SINAMICS S120

Line infeed

System manual · 01/2011

SINAMICS

SIEMENS

SIEMENS

SINAMICS

S120
Line infeed

System Manual

2011

A5E03347436A

Legal information

Warning notice system

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

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

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

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

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 complied with. The information in the relevant documentation must be observed.

Trademarks

All names identified by ® are registered trademarks of Siemens AG. The remaining trademarks in this publication may be trademarks whose use by third parties for their own purposes could violate the rights of the owner.

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

Order number: A5E03347436A
℗ 07/2011

Preface

Objective

This document describes SINAMICS units and functions which enable power to be fed into a power grid or to an island grid. Reference is made only to the hardware components required for infeed and the necessary software functions/options. The hardware differs from the conventional, widely used SINAMICS infeed and regenerative feedback units for industrial applications. The software offers options to provide additional functionality.

Detailed information on general hardware, software functions and engineering information/instructions are described in separate documentation and can obtained from the regional SIEMENS office and used as supplementary information for this documentation.

Target group

This document is used by system integrators and Original Equipment Manufacturers (OEMs) to operate, parameterize and commission the SINAMICS devices with the associated software functions for power infeed.

Further reference documents

- SINAMICS S120/S150 List Manual
- SINAMICS S120 Commissioning Manual
- SINAMICS S120 Function Manual Drive Functions
- SINAMICS S120 Equipment Manual for Chassis Power Units
- SINAMICS LV Configuration Manual

Internet address

Up-to-date information about our products can be found on the Internet at:

http://www.siemens.com

You can find information on SINAMICS at:

http://www.siemens.com/sinamics.

⚠ DANGER

- Commissioning is absolutely prohibited until it has been completely ensured that the machine, in which the components described here are to be installed, is in full compliance with the provisions of the EC Machinery Directive.
- SINAMICS devices and AC motors must only be commissioned by suitably qualified personnel.
- The personnel must take into account the information provided in the technical customer documentation for the product, and be familiar with and follow the specified danger and warning notices.
- When electrical equipment and motors are operated, the electrical circuits are automatically at hazardous voltage levels.
- Dangerous mechanical movements of the driven machine components are possible when the system is operational.
- All of the work carried-out on the electrical machine or system must be carried-out with it in a no-voltage condition.
- SINAMICS devices with three-phase motors must only be connected to the power supply via an AC-DC residual-current-operated device with selective switching once verification has been provided that the SINAMICS device is compatible with the residual-current-operated device in accordance with IEC 61800-5-1, Section 5.2.11.2.

⚠ WARNING

- The successful and safe operation of this equipment and motors is dependent on correct transport, proper storage, installation and mounting as well as careful operator control, service and maintenance.
- For special versions of the drive units and motors, information and data in the Catalogs and quotations additionally apply.
- In addition to the danger and warning information provided in the technical customer documentation, the applicable national, local, and plant-specific regulations and requirements must be taken into account.
- Only protective extra-low voltages (PELV, DVC-A) that comply with EN 60204-1:2006 can be connected to the connections and terminals between 0 V and 48 V.

⚠ CAUTION

- The motors can have surface temperatures of over +80 °C.
- This is the reason that temperature-sensitive components, e.g. cables or electronic components may neither be in contact nor be attached to the motor.
- When attaching the connecting cables, you must ensure that:
  – they are not damaged
  – they are not under tension
  – they cannot come into contact with any rotating parts

CAUTION

- As part of routine tests, SINAMICS devices are subject to a voltage test in accordance with EN 61800-5-1. Before the voltage test is performed on the electrical equipment of industrial machines to EN 60204-1:2006, Section 18.4, all connectors of SINAMICS equipment must be disconnected/unplugged to prevent the equipment from being damaged.
- Motors should be connected-up according to the circuit diagram provided. Otherwise they can be destroyed.

⚠DANGER

Five safety rules

When carrying out any kind of work on electrical devices, the "five safety rules" according to EN 50110 must always be observed:

1. Isolate the equipment from the power supply
2. Lockout to prevent reconnection.
3. Make sure that the equipment is de-energized and in a no-voltage condition
4. Ground and short-circuit
5. Cover or enclose adjacent components that are still live

Note

When operated in dry areas, in an operational state, SINAMICS devices with three-phase motors conform to the Low-Voltage Directive 2006/95/EC.

Technical support

European and African time zones	
Telephone	+49 (0) 911 895 7222
Fax	+49 (0) 911 895 7223
Internet	http://www.siemens.com/automation/support-request

America time zones	
Telephone	+1 423 262 2522
Fax	+1 423 262 2200
Internet	techsupport.sea@siemens.com

Asia/Pacific time zones	
Telephone	+86 1064 757 575
Fax	+86 1064 747 474
Internet	support.asia.automation@siemens.com

Note

For technical support telephone numbers for different countries, go to:

http://www.automation.siemens.com/partners

EC Declaration of Conformity

The EC Declaration of Conformity for the EMC Directive can be obtained from:

- Internet address
  http://support.automation.siemens.com
  under the Product/Order number 15257461
- At the relevant regional office of the I DT MC Business Unit of Siemens AG.

⚠ CAUTION

Electrostatic sensitive devices (ESD) are single components, integrated circuits or devices that can be damaged by electrostatic fields or electrostatic discharges.

Regulations for handling ESD:

When handling electronic components, pay attention to the grounding of the person, workplace and packaging!

Electronic components may be touched by persons only when

- these persons are grounded using an ESD bracelet, or
- these persons in ESD areas with a conducting floor wear ESD shoes or ESD grounding straps.

Electronic components should be touched only when this is unavoidable. It is only permissible to touch electronic modules and similar at the front panel or on the edge of the circuit board.

Electronic modules must not be brought into contact with plastics or clothing made of artificial fibers.

Electronic modules may only be placed on conducting surfaces (table with ESD coating, conducting ESD foam, ESD packing bag, ESD transport container).

Electronic modules may not be placed near display units, monitors or televisions (minimum distance from the screen > 10 cm).

Measurements must only be taken on boards when the measuring instrument is grounded (via protective conductors, for example) or the measuring probe is briefly discharged before measurements are taken with an isolated measuring device (for example, touching a bare metal housing).

Table of contents

General information

1

To assess the inverter system required, the following distinction can be made between the types of power generation:

- Power generation with rotating machines
- Power generation without rotating machines

Both in power technologies based on fossil fuels, or nuclear energy as well as regenerative energies with solar thermal, wind, water or biomass, generators are normally used to convert the kinetic energy into electrical energy and supply it to the consumers via power grids.

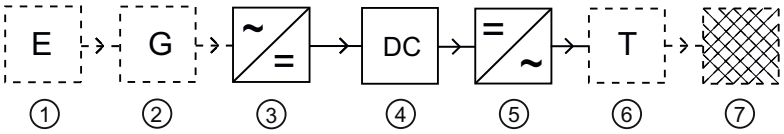


Figure 1-1 Energy flow for power generation with rotating machines

1	Power generation	Energy producers
2	Conversion into electrical energy	
3	Conversion into DC voltage	Scope of delivery
4	DC link	
5	Conversion into AC voltage with output filter	
6	Transformer to connect to the grid	Company operating the grid
7	Power grid	

For power sources such as batteries, fuel cells or photovoltaic, for example, the electrical energy is generated via chemical processes or using semiconductors. As a rule, the resulting DC voltage must be converted to a 3-phase AC voltage for distribution in the power grid.

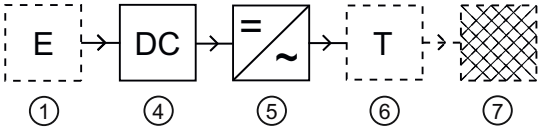


Figure 1-2 Energy flow for power generation without rotating machines

1	Power generation	Energy producers
4	DC link	Scope of delivery
5	Conversion into AC voltage with output filter	
6	Transformer to connect to the grid	Company operating the grid
7	Power grid	

In particular, the amount of power generated depends largely on fluctuating ambient conditions, such as wind speed or exposure to sunlight. The amplitude and frequency of the generated voltage vary accordingly, and decoupling of the producer and consumer grid is required. This task is handled using state-of-the-art power electronics.

Grid types

2

2.1 Island grid

An island grid generally has only a few power generation plants, supplies a limited area and has no connection to the public power grid or to other grids. The company operating the grid must maintain the balance between used and generated power in the island grid.

The company operating an island grid can make individual regulations. These regulations may deviate from the standard regulations.

Requirements placed on distributed power producers

- Matching the generated power (active power/reactive power) at the rated frequency to the load power (active power/reactive power)
- Distribution of the generated power between the power generating units
- Control of the line frequency

Task in the event of disturbances

- Provision of the entire short-circuit current in the event of a short-circuit
- Provision of reactive power for grid support
- Re-establish the voltage and maintain the frequency after the short-circuit has been cleared

Function modules for an island grid

Operation in an island grid requires software functions, which are defined as function modules and which only become visible when enabled.

The following function modules are required for operation in an island grid:

- Line transformer
- Grid droop control

2.2 Power grid

A power grid is a grouping of several (island) grids with their own power producers.

Requirements

Every power grid operator has defined conditions when it comes to feeding in electrical energy. All energy suppliers must satisfy these conditions.

For example, in Germany this is the "Federal Association of Energy and Water Industry e. V." (in short: BDEW) which has specified the following conditions for energy infeed:

- Fault ride through: No disconnection from the grid in the case of defined short grid disturbances
- Provision of a steady-state reactive power for compensation if necessary
- Maintaining the limits of the voltage quality formulated in EN 50160

Task in the event of disturbances

- Provision of a contribution to the short-circuit current
- Provision of a dynamically variable reactive current for grid support

Function modules for the power grid

Operation in a power grid requires software functions that are defined as function modules, which become visible when enabled.

The following function modules are required for operation in a power grid:

- Line transformer
- Dynamic grid support

Function modules

3

This chapter describes the licensed function modules that are required for energy infeed to a power grid or to an island grid.

3.1 Overview

As described in the previous chapter, power grid and island grids have different requirements for open-loop and closed-loop control of line infeeds. The software has function modules that can be selected depending on the particular control task.

- Line transformer

  The "Line transformer" function module does not require any license and is used to premagnetize and switch the line transformer to the power grid or to the island grid. This function module is activated in the STARTER operating software.

  A detailed description of the activation is provided in chapter "Commissioning".

- Grid droop control

  The "Grid droop control" function module enables operation in an island grid. The inverter for the line infeed has the task of controlling the frequency and the voltage in the grid, and assumes an "anti-islanding function". The DC voltage present in the DC link must be controlled by other participants, such as motor-side inverters, or provided by other sources (e.g. from a photovoltaic field).

  Active Line Modules are used in conventional operation for the closed-loop control of the DC-link voltage. With the "Grid droop control" function module, the Active Line Module is used for frequency and voltage control of the grid and ensures stable grid operation.

- Dynamic grid support

  The "Dynamic grid support" function module is always required when the grid operators stipulate grid support when feeding power into a power grid or island grid.

  Both power grids and island grids must not collapse, for example in the event of extremely brief voltage dips. A contribution from distributed generating units to the necessary reactive current or short-circuit current is also required in power grids to clear power system faults and to ride through without power failure

The function modules "Grid droop control" and "Dynamic grid support" must be ordered as an option for the SINAMICS S120 CompactFlash card:

- S01: Dynamic grid support for feeding power into a power grid
- S02: Grid droop control for feeding power into an island grid

3.2 Preconditions

Hardware

- Control Unit CU320-2
- Active Line Module, order number ending in ...AA4 with associated Active Interface Module
- Additional Voltage Sensing Module (VSM10) for measuring the line voltage on the primary side of the transformer
- Motor Module for rotating power generation using a generator

Software

- STARTER with firmware version 4.1.5.1 or higher
  SSP for SINAMICS V4.3 SP2
- SINAMICS S120 firmware version 4.3 SP2 or higher
- CompactFlash card for CU320-2 with one of the options
  - S01: Dynamic grid support for feeding power into a power grid
  - S02: Grid droop control for feeding power into an island grid

Hardware to be supplied on-site

- Transformer
- Line contactor
- Generator

3.3 Description of the function modules

3.3.1 Line transformer

Task

The main task of this function module is to magnetize a line transformer before connecting the power generation system to the grid. This magnetization is always necessary and expedient when - as shown in Figure 3.1 - the line transformer forms part of the system and is also disconnected from the grid when the system is shut down. Without magnetization by the inverter, very high transformer inrush currents would otherwise flow when closing the circuit breaker, and these could, among other things, cause excessive grid harmonics.

In addition, the function module allows identification of the transformer data. This can compensate the voltage drop across the transformer during operation and optimize the behavior of the power generation plant at the grid connection point.

3.3.1.1 Premagnetization

This function controls the premagnetization of the line transformer before connection to the existing grid. The energy for premagnetization is provided from the DC link.

Functional sequence

Premagnetization starts after completion of the DC link pre-charging.

With an open circuit breaker between transformer and the grid, the Active Line Module produces an output voltage for premagnetization of the primary side of the transformer.

Any residual magnetization of the transformer, or a residual voltage in line filter, is taken into account during the premagnetization process.

- At the beginning of the power-up sequence, r0899.8 is set to "1".
- On completion of the DC link pre-charging, r0899.11 = 1.
- During transformer magnetization, r0899.8 = 1 and r0899.11 = 1.
- After completion of the transformer magnetization, the converter has the status "Ready to Operate": r0899.1 = 1 (r0899.8 = 0 and r0899.11 = 1).

Parameter r0863.1 (control external line contactor) is used as output to control the circuit breaker. If the function "Line transformer" is activated (ramp time p5481[0] > 0), the command to close is issued via r0863.1 after the expiry of the premagnetizing ramp and when synchronization is achieved.

3.3.1.2 Grid synchronization

Two VSM10s are required for this function. The first VSM10 in the Active Interface Module measures the output voltage of an Active Line Module on the transformer secondary side. The second VSM10 (VSM2) measures the grid voltage on the transformer primary side . The Control Unit calculates the amplitude, frequency and phase position of the voltages. The Active Line Module corrects the generated voltage to the existing grid until exact synchronization is achieved. Then, the infeed is connected to the grid via the circuit breaker.

The adjustable parameters for the second VSM10 (VSM2) become visible on activation of the "Line transformer" function module in the expert list.

DRIVE-CLiQ topology

The following DRIVE-CLiQ topology must be used so that auto-commissioning will work. If a different topology selected, the user must assign all the VSM10s manually in offline configuration using the STARTER tool.

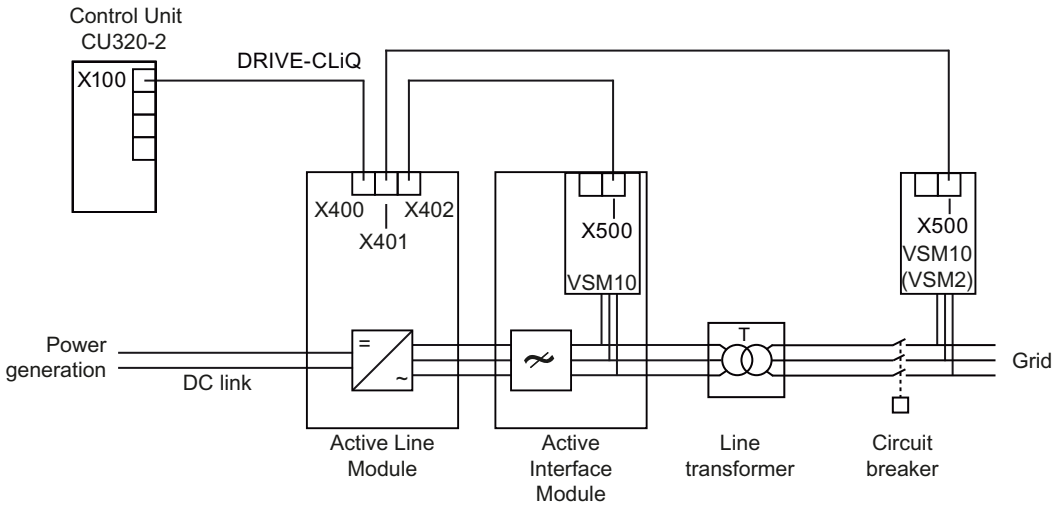


Figure 3-1 DRIVE-CLiQ topology

3.3.1.3 Identification of the transformer data

In contrast to the regular line/DC link identification routine (p3410 > 3), identification of the magnetizing inductance and leakage inductance of the transformer, as well as phase shift and voltage correction is performed in separate individual steps.

Prior to identification, the rated values for primary voltage (p5486) and secondary voltage (p0210) of the transformer must be set correctly. Furthermore, a value that is as precise as possible must be entered for the shift of the phase angle (p6420). This angle depends on the vector group of the transformer and, if applicable, on an additional shift based on a potential transformer for recording the mean voltages using a VSM10.

Identification sequence:

1. Switching on the Active Line Modules with p5480 = 11 identifies the magnetizing inductance of the transformer. The circuit breaker is not closed, the power supply to the DC link must be ensured however. The measured value r5491 should be adopted for p5492.
2. Switching on the Active Line Modules with p5480 = 12 identifies the total effective phase shift, and determines a correction value for the effective transformation ratio. The measured values r6440 and r6441 must be transferred explicitly into the adjustable parameters p6420 and p6421.
   Note: The circuit-breaker is closed for this measurement.

3. Switching on the Active Line Modules with p3410 = 5 executes an identification of the line inductance and DC link capacitance. On the basis of the measured values, optimization of current and voltage control is carried out automatically and the settings are saved and in a non-volatile memory.
   Note: The converter goes into full operation and injects a defined reactive current at the grid connection point for test purposes.
4. Switching on the Active Line Modules with p5480 = 13 identifies the effective total leakage inductance of the transformer. The measured value r5489 should be transferred into the adjustable parameter p5490 to compensate for the voltage drop across the transformer correctly in regular infeed operation and enable optimal control of the voltage at the network connection point.

Note

In contrast to p3410 for the general identification of line and the DC link, control parameter p5480 is not reset automatically for the identification of the transformer data. After completion of the identification, the operating mode must be set manually to "0 = OFF" or "1 = regular operation with transformer magnetization"!

Operation on weak networks (with a high inductance and low short-circuit power)

Note for operation on grids with low short-circuit power in relation to the rated power of the Active Line Modules (uk_grid> 10):

- Prior to switching on for the first time, set the following parameters:
  p3560 = 50 %, p3615 = 50 %, p3603 = 0 %, p3415[0] = p3415[1] = 5 %.
- If the controller dynamics without feedforward control is not sufficient for the load duty cycle of the respective application (e.g. due to abrupt load changes), the feedforward control p3603 may be increased up to 50%.
  Note: Large abrupt load changes should be avoided on very soft networks.

3.3.1.4 Line filter and transformer monitoring

As already described, network connection regulations stipulate the provision of short-circuit current during short-term short-circuits in the power grid. Short-circuits within the power generation system (between the inverter and the network connection point) however must result in an immediate shutdown to prevent additional damage to the system.

With the aid of the line filter and transformer monitoring function, a distinction/detection is carried out for external line short-circuits (requiring grid support) and internal short-circuits that produce a safety shutdown with F6855. Parameters p3678 and p3679 are used as adjustable parameters.

3.3.1.5 Overview of important parameters

Line transformer premagnetization line

- p5480 Transformer magnetization mode
- p5481[0...2] Transformer magnetization ramp-up time/bounce time/timeout
- p5482 Transf magnetization state
- p5483 BI: Transf. magnetiz. signal source for circuit breaker activation
- p5484[0...2] Transf magnetization integration times
- p5485 Transf magnetization voltage threshold
- p5486 Transf rated voltage primary
- p5487[0...1] CI: Transf primary voltage
- r5488[0...2] CO: Transformer secondary voltage transformed
- r5489 transf leakage inductance identified
- p5490 Transf leakage inductance
- r5491 Transf magnetizing inductance identified
- p5492 Transf magnetizing inductance
- r5493.0 CO/BO: Transf control signals
- r5497[0...1] CO: Transf secondary current
- r5498[0...2] CO: Transf secondary voltage

Function line transformer VSM2

Display and parameter assignment of the VSM2 for transformer primary voltage

- p5460 VSM2 input line connection voltage, voltage scaler
- r5461[0…n] CO: VSM2 input line connection voltage u1 - u2
- r5462[0...n] CO: VSM2 input line connection voltage u2 - u3
- r5464[0...n] CO: VSM2 temperature evaluation status
- p5465[0...n] VSM2 temperature evaluation sensor type
- r5466[0...n] CO: VSM2 temperature KTY
- p5467[0...n] VSM2 overtemperature alarm threshold
- p5468[0...n] VSM2 overtemperature shutdown threshold
- p5469[0...n] VSM2 overtemperature hysteresis
- p5470[0...n] VSM2 10 V input CT gain
- r5471[0...n] CO: VSM2 10 V input CT 1 actual value
- r5472[0...n] CO: VSM2 10 V input CT 2 actual value
- r5473[0...n] CO: VSM2 10 V input 1 actual value
- r5474[0...n] CO: VSM2 10 V input 2 actual value

3.3.1.6 Function diagrams, line transformer

- 7990 Transformation model
- 7991 Line filter monitoring
- 7993 Transformer magnetization, voltage threshold
- 7994 Transformer magnetization sequence control

3.3.2 Grid droop control

In normal operation, the Active Line Module acts as a grid support by injecting sinusoidal line currents. The function module "Grid droop control" also enables anti-islanding operation, i.e. the line voltage and line frequency are controlled instead of the DC link voltage and the reactive current. Droop characteristic curves using a stable network operation is possible with other generators (e.g. diesel generators) in an island grid without further communication connection. After the synchronization to the existing network, the Active Line Module can also work as the sole anti-islanding component in the island grid.

Prerequisite for the operating mode "Grid droop control" is that the DC link voltage is specified or controlled by one of the connected power generation facilities (battery, photovoltaic field, etc.).

Task

- Control of line voltage and line frequency (anti-islanding)
- Stationary and dynamic load distribution to other energy producers in the network using droop characteristics
- Provision of reactive current and short-circuit current for clearing network incidents
- Active control of DC components in the line current

Design

Grid droop control includes the following functions:

- Droop function to control the frequency and voltage of the network, including load distribution
- Sequential control and current limitation control for mains voltage dips and short-circuits
- Modulation depth control to achieve the optimum modulation depth for minimum grid harmonics
- DC component control ensures a line current that is free from DC components and thus avoids saturation effects in the transformer
- Voltage control for compensating the voltage drop at transformer

Function

After the synchronization to a power supply network, switchover between normal current/voltage DC link control and grid droop control is possible at any time during operation. In these two modes, the line inverter can operate as a power source or load, depending on the valid setpoints for DC link voltage and reactive current or line frequency and line voltage.

The prerequisite for this is that at least one further component is operating on the DC link and that this component can produce and handle the required power and can maintain a defined DC link voltage. This can be a motor-side inverter or a battery or a PV field, for example..

The table below shows the essential features of the two modes in comparison.

	Closed-loop control mode	
	Line current DC link voltage	**Line frequency Line voltage**
Island grid	Only as loads or lower-level generating subunits (grid support)	Operation of an island grid as the sole generating source or in a power grid (anti-islanding)
Infeed active power	Infeed of the entire power available in the DC link infeed into the grid, regardless of the operating state of the grid (under standard conditions)	Contribution to frequency and voltage control in the network; time-variant infeed of active power to the network depending on the operating point
Load distribution	Only by external setpoint input from the higher-level power management system	With the aid of droop characteristics
Stationary reactive power compensation	possible (fixed setpoint)	Automatic provision of the required line reactive power
Dynamic reactive power compensation (incl. line fault)	Only possible with "Dynamic grid support" function module or by external setpoint input	Automatic provision of the required line reactive power
Short-circuit current on line faults	Only possible with "Dynamic grid support" function module	Automatically up to 115% of the regular maximum inverter current
DC link voltage	Control of the DC link voltage by the line inverter	Maintenance of the DC-link voltage required by other components

NOTICE

No self-contained start capability

Self-contained starting of the island grid is not supported. A line voltage must be present when switching on the infeed.

NOTICE

Island grid capability

The infeed is capable of maintaining the island grid on its own.

3.3.2.1 Overview of important parameters

Parameter list for grid droop control

- r0206[0...4] Rated power unit power
- r0207[0...4] Rated power unit current
- p0210 Drive unit line connection voltage
- P0211 Rated line frequency
- p1300[0...n] Open-loop/closed-loop control operating mode
- r5402.0...5 CO/BO: Grid droop control status word
- p5405 Grid droop control frequency droop no-load frequency
- P5407 Grid droop control frequency droop gradient
- p5409 Grid droop control frequency droop smoothing time
- r5410 Grid droop control frequency droop output
- r5411[0...1] Grid droop control frequency droop active power
- p5415 Grid droop control voltage droop no-load voltage
- p5417 Grid droop control voltage droop gradient
- p5419 Grid droop control voltage droop smoothing time
- r5420 Grid droop control voltage droop output
- r5421[0...1] Grid droop control voltage droop reactive current
- r5422[0...1] Grid droop control voltage droop reactive power
- p6890 Setpoint generator start value
- p6891 Setpoint generator maximum amplitude
- p6892 Setpoint generator frequency scaling factor
- p6893 Setpoint generator angular integrator setting value
- p6894 Setpoint generator start value frequency
- p6895 Setpoint generator acceleration frequency

Parameter interconnections

- p5401 BI: Grid droop control activation
- p5403[0...1] CI: Grid droop control current signal source
- p5404[0...1] CI: Grid droop control voltage signal source
- p5406 CI: Grid droop control frequency droop supplementary setpoint
- p5416 CI: Grid droop control voltage droop supplementary setpoint

3.3.2.2 Function diagrams, grid droop control

- 7982 Grid droop, DC component control
- 7984 Modulation depth control
- 7986 Sequence control, overcurrent

3.3.3 Dynamic grid support

The "Dynamic grid support" function controls the network in the event of voltage dips for a defined time, as stipulated by the regional network operators.

Task

The infeed systems in a medium-voltage network must participate in dynamic grid support:

- They must not disconnect from the grid when line faults occur.
- They must participate in the provision of the short-circuit current when a short circuit occurs.
- They must control the network with reactive power infeed during a voltage fault.
- They may not draw more inductive reactive power from the medium-voltage network after clearing the fault than prior to occurrence of the fault.

These requirements apply to all types of short circuits (i.e. for 1-phase, 2-phase and 3-phase phase and ground-short circuits).

Design

The function module for dynamic grid support includes the necessary additional functions for monitoring and control of the network. This allows most of the important line supply infeed guidelines - such as the German BDEW Guidelines for connection to medium-voltage networks - to be satisfied.
It must be checked individually whether deviating guidelines are also fulfilled and, if necessary, parameter settings must be adapted accordingly.

Function

The dynamic grid support is activated by setting parameter p5501 = 1.

With dynamic grid support activated, the regulated boost mode of the Active Line Module is maintained even when network incidents occur (amplitude and phase errors in the network voltage). The network is controlled by injection an additional reactive current, which is calculated according to a parameterizable characteristic. According to the characteristic curve for dynamic grid support, the reactive power injected depends on the line voltage fault.

The supplementary setpoint for the reactive current controller causes an increase of the output voltage if the line voltage is too low, and reduction of output voltage if the line voltage is too high.

NOTICE
Automatic shutdown
The Active Line Module shuts down in the event of the frequency being out of range (120% of p0284 or p0285) or if it is tripped by a protection function (overcurrent, overvoltage, overtemperature, etc.). In all other cases, the Active Line Module supports the network by injecting a reactive current in accordance with the characteristic curve..

Example for network connection directive: German BDEW Guidelines

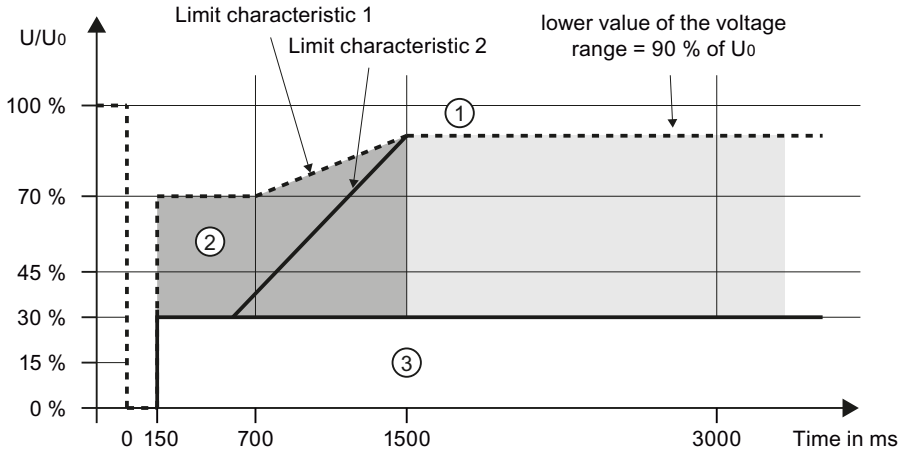


Figure 3-2 Limiting characteristics for the voltage characteristic at the network connection point

Explanation of the voltage characteristic

① In the area above the borderline 1, the infeed operation is stabile

② In the area between borderline 1 and borderline 2, it must be agreed with the network operator whether the infeed mode should be maintained or whether the infeed is to be disconnected from the power system.

③ Careful disconnection from the network may take place in this area.

The function "dynamic grid support" function ensures that the power inverter can uphold grid support for at least the time required in this example directive. Depending on the parameter settings (e.g. p5528[1]) and the thermal preloading, a network short circuit can be controlled for up to 2 s. Additional time-dependent shutdown conditions (e.g. in accordance with Fig. 3-2 after 150 ms short circuit), which may vary depending on the applicable national or local guidelines, must be implemented in a higher-level controller.

Example of a characteristic curve for dynamic grid support in accordance with German BDEW Guidelines for connection to medium-voltage networks:

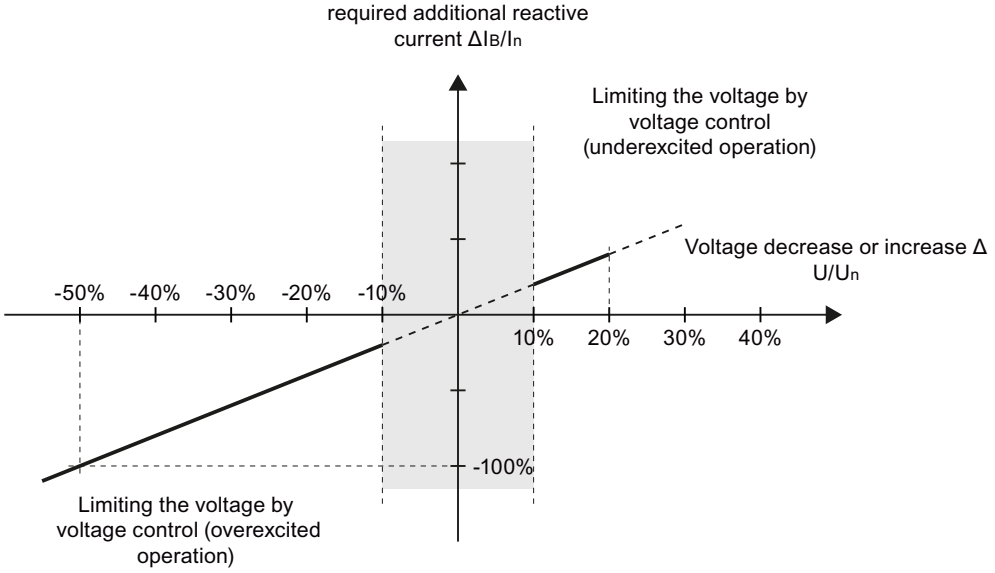


Figure 3-3 Dynamic grid support with voltage control in accordance with German BDEW Guidelines

Explanations for voltage control:

- Voltage deadband:
  In the range between 0.9 x U_n ≤ 1.1 x U_n, there is no requirement for dynamic grid support.
- The rise time is < 20 ms (typical ~10 ms).
- Voltage control after returning to the voltage deadband is maintained for a further 500 ms (p5507[0], parameterizable).
- Reactive current $I_B = k \frac{U - U_0}{U_n} I_n$
- The parameters for voltage control are p5505[0...3] (voltage values), p5506[0...3] (reactive current values), p5509[3] (hysteresis).
- The default setting of the characteristic curve parameter corresponds to the characteristic in accordance with Figure 3-3.

$\Delta I_B = I_B - I_{B0}$

$\Delta U = U - U_0$

U_n: Rated voltage

U_0: Voltage before the fault

U: Current voltage (during the fault)

I_n: Rated current

I_{B0}: Reactive current before the fault

I_B: Reactive current

Difference to normal operation

In normal operation, a severe grid fault (thresholds for tripping A6205 are exceeded) will disable the pulses as well as the boost mode, until the grid has been restored. Injection of active or reactive current to the network is therefore not possible while the fault is present.

By evaluating the alarm bits r3405.2 or re-parameterizing alarm A06205 into a fault, it is also possible to achieve a fast safety shutdown in the event of grid faults.

3.3.3.1 Overview of important parameters

Parameter list for dynamic grid support

- p5500 Dynamic grid support configuration / Dyn Network config
- p5501 BI: Dynamic grid support activation
- r5502.0...1 CO/BO: Dynamic grid support status word
- p5504[0...1] CI: Dynamic grid support line voltage input
- p5505[0...3] Dynamic grid support characteristic voltage values
- p5506[0...3] Dynamic grid support characteristic voltage values
- P5507[0...3] Dynamic grid support times
- p5508 Dynamic grid support Vdc threshold
- P5509[0...5] Dynamic grid support scaling values
- r5510[0...3] CO: Dynamic grid support output
- r5511[0...1] CO: Dynamic grid support line voltage amplitude
- r5512[0...1] CO: Dynamic grid support line voltage amount

3.3.3.2 Function diagrams, dynamic grid support

refer to Section 6

- 7997 Characteristic
- 7998 Sequence control

Commissioning

4

4.1 Safety notices

⚠ DANGER

Five safety rules

When carrying out any kind of work on electrical devices, the "five safety rules" according to EN 50110 must always be observed:

1. Isolate the equipment from the power supply
2. Lockout to prevent reconnection.
3. Make sure that the equipment is de-energized and in a no-voltage condition
4. Ground and short-circuit
5. Cover or enclose adjacent components that are still live

⚠WARNING

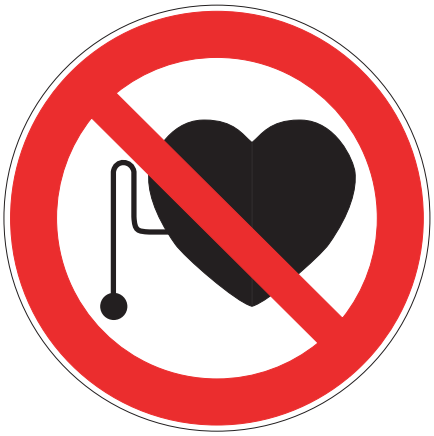
Electromagnetic fields "electro smog"

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 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. use shields, to reduce electromagnetic fields at their source.
- Make sure that personnel wear the appropriate protective gear.

4.2 Commissioning

When commissioning offline with the STARTER, you must select the infeeds on the basis of their order numbers.

Table 4- 1 Order numbers for infeed into the island grid

Active Line Module (LINE_CONVERTER)	Line voltage	Rated power	Rated input current
6SL3330-7TG41-0AA4	500 to 690 V AC, 3-phase	1100 kW	1025 A
6SL3330-7TG41-3AA4	500 to 690 V AC, 3-phase	1400 kW	1270 A

Table 4- 2 Order numbers for infeed into the power grid

Active Line Module (LINE_CONVERTER)	Line voltage	Rated power	Rated current
6SL3330-7TE35-0AA4	380 to 480 V AC, 3-phase	300 kW	490 A
6SL3330-7TE41-0AA4	380 to 480 V AC, 3-phase	630 kW	985 A
6SL3330-7TE41-4AA4	380 to 480 V AC, 3-phase	900 kW	1405 A

4.3 Commissioning an infeed with voltage and frequency control for an island grid.

4.3.1 Design

Generator plant

In the example, the electrical power generated by a rotating generator is fed into an island grid. The base load of the island grid can be produced using a diesel generator for example.

The generator is driven by a motor or a turbine. Examples for sources of energy are biogas, solar energy (solar thermal), natural gas, diesel, or hydro-electric power.

Block diagram

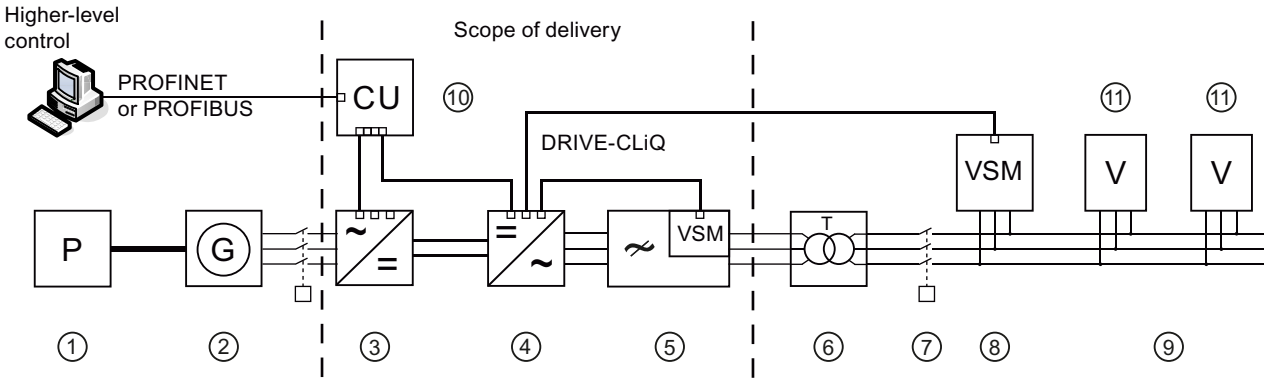


Figure 4-1 Infeed to a island grid via a generator

Table 4- 3 Components for infeed into an island grid via a generator

Number	Description
1	Driving machine (turbines, blade wheel, etc.)
2	Generator
3	Motor Module
4	Active Line Module
5	Active Interface Module with integrated Voltage Sensing Module VSM10
6	Line transformer
7	Circuit breaker
8	VSM10 Voltage Sensing Module for measuring the line voltage on the primary side of the line transformer
9	Island grid (low voltage)
10	Control Unit
11	Consumers

4.3.2 General information

Commissioning procedure

The following procedure performs offline commissioning of an Active Line Module for an island grid.
The Active Line Module should participate in the frequency and voltage control of the island grid.
In this case, a generator is used as an example to generate the power.

1. Create project
2. Create drive units.
   The drive unit for the infeed to the supply system is designated as the INVERTER.
   The drive unit for the closed-loop control of the Motor Modules is called the CONVERTER.
3. Function modules for creating a line infeed to an island grid.
4. Create additional VSM10 for measuring the line voltage on the primary side of the line transformer.
5. Adapt the topology and the VSM10 assignments
6. Perform additional parameter settings in the expert list

To do this, the sequence of the individual sequential steps for identification and setting of the transformer data must be taken into consideration (see Chapter 3.3.1.3).

Additional recommended settings (see Section 3.3.1.3) apply for weak networks (large inductance and low short-circuit power).

Note

Access level

Some of the parameters to be set are accessible only under access level 4 (Service). This access level is protected by password. Only authorized persons will receive the required password within the scope of expert training provided by Siemens.

4.3.3 Creating a project

- Create a project in the STARTER using "New with Wizard".
- Configure the drive units offline.
- Project name: "INFEED_ISLAND".
- Set up the PG/PC interface.
- Insert a drive unit:
  - Device: Sinamics
  - Type: S120 CU 320-2 DP
  - Version: 4.3.2 or higher
  - Enter the bus address
  - Name: "S120_CU320_2_DP"
  - Click on "Insert" and in the next screen on "Finish".

4.3.4 Creating drive units

Mark "SS120_CU320_2_DP" in the project and expand the tree; then double-click on "Configure drive device".

- Option module (TB30, CBC10, CBE20) – do not select anything.
- Insert Infeed?: Yes
- Drive object name: INVERTER
  Drive object type: Active Infeed
  Drive object No.: Do not enter anything.
- Component name: LINE_MODULE
  Line voltage range: Select "3AC 500 - 690 V".
  Cooling type: Select "Internal air cooling.
  Type: Select "All".
  Select infeed, e.g. "6SL3330-7TG41-0AAx"
- Line/DC link ID during initial start-up: Select as required.
  Device connection voltage: 690 V
  Parallel connection infeed - number of parallel modules: Enter number if necessary.
  External Braking Module: No
  Master/Slave: No
- PROFIdrive telegram type: Select "[999] Free telegram configuration with BICO".
- Do you want to configure a drive?: Yes
- Drive object name: CONVERTER
  Drive object No.: Vector
  Drive object No.: Do not enter anything

- Activate the "Technology controller" function module
  Activate the function module "Extended messages/monitoring functions" as required.
  Activate the closed-loop control "n/M control + V/f control, I/f control".
  Control type: Select as required.
- Component name: MOTOR_MODULE
  Connection voltage: Select "DC 675 - 932 V"
  Cooling type: Select "Internal air cooling.
  Type: Select "All".
  Select power unit, e.g. "6SL3320-1TG41-0AAx"
- Select additional data for power unit as required.
  Select "No filter/reactor", "Output reactor", dv/dt filter with VPL" as required.
  Select "Voltage Sensing Module" "Parallel connection" as required.
- Standard: Select "IEC motor (50 Hz, SI unit)".
  Connection voltage: 1035 V
  Power unit application: Select "(0) Load duty cycle with high overload for vector drives".
- Motor name: MACHINE
  Select "Enter motor data".
  Select the motor type.
  Parallel motor connection: No.
- Enter motor data.
  Do you want to enter optional data? Select as required.
  Do you want to enter data for the equivalent circuit diagram? Select as required.
- Select calculation of the motor/controller data as required.
- Select holding brake configuration as required.
- Which encoders do you want to use: Select as required.
- Technological application: Select "[0] Standard drive (VECTOR)".
  Motor identification: Select as required.
- PROFIdrive telegram type: Select "[999] Free telegram configuration with BICO".
- Enter important parameters:
  Current limit (p0640)
  Minimum speed (p1080)
  Maximum speed (p1082)
  Ramp-up time (p1120)
  Ramp-down time (p1121)
  OFF3 ramp-down time (p1135)
- Finished – Save the project.

4.3.5 Function modules for creating a line infeed in an island grid

Right click on "INVERTER" under "Infeeds" and then select "Properties..." in the "S120_CU320_2_DP" project

- In the "Function modules" tab, select the "Line transformer" and "Grid droop control" modules.

Note

Activation of the function modules by a higher-level controller

The function modules can also be activated by a higher-level controller. For this purpose, parameter p0009 of the Control Unit must be set to "2" (defining the drive type function module). You can then use parameter p0108[x].y = 1 of the Control Unit to activate the individual function modules.
In this case, the object number of the INVERTER must be used for the index "x".
The meanings of the "y" bits for the function modules for line infeed are as follows:

- Bit 04 = line transformer
- Bit 07 = dynamic grid support
- Bit 12 = grid droop control

Activation of the function modules is carried out with p0009 = 0.

4.3.6 Creating an additional VSM10

Double-click on "Configuration" under "Infeeds" under "INVERTER, and click on "Wizard..." in the configuration window in the "S120_CU320_2_DP" project.

- Do not change anything in the first screen.
- Select "Number of VSMs:" in the second screen in the list box Select as required.
  A VSM is entered in the "Number VSM" for each Active Line Module; this number of VSMs must be incremented by 1 to create an additional VSM10.
- Click through the remaining screens without making changes and close the wizard.
- This adds an additional VSM10 to the topology.

4.3.7 Adapting the topology and the VSM10 assignments

Double-click on "Topology" in the "S120_CU320_2_DP" project; the topology view appears.

The topology looks like this after the above commissioning steps:

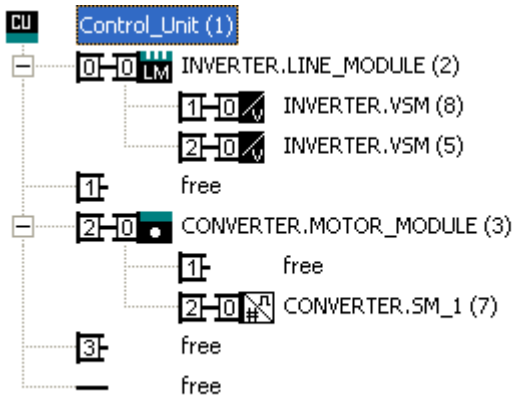


Figure 4-2 Topology

The numbers in brackets to the right of the components in the topology view are the "Component numbers".

- The VSM10 for the closed-loop control functionality of the infeed must be connected to the -X402 DRIVE-CLiQ socket of the INVERTER infeed.
- The VSM10 for synchronization with the power supply (on the primary side of the line transformer) must be connected to the -X401 DRIVE-CLiQ socket of the INVERTER drive.

You must use the expert list to check the assignments of the VSM10 components present in the project and correct these where necessary.
The following settings refer to the topology shown above.

- The VSM10 with component number 5 is responsible for the closed-loop control functionality of the infeed.
  INVERTER.p0140 = 1 (access level 4)
  INVERTER.p0141[0] = 5 (access level 4)
- The VSM10 with component number 8 is responsible for synchronizing the infeed with island grid (VSM2 functionality).
  INVERTER.p0150 = 1 (access level 4)
  INVERTER.p0151[0] = 8 (access level 4)

4.3.8 Performing additional parameter settings in the expert list

Parameter settings for "INVERTER" drive unit

Right click on "INVERTER" under "Infeeds" and then select "Expert list" in the "S120_CU320_2_DP" project

Table 4- 4 Parameter settings for "INVERTER" drive unit

Parameter	Value	Comment
p0210	690 V	Enter the grid-side connection voltage for the grid converter
p0840[0]	INVERTER.r2090.0	BI: On/Off1 via PROFIdrive PZD1, bit 0
p0844[0]	CONTROL_UNIT.r0722.0	BI: 1.OFF2 in CDS 0 via DI0 (-X122.1) of the Control Unit
p0852[0]	1	BI: Enable operation
p0860	CONTROL_UNIT.r0722.1	BI: Line contactor feedback signal The feedback signal from the generator switch must be wired to terminal DI1 (X122.2) of the Control Unit.
p0861	200 ms [1]	Line contactor monitoring time Monitors activation/feedback signal from the generator switch.
Pulse frequency wobbulation		
p1810.2	Yes	Activate sweep (access level 4)
p1810.4	Yes	Inhibit sweep amplitude (access level 4)
p1810.15	Yes	Activate flat-top modulation (access level 4)
p1811	5 % [2]	Pulse frequency wobbulation amplitude (access level 4)
DC link control		
p3410	0	Infeed identification method – Identification (Id) off
p3415[0]	10,00 %	Infeed excitation current L identification – Run 1 Amplitude of the measured currents for identifying the DC link capacitance
p3415[1]	10,00 %	Infeed excitation current L identification – Run 2 Amplitude of the measured currents for identifying the DC link capacitance
p3510	1035 V	Infeed DC link voltage setpoint for 690 V 3 AC devices: 1035 V DC
p3560	50 %	Infeed Vdc controller proportional gain Note: Setting for soft networks (low short-circuit power)
p3603	0 %	Infeed current pre-control factor D component can be increased by up to 50% for load surges in the event of a poor dynamic response of the controller. Note: Setting for soft networks (low short-circuit power)
p3615	50 %	Infeed current controller P gain Note: Setting for soft networks (low short-circuit power)
Generator operation		
p5401	INVERTER.r2090.0	BI: Grid droop control activation via PROFIdrive PZD1, bit 1
p5405	100 %	Grid droop control frequency droop no-load frequency "No-load frequency" = Enter the rated line frequency
p5407		Grid droop control frequency droop gradient The active load droop of the diesel generator must be entered as the start value and then optimized.

Parameter	Value	Comment
p5415	93 % [1]	Grid droop control voltage droop no-load voltage Measure the no-load voltage of the diesel generator and set the output voltage to the same value in test mode 2.
p5417		Grid droop control voltage droop gradient Enter the reactive load droop of the diesel generator as the start value and then optimize.
Line transformer		
p5480	1 (Normal operation)	Transformer magnetization mode activates transformer magnetization and synchronization in test mode 101/102 Notice: When magnetizing is deactivated, the circuit-breaker is controlled when the DC link is precharged independently of the operating state of any transformer that may be present. This can cause an overload of the line or system components, or may also lead to damage if a transformer present. Use of an external independent synchronization monitor is recommended.
p5481[0]	2 s	Transformer magnetization ramp-up time/bounce time/timeout Voltage ramp-up time Magnetization ramp-up time of the line transformer
p5481[1]	0.7 s [2]	Transformer magnetization ramp-up time/bounce time/timeout Circuit breaker bounce time If the time set is less than the actual bounce time, extremely high currents can occur on pulse enable and cause damage to the circuit breaker. Note: A permanent feedback signal from the switch is not a sure sign that the switching process has been completed! Note: If problems occur when connecting to the supply system (e.g. overcurrent, overvoltage, power failure F6200), you should increase the bounce time.
p5483	1	BI: Transformer magnetizing signal source for circuit breaker activation (sets the signal source for activating the circuit breaker after voltage ramp-up) Enables the function for closing the circuit breaker when transformer magnetization and synchronization are selected
p5486	400 V [2]	Transformer rated voltage primary Sets the on-board power supply voltage.
p5487[0]	INVERTER.r5461[0] preset	Transformer primary voltage u12 VSM 2 input line voltage u1-u2
p5487[1]	INVERTER.r5462[0] preset	Transformer primary voltage u23 VSM 2 input line voltage u2-u3
p5490		Transformer leakage inductance (is identified by transformer ID, p5480 = 13)
p5492		Transformer magnetizing inductance (is identified by transformer ID, p5480 = 11)

Parameter	Value	Comment
p6420	1)	Line transformer phase shift Enter the shift angle of the line transformer. Vector group Dy5 => -150° (is determined more precisely with transformer identification p5480 = 12). For successful completion of transformer identification in mode p5480 = 12, a coarse setting must be made manually (otherwise, transformer inrush will occur!)
p6421	1)	Line transformer gain adaptation (is determined more precisely with transformer identification, p5480 = 12) For the successful transformer identification in mode p5480 = 12, the coarse setting must be made manually (otherwise, transformer inrush will occur!)

1) Values are system-specific and must be adapted to the particular system configuration.

2) Adapt the value if necessary.

Parameter settings for "CONVERTER" drive unit

Right click on "CONVERTER" under "Infeeds" and then select "Expert list" in the "S120_CU320_2_DP" project

Table 4- 5 Parameter settings for "CONVERTER" drive unit

Parameter	Value	Comment
p0308[0]	1	Rated motor power factor
p0346[0]	0.5 s 1)	Motor excitation build-up time
p0390[0]	1)	Rated excitation current
p0810	0	BI: Command data set selection CDS bit 0
p0820[0]	0	BI: Drive data set selection DDS bit 0 in CDS 0
p0840[0]	INVERTER.r0863.1	ON/OFF1 in CDS 0 Triggered by "Energize contactor" signal from infeed
p0844[0]	CONTROL_UNIT.r0722.0	BI: 1.OFF2 in CDS 0 via DI0 (X122.1) of the Control Unit
p0845[0]	1	BI: 2.OFF2 in CDS 0 is always on
p0848[0]	1	BI: 1.OFF3 in CDS 0 is always on
p0849[0]	1	BI: 2.OFF3 in CDS 0 is always on
p0852[0]	1	BI: Enable operation in CDS 0 The CONVERTER drive obtains the operation enable when the controller for the CONVERTER drive is in operation
p0854[0]	1	BI: Activate master control by PLC in CDS 0
p0860	CONVERTER.r0863.1	BI: Line contactor feedback signal is coupled internally to power-up signal by default
p0864	INVERTER.r0863.0	BI: Infeed operation Feedback signal from infeed: infeed in operation
p0868	0 ms	Power unit DC switch debounce time
p1001[0]	0	Fixed speed setpoint 1 in DDS 0 Fixed speed setpoint for control mode "Speed control"
p1200[0]	1	Flying restart operating mode in DDS 0 Flying restart always active, start in setpoint direction

Parameter	Value	Comment
p1300[0]	20	Open-loop/closed-loop control operating mode in DDS 0 Speed control (encoderless)
p1501[0]	1	BI: Change over between closed-loop speed/torque control in CDS 0 1 signal = Closed-loop torque control 0 signal = Closed-loop speed control
Technology controller		
p3422	1)	DC-link capacitance, total Note: Set to same value as for INVERTER.p3422 (after DC link identification!)
p3510	1035 V	DC link voltage setpoint (this is DC 1035 V for 690 V AC devices) Note: Set to the same value as for INVERTER.p3510
p3513	INVERTER.r5402.0	BI: Inhibit voltage-controlled operation Interconnected to "Grid droop control inactive" signal from infeed
p3520[0]	INVERTER.r0082	CI: DC link pre-control power Interconnected to "Active power actual value" from infeed
p3521[0]	100 %	DC link pre-control power scaling
p3523[0]	0	DC link pre-control power smoothing
p3560	60 % 1)	Vdc controller proportional gain
p3562	90 % 1)	Vdc controller integral time

1) Values are system-specific and must be adapted to the particular system configuration.

2) Adapt the value if necessary.

4.3.9 Signal interfaces

Description

The following signals are required by the drive unit for operation and/or provided for monitoring purposes.

Transfer signals to the drive unit

Table 4- 6 Transfer signals to the drive unit

Parameter	Drive Object	Signal	Type	Unit
p0840[0]	INVERTER	BI: ON/OFF1 Sets the signal source for control word 1 bit 0 (ON/OFF1).	Bit	-
p5401	INVERTER	BI: Line control activation 1 signal: Activation of grid droop control and deactivation of closed-loop DC-link voltage control/closed-loop current control. 0 signal: Activation of grid droop control and deactivation of closed-loop DC-link voltage control/closed-loop current control.	Bit	-
p3611	INVERTER	CI: Infeed reactive current supplementary setpoint Reactive current setpoint for operation with p5401 = 0	Unsigned32 / FloatingPoint32	-
p5406	INVERTER	CI: Line control frequency droop supplementary setpoint dynamic supplementary frequency setpoint for operation with p5401 = 1	Unsigned32 / FloatingPoint32	-
p5451	INVERTER	BI: Current hysteresis controller operating mode Parallel operation with diesel generator 1 signal: Combined operation (INVERTER and additional infeeds together supply the island grid) 0 signal: Island operation (INVERTER supplies the island grid alone)	Bit	-
p5480	INVERTER	Transformer magnetization mode 0 = Deactivated 1 = Normal operation Notice: When magnetization is deactivated, the circuit-breaker is controlled independently of the operating state of any transformer that may be present. This can cause an overload of the line or system components, or may also lead to damage if a transformer present. Use of an external independent synchronization monitor is recommended.	Integer, 16-bit	-

Transfer signals from drive unit

Table 4- 7 Transfer signals from drive unit

Parameter	Drive Object	Signal	Type	Unit
r0899.0	INVERTER	Ready for switching on 1 signal: Ready for switching on 0 signal: Not ready for switching on	Bit	-
r0899.1	INVERTER	Ready 1 signal: Ready 0 signal: Not ready	Bit	-
r0899.2	INVERTER	Operation enabled 1 signal: Operation enabled 0 signal: Operation not enabled	Bit	-
r0046.0	INVERTER	OFF1 enable missing 1 signal: OFF1 enable missing 0 signal: OFF1 enable not missing	Bit	-
r2139.3	INVERTER	Fault active 1 signal: Fault active 0 signal: Fault not active The 1 signal is set if a fault occurs in one or more drive objects	Bit	-
r2139.7	INVERTER	Alarm active 1 signal: Alarm active 0 signal: Alarm not active The 1 signal is set if an alarm occurs in one or more drive objects	Bit	-
r5411[1]	INVERTER	Line control frequency droop active power (smoothed) Displays the input active power of the active power frequency droop.	FloatingPoint32	kW
r5421[1]	INVERTER	Line control frequency droop reactive current (smoothed) Displays the input reactive current of the reactive current voltage droop.	FloatingPoint32	A
r0068	INVERTER	Absolute current actual value Displays actual absolute current.	FloatingPoint32	Arms
r5410	INVERTER	Line control frequency droop output Displays the smoothed output frequency of the active power frequency droop.	FloatingPoint32	Hz
r0025	CONVERTER	Output voltage smoothed Displays the smoothed output voltage of the power unit.	FloatingPoint32	Vrms
r0027	CONVERTER	Absolute actual current smoothed Displays the smoothed absolute actual current value.	FloatingPoint32	Arms
r0024	CONVERTER	Output frequency smoothed Displays the smoothed converter frequency.	FloatingPoint32	Hz
r0070	CONVERTER	Actual DC link voltage Displays the measured actual value of the DC link voltage.	FloatingPoint32	V
r0722.0	CU	CU digital inputs, status: DI 0 (X122.1) Feedback signal, circuit-breaker (prerequisite is the wiring of the feedback signal with the DI0 of the Control Unit, terminal X122.1)	Bit	-

4.4 Commissioning an infeed with dynamic grid support for power grid

4.4.1 Design

Photovoltaic plant

The example shows a photovoltaic plant feeding the electrical energy generated into a power grid.

Closed-loop control

Characteristic for a photovoltaic system is that the energy flows in one direction from the DC link into the power grid. The optimum operating voltage for the solar cells or the DC link voltage is highly dependent on the working point, and is decisive for achieving the best possible efficiency. The setpoint voltage for the maximum power (maximum power point: MPP) of course depends on the actual intensity of solar radiation but also on many other parameters, such as the ambient temperature.

A superimposed maximum power-point closed-loop control (MPP) in an external controller determines the optimum V_{DC} setpoint and transfers this to the closed-loop controller of the Active Line Module.

The Active Line Module is operated in "closed-loop DC link voltage control" mode in this case.

Design

The solar cells are interconnected in such a manner that they directly charge the DC link of the Active Line Modules.

Sequence

The higher-level control system closes the optional DC contactors and issues the command to start the line infeed, provided that sufficient sunlight is present. The DC link voltage generated from the PV field must correspond to at least 1.5 times the transformer secondary voltage. First, the line transformer is magnetized and synchronized with the network. The required power must be provided from the PV field. The VSM10 performs sensing of the line voltage on the primary side of the line transformer until synchronization is achieved. After synchronization, the circuit breaker is closed and power infeed to the network started.

Line fault

Fault ride through in accordance with grid operators guidelines (Fig. 3-2, 3-3) occurs automatically via the line inverter according to the desired parameter settings.

Block diagram

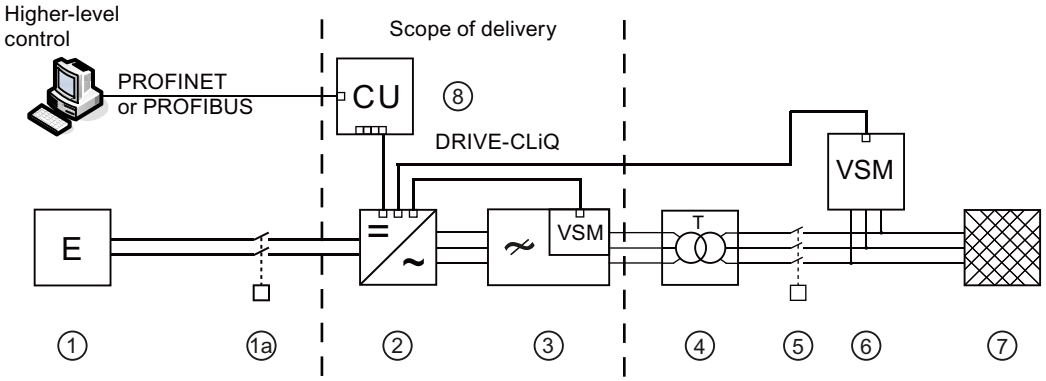


Figure 4-3 Infeed to a power grid

Table 4- 8 Components for infeed to a power grid

Number	Description
1	Photovoltaic plant
1a	Optional DC contactor
2	Active Line Module
3	Active Interface Module with integrated Voltage Sensing Module VSM10
4	Line transformer
5	Circuit breaker
6	VSM10 Voltage Sensing Module for measuring the line voltage on the primary side of the line transformer
7	Power grid
8	Control Unit

4.4.2 General information

Commissioning procedure

The following procedure performs offline commissioning of an infeed with dynamic grid support for a power grid.
A photovoltaic system for power generation is used as an example in this case.

1. Create project
2. Create drive units
   The drive unit for infeed to the network is designated INVERTER.
3. Function modules for line infeed to a power grid.
4. Create additional VSM10 for measuring the line voltage on the primary side of the line transformer.
5. Adapt the topology and the VSM10 assignments
6. Perform additional parameter settings in the expert list

To do this, the sequence of the individual sequential steps for identification and setting of the transformer data must be taken into consideration (see Chapter 3.3.1.3).

Additional recommended settings (see Section 3.3.1.3) apply for weak networks (large inductance and low short-circuit power).

Note

Access level

Some of the parameters to be set are accessible only under access level 4 (Service). This access level is protected by password. Only authorized persons will receive the required password within the scope of expert training provided by Siemens.

4.4.3 Creating a project

- Create a project in the STARTER using "New with Wizard".
- Configure the drive units offline.
- Project name: "INFEED_GRID".
- Set up the PG/PC interface.
- Insert a drive unit:
  - Device: Sinamics
  - Type: S120 CU 320-2 DP
  - Version: 4.3.2 or higher
  - Enter the bus address
  - Name: "S120_CU320_2_DP"
  - Click on "Insert" and in the next screen on "Finish".

4.4.4 Creating a drive unit

Mark "SS120_CU320_2_DP" in the project and expand the tree; then double-click on "Configure drive device".

- Option module (TB30, CBC10, CBE20) – do not select anything.
- Insert Infeed?: Yes
- Drive object name: INVERTER
  Drive object type: Active Infeed
  Drive object No.: Do not enter anything.
- Component name: LINE_MODULE
  Line voltage range: Select "3AC 380 - 480 V".
  Cooling type: Select "Internal air cooling.
  Type: Select "All".
  Select infeed, e.g. "6SL3330-7TE41-0AAx"
- Line/DC link ID during initial start-up: No.
  Unit supply voltage: Enter the rated value for the transformer secondary voltage
  Parallel connection infeed - number of parallel modules: Enter number if necessary.
  External Braking Module: As required
  (depending on the maximum voltage of the photovoltaic field, a Braking Module may be required to limit the voltage to the inverter maximum voltage of DC 820 V.)
  Master/Slave: No
- PROFIdrive telegram type: Select "[999] Free telegram configuration with BICO".
- Do you want to configure a drive?: No
- Finished – Save the project.

4.4.5 Function modules for creating a line infeed in a power grid

Right click on "INVERTER" under "Infeeds" and then select "Properties..." in the "S120_CU320_2_DP" project

- In the "Function modules" tab, select the "Line transformer" and "Dynamic grid support" modules.

Note

Activation of the function modules by a higher-level controller

The function modules can also be activated by a higher-level controller. For this purpose, parameter p0009 of the Control Unit must be set to "2" (defining the drive type function module). You can then use parameter p0108[x].y = 1 of the Control Unit to activate the individual function modules.
In this case, the object number of the INVERTER must be used for the index "x".
The meanings of the "y" bits for the function modules for line infeed are as follows:

- Bit 04 = line transformer
- Bit 07 = dynamic grid support
- Bit 12 = grid droop control

Activation of the function modules is carried out with p0009 = 0.

4.4.6 Creating an additional VSM10

Double-click on "Configuration" under "Infeeds" under "INVERTER, and click on "Wizard..." in the configuration window in the "S120_CU320_2_DP" project.

- Do not change anything in the first screen.
- Select "Number of VSMs:" in the second screen in the list box Select as required.
  A VSM is entered in the "Number VSM" for each Active Line Module; this number of VSMs must be incremented by 1 to create an additional VSM10.
- Click through the remaining screens without making changes and close the wizard.
- This adds an additional VSM10 to the topology.

4.4.7 Adapting the topology and the VSM10 assignments

Double-click on "Topology" in the "S120_CU320_2_DP" project; the topology view appears.

The topology looks like this after the above commissioning steps:

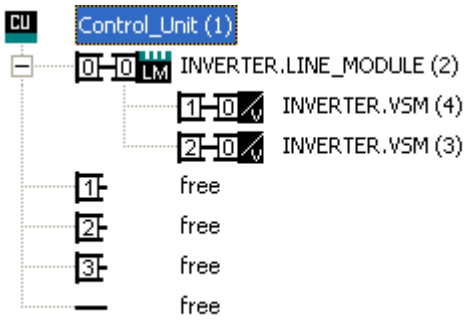


Figure 4-4 Topology

The numbers in brackets to the right of the components in the topology view are the "Component numbers".

- The VSM10 for the closed-loop control functionality of the infeed must be connected to the -X402 DRIVE-CLiQ socket of the INVERTER infeed.
- The VSM10 for synchronization with the power supply (on the primary side of the line transformer) must be connected to the -X401 DRIVE-CLiQ socket of the INVERTER drive.

You must use the expert list to check the assignments of the VSM10 components present in the project and correct these where necessary.
The following settings refer to the topology shown above.

- The VSM10 with component number 3 is responsible for the closed-loop control functionality of the infeed.
  Infeed_1.p0140 = 1 (access level 4)
  Infeed_1.p0141[0] = 3 (access level 4)
- The VSM10 with component number 4 is responsible for synchronizing the infeed with the power grid (VSM2 functionality).
  Infeed_1.p0150 = 1 (access level 4)
  Infeed_1.p0151[0] = 4 (access level 4)

4.4.8 Performing additional parameter settings in the expert list

Parameter settings for "INVERTER" drive unit

Right click on "INVERTER" under "Infeeds" and then select "Expert list" in the "S120_CU320_2_DP" project

Table 4- 9 Parameter settings for "INVERTER" drive unit

Parameter	Value	Comment
p0210	1)	Enter the grid connection voltage for the grid converter (corresponds to the transformer secondary voltage)
p0840[0]	INVERTER.r2090.0	BI: On/Off1 via PROFIdrive PZD1, bit 0
p0844[0]	CONTROL_UNIT.r0722.0	BI: 1.OFF2 in CDS 0 via DI0 (-X122.1) of the Control Unit
p0852[0]	1	BI: Enable operation
p0860		BI: Line contactor feedback signal You must enter the parameter for the terminal for the feedback signal of the circuit breaker.
p0861	200 ms 1)	Line contactor monitoring time Monitors activation/feedback signal from the circuit breaker.
Pulse frequency wobbulation		
p1810.2	Yes	Activate sweep (access level 4)
p1810.4	No	Inhibit sweep amplitude (access level 4)
p1810.15	Yes	Activate flat-top modulation (access level 4)
p1811	5 % 2)	Pulse frequency wobbulation amplitude (access level 4)
DC link control		
p3410	0	Infeed identification method – Identification (Id) off
p3415[0]	10,00 %	Infeed excitation current L identification – Run 1 Amplitude of the measured currents for identifying the DC link capacitance
p3415[1]	10,00 %	Infeed excitation current L identification – Run 2 Amplitude of the measured currents for identifying the DC link capacitance
p3510	1.5 * p0210	Infeed DC link voltage setpoint for 400 V 3 AC devices: 600 V DC

Parameter	Value	Comment
Line transformer		
p5460		VSM2 input line voltage for voltage divider Setting a voltage divider for Voltage Sensing Module 2 (VSM2) For a primary voltage of 20 kV, connection to -X521 (100 V input), and instrument transformers with a ratio of 200:1, 20000 % must be set as a value.
p5480	1 (Normal operation)	Transformer magnetization mode
p5481[0]	2 s	Transformer magnetization ramp-up time/bounce time/timeout Voltage ramp-up time Magnetization ramp-up time of the line transformer
p5481[1]	1 s [1)]	Transformer magnetization ramp-up time/bounce time/timeout Circuit breaker bounce time If the time set is less than the actual bounce time, extremely high currents can occur on pulse enable and cause damage to the circuit breaker. Note: A permanent feedback signal from the switch is not a sure sign that the switching process has been completed! Note: If problems occur when connecting to the supply system (e.g. overcurrent, overvoltage, power failure F6200), you should increase the bounce time.
p5483	1	BI: Transformer magnetizing signal source for circuit breaker activation (sets the signal source for activating the circuit breaker after voltage ramp-up) Enables the function for closing the circuit breaker when transformer magnetization and synchronization are selected
p5486	[1)]	Transformer rated voltage primary Sets the primary voltage.
p5487[0]	INVERTER.r5461[0] preset	Transformer primary voltage u12 VSM 2 input line voltage u1-u2
p5487[1]	INVERTER.r5462[0] preset	Transformer primary voltage u23 VSM 2 input line voltage u2-u3
p5490		Transformer leakage inductance (is identified by transformer, p5480 = 13) Value of r5489 entered
p5492		Transformer magnetizing inductance (is identified by transformer, p5480 = 11) Value of r5490 entered
p6420	[1)]	Line transformer phase shift Enter the phase shift (in degrees) of the line transformer. Vector group Dy5 => -150° (is determined more precisely with transformer identification p5480 = 12). Enter the value from r6440 For the successful transformer identification in mode p5480 = 12, the coarse setting must be made manually (otherwise, transformer inrush will occur!)
p6421	[1)]	Line transformer gain adaptation (is determined more precisely with transformer identification, p5480 = 12) Value of r6441 entered For the successful transformer identification in mode p5480 = 12, the coarse setting must be made manually (otherwise, transformer inrush will occur!)

Parameter	Value	Comment
Dynamic grid support		
p5500	Factory setting	Dynamic grid support configuration
p5501		BI: Dynamic grid support activation You must enter the parameter for the terminal for activating the dynamic grid support.
p5505[0..3]	In accordance with country-specific guideline[1)]	Dynamic grid support characteristic voltage values
p5506[0..3]	In accordance with country-specific guideline[1)]	Dynamic grid support characteristic reactive current setpoint
p5507[0..3]	Factory setting [1)]	Dynamic grid support times
p5508	Factory setting [1)]	Dynamic grid support Vdc threshold
p5509[x]	Factory setting (depending on country-specific directive) [1)]	Dynamic grid support scaling values Reactive current ramp for exceeded Vdc threshold

1) Values are system-specific and must be adapted to the particular system configuration.

2) Adapt the value if necessary.

4.4.9 Signal interfaces

Description

The following signals are required by the drive unit for operation and/or provided for monitoring purposes.

Transfer signals to the drive unit

Table 4- 10 Transfer signals to the drive unit

Parameter	Drive Object	Signal	Type	Unit
p0840[0]	INVERTER	BI: ON/OFF1 Sets the signal source for control word 1 bit 0 (ON/OFF1).	Bit	-
p5501	INVERTER	BI: Dynamic grid support activation 1 signal: Activates dynamic grid support. 0 Signal: Deactivates dynamic grid support.	Bit	-
p3511	INVERTER	CI: Infeed DC link voltage supplementary setpoint Signal input for control signal of the higher-level external MPP controller	Unsigned32 / FloatingPoint32	
p3611	INVERTER	CI: Infeed reactive current supplementary setpoint Reactive current setpoint for operation with p5501 = 0	Unsigned32 / FloatingPoint32	-
p5480	INVERTER	Transformer magnetization mode 0 = deactivated 1 = Normal operation Notice: When magnetization is deactivated, the circuit-breaker is controlled independently of the operating state of any transformer that may be present. This can cause an overload of the line or system components, or may also lead to damage if a transformer present. Use of an external independent synchronization monitor is recommended.	Integer, 16-bit	-

Transfer signals from drive unit

Table 4- 11 Transfer signals from drive unit

Parameter	Drive Object	Signal	Type	Unit
r0899.0	INVERTER	Ready for switching on 1 signal: Ready for switching on 0 signal: Not ready for switching on	Bit	-
r0899.1	INVERTER	Ready 1 signal: Ready 0 signal: Not ready	Bit	-
r0899.2	INVERTER	Operation enabled 1 signal: Operation enabled 0 signal: Operation not enabled	Bit	-
r0046.0	INVERTER	OFF1 enable missing 1 signal: OFF1 enable missing 0 signal: OFF1 enable not missing	Bit	-
r2139.3	INVERTER	Fault active 1 signal: Fault active 0 signal: Fault not active The 1 signal is set if a fault occurs in one or more drive objects	Bit	-
r2139.7	INVERTER	Alarm active 1 signal: Alarm active 0 signal: Alarm not active The 1 signal is set if an alarm occurs in one or more drive objects	Bit	-
r5502.1	INVERTER	Dynamic grid support status word 1 signal: Activates dynamic grid support. 0 signal: Deactivates dynamic grid support.	Bit	
r5482	INVERTER	Transf magnetization status Status of the transformer magnetization	Integer	
r0068	INVERTER	Absolute current actual value Displays actual absolute current.	FloatingPoint32	Arms
r0070	INVERTER	Actual DC link voltage	FloatingPoint32	
r0072[1]	INVERTER	Voltage at the input terminals of the line filter	FloatingPoint32	
r0082	INVERTER	Active power actual value	FloatingPoint32	
r0722.0	CU	CU digital inputs, status: DI 0 (X122.1) Feedback signal, circuit-breaker (prerequisite is the wiring of the feedback signal with the DI0 of the Control Unit, terminal X122.1)	Bit	-

Device overview

5

5.1 Control Unit CU320-2

5.1.1 Description

The Control Unit CU320-2 DP is a central control module in which the closed-loop and open-loop functions are implemented for one or more Line Modules and/or Motor Modules. It can be used with firmware version 4.3 or higher.

The CU320-2 DP has the following interfaces (ports):

Table 5- 1 Overview of the CU320-2 DP interfaces

Type	Quantity
Digital inputs	12
Digital inputs/outputs	8
DRIVE-CLiQ interfaces	4
PROFIBUS interface	1
LAN (Ethernet)	1
Serial interface (RS232)	1
Option slot	1
Measuring sockets	3

5.1.2 Safety information

⚠ WARNING

The ventilation spaces of 80 mm above and below the component must be observed.

⚠ CAUTION

A potential bonding conductor with a cross-section of at least 25 mm² must be used between components in a system that are located at a distance from each other. If a potential bonding conductor is not used, high leakage currents that could destroy the Control Unit or other PROFIBUS nodes can be conducted via the PROFIBUS cable.

CAUTION
The memory card may only be removed and inserted when the Control Unit is switched off; doing this during operation instead could result in a loss of data and, where applicable, a plant standstill.

CAUTION
The memory card is an electrostatic sensitive component. ESD regulations must be observed when inserting and removing the card.

CAUTION
The Option Board should only be inserted and removed when the power supply for the Control Unit and Option Board is switched off.

5.1.3 Interface description

5.1.3.1 Overview

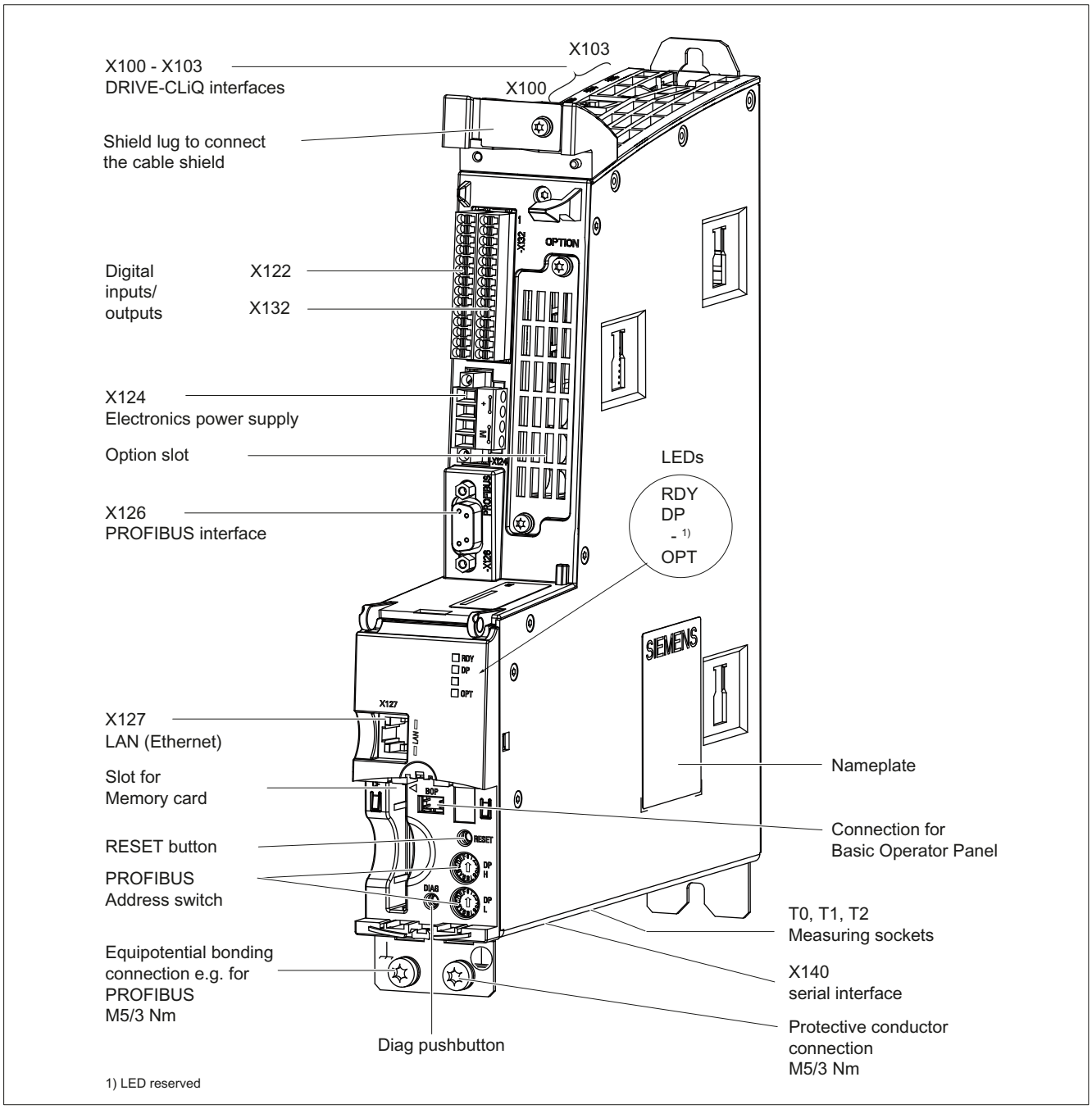


Figure 5-1 Interface description of the CU320-2 DP (covers removed)

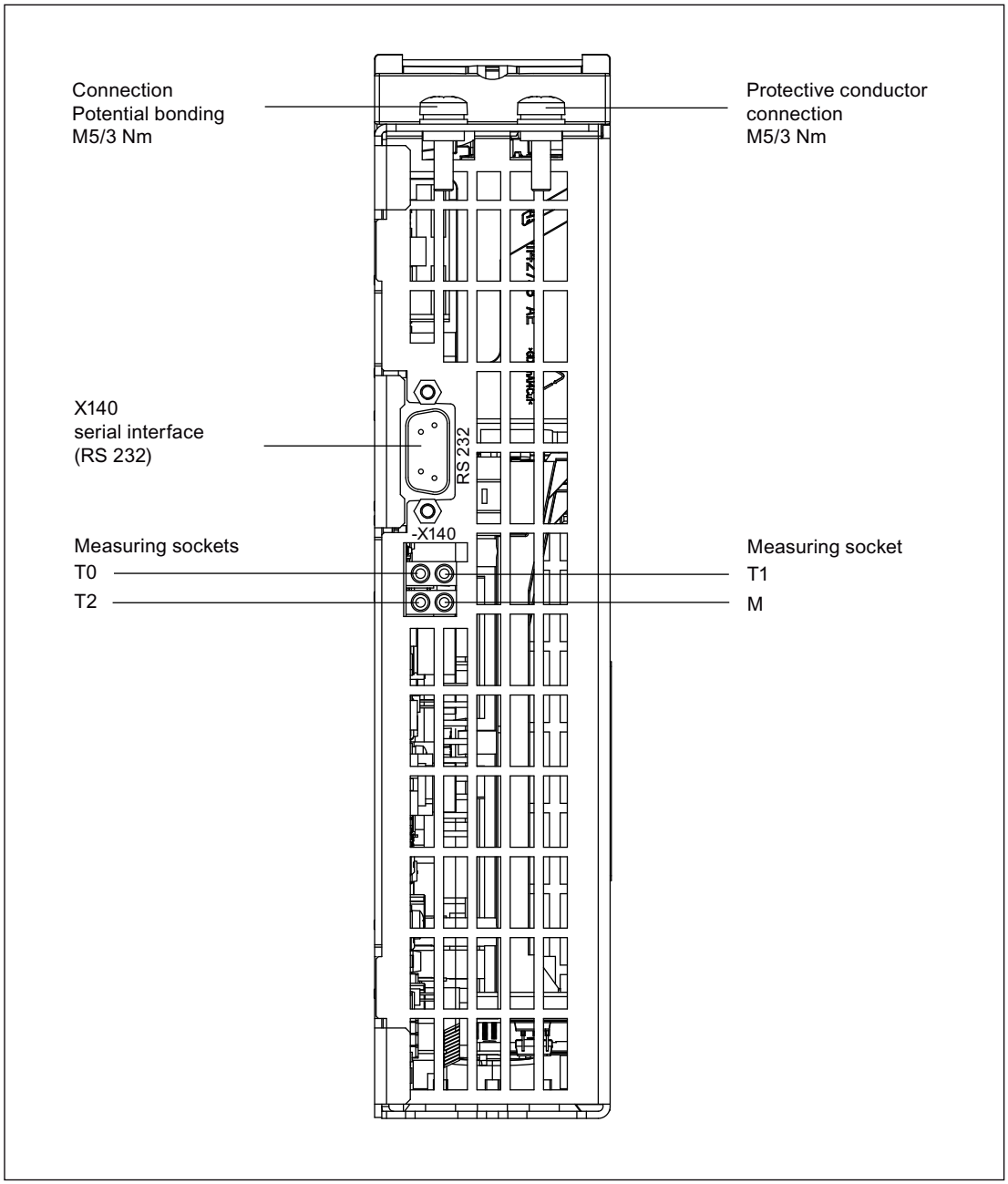
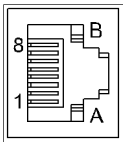


Figure 5-2 Interface X140 and measuring sockets T0 to T2 - CU320-2 DP (view from below)

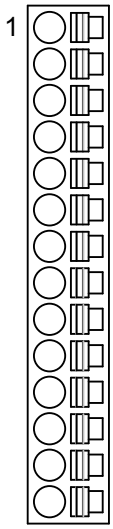
5.1.3.2 X100 - X103 DRIVE-CLiQ interface

Table 5- 2 DRIVE-CLiQ interface

	Pin	Signal name	Technical specifications
	1	TXP	Transmit data +
	2	TXN	Transmit data -
	3	RXP	Receive data +
	4	Reserved, do not use	
	5	Reserved, do not use	
	6	RXN	Receive data -
	7	Reserved, do not use	
	8	Reserved, do not use	
	A	+ (24 V)	Power supply
	B	M (0 V)	Electronics ground
Connector type: RJ45 socket; blanking plate for DRIVE-CLiQ interface included in the scope of delivery; blanking plate (50 pieces) Order number: 6SL3066-4CA00-0AA0			

5.1.3.3 X122 Digital inputs/outputs

Table 5- 3 Terminal block X122

	Terminal	Designation [1]	Technical specifications
	1	DI 0	Voltage (max.): -30 V to +30 VDC Typical current consumption: 9 mA at 24 V Electrical isolation: The reference potential is terminal M1 Level (incl. ripple) High level: 15 V to 30 V Low level: -3 V to +5 V Input delay (typ.): For "0" → "1": 50 µs For "1" → "0": 150 µs
	2	DI 1	
	3	DI 2	
	4	DI 3	
	5	DI 16	
	6	DI 17	
	7	M1	Reference potential for terminals 1 to 6
	8	M	Ground
	9	DI/DO 8	**As input**: Voltage: -30 V to +30 VDC Typical current consumption: 9 mA at 24 V Level (incl. ripple) High level: 15 V to 30 V Low level: -3 V to +5 V DI/DO 8, 9, 10, and 11 are "rapid inputs" [2] Input delay (typ.): For "0" → "1": 5 µs For "1" → "0": 50 µs **As output**: Voltage: 24 V DC Max. load current per output: 500 mA Continued-short-circuit-proof Output delay (typ./max.): [3] For "0" → "1": 150 µs/400 µs For "1" → "0": 75 µs/100 µs Switching frequency: For resistive load: Max. 100 Hz For inductive load: Max. 0.5 Hz For lamp load: Max. 10 Hz Maximum lamp load: 5 W
	10	DI/DO 9	
	11	M	
	12	DI/DO 10	
	13	DI/DO 11	
	14	M	
Max. connectable cross-section: 1.5 mm^2, Type: Spring-loaded terminal			

1) DI: digital input; DI/DO: bidirectional digital input/output; M: electronics ground; M1: ground reference

2) The rapid inputs can be used as probe inputs or as inputs for the external zero mark

3) Data for: V_{cc} = 24 V; load 48 Ω; high ("1") = 90% V_{out}; low ("0") = 10% V_{out}

NOTICE

An open input is interpreted as "low".

To enable the digital inputs (DI) to function, terminal M1 must be connected.

This is achieved by:

1. providing the ground reference of the digital inputs, or
2. A jumper to terminal M.

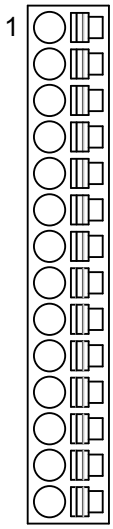
Notice! This removes the electrical isolation for these digital inputs.

Note

If the 24 V supply is briefly interrupted, then the digital outputs are deactivated during this time.

5.1.3.4 X132 Digital inputs/outputs

Table 5- 4 Terminal block X132

	Terminal	Designation [1]	Technical specifications
	1	DI 4	Voltage (max.): -30 V to +30 VDC Typical current consumption: 9 mA at 24 V Electrical isolation: The reference potential is terminal M2 Level (incl. ripple) High level: 15 to 30 V Low level: -3 V to +5 V Input delay (typ.): For "0" → "1": 50 µs For "1" → "0": 150 µs
	2	DI 5	
	3	DI 6	
	4	DI 7	
	5	DI 20	
	6	DI 21	
	7	M2	Reference potential for terminals 1 to 6
	8	M	Ground
	9	DI/DO 12	**As input**: Voltage: -30 V to +30 VDC Typical current consumption: 9 mA at 24 V Level (incl. ripple) High level: 15 to 30 V Low level: -3 V to +5 V DI/DO 12, 13, 14, and 15 are "rapid inputs" [2] Input delay (typ.): For "0" → "1": 5 µs For "1" → "0": 50 µs **As output**: Voltage: 24 V DC Max. load current per output: 500 mA Continued-short-circuit-proof Output delay (typ./max.): [3] For "0" → "1": 150 µs/400 µs For "1" → "0": 75 µs/100 µs Switching frequency: For resistive load: Max. 100 Hz For inductive load: Max. 0.5 Hz For lamp load: Max. 10 Hz Maximum lamp load: 5 W
	10	DI/DO 13	
	11	M	
	12	DI/DO 14	
	13	DI/DO 15	
	14	M	
Max. connectable cross-section: 1.5 mm^2, Type: Spring-loaded terminal			

1) DI: digital input; DI/DO: bidirectional digital input/output; M: electronics ground; M2: ground reference

2) The rapid inputs can be used as probe inputs or as inputs for the external zero mark

3) Data for: V_{cc} = 24 V; load 48 Ω; high ("1") = 90% V_{out}; low ("0") = 10% V_{out}

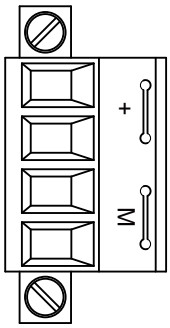
NOTICE
An open input is interpreted as "low". To enable the digital inputs (DI) to function, terminal M2 must be connected. This is achieved by: 1. Providing the ground reference of the digital inputs, or 2. A jumper to terminal M. Notice! This removes the electrical isolation for these digital inputs.

Note

If a momentary interruption in the voltage occurs in the 24 V supply, the digital outputs are deactivated until the interruption has been rectified.

5.1.3.5 X124 Electronics power supply

Table 5- 5 Terminal block X124

	Terminal	Designation	Technical specifications
	+	Electronics power supply	Voltage: 24 V DC (20.4 V to 28.8 V) Current consumption: Max. 1.0 A (without DRIVE-CLiQ or digital outputs) Max. current via jumper in connector: 20 A
	+	Electronics power supply	
	M	Electronics ground	
	M	Electronics ground	
Max. connectable cross-section: 2.5 mm^2, Type: Screw terminal			

Note

The two "+" or "M" terminals are jumpered in the connector. This ensures that the supply voltage is looped through.

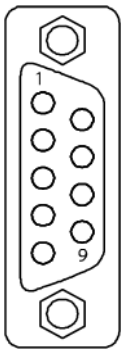
The current consumption increases by the value for the DRIVE-CLiQ node and digital outputs.

Note

The terminal block must be screwed on tightly using a flat-bladed screwdriver.

5.1.3.6 X126 PROFIBUS

Table 5- 6 PROFIBUS interface X126

	Pin	Signal name	Significance	Range
	1	-	Not assigned	
	2	M24_SERV	Teleservice supply, ground	0 V
	3	RxD/TxD–P	Receive/transmit data P (B)	RS485
	4	CNTR–P	Control signal	TTL
	5	DGND	PROFIBUS data reference potential	
	6	VP	Supply voltage plus	5 V ± 10%
	7	P24_SERV	Teleservice supply, + (24 V)	24 V (20.4 V to 28.8 V)
	8	RxD/TxD–N	Receive/transmit data N (A)	RS485
	9	-	Not assigned	
Connector type: 9-pin SUB-D female				

Note

A teleservice adapter can be connected to the PROFIBUS interface (X126) for remote diagnostics purposes.
The power supply for the teleservice terminals 2 and 7 can have a max. load of 150 mA.

⚠ CAUTION

No CAN cables must be connected to interface X126. If CAN cables are connected, the Control Unit and other CAN bus nodes may be destroyed.

⚠ CAUTION

A potential bonding conductor with a cross-section of at least 25 mm² must be used between components in a system that are located at a distance from each other. If a potential bonding conductor is not used, high leakage currents that could destroy the Control Unit or other PROFIBUS nodes can be conducted via the PROFIBUS cable.

PROFIBUS connectors

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

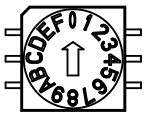
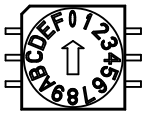
The bus terminating resistors are activated in the connector.

The cable shield must be connected at both ends and over a large surface area.

5.1.3.7 PROFIBUS address switch

On the CU320-2 DP, the PROFIBUS address is set as a hexadecimal value via two rotary coding switches. Values between 0_{dec} (00_{hex}) and 127_{dec} ($7F_{hex}$) can be set as the address. The upper rotary coding switch (H) is used to set the hexadecimal value for 16^1 and the lower rotary coding switch (L) is used to set the hexadecimal value for 16^0.

Table 5- 7 PROFIBUS address switch

Rotary coding switches	Significance	Examples		
		21_{dec}	**35_{dec}**	**126_{dec}**
		15_{hex}	**23_{hex}**	**$7E_{hex}$**
 DP H	$16^1 = 16$	1	2	7
 DP L	$16^0 = 1$	5	3	E

Setting the PROFIBUS address

The factory setting for the rotary coding switches is 0_{dec} (00_{hex}).

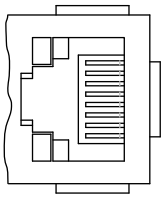
There are two ways to set the PROFIBUS address:

1. Via p0918
   - To set the bus address for a PROFIBUS node using STARTER, first set the rotary code switches to 0_{dec} (00_{hex}) and 127_{dec} ($7F_{hex}$).
   - Then use parameter p0918 to set the address to a value between 1 and 126.
2. Via the PROFIBUS address switches on the Control Unit
   - The address is set manually to values between 1 and 126 using the rotary coding switches. In this case, p0918 is only used to read the address.

The address switch is behind the blanking plate. The blanking plate is part of the scope of supply.

5.1.3.8 X127 LAN (Ethernet)

Table 5- 8 X127 LAN (Ethernet)

	Pin	Designation	Technical specifications
	1	TXP	Ethernet transmit data +
	2	TXN	Ethernet transmit data -
	3	RXP	Ethernet receive data +
	4	Reserved, do not use	
	5	Reserved, do not use	
	6	RXN	Ethernet receive data -
	7	Reserved, do not use	
	8	Reserved, do not use	
Connector type: RJ45 socket			

Note

The X127 interface supports commissioning and diagnostic functions. It is not permissible to set up a process data bus using this interface.

For diagnostic purposes, the X127 LAN interface features a green and a yellow LED. These LEDs indicate the following status information:

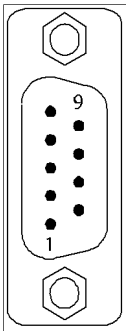
Table 5- 9 LED statuses for the X127 LAN interface

LED	Status	Description
Green	On	10 or 100 Mbit link available
	Off	Missing or faulty link
Yellow	On	Sending or receiving
	Off	No activity

5.1.3.9 X140 serial interface (RS232)

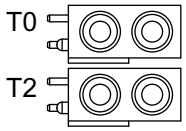
An external display and operator device for operator control/parameterization can be connected via the serial interface. The interface is located on the lower side of the Control Unit.

Table 5- 10 Serial interface (RS-232-C) X140

	Pin	Designation	Technical data
	1	Reserved, do not use	
	2	RxD	Receive data
	3	TxD	Transmit data
	4	Reserved, do not use	
	5	Ground	Ground reference
	6	Reserved, do not use	
	7	Reserved, do not use	
	8	Reserved, do not use	
	9	Reserved, do not use	
Connector type: SUB-D, 9-pin			

5.1.3.10 Measuring sockets

Table 5- 11 Measuring sockets T0, T1, T2

	Socket	Function	Technical specifications
	T0	Measuring socket 0	Voltage: 0 V to 5 V Resolution: 8 bits Load current: max. 3 mA Continued-short-circuit-proof The reference potential is terminal M
	T1	Measuring socket 1	
	T2	Measuring socket 2	
	M	Ground	
The measuring sockets are only suitable for bunch pin plugs with a diameter of 2 mm.			

Note

The measuring sockets support commissioning and diagnostic functions. It must not be connected for normal operation.

5.1.3.11 Diag pushbutton

Diagnostics pushbutton for initiating data backup

This pushbutton can be used to back up the most important diagnostics data on the memory card, without the need for additional tools.

Model:

- Flush-mount pushbutton with rubber cap
- Operation possible only with pin (4 mm)

5.1.3.12 Slot for memory card

Figure 5-3 Slot for memory card

CAUTION
The memory card may only be removed and inserted when the Control Unit is switched off; doing this during operation instead could result in a loss of data and, where applicable, a plant standstill. The memory card may only be inserted as shown in the photo above (arrow at top right).

CAUTION
The memory card is an electrostatic sensitive component. ESD regulations must be observed when inserting and removing the card.

NOTICE
When returning a defective Control Unit, remove the memory card and keep it for insertion in the replacement unit. This is important, otherwise the data on the memory card (parameters, firmware, licenses, and so on) may be lost.

Note

Please note that only SIEMENS memory cards can be used to operate the Control Unit.

5.1.3.13 Meaning of LEDs

Description of the LED statuses

The different statuses that arise during the booting procedure are indicated by means of the LEDs on the Control Unit.

- The duration of the individual statuses varies.
- If an error occurs, the booting procedure is terminated and the cause is indicated accordingly via the LEDs.
- Once the unit has successfully booted up, all the LEDs are switched off briefly.
- Once the unit has booted up, the LEDs are controlled via the loaded software.

Behavior of the LEDs during booting

Table 5- 12 Load software

LED			Status	Comment
RDY	DP	OPT		
Red	Orange	Orange	Reset	Hardware reset RDY LED lights up red, all other LEDs light up orange
Red	Red	Off	BIOS loaded	–
Red 2 Hz	Red	Off	BIOS error	• Error occurred while loading the BIOS
Red 2 Hz	Red 2 Hz	Off	File error	• Memory card not inserted or defective • Software on memory card not inserted or defective
Red	Orange	Off	FW loading	RDY LED lights up red, PN LED flashes orange without fixed frequency
Red	Off	Off	FW loaded	-
Off	Red	Off	FW checked (no CRC error)	
Red 0.5 Hz	Red 0.5 Hz	Off	FW checked (CRC error)	• CRC invalid

Table 5- 13 Firmware

LED			Status	Comment
RDY	DP	OPT		
Orange	Off	Off	Initializing	–
Alternating			Running	See the table below

Behavior of the LEDs after booting

Table 5- 14 Control Unit CU320-2 DP – Description of the LEDs after booting

LED	Color	Status	Description, cause	Remedy
RDY (READY)	-	OFF	Electronics power supply is missing or outside permissible tolerance range.	Check power supply
	Green	Continuous light	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place.	–
		Flashing 0.5 Hz	Commissioning/reset	–
		Flashing 2 Hz	Writing to the memory card	–
	Red	Flashing 2 Hz	General errors	Check parameterization/configuration data

LED	Color	Status	Description, cause	Remedy
	Red/ green	Flashing 0.5 Hz	Control Unit is ready for operation. However there are no software licenses.	Obtain licenses
	Orange	Flashing 0.5 Hz	Updating the firmware of the DRIVE-CLiQ components	–
		Flashing 2 Hz	DRIVE-CLiQ component firmware update complete. Wait for POWER ON for the components in question.	Turn POWER ON for the components in question
	Green/ orange or red/ orange	Flashing 2 Hz	Component detection via LED is activated (p0124[0]). **Note**: Both options depend on the LED status when component detection is activated via p0124[0] = 1.	–
DP PROFIdrive cyclic operation	–	Off	Cyclic communication has not (yet) taken place. **Note:** The PROFIdrive is ready to communicate when the Control Unit is ready to operate (see LED RDY).	–
	Green	Continuous light	Cyclic communication is taking place.	–
		Flashing 0.5 Hz	Full cyclic communication has not yet taken place. Possible causes: • The controller is not transferring any setpoints. • During isochronous operation, no global control (GC) or a faulty global control (GC) is transferred by the controller.	–
	Red	Flashing 0.5 Hz	PROFIBUS master is sending wrong parameterization/configuration data	Adapt configuration between master/controller and CU
		Flashing 2 Hz	Cyclic bus communication has been interrupted or could not be established	Remedy fault
OPT (OPTION)	–	Off	Electronics power supply is missing or outside permissible tolerance range. Component is not ready. Option board not installed or no associated drive object has been created.	Check power supply and/or component
	Green	Continuous light	Option board is ready.	–
		Flashing 0.5 Hz	Depends on the option board used.	–
	Red	Flashing 2 Hz	There is at least one fault of this component. The Option Board is not ready (e.g. after switching on).	Remedy and acknowledge fault
	Orange	0.5 Hz	Firmware update in progress for connected Option Board CBE20	-
RDY and DP	Red	Flashing 2 Hz	Bus error - communication has been interrupted	Remedy fault

5.1.4 Connection example

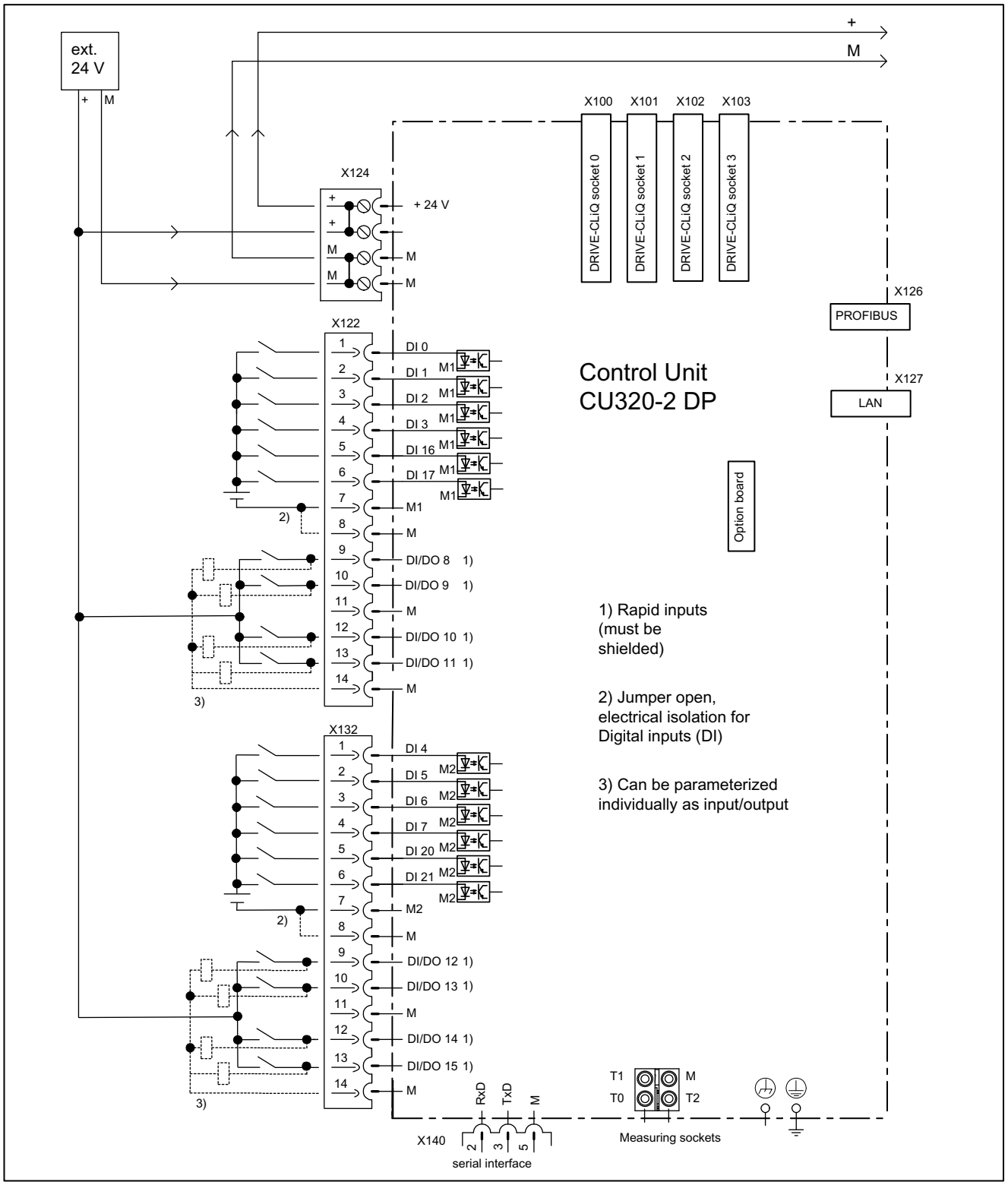


Figure 5-4 Connection example of CU320-2 DP

5.1.5 Dimension drawing

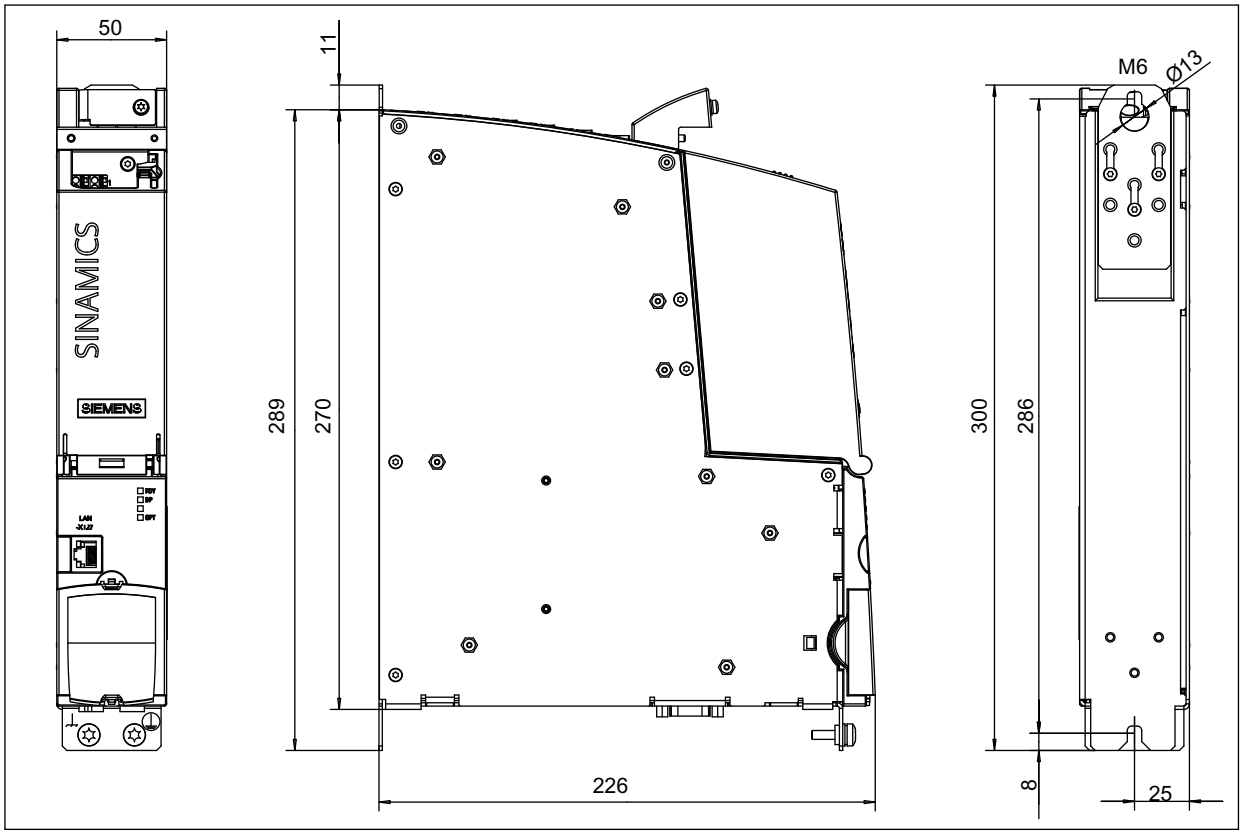
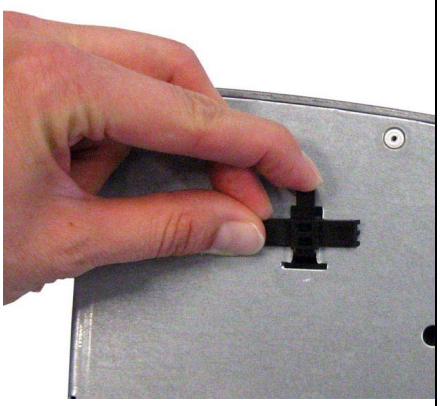
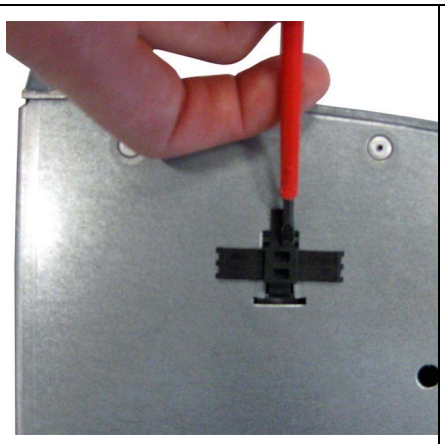
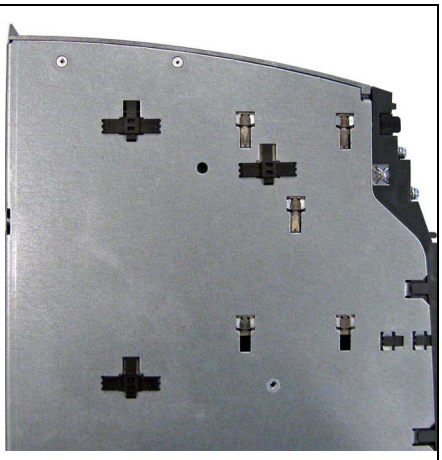


Figure 5-5 Dimension drawing of CU320-2 DP, all data in mm

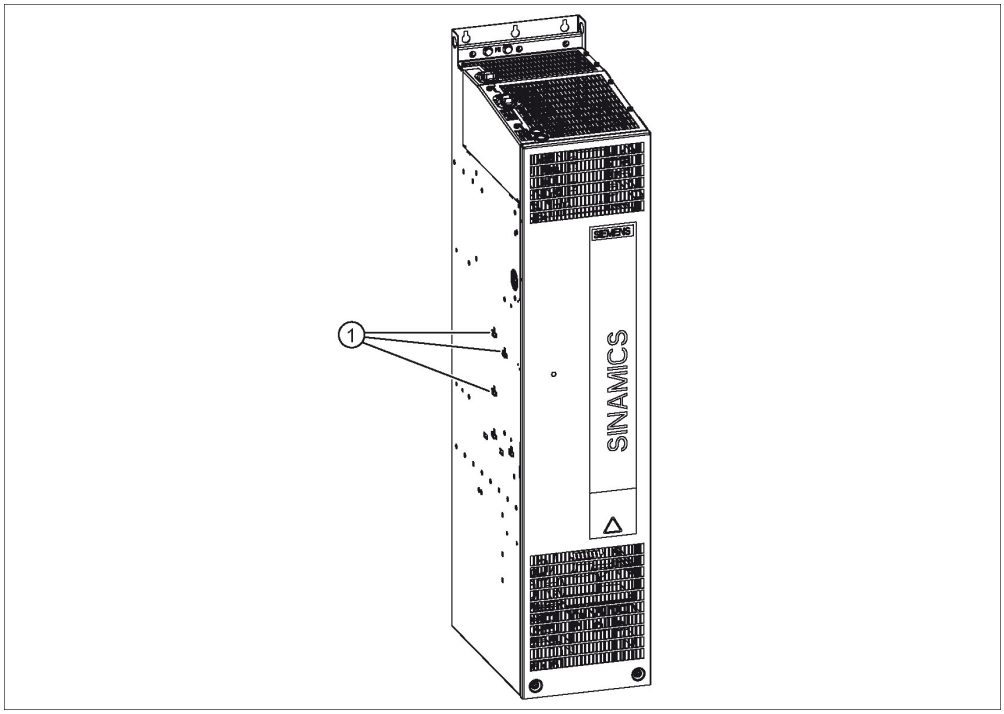
5.1.6 Installation

Installing the holders for securing the Control Unit

		
Insert the holder into the installation opening provided.	Use a suitable tool (such as a screwdriver) to push the holder in as far as it will go.	Installed holders (3 pieces) from the Line Module accessories kit

Installing the CU320-2 DP on a Line Module in the chassis format

The Control Unit CU320-2 DP features integrated lateral holders, which enable it to be installed directly on a power unit in chassis format. The holders required to do this are supplied together with the power units.



① Holders to retain the Control Unit

Figure 5-6 Installing the CU320-2 DP directly on a Line Module in chassis format

Installing the CU320-2 DP directly on a mounting surface

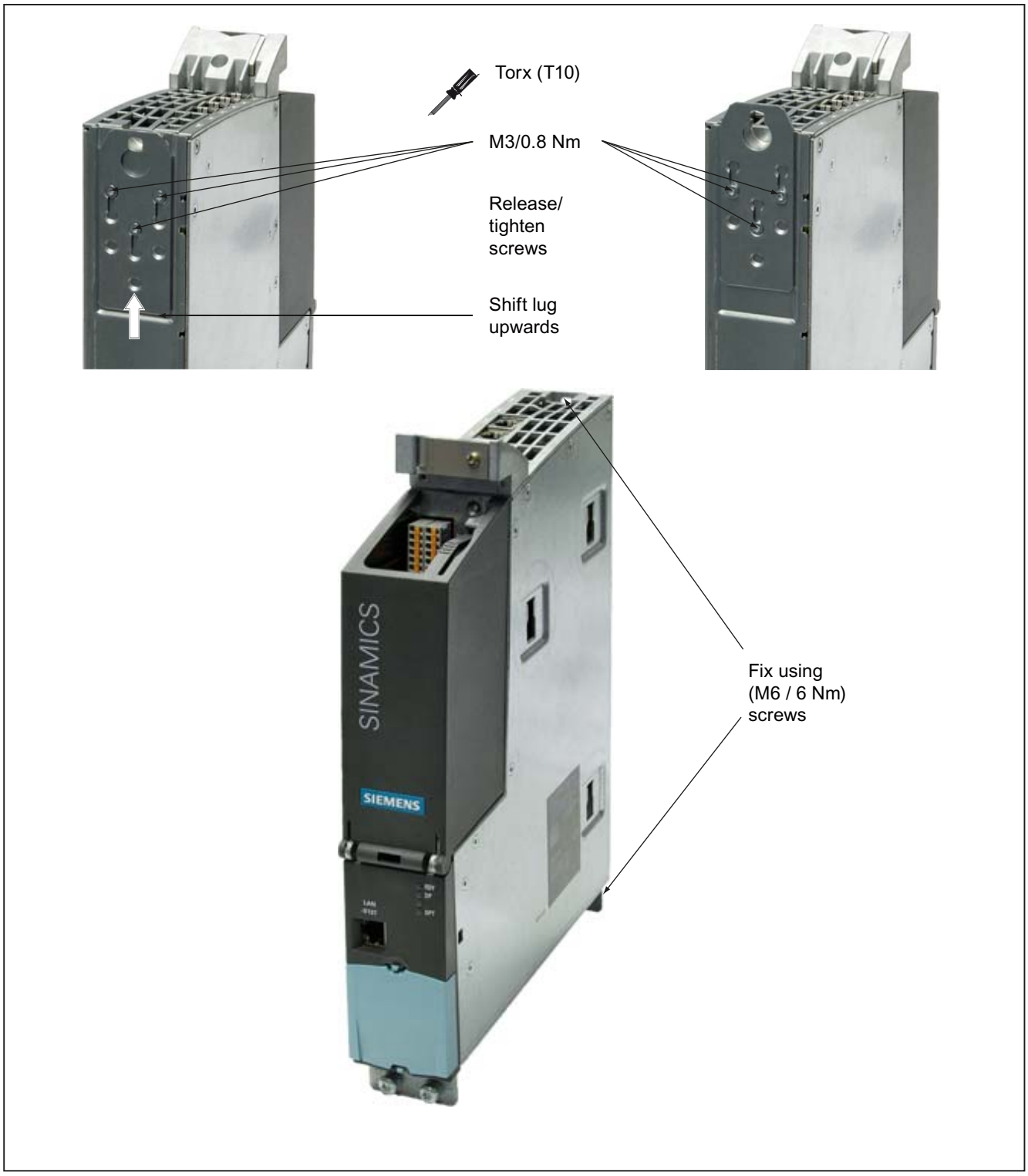


Figure 5-7 Installing the CU320-2 DP on a mounting surface

Removing/opening the cover of the CU320-2 DP

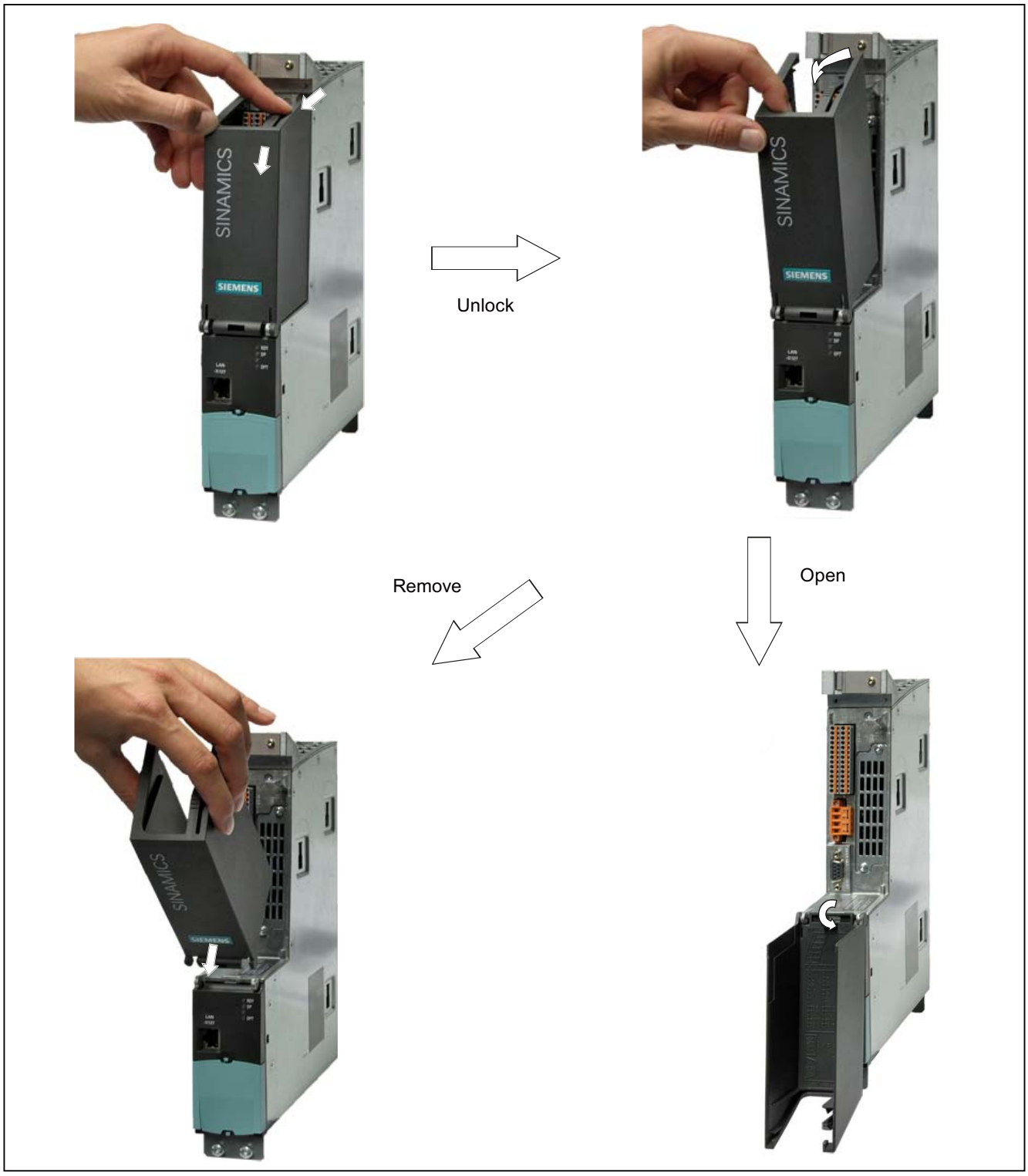


Figure 5-8 Removing/opening the cover of the CU320-2 DP

5.1.7 Technical data

Table 5- 15 Technical data

6SL3040-1MA00-0AA1	Unit	Value
Electronics power supply		
Voltage	V_{DC}	24 DC (20.4 to 28.8)
Current (without DRIVE-CLiQ or digital outputs)	A_{DC}	1.0
Power loss	W	24
Maximum DRIVE-CLiQ cable length	m	100
PE/ground connection	on housing with M5/3 Nm screw	
Response time	The response time of digital inputs/outputs depends on the evaluation (refer to the function diagram). Additional information: SINAMICS S120/S150 List Manual (LH1), Chapter "Function block diagrams"	
Weight	kg	2.3

5.2 Voltage Sensing Module VSM10

5.2.1 Description

The VSM10 Voltage Sensing Module is a Voltage Sensing Module for measuring the three-phase line voltage. The phase difference is measured ungrounded.

The Voltage Sensing Module can be used for the following line types:

- 100 V for connecting to medium-voltage line supplies via a potential transformer
- 400 V / 600 V for all line system types
- 690 V for line supplies with grounded neutral and IT line systems

In addition to the voltage sensing, a temperature sensor can be connected to the VSM10 for temperature monitoring. All data recorded are transferred to the higher-level system via DRIVE-CLiQ.

The Voltage Sensing Module achieves radio interference category C2 with limit classes A1 for interference voltage and A for emitted interference.

Table 5- 16 Interface overview of the VSM10

Type	Quantity
Analog inputs	2
Line supply voltage connections (400/690 V)	3
Line supply voltage connections (100 V)	3
Temperature senor input (KTY/PTC)	1
DRIVE-CLiQ interface	1

5.2.2 Safety information

⚠ WARNING

The ventilation spaces of 50 mm above and below the component must be observed.

NOTICE

The VSM10 has two terminal strips to sense the three-phase line supply voltage (X521 and X522). The maximum voltage that can be connected to X521 is 100 V (phase-to-phase) and is used for voltage sensing via a potential transformer. A maximum voltage to be sensed of up to 690 V (phase-to-phase) can be directly connected to terminal X522. Only one of the two terminals X521 and X522 may be used. Nothing may be connected to the unused terminal.

⚠ CAUTION

Connecting cables to temperature sensors must always be installed with shielding. The cable shield must be connected to the ground potential at both ends over a large surface area. Temperature sensor cables that are routed together with the motor cable must be twisted in pairs and shielded separately.

5.2.3 Interface description

5.2.3.1 Overview

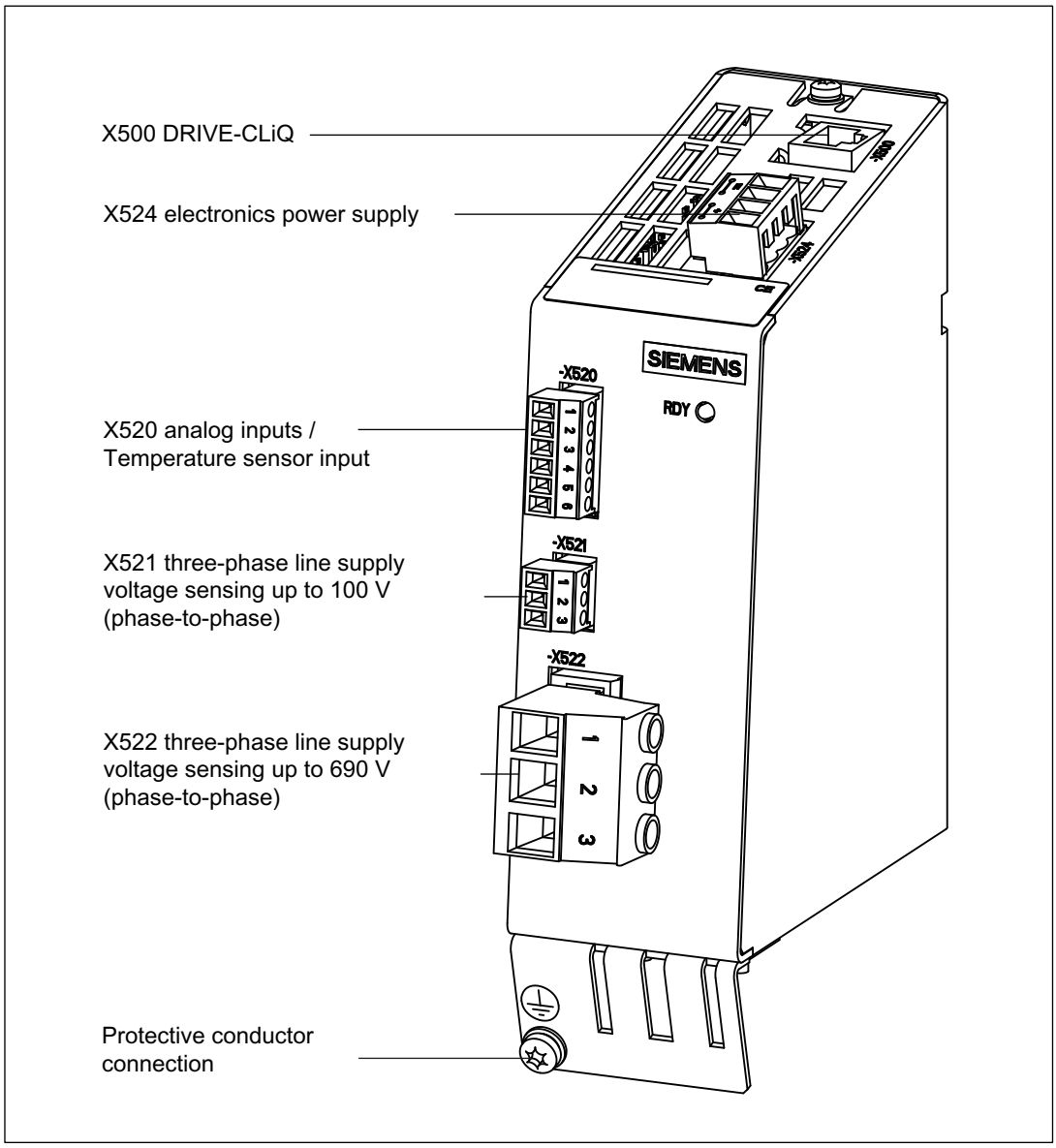
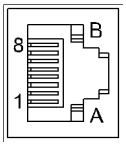


Figure 5-9 Interface description of the VSM10

5.2.3.2 X500 DRIVE-CLiQ interface

Table 5- 17 X500 DRIVE-CLiQ interface

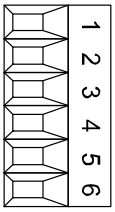
	Pin	Signal name	Technical specifications
	1	TXP	Transmit data +
	2	TXN	Transmit data -
	3	RXP	Receive data +
	4	Reserved, do not use	
	5	Reserved, do not use	
	6	RXN	Receive data -
	7	Reserved, do not use	
	8	Reserved, do not use	
	A	+ (24 V)	Power supply
	B	M (0 V)	Electronics ground
Connector type: RJ45plus socket; blanking plate for DRIVE-CLiQ interface included in the scope of delivery; blanking plate (50 pieces) Order number: 6SL3066-4CA00-0AA0			

Note

The maximum connectable DRIVE-CLiQ cable length is 50 m.

5.2.3.3 X520 analog inputs/temperature sensor

Table 5- 18 Terminal block X520

	Terminal	Designation	Technical specifications
	1	AI 0-	2 analog differential inputs +/- 10V Resolution: 12 bits
	2	AI 0+	
	3	AI 1-	
	4	AI 1+	
	5	+ Temp	Temperature sensor KTY84-1C130 / PTC
	6	- Temp	
Max. connectable cross-section: 1.5 mm², type: Screw terminal			

Note

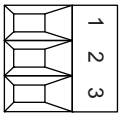
In order to minimize noise emission, shielded cables should be used.

CAUTION
The common mode range may not be violated. This means that the analog differential voltage signals can have a maximum offset voltage of +/-30 V with respect to the ground potential. If the range is not observed, incorrect results may occur during analog/digital conversion.

⚠ DANGER
Risk of electric shock! Only temperature sensors that meet the safety isolation specifications contained in EN 61800-5-1 may be connected to terminals "+Temp" and "-Temp". If these instructions are not complied with, there is a risk of electric shock!

5.2.3.4 X521 three-phase line supply voltage sensing up to 100 V (phase-to-phase)

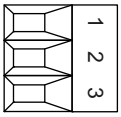
Table 5- 19 Terminal block X522

	Terminal	Designation	Technical specifications
	1	Phase voltage U	Connected to the line supply voltage via a measuring transformer
	2	Phase voltage V	
	3	Phase voltage W	
Max. connectable cross-section: 6 mm², type: Screw terminal			

NOTICE
The phases must be connected to the VSM10 with the same sequence as that of the line connection.

5.2.3.5 X522 three-phase line supply voltage sensing up to 690 V (phase-to-phase)

Table 5- 20 Terminal block X522

	Terminal	Designation	Technical specifications
	1	Phase voltage U	Directly connected to sense the line supply voltage
	2	Phase voltage V	
	3	Phase voltage W	
Max. connectable cross-section: 6 mm², type: Screw terminal			

NOTICE

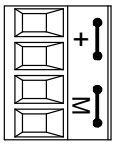
Only one of the two terminals X521 and X522 may be used. Nothing may be connected to the unused terminal.

NOTICE

The phases must be connected to the VSM10 with the same sequence as that of the line connection.

5.2.3.6 X524 Electronics power supply

Table 5- 21 Terminals for the electronics power supply

	Terminal	Designation	Technical specifications
	+	Electronics power supply	Voltage: 24 V DC (20.4 V – 28.8 V) Current consumption: max. 0.2 A Max. current via jumper in connector: 20 A
	+	Electronics power supply	
	M	Electronics ground	
	M	Electronics ground	
Max. connectable cross-section: 2.5 mm², type: Screw terminal			

The maximum cable length that can be connected is 10 m.

Note

The two "+" and "M" terminals are jumpered in the connector. This ensures that the supply voltage is looped through.

5.2.3.7 Significance of the LEDs for the Voltage Sensing Module VSM10

Table 5- 22 Significance of the LEDs on the VSM10

LED	Color	Status	Description
RDY	---	Off	The electronics power supply is missing or out of tolerance.
	Green	Continuous light	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place.
	Orange	Continuous light	DRIVE-CLiQ communication is being established.
	Red	Continuous light	At least one fault is present in this component.
	Green / red	2 Hz flashing light	Firmware is being downloaded.
	Green / orange or red / orange	2 Hz flashing light	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.

5.2.4 Dimension drawing

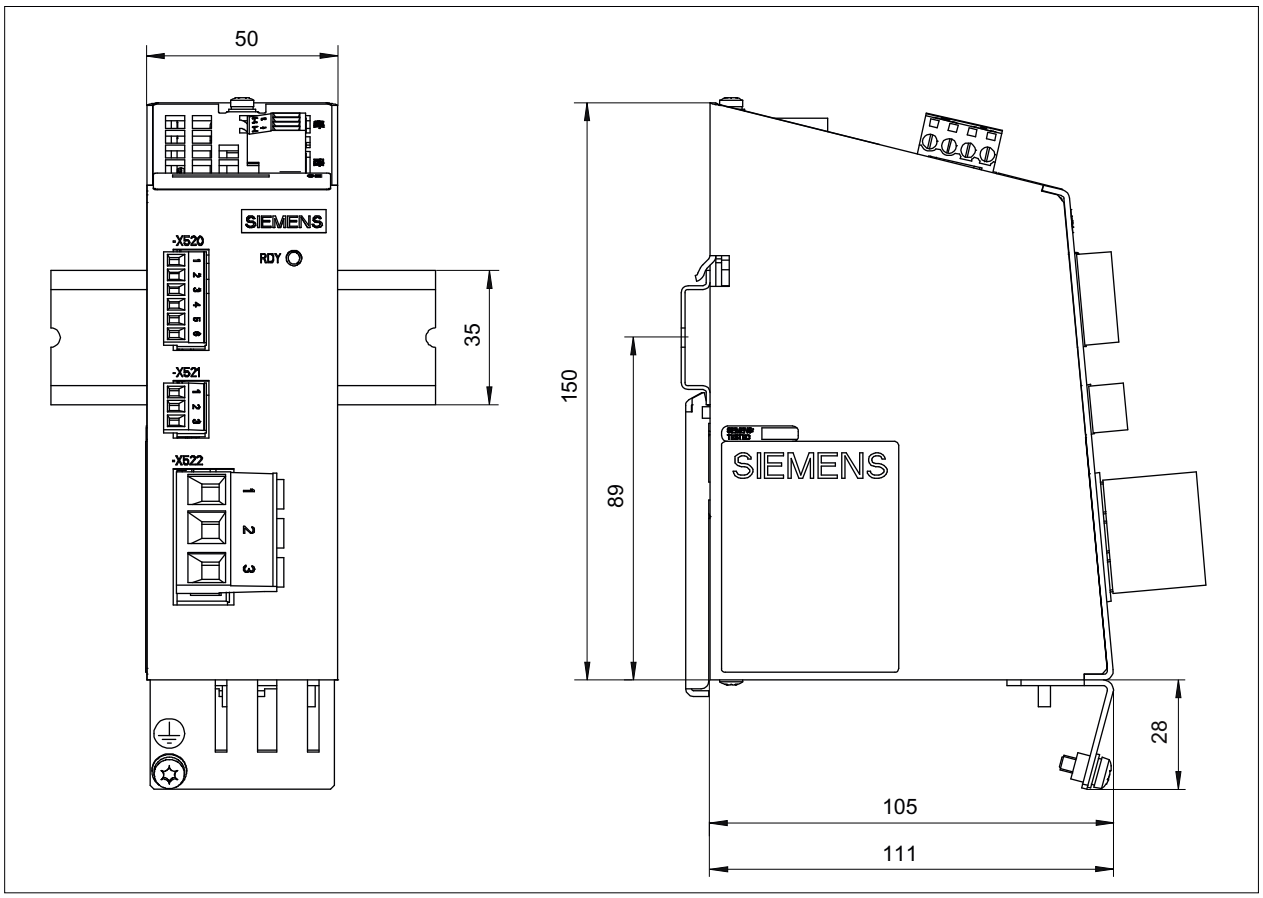


Figure 5-10 Dimension drawing of the Voltage Sensing Module VSM10, all data in mm

5.2.5 Protective conductor connection and shield support

The following figure shows typical Weidmüller shield connection clamps for the shield supports.

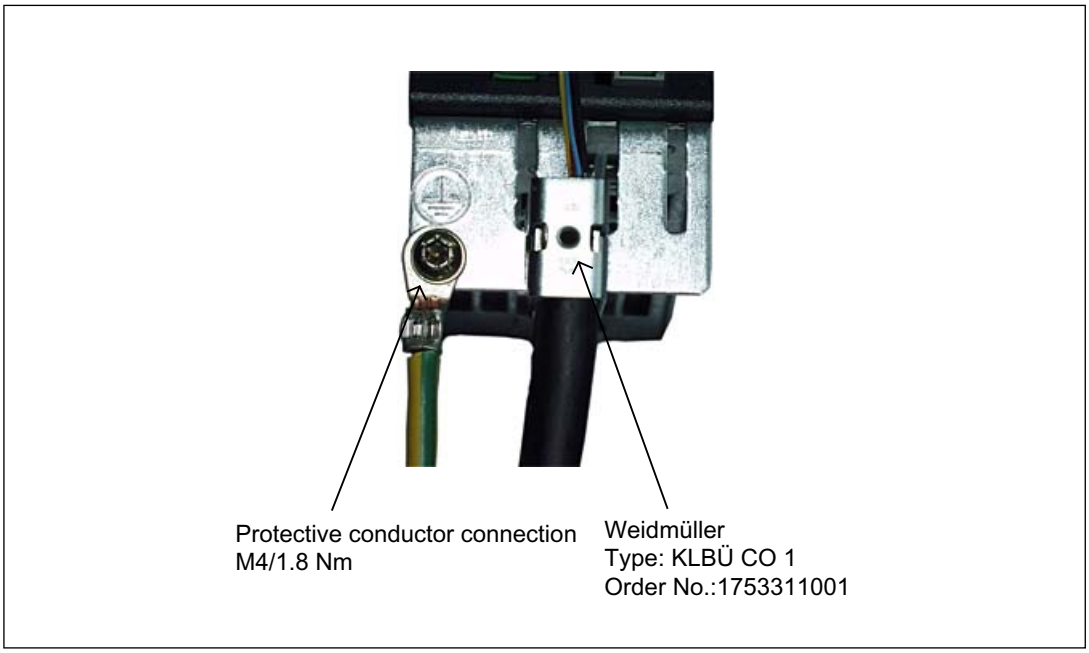


Figure 5-11 Shield contacts

Weidmüller website address: http://www.weidmueller.com

⚠ DANGER
If the shielding procedures described and the specified cable lengths are not observed, the machine may not operate properly.

NOTICE
Only use screws with a permissible mounting depth of 4 - 6 mm.

5.2.6 Technical data

Table 5- 23 Technical data

6SL3053-0AA00-3AAx	Unit	Value
Electronics power supply		
Voltage	V_{DC}	24 DC (20.4 – 28.8)
Current (without DRIVE-CLiQ or digital outputs)	A_{DC}	0.3
Power loss	W	<10
PE/ground connection	On the housing with M4; 1.8 Nm screw	
Weight	kg	1
Degree of protection		IP20

5.3 Active Interface Module

5.3.1 Description

Active Interface Modules are used in conjunction with the Active Line Modules in chassis format. The Active Interface Modules contain a Clean Power Filter with basic RI suppression, the pre-charging circuit for the Active Line Module, the line voltage sensing circuit and monitoring sensors.

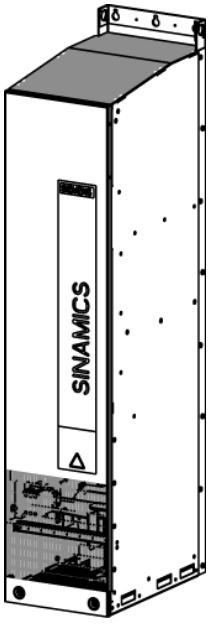
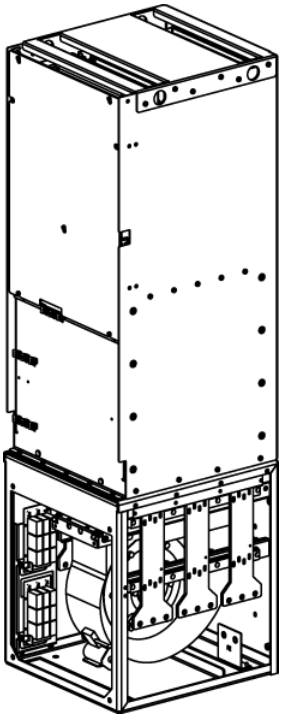
Frame size GI is equipped as standard with a bypass contactor which ensures a highly compact design. The bypass contactor must be provided separately for frame size JI.

The vast majority of line harmonics are suppressed by the Clean Power Filter.

The Active Interface Module contains:

- Clean Power Filter
- Line reactor
- Pre-charging circuit
- Bypass contactor (for frame size GI)
- Voltage Sensing Module (VSM)
- Fan

Table 5- 24 Active Interface Module

	
Frame size GI	Frame size JI

5.3.2 Safety information

⚠ CAUTION

The DC link discharge time hazard warning must be affixed to the component in the relevant local language.

NOTICE

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

⚠ DANGER

Active Interface Modules discharge a high leakage current to the protective ground conductor.
Due to the high leakage current associated with Active Interface Modules, they or the relevant control cabinet must be permanently connected to PE.

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.

5.3.3 Interface description

5.3.3.1 Overview

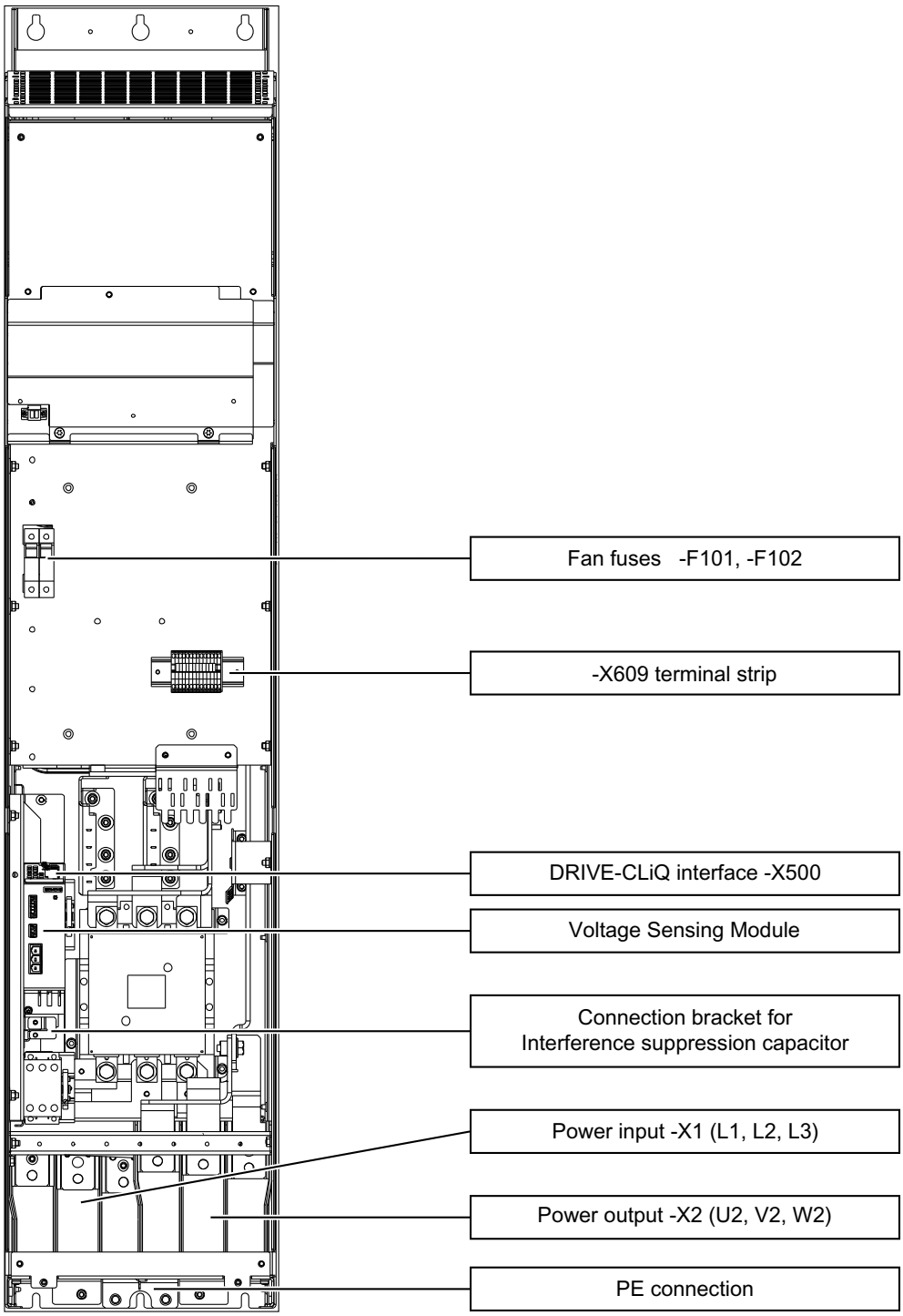


Figure 5-12 Interface overview in the Active Interface Module, frame size GI

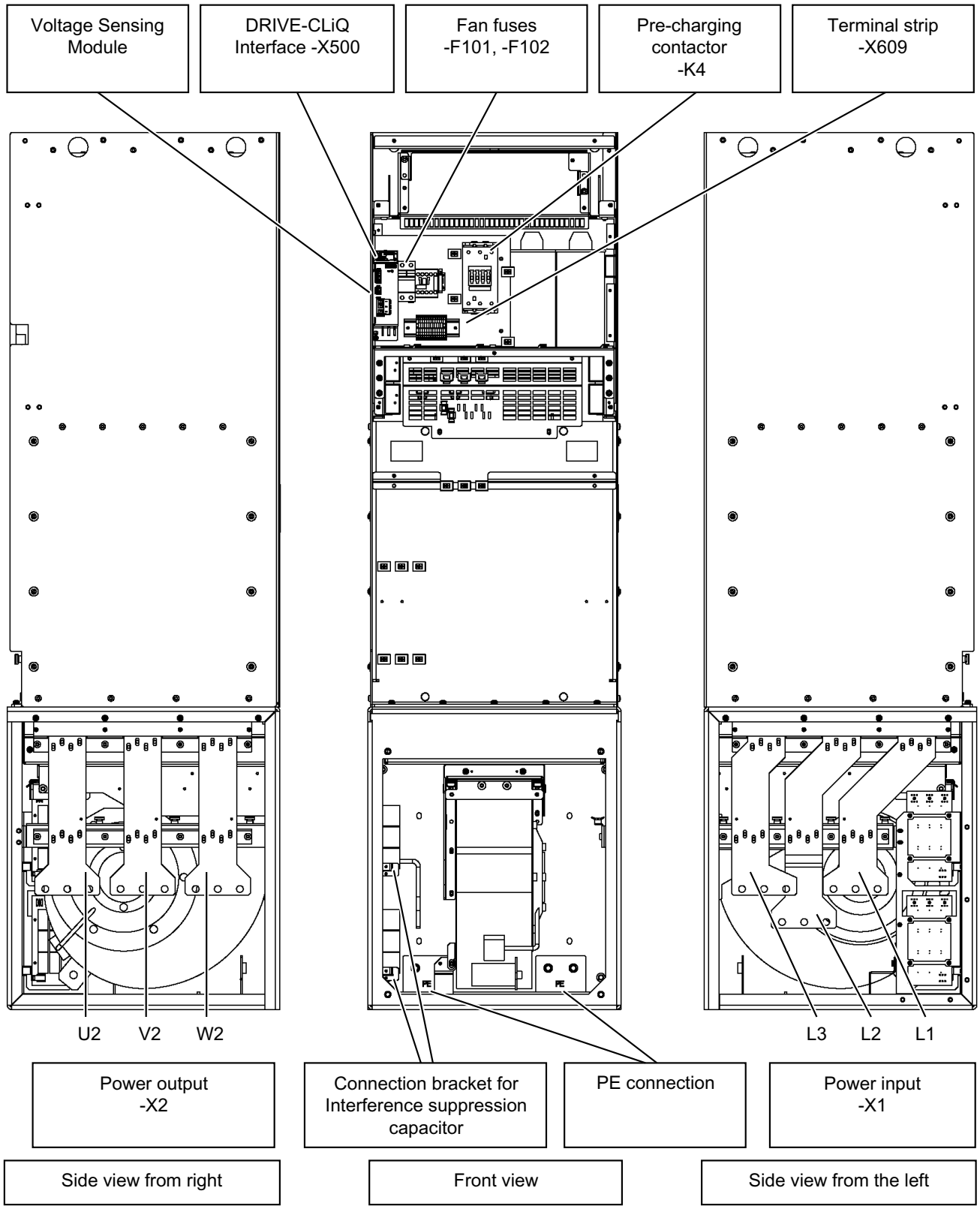


Figure 5-13 Interface overview in the Active Interface Module, frame size JI

5.3.3.2 Connection example

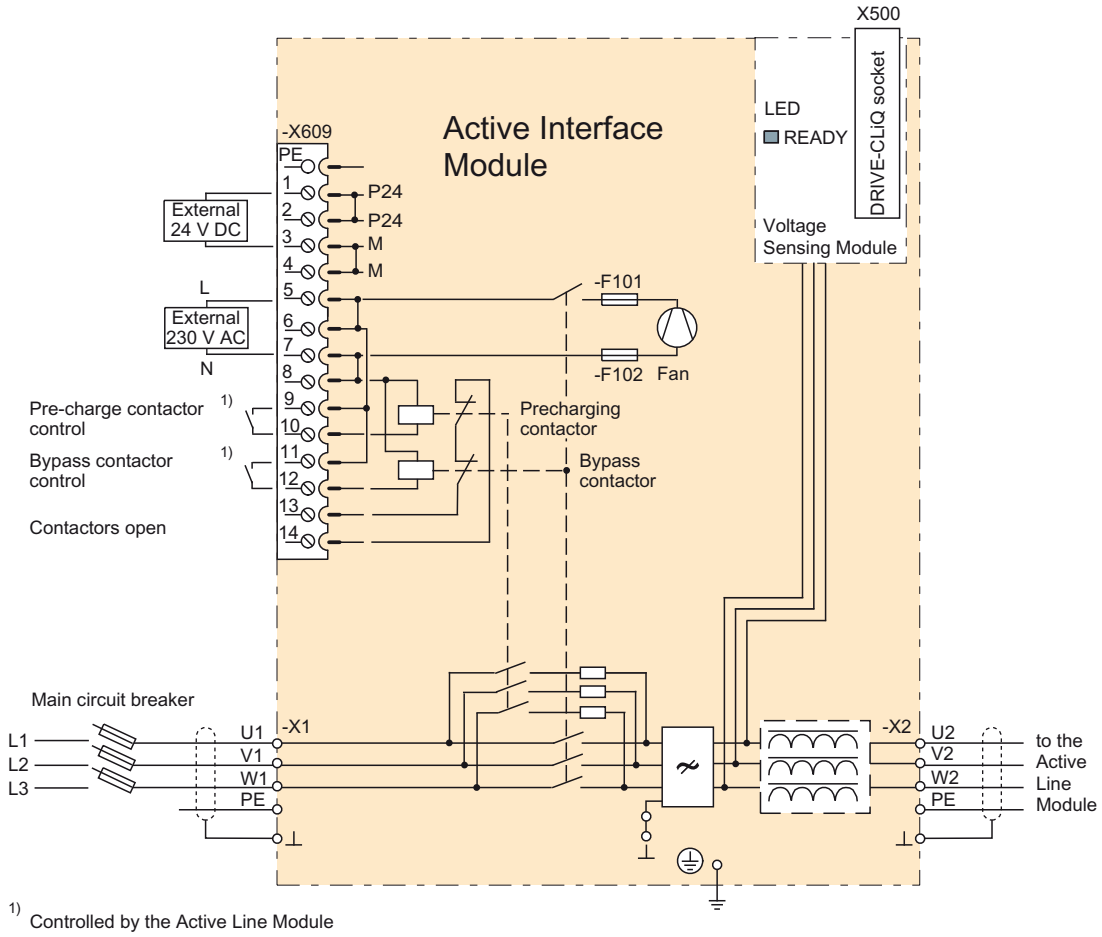


Figure 5-14 Connection example Active Interface Module, frame size GI

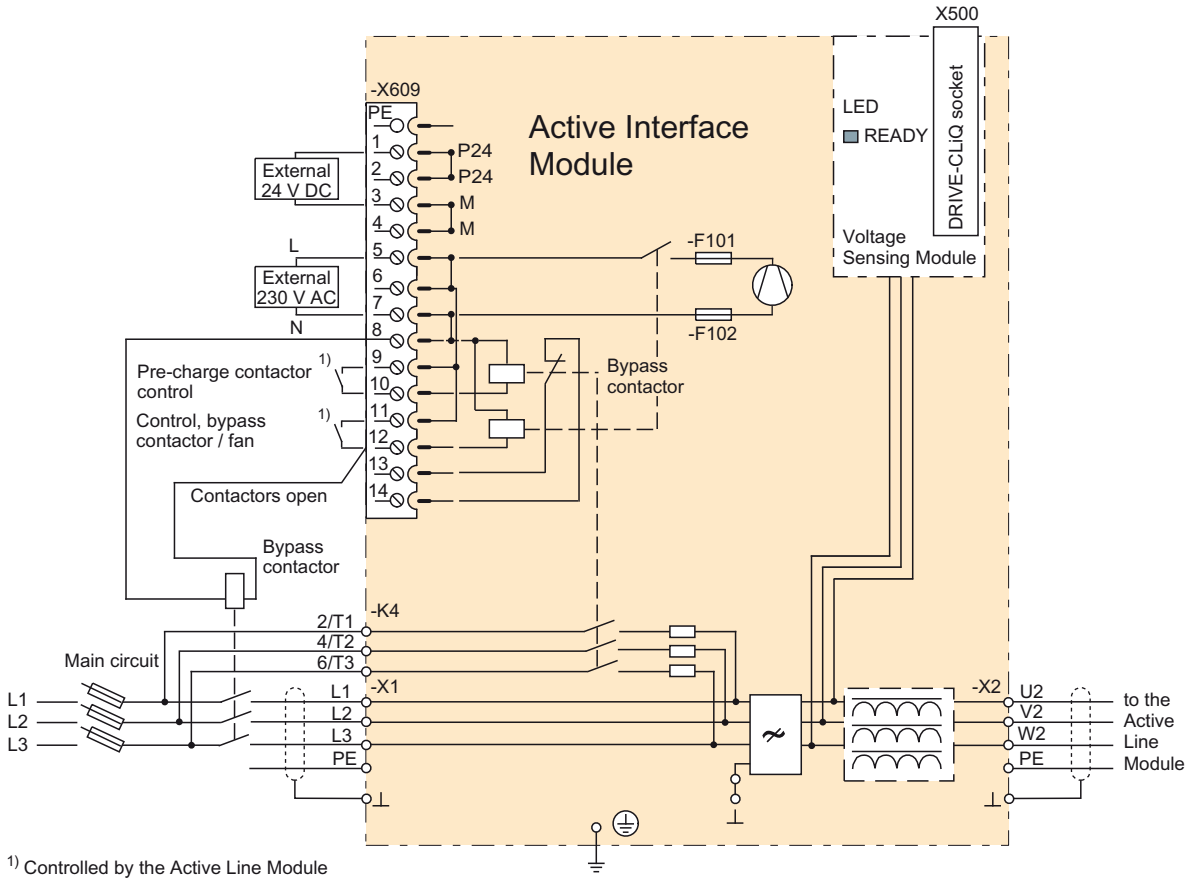


Figure 5-15 Connection example Active Interface Module, frame size JI

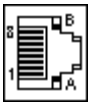
5.3.3.3 X1, X2 line/load connection

Table 5- 25 Connections for the Active Interface Module

Terminals	Designations
X1: L1, L2, L3 X2: U2, V2, W2	Voltage: • 3-ph. 380 V AC -10% (-15% < 1 min) to 3-ph. 480 V AC +10% • 3-ph. 500 V AC -10% (-15% < 1 min) to 3-ph. 690 V AC +10% Frequency: 47 Hz to 63 Hz Connecting thread: • Frame size GI: M10 / 25 Nm for ring cable lugs to DIN 46234 • Frame size JI: M12 / 50 Nm for ring cable lugs to DIN 46234
K4: 2/T1, 4/T2, 6/T3 (for frame size JI only)	Connection for pre-charging circuit directly on precharging contactor: • Frame size JI: 2 x 35mm² max. (3RT1044)
PE connection	Connecting thread: • Frame size GI: M10 / 25 Nm for ring cable lugs to DIN 46234 • Frame size JI: M12 / 50 Nm for ring cable lugs to DIN 46234

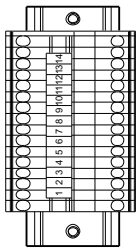
5.3.3.4 DRIVE-CLiQ interface X500

Table 5- 26 DRIVE-CLiQ interface X500

	PIN	Signal name	Technical specifications
	1	TXP	Transmit data +
	2	TXN	Transmit data -
	3	RXP	Receive data +
	4	Reserved, do not use	
	5	Reserved, do not use	
	6	RXN	Receive data -
	7	Reserved, do not use	
	8	Reserved, do not use	
	A	+ (24 V)	24 V power supply
	B	M (0 V)	Electronics ground
Blanking plate for DRIVE-CLiQ interfaces (50 pcs.) Order number: 6SL3066-4CA00-0AA0			

5.3.3.5 X609 terminal strip

Table 5- 27 X609 terminal strip

	Terminal	Designation	Technical specifications	
	1	P24	Voltage: 24 V DC (20.4 V – 28.5 V) Current consumption: max. 0.25 A	
	2	P24		
	3	M		
	4	M		
	5	L	Voltage: 230 V AC (195.5 V – 264.5 V) Current consumption: max. 10 A Fan operating currents, see "Technical data"	
	6	L		
	7	N		
	8	N		
	9	Pre-charge contactor–A1	Voltage: 230 V AC (195.5 V – 264.5 V) Current consumption: max. 4 A	To Active Line Module, X9:5
	10	Pre-charge contactor–A2		To Active Line Module, X9:6
	11	Bypass contactor–A1	Voltage: 230 V AC (195.5 V – 264.5 V) Current consumption: max. 6 A	To Active Line Module, X9:3
	12	Bypass contactor–A2		To Active Line Module, X9:4
	13	Contactor feedback 1 *	Voltage: 230 V AC (195.5 V – 264.5 V) Max. permissible current: 6 A	
	14	Contactor feedback 2 *		
Max. connectable cross-section 1.5 mm^2				

* Series connection NO contact of pre-charge contactor and bypass contactor (only for frame size GI)

CAUTION
Active Interface Modules of frame size JI require a signal on terminal X609:11 and 12 to control the fans. If this signal is not present during operation, the fans do not rotate and the module is shut down on overtemperature.

5.3.3.6 Significance of the LED on the Voltage Sensing Module (VSM) in the Active Interface Module

Table 5- 28 Description of the LED on the Voltage Sensing Module (VSM) in the Active Interface Module

LED	Color	Status	Description
RDY	---	Off	The electronics power supply is missing or out of tolerance
	Green	Continuous light	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place.
	Orange	Continuous light	DRIVE-CLiQ communication is being established.
	Red	Continuous light	At least one fault is present in this component. Note: LED is driven irrespective of the corresponding messages being reconfigured.
	Green / red	Flashing 0.5 Hz	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	Component recognition via LED is activated (p0144) Note: The two options depend on the LED status when module recognition is activated via p0144 = 1.

5.3.4 Dimension drawing

Dimension drawing, frame size GI

The minimum clearances for cooling are indicated by the dotted line.

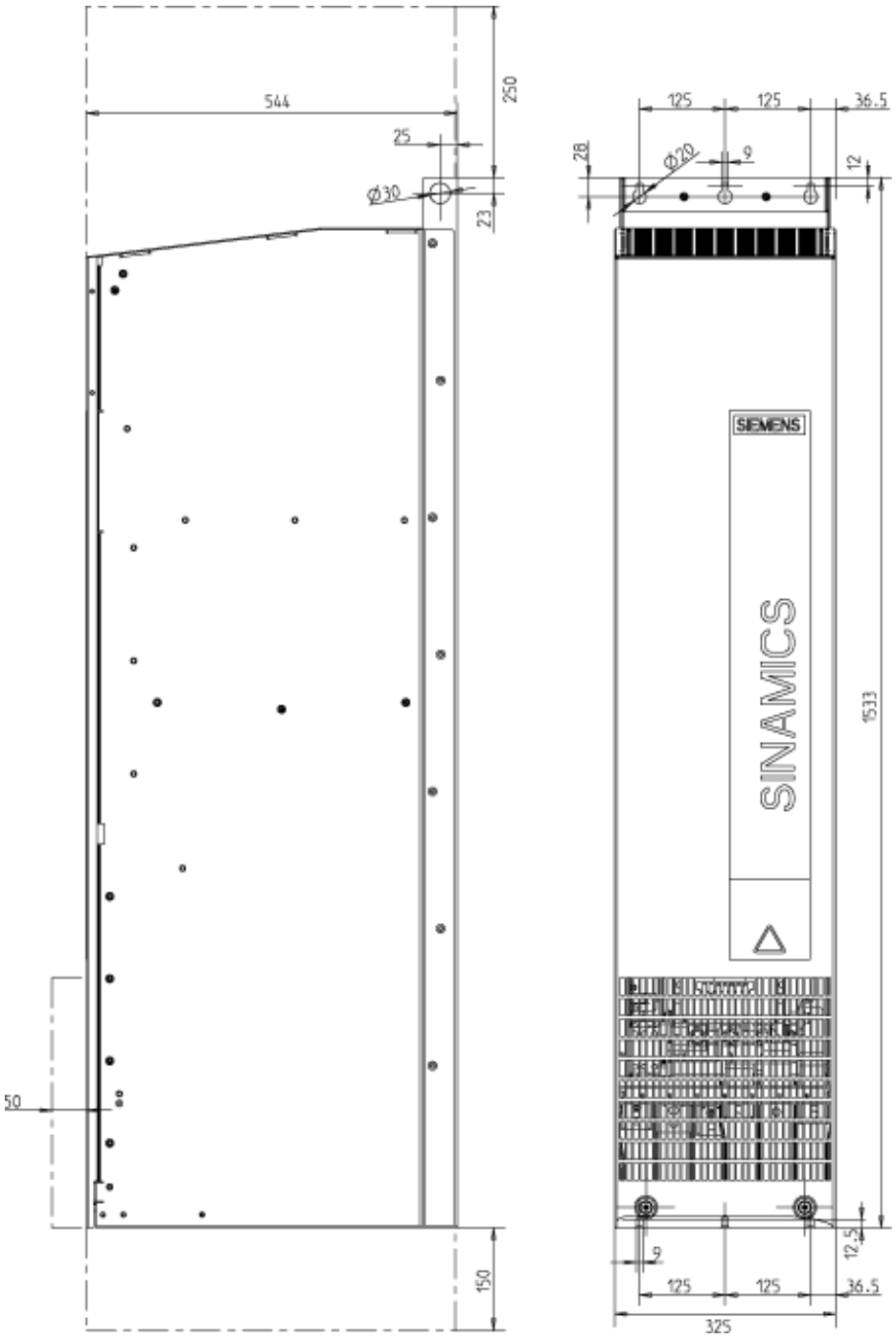


Figure 5-16 Dimension drawing for Active Interface Module, frame size GI Side view, front view

Dimension drawing, frame size JI

The minimum clearances for cooling are indicated by the dotted line.

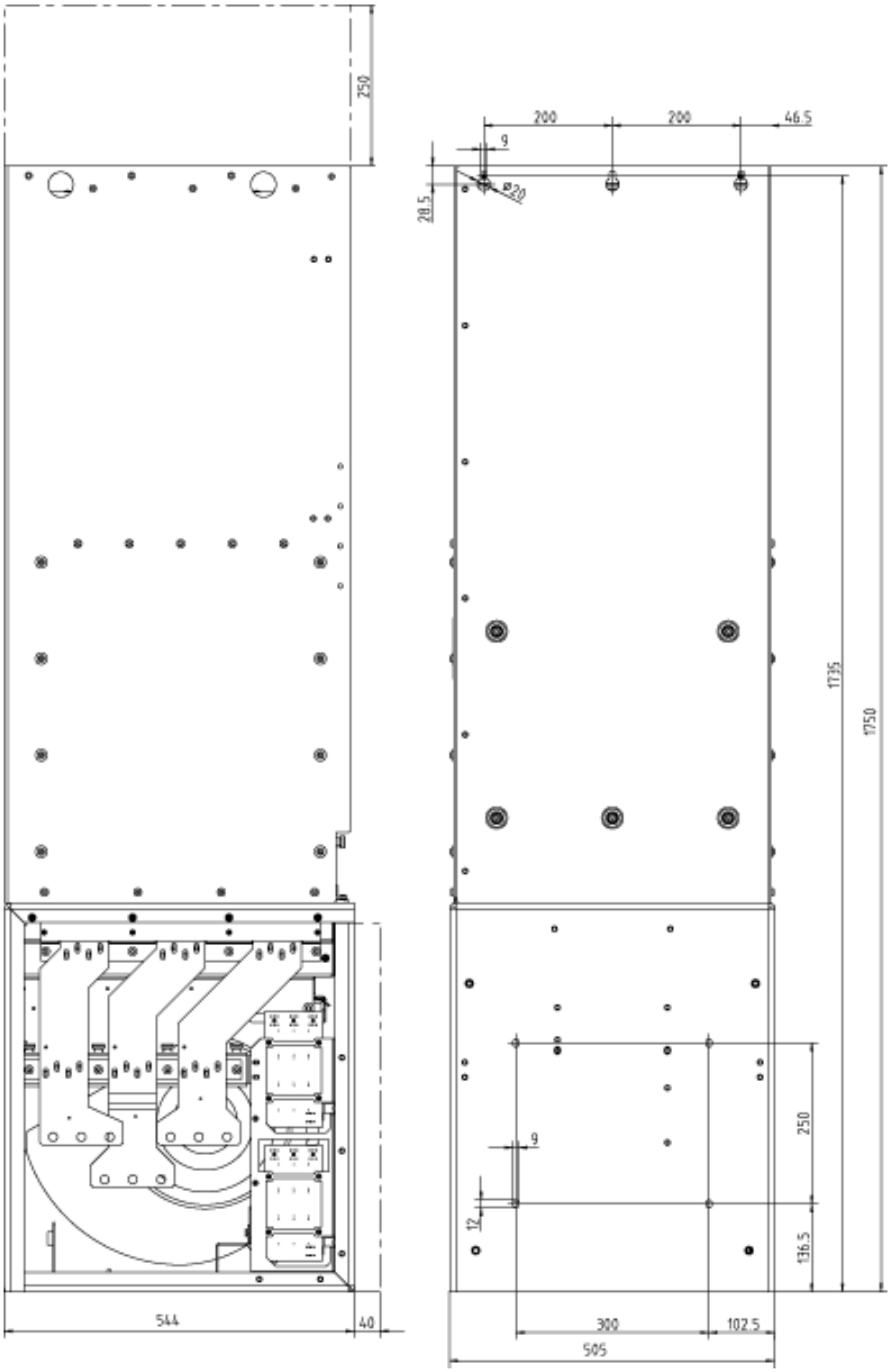


Figure 5-17 Dimension drawing for Active Interface Module, frame size JI Side view, rear view

5.3.5 Electrical connection

The Active Interface Module is electrically connected in accordance with the connection examples shown in section "Interface description".

Operating an Active Interface Module on an ungrounded line supply (IT system)

When the device is operated on an ungrounded line supply (IT system), the connection bracket to the noise suppression capacitor must be removed (e.g.: see "1" in figure below).

The interface overview in the section "Interface description" shows the position of the connection bracket on the different frame sizes.

With devices of frame size JI, two connection brackets must be removed.

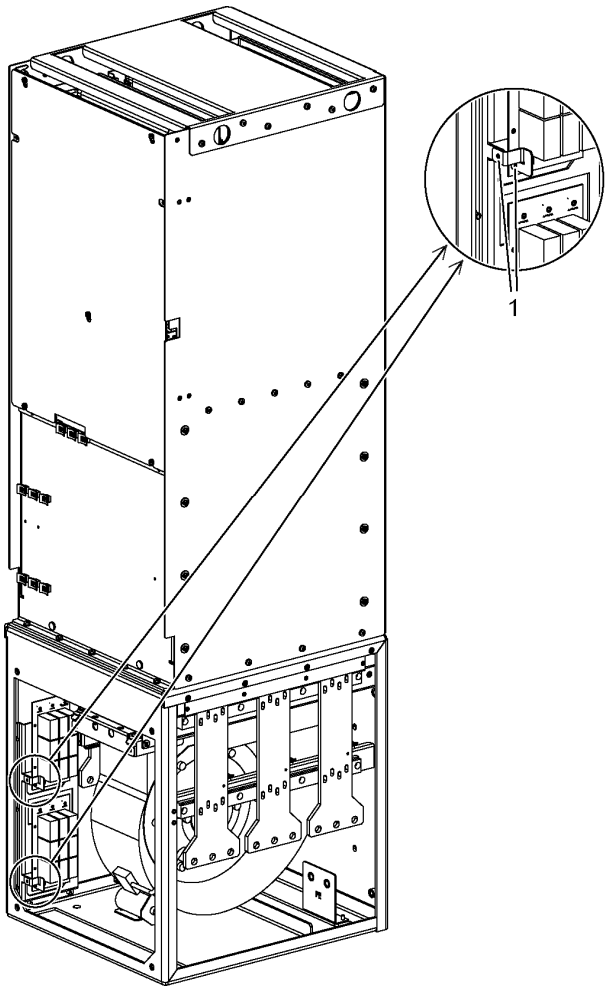


Figure 5-18 Removing the connection bracket to the noise suppression capacitor (example: frame size JI)

⚠ WARNING

Failing to remove the connection bracket for the noise suppression capacitor on an ungrounded line supply/IT system can cause significant damage to the unit.

5.3.6 Technical data

Table 5- 29 Technical data for Active Interface Modules, 380 V – 480 V 3 AC

Order number	**6SL3300–**	**7TE35–0AA0**	**7TE41–4AA0**	**7TE41–4AA0**	
Suitable for Active Line Module Rated power of Active Line Module	6SL3330- kW	7TE35-0AA4 300	7TE41-0AA4 630	7TE41-4AA4 900	
Rated current	A	490	985	1405	
Supply voltages - Line voltage - Line frequency - Electronics power supply - Fan supply voltage	 V_{ACrms} Hz V_{DC} V_{AC}	 380 V 3 AC -10% (-15% < 1 min) to 480 V 3 AC +10% 47 to 63 Hz 24 (20.4 - 28.8) 230 (195.5 - 264.5)			
DC link capacitance of the drive line-up, max.	µF	76800	230400	230400	
Power requirements - Electronics power consumption (24 V DC) - Max. fan power consumption, 230 V 2 AC, 50/60 Hz, max.	 A A	 0.17 0.9 / 1.2	 0.17 3.8 / 4.9	 0.17 3.8 / 4.9	
Bypass contactor	A	Included	3WL1112- 2BB34-4AN2-Z Z=C22	3WL1116- 2BB34-4AN2-Z Z=C22	
Power consumption bypass contactor (230 V AC) - Making current - Holding current	 A A	 2.5 1.2	--	--	
Max. ambient temperature - Without derating - With derating	 °C °C	 40 55	 40 55	 40 55	
Power loss	kW	3.9	7.5	8.5	
Cooling air requirement	m^3/s	0.47	0.40	0.40	
Sound pressure level L_{pA} (1 m) at 50/60 Hz [1]	dB(A)	76 / 78	78 / 80	78 / 80	
Line/load connection L1, L2, L3 / U2, V2, W2		Flat connector for bolt connection			
		M10	M12	M12	
PE connection		M10 screw	M12 screw	M12 screw	
Line/load connection - Line connection (L1, L2, L3) - Load connection (U2, V2, W2) - PE connection	 mm² mm² mm²	 2 x 185 2 x 185 2 x 185	 6 x 240 6 x 240 4 x 240	 6 x 240 6 x 240 4 x 240	
Degree of protection		IP20	IP00	IP00	
Dimensions - Width - Height - Depth	 mm mm mm	 325 1533 542	 505 1750 544	 505 1750 544	
Frame size		GI	JI	JI	
Weight	kg	190	620	620	

[1] Sound pressure level of Active Interface Module and Active Line Module

Table 5- 30 Technical data for Active Interface Modules, 500 V–690 V 3 AC

Order number	**6SL3300–**	**7TG41–3AA0**	**7TG41–3AA0**		
Suitable for Active Line Module Rated power of Active Line Module	6SL3330- kW	7TG41-0AA4 1100	7TG41-3AA4 1400		
Rated current	A	1025	1270		
Supply voltages - Line voltage - Line frequency - Electronics power supply - Fan supply voltage	 V_{ACrms} Hz V_{DC} V_{AC}	500 V 3 AC -10% (-15% < 1 min) to 690 V 3 AC +10% 47 to 63 Hz 24 (20.4 - 28.8) 230 (195.5 - 264.5)			
DC link capacitance of the drive line-up, max.	µF	153600	153600		
Power requirements - Electronics power consumption (24 V DC) - Max. fan power consumption, 230 V 2 AC	 A A	 0.17 4.9	 0.17 4.9		
Bypass contactor	A	3WL1212-4BB34-4AN2-Z Z=C22	3WL1216-4BB34-4AN2-Z Z=C22		
Max. ambient temperature - Without derating - With derating	 °C °C	 40 55	 40 55		
Power loss	kW	9.6	9.6		
Cooling air requirement	m^3/s	0.40	0.40		
Sound pressure level L_{pA} (1 m) at 50/60 Hz [1]	dB(A)	78 / 80	78 / 80		
Line/load connection L1, L2, L3 / U2, V2, W2		Flat connector for bolt connection			
		M12	M12		
PE connection		M12 screw	M12 screw		
Line/load connection - Line connection (L1, L2, L3) - Load connection (U2, V2, W2) - PE connection	 mm² mm² mm²	 6 x 240 6 x 240 4 x 240	 6 x 240 6 x 240 4 x 240		
Degree of protection		IP00	IP00		
Dimensions - Width - Height - Depth	 mm mm mm	 505 1750 544	 505 1750 544		
Frame size		JI	JI		
Weight	kg	620	620		

[1] Sound pressure level of Active Interface Module and Active Line Module

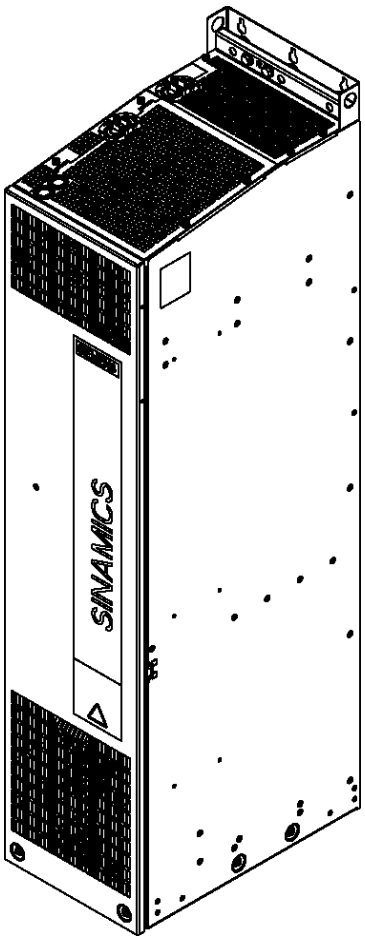
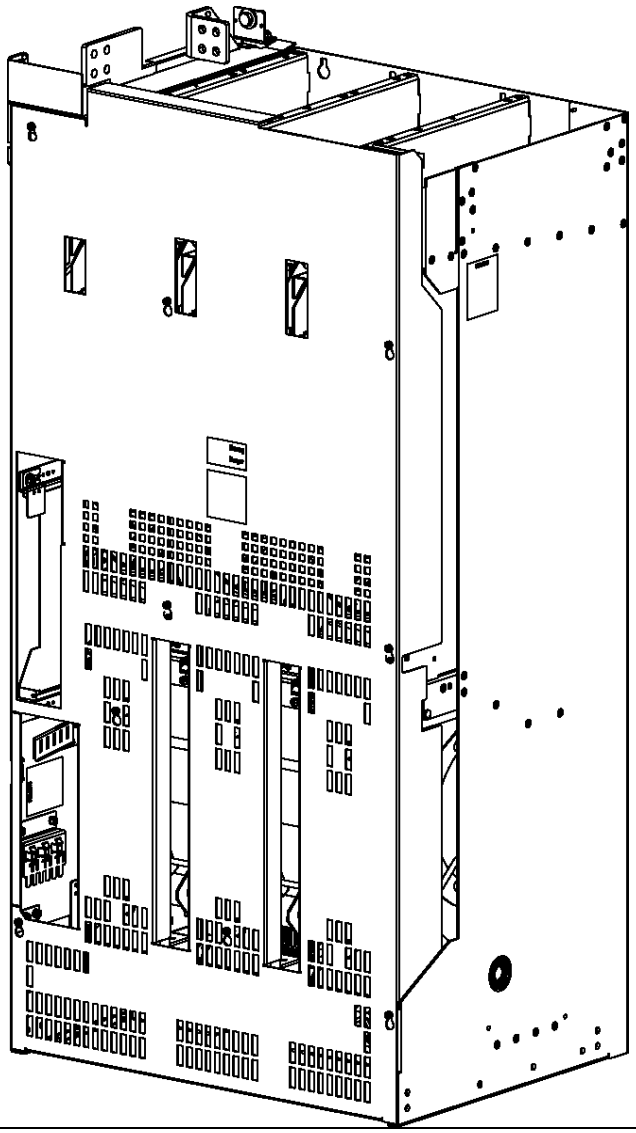
5.4 Active Line Module

5.4.1 Description

The self-commutating infeed / regenerative feedback units act as step-up converters and generate a stabilized DC link voltage that is 1.5x greater than the rated line supply voltage. In this way, the connected Motor Modules are isolated from the line voltage. This improves the dynamic response and control quality because line tolerances and fluctuations do not affect the motor voltage.

If required, the Active Line Modules can also provide reactive power compensation.

Table 5- 31 Overview of Active Line Modules for line infeed

	
Frame size GX	Frame size JX

Active Infeed components

An Active Infeed comprises an Active Interface Module and an Active Line Module.

The bypass contactor is fitted in the relevant Active Interface Module on Active Infeeds which feature an Active Line Module of frame size GX. The Active Interface Modules and Active Line Modules of this frame size have degree of protection IP20.

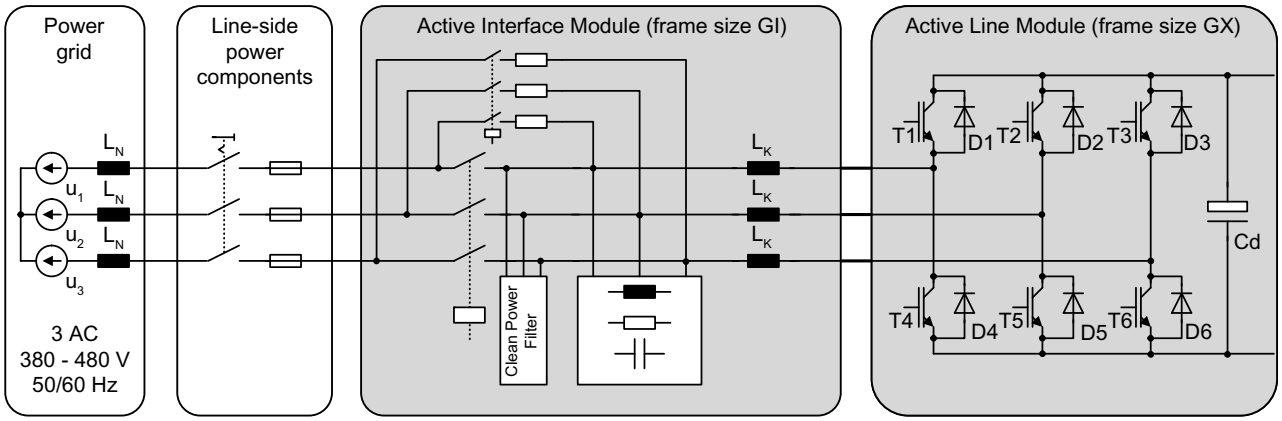


Figure 5-19 Overview of Active Infeeds, frame sizes GI/GX

In the case of an Active Infeed with an Active Line Module of frame size JX, the bypass contactor is not included in the associated Active Interface Module, but must be provided separately. The Active Interface Modules and Active Line Modules of this frame size have degree of protection IP00.

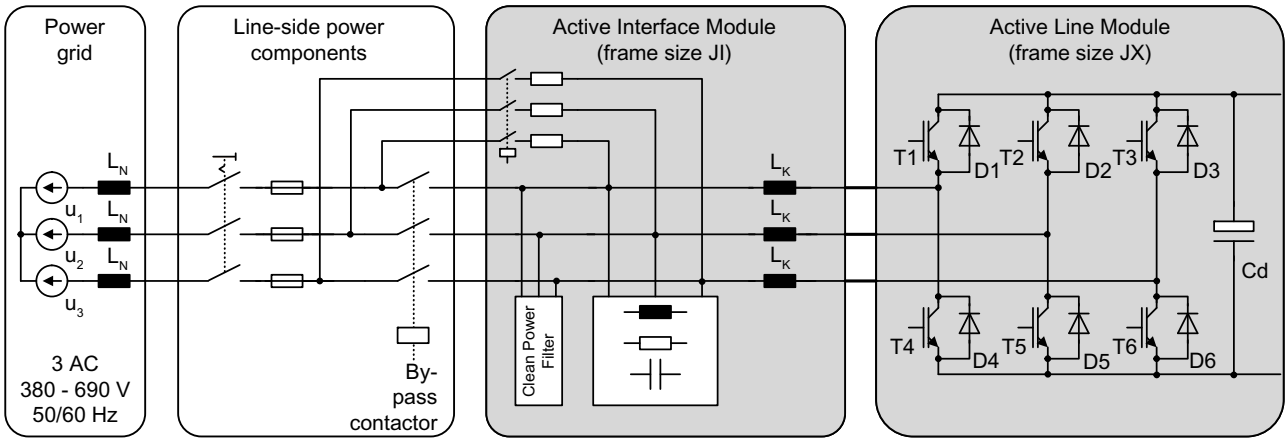


Figure 5-20 Overview of Active Infeeds, frame size JI/JX

Parallel connection of Active Line Modules to increase power rating

To increase the power and for redundancy, it is possible to connect up to four Active Line Modules each with the same output rating and type in parallel.

The following rules must be observed when connecting Active Line Modules in parallel:

- Up to 4 identical Active Line Modules can be connected in parallel.
- A common Control Unit is required whenever the modules are connected in parallel.
- With multiple infeeds, power must be supplied to the systems from a common infeed point (i.e. different supply systems are not permitted).
- A derating factor of 5% must be taken into consideration, regardless of the number of modules connected in parallel.

Note

It is only possible to connect identical power units in parallel if both power units have the same hardware version.

5.4.2 Safety information

⚠ WARNING

A hazardous voltage will be present in the component for a further 5 minutes after all voltage supplies have been disconnected. Work cannot be carried out until this time has elapsed.

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.

⚠ CAUTION

The DC link discharge time hazard warning must be affixed to the component in the relevant local language.

NOTICE

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

⚠ DANGER

Active Line Modules discharge a high leakage current to the protective ground conductor. Due to the high leakage current associated with Active Line Modules, they or the relevant control cabinet must be permanently connected to PE.

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.

5.4.3 Interface description

5.4.3.1 Overview

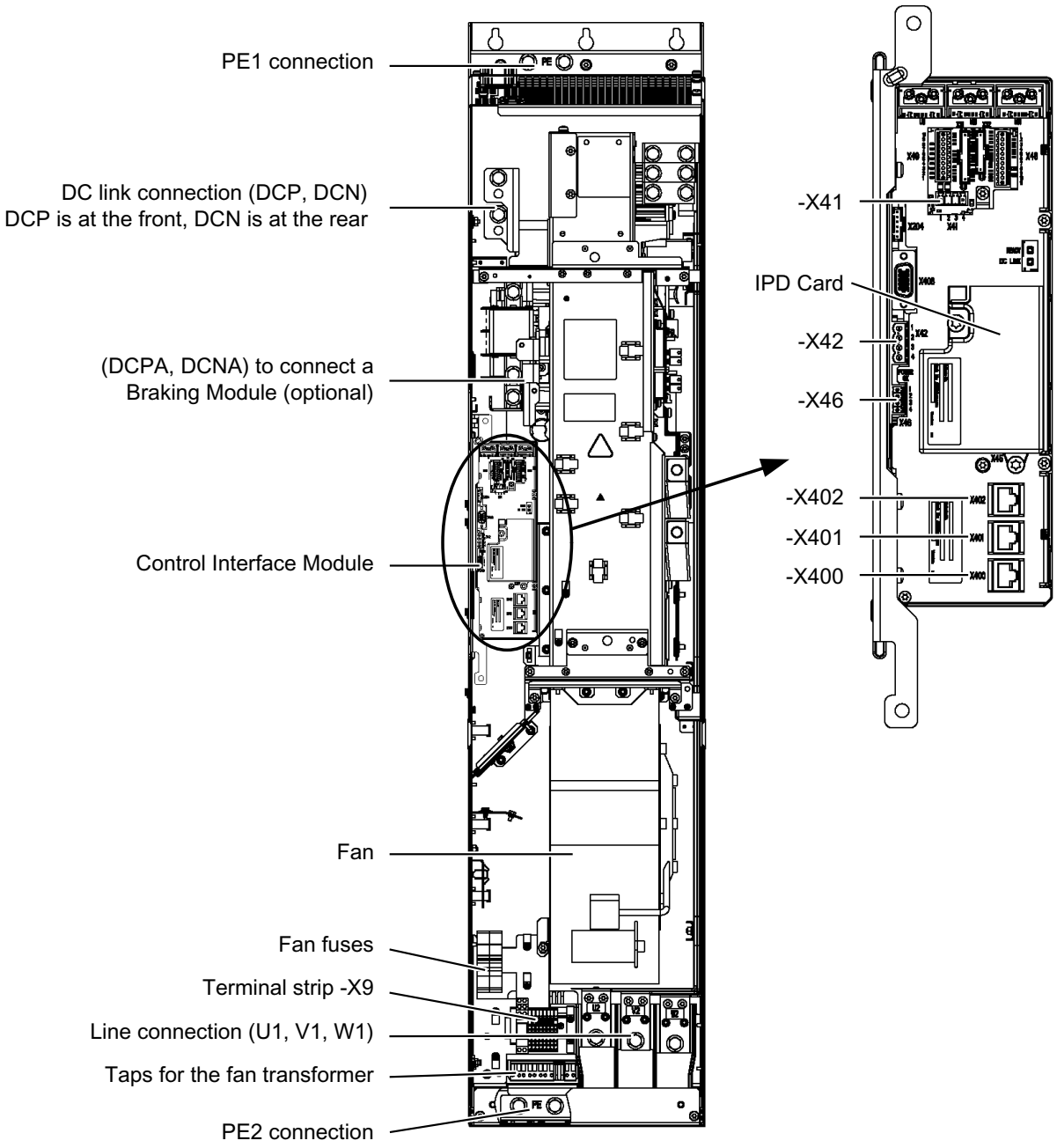


Figure 5-21 Active Line Module, frame size GX

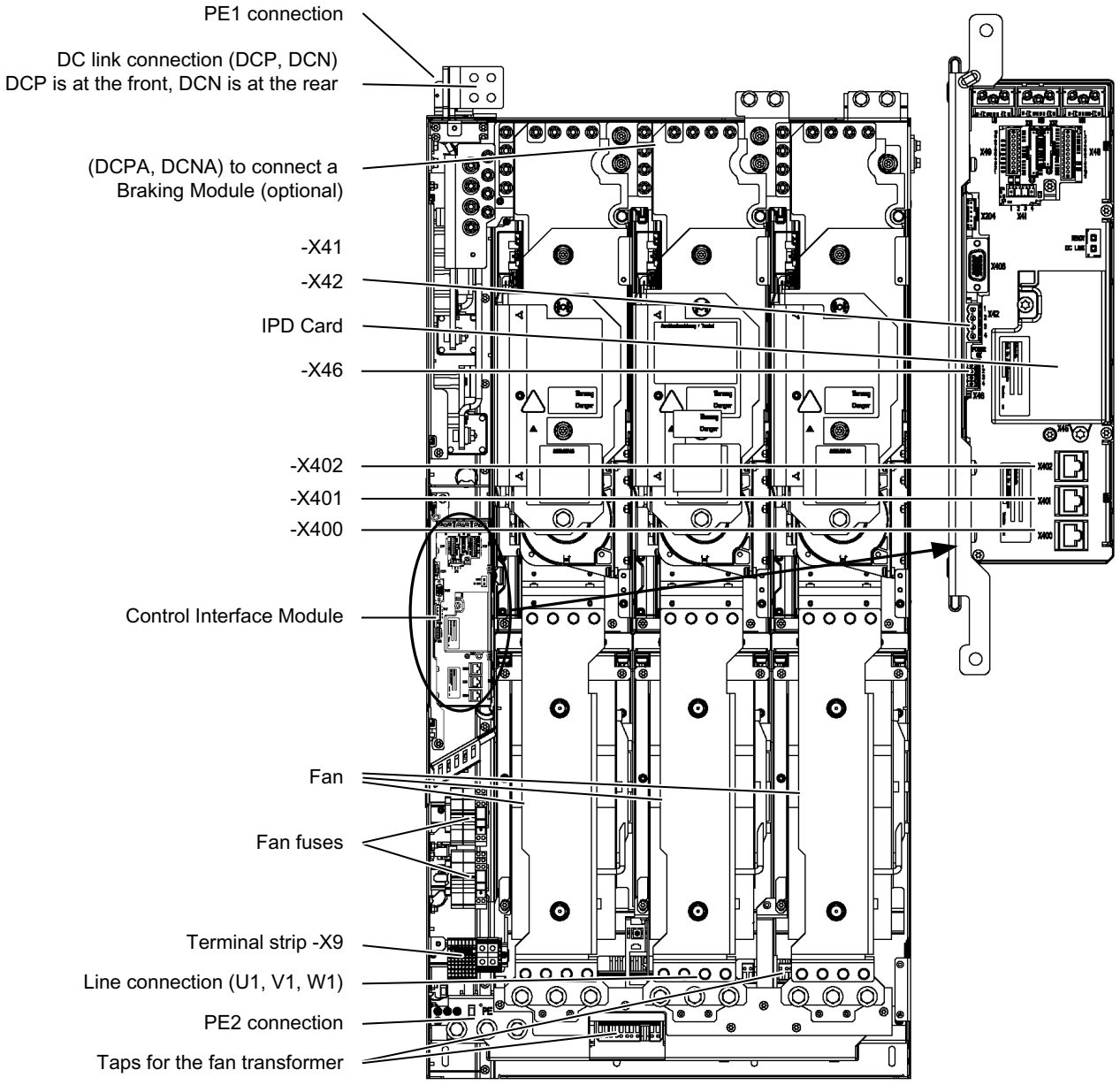


Figure 5-22 Active Line Module, frame size JX

5.4.3.2 Connection example

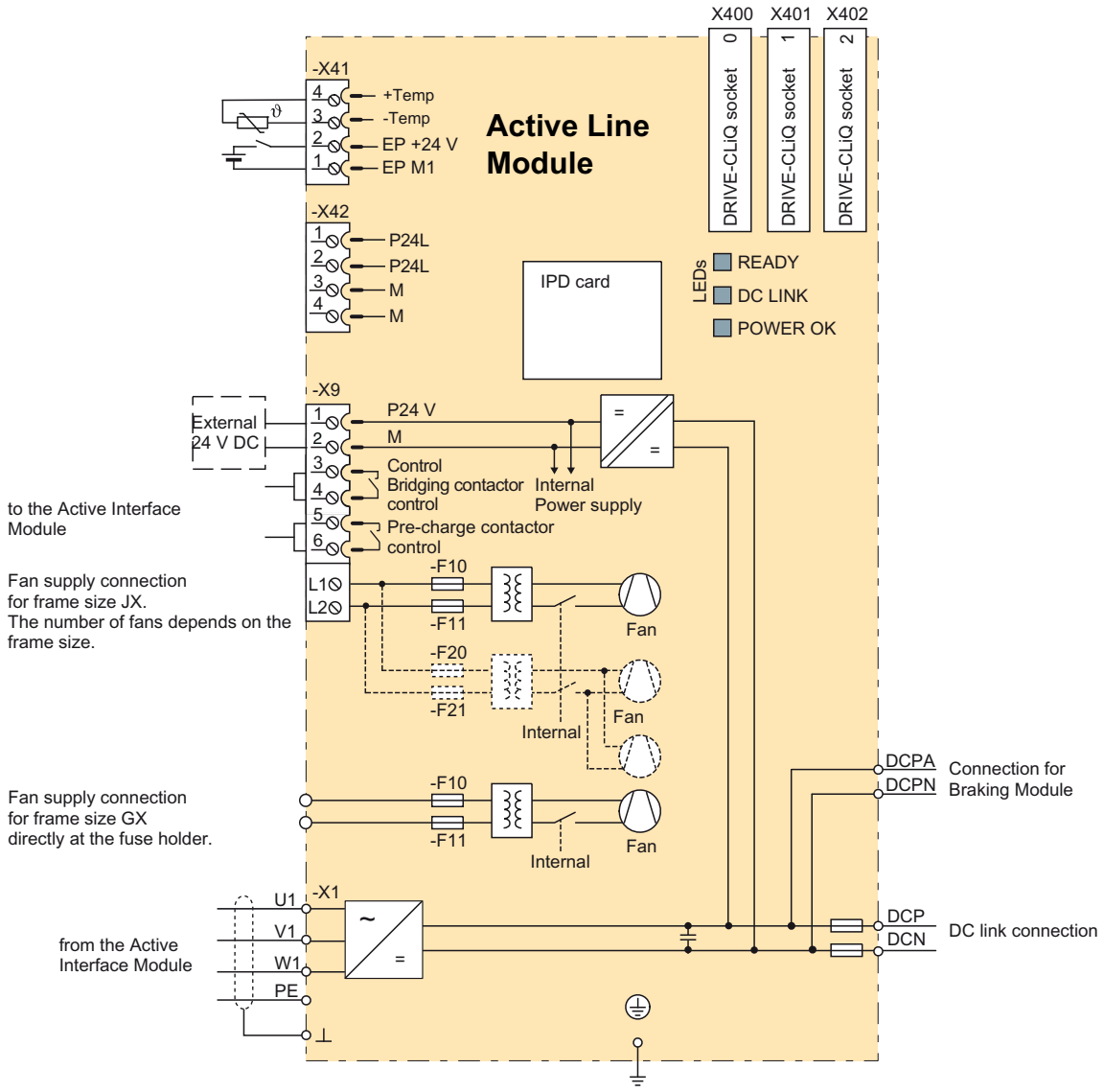


Figure 5-23 Active Line Module connection diagram

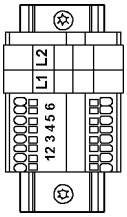
5.4.3.3 Line/load connection

Table 5- 32 Line/load connection of the Active Line Module

Terminals	Technical specifications
U1, V1, W1 3 AC power input	Voltage: • 3-ph. 380 V AC -10% (-15% < 1 min) to 3-ph. 480 V AC +10% • 3-ph. 500 V AC -10% (-15% < 1 min) to 3-ph. 690 V AC +10% Frequency: 47 Hz to 63 Hz Connecting thread: • Frame size GX: M10 / 25 Nm for ring cable lugs to DIN 46234 • Frame size JX: M12 / 50 Nm for ring cable lugs to DIN 46234
DCPA, DCNA Connection for Braking Module	Voltage: • 570 to 720 V DC • 750 V to 1035 V DC Connections: • Frame size GX: Threaded bolt M6 / 6 Nm for ring cable lugs to DIN 46234 • Frame size JX: d = 13 mm (M12/50 Nm) flat connector for busbar
DCP, DCN DC power output	Voltage: • 570 to 720 V DC • 750 V to 1035 V DC Connections: • Frame size GX: Thread M10 / 25 Nm for ring cable lugs to DIN 46234 • Frame size JX: d = 13 mm (M12/50 Nm) flat connector for busbar
PE connection PE1, PE2	Connecting thread: • Frame size GX: M10 / 25 Nm for ring cable lugs to DIN 46234 • Frame size JX: M12 / 50 Nm for ring cable lugs to DIN 46234

5.4.3.4 X9 terminal strip

Table 5- 33 Terminal strip X9

	Terminal	Signal name	Technical specifications
	1	P24V	Voltage: 24 V DC (20.4 V – 28.8 V) Current consumption: max. 1.7 A
	2	M	
	3	Bypass contactor control	for Active Interface Module, X609:11
	4		for Active Interface Module, X609:12
	5	Pre-charge contactor control	for Active Interface Module, X609:9
	6		for Active Interface Module, X609:10
	L1	Connection for fan supply (only for frame size JX)	380 V to 480 V AC / 500 V to 690 V AC Current consumption: See Technical data
	L2		
Max. connectable cross-section: Terminals 1 – 6: 1.5 mm^2, Terminals L1 - L2: 35 mm^2			

Note

Connecting fan supply, with frame size GX

The fan supply for frame size GX is connected directly to fuse holder -F10 or -F11.

5.4.3.5 X41 EP terminal / temperature sensor connection

Table 5- 34 Terminal strip X41

	Terminal	Function	Technical specifications
	1	EP M1 (Enable Pulses)	Supply voltage: 24 V DC (20.4 V – 28.8 V) Current consumption: 10 mA
	2	EP +24 V (Enable Pulses)	
	3	- Temp	Temperature sensor connection KTY84-1C130/PTC
	4	+ Temp	
Max. connectable cross-section 1.5 mm^2			

Note

For operation, 24 V DC must be connected to terminal 2 and ground to terminal 1. Pulse suppression is activated when terminals are disconnected.

⚠DANGER

Risk of electric shock!

Only temperature sensors that meet the safety isolation specifications contained in EN 61800-5-1 may be connected to terminals "+Temp" and "-Temp". If safe electrical separation cannot be guaranteed (for linear motors or third-party motors, for example), a Sensor Module External (SME120 or SME125) must be used.

If these instructions are not complied with, there is a risk of electric shock!

Note

The following probes can be connected to the temperature sensor connection: KTY84-1C130 / PTC.

CAUTION

The temperature sensor connection must be shielded. The shielding must be attached to the shield support of the module.

NOTICE

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

5.4.3.6 X42 terminal strip

Table 5- 35 Terminal strip X42 voltage supply for Control Unit, Sensor Module and Terminal Module

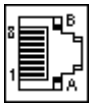
	Terminal	Function	Technical specifications
	1	P24L	Voltage supply for Control Unit, Sensor Module and Terminal Module (18 to 28.8 V) maximum load current: 3 A
	2		
	3	M	
	4		
Max. connectable cross-section 2.5 mm²			

⚠ CAUTION

The terminal block is not intended for free 24 V DC availability (for example for supplying further line-side components), as the voltage supply of the Control Interface Module could also be overloaded and operating capability could thus be compromised.

5.4.3.7 DRIVE-CLiQ interfaces X400, X401, X402

Table 5- 36 DRIVE-CLiQ interfaces X400, X401, X402

	PIN	Signal name	Technical specifications
	1	TXP	Transmit data +
	2	TXN	Transmit data -
	3	RXP	Receive data +
	4	Reserved, do not use	
	5	Reserved, do not use	
	6	RXN	Receive data -
	7	Reserved, do not use	
	8	Reserved, do not use	
	A	+ (24 V)	24 V power supply
	B	M (0 V)	Electronics ground
Blanking plate for DRIVE-CLiQ interfaces (50 pcs.) Order number: 6SL3066-4CA00-0AA0			

5.4.3.8 Significance of the LEDs on the Control Interface Module in the Active Line Module

Table 5- 37 Significance of the LEDs "READY" and "DC LINK" on the Control Interface Module in the Active Line Module

LED state		Description
READY	DC LINK	
Off	Off	The electronics power supply is missing or out of tolerance.
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 present in this component. Note: LED is driven irrespective of the corresponding messages being reconfigured.
Flashing light 0.5 Hz: Green / red	---	Firmware is being downloaded.
2 Hz flashing: Green / red	---	Firmware download is complete. Waiting for POWER ON.
2 Hz flashing: Green / orange or red / orange	---	Component detection using LED is activated (p0124) Note: The two options depend on the LED status when module recognition is activated via p0124 = 1.

Table 5- 38 Meaning of the LED "POWER OK" on the Control Interface Module in the Active Line Module

LED	Color	Status	Description
POWER OK	Green	Off	DC link voltage < 100 V and voltage at -X9:1/2 less than 12 V.
		On	The component is ready for operation.
		Flashing light	There is a fault. If the LED continues to flash after you have performed a POWER ON, please contact your Siemens service center.

⚠WARNING

Irrespective of the state of the LED "DC LINK", hazardous DC link voltages can always be present.

The warning information on the component must be carefully observed!

5.4.4 Dimension drawing

Dimension drawing, frame size GX

The minimum clearances for cooling are indicated by the dotted line.

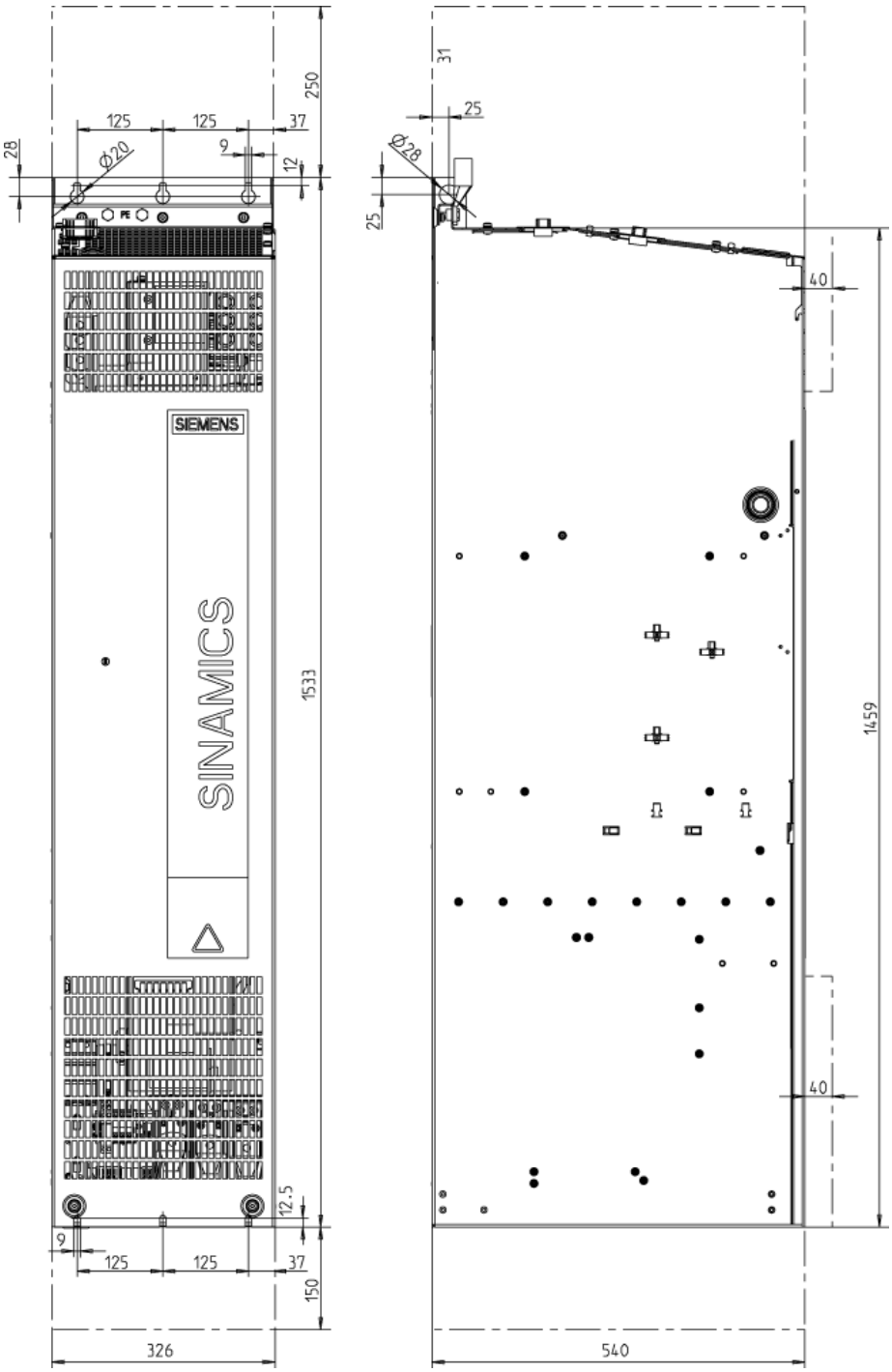


Figure 5-24 Dimension drawing Active Line Module, frame size GX Front view, side view

Dimension drawing, frame size JX

The minimum clearances for cooling are indicated by the dotted line.

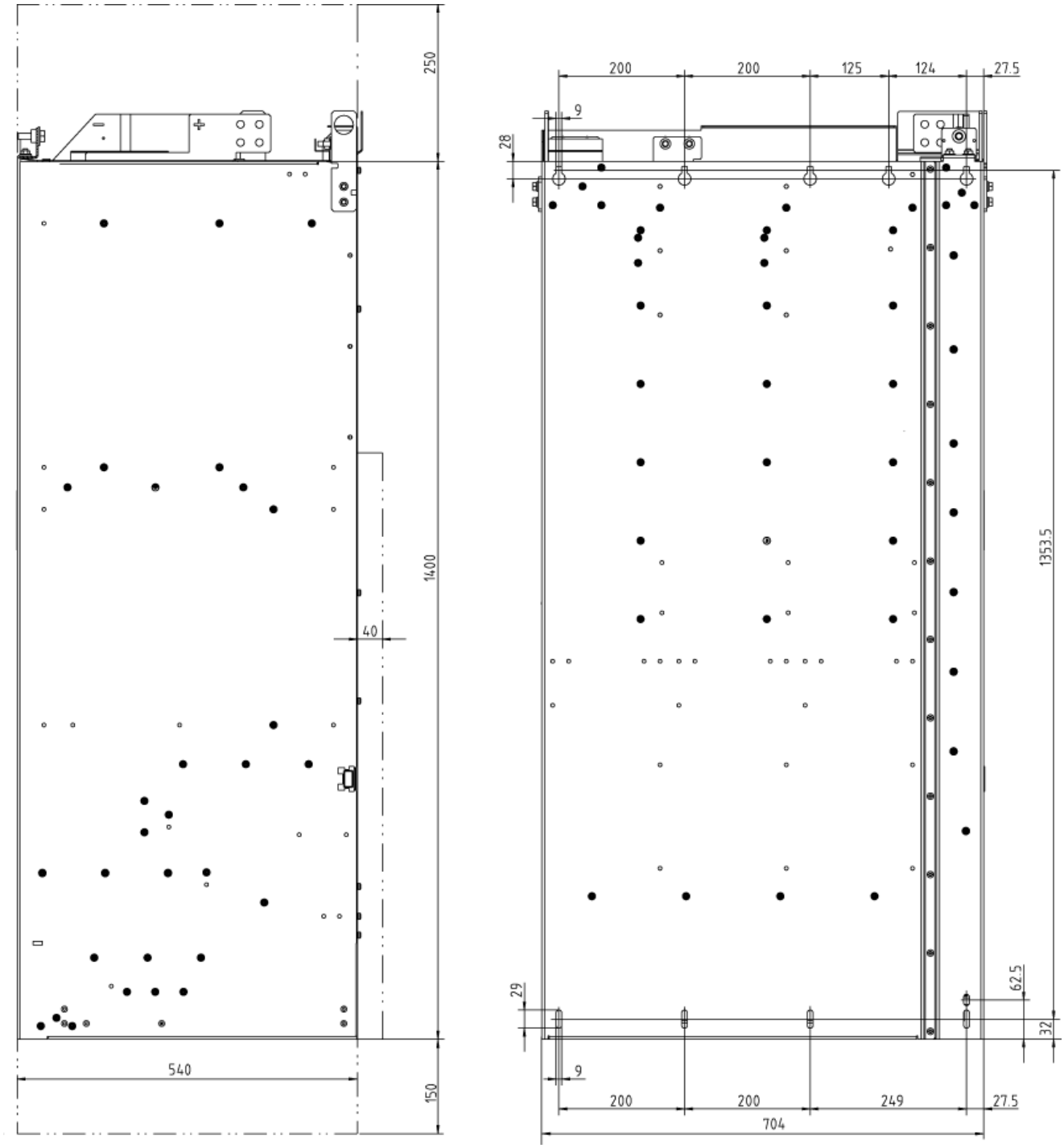


Figure 5-25 Dimension drawing Active Line Module, frame size JX Side view, rear view

5.4.5 Electrical connection

Adjusting the fan voltage (-T10)

The power supply for the device fans (1-ph. 230 V AC) in the Active Line Module (-T10) is taken from the line supply using transformers. The locations of the transformers are indicated in the interface descriptions.

The transformers are fitted with primary taps so that they can be fine-tuned to the line supply 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 (–T10 and –T20) are installed in Active Line Modules, frame size JX. The two primary-side terminals on each of these devices must be adjusted together.

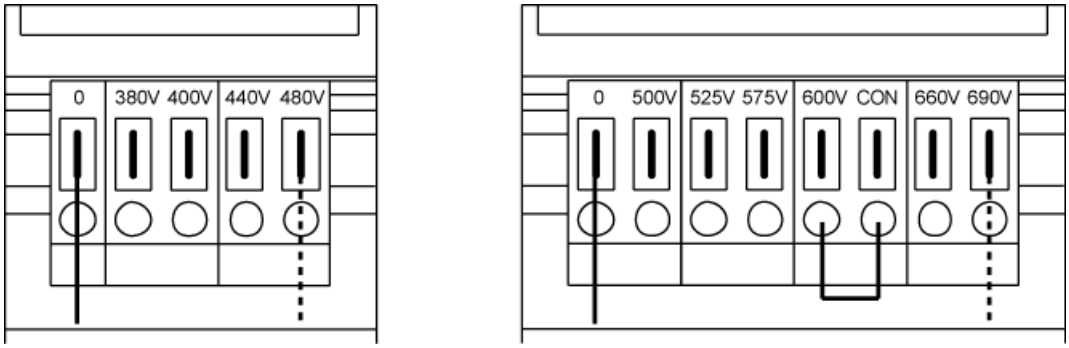


Figure 5-26 Taps for the fan transformers (380 V – 480 V 3 AC / 500 V – 690 V 3 AC)

The supply voltage assignments for making the appropriate setting on the fan transformer are indicated in the following tables (factory presetting: 480 V/0 V or 690 V/0 V).

Note

With the 500 V – 690 V 3 AC fan transformer, a jumper is inserted between the "600 V" terminal and the "CON" terminal. The "600V" and "CON" terminals are reserved for internal use.

CAUTION

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

- The required cooling level will not be provided (risk of overheating).
- The fan fuses may blow (overload).

Table 5- 39 Line voltage assignments for setting the fan transformer (380 to 480 V AC, 3-phase)

Line voltage	Tap at the fan transformer (-T10)
380 V ± 10%	380 V
400 V ± 10%	400 V
440 V ± 10%	440 V
480 V ± 10%	480 V

Table 5- 40 Line voltage assignments for setting the fan transformer (500 V – 690 V AC, 3-phase)

Line voltage	Tap at the fan transformer (-T10)
500 V ± 10%	500 V
525 V ± 10%	525 V
575 V ± 10%	575 V
600 V ± 10%	600 V
660 V ± 10%	660 V
690 V ± 10%	690 V

5.4.6 Technical data

Table 5- 41 Technical data for Active Line Modules, 380 V – 480 V 3 AC

Order number	6SL3330–	7TE35–0AA4	7TE41–0AA4	7TE41–4AA4	
Output power					
- Rated power Pn at 400 V 3 AC	kW	300	630	900	
DC link current					
- Rated current I_{n_DC}	A	549	1103	1574	
- maximum current I_{max_DC}	A	823	1654	2361	
Output current					
- Rated current at 400 V 3 AC	A	490	985	1405	
- maximum	A	735	1477	2107	
Supply voltages					
- Line voltage	V_{ACrms}	3 AC 380 -10% (-15% < 1 min) to 3 AC 480 +10%			
- Line frequency	Hz	47 to 63 Hz			
- Electronics power supply	V_{DC}	24 (20.4 - 28.8)			
Pulse frequency	kHz	4	2.5	2.5	
Power requirements					
- Electronics power consumption (24 V DC)	A	1.35	1.5	1.7	
- Total fan power consumption (at 400 V AC)	A	1.6	7.8	7.8	
Max. ambient temperature					
- Without derating	°C	40	40	40	
- With derating	°C	55	55	55	
Efficiency	η	0.98	0.98	0.98	
Power loss	kW	5.1	10.1	13.3	
Cooling air requirement	m^3/s	0.36	1.08	1.08	
Sound pressure level					
L_{pA} (1 m) at 50/60 Hz	dB(A)	76 / 78	78 / 80	78 / 80	
Line/load connection		Flat connector for bolt connection			
		M10	M12	M12	
Max. connection cross-sections					
- Line connection (U1, V1, W1)	mm^2	2 x 185	6 x 240	6 x 240	
- DC link connection (DCP, DCN)	mm^2	2 x 185	Busbar	Busbar	
- PE connection PE1	mm^2	1 x 185	1 x 240	1 x 240	
- PE connection PE2	mm^2	2 x 185	2 x 240	2 x 240	
Degree of protection		IP20	IP00	IP00	
Dimensions					
- Width	mm	326	704	704	
- Height	mm	1533	1475	1475	
- Depth	mm	543	540	540	
Frame size		GX	JX	JX	
Weight	kg	152	450	450	
UL listed fuse [1]		3NE1436-2	3NE1436-2	3NE1448-2	
- Number (connected in parallel)		1	2	2	
- Rated current		630	630	850	
- Frame size acc. to IEC 60269		3	3	3	

[1] To achieve a UL-approved system, it is absolutely essential to use the fuse types specified in the table.

Table 5- 42 Technical data for Active Line Modules, 500 V – 690 V 3 AC

Order number	6SL3330–	7TG41–0AA4	7TG41–3AA4		
Output power - Rated power Pn at 690 V 3 AC - Rated power Pn at 500 V 3 AC	 kW kW	 1100 800	 1400 1000		
DC link current - Rated current I_{n_DC} - maximum current I_{max_DC}	 A A	 1148 1722	 1422 2133		
Output current - Rated current at 690 V 3 AC - maximum	 A A	 1025 1537	 1270 1905		
Supply voltages - Line voltage - Line frequency - Electronics power supply	 V_{ACrms} Hz V_{DC}	 3 AC 500 -10% (-15% < 1 min) to 3 AC 690 +10% 47 to 63 Hz 24 (20.4 - 28.8)			
Pulse frequency	kHz	2.5	2.5		
Power requirements - Electronics power consumption (24 V DC) - Total fan power consumption (at 690 V AC)	 A A	 1.7 4.5	 1.7 4.5		
Max. ambient temperature - Without derating - With derating	 °C °C	 40 55	 40 55		
Efficiency	η	0.98	0.98		
Power loss	kW	13.6	16.5		
Cooling air requirement	m^3/s	1.1	1.1		
Sound pressure level L_{pA} (1 m) at 50/60 Hz	 dB(A)	 78 / 80	 78 / 80		
Line/load connection		Flat connector for bolt connection			
		M12	M12		
Max. connection cross-sections - Line connection (U1, V1, W1) - DC link connection (DCP, DCN) - PE connection PE1 - PE connection PE2	 mm² mm² mm² mm²	 6 x 240 Busbar 1 x 240 2 x 240	 6 x 240 Busbar 1 x 240 2 x 240		
Degree of protection		IP00	IP00		
Dimensions - Width - Height - Depth	 mm mm mm	 704 1475 540	 704 1475 540		
Frame size		JX	JX		
Weight	kg	450	450		
UL listed fuse [1] - Number (connected in parallel) - Rated current - Frame size acc. to IEC 60269		3NE1436-2 2 630 3	3NE1438-2 2 800 3		

[1] To achieve a UL-approved system, it is absolutely essential to use the fuse types specified in the table.

Overload capability

The Active Line Modules have an overload reserve.

The criterion for overload is that the drive is operated with its base load current before and after the overload occurs (a load duration of 300 s is used as a basis here).

High overload

The base load current for a high overload I_{H_DC} is based on a duty cycle of 150 % for 60 s; the max. current I_{max_DC} can flow for 5 s.

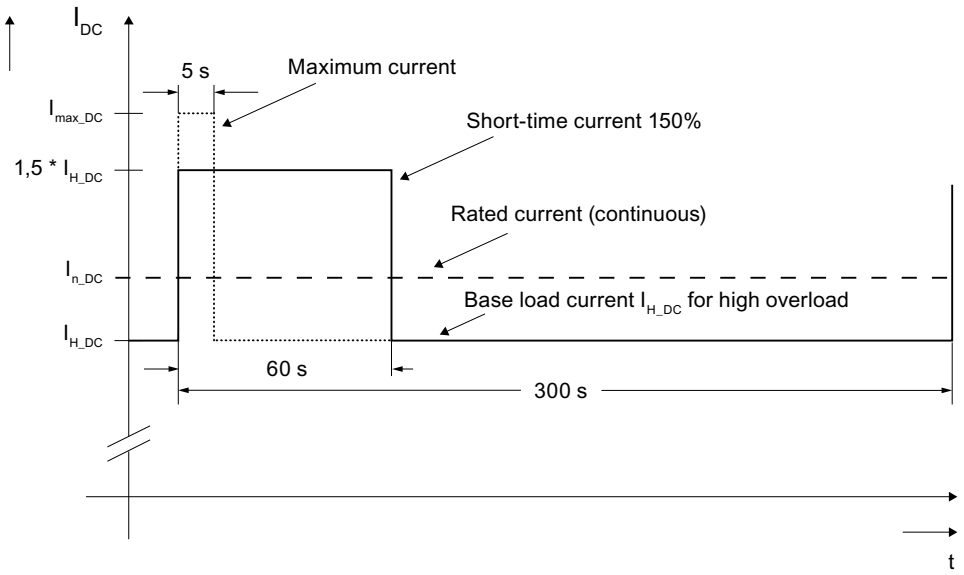


Figure 5-27 High overload

5.4.7 Technical data for photovoltaic applications

For the following data are additional technical data of the Active Line Modules for operation in a photovoltaic-application.

Table 5- 43 Technical data for Active Line Modules, 380 V – 480 V 3 AC

Order number	**6SL3330–**	**7TE35–0AA4**	**7TE41–0AA4**	**7TE41–4AA4**	
Services					
- DC rated input power	kW	275	550	785	
- AC rated output power	kW	270	540	770	
Connection voltages					
- Line voltage	V_{ACrms}	3 AC 320			
- Line frequency	Hz	47 to 63 Hz			
- MPP voltage range	V_{DC}	520 - 750			
- Maximum DC voltage	V_{DC}	800			
- Electronics power supply	V_{DC}	24 (20.4 - 28.8)			
DC link current					
- Rated current I_{n_DC}	A	549	1103	1574	
Harmonics line current (THDi)	%	5	**	**	
Line system configuration		TN, IT	TN, IT	TN, IT	
Efficiency					
- Max. efficiency	%	98.30	**	**	
European efficiency	%	97.70	**	**	
Power loss					
- Standby operation	W	36.5	40	45	
- Intrinsic consumption during operation (auxiliaries)	W	990	3280	3280	

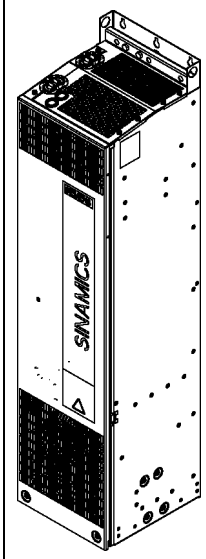
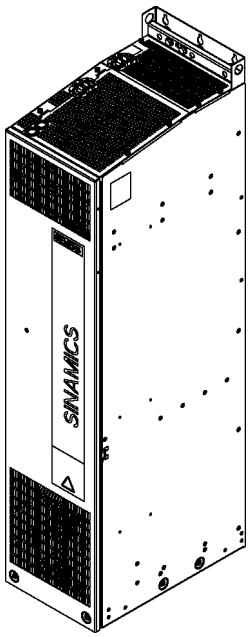
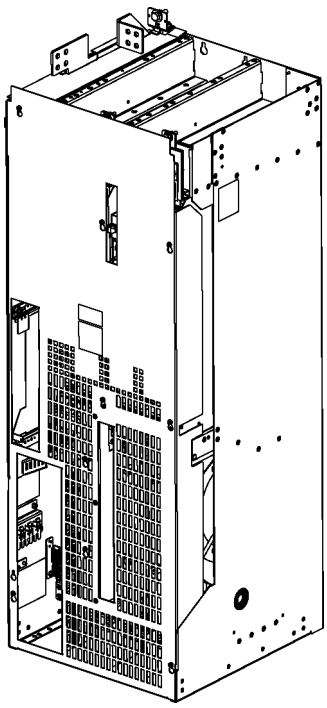
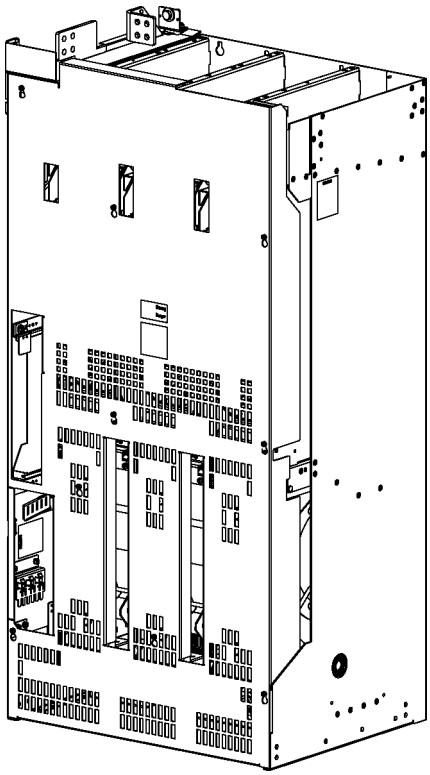
** On request

5.5 Motor Module

5.5.1 Description

A Motor Module is a power unit (DC-AC inverter) that provides the power supply for the motor connected to it. Power is supplied by means of the DC link of the drive unit.
A Motor Module must be connected to a Control Unit via DRIVE-CLiQ. The open-loop and closed-loop control functions are stored in the Control Unit.

Table 5- 44 Overview of Motor Modules

			
Frame size FX	Frame size GX	Frame size HX	Frame size JX

Operating principle

Motor Modules are designed for multi-axis drive systems and are controlled by either a CU320 or a SIMOTION D Control Unit. Motor Modules are interconnected by means of a shared DC busbar.

One or more Motor Modules are supplied with energy for the motors via the DC link. Both synchronous and induction motors can be operated.

Since the Motor Modules share the same DC link, they can exchange energy with one another, i.e. if one Motor Module operating in generator mode produces energy, the energy can be used by another Motor Module operating in motor mode. The DC link is supplied with line voltage by a Line Module.

Characteristics of the Motor Modules

- Version for 510 V DC to 750 V DC from 210 A to 1405 A

  Version for 675 V DC to 1080 V DC from 85 A to 1270 A
- Internal air cooling
- Short-circuit/ground-fault-proof
- Electronic rating plate
- Operating status and error status via LEDs
- DRIVE-CLiQ interface for communication with the Control Unit and/or other components in the drive line-up.
- Integration in system diagnostics

5.5.2 Safety information

⚠ WARNING

After disconnecting all the supply voltages, a hazardous voltage will be present in all components for another 5 minutes. Work cannot be carried out until this time has elapsed.

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.

⚠ CAUTION

The DC link discharge time hazard warning must be affixed to the component in the relevant local language.

NOTICE

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

⚠ WARNING

Cable shields and power cable conductors which are not used, must be connected to PE potential in order to discharge charges as a result of capacitive coupling.

Non-observance can cause lethal shock voltages.

⚠ DANGER

Motor Modules discharge a high leakage current to the protective ground conductor.
Due to the high leakage current associated with Motor Modules, they or the relevant control cabinet must be permanently connected to PE.

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.

5.5.3 Interface description

5.5.3.1 Overview

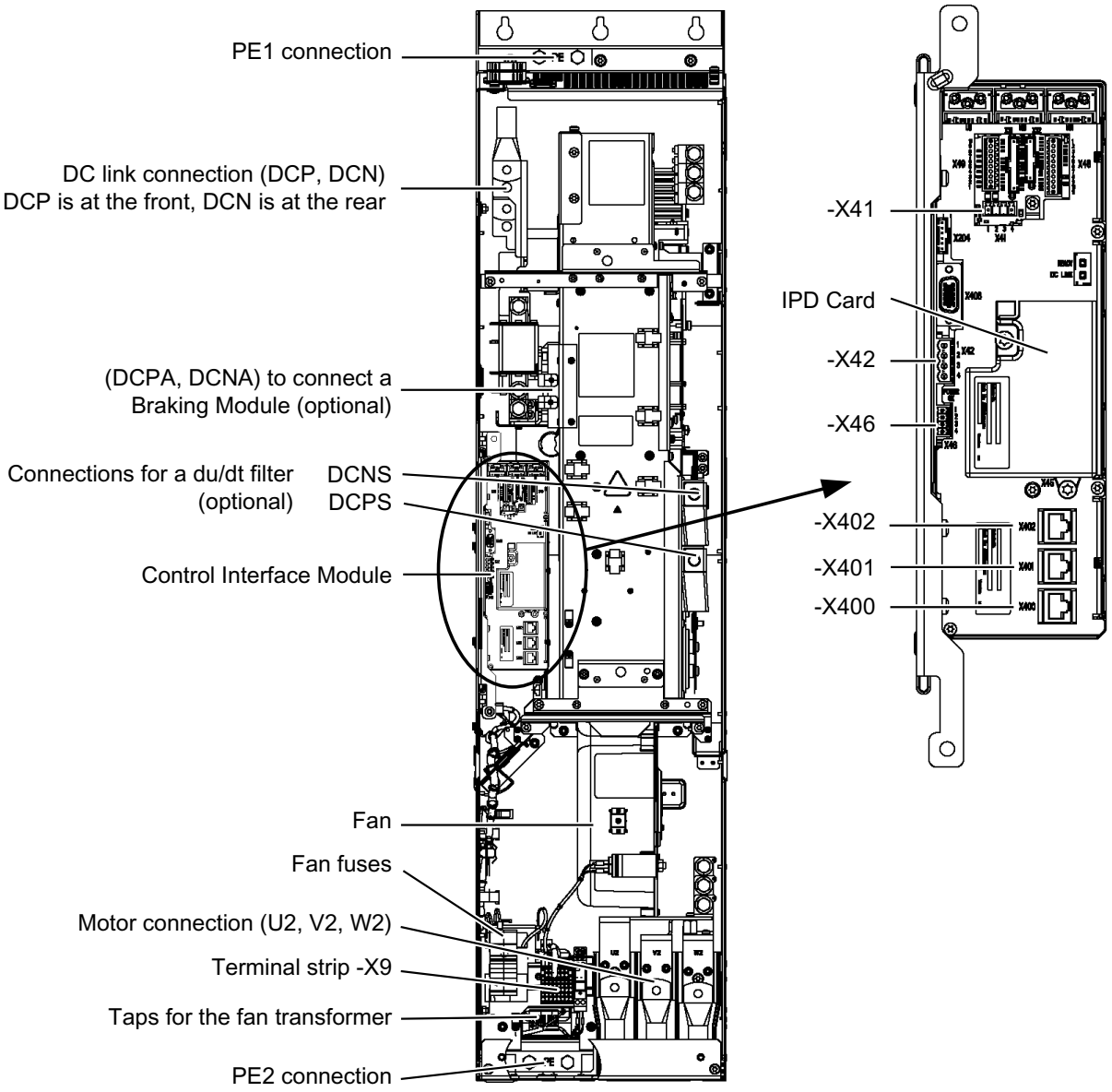


Figure 5-28 Motor Module, frame size FX

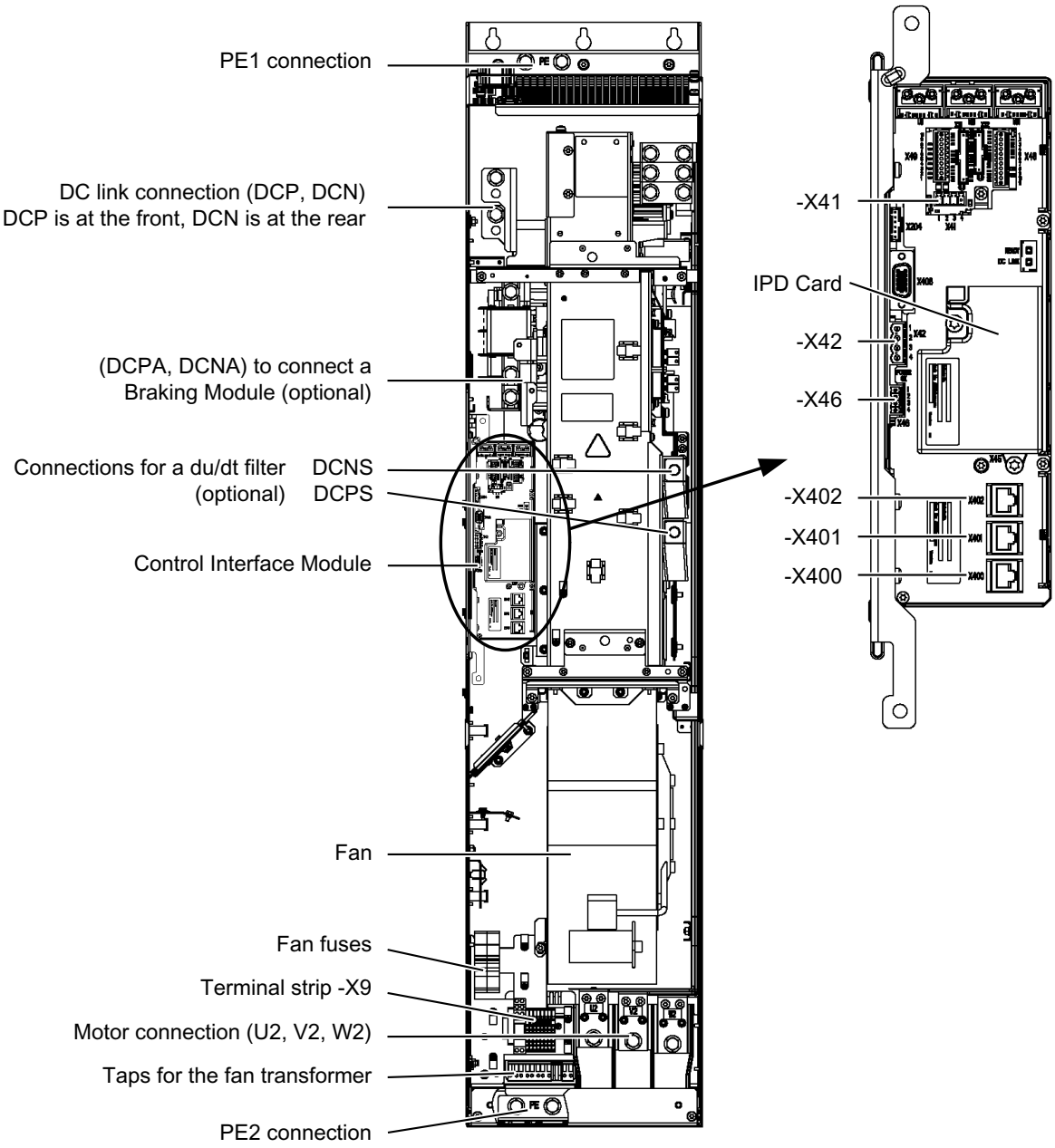


Figure 5-29 Motor Module, frame size GX

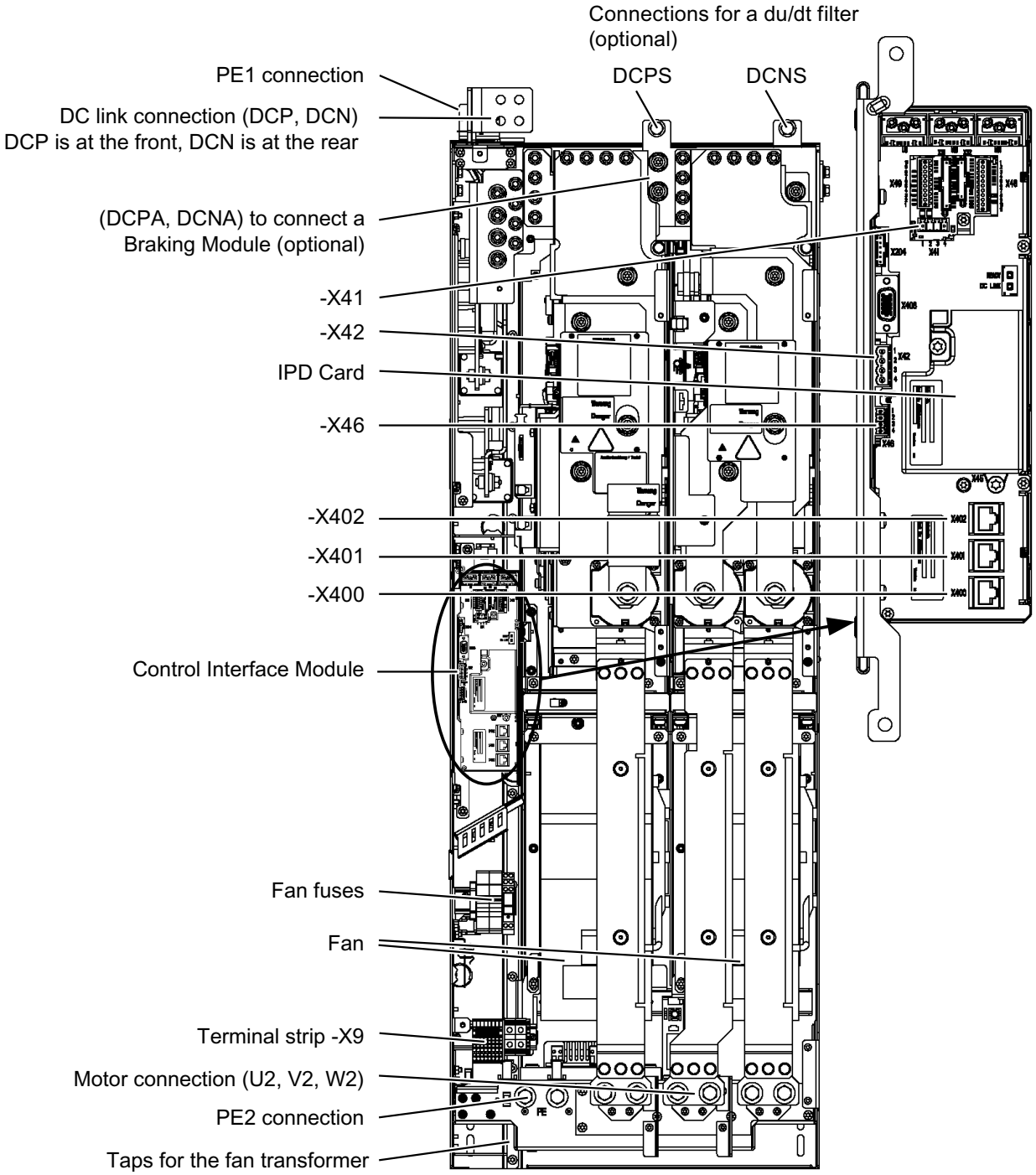


Figure 5-30 Motor Module, frame size HX

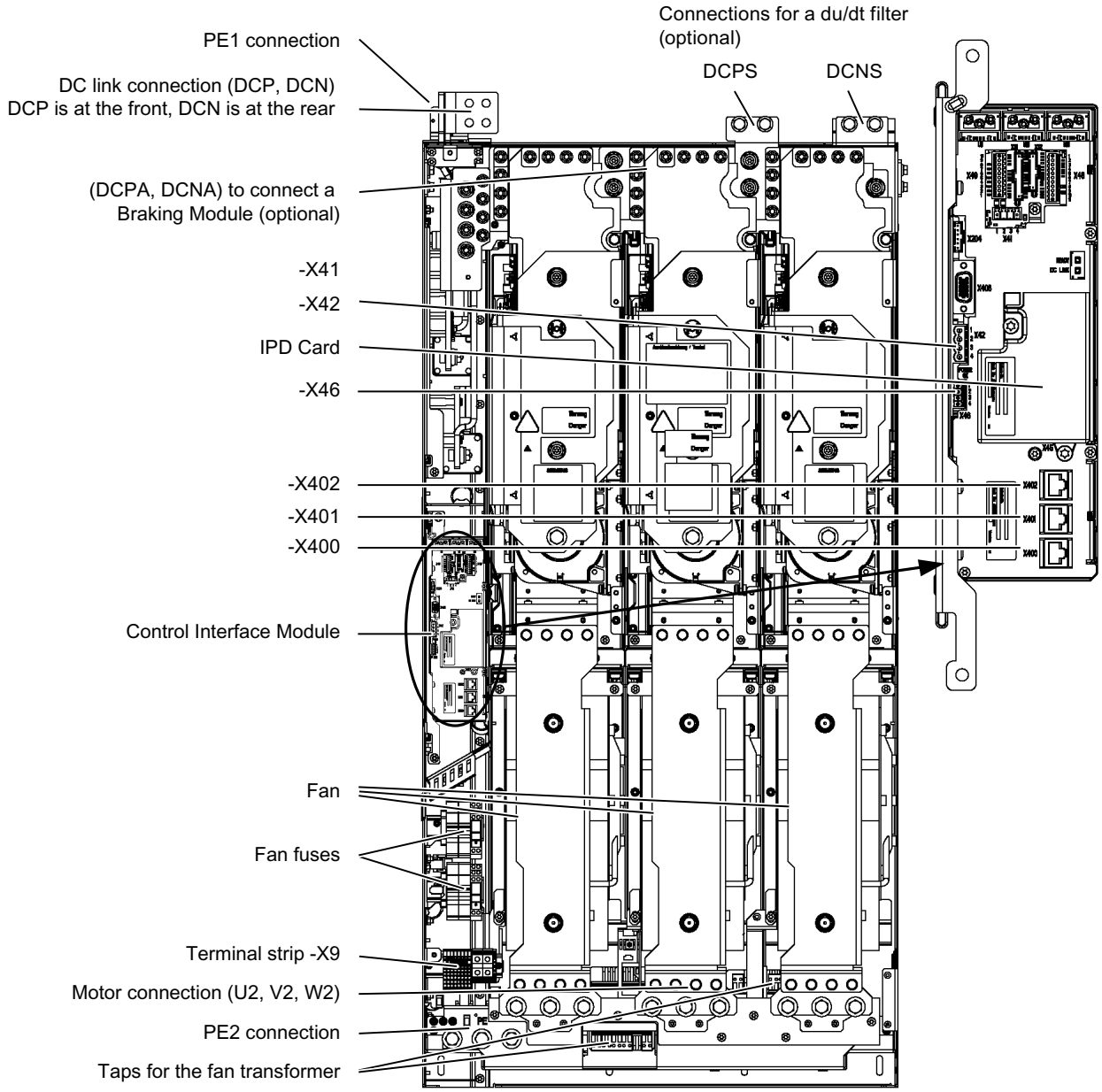


Figure 5-31 Motor Module, frame size JX

5.5.3.2 Connection example

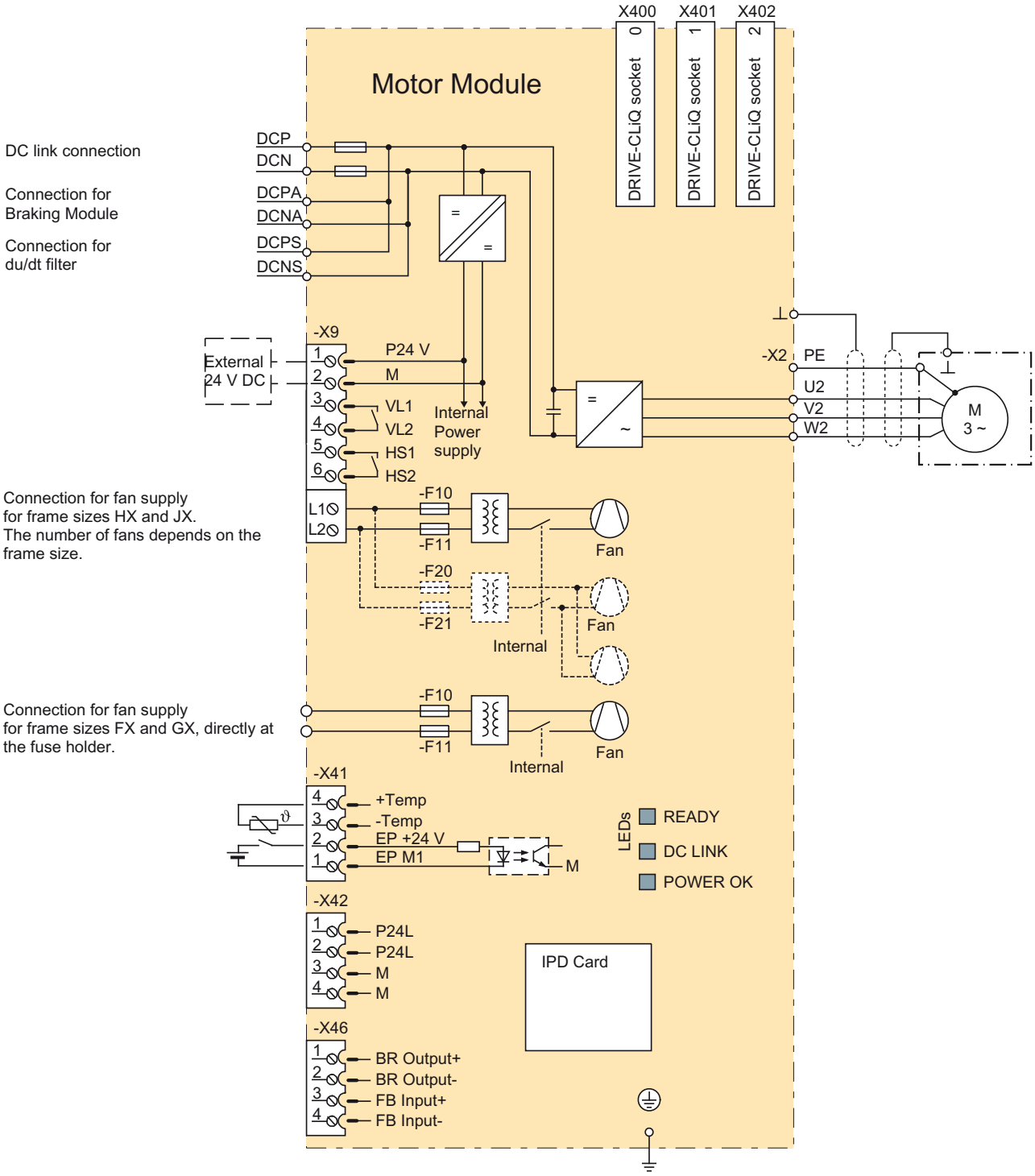


Figure 5-32 Connection example Motor Modules

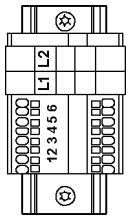
5.5.3.3 DC link/motor connection

Table 5- 45 DC link/motor connection of the Motor Module

Terminals	Technical specifications
DCP, DCN DC power input	Voltage: • 510 to 750 V DC • 675 to 1080 V DC Connections: • Frame sizes FX / GX: Thread M10 / 25 Nm for ring cable lugs to DIN 46234 • Frame sizes HX / JX: d = 13 mm (M12/50 Nm) flat connector for busbar
DCPA, DCNA Connection for Braking Module	Voltage: • 510 to 750 V DC • 675 to 1080 V DC Connections: • Frame sizes FX / GX: Threaded bolt M6 / 6 Nm for ring cable lugs to DIN 46234 • Frame sizes HX / JX: d = 13 mm (M12/50 Nm) flat connector for busbar
DCPS, DCNS connection for a dv/dt filter plus VPL	Voltage: • 510 to 750 V DC • 675 to 1080 V DC Connections: Frame sizes FX / GX: Threaded bolt M6 / 6 Nm for ring cable lugs to DIN 46234 Frame sizes HX / JX: d = 11 mm (M10 / 25 Nm) for ring cable lugs to DIN 46234
U2, V2, W2 3 AC power output	Voltage: • 0 V 3 AC to 0.72 x DC link voltage Connecting thread: • Frame sizes FX / GX: M10 / 25 Nm for ring cable lugs to DIN 46234 • Frame sizes HX / JX: M12 / 50 Nm for ring cable lugs to DIN 46234
PE connection PE1, PE2	Connecting thread: • Frame sizes FX / GX: M10 / 25 Nm for ring cable lugs to DIN 46234 • Frame sizes HX / JX: M12 / 50 Nm for ring cable lugs to DIN 46234

5.5.3.4 X9 terminal strip

Table 5- 46 Terminal strip X9

	Terminal	Signal name	Technical specifications
	1	P24V	Voltage: 24 V DC (20.4 V – 28.8 V) Current consumption: max. 1.4 A
	2	M	
	3	VL1	240 V AC: 8 A max. 24 V DC: max. 1 A isolated
	4	VL2	
	5	HS1	240 V AC: 8 A max. 24 V DC: max. 1 A isolated
	6	HS2	
	L1	Connection for fan supply (frame sizes HX and JX only)	380 V to 480 V AC / 500 V to 690 V AC Current consumption: See Technical data
	L2		
Max. connectable cross-section: Terminals 1 – 6: 1.5 mm², Terminals L1 - L2: 35 mm²			

Note

Connecting fan supply, with frame sizes FX and GX

The fan supply for frame sizes FX and GX is connected directly to fuse holders -F10 and -F11.

5.5.3.5 DCPS, DCNS connection for a dv/dt filter

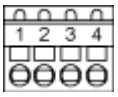
Table 5- 47 DCPS, DCNS

Frame size	Connectable cross-section	Terminal screw
FX	1 x 35 mm²	M8
GX	1 x 70 mm²	M8
HX	1 x 185 mm²	M10
JX	2 x 185 mm²	M10

With frame sizes FX and GX, the connecting cables are routed down through the Motor Module and out.

5.5.3.6 X41 EP terminal / temperature sensor connection

Table 5- 48 Terminal strip X41

	Terminal	Function	Technical specifications
	1	EP M1 (Enable Pulses)	Supply voltage: 24 V DC (20.4 V – 28.8 V) Current consumption: 10 mA Signal propagation delay times: L → H 100 µs H → L: 1000 µs The pulse inhibit function is only available when Safety Integrated Basic Functions are enabled.
	2	EP +24 V (Enable Pulses)	
	3	- Temp	Temperature sensor connection KTY84-1C130/PTC / PT100
	4	+ Temp	
Max. connectable cross-section 1.5 mm^2			

⚠DANGER

Risk of electric shock!

Only temperature sensors that meet the safety isolation specifications contained in EN 61800-5-1 may be connected to terminals "+Temp" and "-Temp". If safe electrical separation cannot be guaranteed (for linear motors or third-party motors, for example), a Sensor Module External (SME120 or SME125) must be used.

If these instructions are not complied with, there is a risk of electric shock!

Note

The following probes can be connected to the temperature sensor connection: KTY84-1C130 / PTC / PT100.

CAUTION

The temperature sensor connection must be shielded. The shielding must be attached to the shield support of the motor module.

NOTICE

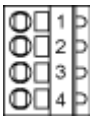
The KTY temperature sensor must be connected with the correct polarity.

NOTICE

The function of the EP terminals is only available when Safety Integrated Basic Functions are enabled.

5.5.3.7 X42 terminal strip

Table 5- 49 Terminal strip X42 voltage supply for Control Unit, Sensor Module and Terminal Module

	Terminal	Function	Technical specifications
	1	P24L	Voltage supply for Control Unit, Sensor Module and Terminal Module (18 to 28.8 V) maximum load current: 3 A
	2		
	3	M	
	4		
Max. connectable cross-section 2.5 mm²			

⚠ CAUTION

The terminal block is not intended for free 24 V DC availability (for example for supplying further line-side components), as the voltage supply of the Control Interface Module could also be overloaded and operating capability could thus be compromised.

5.5.3.8 X46 Brake control and monitoring

Table 5- 50 Terminal strip X46 brake control and monitoring

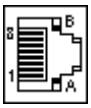
	Terminal	Function	Technical specifications
	1	BR output +	The interface is intended for connection of the Safe Brake Adapter.
	2	BR output -	
	3	FB input +	
	4	FB input -	
Max. connectable cross-section 1.5 mm²			

CAUTION

The length of the connecting lead at terminal strip X46 must not exceed 10 m, and the lead must not be brought out outside the control cabinet or control cabinet group.

5.5.3.9 DRIVE-CLiQ interfaces X400, X401, X402

Table 5- 51 DRIVE-CLiQ interfaces X400, X401, X402

	PIN	Signal name	Technical specifications
	1	TXP	Transmit data +
	2	TXN	Transmit data -
	3	RXP	Receive data +
	4	Reserved, do not use	
	5	Reserved, do not use	
	6	RXN	Receive data -
	7	Reserved, do not use	
	8	Reserved, do not use	
	A	+ (24 V)	24 V power supply
	B	M (0 V)	Electronics ground
Blanking plate for DRIVE-CLiQ interfaces (50 pcs.) Order number: 6SL3066-4CA00-0AA0			

5.5.3.10 Meaning of the LEDs on the Control Interface Module in the Motor Module

Table 5- 52 Meaning of the LEDs "READY" and "DC LINK" on the Control Interface Module in the Motor Module

LED state		Description
READY	DC LINK	
Off	Off	The electronics power supply is missing or out of tolerance.
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 present in this component. Note: LED is driven irrespective of the corresponding messages being reconfigured.
Flashing light 0.5 Hz: Green / red	---	Firmware is being downloaded.
2 Hz flashing: Green / red	---	Firmware download is complete. Waiting for POWER ON.
2 Hz flashing: Green / orange or red / orange	---	Component detection using LED is activated (p0124) Note: The two options depend on the LED status when module recognition is activated via p0124 = 1.

Table 5- 53 Meaning of the LED "POWER OK" on the Control Interface Module in the Motor Module

LED	Color	Status	Description
POWER OK	Green	Off	DC link voltage < 100 V and voltage at -X9:1/2 less than 12 V.
		On	The component is ready for operation.
		Flashing light	There is a fault. If the LED continues to flash after you have performed a POWER ON, please contact your Siemens service center.

⚠WARNING

Irrespective of the state of the LED "DC LINK", hazardous DC link voltages can always be present.

The warning information on the component must be carefully observed!

5.5.4 Dimension drawing

Dimension drawing, frame size FX

The minimum clearances for cooling are indicated by the dotted line.

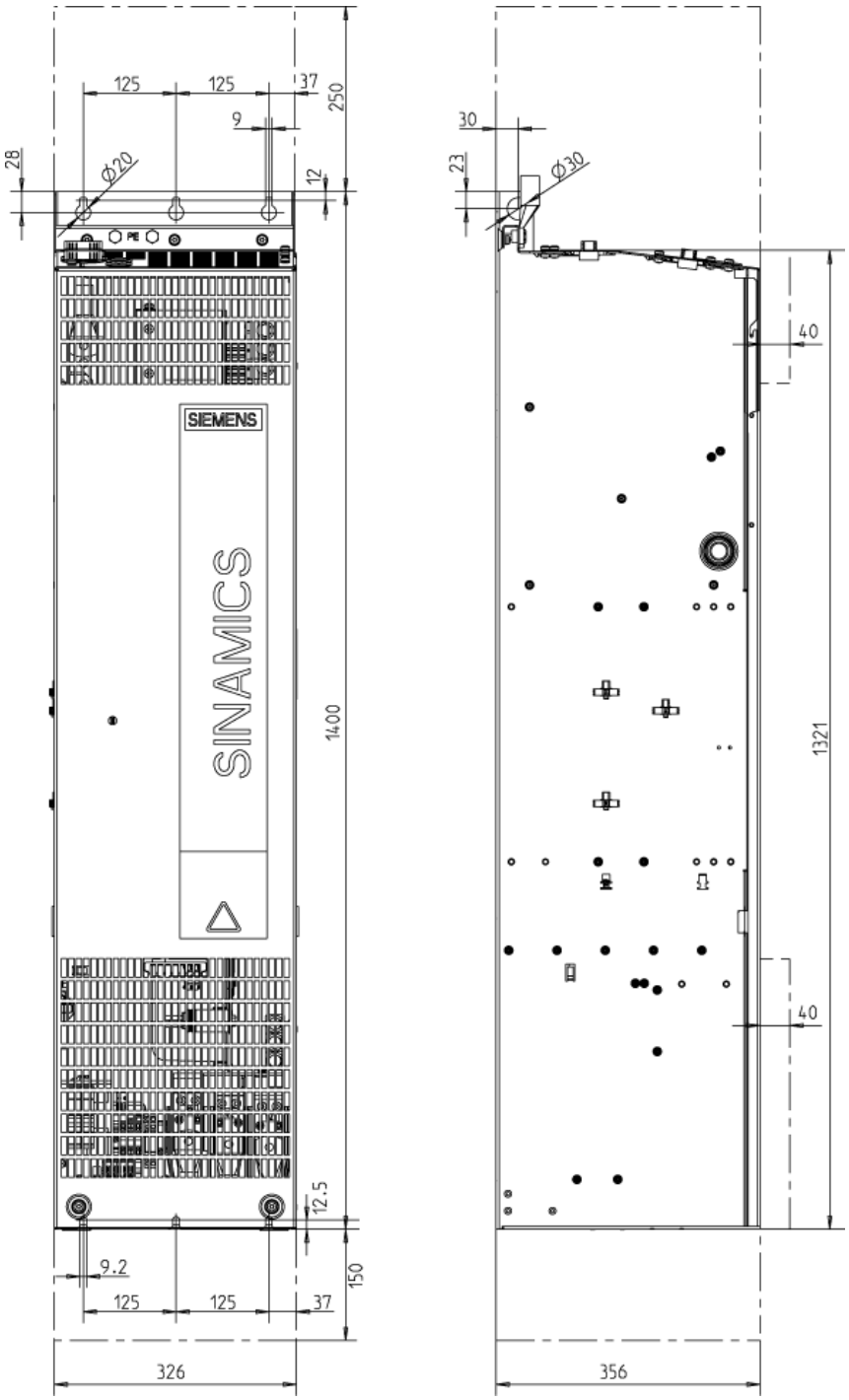


Figure 5-33 Dimension drawing Motor Module, frame size FX Front view, side view

Dimension drawing, frame size GX

The minimum clearances for cooling are indicated by the dotted line.

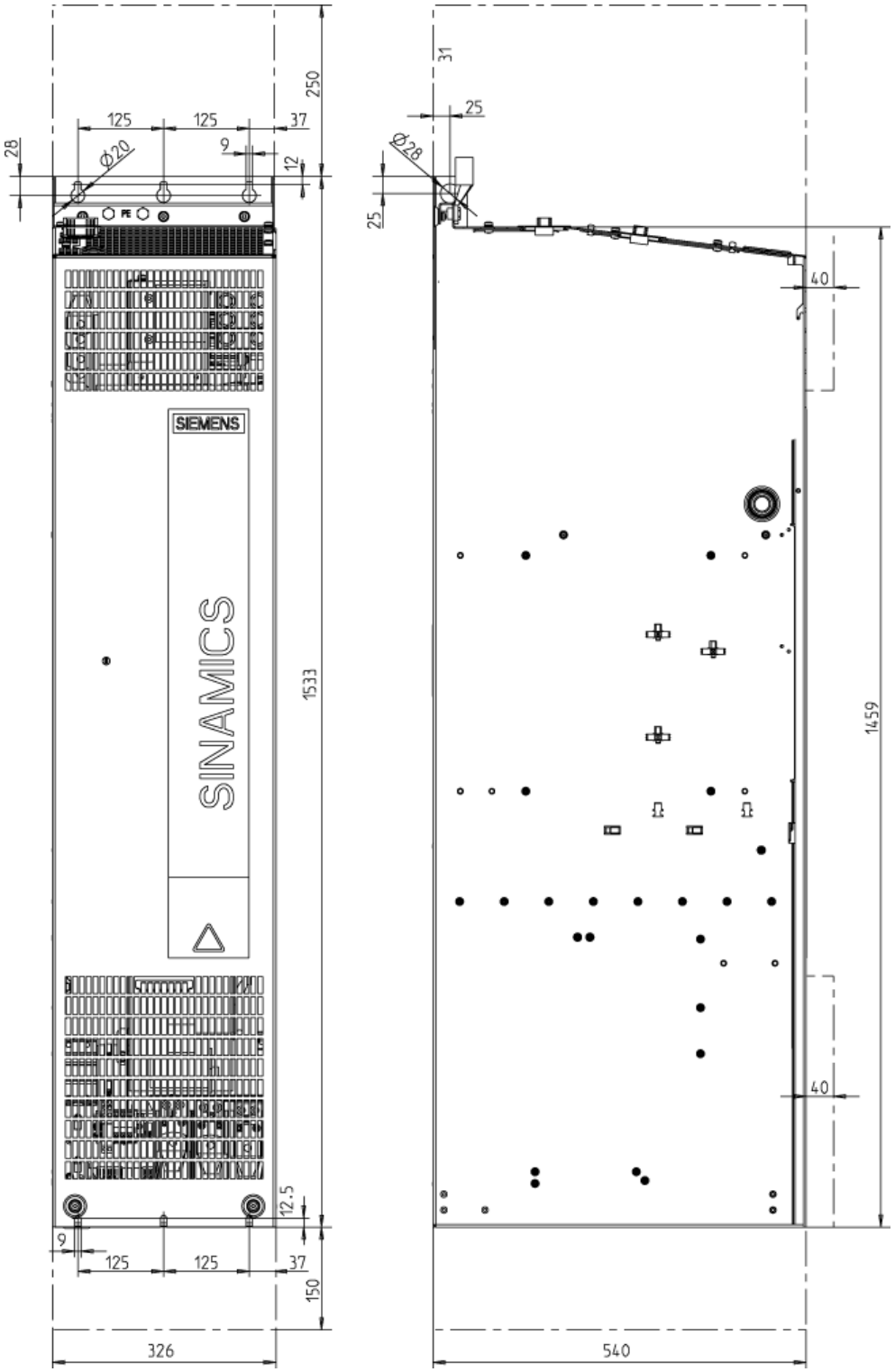


Figure 5-34 Dimension drawing Motor Module, frame size GX Front view, side view

Dimension drawing, frame size HX

The minimum clearances for cooling are indicated by the dotted line.

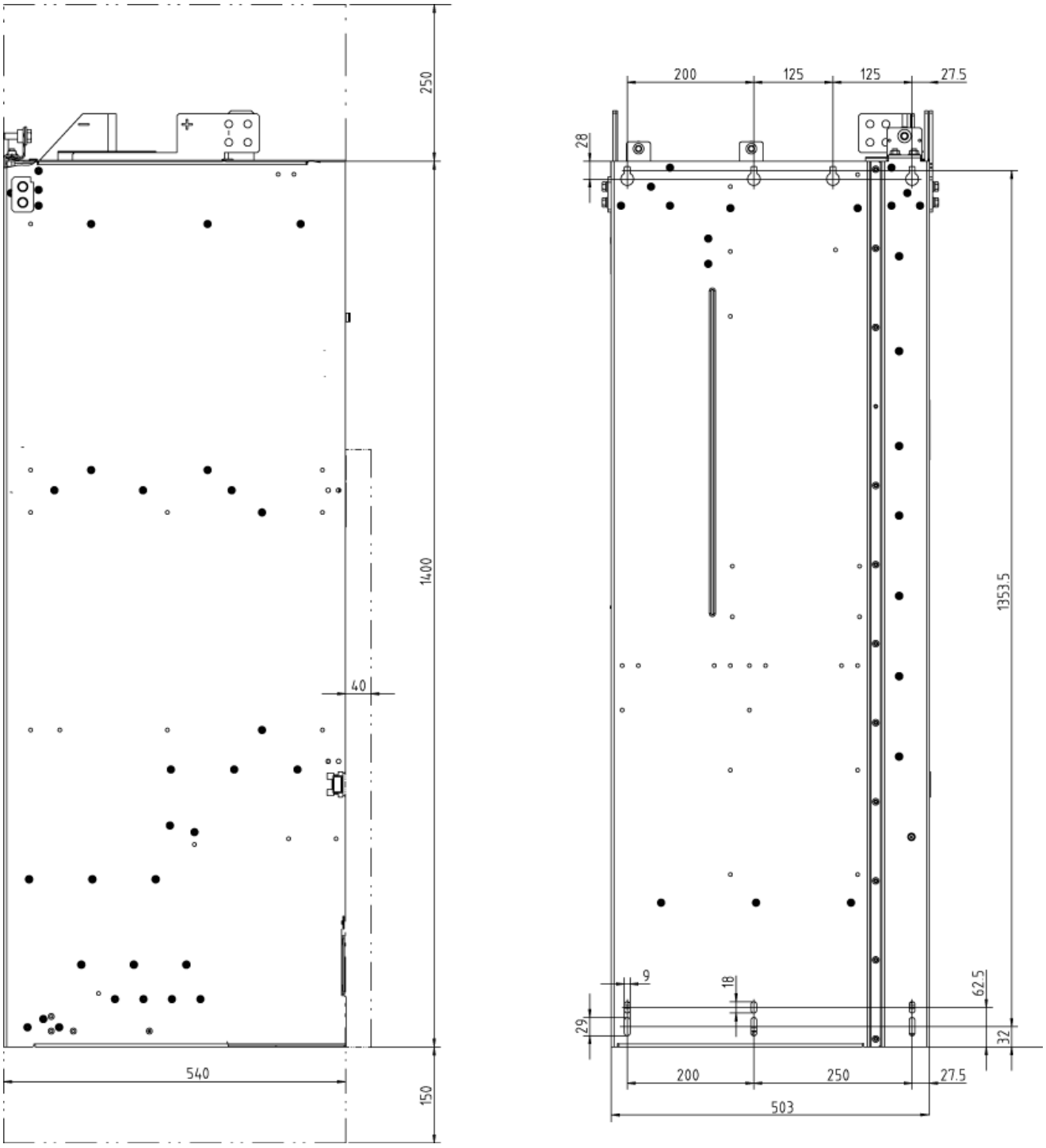


Figure 5-35 Dimension drawing Motor Module, frame size HX Side view, rear view

Dimension drawing, frame size JX

The minimum clearances for cooling are indicated by the dotted line.

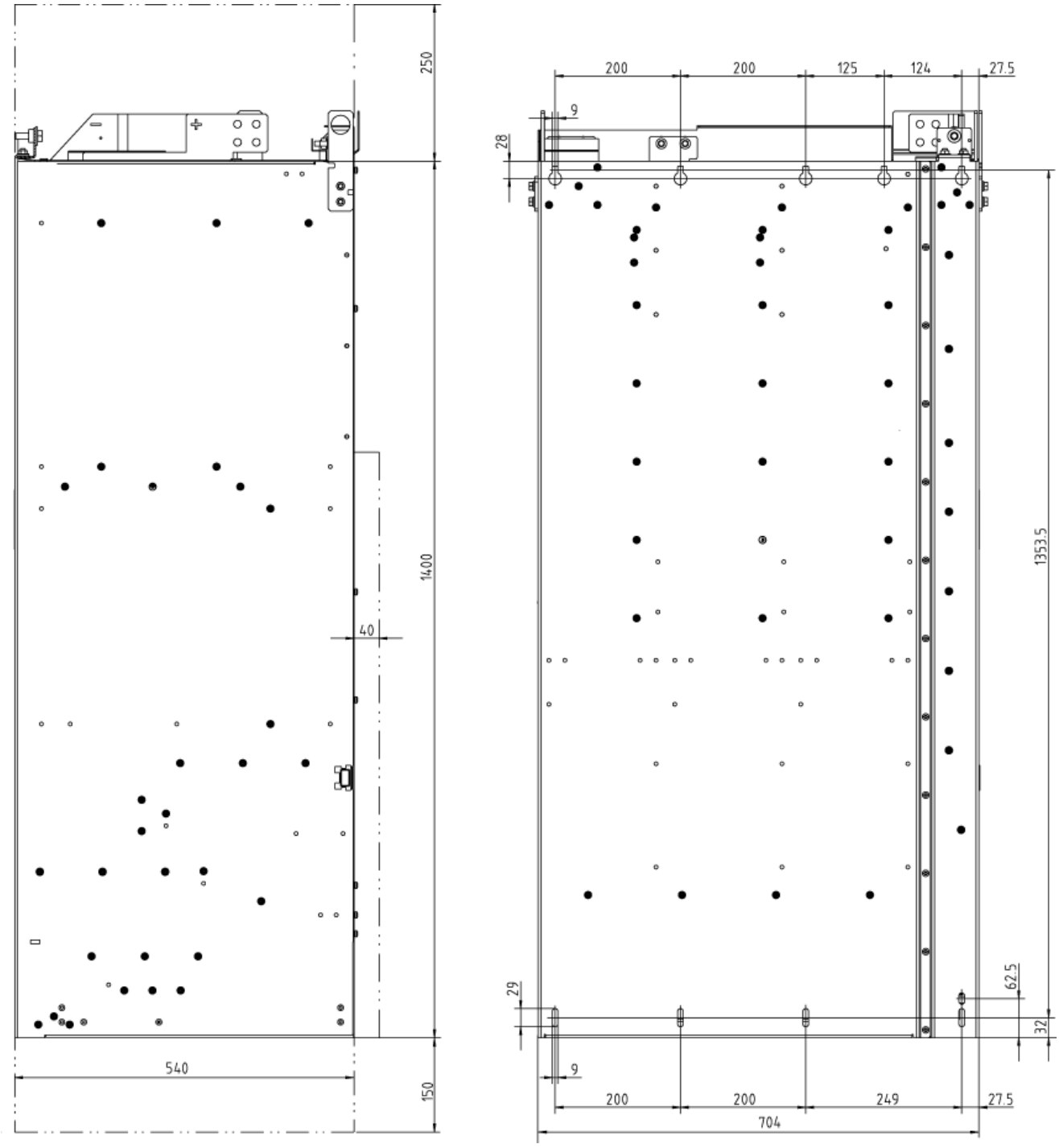


Figure 5-36 Dimension drawing Motor Module, frame size JX Side view, rear view

5.5.5 Electrical connection

Adjusting the fan voltage (-T10)

The power supply for the device fans (1-ph. 230 V AC) in the Motor Module (-T10) is taken from the line supply using transformers. The locations of the transformers are indicated in the interface descriptions.

The transformers are fitted with primary taps so that they can be fine-tuned to the line supply 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 (T10 and -T20) are installed in Motor Modules frame size JX. The two primary-side terminals on each of these devices must be adjusted together.

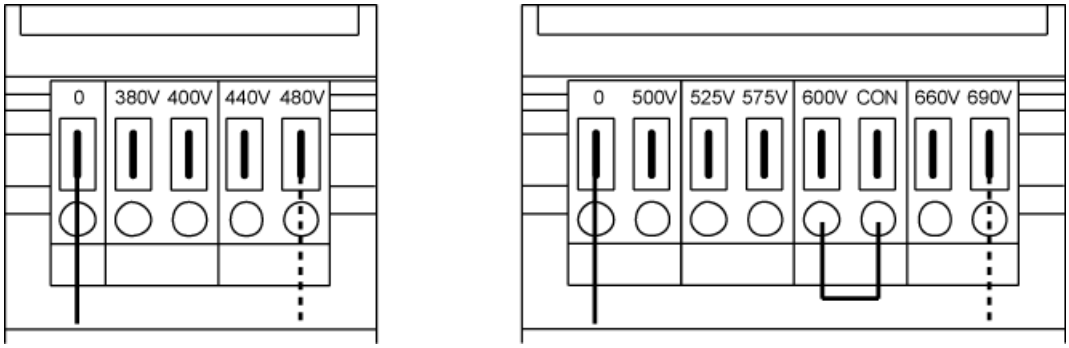


Figure 5-37 Taps for the fan transformers
(380 V – 480 V 3 AC / 500 V – 690 V 3 AC)

The supply voltage assignments for making the appropriate setting on the fan transformer are indicated in the following tables (factory presetting: 480 V/0 V or 690 V/0 V).

Note

With the 500 V – 690 V 3 AC fan transformer, a jumper is inserted between the "600 V" terminal and the "CON" terminal. The "600V" and "CON" terminals are reserved for internal use.

CAUTION

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

- The required cooling level will not be provided (risk of overheating).
- The fan fuses may blow (overload).

Table 5- 54 Line voltage assignments for setting the fan transformer (380 to 480 V AC, 3-phase)

Line voltage	Tap at the fan transformer (-T10)
380 V ± 10%	380 V
400 V ± 10%	400 V
440 V ± 10%	440 V
480 V ± 10%	480 V

Table 5- 55 Line voltage assignments for setting the fan transformer (500 V – 690 V AC, 3-phase)

Line voltage	Tap at the fan transformer (-T10)
500 V ± 10%	500 V
525 V ± 10%	525 V
575 V ± 10%	575 V
600 V ± 10%	600 V
660 V ± 10%	660 V
690 V ± 10%	690 V

5.5.6 Technical data

5.5.6.1 510 V DC – 750 V DC Motor Modules

Table 5- 56 Technical data for Motor Module, 510 – 750 V DC, part 1

Order number	6SL3320–	1TE32–1AA3	1TE32–6AA3	1TE33–1AA3	1TE33–8AA3
Output current					
- Rated current I_n	A	210	260	310	380
- Base load current I_L	A	205	250	302	370
- Base load current I_H	A	178	233	277	340
- for S6 operation (40 %) I_{S6}	A	230	285	340	430
- Max. output current I_{max}	A	307	375	453	555
Unit rating [1]					
- Power on basis of I_n	kW	110	132	160	200
- Power on basis of I_H	kW	90	110	132	160
Rated DC link current					
for power supplied via					
- Basic/Smart Line Module	A	252	312	372	456
- Active Line Module	A	227	281	335	411
Supply voltages					
- DC link voltage	V_{DC}	510 to 750			
- Electronics power supply	V_{DC}	24 (20.4 – 28.8)			
- Output voltage	V_{ACrms}	0 to 0.72 x DC link voltage			
Rated pulse frequency	kHz	2	2	2	2
- Max. pulse frequency without derating	kHz	2	2	2	2
- Max. pulse frequency with derating	kHz	8	8	8	8
Max. ambient temperature					
- Without derating	°C	40	40	40	40
- With derating	°C	55	55	55	55
DC link capacitance	µF	4200	5200	6300	7800
Power requirements					
- Electronics power consumption (24 V DC)	A	0.9	0.9	1.2	1.2
- Fan supply, 400 V 2 AC, 50/60 Hz	A	0.63 / 0.95	1.13 / 1.7	1.6 / 2.4	1.6 / 2.4
Power loss, max.	kW	1.94	2.6	3.1	3.8
Cooling air requirement	m^3/s	0.17	0.23	0.36	0.36
Sound pressure level					
L_{pA} (1 m) at 50/60 Hz	dB(A)	< 67	< 69	< 69	< 69
DC link/motor connection		Flat connector for screws			
		M10	M10	M10	M10
Max. conductor cross-sections					
- DC link connection (DCP, DCN)	mm^2	2 x 185	2 x 185	2 x 185	2 x 185
- Motor connection (U2, V2, W2)	mm^2	2 x 185	2 x 185	2 x 185	2 x 185
- PE connection PE1	mm^2	2 x 185	2 x 185	2 x 185	2 x 185
- PE connection PE2	mm^2	2 x 185	2 x 185	2 x 185	2 x 185
Max. motor cable length					
shielded / unshielded	m	300 / 450	300 / 450	300 / 450	300 / 450
Degree of protection		IP20	IP20	IP20	IP20
Dimensions					
- Width	mm	326	326	326	326
- Height	mm	1400	1400	1533	1533
- Depth	mm	356	356	545	545
Frame size		FX	FX	GX	GX
Weight	kg	88	88	152	152

[1] Rated power of a typical standard induction motor at 400 V 3 AC.

Table 5- 57 Technical data for Motor Module, 510 – 750 V DC, part 2

Order number	6SL3320–	1TE35–0AA3	1TE36–1AA3	1TE37–5AA3	1TE38–4AA3
Output current					
- Rated current I_n	A	490	605	745	840
- Base load current I_L	A	477	590	725	820
- Base load current I_H	A	438	460	570	700
- for S6 operation (40 %) I_{S6}	A	540	--	--	---
- Max. output current I_{max}	A	715	885	1087	1230
Unit rating [1]					
- Power on basis of I_n	kW	250	315	400	450
- Power on basis of I_H	kW	200	250	315	400
Rated DC link current					
for power supplied via					
- Basic/Smart Line Module	A	588	726	894	1008
- Active Line Module	A	530	653	805	907
Supply voltages					
- DC link voltage	V_{DC}	510 to 750			
- Electronics power supply	V_{DC}	24 (20.4 – 28.8)			
- Output voltage	V_{ACrms}	0 to 0.72 x DC link voltage			
Rated pulse frequency	kHz	2	1.25	1.25	1.25
- Max. pulse frequency without derating	kHz	2	1.25	1.25	1.25
- Max. pulse frequency with derating	kHz	8	5	5	5
Max. ambient temperature					
- Without derating	°C	40	40	40	40
- With derating	°C	55	55	55	55
DC link capacitance	µF	9600	12600	15600	16800
Power requirements					
- Electronics power consumption (24 V DC)	A	1.2	1.0	1.0	1.0
- Fan supply, 400 V 2 AC, 50/60 Hz	A	1.6 / 2.4	3.2	3.2	3.2
Power loss, max.	kW	4.5	5.84	6.68	7.15
Cooling air requirement	m^3/s	0.36	0.78	0.78	0.78
Sound pressure level					
L_{pA} (1 m) at 50/60 Hz	dB(A)	< 69	< 72	< 72	< 72
DC link/motor connection		Flat connector for screws			
		M10	M12	M12	M12
Max. conductor cross-sections					
- DC link connection (DCP, DCN)	mm^2	2 x 185	Busbar	Busbar	Busbar
- Motor connection (U2, V2, W2)	mm^2	2 x 185	4 x 240	4 x 240	4 x 240
- PE connection PE1	mm^2	2 x 185	1 x 240	1 x 240	1 x 240
- PE connection PE2	mm^2	2 x 185	2 x 240	2 x 240	2 x 240
Max. motor cable length					
shielded / unshielded	m	300 / 450	300 / 450	300 / 450	300 / 450
Degree of protection		IP20	IP00	IP00	IP00
Dimensions					
- Width	mm	326	503	503	503
- Height	mm	1533	1475	1475	1475
- Depth	mm	545	540	540	540
Frame size		GX	HX	HX	HX
Weight	kg	152	290	290	290

[1] Rated power of a typical standard induction motor at 400 V 3 AC.

Table 5- 58 Technical data for Motor Module, 510 – 750 V DC, part 3

Order number	6SL3320–	1TE41–0AA3	1TE41–2AA3	1TE41–4AA3	
Output current					
- Rated current I_n	A	985	1260	1405	
- Base load current I_L	A	960	1230	1370	
- Base load current I_H	A	860	1127	1257	
- for S6 operation (40 %) I_{S6}	A	--	--	--	
- Max. output current I_{max}	A	1440	1845	2055	
Unit rating [1]					
- Power on basis of I_n	kW	560	710	800	
- Power on basis of I_H	kW	450	560	710	
Rated DC link current					
for power supplied via					
- Basic/Smart Line Module	A	1182	1512	1686	
- Active Line Module	A	1064	1361	1517	
Supply voltages					
- DC link voltage	V_{DC}	510 to 750			
- Electronics power supply	V_{DC}	24 (20.4 – 28.8)			
- Output voltage	V_{ACrms}	0 to 0.72 x DC link voltage			
Rated pulse frequency	kHz	1.25	1.25	1.25	
- Max. pulse frequency without derating	kHz	1.25	1.25	1.25	
- Max. pulse frequency with derating	kHz	5	5	5	
Max. ambient temperature					
- Without derating	°C	40	40	40	
- With derating	°C	55	55	55	
DC link capacitance	µF	18900	26100	28800	
Power requirements					
- Electronics power consumption (24 V DC)	A	1.25	1.4	1.4	
- Fan supply, 400 V 2 AC, 50/60 Hz	A	4.7	4.7	4.7	
Power loss, max.	kW	9.5	11.1	12.0	
Cooling air requirement	m^3/s	1.08	1.08	1.08	
Sound pressure level					
L_{pA} (1 m) at 50/60 Hz	dB(A)	< 72	< 72	< 72	
DC link/motor connection		Flat connector for screws			
		M12	M12	M12	
Max. conductor cross-sections					
- DC link connection (DCP, DCN)	mm^2	Busbar	Busbar	Busbar	
- Motor connection (U2, V2, W2)	mm^2	6 x 240	6 x 240	6 x 240	
- PE connection PE1	mm^2	1 x 240	1 x 240	1 x 240	
- PE connection PE2	mm^2	2 x 240	2 x 240	2 x 240	
Max. motor cable length					
shielded / unshielded	m	300 / 450	300 / 450	300 / 450	
Degree of protection		IP00	IP00	IP00	
Dimensions					
- Width	mm	704	704	704	
- Height	mm	1475	1475	1475	
- Depth	mm	540	540	540	
Frame size		JX	JX	JX	
Weight	kg	450	450	450	

[1] Rated power of a typical standard induction motor at 400 V 3 AC.

5.5.6.2 675 V DC – 1080 V DC Motor Modules

Table 5- 59 Technical data for Motor Module, 675 V DC – 1080 V DC, part 1

Order number	6SL3320–	1TG28–5AA3	1TG31–0AA3	1TG31–2AA3	1TG31–5AA3
Output current					
- Rated current I_n	A	85	100	120	150
- Base load current I_L	A	80	95	115	142
- Base load current I_H	A	76	89	107	134
- Max. output current I_{max}	A	120	142	172	213
Unit rating [1]					
- Power on basis of I_n	kW	75	90	110	132
- Power on basis of I_H	kW	55	75	90	110
Rated DC link current for power supplied via					
- Basic/Smart Line Module	A	102	120	144	180
- Active Line Module	A	92	108	130	162
Supply voltages					
- DC link voltage	V_{DC}	675 to 1080			
- Electronics power supply	V_{DC}	24 (20.4 – 28.8)			
- Output voltage	V_{ACrms}	0 to 0.72 x DC link voltage			
Rated pulse frequency	kHz	1.25	1.25	1.25	1.25
- Max. pulse frequency without derating	kHz	1.25	1.25	1.25	1.25
- Max. pulse frequency with derating	kHz	5	5	5	5
Max. ambient temperature					
- Without derating	°C	40	40	40	40
- With derating	°C	55	55	55	55
DC link capacitance	µF	1200	1200	1600	2800
Power requirements					
- Electronics power consumption (24 V DC)	A	1.0	1.0	1.0	1.0
- Fan supply, 690 V 2 AC, 50/60 Hz	A	0.4 / 0.5	0.4 / 0.5	0.4 / 0.5	0.4 / 0.5
Power loss, max.	kW	1.17	1.43	1.89	1.80
Cooling air requirement	m^3/s	0.17	0.17	0.17	0.17
Sound pressure level L_{pA} (1 m) at 50/60 Hz	dB(A)	< 67	< 67	< 67	< 67
DC link/motor connection		Flat connector for screws			
		M10	M10	M10	M10
Max. conductor cross-sections					
- DC link connection (DCP, DCN)	mm^2	2 x 185	2 x 185	2 x 185	2 x 185
- Motor connection (U2, V2, W2)	mm^2	2 x 185	2 x 185	2 x 185	2 x 185
- PE connection PE1	mm^2	2 x 185	2 x 185	2 x 185	2 x 185
- PE connection PE2	mm^2	2 x 185	2 x 185	2 x 185	2 x 185
Max. motor cable length shielded / unshielded	m	300 / 450	300 / 450	300 / 450	300 / 450
Degree of protection		IP20	IP20	IP20	IP20
Dimensions					
- Width	mm	326	326	326	326
- Height	mm	1400	1400	1400	1400
- Depth	mm	356	356	356	356
Frame size		FX	FX	FX	FX
Weight	kg	88	88	88	88

[1] Rated power of a typical standard induction motor at 690 V 3 AC.

Table 5- 60 Technical data for Motor Module, 675 V DC – 1080 V DC, part 2

Order number	6SL3320–	1TG31–8AA3	1TG32–2AA3	1TG32–6AA3	1TG33–3AA3
Output current					
- Rated current I_n	A	175	215	260	330
- Base load current I_L	A	170	208	250	320
- Base load current I_H	A	157	192	233	280
- Max. output current I_{max}	A	255	312	375	480
Unit rating [1]					
- Power on basis of I_n	kW	160	200	250	315
- Power on basis of I_H	kW	132	160	200	250
Rated DC link current					
for power supplied via					
- Basic/Smart Line Module	A	210	258	312	396
- Active Line Module	A	189	232	281	356
Supply voltages					
- DC link voltage	V_{DC}	675 to 1080			
- Electronics power supply	V_{DC}	24 (20.4 – 28.8)			
- Output voltage	V_{ACrms}	0 to 0.72 x DC link voltage			
Rated pulse frequency	kHz	1.25	1.25	1.25	1.25
- Max. pulse frequency without derating	kHz	1.25	1.25	1.25	1.25
- Max. pulse frequency with derating	kHz	5	5	5	5
Max. ambient temperature					
- Without derating	°C	40	40	40	40
- With derating	°C	55	55	55	55
DC link capacitance	µF	2800	2800	3900	4200
Power requirements					
- Electronics power consumption (24 V DC)	A	1.2	1.2	1.2	1.2
- Fan supply, 690 V 2 AC, 50/60 Hz	A	0.94 / 1.4	0.94 / 1.4	0.94 / 1.4	0.94 / 1.4
Power loss, max.	kW	2.67	3.09	3.62	4.34
Cooling air requirement	m^3/s	0.36	0.36	0.36	0.36
Sound pressure level					
L_{pA} (1 m) at 50/60 Hz	dB(A)	< 69	< 69	< 69	< 69
DC link/motor connection		Flat connector for screws			
		M10	M10	M10	M10
Max. conductor cross-sections					
- DC link connection (DCP, DCN)	mm^2	2 x 185	2 x 185	2 x 185	2 x 185
- Motor connection (U2, V2, W2)	mm^2	2 x 185	2 x 185	2 x 185	2 x 185
- PE connection PE1	mm^2	2 x 185	2 x 185	2 x 185	2 x 185
- PE connection PE2	mm^2	2 x 185	2 x 185	2 x 185	2 x 185
Max. motor cable length					
shielded / unshielded	m	300 / 450	300 / 450	300 / 450	300 / 450
Degree of protection		IP20	IP20	IP20	IP20
Dimensions					
- Width	mm	326	326	326	326
- Height	mm	1533	1533	1533	1533
- Depth	mm	545	545	545	545
Frame size		GX	GX	GX	GX
Weight	kg	152	152	152	152

[1] Rated power of a typical standard induction motor at 690 V 3 AC.

Table 5- 61 Technical data for Motor Module, 675 V DC – 1080 V DC, part 3

Order number	6SL3320–	1TG34–1AA3	1TG34–7AA3	1TG35–8AA3	1TG37–4AA3
Output current					
- Rated current I_n	A	410	465	575	735
- Base load current I_L	A	400	452	560	710
- Base load current I_H	A	367	416	514	657
- Max. output current I_{max}	A	600	678	840	1065
Unit rating [1]					
- Power on basis of I_n	kW	400	450	560	710
- Power on basis of I_H	kW	315	400	450	630
Rated DC link current for power supplied via					
- Basic/Smart Line Module	A	492	558	690	882
- Active Line Module	A	443	502	621	794
Supply voltages					
- DC link voltage	V_{DC}	675 to 1080			
- Electronics power supply	V_{DC}	24 (20.4 – 28.8)			
- Output voltage	V_{ACrms}	0 to 0.72 x DC link voltage			
Rated pulse frequency	kHz	1.25	1.25	1.25	1.25
- Max. pulse frequency without derating	kHz	1.25	1.25	1.25	1.25
- Max. pulse frequency with derating	kHz	5	5	5	5
Max. ambient temperature					
- Without derating	°C	40	40	40	40
- With derating	°C	55	55	55	55
DC link capacitance	µF	7400	7400	7400	11100
Power requirements					
- Electronics power consumption (24 V DC)	A	1.0	1.0	1.0	1.25
- Fan supply, 690 V 2 AC, 50/60 Hz	A	1.84	1.84	2.74	2.74
Power loss, max.	kW	6.13	6.80	10.3	10.9
Cooling air requirement	m^3/s	0.78	0.78	0.78	1.08
Sound pressure level L_{pA} (1 m) at 50/60 Hz	dB(A)	< 72	< 72	< 72	< 72
DC link/motor connection		Flat connector for screws			
		M12	M12	M12	M12
Max. conductor cross-sections					
- DC link connection (DCP, DCN)	mm^2	Busbar	Busbar	Busbar	Busbar
- Motor connection (U2, V2, W2)	mm^2	4 x 240	4 x 240	4 x 240	6 x 240
- PE connection PE1	mm^2	1 x 240	1 x 240	1 x 240	1 x 240
- PE connection PE2	mm^2	2 x 240	2 x 240	2 x 240	2 x 240
Max. motor cable length shielded / unshielded	m	300 / 450	300 / 450	300 / 450	300 / 450
Degree of protection		IP00	IP00	IP00	IP00
Dimensions					
- Width	mm	503	503	503	704
- Height	mm	1475	1475	1475	1475
- Depth	mm	540	540	540	540
Frame size		HX	HX	HX	JX
Weight	kg	290	290	290	450

[1] Rated power of a typical standard induction motor at 690 V 3 AC.

Table 5- 62 Technical data for Motor Module, 675 V DC – 1080 V DC, part 4

Order number	6SL3320–	1TG38–1AA3	1TG38–8AA3	1TG41–0AA3	1TG41–3AA3
Output current					
- Rated current I_n	A	810	910	1025	1270
- Base load current I_L	A	790	880	1000	1230
- Base load current I_H	A	724	814	917	1136
- Max. output current I_{max}	A	1185	1320	1500	1845
Unit rating [1]					
- Power on basis of I_n	kW	800	900	1000	1200
- Power on basis of I_H	kW	710	800	900	1000
Rated DC link current					
for power supplied via					
- Basic/Smart Line Module	A	972	1092	1230	1524
- Active Line Module	A	875	983	1107	1372
Supply voltages					
- DC link voltage	V_{DC}	675 to 1080			
- Electronics power supply	V_{DC}	24 (20.4 – 28.8)			
- Output voltage	V_{ACrms}	0 to 0.72 x DC link voltage			
Rated pulse frequency	kHz	1.25	1.25	1.25	1.25
- Max. pulse frequency without derating	kHz	1.25	1.25	1.25	1.25
- Max. pulse frequency with derating	kHz	5	5	5	5
Max. ambient temperature					
- Without derating	°C	40	40	40	40
- With derating	°C	55	55	55	55
DC link capacitance	µF	11100	14400	14400	19200
Power requirements					
- Electronics power consumption (24 V DC)	A	1.25	1.4	1.4	1.4
- Fan supply, 690 V 2 AC, 50/60 Hz	A	2.74	2.74	2.74	2.74
Power loss, max.	kW	11.5	11.7	13.2	16.0
Cooling air requirement	m^3/s	1.08	1.08	1.08	1.08
Sound pressure level					
L_{pA} (1 m) at 50/60 Hz	dB(A)	< 72	< 72	< 72	< 72
DC link/motor connection		Flat connector for screws			
		M12	M12	M12	M12
Max. conductor cross-sections					
- DC link connection (DCP, DCN)	mm^2	Busbar	Busbar	Busbar	Busbar
- Motor connection (U2, V2, W2)	mm^2	6 x 240	6 x 240	6 x 240	6 x 240
- PE connection PE1	mm^2	1 x 240	1 x 240	1 x 240	1 x 240
- PE connection PE2	mm^2	2 x 240	2 x 240	2 x 240	2 x 240
Max. motor cable length					
shielded / unshielded	m	300 / 450	300 / 450	300 / 450	300 / 450
Degree of protection		IP00	IP00	IP00	IP00
Dimensions					
- Width	mm	704	704	704	704
- Height	mm	1475	1475	1475	1475
- Depth	mm	540	540	540	540
Frame size		JX	JX	JX	JX
Weight	kg	450	450	450	450

[1] Rated power of a typical standard induction motor at 690 V 3 AC.

5.5.6.3 Overload capability

The Motor Modules have an overload reserve e.g. to handle breakaway torques.

In the case of 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 Motor Module is operated with its base load current before and after the overload occurs (a load duration of 300 s is used as a basis here).

Low overload

The base load current for low overload (I_L) is based on a load duty cycle of 110% for 60 s or 150% for 10 s.

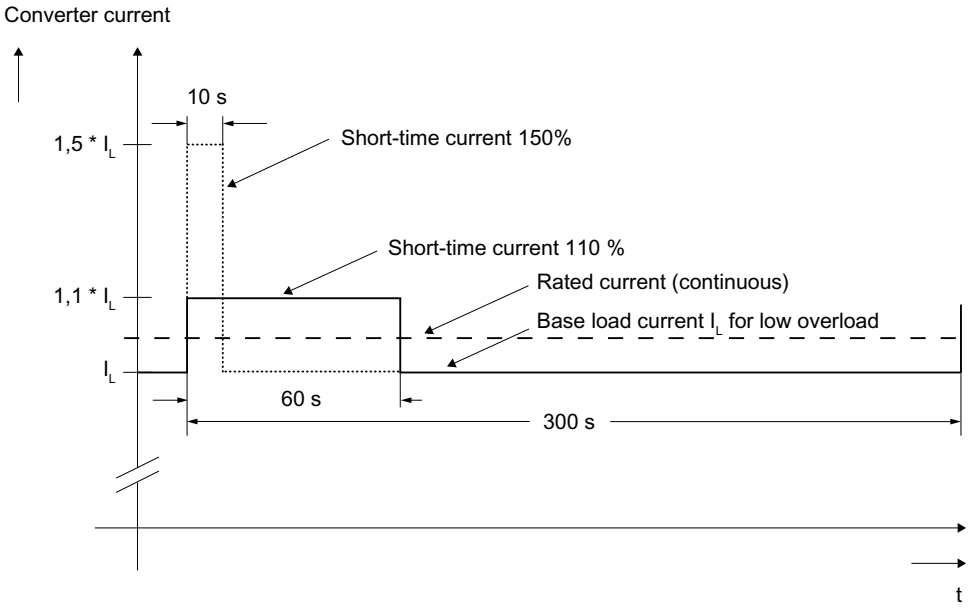


Figure 5-38 Low overload

High overload

The base load current for a high overload I_H is based on a duty cycle of 150% for 60 s or 160% for 10 s.

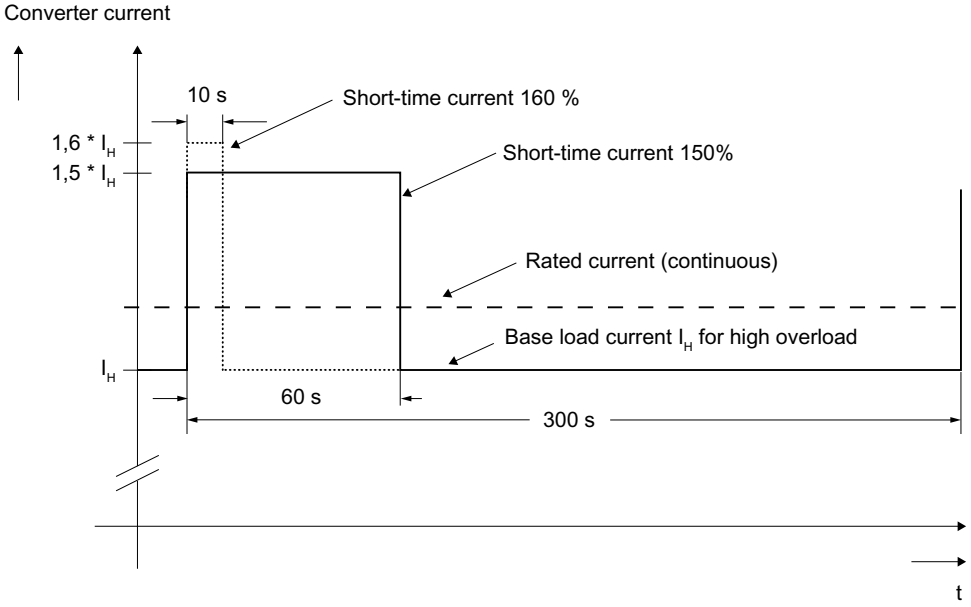


Figure 5-39 High overload

5.5.6.4 Current de-rating depending on 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 data for Motor Modules.

Table 5- 63 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. 6SL3320-...	Unit rating [kW]	Output current for a pulse frequency of 2 kHz [A]	Derating factor for a pulse frequency of 4 kHz
Supply voltage 510 – 750 V DC			
1TE32-1AAx	110	210	82 %
1TE32-6AAx	132	260	83 %
1TE33-1AAx	160	310	88 %
1TE33-8AAx	200	380	87 %
1TE35-0AAx	250	490	78 %

Table 5- 64 Derating factor of the output current as a function of the pulse frequency for devices with a rated pulse frequency of 1.25 kHz

Order no. 6SL3320-...	Unit rating [kW]	Output current for a pulse frequency of 1.25 kHz [A]	Derating factor for a pulse frequency of 2.5 kHz
Supply voltage 510 – 750 V DC			
1TE36-1AAx	315	605	72 %
1TE37-5AAx	400	745	72 %
1TE38-4AAx	450	840	79 %
1TE41-0AAx	560	985	87 %
1TE41-2AAx	710	1260	87 %
1TE41-4AAx	800	1405	95 %
Supply voltage 675 – 1080 V DC			
1TG28-5AAx	75	85	89 %
1TG31-0AAx	90	100	88 %
1TG31-2AAx	110	120	88 %
1TG31-5AAx	132	150	84 %
1TG31-8AAx	160	175	87 %
1TG32-2AAx	200	215	87 %
1TG32-6AAx	250	260	88 %
1TG33-3AAx	315	330	82 %
1TG34-1AAx	400	410	82 %
1TG34-7AAx	450	465	87 %
1TG35-8AAx	560	575	85 %
1TG37-4AAx	710	735	79 %
1TG38-1AAx	800	810	95 %
1TG38-8AAx	900	910	87 %
1TG41-0AAx	1000	1025	86 %
1TG41-3AAx	1200	1270	79 %

For pulse frequencies in the range between the fixed values, the relevant derating factors can be determined by means of linear interpolation.

Maximum output frequencies achieved by increasing the pulse frequency

By multiplying the rated pulse frequency with a multiple integer, the following output frequencies can be achieved taking into account the derating factors:

Table 5- 65 Maximum output frequencies achieved by increasing the pulse frequency in VECTOR mode.

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 (for current controller clock cycle p0115[0] ≤ 400 µs).

Table 5- 66 Maximum output frequencies achieved by increasing the pulse frequency in SERVO mode.

Pulse frequency [kHz]	Maximum output frequency [Hz]
2	300
4	300 / 650 [1]

[1] The maximum output frequency of 650 Hz is can only be achieved for a current controller clock cycle of 125 µs (factory setting: 250 µs). This is only possible for Motor Modules with order numbers 6SL3320–1Txxx–xAA3 and firmware version V4.3 or higher.

5.5.6.5 Parallel connection of Motor Modules

The following rules must be observed when connecting Motor Modules in parallel:

- Up to 4 identical Motor Modules can be connected in parallel.
- A common Control Unit is required whenever the modules are connected in parallel.
- The motor supply cables must be the same length (symmetrical design).
- Power must be supplied to the Motor Modules from a common DC link.
- For motors with a single winding system, supply cables with a minimum length or motor reactors must be used. The cable lengths are listed in the following tables.
- A derating factor of 5 % must be taken into consideration, regardless of the number of modules connected in parallel.

Note

It is only possible to connect identical power units in parallel if both power units have the same hardware version. Mixed operation between a power unit with Control Interface Module (order number 6SL33xx-xxxxx–xAA3) and a power unit with Control Interface Board (order number 6SL33xx-xxxxx–xAA0) is not possible.

Minimum cable lengths for parallel connection and connection to a motor with a single-winding system

NOTICE

The minimum cable lengths specified in the tables below must be observed when two or more Motor Modules are connected in parallel and there is a connection to a motor with a single-winding system. If the cable length required for the application cannot be achieved, a motor reactor must be provided.

Table 5- 67 510 to 750 V DC Motor Modules

Order number	Unit rating [kW]	Output current [A]	Minimum cable length [m]
6SL3320-1TE32-1AAx	110	210	30
6SL3320-1TE32-6AAx	132	260	27
6SL3320-1TE33-1AAx	160	310	20
6SL3320-1TE33-8AAx	200	380	17
6SL3320-1TE35-0AAx	250	490	15
6SL3320-1TE36-1AAx	315	605	13
6SL3320-1TE37-5AAx	400	745	10
6SL3320-1TE38-4AAx	450	840	9
6SL3320-1TE41-0AAx	560	985	8
6SL3320-1TE41-2AAx	710	1260	6
6SL3320-1TE41-4AAx	800	1405	5

Table 5- 68 675 to 1080 V DC Motor Modules

Order number	Unit rating [kW]	Output current [A]	Minimum cable length [m]
6SL3320-1TG28-5AAx	75	85	100
6SL3320-1TG31-0AAx	90	100	90
6SL3320-1TG31-2AAx	110	120	80
6SL3320-1TG31-5AAx	132	150	70
6SL3320-1TG31-8AAx	160	175	60
6SL3320-1TG32-2AAx	200	215	50
6SL3320-1TG32-6AAx	250	260	40
6SL3320-1TG33-3AAx	315	330	30
6SL3320-1TG34-1AAx	400	410	25
6SL3320-1TG34-7AAx	450	465	25
6SL3320-1TG35-8AAx	560	575	20
6SL3320-1TG37-4AAx	710	735	18
6SL3320-1TG38-1AAx	800	810	15
6SL3320-1TG38-8AAx	900	910	12
6SL3320-1TG41-0AAx	1000	1025	10
6SL3320-1TG41-3AAx	1200	1270	8

Function diagrams

6

This chapter describes the function diagrams for line infeed. They are arranged in the schematic according to the function modules described above.

Table 6- 1 Line transformer

Function diagram No.	Function diagram name
7990	Line transformer model
7991	Line transformer line filter monitoring
7993	Line transformer magnetizing voltage threshold
7994	Line transformer magnetization sequence control

Table 6- 2 Grid droop control

Function diagram No.	Function diagram name
7982	Grid droop control, DC component control
7984	Grid droop control-modulation depth control
7986	Grid droop control sequence control, overcurrent

Table 6- 3 Dynamic grid support

Function diagram No.	Function diagram name
7997	Dynamic grid support characteristic
7998	Dynamic grid support sequence control

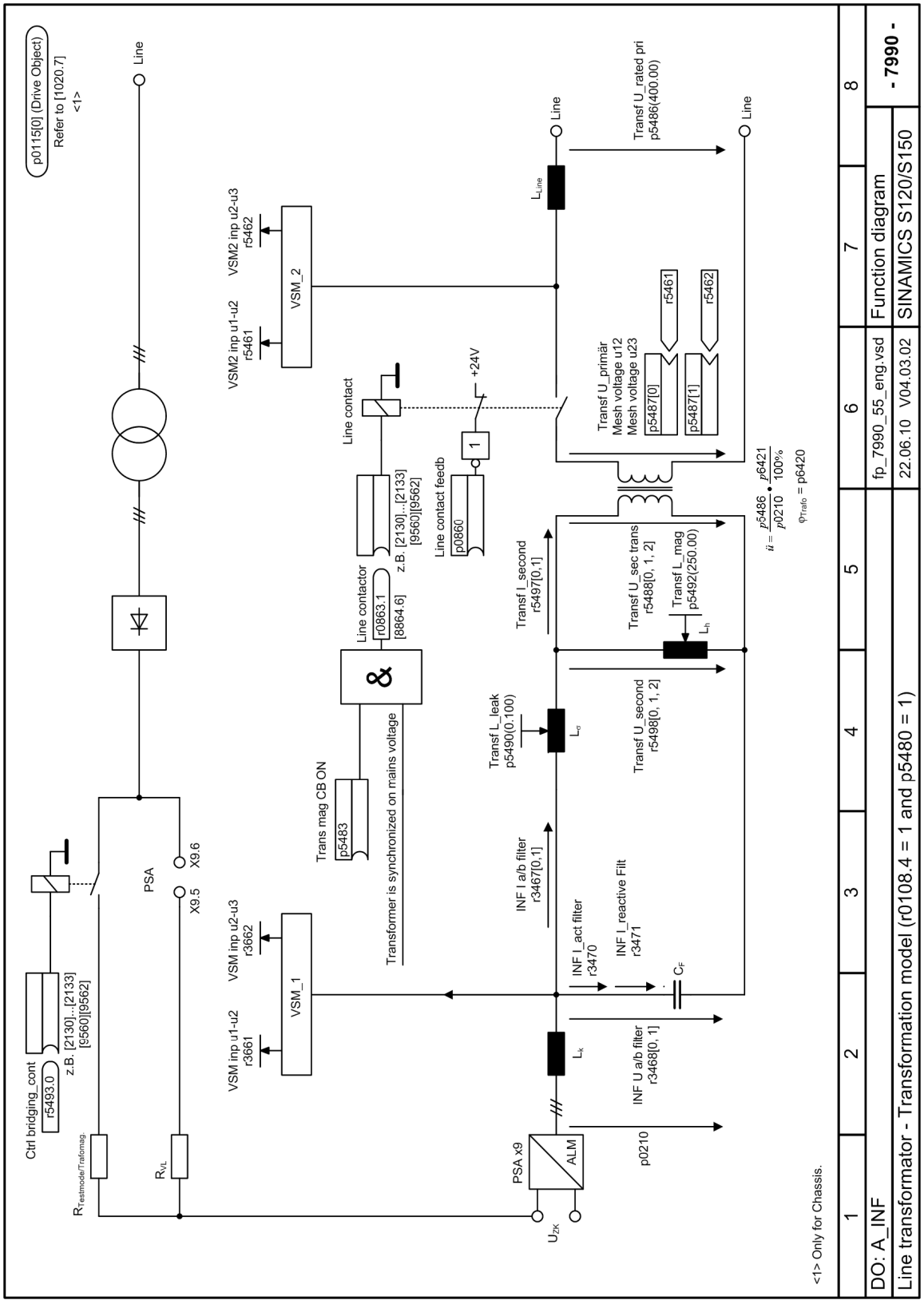


Figure 6-1 Line transformer - Transformer model 7990

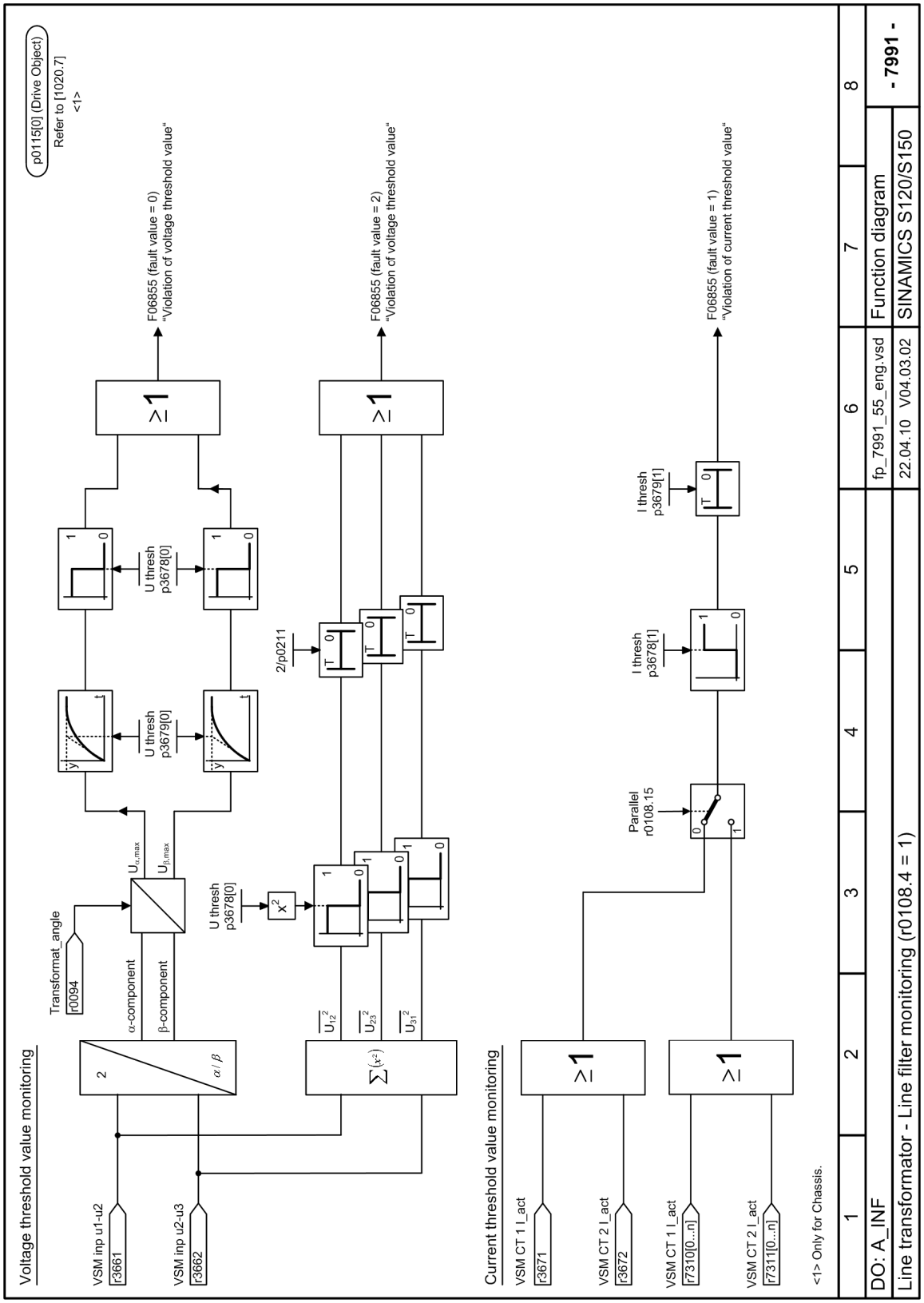


Figure 6-2 Line transformer - Line filter monitoring 7991

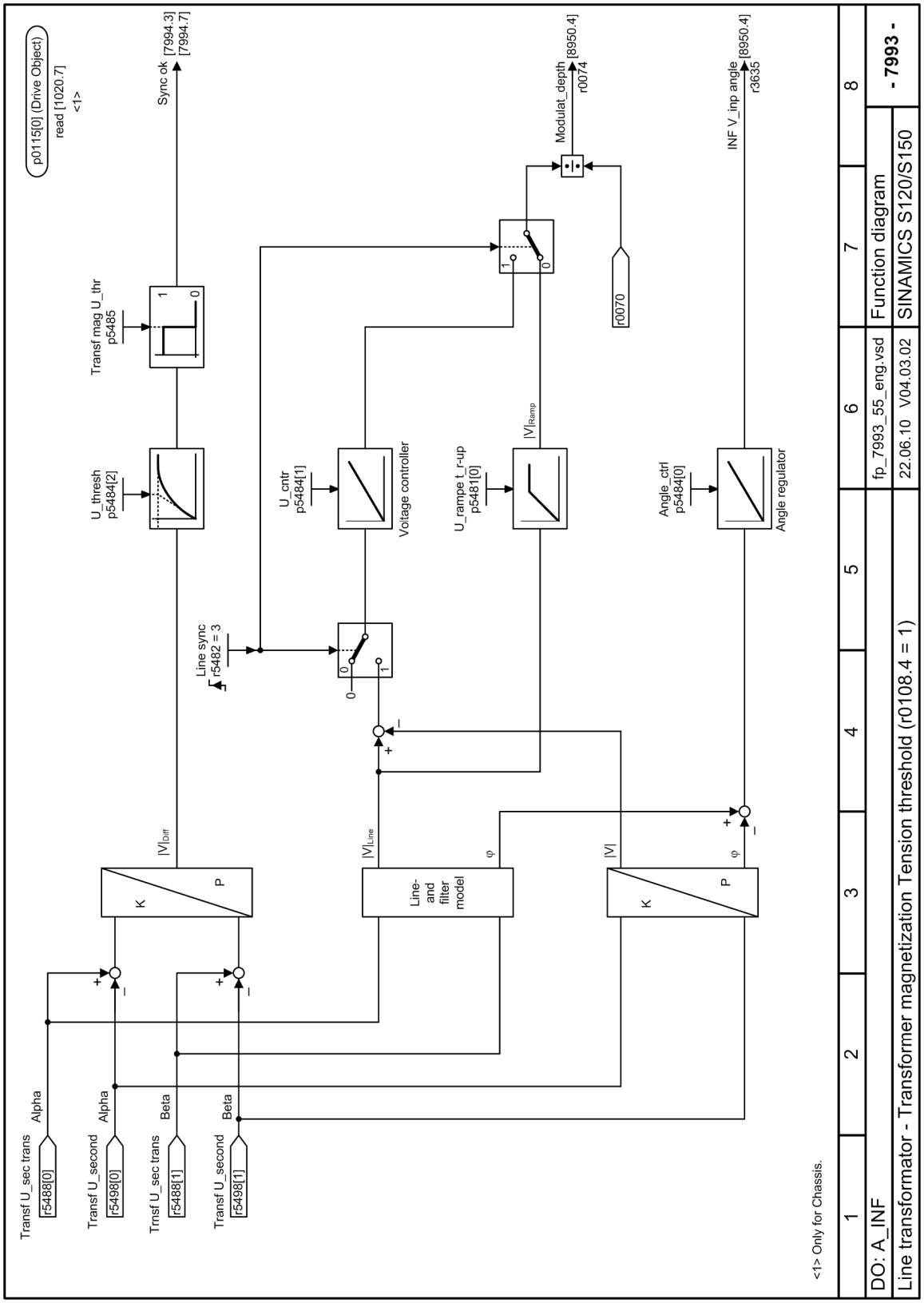


Figure 6-3 Line transformer - Transformer magnetization voltage threshold 7993

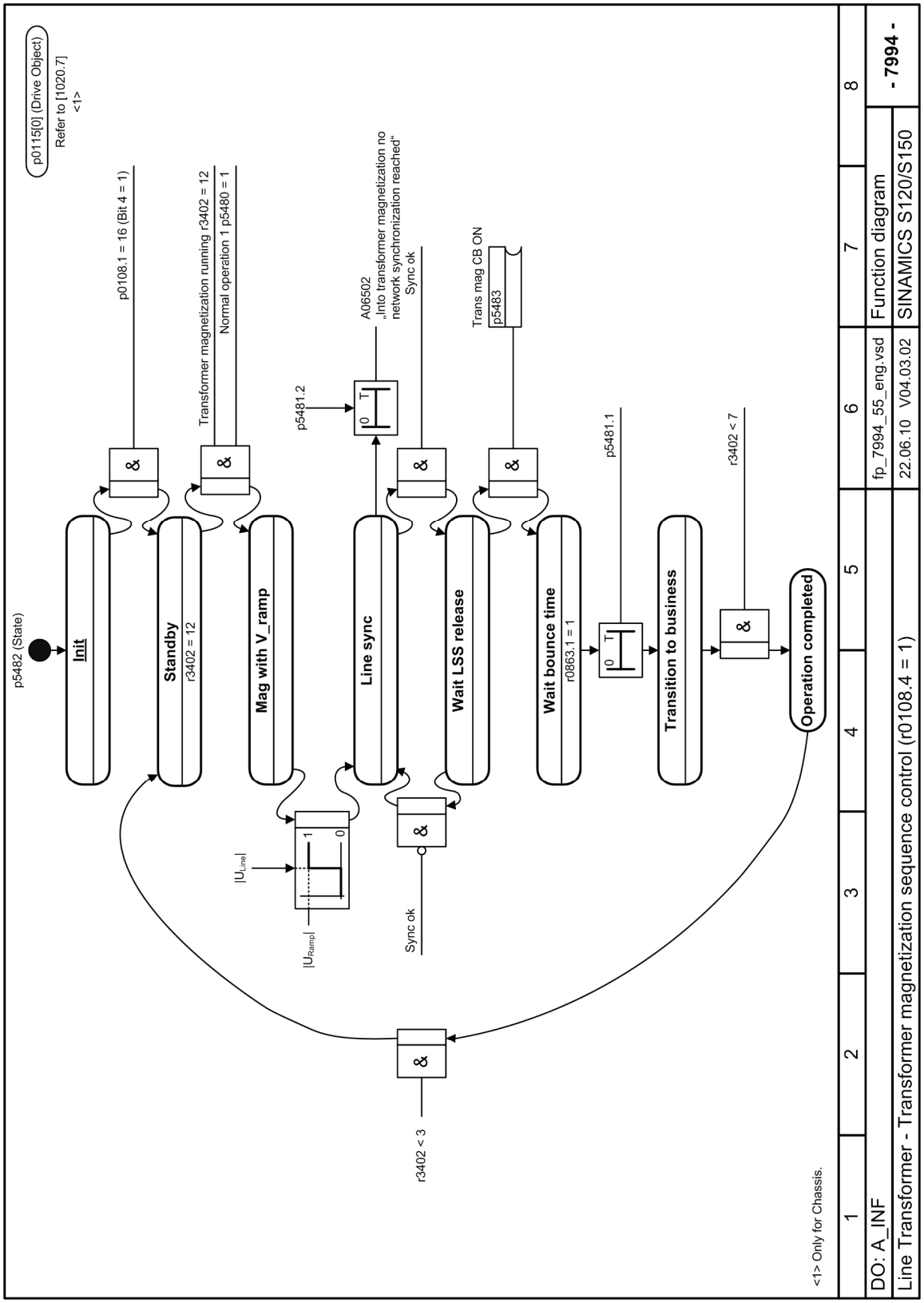


Figure 6-4 Line transformer - Transformer magnetization sequence control 7994

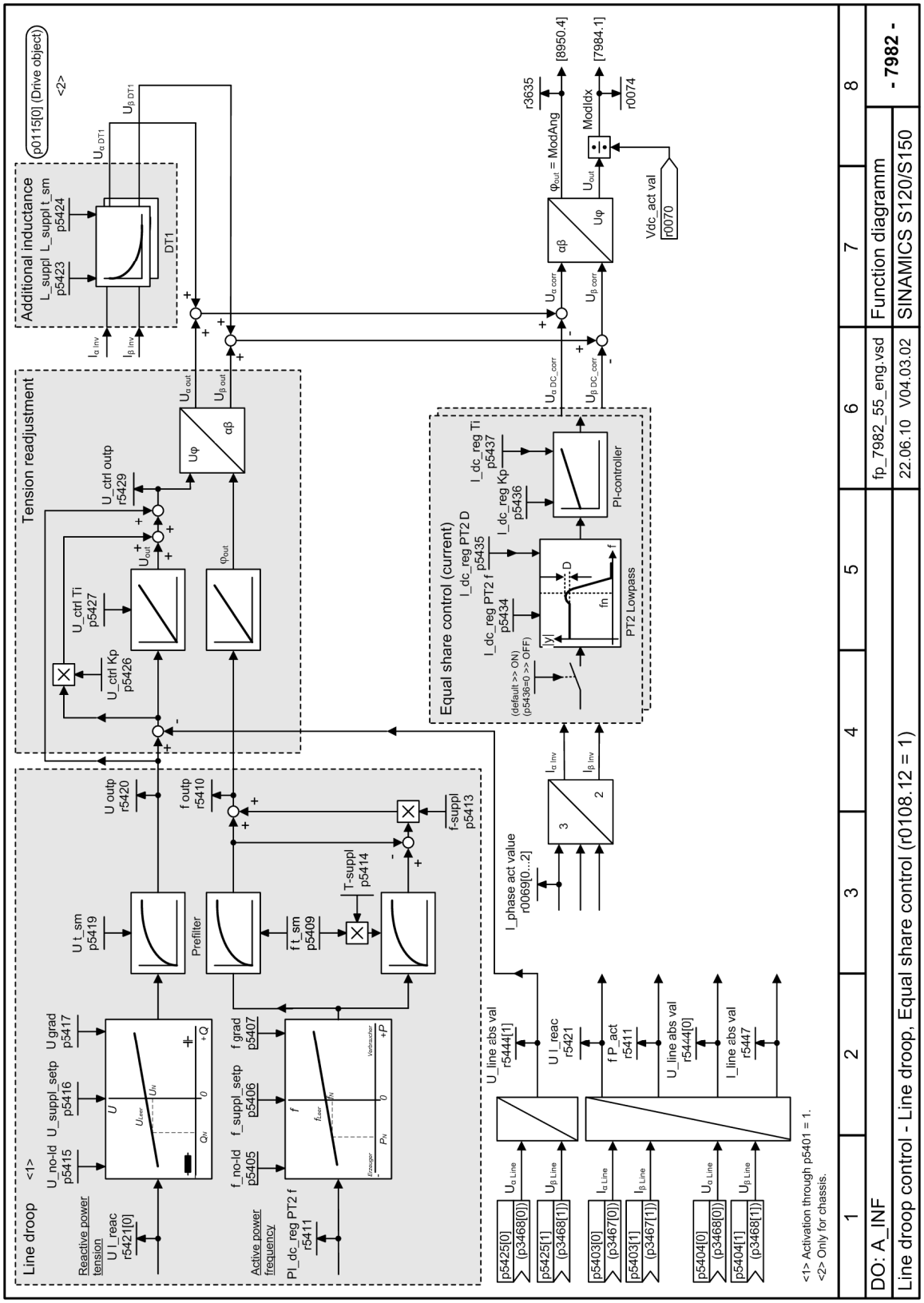


Figure 6-5 Grid droop control, DC component control 7982

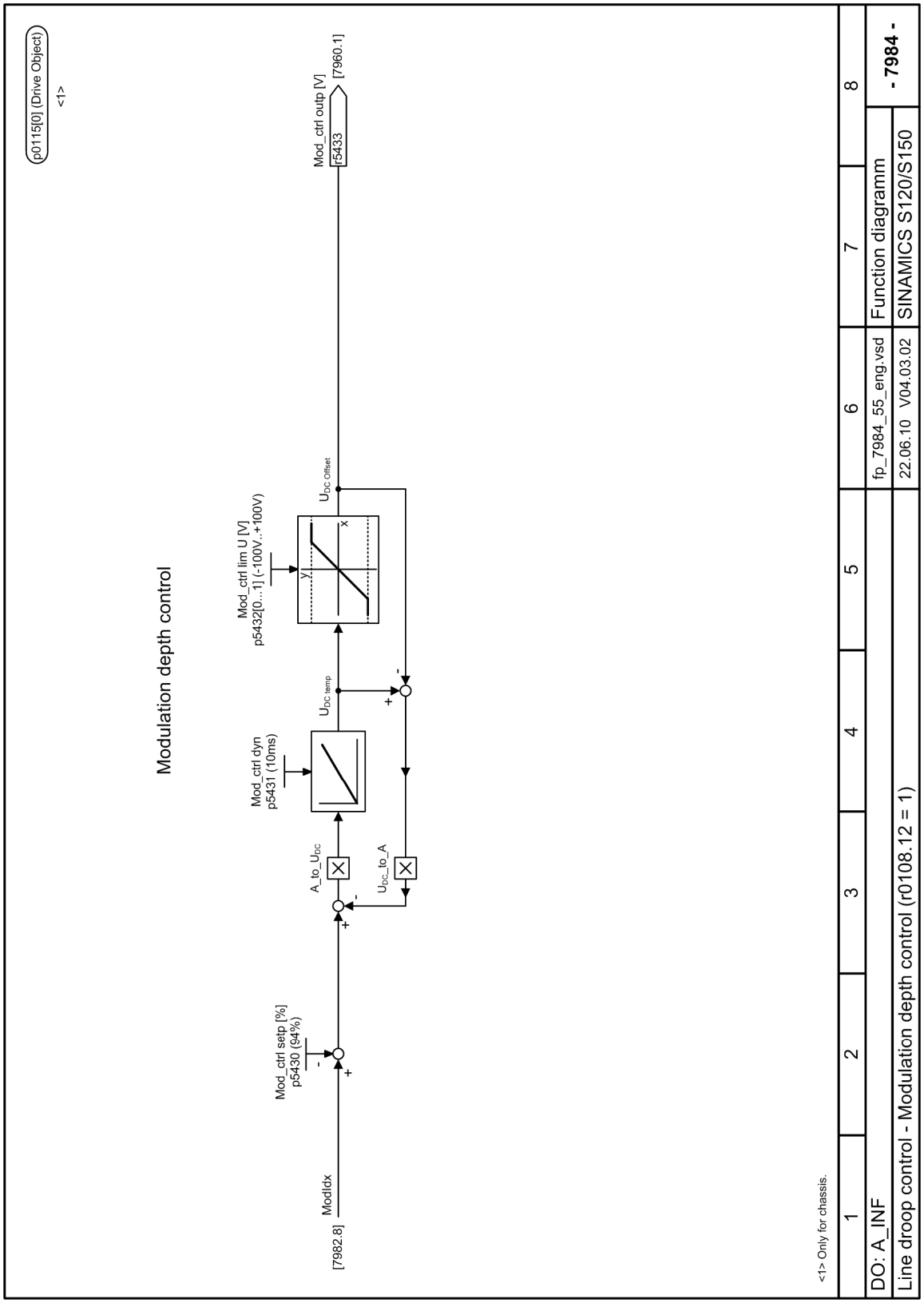


Figure 6-6 Grid droop control - drive level control 7984

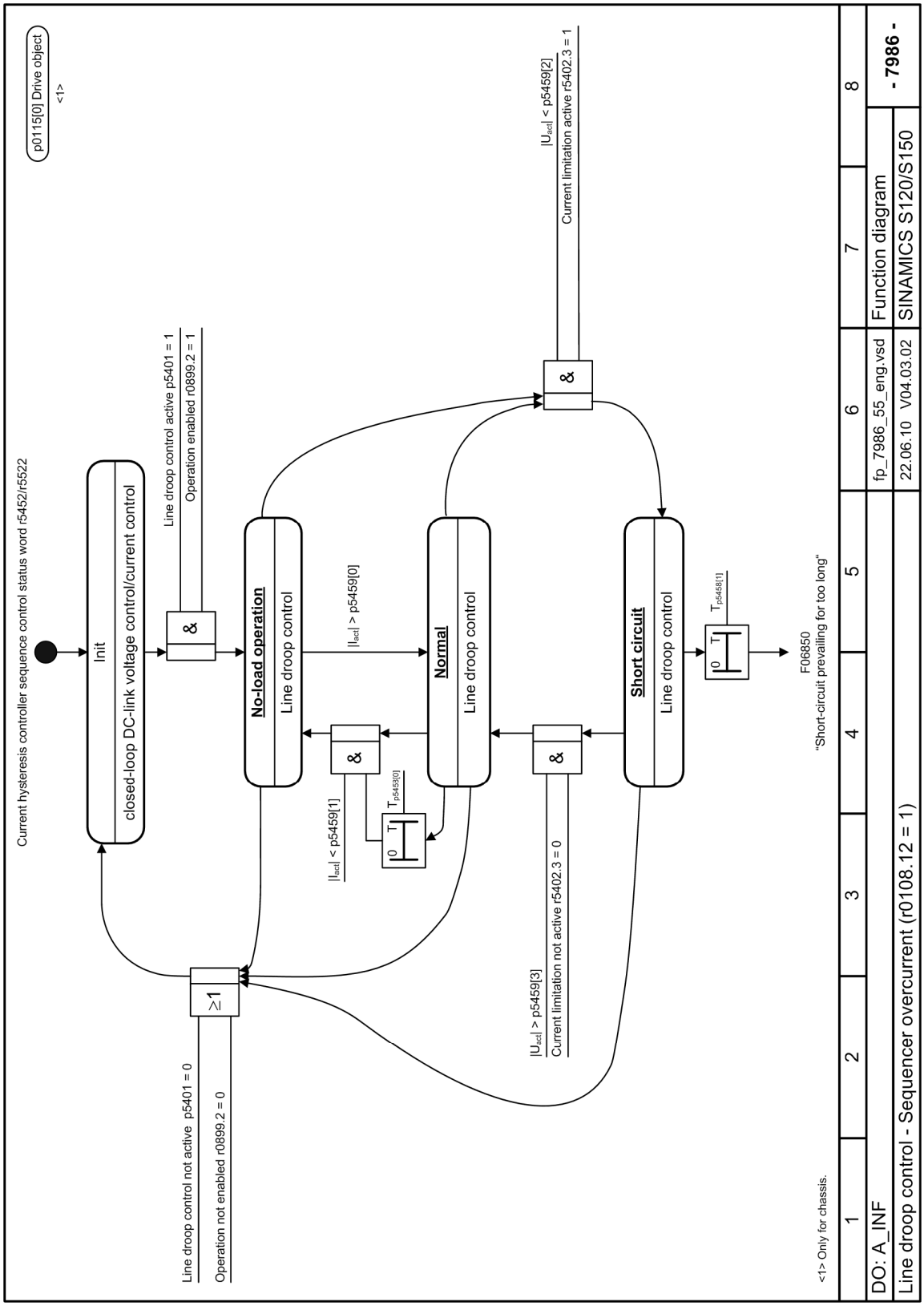


Figure 6-7 Grid droop control - sequence control 7986

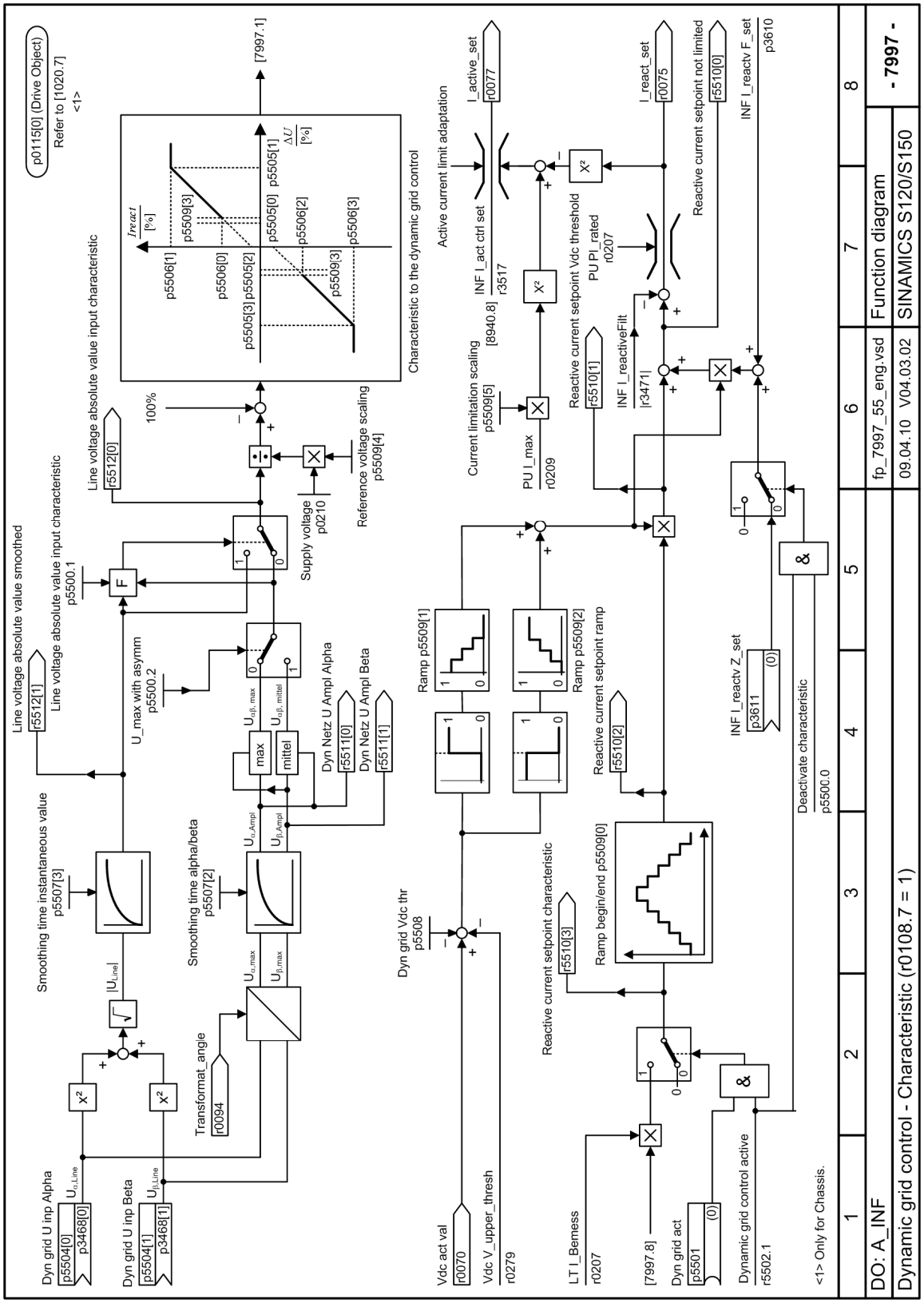


Figure 6-8 Dynamic grid support - Characteristic 7997

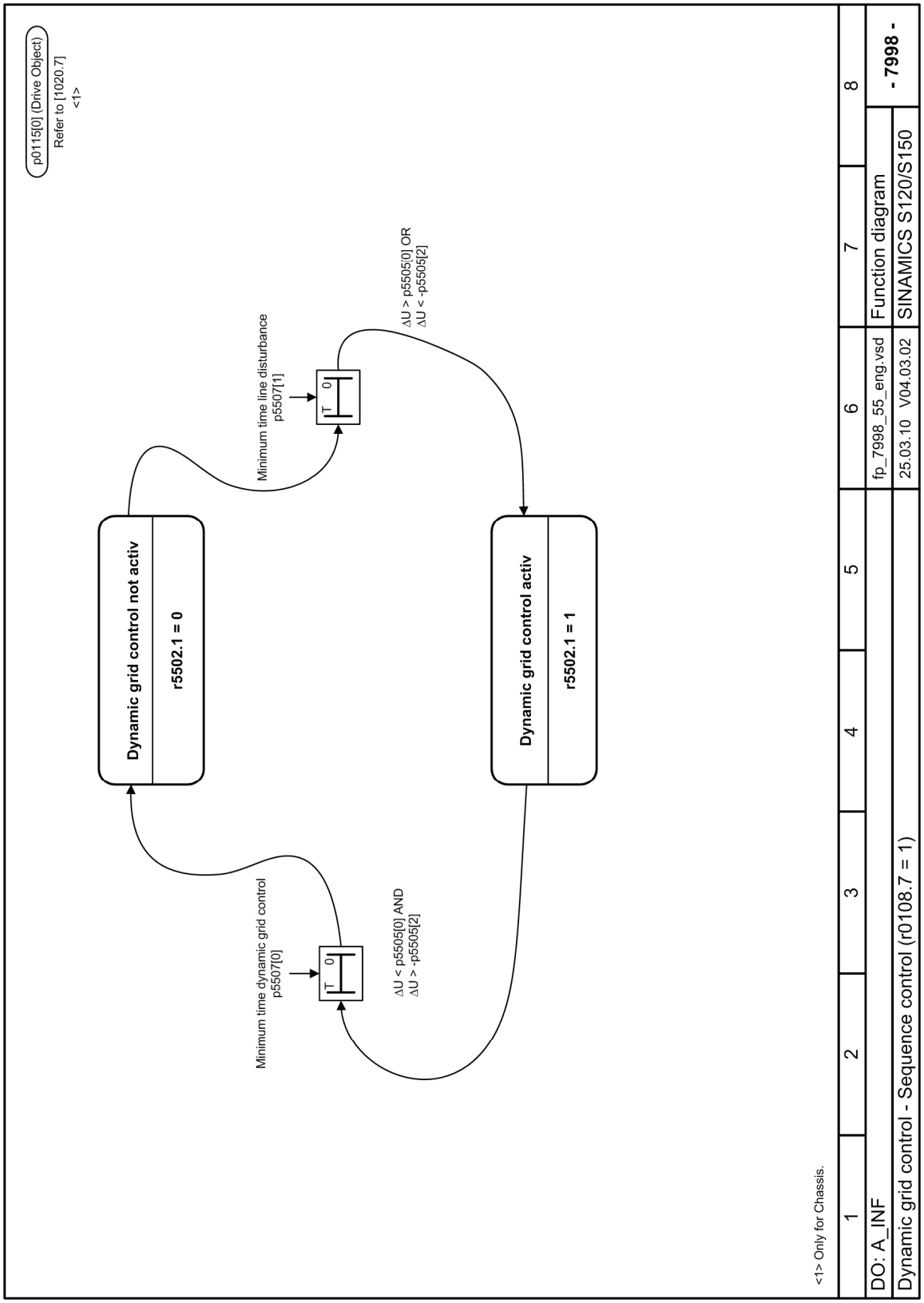


Figure 6-9 Dynamic grid support - Sequence control 7998

Index

M

O

P

S

T

V

Siemens AG
Industry Sector
Drive Technologies
Large Drives
P.O. Box 4743
90025 NUREMBERG
GERMANY

www.siemens.com/automation