the fan, carry out the above steps in reverse order.

CAUTION

The tightening torques specified in Table 11-1 must be observed.

Carefully re-establish the plug connections and ensure that they are secure.

The screwed connections for the protective covers must only be tightened by hand.

11.4.9 Replacing the fan (type JX)

Replacing the fan (left-hand power block)

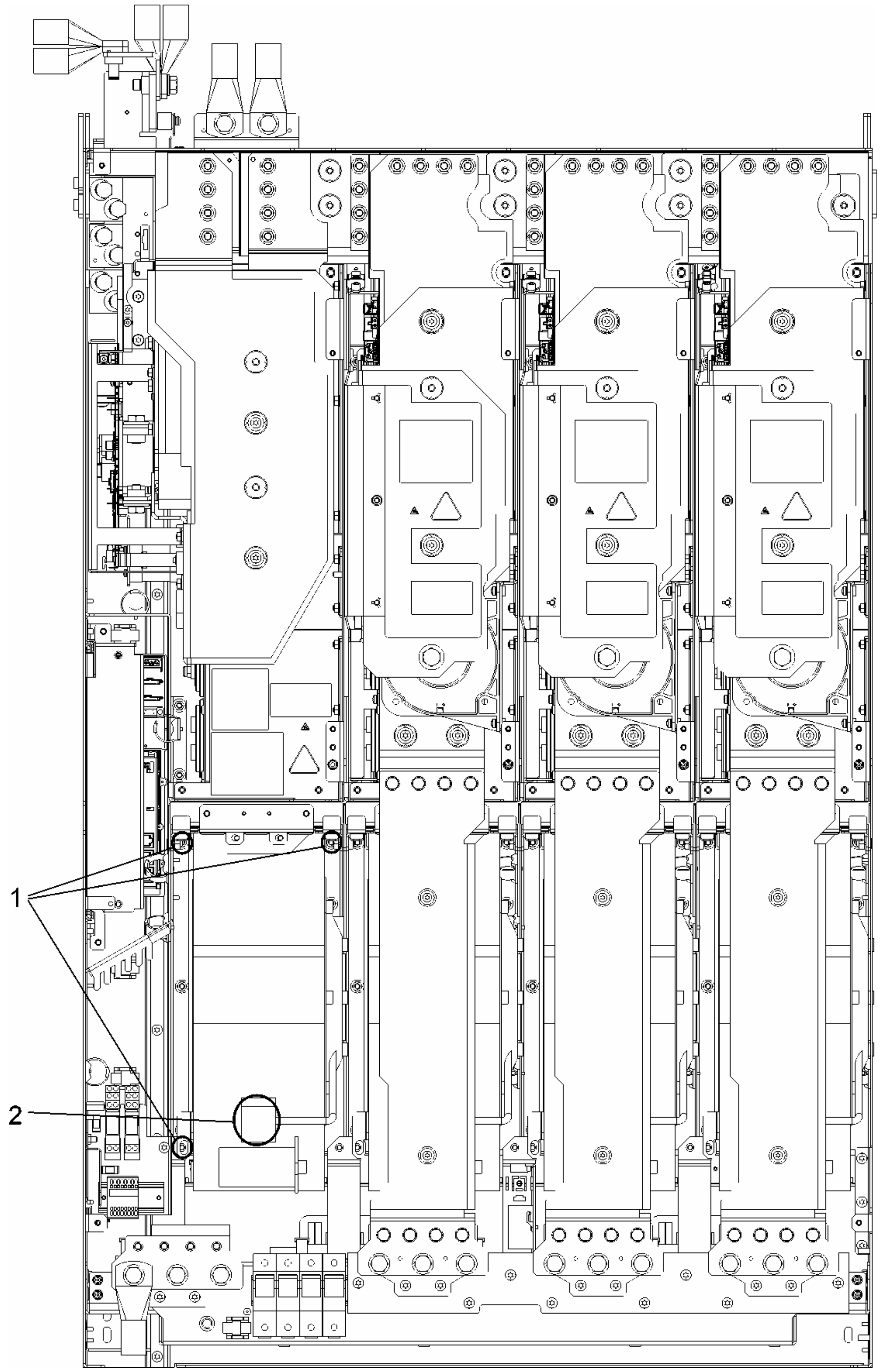


Fig. 11-13 Replacing the fan (type JX) (left-hand power block)

Description

The average service life of the device fans is 50,000 hours. In practice, however, the service life depends on other variables, including ambient temperature and the degree of cabinet protection and, therefore, may deviate from this value.

The fans must be replaced in good time to ensure that the chassis unit is available.

Preparatory steps

- Disconnect the chassis unit from the power supply.
- Allow unimpeded access to the fan.
- Remove the protective cover.

Removal

The steps for the removal procedure are numbered in accordance with Fig. 11-13.

1. Remove the copper bars (6 screws).
2. Remove the retaining screws for the fan (3 screws).
3. Disconnect the supply cables (1 x "L", 1 x "N").

You can now carefully remove the fan.

CAUTION

When removing the fan, ensure that you do not damage any signal cables.

Installation

To re-install the fan, carry out the above steps in reverse order.

CAUTION

The tightening torques specified in Table 11-1 must be observed.

Carefully re-establish the plug connections and ensure that they are secure.

The screwed connections for the protective covers must only be tightened by hand.

Replacing the fan (right-hand power block)

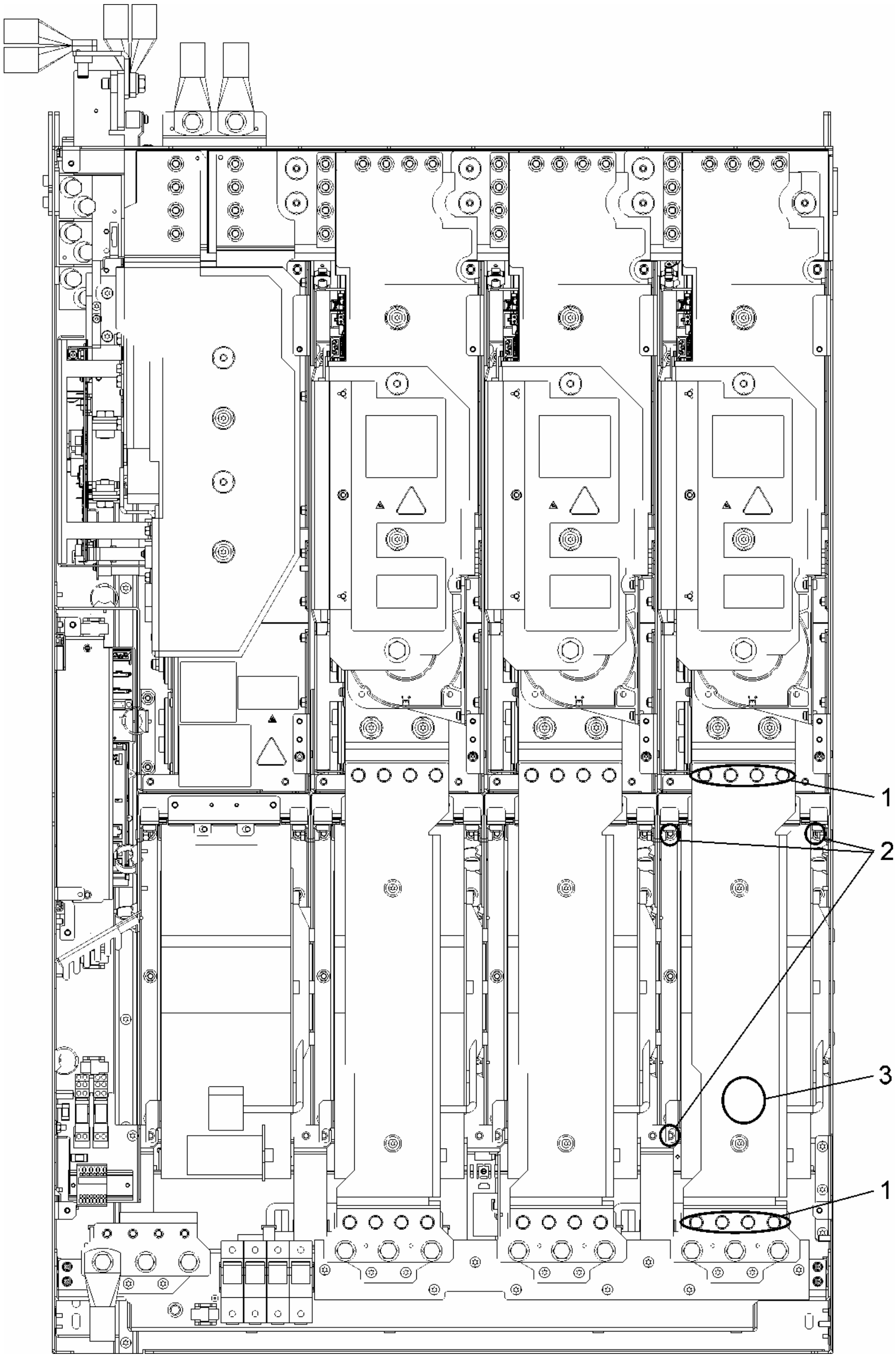


Fig. 11-14 Replacing the fan (type JX) (right-hand power block)

Description

The average service life of the device fans is 50,000 hours. In practice, however, the service life depends on other variables, including ambient temperature and the degree of cabinet protection and, therefore, may deviate from this value.

The fans must be replaced in good time to ensure that the chassis unit is available.

Preparatory steps

- Disconnect the chassis unit from the power supply.
- Allow unimpeded access to the fan.
- Remove the protective cover.

Removal

The steps for the removal procedure are numbered in accordance with Fig. 11-14.

1. Remove the copper bars (8 screws).
2. Remove the retaining screws for the fan (3 screws).
3. Disconnect the supply cables (1 x "L", 1 x "N").

You can now carefully remove the fan.

CAUTION

When removing the fan, ensure that you do not damage any signal cables.

Installation

To re-install the fan, carry out the above steps in reverse order.

CAUTION

The tightening torques specified in Table 11-1 must be observed.

Carefully re-establish the plug connections and ensure that they are secure.

The screwed connections for the protective covers must only be tightened by hand.

11.5 Reforming the DC link capacitors

Description

If the chassis unit is kept in storage for more than 2 years, the DC link capacitors have to be reformed. If this is not carried out, the cabinet may be damaged when the supply voltage is switched on.

If the cabinet is commissioned within two years of its date of manufacture, the DC link capacitors do not need to be reformed. The date of manufacture is indicated in the serial number on the type plate (see "Device Overview").

NOTE

It is important that the period of storage is calculated as of the date of manufacture and not as of the delivery date.

Procedure

The DC link capacitors are reformed by applying the rated voltage without load for at least 30 minutes at room temperature.

- Operation via PROFIBUS:
  - Set bit 3 of control word 1 (operation enable) permanently to "0".
  - Switch on the converter by means of an ON signal (bit 0 of the control word); all the other bits must be set in such a way that the converter can be operated.
  - Once the waiting time has elapsed, switch off the converter and restore the original PROFIBUS setting.
- Operation via terminal block:
  - Set p0852 to "0" (factory setting is "1").
  - Switch on the converter (via digital input 0 on the customer terminal block).
  - Once the waiting time has elapsed, switch off the converter and restore the original setting for p0852.

NOTE

Reforming cannot be carried out in LOCAL mode via the AOP30.

11.6 Messages after replacing DRIVE-CLiQ components

After DRIVE-CLiQ components are replaced (Control Interface Board, TM31, SMCxx) when service is required, generally, after power-up, a message is not output.

The reason for this is that an identical component is detected and accepted as spare part when running-up. If, unexpectedly, a fault message of the "topology fault" category is displayed, then when replacing a component, one of the following faults/errors should have occurred:

- A Control Interface Board with different firmware data was installed.
- When connecting-up DRIVE-CLiQ cables, connections were interchanged.

11.7 Upgrading the chassis unit firmware

When you upgrade the chassis unit firmware (by installing a new CompactFlash Card with a new firmware version, for example), you may also have to upgrade the firmware for the components in the chassis unit.

When you implement new firmware on the CompactFlash card, the firmware for the CU320 is upgraded automatically when you install it and switch it on.

The chassis unit components (Power Module, customer terminal block, and SMC30) are supplied with the firmware by means of the procedure described below.

The firmware versions for the individual components can be read in the following parameters:

- r0128 – Firmware version of the Power Module
- r0148 – Firmware version of the Sensor Module (SMC30)
- r0158 – Firmware version of the customer terminal block (TM31)

NOTE

The power supply to the components must not be interrupted while the firmware is being upgraded.

CAUTION

New firmware should only be installed if there is a problem with the chassis unit.

Problems with the cabinet unit cannot be ruled out after the firmware has been upgraded.

Upgrading the firmware for the chassis unit components via AOP

"Expert" access level	**Setting the "Expert" on the operator panel** <Key pushbutton> - <Access level> - Set "Expert" and confirm
p7828 =	**Select the number of the DRIVE-CLiQ node**
p7829 = 1	**Starting the firmware update** The process takes a few minutes and is successfully complete when p7829 automatically switches to "0".

Select the number of the DRIVE-CLiQ node:

Configuration:	without TM31	with 1 TM31	with 2 TM31
Node	Number	Number	Number
Power Module	2	2	2
TM31	--	3	3
2nd TM31	--	--	4
SMC30	4	5	6

The process must be carried out consecutively for each DRIVE-CLiQ node.

POWER ON	**Switching the power on** To activate the firmware update, switch the device off and then back on.

Fault during update
Fault F1005 (with a fault value) indicates that the firmware update was not successful.

Fig. 11-15 Upgrading the chassis unit firmware

NOTE

Once the firmware has been upgraded, the firmware for the operator panel must also be upgraded.

■

Technical specifications 12

12.1 Chapter content

This chapter provides information on the following:

- General and specific technical data for the SINAMICS G130 chassis units
- Information on restrictions that apply when the chassis units are used in unfavorable ambient conditions (derating)

12.2 General data

Table 12-1 General technical data

Electrical data			
Line frequency	47 Hz to 63 Hz		
Output frequency	0 Hz to 300 Hz		
Power factor Fundamental mode Total	 ≥ 0.98 0.93 to 0.96		
Converter efficiency	> 98 %		
Switching at input	Once every 3 minutes		
Mechanical data			
Degree of protection	IP20 (type GX) IP00 (types HX and JX)		
Cooling method	Forced air cooling		
Sound pressure level	≤ 73 dB(A) at 50 Hz line frequency ≤ 75 dB(A) at 60 Hz line frequency		
Shock-hazard protection	BGV A 3		
Compliance with standards			
Standards	EN 60 146-1, EN 61 800-2, EN 61 800-3, EN 50 178, EN 60 204-1, EN 60 529		
CE marking	According to EMC directive No. 89/336/EC and low voltage directive No. 73/23/EC		
Approval	cULus (File No.: E192450) (only up to 3 AC 600 V)		
RI suppression	In accordance with EMC product standard for variable-speed drives (EN 61 800-3); category C3 (category C2 on request) [1)]		
Ambient conditions			
	Operation	Storage	Transport
Ambient temperature	0 °C to +40 °C Up to + 50 °C with derating	-25 °C to +55 °C	-25 °C to +70 °C Above –40 °C for 24 hours
Humidity range (non-condensing) Corresponds to class	5 % to 95 % 3K3 to IEC 60 721-3-3	5 % to 95 % 1K4 to IEC 60 721-3-1	5 % to 95 % at 40 °C 2K3 to IEC 60 721-3-2
Site altitude	Up to 2000 m above sea level without derating, > 2000 m above sea level with derating, see Section 12.2.1		
Mechanical stability			
Vibratory load: Deflection Acceleration	 0.075 mm at 10 Hz - 58 Hz 10 m/s² at > 58 Hz - 200 Hz	 1.5 mm at 5 Hz - 9 Hz 5 m/s² at > 9 Hz - 200 Hz	 3.1 mm at 5 Hz - 9 Hz 10 m/s² at > 9 Hz - 200 Hz
Shock load: Acceleration	 100 m/s² at 11 ms	 40 m/s² at 22 ms	 100 m/s² at 11 ms

[1)] applies to cable lengths up to 100 m.

12.2.1 Derating data

Current derating as a function of the site altitude and ambient temperature

If the SINAMICS G130 components are operated at a site altitude >2000 m above sea level, the maximum permissible output current can be calculated using the following tables. The site altitude and ambient temperature are compensated here.

Table 12-2 Current derating as a function of the ambient temperature and site altitude

Site altitude above sea level in m	Ambient temperature in °C						
	20	25	30	35	40	45	50
0 to 2000						95.0%	87.0%
Up to 2500		100%			96.3%	91.4%	83.7%
Up to 3000				96.2%	92.5%	87.9%	80.5%
Up to 3500			96.7%	92.3%	88.8%	84.3%	77.3%
Up to 4000		97.8%	92.7%	88.4%	85.0%	80.8%	74.0%

Voltage derating as a function of the site altitude

In addition to current derating, voltage derating must also be considered at site altitudes >2000 m above sea level.

Table 12-3 Voltage derating as a function of the site altitude (380 V – 480 V 3 AC)

Site altitude above sea level in m	Power Module rated voltage					
	380 V	400 V	420 V	440 V	460 V	480 V
0 to 2000						
Up to 2250						96%
Up to 2500					98%	94%
Up to 2750		100%		98%	94%	90%
Up to 3000				95%	91%	88%
Up to 3250			97%	93%	89%	85%
Up to 3500		98%	93%	89%	85%	82%
Up to 3750		95%	91%	87%	83%	79%
Up to 4000	96%	92%	87%	83%	80%	76%

Table 12-4 Voltage derating as a function of the site altitude (500 V – 600 V 3 AC)

Site altitude above sea level in m	Power Module rated voltage				
	500 V	525 V	550 V	575 V	600 V
0 to 2000	100%	100%	100%	100%	100%
Up to 2250	100%	100%	100%	100%	97%
Up to 2500	100%	100%	100%	98%	94%
Up to 2750	100%	100%	99%	95%	91%
Up to 3000	100%	100%	96%	92%	88%
Up to 3250	100%	98%	93%	89%	85%
Up to 3500	99%	94%	90%	86%	83%
Up to 3750	96%	91%	87%	83%	80%
Up to 4000	92%	88%	84%	80%	77%

Table 12-5 Voltage derating as a function of the site altitude (660 V – 690 V 3 AC)

Site altitude above sea level in m	Power Module rated voltage	
	660 V	690 V
0 to 2000	100%	100%
Up to 2250	100%	96%
Up to 2500	98%	94%
Up to 2750	95%	90%
Up to 3000	92%	88%
Up to 3250	89%	85%
Up to 3500	85%	82%
Up to 3750	-	-
Up to 4000	-	-

Current derating as a function of the pulse frequency

When the pulse frequency is increased, the derating factor of the output current must be taken into account. This derating factor must be applied to the currents specified in the technical specifications in 12.3.1.

Table 12-6 Derating factor of the output current as a function of the pulse frequency

Order no. 6SL3310-...	Power [kW]	Output current at 1.25 kHz [A]	Derating factor at 2.5 kHz	Derating factor at 5 kHz
Supply voltage: 380 – 480 V 3 AC				
1GE36-1AA0	315	605	72 %	60 %
1GE37-5AA0	400	745	72 %	60 %
1GE38-4AA0	450	840	79 %	60 %
1GE41-0AA0	560	985	87 %	60 %
Supply voltage: 500 – 600 V 3 AC				
1GF34-7AA0	315	465	87 %	55 %
1GF35-8AA0	400	575	85 %	55 %
1GF37-4AA0	500	735	79 %	55 %
1GF38-1AA0	560	810	72 %	55 %
Supply voltage: 660 – 690 V 3 AC				
1GH33-3AA0	315	330	82 %	55 %
1GH34-1AA0	400	410	82 %	55 %
1GH34-7AA0	450	465	87 %	55 %
1GH35-8AA0	560	575	85 %	55 %
1GH37-4AA0	710	735	79 %	55 %
1GH38-1AA0	800	810	72 %	55 %

For pulse frequencies in the range between the fixed values, the relevant derating factors can be determined by linear interpolation.

The following formula applies for this: $Y_2 = Y_0 + \frac{Y_1 - Y_0}{X_1 - X_0}(X_2 - X_0)$

Example:
The derating factor is sought for when X_2 = 2 kHz für 6SL3310-1GE41-0AA0.

X_0 = 1.25 kHz, Y_0 = 100 %, X_1 = 2.5 kHz, Y_1 = 87 %, X_2 = 2 kHz, Y_2 = ??

$$Y_2 = 100\,\% + \frac{87\,\% - 100\,\%}{2.5\,\text{kHz} - 1.25\,\text{kHz}}(2\,\text{kHz} - 1.25\,\text{kHz}) =$$

$$100\,\% + \frac{-13\,\%}{1.25\,\text{kHz}}(0.75\,\text{kHz}) = 100\,\% - 7.8\,\% = \underline{\underline{92.2\,\%}}$$

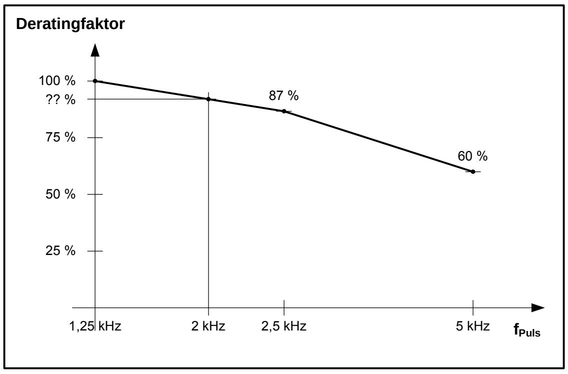


Fig. 12-1 Calculation of derating factors using linear interpolation

12.2.2 Overload capacity

The converter chassis units are equipped with an overload reserve to deal with breakaway torques, for example.

In drives with overload requirements, the appropriate base load current must, therefore, be used as a basis for the required load.

The criterion for overload is that the drive is operated with its base load current before and after the overload occurs (a load duration of 300 s is used as a basis here).

Low overload

The base load current for low overload (I_L) is based on a load duty cycle of 110% for 60 s or 150% for 10 s.

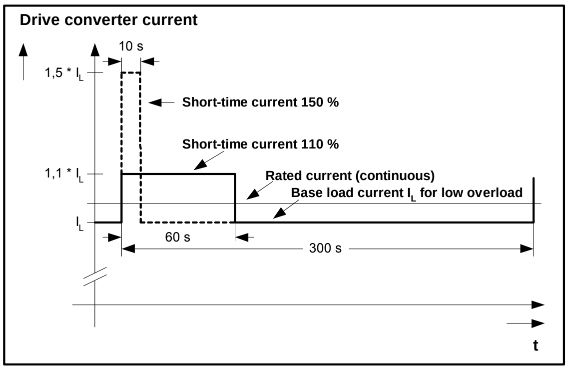


Fig. 12-2 Low overload

High overload

The base load current for a high overload (I_H) is based on a duty cycle of 150% for 60 s or 160% for 10 s.

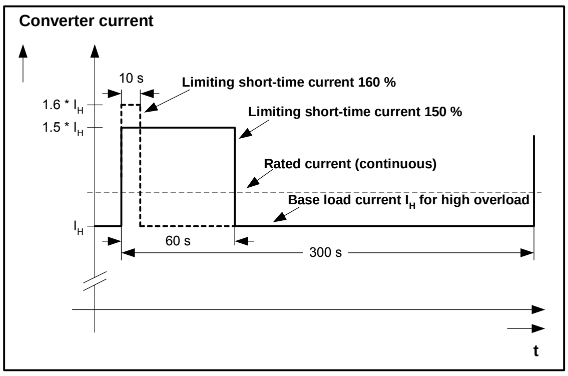


Fig. 12-3 High overload

12.3 Technical data

NOTE

The current, voltage, and output values specified in the following tables are rated values.
The cables to the cabinet unit are protected with fuses with gL characteristic.
The connection cross-sections are calculated for three-core copper cables installed horizontally in free air at an ambient temperature of 30 °C (86 °F) (in accordance with DIN VDE 0298 Part 2 / Group 5) and the recommended line protection in accordance with DIN VDE 0100 Part 430.
AWG (American Wire Gauge for cross-sections < 120 mm²); MCM (Mille Circular Mil): American wire gauge for cross-sections > 120 mm².

12.3.1 Power Module

Power Module, 380 V – 480 V

Table 12-7 Power Module, 380 V – 480 V 3AC, Part 1

Category	Unit			
Order no.: **6SL3310-**		**1GE36-1AA0**	**1GE37-5AA0**	**1GE38-4AA0**
Rated motor output At 400 V, 50 Hz At 460 V, 60 Hz	 kW hp	 315 500	 400 600	 450 700
Rated input voltage	V	380 V 3 AC to 480 V ±10 % (-15 % < 1 min)		
Rated input current	A	629	775	873
Rated output current	A	605	745	840
Base load current I_L [1)]	A	590	725	820
Base load current I_H [2)]	A	460	570	700
Max. output frequency [3)]	Hz	100	100	100
Power loss	kW	7.8	9.1	9.6
Max. Current requirements (at 24 V DC)	A	1	1	1
Cooling air requirement	m³/s	0.78	0.78	0.78
Sound pressure level at 50/60 Hz	dB(A)	70/73	70/73	70/73
Line connection Maximum: DIN VDE AWG / MCM Fastening screw	 mm² 	 4 x 240 4 x (600) M12	 4 x 240 4 x (600) M12	 4 x 240 4 x (600) M12
Motor connection Maximum: DIN VDE AWG / MCM Fastening screw	 mm² 	 4 x 240 4 x (600) M12	 4 x 240 4 x (600) M12	 4 x 240 4 x (600) M12
PE conductor connection Fastening screw Maximum PE1 / GND Maximum PE2 / GND 	 mm² mm² 	 M12 2 x 240 2 x (600) 4 x 240 4 x (600)	 M12 2 x 240 2 x (600) 4 x 240 4 x (600)	 M12 2 x 240 2 x (600) 4 x 240 4 x (600)
Type		HX	HX	HX
Approx. weight	kg	294	294	294
Dimensions (W x H x D)	mm	503 x 1506 x 540	503 x 1506 x 540	503 x 1506 x 540
Recommended protection Conductor protection w/o semi-cond. protection Rated current Size to DIN 43 620-1 Cond./semi-cond. protection Rated current Size to DIN 43 620-1	 A A 	 3NA3475 800 4 3NE1438-2 800 3	 3NA3475 800 4 3NE1448-2 850 3	 Circuit-breaker --- --- Circuit-breaker --- ---

1) The base load current (I_L) is based on a duty cycle of 110% for 60 s or 150% for 10 s with a duty cycle duration of 300 s (see Section 12.2.2).

2) The base load current (I_H) is based on a duty cycle of 150% for 60 s or 160% for 10 s with a duty cycle duration of 300 s (see Section 12.2.2).

3) Maximum output frequency with default pulse frequency (for information on increasing the output frequency, see 9.2.7; for derating data, see Section 12.2.1).

Table 12-8 Power Module, 380 V – 480 V 3AC, Part 2

Category	Unit			
Order no.: **6SL3310-**		**1GE41-0AA0**		
Rated motor output At 400 V, 50 Hz At 460 V, 60 Hz	 kW hp	 560 800		
Rated input voltage	V	380 V 3 AC to 480 V ±10 % (-15 % < 1 min)		
Rated input current	A	1024		
Rated output current	A	985		
Base load current I_L [1)]	A	960		
Base load current I_H [2)]	A	860		
Max. output frequency [3)]	Hz	100		
Power loss	kW	13.8		
Max. Current requirements (at 24 V DC)	A	1.25		
Cooling air requirement	m³/s	1.48		
Sound pressure level at 50/60 Hz	dB(A)	72/75		
Line connection Maximum: DIN VDE AWG / MCM Fastening screw	 mm^2 	 6 x 240 6 x (600) M12		
Motor connection Maximum: DIN VDE AWG / MCM Fastening screw	 mm^2 	 6 x 240 6 x (600) M12		
PE conductor connection Fastening screw Maximum PE1 / GND Maximum PE2 / GND	 mm² mm²	 M12 4 x 240 4 x (600) 6 x 240 6 x (600)		
Type		JX		
Approx. weight	kg	530		
Dimensions (W x H x D)	mm	908.5 x 1510 x 540		
Recommended protection Conductor protection w/o semi-cond. protection Rated current Size to DIN 43 620-1 Cond./semi-cond. protection Rated current Size to DIN 43 620-1	 A A 	 Circuit-breaker --- --- Circuit-breaker --- ---		

1) The base load current (I_L) is based on a duty cycle of 110% for 60 s or 150% for 10 s with a duty cycle duration of 300 s (see Section 12.2.2).

2) The base load current (I_H) is based on a duty cycle of 150% for 60 s or 160% for 10 s with a duty cycle duration of 300 s (see Section 12.2.2).

3) Maximum output frequency with default pulse frequency (for information on increasing the output frequency, see 9.2.7; for derating data, see Section 12.2.1).

Power Module, 500 V – 600 V

Table 12-9 Power Module, 500 V – 600 V 3AC, Part 1

Category	Unit			
Order no.: **6SL3310-**		**1GF34-7AA0**	**1GF35-8AA0**	**1GF37-4AA0**
Rated motor output	kW	315	400	500
Rated input voltage	V	500 V 3 AC to 600 V ±10 % (-15 % < 1 min)		
Rated input current	A	483	598	764
Rated output current	A	465	575	735
Base load current I_L [1)]	A	452	560	710
Base load current I_H [2)]	A	416	514	657
Max. output frequency [3)]	Hz	100	100	100
Power loss	kW	7.3	8.1	12.0
Max. Current requirements (at 24 V DC)	A	1	1	1.25
Cooling air requirement	m³/s	0.78	0.78	1.48
Sound pressure level at 50/60 Hz	dB(A)	70/73	70/73	73/75
Line connection Maximum: DIN VDE AWG / MCM Fastening screw	mm²	4 x 240 4 x (600) M12	4 x 240 4 x (600) M12	6 x 240 6 x (600) M12
Motor connection Maximum: DIN VDE AWG / MCM Fastening screw	mm²	4 x 240 4 x (600) M12	4 x 240 4 x (600) M12	6 x 240 6 x (600) M12
PE conductor connection Fastening screw		M12	M12	M12
Maximum PE1 / GND	mm²	2 x 240 2 x (600)	2 x 240 2 x (600)	4 x 240 4 x (600)
Maximum PE2 / GND	mm²	4 x 240 4 x (600)	4 x 240 4 x (600)	6 x 240 6 x (600)
Type		HX	HX	JX
Approx. weight	kg	294	294	530
Dimensions (W x H x D)	mm	503 x 1506 x 540	503 x 1506 x 540	908.5 x 1510 x 540
Recommended protection Conductor protection w/o semi-cond. protection Rated current Size to DIN 43 620-1	A	3NA3252-6 2 x 315 3	3NA3354-6 2 x 355 3	3NA3365-6 2 x 500 3
Cond./semi-cond. protection Rated current Size to DIN 43 620-1	A	3NE1435-2 560 3	3NE1447-2 670 3	3NE1448-2 850 3

1) The base load current (I_L) is based on a duty cycle of 110% for 60 s or 150% for 10 s with a duty cycle duration of 300 s (see Section 12.2.2).

2) The base load current (I_H) is based on a duty cycle of 150% for 60 s or 160% for 10 s with a duty cycle duration of 300 s (see Section 12.2.2).

3) Maximum output frequency with default pulse frequency (for information on increasing the output frequency, see 9.2.7; for derating data, see Section 12.2.1).

Table 12-10 Power Module, 500 V – 600 V 3AC, Part 2

Category	Unit			
Order no.: **6SL3310-**		**1GF38-1AA0**		
Rated motor output	kW	560		
Rated input voltage	V	500 V 3 AC to 600 V ±10 % (-15 % < 1 min)		
Rated input current	A	852		
Rated output current	A	810		
Base load current I_L [1]	A	790		
Base load current I_H [2]	A	724		
Max. output frequency [3]	Hz	100		
Power loss	kW	13.3		
Max. Current requirements (at 24 V DC)	A	1.25		
Cooling air requirement	m³/s	1.48		
Sound pressure level at 50/60 Hz	dB(A)	73/75		
Line connection Maximum: DIN VDE AWG / MCM Fastening screw	 mm² 	 6 x 240 6 x (600) M12		
Motor connection Maximum: DIN VDE AWG / MCM Fastening screw	 mm² 	 6 x 240 6 x (600) M12		
PE conductor connection Fastening screw Maximum PE1 / GND Maximum PE2 / GND 	 mm² mm² 	 M12 4 x 240 4 x (600) 6 x 240 6 x (600)		
Type		JX		
Approx. weight	kg	530		
Dimensions (W x H x D)	mm	908.5 x 1510 x 540		
Recommended protection Conductor protection w/o semi-cond. protection Rated current Size to DIN 43 620-1 Cond./semi-cond. protection Rated current Size to DIN 43 620-1	 A A 	 Circuit-breaker --- --- Circuit-breaker --- ---		

1) The base load current (I_L) is based on a duty cycle of 110% for 60 s or 150% for 10 s with a duty cycle duration of 300 s (see Section 12.2.2).

2) The base load current (I_H) is based on a duty cycle of 150% for 60 s or 160% for 10 s with a duty cycle duration of 300 s (see Section 12.2.2).

3) Maximum output frequency with default pulse frequency (for information on increasing the output frequency, see 9.2.7; for derating data, see Section 12.2.1).

Power Module, 660 V – 690 V 3AC

Table 12-11 Power Module, 660 V – 690 V 3AC, Part 1

Category	Unit			
Order no.: **6SL3310-**		**1GH33-3AA0**	**1GH34-1AA0**	**1GH34-7AA0**
Rated motor output	kW	315	400	450
Rated input voltage	V	660 V 3 AC to 690 V ±10 % (-15 % < 1 min)		
Rated input current	A	343	426	483
Rated output current	A	330	410	465
Base load current I_L [1)]	A	320	400	452
Base load current I_H [2)]	A	280	367	416
Max. output frequency [3)]	Hz	100	100	100
Power loss	kW	5.8	7.5	8.5
Max. Current requirements (at 24 V DC)	A	0.9	1	1
Cooling air requirement	m³/s	0.36	0.78	0.78
Sound pressure level at 50/60 Hz	dB(A)	69/73	70/73	70/73
Line connection Maximum: DIN VDE AWG / MCM Fastening screw	 mm^2	 2 x 240 2 x (600) M10	 4 x 240 4 x (600) M12	 4 x 240 4 x (600) M12
Motor connection Maximum: DIN VDE AWG / MCM Fastening screw	 mm^2	 2 x 240 2 x (600) M10	 4 x 240 4 x (600) M12	 4 x 240 4 x (600) M12
PE conductor connection Fastening screw Maximum PE1 / GND Maximum PE2 / GND	 mm² mm²	 M10 2 x 240 2 x (600) 2 x 240 2 x (600)	 M12 2 x 240 2 x (600) 4 x 240 4 x (600)	 M12 2 x 240 2 x (600) 4 x 240 4 x (600)
Type		GX	HX	HX
Approx. weight	kg	162	294	294
Dimensions (W x H x D)	mm	326 x 1533 x 545	503 x 1506 x 540	503 x 1506 x 540
Recommended protection Conductor protection w/o semi-cond. protection Rated current Size to DIN 43 620-1 Cond./semi-cond. protection Rated current Size to DIN 43 620-1	 A A	 3NA3365-6 500 3 3NE1334-2 500 2	 3NA3365-6 500 3 3NE1334-2 500 2	 3NA3252-6 2 x 315 3 3NE1435-2 560 3

1) The base load current (I_L) is based on a duty cycle of 110% for 60 s or 150% for 10 s with a duty cycle duration of 300 s (see Section 12.2.2).

2) The base load current (I_H) is based on a duty cycle of 150% for 60 s or 160% for 10 s with a duty cycle duration of 300 s (see Section 12.2.2).

3) Maximum output frequency with default pulse frequency (for information on increasing the output frequency, see 9.2.7; for derating data, see Section 12.2.1).

Table 12-12 Power Module, 660 V – 690 V 3AC, Part 2

Category	Unit			
Order no.: **6SL3310-**		**1GH35-8AA0**	**1GH37-4AA0**	**1GH38-1AA0**
Rated motor output	kW	560	710	800
Rated input voltage	V	660 V 3 AC to 690 V ±10 % (-15 % < 1 min)		
Rated input current	A	598	764	852
Rated output current	A	575	735	810
Base load current I_L [1]	A	560	710	790
Base load current I_H [2]	A	514	657	724
Max. output frequency [3]	Hz	100	100	100
Power loss	kW	10.3	12.8	13.9
Max. Current requirements (at 24 V DC)	A	1	1.25	1.25
Cooling air requirement	m³/s	0.78	1.48	1.48
Sound pressure level at 50/60 Hz	dB(A)	70/73	73/75	73/75
Line connection				
Maximum: DIN VDE AWG / MCM	mm^2	4 x 240 4 x (600)	6 x 240 6 x (600)	6 x 240 6 x (600)
Fastening screw		M12	M12	M12
Motor connection				
Maximum: DIN VDE AWG / MCM	mm^2	4 x 240 4 x (600)	6 x 240 6 x (600)	6 x 240 6 x (600)
Fastening screw		M12	M12	M12
PE conductor connection				
Fastening screw		M12	M12	M12
Maximum PE1 / GND	mm²	2 x 240 2 x (600)	4 x 240 4 x (600)	4 x 240 4 x (600)
Maximum PE2 / GND	mm²	4 x 240 4 x (600)	6 x 240 6 x (600)	6 x 240 6 x (600)
Type		HX	JX	JX
Approx. weight	kg	294	530	530
Dimensions (W x H x D)	mm	503 x 1506 x 540	908.5 x 1510 x 540	908.5 x 1510 x 540
Recommended protection				
Conductor protection w/o semi-cond. protection Rated current Size to DIN 43 620-1	 A 	 3NA3354-6 2 x 355 3	 3NA3365-6 2 x 500 3	 Circuit-breaker --- ---
Cond./semi-cond. protection Rated current Size to DIN 43 620-1	 A 	3NE1447-2 670 3	3NE1448-2 850 3	Circuit-breaker --- ---

1) The base load current (I_L) is based on a duty cycle of 110% for 60 s or 150% for 10 s with a duty cycle duration of 300 s (see Section 12.2.2).

2) The base load current (I_H) is based on a duty cycle of 150% for 60 s or 160% for 10 s with a duty cycle duration of 300 s (see Section 12.2.2).

3) Maximum output frequency with default pulse frequency (for information on increasing the output frequency, see 9.2.7; for derating data, see Section 12.2.1).

12.3.2 Control Unit CU320

Table 12-13 CU320

Max. current requirements (at 24 V DC) (not taking into account digital outputs, option slot extension)	0.8 A
Max. connectable cross-section	2.5 mm^2
Digital inputs	8 floating digital inputs 8 bidirectional, non-floating digital inputs/outputs
Voltage	-3 V to 30 V
Low level (an open digital input is interpreted as "low")	-3 V to 5 V
High level	15 V to 30 V
Current consumption (at 24 V DC)	10 mA
Max. connectable cross-section	0.5 mm^2
Digital outputs (continued-short-circuit-proof)	8 bidirectional, non-floating digital outputs/inputs
Voltage	24 V DC
Max. load current per digital output	500 mA
Max. connectable cross-section	0.5 mm^2
Power loss	20 W
PE connection	On housing with M5 screw
Ground connection	On housing with M5 screw
Width	50 mm
Height	270 mm
Depth	226 mm
Weight, approx.	1.5 kg

12.3.3 TM31 Terminal Module

Table 12-14 Technical specifications for TM31

Max. current requirements (at 24 V DC), not taking into account digital outputs	0.5 A
Max. connectable cross-section	2.5 mm^2
Digital inputs	
Voltage Low level (an open digital input is interpreted as "low") High level Current consumption (at 24 V DC) Signal propagation times of the digital inputs Max. connectable cross-section	-3 V to 30 V -3 V to 5 V 15 V to 30 V 10 mA L → H: 50 µs H → L: 100 µs 1.5 mm^2
Digital outputs (continued-short-circuit-proof)	
Voltage Max. load current per digital output Max. connectable cross-section	24 V DC External/internal 24 V supply 100 mA / 20 mA 1.5 mm^2
Analog inputs (switching between the voltage and current input via the switch)	
As voltage input - Voltage range - Internal resistance R_i As current input - Current range - Internal resistance R_i - Resolution Max. connectable cross-section	 -10 V to 10 V 70 kΩ 4 mA to 20 mA/-20 mA to 20 mA/ 0 mA to 20 mA 250 Ω 12 bits 1.5 mm^2
Analog outputs (continued-short-circuit-proof)	
Voltage range Max. load current Current range Max. load resistance Resolution Max. connectable cross-section	-10 V to 10 V -3 mA to 3 mA 4 mA to 20 mA, -20 mA to 20 mA, 0 mA to 20 mA 500 Ω for outputs in the range -20 mA to 20 mA 12 bits 1.5 mm^2
Relay outputs (two-way contacts)	
Max. load current Max. switching voltage Max. switching capacity (at 250 V AC) Max. switching capacity (at 30 V DC) Required minimum current Max. connectable cross-section	8 A 250 V AC, 30 V DC 2000 VA 240 W (ohmic load) 100 mA 2.5 mm^2
Power loss	< 10 W
PE connection	On housing with M4 screw
Width	50 mm
Height	150 mm
Depth	119 mm
Weight, approx.	0.87 kg

12.3.4 SMC30 Sensor Module

Table 12-15 Technical specifications for the SMC30

Electronics power supply Voltage Current	 24 V DC (20.4 – 28.8) Max. 0.6
Max. ambient temperature up to an altitude of 2000 m	55 °C
Note: As of an altitude of 2000 m, the max. ambient temperature decreases by 7°C every 1000 m.	
PE/ground connection	On housing with M4/1.8 Nm screw
Weight	0.8 kg

■

List of abbreviations

A...	Alarm
AC	Alternating Current
AD, ADC	Analog-Digital Converter
ADR	Address
AI	Analog Input
AO	Analog Output
AOP	Advanced Operator Panel (with plain-text display)
BERO	Company name for a proximity switch
BI	Binector Input
BICO	Binector / Connector
BO	Binector Output
C	Capacitance
CAN	Serial bus system
CB	Communication Board
CDS	Command Data Set
CI	Connector Input
CMD	Command
COM	Mid-position of a changeover contact
CPU	Central Processing Unit
CT	Constant Torque
CTW	PROFIBUS control word
CU	Control Unit
DA, DAC	Digital-Analog Converter
DC	Direct Current
DCL	DC Link
DDS	Drive Data Set
DI	Digital Input
DI/DO	Bidirectional Digital Input/Output
DO	Digital Output
EMC	Electromagnetic Compatibility
EN	European standard
ESD	Electrostatic-Sensitive Device
F ...	Fault
FAQ	Frequently Asked Questions
Float	Floating point number
FW	Firmware
HW	Hardware
I/O	Input/Output
IEC	International Electrotechnical Commission

IGBT	Insulated Gate Bipolar Transistor
JOG	Jog
L	Inductance
LED	Light-Emitting Diode
M	Ground
MB	Megabyte
MDS	Motor data record
MLFB	Machine-readable product designation
NC	Normally-closed contact
NEMA	National Electrical Manufacturers Association (standards committee in the USA)
NO	Normally open contact
OEM	Original Equipment Manufacturer
p ...	Adjustable parameter
PDS	Power Module data set
PE	Protective Earth
PLC	Programmable Logic Controller
PROFIBUS	Serial data bus
PTC	Positive Temperature Coefficient
PZD	PROFIBUS process data
r ...	Visualization parameter (read only)
RAM	Read / write storage medium
RCCB	Residual-Current Circuit-Breaker
RFG	Ramp-Function Generator
RS232	Serial interface
RS485	Standard that describes the physical characteristics of a digital serial interface
S1	Continuous operation
S3	Intermittent operation
SH	Safe standstill
SI	Safety Integrated
STW	PROFIBUS status word
SW	Software
TIA	Totally Integrated Automation
TM	Terminal Module
UL	Underwriters Laboratories Inc.
Vdc	DC link voltage
VDE	Verband Deutscher Elektrotechniker (Union of German Technical Engineers)
VDI	Verein Deutscher Ingenieure (Union of German Engineers)
VT	Variable Torque

Index

A
Analog inputs....................................... 6-28
Analog Inputs....................................... 4-31
Analog inputs, TM31 6-28
Analog Outputs..................................... 4-32
Analog Outputs, TM31 8-2
AOP
  Initial Commissioning 5-36
AOP30 5-33
  First Commissioning 5-34
Applications 2-4
Automatic restart 9-13
Automatic speed controller optimization 9-3
Auxiliary Supply.................................... 4-15
Auxiliary Voltage................................... 4-32
B
Basic commissioning
  entering the basic parameters 5-40
  Entering the encoder data 5-38
Basic Commissioning
  Entering Motor Data.......................... 5-37
  Motor Identification 5-41
  Selecting the Motor Type.................. 5-37
Basic information
  BICO technology............................... 6-15
  binector input (BI) 6-15
  binector output (BO) 6-15
  command data set (CDS) 6-9
  connector input (CI) 6-16
  connector output (CO) 6-16
  copying a motor data set (MDS)....... 6-13
  copying the command data set
    (CDS) 6-13
  copying the drive data set (DDS)...... 6-13
  data sets 6-8
  DDS 6-10
  drive objects.. 6-6
  encoder data set (EDS) 6-11
  interconnecting signals 6-16
  parameter categories 6-4
  parameter types.................................. 6-3
  parameters.. 6-3
Basic Information
  Motor Data Set (MDS) 6-12
Basic information about the drive system6-3
BICO technology 6-15
  interconnecting signals 6-16
Binector input (BI)................................. 6-15
Binector output (BO)............................. 6-15
Block protection.................................... 9-50
Bypass function 9-34
Bypass with synchronizer with
  degree of overlapping 9-35
Bypass with synchronizer without
  degree of overlapping 9-38
Bypass without synchronizer 9-39
C
Cabling Diagram
  DRIVE-CLiQ Connections.................4-16
CDS
  copying 6-13
CDS (command data set) 6-9
Certificate of Compliance with Order......1-2
Certification 1-2
Cleaning 11-2
Closed-loop torque control....................7-32
Command data set.................................6-9
Command sources...............................6-20
  CU Terminals 6-24
  general information..............................6-2
  Profidrive 6-20
  Profidrive+TM31 6-26
  TM31 Terminals 6-22
CompactFlash card..............................3-11
CompactFlash Card
  Slot 4-25
Connection Cross-Sections 4-11
Connector input (CI).............................6-16
Connector output (CO) 6-16
Control Interface Board
  type GX, replace..............................11-16
  type HX, replace..............................11-18
  type JX, replace..............................11-20
Control unit CU320 3-10
Control Unit CU320...............................4-19
Control via PROFIBUS 6-32
Control word 1..............................6-36, 6-37
CU320 4-19
D
Data sets 6-8
Date of Manufacture 2-6
DCNS 4-13
DCPS 4-13
DCPS, DCNS – connection
  for a du/dt filter 4-13
DDS
  copying 6-13
DDS (drive data set) 6-10
Definitions, Safety 1-1
Derating 12-3
Derating data 12-3

Current derating as a function of
the pulse frequency 12-5
Device Overview..................................... 2-1
Devices, Electrostatic Sensitive 1-4
Diagnosis... 10-2
LEDs 10-2
Parameters 10-6
Digital Inputs................................ 4-30, 4-31
Digital inputs/outputs 4-20, 4-21
Digital Inputs/Outputs 4-33
Digital Outputs 8-6
Dimension drawings
Control Unit CU320........................... 3-10
Power Module, GX type...................... 3-7
Power Module, HX type...................... 3-8
Power Module, JX type....................... 3-9
SMC30 Sensor Module..................... 3-13
TM31 Terminal Module..................... 3-12
Direction reversal.................................... 7-4
Drive data set 6-10
Drive functions.. 9-3
Drive objects... 6-6
DRIVE-CLiQ Cabling Diagram 4-16
DRIVE-CLiQ interface 4-29
DRIVE-CLiQ Interface 4-20
Droop Function 7-30
E
EDS (encoder data set)........................ 6-11
Electromagnetic Compatibility
EMC-Compliant Installation 4-6
Introduction 4-4
Noise Emissions 4-4
Operational Reliability and Noise
Immunity.. 4-4
Electronics power supply............. 4-22, 4-29
Electrostatic Sensitive Devices 1-4
Encoder data set 6-11
ESD 1-4
ESD, Protective Measures 1-4
EU Declaration of Conformity................. 1-2
EU Manufacturer's Declaration 1-2
Extended braking control...................... 9-43
Extended functions 9-31
Extended monitoring functions 9-45
External 24 V DC Supply...................... 4-15
F
Factory Settings.................................... 5-43
Fan
type GX, replace 11-22
type HX, replace 11-24
type JX, replace 11-28
Fan voltage, adjusting 4-13
Features 2-4
Firmware
Upgrade 11-33
Fixed setpoints......................................6-31
Fixed speed setpoints...........................6-31
Flying restart 9-14
with encoder 9-16
without encoder 9-15
Friction characteristic............................9-20
H
High overload..12-7
I
Increasing the output frequency 9-22
Initial Commissioning
via AOP 5-36
Installation 3-4
Installation device 11-4
K
Kinetic buffering 9-9
L
Load monitoring 9-45
Low overload...12-7
M
Maintenance 11-2
Maintenance and Servicing 11-1
MDS
Copying 6-13
MDS (Motor Data Set) 6-12
Minimum speed.......................................7-5
Monitoring functions..............................9-47
Motor changeover 9-17
Motor Data
Entry 5-36
Motor Data Set......................................6-12
Motor identification..................................9-3
Motorized potentiometer 6-30
N
NAMUR signaling bit bar 6-44
O
Operating hours counter 9-25
Operating Instructions.............................1-3
Operation 6-1
Operator Panel......................................5-33
Output Terminals 8-1
Overload capacity 12-7
Overload responses..............................9-48
P
Parameter
0050 - Active Command Data Set
(CDS)..10-8
Permanent-magnet synchronous
motors 7-36
Personnel, Required Qualifications 1-1
Power block
type GX, replace................................11-6
type HX, replace................................11-8
type JX, replace...............................11-12
Power Connections...............................4-11

Connecting the Motor and Power Cables ... 4-12
Power Module ... 3-6
PROFIBUS ... 6-32
address switches ... 4-24
bus terminating resistors ... 4-23
connection ... 6-32
connectors ... 4-23
Ident Number ... 6-33
PROFIBUS Connection ... 4-22
Protecting power components ... 9-47
Protection functions ... 9-47
Q
Qualifications, Personnel Requirements 1-1
Qualified Personnel ... 1-1
Quality ... 2-4
R
Ramp-function generator ... 7-7
Reference model ... 7-27
Reforming the DC Link Capacitors ... 11-32
Relay Outputs ... 4-33
Removing the Interference Suppression Capacitor ... 4-14
Replace
Control Interface Board, type GX ... 11-16
Control Interface Board, type HX ... 11-18
Control Interface Board, type JX ... 11-20
fan, type GX ... 11-22
fan, type HX ... 11-24
fan, type JX ... 11-28
Installation device ... 11-4
power block type GX ... 11-6
power block type HX ... 11-8
power block type JX ... 11-12
Replacement
Fault messages ... 11-33
Replacing components ... 11-5
Resetting Parameters ... 5-43
Reversing ... 9-27
Rotating measurement ... 9-5
Runtime ... 9-25
S
S5 – Selector for Voltage/Current AI0, AI1 ... 4-32
Safety, Definitions ... 1-1
Safety, Operating Instructions ... 1-3
Safety, Warning Information ... 1-1
Serial interface (RS232) ... 4-24
Service ... 2-4
Service and Support ... 10-11
Servicing ... 11-3
Setpoint Addition ... 7-3
Setpoint Channel ... 7-3
Setpoint sources ... 6-28
analog inputs ... 6-28
fixed speed setpoints ... 6-31
general information ... 6-2
motorized potentiometer ... 6-30
Signal Connections ... 4-17
Simulation operation ... 9-26
Slip compensation ... 7-15
SMC30 ... 4-34
SMC30 Sensor Module ... 3-13
SMC30 Sensor Module for detecting the actual motor speed ... 4-34
SMC30, connection examples ... 4-39
Speed controller ... 7-20
Speed controller adaptation ... 7-28
Speed controller optimization ... 9-5
Speed controller pre-control ... 7-24
Speed limitation ... 7-6
Stall protection ... 9-51
Standstill measurement ... 9-4
STARTER ... 5-2
Commissioning ... 5-4
configuring the drive unit ... 5-11
Connection via serial interface ... 5-31
Creating Your Project ... 5-4
Installation ... 5-2
Interface ... 5-3
Project Wizard ... 5-6
Starting the Drive Project ... 5-29
Status word 1 ... 6-41, 6-42
Storage ... 3-3
Suppression speed ... 7-5
T
Technical data ... 12-8
Technical specifications
Control Unit CU320 ... 12-15
Power Module, 380 V – 480 V ... 12-9
Power Module, 500 V – 600 V ... 12-11
Power Module, 660 V – 690 V ... 12-13
SMC30 Sensor Module ... 12-17
TM31 Terminal Module ... 12-16
Technology controller ... 9-31
Telegram selection, user defined ... 6-34
Telegrams and process data ... 6-33
Temperature Sensor ... 4-32
Terminal Module TM31 ... 4-27
Thermal monitoring ... 9-48
Thermal motor protection ... 9-52
TM31 ... 4-27
TM31 Terminal Module ... 3-12
TM31, Connection Overview ... 4-28
TM31, Front View ... 4-27
Tools ... 4-2, 11-3
Torque limiting ... 7-34
Transportation ... 3-2
Type Plate ... 2-6
Data ... 2-7

U
Unit changeover 9-28
V
V/f Control.. 7-9
Vdc control.. 9-8
Vdc_max control.................................. 9-11
Vdc_min control...................................... 9-9
Vector Control with Encoder................. 7-19
Vector control without encoder............. 7-17
Vector speed / torque control
  with / without encoder....................... 7-16
Voltage boost....................................... 7-12
  at acceleration 7-14
  permanent... 7-13
W
Warning Information 1-1
Wiring Principle....................................... 2-5
X
X100 4-20
X101 4-20
X102 4-20
X103... 4-20
X122... 4-20
X124... 4-22
X126... 4-22
X132... 4-21
X140... 4-24
X41... 4-17
X500... 4-29
X501... 4-29
X520
  SMC30 4-37
X521... 4-38
X522... 4-32
X524... 4-29
X530... 4-31
X531... 4-38
X540... 4-32
X541... 4-33
X542... 4-33
X9... 4-17

Parameter macros

Parameter macro p0015 = G130 chassis unit

This macro is used to make default settings for operating the chassis unit.

Table 1 Parameter macro p0015 = G130 chassis unit

Sink			Source		
Parameters	**Description**	**DO**	**Parameters**	**Description**	**DO**
p0400[0]	Encoder type selection	Vector	9999	Other	Vector
p0404[0]	Encoder configuration	Vector	200008h		Vector
p0405[0]	Square-wave signal encoder A/B track	Vector	9h	Bipolar, like A/B track	Vector
p0408[0]	Rotary encoder pulses/rev	Vector	1024	1024 pulses per revolution	Vector
p0420[0]	Encoder connection	Vector	0x2	Encoder connection = terminal	Vector
p0500	Technological application	Vector	1	Pumps, fans	Vector
p0600	Motor temperature sensor for monitoring	Vector	0	No sensor	Vector
p0601	Motor temperature sensor type	Vector	0	No sensor	Vector
p0603[0]	CI: motor temperature	Vector	r4105	Sensor on TM31	TM31
p0603[1]	CI: motor temperature	Vector			
p0604	Motor overtemperature alarm threshold	Vector	120	(factory setting)	Vector
p0605	Motor overtemperature fault threshold	Vector	155	(factory setting)	Vector
p0606	Motor overtemperature timer	Vector	0	(factory setting)	Vector
p0610	Response to motor overtemperature condition	Vector	1	Display fault, for alarm Imax red.	Vector
p0700[0]	Preset binector input (BI)	Vector	70001	Profibus	Vector
p0864	Infeed operation	Vector	1		A_Inf
p1000[0]	Preset connector input (CI)	Vector	10001	Profibus	Vector
p1001	CO: Fixed speed setpoint 1	Vector	300 1/min		Vector
p1002	CO: Fixed speed setpoint 2	Vector	600 1/min		Vector
p1003	CO: Fixed speed setpoint 3	Vector	1500 1/min		Vector
p1083	CO: Speed limit in positive direction of rotation	Vector	6000 1/min		Vector
p1086	CO: Speed limit in negative direction of rotation	Vector	-6000 1/min		Vector

Sink			Source		
Parameters	**Description**	**DO**	**Parameters**	**Description**	**DO**
p1115	Ramp-function generator selection	Vector	1	Extended RFG	Vector
p1120	Ramp-function generator ramp-up time	Vector	20 s		Vector
p1121	Ramp-function generator ramp-down time	Vector	30 s		Vector
p1135	OFF3 ramp-down time	Vector	10 s		Vector
p1200	Flying restart operating mode	Vector	0	Flying restart not active	Vector
p1240	Vdc controller configuration	Vector	1	Vdc-max controller enabled	Vector
p1280	Vdc controller configuration (U/f)	Vector	1	Vdc-max controller enabled	Vector
p1300	Open-loop/closed-loop control operating mode	Vector	20	Sensorless speed control	Vector
p1911	Number of phases to be identified	Vector	3	3 phases	Vector
p2051[0]	CI: PROFIBUS PZD send word	Vector	r2089[0]	ZSW1	Vector
p2051[1]	CI: PROFIBUS PZD send word	Vector	r0063	n-act	Vector
p2051[2]	CI: PROFIBUS PZD send word	Vector	r0068	I-act	Vector
p2051[3]	CI: PROFIBUS PZD send word	Vector	r0080	M-act	Vector
p2051[4]	CI: PROFIBUS PZD send word	Vector	r0082	P-act	Vector
p2051[5]	CI: PROFIBUS PZD send word	Vector	r2131	FAULT	Vector
p2080[0]	BI: PROFIBUS send status word 1	Vector	r0899[0]	Ready to power up	Vector
p2080[1]	BI: PROFIBUS send status word 1	Vector	r0899[1]	Ready	Vector
p2080[2]	BI: PROFIBUS send status word 1	Vector	r0899[2]	Operation	Vector
p2080[3]	BI: PROFIBUS send status word 1	Vector	r2139[3]	Fault	Vector
p2080[4]	BI: PROFIBUS send status word 1	Vector	r0899[4]	No OFF2	Vector
p2080[5]	BI: PROFIBUS send status word 1	Vector	r0899[5]	No OFF3	Vector
p2080[6]	BI: PROFIBUS send status word 1	Vector	r0899[6]	Power-up inhibit	Vector
p2080[7]	BI: PROFIBUS send status word 1	Vector	r2139[7]	Alarm active	Vector

Sink			Source		
Parameters	**Description**	**DO**	**Parameters**	**Description**	**DO**
p2080[8]	BI: PROFIBUS send status word 1	Vector	r2197[7]	No setpoint/actual value deviation	Vector
p2080[9]	BI: PROFIBUS send status word 1	Vector	r0899[9]	Control requested	Vector
p2080[10]	BI: PROFIBUS send status word 1	Vector	r2199[1]	Comparison value reached	Vector
p2080[11]	BI: PROFIBUS send status word 1	Vector	r1407[7]	M/I/P limiting not active	Vector
p2080[12]	BI: PROFIBUS send status word 1	Vector	0		Vector
p2080[13]	BI: PROFIBUS send status word 1	Vector	r2129[14]	No alarm for motor overtemperature	Vector
p2080[14]	BI: PROFIBUS send status word 1	Vector	r2197[3]	CW	Vector
p2080[15]	BI: PROFIBUS send status word 1	Vector	r2129[15]	No alarm for thermal overload of Power Module	Vector
p2088	PROFIBUS Invert status word	Vector	B800h		Vector
p2128[14]	Select fault/alarm code for trigger	Vector	7910	Motor overtemperature alarm	Vector
p2128[15]	Select fault/alarm code for trigger	Vector	5000	Alarm for thermal overload of Power Module	Vector
p2153	Speed actual value filter time constant	Vector	20 ms		Vector

Parameter macro p0700 = G130 PROFIBUS (70001)

This macro is used to set the PROFIBUS interface as the command source.

Table 2 Parameter macro p0700 = G130 PROFIBUS

Sink			Source		
Parameters	**Description**	**DO**	**Parameters**	**Description**	**DO**
p0840[0]	ON/OFF1	Vector	r2090.0	PZD 1 bit 0	Vector
p0844[0]	No OFF2_1	Vector	r2090.1	PZD 1 bit 1	Vector
p0845[0]	No OFF2_2	Vector	r0722.4	CU DI4	CU
p0848[0]	No OFF3_1	Vector	r2090.2	PZD 1 bit 2	Vector
p0849[0]	No OFF3_2	Vector	r0722.5	CU DI5	CU
p0806	Inhibit LOCAL mode	Vector	0		
p0810	Switchover CDS bit 0	Vector	0		
p0852	Enable operation	Vector	r2090.3	PZD 1 bit 3	Vector
p0854	Control requested	Vector	r2090.10	PZD 1 bit 10	Vector
p0922	Profibus PZD telegram selection	Vector	999	Free telegram configuration	
p1020	FSW bit 0	Vector	0		
p1021	FSW bit 1	Vector	0		
p1035	MOP raise	Vector	r2090.13	PZD 1 bit 13	Vector
p1036	MOP lower	Vector	r2090.14	PZD 1 bit 14	Vector
p1055	Jog bit 0	Vector	0		
p1056	Jog bit 1	Vector	0		
p1113	Direction of rotation changeover	Vector	r2090.11	PZD 1 bit 11	Vector
p1140	Enable RFG	Vector	r2090.4	PZD 1 bit 4	Vector
p1141	Start RFG	Vector	r2090.5	PZD 1 bit 5	Vector
p1142	Enable nsetp	Vector	r2090.6	PZD 1 bit 6	Vector
p2103	Acknowledge fault_1	Vector	r2090.7	PZD 1 bit 7	Vector
p2104	Acknowledge fault_2	Vector	r0722.3	CU DI3	TM31
p2106	Ext. fault_1	Vector	r0722.6	CU DI6	CU
p2107	Ext. fault_2	Vector	1		
p2112	Ext. alarm_1	Vector	r0722.11	CU DI11	CU
p2116	Ext. alarm_2	Vector	1		
p0738	DI/DO8	CU	r0899.11	Pulses enabled	Vector
p0748[8]	Invert DI/DO8	CU	0	Not inverted	
p0728[8]	Set DI/DO8 input or output	CU	1	Output	CU
p0739	DI/DO9	CU	r2139.3	Fault present	Vector
p0748[9]	Invert DI/DO9	CU	1	Inverted	
p0728[9]	Set DI/DO9 input or output	CU	1	Output	CU
p0740	DI/DO10	CU	1	+24 V	CU

Sink			Source		
Parameters	**Description**	**DO**	**Parameters**	**Description**	**DO**
p0748[10]	Invert DI/DO10	CU	0	Not inverted	
p0728[10]	Set DI/DO10 input or output	CU	1	Output	CU
p0741	DI/DO11	CU	0		CU
p0748[11]	Invert DI/DO11	CU	0	Not inverted	
p0728[11]	Set DI/DO11 input or output	CU	0	Input	CU
p0742	DI/DO12	CU	r2138.7	Ack. fault	Vector
p0748[12]	Invert DI/DO12	CU	0	Not inverted	
p0728[12]	Set DI/DO12 input or output	CU	1	Output	CU
p0743	DI/DO13	CU	1	+24 V	CU
p0748[13]	Invert DI/DO13	CU	0	Not inverted	
p0728[13]	Set DI/DO13 input or output	CU	1	Output	CU
p0744	DI/DO14	CU	1	+24 V	CU
p0748[14]	Invert DI/DO14	CU	0	Not inverted	
p0728[14]	Set DI/DO14 input or output	CU	1	Output	CU
p0745	DI/DO15	CU	1	+24 V	CU
p0748[15]	Invert DI/DO15	CU	0	Not inverted	
p0728[15]	Set DI/DO15 input or output	CU	1	Output	CU

Parameter macro p0700 = G130 terminal block TM31 (70002)

This macro is used to set terminal block TM31 as the command source.

Table 3 Parameter macro p0700 = G130 terminal block TM31

Sink			Source		
Parameters	**Description**	**DO**	**Parameters**	**Description**	**DO**
p0840[0]	ON/OFF1	Vector	r4022.0	TM31 DI0	TM31
p0844[0]	No OFF2_1	Vector	1		
p0845[0]	No OFF2_2	Vector	r4022.4	TM31 DI4	TM31
p0848[0]	No OFF3_1	Vector	1		
p0849[0]	No OFF3_2	Vector	r4022.5	TM31 DI5	TM31
p0806	Inhibit LOCAL mode	Vector	0		
p0810	Switchover CDS bit 0	Vector	0		
p0852	Enable operation	Vector	1		
p0854	Control requested	Vector	1		
p0922	Profibus PZD telegram selection	Vector	999	Free telegram configuration	
p1020	FSW bit 0	Vector	r4022.1	TM31 DI1	TM31
p1021	FSW bit 1	Vector	r4022.2	TM31 DI2	TM31
p1035	MOP raise	Vector	r4022.1	TM31 DI1	TM31
p1036	MOP lower	Vector	r4022.2	TM31 DI2	TM31
p1055	Jog bit 0	Vector	0		
p1056	Jog bit 1	Vector	0		
p1113	Direction of rotation changeover	Vector	0		
p1140	Enable RFG	Vector	1		
p1141	Start RFG	Vector	1		
p1142	Enable nsetp	Vector	1		
p2103	Acknowledge fault_1	Vector	0		
p2104	Acknowledge fault_2	Vector	r4022.3	TM31 DI3	TM31
p2106	Ext. fault_1	Vector	r4022.6	TM31 DI6	TM31
p2107	Ext. fault_2	Vector	1		
p2112	Ext. alarm_1	Vector	r4022.11	TM31 DI11	TM31
p2116	Ext. alarm_2	Vector	1		
p0738	DI/DO8	CU		(factory setting)	
p0748[8]	Invert DI/DO8	CU		(factory setting)	
p0728[8]	Set DI/DO8 input or output	CU		(factory setting)	
p0739	DI/DO9	CU		(factory setting)	
p0748[9]	Invert DI/DO9	CU		(factory setting)	
p0728[9]	Set DI/DO9 input or output	CU		(factory setting)	
p0740	DI/DO10	CU		(factory setting)	

Sink			Source		
Parameters	**Description**	**DO**	**Parameters**	**Description**	**DO**
p0748[10]	Invert DI/DO10	CU		(factory setting)	
p0728[10]	Set DI/DO10 input or output	CU		(factory setting)	
p0741	DI/DO11	CU		(factory setting)	
p0748[11]	Invert DI/DO11	CU		(factory setting)	
p0728[11]	Set DI/DO11 input or output	CU		(factory setting)	
p0742	DI/DO12	CU	r2138.7	Ack. fault	Vector
p0748[12]	Invert DI/DO12	CU	0	Not inverted	
p0728[12]	Set DI/DO12 input or output	CU	1	Output	CU
p0743	DI/DO13	CU		(factory setting)	
p0748[13]	Invert DI/DO13	CU		(factory setting)	
p0728[13]	Set DI/DO13 input or output	CU		(factory setting)	
p0744	DI/DO14	CU		(factory setting)	
p0748[14]	Invert DI/DO14	CU		(factory setting)	
p0728[14]	Set DI/DO14 input or output	CU		(factory setting)	
p0745	DI/DO15	CU		(factory setting)	
p0748[15]	Invert DI/DO15	CU		(factory setting)	
p0728[15]	Set DI/DO15 input or output	CU		(factory setting)	
p2103	Acknowledge fault 1	TM31	0		
p2104	Acknowledge fault 2	TM31	r4022.3	TM31 DI3	TM31
p4030	DO0	TM31	r0899.11	Pulses enabled	Vector
p4031	DO1	TM31	r2139.3	Fault	Vector
p4038	DO8	TM31	r0899.0	Ready to power up	Vector
p4028.8	Set DI/DO8 input or output	TM31	1	Output	TM31
p4039	DO9	TM31		(factory setting)	
p4028.9	Set DI/DO9 input or output	TM31		(factory setting)	
p4040	DO10	TM31		(factory setting)	
p4028.10	Set DI/DO10 input or output	TM31		(factory setting)	
p4041	DO11	TM31		(factory setting)	
p4028.11	Set DI/DO11 input or output	TM31		(factory setting)	

Parameter macro p0700 = G130 CU320 terminals (70003)

This macro is used to set the CU320 terminals as the command source.

Table 4 Parameter macro p0700 = G130 CU320 terminals

Sink			Source		
Parameters	**Description**	**DO**	**Parameters**	**Description**	**DO**
p0840[0]	ON/OFF1	Vector	r0722.0	CU DI0	CU
p0844[0]	No OFF2_1	Vector	1		Vector
p0845[0]	No OFF2_2	Vector	r0722.4	CU DI4	CU
p0848[0]	No OFF3_1	Vector	1		Vector
p0849[0]	No OFF3_2	Vector	r0722.5	CU DI5	CU
p0806	Inhibit LOCAL mode	Vector	0		
p0810	Switchover CDS bit 0	Vector	0		
p0852	Enable operation	Vector	1		Vector
p0854	Control requested	Vector	1		Vector
p0922	Profibus PZD telegram selection	Vector	999	Free telegram configuration	
p1020	FSW bit 0	Vector	r0722.1	CU DI1	CU
p1021	FSW bit 1	Vector	r0722.2	CU DI2	CU
p1035	MOP raise	Vector	r0722.1	CU DI1	CU
p1036	MOP lower	Vector	r0722.2	CU DI2	CU
p1055	Jog bit 0	Vector	0		
p1056	Jog bit 1	Vector	0		
p1113	Direction of rotation changeover	Vector	0		
p1140	Enable RFG	Vector	1		Vector
p1141	Start RFG	Vector	1		Vector
p1142	Enable nsetp	Vector	1		Vector
p2103	Acknowledge fault_1	Vector	0		
p2104	Acknowledge fault_2	Vector	r0722.3	CU DI3	TM31
p2106	Ext. fault_1	Vector	r0722.6	CU DI6	CU
p2107	Ext. fault_2	Vector	1		
p2112	Ext. alarm_1	Vector	r0722.11	CU DI11	CU
p2116	Ext. alarm_2	Vector	1		
p0738	DI/DO8	CU	r0899.11	Pulses enabled	Vector
p0748[8]	Invert DI/DO8	CU	0	Not inverted	
p0728[8]	Set DI/DO8 input or output	CU	1	Output	CU
p0739	DI/DO9	CU	r2139.3	Fault present	Vector
p0748[9]	Invert DI/DO9	CU	1	Inverted	
p0728[9]	Set DI/DO9 input or output	CU	1	Output	CU
p0740	DI/DO10	CU	1	+24 V	CU

Sink			Source		
Parameters	**Description**	**DO**	**Parameters**	**Description**	**DO**
p0748[10]	Invert DI/DO10	CU	0	Not inverted	
p0728[10]	Set DI/DO10 input or output	CU	1	Output	CU
p0741	DI/DO11	CU	0		CU
p0748[11]	Invert DI/DO11	CU	0	Not inverted	
p0728[11]	Set DI/DO11 input or output	CU	0	Input	CU
p0742	DI/DO12	CU	r2138.7	Ack. Fault	Vector
p0748[12]	Invert DI/DO12	CU	0	Not inverted	
p0728[12]	Set DI/DO12 input or output	CU	1	Output	CU
p0743	DI/DO13	CU	1	+24 V	CU
p0748[13]	Invert DI/DO13	CU	0	Not inverted	
p0728[13]	Set DI/DO13 input or output	CU	1	Output	CU
p0744	DI/DO14	CU	1	+24 V	CU
p0748[14]	Invert DI/DO14	CU	0	Not inverted	
p0728[14]	Set DI/DO14 input or output	CU	1	Output	CU
p0745	DI/DO15	CU	1	+24 V	CU
p0748[15]	Invert DI/DO15	CU	0	Not inverted	
p0728[15]	Set DI/DO15 input or output	CU	1	Output	CU

Parameter macro p0700 = G130 PROFIBUS + TM31 (70004)

This macro is used to set the PROFIBUS interface and terminal block TM31 as the command source.

Table 5 Parameter macro p0700 = G130 PROFIBUS + terminal block TM31

Sink			Source		
Parameters	**Description**	**DO**	**Parameters**	**Description**	**DO**
p0840[0]	ON/OFF1	Vector	r2090.0	PZD 1 bit 0	Vector
p0844[0]	No OFF2_1	Vector	r2090.1	PZD 1 bit 1	Vector
p0845[0]	No OFF2_2	Vector	r4022.4	TM31 DI4	TM31
p0848[0]	No OFF3_1	Vector	r2090.2	PZD 1 bit 2	Vector
p0849[0]	No OFF3_2	Vector	r4022.5	TM31 DI5	TM31
p0806	Inhibit LOCAL mode	Vector	0		
p0810	Switchover CDS bit 0	Vector	0		
p0852	Enable operation	Vector	r2090.3	PZD 1 bit 3	Vector
p0854	Control requested	Vector	r2090.10	PZD 1 bit 10	Vector
p0922	Profibus PZD telegram selection	Vector	999	Free telegram configuration	
p1020	FSW bit 0	Vector	0		
p1021	FSW bit 1	Vector	0		
p1035	MOP raise	Vector	r2090.13	PZD 1 bit 13	Vector
p1036	MOP lower	Vector	r2090.14	PZD 1 bit 14	Vector
p1055	Jog bit 0	Vector	0		
p1056	Jog bit 1	Vector	0		
p1113	Direction of rotation changeover	Vector	r2090.11	PZD 1 bit 11	Vector
p1140	Enable RFG	Vector	r2090.4	PZD 1 bit 4	Vector
p1141	Start RFG	Vector	r2090.5	PZD 1 bit 5	Vector
p1142	Enable nsetp	Vector	r2090.6	PZD 1 bit 6	Vector
p2103	Acknowledge fault_1	Vector	r2090.7	PZD 1 bit 7	Vector
p2104	Acknowledge fault_2	Vector	r4022.3	TM31 DI3	TM31
p2106	Ext. fault_1	Vector	r4022.6	TM31 DI6	TM31
p2107	Ext. fault_2	Vector	1		
p2112	Ext. alarm_1	Vector	r4022.11	TM31 DI11	TM31
p2116	Ext. alarm_2	Vector	1		
p0738	DI/DO8	CU		(factory setting)	
p0748[8]	Invert DI/DO8	CU		(factory setting)	
p0728[8]	Set DI/DO8 input or output	CU		(factory setting)	
p0739	DI/DO9	CU		(factory setting)	
p0748[9]	Invert DI/DO9	CU		(factory setting)	
p0728[9]	Set DI/DO9 input or output	CU		(factory setting)	
p0740	DI/DO10	CU		(factory setting)	

Sink			Source		
Parameters	**Description**	**DO**	**Parameters**	**Description**	**DO**
p0748[10]	Invert DI/DO10	CU		(factory setting)	
p0728[10]	Set DI/DO10 input or output	CU		(factory setting)	
p0741	DI/DO11	CU		(factory setting)	
p0748[11]	Invert DI/DO11	CU		(factory setting)	
p0728[11]	Set DI/DO11 input or output	CU		(factory setting)	
p0742	DI/DO12	CU	r2138.7	Ack. Fault	Vector
p0748[12]	Invert DI/DO12	CU	0	Not inverted	
p0728[12]	Set DI/DO12 input or output	CU	1	Output	CU
p0743	DI/DO13	CU		(factory setting)	
p0748[13]	Invert DI/DO13	CU		(factory setting)	
p0728[13]	Set DI/DO13 input or output	CU		(factory setting)	
p0744	DI/DO14	CU		(factory setting)	
p0748[14]	Invert DI/DO14	CU		(factory setting)	
p0728[14]	Set DI/DO14 input or output	CU		(factory setting)	
p0745	DI/DO15	CU		(factory setting)	
p0748[15]	Invert DI/DO15	CU		(factory setting)	
p0728[15]	Set DI/DO15 input or output	CU		(factory setting)	
p2103	Acknowledge fault 1	TM31	r2090.7	PZD 1 bit 1	Vector
p2104	Acknowledge fault 2	TM31	r4022.3	TM31 DI3	TM31
p4030	DO0	TM31	r0899.11	Pulses enabled	Vector
p4031	DO1	TM31	r2139.3	Fault	Vector
p4038	DO8	TM31	r0899.0	Ready to power up	Vector
p4028.8	Set DI/DO8 input or output	TM31	1	Output	TM31
p4039	DO9	TM31		(factory setting)	
p4028.9	Set DI/DO9 input or output	TM31		(factory setting)	
p4040	DO10	TM31		(factory setting)	
p4028.10	Set DI/DO10 input or output	TM31		(factory setting)	
p4041	DO11	TM31		(factory setting)	
p4028.11	Set DI/DO11 input or output	TM31		(factory setting)	

Parameter macro p1000 = PROFIBUS (100001)

This macro is used to set PROFIBUS as the setpoint source.

Table 6 Parameter macro p1000 = PROFIBUS

Sink			Source		
Parameters	**Description**	**DO**	**Parameters**	**Description**	**DO**
p1070	Main setpoint	Vector	r2050[1]	PROFIBUS PZD2	Vector
p1071	Main setpoint scaling	Vector	1	100 %	Vector
p1075	Supplementary setpoint	Vector	0		Vector
p1076	Supplementary setpoint scaling	Vector	1	100 %	Vector

Parameter macro p1000 = AI0 – TM31 (100002)

This macro is used to set analog input 0 of terminal block TM31 as the setpoint source.

Table 7 Parameter macro p1000 = AI0 – TM31

Sink			Source		
Parameters	**Description**	**DO**	**Parameters**	**Description**	**DO**
p1070	Main setpoint	Vector	r4055	AI0 TM31	TM31
p1071	Main setpoint scaling	Vector	1	100 %	TM31
p1075	Supplementary setpoint	Vector	0		TM31
p1076	Supplementary setpoint scaling	Vector	1	100 %	TM31

Parameter macro p1000 = Motorized potentiometer (100003)

This macro is used to set the motorized potentiometer as the setpoint source.

Table 8 Parameter macro p1000 = motorized potentiometer

Sink			Source		
Parameters	**Description**	**DO**	**Parameters**	**Description**	**DO**
p1070	Main setpoint	Vector	r1050	Motorized potentiometer	Vector
p1071	Main setpoint scaling	Vector	1	100 %	Vector
p1075	Supplementary setpoint	Vector	0		Vector
p1076	Supplementary setpoint scaling	Vector	1	100 %	Vector

Parameter macro p1000 = fixed setpoint (100004)

This macro is used to set the fixed setpoint as the setpoint source.

Table 9 Parameter macro p1000 = fixed setpoint

Sink			Source		
Parameters	**Description**	**DO**	**Parameters**	**Description**	**DO**
p1070	Main setpoint	Vector	r1024	Active fixed setpoint	Vector
p1071	Main setpoint scaling	Vector	1	100 %	Vector
p1075	Supplementary setpoint	Vector	0		Vector
p1076	Supplementary setpoint scaling	Vector	1	100 %	Vector

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