SINAMICS G150

Converter Cabinet Units 75 kW to 1500 kW

Operating Instructions · 10/2008





SIEMENS

SINAMICS G150

Operating Instructions

Drive converter cabinet units

SINAMICS

1 Safety information 2 **Device Overview** 3 Mechanical installation 4 **Electrical installation** 5 Commissioning 6 Operation Setpoint channel and closed-7 loop control 8 **Output terminals** Functions, Monitoring, and 9 **Protective Functions** 10 Diagnosis / faults and alarms 11 Maintenance and servicing 12 **Technical specifications**

Foreword

| Appendix | A |
|----------|---|
| | |

Control version V2.6 SP1

Legal information

Warning notice system

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

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

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

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

CAUTION

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

NOTICE

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

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

Qualified Personnel

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

Proper use of Siemens products

Note the following:

/!\WARNING

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

Trademarks

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Disclaimer of Liability

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

Siemens AG Industry Sector Postfach 48 48 90026 NÜRNBERG GERMANY A5E00189855A @ 02/2009

Foreword

User documentation

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

Structure of this documentation

The customer documentation comprises general and individual documentation.

The general documentation describes the topics that apply to all cabinet units:

• Operating Instructions

The Operating Instructions consist of the following sections:

- Device description
- Mechanical installation
- Electrical installation
- Commissioning guide
- Description of function
- Maintenance instructions
- Technical specifications

Overview diagrams

These provide a general overview of the functionality of the cabinet units.

- **Basic function diagrams** These provide an overview of the basic functions of the cabinet unit for simple applications.
- List Manual

The List Manual consists of the following sections:

- Parameter list
- Function diagrams
- Fault / warning list
- Documentation for Drive Control Chart (DCC)
 - Programming and Operating Manual: DCC Editor description
 - Function Manual: Description of the standard DCC blocks

The individual documentation describes precisely one customized cabinet unit and contains the following:

Dimension drawing

The dimension drawing documents the dimensions of the ordered cabinet unit.

• Layout diagram

The layout diagram shows the components installed in the ordered cabinet unit.

Circuit diagram

The circuit diagram shows the electrical components installed in the ordered cabinet unit, their interconnections and the customer interfaces.

Terminal diagram

The terminal diagram shows all the customer terminals in the ordered cabinet unit, and the associated internal wiring in the cabinet unit. This diagram documents the line-side target wiring.

- Spare parts list The spare parts list contains all the available spare parts for the ordered cabinet unit.
- Additional operating instructions

The instructions for OEM components installed in the ordered cabinet unit are supplied as OEM documentation.

Technical support

- Tel: +49 (0) 180 50 50 222
- Fax: +49 (0) 180 50 50 223
- Internet: http://www.siemens.de/automation/support-request

Note

Calls are subject to charge (e.g. \in 0.14/min from fixed lines within Germany). Tariffs of other phone providers may differ.

Spare parts

You will find spare parts on the Internet at: http://support.automation.siemens.com/WW/view/en/16612315.

Internet address

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

Table of contents

| | Forewo | rd | 5 |
|---|---|---|----------------------------|
| 1 | Safety i | information | 15 |
| | 1.1 | Warnings | 15 |
| | 1.2 | Safety and operating instructions | 16 |
| | 1.3 | Components that can be destroyed by electrostatic discharge (ESD) | 17 |
| 2 | Device | Overview | 21 |
| | 2.1 | Chapter content | 21 |
| | 2.2 2.2.1 2.2.2 | Applications, features, and design Field of applications Characteristics, quality, service | 21 |
| | 2.3 2.3.1 2.3.2 | Design Version A Version C | 24 |
| | 2.4 | Wiring Principle | 28 |
| | 2.5 | Type plate | 33 |
| 3 | Mechanical installation | | |
| | 3.1 | Chapter content | 37 |
| | 3.2 | Transportation and storage | |
| | 3.3 3.3.1 3.3.2 3.3.3 3.3.4 3.3.5 3.3.6 | Assembly Mechanical installation: checklist Preparatory steps Installation Mechanical connection of units that are connected in parallel Fitting additional canopies (option M21) or hoods (option M23, M43, M54) Line connection from above (option M13), motor connection from above (option M78) | 41 42 43 44 44 |
| 4 | Electric | al installation | 49 |
| | 4.1 | Chapter content | 49 |
| | 4.2 | Checklist for electrical installation | 50 |
| | 4.3 | Important safety precautions | 55 |
| | 4.4 | Introduction to EMC | 56 |
| | 4.5 | EMC compliant design | 58 |
| | 4.6 4.6.1 4.6.2 4.6.3 4.6.4 | Electrical connection of units that are connected in parallel Connecting the PE busbars Establishing the DC link connections Connecting the power supply and signal cables Connecting the DRIVE-CLiQ topology | 60 61 61 |

| 4.7 4.7.1 | Power connections Connection cross-sections and cable lengths | |
|--------------------|---|----------|
| 4.7.2 | Connecting the motor and power cables | |
| 4.7.3 | Adjusting the fan voltage (-T1-T10) | |
| 4.7.4 | Adjusting the internal power supply (-A1 -T10, version A only) | |
| 4.7.5 | Removing the connection bracket for the interference-suppression capacitor with operation from an ungrounded supply | 68 |
| 4.8 | External Supply of the Auxiliary Supply from a Secure Line | 69 |
| 4.8.1 | 230 V AC auxiliary supply | 70 |
| 4.8.2 | 24 V DC auxiliary supply | 70 |
| 4.9 | Signal connections | |
| 4.9.1 | Customer terminal block (-A60) | 71 |
| 4.10 | Other connections | |
| 4.10.1 | dv/dt filter plus Voltage Peak Limiter (option L10) | |
| 4.10.2 | Main Contactor (Option L13) | |
| 4.10.3 | Sinusoidal Filter (Option L15) | |
| 4.10.4 | Connection for External Auxiliary Equipment (Option L19) | 83 |
| 4.10.5 | Main switch incl. fuses or circuit breaker (option L26) | |
| 4.10.6 | EMERGENCY OFF pushbutton installed in the cabinet door (option L45) | |
| 4.10.7 | Cabinet illumination with service socket (option L50) | |
| 4.10.8 | Cabinet anti-condensation heating (option L55) | |
| 4.10.9 | EMERGENCY OFF category 0; 230 V AC or 24 V DC (option L57) | |
| 4.10.10 4.10.11 | EMERGENCY STOP category 1; 230 V AC (option L59) | |
| 4.10.11 | EMERGENCY STOP category 1; 24 V DC (option L60) 25 kW Braking Unit (Option L61); 50 kW Braking Unit (Option L62) | ອາ ດາ |
| 4.10.12 | Thermistor Motor Protection Unit (Option L83/L84) | 92 00 |
| 4.10.13 | PT100 Evaluation Unit (Option L86) | |
| 4.10.14 | Insulation Monitor (Option L87) | |
| 4.10.15 | Communication Board Ethernet CBE20 (Option G33) | |
| 4.10.17 | | |
| | SMC30 Sensor Module Cabinet-Mounted (option K50) | |
| | Description | |
| | 2 Connection | |
| | Connection examples | |
| | Voltage Sensing Module for determining the actual motor speed and the phase angle (option K51) | |
| 4.10.20 | Customer terminal block extension (option G61) | |
| 4.10.21 | Terminal module for activation of "Safe Torque Off" and "Safe STOP 1" (option K82) | 116 |
| 4.10.22 | NAMUR terminal block (option B00) | 117 |
| 4.10.23 | Separate 24 V DC power supply for NAMUR (option B02) | |
| 4.10.24 | Outgoing section for external auxiliary equipment for NAMUR (option B03) | 119 |
| Commiss | sioning | 121 |
| 5.1 | Chapter content | 121 |
| 5.2 | STARTER commissioning tool | 123 |
| 5.2.1 | Installing the STARTER commissioning tool | |
| 5.2.2 | Layout of the STARTER user interface | |
| 5.3 | Procedure for commissioning via STARTER | 125 |
| 5.3.1 | Creating the project. | |
| 5.3.2 | Configure the drive unit | |
| 5.3.3 | Additional settings required for units that are connected in parallel | |
| 5.3.4 | Starting the drive project | |
| 5.3.5 | Connection via serial interface | 161 |
| | | |

5

| | 5.4 | The AOP30 operator panel | 164 |
|---|----------|---|-----|
| | 5.5 | First commissioning with the AOP30 | |
| | 5.5.1 | Initial ramp-up | |
| | 5.5.2 | Basic Commissioning | |
| | 5.5.3 | Additional settings required for units that are connected in parallel | 173 |
| | 5.6 | Status after commissioning | 175 |
| | 5.7 | Parameter reset to factory settings | |
| 6 | Operatio | on | 179 |
| | 6.1 | Chapter content | 179 |
| | 6.2 | General information about command and setpoint sources | |
| | 6.3 | Basic information about the drive system | |
| | 6.3.1 | Parameters | |
| | 6.3.2 | Drive objects | |
| | 6.3.3 | Data Sets | |
| | 6.3.4 | BICO technology: interconnecting signals | |
| | 6.4 | Command sources | |
| | 6.4.1 | "PROFIdrive" default setting | |
| | 6.4.2 | "TM31 terminals" default setting | |
| | 6.4.3 | "NAMUR" default setting | |
| | 6.4.4 | "PROFIdrive NAMUR" default setting | |
| | 6.5 | Setpoint sources | |
| | 6.5.1 | Analog inputs | |
| | 6.5.2 | Motorized potentiometer | |
| | 6.5.3 | Fixed speed setpoints | 208 |
| | 6.6 | PROFIBUS | |
| | 6.6.1 | PROFIBUS connection | |
| | 6.6.2 | Control via PROFIBUS | |
| | 6.6.3 | Monitoring: Telegram failure | |
| | 6.6.4 | Telegrams and process data | |
| | 6.6.5 | Structure of the telegrams | |
| | 6.6.5.1 | Overview of control words and setpoints | |
| | 6.6.5.2 | Overview of status words and actual values | 218 |
| | 6.7 | Control via the operator panel | |
| | 6.7.1 | Operator panel (AOP30) overview and menu structure | |
| | 6.7.2 | Operation screen menu | |
| | 6.7.3 | Parameterization menu | |
| | 6.7.4 | Menu: Fault/alarm memory | |
| | 6.7.5 | Menu commissioning / service | |
| | 6.7.5.1 | Drive commissioning | |
| | 6.7.5.2 | Device commissioning | |
| | 6.7.5.3 | AOP settings | |
| | 6.7.5.4 | Lists of signals for the operation screen | |
| | 6.7.5.5 | AOP30 diagnosis | |
| | 6.7.6 | Language/Sprache/Langue/Idioma/Lingua | |
| | 6.7.7 | Operation via the operator panel (LOCAL mode) | |
| | 6.7.7.1 | | |
| | 6.7.7.2 | ON key / OFF key | |
| | 6.7.7.3 | Switching between clockwise and counter-clockwise rotation | |
| | 6.7.7.4 | Jog | |
| | 6.7.7.5 | Increase setpoint / decrease setpoint | |

| | 6.7.7.6 6.7.7.7 6.7.7.8 6.7.8 6.7.9 6.7.10 | AOP setpoint Timeout monitoring Operator input inhibit / parameterization inhibit Faults and alarms Saving the parameters permanently Parameterization errors | 234 234 236 237 |
|---|---|---|--|
| | 6.8 6.8.1 6.8.2 6.8.2.1 6.8.2.2 6.8.2.3 6.8.2.4 6.8.3 | PROFINET IO Activating online operation: STARTER via PROFINET IO General information about PROFINET IO General information about PROFINET IO for SINAMICS Real-time (RT) and isochronous real-time (IRT) communication Addresses Data transmission Further information about communication via PROFINET IO | 239 245 245 246 247 249 |
| | 6.9 | Engineering Software Drive Control Chart (DCC) | 250 |
| 7 | Setpoint | channel and closed-loop control | 251 |
| | 7.1 | Chapter content | 251 |
| | 7.2 7.2.1 7.2.2 7.2.3 7.2.4 7.2.5 | Setpoint channel Setpoint addition Direction reversal Suppression bandwidths and minimum speeds Speed limitation Ramp-function generator | 252 253 254 255 |
| | 7.3 7.3.1 7.3.2 | V/f control Voltage Boost Slip compensation | 261 |
| | 7.4 7.4.1 7.4.2 7.4.3 7.4.3.1 7.4.3.2 7.4.3.3 7.4.3.4 7.4.4 7.4.5 7.4.6 | Vector speed/torque control with/without encoder Vector control without encoder Vector control with encoder Speed controller Speed controller pre-control (integrated pre-control with balancing) Reference model Speed controller adaptation Droop Function Closed-loop torque control Torque limiting Permanent-magnet synchronous motors | 266 269 270 272 275 276 278 278 279 282 |
| 8 | Output te | rminals | 287 |
| | 8.1 | Chapter content | 287 |
| | 8.2 8.2.1 | Analog outputs List of signals for the analog signals | |
| | 8.3 | Digital outputs | 291 |

| 9 | Functions, Monitoring, and Protective Functions | | |
|---|---|---|------------|
| | 9.1 | Chapter content | |
| | 9.2 | Drive Functions | 295 |
| | 9.2.1 | Motor identification and automatic speed controller optimization | 295 295 |
| | 9.2.1.1 | Standstill measurement | |
| | 9.2.1.1 | Rotating measurement and speed controller optimization | |
| | 9.2.2 | Efficiency optimization | |
| | 9.2.3 | Fast magnetization for induction motors | |
| | 9.2.4 | Vdc control | |
| | 9.2.5 | Automatic restart function | |
| | 9.2.6 | Flying restart | |
| | 9.2.6.1 | Flying restart without encoder | |
| | 9.2.6.2 | Flying restart with encoder | |
| | 9.2.6.3 | Parameters | |
| | 9.2.7 | Motor changeover/selection | 313 |
| | 9.2.7.1 | Description | 313 |
| | 9.2.7.2 | Example of changing over between two motors | 313 |
| | 9.2.7.3 | Function diagram | |
| | 9.2.7.4 | Parameters | |
| | 9.2.8 | Friction characteristic curve | |
| | 9.2.9 | Increasing the output frequency | |
| | 9.2.9.1 | Description | |
| | 9.2.9.2 | Default pulse frequencies | |
| | 9.2.9.3 | Increasing the pulse frequency | |
| | 9.2.9.4 | Maximum output frequency achieved by increasing the pulse frequency | |
| | 9.2.9.5 | Parameters | |
| | 9.2.10 | Runtime (operating hours counter) | |
| | 9.2.11 | Simulation operation | |
| | 9.2.12 | Direction reversal | |
| | 9.2.13 | Unit changeover | |
| | 9.2.14 | Derating behavior at increased pulse frequency | |
| | 9.3 | Extended functions | |
| | 9.3.1 | Technology controller | 327 |
| | 9.3.2 | Bypass function | |
| | 9.3.2.1 | Bypass with synchronizer with degree of overlapping (p1260 = 1) | |
| | 9.3.2.2 | Bypass with synchronizer without degree of overlapping (p1260 = 2) | |
| | 9.3.2.3 | Bypass without synchronizer (p1260 = 3) | |
| | 9.3.2.4 | Function diagram | |
| | 9.3.2.5 | Parameters | |
| | 9.3.3 | Extended braking control | |
| | 9.3.4 | Extended monitoring functions | 340 |
| | 9.4 | Monitoring and protective functions | |
| | 9.4.1 | Protecting power components | |
| | 9.4.2 | Thermal monitoring and overload responses | 343 |
| | 9.4.3 | Block protection | 345 |
| | 9.4.4 | Stall protection (only for vector control) | |
| | 9.4.5 | Thermal motor protection | |

| 10 | Diagnosis / faults and alarms | | |
|----|---|---|--|
| | 10.1 | Chapter content | 349 |
| | 10.2 10.2.1 10.2.2 10.2.3 | Diagnosis Diagnostics using LEDs Diagnostics via parameters Indicating and rectifying faults | 350 355 |
| | 10.3 10.3.1 10.3.2 10.3.3 10.3.4 | Overview of warnings and faults "External alarm 1" "External fault 1" "External fault 2" "External fault 3" | 359 360 360 |
| | 10.4 10.4.1 | Service and SupportSpare parts | |
| 11 | Maintena | ance and servicing | 363 |
| | 11.1 | Chapter content | |
| | 11.2 11.2.1 | Maintenance Cleaning | |
| | 11.3 11.3.1 11.3.2 | Maintenance Installation device Using crane lifting lugs to transport power blocks | 366 |
| | $\begin{array}{c} 11.4\\ 11.4.1\\ 11.4.2\\ 11.4.3\\ 11.4.4\\ 11.4.5\\ 11.4.6\\ 11.4.7\\ 11.4.8\\ 11.4.9\\ 11.4.10\\ 11.4.10\\ 11.4.11\\ 11.4.12\\ 11.4.13\\ 11.4.15\\ 11.4.16\\ 11.4.17\\ 11.4.18\end{array}$ | Replacing components Replacing the filter mats Replacing the power block (type FX) Replacing the power block (type GX) Replacing the power block (type HX). Replacing the Control Interface Board (type FX). Replacing the Control Interface Board (type GX). Replacing the Control Interface Board (type HX). Replacing the Control Interface Board (type JX). Replacing the Control Interface Board (type JX). Replacing the fan (type FX). Replacing the fan (type FX). Replacing the fan (type GX). Replacing the fan (type GX). Replacing the fan (type JX). Replacing the fan (type JX). Replacing the fan (type JX). Replacing the fan (type JX). Replacing the fan fuse (-T1 -F10 / -T1 -F11). Replacing the fan fuse (-T1 -F10 / -T1 -F11). Replacing the fan fuse (-T1 -F21). Replacing the fan fuse (-T1 -F21). Replacing the fan fuse operator panel. Replacing the Backup Battery for the Cabinet Operator Panel. | 369 370 372 374 378 382 384 386 388 390 392 392 394 398 402 402 402 402 |
| | 11.5 | Forming the DC link capacitors | 405 |
| | 11.6 | Messages after replacing DRIVE-CLiQ components | |
| | 11.7 | Upgrading the cabinet unit firmware | |
| | 11.8 | Load the new operator panel firmware from the PC. | 408 |

| 12 | Technic | cal specifications | |
|----|---------|--|-----|
| | 12.1 | Chapter content | 409 |
| | 12.2 | General data | 410 |
| | 12.2.1 | Derating data | 411 |
| | 12.2.2 | Overload capability | |
| | 12.3 | Technical specifications | |
| | 12.3.1 | Cabinet unit version A, 380 V - 480 V 3 AC | |
| | 12.3.2 | Cabinet unit version C, 380 V - 480 V 3 AC | |
| | 12.3.3 | Cabinet unit version A, 500 V - 600 V 3 AC | |
| | 12.3.4 | Cabinet unit version C, 500 V - 600 V 3 AC | |
| | 12.3.5 | Cabinet unit version A, 660 V - 690 V 3 AC | |
| | 12.3.6 | Cabinet unit version C, 660 V - 690 V 3 AC | |
| Α | Append | lix | |
| | A.1 | List of abbreviations | 469 |
| | A.2 | Parameter macros | 471 |
| | INDEX | | |
| | | | |

Table of contents

Safety information

1.1 Warnings



Hazardous voltages are present when electrical equipment is in operation. Severe personal injury or substantial material damage may result if these warnings are not observed.

Only qualified personnel are permitted to work on or around the equipment. This personnel must be thoroughly familiar with all warning and maintenance procedures described in these operating instructions. 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.



Five safety rules

When carrying out any kind of work on electrical devices, the "five safety rules" must always be observed:

- 1. Disconnect the system.
- 2. Protect against reconnection.
- 3. Make sure that the equipment is de-energized.
- 4. Ground and short-circuit.
- 5. Cover or enclose adjacent components that are still live.

Certification

The following certificates:

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

can be found under "Safety and Operating Instructions" in the documentation folder.

1.2 Safety and operating instructions

1.2 Safety and operating instructions



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 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 contain 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

We recommend engaging the support and services of your local Siemens service center for all planning, installation, commissioning and maintenance work.

1.3 Components that can be destroyed by electrostatic discharge (ESD)

1.3 Components that can be destroyed by electrostatic discharge (ESD)

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 wristband
- f = cabinet ground connection
- g = contact with conductive flooring



Figure 1-1 ESD protective measures

1.3 Components that can be destroyed by electrostatic discharge (ESD)

Residual risks of power drive systems

When carrying out a risk assessment of the machine/plant in accordance with the EU Machinery Directive, the machine manufacturer/plant operator must consider the following residual risks associated with the control and drive components of a power drive system (PDS).

- 1. Unintentional movements of driven machine components during commissioning, operation, maintenance, and repairs caused by, for example:
 - Hardware defects and/or software errors in the sensors, controllers, actuators, and connection technology
 - Response times of the controller and drive
 - Operating and/or ambient conditions not within the scope of the specification
 - Parameterization, programming, cabling, and installation errors
 - Use of radio devices / cellular phones in the immediate vicinity of the controller
 - External influences / damage
- 2. Exceptional temperatures as well as emissions of light, noise, particles, or gas caused by, for example:
 - Component malfunctions
 - Software errors
 - Operating and/or ambient conditions not within the scope of the specification
 - External influences / damage
- 3. Hazardous shock voltages caused by, for example:
 - Component malfunctions
 - Influence of electrostatic charging
 - Induction of voltages in moving motors
 - Operating and/or ambient conditions not within the scope of the specification
 - Condensation / conductive contamination
 - External influences / damage
- 4. Electrical, magnetic and electromagnetic fields generated in operation that can pose a risk to people with a pacemaker, implants or metal replacement joints, etc. if they are too close.
- 5. Release of environmental pollutants or emissions as a result of improper operation of the system and/or failure to dispose of components safely and correctly.

For more information about residual risks of the Power Drive System components, see the relevant chapters in the technical user documentation.

Safety information

1.3 Components that can be destroyed by electrostatic discharge (ESD)

Electromagnetic fields "electro smog"

Electromagnetic fields are generated by the operation of electrical power engineering installations such as transformers, converters or motors.

Electromagnetic fields can interfere with electronic devices, which could cause them to malfunction. For example, the operation of heart pacemakers can be impaired, potentially leading to damage to a person's health or even death. It is therefore forbidden for persons with heart pacemakers to enter these areas.

The plant operator is responsible for taking appropriate measures (labels and hazard warnings) to adequately protect operating personnel and others against any possible risk.

- Observe the relevant nationally applicable health and safety regulations. In Germany, "electromagnetic fields" are subject to regulations BGV B11 and BGR B11 stipulated by the German statutory industrial accident insurance institution.
- Display adequate hazard warning notices.



- Place barriers around hazardous areas.
- Take measures, e.g. using shields, to reduce electromagnetic fields at their source.
- · Make sure that personnel are wearing the appropriate protective gear.

1.3 Components that can be destroyed by electrostatic discharge (ESD)

2

Device Overview

2.1 Chapter content

This chapter provides information on the following:

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

2.2 Applications, features, and design

2.2.1 Field of applications

SINAMICS G150 drive converter cabinet units are specially designed to meet the requirements of drives with a quadratic and constant load characteristic, medium performance requirements, and no regenerative feedback. Applications include:

- Pumps and fans
- Compressors
- Extruders and mixers
- Mills

2.2 Applications, features, and design

2.2.2 Characteristics, quality, service

Features

The accuracy of sensorless vector control ensures that the system can be used for a wide variety of applications and, as a result, an additional speed sensor is not required.

Optionally, applications with system-specific requirements for an encoder can use an encoder evaluator.

SINAMICS G150 takes this into account and, as a result, offers a low-cost drive solution tailored to actual requirements.

In addition, factors have been considered to ensure easy handling of the drive from the planning and design phase through to operation. These factors include:

- Compact, modular, service-friendly design
- Straightforward planning and design thanks to the Sizer and Starter tools
- Ready to connect to facilitate the installation process
- Quick, menu-driven commissioning with no complex parameterization
- Clear and convenient operation via a user-friendly graphical operator panel with measured values displayed in plain text or in a quasi-analog bar display.
- SINAMICS is 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.

Integration in SIMATIC H systems is possible via a Y link.

Drive Control Chart (DCC)
 Drive Control Chart (DCC) expands the facility for the simplest possible configuring of technological functions for the SINAMICS drive system.
 The block library encompasses a large selection of closed-loop, arithmetic and logic function blocks, as well as more comprehensive open-loop and closed-loop control functions. The user-friendly DCC editor enables easy graphical configuration and a clear representation of control loop structures as well as a high degree of reusability of existing diagrams. DCC is an add-on to the STARTER commissioning tool.

Quality

The SINAMICS G150 drive converter cabinet 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 certified to DIN ISO 9001 by an independent authority.

2.2 Applications, features, and design

Service

Our worldwide sales and service network offers our customers consulting services tailored to their needs, 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, refer to chapter "Diagnosis / faults and alarms", section "Service and Support".

2.3 Design

2.3 Design

The SINAMICS G150 cabinet units are characterized by their compact, modular, and service-friendly design.

A wide range of electrical and mechanical components enable the drive system to be optimized for the appropriate requirements.

Two cabinet unit versions are available depending on the options that are chosen.

2.3.1 Version A

All the required power supply connection components, such as the main circuit breaker, circuit breakers, main contactor, line fuses, radio interference suppression filter, motor components, and additional protection and monitoring devices, can be installed as required.

The cabinet unit comprises up to two cabinet panels with a total width of between 800 and 1600 mm, depending on the output, and 3200 mm for units that are connected in parallel.



Figure 2-1 Example of the cabinet drive, version A (e.g., 132 kW, 400 V 3 AC) (certain components are optional)

Version A, units that are connected in parallel

For very high power ratings, the cabinet drive comprises two cabinet units that combined to drive a motor in a parallel connection:

- At 380 V 480 V 3 AC: 6SL3710-2GE41-1AA0, 6SL3710-2GE41-4AA0, 6SL3710-2GE41-6AA0
- With 500 V 600 V 3 AC: 6SL3710-2GF38-6AA0, 6SL3710-2GF41-1AA0, 6SL3710-2GF41-4AA0
- With 660 V 690 V 3 AC: 6SL3710-2GH41-1AA0, 6SL3710-2GH41-4AA0, 6SL3710-2GH41-5AA0



Figure 2-2 Example of the cabinet drive, version A (e.g., 1500 kW, 690 V 3 AC) (certain components are optional)

2.3 Design

Special features when connecting-up and operating units that are connected in parallel

The DC links of the sub-cabinets conntected in parallel must always be interconnected and the connecting cables between the two sub-cabinets (cable numbers -W001 and -W002) must be connected.

The cabinet drive units can be connected to the line supply in either a 6-pulse or 12-pulse connection.

For a 12-pulse connection, the following special considerations must be taken into account:

• The 12-pulse connection to the line supply is only possible using a double-tier transformer with three winding systems. Transformer vector groups Dy5Dd0 or Dy11Dd0 should preferably be selected. When using sub-windings that are electrically offset with respect to one another, the line harmonics are reduced with respect to the 6-pulse infeed.

Requirements for the transformer:

- The no-load voltages of both secondary windings must not differ from each other by more than 0.5% (with reference to the rated voltage).
- The differences between the short-circuit voltages of the two secondary windings must be less than 5% of the rated value.
- The minimum short-circuit voltage of the transformer should be 4%.
- The checkback contacts of the main contactors and the circuit breakers are connected in series in the factory and wired to digital input 5 of the Control Unit.
 When the drive unit is being commissioned, the checkback signal monitoring function must be activated.
 This is realized using parameter p0860{VECTOR} = 722.5{CONTROL UNIT}.

Motors with two electrically isolated winding systems and also motors with one winding system can be used.

- When connecting a motor with one winding system, the following special considerations must be taken into account:
 - The motor connections of the Power Modules can be connected to one another at the motor per phase. Parameter p7003 (winding system) must be set to "0" (one winding system).
 - If a motor reactor is not being used (option L08), observation of the minimum motor cable lengths is mandatory (refer to the section titled "Electrical installation").
 - Edge modulation is not possible.
- When connecting a motor with separate winding systems, the following special considerations must be taken into account:
 - Every Power Module motor connection must be connected to its own winding system.
 Parameter p7003 (winding system) must be set to "1" (multiple separate winding systems or motors).
 - Edge modulation is possible.



During connection, installation and repair work on units that are connected in parallel, it must be ensured that both sub-cabinets are electrically disconnected from the power supply.

2.3.2 Version C

This version is particularly compact in design with an in-built line reactor.

It can be used, for example, when the power supply connection components, such as the main contactor and main circuit-breaker with fuses for conductor protection and semiconductor protection, are installed in an existing central low-voltage distribution unit.

Line fuses are required for conductor protection (VDE 636, Part 10). Line fuses can also be used to protect the semi-conductors of the line-commutated converter (VDE 636, Part 40/ EN 60 269-4).

The cabinet unit simply comprises a single cabinet with a width of 400 mm, 600 mm, or 1000 mm.



Figure 2-3 Example of a cabinet unit, version C (e.g. 315 kW, 690 V 3 AC)

Wiring principle: versions A and C



1)The main switch, fuses, and main contactor functions are implemented using circuit breakers at and above an output current of > 800 A

Figure 2-4 Wiring principle: versions A and C



Circuit principle for version A, units that are connected in parallel with 6-pulse infeed, motor with one winding system









1) The main switch, fuses and main contactor functions are implemented by a main switch upwards of an output voltage > 800 A.



Device Overview

2.4 Wiring Principle



Circuit principle for version A, units that are connected in parallel with 12-pulse infeed, motor with one winding system





Drive converter cabinet units Operating Instructions, 10/2008, A5E00189855A

Circuit principle for version A, units that are connected in parallel with 12-pulse infeed, motor with separate winding systems



1)The main switch, fuses, and main contactor functions are implemented using circuit breakers at and above an output current of > 800 A.



NOTICE

The PE connection at the motor must be fed back directly to the cabinet unit.

2.5 Type plate

Specifications on the type plate



Made in EU (Germany)



Date of manufacture

The date of manufacture can be determined as follows:

| Letter/numbe r | Year of manufacture | Letter/number | Month of manufacture |
|-------------------|---------------------|---------------|----------------------|
| S | 2004 | 1 to 9 | January to September |
| Т | 2005 | 0 | October |
| U | 2006 | N | November |
| V | 2007 | D | December |
| W | 2008 | | |
| Х | 2009 | | |

Table 2-1 Production year and month

2.5 Type plate

Type plate specifications (from type plate above)

| Table 2- 2 | Specifications or | n the type plate |
|------------|--------------------|------------------|
| | opoolinoutionio ol | i the type plate |

| Specification | Value | Explanation |
|----------------------|------------------------------|--|
| Input | 3 AC 380 – 480 V 239 A | Three-phase connection Rated input voltage Rated input current |
| Output | 3 AC 0 – 480 V 210 A | Three-phase connection Rated output voltage Rated output current |
| Temperature range | 0 – 40 °C | Ambient temperature range within which the cabinet unit can operate under 100 % load |
| Degree of protection | IP20 | Degree of protection |
| Duty class | I | I: Duty class I to EN 60146-1-1 = 100 % (continuously) (with the specified current values, the cabinet unit can operate continuously under 100 % load) |
| Cooling method | AF | A: Cooling medium: air F: circulation method: forced cooling, drive unit (fan) in the device |
| Weight | | Weight of the cabinet unit |

Explanation of the option short codes

| Table 2- 3 | Explanation of the option short codes |
|------------|---------------------------------------|
| | Explanation of the option short bodes |

| | | Version A | Version C |
|---------|---|--------------|--------------|
| Input c | ptions | | |
| L00 | Line filter for use in the first environment to EN 61800-3, category C2 (TN/TT systems) | 1 | - |
| L13 | Main contactor | 1 | - |
| L22 | Line reactor not included in scope of delivery | \checkmark | ✓ |
| L23 | Line reactor uk = 2 % | ✓ | ✓ |
| L26 | Main circuit breaker (incl. fuses/circuit breakers) | \checkmark | - |
| Output | options | | |
| L08 | Motor reactor | \checkmark | - |
| L10 | dv/dt filter plus Voltage Peak Limiter | ✓ | - |
| L15 | Sine-wave filter (for 380 V – 480 V 3 AC up to 250 kW and for 500 V – 600 V 3 AC up to 132 kW only) | 1 | _ |
| Input a | nd output options | | |
| M70 | EMC shield bus | √ | ✓ |
| M75 | PE busbar | ✓ | ✓ |
| Motor | protection and safety functions | | |
| L45 | EMERGENCY OFF pushbutton installed in the cabinet door | ✓ | - |
| L57 | EMERGENCY OFF category 0, 230 V AC or 24 V DC | ✓ | - |
| L59 | EMERGENCY STOP category 1, 230 V AC | ✓ | - |
| L60 | EMERGENCY STOP category 1, 24 V AC | 1 | - |
| L83 | Thermistor motor protection unit (alarm) | ✓ | - |
| L84 | Thermistor motor protection unit (shutdown) | ✓ | - |
| L86 | PT100 evaluation unit | ✓ | - |
| L87 | Insulation monitoring | ✓ | - |
| M60 | Additional shock protection | ✓ | ✓ |
| Increa | se in degree of protection | | |
| M21 | Degree of protection IP21 | ✓ | √ |
| M23 | Degree of protection IP23 | ✓ | 1 |
| M43 | Degree of protection IP43 | ✓ | √ |
| M54 | Degree of protection IP54 | ✓ | ~ |
| Mecha | nical options | | |
| M06 | Base 100 mm high, RAL 7022 | \checkmark | 1 |
| M07 | Cable compartment 200 mm high, RAL 7035 | √ | 1 |
| M13 | Line connection from above | √ | - |
| M78 | Motor connection from above | 1 | - |
| M90 | Crane transport assembly (top-mounted) | \checkmark | \checkmark |
| Other | options | | |
| G20 | CBC10 Communication Board | √ | 1 |
| G33 | CBE20 Communication Board | ✓ | 1 |

2.5 Type plate

| | | Version A | Version C |
|---------|--|--------------|--------------|
| G61 | Customer terminal block extension TM31 | ✓ | - |
| K50 | Sensor Module Cabinet-Mounted SMC30 | ✓ | 1 |
| K51 | VSM10 Voltage Sensing Module Cabinet-Mounted | ✓ | - |
| K82 | Terminal module for controlling the "Safe Torque Off" and "Safe Stop 1" safety functions | ~ | - |
| L19 | Connection for external auxiliary equipment | ✓ | - |
| L50 | Cabinet illumination with service socket | ✓ | - |
| L55 | Cabinet anti-condensation heating | ✓ | 1 |
| L61 | 25 kW / 125 kW braking unit | √ | - |
| L62 | 50 kW / 250 kW braking unit | √ | _ |
| Y09 | Special paint finish for cabinet | √ | 1 |
| Docum | nentation (standard: English / German) | | • |
| D02 | Customer documentation (circuit diagram, terminal diagram, layout diagram) in DXF format | ✓ | ~ |
| D04 | Customer documentation as hard copy | 1 | 1 |
| D14 | Draft of customer documentation | √ | 1 |
| D58 | Documentation language: English / French | ✓ | 1 |
| D60 | Documentation language: English / Spanish | √ | 1 |
| D80 | Documentation language: English / Italian | √ | 1 |
| Langua | ages (standard: English / German) | | • |
| T58 | Rating plate data in English / French | \checkmark | ✓ |
| T60 | Rating plate data in English / Spanish | √ | 1 |
| T80 | Rating plate data in English / Italian | ✓ | 1 |
| Industr | y-specific options (chemicals) | | · |
| B00 | NAMUR terminal block | ✓ | - |
| B02 | Electrically separated 24 V power supply (PELV) | √ | _ |
| B03 | Outgoing section for external auxiliary equipment (uncontrolled) | √ | _ |
| Option | s specific to the shipbuilding industry | | · |
| M66 | Marine version | √ | ✓ |
| E11 | Individual certificate from Germanischer Lloyd (GL) | √ | 1 |
| E21 | Individual certificate from Lloyds Register (LR) | √ | 1 |
| E31 | Individual certificate from Bureau Veritas (BV) | ✓ | 1 |
| E51 | Individual certificate from Det Norske Veritas (DNV) | √ | ✓ |
| E61 | Individual certificate from American Bureau of Shipping (ABS) | 1 | 1 |
| | rter acceptance inspection in presence of customer | • | • |
| F03 | Visual acceptance | ✓ | 1 |
| F71 | Function test of the converter without motor connected | ✓ | 1 |
| F75 | Function test of the converter with test bay motor (no load) | ✓ ✓ | 1 |
| F77 | Insulation test on converter | ✓ | 1 |
| F97 | Customer-specific converter acceptance inspections (on request) | 1 | 1 |

 \checkmark indicates that this option is available for that version.

- indicates that this option is not available for that version.
Mechanical installation

3.1 Chapter content

This chapter provides information on the following:

- The conditions for transporting, storing, and installing the cabinet unit
- Preparing and installing the cabinet unit

3.2 Transportation and storage

3.2 Transportation and storage

Transportation

∕!∖warning

The following must be taken into account when the devices are transported:

- 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.

Note

Information about shipping

- The devices are packaged by the manufacturer 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.
- For transportation using forklifts, the devices must be set down on a wooden pallet.
- When the devices are unpacked, they can be transported using the optional transport eyebolts (option M90) or rails on the cabinet unit. The load must be distributed evenly. 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 Down to -40°C for max. 24 hours

Note

Notes regarding built-in line-side components

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

- The degree of protection (IP20, IP21, IP23, IP43, IP54) must not be reduced as a result.
- The electromagnetic compatibility of the cabinet unit must not be adversely affected.
- When control elements are installed on side or rear panels, these panels must be grounded separately.

3.2 Transportation and storage

Note

Notes regarding damage in transit

- Carry out a thorough visual inspection of the device before accepting the delivery from the shipping company.
- Check that you have received all the items specified on the delivery note.
- Notify the shipping company immediately of any missing components or damage.
- If you identify any hidden defects or damage, contact the shipping 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 defects and damage.
- If necessary, you can request the support of your local Siemens office.

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

Non-observance can result in death, severe personal injury or substantial property damage.

Storage

The devices must be stored in clean, dry rooms. Temperatures between –25°C and +70°C are permissible. 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. Failure to take such measures will invalidate any claims for damages under the terms of the warranty.

The device should not be stored for more than two years. If the device is stored for more than two years, its DC link capacitors must be reformed during commissioning.

The reforming procedure is described in "Maintenance and servicing".

3.3 Assembly

To ensure that the devices operate safely and reliably, they must be properly installed and commissioned by qualified personnel, taking into account the warnings provided in these operating instructions.

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

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

3.3.1 Mechanical installation: checklist

Use the following checklist to guide you through the mechanical installation procedure for the cabinet unit. Read the safety information at the start of these Operating Instructions before you start working on the device.

Note

Check the boxes accordingly in the right-hand column if the activity applies to the cabinet unit in your scope of supply. In the same way, check the boxes once you have finished the installation procedure to confirm that the activities are complete.

| Item | Activity | Fulfilled/Complete |
|------|--|--------------------|
| 1 | The ambient conditions must be permissible. See "Technical specifications, General technical specifications". | |
| | The cabinet unit must be firmly attached to the fixing points provided. With version C with a width of 400 mm, the cabinet unit can, if required, be secured to a non-flammable vertical surface by means of the wall support supplied (see "Mechanical installation/preparation"). | |
| | The cooling air can flow unobstructed. | |
| 2 | The minimum ceiling height (for unhindered air outlet) specified in the Operating Instructions must be observed. The cooling air supply must be not be obstructed (see "Mechanical installation/preparation"). | |
| 3 | Transport units separately shipped must be connected to one another (refer to Chapter "Mechanical installation / Mechanically connecting separately shipped transport units"). | |
| 4 | Components that are supplied separately for transport reasons (canopy or hood) must be fitted (see "Mechanical installation/Fitting additional canopies (option M21) or hoods (option M23/M43/M54)"). | |
| 5 | The clearance around an open door (escape route) specified in the applicable accident prevention guidelines must be observed. | |
| 6 | With option M13/M78: Choose the required metric screw connections or conduit thread connections on the basis of the cable cross-section and drill the required holes in the blanking plates. When the cable is fed in from above, ensure that enough room is available if the cable has to be bent because of the cable feeder and cross-sections. The cable entries should be fed in vertically to minimize transverse forces on the entries (see "Mechanical installation / line connection from above (option M13), motor connection from above (option M78)"). | |

3.3.2 Preparatory steps

On-site requirements

The cabinet units are designed for installation in closed, electrical operating areas in compliance with EN 61800-5-1. A closed electrical operating area is a room or area containing electrical equipment which can be accessed by trained personnel only. Access is controlled by a door or other form of barricade which can be opened only by means of a key or other tool. The room or area is also clearly signed with appropriate warning notices.

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 operation. It may be necessary to filter the air supplied to the installation room. If the air contains dust, filter mats (option M54) can be installed in front of the ventilation grilles in the cabinet doors and also in front of the hoods, if necessary. Option M54 offers additional protection against water sprayed against the housing from any direction and corresponds to degree of protection IP54.

The permissible values for climatic ambient conditions must be taken into account.

At temperatures > 40°C (104°F) and altitudes > 2000 m, the devices must be derated.

The basic version of the cabinet units complies with the IP20 degree of protection in accordance with EN 60529.

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

The cooling air for the power unit is drawn in from the front through the ventilation grilles in the lower part of the cabinet doors. The warmed air is expelled through the perforated top cover or the ventilation grilles in the top cover (with option M13/M23/M43/M54/M78). Cooling air can also be supplied from below through raised floors or air ducts, for example. To allow this, you have to create openings in the 3-section bottom plate.

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

Additional measures (e.g. line filter, option L00) can be fitted for use in the first environment to EN 61800--3 category C2.

Unpacking the cabinets

Check the delivery against the delivery note to ensure that all the items have been delivered. Check that the cabinet is intact.

The packaging material must be discarded in accordance with the applicable country-specific guidelines and rules.

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 wrench up to 50 Nm
- Screwdriver, size 2
- Screwdriver Torx T20
- Screwdriver Torx T30

3.3.3 Installation

Lifting the cabinet off the transport pallet

The applicable local guidelines regarding the transportation of the cabinet from the transport palette to the installation location must be observed.

A crane transport assembly (option M90) can also be fitted on the top of the cabinet.

The fixing screws on the transport pallet can be removed from the pallet base without having to raise the cabinet unit. The positions of the fixing screws are indicated by red markings on the outside of the pallets.

Installation

Four holes for M12 screws are provided on each cabinet panel to secure the cabinet to the ground. The fixing dimensions are specified on the dimension drawings enclosed.

Two wall supports for attaching the top of the cabinet to the wall are also supplied for 400 mm-wide cabinets to provide extra security.

3.3.4 Mechanical connection of units that are connected in parallel

The following cabinet units (units that are connected in parallel) are supplied in two separate transport units:

- 380 V 480 V 3 AC: 6SL3710-2GE41-1AA0, 6SL3710-2GE41-4AA0, 6SL3710-2GE41-6AA0
- 500 V 600 V 3 AC: 6SL3710-2GF38-6AA0, 6SL3710-2GF41-1AA0, 6SL3710-2GF41-4AA0
- 660 V 690 V 3 AC:
 6SL3710-2GH41-1AA0, 6SL3710-2GH41-4AA0, 6SL3710-2GH41-5AA0

The left-hand sub-cabinet has the locator code "+H.A24" and "+H.A49" and the right-hand sub-cabinet has the locator code "+H.A25" and "+H.A50". The cabinet operator panel is also mounted here.

Numerous connectors are provided attached loose with the equipment to mechanically connect the two sub-cabinets. These connectors should be attached and as far as possible evenly distributed.

3.3.5 Fitting additional canopies (option M21) or hoods (option M23, M43, M54)

To increase the degree of protection of the cabinets from IP20 (standard) to IP21, IP23, IP43, or IP54, additional canopies or hoods are supplied. These must be fitted once the cabinets have been installed.

Description

The degree of protection can be increased to IP21 by fitting an additional canopy. The canopy is flush-mounted with the cabinet unit and is fitted using spacers at a distance of 250 mm above the top of the cabinet. As a result, cabinets with a canopy are 250 mm higher.

Cabinet units with degree of protection IP23 are supplied with additional hoods, as well as plastic ventilation grilles and braided plastic in the air inlet (doors) and outlet (hoods). The hoods are flush with the cabinets at the side and front and have a recess at the rear so that air can escape even if the cabinet is wall mounted. Air escapes from the front and back. The hood is secured by means of the four holes for the crane hooks in the cabinet. Fitting hoods increases the height of the cabinet by 400 mm.

Cabinet units with degree of protection IP43 are supplied with additional hoods, as well as plastic ventilation grilles and close-meshed braided plastic in the air inlet (doors) and outlet (hoods). The hoods are flush with the cabinets at the side and front and have a recess at the rear so that air can escape even if the cabinet is wall mounted. Air escapes from the front and back. The hood is secured by means of the four holes for the crane hooks in the cabinet. Fitting hoods increases the height of the cabinets by 400 mm.

Compliance with degree of protection IP43 requires an intact filter medium, which must be serviced on a regular basis according to the prevailing ambient conditions.

Cabinet units with degree of protection IP54 are supplied with additional hoods, plastic ventilation grilles, and a filter medium in the air inlet (doors) and outlet (hoods). The hoods are flush with the cabinets at the side and front and have a recess at the rear so that air can escape even if the cabinet is wall mounted. Air escapes from the front and back. The hood is secured by means of the four holes for the crane hooks in the cabinet. Hoods increase the height of the cabinet by 400 mm.

Compliance with degree of protection IP54 requires an intact filter medium, which must be replaced on a regular basis according to the prevailing ambient conditions. Filters can be fitted and replaced from outside the cabinet relatively easily.

Attaching a canopy to increase the degree of protection to IP21 (option M21)

- 1. Remove the crane transport assembly (if fitted).
- 2. Attach the spacers to the roof of the cabinet at the positions specified. You may have to remove the protective grille.
- 3. Fit the canopy to the spacers.

NOTICE

In order to prevent water dripping into the spaces between the cabinet units connected in series, there are "drain channels" on the sides of the canopies. When fitting the canopies, make sure that the "drain channels" interlock.



Figure 3-1 Fitting a canopy

Fitting a hood to increase the degree of protection to IP23/IP43/IP54 (option M23/M43/M54)

- 1. Remove the crane transport assembly (if fitted).
- 2. Make sure that a perforated top cover is not fitted on the top of the cabinet (depending on production requirements, this can be fitted at a later stage).
- Options M43 and M54 only: Use the sealing tape provided to attach the contact surfaces of the hood to the top of the cabinet.
- 4. Fit the hood to the roof of the cabinet at the positions specified (fixing points for the crane transport assembly).



Figure 3-2 Attaching a hood

3.3.6 Line connection from above (option M13), motor connection from above (option M78)

Description

With options M13 and M78, the cabinet unit is equipped with an additional hood. The connection straps for the power cables, the clamping bar for mechanically securing the cables, an EMC shield bus, and a PE busbar are located within the hood.

The hood adds an extra 405 mm to the cabinet height. The busbars for connection from above are fully mounted when the system is delivered. For transport reasons, the hoods are delivered separately and must be mounted on site. With options M23, M43 and M54, plastic ventilation grilles and filter mats are also supplied.

A 5 mm aluminum mounting plate (with no holes) is fitted in the roof of the cover for feeding in the cables. Depending on the number of cables and the cross-sections used, holes for attaching cable glands for feeding in the cables must be drilled in this mounting plate on site.

Note

The control cables and optional brake resistors are connected as before from below.

Attaching the Hood

- 1. Remove the crane transport assembly (if fitted).
- Options M43 and M54 only: Use the sealing tape provided to attach the contact surfaces of the hood to the top of the cabinet.
- 3. Fit the hood to the roof of the cabinet at the positions specified (fixing points for the crane transport assembly).
- 4. To secure the power cables, remove the front panel of the hood.



Figure 3-3 Attaching the hood with M13 / M78

Electrical installation

4.1 Chapter content

This chapter provides information on the following:

- Establishing the electrical connections for the cabinet unit
- Adjusting the fan voltage and the internal power supply to local conditions (supply voltage)
- The customer terminal block and its interfaces
- The interfaces for additional options

4.2 Checklist for electrical installation

4.2 Checklist for electrical installation

Use the following checklist to guide you through the electrical installation procedure for the cabinet unit. Read the safety information at the start of these Operating Instructions before you start working on the device.

Note

Check the boxes accordingly in the right-hand column if the activity applies to the cabinet unit in your scope of supply. In the same way, check the boxes once you have finished the installation procedure to confirm that the activities are complete.

| Item | Activity | Fulfilled/Complete |
|-------|--|--------------------|
| Power | connections | |
| 1 | The electrical connections of the two sub-cabinets must be established for transport units that have been shipped separately (refer to "Electrical installation / Power connections / Electrical connection of separately shipped transport units"). | |
| 2 | The line-side and motor-side power cables must be dimensioned and routed in accordance with the ambient and routing conditions. The maximum permissible cable lengths between the converter and motor must be observed depending on the type of cable used (see "Electrical installation / Power connections / Connection cross-sections and cable lengths"). | |
| | The PE ground at the motor must be fed back directly to the cabinet unit. | |
| | The cables must be properly connected with a torque of 50 Nm to the cabinet unit terminals. The cables for the motor and low-voltage switchgear must also be connected with the required torques. | |
| 3 | For units that are connected in parallel, the connecting cables (-W001, -W002) for the DC links on the two sub-cabinets must be closed (see "Electrical installation / Power connections / Connection of DC link connectors"). | |
| 4 | The cables between the low-voltage switchgear and the cabinet unit must be protected with line fuses to provide adequate conductor protection (VDE 636, Part 10). With version C, combined fuses must be used for conductor and semi-conductor protection (VDE 636, Part 40 / EN 60269-4). See "Technical specifications" for the appropriate fuses. | |
| 5 | For strain relief, the cables must be clamped on the cable propping bar (C-type mounting bar). | |
| 6 | When EMC-shielded cables are used, screwed glands that connect the shield to ground with the greatest possible surface area must be provided on the motor terminal box. On the cabinet, the cables must be grounded with the clips supplied with the EMC shield bus with the greatest possible surface area (shield bus supplied with option L00 or can be ordered separately with option M70 – see "Electrical installation / EMC-compliant installation"). | |
| 7 | The cable shields must be properly applied and the cabinet properly grounded at the appropriate points (see "Electrical installation / EMC-compliant installation"). | |
| 8 | The voltage for the fan transformer (-T1-T10) for versions A and C, and the internal power supply (-A1-T10) for version A (only with option L13, L26, L83, L84, L86, L87) must be adapted to the supply voltage for the cabinet unit. Larger cabinet units have 2 fan transformers (-T1 -T10/-T20), which must be set jointly. For units that are connected in parallel, the fan transformers must be set jointly in each sub-cabinet (see section "Electrical installation / Power connections / Adjusting the fan voltage (-T 1-T10)" and "Electrical installation / Power connections / Adjusting the internal power supply (-A1 -T10)"). | |

Electrical installation

| Item | Activity | | | omplete |
|------|---|--|--------|---------|
| 9 | Before the cabinet is operated from a non-grounded supply/IT system, the connection bracket for the basic interference suppression device must be removed (see "Electrical installation / Power connections / Removing the connection bracket for the interference suppression capacitor with operation from a non-grounded supply"). | | | |
| 10 | date of manufact years, the DC lin than two years, th | an be used to ascertain the date of manufacture. If the period from the ure to initial commissioning or the cabinet unit downtime is less than two k capacitors do not have to be re-formed. If the downtime period is longer hey must be reformed in accordance with the description found in the ance and servicing / Reforming the DC link capacitors". | | |
| 11 | terminal –X40, w | auxiliary supply, the cable for the 230 V AC supply must be connected to hile the cable for the 24 V DC supply must be connected to terminal –X9 installation / Power connections / External supply of the auxiliary supply e"). | | |
| 12 | Option L10 dv/dt filter plus Voltage Peak Limiter | During commissioning, the filter must be selected via STARTER or AOP30. You are advised to check the selection by ensuring that p0230 is set to 2. The required parameters are set automatically (see "Electrical installation / Other connections / dv/dt filter plus Voltage Peak Limiter (option L10)"). | | |
| 13 | Option L15 Sine-wave filter | During commissioning, the filter must be selected via STARTER or AOP30. You are advised to check the selection by ensuring that p0230 is set to 3. The required parameters are set automatically (see "Electrical installation / Other connections / Sine-wave filter (option L15)"). | | |
| 14 | Option L19 Connection for external auxiliary equipment | To supply auxiliary equipment (e.g. separately-driven fan for motor), the drive must be properly connected to terminals -X155:1 (L1) to -X155:3 (L3). The supply voltage of the auxiliary equipment must match the input voltage of the cabinet unit. The load current must not exceed 10 A and must be set at -Q155 in accordance with the load connected (see "Electrical installation / Other connections / Connection for external auxiliary equipment (option L19)"). | Set va | alue: |
| 15 | Option L26 Main circuit breaker (incl. fuses/circuit breakers) | In equipment with main circuit breaker, the release current must be set to match the installation requirements (see "Electrical Installation / Other connections / Main switch incl. fuses or main circuit breaker (option L26)"). | | |
| 16 | Option L50 Cabinet illumination with service socket | The 230 V auxiliary supply for the cabinet illumination with an integrated service socket must be connected to terminal -X390 and protected with a fuse (max. 10 A) on the line side (see "Electrical installation / Other connections / Cabinet illumination with service socket (option L50)"). | | |
| 17 | Option L55 Cabinet anti- condensation heating | The 230 V auxiliary supply for the anti-condensation heating for the cabinet (230 V / 50 Hz, 100 W / or 230 V / 50 Hz 2 x 100 W for cabinets with a width of 800 to 1200 mm) must be connected to terminals -X240: 1 to 3 and protected with fuses (max. 16 A) (see "Electrical installation / Other connections / Anti-condensation heating for cabinet (option L55)"). | | |

4.2 Checklist for electrical installation

| ltem | Activity | | | Fulfilled/Complete | | |
|--------|--|---|--|--------------------|--|--|
| Signal | gnal connections | | | | | |
| 18 | Cabinet unit operation by higher-level controller / control room. The control cables must be connected in accordance with the interface assignment and the shield applied. Taking into account electrical interference and the distance from power cables, the digital and analog signals must be routed with separate cables. When the analog inputs on the customer terminal block are used as current or voltage | | | | | |
| | | S5.0 and S5.1 must be set accordingly (see "Electrical installation / Signal stomer terminal block (-A60)"). | | | | |
| 19 | Option K50 Sensor Module Cabinet- | The SMC30 Sensor Module is used for determining the actual motor speed. In conjunction with SINAMICS G150, the following encoders are | | | | |
| | Mounted SMC30 | supported by the SMC30 Sensor Module: | | | | |
| | | TTL encoderHTL encoder | | | | |
| | | The motor temperature can also be detected using KTY84-130 or PTC thermistors. | | | | |
| | | In the factory setting, an HTL encoder is bipolar with 1024 pulses per revolution (see "Electrical installation / Other connections / SMC30 Sensor Module Cabinet-Mounted (option K50)"). | | | | |
| Conne | ecting protection a | nd monitoring devices | | | | |
| 20 | Option L45 EMERGENCY OFF pushbutton installed in the cabinet door | The contacts for the EMERGENCY OFF pushbutton are available at terminal -X120 and can be picked off so that they can be integrated in a higher-level line-side protection concept ("Electrical installation / Other connections / EMERGENCY OFF pushbutton, integrated in the door of the cabinet unit (option L45)"). | | | | |
| 21 | Option L57 EMERGENCY OFF category 0, 230 V AC or 24 V DC | EMERGENCY OFF category 0 stops the drive in an uncontrolled manner. No additional wiring is necessary when implemented in conjunction with option L45. If the cabinet unit is integrated in an external safety circuit, however, the contact must be looped in via terminal block -X120 ("Electrical installation / Other connections / EMERGENCY OFF category 0, 230 V AC / 24 V DC (option L57)"). | | | | |
| 22 | Option L59 EMERGENCY STOP category 1, 230 V AC | EMERGENCY STOP category 1 stops the drive in a controlled manner. With this option, braking units (brake chopper and external braking resistors) may need to be implemented due to the load characteristic and to achieve the required shutdown times. No additional wiring is necessary when implemented in conjunction with option L45. If the cabinet unit is integrated in an external safety circuit, however, the contact must be looped in via terminal block -X120. The timer relay at - K121 must be adapted to match system requirements (see "Electrical installation / Other connections / EMERGENCY STOP category 1, 230 V AC (option L59)"). | | | | |

Electrical installation

4.2 Checklist for electrical installation

| Item | Activity | | Fulfilled/Complete |
|------|---|---|--------------------|
| 23 | Option L60 EMERGENCY STOP category 1, 24 V AC | EMERGENCY STOP category 1 stops the drive in a controlled manner. With this option, braking units (brake chopper and external braking resistors) may need to be implemented due to the load characteristic and to achieve the required shutdown times. No additional wiring is necessary when implemented in conjunction with option L45. If the cabinet unit is integrated in an external safety circuit, however, the contact must be looped in via terminal block -X120. The timer relay at - K120 must be adapted to match system requirements (see "Electrical installation / Other connections / EMERGENCY STOP category 1, 24 V AC (option L60)"). | |
| 24 | Option L61/L62 25 kW/125 kW 50 kW/250 kW braking unit | The connecting cables and ground for the braking resistor must be connected to terminal block –X5: 1/2. A connection must be established between the braking resistor thermostatic switch and customer terminal block –A60. When commissioning via AOP30, the settings for evaluating "external fault 3" must be made. The settings for evaluating the thermostatic switch as "external fault 2" must be made (see "Electrical installation / Other connections / Braking unit 25 kW / 125 kW (option L61); braking unit 50 kW / 250 kW (option L62)"). | |
| 25 | Option L83 Thermistor motor protection device (alarm) | The PTC thermistor sensors (PTC resistor type A) must be connected to the thermistor motor protection unit -F127 at terminals T1 and T2 for alarms (see "Electrical installation / Other connections / Thermistor motor protection device (option L83/L84)"). | |
| 26 | Option L84 Thermistor motor protection device (shutdown) | The PTC thermistor sensors (PTC resistor type A) must be connected to the thermistor motor protection unit -F125 at terminals T1 and T2 for shutdown (see "Electrical installation / Other connections / Thermistor motor protection device (option L83/L84)"). | |
| 27 | Option L86 PT100 evaluation unit | The resistor thermometers must be connected to evaluation unit -B140 for the PT100 evaluation. A two-wire or three-wire system can be used here to connect the PT100 sensors. The sensors are divided into two groups (see "Electrical installation / Other connections / PT100 evaluation unit (option L86)"). This must be taken into account for the evaluation (factory setting). | |
| 28 | Option L87 Insulation monitoring | The insulation monitor can only be operated from an insulated network. Only one insulation monitor can be used in an electrically-connected network. For line-side control, the signaling relays must be connected accordingly or, with individual drives (the cabinet unit is fed via a converter transformer assigned to the cabinet unit), integrated in the cabinet unit alarm train (see "Electrical installation / Other connections / Insulation monitoring (option L87)"). Point 9 must also be taken into account: "Before the cabinet is operated from an ungrounded supply/IT system, the connection bracket for the basic interference suppression device must be removed" (see "Electrical installation / Power connections / Removing the connection bracket for the interference suppression capacitor with operation from an ungrounded supply"). | |

4.2 Checklist for electrical installation

| Item | Activity | | Fulfilled/C | Complete |
|--------|---|--|-------------|----------|
| Safety | ^r Integrated | | | |
| 29 | Option K82 "Safe Torque Off" and "Safe Stop 1" safety functions | The terminal block -X41 must be connected line-side, the safety functions must be activated prior to use via parameter assignment, in addition an acceptance test must be performed and an acceptance log must be created (see section "Electrical installation / Other connections / Terminal module for activating "Safe Torque Off" and "Safe Stop 1" (option K82)"). | | |

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 wrench up to 50 Nm
- Screwdriver, size 2
- Screwdriver Torx T20
- Screwdriver Torx T30

4.3 Important safety precautions



The cabinet units are operated with high voltages.

All connection procedures must be carried out when the cabinet is de-energized. All work on the device must be carried out by trained personnel only.

Non-observance of these warning notices can result in death, severe personal injury or substantial property damage.

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 device up to five minutes after it has been disconnected due to the DC link capacitors. For this reason, the unit should not be opened until 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, its DC link capacitors must be reformed during commissioning. The reforming procedure is described in "Maintenance and servicing".

The operator is responsible for ensuring that the motor, converter, and other devices are installed and connected in accordance with recognized engineering practice in the country of installation and in compliance with applicable regional regulations. 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 fault current may have been disconnected. To reduce the risk of fire or an electric shock, the current-conducting 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

Standard cabinet units are equipped with touch protection to BGV A3 in accordance with DIN 57 106, Part 100/VDE 0106, Part 100 (Germany).

The version with option M60 features additional protective covers that offer a higher level of touch protection for current-conducting parts when the cabinet doors are open. These protective covers may have to be removed during installation and connection procedures. Once work has been completed, the protective covers must be properly refitted.

Note

On ungrounded systems and systems with a grounded phase conductor and a line voltage >600 VAC, measures must be taken on the line side to limit overvoltages to overvoltage category II in accordance with IEC 60664-1.

CAUTION

Only original DRIVE-CLiQ cables may be used for wiring the DRIVE-CLiQ nodes.

4.4 Introduction to EMC

What is meant by 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 feature for the

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

To ensure that the cabinet unit functions satisfactorily in the system, the environment subject to interference must not be neglected. For this reason, special requirements exist regarding the structure and the EMC of the system.

Operational reliability and noise immunity

In order to achieve the greatest possible operational reliability and immunity to noise of a complete system (converter, automation, drive machines etc.), measures must be taken by the converter manufacturer and the user. Only when all these measures are fulfilled can the faultless functioning of the converter be guaranteed and the specified legal requirements (2004/108/EC) be met.

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.



Figure 4-1 Definition of the first and second environments

| First environment | C1 | |
|----------------------|----|-------------|
| | C2 | Second |
| | C3 | environment |
| | C4 | |

Figure 4-2 Definition of categories C1 to C4

| Table 4- 1 | Definition of the first and second environments |
|------------|---|
| | |

| Definition of the first and second environments | | |
|--|---|--|
| First environment | Residential buildings or locations at which the drive system is connected to a public low-voltage supply network without a transformer. | |
| Second environment Industrial locations supplied by a medium-voltage network via a separate transformer. | | |

Table 4-2 Definition of categories C1 to C4

| Definition of categories C1 to C4 | | |
|--|--|--|
| Category C1 | Rated voltage <1000 V; unrestricted use in the first environment. | |
| Category C2 | Rated voltage for stationary drive systems <1000 V; for use in the second environment. For use in the first environment only when sold and installed by skilled personnel. | |
| Category C3 | Rated voltage <1000 V; use in the second environment only. | |
| Category C4 Rated voltage ≥1000 V or for rated currents ≥ 400 A in complex systems the second environment. | | |

4.5 EMC compliant design

4.5 EMC compliant design

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

cabinet assembly

- 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 signal cables and motor cables in parallel to each other.

Use anti-interference elements

- Lay an equalizing cable parallel to the control cable (the cable cross-section must be at least 16 mm²).
- 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.
- All cables are to be laid as close as possible to grounded enclosure parts such as mounting plates or cabinet frames. This reduces both noise radiation and interference injection.
- Reserve cores of signal and data cables must be grounded at both ends to achieve an additional shielding effect.
- Long cables should be shortened or laid in noise resistant areas to avoid additional connecting points.

- If it is impossible to avoid crossing cables, 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 interfaces, 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 interfacing

- 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, the device is equipped with a radio interference suppression filter as standard (in accordance with the limit values defined in category C3). Optional filters can be fitted for use in the first environment (category C2).

4.6 Electrical connection of units that are connected in parallel

Protective ground conductors

 According to EN 61800-5-1, Section. 6.3.6.7, the minimum cross-section of the protective ground conductor must conform to the local safety regulations for protective ground conductors for equipment with a high leakage current.

4.6 Electrical connection of units that are connected in parallel

Description

After the mechanical installation has been completed, the following electrical connections must be established between the right-hand and left-hand sub-cabinets for units that are connected in parallel:

- The PE buses must be connected
- Connecting the DC link connections
- The 24 V DC, 230 V AC power supply and signal cables must be connected
- The DRIVE-CLiQ topology must be connected



During connection, installation and repair work on units that are connected in parallel, it must be ensured that both sub-cabinets are electrically disconnected from the power supply.

4.6.1 Connecting the PE busbars

Connecting the PE buses

A connector jumper is provided loose to connect the PE buses of the two sub-cabinets.

Establishing the connection

- 1. At the right-hand side of the left sub-cabinet release 1 x M12 nut of the PE rail, remove the nut, washer and screw.
- 2. At the left-hand side of the right sub-cabinet release 1 x M12 nut of the PE rail, remove the nut, washer and screw.
- 3. Locate the connecting jumper at the PE rails of the sub-cabinets to be connected.
- 4. Insert the bolts from the front into the grounding lugs of the PE buses.
- 5. Re-locate the washers and nuts.
- 6. Tighten the nuts (tightening torque: 50 Nm).

4.6 Electrical connection of units that are connected in parallel

4.6.2 Establishing the DC link connections

Connecting the DC link connections

The DC link connection on the two sub-cabinets must be made using preassembled cables; these must be connected from the left-hand sub-cabinet (+H.A49) to the right-hand sub-cabinet (+H.A25/50).

Under no circumstances may the connections be interchanged or short-circuited!

The cabinet unit will be destroyed if the DC link connections are either interchanged or short-circuited!

The following connecting cables must be connected:

- DCPS (cable number -W001 in sub-cabinet +H.A49) to +H.A25/50 DCPS
- DCNS (cable number -W002 in sub-cabinet +H.A49) to +H.A25/50 DCNS

4.6.3 Connecting the power supply and signal cables

Connecting-up the power supply and the signal cables

The connecting cables for 24 V DC and 230 V AC to supply the left-hand sub-cabinet with power and for the signal cables must be connected. Depending on the installed options, this will involve up to 3 connecting cables that must be connected from the right-hand sub-cabinet (cabinet panel +H.A25) to the lower connector sections in the left-hand sub-cabinet (cabinet panel +H.A24):

- Connecting cable with the connector designation –A1–X97 in the lower connector section -A1–X97.
- Connecting cable with the connector designation –A1–X98 in the lower connector section -A1–X98.
- Connecting cable with the connector designation –A1–X99 in the lower connector section -A1–X99.

The cables must be routed so that power cables cannot interfere with data and signals that are being transferred along the connecting cables.

4.6.4 Connecting the DRIVE-CLiQ topology

Connecting-up the DRIVE-CLiQ topology

The DRIVE-CLiQ connection from the Power Module in the left-hand sub-cabinet (cabinet field +H.A49) to the Control Unit CU320 (cabinet field +H.A50).

The connecting cable (cable number –W003) is inserted in the Power Module in the plant and must be inserted in the DRIVE-CLiQ socket –X102 of the Control Unit. The cables must be routed so that power cables cannot cause interference on the DRIVE-CLiQ connection. 4.7 Power connections

4.7 Power connections

Swapping the input and output terminals can destroy the device!

Swapping or short-circuiting the DC link terminals can destroy the device!

The contactor and relay operating coils that are connected to the same supply network as the device or are located near the device must be connected to overvoltage limiters (e.g. RC elements).

The device must not be operated via a residual current operated device (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 device are specified in the tables provided in the "Technical specifications" 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 listed cable length represents the actual distance between the converter and the motor, taking account factors such as parallel laying, current-carrying capacity, and the 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 cable lengths specified are also valid if a motor choke is in use (option L08).

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 EN61800-3 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.

Minimum motor cable lengths for connection to a motor with one-winding system for units that are connected in parallel

For units that are connected in parallel for a connection to a motor with one-winding system, it must be ensured that the motor cable lengths are kept to a minimum if a motor reactor (option L08) is not being used.

| Order number | Type performance [kW] | Minimum cable length [m] | | | |
|--------------------|-----------------------|--------------------------|--|--|--|
| | 380 V – 480 V 3 AC | | | | |
| 6SL3710-2GE41-1AA0 | 630 | 13 | | | |
| 6SL3710-2GE41-4AA0 | 710 | 10 | | | |
| 6SL3710-2GE41-6AA0 | 900 | 9 | | | |
| | 500 V – 600 V 3 AC | | | | |
| 6SL3710-2GF38-6AA0 | 630 | 18 | | | |
| 6SL3710-2GF41-1AA0 | 710 | 15 | | | |
| 6SL3710-2GF41-4AA0 | 1000 | 13 | | | |
| | 660 V – 690 V 3 AC | | | | |
| 6SL3710-2GH41-1AA0 | 1000 | 20 | | | |
| 6SL3710-2GH41-4AA0 | 1350 | 18 | | | |
| 6SL3710-2GH41-5AA0 | 1500 | 15 | | | |

Table 4-3 Minimum cable lengths

4.7.2 Connecting the motor and power cables

Connecting the motor and power cables on the cabinet unit

Note

For the location of the connections, see the layout diagrams.

- Open the cabinet, remove the covers (if necessary) 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. Move or remove the bottom plate below the connection panel through which the motor cables are fed.
- 3. Screw the protective earth (PE) into the appropriate terminal (with earth symbol) (50 Nm for M12) at the points provided in the cabinet.

Note

With version C, connect the power cables first and then the motor cables.

 Connect the motor cables to the connections. Make sure that you connect the conductors in the correct sequence: U2/T1, V2/T2, W2/T3 and U1/L1, V1/L2, W1/L3! 4.7 Power connections

CAUTION

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

Note

The PE connection on the motor must be guided back directly to the cabinet unit and connected there.

Direction of motor rotation

With induction machines with a clockwise phase sequence (looking at the drive shaft), the motor must be connected to the cabinet unit as follows.

| Cabinet unit (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 rotating field was connected when the cables were installed, and the rotating field cannot be corrected by swapping the motor cables, it can be corrected when commissioning the drive via p1821 (rotating field direction reversal) by changing the rotating field and thus enabling a direction reversal (see section "Functions, Monitoring and protective functions / Direction reversal").

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 cabinet unit.

4.7.3 Adjusting the fan voltage (-T1-T10)

The power supply for the device fan (230 V 1 AC) in the Power Module (-T1- T10) is taken from the main supply system using a transformer.

The location of the transformer is indicated in the layout diagrams supplied.

The transformer is fitted with primary taps so that it can be fine-tuned to the line voltage.

If necessary, the connection fitted in the factory, shown with a dashed line, must be reconnected to the actual line voltage.

Note

Two transformers (-T1, -T10, and -T20) are installed in the following cabinet units. The two primary terminals on these devices must be set together.

- With 380 V 480 V 3 AC: 6SL3710-1GE41-0_A0
- With 500 V 600 V 3 AC: 6SL3710-1GF37-4_A0, 6SL3710-1GF38-1_A0
- With 660 V 690 V 3 AC: 6SL3710-1GH37-4_A0, 6SL3710-1GH38-1_A0

Note

For units that are connected in parallel, the setting terminals must be set jointly in both subcabinets:

- With 380 V 480 V 3 AC: 6SL3710-2GE41-1AA0, 6SL3710-2GE41-4AA0, 6SL3710-2GE41-6AA0
- With 500 V 600 V 3 AC: 6SL3710-2GF38-6AA0, 6SL3710-2GF41-1AA0, 6SL3710-2GF41-4AA0
- With 660 V 690 V 3 AC: 6SL3710-2GH41-1AA0, 6SL3710-2GH41-4AA0, 6SL3710-2GH41-5AA0



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

The line voltage assignments for making the appropriate setting on the fan transformer are indicated in the following tables.

Note

With the 660 V – 690 V 3 AC fan transformer, a jumper is inserted between the "600 V" terminal and "CON" terminal. The "600V" and "CON" terminals are for internal use.

CAUTION

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

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

4.7 Power connections

Note

The order numbers for fan fuses that have blown can be found in the spare parts list.

Table 4- 5Line voltage assignments for setting the fan transformer
(380 V - 480 V 3 AC)

| Line voltage | Taps of the fan transformer (-T1- T10) |
|--------------|--|
| 380 V ± 10% | 380 V |
| 400 V ± 10% | 400 V |
| 440 V ± 10% | 440 V |
| 480 V ± 10% | 480 V |

Table 4- 6Line voltage assignments for setting the fan transformer
(500 V - 600 V 3 AC)

| Line voltage | Taps of the fan transformer (-T1- T10) | | |
|--------------|--|--|--|
| 500 V ± 10% | 500 V | | |
| 525 V ± 10% | 525 V | | |
| 575 V ± 10% | 575 V | | |
| 600 V ± 10% | 600 V | | |

Table 4-7 Line voltage assignments for setting the fan transformer (660 V - 690 V 3 AC)

| Line voltage | Taps of the fan transformer (-T1- T10) | | |
|--------------|--|--|--|
| 660 V ± 10% | 660 V | | |
| 690 V ± 10% | 690 V | | |

4.7.4 Adjusting the internal power supply (-A1 -T10, version A only)

A transformer (-A1-T10) is installed for the internal 230 V AC power supply for the cabinet unit. The location of the transformer is indicated in the layout diagrams supplied.

When delivered, the taps are always set to the highest level. The line-side terminals of the transformer may need to be reconnected to the existing line voltage.

The line voltage assignments for making the appropriate setting on the transformer for the internal power supply are indicated in the following tables.

NOTICE

If the terminals are not reconnected to the actual line voltage, the internal power supply will not be correct.

Table 4- 8Line voltage assignments for the internal power supply
(380 V - 480 V 3 AC)

| Line voltage range | Тар | Taps of voltage adaptation transformer (-A1-T10) LH1 – LH2 | | |
|--------------------|-------|--|--|--|
| 342 V – 390 V | 380 V | 1 - 2 | | |
| 391 V – 410 V | 400 V | 1 – 3 | | |
| 411 V – 430 V | 415 V | 1 – 4 | | |
| 431 V – 450 V | 440 V | 1 – 5 | | |
| 451 V – 470 V | 460 V | 1 – 6 | | |
| 471 V – 528 V | 480 V | 1 – 7 | | |

Table 4- 9Line voltage assignments for the internal power supply
(500 V - 600 V 3 AC)

| Line voltage range | Тар | Taps of voltage adaptation transformer (-A1-T10) LH1 – LH2 | | |
|--------------------|-------|--|--|--|
| 450 V – 515 V | 500 V | 1 - 8 | | |
| 516 V – 540 V | 525 V | 1 – 9 | | |
| 541 V – 560 V | 550 V | 1 – 10 | | |
| 561 V – 590 V | 575 V | 1 – 11 | | |
| 591 V – 670 V | 600 V | 1 – 12 | | |

Table 4- 10Line voltage assignments for the internal power supply
(660 V - 690 V 3 AC)

| Line voltage range | Тар | Taps of voltage adaptation transformer (-A1-T10) LH1 – LH2 | | |
|--------------------|-------|--|--|--|
| 591 V – 630 V | 600 V | 1 – 12 | | |
| 631 V – 680 V | 660 V | 1 – 14, terminals 12 and 13 are jumpered | | |
| 681 V – 759 V | 690 V | 1 – 15, terminals 12 and 13 are jumpered | | |

4.7 Power connections

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

If the cabinet unit is operated on a non-grounded system/IT system, the connection bracket for the converter's interference suppression capacitor (-T1) must be removed.



Unscrew the M4 (Torx T20) screws and remove the connection bracket.

Figure 4-4 Removing the connection bracket for the interference suppression capacitor

Failing to remove the connection bracket for the interference suppression capacitor on a non-grounded system/IT system can cause significant damage to the cabinet unit.

Note

For units that are connected in parallel, the connection bracket must be removed in both sub-cabinets:

- With 380 V 480 V 3 AC: 6SL3710-2GE41-1AA0, 6SL3710-2GE41-4AA0, 6SL3710-2GE41-6AA0
- With 500 V 600 V 3 AC: 6SL3710-2GF38-6AA0, 6SL3710-2GF41-1AA0, 6SL3710-2GF41-4AA0
- With 660 V 690 V 3 AC: 6SL3710-2GH41-1AA0, 6SL3710-2GH41-4AA0, 6SL3710-2GH41-5AA0

4.8 External Supply of the Auxiliary Supply from a Secure Line

4.8 External Supply of the Auxiliary Supply from a Secure Line

Description

An external auxiliary supply 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.

When the external auxiliary supply is connected, dangerous voltages are present in the cabinet unit even when the main circuit-breaker is open.

NOTICE

An external auxiliary supply (infeed) must always be used if the automatic restart (WEA) function is to be used with integrated EMERGENCY OFF option (L57) or EMERGENCY STOP option (L59, L60).

Otherwise, the automatic restart function does not work.

Table 4-11 Connection options for the external auxiliary voltage depending on the selected options.

| Cabinet unit option | External supply of auxiliary voltage independent of the main supply | | | supply |
|---------------------------|---|---------------------------|---|--|
| | 24 V DC Terminal –X9 | 230 V AC Terminal –X40 | 230 V AC (terminal –X40) ¹⁾ | 230 V AC (terminal –X40) with options L13 / L26 (when I > 800 A) |
| - With no further options | x | | | |
| - Version C | | | | |
| L13 | | Х | | |
| L26 (when I > 800 A) | | Х | | |
| L83 | | | Х | Х |
| L84 | | | Х | Х |
| L86 | | | Х | Х |
| L87 | | | Х | Х |

¹⁾ This is required not only when the open and closed-loop control but also when the 230 V AC load (thermistor motor protection, PT100 evaluation, or insulation monitor) is to remain in operation if the main supply fails.

4.8 External Supply of the Auxiliary Supply from a Secure Line

4.8.1 230 V AC auxiliary supply

The maximum fuse rating is 16 A.

The connection is protected inside the cabinet with 3 A or 5 A.

Connection

- On terminal block -X40, remove the jumpers between terminals 1 and 2 as well as 5 and 6.
- Connect the external 230 V AC supply to terminals 2 (L1) and 6 (N).

4.8.2 24 V DC auxiliary supply

The power requirement is 5 A.

Connection

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

4.9 Signal connections

4.9.1 Customer terminal block (-A60)

Note

The factory setting and description of the customer terminal blocks can be found in the circuit diagrams.

The location of the customer terminal block in the cabinet unit is indicated in the layout diagram.

Shield connection

The shield connection of shielded control cables on the customer terminal block –A60 is established in the immediate vicinity of the terminal block. For this purpose, the customer terminal block –A60 and the mounting plates have cut-out sections which are used to snap the enclosed shield springs into place. The shields of incoming and outgoing cables must be applied directly to these shield connections. It is important here to establish the greatest possible area of contact and a good conductive connection.

Note

These shield springs can be used for all control cables in the cabinet unit because all the shield connections are identical in design.



Figure 4-5 Shield connection

Electrical installation

4.9 Signal connections

Overview




Electrical installation

4.9 Signal connections



Figure 4-7 Connection overview of TM31 customer terminal block

4.9 Signal connections

Note

The digital inputs (terminals -X520 and -X530) in the example are powered by the internal 24 V supply of the customer terminal block (terminal -X540).

The two groups of digital inputs (optocoupler inputs) have a common reference potential for each group (ground reference M1 or M2). 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 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 in order to avoid potential rounding. The external ground must then be connected to terminals M1 and M2.

X520: 4 digital inputs

| | Terminal | Designation 1) | Technical specifications | |
|----------------------------|----------|--|---|--|
| 2 DI 1 2 DI 2 3 DI 2 | 1 | DI 0 | Voltage: - 3 V to 30 V | |
| | 2 | DI 1 | Typical current consumption: 10 mA at 24 V | |
| | 3 | DI 2 | Reference potential is always terminal M1 Level: | |
| | DI 3 | - high level: 15 V to 30 V - low level: -3 V to 5 V | | |
| Б П | 5 | M1 | Ground reference | |
| | 6 | M | Electronics ground | |

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

Max. connectable cross-section: 1.5 mm²

Note

An open input is interpreted as "low".

X530: 4 digital inputs

Table 4-13 Terminal block X530

| | Terminal | Designation 1) | Technical specifications | |
|--|----------------------------|----------------|--------------------------|--|
| | 1 | DI 4 | | |
| | 2 | DI 5 | | |
| | 3 | DI 6 | | |
| | - high level: 15 V to 30 V | | | |
| | 5 | M2 | Ground reference | |
| | 6 | М | Electronics ground | |

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

Max. connectable cross-section: 1.5 mm²

Note

An open input is interpreted as "low".

X521: 2 analog inputs (differential inputs)

Table 4- 14 Terminal block X521

| | Terminal | Designation 1) | Technical specifications |
|--|----------|----------------|--|
| 1 AI 0+ As voltage input: 2 AI 0- -10 V - +10 V, Ri = 100 kΩ | 1 | AI 0+ | As voltage input: |
| | | | |
| l ∞ 🖽 | 3 | AI 1+ | Resolution: 11 bits + sign |
| 4 5 6 | 4 | AI 1- | As current input: +4 mA - +20 mA / -20 mA - +20 mA / 0 mA - +20 mA, Ri = 250 Ω Resolution: 10 bits + sign |
| | 5 | P10 | Auxiliary voltage +10 V, continued short-circuit proof |
| B B B | 6 | М | Ground reference |
| | 7 | N10 | Auxiliary voltage -10 V, continued short-circuit proof |
| | 8 | М | Ground reference |

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

Max. connectable cross-section: 1.5 mm²

CAUTION

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

4.9 Signal connections

S5: Selector for voltage/current Al0, Al1

Table 4-15 Selector for voltage/current S5

| | Switch | Function |
|----------------------|--------|--|
| | S5.0 | Selector voltage (V) / current (I) Al0 |
| V I S5.0 V I S5.1 | S5.1 | Selector voltage (V) / current (I) Al1 |

Note

When delivered, both switches are set to current measurement (switch set to "I").

X522: 2 analog outputs, temperature sensor connection

Table 4- 16 Terminal block X522

| | Terminal | Designation 1) | Technical specifications |
|---------------------------|----------|----------------|---|
| | 1 | AO 0V+ | -10 V - +10 V (max. 3 mA) |
| | 2 | AO 0- | +4 mA - +20 mA (max. load resistance \leq 500 Ω) |
| l a 🖂 | 3 | AO 0C+ | -20 mA - +20 mA (max. load resistance \leq 500 Ω) |
| 5₩ | 4 | AO 1V+ | 0 mA - +20 mA (max. load resistance \leq 500 Ω) |
| | 5 | AO 1- | Resolution: 11 bits + sign |
| | 6 | AO 1C+ | continued short-circuit proof |
| $\mathbb{H}_{\mathbb{N}}$ | 7 | +Temp | Temperature sensor connection: KTY84-1C130 / PTC |
| | 8 | -Temp | |

¹⁾ AO xV: analog output voltage; AO xC: Analog output current

Max. connectable cross-section: 1.5 mm²

| CAUTION | |
|---|--|
| The permissible back EMF at the outputs is ± 15 V | |

X540: Joint auxiliary voltage for the digital inputs

| | Terminal | Designation | Technical specifications |
|--|----------|-------------|--|
| 87654321 000000000000000000000000000000000000 | 8 | P24 | 24 V DC |
| | 7 | P24 | Max. total load current of +24 V auxiliary voltage of terminal blocks X540 and |
| | 6 | P24 | X541 combined: 150 mA |
| | 5 | P24 | continued short-circuit proof |
| | 4 | P24 | |
| | 3 | P24 | |
| | 2 | P24 | |
| | 1 | P24 | |
| | | | |

Table 4- 17 Terminal block X540

Max. connectable cross-section: 1.5 mm²

Note

This voltage supply is only for powering the digital inputs.

X541: 4 non-floating digital inputs/outputs

Table 4- 18 Terminal strip X541

| | Terminal | Designation 1) | Technical specifications |
|-----|----------|----------------|--|
| Flo | 6 | М | Electronics ground |
| 5 | 5 | DI/DO 11 | As input: |
| 4 | 4 | DI/DO 10 | Voltage: -3 V to 30 V |
| | 3 | DI/DO 9 | Typical current consumption: 10 mA at 24 V DC |
| | 2 | DI/DO 8 | As output: The summation current of the four outputs (including the currents of the inputs) is limited to 100 mA (continued short-circuit proof) in the delivery condition. |
| | 1 | P24 | Auxiliary voltage: +24 V DC Max. total load current of +24 V auxiliary voltage of terminal blocks X540 and X541 combined: 150 mA |

¹⁾ DI/DO: Digital input/output: M: Electronics ground

Max. connectable cross-section: 1.5 mm²

Note

An open input is interpreted as "low".

When externally generated 24 V DC signals are connected to a digital input, the ground reference of the external signal must also be connected.

4.9 Signal connections

CAUTION

Due to the limitation of the aggregate of the output currents an over-current can cause a short circuit on an output terminal or even intrusion of the signal of a different terminal.

X542: 2 relay outputs (two-way contact)

| Table 4-19 | Terminal block X542 |
|------------|---------------------|
|------------|---------------------|

| | Terminal | Designation 1) | Technical specifications | |
|-----|----------|----------------|--|--|
| | 1 | DO 0.NC | Contact type: Changeover contact max. load current: 8 A | |
| | 2 | DO 0.COM | Max. switching voltage: 250 V AC, 30 V DC | |
| 2 3 | 3 | DO 0.NO | Max. switching voltage: - at 250 V AC: 2000 VA (cosφ = 1) - at 250 V AC: 750 VA (cosφ = 0.4) | |
| 4 | 4 | DO 1.NC | | |
| 5 6 | 5 | DO 1.COM | - at 30 V DC: 240 W (ohmic load) | |
| | 6 | DO 1.NO | Required minimum current: 100 mA | |

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

Max. connectable cross-section: 2.5 mm²

Note

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

Depending on the options installed, further connections have to be established, for example, dv/dt filter plus Voltage Peak Limiter, main contactor, sine-wave filter, connection for external auxiliary equipment, main circuit-breaker including fuses or circuit-breaker, EMERGENCY OFF button, cabinet illumination with service socket, anti-condensation heating for cabinet, contactor safety combinations (EMERGENCY OFF / EMERGENCY STOP), thermistor motor protection unit, braking unit, PT100 evaluation unit, insulation monitor, communication modules, encoder evaluator, and NAMUR option.

Detailed information on connecting individual options with interfaces can be found on the documentation CD.

4.10.1 dv/dt filter plus Voltage Peak Limiter (option L10)

Description

The dv/dt filter plus Voltage Peak Limiter comprises two components: the dv/dt reactor and the Voltage Peak Limiter, which limits transients and returns the energy to the DC link.

The dv/dt filters plus Voltage Peak Limiter must be used for motors for which the proof voltage of the insulation system is unknown or insufficient. Standard motors of the 1LA5, 1LA6 and 1LA8 series only require them at supply voltages > 500 V +10%.

The dv/dt filter plus Voltage Peak Limiter limits the voltage gradient to values < 500 V/ μ s and the typical transients to the values below (with motor cable lengths of < 150 m):

- < 1000 V at Uline < 575 V
- < 1250 V at 660 V < U_{line} < 690 V.

Depending on the converter power, option L10 can be accommodated in the drive converter cabinet unit or an additional cabinet with a width 400 mm is required.

| Voltage range | Installation of the dv/dt filter plus Voltage Peak Limiter within the converter cabinet unit | Installation of the VPL in an additional cabinet |
|---------------------|--|--|
| 380 V to 480 V 3 AC | 6SL3710-1GE32-1AA0 6SL3710-1GE32-6AA0 6SL3710-1GE33-1AA0 6SL3710-1GE33-8AA0 6SL3710-1GE35-0AA0 | 6SL3710-1GE36-1AA0 6SL3710-1GE37-5AA0 6SL3710-1GE38-4AA0 6SL3710-1GE41-0AA0 6SL3710-2GE41-1AA0 ¹⁾ 6SL3710-2GE41-4AA0 ¹⁾ 6SL3710-2GE41-6AA0 ¹⁾ |

| Table 4- 20 | Accommodating the voltage limiting network in the cabinet or in an additional cabinet |
|-------------|---|
|-------------|---|

Electrical installation

4.10 Other connections

| Voltage range | Installation of the dv/dt filter plus Voltage Peak Limiter within the converter cabinet unit | Installation of the VPL in an additional cabinet |
|---------------------|--|--|
| 500 V to 600 V 3 AC | 6SL3710-1GF31-8AA0 6SL3710-1GF32-2AA0 6SL3710-1GF32-6AA0 6SL3710-1GF33-3AA0 | 6SL3710-1GF34-1AA0 6SL3710-1GF34-7AA0 6SL3710-1GF35-8AA0 6SL3710-1GF37-4AA0 6SL3710-1GF38-1AA0 6SL3710-2GF38-6AA0 ¹⁾ 6SL3710-2GF41-1AA0 ¹⁾ 6SL3710-2GF41-4AA0 ¹⁾ |
| 660 V to 690 V 3 AC | 6SL3710-1GH28-5AA0 6SL3710-1GH31-0AA0 6SL3710-1GH31-2AA0 6SL3710-1GH31-5AA0 6SL3710-1GH31-8AA0 6SL3710-1GH32-2AA0 6SL3710-1GH32-6AA0 6SL3710-1GH33-3AA0 | 6SL3710-1GH34-1AA0 6SL3710-1GH34-7AA0 6SL3710-1GH35-8AA0 6SL3710-1GH37-4AA0 6SL3710-1GH38-1AA0 6SL3710-2GH41-1AA0 ¹⁾ 6SL3710-2GH41-4AA0 ¹⁾ 6SL3710-2GH41-5AA0 ¹⁾ |

¹⁾ With units that are connected in parallel, each individual sub-cabinet has a separate auxiliary cabinet for the Voltage Peak Limiter.

Restrictions

The following restrictions should be noted when a dv/dt filter plus Voltage Peak Limiter is used:

- The output frequency is limited to no more than 150 Hz.
- Maximum permissible motor cable lengths:
 - Shielded cable: max. 300 m
 - Unshielded cable: max. 450 m

Commissioning

During commissioning, the dv/dt filter plus Voltage Peak Limiter must be logged on using STARTER or the AOP30 operator panel (p0230 = 2).

Note

When the factory settings are restored, parameter p0230 is reset. The parameter must be reset if the system is commissioned again.

4.10.2 Main Contactor (Option L13)

Description

The SINAMICS G150 cabinet unit is designed as standard without a line contactor. Option L13 (main contactor) is needed if a switching element is required for disconnecting the cabinet from the supply (necessary with EMERGENCY OFF). The contactor is energized and supplied within the cabinet.

Connection

Table 4-21 Terminal block X50 – checkback contact "main contactor closed"

| Terminal | Designation 1) | Technical specifications |
|----------|----------------|----------------------------------|
| 4 | NO | Max. load current: 10 A |
| 5 | NC | Max. switching voltage: 250 V AC |
| 6 | COM | Max. switching capacity: 250 VA |
| | | Required minimum load: ≥1 mA |

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

Max. connectable cross-section: 4 mm²

4.10.3 Sinusoidal Filter (Option L15)

Description

The sine-wave filter limits the voltage gradient and the capacitive charge/discharge currents which usually occur with inverter operation. It also prevents additional noise caused by the pulse frequency. The service life of the motor is as long as that attained with direct mains operation.

CAUTION

If a sine-wave filter is connected to the converter, the converter must be activated during commissioning to prevent the filter from being destroyed (see "Commissioning").

Restrictions

The following restrictions must be taken into account when a sine-wave filter is used:

- The output frequency is limited to max. 115 Hz (at 500 600 V) and 150 Hz (at 380 480 V).
- The modulation type is permanently set to space-vector modulation without overmodulation.
- The maximum output frequency is limited to 85% of the input frequency.

- Maximum permissible motor cable lengths:
 - Unshielded cable: max. 450 m
 - Shielded cable: max. 300 m
- During commissioning, the pulse frequency rises to double the factory setting. This induces current derating, which must be applied to the cabinet unit rated currents listed in the technical specifications.

Note

If a filter cannot be parameterized ($p0230 \neq 3$), this means that a filter has not been provided for the cabinet unit. In this case, the cabinet unit must not be operated with a sine-wave filter.

| Order no. SINAMICS G150 | Voltage [V] | Pulse frequency [kHz] | Output current [A] ^{1).} |
|----------------------------|----------------|--------------------------|--------------------------------------|
| 6SL3710-1GE32-1AA0 | 3 AC 380 – 480 | 4 | 172 A |
| 6SL3710-1GE32-6AA0 | 3 AC 380 – 480 | 4 | 216 A |
| 6SL3710-1GE33-1AA0 | 3 AC 380 – 480 | 4 | 273 A |
| 6SL3710-1GE33-8AA0 | 3 AC 380 – 480 | 4 | 331 A |
| 6SL3710-1GE35-0AA0 | 3 AC 380 – 480 | 4 | 382 A |
| 6SL3710-1GF31-8AA0 | 3 AC 500 – 600 | 2,5 | 152 A |
| 6SL3710-1GF32-2AA0 | 3 AC 500 – 600 | 2,5 | 187 A |

| Table 4- 22 | Technical specifications for sine-wave filters with SINAMICS G150 |
|-------------|---|
|-------------|---|

¹⁾ The values apply to operation with a sine-wave filter and do not correspond with the rated current on the type plate.

Commissioning

When commissioning using the STARTER or AOP30, the sine-wave filter must be activated by means of appropriate selection screenforms or dialog boxes (p0230 = 3), see section "Commissioning".

The following parameters are changed automatically during commissioning.

| Table 4- 23 | Parameter settings for sine-wave filters with SINAMICS G150 | |
|-------------|---|--|
|-------------|---|--|

| Parameter | Name | Setting |
|-----------|--|--|
| p0230 | Drive filter type, motor side | 3: Siemens sine-wave filter |
| p0233 | Power unit motor reactor | Filter inductance |
| p0234 | Power unit sine-wave filter capacitance | Filter capacitance |
| p0290 | Power unit overload response | Disable pulse frequency reduction |
| p1082 | Maximum speed | Fmax filter / pole pair number |
| p1800 | Pulse frequency | Nominal pulse frequency of the filter (see previous table) |
| p1802 | Modulator mode | Space-vector modulation without overmodulation |
| p1909 | Motor data identification, control word | Rs measurement only |

Note

When the factory settings are restored, parameter p0230 is reset. The parameter must be reset if the system is commissioned again.

4.10.4 Connection for External Auxiliary Equipment (Option L19)

Description

This option includes an outgoing circuit fused at max. 10 A for external auxiliary equipment (e.g. separately-driven fan for motor). The voltage is tapped at the converter input upstream of the main contactor/circuit-breaker and, therefore, has the same level as the supply voltage. The outgoing circuit can be switched within the converter or externally.

Connection

Table 4- 24 Terminal block X155 - Connection for external auxiliary equipment

| Terminal | Designation 1) | Technical specifications |
|----------|-----------------------|--------------------------|
| 1 | L1 | 380 - 480 V 3 AC |
| 2 | L2 | 500 - 600 V 3 AC |
| 3 | L3 | 660 - 690 V 3 AC |
| 11 | Contactor control | 230 V AC |
| 12 | | |
| 13 | NO: Checkback | 230 V AC / 0.5 A |
| 14 | motor circuit breaker | 24 V DC / 2 A |
| 15 | NO: Checkback from | 240 V AC / 6 A |
| 16 | contactor | |
| PE | PE | PE |

¹⁾ NO: NO contact

Max. connectable cross-section: 4 mm²

Note

The connection for external auxiliary equipment must be set in accordance with the connected consumer (-Q155).

Circuit proposal for controlling the auxiliary contactor from within the converter

The following circuit, for example, can be used if the auxiliary contactor is to be controlled from within the converter. The "Operation" message is then no longer available for other purposes.





Note

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

4.10.5 Main switch incl. fuses or circuit breaker (option L26)

Description

Up to 800 A (single units) and up to 1380 A (units that are connected in parallel), a switch disconnector with externally-mounted fuses is used as the main circuit breaker. Above 800 A (single units) and above 1380 A (units that are connected in parallel), the standard circuit breaker is used to disconnect the voltage and provide overload and short-circuit protection. The circuit breaker is controlled and supplied within the converter.

Switching at input

Cabinet units with circuit breaker may be powered up only once every 3 minutes. Failure to observe this rule can cause damage to the circuit breaker.

Connection

Table 4- 25 Terminal block X50 – checkback contact "main/circuit breaker closed"

| Terminal | Designation 1) | Technical specifications |
|----------|----------------|----------------------------------|
| 1 | NO | Max. load current: 10 A |
| 2 | NC | Max. switching voltage: 250 V AC |
| 3 | COM | Max. switching capacity: 250 VA |
| | | Required minimum load: ≥ 1mA |

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

Max. connectable cross-section: 4 mm²



At currents of more than 800 A (single units) and above 1380 A (units that are connected in parallel) and with a live line voltage, dangerous voltages are present in the cabinet unit even when the circuit breaker is open. The upstream protective gear must be de-energized when working on cabinets.

Setting the release current for the circuit breaker

In equipment with a circuit breaker, the release current must be set to match the plant requirements. The appropriate specifications are given in the operating instructions supplied with the circuit breaker.

The release current is set as follows per default:

| Order number | Output current | Overcurrent trip (L) | Short-circuit trip, non-delayed (I) |
|--------------------|----------------|----------------------|-------------------------------------|
| 6SL3710-1GE38-4AA0 | 840 A | 1,0 | 2 |
| 6SL3710-1GE41-0AA0 | 985 A | 0,9 | 2 |
| 6SL3710-2GE41-6AA0 | 1560 A | 1.0 (both switches) | 2 (both switches) |
| 6SL3710-1GF38-1AA0 | 810 A | 1,0 | 2 |
| 6SL3710-1GH38-1AA0 | 810 A | 1,0 | 2 |
| 6SL3710-2GH41-5AA0 | 1500 A | 0.9 (both switches) | 2 (both switches) |

NOTICE

If the release current is not set correctly, the circuit breaker could trip inadvertently or even fail to trip.

Diagnostics

Messages output during operation and in the event of faults are described in "Additional Operating Instructions" of the Operating Instructions.

4.10.6 EMERGENCY OFF pushbutton installed in the cabinet door (option L45)

Description

The EMERGENCY OFF pushbutton with protective collar is integrated in the door of the cabinet unit. The contacts of the pushbutton are connected to terminal block –X120. In conjunction with options L57, L59, and L60, EMERGENCY OFF of category 0 and EMERGENCY STOP of category 1 can be activated.

A braking unit may be necessary to achieve the required shutdown times.

Note

When the EMERGENCY OFF pushbutton is pressed, the motor coasts to a standstill and the main motor voltage is disconnected (to EN 60204-1 (VDE 0113)) in conjunction with options L57, L59 and L60. Auxiliary voltages (e.g. for separately-driven fans or anti-condensation heating) may still be present. Certain sections of the converter (e.g., the closed-loop controller or any auxiliary equipment) may also remain live. If all the voltages have to be completely disconnected, the EMERGENCY OFF pushbutton must be integrated in a protection concept, which must be implemented on the line side. For this purpose, an NC contact is installed at terminal block -X120.

Connection

| Table 4- 27 | Terminal block X120 – checkback contact "EMERGENCY OFF pushbutton in the cabinet |
|-------------|--|
| | door" |

| Terminal | Designation 1) | Technical specifications |
|----------|--------------------|---|
| 1 | NC 1 | Checkback contacts of EMERGENCY OFF pushbutton in |
| 2 | | cabinet door |
| 3 | NC 2 ²⁾ | Max. load current: 10 A |
| 4 | | Max. switching voltage: 250 V AC |
| | | Max. switching capacity: 250 VA |
| | | Required minimum load: ≥1 mA |

¹⁾ NC: normally-closed contact

²⁾ Factory setting in converter for options L57, L59, and L60

Max. connectable cross-section: 4 mm²

4.10.7 Cabinet illumination with service socket (option L50)

Description

A universal lamp with an integrated service socket is installed in each cabinet panel. The power supply for the cabinet illumination and socket must be provided externally and fused at max. 10 A. The cabinet illumination is switched on manually via a slide switch or automatically by means of an integrated motion detector (factory setting). The mode is selected via the switch on the light.

Connection

Table 4- 28 Terminal block X390 – connection for cabinet illumination with service socket

| Terminal | Designation | Technical specifications |
|----------|-------------|--------------------------|
| 1 | L1 | 230 V AC |
| 2 | N | power supply |
| 3 | PE | Protective conductor |

Max. connectable cross-section: 4 mm²

4.10.8 Cabinet anti-condensation heating (option L55)

Description

The anti-condensation heating is used at low ambient temperatures and high levels of humidity to prevent condensation forming.

One 100 W heater is installed for a 400 mm and 600 mm cabinet panel, and two 100 W heaters for an 800/1000 and 1200 mm cabinet panel. The power supply for the heating (110 V – 230 V AC) must be provided externally and fused at max. 16 A.



When the supply voltage for the cabinet anti-condensation heating is connected, dangerous voltages are present in the cabinet unit even when the main circuit breaker is open.

Connection

Table 4- 29 Terminal block X240 - connection for cabinet anti-condensation heating

| Terminal | Designation | Technical specifications |
|----------|-------------|--------------------------|
| 1 | L1 | 110 V – 230 V AC |
| 2 | N | Voltage supply |
| 3 | PE | Protective conductor |

Max. connectable cross-section: 4 mm²

4.10.9 EMERGENCY OFF category 0; 230 V AC or 24 V DC (option L57)

Description

EMERGENCY OFF category 0 for uncontrolled stop to EN 60204-1. This function involves disconnecting the cabinet unit from the supply via the line contactor bypassing the electronics by means of a safety combination to EN 60204-1. The motor then coasts to a stop. To prevent the main contactor from switching under load, an OFF2 is triggered simultaneously. The operational status is indicated by means of three LEDs (-K120).

In the factory setting, this version is set with a 230 V AC button circuit.

Note

When the EMERGENCY OFF button is pressed, the motor coasts to an uncontrolled standstill and the main motor voltage is disconnected (to EN 60204-1). Auxiliary voltages (e.g. for separately-driven fans or anti-condensation heating) may still be present. Certain sections of the converter (e.g., the closed-loop controller or any auxiliary equipment) may also remain live. If all the voltages have to be completely disconnected, the EMERGENCY OFF pushbutton must be integrated in a protection concept, which must be implemented on the line side. For this purpose, an NC contact is installed at terminal -X120.

Connection

| Table 4- 30 | Terminal block X120 – connection for EMERGENCY OFF category 0, 230 V AC and |
|-------------|---|
| | 24 V DC |

| Terminal | 230 V AC and 24 V DC button circuit | | |
|----------|--|--|--|
| 4 | Jumper wired in the factory | | |
| 5 | | | |
| 7 | Loop in EMERGENCY OFF button from line side, | | |
| 8 | remove jumpers 7-8 and connect button | | |
| 9 | Jumper wired in the factory | | |
| 10 | | | |
| 11 | Jumper wired in the factory | | |
| 14 | | | |
| 12 | Jumper wired in the factory | | |
| 13 | | | |
| 15 | "On" for monitored start: | | |
| 16 | Remove jumpers 15–16 and connect button. | | |
| 17 | NO ¹⁾ : Checkback "trip safety combination" | | |
| 18 | | | |

1) NO: NO contact

Max. connectable cross-section: 4 mm²

Electrical installation 4.10 Other connections

Reconnection to the 24 V DC Button Circuit

When using the 24 V DC button circuit, you must remove the following jumpers at terminal block X120:

• 4-5, 9-10, and 11-14

You must also insert the following jumpers at terminal block X120:

• 4-11, 5-10, and 9-14

Diagnostics

Messages output during operation and in the event of faults (meaning of LEDs on -K120) are described in the "Additional Operating Instructions" of the Operating Instructions.

4.10.10 EMERGENCY STOP category 1; 230 V AC (option L59)

Description

EMERGENCY STOP category 1 for controlled stop to EN 60204-1. This function stops the drive by means of a quick stop along a deceleration ramp that must be parameterized. The cabinet unit is then disconnected from the power supply via the line contactor, which bypasses the electronics by means of a safety combination (to EN 60204-1). The operating status and the function are indicated by means of eight LEDs (-K120, -K121).

Connection

| Table 4- 31 | Terminal block X120 – connection for EMERGENCY STOP category 1 (230 V AC) |
|-------------|---|
|-------------|---|

| Terminal | Technical specifications |
|----------|--|
| 4 | Jumper wired in the factory |
| 5 | |
| 7 | Loop in EMERGENCY OFF button from line side, |
| 8 | remove jumpers 7-8 and connect button |
| 9 | Jumper wired in the factory |
| 10 | |
| 11 | Jumper wired in the factory |
| 14 | |
| 12 | Jumper wired in the factory |
| 13 | |
| 15 | "On" for monitored start: |
| 16 | Remove jumpers 15–16 and connect button. |
| 17 | NO ¹⁾ : Checkback "trip safety combination" |
| 18 | |

¹⁾ NO: NO contact

Max. connectable cross-section: 4 mm²

Setting

The time (0.5 to 30 s) set at the contactor safety combination (-K121) should be greater (or at least identical to) the time that the drive requires to reach standstill via quick stop (OFF3 ramp-down time, p1135), since the converter is disconnected from the power supply after expiry of the time (at -K121).

Diagnostics

Messages output during operation and in the event of faults (meaning of LEDs on -K120, -K121) are described in the "Additional Operating Instructions" of the Operating Instructions.

4.10.11 EMERGENCY STOP category 1; 24 V DC (option L60)

Description

EMERGENCY STOP category 1 for controlled stop to EN 60204-1. This function stops the drive by means of a quick stop along a deceleration ramp that must be parameterized. The cabinet unit is then disconnected from the power supply via the line contactor, which bypasses the electronics by means of a safety combination to EN 60204-1. The operating status and the function are indicated by means of five LEDs (-K120).

Connection

| Table 4- 32 Terminal block X120 – connection for EMERGENCY STOP categor |
|---|
|---|

| Terminal | Technical specifications |
|----------|--|
| 4 | Jumper wired in the factory |
| 11 | |
| 5 | Jumper wired in the factory |
| 10 | |
| 7 | Loop in EMERGENCY OFF button from line side, |
| 8 | remove jumpers 7-8 and connect button |
| 9 | Jumper wired in the factory |
| 14 | |
| 12 | Jumper wired in the factory |
| 13 | |
| 15 | "On" for monitored start: |
| 16 | Remove jumpers 15–16 and connect button. |
| 17 | NO ¹⁾ : Checkback "trip safety combination" |
| 18 | |

¹⁾ NO: NO contact

Max. connectable cross-section: 4 mm²

Setting

The time (0.5 to 30 s) set at the contactor safety combination (-K120) should be greater (or at least identical to) the time that the drive requires to reach standstill via quick stop (OFF3 ramp-down time, p1135), since the converter is disconnected from the power supply after expiry of the time (at -K120).

Diagnostics

Messages output during operation and in the event of faults (meaning of LEDs on -K120) are described in the "Additional Operating Instructions" of the Operating Instructions.

4.10.12 25 kW Braking Unit (Option L61); 50 kW Braking Unit (Option L62)

Description

Braking units are used when regenerative energy occurs occasionally and briefly, for example when the brake is applied to the drive (emergency stop). The braking units comprise a chopper power unit and a load resistor, which must be attached externally. To monitor the braking resistance, a thermostat integrated in the shutdown train of the cabinet unit is installed in the braking resistor.

Table 4-33 Load data for the braking units

| Supply voltage | Continuous chopper power P _{DB} | Peak chopper output P ₁₅ | Chopper P ₂₀ output P ₂₀ | Chopper P ₄₀ output P ₄₀ | Braking resistor R _B | Max. current |
|----------------|--|---|--|--|------------------------------------|--------------|
| 380 V – 480 V | 25 kW | 125 kW | 100 kW | 50 kW | $4.4 \Omega \pm 7.5 \%$ | 189 A |
| 380 V – 480 V | 50 kW | 250 kW | 200 kW | 100 kW | $2.2 \Omega \pm 7.5 \%$ | 378 A |
| 500 V – 600 V | 50 kW | 250 kW | 200 kW | 100 kW | $3.4 \Omega \pm 7.5 \%$ | 306 A |
| 660 V – 690 V | 25 kW | 125 kW | 100 kW | 50 kW | $9.8 \Omega \pm 7.5 \%$ | 127 A |
| 660 V – 690 V | 50 kW | 250 kW | 200 kW | 100 kW | 4.9 Ω ± 7.5 % | 255 A |

Installing the braking resistor

The braking resistor should not be installed in the vicinity of the converter. The installation location must fulfill the following conditions:

- The braking resistors are only suitable for floor mounting.
- The maximum cable length between the cabinet unit and braking resistor is 100 m.
- Sufficient space must be available for dissipating the energy converted by the braking resistor.
- A sufficient distance from flammable objects must be maintained.
- The braking resistor must be installed as a free-standing unit.
- Objects must not be placed on or anywhere above the braking resistor.
- The braking resistor should not be installed underneath fire detection systems, since these could be triggered by the resulting heat.
- For outdoor installation, a hood should be provided to protect the braking resistor against precipitation (in accordance with degree of protection IP20).

CAUTION

A ventilation clearance of 200 m must be maintained on all sides of the braking resistor (with ventilation grilles).

| | Unit | 25 kW resistor (option L61) | 50 kW resistor (option L62) |
|--------|------|-----------------------------|-----------------------------|
| Width | mm | 740 | 810 |
| Height | mm | 605 | 1325 |
| Depth | mm | 485 | 485 |

Table 4- 34 Dimensions of the braking resistors



Figure 4-9 Dimension drawing for braking resistor (25 kW)



Figure 4-10 Dimension drawing for braking resistor (50 kW)

Drive converter cabinet units Operating Instructions, 10/2008, A5E00189855A

Connecting the braking resistor

/!\warning

The cables must only be connected to terminal block -X5 when the cabinet unit is switched off and the DC link capacitors are discharged.

CAUTION

The braking resistor cables must be laid in such a way that they are short-circuit and ground-fault proof.

The length of the connecting cables between the cabinet unit and external braking resistor must not exceed 100 m.

Table 4-35 Terminal block -X5 – connection for external braking resistor

| Terminal | Description of function | |
|----------|-----------------------------|--|
| 1 | Braking resistor connection | |
| 2 | Braking resistor connection | |

Max. connectable cross-section: 70 mm²

Recommended cable cross-sections:

- For L61 (25 kW): 35 mm²
- For L62 (50 kW): 50 mm²

 Table 4- 36
 Installing the thermostatic switch for the external braking resistor in the monitoring train of the cabinet unit

| Terminal | Description of function |
|----------|---|
| T1 | Thermostatic switch connection: connection with terminal X541:1 (P24 V) |
| T2 | Thermostatic switch connection: connection with terminal X541:5 (DI11) |

Max. connectable cross-section (due to TM31): 1.5 mm²

Commissioning

When commissioning via STARTER, parameters are assigned to "external fault 3" and acknowledged automatically when option L61 or L62 are selected.

When commissioning via AOP30, the parameter entries required have to be set subsequently.



Set the "Expert" access level on the operator panel <Key pushbutton> - <Access level> - Set "Expert" and confirm

Connect digital input 4 (DI4) on the CU320 to the first input of "External fault 3".

Connect the "Operation" signal to the second input of "External fault 3".

Connect "Acknowledge fault" to digital output 15 (DO15) on the CU320.

Cabinet unit settings

If the thermostatic switch for the braking resistor is connected to digital input 11, appropriate settings have to be made so that the drive is brought to a standstill if a fault occurs.

Once the device has been successfully commissioned, you have to make the following changes:



Set the "Expert" access level on the operator panel <Key pushbutton> - <Access level> - Set "Expert" and confirm

Switch external fault 2 to DI 11 on the TM31.

Disabling the Vdc-max controller

When the brake chopper is used, the Vdc-max controller must be switched off.

Diagnosis

If the thermostat is opened due to a thermal overload on the braking resistor, fault F7861 ("External Fault 2") is triggered and the drive is switched off with OFF2.

If the brake chopper triggers a fault, fault F7862 "External fault 3" is triggered in the drive.

You can acknowledge malfunctions in the braking unit by pressing the "Acknowledge" button on the operator panel when the DC link voltage is present).

Duty cycles



Threshold switch

The response threshold at which the braking unit is activated and the DC link voltage generated during braking are specified in the following table.

The threshold switch must only be used when the cabinet unit is switched off and the DC link capacitors are discharged.

| Rated voltage | Response threshold | Switch position | Comments | |
|---------------|-----------------------|-----------------|--|--|
| 380 V – 480 V | 673 V | 1 | 774 V is the default factory setting. With supply voltages of between 380 V | |
| | 774 V | 2 | and 400 V, the response threshold can be set to 673 V to reduce the voltage stress on the motor and converter. This does, however, reduce the possible braking power with the square of the voltage $(673/774)^2 = 0.75$. | |
| | | | The maximum possible braking power is, therefore, 75%. | |
| 500 V – 600 V | 841 V | 1 | 967 V is the default factory setting. With a supply voltage of 500 V, the | |
| | 967 V | 2 | response threshold can be set to 841 V to reduce the voltage stress on the motor and converter. This does, however, reduce the possible braking power with the square of the voltage $(841/967)^2 = 0.75$. | |
| | | | The maximum possible braking power is, therefore, 75%. | |
| 660 V – 690 V | 1070 V | 1 | 1158 V is the default factory setting. With a supply voltage of 660 V, the | |
| | 1158 V | 2 | response threshold can be set to 1070 V to reduce the voltage stress on the motor and converter. This does, however, reduce the possible braking power with the square of the voltage $(1070/1158)^2 = 0.85$. | |
| | | | The maximum possible braking power is, therefore, 85 %. | |

Table 4- 37 Response thresholds of the braking units

4.10.13 Thermistor Motor Protection Unit (Option L83/L84)

Description

This option includes the thermistor motor protection unit (with PTB approval) for PTC thermistor sensors (PTC resistor type A) for warning and shutdown. The power supply for the thermistor motor protection unit is provided inside the converter where the evaluation is also performed.

Option L83 triggers the "external alarm 1" (A7850) if a fault occurs.

Option L84 triggers the "external fault 1" (F7860) if a fault occurs.

Connection

Table 4- 38 F127/F125 – connection for thermistor motor protection unit

| Equipment designation | Description of function |
|-----------------------|--|
| -F127: T1, T2 | Thermistor motor protection (alarm) |
| -F125: T1, T2 | Thermistor motor protection (shutdown) |

The PTC thermistor sensors are connected directly to terminals T1 and T2 of the evaluation unit.

Table 4- 39 Maximum cable length for the sensor circuit

| Line cross-section in mm ² | Line length in m |
|---------------------------------------|------------------|
| 2,5 | 2 x 2800 |
| 1,5 | 2 x 1500 |
| 0,5 | 2 x 500 |

Diagnostics

Messages output during operation and in the event of faults (meaning of LEDs on -F125, F127) are described in the "Additional Operating Instructions" of the Operating Instructions.

4.10.14 PT100 Evaluation Unit (Option L86)

Description

Note

The PT100 evaluation unit and the parameters for the measurement channels are described in the "Additional Operating Instructions".

The PT100 evaluation unit can monitor up to six sensors. The sensors can be connected in a two or three-wire system. With the two-wire system, inputs Tx1 and Tx3 must be assigned. With the three-wire system, input Tx2 must also be connected (x = 1, 2, ...6). The limit values can be freely programmed for each channel. Shielded signal cables are recommended. If this is not possible, however, the sensor cables should at least be twisted in pairs.

In the factory setting, the measurement channels are divided into two groups of three channels. With motors, for example, this means that three PT100s in the stator windings and two PT100s in the motor bearings can be monitored. Unused channels can be suppressed via parameters.

The output relays are integrated in the internal fault and alarm train of the cabinet unit. The messages can also be picked up by the customer via two spare signaling relays. Two user-programmable analog outputs (0/4 to 20 mA and 0/2 to 10 V) are also available for integration in a higher-level controller. The power for the PT100 evaluation unit is supplied and the evaluation itself executed within the converter.

In the event of a fault, the "external alarm 1" (A7850) and "external fault 1" (F7860) are triggered.

Connection

| Terminal | Designation | Technical specifications |
|----------|-------------|--|
| T11-T13 | | 90–240 V AC/DC; PT100; sensor 1; group 1 |
| T21-T23 | | 90–240 V AC/DC; PT100; sensor 2; group 1 |
| T31-T33 | | 90–240 V AC/DC; PT100; sensor 3; group 1 |
| T41-T43 | | 90–240 V AC/DC; PT100; sensor 1; group 2 |
| T51-T53 | | 90–240 V AC/DC; PT100; sensor 2; group 2 |
| T61-T63 | | 90–240 V AC/DC; PT100; sensor 3; group 2 |
| 51/52/54 | | 90–240 V AC/DC |
| | | Relay output limit value group 1 reached; (changeover contact) |
| 61/62/64 | | 90–240 V AC/DC |
| | | Relay output limit value group 2 reached; (changeover contact) |
| Ground _ | OUT 1 | 0/4–20 mA |
| U1 | OUT 1 | 0/2–10V |
| l1 | OUT 1 | Analog output out 1, sensor group 1 |
| Ground _ | OUT 2 | 0/4–20 mA |
| U2 | OUT 2 | 0/2–10V |
| 12 | OUT 2 | Analog output out 2, sensor group 2 |

Table 4- 40 Terminal block -A1-B140 – connection for evaluation unit PT100 resistors

Max. connectable cross-section: 2.5 mm²

Diagnostics

Messages output during operation and in the event of faults (meaning of LEDs on -B140) are described in the "Additional Operating Instructions" of the Operating Instructions.

4.10.15 Insulation Monitor (Option L87)

Description

In non-grounded systems (IT systems), the insulation monitor checks the entire electricallyconnected circuit for insulation faults. The insulation resistance as well as all the insulation faults from the mains supply to the motor in the cabinet are detected. Two response values (between 1 k Ω and 10 M Ω) can be set. If a response value in undershot, an alarm is output to the terminal. A system fault is output via the signaling relay system.

When the cabinet unit is delivered, the plant configuration (one or several loads in one electrically-connected network) and the protection philosophy (immediate shutdown in the event of an insulation fault or restricted continued motion) can vary. This means that the signaling relays of the insulation monitor must be integrated by the customer in the fault and warning sequence.

Safety information

NOTICE

Only one insulation monitor can be used within the same electrically-connected network.

Note

When the insulation monitor is used, the connection bracket for the interference suppression capacitor must be removed (see "Electrical installation / Removing the connection bracket for the interference suppression capacitor with operation from an ungrounded supply").

Controls and displays on the insulation monitor



Figure 4-12 Controls and displays on the insulation monitor

| Position | Meaning |
|----------|---|
| 1 | INFO key: To request standard information/ |
| | ESC key: Back menu function |
| 2 | TEST key: Call up self-test |
| | Arrow key up: Parameter change, scroll |
| 3 | RESET button: Delete insulation and fault messages |
| | Arrow key down: Parameter change, scroll |
| 4 | Menu key: Call up menu system |
| | Enter key: Confirm parameter change |
| 5 | Alarm LED 1 lights up: Insulation fault, first alarm threshold reached |
| 6 | Alarm LED 2 lights up: Insulation fault, second alarm threshold reached |
| 7 | LED lights up: System error present |

| Table 1- 11 | Meaning of the controls and displays on the insulation monitor |
|---------------|--|
| 1 able 4- 4 l | wearing of the controls and displays on the insulation monitor |

Connection

| | Table 4- 42 | Connections on insulation monitor |
|--|-------------|-----------------------------------|
|--|-------------|-----------------------------------|

| Terminal | Technical specifications |
|----------|---|
| A1 | Supply voltage via 6 A melting fuse: |
| A2 | 88 to 264 V AC, 77 to 286 V DC |
| L1 | Connection of the 3 AC system to be monitored |
| L2 | |
| AK | Connection to coupling device |
| KE | PE connection |
| T1 | External test button |
| T2 | External test button |
| R1 | External reset key (NC contact or wire jumper otherwise the fault code is not stored) |
| R2 | External reset key (NC contact or wire jumper) |
| F1 | STANDBY with aid of F1, F2 function input: |
| F2 | |
| M+ | External k Ω display, analog output (0 μ A 400 μ A) |
| M- | External k Ω display, analog output (0 μ A 400 μ A) |
| А | Serial interface RS 485 |
| В | (termination by means of 120 ohm resistor) |
| 11 | Signaling relay ALARM 1 (mid-position contact) |
| 12 | Signaling relay ALARM 1 (NC contact) |
| 14 | Signaling relay ALARM 1 (NO contact) |
| 21 | Signaling relay ALARM 2 (mid-position contact) |
| 22 | Signaling relay ALARM 2 (NC contact) |
| 24 | Signaling relay ALARM 2 (NO contact) |

Max. connectable cross-section: 2.5 mm²

Diagnostics

Messages output during operation and in the event of faults (meaning of LEDs on -B101) are described in the "Additional Operating Instructions" of the Operating Instructions.

4.10.16 Communication Board Ethernet CBE20 (Option G33)

Description

Interface module CBE20 is used for communication via PROFINET.

The module is delivered mounted in a supplementary pack on the CU320 Control Unit and must be installed line-side in the option slot of the CU320 Control Unit.

4 Ethernet interfaces are available on the module. Diagnosis of the function mode and communication are possible via LEDs.

Interface overview



MAC address

The MAC address of the Ethernet interfaces is indicated on the upper side of the CBE20. The plate is no longer visible after installation.

Note

Please note the MAC address prior to installing the module so that it is available to you for the subsequent commissioning.

X1400 Ethernet interface

Table 4- 43 Connector X1400, port 1 - 4

| | Pin | Signal name | Technical specifications |
|---|--------------------|-------------|-------------------------------|
| | 1 | RX+ | Receive data + |
| | 2 | RX- | Receive data - |
| 8 | 3 | TX+ | Transmit data + |
| | 4 | | Reserved, do not use |
| | 5 | | Reserved, do not use |
| | 6 | TX- | Transmit data - |
| | 7 | | Reserved, do not use |
| | 8 | | Reserved, do not use |
| | Screened backshell | M_EXT | Screen, permanently connected |

Assembly

CAUTION

The Option Board should only be inserted and removed when the Control Unit and Option Board are disconnected from the power supply.



Figure 4-14 Mounting the CBE20

4.10.17 CBC10 CAN Communication Board (option G20)

Description



Figure 4-15 CAN CBC10 Communication Board

The CBC10 CANopen communication board (CAN Communication Board) is used to connect drives in the SINAMICS drive system to higher-level automation systems with a CAN bus.

The CANopen Option Board uses two 9-pin sub D connectors for the connection to the CAN bus system.

The connectors can be used as inputs or outputs. Unused pins are plated through.

Among others, the following transmission rates are supported: 10, 20, 50, 125, 250, 500, 800 kBaud, and 1 Mbaud.

CAUTION

The Option Board should only be inserted and removed when the Control Unit and Option Board are disconnected from the power supply.

The CBC10 must only be operated by qualified personnel. The ESD notices must be observed.

Note

Detailed and comprehensive instructions and information for the CBC10 Communication Board can be found in the accompanying Operating Instructions. These Operating Instructions are available as additional documentation on the enclosed customer CD.

Interface overview



Figure 4-16 CAN CBC10 Communication Board

CAN bus interface -X451

CAN bus interface -X451 features the following socket assignments:

| Pin | | Designation | Technical specifications |
|--------------------------|---|-------------|---------------------------|
| | 1 | Reserved | |
| | 2 | CAN_L | CAN signal (dominant low) |
| | 3 | CAN_GND | CAN ground |
| | 4 | Reserved | |
| | 5 | CAN_SHLD | Optional shield |
| | 6 | GND | CAN ground |
| | 7 | CAN_H | CAN signal |
| | 8 | Reserved | |
| | 9 | Reserved | |
| Type: 9-pin sub D socket | | | |

Table 4- 44 CAN bus interface -X451

CAN bus interface -X452

CAN bus interface -X452 features the following socket assignments:

Table 4- 45 CAN bus interface -X452

| | Pin | Designation | Technical specifications | |
|-------------------|-----------------------|-------------|---------------------------|--|
| | 1 | Reserved | | |
| | 2 | CAN_L | CAN signal (dominant low) | |
| | 3 | CAN_GND | CAN ground | |
| | 4 | Reserved | | |
| | 5 | CAN_SHLD | Optional shield | |
| | 6 | GND | CAN ground | |
| | 7 | CAN_H | CAN signal | |
| | 8 | Reserved | | |
| | 9 | Reserved | | |
| Type: 9-pin sub D | Type: 9-pin sub D pin | | | |

Note

Detailed and comprehensive instructions and information for the CANopen interface can be found in the accompanying Function Manual. This manual is available as additional documentation on the accompanying customer CD.

4.10.18 SMC30 Sensor Module Cabinet-Mounted (option K50)

4.10.18.1 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 to the closed-loop controller via the DRIVE-CLiQ interface for evaluation purposes.

In conjunction with SINAMICS G150 the following sensors can be connected to the SMC30 Sensor Module:

- TTL encoder
- HTL encoder
- KTY or PTC temperature sensor

Table 4- 46 Connectable encoders with supply voltage

| Encoder type | X520 (D-Sub) | X521 (terminal) | X531 (terminal) | Open-circuit monitoring | Remote sense |
|-------------------|--------------|-----------------|-----------------|----------------------------|--------------|
| HTL bipolar 24 V | Yes | Yes | Yes | Yes | No |
| HTL unipolar 24 V | Yes | Yes | Yes | No | No |
| TTL bipolar 24 V | Yes | Yes | Yes | Yes | No |
| TTL bipolar 5 V | Yes | Yes | Yes | Yes | To X520 |
| TTL unipolar | No | No | No | No | No |

Table 4- 47Maximum signal cable lengths

| Encoder type | Maximum signal cable length in m | | |
|--------------|----------------------------------|--|--|
| TTL | 100 | | |
| HTL unipolar | 100 | | |
| HTL bipolar | 300 | | |

Note

Because the physical transmission media is more robust, the bipolar connection should always be used for HTL encoders. The unipolar connection should only be used if the encoder type does not output push-pull signals.

Electrical installation

4.10 Other connections

| Parameter | Designation | Threshold ⁴⁾ | Min. | Max. | Unit |
|---|--------------------|-------------------------|------|---|------|
| High signal level (TTL bipolar at X520 or X521/X531) ¹⁾ | U _{Hdiff} | | 2 | 5 | V |
| Low signal level (TTL bipolar at X520 or X521/X531) ¹⁾ | U_{Ldiff} | | -5 | -2 | V |
| High signal level | UH ⁴⁾ | High | 17 | Vcc | V |
| (HTL unipolar) | | Low | 10 | Vcc | V |
| Low signal level | UL ⁴⁾ | High | 0 | 7 | V |
| (HTL unipolar) | | Low | 0 | 2 | V |
| High signal level (HTL bipolar) ²⁾ | U _{Hdiff} | | 3 | Vcc | V |
| Low signal level (HTL bipolar) ²⁾ | U _{Ldiff} | | -Vcc | -3 | V |
| Signal frequency | fs | | - | 300 | kHz |
| Edge clearance | t _{min} | | 100 | - | ns |
| Zero pulse inactive time (before and after A=B=high) | t∟o | | 500 | (t _{ALo-BHi} - t _{Hi})/2 ³⁾ | ns |
| Zero pulse active time (while A=B=high and beyond) | t _{Hi} | | 500 | t _{ALo-BHi} - 2 x t _{Lo} ³⁾ | ns |

Table 4-48 Specification of measuring systems that can be connected

¹⁾ Other signal levels according to the RS 422 standard.

 $^{\rm 2)}$ The absolute level of the individual signals varies between 0 V and V_{CC} of the measuring system.

 $^{3)}$ t_{ALo-BHi} is not a specified value, but is the time between the falling edge of track A and the next but one rising edge of track B.

⁴⁾ The threshold can be set via p0405.04 (switching threshold); the factory setting is "Low".



Figure 4-17 Signal characteristic of the A and B track between two edges: Time between two edges with pulse encoders
Electrical installation

4.10 Other connections



Figure 4-18 Position of the zero pulse to the track signals

4.10 Other connections



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):

Figure 4-19 Signal cable length as a function of the sensor current consumption



Figure 4-20 SMC30 Sensor Module

4.10 Other connections

4.10.18.2 Connection

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

| | Pin | Signal name | Technical specifications |
|------------|-----|----------------------|---|
| \bigcirc | 1 | +Temp | Temperature sensor connection KTY84-1C130/PTC |
| \bigcirc | 2 | Reserved, do not use | |
| (15.0) | 3 | Reserved, do not use | |
| | 4 | P_Encoder 5 V / 24 V | Encoder supply |
| | 5 | P_Encoder 5 V / 24 V | Encoder supply |
| | 6 | P_Sense | Sense input encoder power supply |
| 00 | 7 | M_Encoder (M) | Ground for encoder power supply |
| 200 | 8 | -Temp | Temperature sensor connection KTY84-1C130/PTC |
| (° o) | 9 | M_Sense | Ground sense input |
| | 10 | R | Reference signal R |
| | 11 | R* | Inverted reference signal R |
| \square | 12 | B* | Inverted incremental signal B |
| | 13 | В | Incremental signal B |
| | 14 | A* | Inverted incremental signal A |
| | 15 | A | Incremental signal A |

Table 4- 49 Encoder connection X520

Connector type: 15-pin socket

CAUTION

The encoder power supply can be parameterized to 5 V or 24 V. The encoder may be destroyed if you enter the wrong parameter.

NOTICE

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

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

| | Terminal | Signal name | Technical specifications |
|------|----------|-------------|-------------------------------|
| | 1 | A | Incremental signal A |
| | 2 | A* | Inverted incremental signal A |
| ωЩ | 3 | В | Incremental signal B |
| L₅H⊒ | 4 | B* | Inverted incremental signal B |
| | 5 | R | Reference signal R |
| | 6 | R* | Inverted reference signal R |
| B | 7 | CTRL | Control signal |
| | 8 | М | Ground via inductivity |

Table 4- 50 Encoder connection X521

Max. connectable cross-section: 1.5 mm²

Note

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

Table 4-51 Encoder connection X531

| | Terminal | Signal name | Technical specifications |
|-------|----------|----------------------|---|
| | 1 | P_Encoder 5 V / 24 V | Encoder supply |
| 2 | 2 | M_Encoder | Ground for encoder power supply |
| зĦ | 3 | -Temp | Temperature sensor connection KTY84-1C130/PTC |
| Lª H⊒ | 4 | +Temp | |
| 6 | 5 | Reserved, do not use | |
| | 6 | Reserved, do not use | |
| 8 | 7 | Reserved, do not use | |
| | 8 | Reserved, do not use | |

Max. connectable cross-section: 1.5 mm²

Note

Note that when the encoder is connected via terminals, the cable shield must be applied to the module.

NOTICE

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

4.10 Other connections

4.10.18.3 Connection examples



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

Figure 4-21 Connection example 1: HTL encoder, bipolar, without zero marker

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



Figure 4-22 Connection example 2: TTL encoder, unipolar, without zero marker

4.10.19 Voltage Sensing Module for determining the actual motor speed and the phase angle (option K51)

Voltage recording module VSM10 is used to operate a permanent-field synchronous machine without encoder with the requirement for switching to a machine which is already running (capture function).

The terminals on the Voltage Sensing Module (-B51) are pre-assigned in the factory and must not be changed by the customer.

To commission the function, the permanent-field synchronous machine without encoder must be input and "Flying restart" activated with p1200.

4.10.20 Customer terminal block extension (option G61)

Description

A TM31 interface module (customer terminal block –A60) is already installed in standard. A second module (–A61) provides the following additional digital and analog inputs/outputs in the drive system:

- 8 digital inputs
- 4 bidirectional digital inputs/outputs
- 2 relay outputs with changeover contact
- 2 analog inputs
- 2 analog outputs
- 1 temperature sensor input (KTY84-130/PTC)

The second TM31 must be installed on the system side. Default settings are not provided.

4.10.21 Terminal module for activation of "Safe Torque Off" and "Safe STOP 1" (option K82)

Description

Option K82 (terminal module for activating "Safe Torque Off" and "Safe Stop 1") is used for isolated activation via a variable control-voltage range of the safety functions already present in the standard version, which can also be used without option K82.

Use the option K82 to activate the following safety integrated functions (terminology according to draft IEC 61800-5-2):

- Safe torque off (STO)
- Safe Stop 1 (SS1, time-controlled)

Note

The integrated safety functions, starting from the Safety Integrated (SI) input terminals of the SINAMICS components (Control Unit, Power Module), satisfy the requirements in accordance with the equipment directive 98/37/EC, the EN 60204-1, DIN EN ISO 13849-1 category 3 (formerly EN954-1) as well as the requirements for Performance Level (PL) d and IEC 61508 SIL2.

In combination with option K82, the requirements specified in Machinery Directive 98/37/EC, as well as in EN 60204-1 and DIN EN ISO 13849-1 category 3 (formerly EN 954-1) are satisfied for Performance Level (PL) d and IEC 61508 SIL2.

Note

Detailed and comprehensive instructions and information for the Safety Integrated functions can be found in the accompanying operating instructions, which are available as additional documentation on the enclosed customer CD.

4.10.22 NAMUR terminal block (option B00)

Description

The terminal block is designed in accordance with the requirements and guidelines defined by the standards association for measurement and control systems in the chemical industry (NAMUR – recommendation NE37), that is, certain device functions are assigned to fixed terminals. The inputs and outputs assigned to the terminals fulfill PELV ("protective extra-low voltage and protective separation") requirements.

The terminal block only contains the necessary functions. Unlike the NAMUR recommendation, optional terminals are not available.

The 24 V DC is supplied on the line side via terminals –A1-X2:1-3 (protected with 1 A within the converter). You must ensure that the PELV safety requirements (protective extra-low voltage with protective separation) are fulfilled.

To monitor the temperature of explosion-proof motors, option B00 features a PTC thermistor release mechanism with PTB approval. Shutdown if limit value is exceeded. The associated PTC sensor is connected to terminal –A1-X3:90, 91.

The terminal block is divided into three sections:

- -X1; -X2: for the power connections
- -A1-X2: for signal cables, which must fulfill PELV requirements with electrical separation.
- -A1-X3: for connecting the motor PTC thermistor detector

Connection

Table 4- 52 Terminal block -A1-X2 – 24 V supply voltage connection

| Terminal | Designation | Default | Comments |
|----------|-------------|--------------------------|--------------------------------------|
| 1 | М | Reference conductor | |
| 2 | P24 V | 24 V DC supply | Protected internally with fuse (1 A) |
| 3 | P24 V | 24 V DC outgoing circuit | |

Max. connectable cross-section: 2.5 mm²

4.10 Other connections

| Terminal | Designation | Default | Comments |
|----------|--------------|--------------------------------------|--|
| 10 | DI | ON/OFF (dynamic)/ ON/OFF (static) | Effective operation can be coded by a wire jumper on terminal –A1-X400:9;10 (factory setting: jumper inserted): jumper inserted: ON/OFF (dynamic)/ jumper removed: ON/OFF (static) |
| 11 | DI | OFF (dynamic) | |
| 12 | DI | Faster | Motorized potentiometer |
| 13 | DI | Slower | Motorized potentiometer |
| 14 | DI | RESET | Acknowledge error |
| 15 | DI | Interlock | OFF2 |
| 16 | DI | Counterclockwise | "0" signal: CW phase sequence "1" signal: CCW phase sequence |
| 17 18 | DI | Power Disconnection | EMERGENCY OFF circuit "0" signal: Power disconnection "1" signal: No power disconnection |
| 30 | DO (COM) | Ready for operation | Relay output (NO contact) |
| 31 | DO (NO) | | |
| 32 | DO (COM) | Motor turning | Relay output (NO contact) |
| 33 | DO (NO) | | |
| 34 | DO (NO) | Fault | Relay output (two-way contact) |
| 35 | DO (COM) | | |
| 36 | DO (NC) | | |
| 50/51 | AI 0/4-20 mA | Speed setpoint | Default: 4 to 20 mA |
| 60/61 | AO 0/4-20 mA | Motor frequency | Default: 4 - 20 mA (defaulted with motor frequency, can be reparameterized for other variables) |
| 62/63 | AO 0/4-20 mA | Motor current | Default: 4 - 20 mA (defaulted with motor current, can be reparameterized for other variables) |

| Table 4- 53 | Terminal block -A1-X2 – connection NAMUR control terminal block |
|-------------|---|
| | |

Max. connectable cross-section: 2.5 mm²

Table 4- 54 Terminal block -A1-X3 – connection for the motor PTC thermistor sensor

| Termin | al | Designation | Default | Comments |
|--------|----|-------------|---------------------------------|--------------------------------------|
| 90/91 | | AI | Connection for a PTC thermistor | Shutdown if limit value is exceeded. |

Max. connectable cross-section: 2.5 mm²

Adapting the analog inputs and outputs

If the setting ranges of the analog inputs and outputs are to be changed, the associated interface converters (-T411 / -T412 / -T413) must be set. The corresponding interface converter must be removed for this purpose and the rotary switch on the side ("S1") turned to the corresponding position.

Table 4-55 Terminal block -A1-X2 – Adaptation of analog inputs and outputs

| Terminal | Designation | Item code of interface converter | Settings on rotary switch S1 |
|----------|-------------|-------------------------------------|--|
| 50/51 | AI | T411 | 2: 0 - 20 mA 4: 4 - 20 mA (preassignment) |
| 60/61 | AO | T412 | 1: 0 - 20 mA 2: 4 - 20 mA (preassignment) |
| 62/63 | AO | T413 | 1: 0 - 20 mA 2: 4 - 20 mA (preassignment) |

4.10.23 Separate 24 V DC power supply for NAMUR (option B02)

Description

If the customer cannot provide a separate 24 V DC supply (PELV), this option enables a second power supply to be installed to provide the PELV (terminal assignment as option B00, 24 V infeed at terminal –A1-X1:1,2,3 no longer needed).

4.10.24 Outgoing section for external auxiliary equipment for NAMUR (option B03)

Description

If power is to be supplied to a motor fan on site, option B03 provides an uncontrolled fuseprotected (10 A) outgoing section. As soon as the supply voltage is present at the converter input, it is also present at these terminals. The voltage corresponds to the converter input voltage. You must take this into account when configuring the separately driven fan.

Connection

 Table 4- 56
 Terminal block -A1-X1 – uncontrolled power outlet (10 A) for supplying a separately driven motor fan

| Terminal | Default | Comments |
|-------------|---|-----------------------|
| 1, 2, 3, PE | Outgoing section for separately driven motor fan | U = U _{line} |

Max. connectable cross-section: 2.5 mm²

Electrical installation

4.10 Other connections

5.1 Chapter content

This chapter provides information on the following:

- An overview of the operator panel functions
- Initial commissioning of the cabinet (initialization)
 - Entering the motor data (drive commissioning)
 - Entering the most important parameters (basic commissioning), concluding with motor identification
- Data backup
- Parameter reset to factory settings



5.1 Chapter content

Important information prior to commissioning

The cabinet unit offers a varying number of internal signal interconnections depending on the delivery condition and the options installed. For the converter control to be able to process the signals correctly, several software settings must be made.

During initial power-up of the CU320 Control Unit and during first commissioning, parameter macros are executed and the necessary settings made. The settings are documented in the Appendix.

After initial power-up, first commissioning, and also following a "Parameter reset to factory settings", individual parameter values deviate from the factory settings stated in the List Manual.

5.2 STARTER commissioning tool

5.2 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. For this reason, this chapter only describes the individual commissioning steps.

Prerequisites for installing STARTER

Hardware requirements:

- PG or PC
- Pentium II 400 MHz (Windows 2000)
- Pentium III 500 MHz (Windows XP Professional)
- 512 MB main memory (1 GB recommended)
- 1024 x 768 pixel screen resolution

Software requirements for using STARTER without existing STEP7 installation:

- Microsoft Windows 2000 SP3, SP4
- Microsoft Windows Server 2003 SP1
- Microsoft Windows XP Professional SP1, SP2
- Internet Explorer V5.0.1 or higher
- Acrobat Reader V5.0 or higher is required to open the function diagrams in the online help.

Note

If STARTER is used in combination with other STEP7 components, the prerequisites for the S7 components shall apply.

5.2 STARTER commissioning tool

5.2.1 Installing the STARTER commissioning tool

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 Layout of the STARTER user interface

STARTER features four operating areas:



Figure 5-1 STARTER operating areas

| Operating area | Explanation |
|----------------------|--|
| 1: Toolbars | In this area, you can access frequently used functions via the icons. |
| 2: Project navigator | The elements and projects available in the project are displayed here. |
| 3: Working area | In this area, you can change the settings for the drive units. |
| 4: Detail view | Detailed information about faults and alarms, for example, is displayed this area. |

5.3 Procedure for commissioning via STARTER

5.3 Procedure for commissioning via STARTER

Basic procedure using STARTER

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

NOTICE

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

This is intentional because

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 the 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



Figure 5-2 Main screen of the STARTER parameterization and commissioning tool

⇒ 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.

5.3 Procedure for commissioning via STARTER

The STARTER project wizard



Figure 5-3 STARTER project wizard

⇒ Click Arrange drive units offline... in the STARTER project wizard.

| Project Wizard | Starter | | | | × | |
|----------------|-----------------------------|--|---|---------------|---|--|
| Introduction | 1. Create new project | 2. PG/PC - Set interface | 3. Insert drive units | 4. Summary | | |
| | | Please enter th Project name: Author: Storage loc.: Comment: | e project data: Project C:\Siemens\Step | 7\S7proj | | |
| | < Back Continue > Cancel | | | | | |

Figure 5-4 Create new project

- ⇒ Enter a project name and, if necessary, the author, memory location and a comment.
- \Rightarrow Click **Continue >** to set up the PG/PC interface.

| | Project Wizard Starter | | | | | |
|---|------------------------|-----------------------------|--------------------------------|-----------------------------|-----------------|-----------|
| | Introduction | 1. Create new project | 2. PG/PC - Set interface | 3. Insert drive units | 4. Summary | |
| | 200 | ก | Specify the o | nline connection to | the drive unit: | |
| | | | Set interface: | PC Adap | ter(PROFIBUS) | |
| | | | | | ge and test | 1 |
| — | | | Back Conti | | Cancel | ' |

Figure 5-5 Set up interface

⇒ Click **Change and test...** and set up the interface in accordance with your device configuration.

The Properties..., Copy... and Select... pushbuttons are now active.

5.3 Procedure for commissioning via STARTER

| Set PG/PC Interface | < |
|--|---|
| Access Path | |
| Access Point of the Application: | |
| S70NLINE (STEP 7)> PC Adapter(PROFIBUS) | |
| (Standard for STEP 7) | |
| Interface Parameter Assignment Used: PC Adapter(PROFIBUS) | |
| ISO Ind. Ethernet -> Intel(R) PRO/1 PC Adapter(Auto) PC Adapter(MPI) PC Adapter(PROFIBUS) Delete | |
| (Parameter assignment of your PC adapter for a PROFIBUS network) | |
| Interfaces | |
| Add/Remove: Sele <u>c</u> t | |
| OK Cancel Help | |

Figure 5-6 Setting the interface

Note

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

| Properties - PC Adapter(PROFIBUS) |
|---|
| PROFIBUS Local Connection |
| Station Parameters |
| PG/PC is the only master on the bus |
| Address: 0 |
| |
| _imeout: 30 s |
| Network Parameters |
| Transmission rate: |
| Highest station address: |
| Profile: DP Standard Universal (DP/FMS) User-Defined |
| Bus Parameters |
| |
| Network Configuration |
| □ Use the following network configuration |
| Master: 1 Slaves: 0 |
| |
| Default Cancel Help |

Figure 5-7 Setting the interface - properties

NOTICE

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.

 \Rightarrow Once you have done this, click **OK** to confirm the settings and return to the project wizard.

5.3 Procedure for commissioning via STARTER

| Pr | oject Wizard | Starter | | | | × |
|----|--------------|-----------------------------|--------------------------------|-----------------------------|-------------------|---|
| | Introduction | 1. Create new project | 2. PG/PC - Set interface | 3. Insert drive units | 4. Summary | |
| | 1.24 | <i>ъ</i> | Specify the o | nline connection t | o the drive unit: | |
| | | | Set interface: | PC Ada | pter(PROFIBUS) | |
| | (anna) | | | | | |
| | | | | Char | nge and test | |
| | | < | Back Conti | | Cancel | |

Figure 5-8 Setting the interface

 \Rightarrow Click **Continue >** to set up a drive unit in the project wizard.

| Pr | oject Wizard | Starter | | | | | × |
|----|--------------|-----------------------------|--------|--|--|------------------|---|
| | Introduction | 1. Create new project | | 2. PC - Set erface | 3. Insert drive units | 4. Summary | |
| | Preview | | | Please ente – Drive unit | r the drive unit d | lata: |] |
| | Project | | | Device: Type: Version: Bus addr. Name: | Sinamics G150 2.6x 33 SINAMICS | • • • • | |
| | | | < Back | Sinamic: | <u> </u> | Insert Cancel | |

Figure 5-9 Inserting the drive unit

⇒ Choose the following data from the list fields:
Device: Sinamics
Type: G150
Version: 2.6x
Bus address: the corresponding bus address for the cabinet unit.
The entry in field Name: field is user defined.

⇒ Click Insert

The selected drive unit is displayed in a preview window in the project wizard.

| P | roject Wizard | Starter | | | | | × |
|---|---------------|-----------------------------|------|--|----------------------------------|---------------|---|
| | Introduction | 1. Create new project | | 2. /PC - Set terface | 3. Insert drive units | 4. Summary | |
| Γ | Preview | | | Drive unit | | |] |
| | ⊡- 🞒 Project | MICS_G150 | | Device: Type: Version: Bus addr | Sinamics G150 2.6x : 34 | • • • | |
| | | | | Name: | SINAMICS | G150_1 | |
| _ | | | | Sinamic | s tutorial | Insert | |
| | | < | Back | Continu | | Cancel | |

Figure 5-10 Inserting the drive unit

⇒ Click Continue >

A project summary is displayed.

5.3 Procedure for commissioning via STARTER

| Project Wizard Starte | er | | |
|-----------------------|--|----------------------|---------------|
| | 1. 2. reate PG/PC - So project interface | | 4. Summary |
| | - Interface: PC Adapter - Drive units: | Siemens\Step7\S7proj | r. 33) |
| | < Back | omplete | Cancel |

Figure 5-11 Summary

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

5.3.2 Configure the drive unit

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



Figure 5-12 Project navigator - Configure drive unit

 \Rightarrow 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.

⇒ Double-click Configure the drive unit.

5.3 Procedure for commissioning via STARTER

Configuring the drive unit

Configuration - SINAMICS_G150 - Drive unit Configure the drive unit: Options All Connection voltage: • Control structure Drive setting All Cooling method: • Motor Motor holding brake Drive unit selection: Defaults of the setpoint Order no. Voltage Rated cur... Rated po... ~ Drive functions 6SL3710-1GE32-1AA0 110kw 210A 400\ PROFIBUS process da 6SL3710-1GE32-1CA0 400V 210A 110kW Important parameters 6SL3710-1GE32-1CU0 400V 210A 110kW Summary 6SL3710-1GE32-1AU0 400V 210A 110kW 6SL3710-1GE32-6AA0 400V 260A 132kW 6SL3710-1GE32-6CA0 400V 260A 132kW 6SL3710-1GE32-6CU0 400V 260A 132kW 6SL3710-1GE32-6AU0 400V 260A 132kW 6SL3710-1GE33-1AA0 400V 310A 160kW 6SL3710-1GE33-1CA0 400V 310A 160kW < > 6SL3710-1GE33-1CU0 400V 310A 160kW 6SL3710-1GE33-1AU0 400V 310A 160kW 6SL3710-1GE33-8AA0 400V 380A 200kW 6SL3710-1GE33-8CA0 200kW 400V 380A v Configure the drive: Drive object type: Vector Default macro: G150 cabinet unit V2.x Ŧ Continue > Cancel <u>H</u>elp

Figure 5-13 Configuring the drive unit

⇒ Under **Connection voltage**, choose the correct voltage. Under **Cooling method:** choose the correct cooling method for your drive unit.

Note

In this step, you make a preliminary selection of the cabinet units. You do not define the line voltage and cooling method yet.

 \Rightarrow A list is now displayed under **Drive unit selection:**. Choose the corresponding drive unit according to type (order no.) (see type plate).

⇒ Click Continue >

Choosing the options

Configuration - SINAMICS_G150 - Options Configure the order options: Drive unit. Control structure Options selection: Drive setting □Motor 🗖 BOO 💠 NAMUR terminal block ~ Motor holding brake Safely isolated 24 V supply (PELV) 🗖 B02 : Defaults of the setpoint 🗖 B03 : External auxiliaries outlet (uncontrolled) Drive functions 🗖 G33 Profinet : Process data exchange User terminal block extension module 🗖 G61 : Important parameters SMC30 Sensor Module 🗹 K50 : Summary S Flying restart with synchronous machine without end K51 🗖 K82 : Safe torque off on the power module 🗖 LOO Line filter for use in the first environment in accordar : 🗖 L08 : Motor reactor 🗖 L10 dv/dt filter plus voltage peak limiter : < > 🗖 L15 Sine-wave filter : Main contactor (for currents < 800 A) 🗖 L13 : 🗖 L19 Connection for external auxiliaries (controlled max, 1 : Without line choke in the power range P < 500 kW 🗖 L22 : 🗖 L26 Mains switch incl. fuses or circuit breaker EMERGENCY STOP pushbutton in the cabinet doc 🚩 🗖 L45 < > The options and the selection of the drive unit can no longer be changed after the Wizard page has been exited with "Next". Next > < <u>B</u>ack Cancel <u>H</u>elp

Figure 5-14 Choosing the options

 \Rightarrow From the combination box **Options selection:** select the options belonging to your drive unit by clicking on the corresponding check box (see type plate).

CAUTION

If a sine-wave filter (option L15) is connected, it must be activated when the options are selected to prevent the filter from being destroyed.

Note

Check your options carefully against the options specified on the type plate.

Since the wizard establishes internal interconnections on the basis of the options selected, you cannot change the selected options by clicking **< Back**. If you make an incorrect entry, delete the entire drive unit from the project navigator and create a new one.

⇒ Check your options carefully and then click Continue >

Selecting the control structure



Figure 5-15 Selecting the control structure

⇒ Select the required data:

- Function modules:
 - Technology controller
 - Extended messages/monitoring

5.3 Procedure for commissioning via STARTER

• Control method:

choose one of the following open-loop/closed-loop control types:

- Torque control (without encoder)
- Torque control (with encoder)
- Speed control (without encoder)
- Speed control (with encoder)
- I/f control with fixed current
- V/f control for drive requiring a precise frequency (e.g. textiles)
- V/f control for drive requiring a precise frequency with FCC
- V/f control with linear characteristic
- V/f control with linear characteristic and FCC
- V/f control with parabolic characteristic
- V/f control with parameterizable characteristic
- V/f control with independent voltage setpoint
- ⇒ Click Continue >

Configuring the drive unit properties

| Configuration - SINAMIC | S_G150 - Drive setting | |
|---|--------------------------------|----------------------------|
| Drive unit | Drive: Drive_1, DDS 0 | |
| ✓ Options ✓ Control structure ✓ Drive setting | Configure the drive properties | : |
| Motor Motor holding brake | Sta <u>n</u> dard: | IEC-Motor (50Hz, SI units) |
| Defaults of the setpoint Drive functions PROFIBUS process da Important parameters Summary | Connection <u>v</u> oltage: | 400 V |
| < | | |
| | | |
| | < <u>B</u> ack | ntinue > Cancel Help |

Figure 5-16 Configuring the drive unit properties

 \Rightarrow Under **Standard:**, choose the appropriate standard for your motor, whereby the following is defined:

- IEC motor (50 Hz, SI unit): Line frequency 50 Hz, motor data in kW
- NEMA motor (60 Hz, US unit): Line frequency 60 Hz, motor data in hp
- ⇒ Under Connection voltage:, enter the appropriate voltage of the cabinet unit.
- ⇒ Click Continue >

5.3 Procedure for commissioning via STARTER

Configuring the motor – Selecting the motor type

| Configuration - SINAMIC | S_G150 - Motor | | |
|---|--|---|--------------|
| Drive unit Options Control structure Drive setting Motor Motor holding brake Encoder Defaults of the setpoint Drive functions Process data exchange | Drive: Drive_1, DDS Configure the motor: Motor <u>n</u> ame: | 0, MDS 0 Motor Motor with DRIVE-CLiQ interface Read out motor again Select <u>s</u> tandard motor from list Enter motor <u>d</u> ata | |
| Important parameters Summary | <u>M</u> otor type: | Induction motor (rotating) (1) | • |
| | Parallel motor | connection | Number: 1 |
| | < <u>B</u> ack | <u>Next></u> | <u>H</u> elp |

Figure 5-17 Configuring the motor – Selecting the motor type

 \Rightarrow Under **Motor name:** enter a name for the motor.

 \Rightarrow From the selection box next to **Motor type:** select the appropriate motor for your application.

 \Rightarrow In the **Parallel connection motor** field, enter the number of motors connected in parallel, if necessary. Motors connected in parallel must be of the same type and size.

Note

The steps described below also apply to commissioning an induction motor.

When commissioning a permanent-magnet synchronous motor, there are a few special conditions that apply, which are detailed in a separate chapter (see "Setpoint channel and closed-loop control/permanent-magnet synchronous motors").

⇒ Click Continue >

5.3 Procedure for commissioning via STARTER

Configuring the motor – Entering motor data

| ✓Options ✓Control structure | hdatas da | te la duction en ter (netern) | Temp | olate |
|---------------------------------|---------------------------|--|---------------|-----------|
| ✓Drive setting | <u>M</u> otor da | ta, Induction motor (rotary): | | |
| √ Motor | Name | Comment | Value | Unit |
| Motor data | p304[0] | Rated motor voltage | 340 | Vrms |
| Motor holding brake | p305[0] | Rated motor current | 233.00 | Arms |
| Encoder | p307[0] | Rated motor power | 108.00 | KVV |
| Defaults of the setpoint | p308[0] | Rated motor power factor | 0.850 | |
| Drive functions | p310[0] | Rated motor frequency | 50.90 | Hz |
| PROFIBUS process da | | Rated motor speed | 1500.0 | RPM |
| Important parameters Summary | p335[0] | Motor cooling type | Non-ventila | at |
| < | | | | |
| | | or data must be entered completely! | | |
| <> | | or data must be entered completely! ou want to enter the optional data? | | |
| < < | 🔽 Doya | | diagram data? | |
| | I Doyo I Doyo Note: | ou want to enter the optional data? ou want to enter the <u>e</u> quivalent circuit ion of the optional or equivalent circui | - | ets these |

Figure 5-18 Configuring the motor – Entering motor data

- \Rightarrow Enter the motor data (see motor type plate).
- ⇒ If necessary, check Do you want to enter the optional data?
- ⇒ If necessary, activate Do you want to enter the equivalent circuit diagram data?

Note

Click **Template** to open another selection screenform where you can choose the motor used in your application from a long list of standard motor types. Select a motor from the list to enter the data stored in the system for that motor automatically in the data fields.

NOTICE

You should only check the "Do you want to enter equivalent circuit diagram data?" box if the data sheet with 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.

⇒ Click Continue >
5.3 Procedure for commissioning via STARTER

Configuring the motor - Entering optional data

| Drive unit Options | | - Optional Motor Data ive_1, DDS 0, MDS 0 | | | | |
|---|------------------|---|----------|--------------|--|--|
| Control structure | <u>M</u> otor da | Motor data, Induction motor (rotary): | | | | |
| Motor | Name | Comment | Value | Unit | | |
| Motor data | p320[0] | Motor rated magnetization current/short-circ | 91.000 | Arms | | |
| Optional Motor Date | p322[0] | Maximum motor speed | 5000.0 | RPM | | |
| Equivalent Circuit D | p341[0] | Motor moment of inertia | 0.666000 | kgm² | | |
| Calculation of the N | p342[0] | Ratio between the total and motor moment of | 1.000 | | | |
| ☐ Motor holding brake | | Motor weight | 440.0 | kg | | |
| | p352[0] | Cable resistance | 0.00000 | Ohm | | |
| Defaults of the setc | | Motor series inductance | 0.000 | mH | | |
| | | | | | | |
| | The optio | onal motor data do not have to be entered com | pletely! | | | |
| | Note: Unknowi | n data must be set to their default values! | | | | |
| If you want to reset all optional data, you must deselect their input on the Motor Data page. | | | | | | |
| | | < Back Continue > Cancel | | <u>H</u> elp | | |

Figure 5-19 Entering optional motor data

 \Rightarrow If required, enter the optional motor data.

⇒ Click Continue >

| ✓Drive unit | <u> </u> | Drive: Drive_1, DDS 0, MDS 0 | | |
|---|----------|---|---------|-----|
| Control structure | F | Repres. of equiv. circuit diag. data: System of units, ph | ysical | |
| ✓Motor ✓Motor data | ŀ | Motor data, Induction motor (rotary): | | |
| Optional Motor Date | ſ | Name Comment | Value | Uni |
| Equivalent Circuit D | | p350[0] Motor stator resistance, cold | 0.01700 | Ohr |
| Calculation of the M | | p354[0] Motor rotor resistance cold / damping resistanc | 0.01200 | Ohr |
|]Motor holding brak∉ | | p356[0] Motor stator leakage inductance | 0.21262 | |
| Encoder | | p358[0] Motor rotor leakage inductance / damping induc | | |
| Defaults of the setp Drive functions | | p360[0] Motor magnetizing inductance/magn. inductanc | 6.59758 | mΗ |
| Important paramete | | | | |
| Summary | | | | |

Configuring the motor - Entering the equivalent circuit diagram data

Figure 5-20 Entering equivalent circuit diagram data

- \Rightarrow If required, enter the equivalent circuit diagram data.
- ⇒ Click Continue >

5.3 Procedure for commissioning via STARTER

Calculating the motor/controller data



Figure 5-21 Calculating the motor/controller data

⇒ In Calculation of the motor/controller data, select the appropriate default settings for your device configuration.

Note

If the equivalent circuit diagram data was entered manually (see figure "Entering the equivalent circuit diagram data"), the motor/controller data should be calculated without calculating the equivalent circuit diagram data.

⇒ Click Continue >

Configuring the motor holding brake



Figure 5-22 Configuring the motor holding brake

⇒ Under **Holding brake configuration:** choose the appropriate settings for your device configuration.

⇒ Click Continue >

5.3 Procedure for commissioning via STARTER

Entering the encoder data (option K50)

Note

If you have specified option K50 (SMC30 Sensor Module), the following screen is displayed in which you can enter the encoder data.

| Configuration - SINAMIC | S_G150 - Encoder | | |
|---|---|---|--|
| ✓Drive unit | Drive: Drive_1, DDS 0, | MDS 0 | |
| Options Control structure Drive setting | W <u>h</u> ich encoder do you | want to use? | |
| Motor Motor data | | Encoder <u>2</u> | Encoder <u>3</u> |
| ✓ Optional Motor Dat. ✓ Equivalent Circuit C ■ ✓ Calculation of the M | Encoder 1 | Encoder_1 | |
| Motor holding brake Encoder | Encoder evaluation: | SMC30 - "SMC30" (4) | |
| Defaults of the setp Drive functions Process data excha | | C Encoder with Drive | |
| Important paramete | | Select standard encoder from list | Vja motor order no. |
| | | Enter data | Encoder data |
| | Encoder type 2048 HTL A/B R 1024 HTL A/B 1024 TTL A/B 2048 HTL A/B 2048 HTL A/B 1024 HTL A/B unip 2048 HTL A/B unip 2048 HTL A/B R, w User-defined | olar | Code number ▲ 3003 3005 3006 3007 3008 3009 3011 3020 9999 ✓ |
| | | | Details |
| | < <u>B</u> ack | <u>Next></u> | Cancel <u>H</u> elp |

Figure 5-23 Entering the encoder data



Note

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

 \Rightarrow To select a different predefined encoder configuration, check the **Select standard encoder** from list radio button and select one of the encoders from the list.

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

| Encoder data | | |
|------------------------------|---|--------------|
| Encoder data Encoder type | Incremental tracks Pulges/revolution: 1024 Level: HT Track monitoring Signal: Un Zero marks Configuration: No zero mark Zero mark spacing: No. of zero marks: | |
| | KCancel | <u>H</u> elp |

Figure 5-24 Entering encoder data – User-defined encoder data

 \Rightarrow Select the **measuring system**.

In conjunction with SINAMICS G150, the following encoders can be selected:

- HTL
- TTL
- \Rightarrow Enter the required encoder data.
- ⇒ 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

| Configuration - SINAMIC | CS_G150 - Defaults of the setpoints/command sources |
|---|--|
| | |
| Drive unit Options | Drive: Drive_1, DDS 0 |
| Control structure | Select the default macros for your command sources: |
| ✓Drive setting | Select the default indefes for your command sources. |
| Motor Motor data | CDS0 TM31 terminals |
| ✓ Optional Motor Dat. | Co <u>m</u> mand sources: |
| 🗹 Equivalent Circuit D 🗐 | CDS1 No selection |
| ✓Calculation of the M ✓Motor holding brake | All binector inputs (BI) of the corresponding command data |
| ✓ Inoter Holding brakt | set (CDS) will be interconnected accordingly. |
| Defaults of the setp | |
| Drive functions | Calastilla defendencias formas alteriations |
| Important paramete | Select the default macros for your setpoint sources: |
| Summary | |
| | CD <u>S</u> 0 TM31 terminals |
| | Setgoint sources: |
| | CDS1 No selection |
| | |
| | All connector inputs (CI) of the corresponding command data set (CDS) will be interconnected accordingly. |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | < Back Continue Cancel Help |
| | |

Figure 5-25 Default settings for setpoints/command sources

⇒ Under **Command sources:**, choose 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 |
| | NAMUR |
| | PROFIdrive NAMUR |
| Setpoint sources: | PROFIdrive |
| | TM31 terminals |
| | Motorized potentiometer |
| | Fixed setpoint |
| | |

Note

With SINAMICS G150, only CDS0 is normally used as a default setting for the command and setpoint sources.

Make sure that the selected default setting is compatible with the actual system configuration.

Note

The choice "no selection" is also available as default setting for the command and setpoint sources; if selected, no default settings are applied for the command and setpoint sources.

⇒ Check your default settings carefully and then click Continue >

5.3 Procedure for commissioning via STARTER

Defining the technological application/motor identification

| Configuration - SINAMI | CS_G150 - Drive functions |
|-----------------------------------|---|
| | |
| Drive unit | Drive: Drive_1, DDS 0 |
| Control structure | |
| ✓ Drive setting | |
| Motor | Iechnological application: Pumps and fans (1) |
| Motor data Optional Motor Dat- | |
| Equivalent Circuit D = | A motor identification is recommended at the initial commissioning: |
| ✓Calculation of the M | |
| Motor holding brake | Motor identification: Motor data identification at stan |
| ✓Encoder ✓Defaults of the setp | , |
| | |
| PROFIBUS process | |
| Important paramete | |
| Summary | |
| | |
| | |
| | |
| | A motor data identification is performed once at the drive enable. The motor is under current and may turn up to a |
| | quarter of a revolution. |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | < <u>B</u> ack (<u>Continue</u> >) <u>C</u> ancel <u>H</u> elp |
| | |

Figure 5-26 Defining the technological application/motor identification

- \Rightarrow Select the required data:
- Technological application:
 - "Standard drive (VECTOR) (0)"
 Edge modulation is not enabled.
 The dynamic voltage reserve is increased (10 V), which reduces the maximum output voltage.
 - "Pumps and fans (1)"(default setting)

Edge modulation is enabled.

The dynamic voltage reserve is reduced (2 V), which increases the maximum output voltage.

- "Passive loads (for sensorless control down to f = 0) (2)"

Controlled operation down to standstill is possible for passive loads. These include applications in which the load cannot produce a regenerative torque on startup and the motor comes to a standstill when pulses are inhibited.

• Motor identification:

In many cases, "Motor identification at standstill" is the correct default setting for SINAMICS G150.

"Motor identification with motor running" is the recommended setting for speed control with encoder; this measurement is normally performed on non-coupled machines.

When the rotating measurement is selected, 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 machines and personnel, the relevant safety regulations must be observed.

⇒ Click Continue >

5.3 Procedure for commissioning via STARTER

Selecting the PROFIBUS message frame



Figure 5-27 Selecting the PROFIBUS message frame

⇒ Under **PROFIBUS process data exchange (drive):** select the PROFIBUS message frame type.

Message frame types

- Standard telegram 1
- Standard telegram 2
- Standard telegram 3
- Standard telegram 4
- VIK-NAMUR telegram 20
- SIEMENS telegram for metal industry 220
- PCS7 telegram 352
- Free telegram configuration with BICO
- ⇒ Click Continue >

5.3 Procedure for commissioning via STARTER

Entering important parameters

Configuration - SINAMICS_G150 - Important parameters Drive: Drive_1, DDS 0 Drive unit ~ ✓Options Control structure Set the values for the most important parameters: ✓Drive setting Motor 307.50 Current limit: Arms Motor data Optional Motor Date 0.000 Minimum speed: **RPM** Equivalent Circuit D Calculation of the M 5000.000 **RPM** Maximum speed: Motor holding brakε Encoder 20.000 Ramp-up time: s Defaults of the setp Drive functions 30.000 Ramp-<u>d</u>own time: s PROFIBUS proces: 10.000 Bamp-down time with OFF3: s Summary < > Continue > < <u>B</u>ack <u>C</u>ancel <u>H</u>elp

Figure 5-28 Important parameters

 \Rightarrow Enter the required parameter values.

Note

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

⇒ Click Continue >

Summary of the drive unit data



Figure 5-29 Summary of the drive unit data

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

- ⇒ Click Finish.
- ⇒ Save your project to the hard disk by choosing **Project > Save**.

5.3 Procedure for commissioning via STARTER

5.3.3 Additional settings required for units that are connected in parallel

After commissioning by means of STARTER, additional settings must be made for units that are connected in parallel:

- With 380 V 480 V 3 AC: 6SL3710-2GE41-1AA0, 6SL3710-2GE41-4AA0, 6SL3710-2GE41-6AA0
- With 500 V 600 V 3 AC: 6SL3710-2GF38-6AA0, 6SL3710-2GF41-1AA0, 6SL3710-2GF41-4AA0
- With 660 V 690 V 3 AC: 6SL3710-2GH41-1AA0, 6SL3710-2GH41-4AA0, 6SL3710-2GH41-5AA0

Settings to monitor the checkback signal from the main contactor or circuit breaker for 12-pulse infeed

The checkback contacts of the main contactors and the circuit breakers are connected in series in the factory and wired to digital input 5 of the CU320 Control Unit.

After the drive unit has been commissioned, the checkback signal monitoring function must be activated. This is realized using parameter p0860{Vector} = 722.5{Control_Unit}.

If the monitoring function for the main contactor or circuit breaker checkback signal is not activated, then the drive could be powered up even if the main contactor or circuit breaker on an individual system fails. This could overload and damage the input rectifiers on the individual system.

NOTICE

When resetting (restoring) the parameterization to the factory setting, this setting must be again made after the drive unit has been recommissioned.

Settings for motor connection to a motor with one-winding system

During commissioning, a motor with several winding systems is automatically defined.

The setting for a one-winding system is made after commissioning has been completed by setting parameter p7003 to 0.

NOTICE

If the "motor with a one-winding system" is not set using p7003 = 0, then the drive can be powered down (tripped) during the motor identification routine with an "overcurrent" fault message. The system will not be properly tuned.

NOTICE

When resetting (restoring) the parameterization to the factory setting, this setting must be again made after the drive unit has been recommissioned.

5.3.4 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 | <mark>₅</mark> <u>⊾⊿</u> [' |

NOTICE

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 | Step | | | | |
|------|--|--|--|--|--|
| 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.

5.3 Procedure for commissioning via STARTER

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.

5.3.5 Connection via serial interface

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

Prerequisites

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

Settings

1. In STARTER, select the **Serial cable (PPI)** interface from **Project > Set PC/PG 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 is located under the following path on the STARTER CD: \installation\starter\bisk1\SerialCable_PPI\ STARTER must not be active while the driver is being installed.

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

5.3 Procedure for commissioning via STARTER

| Set PG/PC Interface | | |
|--|--|---------------------|
| Set PG/PC Interface Access Path Access Point of the Application: S70NLINE (STEP 7) > Serial cable(I (Standard for STEP 7) Interface Parameter Assignment Used: Serial cable(PPI) | PPI) ▼ | |
| PC Adapter(PROFIBUS) PC/PPI cable(PPI) Serial cable(PPI) TCP/IP -> Intel(R) PRO/100 VE Ne (Assigning Parameters to an PC/PPI cable for an PPI Network) | Properties - Serial cable(PPI) PPI Local Connection Station Parameters | |
| Add/Remove: | Network Parameters Advanced PPI Multiple master network. Transmission rate: Highest station address: | 19.2 kbps 💌 15 💌 |
| | OK Default | Cancel Help |

Figure 5-30 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".

5.3 Procedure for commissioning via STARTER

| Starter - Projektassistent 🛛 🔀 | | | | | | |
|---------------------------------------|------------|----------------------------------|-----|--|---------------------------------------|----------------------------|
| | Einführung | 1. Neues Projekt erstellen | Sch | 2. / PC - nittstelle istellen | 3. Antriebs- geräte einfügen | 4. Zusammen- fassung |
| Γ | Vorschau | | | Geben Sie b – Antriebsge | | bsgerätedaten ein: |
| | 🞒 Projekt | | | Gerät: Typ: | Sinamics G150 | |
| | | | | Version: | 2.5x | • • |
| | | | | Busadres | se: <mark>3</mark> | - |
| | | | | Name: | SINAMIC | CS_G150 |
| Sinamics Tutorial Einfügen | | | | | | |
| <zurück weiter=""> Abbrechen</zurück> | | | | | | |

Figure 5-31 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 used here to connect the PC (COM interface) and CU320. This interface must not be switched.

5.4 The AOP30 operator panel

5.4 The AOP30 operator panel

Description

An operator panel is located in the cabinet door of the cabinet unit for operating, monitoring, and commissioning tasks. It has the following features:

- Graphical, back-lit LCD for plain-text display and a "bar display" of process variables
- LEDs for indicating the operating modes
- 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)

Figure 5-32 Components of the cabinet unit operator panel (AOP30)

5.5.1 Initial ramp-up

Start screen

When the system is switched on for the first time, the Control Unit (CU320) is initialized automatically. The following screen is displayed:

| SIEMENS | | | SINAM | lics |
|---------|----|----|-------|------|
| | | | | |
| F1 | F2 | F3 | F4 | F5 |

Figure 5-33 Initial screen

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

| NOTE Load pa | arameter d | escription | | |
|-----------------|------------|------------|------|----|
| 0% PLEAS | E WAIT | 50% | 100% | |
| F1 | F2 | F3 | F4 | F5 |

Figure 5-34 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.

| Sprach | hauswahl/La | anguage sel | lection | |
|--------|-------------|-------------|---------|----|
| Engli | sh | | | |
| Deut | sch | | | |
| Fran | çais | | | |
| Espa | ñol | | | |
| Italia | no | | | |
| Chine | ese | | | |
| | | | | |
| | | | | |
| F1 | F2 | F3 | F4 | F5 |

You can select the language in the dialog screen.

To change the language, choose <F2> or <F3>. To select the language, choose <F5>.

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 fields are generally texts surrounded by a frame. When they are selected, they are highlighted with a white text on a 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 one interactive screen to the next or previous screen by selecting the "Next" or "Previous" selection boxes and then confirming by pressing <F5> "OK". If a screen contains particularly important parameters, the selection field "Continue" only appears at the bottom of the screen. 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 First commissioning with the AOP30

5.5.2 Basic 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.



Figure 5-35 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 | IEC [50 Hz / kW] |
| | | 1 | NEMA [60 Hz / hp] |
| Motor: | | | |
| Rated voltage | p0304 | | [V] |
| Rated current | p0305 | | [A] |
| Rated power | p0307 | | [kW] / [hp] |
| Rated power factor $\cos \phi$ (at p0100 = 0 only) | p0308 | | |
| Rated efficiency η (at p0100 = 1only) | p0309 | | [%] |
| Rated frequency | p0310 | | [Hz] |
| Rated speed | p0311 | | [min-1] / [rpm] |

Basic commissioning: Selecting the motor type and entering the motor data

For the following cabinet units, possible additional settings must be made before the following sequence (see "Additional settings for cabinet units with high power rating"):

- With 380 V 480 V 3 AC: 6SL3710-2GE41-1AA0, 6SL3710-2GE41-4AA0, 6SL3710-2GE41-6AA0
- With 500 V 600 V 3 AC: 6SL3710-2GF38-6AA0, 6SL3710-2GF41-1AA0, 6SL3710-2GF41-4AA0
- With 660 V 690 V 3 AC: 6SL3710-2GH41-1AA0, 6SL3710-2GH41-4AA0, 6SL3710-2GH41-5AA0

| {2:VECTOR} motor standard/motor type Contin p0100 Motor standard IEC/NEMA 0:IEC[50Hz/kW] p0300m motor type selection 1:Async_motor Lelp ▲ ▼ OK F1 F2 F3 F4 F5 | You can select the motor standard and type in the dialog screen. The following is defined for the motor standard: 0: Line frequency 50 Hz, motor data in kW 1: line frequency 60 Hz, motor data in hp The following selection options are available for the motor type: |
|---|---|
| ¥ | 1: Induction motor 2: Permanent-magnet synchronous motor Other values are not permitted. |
| | To navigate through the selection fields, choose <f2> or <f3>. To activate a selection, choose <f5>.</f5></f3></f2> |
| {2:VECTOR} motor parameter m:0 | Entering motor data specified on the type plate |
| p0210 supply voltage 400 V p0304mMot U_Bemes 400.00 Vrms p0305mMot I_Bemes 405.00 Aeff p0307mMot P_Bemes 235.00 kW | To navigate through the selection fields, choose <f2> or <f3>. To activate a selection, choose <f5>.</f5></f3></f2> |
| Help ▲ ▼ OK F1 F2 F3 F4 F5 | To change a parameter value, navigate to the required selection field and activate your entries with <f5>.</f5> |
| | The system displays another window in which you can: |
| {2:VECTOR} motor parameter m:0 p0308mMot cosphi_Bemes 0.870 p0310mMot f_Bemes 50.00 Hz p0311mMot n_Bemes 1485.00 min-1 p0335mMotor cooling method 0:Selbstkühlung Help ✓ F1 F2 F3 F4 F5 | Enter the value directly, or select the value from a list. When you have finished entering the motor data, choose "Continue" underneath the final parameter value and activate with <f5>.</f5> |

Note

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

When commissioning a permanent-magnet synchronous motor (p0300 = 2), there are a few special conditions that apply, which are detailed in a separate chapter (see "Setpoint channel and closed-loop control/Permanent-magnet synchronous motors").

Basic commissioning: entering the encoder data (if available)



When the SMC30 is connected for encoder evaluation (with option K50), it is recognized by the AOP30 and a screen is displayed in which you can enter the encoder data.

To navigate through the selection fields, choose <F2> or <F3>. To activate a selection, choose <F5>.

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 with sense to X520 |

Note

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

The section ("Electrical Installation") contains two connection examples for HTL and TTL encoders.

Note

If the connected encoder does not match any of the encoders predefined in p0400, follow the simple procedure below for entering the encoder data:

- Via p0400, select an encoder type whose data is similar to that of the connected encoder.
- Select "User-defined encoders" (p0400 = 9999). Previously set values are stored here.
- Adjust the bit fields of p0404, p0405, and p0408 to the data for the connected encoder.

| Table 5-2 Meaning of the bit settin |
|-------------------------------------|
|-------------------------------------|

| Bit | Meaning | Value 0 | Value 1 |
|-----|--------------|---------|---------|
| 20 | Voltage 5 V | No | yes |
| 21 | Voltage 24 V | No | yes |

| Table 5-5 Meaning of the bit settings for p040 | Table 5- 3 | e bit settings for p0405 |
|--|------------|--------------------------|
|--|------------|--------------------------|

| 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 unipolar | 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.

5.5 First commissioning with the AOP30

Basic commissioning: Entering the basic parameters

| | R} basic c | ommissioni | ng | |
|--|--|---|----------------------------|---|
| | Contin | | | |
| 1. | ve filter type | е | 0:no filter | |
| p0700cMa | acro Bl | | 6:terminals | |
| p1000cMa | acro CI n_ta | arget | 2:terminals | sTM31 |
| Help | | ▼ | | ок⊔ |
| F1 | F2 | F3 | F4 | F5 |
| | | ↓ | | |
| 1. | - | ommissioni | - | d:0 |
| 1. | ain setpoint | | {03}0405 | |
| 1. | nimum spe | | |) min-1 |
| 1. | aximum spe | | 1500.000 | ו∎ו |
| p1120dHL | .G ramp-up | time | 20.000 |)]s ∎ |
| Help | | ▼ | | ок⊔ |
| F1 | F2 | F3 | F4 | F5 |
| | | | | |
| | T | • | | |
| 1. | - | ommissioni | | d:0 |
| p1120dHL | .G Ramp-u | p time | 20.000 |)s |
| p1120dHL p1121dHL | .G Ramp-u .G Ramp-de | p time own time | 20.000 | Ds |
| p1120dHL p1121dHL | .G Ramp-u | p time own time | 20.000 | Ds |
| p1120dHL p1121dHL | .G Ramp-u .G Ramp-de | p time own time | 20.000 30.000 10.000 | Ds |
| p1120dHL p1121dHL | .G Ramp-u .G Ramp-de | p time own time | 20.000 30.000 10.000 |)s)s)s |
| p1120dHL p1121dHL p1135dHL | .G Ramp-u .G Ramp-de | p time own time | 20.000 30.000 10.000 |)]s)]s)]s ontin |
| p1120dHL p1121dHL p1135dHL Help | .G Ramp-u .G Ramp-d .G OFF3 t_ F2 | p time own time R-down | 20.000 30.000 10.000 |) s) s) s ontin OK |
| p1120dHL p1121dHL p1135dHL Help | .G Ramp-u .G Ramp-d .G OFF3 t_ F2 | p time own time R-down | 20.000 30.000 10.000 |) s) s) s ontin OK |
| p1120dHL p1121dHL p1135dHL Help F1 Final confi Back | .G Ramp-u .G Ramp-d .G OFF3 t_ F2 | p time own time R-down F3 | 20.000 30.000 10.000 |) s) s) s ontin OK |
| p1120dHL p1121dHL p1135dHL Help F1 Final confi Back Permane | G Ramp-u G Ramp-de G OFF3 t_ F2 irmation | p time own time R-down F3 | 20.000 30.000 10.000 |) s) s) s ontin OK |
| p1120dHL p1121dHL p1135dHL Help F1 Final confi Back Permane | G Ramp-u G Ramp-de G OFF3 t_ F2 irmation | p time own time R-down F3 er transfer | 20.000 30.000 10.000 |) s) s) s ontin OK |
| p1120dHL p1121dHL p1135dHL Help F1 Final confi Back Permane | G Ramp-u G Ramp-de G OFF3 t_ F2 irmation | p time own time R-down F3 er transfer | 20.000 30.000 10.000 | D)s D)s D)s D)s Ontin OK |

Entering the basic commissioning parameters:

If a sine-wave filter (option L15) is connected, it must be activated in p0230 (p0230 = 3) otherwise it could be destroyed. p0700: Preset command source 5: PROFIdrive 6: TM31 terminals

- 7: Namur
- 10: PROFIdrive Namur

p1000: Preset setpoint source

- 1: PROFIdrive
- 2: TM31 terminals
- 3: Motorized potentiometer
- 4: Fixed setpoint

Once a setpoint source has been selected (p1000), the main setpoint p1070 is defaulted accordingly.

To navigate through the selection fields, choose $\langle F2 \rangle$ or $\langle F3 \rangle$.

To activate a selection, choose <F5>.

To change a parameter value, navigate to the required selection field and activate with <F5>.

Another window appears in which you can - enter the required value directly, or

- select the value from a list.

Final confirmation

Confirm the basic parameters to save them.

Once you have selected "Continue" and activated your entries with <F5>, the basic parameters you entered are permanently saved and the calculations required for closed-loop control are carried out.

NOTICE

A filter at the motor end must be entered in p0230 (option L08 – motor reactor: p0230 = 1, option L10 – dV/dt filter with Voltage Peak Limiter: p0230 = 2, option L15 – sine-wave filter: p0230 = 3). Motor control will not otherwise function properly. When p0230 = 4 "Sine-wave filter, third-party", a separate sine-wave filter can be entered. An input screen then appears in which the specific filter can be entered.

Note

The choice "no selection" is also available as default setting for the command and setpoint sources; if selected, no default settings are applied for the command and setpoint sources.

Basic commissioning: Motor identification

| {2:VECTOR} motor identification | | |
|--|--------|-------|
| Select the type of identification: | | |
| Stationary and rotating | | |
| Only stationary | | |
| No identification | | |
| Help 🔻 | | ОК |
| F1 F2 F3 | F4 | F5 |
| | | 1 |
| | | |
| {2:VECTOR} motor identification | | • |
| {2:VECTOR} motor identification | | ▼ |
| | | |
| NOTE | | |
| NOTE Start the drive | Cancel | |
| NOTE Start the drive with LOCAL and ON key | Cancel | |

Selecting motor identification

To navigate through the selection fields, choose F_2 or F_3 .

To activate a selection, choose <F5>.

Stationary measurement increases the control performance as deviations in the electrical characteristic values are minimized on account of deviations in the material properties and manufacturing tolerances.

Rotary measurement 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.

To activate this function, press the LOCAL key (wait until the LED in the LOCAL key lights up) and then ON.

If motor identification is not carried out, the motor control uses the motor characteristic values calculated from the type plate data rather than the measured values.

∕!∖DANGER

When the the rotating measurement is selected, 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 carefully observed.

Note

If a fault is present when selecting the stationary or rotary measurement, motor identification cannot be carried out.

Before rectifying the fault, you have to leave the screen with "No identification". Motor identification can then be selected again via <MENU> - <Commissioning/service> -<Drive commissioning> - <Motor identification>.

5.5.3 Additional settings required for units that are connected in parallel

Additional settings must be made for units that are connected in parallel before selecting the motor and entering the motor data via the operator panel:

- With 380 V 480 V 3 AC: 6SL3710-2GE41-1AA0, 6SL3710-2GE41-4AA0, 6SL3710-2GE41-6AA0
- With 500 V 600 V 3 AC: 6SL3710-2GF38-6AA0, 6SL3710-2GF41-1AA0, 6SL3710-2GF41-4AA0
- With 660 V 690 V 3 AC: 6SL3710-2GH41-1AA0, 6SL3710-2GH41-4AA0, 6SL3710-2GH41-5AA0

Settings to monitor the checkback signal from the main contactor or circuit breaker for 12-pulse infeed

The checkback contacts of the main contactors and the circuit breakers are connected in series in the factory and wired to digital input 5 of the CU320 Control Unit.

After the drive unit has been commissioned, the checkback signal monitoring function must be activated. This is realized using parameter p0860{Vector} = 722.5{Control_Unit}.

p0860 = r0722.5

Select parameter p0860 "Line contactor checkback" and connect to digital input DI5. <MENU> <Parameterization> <Single DO> <2:VECTOR> <OK> select "p0860", <change> select "{1:CU_G}" <OK>, select "r0722" <OK>, select ".05 DI 5 (X132.2)" <OK>

5.5 First commissioning with the AOP30

| p0860 | 0[0] Line con | tactor check | ۵. | |
|-------------|-------------------------------|--------------|--------|----|
| DO: | | 1:Cl | J_G | |
| Param | Parameter: r0722:CU_DI_Status | | | |
| Bit: 5:DI 5 | | 5 (X132.2) | | |
| | | | | |
| Help | | | Cancel | ОК |
| F1 | F2 | F3 | F4 | F5 |

A confirmation window is displayed in which a summary of the line contactor feedback is displayed.

To confirm the set connection, choose <F5>.

If the monitoring function for the main contactor or circuit breaker checkback signal is not activated, then the drive could be powered up even if the main contactor or circuit breaker on an individual system fails. This could overload and damage the input rectifiers on the individual system.

NOTICE

When resetting (restoring) the parameterization to the factory setting, this setting must be again made after the drive unit has been recommissioned.

Settings for motor connection to a motor with one-winding system

Before the commissioning, a motor with several winding systems is automatically defined.

The setting for a one-winding system is made during commissioning by setting parameter p7003 to 0.

Settings via the AOP30

During commissioning, you are asked whether a motor is connected to a one-winding system or multiple winding system. This setting must be made according to the motor connected.

NOTICE

If the "motor with a one-winding system" is not set using p7003 = 0, then the drive can be powered down (tripped) during the motor identification routine with an "overcurrent" fault message. The system will not be properly tuned.

NOTICE

When resetting (restoring) the parameterization to the factory setting, this setting must be again made before the drive unit is re-commissioned.

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

- The actual speed (r0063) is output as a current output in the range 0 to 20 mA at analog output 0 (X522:2 and 3).
 A current of 20 mA is equal to the maximum speed in p1082.
- The actual current value (r0068) is output as a current output in the range 0 to 20 mA at analog output 1 (X522:5 and 6).
 A current of 20 mA corresponds to the current limit (p0640), which is set to 1.5 x the rated motor current (p0305).

Digital outputs

- 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 Parameter reset to factory settings

5.7 Parameter reset to factory settings

The factory settings represent the defined original status of the device 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





5.7 Parameter reset to factory settings

Parameter reset via STARTER

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

| Step | Selection in toolbar |
|---|----------------------|
| Choose Project > Connect to target system | |
| Click the drive unit whose parameters you want to reset to the factory settings and click Restore factory settings icon in the toolbar. | * |
| To confirm, click OK . | |
| Restore Factory Settings | |
| Do you really want to restore the factory settings? Bus address and baud rate will not be reset. Restore factory settings ✓ Save factory settings to ROM | |
| 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.

5.7 Parameter reset to factory settings

6

Operation

6.1 Chapter content

This chapter provides information on the following:

- Basic information about the drive system
- Selecting command sources via:
 - PROFIdrive
 - Terminal strip
 - NAMUR terminal block
- Specifying setpoints via:
 - PROFIdrive
 - Analog inputs
 - Motorized potentiometer
 - Fixed setpoints
- Control via the AOP30 operator panel



6.2 General information about command and setpoint sources

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 G150 cabinet unit. The choice "no selection" is also available; if selected, no default settings are applied for the command and setpoint sources.

Command sources

- PROFIdrive
- TM31 terminals
- NAMUR
- PROFIdrive NAMUR

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 cabinet configuration (see "Commissioning")

Emergency STOP signals (L57, L59, and L60) and motor protection signals (L83 and L84) are always active (regardless of the command source).

Function diagrams

To supplement these Operating Instructions, the documentation folder contains simplified function diagrams describing the operating principle.

The diagrams are arranged in accordance with the chapters in the Operating Instructions. 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 documentation CD in the "SINAMICS G List Manual", which provides experienced users with detailed descriptions of all the functions.
Operation

6.3 Basic information about the drive system

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).

The parameters can be accessed via the following means:

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

Parameter types

The following adjustable and display 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

• Display parameters (read only)

These parameters are used to display internal variables.

Example: Current motor current



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

Parameter categories

The parameters for the individual drive objects (see "Drive objects") are categorized according to data sets as follows (see "Operation/data sets"):

- 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
 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.
 - PDS: Powerstack Data Set The number of powerstack data sets corresponds to the number of power units combined for units that are connected in parallel.

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 changeover.

- EDS: encoder data set
- MDS: Motor data set



Figure 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).



Figure 6-3 Drive objects

Standard drive objects

- Drive control Drive control handles closed-loop control of the motor. At least 1 Power Module and at least 1 motor and up to 3 encoders are assigned to the drive control.
- Control Unit, inputs/outputs The inputs/outputs on the Control Unit are evaluated within a drive object.

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.

Operation

6.3 Basic information about the drive system

Properties of a drive object

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

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 sets can be selected in the associated STARTER screen forms.

CDS: Command data set

The BICO parameters (binector and connector inputs) are grouped together in a command data set. These parameters are used to interconnect the signal sources of a drive (see "Operation/BICO technology: Interconnecting signals").

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)

In the factory setting, two command data sets are available; this number can be increased to a maximum of four using p0170 (number of command data sets (CDS)).

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

| | Select bit 1 | Select bit 0 | Display | | |
|-----|--------------|--------------|------------------|----------------|--|
| CDS | p0811 | p0810 | selected (r0836) | active (r0050) | |
| 0 | 0 | 0 | 0 | 0 | |
| 1 | 0 | 1 | 1 | 1 | |
| 2 | 1 | 0 | 2 | 2 | |
| 3 | 1 | 1 | 3 | 3 | |

Table 6-1 Command data set: selection and display

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



Figure 6-4 Example: Switching between command data set 0 and 1

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 p0824 are used to select a drive data set. They represent the number of the drive data set (0 to 31) in binary format (where p0824 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
- p0824 BI: Drive data set selection DDS, bit 4

Supplementary conditions and recommendations

- Recommendation for the number of DDS in a drive The number of DDS in a drive should correspond with the number of changeover options; in other words 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. A contactor circuit is used to changeover between these motors. Each of the motors can be equipped with an encoder or be operated without an encoder. Each encoder must be connected to its own SMx.

If encoder 1 (p0187) is changed over via DDS, then 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 display parameters with calculated data.

- Adjustable parameters, e.g.:
 - Motor component number (p0131)
 - Motor type selection (p0300)
 - Rated motor data (p0304 ff)
 - ...
- Display 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 Motor Module, a corresponding number of drive data sets must be created. See "Functions / Drive functions" for additional information and instructions on changing over motors.

One drive object can manage up to 16 motor data sets. The number of motor data sets in p0130 may not exceed the number of drive data sets in p0180.

Example of data set assignment

| DDS | Motor (p0186) | Encoder 1 (p0187) | Encoder 2 (p0188) | Encoder 3 (p0189) |
|-------|---------------|-------------------|-------------------|-------------------|
| DDS 0 | MDS 0 | EDS 0 | EDS 1 | EDS 2 |
| DDS 1 | MDS 0 | EDS 0 | EDS 3 | |
| DDS 2 | MDS 0 | EDS 0 | EDS 4 | EDS 5 |
| DDS 3 | MDS 1 | EDS 0 | | |

Table 6-2 Example, data set assignment

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.

Copy motor data set (MDS)

Set parameter p0139 as follows:

- 1. p0139[0] = Number of the motor data set that is 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 has been completed, if p0139[2] = 0.

Function diagram

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

Parameter

- 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
- p0186 Assigned motor data set (MDS)
- 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 Copy command data set CDS
- p0810 BI: Command data set selection CDS bit 0
- p0811 BI: Command data set selection CDS bit 1
- 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 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).

| Abbreviation and symbol | Name | Description |
|-------------------------|---|--|
| ві | 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. |
| во | 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 emulate 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.

| Abbreviation and symbol | Name | Description | |
|-------------------------|---|--|--|
| cı > | 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. | |

Table 6-4 Connectors

Interconnecting signals using 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

Operation

6.3 Basic information about the drive system

| BO: Binector output CO: Connector output Signal source | BI: Binector input CI: Connector input Signal sink |
|---|--|
| BO r0722.0 | BI pxxxx.y 722.0 |
| CO (without index) | CI pxxxx.y 36 |
| CO (with index) Index [0] r0037 [1] r0037 [2] r0037 [3] r0037 | CI pxxxx.y 37[2] |

Figure 6-5 Interconnecting signals using BICO technology

Note

A connector input (CI) cannot be interconnected with any connector output (CO, signal source). The same applies to the binector input (BI) and binector output (BO).

"Data type" in the parameter list provides information about the data type of the parameter and the data type of the BICO parameter for each CI und BI parameter.

For CO and BO parameters, only the data type of the BICO parameter is given.

Notation:

- Data type BICO input: Data type parameter / Data type BICO parameter Example: Unsigned32 / Integer16
- Data type BICO output: Data type BICO parameter Example: FloatingPoint32

The possible interconnections between BICO input (signal sink) and BICO output (signal source) are described in the List Manual in the table "Possible combinations for BICO interconnections" in the section "Explanations on the parameter list".

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

Internal encoding of the binector/connector output parameters

The internal codes are needed, for example, to write BICO input parameters via PROFIdrive.



Figure 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.



Figure 6-7 Interconnection of 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).



Figure 6-8 Connection of OFF3 to several drives (example)

BICO interconnections to other drives

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

- r9490 Number of 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: PROFIdrive 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 PROFIdrive 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 "PROFIdrive" default setting was chosen during commissioning:

- STARTER: "PROFIdrive"
- AOP30: "5: PROFIdrive"

Command sources



Figure 6-9 Command sources - AOP30 \leftarrow > PROFIdrive

Priority

The command source priorities are shown in the diagram "Command sources - AOP30 \leftarrow >PROFIdrive".

Note

The EMERGENCY STOP and motor protection signals are always active (regardless of the command source).

All of the supplementary setpoints are deactivated for LOCAL master control.

Operation 6.4 Command sources

TM31 terminal assignment with "PROFIdrive" default setting



When you choose the "PROFIdrive" default setting, use the following terminal assignment for TM31:

Figure 6-10 TM31 terminal assignment with "PROFIdrive" default setting

Control word 1

The bit assignment for control word 1 is described in "Description of the control words and setpoints".

Status word 1

The bit assignment for status word 1 is described in "Description of the status words and actual values".

Switching the command source

The command source can be switched using the LOCAL/REMOTE key on the AOP30.

6.4 Command sources

6.4.2 "TM31 terminals" default setting

Prerequisites

The "TM31 Terminals" default setting was chosen during commissioning:

- STARTER: "TM31 Terminals"
- AOP30: "6: TM31 terminals

Command sources



Figure 6-11 Command sources - AOP30 ←→ terminal TM31

Priority

The priority of the command sources is shown in the diagram "Command sources - AOP30 $\leftarrow \rightarrow$ terminal TM31".

Note

The emergency OFF and motor protection signals are always active (regardless of the command source).

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" default setting, the terminal assignment for TM31 is as follows:

Figure 6-12 TM31 terminal assignment with "TM31 Terminals" default setting

Switching the command source

The command source can be switched using the LOCAL/REMOTE key on the AOP30.

6.4 Command sources

6.4.3 "NAMUR" default setting

Prerequisites

The NAMUR terminal block (option B00) is installed in the cabinet unit. The "NAMUR" default setting was chosen during commissioning:

- STARTER: "NAMUR"
- AOP30: "7: NAMUR"

Command sources



Figure 6-13 Command sources - AOP30←→NAMUR terminal block

Priority

The priority of the command sources is shown in the diagram "Command sources - AOP30 \leftarrow -NAMUR terminal block".

Note

The EMERGENCY STOP and motor protection signals are always active (regardless of the command source).

For LOCAL master control, all of the supplementary setpoints are deactivated.

Terminal Assignment with the "NAMUR" Default Setting

When you choose the "NAMUR" default setting, the terminal assignment is as follows (as with option B00):

| NAMUR termi | nal block |
|---|--|
| | -A1X2 |
| ON (dynamic)/ ON/OFF (static) OFF (dynamic) | $ \begin{array}{c} - \otimes \left(-\frac{1}{2} \right) \\ - \otimes \left(-\frac{2}{2} \right) \\ - \otimes \left(-\frac{10}{2} \right) \\ - \left(-$ |
| Faster | |
| Slower | $ \frac{12}{13}$ DI |
| RESET | $-\underline{\otimes} \underbrace{-13}_{-\underline{\otimes}} \underline{D} \mathbf{I}$ |
| Interlock | $-\otimes(-15)$ |
| Counterclockwise | $ 0^{-16}$ 0^{-17} |
| Power disconnection | 17 = 17 signal = counterclockwise phase sequence |
| Ready | $ \begin{array}{c} 30 \\ - \\ 31 \\ - \\ - \\ \end{array} $ |
| Motor running | $-\otimes \frac{32}{32}$ |
| Fault | $ \begin{array}{c c} & 33 \\ \hline & 34 & DO (NO) \\ \hline & 35 & DO (COM) \\ \hline & & 36 & DO (NC) \\ \hline & & 50 \end{array} $ |
| Speed setpoint 0/4 - 20 mA | |
| Motor frequency 0/4 - 20 mA | $ \begin{array}{c} - \otimes \left(\frac{60}{61} \right) \\ - \otimes \left(\frac{61}{61} \right) \end{array} $ |
| Motor current 0/4 - 20 mA | $-\otimes \left(\begin{array}{c} \frac{62}{63} \\ -\otimes \end{array} \right) AO$ |
| PTC sensor | -A1X3 |

Figure 6-14 Terminal assignment with "NAMUR terminal block" default setting

Switching the command source

The command source can be switched using the LOCAL/REMOTE key on the AOP30.

6.4 Command sources

6.4.4 "PROFIdrive NAMUR" default setting

Prerequisites

The NAMUR terminal block (option B00) is installed in the cabinet unit. The "PROFIdrive" default setting was chosen during commissioning:

- STARTER: "PROFIdrive Namur"
- AOP30: "10: PROFIdrive Namur"

Command sources



Figure 6-15 Command sources - AOP30←→PROFIdrive NAMUR

Priority

The priority of the command sources is shown in the diagram "Command sources - $AOP30 \leftarrow PROFIdrive NAMUR$ ".

Note

The EMERGENCY STOP and motor protection signals are always active (regardless of the command source).

All of the supplementary setpoints are deactivated for LOCAL master control.

Terminal assignment for the "PROFIdrive NAMUR" default setting

When you choose the "PROFIdrive NAMUR" default setting, the terminal assignment is as follows (as with option B00):

| NAMUR termi | inal block |
|----------------------------------|--|
| | -A1X2 |
| ON (dynamic)/ ON/OFF (static) | $ \begin{array}{c} - \otimes \left(-\frac{1}{2} \right) \\ - \otimes \left(-\frac{2}{2} \right) \\ - \otimes \left(-\frac{10}{2} \right) \\ \end{array} $ |
| OFF (dynamic) | |
| Faster | |
| Slower | $-\otimes (-13)$ DI |
| RESET | |
| Interlock Counterclockwise | |
| Counterclockwise | 16 17 17 17 17 17 17 17 17 17 17 17 17 17 |
| Power disconnection | |
| Ready | $ \begin{array}{c} $ |
| Motor running | |
| Fault | $ \begin{array}{c c} 33 \\ \hline & 34 \\ \hline & DO (NO) \\ \hline & 35 \\ \hline & DO (COM) \\ \hline & \\ & \\ \hline & \\ & \\ \hline & \\ & \\ & \\ \hline & \\ & \\$ |
| Speed setpoint 0/4 - 20 mA | $ \bigcirc (\begin{array}{c} 50 \\ 51 \\ \hline \\ $ |
| Motor frequency 0/4 - 20 mA | $ \begin{array}{c} - \otimes \left(\frac{1}{60} \right) \\ - \otimes \left(\frac{1}{61} \right) \\ - \left(\frac{1}$ |
| Motor current 0/4 - 20 mA | $- \otimes \left(\frac{62}{63} \right) AO$ |
| PTC sensor | $-A1X3$ $-\otimes(-90)$ $-\otimes(-91)$ AI |

Figure 6-16 Terminal assignment for the "PROFIdrive NAMUR" default setting

Control word 1

The bit assignment for control word 1 is described in "Description of the control words and setpoints".

Status word 1

The bit assignment for status word 1 is described in "Description of the status words and actual values".

Switching the command source

The command source can be switched using the LOCAL/REMOTE key on the AOP30.

6.5 Setpoint sources

6.5 Setpoint sources

6.5.1 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 current input in the range 0 to 20 mA.

Requirement

The default setting for analog inputs was chosen during commissioning:



"TM31 Terminals"

Figure 6-17 Signal flow diagram: analog input 0

STARTER:

Function diagram

| FP 9566 | TM31 – analog input 0 (AI 0) |
|---------|------------------------------|
| FP 9568 | TM31 – analog input 1 (AI 1) |

Parameter

- 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 current of 20 mA 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 Current to Voltage Input -10 to +10 V





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 wire breakage"

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

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



| TM: Analog in F value Cause: TM31.Wire br Remedy: TM31.Check | 00 eak ana | log input | 0x0000003 | (hex) | Component number 3: module -A60 4: module -A61 (optional) 0: Analog input 0: -X521:1/2 1: Analog input 1: -X521:3/4 |
|---|---------------|-----------|-----------|-------|---|
| Back | ▲ F2 | ▼ F3 | F4 | F5 | |

6.5 Setpoint sources

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.

Prerequisites

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

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

Signal flow diagram



Figure 6-18 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 Setpoint sources

6.5.3 Fixed speed setpoints

Description

A total of 15 variable fixed speed setpoints are available. The default setting specified for the setpoint sources during commissioning via STARTER or the operating panel makes 3 fixed speed setpoints available. They can be selected via terminals or PROFIBUS.

Requirement

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

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

Signal flow diagram



Figure 6-19 Signal flow diagram: Fixed speed setpoints

Function diagram

FP 3010 Fixed speed setpoints

Parameter

- p1001 Fixed speed setpoint 01
- p1002 Fixed speed setpoint 02
- p1003 Fixed speed setpoint 03
- 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

PROFIBUS Connection Position, Address Switch, and Diagnostic LED

The PROFIBUS connection, address switch, and diagnostics LED are located on the Control Unit CU320.



Figure 6-20 View of the Control Unit with PROFIBUS interface

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Operation
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6.6 PROFIBUS

PROFIBUS link

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

Table 6- 7 X126 - PROFIBUS connection

| | Pin | Signal name | Meaning | Range |
|--------|----------|-------------|--|------------------------|
| | 1 | SHIELD | Ground connection | |
| | 2 M24_SE | | Power supply for teleservice, ground | 0 V |
| 69 | 3 | RxD/TxD-P | Receive / transmit data P (B/B') | RS485 |
| 4 CNTR | | CNTR-P | Control signal | TTL |
| | | DGND | PROFIBUS data reference potential (C/C') | |
| 09 | 6 | VP | Supply voltage plus | 5 V ± 10 % |
| 6 | 7 | P24_SERV | Power supply for teleservice P, + (24 V) | 24 V (20.4 V - 28.8 V) |
| | 8 | RxD/TxD-N | Receive / transmit data N (A/A') | RS485 |
| | 9 | - | not assigned | |

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.



PROFIBUS connector without PG/PC connection 6ES7972-0BA41-0XA0



PROFIBUS connector with PG/PC connection 6ES7972-0BB41-0XA0

Bus terminating resistor

The bus terminating resistor must be switched on or off depending on its position in the bus, otherwise the data will not be transmitted properly.

Principle: the terminating resistors must only be switched on at both ends of the bus line; the resistors must be switched off at all other connectors.

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



Figure 6-21 Posisition of the bus terminating resistors

6.6 PROFIBUS

Cable routing



Figure 6-22 Cable routing

6.6.2 Control via PROFIBUS

More information on PROFIBUS programming

For more information about the PROFIBUS programming, refer to the section "PROFIBUS DP/PROFINET IO communication" in the documentation "SINAMICS S120 Function Manual".

"DP1 (PROFIBUS)" diagnostics LED

The PROFIBUS diagnostics LED is located on the front of the Control Unit CU320. Its statuses are described in the following table.

Table 6-8 Description of the LEDs

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

Setting the PROFIBUS Address

Two methods are available for setting the PROFIBUS address:

• The address switches (DIP switches) on the front of the Control Unit behind the cover plate (see "PROFIBUS connection"). In this case, p0918 is read-only and shows the address setting.

A change to the switch only becomes effective after the Control Unit has been switched on.

 Entering parameter p0918 via the operator panel. You can only do this if the address has been set to 0 or 127, that is, all switches from S1 to S7 are set to ON or OFF. In this case, changes become effective immediately.

| Switch | Significance | Technical specifications |
|--------|---------------------|---|
| S1 | 2 ⁰ = 1 | Significance 2 ⁰ 2 ¹ 2 ² 2 ³ 2 ⁴ 2 ⁵ 2 ⁶ |
| S2 | 21 = 2 | |
| S3 | 2 ² = 4 | |
| S4 | 2 ³ = 8 | |
| S5 | 24 = 16 | |
| S6 | 2 ⁵ = 32 | Example |
| S7 | 2 ⁶ = 64 | 1 + 4 + 32 = 37 |

| Table 6-9 PROFIBU | S address switches |
|-------------------|--------------------|
|-------------------|--------------------|

Operation

6.6 PROFIBUS

Setting the PROFIBUS ID 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

New settings do not become active until after POWER ON, reset, or download.

Note

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

6.6.3 Monitoring: Telegram failure

Description

Following a telegram failure and after a monitoring time has elapsed (t_An), bit r2043.0 is set to "1" and alarm A01920 is output. Binector output r2043.0 can be used for an emergency stop, for example.

Once a delay time (p2044) has elapsed, fault F01910 is output and fault reaction OFF3 (quick stop) is triggered. If no OFF response is to be triggered, the fault response can be reparameterized accordingly.

Fault F01910 can be acknowledged immediately. The drive can then be operated even without PROFIBUS.



Figure 6-23 Monitoring: Telegram failure

6.6.4 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), 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

Default setting "Profidrive"

When the "Profidrive" default setting is chosen for command and setpoint selection (see "Command sources / "Profidrive" default settings"), "Free telegram" (p0922 = 999) is selected.

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

| STW1 | NSOLL_A |
|------|---------|
| | |

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

| ZSW1 | NIST_GLATT | IAIST_GLATT | MIST_GLATT | PIST_GLATT | FAULT_CODE |
|------|------------|-------------|------------|------------|------------|
|------|------------|-------------|------------|------------|------------|

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 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 setpoint, 16 bit
- p0922 = 2 -> Speed setpoint, 32 bit
- p0922 = 3 -> Speed setpoint 32 bit with 1 position controller
- p0922 = 4 -> Speed setpoint 32 bit with 2 position controller
- p0922 = 20 -> Speed setpoint, 16 bit VIK-NAMUR
- p0922 = 352 -> Speed setpoint, 16 PCS7

Operation

6.6 PROFIBUS

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. Manufacturer-specific telegrams

The manufacturer-specific telegrams are structured in accordance with internal company specifications. The internal process data links are set up automatically in accordance with the telegram number setting.

The following vendor-specific telegrams can be set via p0922:

p0922 = 220 Speed setpoint 32 bit, metal industry

c. 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 changeover 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 (STW 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.

Telegram interconnections

After changing p0922 = 999 (factory setting) to $p0922 \neq 999$, the telegrams are interconnected and blocked automatically.

Note

Telegrams 20 and 352 are the exceptions. Here, the PZD06 in the send telegram and PZD03 to PZD06 in the receive telegram can be interconnected as required.

When you change $p0922 \neq 999$ to p0922 = 999, the previous telegram interconnection is retained and can be changed.

Note

If p0922 = 999, a telegram can be selected in p2079. A telegram interconnection is automatically made and blocked. However, the telegram can also be extended.

This is an easy method of creating extended telegram interconnections on the basis of existing telegrams.
6.6.5 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 | STW1 | NSOLL_A | | | | | | | | |
| | ZSW1 | NIST_A | | | | | | | | |
| 2 | STW1 | NSO | LL_B | STW2 | | | | | | |
| | ZSW1 | NIS | T_B | ZSW2 | | | | | | |
| 3 | STW1 | NSO | LL_B | STW2 | G1_STW | | | | | |
| | ZSW1 | NIS | T_B | ZSW2 | G1_ZSW | G1_XIS | ST1 | G1_X | ACT2 | |
| 4 | STW1 | NSO | LL_B | STW2 | G1_STW | G2_STW | | | | |
| | ZSW1 | NIS | T_B | ZSW2 | G1_ZSW | Further a | ssignmen | t, see FP | 2420 | |
| 20 | STW1 | NSOLL_A | | | | | | | | |
| | ZSW1 | NIST_A_ GLATT | IAIST_ GLATT | MIST_ GLATT | PIST_ GLATT | MELD_ NAMUR | | | | |
| 220 | STW1_ BM | NSO | LL_B | STW2_BM | M_ADD | M_LIM | free | free | free | free |
| | ZSW1_ BM | NIST_A | IAIST | MIST | WARN_ CODE | FAULT_ CODE | ZSW2_ BM | free | free | free |
| 352 | STW1 | NSOLL_A | PCS7_3 | PCS7_4 | PCS7_5 | PCS7_6 | | | | |
| | ZSW1 | NIST_A_ GLATT | IAIST_ GLATT | MIST_ GLATT | WARN_ CODE | FAULT_ CODE | | | | |
| 999 | STW1 | free | free | free | free | free | free | free | free | free |
| | ZSW1 | free | free | free | free | free | free | free | free | free |

Table 6- 10 Structure of the telegrams

6.6.5.1 Overview of control words and setpoints

 Table 6- 11
 Overview of control words and setpoints

| Abbreviation | Description | Parameter | Function diagram |
|--------------|--|--|------------------|
| STW1 | Control word 1 (interface mode SINAMICS, p2038 = 0) | See table "Control word 1 (interface mode SINAMICS, p2038 = 0)" | FP2442 |
| STW1 | Control word 1 (interface mode VIK- NAMUR, p2038 = 2) | See table "Control word 1 (interface mode VIK-NAMUR, p2038 = 2)" | FP2441 |
| STW1_BM | Control word 1, metal industry (interface mode SINAMICS, p2038 = 0) | See table "Control word 1, metal industry (interface mode SINAMICS, p2038 = 0)" | FP2425 |
| STW2 | Control word 2 (interface mode SINAMICS, p2038 = 0) | See table "Control word 2 (interface mode SINAMICS, p2038 = 0)" | FP2444 |
| STW2_BM | Control word 2, metal industry (interface mode SINAMICS, p2038 = 0) | See table "Control word 2, metal industry (interface mode SINAMICS, p2038 = 0)" | FP2426 |
| NSOLL_A | Speed setpoint A (16-bit) | p1070 | FP3030 |
| NSOLL_B | Speed setpoint B (32-bit) | p1155 | FP3080 |
| PCS7_x | PCS7-specific setpoints | | |

6.6 PROFIBUS

6.6.5.2 Overview of status words and actual values

| Abbreviation | Description | Parameter | Function diagram |
|--------------|---|--|------------------|
| ZSW1 | Status word 1 (interface mode SINAMICS, p2038 = 0) | See table "Status word 1 (interface mode SINAMICS, p2038 = 0)" | FP2452 |
| ZSW1 | Status word 1 (interface mode VIK- NAMUR, p2038 = 2) | See table "Status word 1 (interface mode VIK-NAMUR, p2038 = 2)" | FP2451 |
| ZSW1_BM | Status word 1, metal industry (interface mode SINAMICS, p2038 = 0) | See table "Status word 1, metal industry (interface mode SINAMICS, p2038 = 0)" | FP2428 |
| ZSW2 | Status word 2 (interface mode SINAMICS, p2038 = 0) | See table "Status word 2 (interface mode SINAMICS, p2038 = 0)" | FP2454 |
| ZSW2_BM | Status word 2, metal industry (interface mode SINAMICS, p2038 = 0) | See table "Status word 2, metal industry (interface mode SINAMICS, p2038 = 0)" | FP2429 |
| NIST_A | Speed setpoint A (16 bit) | r0063[0] | FP4715 |
| NIST_B | Speed setpoint B (32 bit) | r0063 | FP4710 |
| IAIST | Actual value of current | r0068[0] | FP6714 |
| MIST | Actual torque value | r0080[0] | FP6714 |
| PIST | Actual power value | r0082[0] | FP6714 |
| NIST_GLATT | Actual speed value smoothed | r0063[1] | FP4715 |
| IAIST_GLATT | Current actual value, smoothed | r0068[1] | FP6714 |
| MIST_GLATT | Torque actual value, smoothed | r0080[1] | FP6714 |
| PIST_GLATT | Power actual value, smoothed | r0082[1] | FP6714 |
| MELD_NAMUR | VIK-NAMUR message bit bar | r3113, see table "NAMUR message bit bar" | |
| WARN_CODE | Alarm code | r2132 | FP8065 |
| ERROR_CODE | Error code | r2131 | FP8060 |

Table 6-12 Overview of status words and actual values

6.7.1 Operator panel (AOP30) overview and menu structure

Description

The operator panel can be used for the following activities:

- Parameterization (commissioning)
- Monitoring status variables
- Controlling the drive
- Diagnosing faults and alarms

All the functions can be accessed via a menu.

Your starting point is the main menu, which you can always call up using the yellow MENU key:



Dialog screen for the main menu: It can be accessed at any time with the "MENU" key.

Press "F2" or "F3" to navigate through the menu options in the main menu.

Operation

Menu structure of the operator panel



Figure 6-24 Menu structure of the operator panel

6.7.2 Operation screen menu

Description

The operation screen displays the most important status variables for the drive unit:

In its condition on delivery, it displays the operating status of the drive, the direction of rotation, the time, as well as four drive variables (parameters) numerically and two in the form of a bar display for continuous monitoring.

You can call up the operation screen in one of two ways:

- 1. After the power supply has been switched on and the system has ramped up.
- 2. By pressing the MENU key twice and then F5 "OK".

| {2:VECTOR | | | | 12:25:30 S |
|-------------|-------------|------------|------------|------------|
| | , | | _ | |
| NSETP= | 1450,000 rp | om F_OU | T = | 50.0 Hz |
| PACTV= | 235.0k | W U_DC | = | 620.0V |
| N_ACT[min- | 1 | | | |
| 1450.0 | 0% ' ' | 50 | 9% | 100% |
| I_ACT[Aeff] | | | | |
| 450.0 | 0% | 50 |)% | 100% |
| Help | (| Change | sel.par | Diag |
| F1 | E O | F 2 | F4 | F5 |
| | F2 | F3 | F 4 | FS |

Figure 6-25 Operation screen

If a fault occurs, the system automatically displays the fault screen (see "Faults and alarms").

In LOCAL control mode, you can choose to enter the setpoint numerically (F2: setpoint).

The "Define operation screen" menu can be selected directly using F3 "Change".

The individual parameters of the operation screen can be selected using F4 "Sel. par". The corresponding parameter number of the short identifier is displayed using F1 "Help+" and a description of the parameter can be called up.

Settings

When you choose Commissioning / service -> AOP settings -> Define operation screen, you can adjust the display type and the values displayed as required (see "Operation / AOP30 settings").

6.7.3 Parameterization menu

You can adjust the device settings in the Parameterization menu.

The drive software is modular. The individual modules are called DOs ("drive objects").

The following DOs are available in the SINAMICS G150:

- CU: General parameters for the Control Unit (CU320)
- VECTOR: Drive control
- TM31: Terminal Module TM31

Parameters with identical functions may exist with the same parameter number in more than one DO (e.g. p0002).

The AOP30 is used for operating devices that comprise more than one drive so that attention is focused on one drive (i.e. the "current" drive). You can switch between the drives either in the operation screen or in the main menu. The corresponding function key is labeled "Drive".

This drive determines the following:

- Operation screen
- Fault and alarm displays
- The controller (ON, OFF, ...) of a drive

Depending on your requirements, you can choose between two AOP display types:

1. All parameters

All the parameters present in the device are listed here. The DO to which the parameter currently selected belongs (inverted) is displayed in curly brackets in the top left of the screen.

2. DO selection

In this display, you can pre-select a DO Only the parameters for this DO are then listed. (The expert list display in STARTER only uses this DO view)

In both cases, the set access level governs which parameters are displayed. You can set the access level in the menu for inhibit functions, which can be called up using the key button.

The parameters for access levels 1 and 2 are sufficient for simple applications.

At access level 3 "Expert", you can change the structure of the function by interconnecting BICO parameters.

In the data set selection menu, you can choose which of the data sets chosen is currently DISPLAYED.

Data set parameters are indicated by a "c", "d", "m", "e", or "p" between the parameter number and parameter designator.

When a data set parameter is changed, the data set selection dialog appears.

| Data bloc | k selection | | | | |
|-----------|-------------|------|------|-------|-----|
| Туре | | N | /lax | Drive | AOP |
| Command | d DB | c: | 1 | 0 | 0 |
| Drive DB | | d: [| 0 | 0 | 0 |
| Motor DB | | m: [| 0 | 0 | 0 |
| Help | | ▼ | | Back | оκ |
| F1 | F2 | F3 | [| F4 | F5 |

Figure 6-26 Data set selection

Explanation of the operator control dialog

- "Max" shows the maximum number of data sets parameterized (and thereby available for selection) in the drive.
- "Drive" indicates which data set is currently active in the drive.
- "AOP" indicates which particular data set is currently being displayed in the operator panel.

6.7.4 Menu: Fault/alarm memory

When you select the menu, a screen appears containing an overview of faults and alarms that are present.

For each drive object, the system indicates whether any faults or alarms are present. ("Fault" or "Alarm" appears next to the relevant drive object).

In the graphic below, you can see that at least one active fault/alarm is present for the "VECTOR" drive object. No faults/alarms are indicated for the other drive objects.



Fault/alarm memory

When you navigate to the line with active alarms/faults and then press the F5 <Diag> key, the system displays a screen in which you have to select the current or old alarms/faults.

Display diagnosis

When you navigate to the required line and then press the F5 <OK> key, the corresponding faults/alarms are displayed. The list of current faults is selected here as an example.

Displays the current faults.

A maximum of eight current faults are displayed along with their fault number and a description of the fault.

To display additional help regarding the cause of the problem and how to solve it, choose F1 <Help>.

To acknowledge the faults, choose F5 <Ack.>. If a fault cannot be acknowledge, the fault remains.

6.7.5 Menu commissioning / service

6.7.5.1 Drive commissioning

This option enables you to re-commission the drive from the main menu.

Basic Commissioning

Only the basic commissioning parameters are queried and stored permanently.

Complete commissioning

Complete commissioning with motor and encoder data entry is carried out. Following this, key motor parameters are recalculated from the motor data. The parameter values calculated during previous commissioning are lost.

In a subsequent motor identification procedure, the calculated values are overwritten.

Motor identification

The selection screen for motor identification appears.

Resetting the fan runtime

After a fan replacement, the time counter for monitoring the fan runtime must be reset.

6.7.5.2 Device commissioning

Device commissioning

In this menu, you can enter the device commissioning status directly. This is the only way that you can reset parameters to the factory setting for example.

6.7.5.3 AOP settings

Control settings

This defines the settings for the control keys in LOCAL mode (see "Operation / Control via the operator panel / Operation via the operator panel").

Display settings

In this menu, you set the lighting, brightness, and contrast for the display.

```
Operation
```

Defining the operation screen

In this menu, you can switch between five operation screens. You can set the parameters that are to be displayed.



Figure 6-27 Defining the operation screen

The following image shows how the entries are assigned to the screen positions:



Figure 6-28 Layout of the entries in the operation screen

6.7.5.4 Lists of signals for the operation screen

The following tables list some of the main signals for the operation screen along with the associated reference variables and default settings for fast commissioning.

Vector object

| Signal | | Parameters | Short name | Unit | Scaling (100 %=) See table below |
|--|-----------|------------|------------|-------|-------------------------------------|
| Factory setting (e | ntry no.) | | | | |
| Speed setpoint upstream of ramp-function generator | (1) | r1114 | NSETP | 1/min | p2000 |
| Output frequency | (2) | r0024 | F_OUT | Hz | Reference frequency |
| Power smoothed | (3) | r0032 | PACTV | kW | r2004 |
| DC link voltage smoothed | (4) | r0026 | U_DC | V | p2001 |
| Actual speed smoothed | (5) | r0021 | N_ACT | 1/min | p2000 |
| Absolute actual current smoothed | (6) | r0027 | I_IST | А | p2002 |
| Motor temperature | (7) | r0035 1) | T_MOT | °C | Reference temperature |
| Converter temperature | (8) | r0037 | T_LT | °C | Reference temperature |
| Actual torque smoothed | (9) | r0031 | M_ACT | Nm | p2003 |
| Converter output voltage smoothed | (10) | r0025 | C_OUT | V | p2001 |
| For diagnostic purposes | | | | | |
| Speed setpoint smoothed | | r0020 | NSETP | 1/min | p2000 |
| Control factor smoothed | | r0028 | AUSST | % | Reference modulation depth |
| Field-producing current component | | r0029 | IDACT | А | p2002 |
| Torque-producing current component | | r0030 | IQACT | А | p2002 |
| Converter overload Degree of thermal overload | | r0036 | LTI2T | % | 100 % = Shutdown |
| Speed actual value motor encoder | | r0061 | N_ACT | 1/min | p2000 |
| Speed setpoint after filter | | r0062 | NSETP | 1/min | p2000 |
| Actual speed smoothed | | r0063 | N_ACT | 1/min | p2000 |
| Control deviation | | r0064 | NDIFF | 1/min | p2000 |
| Slip frequency | | r0065 | FSCHL | Hz | Reference frequency |
| Output frequency | | r0066 | F_OUT | Hz | Reference frequency |
| Output voltage | | r0072 | UACT | V | p2001 |
| Control factor | | r0074 | AUSST | % | Reference modulation depth |
| Torque-generating actual current | | r0078 | IQACT | А | p2002 |
| Actual torque value | | r0080 | M_ACT | Nm | p2003 |
| For further diagnostic purposes | | | | | |
| Fixed speed setpoint effective | | r1024 | | 1/min | p2000 |
| Active motorized potentiometer setpoint | | r1050 | | 1/min | p2000 |
| Resulting speed setpoint | r1119 | NSETP | 1/min | p2000 | |
| Speed controller output | r1508 | NREGY | Nm | p2003 | |
| I component of speed controller | | r1482 | NREGI | Nm | p2003 |
| PROFIBUS setpoint | | r2050 | PBSOL | 1/min | p2000 |

Table 6-13 List of signals for the operation screen - vector object

¹⁾ If a temperature sensor has not been installed, a value of –200°C is displayed.

Scalings for vector object

| Table 6-14 | Scalings for vector | or object |
|------------|---------------------|-----------|
|------------|---------------------|-----------|

| Size | 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 = (p2003 x p2000 x π) / 30 |
| Reference frequency | 100% = p2000/60 | |
| Reference modulation depth | 100 % = Maximum output voltage without overload | |
| Reference flux | 100 % = Rated motor flux | |
| Reference temperature | 100% = 100°C | |

TM31 object

| Table 6-15 | List of signals for the operation screen – TM31 object |
|------------|--|
|------------|--|

| Signal | Parameter | Short name | Unit | Scaling (100 % =) |
|------------------------|-----------|------------|-------|-----------------------|
| Analog input 0 [V, mA] | r4052[0] | AI_UI | V, mA | V: 100 V / mA: 100 mA |
| Analog input 1 [V, mA] | r4052[1] | AI_UI | V, mA | V: 100 V / mA: 100 mA |
| Analog input 0, scaled | r4055[0] | AI_% | % | as set in p200x |
| Analog input 1, scaled | r4055[1] | AI_% | % | as set in p200x |

Setting the date/time (for date stamping of error messages)

In this menu, you set the date and time.

You can also set whether and/or how the AOP and drive unit are to be synchronized. Synchronization of the AOP with the drive enables error messages to be date- and timestamped.

- None (factory setting) The times for the AOP and drive unit are not synchronized.
- AOP -> Drive
 - If you activate this option, the AOP and drive unit are synchronized immediately whereby the current AOP time is transferred to the drive unit.
 - The current AOP time is transferred to the drive unit every time the AOP is started.
 - At 02:00 (AOP time) every day, the current AOP time is transferred to the drive unit.
- Drive -> AOP
 - If you activate this option, the AOP and drive unit are synchronized immediately whereby the current drive unit time is transferred to the AOP.
 - The current drive unit time is transferred to the AOP every time the AOP is started.
 - At 02:00 (AOP time) every day, the current drive unit time is transferred to the AOP.

Date format

In this menu, the date format can be set:

- DD.MM.YYYY: European date format
- MM/DD/YYYY: North American data format

Resetting AOP settings

When you choose this menu option, the AOP factory settings for the following are restored:

- Language
- Display (brightness, contrast)
- Operation screen
- Control settings

NOTICE

When you reset parameters, all settings that are different to the factory settings are reset immediately. This may cause the cabinet unit to switch to a different, unwanted operational status.

For this reason, you should always take great care when resetting parameters.

6.7.5.5 AOP30 diagnosis

Software/database version

You can use this menu to display the firmware and database versions.

The database version must be compatible with the drive software status (you can check this in parameter r0018).

Battery status

In this menu, you can display the battery voltage numerically (in Volts) or as a bar display. The battery ensures that the data in the database and the current time are retained.

When the battery voltage is represented as a percentage, a battery voltage of ≤ 2 V is equal to 0%, and a voltage of ≥ 3 V to 100%.

The data is secure up to a battery voltage of 2 V.

- If the battery voltage is ≤ 2.45 V, the message "Replace battery" is displayed in the status bar.
- If the battery voltage is ≤ 2.30 V, the system displays the following message: "Warning: weak battery".
- If the battery voltage is ≤ 2 V, the system displays the following message: "Warning: battery is empty".
- If the time and/or database are not available after the system has been switched off for a
 prolonged period due to the voltage being too low, the loss is established by means of a
 CRC check when the system is switched on again. This triggers a message instructing
 the user to replace the battery and then load the database and/or set the time.

For instructions on how to change the battery, see "Maintenance and servicing".

Keyboard test

In this screen, you can check that the keys are functioning properly. Keys that you press are represented on a symbolic keyboard on the display. You can press the keys in any order you wish. You cannot exit the screen (F4 – "back") until you have pressed each key at least once.

Note

You can also exit the key test screen by pressing any key and keeping it pressed.

LED test

In this screen, you can check that the 4 LEDs are functioning properly.

6.7.6 Language/Sprache/Langue/Idioma/Lingua

The operator panel downloads the texts for the different languages from the drive.

You can change the language of the operator panel via the "Language/Sprache/Langue/Idioma/Lingua" menu.

Note

Additional languages for the display

Languages in addition to the current available languages in the display are available on request.

6.7.7 Operation via the operator panel (LOCAL mode)

You activate the control keys by switching to LOCAL mode. If the green LED in the LOCAL/REMOTE key does not light up, the key is not active.

Note

If the "OFF in REMOTE" function is activated, the LED in the LOCAL-REMOTE key flashes.

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

After the master control has been transferred to the operator panel, the BICO interconnections at bit 0 to bit 10 of the control word of the sequence control are not effective (refer to function diagram 2501).

6.7.7.1 LOCAL/REMOTE key

REMOTE

LOCAL mode: LED lights up

REMOTE mode: LED does not light up: the ON, OFF, JOG, direction reversal, faster, and slower keys are not active.

Settings: Menu – Commissioning / Service – AOP Settings – Control Settings

Activate LOCAL mode: Press the LOCAL key.

Save LOCAL mode (factory setting: yes)

- Yes: The "LOCAL" or "REMOTE" operating mode is saved when the power supply is switched off and restored when the power supply is switched back on.
- No: "LOCAL" or "REMOTE" operating mode is not saved. "REMOTE" is active when the supply voltage is switched back on.

OFF in REMOTE (factory setting: no)

- Yes: The OFF key functions in REMOTE mode even if the drive is being controlled by external sources (PROFIBUS, customer terminal strip, NAMUR terminal strip).
 WARNING This function is not an EMERGENCY STOP function!
- No: The OFF key is only effective in LOCAL mode.

LOCAL/REMOTE also during operation (factory setting: no)

- Yes: You can switch between LOCAL and REMOTE when the drive is switched on (motor is running).
- No: Before the system switches to LOCAL, a check is carried out to determine whether the drive is in the operational status. If so, the system does not switch to LOCAL and outputs the message "Local not possible". Before the system switches to REMOTE, the drive is switched off and the setpoint is set to 0.

6.7.7.2 ON key / OFF key



ON key: always active in LOCAL when the operator input inhibit is deactivated.

OFF key: in the factory setting, acts as OFF1 = ramp-down at the deceleration ramp (p1121); when n = 0: voltage disconnection (only if a main contactor is installed) The OFF key is effective in the LOCAL mode and when the "OFF in REMOTE" function is active.

Settings: Menu - Commissioning / Service - AOP Settings - Control Settings

Red OFF key acts as: (factory setting: OFF1)

- OFF1: Ramp-down on the deceleration ramp (p1121)
- OFF2: Immediate pulse block, motor coasts to a standstill
- **OFF3**: Ramp-down on the emergency stop ramp (p1135)

6.7.7.3 Switching between clockwise and counter-clockwise rotation



Settings: Menu – Commissioning / Service – AOP Settings – Control Settings

Switching between CCW/CW (factory setting: no)

- Yes: Switching between CW/CCW rotation by means of the CW/CCW key possible in LOCAL mode
- No: The CW/CCW key has no effect in LOCAL mode

For safety reasons, the CW/CCW key is disabled in the factory setting (pumps and fans must normally only be operated in one direction).

In the operation status in LOCAL mode, the current direction of rotation is indicated by an arrow next to the operating mode.

Note

You have to make additional settings when switching between CW/CCW rotation.

6.7.7.4 Jog

JOG

Settings: Menu – Commissioning / Service – AOP Settings – Control Settings

JOG key active (factory setting: no)

- **Yes**: The jog key is effective in the LOCAL mode in the state "ready to power-up" (not in "operation"). The speed that is set in parameter p1058 is approached.
- No: The JOG key has no effect in LOCAL mode

6.7.7.5 Increase setpoint / decrease setpoint



You can use the increase and decrease keys to set the setpoint with a resolution of 1min⁻¹ of the maximum speed.

You can also enter the setpoint numerically. To do so, press F2 in the operation screen. The system displays an inverted edit field for entering the required speed. Enter the required value using the numeric keypad. Press F5 "OK" to confirm the setpoint.

When you enter values numerically, you can enter any speed between the minimum speed (p1080) and the maximum speed (p1082).

Setpoint entry in LOCAL mode is unipolar. You can change the direction of rotation by pressing the key that allows you to switch between CW/CCW rotation.

- CW rotation and "Increase key" mean: The displayed setpoint is positive and the output frequency is increased.
- CCW rotation and "Increase key" mean: The displayed setpoint is negative and the output frequency is increased.

6.7.7.6 AOP setpoint

Settings: MENU – Commissioning/Service – AOP Settings – Control Settings

Save AOP setpoint (factory setting: no)

 Yes: In LOCAL mode, the last setpoint (once you have released the INCREASE or DECREASE key or confirmed a numeric entry) is saved.
 The next time you switch the system on in LOCAL mode, the saved value is selected.
 This is also the case if you switched to REMOTE in the meantime or the power supply was switched off.

When the system is switched from REMOTE to LOCAL mode while the drive is switched on (motor is running), the actual value that was last present is set as the output value for the motorized potentiometer setpoint and saved.

If the system is switched from REMOTE to LOCAL mode while the drive is switched off, the motorized potentiometer setpoint that was last saved is used.

 No: On power-up in LOCAL mode, the speed is always set to the value entered under "AOP starting setpoint". When the system is switched from REMOTE to LOCAL mode while the drive is switched on (motor is running), the actual value that was last present is set as the output value for the AOP setpoint.

AOP setpoint ramp-up time (factory setting: 10 s)

AOP setpoint ramp-down time (factory setting: 10 s)

• **Recommendation**: set as ramp-up/ramp-down time (p1120 / p1121). Changing the ramp-up/ramp-down times does not affect the settings for parameters p1120 and p1121 because this is an AOP-specific setting.

AOP starting setpoint (factory setting: 0.000 rpm)

Note

The internal drive ramp-function generator is always active.

Settings: MENU – Commissioning/Service – AOP Settings – Control Settings

Save AOP local mode (factory setting: no)

- Yes: Deactivates the "Control via operator panel" function, thereby disabling the LOCAL/REMOTE key.
- No: Activates the LOCAL/REMOTE key.

Note

LOCAL functionality can also be locked on the drive by means of the p0806 parameter (BI: Lock master control).

Settings: MENU – Commissioning/Service – AOP Settings – Control Settings

Acknowledge error from the AOP (factory setting: yes)

- Yes: Errors can be acknowledged via the AOP.
- No: Errors cannot be acknowledged via the AOP.

6.7.7.7 Timeout monitoring

In "LOCAL" mode or if "OFF in REMOTE" is active, the drive is shut down after 1 s if the data cable between the AOP and drive is disconnected.

6.7.7.8 Operator input inhibit / parameterization inhibit



To prevent users from accidentally actuating the control keys and changing parameters, you can activate an operator input / parameters disable using a key pushbutton. Two key icons appear in the top right of the display when these inhibit functions are enabled.

| Inhibit type | Online operation | Offline operation |
|---|------------------|-------------------|
| No inhibit | | |
| Operator input inhibit | -0 | |
| Parameters disable | -0 | |
| Operator input inhibit + parameters disable | | |

Table 6-16 Display of operator input/parameters disable

Settings

| Safety locks | | Parameters disable |
|---|----------------------------------|--------------------|
| Operator inhibit lock Parameters disable | not_active ◀▶ not_active Chan | ge F5 Password |
| Access level | 1:Standard Chan | |
| Help | ▼ Back Oł | ✓ ✓ ✓ C Cancel OK |
| F1 F2 | F3 F4 F5 | 5 F1 F2 F3 F4 F5 |

Figure 6-29 Set inhibit functions

The "Operator input inhibit" setting can be changed directly via <F5> "Change" once you have selected the selection field.

When "Parameterization inhibit" is activated, you have to enter a numeric password (repeat this entry). You must also enter this password when deactivating "Parameterization inhibit".

Operator input inhibit (factory setting: not active)

 Active: The parameters can still be viewed, but a parameter value cannot be saved (message: "Note: operator input inhibit active"). The OFF key (red) is enabled. The LOCAL, REMOTE, ON (green), JOG, CW/CCW, INCREASE, and DECREASE keys are disabled.

Parameterization inhibit (factory setting: not active)

 Active: Parameters cannot be changed unless a password is entered. The parameterization process is the same as with the operator input inhibit. If you try and change parameters, the message "Note: Parameterization inhibit active" is displayed. All the control keys can, however, still be actuated.

Access level (factory setting: Expert):

The different parameters required for this complex application are filtered so that they can be displayed as clearly as possible. You select them according to the access level.

An expert level, which must only be used by expert personnel, is required for certain actions.

6.7.8 Faults and alarms

Indicating faults and alarms

If a fault occurs, the drive displays the fault and/or alarm on the 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.

Alarms are indicated by means of the yellow "ALARM" LED. The system also displays a note in the status bar providing information on the cause.

What is a fault?

A fault is a message from the drive indicating an error or other exceptional (unwanted) status that causes the drive to shutdown. This could be caused by a fault within the converter or an external fault triggered, for example, by the winding temperature monitor for the 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.

Fault and alarm displays

Every fault and alarm is entered in the fault/alarm buffer along with time the error occurred. The time stamp refers to the relative system time in milliseconds (r0969).

You can call up an overview screen that displays the current status of faults and/or alarms for every drive object in the system by choosing MENU – Fault memory / alarm memory.

A context menu featuring the "Back" and "Quit" options appears when you press F4 "Next". The function required can be selected using F2 and F3 and executed by pressing F5 "OK". The "Acknowledge" function sends an acknowledgement signal to each drive object. The red FAULT LED extinguishes once all the faults have been acknowledged.

Operation

6.7 Control via the operator panel







Alarms that are no longer active are removed from the alarm memory with F5 Clear.

6.7.9 Saving the parameters permanently

Description

If parameters have been changed using the operator panel (confirm with OK in the Parameter Editor), the new values are initially stored in the volatile memory (RAM) of the converter. An "S" flashes in the top right of the AOP display until they are saved to a permanent memory. This indicates that at least 1 parameter has been changed and not yet stored permanently.

Two methods are available for permanently saving parameters that have been changed:

- To store the parameters permanently, choose <MENU> <Parameterization> <OK> <Permanent parameter transfer>.
- When confirming a parameter setting with OK, press the OK key for > 1 s. The system displays a message asking you whether the setting is to be saved in the EEPROM. If you press "Yes", the system saves the setting in the EEPROM. If you press "No", the setting is not saved permanently and the "S" starts flashing.

In both cases, **all** changes that have not yet been saved permanently are stored in the EEPROM.

6.7.10 Parameterization errors

If a fault occurs when reading or writing parameters, a popup window containing the cause of the problem is displayed.

The system displays:

Parameter write error (d)pxxxx.yy:0xnn

and a plain-text explanation of the type of parameterization error.

6.8 PROFINET IO

6.8.1 Activating online operation: STARTER via PROFINET IO

Description

The following options are available for online operation via PROFINET IO:

• Online operation via IP

Prerequisites

- STARTER with version ≥ 4.1.1
- Firmware version ≥ 2.5.1
- CBE20

STARTER via PROFINET IO (example)



Figure 6-32 STARTER via PROFINET (example)

Procedure, establishing online operation with PROFINET

1. Set the IP address in Windows XP

The PC/PG is referred here to a fixed, free IP address.

- 2. Settings in STARTER
- Assignment of the IP address and the name for the PROFINET interface of the drive unit The PROFINET interface must be "baptized" so that the STARTER can establish communication.
- 4. Select online operation in STARTER.

```
Operation
```

6.8 PROFINET IO

Set the IP address in Windows XP

On the desktop, right-click on "Network environment" -> Properties -> double-click on Network card and choose -> Properties -> Internet Protocol (TCP/IP) -> Properties -> Enter the freely-assignable addresses.

| Internet Protocol (TCP/IP) Properties 🛛 🛛 🛛 🤇 | | |
|---|-------------------|--|
| General | | |
| You can get IP settings assigned automatically if your network supports this capability. Otherwise, you need to ask your network administrator for the appropriate IP settings. | | |
| O <u>O</u> btain an IP address automaticall | y | |
| • Use the following IP address: | | |
| IP address: | 192.168.0.10 | |
| S <u>u</u> bnet mask: | 255.255.0.0 | |
| <u>D</u> efault gateway: | · · · | |
| O Obtain DNS server address automatically | | |
| • Use the following DNS server addresses: | | |
| Preferred DNS server: | · · · | |
| Alternate DNS server: | <u> </u> | |
| | Ad <u>v</u> anced | |
| OK Cancel | | |

Figure 6-33 Properties of the Internet Protocol (TCP/IP)

Settings in STARTER

The following settings are required in STARTER for communication via PROFINET:

• Extras -> Set PG/PC interface

| Set PG/PC Interface | | | |
|--|------------------------|--|--|
| Access Path | | | |
| Access Point of the Application: | | | |
| S70NLINE (STEP 7)> TCP/IP(Au | to) -> Broadcom NetX 💌 | | |
| (Standard for STEP 7) | | | |
| Interface Parameter Assignment Used: | Properties | | |
| TCP/IP(Auto) -> Broadcom NetXtreme Gig. | | | |
| Emission Diagnostics Emission Diagnostics | | | |
| I CP/IP -> NdisWanIp | Сор <u>у</u> | | |
| E TCP/IP(Auto) -> Broadcom NetXtrei | Dejete | | |
| | | | |
| (Assigning Parameters for the IE-PG access to your NDIS CPs with TCP/IP Protocol (RFC-1006)) | | | |
| Interfaces | | | |
| Add/Remove: | Sele <u>c</u> t | | |
| | Cancel Help | | |

Figure 6-34 Set the PG/PC interface

Assignment of the IP address and the name for the PROFINET interface of the drive unit

Use the STARTER to assign an IP address and a name to the PROFINET interface (e.g. CBE20).

Requirement:

- Connect the direct Ethernet cable from the PG/PC to the PROFINET interface of the CU320 Control Unit.
- Switch on Control Unit CU320

The accessible nodes must be searched in the STARTER:

• Project -> Accessible nodes

Subsequently the nodes found are displayed in the interactive screen.

6.8 PROFINET IO

| 🚰 Accessible nodes - TCP/IP(Auto) -> Broadcom NetXtreme Gig | |
|--|------|
| Accessible nodes Bus node (address = 0.0.0.0, name =) | |
| C Activate extended slot search | |
| Do you want to accept the selected drive units into the project? | |
| Accept Select drive units Refresh (F5) Close | Help |

Figure 6-35 STARTER -> Accessible nodes

The selected node is edited by selecting the field for the node with the right mouse button and selecting the option "Edit Ethernet node...".

| Karal Accessible nodes - TCP/IP(Auto) -> Broadcom NetXtreme Gig | |
|--|------|
| Accessible nodes | |
| Activate extended slot search | |
| Do you want to accept the selected drive units into the project? | |
| Accept Select drive units Refresh (F5) Close | Help |

Figure 6-36 STARTER - Accessible nodes - Edit Ethernet node

In the following interactive screen enter a freely selectable device name and the IP address and subnet mask.

| Edit Ethernet Node | | |
|---|---|------------------------------------|
| Node: MAC address: Device | 08-00-06-93-ad-57 SINAMICS | Detection using LED Assign name |
| IP Configuration IP address: Subnet screen: | 192 . 168 . 0 . 10 255 . 255 . 0 . 0 | Gateway: © Do not use router |
| | ign IP configuration | C Use router Address: |

The subnet screens must match before STARTER can be run.

Figure 6-37 STARTER - Edit Ethernet nodes

After selecting the "Assign name" button, the following confirmation will appear if the assignment was successful.



Figure 6-38 STARTER - Successful assignment of the device name

After selecting the "Assign IP configuration" button, the following confirmation will appear if the assignment was successful.



Figure 6-39 STARTER - Successful assignment of the IP configuration

After closing the "Edit Ethernet node" interactive screen the successful "christening" of the node is displayed in the node overview after updating (F5).

| Maccessible nodes - TCP/IP(Auto) -> Broadcom NetXtreme Gig | |
|--|------|
| Accessible nodes | |
| C Activate extended slot search | |
| Do you want to accept the selected drive units into the project? | |
| Accept Select drive units Refresh (F5) Close | Help |

Figure 6-40 STARTER - Accessible nodes update completed

Note

The IP address and device name for the Control Unit are stored on the CompactFlash Card (non-volatile).

6.8.2 General information about PROFINET IO

6.8.2.1 General information about PROFINET IO for SINAMICS

General information

PROFINET IO is an open Industrial Ethernet standard for a wide range of production and process automation applications. PROFINET IO is based on Industrial Ethernet and observes TCP/IP and IT standards.

The following standards ensure open, multi-vendor systems:

• International standard IEC 61158

PROFINET IO is optimized for high-speed, time-critical data communication at field level.

PROFINET

Within the framework of Totally Integrated Automation (TIA), PROFINET represents a consequent enhancement of:

- PROFIBUS DP, the established field bus, and
- Industrial Ethernet, the communications bus for the cell level.

Experience gained from both systems was and is being integrated into PROFINET. As an Ethernet-based automation standard defined by PROFIBUS International (PROFIBUS user organization), PROFINET is a manufacturer-independent communication and engineering model.

When a CBE20 Communication Board is inserted, SINAMICS G150 becomes an IO device in terms of PROFINET. SINAMICS G150 and CBE20 can be used for communication via PROFINET IO with RT.

CAUTION

Inserting the CBE20 Communication Board deactivates the cyclic PZD channel for PROFIBUS DP.

Note

PROFINET for drive technology is standardized and described in the following document:

Reference: PROFIdrive Profile Drive Technology PROFINET System Description, Order no. 6ES7398-8FA10-8AA0, 6ES7151-1AA10-8AA0

6.8.2.2 Real-time (RT) and isochronous real-time (IRT) communication

Real-time communication

If supervisors are involved in communication, this can result in excessively long runtimes for the production automation system. When communicating time-critical IO user data, PROFINET therefore uses its own real time channel, rather than TCP/IP.

Definition: Real Time (RT) and determinism

Real time means that a system processes external events over a defined period.

Determinism means that a system responds in a predictable manner (deterministically).

In industrial networks, both of these requirements are important. PROFINET meets these requirements. PROFINET is implemented as a deterministic real time network as follows:

- Transmission of time-critical data takes place at guaranteed time intervals. To achieve this, PROFINET provides an optimized communication channel for real time communication: Real Time (RT).
- An exact prediction of the time at which the data transfer takes place is possible.
- Problem-free communication using other standard protocols is guaranteed within the same network.

Definition: Isochronous real time communication (IRT)

Isochronous Real Time Ethernet: Real time properties of PROFINET IO where IRT telegrams are transmitted deterministically via planned communication paths in a defined sequence to achieve the best possible synchronism and performance. This is also known as time-scheduled communications whereby knowledge about the network structure is utilized. IRT requires special network components that support planned data transfer.

When the transfer procedure is implemented in the ERTEC ASICs (Enhanced Real-Time Ethernet Controller), this results in cycle times of at least. 500 μ s and a jitter accuracy of less than 1 μ s.



Figure 6-41 Broadband distribution/reservation, PROFINET IO IRT

Note

When operating S7-300 stations with SINAMICS drives, presently only communications via PROFINET IO with RT are possible.

6.8.2.3 Addresses

Definition: MAC address

Each PROFINET device is assigned a worldwide unique device identifier in the factory. This 6-byte long device identifier is the MAC address. The MAC address is divided up as follows:

- 3 bytes manufacturer's ID and
- 3 bytes device identifier (consecutive number).

The MAC address is usually indicated on the front of the device.

e.g.: 08-00-06-6B-80-C0

IP address

To allow a PROFINET device to be addressed as a node on Industrial Ethernet, this device also requires an IP address that is unique within the network. The IP address is made up of 4 decimal numbers with a range of values from 0 through 255. The decimal numbers are separated by a period. The IP address is made up of

- The address of the (sub-) network and
- The address of the node (generally called the host or network node)

IP address assignment

The TCP/IP protocol is a prerequisite for establishing a connection and parameterization. This is the reason that an IP address is required.

The IP addresses of IO devices can be assigned by the IO controller and always have the same sub-network mask as the IO controller. The can be consecutively assigned from the IP address of the IO controller. The IP address can be changed manually, if necessary - and is saved in a volatile fashion.

If the IP address is to be stored in a non-volatile memory, the address must be assigned using the Primary Setup Tool (PST) or STARTER.

This can also be carried out in HWConfig in STEP 7, where the function is called "Edit Ethernet node".

Note

If the network is part of an existing Ethernet company network, obtain the information from your network administrator (IP address, sub-network mask and a router that is possibly being used.)

Device name

When it is shipped, an IO device does not have a device name. An IO device can only be addressed by an IO controller, for example, for the transfer of project engineering data (including the IP address) during startup or for user data exchange in cyclic operation, after it has been assigned a device name with the IO supervisor.

NOTICE

The device name must be saved in a non-volatile fashion either using the Primary Setup Tool (PST) or using HW Config from STEP 7.

Replacing Control Unit CU320 (IO device)

If the IP address and device name are stored in a non-volatile memory, this data is also forwarded with the memory card (CF card) of the Control Unit.

If an IO device must be completely replaced due to a device or module defect, the Control Unit automatically assigns parameters and configures the new device or module. Following this, cyclic exchange of user data is restarted. The CF card allows module exchange without an IO supervisor when a fault occurs in a PROFINET device.

Definition: Sub-network mask

The bits set in the sub-network define the part of the IP address that contains the address of the (sub-)network. The following generally applies:

- The network address is obtained by an AND operation on the IP address and subnetwork mask
- The node address is obtained by an AND NOT operation on the IP address and subnetwork mask.

Example of the sub-network mask

Sub-network mask: 255.255.0.0 (decimal) = 11111111.1111111.00000000.00000000 (binary) IP address: 140.80.0.2, significance: The first 2 bytes of the IP address decide the sub-network - in other words 140.80. The last two bytes address the node - in other words 0.2.

Default router

If data needs to be forwarded by means of TCP/IP to a partner located outside the subnetwork, this is carried out via the default router. In the properties dialog in STEP 7 (Properties of Ethernet interface > Parameters > Network transfer), the default router is described as the router. STEP 7 assigns the local IP address to the default router.

6.8.2.4 Data transmission

Features

The Communication Board CBE20 supports:

- IRT isochronous real-time Ethernet
- RT real-time Ethernet
- Standard Ethernet services (TCP/IP, LLDP, UDP and DCP)

PROFIdrive telegram for cyclic data transmission and non-cyclic services

Telegrams to send and receive process data are available for each drive object of a drive unit with cyclic process data exchange. In addition to cyclic data transfer, acyclic services can also be used for parameterizing and configuring the drive. These acyclic services can be used by the supervisor or the controller.

The total length of the Ethernet frame increases with the number of drive objects in a drive unit.

Sequence of drive objects in the data transfer

The sequence of drive objects is displayed via a list in p0978[0...15] where it can also be changed.

Note

The sequence of drive objects in HW Config must be the same as that in the drive (p0978).

NOTICE

A ring-type topology is not permissible.

6.8.3 Further information about communication via PROFINET IO

Further information about communication via PROFINET IO

For more information about the PROFINET IO communication, refer to the section "PROFIBUS DP/PROFINET IO communication" in the documentation "SINAMICS S120 Function Manual". 6.9 Engineering Software Drive Control Chart (DCC)

6.9 Engineering Software Drive Control Chart (DCC)

Graphical configuring and expansion of the device functionality by means of freely available closedloop control, arithmetic, and logic function blocks

Drive Control Chart (DCC) expands the facility for the simplest possible configuring of technological functions both for the SIMOTION motion control system as well as for the SINAMICS drive system. This provides the user with a new dimension of system adaptability for specific machine functions.

DCC does not restrict the number of functions that can be used; the only restriction is the performance of the target platform.

The user-friendly DCC editor enables easy graphical configuration and a clear representation of control loop structures as well as a high degree of reusability of existing diagrams.

The open-loop and closed-loop control functionality is defined by using multi-instanceenabled blocks (Drive Control Blocks (DCBs)) from a pre-defined library (DCB library) that are selected and graphically linked by dragging and dropping.

Test and diagnostic functions allow verification of the program behavior, and troubleshooting in the event of a fault.

The block library encompasses a large selection of closed-loop, arithmetic and logic function blocks, as well as comprehensive open-loop and closed-loop control functions.

For combining, analyzing and acquiring binary signals, all commonly used logic functions are available for selection (AND, XOR, on/off delay, RS flipflop, counter, etc.). Numerous computation functions are available for monitoring and evaluating numerical variables; for example absolute value generation, division, min/max evaluation.

Besides drive control functions, it is also a simple matter to configure axis winding functions, PI controllers, ramp-function generators, and wobble generators.

Almost unlimited programming of control structures is possible in conjunction with the SIMOTION motion control system. These can then be combined with other program sections to form an overall program.

Drive Control Chart for SINAMICS also provides a convenient basis for resolving drive-level open-loop and closed-loop control tasks directly in the converter. This results in further adaptability of SINAMICS for the tasks set. On-site processing in the drive supports modular machine concepts and results in increased overall machine performance.

Note

A detailed description of the DCC Editor and the available Drive Control Blocks is given in the relevant documentation. This documentation is available on the accompanying customer CD.

7

Setpoint channel and closed-loop control

7.1 Chapter content

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

- Setpoint channel
 - Direction reversal
 - Skip speed
 - Minimum speed
 - Speed limitation
 - Ramp-function generator
- V/f control
- Speed control with / without encoder



7.2 Setpoint channel

Function diagrams

To supplement these operating instructions, the documentation folder contains simplified function diagrams describing the operating principle.

The diagrams are arranged in accordance with the chapters in the operating instructions. 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 can be found on the documentation CD in the "SINAMICS 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 closedloop 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/added 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 reversal

Description

Due to the direction reversal in the setpoint channel the drive can be operated in both directions with the same setpoint polarity.

Use the p1110 or p1111 parameter to block negative or positive direction of rotation.

Note

If an incorrect rotating field was connected when the cables were installed, and the rotating field cannot be corrected by swapping the motor cables, it can be corrected when commissioning the drive via p1821 (rotating field direction reversal) by changing the rotating field and thus enabling a direction reversal (see section "Direction reversal").

Prerequisites

Direction of rotation changeover is triggered:

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

Note

Note that only one direction of rotation is enabled in the factory setting when control is carried out via the AOP30.

Function diagram

FP 3040 Direction of rotation limiting and direction of rotation changeover

Parameter

- p1110 Inhibit negative direction
- p1111 Inhibit positive direction
- p1113 Direction reversal

7.2 Setpoint channel

7.2.3 Suppression bandwidths and minimum speeds

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 skip frequency bands 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 around speed 0 rpm for steady-state operation.

Signal flow diagram





Function diagram

FP 3050 Skip frequency bands and speed limiting

Parameter

- p1080 Minimum speed
- p1091 Skip frequency speed 1
- p1092 Skip frequency speed 2
- p1093 Skip frequency speed 3
- p1094 Skip frequency speed 4
- p1101 Skip frequency speed bandwidth
- 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



Figure 7-2 Signal flow diagram: Speed limitation

7.2 Setpoint channel

Function diagram

| | FP 3050 | Skip frequency bands and speed limiting |
|--|---------|---|
|--|---------|---|

Parameter

- p1082 Maximum speed
- p1083 CO: Speed limit in positive direction of rotation
- r1084 CO: Speed limit positive effective
- p1085 CI: Speed limit in positive direction of rotation
- p1086 CO: Speed limit in negative direction of rotation
- r1087 CO: Speed limit negative effective
- p1088 CI: 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 p1151.0 in the zero point.

Signal flow diagram



Figure 7-3

Signal flow diagram: Ramp-function generator

Function diagram

| FP 3060 | Simple ramp-function generator |
|---------|----------------------------------|
| FP 3070 | Extended ramp-function generator |

Parameter

| • | r1119 | Ramp-function generator setpoint at the input |
|---|-------|---|
|---|-------|---|

- p1120 Ramp-function generator ramp-up time
- p1121 Ramp-function generator ramp-down time
- p1130 Ramp-function generator initial rounding time
- p1131 Ramp-function generator final rounding time
- p1134 Ramp-function generator rounding type
- p1135 OFF3 ramp-down time
- p1136 OFF3 initial rounding time
- p1137 OFF3 final rounding time
- r1150 Ramp-function generator speed setpoint at the output
- p1151 Ramp-function generator configuration

Note

The effective ramp-up time increases when you enter initial and final rounding times. Effective ramp-up time = $p1120 + (0.5 \times p1130) + (0.5 \times p1131)$ 7.3 V/f control

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

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).

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

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

 $M \sim \Phi \times I$

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 (V) must change 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 decrease as the frequency increases; this is illustrated in the following diagram.





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

7.3 V/f control

| Parameter value | Meaning | Application / | property |
|-----------------|---|--|---|
| 0 | Linear characteristic | Standard with variable voltage boost | v_n $p_{1300} = 0$ f_n f |
| 1 | Linear characteristic with flux current control (FCC) | Characteristic that compensates for voltage losses 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. | V _{max} r0071 p0304 Load-current- dependent o p0310 f |
| 2 | Parabolic characteristic | Characteristic that takes into account the motor torque curve (e.g. fan/pump). Quadratic characteristic (f² characteristic) Energy saving because the low voltage also results in small currents and losses. | v_n $p_{1300} = 2$ f_n f |
| 3 | Programmable characteristic | Characteristic that takes into account the motor/machine torque characteristic. | V Vmax p1327 p1325 p1323 p1321 r1315 0 f1 f2 f3 f4 fmax p1326 p1322 p1324 p1326 p1082 |
| 5 | Precise frequency drives (textiles) | Characteristic (see parameter value 0) that ta particularity of an application (e.g. textile appli Whereby current limitation (Imax controlle the output frequency. By disabling slip compensation and resonant experimentation (Imax controlle the compensation and resonant) | ications): r) only affects the output voltage and not |

Table 7-1 p1300 V/f characteristics

Setpoint channel and closed-loop control

7.3 V/f control

| Parameter value | Meaning | Application / property |
|-----------------|--|---|
| 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 current limitation (Imax controller) only affects the output voltage and not the output frequency. By disabling slip compensation and resonance damping Voltage losses in the stator resistance for static / dynamic loads are also compensated (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 Al0 of the TM31 \rightarrow p1330 = r4055[0]). |

Function diagram

FP 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 (p1310) or only during acceleration (p1311).



Figure 7-5 Voltage boost total

Note

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

NOTICE

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

7.3 V/f control

Permanent voltage boost (p1310)



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

Figure 7-6 Permanent voltage boost (example: p1300 = 0, p1310 >0, p1311 = 0)

Voltage boost during acceleration (p1311)

Voltage boost is only active during acceleration or braking. Voltage boost is only active if the "Ramp-up active" signal (r1199.0 = 1) or "Ramp-down active" (r1199.1 = 1) is pending.



Figure 7-7 Voltage boost during acceleration (example: p1300 = 0, p1310 = 0, p1311 > 0)

Function diagram

FP 6300 V/f characteristic and voltage boost

Parameter

- p0304 Rated motor voltage
- p0305 Rated motor current
- r0395 Stator resistance, actual
- p1310 Permanent voltage boost
- p1311 Voltage boost during 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.



Figure 7-8 Slip compensation

Function diagram

FP 6310 Resonance damping and slip compensation

Parameters

| ٠ | 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

Setpoint channel and closed-loop control

7.4 Vector speed/torque control with/without encoder

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 adjustable 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 is required in a control range greater than 1:10
- Allows a defined and/or variable torque for speeds below approx. 10% of the rated motor frequency (p0310) to be maintained.
- A speed controller is normally always required for applications in which an unknown speed can represent a safety risk (where a load can be dropped, e.g. lifting gear, elevators, etc).

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

- Speed control
- Torque/current control (in short: torque control)

7.4.1 Vector control without encoder

Description

For sensorless vector control only (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 changeover between closed-loop/open-loop operation is controlled on the basis of time and frequency conditions (p1755, p1756, p1758 - only for induction motors). The system does not wait for the time condition to elapse if the setpoint frequency at the ramp-function generator input and the actual frequency are below p1755 x (1 - (p1756 / 100 %)) simultaneously.

Transition from open-loop to closed-loop operation always takes place when the changeover speed in p1755 (characteristic "1" in the figure below). If the speed increase is set very slow and a changeover delay time >0 is set in p1759, transition takes place after the changeover delay time (characteristic "2" in the figure below).



Figure 7-9 Changeover conditions

In open-loop operation, the calculated actual speed value is the same as the setpoint value. For vertical loads and acceleration processes, 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, on induction motors, p1610 is set to 0%, only the magnetizing current r0331 is injected; at a value of 100%, the rated motor current p0305 is injected. For permanent-magnet synchronous motors, at p1610 = 0%, a pre-control absolute value derived from the supplementary torque r1515 remains instead of the magnetizing current. 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
- Starting in closed-loop operation (directly after the drive has been energized) (induction motors only)

Note

In this case, the speed setpoint upstream of the ramp-function generator must be greater than the changeover speed in 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 changeover 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, if p1758 > 2 s).

Permanent-magnet synchronous motors are always started and reversed in open-loop operation. The changeover speeds are set to 10% or 5% of the rated motor speed. Changeover is not subject to any time condition (p1758 is not evaluated). Prevailing load torques (motor or regenerative) are adapted in open-loop operation, facilitating constant-torque crossover to closed-loop operation even under high static loads. Whenever the pulses are enabled, the rotor position is identified.

Closed-loop operation down to standstill for passive loads

By restricting to a passive load at the starting point, it is possible to maintain stationary closed-loop operation down to zero frequency (standstill) without having to change over to open-loop operation.

Parameter p1750.2 must be set to 1.

Closed-loop control without changeover is restricted to applications with passive load: These include applications in which the load cannot produce a regenerative torque on startup and the motor comes to a standstill when pulses are inhibited; for example, moments of inertia, brakes, pumps, fans, centrifuges, extruders, etc.

Standstill of any duration is possible without holding current, only the motor magnetization current is impressed.

The stationary regenerating operation at a frequency close to zero is not permissible.

It is also possible to select sensorless control for passive loads during commissioning by setting p0500 = 2 (technology application = passive loads (for sensorless control down to f = 0)).

This function is activated automatically if quick commissioning is exited with p3900 > 0, or if automatic calculation is called (p0340 = 1, 3, 5 or p0578 = 1).

Function diagram

FP 6730 Interface to Motor Module

Parameter

- p0305 Rated motor current
- r0331 Motor magnetizing current/short-circuit current
- p0500 Technology application
- p0578 Calculating technology/unit-dependent parameters
- p1610 Torque setpoint static (SLVC)
- p1611 Supplementary accelerating torque (SLVC)
- p1750 Motor model configuration
- p1755 Motor model changeover speed encoderless 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 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.

Motor model change

A model change takes place between the current model and the observer model within the speed range p1752 x (100 % - p1756) and p1752. In the current-model range (i.e., at lower speeds), torque accuracy depends on whether thermal tracking of the rotor resistance is carried out correctly. In the observer-model range and at speeds of less than approx. 20% of the rated speed, torque accuracy depends primarily on whether thermal tracking of the stator resistance is carried out correctly. If the resistance of the supply cable is greater than 20% to 30 % of the total resistance, this should be entered in p0352 before motor data identification is carried out (p1900/p1910).

To deactivate thermal adaptation, set p0620 = 0. This may be necessary if adaptation cannot function accurately enough due to the following supplementary conditions: For example, if a KTY sensor is not used for temperature detection and the ambient temperatures fluctuate significantly or the overtemperatures of the motor ($p0626 \dots p0628$) deviate significantly from the default settings due to the design of the motor.

Function diagram

- FP 4715 Actual speed value and rotor position measurement, motor encoder
- FD 6030 Speed setpoint, droop
- FP 6040 Speed controller
- FP 6050 Kp_n-/Tn_n adaptation
- FP 6060 Torque setpoint
- FP 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 torque setpoint is generated from the total of the output variables and reduced to the permissible magnitude by means of torque setpoint limitation.

The speed controller receives its setpoint (r0062) from the setpoint channel and its actual value (r0063) either directly from the speed actual value encoder (vector control with encoder) or indirectly via the motor model (encoderless vector control). 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.





The optimum speed controller setting can be determined via the automatic speed controller optimization function (p1900 = 1, rotating measurement).

If the moment of inertia 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:

 $Tn = 4 \times Ts$

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) will need to 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 increased. However, signal ripples and vibrations in the speed control loop will increase.
- Although reducing Tn will also speed up the controller, it will increase overshoot.

When setting speed control manually, you are advised to define the dynamic response via Kp (and actual-speed-value smoothing) first, so that the integral time can subsequently be reduced as much as possible. Please remember that 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 p1452 for operation without an encoder or p1442 for operation with an encoder, 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

In comparison with speed control with an encoder, the dynamic response of drives without an encoder is significantly reduced. The actual speed is derived by means of a model calculation based on the converter output variables for current and voltage that have a corresponding interference level. To this end, the actual speed must be adjusted by means of filter algorithms in the software.

Function diagram

FP 6040 Speed controller

Parameter

- r0062 CO: Speed setpoint after the filter
- r0063 CO: Actual speed value smoothed
 - p0340 Automatic calculation, control parameters
- r0345 CO: Rated motor startup time
- p1442 Speed-actual-value smoothing time (VC)
- p1452 Speed-actual-value smoothing time (encoderless VC)
- p1460 Speed controller P gain with encoder
- p1462 Speed controller integral time with encoder
- p1470 Speed controller encoderless operation P gain
- p1472 Speed controller encoderless operation integral time
- r1482 CO: Torque output I speed controller
- r1508 CO: Torque setpoint before supplementary torque
- p1960 Speed controller optimization selection

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.

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:

 $mv = p1496 \text{ x J x } (d\omega/dt) = p1496 \text{ x } p0341 \text{ x } p0342 \text{ x } (d\omega/dt), \omega = 2\pi f$

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.

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 %.





Figure 7-11 Speed controller with pre-control

When correctly adapted, when accelerating, the speed controller only has to compensate disturbance variables in its control loop. This is achieved with a relatively minor controlled variable change at the controller output.

The effect of the pre-control variable can be adapted according to the application using the weighting factor p1496. For p1496 = 100%, pre-control is calculated according to the motor and load moment of inertia (p0341, p0342). A balancing filter is used automatically to prevent the speed controller acting against the injected torque setpoint. The time constant of the balancing filter corresponds to the equivalent delay time of the speed control loop. 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, pre-control allows a new speed setpoint to be approached without overshoot (prerequisite: torque limiting does switch in and the moment of inertia remains constant).

If the speed controller is pre-controlled by means of 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 speed setpoint or activating ramp-function generator rounding p1130 – p1131.

The startup time r0345 ($T_{startup}$) is a measure for the total moment of inertia J of the machine and describes the time during which the unloaded drive can be accelerated with the rated motor torque r0333 ($M_{mot,rated}$) from standstill to the rated motor speed p0311 ($n_{mot,rated}$).

r0345 = T_{startup} = J x (2 x π x n_{mot,rated}) / (60 x M_{mot,rated}) = p0341 x p0342 x (2 x π x p0311) / (60 x r0333)

The ramp-up and ramp-down times should always be set to values larger than the startup 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 will optimize the function of speed controller precontrol.

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 reference/acceleration model

Parameter

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



Figure 7-12 Reference model

Function diagram

FP 6031 Pre-control balancing 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 dead time
- r1436 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.



Figure 7-13 Free Kp adaptation

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

Example of speed-dependent adaptation

Note

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



Function diagram

FP 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 encoderless 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 time adaptation speed lower
- p1463 Speed controller integral 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 (encoderless VC only)

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

7.4.3.4 Droop Function

Description

Droop (enabled via p1492) ensures that the speed setpoint is reduced proportionally as the load torque increases.

The droop function has a torque limiting effect on a drive that is mechanically coupled to a different speed (e.g. guide roller on a goods train). In this way, a very effective load distribution can also be realized in connection with the torque setpoint of a leading speed-controlled drive. In contrast to torque control or load distribution with overriding and limitation, with the appropriate setting, such a load distribution controls even a smooth mechanical connection.

This method is only suitable to a limited extent for drives that are accelerated and braked with significant changes in speed.

The droop feedback 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. It limits the torque differences that can occur as a result of the mechanical connection between the motors by modifying the speeds of the individual motors (drive is relieved when the torque becomes too great).



Figure 7-15 Speed controller with droop

Requirement

- All connected drives must be operated with vector and speed control (with or without speed actual value encoder).
- The setpoints at the ramp function generators of the mechanically connected drives must be identical; the ramp function generators must have identical ramp-up and ramp-down times.

Setpoint channel and closed-loop control

7.4 Vector speed/torque control with/without encoder

Function diagram

FP 6030 Speed setpoint, droop

Parameter

- r0079 Total speed setpoint
- r1482 Speed controller I torque output
- p1488 Droop input source
- p1489 Droop feedback scaling
- r1490 Droop feedback speed reduction
- p1492 Droop feedback enable
- 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.



Figure 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.

OFF responses

- OFF1 and p1300 = 22, 23
 - Response as for OFF2
- OFF1, p1501 = "1" signal and p1300 ≠ 22, 23
 - No separate braking response; the braking response is provided by a drive that specifies the torque.
 - The pulses are inhibited when the brake application time (p1217) expires. Standstill is detected when the speed actual value of the speed threshold (p1226) is undershot or when the monitoring time (p1227) started when speed setpoint ≤ speed threshold (p1226) expires.
 - Switching on inhibited is activated.

- OFF2
 - Immediate pulse suppression, the drive coasts to standstill.
 - The motor brake (if parameterized) is closed immediately.
 - Switching on inhibited is activated.
- OFF3
 - Switch to speed-controlled operation
 - n_set = 0 is input immediately to brake the drive along the OFF3 deceleration ramp (p1135).
 - When standstill is detected, the motor brake (if parameterized) is closed.
 - The pulses are inhibited when the motor brake closing time (p1217) has elapsed. Standstill is detected when the speed actual value of the speed threshold (p1226) is undershot or when the monitoring time (p1227) started when speed setpoint ≤ speed threshold (p1226) expires.
 - Switching on inhibited is activated.

Function diagram

FP 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



Figure 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 CO: Torque limit, upper/motoring
- p1521 CO: Torque limit, lower/regenerative
- p1522 CI: Torque limit, upper/motoring
- p1523 CI: Torque limit, lower/regenerative
- p1524 CO: Torque limit, upper/motoring, scaling
- p1525 CO: Torque limit, lower/regenerative 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

| FP 6060 | Torque setpoint |
|---------|-----------------------------|
| FP 6630 | Upper/lower torque limit |
| FP 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 operation is not possible when the motor is 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 these drives are used, gear units and mechanical parts subject to wear can be dispensed with if the application allows this.



As soon as the motor starts to rotate, a voltage is generated. When work is carried out on the converter, the motor must be safely disconnected. If this is not possible, the motor must be locked by a holding brake, for example.

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 (option K51))
- 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 depend on the converter output voltage available • and the back EMF of the motor (calculation specifications: EMF must not exceed Urated, converter).
- Calculating the maximum speed: $n_{max} = n_n \cdot \sqrt{\frac{3}{2}} \cdot \frac{U_{DC \ link \ max} \cdot I_n}{P_n}$
- Depending on the terminal voltage and load cycle, the maximum torque can be taken from the motor data sheets / configuration instructions.
- No thermal model is available 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 level of torque accuracy.

Commissioning

The following sequence is recommended for commissioning:

Configure the drive

When the drive is being commissioned using STARTER or the AOP30 operator panel, the permanent-magnet synchronous motor must be selected. The motor data specified in the table below must then be entered. Finally, the motor identification routine and speed optimization (p1900) are activated. Encoder adjustment is activated automatically together with the motor identification routine.

entered.

- 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 | | |
|------------------------------------|------------------------|--|
| Parameter | Description | Comments |
| p0304 | Rated motor voltage | If this value is not known, the value "0" can also be entered. Entering the correct value, however, means that the stator leakage inductance (p0356, p0357) can be calculated more accurately. |
| 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, the value "0" can also be entered. |
| p0316 | Motor torque constant | If this value is not known, the value "0" can also be |

Та

If the torque constant k_T is not stamped on the rating plate or specified in the data sheet, you can calculate this value from the rated motor data or from the stall current I_0 and stall torque M_0 as follows:

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

The optional motor data can be entered if it is known. Otherwise, this data is estimated from the type plate data or determined by means of motor identification or speed controller optimization.

| Table 7- 3 | Motor data | type plate |
|------------|------------|------------|
|------------|------------|------------|

| Parameter | Description | Comments |
|-----------|--|---|
| 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 short circuits 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 particularly 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 (VECTOR) is used to control the contactor via a free digital output; the checkback 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

| FP 6721 | Current control - Id setpoint (PEM, p0300 = 2) |
|---------|--|
| FP 6724 | Current control – field weakening controller (PEM, $p0300 = 2$) |
| FP 6731 | Current control - interface to Motor Module (PEM, p0300 = 2) |

Setpoint channel and closed-loop control

7.4 Vector speed/torque control with/without encoder

8

Output terminals

8.1 Chapter content

This chapter provides information on:

- Analog outputs
- Digital outputs



Function diagrams

To supplement this operating manual, the documentation folder contains simplified function diagrams describing the operating principle.

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 documentation CD in the "SINAMICS List Manual", which provides experienced users with detailed descriptions of all the functions.

8.2 Analog outputs

8.2 Analog outputs

Description

The Customer Terminal Block features two analog outputs for outputting setpoints via current or voltage signals.

Factory setting:

- AO0: Actual speed value: 0 20 mA
- AO1: Actual motor current: 0 20 mA

Signal flow diagram



Figure 8-1 Signal flow diagram: analog output 0

Function diagram

FD 1840, TM31 - analog outputs (AO 0 ... AO 1) FD 9572

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 List of signals for the analog signals

List of signals for the analog outputs

 Table 8-1
 List of signals for the analog outputs

| Signal | Parameters | Unit | Scaling (100 %=) See table below |
|---|------------|------|-------------------------------------|
| Speed setpoint before the setpoint filter | r0060 | rpm | p2000 |
| Motor speed unsmoothed | r0061 | rpm | p2000 |
| Actual speed smoothed | 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 |
| Modulation depth | r0074 | % | Reference modulation depth |
| Torque-generating current setpoint | r0077 | А | p2002 |
| Torque-generating actual current | r0078 | А | 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 8-2 Scaling

| Size | 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 = (p2003 x p2000 x π) / 30 |
| Reference frequency | 100 % = p2000/60 | |
| Reference modulation depth | 100 % = Maximum output voltage without overload | |
| Reference flux | 100 % = Rated motor flux | |
| Reference temperature | 100% = 100°C | |

8.2 Analog outputs

Example: changing analog output 0 from current to voltage output -10 V ... +10 V



Example: changing analog output 0 from current to voltage output -10 V ... +10 V and setting the characteristic



Voltage output present at terminal 1, ground is at terminal 2 Set TM31.AO_type [analog output 0] to -10 V ... +10 V. Set TM31.AO_char. x1 to 0.00 %. Set TM31.AO_char. y1 to 0.000 V. Set TM31.AO_char. x2 to 100.00%.

Set TM31.AO_char. y2 to 10.000 V.

8.3 Digital outputs

Description

Four bi-directional digital outputs (terminal X541) and two relay outputs (terminal X542) are available. These outputs are, for the most part, freely parameterizable.

Signal flow diagram



Figure 8-2 Signal flow diagram: Digital outputs

Factory settings

| Table 8-3 | Factory settings for digital outputs |
|-----------|--------------------------------------|
|-----------|--------------------------------------|

| 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 | |

8.3 Digital outputs

Selection of possible connections for the digital outputs

Table 8-4 Selection of possible connections for the digital outputs

| Signal | Bit in status word 1 | Parameter |
|---|-------------------------|-----------|
| 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_set) | 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 unit (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 or control panel) | | r0807.0 |
| 0 = Motor blocked | | r2198.6 |

Functions, Monitoring, and Protective Functions

9.1 Chapter content

This chapter provides information on:

• Drive functions:

Motor identification, Vdc control, automatic restart, flying restart, motor changeover, friction characteristic, increase in the output frequency, runtime, simulation operation, direction reversal, unit changeover

- Extended functions: Technology controller, bypass function, extended brake control, extended monitoring functions
- Monitoring and protective functions: Power unit protection, thermal monitoring functions and overload responses, blocking protection, stall protection, thermal motor protection.



9.1 Chapter content

Function diagrams

To supplement these operating instructions, the documentation folder contains simplified function diagrams describing the operating principle.

The diagrams are arranged in accordance with the chapters in the operating instructions. 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 can be found on the documentation CD in the "SINAMICS List Manual", which provides experienced users with detailed descriptions of all the functions.

Functions, Monitoring, and Protective Functions 9.2 Drive 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, if p1300 = 20 or 22 (encoderless control)
- p1960 = 2, if p1300 = 21 or 23 (control with encoder)

The measurements parameterized using p1900 are started in the following sequence after the corresponding drive has been enabled:

- Standstill (static) measurement after the measurement has been completed, the pulses are inhibited and parameter p1910 is reset to 0.
- Encoder adjustment after the measurement has been completed, the pulses are inhibited and parameter p1990 is reset to 0.
- Rotating measurement after the measurement has been completed, the pulses are inhibited and parameter p1960 is reset to 0.
- After all of the measurements activated using p1900 have been successfully completed, p1900 itself is set to 0.

Note

To set the new controller setting permanently, the data must be saved with p0977 or p0971 on the non-volatile CompactFlash card.

During motor identification, the drive might set the motor in motion.

The EMERGENCY STOP functions must be fully operational during commissioning. To protect the machines and personnel, the relevant safety regulations must be observed.

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
- Magnetization characteristic p1910 = 3

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 the data on the type plate is used. 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 resistance (Rcable) and
 - Stator resistance (Rs)
- IGBT on-state voltage/compensation for the IGBT lockout time

Since the type plate data provides the initialization values for identification, you must ensure that it is entered correctly and consistently (taking into account the connection type (star/delta)) so that the above data can be determined.

If the resistance of the motor supply cable is known, you are advised to enter this value before the standstill measurement (p0352) so that it can be subtracted from the total measured resistance when the stator resistance (p0350) is calculated.

Entering the cable resistance improves the accuracy of thermal resistance adaptation, particularly when long supply cables are used. This governs behavior at low speeds, particularly during encoderless vector control.



Figure 9-1 Equivalent circuit diagram for induction motor and cable

If an output filter (see p0230) or series inductance (p0353) is used, its data must also be entered before the standstill measurement is carried out.

The inductance value is then subtracted from the total measured value of the leakage. With sine-wave filters, only the stator resistance, valve threshold voltage, and valve interlocking time are measured.

Note

Leakage values in excess of 35 to 40% of the rated motor impedance will restrict the dynamic response of speed and current control in the voltage limit range and in field-weakening operation.

Note

Standstill measurement must be carried out when the motor is cold. In p0625, enter the estimated ambient temperature of the motor during the measurement (with KTY sensor: set p0600, p0601 and read r0035). This is the reference point for the thermal motor model and thermal R_s/R_B adaptation.

In addition to the equivalent circuit diagram data, motor data identification (p1910 = 3) can be used for induction motors to determine the magnetization characteristic of the motor. Due to the higher accuracy, the magnetization characteristic should, if possible, be determined during rotating measurement (without encoder: p1960 = 1, 3; with encoder: p1960 = 2, 4). If the drive 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

In comparison with standstill measurement (p1910) for induction motors, rotating measurement (p1960) allows the rated magnetization current and saturation characteristic to be determined more accurately.



Figure 9-2 Magnetization characteristic

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.
- r0047 displays the current status of the measurement.

Note

To set the new controller setting permanently, the data must be saved with p0977 or p0971 on the non-volatile CompactFlash card.

During motor identification, the drive might set the motor in motion.

The EMERGENCY STOP functions must be fully operational during commissioning. To protect machines and personnel, the relevant safety regulations must be observed.

The following parameters are determined by means of motor identification:

- p1910 = 1 and induction motor: p0350, p0354, p0356, p0358, p0360, p1825, p1828, p1829, p1830
- p1910 = 3 and induction motor: p0362 ... p0366
- p1910 = 1 and permanent-magnet synchronous motor: p0350, p0356, p0357, p1825, p1828, p1829, p1830

9.2.1.2 Rotating measurement and speed controller optimization

Description

"Rotating measurement" can be activated via p1960 or p1900 = 1.

The main difference between rotating measurement and standstill measurement is speed control optimization, with which the drive's moment of inertia is ascertained and speed controller is set. On induction motors, the saturation characteristic and rated magnetization current are also measured.

If rotating measurement is not to be carried out at the speed set in p1965, this parameter can be changed before the measurement is started. Higher speeds are recommended. The same applies to the speed in p1961, at which the saturation characteristic is determined and the encoder test is carried out.

The speed controller is set to the symmetrical optimum in accordance with dynamic factor p1967. p1967 must be set before the optimization run and only affects the calculation of the controller parameters.

If, during the measurement, it becomes clear that the the drive cannot operate in a stable manner with the specified dynamic factor or that the torque ripples are too great, the dynamic response is reduced automatically and the result displayed in r1968. The drive must

also be checked to ensure that it is stable across the entire range. The dynamic response might need to be reduced or Kp/Tn adaptation for the speed controller parameterized accordingly.

When commissioning induction machines, you are advised to proceed as follows:

- Before connecting the load, a complete "rotating measurement" (without encoder: p1960 = 1; with encoder: p1960 = 2) should be carried out. Since the induction machine is idling, you can expect highly accurate results for the saturation characteristic and the rated magnetization current.
- When the load is connected, speed controller optimization should be repeated because the total moment of inertia has changed. This is realized by selecting parameter p1960 (without encoder: p1960 = 3; with encoder: p1960 = 4).

When permanent-magnet synchronous motors are commissioned, the speed controller should be optimized (p1960 = 2/4) when the load is connected.

Carrying out the rotating measurement (p1960 = 1, 2)

The following measurements are carried out when the enable signals are set and a switchon command is issued in accordance with the settings in p1959 and p1960.

- Encoder test If a speed encoder is used, the direction of rotation and the pulse number are checked.
- Only for induction motors:
 - Measurement of the magnetization characteristic (p0362 to p0369)
 - Measurement of the magnetization current (p0320) and determination of the offset voltage of the converter for offset compensation
 - Measurement of the saturation of the leakage inductance and setting of the current controller adaptation (p0391...p0393)
 This is automatically activated with 1LA1 and 1LA8 motors (p0300 = 11, 18) (see p1959.5).
- Speed controller optimization
 - p1470 and p1472, if p1960 = 1 (encoderless operation)
 - p1460 and p1462, if p1960 = 2 (operation with encoder)
 - 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 to non-volatile memory on the CompactFlash card.

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 machines and personnel, the relevant safety regulations must be observed.

Note

If speed controller optimization is carried out for operation with an encoder, the control mode will be changed over to encoderless speed control automatically, in order to be able to carry out the encoder test.

Parameter

- r0047 Status identification
- p1300 Open-loop/closed-loop control operating mode
- p1900 Motor data identification and rotating measurement
- 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
- r3925 Identification complete indicator
- r3927 MotId control word
- r3928 Rotating measurement configuration

9.2.2 Efficiency optimization

Description

The following can be achieved when optimizing efficiency using p1580:

- Lower motor losses in the partial load range
- Minimization of noise in the motor



Figure 9-3 Efficiency optimization

It only makes sense to activate this function if the dynamic response requirements of the speed controller are low (e.g., pump and fan applications).

For p1580 = 100%, the flux in the motor under no-load operating conditions is reduced to half of the setpoint (reference flux) (p1570/2). As soon as load is connected to the drive, the setpoint (reference) flux increases linearly with the load and, reaching the setpoint set in p1570 at approx. $r0077 = r0331 \times p1570$.

In the field-weakening range, the final value is reduced by the actual degree of field weakening. The smoothing time (p1582) should be set to approx. 100 to 200 ms. Flux differentiation (see also p1401.1) is automatically deactivated internally following magnetization.

Function diagram

| FP 6722 | Field weakening characteristic, Id setpoint (ASM, p0300 = 1) |
|---------|---|
| FP 6723 | Field weakening control, flux control for induction motor (p0300 = 1) |

Parameters

- r0077 Current setpoints, torque-generating
- r0331 Motor magnetizing current/short-circuit current (actual)
- p1570 Flux setpoint
- p1580 Efficiency optimization

9.2.3 Fast magnetization for induction motors

Description

Fast magnetization for induction motors is used to reduce delay time during magnetization.

Features

- Rapid flux build-up by impressing a field-producing current at the current limit, which considerably reduces the magnetization time.
- If the "Flying restart" function is activated, the excitation build-up time set in p0346 is still used.

Commissioning

Parameter setting p1401.6 = 1 is necessary to activate fast magnetization.

Then magnetization is carried out with maximum current (0.9 x r0067). When the flux setpoint is reached, the current is reduced via the smoothing p1616 (maximum 32 x p0115[2]).

If stator resistance identification is activated (see p0621), fast magnetization is deactivated internally and alarm A07416 displayed.

If there are conflicts in the configuration of parameter p1401, alarm A07416 is output and a fault detection procedure is used to display the particular conflict.

Function diagram

| FP 6491 | Flux control configuration |
|---------|--|
| FP 6722 | Field weakening characteristic, Id setpoint (ASM, p0300 = 1) |
| FP 6723 | Field weakening controller, flux controller (ASM, p0300 = 1) |

Parameter

- p0320 Motor rated magnetization current/short-circuit current
- p0346 Motor excitation build-up time
- p0621 Stator resistance identification after restart
- p0640 Current limit
- p1401 Flux control configuration
- p1570 Flux setpoint
- p1573 Flux threshold value magnetization
- p1590 Flux controller P gain
- p1616 Current setpoint smoothing time

9.2.4 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 This process is known as kinetic buffering.

Kinetic buffering is only possible as long as energy is generated by the movement of the drive.

Characteristics

- 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 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-Regelung
 - This function can be used to control a momentary regenerative load without shutdown with "overvoltage in DC link".
 - Vdc_max control is only recommended for a supply without active closed-loop control for the DC link and without feedback.



Description of Vdc_min control (kinetic buffering)



Note

Kinetic buffering must only be activated in version A in conjunction with an external power supply.

When Vdc_min control is enabled with p1240 = 2.3 (p1280), it is activated if the power fails 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 buffer 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 zero. The SINAMICS system continues operating until the shutdown threshold of the DC link voltage is undershot (see "Switching Vdc_min control on/off" <1>).

Note

All parameter specifications in parentheses refer to V/f control.

• V/f control

The Vdc_min controller acts on the speed setpoint channel. 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 torquegenerating current setpoint. When Vdc_min control is active, the torque-generating current setpoint is reduced so that the drive becomes regenerative.

If the power fails, 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. An alarm A7402 (drive: DC link voltage minimum controller active) will be issued while 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 "Switching Vdc_min control on/off" <1>), the drive will shut down with fault F30003 (power unit: DC link undervoltage).

If, during active Vdc_min control, a speed threshold set with parameter p1257 (p1297) (see "Switching Vdc_min control on/off" <2>) is undershot, the drive will shut down with F7405 (drive: kinetic buffering minimum speed not reached).

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 sufficient 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 will shut down with fault F7406 (drive: kinetic buffering maximum time 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



Figure 9-5 Activating/deactivating the Vdc_max control

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 (device supply voltage, DC link)
- when the automatic switch-on level sensing is enabled (p1254 = 1) r1242 (r1282) = Vdc_max - 50 V (Vdc_max: overvoltage threshold of the converter)

Function diagram

FD 6220 (FP 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

9.2.5 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 low moments of inertia and load torques facilitating the stopping of the drive within a matter of seconds (e.g., pump drives with water gauges), starting from standstill is recommended.

Note

The flying restart function can also be activated for drives with large moments of inertia (such as fan drives). This enables you to switch to the motor that is still rotating.

If p1210 is set to values >1, 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.

Automatic restart mode

| p1210 | Mode | Meaning |
|-------|---|--|
| 0 | Disables automatic restart | Automatic restart inactive |
| 1 | Acknowledges all faults without restarting | If p1210 = 1, pending faults will be acknowledged automatically once their cause has been rectified. If further faults occur after faults have been acknowledged, these will also be acknowledged automatically. A minimum time of p1212 + 1 s must expire between successful fault acknowledgement and a fault re-occurring if the signal ON/OFF1 (control word 1, bit 0) is at a HIGH signal level. If the ON/OFF1 signal is set to LOW, the time between when a fault is acknowledged and another one occurs must be at least 1 s. If p1210 = 1, fault F07320 will not be generated if the acknowledge attempt fails (e.g., because the faults occurred too frequently). |
| 4 | Automatic restart after line supply failure, no additional startup attempts | If p1210 = 4, an automatic restart will only be performed if in addition fault F30003 occurs on the Motor Module or there is a high signal at binector input p1208[1], or in the case of an infeed drive object (A_Infeed), F06200 is pending. If additional faults are pending, then these faults will also be acknowledged; if this is successful, the startup attempt will be resumed. The failure of the CU's 24 V power supply will be interpreted as a line supply failure. |
| 6 | Restart after any fault with additional startup attempts | If $p1210 = 6$, an automatic restart will be performed after any fault or at $p1208[0] = 1$. If the faults occur one after the other, then the number of startup attempts is defined using p1211. Monitoring over time can be set using $p1213$. |

| Table 9- 1 | Automatic restart mode |
|------------|------------------------|
| | |

Startup attempts (p1211) and waiting time (p1212)

p1211 is used to specify the number of startup attempts. The number is decremented internally after each successful fault acknowledgement (line supply voltage must be restored or the infeed signals that it is ready). Fault F07320 is output when the number of parameterized startup attempts is reached.

If p1211 = x, x + 1 startup attempts will be made.

Note

A startup attempt starts immediately when the fault occurs.

The faults are acknowledged automatically at intervals of half the waiting time p1212.

Following successful acknowledgement and restoration of the voltage, the system is automatically powered up again.

The startup attempt has been completed successfully once the flying restart and magnetization of the motor (induction motor) has been completed (r0056.4 = 1) and one additional second has expired. The startup counter is not reset to the initial value p1211 until this point.

If additional faults occur between successful acknowledgement and the end of the startup attempt, then the startup counter, when it is acknowledged, is also decremented.

Monitoring time power restoration (p1213)

The monitoring time starts when the faults are detected. If the automatic acknowledgements are not successful, the monitoring time will continue. If the drive has not successfully restarted by the time the monitoring time expires (flying restart and motor magnetization must have been completed: r0056.4 = 1), fault F07320 is output. Monitoring is deactivated by setting p1213 = 0.

If p1213 is set to a value lower than the sum of p1212, the magnetization time r0346 and the additional delay time due to flying restart, then fault F07320 will be generated on every restart attempt. If, for p1210 = 1, the time in p1213 is set to a value lower than p1212, then fault F07320 will also be generated on every restart attempt. The monitoring time must be extended if the faults that occur cannot be immediately and successfully acknowledged.

Parameter

- p1210 Automatic restart mode
- p1211 Automatic restart, start attempts
- p p1212 Automatic restart, delay time start attempts
- p1213 Automatic restart, monitoring line supply return

Settings

To prevent the motor from switching to phase opposition when the drive is being restarted, there is a delay while the motor demagnetizes ($t = 2.3 \times motor$ magnetization time constant). Once this time has elapsed, the inverter is enabled and the motor is supplied with power.

9.2.6 Flying restart

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:

- 1. 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.
- 2. 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 moment of inertia and a steeply descending load characteristic in the lower speed range).

In accordance with 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.

9.2.6.1 Flying restart without encoder

Description

Depending on parameter p1200, the flying restart function is started with the maximum search speed $n_{\text{search,max}}$ once the de-excitation time (p0347) has elapsed (see diagram "Flying restart").

 $n_{\text{Search,max}} = 1.25 \text{ x } n_{\text{max}} (p1082)$

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 "Flying restart").

• 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.







/!\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.

9.2.6.2 Flying restart with encoder

Description

The flying restart function behaves differently with V/f control and vector control:

- V/f characteristic (p1300 < 20): Flying restart without encoder (see "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.

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.

9.2.6.3 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

Note

For p1200 = 1, 2, 3, the following applies: Search in both directions, start only in the setpoint direction.

For p1200 = 4, 5, 6, the following applies: Search only in the setpoint direction.

9.2.7 Motor changeover/selection

9.2.7.1 Description

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

- Changing over between different motors
- Motor data adaptation

Note

To switch to a rotating motor, the "flying restart" function must be activated.

9.2.7.2 Example of changing over between two motors

Prerequisites

- 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)



Figure 9-7

Example of motor changeover

| Parameters | Settings | Comments |
|---------------------|---------------------------------------|---|
| p0130 | 2 | Configure 2 MDS |
| p0180 | 2 | Configure 2 DDS |
| p0186[01] | 0, 1 | The MDS are assigned to the DDS. |
| p0820 | Digital input, DDS selection | The digital input to change over the motor is selected via the |
| p0821 to p0824 | 0 | DDS. Binary coding is used (p0820 = bit 0, etc.). |
| p0826[01] | 1, 2 | Different numbers mean different thermal models. |
| p0827[01] | 0, 1 | The bits of p0830 are assigned to the MDS. If p0827[0] = 0, for example, bit p0830.0 is set via DDS0 when MDS0 is selected. |
| p0830.0 and p0830.1 | Digital outputs, auxiliary contactors | The digital outputs for the auxiliary contactors are assigned to the bits. |
| p0831[01] | Digital inputs, auxiliary contacts | The digital inputs for the feedback signal of the motor contactors are assigned. |
| p0833.00 and .01 | 0, 0 | The drive controls the contactor circuit and pulse suppression. |

Table 9-2 Settings for the motor changeover example

Motor changeover sequence

- Pulse suppression: The pulses are suppressed following the selection of a new drive data set using p0820 to p0824.
- Open motor contactor: Motor contactor 1 is opened r0830 = 0 and the status bit "Motor changeover active" (r0835.0) is set.
- Change over drive data set: The requested data set is activated (r0051 = data set currently effective, r0837 = requested data set).
- 4. Energize motor contactor: After the feedback signal (motor contactor opened) from motor contactor 1, the appropriate bit of r0830 is set and motor contactor 2 is energized.
- 5. Enable pulses: After the feedback signal (motor contactor closed) from motor contactor 2, the bit "motor data set changeover active" (r0835.0) is reset and the pulses are enabled. The motor has now been changed over.

9.2.7.3 Function diagram

| FP 8565 | Drive Data Set (DDS) |
|---------|-----------------------|
| FP 8575 | Motor Data Sets (MDS) |

Functions, Monitoring, and Protective Functions 9.2 Drive Functions

9.2.7.4 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 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
- p0824 BI: Drive data set selection DDS, bit 4
- p0826 Motor changeover, motor number
- p0827 Motor changeover status word bit number
- p0828 Motor changeover, feedback signal
- r0830 Motor changeover, status
- p0831 Motor changeover, contactor feedback signal
- p0833 Data set changeover configuration

9.2.8 Friction characteristic curve

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 response..

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 preassigned 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

When the friction characteristic is plotted, the drive can cause the motor to move. As a result, the motor may reach maximum speed.

When commissioning the drive, the EMERGENCY STOP functions must function perfectly. To protect the machines and personnel, the relevant safety regulations must be observed.

Function diagram

FD 7010 Friction characteristic curve

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

9.2.9 Increasing the output frequency

9.2.9.1 Description

In applications that require higher output frequencies, the pulse frequency of the converter 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 unit protection.

Note

Use of a sine-wave filter (option L15) must be selected using p0230 = 3 when commissioning. This setting fixes the pulse frequency to 4 kHz or 2.5 kHz and it cannot be changed.

9.2.9.2 Default pulse frequencies

The specified maximum output frequencies can be achieved with the default pulse frequencies listed below.

| Converter rating [kW] | Default pulse frequency [kHz] | Maximum output frequency [Hz] | | |
|---------------------------------|----------------------------------|----------------------------------|--|--|
| Supply voltage 380 – 480 V 3 AC | | | | |
| 110 – 250 | 2 | 160 | | |
| 315 – 900 | 1.25 | 100 | | |
| | Supply voltage 500 – 600 V 3 AC | | | |
| 110 – 1000 | 1.25 | 100 | | |
| Supply voltage 660 – 690 V 3 AC | | | | |
| 75 – 1500 | 1.25 | 100 | | |

Table 9-3 Maximum output frequency with default pulse frequency

The pulse frequencies set in the factory are also the minimum frequencies.

The scanning times for the inputs and outputs of the customer terminal block TM31 are set in the factory to 4000 μ s. This is also the minimum limit.

9.2.9.3 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.

Procedure

- 1. Parameter p0009 on the Control Unit must be set to 3 "Basic drive configuration".
- 2. Parameter p0112 "Sampling times default setting p0115" of the DO VECTOR must be set to 0 "Expert".
- 3. Use p0113 to enter any pulse frequency between 1 kHz and 2 kHz. If a higher pulse frequency is to be set (e.g. 2.2 kHz), this value must be divided by 2 or by 4 to obtain a result between 1 kHz and 2 kHz (e.g. 2.2 kHz divided by 2 is 1.1 kHz).
- 4. Not all pulse frequencies are accepted in parameter p0113; in such cases, the alarm "Impermissible value" is output.
- 5. If the frequency entered in parameter p0113 is not accepted, parameter r0114[0] recommends a different frequency that can deviate from the entered pulse frequency by several Hertz. This frequency should be entered in p0113.
- 6. After entering the frequency in p0113, parameter p0009 on the Control Unit must be set to 0 "Ready" again.
- The Control Unit re-initializes. After booting, the pulse frequencies recommended in r0114[i] (i = 1, 2, ...) can be entered in parameter p1800 "Pulse frequency" of the DO VECTOR.

NOTICE

The pulse frequency entered in p1800 must correspond precisely to the value given in r0114[i]; otherwise, the entry will be rejected.

9.2.9.4 Maximum output frequency achieved by increasing the pulse frequency

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 9-4
 Maximum output frequency achieved by increasing the pulse frequency

| Pulse frequency [kHz] | Maximum output frequency [Hz] |
|--------------------------|----------------------------------|
| 1,25 | 100 |
| 2 | 160 |
| 2,5 | 200 |
| 4 | 300 ¹) |
| 5 | 300 ¹⁾ |

¹⁾ The maximum output frequency is limited to 300 Hz due to the closed-loop control.

9.2.9.5 Parameters

- p0009 Device commissioning parameter filter
- p0112 Sampling times pre-setting p0115
- p0113 Selects the minimum pulse frequency
- p0115 Sampling times
- p1800 Pulse frequency

9.2.10 Runtime (operating hours counter)

Total system runtime

The entire system runtime is displayed in r2114 (Control Unit); it is made up of r2114[0] (milliseconds) and r2114[1] (days). Index 0 indicates the system runtime in milliseconds; after reaching 86.400.000 ms (24)

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. Once the drive unit has been switched on, the counter continues to run with the value that was saved the last time the drive was switched off.

Relative system runtime

The relative system runtime since the last POWER ON is displayed in p0969 (Control Unit). The value is indicated in milliseconds and the counter overflows after 49 days.

Actual motor operating hours

The motor operating hours counter p0650 (drive) resumes when the pulses are enabled. When the pulse enable is withdrawn, the counter is stopped and the value saved.

To store the value, you need 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, alarm A01590 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 unit are displayed in p0251 (drive).

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 (drive).

Alarm A30042 (service life of the fan reached or exceeded) is output when this figure is reached, and also 500 hours beforehand. Evaluation of the fault value in the alarm provides details of the cause of the alarm.

Monitoring is deactivated with p0252 = 0.

9.2.11 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, note that it must be switched over to encoderless operation during simulation mode. This means that large parts of the SINAMICS software (e.g., 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 75 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.

Parameters

• p1272 Simulation operation

9.2.12 Direction reversal

Description

The direction of rotation of the motor can be reversed using direction reversal via p1821 without having to change the motor rotating field by interchanging two phases on the motor and inverting the encoder signals using p0410.

Reversal via p1821 can be detected from the motor direction of rotation. The speed setpoint and actual value, torque setpoint and actual value remain unchanged, as does the relative position change.

A pulse inhibit must be set prior to attempting reversal.

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). The absolute position reference is lost on reversal.

Function diagram

| FD 4704, 4715 | Encoder evaluation |
|---------------|--------------------|
| FD 6730, 6731 | Current control |

Parameters

- r0069 Phase currents actual value
- r0089 Phase voltage actual value
- p1820 Output phase direction reversal
- p1821 Direction reversal

9.2.13 Unit changeover

Description

Parameters and process variables for input and output can be switched to a suitable units system (SI units, US units or referenced variables (%)) with the help of the unit changeover function.

The following constraints apply to the unit changeover:

- Unit changeover is only possible for the "VECTOR" drive object.
- Parameters of the rating plate of the drive converter or the motor rating plate can be changed over between SI/US units; however, a per unit representation is not possible.
- Once the changeover parameter has been changed, all parameters that are assigned to a unit group depending on this parameter are jointly changed over to the new unit.
- A separate parameter is available for selecting technological units (p0595) for the representation of technological variables in the technology controller.
- If a changeover is made to referenced variables and the reference variable is subsequently changed, the % value entered in a parameter will not change.

Example:

- With a reference speed of 1500 1/min, a fixed speed of 80 % corresponds to a value of 1200 1/min.
- If the reference speed is changed to 3000 1/min, the value of 80 % is retained and is now 2400 1/min.

Restrictions

- When a unit changeover occurs, rounding to the decimal places is carried out. This can mean that the original value might change by up to one decimal place.
- If a referenced form is selected and the reference parameters (e.g. p2000) are changed retrospectively, the physical significance of some of the control parameters is also adjusted, which can affect the control behavior.
- Changing the reference variables (p2000 to p2007) in the STARTER in offline mode can cause parameter value limit violations, leading in turn to error messages when the values are loaded to the drive unit.

Changing over the units

The units can be changed over via the AOP30 and via STARTER.

- Unit changeover via AOP30 is always carried out immediately. Once the corresponding parameters have been changed, the values affected are displayed in the new selected unit.
- If STARTER is used, unit changeover can only take place in offline mode in the configuration screen of the corresponding drive object. The new units are not displayed until after the download ("Load project to target system") and subsequent upload ("Load project to PG") have been completed.

Unit groups

Each parameter that can be switched is assigned to a unit group which can be switched within certain limits depending on the group.

This assignment and the units groups for each parameter appear in the parameter list in the SINAMICS List Manual.

The unit groups can be individually switched using 4 parameters (p0100, p0349, p0505 and p0595).

Parameter

- p0010 Commissioning parameter filter
- 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
- p2000 Reference frequency/speed
- p2001 Reference voltage
- p2002 Reference current
- p2003 Reference torque
- p2004 Reference power
- p2005 Reference angle
- p2007 Reference acceleration

9.2.14 Derating behavior at increased pulse frequency

Description

To reduce motor noise or to increase output frequency, the pulse frequency can be increased relative to the factory setting.

The increase in the pulse frequency normally results in a reduction of the maximum output current (see "Technical data/current derating depending on the pulse frequency").

When commissioning the converter the behavior at overload is adjusted in such a manner that the pulse frequency is variably reduced so that the required power can be obtained.
Characteristics:

- The reaction to overload depends on the setting of parameter p0290:
 - p0290 = 0: Reduce output current or output frequency
 - p0290 = 1: No reduction, shutdown when overload threshold is reached
 - p0290 = 2: Reduce the output current or output and pulse frequency (not using l²t).
 - p0290 = 3: Reduce the pulse frequency (not using l^2t)
- For p0290 = 2 at overload first reduce the pulse frequency (and consequently the output frequency) until it has dropped to rated pulse frequency, then reduce the output frequency if overload continues to persist.
 The rated pulse frequency is half the inverse value of the current controller clock cycle: 0.5 x 1/p0115[0].
- Reduction of the pulse frequency is executed in whole multiples based on the rated pulse frequency (5 kHz -> 2.5 kHz -> 1.25 kHz or 4 kHz -> 2 kHz).
- After entering the maximum speed in p1082 the system automatically calculates whether the pulse frequency is sufficient for the entered maximum speed, if necessary the pulse frequency is increased automatically to a value that is necessary for this. At overload, then also for p0290 = 2 or 3, this new pulse frequency will no longer be underranged, the downstream reaction (reduce output voltage or switch off) will be triggered.

Exceptions:

• With an activated sinus filter (p0230 = 3, 4), this behavior is not permitted because the factory set pulse frequency (2.5 kHz or 4 kHz) should not be changed through this measure. Consequently in this case the selection possibility for the parameter p0290 is limited to "0" and "1".

Activation of the variable pulse frequency

At commissioning the parameter p 0290 is automatically set to the value "2". This activates pulse frequency reduction at overload.

Deactivation of the variable pulse frequency

By changing the parameter p0290 to "0" or "1" the variable pulse frequency is deactivated.

Function diagram

FP 8014 Signals and monitoring functions - thermal monitoring power unit

9.2 Drive Functions

Parameter

- r0036 Power unit overload I2t
- r0037 CO: Power unit temperatures
- p0115 Sampling times for internal control loops
- p0230 Drive filter type, motor side
- p0290 Power unit overload response
- p1082 Maximum speed
- r2135.13 Fault thermal overload power unit
- r2135.15 Thermal overload in power unit alarm

9.3 Extended functions

9.3.1 Technology controller

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 features:

- Two scalable setpoints
- Scalable output signal
- Separate fixed values
- Separate motorized potentiometer
- The output limits can be activated and deactivated via the ramp-function generator.
- The D component can be switched to the system deviation or actual value channel.
- The motorized potentiometer of the technology controller is only active when the drive pulses are enabled.

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 rampup/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.

Note

With the entry "0" sec. as power up time or ramp-down time for the ramp function generator of the technology controller, the current values of the respective ramp function generator will be frozen.

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 |

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.

9.3 Extended functions



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 X_{actual} via AI0 of TM31 [FP 9566]
- p2280 = Kp Calculate P gain by means of optimization
- p2285 = Tn Calculate integral time by means of optimization
- p2200 = 1 Technology controller enabled

9.3.2 Bypass function

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 switch is also shut down when one of the "OFF2" or "OFF3" control word signals is canceled.
- Exception: If necessary, the bypass switch

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 protective interlocking must be implemented on the system 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 via a control signal, the control signal (p1266) is still present once the system has been ramped up, and the automatic restart function (p1200 = 4) is active.
- 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.

Prerequisites

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 reactor is used to de-couple the drive converter from the line supply - the uk value for the reactor is 10 (\pm 2) %.



Figure 9-10 Typical circuit diagram for bypass with synchronizer with degree of overlapping

Activation

The function 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:

Functions, Monitoring, and Protective Functions 9.3 Extended functions

| Table 9- 5 | Parameter settings for bypass | function with synchronizer wit | h degree of overlapping |
|------------|-------------------------------|--------------------------------|-------------------------|
| | | | |

| Parameter | Description |
|----------------------------|--|
| p1266 = | Control signal setting when p1267.0 = 1 |
| p1267.0 = 1 p1267.1 = 0 | Bypass function is initiated by the control signal |
| p1269[0] = | Signal source for contactor K1 feedback |
| p1269[1] = | Signal source for contactor K2 feedback |
| p3800 = 1 | The internal voltages are used for synchronization. |
| p3802 = r1261.2 | Synchronizer activation is triggered by the bypass function. |

Transfer process

| | Motor on converter | Converter - Line supply changeover | Motor on line supply | Line supply - Converter changeover | Motor on converter |
|--|-----------------------|---------------------------------------|-------------------------|--|-----------------------|
| p1266 Bypass command | | | | | |
| r1261.2 Request to synchronize (sent by bypass function) | | | | | |
| r3819.2 "Synchronized" | | | | | |
| r1261.1 Close contactor K2 | | | | | |
| p1269.1 Contactor K2 closed | | | | | |
| r1261.0 Close contactor K1 | | | | | |
| p1269.0 Contactor K1 closed | | | | | |

Figure 9-11 Signal diagram, bypass with synchronization with overlap

Transfer of motor to line supply (contactors K1 and K2 are activated by the converter):

- The initial state is as follows: Contactor K1 is closed, contactor K2 is open and the motor is fed from the converter.
- The control bit "bypass command" (p1266) is set (e.g., by the higher-level automation).
- The bypass function sets the control word bit "synchronizing" (r1261.2).
- Since the bit is set while the converter is running, the "Transfer motor to line supply" synchronization process is started.
- Once motor synchronization to line frequency, line voltage and line phasing is complete, the synchronization algorithm reports this state (r3819.2).
- The bypass mechanism evaluates this signal and closes contactor K2 (r1261.1 = 1). The signal is evaluated internally BICO wiring is not required.

- After contactor K2 has fed back the "closed" state (r1269[1] = 1), contactor K1 is opened and the converter inhibits the pulses. The converter is in "Ready for operation and bypass" state.
- If the On command is cancelled in this phase, the converter will change to "Ready to start and bypass" status. If the appropriate contactors are being used, the converter will be isolated from the line supply and the DC link discharged.

To transfer the motor back from the line supply, the sequence is simply reversed: At the start of the process, contactor K2 is closed and contactor K1 is open.

- The "Command bypass" control bit is canceled (e.g., by the higher-level automation).
- The bypass function sets the control word bit "synchronizing".
- The pulses are enabled. Since "synchronizing" is set before "pulse enable", the converter interprets this as a command to retrieve the motor from the line supply.
- Once converter synchronization to line frequency, line voltage and line 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 required.
- Once contactor K1 has reported "closed" status, contactor K2 is opened and the motor returns to operation on the converter.

9.3.2.2 Bypass with synchronizer without degree of overlapping (p1260 = 2)

Description

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.

In order for the function to run correctly, the moment of inertia must be sufficient.

Due to the expense of determining the synchronization setpoint (p3809), the decoupling restrictor is not needed.

The "flying restart" function must be activated (p1200 = 1).

Functions, Monitoring, and Protective Functions

9.3 Extended functions



Figure 9-12 Example circuit for bypass with synchronizer without degree of overlapping

Activation

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 9-6 Parameter settings for bypass function with synchronizer without degree of overlapping

| Parameters | Description |
|----------------------------|--|
| p1266 = | Control signal setting when p1267.0 = 1 |
| p1267.0 = 1 p1267.1 = 0 | Bypass function is initiated by the control signal |
| p1269[0] = | Signal source for contactor K1 feedback |
| p1269[1] = | Signal source for contactor K2 feedback |
| p3800 = 1 | The internal voltages are used for synchronization. |
| p3802 = r1261.2 | Synchronizer activation is triggered by the bypass function. |
| p1200 = 1 | The "flying restart" function is always active. |

9.3.2.3 Bypass without synchronizer (p1260 = 3)

Description

When the motor is transferred to the supply, contactor K1 is opened (following converter's pulse inhibit). The system then waits for the motor excitation time to elapse after which contactor K2 is closed and 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 diagram "Circuit bypass without synchronization").

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.

The "flying restart" function must be activated (p1200 = 1).



Figure 9-13 Example circuit for bypass without synchronization

9.3 Extended functions

Activation

The bypass with synchronizer (p1260 = 3) can be triggered by the following signals (p1267):

- Bypass by means of control signal (p1267.0 = 1): The bypass can be activated by means of a digital signal (p1266) (e.g. from a higher-level automation system). If the digital signal is canceled, a changeover to converter operations is triggered once the debypass delay time (p1263) has expired.
- Bypass at speed threshold (p1267.1 = 1): Once a certain speed is reached, the system switches to bypass (i.e. the converter is used as a start-up converter). The bypass cannot be connected until the speed setpoint is greater than the bypass speed threshold (p1265). The system reverts to converter mode when the setpoint (on the input of the ramp-function generator, r1119) falls 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- 7 | Parameter settings for bypass fun | ction with synchronizer witho | ut degree of overlapping |
|------------|------------------------------------|-------------------------------|--------------------------|
| | i alameter settings for bypass fan | ouon with synonicine metro | at acgree of overlapping |

| Parameter | 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 |
| p3800 = 1 | The internal voltages are used for synchronization. |
| p3802 = r1261.2 | Synchronizer activation is triggered by the bypass function. |
| P1200 = 1 | The "flying restart" function is always active. |

9.3.2.4 Function diagram

FP 7020 Synchronization

Functions, Monitoring, and Protective Functions 9.3 Extended functions

9.3.2.5 Parameters

Bypass function

- p1200 Flying restart operating mode
- 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 command
- p1267 Bypass changeover source configuration
- p1268 BI: Bypass feedback signal synchronization completed
- p1269 BI: Bypass switch feedback signal
- p1274 BI: Bypass switch monitoring time

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
- r3819 CO/BO: Sync–supply–drive status word

9.3 Extended functions

9.3.3 Extended braking control

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

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 controlled via a digital output on customer terminal strip TM31.

Function diagram

| FD 2704 | Zero speed detection |
|---------|----------------------|
| FD 2707 | Release/apply brake |
| FD 2711 | Signal outputs |

Example 1: 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 starts by generating a 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).

Example 2: 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").

To prevent the converter working in opposition to the brake, the OFF3 ramp (p1135) should be set to 0 seconds. Any prevailing regenerative energy must be converted into heat via a braking resistor.

This is often used, for example, in calendar stacks, cutting tools, running gears, and presses.

Example 3: Service brake on crane drives

For cranes with manual control, it is important that the drive responds immediately when the control lever is moved (master switch). To this end, the drive is powered up using the on command (p0840) (the pulses are enabled). Speed setpoint (p1142) and speed controller (p0856) are inhibited. The motor is magnetized. The magnetization time generally applicable for three-phase motors (1-2 seconds) is, therefore, eliminated.

Now, only the brake opening time will delay the motor starting to rotate following activation of the master switch. Movement of the master switch generates a "setpoint enable from the control" (bit interconnected with p1142, p1229.2, p1224.0). The speed controller is enabled immediately and the speed setpoint is enabled once the brake opening time (p1216) has elapsed. When the master switch is in the zero position, the speed setpoint is inhibited and the drive ramps down along the ramp-function generator's ramp-down ramp. The brake closes once the standstill limit (p1226) is undershot. Once the brake closing time (p1217) has elapsed, the speed controller is inhibited (the motor is no longer generating any force). Extended braking control is used with the modifications described below.



Figure 9-14 Example: Service brake on a crane drive

9.3.4 Extended monitoring functions

Description

The "extended monitoring functions" function module enables additional monitoring functions:

- Speed setpoint monitoring: |n_setp| ≤ p2161
- Speed setpoint monitoring: n_set > 0
- Load monitoring

Description of 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.



Figure 9-15 Load monitoring (p2181 =1)

Commissioning

The "extended monitoring functions" function module can be activated by running the commissioning wizard. Parameter r0108.17 indicates whether it has been activated.

Function diagram

| FD 8010 | Speed messages |
|---------|-----------------|
| FD 8013 | Load monitoring |

Parameters

- p2150 Hysteresis speed 3
- p2151 CI: Speed setpoint
- p2161 Speed threshold 3
- p2181 Load monitoring, response
- p2182 Load monitoring, speed threshold 1
- p2183 Load monitoring, speed threshold 2
- p2184 Load monitoring, speed threshold 3
- p2185 Load monitoring, speed threshold 1 upper
- ...
- p2190 Load monitoring, speed threshold 3 lower
- p2192 Load monitoring, delay time
- r2198.4 BO: ZSW monitoring 2, |n_setp| ≤ p2161
- r2198.5 BO: ZSW monitoring 2, n_setp < 0

9.4 Monitoring and protective functions

9.4 Monitoring and protective functions

9.4.1 Protecting power components

Description

SINAMICS power units offer comprehensive functions for protecting power components.

Table 9-8 General protection for power units

| Protection against: | Protective measure | Response |
|--|--|---|
| Overcurrent ¹⁾ | Monitoring with two thresholds: | |
| | First threshold exceeded | A30031, A30032, A30033 Current limiting in phase U has responded. Pulsing in this phase is inhibited for one pulse period. F30017 -> OFF2 is triggered if the threshold is exceeded too often. |
| | Second threshold exceeded | F30001 "Overcurrent" -> OFF2 |
| DC link overvoltage ¹⁾ | Comparison of DC link voltage with hardware shutdown threshold | F30002 "Overvoltage" -> OFF2 |
| DC link undervoltage ¹⁾ | Comparison of DC link voltage with hardware shutdown threshold | F30003 "Undervoltage" -> OFF2 |
| Short-circuit ¹⁾ | Second monitoring threshold checked for overcurrent | F30001 "Overcurrent" -> OFF2 |
| | Uce monitoring for IGBT module | F30022 "Monitoring Uce" -> OFF2 |
| Ground fault | Monitoring the sum of all phase | After threshold in p0287 is exceeded: |
| | currents | F30021 "power unit: 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 set 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:

- i²t monitoring A07805 F30005
 i²t monitoring is used to protect components that have a high thermal time constant compared with semi-conductors. Overload with regard to i²t is present when the converter load (r0036) is greater than 100% (load in % in relation to rated operation).
- Heatsink 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 barrier layer of the IGBT and the heatsink. 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 (i²t monitoring) can be parameterized relative to the shutdown (trip) values.

Example

The factory setting for the alarm threshold for chip temperature monitoring is 15 Kelvin (K), and 5 K for the heat sink and inlet air. This means that the "Overtemperature, overload" alarm is triggered at 15 K or 5 K 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 unit, since switching losses account for a high proportion of overall losses. In many applications, a temporary reduction in the pulse frequency can be tolerated to allow the process to continue. Disadvantage:

As a result of the pulse frequency reduction, the current ripple is increased which can mean that the torque ripple is increased at the motor shaft (for low moments of inertia) and also an increased 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.

9.4 Monitoring and protective functions

- 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 unit.
- No reduction (p0290 = 1) You should choose this option if it is neither possible to reduce the pulse frequency nor reduce the output current. 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

FP 8014 Thermal monitoring, power unit

Parameter

- r0036 Power Module overload
- r0037 Power Module temperatures
- p0290 Power Module overload response
- p0294 Power Module alarm with i²t 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.





Function diagram

FD 8012 Messages and monitoring - Torque messages, motor blocked/stalled

Parameters

- p2175 Speed threshold motor blocked
- p2177 Delay time motor blocked

9.4 Monitoring and protective functions

9.4.4 Stall protection (only for vector control)

Description

If, for closed-loop speed control with encoder, the speed threshold set in p1744 for stall detection is exceeded, then r1408.11 (speed adaptation, speed deviation) 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, then after the delay time in p2178, fault F7902 (motor stalled) is output.



Figure 9-17 Stall protection

Function diagram

| FD 6730 | Current control |
|---------|--|
| FD 8012 | Messages and monitoring - Torque messages, motor blocked/stalled |

Parameters

- r1408 CO/BO: Control status word 3
- p1744 Motor model speed threshold stall detection
- p1745 Motor model error threshold stall detection
- p1755 Motor model changeover speed encoderless operation
- p1756 Motor model changeover speed hysteresis
- p2178 Delay time motor stalled

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 diagram 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 (TM31) in the forward direction of the diode. The measured temperature is limited to between -140 °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 In the delivery condition and on completion of commissioning, the source for the external sensor is set to the customer terminal block (TM31) (p0603 = (TM31) r4105).
- 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.

9.4 Monitoring and protective functions

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 PTC temperature sensor type: p4100 = 1
- Activate motor temperature measurement via the external sensor: p0600 = 10 In the delivery condition and on completion of commissioning, the source for the external sensor is set to the customer terminal block (TM31) (p0603 = (TM31) r4105).
- Alarm A7910 is triggered once the PTC responds.
- Fault F7011 is triggered once the delay time defined in p0606 has elapsed.

Sensor monitoring for wire breakage/short-circuit

If the temperature of the motor temperature monitor is outside the range -140 °C to +250 °C, the sensor cable is broken or has short-circuited. Alarm A07015 ("Alarm: temperature sensor fault") is triggered. Fault F07016 ("Fault: temperature sensor fault") is triggered once the delay 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 diagram

| FP 8016 | Thermal monitoring motor |
|---------|--------------------------------------|
| FP 9576 | TM31 -temperature evaluation KTY/PTC |
| FP 9577 | TM31 -sensor monitoring KTY/PTC |

Parameter

- p0600 Motor temperature sensor for monitoring
- p0604 Motor overtemperature fault threshold
- p0605 Motor overtemperature alarm threshold
- p0606 Motor overtemperature timer
- p0607 Temperature sensor fault timer
- p0610 Response to motor overtemperature condition
- p4100 Temperature evaluation sensor type

10

Diagnosis / faults and alarms

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 device, 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 Diagnostics using LEDs

CU320 Control Unit (-A10)

Table 10-1 Description of the LEDs on the CU320

| LED | Color | State | Description |
|---------|-------------|--------------------------|--|
| | | OFF | The electronics power supply is missing or lies outside permissible tolerance range. |
| RDY | Green | Steady light | The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place. The Control Unit is awaiting first commissioning. |
| (ready) | | 2 Hz flashing light | Writing to CompactFlash card. |
| | Red | Steady light | At least one fault is present in this component. |
| | | 0.5 Hz flashing light | CompactFlash card has not been inserted. Boot error (e.g., firmware cannot be loaded to the RAM). |
| | Green / red | 0.5 Hz flashing light | Control Unit 320 is ready for operation. However, there are no software licenses. |
| | Orange | Steady light | System is booting and DRIVE-CLiQ communication is being established. |
| | | 0.5 Hz flashing light | DRIVE-CLiQ component firmware update in progress. |
| | | 2 Hz flashing light | Component firmware update complete. Waiting for POWER ON of relevant components. |

| LED | Color | State | Description |
|----------------------------------|--------|--------------------------|--|
| 201 | | OFF | Cyclic communication is not (yet) running. Note: The PROFIdrive is ready for communication when the Control Unit is ready for operation (see RDY LED). |
| DP1 | Green | Steady light | Cyclic communication is running. |
| (PROFIdrive cyclic transmission) | | 0.5 Hz flashing light | Cyclic communication is not yet fully underway. Possible causes: - The controller is not transmitting any setpoints. - In isochronous mode, the controller did not send a Global Control or it sent a defective Global Control (GC). |
| | Red | Steady light | Cyclic communication has been interrupted. |
| | Orange | 2 Hz flashing light | Firmware checksum error (CRC error). |
| OPT (option) | | OFF | Electronic power supply outside permissible tolerance range. The component is not ready for operation. The Option Board is missing or an associated drive object has not been created. |
| | Green | Steady light | Option Board is ready. |
| | | 0.5 Hz flashing light | Depends on the Option Board used. |
| | Red | Steady light | At least one fault is pending on this component. The Option Board is not ready (e.g., after switching on). |
| MOD | | OFF | Reserved |

Customer Terminal Block TM31 (-A60)

| LED | Color | State | 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 pending on this component. Note: LED is driven irrespective of the corresponding messages being reconfigured. |
| | Green / red | 0.5 Hz flashing light | Firmware is being downloaded. |
| | | 2 Hz flashing light | Firmware download is complete. Waiting for POWER ON. |
| | Green orange or red orange | 2 Hz flashing light | Detection of the components via LED is activated (p0154). Note: Both options depend on the LED status when module recognition is activated via p0154 = 1. |

Control Interface Board - Interface module in the Power Module (-T1)

Table 10-3 Description of the LEDs on the Control Interface Board

| LED s | state | Description | |
|---|--------|--|--|
| H200 | H201 | | |
| OFF | OFF | The electronics power supply is missing or lies outside the permissible tolerance range. | |
| Green | OFF | The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place. | |
| | Orange | The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place. The DC link voltage is present. | |
| | Red | The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place. The DC link voltage is too high. | |
| Orange | Orange | DRIVE-CLiQ communication is being established. | |
| Red | | At least one fault is pending on this component. Note: LED is driven irrespective of the corresponding messages being reconfigured. | |
| Flashing, 0.5 Hz: Green Red | | Firmware is being downloaded. | |
| Flashing, 2 Hz: Green Red | | Firmware download is complete. Waiting for POWER ON. | |
| Flashing, 2 Hz: Green / orange or red / orange | | Detection of the components via LED is activated (p0124). Note: Both options depend on the LED status when module recognition is activated via p0124 = 1. | |



Hazard DC link voltages may be present at any time regardless of the status of the "H201" LED. The warning information on the components must be carefully observed!

SMC30 - encoder evaluation (-B83)

| LED | Color | State | Description |
|---------|--------------------------------------|------------------|--|
| RDY | | OFF | The electronics power supply is missing or lies outside the 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 pending on this component. Note: LED is driven irrespective of the corresponding messages being reconfigured. |
| | Green Red | Flashing, 0.5 Hz | Firmware is being downloaded. |
| | | Flashing, 2 Hz | Firmware download is complete. Waiting for POWER ON. |
| | Green / orange or red / orange | Flashing, 2 Hz | Detection of the components via LED is activated (p0144). Note: Both options depend on the LED status when module recognition is activated via p0144 = 1. |
| OUT>5 V | | OFF | Electronics power supply is missing or outside permissible tolerance range. Power supply ≤ 5 V. |
| | Orange | Steady light | Electronic power supply for measuring system present. Supply voltage > 5 V. Notice: You must ensure that the connected encoder can be operated with a 24 V supply. Operating an encoder designed for a 5 V supply with a 24 V supply can damage the encoder electronics beyond repair. |

Table 10-4 Description of the LEDs on the SMC30

CBE20 – Communication Board Ethernet (option G33)

Table 10-5 Description of the LEDs on the CBE20

| LED | Color | State | Description |
|------------------|--------|--------------|--|
| Link port | | OFF | The electronics power supply is missing or lies outside the permissible tolerance range. |
| | Green | Steady light | A different device is connected to port x and a physical connection exists. |
| Activity port | | OFF | The electronics power supply is missing or lies outside the permissible tolerance range. |
| | Yellow | Steady light | Data is being received or sent at port x. |

Diagnosis / faults and alarms

10.2 Diagnosis

| LED | Color | State | Description |
|-------------------------------|--------|------------------|--|
| Fault | | OFF | If the link port LED is green: The CBE20 is operating normally, data is being exchanged with the configured IO Controller. |
| | Red | Flashing | The response monitoring time has elapsed. Communication has been interrupted. The IP address is incorrect. Incorrect or missing configuration. Incorrect parameterization. Incorrect or missing device name. IO Controller not present/switched off but Ethernet connection present. Other CBE20 errors |
| | | Steady light | CBE20 bus fault - No physical connection to a subnet/switch. - Incorrect transmission rate. - Full-duplex transmission not activated. |
| Sync | | OFF | If the link port LED is green: Control Unit task system is not synchronized with the IRT clock. An internal substitute clock is generated. |
| | Green | Flashing | Control Unit task system has synchronized with the IRT clock and data is being exchanged. |
| | | Steady light | Task system and MC-PLL have synchronized with the IRT clock. |
| OPT on the Control Unit | | OFF | The electronics power supply is missing or lies outside the permissible tolerance range. Communication Board either defective or not inserted. |
| | Green | Steady light | Communication Board is ready and cyclic communication is taking place. |
| | | Flashing, 0.5 Hz | The Communication Board is ready, but cyclic communication is not yet taking place. Possible causes: - At least one fault is pending. - Communication is being established. |
| | Red | Steady light | Cyclic communication via PROFINET has not yet been established. However, acyclic communication is possible. SINAMICS is waiting for a parameterization/configuration telegram. |
| | | Flashing, 0.5 Hz | The firmware download to the CBE20 has failed. Possible causes: - The CBE20 is defective. - The memory card for the Control Unit is defective. In this state, the CBE20 cannot be used. |
| | | Flashing, 2.5 Hz | Communication between the Control Unit and the CBE20 is faulty. Possible causes: - The CBE20 was removed following power-up. - The CBE20 is defective. |
| | Orange | Flashing, 2.5 Hz | Firmware is being downloaded. |

10.2.2 Diagnostics via parameters

All Objects: key diagnostic parameters (details in List Manual)

| Parameters | Name | | |
|------------|---|--|--|
| | Description | | |
| r0945 | Fault code | | |
| | Displays the fault number. Index 0 is the most recent fault (last fault to have occurred). | | |
| r0948 | Fault time received in milliseconds | | |
| | Displays the system runtime in ms at which the fault occurred. | | |
| r0949 | Fault value | | |
| | Displays additional information about the fault. This information is required for detailed fault diagnosis. | | |
| r2109 | Fault time removed in milliseconds | | |
| | Displays the system runtime in ms at which the fault was rectified. | | |
| r2123 | Alarm time received in milliseconds | | |
| | Displays the system runtime in ms at which the alarm occurred. | | |
| r2124 | Alarm value | | |
| | Displays additional information about the alarm. This information is required for detailed alarm diagnosis. | | |
| r2125 | Alarm time removed in milliseconds | | |
| | Displays the system runtime in ms at which the alarm was rectified. | | |

CU320: key diagnostic parameters (details in List Manual)

| Parameters | Name | | | |
|------------|---|--|--|--|
| | Description | | | |
| r0002 | Control Unit status display | | | |
| | Status 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 | Digital inputs actual terminal 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 | Status of digital inputs (CU) | | | |
| | 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 | Status of digital outputs (CU) | | | |
| | 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. | | | |

Diagnosis / faults and alarms

10.2 Diagnosis

| Parameters | Name |
|------------|--|
| | Description |
| r9976[07] | 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)

| Parameters | Name | | | | |
|------------|--|--|--|--|--|
| | Description | | | | |
| 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. | | | | |
| 0007 | 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. | | | | |
| r0049 | Motor/encoder data set effective (MDS, EDS) | | | | |
| | Displays the effective motor data set (MDS) and the effective encoder data sets (EDS). | | | | |
| r0050 | Command data set effective (CDS) | | | | |
| | Displays the effective command data set (CDS) | | | | |

| Parameters | Name |
|------------|---|
| | Description |
| 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 power for various load duty cycles. |
| r0208 | Rated power module line supply voltage |
| | Displays the rated line supply voltage of the power module. |

TM31: key diagnostic parameters (details in List Manual)

| Parameters | Name |
|------------|--|
| | Description |
| r0002 | TM31 operating display |
| | Operating display for terminal board 31 (TB31). |
| r4021 | Digital inputs actual terminal 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 | Status of digital inputs |
| | 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 | Status of digital outputs |
| | Displays the status of the TM31 digital outputs. Inversion via p4048 is taken into account. |

Additional diagnostic parameters for units that are connected in parallel (details in List Manual)

For units that are connected in parallel, there are additional diagnostic parameters that provide detailed information about individual Power Modules for a parallel circuit configuration.

- With 380 V 480 V 3 AC: 6SL3710-2GE41-1AA0, 6SL3710-2GE41-4AA0, 6SL3710-2GE41-6AA0
- With 500 V 600 V 3 AC: 6SL3710-2GF38-6AA0, 6SL3710-2GF41-1AA0, 6SL3710-2GF41-4AA0
- With 660 V 690 V 3 AC: 6SL3710-2GH41-1AA0, 6SL3710-2GH41-4AA0, 6SL3710-2GH41-5AA0

r7000 - r7252 Special parameters for Power Modules in a parallel circuit configuration

10.2.3 Indicating and rectifying faults

The device 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. The time stamp refers to the relative system time in milliseconds (r0969).

Activate the "Set date/time - AOP synchronization -> Drive" setting to date- and time-stamp errors on the AOP30.

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 induction motor. The faults are displayed and can be reported to a higher-level control system via PROFIdrive. 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 Overview of warnings and faults

10.3 Overview of warnings and faults

If a fault occurs, the drive indicates the fault and/or alarm. Faults and alarms are listed in a fault/alarm list, together with the following information:

- Fault/alarm number
- Standard drive response
- Description of the possible cause of the fault/alarm
- Description of the procedure for rectifying the problem
- Standard fault acknowledgement after it has been rectified

Note

The list of faults and alarms is contained on the documentation CD.

It also contains descriptions of the responses (OFF1, OFF2, etc.).

Note

The faults and alarms described below have been wired specially for the cabinet units listed in this document and preset via macro. In this way, the appropriate reaction is triggered by the additional components in the cabinet unit when faults and alarms are signaled.

It is possible to reprogram the faults and alarms described, provided that the stated options are not included in the scope of the equipment.

10.3.1 "External alarm 1"

Causes

Alarm A7850 ("External alarm 1") is triggered by the following optional protection devices in the cabinet unit:

- Thermistor motor protection unit alarm (option L83)
- PT100 Evaluation Unit (Option L86)

Remedy

When a fault is indicated, the following procedure is recommended:

- 1. Identify the cause by examining the specified devices (display or LEDs).
- 2. Check the fault display on the relevant protection device and establish the fault.
- 3. Rectify the displayed fault with the help of the appropriate operating instructions provided in "Additional Operating Instructions".

10.3 Overview of warnings and faults

10.3.2 "External fault 1"

Causes

Fault code F7860 ("External Fault 1") is triggered by the following optional protection devices in the cabinet unit:

- Thermistor motor protection unit shutdown (option L84)
- PT100 Evaluation Unit (Option L86)

Remedy

When a fault is indicated, the following procedure is recommended:

- 1. Identify the cause by examining the specified devices (display or LEDs).
- 2. Check the fault display on the relevant protection device and establish the fault.
- 3. Rectify the displayed fault with the help of the appropriate operating instructions provided in "Additional Operating Instructions".

10.3.3 "External fault 2"

Causes

Fault code F7861 ("External Fault 2") is triggered when the braking resistor available with options L61 and L62 is subject to thermal overload, thereby activating the thermostat. The drive is switched off with OFF2.

Remedy

The cause of the braking resistor overload must be eliminated and the fault code acknowledged.

10.3.4 "External fault 3"

Causes

Fault code F7862 "External fault 3" is triggered when the braking unit fitted for options L61 and L62 triggers a fault. The drive is switched off with OFF2.

Remedy

The cause of the braking unit overload must be eliminated and the fault code acknowledged.
10.4 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.

10.4 Service and Support

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

Note

Calls are subject to charge (e.g. \in 0.14/min from fixed lines within Germany). Tariffs of other phone providers may differ.

10.4.1 Spare parts

The spare parts available for the ordered cabinet unit can be found in the spare parts list.

This list is provided on the documentation CD.

11

Maintenance and servicing

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 cabinet units.
- Exchanging device components when the unit is serviced
- Forming the DC link capacitors
- Upgrading the cabinet unit firmware
- Loading the new operator panel firmware from the PC.



Five safety rules

When carrying out any kind of work on electrical devices, the "five safety rules" must always be observed:

- 1. Disconnect the system
- 2. Protect against reconnection.
- 3. Make sure that the equipment has zero potential
- 4. Ground and short-circuit.
- 5. Cover or fence off adjacent components that are still live.



Before carrying out any maintenance or repair work on the de-energized cabinet 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. The voltage can be measured on DC link terminals DCP and DCN.



When the external power supply for individual options (L50 / L55) or the external 230 V AC auxiliary supply is connected, dangerous voltages are still present in the cabinet unit even when the main circuit breaker is open.



During connection, installation and repair work on units that are connected in parallel, it must be ensured that both sub-cabinets are electrically disconnected from the power supply.

11.2 Maintenance

11.2 Maintenance

The cabinet unit mainly comprises electronic components. Apart from the fan(s), the unit contains very few components that are subject to wear or require maintenance or servicing. Maintenance aims to preserve the specified condition of the cabinet 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 cabinet 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

The ventilation openings in the cabinet must never be 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 (cabinet environment) 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 Maintenance

Servicing involves activities and procedures for maintaining and restoring the specified condition of the device.

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 wrench up to 50 Nm
- Screwdriver size 1 / 2
- Screwdriver Torx T20
- Screwdriver Torx T30

Tightening torques for current-carrying parts

When securing connections for current-conducting 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 Maintenance

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.





Order number

Order number for the installation device: 6SL3766-1FA00-0AA0.

11.3.2 Using crane lifting lugs to transport power blocks

Crane lifting lugs

The power blocks are fitted with crane lifting lugs for transportation on a lifting harness in the context of replacement.

The positions of the crane lifting lugs are illustrated by arrows in the figures below.

A lifting harness with vertical ropes or chains must be used to prevent any risk of damage to the housing.

CAUTION

The power block busbars must not be used to support or secure lifting harnesses for the purpose of transportation.



Figure 11-2 Crane lifting lugs on FX, GX power block

11.3 Maintenance



Figure 11-3 Crane lifting lugs on HX, JX power block

Note

On HX and JX power blocks, the front crane lifting lug is located behind the busbar.

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.



The devices are operated with high voltages.

All connection work must be carried out when the cabinet is de-energized!

All work on the device must be carried out by trained personnel only. Non-observance of these warnings can result in death, serious personal injury, or substantial property damage.

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 device up to five minutes after it has been disconnected due to the DC link capacitors. For this reason, the unit should not be opened until a reasonable period of time has elapsed.



Five safety rules

When carrying out any kind of work on electrical devices, the "five safety rules" must always be observed:

- 1. Disconnect the system
- 2. Protect against reconnection.
- 3. Make sure that the equipment has zero potential
- 4. Ground and short-circuit.
- 5. Cover or fence off adjacent components that are still live.

11.4.1 Replacing the filter mats

The filter mats must be checked at regular intervals. If the mats are too dirty to allow the air supply to flow normally, they must be replaced.

Note

Filter mat replacement is only relevant for options M23, M43 and M54.

Not replacing contaminated filter mats can cause premature drive shutdown.

11.4.2 Replacing the power block (type FX)

Replacing the power block



Figure 11-4 Replacing the power block (frame size FX)

- Disconnect the cabinet unit from the power supply.
- Allow unimpeded access to the power block.
- Remove the protective cover.

Removal steps

The removal steps are numbered in accordance with the figure.

- 1. Unscrew the connection to the outgoing motor section (3 screws).
- 2. Unscrew the connection to the line 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 DRIVE-CLiQ cables and connections to the CU320 (5 plugs).
- 6. Remove the CU320 mounts (1 screw and 2 nuts). If necessary, remove the PROFIBUS plug and connection to the operator panel (-X140 on the CU320) and remove the CU320.
- 7. Disconnect the plug-in connections for the fiber-optic cables and signal cables (5 plugs).
- 8. Disconnect the plug for the thermocouple.
- 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 steps

For installation, carry out the above steps in reverse order.

CAUTION

The tightening torques specified in the table "Tightening torques for connecting currentconducting parts" must be observed.

Carefully establish the plug-in connections and then ensure that they are secure.

The screwed connections for the protective covers must only be tightened by hand.

The fiber-optic cable plugs must be remounted at their original slot. Fiber-optic cables and sockets are accordingly labeled for correct assignment (U11, U21, U31).

11.4.3 Replacing the power block (type GX)

Replacing the power block



Figure 11-5 Replacing the power block (frame size GX)

- Disconnect the cabinet unit from the power supply.
- Allow unimpeded access to the power block.
- Remove the protective cover.

Removal steps

The removal steps are numbered in accordance with the figure.

- 1. Unscrew the connection to the outgoing motor section (3 screws).
- 2. Unscrew the connection to the line 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 connectors 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 steps

For installation, carry out the above steps in reverse order.

CAUTION

The tightening torques specified in the table "Tightening torques for connecting currentconducting parts" must be observed.

Carefully establish the plug-in connections and then ensure that they are secure.

The screwed connections for the protective covers must only be tightened by hand.

The fiber-optic cable plugs must be remounted at their original slot. Fiber-optic cables and sockets are accordingly labeled for correct assignment (U11, U21, U31).

11.4.4 Replacing the power block (type HX)

Replacing the left-hand power block



Figure 11-6 Replacing the power block (frame size HX) (left-hand power block)

- Disconnect the cabinet unit from the power supply.
- Allow unimpeded access to the power block.
- Remove the protective cover.

Removal steps

The removal steps are numbered in accordance with the figure.

- 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 plug-in connections for the fiber-optic cables and signal cables (3 plugs).
- 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 steps

For installation, carry out the above steps in reverse order.

CAUTION

The tightening torques specified in the table "Tightening torques for connecting currentconducting parts" must be observed.

Carefully establish the plug-in connections and then ensure that they are secure.

The screwed connections for the protective covers must only be tightened by hand.

The fiber-optic cable plugs must be remounted at their original slot. Fiber-optic cables and sockets are accordingly labeled for correct assignment (U11, U21, U31).

Replacing the right-hand power block



Figure 11-7 Replacing the power block (frame size HX) (right-hand power block)

- Disconnect the cabinet unit from the power supply.
- Allow unimpeded access to the power block.
- Remove the protective cover.

Removal steps

The removal steps are numbered in accordance with the figure.

- 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 plug-in connections for the fiber-optic cables and signal cables (3 plugs).
- Remove the connection for the current transformer and associated PE connection (2 plugs).
- 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 steps

For installation, carry out the above steps in reverse order.

CAUTION

The tightening torques specified in the table "Tightening torques for connecting currentconducting parts" must be observed.

Carefully establish the plug-in connections and then ensure that they are secure.

The screwed connections for the protective covers must only be tightened by hand.

The fiber-optic cable plugs must be remounted at their original slot. Fiber-optic cables and sockets are accordingly labeled for correct assignment (U11, U21, U31).

11.4.5 Replacing the power block (type JX)

Replacing the left-hand power block



Figure 11-8 Replacing the power block (frame size JX) (left-hand power block)

- Disconnect the cabinet unit from the power supply.
- Allow unimpeded access to the power block.
- Remove the protective cover.

Removal steps

The removal steps are numbered in accordance with the figure.

- 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 plug-in connections for the fiber-optic cables and signal cables (2 plugs).
- 5. Remove the connections to the mains supply (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 steps

For installation, carry out the above steps in reverse order.

CAUTION

The tightening torques specified in the table "Tightening torques for connecting currentconducting parts" must be observed.

Carefully establish the plug-in connections and then ensure that they are secure.

The screwed connections for the protective covers must only be tightened by hand.

The fiber-optic cable plugs must be remounted at their original slot. Fiber-optic cables and sockets are accordingly labeled for correct assignment (U11, U21, U31).

Replacing the right-hand power block



Figure 11-9 Replacing the power block (frame size JX) (right-hand power block)

- Disconnect the cabinet unit from the power supply.
- Allow unimpeded access to the power block.
- Remove the protective cover.

Removal steps

The removal steps are numbered in accordance with the figure.

- 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 plug-in connections for the fiber-optic cables and signal cables (2 plugs).
- 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 steps

For installation, carry out the above steps in reverse order.

CAUTION

The tightening torques specified in the table "Tightening torques for connecting currentconducting parts" must be observed.

Carefully establish the plug-in connections and then ensure that they are secure.

The screwed connections for the protective covers must only be tightened by hand.

The fiber-optic cable plugs must be remounted at their original slot. Fiber-optic cables and sockets are accordingly labeled for correct assignment (U11, U21, U31).

11.4.6 Replacing the Control Interface Board (type FX)

Replacing the Control Interface Board



Figure 11-10 Replacing the control interface board (frame size FX)

- Disconnect the cabinet unit from the power supply.
- Allow unimpeded access.
- Remove the protective cover.

Removal steps

The removal steps are numbered in accordance with the figure.

- 1. Remove the CU320 mounts (1 screw and 2 nuts). If necessary, remove the PROFIBUS plug and connection to the operator panel (-X140 on the CU320) and remove the CU320.
- 2. Disconnect the plug-in connections for the fiber-optic cables and signal cables (5 plugs).
- 3. Remove the DRIVE-CLiQ cables and connections to the CU320 (5 plugs).
- 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 unit, ensure that you do not damage any signal cables.

The Control Interface Board can then be removed from the slide-in electronics unit.

CAUTION

When removing the ribbon cable's connectors, make sure that you actuate the locking lever on the connector very carefully (e.g. with a screwdriver) because otherwise the lock could be damaged.

Installation steps

For installation, carry out the above steps in reverse order.

CAUTION

The tightening torques specified in the table "Tightening torques for connecting currentconducting parts" must be observed.

Carefully establish the plug-in connections and then ensure that they are secure.

When dealing with connectors with a lock, make sure that the locking lever is securely engaged once connected.

The fiber-optic cable plugs must be remounted at their original slot. Fiber-optic cables and sockets are accordingly labeled for correct assignment (U11, U21, U31).

The screwed connections for the protective covers must only be tightened by hand.

11.4.7 Replacing the Control Interface Board (type GX)

Replacing the Control Interface Board



Figure 11-11 Replacing the Control Interface Board (frame size GX)

- Disconnect the cabinet unit from the power supply.
- Allow unimpeded access.
- Remove the protective cover.

Removal steps

The removal steps are numbered in accordance with the figure.

- 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 plug-in connections for the fiber-optic cables and signal cables (5 plugs).
- 3. Remove the DRIVE-CLiQ cables and connections to the CU320 (5 plugs).
- 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 unit, ensure that you do not damage any signal cables.

The Control Interface Board can then be removed from the slide-in electronics unit.

CAUTION

When removing the ribbon cable's connectors, make sure that you actuate the locking lever on the connector very carefully (e.g. with a screwdriver) because otherwise the lock could be damaged.

Installation steps

For installation, carry out the above steps in reverse order.

CAUTION

The tightening torques specified in the table "Tightening torques for connecting currentconducting parts" must be observed.

Carefully establish the plug-in connections and then ensure that they are secure.

When dealing with connectors with a lock, make sure that the locking lever is securely engaged once connected.

The fiber-optic cable plugs must be remounted at their original slot. Fiber-optic cables and sockets are accordingly labeled for correct assignment (U11, U21, U31).

The screwed connections for the protective covers must only be tightened by hand.

11.4.8 Replacing the Control Interface Board (type HX)

Replacing the Control Interface Board



Figure 11-12 Replacing the Control Interface Board (frame size HX)

- Disconnect the cabinet unit from the power supply.
- Allow unimpeded access.
- Remove the protective cover.

Removal steps

The removal steps are numbered in accordance with the figure.

- 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 plug-in connections for the fiber-optic cables and signal cables (5 plugs).
- 3. Remove the DRIVE-CLiQ cables and connections to the CU320 (5 plugs).
- 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 unit, ensure that you do not damage any signal cables.

The Control Interface Board can then be removed from the slide-in electronics unit.

CAUTION

When removing the ribbon cable's connectors, make sure that you actuate the locking lever on the connector very carefully (e.g. with a screwdriver) because otherwise the lock could be damaged.

Installation steps

For installation, carry out the above steps in reverse order.

CAUTION

The tightening torques specified in the table "Tightening torques for connecting currentconducting parts" must be observed.

Carefully establish the plug-in connections and then ensure that they are secure.

When dealing with connectors with a lock, make sure that the locking lever is securely engaged once connected.

The fiber-optic cable plugs must be remounted at their original slot. Fiber-optic cables and sockets are accordingly labeled for correct assignment (U11, U21, U31).

The screwed connections for the protective covers must only be tightened by hand.

11.4.9 Replacing the Control Interface Board (type JX)

Replacing the Control Interface Board



Figure 11-13 Replacing the Control Interface Board (frame size JX)

- Disconnect the cabinet unit from the power supply.
- Allow unimpeded access.
- Remove the protective cover.

Removal steps

The removal steps are numbered in accordance with the figure.

- 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 plug-in connections for the fiber-optic cables and signal cables (5 plugs).
- 3. Remove the DRIVE-CLiQ cables and connections to the CU320 (5 plugs).
- 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 unit, ensure that you do not damage any signal cables.

The Control Interface Board can then be removed from the slide-in electronics unit.

CAUTION

When removing the ribbon cable's connectors, make sure that you actuate the locking lever on the connector very carefully (e.g. with a screwdriver) because otherwise the lock could be damaged.

Installation steps

For installation, carry out the above steps in reverse order.

CAUTION

The tightening torques specified in the table "Tightening torques for connecting currentconducting parts" must be observed.

Carefully establish the plug-in connections and then ensure that they are secure.

When dealing with connectors with a lock, make sure that the locking lever is securely engaged once connected.

The fiber-optic cable plugs must be remounted at their original slot. Fiber-optic cables and sockets are accordingly labeled for correct assignment (U11, U21, U31).

The screwed connections for the protective covers must only be tightened by hand.

11.4.10 Replacing the fan (type FX)

Replacing the fan



Figure 11-14 Replacing the fan (frame size FX)

Description

The average service life of the device fans is 50,000 hours. In practice, however, the service life depends on other variables (e.g. ambient temperature, degree of cabinet protection, etc.) and, therefore, may deviate from this value.

The fans must be replaced in good time to ensure that the cabinet unit is available.

Preparatory steps

- Disconnect the cabinet unit from the power supply.
- Allow unimpeded access.
- Remove the protective cover.

Removal

The steps for the removal procedure are numbered in accordance with the diagram.

1. Remove the retaining screws for the fan (2 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

For re-installation, carry out the above steps in reverse order.

CAUTION

The tightening torques specified in the table "Tightening torques for connecting currentcarrying parts" 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.

11.4.11 Replacing the fan (type GX)

Replacing the fan



Figure 11-15 Replacing the fan (frame size GX)

Description

The average service life of the device fans is 50,000 hours. In practice, however, the service life depends on other variables (e.g. ambient temperature, degree of cabinet protection, etc.) and, therefore, may deviate from this value.

The fans must be replaced in good time to ensure that the cabinet unit is available.

Preparatory steps

- Disconnect the cabinet unit from the power supply.
- Allow unimpeded access.
- Remove the protective cover.

Removal

The steps for the removal procedure are numbered in accordance with the diagram.

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

For re-installation, carry out the above steps in reverse order.

CAUTION

The tightening torques specified in the table "Tightening torques for connecting currentcarrying parts" 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.

11.4.12 Replacing the fan (type HX)

Replacing the fan (left-hand power block)



Figure 11-16 Replacing the fan (frame size 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 (e.g. ambient temperature, degree of cabinet protection, etc.) and, therefore, may deviate from this value.

The fans must be replaced in good time to ensure that the cabinet unit is available.

Preparatory steps

- Disconnect the cabinet unit from the power supply.
- Allow unimpeded access.
- Remove the protective cover.

Removal steps

The removal steps are numbered in accordance with the figure.

- 1. Remove the busbar (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 unit, ensure that you do not damage any signal cables.

Installation steps

For installation, carry out the above steps in reverse order.

CAUTION

The tightening torques specified in the table "Tightening torques for connecting currentconducting parts" must be observed.

Carefully establish the plug-in connections and then 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)



Figure 11-17 Replacing the fan (frame size 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 (e.g. ambient temperature, degree of cabinet protection, etc.) and, therefore, may deviate from this value.

The fans must be replaced in good time to ensure that the cabinet unit is available.

Preparatory steps

- Disconnect the cabinet unit from the power supply.
- Allow unimpeded access.
- Remove the protective cover.

Removal steps

The removal steps are numbered in accordance with the figure.

- 1. Remove the busbar (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 unit, ensure that you do not damage any signal cables.

Installation steps

For installation, carry out the above steps in reverse order.

CAUTION

The tightening torques specified in the table "Tightening torques for connecting currentconducting parts" must be observed.

Carefully establish the plug-in connections and then ensure that they are secure.

The screwed connections for the protective covers must only be tightened by hand.

11.4 Replacing components

11.4.13 Replacing the fan (type JX)

Replacing the fan (left-hand power block)



Figure 11-18 Replacing the fan (frame size 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 (e.g. ambient temperature, degree of cabinet protection, etc.) and, therefore, may deviate from this value.

The fans must be replaced in good time to ensure that the cabinet unit is available.

Preparatory steps

- Disconnect the cabinet unit from the power supply.
- Allow unimpeded access.
- Remove the protective cover.

Removal steps

The removal steps are numbered in accordance with the figure.

- 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 unit, ensure that you do not damage any signal cables.

Installation steps

For installation, carry out the above steps in reverse order.

CAUTION

The tightening torques specified in the table "Tightening torques for connecting currentconducting parts" must be observed.

Carefully establish the plug-in connections and then ensure that they are secure.

The screwed connections for the protective covers must only be tightened by hand.

11.4 Replacing components

Replacing the fan (right-hand power block)



Figure 11-19 Replacing the fan (frame size 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 (e.g. ambient temperature, degree of cabinet protection, etc.) and, therefore, may deviate from this value.

The fans must be replaced in good time to ensure that the cabinet unit is available.

Preparatory steps

- Disconnect the cabinet unit from the power supply.
- Allow unimpeded access.
- Remove the protective cover.

Removal steps

The removal steps are numbered in accordance with the figure.

- 1. Remove the busbar (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 unit, ensure that you do not damage any signal cables.

Installation steps

For installation, carry out the above steps in reverse order.

CAUTION

The tightening torques specified in the table "Tightening torques for connecting currentconducting parts" must be observed.

Carefully establish the plug-in connections and then ensure that they are secure.

The screwed connections for the protective covers must only be tightened by hand.

11.4 Replacing components

11.4.14 Replacing the fan fuse (-T1 -F10 / -T1 -F11)

The order numbers for replacement fan fuses can be found in the spare parts list.



Make sure that the cause of the fault is found before the fuse is replaced.

11.4.15 Replacing the fuses for the auxiliary power supply (-A1 -F11 / -A1 -F12)

The order numbers for replacing auxiliary power supply fuses that have blown can be found in the spare parts list.

You must carry out the following:

- First disconnect the auxiliary power supply.
- Then rectify the cause of the fault.
- Replace the fuse.

11.4.16 Replacing the fuse -A1 -F21

- 1. Open the cabinet.
- 2. Remove the defective fuse.
- 3. Fit the replacement fuse and close the fuse holder.
- 4. Close the cabinet.

The order numbers for replacing fuses that have blown can be found in the spare parts list.

You must carry out the following:

- First disconnect the auxiliary power supply.
- Then rectify the cause of the fault.
- Replace the fuse.

11.4.17 Replacing the cabinet operator panel

- 1. Switch the unit into a no-voltage condition.
- 2. Open the cabinet.
- 3. Disconnect the power supply and communications line on the operator panel.
- 4. Release the fastenings on the operator panel.
- 5. Remove the operator panel.
- 6. Install the new operator panel.
- 7. Carry out any other work by reversing the sequence.

11.4.18 Replacing the Backup Battery for the Cabinet Operator Panel

| Туре | CR2032 3 V lithium battery |
|--------------------------------------|---|
| Manufacturer | Maxell, Sony, Panasonic |
| Nominal capacity | 220 mAh |
| Maximum permissible charging current | 10 mA (restricted to <2 mA in operator panel) |
| Self-discharge at 20 °C | 1 %/year |
| Service life (in backup mode) | > 1 year at 70 °C; >1.5 years at 20 °C |
| Service life (in operation) | > 2 years |

Table 11-2 Technical specifications of the backup battery

Replacing

- 1. Switch the unit into a no-voltage condition.
- 2. Open the cabinet.
- 3. Disconnect the 24 V DC power supply and communications line on the operator panel.
- 4. Open the cover of the battery compartment.
- 5. Remove the old battery.
- 6. Insert the new battery.
- 7. Close the cover of the battery compartment.
- 8. Reconnect the 24 V DC power supply and communications line.
- 9. Close the cabinet.

NOTICE

The battery must be replaced within one minute to ensure that no AOP settings are lost.

11.4 Replacing components



Figure 11-20 Replacing the backup battery for the cabinet operator panel

11.5 Forming the DC link capacitors

Description

If the device is kept in storage for more than 2 years, the DC link capacitors have to be reformed. If this is not done, the unit could be damaged when it is operated under load.

If the cabinet is commissioned within two years of its date of manufacture, the DC link capacitors do not need to be re-formed. The date of manufacture is indicated in the serial number on the type plate (see "Device Overview").

Note

It is important that the storage period is calculated from the date of manufacture and not from the date that the equipment was shipped.

Procedure

The DC link capacitors are re-formed 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 delay 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 delay 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

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.

Automatic firmware update

As of firmware 2.5, an automatic firmware update can be carried out once the electronics have been powered up on replacement DRIVE-CLiQ components.

 The following LEDs will flash slowly to indicate that an automatic firmware update is in progress: the "RDY" LED on the Control Unit (orange, 0.5 Hz) and an LED on the relevant DRIVE-CLiQ component (green/red, 0.5 Hz).

CAUTION

The drive converter must not be shut down during this process!

- Once the automatic firmware update is complete, the "RDY" LED on the Control Unit will flash quickly (orange, 2 Hz) along with an LED on the relevant DRIVE-CLiQ component (green/red, 2 Hz).
- To complete the automatic firmware update process, a POWER ON is required (switch the device off and back on again).

11.7 Upgrading the cabinet unit firmware

11.7 Upgrading the cabinet unit firmware

When you upgrade the cabinet unit firmware (by installing a new CompactFlash Card with a new firmware version, for example), you might also have to upgrade the firmware for the DRIVE-CLiQ components in the cabinet unit.

If the system detects that the firmware in the DRIVE-CLiQ components needs to be updated, it will trigger this process automatically when the automatic firmware update is performed.

Automatic firmware update sequence

- 1. During an automatic firmware update, the "RDY" LED on the CU320 Control Unit flashes slowly (orange, 0.5 Hz).
- 2. The firmware update is performed automatically and in sequence on the DRIVE-CLiQ components; during the update process, an LED on the component whose firmware is being updated will flash slowly (green/red, 0.5 Hz).
- 3. Once the firmware update on an individual DRIVE-CLiQ component is complete, the LED on that component will flash quickly (green/red, 2 Hz).
- 4. Once the firmware update on all components is complete, the LED on the CU320 Control Unit will flash quickly (orange, 2 Hz).
- 5. To complete the automatic firmware update process, a POWER ON is required (switch the device off and back on again).

CAUTION

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 cabinet unit.

11.8 Load the new operator panel firmware from the PC.

11.8 Load the new operator panel firmware from the PC.

Description

Firmware might need to be loaded to the AOP if the AOP functionality needs to be upgraded.

If, once the drive has powered up, the CompactFlash Card is found to contain a newer version of the firmware, a message will appear on the AOP30 prompting you to load the new firmware. You should click "YES" in response to this prompt. The firmware will then be loaded automatically on the operator panel and the following dialog screen will appear.

| SIEMENS SINAM | ICS | | |
|---------------|-----------------------------|----|-------------------|
| | ing loaded ot disconnect | | - 1 |
| F1 F2 | F3 | F4 | F5 |

Figure 11-21 Dialog screen: loading firmware

If the firmware cannot be loaded successfully, it can be loaded using the following manual method.

The load program LOAD_AOP30 and the firmware file can be found on the CD.

Loading the firmware

- 1. Establish the RS232 connection from the PC to the AOP30.
- 2. Provide the supply voltage (24 V DC).
- 3. Start the LOAD_AOP30 program on the PC.
- 4. Choose the PC interface (COM1, COM2).
- 5. Choose and open the firmware (AOP30.H86).
- 6. Follow the instructions in the status window of the program and connect the power supply for the AOP30 while pressing the red key (O).
- 7. The load procedure is started automatically.
- 8. Switch the power on (switch the power supply off and then back on).

12.1 Chapter content

This chapter provides information on the following:

- General and specific technical specifications for the devices.
- Information on restrictions that apply when the devices are used in unfavorable ambient conditions (derating)

12.2 General data

| Table 12-1 | General technical specifications |
|------------|----------------------------------|
|------------|----------------------------------|

| Electrical data | | | | |
|--|--|--|--------------------------------|--|
| Line system configurations | TN/TT supplies or insulated | supplies (IT supplies) | | |
| Line frequency | 47 63 Hz | | | |
| Output frequency | 0 300 Hz | | | |
| Power factor - Fundamental mode - Total | ≥ 0,98 0,93 0,96 | | | |
| Converter efficiency | > 98 % | | | |
| Switching at input | Once every 3 minutes | | | |
| Mechanical data | | | | |
| Degree of protection | IP20 (higher degrees of prot | tection up to IP54 optional) | | |
| Class of protection | I to EN 50178, Part 1 | | | |
| Cooling method | Forced air cooling AF to EN | 60146 | | |
| Sound pressure level L_{pA} (1 m) | at 50 Hz line frequency ≤ 72 dB(A) (single units) / ≤ 75 dB(A) (units that are connected in parallel) at 60 Hz line frequency ≤ 75 dB(A) (single units) / ≤ 78 dB(A) (units that are connected in parallel) | | | |
| Touch protection | BGV A3 | | | |
| Cabinet system | Rittal TS 8, doors with doub | le-barb lock, three-section base | e plates for cable entry | |
| Paint finish | RAL 7035 (indoor requireme | ents) | | |
| Compliance with standards | | | | |
| Standards | EN 60146-1, EN 61800-2, E | EN 61800-3, EN 50178 ²⁾ , EN 60 | 0204-1, EN 60529 ³⁾ | |
| CE mark | To EMC directive No. 2004/ | 108/EC and low-voltage directiv | /e No. 2006/95/EC | |
| RI suppression | "second environment". | product standard for variable-s | | |
| Ambient conditions | Storage | Transport | During operation | |
| Ambient temperature | -25 +55 °C -25 +70°C 0 +40 °C as of -40 °C for 24 hours up to +50 °C with derating | | | |
| Humidity range ³⁾ (non-condensing) | 5 to 95 % | 5 95 % at 40 °C | 5 <i>95 %</i> | |
| corresponds to class Environmental class/harmful chemical substances ³⁾ | 1K4 to EN 60721-3-1 2K3 to EN 60721-3-2 3K3 to EN 60721-3-3 1C2 to EN 60721-3-1 2C2 to EN 60721-3-2 3C2 to EN 60721-3-3 | | | |
| Organic/biological influences 3) | 1B1 to EN 60721-3-1 | 2B1 to EN 60721-3-2 | 3B1 to EN 60721-3-3 | |
| Installation altitude | Up to 2000 m above sea level with derating (see "Derating data") | | | |

| Electrical data | | | | | | |
|--|--|--|--|--|--|--|
| Mechanical stability | Storage | Transport | During operation | | | |
| Vibrational load ³⁾ - Displacement - Acceleration corresponds to class | 1.5 mm at <i>5</i> to 9 Hz 5 m/s² at > 9 to 200 Hz 1M2 to EN 60721-3-1 | <i>3.1 mm</i> at <i>5</i> 9 Hz 10 m/s² at > 9 200 Hz 2M2 to EN 60721-3-2 | 0.075 mm at 10 58 Hz 10 m/s² at >58 200 Hz - | | | |
| Shock load ³⁾ - Acceleration corresponds to class | 40 m/s² at 22 ms 1M2 to EN 60721-3-1 | 100 m/s² at 11 ms 2M2 to EN 60721-3-2 | 100 m/s² at 11 ms 3M4 to EN 60721-3-3 | | | |

Deviations from the defined classes are shown in *italics*.

¹⁾ Applies to cable lengths of up to 100 m.

²⁾ The EN standard specified is the European edition of international standard IEC 62103.

³⁾ The EN standards specified are the European editions of the international IEC standards with the same designations.

12.2.1 Derating data

Current derating as a function of the installation altitude and ambient temperature

If the cabinet units are operated at a installation altitude >2000 m above sea level, the maximum permissible output current can be calculated using the following tables. The installation altitude and ambient temperature are compensated here. The degree of protection selected for the cabinet units must also be taken into account.

| Table 12- 2 | Current derating as a function of ambient temperature (inlet air temperature at the air inlet of the cabinet unit) |
|-------------|--|
| | and installation altitude for cabinet units with degree of protection IP20/IP21/IP23/IP43 |

| Installation altitude above sea level in m | Ambient temperature in °C | | | | | | |
|--|---------------------------|----------------|--------|--------|--------|--------|--------|
| | 20 | 25 | 40 | 45 | 50 | | |
| 0 to 2000 | | 100 % | | | | | 87.0 % |
| Up to 2500 | | 100 % 96.3 9 | | | | | 83.7 % |
| Up to 3000 | | 100 % 96.2 % 9 | | | | 87.9 % | 80.5 % |
| Up to 3500 | 100 % 96.7 % 92.3 % | | | 88.8 % | 84.3 % | 77.3 % | |
| Up to 4000 | 100 % | 97.8 % | 92.7 % | 88.4 % | 85.0 % | 80.8 % | 74.0 % |

 Table 12-3
 Current derating as a function of the ambient temperature (inlet air temperature at the air inlet of the cabinet unit) and installation altitude for cabinet units with degree of protection IP54

| Installation altitude above sea level in m | Ambient temperature in °C | | | | | | |
|--|---------------------------|---------------------|--------|--------|--------|--------|--------|
| | 20 | 20 25 30 35 | | | | 45 | 50 |
| 0 to 2000 | 100 % | | | 95.0 % | 87.5 % | 80.0 % | |
| Up to 2500 | | 100 % | | 96.3 % | 91.4 % | 84.2 % | 77.0 % |
| Up to 3000 | 10 | 100 % 96.2 % 92.5 % | | | 87.9 % | 81.0 % | 74.1 % |
| Up to 3500 | 100 % | 96.7 % | 92.3 % | 88.8 % | 84.3 % | 77.7 % | 71.1 % |
| Up to 4000 | 97.8 % | 92.7 % | 88.4 % | 85.0 % | 80.8 % | 74.7 % | 68.0 % |

Voltage derating as a function of the installation altitude

In addition to current derating, voltage derating must also be considered at installation altitudes >2000 m above sea level.

Table 12-4 Voltage derating as a function of the installation altitude (380 V – 480 V 3 AC)

| Installation altitude above sea level in m | Rated converter input voltage | | | | | |
|---|-------------------------------|-------|-------|-------|-------|-------|
| | 380 V | 400 V | 420 V | 440 V | 460 V | 480 V |
| 0 to 2000 | | | 100 | 1% | | |
| Up to 2250 | 100 % | | | | | 96 % |
| Up to 2500 | 100 % 98 % | | | | | 94 % |
| Up to 2750 | | 100 % | | 98 % | 94 % | 90 % |
| Up to 3000 | | 100 % | | 95 % | 91 % | 88 % |
| Up to 3250 | 100 |) % | 97 % | 93 % | 89 % | 85 % |
| Up to 3500 | 100 % | 98 % | 93 % | 89 % | 85 % | 82 % |
| Up to 3750 | 100 % | 95 % | 91 % | 87 % | 83 % | 79 % |
| Up to 4000 | 96 % | 92 % | 87 % | 83 % | 80 % | 76 % |

Table 12-5 Voltage derating as a function of the installation altitude (500 V – 600 V 3 AC)

| Installation altitude above sea level in m | Rated converter input voltage | | | | | |
|--|-------------------------------|-------|-------|-------|-------|--|
| | 500 V | 525 V | 550 V | 575 V | 600 V | |
| 0 to 2000 | 100 % | | | | | |
| Up to 2250 | 100 % | | | | | |
| Up to 2500 | 100 % | | | | | |
| Up to 2750 | | | 100 % | | | |
| Up to 3000 | 100 % | | | | | |
| Up to 3250 | 100 % 98 % | | | | | |
| Up to 3500 | 100 % 98 % 94 % | | | 94 % | | |
| Up to 3750 | 10 | 0 % | 98 % | 95 % | 91 % | |
| Up to 4000 | 100 % 95 % 91 % 87 % | | | | 87 % | |

| Installation altitude above sea level in m | Rated converter input voltage | | | |
|---|-------------------------------|-------|--|--|
| | 660 V | 690 V | | |
| 0 to 2000 | 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 | - | - | | |

Table 12-6 Voltage derating as a function of the installation altitude (660 V – 690 V 3 AC)

Note

On systems with a grounded phase conductor and a line voltage >600 V AC, line-side components should be installed to limit overvoltages to overvoltage category II in accordance with IEC 60664-1.

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 for the cabinet units.

Table 12-7 Derating factor of the output current as a function of the pulse frequency for devices with a rated pulse frequency of 2 kHz

| Order no. 6SL3710 | Power [kW] | Output current at 2 kHz [A] | Derating factor at 4 kHz | | | | | |
|----------------------|-------------------------------------|--------------------------------|--------------------------|--|--|--|--|--|
| | Connection voltage 380 – 480 V 3 AC | | | | | | | |
| 1GE32-1_A0 | 110 | 210 | 82 % | | | | | |
| 1GE32-6_A0 | 132 | 260 | 83 % | | | | | |
| 1GE33-1_A0 | 160 | 310 | 88 % | | | | | |
| 1GE33-8_A0 | 200 | 380 | 87 % | | | | | |
| 1GE35-0_A0 | 250 | 490 | 78 % | | | | | |

| Order no. 6SL3710 | Power [kW] | Output current at 1.25 kHz [A] | Derating factor at 2.5 kHz | Derating factor at 5 kHz |
|----------------------|---------------|-----------------------------------|-------------------------------|-----------------------------|
| | | Connection voltage 380 – 480 V | ' 3 AC | |
| 1GE36-1_A0 | 315 | 605 | 72% | 60% |
| 1GE37-5_A0 | 400 | 745 | 72% | 60% |
| 1GE38-4_A0 | 450 | 840 | 79% | 60% |
| 1GE41-0_A0 | 560 | 985 | 87% | 60% |
| 2GE41-1AA0 | 630 | 1120 | 72% | 60% |
| 2GE41-4AA0 | 710 | 1380 | 72% | 60% |
| 2GE41-6AA0 | 900 | 1560 | 79% | 60% |
| | · | Connection voltage 500 - 600 V | ' 3 AC | |
| 1GF31-8_A0 | 110 | 175 | 87% | 60% |
| 1GF32-2_A0 | 132 | 215 | 87% | 60% |
| 1GF32-6_A0 | 160 | 260 | 88% | 60% |
| 1GF33-3_A0 | 200 | 330 | 82% | 55% |
| 1GF34-1_A0 | 250 | 410 | 82% | 55% |
| 1GF34-7_A0 | 315 | 465 | 87% | 55% |
| 1GF35-8_A0 | 400 | 575 | 85% | 55% |
| 1GF37-4_A0 | 500 | 735 | 79% | 55% |
| 1GF38-1_A0 | 560 | 810 | 72% | 55% |
| 2GF38-6AA0 | 630 | 860 | 87% | 55% |
| 2GF41-1AA0 | 710 | 1070 | 85% | 55% |
| 2GF41-4AA0 | 1000 | 1360 | 79% | 55% |
| | · | Connection voltage 660 – 690 V | ' 3 AC | |
| 1GH28-5_A0 | 75 | 85 | 89% | 60% |
| 1GH31-0_A0 | 90 | 100 | 88% | 60% |
| 1GH31-2_A0 | 110 | 120 | 88% | 60% |
| 1GH31-5_A0 | 132 | 150 | 84% | 55% |
| 1GH31-8_A0 | 160 | 175 | 87% | 60% |
| 1GH32-2_A0 | 200 | 215 | 87% | 60% |
| 1GH32-6_A0 | 250 | 260 | 88% | 60% |
| 1GH33-3_A0 | 315 | 330 | 82% | 55% |
| 1GH34-1_A0 | 400 | 410 | 82% | 55% |
| 1GH34-7_A0 | 450 | 465 | 87% | 55% |
| 1GH35-8_A0 | 560 | 575 | 85% | 55% |
| 1GH37-4_A0 | 710 | 735 | 79% | 55% |
| 1GH38-1_A0 | 800 | 810 | 72% | 55% |
| 2GH41-1AA0 | 1000 | 1070 | 85% | 55% |
| 2GH41-4AA0 | 1350 | 1360 | 79% | 55% |
| 2GH41-5AA0 | 1500 | 1500 | 72% | 55% |

Table 12- 8Derating factor of the output current as a function of the pulse frequency for devices with a rated pulse
frequency of 1.25 kHz

For pulse frequencies in the range between the fixed values, the relevant derating factors can be determined by means of linear interpolation.

The following formula applies for this: $Y_2 = Y_0 + \frac{Y_1 - Y_0}{X_1 - X_0} (X_2 - X_0)$

The derating factor is required for when $X_2 = 2 \text{ kHz}$ for 6SL3710-1GE41-0_A0.

 $X_{0} = 1.25 \text{ kHz}, Y_{0} = 100\%, X_{1} = 2.5 \text{ kHz}, Y_{1} = 87\%, X_{2} = 2 \text{ kHz}, Y_{2} = ??$ $Y_{2} = 100 \% + \frac{87 \% - 100 \%}{2.5 \text{ kHz} - 1.25 \text{ kHz}} (2 \text{ kHz} - 1.25 \text{ kHz}) =$ $100 \% + \frac{-13 \%}{1.25 \text{ kHz}} (0.75 \text{ kHz}) = 100 \% - 7.8 \% = \underline{92.2 \%}$

Derating factor

Example:





12.2.2 Overload capability

The converter is 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 on the basis of a duty cycle duration of 300 s.

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.



Figure 12-2 Low overload

High overload

The base load current for a high overload $I_{\rm H} is$ based on a duty cycle of 150% for 60 s or 160% for 10 s.



Figure 12-3 High overload

Note

The current, voltage and output values specified in the following tables are rated values. The cables to the cabinet unit are protected by 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.

12.3.1 Cabinet unit version A, 380 V - 480 V 3 AC

Table 12-9 Version A, 380 V – 480 V 3 AC, part 1

| | 110 90 150 125 210 205 178 229 | 132 110 200 150 260 250 233 284 | 160 132 250 200 310 302 277 |
|-----------------|--|---|--|
| | 90 150 125 210 205 178 229 | 110 200 150 260 250 233 | 132 250 200 310 302 |
| | 150 125 210 205 178 229 | 200 150 260 250 233 | 250 200 310 302 |
| | 125 210 205 178 229 | 150 260 250 233 | 200 310 302 |
| | 210 205 178 229 | 260 250 233 | 310 302 |
| | 205 178 229 | 250 233 | 302 |
| | 205 178 229 | 250 233 | 302 |
| λ Λ Λ | 178 229 | 233 | |
| λ λ | 229 | | 277 |
| \ | | 284 | |
| \ | | 284 | |
| | | 1 — • · | 338 |
| ` | 335 | 410 | 495 |
| | 1.1 | 1.1 | 1.35 |
| | | | |
| | | | |
| ACrms | 380 V 3 AC -10 | % to 480 V 3 AC +10 % | (-15 % < 1 min) |
| lz | | 47 to 63 Hz | |
| / _{DC} | | 24 (20.4 - 28.8) | |
| W | 2.9 | 3.8 | 4.4 |
| n³/s | 0.17 | 0.23 | 0.36 |
| B(A) | 67/68 | 69/73 | 69/73 |
| -(-') | | | |
| | | | |
| nm² | 2 x 70 | 2 x 95 | 2 x 120 |
| nm² | 4 x 240 | 4 x 240 | 4 x 240 |
| | | - | M12 (2 holes) |
| | · · · · · | , , | , <u>,</u> |
| nm² | 2 x 50 | 2 x 70 | 2 x 95 |
| nm² | | | 2 x 150 |
| | | | M12 (2 holes) |
| | · / | / | · · · · / |
| | M12 (2 holes) | M12 (2 holes) | M12 (2 holes) |
| | . , | | |
| n | 300 / 450 | 300 / 450 | 300 / 450 |
| | | | |
| nm | 800 | 800 | 800 |
| nm | 2000 | 2000 | 2000 |
| nm | 600 | 600 | 600 |
| | FX | FX | GX |
| g | | | 390 |
| | ACrms z DC W 3 ³ /s B(A) m ² m ² m ² m ² | ACrms 380 V 3 AC -10 Z DC M 2.9 3 ³ /s 0.17 B(A) 67/68 Im ² 2 x 70 4 x 240 M12 (2 holes) Im ² 2 x 50 Im ² 2 x 50 Im ² 2 x 150 M12 (2 holes) FX | ACrms 380 V 3 AC -10 % to 480 V 3 AC +10 % 47 to 63 Hz 24 (20.4 - 28.8) N 2.9 3.8 Imm2 0.17 0.23 Imm2 2 x 70 4 x 240 M12 (2 holes) 2 x 95 4 x 240 M12 (2 holes) Imm2 2 x 50 2 x 150 M12 (2 holes) 2 x 70 M12 (2 holes) Imm2 300 / 450 2 x 70 2 x 150 M12 (2 holes) Imm2 2 x 50 2 x 150 M12 (2 holes) 2 x 70 M12 (2 holes) Imm2 300 / 450 300 / 450 Imm3 800 2000 600 800 2000 600 Imm3 800 2000 600 800 2000 600 |

| Order number | 6SL3710- | 1GE32-1AA0 | 1GE32-6AA0 | 1GE33-1AA0 |
|-------------------------------------|----------|------------|------------|------------|
| Recommended protection | | | | |
| - Line protection | | | | |
| (with option L26) | | 3NA3144 | 3NA3250 | 3NA3254 |
| Rated current | А | 250 | 300 | 355 |
| frame size to DIN 43620-1 | | 2 | 2 | 3 |
| - Line and semiconductor protection | | | | |
| (without option L26) | | 3NE1230-2 | 3NE1331-2 | 3NE1334-2 |
| Rated current | А | 315 | 350 | 500 |
| Frame size to DIN 43620-1 | | 1 | 2 | 2 |

 $^{1)}$ Rated output of a typical 6-pole standard induction motor based on IL or IH at 400 V 3 AC 50 Hz.

 $^{2)}$ Rated output of a typical 6-pole standard induction motor based on I_L or I_H at 460 V 3 AC 60 Hz.

³⁾ 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 "Overload capability").

⁴⁾ 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 "Overload capability").

⁵⁾ The current values given here are based on the rated output current.

⁶⁾ The recommendations for the North American market in AWG or MCM must be taken from the appropriate NEC (National Electrical Code) or CEC (Canadian Electrical Code) standards.

| Order number | 6SL3710- | 1GE33-8AA0 | 1GE35-0AA0 | 1GE36-1AA0 |
|---|-----------------|----------------|-----------------------|-----------------|
| Unit rating | | | | |
| - for I∟ at 50 Hz 400 V ¹) | kW | 200 | 250 | 315 |
| - for I _H at 50 Hz 400 V ¹⁾ | kW | 160 | 200 | 250 |
| - for I _L at 60 Hz 460 V ²⁾ | hp | 300 | 400 | 500 |
| - for I _H at 60 Hz 460 V ²⁾ | hp | 250 | 350 | 350 |
| Output current | | | | |
| - Rated current I _N | А | 380 | 490 | 605 |
| - Base load current IL ³⁾ | А | 370 | 477 | 590 |
| - Base load current I _H ⁴⁾ | А | 340 | 438 | 460 |
| Input current | | | | |
| - Rated input current ⁵⁾ | А | 395 | 509 | 629 |
| - Input current, max. | А | 606 | 781 | 967 |
| - Current requirements for 24 V DC | А | 1.35 | 1.35 | 1.4 |
| auxiliary supply | | | | |
| Connection voltages | | | | |
| - Line voltage | VACrms | 380 V 3 AC -10 | % to 480 V 3 AC +10 % | (-15 % < 1 min) |
| - Line frequency | Hz | | 47 to 63 Hz | |
| - Electronics power supply | VDC | | 24 (20.4 - 28.8) | |
| Power loss | kW | 5.3 | 6.4 | 8.2 |
| Cooling air requirement | m³/s | 0.36 | 0.36 | 0.78 |
| Sound pressure level L _{pA} (1 m) at 50/60 Hz | dB(A) | 69/73 | 69/73 | 70/73 |
| | | | | |
| - recommended: DIN VDE ⁶⁾ | mm ² | 2 x 120 | 2 x 185 | 2 x 240 |
| - maximum: DIN VDE | mm ² | 4 x 240 | 4 x 240 | 4 x 240 |
| - Fixing screw | | M12 (2 holes) | M12 (2 holes) | M12 (2 holes) |
| Motor connection | | | | |
| - recommended: DIN VDE ⁶⁾ | mm ² | 2 x 95 | 2 x 150 | 2 x 185 |
| - maximum: DIN VDE | mm ² | 2 x 150 | 2 x 240 | 2 x 240 |
| - Fixing screw | | M12 (2 holes) | M12 (2 holes) | M12 (2 holes) |
| | | | | |
| Protective conductor connection | | M12 (2 holes) | M12 (2 holes) | M12 (2 holes) |
| U | | | | |
| Max. motor cable length | | 000 / 450 | 200 / 450 | 000 / 450 |
| shielded / unshielded | m | 300 / 450 | 300 / 450 | 300 / 450 |
| Dimensions (standard version) | | | | |
| - Width | mm | 1000 | 1000 | 1200 |
| - Height | mm | 2000 | 2000 | 2000 |
| - Depth | mm | 600 | 600 | 600 |
| Power block frame size | | GX | GX | HX |
| Weight (without options), approx. | kg | 480 | 480 | 860 |
| Recommended protection | | | | |
| - Line protection | | | | |
| (with option L26) | | 3NA3260 | 3NA3372 | 3NA3475 |
| Rated current | А | 400 | 630 | 800 |
| frame size to DIN 43620-1 | | 3 | 3 | 4 |
| - Line and semiconductor protection | | | | |
| (without option L26) | | 3NE1334-2 | 3NE1436-2 | 3NE1438-2 |
| Rated current | А | 500 | 630 | 800 |
| Frame size to DIN 43620-1 | | 2 | 3 | 3 |

12.3 Technical specifications

| | Order number | 6SL3710- | 1GE33-8AA0 | 1GE35-0AA0 | 1GE36-1AA0 | | |
|--|--|-------------|-----------------------|------------|------------|--|--|
| | ¹⁾ Rated output of a typical 6-pole standard induction motor based on I _L or I _H at 400 V 3 AC 50 Hz. | | | | | | |
| ²⁾ Rated output of a typical 6-pole standard induction motor based on I _L or I _H at 460 V 3 AC 60 Hz. | | | | | | | |
| ³⁾ 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 "Overload capability"). | | | | | | | |
| | $^{\rm 4)}$ 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 "Overload capability"). | | | | | | |
| | ⁵⁾ The current values given here are ba | ased on the | rated output current. | | | | |

⁶⁾ The recommendations for the North American market in AWG or MCM must be taken from the appropriate NEC (National Electrical Code) or CEC (Canadian Electrical Code) standards.

| Order number | 6SL3710- | 1GE37-5AA0 | 1GE38-4AA0 | 1GE41-0AA0 |
|---|-----------------|----------------|-------------------------|-------------------|
| Unit rating | | | | |
| - for I∟ at 50 Hz 400 V ¹) | kW | 400 | 450 | 560 |
| - for I _H at 50 Hz 400 V ¹⁾ | kW | 315 | 400 | 450 |
| - for I _L at 60 Hz 460 V $^{2)}$ | hp | 600 | 600 | 800 |
| - for I _H at 60 Hz 460 V $^{2)}$ | hp | 450 | 500 | 700 |
| Output current | | | | |
| - Rated current I _N | А | 745 | 840 | 985 |
| - Base load current IL 3) | А | 725 | 820 | 960 |
| - Base load current I _H ⁴⁾ | A | 570 | 700 | 860 |
| Input current | | | | |
| - Rated input current ⁵⁾ | А | 775 | 873 | 1024 |
| - Input current, max. | А | 1188 | 1344 | 1573 |
| - Current requirements for 24 V DC | А | 1.4 | 1.4 | 1.5 |
| auxiliary supply | | | | |
| Connection voltages | | | | |
| - Line voltage | VACrms | 380 V 3 AC -10 |) % to 480 V 3 AC +10 % | o (-15 % < 1 min) |
| - Line frequency | Hz | | 47 to 63 Hz | |
| - Electronics power supply | VDC | | 24 (20.4 - 28.8) | T |
| Power loss | kW | 9.6 | 10.1 | 14.4 |
| Cooling air requirement | m³/s | 0.78 | 0.78 | 1.48 |
| Sound pressure level L _{pA} (1 m) at 50/60 Hz | dB(A) | 70/73 | 70/73 | 72/75 |
| Line connection | | | | |
| - recommended: DIN VDE 6) | mm ² | 3 x 185 | 4 x 150 | 4 x 185 |
| - maximum: DIN VDE | mm ² | 4 x 240 | 8 x 240 | 8 x 240 |
| - Fixing screw | | M12 (2 holes) | M12 (4 holes) | M12 (4 holes) |
| Motor connection | | | | |
| - recommended: DIN VDE 6) | mm ² | 3 x 150 | 3 x 185 | 4 x 185 |
| - maximum: DIN VDE | mm ² | 2 x 240 | 4 x 240 | 6 x 240 |
| - Fixing screw | | M12 (2 holes) | M12 (2 holes) | M12 (3 holes) |
| Protective conductor connection | | | | |
| Fixing screw | | M12 (10 holes) | M12 (16 holes) | M12 (18 holes) |
| Max. motor cable length | | | | |
| shielded / unshielded | m | 300 / 450 | 300 / 450 | 300 / 450 |
| Dimensions (standard version) | | | | |
| - Width | mm | 1200 | 1200 | 1600 |
| - Height | mm | 2000 | 2000 | 2000 |
| - Depth | mm | 600 | 600 | 600 |
| Power block frame size | | НХ | HX | JX |
| Weight (without options), approx. | kg | 865 | 1075 | 1360 |
| Recommended protection | | | | |
| - Line protection | | | | |
| (with option L26) | | 3NA3475 | 3NA3365 | 3NA3472 |
| Rated current | А | 800 | 2 x 500 | 2 x 630 |
| frame size to DIN 43620-1 | | 4 | 3 | 3 |
| - Line and semiconductor protection | | | | |
| (without option L26) | | 3NE1448-2 | 3NE1436-2 | 3NE1437-2 |
| Rated current | А | 850 | 2 x 630 | 2 x 710 |
| Frame size to DIN 43620-1 | | 3 | 3 | 3 |

Table 12- 11 Version A, 380 V - 480 V 3 AC, part 3

12.3 Technical specifications

| Order number | 6SL3710- | 1GE37-5AA0 | 1GE38-4AA0 | 1GE41-0AA0 | | | |
|---|--------------|----------------------|------------|------------|--|--|--|
| ¹⁾ Rated output of a typical 6-pole standard induction motor based on I _L or I _H at 400 V 3 AC 50 Hz. | | | | | | | |
| ²⁾ Rated output of a typical 6-pole standard induction motor based on I _L or I _H at 460 V 3 AC 60 Hz. | | | | | | | |
| ³⁾ 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 "Overload capability"). | | | | | | | |
| ⁴⁾ 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 "Overload capability"). | | | | | | | |
| 5) The current values given here are | bacad on the | rated output current | | | | | |

⁵⁾ The current values given here are based on the rated output current.

⁶⁾ The recommendations for the North American market in AWG or MCM must be taken from the appropriate NEC (National Electrical Code) or CEC (Canadian Electrical Code) standards.

| Order number | 6SL3710- | 2GE41-1AA0 | 2GE41-4AA0 | 2GE41-6AA0 |
|--|-----------------|------------------|-----------------------|------------------|
| Unit rating | | | | |
| - for I∟ at 50 Hz 400 V ¹) | kW | 630 | 710 | 900 |
| - for I _H at 50 Hz 400 V ¹⁾ | kW | 500 | 560 | 710 |
| - for I _L at 60 Hz 460 V $^{2)}$ | hp | 900 | 1000 | 1250 |
| - for I _H at 60 Hz 460 V ²⁾ | hp | 700 | 900 | 1000 |
| Output current | | | | |
| - Rated current I _N | А | 1120 | 1380 | 1560 |
| - Base load current IL ³⁾ | А | 1092 | 1340 | 1516 |
| - Base load current I _H ⁴⁾ | A | 850 | 1054 | 1294 |
| Input current | | | | |
| - Rated input current ⁵⁾ | А | 1174 | 1444 | 1624 |
| - Input current, max. | А | 1800 | 2215 | 2495 |
| - Current requirements for 24 V DC | А | 2.8 | 2.8 | 3.0 |
| auxiliary supply | | | | |
| Connection voltages | | | | |
| - Line voltage | VACrms | 380 V 3 AC -10 | % to 480 V 3 AC +10 % | (-15 % < 1 min) |
| - Line frequency | Hz | | 47 to 63 Hz | |
| - Electronics power supply | VDC | | 24 (20.4 - 28.8) | • |
| Power loss | kW | 16.2 | 19.0 | 19.9 |
| Cooling air requirement | m³/s | 1.56 | 1.56 | 1.56 |
| Sound pressure level L _{pA} (1 m) at 50/60 Hz | dB(A) | 73/76 | 73/76 | 73/76 |
| Line connection | | Per sub-cabinet: | Per sub-cabinet: | Per sub-cabinet: |
| - recommended: DIN VDE 6) | mm ² | 2 x 240 | 3 x 185 | 4 x 150 |
| - maximum: DIN VDE | mm ² | 4 x 240 | 4 x 240 | 8 x 240 |
| - Fixing screw | | M12 (2 holes) | M12 (2 holes) | M12 (4 holes) |
| Motor connection | | Per sub-cabinet: | Per sub-cabinet: | Per sub-cabinet: |
| - recommended: DIN VDE 6) | mm ² | 2 x 185 | 3 x 150 | 3 x 185 |
| - maximum: DIN VDE | mm ² | 4 x 240 | 4 x 240 | 4 x 240 |
| - Fixing screw | | M12 (2 holes) | M12 (2 holes) | M12 (2 holes) |
| Protective conductor connection | | Per sub-cabinet: | Per sub-cabinet: | Per sub-cabinet: |
| Fixing screw | | M12 (2 holes) | M12 (10 holes) | M12 (16 holes) |
| Max. motor cable length | | | | |
| shielded / unshielded | m | 300 / 450 | 300 / 450 | 300 / 450 |
| Dimensions (standard version) | | | | |
| - Width | mm | 2400 | 2400 | 2400 |
| - Height | mm | 2000 | 2000 | 2000 |
| - Depth | mm | 600 | 600 | 600 |
| Power block frame size | | НХ | НХ | НХ |
| Weight (without options), approx. | kg | 1700 | 1710 | 2130 |
| Recommended protection | | | | |
| - Line protection | | Per sub-cabinet: | Per sub-cabinet: | Per sub-cabinet: |
| (with option L26) | | 3NA3475 | 3NA3475 | 3NA3365 |
| Rated current | А | 800 | 800 | 2 x 500 |
| frame size to DIN 43620-1 | | 4 | 4 | 3 |
| - Line and semiconductor protection | | Per sub-cabinet: | Per sub-cabinet: | Per sub-cabinet: |
| (without option L26) | . | 3NE1438-2 | 3NE1448-2 | 3NE1436-2 |
| Rated current | A | 800 | 850 | 2 x 630 |
| Frame size to DIN 43620-1 | | 3 | 3 | 3 |

Table 12- 12 Version A, 380 V - 480 V 3 AC, part 4

12.3 Technical specifications

| Order number | 6SL3710- | 2GE41-1AA0 | 2GE41-4AA0 | 2GE41-6AA0 | | |
|---|----------|---------------------------------|------------|------------|--|--|
| ¹⁾ Rated output of a typical 6-pole standard induction motor based on I _L or I _H at 400 V 3 AC 50 Hz. | | | | | | |
| ²⁾ Rated output of a typical 6-pole standard induction motor based on I _L or I _H at 460 V 3 AC 60 Hz. | | | | | | |
| ³⁾ 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 "Overload capability"). | | | | | | |
| ⁴⁾ 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 "Overload capability"). | | | | | | |
| 5) T he summer to a line a stress have a set | | and and a subserved as some and | | | | |

⁵⁾ The current values given here are based on the rated output current.

⁶⁾ The recommendations for the North American market in AWG or MCM must be taken from the appropriate NEC (National Electrical Code) or CEC (Canadian Electrical Code) standards.

12.3.2 Cabinet unit version C, 380 V - 480 V 3 AC

Table 12- 13 Version C, 380 V - 480 V 3 AC, part 1

| Order number | 6SL3710- | 1GE32-1CA0 | 1GE32-6CA0 | 1GE33-1CA0 |
|---|--------------------|----------------|-------------------------|------------------|
| Unit rating | | | | |
| - for I _L at 50 Hz 400 V ¹⁾ | kW | 110 | 132 | 160 |
| - for I _H at 50 Hz 400 V ¹⁾ | kW | 90 | 110 | 132 |
| - for I∟ at 60 Hz 460 V ²⁾ | hp | 150 | 200 | 250 |
| - for I _H at 60 Hz 460 V ²⁾ | hp | 125 | 150 | 200 |
| Output current | | | | |
| - Rated current I _N | А | 210 | 260 | 310 |
| - Base load current IL ³⁾ | A | 205 | 250 | 302 |
| - Base load current $I_{\rm H}^{4}$ | A | 178 | 233 | 277 |
| Input current | 7 | 170 | 200 | 211 |
| Rated input current ⁵⁾ | А | 229 | 284 | 338 |
| - Input current, max. | A | 335 | 410 | 495 |
| | | 1.1 | 1.1 | 1.35 |
| - Current requirements for 24 V DC auxiliary supply | A | 1.1 | 1.1 | 1.55 |
| Connection voltages | | | 1 | <u> </u> |
| - Line voltage | V _{ACrms} | 380 1/ 3 AC 1 | 0 % to 480 V 3 AC +10 % | (-15% < 1min) |
| • | V ACrms Hz | 300 V 3 AC - N | 47 to 63 Hz | s (-13 % < 1 mm) |
| - Line frequency | | | | |
| - Electronics power supply | | | 24 (20.4 - 28.8) | |
| Power loss | kW | 2.9 | 3.8 | 4.4 |
| Cooling air requirement | m³/s | 0.17 | 0.23 | 0.36 |
| Sound pressure level LpA | dB(A) | 67/68 | 69/73 | 69/73 |
| (1 m) at 50/60 Hz | | | | |
| Line connection | | | | |
| - recommended: DIN VDE 6) | mm ² | 2 x 70 | 2 x 95 | 2 x 120 |
| - maximum: DIN VDE | mm ² | 4 x 240 | 4 x 240 | 4 x 240 |
| - Fixing screw | | M12 (1 hole) | M12 (1 hole) | M12 (1 hole) |
| Motor connection | | | | |
| - recommended: DIN VDE 6) | mm ² | 2 x 50 | 2 x 70 | 2 x 95 |
| - maximum: DIN VDE | mm ² | 2 x 150 | 2 x 150 | 2 x 150 |
| - Fixing screw | | M12 (1 hole) | M12 (1 hole) | M12 (1 hole) |
| Protective conductor connection | | | | |
| Fixing screw | | M12 (2 holes) | M12 (2 holes) | M12 (2 holes) |
| Max. motor cable length | | | | |
| shielded / unshielded | m | 300 / 450 | 300 / 450 | 300 / 450 |
| Dimensions (standard version) | | | | |
| - Width | mm | 400 | 400 | 400 |
| - Height | mm | 2000 | 2000 | 2000 |
| - Depth | mm | 600 | 600 | 600 |
| Power block frame size | | FX | FX | GX |
| Weight (without options), approx. | kg | 225 | 225 | 300 |
| Recommended protection | | | | |
| -Line and semi-cond. protection | | 3NE1230-2 | 3NE1331-2 | 3NE1334-2 |
| Rated current | А | 315 | 350 | 500 |
| frame size to DIN 43620-1 | | 1 | 2 | 2 |
| | 1 | 1' | <u> </u> | <u> </u> |

12.3 Technical specifications

| | Order number | 6SL3710- | 1GE32-1CA0 | 1GE32-6CA0 | 1GE33-1CA0 | | | |
|--|--|------------|----------------------|------------|------------|--|--|--|
| ¹⁾ Rated output of a typical 6-pole standard induction motor based on I _L or I _H at 400 V 3 AC 50 Hz. | | | | | | | | |
| ²⁾ Rated output of a typical 6-pole standard induction motor based on I _L or I _H at 460 V 3 AC 60 Hz. | | | | | | | | |
| | ³⁾ 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 "Overload capability"). | | | | | | | |
| | ⁴⁾ 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 "Overload capability"). | | | | | | | |
| | 5) The ourrent values given here are he | and on the | rated autout aurrant | | | | | |

⁵⁾ The current values given here are based on the rated output current.

⁶⁾ The recommendations for the North American market in AWG or MCM must be taken from the appropriate NEC (National Electrical Code) or CEC (Canadian Electrical Code) standards.

| Order number | 6SL3710- | 1GE33-8CA0 | 1GE35-0CA0 | 1GE36-1CA0 |
|---|-----------------|----------------|-----------------------|-----------------|
| Unit rating | | | | |
| - for I _L at 50 Hz 400 V ¹⁾ | kW | 200 | 250 | 315 |
| - for I _H at 50 Hz 400 V ¹⁾ | kW | 160 | 200 | 250 |
| - for I _L at 60 Hz 460 V ²⁾ | hp | 300 | 400 | 500 |
| - for I _H at 60 Hz 460 V ²⁾ | hp | 250 | 350 | 350 |
| Output current | | | | |
| - Rated current I _N | А | 380 | 490 | 605 |
| - Base load current IL ³⁾ | А | 370 | 477 | 590 |
| - Base load current I _H ⁴⁾ | А | 340 | 438 | 460 |
| Input current | | | | |
| - Rated input current ⁵⁾ | А | 395 | 509 | 629 |
| - Input current, max. | А | 606 | 781 | 967 |
| - Current requirements for 24 V DC | А | 1.35 | 1.35 | 1.4 |
| auxiliary supply | | | | |
| Connection voltages | | | | |
| - Line voltage | VACrms | 380 V 3 AC -10 | % to 480 V 3 AC +10 % | (-15 % < 1 min) |
| - Line frequency | Hz | | 47 to 63 Hz | |
| - Electronics power supply | VDC | | 24 (20.4 - 28.8) | |
| Power loss | kW | 5.3 | 6.4 | 8.2 |
| Cooling air requirement | m³/s | 0.36 | 0.36 | 0.78 |
| Sound pressure level LpA | dB(A) | 69/73 | 69/73 | 70/73 |
| (1 m) at 50/60 Hz | | | | |
| Line connection | | | | |
| - recommended: DIN VDE 6) | mm ² | 2 x 120 | 2 x 185 | 2 x 240 |
| - maximum: DIN VDE | mm ² | 4 x 240 | 4 x 240 | 4 x 240 |
| - Fixing screw | | M12 (1 hole) | M12 (1 hole) | M12 (4 holes) |
| Motor connection | | | | |
| - recommended: DIN VDE 6) | mm ² | 2 x 95 | 2 x 150 | 2 x 185 |
| - maximum: DIN VDE | mm ² | 2 x 150 | 2 x 240 | 8 x 240 |
| - Fixing screw | | M12 (1 hole) | M12 (1 hole) | M12 (4 holes) |
| Protective conductor connection | | | | |
| Fixing screw | | M12 (2 holes) | M12 (2 holes) | M12 (2 holes) |
| Max. motor cable length | | | | |
| shielded / unshielded | m | 300 / 450 | 300 / 450 | 300 / 450 |
| Dimensions (standard version) | | | | |
| - Width | mm | 400 | 400 | 600 |
| - Height | mm | 2000 | 2000 | 2000 |
| - Depth | mm | 600 | 600 | 600 |
| Power block frame size | | GX | GX | НХ |
| Weight (without options), approx. | kg | 300 | 300 | 670 |
| Recommended protection | | | | |
| - Line and semi-cond. protection | | 3NE1334-2 | 3NE1436-2 | 3NE1438-2 |
| Rated current | А | 500 | 630 | 800 |
| frame size to DIN 43620-1 | | 2 | 3 | 3 |

Table 12- 14 Version C, 380 V - 480 V 3 AC, part 2

12.3 Technical specifications

| | Order number | 6SL3710- | 1GE33-8CA0 | 1GE35-0CA0 | 1GE36-1CA0 | |
|---|--|-------------|-----------------------|------------|------------|--|
| | ¹⁾ Rated output of a typical 6-pole standard induction motor based on I _L or I _H at 400 V 3 AC 50 Hz. | | | | | |
| : | ²⁾ Rated output of a typical 6-pole standard induction motor based on I _L or I _H at 460 V 3 AC 60 Hz. | | | | | |
| | ³⁾ 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 "Overload capability"). | | | | | |
| | ⁴⁾ 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 "Overload capability"). | | | | | |
| ! | ⁵⁾ The current values given here are ba | ased on the | rated output current. | | | |

⁶⁾ The recommendations for the North American market in AWG or MCM must be taken from the appropriate NEC (National Electrical Code) or CEC (Canadian Electrical Code) standards.

| Order number | 6SL3710- | 1GE37-5CA0 | 1GE38-4CA0 | 1GE41-0CA0 |
|--|------------|-------------------------------------|-------------------------------------|-------------------------------------|
| Unit rating | | | | |
| - for I∟ at 50 Hz 400 V ¹⁾ | kW | 400 | 450 | 560 |
| - for I _H at 50 Hz 400 V ¹⁾ | kW | 315 | 400 | 450 |
| - for I _L at 60 Hz 460 V ²⁾ | hp | 600 | 600 | 800 |
| - for I _H at 60 Hz 460 V ²⁾ | hp | 450 | 500 | 700 |
| Output current | | | | |
| - Rated current I _N | А | 745 | 840 | 985 |
| - Base load current IL ³⁾ | А | 725 | 820 | 960 |
| - Base load current I _H ⁴⁾ | А | 570 | 700 | 860 |
| Input current | | | | |
| - Rated input current ⁵⁾ | А | 775 | 873 | 1024 |
| - Input current, max. | А | 1188 | 1344 | 1573 |
| - Current requirements for 24 V DC | А | 1.4 | 1.4 | 1.5 |
| auxiliary supply | | | | |
| Connection voltages | | | | |
| - Line voltage | VACrms | 380 V 3 AC -10 | % to 480 V 3 AC +10 % | (-15 % < 1 min) |
| - Line frequency | Hz | | 47 to 63 Hz | |
| - Electronics power supply | VDC | | 24 (20.4 - 28.8) | • |
| Power loss | kW | 9.6 | 10.1 | 14.4 |
| Cooling air requirement | m³/s | 0.78 | 0.78 | 1.48 |
| Sound pressure level L _{pA} (1 m) at 50/60 Hz | dB(A) | 70/73 | 70/73 | 72/75 |
| Line connection - recommended: DIN VDE ⁶⁾ - maximum: DIN VDE - Fixing screw | mm² mm² | 3 x 185 4 x 240 M12 (4 holes) | 4 x 150 8 x 240 M12 (4 holes) | 4 x 185 8 x 240 M12 (4 holes) |
| Motor connection - recommended: DIN VDE ⁶⁾ - maximum: DIN VDE - Fixing screw | mm² mm² | 3 x 150 8 x 240 M12 (4 holes) | 3 x 185 8 x 240 M12 (4 holes) | 4 x 185 8 x 240 M12 (4 holes) |
| Protective conductor connection Fixing screw | | M12 (8 holes) | M12 (8 holes) | M12 (10 holes) |
| Max. motor cable length | | | | |
| shielded / unshielded | m | 300 / 450 | 300 / 450 | 300 / 450 |
| Dimensions (standard version) | | | | |
| - Width | mm | 600 | 600 | 1000 |
| - Height | mm | 2000 | 2000 | 2000 |
| - Depth | mm | 600 | 600 | 600 |
| Power block frame size | | НХ | НХ | JX |
| Weight (without options), approx. | kg | 670 | 670 | 980 |
| Recommended protection Line and semi-cond. protection Rated current frame size to DIN 43620-1 | А | 3NE1448-2 850 3 | 3NE1436-2 2 x 630 3 | 3NE1437-2 2 x 710 3 |

Table 12- 15 Version C, 380 V - 480 V 3 AC, part 3

12.3 Technical specifications

| Order number | 6SL3710- | 1GE37-5CA0 | 1GE38-4CA0 | 1GE41-0CA0 | |
|--|--------------|----------------------|------------|------------|--|
| ¹⁾ Rated output of a typical 6-pole standard induction motor based on I_L or I_H at 400 V 3 AC 50 Hz. | | | | | |
| ²⁾ Rated output of a typical 6-pole standard induction motor based on I _L or I _H at 460 V 3 AC 60 Hz. | | | | | |
| ³⁾ The base-load current l _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 "Overload capability"). | | | | | |
| ⁴⁾ 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 "Overload capability"). | | | | | |
| ⁵⁾ The current values given here are I | based on the | rated output current | | | |

⁶⁾ The recommendations for the North American market in AWG or MCM must be taken from the appropriate NEC (National Electrical Code) or CEC (Canadian Electrical Code) standards.

12.3.3 Cabinet unit version A, 500 V - 600 V 3 AC

Table 12- 16 Version A, 500 V - 600 V 3 AC, part 1

| Order number | 6SL3710- | 1GF31-8AA0 | 1GF32-2AA0 | 1GF32-6AA0 |
|--|--------------------|----------------|-----------------------|-----------------|
| | | | 100 | 100 |
| - for I _L at 50 Hz 500 V ¹) | kW | 110 | 132 | 160 |
| - for I _H at 50 Hz 500 V ¹⁾ | kW | 90 | 110 | 132 |
| - for I _L at 60 Hz 575 V ²⁾ | hp | 150 | 200 | 250 |
| - for I _H at 60 Hz 575 V ²⁾ | hp | 150 | 200 | 200 |
| Output current | | | | |
| - Rated current I _N | А | 175 | 215 | 260 |
| - Base load current I _L ³⁾ | А | 171 | 208 | 250 |
| - Base load current I _H ⁴⁾ | A | 157 | 192 | 233 |
| Input current | | | | |
| - Rated input current ⁵⁾ | А | 191 | 224 | 270 |
| - Input current, max. | А | 279 | 341 | 410 |
| - Current requirements for 24 V DC | А | 1.35 | 1.35 | 1.35 |
| auxiliary supply | | | | |
| Connection voltages | | | | |
| - Line voltage | V _{ACrms} | 500 V 3 AC -10 | % to 600 V 3 AC +10 % | (-15 % < 1 min) |
| - Line frequency | Hz | | 47 to 63 Hz | |
| - Electronics power supply | VDC | | 24 (20.4 - 28.8) | |
| Power loss | kW | 3.8 | 4.2 | 5.0 |
| Cooling air requirement | m ³ /s | 0.36 | 0.36 | 0.36 |
| Sound pressure level L _{pA} | dB(A) | 69/73 | 69/73 | 69/73 |
| (1 m) at 50/60 Hz | 00(71) | 00/10 | 00/10 | 00/10 |
| Line connection | | | | |
| - recommended: DIN VDE ⁶⁾ | mm ² | 120 | 2 x 70 | 2 x 95 |
| - maximum: DIN VDE | mm ² | 4 x 240 | 4 x 240 | 4 x 240 |
| - Fixing screw | | M12 (2 holes) | M12 (2 holes) | M12 (2 holes) |
| | | | | |
| | | 05 | 100 | 0 70 |
| - recommended: DIN VDE ⁶⁾ | mm ² | 95 | 120 | 2 x 70 |
| - maximum: DIN VDE | mm ² | 2 x 150 | 2 x 150 | 2 x 150 |
| - Fixing screw | | M12 (2 holes) | M12 (2 holes) | M12 (2 holes) |
| Protective conductor connection | | | | |
| Fixing screw | | M12 (2 holes) | M12 (2 holes) | M12 (2 holes) |
| Max. motor cable length | | | | |
| shielded / unshielded | m | 300 / 450 | 300 / 450 | 300 / 450 |
| Dimensions (standard version) | | | | |
| - Width | mm | 800 | 800 | 800 |
| - Height | mm | 2000 | 2000 | 2000 |
| - Depth | mm | 600 | 600 | 600 |
| Power block frame size | | GX | GX | GX |
| Weight (without options), approx. | kg | 390 | 390 | 390 |
| troight (milliout options), approx. | a | | | |
| Order number | 6SL3710- | 1GF31-8AA0 | 1GF32-2AA0 | 1GF32-6AA0 |
|-------------------------------------|----------|------------|------------|------------|
| Recommended protection | | | | |
| - Line protection | | | | |
| (with option L26) | | 3NA3244-6 | 3NA3252-6 | 3NA3354-6 |
| Rated current | А | 250 | 315 | 355 |
| frame size to DIN 43620-1 | | 2 | 2 | 3 |
| - Line and semiconductor protection | | | | |
| (without option L26) | | 3NE1227-2 | 3NE1230-2 | 3NE1331-2 |
| Rated current | А | 250 | 315 | 350 |
| Frame size to DIN 43620-1 | | 1 | 1 | 2 |

 $^{1)}$ Rated output of a typical 6-pole standard induction motor based on IL or IH at 500 V 3 AC 50 Hz.

 $^{2)}$ Rated output of a typical 6-pole standard induction motor based on I_L or I_H at 575 V 3 AC 60 Hz.

³⁾ 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 "Overload capability").

⁴⁾ 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 "Overload capability").

⁵⁾ The current values given here are based on the rated output current.

| Order number | 6SL3710- | 1GF33-3AA0 | 1GF34-1AA0 | 1GF34-7AA0 |
|--|-----------------|---------------|-------------------------|-------------------|
| Unit rating | | | | |
| - for I∟ at 50 Hz 500 V ¹) | kW | 200 | 250 | 315 |
| - for I _H at 50 Hz 500 V ¹⁾ | kW | 160 | 200 | 250 |
| - for I _L at 60 Hz 575 V $^{2)}$ | hp | 300 | 400 | 450 |
| - for I _H at 60 Hz 575 V ²⁾ | hp | 250 | 350 | 450 |
| Output current | | | | |
| - Rated current I _N | А | 330 | 410 | 465 |
| - Base load current IL ³⁾ | А | 320 | 400 | 452 |
| - Base load current I _H ⁴⁾ | А | 280 | 367 | 416 |
| Input current | | | | |
| - Rated input current ⁵⁾ | А | 343 | 426 | 483 |
| - Input current, max. | А | 525 | 655 | 740 |
| - Current requirements for 24 V DC | А | 1.4 | 1.4 | 1.4 |
| auxiliary supply | | | | |
| Connection voltages | | | | |
| - Line voltage | VACrms | 500 V 3 AC -1 | 0 % to 600 V 3 AC +10 % | 5 (-15 % < 1 min) |
| - Line frequency | Hz | | 47 to 63 Hz | |
| - Electronics power supply | VDC | | 24 (20.4 - 28.8) | |
| Power loss | kW | 6.1 | 8.1 | 7.8 |
| Cooling air requirement | m³/s | 0.36 | 0.78 | 0.78 |
| Sound pressure level L _{pA} (1 m) at 50/60 Hz | dB(A) | 69/73 | 72/75 | 72/75 |
| Line connection | | | | |
| - recommended: DIN VDE 6) | mm ² | 2 x 120 | 2 x 185 | 2 x 185 |
| - maximum: DIN VDE | mm ² | 4 x 240 | 4 x 240 | 4 x 240 |
| - Fixing screw | | M12 (2 holes) | M12 (2 holes) | M12 (2 holes) |
| Motor connection | | | | |
| - recommended: DIN VDE 6) | mm ² | 2 x 95 | 2 x 120 | 2 x 150 |
| - maximum: DIN VDE | mm ² | 2 x 240 | 4 x 240 | 4 x 240 |
| - Fixing screw | | M12 (2 holes) | M12 (2 holes) | M12 (2 holes) |
| Protective conductor connection | | | | |
| Fixing screw | | M12 (2 holes) | M12 (2 holes) | M12 (2 holes) |
| Max. motor cable length | | | | |
| shielded / unshielded | m | 300 / 450 | 300 / 450 | 300 / 450 |
| Dimensions (standard version) | | | | |
| - Width | mm | 800 | 1200 | 1200 |
| - Height | mm | 2000 | 2000 | 2000 |
| - Depth | mm | 600 | 600 | 600 |
| Power block frame size | | GX | НХ | HX |
| Weight (without options), approx. | kg | 390 | 860 | 860 |
| Recommended protection | | | | |
| - Line protection | | | | |
| (with option L26) | | 3NA3365-6 | 3NA3365-6 | 3NA3352-6 |
| Rated current | А | 500 | 500 | 2 x 315 |
| frame size to DIN 43620-1 | | 3 | 3 | 2 |
| - Line and semiconductor protection | | | | |
| (without option L26) | | 3NE1334-2 | 3NE1334-2 | 3NE1435-2 |
| Rated current | А | 500 | 500 | 560 |
| Frame size to DIN 43620-1 | | 2 | 2 | 3 |

Table 12- 17 Version A, 500 V - 600 V 3 AC, part 2

12.3 Technical specifications

| Order number | 6SL3710- | 1GF33-3AA0 | 1GF34-1AA0 | 1GF34-7AA0 | | |
|--|-------------|----------------------|------------|------------|--|--|
| ¹⁾ Rated output of a typical 6-pole standard induction motor based on I _L or I _H at 500 V 3 AC 50 Hz. | | | | | | |
| ²⁾ Rated output of a typical 6-pole standard induction motor based on I _L or I _H at 575 V 3 AC 60 Hz. | | | | | | |
| ³⁾ 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 "Overload capability"). | | | | | | |
| $^{4)}$ 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 "Overload capability"). | | | | | | |
| ⁵⁾ The current values given here are ba | ased on the | rated output current | • | | | |

| Order number | 6SL3710- | 1GF35-8AA0 | 1GF37-4AA0 | 1GF38-1AA0 |
|--|--------------------|---------------|------------------------|-------------------|
| Unit rating | | | | |
| - for I _L at 50 Hz 500 V ¹⁾ | kW | 400 | 500 | 560 |
| - for $I_{\rm H}$ at 50 Hz 500 V ¹) | kW | 315 | 450 | 500 |
| - for I _L at 60 Hz 575 V ²⁾ | hp | 600 | 700 | 800 |
| - for I _H at 60 Hz 575 V ²⁾ | hp | 500 | 700 | 700 |
| Output current | | | | |
| - Rated current I _N | А | 575 | 735 | 810 |
| - Base load current IL ³⁾ | А | 560 | 710 | 790 |
| - Base load current I _H ⁴⁾ | A | 514 | 657 | 724 |
| Input current | | | | |
| - Rated input current ⁵⁾ | А | 598 | 764 | 842 |
| - Input current, max. | А | 918 | 1164 | 1295 |
| - Current requirements for 24 V DC | А | 1.4 | 1.5 | 1.5 |
| auxiliary supply | | | | |
| Connection voltages | | | | |
| - Line voltage | V _{ACrms} | 500 V 3 AC - | 10 % to 600 V 3 AC +10 | % (-15 % < 1 min) |
| - Line frequency | Hz | | 47 to 63 Hz | |
| - Electronics power supply | VDC | | 24 (20.4 - 28.8) | 1 |
| Power loss | kW | 8.7 | 12.7 | 14.1 |
| Cooling air requirement | m³/s | 0.78 | 1.48 | 1.48 |
| Sound pressure level L _{pA} (1 m) at 50/60 Hz | dB(A) | 72/75 | 72/75 | 72/75 |
| Line connection | | | | |
| - recommended: DIN VDE 6) | mm ² | 2 x 240 | 3 x 185 | 4 x 150 |
| - maximum: DIN VDE | mm ² | 4 x 240 | 8 x 240 | 8 x 240 |
| - Fixing screw | | M12 (2 holes) | M12 (4 holes) | M12 (4 holes) |
| Motor connection | | | | |
| - recommended: DIN VDE 6) | mm ² | 2 x 185 | 3 x 150 | 3 x 185 |
| - maximum: DIN VDE | mm ² | 4 x 240 | 6 x 240 | 6 x 240 |
| - Fixing screw | | M12 (2 holes) | M12 (3 holes) | M12 (3 holes) |
| Protective conductor connection Fixing screw | | M12 (2 holes) | M12 (18 holes) | M12 (18 holes) |
| Max. motor cable length | | , , | , | |
| shielded / unshielded | m | 300 / 450 | 300 / 450 | 300 / 450 |
| Dimensions (standard version) | | | | |
| - Width | mm | 1200 | 1600 | 1600 |
| - Height | mm | 2000 | 2000 | 2000 |
| - Depth | mm | 600 | 600 | 600 |
| Power block frame size | | НХ | JX | JX |
| Weight (without options), approx. | kg | 860 | 1320 | 1360 |
| Recommended protection | | | | |
| - Line protection | | | | |
| (with option L26) | | 3NA3354-6 | 3NA3365-6 | 3NA3365-6 |
| Rated current | А | 2 x 355 | 2 x 500 | 2 x 500 |
| frame size to DIN 43620-1 | | 3 | 3 | 3 |
| - Line and semiconductor protection | | | | |
| (without option L26) | | 3NE1447-2 | 3NE1448-2 | 3NE1334-2 |
| Rated current | А | 670 | 850 | 2 x 500 |
| Frame size to DIN 43620-1 | 1 | 3 | 3 | 2 |

12.3 Technical specifications

| Order number | 6SL3710- | 1GF35-8AA0 | 1GF37-4AA0 | 1GF38-1AA0 | | |
|--|--|-----------------------|------------|------------|--|--|
| ¹⁾ Rated output of a typical 6-pole standard induction motor based on I _L or I _H at 500 V 3 AC 50 Hz. | | | | | | |
| ²⁾ Rated output of a typical 6-pole stand | ²⁾ Rated output of a typical 6-pole standard induction motor based on I _L or I _H at 575 V 3 AC 60 Hz. | | | | | |
| ³⁾ 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 "Overload capability"). | | | | | | |
| $^{4)}$ 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 "Overload capability"). | | | | | | |
| ⁵⁾ The current values given here are ba | ased on the | rated output current. | | | | |

| Order number | 6SL3710- | 2GF38-6AA0 | 2GF41-1AA0 | 2GF41-4AA0 |
|--|-----------------------|-----------------------------------|-----------------------------------|------------------------------------|
| Unit rating | | | | |
| - for I∟ at 50 Hz 500 V ¹⁾ | kW | 630 | 710 | 1000 |
| - for I _H at 50 Hz 500 V ¹⁾ | kW | 560 | 630 | 800 |
| - for IL at 60 Hz 575 V $^{2)}$ | hp | 900 | 1000 | 1250 |
| - for I _H at 60 Hz 575 V ²⁾ | hp | 800 | 900 | 1000 |
| Output current | | | | |
| - Rated current I _N | А | 860 | 1070 | 1360 |
| - Base load current IL ³⁾ | А | 836 | 1036 | 1314 |
| - Base load current I _H ⁴⁾ | А | 770 | 950 | 1216 |
| Input current | | | | |
| - Rated input current ⁵⁾ | А | 904 | 1116 | 1424 |
| - Input current, max. | A | 1388 | 1708 | 2186 |
| - Current requirements for 24 V DC | А | 2.8 | 2.8 | 3.0 |
| auxiliary supply | | | | |
| Connection voltages | | 500.1/0.10 | | |
| - Line voltage | VACrms | 500 V 3 AC -10 |) % to 600 V 3 AC +10 % | (-15 % < 1 min) |
| Line frequency Electronics power supply | Hz V _{DC} | | 47 to 63 Hz 24 (20.4 - 28.8) | |
| 1 11 9 | - | 45.4 | , , , | 22.0 |
| Power loss | kW | 15.4 | 17.2 | 23.8 |
| Cooling air requirement | m³/s | 1.56 | 1.56 | 2.96 |
| Sound pressure level L _{pA} (1 m) at 50/60 Hz | dB(A) | 75/78 | 75/78 | 75/78 |
| Line connection | | Per sub-cabinet: | Per sub-cabinet: | Per sub-cabinet: |
| - recommended: DIN VDE 6) | mm ² | 2 x 185 | 2 x 240 | 3 x 185 |
| - maximum: DIN VDE | mm ² | 4 x 240 | 4 x 240 | 8 x 240 |
| - Fixing screw | | M12 (2 holes) | M12 (2 holes) | M12 (4 holes) |
| Motor connection | | Per sub-cabinet: | Per sub-cabinet: | Per sub-cabinet: |
| - recommended: DIN VDE 6) | mm ² | 2 x 150 | 2 x 185 | 3 x 150 |
| - maximum: DIN VDE | mm ² | 4 x 240 | 4 x 240 | 6 x 240 |
| - Fixing screw | | M12 (2 holes) | M12 (2 holes) | M12 (3 holes) |
| Protective conductor connection Fixing screw | | Per sub-cabinet: M12 (2 holes) | Per sub-cabinet: M12 (2 holes) | Per sub-cabinet: M12 (18 holes) |
| Max. motor cable length | | | | |
| shielded / unshielded | m | 300 / 450 | 300 / 450 | 300 / 450 |
| Dimensions (standard version) | | | | |
| - Width | mm | 2400 | 2400 | 3200 |
| - Height | mm | 2000 | 2000 | 2000 |
| - Depth | mm | 600 | 600 | 600 |
| Power block frame size | | HX | HX | JX |
| Weight (without options), approx. | kg | 1700 | 1700 | 2620 |
| Recommended protection | | | | |
| - Line protection | | Per sub-cabinet: | Per sub-cabinet: | Per sub-cabinet: |
| (with option L26) | | 3NA3352-6 | 3NA3365-6 | 3NA3365-6 |
| Rated current | А | 2 x 315 | 2 x 500 | 2 x 500 |
| frame size to DIN 43620-1 | | 3 | 3 | 3 |
| - Line and semiconductor protection | | Per sub-cabinet: | Per sub-cabinet: | Per sub-cabinet: |
| (without option L26) | Ι. | 3NE1435-2 | 3NE1447-2 | 3NE1448-2 |
| Rated current | A | 560 | 670 | 850 |
| Frame size to DIN 43620-1 | | 3 | 3 | 3 |

Table 12- 19 Version A, 500 V – 600 V 3 AC, part 4

12.3 Technical specifications

| Order number | 6SL3710- | 2GF38-6AA0 | 2GF41-1AA0 | 2GF41-4AA0 | | |
|--|----------|------------|------------|------------|--|--|
| ¹⁾ Rated output of a typical 6-pole standard induction motor based on I _L or I _H at 500 V 3 AC 50 Hz. | | | | | | |
| ²⁾ Rated output of a typical 6-pole standard induction motor based on I _L or I _H at 575 V 3 AC 60 Hz. | | | | | | |
| ³⁾ 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 "Overload capability"). | | | | | | |
| $^{\rm 4)}$ The base-load current $I_{\rm H}$ 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 "Overload capability"). | | | | | | |
| | | | | | | |

⁵⁾ The current values given here are based on the rated output current.

12.3.4 Cabinet unit version C, 500 V - 600 V 3 AC

Table 12- 20 Version C, 500 V - 600 V 3 AC, part 1

| Order number | 6SL3710- | 1GF31-8CA0 | 1GF32-2CA0 | 1GF32-6CA0 |
|---|--------------------|---------------|--------------------------|-----------------------|
| Unit rating | | | | |
| - for I _L at 50 Hz 500 V ¹⁾ | kW | 110 | 132 | 160 |
| - for I _H at 50 Hz 500 V ¹⁾ | kW | 90 | 110 | 132 |
| - for I∟ at 60 Hz 575 V ²⁾ | hp | 150 | 200 | 250 |
| - for I _H at 60 Hz 575 V ²⁾ | hp | 150 | 200 | 200 |
| Output current | | | | |
| - Rated current I _N | А | 175 | 215 | 260 |
| - Base load current $I_{L^{3}}$ | A | 171 | 208 | 250 |
| - Base load current I _H ⁴⁾ | A | 157 | 192 | 233 |
| | <u></u> | 101 | 132 | 200 |
| - Rated input current ⁵⁾ | А | 191 | 224 | 270 |
| | | 279 | 341 | 410 |
| - Input current, max. | A | | | |
| - Current requirements for 24 V DC auxiliary supply | A | 1.35 | 1.35 | 1.35 |
| | | | | |
| Connection voltages | V | | | ((45.0) < 4.00 = 10) |
| - Line voltage | V _{ACrms} | 500 V 3 AC -1 | 10 % to 600 V 3 AC +10 % | % (-15 % < 1 min) |
| - Line frequency | Hz | | 47 to 63 Hz | |
| - Electronics power supply | VDC | | 24 (20.4 - 28.8) | |
| Power loss | kW | 3.8 | 4.2 | 5.0 |
| Cooling air requirement | m³/s | 0.36 | 0.36 | 0.36 |
| Sound pressure level LpA | dB(A) | 69/73 | 69/73 | 69/73 |
| (1 m) at 50/60 Hz | | | | |
| Line connection | | | | |
| - recommended: DIN VDE 6) | mm ² | 120 | 2 x 70 | 2 x 95 |
| - maximum: DIN VDE | mm ² | 4 x 240 | 4 x 240 | 4 x 240 |
| - Fixing screw | | M12 (1 hole) | M12 (1 hole) | M12 (1 hole) |
| Motor connection | | | | |
| - recommended: DIN VDE ⁶⁾ | mm ² | 95 | 120 | 2 x 70 |
| - maximum: DIN VDE | mm ² | 2 x 150 | 2 x 150 | 2 x 150 |
| - Fixing screw | | M12 (1 hole) | M12 (1 hole) | M12 (1 hole) |
| | | | | |
| Protective conductor connection Fixing screw | | M12 (2 holes) | M12 (2 holes) | M12 (2 holes) |
| | | | | |
| Max. motor cable length shielded / unshielded | m | 300 / 450 | 300 / 450 | 300 / 450 |
| | m | 5007430 | 5007450 | 5007450 |
| Dimensions (standard version) | | 400 | 400 | 400 |
| - Width | mm | 400 | 400 | 400 |
| - Height | mm | 2000 | 2000 | 2000 |
| - Depth | mm | 600 | 600 | 600 |
| Power block frame size | | GX | GX | GX |
| Weight (without options), approx. | kg | 300 | 300 | 300 |
| Recommended protection | | | | |
| -Line and semi-cond. protection | | 3NE1227-2 | 3NE1230-2 | 3NE1331-2 |
| Rated current | А | 250 | 315 | 350 |
| frame size to DIN 43620-1 | | 1 | 1 | 2 |

12.3 Technical specifications

| Order number | 6SL3710- | 1GF31-8CA0 | 1GF32-2CA0 | 1GF32-6CA0 | | |
|--|-------------|----------------------|------------|------------|--|--|
| ¹⁾ Rated output of a typical 6-pole standard induction motor based on I _L or I _H at 500 V 3 AC 50 Hz. | | | | | | |
| ²⁾ Rated output of a typical 6-pole standard induction motor based on I _L or I _H at 575 V 3 AC 60 Hz. | | | | | | |
| ³⁾ 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 "Overload capability"). | | | | | | |
| $^{\rm 4)}$ The base-load current $I_{\rm H}$ 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 "Overload capability"). | | | | | | |
| ⁵⁾ The current values given here are b | ased on the | rated output current | | | | |

| Order number | 6SL3710- | 1GF33-3CA0 | 1GF34-1CA0 | 1GF34-7CA0 | |
|--|-----------------|------------------|-----------------------|-----------------|--|
| Unit rating | | | | | |
| - for I∟ at 50 Hz 500 V ¹) | kW | 200 | 250 | 315 | |
| - for I _H at 50 Hz 500 V ¹⁾ | kW | 160 | 200 | 250 | |
| - for I _L at 60 Hz 575 V ²⁾ | hp | 300 | 400 | 450 | |
| - for I _H at 60 Hz 575 V ²⁾ | hp | 250 | 350 | 450 | |
| Output current | | | | | |
| - Rated current I _N | А | 330 | 410 | 465 | |
| - Base load current IL ³⁾ | А | 320 | 400 | 452 | |
| - Base load current I _H ⁴⁾ | А | 280 | 367 | 416 | |
| Input current | | | | | |
| - Rated input current ⁵⁾ | А | 343 | 426 | 483 | |
| - Input current, max. | А | 525 | 655 | 740 | |
| - Current requirements for 24 V DC | А | 1.4 | 1.4 | 1.4 | |
| auxiliary supply | | | | | |
| Connection voltages | | | | | |
| - Line voltage | VACrms | 500 V 3 AC -10 | % to 600 V 3 AC +10 % | (-15 % < 1 min) | |
| - Line frequency | Hz | | 47 to 63 Hz | | |
| - Electronics power supply | VDC | 24 (20.4 - 28.8) | | | |
| Power loss | kW | 6.1 | 8.1 | 7.8 | |
| Cooling air requirement | m³/s | 0.36 | 0.78 | 0.78 | |
| Sound pressure level L _{pA} (1 m) at 50/60 Hz | dB(A) | 69/73 | 72/75 | 72/75 | |
| Line connection | | | | | |
| - recommended: DIN VDE 6) | mm ² | 2 x 120 | 2 x 185 | 2 x 185 | |
| - maximum: DIN VDE | mm ² | 4 x 240 | 4 x 240 | 4 x 240 | |
| - Fixing screw | | M12 (1 hole) | M12 (2 holes) | M12 (2 holes) | |
| Motor connection | | | | | |
| - recommended: DIN VDE 6) | mm ² | 2 x 95 | 2 x 120 | 2 x 150 | |
| - maximum: DIN VDE | mm ² | 2 x 150 | 4 x 240 | 4 x 240 | |
| - Fixing screw | | M12 (1 hole) | M12 (2 holes) | M12 (2 holes) | |
| Protective conductor connection | | | | | |
| Fixing screw | | M12 (2 holes) | M12 (2 holes) | M12 (2 holes) | |
| Max. motor cable length | | | | | |
| shielded / unshielded | m | 300 / 450 | 300 / 450 | 300 / 450 | |
| Dimensions (standard version) | | | | | |
| - Width | mm | 400 | 600 | 600 | |
| - Height | mm | 2000 | 2000 | 2000 | |
| - Depth | mm | 600 | 600 | 600 | |
| Power block frame size | | GX | HX | НХ | |
| Weight (without options), approx. | kg | 300 | 670 | 670 | |
| Recommended protection | | | | | |
| -Line and semi-cond. protection | | 3NE1334-2 | 3NE1334-2 | 3NE1435-2 | |
| Rated current | А | 500 | 500 | 560 | |
| frame size to DIN 43620-1 | | 2 | 2 | 3 | |

Table 12- 21 Version C, 500 V - 600 V 3 AC, part 2

12.3 Technical specifications

| Order number | 6SL3710- | 1GF33-3CA0 | 1GF34-1CA0 | 1GF34-7CA0 | | |
|--|--------------|---------------------|------------|------------|--|--|
| ¹⁾ Rated output of a typical 6-pole standard induction motor based on I_L or I_H at 500 V 3 AC 50 Hz. | | | | | | |
| ²⁾ Rated output of a typical 6-pole standard induction motor based on I _L or I _H at 575 V 3 AC 60 Hz. | | | | | | |
| ³⁾ 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 "Overload capability"). | | | | | | |
| $^{\rm 4)}$ The base-load current $I_{\rm H}$ 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 "Overload capability"). | | | | | | |
| ⁵⁾ The current values given here are I | based on the | rated output curren | | | | |

| Order number | 6SL3710- | 1GF35-8CA0 | 1GF37-4CA0 | 1GF38-1CA0 | |
|---|-----------------|------------------|-----------------------|-----------------|--|
| Unit rating | | | | | |
| - for I _L at 50 Hz 500 V ¹⁾ | kW | 400 | 500 | 560 | |
| - for I _H at 50 Hz 500 V ¹⁾ | kW | 315 | 450 | 500 | |
| - for I _L at 60 Hz 575 V ²⁾ | hp | 600 | 700 | 800 | |
| - for I _H at 60 Hz 575 V ²⁾ | hp | 500 | 700 | 700 | |
| Output current | | | | | |
| - Rated current I _N | А | 575 | 735 | 810 | |
| - Base load current IL ³⁾ | А | 560 | 710 | 790 | |
| - Base load current I _H ⁴⁾ | А | 514 | 657 | 724 | |
| Input current | | | | | |
| - Rated input current ⁵⁾ | А | 598 | 764 | 842 | |
| - Input current, max. | А | 918 | 1164 | 1295 | |
| - Current requirements for 24 V DC | А | 1.4 | 1.5 | 1.5 | |
| auxiliary supply | | | | | |
| Connection voltages | | | | | |
| - Line voltage | VACrms | 500 V 3 AC -10 | % to 600 V 3 AC +10 % | (-15 % < 1 min) | |
| - Line frequency | Hz | | 47 to 63 Hz | · , | |
| - Electronics power supply | VDC | 24 (20.4 - 28.8) | | | |
| Power loss | kW | 8.7 | 12.7 | 14.1 | |
| Cooling air requirement | m³/s | 0.78 | 1.48 | 1.48 | |
| Sound pressure level LpA | dB(A) | 72/75 | 72/75 | 72/75 | |
| (1 m) at 50/60 Hz | | | | | |
| Line connection | | | | | |
| - recommended: DIN VDE 6) | mm ² | 2 x 240 | 3 x 185 | 4 x 150 | |
| - maximum: DIN VDE | mm ² | 4 x 240 | 8 x 240 | 8 x 240 | |
| - Fixing screw | | M12 (2 holes) | M12 (4 holes) | M12 (4 holes) | |
| Motor connection | | | | | |
| - recommended: DIN VDE 6) | mm ² | 2 x 185 | 3 x 150 | 3 x 185 | |
| - maximum: DIN VDE | mm ² | 4 x 240 | 6 x 240 | 6 x 240 | |
| - Fixing screw | | M12 (2 holes) | M12 (3 holes) | M12 (3 holes) | |
| Protective conductor connection | | | | | |
| Fixing screw | | M12 (2 holes) | M12 (18 holes) | M12 (18 holes) | |
| Max. motor cable length | | | | | |
| shielded / unshielded | m | 300 / 450 | 300 / 450 | 300 / 450 | |
| Dimensions (standard version) | | | | | |
| - Width | mm | 600 | 1000 | 1000 | |
| - Height | mm | 2000 | 2000 | 2000 | |
| - Depth | mm | 600 | 600 | 600 | |
| Power block frame size | | НХ | JX | JX | |
| Weight (without options), approx. | kg | 670 | 940 | 980 | |
| Recommended protection | | | | | |
| -Line and semi-cond. protection | | 3NE1447-2 | 3NE1448-2 | 3NE1334-2 | |
| Rated current | А | 670 | 850 | 2 x 500 | |
| frame size to DIN 43620-1 | | 3 | 3 | 2 | |

Table 12- 22 Version C, 500 V - 600 V 3 AC, part 3

12.3 Technical specifications

| Order number | 6SL3710- | 1GF35-8CA0 | 1GF37-4CA0 | 1GF38-1CA0 | | |
|--|-------------|----------------------|------------|------------|--|--|
| ¹⁾ Rated output of a typical 6-pole standard induction motor based on I _L or I _H at 500 V 3 AC 50 Hz. | | | | | | |
| ²⁾ Rated output of a typical 6-pole standard induction motor based on I_L or I_H at 575 V 3 AC 60 Hz. | | | | | | |
| ³⁾ 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 "Overload capability"). | | | | | | |
| $^{\rm 4)}$ The base-load current $I_{\rm H}$ 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 "Overload capability"). | | | | | | |
| ⁵⁾ The current values given here are b | ased on the | rated output current | | | | |

12.3.5 Cabinet unit version A, 660 V - 690 V 3 AC

Table 12- 23 Version A, 660 V - 690 V 3 AC, part 1

| Order number | 6SL3710- | 1GH28-5AA0 | 1GH31-0AA0 | 1GH31-2AA0 | |
|---|------------------------------------|------------------|-----------------------|----------------|--|
| Unit rating - for I _L at 50 Hz 690 V ¹⁾ | kW | 75 | 90 | 110 | |
| - for I _H at 50 Hz 690 V ¹⁾ | kW | 55 | 75 | 90 | |
| Output current | | | | | |
| - Rated current I _N | А | 85 | 100 | 120 | |
| - Base load current IL ²⁾ | A | 80 | 95 | 115 | |
| - Base load current I _H ³⁾ | A | 76 | 89 | 107 | |
| | • | 93 | 100 | 131 | |
| - Rated input current ⁴⁾ - Input current, max. | A | 131 | 109 155 | 188 | |
| - Current requirements for 24 V DC | A | 1.1 | 1.1 | 1.0 | |
| auxiliary supply | ^ | 1.1 | 1.1 | 1.1 | |
| Connection voltages | | | | | |
| - Line voltage | VACrms | 660 V 3 AC -1 | 0% to 690 V 3 AC +10% | (-15% < 1 min) | |
| - Line frequency | Hz | | 47 to 63 Hz | | |
| - Electronics power supply | V _{DC} | 24 (20.4 - 28.8) | | | |
| Power loss | kW | 1.7 | 2.1 | 2.7 | |
| Cooling air requirement | m³/s | 0.17 | 0.17 | 0.17 | |
| Sound pressure level L _{pA} (1 m) at 50/60 Hz | dB(A) | 67/68 | 67/68 | 67/68 | |
| Line connection | | | | | |
| - recommended: DIN VDE ⁵⁾ | mm ² | 50 | 50 | 70 | |
| - maximum: DIN VDE | mm ² | 4 x 240 | 4 x 240 | 4 x 240 | |
| - Fixing screw | | M12 (2 holes) | M12 (2 holes) | M12 (2 holes) | |
| Motor connection | 2 | 0.5 | 50 | | |
| - recommended: DIN VDE ⁵⁾ | mm ² mm ² | 35 2 x 70 | 50 2 x 150 | 70 2 x 150 | |
| - maximum: DIN VDE - Fixing screw | mm² | M12 (2 holes) | M12 (2 holes) | M12 (2 holes) | |
| Protective conductor connection | | | | | |
| Fixing screw | | M12 (2 holes) | M12 (2 holes) | M12 (2 holes) | |
| Max. motor cable length | | | (| | |
| shielded / unshielded | m | 300 / 450 | 300 / 450 | 300 / 450 | |
| Dimensions (standard version) | | | | | |
| - Width | mm | 800 | 800 | 800 | |
| - Height | mm | 2000 | 2000 | 2000 | |
| - Depth | mm | 600 | 600 | 600 | |
| Power block frame size | | FX | FX | FX | |
| Weight (without options), approx. | kg | 320 | 320 | 320 | |

| Order number | 6SL3710- | 1GH28-5AA0 | 1GH31-0AA0 | 1GH31-2AA0 |
|-------------------------------------|----------|------------|------------|------------|
| Recommended protection | | | | |
| - Line protection | | | | |
| (with option L26) | | 3NA3132-6 | 3NA3132-6 | 3NA3136-6 |
| Rated current | А | 125 | 125 | 160 |
| frame size to DIN 43620-1 | | 1 | 1 | 1 |
| - Line and semiconductor protection | | | | |
| (without option L26) | | 3NE1022-2 | 3NE1022-2 | 3NE1224-2 |
| Rated current | А | 125 | 125 | 160 |
| Frame size to DIN 43620-1 | | 00 | 00 | 1 |

 $^{1)}$ Rated output of a typical 6-pole standard induction motor based on IL or IH at 690 V 3 AC 50 Hz.

 $^{2)}$ 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 "Overload capability").

 $^{3)}$ 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 "Overload capability").

⁴⁾ The current values given here are based on the rated output current.

| Order number | 6SL3710- | 1GH31-5AA0 | 1GH31-8AA0 | 1GH32-2AA0 |
|---|-----------------|---------------|-----------------------|---------------------------------------|
| Unit rating | | | | |
| - for I _L at 50 Hz 690 V ¹⁾ | kW | 132 | 160 | 200 |
| - for I _H at 50 Hz 690 V ¹⁾ | kW | 110 | 132 | 160 |
| Output current | | | | |
| - Rated current I _N | А | 150 | 175 | 215 |
| - Base load current $I_{L^{(2)}}$ | A | 142 | 171 | 208 |
| - Base load current $I_{H^{(3)}}$ | A | 134 | 157 | 192 |
| Input current | | | | |
| - Rated input current ⁴⁾ | А | 164 | 191 | 224 |
| - Input current, max. | A | 232 | 279 | 341 |
| - Current requirements for 24 V DC | A | 1.1 | 1.35 | 1.35 |
| auxiliary supply | ^ | | 1.00 | |
| Connection voltages | | | | |
| - Line voltage | VACrms | 660 V 3 AC -1 | 0% to 690 V 3 AC +10% | (-15% < 1 min) |
| - Line frequency | Hz | | 47 to 63 Hz | , , , , , , , , , , , , , , , , , , , |
| - Electronics power supply | VDC | | 24 (20.4 - 28.8) | |
| Power loss | kW | 2.8 | 3.8 | 4.2 |
| Cooling air requirement | m³/s | 0.17 | 0.36 | 0.36 |
| Sound pressure level LpA | dB(A) | 67/68 | 67/73 | 67/73 |
| (1 m) at 50/60 Hz | | | | |
| Line connection | | | | |
| - recommended: DIN VDE ⁵⁾ | mm ² | 95 | 120 | 2 x 70 |
| - maximum: DIN VDE | mm ² | 4 x 240 | 4 x 240 | 4 x 240 |
| - Fixing screw | | M12 (2 holes) | M12 (2 holes) | M12 (2 holes) |
| Motor connection | | | | |
| - recommended: DIN VDE ⁵⁾ | mm ² | 70 | 95 | 120 |
| - maximum: DIN VDE | mm ² | 2 x 150 | 2 x 150 | 2 x 150 |
| - Fixing screw | | M12 (2 holes) | M12 (2 holes) | M12 (2 holes) |
| Protective conductor connection | | | | |
| Fixing screw | | M12 (2 holes) | M12 (2 holes) | M12 (2 holes) |
| Max. motor cable length | | | | |
| shielded / unshielded | m | 300 / 450 | 300 / 450 | 300 / 450 |
| Dimensions (standard version) | | | | |
| - Width | mm | 800 | 800 | 800 |
| - Height | mm | 2000 | 2000 | 2000 |
| - Depth | mm | 600 | 600 | 600 |
| Power block frame size | | FX | GX | GX |
| Weight (without options), approx. | kg | 320 | 390 | 390 |
| Recommended protection | | | | |
| - Line protection | | | | |
| (with option L26) | 1. | 3NA3240-6 | 3NA3244-6 | 3NA3252-6 |
| Rated current | A | 200 | 250 | 315 |
| frame size to DIN 43620-1 | | 2 | 2 | 2 |
| - Line and semiconductor protection | | | 0154007.0 | |
| (without option L26) | | 3NE1225-2 | 3NE1227-2 | 3NE1230-2 |
| Rated current | A | 200 | 250 | 315 |
| Frame size to DIN 43620-1 | | 1 | 1 | 1 |

Table 12- 24 Version A, 660 V - 690 V 3 AC, part 2

12.3 Technical specifications

| Order number | 6SL3710- | 1GH31-5AA0 | 1GH31-8AA0 | 1GH32-2AA0 |
|--------------|----------|------------|------------|------------|
| | | | | |

¹⁾ Rated output of a typical 6-pole standard induction motor based on I_L or I_H at 690 V 3 AC 50 Hz.

²⁾ 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 "Overload capability").

 $^{3)}$ The base-load current $I_{\rm H}$ 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 "Overload capability").

⁴⁾ The current values given here are based on the rated output current.

12.3 Technical specifications

| Order number | 6SL3710- | 1GH32-6AA0 | 1GH33-3AA0 | 1GH34-1AA0 |
|--|-------------------|---------------|--------------------------------------|----------------|
| Unit rating | | | | |
| - for I∟ at 50 Hz 690 V ¹⁾ | kW | 250 | 315 | 400 |
| - for $I_{\rm H}$ at 50 Hz 690 V ¹⁾ | kW | 200 | 250 | 315 |
| Output current | | | | |
| - Rated current I _N | А | 260 | 330 | 410 |
| - Base load current $I_{L}^{2)}$ | A | 250 | 320 | 400 |
| - Base load current $I_{H}^{(3)}$ | A | 233 | 280 | 367 |
| | <i>N</i> | 200 | 200 | 001 |
| Input current | | 270 | 343 | 426 |
| - Rated input current ⁴⁾ | A | | | |
| - Input current, max. | A | 410 | 525 | 655 |
| - Current requirements for 24 V DC auxiliary supply | А | 1.35 | 1.35 | 1.4 |
| | | | | |
| Connection voltages - Line voltage | VACrms | | 0% to 600 \/ 2 AC + 10% | (1E0/ < 1 min) |
| | | 000 V 3 AC -1 | 0% to 690 V 3 AC +10% 47 to 63 Hz | (-15% < 1 min) |
| - Line frequency | Hz | | | |
| - Electronics power supply | | 50 | 24 (20.4 - 28.8) | |
| Power loss | kW | 5.0 | 6.1 | 8.1 |
| Cooling air requirement | m ³ /s | 0.36 | 0.36 | 0.78 |
| Sound pressure level L _{pA} (1 m) at 50/60 Hz | dB(A) | 67/73 | 67/73 | 72/75 |
| Line connection | | | | |
| - recommended: DIN VDE ⁵⁾ | mm ² | 2 x 95 | 2 x 120 | 2 x 185 |
| - maximum: DIN VDE | mm ² | 4 x 240 | 4 x 240 | 4 x 240 |
| - Fixing screw | | M12 (2 holes) | M12 (2 holes) | M12 (2 holes) |
| Motor connection | | | | |
| - recommended: DIN VDE ⁵⁾ | mm ² | 2 x 70 | 2 x 95 | 2 x 120 |
| - maximum: DIN VDE | mm ² | 2 x 185 | 2 x 240 | 4 x 240 |
| - Fixing screw | | M12 (2 holes) | M12 (2 holes) | M12 (2 holes) |
| Protective conductor connection | | | | |
| Fixing screw | | M12 (2 holes) | M12 (2 holes) | M12 (2 holes) |
| Max. motor cable length | | | | |
| shielded / unshielded | m | 300 / 450 | 300 / 450 | 300 / 450 |
| Dimensions (standard version) | | | | |
| - Width | mm | 800 | 800 | 1200 |
| - Height | mm | 2000 | 2000 | 2000 |
| - Depth | mm | 600 | 600 | 600 |
| Power block frame size | | GX | GX | НХ |
| Weight (without options), approx. | kg | 390 | 390 | 860 |
| Recommended protection | | | | |
| - Line protection | | | | |
| (with option L26) | 1. | 3NA3354-6 | 3NA3365-6 | 3NA3365-6 |
| Rated current | A | 355 | 500 | 500 |
| frame size to DIN 43620-1 | | 3 | 3 | 3 |
| - Line and semiconductor protection | | | | |
| (without option L26) | | 3NE1331-2 | 3NE1334-2 | 3NE1334-2 |
| Rated current | A | 350 | 500 | 500 |
| Frame size to DIN 43620-1 | <u> </u> | 2 | 2 | 2 |

Table 12- 25 Version A, 660 V - 690 V 3 AC, part 3

12.3 Technical specifications

| Order number | 6SL3710- | 1GH32-6AA0 | 1GH33-3AA0 | 1GH34-1AA0 |
|--------------|----------|------------|------------|------------|
| | | | | |

¹⁾ Rated output of a typical 6-pole standard induction motor based on I_L or I_H at 690 V 3 AC 50 Hz.

²⁾ 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 "Overload capability").

 $^{3)}$ 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 "Overload capability").

⁴⁾ The current values given here are based on the rated output current.

| Order number | 6SL3710- | 1GH34-7AA0 | 1GH35-8AA0 | 1GH37-4AA0 |
|---|--------------------|--------------------|-----------------------|----------------|
| Unit rating | | | | |
| - for I _L at 50 Hz 690 V ¹⁾ | kW | 450 | 560 | 710 |
| - for I _H at 50 Hz 690 V $^{1)}$ | kW | 400 | 450 | 560 |
| Output current | | | | |
| - Rated current I _N | А | 465 | 575 | 735 |
| - Base load current $I_{L}^{(2)}$ | A | 452 | 560 | 710 |
| - Base load current I _H ³⁾ | A | 416 | 514 | 657 |
| Input current | | | | |
| - Rated input current ⁴⁾ | А | 483 | 598 | 764 |
| - Input current, max. | A | 740 | 918 | 1164 |
| - Current requirements for 24 V DC | A | 1.4 | 1.4 | 1.5 |
| auxiliary supply | | | | |
| Connection voltages | | | | |
| - Line voltage | V _{ACrms} | 660 V 3 AC -1 | 0% to 690 V 3 AC +10% | (-15% < 1 min) |
| - Line frequency | Hz | 000 0 0 / 0 / 10 1 | 47 to 63 Hz | |
| - Electronics power supply | VDC | | 24 (20.4 - 28.8) | |
| Power loss | kW | 9.1 | 10.8 | 13.5 |
| Cooling air requirement | m ³ /s | 0.78 | 0.78 | 1.48 |
| Sound pressure level L _{pA} | dB(A) | 72/75 | 72/75 | 72/75 |
| (1 m) at 50/60 Hz | | 12/13 | 12/13 | 12/13 |
| Line connection | | | | |
| - recommended: DIN VDE ⁵⁾ | mm ² | 2 x 185 | 2 x 240 | 3 x 185 |
| - maximum: DIN VDE | mm ² | 4 x 240 | 4 x 240 | 8 x 240 |
| - Fixing screw | | M12 (2 holes) | M12 (2 holes) | M12 (4 holes) |
| Motor connection | | | | |
| - recommended: DIN VDE 5) | mm ² | 2 x 150 | 2 x 185 | 3 x 150 |
| - maximum: DIN VDE | mm ² | 4 x 240 | 4 x 240 | 6 x 240 |
| - Fixing screw | | M12 (2 holes) | M12 (2 holes) | M12 (3 holes) |
| Protective conductor connection | | | | |
| Fixing screw | | M12 (2 holes) | M12 (2 holes) | M12 (18 holes) |
| Max. motor cable length | | | | |
| shielded / unshielded | m | 300 / 450 | 300 / 450 | 300 / 450 |
| Dimensions (standard version) | | | | |
| - Width | mm | 1200 | 1200 | 1600 |
| - Height | mm | 2000 | 2000 | 2000 |
| - Depth | mm | 600 | 600 | 600 |
| Power block frame size | | НХ | HX | JX |
| Weight (without options), approx. | kg | 860 | 860 | 1320 |
| Recommended protection | | | | |
| - Line protection | | | | |
| (with option L26) | | 3NA3352-6 | 3NA3354-6 | 3NA3365-6 |
| Rated current | A | 2 x 315 | 2 x 355 | 2 x 500 |
| frame size to DIN 43620-1 | | 3 | 3 | 3 |
| - Line and semiconductor protection | | | | |
| (without option L26) | | 3NE1435-2 | 3NE1447-2 | 3NE1448-2 |
| Rated current | A | 560 | 670 | 850 |
| Frame size to DIN 43620-1 | | 3 | 3 | 3 |

Table 12- 26 Version A, 660 V - 690 V 3 AC, part 4

12.3 Technical specifications

| Order number | 6SL3710- | 1GH34-7AA0 | 1GH35-8AA0 | 1GH37-4AA0 |
|--------------|----------|------------|------------|------------|
| | | | | |

¹⁾ Rated output of a typical 6-pole standard induction motor based on I_L or I_H at 690 V 3 AC 50 Hz.

²⁾ 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 "Overload capability").

 $^{3)}$ 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 "Overload capability").

⁴⁾ The current values given here are based on the rated output current.

12.3 Technical specifications

| Order number | 6SL3710- | 1GH38-1AA0 | 2GH41-1AA0 | 2GH41-4AA0 |
|--|-----------------|----------------|-------------------------------|----------------------|
| Unit rating | | | | |
| - for I∟ at 50 Hz 690 V ¹⁾ | kW | 800 | 1000 | 1350 |
| - for I _H at 50 Hz 690 V ¹⁾ | kW | 710 | 900 | 1200 |
| Output current | | | | |
| - Rated current I _N | А | 810 | 1070 | 1360 |
| - Base load current IL ²⁾ | А | 790 | 1036 | 1314 |
| - Base load current I _H 3) | А | 724 | 950 | 1216 |
| Input current | | | | |
| - Rated input current ⁴⁾ | А | 842 | 1116 | 1424 |
| - Input current, max. | А | 1295 | 1708 | 2186 |
| - Current requirements for 24 V DC | А | 1.5 | 2.8 | 2.8 |
| auxiliary supply | | | | |
| Connection voltages | | | | |
| - Line voltage | VACrms | 660 V 3 AC - | 10% to 690 V 3 AC +10% | o (-15% < 1 min) |
| - Line frequency | Hz | | 47 to 63 Hz | |
| - Electronics power supply | VDC | | 24 (20.4 - 28.8) | |
| Power loss | kW | 14.7 | 21.3 | 26.6 |
| Cooling air requirement | m³/s | 1.48 | 1.56 | 2.96 |
| Sound pressure level L _{pA} (1 m) at 50/60 Hz | dB(A) | 72/75 | 75/78 | 75/78 |
| Line connection | | | Per sub-cabinet: | Per sub-cabinet: |
| - recommended: DIN VDE 4) | mm ² | 4 x 150 | 2 x 240 | 3 x 185 |
| - maximum: DIN VDE | mm ² | 8 x 240 | 4 x 240 | 8 x 240 |
| - Fixing screw | | M12 (4 holes) | M12 (2 holes) | M12 (4 holes) |
| Motor connection | | | Per sub-cabinet: | Per sub-cabinet: |
| - recommended: DIN VDE ⁵⁾ | mm ² | 3 x 185 | 2 x 185 | 3 x 150 |
| - maximum: DIN VDE | mm ² | 6 x 240 | 4 x 240 | 6 x 240 |
| - Fixing screw | | M12 (3 holes) | M12 (2 holes) | M12 (3 holes) |
| Protective conductor connection | | | Per sub-cabinet: | Per sub-cabinet: |
| Fixing screw | | M12 (18 holes) | M12 (2 holes) | M12 (18 holes) |
| Max. motor cable length | | | | |
| shielded / unshielded | m | 300 / 450 | 300 / 450 | 300 / 450 |
| Dimensions (standard version) | | | | |
| - Width | mm | 1600 | 2400 | 3200 |
| - Height | mm | 2000 | 2000 | 2000 |
| - Depth | mm | 600 | 600 | 600 |
| Power block frame size | | JX | HX | JX |
| Weight (without options), approx. | kg | 1360 | 1700 | 2620 |
| Recommended protection | | | | |
| - Line protection | | | Per sub-cabinet: | Per sub-cabinet: |
| (with option L26) | | 3NA3365-6 | 3NA3354-6 | 3NA3365-6 |
| Rated current | A | 2 x 500 | 2 x 355 | 2 x 500 |
| frame size to DIN 43620-1 | | 3 | 3 Der sub sebinati | 3 Der sub sehinst |
| - Line and semiconductor protection | | 3NE1334-2 | Per sub-cabinet: 3NE1447-2 | Per sub-cabinet: |
| (without option L26) Rated current | А | 2 x 500 | 3NE 1447-2 670 | 3NE1448-2 850 |
| Frame size to DIN 43620-1 | | 2 x 500 | 3 | 3 |
| 1 Tame SIZE 10 DIN 43020-1 | | ۷ | 5 | 5 |

Table 12- 27 Version A, 660 V - 690 V 3 AC, part 5

12.3 Technical specifications

| Order number 6SL3710- 1GH38-1AA0 2GH41-1AA0 2GH41-4AA0 | | | | | |
|--|--------------|----------|------------|------------|------------|
| | Order number | 6SL3710- | 1GH38-1AA0 | 2GH41-1AA0 | 2GH41-4AA0 |

¹⁾ Rated output of a typical 6-pole standard induction motor based on I_L or I_H at 690 V 3 AC 50 Hz.

²⁾ 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 "Overload capability").

 $^{3)}$ The base-load current $I_{\rm H}$ 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 "Overload capability").

⁴⁾ The current values given here are based on the rated output current.

12.3 Technical specifications

| Order number | 6SL3710- | 2GH41-5AA0 | | |
|---|---|--|--|----------------|
| Unit rating - for I∟ at 50 Hz 690 V ¹⁾ - for I _H at 50 Hz 690 V ¹⁾ | kW kW | 1500 1350 | | |
| Output current - Rated current I _N - Base load current I _L ²⁾ - Base load current I _H ³⁾ | A A A | 1500 1462 1340 | | |
| Input current - Rated input current ⁴⁾ - Input current, max. - Current requirements for 24 V DC auxiliary supply | A A A | 1568 2406 3.0 | | |
| Connection voltages - Line voltage - Line frequency - Electronics power supply | V _{ACrms} Hz V _{DC} | 660 V 3 AC -10 | 0% to 690 V 3 AC +10% 47 to 63 Hz 24 (20.4 - 28.8) | (-15% < 1 min) |
| Power loss | kW | 29.0 | | |
| Cooling air requirement | m³/s | 2.96 | | |
| Sound pressure level L _{pA} (1 m) at 50/60 Hz | dB(A) | 75/78 | | |
| Line connection - recommended: DIN VDE ⁴⁾ - maximum: DIN VDE - Fixing screw | mm² mm² | Per sub-cabinet: 4 x 150 8 x 240 M12 (4 holes) | | |
| Motor connection - recommended: DIN VDE ⁵⁾ - maximum: DIN VDE - Fixing screw | mm² mm² | Per sub-cabinet: 3 x 185 6 x 240 M12 (3 holes) | | |
| Protective conductor connection Fixing screw | | Per sub-cabinet: M12 (18 holes) | | |
| Max. motor cable length shielded / unshielded | m | 300 / 450 | | |
| Dimensions (standard version) - Width - Height - Depth | mm mm mm | 3200 2000 600 | | |
| Power block frame size | | JX | | |
| Weight (without options), approx. | kg | 2700 | | |
| Recommended protection - Line protection (with option L26) Rated current frame size to DIN 43620-1 - Line and semiconductor protection (without option L26) Rated current Frame size to DIN 43620-1 | A | Per sub-cabinet: 3NA3365-6 2 x 500 3 Per sub-cabinet: 3NE1334-2 2 x 500 2 | | |

Table 12- 28 Version A, 660 V - 690 V 3 AC, part 6

12.3 Technical specifications

| Order number | 6SL3710- | 2GH41-5AA0 | | |
|--------------|----------|------------|--|--|
|--------------|----------|------------|--|--|

¹⁾ Rated output of a typical 6-pole standard induction motor based on I_L or I_H at 690 V 3 AC 50 Hz.

²⁾ 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 "Overload capability").

 $^{3)}$ 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 "Overload capability").

⁴⁾ The current values given here are based on the rated output current.

12.3.6 Cabinet unit version C, 660 V - 690 V 3 AC

Table 12- 29 Version C, 660 V - 690 V 3 AC, Part 1

| Order number | 6SL3710- | 1GH28-5CA0 | 1GH31-0CA0 | 1GH31-2CA0 |
|--|--------------------------|---------------|--------------------------------------|-----------------|
| Unit rating | | | | |
| - for I _L at 50 Hz 690 V ¹⁾ | kW | 75 | 90 | 110 |
| - for I _H at 50 Hz 690 V ¹⁾ | kW | 55 | 75 | 90 |
| Output current | | 05 | 100 | 100 |
| - Rated current I _N - Base load current I _L ²⁾ | A A | 85 80 | 100 95 | 120 115 |
| - Base load current IL ³ | A | 76 | 89 | 107 |
| Input current | | | | |
| - Rated input current ⁴⁾ | А | 93 | 109 | 131 |
| - Input current, max. | А | 131 | 155 | 188 |
| - Current requirements for 24 V DC | A | 1.1 | 1.1 | 1.1 |
| auxiliary supply | | | | |
| Connection voltages | VACrms | 660 1/2 40 4 | 10% to 600 \/ 2 AC +40% | (150/ < 1 min) |
| - Line voltage - Line frequency | V _{ACrms} Hz | 000 V 3 AC -1 | 0% to 690 V 3 AC +10% 47 to 63 Hz | (-13% < 111111) |
| - Electronics power supply | V _{DC} | | 24 (20.4 - 28.8) | |
| Power loss | kW | 1.7 | 2.1 | 2.7 |
| Cooling air requirement | m³/s | 0.17 | 0.17 | 0.17 |
| Sound pressure level L _{pA} | dB(A) | 67/68 | 67/68 | 67/68 |
| (1 m) at 50/60 Hz | . , | | | |
| Line connection | | | | |
| - recommended: DIN VDE ⁵⁾ | mm ² | 50 | 50 | 70 |
| - maximum: DIN VDE | mm ² | 4 x 240 | 4 x 240 | 4 x 240 |
| - Fixing screw | | M12 (1 hole) | M12 (1 hole) | M12 (1 hole) |
| - recommended: DIN VDE ⁵⁾ | mm ² | 35 | 50 | 70 |
| - maximum: DIN VDE | mm ² | 2 x 70 | 2 x 150 | 2 x 150 |
| - Fixing screw | | M12 (1 hole) | M12 (1 hole) | M12 (1 hole) |
| Protective conductor connection | | | | |
| Fixing screw | | M12 (2 holes) | M12 (2 holes) | M12 (2 holes) |
| Max. motor cable length | | | | |
| shielded / unshielded | m | 300 / 450 | 300 / 450 | 300 / 450 |
| Dimensions (standard version) | | 400 | 100 | 400 |
| - Width | mm | 400 | 400 | 400 |
| - Height - Depth | mm mm | 2000 600 | 2000 600 | 2000 600 |
| Power block frame size | | FX | FX | FX |
| Weight (without options), approx. | kg | 225 | 225 | 225 |
| Recommended protection | | - | | - |
| -Line and semi-cond. protection | | 3NE1022-2 | 3NE1022-2 | 3NE1224-2 |
| Rated current | А | 125 | 125 | 160 |
| frame size to DIN 43620-1 | | 00 | 00 | 1 |

12.3 Technical specifications

| | Order number | 6SL3710- | 1GH28-5CA0 | 1GH31-0CA0 | 1GH31-2CA0 |
|--|--------------|----------|------------|------------|------------|
|--|--------------|----------|------------|------------|------------|

¹⁾ Rated output of a typical 6-pole standard induction motor based on I_L or I_H at 690 V 3 AC 50 Hz.

²⁾ 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 "Overload capability").

 $^{3)}$ 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 "Overload capability").

⁴⁾ The current values given here are based on the rated output current.

12.3 Technical specifications

| Order number | 6SL3710- | 1GH31-5CA0 | 1GH31-8CA0 | 1GH32-2CA0 |
|---|-----------------|---------------|---------------------------------------|----------------|
| Unit rating | | | | |
| - for I∟ at 50 Hz 690 V ¹⁾ | kW | 132 | 160 | 200 |
| - for I _H at 50 Hz 690 V ¹⁾ | kW | 110 | 132 | 160 |
| Output current | | | | |
| - Rated current IN | A | 150 | 175 | 215 |
| - Base load current IL ²⁾ | A A | 142 134 | 171 157 | 208 192 |
| - Base load current I _H ³⁾ | A | 134 | 157 | 192 |
| - Rated input current ⁴⁾ | А | 164 | 191 | 224 |
| - Input current, max. | A | 232 | 279 | 341 |
| - Current requirements for 24 V DC | A | 1.1 | 1.35 | 1.35 |
| auxiliary supply | | | | |
| Connection voltages | | | | |
| - Line voltage | VACrms | 660 V 3 AC -1 | 0% to 690 V 3 AC +10% | (-15% < 1 min) |
| - Line frequency | Hz | | 47 to 63 Hz | |
| - Electronics power supply | VDC | | 24 (20.4 - 28.8) | Ι |
| Power loss | kW | 2.8 | 3.8 | 4.2 |
| Cooling air requirement | m³/s | 0.17 | 0.36 | 0.36 |
| Sound pressure level L _{pA} | dB(A) | 67/68 | 67/73 | 67/73 |
| (1 m) at 50/60 Hz | | | | |
| Line connection | | | | |
| - recommended: DIN VDE ⁵⁾ | mm ² | 95 | 120 | 2 x 70 |
| - maximum: DIN VDE | mm ² | 4 x 240 | 4 x 240 | 4 x 240 |
| - Fixing screw | | M12 (1 hole) | M12 (1 hole) | M12 (1 hole) |
| - recommended: DIN VDE ⁵⁾ | mm ² | 70 | 95 | 120 |
| - maximum: DIN VDE | mm ² | 2 x 150 | 95 2 x 150 | 2 x 150 |
| - Fixing screw | | M12 (1 hole) | M12 (1 hole) | M12 (1 hole) |
| Protective conductor connection | 1 | (, | () | () |
| Fixing screw | | M12 (2 holes) | M12 (2 holes) | M12 (2 holes) |
| Max. motor cable length | | | , , , , , , , , , , , , , , , , , , , | |
| shielded / unshielded | m | 300 / 450 | 300 / 450 | 300 / 450 |
| Dimensions (standard version) | | | | |
| - Width | mm | 400 | 400 | 400 |
| - Height | mm | 2000 | 2000 | 2000 |
| - Depth | mm | 600 | 600 | 600 |
| Power block frame size | | FX | GX | GX |
| Weight (without options), approx. | kg | 225 | 300 | 300 |
| Recommended protection | | | | |
| -Line and semi-cond. protection | | 3NE1225-2 | 3NE1227-2 | 3NE1230-2 |
| Rated current | A | 200 | 250 | 315 |
| frame size to DIN 43620-1 | | 1 | 1 | 1 |

Table 12- 30 Version C, 660 V – 690 V 3 AC, Part 2

12.3 Technical specifications

| | Order number | 6SL3710- | 1GH31-5CA0 | 1GH31-8CA0 | 1GH32-2CA0 |
|--|--------------|----------|------------|------------|------------|
|--|--------------|----------|------------|------------|------------|

¹⁾ Rated output of a typical 6-pole standard induction motor based on I_L or I_H at 690 V 3 AC 50 Hz.

²⁾ 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 "Overload capability").

 $^{3)}$ 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 "Overload capability").

⁴⁾ The current values given here are based on the rated output current.

12.3 Technical specifications

| Order number | 6SL3710- | 1GH32-6CA0 | 1GH33-3CA0 | 1GH34-1CA0 |
|---|-----------------|-------------------------|-------------------------|--------------------------|
| Unit rating | | | | |
| - for I∟ at 50 Hz 690 V ¹⁾ | kW | 250 | 315 | 400 |
| - for I _H at 50 Hz 690 V ¹⁾ | kW | 200 | 250 | 315 |
| Output current | | | | |
| - Rated current I _N | А | 260 | 330 | 410 |
| - Base load current $I_{L^{(2)}}$ | A | 250 | 320 | 400 |
| - Base load current I _H ³⁾ | A | 233 | 280 | 367 |
| Input current | | 070 | 0.40 | 100 |
| - Rated input current ⁴⁾ | A | 270 410 | 343 525 | 426 |
| - Input current, max. - Current requirements for 24 V DC | A A | 1.35 | 1.35 | 655 1.4 |
| auxiliary supply | | 1.55 | 1.55 | 1.4 |
| Connection voltages | | | | |
| - Line voltage | VACrms | 660 V 3 AC - | 10% to 690 V 3 AC +10% | o (-15% < 1 min) |
| - Line frequency | Hz | | 47 to 63 Hz | · · · · |
| - Electronics power supply | VDC | | 24 (20.4 - 28.8) | |
| Power loss | kW | 5.0 | 6.1 | 8.1 |
| Cooling air requirement | m³/s | 0.36 | 0.36 | 0.78 |
| Sound pressure level L _{pA} (1 m) at 50/60 Hz | dB(A) | 67/73 | 67/73 | 72/75 |
| Line connection | | | | |
| - recommended: DIN VDE ⁵⁾ | mm ² | 2 x 95 | 2 x 120 | 2 x 185 |
| - maximum: DIN VDE | mm ² | 4 x 240 | 4 x 240 | 4 x 240 |
| - Fixing screw | | M12 (1 hole) | M12 (1 hole) | M12 (2 holes) |
| Motor connection | | | | |
| - recommended: DIN VDE ⁵⁾ | mm ² | 2 x 70 | 2 x 95 | 2 x 120 |
| - maximum: DIN VDE - Fixing screw | mm ² | 2 x 185 M12 (1 hole) | 2 x 240 M12 (1 hole) | 4 x 240 M12 (2 holes) |
| | | | | |
| Protective conductor connection Fixing screw | | M12 (2 holes) | M12 (2 holes) | M12 (2 holes) |
| Max. motor cable length | | | | |
| shielded / unshielded | m | 300 / 450 | 300 / 450 | 300 / 450 |
| Dimensions (standard version) | | | | |
| - Width | mm | 400 | 400 | 600 |
| - Height | mm | 2000 | 2000 | 2000 |
| - Depth | mm | 600 | 600 | 600 |
| Power block frame size | | GX | GX | HX |
| Weight (without options), approx. | kg | 300 | 300 | 670 |
| Recommended protection | | | | |
| -Line and semi-cond. protection | | 3NE1331-2 | 3NE1334-2 | 3NE1334-2 |
| Rated current frame size to DIN 43620-1 | A | 350 2 | 500 | 500 2 |
| 11ame Size to Din 43020-1 | | 2 | 2 | ۷ |

Table 12- 31 Version C, 660 V – 690 V 3 AC, Part 3

12.3 Technical specifications

| Order number | 6SL3710- | 1GH32-6CA0 | 1GH33-3CA0 | 1GH34-1CA0 |
|--------------|----------|------------|------------|------------|
| | | | | |
| | | | | |

¹⁾ Rated output of a typical 6-pole standard induction motor based on I_L or I_H at 690 V 3 AC 50 Hz.

²⁾ 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 "Overload capability").

 $^{3)}$ 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 "Overload capability").

⁴⁾ The current values given here are based on the rated output current.

12.3 Technical specifications

| Order number | 6SL3710- | 1GH34-7CA0 | 1GH35-8CA0 | 1GH37-4CA0 |
|---|------------------------------------|--------------------|------------------------|--------------------|
| Unit rating | | | | |
| - for I∟ at 50 Hz 690 V ¹⁾ | kW | 450 | 560 | 710 |
| - for I _H at 50 Hz 690 V ¹⁾ | kW | 400 | 450 | 560 |
| Output current | | | | |
| - Rated current I _N | А | 465 | 575 | 735 |
| - Base load current IL ²⁾ | A | 452 | 560 | 710 |
| - Base load current I _H ³⁾ | A | 416 | 514 | 657 |
| Input current | | 100 | 500 | |
| - Rated input current ⁴⁾ | A | 483 | 598 | 764 |
| Input current, max. Current requirements for 24 V DC | A | 740 1.4 | 918 1.4 | 1164 1.5 |
| auxiliary supply | ^ | 1.4 | 1.4 | 1.5 |
| Connection voltages | | | | |
| - Line voltage | VACrms | 660 V 3 AC - | 10% to 690 V 3 AC +10% | (-15% < 1 min) |
| - Line frequency | Hz | | 47 to 63 Hz | (, |
| - Electronics power supply | V _{DC} | | 24 (20.4 - 28.8) | |
| Power loss | kW | 9.1 | 10.8 | 13.5 |
| Cooling air requirement | m³/s | 0.78 | 0.78 | 1.48 |
| Sound pressure level L _{pA} | dB(A) | 72/75 | 72/75 | 72/75 |
| (1 m) at 50/60 Hz | | | | |
| Line connection | | | | |
| - recommended: DIN VDE ⁵⁾ | mm ² | 2 x 185 | 2 x 240 | 3 x 185 |
| - maximum: DIN VDE | mm ² | 4 x 240 | 4 x 240 | 8 x 240 |
| - Fixing screw | | M12 (2 holes) | M12 (2 holes) | M12 (4 holes) |
| | | 0 450 | 0 405 | 0 |
| - recommended: DIN VDE ⁵⁾ - maximum: DIN VDE | mm ² mm ² | 2 x 150 4 x 240 | 2 x 185 4 x 240 | 3 x 150 6 x 240 |
| - Fixing screw | 11111- | M12 (2 holes) | M12 (2 holes) | M12 (3 holes) |
| Protective conductor connection | | | | |
| Fixing screw | | M12 (2 holes) | M12 (2 holes) | M12 (18 holes) |
| Max. motor cable length | | | | |
| shielded / unshielded | m | 300 / 450 | 300 / 450 | 300 / 450 |
| Dimensions (standard version) | | | | |
| - Width | mm | 600 | 600 | 1000 |
| - Height | mm | 2000 | 2000 | 2000 |
| - Depth | mm | 600 | 600 | 600 |
| Power block frame size | | HX | HX | JX |
| Weight (without options), approx. | kg | 670 | 670 | 940 |
| Recommended protection | | | | |
| -Line and semi-cond. protection | | 3NE1435-2 | 3NE1447-2 | 3NE1448-2 |
| Rated current | A | 560 | 670 | 850 |
| frame size to DIN 43620-1 | | 3 | 3 | 3 |

Table 12- 32 Version C, 660 V - 690 V 3 AC, Part 4

12.3 Technical specifications

| | Order number | 6SL3710- | 1GH34-7CA0 | 1GH35-8CA0 | 1GH37-4CA0 |
|--|--------------|----------|------------|------------|------------|
|--|--------------|----------|------------|------------|------------|

¹⁾ Rated output of a typical 6-pole standard induction motor based on I_L or I_H at 690 V 3 AC 50 Hz.

²⁾ 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 "Overload capability").

 $^{3)}$ 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 "Overload capability").

⁴⁾ The current values given here are based on the rated output current.

12.3 Technical specifications

| Order number | 6SL3710- | 1GH38-1CA0 | | |
|--|---|-------------------------------------|---|----------------|
| Unit rating - for I _L at 50 Hz 690 V ¹⁾ - for I _H at 50 Hz 690 V ¹⁾ | kW kW | 800 710 | | |
| Output current - Rated current I _N - Base load current I _L ²⁾ - Base load current I _H ³⁾ | A A A | 810 790 724 | | |
| Input current - Rated input current ⁴⁾ - Input current, max. - Current requirements for 24 V DC auxiliary supply | A A A | 842 1295 1.5 | | |
| Connection voltages - Line voltage - Line frequency - Electronics power supply | V _{ACrms} Hz V _{DC} | 660 V 3 AC -10% | % to 690 V 3 AC +10% 47 to 63 Hz 24 (20.4 - 28.8) | (-15% < 1 min) |
| Power loss | kW | 14.7 | | |
| Cooling air requirement | m³/s | 1.48 | | |
| Sound pressure level L _{pA} (1 m) at 50/60 Hz | dB(A) | 72/75 | | |
| Line connection - recommended: DIN VDE ⁴⁾ - maximum: DIN VDE - Fixing screw | mm² mm² | 4 x 150 8 x 240 M12 (4 holes) | | |
| Motor connection - recommended: DIN VDE ⁵⁾ - maximum: DIN VDE - Fixing screw | mm² mm² | 3 x 185 6 x 240 M12 (3 holes) | | |
| Protective conductor connection Fixing screw | | M12 (18 holes) | | |
| Max. motor cable length shielded / unshielded | m | 300 / 450 | | |
| Dimensions (standard version) - Width - Height - Depth | mm mm mm | 1000 2000 600 | | |
| Power block frame size | | JX | | |
| Weight (without options), approx. | kg | 980 | | |
| Recommended protection -Line and semi-cond. protection Rated current frame size to DIN 43620-1 | A | 3NE1334-2 2 x 500 2 | | |

Table 12- 33 Version C, 660 V - 690 V 3 AC, Part 5

12.3 Technical specifications

| Order number | 6SL3710- | 1GH38-1CA0 | | |
|--------------|----------|------------|--|--|
|--------------|----------|------------|--|--|

¹⁾ Rated output of a typical 6-pole standard induction motor based on I_L or I_H at 690 V 3 AC 50 Hz.

²⁾ 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 "Overload capability").

 $^{3)}$ The base-load current $I_{\rm H}$ 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 "Overload capability").

⁴⁾ The current values given here are based on the rated output current.

12.3 Technical specifications
A

Appendix

A.1 List of abbreviations

| Α | |
|-------|---|
| A | Alarm |
| AC | Alternating current |
| AI | Analog input |
| AO | Analog output |
| AOP | Advanced operator panel (with plain-text display) |
| В | |
| BI | Binector input |
| BICO | Binector/connector |
| BO | Binector output |
| С | |
| С | Capacitance |
| CAN | Serial bus system |
| СВ | Communication board |
| CDS | Command data set |
| CI | Connector input |
| COM | Center contact on a changeover contact |
| CU | Control Unit |
| D | |
| DC | Direct current |
| DDS | Drive data set |
| DI | Digital input |
| DI/DO | Digital input/output bidirectional |
| DO | Digital output |
| E | |
| ESD | Electrostatic devices |
| EMC | Electromagnetic compatibility |
| EN | European standard |
| F | |
| F | Fault |
| FAQ | Frequently asked questions |
| FW | Firmware |
| Н | |
| RFG | Ramp-function generator |
| HW | Hardware |

A.1 List of abbreviations

I

| I/O | Input/output |
|----------|---|
| IEC | International electrical engineering standard |
| IGBT | Insulated gate bipolar transistor |
| J | |
| JOG | Jog mode |
| L | C C C C C C C C C C C C C C C C C C C |
| L | Inductance |
| LED | Light-emitting diode |
| м | 5 5 |
| М | Ground |
| MDS | Motor data set |
| N | |
| NC | Normally closed contact |
| NEMA | Standardization body in the USA (United States of America) |
| NO | Normally open contact |
| Р | |
| р | Adjustable parameter |
| PDS | Power unit data set |
| PE | Protective earth |
| PROFIBUS | Serial data bus |
| PTC | Positive temperature coefficient |
| R | |
| r | Visualization parameter (read-only) |
| RAM | Read and write memory |
| RS 232 | Serial interface |
| RS 485 | Standard. Describes the physical characteristics of a digital serial interface. |
| S | |
| SI | Safety Integrated |
| STW | PROFIdrive control word |
| SW | Software |
| т | |
| TIA | Totally Integrated Automation |
| ТМ | Terminal Module |
| U | |
| UL | Underwriters Laboratories Inc. |
| v | |
| Vdc | DC link voltage |
| z | |
| ZSW | PROFIdrive status word |

A.2 Parameter macros

Parameter macro p0015 = G150 cabinet unit

This macro is used to make default settings for operating the cabinet unit.

| | Sink | | Source | | | |
|-----------|---|--------|-----------|------------------------------------|--------|--|
| Parameter | Description | DO | Parameter | Description | DO | |
| p0400[0] | Encoder type selection | Vector | 9999 | Other | Vector | |
| p0404[0] | Encoder configuration | Vector | 200008h | | Vector | |
| p0405[0] | Square-wave encoder track A/B | Vector | 9h | Bipolar, like A/B track | Vector | |
| p0408[0] | Rotary encoder pulse no. | Vector | 1024 | 1024 pulses per revolution | Vector | |
| p0420[0] | Encoder connection | Vector | 0x2 | Encoder connection = terminal | Vector | |
| p0500 | Technology 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 | CI: Motor temperature | Vector | r4105 | Sensor on TM31 | TM31 | |
| p0604 | Motor overtemperature alarm threshold | Vector | 120 | 120 °C | Vector | |
| p0605 | Motor overtemperature fault threshold | Vector | 155 | 155 °C | Vector | |
| p0606 | Motor overtemperature timer | Vector | 0 | 0 s | Vector | |
| p0610 | Response to motor overtemperature condition | Vector | 1 | Display fault, for alarm Imax red. | Vector | |
| p0700[0] | Macro binector input (BI) | Vector | 70006 | TM31 terminals | Vector | |
| p0864 | BI: Infeed operation | Vector | 1 | | Vector | |
| p1000[0] | Macro connector inputs (CI) for speed setpoints | Vector | 10002 | TM31_AI0 | Vector | |
| p1001 | CO: Fixed speed setpoint 1 | Vector | 300 | 300 rpm | Vector | |
| p1002 | CO: Fixed speed setpoint 2 | Vector | 600 | 600 rpm | Vector | |
| p1003 | CO: Fixed speed setpoint 3 | Vector | 1500 | 1500 rpm | Vector | |
| p1083 | CO: Speed limit in positive direction of rotation | Vector | 6000 | 6000 rpm | Vector | |
| p1086 | CO: Speed limit in negative direction of rotation | Vector | -6000 | -6000 rpm | Vector | |
| p1115 | Ramp-function generator selection | Vector | 1 | Extended RFG | Vector | |
| p1120 | Ramp-function generator ramp-up time | Vector | 20 | 20 s | Vector | |
| p1121 | Ramp-function generator ramp- down time | Vector | 30 | 30 s | Vector | |
| p1135 | OFF3 ramp-down time | Vector | 10 | 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 | |

Table A- 1Parameter macro p0015 = G150 cabinet unit

| | Sink | | | Source | | |
|-----------|---|--------|-----------|---|--------|--|
| Parameter | Description | DO | Parameter | Description | DO | |
| p1254 | Vdc controller automatic ON level detection | Vector | 1 | Automatic detection enabled | Vector | |
| p1280 | Vdc controller configuration (V/f) | Vector | 1 | Vdc-max controller enabled | Vector | |
| p1300 | Open-loop/closed-loop control operating mode | Vector | 20 | Encoderless 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 for switching on | Vector | |
| p2080[1] | BI: PROFIBUS send status word 1 | Vector | r0899.1 | Ready for operation | 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 | Switching on inhibited | Vector | |
| p2080[7] | BI: PROFIBUS send status word 1 | Vector | r2139.7 | Alarm active | Vector | |
| 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 request | 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 | Clockwise | Vector | |
| p2080[15] | BI: PROFIBUS send status word 1 | Vector | r2129.15 | No Therm. alarm Power unit overload | Vector | |
| p2088 | PROFIBUS Invert status word | Vector | B800h | | Vector | |
| p2128[14] | Select fault/alarm code for trigger | Vector | 7910 | A7910: Alarm, motor overtemperature | Vector | |
| p2128[15] | Select fault/alarm code for trigger | Vector | 5000 | A5000: Therm. alarm Power unit overload | Vector | |
| p2153 | Time constant revolutions actual value filter | Vector | 20 | 20 ms | Vector | |
| p4053[0] | TM31 analog inputs, smoothing time constant | TM31 | 0 | 0 ms | TM31 | |
| p4053[1] | TM31 analog inputs, smoothing time constant | TM31 | 0 | 0 ms | TM31 | |
| p4056[0] | Type of analog inputs | TM31 | 2 | Current 020 mA | TM31 | |
| p4056[1] | Type of analog inputs | TM31 | 2 | Current 020 mA | TM31 | |

| | Sink | | | Source | | |
|-----------|---|--------|-----------|---|--------|--|
| Parameter | Description | DO | Parameter | Description | DO | |
| p4076[0] | Type of analog outputs | TM31 | 0 | Current 020 mA | TM31 | |
| p4076[1] | Type of analog outputs | TM31 | 0 | Current 020 mA | TM31 | |
| p4071[0] | Signal analog output 0 | TM31 | r0063 | Actual speed smoothed | TM31 | |
| p4071[1] | Signal analog output 1 | TM31 | r0068 | Absolute current actual value | TM31 | |
| p4100 | Type of temperature sensor | TM31 | 0 | (Factory setting) | TM31 | |
| p4102[0] | Alarm threshold, temperature sensing | TM31 | 251 °C | When this value is exceeded, alarm A35211 is triggered. | TM31 | |
| p4102[1] | Fault threshold for temperature sensing | TM31 | 251 °C | When this value is exceeded, fault F35207 is triggered. | TM31 | |
| p7003 | Winding system | Vector | 1 | Separate winding systems | Vector | |

Parameter macro p0700 = 5: PROFIdrive (70005)

This macro is used to set the PROFIdrive interface as the default command source.

| Table A- 2 | Parameter macro | p0700 = 5: PROFIdrive |
|------------|------------------|-----------------------|
| | i aramotor maoro | |

| | Sink | | | Source | | | |
|-----------|-----------------------------------|--------|-----------|-----------------------------|--------|--|--|
| Parameter | Description | DO | Parameter | 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 | r0722.3 | CU DI3 | CU | | |
| p0848[0] | No OFF3_1 | Vector | r2090.2 | PZD 1 bit 2 | Vector | | |
| p0849[0] | No OFF3_2 | Vector | r0722.2 | CU DI2 | CU | | |
| p0806 | Inhibit LOCAL mode | Vector | 0 | | Vector | | |
| p0810 | Changeover CDS bit 0 | Vector | 0 | | Vector | | |
| p0852 | Enable operation | Vector | r2090.3 | PZD 1 bit 3 | Vector | | |
| p0854 | Control request | Vector | r2090.10 | PZD 1 bit 10 | Vector | | |
| p0922 | PROFIdrive PZD telegram selection | Vector | 999 | Free telegram configuration | | | |
| p1020 | FSW bit 0 | Vector | 0 | | Vector | | |
| p1021 | FSW bit 1 | Vector | 0 | | Vector | | |
| p1035 | MOP raise | Vector | r2090.13 | PZD 1 bit 13 | Vector | | |
| p1036 | MOP lower | Vector | r2090.14 | PZD 1 bit 14 | Vector | | |
| p1113 | Direction of rotation reversal | 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 | r0722.1 | CU DI1 | CU | | |
| p2107 | Ext. fault_2 | Vector | 1 | | Vector | | |
| p2112 | Ext. alarm_1 | Vector | r0722.0 | CU DI0 | CU | | |
| p2116 | Ext. alarm_2 | Vector | 1 | | Vector | | |

| | Sink | | Source | | |
|-----------|-----------------------------|------|-----------|------------------------|--------|
| Parameter | Description | DO | Parameter | Description | DO |
| p0738 | DI/DO8 | CU | 1 | +24 V | CU |
| p0748.8 | Invert DI/DO8 | CU | 0 | Not inverted | |
| p0728.8 | Set DI/DO8 input or output | CU | 1 | Output | |
| p0739 | DI/DO9 | CU | 1 | +24 V | CU |
| p0748.9 | Invert DI/DO9 | CU | 0 | Not inverted | |
| p0728.9 | Set DI/DO9 input or output | CU | 1 | Output | |
| p0740 | DI/DO10 | CU | 1 | +24 V | CU |
| p0748.10 | Invert DI/DO10 | CU | 0 | Not inverted | |
| p0728.10 | Set DI/DO10 input or output | CU | 1 | Output | |
| p0741 | DI/DO11 | CU | 1 | +24 V | CU |
| p0748.11 | Invert DI/DO11 | CU | 0 | Not inverted | |
| p0728.11 | Set DI/DO11 input or output | CU | 1 | Output | |
| p0742 | DI/DO12 | CU | 1 | +24 V | CU |
| p0748.12 | Invert DI/DO12 | CU | 0 | Not inverted | |
| p0728.12 | Set DI/DO12 input or output | CU | 1 | Output | |
| p0743 | DI/DO13 | CU | r0899.6 | Switching on inhibited | Vector |
| p0748.13 | Invert DI/DO13 | CU | 1 | Inverted | |
| p0728.13 | Set DI/DO13 input or output | CU | 1 | Output | |
| 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 | |
| p0745 | DI/DO15 | CU | r2138.7 | Ack. fault | Vector |
| p0748.15 | Invert DI/DO15 | CU | 0 | Not inverted | |
| p0728.15 | Set DI/DO15 input or output | CU | 1 | Output | |
| p2103 | Acknowledge fault 1 | TM31 | r2090.7 | PZD 1 bit 7 | 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 |
| p4048.1 | Invert DO1 | TM31 | 1 | Inverted | |
| p4038 | DO8 | TM31 | r0899.0 | Ready for switching on | Vector |
| p4028.8 | Set DI/DO8 input or output | TM31 | 1 | Output | |
| p4039 | DO9 | TM31 | 0 | | TM31 |
| p4028.9 | Set DI/DO9 input or output | TM31 | 0 | Input | |
| p4040 | DO10 | TM31 | 0 | | TM31 |
| p4028.10 | Set DI/DO10 input or output | TM31 | 0 | Input | |
| p4041 | DO11 | TM31 | 0 | | TM31 |
| p4028.11 | Set DI/DO11 input or output | TM31 | 0 | Input | |

Parameter macro p0700 = 6: Terminal block TM31 (70006)

This macro is used to set customer terminal block TM31 as the command source.

| | Sink | | Source | | | |
|-----------|-----------------------------------|--------|-----------|-----------------------------|--------|--|
| Parameter | Description | DO | Parameter | Description | DO | |
| p0840[0] | ON/OFF1 | Vector | r4022.0 | TM31 DI0 | TM31 | |
| p0844[0] | No OFF2_1 | Vector | 1 | | CU | |
| p0845[0] | No OFF2_2 | Vector | r0722.3 | CU DI3 | CU | |
| p0848[0] | No OFF3_1 | Vector | 1 | | Vector | |
| p0849[0] | No OFF3_2 | Vector | r0722.2 | CU DI2 | CU | |
| p0806 | Inhibit LOCAL mode | Vector | 0 | | Vector | |
| p0810 | Changeover CDS bit 0 | Vector | 0 | | Vector | |
| p0852 | Enable operation | Vector | r4022.4 | TM31 DI4 | TM31 | |
| p0854 | Control request | Vector | 1 | | Vector | |
| p0922 | PROFIdrive 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 | |
| p1113 | Direction of rotation reversal | Vector | 0 | | TM31 | |
| p1140 | Enable RFG | Vector | 1 | | Vector | |
| p1141 | Start RFG | Vector | 1 | | Vector | |
| p1142 | Enable nsetp | Vector | 1 | | Vector | |
| p2103 | Acknowledge fault 1 | Vector | 0 | | Vector | |
| p2104 | Acknowledge fault 2 | Vector | r4022.3 | TM31 DI3 | TM31 | |
| p2106 | Ext. fault_1 | Vector | r0722.1 | CU DI1 | CU | |
| p2107 | Ext. fault_2 | Vector | 1 | | Vector | |
| p2112 | Ext. alarm_1 | Vector | r0722.0 | CU DI0 | CU | |
| p2116 | Ext. alarm_2 | Vector | 1 | | Vector | |
| p0738 | DI/DO8 | CU | 1 | +24 V | CU | |
| p0748.8 | Invert DI/DO8 | CU | 0 | Not inverted | | |
| p0728.8 | Set DI/DO8 input or output | CU | 1 | Output | | |
| p0739 | DI/DO9 | CU | 1 | +24 V | CU | |
| p0748.9 | Invert DI/DO9 | CU | 0 | Not inverted | | |
| p0728.9 | Set DI/DO9 input or output | CU | 1 | Output | | |
| p0740 | DI/DO10 | CU | 1 | +24 V | CU | |
| p0748.10 | Invert DI/DO10 | CU | 0 | Not inverted | | |
| p0728.10 | Set DI/DO10 input or output | CU | 1 | Output | | |
| p0741 | DI/DO11 | CU | 1 | +24 V | CU | |
| p0748.11 | Invert DI/DO11 | CU | 0 | Not inverted | | |
| p0728.11 | Set DI/DO11 input or output | CU | 1 | Output | | |

Table A- 3 Parameter macro p0700 = 6: Terminal block TM31

| | Sink | | Source | | |
|-----------|-----------------------------|------|-----------|------------------------|--------|
| Parameter | Description | DO | Parameter | Description | DO |
| p0742 | DI/DO12 | CU | 1 | +24 V | CU |
| p0748.12 | Invert DI/DO12 | CU | 0 | Not inverted | |
| p0728.12 | Set DI/DO12 input or output | CU | 1 | Output | |
| p0743 | DI/DO13 | CU | r0899.6 | Switching on inhibited | Vector |
| p0748.13 | Invert DI/DO13 | CU | 1 | Inverted | |
| p0728.13 | Set DI/DO13 input or output | CU | 1 | Output | |
| 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 | |
| p0745 | DI/DO15 | CU | r2138.7 | Ack. fault | Vector |
| p0748.15 | Invert DI/DO15 | CU | 0 | Not inverted | |
| p0728.15 | Set DI/DO15 input or output | CU | 1 | Output | |
| p2103 | Acknowledge fault 1 | TM31 | 0 | | TM31 |
| 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 |
| p4048.1 | Invert DO1 | TM31 | 1 | Inverted | |
| p4038 | DO8 | TM31 | r0899.0 | Ready for switching on | Vector |
| p4028.8 | Set DI/DO8 input or output | TM31 | 1 | Output | |
| p4039 | DO9 | TM31 | 0 | | TM31 |
| p4028.9 | Set DI/DO9 input or output | TM31 | 0 | Input | |
| p4040 | DO10 | TM31 | 0 | | TM31 |
| p4028.10 | Set DI/DO10 input or output | TM31 | 0 | Input | |
| p4041 | DO11 | TM31 | 0 | | TM31 |
| p4028.11 | Set DI/DO11 input or output | TM31 | 0 | Input | |

Parameter macro p0700 = 7: NAMUR (70007)

This macro is used to set the NAMUR terminal block as the default command source.

| | Sink | | Source | | |
|-----------|-----------------------------------|--------|-----------|-----------------------------|--------|
| Parameter | Description | DO | Parameter | Description | DO |
| p0840[0] | ON/OFF1 | Vector | r4022.0 | TM31 DI0 | TM31 |
| p0844[0] | No OFF2_1 | Vector | r4022.4 | TM31 DI4 | TM31 |
| p0845[0] | No OFF2_2 | Vector | r0722.3 | CU DI3 | CU |
| p0848[0] | No OFF3_1 | Vector | r4022.5 | TM31 DI5 | TM31 |
| p0849[0] | No OFF3_2 | Vector | 1 | | Vector |
| p0806 | Inhibit LOCAL mode | Vector | 0 | | Vector |
| p0810 | Changeover CDS bit 0 | Vector | 0 | | Vector |
| p0852 | Enable operation | Vector | 1 | | Vector |
| p0854 | Control request | Vector | 1 | | Vector |
| p0922 | PROFIdrive 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 |
| p1113 | Direction of rotation reversal | Vector | r4022.6 | TM31 DI6 | TM31 |
| p1140 | Enable RFG | Vector | 1 | | Vector |
| p1141 | Start RFG | Vector | 1 | | Vector |
| p1142 | Enable nsetp | Vector | 1 | | Vector |
| p2103 | Acknowledge fault 1 | Vector | 0 | | Vector |
| p2104 | Acknowledge fault 2 | Vector | r4022.3 | TM31 DI3 | TM31 |
| p2106 | Ext. fault_1 | Vector | r0722.1 | CU DI1 | CU |
| p2107 | Ext. fault_2 | Vector | 1 | | Vector |
| p2112 | Ext. alarm_1 | Vector | r0722.0 | CU DI0 | CU |
| p2116 | Ext. alarm_2 | Vector | 1 | | Vector |
| p0738 | DI/DO8 | CU | 1 | +24 V | CU |
| p0748.8 | Invert DI/DO8 | CU | 0 | Not inverted | |
| p0728.8 | Set DI/DO8 input or output | CU | 1 | Output | |
| p0739 | DI/DO9 | CU | 1 | +24 V | CU |
| p0748.9 | Invert DI/DO9 | CU | 0 | Not inverted | |
| p0728.9 | Set DI/DO9 input or output | CU | 1 | Output | |
| p0740 | DI/DO10 | CU | 1 | +24 V | CU |
| p0748.10 | Invert DI/DO10 | CU | 0 | Not inverted | |
| p0728.10 | Set DI/DO10 input or output | CU | 1 | Output | |
| p0741 | DI/DO11 | CU | 1 | +24 V | CU |
| p0748.11 | Invert DI/DO11 | CU | 0 | Not inverted | |
| p0728.11 | Set DI/DO11 input or output | CU | 1 | Output | |
| p0742 | DI/DO12 | CU | 1 | +24 V | CU |

Table A- 4 Parameter macro p0700 = 7: NAMUR

| | Sink | | Source | | |
|-----------|-----------------------------|------|-----------|------------------------|--------|
| Parameter | Description | DO | Parameter | Description | DO |
| p0748.12 | Invert DI/DO12 | CU | 0 | Not inverted | |
| p0728.12 | Set DI/DO12 input or output | CU | 1 | Output | |
| p0743 | DI/DO13 | CU | r0899.6 | Switching on inhibited | Vector |
| p0748.13 | Invert DI/DO13 | CU | 1 | Inverted | |
| p0728.13 | Set DI/DO13 input or output | CU | 1 | Output | |
| 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 | |
| p0745 | DI/DO15 | CU | r2138.7 | Ack. fault | Vector |
| p0748.15 | Invert DI/DO15 | CU | 0 | Not inverted | |
| p0728.15 | Set DI/DO15 input or output | CU | 1 | Output | |
| p2103 | Acknowledge fault 1 | TM31 | 0 | | TM31 |
| 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 |
| p4048.1 | Invert DO1 | TM31 | 1 | Inverted | |
| p4038 | DO8 | TM31 | r0899.0 | Ready for switching on | Vector |
| p4028.8 | Set DI/DO8 input or output | TM31 | 1 | Output | |
| p4039 | DO9 | TM31 | 0 | | TM31 |
| p4028.9 | Set DI/DO9 input or output | TM31 | 0 | Input | |
| p4040 | DO10 | TM31 | 0 | | TM31 |
| p4028.10 | Set DI/DO10 input or output | TM31 | 0 | Input | |
| p4041 | DO11 | TM31 | 0 | | TM31 |
| p4028.11 | Set DI/DO11 input or output | TM31 | 0 | Input | |

Parameter macro p0700 = 10: PROFIdrive NAMUR (70010)

This macro is used to set the PROFIdrive NAMUR interface as the default command source.

| Sink | | | Source | | |
|-----------|--------------------------------------|--------|-----------|----------------------------|--------|
| Parameter | Description | DO | Parameter | Description | DO |
| p0840[0] | ON/OFF1 | Vector | 0 | Assignment with p0922 = 20 | Vector |
| p0844[0] | No OFF2_1 | Vector | 1 | Assignment with p0922 = 20 | Vector |
| p0845[0] | No OFF2_2 | Vector | r0722.3 | CU DI3 | CU |
| p0848[0] | No OFF3_1 | Vector | 0 | Assignment with p0922 = 20 | Vector |
| p0849[0] | No OFF3_2 | Vector | 1 | | Vector |
| p0806 | Inhibit LOCAL mode | Vector | 0 | | Vector |
| p0810 | Changeover CDS bit 0 | Vector | 0 | | Vector |
| p0852 | Enable operation | Vector | 1 | Assignment with p0922 = 20 | Vector |
| p0854 | Control request | Vector | 1 | Assignment with p0922 = 20 | Vector |
| p0922 | PROFIdrive PZD telegram selection | Vector | 20 | PROFIdrive NAMUR | |
| p1020 | FSW bit 0 | Vector | 0 | | Vector |
| p1021 | FSW bit 1 | Vector | 0 | | Vector |
| p1035 | MOP raise | Vector | 0 | | Vector |
| p1036 | MOP lower | Vector | 0 | | Vector |
| p1113 | Direction of rotation reversal | Vector | 0 | Assignment with p0922 = 20 | Vector |
| p1140 | Enable RFG | Vector | 1 | Assignment with p0922 = 20 | Vector |
| p1141 | Start RFG | Vector | 1 | Assignment with p0922 = 20 | Vector |
| p1142 | Enable nsetp | Vector | 1 | Assignment with p0922 = 20 | Vector |
| p2103 | Acknowledge fault_1 | Vector | 0 | Assignment with p0922 = 20 | Vector |
| p2104 | Acknowledge faults_2 | Vector | 0 | | Vector |
| p2106 | Ext. fault_1 | Vector | r0722.1 | CU DI1 | CU |
| p2107 | Ext. fault_2 | Vector | 1 | | Vector |
| p2112 | Ext. alarm_1 | Vector | r0722.0 | CU DI0 | CU |
| p2116 | Ext. alarm_2 | Vector | 1 | | Vector |
| p0738 | DI/DO8 | CU | 1 | +24 V | CU |
| p0748.8 | Invert DI/DO8 | CU | 0 | Not inverted | |
| p0728.8 | Set DI/DO8 input or output | CU | 1 | Output | |
| p0739 | DI/DO9 | CU | 1 | +24 V | CU |
| p0748.9 | Invert DI/DO9 | CU | 0 | Not inverted | |
| p0728.9 | Set DI/DO9 input or output | CU | 1 | Output | |
| p0740 | DI/DO10 | CU | 1 | +24 V | CU |
| p0748.10 | Invert DI/DO10 | CU | 0 | Not inverted | |
| p0728.10 | Set DI/DO10 input or output | CU | 1 | Output | |
| p0741 | DI/DO11 | CU | 1 | +24 V | CU |
| p0748.11 | Invert DI/DO11 | CU | 0 | Not inverted | |
| p0728.11 | Set DI/DO11 input or output | CU | 1 | Output | |

Table A- 5Parameter macro p0700 = 10: PROFIdrive NAMUR

| Sink | | | Source | | |
|-----------|-----------------------------|------|-----------|------------------------|--------|
| Parameter | Description | DO | Parameter | Description | DO |
| p0742 | DI/DO12 | CU | 1 | +24 V | CU |
| p0748.12 | Invert DI/DO12 | CU | 0 | Not inverted | |
| p0728.12 | Set DI/DO12 input or output | CU | 1 | Output | |
| p0743 | DI/DO13 | CU | r0899.6 | Switching on inhibited | Vector |
| p0748.13 | Invert DI/DO13 | CU | 1 | Inverted | |
| p0728.13 | Set DI/DO13 input or output | CU | 1 | Output | |
| 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 | |
| p0745 | DI/DO15 | CU | r2138.7 | Ack. fault | Vector |
| p0748.15 | Invert DI/DO15 | CU | 0 | Not inverted | |
| p0728.15 | Set DI/DO15 input or output | CU | 1 | Output | |
| p2103 | Acknowledge fault 1 | TM31 | 0 | | TM31 |
| p2104 | Acknowledge fault 2 | TM31 | 0 | | TM31 |
| p4030 | DO0 | TM31 | 0 | | Vector |
| p4031 | DO1 | TM31 | 0 | | Vector |
| p4038 | DO8 | TM31 | 0 | | Vector |
| p4028.8 | Set DI/DO8 input or output | TM31 | 0 | Input | |
| p4039 | DO9 | TM31 | 0 | | TM31 |
| p4028.9 | Set DI/DO9 input or output | TM31 | 0 | Input | |
| p4040 | DO10 | TM31 | 0 | | TM31 |
| p4028.10 | Set DI/DO10 input or output | TM31 | 0 | Input | |
| p4041 | D011 | TM31 | 0 | | TM31 |
| p4028.11 | Set DI/DO11 input or output | TM31 | 0 | Input | |

Parameter macro p1000 = 1: PROFIdrive (100001)

This macro is used to set the default setpoint source via PROFIdrive.

Table A- 6 Parameter macro p1000 = 1: PROFIdrive

| Sink | | | Source | | |
|------------|--------------------------------|--------|------------|-----------------|--------|
| Parameters | Description | DO | Parameters | Description | DO |
| p1070 | Main setpoint | Vector | r2050[1] | PROFIdrive 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 = 2: Terminal TM31 (100002)

This macro is used to set analog input 0 on customer terminal block TM31 as the setpoint source.

Table A-7 Parameter macro p1000 = 2: TM31 terminals

| Sink | | | Source | | |
|-----------|--------------------------------|--------|-----------|-------------|--------|
| Parameter | Description | DO | Parameter | Description | DO |
| p1070 | Main setpoint | Vector | r4055 | AI0 TM31 | TM31 |
| 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 = 3: Motorized potentiometer (100003)

This macro is used to set the motorized potentiometer as the setpoint source.

 Table A- 8
 Parameter macro p1000 = 3: 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 |

A.2 Parameter macros

Parameter macro p1000 = 4: Fixed setpoint (100004)

This macro is used to set the fixed setpoint as the setpoint source.

Table A-9 Parameter macro p1000 = 4: 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 |

INDEX

Α

A7850 - External alarm 1, 359 Acknowledge error from the AOP, 234 Alarms, 359 Analog inputs, 75, 204 Analog outputs, 76, 288 AOP setpoint, 233 AOP30, 164 Assembly Canopies and hoods, 44 Canopy to increase the degree of protection to IP21, 45 Hood to increase the degree of protection to IP23/IP43/IP54, 46 Line connection from above, 47 Motor connection from above, 47 Automatic restart, 307 Automatic speed controller optimization, 295 Auxiliary supply, 69 Auxiliary Supply 230 V AC, 70 24 V DC, 70 Auxiliary Voltage, 77

В

B00, 117 B02, 119 B03, 119 Basic commissioning Entering the basic parameters, 171 Settings for units that are connected in parallel, 159, 173 **Basic Commissioning** Enter the motor data, 168 Entering the encoder data., 169 Motor identification, 172 Selecting the motor type, 168 **Basic information** BICO technology, 191 Binector input (BI), 192 Binector output (BO), 192 Command data set (CDS), 186 Connector input (CI), 192 Connector output (CO), 192

Copy motor data set (MDS), 190 Copying the command data set (CDS), 190 Copying the drive data set (DDS), 190 Data sets, 186 Drive data set (DDS), 187 Drive objects, 184 Encoder data set (EDS), 188 Interconnecting signals, 192 Motor data set (MDS), 189 Parameter categorization, 182 Parameter types, 181 Parameters, 181 Basic information about the drive system, 181 BICO technology, 191 Interconnecting signals, 192 Binector input (BI), 192 Binector output (BO), 192 Blocking protection, 345 Bremseinheit 25 kW (Option L61), 92 Bremseinheit 50 kW (Option L62), 92 **Bypass** Bypass with synchronizer with degree of overlapping, 331 Bypass with synchronizer without degree of overlapping, 333 Without synchronization, 335 Bypass function, 330

С

Cabinet anti-condensation heating (option L55), 87 Cabinet illumination with service socket (option L50), 87 Cable lengths, 62 CAN bus, 104 CBC10, 104 **CBC10** Communication Board CAN bus, 104 CBE20, 102 CDS (command data set), 186 Copy, 190 Certificate of compliance with order, 15 Certification, 15 Changing the language, 231 Checklist Electrical installation, 50 Mechanical installation, 41 Circuit breaker (option L26), 84

Cleaning, 364 Closed-loop torque control, 279 Command data set, 186 Command sources General information, 180 NAMUR, 200 PROFIdrive, 196 **PROFIdrive NAMUR, 202** TM31 terminals, 198 Communication Board Ethernet CBE20 (option G33), 102 Connecting the DC link connections, 61 Connecting the PE buses, 60 Connecting-up the DRIVE-CLiQ topology, 61 Connecting-up the power supply and the signal cables, 61 Connection cross-sections, 62 Connection for External Auxiliary Equipment (Option L19), 83 Connector input (CI), 192 Connector output (CO), 192 Control Interface Board Frame size FX, replacement, 382 Frame size GX, replacement, 384 Frame size HX, replacement, 386 Frame size JX, replacement, 388 Control via PROFIBUS, 213 Customer terminal block, 71 Customer terminal block extension (option G61), 115

D

Data sets, 186 Date of manufacture, 33 DCC, 22, 250 DDS (drive data set), 187 Copy, 190 Decrease Key, 233 Derating, 411 Derating behavior at increased pulse frequency, 324 Derating data, 411 Current derating as a function of the installation altitude and ambient temperature, 411 Current derating as a function of the pulse frequency, 413 Voltage derating as a function of the installation altitude. 412 Design, 24 Diagnosis, 350 LEDs. 350 Parameters, 355 Digital inputs, 74, 75

Digital inputs/outputs, 77 Digital outputs, 291 Direction of rotation changeover, 253 Direction reversal, 322 Downloading the firmware (operator panel), 408 Drive Control Chart, 250 Drive Control Chart (DCC), 22 Drive data set, 187 Drive objects, 184 Droop Function, 278 dv/dt filter plus Voltage Peak Limiter (option L10), 79

Ε

EC declaration of conformity, 15 EC manufacturer's declaration, 15 EDS (encoder data set), 188 Efficiency optimization, 301 Electrical connection of units that are connected in parallel, 60 Electromagnetic compatibility EMC compliant design, 58 Introduction, 56 Noise emissions, 56 Operational reliability and noise immunity, 56 EMERGENCY OFF category 0 (option L57), 88 EMERGENCY OFF pushbutton (option L45), 86 EMERGENCY STOP category 1 (option L59), 90 EMERGENCY STOP Category 1 (option L60), 91 Encoder data set, 188 Ethernet interface, 103 Extended braking control, 338 Extended monitoring functions, 340 External alarm 1, 359 External fault 1, 360 External fault 2, 360 External fault 3, 360 External supply, 69

F

F7860 – External fault 1, 360 F7861 – External fault 2, 360 F7862 – External fault 3, 360 Factory setting, 176 Fan Frame size FX, replace, 390 Frame size GX, replacement, 392 Frame size HX, replacement, 394 Frame size JX, replacement, 398 Fan voltage, adjustment, 64

| Fast magnetization, 302 | L |
|---|--|
| Faults, 359 Faults and alarms, 359 Faults and alarms, 236 Features, 22 Field of applications, 21 Filtermatten, Austausch, 369 Firmware update, 407 Firmware, upgrading, 407 Fixed setpoints, 208 Fixed speed setpoints, 208 Flying restart, 310 with encoder, 312 without encoder, 311 Forming the DC link capacitors, 405 Friction characteristic curve, 315 Fuse -A1 -F21, 402 Fans -U1 -F10 / -U1 -F11, 402 Fuse auxiliary power supply (-A1-F11/-A1-F12), 402 | L10, 79 L13, 81 L15, 81 L19, 83 L26, 84 L45, 86 L50, 87 L55, 87 L57, 88 L59, 90 L60, 91 L61, 92 L62, 92 L83, 98 L84, 98 L84, 98 L86, 98 L87, 100 Load monitoring, 340 LOCAL/REMOTE key, 231 |
| | Lock AOP local mode, 234 |

G

G33, 102 G61, 115

Η

High overload, 416

I

Increase Key, 233 Increasing the output frequency, 317 Installation Installation, 43 Lifting the cabinet off the transport pallet, 43 Installation device, 366 Installtion site, 42 Insulation Monitor (Option L87), 100 IT system, 68

Κ

K50, 107 K82, 116 K82, terminal module for activating Safe Torque Off and "Safe STOP 1, 116 Kinetic buffering, 304

М

Low overload, 416

M13, 47 M21, 45 M23, 46 M43, 46 M54, 46 M78, 47 Main circuit breaker incl. fuses (option L26), 84 Main Contactor (Option L13), 81 Maintenance, 364, 365 Maintenance and servicing, 363 MDS (motor data set), 189 Copy, 190 Mechanical connection of units that are connected in parallel, 44 Mechanical installation Checklist, 41 Menu Setting the date, 229 Menu AOP30 settings, 225 Basic Commissioning, 225 Commissioning / service, 225 Complete commissioning, 225 Control settings, 225 Defining the operation screen, 226 Device commissioning, 225

Display settings, 225 Drive commissioning, 225 Fault/alarm memory, 224 Motor identification, 225 Operation screen, 221 Resetting the fan runtime, 225 Structure, 220 Menu Setting the time, 229 Menu Date format, 229 Menu Resetting AOP settings, 229 Menu Software Version, 230 Menu Database version, 230 Menu AOP30 diagnosis, 230 Menu Battery status, 230 Menu Keyboard test, 230 Menu LED test, 230 Menu Language/Sprache/Langue/Idioma/Lingua, 231 Minimum cable lengths, 63 Minimum speed, 254 Monitoring Functions, 342 Motor changeover/selection, 313 Motor data set. 189 Motor identification. 295 Motorized potentiometer, 206

Ν

NAMUR Outlet for external auxiliaries (option B03), 119 Separate 24 V DC power supply (option B02), 119 NAMUR terminal block (option B00), 117 Non-grounded system, 68

0

OFF Key, 232 ON Key, 232 Online operation with STARTER, 239 Operating hours counters, 320 Operation on a non-grounded system, 68 Operation screen, 221 Operator input inhibit / parameters inhibit key, 234 Operator panel, 164 Overview, 219 Option short codes, 35 Outgoing section for external auxiliary equipment for NAMUR (option B03), 119 Output terminals, 287 Overload capability, 416 Overload responses, 343

Ρ

Parameter reset, 176 Parameter reset via STARTER, 177 Resetting Parameters via AOP30, 176 Parameterization errors, 238 Permanent-magnet synchronous motors, 283 Power block Crane lifting lugs, 367 Frame size FX, replacement, 370 Frame size GX, replacement, 372 Frame size HX, replacement, 374 Frame size JX, replacement, 378 Power connections, 62 Connecting the motor and power cables, 63 Power supply, internal, 67 Preparation Mechanical installation, 42 PROFIBUS, 209 Bus terminating resistor, 211 Connectors, 210 Setting the PROFIBUS Address, 213 PROFIBUS link, 209 **PROFINET IO, 245** Addresses, 247 RT and IRT, 246 Protecting power components, 342 Protective functions, 342 PT100 evaluation unit (option L86), 98

Q

Quality, 22

R

Ramp-function generator, 256 Reference model, 275 Relay outputs, 78 Removing the interference suppression capacitor, 68 Replacement

Crane lifting lugs, 367 Fan, frame size FX, 390 Fan, frame size GX, 392 Filter mats, 369 Installation device, 366 Operator panel, 403 Replacing Automatic firmware update, 406 Control Interface Board (frame size FX), 382 Control Interface Board (frame size GX), 384 Control Interface Board (frame size HX), 386 Control Interface Board (frame size JX), 388 Error messages, 406 Fan (frame size HX), 394 Fan (frame size JX), 398 Operator panel battery, 403 Power block (frame size FX), 370 Power block (frame size GX), 372 Power block (frame size HX), 374 Power block (frame size JX), 378 Replacing components, 369 Replacing the Backup Battery of the Cabinet Operator Panel, 403 Replacing the cabinet operator panel, 403 Residual risks, 18 Rotating measurement, 298 Runtime, 320

S

S5 – Selector for voltage/current AI0, AI1, 76 Saving the Parameters, Permanently, 237 Separate 24 V DC power supply for NAMUR (option B02), 119 Service, 23 Service and Support, 361 Setpoint addition, 252 Setpoint channel, 252 Setpoint sources, 204 Analog inputs, 204 Fixed speed setpoints, 208 General information, 180 Motorized potentiometer, 206 Setting the PROFIBUS Address, 213 Shield connection, 71 Signal connections, 71 Simulation operation, 321 Sine-wave filter (option L15), 81 Slip compensation, 264 SMC30, 107 SMC30 Sensor Module Cabinet-Mounted (option K50), 107

SMC30: connection examples, 114 Speed controller, 270 Speed controller adaptation, 276 Speed controller optimization, 298 Speed controller pre-control, 272 Speed limitation, 255 Stall protection, 346 Standstill measurement, 296 STARTER, 123 Commissioning, 125 Connection via serial interface, 161 Creating the project, 125 Installation, 124 Online operation via PROFINET, 239 Starting the drive project, 160 User interface, 124 Storage, 39 Suppression Speed, 254 Switching between clockwise and counter-clockwise rotation, 232

Т

Technical specifications, 417 General, 410 Version A, 380 V - 480 V 3 AC, 418 Version A, 500 V – 600 V 3 AC, 432 Version A, 660 V – 690 V 3 AC, 446 Version C, 380 V - 480 V 3 AC, 426 Version C, 500 V - 600 V 3 AC, 440 Version C, 660 V – 690 V 3 AC, 458 Technology controller, 327 Telegram selection, user defined, 215 Telegrams and process data, 215 Temperature sensor, 76 Thermal monitoring, 343 Thermal motor protection, 347 Thermistor Motor Protection Unit (Option L83/L84), 98 Timeout monitoring, 234 TM31, 71 TM31 (front view), 72 TM31, connection overview, 73 Tool, 43, 54, 365 Torque limiting, 282 Transport units Connecting PE buses, 60 Connecting the DC link connections, 61 Connecting the DRIVE-CLiQ topology, 61 Connecting the signal cables, 61 Connecting the voltage supply, 61 Electrical connection, 60 Transportation, 38

Type plate, 33 Date of manufacture, 33 Option short codes, 35 Specifications, 34

U

Unit changeover, 323 Units that are connected in parallel Mechanical connection, 44 Unpacking the cabinets, 42

V

V/f control, 258
Vdc control, 303
Vdc_max control, 306
Vdc_min control, 304
Vector control sensorless, 266 with encoder, 269
Vector speed/torque control with/without encoder, 265
Version A, Design, 24
Version C, Design, 27
Voltage boost, 261 During acceleration, 263 Permanent, 262

W

Wiring principle, 28

Х

X1400, 103 X451 (CAN bus), 106 X452 (CAN bus), 106 X520, 74 SMC30, 112 X521, 75 SMC30, 113 X522, 76 X530, 75 X531 SMC30, 113 X540, 77 X541, 77 X542, 78

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