SINAMICS S120

Booksize power units

Manual · 01/2012

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S120
Booksize Power Units

Manual

Preface

System overview 1

Line connection and line-side power components 2

Line Modules Booksize 3

Line Modules Booksize Compact 4

Motor Modules Booksize 5

Motor Modules Booksize Compact 6

Electrical connection for Line Modules and Motor Modules 7

DC link components 8

Braking resistors 9

Motor-side power components 10

Accessories 11

Cabinet design and EMC Booksize 12

Cooling circuit and coolant properties 13

Service and Support Booksize 14

Appendix A A

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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.

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Disclaimer of Liability

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

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Preface

SINAMICS documentation

The SINAMICS documentation is organized in the following categories:

- General documentation/catalogs
- User documentation
- Manufacturer/service documentation

More information

Using the following link, you can find information on the topics:

- Ordering documentation/overview of documentation
- Additional links to download documents
- Using documentation online (find and search in manuals/information)

http://www.siemens.com/motioncontrol/docu

Please send any questions about the technical documentation (e.g. suggestions for improvement, corrections) to the following e-mail address:
docu.motioncontrol@siemens.com

My Documentation Manager

Using the following link, you can find information on how to create your own individual documentation based on Siemens' content, and adapt it for your own machine documentation:
http://www.siemens.com/mdm

Training

Using the following link, you can find information on SITRAIN - training from Siemens for products, systems and automation engineering solutions:
http://www.siemens.com/sitrain

FAQs

You can find Frequently Asked Questions in the Service&Support pages under **Product Support**:
http://support.automation.siemens.com

SINAMICS

You can find information on SINAMICS under:
http://www.siemens.com/sinamics

Usage phases and the available tools/documents

Table 1 Usage phases and the available tools/documents

Usage phase	Tools
Orientation	SINAMICS S sales documentation
Planning/engineering	• SIZER configuration tool • Configuration manuals, motors
Decision making/ordering	SINAMICS S Catalogs
Configuring/installation	• SINAMICS S120 Equipment Manual for Control Units and Additional System Components • SINAMICS S120 Equipment Manual for Booksize Power Units • SINAMICS S120 Equipment Manual for Chassis Power Units • SINAMICS S120 Equipment Manual for AC Drives • SINAMICS S120M Equipment Manual Distributed Drive Technology
Commissioning	• STARTER commissioning tool • SINAMICS S120 Getting Started • SINAMICS S120 Commissioning Manual • SINAMICS S120 CANopen Commissioning Manual • SINAMICS S120 Function Manual • SINAMICS S120/S150 List Manual
Using/operating	• SINAMICS S120 Commissioning Manual • SINAMICS S120/S150 List Manual
Maintenance/Service	• SINAMICS S120 Commissioning Manual • SINAMICS S120/S150 List Manual
List of references	• SINAMICS S120/S150 List Manual

Target group

This documentation is intended for machine manufacturers, commissioning engineers, and service personnel who use the SINAMICS drive system.

Benefits

This Manual provides all the information, procedures and operational instructions required for commissioning and servicing SINAMICS S120.

Standard scope

The scope of the functionality described in this document can differ from the scope of the functionality of the drive system that is actually supplied.

- Other functions that are not explained in this documentation may be able to be executed in the drive system. However, no claim can be made regarding the availability of these functions when the equipment is first supplied or in the event of servicing.
- The documentation can also contain descriptions of functions that are not available in a particular product version of the drive system. The functionalities of the supplied drive system should only be taken from the ordering documentation.
- Extensions or changes made by the machine manufacturer must be documented by the machine manufacturer.

For reasons of clarity, this documentation does not contain all of the detailed information on all of the product types. This documentation cannot take into consideration every conceivable type of installation, operation and service/maintenance.

Technical Support

Country-specific telephone numbers for technical support are provided in the Internet under **Contact**:

http://www.siemens.com/automation/service&support

EC Declarations of Conformity

The EC Declaration of Conformity for the EMC Directive can be found on the Internet at:

http://support.automation.siemens.com

There – as a search term – enter the number **15257461** or contact your local Siemens office.

The EC Declaration of Conformity for the Low Voltage Directive can be found on the Internet at:

http://support.automation.siemens.com

There – as a search term – enter the number **22383669** .

Note

When operated in dry areas, SINAMICS S devices conform to the Low Voltage Directive 73/23/EEC or 2006/95/EEC.

Note

SINAMICS S devices fulfill EMC Directive 89/336/EEC or 2004/108/EEC in the configuration specified in the associated EC Declaration of Conformity for EMC and when the EMC installation guideline provided in the Configuration Manual with Order No. 6FC5297-0AD30-0□P□ is implemented.

Note

The Manual describes a desired state which, if maintained, ensures the required level of operational reliability and compliance with EMC limit values.

Should there be any deviation from the requirements in the Manual, appropriate actions (e.g. measurements) must be taken to check/prove that the required level of operational reliability and compliance with EMC limit values are ensured.

EMC limit values in South Korea

이 기기는 업무용(A급) 전자파적합기기로서 판매자 또는 사용자는 이 점을 주의하시기 바라며, 가정외의 지역에서 사용하는 것을 목적으로 합니다.
For sellers or other user, please keep in mind that this device in an A-grade electromagnetic wave device.
This device is intended to be used in areas other than home.

The EMC limit values to be complied with for South Korea correspond to the limit values of the EMC product standard for variable-speed electric drives EN 61800-3, Category C2 or limit value class A, Group 1 according to EN 55011. By applying suitable supplementary measures, the limit values according to Category C2 or according to limit value class A, Group 1, are maintained. Further, additional measures may be required, for instance, using an additional radio interference suppression filter (EMC filter).
The measures for EMC-compliant design of the system are described in detail in this manual respectively in the Installation Guideline EMC.
Please note that the final statement on compliance with the standard is given by the respective label attached to the individual unit.

Spare parts

Spare parts are available on the Internet at:
http://support.automation.siemens.com/WW/view/de/16612315

Test certificates

The Safety Integrated functions of SINAMICS components are generally certified by independent institutes. An up-to-date list of already certified components is available on request from your local Siemens office. If you have any questions relating to certifications that have not been completed, please ask your Siemens contact.

ESD information

⚠ CAUTION

Electrostatic sensitive devices (ESDs) are individual components, integrated circuits, or boards that may be damaged by either electrostatic fields or electrostatic discharge.

Regulations for handling ESD components:

When handling electronic components, you must ensure that the person carrying out the work, the work place, and packaging are properly grounded.

Personnel may only come into contact with electronic components, if

- They are grounded with an ESD wrist band, or
- They are in ESD areas with conductive flooring, ESD shoes or ESD grounding straps.

Electronic boards should only be touched if absolutely necessary. They must only be handled on the front panel or, in the case of printed circuit boards, at the edge.

Electronic boards must not come into contact with plastics or items of clothing containing synthetic fibers.

Boards must only be placed on conductive surfaces (work surfaces with ESD surface, conductive ESD foam, ESD packing bag, ESD transport container).

Do not place boards near display units, monitors, or television sets (minimum distance from screen: 10 cm).

Measurements may only be taken on boards when the measuring device 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).

⚠ DANGER

Electrical, magnetic and electromagnetic fields (EMF) that occur during operation can pose a danger to persons who are present in the direct vicinity of the product - especially persons with pacemakers, implants, or similar devices.

The relevant directives and standards must be observed by the machine/plant operators and persons present in the vicinity of the product. These are, for example, EMF Directive 2004/40/EEC and standards EN 12198-1 to -3 applying to the European Economic Area (EEA) and in Germany the accident prevention regulation BGV 11 and the associated rule BGR 11 "Electromagnetic fields" from the German employer's liability accident insurance association.

These state that a hazard analysis must drawn up for every workplace, from which measures for reducing dangers and their impact on persons are derived and applied, and exposure and danger zones are defined and observed.

The relevant safety notes in each chapter must be observed.

General safety guidelines

⚠ 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.

Only qualified personnel may install, commission and service SINAMICS S units.

The personnel must take into account the information provided in the technical customer documentation for the product, and be familiar with and observe the specified danger and warning notices.

Operational electrical equipment and motors have parts and components which are at hazardous voltage levels that may cause serious injuries or death when touched.

All work on the electrical system must be carried out when the system has been disconnected from the power supply.

In combination with the drive system, the motors are generally approved for operation on TN and TT systems with grounded neutral and on IT systems.

In operation on IT systems, the occurrence of a first fault between an active part and ground must be signaled by a monitoring device. In accordance with IEC 60364-4-41 it is recommended that the first fault should be eliminated as quickly as practically possible.

In systems with a grounded external conductor, an isolating transformer with grounded neutral (secondary side) must be connected between the supply and the drive system to protect the motor insulation from excessive stress. The majority of TT systems have a grounded external conductor, so in this case an isolating transformer must be used.

⚠ DANGER

Correct and safe operation of SINAMICS S units assumes correct transportation in the transport packaging, correct long-term storage in the transport packaging, setup and installation, as well as careful operation and maintenance.

The details in the catalogs and proposals also apply to the design of special equipment versions.

In addition to the danger and warning information provided in the technical customer documentation, the applicable national, local, and system-specific regulations and requirements must be taken into account.

According to EN 61800-5-1 and UL 508, only safely isolated protective extra low voltages may be connected to any of the connections or terminals on the electronics modules.

⚠ DANGER

Using protection against direct contact via DVC A (PELV) is only permissible in areas with equipotential bonding and in dry rooms indoors. If these conditions are not fulfilled, other protective measures against electric shock must be applied, e.g., shock-hazard protection.

⚠ DANGER

As part of routine tests, SINAMICS S components will undergo a voltage test in accordance with EN 61800-5-1. Before the voltage test is performed on the electrical equipment of machines to EN 60204-1, Section 18.4, all connections of SINAMICS units must be disconnected/unplugged to prevent them from being damaged.

Motors should be connected up corresponding to the circuit diagram supplied with the motor (refer to the connection examples of Motor Modules). They must not be connected directly to the three-phase supply because this will damage them.

⚠ WARNING

Operating the equipment in the immediate vicinity (< 1.8 m) of mobile telephones with a transmitter power of > 1 W may cause the equipment to malfunction.

Explanation of symbols

Table 2 Symbols

Symbol	Meaning
	Protective earth (PE)
	Ground (e.g. M 24 V)
	Functional ground Equipotential bonding

Residual risks

Residual risks of power drive systems

The control and drive components of a power drive system (PDS) are approved for industrial and commercial use in industrial line supplies. Their use in public line supplies requires a different configuration and/or additional measures.

These components may only be operated in closed housings or in higher-level control cabinets with protective covers that are closed, and when all of the protective devices are used.

These components may only be handled by qualified and trained technical personnel who are knowledgeable and observe all of the safety information and instructions on the components and in the associated technical user documentation.

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

1. Unintentional movements of driven machine components during commissioning, operation, maintenance, and repairs caused by, for example:
   - Hardware defects and/or software errors in the sensors, controllers, actuators, and connection technology
   - Response times of the controller and drive
   - Operating and/or ambient conditions not within the scope of the specification
   - Condensation / conductive contamination
   - Parameterization, programming, cabling, and installation errors
   - Use of radio devices / cellular phones in the immediate vicinity of the controller
   - External influences / damage
2. Exceptional temperatures as well as emissions of light, noise, particles, or gas caused by, for example:
   - Component malfunctions
   - Software errors
   - Operating and/or ambient conditions not within the scope of the specification
   - External influences / damage
3. Hazardous shock voltages caused by, for example:
   - Component malfunctions
   - Influence of electrostatic charging
   - Induction of voltages in moving motors
   - Operating and/or ambient conditions not within the scope of the specification
   - Condensation / conductive contamination
   - External influences / damage

4. Electrical, magnetic and electromagnetic fields generated in operation that can pose a risk to people with a pacemaker, implants or metal replacement joints, etc. if they are too close.
5. Release of environmental pollutants or emissions as a result of improper operation of the system and/or failure to dispose of components safely and correctly.

Note

Functional safety of SINAMICS components

The components must be protected against conductive contamination (e.g. by installing them in a cabinet with degree of protection IP54B to EN 60529).

Assuming that conductive contamination at the installation site can definitely be excluded, a lower degree of cabinet protection may be permitted.

For more information about residual risks of the components in a power drive system, see the relevant chapters in the technical user documentation.

Table of contents

Preface **3**

1 System overview **27**

1.1 Field of application 27

1.2 Platform Concept and Totally Integrated Automation 28

1.3 Introduction 30

1.4 SINAMICS S120 components 32
1.4.1 Introduction 34
1.4.2 Introduction 37

1.5 System Data 39

1.6 Derating as a function of the installation altitude and ambient temperature 41

1.7 Standards 42

2 Line connection and line-side power components **45**

2.1 Introduction 45

2.2 Information on the disconnector unit 46

2.3 Overcurrent protection by means of line fuses and circuit breakers 47

2.4 Line supply connection via residual-current devices 50
2.4.1 Residual-current operated circuit breakers (RCD) 50
2.4.2 Residual-current monitors (RCM) 52

2.5 Overvoltage protection 54

2.6 Line contactors 54

2.7 Line filters 55
2.7.1 Safety information 57
2.7.2 Basic Line Filters for Active Line Modules 59
2.7.2.1 Description 59
2.7.2.2 Interface description 60
2.7.2.3 Dimension drawing 61
2.7.2.4 Technical specifications 64
2.7.3 Wideband Line Filter for Active Line Modules 65
2.7.3.1 Description 65
2.7.3.2 Interface description 66
2.7.3.3 Dimension drawings 68
2.7.3.4 Technical data 72
2.7.4 Basic Line Filter for Basic Line Modules 73
2.7.4.1 Description 73
2.7.4.2 Interface description 74
2.7.4.3 Dimension drawing 75
2.7.4.4 Technical data 77
2.7.5 Basic Line Filter for Smart Line Modules 78

2.7.5.1 Description ... 78
2.7.5.2 Interface description ... 79
2.7.5.3 Dimension Drawings ... 80
2.7.5.4 Technical Specifications ... 83

2.8 Line reactors ... 84
2.8.1 Safety information ... 85
2.8.2 Line reactors for Active Line Modules ... 86
2.8.2.1 Interface description ... 86
2.8.2.2 Dimension drawings ... 89
2.8.2.3 Technical data ... 94
2.8.3 Damping resistor for HFD line reactors ... 94
2.8.3.1 Description ... 94
2.8.3.2 Safety information ... 94
2.8.3.3 Dimension drawings ... 95
2.8.3.4 Technical data ... 98
2.8.3.5 Wiring with the HFD line reactor ... 99
2.8.4 Line reactors for Basic Line Modules ... 100
2.8.4.1 Interface description ... 100
2.8.4.2 Dimension drawings ... 103
2.8.4.3 Technical data ... 106
2.8.5 Line reactors for Smart Line Modules ... 106
2.8.5.1 Interface description ... 106
2.8.5.2 Dimension Drawings ... 108
2.8.5.3 Technical specifications ... 111

2.9 Active Interface Modules internal air cooling ... 112
2.9.1 Description ... 112
2.9.2 Safety information ... 113
2.9.3 Interface description ... 115
2.9.3.1 Overview ... 115
2.9.3.2 Line/load connection ... 119
2.9.3.3 X121 temperature sensor and fan control ... 119
2.9.3.4 X124 Electronics power supply ... 120
2.9.4 Connection example ... 120
2.9.5 Dimension drawings ... 121
2.9.6 Installation ... 125
2.9.7 Operation on an isolated-neutral system (IT system) ... 128
2.9.8 Electrical tests ... 130
2.9.9 Technical data ... 131

2.10 Combining line reactors and line filters ... 132

2.11 Line connection variants ... 133
2.11.1 Ways of connecting the line supply ... 133
2.11.2 Operation of the line connection components on the supply network ... 134
2.11.3 Operation of the line connection components via a transformer ... 135
2.11.3.1 Safety information ... 135
2.11.3.2 Line supply connection conditions for Line Modules ... 135
2.11.3.3 Dimensioning an isolating transformer/autotransformer for several loads ... 136
2.11.3.4 Operation of the line connection components via an autotransformer ... 141
2.11.3.5 Operation of the line connection components via an isolating transformer ... 143

3 Line Modules Booksize 145

3.1 Active Line Modules with internal air cooling 145
3.1.1 Description 145
3.1.2 Safety information 145
3.1.3 Interface description 148
3.1.3.1 Overview 148
3.1.3.2 X1 line connection 149
3.1.3.3 X12 fan connection 150
3.1.3.4 X21 EP terminals 150
3.1.3.5 X24 24 V terminal adapter 151
3.1.3.6 X200-X202 DRIVE-CLiQ interfaces 152
3.1.4 Connection example 153
3.1.5 Meaning of LEDs 154
3.1.6 Dimension drawings 155
3.1.7 Installation 159
3.1.8 Technical data 161
3.1.8.1 Characteristics 165

3.2 Active Line Modules with external air cooling 168
3.2.1 Description 168
3.2.2 Safety information 168
3.2.3 Interface description 171
3.2.3.1 Overview 171
3.2.3.2 X1 line connection 172
3.2.3.3 X12 fan connection 173
3.2.3.4 X21 EP terminals 173
3.2.3.5 X24 24 V terminal adapter 174
3.2.3.6 X200-X202 DRIVE-CLiQ interfaces 175
3.2.4 Connection example 176
3.2.5 Meaning of LEDs 177
3.2.6 Dimension drawings 178
3.2.7 Installation 181
3.2.8 Technical data 187
3.2.8.1 Characteristics 191

3.3 Active Line Modules with cold plate 194
3.3.1 Description 194
3.3.2 Safety information 194
3.3.3 Interface description 197
3.3.3.1 Overview 197
3.3.3.2 X1 line connection 198
3.3.3.3 X21 EP terminals 199
3.3.3.4 X24 24 V terminal adapter 200
3.3.3.5 X200-X202 DRIVE-CLiQ interfaces 200
3.3.4 Connection example 201
3.3.5 Meaning of LEDs 202
3.3.6 Dimension drawings 203
3.3.7 Installation 205
3.3.8 Technical data 208
3.3.8.1 Characteristics 210

3.4 Active Line Modules Liquid Cooled ... 213
3.4.1 Description ... 213
3.4.2 Safety information ... 213
3.4.3 Interface description ... 216
3.4.3.1 Overview ... 216
3.4.3.2 X1 line connection ... 217
3.4.3.3 X21 EP terminals ... 217
3.4.3.4 X24 24 V terminal adapter ... 219
3.4.3.5 X200-X202 DRIVE-CLiQ interfaces ... 219
3.4.4 Connection example ... 220
3.4.5 Meaning of LEDs ... 221
3.4.6 Dimension drawing ... 222
3.4.7 Installation ... 223
3.4.8 Technical data ... 224
3.4.8.1 Characteristics ... 226

3.5 Basic Line Modules with internal air cooling ... 228
3.5.1 Description ... 228
3.5.2 Safety information ... 229
3.5.3 Interface description ... 231
3.5.3.1 Overview ... 231
3.5.3.2 X1 line connection ... 232
3.5.3.3 X2 braking resistor connection ... 234
3.5.3.4 X21 EP terminals ... 235
3.5.3.5 X24 24 V terminal adapter ... 236
3.5.3.6 X200-X202 DRIVE-CLiQ interfaces ... 236
3.5.4 Connection examples ... 237
3.5.5 Meaning of LEDs ... 239
3.5.6 Dimension drawings ... 240
3.5.7 Installation ... 243
3.5.8 Operation on an isolated-neutral system (IT system) ... 244
3.5.9 Technical data ... 245
3.5.9.1 Characteristics ... 247

3.6 Basic Line Modules with cold plate ... 250
3.6.1 Description ... 250
3.6.2 Safety information ... 251
3.6.3 Interface description ... 253
3.6.3.1 Overview ... 253
3.6.3.2 X1 line connection ... 254
3.6.3.3 X2 braking resistor connection ... 256
3.6.3.4 X21 EP terminals ... 257
3.6.3.5 X24 24 V terminal adapter ... 258
3.6.3.6 X200-X202 DRIVE-CLiQ interfaces ... 258
3.6.4 Connection examples ... 259
3.6.5 Meaning of LEDs ... 261
3.6.6 Dimension drawings ... 262
3.6.7 Installation ... 265
3.6.8 Operation on an isolated-neutral system (IT system) ... 269
3.6.9 Technical data ... 270
3.6.9.1 Characteristics ... 271

3.7 Smart Line Modules with internal air cooling 274
3.7.1 Description 274
3.7.2 Safety Information 274
3.7.3 Interface description 278
3.7.3.1 Overview 278
3.7.3.2 X1 line connection 281
3.7.3.3 X21 EP terminals 283
3.7.3.4 X22 digital inputs 286
3.7.3.5 X24 24 V terminal adapter 287
3.7.3.6 X200-X202 DRIVE-CLiQ interfaces 287
3.7.4 Connection examples 288
3.7.5 Meaning of LEDs 290
3.7.5.1 Smart Line Modules 5 kW and 10 kW 290
3.7.5.2 16 kW to 55 kW Smart Line Modules 291
3.7.6 Dimension drawings 292
3.7.7 Installation 296
3.7.8 Technical data 297
3.7.8.1 Characteristics 299

3.8 Smart Line Modules with external air cooling 301
3.8.1 Description 301
3.8.2 Safety Information 302
3.8.3 Interface description 306
3.8.3.1 Overview 306
3.8.3.2 X1 line connection 309
3.8.3.3 X21 EP terminals 311
3.8.3.4 X22 digital inputs 314
3.8.3.5 X24 24 V terminal adapter 315
3.8.3.6 X200-X202 DRIVE-CLiQ interfaces 315
3.8.4 Connection examples 316
3.8.5 Meaning of LEDs 318
3.8.5.1 Smart Line Modules 5 kW and 10 kW 318
3.8.5.2 16 kW to 55 kW Smart Line Modules 319
3.8.6 Dimension drawings 320
3.8.7 Installation 324
3.8.8 Technical data 330
3.8.8.1 Characteristics 332

3.9 Smart Line Modules with cold plate 334
3.9.1 Description 334
3.9.2 Safety Information 334
3.9.3 Interface description 338
3.9.3.1 Overview 338
3.9.3.2 X1 line connection 339
3.9.3.3 X21 EP terminals 340
3.9.3.4 X22 digital inputs 342
3.9.3.5 X24 24 V terminal adapter 342
3.9.4 Connection example 343
3.9.5 Meaning of LEDs 344
3.9.6 Dimension drawings 345
3.9.7 Installation 346
3.9.8 Technical data 348
3.9.8.1 Characteristics 350

3.9.8.2 Measuring the heat sink temperature ... 352

4 Line Modules Booksize Compact ... 353

4.1 Smart Line Modules Booksize Compact ... 353
4.1.1 Description ... 353
4.1.2 Safety information ... 354
4.1.3 Interface description ... 356
4.1.3.1 Overview ... 356
4.1.3.2 X1 line connection ... 357
4.1.3.3 X21 EP terminals ... 357
4.1.3.4 X24 24 V terminal adapter ... 358
4.1.3.5 X200-X202 DRIVE-CLiQ interfaces ... 359
4.1.4 Connection example ... 360
4.1.5 Meaning of LEDs ... 361
4.1.6 Dimension Drawing ... 362
4.1.7 Installation ... 363
4.1.8 Technical data ... 366
4.1.8.1 Characteristics ... 368

5 Motor Modules Booksize ... 371

5.1 Motor Modules with internal air cooling ... 371
5.1.1 Description ... 371
5.1.2 Safety information ... 371
5.1.3 Interface description ... 374
5.1.3.1 Overview ... 374
5.1.3.2 Motor and brake connection ... 376
5.1.3.3 X12 fan connection ... 378
5.1.3.4 X21/X22 EP terminals/temperature sensor ... 378
5.1.3.5 X200-X203 DRIVE-CLiQ interface ... 379
5.1.4 Connection Examples ... 380
5.1.5 Meaning of LEDs ... 382
5.1.6 Dimension drawings ... 383
5.1.7 Installation ... 388
5.1.8 Technical data ... 390
5.1.8.1 Single Motor Modules ... 390
5.1.8.2 Double Motor Modules ... 392
5.1.8.3 Characteristics ... 393

5.2 Motor Module with external air cooling ... 397
5.2.1 Description ... 397
5.2.2 Safety information ... 397
5.2.3 Interface description ... 400
5.2.3.1 Overview ... 400
5.2.3.2 Motor and brake connection ... 402
5.2.3.3 X12 fan connection ... 404
5.2.3.4 X21/X22 EP terminals/temperature sensor ... 404
5.2.3.5 X200-X203 DRIVE-CLiQ interface ... 405
5.2.4 Connection Examples ... 406
5.2.5 Meaning of LEDs ... 408
5.2.6 Dimension drawings ... 409
5.2.7 Installation ... 414
5.2.8 Technical data ... 421
5.2.8.1 Single Motor Modules ... 421

5.2.8.2 Double Motor Modules 423
5.2.8.3 Characteristics 424
5.3 Motor Modules with cold plate 428
5.3.1 Description 428
5.3.2 Safety information 428
5.3.3 Interface description 431
5.3.3.1 Overview 431
5.3.3.2 Motor and brake connection 433
5.3.3.3 X21/X22 EP terminals/temperature sensor 435
5.3.3.4 X200-X203 DRIVE-CLiQ interface 436
5.3.4 Connection Examples 437
5.3.5 Meaning of LEDs 439
5.3.6 Dimension Drawings 440
5.3.7 Installation 444
5.3.8 Technical data 447
5.3.8.1 Single Motor Modules 447
5.3.8.2 Double Motor Modules 449
5.3.8.3 Characteristics 450
5.4 Motor Modules Liquid Cooled 454
5.4.1 Description 454
5.4.2 Safety information 454
5.4.3 Interface description 457
5.4.3.1 Overview 457
5.4.3.2 Motor and brake connection 458
5.4.3.3 X21 EP terminal/temperature sensor 459
5.4.3.4 X200-X202 DRIVE-CLiQ interface 460
5.4.4 Connection example 461
5.4.5 Meaning of LEDs 462
5.4.6 Dimension drawing 463
5.4.7 Installation 464
5.4.8 Technical data 465
5.4.8.1 Characteristics 466
6 Motor Modules Booksize Compact 471
6.1 Description 471
6.2 Safety information 471
6.3 Interface description 474
6.3.1 Overview 474
6.3.2 X1/X2 motor connection 476
6.3.3 X11/X12 motor brake connection 477
6.3.4 X21/X22 EP terminals/temperature sensor 478
6.3.5 X200-X203 DRIVE-CLiQ interface 479
6.4 Connection example 480
6.5 Meaning of LEDs 481
6.6 Dimension drawings 482
6.7 Installation 485
6.8 Technical data 488
6.8.1 Single Motor Modules 488

6.8.2 Double Motor Modules ... 489
6.8.3 Characteristics ... 490

7 Electrical connection for Line Modules and Motor Modules ... 495

7.1 Connection of DC-link busbars and 24 V busbars ... 495
7.2 Installation of the 24 V terminal adapter ... 496
7.3 Shield connection for terminals X21/X22 on the Motor Module ... 499

8 DC link components ... 501

8.1 Braking Module Booksize ... 501
8.1.1 Description ... 501
8.1.2 Safety information ... 503
8.1.3 Interface description ... 504
8.1.3.1 Overview ... 504
8.1.3.2 X1 braking resistor connection ... 505
8.1.3.3 X21 digital inputs/outputs ... 506
8.1.4 Connection example ... 507
8.1.5 Meaning of LEDs ... 508
8.1.6 Dimension drawing ... 509
8.1.7 Installation ... 510
8.1.8 Technical data ... 511
8.1.8.1 Characteristic curves ... 512
8.1.8.2 Configuration instructions ... 513

8.2 Braking Module Booksize Compact ... 514
8.2.1 Description ... 514
8.2.2 Safety information ... 516
8.2.3 Interface description ... 517
8.2.3.1 Overview ... 517
8.2.3.2 X1 braking resistor connection ... 518
8.2.3.3 X21 digital inputs/outputs ... 519
8.2.3.4 X22 digital output/temperature switch ... 520
8.2.3.5 DIP switch ... 520
8.2.4 Connection examples ... 521
8.2.5 Meaning of LEDs ... 523
8.2.6 Dimension drawing ... 524
8.2.7 Installation ... 525
8.2.8 Technical data ... 527
8.2.8.1 Characteristic curves ... 528
8.2.9 Configuration instructions ... 530

8.3 Braking units for 100 kW Basic Line Modules ... 531
8.3.1 Description ... 531
8.3.2 Safety information ... 531
8.3.3 Interface description ... 533
8.3.3.1 X3 DC link connection ... 533
8.3.3.2 X6 braking resistor connection ... 534
8.3.3.3 Switch S1 ... 534
8.3.4 Connection example ... 535
8.3.5 Dimension Drawing ... 536
8.3.6 Connection to the Basic Line Module 100 kW ... 537

8.4 Capacitor Module 539
8.4.1 Description 539
8.4.2 Safety Information 539
8.4.3 Interface description 541
8.4.3.1 Overview 541
8.4.4 Dimension Drawing 542
8.4.5 Installation 543
8.4.6 Technical Specifications 544

8.5 Control Supply Module CSM 545
8.5.1 Description 545
8.5.2 Safety information 546
8.5.3 Interface description 547
8.5.3.1 Overview 547
8.5.3.2 X1 line connection 548
8.5.3.3 X21 signaling contact 549
8.5.3.4 X24 24 V terminal adapter 550
8.5.3.5 S1 DIP switch 551
8.5.4 Connection examples 552
8.5.4.1 Single operation 553
8.5.4.2 Parallel operation 554
8.5.5 Meaning of LEDs 559
8.5.6 Dimension drawing 560
8.5.7 Installation 561
8.5.8 Technical data 562
8.5.8.1 Characteristics 563

8.6 Voltage Clamping Module VCM 564
8.6.1 Description 564
8.6.2 Safety information 565
8.6.3 Interface description 567
8.6.3.1 Overview 567
8.6.3.2 X1 functional ground 568
8.6.4 Connection example 569
8.6.5 Dimension drawing 570
8.6.6 Installation 571
8.6.7 Technical specifications 571

9 Braking resistors 575

9.1 Description 575

9.2 Safety information 576

9.3 Dimension drawings 577

9.4 Technical data 584
9.4.1 Characteristic curves 585

10 Motor-side power components 587

10.1 Motor reactors 587
10.1.1 Description 587
10.1.2 Safety information 588
10.1.3 Dimension drawings 589
10.1.4 Technical data 595

10.2 Voltage Protection Module VPM ... 597
10.2.1 Description ... 597
10.2.2 Safety information ... 598
10.2.3 Interface description ... 599
10.2.3.1 Overview ... 599
10.2.3.2 Signaling interface X3 ... 601
10.2.3.3 Connection bars U, V, W, PE ... 602
10.2.4 Connection examples ... 603
10.2.5 Dimension drawings ... 605
10.2.6 Installation ... 607
10.2.7 Electrical connection ... 609
10.2.7.1 Connecting signaling contact X3 ... 610
10.2.7.2 Connecting power cables (using the VPM 200 Dynamik as an example) ... 611
10.2.8 Technical data ... 614

11 Accessories ... 615

11.1 Shield connecting plates for power supply and motor cables ... 615
11.1.1 Description ... 615
11.1.2 Shield connecting plates ... 615
11.1.3 Overview examples ... 618
11.1.4 Dimension drawings ... 622
11.1.4.1 Line Modules and Motor Modules with internal air cooling ... 622
11.1.4.2 Line Modules and Motor Modules with external air cooling ... 626
11.1.4.3 Line Modules and Motor Modules with cold plate ... 630
11.1.4.4 Line Modules and Motor Modules, Liquid Cooled ... 634
11.1.4.5 Active Interface Modules ... 635
11.1.5 Installation ... 638
11.1.6 Connecting the power cables ... 641

11.2 Releasing the DC link protective cover ... 643

11.3 DC link rectifier adapter for Booksize format ... 644
11.3.1 Description ... 644
11.3.2 Safety Information ... 644
11.3.3 Interface description ... 646
11.3.3.1 Overview ... 646
11.3.3.2 DC link connection ... 647
11.3.4 Dimension drawings ... 648
11.3.5 Installation ... 650
11.3.5.1 Safety information ... 650
11.3.5.2 Installation on components that are 50 mm and 100 mm wide ... 651
11.3.5.3 Installation on components that are 150 mm, 200 mm and 300 mm wide ... 653
11.3.6 Electrical connection ... 655
11.3.7 Technical specifications ... 656

11.4 DC link adapter ... 657
11.4.1 Description ... 657
11.4.2 Safety Information ... 657
11.4.3 Interface description ... 659
11.4.3.1 Overview ... 659
11.4.3.2 DC link connection ... 660
11.4.4 Dimension drawing ... 661
11.4.5 Installation ... 662
11.4.6 Electrical connection ... 664

11.4.7 Technical specifications 665
11.5 Reinforced DC-link busbars 666
11.5.1 Description 666
11.5.2 Safety information 666
11.5.3 Dimension drawings 668
11.5.4 Removing the DC link busbars 669
11.5.5 Mounting the reinforced DC link busbars 671
11.6 DRIVE-CLiQ cabinet bushing 673
11.6.1 Description 673
11.6.2 Safety Information 673
11.6.3 Interface description 674
11.6.3.1 Overview 674
11.6.4 Dimension drawing 674
11.6.5 Installation 675
11.6.6 Technical data 677
11.7 DRIVE-CLiQ coupling 678
11.7.1 Description 678
11.7.2 Safety information 678
11.7.3 Interface description 678
11.7.3.1 Overview 678
11.7.4 Dimension drawing 679
11.7.5 Installation 680
11.7.6 Technical data 680
11.8 Spacing bolt for booksize compact components 681
12 Cabinet design and EMC Booksize 685
12.1 General information 685
12.2 Safety information 686
12.3 Directives 687
12.4 Notes on electromagnetic compatibility (EMC) 688
12.5 Cable Shielding and Routing 689
12.6 24 V DC supply voltage 691
12.6.1 General 691
12.6.2 24 V power supply and 24 V connection of components 693
12.6.3 Overcurrent protection 695
12.6.4 Overvoltage protection 696
12.6.5 Typical 24 V current consumption of the components 699
12.6.6 Selecting power supply units 703
12.7 Connection systems 704
12.7.1 DRIVE-CLiQ signal cables 704
12.7.1.1 Cable lengths and types 704
12.7.1.2 Combined use of MOTION-CONNECT 500 and MOTION-CONNECT 800PLUS 706
12.7.2 Power cables for motors 707
12.7.2.1 Configuring the cable length 707
12.7.2.2 Comparison of MOTION-CONNECT power cables 708
12.7.3 Current-carrying capacity and derating factors for power cables and signal cables 709
12.7.4 Maximum cable lengths 711

12.7.5 Connectable conductor cross-sections and tightening torques for motor and power cables ... 712
12.7.6 Motor connection plug ... 714
12.7.6.1 Mounting on the Motor Module ... 715
12.7.6.2 Connecting the motor connector to self-fabricated cables ... 717
12.7.6.3 Removing the motor connector plug from prefabricated power cables ... 719
12.7.6.4 Coding ... 720
12.7.6.5 Shield connection ... 720
12.7.7 Spring-loaded terminals ... 723
12.7.8 Screw terminals ... 724
12.7.9 Handling restrictor collars for touch protection ... 726

12.8 Protective connection and equipotential bonding ... 727

12.9 Arrangement of components and equipment ... 729
12.9.1 General information ... 729
12.9.2 Current Carrying Capacity of the DC Link Busbar ... 730
12.9.3 Single-tier drive line-up ... 733
12.9.4 Multi-tier drive line-up ... 735
12.9.4.1 Arrangement rules ... 735
12.9.4.2 Examples of a multi-tier configuration ... 736
12.9.4.3 Connection example ... 738

12.10 Information on cold plate cooling ... 739
12.10.1 General information ... 739
12.10.2 Cold plate with external air heat sink ... 741
12.10.2.1 Configuration and conditions ... 741
12.10.2.2 Setup example, drive line-up, cold plate with external air heat sink ... 742
12.10.3 Cold plate with an external liquid heat sink ... 744
12.10.3.1 Configuration and conditions ... 744
12.10.3.2 Setup example, drive-line-up, cold plate with external liquid heat sink ... 745

12.11 Notes on electrical cabinet cooling ... 746
12.11.1 Control cabinet cooling options ... 746
12.11.2 General information on ventilation ... 747
12.11.3 Cooling clearances ... 749
12.11.4 Notes on ventilation with cold plate ... 755
12.11.5 Dimensioning Climate Control Equipment ... 755

12.12 Power loss of components during rated operation ... 756
12.12.1 General information ... 756
12.12.2 Power loss for Control Units, Sensor Modules, and other system components ... 757
12.12.3 Power loss for line filters and line reactors ... 758
12.12.4 Power loss for power units with internal air cooling ... 759
12.12.5 Power loss for power units with external air cooling ... 761
12.12.6 Power loss for power units with cold plate ... 762
12.12.7 Power loss for liquid-cooled power units ... 763
12.12.8 Electronics losses of power units ... 764
12.12.9 Losses for power units in the partial load range ... 766
12.12.10 Typical power losses for Motor Modules ... 767

12.13 Insulation test ... 769

13 Cooling circuit and coolant properties 771

13.1 Cooling circuit requirements 771
13.1.1 Technical cooling circuits 771
13.1.2 Cooling system requirements 772
13.1.3 Cooling circuit configuration 773
13.1.4 Installation 776
13.1.5 Preventing cavitation 778
13.1.6 Commissioning 778

13.2 Coolant requirements 779
13.2.1 Coolant properties 779
13.2.2 Corrosion Inhibitor Additive (Inhibiting) 780
13.2.3 Anti-Freeze Additive 781
13.2.4 Biocide additives (only if required) 782

13.3 Anti-condensation measures 783

13.4 Equipotential bonding in the cooling system 784

13.5 Using heat exchangers 784
13.5.1 Water-to-water heat exchanger 784
13.5.2 Air-to-water heat exchanger 785
13.5.3 Active cooling unit 786

14 Service and Support Booksize 787

14.1 Spare parts 787

14.2 Replacing the fan 787
14.2.1 Safety instructions when replacing a fan 787
14.2.2 Replacing the fan for components with internal and external air cooling 788
14.2.3 Replacing the fan on an Active Interface Module 791
14.2.4 Replacing the fan on the Control Supply Module 795
14.2.5 Replacing the fan on the 100 kW Basic Line Module for capacitor cooling 797
14.2.6 Replacing the fan for Booksize Compact components 799

14.3 Forming the DC link capacitors 801

14.4 Recycling and disposal 807

A Appendix A 809

A.1 List of abbreviations 809

Index 821

System overview

1

1.1 Field of application

SINAMICS is the family of drives from Siemens designed for machine and plant engineering applications. SINAMICS offers solutions for all drive tasks:

- Simple pump and fan applications in the process industry.
- Complex individual drives in centrifuges, presses, extruders, elevators, as well as conveyor and transport systems.
- Drive line-ups in textile, plastic film, and paper machines, as well as in rolling mill plants.
- High-precision servo drives in the manufacture of wind turbines
- Highly dynamic servo drives for machine tools, as well as packaging and printing machines.

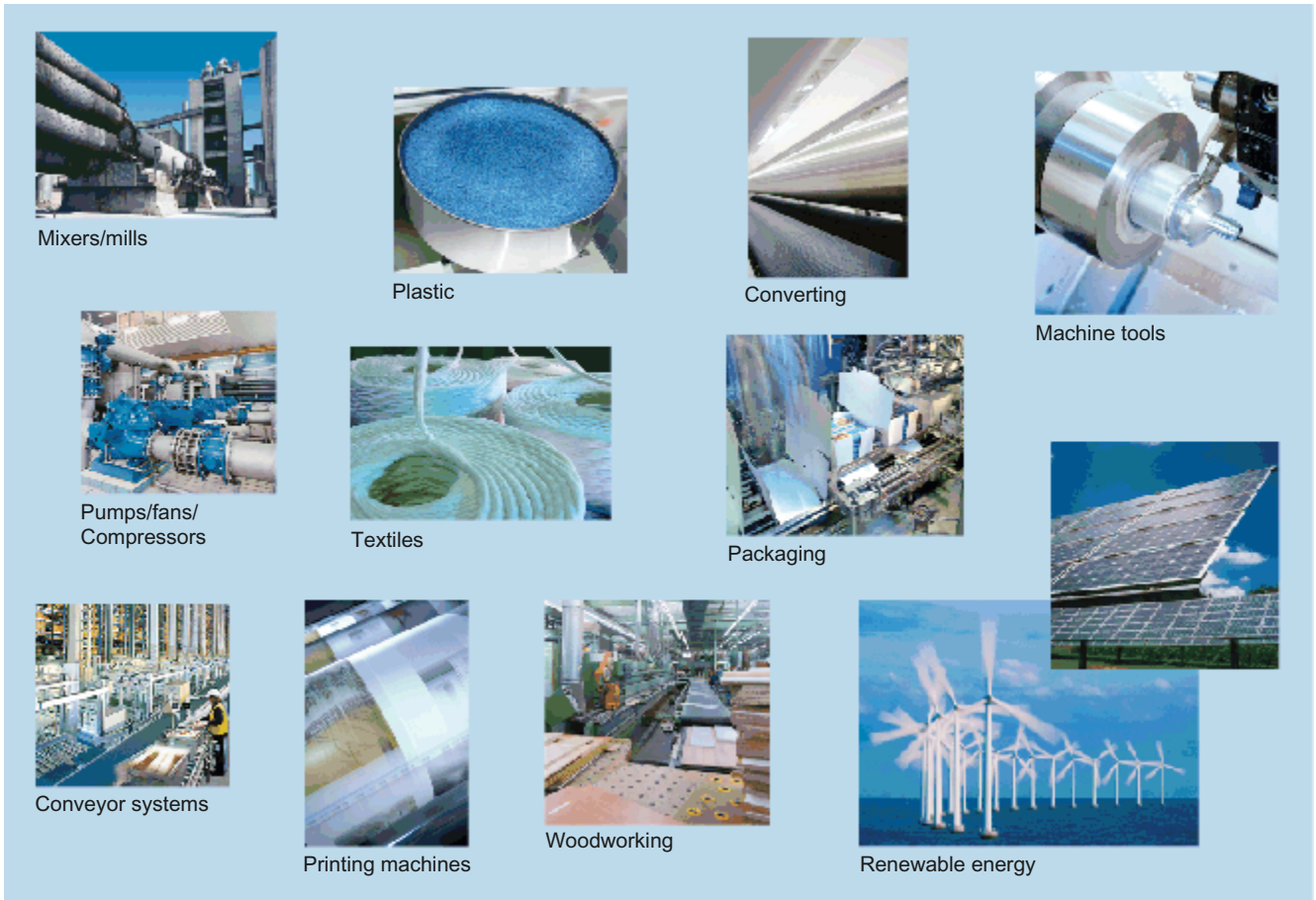


Figure 1-1 SINAMICS applications

Depending on the application, the SINAMICS range offers the ideal variant for any drive task.

- SINAMICS G is designed for standard applications with induction motors. These applications have less stringent requirements regarding the dynamic performance of the motor speed.
- SINAMICS S handles complex drive tasks with synchronous/induction motors and fulfills stringent requirements regarding
  - the dynamic performance and accuracy
  - the integration of extensive technological functions in the drive control system
- SINAMICS DC MASTER is the DC drive belonging to the SINAMICS family. As a result of its standard expandability, it addresses both basic as well as demanding drive applications and in complementary markets.

1.2 Platform Concept and Totally Integrated Automation

All SINAMICS versions are based on a platform concept. Joint hardware and software components, as well as standardized tools for design, configuration, and commissioning tasks ensure high-level integration across all components. SINAMICS handles a wide variety of drive tasks with no system gaps. The different SINAMICS versions can be easily combined with each other.

Totally Integrated Automation (TIA) with SINAMICS S120

Apart from SIMATIC, SIMOTION and SINUMERIK, SINAMICS is one of the core components of TIA. The STARTER commissioning tool is an integral element of the TIA platform. It is thus possible to parameterize, program and commission all components in the automation system using a standardized engineering platform and without any gaps. The system-wide data management functions ensure consistent data and simplify archiving of the entire plant project.

PROFIBUS DP, the standard fieldbus of the TIA system, is supported by all SINAMICS S120 variants. It provides a high-performance, system-wide communication network which links all automation components: HMI, controls, drives and I/O devices.

SINAMICS S120 is also available with a PROFINET interface. This Ethernet-based bus enables control data to be exchanged at high speed via PROFINET IO with IRT or RT and makes SINAMICS S120 a suitable choice for integration in top-performance multi-axis applications. At the same time, PROFINET also uses standard IT mechanisms (TCP/IP) to transport information, e.g. operating and diagnostic data, to higher-level systems. This makes it easy to integrate into an IT corporate network.



Figure 1-2 SINAMICS as part of the Siemens modular automation system

1.3 Introduction

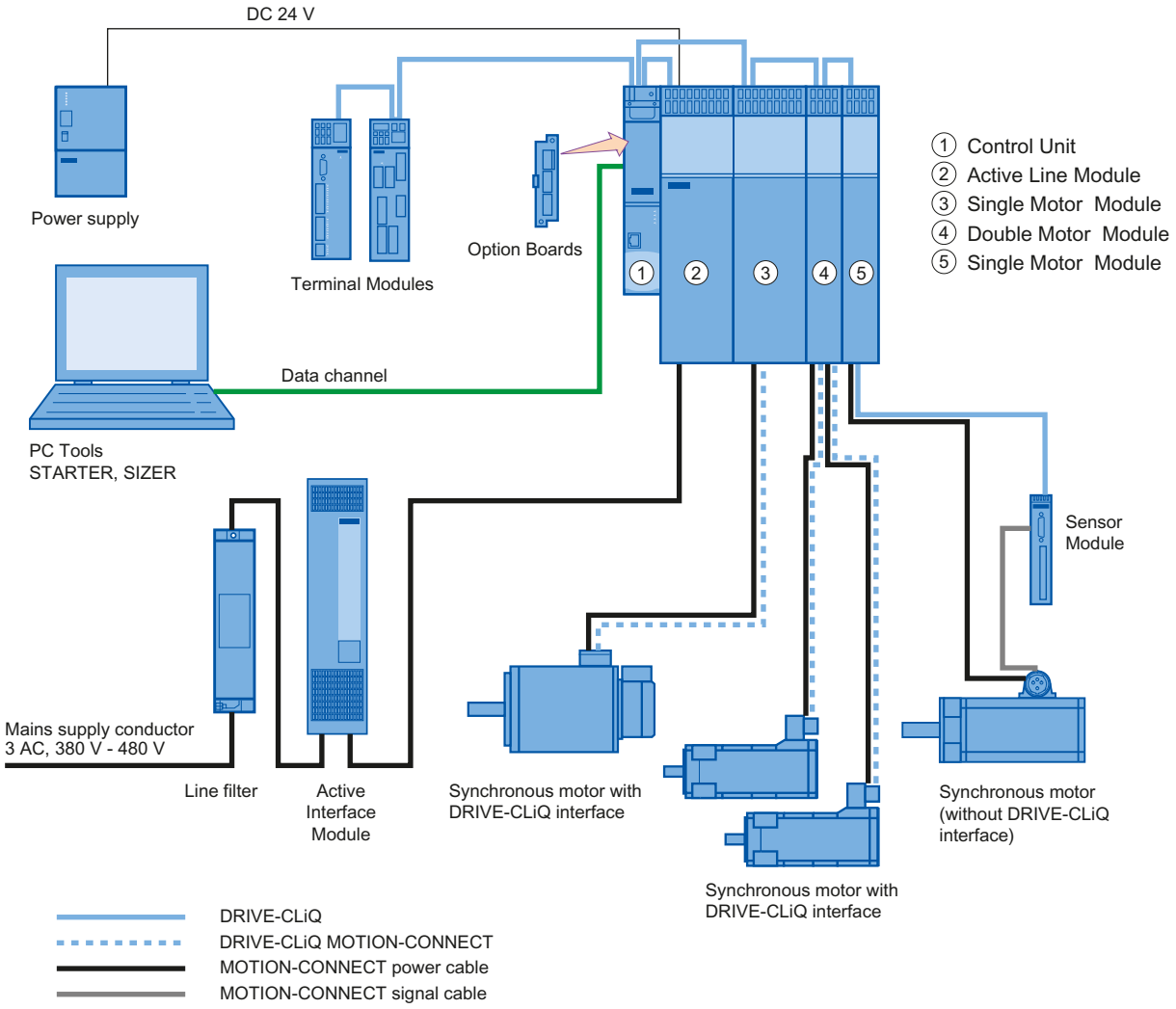


Figure 1-3 SINAMICS S120 system overview

Modular system for sophisticated drive tasks

SINAMICS S120 solves complex drive tasks for a wide range of industrial applications and is, therefore, designed as a modular system. Users can choose from many different harmonized components and functions to create a solution that best meets their requirements. SIZER, a high-performance engineering tool, makes it easier to choose and determine the optimum drive configuration.

SINAMICS S120 is supplemented by a wide range of motors. Whether torque, synchronous or induction motors, whether rotating or linear motors, all of these motors are optimally supported by SINAMICS S120.

System architecture with a central Control Unit

On the SINAMICS S120, the drive intelligence is combined with closed-loop control functions into Control Units. These units are capable of controlling drives in the vector, servo and V/f modes. They also perform the speed and torque control functions plus other intelligent drive functions for all axes on the drive. Inter-axis connections can be established within a component and easily configured in the STARTER commissioning tool using a mouse.

Functions for higher efficiency

- Basic functions: Speed control, torque control, positioning functions
- Intelligent starting functions for independent restart after power supply interruption
- BICO technology with interconnection of drive-related I/Os for easy adaptation of the drive system to its operating environment
- Integrated safety functions for rational implementation of safety concepts
- Regulated infeed/regenerative feedback functions for preventing undesirable reactions on the supply, allowing recovery of braking energy and ensuring greater stability against line fluctuations.

DRIVE-CLiQ – the digital interface between SINAMICS components

The SINAMICS S120 components, including the motors and encoders, are interconnected via a joint serial interface called DRIVE-CLiQ. The standardized cables and connectors reduce the variety of different parts and cut storage costs. Encoder evaluations for converting standard encoder signals to DRIVE-CLiQ are available for third-party motors or retrofit applications.

Electronic rating plates in all components

An important digital linkage element of the SINAMICS S120 drive system are the electronic type plates integrated in every component. They allow all drive components to be detected automatically via a DRIVE-CLiQ link. As a result, data do not need to be entered manually during commissioning or component replacement – helping to ensure that drives are commissioned successfully!

The rating plate contains all the relevant technical data about that particular component. In the motors, for example, this data includes the parameters of the electric equivalent circuit diagram and characteristic values for the built-in motor encoder.

In addition to the technical data, the rating plate includes logistical data (manufacturer ID, order number, and ID). Since this data can be called up electronically on site or remotely, all the components used in a machine can always be individually identified, which helps simplify servicing.

1.4 SINAMICS S120 components

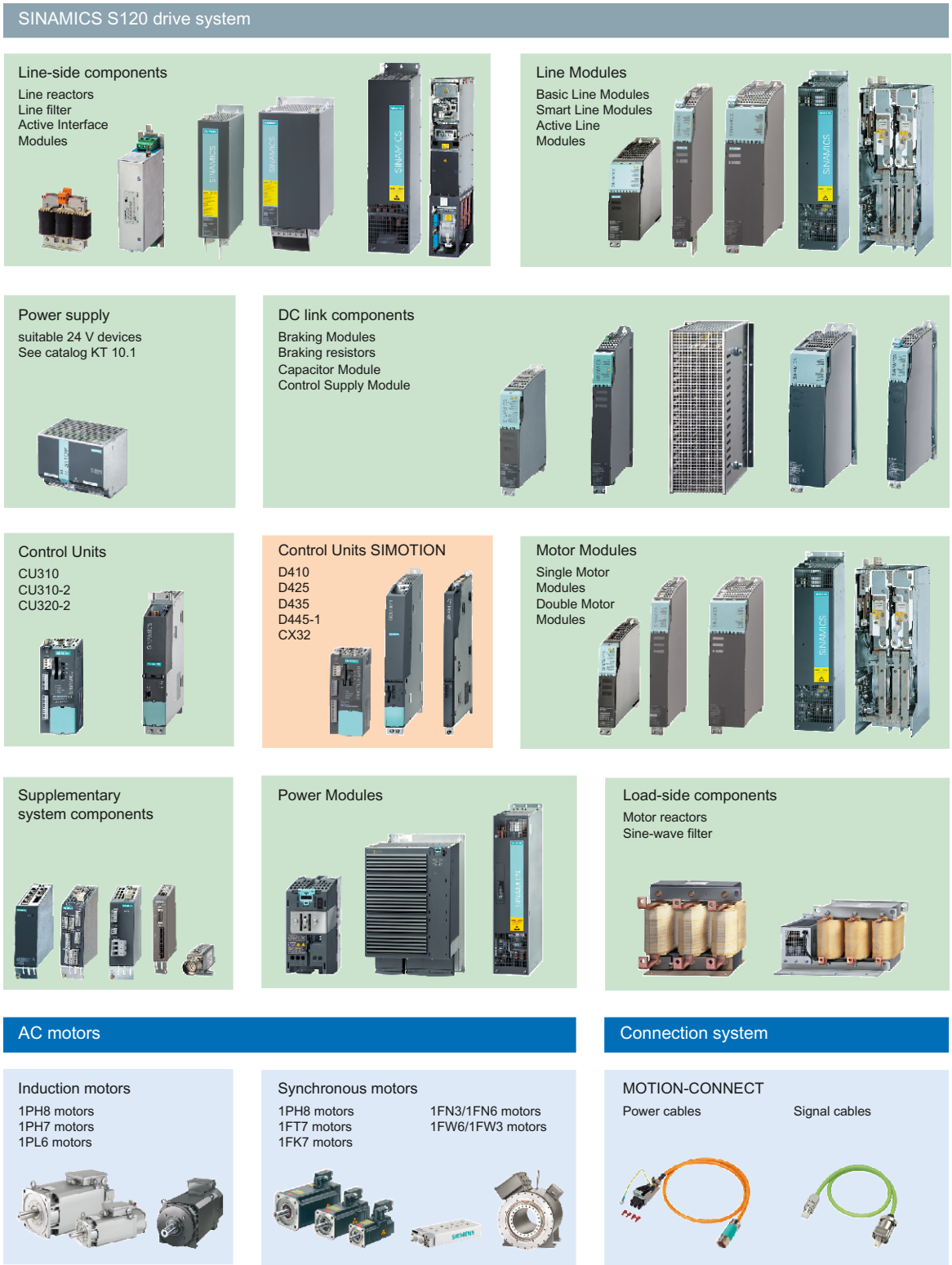


Figure 1-4 Overview of SINAMICS S120 components

System components

- Line-side power components, such as fuses, contactors, reactors, and filters for switching the power supply and meeting EMC requirements.
- Line Modules, which supply power centrally to the DC link.
- DC-link components (optional), which stabilize the DC-link voltage.
- Motor Modules, which act as inverters, receive power from the DC link, and supply the connected motors.

To carry out the required functions, SINAMICS S120 is equipped with:

- Control Units that processes the drive and technological functions across all axes.
- Supplementary system components that enhance functionality and offer different interfaces for encoders and process signals.

SINAMICS S120 components are intended for installation in cabinets. They have the following features and characteristics:

- Easy to handle, simple installation and wiring
- Practical connection system, cable routing in accordance with EMC requirements
- Standardized design, seamless integration

Note

Installation location in the cabinet

The SINAMICS S120 components must always be mounted vertically in the cabinet. Other permissible installation locations are given in the descriptions for the individual components.

Booksize format

Booksize format units are optimized for multi-axis applications and are mounted adjacent to one another. The connection for the shared voltage-source DC link is an integral feature.

The booksize format offers various cooling options:

- Internal air cooling
- External air cooling
- Cold plate cooling
- Liquid Cooled

Booksize compact format

The booksize compact format combines all benefits of the booksize format and provides the same performance with an even smaller overall height and an extended overload capability. The booksize compact format is thus particularly well suited for integration into machines with high dynamic requirements and confined installation conditions.

The booksize compact format offers the following cooling options:

- Internal air cooling
- Cold plate cooling

1.4.1 Introduction

Line Modules generate a DC voltage from the connected rated voltage that is used to power the Motor Modules.

All Basic Line Modules and Active Line Modules as well as the 16 kW, 36 kW, and 55 kW Smart Line Modules are equipped with DRIVE-CLiQ interfaces for communicating with the Control Unit. The 5 kW and 10 kW Smart Line Modules must be connected with the Control Unit via terminals.

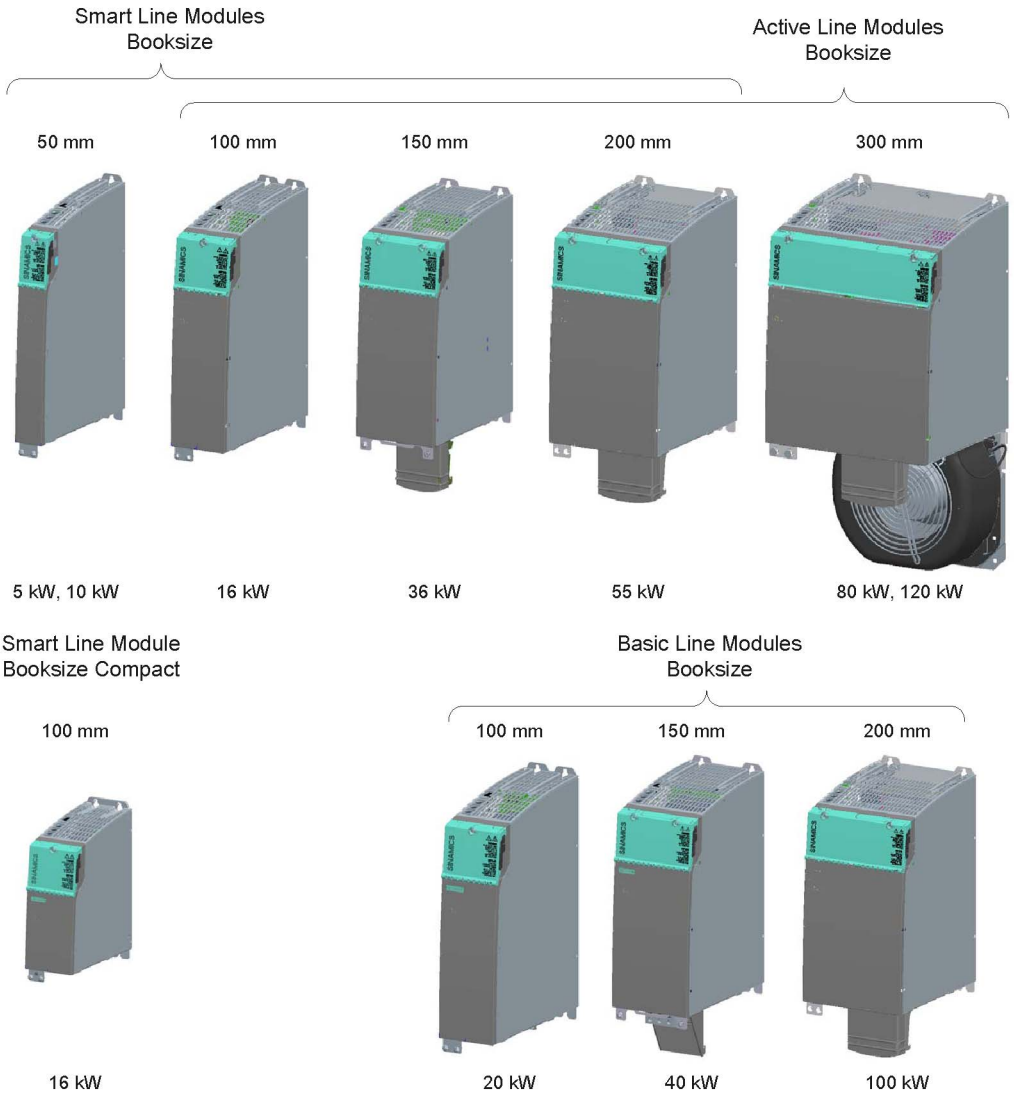


Figure 1-5 Overview of Line Modules

General characteristics of the Line Modules

- Connection voltage 3 AC 380 V –10% (-15% <1 min) to 3 AC 480 V +10% (47 to 63 Hz)
- Suitable for TN, TT, and IT supply systems
- Internal/external air cooling
- Liquid cooling and cold plate cooling
- Short-circuit/ground-fault-proof during the precharge phase
- Integrated DC link and electronics current busbar connection
- LEDs for indicating statuses and for diagnostics

Characteristics of the Active Line Modules

- Regulated DC link voltage
- Regenerative feedback capability
- Sinusoidal line currents
- Electronic rating plate
- DRIVE-CLiQ interface for communicating with the Control Unit and/or other components in the drive line-up.
  - Integration in system diagnostics
- For all Active Line Modules with order numbers ending in 3 ((6SL...-...3)), outgoing circuit for DC link busbar possible on both sides.

Characteristics of the Smart Line Modules

- Unregulated DC link voltage
- Regenerative feedback capability
- Block-type network currents in feedback direction
- For 16 kW to 55 kW Smart Line Modules: outgoing circuit for DC link busbar possible on both sides.

Characteristics of the Basic Line Modules

- Unregulated DC link voltage
- No regenerative feedback capability
- For all Basic Line Modules, an outgoing circuit for DC link busbar is possible on both sides.

Frequency with which the DC link is precharged

The frequency with which the DC link capacitance is precharged via the Line Module is determined using the following formula:

$$\text{Number of pre-charging operations within 8 min} = \frac{\text{max. permissible DC link capacitance Line Module in µF}}{\Sigma\text{DC link capacitance of the configured drive group in µF}}$$

The DC link capacitances of the individual components can be taken from the relevant technical data.

1.4.2 Introduction

The Motor Modules in the SINAMICS S system in "booksize" format are inverters. They make the energy from the connected motors' DC link available at an adjusted voltage and with variable frequency. The control information is generated in the Control Unit and distributed to the individual Motor Modules via DRIVE-CLiQ.

Depending on the type (Single or Double), each Motor Module has one or two DRIVE-CLiQ interfaces for connecting the motor encoder evaluation (Sensor Modules).

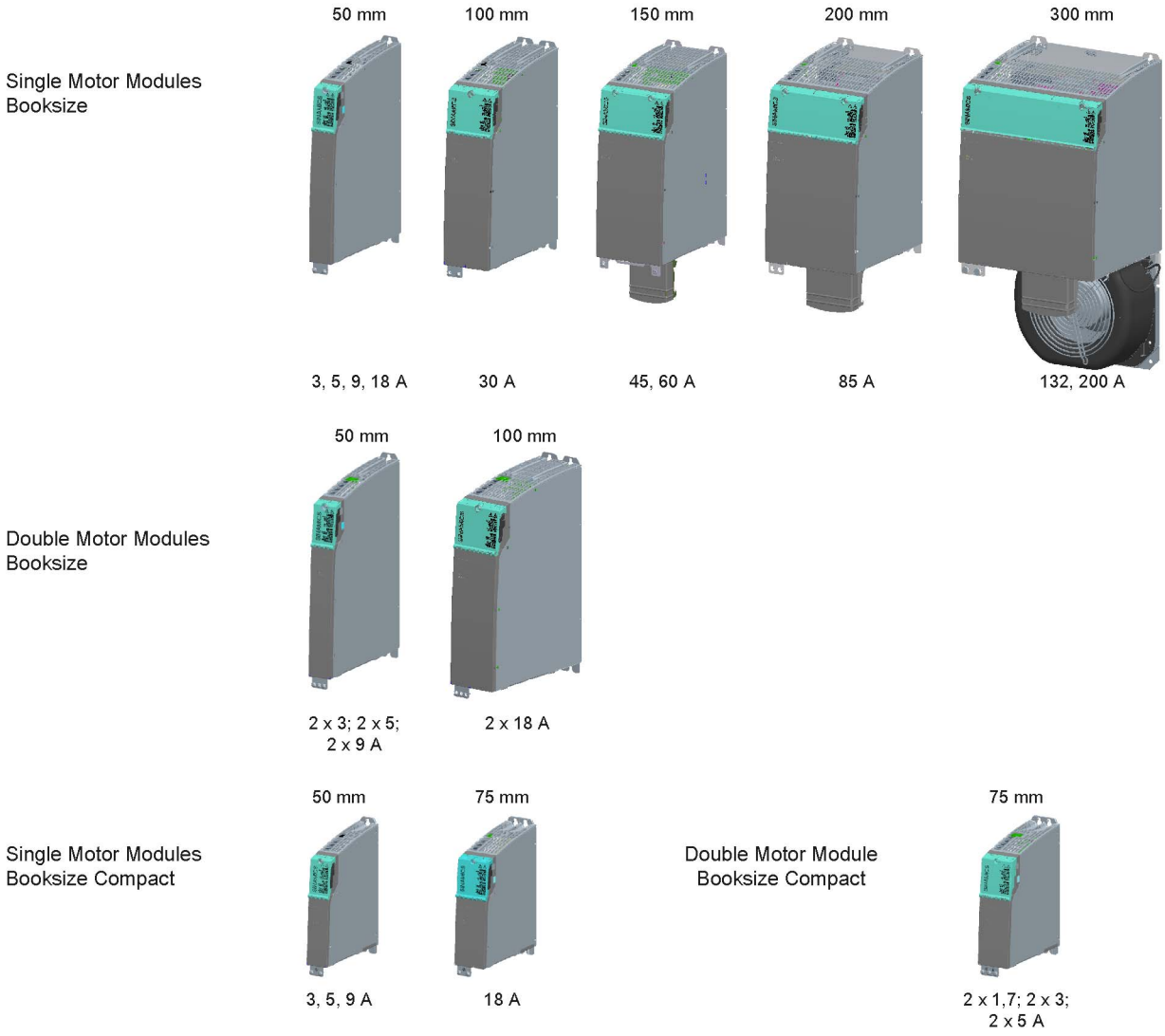


Figure 1-6 Overview of Motor Modules

Characteristics of the Motor Modules:

- Single type from 3 A to 200 A
- Double type from 1.7 A to 18 A
- Internal/external air cooling
- Liquid cooling and cold plate cooling
- Short-circuit/ground-fault-proof
- Integrated DC link and electronics current busbar connection
- Integrated "safety motor braking control"
- 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

1.5 System Data

Technical data

Unless explicitly specified otherwise, the following technical data are valid for components of the SINAMICS S120 booksize drive system.

Electrical data	
Line connection voltage	3-ph. 380 V to 480 V AC ±10% (-15% < 1 min)
Line frequency	47 Hz to 63 Hz
Electronics power supply	24 VDC -15/+20% 1), protective extra low voltage DVC A (PELV)
Short-circuit current rating SCCR in accordance with UL508C (up to 600 V)	• 1.1 kW – 447 kW: 65 kA • 448 kW – 671 kW: 84 kA • 672 kW – 1193 kW: 170 kA • ≥ 1194 kW: 200 kA
Radio interference suppression acc. to EN 61800-3	Category C2 (optional) for system versions conformant with documentation
Overvoltage category	III to EN 61800-5-1
Degree of contamination	2 to EN 61800-5-1

1) If a motor holding brake is used, restricted voltage tolerances (24 V ± 10%) may have to be taken into account.

Modules	
Line Modules in booksize format • Max. permissible supply voltage • Rated pulse frequency (for Active Line Modules in booksize format only)	480 V 3 AC 8 kHz
Motor Modules in booksize format • DC link connection voltage • Rated pulse frequency	510 VDC up to 720 V 4 kHz For higher pulse frequencies the corresponding characteristic for current derating must be taken into consideration.

Environmental conditions	
Degree of protection	IP20 or IPXXB to EN 60529, open type to UL508
Protection class for line current circuits Protection class for electronic circuits	I (with protective conductor connection) and III (protective extra low voltage DVC A / PELV) acc. to EN 61800-5-1

Environmental conditions	
Permissible coolant temperature (air) and installation altitude during operation	0 °C to +40 °C and an installation altitude of up to 1000 m without derating, >40 °C to +55 °C see the characteristic for current derating. Installation altitude >1000 m up to 4000 m see characteristic for current derating or reduction of the ambient temperature by 3.5 K per 500 m.
Chemically active substances • Long-term storage in the transport packaging • Transport in the transport packaging • Operation	Class 1C2 acc. to EN 60721-3-1 Class 2C2 acc. to EN 60721-3-2 Class 3C2 acc. to EN 60721-3-3
Biological environmental conditions • Long-term storage in the transport packaging • Transport in the transport packaging • Operation	Class 1B1 acc. to EN 60721-3-1 Class 2B1 acc. to EN 60721-3-2 Class 3B1 acc. to EN 60721-3-3
Vibratory load • Long-term storage in the transport packaging • Transport in the transport packaging • Operation	Class 1M2 acc. to EN 60721-3-1 Class 2M3 acc. to EN 60721-3-2 Test values: Frequency range: 10 Hz to 58 Hz With constant deflection of 0.075 mm Frequency range: 58 Hz to 200 Hz With constant acceleration of 1 g
Shock stressing • Long-term storage in the transport packaging • Transport in the transport packaging • Operation Booksize format, Booksize Compact	Class 1M2 acc. to EN 60721-3-1 Class 2M3 acc. to EN 60721-3-2 Test values: 15 g / 11 ms
Climatic environmental conditions • Long-term storage in the transport packaging • Transport in the transport packaging • Operation	Class 1K4 acc. to EN 60721-3-1 Temperature -25 °C to +55 °C Class 2K4 acc. to EN 60721-3-2 Temperature -40 °C to +70 °C Class 3K3 acc. to EN 60721-3-3 Temperature +0 °C to +40 °C Relative atmospheric humidity 5% to 90% Oil mist, salt mist, icing, condensation, dripping, spraying, splashing, and water jet not permissible

Certificates	
Declarations of Conformity	CE (Low-Voltage and EMC Directives)
Approvals	cULus cURus

1.6 Derating as a function of the installation altitude and ambient temperature

The Line Modules and Motor Modules are designed for operation at an ambient temperature of 40 °C, installation altitudes up to 1000 m above sea level and the relevant specified pulse frequency.

The air pressure and therefore air density drop at altitudes above sea level. At these altitudes, the same quantity of air does not have the same cooling effect and the air gap between two electrical conductors can only insulate a lower voltage. Typical values for air pressure are summarized in the table below:

Table 1- 1 Air pressure for various installation altitudes

Installation altitude above sea level in [m]	0	2000	3000	4000	5000
Air pressure in mbar [kPa]	100	80	70	62	54

The output current must be reduced if the modules are operated at ambient temperatures above 40 °C (see derating characteristics for the individual modules). Ambient temperatures above 55 °C are not permissible.

The air gaps inside the devices can insulate surge voltages of surge voltage category III in accordance with EN 60664-1 up to an installation altitude of 2000 m. At installation altitudes above 2000 m, the Line Modules must be connected via an isolating transformer. The isolating transformer reduces surge voltages of surge voltage category III in power supplies to surge voltages of surge category II at the power terminals of the Power Modules and thereby conforms to the permissible voltage values for air gaps inside the unit. The design of the secondary line supply system must be as follows:

- TN system with grounded star point (no grounded outer conductor)
- IT system

A reduction of the line supply voltage phase-phase is not necessary.

1.7 Standards

Note

The standards listed in the table below are non-binding and do not in any way claim to be complete. The standards listed do not represent a guaranteed property of the product.

Only the statements made in the Declaration of Conformity shall be deemed binding.

Table 1- 2 Fundamental, application-relevant standards in succession: EN, IEC/ISO, DIN, VDE

Standards*	Title
EN 1037 ISO 14118 DIN EN 1037	Safety of machinery; avoiding unexpected starting
EN ISO 9001 ISO 9001 DIN EN ISO 9001	Quality management systems - requirements
EN ISO 12100-x ISO 12100-x DIN EN ISO 12100-x	Safety of Machinery; General Design Guidelines; Part 1: Basic terminology, methodology Part 2: Technical Principles and Specifications
EN ISO 13849-x ISO 13849-x DIN EN ISO 13849-x	Safety of machinery; safety-related parts of control systems; Part 1: General basic design principles Part 2: Validation
EN ISO 14121-1 ISO 14121-1 DIN EN ISO 14121-1	Safety of Machinery - Risk Assessment; Part 1: Guidelines
EN 55011 CISPR 11 DIN EN 55011 VDE 0875-11	Industrial, scientific and medical high-frequency devices (ISM devices) - radio interference - limit values and measuring techniques
EN 60146-1-1 IEC 60146-1-1 DIN EN 60146-1-1 VDE 0558-11	Semiconductor converters; general requirements and line-commutated converters; Part 1-1: Defining the basic requirements
EN 60204-1 IEC 60204-1 DIN EN 60204-1 VDE 0113-1	Electrical equipment of machines; Part 1: General definitions
EN 60228 IEC 60228 DIN EN 60228 VDE0295	Conductors for cables and insulated leads
EN 60269-1 IEC 60269-1 DIN EN 60269-1 VDE 0636-1	Low-voltage fuses; Part 1: General requirements

Standards*	Title
IEC 60287-1 to -3	Cables - Calculation of the current carrying capacity Part 1: Current carrying capacity equations (100 % load factor) and calculating the losses Part 2: Thermal resistance - Part 3: Main sections for operating conditions
HD 60364-x-x IEC 60364-x-x DIN VDE 0100-x-x VDE 0100-x-x	Erection of power installations with nominal voltages up to 1000 V; Part 200: Definitions Part 410: Protection for safety, protection against electric shock Part 420: Protection for safety, protection against thermal effects Part 430: Protection of cables and conductors for over-current Part 450: Protection for safety, protection against undervoltage Part 470: Protection for safety; use of protection for safety Part 5xx: Selecting and erecting electrical equipment Part 520: Wiring systems Part 540: Earthing, protective conductor, potential bonding conductor Part 560: Electrical equipment for safety purposes
EN 60439 IEC 60439 DIN EN 60439 VDE 0660-500	Low-voltage switchgear assemblies; Part 1: Type-tested and partially type-tested assemblies
EN 60529 IEC 60529 DIN EN 60529 VDE 0470-1	Degrees of protection provided by enclosures (IP code)
EN 60721-3-x IEC 60721-3-x DIN EN 60721-3-x	Classification of environmental conditions Part 3-0: Classification of environmental parameters and their severities; Introduction Part 3-1: Classification of environmental parameters and their severities; Long-term storage Part 3-2: Classification of environmental parameters and their severities; Transport Part 3-3: Classification of environmental parameters and their severities; stationary use, weather protected
EN 60947-x-x IEC 60947 -x-x DIN EN 60947-x-x VDE 0660-x	Low-voltage switchgear
EN 61000-6-x IEC 61000-6-x DIN EN 61000-6-x VDE 0839-6-x	Electromagnetic compatibility (EMC) Part 6-1: Generic standard; Immunity for residential, commercial and light-industrial environments Part 6-2: Generic standards; Immunity for industrial environments Part 6-3: Generic standards; Generic standard emission for residential, commercial and light-industrial environments Part 6-4: Generic standards; Generic standard noise emission for industrial environments
EN 61140 IEC 61140 DIN EN 61140 VDE 0140-1	Protection against electric shock; Common aspects for installation and equipment
EN 61800-2 IEC 61800-2 DIN EN 61800-2 VDE 0160-102	Adjustable-speed electrical power drive systems; Part 2: General requirements - Rating specifications for low-voltage adjustable frequency a.c. power drive systems
EN 61800-3 IEC 61800-3 DIN EN 61800-3 VDE 0160-103	Adjustable-speed electrical power drive systems; Part 3: EMC - Requirements and specific test methods

Standards*	Title
EN 61800-5-x IEC 61800-5-x DIN EN 61800-5-x VDE 0160-105-x	Adjustable-speed electrical power drive systems; Part 5: Safety requirements; Main section 1: Electrical, thermal and energy requirements Main section 2: Functional safety requirements
EN 62061 IEC 62061 DIN EN 62061 VDE 0113-50	Safety of machinery; Functional safety of safety-related electrical, electronic and programmable electronic control systems
UL 50 CSA C22.2 No. 94.1	Enclosures for Electrical Equipment
UL 508 CSA C22.2 No. 142	Industrial Control Equipment Process Control Equipment
UL 508C CSA C22.2 No. 14	Power Conversion Equipment Industrial Control Equipment

* The technical requirements in the standards listed are not necessarily identical.

Line connection and line-side power components 2

2.1 Introduction

The following components should be used to connect a SINAMICS S120 drive line-up in booksize format to the power supply:

- Disconnector unit (for Active Line Modules, Basic Line Modules, Smart Line Modules)
- Overcurrent protection device (line fuse or circuit breaker)
- Line contactor (this is required for galvanic isolation)
- Line filter (optional)
- Line reactor (always required)

The following line filter and line reactor variants are available:

- Line filter variants:
  - Basic Line Filter for Active Line Modules with line reactor
  - Basic Line Filter for Active Line Modules with Active Interface Module
  - Wideband Line Filter for Active Line Modules
  - Basic Line Filter for Basic Line Modules
  - Basic Line Filter for Smart Line Modules
- Line reactor variants:
  - Line reactors for Active Line Modules
  - Line reactors for Smart Line Modules
  - Line reactors for Basic Line Modules

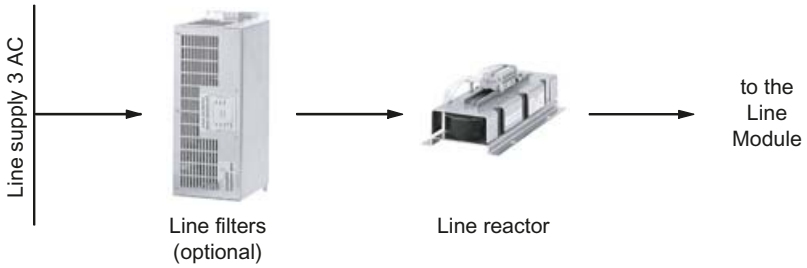


Figure 2-1 Overview diagram, line connection with line filter and line reactor

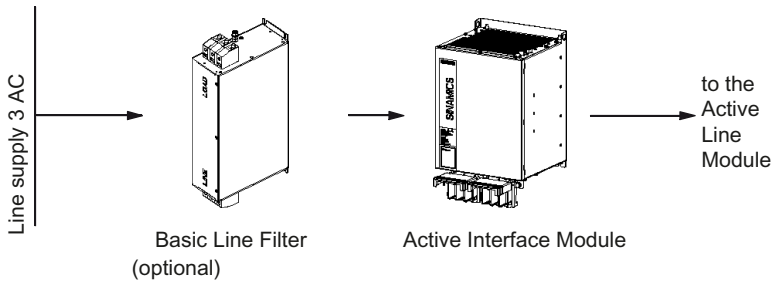


Figure 2-2 Overview diagram, line connection with Active Interface Module

2.2 Information on the disconnector unit

Disconnector units for Active Line Modules, Basic Line Modules, and Smart Line Modules

A disconnector unit is required for disconnecting the drive line-up from the supply system correctly. The disconnector unit of the machine's electrical equipment can be used for this purpose. The disconnector unit must be selected in compliance with the requirements of the internationally binding standard relating to the electrical equipment of machines IEC 60204-1, Section 5.3. The relevant technical data and any other loads connected to the electrical equipment must be taken into account when making your selection.

NOTICE

If an active drive line-up is switched off by means of the disconnector unit, on Line Modules with regenerative feedback capability, the voltage at terminals 3 (EP +24 V) and 4 (EP M) must be interrupted beforehand. This can be carried out using a leading breaking auxiliary contact (≥ 10 ms), for example.

This protects external loads located parallel to the drive on the same switching component.

Note

If you are using a VSM10 Voltage Sensing Module, the leading opening contact can be omitted.

The accessories required for the disconnector unit must be selected from the manufacturer catalogs. Refer also to catalogs PM21 and NC61.

2.3 Overcurrent protection by means of line fuses and circuit breakers

Line fuses or, preferably, circuit breakers must be used for line/overcurrent protection in order to limit the damage to the Line Module if a fault occurs. NH, D, and DO type fuses with a gL characteristic or suitable circuit breakers according to EN 60947 can be used for this purpose.

Table 2- 1 Recommended LV HRC line fuse (gL) and circuit breaker for Active Line Modules

	16 kW	36 kW	55 kW	80 kW	120 KW
I_{rated} fuse	35 A	80 A	125 A	160 A	250 A
Line fuse	3NA3 814	3NA3 824	3NA3 132	3NA3 136	3NA3 144
Circuit breaker	3RV1031-4FA10	3RV1041-4LA10	3VL2712-1DC33	3VL3720-1DC33	3VL3725-1DC36

Table 2- 2 Recommended LV HRC. line fuse (gL) and circuit breaker for Smart Line Modules

	5 kW	10 kW	16 kW	36 kW	55 kW
I_{rated} fuse	16 A	35 A	35 A	80 A	125 A
Line fuse	3NA3 805	3NA3 814	3NA3 814	3NA3 824	3NA3 132
Circuit breaker	3RV1031-4BA10	3RV1031-4FA10	3RV1031-4FA10	3RV1041-4LA10	3VL2712-1DC33

Table 2- 3 Recommended LV HRC line fuse (gL) and circuit breaker for Basic Line Modules

	20 kW	40 kW	100 kW
I_{rated} fuse	63 A	100 A	250 A
Line fuse	3NA3 822	3NA3 830	3NA3 144
Circuit breaker	3RV1041-4JA10	3VL2710-1DC33	3VL3725-1DC36

If used in conjunction with a residual-current monitor (RCM), circuit breakers providing an "undervoltage tripping" option should be used, with the following suffixes added to the order numbers:

...-2AJ0 for 380 VAC - 415 VAC

...-2AK0 for 440 VAC - 480 VAC

⚠DANGER

As a general rule, the higher loop impedance of TT systems means they are not suitable for tripping the installed overcurrent protection devices within the prescribed period should an insulation fault occur. If TT systems are used, residual-current-operated circuit breakers (see chapter titled "Residual-current-operated circuit breakers (RCD)") should ideally be used in addition to the overcurrent protection devices.

At infeed powers above 55 kW and with systems that extend across a large area, residual-current monitors (see chapter titled "Residual-current monitors (RCM)") must be installed in addition to appropriate circuit breakers for operation on TT systems.

⚠WARNING

Selecting the overcurrent protection devices

In order to avoid the risk of fire or electric shock, overcurrent protection devices should be dimensioned so that, when a fault occurs, the equipment is switched off sufficiently quickly. Measurements must be taken at the installation site to determine whether the short-circuit current flowing there is adequate to trip the protective devices fast enough. Not only must the loop impedance be measured and the expected short-circuit current calculated, but the time-current characteristics of the overcurrent protection devices must also be compared, using measuring instruments in accordance with EN 61557-3.

If the necessary break times are not maintained, then the next-smallest overcurrent protection devices must be used.

⚠WARNING

It is not permissible to overdimension fuses as this can result in significant levels of danger and also faults.

Note

The devices can be connected to supply systems up to 480 V_{AC}, which can supply a maximum of 65 kA symmetrical ("prospective current" according to EN 60269-1).

Information on the tripping time of line fuses

In order that the line fuses trip in a timely manner, the loop resistance as well as the vector group of the feeding line transformer must ensure that, if a fault occurs, the touch voltage of the devices is disconnected by the fuses provided within the permissible tripping time (see figure below, in accordance with EN 61800-5-1 Ed. 2).

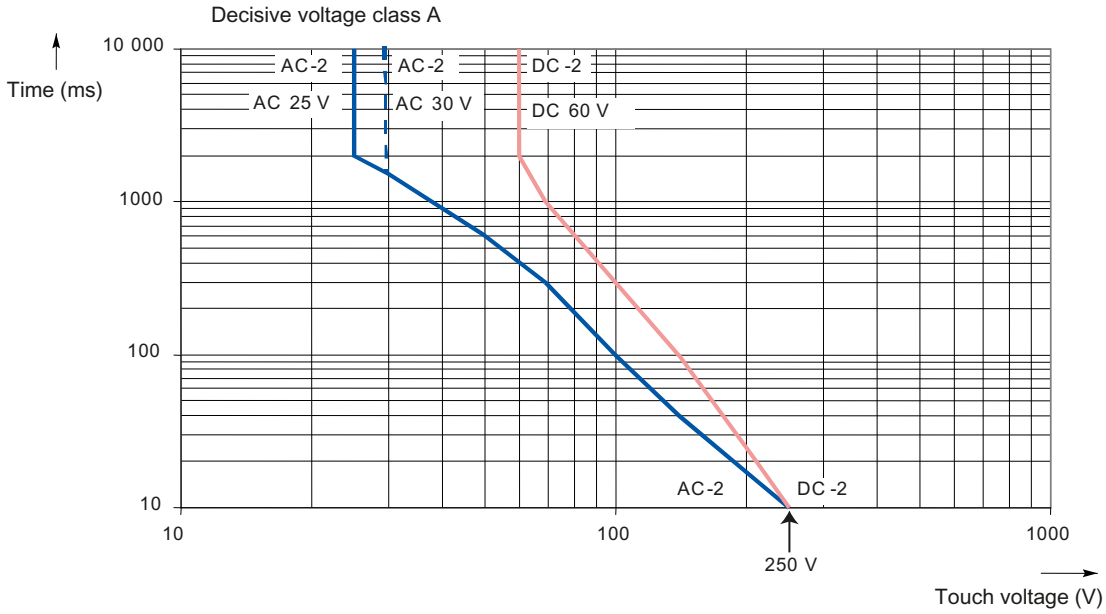


Figure 2-3 Permissible tripping time of fuses

The boundary conditions indicated above also serve to avoid a fire in case of a fault. If you do not comply with these boundary conditions, you must take additional measures, e.g., residual current transformer.

Fuse and plant conditions such as loop resistance and short-circuit power must be harmonized to one another so that the limit curve is not exceeded. This guarantees the shock-hazard protection.

2.4 Line supply connection via residual-current devices

Selectively tripping, AC/DC-sensitive residual-current devices (type B) can be used in addition to the overcurrent protection devices.

⚠DANGER

It is not permissible to use residual-current devices as the sole means of protection.

NOTICE

Residual-current devices have to be installed if the power supply conditions in terms of short-circuit power and loop impedance at the infeed point are not such that the installed overcurrent protection devices will trip within the prescribed period if a fault occurs. Since TT systems do not generally meet this requirement, residual-current devices must always be installed for this type of system.

2.4.1 Residual-current operated circuit breakers (RCD)

Residual-current operated circuit breakers (RCD) can be used in addition to the overcurrent protection devices provided.

⚠DANGER

Residual-current circuit-breakers alone are not permissible to provide protection against direct and indirect contact.

⚠DANGER

As a general rule, the higher loop impedance of TT systems means they are not suitable for tripping the installed overcurrent protection devices within the prescribed period should an insulation fault occur. If TT systems are used, residual-current operated circuit breakers should ideally be used in addition to the overcurrent protection devices.

Note

Operation on residual-current operated circuit breakers is currently only possible with Line Modules up to and including 36 kW.

Please note the following:

- It is only permissible to use a delayed tripping, selective AC/DC-sensitive residual-current operated circuit breaker, type B.
- The max. permitted grounding resistance of the "selective protective device" is observed (83 Ω max. for residual-current devices with 0.3 A rated differential current).
- Accessible parts of the Power Drive System and the machine are connected to the system's protective ground conductor.
- The total length of the shielded power cables in the drive line-up (motor cables incl. line supply conductors from line filters to the connecting terminals of the Line Module) must be less than 350 m.
- Only recommended line filters must be used during operation.
- Only one residual-current circuit-breaker may be connected in series (cascading is not possible).
- Switching elements (disconnector unit, contactors) for connecting and disconnecting the drive line-up have max. 35 ms delay time time between the closing/opening of the individual main contacts.

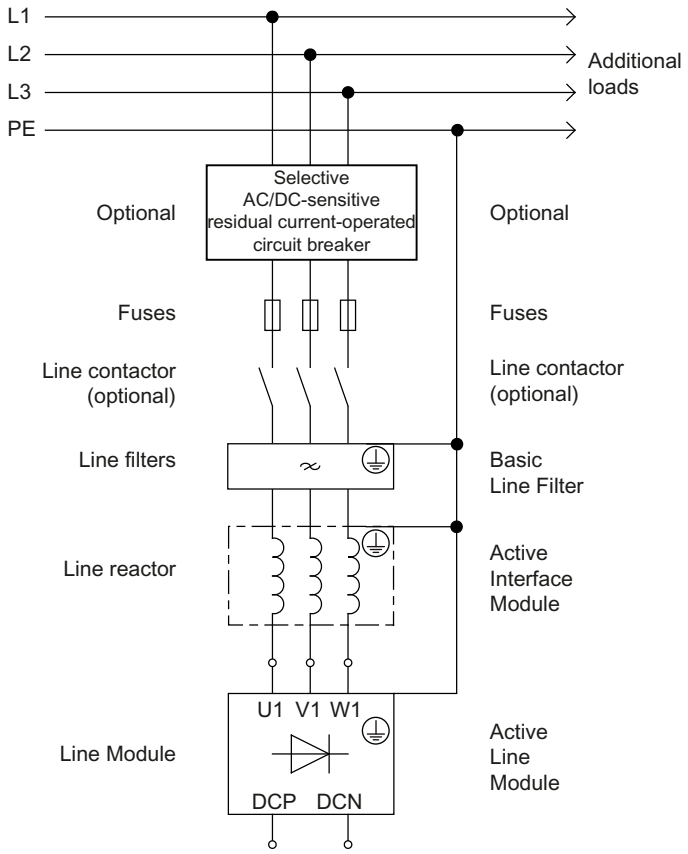


Figure 2-4 Connecting a residual-current operated circuit breaker

Recommendation

SIEMENS selectively switching AC/DC-sensitive residual-current circuit-breakers in accordance with EN 61009-1 of the 5SM series (e.g. 5SM3646-4 or 5SM3646-4+5SW3300 with an auxiliary disconnector (1 NC contact / 1 NO contact) for a rated current of 63 A and rated fault current of 0.3 A (see catalog "BETA Modular Installation Devices - ET B1")).

NOTICE
AC or pulse-sensitive RCCBs are not suitable.

2.4.2 Residual-current monitors (RCM)

Used in conjunction with appropriate circuit breakers, residual-current monitors (RCMs) provide fire and system protection even at high levels of grounding resistance (in TT systems, for example).

⚠ DANGER
Residual-current monitors must always be used in conjunction with appropriate circuit breakers.

⚠ DANGER
As a general rule, the higher loop impedance of TT systems means they are not suitable for tripping the installed overcurrent protection devices within the prescribed period should an insulation fault occur. When operating on TT systems at infeed powers above 55 kW and with systems that extend across a large area, residual-current monitors must be installed in addition to appropriate circuit breakers.

Please note the following:

- It is only permissible to use a delayed tripping, AC/DC-sensitive RCM type B, in order to ensure reliable tripping even with smooth residual currents.
- Accessible parts of the power drive system and the machine are connected to the system's protective conductor.
- The protective conductor must not be routed through the measuring current transformer, as this would negate its protection function.

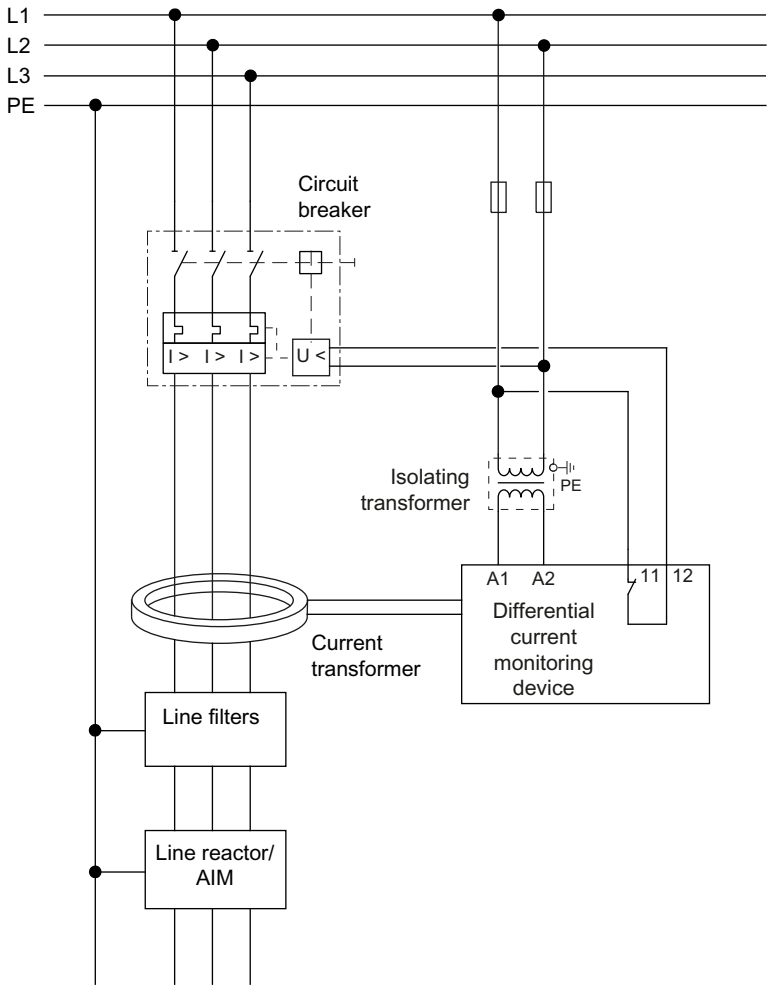


Figure 2-5 Connecting a residual-current monitor

Recommendation

- Bender AC/DC-sensitive residual-current monitor RCMA471LY, with measuring current transformer W120B (120 mm) or W210B (210 mm)
- Circuit breaker with thermal overload release, short-circuit release, and undervoltage release

2.5 Overvoltage protection

To protect the units against line-side surge voltages, you are advised to install an overvoltage protection device directly at the infeed point (upstream of the main switch). To fulfill the requirements of CSA C22.2 no. 14-05, surge protection is essential. The Raycap company has suitable surge arresters.

2.6 Line contactors

A line contactor is required if the drive line-up needs to be electrically isolated from the power supply.

When selecting a line contactor, the characteristic values in the technical data apply. The cable routing, the bundling factor and the factor for the ambient temperature according to EN 60204-1 must be taken into account when dimensioning the various cables.

⚠ CAUTION
Line contactors must not be switched under load.

Note

To limit the switching overvoltage, the contactor coil must be connected to an overvoltage limiter (e.g. flywheel diode or varistor).

When the digital output is used to control the line contactor, its making/breaking capacity must be taken into account.

2.7 Line filters

In conjunction with line reactors and a consistent EMC-compliant system configuration, line filters limit the conducted electromagnetic emissions generated by the Line Modules to the limit values according to EN 61800-3. A separate line filter (see catalog) must be used for the SINAMICS S120 drive line-up.

NOTICE
An additional line filter must be used to suppress interference in other loads. To prevent mutual interference, this line filter must not be equipped with line-side capacitors with respect to ground. Filter series B84144A*R120 (EPCOS) is recommended.

Note

According to product standard EN 61800-3, RFI suppression commensurate with the relevant rated conditions must be provided and is a legal requirement in the EU (EMC Directive). Line filters and line reactors are required in order to comply with this standard. The use of filters of other makes can lead to limit value violations, resonances, overvoltages, and irreparable damage to motors or other equipment. The machine manufacturer must provide verification that the machinery to be operated with the drive products and the installed suppression elements, e.g. line filters, are CE/EMC-compliant before the machines are approved for delivery.

Line filter ranges that are coordinated with the different power stages are available for the SINAMICS S120 drive system. These line filters differ with regard to the frequency range in which they reduce the conducted emissions.

The line filter versions listed below are available for use with Line Modules.

Table 2- 4 Overview of line filters

	Order number
Basic Line Filter for Active Line Modules with line reactor	
16 kW	6SL3000-0BE21-6DAx
36 kW	6SL3000-0BE23-6DA1
55 kW	6SL3000-0BE25-5DAx
Basic Line Filter for Active Line Modules with Active Interface Modules	
16 kW	6SL3000-0BE21-6DAx
36 kW	6SL3000-0BE23-6DA1
55 kW	6SL3000-0BE25-5DAx
80 kW	6SL3000-0BE28-0DAx
120 kW	6SL3000-0BE31-2DAx
Wideband Line Filter for Active Line Modules	
16 kW	6SL3000-0BE21-6AAx
36 kW	6SL3000-0BE23-6AAx
55 kW	6SL3000-0BE25-5AAx
80 kW	6SL3000-0BE28-0AAx
120 kW	6SL3000-0BE31-2AAx
Basic Line Filter for Basic Line Modules	
20 kW	6SL3000-0BE21-6DAx
40 kW	6SL3000-0BE23-6DA1
100 kW	6SL3000-0BE31-2DAx
Basic Line Filter for Smart Line Modules	
5 kW	6SL3000-0HE15-0AAx
10 kW	6SL3000-0HE21-0AAx
16 kW	6SL3000-0BE21-6DAx
36 kW	6SL3000-0BE23-6DA1
55 kW	6SL3000-0BE25-5DAx

2.7.1 Safety information

⚠ CAUTION

Line filters are only suitable for direct connection to TN line supplies.

⚠ DANGER

The drive components generate high leakage currents in the protective conductor. The components must only be operated in cabinets or in closed electrical operating areas and must be connected with the protective conductor. To protect against electric shock, the protective conductor connection at the control cabinet or machine must be implemented in accordance with one of the following measures:

- Fixed connection and protective conductor connection using ≥ 10 mm^2 Cu or ≥ 16 mm^2 Al
- Fixed connection and automatic disconnection of the supply system if the protective conductor is interrupted

⚠ DANGER

Risk of electric shock

A hazardous voltage is still present for up to 5 minutes after the power supply has been switched off.

⚠ WARNING

The input and output connections/terminals must not be interchanged:

- Incoming line cable to LINE L1, L2, L3, and
- Outgoing line to line reactor at LOAD L1´, L2´, L3´ (U, V, W).

The line filter may be damaged if this is not observed.

⚠ WARNING

The cooling clearances of 100 mm above and below the components must be observed. This prevents thermal overloading of the filter.

⚠ WARNING

Line filters may only be used in combination with the components listed in the chapter titled "Combination options: Line reactors and line filters".

CAUTION

Only the line filters described in this Manual must be used. Other line filters can cause line harmonics that can interfere with or damage other loads fed from the line supply.

NOTICE

The associated Line Module must only be connected to the SINAMICS line filter via the associated line reactor. Additional loads must be connected upstream of the SINAMICS line filter (if required, via a separate line filter). If this is not observed, other loads could be damaged or destroyed.

NOTICE

The line/load connection must not be interchanged.

Note

High-voltage test

If a high-voltage test is conducted with alternating voltage in the system, the existing line filters must be disconnected in order to obtain accurate measurements.

2.7.2 Basic Line Filters for Active Line Modules

2.7.2.1 Description

Basic Line Filters for Active Line Modules are designed to attenuate conducted interference emissions in accordance with the specifications contained in the relevant EMC legislation. They are mainly effective in the frequency range from 150 kHz to 30 MHz; this is the range relevant to ensure compliance with the appropriate standard.

Basic Line Filters can be used in conjunction with a line reactor for 16 kW, 36 kW, and 55 kW Active Line Modules or with an Active Interface Module for 16 kW, 36 kW, 55 kW, 80 kW, and 120 kW Active Line Modules. Assuming that an EMC-compatible design is used, the interference voltage categories listed below will be achieved (see also the chapter titled "Combination options: Line reactors and line filters").

Basic Line Filter for Active Line Modules and line reactor

- EN 61800-3 category C2 up to a total cable length [1] of 150 m (shielded) for 16 kW, 36 kW, and 55 kW components
- EN 61800-3 category C3 up to a total cable length [1] of 150 m (shielded) for 16 kW, 36 kW, and 55 kW components

Basic Line Filters for Active Line Modules and Active Interface Module

- EN 61800-3 category C2 up to a total cable length [1] of 350 m (shielded) for 16 kW, 36 kW, 55 kW, 80 kW, and 120 kW components
- EN 61800-3, category C3, up to a total cable length [1] of
  - 630 m (shielded) for 16 kW and 36 kW components
  - 1000 m (shielded) for 55 kW, 80 kW and 120 kW components.

The Basic Line Filters can be used in accordance with the following general conditions for ensuring CE conformity with regard to cable-borne interference:

- The machine/system must only be used in industrial power systems
- Only connect the Basic Line Filters to TN systems; otherwise an isolating transformer will be required
- Number of axes ≤ 12 when using a Basic Line Filter with an Active Line Module and a line reactor

Note

Basic Line Filters for Active Line Modules with line reactor must be approved (incurs a fee).

[1] Maximum total cable length = Σ motor cables, mains supply conductor from line filter to Line Module

2.7.2.2 Interface description

Overview

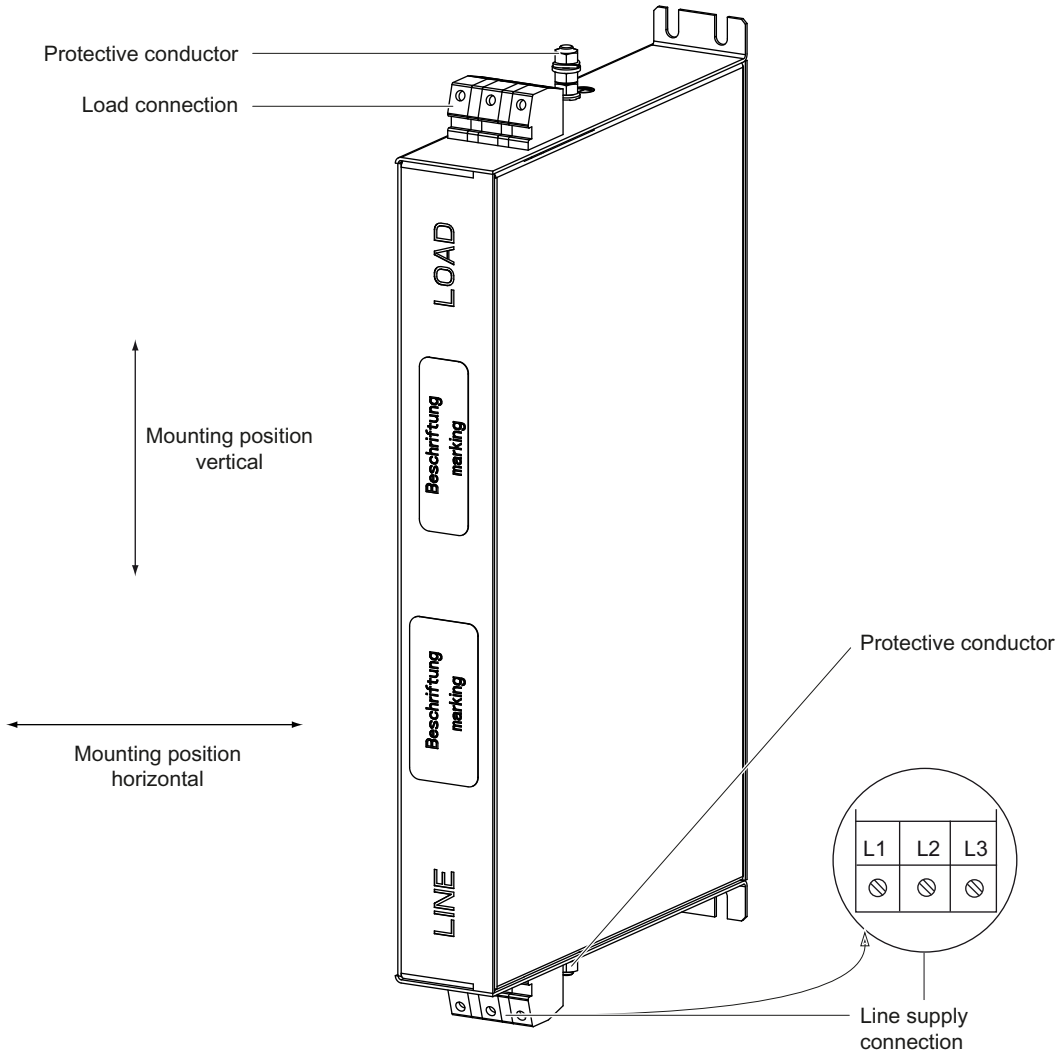


Figure 2-6 Interface overview, Basic Line Filter for Active Line Modules (example: 16 kW)

Either the upper or lower PE screw can be used for the connection. One of the screws remains unused. "Looping-through" the protective connection to the line reactor is not permissible.

Line/load connection

Table 2- 5 Line and load connection, Basic Line Filter for Active Line Modules

	6SL3000-0BE21-6DAx	6SL3000-0BE23-6DA1	6SL3000-0BE25-5DAx	6SL3000-0BE28-0DAx	6SL3000-0BE31-2DAx
Rated power [kW]	16	36	55	80	120
Line supply connection L1, L2, L3	Screw terminals: 10 mm² 3 pole 1.5 - 1.8 Nm	Screw terminals: 35 mm² 3 pole 3.2 - 3,7 Nm	Screw terminals: 50 mm² 3 pole 6 - 8 Nm	Screw terminals: 95 mm², 3-pole 15 - 20 Nm	
Load connection L1´, L2´, L3´,					
PE connection 1)	Terminal studs M6 / 6 Nm	Terminal studs M6 / 6 Nm	Terminal studs M8 / 8 Nm	Terminal studs M10 / 10 Nm	

1) For ring cable lugs in accordance with DIN 46234

2.7.2.3 Dimension drawing

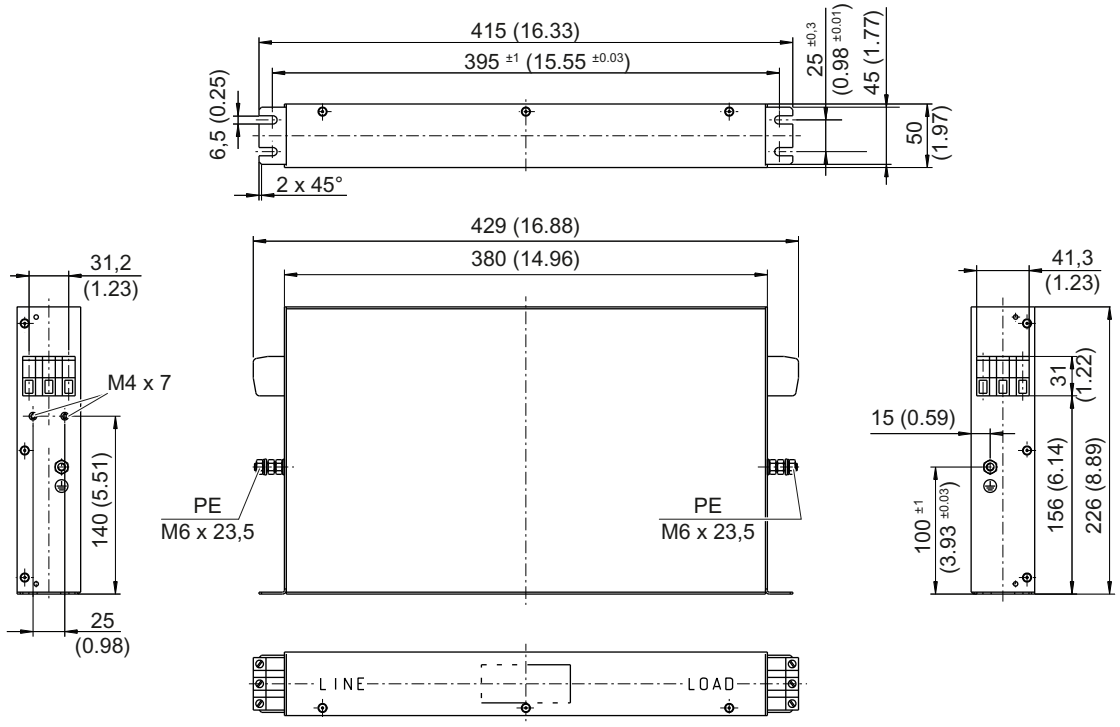


Figure 2-7 Dimension drawing of the Basic Line Filter for Active Line Modules 16 kW, all data in mm and (inches)

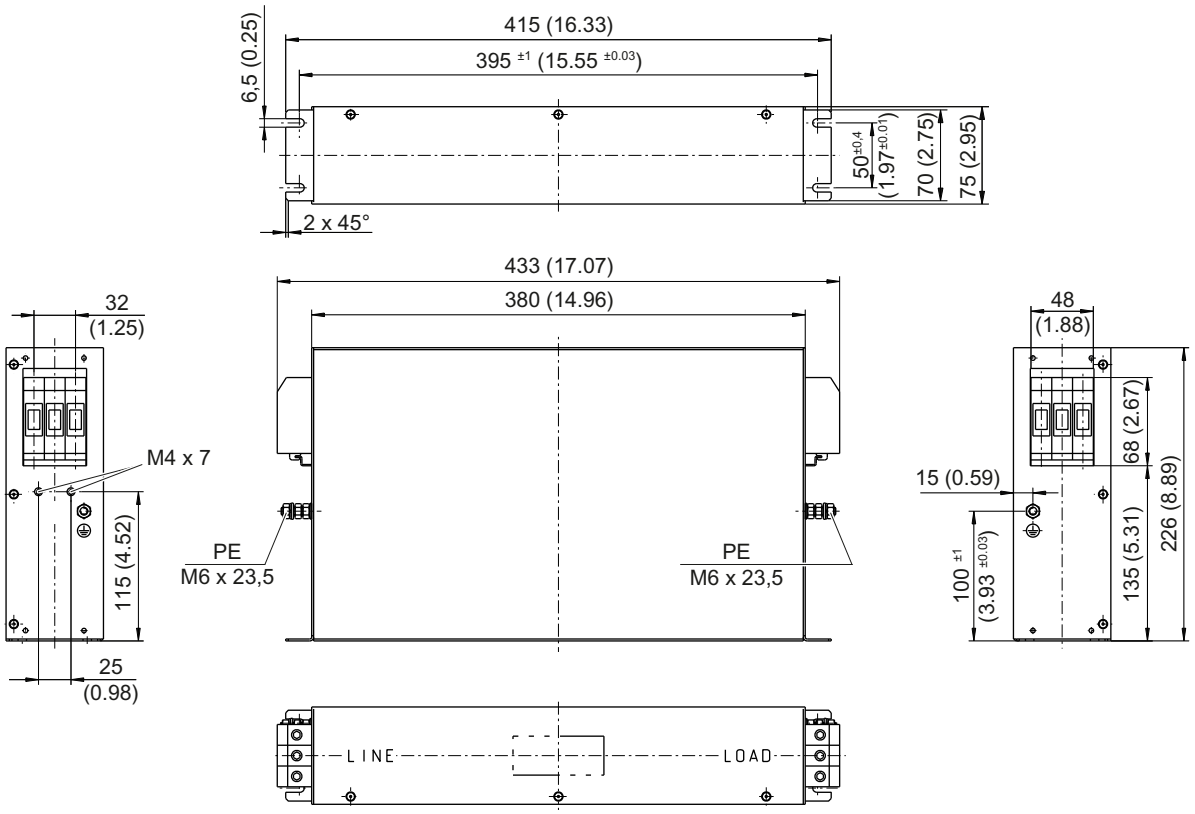


Figure 2-8 Dimension drawing of Basic Line Filter for Active Line Modules 36 kW, all data in mm and (inches)

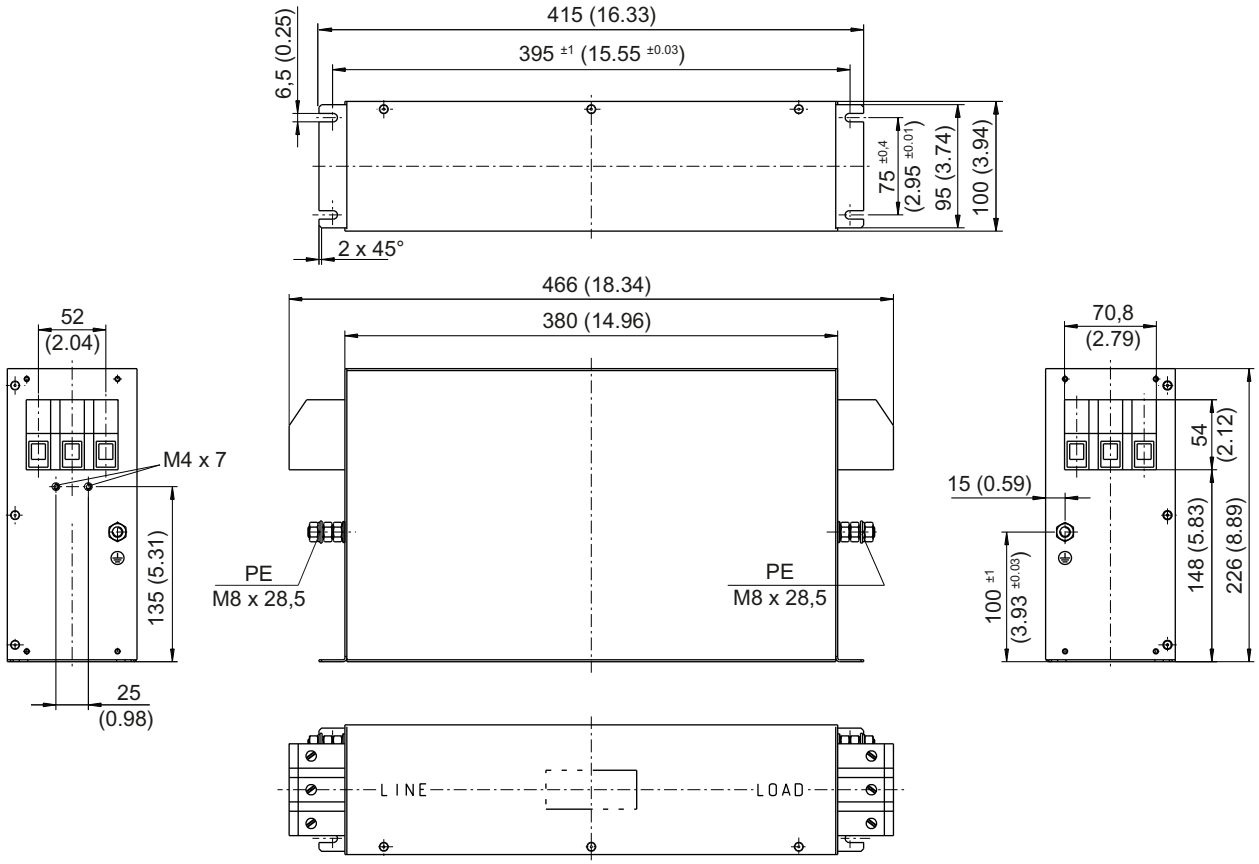


Figure 2-9 Dimension drawing of Basic Line Filter for Active Line Modules 55 kW, all data in mm and (inches)

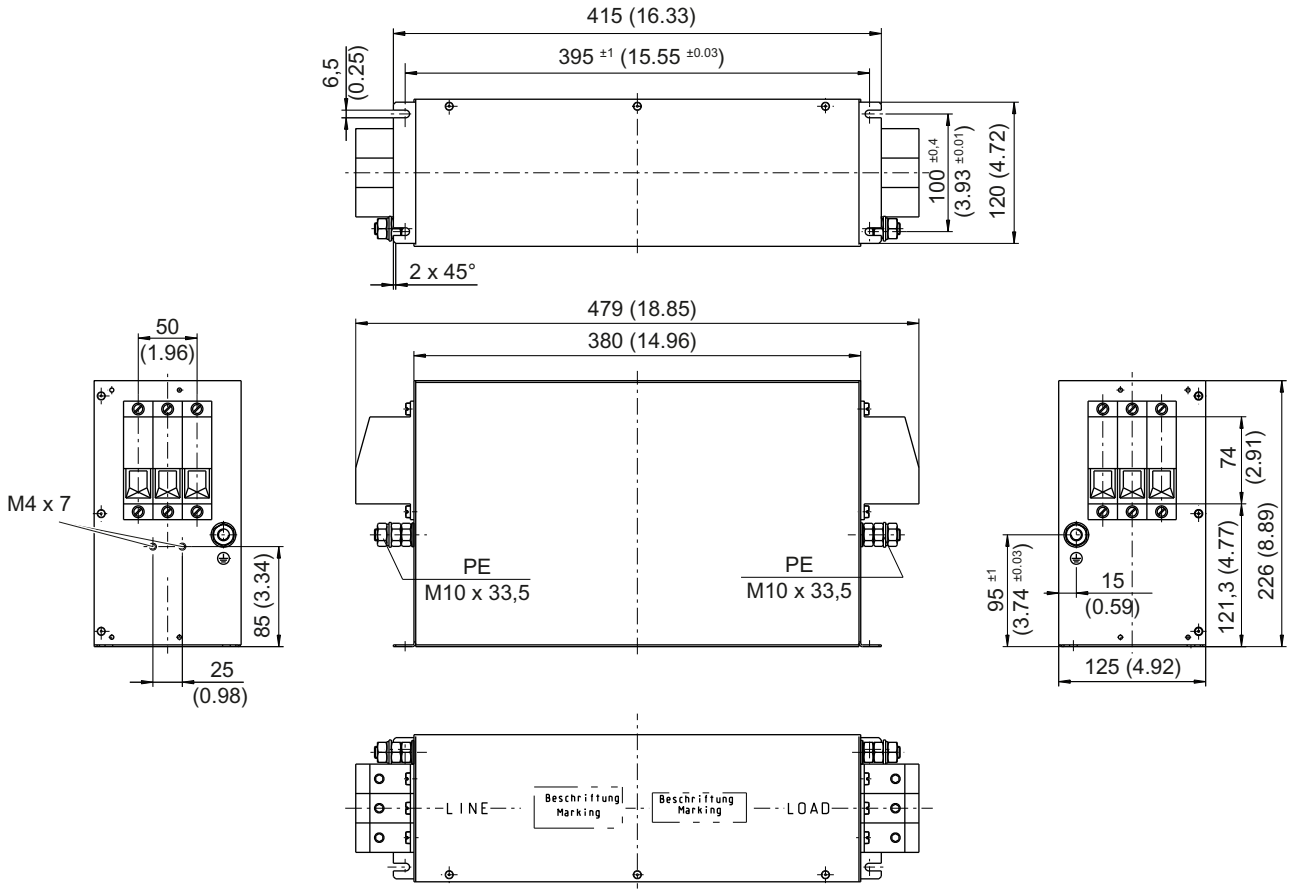


Figure 2-10 Dimension drawing of Basic Line Filter for Active Line Modules 80 kW and 120 kW, all dimensions in mm and (inches)

2.7.2.4 Technical specifications

Table 2- 6 Technical data of the Basic Line Filter for Active Line Modules with Active Interface Module

	6SL3000-	0BE21-6DAx	0BE23-6DA1	0BE25-5DAx	0BE28-0DAx	0BE31-2DAx
Rated power	kW	16	36	55	80	120
Connection voltage: Supply voltage Line frequency	 V_{AC} Hz	 3 AC 380 -10% (-15% < 1 min) to 3 AC 480 +10% 47 to 63 Hz				
Rated current	A_{AC}	36	74	105	132	192
Power loss [1]	W	16	26	43	56	73
Weight	kg	5	7.5	11.5	17.5	18.5

1) For an overview, see the power loss tables in Chapter, Control cabinet installation

2.7.3 Wideband Line Filter for Active Line Modules

2.7.3.1 Description

Wideband Line Filters for Active Line Modules are mainly effective in the frequency range from 150 kHz to 30 MHz; this is the range relevant to ensure compliance with the appropriate standard. Wideband Line Filters can also effectively limit low-frequency line harmonics of 2 kHz and above; this protects additional loads connected to the same supply system against disturbances and damage. As a result, these line filters have an extended function area, which means that they can, to a certain extent, be used regardless of the machine installation location and any unknown line properties (e.g. line impedance).

Wideband Line Filters must always be used in conjunction with a line reactor for Active Line Modules and not with an Active Interface Module.

Wideband Line Filters for Active Line Modules can achieve the interference voltage categories listed below, when used in conjunction with the associated line reactor and an EMC-compliant design (see also the chapter titled "Combination options: Line reactors and line filters"):

- EN 61800-3 category C2 up to a total cable length [1] of 350 m (shielded) for 16 kW, 36 kW, 55 kW, 80 kW, and 120 kW components
- EN 61800-3 category C2 up to a total cable length [1] of 350 m (shielded) for 16 kW, 36 kW, 55 kW, 80 kW, and 120 kW components

[1] Maximum total cable length = Σ motor cables, mains supply conductor from line filter to Line Module

2.7.3.2 Interface description

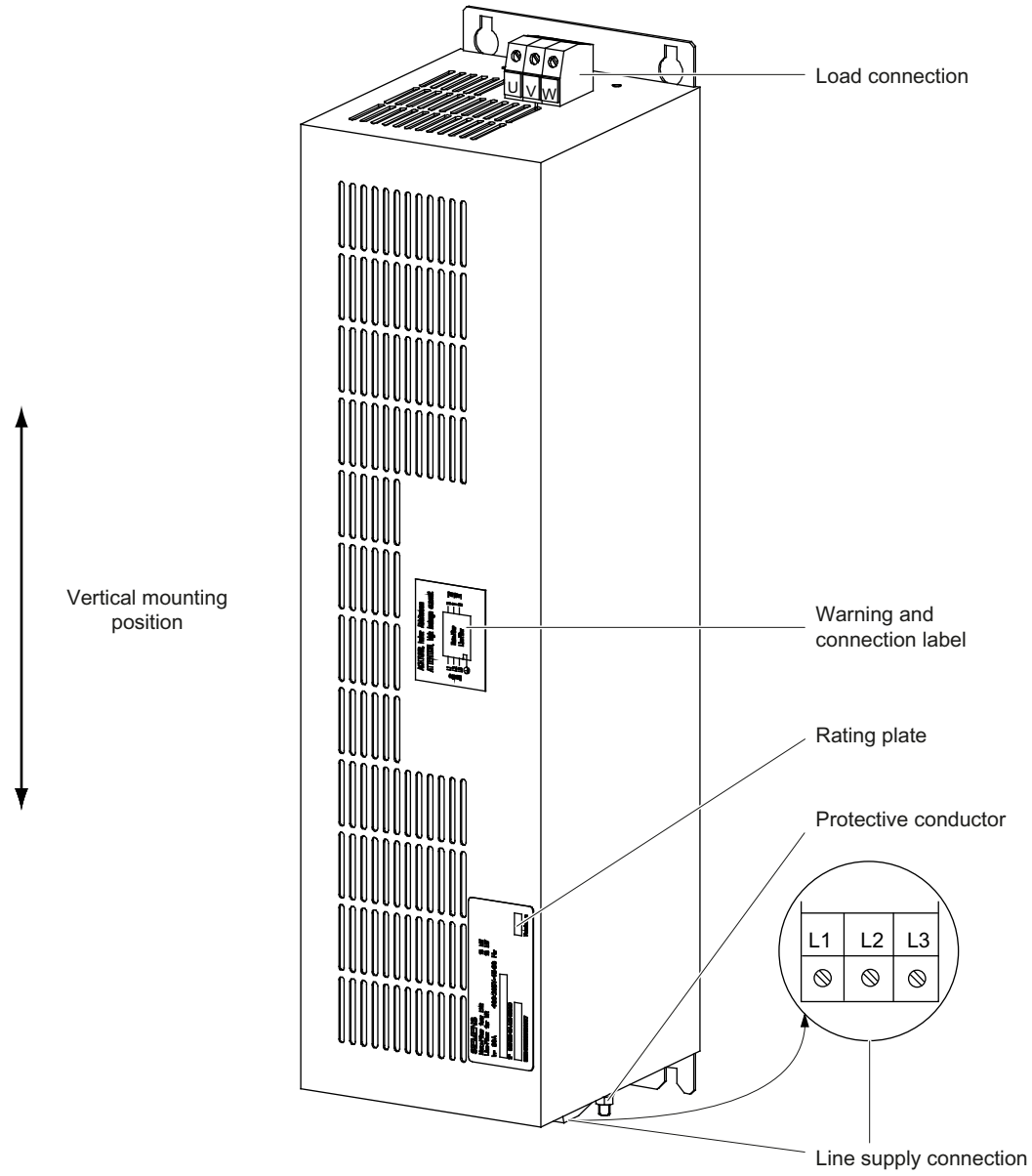


Figure 2-11 Interface overview, Wideband Line Filter for Active Line Modules (example: 16 kW)

NOTICE
The component must only be operated when installed in a vertical position with the power supply terminals at the bottom.

Line/load connection

Table 2- 7 Line and load connection, Wideband Line Filter for Active Line Modules

	6SL3000-0BE21-6AAx	6SL3000-0BE23-6AAx	6SL3000-0BE25-5AAx	6SL3000-0BE28-0AAx	6SL3000-0BE31-2AAx
Rated power [kW]	16	36	55	80	120
Line supply connection L1, L2, L3	Screw terminals: 10 mm^2 3 pole M4 / 1.5 - 1.8 Nm	Screw terminals 50 mm^2 3–pole M6 / 6 - 8 Nm		Screw terminals 95 mm^2 3–pole M8 / 15 -20 Nm	Connecting lugs d = 11 mm M10 / 25 Nm **Note: No touch protection (IP00B acc. to EN 60529)**
Load connection U, V, W					
PE connection 1)	Terminal studs M5 / 3 Nm	Terminal studs M8 / 13 Nm	Terminal studs M8 / 13 Nm	Terminal studs M8 / 13 Nm	Terminal studs M10 / 25 Nm

1) For ring cable lugs in accordance with DIN 46234

2.7.3.3 Dimension drawings

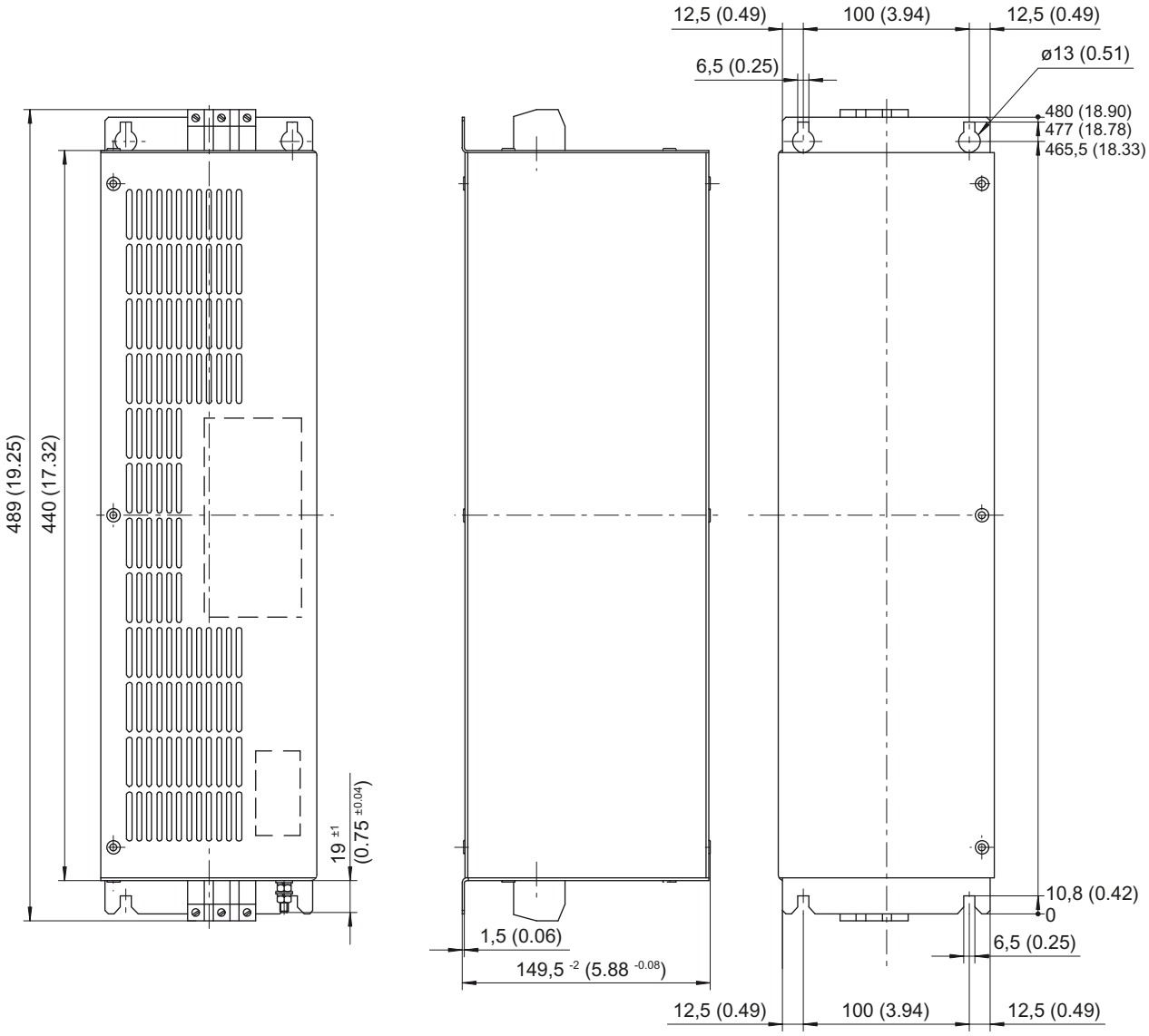


Figure 2-12 Dimension drawing of Wideband Line Filter 16 kW for Active Lines Modules, all dimensions in mm and (inches)

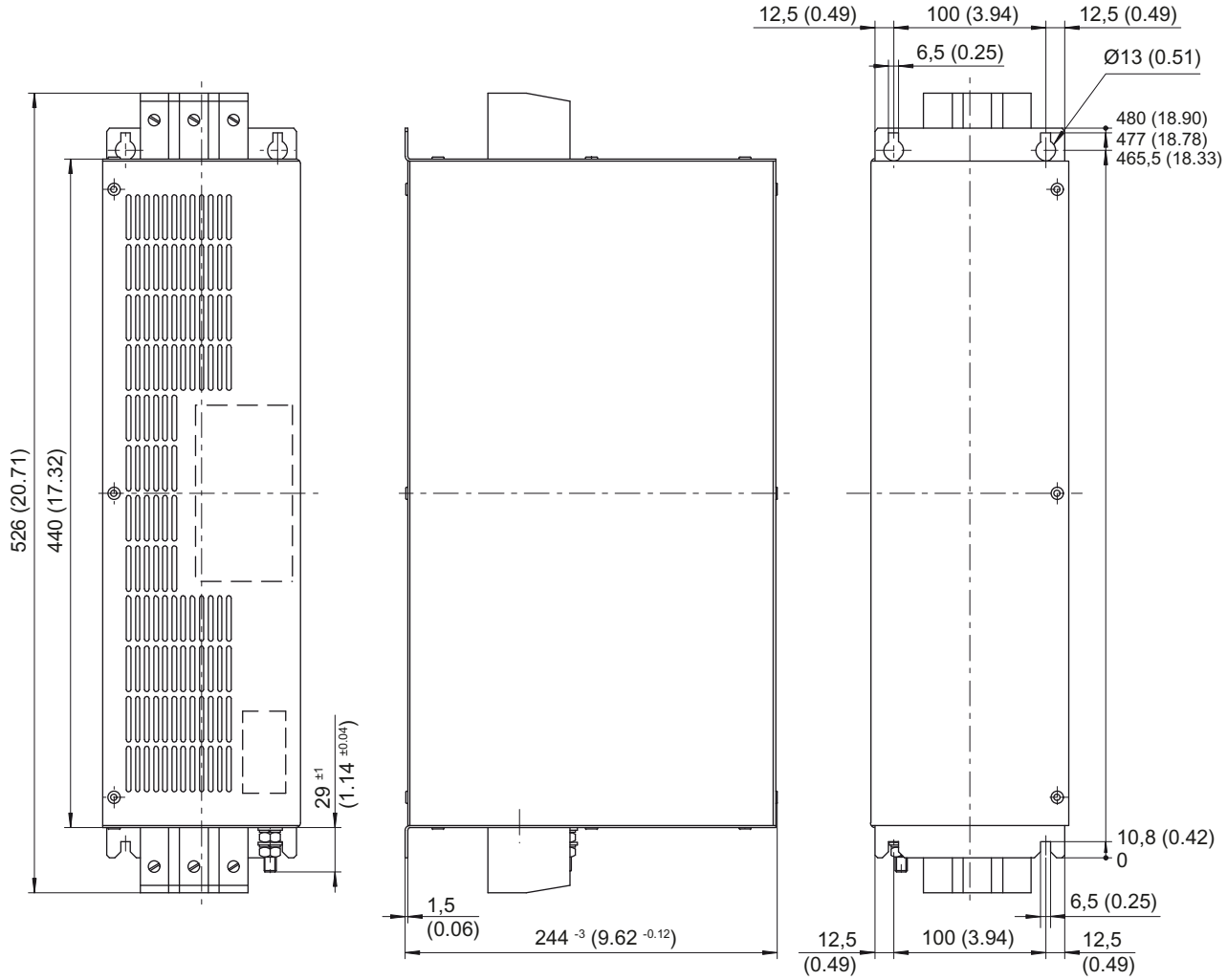


Figure 2-13 Dimension drawing of Wideband Line Filter 36 kW for Active Lines Modules, all dimensions in mm and (inches)

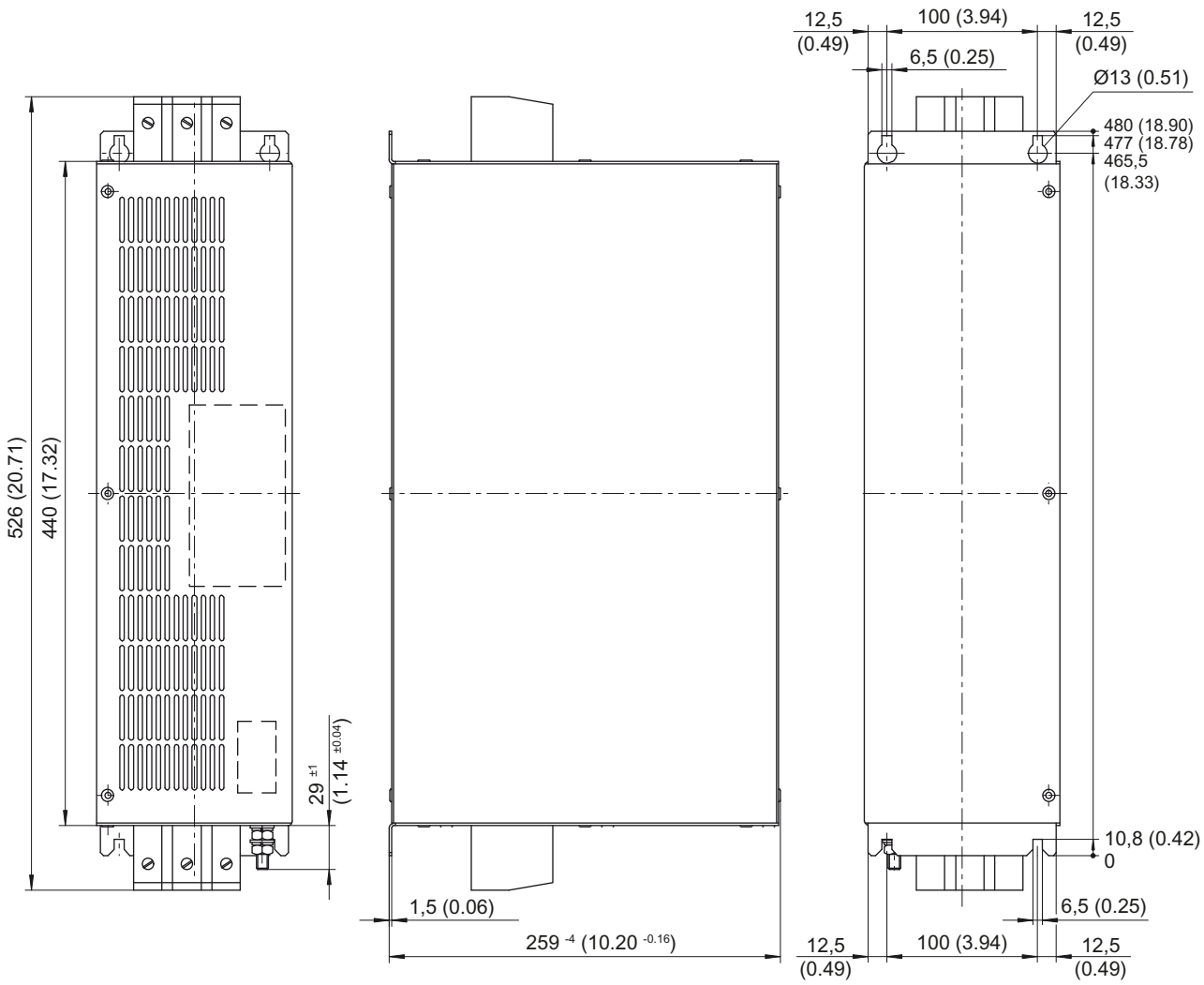


Figure 2-14 Dimension drawing of Wideband Line Filter 55 kW for Active Lines Modules, all dimensions in mm and (inches)

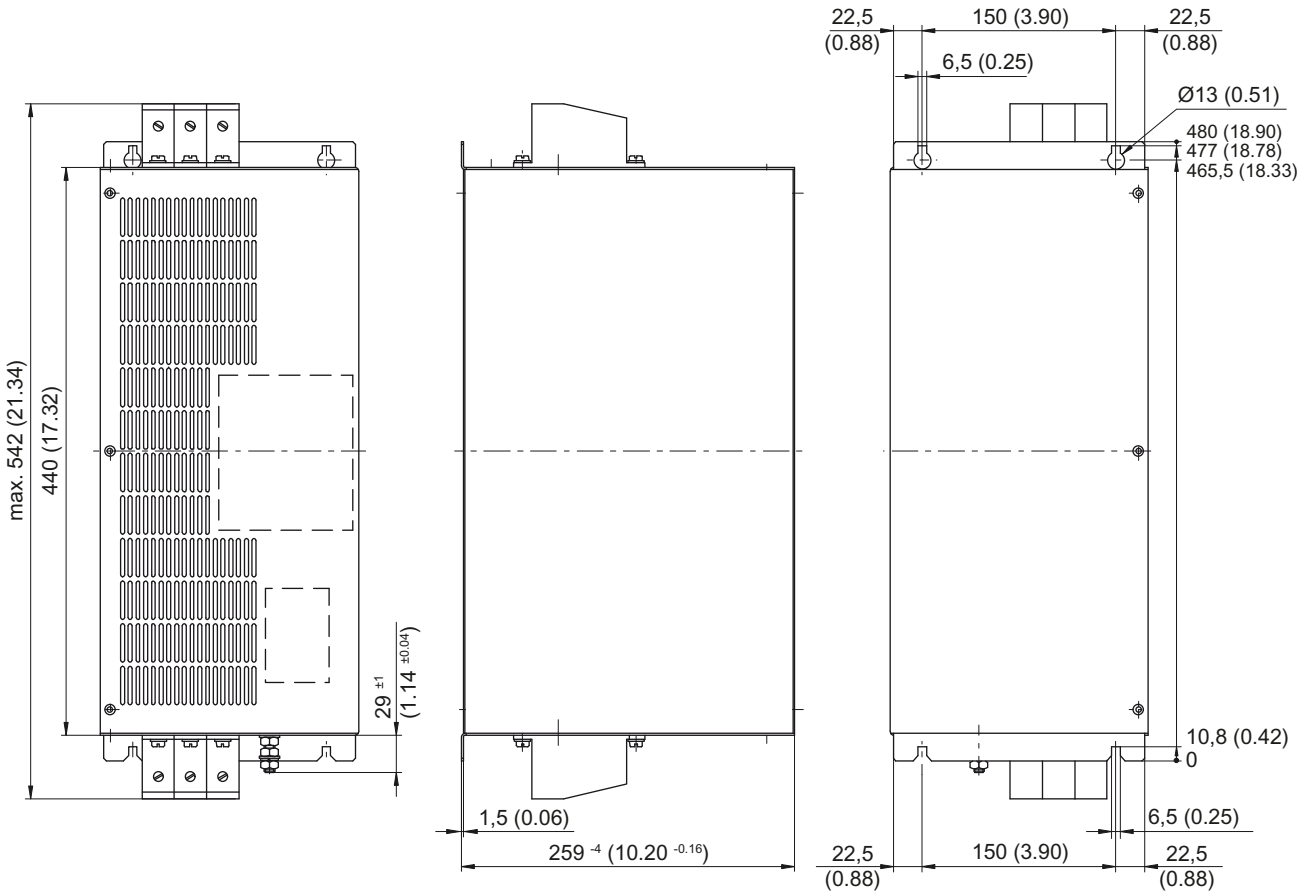


Figure 2-15 Dimension drawing of Wideband Line Filter 80 kW for Active Lines Modules, all dimensions in mm and (inches)

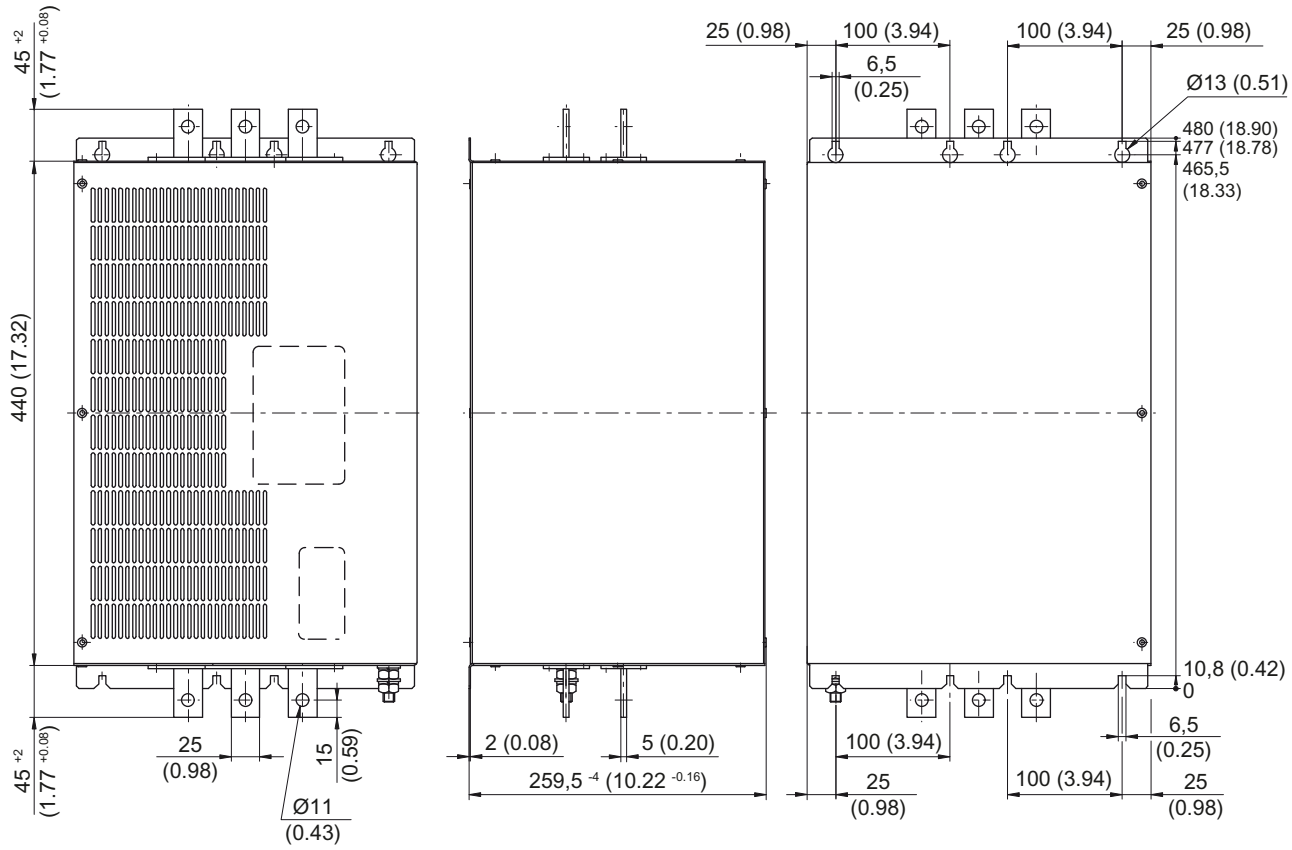


Figure 2-16 Dimension drawing of Wideband Line Filter 120 kW for Active Lines Modules, all dimensions in mm and (inches)

2.7.3.4 Technical data

Table 2- 8 Technical data: Wideband Line Filter for Active Line Modules

	6SL3000 unit	0BE21-6AAx	0BE23-6AAx	0BE25-5AAx	0BE28-0AAx	0BE31-2AAx
Rated power	kW	16	36	55	80	120
Connection voltages: Supply voltage Line frequency	 V_{AC} Hz	 380 3 AC -10% (-15% < 1 min) to 480 3 AC +10% 47 to 63 Hz				
Rated current	A_{AC}	30	67	103	150	225
Power loss[1]	W	70	90	110	150	200
Weight	kg	8.5	14.5	15.5	26	34.5

1) For an overview, see the power loss tables in chapter Control cabinet installation

2.7.4 Basic Line Filter for Basic Line Modules

2.7.4.1 Description

Basic Line Filters for Basic Line Modules are designed to attenuate conducted interference emissions in accordance with the specifications contained in the relevant EMC legislation. They are mainly effective in the frequency range from 150 kHz to 30 MHz; this is the range relevant to ensure compliance with the appropriate standard.
The machine manufacturer must certify the machine that he plans to launch on the market is in accordance with the EC EMC Directive.

Basic Line Filters for Basic Line Modules can achieve the interference voltage categories listed below, when used in conjunction with the associated line reactors and an EMC-compliant design (see also the chapter titled "Combination options: Line reactors and line filters"):

- EN 61800-3 category C2 up to a total cable length [1] of 350 m (shielded) for 20 kW, 40 kW, and 100 kW components
- EN 61800-3 category C3 up to a total cable length [1] of 630 m (shielded) for 20 kW, 40 kW, and 100 kW components

Basic Line Filters are only suitable for direct use on TN systems. An isolating transformer is required for other types of system.

[1] Maximum total cable length = Σ motor cables, mains supply conductor from line filter to Line Module

2.7.4.2 Interface description

Overview

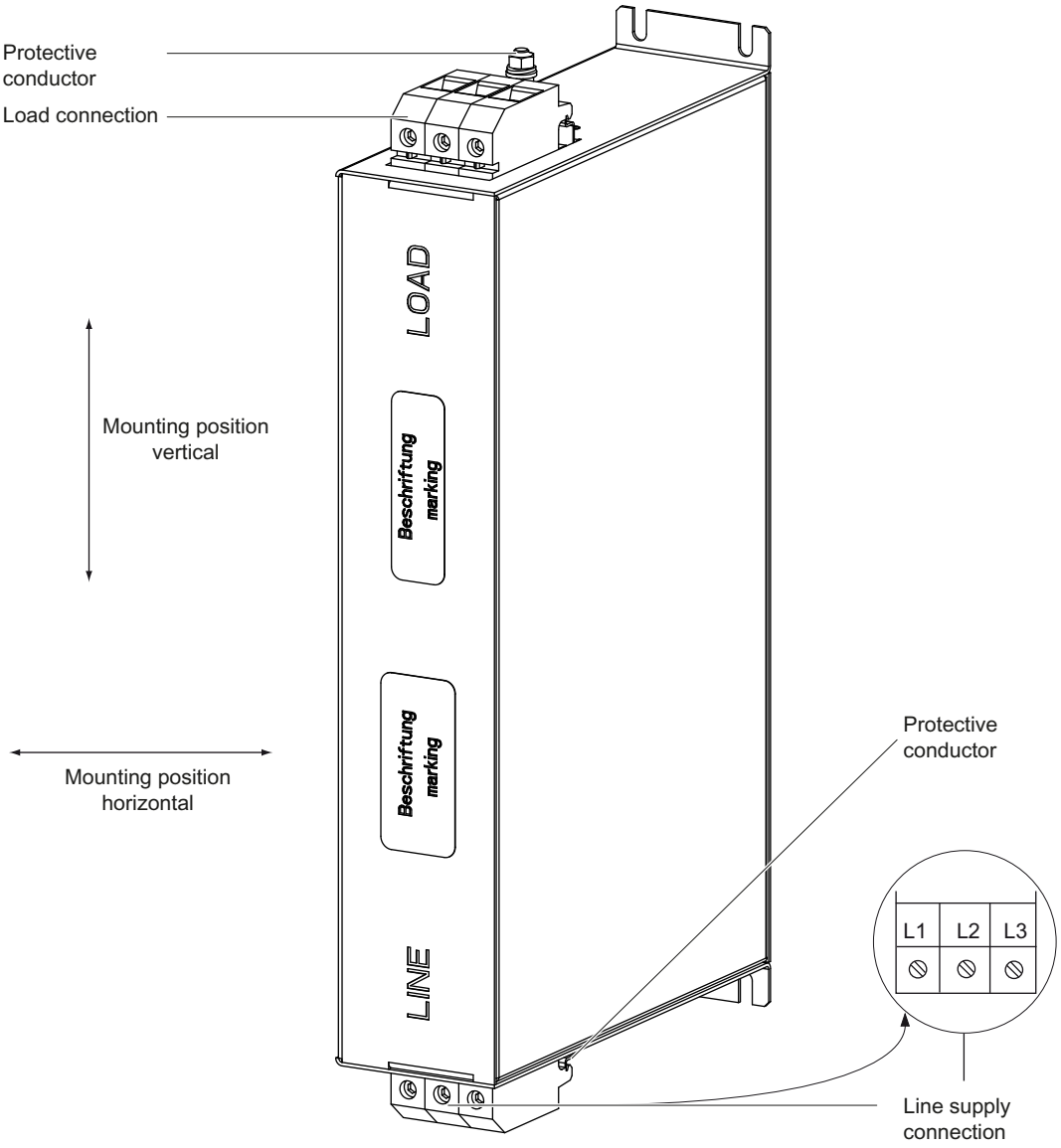


Figure 2-17 Interface overview, Basic Line Filter for Basic Line Modules (example: 40 kW)

Either the upper or lower PE screw can be used for the connection. One of the screws remains unused. "Looping-through" the protective connection to the line reactor is not permissible.

Line/load connection

Table 2- 9 Line and load connection, Basic Line Filter for Basic Line Modules

	6SL3000-0BE21-6DAx	6SL3000-0BE23-6DA1	6SL3000-0BE31-2DAx
Rated power [kW]	20	40	100
Line supply connection L1, L2, L3	Screw terminals 10 mm² 3 pole 1.5 - 1.8 Nm	Screw terminals 35 mm² 3-pole 3.2 - 3.7 Nm	Screw terminals 95 mm², 3-pole 15 - 20 Nm
Load connection L1´, L2´, L3´			
PE connection 1)	Terminal studs M6 / 6 Nm	Terminal studs M6 / 6 Nm	Terminal studs M10 / 10 Nm

1) For ring cable lugs in accordance with DIN 46234

2.7.4.3 Dimension drawing

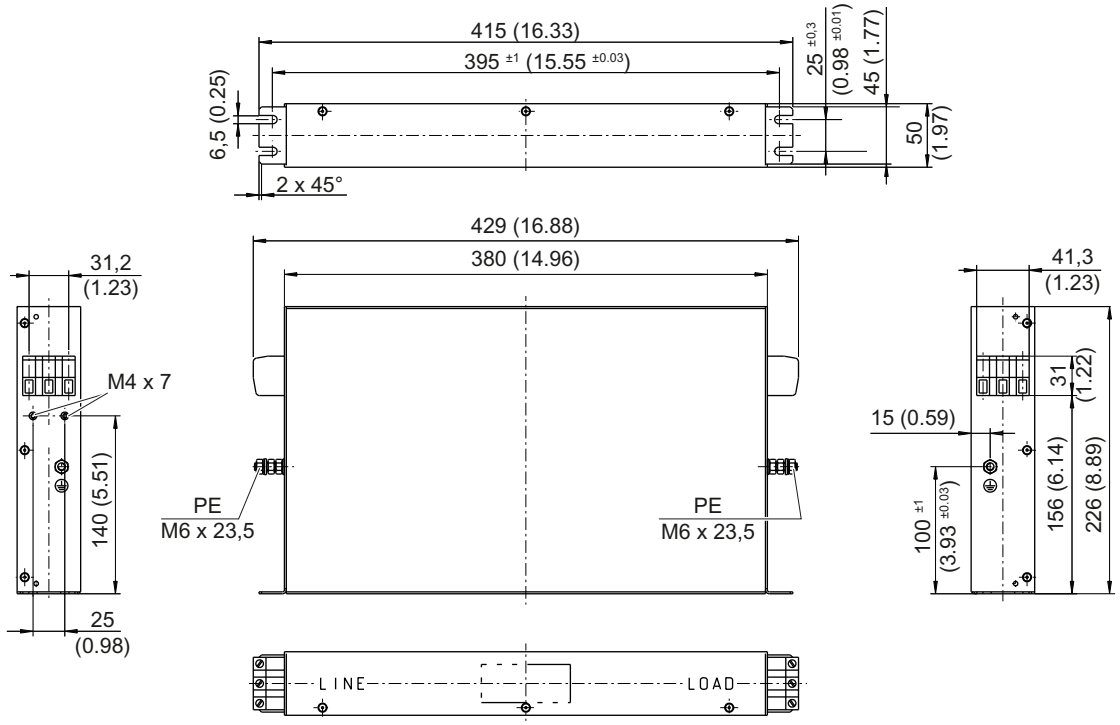


Figure 2-18 Dimension drawing of Basic Line Filter for Basic Line Modules 20 kW, all data in mm and (inches)

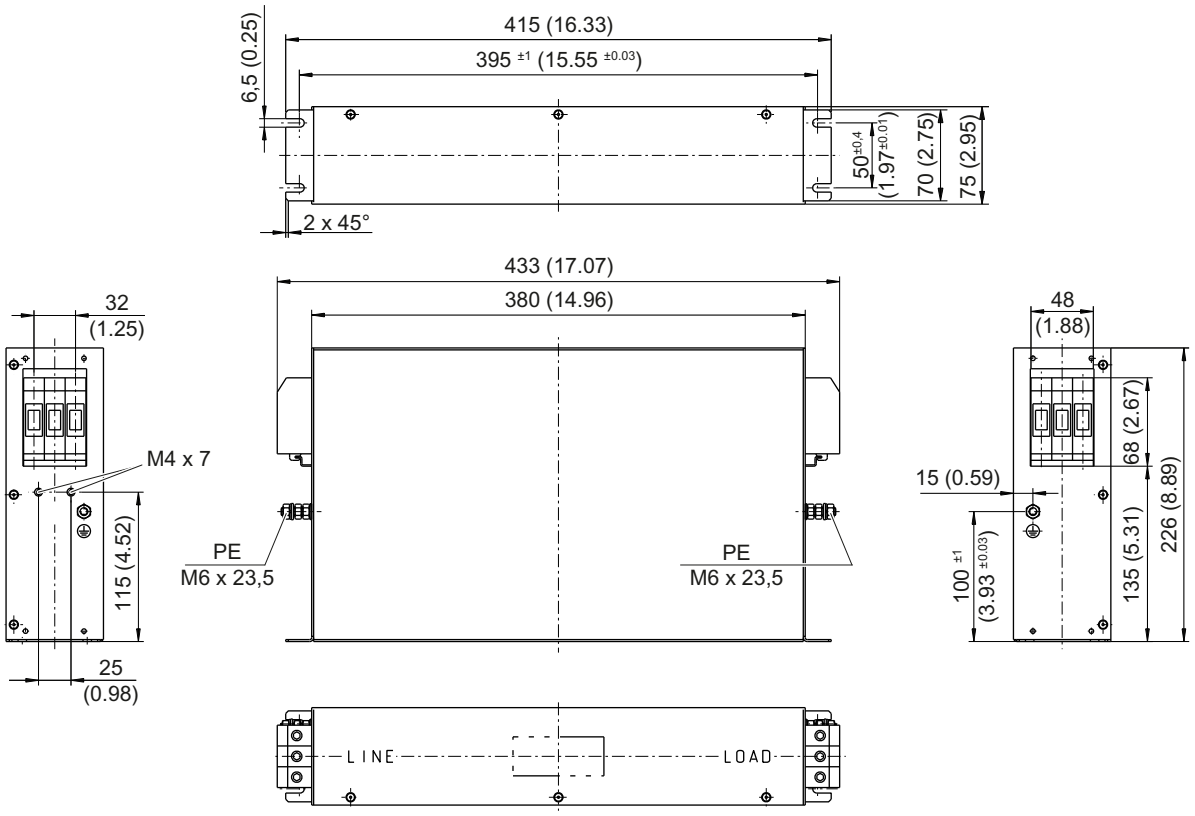


Figure 2-19 Dimension drawing of Basic Line Filter for Basic Line Modules 40 kW, all data in mm and (inches)

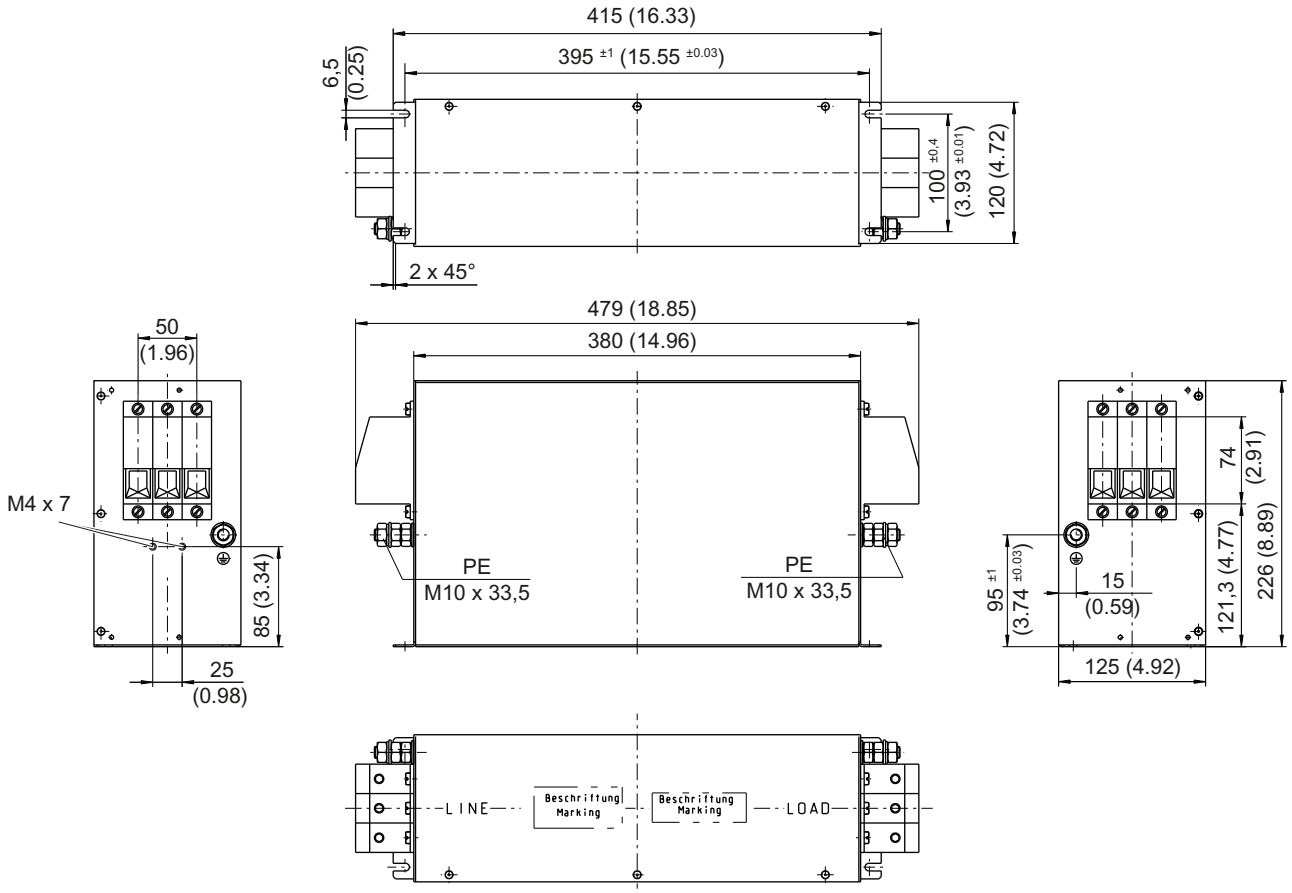


Figure 2-20 Dimension drawing of Basic Line Filter for Basic Line Modules 100 kW, all data in mm and (inches)

2.7.4.4 Technical data

Table 2- 10 Technical data for Basic Line Filter for Basic Line Modules

	6SL3000-	0BE21-6DAx	0BE23-6DA1	0BE31-2DAx
Rated power	kW	20	40	100
Connection voltage: Supply voltage Line frequency	 V_{AC} Hz	 3 AC 380 -10% (-15% < 1 min) to 3 AC 480 +10% 47 to 63 Hz		
Rated current	A_{AC}	36	74	192
Power loss 1)	W	16	26	43
Weight	kg	5	7.5	18.5

1) For an overview, see the power loss tables in Chapter, Control cabinet installation

2.7.5 Basic Line Filter for Smart Line Modules

2.7.5.1 Description

Basic Line Filters for Smart Line Modules are designed to attenuate conducted interference emissions in accordance with the specifications contained in the relevant EMC legislation. They are mainly effective in the frequency range from 150 kHz to 30 MHz; this is the range relevant to ensure compliance with the appropriate standard.

Basic Line Filters for Smart Line Modules can achieve the interference voltage categories listed below, when used in conjunction with the associated line reactors and an EMC-compliant design (see also the chapter titled "Combination options: Line reactors and line filters"):

- EN 61800-3 category C2 up to a total cable length [1] of 350 m (shielded) for 5 kW to 55 kW components
- EN 61800-3 category C3 up to a total cable length [1] of 350 m (shielded) for 5 kW to 55 kW components

Basic Line Filters are only suitable for direct connection to TN systems. An isolating transformer is required for other types of system.

[1] Maximum total cable length = Σ motor cables, mains supply conductor from line filter to Line Module

2.7.5.2 Interface description

Overview

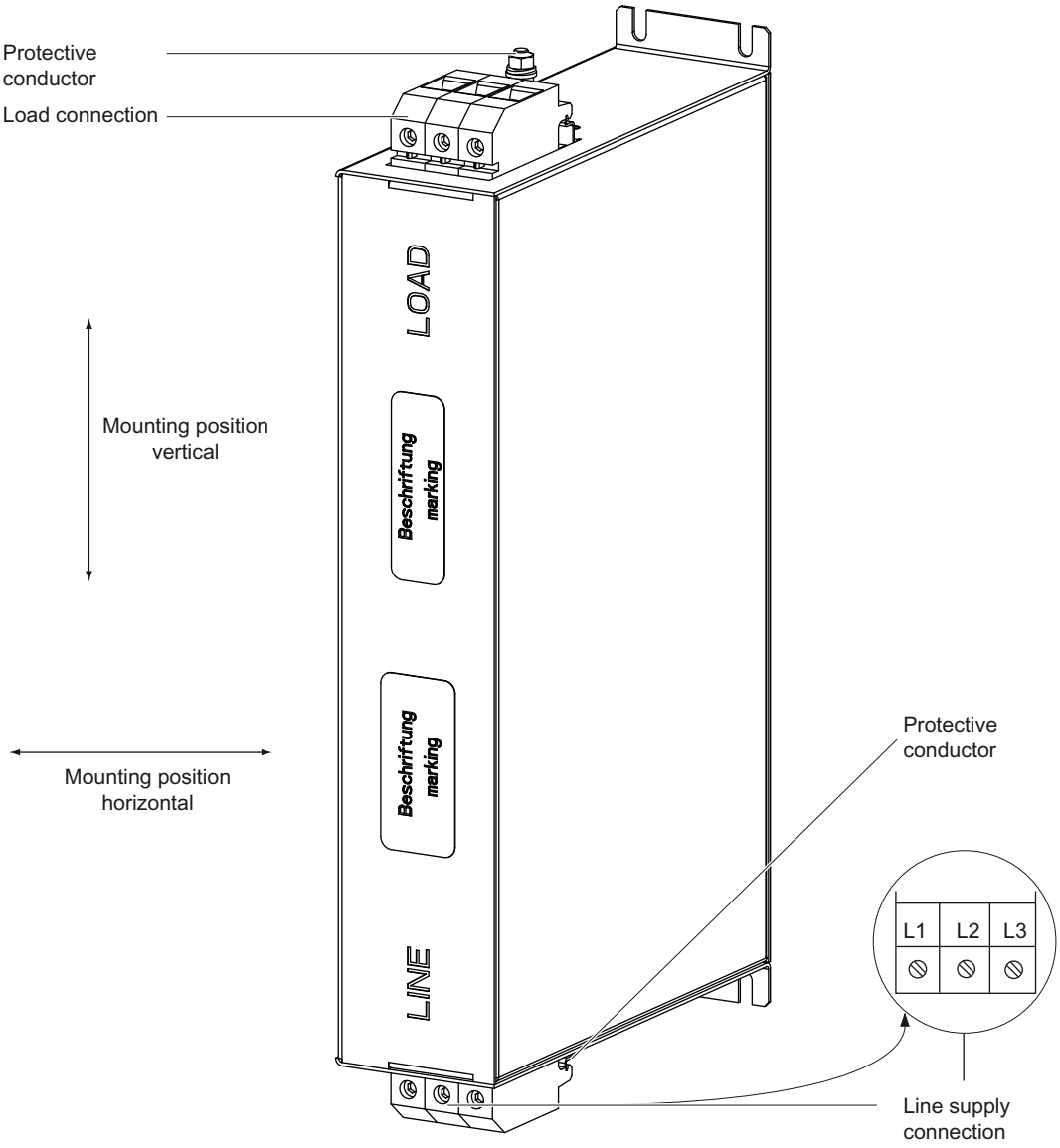


Figure 2-21 Interface overview, Basic Line Filter for Smart Line Modules (example: 36 kW)

Either the upper or lower PE screw can be used for the connection. One of the screws remains unused. "Looping-through" the protective connection to the line reactor is not permissible.

Line/load connection

Table 2- 11 Line and load connection, Basic Line Filter for Smart Line Modules

	6SL3000-0HE15-0AAx	6SL3000-0HE21-0AAx	6SL3000-0BE21-6DAx	6SL3000-0BE23-6DA1	6SL3000-0BE25-5DAx
Rated power [kW]	5	10	16	36	55
Line supply connection L1, L2, L3	Screw terminals 10 mm² 3-pole 1.2 - 1.5 Nm			Screw terminals 35 mm² 3-pole 3.2 - 3.7 Nm	Screw terminals 50 mm² 3-pole 6 - 8 Nm
Load connection L1´, L2´, L3´					
PE connection 1)	Terminal studs M6 / 6 Nm			Terminal studs M6 / 6 Nm	Terminal studs M8 / 8 Nm

1) For ring cable lugs in accordance with DIN 46234

2.7.5.3 Dimension Drawings

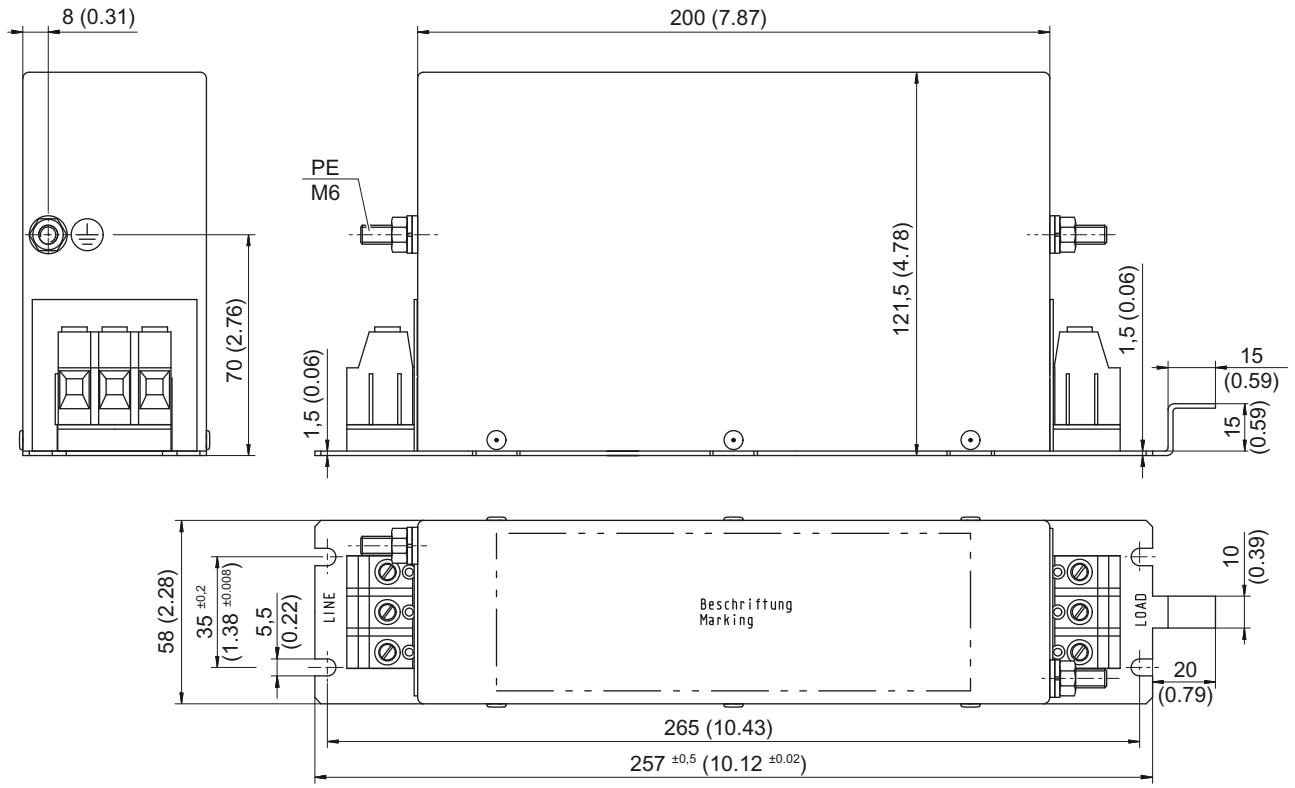


Figure 2-22 Dimension drawing of Basic Line Filter for 5 kW and 10 kW Smart Line Modules, all dimensions in mm and (inches)

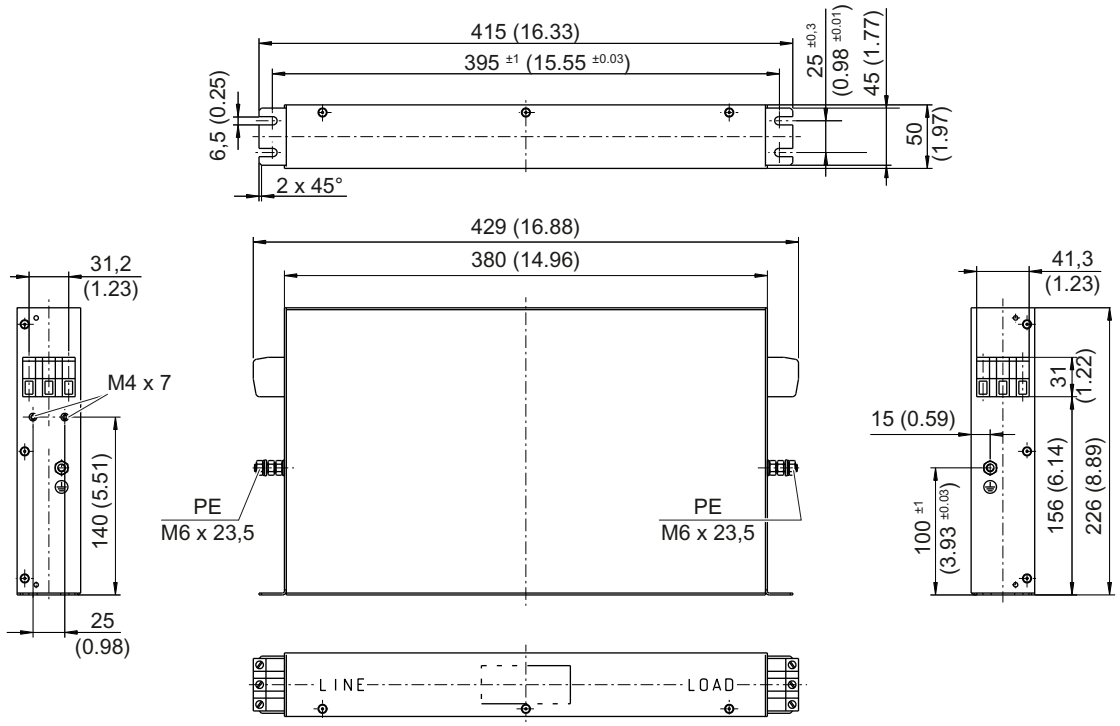


Figure 2-23 Dimension drawing of Basic Line Filter for Smart Line Modules 16 kW, all data in mm and (inches)

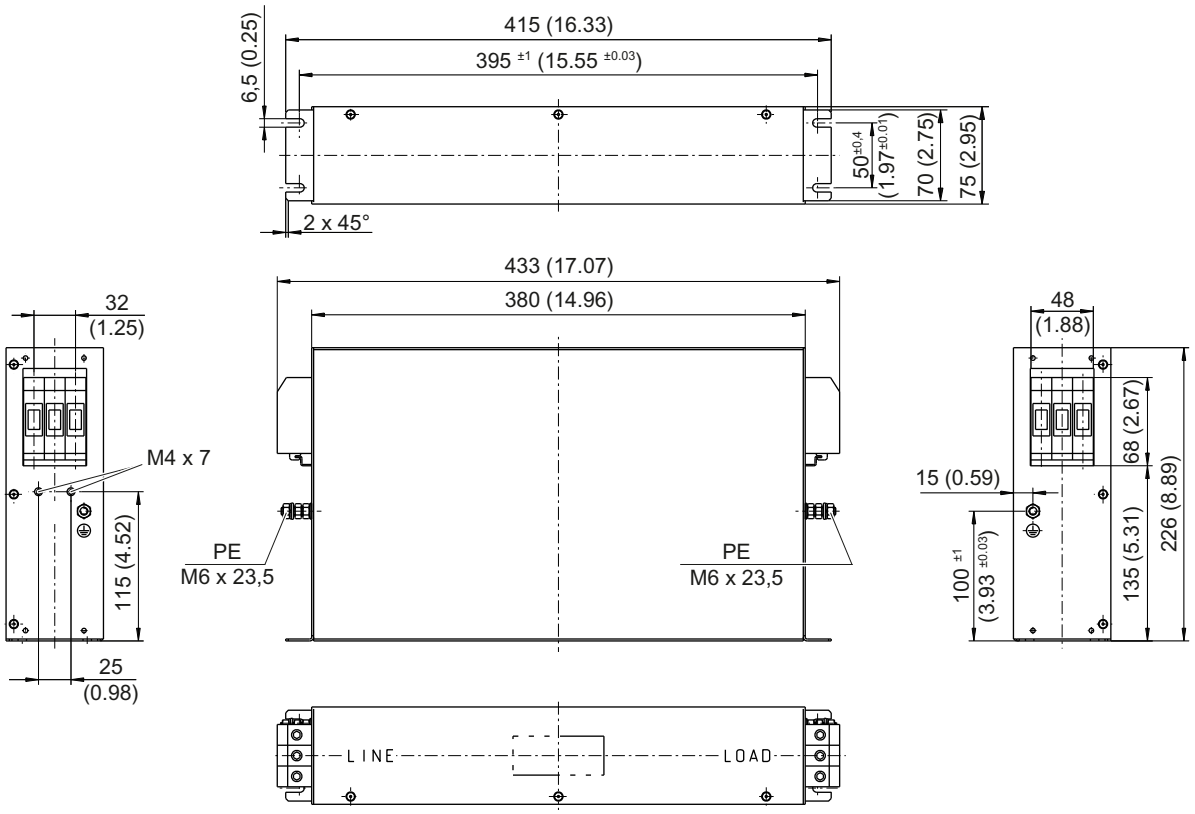


Figure 2-24 Dimension drawing of Basic Line Filter for Smart Line Modules 36 kW, all data in mm and (inches)

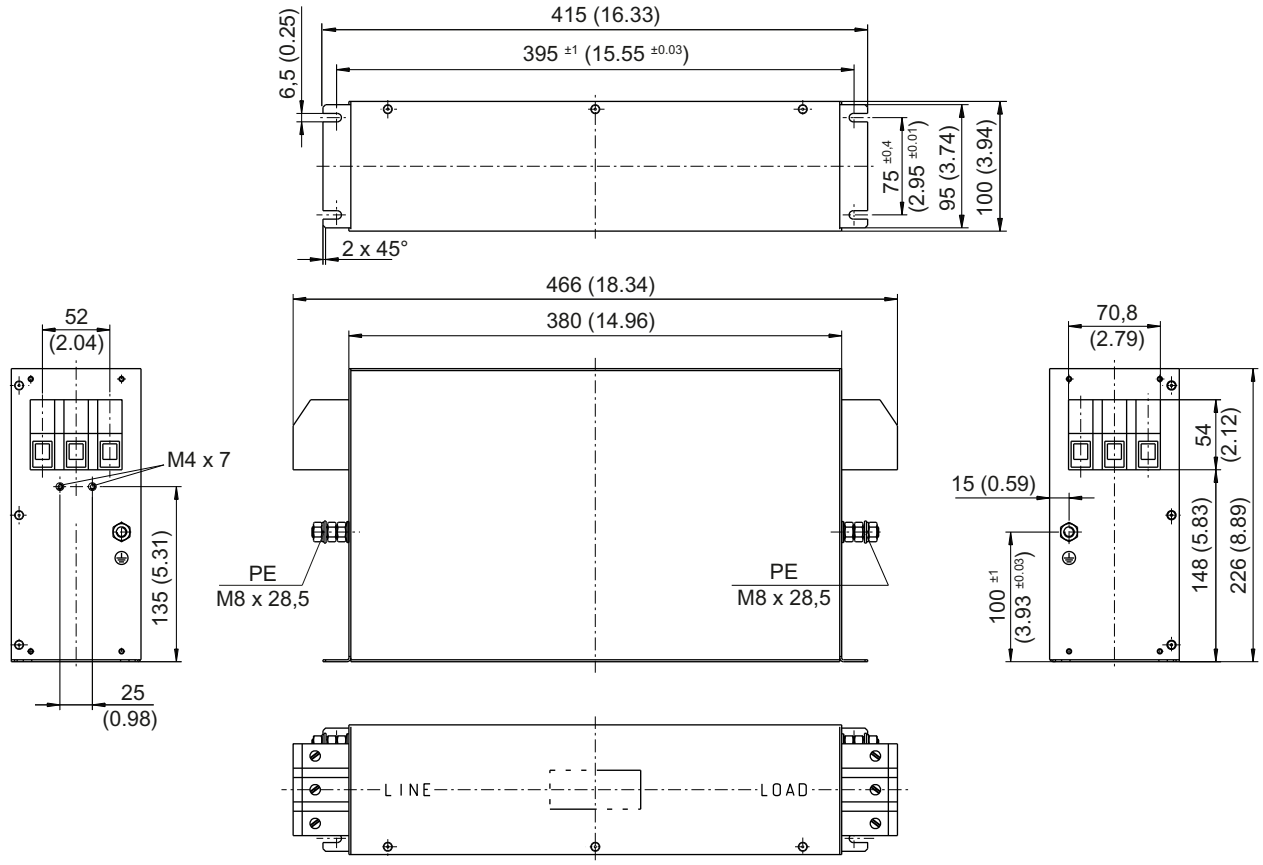


Figure 2-25 Dimension drawing of Basic Line Filter for Smart Line Modules 55 kW, all data in mm and (inches)

2.7.5.4 Technical Specifications

Table 2- 12 Technical data for: Basic Line Filter for Smart Line Modules

	6SL3000-	0HE15-0AAx	0HE21-0AAx	0BE21-6DAx	0BE23-6DA1	0BE25-5DAx
Rated power	kW	5	10	16	36	55
Connection voltage: Supply voltage Line frequency	 V_{AC} Hz	 3 AC 380 -10% (-15% < 1 min) to 3 AC 480 +10% 47 to 63 Hz				
Rated current	A_{AC}	12	25	36	74	105
Power loss[1)]	W	20	20	16	26	43
Weight	kg	2.1	2.3	5	7.5	11.5

1) For an overview, see the power loss tables in the chapter titled Control cabinet installation

2.8 Line reactors

Line reactors limit line harmonics to permissible values. For this reason, line reactors should always be used.

They must be used in conjunction with Active Line Modules as an energy storage feature for the step-up converter function.

HFD line reactors have an additional winding, to which a separate damping resistor must be connected. This device dampens any possible system oscillations (with voltage amplitudes that could shorten the equipment's service life because of parasitic points of resonance caused by line capacities and supply system characteristics) in converter systems to safe values. Hence, the damping resistor improves operational reliability and extends the service life.

Note

Ideally, new systems using Active Line Modules should be designed with Active Interface Modules as line connection components.

The line reactors listed below are available for use with Line Modules.

Table 2- 13 Overview of line reactors

Line reactors	Order number
Line reactors for Active Line Modules	
16 kW	6SL3000-0DE21-6AAx
36 kW	6SL3000-0DE23-6AAx
55 kW	6SL3000-0DE25-5AAx
80 kW	6SL3000-0DE28-0AAx
120 kW	6SL3000-0DE31-2AAx
Line reactors for Smart Line Modules	
5 kW	6SL3000-0CE15-0AAx
10 kW	6SL3000-0CE21-0AAx
16 kW	6SL3000-0CE21-6AAx
36 kW	6SL3000-0CE23-6AAx
55 kW	6SL3000-0CE25-5AAx
Line reactors for Basic Line Modules	
20 kW	6SL3000-0CE22-0AAx
40 kW	6SL3000-0CE24-0AAx
100 kW	6SL3000-0CE31-0AAx

2.8.1 Safety information

CAUTION

Only the line reactors or Active Interface Modules described in this Manual are to be used.

The following can occur if line reactors are used that have not been approved for SINAMICS S120 by SIEMENS:

- The Line Modules may become damaged/faulty
- Line harmonics may occur and damage or interfere with other loads powered from the same supply system.

⚠ CAUTION

If system oscillations do occur and no damping resistor is connected, impermissibly high voltages may arise at the additional winding of the HFD line reactors. For this reason, it is essential that a damping resistor be connected.

⚠ CAUTION

The line reactors may reach high surface temperatures of > 80° C. To prevent adjacent components from suffering damage due to these high temperatures, a clearance of 100 mm must be left on all sides of the reactors.

If this clearance cannot be observed, additional measures such as shielding plates or a cooling function must be put in place.

CAUTION

Reactors generate magnetic fields. Components and cables which could be subject to interference or be affected by these fields must, therefore, be located a sufficient distance (at least 200 mm) away or be shielded accordingly.

Note

Connection cables

The connection cables between line reactor and Line Module, as well as between line reactor and line filter, must be kept as short as possible (max. 10 m).

You must use shielded connection cables, whose cable shields are attached at both ends.

Shielding can only be omitted if the following conditions are met:

- The cables do not exceed 1 m in length.
- The cables are laid flush with the rear metal wall of the control cabinet.
- The cables are laid in a way that keeps them physically separate from signal cables.

Do not route any cables near the line reactor. If this cannot be avoided, observe a minimum distance of 200 mm.

2.8.2 Line reactors for Active Line Modules

2.8.2.1 Interface description

Overview

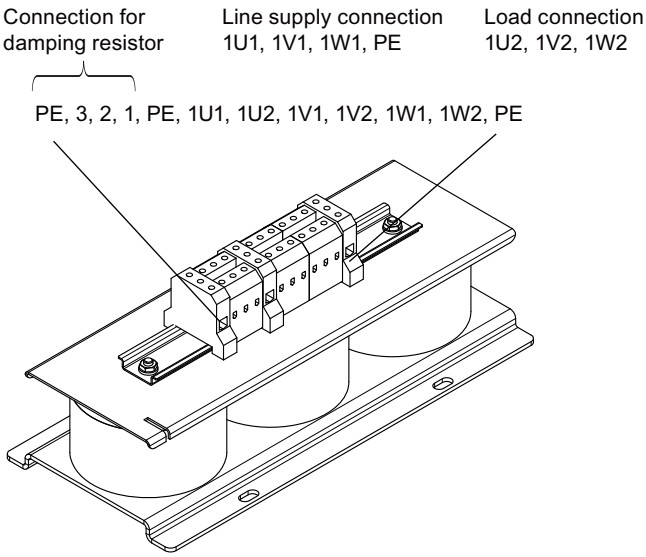


Figure 2-26 Interface overview, HFD line reactor 16 kW

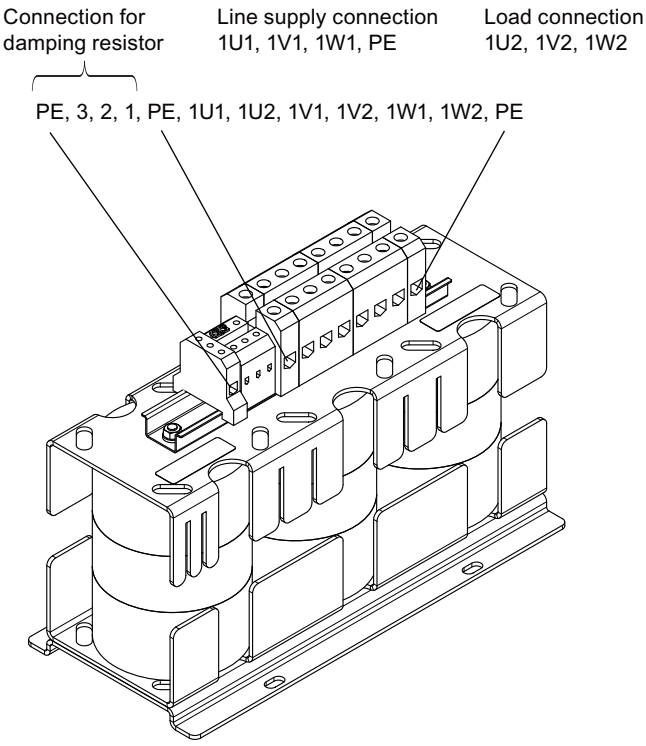


Figure 2-27 Interface overview, HFD line reactor 36 kW

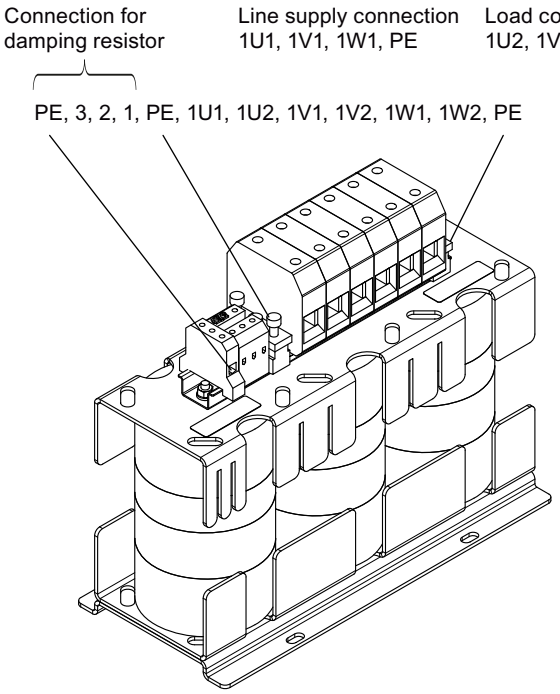


Figure 2-28 Interface overview, HFD line reactor 55 kW

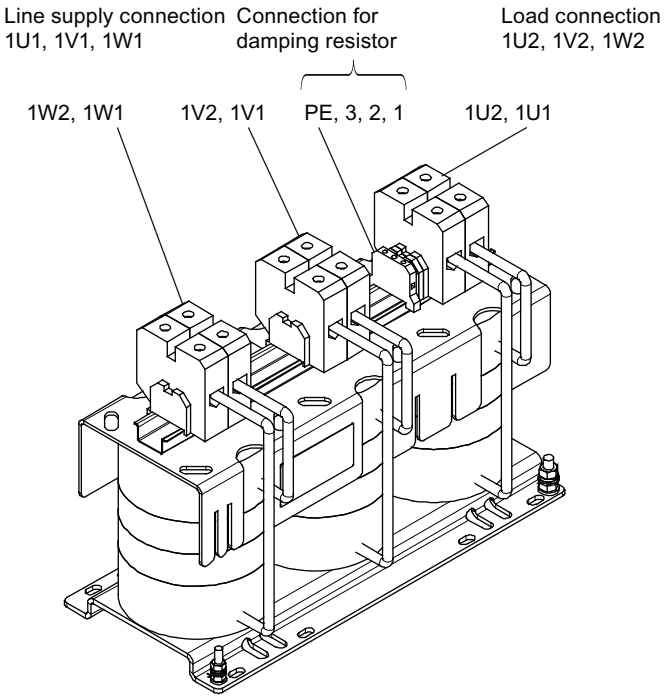


Figure 2-29 Interface overview, HFD line reactor 80 kW

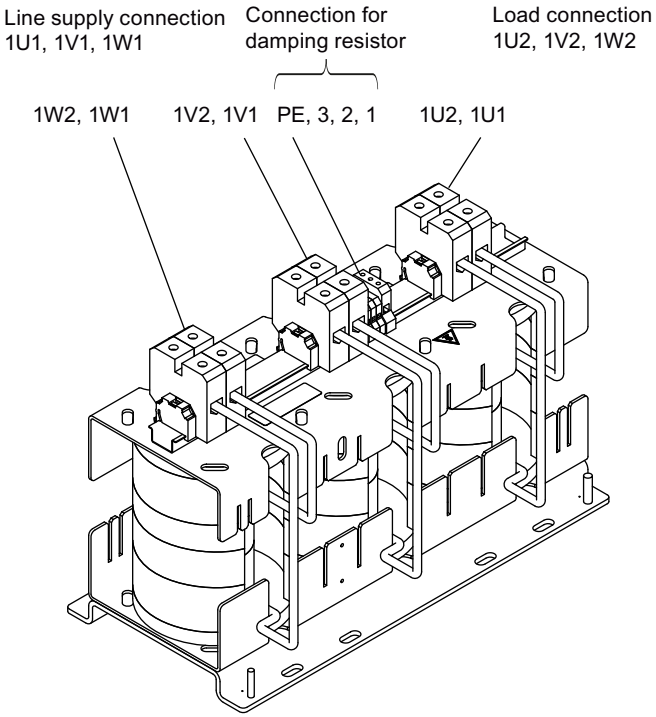


Figure 2-30 Interface overview, HFD line reactor 120 kW

Line/load connection

Table 2- 14 Connection of HFD line reactors

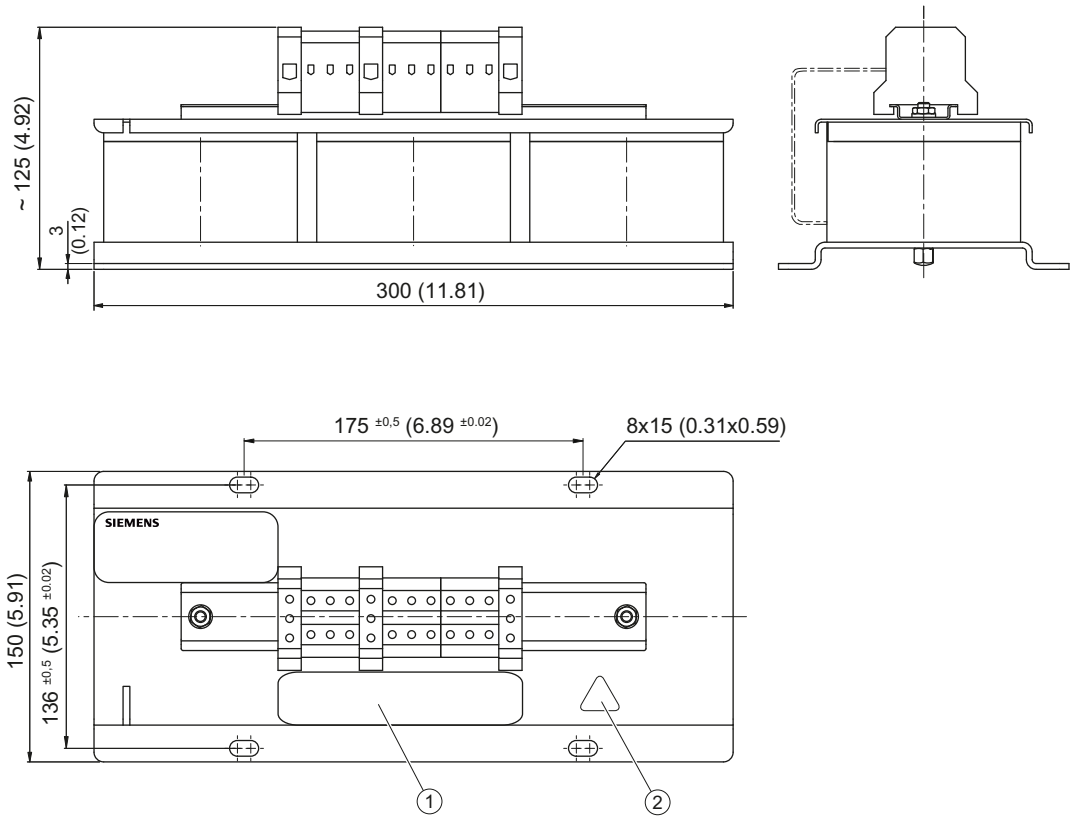
Order number	6SL3000-0DE21-6AAx	6SL3000-0DE23-6AAx	6SL3000-0DE25-5AAx	6SL3000-0DE28-0AAx	6SL3000-0DE31-2AAx
Power [kW]	16	36	55	80	120
Line supply connection 1U1, 1V1, 1W1	Screw terminal 16 mm²/1.2 Nm	Screw terminal 35 mm²/2.5 Nm	Screw terminal 70 mm²/7 Nm	POWER CAGE CLAMPS 95 mm²/self-locking 1)	
Load connection 1U2, 1V2, 1W2				POWER CAGE CLAMPS 95 mm²/self-locking 1)	
PE connection	Screw terminal 16 mm²/1.2 Nm	Screw terminal 35 mm²/2.5 Nm	Screw terminal 70 mm²/3.5 Nm	PE connecting lug M10/25 Nm for ring cable lugs in accordance with DIN 46234	
				Note: No touch protection (IP00B acc. to EN 60529)	
Damping-resistor connection 1, 2, 3 PE	Screw terminal max. 1.5 mm²/1.2 Nm				

1) See chapter Spring-loaded terminals

Note

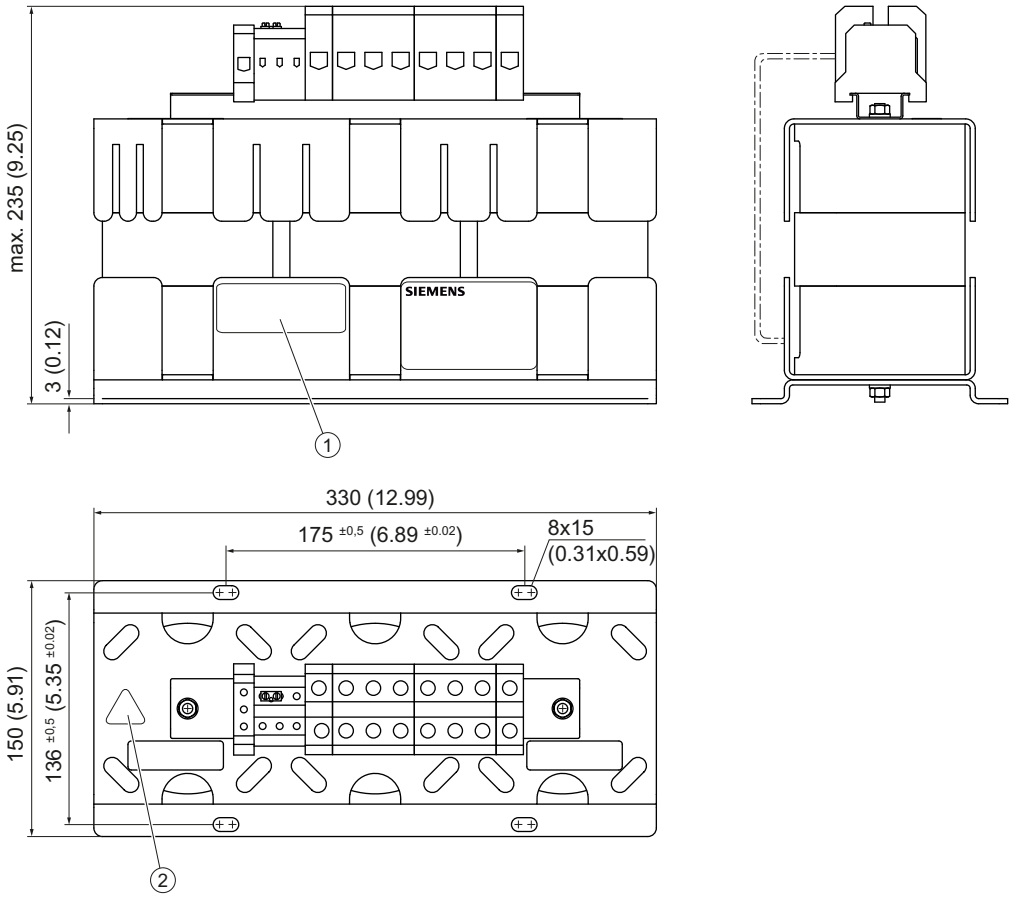
Data relating to the permissible tightening torques can also be found on the label showing the terminal layout of the screw terminal for the corresponding HFD line reactor.

2.8.2.2 Dimension drawings



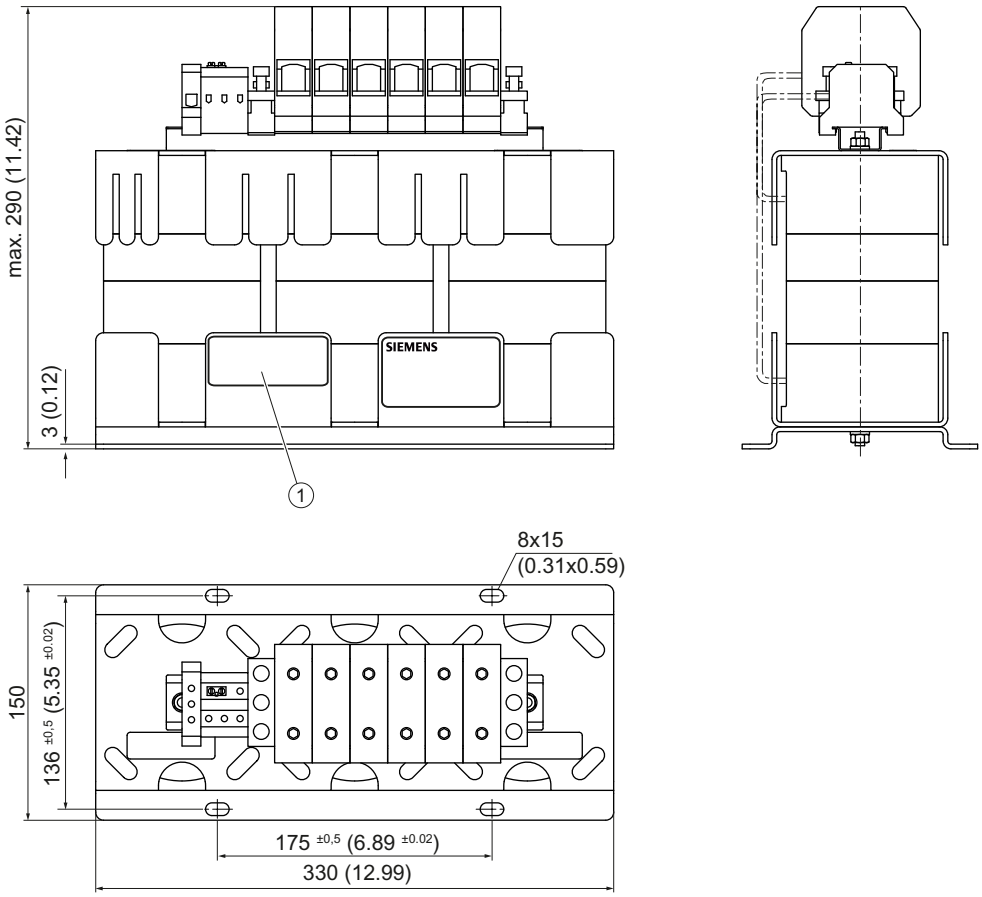
① Terminal arrangement
② Warning label

Figure 2-31 Dimension drawing of HFD line reactor 16 kW, all dimensions in mm and (inches)



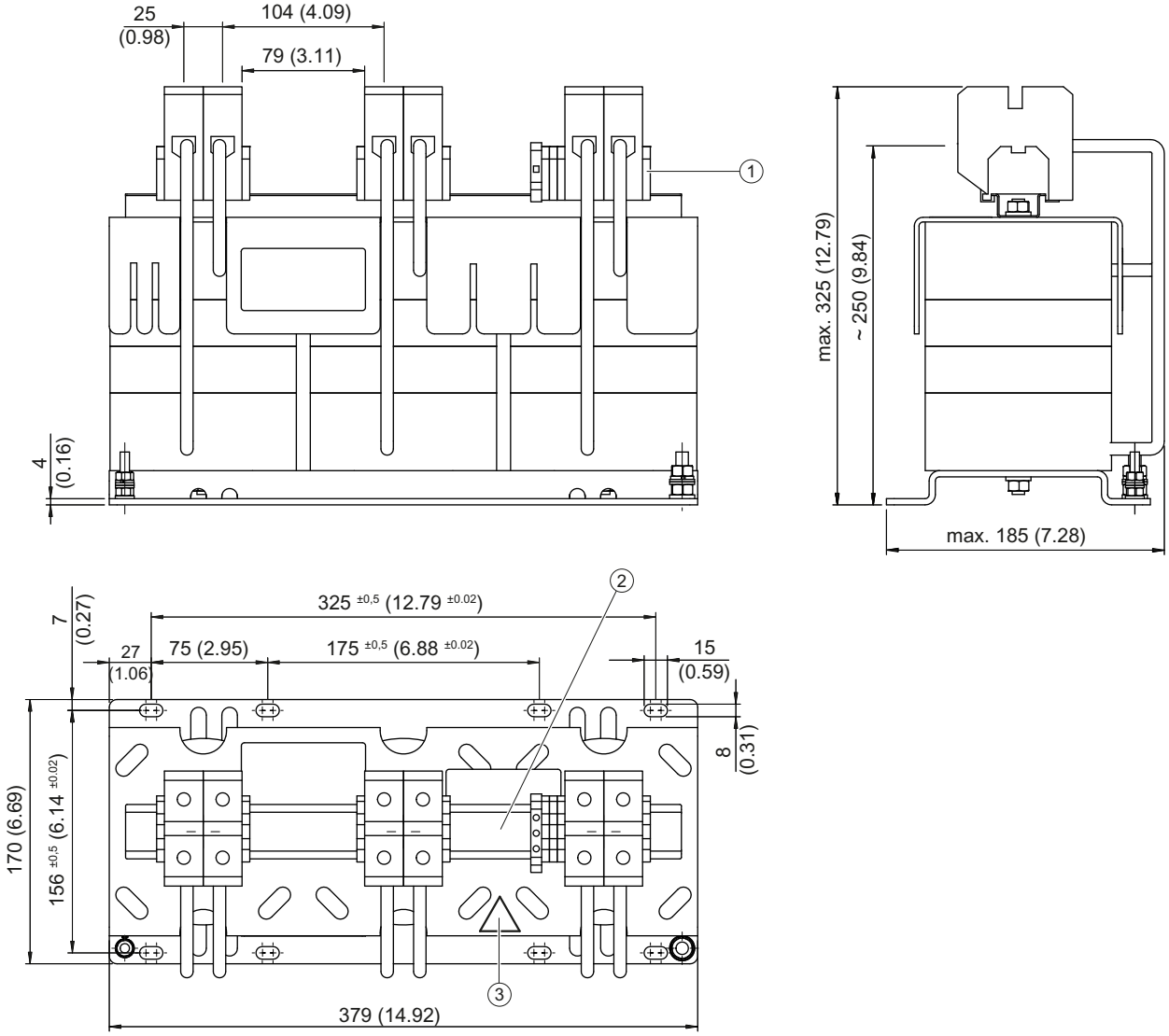
① Terminal arrangement
② Warning label

Figure 2-32 Dimension drawing of HFD line reactor 36 kW, all dimensions in mm and (inches)



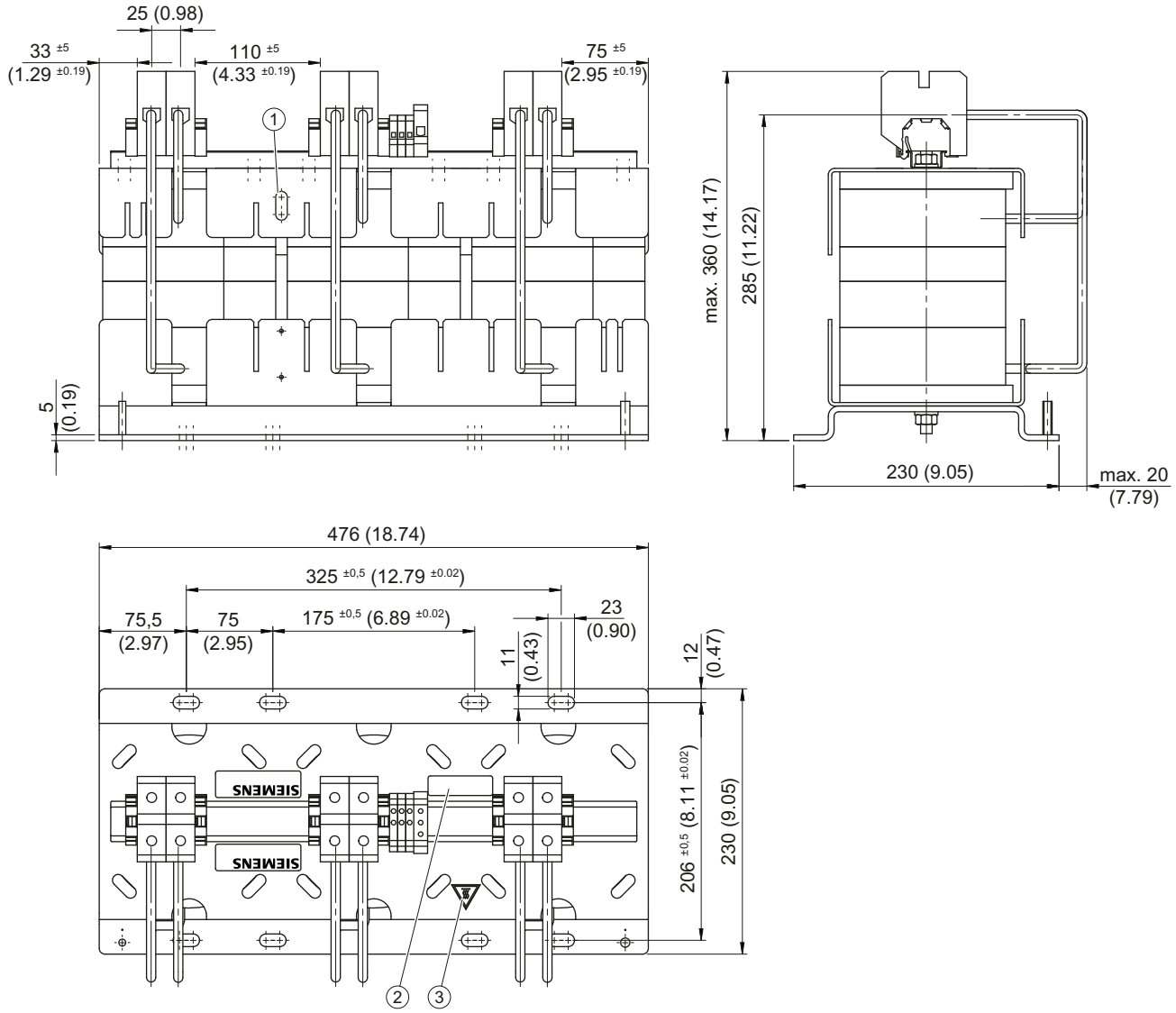
① Terminal arrangement

Figure 2-33 Dimension drawing of HFD line reactor 55 kW, all dimensions in mm and (inches)



① End retainers
② Terminal arrangement
③ Warning label

Figure 2-34 Dimension drawing of HFD line reactor 80 kW, all dimensions in mm and (inches)



① Transport eyebolts 10 x 25 mm (0.39 x 0.98 inch)
② Terminal arrangement
③ Warning label

Figure 2-35 Dimension drawing of HFD line reactor 120 kW, all dimensions in mm and (inches)

2.8.2.3 Technical data

Table 2- 15 Technical data for HFD line reactors

	Unit	6SL3000–0DE21-6AAx	6SL3000–0DE23-6AAx	6SL3000–0DE25-5AAx	6SL3000–0DE28-0AAx	6SL3000-0DE31-2AAx
Power	kW	16	36	55	80	120
Rated current	A_{rms}	30	67	103	150	225
Power loss[1)]	W	170	250	350	450	590
Weight	kg	13	21	27	37	67
Mounting position		Any				

1) For the data for rated operation/an overview, see the power loss tables in the chapter titled "Control cabinet installation".

2.8.3 Damping resistor for HFD line reactors

2.8.3.1 Description

Using a damping resistor

In some systems, oscillations can be generated which place an impermissibly high strain on the insulation systems of the motors and converters involved. Connecting a damping resistor to the additional winding of the HFD line reactor is an effective means of damping just such system oscillations.

Note

Ideally, new systems using Active Line Modules should be designed with Active Interface Modules as line connection components.

2.8.3.2 Safety information

⚠ CAUTION

The damping resistor can become very hot. Consequently, it must be installed so that it cannot be touched or, if this is not possible, an appropriate warning notice must be attached to it.

Note

Ideally, the damping resistor should be mounted externally, i.e. outside of the control cabinet.

2.8.3.3 Dimension drawings

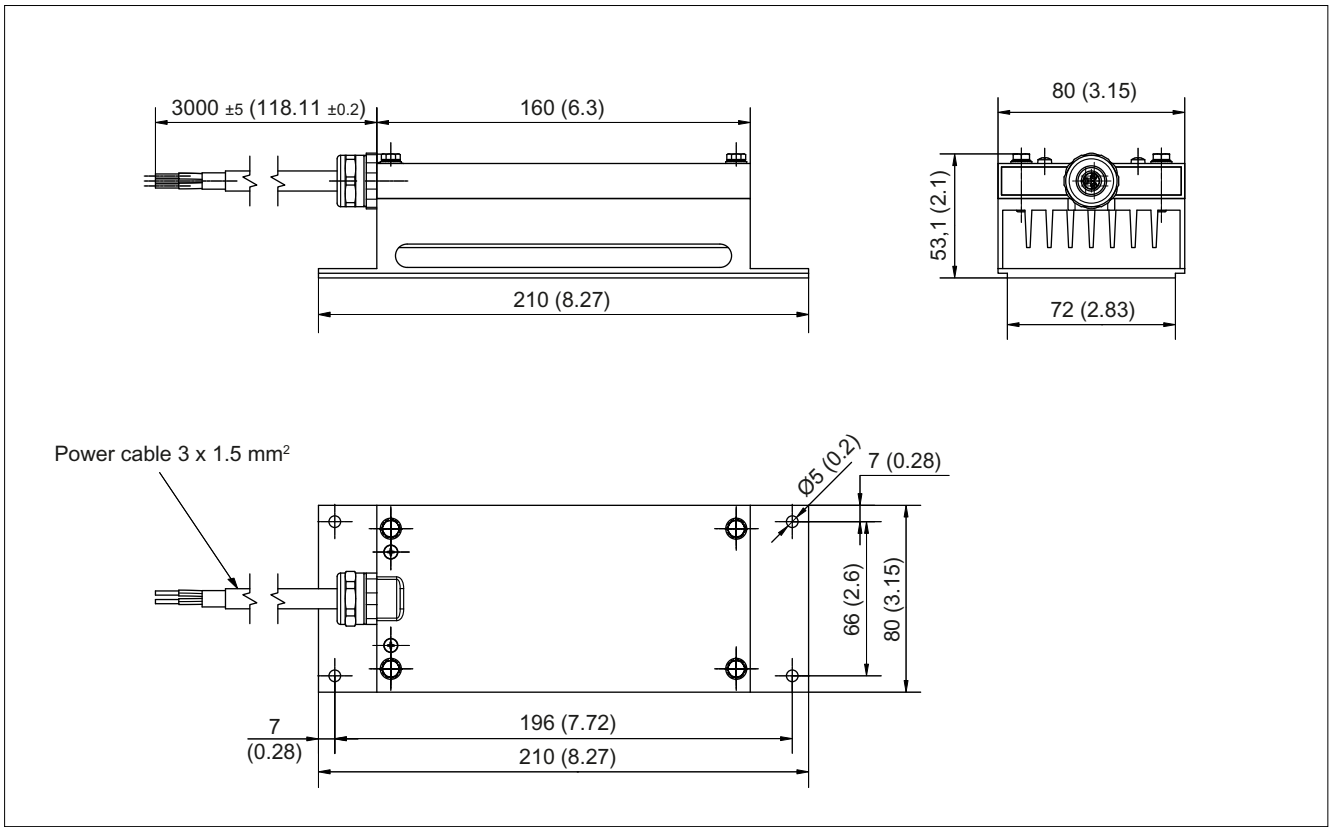


Figure 2-36 300 W damping resistor for HFD line reactors, all dimensions in mm and (inches)

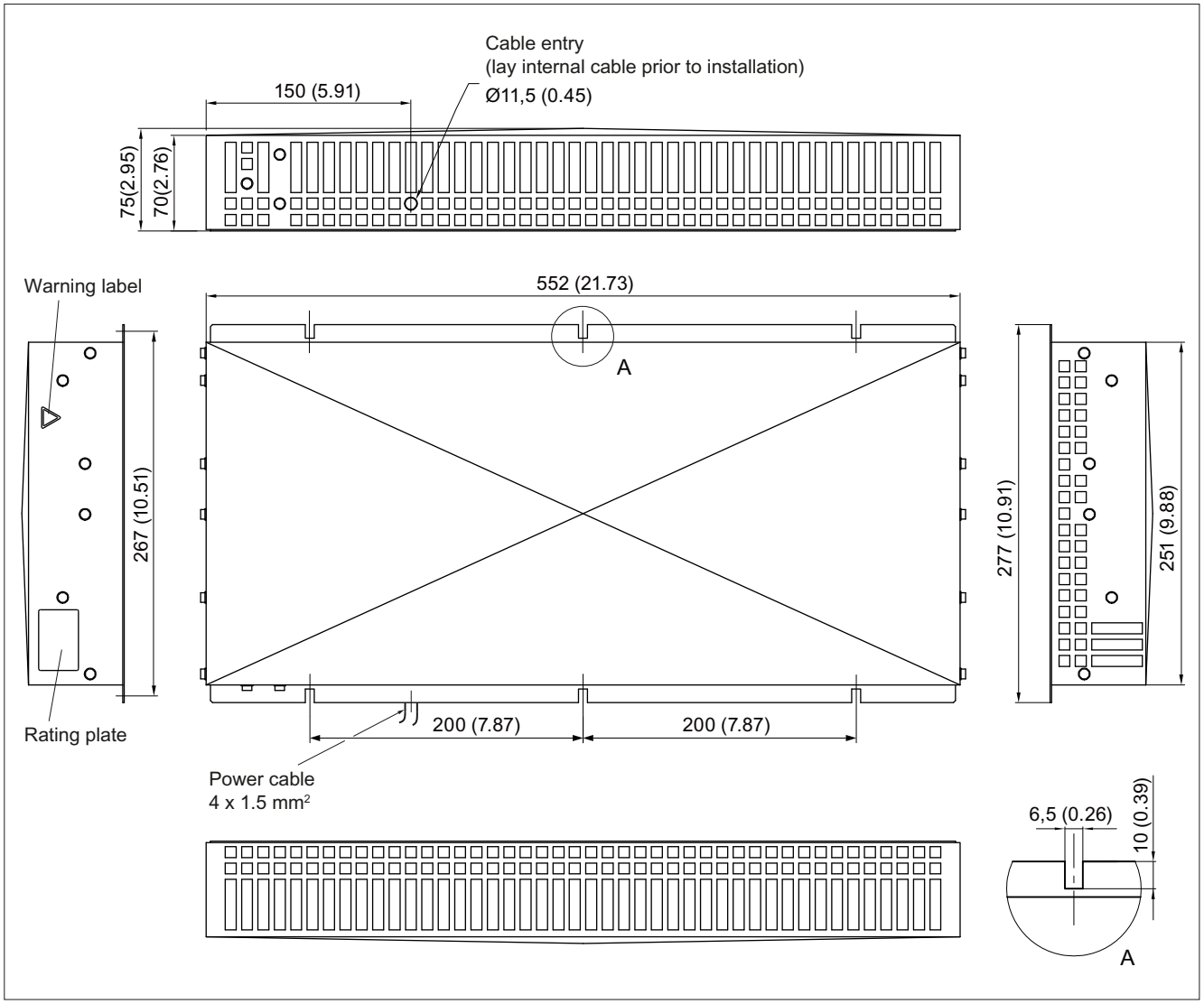


Figure 2-37 800 W damping resistor for HFD line reactors, all dimensions in mm and (inches)

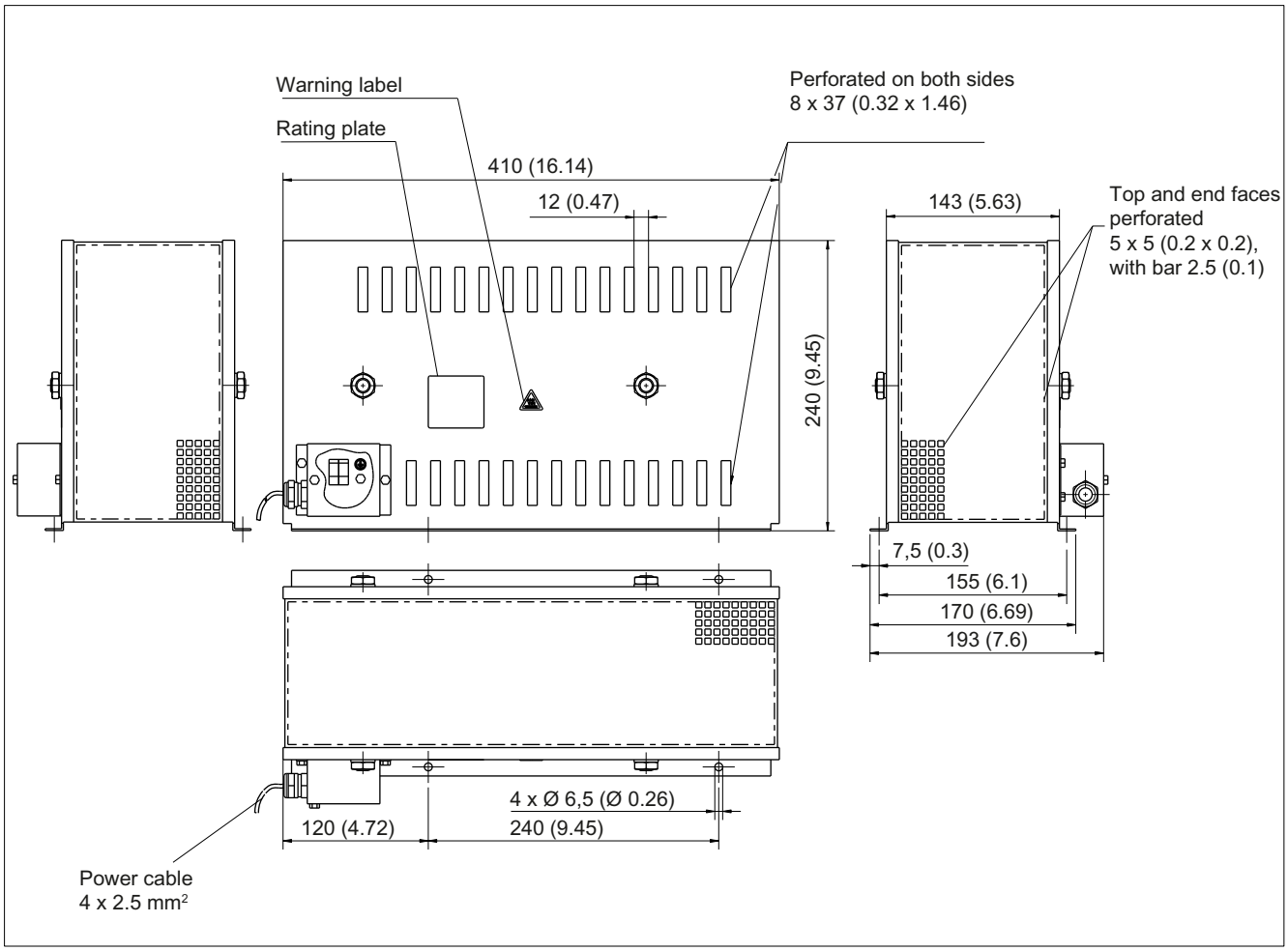


Figure 2-38 1500 W damping resistor for HFD line reactors, all dimensions in mm and (inches)

2.8.3.4 Technical data

Together with the HFD line reactor, an external resistor must be used for damping purposes (see also chapter "Wiring with the HFD line reactor").

Table 2- 16 Technical data for HFD damping resistors

Order number	6SN1113-1AA00-0DAx 1)	6SL3100-1BE21-3AAx 2)	6SL3100-1BE22-5AAx 3)
Rated power [W]	300	800	1500
Damping resistor	0 to 230 kHz ≤ 3 dB		
Connection cable [m], included in scope of delivery	3	5	5
Connection	3 x 1.5 mm^2	4 x 1.5 mm^2	4 x 1.5 mm^2
Weight [kg]	1.45	5.5	5.6
Degree of protection to EN 60529	IP54	IP51	IP20
UL file	E-228809	E-212934	E-192450
Ambient temperature [°C]	0...55		
Dimensions (W x H x D) [mm]	80 x 210 x 53	277 x 552 x 75	193 x 410 x 240

1) The 300 W damping resistor can be used for HFD applications if the following is true after a warm-up run when all axes are shut down in a regulated way:

- After an operating period of over 2 hours, the surface temperature of resistor 6SN1113-1AA00-0DA0 must not exceed 150 °C.
- This warm-up run must be repeated if the hardware configuration, e.g. motor cable lengths, is changed.

2) Preferred type

3) Alternative possible

Note

Ideally, the 800 W damping resistor should be used.

2.8.3.5 Wiring with the HFD line reactor

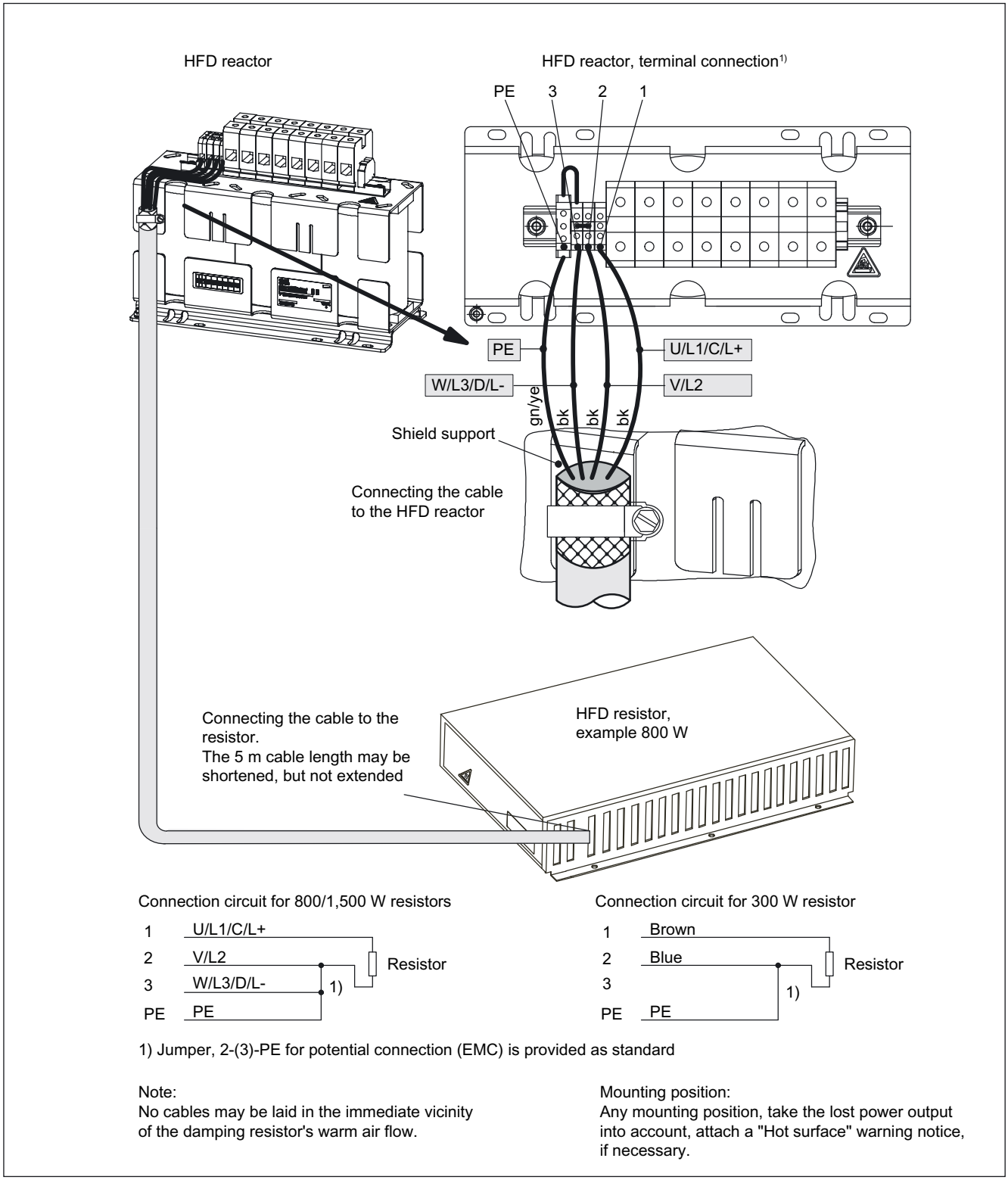


Figure 2-39 Wiring the HFD line reactor with a damping resistor

2.8.4 Line reactors for Basic Line Modules

2.8.4.1 Interface description

Overview

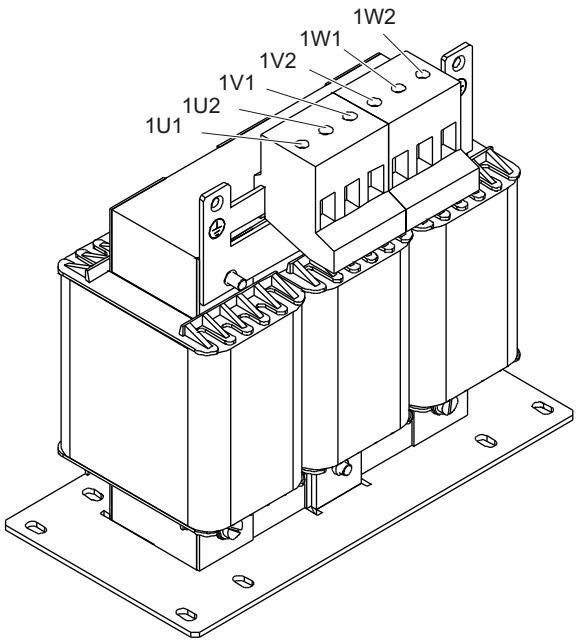


Figure 2-40 Interface overview, line reactor for Basic Line Modules (20 kW)

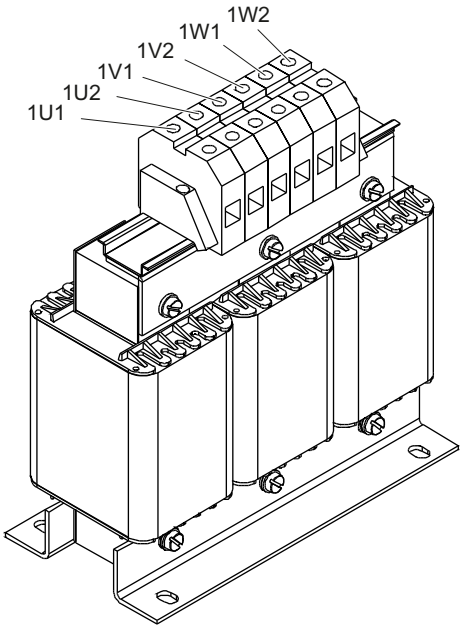


Figure 2-41 Interface overview, line reactor for Basic Line Modules (40 kW)

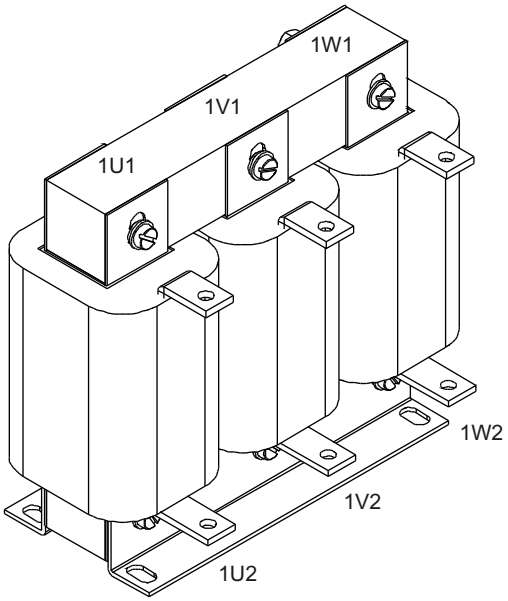


Figure 2-42 Interface overview, line reactor for Basic Line Modules (100 kW)

Line/power connection

Table 2- 17 Line and load connection line reactors for Basic Line Modules

	6SL3000-0CE22-0AAx	6SL3000-0CE24-0AAx	6SL3000-0CE31-0AAx
Power	20 kW	40 kW	100 kW
Line supply connection 1U1, 1V1, 1W1	Screw terminals 16 mm^2; 0.6 - 0.8 Nm	Screw terminals 35 mm^2; 2.5 - 5.0 Nm	Copper rails with 8.5 mm holes
Load connection 1U2, 1V2, 1W2			
PE connection			

2.8.4.2 Dimension drawings

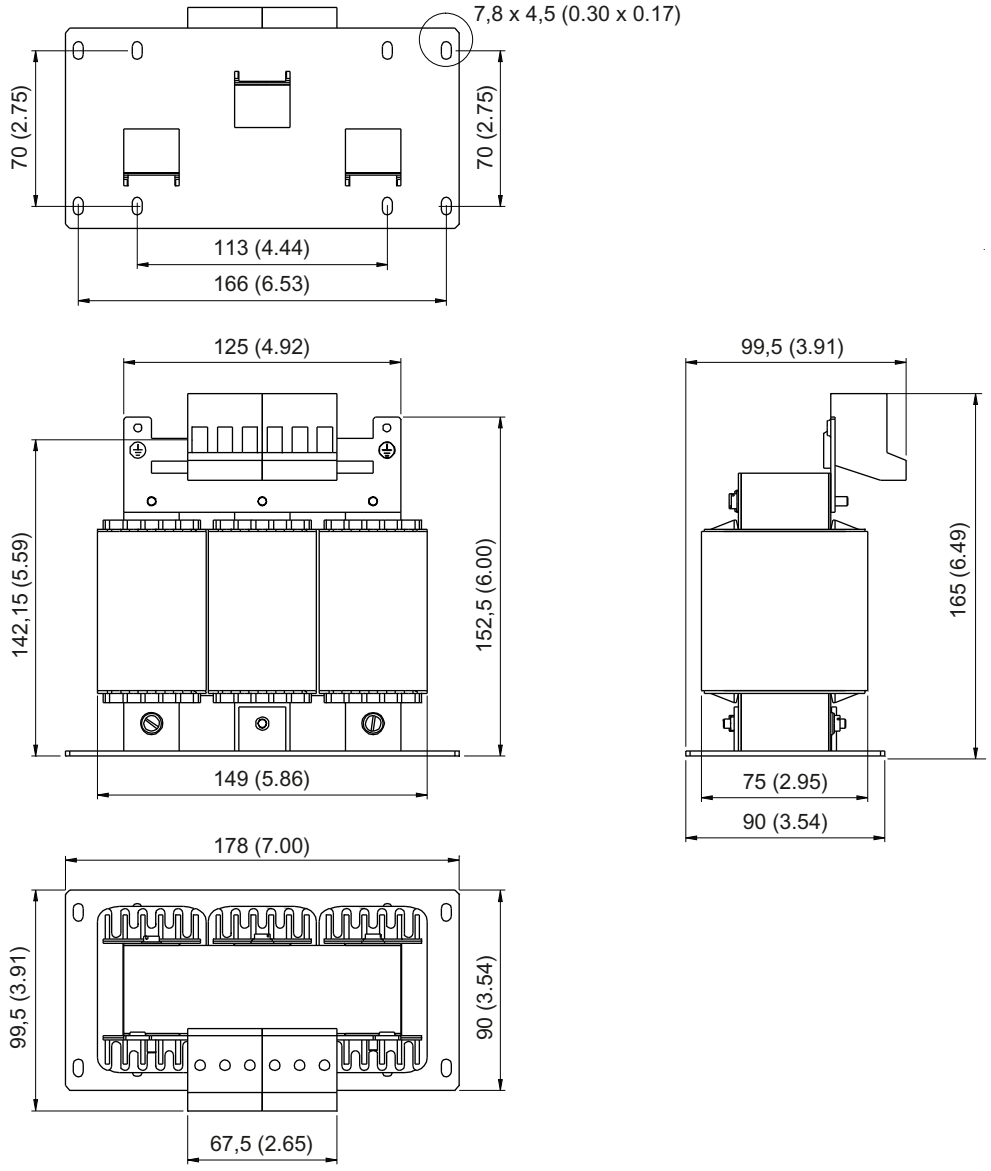


Figure 2-43 Dimension drawing of line reactor for Basic Line Module 20 kW, all dimensions in mm and (inches)

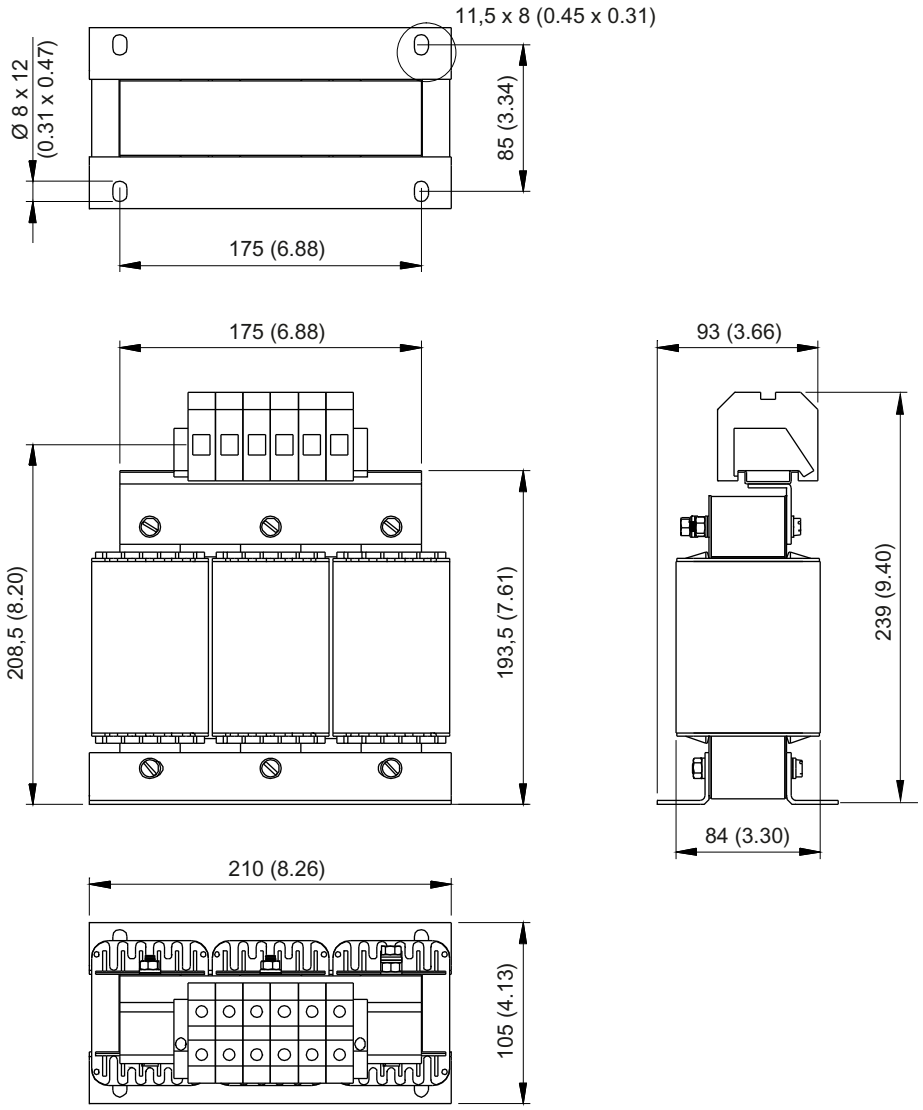


Figure 2-44 Dimension drawing of line reactor for Basic Line Module 40 kW, all dimensions in mm and (inches)

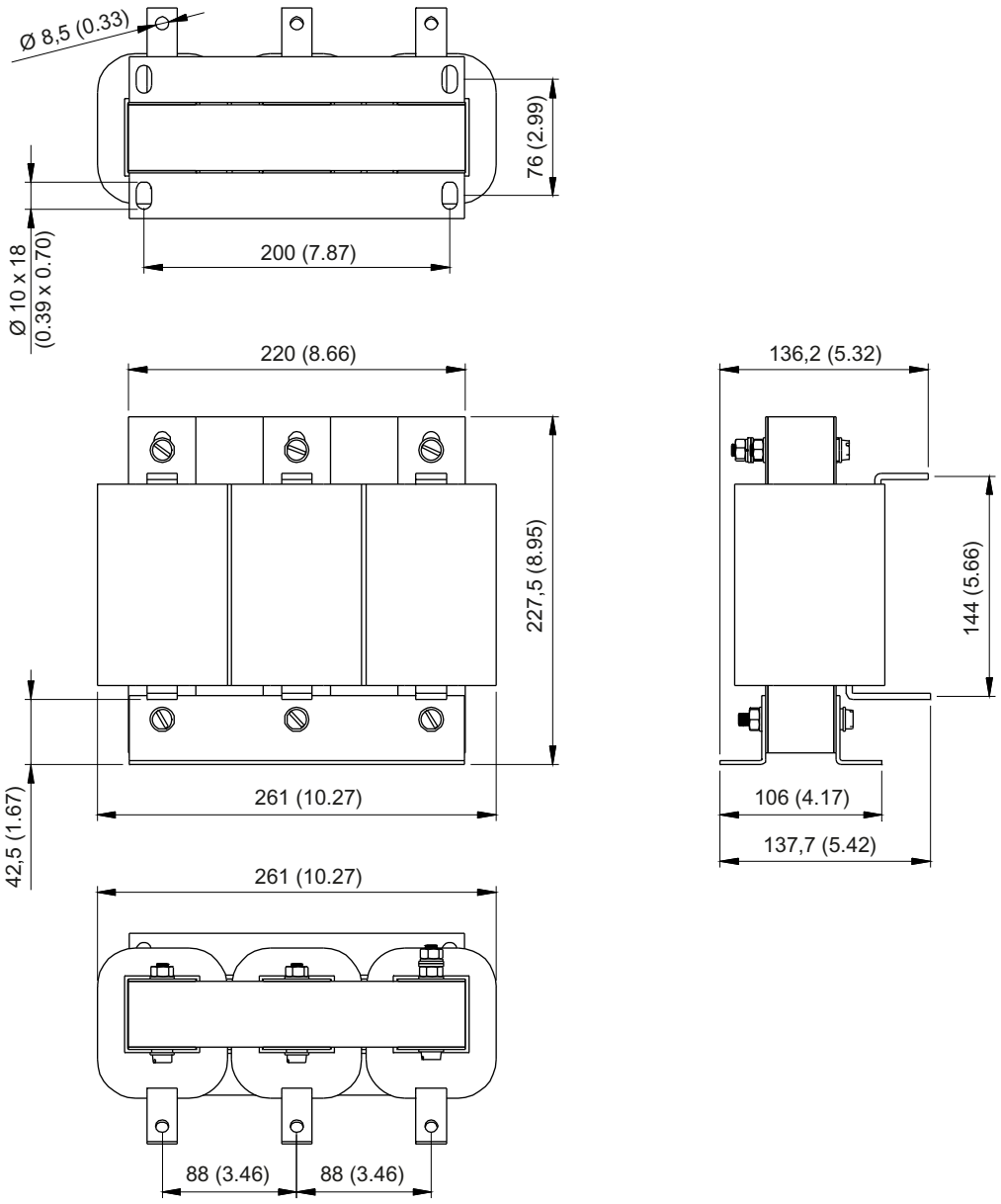


Figure 2-45 Dimension drawing of line reactor for Basic Line Module 100 kW, all dimensions in mm and (inches)

2.8.4.3 Technical data

Table 2- 18 Technical specifications of line reactors for the Basic Line Modules

6SL3000-	Unit	0CE22-0AAx	0CE24-0AAx	0CE31-0AAx
Power	kW	20	40	100
Rated current	A_{rms}	37	74	185
Power loss	W	130	270	480
Weight	kg	5.2	11.2	21.7

2.8.5 Line reactors for Smart Line Modules

2.8.5.1 Interface description

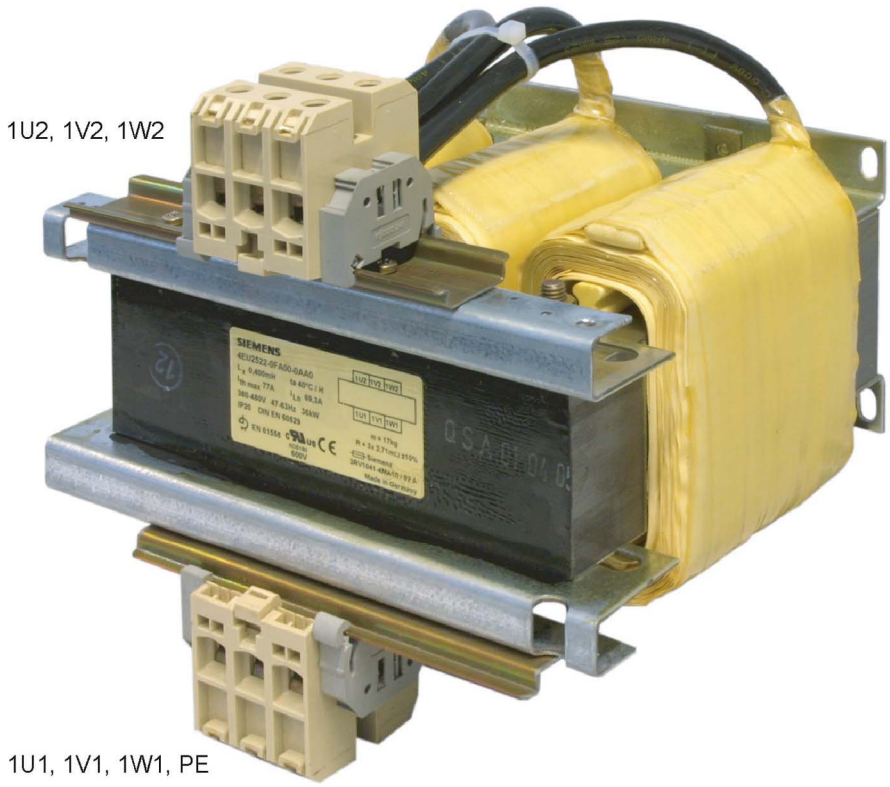


Figure 2-46 Interface overview, line reactors for Smart Line Modules (example: 36 kW)

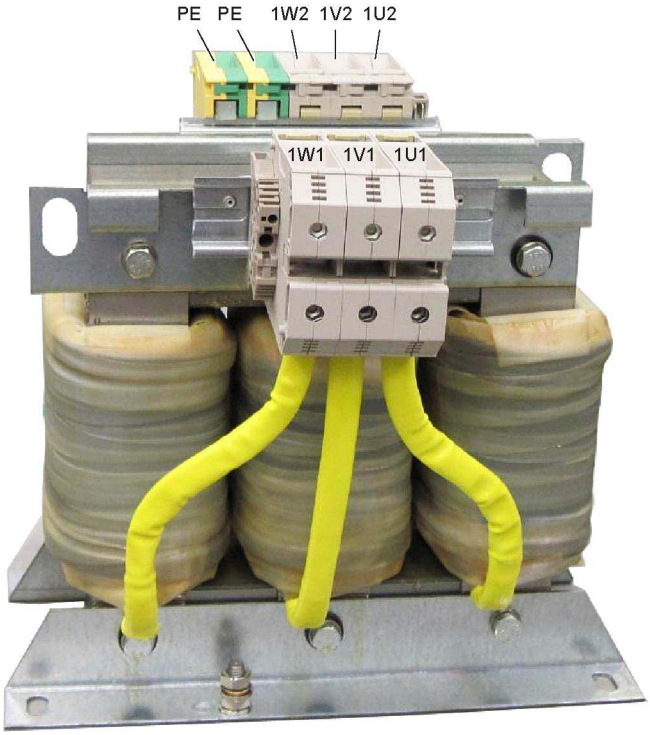


Figure 2-47 Interface overview, line reactors for Smart Line Modules (example: 55 kW)

Line/load connection

Table 2- 19 Line and load connection line reactors for Smart Line Modules

	6SL3000-0CE15-0AAx	6SL3000-0CE21-0AAx	6SL3000-0CE21-6AAx	6SL3000-0CE23-6AAx	6SL3100-0CE25-5DAx
Power	5 kW	10 kW	16 kW	36 kW	55 kW
Line supply connection 1U1, 1V1, 1W1	Screw terminals 4 mm^2 0.5 - 0.6 Nm	Screw terminals 10 mm^2 1.2 - 1.5 Nm	Screw terminals 10 mm^2 1.2 - 1.5 Nm	Screw terminals 16 mm^2 1.5 - 1.8 Nm	Screw terminals 70 mm^2 8-12 Nm
Load connection 1U2, 1V2, 1W2					
PE connection			Terminal studs M5 1)	Terminal studs M6 1)	Terminal studs M8 1)

1) For ring cable lug in accordance with DIN 46234

2.8.5.2 Dimension Drawings

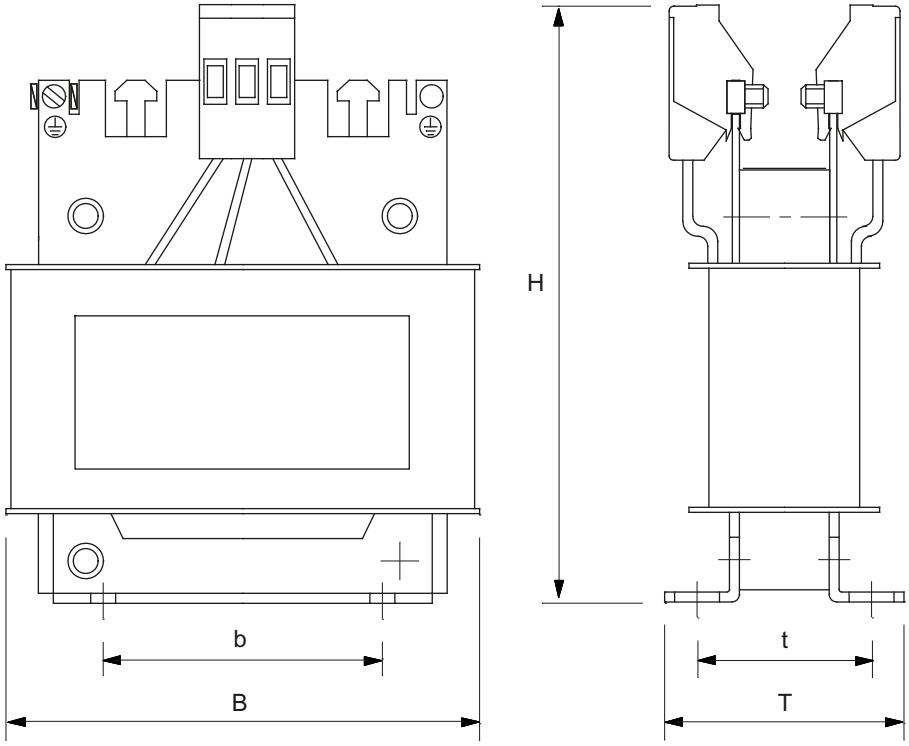


Figure 2-48 Dimension drawing of line reactor for Smart Line Modules (5 kW and 10 kW)

Table 2- 20 Dimensions of line reactors for Smart Line Modules (5 kW and 10 kW)

	Order number 6SL3000-	B [mm] (inches)	b [mm] 1) (inches)	H [mm] (inches)	D [mm] (inches)	t [mm] 1) (inches)
5 kW	0CE-15-0AAx	150 (5.91)	113 (4.53)	175 (6.89)	66.5 (2.62)	49.5 (1.95)
10 kW	0CE-21-0AAx	177 (6.97)	136 (5.35)	196 (7.72)	86 (3.39)	67 (2.64)

1) The lengths b and t correspond to the hole spacing

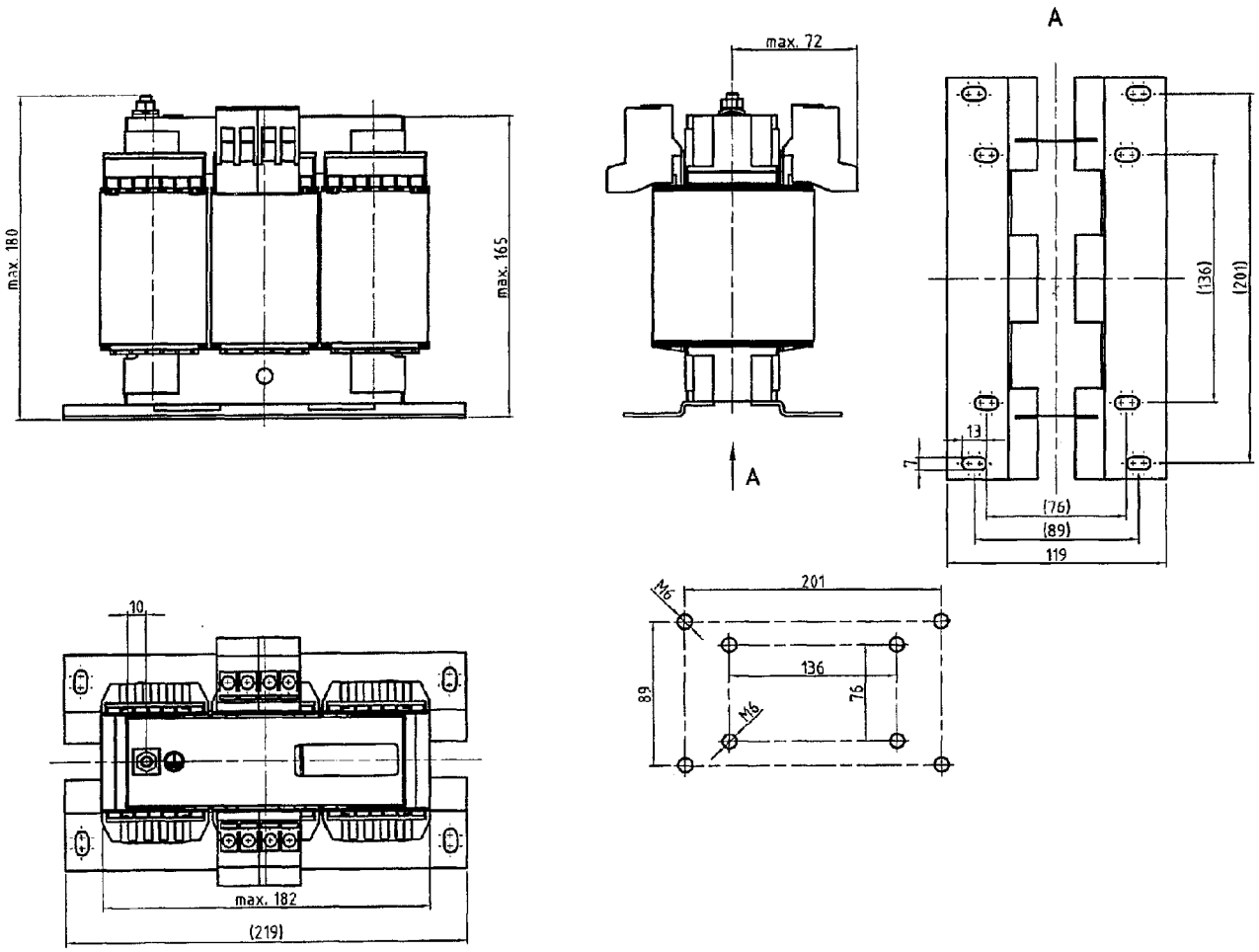


Figure 2-49 Dimension drawing of line reactor for Smart Line Module 16 kW

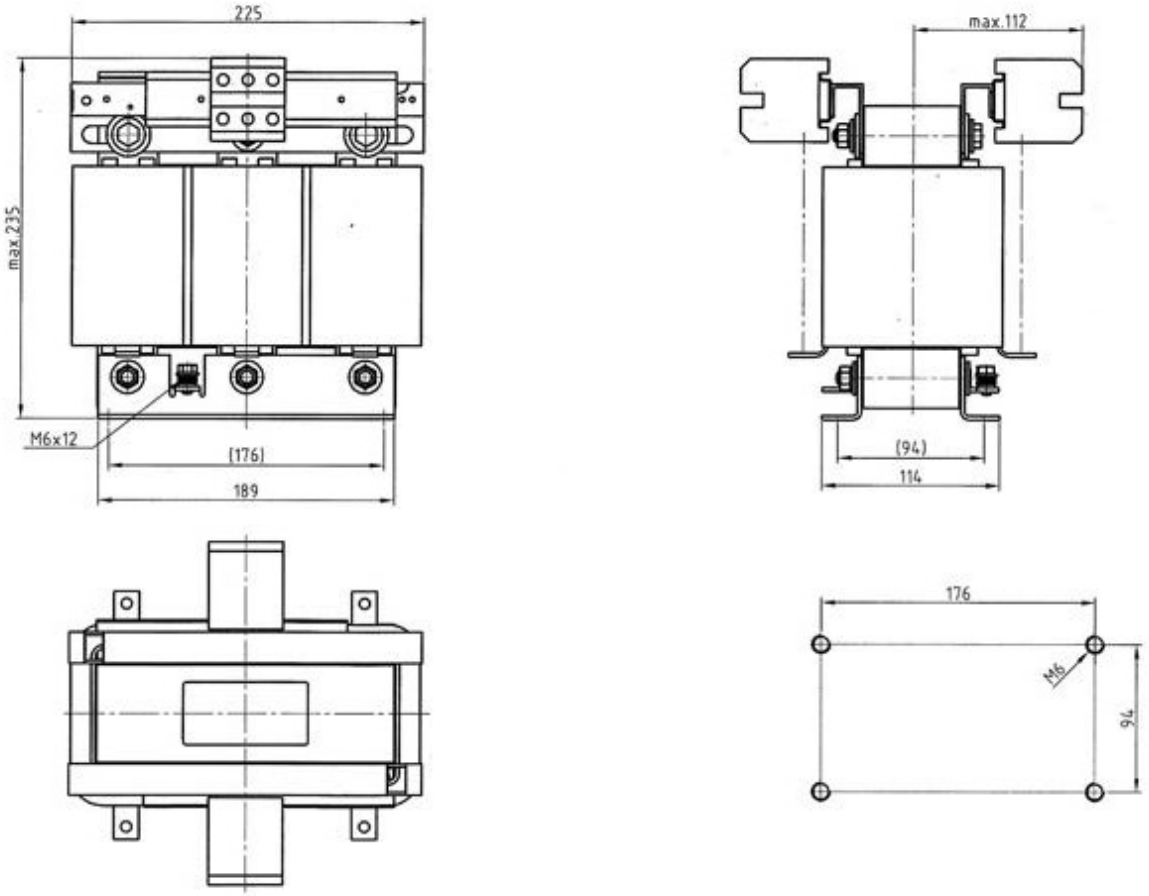


Figure 2-50 Dimension drawing of line reactor for Smart Line Module 36 kW

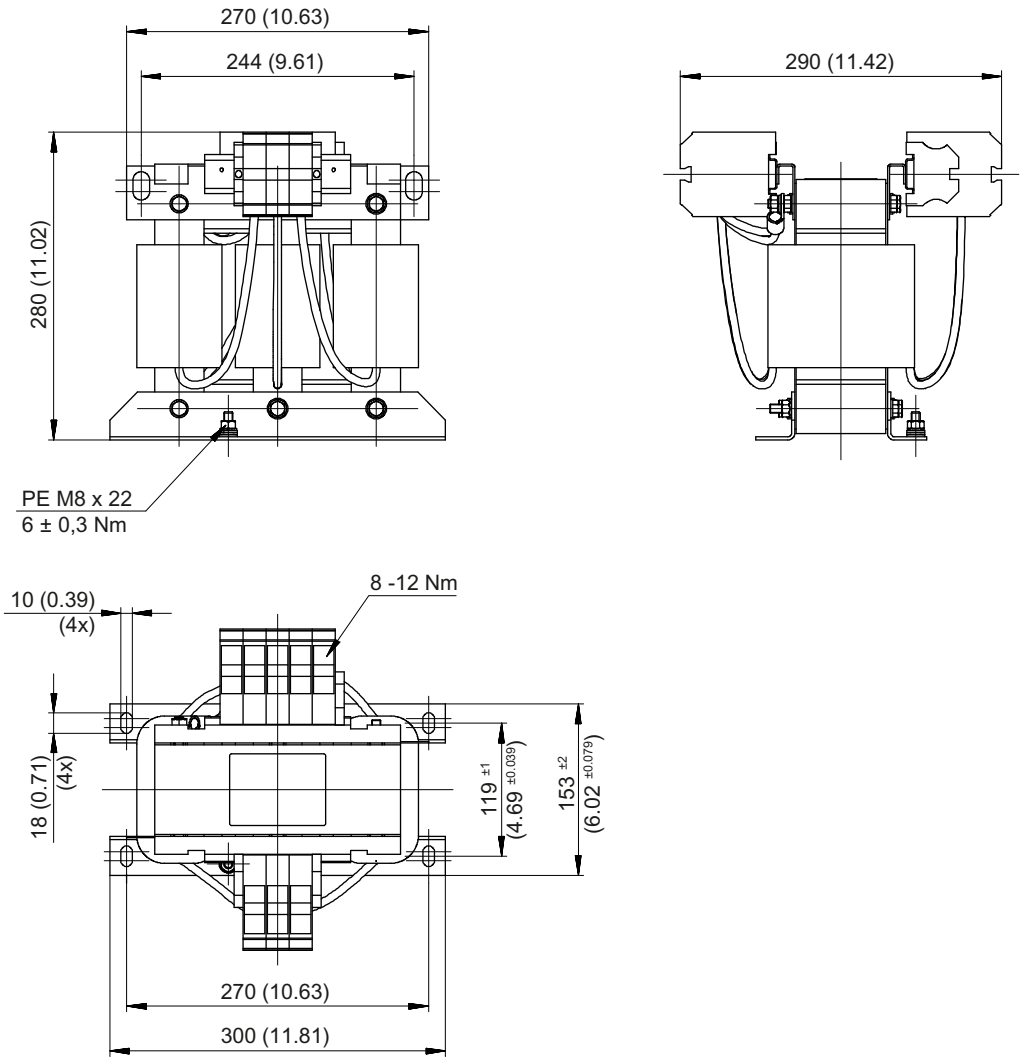


Figure 2-51 Dimension drawing of line reactor for Smart Line Module 55 kW, all dimensions in mm and (inches)

2.8.5.3 Technical specifications

Table 2- 21 Technical data of line reactors for the Smart Line Module

		6SL3000-0CE15-0AAx	6SL3000-0CE21-0AAx	6SL3000-0CE21-6AAx	6SL3000-0CE23-6AAx	6SL3100-0CE25-5AAx
Power	kW	5	10	16	36	55
Rated current	A_{rms}	14	28	35	69	103
Power loss 1)	W	62	116	110	170	190
Weight	kg	3.7	7.5	9.5	17	37

1) For an overview, see the power loss tables in chapter "Control cabinet installation"

2.9 Active Interface Modules internal air cooling

2.9.1 Description

Active Interface Modules are line-side interfaces for the Active Line Modules.

They contain the following functional units:

- Line reactors
- Low-frequency/switching frequency filters
- Line filters to EN 61800-3, category C3, max. total motor cable length 350 m (shielded)
- Reduction of the stress on the motor insulation from system-dependent resonance factors

In conjunction with an Active Line Module and an EMC-compliant configuration the following radio interference voltage categories are achieved:

- EN 61800-3 category C3 without an additional line filter up to a total cable length of 350 m (shielded) for 16 kW, 36 kW, 55 kW, 80 kW and 120 kW components
- EN 61800-3 category C2 with an additional Basic Line Filter up to a total cable length of 350 m (shielded) for 16 kW, 36 kW, 55 kW, 80 kW and 120 kW components
- EN 61800-3, category C3, with an additional Basic Line Filter up to a total cable length of
  - 630 m (shielded) for 16 kW and 36 kW components
  - 1000 m (shielded) for 55 kW, 80 kW and 120 kW components.

The Active Interface Module is fitted with a fan. The 24 V supply is essential for operating the component. Connection of the temperature signaling contact to the Active Line Module is also required.

2.9.2 Safety information

NOTICE

Active Interface Modules must only be operated if the option "Line filter available" has been set for the Active Line Module in the commissioning wizard, and if "AIM 400 V xxkW (6SL3100-0BE**-*AB*)" has been selected as the line filter. With SINAMICS V2.6, the appropriate Active Interface Module is already set by default when the wizard is run in STARTER.
With the SINAMICS V2.5 software release, the default is "Wideband Line Filter" and must be changed manually to "AIM (P220=4*)".
Operation with SINAMICS software lower than V2.5 is not permitted.

Before putting the Active Interface Module into operation, it is essential to connect 24 VDC at connector X124 to supply the fans. Current required ≤ 1.2 A.

The temperature signaling contact of the Active Interface Module must be connected to the temperature input of the associated Active Line Module.

If this is not the case, the Active Interface Module may be destroyed.

⚠ DANGER

The drive components generate high leakage currents in the protective conductor. The components must only be operated in cabinets or in closed electrical operating areas and must be connected with the protective conductor. To protect against electric shock, the protective conductor connection at the control cabinet or machine must be implemented in accordance with one of the following measures:

- Fixed connection and protective conductor connection by means of ≥ 10 mm^2 Cu or ≥ 16 mm^2 Al
- Fixed connection and automatic disconnection of the supply system if the protective conductor is interrupted

(See connection example: Active Interface Module)

⚠ CAUTION

The surface temperatures of the component may be high.

⚠ DANGER

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

Note

The Active Interface Modules must only be operated when installed in a vertical position ("hanging").

Note

Connection cables

The connection cables between the Active Interface Module and the Active Line Module, as well as between the Active Interface Module and the Basic Line Filter, must be kept as short as possible (max. 10 m in total).

Shielded connection cables must be used in order to achieve interference voltage category C2. The cable shields must be connected on both sides.

2.9.3 Interface description

2.9.3.1 Overview

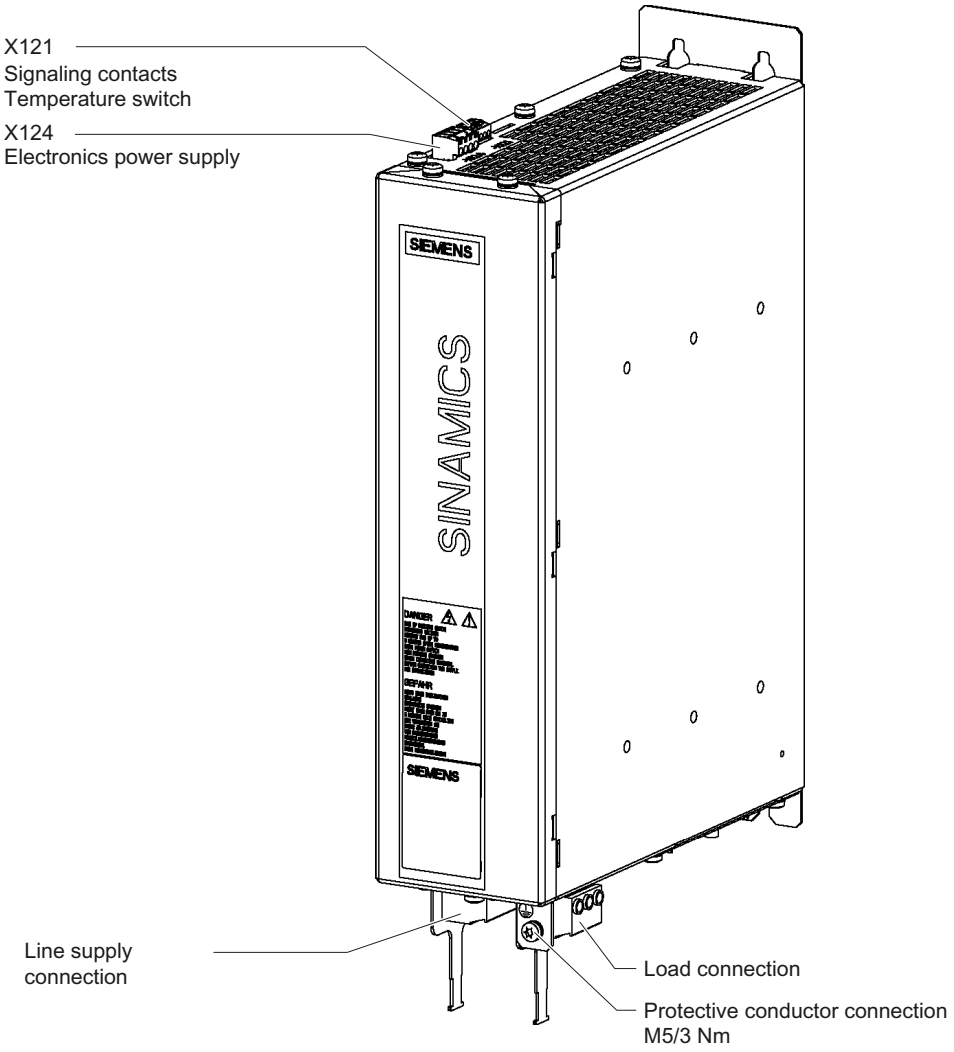


Figure 2-52 Interface overview, Active Interface Module 16 kW

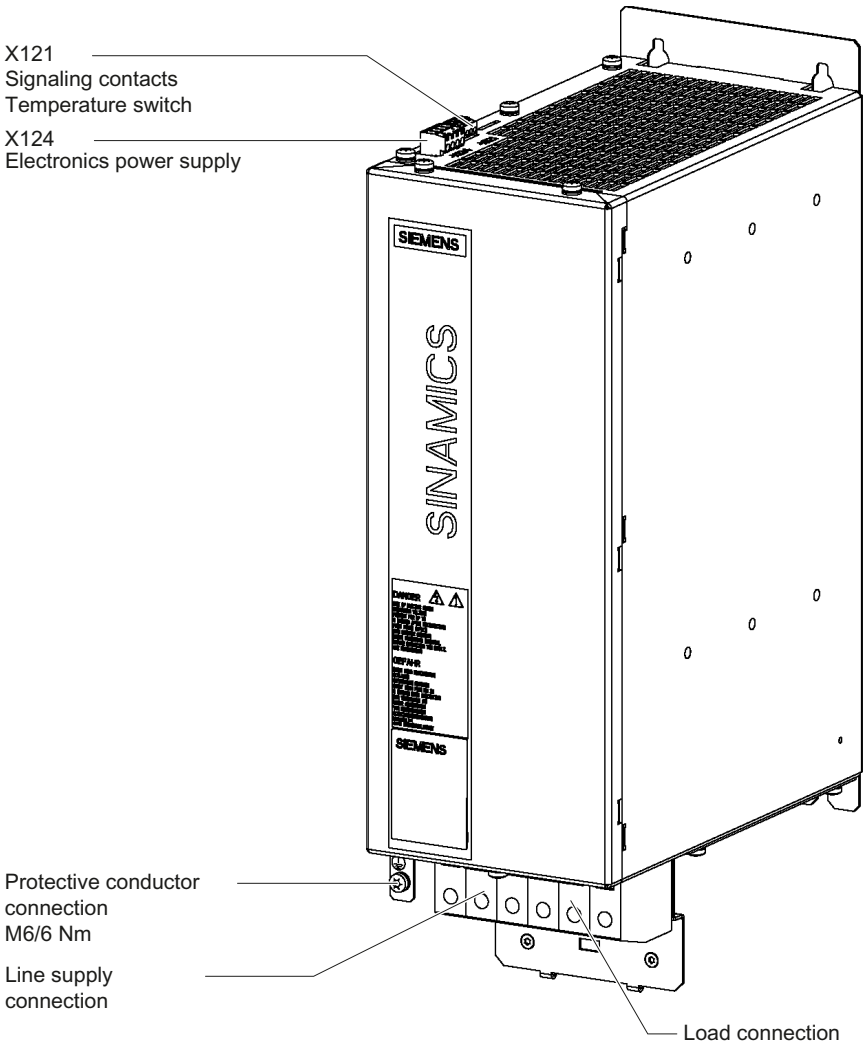


Figure 2-53 Interface overview, Active Interface Module 36 kW

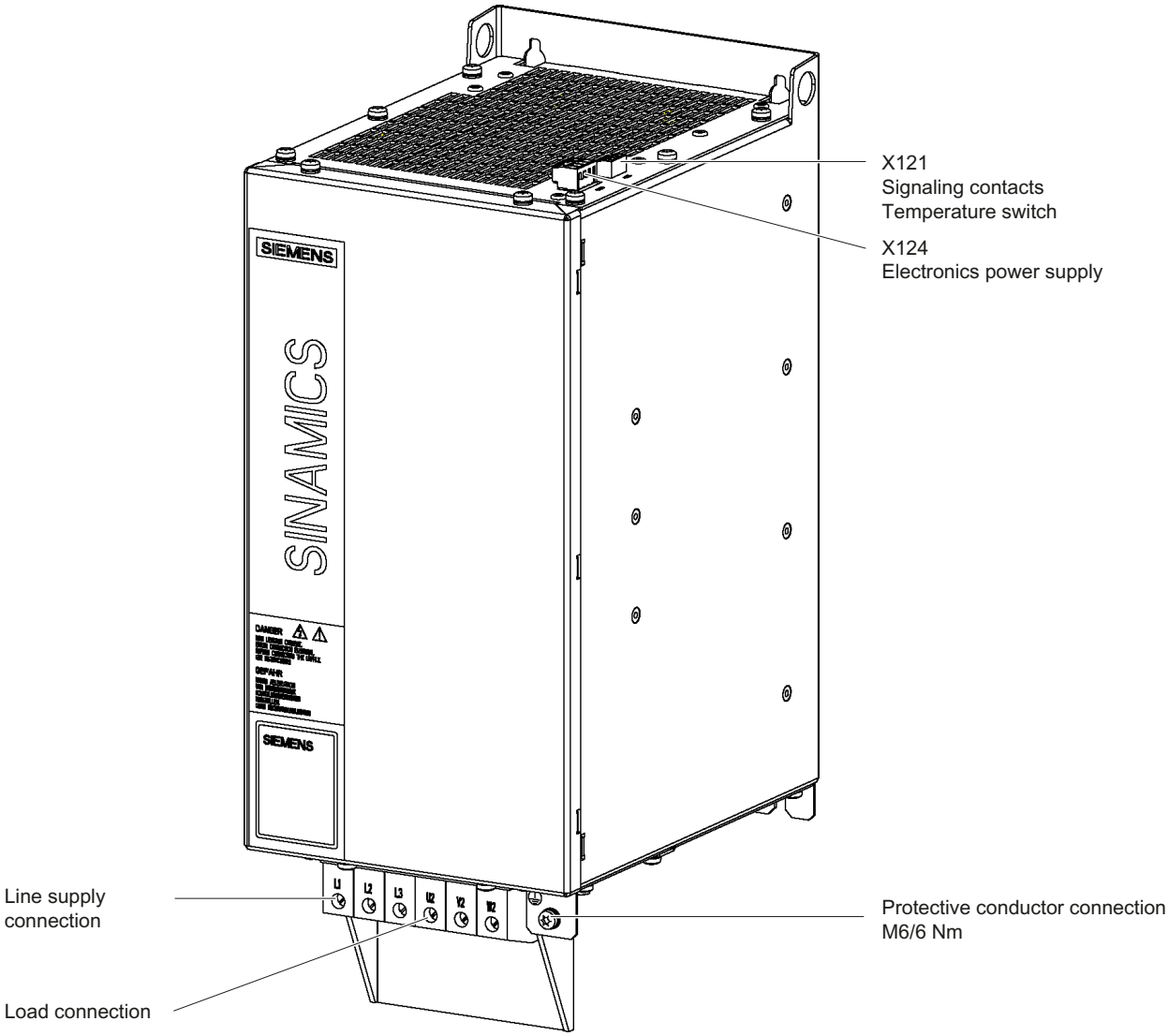


Figure 2-54 Interface overview, Active Interface Module 55 kW

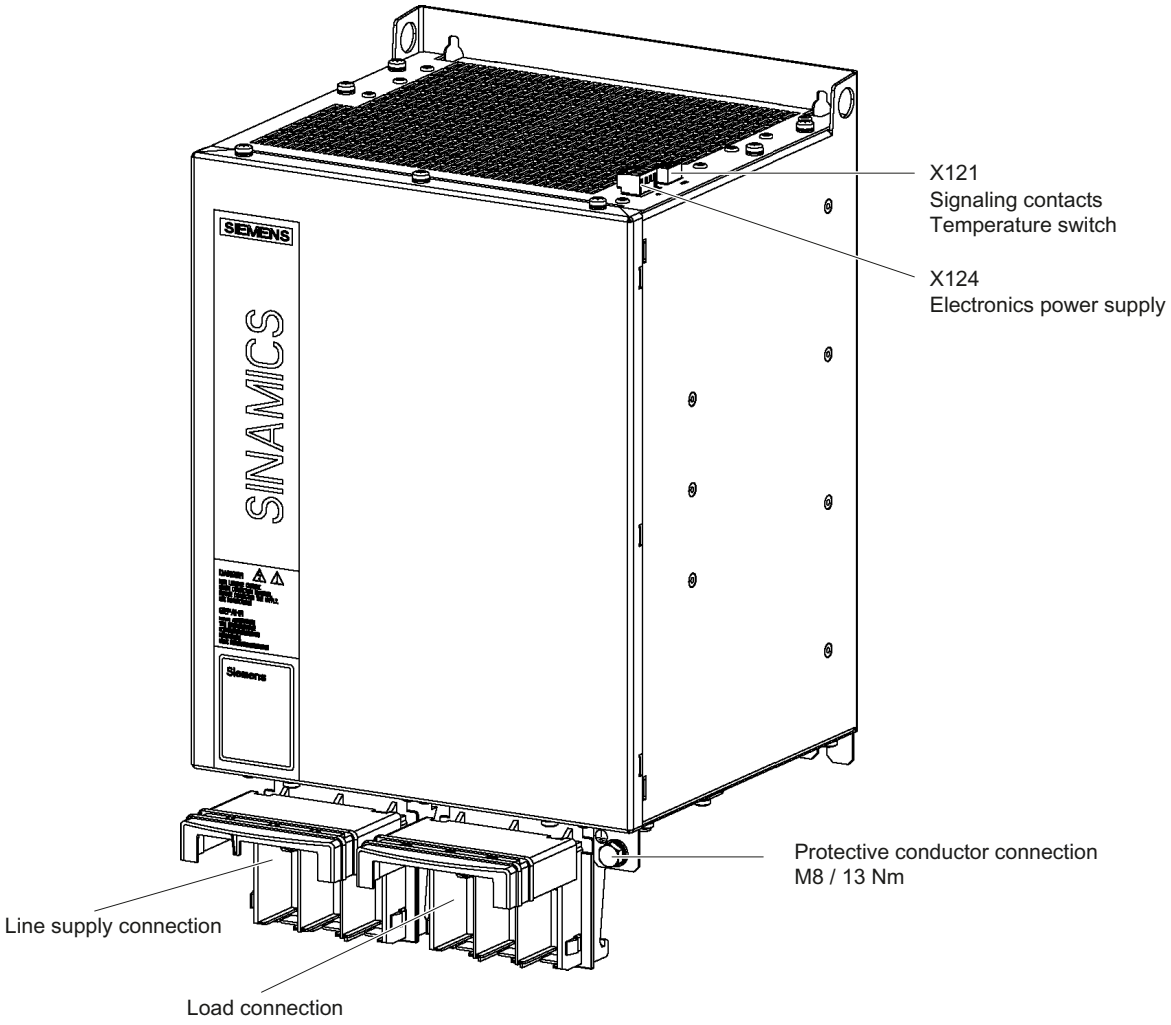


Figure 2-55 Interface overview, Active Interface Module 80 kW and 120 kW

2.9.3.2 Line/load connection

Table 2- 22 Line and load connection Active Interface Module

	6SL3100-0BE21-6ABx	6SL3100-0BE23-6ABx	6SL3100-0BE25-5ABx	6SL3100-0BE28-0ABx	6SL3100-0BE31-2ABx
Power	16 kW	36 kW	55 kW	80 kW	120 kW
Line supply connection L1, L2, L3	Connector, 16 mm² 1.7 Nm	Screw terminal 50 mm², end sleeve, 6 Nm	Screw terminal 50 mm², end sleeve, 6 Nm	Threaded bolt M8, cross-section 120 / 2 x 50 mm², 13 Nm[1)]	
Load connection U2, V2, W2					

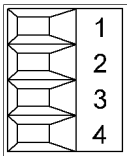
1) For ring cable lugs in accordance with DIN 46234

Note

The connection terminals of the 36 kW and 55 kW Active Interface Modules are only certain to be safe from finger touch if cables with a minimum cross-section of 25 mm² and insulated end sleeve are used.

2.9.3.3 X121 temperature sensor and fan control

Table 2- 23 Plug-in screw terminal X121

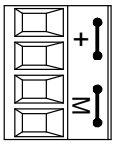
	Terminal	Designation	Technical specifications
	1	+Temp	Output Temperature switch must be connected to X21 of the Active Line Module.
	2	-Temp	Temperature switch output
	3	+24 V power supply for digital inputs	Current carrying capacity: 500 mA
	4	Disable Fan	**The fan can be disabled. The fan may only be switched off while the Active Line Module is disabled.**
Max. connectable cross-section: 1.5 mm²			

Note

If the terminals are not connected (or connected with low level), the fan will run in continuous mode.

2.9.3.4 X124 Electronics power supply

Table 2- 24 X124 Electronics power supply

	Terminal	Function	Technical specifications
	+	Electronics power supply	Voltage: 24 V DC (20.4 V - 28.8 V)
	+	Electronics power supply	Current consumption: max. 1.6 A
	M	Electronics ground	Max. current via jumper in connector: 20 A at 55 °C
	M	Electronics ground	
Max. connectable cross-section: 2.5 mm^2			

Note

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

2.9.4 Connection example

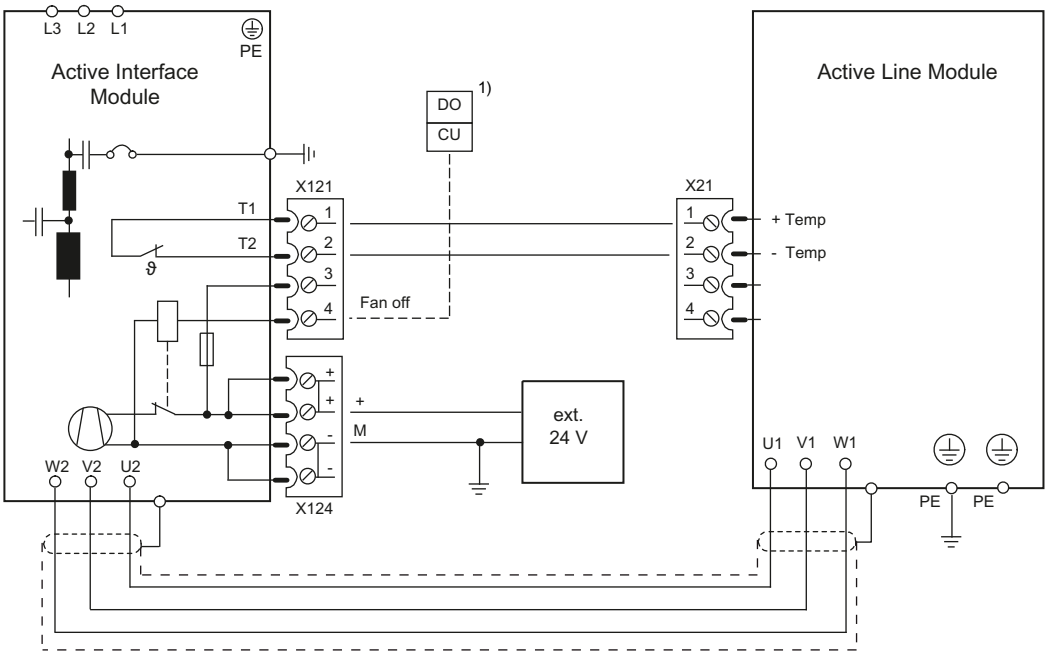


Figure 2-56 Connection example: Active Interface Module

1) Digital output (DO) controlled from the Control Unit

2.9.5 Dimension drawings

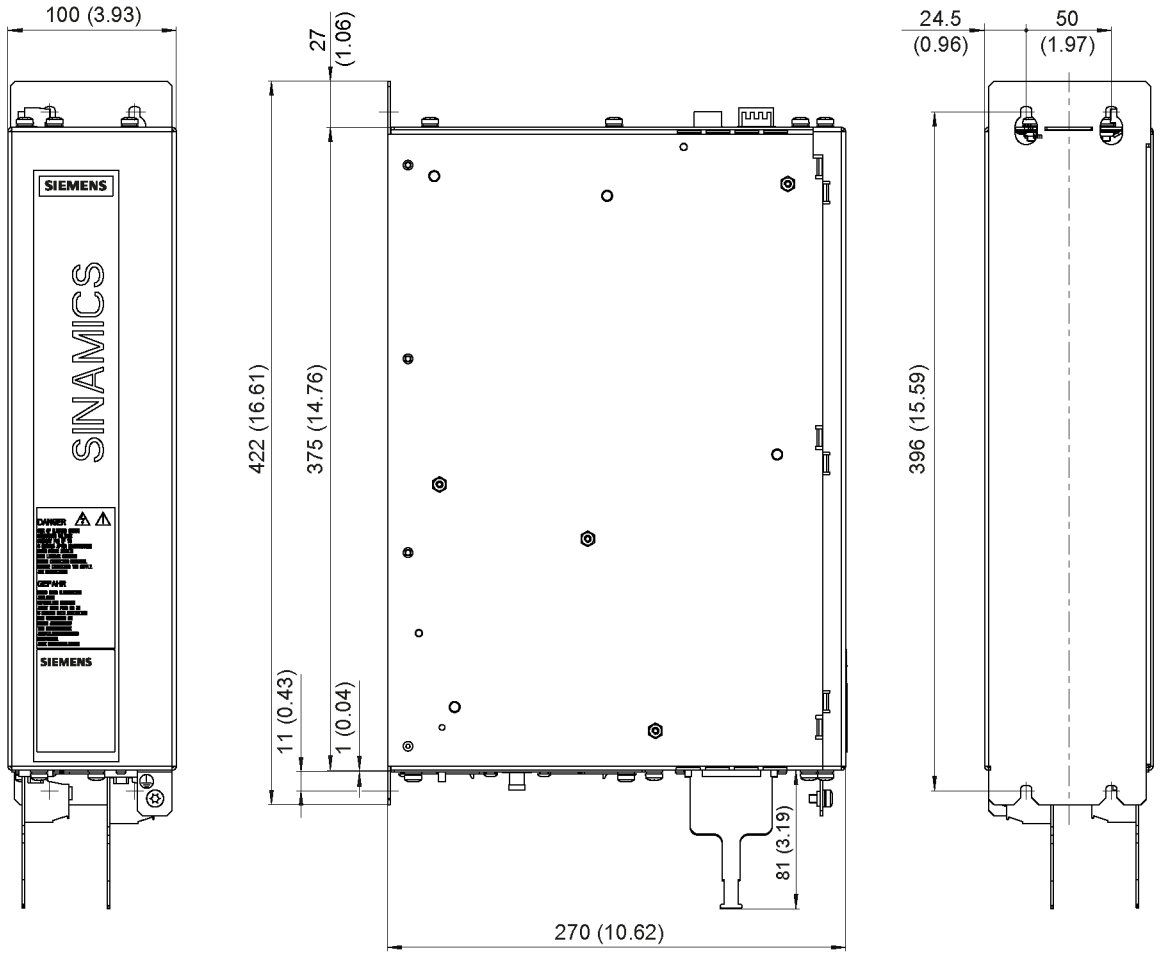


Figure 2-57 Dimension drawing of Active Interface Module 16 kW, all dimensions in mm and (inches)

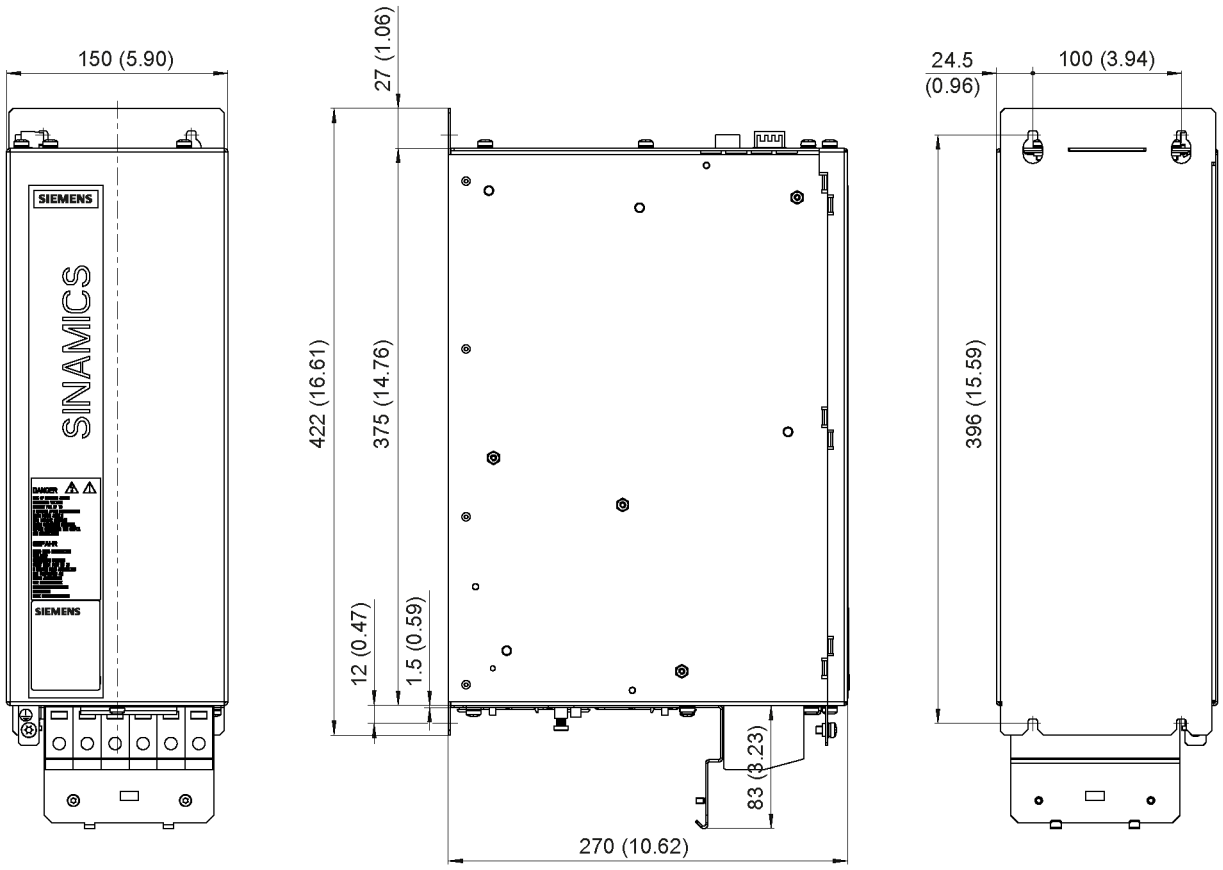


Figure 2-58 Dimension drawing of Active Interface Module 36 kW, all dimensions in mm and (inches)

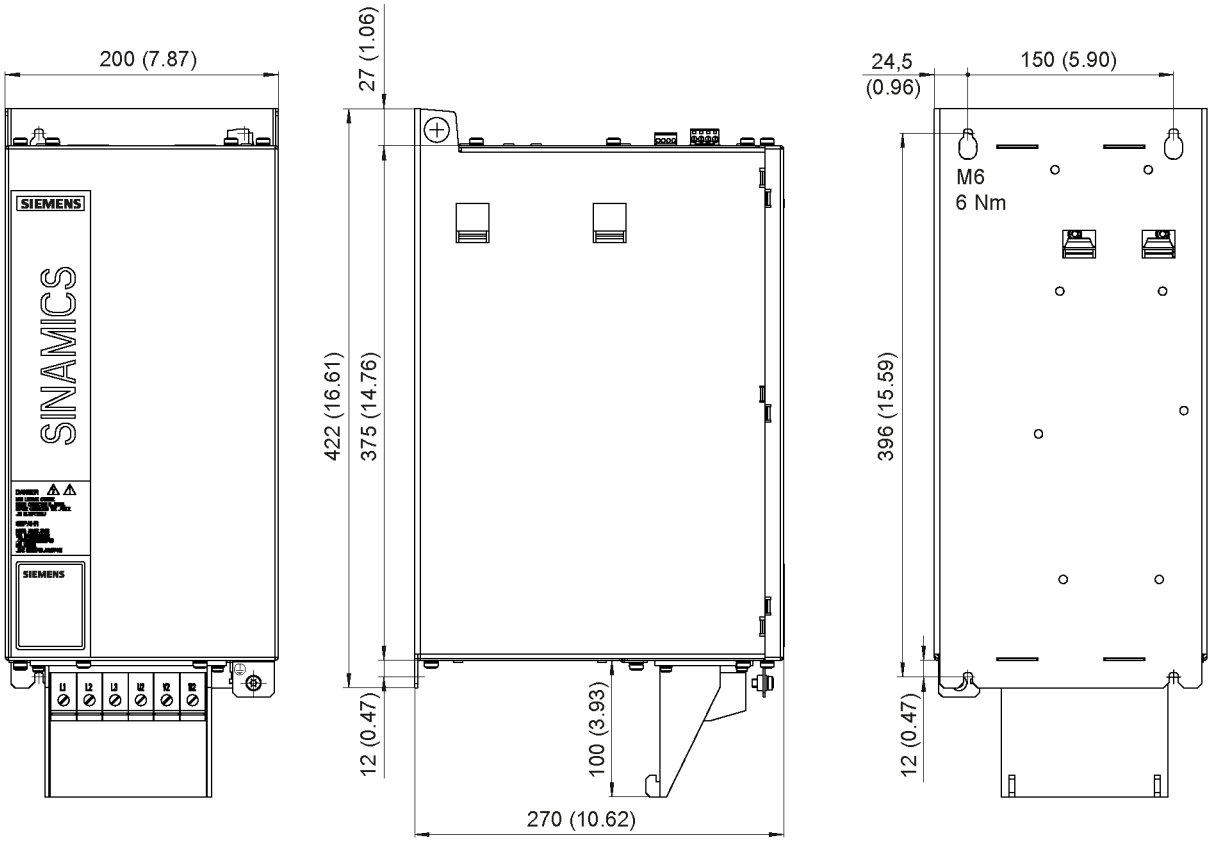


Figure 2-59 Dimension drawing of Active Interface Module 55 kW, all dimensions in mm and (inches)

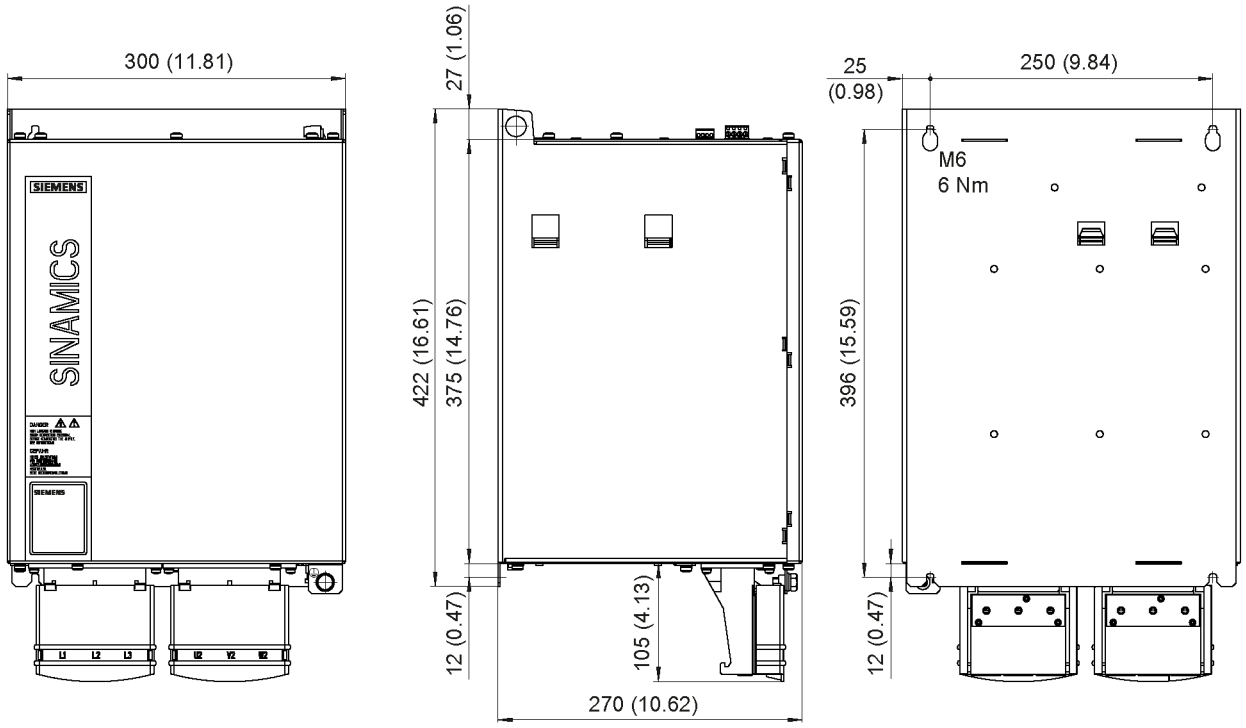
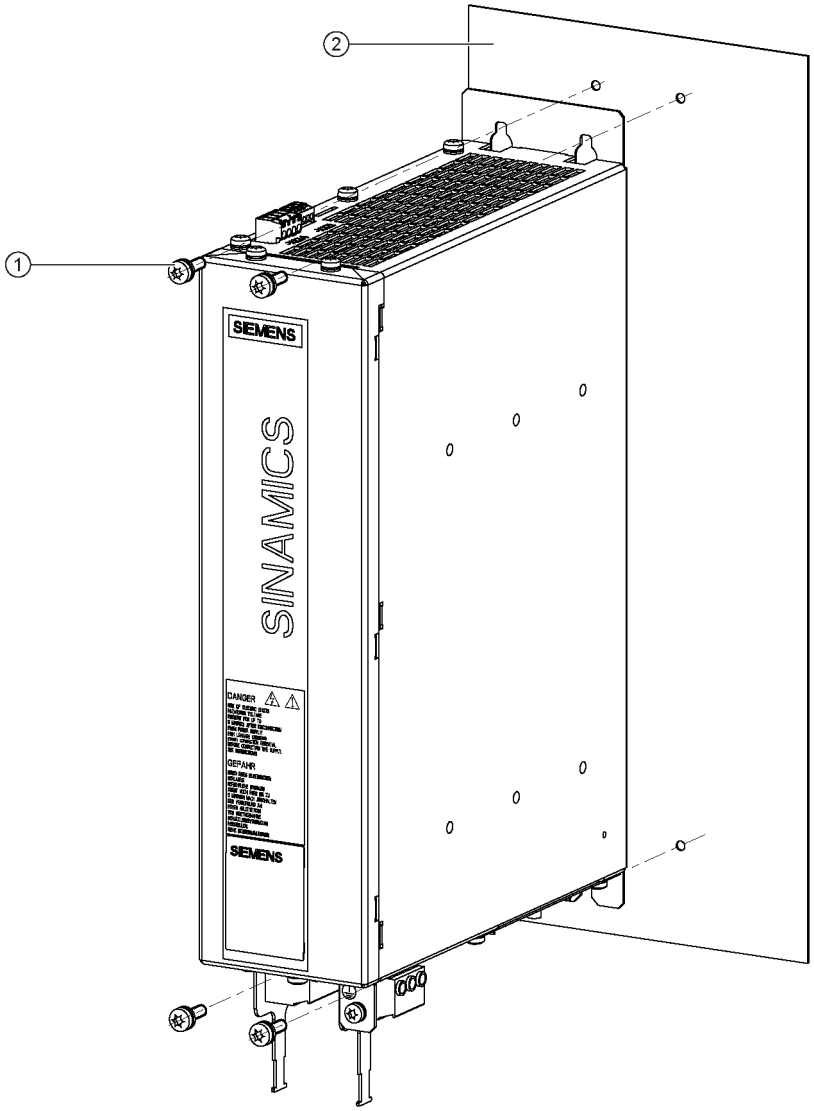


Figure 2-60 Dimension drawing of Active Interface Module 80 kW and 120 kW, all dimensions in mm and (inches)

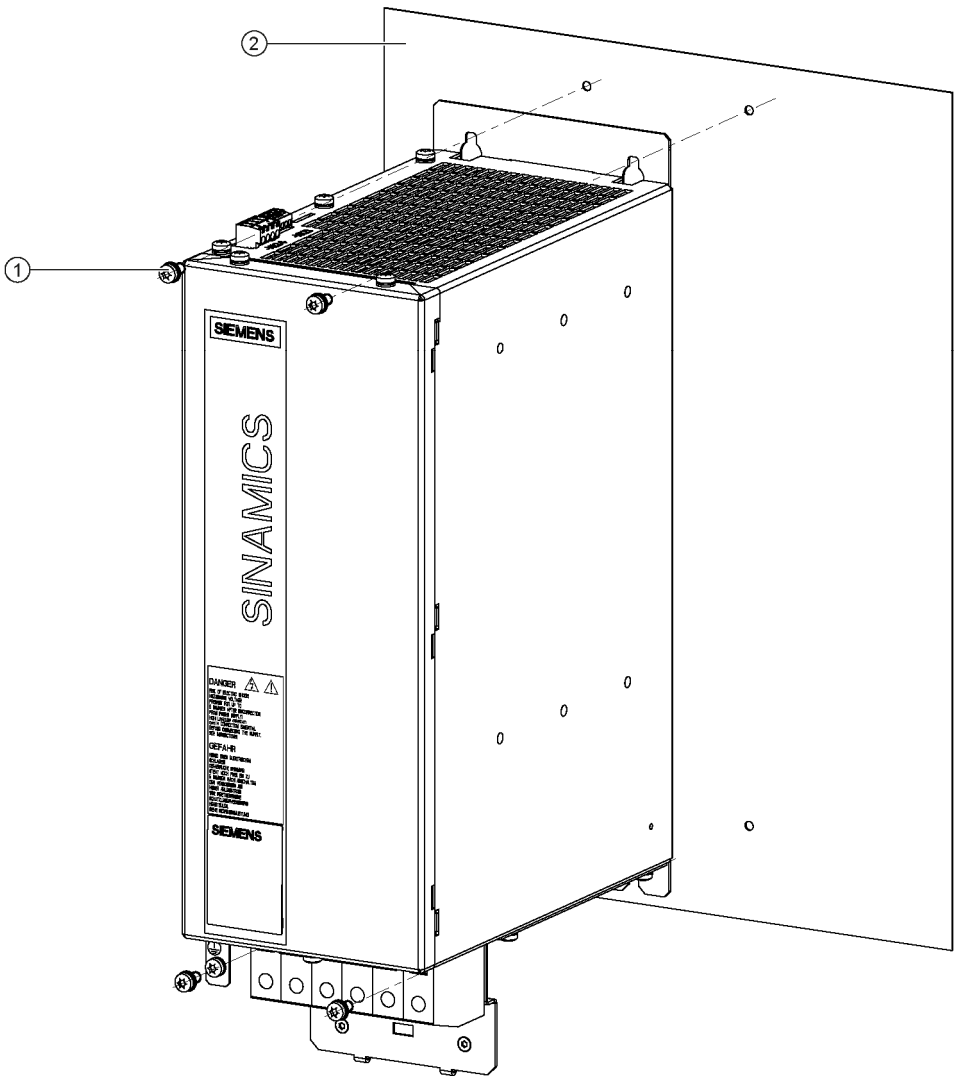
2.9.6 Installation

The Active Interface Modules are designed for installation in the control cabinet. The Active Interface Modules should if possible be mounted directly next to the Active Line Module.



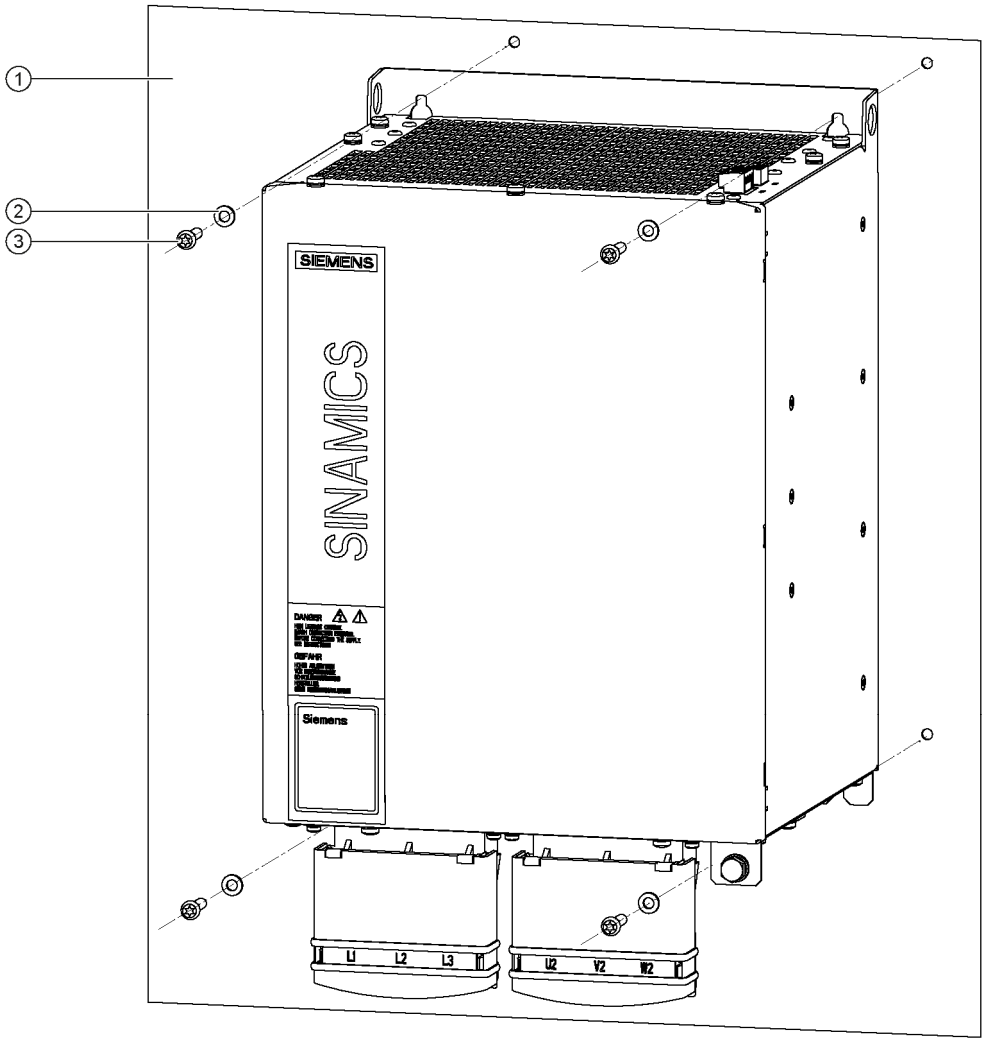
① Mounting panel
② M6 screws, Torx T30 (not hexagon-head screws)

Figure 2-61 Installation of 16 kW Active Interface Module



① Mounting panel
② M6 screws, Torx T30 (not hexagon-head screws)

Figure 2-62 Installation of 36 kW Active Interface Module



① Mounting panel
② Washer
③ M6 screws, Torx T30 (not hexagon-head screws)

Figure 2-63 Installation of 55 kW Active Interface Module

Tightening torque for all screws: 6 Nm

Table 2- 25 Protective conductor connection

Active Interface Module	
16 kW, 36 kW, 55 kW	Threaded hole M6 / 6 Nm
80 / 120 kW	Threaded hole M8 / 13 Nm

2.9.7 Operation on an isolated-neutral system (IT system)

IT system

In IT systems, all live parts are isolated from ground, or one point is connected to ground through an impedance. The exposed conductive parts of the electrical installation are either grounded separately or grounded together, or jointly connected to the system ground.

Only Line Modules without line filters are to be operated on this system type. The emitted interference can exceed the limit values of category C3. The Active Interface Module must be set for operation on an IT system.

Operating an Active Interface Module on an isolated-neutral network (IT system)

Note

When an Active Interface Module is operated on an isolated-neutral network (IT system), the connection bracket for the interference-suppression capacitor in the Active Interface Module must be removed. The connection bracket for the interference-suppression capacitor is located on the lower side of the component.

If the connection bracket for the interference-suppression capacitor is not removed, an insulated supply will be grounded and may cause tripping of the isolation monitor in the case of failure.

There are no limits of interference for isolated-neutral systems. Removing the connection bracket to the interference-suppression capacitor eliminates the effect of the filter against ground. It nevertheless makes sense to install an Active Interface Module because the clock frequency filter is still effective and also protects other loads on the same network from clock frequency disturbances.

⚠DANGER

The connecting bracket may only be removed in the de-energized state.
Risk of electric shock. Dangerous voltages are still present for up to 5 minutes after the power supply has been switched off.

		
Remove the connection bracket for the interference-suppression capacitor with a Tx25 screwdriver.	Remove the connection bracket	Connection bracket for the interference-suppression capacitor

Note

Installing the connection bracket for the interference-suppression capacitor

For operation in other systems, the connection bracket must be reinstalled and fixed with a tightening torque of 1.8 Nm.

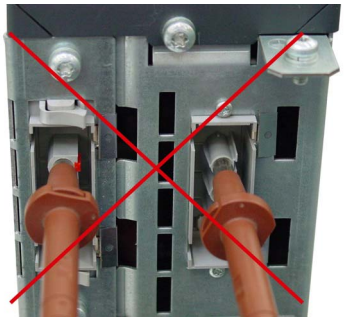
2.9.8 Electrical tests

Tests on the 16 kW Active Interface Module

Electrical tests on the 16 kW Active Interface Module may only be performed via the associated terminal connectors. The socket contacts will expand if unsuitable testing equipment is used (e.g. 4 mm safety plugs inserted directly into device sockets).

Using such equipment will result in contact problems involving the Active Interface Module's power connections.

Table 2- 26 Electrical test on the 16 kW Active Interface Module

		
Active Interface Module 16 kW	**RIGHT**: Measurement with original terminal connectors	**WRONG**: Measurement via the device sockets

2.9.9 Technical data

Table 2- 27 Technical data

Active Interface Module	6SL3100-	0BE21-6ABx	0BE23-6ABx	0BE25-5ABx	0BE28-0ABx	0BE31-2ABx
		16 kW	36 kW	55 kW	80 kW	120 kW
P_{max}	kW	35	70	110	131	175
I_{rated}	A	27	60	88	132	200
I_{max}	A	59	117	176	218	292
Current requirements of the 24 VDC electronic power supply	A	0.25	0.49	0.6	1.2	1.2
Line voltage	V	380 V to 480 V 3 AC ±10%				
Line frequency	Hz	47 - 63				
Cooling air requirement	m^3/h	112	160	300	600	600
Power loss[1)]	W	270	340	380	490	585
Weight	kg	10.7	18.5	21	29	35.5
Connection cross-section	mm^2	10	35	50	120	120
PE connecting studs		M5	M5	M6	M8	M8

1) Based on U_{dc} of 600 V

2.10 Combining line reactors and line filters

Selected combinations								Achievable characteristics				Available for										
Active Line Module	Smart Line Module	Basic Line Module	Basic Line Filter	Wideband Line Filter	HFD line reactor	FE line reactor	Active Interface Module	DC link step-up factor or rectified value B6	RFI suppression acc. to		Integrated clock frequency filter 8 kHz	Can be operated on IT systems	5 kW	10 kW	16 kW	20 kW	36 kW	40 kW	55 kW	80 kW	100 kW	120 kW
									EN 61800-3-C2 total cable length, shielded	EN 61800-3-C3 total cable length, shielded												
X					X			1,4 - 1,6	No [3]	No [3]	No	Yes			X		X		X	X		X
X			X		X			1,4 - 1,6	150 m	150 m	No	No			X		X		X			
X				X	X			1,4 - 1,6	350 m	350 m	Yes	No			X		X		X	X		X
X							X	1,4 - 2 [2]	No [3]	350 m	Yes	Yes [1]			X		X		X	X		X
X			X				X	1,4 - 2 [2]	350 m	630 m	Yes	No			X		X					
X			X				X	1,4 - 2 [2]	350 m	1,000 m	Yes	No							X	X		X
	X					X		1,35	No [3]	No [3]	Not relevant	Yes	X	X	X		X		X			
	X		X			X		1,35	350 m	350 m	Not relevant	No	X	X	X		X		X			
		X				X		1,35	No [3]	No [3]	Not relevant	Yes [1]									X	
		X	X			X		1,35	350 m	630 m	Not relevant	No				X		X				X

1) Remove connection bracket
2) Observe the insulation strength of the motors
3) Only permissible with vector control and sine-wave filter

Figure 2-64 Combining line reactors and line filters

Note

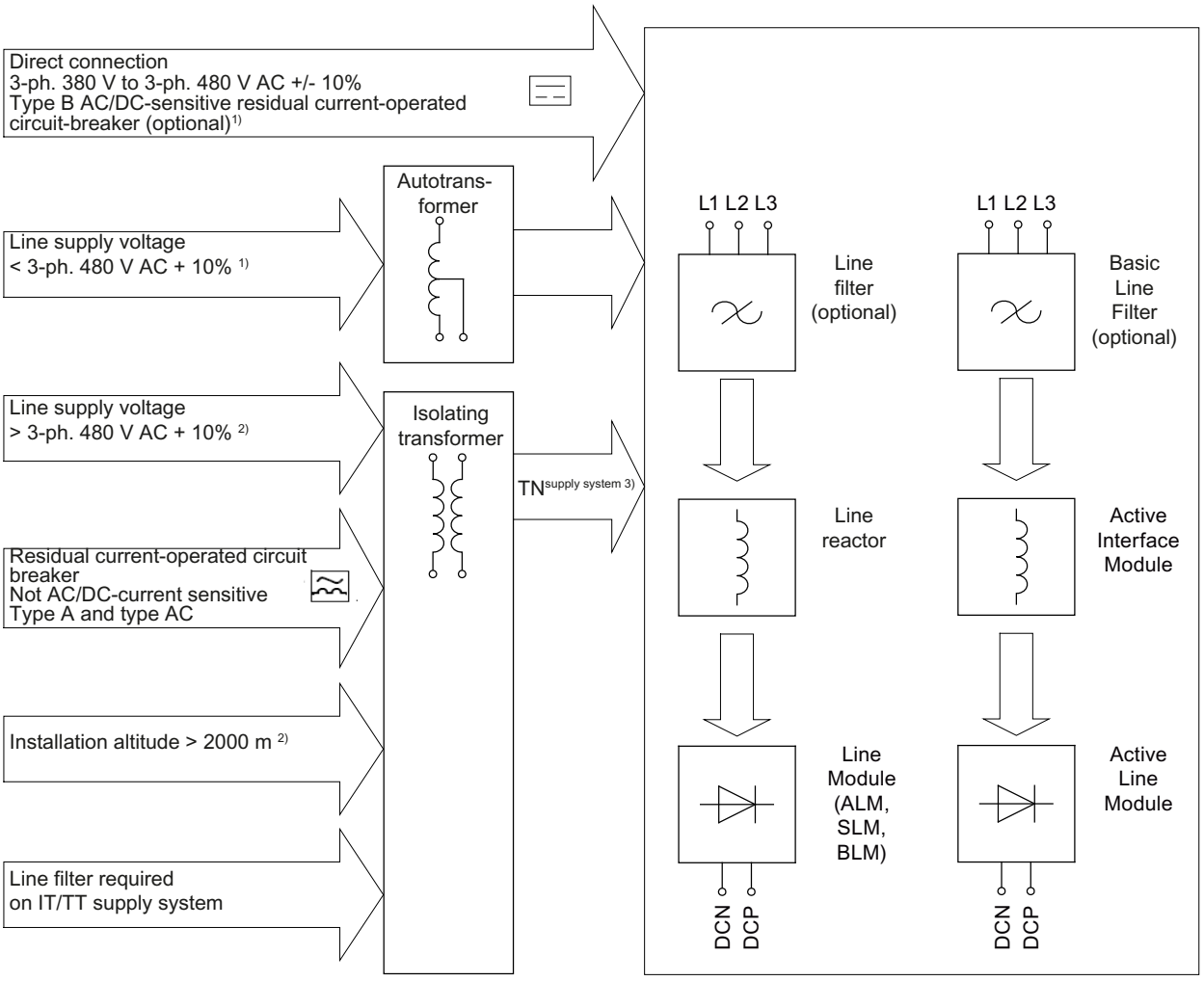
Ideally, new systems using Active Line Modules should be designed with Active Interface Modules as line connection components.

2.11 Line connection variants

2.11.1 Ways of connecting the line supply

A distinction is made between:

- Direct operation of the line connection components on the supply system
- Operating line connection components via an autotransformer
- Operating line connection components via an isolating transformer



1) TN or TT supply systems with grounded neutral point or IT supply systems with monitoring
2) Any supply system
3) With grounded neutral point

Figure 2-65 Overview of line connection versions

Note

Line connection of motors

In combination with the drive system, the motors are generally approved for operation on TN and TT systems with grounded neutral point and on IT systems.

In operation on IT systems, the occurrence of a first fault between an active part and ground must be signaled by a monitoring device. In accordance with IEC 60364-4-41, it is recommended that the first fault be eliminated as quickly as is practically possible in order to minimize the temporary overload of the motor insulation.

In all other systems, except TN and TT systems with grounded neutral point and IT systems, such as systems with a grounded line conductor, an isolation transformer with grounded neutral point (secondary side) must be connected between the supply and the drive system in order to protect the motor insulation from excessive stress.

2.11.2 Operation of the line connection components on the supply network

The SINAMICS S Booksize converter system is rated for direct operation on TN, TT, and IT line supply systems with a rated voltage of 380 V 3 AC to 480 V 3 AC.

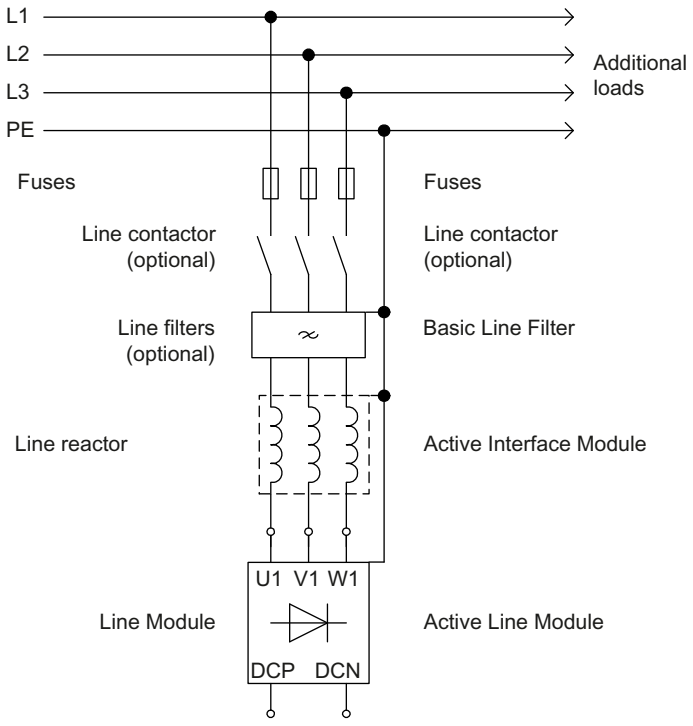


Figure 2-66 Direct operation on the line supply

2.11.3 Operation of the line connection components via a transformer

2.11.3.1 Safety information

NOTICE
If line filters are used that SIEMENS has not certified for use with SINAMICS S120, this can result in harmonics being fed back into the line supply. These harmonics can damage/disturb other equipment connected to this line supply. It is not permissible to connect other loads after the line filter.

NOTICE
If the system fault level is too low, this can result in faults/disturbances at the SINAMICS Line Module. It can also result in faults and damage to other equipment and devices that are connected at the same point of the line supply as the Line Module.

Note

If, for Line Modules, a transformer is used, this does not replace the external line reactor.

2.11.3.2 Line supply connection conditions for Line Modules

Table 2- 28 Line supply connection conditions for Line Modules

Module	Description 1)
Basic Line Module	Operation on line supplies from $S_{Kline}/P_n \geq 30$
Smart Line Module	Operation on line supplies from $S_{Kline}/P_n \geq 70$
Active Line Modules with Active Interface Modules	Operation on line supplies from $S_{Kline}/P_n \geq 30$ 2)
Active Line Module	Operation on line supplies from $S_{Kline}/P_n \geq 70$

1) S_{Kline} = short-circuit power of the line supply; P_n = rated power of the Line Module

2) Applies only for operation in the Active Mode. For line supplies 3-ph 480 V AC ±10%, it must be checked as to whether the motor systems are suitable for this mode.

If a TN system is required on the secondary side, for example when using a Wideband Line Filter, a transformer with grounded neutral point must be used. However, the loop resistance must be small enough to trigger the fuses as fast as required.

See the Chapter, "Overcurrent protection using line fuses and circuit breakers".

Vector group

Suggestion: Dyn5 or Yyn0; this means either a delta or star circuit on the primary side and star circuit on the secondary side where the neutral point is brought-out.

2.11.3.3 Dimensioning an isolating transformer/autotransformer for several loads

A SINAMICS Line Module and other loads/machines should be connected via an isolating/autotransformer (matching transformer) to the line supply. The following diagram shows the connection using an isolating transformer as example.

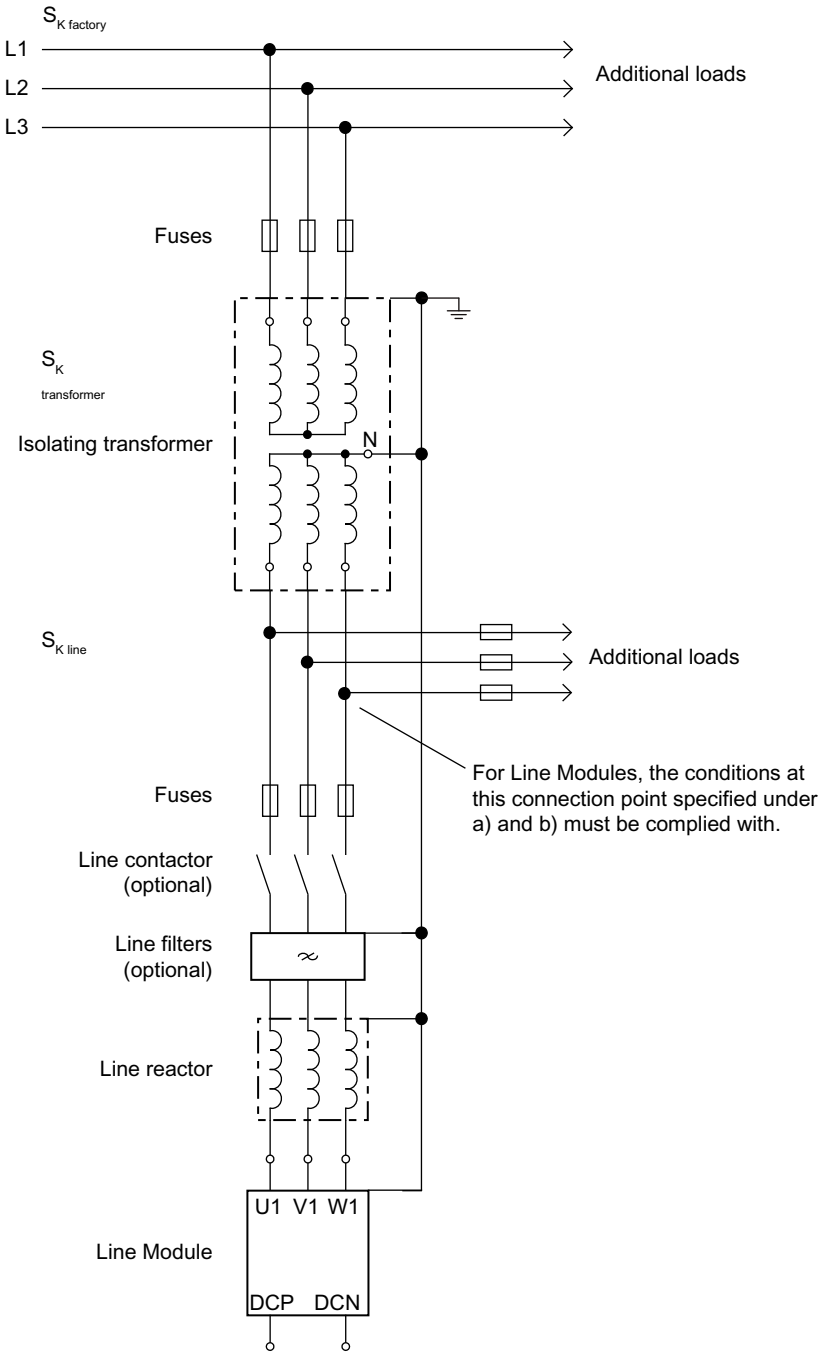


Figure 2-67 Operation of a Line Module and additional loads via an isolating transformer

An isolating/autotransformer (matching transformer) must be dimensioned for the total of all loads connected to it. The apparent powers required for the Line Modules must be determined and added as indicated in the table titled "Transformer configuration instructions". If the transformer is too small (S_n or S_k), this can lead to increased line voltage dips and faults in the line supply and in other loads at this connecting point.

If other loads are connected to the secondary side of the matching transformer, the boundary conditions indicated under a) and b) must be complied with when selecting the matching transformer.

S_{n1}, S_{n2} = calculated rated power of the transformer resulting from a) and b)

u_k = short-circuit voltage of the matching transformer in %
(must be between 1% and 3% for Active Line Modules and Smart Line Modules)

S_K = short-circuit power.

⚠ WARNING

A sufficiently high system fault level (short-circuit power) is required to ensure that when a fault does occur, the fuses rupture in the specified time. An insufficient system fault level (short-circuit power) increases the time to trip beyond permissible levels (e.g. a fire is possible).

Supplementary condition

a) Rated power

The rated power of the matching transformer S_{n1} must always be a factor of 1.27 higher than the rated power P_n of the Line Module.

$S_{n1} \geq 1.27 \bullet P_n$

Example:

The minimum rated power of a matching transformer for a 16 kW Line Modules is 21 kVA.

b) Short-circuit power

In order to avoid faults and disturbances at the other loads that are connected to the secondary side of the matching transformer, the total short-circuit power of the plant connection and that of the matching transformer at the connection point must reach the following values:

$S_{K\,line} \geq 70 \bullet P_n$ (for Active Line Module and Smart Line Module)

$S_{K\,line} \geq 30 \bullet P_n$ (for Basic Line Module)

Special case:

When operating with only one supply at a transformer, the values may be reduced by the factor 0.73.

$S_{K\,line} \geq 0.73 \bullet 70 \bullet P_n$ (for Active Line Module and Smart Line Module)

$S_{K\,line} \geq 0.73 \bullet 30 \bullet P_n$ (for Basic Line Module)

For example $S_{K\,line}$ for 16 kW Active Line Module: $S_{K\,line}$ = 0.82 MVA = 820 kVA

From $S_{K\ transformer}$ the required rated power of the matching transformer can be calculated.

$$S_{n2} = \frac{S_{K\ plant}\,[kVA] \bullet S_{K\ line}\,[kVA] \bullet uk\ [\%]}{(S_{K\ plant}\,[kVA] - S_{K\ line}\,[kVA]) \bullet 100\ [\%]}\ [kVA]$$

Note:

The system fault level (short-circuit power) at the plant connection $S_{K\ plant}$ plays a decisive role in dimensioning/selecting the matching transformer.

From the rated power (S_{n1} or S_{n2}) calculated under a) and b), the higher value must be used for the matching transformer.

Table 2- 29 Transformer configuration instructions

Used Active Line Module P_n	**Required rated power S_n of the isolation transformer/autotransformer**	**Required short-circuit voltage u_k**	**Required system fault level S_{Kline}**
16 kW	$S_n \geq 21$ kVA	$u_k \leq 3\%$	$S_{Kline} \geq 1.12$ MVA
36 kW	$S_n \geq 46$ kVA	$u_k \leq 3\%$	$S_{Kline} \geq 2.52$ MVA
55 kW	$S_n \geq 70$ kVA	$u_k \leq 3\%$	$S_{Kline} \geq 3.85$ MVA
80 kW	$S_n \geq 102$ kVA	$u_k \leq 3\%$	$S_{Kline} \geq 5.6$ MVA
120 kW	$S_n \geq 153$ kVA	$u_k \leq 3\%$	$S_{Kline} \geq 8.4$ MVA
Used Smart Line Module P_n	**Required rated power S_n of the isolation transformer/autotransformer**	**Required short-circuit voltage u_k**	**Minimum system fault level $S_{K\ line}$** required
5 kW	$S_n \geq 6.4$ kVA	$u_k \leq 3\%$	$S_{Kline} \geq 0.35$ MVA
10 kW	$S_n \geq 13$ kVA	$u_k \leq 3\%$	$S_{Kline} \geq 0.7$ MVA
16 kW	$S_n \geq 21$ kVA	$u_k \leq 3\%$	$S_{Kline} \geq 1.12$ MVA
36 kW	$S_n \geq 46$ kVA	$u_k \leq 3\%$	$S_{Kline} \geq 2.52$ MVA
55 kW	$S_n \geq 70$ kVA	$u_k \leq 3\%$	$S_{Kline} \geq 3.85$ MVA
Used Basic Line Module P_n	**Required rated power S_n of the isolation transformer/autotransformer**	**Required short-circuit voltage u_k**	**Minimum system fault level $S_{K\ line}$** required
20 kW	$S_n \geq 26$ kVA	$u_k \leq 10\%$	$S_{Kline} \geq 1.4$ MVA
40 kW	$S_n \geq 51$ kVA	$u_k \leq 10\%$	$S_{Kline} \geq 2.8$ MVA
100 kW	$S_n \geq 127$ kVA	$u_k \leq 10\%$	$S_{Kline} \geq 7.0$ MVA

Note

Ask your local power utility company for the system fault level $S_{K\ line}$.

Example 1

u_k matching transformer = 3%,
$S_{K\ plant}$ = 50,000 kVA
$S_{K\ line}$ = 16 kW • 70 • 0.73 = 820 kVA

According to a)
S_{n1} = 1.27 • 16 kW = 21 kVA

According to b)

$$S_{n2} = \frac{50000\ kVA \bullet 820\ kVA \bullet 3\%}{(\ 50000\ kVA - 820\ kVA\ ) \bullet 100\%} = 25\ kVA$$

$S_{n2} > S_{n1} \Rightarrow S_{n2}$ is decisive.
The matching transformer requires a rated power S_n of 25 kVA for a short-circuit voltage u_k of 3%.

Example 2:

u_k matching transformer = 1%,
$S_{K\ plant}$ = 50,000 kVA
$S_{K\ line}$ = 16 kW • 70 • 0.73 = 820 kVA

According to a)
S_{n1} = 1.27 • 16 kW = 21 kVA

According to b)

$$S_{n2} = \frac{50000\ kVA \bullet 820\ kVA \bullet 1\%}{(\ 50000\ kVA - 820\ kVA\ ) \bullet 100\%} = 8.3\ kVA$$

$S_{n1} > S_{n2} \Rightarrow S_{n1}$ is decisive.
The matching transformer requires a rated power S_n of 21 kVA for a short-circuit voltage u_k of 1%.

Example 3:

If $S_{K\ plant}$ is smaller, the transformer must be stronger.

u_k matching transformer = 3%,
$S_{K\ plant}$ = 3,000 kVA
$S_{K\ line}$ = 16 kW • 70 • 0.73 = 820 kVA

According to a)
S_{n1} = 1.27 • 16 kW = 21 kVA

According to b)

$$S_{n2} = \frac{3000\ kVA \bullet 820\ kVA \bullet 3\%}{(\ 3000\ kVA - 820\ kVA\ ) \bullet 100\%} = 33.9\ kVA$$

$S_{n2} > S_{n1} \Rightarrow S_{n2}$ is decisive

The matching transformer requires a rated power S_n of 34 kVA for a short-circuit voltage u_k of 3%.

Example 4:

If $S_{K\ plant}$ is smaller, you can use, alternatively to example 3, a transformer with a smaller u_k.
u_k matching transformer = 1%,
$S_{K\ plant}$ = 3,000 kVA
$S_{K\ line}$ = 16 kW • 70 • 0.73 = 820 kVA

According to a)
S_{n1} = 1.27 • 16 kW = 21 kVA

According to b)

$$S_{n2} = \frac{3000\ kVA \bullet 820\ kVA \bullet 1\%}{(\ 3000\ kVA - 820\ kVA\ ) \bullet 100\%} = 11.3\ kVA$$

$S_{n1} > S_{n2} \Rightarrow S_{n1}$ is decisive

The matching transformer requires a rated power S_n of 21 kVA for a short-circuit voltage u_k of 1%.

Note

S_{n2} for the matching transformer can be reduced by reducing u_k. In the examples above, the power drawn from other loads has not been taken into account.

2.11.3.4 Operation of the line connection components via an autotransformer

An autotransformer can be used to adapt the voltage in the range up to 3-ph. 480 V AC +10 %.

⚠ DANGER

To ensure protective separation an isolating transformer must be used for voltages greater than 3-ph. AC 480 V AC +10 %.

Applications:

- The motor insulation must be protected from excessive voltages.
- The active line module must provide a stabilized DC link voltage. This is possible with a rated voltage of 380 V to 415 V.
  A combination with motors that may be operated with a DC link voltage of up to 660 V, and a line voltage > 415 V requires a controlled DC link voltage.

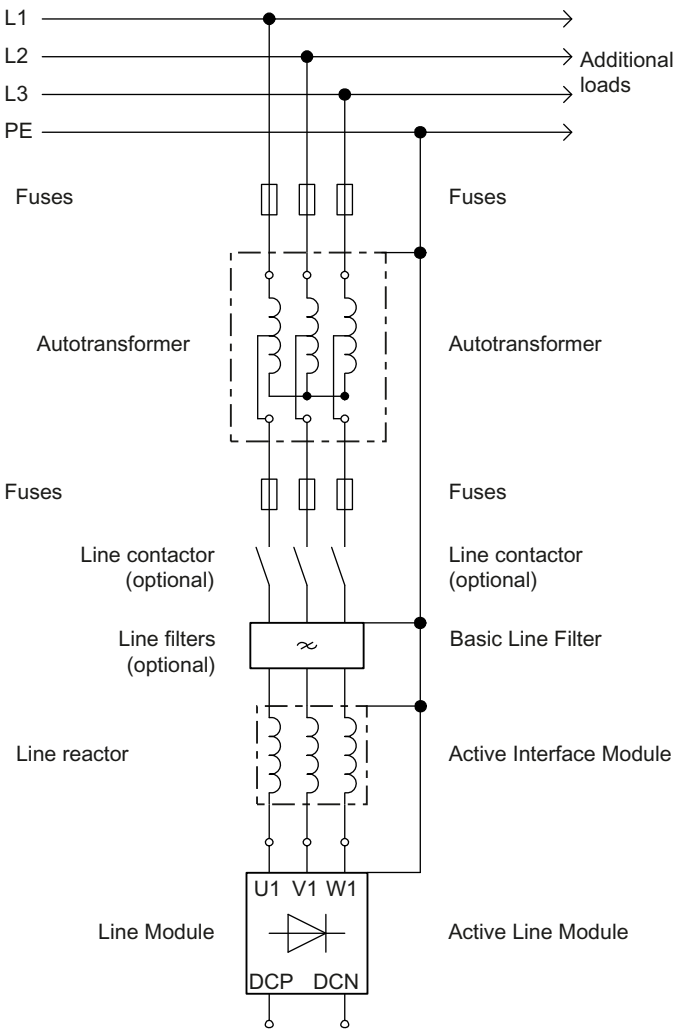


Figure 2-68 Operation of a Line Module via an autotransformer

2.11.3.5 Operation of the line connection components via an isolating transformer

An isolating transformer converts the line supply type of the plant or system (e.g. IT/TT system) to a TN system. Additional voltage adaptation to the permissible voltage tolerance range is possible.

An isolating transformer must be used in the following cases:

- The insulation of the Motor Module and/or the motor is not suitable for the voltages that occur.
- There is no compatibility with an existing residual-current protective device.
- The installation altitude is greater than 2000 m above sea level.
- A line filter should be used in a line supply system that is not a TN line supply system with grounded neutral conductor.

CAUTION
If the line supply voltage is greater than 480 V +10 %, it is not permissible to use an autotransformer. An isolating transformer must be used to ensure protective separation.

An isolating transformer must have the following properties:

- The transformer secondary must be in the star connection (a delta connection is not permissible!)
- The neutral conductor must be brought out. It must be connected to the PE of the line filter, line reactor or AIM and Line Module (infeed).
  Caution: If the neutral conductor is not brought out and/or not connected, then all of the restrictions of an IT supply system apply!
- If the line supply is available in a star connection on the primary side, then the vector group that is required is: Yyn0
- If the line supply is available in a delta connection on the primary side, then the vector group that is required is: Dyn5

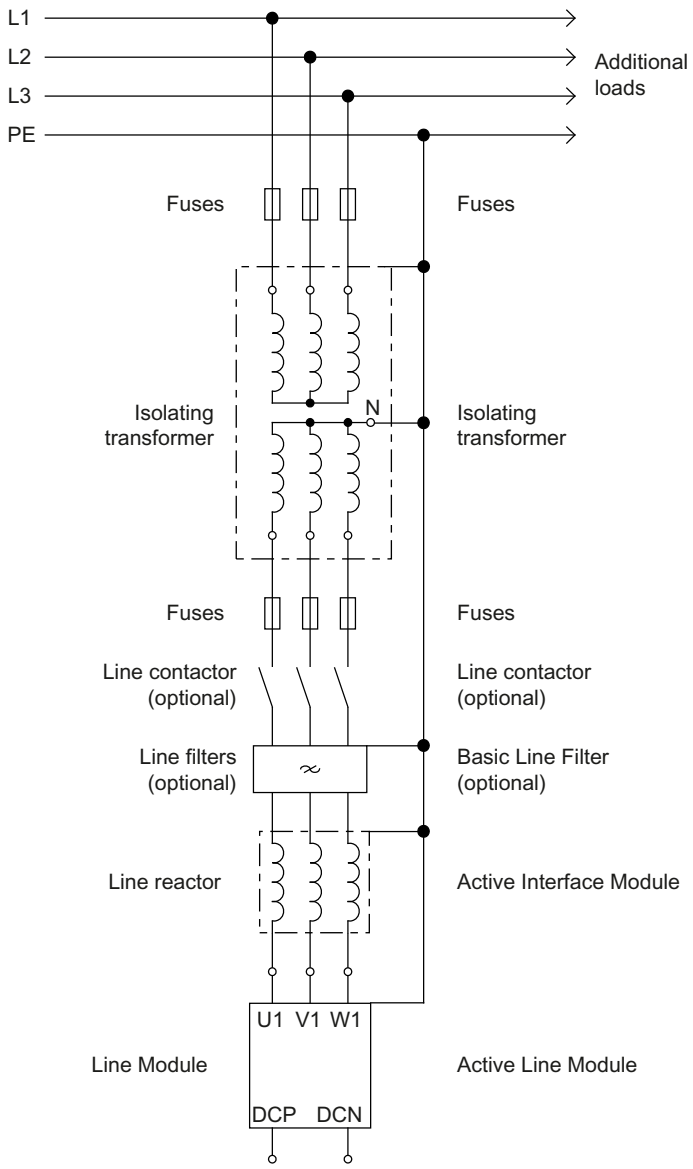


Figure 2-69 Operation of a Line Module via an isolating transformer

Line Modules Booksize

3

3.1 Active Line Modules with internal air cooling

3.1.1 Description

Active Line Modules generate a constant, regulated DC voltage in the DC link from the three-phase line supply voltage that supplies the connected Motor Modules with power.

This ensures that they are not influenced by network fluctuations.

When the motors are in feedback mode, Active Line Modules supply power back to the network. The regenerative feedback capability of the modules can be deactivated by parameterization.

The DC link starts precharging as soon as the supply voltage is applied and is independent of its phase sequence direction. Load can be applied to the DC link after the modules have been enabled. An optional main contactor is required for disconnecting the voltage.

Active Line Modules can be directly connected to TN and TT line supplies - both with grounded neutral point and also with grounded protective conductor; they can also be connected to IT line supplies. The Line Modules have an integrated overvoltage protection function.

3.1.2 Safety information

⚠ DANGER

Risk of electric shock

A hazardous voltage is present for up to 5 minutes after the power supply has been disconnected.
The protective cover may only be opened after this time has expired.

When opening the protective cover for the DC link, you must press the release catch. A suitable tool (e.g. screwdriver or supplied unlocking tool) must be used for this purpose.

The components must only be operated when the protective cover of the DC link is closed. Damaged components must not be operated further, otherwise this could result in secondary damage or accidents.

⚠DANGER

DC-link discharge time

A hazard warning for the DC link discharge time must be attached in the local language to all of the components.
A set of labels in 16 languages is supplied with the component.

⚠DANGER

In the interests of operator and fire protection, the power supply conditions in terms of short-circuit power and loop impedance at the infeed point must be such that they will trip the installed overcurrent protection devices within the prescribed period if a fault occurs (short circuit or short circuit to exposed conductive part).

Note

Line short-circuit power at the infeed point

The line short-circuit power at the infeed point must be at least 70 times greater than the rated power of the Line Module in order to limit the line harmonics to an acceptable level for other loads.

⚠DANGER

The drive components generate high leakage currents in the protective conductor. The components must only be operated in cabinets or in closed electrical operating areas and must be connected with the protective conductor. To protect against electric shock, the protective conductor connection at the control cabinet or machine must be implemented in accordance with one of the following measures:

- Fixed connection and protective conductor connection by means of ≥ 10 mm^2 Cu or ≥ 16 mm^2 Al
- Fixed connection and automatic disconnection of the supply system if the protective conductor is interrupted

⚠DANGER

It is only permissible to establish connections to the DC link using the adapters that SIEMENS has recommended (DC link adapter and DC link rectifier adapter).

⚠DANGER

If the Line Module is not disconnected from the supply system (e.g. via the line contactor or main switch), the DC link remains charged.

⚠ CAUTION

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

For the 80 kW and 120 kW Active Line Modules, a cooling clearance of 50 mm must be observed in front of the fan.

CAUTION

The tightening torque of the DC-link busbar screws (1.8 Nm, tolerance: +30 %) must be checked before startup when the system is disconnected from the power supply and the DC link is discharged. After transportation, the screws must be tightened.

For lines without regenerative feedback capability (e.g. a diesel generator), the regenerative feedback capability of the Active Line Module must be deactivated by means of parameters (see Description of functions). The braking energy must then be dissipated via an additional Braking Module with braking resistor provided in the drive line-up.

CAUTION

The overall length of all power cables (motor supply cables and DC-link cables) must not exceed the values given in the chapter titled "Possible line reactor and line filter combinations".

CAUTION

Only cables from Siemens may be used for DRIVE-CLiQ connections.

CAUTION

DC link side covers are supplied with the components as standard and must be attached to the first and last components in the drive line-up. They can also be ordered separately, if required (order number: 6SL3162-5AA00-0AA0).

3.1.3 Interface description

3.1.3.1 Overview

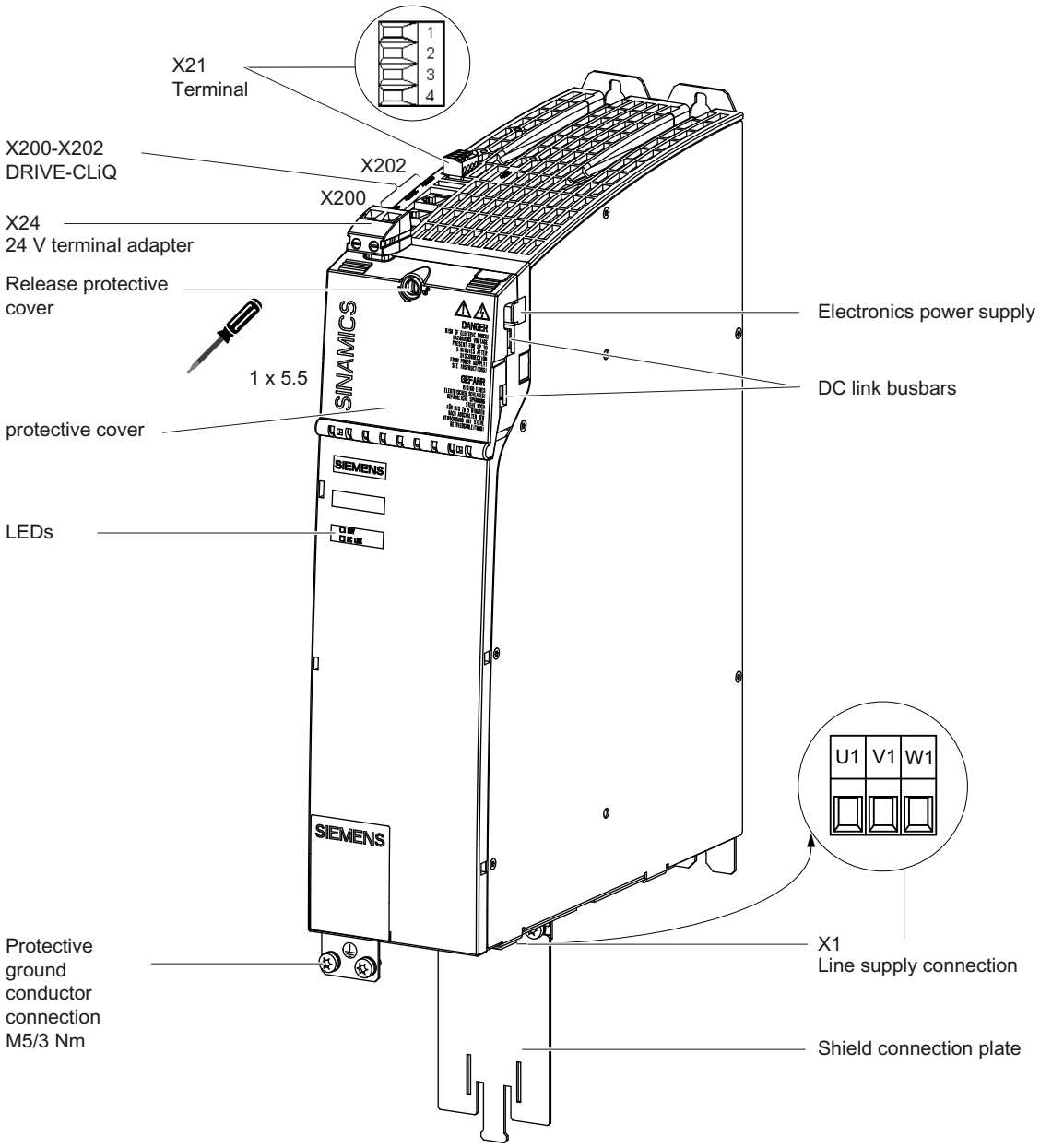
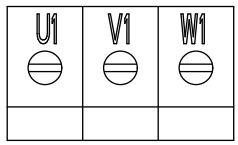
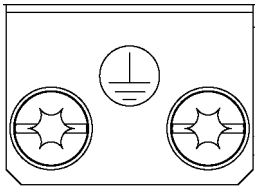


Figure 3-1 Interface overview, Active Line Module with internal air cooling (example: 16 kW)

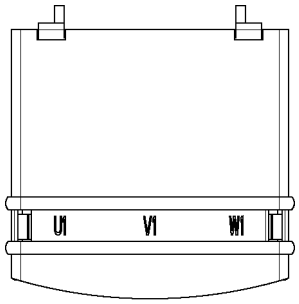
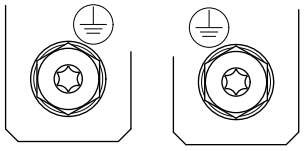
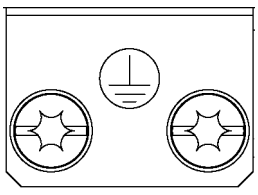
3.1.3.2 X1 line connection

Table 3- 1 X1: Line connection for Active Line Modules 16 kW

	Terminal	Technical specifications
	U1 V1 W1	Max. connectable cross-section: 10 mm² Type: Screw terminal 6 Tightening torque: 1.5 - 1.8 Nm (see Chapter, "Control cabinet installation/connection system")
	PE connection	Threaded hole M5/3 Nm [1)]

1) For ring cable lugs in accordance with DIN 46234

Table 3- 2 X1: Line supply connection for Active Line Modules 36 kW to 120 kW

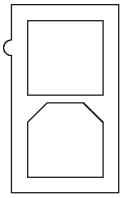
	Terminal	Technical specifications
	U1 V1 W1	Supply voltage: 380 V - 480 V 3 AC, 50/60 Hz **36 kW:** Threaded bolts M6 / 6 Nm [1)] **55 kW, 80 kW and 120 kW:** Threaded bolts M8 / 13 Nm [1)]
	PE connection	**36 kW:** Threaded hole M6 / 6 Nm [1)]
		**55 kW:** Threaded hole M6 / 6 Nm [1)] **80 kW and 120 kW:** Threaded hole M8 / 13 Nm [1)]

1) For ring cable lugs in accordance with DIN 46234

3.1.3.3 X12 fan connection

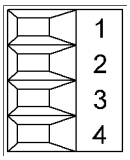
Active Line Modules 80 kW and 120 kW are equipped with an interface for connecting the sub-chassis fan. The interface is located on the underside of the Line Module.

Table 3- 3 X12 fan connection

	Terminal	Function	Technical specifications
	1	Fan connection +	Voltage 48 V DC for the supplied fan
	2	Fan connection -	

3.1.3.4 X21 EP terminals

Table 3- 4 X21 EP terminal/temperature sensor

	Terminal	Designation	Technical specifications
	1	+ Temp	Temperature sensors[1]: KTY 84–1C130[2]/PTC[2]/bimetallic switch with NC contact If an Active Interface Module is used, the temperature input must be connected to the Active Interface Module sensor (bimetallic switch with NC contact).
	2	- Temp	
	3	EP +24 V (Enable Pulses)	Voltage 24 VDC Current consumption: 10 mA Isolated input Signal propagation times: L → H: 100 µs H → L: 1000 µs
	4	EP M (Enable Pulses)	
Max. connectable cross-section: 1.5 mm^2 Type: Screw terminal 1 (see Chapter, "Control cabinet installation and EMC/connection system")			

1) The temperature sensor type can be selected via parameter p0601; the temperature is displayed via r0035 (see SINAMICS S120/S150 List Manual LH1).

2) Temperatures are detected but not evaluated in the Active Line Module.

⚠ CAUTION

If an Active Interface Module is connected, the temperature output of the Active Interface Module must be connected to terminals 1 and 2.

⚠ WARNING

For operation, the 24 V DC voltage must be connected to terminal 3 and ground to terminal 4. When withdrawn, pulse suppression is activated. Regenerative feedback is deactivated and the bypass relay drops out. If the Line Module is not disconnected from the supply system when the EP terminal is deactivated (e.g. a line contactor is not installed), the DC link remains charged.

NOTICE

If an active drive line-up is switched off by means of the disconnector unit, the voltage at terminals 3 (EP +24 V) and 4 (EP M) must be interrupted beforehand. This can be carried out using a leading breaking auxiliary contact (≥ 10 ms), for example.

This protects external loads located parallel to the drive on the same switching component.

⚠ DANGER

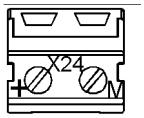
Risk of electric shock!

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) or Terminal Module TM120 must be used.

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

3.1.3.5 X24 24 V terminal adapter

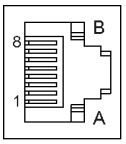
Table 3- 5 X24 24 V terminal adapter

	Terminal	Designation	Technical specifications
	+	24 V power supply	24 V DC supply voltage
	M	Ground	Electronics ground
Max. connectable cross-section: 6 mm^2 Type: Screw terminal 5 (see Chapter, "Control cabinet installation and EMC/connection system")			

The 24 V terminal adapter is included in the scope of supply.

3.1.3.6 X200-X202 DRIVE-CLiQ interfaces

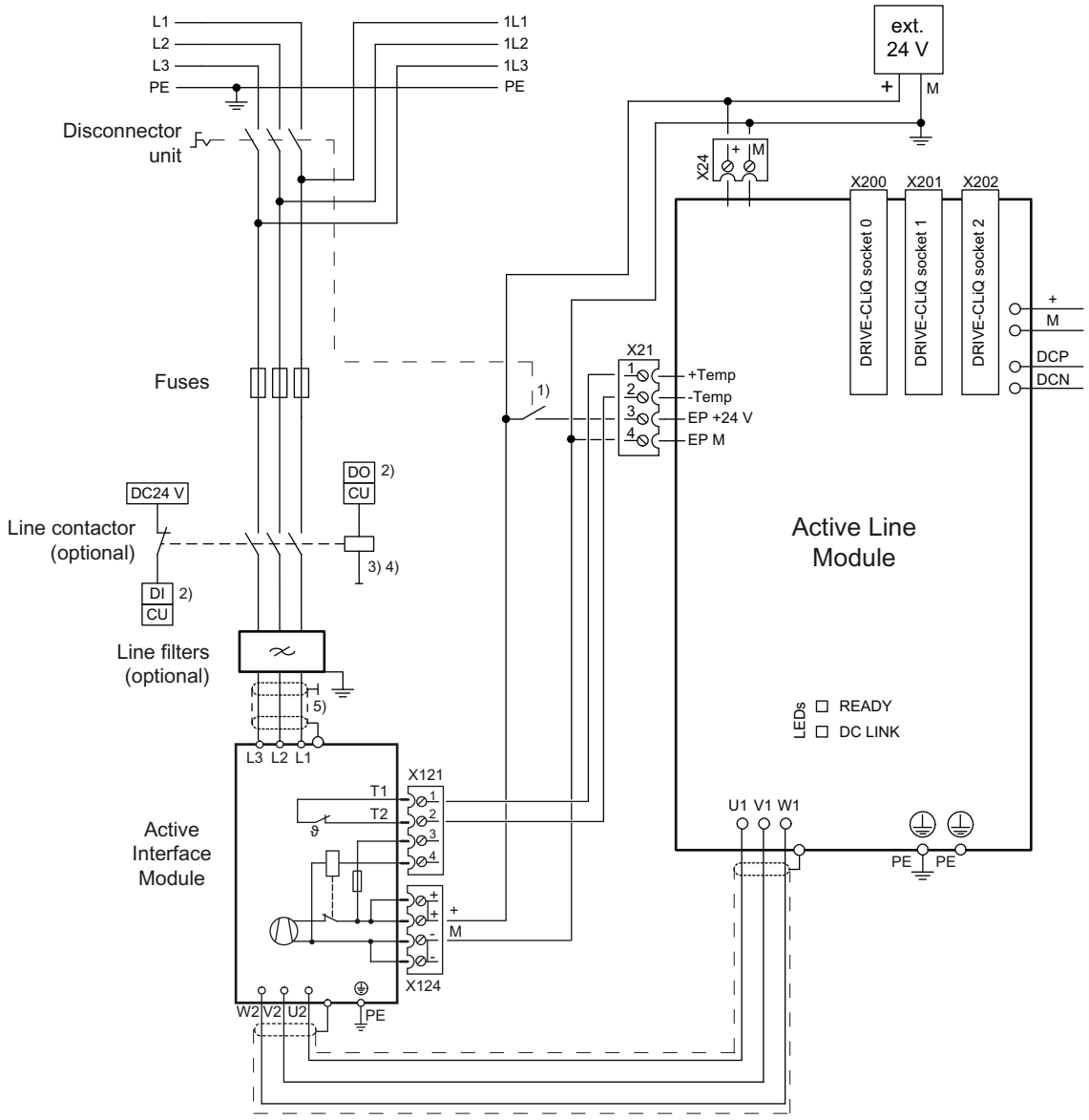
Table 3- 6 X200-X202 DRIVE-CLiQ interfaces

	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

The blanking covers for the DRIVE-CLiQ interfaces are included in the scope of delivery.

Blanking cover (50 pcs.) Order number: 6SL3066-4CA00-0AA0

3.1.4 Connection example



1) Leading NC contact t > 10 ms
2) DI/DO, controlled by the Control Unit.
3) No additional load permitted downstream of line contactor!
4) The current carrying capacity of the DO must be observed; an output coupling device must be used if required.
5) Contacting via rear mounting panel or shielding buses in accordance with EMC Directive.

Figure 3-2 Example connection of Active Line Module

Note

If you are using a VSM10 Voltage Sensing Module, the leading opening contact can be omitted.

3.1.5 Meaning of LEDs

Table 3- 7 Meaning of the LEDs on the Active Line Module

Status		Description, cause	Remedy
RDY	DC LINK		
off	off	Electronics power supply is missing or outside permissible tolerance range.	–
Green	--	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.	Check line voltage
Orange	Orange	DRIVE-CLiQ communication is being established.	–
Red	--	At least one fault is present in this component. **Note:** The LED is activated regardless of whether the corresponding messages have been reconfigured.	Remedy and acknowledge fault
Green/ red (0.5 Hz)	--	Firmware is being downloaded.	–
Green/red (2 Hz)	--	Firmware download is complete. Wait for POWER ON.	Carry out a POWER ON
Green/orange or Red/orange	--	Detection of the components via LED is activated (p0124). **Note:** Both options depend on the LED status when module recognition is activated via p0124 = 1.	–

⚠ DANGER

Hazardous DC link voltages may be present at any time regardless of the status of the "DC LINK" LED.
The warning information on the components must be carefully observed!

3.1.6 Dimension drawings

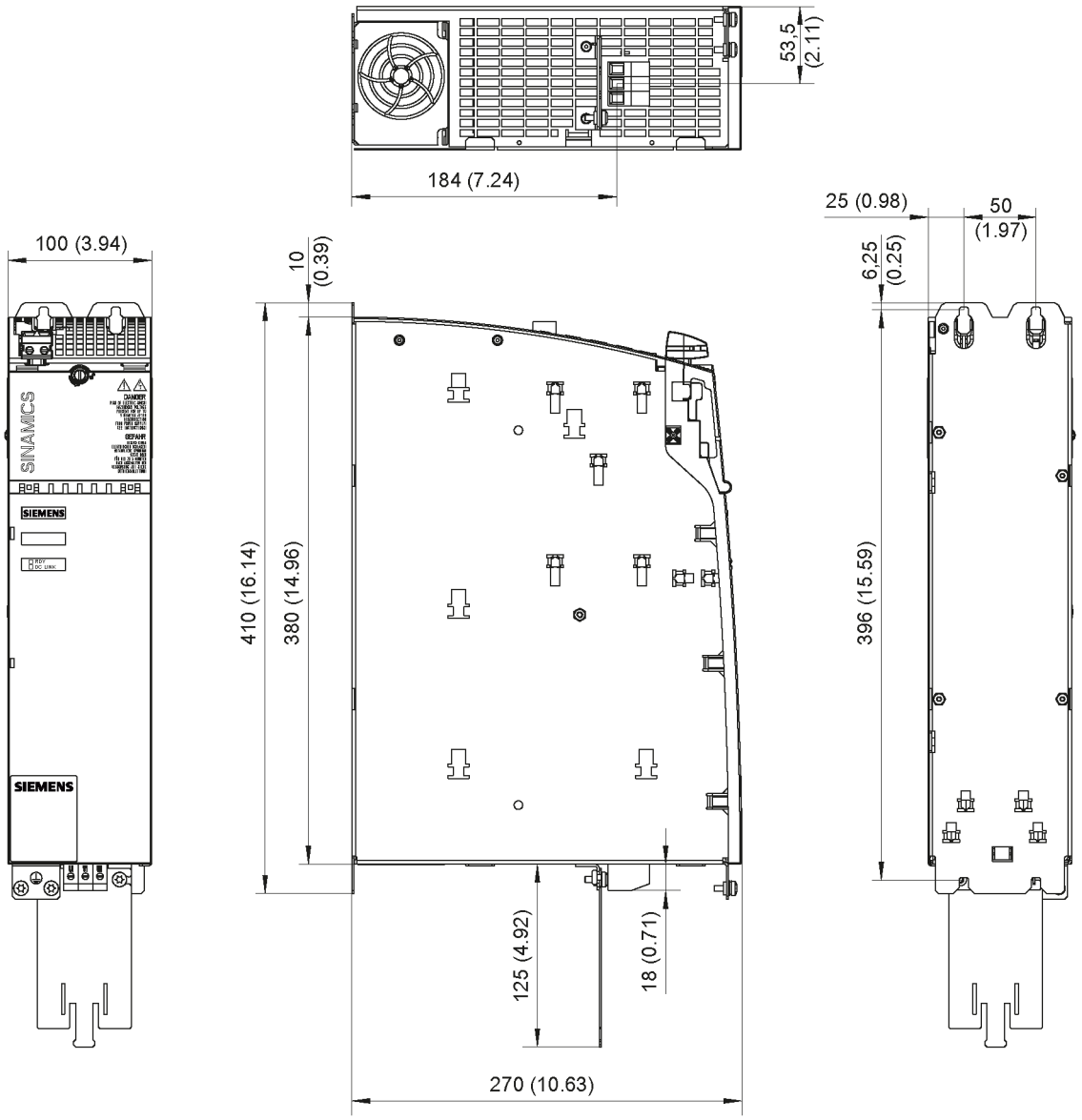


Figure 3-3 Dimension drawing of 16 kW Active Line Module with internal air cooling, all dimensions in mm and (inches)

Note

The shield connecting plate is supplied as standard with a 100 mm Line Module.
For more information, see the chapter titled "Accessories".

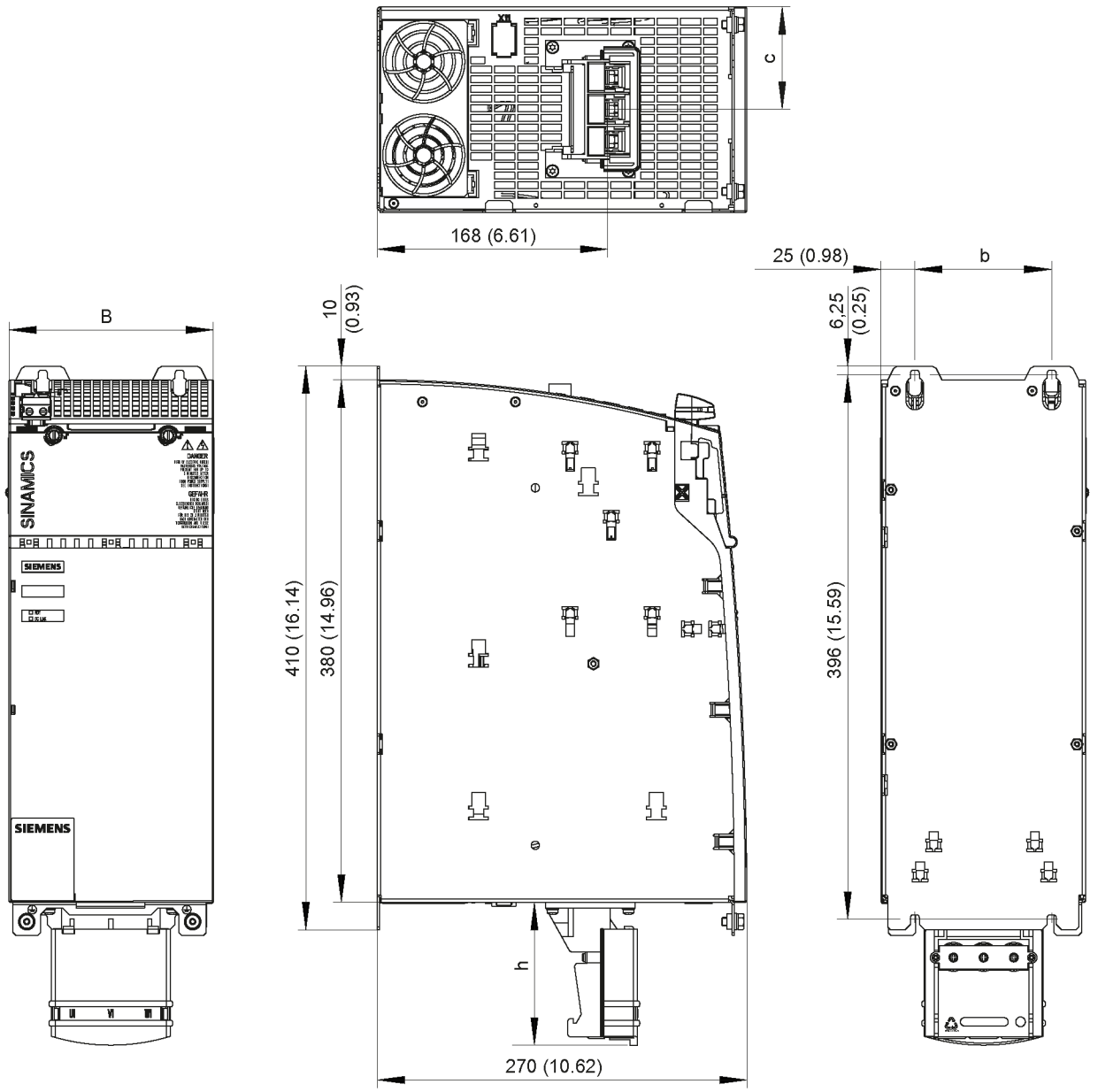


Figure 3-4 Dimension drawing of 36 kW and 55 kW Active Line Modules with internal air cooling (example, 36 kW), all dimensions in mm and (inches)

Table 3- 8 Dimensions of 36 kW and 55 kW Active Line Modules with internal air cooling

Active Line Module	Order number	B [mm] (inches)	b [mm] (inches)	c [mm] (inches)	h [mm] (inches)
36 kW	6SL3130-7TE23-6AAx	150 (5.91)	100 (3.94)	75 (2.95)	105 (4.13)
55 kW	6SL3130-7TE25-5AAx	200 (7.87)	150 (5.91)	100 (3.94)	105 (4.13)

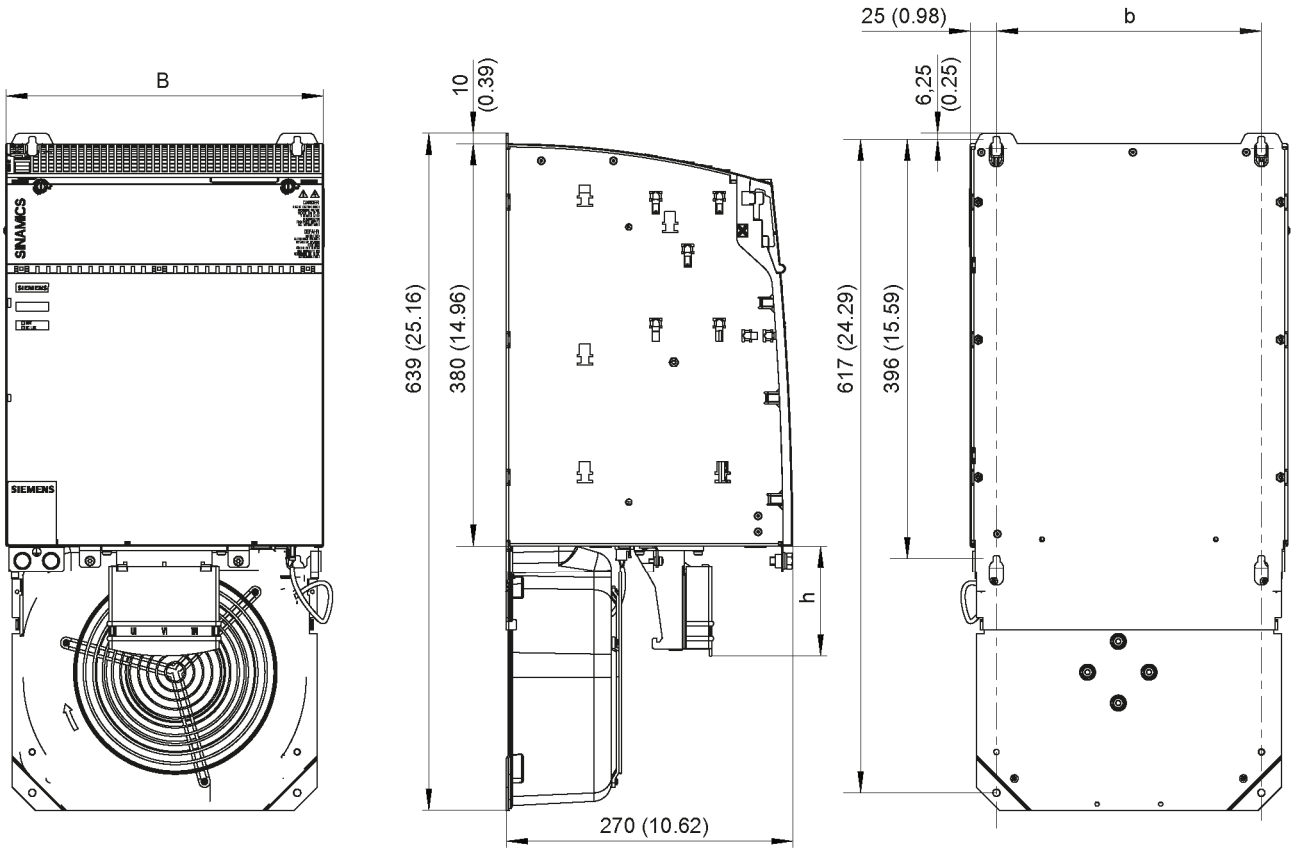


Figure 3-5 Dimension drawing of 80 kW and 120 kW Active Line Modules with internal air cooling, all dimensions in mm and (inches)

Table 3- 9 Dimensions of 80 kW and 120 kW Active Line Modules with internal air cooling

Active Line Module	Order number	B [mm] (inches)	b [mm] (inches)	h [mm] (inches)
80 kW	6SL3130-7TE28-0AAx	300 (11.81)	250 (9.84)	105 (4.13)
120 kW	6SL3130-7TE31-2AAx	300 (11.81)	250 (9.84)	105 (4.13)

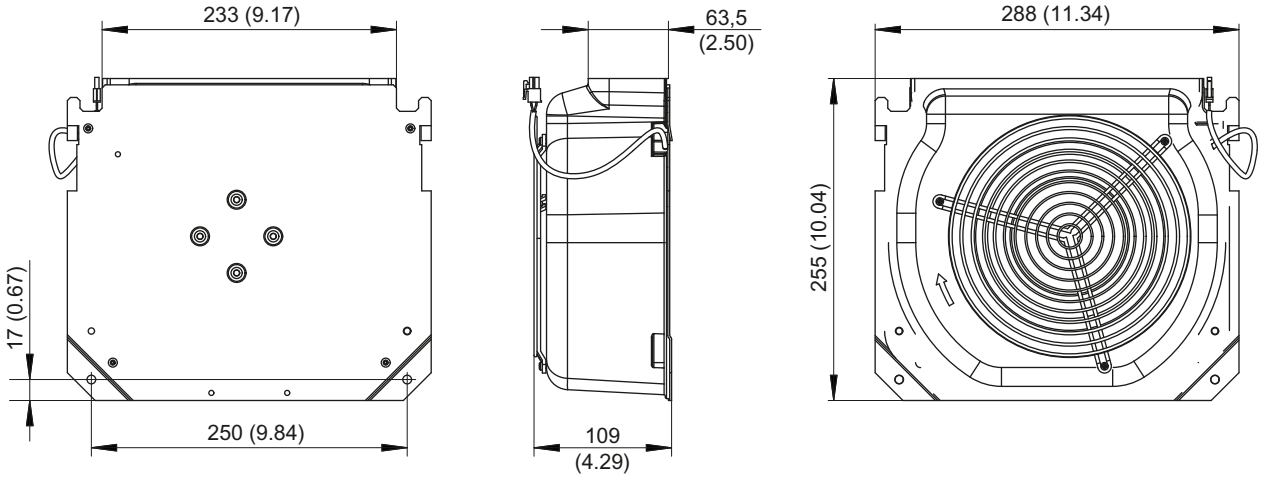
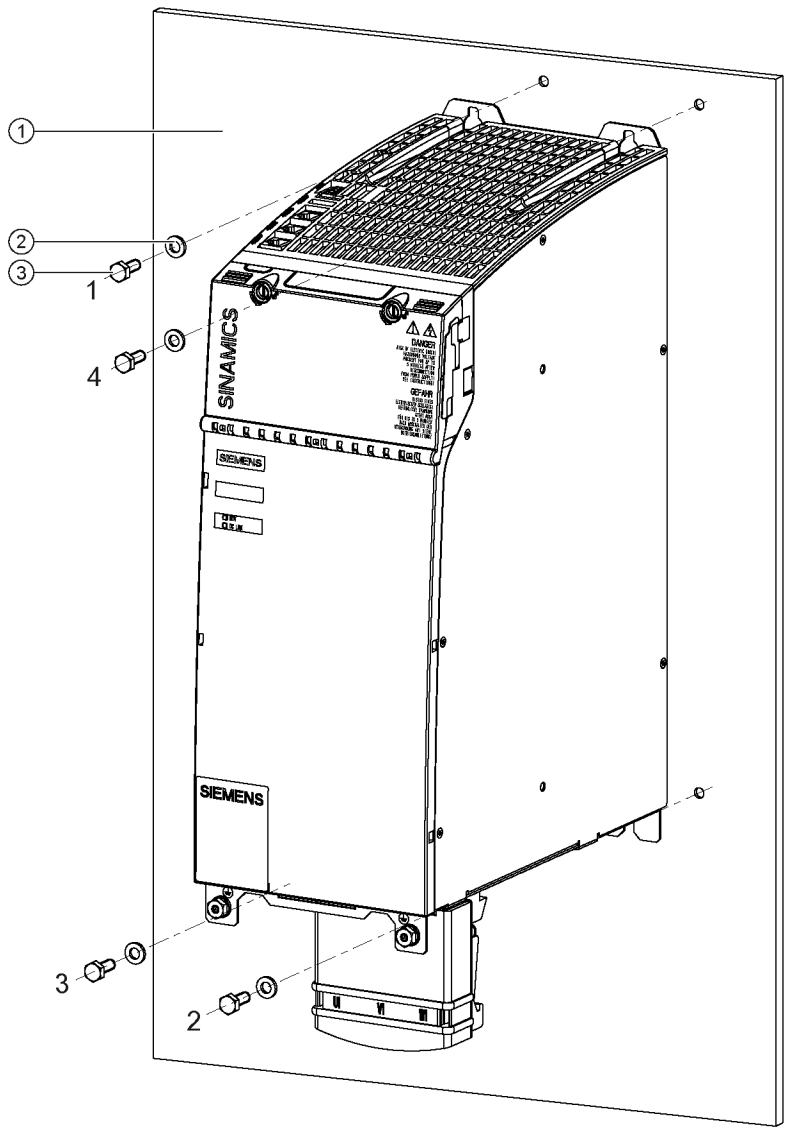


Figure 3-6 Dimension drawing of fan for 80 kW and 120 kW Active Line Modules with internal air cooling, all dimensions in mm and (inches)

3.1.7 Installation

Active Line Modules are designed for installation in the control cabinet. They are fixed to the control cabinet panel or a mounting panel using M6 screws.



① Control cabinet panel/mounting panel
② Washer
③ M6 screw

Figure 3-7 Mounting an Active Line Module with internal air cooling (example: 36 kW)

Tightening torques:

- Initially, tighten the nuts by hand (0.5 Nm)
- Then tighten with 6 Nm (in the specific sequence 1 to 4)

Installing the sub-chassis fan

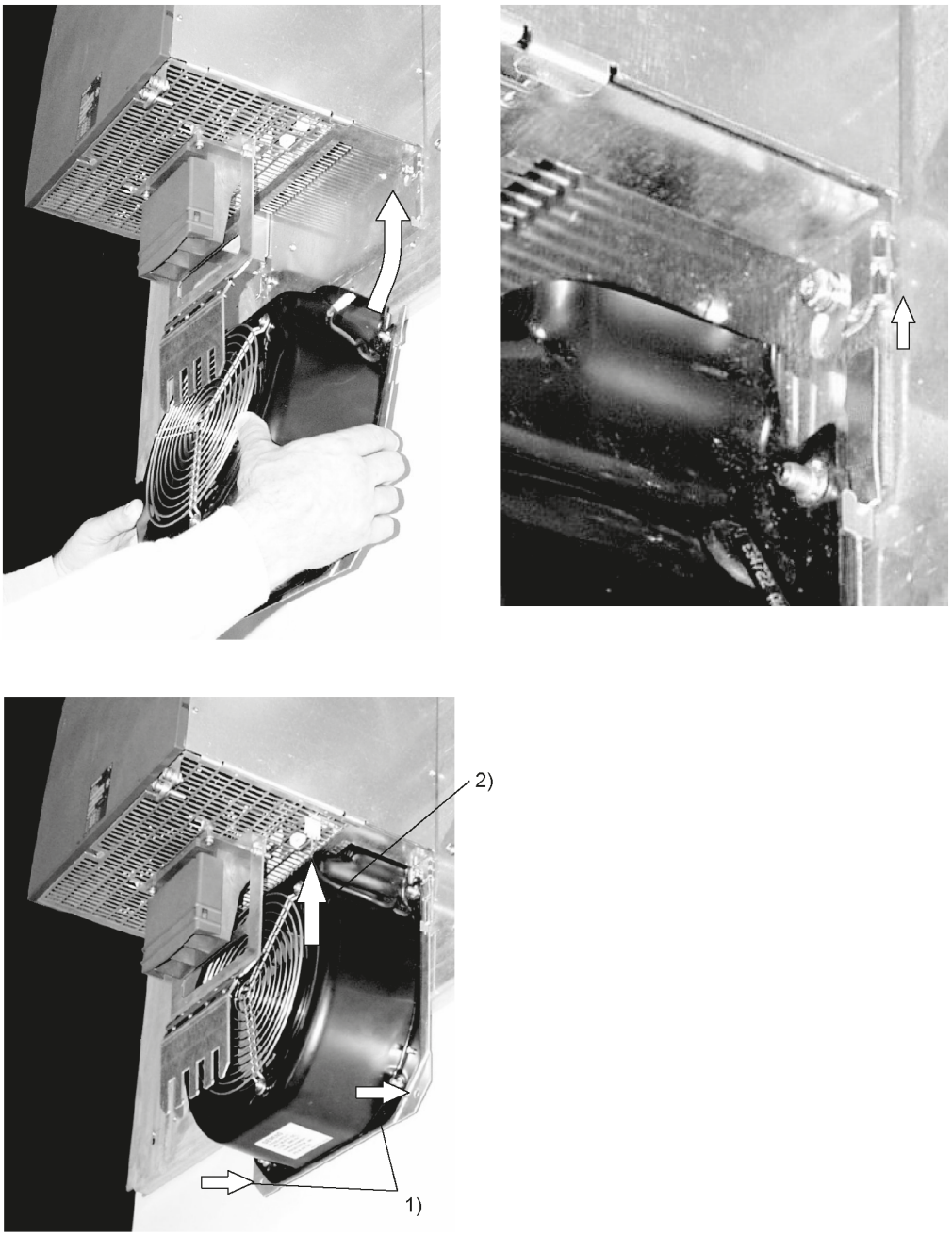


Figure 3-8 Mounting the fan for Active Line Modules 80 kW and 120 kW

1. Attach the fan with M6 / 6 Nm screws
2. Connect the power supply for the fan

3.1.8 Technical data

Table 3- 10 Technical data of Active Line Modules

Internal air cooling	**6SL3130–**	**7TE21–6AAx**	**7TE23–6AAx**	**7TE25–5AAx**	**7TE25–5AA3 + Active Interface Module**
Rated power	**kW**	**16**	**36**	**55**	**55**
Infeed					
Rated power (S1) [1]	kW (P_n)	16	36	55	55
Infeed power (S6-40%) [1]	kW (P_{s6})	21	47	71	71
Peak infeed power [1]	kW (P_{max})	35	70	91	110
Regenerative feedback					
Continuous regenerative power	kW	16	36	55	55
Peak regenerative power	kW	35	70	91	110
Supply voltages					
Line voltage	V_{ACrms}	3 AC 380 -10 % (-15% < 1 min) to 3 AC 480 +10 %			
Line frequency	Hz	47 to 63			
Electronics power supply	V_{DC}	24 (20.4 - 28.8)			
DC link voltage	V_{DC}	510 - 720			
Overvoltage trip	V_{DC}	820 ± 2 %			
Undervoltage trip [2]	V_{DC}	360 ± 2 %			
Input currents					
Rated input current at 400 V_{AC}:	A_{AC}	25	55	84	84
Input current					
at 380 V_{AC} / 480 V_{AC}	A_{AC}	26 / 21	58 /46	88 / 70	88 /70
at 400 V_{AC}; S6-40%	A_{AC}	32	71	108	108
at 400 V_{AC}; peak current	A_{AC}	54	107	139	168
DC link currents					
Rated DC link current at 600 V:	A_{DC}	27	60	92	92
DC link current:					
at 600 V_{DC}; at S6-40%	A_{DC}	35	79	121	121
at 600 V_{DC}; peak current	A_{DC}	59	117	152	176
Current carrying capacity					
DC link busbar	A_{DC}	100	200	200	200
Reinforced DC link busbars:	A_{DC}	150	--	--	--
24 V busbar:	A_{DC}	20	20	20	20
Electronics current consumption at 24 V DC	A_{DC}	0.95	1.5	1.9	1.9
Total power loss (including electronics losses) [3]	W	282.8	666	945.6	945.6
Max. ambient temperature					
Without derating	°C	40	40	40	40
With derating	°C	55	55	55	55
DC link capacitance					
Active Line Module	µF	705	1410	1880	1880
Drive line-up, max.	µF	20000	20000	20000	20000
Power factor	cosϕ	1	1	1	1

Internal air cooling	**6SL3130–**	**7TE21–6AAx**	**7TE23–6AAx**	**7TE25–5AAx**	**7TE25–5AA3 + Active Interface Module**
Rated power	**kW**	**16**	**36**	**55**	**55**
Circuit breaker (UL) Type designation Rated current: Resulting rated short-circuit current [5] SCCR at 480 V_{AC}:	 A kA	 3VL1135-2KM30 35 65	 3VL2108-2KN30 80 65	 3VL2112-2KN30 125 65	 3VL2112-2KN30 125 65
Safety fuse (UL) Type AJT Class J [4] Rated current Resulting rated short-circuit current [5] SCCR at 480 V_{AC}:	 A kA	 AJT35 35 65	 AJT80 80 65	 AJT125 125 65	 AJT125 125 65
Cooling method (internal air cooling)		Internal fan	Internal fan	Internal fan	Internal fan
Sound pressure level	dB(A)	<60	<65	<60	<60
Cooling air requirement	m^3/h	56	112	160	160
Rated voltage for rated data 3 AC 380 V					
Weight	kg	7	10	17	17

1) The powers specified apply to the rated voltage range from 380 V to 480 V.

2) Default for 400 V line supplies; undervoltage trip threshold is adjusted to the parameterized rated voltage.

3) For an overview, see the power loss tables in Chapter, Control cabinet installation

4) Source of supply: The Ferraz Shawmut company

5) The resulting rated short-circuit current is obtained from the combination of the fuse, or circuit breaker, and the Line Module in the drive system.

Table 3- 11 Technical data of Active Line Modules

Internal air cooling	**6SL3130–**	**7TE28–0AAx**	**7TE31–2AAx**
Rated power	**kW**	**80**	**120**
Infeed			
Rated power (S1)[1]	kW (P_n)	80	120
Infeed power (S6-40%) [1]	kW (P_{s6})	106	145
Peak infeed power[1]	kW (P_{max})	131	175
Regenerative feedback			
Continuous regenerative power	kW	80	120
Peak regenerative power	kW	131	175
Supply voltages			
Line voltage	V_{ACrms}	3 AC 380 -10% (-15% < 1 min) to 3 AC 480 +10%	
Line frequency	Hz	47 to 63	
Electronics power supply	V_{DC}	24 (20.4 - 28.8)	
DC link voltage	V_{DC}	510 - 720	
Overvoltage trip	V_{DC}	820 ± 2%	
Undervoltage trip [2]	V_{DC}	360 ± 2%	
Input currents			
Rated input current			
at 400 V_{AC}:	A_{AC}	122	182
Input current			
at 380 V_{AC} / 480 V_{AC}	A_{AC}	128 / 102	192 / 152
at 400 V_{AC}; S6-40%	A_{AC}	161	220
at 400 V_{AC}; peak current	A_{AC}	200	267
DC link currents			
Rated DC link current			
at 600 V:	A_{DC}	134	200
DC link current:			
at 600 V_{DC}; at S6-40%	A_{DC}	176	244
at 600 V_{DC}; peak current	A_{DC}	218	292
Current carrying capacity			
DC link busbar:	A_{DC}	200	200
24 V busbar:	A_{DC}	20	20
Electronics current consumption at 24 V DC	A_{DC}	1.4	1.8
Total power loss (including electronics losses) [3]	W	1383.6	2243.2
Max. ambient temperature			
Without derating	°C	40	40
With derating	°C	55	55
DC link capacitance			
Active Line Module	µF	2820	3995
Drive line-up, max.	µF	20000	20000
Power factor	cosϕ	1	1
Circuit breaker (UL)			
Type designation		3VL3117-2KN30	3VL3125-2KN30
Rated current:	A	175	250
Resulting rated short-circuit current [5]			
SCCR at 480 V_{AC}:	kA	65	65

Internal air cooling	**6SL3130–**	**7TE28–0AAx**	**7TE31–2AAx**
Rated power	**kW**	**80**	**120**
Safety fuse (UL) Type AJT Class J [4] Rated current Resulting rated short-circuit current [5] SCCR at 480 V_{AC}:	 A kA	 AJT175 175 65	 AJT250 250 65
Cooling method (internal air cooling)		Mounted fan	Mounted fan
Sound pressure level	dB(A)	<73	<73
Cooling air requirement	m^3/h	520	520
Rated voltage for rated data 3 AC 380 V			
Weight	kg	23	23

1) The powers specified apply to the rated voltage range from 380 V to 480 V.

2) Default for 400 V line supplies; undervoltage trip threshold is adjusted to the parameterized rated voltage.

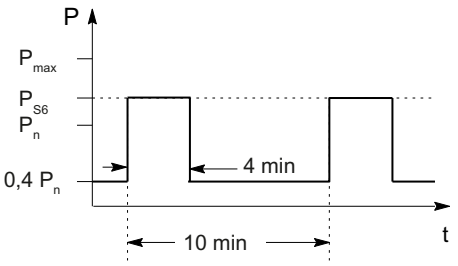
3) For an overview, see the power loss tables in Chapter, Control cabinet installation

4) Source of supply: The Ferraz Shawmut company

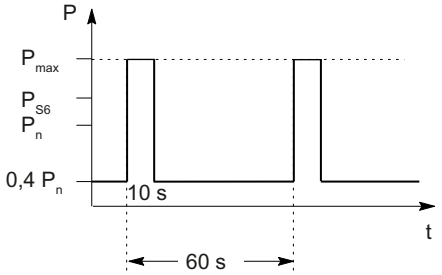
5) The resulting rated short-circuit current is obtained from the combination of the fuse, or circuit breaker, and the Line Module in the drive system.

3.1.8.1 Characteristics

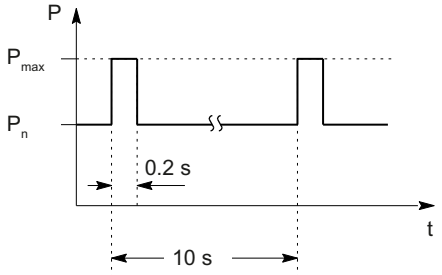
Rated duty cycles for Active Line Modules



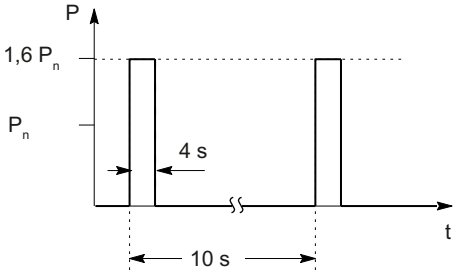
S6 duty cycle with pre-load condition



S6 peak power duty cycle with pre-load condition



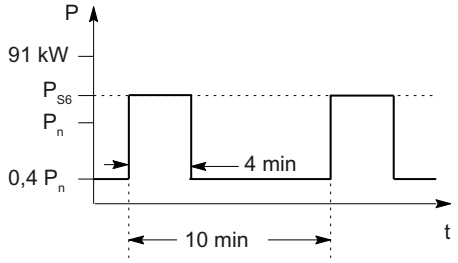
Peak power load duty cycle with pre-load condition



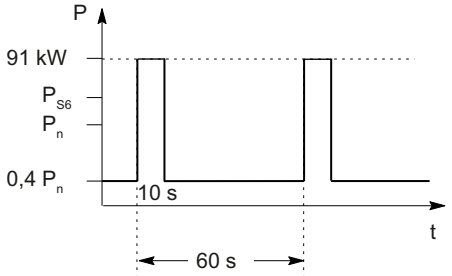
Peak power load duty cycle without pre-load condition

Figure 3-9 Rated duty cycles for Active Line Modules (**exception**: not applicable for 55 kW Active Line Module with Active Interface Module)

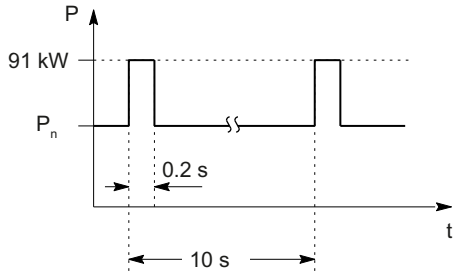
Rated duty cycles for Active Line Modules with Active Interface Modules



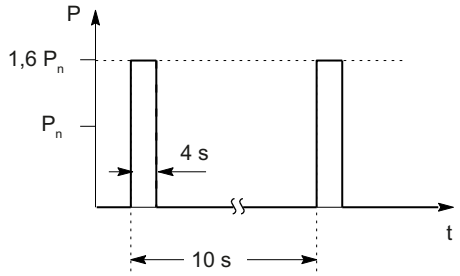
S6 duty cycle with pre-load condition



S6 peak power duty cycle with pre-load condition



Peak power load duty cycle with pre-load condition



Peak power load duty cycle without pre-load condition

Figure 3-10 Load cycles for 55 kW Active Line Modules with Active Interface Module

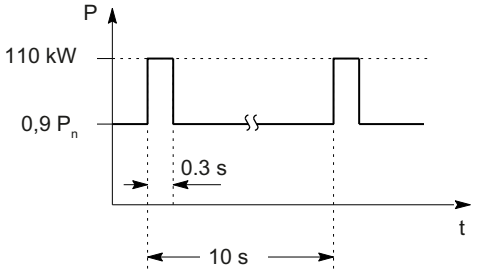


Figure 3-11 Peak load cycle with initial load for 55 kW Active Line Modules with Active Interface Module

Derating characteristics

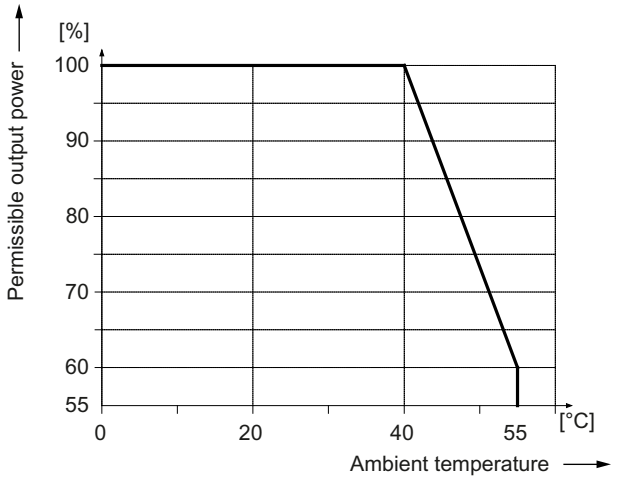


Figure 3-12 Output power as a function of the ambient temperature

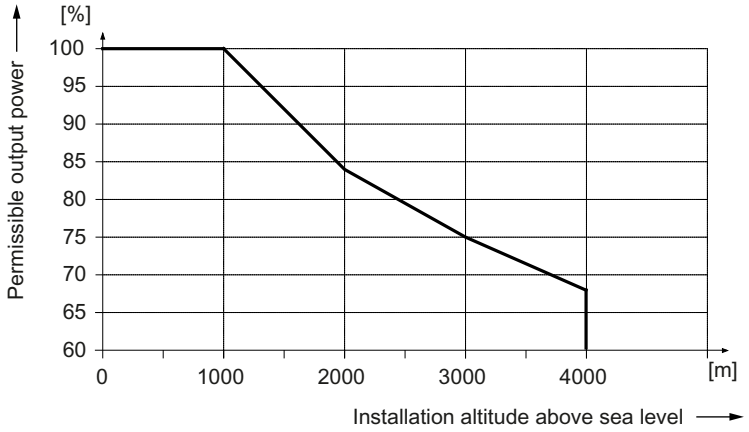


Figure 3-13 Output power as a function of the installation altitude

At installation altitudes >2000 m, an insolating transformer must be used (see "System overview/Derating as a function of the installation altitude and ambient temperature"). The design of the secondary line supply system must be as follows:

- TN system with grounded star point (no grounded outer conductor)
- IT system

A reduction of the line supply voltage phase-phase is not necessary.

3.2 Active Line Modules with external air cooling

3.2.1 Description

The Motor Modules are connected to the power supply network via the Active Line Modules with external air cooling, which provide the Motor Modules with a constant DC link voltage.

This ensures that they are not influenced by network fluctuations.

When the motors are in feedback mode, Active Line Modules supply power back to the system. The regenerative feedback capability of the modules can be deactivated by parameterization.

The DC link starts precharging as soon as the supply voltage is applied and is independent of its phase sequence direction. Load can be applied to the DC link after the modules have been enabled. An optional main contactor is required for disconnecting the voltage.

The Active Line Modules are suitable for direct operation on TN, IT, and TT systems. The Line Modules have an integrated overvoltage protection function.

External air cooling uses the "through-hole" method. This is a cooling method for SINAMICS power units that is only available for booksize devices. The power unit and its heat sink can be inserted in a rectangular knockout at the rear of the control cabinet and mounted with a seal. The heat sink and the fan (included in the scope of supply) project beyond the rear of the control cabinet and the heat is dissipated outside the control cabinet or in a separate air duct.

3.2.2 Safety information

⚠DANGER

Risk of electric shock

A hazardous voltage is present for up to 5 minutes after the power supply has been disconnected.
The protective cover may only be opened after this time has expired.

When opening the protective cover for the DC link, you must press the release catch. A suitable tool (e.g. screwdriver or supplied unlocking tool) must be used for this purpose.

The components must only be operated when the protective cover of the DC link is closed. Damaged components must not be operated further, otherwise this could result in secondary damage or accidents.

⚠ DANGER

DC-link discharge time

A hazard warning for the DC link discharge time must be attached in the local language to all of the components.
A set of labels in 16 languages is supplied with the component.

⚠ DANGER

In the interests of operator and fire protection, the power supply conditions in terms of short-circuit power and loop impedance at the infeed point must be such that they will trip the installed overcurrent protection devices within the prescribed period if a fault occurs (short circuit or short circuit to exposed conductive part).

Note

Line short-circuit power at the infeed point

The line short-circuit power at the infeed point must be at least 70 times greater than the rated power of the Line Module in order to limit the line harmonics to an acceptable level for other loads.

⚠ DANGER

The drive components generate high leakage currents in the protective conductor. The components must only be operated in cabinets or in closed electrical operating areas and must be connected with the protective conductor. To protect against electric shock, the protective conductor connection at the control cabinet or machine must be implemented in accordance with one of the following measures:

- Fixed connection and protective conductor connection by means of ≥ 10 mm^2 Cu or ≥ 16 mm^2 Al
- Fixed connection and automatic disconnection of the supply system if the protective conductor is interrupted

⚠ DANGER

It is only permissible to establish connections to the DC link using the adapters that SIEMENS has recommended (DC link adapter and DC link rectifier adapter).

⚠ DANGER

If the Line Module is not disconnected from the network (e.g. via the line contactor or main switch), the DC link remains charged.

⚠ CAUTION

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

CAUTION

The correct tightening torque of the DC link busbar screws (1.8°Nm, tolerance +30%) must be checked before commissioning with the complete system in a voltage-free state (powered-down) and with the DC link discharged. After transportation, the screws must be tightened.

For lines without regenerative feedback capability (e.g. a diesel generator), the regenerative feedback capability of the Active Line Module must be deactivated by means of parameters (see Description of functions). The braking energy must then be dissipated via an additional Braking Module with braking resistor provided in the drive line-up.

CAUTION

The overall length of the power cables (motor supply cables and DC link cables) must not exceed the values given in the chapter titled "Possible line reactor and line filter combinations".

CAUTION

Only cables from Siemens may be used for DRIVE-CLiQ connections.

CAUTION

DC link side covers are supplied with the components as standard and must be attached to the first and last components in the drive line-up. They can also be ordered separately, if required (order number: 6SL3162-5AA00-0AA0).

NOTICE

The external air cooling can cause the fans and the heat sink to become heavily contaminated, which may trigger the temperature monitor in the power unit. The fans and heat sink must be checked for contamination at regular intervals and, if necessary, cleaned.

Note

After installation, the seal on the rear of the device must be checked to ensure that it is tight. Additional sealing can be used, if necessary.

3.2.3 Interface description

3.2.3.1 Overview

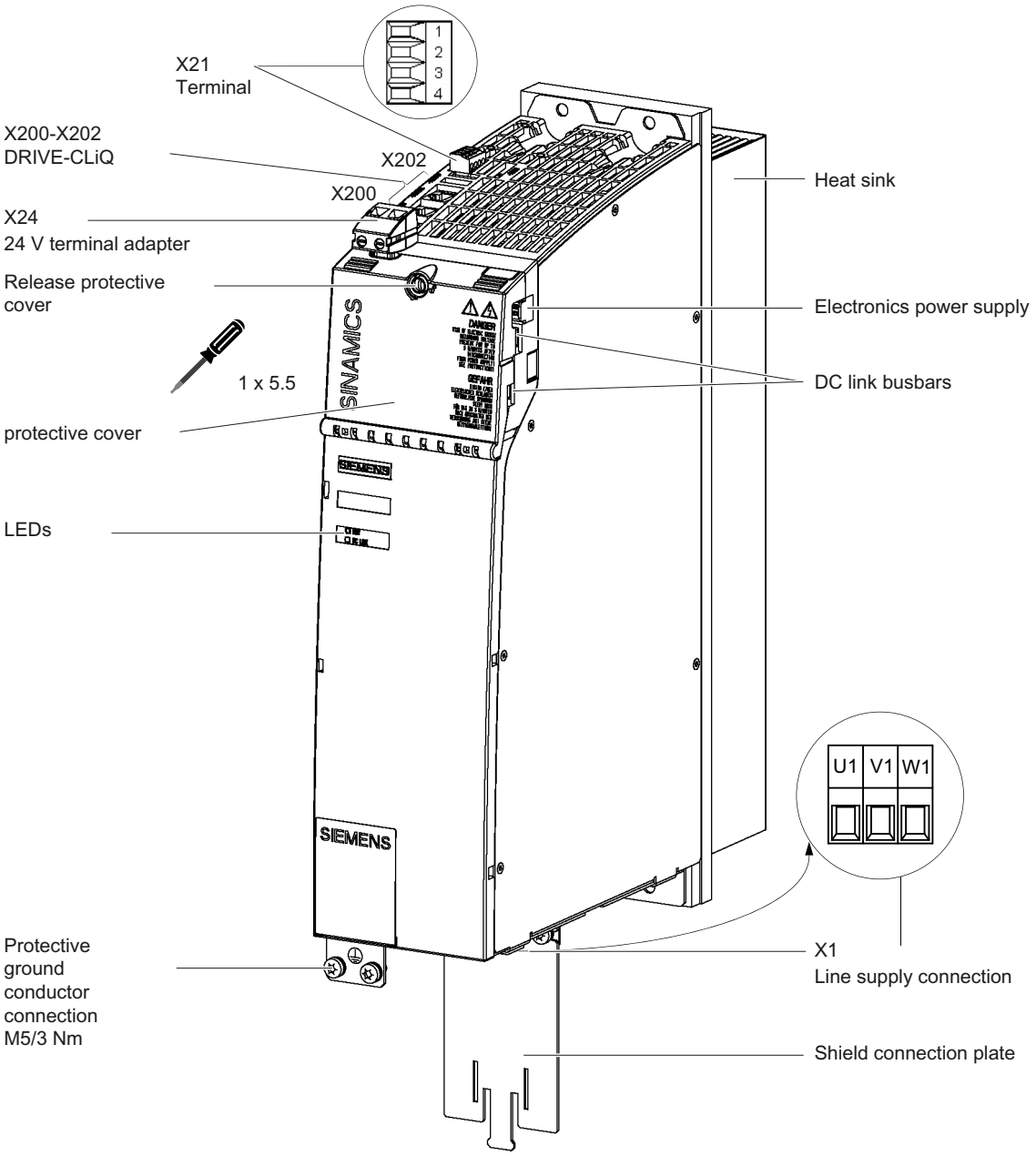
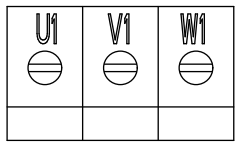
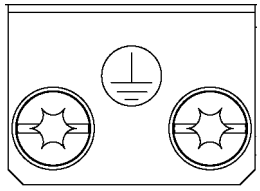


Figure 3-14 Interface overview, Active Line Module with external air cooling (example: 16 kW)

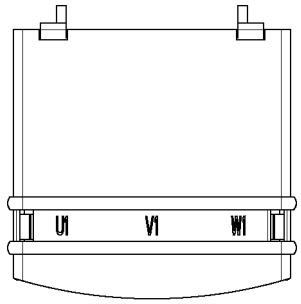
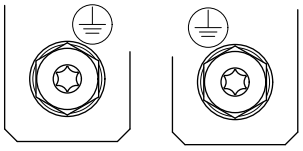
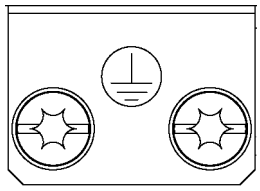
3.2.3.2 X1 line connection

Table 3- 12 X1: Line connection for Active Line Modules 16 kW

	Terminal	Technical specifications
	U1 V1 W1	Max. connectable cross-section: 10 mm² Type: Screw terminal 6 Tightening torque: 1.5 - 1.8 Nm (see Chapter, "Control cabinet installation/connection system")
	PE connection	Threaded hole M5/3 Nm 1)

1) For ring cable lugs in accordance with DIN 46234

Table 3- 13 X1: Line supply connection for Active Line Modules 36 kW to 120 kW

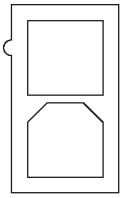
	Terminal	Technical specifications
	U1 V1 W1	Supply voltage: 380 V - 480 V 3 AC, 50/60 Hz **36 kW:** Threaded bolts M6 / 6 Nm 1) **55 kW, 80 kW and 120 kW:** Threaded bolts M8 / 13 Nm 1)
	PE connection	**36 kW:** Threaded hole M6 / 6 Nm 1)
		**55 kW:** Threaded hole M6 / 6 Nm 1) **80 kW and 120 kW:** Threaded hole M8 / 13 Nm 1)

1) For ring cable lugs in accordance with DIN 46234

3.2.3.3 X12 fan connection

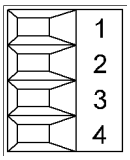
Active Line Modules 80 kW and 120 kW are equipped with an interface for connecting the sub-chassis fan. The interface is located on the underside of the Line Module.

Table 3- 14 X12 fan connection

	Terminal	Function	Technical specifications
	1	Fan connection +	Voltage 48 V DC for the supplied fan
	2	Fan connection -	

3.2.3.4 X21 EP terminals

Table 3- 15 X21 EP terminal/temperature sensor

	Terminal	Designation	Technical specifications
	1	+ Temp	Temperature sensors[1]: KTY 84–1C130[2]/PTC[2]/bimetallic switch with NC contact If an Active Interface Module is used, the temperature input must be connected to the Active Interface Module sensor (bimetallic switch with NC contact).
	2	- Temp	
	3	EP +24 V (Enable Pulses)	Voltage 24 VDC Current consumption: 10 mA Isolated input Signal propagation times: L → H: 100 µs H → L: 1000 µs
	4	EP M (Enable Pulses)	
Max. connectable cross-section: 1.5 mm^2 Type: Screw terminal 1 (see Chapter, "Control cabinet installation and EMC/connection system")			

1) The temperature sensor type can be selected via parameter p0601; the temperature is displayed via r0035 (see SINAMICS S120/S150 List Manual LH1).

2) Temperatures are detected but not evaluated in the Active Line Module.

⚠ CAUTION

If an Active Interface Module is connected, the temperature output of the Active Interface Module must be connected to terminals 1 and 2.

⚠ WARNING

For operation, the 24 V DC voltage must be connected to terminal 3 and ground to terminal 4. When withdrawn, pulse suppression is activated. Regenerative feedback is deactivated and the bypass relay drops out. If the Line Module is not disconnected from the supply system when the EP terminal is deactivated (e.g. a line contactor is not installed), the DC link remains charged.

NOTICE

If an active drive line-up is switched off by means of the disconnector unit, the voltage at terminals 3 (EP +24 V) and 4 (EP M) must be interrupted beforehand. This can be carried out using a leading breaking auxiliary contact (≥ 10 ms), for example.

This protects external loads located parallel to the drive on the same switching component.

⚠ DANGER

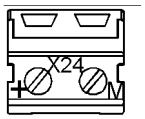
Risk of electric shock!

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) or Terminal Module TM120 must be used.

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

3.2.3.5 X24 24 V terminal adapter

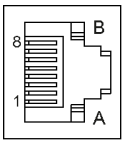
Table 3- 16 X24 24 V terminal adapter

	Terminal	Designation	Technical specifications
	+	24 V power supply	24 V DC supply voltage
	M	Ground	Electronics ground
Max. connectable cross-section: 6 mm^2 Type: Screw terminal 5 (see Chapter, "Control cabinet installation and EMC/connection system")			

The 24 V terminal adapter is included in the scope of supply.

3.2.3.6 X200-X202 DRIVE-CLiQ interfaces

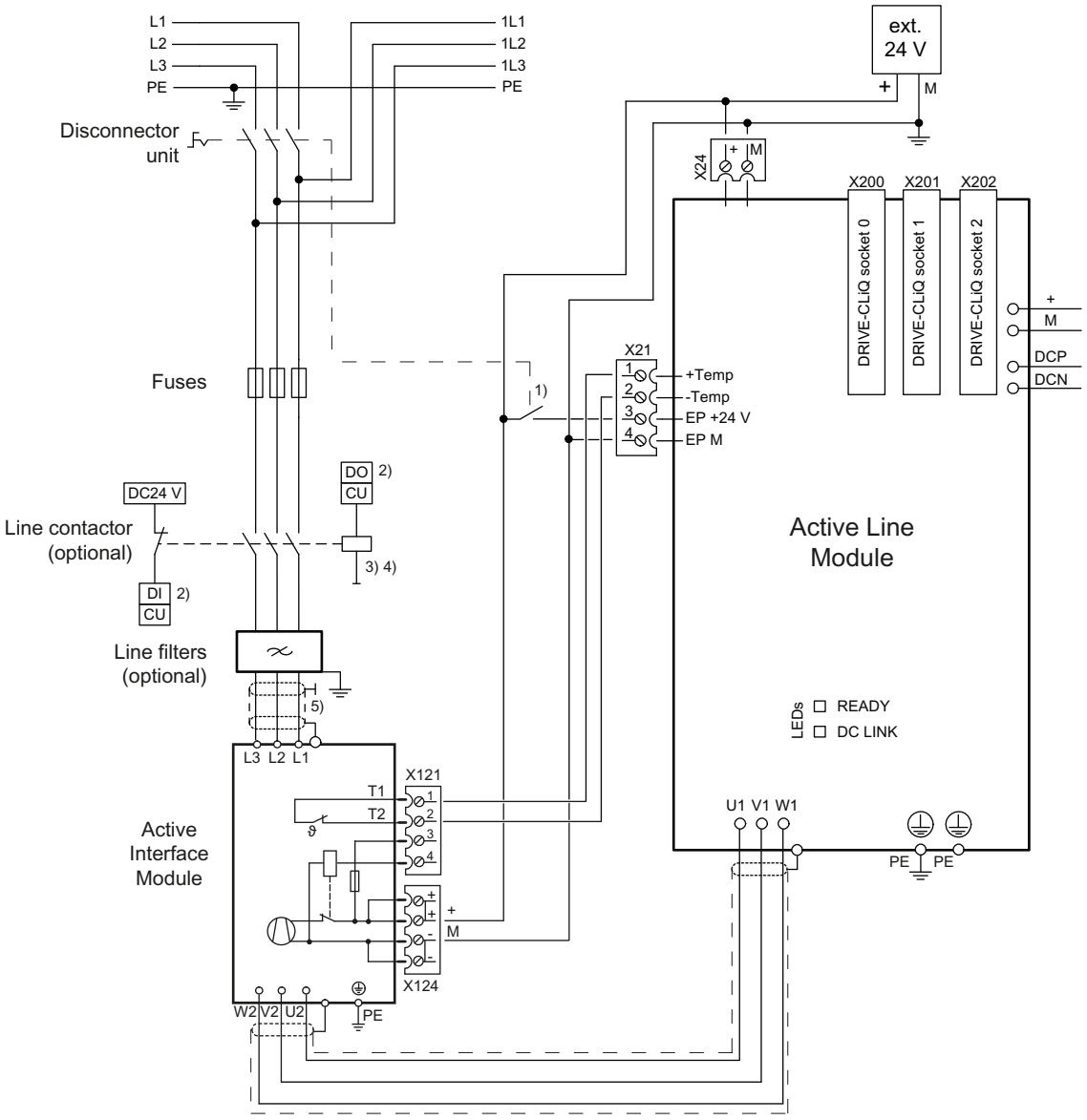
Table 3- 17 X200-X202 DRIVE-CLiQ interfaces

	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

The blanking covers for the DRIVE-CLiQ interfaces are included in the scope of delivery.

Blanking cover (50 pcs.) Order number: 6SL3066-4CA00-0AA0

3.2.4 Connection example



1) Leading NC contact t > 10 ms
2) DI/DO, controlled by the Control Unit.
3) No additional load permitted downstream of line contactor!
4) The current carrying capacity of the DO must be observed; an output coupling device must be used if required.
5) Contacting via rear mounting panel or shielding buses in accordance with EMC Directive.

Figure 3-15 Example connection of Active Line Module

Note

If you are using a VSM10 Voltage Sensing Module, the leading opening contact can be omitted.

3.2.5 Meaning of LEDs

Table 3- 18 Meaning of the LEDs on the Active Line Module

Status		Description, cause	Remedy
RDY	DC LINK		
off	off	Electronics power supply is missing or outside permissible tolerance range.	–
Green	--	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.	Check line voltage
Orange	Orange	DRIVE-CLiQ communication is being established.	–
Red	--	At least one fault is present in this component. **Note:** The LED is activated regardless of whether the corresponding messages have been reconfigured.	Remedy and acknowledge fault
Green/ red (0.5 Hz)	--	Firmware is being downloaded.	–
Green/red (2 Hz)	--	Firmware download is complete. Wait for POWER ON.	Carry out a POWER ON
Green/orange or Red/orange	--	Detection of the components via LED is activated (p0124). **Note:** Both options depend on the LED status when module recognition is activated via p0124 = 1.	–

⚠ DANGER

Hazardous DC link voltages may be present at any time regardless of the status of the "DC LINK" LED.
The warning information on the components must be carefully observed!

3.2.6 Dimension drawings

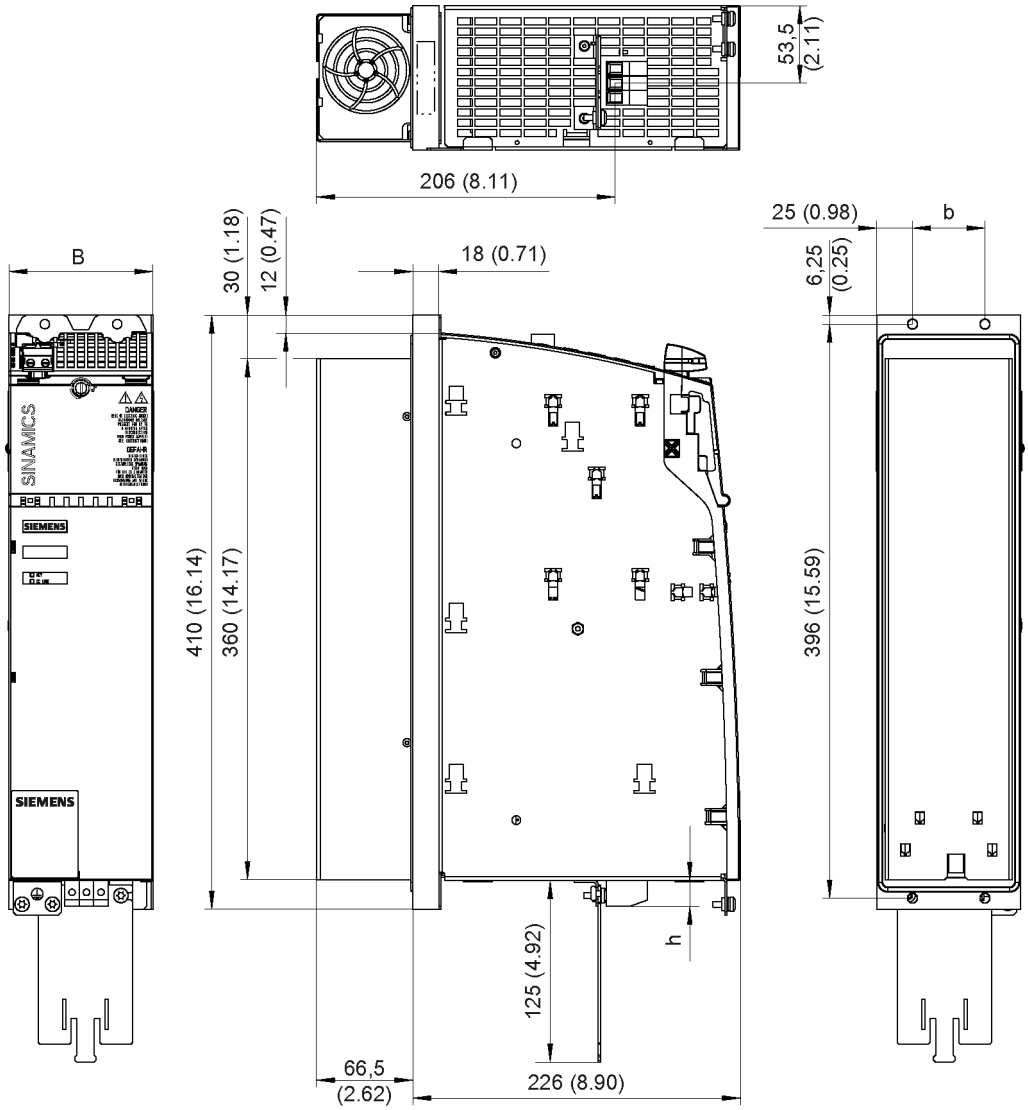


Figure 3-16 Dimension drawing of 16 kW Active Line Module with external air cooling, all dimensions in mm and (inches)

Table 3- 19 Dimensions of 16 kW Active Line Module with external air cooling

Active Line Module	Order number	B [mm] (inches)	b [mm] (inches)	h [mm] (inches)
16 kW	6SL3131-7TE21-6AAx	100 (3.94)	50 (1.97)	18 (0.71)

Note

The shield connecting plate is supplied as standard with a 100 mm Line Module.
For more information, see the chapter titled "Accessories".

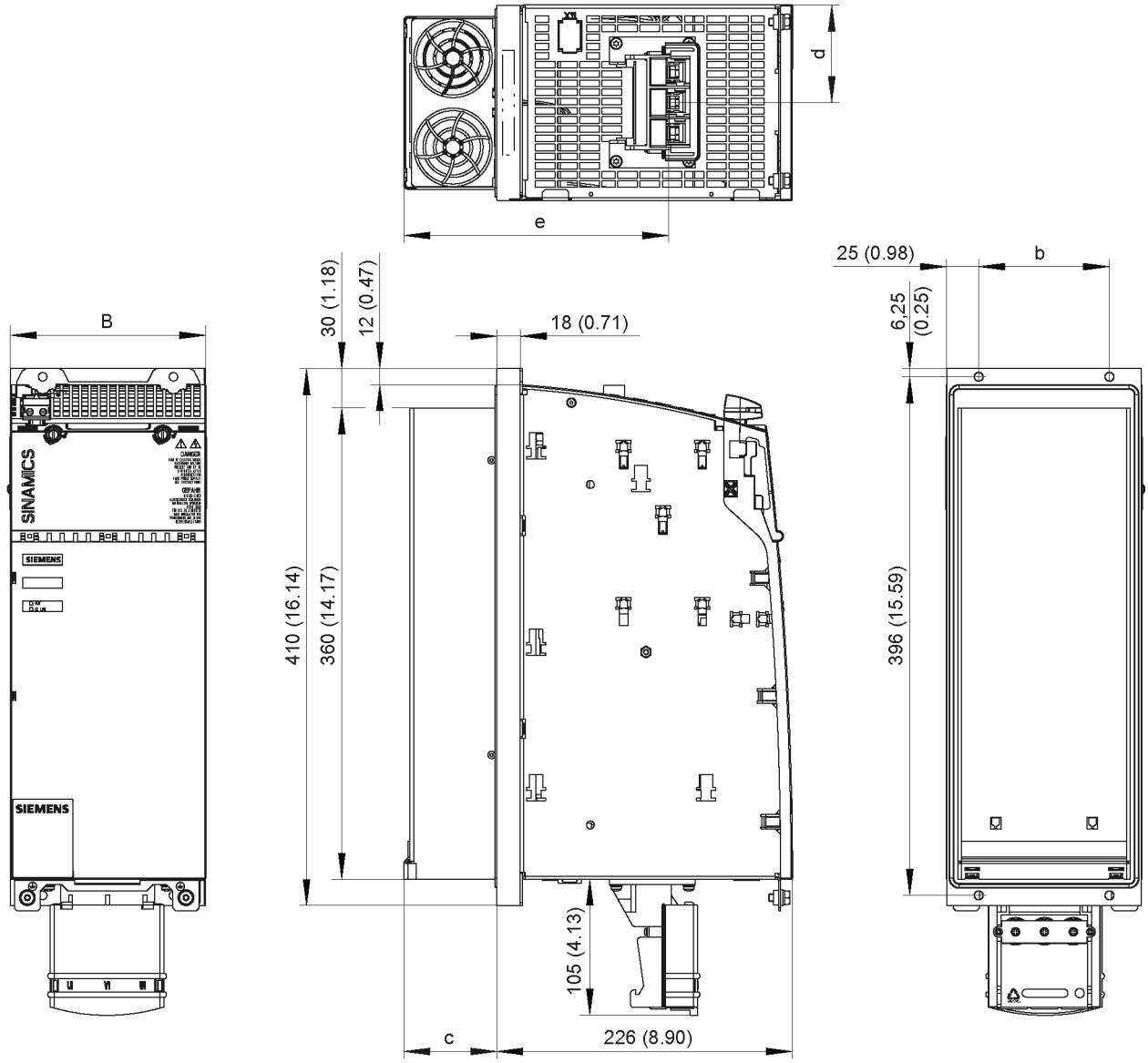


Figure 3-17 Dimension drawing of 36 kW, 55 kW, 80 kW, and 120 kW Active Line Modules with external air cooling (example 36 kW), all dimensions in mm and (inches)

Table 3- 20 Dimensions of 36 kW, 55 kW, 80 kW, and 120 kW Active Line Modules with external air cooling

Active Line Module	Order number	B [mm] (inches)	b [mm] (inches)	c [mm] (inches)	d [mm] (inches)	e [mm] (inches)
36 kW	6SL3131-7TE23-6AAx	150 (5.91)	100 (3.94)	71 (2.80)	75 (2.95)	203 (7.99)
55 kW	6SL3131-7TE25-5AAx	200 (7.87)	150 (5.91)	92 (3.62)	100 (3.94)	224 (8.82)
80 kW	6SL3131-7TE28-0AAx	300 (11.81)	250 (9.84)	82 (3.23)	150 (5.91)	214 (8.43)
120 kW	6SL3131-7TE31-2AAx	300 (11.81)	250 (9.84)	82 (3.23)	150 (5.91)	214 (8.43)

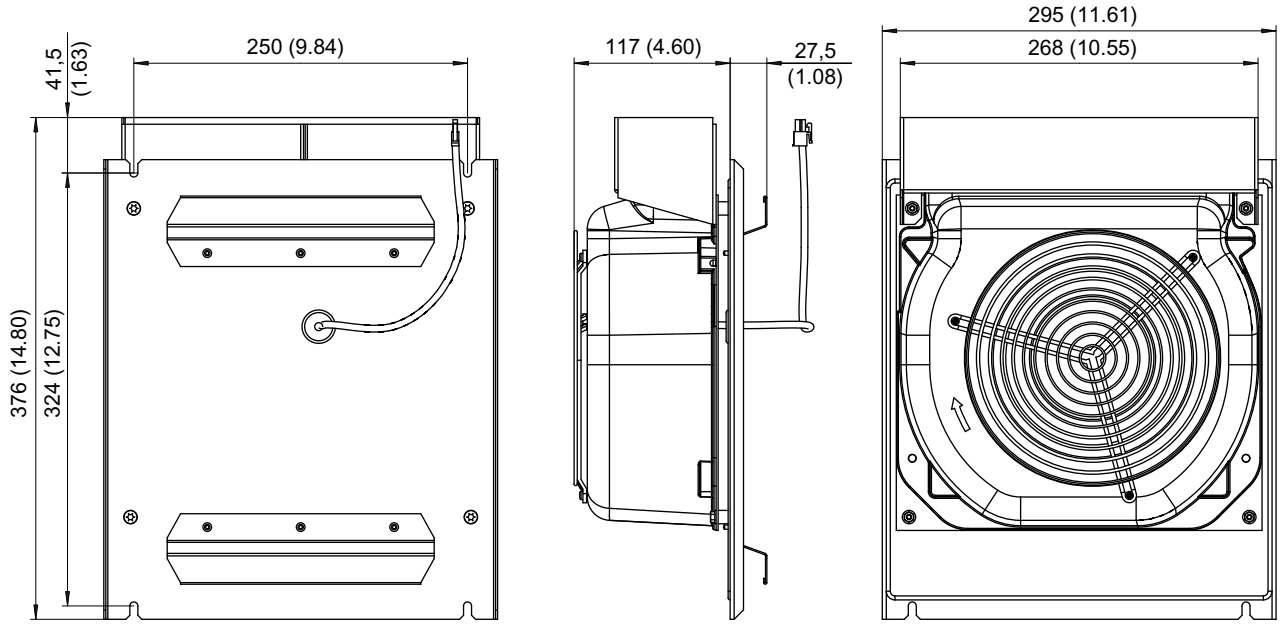
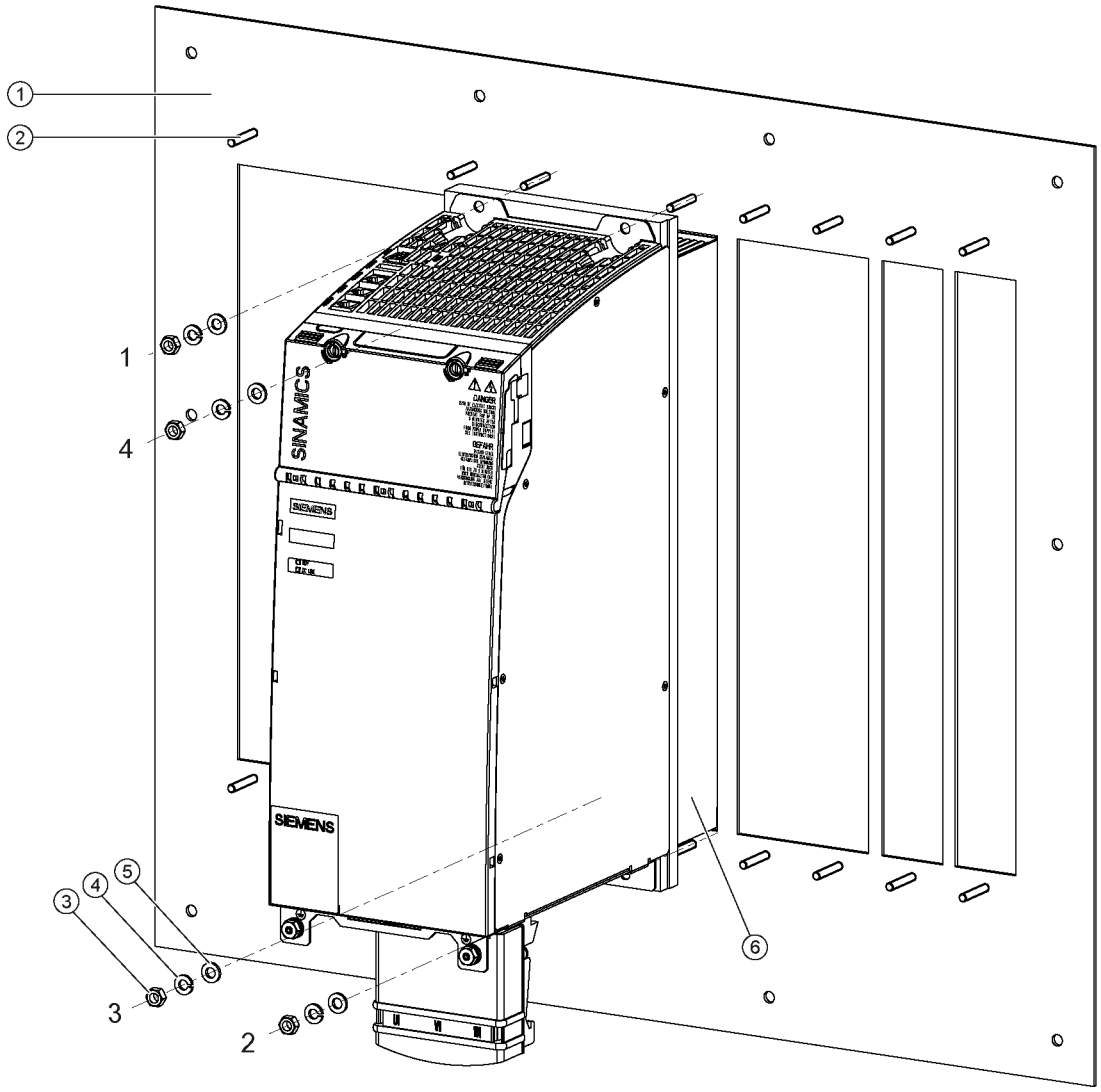


Figure 3-18 Dimension drawing of fan for 80 kW and 120 kW Active Line Modules with external air cooling, all dimensions in mm and (inches)

3.2.7 Installation



① Mounting plate with installation openings
② M6 studs
③ M6 nut
④ Spring washer
⑤ Washer
⑥ Fan assembly

Figure 3-19 Mounting an Active Line Module with external air cooling (example: 36 kW)

Tightening torques:

- Initially, tighten the nuts by hand (0.5 Nm)
- Then tighten with 6 Nm (in the specific sequence 1 to 4)

Help with the mechanical control cabinet installation is available from:

Siemens AG
Industry Sector, IA SE WKC
TCCCC (Technical Competence Center Cabinets Chemnitz)
P.O. Box 1124
09070 Chemnitz, Germany

E-mail: cc.cabinetcooling.aud@siemens.com

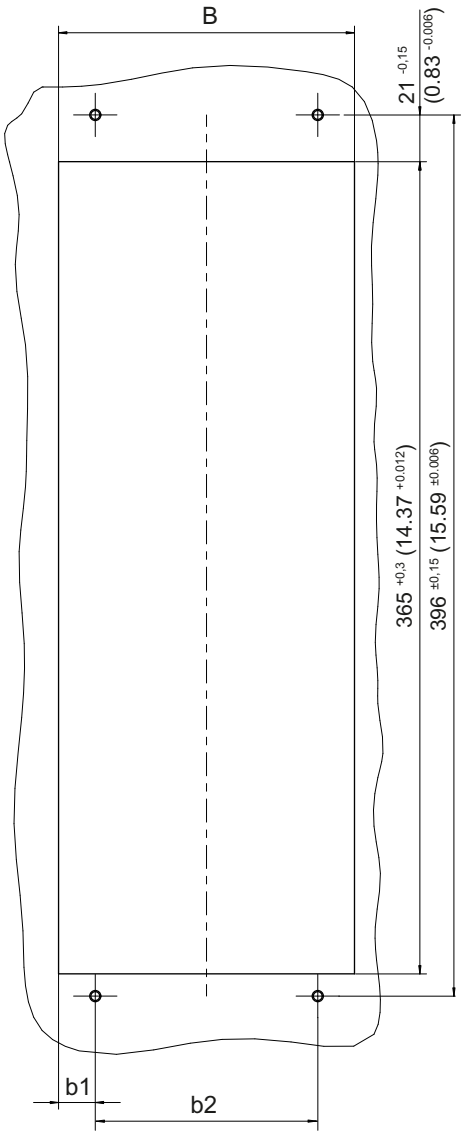
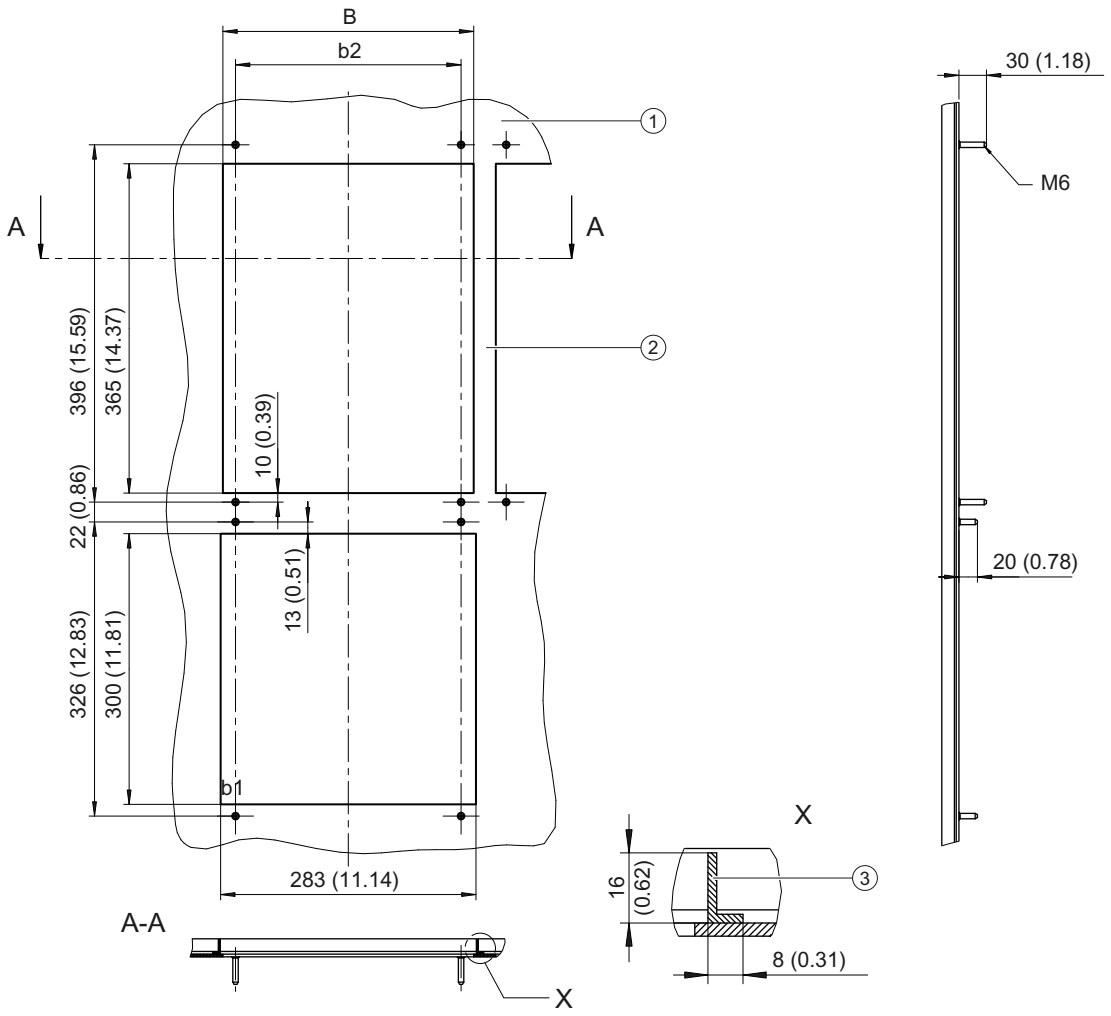


Figure 3-20 Installation openings for Active Line Modules 50 mm to 200 mm with external air cooling, all data in mm and (inches)

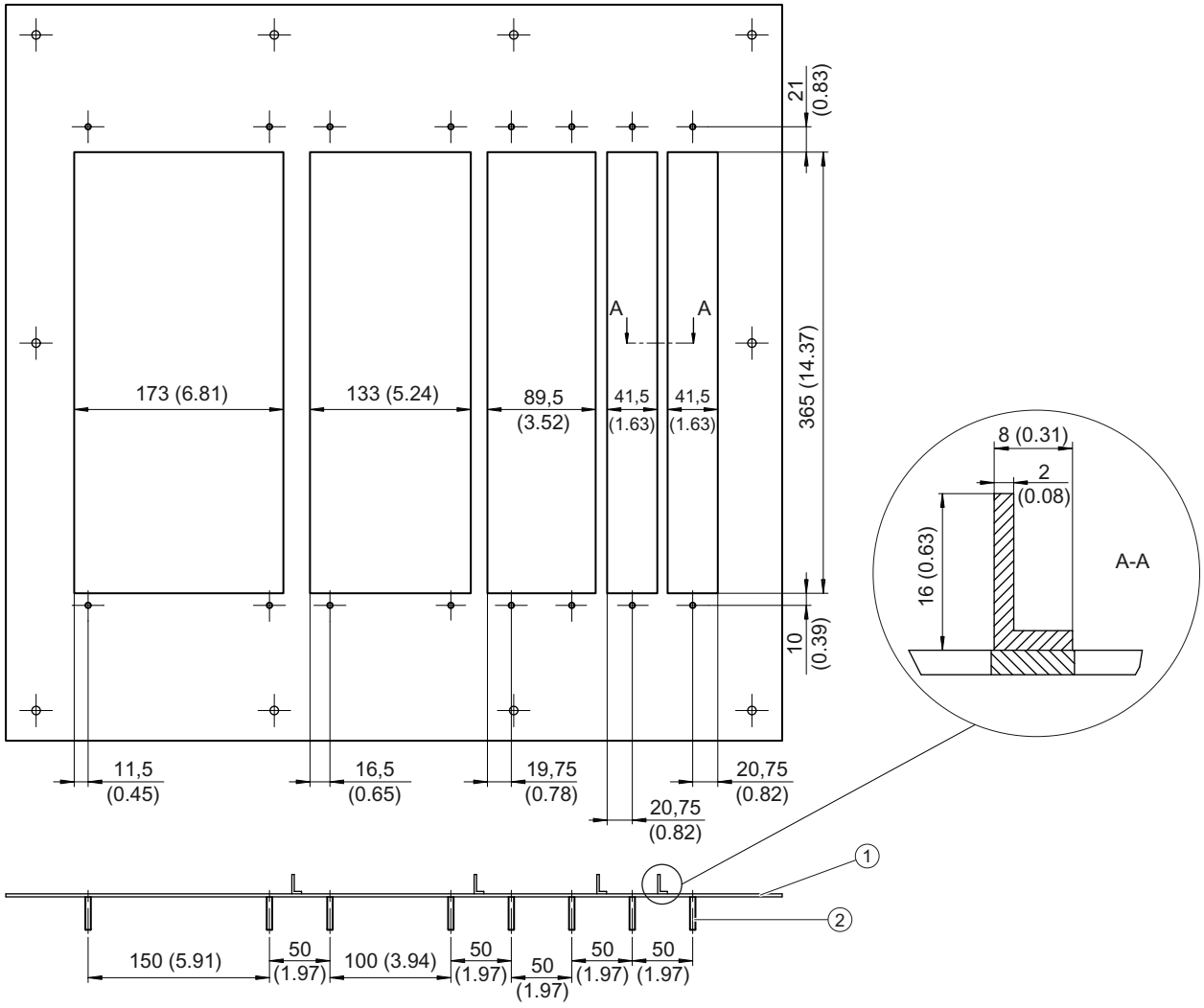


① Insert or mounting plate
② Cross-piece
③ Reinforcing bracket

Figure 3-21 Installation openings for an Active Line Modules 300 mm with external air cooling, all data in mm and (inches)

Table 3- 21 Dimensions of installation openings for Active Line Modules with external air cooling

Component width	B [mm] (inches)	w1 [mm] (inches)	w2 [mm] (inches)
50 mm	41.5 $^{+0.3}$ (1.63 $^{+0.012}$)	20.75 $^{+0.15}$ (0.82 $^{+0.006}$)	0
100 mm	89.5 $^{+0.3}$ (3.52 $^{+0.012}$)	19.75 $^{+0.15}$ (0.78 $^{+0.006}$)	50 $^{\pm 0.15}$ (1.97 $^{\pm 0.006}$)
150 mm	133 $^{+0.3}$ (5.24 $^{+0.012}$)	16.5 $^{+0.15}$ (0.65 $^{+0.006}$)	100 $^{\pm 0.15}$ (3.94 $^{\pm 0.006}$)
200 mm	173 $^{+0.3}$ (6.81 $^{+0.012}$)	11.5 $^{+0.15}$ (0.45 $^{+0.006}$)	150 $^{\pm 0.15}$ (5.91 $^{\pm 0.006}$)
300 mm	278 $^{+0.3}$ (10.94 $^{+0.012}$)	14.0 $^{\pm 0.15}$ (0.55 $^{\pm 0.006}$)	250 $^{+0.15}$ (9.84 $^{+0.006}$)

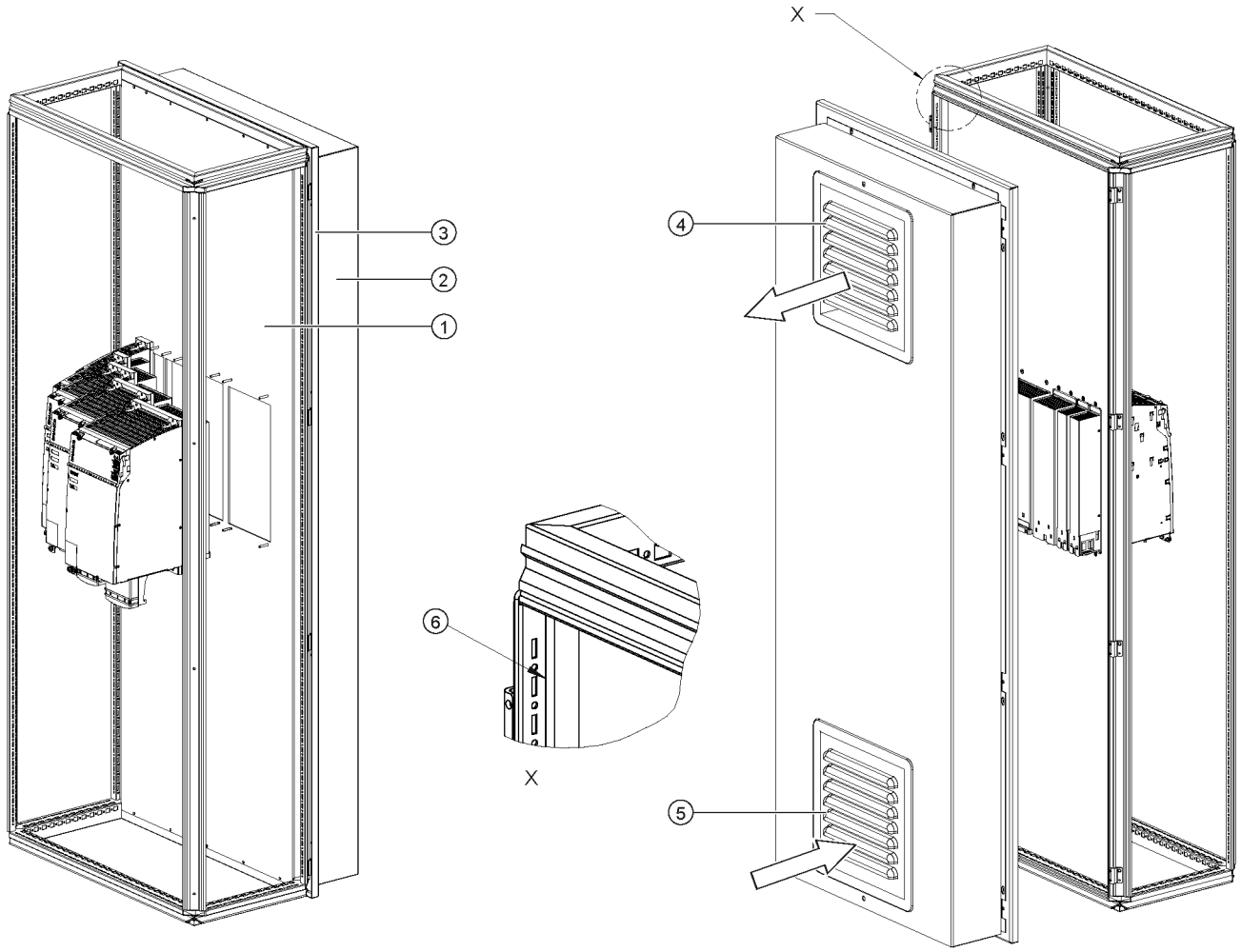


① Insert or mounting plate
② Threaded bolts M5 x 28

Figure 3-22 Example of a mounting plate for a drive line-up with external air cooling

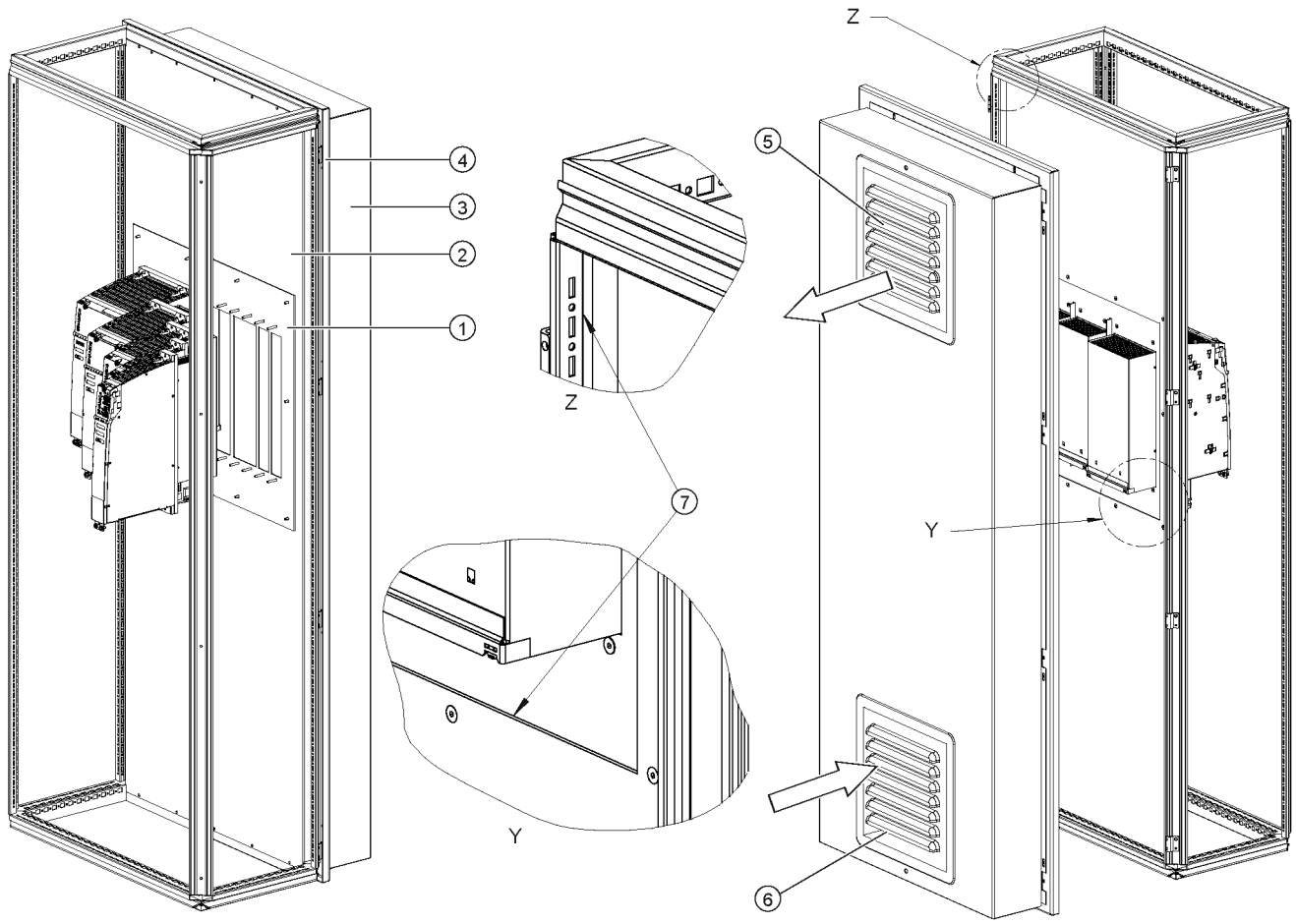
During installation it must be ensured that the component's seal is tight throughout. The cross-pieces must have the appropriate stability. If necessary, the cross-pieces of the openings must be reinforced.

In our example, the cross-pieces have been reinforced using brackets to EN 755-9. You are free to select the way that the bracket is attached to the insert.



① Mounting plate
② Cover
③ Rear panel
④ Air discharge
⑤ Air inlet - filter with filter fan
⑥ To comply with degree of protection IP54, the surfaces ⑥ between the mounting plate and the cabinet strip must be sealed all round. (for example, sealant Terostat-91 from the Teroson company)

Figure 3-23 Example 1: installation in cabinet with mounting plate



① Insert
② Mounting plate
③ Cover
④ Rear panel
⑤ Air discharge
⑥ Air inlet - filter with filter fan
⑦ To maintain the degree of protection IP54, the surfaces ⑦ between the mounting plate and the cabinet strip as well as between the mounting plate and insert must be sealed all around. (for example, sealant Terostat-91 from the Teroson company)

Figure 3-24 Example 2: installation in cabinet with mounting plate

We recommend that you attach a cover and filter fan to the cabinet.

The filtered fan must be fitted in such a way that the cooling air required by the drive line-up is not restricted. The overall cooling air requirement is obtained from the sum of the individual components (refer to Chapter, "Technical data").

Note

If the cooling air requirement is not covered by the filtered fan, the components cannot output their specified power.

The filters with a filtered fan must be regularly checked for dirt and cleaned if necessary.

3.2.8 Technical data

Table 3- 22 Technical data for Active Line Modules with external air cooling, part 1

External air cooling	6SL3131–	7TE21–6AAx	7TE23–6AAx	7TE25–5AAx	7TE25–5AA3 + Active Interface Module
Rated power	**kW**	**16**	**36**	**55**	**55**
Infeed					
Rated power (S1) [1]	kW (P_n)	16	36	55	55
Infeed power (S6-40%) [1]	kW (P_{s6})	21	47	71	71
Peak infeed power [1]	kW (P_{max})	35	70	91	110
Regenerative feedback					
Continuous regenerative power	kW	16	36	55	55
Peak regenerative power	kW	35	70	91	110
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)			
DC link voltage	V_{DC}	510 - 720			
Overvoltage trip	V_{DC}	820 ± 2 %			
Undervoltage trip [2]	V_{DC}	360 ± 2 %			
Input currents					
Rated input current at 400 V_{AC}:	A_{AC}	25	55	84	84
Input current					
at 380 V_{AC} / 480 V_{AC}	A_{AC}	26 / 21	58 /46	88 / 70	88 /70
at 400 V_{AC}; S6-40%	A_{AC}	32	71	108	108
at 400 V_{AC}; peak current	A_{AC}	54	107	139	168
DC link currents					
Rated DC link current at 600 V:	A_{DC}	27	60	92	92
DC link current:					
at 600 V_{DC}; at S6-40%	A_{DC}	35	79	121	121
at 600 V_{DC}; peak current	A_{DC}	59	117	152	176
Current carrying capacity					
DC link busbar	A_{DC}	100	200	200	200
Reinforced DC link busbars:	A_{DC}	150	--	--	--
24 V busbar:	A_{DC}	20	20	20	20

External air cooling	6SL3131–	7TE21–6AAx	7TE23–6AAx	7TE25–5AAx	7TE25–5AA3 + Active Interface Module
Rated power	**kW**	**16**	**36**	**55**	**55**
Electronics current consumption at 24 V DC	A_{DC}	0.95	1.5	1.9	1.9
Total power loss (including electronics losses) [3]	W	282.8	666	945.6	945.6
Max. ambient temperature Without derating With derating	 °C °C	 40 55	 40 55	 40 55	 40 55
DC link capacitance Active Line Module Drive line-up, max.	 µF µF	 705 20000	 1410 20000	 1880 20000	 1880 20000
Power factor	cosϕ	1	1	1	1
Circuit breaker (UL) Type designation Rated current: Resulting rated short-circuit current [5] SCCR at 480 V_{AC}:	 A kA	 3VL1135-2KM30 35 65	 3VL2108-2KN30 80 65	 3VL2112-2KN30 125 65	 3VL2112-2KN30 125 65
Safety fuse (UL) Type AJT Class J [4] Rated current Resulting rated short-circuit current [5] SCCR at 480 V_{AC}:	 A kA	 AJT35 35 65	 AJT80 80 65	 AJT125 125 65	 AJT125 125 65
Sound pressure level	dB(A)	<60	<65	<60	<60
Cooling air requirement	m^3/h	56	112	160	160
Rated voltage for rated data 3 AC 380 V					
Weight	kg	8.78	13.77	18.5	18.5

1) The powers specified apply to the rated voltage range from 380 V to 480 V.

2) Default for 400 V line supplies; undervoltage trip threshold is adjusted to the parameterized rated voltage.

3) For an overview, see the power loss tables in Chapter, Control cabinet installation

4) Source of supply: The Ferraz Shawmut company

5) The resulting rated short-circuit current is obtained from the combination of the fuse, or circuit breaker, and the Line Module in the drive system.

Table 3- 23 Technical data for Active Line Modules with external air cooling, part 2

External air cooling	**6SL3131–**	**7TE28–0AAx**	**7TE31-2AAx**
Rated power	**kW**	**80**	**120**
Infeed			
Rated power (S1) [1]	kW (P_n)	80	120
Infeed power (S6-40%) [1]	kW (P_{s6})	106	145
Peak infeed power [1]	kW (P_{max})	131	175
Regenerative feedback			
Continuous regenerative power	kW	80	120
Peak regenerative power	kW	131	175
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)	
DC link voltage	V_{DC}	510 - 720	
Overvoltage trip	V_{DC}	820 ± 2 %	
Undervoltage trip [2]	V_{DC}	360 ± 2 %	
Input currents			
Rated input current at 400 V_{AC}:	A_{AC}	122	182
Input current			
at 380 V_{AC} / 480 V_{AC}	A_{AC}	128 / 102	192 / 152
at 400 V_{AC}; S6-40%	A_{AC}	161	220
at 400 V_{AC}; peak current	A_{AC}	200	267
DC link currents			
Rated DC link current at 600 V:	A_{DC}	134	200
DC link current:			
at 600 V_{DC}; at S6-40%	A_{DC}	176	244
at 600 V_{DC}; peak current	A_{DC}	218	292
Current carrying capacity			
DC link busbar:	A_{DC}	200	200
24 V busbar:	A_{DC}	20	20
Electronics current consumption at 24 V DC	A_{DC}	1.4	1.8
Total power loss (including electronics losses) [3]	W	1383.6	2243.2
Max. ambient temperature			
Without derating	°C	40	40
With derating	°C	55	55
DC link capacitance			
Active Line Module	µF	2820	3995
Drive line-up, max.	µF	20000	20000
Power factor	cosϕ	1	1
Circuit breaker (UL)			
Type designation		3VL3117-2KN30	3VL3125-2KN30
Rated current:	A	175	250
Resulting rated short-circuit current [5]			
SCCR at 480 V_{AC}:	kA	65	65

External air cooling	**6SL3131–**	**7TE28–0AAx**	**7TE31-2AAx**
Rated power	**kW**	**80**	**120**
Safety fuse (UL) Type AJT Class J [4] Rated current Resulting rated short-circuit current [5] SCCR at 480 V_{AC}:	 A kA	 AJT175 175 65	 AJT250 250 65
Sound pressure level	dB(A)	<73	<73
Cooling air requirement	m^3/h	520	520
Rated voltage for rated data 3 AC 380 V			
Weight	kg	27.66	30.74

1) The powers specified apply to the rated voltage range from 380 V to 480 V.

2) Default for 400 V line supplies; undervoltage trip threshold is adjusted to the parameterized rated voltage.

3) For an overview, see the power loss tables in Chapter, Control cabinet installation

4) Source of supply: The Ferraz Shawmut company

5) The resulting rated short-circuit current is obtained from the combination of the fuse, or circuit breaker, and the Line Module in the drive system.

3.2.8.1 Characteristics

Rated duty cycles for Active Line Modules

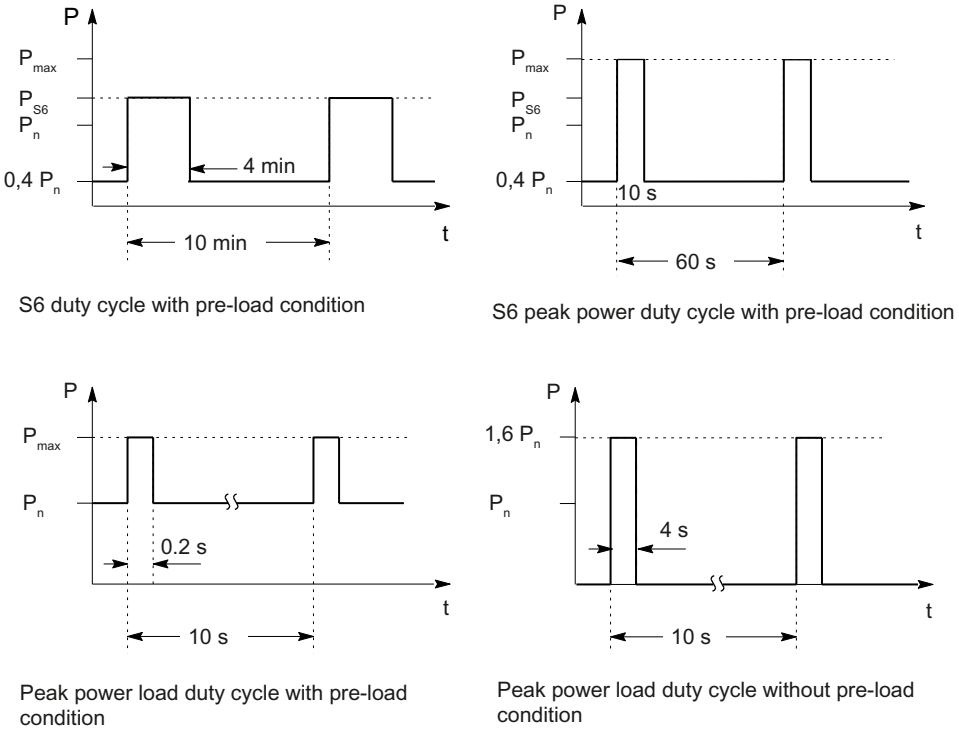
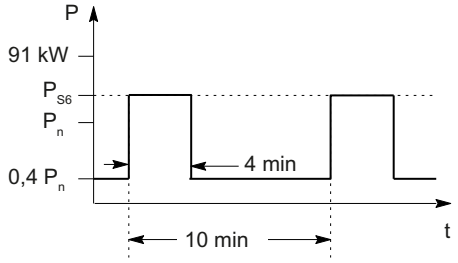
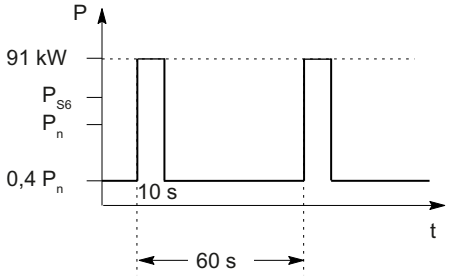


Figure 3-25 Rated duty cycles for Active Line Modules (**exception**: not applicable for 55 kW Active Line Module with Active Interface Module)

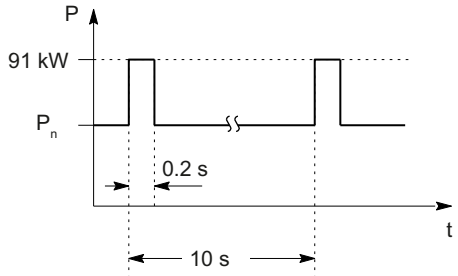
Rated duty cycles for Active Line Modules with Active Interface Modules



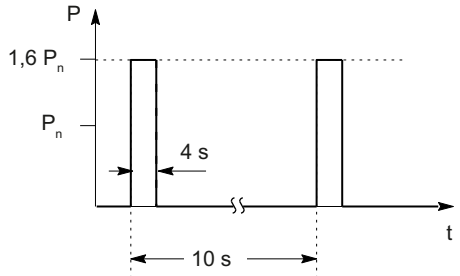
S6 duty cycle with pre-load condition



S6 peak power duty cycle with pre-load condition



Peak power load duty cycle with pre-load condition



Peak power load duty cycle without pre-load condition

Figure 3-26 Load cycles for 55 kW Active Line Modules with Active Interface Module

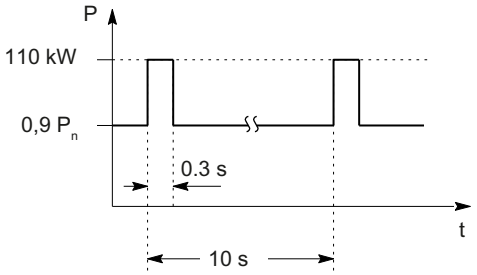


Figure 3-27 Peak load cycle with initial load for 55 kW Active Line Modules with Active Interface Module

Derating characteristics

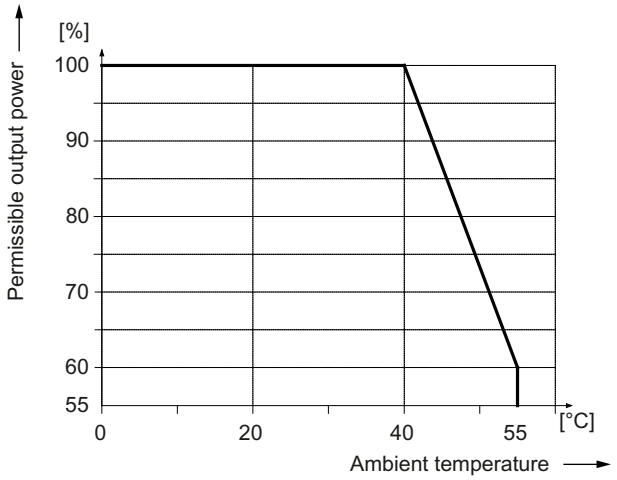


Figure 3-28 Output power as a function of the ambient temperature

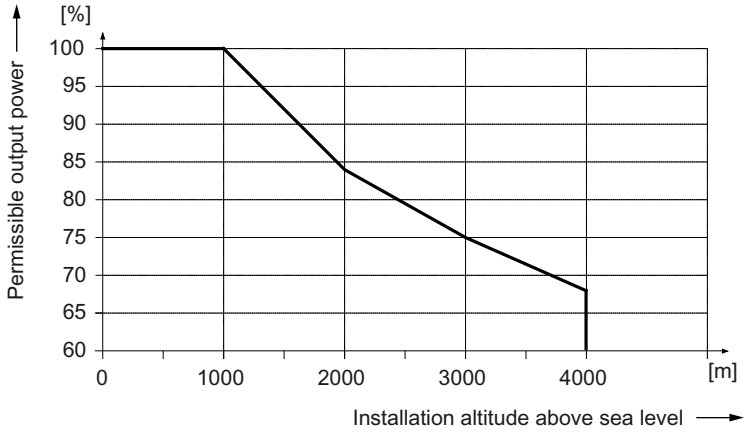


Figure 3-29 Output power as a function of the installation altitude

At installation altitudes >2000 m, an insolating transformer must be used (see "System overview/Derating as a function of the installation altitude and ambient temperature"). The design of the secondary line supply system must be as follows:

- TN system with grounded star point (no grounded outer conductor)
- IT system

A reduction of the line supply voltage phase-phase is not necessary.

3.3 Active Line Modules with cold plate

3.3.1 Description

Active Line Modules generate a constant, regulated DC voltage in the DC link from the three-phase line supply voltage that supplies the connected Motor Modules with power.

This ensures that they are not influenced by network fluctuations.

When the motors are in feedback mode, Active Line Modules supply power back to the network. The regenerative feedback capability of the modules can be deactivated by parameterization.

The DC link starts precharging as soon as the supply voltage is applied and is independent of its phase sequence direction. Load can be applied to the DC link after the modules have been enabled. An optional main contactor is required for disconnecting the voltage.

Active Line Modules can be directly connected to TN and TT line supplies - both with grounded neutral point and also with grounded protective conductor; they can also be connected to IT line supplies. The Line Modules have an integrated overvoltage protection function.

3.3.2 Safety information

⚠DANGER

Risk of electric shock

A hazardous voltage is present for up to 5 minutes after the power supply has been disconnected.
The protective cover may only be opened after this time has expired.

When opening the protective cover for the DC link, you must press the release catch. A suitable tool (e.g. screwdriver or supplied unlocking tool) must be used for this purpose.

The components must only be operated when the protective cover of the DC link is closed. Damaged components must not be operated further, otherwise this could result in secondary damage or accidents.

⚠DANGER

DC-link discharge time

A hazard warning for the DC link discharge time must be attached in the local language to all of the components.
A set of labels in 16 languages is supplied with the component.

⚠ DANGER

In the interests of operator and fire protection, the power supply conditions in terms of short-circuit power and loop impedance at the infeed point must be such that they will trip the installed overcurrent protection devices within the prescribed period if a fault occurs (short circuit or short circuit to exposed conductive part).

Note

Line short-circuit power at the infeed point

The line short-circuit power at the infeed point must be at least 70 times greater than the rated power of the Line Module in order to limit the line harmonics to an acceptable level for other loads.

⚠ DANGER

The drive components generate high leakage currents in the protective conductor. The components must only be operated in cabinets or in closed electrical operating areas and must be connected with the protective conductor. To protect against electric shock, the protective conductor connection at the control cabinet or machine must be implemented in accordance with one of the following measures:

- Fixed connection and protective conductor connection by means of ≥ 10 mm^2 Cu or ≥ 16 mm^2 Al
- Fixed connection and automatic disconnection of the supply system if the protective conductor is interrupted

⚠ DANGER

It is only permissible to establish connections to the DC link using the adapters that SIEMENS has recommended (DC link adapter and DC link rectifier adapter).

⚠ DANGER

If the Line Module is not disconnected from the supply system (e.g. via the line contactor or main switch), the DC link remains charged.

⚠ CAUTION

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

CAUTION

The correct tightening torque of the DC link busbar screws (1.8 Nm, tolerance +30%) must be checked before commissioning. After transportation, the screws must be tightened.

For lines without regenerative feedback capability (e.g. a diesel generator), the regenerative feedback capability of the Active Line Module must be deactivated by means of parameters (see Description of functions). The braking energy must then be dissipated via an additional Braking Module with braking resistor provided in the drive line-up.

CAUTION

The overall length of the power cables (motor supply cables and DC link cables) must not exceed the values given in the chapter titled "Possible line reactor and line filter combinations".

CAUTION

Only cables from Siemens may be used for DRIVE-CLiQ connections.

CAUTION

DC link side covers are supplied with the components as standard and must be attached to the first and last components in the drive line-up. They can also be ordered separately, if required (order number: 6SL3162-5AA00-0AA0).

3.3.3 Interface description

3.3.3.1 Overview

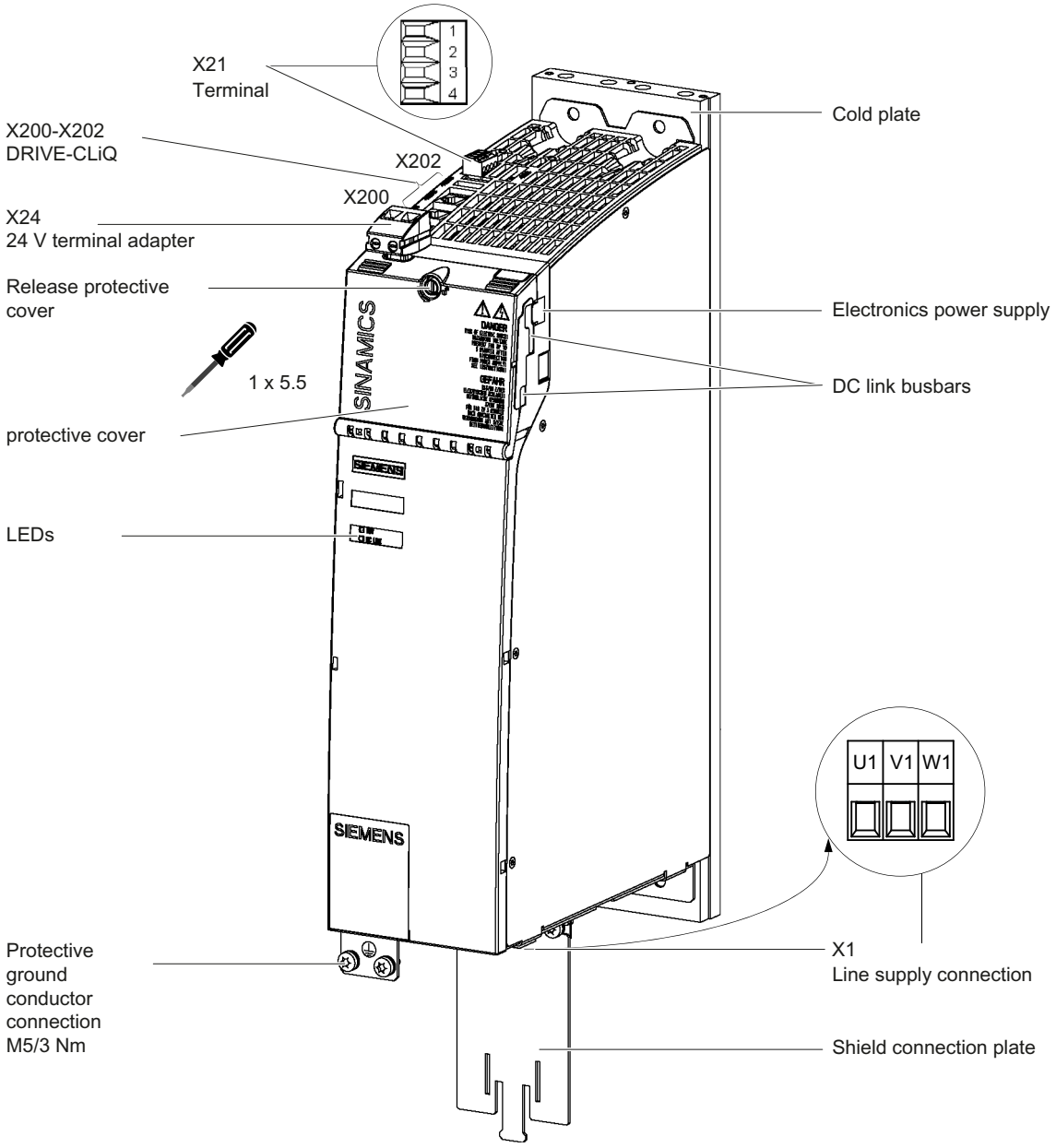
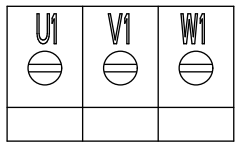
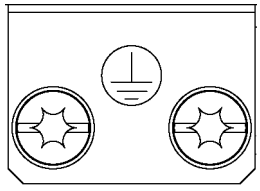


Figure 3-30 Interface overview, Active Line Module with cold plate (example: 16 kW)

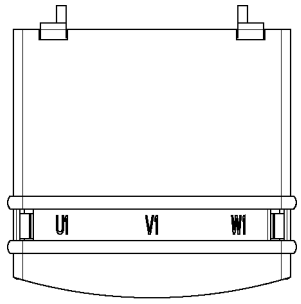
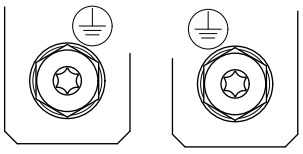
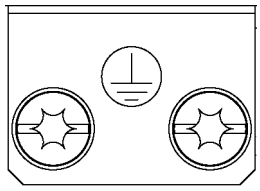
3.3.3.2 X1 line connection

Table 3- 24 X1: Line connection for Active Line Modules 16 kW

	Terminal	Technical specifications
	U1 V1 W1	Max. connectable cross-section: 10 mm² Type: Screw terminal 6 Tightening torque: 1.5 - 1.8 Nm (see Chapter, "Control cabinet installation/connection system")
	PE connection	Threaded hole M5/3 Nm [1]

1) For ring cable lugs in accordance with DIN 46234

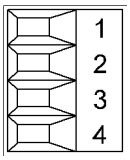
Table 3- 25 X1: Line supply connection for Active Line Modules 36 kW to 120 kW

	Terminal	Technical specifications
	U1 V1 W1	Supply voltage: 380 V - 480 V 3 AC, 50/60 Hz **36 kW:** Threaded bolts M6 / 6 Nm [1] **55 kW, 80 kW and 120 kW:** Threaded bolts M8 / 13 Nm [1]
	PE connection	**36 kW:** Threaded hole M6 / 6 Nm [1]
		**55 kW:** Threaded hole M6 / 6 Nm [1] **80 kW and 120 kW:** Threaded hole M8 / 13 Nm [1]

1) For ring cable lugs in accordance with DIN 46234

3.3.3.3 X21 EP terminals

Table 3- 26 X21 EP terminal/temperature sensor

	Terminal	Designation	Technical specifications
	1	+ Temp	Temperature sensors[1]: KTY 84–1C130[2]/PTC[2]/ bimetallic switch with NC contact If an Active Interface Module is used, the temperature input must be connected to the Active Interface Module sensor (bimetallic switch with NC contact).
	2	- Temp	
	3	EP +24 V (Enable Pulses)	Voltage 24 VDC Current consumption: 10 mA Isolated input Signal propagation times: L → H: 100 µs H → L: 1000 µs
	4	EP M (Enable Pulses)	
Max. connectable cross-section: 1.5 mm^2 Type: Screw terminal 1 (see Chapter, "Control cabinet installation and EMC/connection system")			

1) The temperature sensor type can be selected via parameter p0601; the temperature is displayed via r0035 (see SINAMICS S120/S150 List Manual LH1).

2) Temperatures are detected but not evaluated in the Active Line Module.

⚠ CAUTION

If an Active Interface Module is connected, the temperature output of the Active Interface Module must be connected to terminals 1 and 2.

⚠ WARNING

For operation, the 24 V DC voltage must be connected to terminal 3 and ground to terminal 4. When withdrawn, pulse suppression is activated. Regenerative feedback is deactivated and the bypass relay drops out. If the Line Module is not disconnected from the supply system when the EP terminal is deactivated (e.g. a line contactor is not installed), the DC link remains charged.

NOTICE

If an active drive line-up is switched off by means of the disconnector unit, the voltage at terminals 3 (EP +24 V) and 4 (EP M) must be interrupted beforehand. This can be carried out using a leading breaking auxiliary contact (≥ 10 ms), for example.

This protects external loads located parallel to the drive on the same switching component.

⚠ DANGER

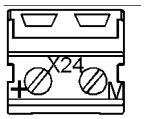
Risk of electric shock!

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) or Terminal Module TM120 must be used.

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

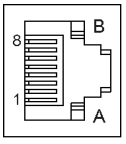
3.3.3.4 X24 24 V terminal adapter

Table 3- 27 X24 24 V terminal adapter

	Terminal	Designation	Technical specifications
	+	24 V power supply	24 V DC supply voltage
	M	Ground	Electronics ground
The 24 V terminal adapter is included in the scope of delivery. Max. connectable cross-section: 6 mm^2 Type: Screw terminal 5 (see the Chapter, "Control cabinet installation and EMC/connection system")			

3.3.3.5 X200-X202 DRIVE-CLiQ interfaces

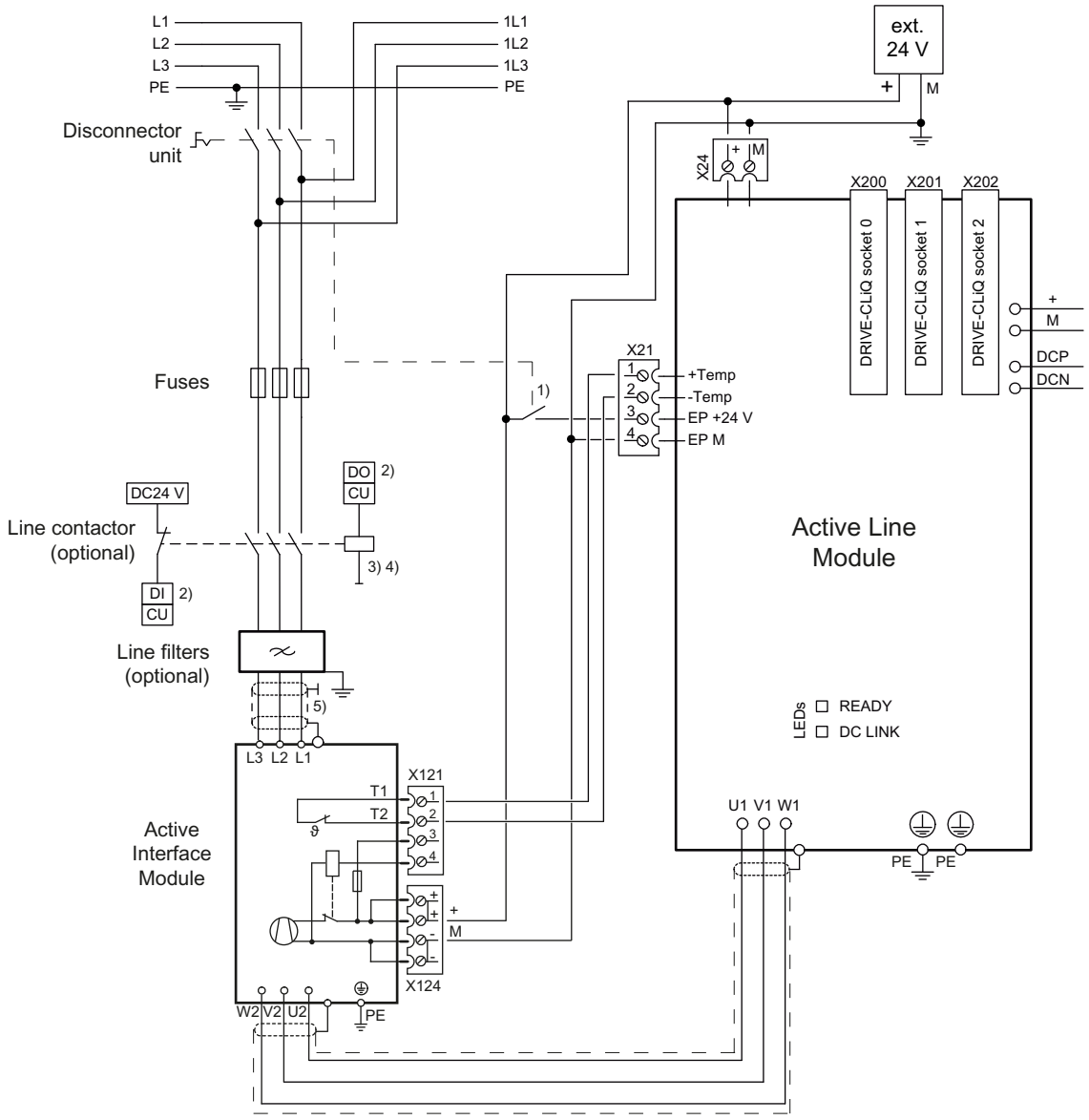
Table 3- 28 X200-X202 DRIVE-CLiQ interfaces

	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

The blanking covers for the DRIVE-CLiQ interfaces are included in the scope of delivery.

Blanking cover (50 pcs.) Order number: 6SL3066-4CA00-0AA0

3.3.4 Connection example



1) Leading NC contact t > 10 ms
2) DI/DO, controlled by the Control Unit.
3) No additional load permitted downstream of line contactor!
4) The current carrying capacity of the DO must be observed; an output coupling device must be used if required.
5) Contacting via rear mounting panel or shielding buses in accordance with EMC Directive.

Figure 3-31 Connection example: Active Line Module with cold plate

Note

If you are using a VSM10 Voltage Sensing Module, the leading opening contact can be omitted.

3.3.5 Meaning of LEDs

Table 3- 29 Meaning of the LEDs on the Active Line Module

Status		Description, cause	Remedy
RDY	DC LINK		
off	off	Electronics power supply is missing or outside permissible tolerance range.	–
Green	--	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.	Check line voltage
Orange	Orange	DRIVE-CLiQ communication is being established.	–
Red	--	At least one fault is present in this component. **Note:** The LED is activated regardless of whether the corresponding messages have been reconfigured.	Remedy and acknowledge fault
Green/ red (0.5 Hz)	--	Firmware is being downloaded.	–
Green/red (2 Hz)	--	Firmware download is complete. Wait for POWER ON.	Carry out a POWER ON
Green/orange or Red/orange	--	Detection of the components via LED is activated (p0124). **Note:** Both options depend on the LED status when module recognition is activated via p0124 = 1.	–

⚠ DANGER

Hazardous DC link voltages may be present at any time regardless of the status of the "DC LINK" LED.
The warning information on the components must be carefully observed!

3.3.6 Dimension drawings

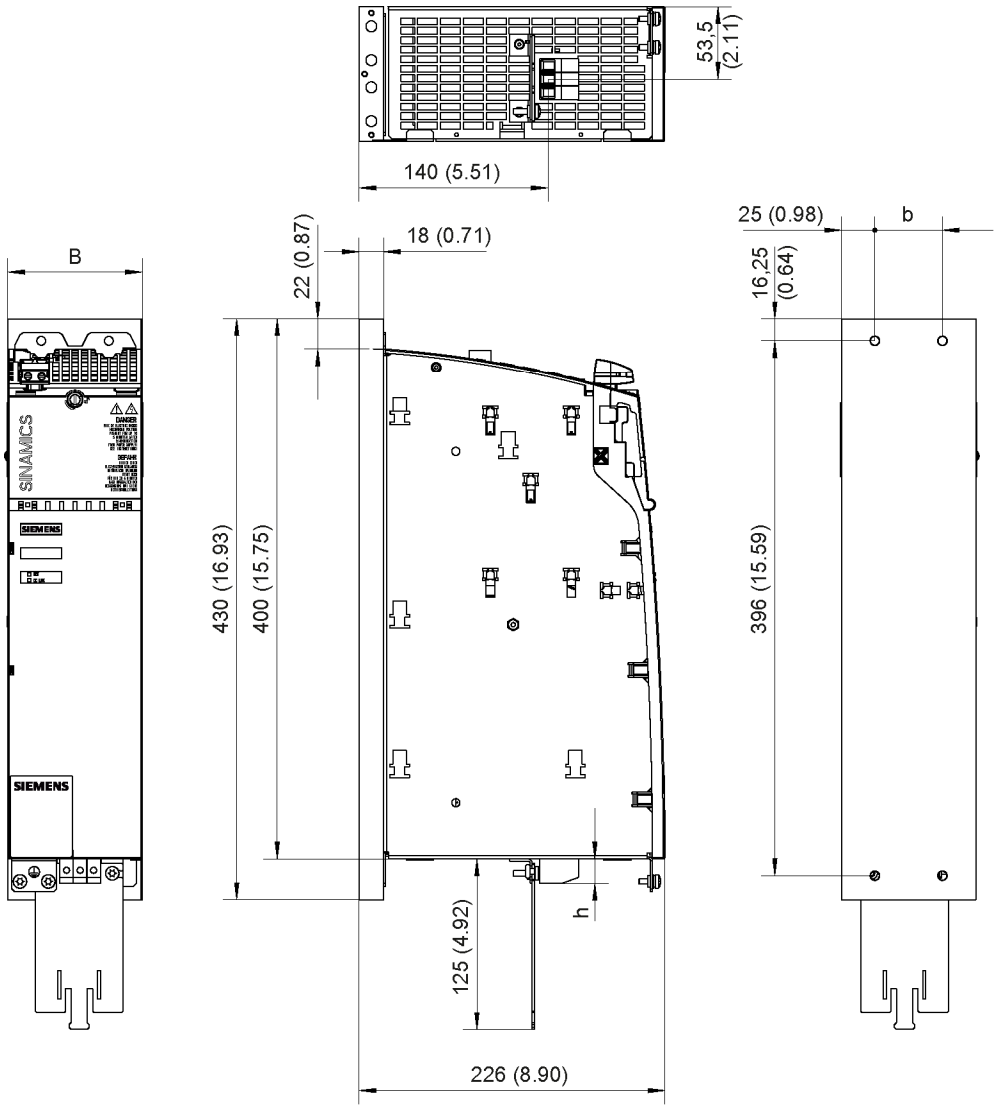


Figure 3-32 Dimension drawing of 16 kW Active Line Module with cold plate, all dimensions in mm and (inches)

Table 3- 30 Dimensions of 16 kW Active Line Module with cold plate

Active Line Module	Order number	B [mm] (inches)	b [mm] (inches)	h [mm] (inches)
16 kW	6SL3136-7TE21-6AAx	100 (3.94)	50 (1.97)	18 (0.71)

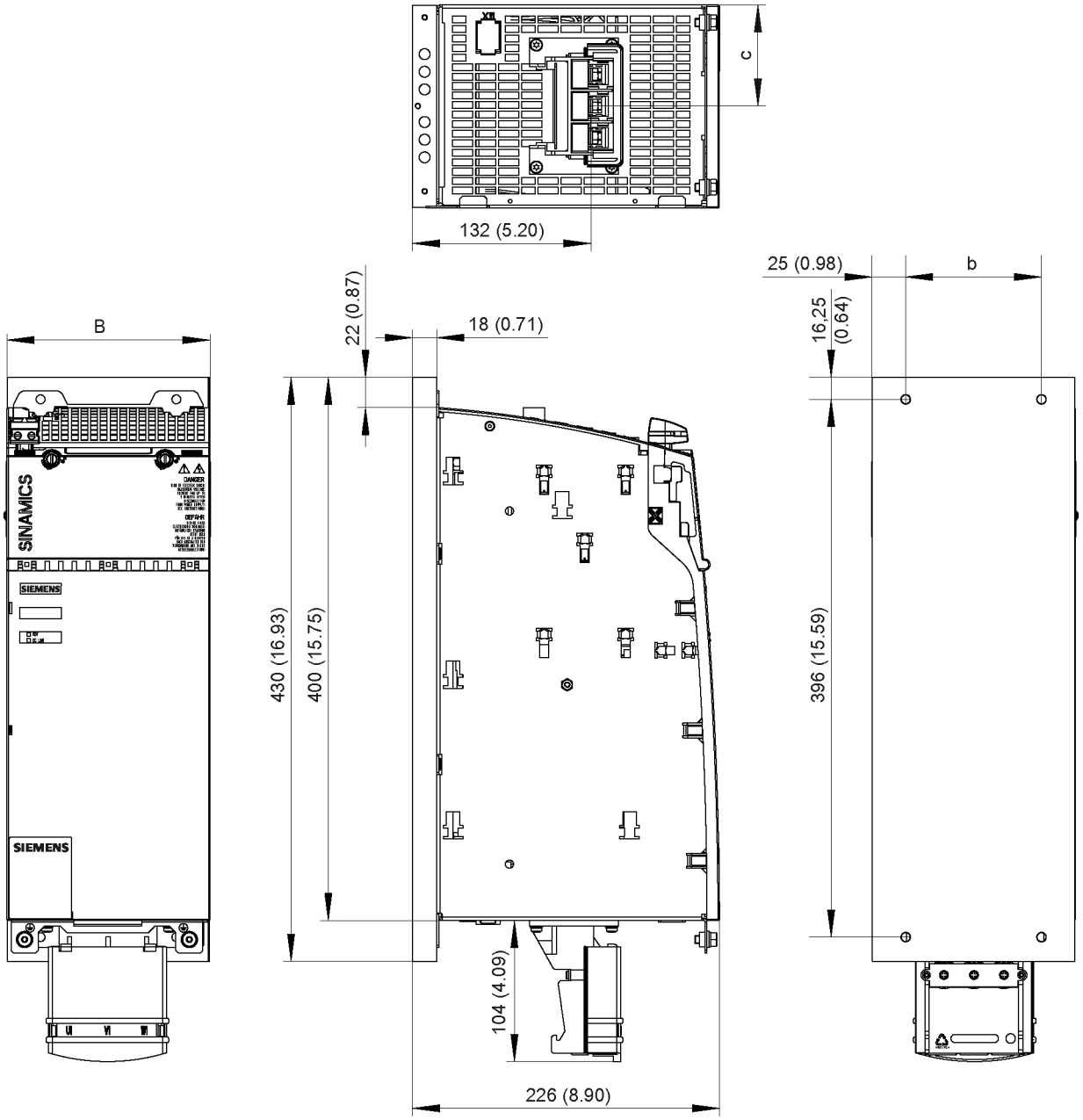


Figure 3-33 Dimension drawing of 36 kW, 55 kW, 80 kW, and 120 kW Active Line Modules with cold plate, all dimensions in mm and (inches)

Table 3- 31 Dimensions of 36 kW, 55 kW, 80 kW, and 120 kW Active Line Modules with cold plate

Active Line Module	Order number	B [mm] (inches)	b [mm] (inches)	c [mm] (inches)
36 kW	6SL3136-7TE23-6AAx	150 (5.91)	100 (3.94)	75 (2.95)
55 kW	6SL3136-7TE25-5AAx	200 (7.87)	150 (5.91)	100 (3.94)
80 kW	6SL3136-7TE28-0AAx	300 (11.81)	250 (9.84)	150 (5.91)
120 kW	6SL3136-7TE31-2AAx	300 (11.81)	250 (9.84)	150 (5.91)

3.3.7 Installation

Please note the following before installing an Active Line Module with cold plate on a customer-specific heat sink:

- Check the surface of the heat sink to ensure that it is not damaged.
- To improve heat transfer, a heat-conducting medium must be used. Special spherical-indented heat-conducting foil must be used for this purpose. Every component with cold plate is supplied with heat-conducting foil cut to the right size. Note the installation position of the heat-conducting foil (see diagram below).

Note

When a component is replaced, the heat-conducting foil must also be replaced.
Only heat-conducting foil approved or supplied by Siemens can be used.

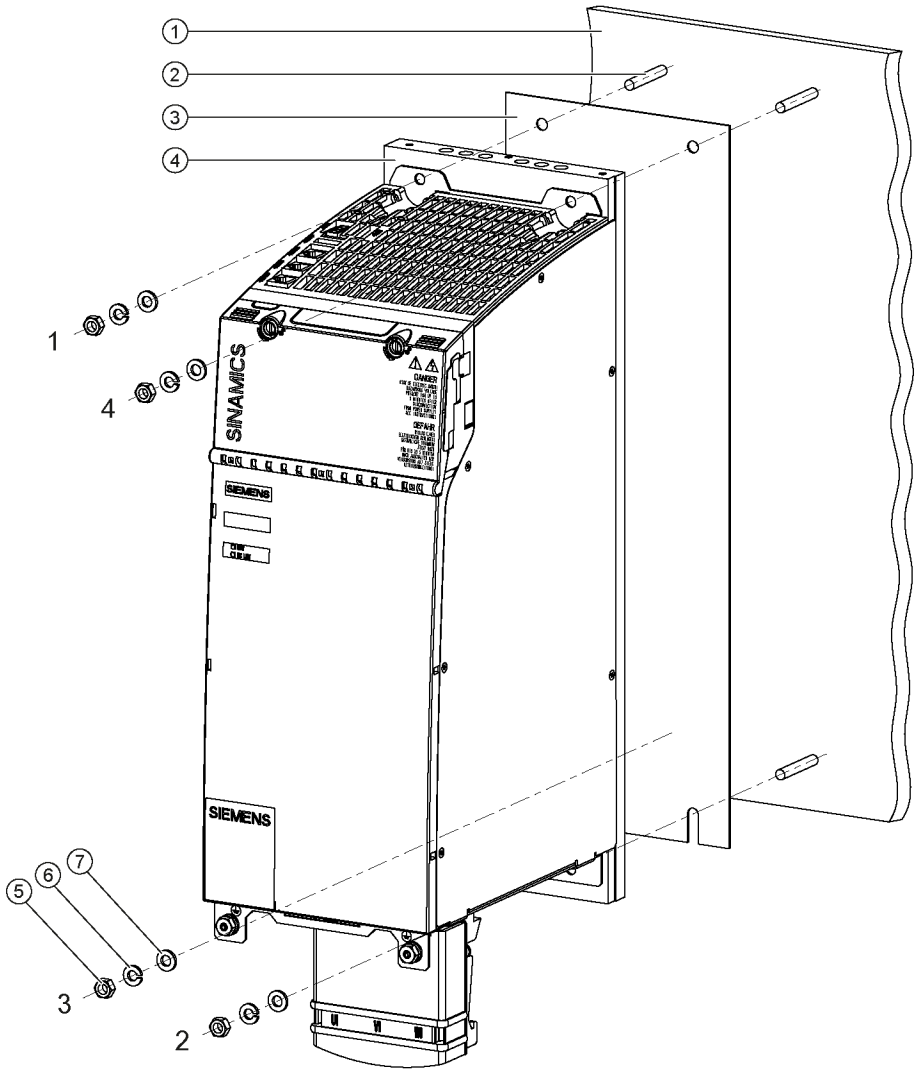
Table 3- 32 Overview of heat-conducting foils

	Order number
Heat-conducting foil, 50 mm	6SL3162-6FB00-0AA0
Heat-conducting foil, 100 mm	6SL3162-6FD00-0AA0
Heat-conducting foil, 150 mm	6SL3162-6FF00-0AA0
Heat-conducting foil, 200 mm	6SL3162-6FH00-0AA0
Heat-conducting foil, 300 mm	6SL3162-6FM00-0AA0

Note

M6 studs and hexagon nuts/grub screws (ISO 7436-M6x40-14 H, property class 8.8) are recommended for installing the components.

Installation



① External heat sink (air or liquid)
② M6 studs
③ Heat-conducting foil
④ Cold plate
⑤ M6 nut
⑥ Spring washer
⑦ Washer

Figure 3-34 Mounting an Active Line Module with cold plate on a an external heat sink (example: 36 kW)

Tightening torques:

- Initially, tighten the nuts by hand (0.5 Nm)
- Then tighten with 10 Nm (in the specific sequence 1 to 4)

Help with the mechanical control cabinet installation is available from:

Siemens AG
Industry Sector, IA SE WKC
TCCCC (Technical Competence Center Cabinets Chemnitz)
P.O. Box 1124
09070 Chemnitz, Germany

E-mail: cc.cabinetcooling.aud@siemens.com

Properties of the heat sink

We recommend using AlMgSi 0.5 as the heat sink material.
The roughness of the external heat sink surface should be at least Rz 16. The contact surface between the heat sink and cold plate should have an evenness of 0.2 mm (applicable to a height of 450 mm and a width of 300 mm).

Note

The machine manufacturer can adapt the heat sink version to his special requirements. The specified rated data for the Line Modules can only be achieved if the power losses can be dissipated by the external heat sink under the specified general conditions.

NOTICE
During the installation, you must ensure that the threaded bolts do not damage the cold plate.

3.3.8 Technical data

Table 3- 33 Technical data for Active Line Modules with cold plate cooling

Cold plate	**6SL3136-7TE**	**21-6AAx**	**23-6AAx**	**25-5AAx**	**25-5AA3 + Active Interface Module**	**28-0AAx**	**31-2AAx**
Rated power	**kW**	**16**	**36**	**55**	**55**	**80 (64)** [1]	**120 (84)** [1]
Infeed							
Rated power (S1)[2]	kW (P_n)	16	36	55	55	80 (64) [1]	120 (84) [1]
Infeed power (S6-40%) [2]	kW (P_{s6})	21	47	71	71	106 (85) [1]	145 (116)[1]
Peak infeed power[2]	kW (P_{max})	35	70	91	110	131	175
Regenerative feedback							
Continuous regenerative power	kW	16	36	55	55	80 (64) [1]	120 (84) [1]
Peak regenerative power	kW	35	70	91	110	131	175
Supply voltages							
Line voltage	V_{ACrms}	3 AC 380 10 % (-15 % < 1 min) to 3 AC 480 10 %					
Line frequency	Hz	47 to 63					
Electronics power supply	V_{DC}	24 (20.4 - 28.8)					
DC link voltage	V_{DC}	510 – 720					
Overvoltage trip							
Undervoltage trip [3]	V_{DC}	820 ± 2 %					
	V_{DC}	360 ± 2 %					
Input currents							
Rated input current at 400 V_{AC}:							
Input current	A_{AC}	25	55	84	84	122 (98) [1]	182 (127)[1]
at 380 V_{AC}							
at 480 V_{AC}	A_{AC}	26	58	88	88	128 (102)[1]	192 (134)[1]
at 400 V_{AC}; S6-40%	A_{AC}	21	46	70	70	102 (82) [1]	152 (106)[1]
at 400 V_{AC}; peak current	A_{AC}	32	71	108	108	161 (129)[1]	220 (154)[1]
	A_{AC}	54	107	139	168	200	267
DC link currents							
Rated DC link current at 600 V:	A_{DC}	27	60	92	92	134 (99) [1]	200 (140)
DC link current:							
at 600 V_{DC}; at S6-40%	A_{DC}	35	79	121	121	176 (141)[1]	244 (171)[1]
at 600 V_{DC}; peak current	A_{DC}	59	117	152	176	195	292
Current carrying capacity							
DC link busbar	A_{ACrms}	100	200	200	200	200	200
Reinforced DC link busbars:							
24 V busbar:	A_{ACrms}	150	--	--	--	--	
	A_{ACrms}	20	20	20	20	20	20
Electronics current consumption at 24 V DC	A_{DC}	0.85	1.05	1.15	1.15	1.4	1.8

Cold plate	6SL3136-7TE	21-6AAx	23-6AAx	25-5AAx	25-5AA3 + Active Interface Module	28-0AAx	31-2AAx
Total power loss [6] (including electronics losses)	W	280.4	655.2	927.6	927.6	1383.6	2243.2
DC link capacitance Active Line Module Drive line-up, max.:	 µF µF	 710 20000	 1410 20000	 1880 20000	 1880 20000	 2820 20000	 3760 20000
Power factor	cosϕ	1	1	1	1	1	1
Circuit breaker (UL) Type designation: Rated current: Resulting rated short-circuit current [5] SCCR at 480 V_{AC}: 	 A kA	 3VL1135-2KM30 35 65	 3VL2108-2KN30 80 65	 3VL2112-2KN30 125 65	 3VL2112-2KN30 125 65	 3VL3117-2KN30 175 65	 3VL3125-2KN30 250 65
Safety fuse (UL) Type AJT Class J [4] Rated current: Resulting rated short-circuit current [5] SCCR at 480 V_{AC}: 	 A kA	 AJT35 35 65	 AJT80 80 65	 AJT125 125 65	 AJT125 125 65	 AJT175 175 65	 AJT250 250 65
Max. permissible heat-sink temperature	°C	70	70	78	78	70	75
Max. ambient temperature Without derating With derating	 °C °C	 40 55	 40 55	 40 55	 40 55	 40 55	 40 55
Weight	kg	6.1	10.2	13.8	13.8	20.3	20.4

1) Derating must be applied due to the transfer of heat to the external heat sink. At a temperature of 40 °C at the interface to the power unit, 80% derating occurs for 6SL3136-7TE28-0AAx and 70% for 6SL3136-7TE31-2AAx

2) The powers specified apply to the rated voltage range from 380 V to 480 V.

3) Default for 400 V line supplies; undervoltage trip threshold is adjusted to the parameterized rated voltage.

4) Source of supply: The Ferraz Shawmut company

5) The resulting rated short-circuit current is obtained from the combination of the fuse, or circuit breaker, and the Line Module in the drive system.

6) For an overview, see the power loss tables in Chapter, Control cabinet installation

Note

New systems with 80 kW and 120 kW Active Line Modules should ideally be designed with 120 kW Active Line Modules Liquid Cooled in order to avoid power derating.

3.3.8.1 Characteristics

Rated duty cycles for Active Line Modules

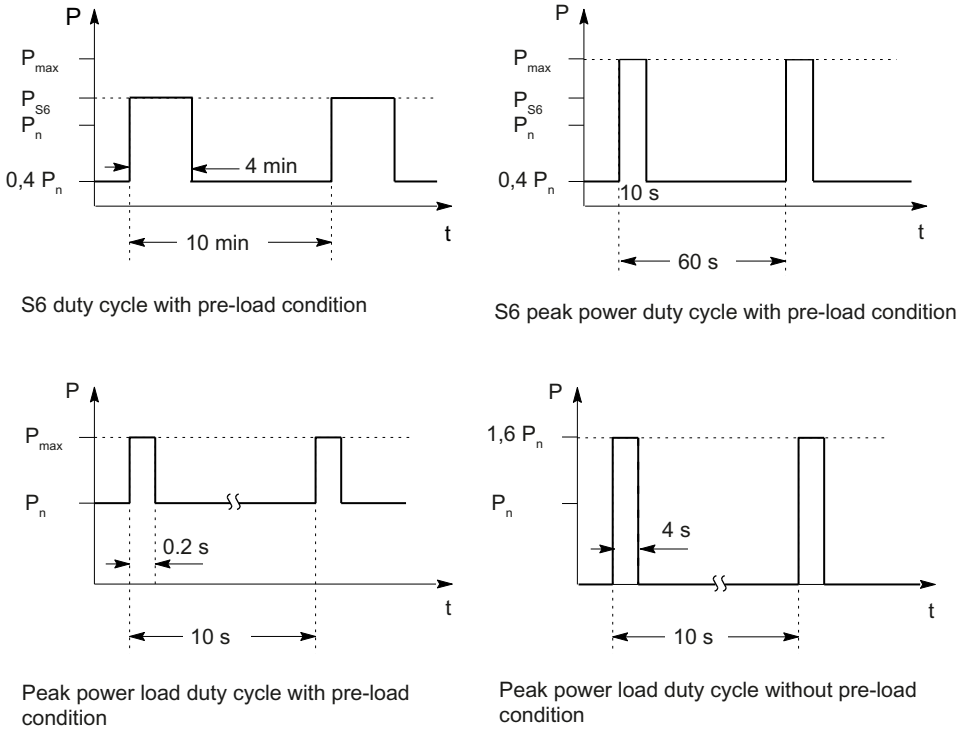


Figure 3-35 Rated duty cycles for Active Line Modules (**exception**: not applicable for 55 kW Active Line Module with Active Interface Module)

Rated duty cycles for Active Line Modules with Active Interface Modules

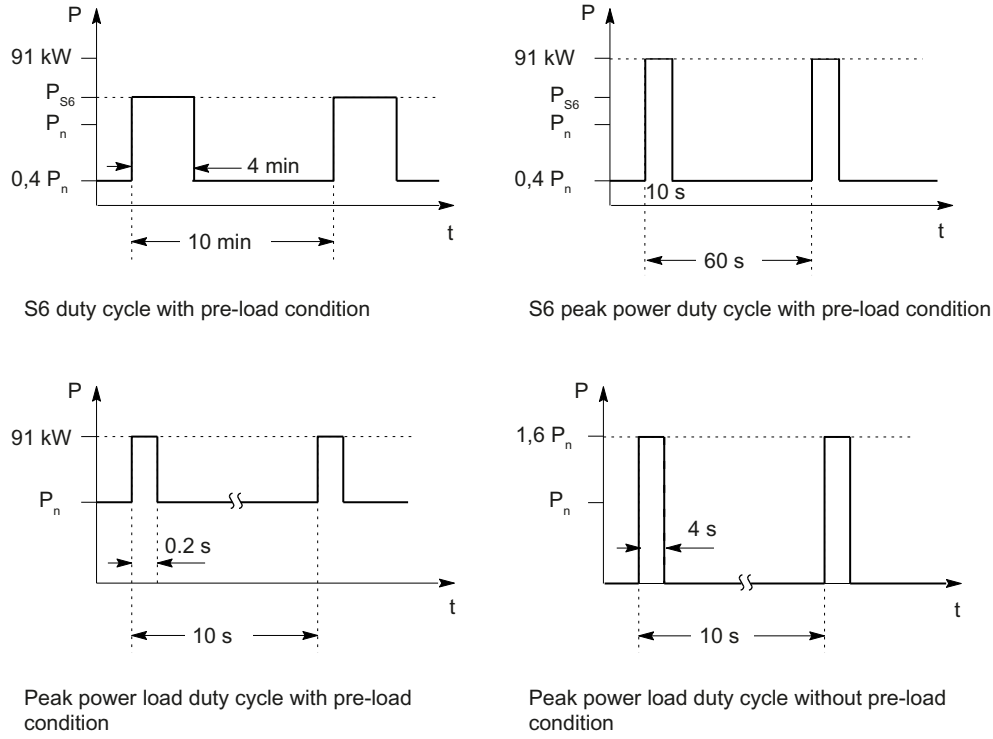


Figure 3-36 Load cycles for 55 kW Active Line Modules with Active Interface Module

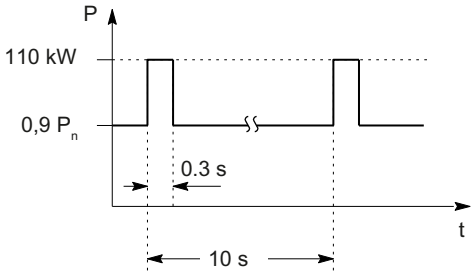


Figure 3-37 Peak load cycle with initial load for 55 kW Active Line Modules with Active Interface Module

Derating characteristics

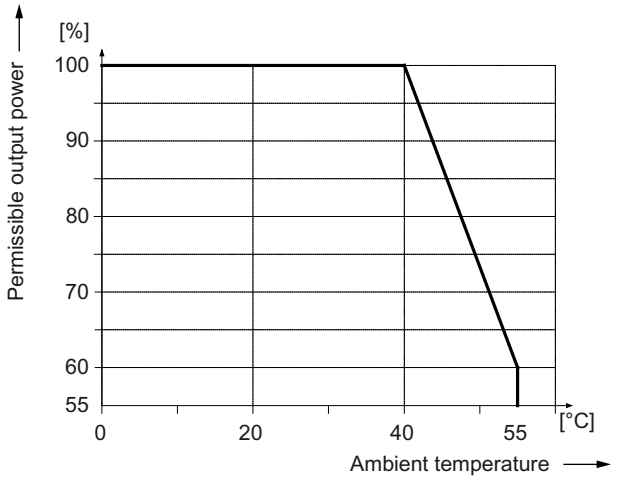


Figure 3-38 Output power as a function of the ambient temperature

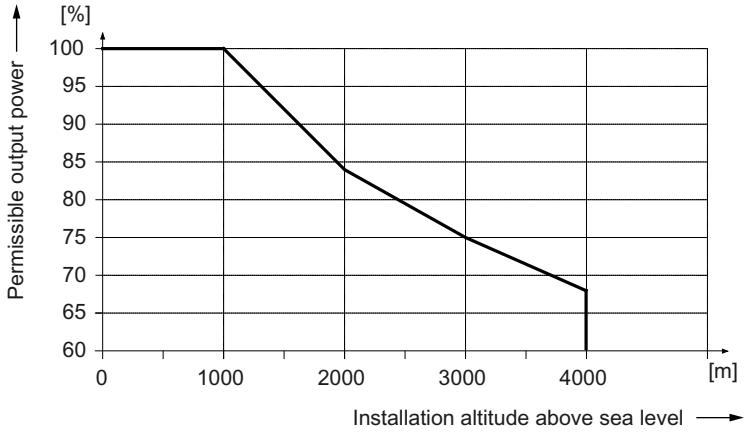


Figure 3-39 Output power as a function of the installation altitude

At installation altitudes >2000 m, an insolating transformer must be used (see "System overview/Derating as a function of the installation altitude and ambient temperature"). The design of the secondary line supply system must be as follows:

- TN system with grounded star point (no grounded outer conductor)
- IT system

A reduction of the line supply voltage phase-phase is not necessary.

3.4 Active Line Modules Liquid Cooled

3.4.1 Description

Active Line Modules generate a constant, regulated DC voltage in the DC link from the three-phase line voltage that supplies the connected Motor Modules with power.

This ensures that they are not influenced by network fluctuations.

When the motors are in feedback mode, Active Line Modules supply power back to the system. The regenerative feedback capability of the modules can be deactivated by parameterization.

The DC link starts precharging as soon as the line voltage is applied and is independent of its phase sequence direction. Load can be applied to the DC link after the module has been enabled. An optional line contactor is required for disconnecting the voltage.

Active Line Modules can be directly connected to TN and TT systems - both with grounded neutral point and also with grounded line conductor; they can also be connected to IT systems. The Line Modules have an integrated overvoltage protection function.

3.4.2 Safety information

⚠ DANGER

Risk of electric shock

A hazardous voltage is present for up to 5 minutes after the power supply has been disconnected.
The protective cover may only be opened after this time has expired.

When opening the protective cover for the DC link, you must press the release catch. A suitable tool (e.g. screwdriver or supplied unlocking tool) must be used for this purpose.

The components must only be operated when the protective cover of the DC link is closed. Damaged components must not be operated further, otherwise this could result in secondary damage or accidents.

⚠ DANGER

DC-link discharge time

A hazard warning for the DC link discharge time must be attached in the local language to all of the components.
A set of labels in 16 languages is supplied with the component.

⚠ DANGER

In the interests of operator and fire protection, the power supply conditions in terms of short-circuit power and loop impedance at the infeed point must be such that they will trip the installed overcurrent protection devices within the prescribed period if a fault occurs (short circuit or short circuit to exposed conductive part).

Note

Line short-circuit power at the infeed point

The line short-circuit power at the infeed point must be at least 70 times greater than the rated power of the Line Module in order to limit the line harmonics to an acceptable level for other loads.

⚠ DANGER

The drive components generate high leakage currents in the protective conductor. The components must only be operated in cabinets or in closed electrical operating areas and must be connected with the protective conductor. To protect against electric shock, the protective conductor connection at the control cabinet or machine must be implemented in accordance with one of the following measures:

- Fixed connection and protective conductor connection by means of ≥ 10 mm^2 Cu or ≥ 16 mm^2 Al
- Fixed connection and automatic disconnection of the supply system if the protective conductor is interrupted

⚠ DANGER

It is only permissible to establish connections to the DC link using the adapters that SIEMENS has recommended (DC link adapter and DC link rectifier adapter).

⚠ DANGER

If the Line Module is not disconnected from the supply system (e.g. via the line contactor or main switch), the DC link remains charged.

⚠ CAUTION

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

CAUTION

The correct tightening torque of the DC link busbar screws (1.8 Nm, tolerance +30%) must be checked before commissioning. After transportation, the screws must be tightened.

For lines without regenerative feedback capability (e.g. a diesel generator), the regenerative feedback capability of the Active Line Module must be deactivated by means of parameters (see Description of functions). The braking energy must then be dissipated via an additional Braking Module with braking resistor provided in the drive line-up.

CAUTION

The overall length of the power cables (motor supply cables and DC link cables) must not exceed the values given in the chapter titled "Possible line reactor and line filter combinations".

CAUTION

Only cables from Siemens may be used for DRIVE-CLiQ connections.

CAUTION

DC link side covers are supplied with the components as standard and must be attached to the first and last components in the drive line-up. They can also be ordered separately, if required (order number: 6SL3162-5AA00-0AA0).

3.4.3 Interface description

3.4.3.1 Overview

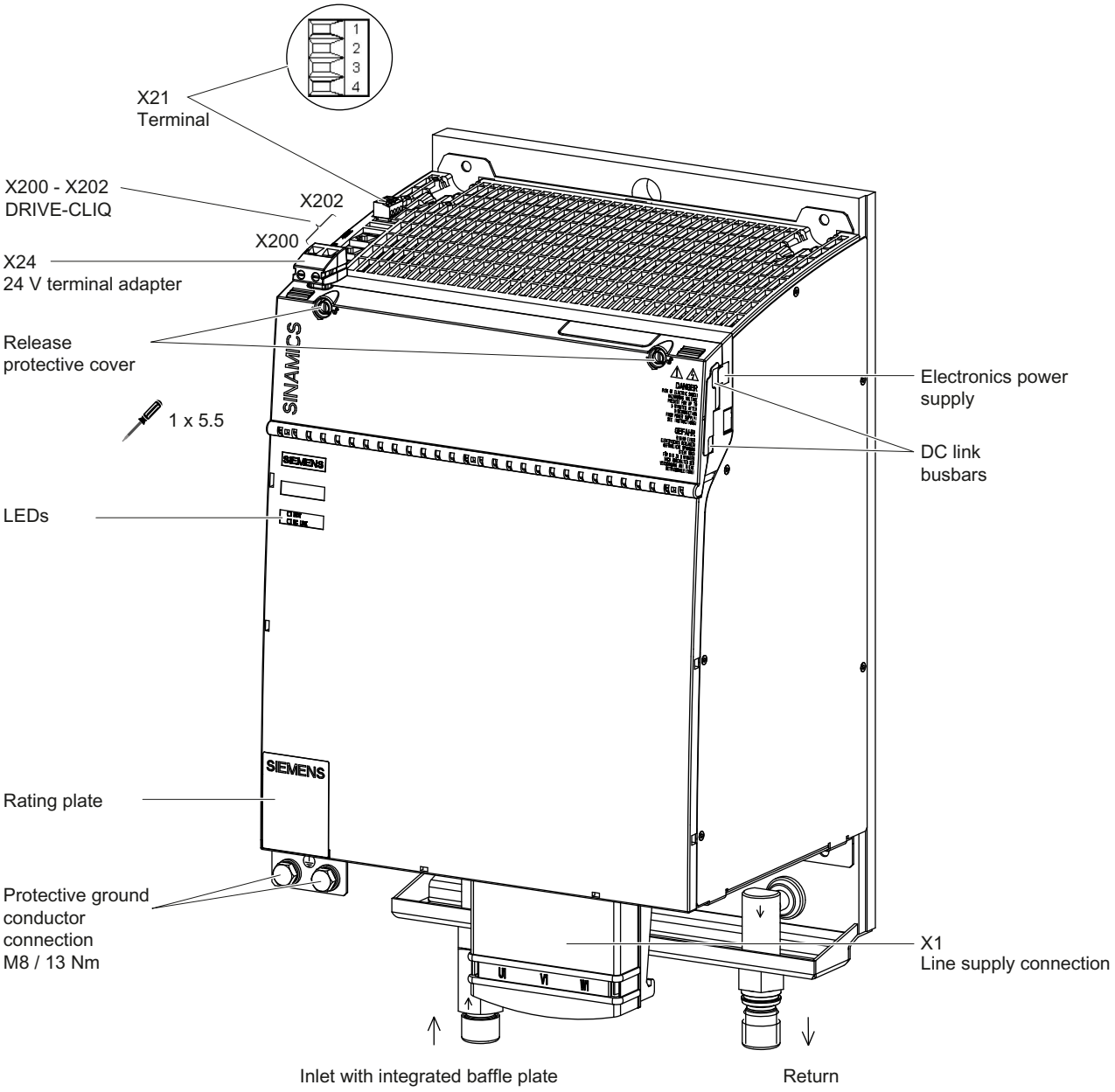
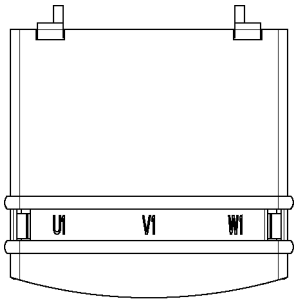
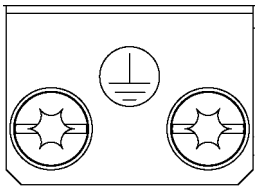


Figure 3-40 Interface overview, Active Line Module Liquid Cooled (120 kW)

3.4.3.2 X1 line connection

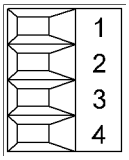
Table 3- 34 X1 line connection

	Terminals	Technical specifications
	U1 V1 W1	Supply voltage: 380 V - 480 V 3 AC, 50 / 60 Hz Threaded bolts M8 / 13 Nm 1)
	PE connection	Threaded hole M8 / 13 Nm 1)

1) For ring cable lugs in accordance with DIN 46234

3.4.3.3 X21 EP terminals

Table 3- 35 X21 EP terminal/temperature sensor

	Terminal	Designation	Technical specifications
	1	+ Temp	Temperature sensors1): KTY 84–1C1302)/PTC2)/bimetallic switch with NC contact If an Active Interface Module is used, the temperature input must be connected to the Active Interface Module sensor (bimetallic switch with NC contact).
	2	- Temp	
	3	EP +24 V (Enable Pulses)	Voltage 24 VDC Current consumption: 10 mA Isolated input Signal propagation times: L → H: 100 µs H → L: 1000 µs
	4	EP M (Enable Pulses)	
Max. connectable cross-section: 1.5 mm² Type: Screw terminal 1 (see Chapter, "Control cabinet installation and EMC/connection system")			

1) The temperature sensor type can be selected via parameter p0601; the temperature is displayed via r0035 (see SINAMICS S120/S150 List Manual LH1).

2) Temperatures are detected but not evaluated in the Active Line Module.

⚠ CAUTION

If an Active Interface Module is connected, the temperature output of the Active Interface Module must be connected to terminals 1 and 2.

⚠ WARNING

For operation, the 24 V DC voltage must be connected to terminal 3 and ground to terminal 4. When withdrawn, pulse suppression is activated. Regenerative feedback is deactivated and the bypass relay drops out. If the Line Module is not disconnected from the supply system when the EP terminal is deactivated (e.g. a line contactor is not installed), the DC link remains charged.

NOTICE

If an active drive line-up is switched off by means of the disconnector unit, the voltage at terminals 3 (EP +24 V) and 4 (EP M) must be interrupted beforehand. This can be carried out using a leading breaking auxiliary contact (≥ 10 ms), for example.

This protects external loads located parallel to the drive on the same switching component.

⚠ DANGER

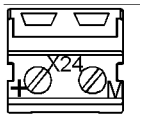
Risk of electric shock!

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) or Terminal Module TM120 must be used.

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

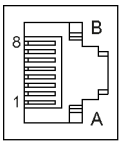
3.4.3.4 X24 24 V terminal adapter

Table 3- 36 X24 24 V terminal adapter

	Terminal	Designation	Technical specifications
	+	24 V power supply	24 V DC supply voltage
	M	Ground	Electronics ground
The 24 V terminal adapter is included in the scope of delivery. Max. connectable cross-section: 6 mm^2 Type: Screw terminal 5 (see Chapter, "Control cabinet installation and EMC/connection system")			

3.4.3.5 X200-X202 DRIVE-CLiQ interfaces

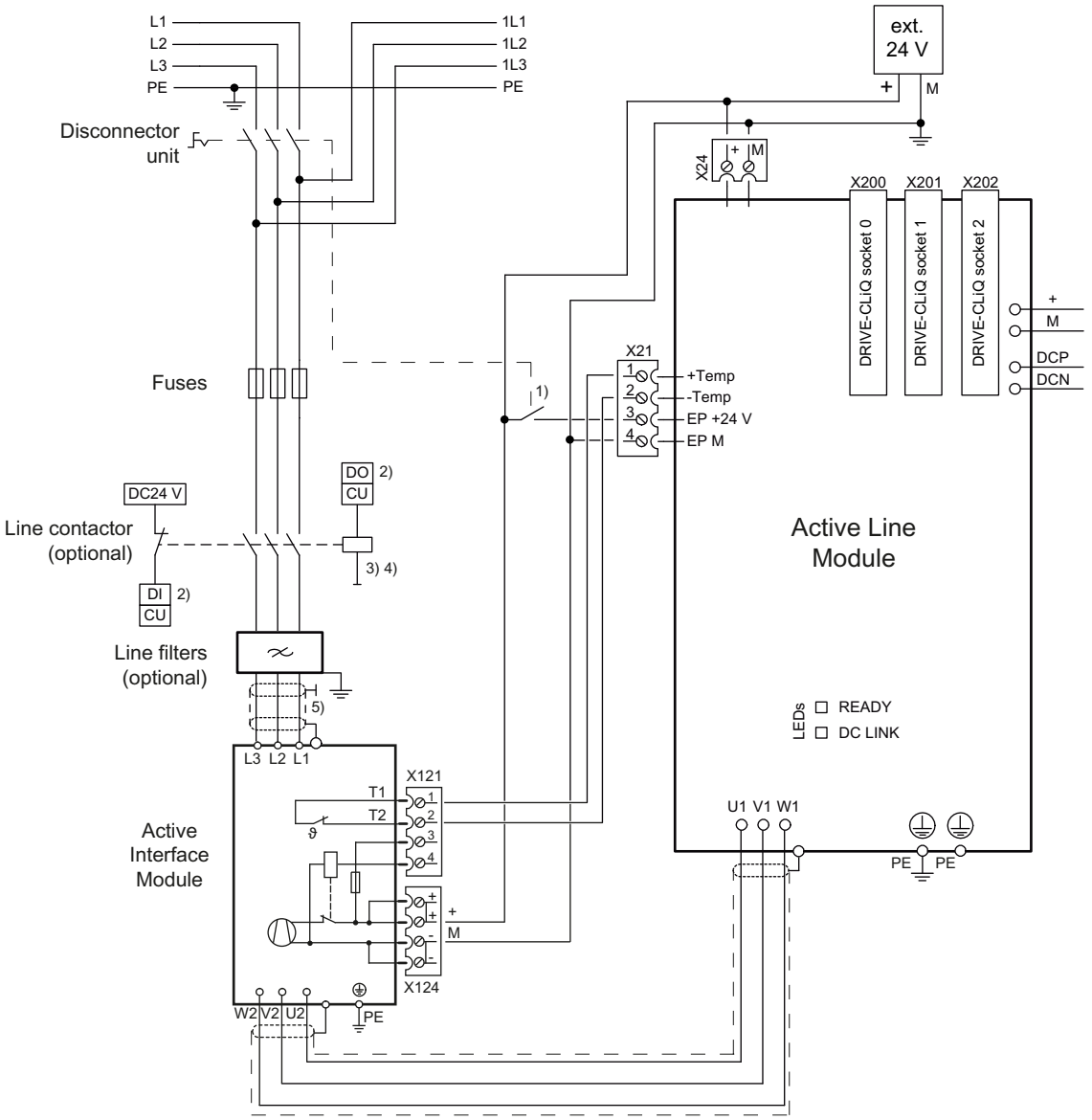
Table 3- 37 X200-X202 DRIVE-CLiQ interfaces

	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

The blanking covers for the DRIVE-CLiQ interfaces are included in the scope of delivery.

Blanking cover (50 pcs.) Order number: 6SL3066-4CA00-0AA0

3.4.4 Connection example



1) Leading NC contact t > 10 ms
2) DI/DO, controlled by the Control Unit.
3) No additional load permitted downstream of line contactor!
4) The current carrying capacity of the DO must be observed; an output coupling device must be used if required.
5) Contacting via rear mounting panel or shielding buses in accordance with EMC Directive.

Figure 3-41 Example connection of Active Line Module

Note

If you are using a VSM10 Voltage Sensing Module, the leading opening contact can be omitted.

3.4.5 Meaning of LEDs

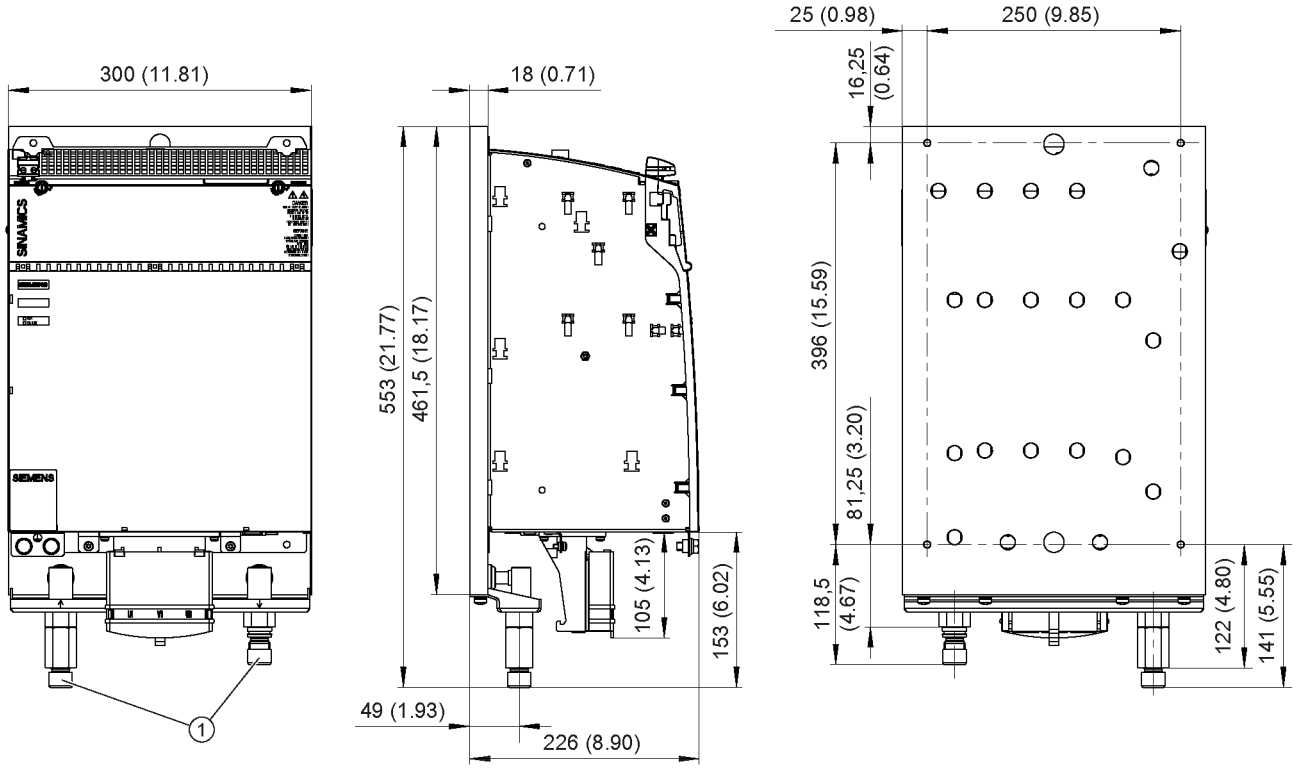
Table 3- 38 Meaning of the LEDs on the Active Line Module

Status		Description, cause	Remedy
RDY	DC LINK		
off	off	Electronics power supply is missing or outside permissible tolerance range.	–
Green	--	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.	Check line voltage
Orange	Orange	DRIVE-CLiQ communication is being established.	–
Red	--	At least one fault is present in this component. **Note:** The LED is activated regardless of whether the corresponding messages have been reconfigured.	Remedy and acknowledge fault
Green/ red (0.5 Hz)	--	Firmware is being downloaded.	–
Green/red (2 Hz)	--	Firmware download is complete. Wait for POWER ON.	Carry out a POWER ON
Green/orange or Red/orange	--	Detection of the components via LED is activated (p0124). **Note:** Both options depend on the LED status when module recognition is activated via p0124 = 1.	–

⚠ DANGER

Hazardous DC link voltages may be present at any time regardless of the status of the "DC LINK" LED.
The warning information on the components must be carefully observed!

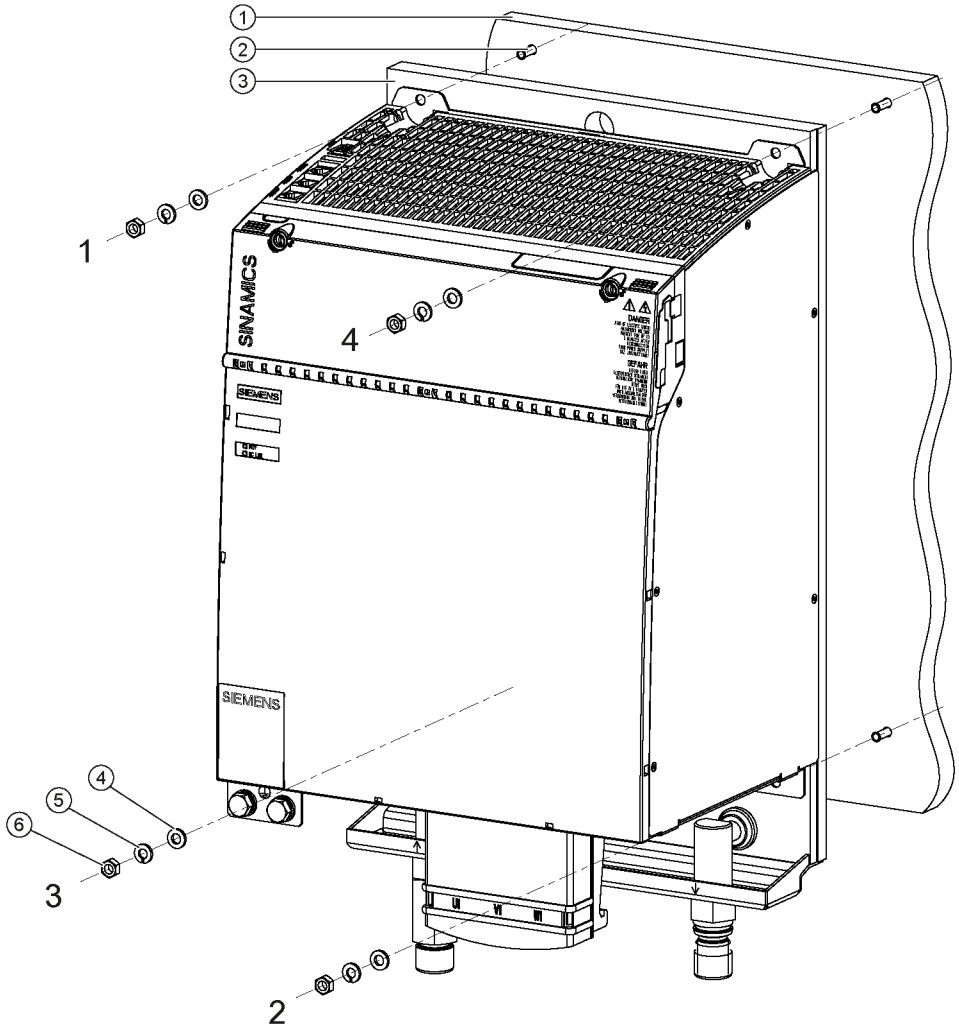
3.4.6 Dimension drawing



① Pipe thread ISO 228 G ½ B.

Figure 3-42 Dimension drawing of Active 120 kW Line Module Liquid Cooled, all dimensions in mm and (inches)

3.4.7 Installation



① Mounting surface
② M6 studs
③ Heat sink
④ Washer
⑤ Spring washer
⑥ M6 nut

Figure 3-43 Mounting an Active Line Module Liquid Cooled

Tightening torques:

- Initially, tighten the nuts by hand (0.5 Nm)
- Then tighten with 10 Nm (in the specific sequence 1 to 4)

For installation, M6 screw bolts and hexagon nuts/grub screws ISO 7436-M6x40-14 H, property class 8.8 are recommended.

The coolant connections are located on the lower side of the components. All connection elements can be accessed using an appropriate tool.

- Thread type of water connections: Pipe thread ISO 228 G ½ B.

3.4.8 Technical data

Table 3- 39 Technical data for an Active Line Module Liquid Cooled

Liquid Cooled		**6SL3135-7TE31-2AA3**
Rated power	**kW**	**120**
Infeed		
Rated power (S1)[1)]	kW (P_n)	120
Infeed power (S6-40%)[1)]	kW (P_{s6})	145
Peak infeed power[1)]	kW (P_{max})	175
Regenerative feedback		
Continuous regenerative power	kW	120
Peak regenerative power	kW	175
Supply voltages		
Line voltage	V_{ACrms}	3 AC 380 10 % (-15 % < 1 min) to 3 AC 480 10 %
Line frequency	Hz	47 to 63
Electronics power supply	V_{DC}	24 (20.4 - 28.8)
DC link voltage	V_{DC}	510 – 720
Overvoltage trip	V_{DC}	820 ± 2 %
Undervoltage trip [2)]	V_{DC}	360 ± 2 %
Input currents		
Rated input current at 400 V_{AC}:	A_{AC}	182
Input current		
at 380 V_{AC} / 480 V_{AC}	A_{AC}	192 / 152
at 400 V_{AC}; S6-40%	A_{AC}	220
at 400 V_{AC}; peak current	A_{AC}	267
DC link currents		
Rated DC link current at 600 V:	A_{DC}	200
DC link current:		
at 600 V_{DC}; at S6-40%	A_{DC}	244
at 600 V_{DC}; peak current	A_{DC}	292
Current carrying capacity		
DC link busbar:	A_{DC}	200
24 V busbar:	A_{DC}	20
Electronics current consumptionat 24 V DC	A_{DC}	1.8
Total power loss (including electronics losses) [3)]	W	2243.2
Max. ambient temperature		
Without derating	°C	40
With derating	°C	55
DC link capacitance:		
Active Line Module	µF	3995
Drive line-up, max.	µF	20000
Power factor	cosϕ	1

Liquid Cooled		**6SL3135-7TE31-2AA3**
Rated power	**kW**	**120**
Circuit breaker (UL) Type designation Rated current: Resulting rated short-circuit current [6] SCCR at 480 V_{AC}:	 A kA	 3VL3125-2KN30 250 65
Safety fuse (UL) Type AJT Class J [4] Rated current Resulting rated short-circuit current [6] SCCR at 480 V_{AC}:	 A kA	 AJT250 250 65
Rated volumetric flow for water at 70 kPa pressure drop [5]	l/min	8
Volume of liquid internal	ml	100
Max. coolant temperature Without derating With derating	 °C °C	 45 50
Weight	kg	23

1) The powers specified apply to the rated voltage range from 380 V to 480 V.

2) Default for 400 V line supplies; undervoltage trip threshold is adjusted to the parameterized rated voltage.

3) For an overview, see the power loss tables in Chapter, Control cabinet installation

4) Source of supply: The Ferraz Shawmut company

5) This value applies to the water coolant option; for other coolant types, see chapter "Cooling circuit and coolant properties".

6) The resulting rated short-circuit current is obtained from the combination of the fuse, or circuit breaker, and the Line Module in the drive system.

3.4.8.1 Characteristics

Rated duty cycles of Active Line Modules Liquid Cooled

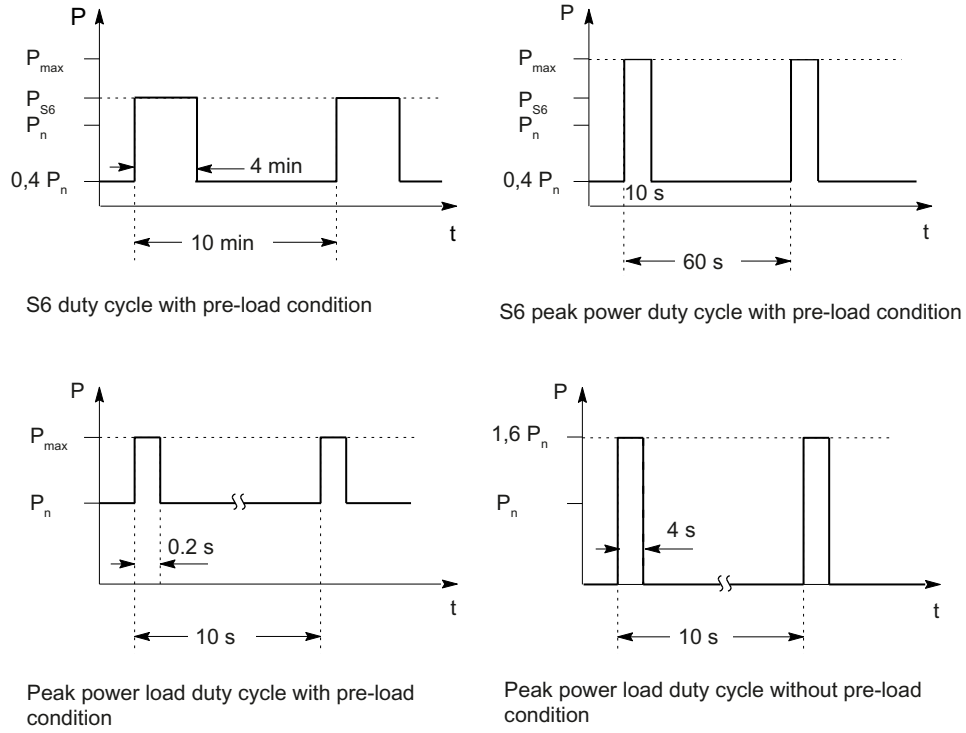


Figure 3-44 Rated duty cycles of Active Line Modules

Derating characteristics

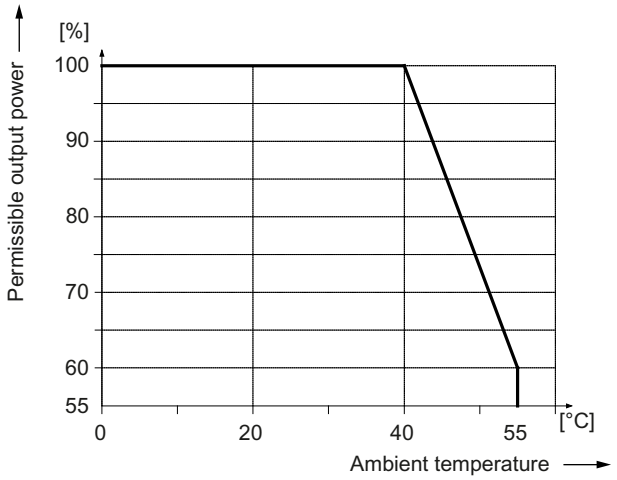


Figure 3-45 Output power as a function of the ambient temperature

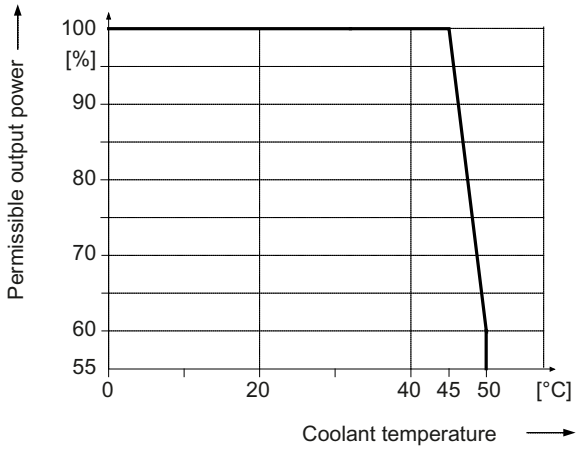


Figure 3-46 Output power as a function of the coolant temperature

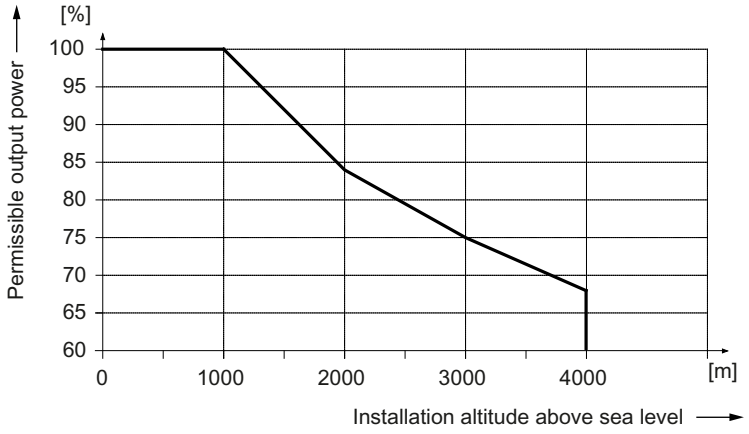


Figure 3-47 Output power as a function of the installation altitude

At installation altitudes >2000 m, an insolating transformer must be used (see "System overview/Derating as a function of the installation altitude and ambient temperature"). The design of the secondary line supply system must be as follows:

- TN system with grounded star point (no grounded outer conductor)
- IT system

A reduction of the line supply voltage phase-phase is not necessary.

3.5 Basic Line Modules with internal air cooling

3.5.1 Description

The Basic Line Modules generate a non-regulated DC voltage, which matches the rectified line input voltage, from the 3-phase line voltage and feed this DC voltage into the DC link. One Basic Line Module can supply one or more Motor Modules with power via the DC link.

To reduce the energy, e.g. for emergency retraction, the 20 kW and 40 kW Basic Line Modules feature a control for an external braking resistor.

For 100 kW Basic Line Modules, an external braking unit is required for degradation of energy. Either Braking Modules Booksize Compact (also in parallel circuit) or a MASTERDRIVES braking unit (see chapter "Braking units for 100 kW Basic Line Modules") can be used.

Basic Line Modules are suitable for direct operation on TN, TT, and IT systems.

The 100 kW Basic Line Module features basic interference suppression, the 20 kW and 40 kW Basic Line Modules do not.

The ratio of line short-circuit power to rated power must be ≥ 30.

The maximum total signal cable length is as follows

- For all Basic Line Modules with upstream Basic Line Filter
  - 350 m shielded for radio interference voltage category C2
  - 630 m shielded for radio interference voltage category C3
- For 100 kW Basic Line Modules without upstream Basic Line Filter
  - 350 m for radio interference voltage category C3
- For all Basic Line Modules without maintaining the limit values
  - 630 m shielded
  - 1000 m shielded with Voltage Clamping Module

3.5.2 Safety information

⚠ DANGER

Risk of electric shock

A hazardous voltage is present for up to 5 minutes after the power supply has been disconnected.
The protective cover may only be opened after this time has expired.

When opening the protective cover for the DC link, you must press the release catch. A suitable tool (e.g. screwdriver or supplied unlocking tool) must be used for this purpose.

The components must only be operated when the protective cover of the DC link is closed. Damaged components must not be operated further, otherwise this could result in secondary damage or accidents.

⚠ DANGER

DC-link discharge time

The DC-link discharge time warning in the relevant national language must be attached to all of the components.
A set of labels in 16 languages is supplied with the component.

⚠ DANGER

In the interests of operator and fire protection, the power supply conditions in terms of short-circuit power and loop impedance at the infeed point must be such that they will trip the installed overcurrent protection devices within the prescribed period if a fault occurs (short circuit or short circuit to exposed conductive part).

Note

Line short-circuit power at the infeed point

The line short-circuit power at the infeed point must be at least 30 times greater than the rated power of the Line Module in order to limit the line harmonics to an acceptable level for other loads.

⚠ DANGER

The drive components generate high leakage currents in the protective conductor. The components must only be operated in cabinets or in closed electrical operating areas and must be connected with the protective conductor. To protect against electric shock, the protective conductor connection at the control cabinet or machine must be implemented in accordance with one of the following measures:

- Fixed connection and protective conductor connection by means of ≥ 10 mm^2 Cu or ≥ 16 mm^2 Al
- Fixed connection and automatic disconnection of the supply system if the protective conductor is interrupted

⚠ DANGER

It is only permissible to establish connections to the DC link using the adapters that SIEMENS has recommended (DC link adapter and DC link rectifier adapter).

⚠ CAUTION

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

CAUTION

The correct tightening torque of the DC link busbar screws (1.8°Nm, tolerance +30%) must be checked before commissioning with the complete system in a voltage-free state (powered-down) and with the DC link discharged. After transportation, the screws must be tightened.

CAUTION

The overall length of the power cables (motor supply cables and DC link cables) must not exceed the values given in the chapter titled "Possible line reactor and line filter combinations".

CAUTION

Only cables from Siemens may be used for DRIVE-CLiQ connections.

CAUTION

DC link side covers are supplied with the components as standard and must be attached to the first and last components in the drive line-up. They can also be ordered separately, if required (order number: 6SL3162-5AA00-0AA0).

3.5.3 Interface description

3.5.3.1 Overview

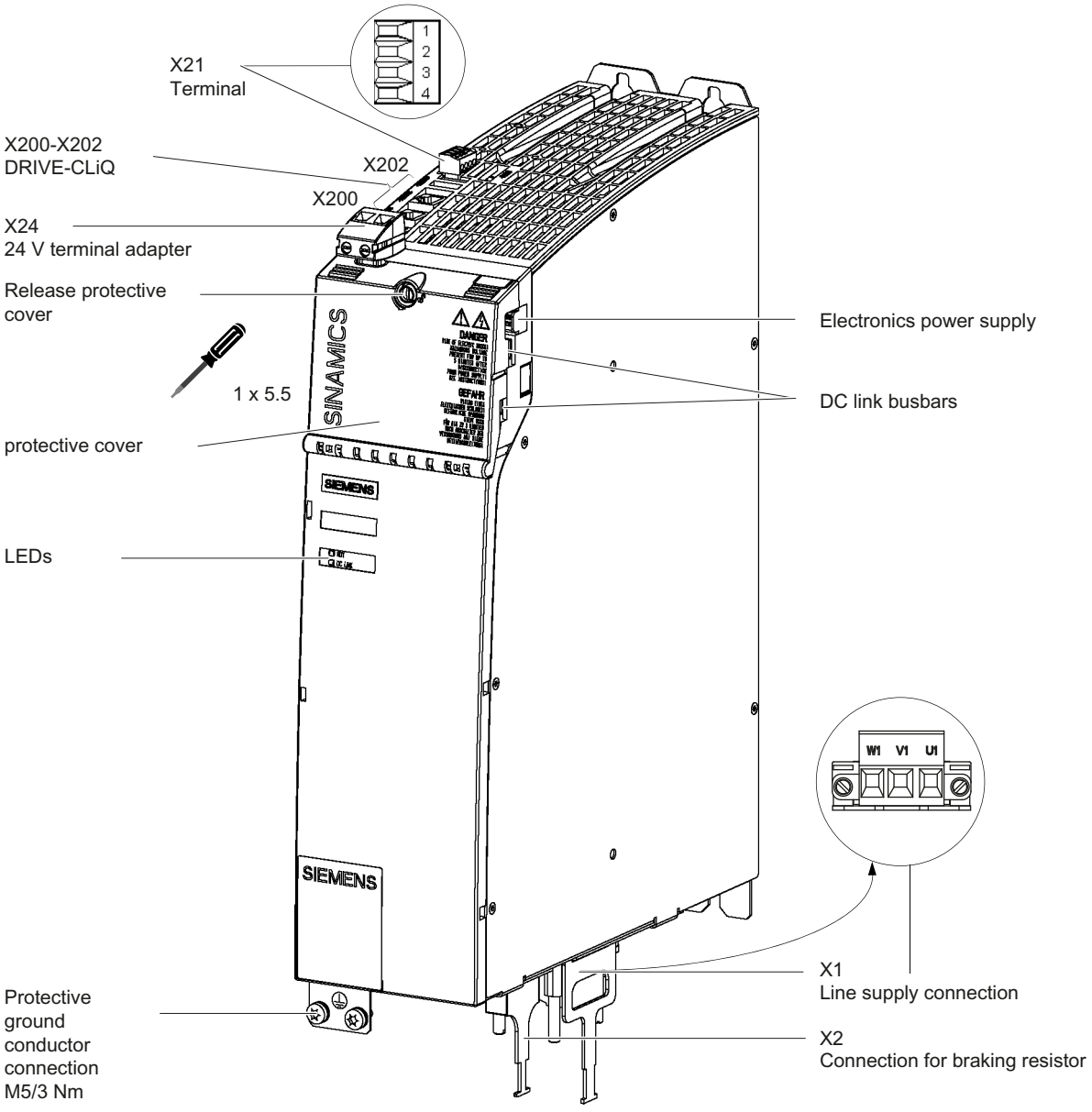
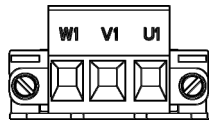
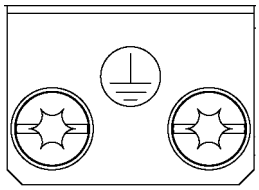


Figure 3-48 Interface overview, Basic Line Module with internal air cooling (example: 20 kW)

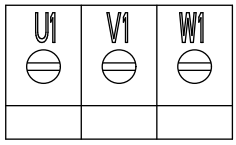
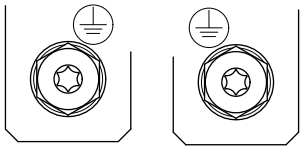
3.5.3.2 X1 line connection

Table 3- 40 X1: Line supply connection for Basic Line Modules 20 kW

	Terminal	Technical specifications
	U1 V1 W1	Supply voltage: 380 V - 480 V 3 AC, 50/60 Hz Max. connectable cross-section: 16 mm^2 Type: Screw terminal 7 Tightening torque: 1.5 - 1.7 Nm (see Chapter, "Control cabinet installation/connection system")
	PE connection	Threaded hole M5/3 Nm 1)

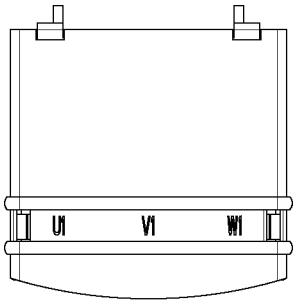
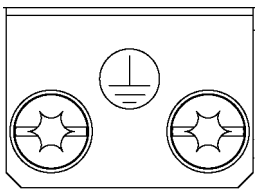
1) For ring cable lugs in accordance with DIN 46234

Table 3- 41 X1: Line supply connection for Basic Line Modules 40 kW

	Terminal	Technical specifications
	U1 V1 W1	Supply voltage: 380 V - 480 V 3 AC, 50/60 Hz Max. connectable cross-section, 50 mm², end sleeves Tightening torque, min. 6 Nm
	PE connection	Threaded hole M6 / 6 Nm 1)

1) For ring cable lugs in accordance with DIN 46234

Table 3- 42 X1: Line supply connection for Basic Line Modules 100 kW

	Terminal	Technical specifications
	U1 V1 W1	Supply voltage: 380 V - 480 V 3 AC, 50/60 Hz Max. connectable cross-section: 120 mm^2 Type: Threaded bolts M8 1) Tightening torque: 13 Nm
	PE connection	Threaded hole M6 / 6 Nm 1)

1) For ring cable lugs in accordance with DIN 46234

3.5.3.3 X2 braking resistor connection

Table 3- 43 X2: Braking resistor connection at the Basic Line Module 20 kW

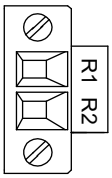
	Terminal	Designation	Technical specifications
	1	Braking resistor connection R1	Max. connectable cross-section: 4 mm²
	2	Braking resistor connection R2	Type: Screw terminal 4 (see the chapter titled "Control cabinet installation/Connection system") Tightening torque: 0.5 - 0.6 Nm

Table 3- 44 X2: Braking resistor connection at the Basic Line Module 40 kW

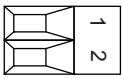
	Terminal	Designation	Technical specifications
	1	Braking resistor connection R1	Max. connectable cross-section: 10 mm²
	2	Braking resistor connection R2	Type: Screw terminal 6 (see the chapter titled "Control cabinet installation/Connection system") Tightening torque: min 1.5 - 1.8 Nm

Table 3- 45 Braking resistors with a thermostatic switch for 20 kW and 40 kW Basic Line Modules

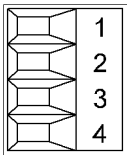
Braking resistor	R in Ω	P_N in kW	4 x P_N in kW	P_{max} in kW
6SE7018-0ES87-2DC0	80	1.25	5	7.5
6SE7021-6ES87-2DC0	40	2.5	10	15
6SE7023-2ES87-2DC0	20	5	20	30
6SE7028-0ES87-2DC0 [1)]	8	12.5	50	75

1) Not suitable for 20 kW Basic Line Module

For detailed technical information on the braking resistors, see the chapter titled "Braking resistors".

3.5.3.4 X21 EP terminals

Table 3- 46 X21 EP terminal/temperature sensor

	Terminal	Designation	Technical specifications
	1	+ Temp	Temperature sensors[1]: KTY84-1C130[2]/PTC[2]/bimetallic switch with NC contact With the 20 kW and 40 kW Basic Line Modules, the temperature sensor of the braking resistor (bimetallic switch with NC contact) is connected to the temperature input. **Response thresholds** of the temperature input: Temperature at the braking resistor in the operating range → resistance value ≤ 100 ohms Overtemperature at the braking resistor → resistance value > 100 ohms **Fault reactions**: An alarm is output and the Basic Line Module is deactivated with a fault after one minute, if overtemperature is still present at the braking resistor. If there is no braking resistor, terminals 1 and 2 must be jumpered to deactivate the overtemperature.
	2	- Temp	
	3	EP +24 V (Enable Pulses)	Voltage 24 VDC Current consumption: 10 mA Isolated input Signal propagation times: L → H: 100 µs H → L: 1000 µs
	4	EP M (Enable Pulses)	
Max. connectable cross-section: 1.5 mm^2 Type: Screw terminal 1 (see Chapter, "Control cabinet installation and EMC/connection system")			

1) The temperature sensor type can be selected via parameter p0601; the temperature is displayed via r0035 (see SINAMICS S120/S150 List Manual LH1).

2) Temperatures are detected but not evaluated in the Basic Line Module.

⚠WARNING

For operation, the 24 V DC voltage must be connected to terminal 3 and ground to terminal 4. When removed, the bypass relay drops out. If the Line Module is not disconnected from the supply system when the EP terminal is deactivated (e.g. a line contactor is not installed), the DC link remains charged.

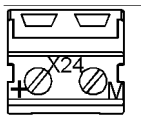
⚠DANGER

If the temperature switch is not connected, this can cause the resistor to overheat.

⚠ 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) or Terminal Module TM120 must be used. If these instructions are not complied with, there is a risk of electric shock!

3.5.3.5 X24 24 V terminal adapter

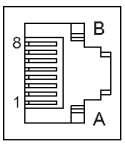
Table 3- 47 X24 24 V terminal adapter

	Terminal	Designation	Technical specifications
	+	24 V power supply	24 V DC supply voltage
	M	Ground	Electronics ground
Max. connectable cross-section: 6 mm² Type: Screw terminal 5 (see Chapter, "Control cabinet installation and EMC/connection system")			

The 24 V terminal adapter is included in the scope of supply.

3.5.3.6 X200-X202 DRIVE-CLiQ interfaces

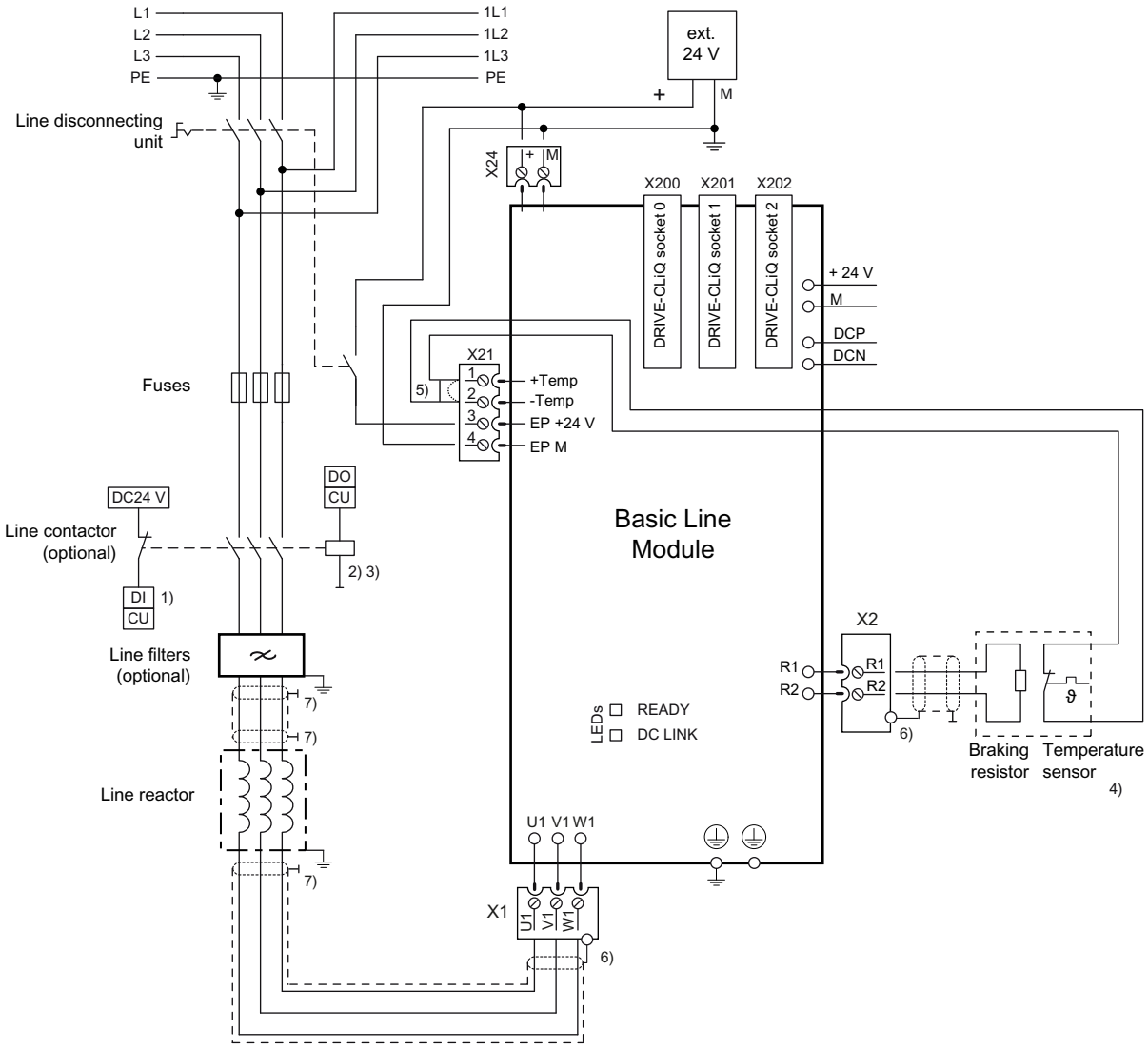
Table 3- 48 X200-X202 DRIVE-CLiQ interfaces

	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

The blanking covers for the DRIVE-CLiQ interfaces are included in the scope of delivery.

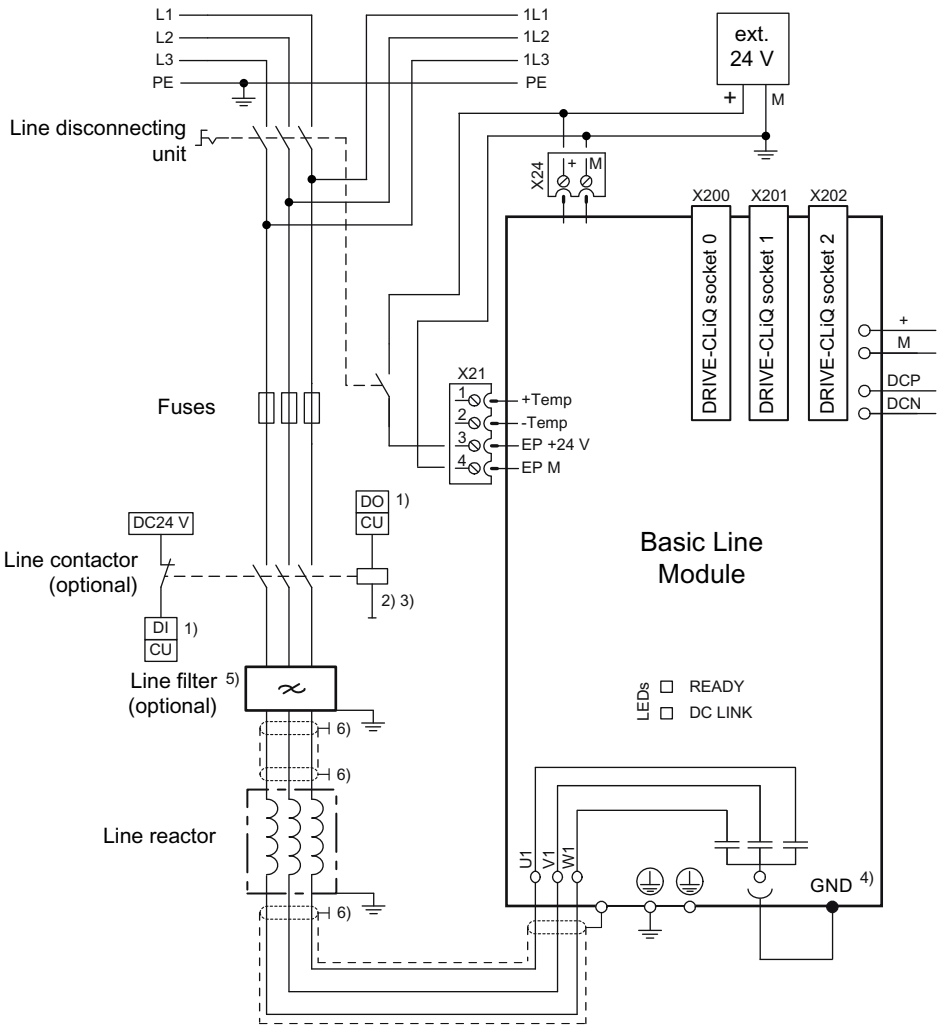
Blanking cover (50 pcs.) Order number: 6SL3066-4CA00-0AA0

3.5.4 Connection examples



1) DI/DO, controlled from the Control Unit
2) No additional load permitted downstream of line contactor!
3) The current carrying capacity of the digital output (DO) must be observed; an output interface must be used if required.
4) The bimetallic switch with wiring must not exceed a resistance value of 100 ohms in the closed state.
5) Jumper for switching off the temperature monitoring for the braking resistor.
6) Contact via connector (20 kW) or shield plate (40 kW).
7) Contact via rear mounting panel or shielding buses in accordance with EMC installation guideline.

Figure 3-49 Connection example: Basic Line Module (20 kW and 40 kW)



1) DI/DO, controlled from the Control Unit
2) No additional load permitted downstream of line contactor!
3) The current carrying capacity of the DO must be observed; an output interface must be used if required.
4) When operating the component on an IT system, the connecting bar must be removed.
5) Line filter is required in order to maintain radio interference voltage according to category C2.
6) Contact via rear mounting panel or shielding buses in accordance with EMC installation guideline.

Figure 3-50 Connection example: Basic Line Module (100 kW)

3.5.5 Meaning of LEDs

Table 3- 49 Meaning of the LEDs on the Basic Line Module

Status		Description, cause	Remedy
RDY	DC LINK		
Off	Off	Electronics power supply is missing or outside permissible tolerance range.	–
Green	--	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.	Check the line voltage.
Orange	Orange	DRIVE-CLiQ communication is being established.	–
Red	--	At least one fault is present in this component. **Note:** The LED is activated regardless of whether the corresponding messages have been reconfigured.	Remedy and acknowledge fault.
Green/ red (0.5 Hz)	--	Firmware is being downloaded.	–
Green/red (2 Hz)	--	Firmware download is complete. Wait for POWER ON.	Carry out a POWER ON
Green/orange or Red/orange	--	Component detection via LED is activated (p0124). **Note:** Both options depend on the LED status when component recognition is activated via p0124 = 1.	–

⚠ DANGER

Hazardous DC link voltages may be present at any time regardless of the status of the "DC LINK" LED.
The warning information on the components must be carefully observed!

3.5.6 Dimension drawings

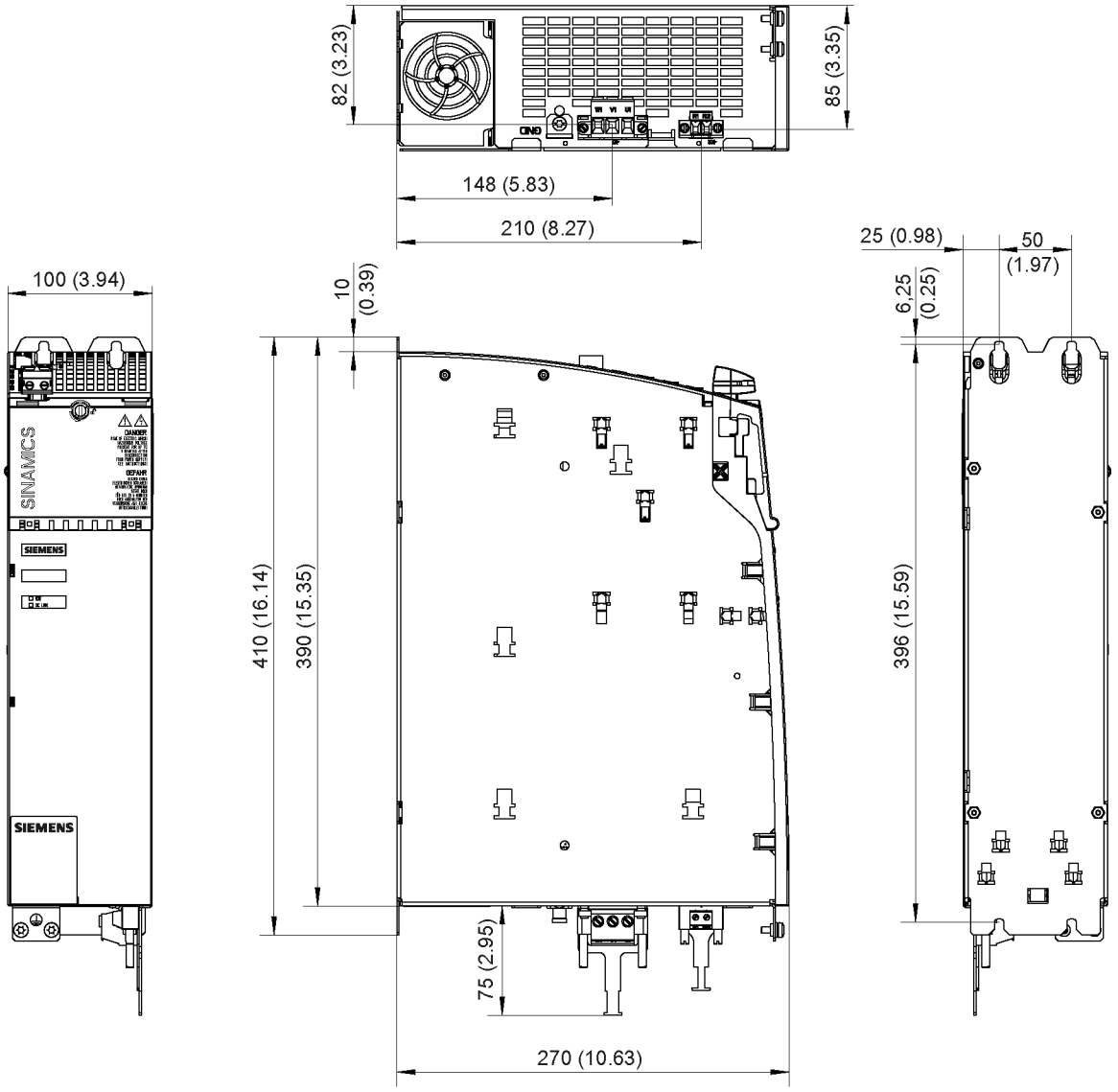


Figure 3-51 Dimension drawing of 20 kW Basic Line Module with internal air cooling, all dimensions in mm and (inches)

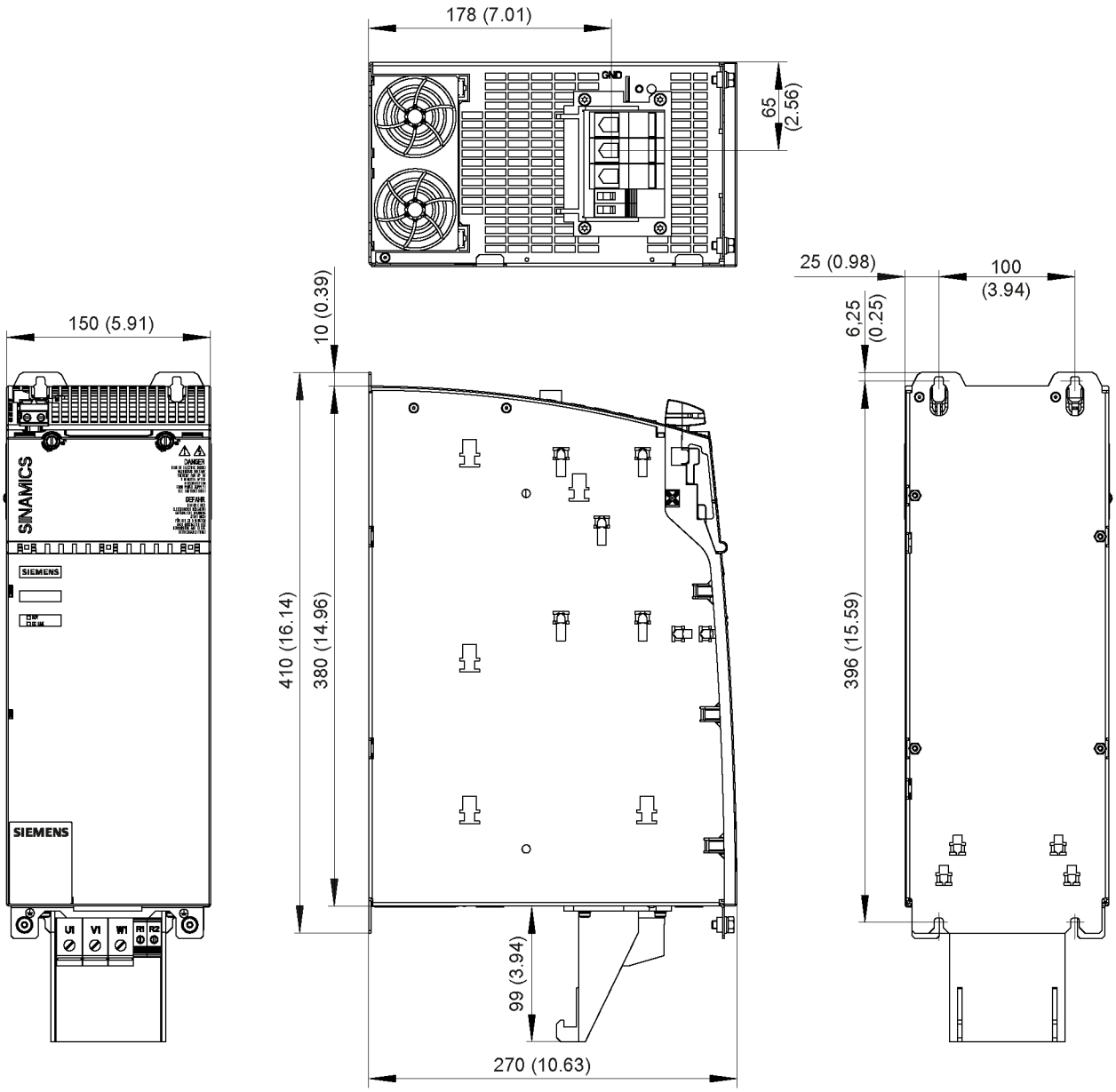


Figure 3-52 Dimension drawing of 40 kW Basic Line Module with internal air cooling, all dimensions in mm and (inches)

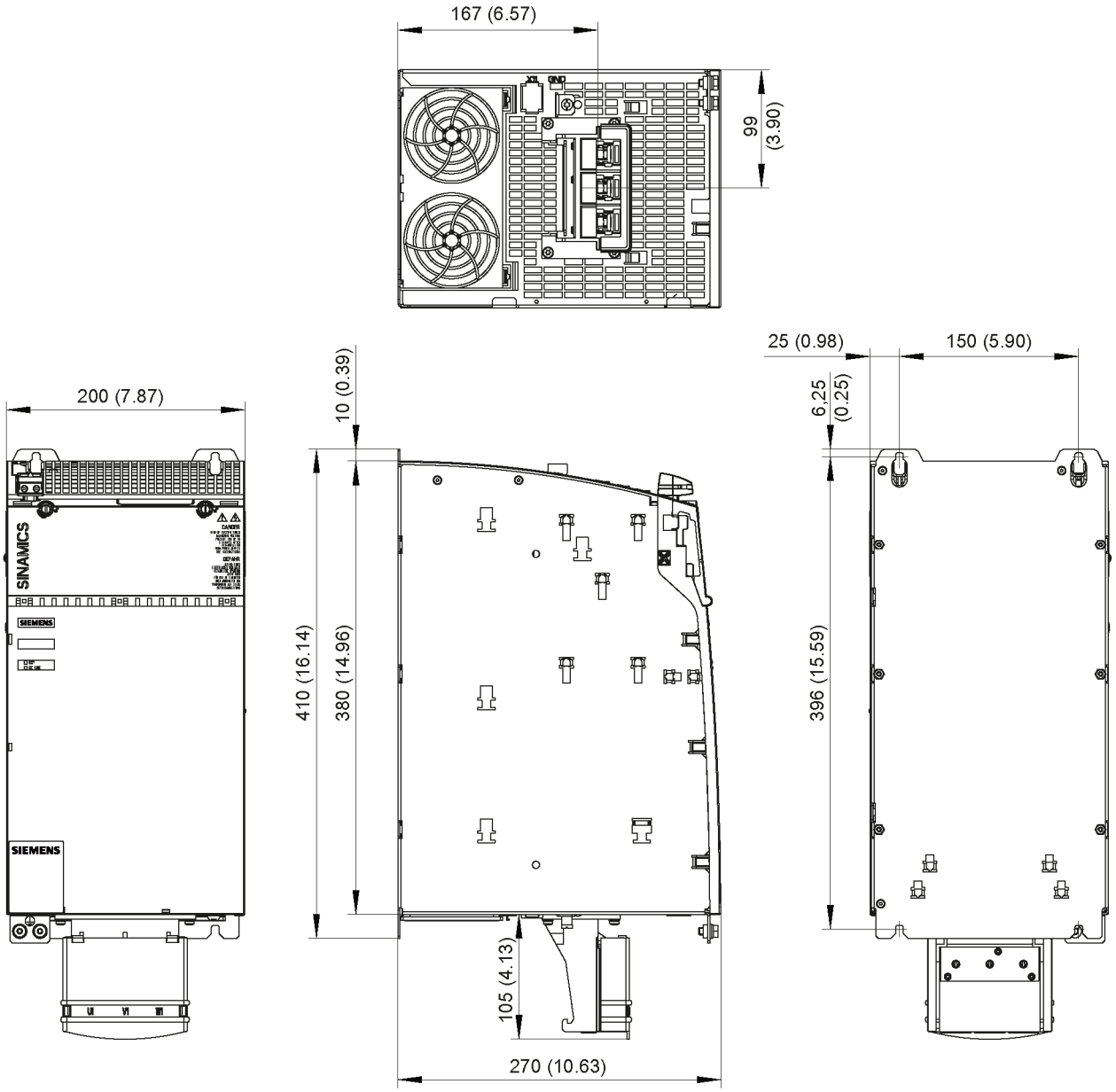
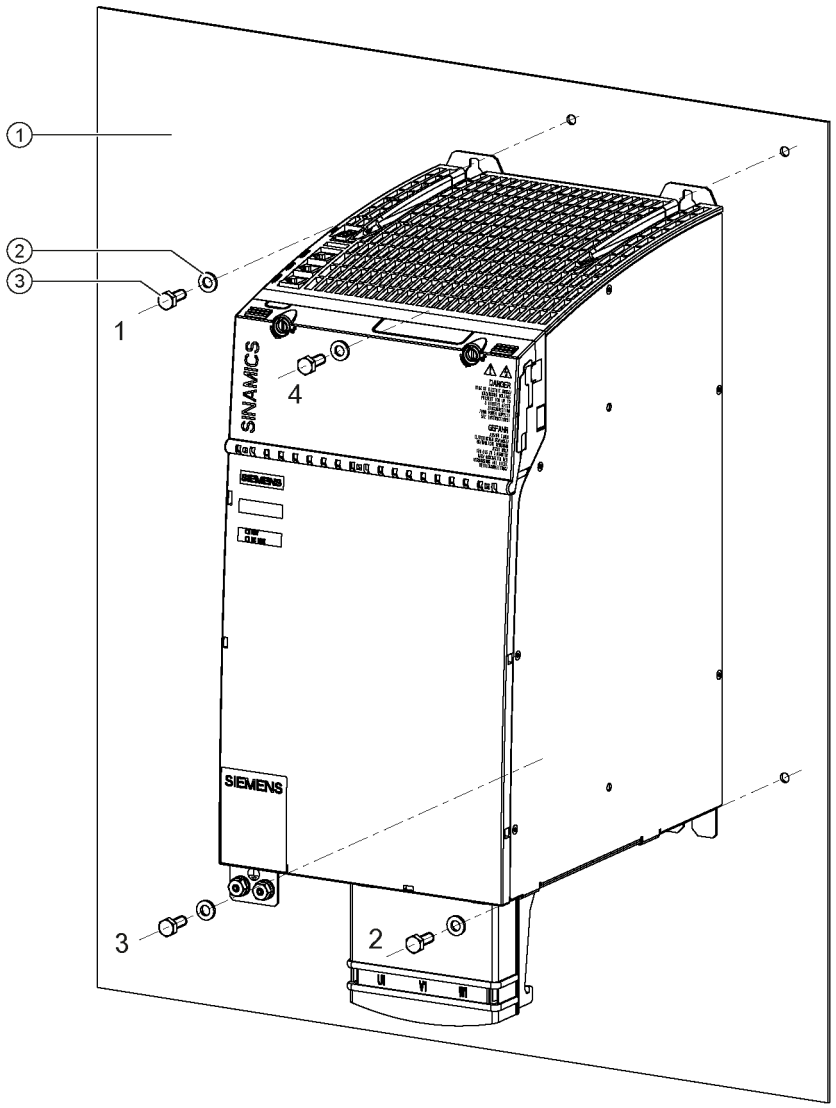


Figure 3-53 Dimension drawing of 100 kW Basic Line Module with internal air cooling, all dimensions in mm and (inches)

3.5.7 Installation

The Basic Line Modules are designed for installation in the control cabinet. They are fixed to the control cabinet panel or a mounting panel using M6 screws.



① Control cabinet panel/mounting panel
② Washer
③ M6 screw

Figure 3-54 Mounting a Basic Line Module with internal air cooling (example: 100 kW)

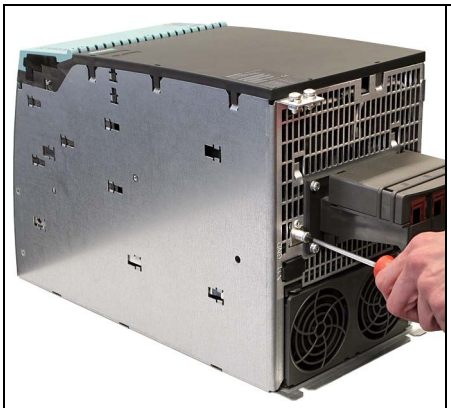
Tightening torques:

- Initially, tighten the nuts by hand (0.5 Nm)
- Then tighten with 6 Nm (in the specific sequence 1 to 4)

3.5.8 Operation on an isolated-neutral system (IT system)

To operate a 100 kW Basic Line Module on an isolated-neutral (IT) system, the connection bracket for the interference suppression capacitor must be removed. The connection bracket is located on the lower side of the component.

CAUTION
If the connection bracket for the interference suppression capacitor is not removed, an error message might be output via the insulation monitor in the system.

		
Remove the connection bracket for the interference-suppression capacitor with a Tx25 screwdriver.	Remove the connection bracket	Connection bracket for the interference-suppression capacitor

Note

Installing the connection bracket for the interference-suppression capacitor

For operation in other systems, the connection bracket must be reinstalled and fixed with a tightening torque of 1.8 Nm.

3.5.9 Technical data

Table 3- 50 Technical data: Basic Line Modules

Internal air cooling	6SL3130-	1TE22-0AA0	1TE24-0AA0	1TE31-0AA0
Rated power	kW	20	40	100
Infeed				
Rated power (S1) [1]	kW (P_n)	20	40	100
Infeed power (S6-40%) [1]	kW (P_{s6})	26	52	130
Peak infeed power [1]	kW (P_{max})	60	120	175
Braking power				
Continuous power	kW (P_n)	5	10	-
Peak power	kW (P_{max})	40	80	-
Supply voltages				
Line voltage	V_{ACrms}	3 AC 380 – 10% (-15% < 1 min) to 3 AC 480 + 10% [2]		
Line frequency	Hz	47 to 63		
Electronics power supply	V_{DC}	24 (20.4 – 28.8)		
DC link voltage	V_{DC}	480 – 720		
Overvoltage trip	V_{DC}	820 ± 2 %		
Undervoltage trip [3]	V_{DC}	360 ± 2 %		
Input currents				
Rated input current				
at 400 V_{AC}:	A_{AC}	33	66	166
Input current				
at 380 V_{AC} / 480 V_{AC}	A_{AC}	35 / 28	70 / 55	172 / 138
at 400 V_{AC}; S6-40%	A_{AC}	43	86	216
at 400 V_{AC}; peak current	A_{AC}	100	199	290
DC link currents				
Rated DC link current at 600 V:				
DC link current at 540 V:	A_{DC}	33.5	67	167
at 600 V_{DC}; S6-40%	A_{DC}	37	48	185
at 600 V_{DC}; peak current	A_{DC}	43	87	217
	A_{DC}	100	200	292
Current carrying capacity				
DC link busbar	A_{DC}	100	200	200
Reinforced DC link busbars:	A_{DC}	150	--	--
24 V busbar:	A_{DC}	20	20	20
Electronics current consumptionat 24 V DC	A_{DC}	1	1.4	2.0
Total power loss (including electronics losses) [4]	W	144	283.6	628
Max. ambient temperature				
Without derating	°C	40	40	40
With derating	°C	55	55	55
DC link capacitance				
Basic Line Module	µF	940	1880	4100
Drive line-up, max.	µF	20000	20000	50000
Power factor [5]	cosϕ	0.98	0.98	0.98

Internal air cooling	6SL3130-	1TE22-0AA0	1TE24-0AA0	1TE31-0AA0
Circuit breaker (UL)				
Type designation		3VL2106-2KN30	3VL2110-2KN30	3VL3125-2KN30
Rated current:	A	60	100	250
Resulting rated short-circuit current [7]				
SCCR at 480 V_{AC}:	kA	65	65	65
Safety fuse (UL)				
Type AJT Class J [6]		AJT60	AJT100	AJT250
Rated current	A	60	100	250
Resulting rated short-circuit current [7]				
SCCR at 480 V_{AC}:	kA	65	65	65
Cooling method (internal air cooling)		Internal fan	Internal fan	Internal fan
Sound pressure level	dB(A)	<60 dB	<65 dB	<65 dB
Cooling air requirement	m^3/h	56	112	180
Rated voltage for rated data 3 AC 380 V				
Weight	kg	6.8	11.3	15.8

1) The powers specified apply to the rated voltage range from 380 V to 480 V.

2) Can also be operated on supply systems with 200 to 240 V 3 AC ±10% with appropriate parameter assignment and reduced output.

3) Default for 400 V line supplies; undervoltage trip threshold is adjusted to the parameterized rated voltage.

4) For an overview, see the power loss tables in Chapter, Control cabinet installation

5) Fundamental component only

6) Source of supply: The Ferraz Shawmut company

7) The resulting rated short-circuit current is obtained from the combination of the fuse, or circuit breaker, and the Line Module in the drive system.

3.5.9.1 Characteristics

Rated duty cycles for Basic Line Modules

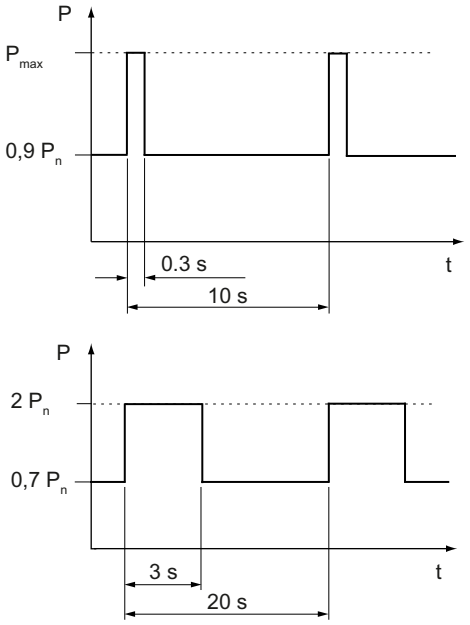


Figure 3-55 Duty cycles with initial load

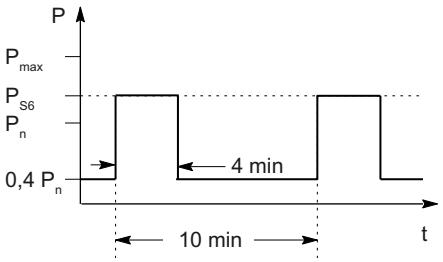


Figure 3-56 S6 duty cycle with pre-load condition

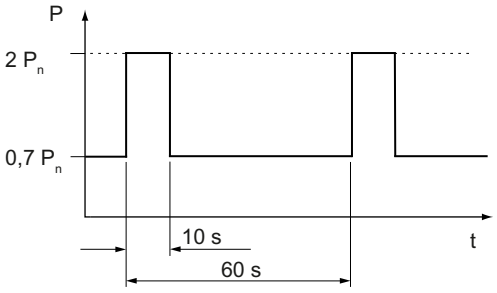


Figure 3-57 Duty cycle with pre-load condition for 20 kW and 40 kW Basic Line Modules

Braking duty cycle for Basic Line Modules

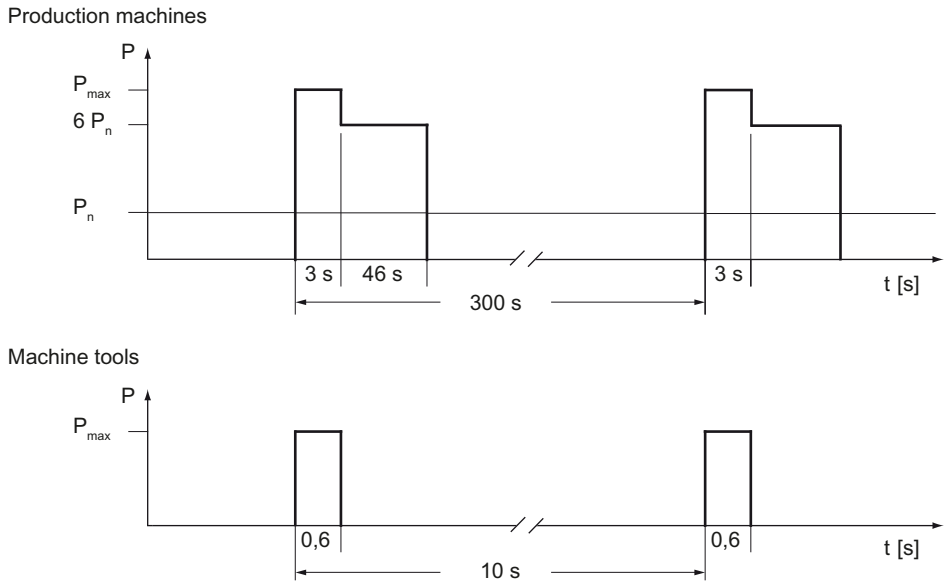


Figure 3-58 Braking duty cycle for Basic Line Modules

Derating characteristics

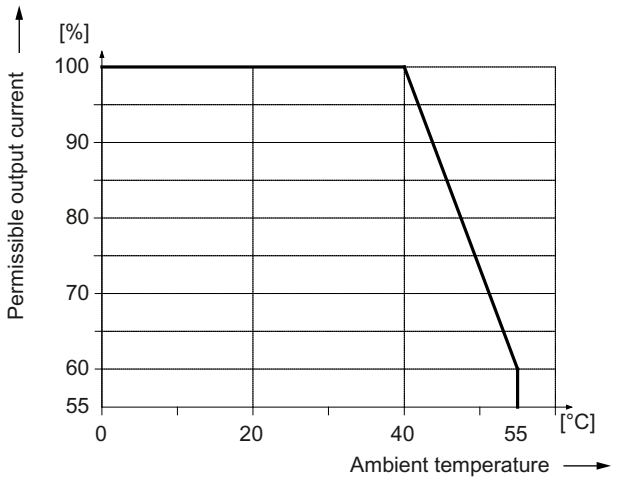


Figure 3-59 Output current as a function of the ambient temperature

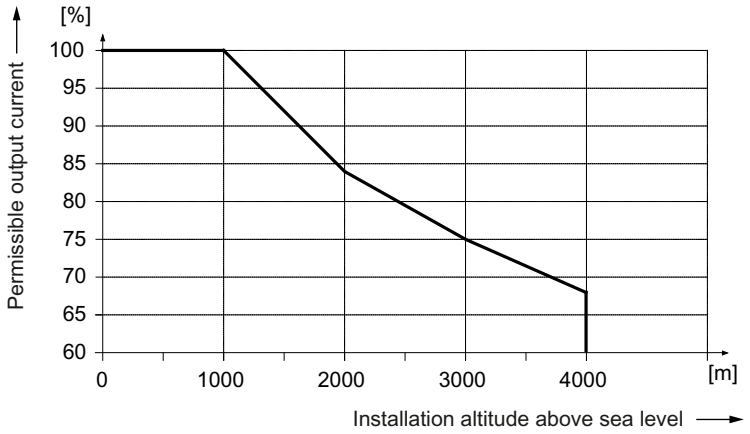


Figure 3-60 Output current as a function of the installation altitude

At installation altitudes >2000 m, an insolating transformer must be used (see "System overview/Derating as a function of the installation altitude and ambient temperature"). The design of the secondary line supply system must be as follows:

- TN system with grounded star point (no grounded outer conductor)
- IT system

A reduction of the line supply voltage phase-phase is not necessary.

3.6 Basic Line Modules with cold plate

3.6.1 Description

The Basic Line Modules generate a non-regulated DC voltage, which matches the rectified line input voltage, from the 3-phase line voltage and feed this DC voltage into the DC link. One Basic Line Module can supply one or more Motor Modules with power via the DC link.

To reduce the energy, e.g. for emergency retraction, the 20 kW and 40 kW Basic Line Modules feature a control for an external braking resistor.

For 100 kW Basic Line Modules, an external braking unit is required for degradation of energy. Either Braking Modules Booksize Compact (also in parallel circuit) or a MASTERDRIVES braking unit (see chapter "Braking units for 100 kW Basic Line Modules") can be used.

Basic Line Modules are suitable for direct operation on TN, TT, and IT systems.

The 100 kW Basic Line Module features basic interference suppression, the 20 kW and 40 kW Basic Line Modules do not.

The ratio of line short-circuit power to rated power must be ≥ 30.

The maximum total signal cable length is as follows

- For all Basic Line Modules with upstream Basic Line Filter
  - 350 m shielded for radio interference voltage category C2
  - 630 m shielded for radio interference voltage category C3
- For 100 kW Basic Line Modules without upstream Basic Line Filter
  - 350 m for radio interference voltage category C3
- For all Basic Line Modules without maintaining the limit values
  - 630 m shielded
  - 1000 m shielded with Voltage Clamping Module

3.6.2 Safety information

⚠ DANGER

Risk of electric shock

A hazardous voltage is present for up to 5 minutes after the power supply has been disconnected.
The protective cover may only be opened after this time has expired.

When opening the protective cover for the DC link, you must press the release catch. A suitable tool (e.g. screwdriver or supplied unlocking tool) must be used for this purpose.

The components must only be operated when the protective cover of the DC link is closed. Damaged components must not be operated further, otherwise this could result in secondary damage or accidents.

⚠ DANGER

DC-link discharge time

The DC-link discharge time warning in the relevant national language must be attached to all of the components.
A set of labels in 16 languages is supplied with the component.

⚠ DANGER

In the interests of operator and fire protection, the power supply conditions in terms of short-circuit power and loop impedance at the infeed point must be such that they will trip the installed overcurrent protection devices within the prescribed period if a fault occurs (short circuit or short circuit to exposed conductive part).

Note

Line short-circuit power at the infeed point

The line short-circuit power at the infeed point must be at least 30 times greater than the rated power of the Line Module in order to limit the line harmonics to an acceptable level for other loads.

⚠ DANGER

The drive components generate high leakage currents in the protective conductor. The components must only be operated in cabinets or in closed electrical operating areas and must be connected with the protective conductor. To protect against electric shock, the protective conductor connection at the control cabinet or machine must be implemented in accordance with one of the following measures:

- Fixed connection and protective conductor connection by means of ≥ 10 mm^2 Cu or ≥ 16 mm^2 Al
- Fixed connection and automatic disconnection of the supply system if the protective conductor is interrupted

⚠ DANGER

It is only permissible to establish connections to the DC link using the adapters that SIEMENS has recommended (DC link adapter and DC link rectifier adapter).

⚠ CAUTION

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

CAUTION

The correct tightening torque of the DC link busbar screws (1.8°Nm, tolerance +30%) must be checked before commissioning with the complete system in a voltage-free state (powered-down) and with the DC link discharged. After transportation, the screws must be tightened.

CAUTION

The overall length of the power cables (motor supply cables and DC link cables) must not exceed the values given in the chapter titled "Possible line reactor and line filter combinations".

CAUTION

Only cables from Siemens may be used for DRIVE-CLiQ connections.

CAUTION

DC link side covers are supplied with the components as standard and must be attached to the first and last components in the drive line-up. They can also be ordered separately, if required (order number: 6SL3162-5AA00-0AA0).

3.6.3 Interface description

3.6.3.1 Overview

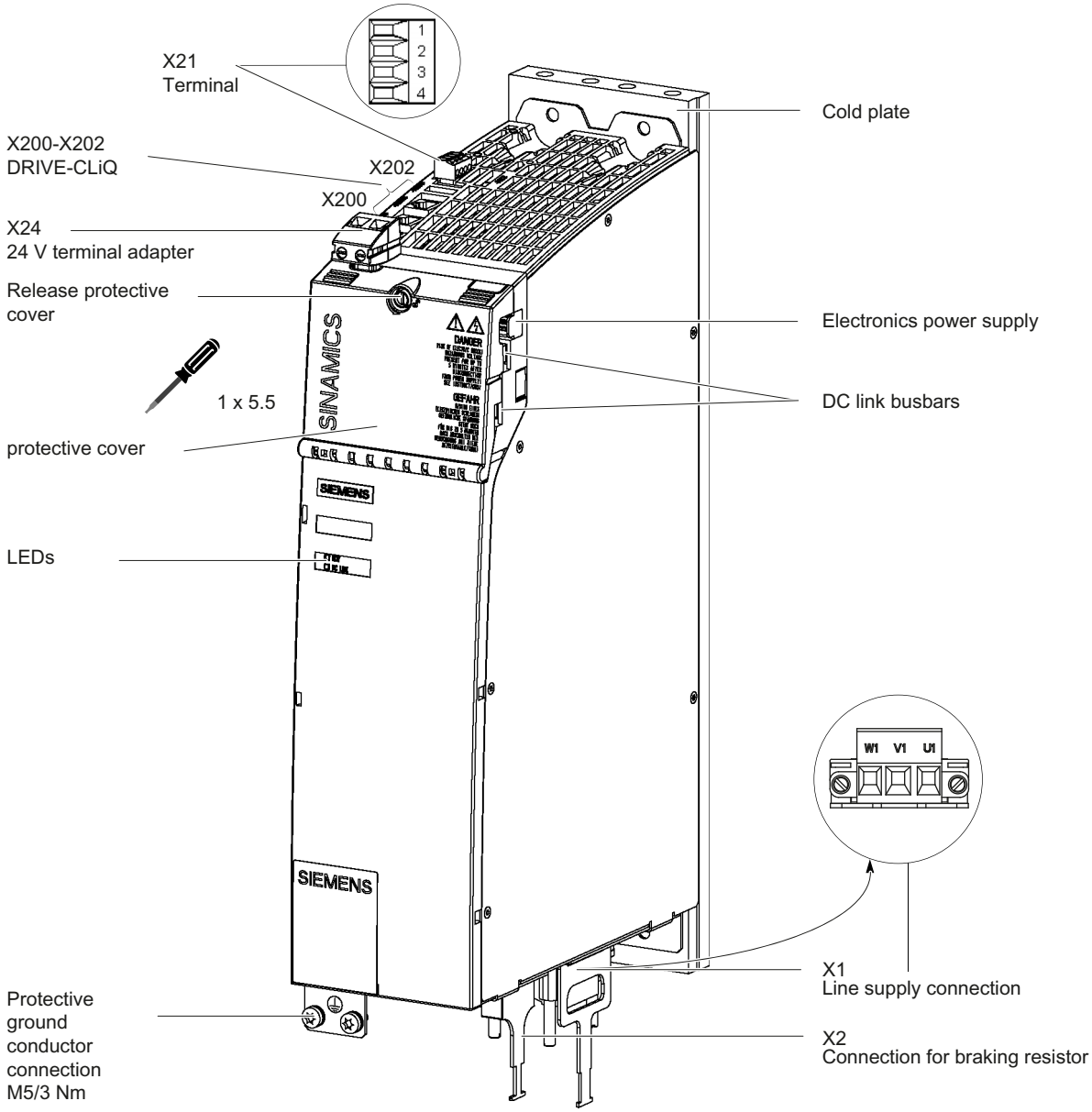
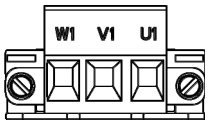
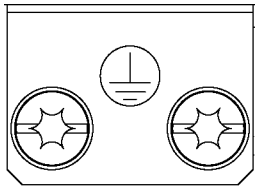


Figure 3-61 Interface overview, Basic Line Module with cold plate (example: 20 kW)

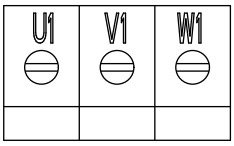
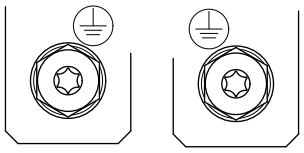
3.6.3.2 X1 line connection

Table 3- 51 X1: Line supply connection for Basic Line Modules 20 kW

	Terminal	Technical specifications
	U1 V1 W1	Supply voltage: 380 V - 480 V 3 AC, 50/60 Hz Max. connectable cross-section: 16 mm^2 Type: Screw terminal 7 Tightening torque: 1.5 - 1.7 Nm (see Chapter, "Control cabinet installation/connection system")
	PE connection	Threaded hole M5/3 Nm 1)

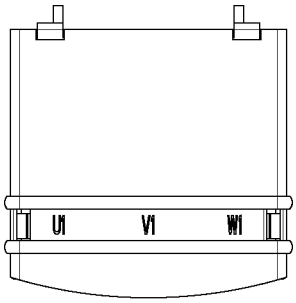
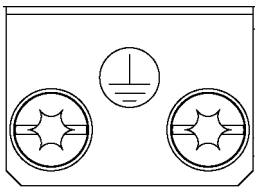
1) For ring cable lugs in accordance with DIN 46234

Table 3- 52 X1: Line supply connection for Basic Line Modules 40 kW

	Terminal	Technical specifications
	U1 V1 W1	Supply voltage: 380 V - 480 V 3 AC, 50/60 Hz Max. connectable cross-section, 50 mm², end sleeves Tightening torque, min. 6 Nm
	PE connection	Threaded hole M6 / 6 Nm 1)

1) For ring cable lugs in accordance with DIN 46234

Table 3- 53 X1: Line supply connection for Basic Line Modules 100 kW

	Terminal	Technical specifications
	U1 V1 W1	Supply voltage: 380 V - 480 V 3 AC, 50/60 Hz Max. connectable cross-section: 120 mm^2 Type: Threaded bolts M8 1) Tightening torque: 13 Nm
	PE connection	Threaded hole M6 / 6 Nm 1)

1) For ring cable lugs in accordance with DIN 46234

3.6.3.3 X2 braking resistor connection

Table 3- 54 X2: Braking resistor connection at the Basic Line Module 20 kW

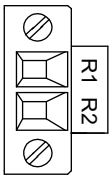
	Terminal	Designation	Technical specifications
	1	Braking resistor connection R1	Max. connectable cross-section: 4 mm²
	2	Braking resistor connection R2	Type: Screw terminal 4 (see the chapter titled "Control cabinet installation/Connection system") Tightening torque: 0.5 - 0.6 Nm

Table 3- 55 X2: Braking resistor connection at the Basic Line Module 40 kW

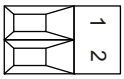
	Terminal	Designation	Technical specifications
	1	Braking resistor connection R1	Max. connectable cross-section: 10 mm²
	2	Braking resistor connection R2	Type: Screw terminal 6 (see the chapter titled "Control cabinet installation/Connection system") Tightening torque: min 1.5 - 1.8 Nm

Table 3- 56 Braking resistors with a thermostatic switch for 20 kW and 40 kW Basic Line Modules

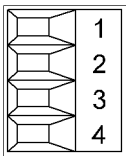
Braking resistor	R in Ω	P_N in kW	4 x P_N in kW	P_{max} in kW
6SE7018-0ES87-2DC0	80	1.25	5	7.5
6SE7021-6ES87-2DC0	40	2.5	10	15
6SE7023-2ES87-2DC0	20	5	20	30
6SE7028-0ES87-2DC0 1)	8	12.5	50	75

1) Not suitable for 20 kW Basic Line Module

For detailed technical information on the braking resistors, see the chapter titled "Braking resistors".

3.6.3.4 X21 EP terminals

Table 3- 57 X21 EP terminal/temperature sensor

	Terminal	Designation	Technical specifications
	1	+ Temp	Temperature sensors[1]: KTY84-1C130[2]/PTC[2]/bimetallic switch with NC contact With the 20 kW and 40 kW Basic Line Modules, the temperature sensor of the braking resistor (bimetallic switch with NC contact) is connected to the temperature input. **Response thresholds** of the temperature input: Temperature at the braking resistor in the operating range → resistance value ≤ 100 ohms Overtemperature at the braking resistor → resistance value > 100 ohms **Fault reactions**: An alarm is output and the Basic Line Module is deactivated with a fault after one minute, if overtemperature is still present at the braking resistor. If there is no braking resistor, terminals 1 and 2 must be jumpered to deactivate the overtemperature.
	2	- Temp	
	3	EP +24 V (Enable Pulses)	Voltage 24 VDC Current consumption: 10 mA Isolated input Signal propagation times: L → H: 100 µs H → L: 1000 µs
	4	EP M (Enable Pulses)	
Max. connectable cross-section: 1.5 mm^2 Type: Screw terminal 1 (see Chapter, "Control cabinet installation and EMC/connection system")			

1) The temperature sensor type can be selected via parameter p0601; the temperature is displayed via r0035 (see SINAMICS S120/S150 List Manual LH1).

2) Temperatures are detected but not evaluated in the Basic Line Module.

⚠WARNING

For operation, the 24 V DC voltage must be connected to terminal 3 and ground to terminal 4. When removed, the bypass relay drops out. If the Line Module is not disconnected from the supply system when the EP terminal is deactivated (e.g. a line contactor is not installed), the DC link remains charged.

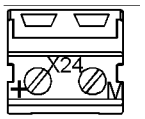
⚠DANGER

If the temperature switch is not connected, this can cause the resistor to overheat.

⚠ 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) or Terminal Module TM120 must be used. If these instructions are not complied with, there is a risk of electric shock!

3.6.3.5 X24 24 V terminal adapter

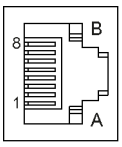
Table 3- 58 X24 24 V terminal adapter

	Terminal	Designation	Technical specifications
	+	24 V power supply	24 V DC supply voltage
	M	Ground	Electronics ground
Max. connectable cross-section: 6 mm² Type: Screw terminal 5 (see Chapter, "Control cabinet installation and EMC/connection system")			

The 24 V terminal adapter is included in the scope of supply.

3.6.3.6 X200-X202 DRIVE-CLiQ interfaces

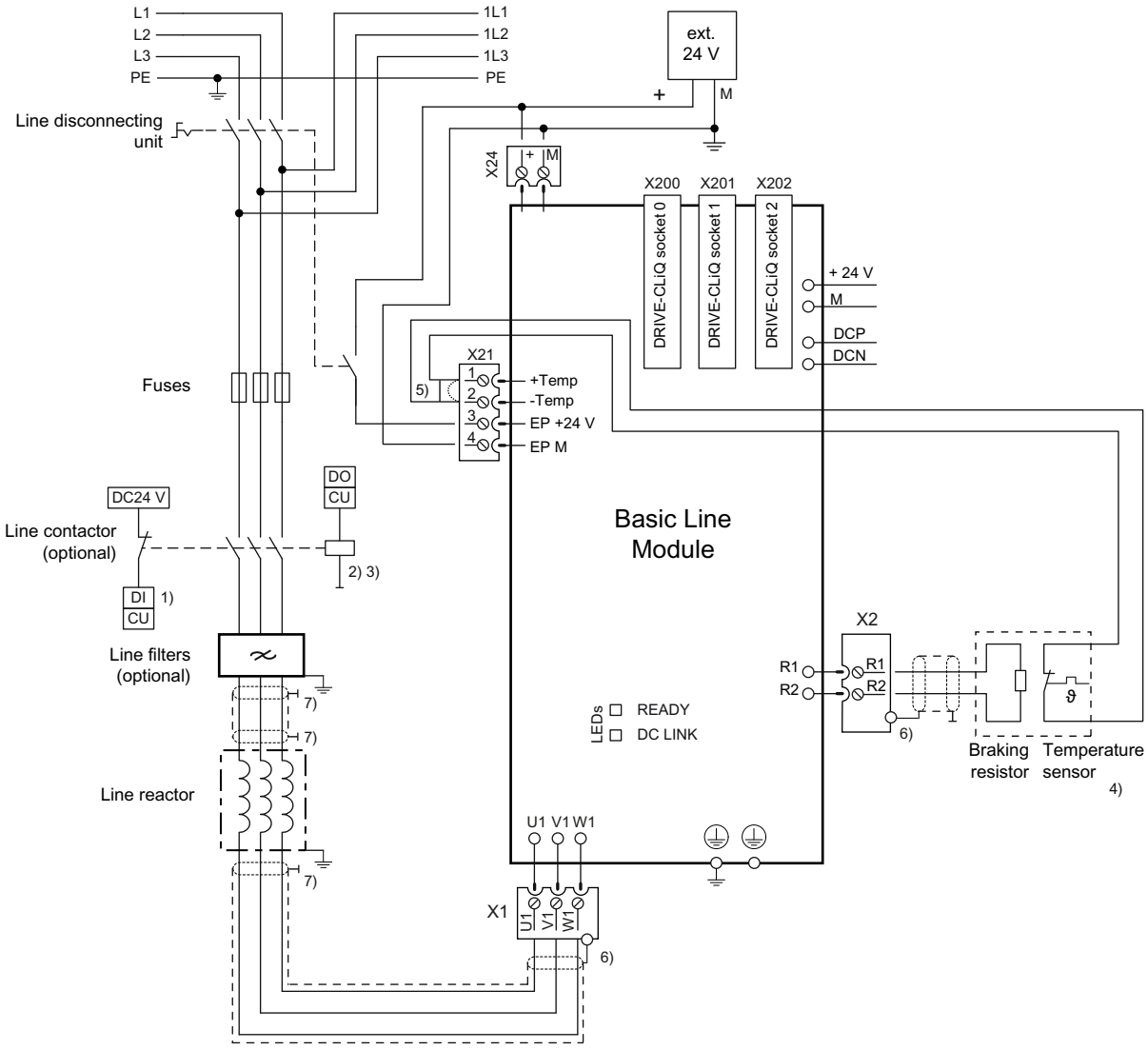
Table 3- 59 X200-X202 DRIVE-CLiQ interfaces

	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

The blanking covers for the DRIVE-CLiQ interfaces are included in the scope of delivery.

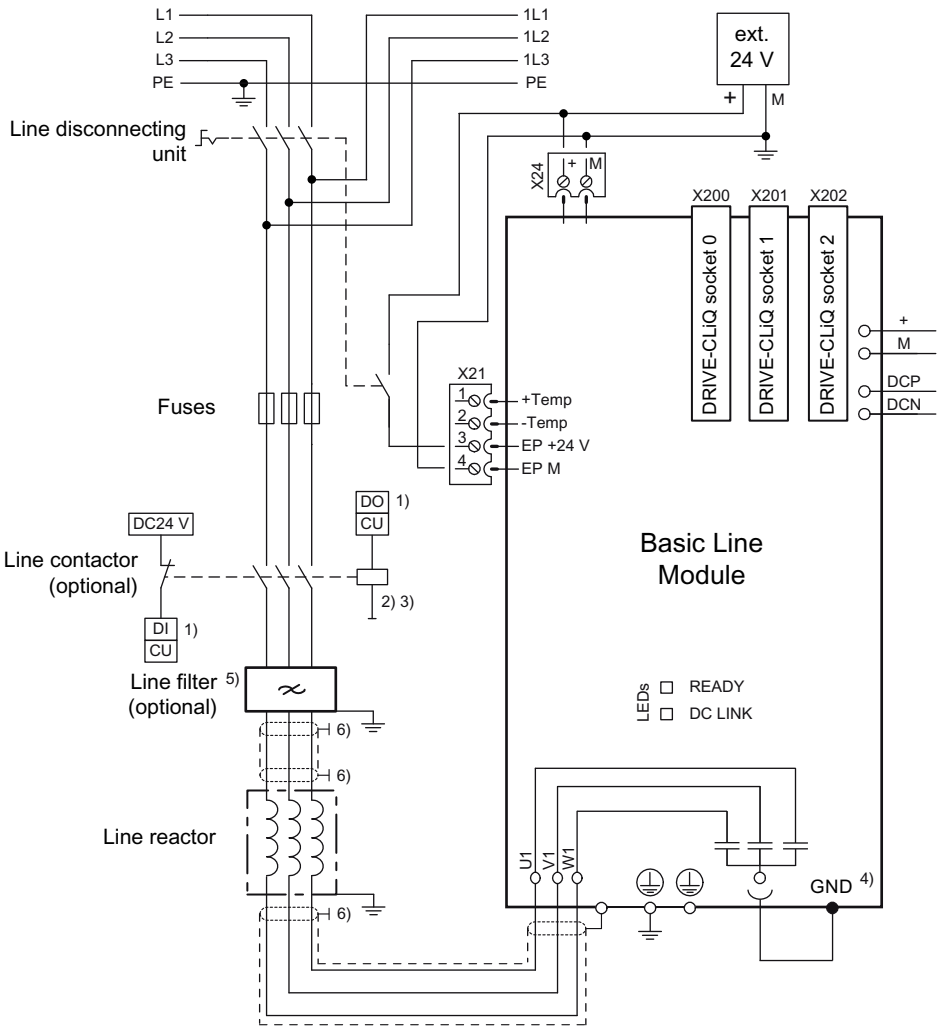
Blanking cover (50 pcs.) Order number: 6SL3066-4CA00-0AA0

3.6.4 Connection examples



1) DI/DO, controlled from the Control Unit
2) No additional load permitted downstream of line contactor!
3) The current carrying capacity of the digital output (DO) must be observed; an output interface must be used if required.
4) The bimetallic switch with wiring must not exceed a resistance value of 100 ohms in the closed state.
5) Jumper for switching off the temperature monitoring for the braking resistor.
6) Contact via connector (20 kW) or shield plate (40 kW).
7) Contact via rear mounting panel or shielding buses in accordance with EMC installation guideline.

Figure 3-62 Connection example: Basic Line Module (20 kW and 40 kW)



1) DI/DO, controlled from the Control Unit
2) No additional load permitted downstream of line contactor!
3) The current carrying capacity of the DO must be observed; an output interface must be used if required.
4) When operating the component on an IT system, the connecting bar must be removed.
5) Line filter is required in order to maintain radio interference voltage according to category C2.
6) Contact via rear mounting panel or shielding buses in accordance with EMC installation guideline.

Figure 3-63 Connection example: Basic Line Module (100 kW)

3.6.5 Meaning of LEDs

Table 3- 60 Meaning of the LEDs on the Basic Line Module

Status		Description, cause	Remedy
RDY	DC LINK		
Off	Off	Electronics power supply is missing or outside permissible tolerance range.	–
Green	--	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.	Check the line voltage.
Orange	Orange	DRIVE-CLiQ communication is being established.	–
Red	--	At least one fault is present in this component. **Note:** The LED is activated regardless of whether the corresponding messages have been reconfigured.	Remedy and acknowledge fault.
Green/ red (0.5 Hz)	--	Firmware is being downloaded.	–
Green/red (2 Hz)	--	Firmware download is complete. Wait for POWER ON.	Carry out a POWER ON
Green/orange or Red/orange	--	Component detection via LED is activated (p0124). **Note:** Both options depend on the LED status when component recognition is activated via p0124 = 1.	–

⚠ DANGER

Hazardous DC link voltages may be present at any time regardless of the status of the "DC LINK" LED.
The warning information on the components must be carefully observed!

3.6.6 Dimension drawings

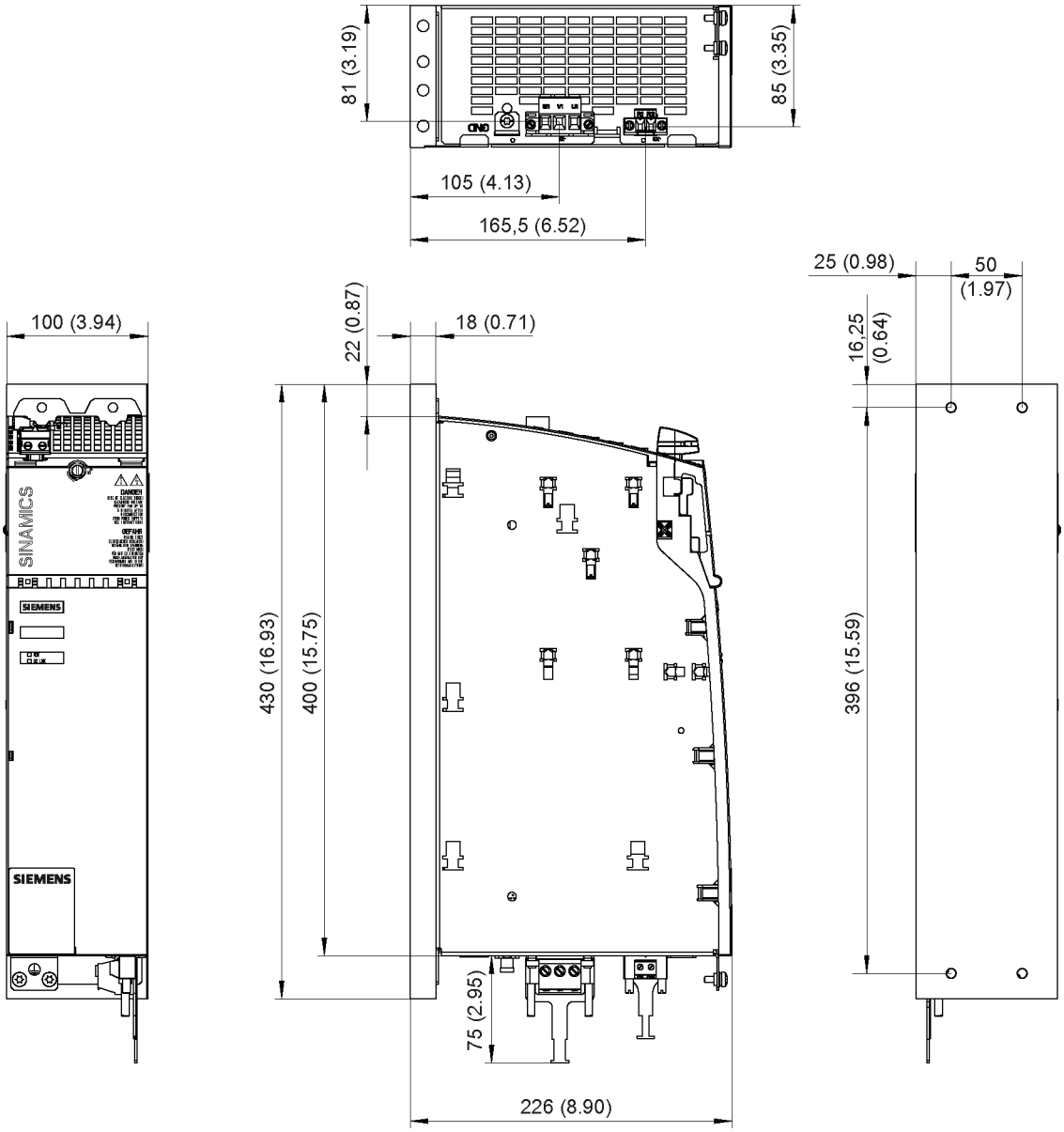


Figure 3-64 Dimension drawing of 20 kW Basic Line Module with cold plate, all dimensions in mm and (inches)

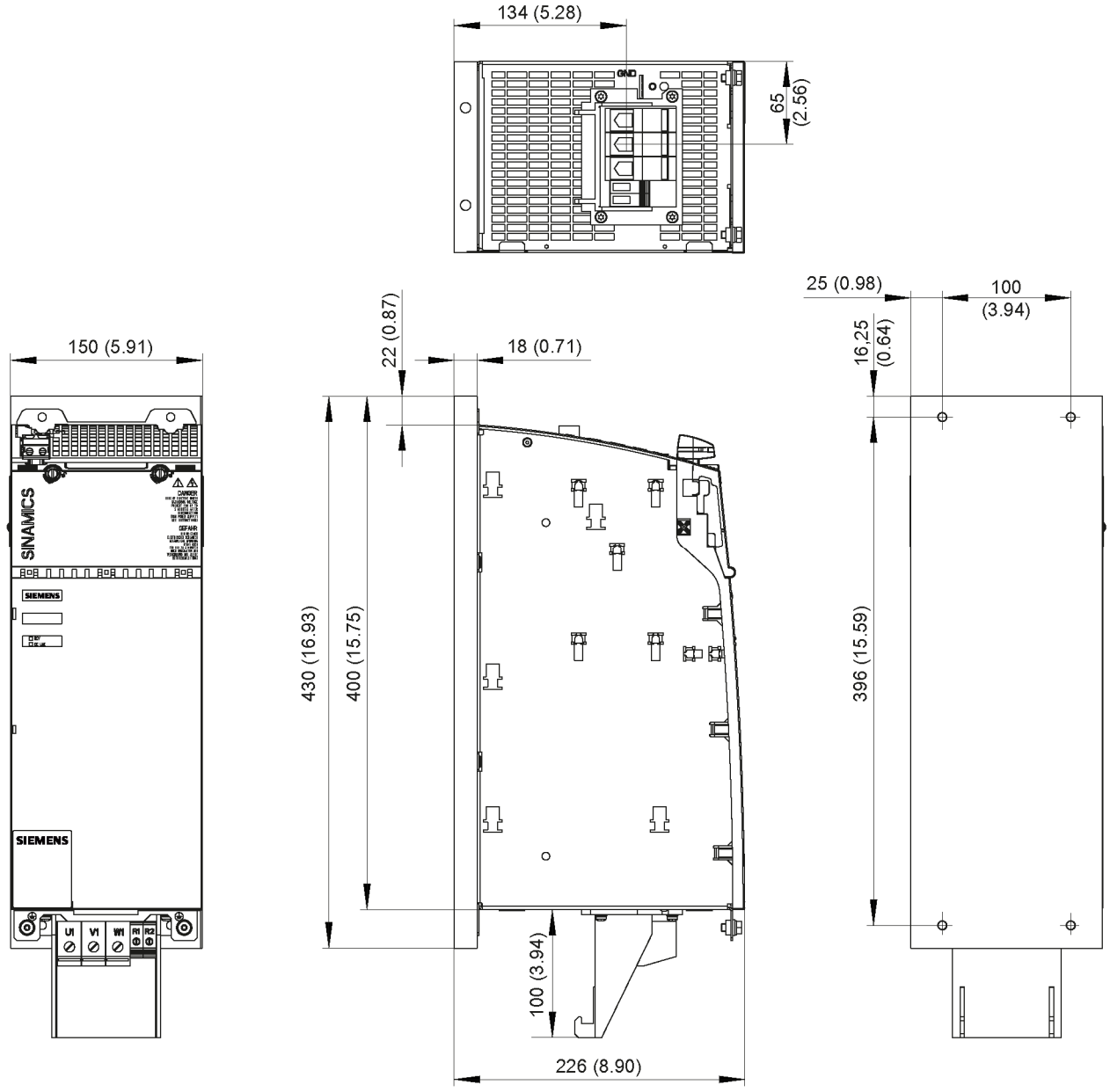


Figure 3-65 Dimension drawing of 40 kW Basic Line Module with cold plate, all dimensions in mm and (inches)

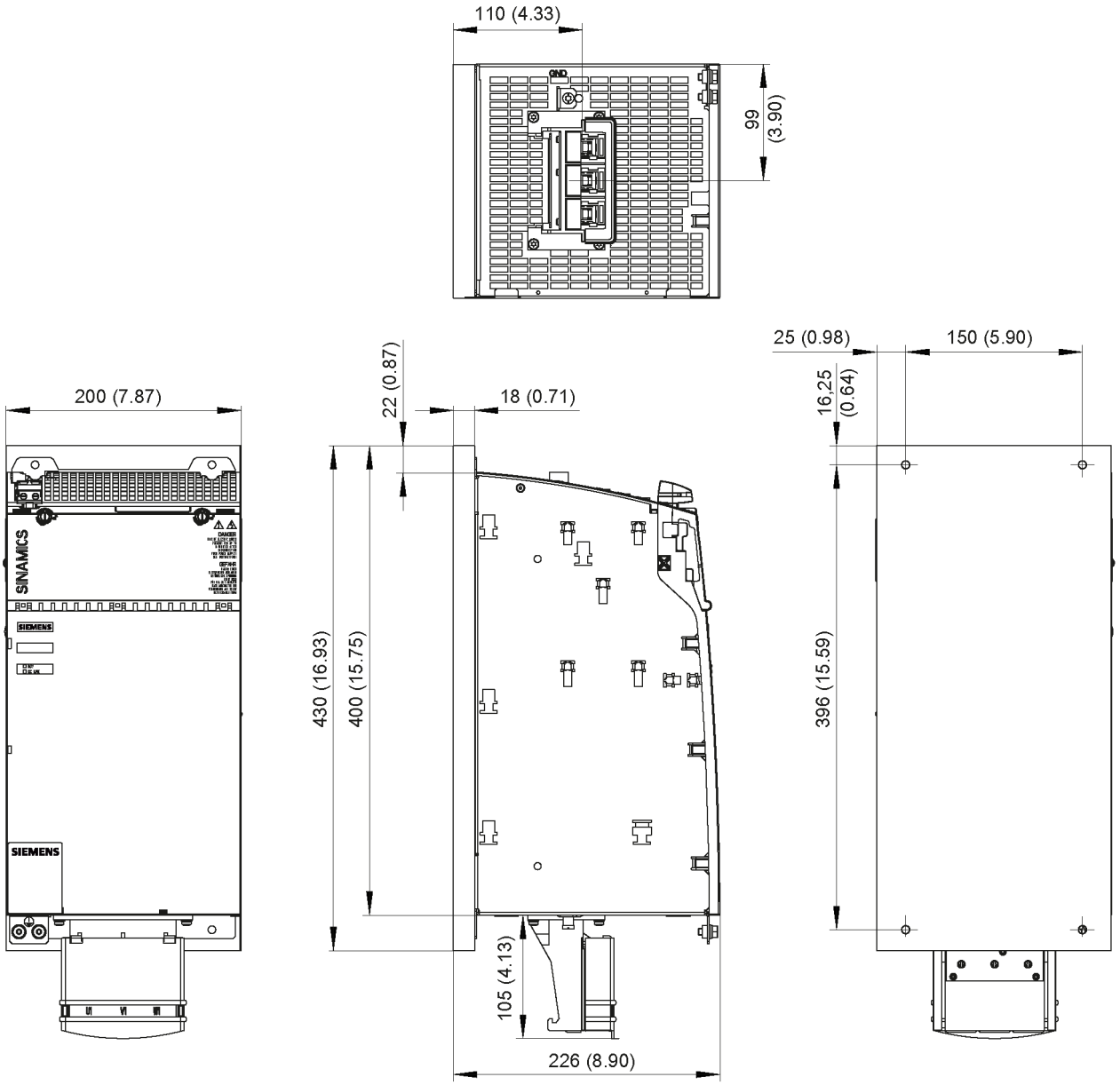


Figure 3-66 Dimension drawing of 100 kW Basic Line Module with cold plate, all dimensions in mm and (inches)

3.6.7 Installation

Please note the following before installing a Basic Line Module with cold plate on a customer-specific heat sink:

- Before the installation, check the surface of the heat sink to ensure that it is not damaged.
- To improve heat transfer, a heat-conducting medium must be used. Special spherical-indented heat-conducting foil must be used for this purpose. Every Basic Line Module cold plate is supplied with heat-conducting foil cut to the right size. Note the mounting position of the heat-conducting foil (see figures below).

Note

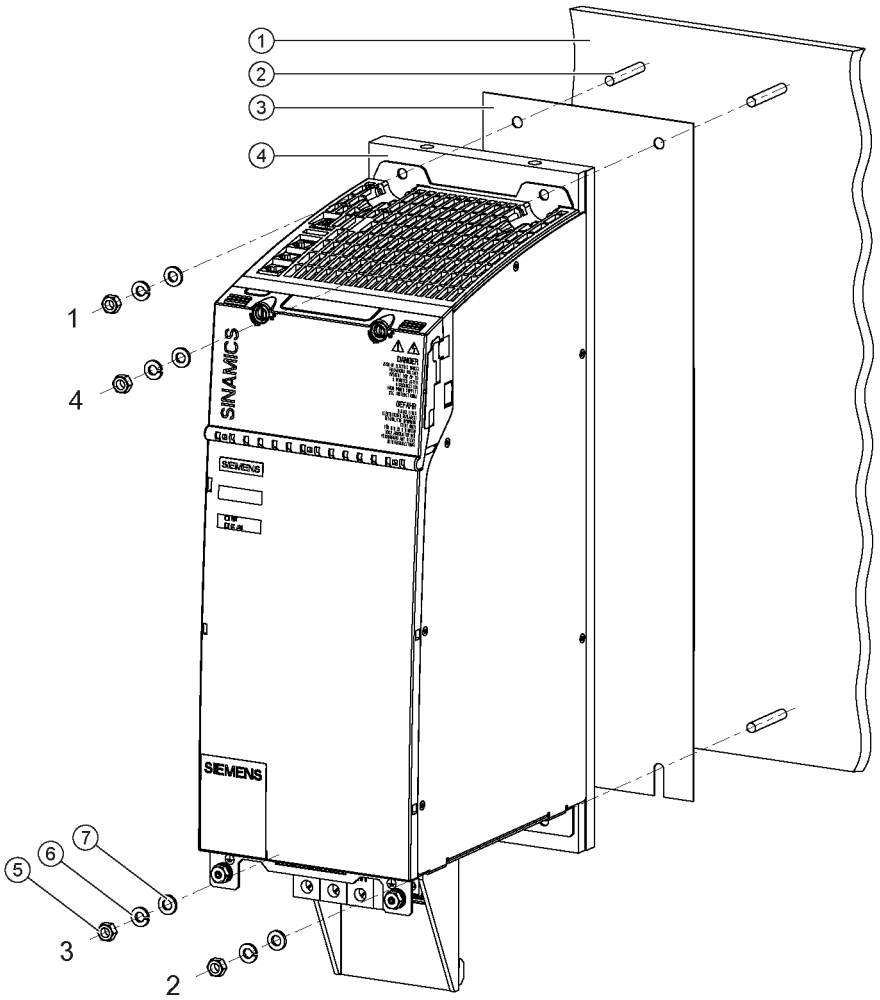
When a component is replaced, the heat-conducting foil must also be replaced. Only heat-conducting foil approved or supplied by Siemens may be used.

Table 3- 61 Overview of heat-conducting foils

	Order number
Heat-conducting foil, 100 mm	6SL3162-6FD00-0AA0
Heat-conducting foil, 150 mm	6SL3162-6FF00-0AA0
Heat-conducting foil, 200 mm	6SL3162-6FH00-0AA0

Note

M6 screw bolts and hexagon nuts/grub screws (ISO 7436-M6x40-14 H, property class 8.8) are recommended for installing the components.

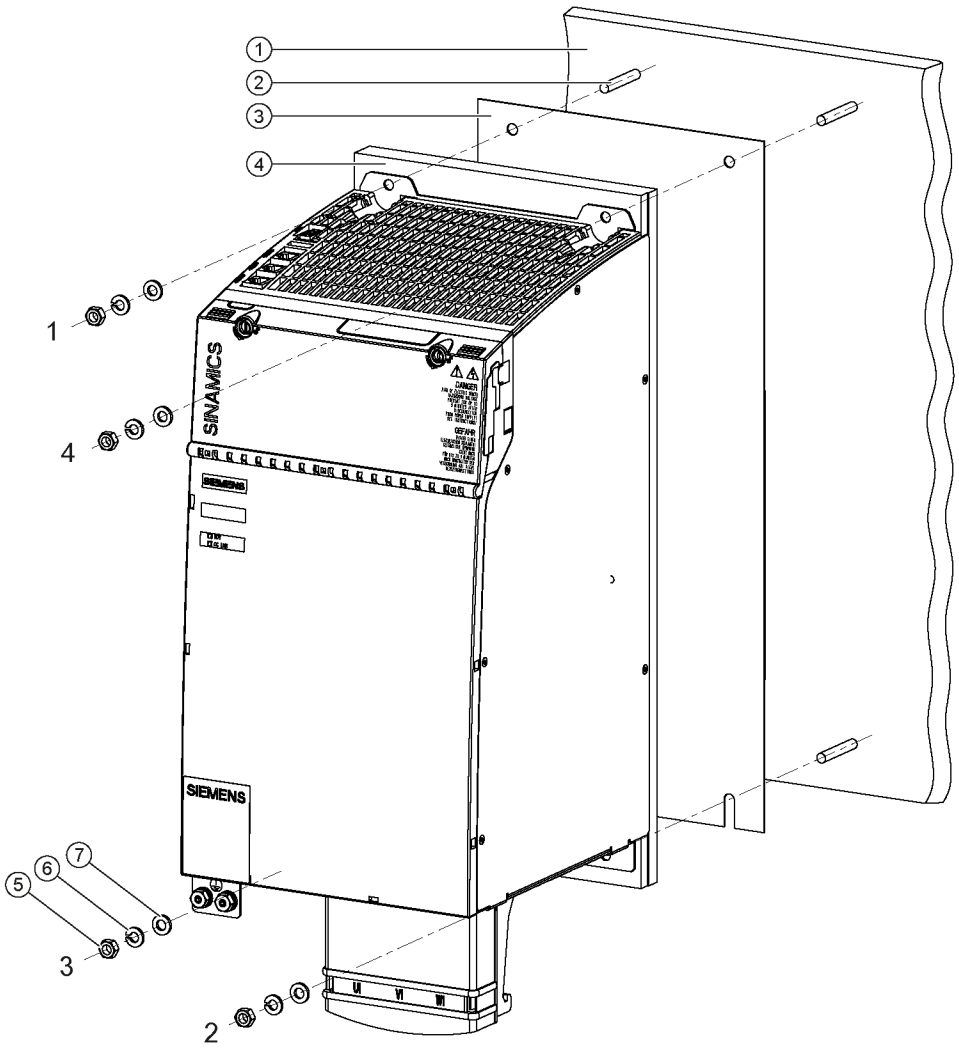


① External heat sink
② M6 studs
③ Heat-conducting foil
④ Cold plate
⑤ M6 nut
⑥ Spring washer
⑦ Washer

Figure 3-67 Mounting a Basic Line Module 40 kW with cold plate on an external heat sink

Tightening torques:

- Initially, tighten the nuts by hand (0.5 Nm)
- Then tighten with 10 Nm (in the specific sequence 1 to 4)



① External heat sink
② M6 studs
③ Heat-conducting foil
④ Cold plate
⑤ M6 nut
⑥ Spring washer
⑦ Washer

Figure 3-68 Mounting a Basic Line Module 100 kW with cold plate on an external heat sink

Tightening torques:

- Initially, tighten the nuts by hand (0.5 Nm)
- Then tighten with 10 Nm (in the specific sequence 1 to 4)

Help with the mechanical control cabinet installation is available from:

Siemens AG
Industry Sector, IA SE WKC
TCCCC (Technical Competence Center Cabinets Chemnitz)
P.O. Box 1124
09070 Chemnitz, Germany

E-mail: cc.cabinetcooling.aud@siemens.com

Properties of the heat sink

AlMgSi 0.5 is recommended as the heat sink material.
The roughness of the external heat sink surface should be at least Rz 16 and the contact surface between the heat sink and cold plate should have an evenness of 0.2 mm (applicable to a height of 450 mm and width of 300 mm).

Note

The machine manufacturer can adapt the heat sink version to his special requirements. The specified rated data for the Power Modules can only be achieved if the power losses can be dissipated by the external heat sink under the specified general conditions.

NOTICE

During the installation, you must ensure that the threaded bolts do not damage the cold plate.

3.6.8 Operation on an isolated-neutral system (IT system)

To operate a 100 kW Basic Line Module on an isolated-neutral (IT) system, the connection bracket for the interference suppression capacitor must be removed. The connection bracket is located on the lower side of the component.

CAUTION
If the connection bracket for the interference suppression capacitor is not removed, an error message might be output via the insulation monitor in the system.

		
Remove the connection bracket for the interference-suppression capacitor with a Tx25 screwdriver.	Remove the connection bracket	Connection bracket for the interference-suppression capacitor

Note

Installing the connection bracket for the interference-suppression capacitor

For operation in other systems, the connection bracket must be reinstalled and fixed with a tightening torque of 1.8 Nm.

3.6.9 Technical data

Table 3- 62 Technical data for Basic Line Modules with cold plate cooling

	6SL3136-	1TE22-0AA0	1TE24-0AA0	1TE31-0AA0
Rated power	**kW**	**20**	**40**	**100**
Infeed				
Rated power (S1) [1]	kW (P_n)	20	40	100
Infeed power (S6-40%) [1]	kW (P_{s6})	26	52	130
Peak infeed power [1]	kW (P_{max})	60	120	175
Braking power				
Continuous power	kW (P_n)	5	10	-
Peak power	kW (P_{max})	40	80	-
Supply voltages				
Line voltage	V_{ACrms}	3 AC 380 10 % (-15 % < 1 min) to 3 AC 480 10 %		
Line frequency	Hz	47 to 63		
Electronics power supply	V_{DC}	24 (20.4 - 28.8)		
DC link voltage	V_{DC}	510 – 720		
Overvoltage trip	V_{DC}	820 ± 2 %		
Undervoltage trip [2]	V_{DC}	360 ± 2 %		
Rated input currents				
at 380 V_{AC}	A_{AC}	34.5	69	172
at 480 V_{AC}/528 V_{AC}	A_{AC}	31 / 29	62 / 58	154 / 145
at 480 V; S6-40%	A_{AC}	38	78	193
Peak current (at 400 V_{AC}/480 V_{AC})	A_{AC}	113 / 91	208 / 172	265 / 252
DC link currents				
Rated DC link current at 600 V:	A_{DC}	33.5	67	167
DC link current at 540 V:	A_{DC}	37	48	185
at 600 V_{DC}; at S6-40%	A_{DC}	43	87	217
at 600 V_{DC}; peak current	A_{DC}	100	200	292
Current carrying capacity				
DC link busbar	A_{ACrms}	100	200	200
Reinforced DC link busbars:	A_{ACrms}	150	--	--
24 V busbar:	A_{ACrms}	20	20	20
Electronics current consumption at 24 V DC	A_{DC}	0.9	1.1	1.6
Total power loss (incl. electronics losses) [6]	W	141.6	276.4	618.4
DC link capacitance				
Basic Line Module	µF	940	1880	4100
Drive line-up, max.	µF	20000	20000	20000
Power factor [3]	cosϕ	approx. 0.98	approx. 0.98	approx. 0.98
Circuit breaker (UL)				
Type designation		3VL2106-2KN30	3VL2110-2KN30	3VL3125-2KN30
Rated current:	A	60	100	250
Resulting rated short-circuit current [5]				
SCCR at 480 V_{AC}:	kA	65	65	65

	6SL3136-	1TE22-0AA0	1TE24-0AA0	1TE31-0AA0
Safety fuse (UL)				
Type AJT Class J [4]		AJT60	AJT100	AJT250
Rated current	A	60	100	250
Resulting rated short-circuit current [5]				
SCCR at 480 V_{AC}:	kA	65	65	65
Max. permissible heat-sink temperature	°C	65	70	70
Max. ambient temperature				
Without derating	°C	40	40	40
With derating	°C	55	55	55
Weight	kg	6.4	10.9	16.4

1) The powers specified apply to the rated voltage range from 380 V to 480 V.

2) Default for 400 V line supplies; undervoltage trip threshold is adjusted to the parameterized rated voltage.

3) Fundamental component only

4) Source of supply: The Ferraz Shawmut company

5) The resulting rated short-circuit current is obtained from the combination of the fuse, or circuit breaker, and the Line Module in the drive system.

6) For an overview, see the power loss tables in Chapter, Control cabinet installation

3.6.9.1 Characteristics

Rated duty cycles for Basic Line Modules

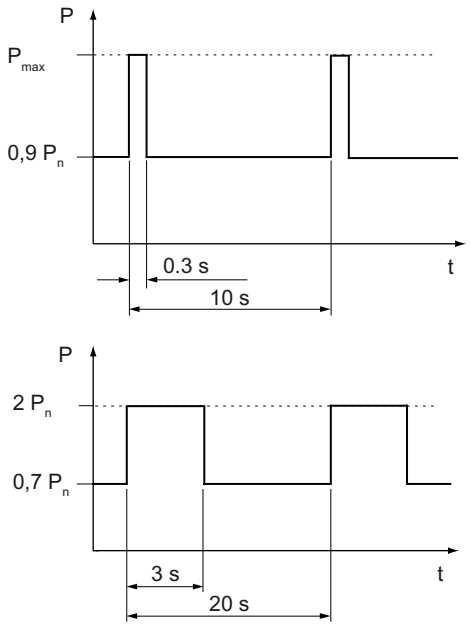


Figure 3-69 Duty cycles with initial load

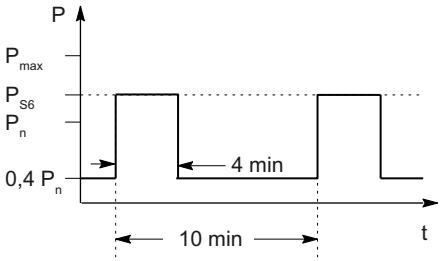


Figure 3-70 S6 duty cycle with pre-load condition

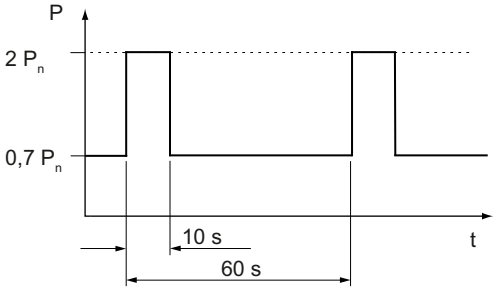


Figure 3-71 Duty cycle with pre-load condition for 20 kW and 40 kW Basic Line Modules

Braking duty cycle for Basic Line Modules

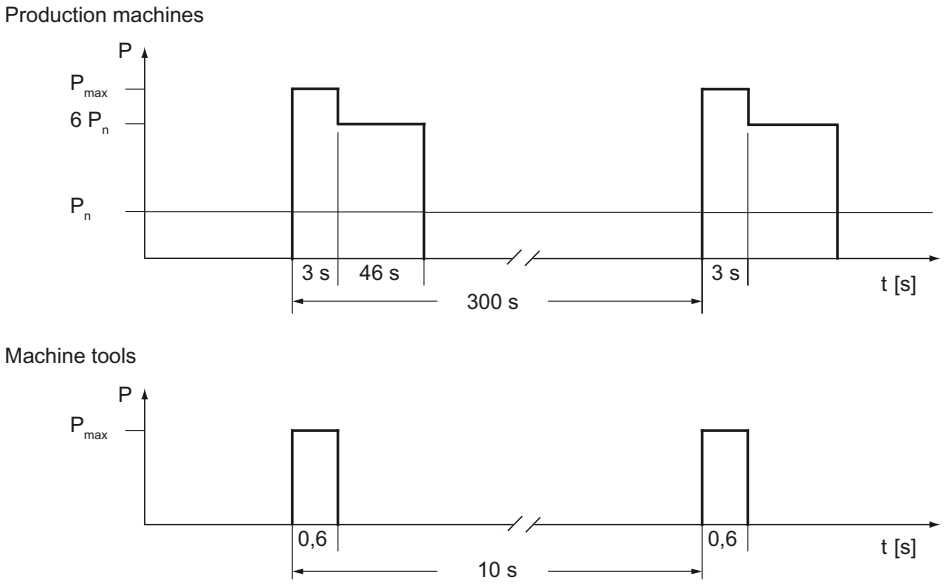


Figure 3-72 Braking duty cycle for Basic Line Modules

Derating characteristics

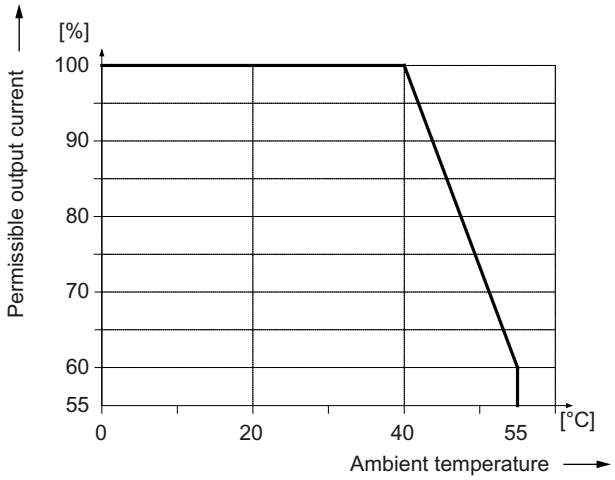


Figure 3-73 Output current as a function of the ambient temperature

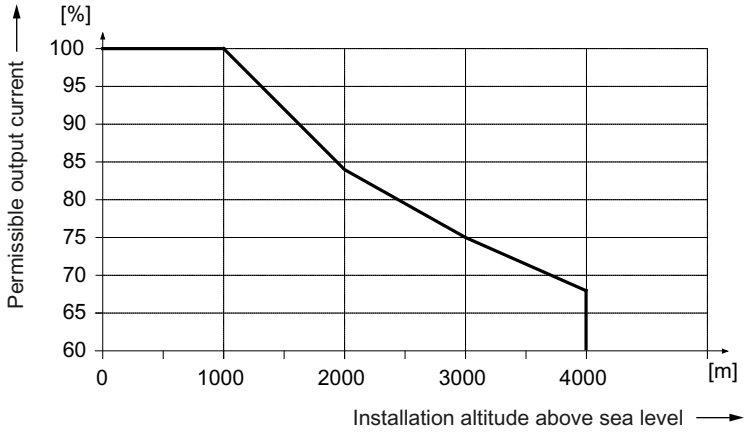


Figure 3-74 Output current as a function of the installation altitude

At installation altitudes >2000 m, an insolating transformer must be used (see "System overview/Derating as a function of the installation altitude and ambient temperature"). The design of the secondary line supply system must be as follows:

- TN system with grounded star point (no grounded outer conductor)
- IT system

A reduction of the line supply voltage phase-phase is not necessary.

3.7 Smart Line Modules with internal air cooling

3.7.1 Description

The Smart Line Module is a non-regulated infeed/regenerative feedback unit. The Smart Line Module supplies the Motor Module(s) with a non-regulated DC voltage at the DC output. In the infeed mode the Smart Line Module exhibits the typical current and voltage waveforms of a 6-pulse diode rectifier bridge.

In feedback mode, the current waveform is square waved. Regenerative feedback can be deactivated if required. On 5 kW and 10 kW Smart Line Modules, this is done via a terminal, since these modules do not feature a DRIVE-CLiQ connection. On 16 kW to 55 kW Smart Line Modules, regenerative feedback can be deactivated via parameters, as, just like Active Line Modules, these modules are equipped with a DRIVE-CLiQ connection.

The DC link starts precharging as soon as the supply voltage is applied and is independent of its phase sequence direction. Load can be applied to the DC link after the module has been enabled. An optional main contactor is required for disconnecting the voltage.

Smart Line Modules are suitable for direct operation on TN, IT, and TT systems. The modules have an integrated overvoltage protection function.

3.7.2 Safety Information

⚠DANGER

Risk of electric shock

A hazardous voltage is present for up to 5 minutes after the power supply has been disconnected.
The protective cover may only be opened after this time has expired.

You must use a suitable tool (slot-head screwdriver) to open the protective cover on the DC link.

The components must only be operated when the protective cover of the DC link is closed. Damaged components must not be operated further, otherwise this could result in secondary damage or accidents.

⚠DANGER

DC link discharge time

A DC link discharge time danger notice in the local language must be attached to the components.
A set of labels in 16 languages is supplied with the component.

⚠DANGER

In the interests of operator and fire protection, the power supply conditions in terms of short-circuit power and loop impedance at the infeed point must be such that they will trip the installed overcurrent protection devices within the prescribed period if a fault occurs (short circuit or short circuit to exposed conductive part).

Note

Line short-circuit power at the infeed point

The line short-circuit power at the infeed point must be at least 70 times greater than the rated power of the Line Module in order to limit the line harmonics to an acceptable level for other loads.

⚠DANGER

DC link

If the Line Module is not disconnected from the supply system (e.g. via the line contactor or main switch), the DC link remains charged.

⚠DANGER

Deactivating the regenerative feedback capability

For line supplies without regenerative feedback capability (e.g. diesel generator), the regenerative feedback capability of the Smart Line Modules must be deactivated.

- 5 kW and 10 kW Smart Line Modules: jumper between terminals X22.1 and X22.2, as well as ground at X22.4
- 16 kW to 55 kW Smart Line Modules: via parameter p3533

In this case, the braking energy must be dissipated via an additional Braking Module with braking resistor provided in the drive line-up.

⚠DANGER

It is only permissible to establish connections to the DC link using the adapters that SIEMENS has recommended (DC link adapter and DC link rectifier adapter).

⚠DANGER

If a 50 mm wide Motor Module or a 50 mm wide DC link component (e.g. Braking Module, Control Supply Module, Voltage Clamping Module) is located at the left-hand end of the drive line-up, then the DC link bridges, including all of the screws, must be removed from this component. It is not permissible to insert the screws without a DC link bridge.

For all other components that are 75 mm wide or wider, it is neither permissible to move the DC link bridge to the left nor to remove it.

If this is not carefully observed, this can result in damage and accidents.

⚠ CAUTION

The 80 mm clearances above and below the components must be observed.

CAUTION

It is essential that a particular switch-on and switch-off sequence is followed in order to control the 5 kW and 10 kW Smart Line Modules; if this sequence is not observed, the Smart Line Module could be damaged beyond repair. To prevent the SLM being destroyed, the "Ready" signal must be evaluated at output terminal X21.1.

Switch on:

- 24 V DC power supply X24 ON
- Line contactor ON
- EP signal X21 pins 3 and 4 ON
- Wait until precharging is complete
- "Ready" signal at terminal X21 pin 1 set to "high"
- Infeed is ready, pulse enable possible for motors

Switch off:

- Shut drives down
- Cancel pulse enable for motors (OFF1 signal)
- EP signal X21 pins 3 and 4 OFF
- Line contactor OFF
- 24 V DC power supply X24 OFF

Overload:

- "Prewarning" signal at terminal X21 pin 2 set to "low"
- Shut drives down via the control system
- "Ready" signal at terminal X21 pin 1 set to "low"
- Pulse inhibit for all the drives supplied by this infeed within 4 ms

CAUTION

The correct tightening torque of the DC link busbar screws (1.8°Nm, tolerance +30%) must be checked before commissioning with the complete system in a voltage-free state (powered-down) and with the DC link discharged. After transportation, the screws must be tightened.

CAUTION

The overall length of the power cables (motor supply cables and DC link cables) must not exceed the values given in the chapter titled "Possible line reactor and line filter combinations".

CAUTION
DC link side covers are supplied with the components as standard and must be attached to the first and last components in the drive line-up. They can also be ordered separately, if required (order number: 6SL3162-5AA00-0AA0).

CAUTION
Only cables from Siemens may be used for DRIVE-CLiQ connections.

NOTICE
Operation without the line reactor is not permissible.

Note

Smart Line Modules have been designed for use in the industrial environment and generate current harmonics on the line side as a result of the rectifier circuit.

When connecting a machine with integrated Smart Line Modules to the public low-voltage network, authorization is required in advance from the local power supply company (utility company) if

- The rated current of the machine ≤ 16 A per conductor, and
- The rated machine current does not comply with the requirements specified in EN 61000-3-2 regarding current harmonics.

3.7.3 Interface description

3.7.3.1 Overview

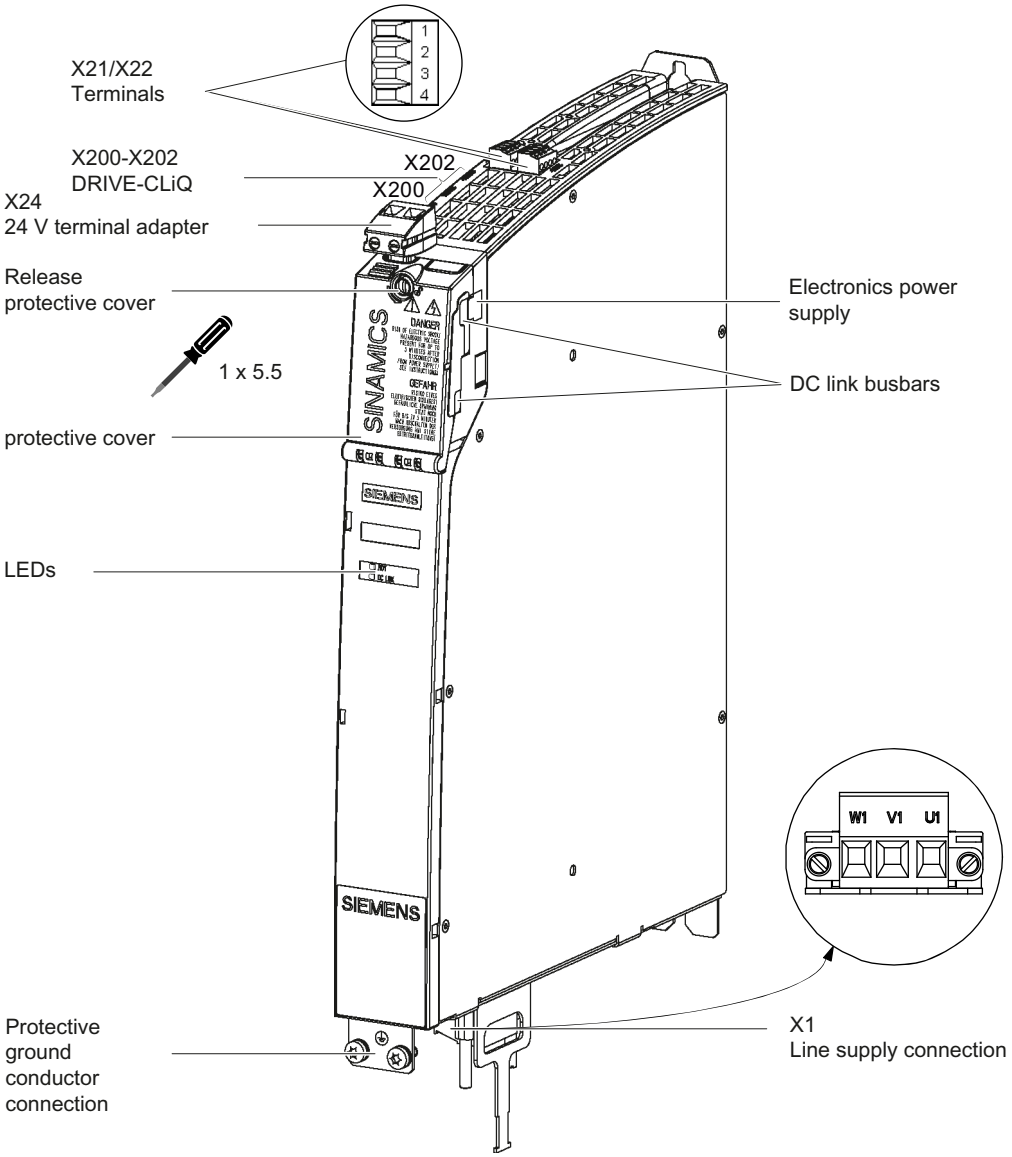


Figure 3-75 Interface overview, 5 kW and 10 kW Smart Line Modules with internal air cooling (example: 5 kW)

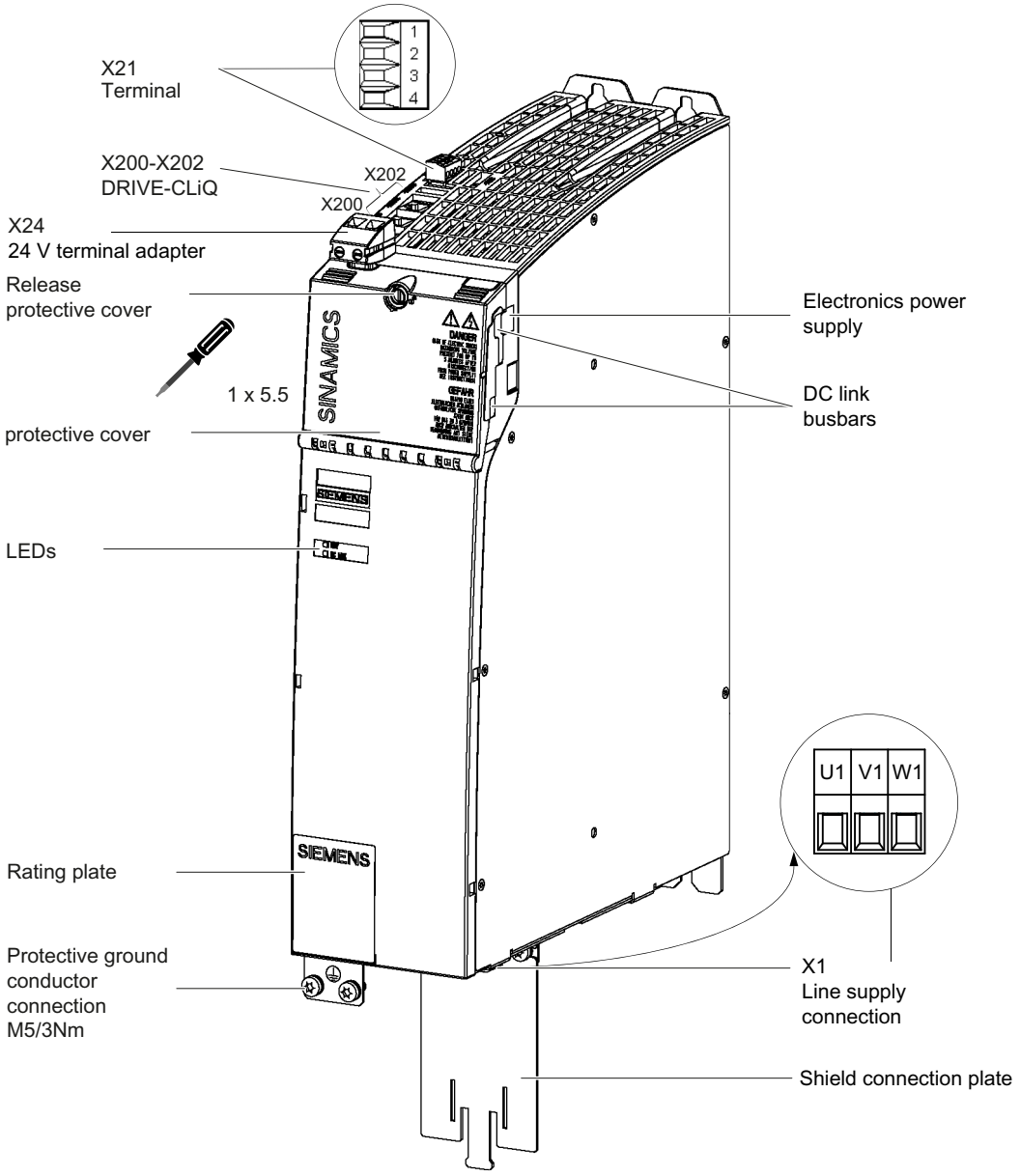


Figure 3-76 Interface overview, 16 kW Smart Line Module with internal air cooling

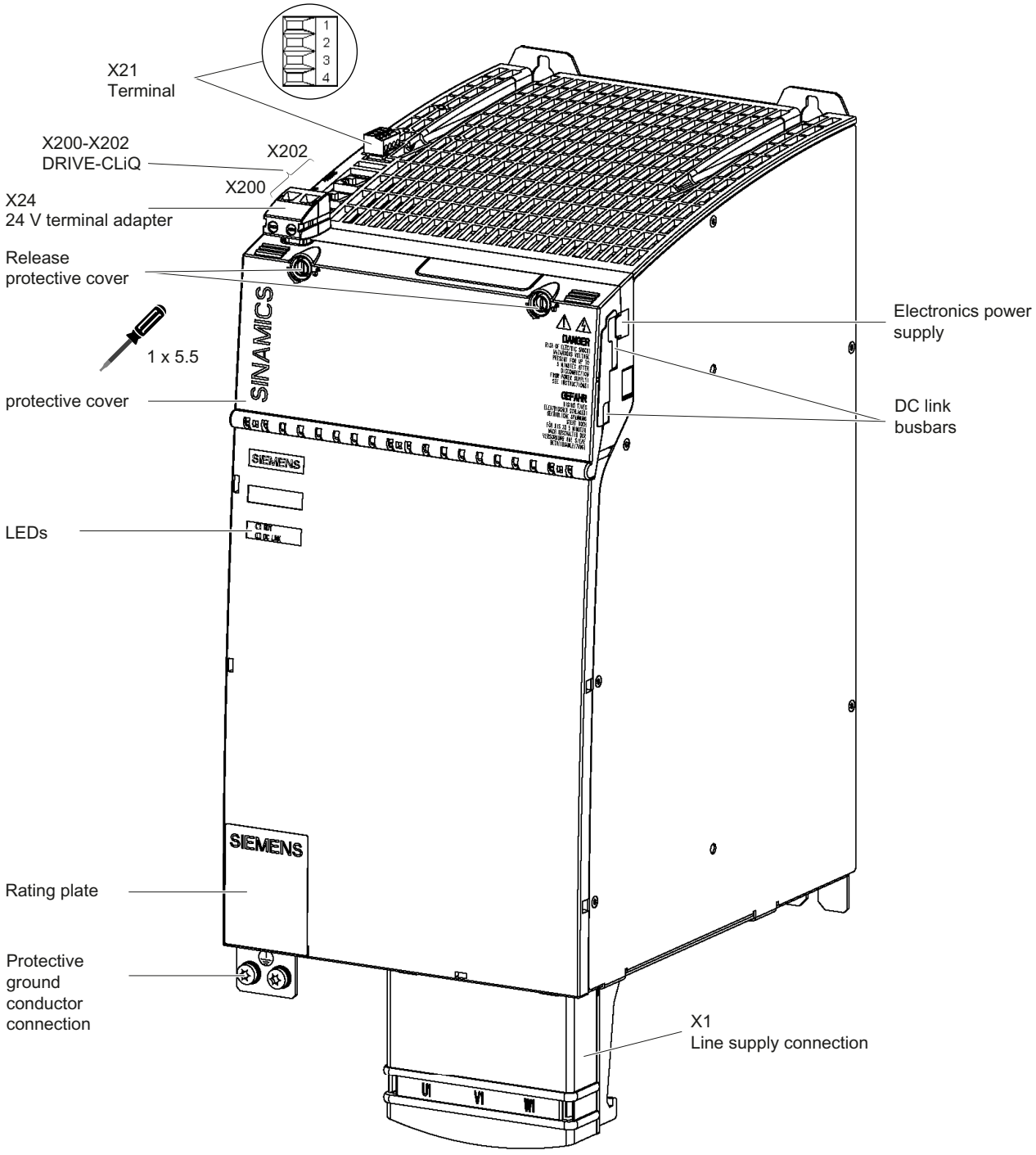
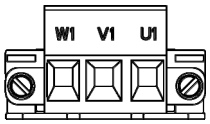
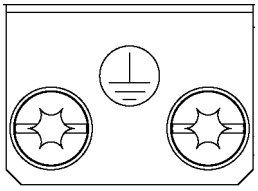


Figure 3-77 Interface overview, 36 kW and 55 kW Smart Line Modules with internal air cooling (example: 55 kW)

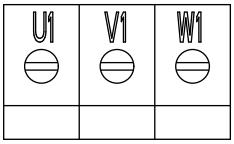
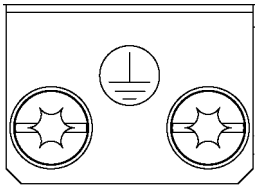
3.7.3.2 X1 line connection

Table 3- 63 X1: Line connection for Smart Line Modules 5 kW and 10 kW

	Terminal	Technical specifications
	U1 V1 W1	Supply voltage: 380 V - 480 V 3 AC, 50/60 Hz Max. connectable cross-section: 6 mm^2 Type: Screw terminal 5 Tightening torque: 1.2 - 1.5 Nm (see Chapter, "Control cabinet installation/connection system")
	PE connection	Threaded hole M5/3 Nm [1]

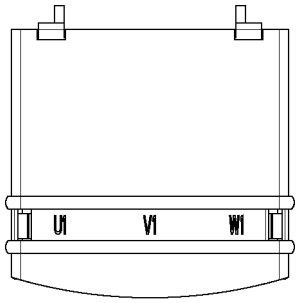
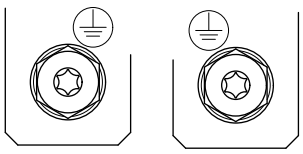
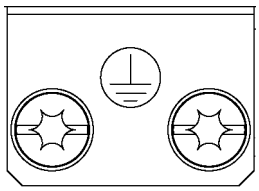
1) For ring cable lugs in accordance with DIN 46234

Table 3- 64 X1: Line supply connection for Smart Line Modules 16 kW

	Terminal	Technical specifications
	U1 V1 W1	Supply voltage: 380 V - 480 V 3 AC, 50/60 Hz Max. connectable cross-section: 10 mm^2 Type: Screw terminal 6 Tightening torque: 1.5 - 1.8 Nm (see Chapter, "Control cabinet installation/connection system")
	PE connection	Threaded hole M5/3 Nm [1]

1) For ring cable lugs in accordance with DIN 46234

Table 3- 65 X1: Line connection for Smart Line Modules 36 kW and 55 kW

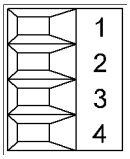
	Terminal	Technical specifications
	U1 V1 W1	Supply voltage: 380 V - 480 V 3 AC, 50/60 Hz **36 kW**: Threaded bolt M6 / 6 Nm 1) **55 kW**: Threaded bolt M8/13 Nm 1)
	PE connection	**36 kW**: Threaded hole M6 / 6 Nm 1)
		**55 kW**: Threaded hole M6 / 6 Nm 1)

1) For ring cable lugs in accordance with DIN 46234

3.7.3.3 X21 EP terminals

Smart Line Modules 5 kW and 10 kW

Table 3- 66 X21 EP terminal for Smart Line Modules 5 kW and 10 kW

	Terminal	Designation	Technical specifications
	1	DO: Ready	Checkback signal: Smart Line Module ready The signal switches to high level when the following conditions have been met: • Electronics power supply (X24) OK • DC link is precharged • Pulses enabled (X21.3/4) • No overtemperature • No overcurrent
	2	DO: Prewarning	DO: Prewarning High = no prewarning Low = prewarning • Overtemperature warning threshold/I^2t 5 kW prewarning: 64°C, overtemperature threshold: 69°C 10 kW prewarning: 68°C, overtemperature threshold: 73 °C • No regenerative feedback capability due to a line fault [only monitored when feedback is activated (see terminal X22.2)]
	3	EP +24 V (Enable Pulses)	Voltage 24 VDC Current consumption: 10 mA Isolated input
	4	EP M (Enable Pulses)	
Max. connectable cross-section: 1.5 mm^2 Type: Screw terminal 1 (see Chapter, "Control cabinet installation and EMC/connection system")			

⚠ WARNING

For operation, the 24 V DC voltage must be connected to terminal X21.3 and ground to terminal X21.4. When withdrawn, pulse suppression is activated. The regenerative feedback is deactivated. If the Line Module is not disconnected from the supply system when the EP terminal is deactivated (e.g. a line contactor is not installed), the DC link remains charged.

CAUTION

It is essential that a particular switch-on and switch-off sequence is followed in order to control the 5 kW and 10 kW Smart Line Modules; if this sequence is not observed, the Smart Line Module could be damaged beyond repair. To prevent the SLM being destroyed, the "Ready" signal must be evaluated at output terminal X21.1. (see the "Safety information" chapter).

NOTICE

Output terminal X21.1 must be wired to a digital input on the CU. The drives supplied with power by the Smart Line Module have to use this signal as a "Ready" message (BI: p0864 = digital input). This ensures that a pulse enable can only be issued for the drives (motor or generator operation) when the infeed is ready.
If interconnection with a digital input on the CU is not possible, the signal must be evaluated by a higher-level control system instead. The control system cannot set the drives to ready until the infeed "Ready" signal is present.

NOTICE

The "Prewarning" signal at output terminal X21.2 warns against an overload. If this signal is set, the control system shuts the drives down before the "Ready" signal switches to "low". If the "Ready" signal changes to "low", the drive pulses must be suppressed within 4 ms.

NOTICE

If an active drive line-up is switched off by means of the disconnector unit, the voltage at terminals X21.3 (EP +24 V) and X21.4 (EP M) must be interrupted beforehand. This can be carried out using a leading breaking auxiliary contact (≥ 10 ms), for example.

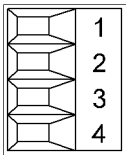
This protects external loads located parallel to the drive on the same switching component.

Note

The Smart Line Module signals that it is ready, even if one of the line conductors is not available. In this case, regenerative feedback is deactivated and an alarm is output at X21.2 (DO, Warning I^2t). If regenerative feedback was deactivated by applying a "high" signal to terminal X22.2 (DI, Disable), no alarm will be output at X21.2 (DO, Warning I^2t).

16 kW to 55 kW Smart Line Modules

Table 3- 67 X21 EP terminal/temperature Sensor for 16 kW to 55 kW Smart Line Modules

	Terminal	Function	Technical specifications
	1	+ Temp	Temperature sensors[1]: KTY 84-1C130/PTC/bimetallic switch with NC contact
	2	- Temp	
	3	EP +24 V (Enable Pulses)	Voltage: 24 VDC Current consumption: 10 mA Isolated input Signal propagation times: L → H: 100 µs H → L: 1000 µs
	4	EP M (Enable Pulses)	
Max. connectable cross-section 1.5 mm^2 Type: Screw terminal 1 (see Chapter, "Control cabinet installation and EMC/connection system")			

1) The temperature sensor type can be selected via parameter p0601; the temperature is displayed via r0035 (see SINAMICS S120/S150 List Manual).
Temperatures are detected but not evaluated in the Smart Line Module.

⚠ WARNING

For operation, the 24 V DC voltage must be connected to terminal X21.3 and ground to terminal X21.4. When withdrawn, pulse suppression is activated. Regenerative feedback is deactivated and the bypass relay drops out. If the Line Module is not disconnected from the supply system when the EP terminal is deactivated (e.g. a line contactor is not installed), the DC link remains charged.

NOTICE

If an active drive line-up is switched off by means of the disconnector unit, the voltage at terminals X21.3 (EP +24 V) and X21.4 (EP M) must be interrupted beforehand. This can be carried out using a leading breaking auxiliary contact (≥ 10 ms), for example.

This protects external loads located parallel to the drive on the same switching component.

NOTICE

The KTY temperature sensor must be connected with the correct polarity.
If the polarity is reversed, the sensor will not be able to detect if the motor overheats.

⚠ DANGER

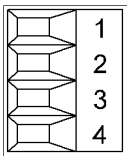
Risk of electric shock!

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) or Terminal Module TM120 must be used.

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

3.7.3.4 X22 digital inputs

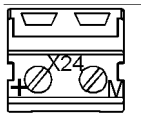
Table 3- 68 X22 digital inputs for Smart Line Modules 5 kW and 10 kW

	Terminal	Designation 1)	Technical specifications
	1	24 V power supply	Electronics power supply for controlling digital inputs X22.2 and 3.
	2	DI: Disable Regeneration	Deactivate feedback (high active). No power is supplied back to the network from the DC link. The regenerative energy of the motors may have to be reduced using a combination of the Braking Module and braking resistor.
	3	DI: Reset	Reset faults (negative edge)
	4	Ground	Electronics ground
Max. connectable cross-section: 1.5 mm^2 Type: Screw terminal 1 (see Chapter, "Control cabinet installation and EMC/connection system")			

1) DI: Digital input

3.7.3.5 X24 24 V terminal adapter

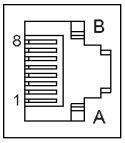
Table 3- 69 X24 24 V terminal adapter

	Terminal	Designation	Technical specifications
	+	24 V power supply	24 V DC supply voltage
	M	Ground	Electronics ground
Max. connectable cross-section: 6 mm^2 Type: Screw terminal 5 (see Chapter, "Control cabinet installation and EMC/connection system")			

The 24 V terminal adapter is included in the scope of supply.

3.7.3.6 X200-X202 DRIVE-CLiQ interfaces

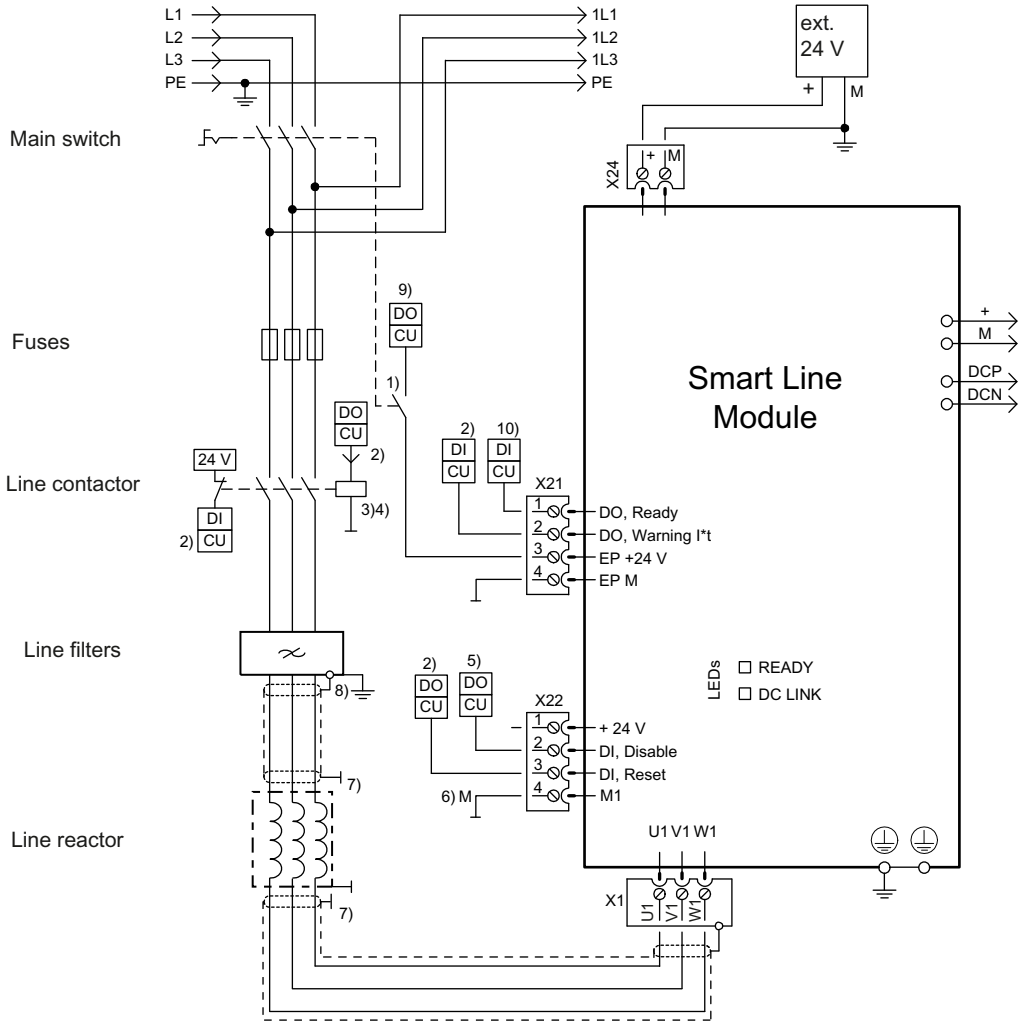
Table 3- 70 X200-X202 DRIVE-CLiQ interfaces

	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

The blanking covers for the DRIVE-CLiQ interfaces are included in the scope of delivery.

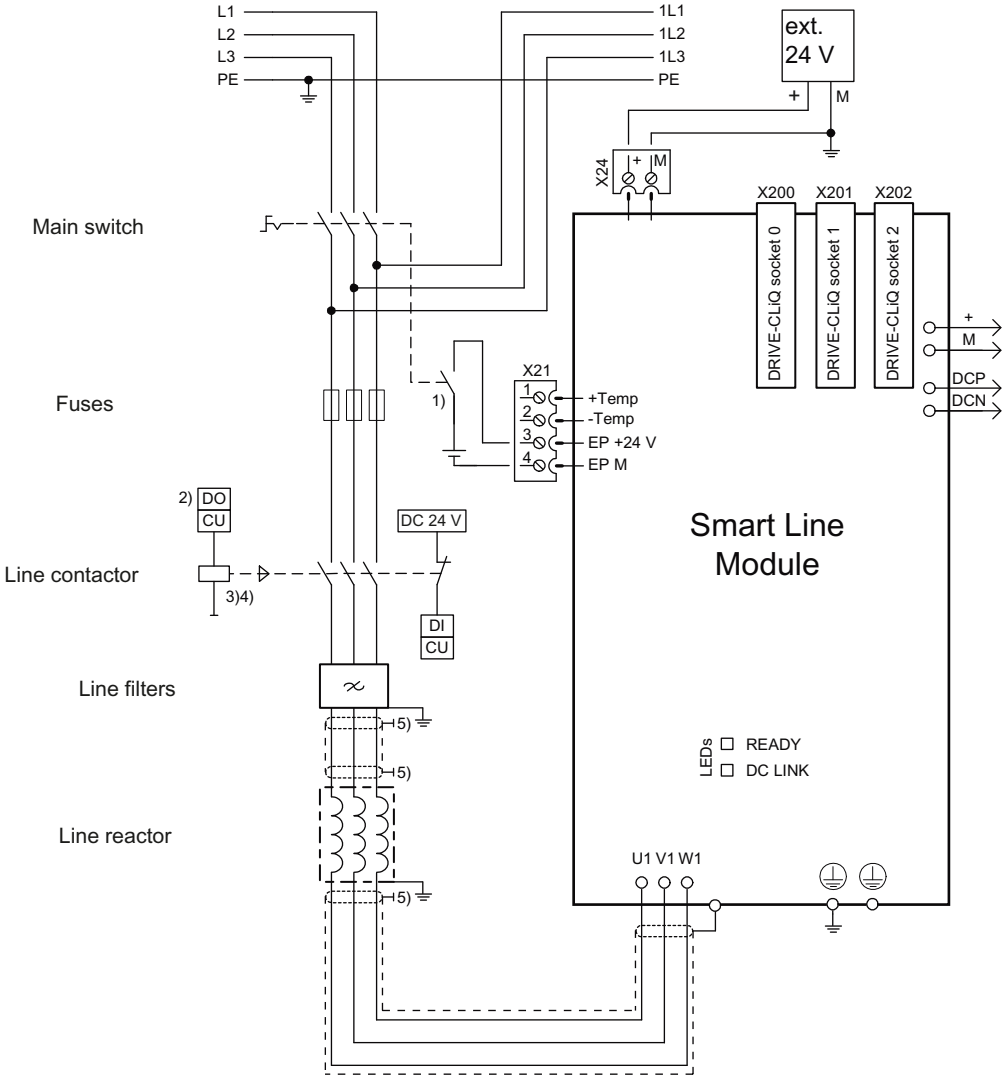
Blanking cover (50 pcs.) Order number: 6SL3066-4CA00-0AA0

3.7.4 Connection examples



1) Leading opening contact t > 10ms, 24 V DC and ground must be connected for operation.
2) DI/DO controlled by the Control Unit
3) No additional load permitted downstream of line contactor
4) The current carrying capacity of the DO must be observed; an output interface must be used if required.
5) DO high, regenerative feedback deactivated (for permanent deactivation, a jumper can be installed between X22 pin 1 and 2)
6) X22 pin 4 must be connected to ground (external 24 V)
7) Contact via rear mounting panel or shielding buses in accordance with EMC installation guideline
8) 5 kW and 10 kW line filters via shield connection
9) Signal output of the control to avoid reaction of the 24 V supply on the EP terminal
10) Connect to parameter p0864 via BICO

Figure 3-78 Connection example for 5 kW and 10 kW Smart Line Modules



1) Leading opening contact t > 10 ms
2) DI/DO, controlled by the Control Unit
3) No additional load permitted downstream of line contactor
4) The current carrying capacity of the DO must be observed; an output interface must be used if required.
5) Contact via rear mounting panel or shielding buses in accordance with EMC installation guideline

Figure 3-79 Connection example for 16 kW to 55 kW Smart Line Modules

Note

If you are using a VSM10 Voltage Sensing Module, the leading opening contact can be omitted.

3.7.5 Meaning of LEDs

3.7.5.1 Smart Line Modules 5 kW and 10 kW

Table 3- 71 Meaning of the LEDs on 5 kW and 10 kW Smart Line Modules

LED	Color	Status	Description, cause	Remedy
RDY	–	Off	Electronics power supply is missing or outside permissible tolerance range.	–
	Green	Continuous light	Component is ready to operate.	–
	Yellow	Continuous light	Pre-charging not yet complete. bypass relay dropped out EP terminals not supplied with 24 VDC.	–
	Red	Continuous light	Overtemperature, overcurrent	Diagnose fault (via output terminals) and acknowledge it (via input terminal)
DC LINK	–	Off	Electronics power supply is missing or outside permissible tolerance range.	–
	Yellow	Continuous light	DC link voltage within permissible tolerance range.	–
	Red	Continuous light	DC link voltage outside permissible tolerance range. Line supply fault.	Check the line voltage.

⚠DANGER

Hazardous DC link voltages may be present at any time regardless of the status of the "DC LINK" LED.
The warning information on the components must be carefully observed!

3.7.5.2 16 kW to 55 kW Smart Line Modules

Table 3- 72 Meaning of the LEDs on Smart Line Modules ≥ 16 kW

Status		Description, cause	Remedy
RDY	DC LINK		
Off	Off	Electronics power supply is missing or outside permissible tolerance range.	–
Green	--	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.	Check line voltage
Orange	Orange	DRIVE-CLiQ communication is being established.	–
Red	--	At least one fault is present in this component. **Note:** The LED is activated regardless of whether the corresponding messages have been reconfigured.	Remedy and acknowledge fault
Green/red (0.5 Hz)	--	Firmware is being downloaded.	–
Green/red (2 Hz)	--	Firmware download is complete. Wait for POWER ON.	Carry out a POWER ON
Green/orange or Red/orange	--	Component detection via LED is activated (p0124). **Note:** Both options depend on the LED status when component recognition is activated via p0124 = 1.	–

⚠ DANGER

Hazardous DC link voltages may be present at any time regardless of the status of the "DC LINK" LED.
The warning information on the components must be carefully observed!

3.7.6 Dimension drawings

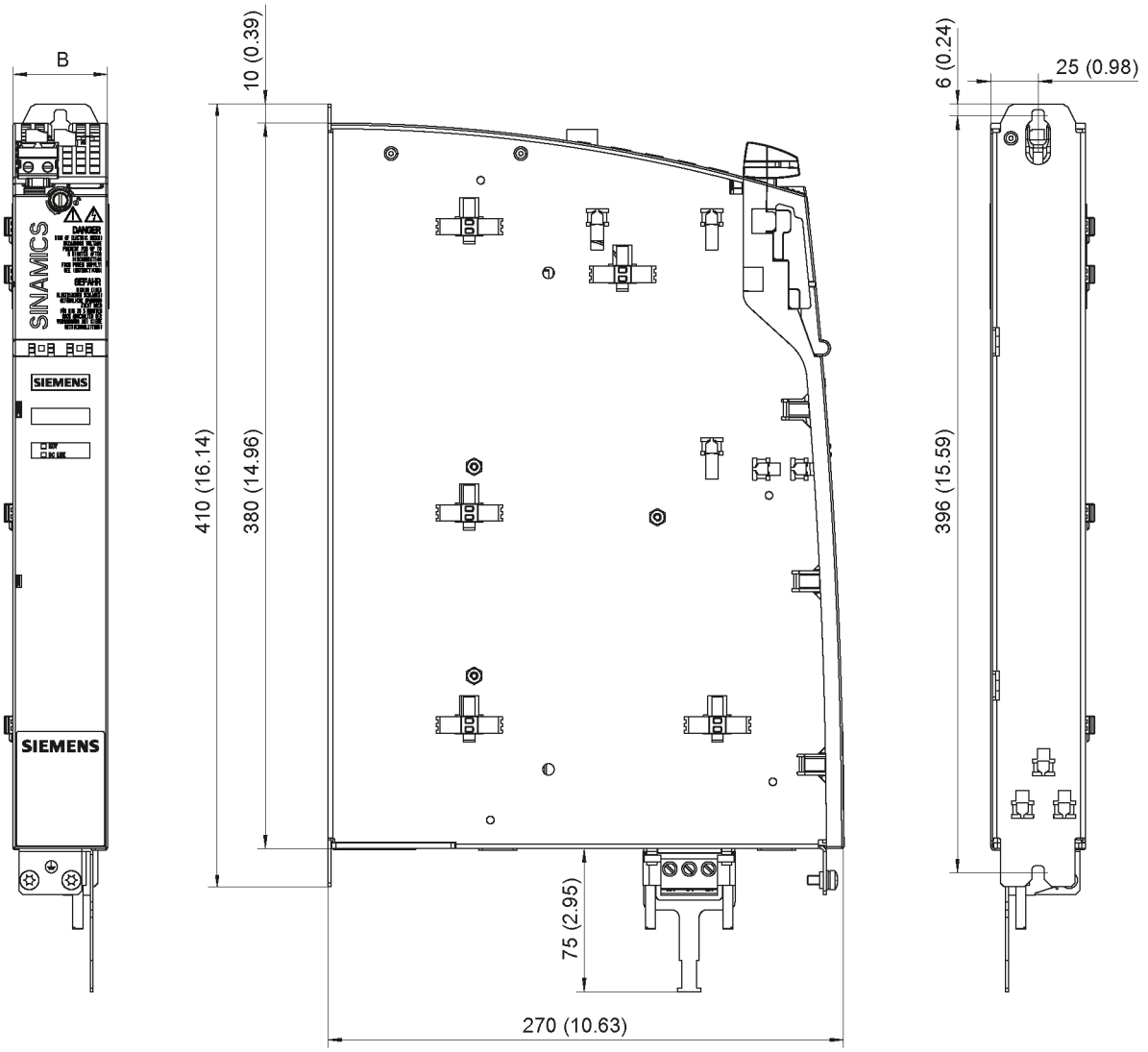


Figure 3-80 Dimension drawing of 5 kW and 10 kW Smart Line Modules with internal air cooling, all dimensions in mm and (inches)

Table 3- 73 Dimensions of Smart Line Modules with internal air cooling (5 kW and 10 kW)

Smart Line Module	Order number	W in mm (inches)
5 kW	6SL3130-6AE15-0Axx	50 (1.97)
10 kW	6SL3130-6AE21-0Axx	50 (1.97)

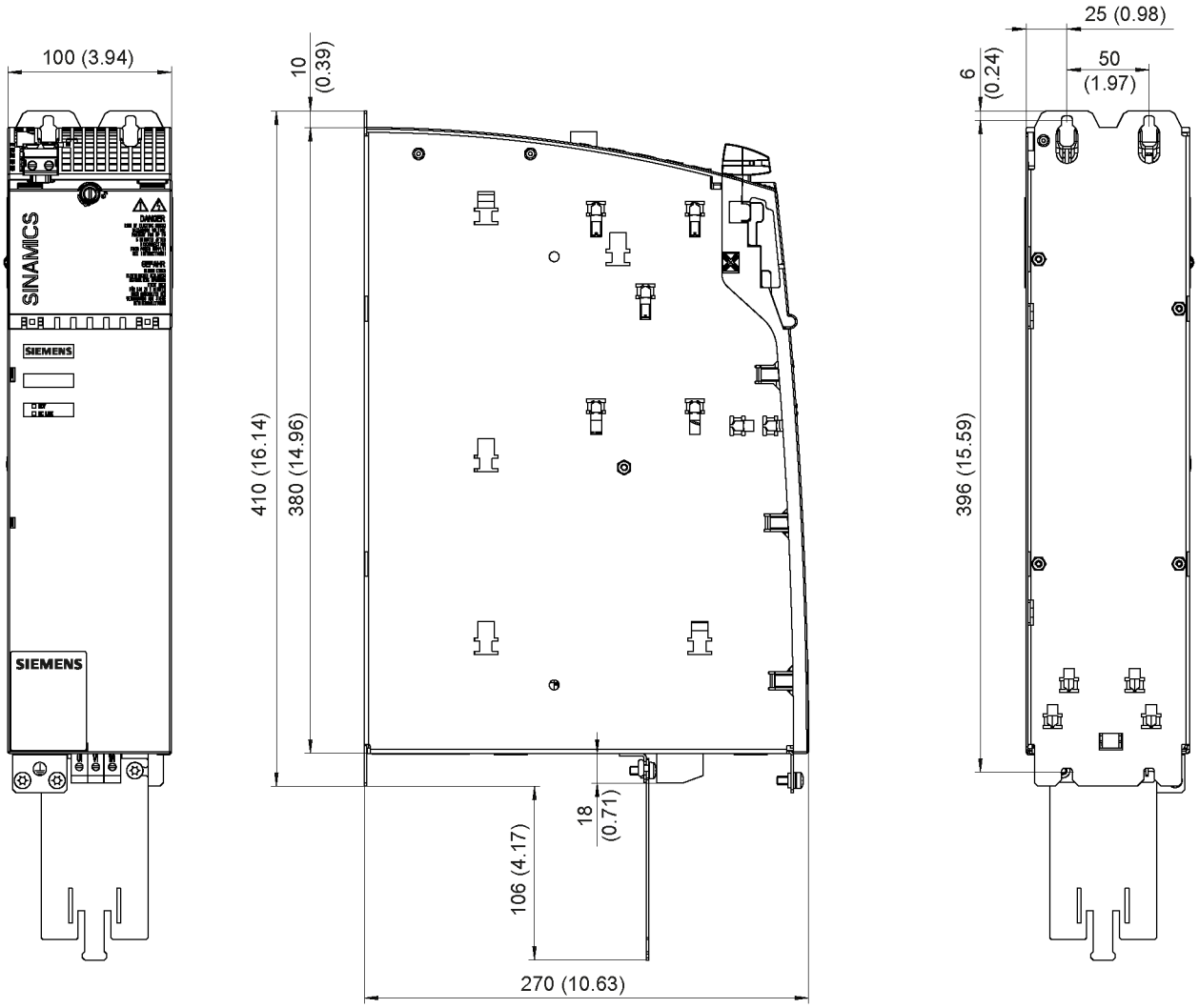


Figure 3-81 Dimension drawing of 16 kW Smart Line Module with internal air cooling, all dimensions in mm and (inches)

Note

The shield connecting plate is included in the scope of delivery of the 50 mm and 100 mm Smart Line Modules.

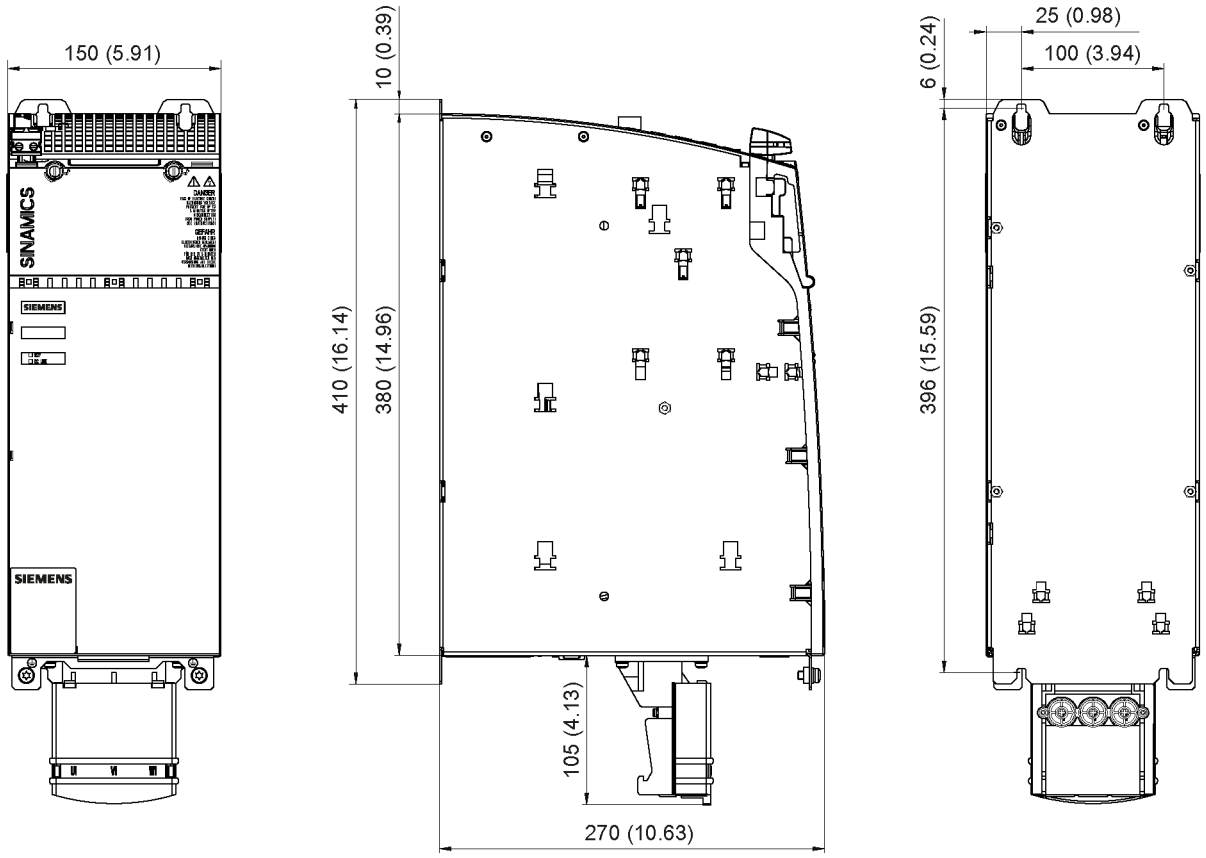


Figure 3-82 Dimension drawing of 36 kW Smart Line Module with internal air cooling, all dimensions in mm and (inches)

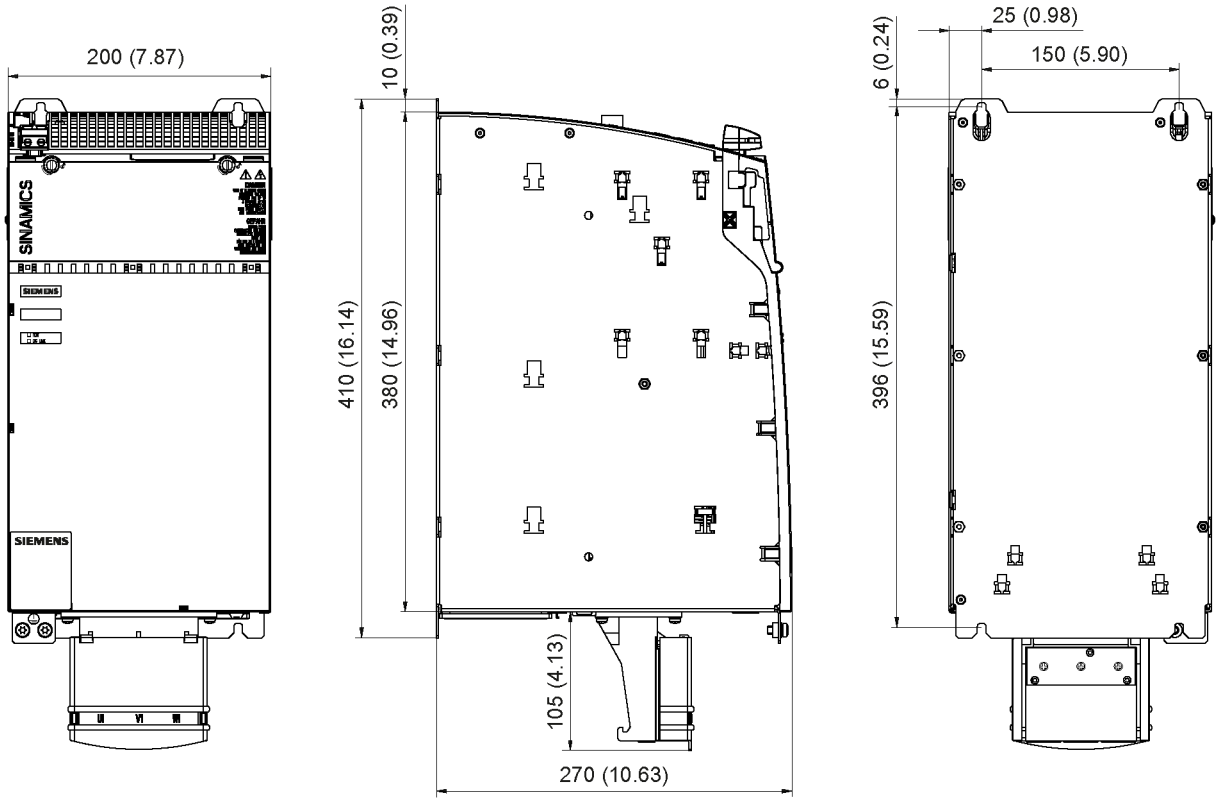
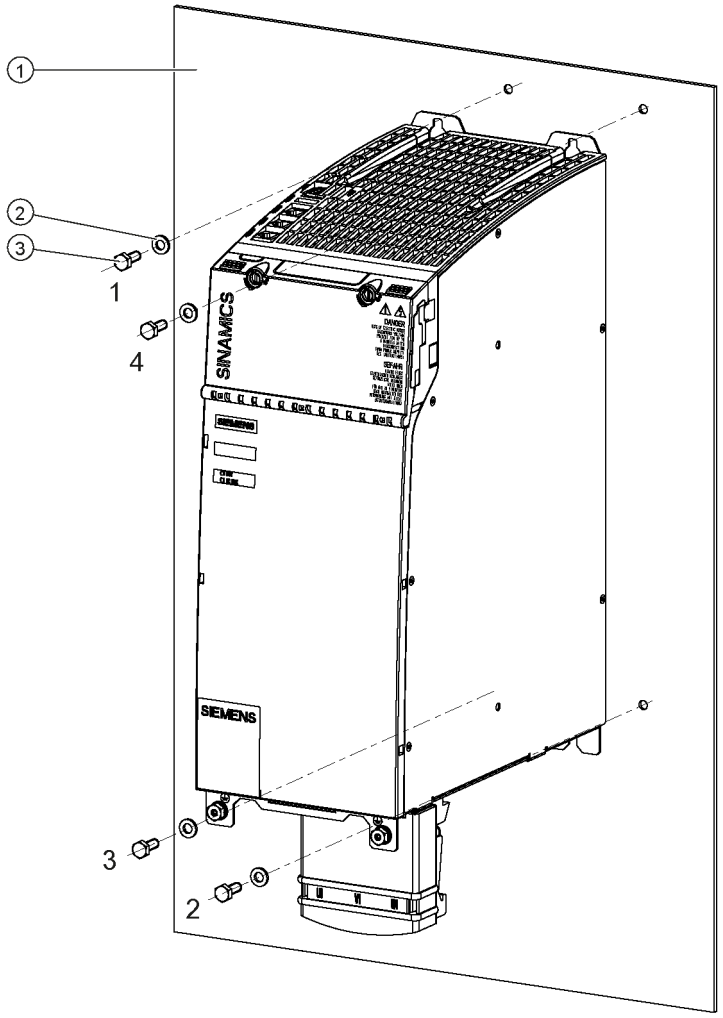


Figure 3-83 Dimension drawing of 55 kW Smart Line Module with internal air cooling, all dimensions in mm and (inches)

3.7.7 Installation

Smart Line Modules are designed for installation in the control cabinet. They are fixed to the control cabinet panel or a mounting panel using M6 screws.



① Control cabinet panel/mounting panel
② Washer
③ M6 screw

Figure 3-84 Mounting a Smart Line Module with internal air cooling (example: 36 kW)

Tightening torques:

- Initially, tighten the nuts by hand (0.5 Nm)
- Then tighten with 6 Nm (in the specific sequence 1 to 4)

3.7.8 Technical data

Table 3- 74 Technical data for Smart Line Modules in booksize format with internal air cooling

Internal air cooling	**6SL3130–**	**6AE15–0Axx**	**6AE21–0Axx**	**6TE21-6Axx**	**6TE23-6Axx**	**6TE25-5AAx**
Rated power	**kW**	**5**	**10**	**16**	**36**	**55**
Infeed						
Rated power (S1) 1)	kW (P_n)	5	10	16	36	55
S6 operation (40%)1)	kW (P_{S6})	6.5	13	21	47	71
Peak infeed power 1)	kW (P_{max})	10	20	35	70	91
Regenerative feedback						
Continuous regenerative power	kW	5	10	16	36	55
Peak regenerative power	kW	10	20	35	70	91
Supply voltages						
Line voltage	V_{AC}	3 AC 380 -10 % (-15 % < 1 min) to 3 AC 480 +10 %				
Line frequency	Hz	47 to 63				
Electronics power supply	V_{DC}	24 (20.4 - 28.8)				
DC link voltage	V_{DC}	510 – 720				
Overvoltage trip	V_{DC}	820 ± 2 %				
Undervoltage trip2)	V_{DC}	360 ± 2 %				
Input currents						
Rated input current						
at 400 V_{AC}	A_{AC}	8.1	16.2	27.5	59	90
at 380 V_{AC}/480 V_{AC}	A_{AC}	8.6 / 6.7	17 / 12.8	29 / 24.5	62 / 51	94 / 77
S6 (40%) at 400 V_{AC}	A_{AC}	10.6	21.1	35	76	106
Peak current at 400 V_{AC}	A_{AC}	15.7	31.2	57.5	112	130
DC link currents						
DC link output current						
at 600 V	A_{DC}	8.3	16.6	27	60	92
at 540 V	A_{DC}	9.3	18.5	30	67	105
S6 (40%) at 600 V_{DC}	A_{DC}	11	22	35	79	138
Peak current at 600 V_C	A_{DC}	16.6	33.2	59	118	178
Current carrying capacity						
DC link busbar	A_{DC}	100	100	100	200	200
Reinforced DC link busbars:						
24 V busbar:	A_{DC}	150	150	150	--	--
	A_{DC}	20	20	20	20	20
Electronics current consumption at 24 V DC	A_{DC}	0.8	0.9	0.95	1.5	1.9
Total power loss (including electronics losses) 3)	W	79.2	141.6	187.8	406	665.6
Max. ambient temperature						
Without derating	°C	40				
With derating	°C	55				
DC link capacitance						
Smart Line Module	µF	220	330	705	1410	1880
Drive line-up, max.	µF	6000	6000	20000	20000	20000
Power factor	cos ϕ	0.98				

Internal air cooling	**6SL3130–**	**6AE15–0Axx**	**6AE21–0Axx**	**6TE21-6Axx**	**6TE23-6Axx**	**6TE25-5AAx**
Rated power	**kW**	**5**	**10**	**16**	**36**	**55**
Circuit breaker (UL)						
Type designation		3VL1102-2KM30	3VL1135-2KM30	3VL1135-2KM30	3VL2108-2KN30	3VL2112-2KN30
Rated current:	A	20	35	35	80	125
Resulting rated short-circuit current [6] SCCR						
at 480 V_{AC}:	kA	65	65	65	65	65
Safety fuse (UL)						
Type AJT Class J [4]		AJT17-1/2	AJT35	AJT35	AJT80	AJT125
Rated current:	A	17.5	35	35	80	125
Resulting rated short-circuit [5] current SCCR						
at 480 V_{AC}:	kA	65	65	65	65	65
Cooling method (internal air cooling)		Internal fan				
Sound pressure level	dB(A)	<60	<60	<60	<65	<60
Cooling air requirement	m^3/h	29.6	29.6	56	112	160
Rated voltage for rated data 3 AC 380 V						
Weight	kg	4.7	4.8	7	10	17

1) The powers specified apply to the rated voltage range from 380 V to 480 V.

2) For 16 kW and 36 kW Smart Line Modules: Default for 400 V line supplies; undervoltage trip threshold is adjusted to the parameterized rated voltage.

3) For an overview, see the power loss tables in Chapter, Control cabinet installation

4) Source of supply: The Ferraz Shawmut company

5) The resulting rated short-circuit current is obtained from the combination of the fuse, or circuit breaker, and the Line Module in the drive system.

3.7.8.1 Characteristics

Rated duty cycles of Smart Line Modules

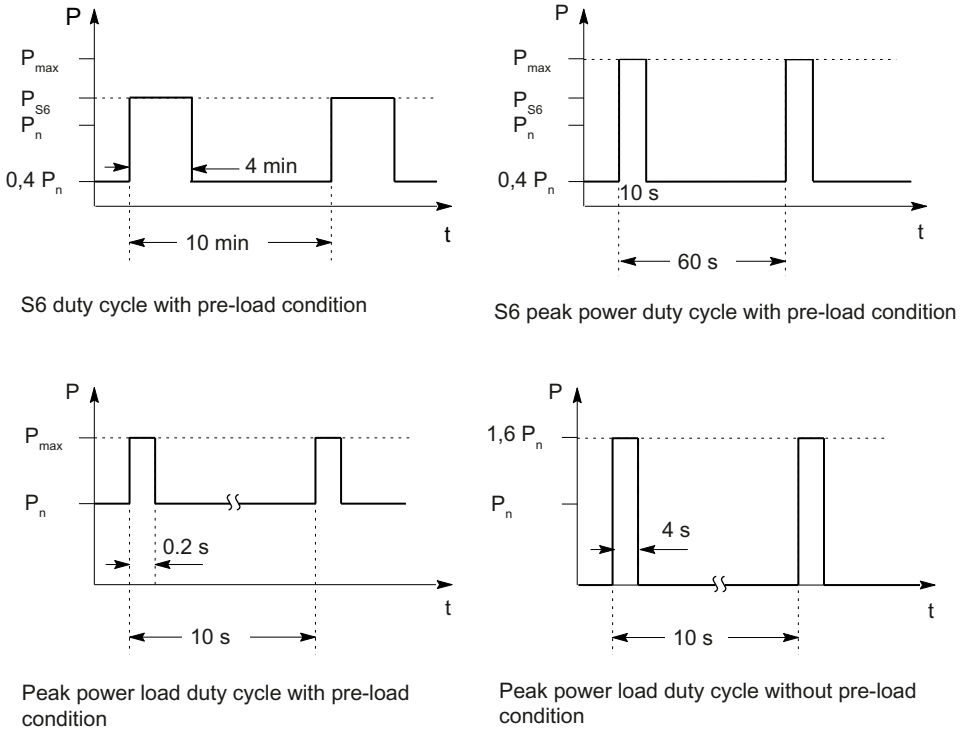


Figure 3-85 Rated duty cycles of Smart Line Modules

Derating characteristics

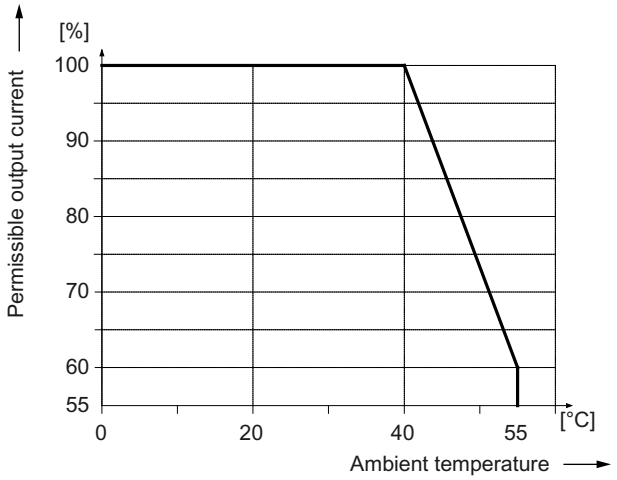


Figure 3-86 Output current as a function of the ambient temperature

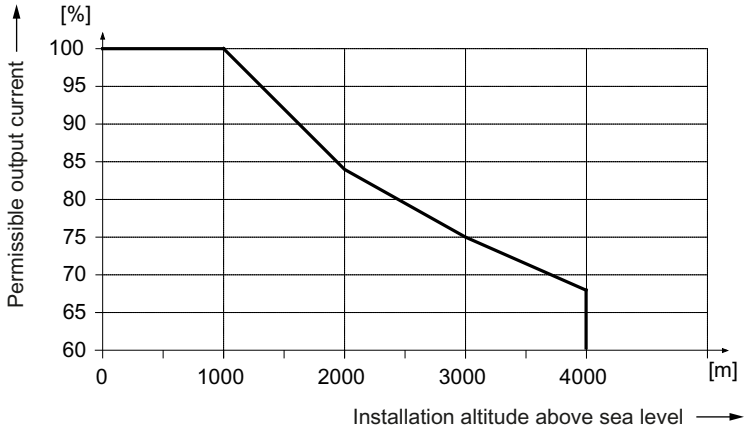


Figure 3-87 Output current as a function of the installation altitude

At installation altitudes >2000 m, an insolating transformer must be used (see "System overview/Derating as a function of the installation altitude and ambient temperature"). The design of the secondary line supply system must be as follows:

- TN system with grounded star point (no grounded outer conductor)
- IT system

A reduction of the line supply voltage phase-phase is not necessary.

3.8 Smart Line Modules with external air cooling

3.8.1 Description

The Smart Line Module is a non-regulated infeed/regenerative feedback unit. The Smart Line Module supplies the Motor Module(s) with a non-regulated DC voltage at the DC output. In the infeed mode the Smart Line Module exhibits the typical current and voltage waveforms of a 6-pulse diode rectifier bridge.

In feedback mode, the current waveform is square waved. Regenerative feedback can be deactivated if required. On 5 kW and 10 kW Smart Line Modules, this is done via a terminal, since these modules do not feature a DRIVE-CLiQ connection. On 16 kW to 55 kW Smart Line Modules, regenerative feedback can be deactivated via parameters, as, just like Active Line Modules, these modules are equipped with a DRIVE-CLiQ connection.

The DC link starts precharging as soon as the supply voltage is applied and is independent of its phase sequence direction. Load can be applied to the DC link after the module has been enabled. An optional main contactor is required for disconnecting the voltage.

Smart Line Modules are suitable for direct operation on TN, IT, and TT systems. The modules have an integrated overvoltage protection function.

External air cooling uses the "through-hole" method. This is a cooling method that is only available for SINAMICS booksize units. The Smart Line Module and its heat sink can be inserted in a rectangular knockout at the rear of the control cabinet and mounted with a seal. The heat sink and the fan (included in the scope of supply) project beyond the rear of the control cabinet and the heat is dissipated outside the control cabinet or in a separate air duct.

3.8.2 Safety Information

⚠DANGER

Risk of electric shock

A hazardous voltage is present for up to 5 minutes after the power supply has been disconnected.
The protective cover may only be opened after this time has expired.

You must use a suitable tool (slot-head screwdriver) to open the protective cover on the DC link.

The components must only be operated when the protective cover of the DC link is closed. Damaged components must not be operated further, otherwise this could result in secondary damage or accidents.

⚠DANGER

DC link discharge time

A DC link discharge time danger notice in the local language must be attached to the components.
A set of labels in 16 languages is supplied with the component.

⚠DANGER

In the interests of operator and fire protection, the power supply conditions in terms of short-circuit power and loop impedance at the infeed point must be such that they will trip the installed overcurrent protection devices within the prescribed period if a fault occurs (short circuit or short circuit to exposed conductive part).

Note

Line short-circuit power at the infeed point

The line short-circuit power at the infeed point must be at least 70 times greater than the rated power of the Line Module in order to limit the line harmonics to an acceptable level for other loads.

⚠DANGER

DC link

If the Line Module is not disconnected from the supply system (e.g. via the line contactor or main switch), the DC link remains charged.

⚠ DANGER

Deactivating the regenerative feedback capability

For line supplies without regenerative feedback capability (e.g. diesel generator), the regenerative feedback capability of the Smart Line Modules must be deactivated.

5 kW and 10 kW Smart Line Modules: jumper between terminals X22.1 and X22.2, as well as ground at X22.4

16 kW to 55 kW Smart Line Modules: via parameter p3533

In this case, the braking energy must be dissipated via an additional Braking Module with braking resistor provided in the drive line-up.

⚠ DANGER

It is only permissible to establish connections to the DC link using the adapters that SIEMENS has recommended (DC link adapter and DC link rectifier adapter).

⚠ DANGER

If a 50 mm wide Motor Module or a 50 mm wide DC link component (e.g. Braking Module, Control Supply Module, Voltage Clamping Module) is located at the left-hand end of the drive line-up, then the DC link bridges, including all of the screws, must be removed from this component. It is not permissible to insert the screws without a DC link bridge.

For all other components that are 75 mm wide or wider, it is neither permissible to move the DC link bridge to the left nor to remove it.

If this is not carefully observed, this can result in damage and accidents.

⚠ CAUTION

The 80 mm clearances above and below the components must be observed.

CAUTION

It is essential that a particular switch-on and switch-off sequence is followed in order to control the 5 kW and 10 kW Smart Line Modules; if this sequence is not observed, the Smart Line Module could be damaged beyond repair. To prevent the SLM being destroyed, the "Ready" signal must be evaluated at output terminal X21.1.

Switch on:

- 24 V DC power supply X24 ON
- Line contactor ON
- EP signal X21 pins 3 and 4 ON
- Wait until precharging is complete
- "Ready" signal at terminal X21 pin 1 set to "high"
- Infeed is ready, pulse enable possible for motors

Switch off:

- Shut drives down
- Cancel pulse enable for motors (OFF1 signal)
- EP signal X21 pins 3 and 4 OFF
- Line contactor OFF
- 24 V DC power supply X24 OFF

Overload:

- "Prewarning" signal at terminal X21 pin 2 set to "low"
- Shut drives down via the control system
- "Ready" signal at terminal X21 pin 1 set to "low"
- Pulse inhibit for all the drives supplied by this infeed within 4 ms

CAUTION

The correct tightening torque of the DC link busbar screws (1.8°Nm, tolerance +30%) must be checked before commissioning with the complete system in a voltage-free state (powered-down) and with the DC link discharged. After transportation, the screws must be tightened.

CAUTION

The overall length of the power cables (motor supply cables and DC link cables) must not exceed the values given in the chapter titled "Possible line reactor and line filter combinations".

CAUTION

DC link side covers are supplied with the components as standard and must be attached to the first and last components in the drive line-up. They can also be ordered separately, if required (order number: 6SL3162-5AA00-0AA0).

CAUTION
Only cables from Siemens may be used for DRIVE-CLiQ connections.

NOTICE
Operation without the line reactor is not permissible.

NOTICE
The external air cooling can cause the fans and the heat sink to become heavily contaminated, which may trigger the temperature monitor in the power unit. The fans and heat sink must be checked for contamination at regular intervals and, if necessary, cleaned.

Note

After installation, the seal on the rear of the device must be checked to ensure that it is tight. Additional sealing can be used, if necessary.

Note

The mounting frames can only be used if the cabinet has an unpainted metal surface.

Note

Smart Line Modules have been designed for use in the industrial environment and generate current harmonics on the line side as a result of the rectifier circuit.

When connecting a machine with integrated Smart Line Modules to the public low-voltage network, authorization is required in advance from the local power supply company (utility company) if

- the rated current of the machine ≤ 16 A per conductor, and
- the rated machine current does not comply with the requirements specified in EN 61000-3-2 regarding current harmonics.

3.8.3 Interface description

3.8.3.1 Overview

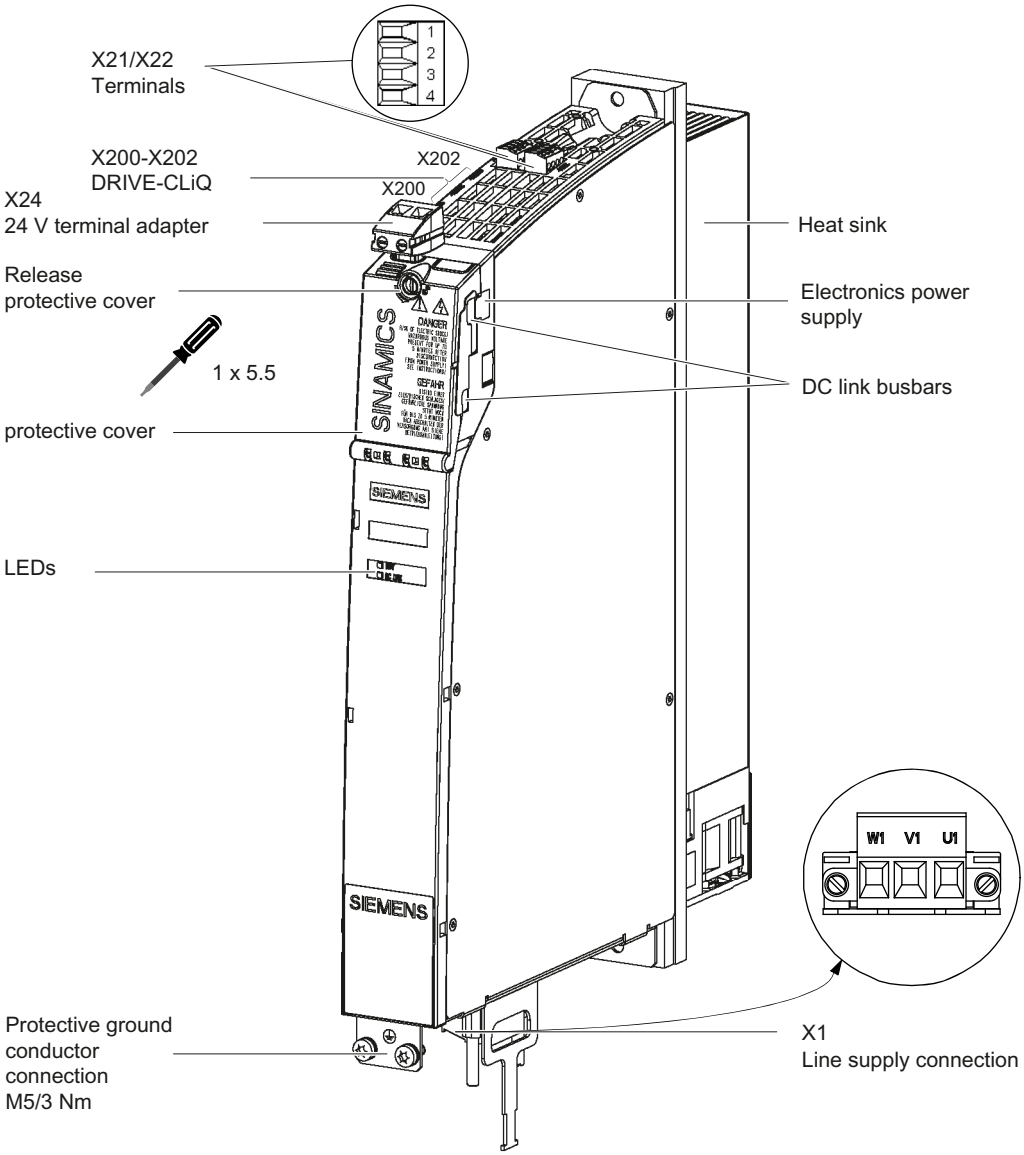


Figure 3-88 Interface overview, 5 kW and 10 kW Smart Line Modules with external air cooling (example: 5 kW)

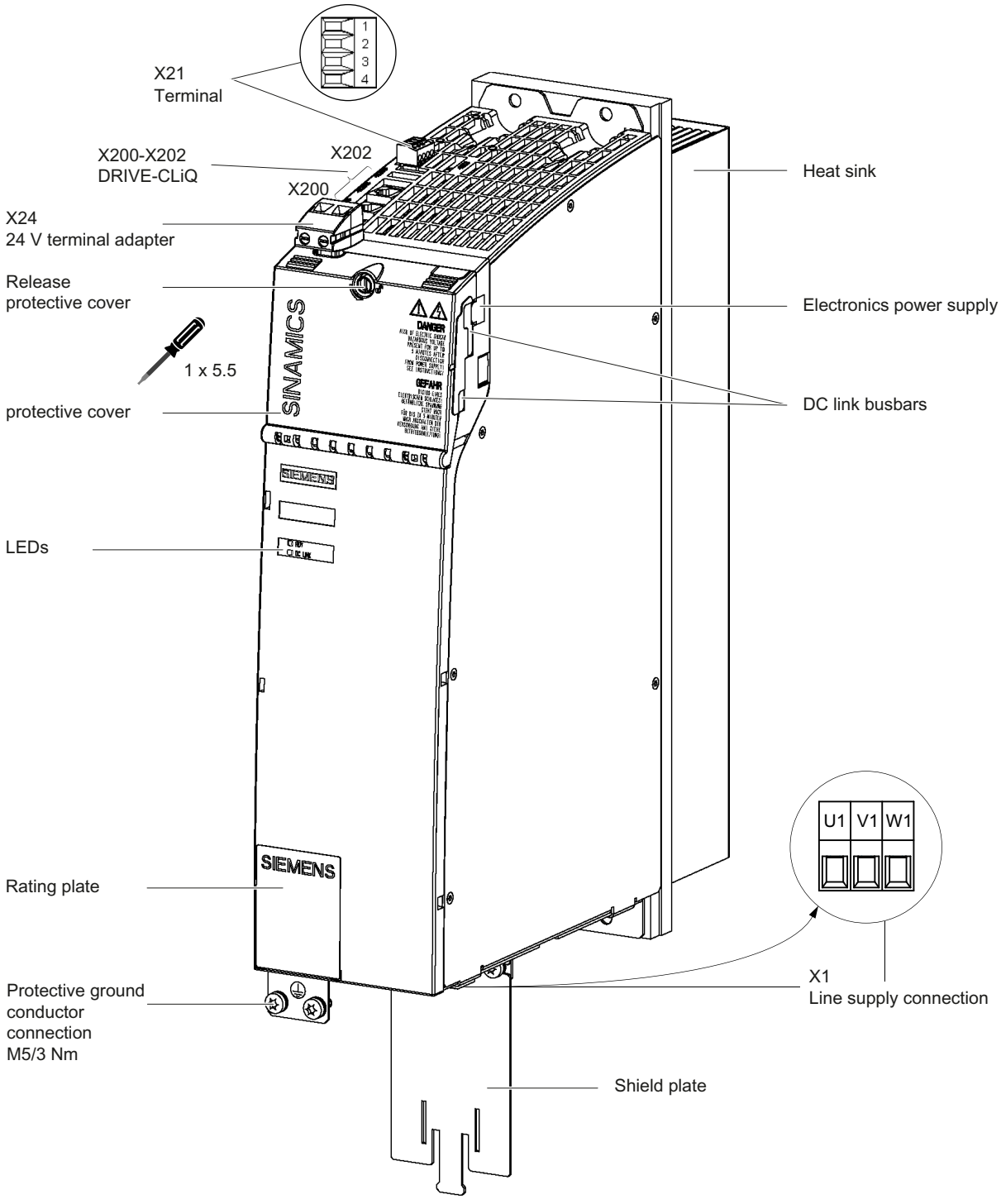


Figure 3-89 Interface overview, 16 kW Smart Line Module with external air cooling

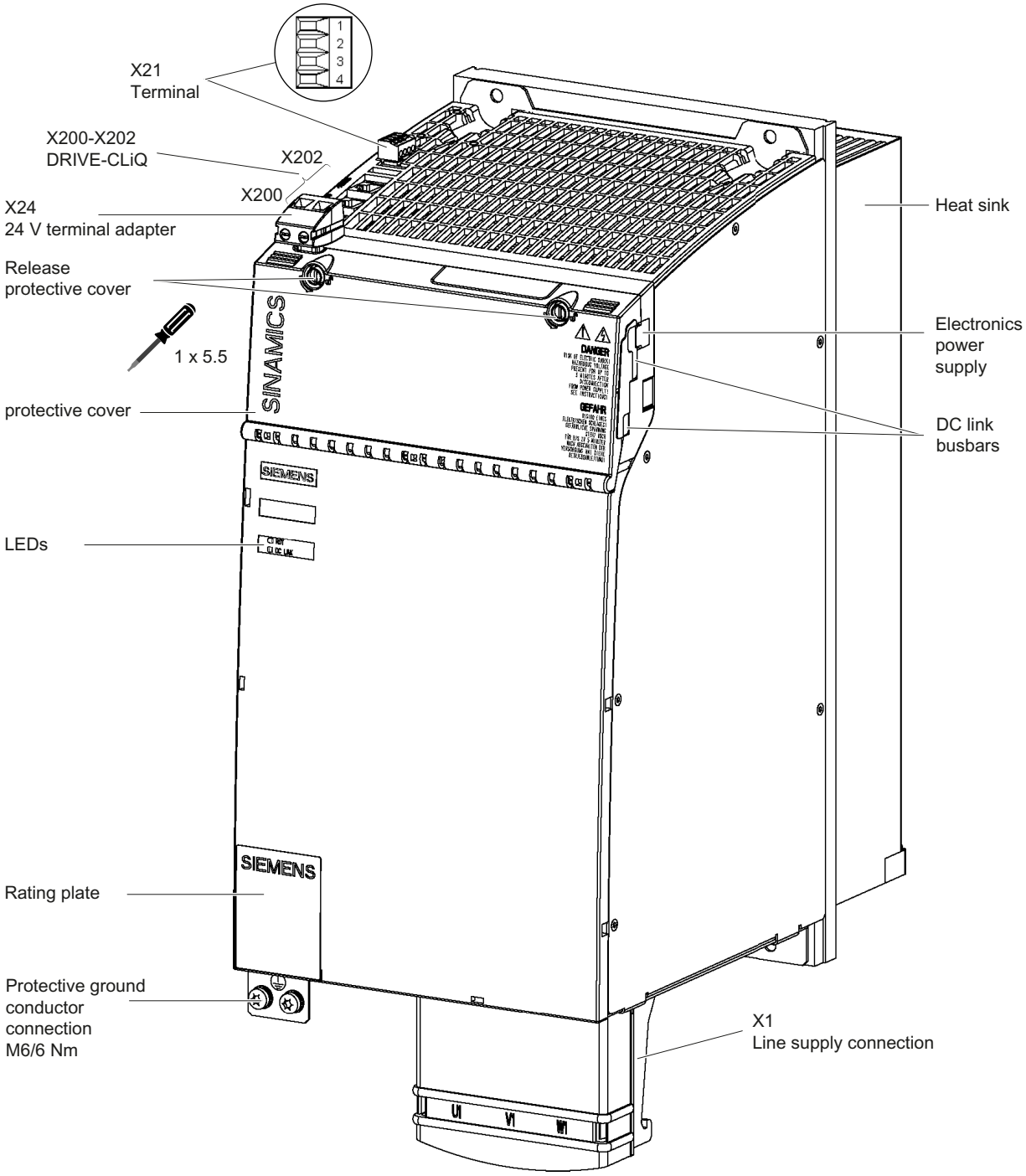
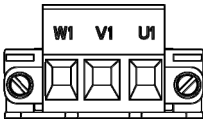
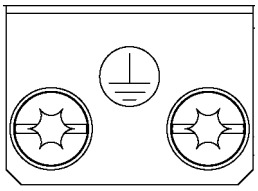


Figure 3-90 Interface overview, 36 kW and 55 kW Smart Line Modules with external air cooling (example: 55 kW)

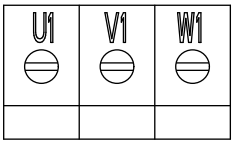
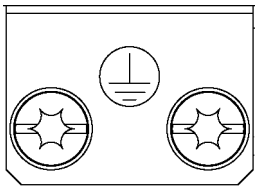
3.8.3.2 X1 line connection

Table 3- 75 X1: Line connection for Smart Line Modules 5 kW and 10 kW

	Terminal	Technical specifications
	U1 V1 W1	Supply voltage: 380 V - 480 V 3 AC, 50/60 Hz Max. connectable cross-section: 6 mm^2 Type: Screw terminal 5 Tightening torque: 1.2 - 1.5 Nm (see Chapter, "Control cabinet installation/connection system")
	PE connection	Threaded hole M5/3 Nm [1)]

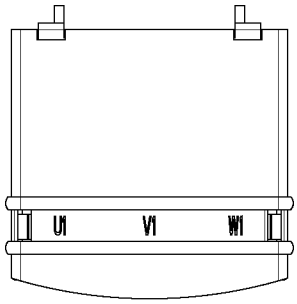
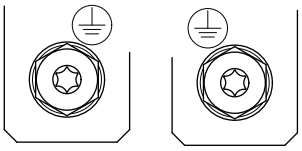
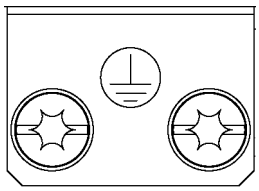
1) For ring cable lugs in accordance with DIN 46234

Table 3- 76 X1: Line supply connection for Smart Line Modules 16 kW

	Terminal	Technical specifications
	U1 V1 W1	Supply voltage: 380 V - 480 V 3 AC, 50/60 Hz Max. connectable cross-section: 10 mm^2 Type: Screw terminal 6 Tightening torque: 1.5 - 1.8 Nm (see Chapter, "Control cabinet installation/connection system")
	PE connection	Threaded hole M5/3 Nm [1)]

1) For ring cable lugs in accordance with DIN 46234

Table 3- 77 X1: Line connection for Smart Line Modules 36 kW and 55 kW

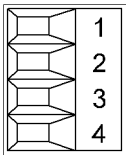
	Terminal	Technical specifications
	U1 V1 W1	Supply voltage: 380 V - 480 V 3 AC, 50/60 Hz **36 kW**: Threaded bolt M6 / 6 Nm 1) **55 kW**: Threaded bolt M8/13 Nm 1)
	PE connection	**36 kW**: Threaded hole M6 / 6 Nm 1)
		**55 kW**: Threaded hole M6 / 6 Nm 1)

1) For ring cable lugs in accordance with DIN 46234

3.8.3.3 X21 EP terminals

Smart Line Modules 5 kW and 10 kW

Table 3- 78 X21 EP terminal for Smart Line Modules 5 kW and 10 kW

	Terminal	Designation	Technical specifications
	1	DO: Ready	Checkback signal: Smart Line Module ready The signal switches to high level when the following conditions have been met: • Electronics power supply (X24) OK • DC link is precharged • Pulses enabled (X21.3/4) • No overtemperature • No overcurrent
	2	DO: Prewarning	DO: Prewarning High = no prewarning Low = prewarning • Overtemperature warning threshold/I^2t 5 kW prewarning: 64°C, overtemperature threshold: 69°C 10 kW prewarning: 68°C, overtemperature threshold: 73 °C • No regenerative feedback capability due to a line fault [only monitored when feedback is activated (see terminal X22.2)]
	3	EP +24 V (Enable Pulses)	Voltage 24 VDC Current consumption: 10 mA Isolated input
	4	EP M (Enable Pulses)	
Max. connectable cross-section: 1.5 mm^2 Type: Screw terminal 1 (see Chapter, "Control cabinet installation and EMC/connection system")			

⚠ WARNING

For operation, the 24 V DC voltage must be connected to terminal X21.3 and ground to terminal X21.4. When withdrawn, pulse suppression is activated. The regenerative feedback is deactivated. If the Line Module is not disconnected from the supply system when the EP terminal is deactivated (e.g. a line contactor is not installed), the DC link remains charged.

CAUTION

It is essential that a particular switch-on and switch-off sequence is followed in order to control the 5 kW and 10 kW Smart Line Modules; if this sequence is not observed, the Smart Line Module could be damaged beyond repair. To prevent the SLM being destroyed, the "Ready" signal must be evaluated at output terminal X21.1. (see the "Safety information" chapter).

NOTICE

Output terminal X21.1 must be wired to a digital input on the CU. The drives supplied with power by the Smart Line Module have to use this signal as a "Ready" message (BI: p0864 = digital input). This ensures that a pulse enable can only be issued for the drives (motor or generator operation) when the infeed is ready.
If interconnection with a digital input on the CU is not possible, the signal must be evaluated by a higher-level control system instead. The control system cannot set the drives to ready until the infeed "Ready" signal is present.

NOTICE

The "Prewarning" signal at output terminal X21.2 warns against an overload. If this signal is set, the control system shuts the drives down before the "Ready" signal switches to "low". If the "Ready" signal changes to "low", the drive pulses must be suppressed within 4 ms.

NOTICE

If an active drive line-up is switched off by means of the disconnector unit, the voltage at terminals X21.3 (EP +24 V) and X21.4 (EP M) must be interrupted beforehand. This can be carried out using a leading breaking auxiliary contact (≥ 10 ms), for example.

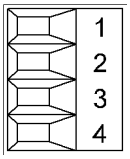
This protects external loads located parallel to the drive on the same switching component.

Note

The Smart Line Module signals that it is ready, even if one of the line conductors is not available. In this case, regenerative feedback is deactivated and an alarm is output at X21.2 (DO, Warning I^2t). If regenerative feedback was deactivated by applying a "high" signal to terminal X22.2 (DI, Disable), no alarm will be output at X21.2 (DO, Warning I^2t).

16 kW to 55 kW Smart Line Modules

Table 3- 79 X21 EP terminal/temperature Sensor for 16 kW to 55 kW Smart Line Modules

	Terminal	Function	Technical specifications
	1	+ Temp	Temperature sensors[1]: KTY 84-1C130/PTC/bimetallic switch with NC contact
	2	- Temp	
	3	EP +24 V (Enable Pulses)	Voltage: 24 VDC Current consumption: 10 mA Isolated input Signal propagation times: L → H: 100 µs H → L: 1000 µs
	4	EP M (Enable Pulses)	
Max. connectable cross-section 1.5 mm^2 Type: Screw terminal 1 (see Chapter, "Control cabinet installation and EMC/connection system")			

1) The temperature sensor type can be selected via parameter p0601; the temperature is displayed via r0035 (see SINAMICS S120/S150 List Manual).
Temperatures are detected but not evaluated in the Smart Line Module.

⚠ WARNING

For operation, the 24 V DC voltage must be connected to terminal X21.3 and ground to terminal X21.4. When withdrawn, pulse suppression is activated. Regenerative feedback is deactivated and the bypass relay drops out. If the Line Module is not disconnected from the supply system when the EP terminal is deactivated (e.g. a line contactor is not installed), the DC link remains charged.

NOTICE

If an active drive line-up is switched off by means of the disconnector unit, the voltage at terminals X21.3 (EP +24 V) and X21.4 (EP M) must be interrupted beforehand. This can be carried out using a leading breaking auxiliary contact (≥ 10 ms), for example.

This protects external loads located parallel to the drive on the same switching component.

NOTICE

The KTY temperature sensor must be connected with the correct polarity.
If the polarity is reversed, the sensor will not be able to detect if the motor overheats.

⚠ DANGER

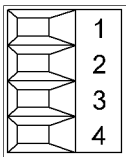
Risk of electric shock!

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) or Terminal Module TM120 must be used.

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

3.8.3.4 X22 digital inputs

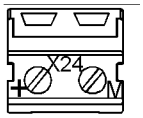
Table 3- 80 X22 digital inputs for Smart Line Modules 5 kW and 10 kW

	Terminal	Designation 1)	Technical specifications
	1	24 V power supply	Electronics power supply for controlling digital inputs X22.2 and 3.
	2	DI: Disable Regeneration	Deactivate feedback (high active). No power is supplied back to the network from the DC link. The regenerative energy of the motors may have to be reduced using a combination of the Braking Module and braking resistor.
	3	DI: Reset	Reset faults (negative edge)
	4	Ground	Electronics ground
Max. connectable cross-section: 1.5 mm^2 Type: Screw terminal 1 (see Chapter, "Control cabinet installation and EMC/connection system")			

1) DI: Digital input

3.8.3.5 X24 24 V terminal adapter

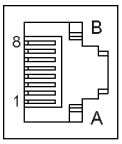
Table 3- 81 X24 24 V terminal adapter

	Terminal	Designation	Technical specifications
	+	24 V power supply	24 V DC supply voltage
	M	Ground	Electronics ground
Max. connectable cross-section: 6 mm^2 Type: Screw terminal 5 (see Chapter, "Control cabinet installation and EMC/connection system")			

The 24 V terminal adapter is included in the scope of supply.

3.8.3.6 X200-X202 DRIVE-CLiQ interfaces

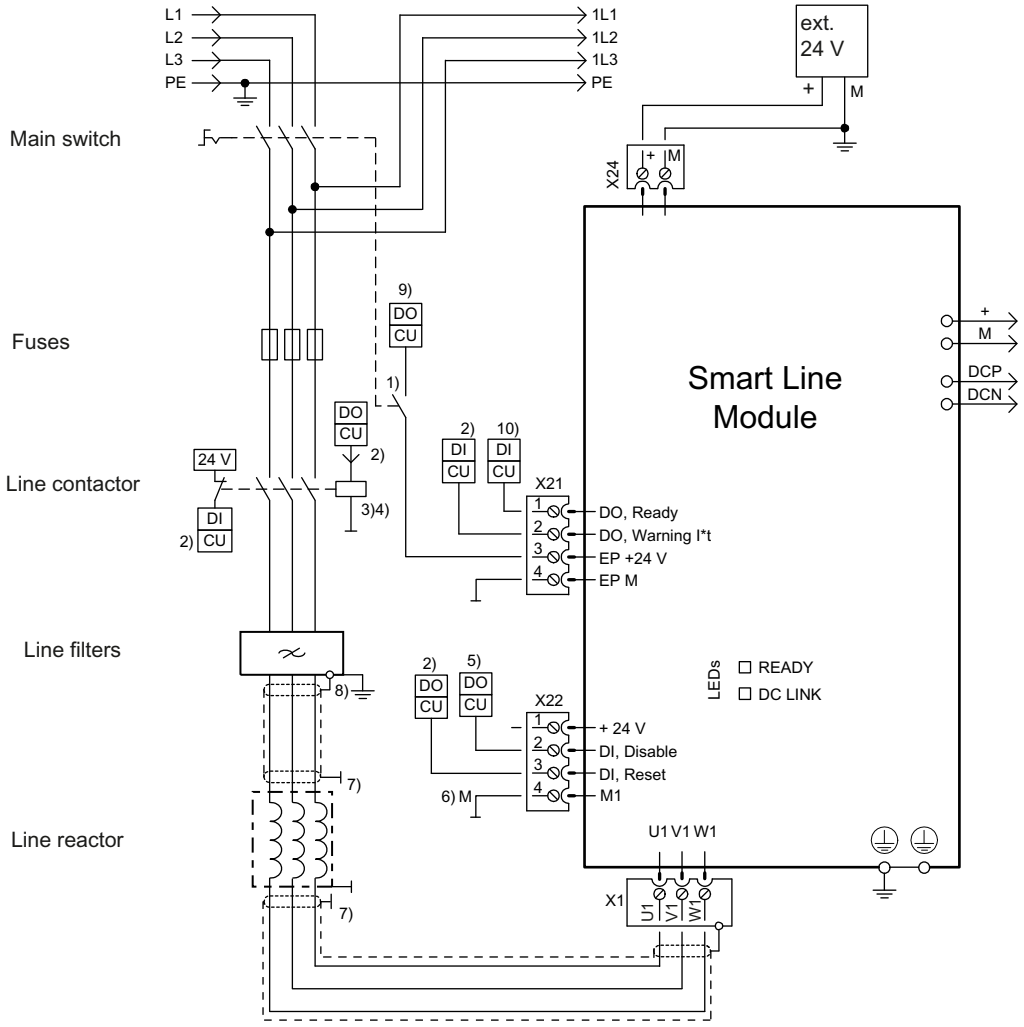
Table 3- 82 X200-X202 DRIVE-CLiQ interfaces

	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

The blanking covers for the DRIVE-CLiQ interfaces are included in the scope of delivery.

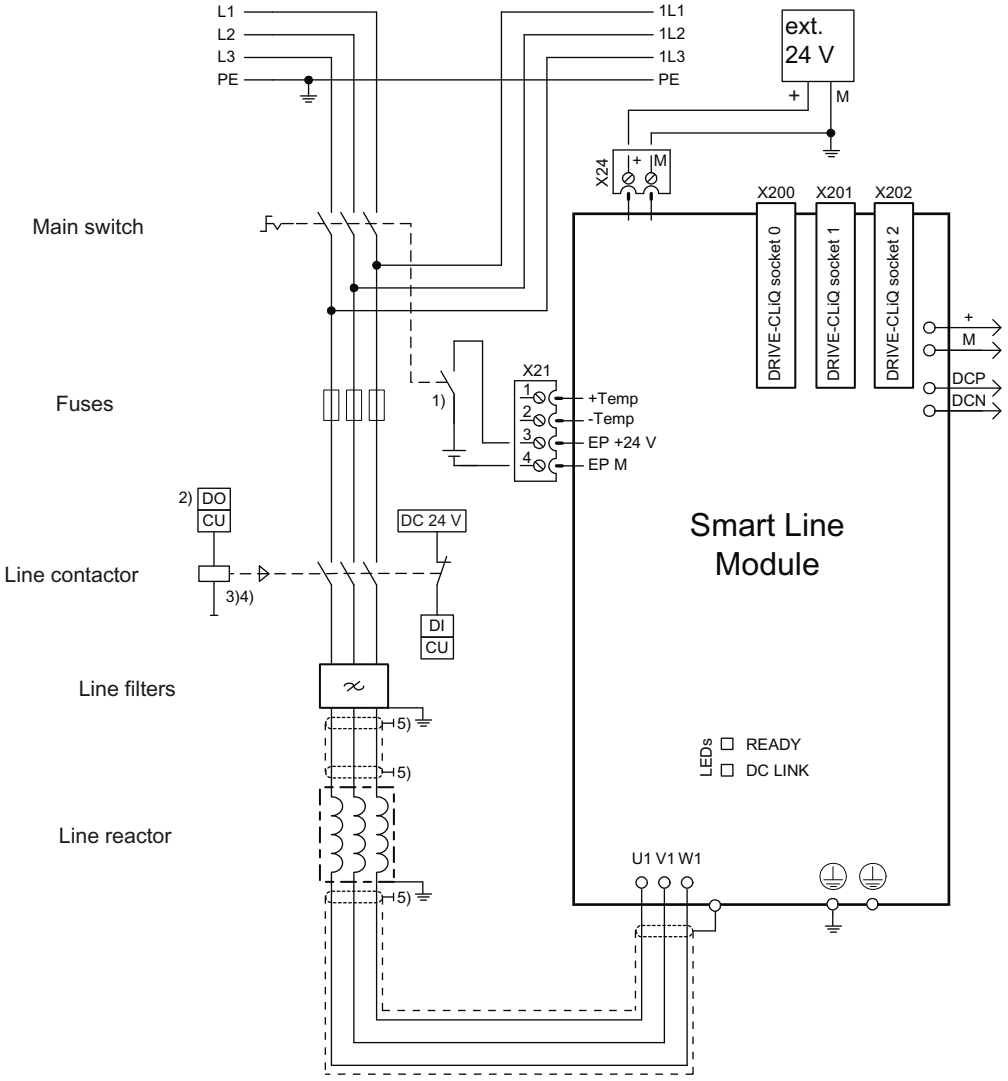
Blanking cover (50 pcs.) Order number: 6SL3066-4CA00-0AA0

3.8.4 Connection examples



1) Leading opening contact t > 10ms, 24 V DC and ground must be connected for operation.
2) DI/DO controlled by the Control Unit
3) No additional load permitted downstream of line contactor
4) The current carrying capacity of the DO must be observed; an output interface must be used if required.
5) DO high, regenerative feedback deactivated (for permanent deactivation, a jumper can be installed between X22 pin 1 and 2)
6) X22 pin 4 must be connected to ground (external 24 V)
7) Contact via rear mounting panel or shielding buses in accordance with EMC installation guideline
8) 5 kW and 10 kW line filters via shield connection
9) Signal output of the control to avoid reaction of the 24 V supply on the EP terminal
10) Connect to parameter p0864 via BICO

Figure 3-91 Connection example for 5 kW and 10 kW Smart Line Modules



1) Leading opening contact t > 10 ms
2) DI/DO, controlled by the Control Unit
3) No additional load permitted downstream of line contactor
4) The current carrying capacity of the DO must be observed; an output interface must be used if required.
5) Contact via rear mounting panel or shielding buses in accordance with EMC installation guideline

Figure 3-92 Connection example for 16 kW to 55 kW Smart Line Modules

Note

If you are using a VSM10 Voltage Sensing Module, the leading opening contact can be omitted.

3.8.5 Meaning of LEDs

3.8.5.1 Smart Line Modules 5 kW and 10 kW

Table 3- 83 Meaning of the LEDs on 5 kW and 10 kW Smart Line Modules

LED	Color	Status	Description, cause	Remedy
RDY	–	Off	Electronics power supply is missing or outside permissible tolerance range.	–
	Green	Continuous light	Component is ready to operate.	–
	Yellow	Continuous light	Pre-charging not yet complete. bypass relay dropped out EP terminals not supplied with 24 VDC.	–
	Red	Continuous light	Overtemperature, overcurrent	Diagnose fault (via output terminals) and acknowledge it (via input terminal)
DC LINK	–	Off	Electronics power supply is missing or outside permissible tolerance range.	–
	Yellow	Continuous light	DC link voltage within permissible tolerance range.	–
	Red	Continuous light	DC link voltage outside permissible tolerance range. Line supply fault.	Check the line voltage.

⚠DANGER

Hazardous DC link voltages may be present at any time regardless of the status of the "DC LINK" LED.
The warning information on the components must be carefully observed!

3.8.5.2 16 kW to 55 kW Smart Line Modules

Table 3- 84 Meaning of the LEDs on Smart Line Modules ≥ 16 kW

Status		Description, cause	Remedy
RDY	DC LINK		
Off	Off	Electronics power supply is missing or outside permissible tolerance range.	–
Green	--	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.	Check line voltage
Orange	Orange	DRIVE-CLiQ communication is being established.	–
Red	--	At least one fault is present in this component. **Note:** The LED is activated regardless of whether the corresponding messages have been reconfigured.	Remedy and acknowledge fault
Green/red (0.5 Hz)	--	Firmware is being downloaded.	–
Green/red (2 Hz)	--	Firmware download is complete. Wait for POWER ON.	Carry out a POWER ON
Green/orange or Red/orange	--	Component detection via LED is activated (p0124). **Note:** Both options depend on the LED status when component recognition is activated via p0124 = 1.	–

⚠ DANGER

Hazardous DC link voltages may be present at any time regardless of the status of the "DC LINK" LED.
The warning information on the components must be carefully observed!

3.8.6 Dimension drawings

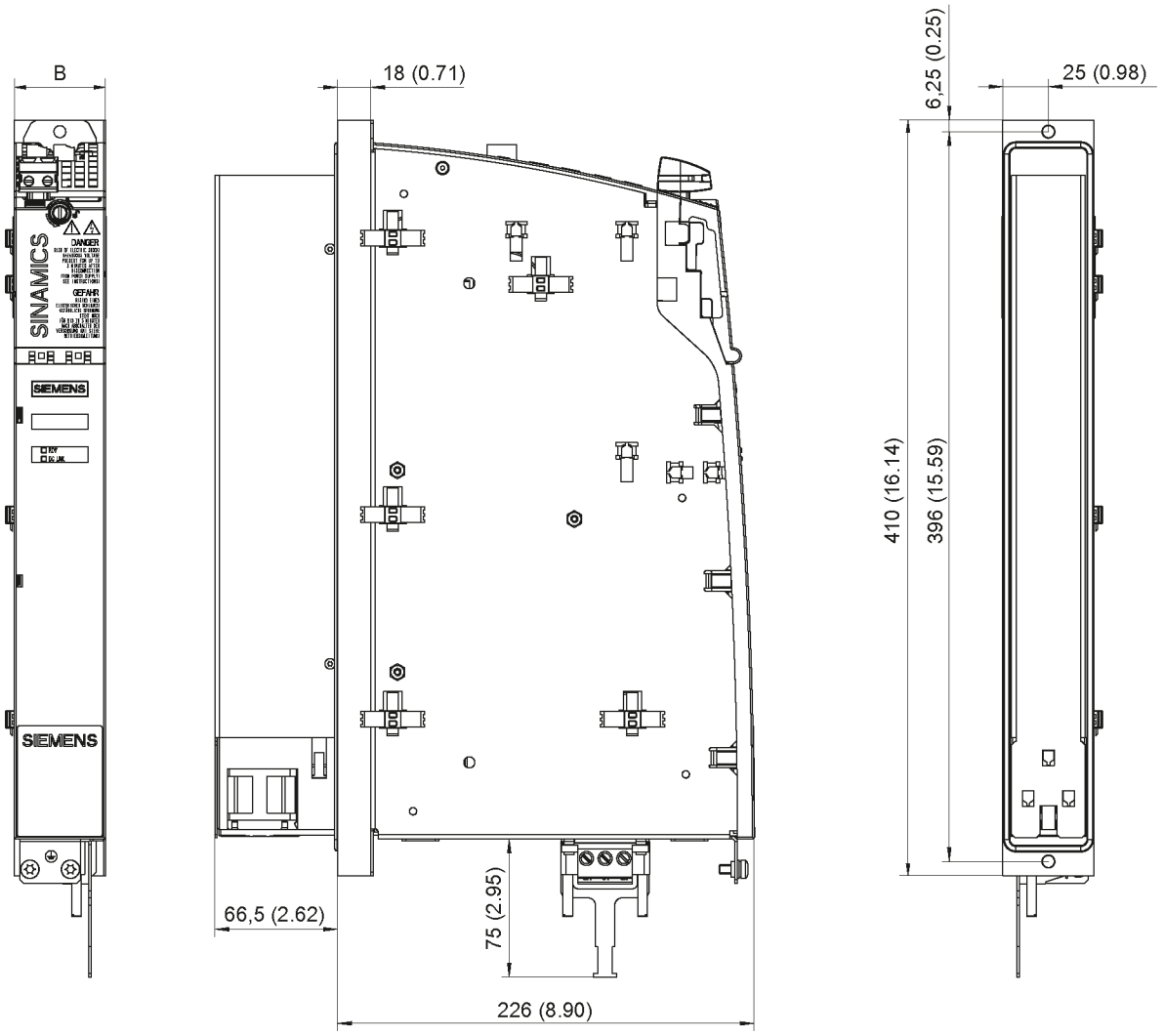


Figure 3-93 Dimension drawing of 5 kW and 10 kW Smart Line Modules with external air cooling, all dimensions in mm and (inches)

Table 3- 85 Dimensions of Smart Line Modules with external air cooling

Line Module	Order number	W [mm] (inches)
5 kW	6SL3131-6AE15-0AAx	50 (1.97)
10 kW	6SL3131-6AE21-0AAx	50 (1.97)

Note

The shield connecting plate is part of the scope of supply of the 50 mm Smart Line Module.

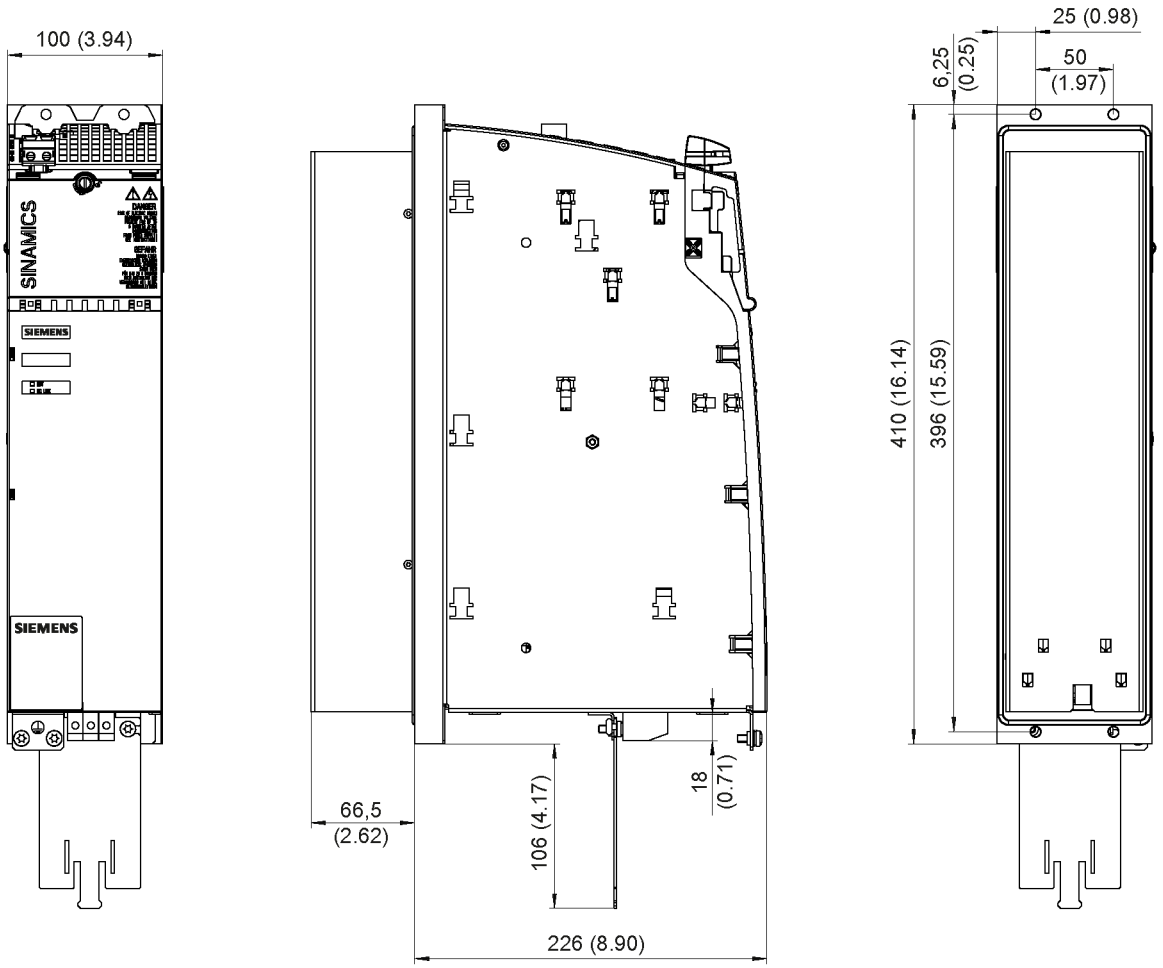


Figure 3-94 Dimension drawing of 16 kW Smart Line Module with external air cooling, all dimensions in mm and (inches)

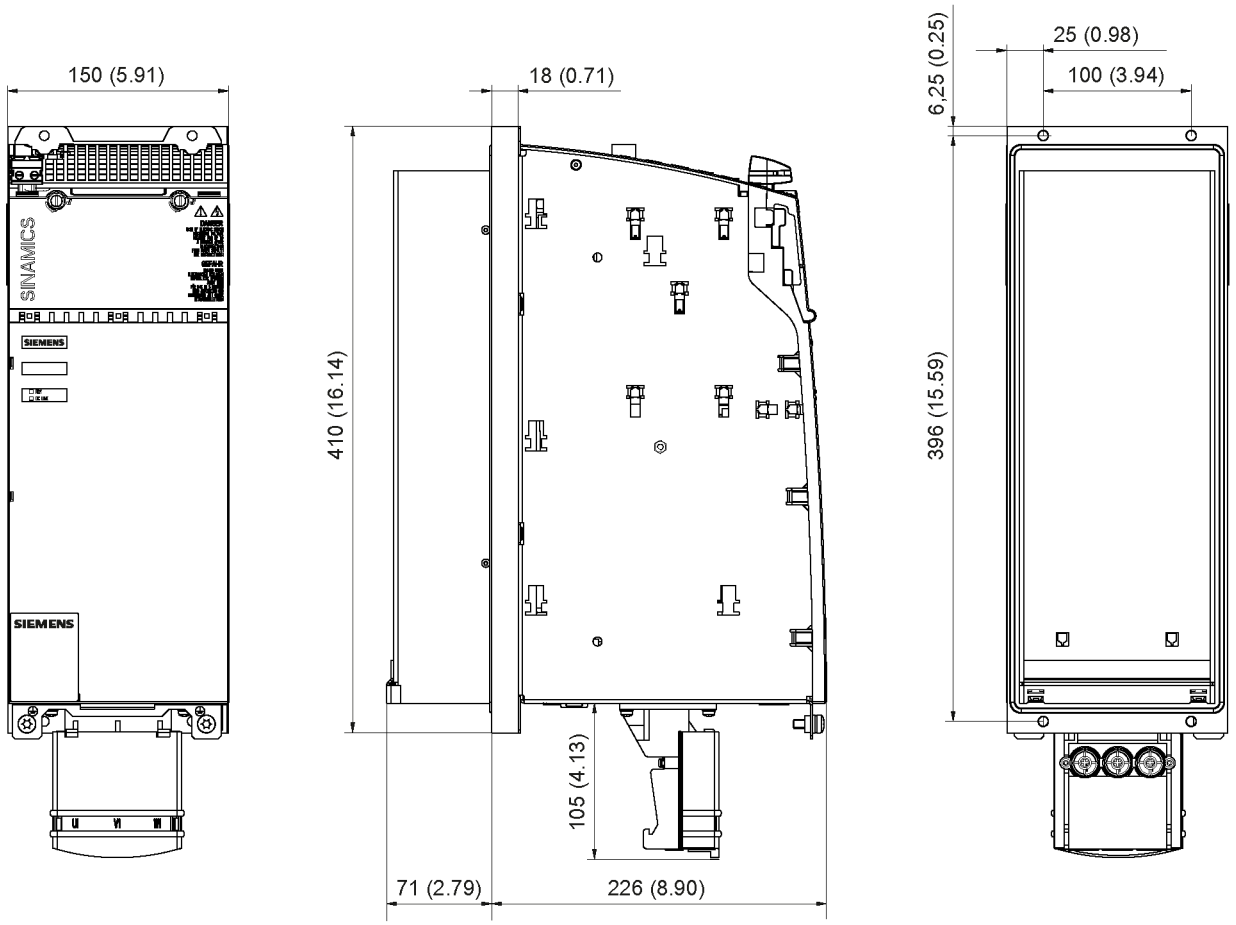


Figure 3-95 Dimension drawing of 36 kW Smart Line Module with external air cooling, all dimensions in mm and (inches)

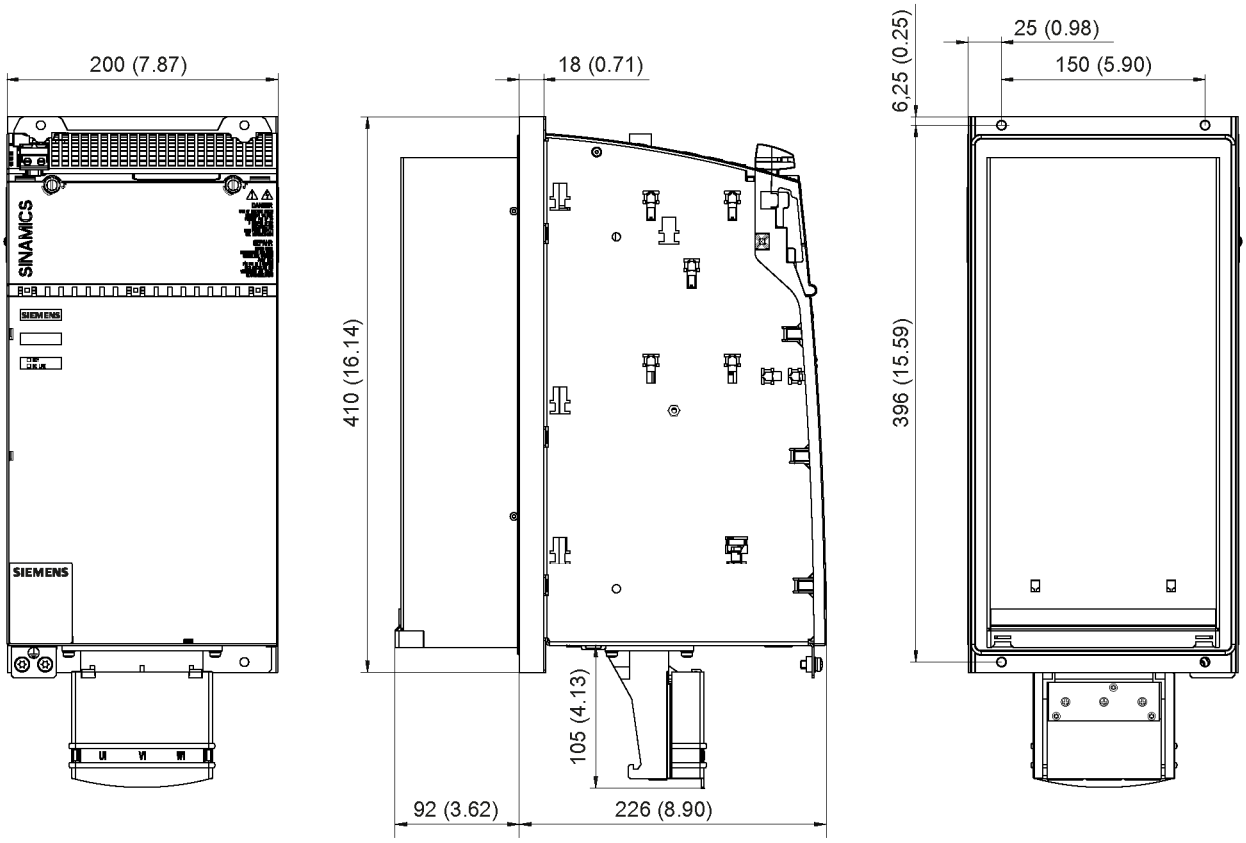
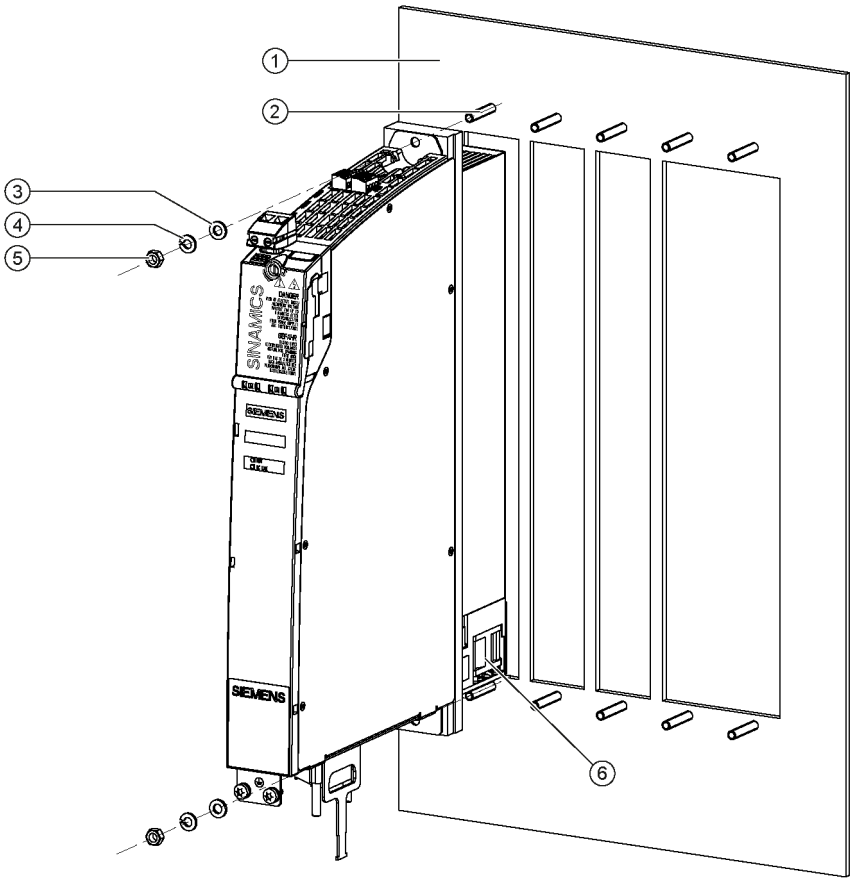


Figure 3-96 Dimension drawing of 55 kW Smart Line Module with external air cooling, all dimensions in mm and (inches)

3.8.7 Installation



① Mounting plate with openings
② M6 studs
③ Washer
④ Spring washer
⑤ M6 nut, width A/F 10 (hexagon head)
⑥ Fan assembly

Figure 3-97 Installing a Smart Line Module with external air cooling on a mounting plate, using a 5 kW Smart Line Module as an example

Tightening torques:

- Initially, tighten by hand (0.5 Nm)
- Then tighten with 6 Nm.

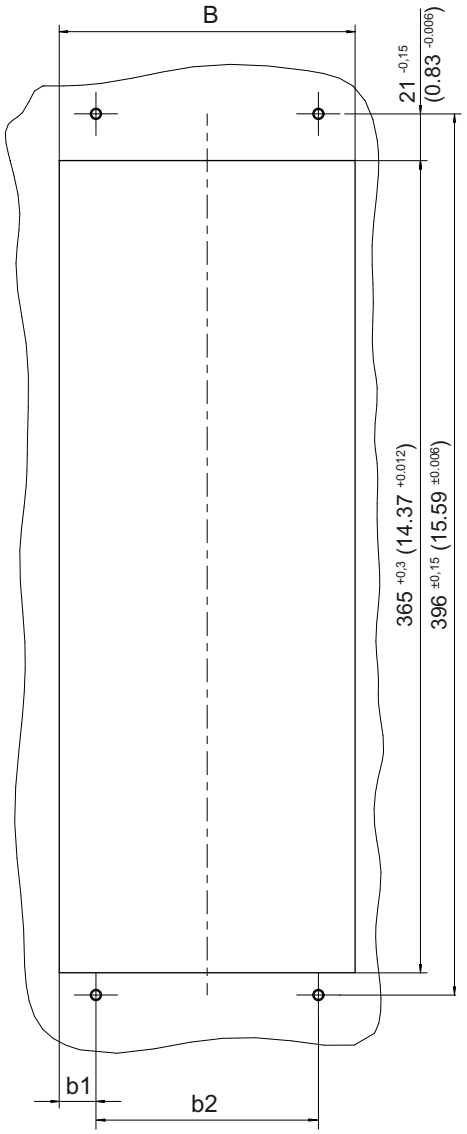
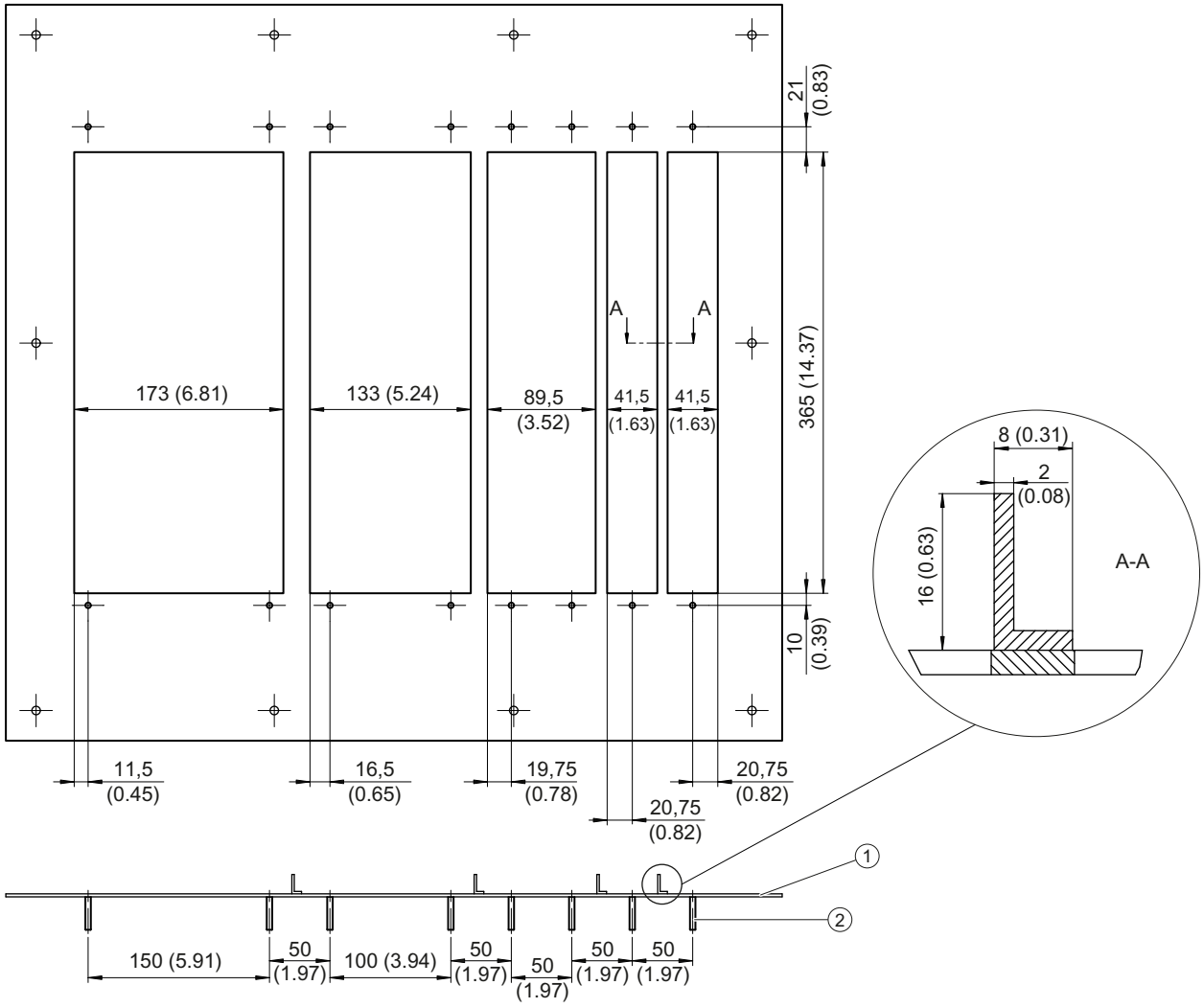


Figure 3-98 Installation opening for Smart Line Modules 50 mm to 200 mm with external air cooling, all data in mm and (inches)

Table 3- 86 Dimensions of installation openings for Smart Line Modules with external air cooling

Module width	W in mm (inches)	w1 in mm (inches)	w2 in mm (inches)
50 mm	41.5 +0.3 (1.63 +0.012)	20.75 +0.15 (0.82 +0.006)	--
100 mm	89.5 +0.3 (3.52 +0.012)	19.75 +0.15 (0.78 +0.006)	50 ±0.15 (1.97 ±0.006)
150 mm	133 +0.3 (5.24 +0.012)	16.5 +0.15 (0.65 +0.006)	100 ±0.15 (3.94 ±0.006)
200 mm	173 +0.3 (6.81 +0.012)	11.5 +0.15 (0.45 +0.006)	150 ±0.15 (5.91 ±0.006)

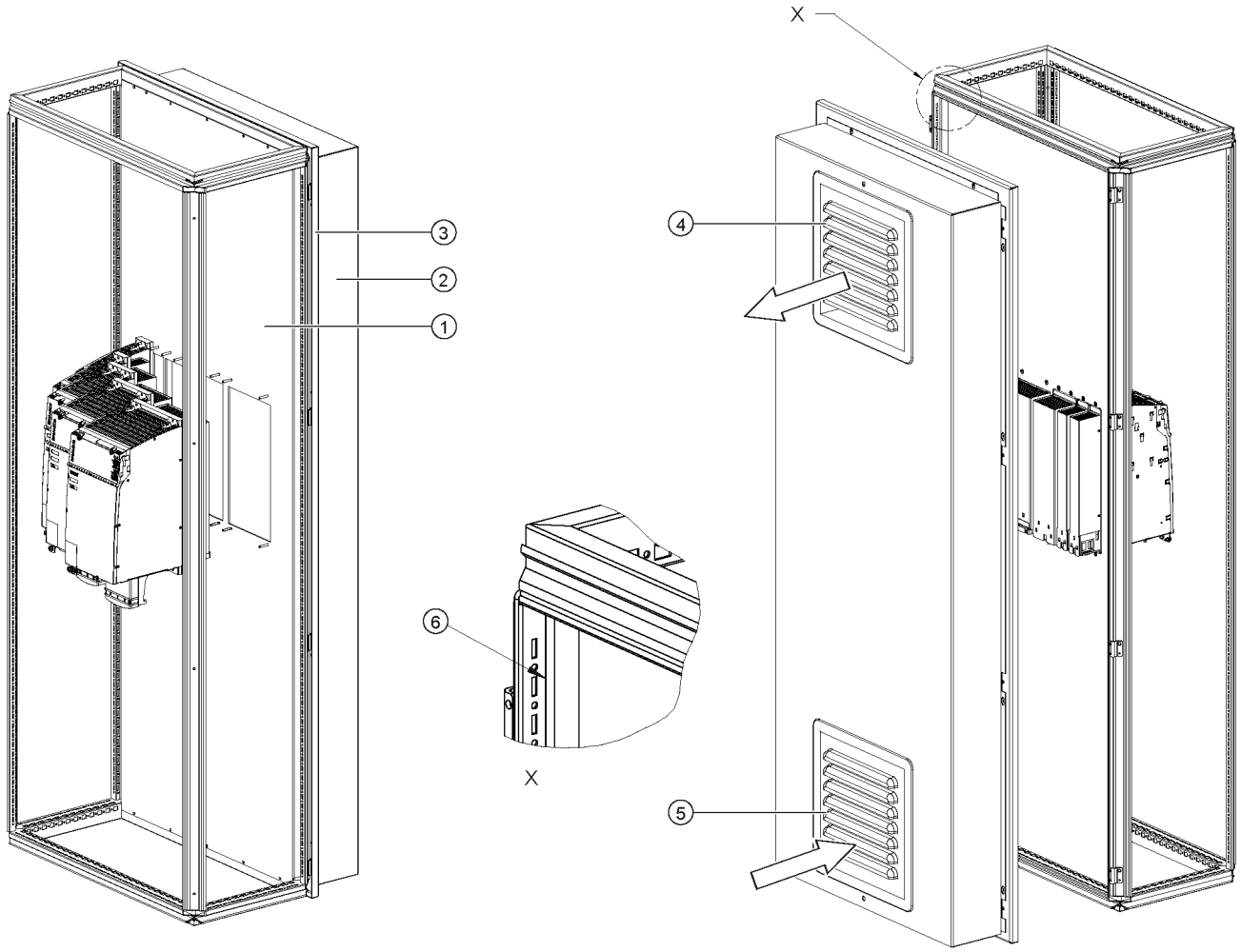


① Insert or mounting plate
② Threaded bolts M5 x 28

Figure 3-99 Example of a mounting plate for a drive line-up with external air cooling

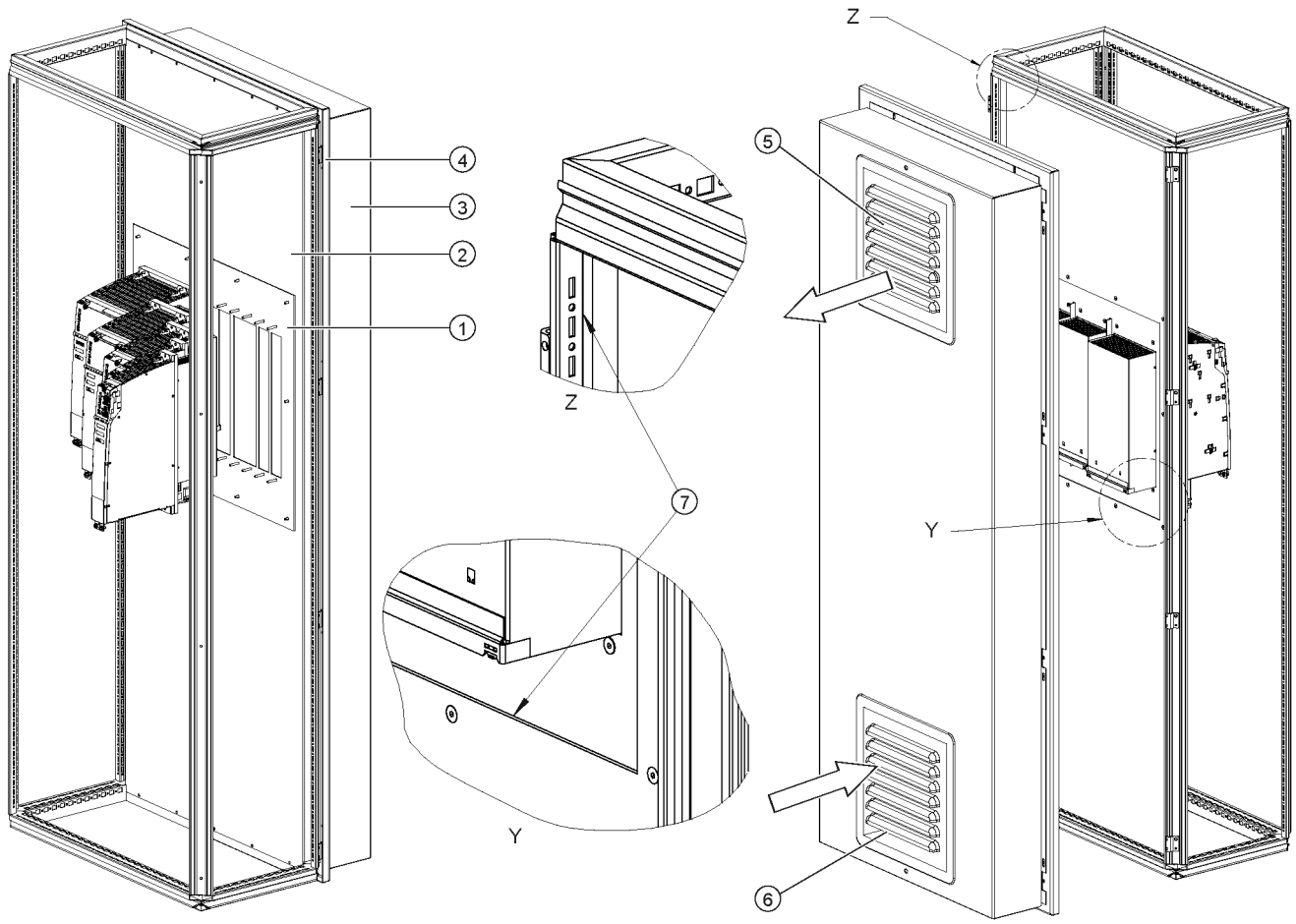
During installation it must be ensured that the component's seal is tight throughout. The cross-pieces must have the appropriate stability. If necessary, the cross-pieces of the openings must be reinforced.

In our example, the cross-pieces have been reinforced using brackets to EN 755-9. You are free to select the way that the bracket is attached to the insert.



① Mounting plate
② Cover
③ Rear panel
④ Air discharge
⑤ Air inlet - filter with filter fan
⑥ To comply with degree of protection IP54, the surfaces ⑥ between the mounting plate and the cabinet strip must be sealed all round. (for example, sealant Terostat-91 from the Teroson company)

Figure 3-100 Example 1: installation in cabinet with mounting plate



① Insert
② Mounting plate
③ Cover
④ Rear panel
⑤ Air discharge
⑥ Air inlet - filter with filter fan
⑦ To maintain the degree of protection IP54, the surfaces ⑦ between the mounting plate and the cabinet strip as well as between the mounting plate and insert must be sealed all around. (for example, sealant Terostat-91 from the Teroson company)

Figure 3-101 Example 2: installation in cabinet with mounting plate

We recommend that you attach a cover and filter fan to the cabinet.

The filtered fan must be fitted in such a way that the cooling air required by the drive line-up is not restricted. The overall cooling air requirement is obtained from the sum of the individual components (refer to Chapter, "Technical data").

Note

If the cooling air requirement is not covered by the filtered fan, the components cannot output their specified power.

The filters with a filter fan must be regularly checked for dirt and cleaned if necessary.

Help with the mechanical control cabinet installation is available from:

Siemens AG
Industry Sector, IA SE WKC
TCCCC (Technical Competence Center Cabinets Chemnitz)
P.O. Box 1124
09070 Chemnitz, Germany

E-mail: cc.cabinetcooling.aud@siemens.com

3.8.8 Technical data

Table 3- 87 Technical data Smart Line Modules Booksize external air cooling

Internal air cooling	6SL3131–	6AE15–0AAx	6AE21–0AAx	6TE21-6AAx	6TE23-6AAx	6TE25-5AAx
Rated power	**kW**	**5**	**10**	**16**	**36**	**55**
Infeed						
Rated power (S1) 1)	kW (P_n)	5	10	16	36	55
S6 operation (40%)1)	kW (P_{s6})	6.5	13	21	47	71
Peak infeed power 1)	kW (P_{max})	10	20	35	70	91
Regenerative feedback						
Continuous regenerative power	kW	5	10	16	36	55
Peak regenerative power	kW	10	20	35	70	91
Supply voltages						
Line voltage	V_{AC}	3 AC 380 -10 % (-15 % < 1 min) to 3 AC 480 +10 %				
Line frequency	Hz	47 to 63				
Electronics power supply	V_{DC}	24 (20.4 - 28.8)				
DC link voltage	V_{DC}	510 – 720				
Overvoltage trip	V_{DC}	820 ± 2 %				
Undervoltage trip	V_{DC}	360 ± 2 %				
Input currents						
Rated input current						
at 400 V_{AC}	A_{AC}	8.1	16.2	27.5	59	90
at 380 V_{AC}/480 V_{AC}	A_{AC}	8.6 / 6.7	17 / 12.8	29 / 24.5	62 / 51	94 / 77
S6 (40%) at 400 V_{AC}	A_{AC}	10.6	21.1	35	76	106
Peak current at 400 V_{AC}	A_{AC}	15.7	31.2	57.5	112	130
DC link currents						
DC link output current						
at 600 V_{DC}						
at 540 V_{DC}	A_{DC}	8.3	16.6	27	60	92
S6 (40%) at 600 V_{DC}	A_{DC}	9.3	18.5	30	67	105
Peak current at 600 V_{DC}	A_{DC}	11	22	35	79	138
	A_{DC}	16.6	33.2	59	118	178
Current carrying capacity						
DC link busbar	A_{DC}	100	100	100	200	200
Reinforced DC link busbars:						
24 V busbar:	A_{DC}	150	150	150	--	--
	A_{DC}	20	20	20	20	20
Electronics current consumption at 24 V DC	A_{DC}	0.8	0.9	0.95	1.5	1.9
Total power loss (incl. electronics losses) 2)	W	79.2	141.6	187.8	406	665.6
Internal	W	41.2	66.6	64.8	116	185.6
External	W	38	75	123	290	480
Max. ambient temperature						
Without derating	°C	40				
With derating	°C	55				
DC link capacitance						
Smart Line Module	µF	220	330	705	1410	1880
Drive line-up, max.	µF	6000	6000	20000	20000	20000

Internal air cooling	**6SL3131–**	**6AE15–0AAx**	**6AE21–0AAx**	**6TE21-6AAx**	**6TE23-6AAx**	**6TE25-5AAx**
Rated power	**kW**	**5**	**10**	**16**	**36**	**55**
Power factor	cos ϕ	0.98	0.98	0.98	0.98	0.98
Circuit breaker (UL) Type designation: Rated current: Resulting rated short-circuit current [4] SCCR at 480 V_{AC}:	 A kA	 3VL1102-2KM30 20 65	 3VL1135-2KM30 35 65	 3VL1135-2KM30 35 65	 3VL2108-2KN30 80 65	 3VL2112-2KN30 125 65
Safety fuse (UL) Type AJT Class J [3] Rated current Resulting rated short-circuit current [4] SCCR at 480 V_{AC}:	 A kA	 AJT17-1/2 17.5 65	 AJT35 35 65	 AJT35 35 65	 AJT80 80 65	 AJT125 125 65
Sound pressure level	dB(A)	< 60	< 60	< 60	<65	< 60
Cooling air requirement	m^3/h	29.6	29.6	56	112	160
Rated voltage for rated data 3 AC 380 V						
Weight	kg	5.3	5.4	8.8	13.8	18.5

1) The powers specified apply to the rated voltage range from 380 V to 480 V.

2) For an overview, see the power loss tables in Chapter, Control cabinet installation

3) Source of supply: The Ferraz Shawmut company

4) The resulting rated short-circuit current is obtained from the combination of the fuse, or circuit breaker, and the Line Module in the drive system.

3.8.8.1 Characteristics

Rated duty cycles of Smart Line Modules

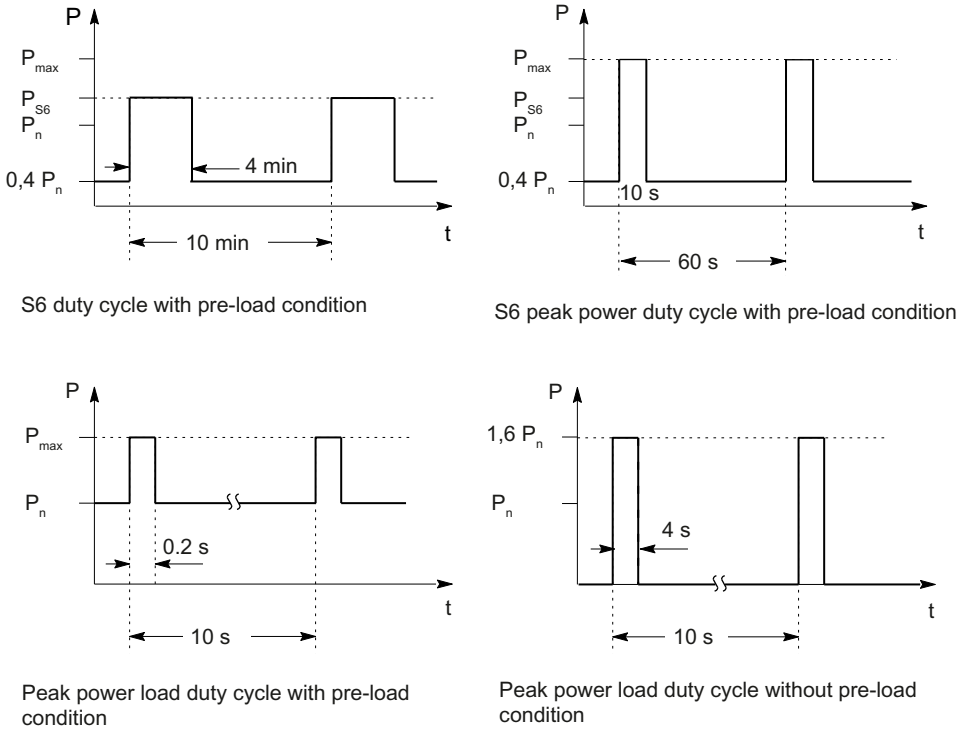


Figure 3-102 Rated duty cycles of Smart Line Modules

Derating characteristics

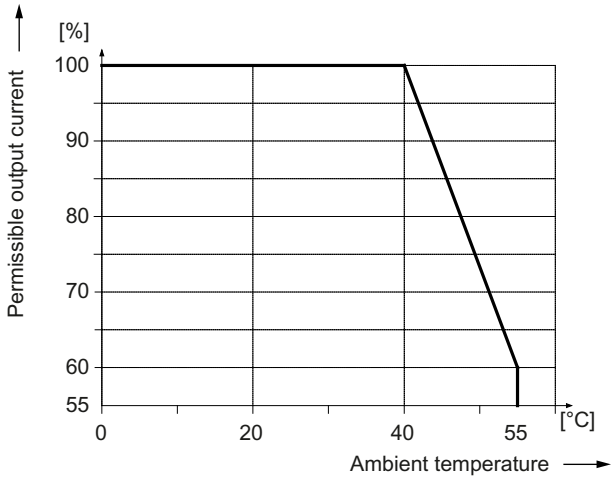


Figure 3-103 Output current as a function of the ambient temperature

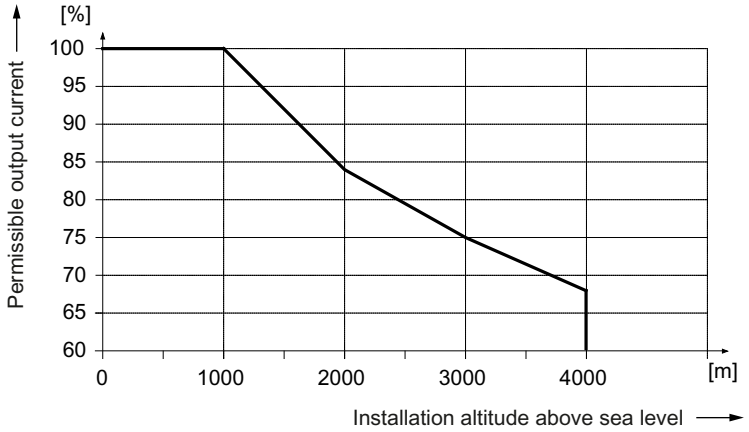


Figure 3-104 Output current as a function of the installation altitude

At installation altitudes >2000 m, an insolating transformer must be used (see "System overview/Derating as a function of the installation altitude and ambient temperature"). The design of the secondary line supply system must be as follows:

- TN system with grounded star point (no grounded outer conductor)
- IT system

A reduction of the line supply voltage phase-phase is not necessary.

3.9 Smart Line Modules with cold plate

3.9.1 Description

The Smart Line Module is a non-regulated infeed/regenerative feedback unit. The Smart Line Module supplies the Motor Module(s) with a non-regulated DC voltage at the DC output. In the infeed mode the Smart Line Module exhibits the typical current and voltage waveforms of a 6-pulse diode rectifier bridge.

In feedback mode, the current waveform is square waved. Feedback can be deactivated by means of a terminal because these Smart Line Modules are not equipped with a DRIVE-CLiQ connection.

The DC link starts precharging as soon as the supply voltage is applied and is independent of its phase sequence direction. Load can be applied to the DC link after the module has been enabled. An optional main contactor is required for disconnecting the voltage.

Smart Line Modules are suitable for direct operation on TN, IT, and TT systems. The modules have an integrated overvoltage protection function.

3.9.2 Safety Information

⚠ DANGER

Risk of electric shock

A hazardous voltage is present for up to 5 minutes after the power supply has been disconnected.
The protective cover may only be opened after this time has expired.

You must use a suitable tool (slot-head screwdriver) to open the protective cover on the DC link.

The components must only be operated when the protective cover of the DC link is closed. Damaged components must not be operated further, otherwise this could result in secondary damage or accidents.

⚠ DANGER

DC link discharge time

A DC link discharge time danger notice in the local language must be attached to the components.
A set of labels in 16 languages is supplied with the component.

⚠DANGER

In the interests of operator and fire protection, the power supply conditions in terms of short-circuit power and loop impedance at the infeed point must be such that they will trip the installed overcurrent protection devices within the prescribed period if a fault occurs (short circuit or short circuit to exposed conductive part).

Note

Line short-circuit power at the infeed point

The line short-circuit power at the infeed point must be at least 70 times greater than the rated power of the Line Module in order to limit the line harmonics to an acceptable level for other loads.

⚠DANGER

DC link

If the Line Module is not disconnected from the supply system (e.g. via the line contactor or main switch), the DC link remains charged.

⚠DANGER

Deactivating the regenerative feedback capability

For supply systems without regenerative feedback capability (e.g. diesel generator), the regenerative feedback capability of the Smart Line Modules must be deactivated by means of a jumper between terminals X22.1 and X22.2. Terminal X22.4 must be connected to ground.

In this case, the braking energy must be dissipated via an additional Braking Module with braking resistor provided in the drive line-up.

⚠DANGER

It is only permissible to establish connections to the DC link using the adapters that SIEMENS has recommended (DC link adapter and DC link rectifier adapter).

⚠DANGER

If a 50 mm wide Motor Module or a 50 mm wide DC link component (e.g. Braking Module, Control Supply Module, Voltage Clamping Module) is located at the left-hand end of the drive line-up, then the DC link bridges, including all of the screws, must be removed from this component. It is not permissible to insert the screws without a DC link bridge.

For all other components that are 75 mm wide or wider, it is neither permissible to move the DC link bridge to the left nor to remove it.

If this is not carefully observed, this can result in damage and accidents.

⚠ CAUTION

The 80 mm clearances above and below the components must be observed.

CAUTION

It is essential that a particular switch-on and switch-off sequence is followed in order to control the 5 kW and 10 kW Smart Line Modules; if this sequence is not observed, the Smart Line Module could be damaged beyond repair. To prevent the SLM being destroyed, the "Ready" signal must be evaluated at output terminal X21.1.

Switch on:

- 24 V DC power supply X24 ON
- Line contactor ON
- EP signal X21 pins 3 and 4 ON
- Wait until precharging is complete
- "Ready" signal at terminal X21 pin 1 set to "high"
- Infeed is ready, pulse enable possible for motors

Switch off:

- Shut drives down
- Cancel pulse enable for motors (OFF1 signal)
- EP signal X21 pins 3 and 4 OFF
- Line contactor OFF
- 24 V DC power supply X24 OFF

Overload:

- "Prewarning" signal at terminal X21 pin 2 set to "low"
- Shut drives down via the control system
- "Ready" signal at terminal X21 pin 1 set to "low"
- Pulse inhibit for all the drives supplied by this infeed within 4 ms

CAUTION

The correct tightening torque of the DC link busbar screws (1.8°Nm, tolerance +30%) must be checked before commissioning with the complete system in a voltage-free state (powered-down) and with the DC link discharged. After transportation, the screws must be tightened.

CAUTION

The overall length of the power cables (motor supply cables and DC link cables) must not exceed the values given in the chapter titled "Possible line reactor and line filter combinations".

CAUTION
DC link side covers are supplied with the components as standard and must be attached to the first and last components in the drive line-up. They can also be ordered separately, if required (order number: 6SL3162-5AA00-0AA0).

NOTICE
Operation without the line reactor is not permissible.

Note

Smart Line Modules have been designed for use in the industrial environment and generate current harmonics on the line side as a result of the rectifier circuit.

When connecting a machine with integrated Smart Line Modules to the public low-voltage network, authorization is required in advance from the local power supply company (utility company) if

- the rated current of the machine ≤ 16 A per conductor, and
- the rated machine current does not comply with the requirements specified in EN 61000-3-2 regarding current harmonics.

3.9.3 Interface description

3.9.3.1 Overview

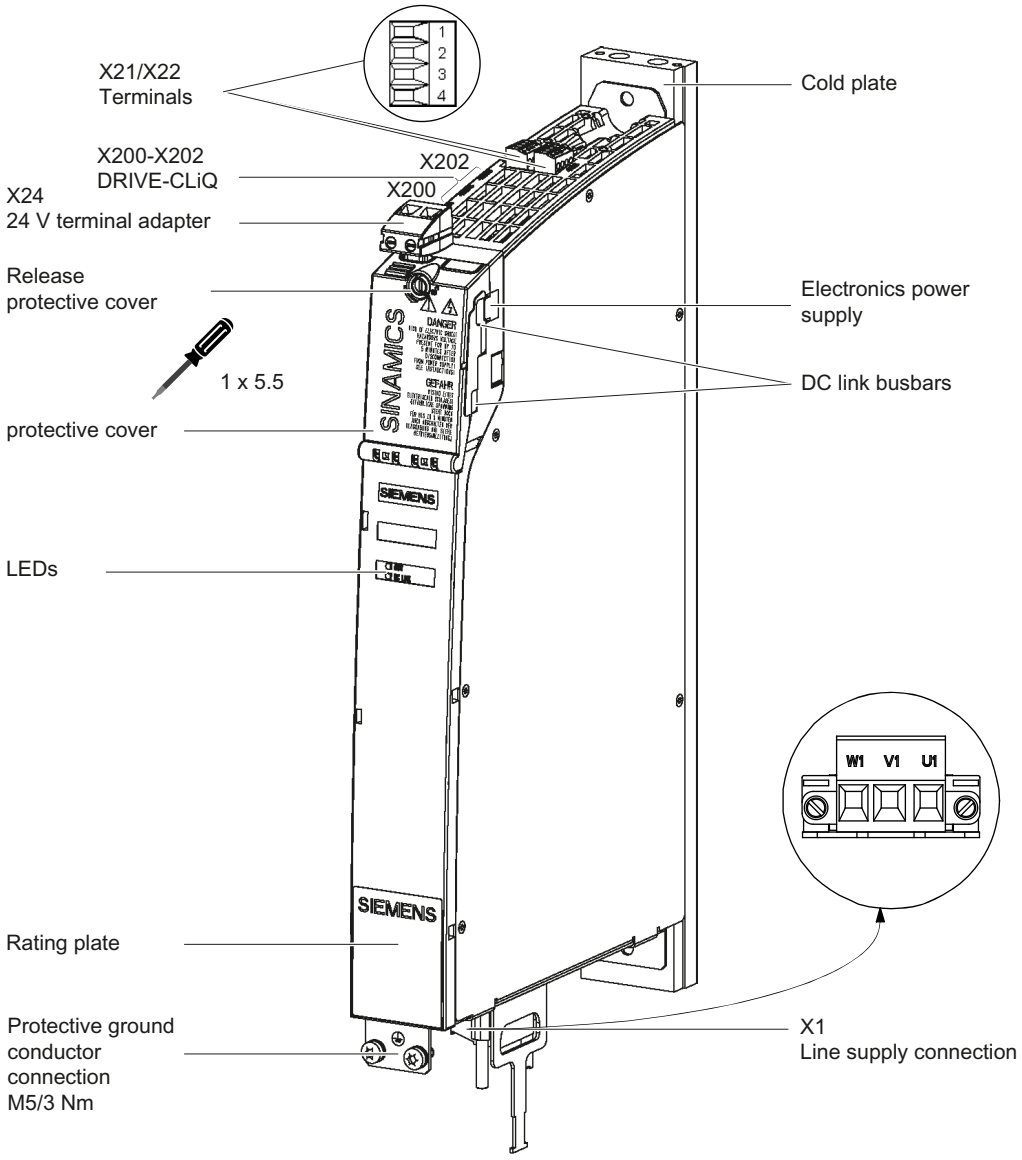
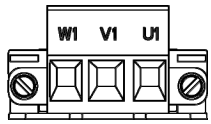
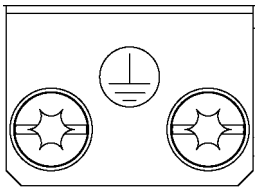


Figure 3-105 Interface overview, Smart Line Module with cold plate (example: 5 kW)

3.9.3.2 X1 line connection

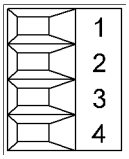
Table 3- 88 X1 line connection

	Terminal	Technical specifications
	U1 V1 W1	Supply voltage: 380 V - 480 V 3 AC, 50/60 Hz Max. connectable cross-section: 6 mm^2 Type: Screw terminal 5 Tightening torque: 1.2 - 1.5 Nm (see Chapter, "Control cabinet installation/connection system")
	PE connection	Threaded hole M5/3 Nm 1)

1) For ring cable lugs in accordance with DIN 46234

3.9.3.3 X21 EP terminals

Table 3- 89 X21 EP terminals

	Terminal	Designation	Technical specifications
	1	DO: Ready	Checkback signal: Smart Line Module ready The signal switches to high level when the following conditions have been met: • Electronics power supply (X24) OK • DC link is precharged • Pulses enabled (X21.3/.4) • No overtemperature • No overcurrent switch-off
	2	DO: Prewarning	DO: Prewarning High = no prewarning Low = prewarning • Overtemperature warning threshold / I*t 5 kW prewarning: 64 °C, disconnection: 69 °C 10 kW prewarning: 68 °C, disconnection: 73 °C • No regenerative feedback capability due to a line fault [only monitored when feedback is activated (see terminal X22.2)]
	3	EP +24 V (Enable Pulses)	Voltage 24 VDC Current consumption: 10 mA Isolated input
	4	EP M (Enable Pulses)	
Max. connectable cross-section: 1.5 mm^2 Type: Screw terminal 1 (see Chapter, "Control cabinet installation and EMC/connection system")			

⚠ WARNING

For operation, the 24 V DC voltage must be connected to terminal X21.3 and ground to terminal X21.4. When withdrawn, pulse suppression is activated. Regenerative feedback is deactivated and the bypass relay drops out. If the Line Module is not disconnected from the supply system when the EP terminal is deactivated (e.g. a line contactor is not installed), the DC link remains charged.

CAUTION

It is essential that a particular switch-on and switch-off sequence is followed in order to control the Smart Line Modules; if this sequence is not observed, the Smart Line Module could be destroyed. To prevent the SLM being destroyed, the "Ready" signal must be evaluated at output terminal X21.1. (see the "Safety information" chapter).

NOTICE

Output terminal X21.1 must be wired to a digital input on the CU. The drives supplied with power by the Smart Line Module have to use this signal as a "Ready" message (BI: p0864 = digital input). This ensures that a pulse enable can only be issued for the drives (motor or generator operation) when the infeed is ready.
If interconnection with a digital input on the CU is not possible, the signal must be evaluated by a higher-level control system instead. The control system cannot set the drives to ready until the infeed "Ready" signal is present.

NOTICE

The "Prewarning" signal at output terminal X21.2 warns against an overload. If this signal is set, the control system shuts the drives down before the "Ready" signal switches to "low". If the "Ready" signal changes to "low", the drive pulses must be suppressed within 4 ms.

NOTICE

If an active drive line-up is switched off by means of the disconnector unit, the voltage at terminals X21.3 (EP +24 V) and X21.4 (EP M) must be interrupted beforehand. This can be carried out using a leading breaking auxiliary contact (≥ 10 ms), for example.

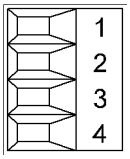
This protects external loads located parallel to the drive on the same switching component.

Note

The Smart Line Module signals that it is ready, even if one of the line conductors is not available. In this case, regenerative feedback is deactivated and an alarm is output at X21.2 (DO, Warning I^2t). If regenerative feedback was deactivated by applying a "high" signal to terminal X22.2 (DI, Disable), no alarm will be output at X21.2 (DO, Warning I^2t).

3.9.3.4 X22 digital inputs

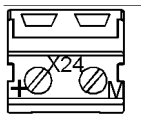
Table 3- 90 X22 digital inputs for Smart Line Modules 5 kW and 10 kW

	Terminal	Designation 1)	Technical specifications
	1	24 V power supply	Electronics power supply for controlling digital inputs X22.2 and 3.
	2	DI: Disable Regeneration	Deactivate feedback (high active). No power is supplied back to the network from the DC link. The regenerative energy of the motors may have to be reduced using a combination of the Braking Module and braking resistor.
	3	DI: Reset	Reset faults (negative edge)
	4	Ground	Electronics ground
Max. connectable cross-section: 1.5 mm^2 Type: Screw terminal 1 (see Chapter, "Control cabinet installation and EMC/connection system")			

1) DI: Digital input

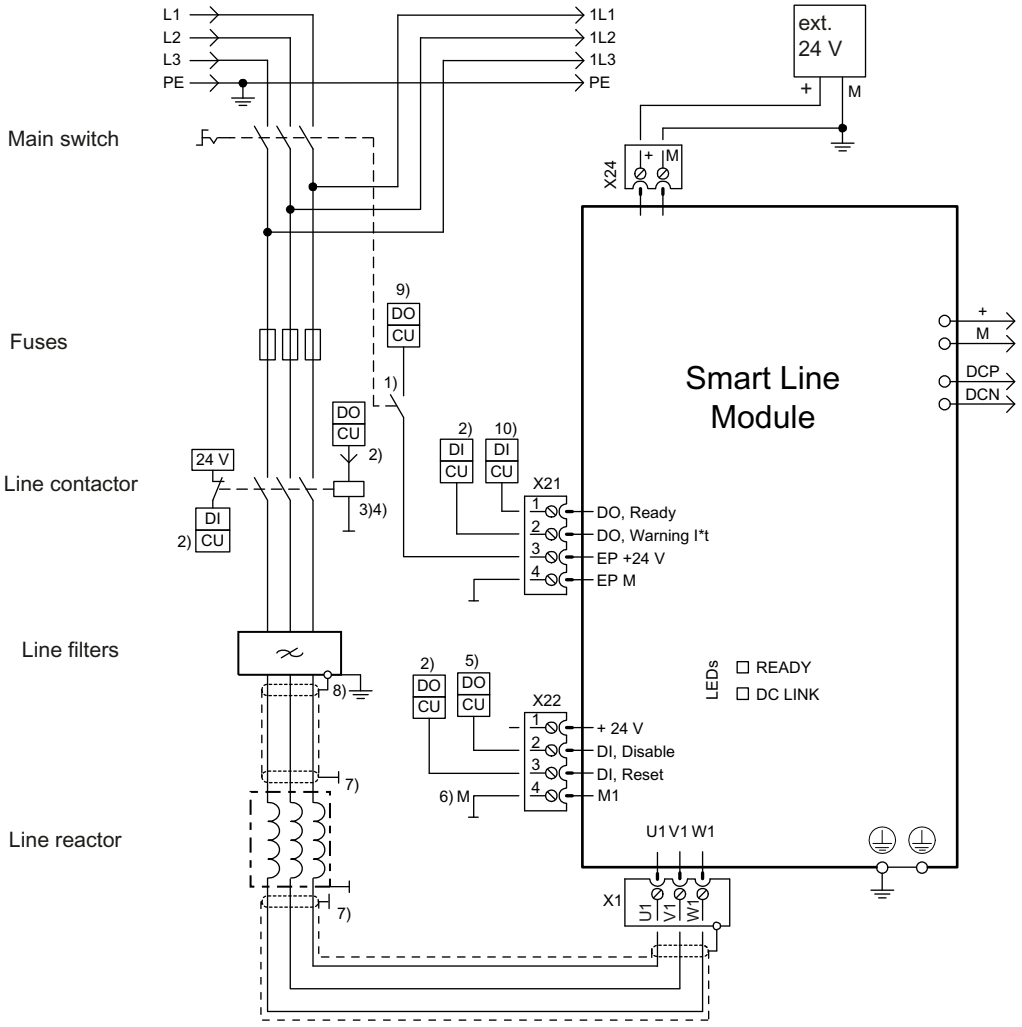
3.9.3.5 X24 24 V terminal adapter

Table 3- 91 X24 24 V terminal adapter

	Terminal	Designation	Technical specifications
	+	24 V power supply	24 V DC supply voltage
	M	Ground	Electronics ground
Max. connectable cross-section: 6 mm^2 Type: Screw terminal 5 (see Chapter, "Control cabinet installation and EMC/connection system")			

The 24 V terminal adapter is included in the scope of supply.

3.9.4 Connection example



1) Leading opening contact t > 10ms, 24 V DC and ground must be connected for operation.
2) DI/DO controlled by the Control Unit
3) No additional load permitted downstream of line contactor
4) The current carrying capacity of the DO must be observed; an output interface must be used if required.
5) DO high, regenerative feedback deactivated (for permanent deactivation, a jumper can be installed between X22 pin 1 and 2)
6) X22 pin 4 must be connected to ground (external 24 V)
7) Contact via rear mounting panel or shielding buses in accordance with EMC installation guideline
8) 5 kW and 10 kW line filters via shield connection
9) Signal output of the control to avoid reaction of the 24 V supply on the EP terminal
10) Connect to parameter p0864 via BICO

Figure 3-106 Connection example for 5 kW and 10 kW Smart Line Modules

Note

If you are using a VSM10 Voltage Sensing Module, the leading opening contact can be omitted.

3.9.5 Meaning of LEDs

Table 3- 92 Meaning of the LEDs on 5 kW and 10 kW Smart Line Modules

LED	Color	Status	Description, cause	Remedy
RDY	–	Off	Electronics power supply is missing or outside permissible tolerance range.	–
	Green	Continuous light	Component is ready to operate.	–
	Yellow	Continuous light	Pre-charging not yet complete. bypass relay dropped out EP terminals not supplied with 24 VDC.	–
	Red	Continuous light	Overtemperature, overcurrent	Diagnose fault (via output terminals) and acknowledge it (via input terminal)
DC LINK	–	Off	Electronics power supply is missing or outside permissible tolerance range.	–
	Yellow	Continuous light	DC link voltage within permissible tolerance range.	–
	Red	Continuous light	DC link voltage outside permissible tolerance range. Line supply fault.	Check the line voltage.

⚠ DANGER

Hazardous DC link voltages may be present at any time regardless of the status of the "DC LINK" LED.
The warning information on the components must be carefully observed!

3.9.6 Dimension drawings

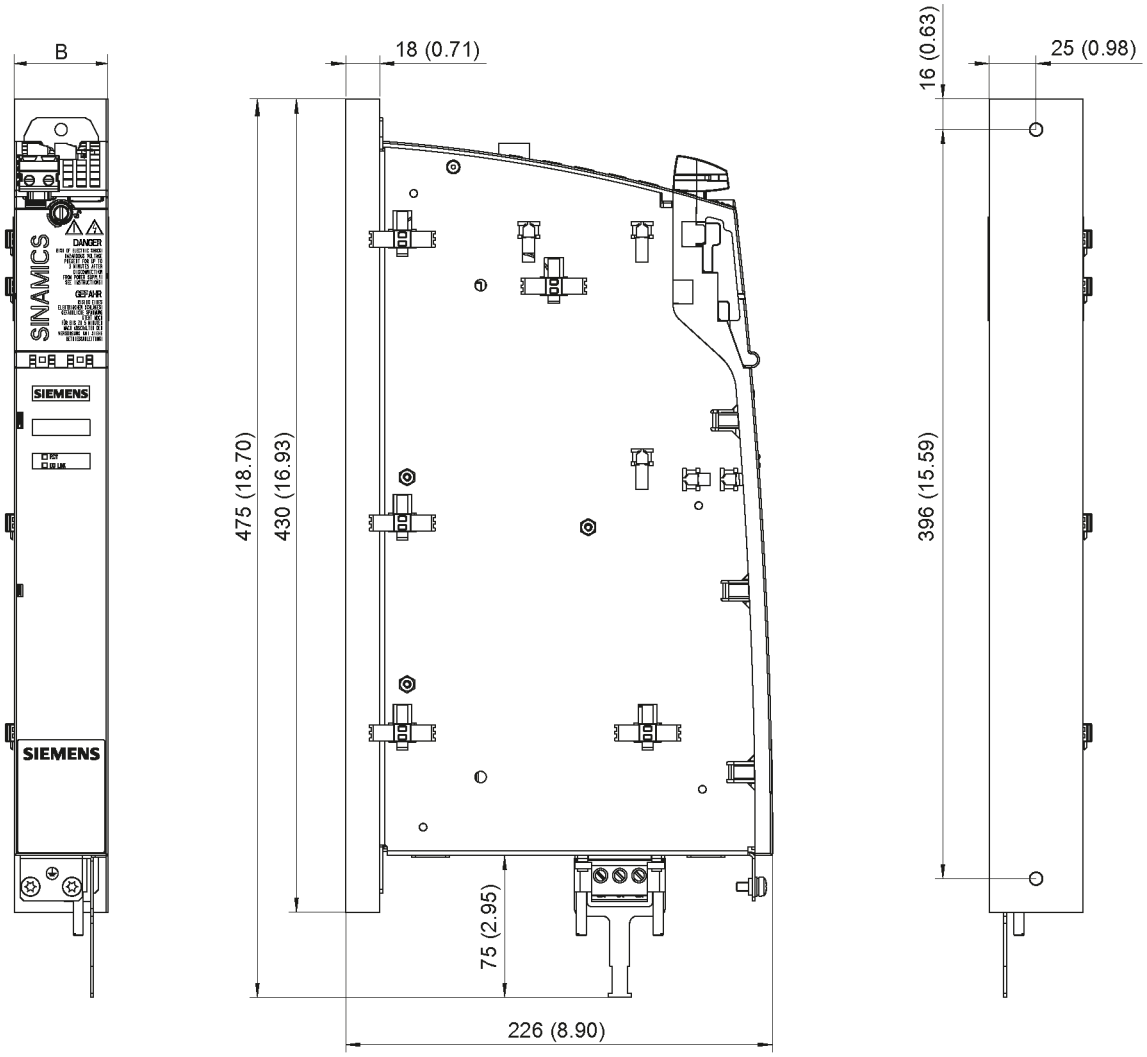


Figure 3-107 Dimension drawing of Smart Line Module with cold plate (5 kW and 10 kW), all dimensions in mm and (inches)

Table 3- 93 Dimensions of Smart Line Modules with cold plate

Line Module	Order number	W [mm] (inches)
5 kW	6SL3136-6AE15-0AAx	50 (1.97)
10 kW	6SL3136-6AE21-0AAx	50 (1.97)

3.9.7 Installation

Please note the following before installing a Smart Line Module with cold plate on a customer-specific heat sink:

- Before the installation, check the surface of the heat sink to ensure that it is not damaged.
- To improve heat transfer, a heat-conducting medium must be used. Special spherical-indented heat-conducting foil must be used for this purpose. Every cold plate power unit is supplied with heat-conducting foil cut to the right size. Note the mounting position of the heat-conducting foil (see figures below).

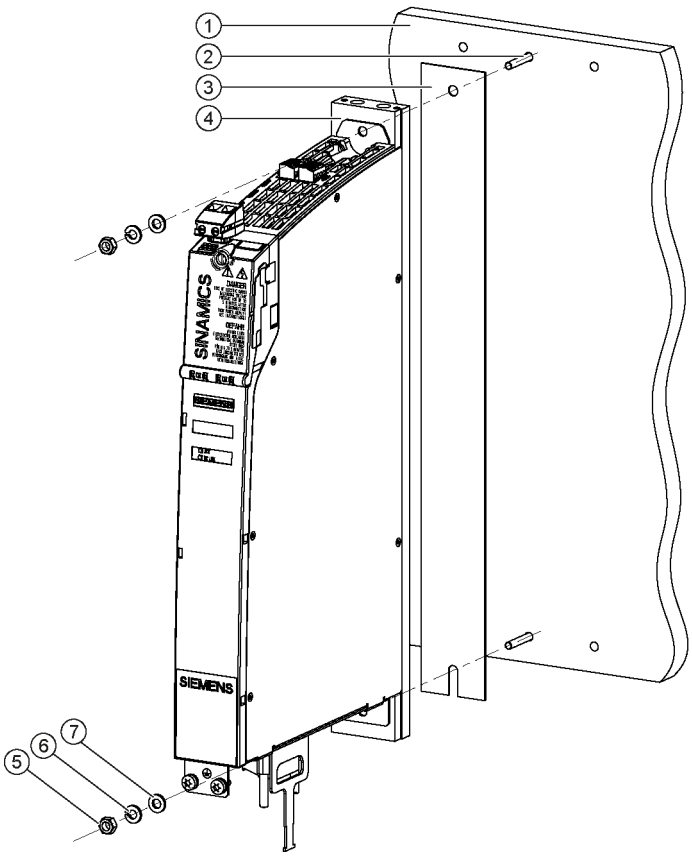
Note

When a component is replaced, the heat-conducting foil must also be replaced. Only heat-conducting foil approved or supplied by Siemens may be used.

	Order number
Heat-conducting foil, 50 mm	6SL3162-6FB00-0AA0

Note

M6 screw bolts and hexagon nuts/grub screws (ISO 7436-M6x40-14 H, property class 8.8) are recommended for installing the components.



① External heat sink (air or liquid)
② M6 studs
③ Heat-conducting foil
④ Cold plate
⑤ M6 nut
⑥ Spring washer
⑦ Washer

Figure 3-108 Installing a Smart Line Module with cold plate on an external heat sink, using a 5 kW Smart Line Module as an example

Tightening torques:

- Initially, only tighten the nuts by hand (0.5 Nm)
- Then tighten with 10 Nm.

Help with the mechanical control cabinet installation is available from:
Siemens AG
Industry Sector, IA SE WKC
TCCCC (Technical Competence Center Cabinets Chemnitz)
P.O. Box 1124
09070 Chemnitz, Germany
E-mail: cc.cabinetcooling.aud@siemens.com

Properties of the heat sink

We recommend using AlMgSi 0.5 as the heat sink material.
The roughness of the external heat sink surface should be at least Rz 16 and the contact surface between the heat sink and cold plate should have an evenness of 0.2 mm.

Note

The machine manufacturer can adapt the heat sink version to his special requirements. The specified rated data for the Power Modules can only be achieved if the power losses can be dissipated by the external heat sink under the specified general conditions.

NOTICE
During the installation, you must ensure that the threaded bolts do not damage the cold plate.

3.9.8 Technical data

Table 3- 94 Technical data for Smart Line Modules with cold plate cooling

	6SL3136-6AE	15-0AAx	21-0AAx
Rated power	**kW**	**5**	**10**
Infeed			
Rated power (S1) 1)	kW (P_n)	5	10
Infeed power (S6-40%) 1)	kW (P_{S6})		
Peak infeed power 1)	kW (P_{max})	10	20
Regenerative feedback			
Continuous regenerative power	kW	5	10
Peak regenerative power	kW	10	20
Supply voltages			
Line voltage	V_{AC}	3 AC 380 10 % (-15 % < 1 min) to 3 AC 480 10 %	
Line frequency	Hz	47 to 63	
Electronics power supply	V_{DC}	24 (20.4 - 28.8)	
DC link voltage	V_{DC}	510 – 720	
Overvoltage trip	V_{DC}	820 ± 2 %	
Undervoltage trip	V_{DC}	360 ± 2 %	
Input currents			
Rated input current			
at 400 V_{AC}:	A_{AC}	8.1	16.2
Input current			
at 380 V_{AC} / 480 V_{AC}	A_{AC}	8.6 / 6.7	17 / 12.8
at 400 V_{AC}; S6-40%	A_{AC}	10.6	21.1
at 400 V_{AC}; peak current	A_{AC}	15.7	31.2

	6SL3136-6AE	15-0AAx	21-0AAx
DC link currents			
Rated DC link current			
at 600 V:	A_{DC}	8.3	16.6
DC link current at 540 V:	A_{DC}	9.3	18.5
at 600 V_{DC}; at S6-40%	A_{DC}	11	22
at 600 V_{DC}; peak current	A_{DC}	16.6	33.2
Current carrying capacity			
DC link busbar	A_{DC}	100	100
Reinforced DC link busbars:	A_{DC}	150	150
24 V busbar:	A_{DC}	20	20
Electronics current consumptionat 24 V DC	A_{DC}	0.6	0.7
Power loss distribution			
(incl. electronics losses) [4]			
internal	W	34.4	56.8
external	W	40	80
DC link capacitance			
Smart Line Module	µF	220	330
Drive line-up, max.	µF	6000	6000
Power factor	cosϕ	1	1
Circuit breaker (UL)			
Type designation		3VL1102-2KM30	3VL1135-2KM30
Rated current:	A	20	35
Resulting rated short-circuit current [3]			
SCCR at 480 V_{AC}:	kA	65	65
Safety fuse (UL)			
Type AJT Class J [2]		AJT17-1/2	AJT35
Rated current	A	17.5	35
Resulting rated short-circuit current [3]			
SCCR at 480 V_{AC}:	kA	65	65
Max. permissible heat-sink temperature	°C	60	65
Max. ambient temperature			
Without derating	°C	40	40
With derating	°C	55	55
Weight	kg	4.0	4.0

1) The powers specified apply to the rated voltage range from 380 V to 480 V.

2) Source of supply: The Ferraz Shawmut company

3) The resulting rated short-circuit current is obtained from the combination of the fuse, or circuit breaker, and the Line Module in the drive system.

4) For an overview, see the power loss tables in Chapter, Control cabinet installation

3.9.8.1 Characteristics

Rated duty cycles of Smart Line Modules

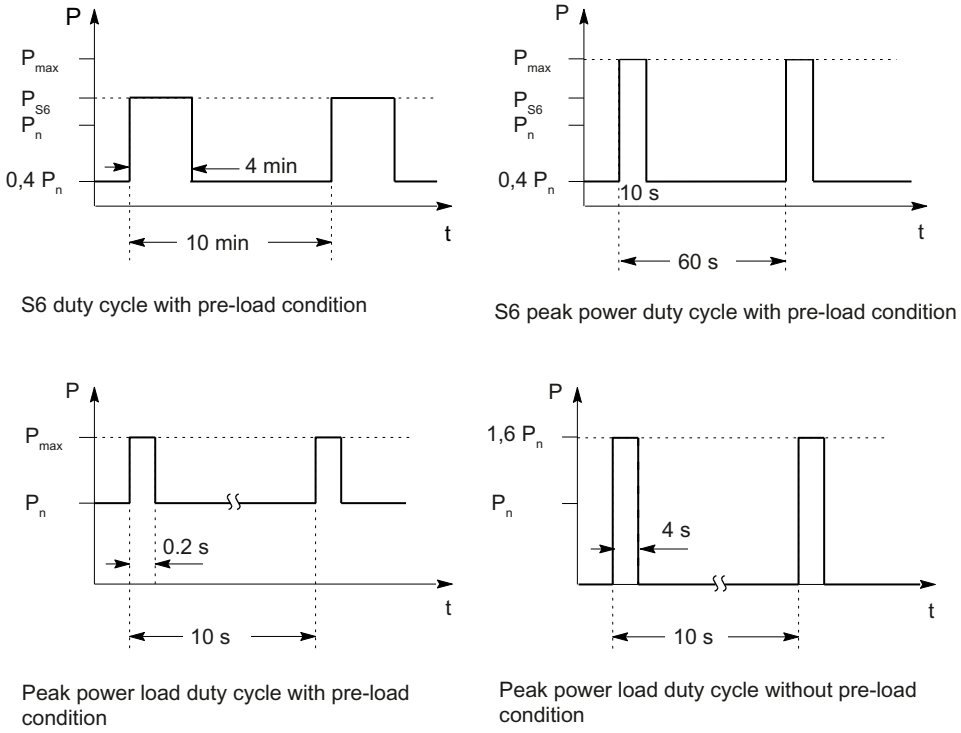


Figure 3-109 Rated duty cycles of Smart Line Modules

Derating characteristics

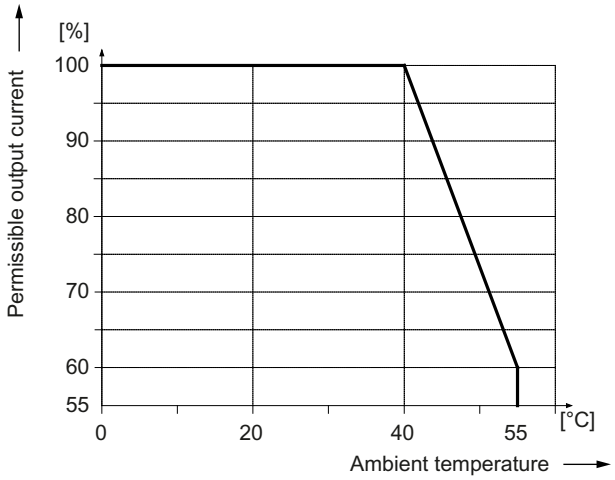


Figure 3-110 Output current as a function of the ambient temperature

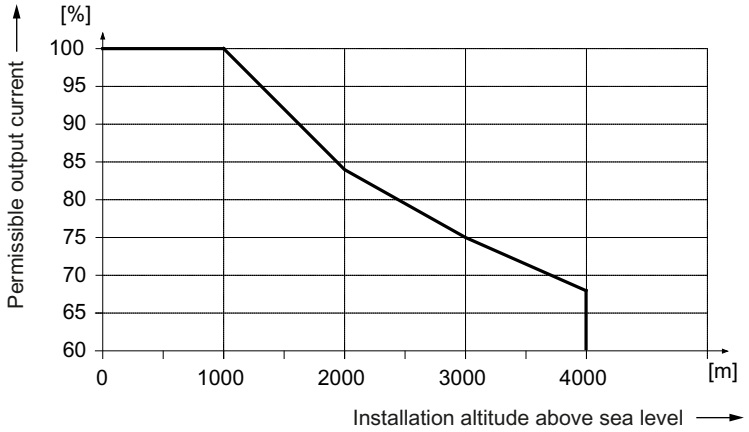


Figure 3-111 Output current as a function of the installation altitude

At installation altitudes >2000 m, an insolating transformer must be used (see "System overview/Derating as a function of the installation altitude and ambient temperature"). The design of the secondary line supply system must be as follows:

- TN system with grounded star point (no grounded outer conductor)
- IT system

A reduction of the line supply voltage phase-phase is not necessary.

3.9.8.2 Measuring the heat sink temperature

The maximum permissible heat sink temperature is calculated at the cold plate in the measuring range shown below.

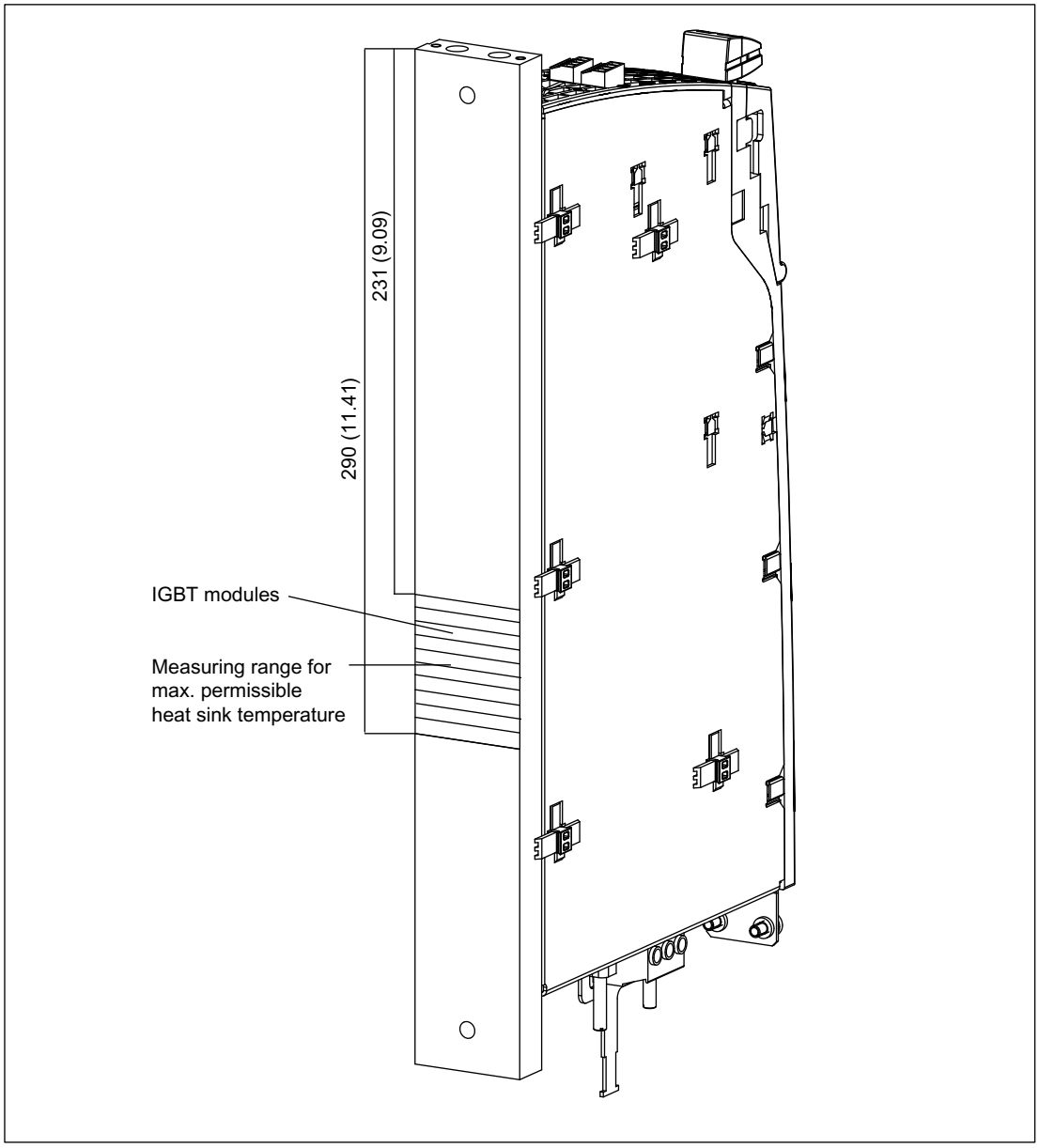


Figure 3-112 Measuring range for max. permissible heat-sink temperature for a Smart Line Module with cold plate

Line Modules Booksize Compact 4

4.1 Smart Line Modules Booksize Compact

4.1.1 Description

The Smart Line Module booksize compact is a non-regulated infeed/regenerative feedback unit. The Smart Line Module supplies the Motor Module(s) with a non-regulated DC voltage at the DC output. In the infeed mode the Smart Line Module exhibits the typical current and voltage waveforms of a 6-pulse diode rectifier bridge.

In feedback mode, the current waveform is square waved. The regenerative feedback can be deactivated by means of parameters.

If the system requires metallic isolation from the network for safety isolation, a main contactor can be series-connected on the line side.

The Smart Line Module in bookzse compact format can be used with cooling types "internal air cooling" or "cold plate". The cooling type is selected via parameter p249 "Power unit cooling type".

Smart Line Modules are suitable for direct operation in TN, IT, and TT systems. The Line Modules have an integrated overvoltage protection function.

4.1.2 Safety information

⚠DANGER

Risk of electric shock

A hazardous voltage is present for up to 5 minutes after the power supply has been disconnected.
The protective cover may only be opened after this time has expired.

When opening the protective cover for the DC link, you must press the release catch. A suitable tool (e.g. screwdriver or supplied unlocking tool) must be used for this purpose.

The components must only be operated when the protective cover of the DC link is closed. Damaged components must not be operated further, otherwise this could result in secondary damage or accidents.

⚠DANGER

DC-link discharge time

A hazard warning for the DC link discharge time must be attached in the local language to all of the components.
A set of labels in 16 languages is supplied with the component.

⚠DANGER

In the interests of operator and fire protection, the power supply conditions in terms of short-circuit power and loop impedance at the infeed point must be such that they will trip the installed overcurrent protection devices within the prescribed period if a fault occurs (short circuit or short circuit to exposed conductive part).

Note

Line short-circuit power at the infeed point

The line short-circuit power at the infeed point must be at least 70 times greater than the rated power of the Line Module in order to limit the line harmonics to an acceptable level for other loads.

⚠DANGER

It is only permissible to establish connections to the DC link using the adapters that SIEMENS has recommended (DC link adapter and DC link rectifier adapter).

⚠DANGER

If the Line Module is not disconnected from the supply system (e.g. via the line contactor or main switch), the DC link remains charged.

⚠ CAUTION

The 80 mm clearances above and below the components must be observed.

CAUTION

The correct tightening torque of the DC link busbar screws (1.8°Nm, tolerance +30%) must be checked before commissioning with the complete system in a voltage-free state (powered-down) and with the DC link discharged. After transportation, the screws must be tightened.

For line supplies without regenerative feedback capability (e.g. diesel generator), the regenerative feedback capability of the Smart Line Modules must be deactivated by means of parameters. The braking energy must then be dissipated via an additional Braking Module with braking resistor provided in the drive line-up.

CAUTION

The overall length of the power cables (motor supply cables and DC link cables) must not exceed the values given in the chapter titled "Possible line reactor and line filter combinations".

CAUTION

DC link side covers are supplied with the components as standard and must be attached to the first and last components in the drive line-up. They can also be ordered separately, if required (order number: 6SL3162-5AA00-0AA0).

NOTICE

Operation without the line reactor is not permissible.

Note

Activation of the fan is dependent on heat sink temperature and pulse enable.

4.1.3 Interface description

4.1.3.1 Overview

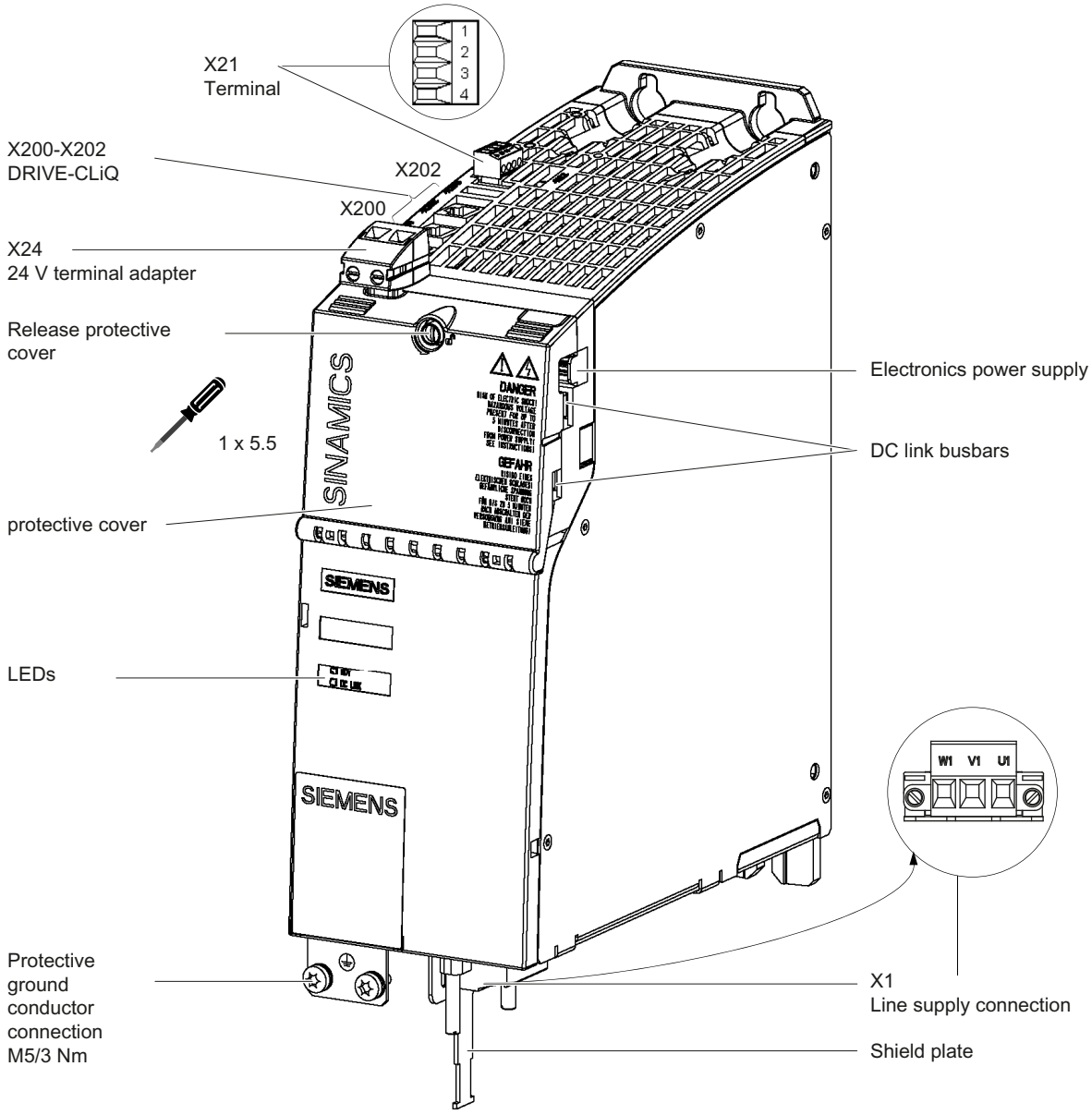
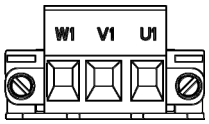
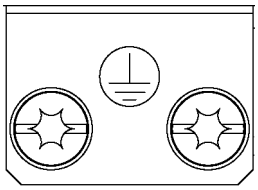


Figure 4-1 Interface overview, Smart Line Module in Booksize Compact format (16 kW)

4.1.3.2 X1 line connection

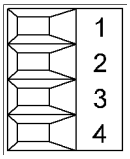
Table 4- 1 X1 line connection

	Terminal	Technical specifications
	U1 V1 W1	Supply voltage: 380 V - 480 V 3 AC, 50/60 Hz Max. connectable cross-section: 16 mm² Type: Screw terminal 7 Tightening torque: 1.5 - 1.8 Nm (see Chapter, "Control cabinet installation/connection system")
	PE connection	Threaded hole M5/3 Nm 1)

1) For ring cable lugs in accordance with DIN 46234

4.1.3.3 X21 EP terminals

Table 4- 2 X21 EP terminal/temperature sensor

	Terminal	Function	Technical specifications
	1	+ Temp	Temperature sensors: KTY 84–1C130 1)/PTC 1)/bimetallic switch with NC contact The temperature sensor type can be selected via parameter p0601 and the temperature display via r35. 2)
	2	- Temp	
	3	EP +24 V (Enable Pulses)	Voltage: 24 VDC Current consumption: 10 mA Isolated input Signal propagation times: L → H: 100 µs H → L: 1000 µs
	4	EP M (Enable Pulses)	
Max. connectable cross-section 1.5 mm² Type: Screw terminal 1 (see Chapter, "Control cabinet installation and EMC/connection system")			

1) Temperatures are detected but not evaluated in the Smart Line Module.

2) For further information see SINAMICS S120, Commissioning Manual

⚠ WARNING

For operation, the 24 V DC voltage must be connected to terminal X21.3 and ground to terminal X21.4. When withdrawn, pulse suppression is activated. Regenerative feedback is deactivated and the bypass relay drops out. If the Line Module is not disconnected from the supply system when the EP terminal is deactivated (e.g. a line contactor is not installed), the DC link remains charged.

NOTICE

If an active drive line-up is switched off by means of the disconnector unit, the voltage at terminals X21.3 (EP +24 V) and X21.4 (EP M) must be interrupted beforehand. This can be carried out using a leading breaking auxiliary contact (≥ 10 ms), for example.

This protects external loads located parallel to the drive on the same switching component.

NOTICE

The KTY temperature sensor must be connected with the correct polarity.
If the polarity is reversed, the sensor will not be able to detect if the motor overheats.

⚠DANGER

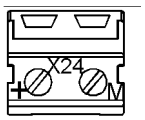
Risk of electric shock!

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) or Terminal Module TM120 must be used.

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

4.1.3.4 X24 24 V terminal adapter

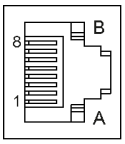
Table 4- 3 X24 24 V terminal adapter

	Terminal	Designation	Technical specifications
	+	24 V power supply	24 V DC supply voltage
	M	Ground	Electronics ground
Max. connectable cross-section: 6 mm^2 Type: Screw terminal 5 (see Chapter, "Control cabinet installation and EMC/connection system")			

The 24 V terminal adapter is included in the scope of supply.

4.1.3.5 X200-X202 DRIVE-CLiQ interfaces

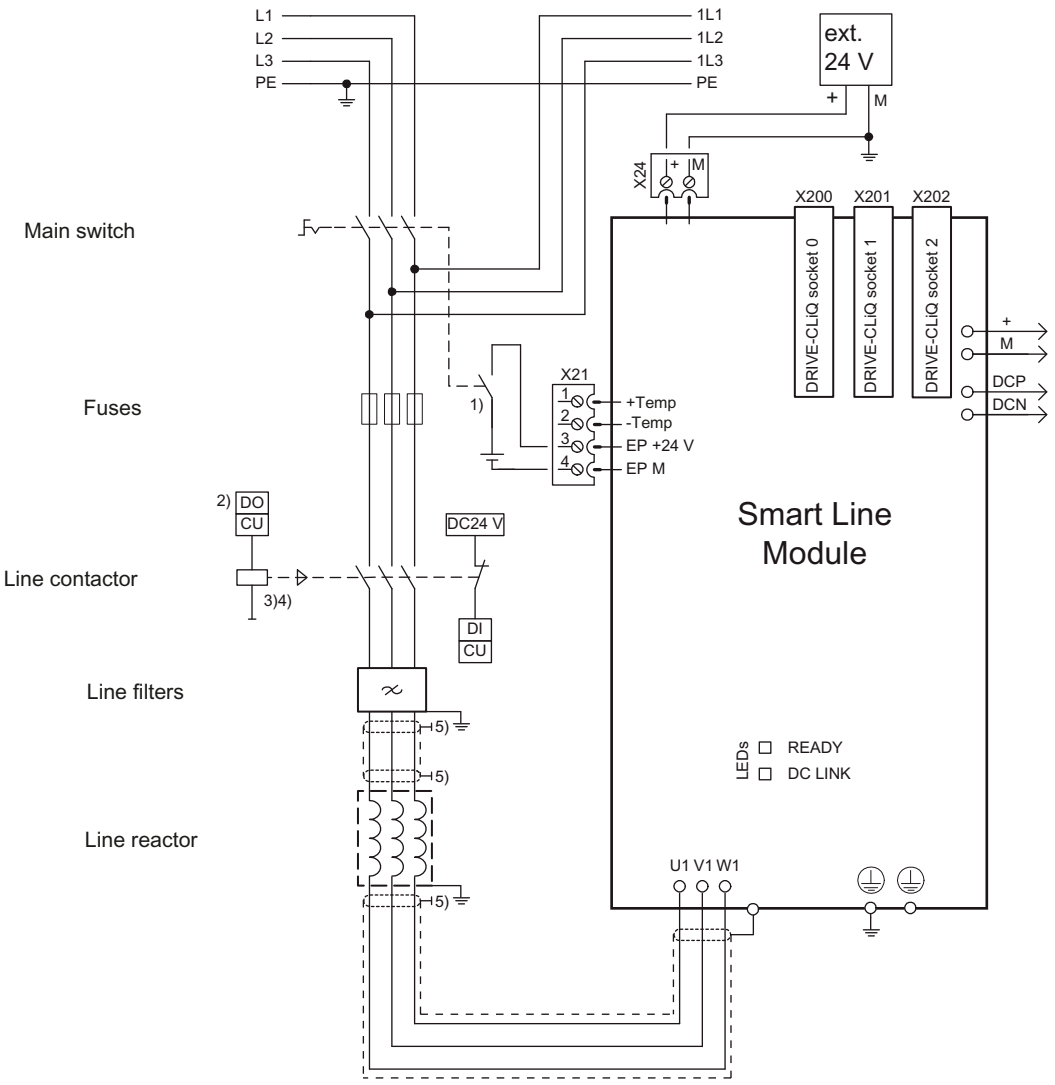
Table 4- 4 X200-X202 DRIVE-CLiQ interfaces

	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

The blanking covers for the DRIVE-CLiQ interfaces are included in the scope of delivery.

Blanking cover (50 pcs.) Order number: 6SL3066-4CA00-0AA0

4.1.4 Connection example



1) Leading opening contact t > 10 ms
2) DI/DO, controlled by the Control Unit
3) No additional load permitted downstream of line contactor
4) The current carrying capacity of the DO must be observed; an output interface must be used if required.
5) Contact via rear mounting panel or shielding buses in accordance with EMC installation guideline

Figure 4-2 Connection example, Smart Line Module Booksize Compact 16 kW

Note

If you are using a VSM10 Voltage Sensing Module, the leading opening contact can be omitted.

4.1.5 Meaning of LEDs

Table 4- 5 Meaning of the LEDs on the Smart Line Module booksize compact

State		Description, cause	Remedy
RDY	DC LINK		
Off	Off	Electronic power supply is missing or outside permissible tolerance range.	–
Green	--	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.	Check the line voltage
Orange	Orange	DRIVE-CLiQ communication is being established.	–
Red	--	This component has at least one fault. **Note:** The LED is activated regardless of whether the corresponding messages have been reconfigured.	Remedy and acknowledge fault
Green/red (0.5 Hz)	--	Firmware is being downloaded.	–
Green/red (2 Hz)	--	Firmware download is complete. Wait for POWER ON.	Carry out a POWER ON
Green / orange or red / orange	--	Detection of the components via LED is activated (p0124). **Note:** Both options depend on the LED state when activated via p0124 = 1.	–

⚠ DANGER

Hazardous DC link voltages may be present at any time regardless of the state of the "DC LINK" LED.
The warning information on the component must be carefully observed!

4.1.6 Dimension Drawing

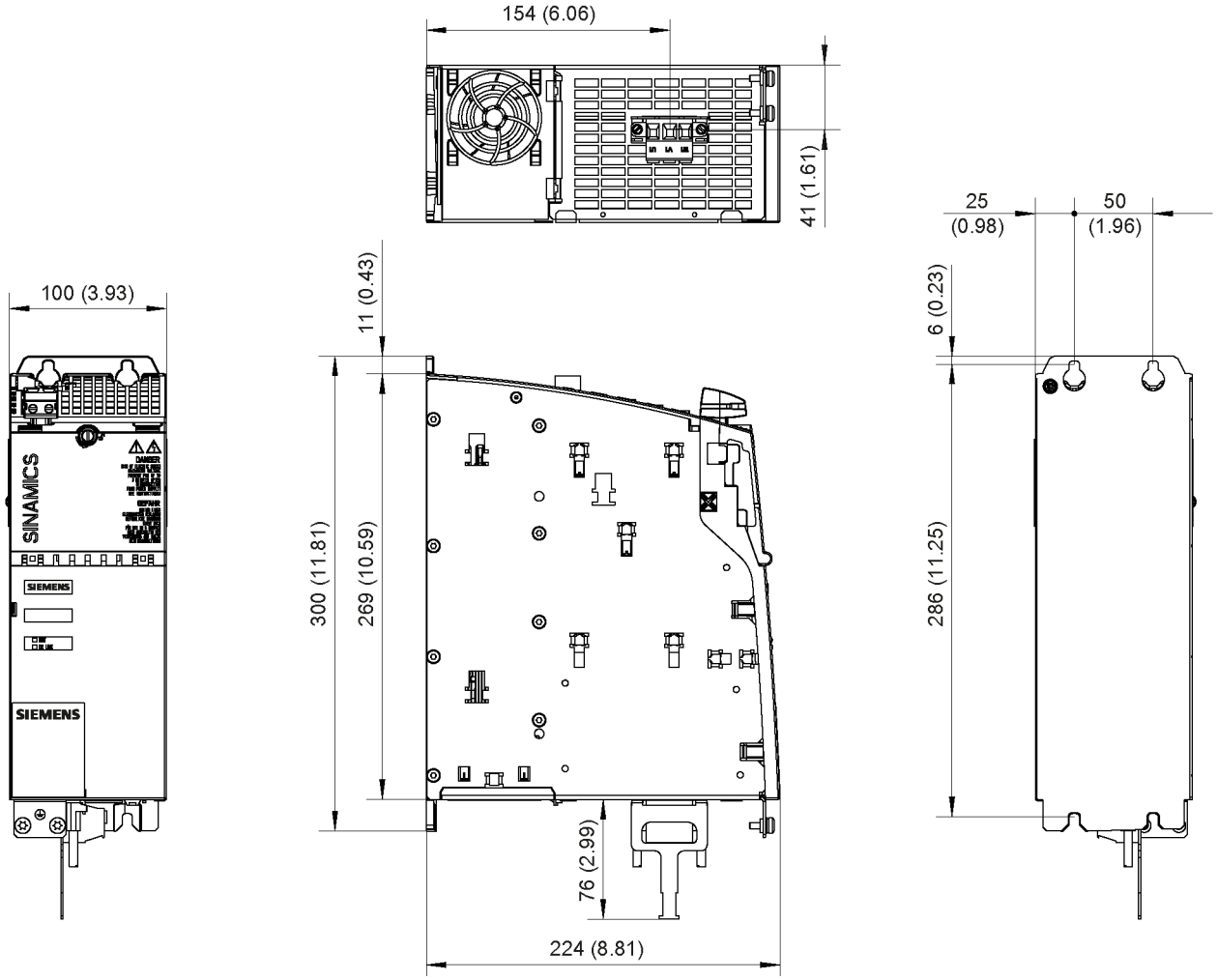
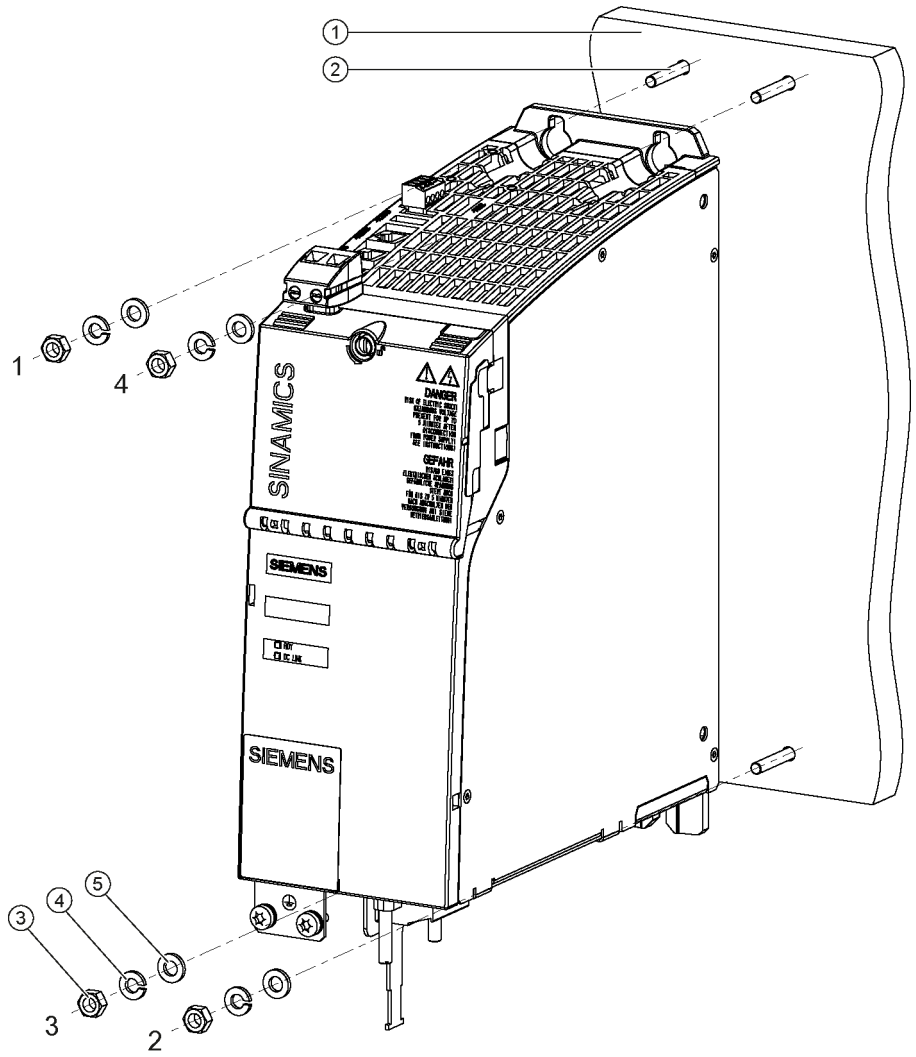


Figure 4-3 Dimension drawing Smart Line Module Booksize Compact format (16 kW), all dimensions in mm and (inches)

4.1.7 Installation

Installing a Smart Line Module Booksize Compact with internal air cooling



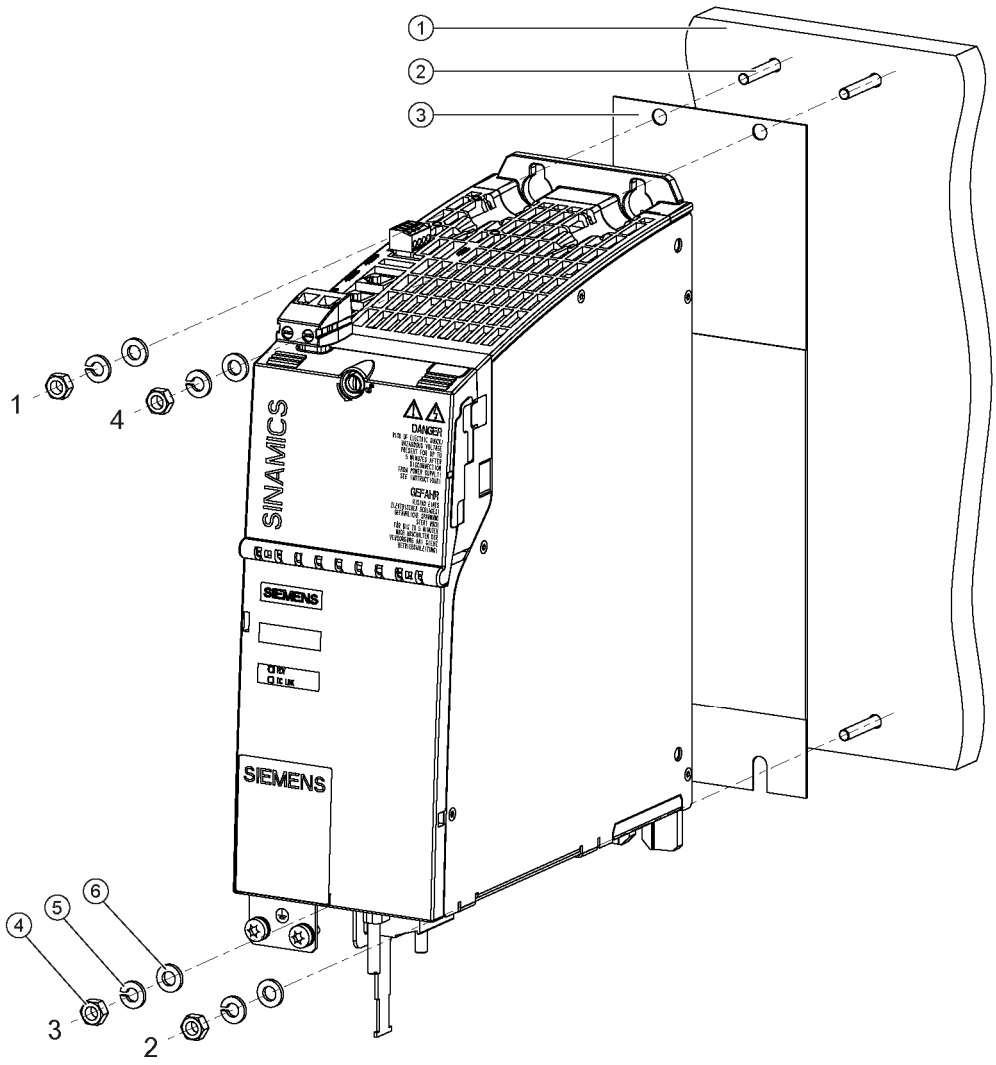
① Mounting panel
② M6 studs
③ M6 nut
④ Spring washer
⑤ Washer

Figure 4-4 Installing a Smart Line Module Booksize Compact with internal cooling

Tightening torques:

- Initially, only tighten the nuts by hand (0.5 Nm)
- Then tighten with 6 Nm (in the specific sequence 1 to 4)

Installing a Smart Line Module Booksize Compact on a cold plate



① Cold plate
② M6 studs
③ Heat-conducting foil
④ M6 nut
⑤ Spring washer
⑥ Washer

Figure 4-5 Installing a Smart Line Module Booksize Compact on a cold plate

Tightening torques:

- Initially, only tighten the nuts by hand (0.5 Nm)
- Then tighten with 10 Nm (in the specific sequence 1 to 4)

Special points to note in relation to installation on a cold plate

To improve heat transfer, a heat-conducting medium must be used. Special spherical-indented heat-conducting foil must be used for this purpose. Every Smart Line Module Booksize Compact is supplied with heat-conducting foil cut to the right size. Note the mounting position of the heat-conducting foil.

Note

When a component is replaced, the heat-conducting foil must also be replaced. Only heat-conducting foil approved or supplied by Siemens may be used.

Table 4- 6 Heat-conducting foil

	Order number
Heat-conducting foil, 100 mm	6SL3162-6FD01-0AA0

4.1.8 Technical data

Table 4- 7 Technical data Smart Line Modules Booksize Compact

Smart Line Module Booksize Compact	**6SL3430–**	**6TE21-6AAx**
Rated power	**kW**	**16**
Infeed		
Rated power (S1) 1)	kW (P_n)	16
Infeed power (S6-40%) 1)	kW (P_{S6})	21
Peak infeed power 1)	kW (P_{max})	35
Regenerative feedback		
Continuous regenerative power	kW	16
Peak regenerative power	kW	35
Supply voltages		
Line voltage	V_{AC}	3 AC 380 -10 % (-15 % < 1 min) to 3 AC 480 +10 %
Line frequency	Hz	47 to 63
Electronics power supply	V_{DC}	24 (20.4 - 28.8)
DC link voltage	V_{DC}	510 – 720
Overvoltage trip	V_{DC}	820 ± 2 %
Undervoltage trip 2)	V_{DC}	360 ± 2 %
Input currents		
Rated input current at 400 V_{AC}:	A_{AC}	27.5
Input current		
at 380 V_{AC} / 480 V_{AC}	A_{AC}	29 / 24.5
at 400 V_{AC}; S6-40%	A_{AC}	35
at 400 V_{AC}; peak current	A_{AC}	57.5
DC link currents		
Rated DC link current at 600 V:	A_{DC}	27
DC link current at 540 V:	A_{DC}	30
at 600 V_{DC}; S6-40%	A_{DC}	35
at 600 V_{DC}; peak current	A_{DC}	59
Current carrying capacity		
DC link busbar	A_{DC}	100
Reinforced DC link busbar:	A_{DC}	150
24 V busbar:	A_{DC}	20
Electronics current consumption at 24 V DC		
for internal air cooling	A_{DC}	0.95
for cold plate cooling	A_{DC}	0.85
Total power loss for internal air cooling (including electronics losses) 3)	W	187.8
Power loss distribution for cold plate (including electronics losses) 3)	W	
Internal		56.6
External		130
Max. ambient temperature		
Without derating	°C	40
With derating	°C	55
DC link capacitance		
Smart Line Module	µF	705
Drive line-up, max.	µF	6000
Power factor	cos ϕ	0.98

Smart Line Module Booksize Compact	**6SL3430–**	**6TE21-6AAx**
Rated power	**kW**	**16**
Circuit breaker (UL) Type designation Rated current: Resulting rated short-circuit current [5] SCCR at 480 V_{AC}:	 A kA	 3VL1135-2KM30 35 65
Safety fuse (UL) Type AJT Class J [4] Rated current Resulting rated short-circuit [5] current SCCR at 480 V_{AC}:	 A kA	 AJT35 35 65
Cooling methods		Internal air cooling Cold plate cooling
Cooling air requirement with internal air cooling	m^3/h	56
Max. permissible heat-sink temperature cold plate	°C	70
Sound pressure level	dB(A)	<60
Weight	kg	5.3

1) The powers specified apply to the rated voltage range from 380 V to 480 V.

2) Default for 400 V line supplies; undervoltage trip threshold is adjusted to the parameterized rated voltage.

3) For an overview, see the power loss tables in Chapter, Control cabinet installation

4) Source of supply: The Ferraz Shawmut company

5) The resulting rated short-circuit current is obtained from the combination of the fuse, or circuit breaker, and the Line Module in the drive system.

4.1.8.1 Characteristics

Rated duty cycles of Smart Line Modules

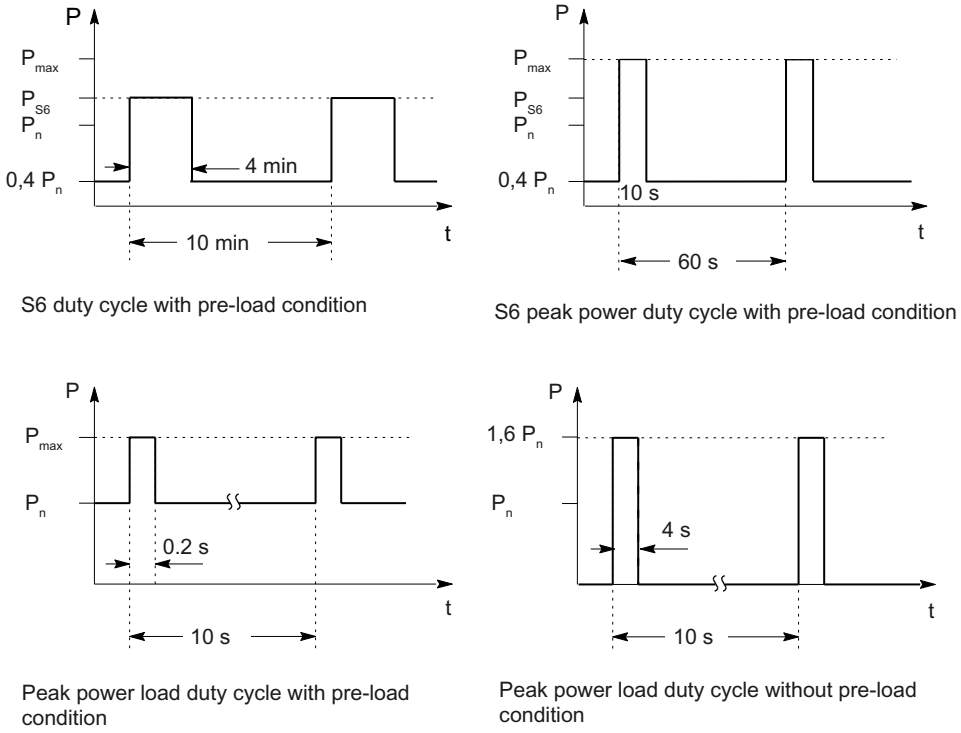


Figure 4-6 Rated duty cycles of Smart Line Modules

Derating characteristics

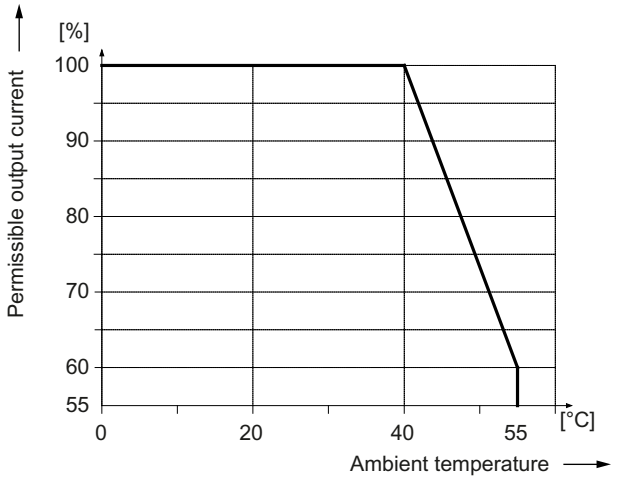


Figure 4-7 Output current as a function of the ambient temperature

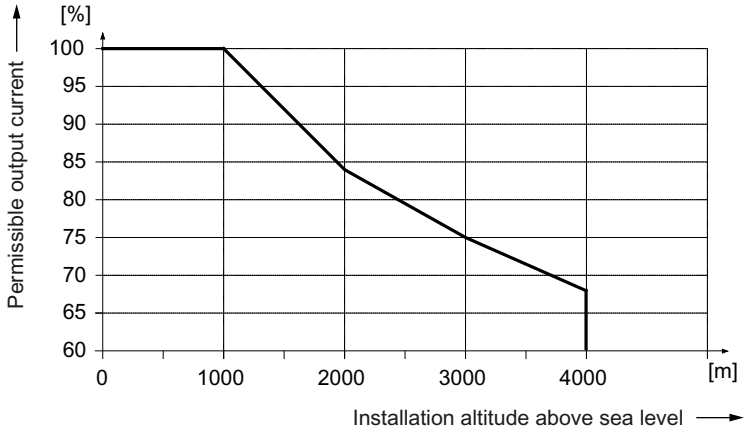


Figure 4-8 Output current as a function of the installation altitude

At installation altitudes >2000 m, an insolating transformer must be used (see "System overview/Derating as a function of the installation altitude and ambient temperature"). The design of the secondary line supply system must be as follows:

- TN system with grounded star point (no grounded outer conductor)
- IT system

A reduction of the line supply voltage phase-phase is not necessary.

Motor Modules Booksize

5

5.1 Motor Modules with internal air cooling

5.1.1 Description

A Motor Module is a power unit (inverter) that provides the power supply for the connected motor(s). 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 for the Motor Module are stored in the Control Unit.

One motor can be connected to Single Motor Modules and two motors can be connected to Double Motor Modules.

5.1.2 Safety information

⚠DANGER

Risk of electric shock

A hazardous voltage is still present for up to 5 minutes after the power supply has been switched off.
It is only permissible to open the protective cover after this time has expired.

When opening the protective cover for the DC link, you must press the release catch. A suitable tool (e.g. screwdriver or the release tool supplied) must be used for this purpose.

The components must only be operated when the protective cover of the DC link is closed. Damaged components must not be operated further, otherwise this could result in secondary damage or accidents.

⚠DANGER

DC link discharge time

A hazard warning in the local language for the DC link discharge time must be attached to the component.
A set of labels in 16 languages is supplied with the component.

⚠ DANGER

The drive components generate high leakage currents in the protective conductor. The components must only be operated in cabinets or in closed electrical operating areas and must be connected with the protective conductor. To protect against electric shock, the protective conductor connection at the control cabinet or machine must be implemented in accordance with one of the following measures:

- Fixed connection and protective conductor connection using ≥ 10 mm^2 Cu or ≥ 16 mm^2 Al
- Fixed connection and automatic disconnection of the supply system if the protective conductor is interrupted

⚠ DANGER

It is only permissible to establish connections to the DC link using the adapters that SIEMENS has recommended (DC link adapter and DC link rectifier adapter).

⚠ DANGER

If a 50 mm wide Motor Module or a 50 mm wide DC link component (e.g. Braking Module, Control Supply Module, Voltage Clamping Module) is located at the left-hand end of the drive line-up, then the DC link bridges, including all of the screws, must be removed from this component. It is not permissible to insert the screws without a DC link bridge.

For all other components that are 75 mm wide or wider, it is neither permissible to move the DC link bridge to the left nor to remove it.

If this is not carefully observed, this can result in damage and accidents.

⚠ DANGER

It is essential to connect the shield for the motor holding brake. Furthermore, only MOTION-CONNECT cables must be used for integrated motor holding brakes, as otherwise insulation of the cores is not guaranteed. Risk of electric shock.

⚠ WARNING

Cable shields and unused power-cable cores (e.g. brake cores) must be connected to PE potential to dissipate capacitive cross-talk charges.

If this is not carefully observed, lethal shock voltages could result.

⚠ CAUTION

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

For the 132 A and 200 A Motor Modules, a cooling clearance of 50 mm must be observed in front of the fan.

CAUTION
The correct tightening torque of the DC link busbar screws (1.8 Nm, tolerance +30%) must be checked before commissioning. After transportation, the screws must be tightened.

CAUTION
Only cables from Siemens may be used for DRIVE-CLiQ connections.

CAUTION
Connecting cables to temperature sensors must always be installed with shielding. The cable shield must be connected to the chassis 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.

CAUTION
DC link side covers are supplied with the components as standard and must be attached to the first and last components in the drive line-up. They can also be ordered separately, if required (order number: 6SL3162-5AA00-0AA0).

Note

A regulated DC power supply is required to operate motors with a built-in holding brake. The voltage is supplied via the internal 24 V busbars. The voltage tolerances of the motor holding brakes (24 V ± 10%) and the voltage drops of the connection cables must be taken into account.

The DC power supply should be set to 26 V. This ensures that the supply voltage for the brake remains within the permissible range when the following conditions are fulfilled:

- Use of Siemens three-phase motors
- Use of Siemens MOTION-CONNECT power cables
- Motor cable lengths: max. 100 m

5.1.3 Interface description

5.1.3.1 Overview

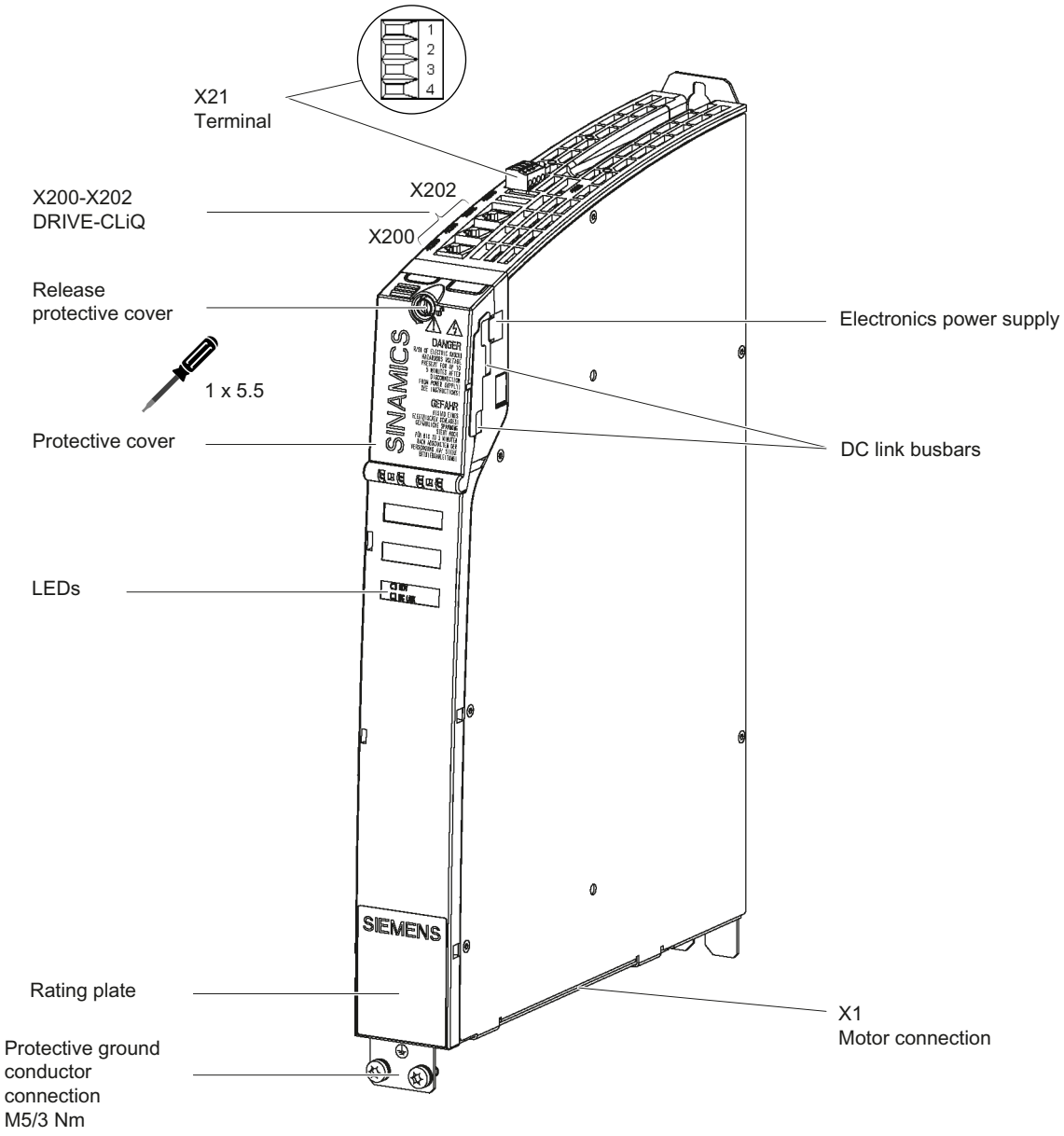


Figure 5-1 Interface overview, Single Motor Module Booksize with internal air cooling (example: 5 A)

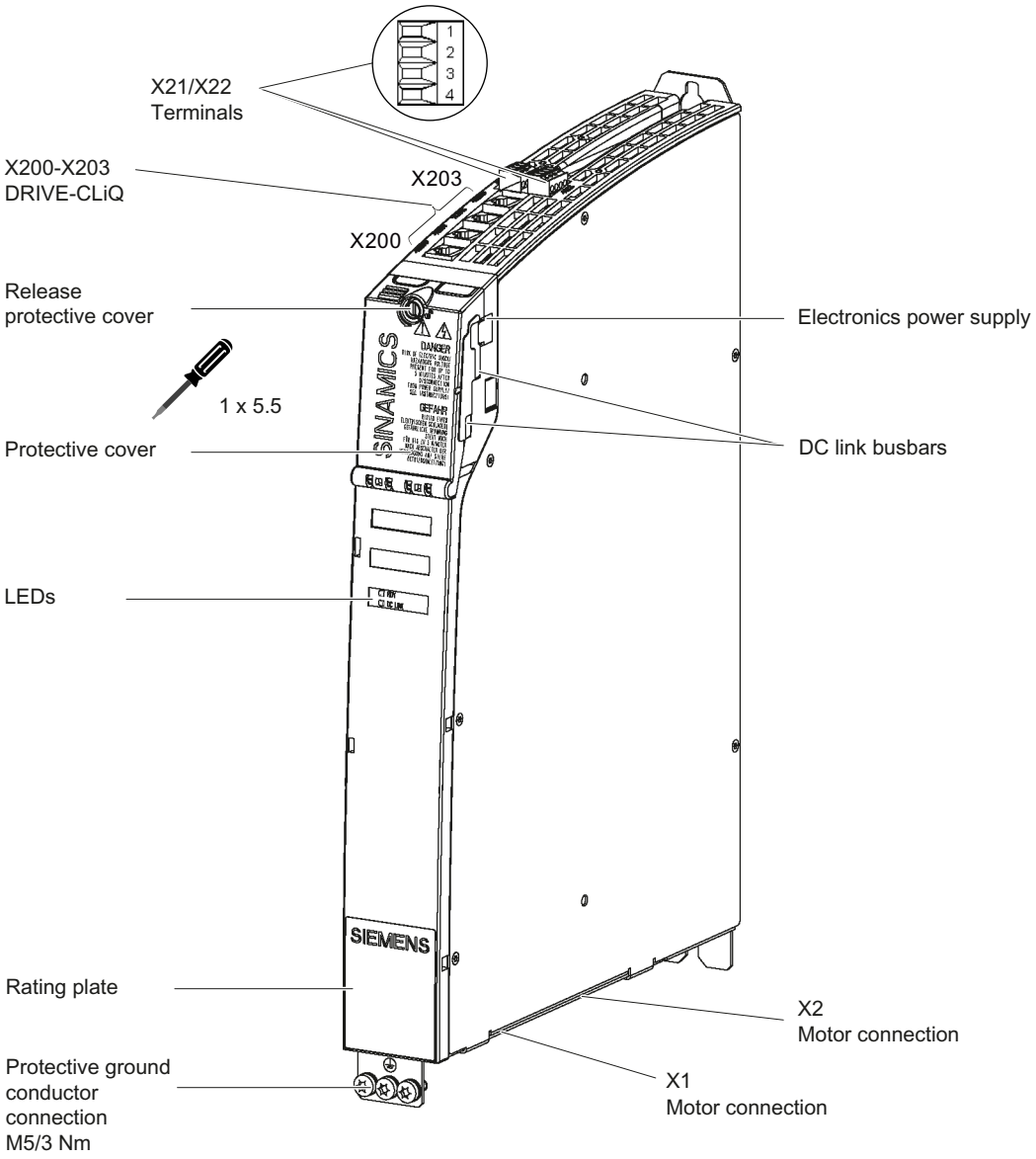
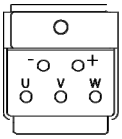
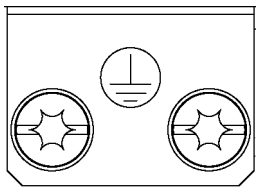
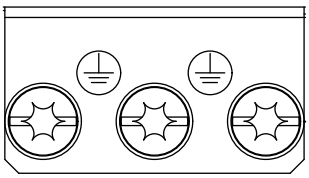


Figure 5-2 Interface overview, Double Motor Module Booksize with internal air cooling (example: 2 x 5 A)

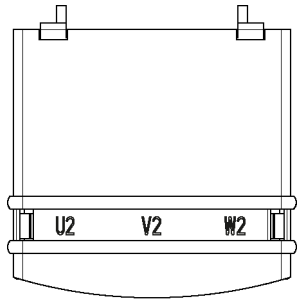
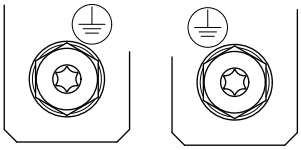
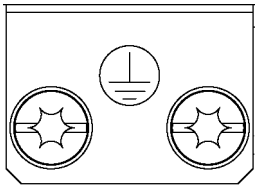
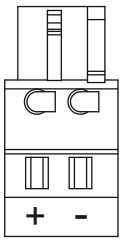
5.1.3.2 Motor and brake connection

Table 5- 1 X1/X2 motor and brake connection for Single Motor Modules 3 A to 30 A and Double Motor Modules 3 A to 18 A

	Terminal	Technical specifications
	U (U2)	Motor connection
	V (V2)	
	W (W2)	
	+ (BR+)	Brake connection max. load current 2 A min. load current 0.1 A
	- (BR-)	
	PE connection	**Single Motor Modules 3 A to 30 A:** Threaded hole M5 / 3 Nm [1)]
		**Double Motor Modules 3 A to 18 A:** Threaded hole M5 / 3 Nm [1)]

1) For ring cable lugs in accordance with DIN 46234

Table 5- 2 X1 motor connection and X11 brake connection for Single Motor Modules 45 A to 200 A

	Terminal	Technical specifications
	U2 V2 W2	**45 A to 60 A:** Threaded bolts M6 / 6 Nm 1) **85 A:** Threaded bolts M8 / 13 Nm 1) **132 A to 200 A:** Threaded bolts M8 / 13 Nm 1)
	PE connection	**45 A to 60 A:** Threaded bolts for motor cables: M6 / 6 Nm 1) Threaded hole for PE: M6 / 6 Nm 1)
		**85 A:** Threaded bolts for motor cables: M8 / 13 Nm 1) Threaded hole for PE: M6 / 6 Nm 1) **132 A to 200 A:** Threaded bolts for motor cables: M8 / 13 Nm 1) Threaded hole for PE: M8 / 13 Nm 1)
	+ (BR+) - (BR-)	**X11 brake connector** 2): Voltage 24 V DC Max. load current 2 A Min. load current 0.1 A Max. connectable cross-section 2.5 mm² Type: Spring-loaded terminal 2 (see Chapter, "Control cabinet installation and EMC / connection system") The brake connector is part of the prefabricated cable

1) For ring cable lugs in accordance with DIN 46234

2) The circuit for protecting the brake against overvoltage is integrated in the Motor Module and does not need to be installed externally. The max. load current is 2 A, the min. load current 0.1 A.

Note

The overall length of the power cables (motor supply cables and DC link cables) must not exceed the values given in chapter "Possible line reactor and line filter combinations".

Note

The motor brake must be connected via connector X11. It is not permitted to directly connect the cable BR – to the electronics ground M.

⚠ WARNING

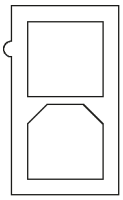
Only protective extra-low voltages (DVC A) that comply with EN 60204-1 must be connected to all connections and terminals between 0 and 48 V DC.

The voltage tolerances of the motor holding brakes (24 V ± 10%) must be taken into account.

5.1.3.3 X12 fan connection

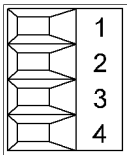
The Motor Modules 132 A and 200 A are equipped with an interface to connect a sub-chassis fan. The interface is located on the underside of the Motor Module.

Table 5- 3 X12 fan connection

	Terminal	Function	Technical specifications
	1	Fan connection +	Voltage 48 V DC for the supplied fan
	2	Fan connection -	

5.1.3.4 X21/X22 EP terminals/temperature sensor

Table 5- 4 X21/X22 EP terminals/temperature sensor

	Terminal	Function	Technical specifications
	1	+ Temp	Temperature sensors: KTY 84-1C130/PTC/bimetallic switch with NC contact
	2	- Temp	
	3	EP +24 V (Enable Pulses)	Supply voltage: 24 V DC (20.4 V to 28.8 V) Current consumption: 10 mA Isolated input Signal propagation times: L → H: 100 µs H → L: 1000 µs The pulse inhibit function is only available when Safety Integrated Basic Functions are enabled.
	4	EP M1 (Enable Pulses)	
Max. connectable cross-section 1.5 mm^2 Type: Screw terminal 1 (see Chapter, "Control cabinet installation/Connection system")			

NOTICE

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

Parameters p9651 and p9851 are used to set the filter times to debounce terminals X21.3 and X21.4, as well as X22.3 and X22.4. Additional parameter settings are also required in order to prevent discrepancy errors when performing bit pattern tests (light/dark tests). For comprehensive information, see the SINAMICS S120 Safety Integrated Function Manual, Chapter 6 "Controlling the safety functions".

NOTICE

The KTY temperature sensor must be connected with the correct polarity.
If the polarity is reversed, the sensor will not be able to detect if the motor overheats.

Note

The temperature sensor input is not needed if the motors feature an integrated DRIVE-CLiQ interface or if temperature values are detected by means of a different module (SMC, SME, TM).

⚠DANGER

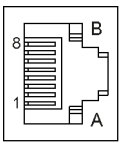
Risk of electric shock!

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) or Terminal Module TM120 must be used.

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

5.1.3.5 X200-X203 DRIVE-CLiQ interface

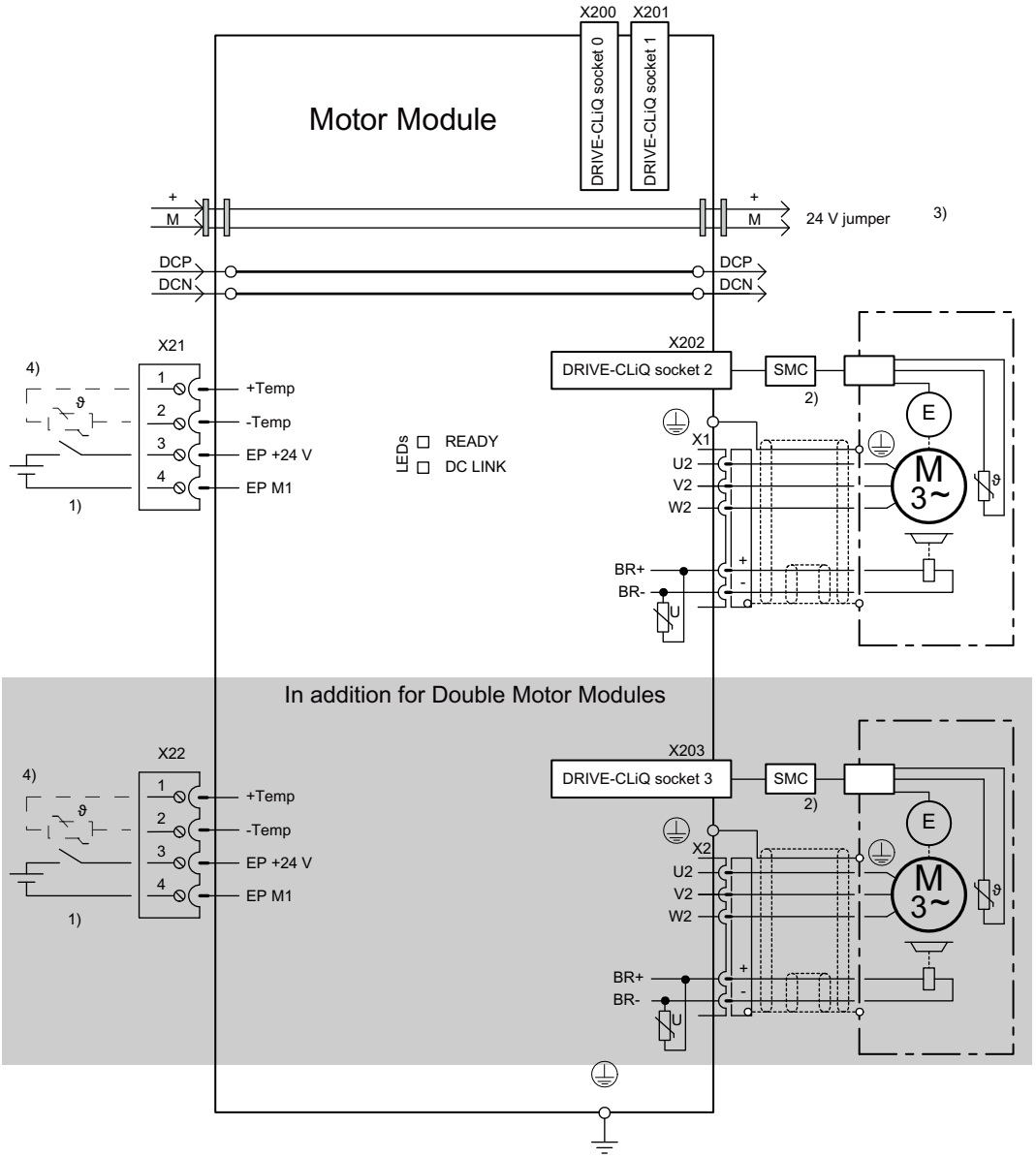
Table 5- 5 X200-X202: DRIVE-CLiQ interfaces for Single Motor Modules
X200-X203: DRIVE-CLiQ interfaces for Double Motor Modules

	Pin	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

The blanking covers for the DRIVE-CLiQ interfaces are included in the scope of delivery.

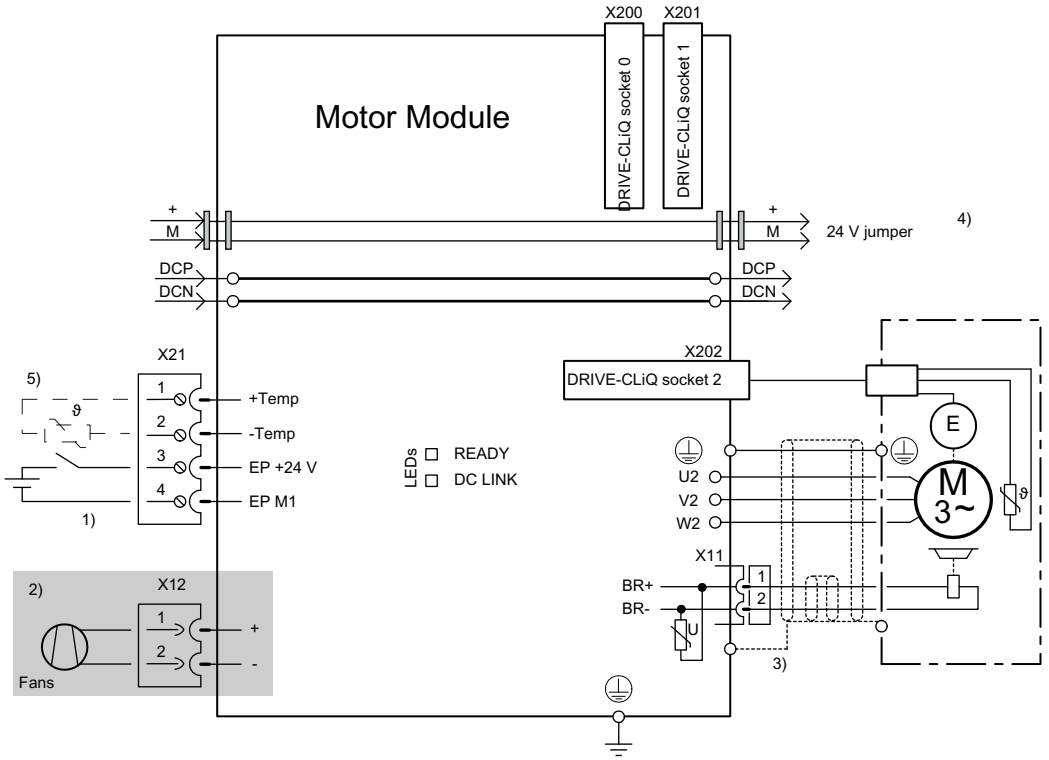
Blanking cover (50 pcs.) Order number: 6SL3066-4CA00-0AA0

5.1.4 Connection Examples



1) Required for Safety
2) SMC required for motors without DRIVE-CLiQ interface
3) 24 V to the next module
4) Optional, e.g. for encoderless motor

Figure 5-3 Connection example of Motor Modules 3 A to 30 A and Double Motor Modules 3 A to 18 A



1) Required for Safety
2) In addition for Motor Modules 132 A to 200 A
3) Contact through the shield connection plate
4) 24 V to the next module
5) Optional, e.g. for encoderless motor

Figure 5-4 Example connection of Single Motor Modules 45 A to 200 A

5.1.5 Meaning of LEDs

Table 5- 6 Meaning of the LEDs on the Motor Module

Status		Description, cause	Remedy
RDY	DC LINK		
Off	Off	Electronics power supply is missing or outside permissible tolerance range.	–
Green	--	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.	Check line voltage
Orange	Orange	DRIVE-CLiQ communication is being established.	–
Red	--	At least one fault is present in this component. **Note:** The LED is driven irrespective of the corresponding messages being reconfigured.	Remedy and acknowledge fault
Green/red (0.5 Hz)	--	Firmware is being downloaded.	–
Green/red (2 Hz)	--	Firmware download is complete. Wait for POWER ON.	Carry out a POWER ON
Green/orange or Red/orange	--	Detection of the components via LED is activated (p0124). **Note:** Both options depend on the LED status when module recognition is activated via p0124 = 1.	–

⚠ DANGER

Hazardous DC link voltages may be present at any time regardless of the status of the "DC LINK" LED.
The warning information on the components must be carefully observed!

5.1.6 Dimension drawings

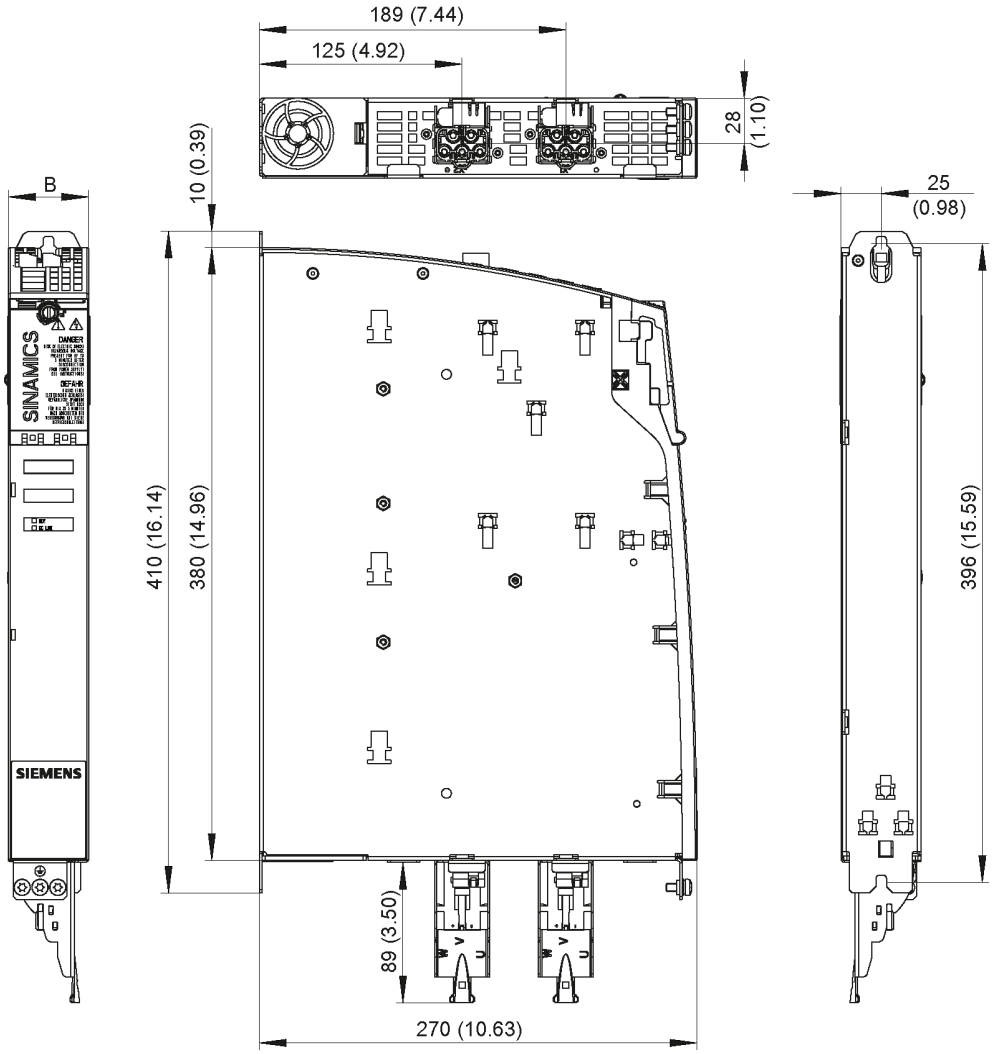


Figure 5-5 Dimension drawing of Motor Modules Booksize with internal air cooling 3 A to 18 A and 2 x 3 A to 2 x 9 A, all dimensions in mm and (inches); example: Double Motor Module 2 x 5 A

Table 5- 7 Dimensions of Motor Modules Booksize with internal air cooling 3 A to 18 A and 2 x 3 A to 2 x 9 A

Motor Module	Order number	B [mm] (inches)
3 A Single Motor Module	6SL3120-1TE13-0AAx	50 (1.97)
5 A Single Motor Module	6SL3120-1TE15-0AAx	
9 A Single Motor Module	6SL3120-1TE21-0AAx	
18 A Single Motor Module	6SL3120-1TE21-8AAx	
3 A Double Motor Module	6SL3120-2TE13-0AAx	
5 A Double Motor Module	6SL3120-2TE15-0AAx	
9 A Double Motor Module	6SL3120-2TE21-0AAx	

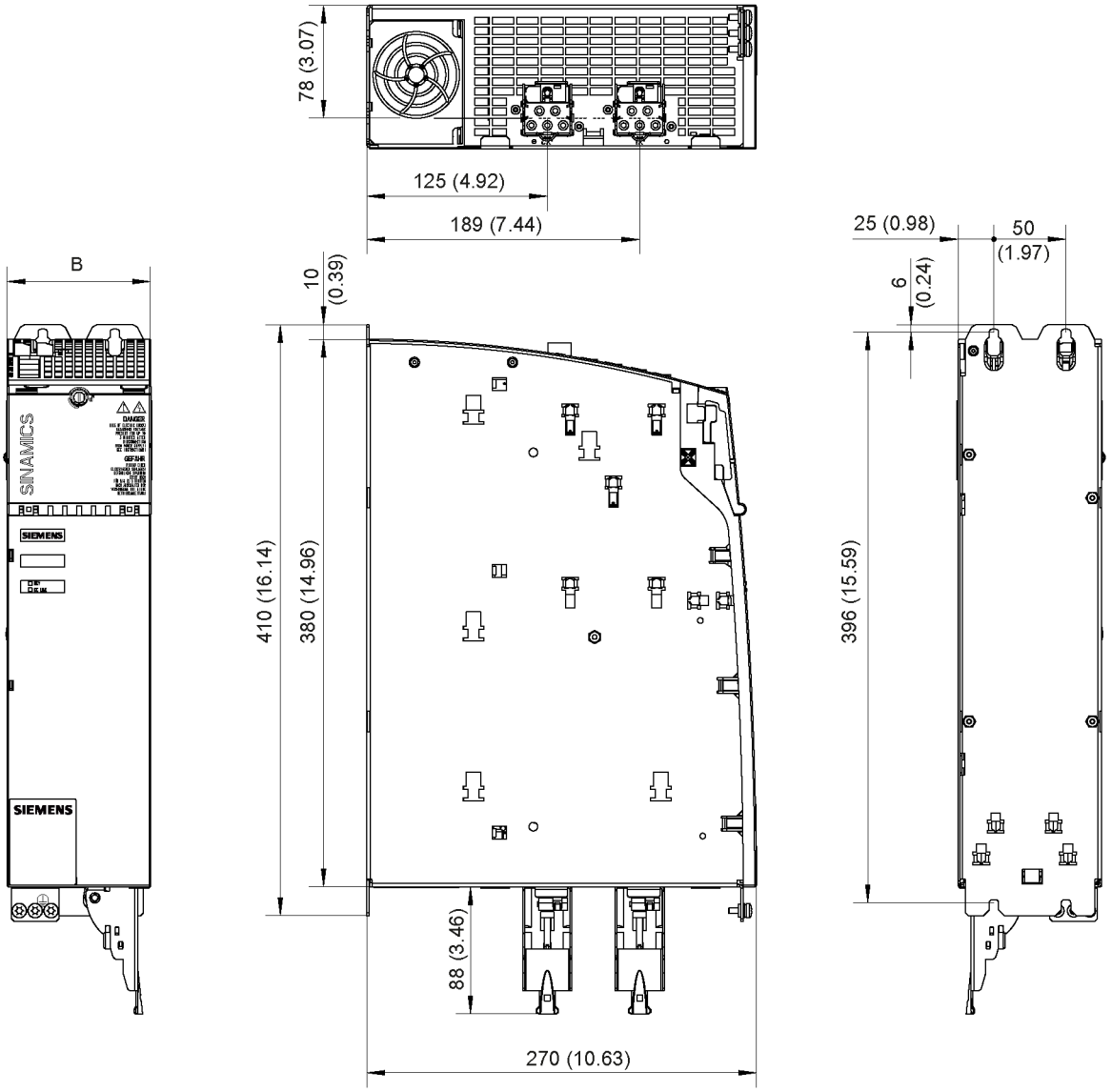


Figure 5-6 Dimension drawing of Motor Modules Booksize with internal air cooling 30 A and 2 x 18 A, all dimensions in mm and (inches); example: Double Motor Module 2 x 18 A

Table 5- 8 Dimensions of Motor Modules Booksize with internal air cooling 30 A and 2 x 18 A

Motor Module	Order number	B [mm] (inches)
30 A Single Motor Module	6SL3120-1TE23-0AAx	100 (3.94)
18 A Double Motor Module	6SL3120-2TE21-8AAx	

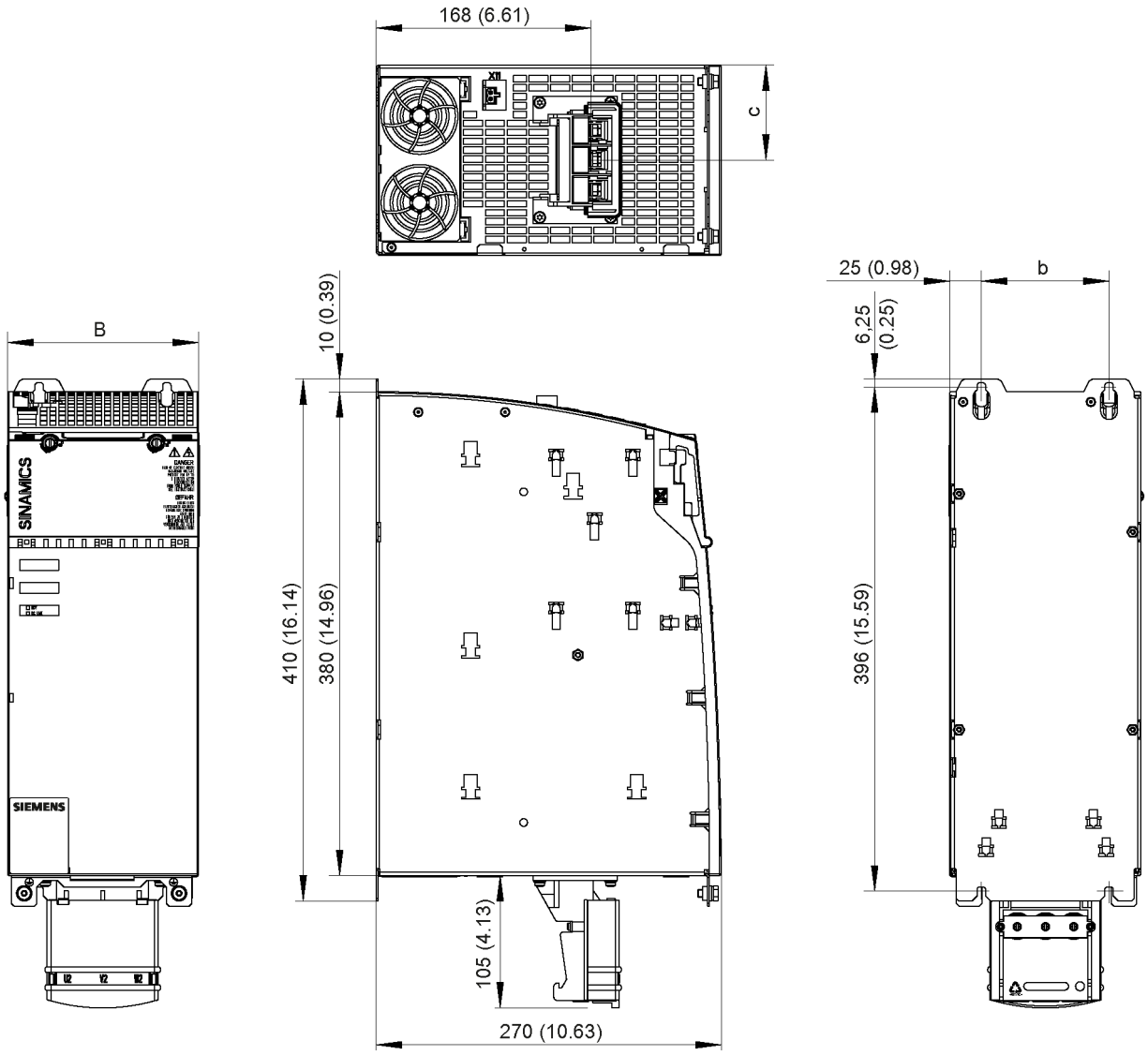


Figure 5-7 Dimension drawing of Motor Modules Booksize with internal air cooling 45 A to 85 A, all dimensions in mm and (inches); example 45 A

Table 5- 9 Dimensions of Motor Modules Booksize with internal air cooling 45 A to 85 A

Motor Module	Order number	B [mm] (inches)	b [mm] (inches)	c [mm] (inches)
Single Motor Module 45 A	6SL3120-1TE24-5AAx	150 (5.91)	100 (3.94)	75 (2.95)
Single Motor Module 60 A	6SL3120-1TE26-0AAx			
Single Motor Module 85 A	6SL3120-1TE28-5AAx	200 (7.87)	150 (5.91)	100 (3.94)

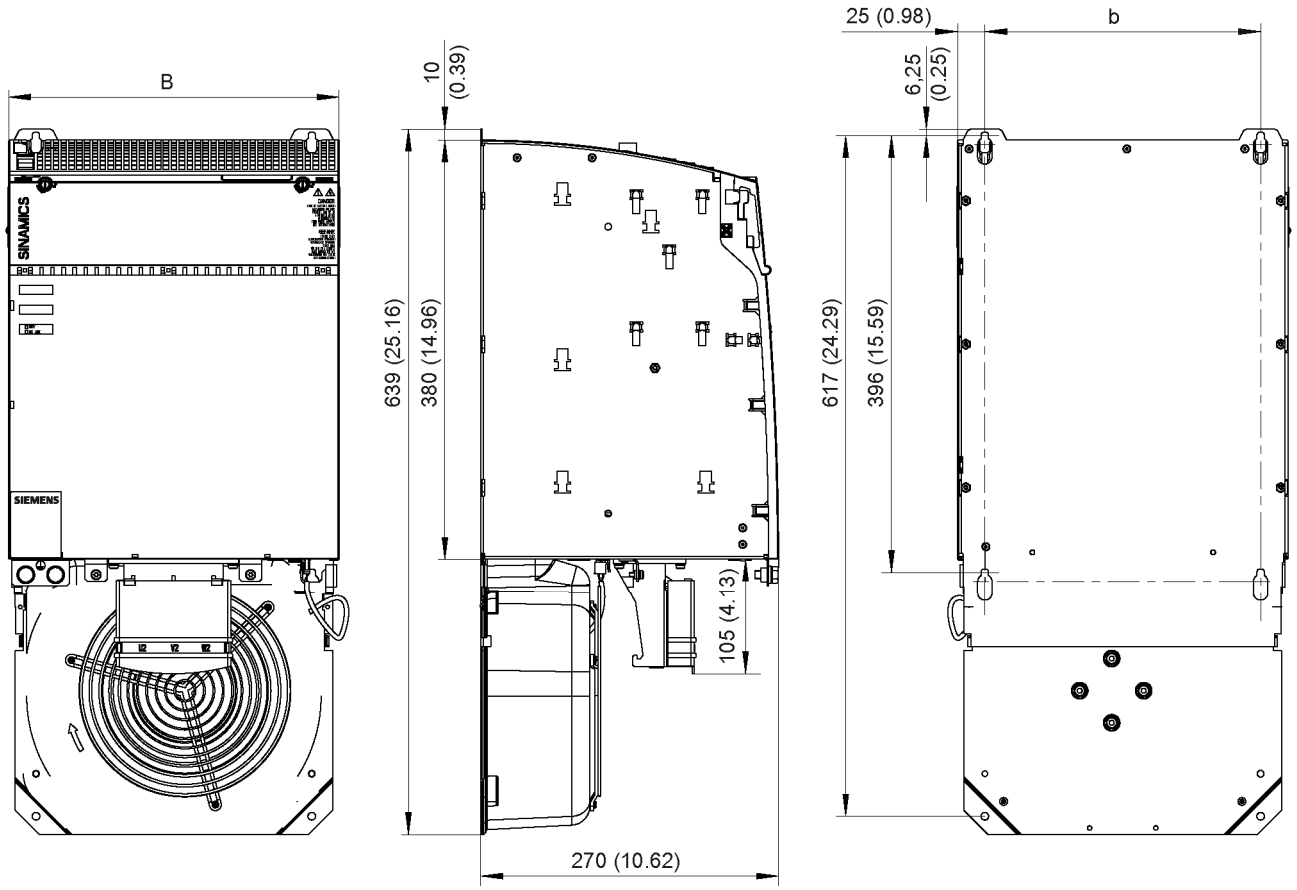


Figure 5-8 Dimension drawing of Motor Modules Booksize with internal air cooling 132 A and 200 A, all dimensions in mm and (inches)

Table 5- 10 Dimensions of Motor Modules Booksize with internal air cooling 132 A and 200 A

Motor Module	Order number	B [mm] (inches)	b [mm] (inches)
Single Motor Module 132 A	6SL3120-1TE31-3AAx	300 (11.81)	250 (9.84)
Single Motor Module 200 A	6SL3120-1TE32-0AAx		

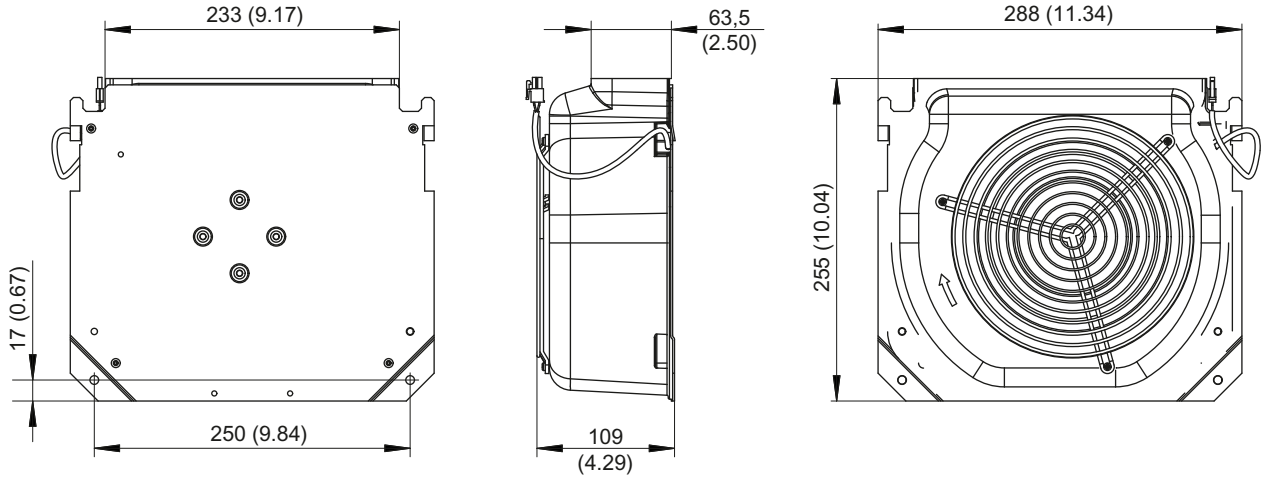
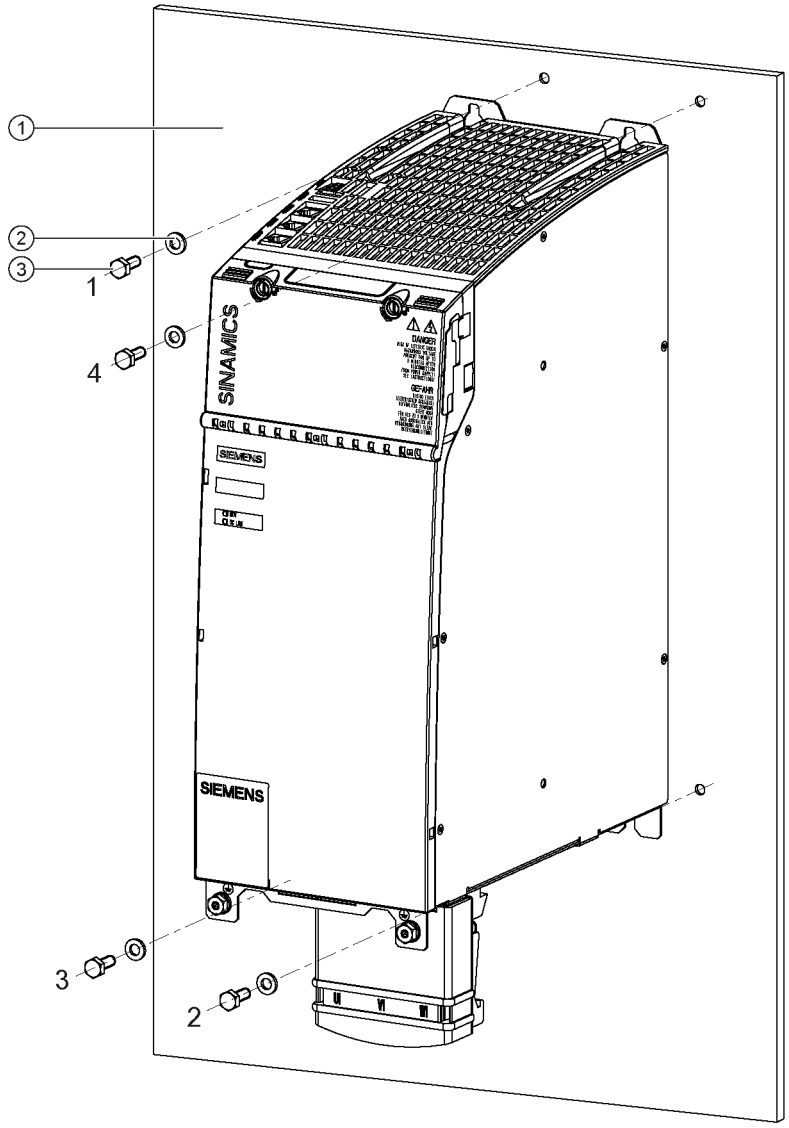


Figure 5-9 Dimension drawing of fans for Motor Modules 132 A and 200 A with internal air cooling, all dimensions in mm and (inches)

5.1.7 Installation

Motor Modules are designed for installation in the control cabinet. They are fixed to the control cabinet panel or a mounting panel using M6 screws.



① Control cabinet panel/mounting panel
② Washer
③ M6 screw

Figure 5-10 Installation of a Motor Module with internal air cooling (example 45 A)

Tightening torques:

- Initially, tighten the nuts by hand (0.5 Nm)
- Then tighten with 6 Nm (in the specific sequence 1 to 4)

Installing the sub-chassis fan

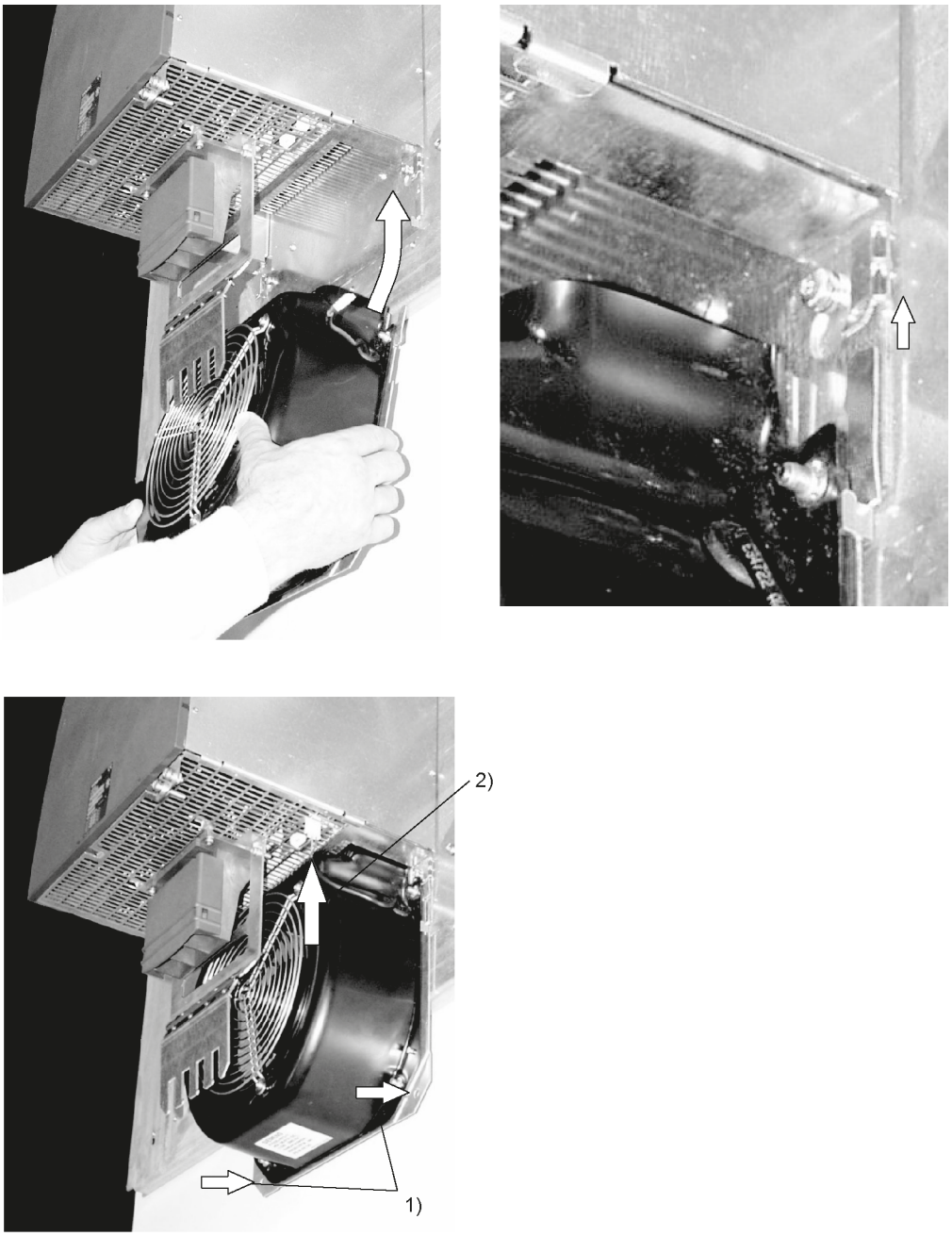


Figure 5-11 Installing the fan for Motor Modules 132 A and 200 A

1. Attach the fan with M6 / 6 Nm screws
2. Connect the power supply for the fan

5.1.8 Technical data

5.1.8.1 Single Motor Modules

Table 5- 11 Technical data Single Motor Modules Booksize (3 to 30 A)

Internal air cooling	6SL3120–	1TE13-0AAx	1TE15-0AAx	1TE21–0AAx	1TE21–8AAx	1TE23-0AAx
Output current						
Rated current (I_n)	A_{ACrms}	3	5	9	18	30
Base-load current (I_H)	A	2.6	4.3	7.7	15.3	25.5
Intermittent duty current (I_{s6}) 40%	A_{ACrms}	3.5	6	10	24	40
Peak current (I_{max})	A_{ACrms}	6	10	18	36	56
Output voltage	V_{ACrms}	0 - 0.717 x DC link voltage				
DC link current I_d	A_{DC}	3.6	6	11	22	36
DC link voltage (up to 2000 m above sea level)	V_{DC}	510 – 720				
DC link capacitance	µF	110	110	110	220	705
Overvoltage trip	V_{DC}	820 ± 2 %				
Undervoltage trip [1]	V_{DC}	380 ± 2 %				
Electronics power supply	V_{DC}	24 (20.4 – 28.8)				
Electronics current consumptionat 24 V DC	A_{DC}	0.85	0.85	0.85	0.85	0.8
Current carrying capacity						
DC link busbar	A_{DC}	100				
Reinforced DC link busbars	A_{DC}	150				
24 V busbar	A_{DC}	20				
Unit rating						
Based on I_n (600 V_{DC}; 4 kHz)	kW	1.6	2.7	4.8	9.7	16
Based on I_H	kW	1.4	2.3	4.1	8.2	13.7
Total power loss (including electronics losses) [2]	W	50.4	73.4	100.4	185.4	309.2
Max. pulse frequency						
Without derating	kHz	4				
With derating	kHz	16				
Max. ambient temperature						
Without derating	°C	40				
With derating	°C	55				
Sound pressure level	dB(A)	<60	<60	<60	<60	<60
Cooling method		Internal fan				
Cooling air requirement	m^3/h	29.6	29.6	29.6	29.6	56
Weight	kg	5	5	5	5	6.9

1) Default for 400 V line supplies; undervoltage trip threshold can be reduced by a maximum of 80 V and is adjusted to the parameterized rated voltage

2) For an overview, see the power loss tables in Chapter, Control cabinet installation

Table 5- 12 Technical data Single Motor Modules Booksize (45 to 200 A)

Internal air cooling	**6SL3120 –**	**1TE24-5AAx**	**1TE26-0AAx**	**1TE28-5AAx**	**1TE31-3AAx**	**1TE32-0AAx**
Output current						
Rated current (I_n)	A_{ACrms}	45	60	85	132	200
Base-load current (I_H)	A	38	51	68	105	141
Intermittent duty current (I_{s6}) 40%	A_{ACrms}	60	80	110	150	230
Peak current (I_{max})	A_{ACrms}	85	113	141	210	282
Output voltage	V_{ACrms}	0 - 0.717 x DC link voltage				
DC link current I_d	A_{DC}	54	72	102	158	200
DC link voltage (up to 2000 m above sea level)	V_{DC}	510 – 720				
DC link capacitance	µF	1175	1410	1880	2820	3995
Overvoltage trip	V_{DC}	820 ± 2 %				
Undervoltage trip [1]	V_{DC}	380 ± 2 %				
Electronics power supply	V_{DC}	24 (20.4 – 28.8)				
Electronics current consumption at 24 V DC	A_{DC}	1.05	1.05	1.5	0.85	0.85
Current carrying capacity						
DC link busbar	A_{DC}	200	200	200	200	200
24 V busbar	A_{DC}	20	20	20	20	20
Unit rating						
Based on I_n (600 V_{DC}; 4 kHz)	kW	24	32	46	71	107
Based on I_H	kW	21	28	37	57	76
Total power loss (incl. electronics losses) [2]	W	455.2	615.2	786	1270.4	2070.4
Max. pulse frequency						
Without derating	kHz	4				
With derating	kHz	16				
Max. ambient temperature						
Without derating	°C	40				
With derating	°C	55				
Sound pressure level	dB(A)	<65	<65	<60	<73	<73
Cooling method (with fan)		Internal fan			Mounted fan	
Cooling air requirement	m^3/h	112	112	160	520	520
Weight	kg	9	9	15	21	21

1) Default for 400 V supply systems; undervoltage trip threshold can be reduced by a maximum of 80 V (exception: 132 A and 200 A Motor Modules) and is adjusted to the parameterized rated voltage

2) For an overview, see the power loss tables in Chapter, Control cabinet installation

5.1.8.2 Double Motor Modules

Table 5- 13 Technical data Double Motor Modules Booksize (3 to 18A)

Internal air cooling	6SL3120-	2TE13-0AAx	2TE15-0AAx	2TE21-0AAx	2TE21-8AAx
Output current					
Rated current (I_n)	A_{ACrms}	2 x 3	2 x 5	2 x 9	2 x 18
Base-load current (I_H)	A	2 x 2.6	2 x 4.3	2 x 7.7	2 x 15.3
Intermittent duty current (I_{s6}) 40%	A_{ACrms}	2 x 3.5	2 x 6	2 x 10	2 x 24
Peak current (I_{max})	A_{ACrms}	2 x 6	2 x 10	2 x 18	2 x 36
Output voltage	V_{ACrms}	0 - 0.717 x DC link voltage			
DC link current I_d	A_{DC}	7.2	12	22	43
DC link voltage	V_{DC}	510 – 720			
DC link capacitance	µF	110	220	220	705
Overvoltage trip	V_{DC}	820 ± 2 %			
Undervoltage trip [1]	V_{DC}	380 ± 2 %			
Electronics power supply	V_{DC}	24 (20.4 – 28.8)			
Electronics current consumptionat 24 V DC	A_{DC}	1.15	1.15	1.15	1.3
Current carrying capacity					
DC link busbar	A_{DC}	100			
Reinforced DC link busbars	A_{DC}	150			
24 V busbar	A	20			
Unit rating					
Based on I_n (600 V_{DC}, 4 kHz)	kW	2 x 1.6	2 x 2.7	2 x 4.8	2 x 9.7
Based on I_H	kW	2 x 1.4	2 x 2.3	2 x 4.1	2 x 8.2
Total power loss (including electronics losses) [2]	W	97.6	132.6	187.6	351.2
Max. pulse frequency					
Without derating	kHz	4			
With derating	kHz	16			
Max. ambient temperature					
Without derating	°C	40			
With derating	°C	55			
Sound pressure level	dBA	<60	<60	<60	<60
Cooling method		Internal fan			
Cooling air requirement	m^3/h	29.6	29.6	29.6	56
Weight	kg	5.3	5.3	5.5	6.8

1) Default for 400 V supply systems; undervoltage trip threshold can be reduced by a maximum of 80 V and is adjusted to the parameterized rated voltage

2) For an overview, see the power loss tables in the chapter titled Control cabinet installation

5.1.8.3 Characteristics

Rated duty cycles Motor Modules Booksize

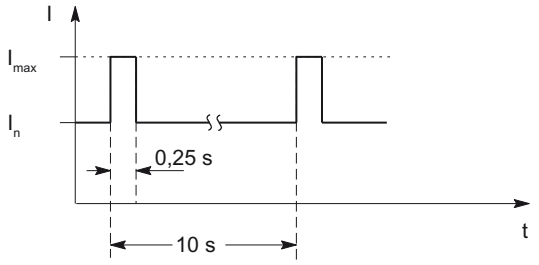


Figure 5-12 Duty cycle with initial load (for servo drives)

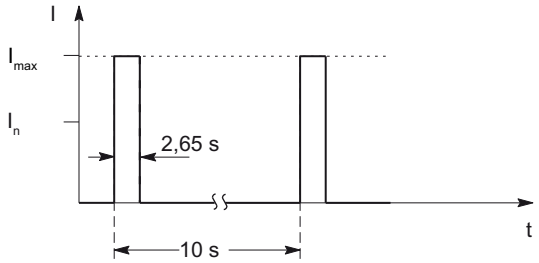


Figure 5-13 Duty cycle without initial load (for servo drives)

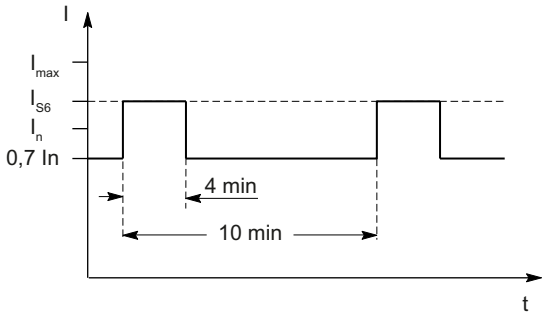


Figure 5-14 S6 duty cycle with initial load with a duty cycle duration of 600 s (for servo drives)

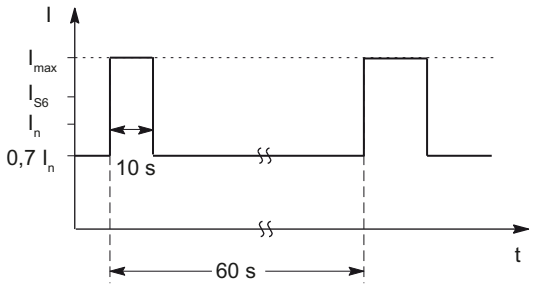


Figure 5-15 S6 duty cycle with initial load with a duty cycle duration of 60 s (for servo drives)

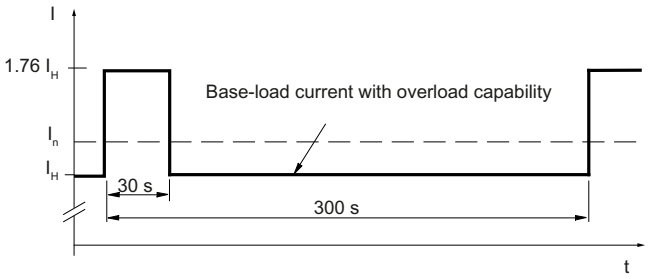


Figure 5-16 Duty cycle with 30 s overload with a duty cycle duration of 300 s

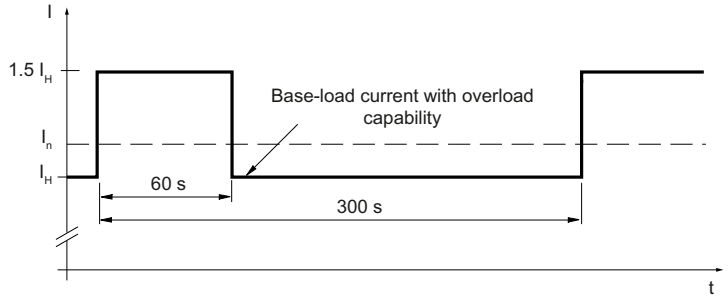


Figure 5-17 Duty cycle with 60 s overload with a duty cycle duration of 300 s

Derating characteristics for Motor Modules Booksize

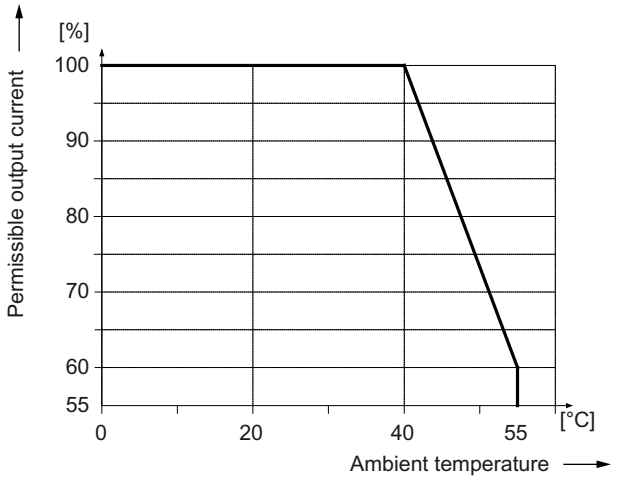


Figure 5-18 Output current as a function of the ambient temperature

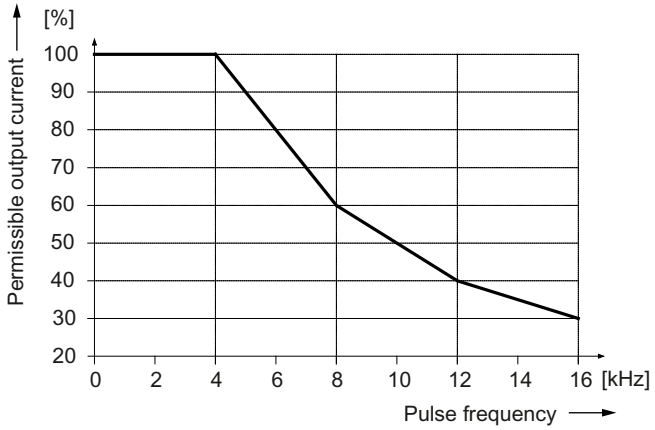


Figure 5-19 Output current as a function of the pulse frequency

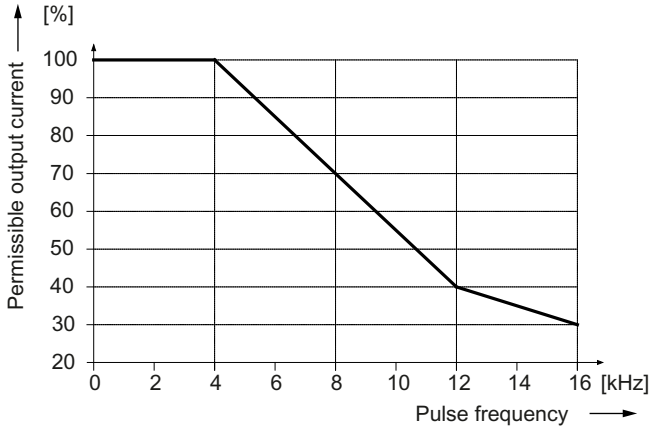


Figure 5-20 Output current as a function of the pulse frequency for 200 A Motor Modules (applies from order number 6SL312x-1TE32-0AA4)

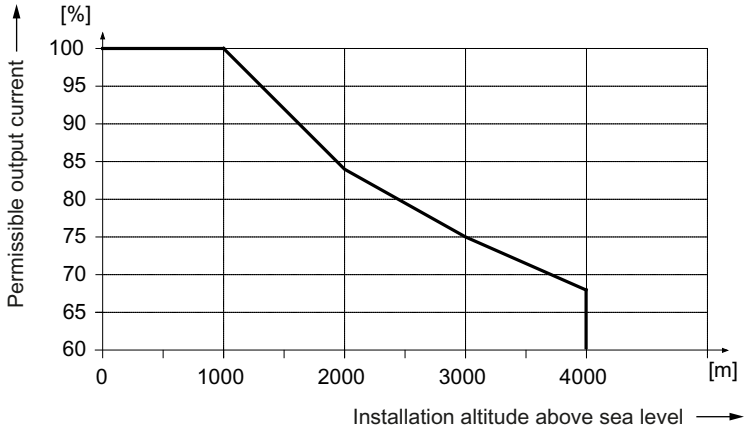


Figure 5-21 Output current as a function of the installation altitude

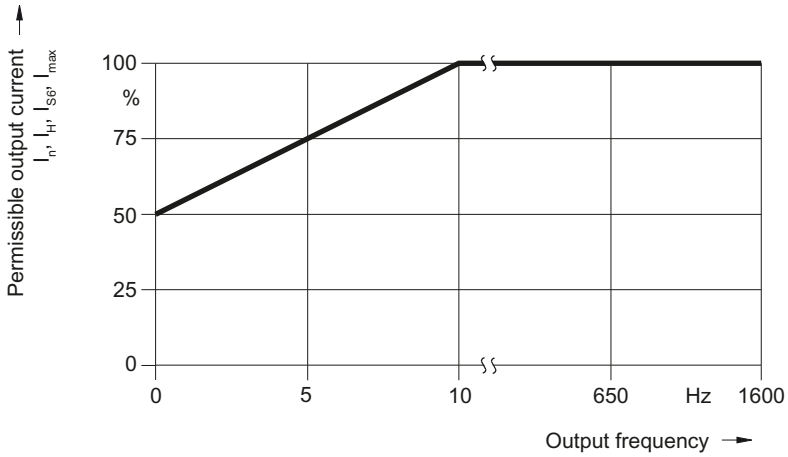


Figure 5-22 Output current as a function of the output frequency

At installation altitudes >2000 m, an insolating transformer must be used (see "System overview/Derating as a function of the installation altitude and ambient temperature"). The design of the secondary line supply system must be as follows:

- TN system with grounded star point (no grounded outer conductor)
- IT system

A reduction of the line supply voltage phase-phase is not necessary.

5.2 Motor Module with external air cooling

5.2.1 Description

A Motor Module with external air cooling is a power unit (inverter) that provides the power supply for the connected motor(s). 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 for the Motor Module are stored in the Control Unit.

Motor Modules with external air cooling are offered as Single Motor Modules and Double Motor Modules. One motor can be connected to Single Motor Modules and two motors can be connected to Double Motor Modules.

External air cooling uses the "through-hole" method. This is a cooling method for SINAMICS power units that is only available for booksize devices. The power unit and its heat sink can be inserted in a rectangular knockout at the rear of the control cabinet and mounted with a seal. The heat sink fins and the fan (included in the scope of supply) project beyond the rear of the control cabinet and the heat is dissipated outside the control cabinet or in a separate air duct.

5.2.2 Safety information

⚠ DANGER

Risk of electric shock

A hazardous voltage is still present for up to 5 minutes after the power supply has been switched off.
It is only permissible to open the protective cover after this time has expired.

When opening the protective cover for the DC link, you must press the release catch. A suitable tool (e.g. screwdriver or the release tool supplied) must be used for this purpose.

The components must only be operated when the protective cover of the DC link is closed. Damaged components must not be operated further, otherwise this could result in secondary damage or accidents.

⚠ DANGER

DC link discharge time

A hazard warning in the local language for the DC link discharge time must be attached to the component.
A set of labels in 16 languages is supplied with the component.

⚠ DANGER

The drive components generate high leakage currents in the protective conductor. The components must only be operated in cabinets or in closed electrical operating areas and must be connected with the protective conductor. To protect against electric shock, the protective conductor connection at the control cabinet or machine must be implemented in accordance with one of the following measures:

- Fixed connection and protective conductor connection using ≥ 10 mm^2 Cu or ≥ 16 mm^2 Al
- Fixed connection and automatic disconnection of the supply system if the protective conductor is interrupted

⚠ DANGER

It is only permissible to establish connections to the DC link using the adapters that SIEMENS has recommended (DC link adapter and DC link rectifier adapter).

⚠ DANGER

If a 50 mm wide Motor Module or a 50 mm wide DC link component (e.g. Braking Module, Control Supply Module, Voltage Clamping Module) is located at the left-hand end of the drive line-up, then the DC link bridges, including all of the screws, must be removed from this component. It is not permissible to insert the screws without a DC link bridge.

For all other components that are 75 mm wide or wider, it is neither permissible to move the DC link bridge to the left nor to remove it.

If this is not carefully observed, this can result in damage and accidents.

⚠ DANGER

It is essential to connect the shield for the motor holding brake. Furthermore, only MOTION-CONNECT cables must be used for integrated motor holding brakes, as otherwise insulation of the cores is not guaranteed. Risk of electric shock.

⚠ WARNING

Cable shields and unused power-cable cores (e.g. brake cores) must be connected to PE potential to dissipate capacitive cross-talk charges.

If this is not carefully observed, lethal shock voltages could result.

⚠ CAUTION

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

CAUTION

The correct tightening torque of the DC link busbar screws (1.8 Nm, tolerance +30%) must be checked before commissioning. After transportation, the screws must be tightened.

CAUTION

Only cables from Siemens may be used for DRIVE-CLiQ connections.

CAUTION

Connecting cables to temperature sensors must always be installed with shielding. The cable shield must be connected to the chassis 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.

CAUTION

DC link side covers are supplied with the components as standard and must be attached to the first and last components in the drive line-up. They can also be ordered separately, if required (order number: 6SL3162-5AA00-0AA0).

NOTICE

The external air cooling can cause the fans and the heat sink to become heavily contaminated, which may trigger the temperature monitor in the power unit. The fans and heat sink must be checked for contamination at regular intervals and, if necessary, cleaned.

Note

After installation, the seal on the rear of the device must be checked to ensure that it is tight. Additional sealing can be used, if necessary.

Note

The mounting frames can only be used if the cabinet has an unpainted metal surface.

Note

A regulated DC power supply is required to operate motors with a built-in holding brake. The voltage is supplied via the internal 24 V busbars. The voltage tolerances of the motor holding brakes (24 V ± 10%) and the voltage drops of the connection cables must be taken into account.

The DC power supply should be set to 26 V. This ensures that the supply voltage for the brake remains within the permissible range when the following conditions are fulfilled:

- Use of Siemens three-phase motors
- Use of Siemens MOTION-CONNECT power cables
- Motor cable lengths: max. 100 m

5.2.3 Interface description

5.2.3.1 Overview

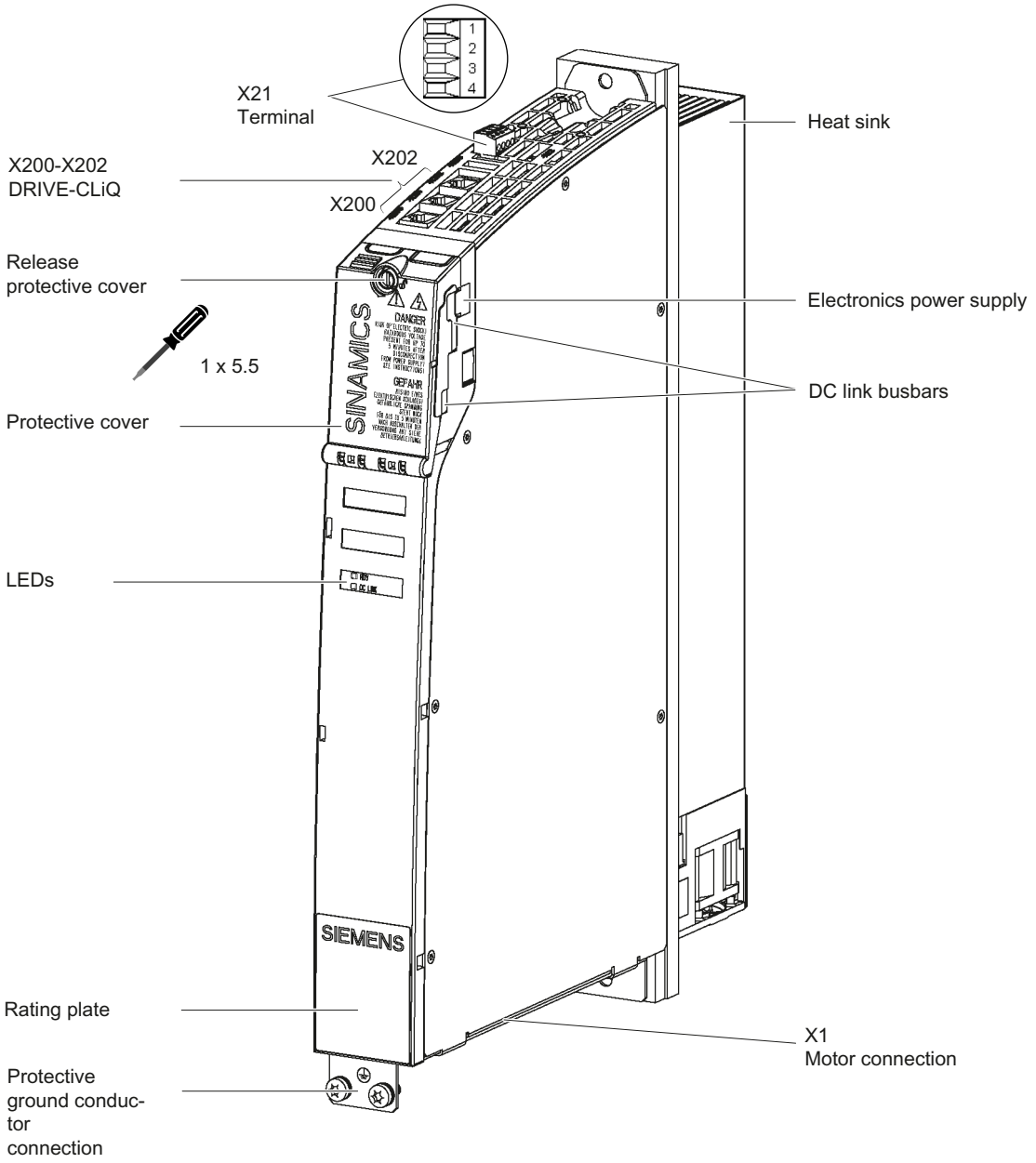


Figure 5-23 Interface overview, Single Motor Module Booksize with external air cooling (example: 5 A)

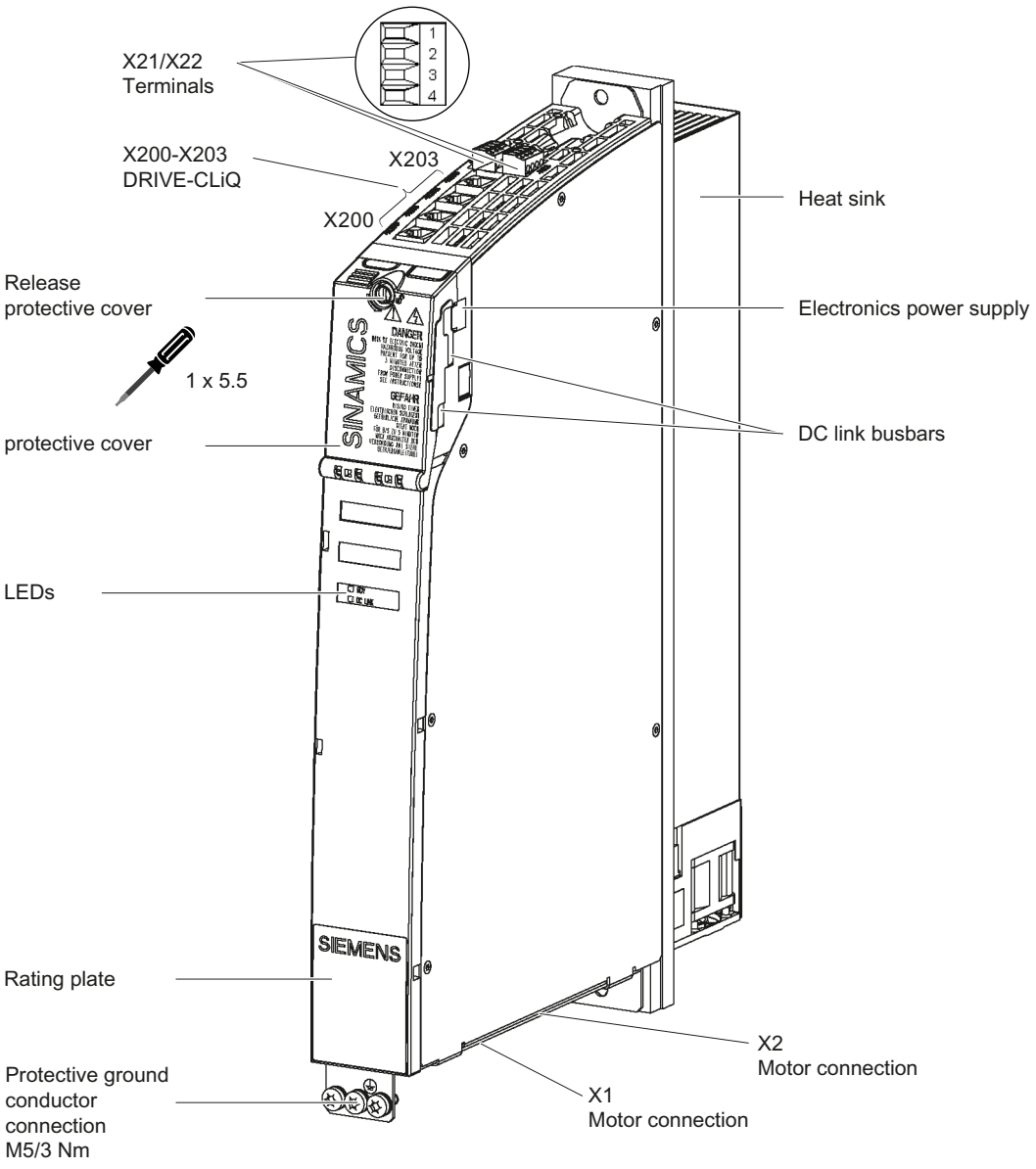
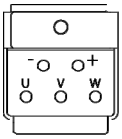
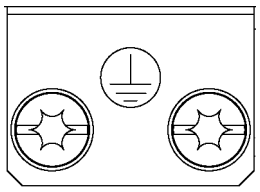
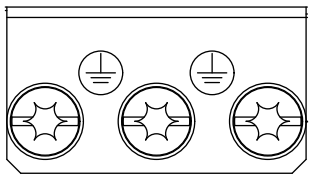


Figure 5-24 Interface overview, Double Motor Module Booksize with external air cooling (example: 2 x 5 A)

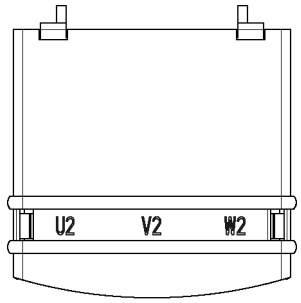
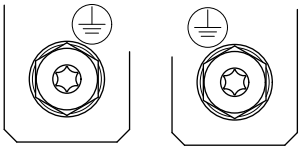
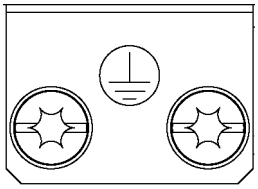
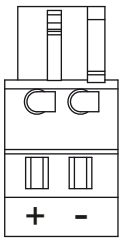
5.2.3.2 Motor and brake connection

Table 5- 14 X1/X2 motor and brake connection for Single Motor Modules 3 A to 30 A and Double Motor Modules 3 A to 18 A

	Terminal	Technical specifications
	U (U2)	Motor connection
	V (V2)	
	W (W2)	
	+ (BR+)	Brake connection max. load current 2 A min. load current 0.1 A
	- (BR-)	
	PE connection	**Single Motor Modules 3 A to 30 A:** Threaded hole M5 / 3 Nm [1)]
		**Double Motor Modules 3 A to 18 A:** Threaded hole M5 / 3 Nm [1)]

1) For ring cable lugs in accordance with DIN 46234

Table 5- 15 X1 motor connection and X11 brake connection for Single Motor Modules 45 A to 200 A

	Terminal	Technical specifications
	U2 V2 W2	**45 A to 60 A:** Threaded bolts M6 / 6 Nm 1) **85 A:** Threaded bolts M8 / 13 Nm 1) **132 A to 200 A:** Threaded bolts M8 / 13 Nm 1)
	PE connection	**45 A to 60 A:** Threaded bolts for motor cables: M6 / 6 Nm 1) Threaded hole for PE: M6 / 6 Nm 1)
		**85 A:** Threaded bolts for motor cables: M8 / 13 Nm 1) Threaded hole for PE: M6 / 6 Nm 1) **132 A to 200 A:** Threaded bolts for motor cables: M8 / 13 Nm 1) Threaded hole for PE: M8 / 13 Nm 1)
	+ (BR+) - (BR-)	**X11 brake connector** 2): Voltage 24 V DC Max. load current 2 A Min. load current 0.1 A Max. connectable cross-section 2.5 mm² Type: Spring-loaded terminal 2 (see Chapter, "Control cabinet installation and EMC / connection system") The brake connector is part of the prefabricated cable

1) For ring cable lugs in accordance with DIN 46234

2) The circuit for protecting the brake against overvoltage is integrated in the Motor Module and does not need to be installed externally. The max. load current is 2 A, the min. load current 0.1 A.

Note

The overall length of the power cables (motor supply cables and DC link cables) must not exceed the values given in chapter "Possible line reactor and line filter combinations".

Note

The motor brake must be connected via connector X11. It is not permitted to directly connect the cable BR – to the electronics ground M.

⚠ WARNING

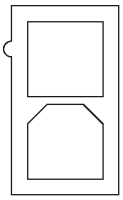
Only protective extra-low voltages (DVC A) that comply with EN 60204-1 must be connected to all connections and terminals between 0 and 48 V DC.

The voltage tolerances of the motor holding brakes (24 V ± 10%) must be taken into account.

5.2.3.3 X12 fan connection

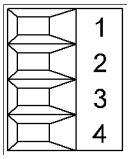
The Motor Modules 132 A and 200 A are equipped with an interface to connect a sub-chassis fan. The interface is located on the underside of the Motor Module.

Table 5- 16 X12 fan connection

	Terminal	Function	Technical specifications
	1	Fan connection +	Voltage 48 V DC for the supplied fan
	2	Fan connection -	

5.2.3.4 X21/X22 EP terminals/temperature sensor

Table 5- 17 X21/X22 EP terminals/temperature sensor

	Terminal	Function	Technical specifications
	1	+ Temp	Temperature sensors: KTY 84-1C130/PTC/bimetallic switch with NC contact
	2	- Temp	
	3	EP +24 V (Enable Pulses)	Supply voltage: 24 V DC (20.4 V to 28.8 V) Current consumption: 10 mA Isolated input Signal propagation times: L → H: 100 µs H → L: 1000 µs The pulse inhibit function is only available when Safety Integrated Basic Functions are enabled.
	4	EP M1 (Enable Pulses)	
Max. connectable cross-section 1.5 mm^2 Type: Screw terminal 1 (see Chapter, "Control cabinet installation/Connection system")			

NOTICE

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

Parameters p9651 and p9851 are used to set the filter times to debounce terminals X21.3 and X21.4, as well as X22.3 and X22.4. Additional parameter settings are also required in order to prevent discrepancy errors when performing bit pattern tests (light/dark tests). For comprehensive information, see the SINAMICS S120 Safety Integrated Function Manual, Chapter 6 "Controlling the safety functions".

NOTICE

The KTY temperature sensor must be connected with the correct polarity.
If the polarity is reversed, the sensor will not be able to detect if the motor overheats.

Note

The temperature sensor input is not needed if the motors feature an integrated DRIVE-CLiQ interface or if temperature values are detected by means of a different module (SMC, SME, TM).

⚠ DANGER

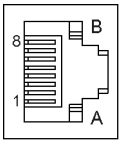
Risk of electric shock!

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) or Terminal Module TM120 must be used.

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

5.2.3.5 X200-X203 DRIVE-CLiQ interface

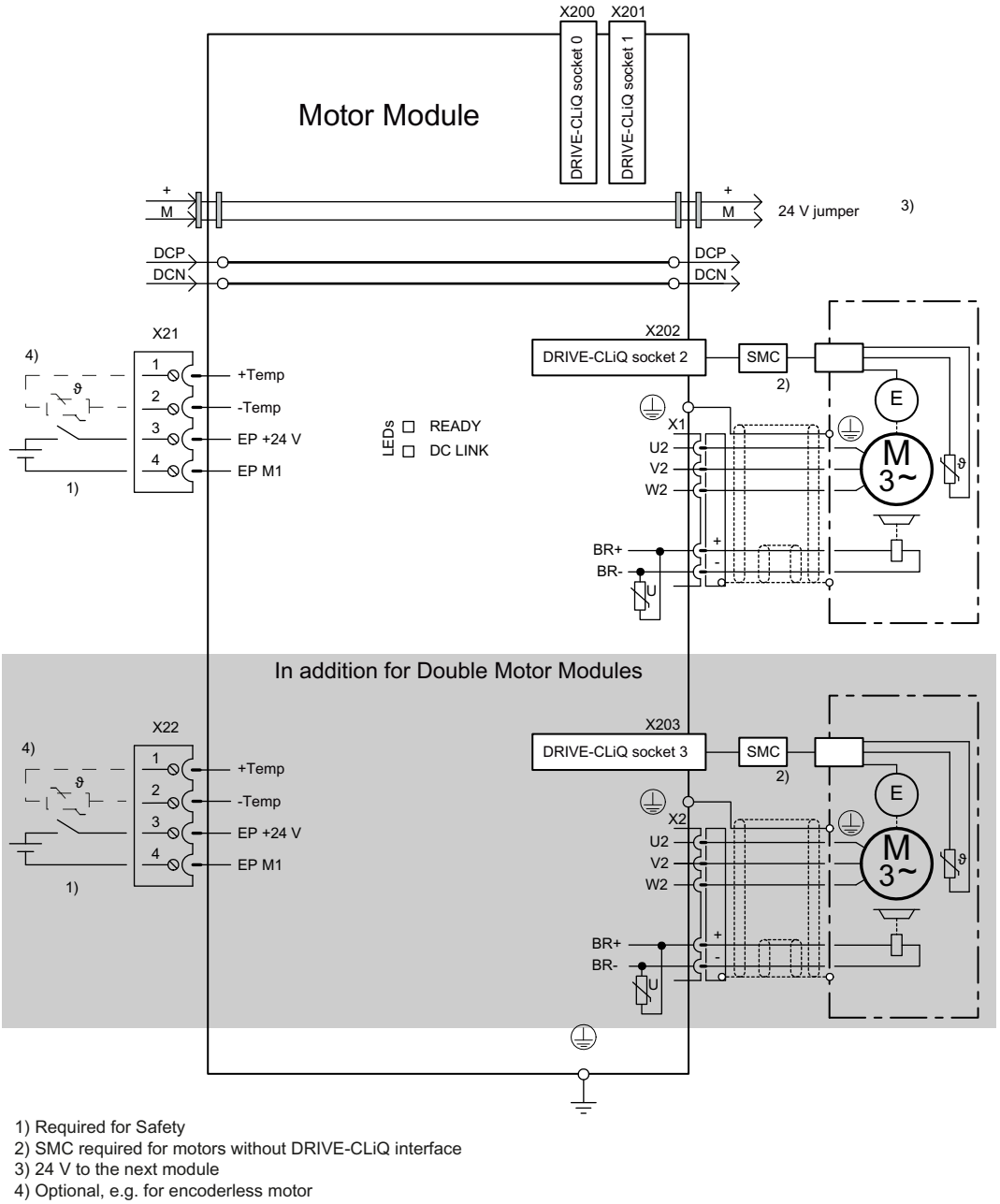
Table 5- 18 X200-X202: DRIVE-CLiQ interfaces for Single Motor Modules
X200-X203: DRIVE-CLiQ interfaces for Double Motor Modules

	Pin	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

The blanking covers for the DRIVE-CLiQ interfaces are included in the scope of delivery.

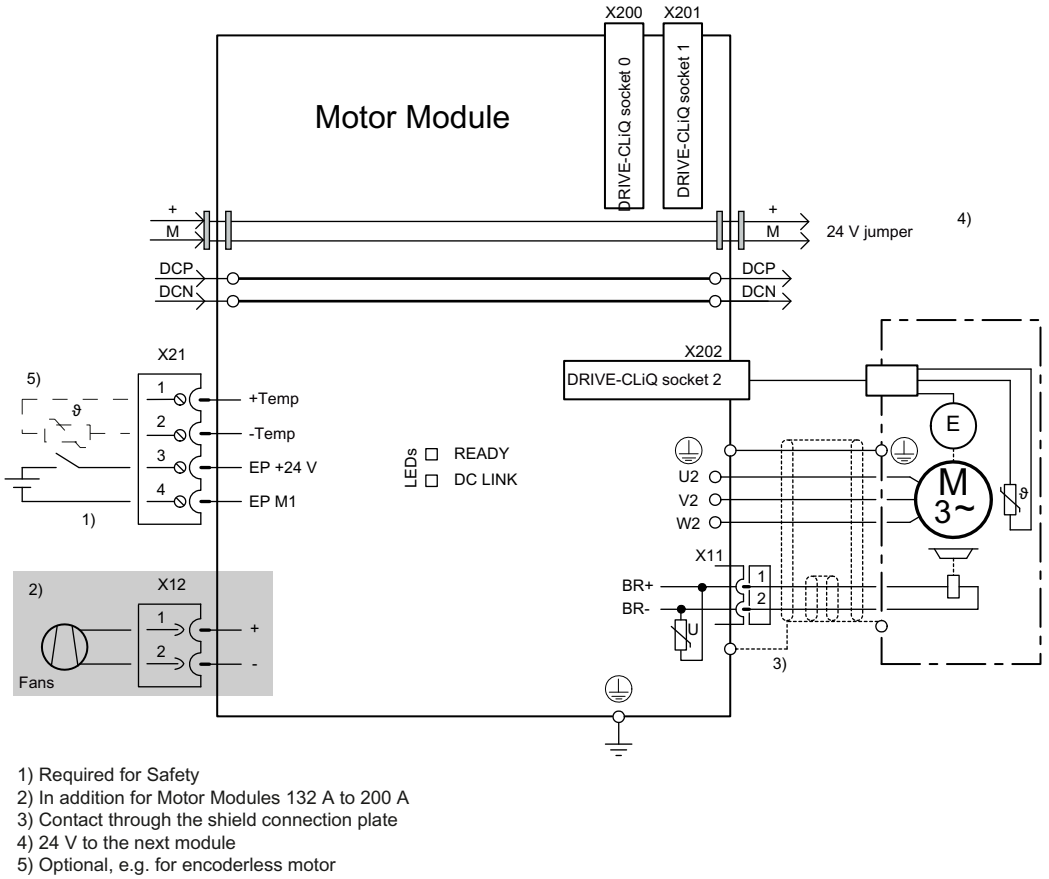
Blanking cover (50 pcs.) Order number: 6SL3066-4CA00-0AA0

5.2.4 Connection Examples



1) Required for Safety
2) SMC required for motors without DRIVE-CLiQ interface
3) 24 V to the next module
4) Optional, e.g. for encoderless motor

Figure 5-25 Connection example of Motor Modules 3 A to 30 A and Double Motor Modules 3 A to 18 A



1) Required for Safety
2) In addition for Motor Modules 132 A to 200 A
3) Contact through the shield connection plate
4) 24 V to the next module
5) Optional, e.g. for encoderless motor

Figure 5-26 Example connection of Single Motor Modules 45 A to 200 A

5.2.5 Meaning of LEDs

Table 5- 19 Meaning of the LEDs on the Motor Module

Status		Description, cause	Remedy
RDY	DC LINK		
Off	Off	Electronics power supply is missing or outside permissible tolerance range.	–
Green	--	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.	Check line voltage
Orange	Orange	DRIVE-CLiQ communication is being established.	–
Red	--	At least one fault is present in this component. **Note:** The LED is driven irrespective of the corresponding messages being reconfigured.	Remedy and acknowledge fault
Green/red (0.5 Hz)	--	Firmware is being downloaded.	–
Green/red (2 Hz)	--	Firmware download is complete. Wait for POWER ON.	Carry out a POWER ON
Green/orange or Red/orange	--	Detection of the components via LED is activated (p0124). **Note:** Both options depend on the LED status when module recognition is activated via p0124 = 1.	–

⚠ DANGER

Hazardous DC link voltages may be present at any time regardless of the status of the "DC LINK" LED.
The warning information on the components must be carefully observed!

5.2.6 Dimension drawings

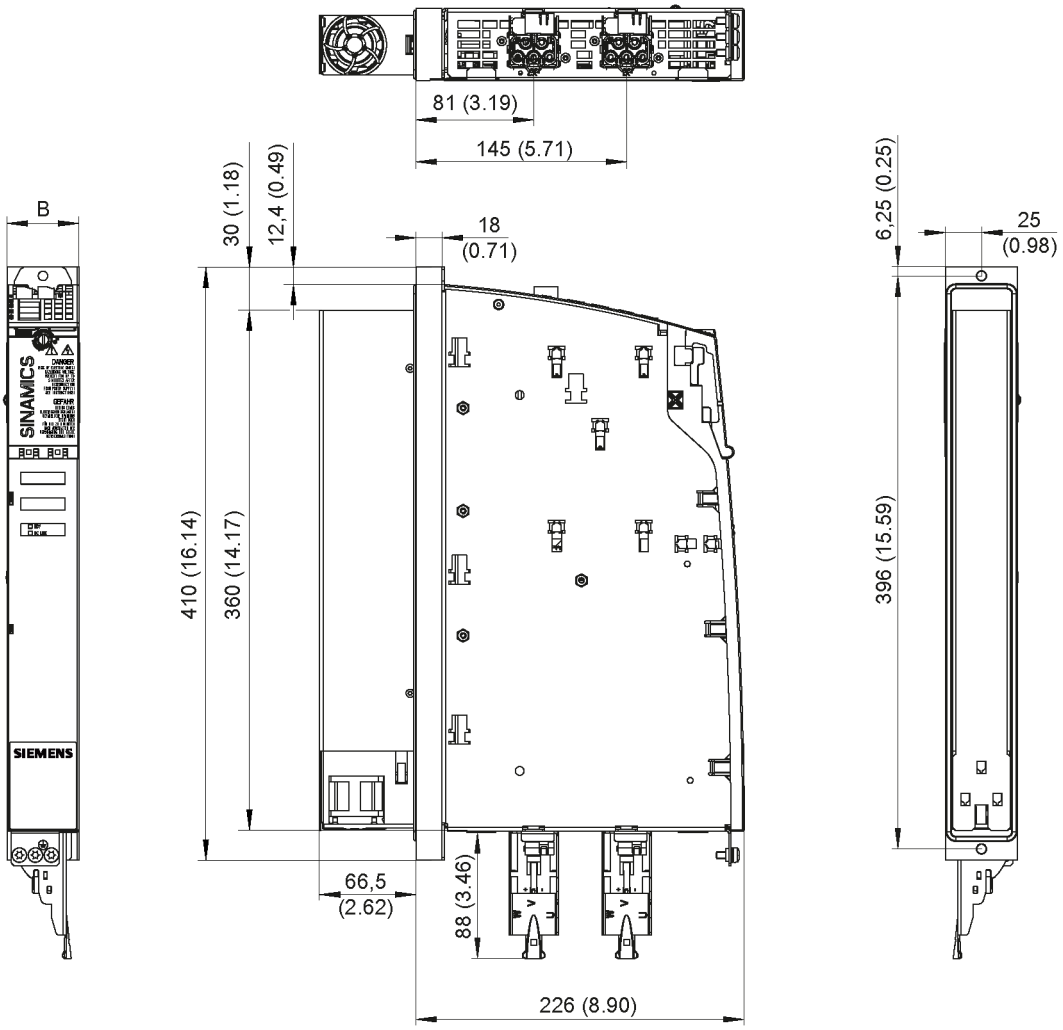


Figure 5-27 Dimension drawing of 3 A to 18 A and 2 x 3 A to 2 x 9 A Motor Modules Booksize with external air cooling, all dimensions in mm and (inches); example: 2 x 5 A Double Motor Module

Table 5- 20 Dimensions of 3 A to 18 A and 2 x 3 A to 2 x 9 A Motor Modules Booksize with external air cooling

Motor Module	Order number	B [mm] (inches)
3 A Single Motor Module	6SL3121-1TE13-0AAx	50 (1.97)
5 A Single Motor Module	6SL3121-1TE15-0AAx	
9 A Single Motor Module	6SL3121-1TE19-0AAx	
18 A Single Motor Module	6SL3121-1TE21-8AAx	
3 A Double Motor Module	6SL3121-2TE13-0AAx	
5 A Double Motor Module	6SL3121-2TE15-0AAx	
9 A Double Motor Module	6SL3121-2TE21-0AAx	

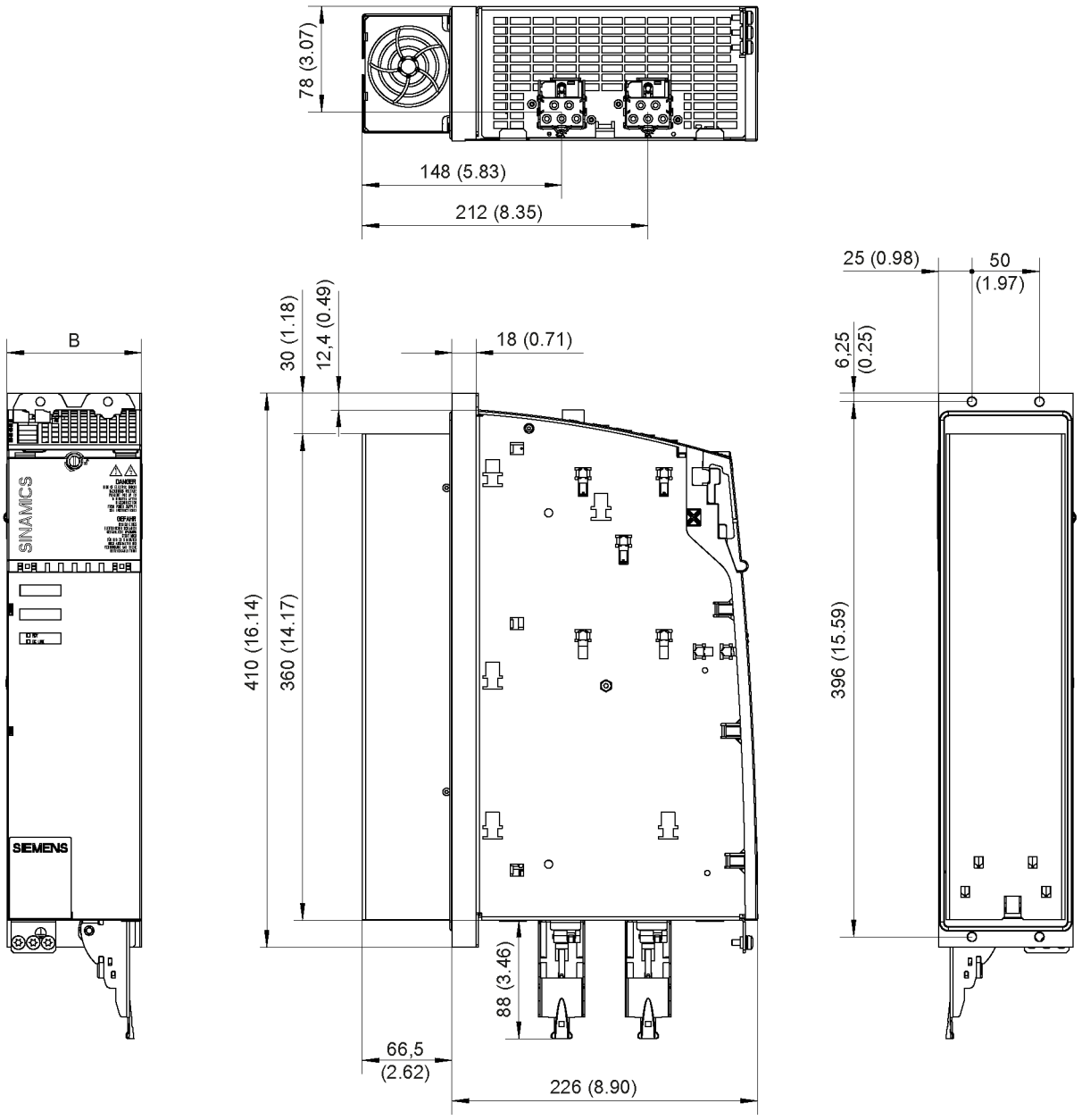


Figure 5-28 Dimension drawing of 30 A and 2 x 18 A Motor Modules Booksize with external air cooling, all dimensions in mm and (inches); example: 2 x 18 A Double Motor Module

Table 5- 21 Dimensions of 30 A and 2 x 18 A Motor Modules Booksize with external air cooling

Motor Module	Order number	B [mm] (inches)
30 A Single Motor Module	6SL3121-1TE23-0AAx	100 (3.94)
18 A Double Motor Module	6SL3121-2TE21-8AAx	

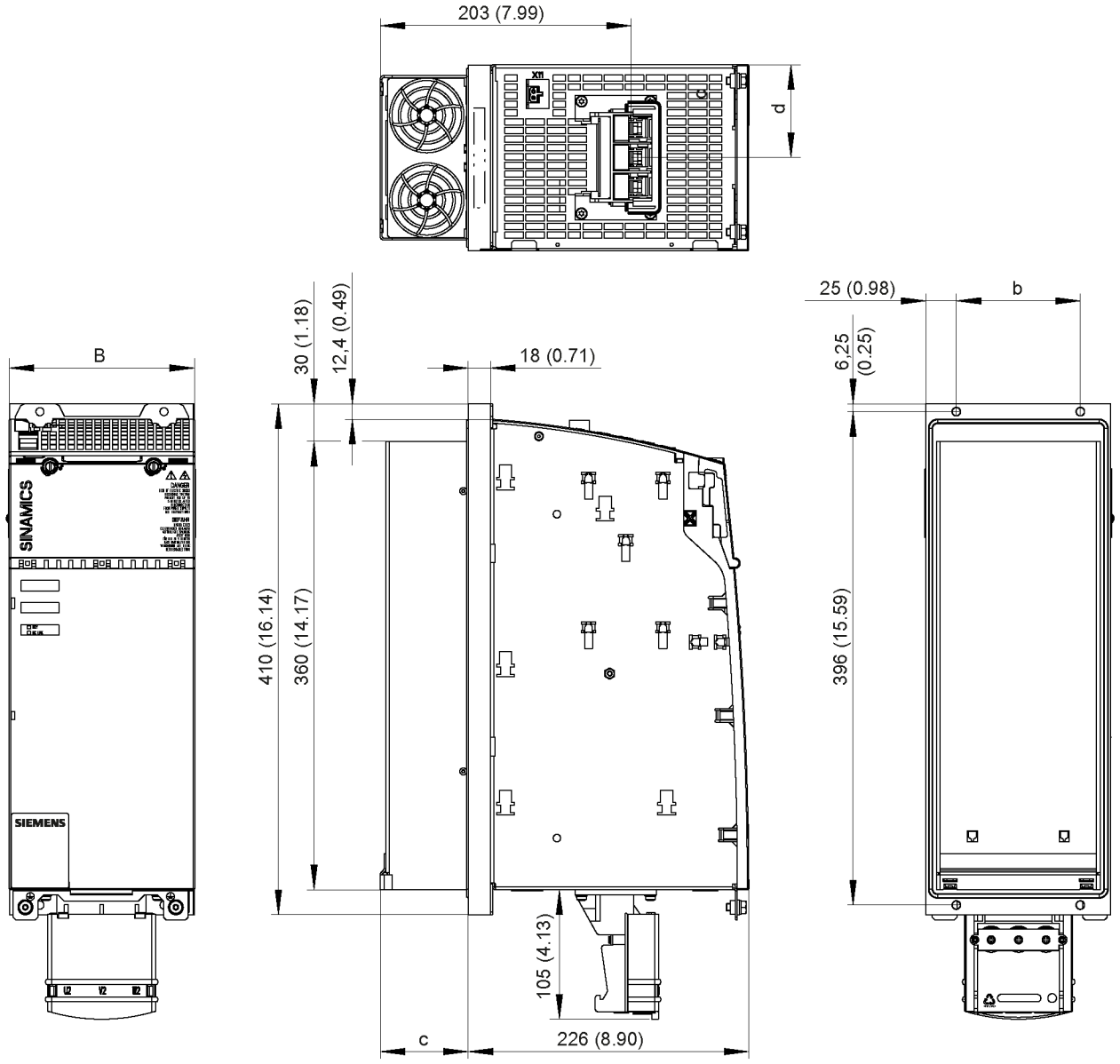


Figure 5-29 Dimension drawing of 45 A, 60 A, and 85 A Motor Modules Booksize with external air cooling, all dimensions in mm and (inches); example 45 A

Table 5- 22 Dimensions of 45 A, 60 A, and 85 A Motor Modules Booksize with external air cooling

Motor Module	Order number	B [mm] (inches)	b [mm] (inches)	c [mm] (inches)	d [mm] (inches)
Single Motor Module 45 A	6SL3121-1TE24-5AAx	150 (5.91)	100 (3.94)	71 (2.80)	75 (2.95)
Single Motor Module 60 A	6SL3121-1TE26-0AAx				
Single Motor Module 85 A	6SL3121-1TE28-5AAx	200 (7.87)	150 (5.91)	92 (3.62)	100 (3.94)

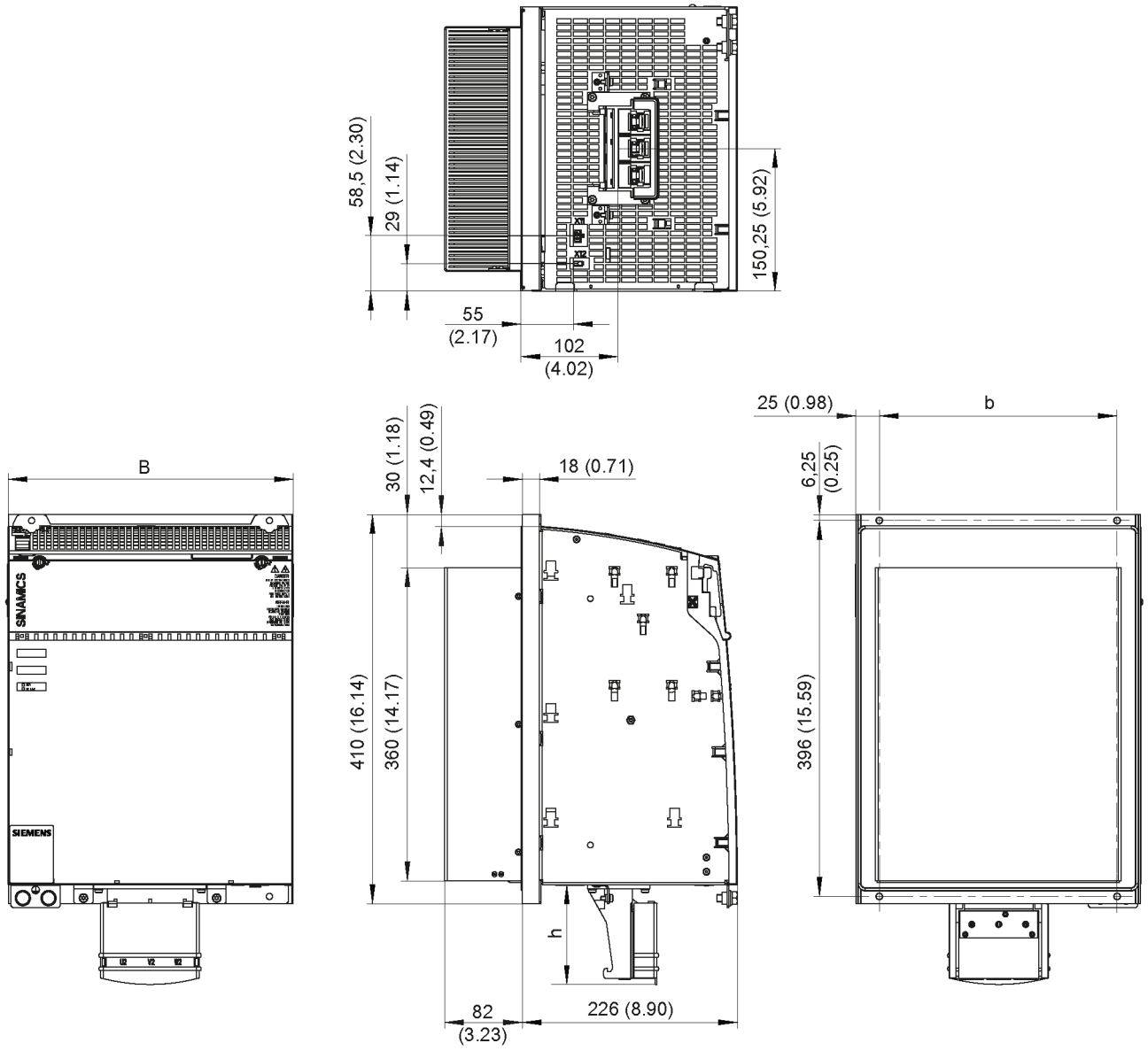


Figure 5-30 Dimension drawing of 132 A and 200 A Motor Modules Booksize, all dimensions in mm and (inches); example: 200 A Single Motor Module

Table 5- 23 Dimensions of 132 A and 200 A Motor Modules Booksize with external air cooling

Motor Module	Order number	B [mm] (inches)	b [mm] (inches)	h [mm] (inches)
Single Motor Module 132 A	6SL3121-1TE31-3AAx	300 (11.81)	250 (9.84)	105 (4.13)
Single Motor Module 200 A	6SL3121-1TE32-0AAx			

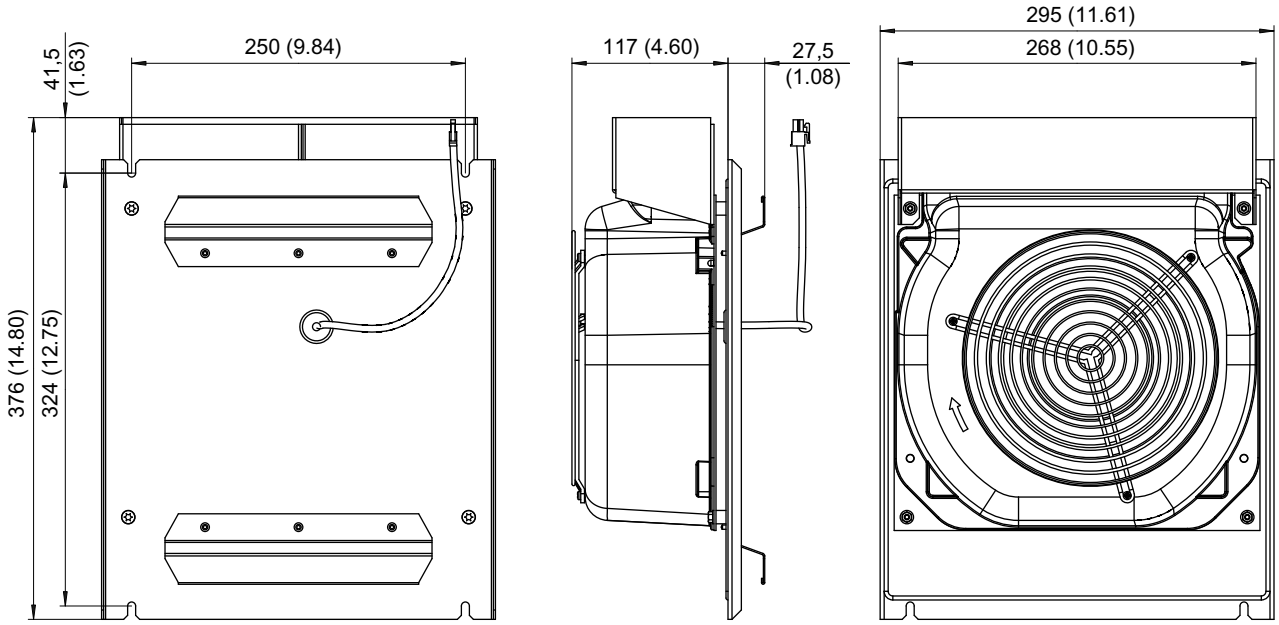
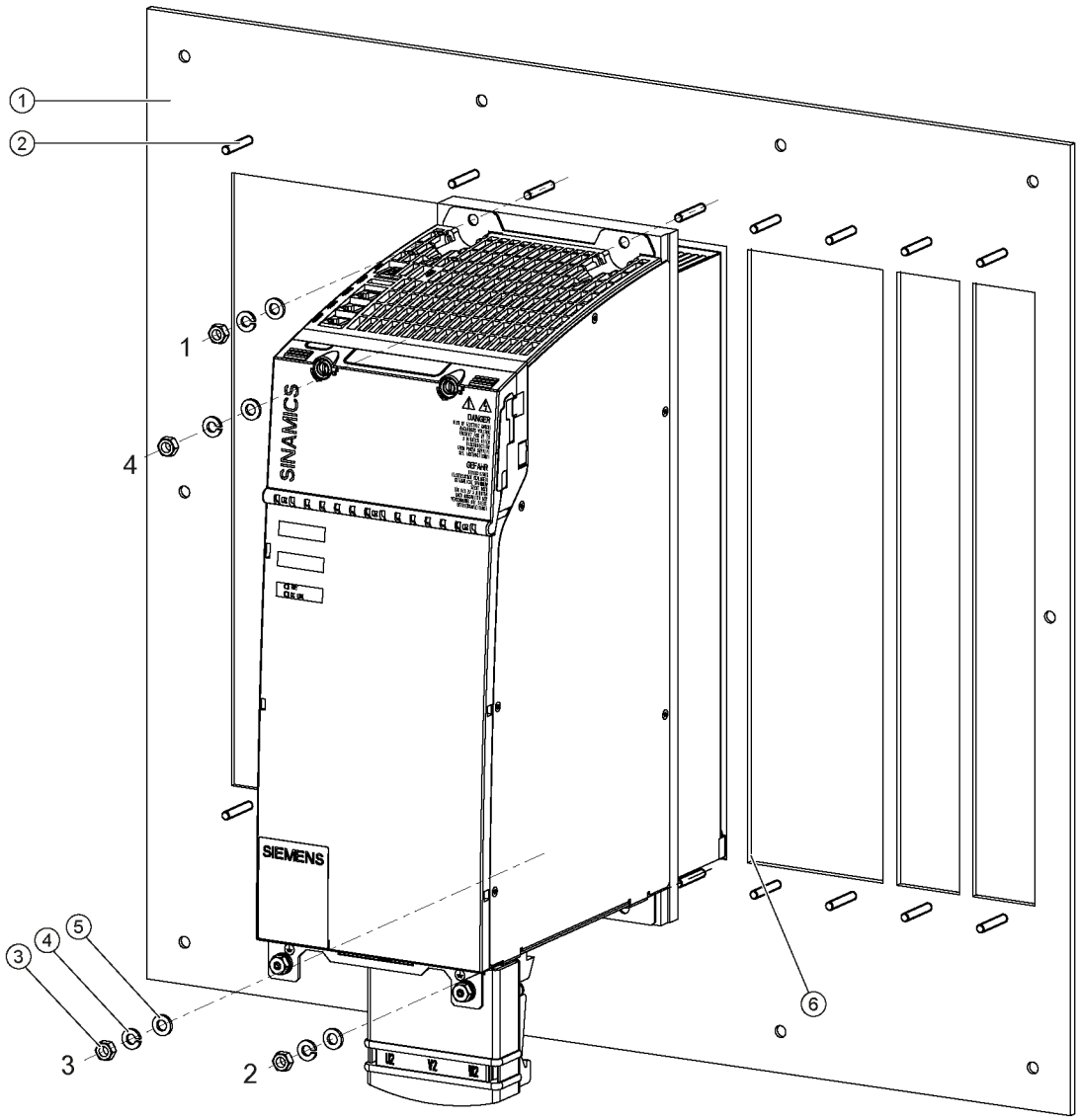


Figure 5-31 Dimension drawing of fan for 132 A and 200 A Motor Modules Booksize with external air cooling, all dimensions in mm and (inches)

5.2.7 Installation



① Mounting plate with installation openings
② M6 studs
③ M6 nut
④ Spring washer
⑤ Washer
⑥ Fan assembly

Figure 5-32 Installation of a Motor Module with external air cooling

Tightening torques:

- Initially, tighten the nuts by hand (0.5 Nm)
- Then tighten with 6 Nm (in the specific sequence 1 to 4)

Help with the mechanical control cabinet installation is available from:

Siemens AG
Industry Sector, IA SE WKC
TCCCC (Technical Competence Center Cabinets Chemnitz)
P.O. Box 1124
09070 Chemnitz, Germany

E-mail: cc.cabinetcooling.aud@siemens.com

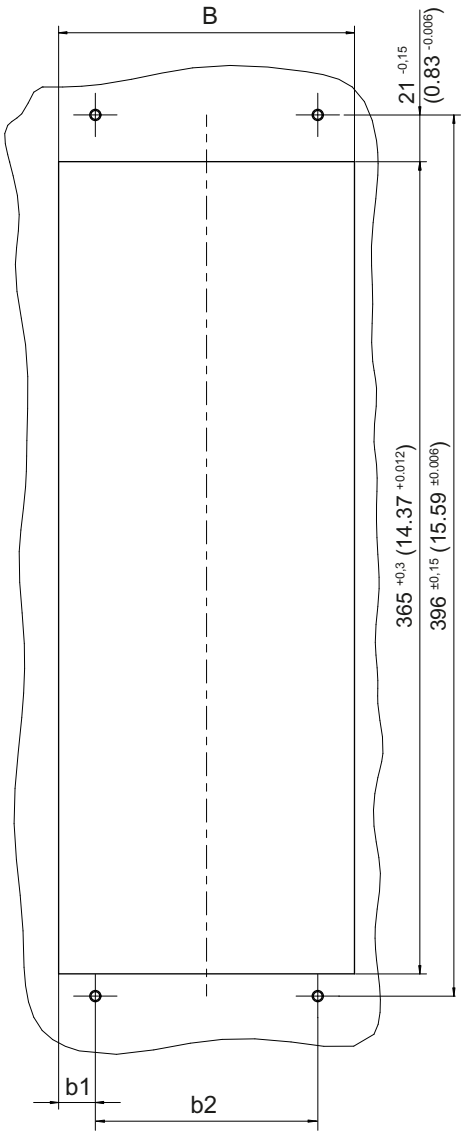
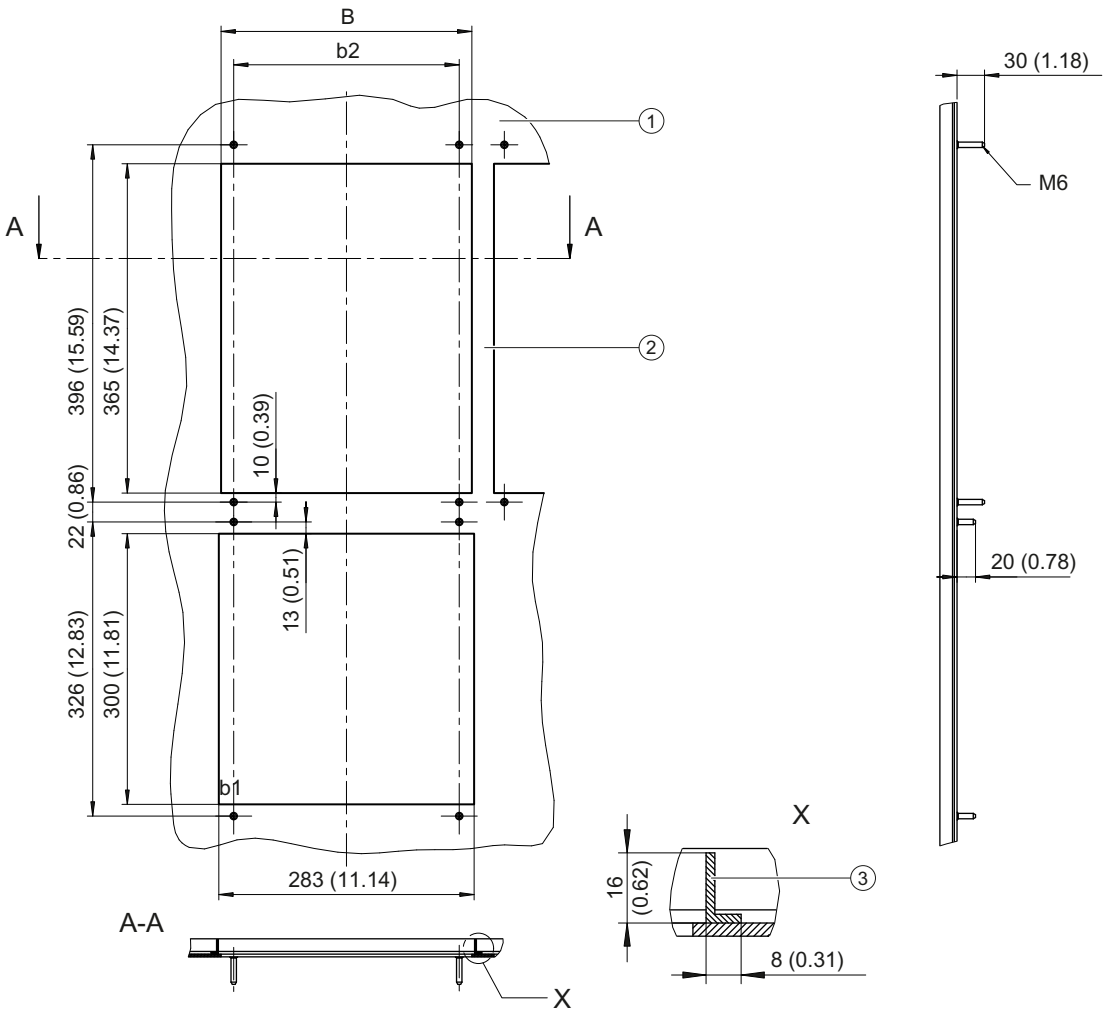


Figure 5-33 Installation opening for Motor Modules 50 mm to 200 mm with external air cooling, all data in mm and (inches)

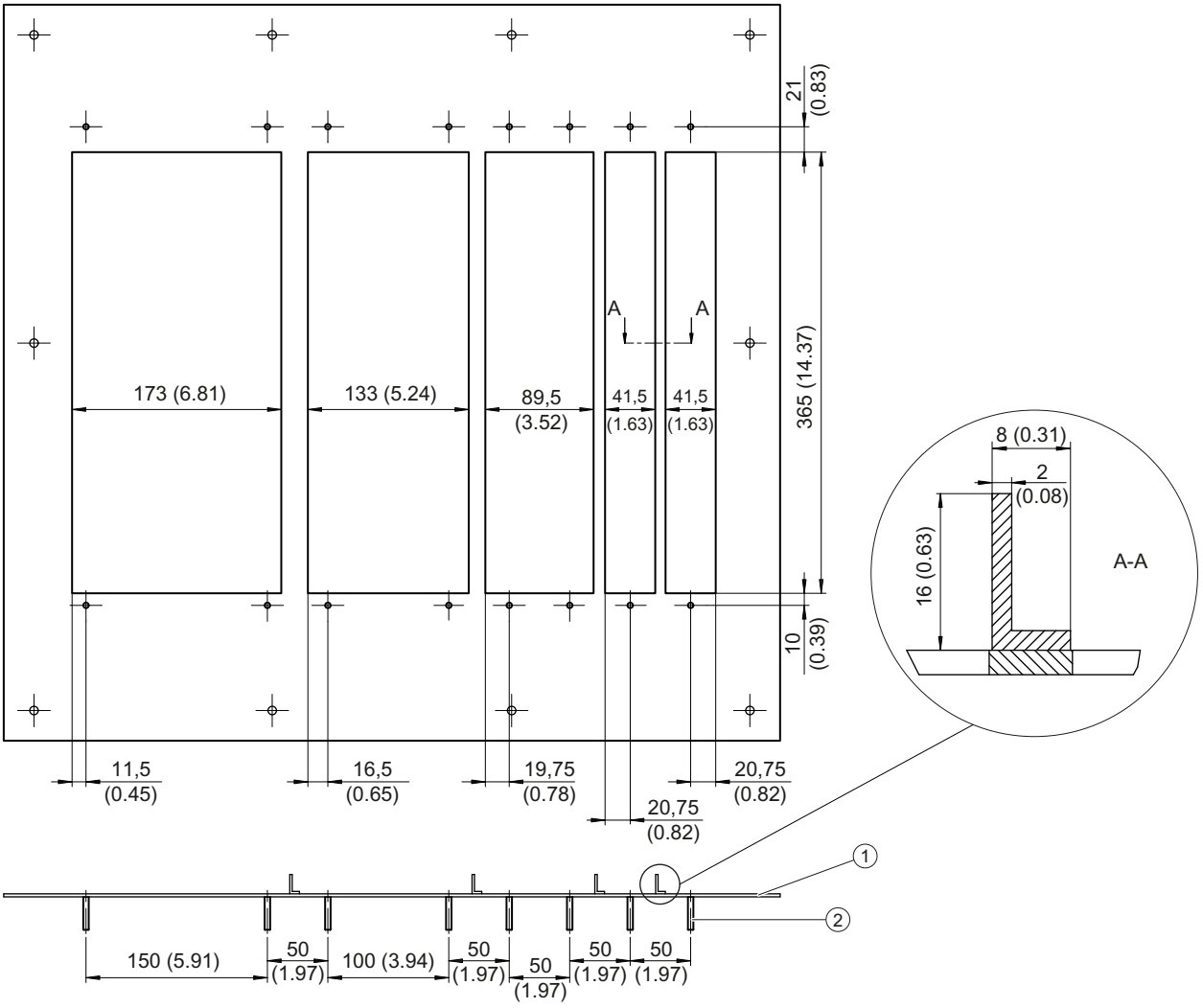


① Insert or mounting plate
② Cross-piece
③ Reinforcing bracket

Figure 5-34 Installation openings for a Motor Module 300 mm with external air cooling, all data in mm and (inches)

Table 5- 24 Dimensions of the installation openings for Motor Modules with external air cooling

Component width	W [mm] (inches)	b1 [mm] (inch)	b2 [mm] (inch)
50 mm	41.5 $^{+0.3}$ (1.63 $^{+0.012}$)	20.75 $^{+0.15}$ (0.82 $^{+0.006}$)	0
100 mm	89.5 $^{+0.3}$ (3.52 $^{+0.012}$)	19.75 $^{+0.15}$ (0.78 $^{+0.006}$)	50 $^{\pm0.15}$ (1.97 $^{\pm0.006}$)
150 mm	133 $^{+0.3}$ (5.24 $^{+0.012}$)	16.5 $^{+0.15}$ (0.65 $^{+0.006}$)	100 $^{\pm0.15}$ (3.94 $^{\pm0.006}$)
200 mm	173 $^{+0.3}$ (6.81 $^{+0.012}$)	11.5 $^{+0.15}$ (0.45 $^{+0.006}$)	150 $^{\pm0.15}$ (5.91 $^{\pm0.006}$)
300 mm	278 $^{+0.3}$ (10.94 $^{+0.012}$)	14.0 $^{\pm 0.15}$ (0.55 $^{\pm0.006}$)	250 $^{+0.15}$ (9.84 $^{+0.006}$)

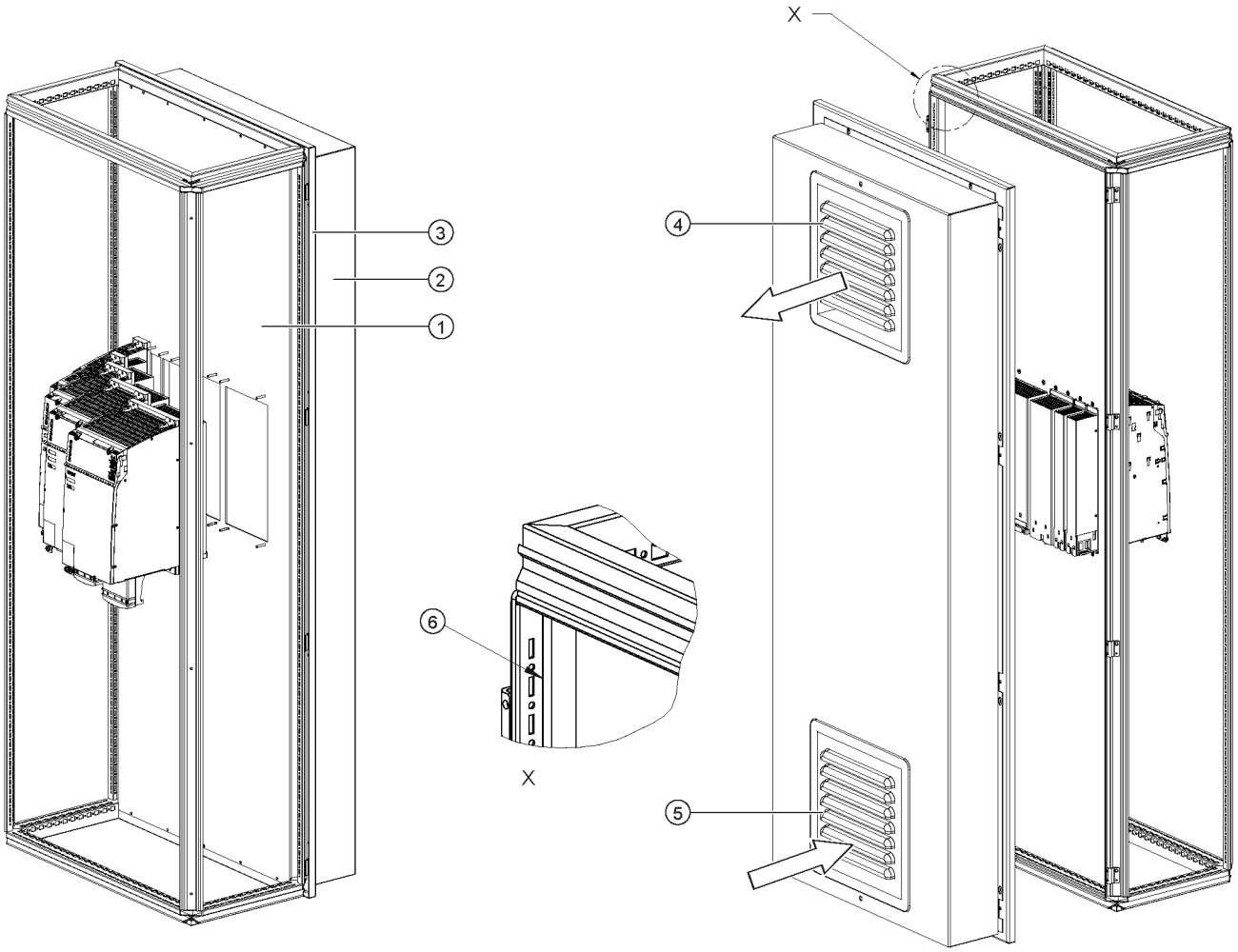


① Insert or mounting plate
② Threaded bolts M5 x 28

Figure 5-35 Example of a mounting plate for a drive line-up with external air cooling

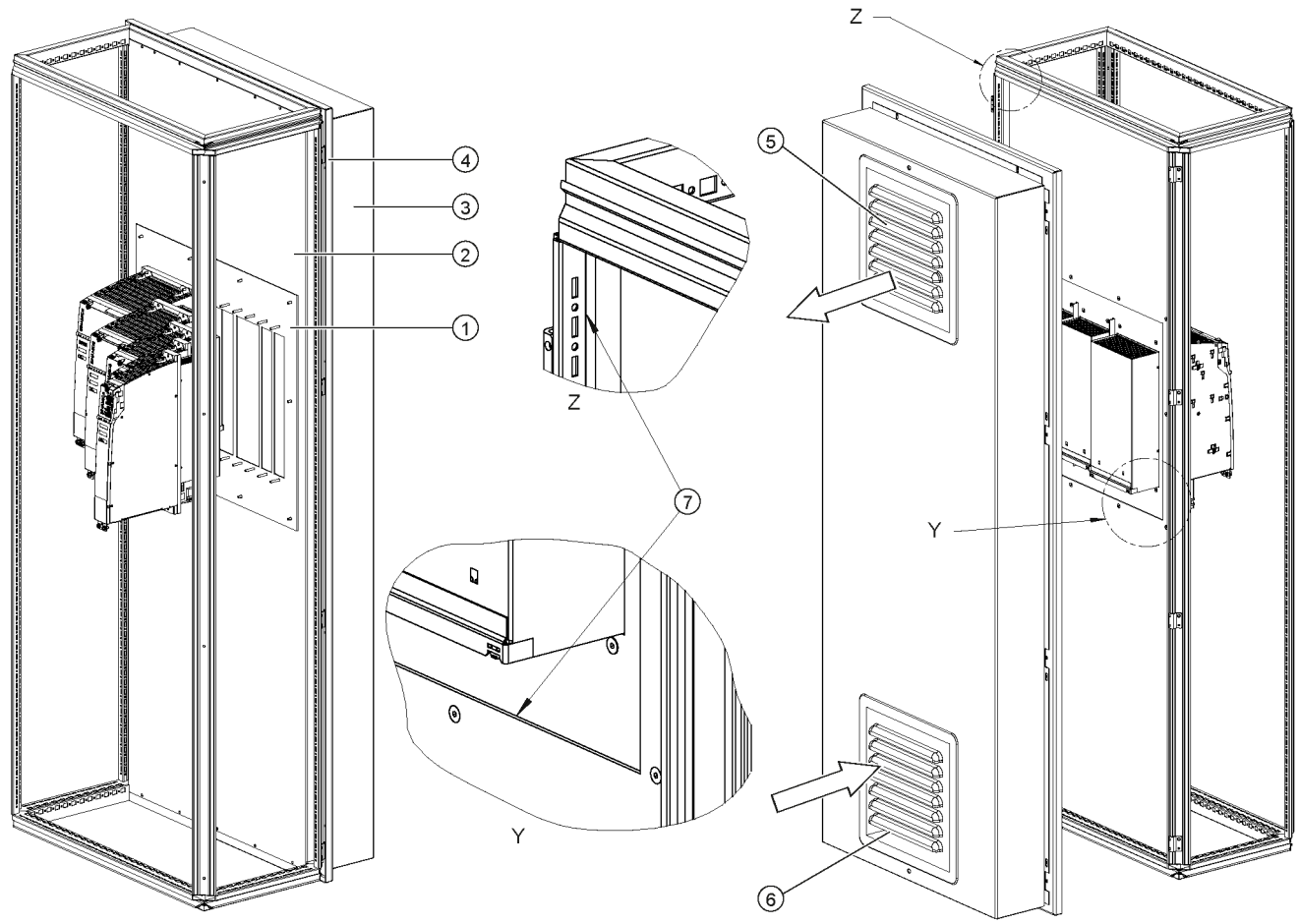
During installation it must be ensured that the component's seal is tight throughout. The cross-pieces must have the appropriate stability. If necessary, the cross-pieces of the openings must be reinforced.

In our example, the cross-pieces have been reinforced using brackets to EN 755-9. You are free to select the way that the bracket is attached to the insert.



① Mounting plate
② Cover
③ Rear panel
④ Air discharge
⑤ Air inlet - filter with filter fan
⑥ To comply with degree of protection IP54, the surfaces ⑥ between the mounting plate and the cabinet strip must be sealed all round. (for example, sealant Terostat-91 from the Teroson company)

Figure 5-36 Example 1: installation in cabinet with mounting plate



① Insert
② Mounting plate
③ Cover
④ Rear panel
⑤ Air discharge
⑥ Air inlet - filter with filter fan
⑦ To maintain the degree of protection IP54, the surfaces ⑦ between the mounting plate and the cabinet strip as well as between the mounting plate and insert must be sealed all around. (for example, sealant Terostat-91 from the Teroson company)

Figure 5-37 Example 2: installation in cabinet with mounting plate

We recommend that you attach a cover and filter fan to the cabinet.

The filtered fan must be fitted in such a way that the cooling air required by the drive line-up is not restricted. The overall cooling air requirement is obtained from the sum of the individual components (refer to Chapter, "Technical data").

Note

If the cooling air requirement is not covered by the filtered fan, the components cannot output their specified power.

The filters with a filtered fan must be regularly checked for dirt and cleaned if necessary.

5.2.8 Technical data

5.2.8.1 Single Motor Modules

Table 5- 25 Technical data Single Motor Modules Booksize (3 to 30 A)

External air cooling	6SL3121–	1TE13-0AAx	1TE15-0AAx	1TE21–0AAx	1TE21–8AAx	1TE23-0AAx
Output current						
Rated current (I_n)	A_{ACrms}	3	5	9	18	30
Base-load current (I_H)	A	2.6	4.3	7.7	15.3	25.5
Intermittent duty current (I_{s6}) 40%	A_{ACrms}	3.5	6	10	24	40
Peak current (I_{max})	A_{ACrms}	6	10	18	36	56
Output voltage	V_{ACrms}	0 - 0.717 x DC link voltage				
DC link current I_d	A_{DC}	3.6	6	11	22	36
DC link voltage	V_{DC}	510 – 720				
DC link capacitance	µF	110	110	110	220	705
Overvoltage trip	V_{DC}	820 ± 2 %				
Undervoltage trip [1]	V_{DC}	380 ± 2 %				
Electronics power supply	V_{DC}	24 (20.4 – 28.8)				
Electronics current consumption at 24 V DC	A_{DC}	0.85	0.85	0.85	0.85	0.8
Current carrying capacity						
DC link busbar	A_{DC}	100	100	100	100	100
Reinforced DC link busbars	A_{DC}	150	150	150	150	150
24 V busbar	A_{DC}	20	20	20	20	20
Unit rating						
Based on I_n (600 V_{DC}; 4 kHz)	kW	1.6	2.7	4.8	9.7	16
Based on I_H	kW	1.4	2.3	4.1	8.2	13.7
Total power loss (incl. electronics losses) [2]	W	50.4	73.4	100.4	185.4	309.2
Max. pulse frequency						
without derating	kHz	4				
with derating	kHz	16				
Max. ambient temperature						
without derating	°C	40				
with derating	°C	55				
Sound pressure level	dB(A)	<60	<60	<60	<60	<60
Cooling air requirement	m^3/h	29.6	29.6	29.6	29.6	56
Weight	kg	5.7	5.7	5.7	5.7	8.4

1) Default for 400 V line supplies; undervoltage trip threshold can be reduced by a maximum of 80 V and is adjusted to the parameterized rated voltage

2) For an overview, see the power loss tables in Chapter, Control cabinet installation

Table 5- 26 Technical data Single Motor Modules Booksize (45 to 200 A)

External air cooling	6SL3121–	1TE24-5AAx	1TE26-0AAx	1TE28-5AAx	1TE31-3AAx	1TE32-0AAx
Output current						
Rated current (I_n)	A_{ACrms}	45	60	85	132	200
Base-load current (I_H)	A	38	51	68	105	141
Intermittent duty current (I_{s6}) 40%	A_{ACrms}	60	80	110	150	230
Peak current (I_{max})	A_{ACrms}	85	113	141	210	282
Output voltage	V_{ACrms}	0 - 0.717 x DC link voltage				
DC link current I_d	A_{DC}	54	72	102	158	200
DC link voltage	V_{DC}	510 – 720				
DC link capacitance	µF	1175	1410	1880	2820	3995
Overvoltage trip	V_{DC}	820 ± 2 %				
Undervoltage trip [1]	V_{DC}	380 ± 2 %				
Electronics power supply	V_{DC}	24 (20.4 – 28.8)				
Electronics current consumption at 24 V DC	A_{DC}	1.05	1.05	1.5	0.85	0.85
Current carrying capacity						
DC link busbar	A_{DC}	200	200	200	200	200
24 V busbar	A_{DC}	20	20	20	20	20
Unit rating						
Based on I_n (600 V_{DC}; 4 kHz)	kW	24	32	46	71	107
Based on I_H	kW	21	28	37	57	76
Total power loss (incl. electronics losses) [2]	W	455.2	615.2	786	1270.4	2070.4
Max. pulse frequency						
without derating	kHz	4				
with derating	kHz	16				
Max. ambient temperature						
without derating	°C	40				
with derating	°C	55				
Sound pressure level	dB(A)	< 65	< 65	< 60	< 73	< 73
Cooling air requirement	m^3/h	112	112	160	520	520
Weight	kg	13.2	13.3	17.2	27.1	28

1) Default for 400 V supply systems; undervoltage trip threshold can be reduced by a maximum of 80 V (exception: 132 A and 200 A Motor Modules) and is adjusted to the parameterized rated voltage

2) For an overview, see the power loss tables in Chapter, Control cabinet installation

5.2.8.2 Double Motor Modules

Table 5- 27 Technical data Double Motor Modules Booksize (3 to 18 A)

External air cooling	6SL3121-	2TE13-0AAx	2TE15-0AAx	2TE21-0AAx	2TE21-8AAx
Output current					
Rated current (I_n)	A_{ACrms}	2 x 3	2 x 5	2 x 9	2 x 18
Base-load current (I_H)	A	2 x 2.6	2 x 4.3	2 x 7.7	2 x 15.3
Intermittent duty current (I_{s6}) 40%	A_{ACrms}	2 x 3.5	2 x 6	2 x 10	2 x 24
Peak current (I_{max})	A_{ACrms}	2 x 6	2 x 10	2 x 18	2 x 36
Output voltage	V_{ACrms}	0 -480			
DC link current I_d	A_{DC}	7.2	12	22	43
DC link voltage	V_{DC}	510 – 720			
DC link capacitance	µF	110	220	220	705
Overvoltage trip	V_{DC}	820 ± 2 %			
Undervoltage trip [1]	V_{DC}	380 ± 2 %			
Electronics power supply	V_{DC}	24 (20.4 – 28.8)			
Electronics current consumptionat 24 V DC	A_{DC}	1.15	1.15	1.15	1.3
Current carrying capacity					
DC link busbar	A_{DC}	100	100	100	100
Reinforced DC link busbars	A_{DC}	150	150	150	150
24 V busbar	A	20	20	20	20
Unit rating					
Based on I_n (600 V_{DC}; 4 kHz)	kW	2 x 1.6	2 x 2.7	2 x 4.8	2 x 9.7
Based on I_H	kW	2 x 1.4	2 x 2.3	2 x 4.4	2 x 8.2
Total power loss (including electronics losses) [2]	W	97.6	132.6	187.6	351.2
Max. pulse frequency					
Without derating	kHz	4			
With derating	kHz	16			
Max. ambient temperature					
Without derating	°C	40			
With derating	°C	55			
Sound pressure level	dBA	<60	<60	<60	<60
Cooling air requirement	m^3/h	29.6	29.6	29.6	56
Weight	kg	5.8	5.8	5.7	8.6

1) Default for 400 V supply systems; undervoltage trip threshold can be reduced by a maximum of 80 V and is adjusted to the parameterized rated voltage

2) For an overview, see the power loss tables in the chapter titled Control cabinet installation

5.2.8.3 Characteristics

Rated duty cycles Motor Modules Booksize

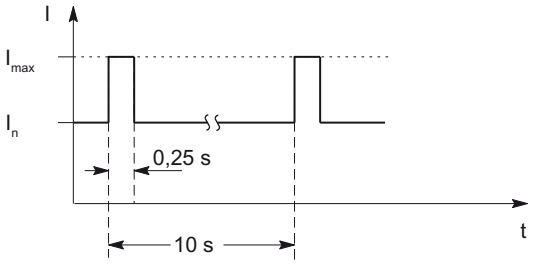


Figure 5-38 Duty cycle with initial load (for servo drives)

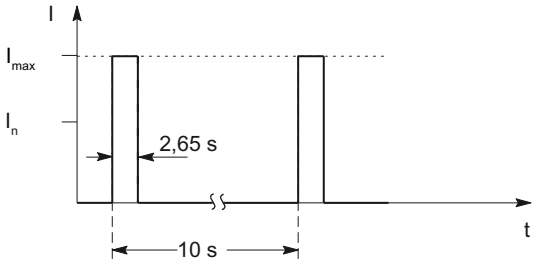


Figure 5-39 Duty cycle without initial load (for servo drives)

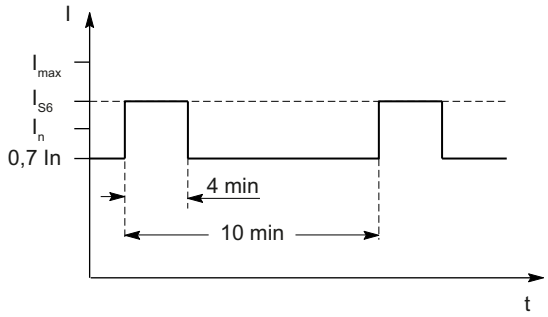


Figure 5-40 S6 duty cycle with initial load with a duty cycle duration of 600 s (for servo drives)

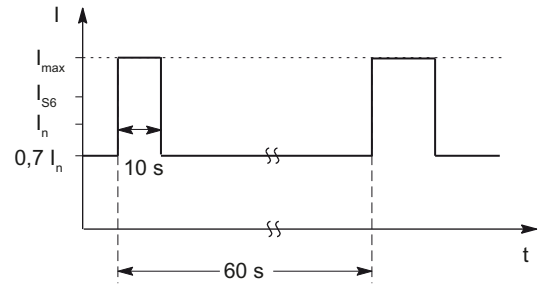


Figure 5-41 S6 duty cycle with initial load with a duty cycle duration of 60 s (for servo drives)

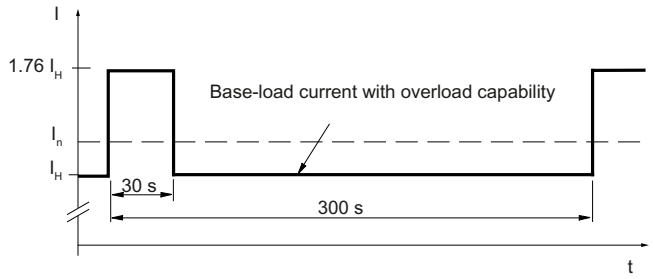


Figure 5-42 Duty cycle with 30 s overload with a duty cycle duration of 300 s

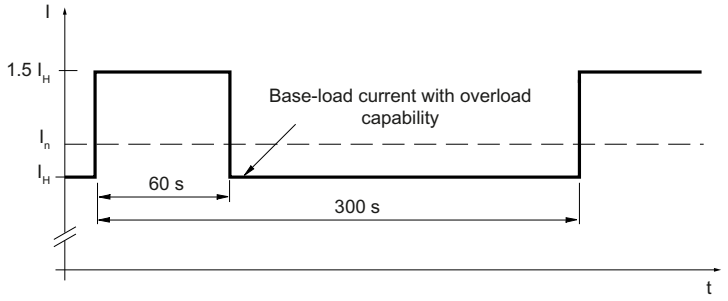


Figure 5-43 Duty cycle with 60 s overload with a duty cycle duration of 300 s

Derating characteristics for Motor Modules Booksize

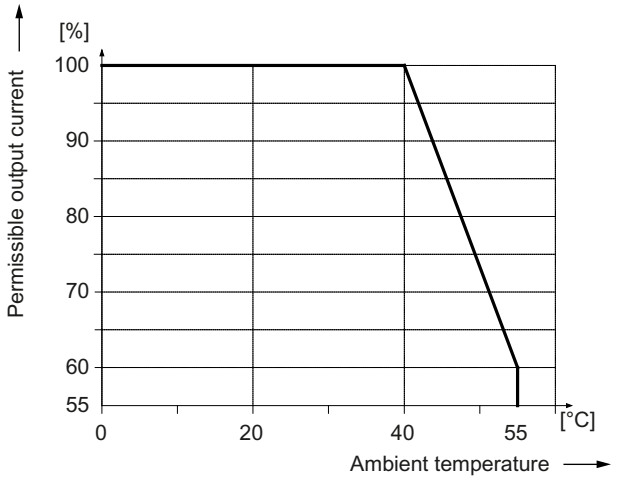


Figure 5-44 Output current as a function of the ambient temperature

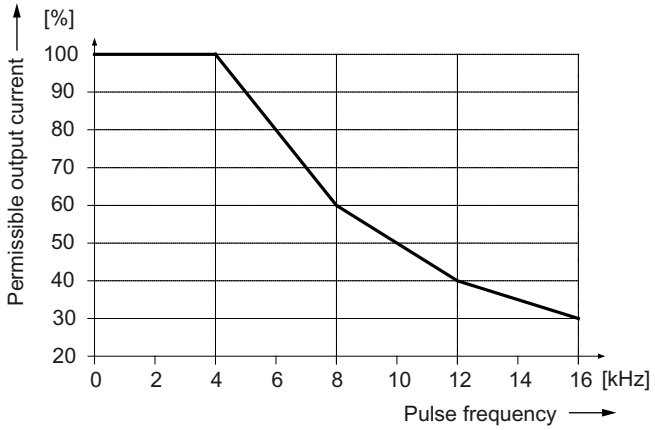


Figure 5-45 Output current as a function of the pulse frequency

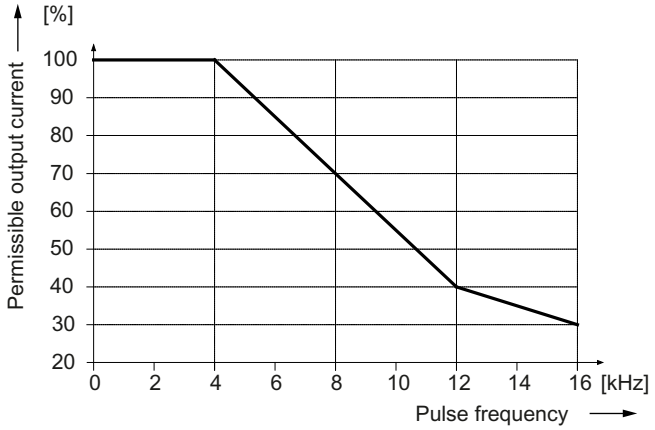


Figure 5-46 Output current as a function of the pulse frequency for 200 A Motor Modules (applies from order number 6SL312x-1TE32-0AA4)

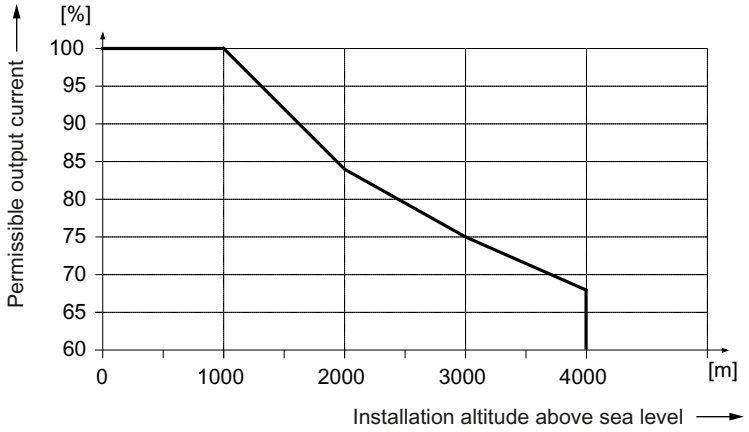


Figure 5-47 Output current as a function of the installation altitude

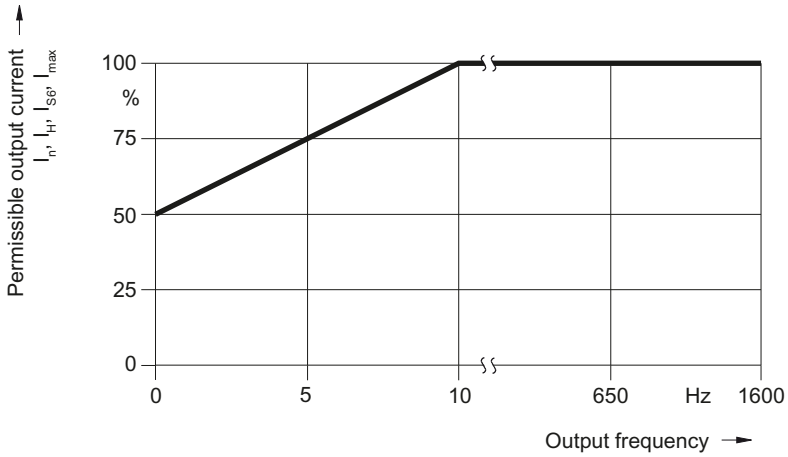


Figure 5-48 Output current as a function of the output frequency

At installation altitudes >2000 m, an insolating transformer must be used (see "System overview/Derating as a function of the installation altitude and ambient temperature"). The design of the secondary line supply system must be as follows:

- TN system with grounded star point (no grounded outer conductor)
- IT system

A reduction of the line supply voltage phase-phase is not necessary.

5.3 Motor Modules with cold plate

5.3.1 Description

A Motor Module is a power unit (inverter) that provides the power supply for the connected motor(s). 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 for the Motor Module are stored in the Control Unit.

One motor can be connected to Single Motor Modules and two motors can be connected to Double Motor Modules.

5.3.2 Safety information

⚠ DANGER

Risk of electric shock

A hazardous voltage is still present for up to 5 minutes after the power supply has been switched off.
It is only permissible to open the protective cover after this time has expired.

When opening the protective cover for the DC link, you must press the release catch. A suitable tool (e.g. screwdriver or the release tool supplied) must be used for this purpose.

The components must only be operated when the protective cover of the DC link is closed. Damaged components must not be operated further, otherwise this could result in secondary damage or accidents.

⚠ DANGER

DC link discharge time

A hazard warning in the local language for the DC link discharge time must be attached to the component.
A set of labels in 16 languages is supplied with the component.

⚠ DANGER

The drive components generate high leakage currents in the protective conductor. The components must only be operated in cabinets or in closed electrical operating areas and must be connected with the protective conductor. To protect against electric shock, the protective conductor connection at the control cabinet or machine must be implemented in accordance with one of the following measures:

- Fixed connection and protective conductor connection using ≥ 10 mm^2 Cu or ≥ 16 mm^2 Al
- Fixed connection and automatic disconnection of the supply system if the protective conductor is interrupted

⚠ DANGER

Only motors with a safe electrically isolated holding brake may be connected. The brake conductors must also be safely electrically isolated.

If the motor power cable is connected to intermediate terminals, the power cables and brake cables must be routed apart (≥ 300 mm).

⚠ DANGER

It is only permissible to establish connections to the DC link using the adapters that SIEMENS has recommended (DC link adapter and DC link rectifier adapter).

⚠ DANGER

If a 50 mm wide Motor Module or a 50 mm wide DC link component (e.g. Braking Module, Control Supply Module, Voltage Clamping Module) is located at the left-hand end of the drive line-up, then the DC link bridges, including all of the screws, must be removed from this component. It is not permissible to insert the screws without a DC link bridge.

For all other components that are 75 mm wide or wider, it is neither permissible to move the DC link bridge to the left nor to remove it.

If this is not carefully observed, this can result in damage and accidents.

⚠ DANGER

It is essential to connect the shield for the motor holding brake. Furthermore, only MOTION-CONNECT cables must be used for integrated motor holding brakes, as otherwise insulation of the cores is not guaranteed. Risk of electric shock.

⚠ WARNING

Cable shields and unused power-cable cores (e.g. brake cores) must be connected to PE potential to dissipate capacitive cross-talk charges. If this is not carefully observed, lethal shock voltages could result.

⚠ CAUTION

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

CAUTION

The correct tightening torque of the DC link busbar screws (1.8 Nm, tolerance +30%) must be checked before commissioning. After transportation, the screws must be tightened.

CAUTION

Only cables from Siemens may be used for DRIVE-CLiQ connections.

CAUTION

Connecting cables to temperature sensors must always be installed with shielding. The cable shield must be connected to the chassis 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.

CAUTION

DC link side covers are supplied with the components as standard and must be attached to the first and last components in the drive line-up. They can also be ordered separately, if required (order number: 6SL3162-5AA00-0AA0).

Note

A regulated DC power supply is required to operate motors with a built-in holding brake. The voltage is supplied via the internal 24 V busbars. The voltage tolerances of the motor holding brakes (24 V ± 10%) and the voltage drops of the connection cables must be taken into account.

The DC power supply should be set to 26 V. This ensures that the supply voltage for the brake remains within the permissible range when the following conditions are fulfilled:

- Use of Siemens three-phase motors
- Use of Siemens MOTION-CONNECT power cables
- Motor cable lengths: max. 100 m

5.3.3 Interface description

5.3.3.1 Overview

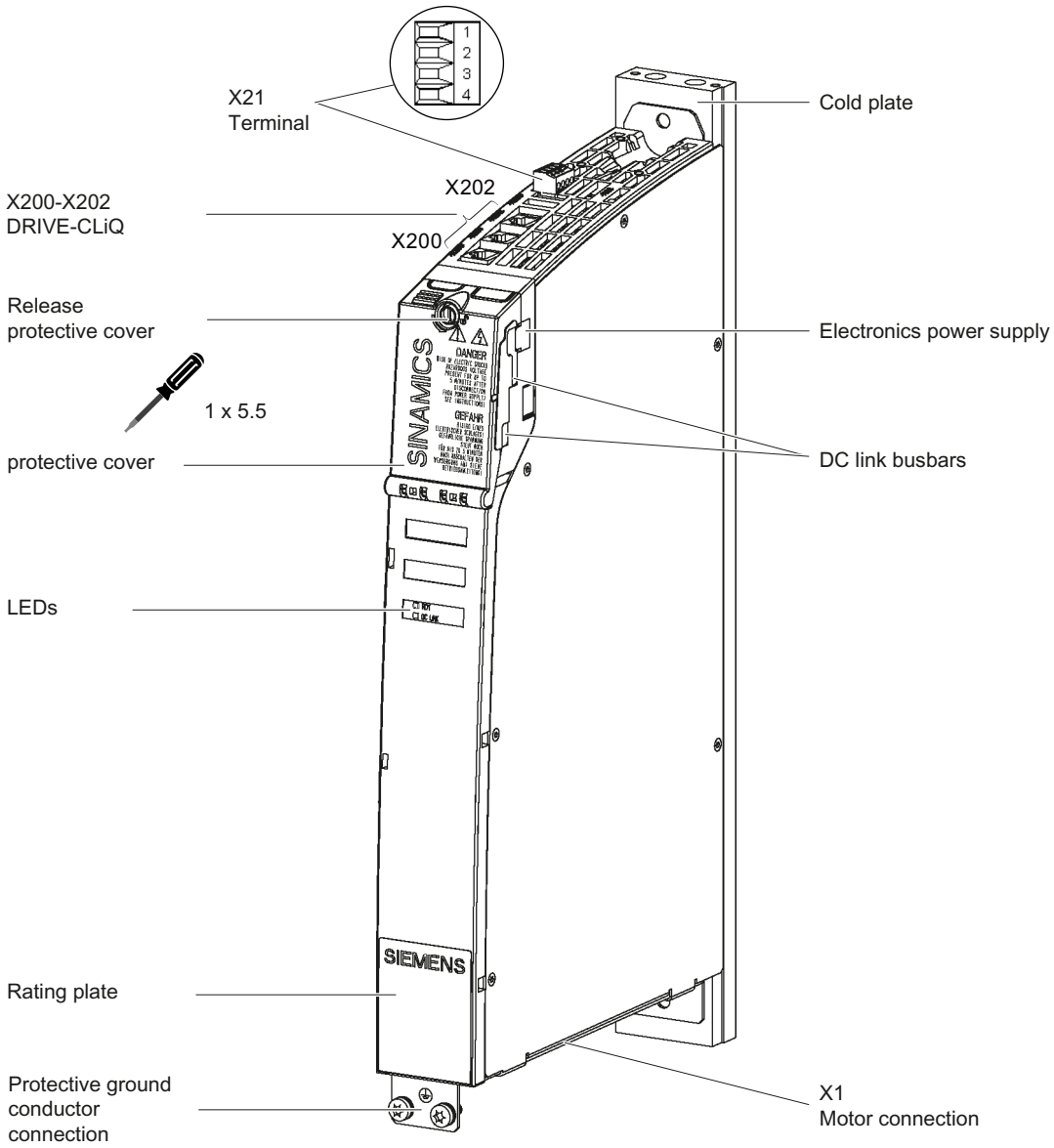


Figure 5-49 Interface overview, Single Motor Module Booksize with cold plate (example: 5 A)

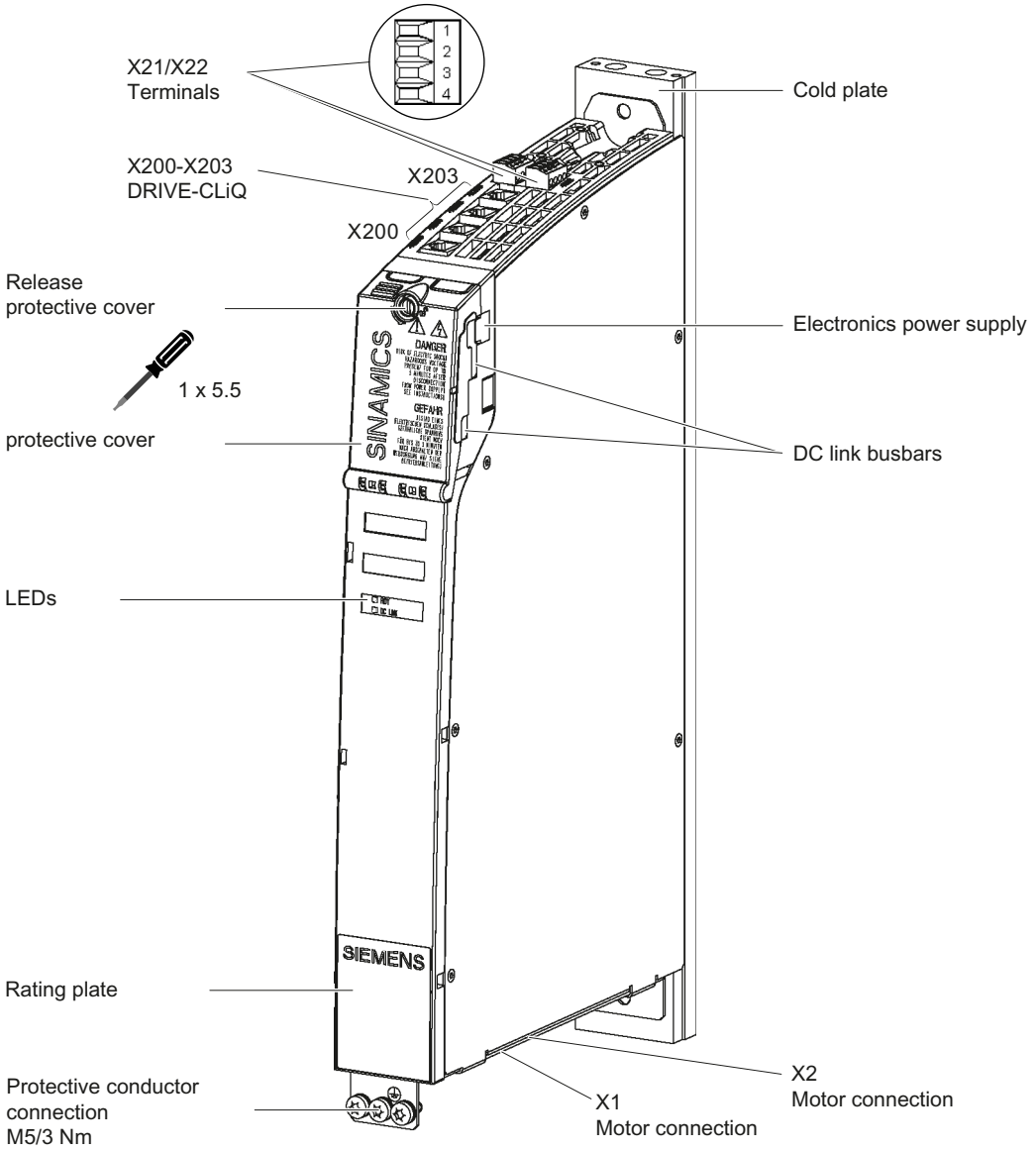
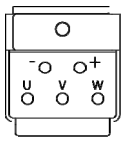
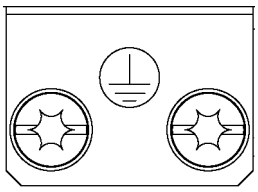
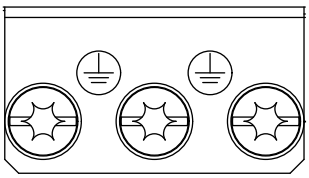


Figure 5-50 Interface overview, Double Motor Module Booksize with cold plate (example: 2 x 5 A)

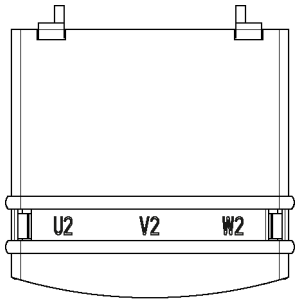
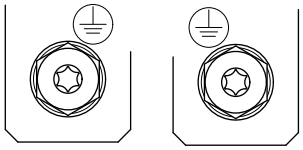
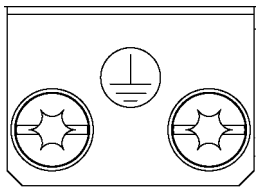
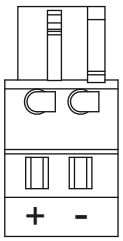
5.3.3.2 Motor and brake connection

Table 5- 28 X1/X2 motor and brake connection for Single Motor Modules 3 A to 30 A and Double Motor Modules 3 A to 18 A

	Terminal	Technical specifications
	U (U2)	Motor connection
	V (V2)	
	W (W2)	
	+ (BR+)	Brake connection max. load current 2 A min. load current 0.1 A
	- (BR-)	
	PE connection	**Single Motor Modules 3 A to 30 A:** Threaded hole M5 / 3 Nm [1]
		**Double Motor Modules 3 A to 18 A:** Threaded hole M5 / 3 Nm [1]

1) For ring cable lugs in accordance with DIN 46234

Table 5- 29 X1 motor connection and X11 brake connection for Single Motor Modules 45 A to 200 A

	Terminal	Technical specifications
	U2 V2 W2	**45 A to 60 A:** Threaded bolts M6 / 6 Nm [1] **85 A:** Threaded bolts M8 / 13 Nm [1] **132 A to 200 A:** Threaded bolts M8 / 13 Nm [1]
	PE connection	**45 A to 60 A:** Threaded bolts for motor cables: M6 / 6 Nm [1] Threaded hole for PE: M6 / 6 Nm [1]
		**85 A:** Threaded bolts for motor cables: M8 / 13 Nm [1] Threaded hole for PE: M6 / 6 Nm [1] **132 A to 200 A:** Threaded bolts for motor cables: M8 / 13 Nm [1] Threaded hole for PE: M8 / 13 Nm [1]
	+ (BR+) - (BR-)	**X11 brake connector** [2]: Voltage 24 V DC Max. load current 2 A Min. load current 0.1 A Max. connectable cross-section 2.5 mm^2 Type: Spring-loaded terminal 2 (see Chapter, "Control cabinet installation and EMC / connection system") The brake connector is part of the prefabricated cable

1) For ring cable lugs in accordance with DIN 46234

2) The circuit for protecting the brake against overvoltage is integrated in the Motor Module and does not need to be installed externally. The max. load current is 2 A, the min. load current 0.1 A.

Note

The overall length of the power cables (motor supply cables and DC link cables) must not exceed the values given in chapter "Possible line reactor and line filter combinations".

Note

The motor brake must be connected via connector X11. It is not permitted to directly connect the cable BR – to the electronics ground M.

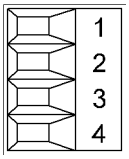
⚠ WARNING

Only protective extra-low voltages (DVC A) that comply with EN 60204-1 must be connected to all connections and terminals between 0 and 48 V DC.

The voltage tolerances of the motor holding brakes (24 V ± 10%) must be taken into account.

5.3.3.3 X21/X22 EP terminals/temperature sensor

Table 5- 30 X21/X22 EP terminals/temperature sensor

	Terminal	Function	Technical specifications
	1	+ Temp	Temperature sensors: KTY 84-1C130/PTC/bimetallic switch with NC contact
	2	- Temp	
	3	EP +24 V (Enable Pulses)	Supply voltage: 24 V DC (20.4 V to 28.8 V) Current consumption: 10 mA Isolated input Signal propagation times: L → H: 100 µs H → L: 1000 µs The pulse inhibit function is only available when Safety Integrated Basic Functions are enabled.
	4	EP M1 (Enable Pulses)	
Max. connectable cross-section 1.5 mm^2 Type: Screw terminal 1 (see Chapter, "Control cabinet installation/Connection system")			

NOTICE

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

Parameters p9651 and p9851 are used to set the filter times to debounce terminals X21.3 and X21.4, as well as X22.3 and X22.4. Additional parameter settings are also required in order to prevent discrepancy errors when performing bit pattern tests (light/dark tests). For comprehensive information, see the SINAMICS S120 Safety Integrated Function Manual, Chapter 6 "Controlling the safety functions".

NOTICE

The KTY temperature sensor must be connected with the correct polarity.
If the polarity is reversed, the sensor will not be able to detect if the motor overheats.

Note

The temperature sensor input is not needed if the motors feature an integrated DRIVE-CLiQ interface or if temperature values are detected by means of a different module (SMC, SME, TM).

⚠ DANGER

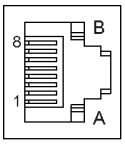
Risk of electric shock!

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) or Terminal Module TM120 must be used.

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

5.3.3.4 X200-X203 DRIVE-CLiQ interface

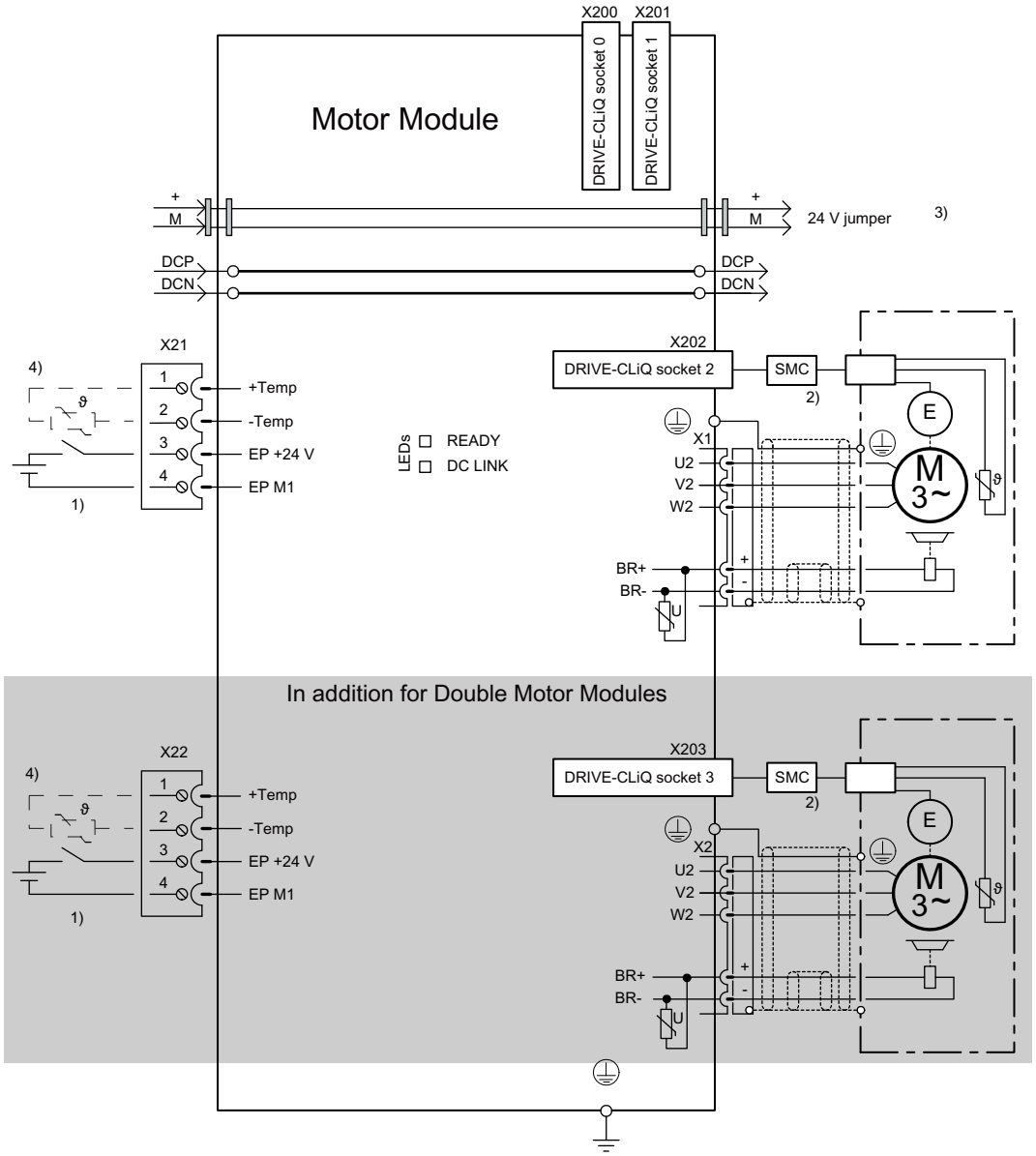
Table 5- 31 X200-X202: DRIVE-CLiQ interfaces for Single Motor Modules
X200-X203: DRIVE-CLiQ interfaces for Double Motor Modules

	Pin	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

The blanking covers for the DRIVE-CLiQ interfaces are included in the scope of delivery.

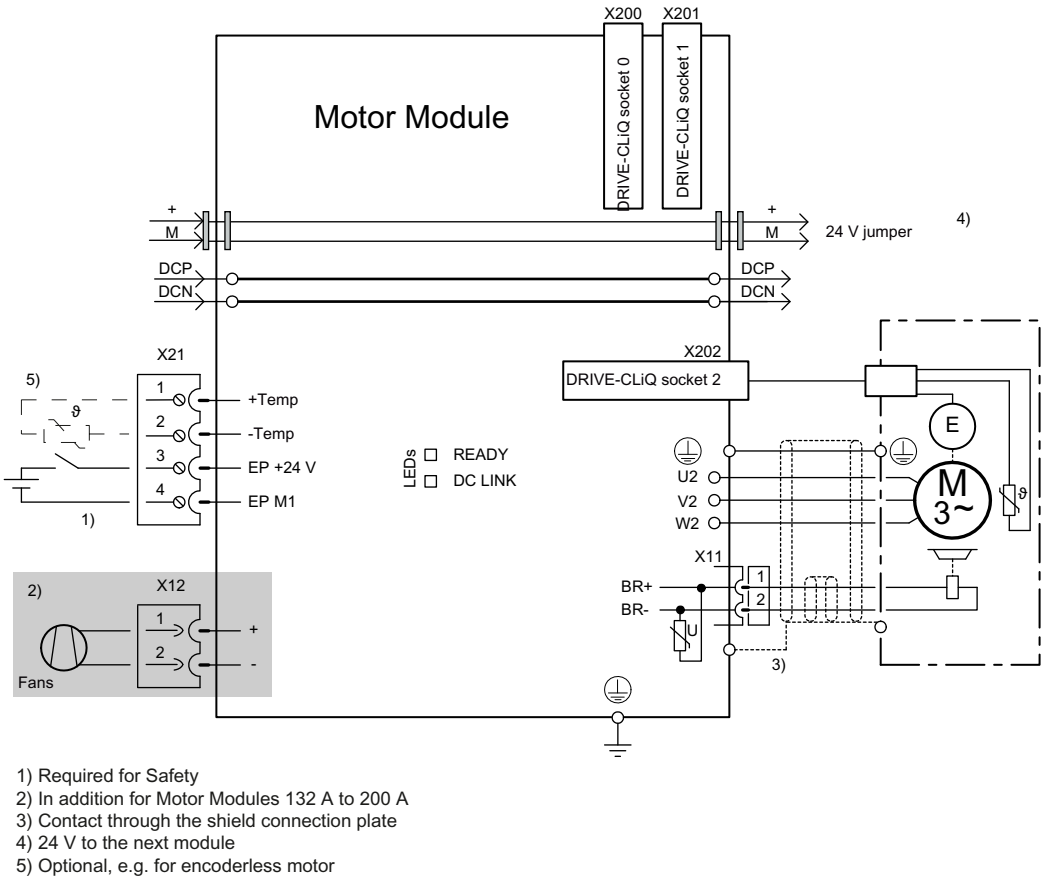
Blanking cover (50 pcs.) Order number: 6SL3066-4CA00-0AA0

5.3.4 Connection Examples



1) Required for Safety
2) SMC required for motors without DRIVE-CLiQ interface
3) 24 V to the next module
4) Optional, e.g. for encoderless motor

Figure 5-51 Connection example of Motor Modules 3 A to 30 A and Double Motor Modules 3 A to 18 A



1) Required for Safety
2) In addition for Motor Modules 132 A to 200 A
3) Contact through the shield connection plate
4) 24 V to the next module
5) Optional, e.g. for encoderless motor

Figure 5-52 Example connection of Single Motor Modules 45 A to 200 A

5.3.5 Meaning of LEDs

Table 5- 32 Meaning of the LEDs on the Motor Module

Status		Description, cause	Remedy
RDY	DC LINK		
Off	Off	Electronics power supply is missing or outside permissible tolerance range.	–
Green	--	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.	Check line voltage
Orange	Orange	DRIVE-CLiQ communication is being established.	–
Red	--	At least one fault is present in this component. **Note:** The LED is driven irrespective of the corresponding messages being reconfigured.	Remedy and acknowledge fault
Green/red (0.5 Hz)	--	Firmware is being downloaded.	–
Green/red (2 Hz)	--	Firmware download is complete. Wait for POWER ON.	Carry out a POWER ON
Green/orange or Red/orange	--	Detection of the components via LED is activated (p0124). **Note:** Both options depend on the LED status when module recognition is activated via p0124 = 1.	–

⚠ DANGER

Hazardous DC link voltages may be present at any time regardless of the status of the "DC LINK" LED.
The warning information on the components must be carefully observed!

5.3.6 Dimension Drawings

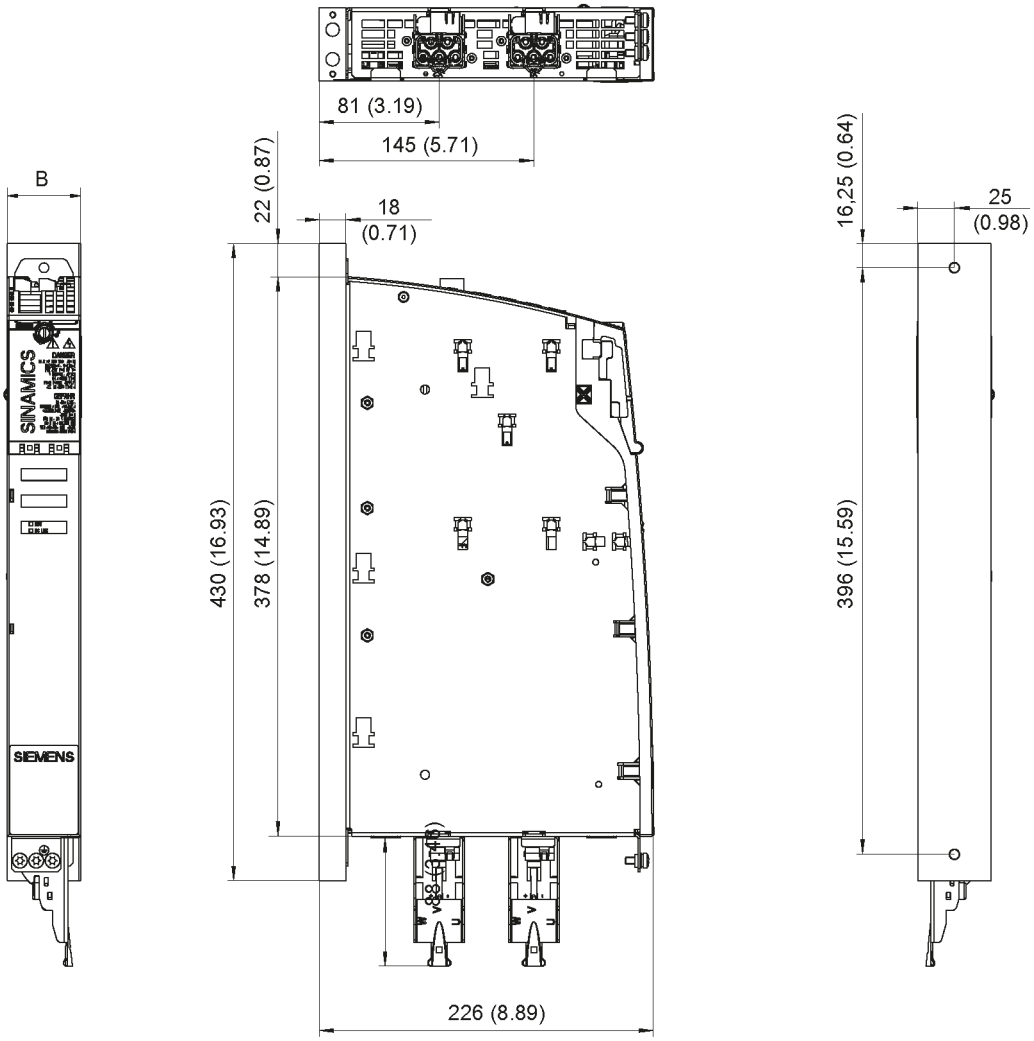


Figure 5-53 Dimension drawing of 3 A to 18 A and 2 x 3 A to 2 x 9 A Motor Modules Booksize with cold plate, all dimensions in mm and (inches); example: 2 x 5 A Double Motor Module

Table 5- 33 Dimensions of 3 A to 18 A and 2 x 3 A to 2 x 9 A Motor Modules Booksize with cold plate

Motor Module	Order number	B [mm] (inches)
3 A Single Motor Module	6SL3126-1TE13-0AAx	50 (1.97)
5 A Single Motor Module	6SL3126-1TE15-0AAx	
9 A Single Motor Module	6SL3126-1TE21-0AAx	
18 A Single Motor Module	6SL3126-1TE21-8AAx	
3 A Double Motor Module	6SL3126-2TE13-0AAx	
5 A Double Motor Module	6SL3126-2TE15-0AAx	
9 A Double Motor Module	6SL3126-2TE21-0AAx	

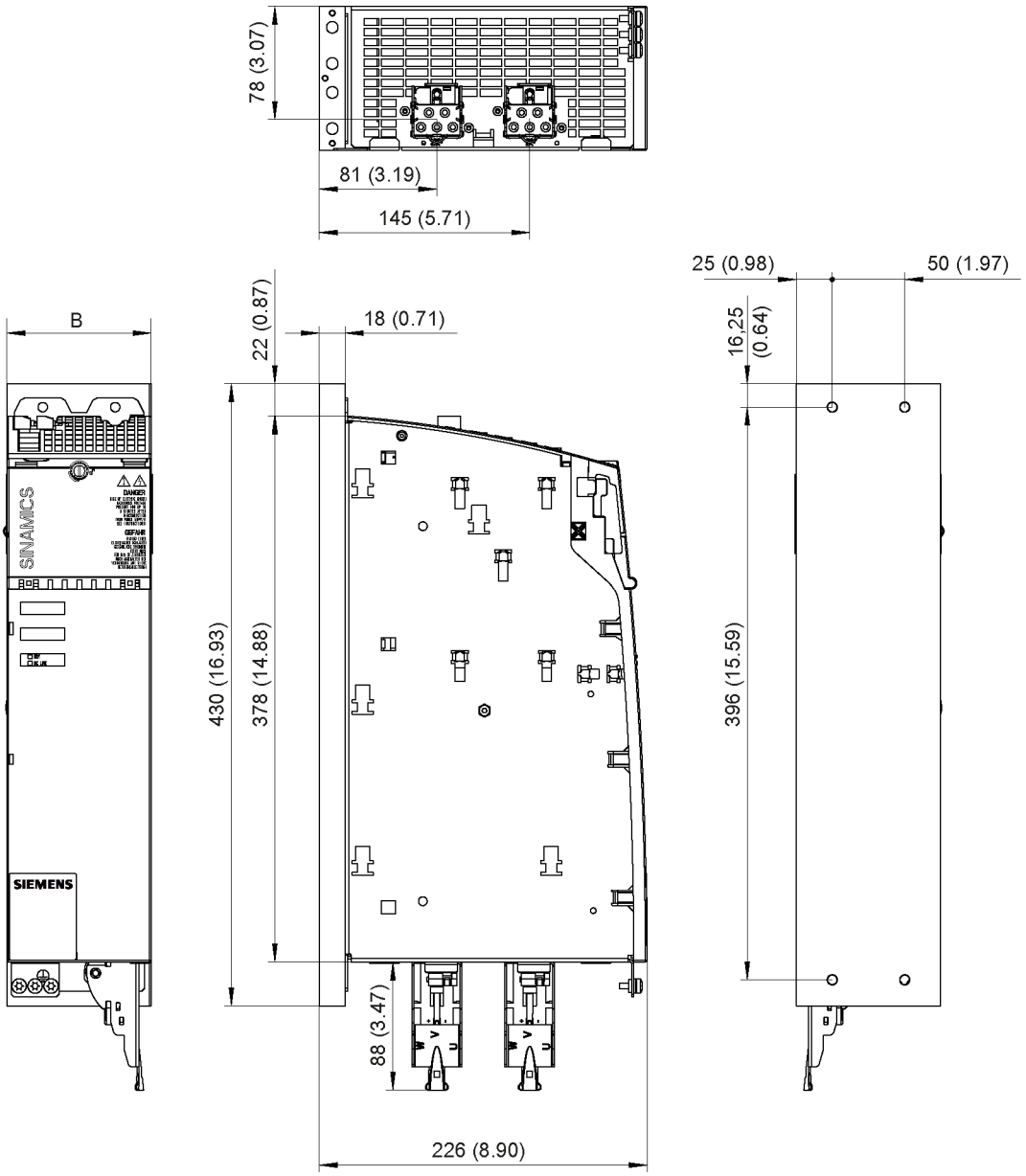


Figure 5-54 Dimension drawing of 30 A and 2 x 18 A Motor Modules Booksize with cold plate, all dimensions in mm and (inches)

Table 5- 34 Dimensions of 30 A and 2 x 18 A Motor Modules Booksize with cold plate

Motor Module	Order number	B [mm] (inches)
30 A Single Motor Module	6SL3126-1TE23-0AAx	100 (3.94)
18 A Double Motor Module	6SL3126-2TE21-8AAx	

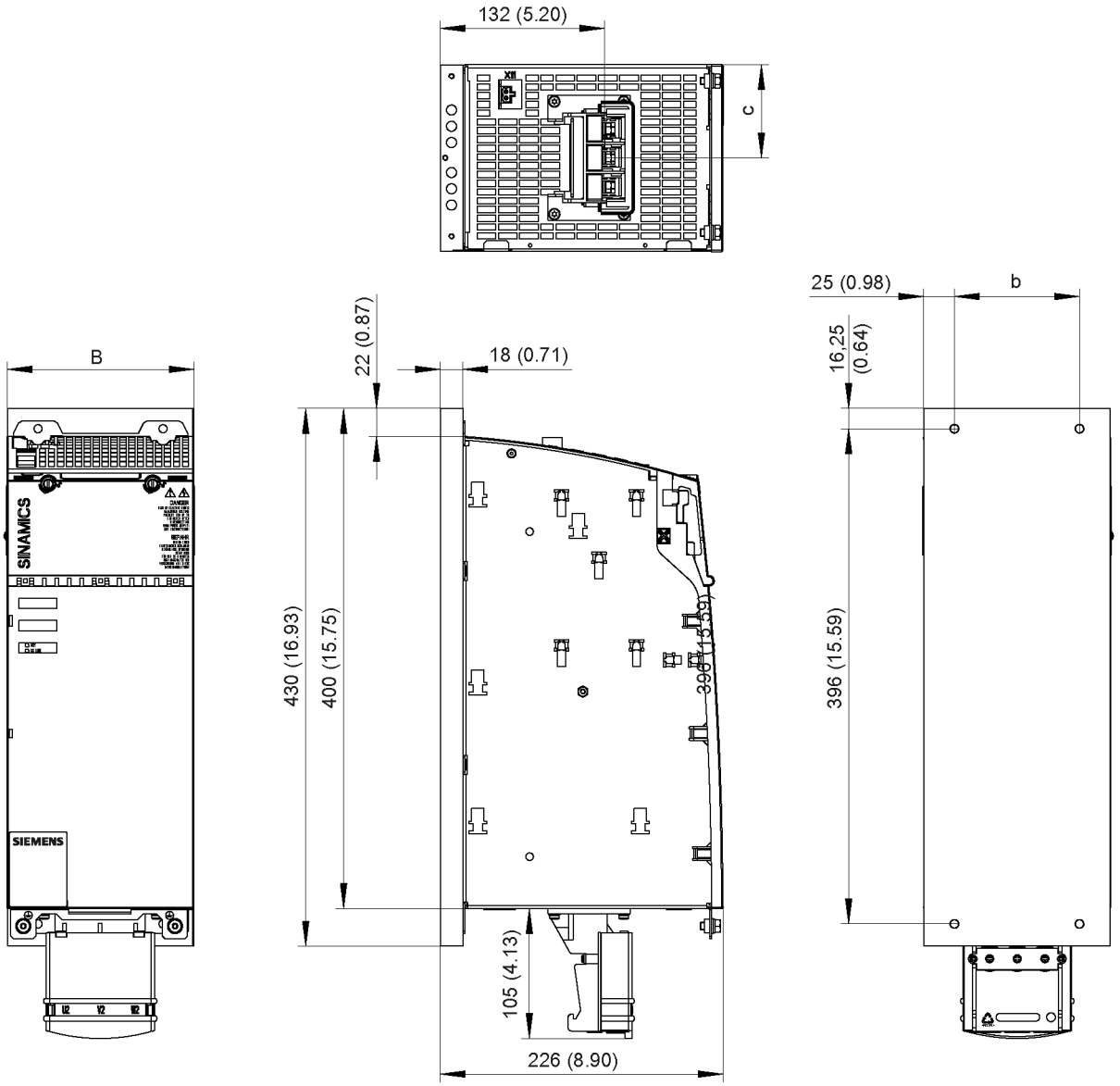


Figure 5-55 Dimension drawing of Motor Modules Booksize 45 A, 60 A, and 85 A with cold plate, all dimensions in mm and (inches); example for Motor Module 45 A

Table 5- 35 Dimensions of 45 A, 60 A, and 85 A Motor Modules Booksize with cold plate

Motor Modules	Order number	B [mm] (inches)	b [mm] (inches)	c [mm] (inches)
Single Motor Module 45 A	6SL3126-1TE24-5AAx	150 (5.91)	100 (3.94)	75 (2.95)
Single Motor Module 60 A	6SL3126-1TE26-0AAx			
Single Motor Module 85 A	6SL3126-1TE28-5AAx	200 (7.87)	150 (5.91)	100 (3.94)

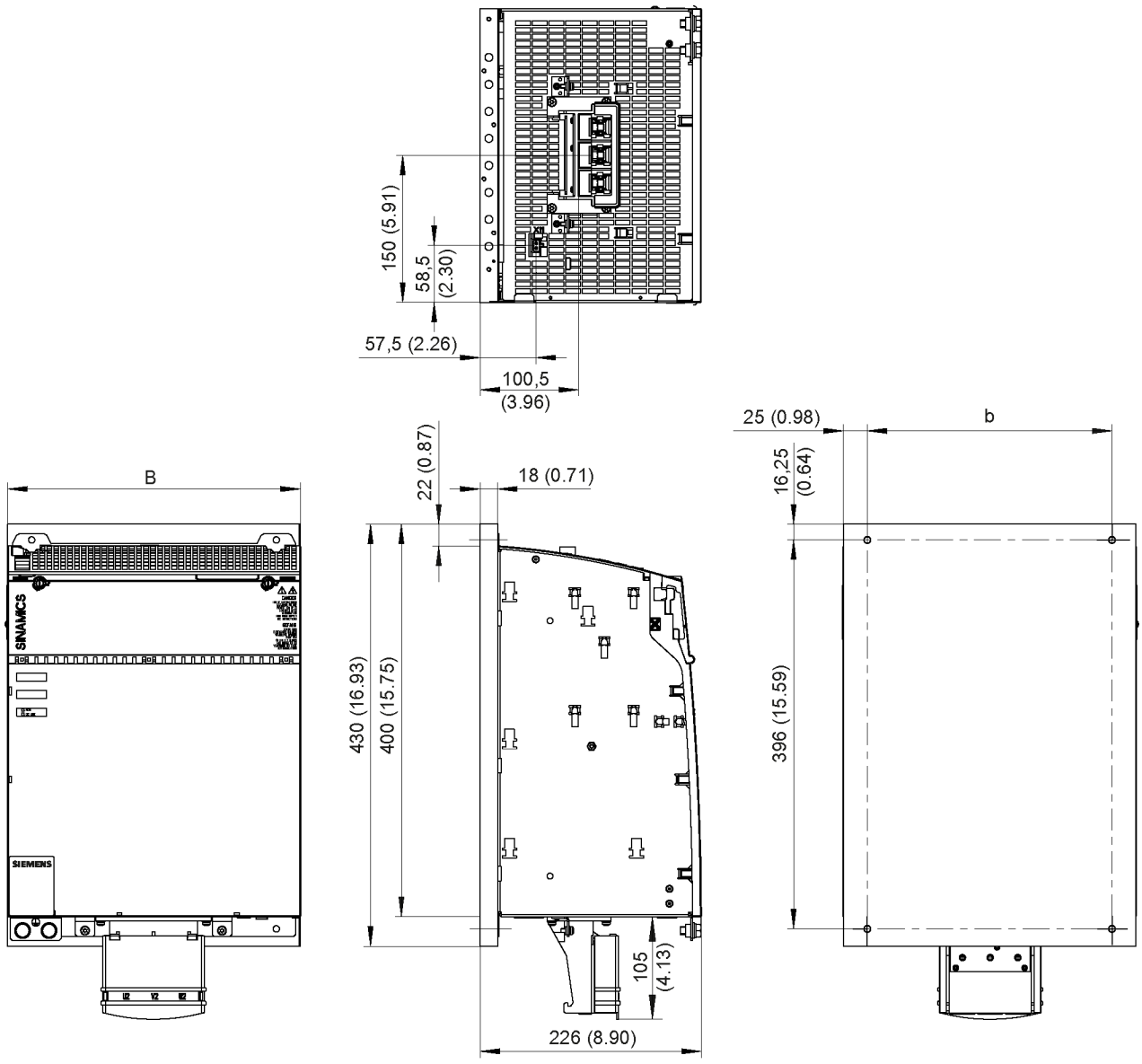


Figure 5-56 Dimension drawing of Motor Modules Booksize 132 A and 200 A with cold plate, all dimensions in mm and (inches); example for Motor Module 200 A

Table 5- 36 Dimensions of 132 A and 200 A Motor Modules Booksize with cold plate

Motor Module	Order number	B [mm] (inches)	b [mm] (inches)
Single Motor Module 132 A	6SL3126-1TE31-3AAx	300 (11.81)	250 (9.84)
Single Motor Module 200 A	6SL3126-1TE32-0AAx		

5.3.7 Installation

Please note the following before installing a Motor Module with cold plate on a customer-specific heat sink:

- Check the surface of the heat sink to ensure that it is not damaged.
- To improve heat transfer, a heat-conducting medium must be used. Special spherical-indented heat-conducting foil must be used for this purpose. Every component with cold plate is supplied with heat-conducting foil cut to the right size. Note the installation position of the heat-conducting foil (see diagram below).

Note

When a component is replaced, the heat-conducting foil must also be replaced.
Only heat-conducting foil approved or supplied by Siemens can be used.

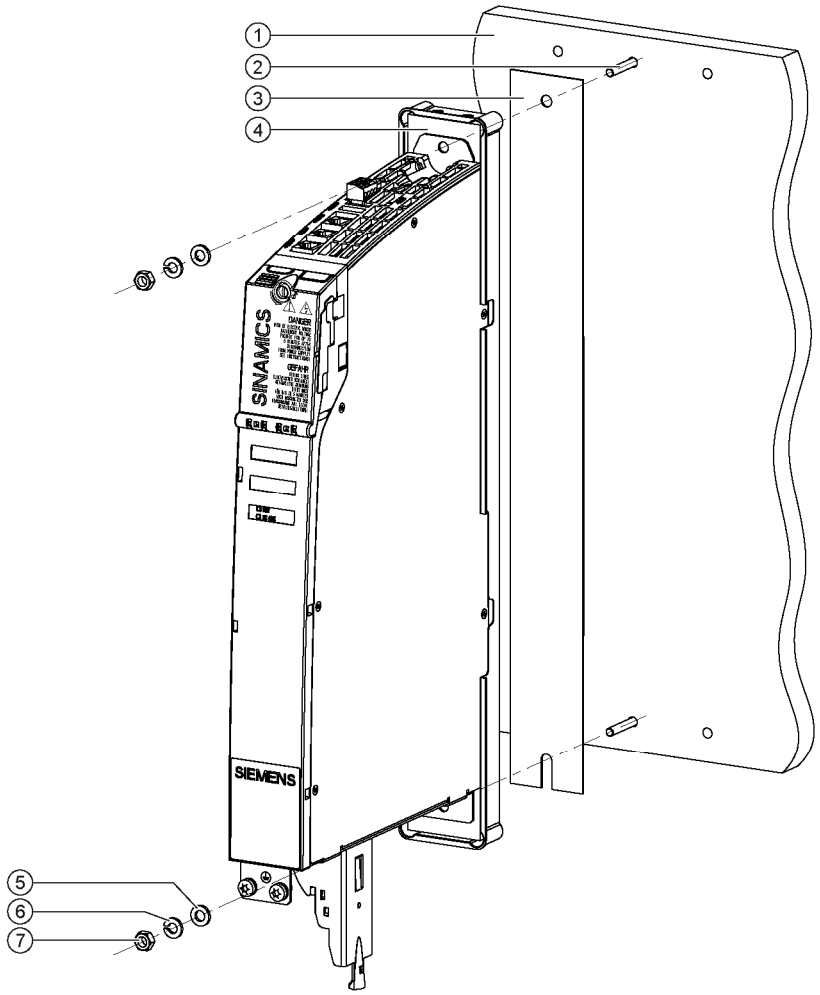
Table 5- 37 Overview of heat-conducting foils

	Order number
Heat-conducting foil, 50 mm	6SL3162-6FB00-0AA0
Heat-conducting foil, 100 mm	6SL3162-6FD00-0AA0
Heat-conducting foil, 150 mm	6SL3162-6FF00-0AA0
Heat-conducting foil, 200 mm	6SL3162-6FH00-0AA0
Heat-conducting foil, 300 mm	6SL3162-6FM00-0AA0

Note

M6 studs and hexagon nuts/grub screws (ISO 7436-M6x40-14 H, property class 8.8) are recommended for installing the components.

Installation



① External heat sink (air or liquid)
② M6 studs
③ Heat-conducting foil
④ Cold plate
⑤ Washer
⑥ Spring washer
⑦ M6 nut

Figure 5-57 Installing a Motor Module with cold plate on an external heat sink (example: 3 A Motor Module)

Tightening torques:

- Initially, tighten the nuts by hand (0.5 Nm)
- Then tighten with 10 Nm.

NOTICE
Where components have 4 fixing points, the nuts must be tightened evenly by alternating diagonally between them.

Help with the mechanical control cabinet installation is available from:

Siemens AG
Industry Sector, IA SE WKC
TCCCC (Technical Competence Center Cabinets Chemnitz)
P.O. Box 1124
09070 Chemnitz, Germany

E-mail: cc.cabinetcooling.aud@siemens.com

Properties of the heat sink

We recommend using AlMgSi 0.5 as the heat sink material.
The roughness of the external heat sink surface should be at least Rz 16. The contact surface between the heat sink and cold plate should have an evenness of 0.2 mm (applicable to a height of 450 mm and a width of 300 mm).

Note

The machine manufacturer can adapt the heat sink version to his special requirements. The specified rated data for the Motor Modules can only be achieved if the power losses can be dissipated by the external heat sink under the specified general conditions.

NOTICE
During the installation, you must ensure that the threaded bolts do not damage the cold plate.

5.3.8 Technical data

5.3.8.1 Single Motor Modules

Table 5- 38 Technical data for Single Motor Modules with cold plate cooling (3 A to 30 A)

Cold plate	6SL3126-	1TE13-0AAx	1TE15-0AAx	1TE21-0AAx	1TE21-8AAx	1TE23-0AAx
Output current						
Rated current (I_n)	A_{ACrms}	3	5	9	18	30
Base-load current (I_H)	A	2.6	4.3	7.7	15.3	25.5
Intermittent duty current (I_{S6}) 40%	A_{ACrms}	3.5	6	10	24	40
Peak current (I_{max})	A_{ACrms}	6	10	18	36	56
Output voltage	V_{ACrms}	0 - 0.717 x DC link voltage				
DC link current I_d	A_{DC}	3.6	6	11	22	36
DC link voltage (up to 2000 m above sea level)	V_{DC}	510 –720				
DC link capacitance	µF	110	110	110	220	710
Overvoltage trip	V_{DC}	820 ± 2 %				
Undervoltage trip [1]	V_{DC}	380				
Electronics power supply	V_{DC}	24 (20.4 – 28.8)				
Electronics current consumption at 24 V DC	A_{DC}	0.65				
Current carrying capacity						
DC link busbar	A_{DC}	100	100	100	100	100
Reinforced DC link busbars	A_{DC}	150	150	150	150	150
24 V busbar	A_{DC}	20	20	20	20	20
Unit rating						
Based on I_n (600 V_{DC}; 4 kHz)	kW	1.6	2.7	4.8	9.7	16
Based on I_H	kW	1.1	2.3	4.1	8.2	13.7
Total power loss (incl. electronics losses) [2]	W	45.5	70.6	95.6	180.6	305.6
Max. pulse frequency						
without derating	kHz	4				
with derating	kHz	16				
Max. ambient temperature						
without derating	°C	40				
with derating	°C	55				
Max. permissible heat-sink temperature	°C	70	70	70	75	70
Weight	kg	4.2	4.2	4.5	4.5	6.1

1) Default for 400 V line supplies; undervoltage trip threshold can be reduced by a maximum of 80 V and is adjusted to the parameterized rated voltage

2) For an overview, see the power loss tables in Chapter, Control cabinet installation

Table 5- 39 Technical data for Single Motor Modules with cold plate cooling (45 A to 200 A)

	6SL3126-	1TE24-5AAx	1TE26-0AAx	1TE28-5AAx	1TE31-3AAx	1TE32-0AAx
Output current						
Rated current (I_n)	A_{ACrms}	45	60	85	132 (105) [1]	200 (140) [1]
Base-load current (I_H)	A	38	51	68	105 (84) [1]	141 (99) [1]
Intermittent duty current (I_{S6}) 40%	A_{ACrms}	60	80	110	150 (120) [1]	230 (161) [1]
Peak current (I_{max})	A_{ACrms}	85	113	141	210	282
Output voltage	V_{ACrms}	0 - 480				
DC link current I_d	A_{DC}	54	72	102	158	200
DC link voltage (up to 2000 m above sea level)	V_{DC}	510 –720				
DC link capacitance	µF	1175	1410	1880	2820	3995
Overvoltage trip Undervoltage trip [2]	V_{DC} V_{DC}	820 ± 2 % 380				
Electronics power supply	V_{DC}	24 (20.4 – 28.8)				
Electronics current consumption at 24 V DC	A_{DC}	0.75	0.75	0.8	0.85	0.85
Current carrying capacity						
DC link busbar	A_{DC}	200	200	200	200	200
24 V busbar	A_{DC}	20	20	20	20	20
Unit rating						
Based on I_n (600 V_{DC}; 4 kHz)	kW	24	32	46	71 (57) [1]	107 (75) [1]
Based on I_H	kW	21	28	37	57 (46) [1]	76 (53) [1]
Total power loss (incl. electronics losses) [3]	W	448	608	769.2	1270.4	2070.4
Max. pulse frequency						
without derating	kHz	4				
with derating	kHz	16				
Max. ambient temperature						
without derating	°C	40				
with derating	°C	55				
Max. permissible heat-sink temperature	°C	75	70	78	70	75
Weight	kg	9.1	9.1	12.5	18.0	18.0

1) Derating must be applied due to the transfer of heat to the external heat sink. At a temperature of 40 °C at the interface to the power unit, 80% derating occurs for 6SL3126-1TE31-3AAx and 70% for 6SL3126-1TE32-0AAx.

2) Default for 400 V supply systems; undervoltage trip threshold can be reduced by a maximum of 80 V (exception: 132 A and 200 A Motor Modules) and is adjusted to the parameterized rated voltage

3) For an overview, see the power loss tables in Chapter, Control cabinet installation

Note

New systems with 132 A and 200 A Motor Modules should ideally be designed with 200 A liquid-cooled Motor Modules in order to avoid current derating.

5.3.8.2 Double Motor Modules

Table 5- 40 Technical data of Double Motor Modules with cold plate cooling (2 x 3 to 2 x18 A)

	6SL3126-	2TE13-0AAx	2TE15-0AAx	2TE21-0AAx	2TE21-8AAx
Output current					
Rated current (I_n)	A_{ACrms}	2 x 3	2 x 5	2 x 9	2 x 18
Base-load current (I_H)	A	2 x 2.6	2 x 4.3	2 x 7.7	2 x 15.3
Intermittent duty current (I_{S6}) 40 %	A_{ACrms}	2 x 3.5	2 x 6	2 x 10	2 x 24
Peak current (I_{max})	A_{ACrms}	2 x 6	2 x 10	2 x 18	2 x 36
Output voltage	V_{ACrms}	0 - 480			
DC link current I_d	A_{DC}	7.2	12	22	43
DC link voltage	V_{DC}	510 –720			
DC link capacitance	µF	110	220	220	705
Overvoltage trip	V_{DC}	820 ± 2%			
Undervoltage trip [1]	V_{DC}	380			
Electronics power supply	V_{DC}	24 (20.4 – 28.8)			
Electronics current consumptionat 24 V DC	A_{DC}	0.9	0.9	0.9	1.05
Current carrying capacity					
DC link busbar	A_{DC}	100	100	100	100
Reinforced DC link busbars	A_{DC}	150	150	150	150
24 V busbar	A_{DC}	20	20	20	20
Unit rating					
Based on I_n (600 V_{DC}; 4 kHz)	kW	2 x 1.6	2 x 2.7	2 x 4.8	2 x 9.7
Based on I_H	kW	2 x 1.4	2 x 2.3	2 x 4.1	2 x 8.2
Total power loss (incl. electronics losses) [2]	W	91.6	126.6	181.6	345.2
Max. pulse frequency					
Without derating	kHz	4			
With derating	kHz	16			
Max. ambient temperature					
Without derating	°C	40			
With derating	°C	55			
Max. permissible heat-sink temperature	°C	75	75	85	80
Weight	kg	4.5	4.5	4.5	5.9

1) Default for 400 V supply systems; undervoltage trip threshold can be reduced by a maximum of 80 V and is adjusted to the parameterized rated voltage

2) For an overview, see the power loss tables in the chapter titled Control cabinet installation

5.3.8.3 Characteristics

Rated duty cycles Motor Modules Booksize

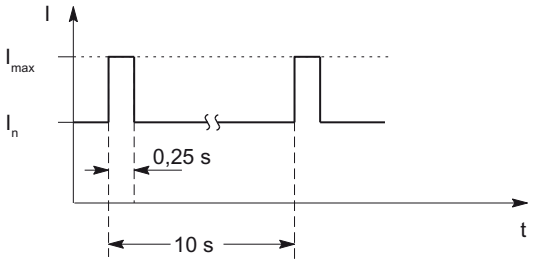


Figure 5-58 Duty cycle with initial load (for servo drives)

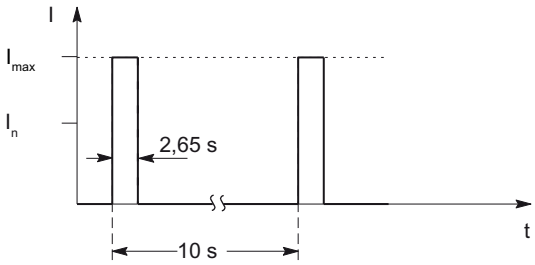


Figure 5-59 Duty cycle without initial load (for servo drives)

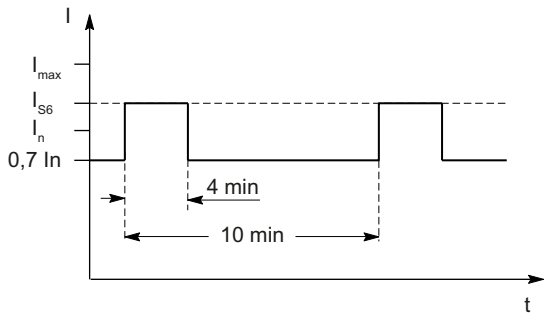


Figure 5-60 S6 duty cycle with initial load with a duty cycle duration of 600 s (for servo drives)

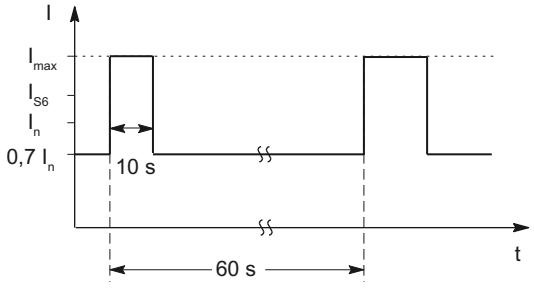


Figure 5-61 S6 duty cycle with initial load with a duty cycle duration of 60 s (for servo drives)

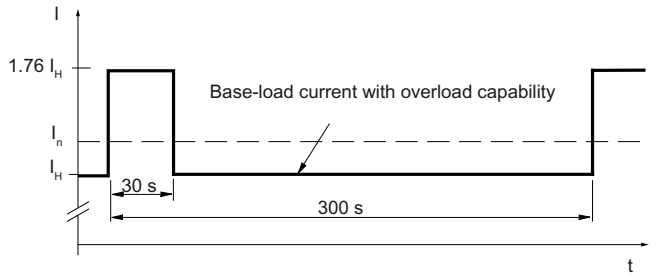


Figure 5-62 Duty cycle with 30 s overload with a duty cycle duration of 300 s

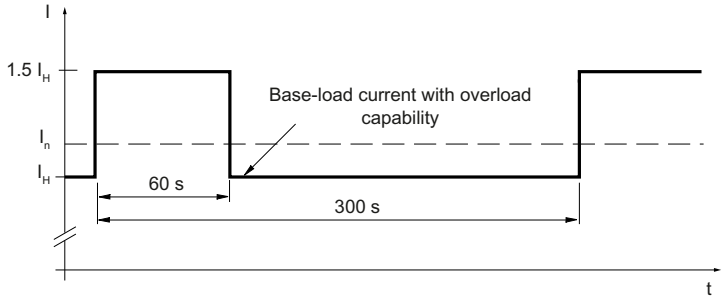


Figure 5-63 Duty cycle with 60 s overload with a duty cycle duration of 300 s

Derating characteristics for Motor Modules Booksize

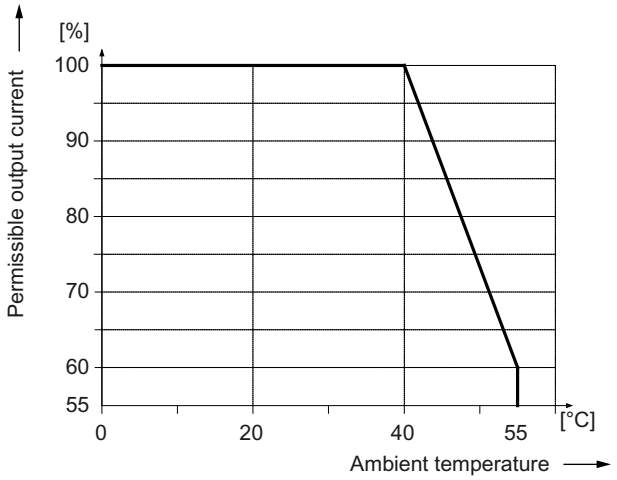


Figure 5-64 Output current as a function of the ambient temperature

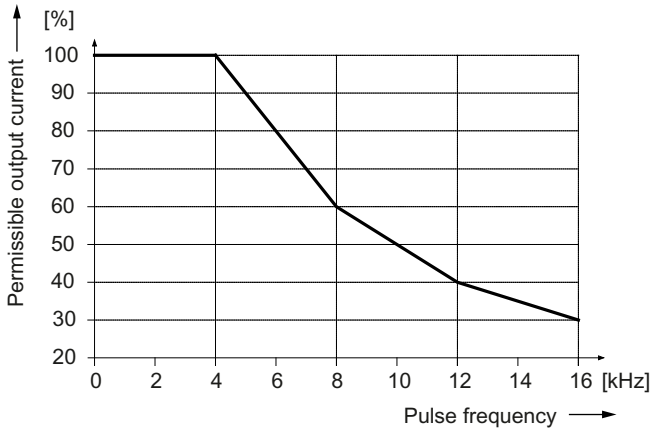


Figure 5-65 Output current as a function of the pulse frequency

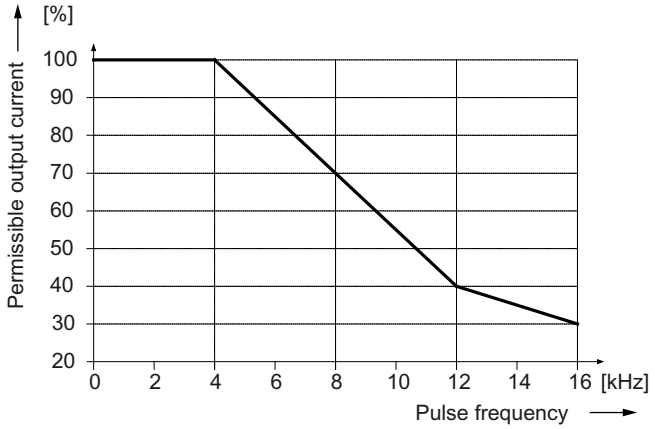


Figure 5-66 Output current as a function of the pulse frequency for 200 A Motor Modules (applies from order number 6SL312x-1TE32-0AA4)

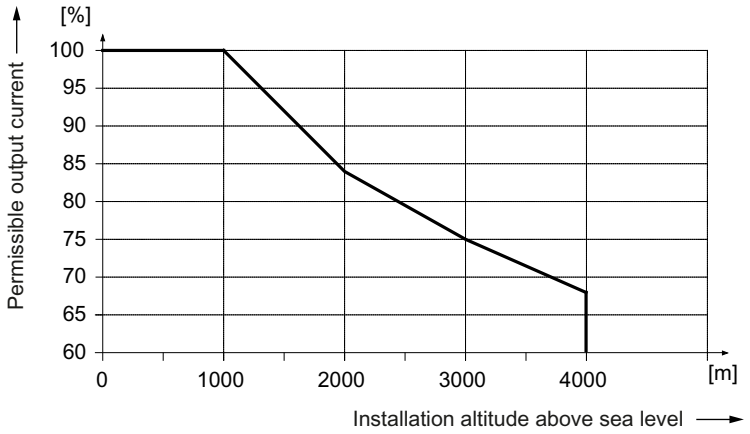


Figure 5-67 Output current as a function of the installation altitude

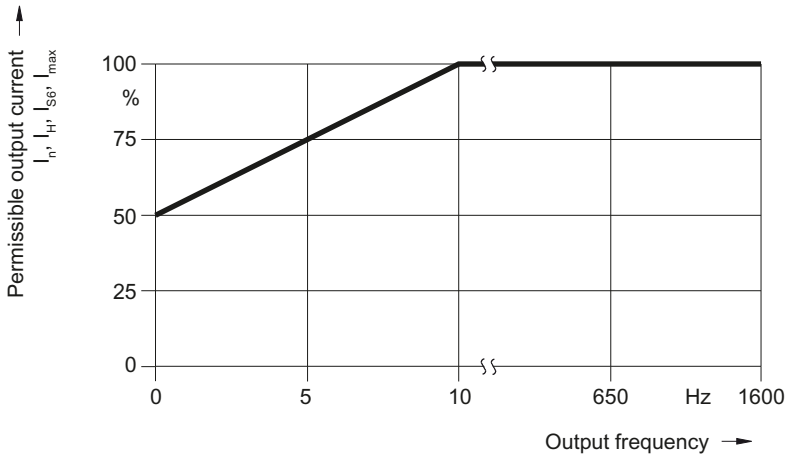


Figure 5-68 Output current as a function of the output frequency

At installation altitudes >2000 m, an insolating transformer must be used (see "System overview/Derating as a function of the installation altitude and ambient temperature"). The design of the secondary line supply system must be as follows:

- TN system with grounded star point (no grounded outer conductor)
- IT system

A reduction of the line supply voltage phase-phase is not necessary.

5.4 Motor Modules Liquid Cooled

5.4.1 Description

A Motor Module is a power unit (inverter) that provides the power supply for the connected motor(s). 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 for the Motor Module are stored in the Control Unit.

5.4.2 Safety information

⚠DANGER

Risk of electric shock

A hazardous voltage is still present for up to 5 minutes after the power supply has been switched off.
It is only permissible to open the protective cover after this time has expired.

When opening the protective cover for the DC link, you must press the release catch. A suitable tool (e.g. screwdriver or the release tool supplied) must be used for this purpose.

The components must only be operated when the protective cover of the DC link is closed. Damaged components must not be operated further, otherwise this could result in secondary damage or accidents.

⚠DANGER

DC link discharge time

A hazard warning in the local language for the DC link discharge time must be attached to the component.
A set of labels in 16 languages is supplied with the component.

⚠DANGER

The drive components generate high leakage currents in the protective conductor. The components must only be operated in cabinets or in closed electrical operating areas and must be connected with the protective conductor. To protect against electric shock, the protective conductor connection at the control cabinet or machine must be implemented in accordance with one of the following measures:

- Fixed connection and protective conductor connection using ≥ 10 mm^2 Cu or ≥ 16 mm^2 Al
- Fixed connection and automatic disconnection of the supply system if the protective conductor is interrupted

⚠ DANGER

It is only permissible to establish connections to the DC link using the adapters that SIEMENS has recommended (DC link adapter and DC link rectifier adapter).

⚠ DANGER

If a 50 mm wide Motor Module or a 50 mm wide DC link component (e.g. Braking Module, Control Supply Module, Voltage Clamping Module) is located at the left-hand end of the drive line-up, then the DC link bridges, including all of the screws, must be removed from this component. It is not permissible to insert the screws without a DC link bridge.

For all other components that are 75 mm wide or wider, it is neither permissible to move the DC link bridge to the left nor to remove it.

If this is not carefully observed, this can result in damage and accidents.

⚠ DANGER

It is essential to connect the shield for the motor holding brake. Furthermore, only MOTION-CONNECT cables must be used for integrated motor holding brakes, as otherwise insulation of the cores is not guaranteed. Risk of electric shock.

⚠ WARNING

Cable shields and unused power-cable cores (e.g. brake cores) must be connected to PE potential to dissipate capacitive cross-talk charges.

If this is not carefully observed, lethal shock voltages could result.

⚠ CAUTION

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

CAUTION

The correct tightening torque of the DC link busbar screws (1.8 Nm, tolerance +30%) must be checked before commissioning. After transportation, the screws must be tightened.

CAUTION

Only cables from Siemens may be used for DRIVE-CLiQ connections.

CAUTION

Connecting cables to temperature sensors must always be installed with shielding. The cable shield must be connected to the chassis 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.

CAUTION
DC link side covers are supplied with the components as standard and must be attached to the first and last components in the drive line-up. They can also be ordered separately, if required (order number: 6SL3162-5AA00-0AA0).

Note

A regulated DC power supply is required to operate motors with a built-in holding brake. The voltage is supplied via the internal 24 V busbars. The voltage tolerances of the motor holding brakes (24 V ± 10%) and the voltage drops of the connection cables must be taken into account.

The DC power supply should be set to 26 V. This ensures that the supply voltage for the brake remains within the permissible range when the following conditions are fulfilled:

- Use of Siemens three-phase motors
- Use of Siemens MOTION-CONNECT power cables
- Motor cable lengths: max. 100 m

5.4.3 Interface description

5.4.3.1 Overview

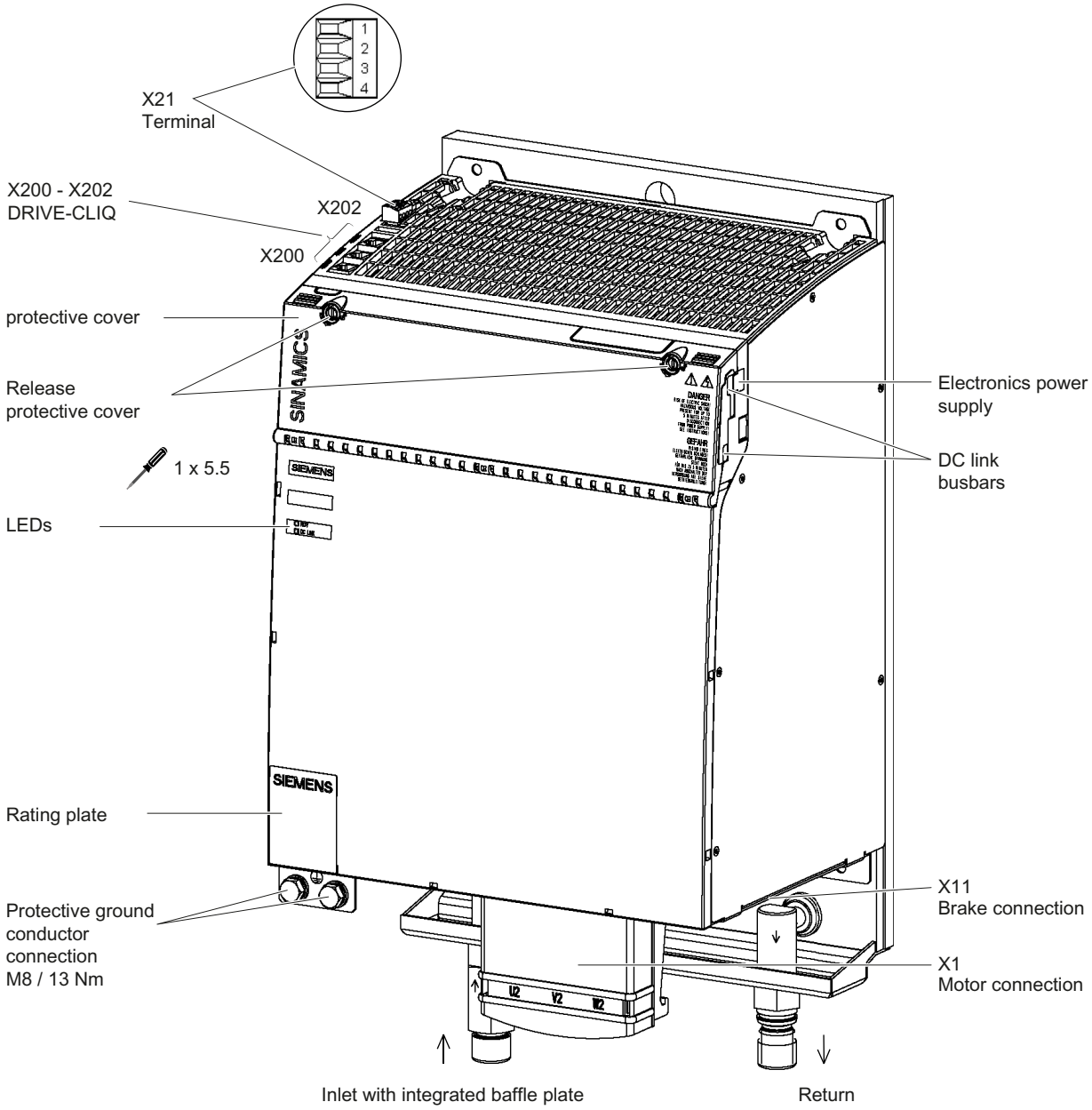
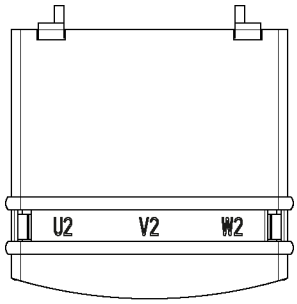
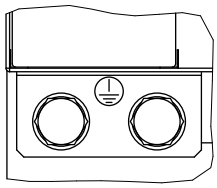


Figure 5-69 Interface overview, Motor Module Liquid Cooled (200 A)

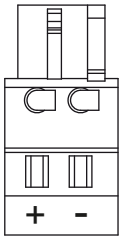
5.4.3.2 Motor and brake connection

Table 5- 41 X1 Motor connection

	Terminal	Technical specifications
	U2	Threaded bolt M8/13 Nm 1) (see Chapter, "Control cabinet installation and EMC/connection system")
	V2	
	W2	
	- (BR-)	
	PE connection	Threaded hole M8/13 Nm 1

1) For ring cable lugs in accordance with DIN 46234

Table 5- 42 X11 brake connector

	Terminal	Technical specifications
	+ (BR+)	Voltage 24 V DC Max. load current 2 A Min. load current 0.1 A Max. connectable cross-section 2.5 mm^2 Type: Spring-loaded terminal 2 (see Chapter "Control cabinet installation and EMC / connection system") The brake connector is part of the prefabricated cable
	- (BR-)	

The circuit for protecting the brake against overvoltage is integrated in the Motor Module and does not need to be installed externally. The max. load current is 2 A, the min. load current 0.1 A.

Note

The overall length of the power cables (motor supply cables and DC link cables) must not exceed the values given in chapter "Possible line reactor and line filter combinations".

Note

The motor brake must be connected via connector X11. It is not permitted to directly connect the cable BR – to the electronics ground M.

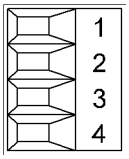
⚠ WARNING

Only protective extra-low voltages (DVC A) that comply with EN 60204-1 must be connected to all connections and terminals between 0 and 48 V DC.

The voltage tolerances of the motor holding brakes (24 V ± 10%) must be taken into account.

5.4.3.3 X21 EP terminal/temperature sensor

Table 5- 43 X21 EP terminal/temperature sensor

	Terminal	Function	Technical specifications
	1	+ Temp	Temperature sensors: KTY 84-1C130/PTC/bimetallic switch with NC contact
	2	- Temp	
	3	EP +24 V (Enable Pulses)	Supply voltage: 24 V DC (20.4 V to 28.8 V) Current consumption: 10 mA Isolated input Signal propagation times: L → H: 100 µs H → L: 1000 µs The pulse inhibit function is only available when Safety Integrated Basic Functions are enabled.
	4	EP M1 (Enable Pulses)	
Max. connectable cross-section 1.5 mm^2 Type: Screw terminal 1 (see Chapter, "Control cabinet installation/Connection system")			

NOTICE

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

Parameters p9651 and p9851 are used to set the filter times to debounce terminals X21.3 and X21.4, as well as X22.3 and X22.4. Additional parameter settings are also required in order to prevent discrepancy errors when performing bit pattern tests (light/dark tests). For comprehensive information, see the SINAMICS S120 Safety Integrated Function Manual, Chapter 6 "Controlling the safety functions".

NOTICE

The temperature sensor must be connected with the correct polarity.
If the polarity is reversed, the sensor will not be able to detect if the motor overheats.

Note

The temperature sensor input is not needed if the motors feature an integrated DRIVE-CLiQ interface or if temperature values are detected by means of a different module (SMC, SME, TM).

⚠ DANGER

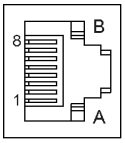
Risk of electric shock!

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) or Terminal Module TM120 must be used.

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

5.4.3.4 X200-X202 DRIVE-CLiQ interface

Table 5- 44 X200-X202: DRIVE-CLiQ interfaces

	Pin	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

The blanking covers for the DRIVE-CLiQ interfaces are included in the scope of delivery.

Blanking cover (50 pcs.) Order number: 6SL3066-4CA00-0AA0

5.4.4 Connection example

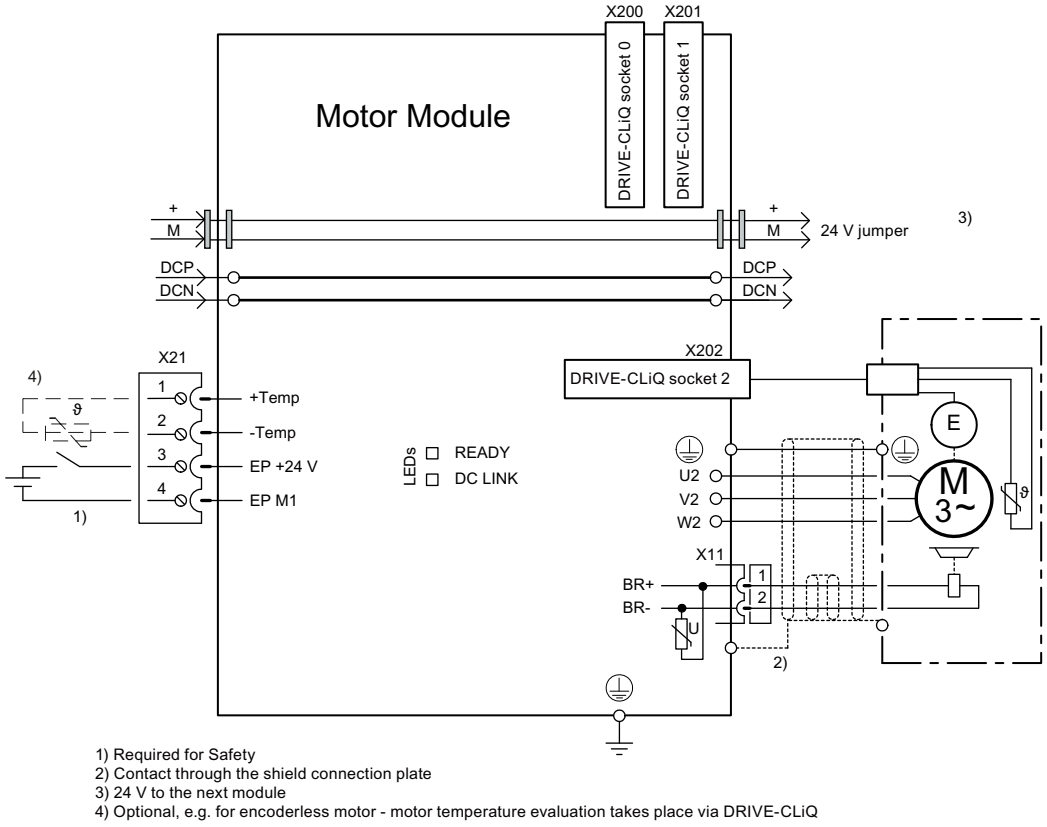


Figure 5-70 Connection example for Motor Module Liquid Cooled (200 A)

5.4.5 Meaning of LEDs

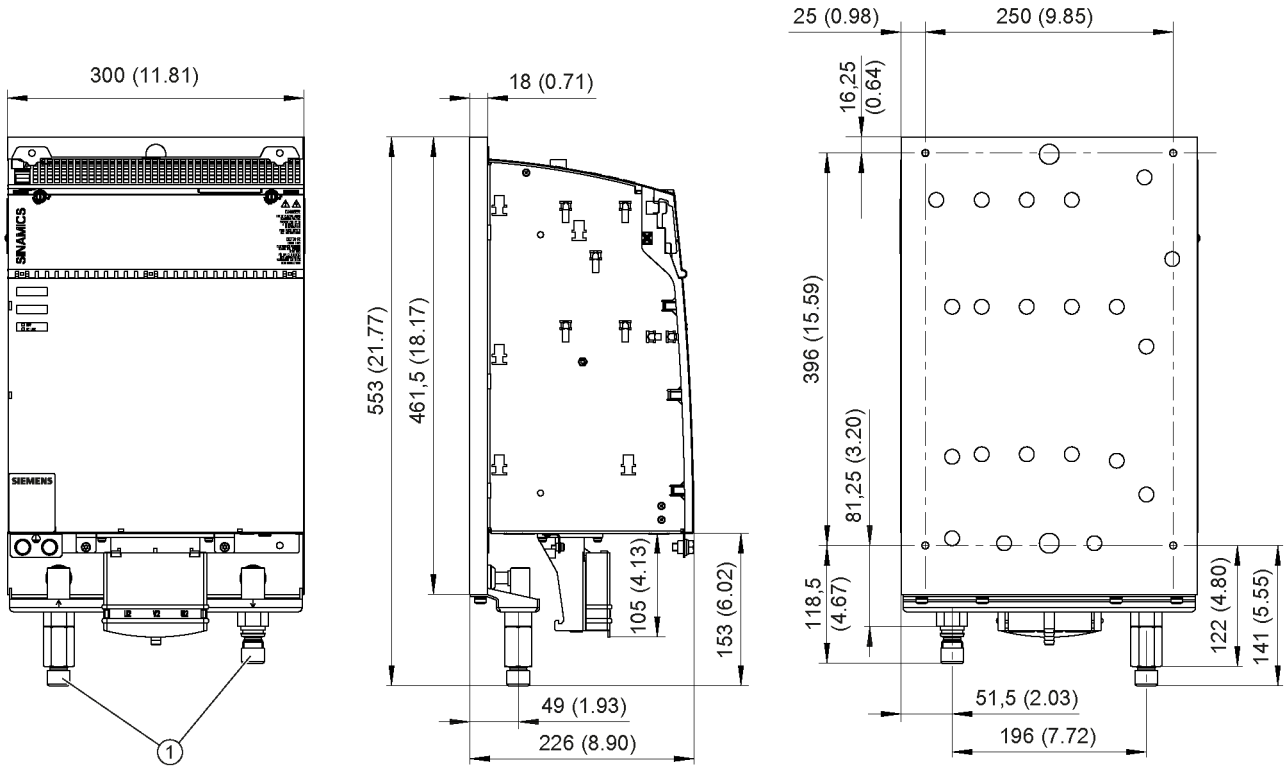
Table 5- 45 Meaning of LEDs

Status		Description, cause	Remedy
RDY	DC LINK		
Off	Off	Electronics power supply is missing or outside permissible tolerance range.	–
Green	--	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.	Check line voltage
Orange	Orange	DRIVE-CLiQ communication is being established.	–
Red	--	At least one fault is present in this component. **Note:** The LED is driven irrespective of the corresponding messages being reconfigured.	Remedy and acknowledge fault
Green/red (0.5 Hz)	--	Firmware is being downloaded.	–
Green/red (2 Hz)	--	Firmware download is complete. Wait for POWER ON.	Carry out a POWER ON
Green/orange or Red/orange	--	Detection of the components via LED is activated (p0124). **Note:** Both options depend on the LED status when module recognition is activated via p0124 = 1.	–

⚠ DANGER

Hazardous DC link voltages may be present at any time regardless of the status of the "DC LINK" LED.
The warning information on the components must be carefully observed!

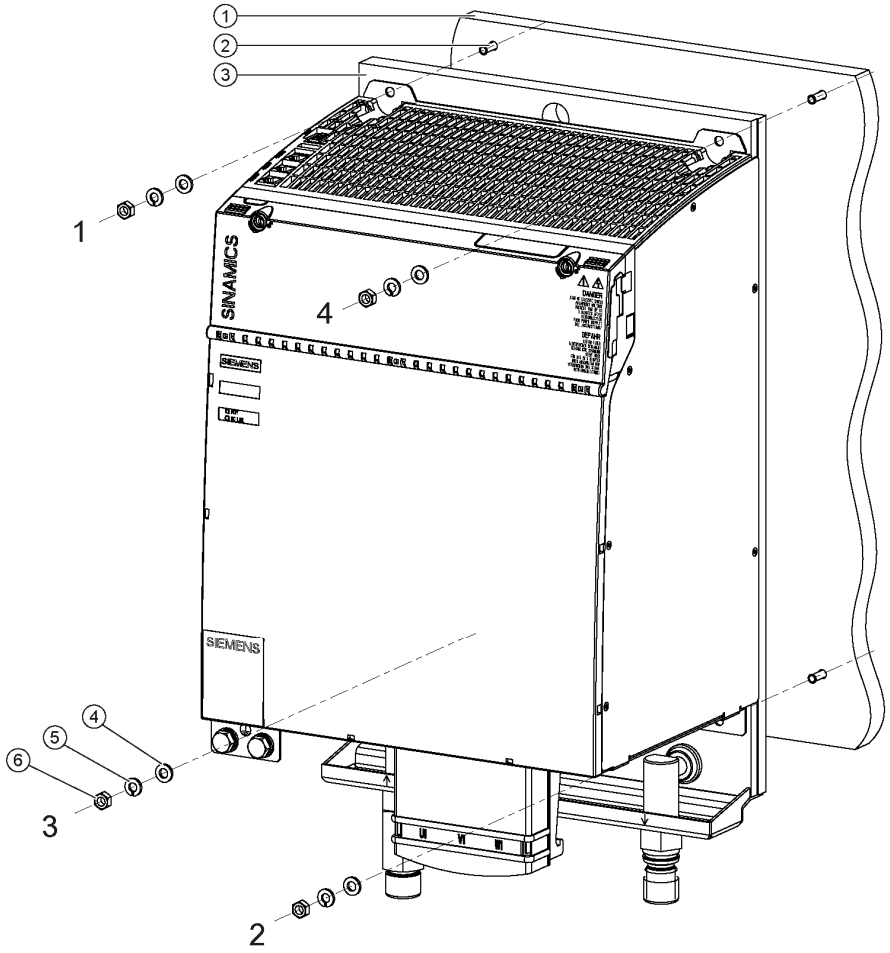
5.4.6 Dimension drawing



① Pipe thread ISO 228 G ½ B.

Figure 5-71 Dimension drawing of Motor Module Liquid Cooled (200 A), all dimensions in mm and (inches)

5.4.7 Installation



① Mounting surface
② M6 studs
③ Heat sink
④ Washer
⑤ Spring washer
⑥ M6 nut

Figure 5-72 Installing a Motor Module Liquid Cooled

Tightening torques:

- Initially, tighten the nuts by hand (0.5 Nm)
- Then tighten with 10 Nm (in the specific sequence 1 to 4)

For installation, M6 screw bolts and hexagon nuts/grub screws ISO 7436-M6x40-14 H, property class 8.8 are recommended.

The coolant connections are located on the lower side of the components. All connection elements can be accessed using an appropriate tool.

- Thread type of water connections: Pipe thread ISO 228 G ½ B.

5.4.8 Technical data

Table 5- 46 Technical data for Motor Module Liquid Cooled 200 A

Liquid Cooled		**6SL3125-1TE32-0AA3**
Output current Rated current (I_n) Base-load current (I_H) Intermittent duty current (I_{S6}) 40 % Peak current (I_{max})	 A_{ACrms} A $A_{ACrms(Is6)}$ $A_{ACrms(Imax)}$	 200 141 230 282
Output voltage	V_{ACrms}	0 - 480
DC link current I_d	A_{DC}	200
DC link voltage (up to 2000 m above sea level)	V_{DC}	510 –720
DC link capacitance	µF	3995
Overvoltage trip Undervoltage trip [1]	V_{DC} V_{DC}	820 ± 2 % 380 ± 2 %
Electronics power supply	V_{DC}	24 (20.4 – 28.8)
Electronics current consumptionat 24 V DC	A_{DC}	0.85
Current carrying capacity DC link busbar 24 V busbar	 A_{DC} A_{DC}	 200 20
Unit rating Based on I_n (600 V_{DC}; 4 kHz) Based on I_H	 kW kW	 107 76
Total power loss(including electronics losses) [2]	W	2070.4
Max. pulse frequency Without derating With derating	 kHz kHz	 4 16
Max. ambient temperature Without derating With derating	 °C °C	 40 55
Max. coolant temperature Without derating With derating	 °C °C	 45 50
Rated volumetric flow for water at 70 kPa pressure drop [3]	l/min	8
Volume of liquid internal	ml	100
Sound pressure level	dB(A)	<73
Weight	kg	21

1) Default for 400 V supply systems; undervoltage trip threshold is adjusted to the parameterized line voltage.

2) For an overview, see the power loss tables in the chapter titled Control cabinet installation

3) This value applies to the water coolant option; for other coolant types, see chapter "Cooling circuit and coolant properties".

5.4.8.1 Characteristics

Motor Modules Booksize Liquid Cooled

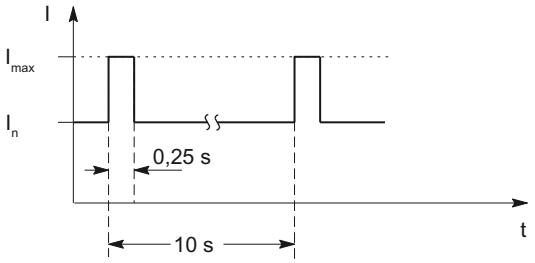


Figure 5-73 Duty cycle with initial load (for servo drives)

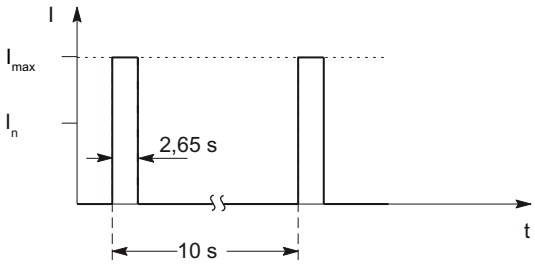


Figure 5-74 Duty cycle without initial load (for servo drives)

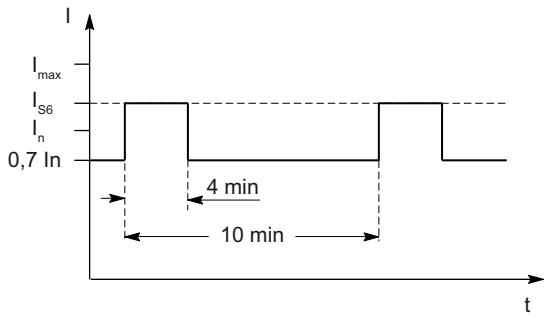


Figure 5-75 S6 duty cycle with initial load with a duty cycle duration of 600 s (for servo drives)

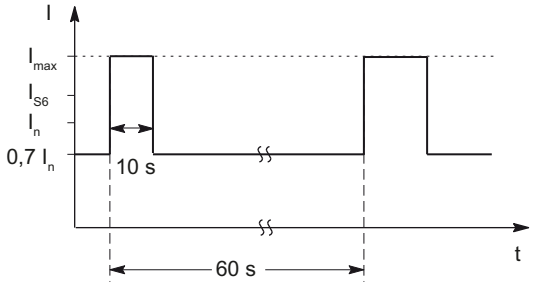


Figure 5-76 S6 duty cycle with initial load with a duty cycle duration of 60 s (for servo drives)

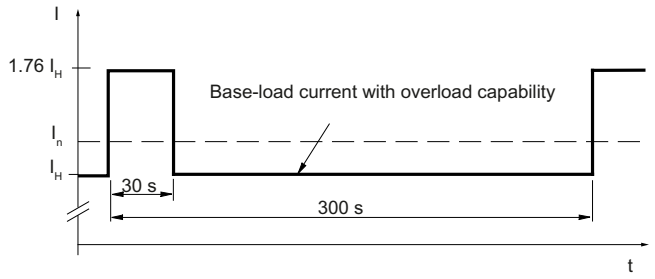


Figure 5-77 Duty cycle with 30 s overload with a duty cycle duration of 300 s

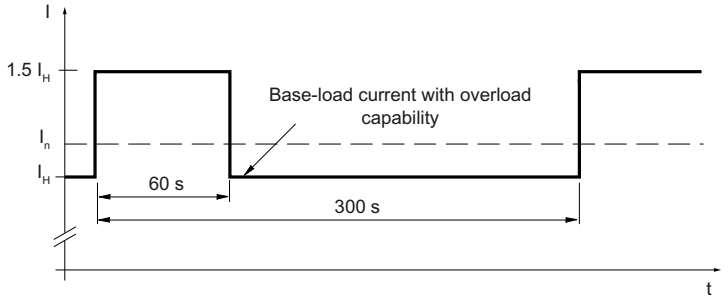


Figure 5-78 Duty cycle with 60 s overload with a duty cycle duration of 300 s

Derating characteristics for Motor Modules Booksize Liquid Cooled

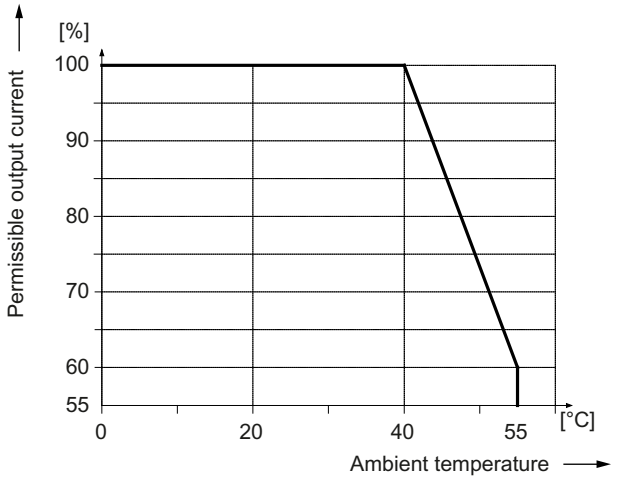


Figure 5-79 Output current as a function of the ambient temperature

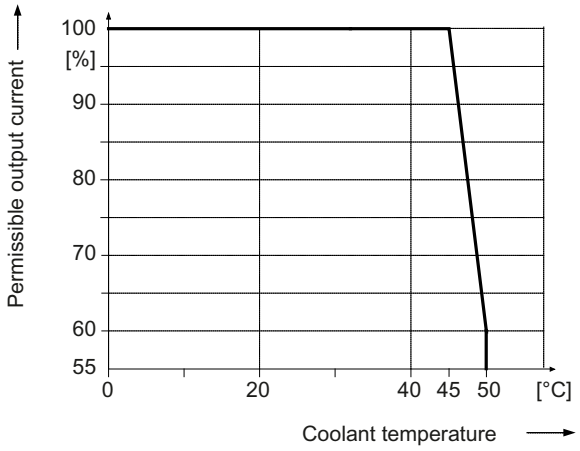


Figure 5-80 Output current as a function of the coolant temperature

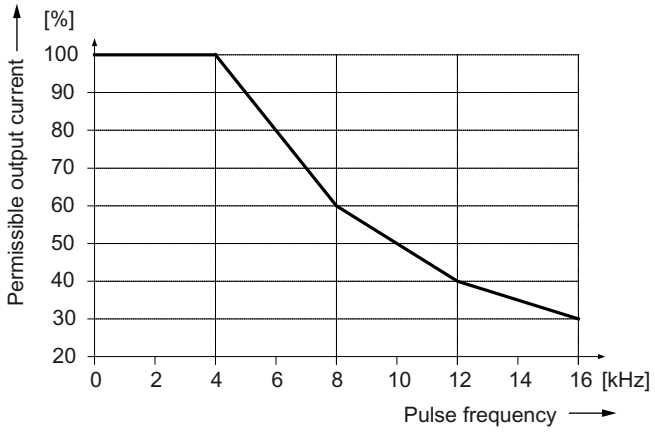


Figure 5-81 Output current as a function of the pulse frequency

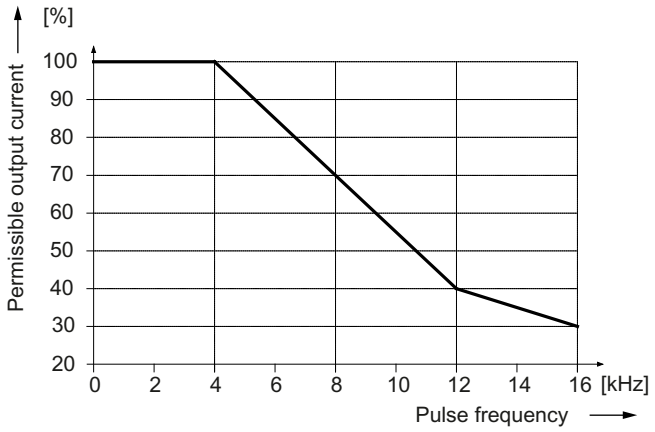


Figure 5-82 Output current as a function of the pulse frequency
(applies from order number 6SL312x-1TE32-0AA4)

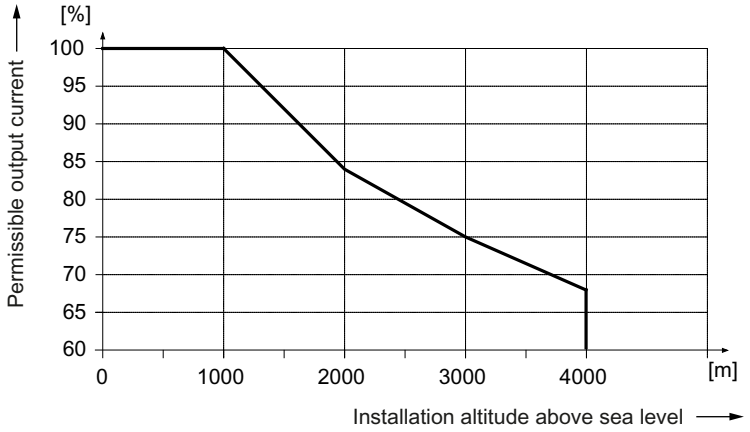


Figure 5-83 Output current as a function of the installation altitude

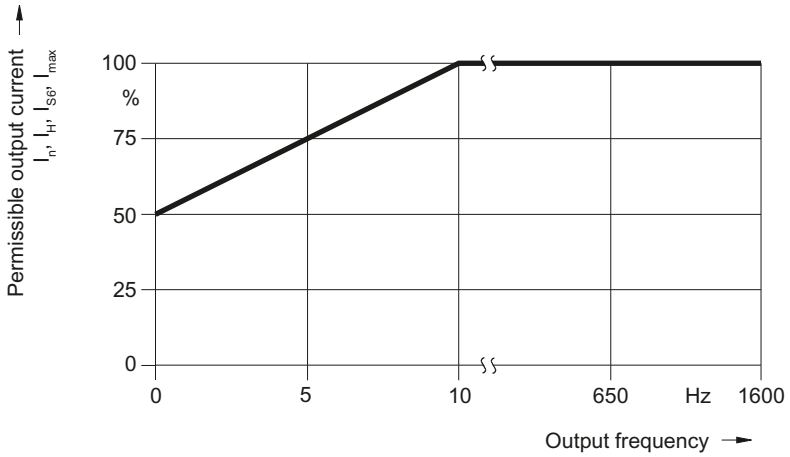


Figure 5-84 Current derating as a function of the output frequency

At installation altitudes >2000 m, an insolating transformer must be used (see "System overview/Derating as a function of the installation altitude and ambient temperature"). The design of the secondary line supply system must be as follows:

- TN system with grounded star point (no grounded outer conductor)
- IT system

A reduction of the line supply voltage phase-phase is not necessary.

Motor Modules Booksize Compact 6

6.1 Description

A Motor Module Booksize Compact is a power unit (inverter) that provides the power supply for the connected motor(s). 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 for the Motor Module are stored in the Control Unit.

One motor can be connected to Single Motor Modules and two motors can be connected to Double Motor Modules.

Motor Modules Booksize Compact can be used either with cooling type "internal air cooling" or cooling type "cold plate". The cooling type is selected via parameter p249 "Power section cooling type".

6.2 Safety information

⚠ DANGER

Risk of electric shock

A hazardous voltage is still present for up to 5 minutes after the power supply has been switched off.
It is only permissible to open the protective cover after this time has expired.

When opening the protective cover for the DC link, you must press the release catch. A suitable tool (e.g. screwdriver or the release tool supplied) must be used for this purpose.

The components must only be operated when the protective cover of the DC link is closed. Damaged components must not be operated further, otherwise this could result in secondary damage or accidents.

⚠ DANGER

DC link discharge time

A hazard warning in the local language for the DC link discharge time must be attached to the component.
A set of labels in 16 languages is supplied with the component.

⚠ DANGER

The drive components generate high leakage currents in the protective conductor. The components must only be operated in cabinets or in closed electrical operating areas and must be connected with the protective conductor. To protect against electric shock, the protective conductor connection at the control cabinet or machine must be implemented in accordance with one of the following measures:

- Fixed connection and protective conductor connection using ≥ 10 mm^2 Cu or ≥ 16 mm^2 Al
- Fixed connection and automatic disconnection of the supply system if the protective conductor is interrupted

⚠ DANGER

It is only permissible to establish connections to the DC link using the adapters that SIEMENS has recommended (DC link adapter and DC link rectifier adapter).

⚠ DANGER

If a 50 mm wide Motor Module or a 50 mm wide DC link component (e.g. Braking Module, Control Supply Module, Voltage Clamping Module) is located at the left-hand end of the drive line-up, then the DC link bridges, including all of the screws, must be removed from this component. It is not permissible to insert the screws without a DC link bridge.

For all other components that are 75 mm wide or wider, it is neither permissible to move the DC link bridge to the left nor to remove it.

If this is not carefully observed, this can result in damage and accidents.

⚠ DANGER

It is essential to connect the shield for the motor holding brake. Furthermore, only MOTION-CONNECT cables must be used for integrated motor holding brakes, as otherwise insulation of the cores is not guaranteed. Risk of electric shock.

⚠ WARNING

Cable shields and unused power cable conductors (e.g. brake conductors) must be connected to PE potential to prevent capacitive cross-talk charges.

If this is not carefully observed, lethal shock voltages could result.

⚠ CAUTION

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

CAUTION
The correct tightening torque of the DC link busbar screws (1.8 Nm, tolerance +30%) must be checked before commissioning. After transportation, the screws must be tightened.

CAUTION
Only cables from Siemens may be used for DRIVE-CLiQ connections.

CAUTION
Connecting cables to temperature sensors must always be installed with shielding. The cable shield must be connected to the chassis 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.

CAUTION
DC link side covers are supplied with the components as standard and must be attached to the first and last components in the drive line-up. They can also be ordered separately, if required (order number: 6SL3162-5AA00-0AA0).

Note

A regulated DC power supply is required to operate motors with a built-in holding brake. The voltage is supplied via the internal 24 V busbars. The voltage tolerances of the motor holding brakes (24 V ± 10%) and the voltage drops of the connection cables must be taken into account.

The DC power supply should be set to 26 V. This ensures that the supply voltage for the brake remains within the permissible range when the following conditions are fulfilled:

- Use of Siemens three-phase motors
- Use of Siemens MOTION-CONNECT power cables
- Motor cable lengths: max. 100 m

6.3 Interface description

6.3.1 Overview

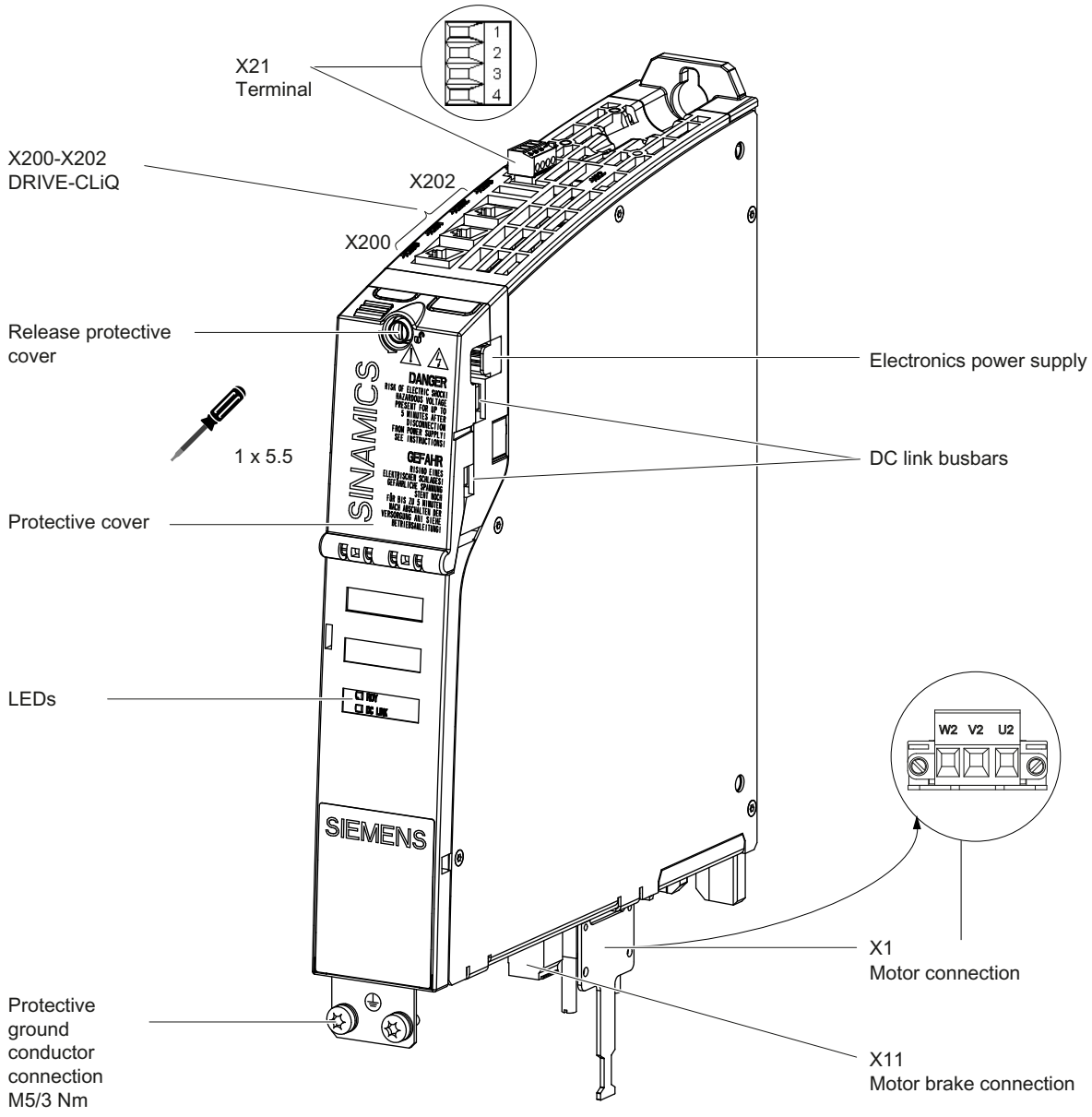


Figure 6-1 Interface overview, Single Motor Module Booksize Compact (example: 5 A)

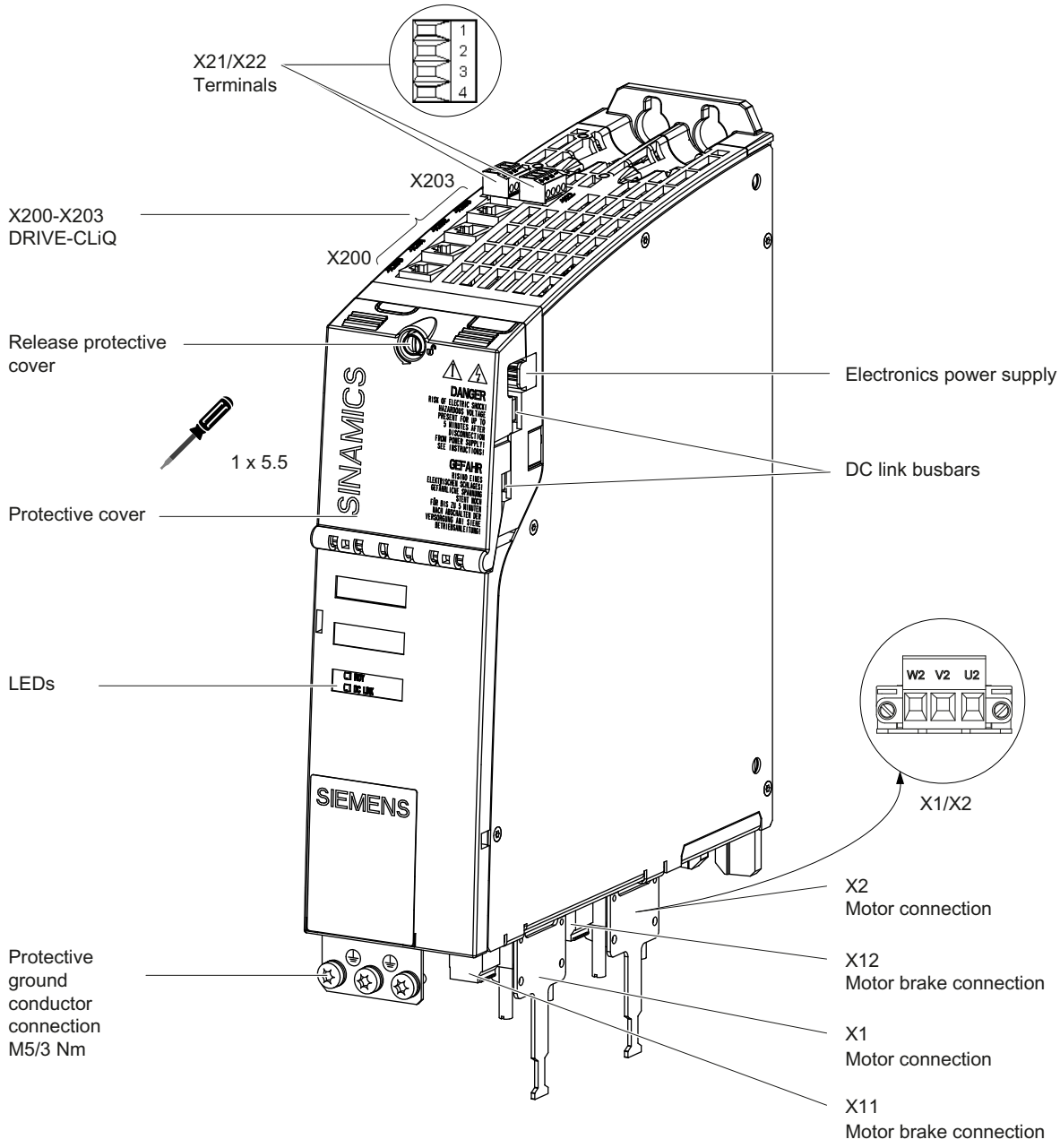
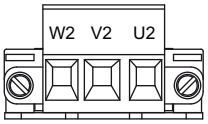
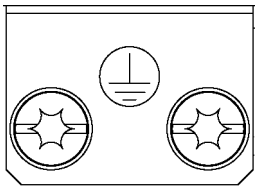
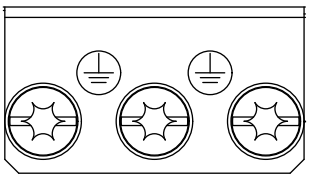


Figure 6-2 Interface overview, Double Motor Module Booksize Compact (example: 2 x 5 A)

6.3.2 X1/X2 motor connection

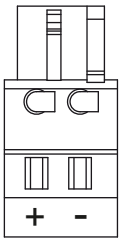
Table 6- 1 X1/X2 motor connection

	Terminal	Technical specifications
	U2 V2 W2	Max. connectable cross-section: 6 mm^2 Type: Screw terminal 5 (see Chapter "Control cabinet installation and EMC / connection system") Tightening torque: 1.2 - 1.5 Nm
	PE connection	**Single Motor Modules 3 A to 18 A** Threaded hole M5/3 Nm [1]
		**Double Motor Modules 1.7 A to 5 A** Threaded hole M5/3 Nm [1]

1) For ring cable lugs in accordance with DIN 46234

6.3.3 X11/X12 motor brake connection

Table 6- 2 X11/X12 motor brake connection

	Terminals	Technical specifications
	+ (BR+)	Brake connector [1]:
	- (BR-)	Voltage 24 V DC Max. load current 2 A Min. load current 0.1 A Max. connectable cross-section 2.5 mm^2 Type: Spring-loaded terminal 2 (see the chapter titled "Control cabinet installation and EMC/Connection system") Manufacturer: Wago; order number: 721-102/026-000/56-000 The brake connector is part of the scope of delivery

1) The circuit for protecting the brake against overvoltage is integrated in the Motor Module and does not need to be installed externally. The max. load current is 2 A, the min. load current 0.1 A.

Note

The overall length of the power cables (motor supply cables and DC link cables) must not exceed the values given in chapter "Possible line reactor and line filter combinations".

Note

The motor brake must be connected via connector X11 and X12 on Double Motor Modules. It is not permitted to directly connect the cable BR- to the electronics ground M.

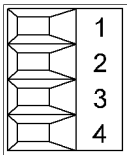
⚠ WARNING

Only protective extra-low voltages (DVC A) that comply with EN 60204-1 must be connected to all connections and terminals between 0 and 48 V DC.

The voltage tolerances of the motor holding brakes (24 V ± 10%) must be taken into account.

6.3.4 X21/X22 EP terminals/temperature sensor

Table 6- 3 X21/X22 EP terminals/temperature sensor

	Terminal	Function	Technical specifications
	1	+ Temp	Temperature sensors: KTY 84-1C130/PTC/bimetallic switch with NC contact
	2	- Temp	
	3	EP +24 V (Enable Pulses)	Supply voltage: 24 V DC (20.4 V to 28.8 V) Current consumption: 10 mA Isolated input Signal propagation times: L → H: 100 µs H → L: 1000 µs The pulse inhibit function is only available when Safety Integrated Basic Functions are enabled.
	4	EP M1 (Enable Pulses)	
Max. connectable cross-section 1.5 mm^2 Type: Screw terminal 1 (see Chapter, "Control cabinet installation/Connection system")			

NOTICE

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

Parameters p9651 and p9851 are used to set the filter times to debounce terminals X21.3 and X21.4, as well as X22.3 and X22.4. Additional parameter settings are also required in order to prevent discrepancy errors when performing bit pattern tests (light/dark tests). For comprehensive information, see the SINAMICS S120 Safety Integrated Function Manual, Chapter 6 "Controlling the safety functions".

NOTICE

The KTY temperature sensor must be connected with the correct polarity.
If the polarity is reversed, the sensor will not be able to detect if the motor overheats.

Note

The temperature sensor input is not needed if the motors feature an integrated DRIVE-CLiQ interface or if temperature values are detected by means of a different module (SMC, SME, TM).

⚠ DANGER

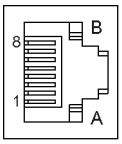
Risk of electric shock!

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) or Terminal Module TM120 must be used.

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

6.3.5 X200-X203 DRIVE-CLiQ interface

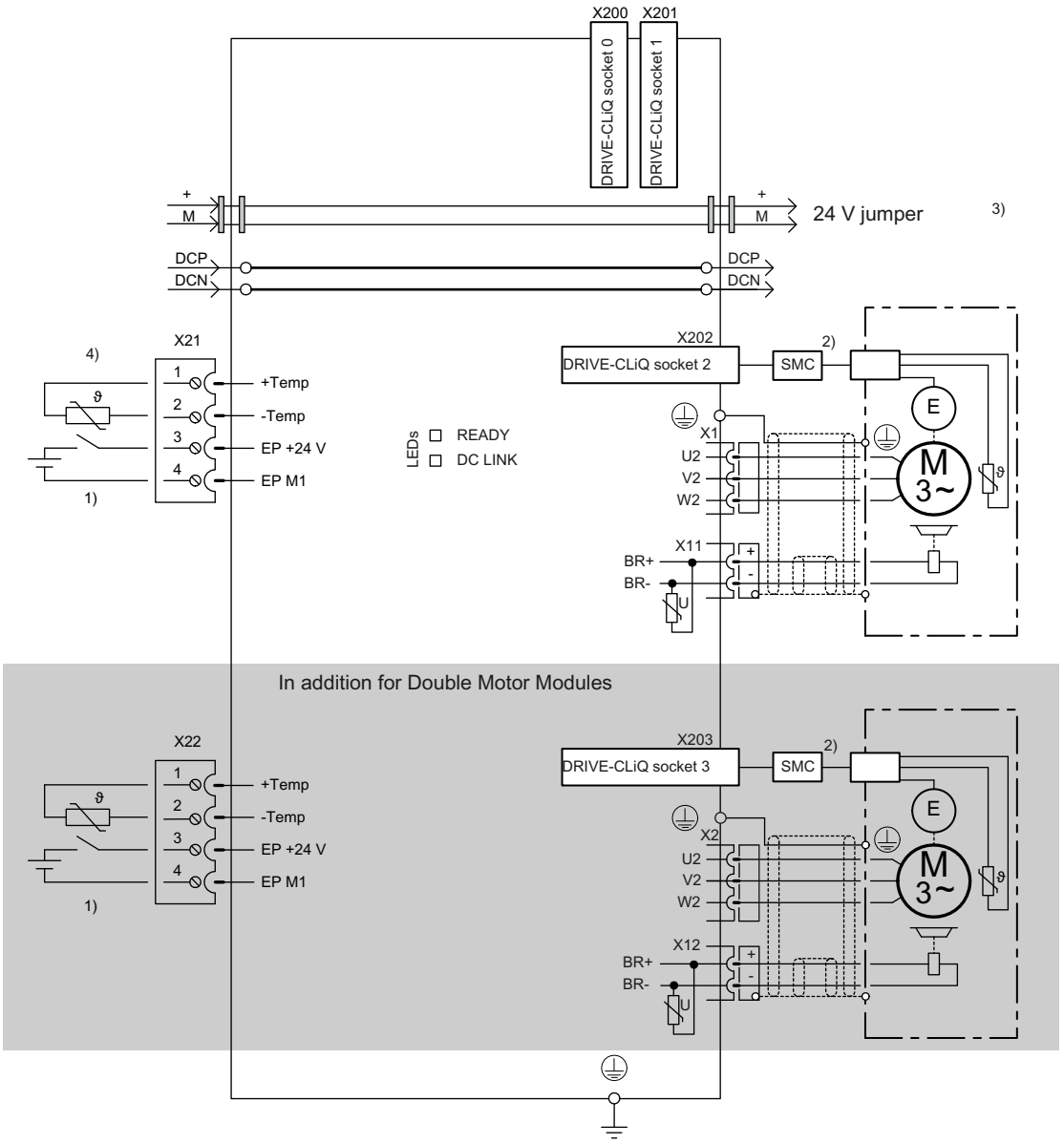
Table 6- 4 X200-X202: DRIVE-CLiQ interfaces for Single Motor Modules
X200-X203: DRIVE-CLiQ interfaces for Double Motor Modules

	Pin	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

The blanking covers for the DRIVE-CLiQ interfaces are included in the scope of delivery.

Blanking cover (50 pcs.) Order number: 6SL3066-4CA00-0AA0

6.4 Connection example



1) Required for Safety
2) SMC required for motors without DRIVE-CLiQ interface
3) 24 V to the next module
4) An alternative possibility of the motor temperature evaluation

Figure 6-3 Connection example, Single Motor Modules Booksize Compact 3 A to 18 A and Double Motor Modules Booksize Compact 1.7 A to 5 A

6.5 Meaning of LEDs

Table 6- 5 Meaning of the LEDs on the Motor Module booksize compact

State		Description, cause	Remedy
RDY	DC LINK		
Off	Off	Electronic power supply is missing or outside permissible tolerance range.	–
Green	--	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.	Check the line voltage
Orange	Orange	DRIVE-CLiQ communication is being established.	–
Red	--	This component has at least one fault. **Note:** The LED is activated regardless of whether the corresponding messages have been reconfigured.	Remedy and acknowledge fault
Green/red (0.5 Hz)	--	Firmware is being downloaded.	–
Green/red (2 Hz)	--	Firmware download is complete. Wait for POWER ON.	Carry out a POWER ON
Green / orange or red/orange	--	Detection of the components via LED is activated (p0124). **Note:** Both options depend on the LED state when activated via p0124 = 1.	–

⚠ DANGER

Hazardous DC link voltages may be present at any time regardless of the state of the "DC LINK" LED.
The warning information on the component must be carefully observed!

6.6 Dimension drawings

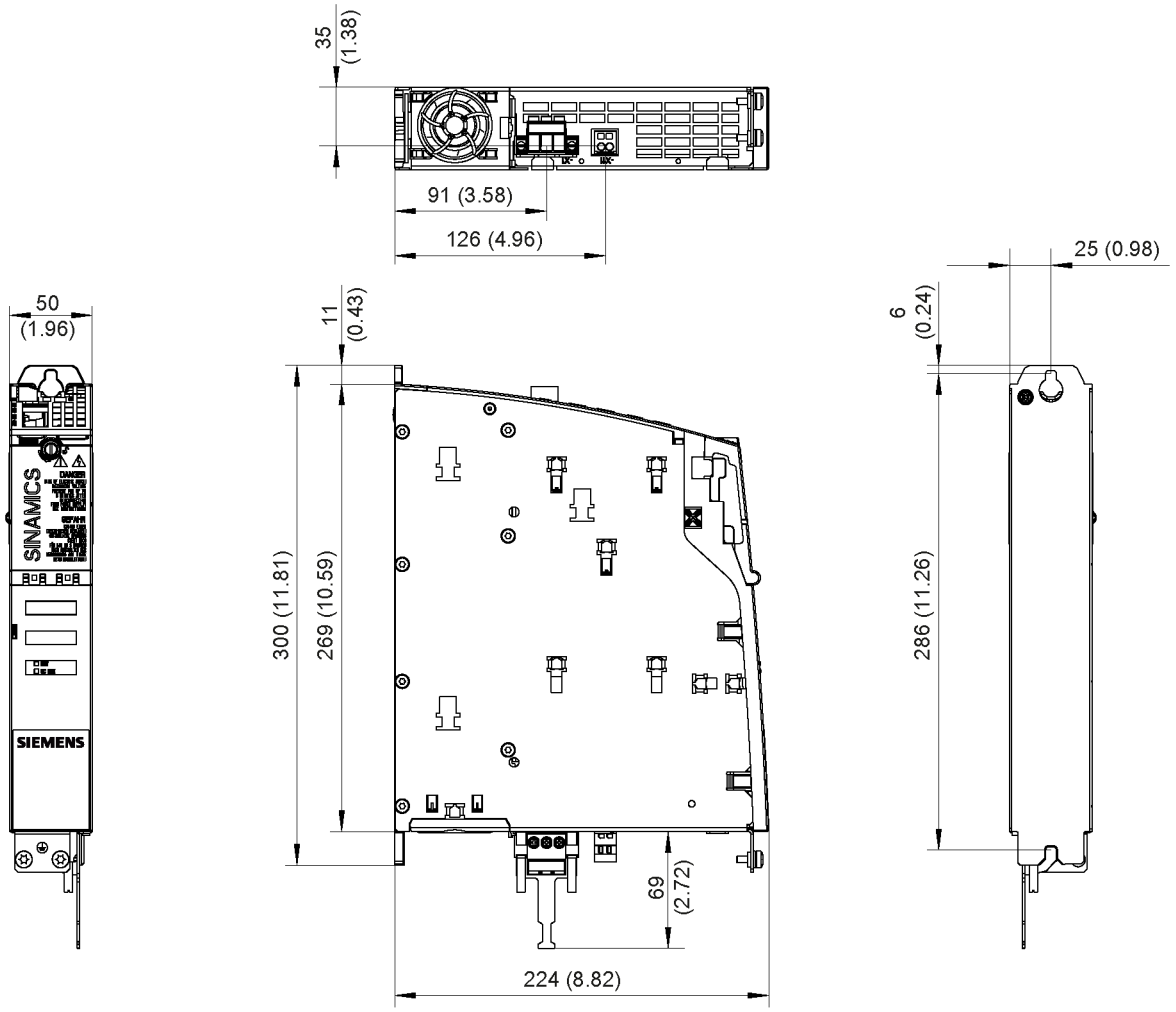


Figure 6-4 Dimension drawing of 3 A, 5 A, and 9 A Motor Modules Booksize Compact, all dimensions in mm and (inches); example: 5 A Single Motor Module

Table 6- 6 Motor Modules Booksize Compact 3 A, 5 A, and 9 A

Motor Module	Order number
3 A Single Motor Module	6SL3420-1TE13-0AAx
5 A Single Motor Module	6SL3420-1TE15-0AAx
9 A Single Motor Module	6SL3420-1TE21-0AAx

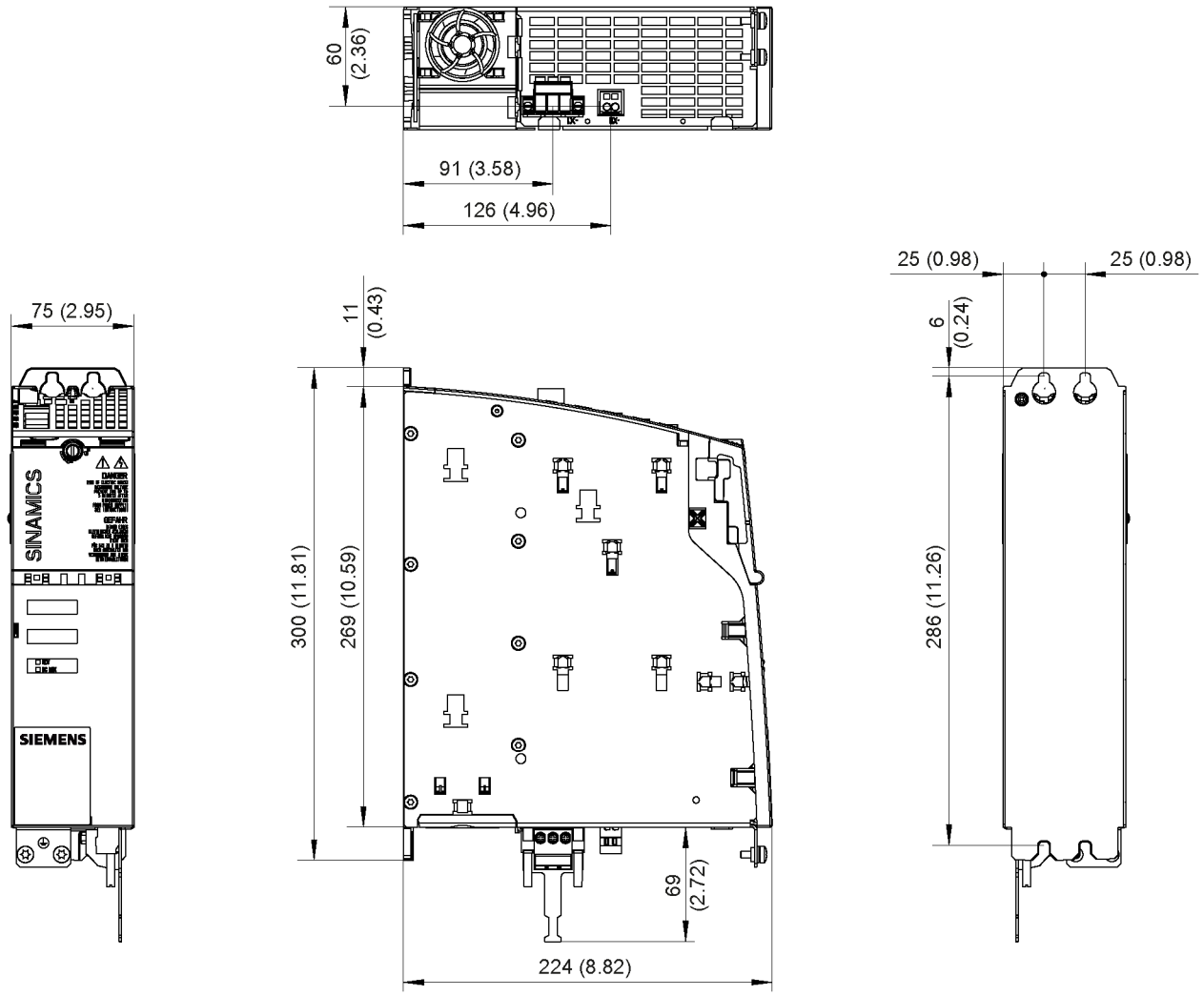


Figure 6-5 Dimension drawing of 18 A Motor Module Booksize Compact, all dimensions in mm and (inches)

Table 6- 7 Motor Module Booksize Compact 18 A

Motor Module	Order number
18 A Single Motor Module	6SL3420-1TE21-8AAx

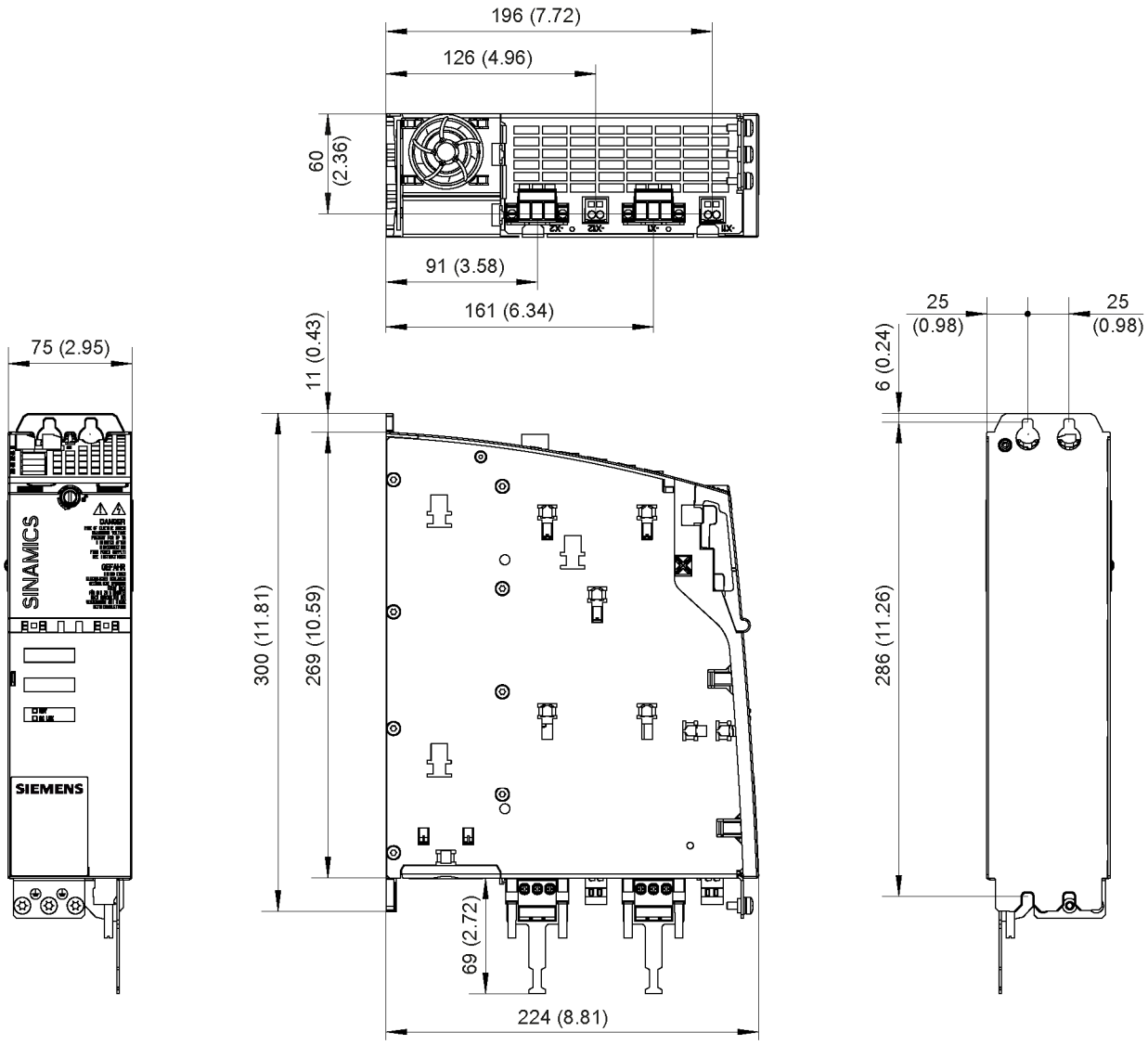


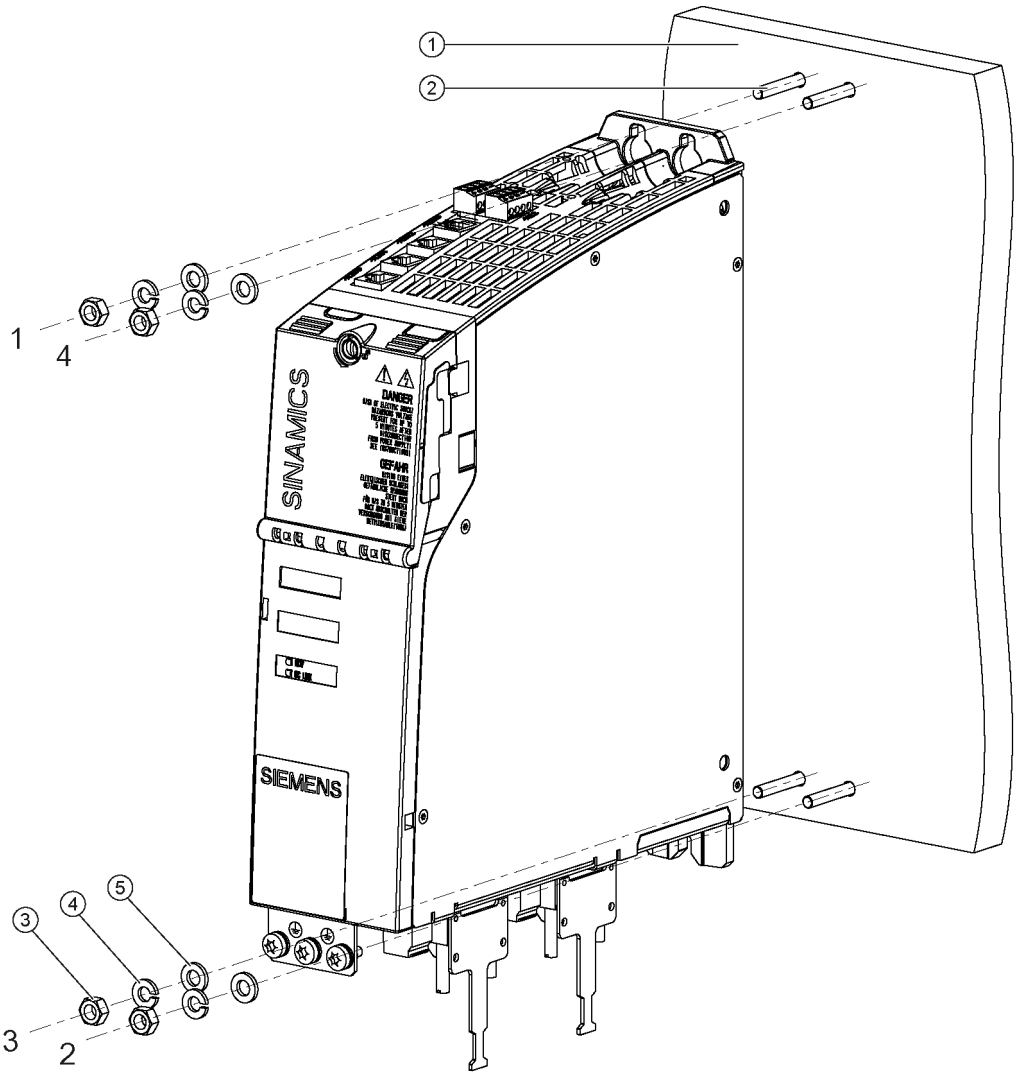
Figure 6-6 Dimension drawing of 2 x 1.7 A, 2 x 3 A, and 2 x 5 A Double Motor Modules Compact, all dimensions in mm and (inches); example: 2 x 5 A Double Motor Module

Table 6- 8 2 x 1.7 A, 2 x 3 A, and 2 x 5 A Double Motor Modules Booksize Compact

Double Motor Module	Order number
2 x 1.7 A Double Motor Module	6SL3420-2TE11-0AAx
2 x 3 A Double Motor Module	6SL3420-2TE13-0AAx
2 x 5 A Double Motor Module	6SL3420-2TE15-0AAx

6.7 Installation

Installing a Motor Module Booksize Compact with internal air cooling



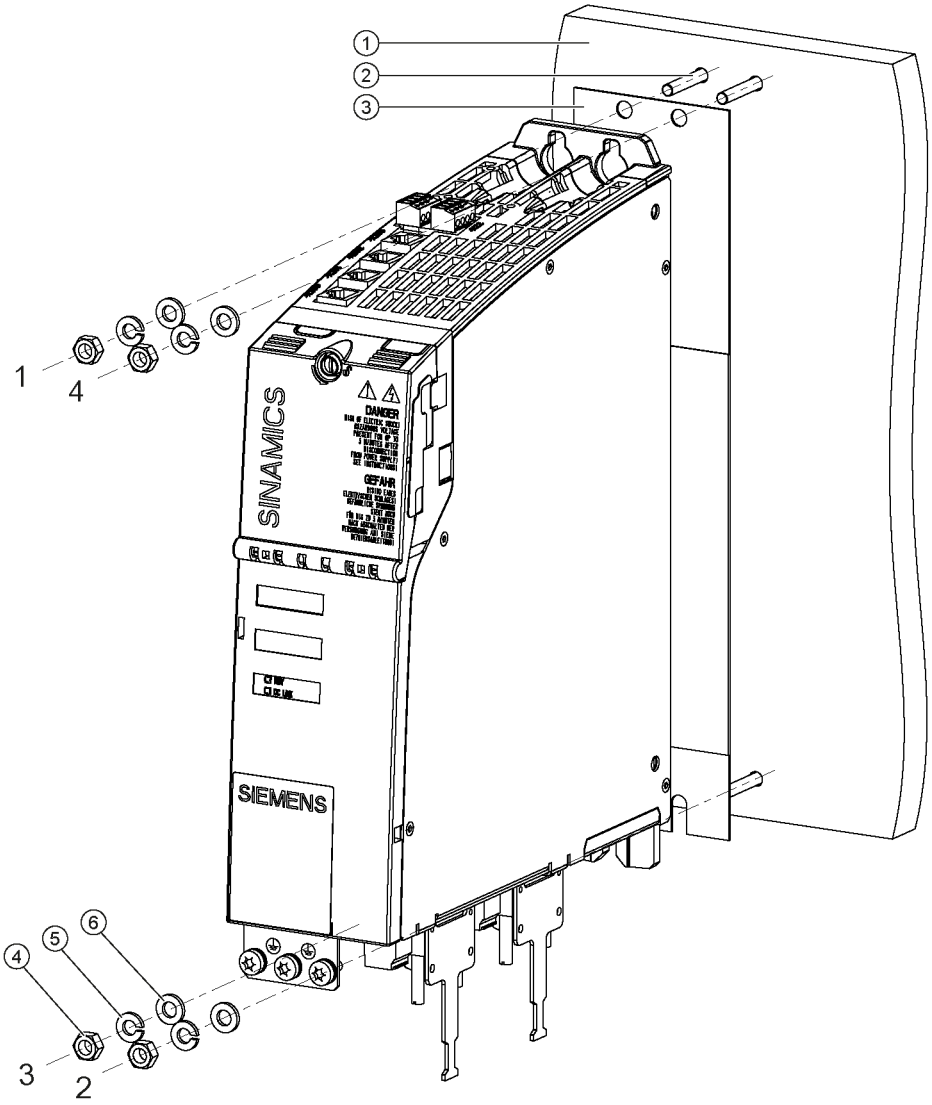
① Mounting wall
② M6 studs
③ M6 nut
④ Spring washer
⑤ Washer

Figure 6-7 Installing a Motor Module Booksize Compact with internal air cooling

Tightening torques:

- Initially, tighten by hand (0.5 Nm)
- Then tighten with 6 Nm (in the specific sequence 1 to 4)

Installing a Motor Module Booksize Compact on a cold plate



① Cold plate (air or liquid cooling)
② M6 studs
③ Heat-conducting foil
④ M6 nut
⑤ Spring washer
⑥ Washer

Figure 6-8 Installing a Motor Module Booksize Compact on a cold plate

Tightening torques:

- Initially, tighten the nuts by hand (0.5 Nm)
- Then tighten with 10 Nm (in the specific sequence 1 to 4)

Special points to note in relation to installation on a cold plate

To improve heat transfer, a heat-conducting medium must be used. Special spherical-indented heat-conducting foil must be used for this purpose. Every Motor Module Booksize Compact is supplied with heat-conducting foil cut to the right size. Note the mounting position of the heat-conducting foil.

Note

When a component is replaced, the heat-conducting foil must also be replaced. Only heat-conducting foil approved or supplied by Siemens may be used.

	Order number
Heat-conducting foil, 50 mm	6SL3162-6FB01-0AA0
Heat-conducting foil, 75 mm	6SL3162-6FC01-0AA0

6.8 Technical data

6.8.1 Single Motor Modules

Table 6- 9 Technical data Single Motor Modules Booksize Compact (3 A to 18 A)

Motor Modules Booksize Compact	6SL3420–	1TE13-0AAx	1TE15-0AAx	1TE21–0AAx	1TE21–8AAx
Output current					
Rated current (I_n)	A_{ACrms}	**3**	**5**	**9**	**18**
Base-load current (I_H)	A	2.6	4.3	7.7	15.3
Intermittent duty current (I_{s6}) 40 %	A_{ACrms}	3.5	6	10	24
Peak current (I_{max})	A_{ACrms}	9	15	27	54
Output voltage	V_{ACrms}	0 - 0.717 x DC link voltage			
DC link current I_d	A_{DC}	3.6	6	11	22
DC link voltage (up to 2000 m above sea level)	V_{DC}	510 – 720			
DC link capacitance	µF	110	110	110	235
Overvoltage trip	V_{DC}	820 ± 2 %			
Undervoltage trip [1]	V_{DC}	380 ± 2 %			
Electronics power supply	V_{DC}	24 (20.4 – 28.8)			
Electronics current consumption at 24 V DC					
For internal air cooling	A_{DC}	0.85	0.85	0.85	0.85
For cold plate cooling	A_{DC}	0.65	0.65	0.65	0.65
Current carrying capacity					
DC link busbar	A_{DC}	100	100	100	100
Reinforced DC link busbars	A_{DC}	150	150	150	150
24 V busbar	A_{DC}	20	20	20	20
Max. current motor brake	A	2	2	2	2
Unit rating					
Based on I_n (600 V_{DC}; 4 kHz)	kW	1.6	2.7	4.8	9.7
Based on I_H	kW	1.4	2.3	4.1	13.7
Total power loss (incl. electronics losses) [2]					
Internal air cooling	W	68 (8 kHz)	98 (8 kHz)	100.4 (4 kHz)	185.4 (4 kHz)
Cold plate int./ext.	W	25.6/40	30.6/65	45.6/50	80.6/100
Max. pulse frequency					
Without derating	kHz	8	8	4	4
With derating	kHz	16	16	16	16
Max. ambient temperature					
Without derating	°C	40			
With derating	°C	55			
Sound pressure level with internal air cooling	dB(A)	<60	<60	<60	<60
Cooling methods		Internal air cooling Cold plate cooling			
Cooling air requirement with internal air cooling	m^3/h	29.6	29.6	29.6	29.6

Motor Modules Booksize Compact	6SL3420–	1TE13-0AAx	1TE15-0AAx	1TE21–0AAx	1TE21–8AAx
Max. permissible heat-sink temperature cold plate	°C	70	70	70	70
Weight	kg	2.7	2.7	2.7	3.4

1) Default for 400 V supply systems; undervoltage trip threshold can be reduced by a maximum of 80 V and is adjusted to the parameterized line voltage.

2) For an overview, see the power loss tables in the chapter titled Control cabinet installation

6.8.2 Double Motor Modules

Table 6- 10 Technical data Double Motor Modules in booksize compact format (2 x 1.7 A to 2 x 5 A)

Double Motor Modules Booksize Compact	6SL3420-	2TE11-7AAx	2TE13-0AAx	2TE15-0AAx
Output current				
Rated current (I_n)	A_{ACrms}	**2 x 1.7**	**2 x 3**	**2 x 5**
Base-load current (I_H)	A	2 x 1.5	2 x 2.6	2 x 4.3
Intermittent duty current (I_{S6}) 40 %	A_{ACrms}	2 x 2	2 x 3.5	2 x 6
Peak current (I_{max})	A_{ACrms}	2 x 5.1	2 x 9	2 x 15
Output voltage	V_{ACrms}	0 - 0.717 x DC link voltage		
DC link current I_d	A_{DC}	4.1	7.2	12
DC link voltage (up to 2000 m above sea level)	V_{DC}	510 – 720		
DC link capacitance	µF	165	165	165
Overvoltage trip	V_{DC}	820 ± 2 %		
Undervoltage trip 1)	V_{DC}	380 ± 2 %		
Electronics power supply	V_{DC}	24 (20.4 – 28.8)		
Electronics current consumption at 24 V DC				
For internal air cooling	A_{DC}	1.15	1.15	1.15
For cold plate cooling	A_{DC}	0.9	0.9	0.9
Current carrying capacity				
DC link busbar	A	100	100	100
Reinforced DC link busbars	A	150	150	150
24 V busbar	A	20	20	20
Max. current motor brake	A	2 x 2	2 x 2	2 x 2
Unit rating				
Based on I_n (600 V, 8 kHz)	kW	2 x 0.9	2 x 1.6	2 x 2.7
Based on I_H	kW	2 x 0.8	2 x 1.4	2 x 2.3
Total power loss (incl. electronics losses) 2)				
Internal air cooling	W	114 (8 kHz)	134 (8 kHz)	194 (8 kHz)
Cold plate int./ext.	W	42/72	44/90	59/135
Max. pulse frequency				
without derating	kHz	8	8	8
with derating	kHz	16	16	16
Max. ambient temperature				
without derating	°C	40		
with derating	°C	55		

Double Motor Modules Booksize Compact	**6SL3420-**	**2TE11-7AAx**	**2TE13-0AAx**	**2TE15-0AAx**
Sound pressure level with internal air cooling	dBA	<60	<60	<60
Cooling methods		Internal air cooling with installed fan cold plate cooling		
Cooling air requirement with internal air cooling	m^3/h	29.6	29.6	29.6
Max. permissible heat-sink temperature cold plate	°C	65	70	70
Weight	kg	3.4	3.4	3.4

1) Default for 400 V line supplies; undervoltage trip threshold can be reduced by a maximum of 80 V and is adjusted to the parameterized line voltage.

2) For an overview, see the power loss tables in Chapter, Control cabinet installation

6.8.3 Characteristics

Rated duty cycles Motor Modules Booksize Compact

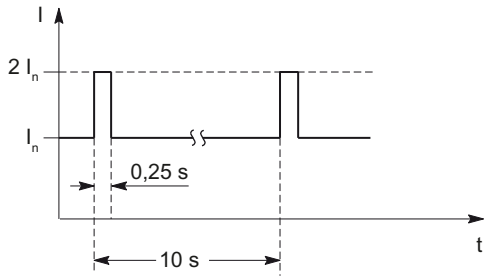


Figure 6-9 Duty cycle with initial load

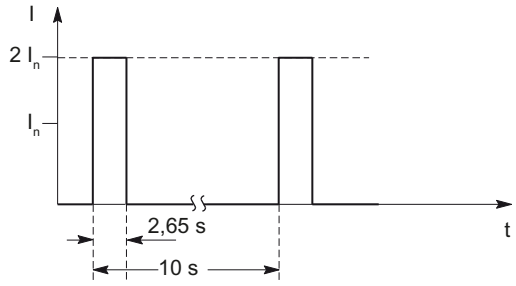


Figure 6-10 Duty cycle without initial load

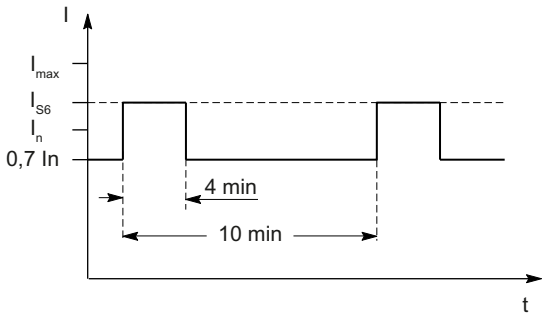


Figure 6-11 S6 duty cycle with initial load with a duty cycle duration of 600 s

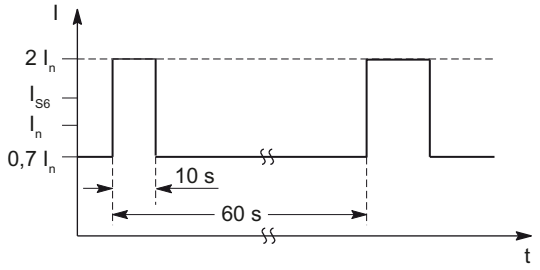


Figure 6-12 S6 duty cycle with initial load with a duty cycle duration of 60 s

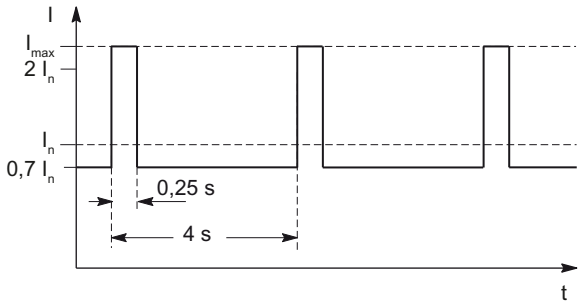


Figure 6-13 Peak current duty cycle with initial load

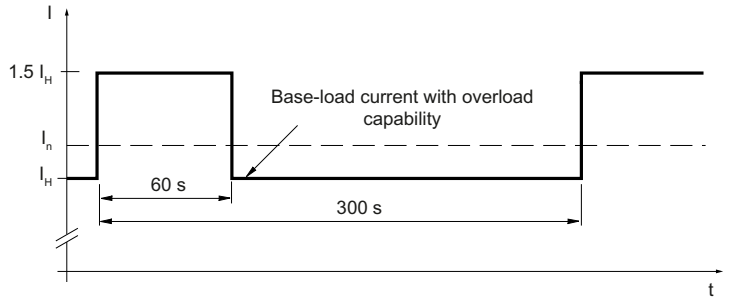


Figure 6-14 Duty cycle with 60 s overload with a duty cycle duration of 300 s

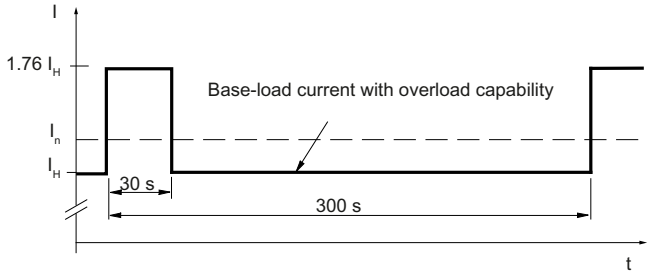


Figure 6-15 Duty cycle with 30 s overload with a duty cycle duration of 300 s

Derating characteristics for Motor Modules Booksize Compact

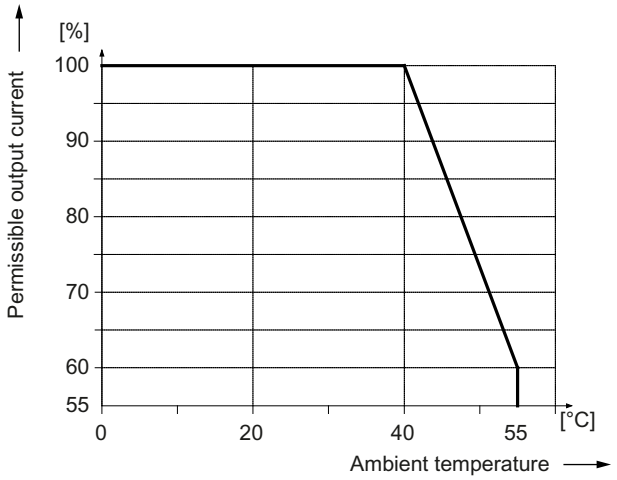


Figure 6-16 Output current as a function of the ambient temperature

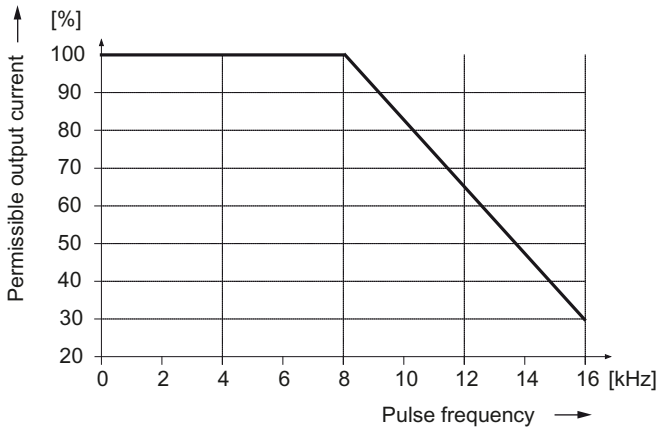


Figure 6-17 Output current as a function of the pulse frequency for the Motor Module ≤ 5 A

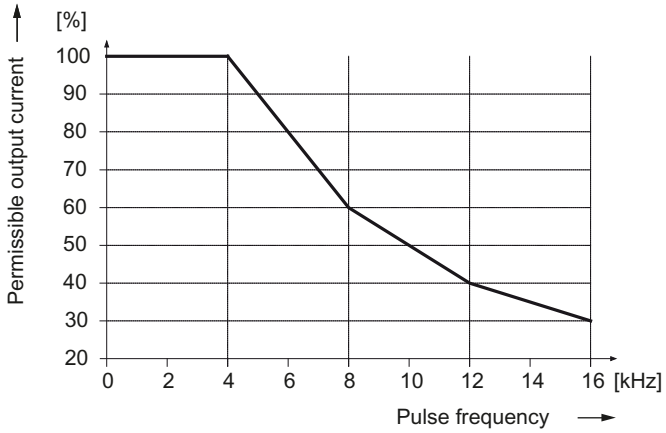


Figure 6-18 Output current as a function of the pulse frequency for the Motor Module ≥ 9 A

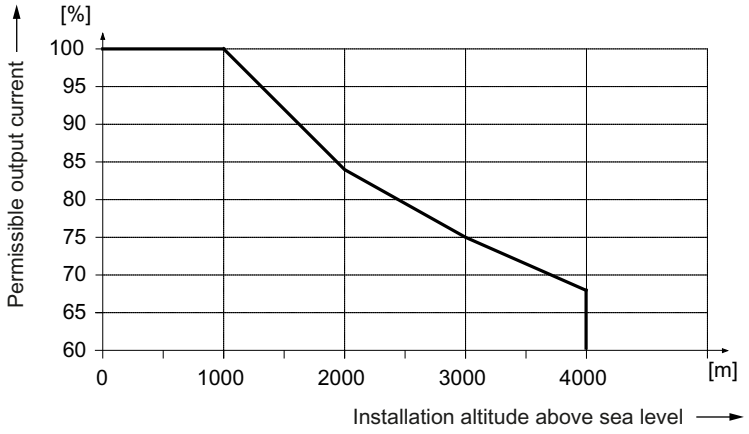


Figure 6-19 Output current as a function of the installation altitude

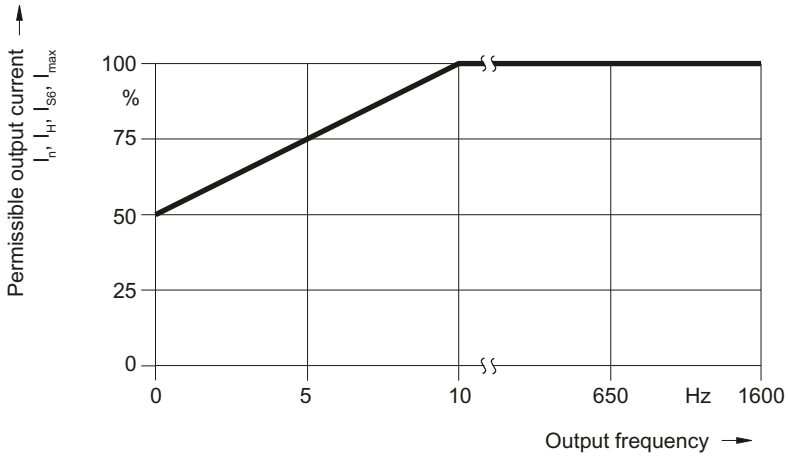


Figure 6-20 Current derating as a function of the output frequency

At installation altitudes >2000 m, an insolating transformer must be used (see "System overview/Derating as a function of the installation altitude and ambient temperature"). The design of the secondary line supply system must be as follows:

- TN system with grounded star point (no grounded outer conductor)
- IT system

A reduction of the line supply voltage phase-phase is not necessary.

Electrical connection for Line Modules and Motor Modules

7

7.1 Connection of DC-link busbars and 24 V busbars

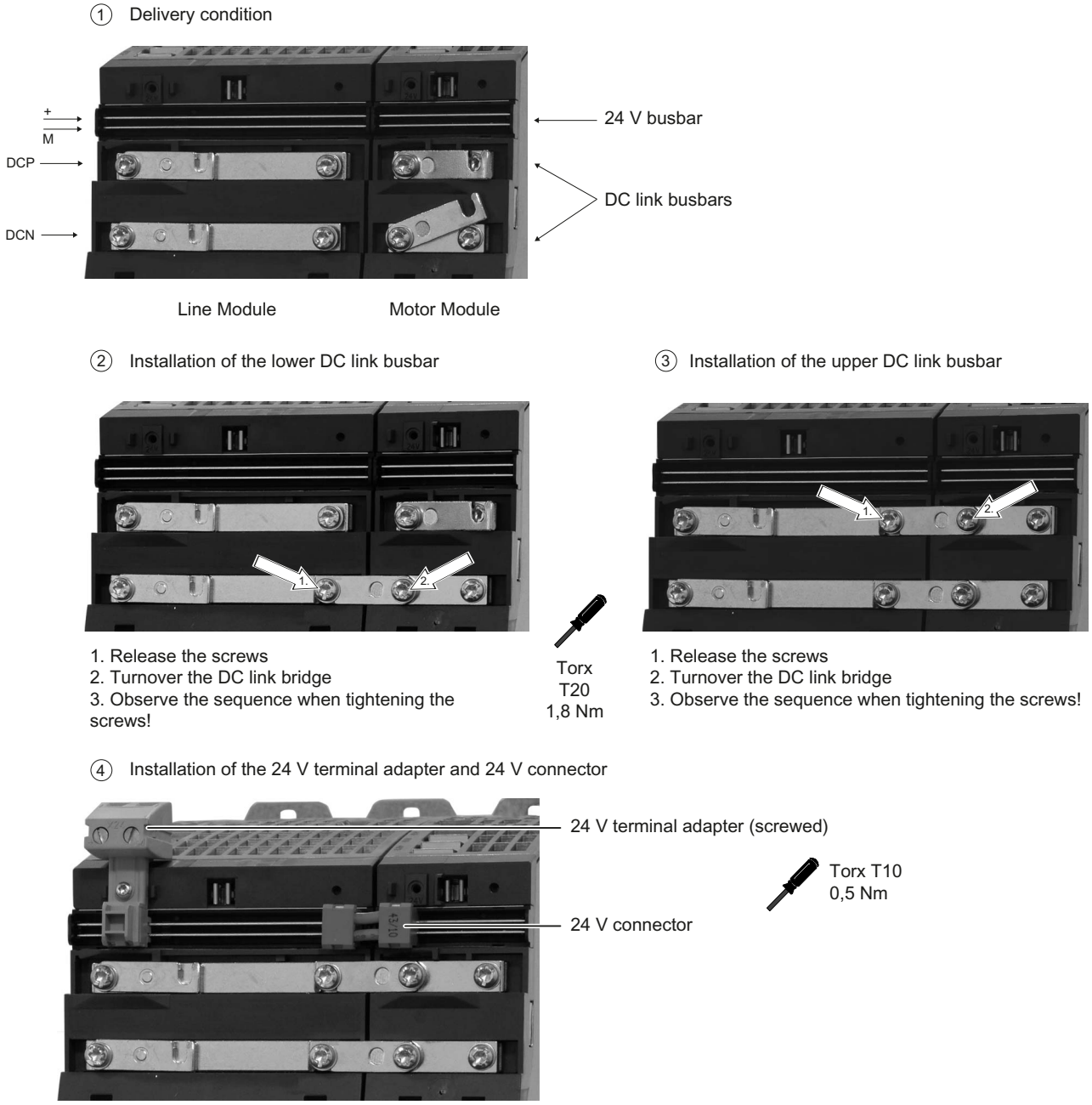


Figure 7-1 Connection of DC-link busbars and 24 V busbars

7.2 Installation of the 24 V terminal adapter

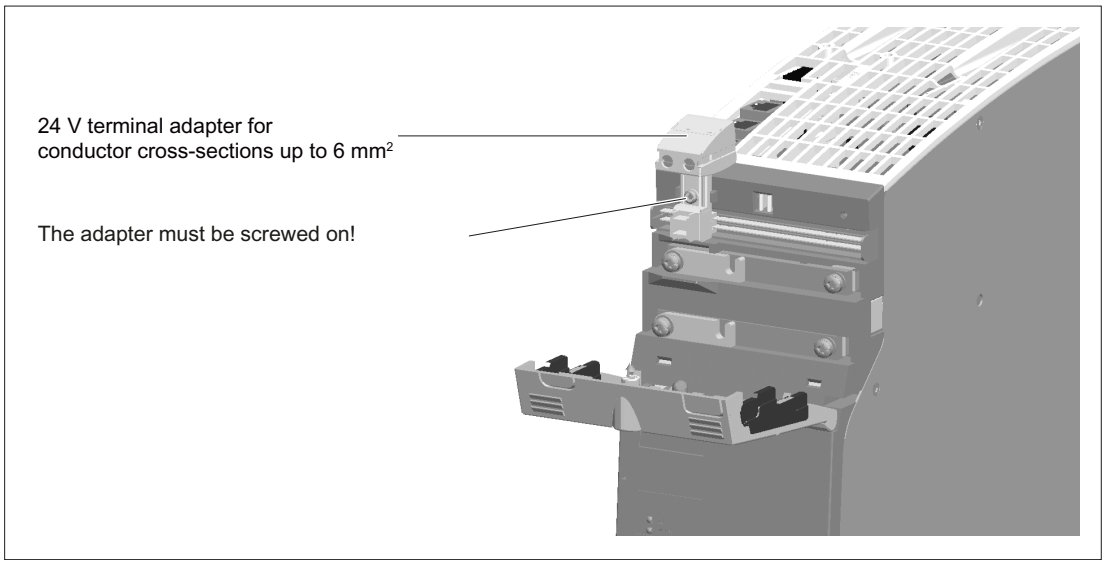


Figure 7-2 24 V terminal adapter installed

The terminal adapter can be fitted to any power unit. A recess must be provided for this purpose on the protective cover of the DC link using suitable pliers. The terminal adapter is snapped on and is retained using the screw provided (tightening torque: 0.5 Nm).

Screw: SHR, PT-TORX K30-3, 0X16-ST-A2F WN1452 / company EJOT

The 24 V terminal adapter is suitable for connecting conductor cross-sections of 0.5 mm² to 6 mm². The terminal adapter and associated screw are included in the scope of delivery of the Line Modules and Control Supply Modules.

⚠ DANGER

The 24 V terminal adapter must not be removed or plugged in with 24 V applied. The 24 V terminal adapter may only be withdrawn vertically to the front plate (i.e. not at an angle).

NOTICE

Once attached, the 24 V terminal adapter must be screwed tight using the screw supplied.

Table 7- 1 Installing the 24 V terminal adapter using an Active Line Module (36 kW) as example

		
Releasing the protective cover using the a flat-bladed screwdriver 1 x 5.5	Opening the protective cover	Attach and tighten the screw fittings of the 24 V terminal adapter

	
Break out the recess using suitable pliers	Close the protective cover (the protective cover must audibly click into place)

Note

The 24 V terminal adapter should always be installed to the left of the component located at the far left, because if it is positioned anywhere else there may not be enough space for the red 24 V jumpers.

If necessary, the 24 V terminal adapter can also be positioned on the right for 50 mm and 100 mm modules.

Note

If the 24 V terminal adapter is removed, the protective cover whose cutout has been broken out must be replaced by a new one for safety reasons.

7.3 Shield connection for terminals X21/X22 on the Motor Module

The image below shows a typical shield connection terminal for shielding the cables to terminal X21.

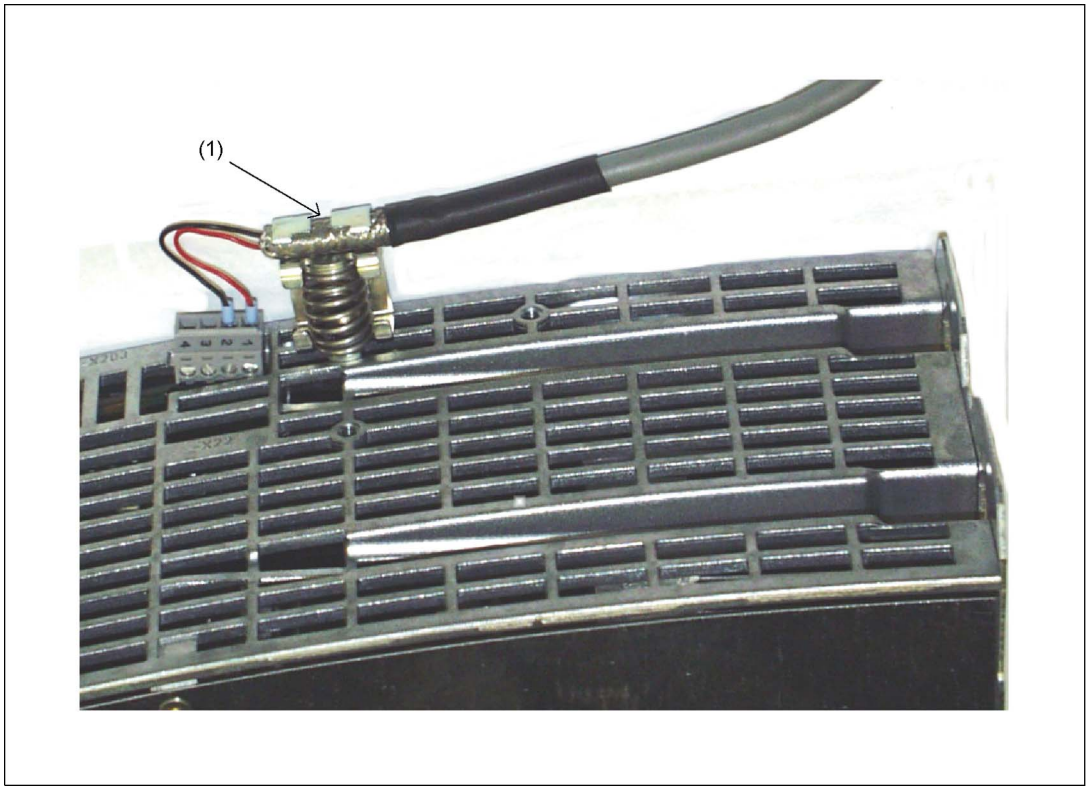


Figure 7-3 Shield connection terminal for shield support

(1) Shield connection terminal: Weidmüller, type KLBÜ 3-8 SC

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

DC link components

8

8.1 Braking Module Booksize

8.1.1 Description

The Braking Module Booksize is always used together with an external braking resistor. It has the following tasks:

- Targeted stop of the drives in the event of a line failure
  (e.g. emergency retraction or EMERGENCY OFF category 1).
- Limit the DC link voltage for brief periods of generator operation (e.g. if the regenerative feedback capability of the Line Module is deactivated or is not adequately dimensioned).

The Braking Module includes the necessary power electronics and control. When the Braking Module is in operation, the power which is fed back into the DC link is dissipated via an external braking resistor.

External braking resistors

Braking resistors without thermostatic switch 6SN1113-1AA00-0DA0 (P_N = 0.3 kW) and 6SL3100-1BE31-0AA0 (P_N = 1.5 kW) can be operated at the Braking Module Booksize.
The cable lengths between the Braking Module and braking resistor is limited to a maximum of 10 m.
The scope of delivery of the braking resistor 6SN1113-1AA00-0DA0 includes a shielded connection cable (3 m, 3 x 1.5 mm^2).

Rapid discharge

Furthermore, the Braking Module Booksize can used with a braking resistor to quickly discharge the DC link capacitors The DC link is discharged in a controlled manner via the braking resistor once the infeed unit has been switched off and the line-up has been disconnected from the line supply (e.g. via the main switch or line contactor). The function can be activated via a digital input on the braking module. A quick discharge makes sense, for example, when maintenance tasks are to be performed at the Motor Module and/or motor installation (reduction of the discharge time).

CAUTION
The drive system must be completely disconnected from the line supply in order for rapid discharge to take place. The motors must be at a standstill.

Monitoring functions

- Automatic detection of braking resistors and braking power monitoring
- I^2t monitoring of the braking resistors.
- Temperature monitoring of the Braking Module
- Short circuit and overload detection
- Ground fault detection

8.1.2 Safety information

⚠ DANGER

Risk of electric shock

A hazardous voltage is present for up to 5 minutes after the power supply has been disconnected.
The protective cover may only be opened after this time has expired.

The components must only be operated when the protective cover of the DC link is closed. Damaged components must not be operated further, otherwise this could result in secondary damage or accidents.

⚠ DANGER

DC-link discharge time

A hazard warning for the DC link discharge time must be attached in the local language to all of the components.
A set of labels in 16 languages is supplied with the component.

With a connected braking resistor, the Braking Module is ground-fault proof.

⚠ DANGER

It is only permissible to establish connections to the DC link using the adapters that SIEMENS has recommended (DC link adapter and DC link rectifier adapter).

⚠ CAUTION

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

CAUTION

The connection to the braking resistors must be made using a shielded cable.

The correct tightening torque of the DC link busbar screws (1.8 Nm, tolerance +30%) must be checked before commissioning. After transportation, the screws must be tightened.

CAUTION

DC link side covers are supplied with the components as standard and must be attached to the first and last components in the drive line-up. They can also be ordered separately, if required (order number: 6SL3162-5AA00-0AA0).

Note

If braking resistors that are not listed in this Manual are used, they can be destroyed.

8.1.3 Interface description

8.1.3.1 Overview

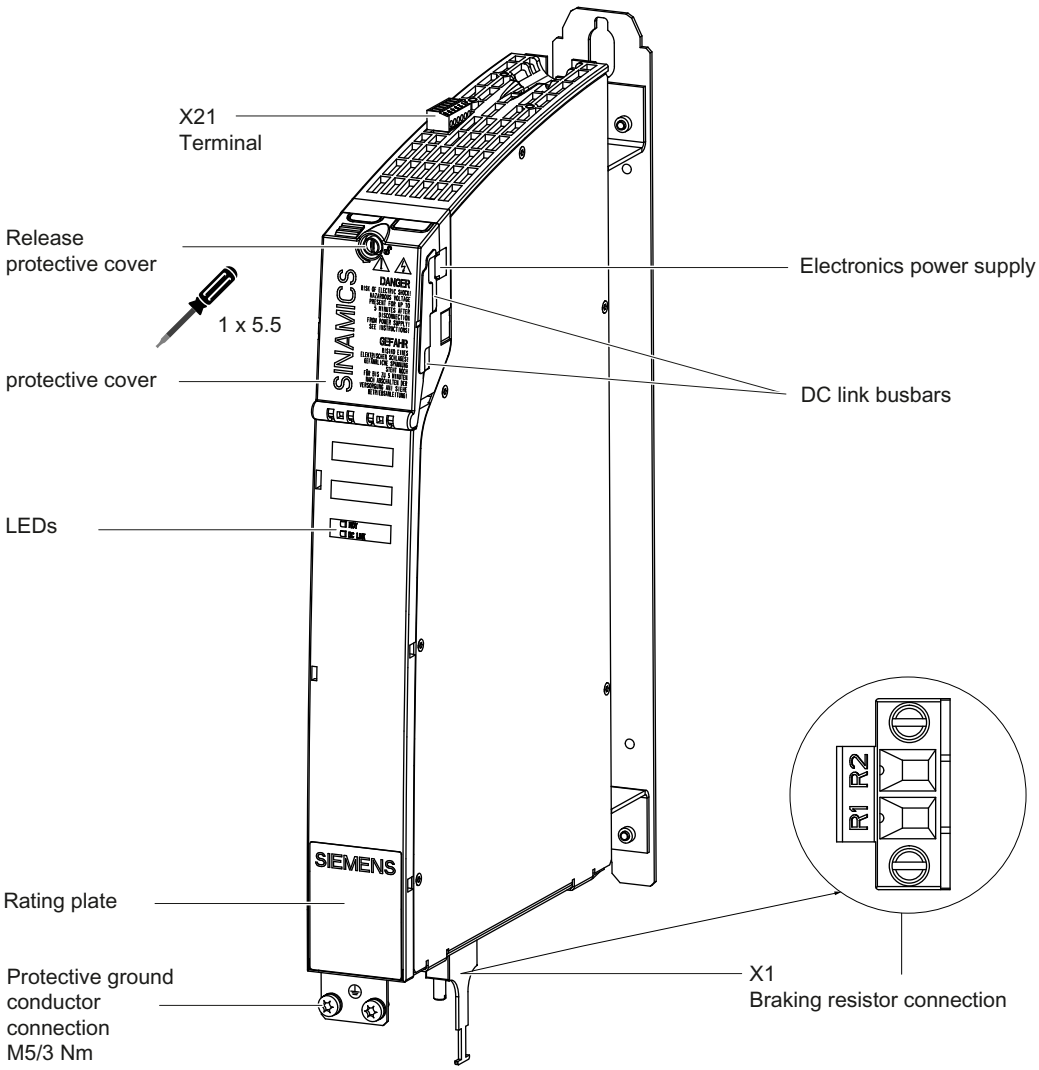


Figure 8-1 Interface overview, Braking Module Booksize

8.1.3.2 X1 braking resistor connection

Table 8- 1 X1 braking resistor connection

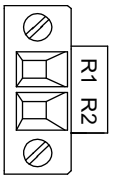
	Terminal	Designation	Technical specifications
	1	Braking resistor connection R1	Continued-short-circuit-proof
	2	Braking resistor connection R2	
Max. connectable cross-section: 4 mm² Type: Screw terminal 4 (see Chapter "Control cabinet installation/Connection system")			

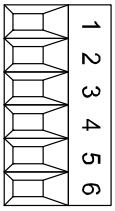
Table 8- 2 Braking resistors without a thermostatic switch for Braking Modules

Braking resistor	R in Ω	P_N in kW	P_{max} in kW
6SN1113-1AA00-0DA0	17	0.3	25
6SL3100-1BE31-0AA0	5.7	1.5	100

For detailed technical information on the braking resistors, see the chapter titled "Braking resistors".

8.1.3.3 X21 digital inputs/outputs

Table 8- 3 X21 digital inputs/outputs

	Terminal	Designation [1]	Technical specifications
	1	DI low: enable Braking Module DI high: inhibit/acknowledge Edge change high -> low: fault acknowledgement	Voltage: -3 V to +30 V Typical current consumption: 10 mA at 24 V DC Level (incl. ripple) High level: 15 V to 30 V Low level: -3 V to +5 V
	2	DI low: braking resistor not activated manually DI high: Braking resistor controlled manually (quick discharge) [2]	
		If X21.1 and 2 are activated simultaneously, the Braking Module inhibit has priority.	
	3	DO high: no prewarning DO low: Prewarning, disconnection imminent	Max. load current per output: 100 mA Continued-short-circuit-proof Voltage: 24 V DC
	4	DO high: ready for operation, no fault DO low: Fault	
	5	Ground	
	6		
Max. connectable cross-section 1.5 mm^2 Type: Screw terminal 1 (see Chapter, "Control cabinet installation and EMC/connection system")			

1) DI: digital input; DO: digital output; M: Electronics ground

2) The "fast discharge function" is used for discharging the capacitors in the DC link after interruption of the mains supply. This functions may be used 1 to 2 times per week at the most.

Terminal X21.1 - inhibit/acknowledge

Applying a high signal to terminal X21.1 inhibits the Braking Module. Fault messages that are available are acknowledged with a falling edge.

Terminal X21.3 - prewarning

When a prewarning is sent, disconnection of the braking module is imminent. This may be due to the following causes:

- The temperature of the Braking Module is 80% of the maximum value.
- 80% of the maximum on-load factor of the braking resistor has been reached (I^2t monitoring).
- 80% of the maximum braking energy of the braking resistor has been reached.
- An incorrect braking resistor is connected (only braking resistors approved by Siemens for this component are identified automatically).

Terminal X21.4 - fault

The fault can have the following causes:

- Electronics power supply is missing or outside permissible tolerance range
- Enable missing (input terminal).
- Overtemperature

- Overcurrent trip
- I^2t monitoring has responded.
- Ground fault/short circuit

In the event of an overtemperature, the fault can only be acknowledged with X21.1= high after a cooling-down time.

8.1.4 Connection example

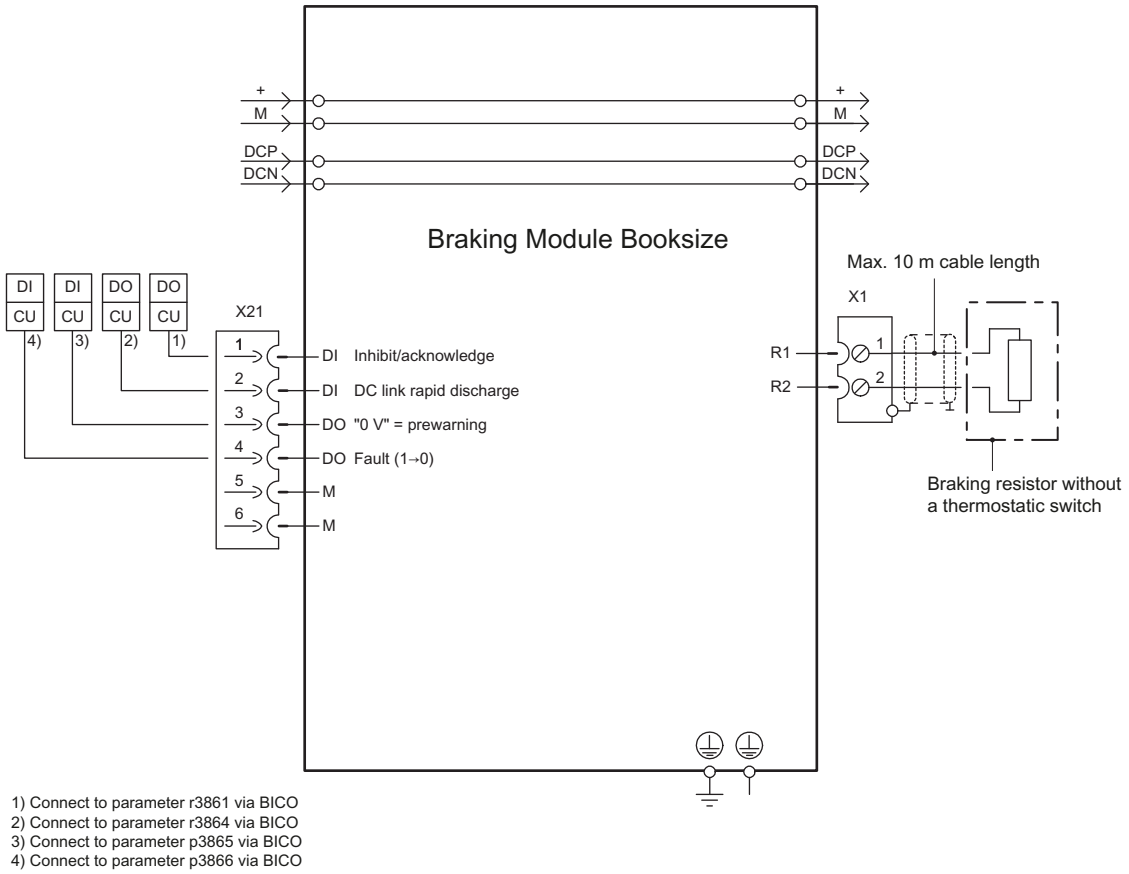


Figure 8-2 Connection example of a Braking Module Booksize

8.1.5 Meaning of LEDs

Table 8- 4 Meaning of the LEDs on the Braking Module Booksize

LED	Color	Status	Description, cause	Remedy
READY	-	Off	Electronics power supply is missing or outside permissible tolerance range. Component deactivated via terminal.	–
	Green	Continuous light	Component is ready to operate.	–
	Red	Continuous light	Enable missing (input terminal) Overtemperature Overcurrent trip I^2t monitoring activated Ground fault/short circuit **Note:** In the event of an overtemperature, the error cannot be acknowledged until a cooling time has elapsed.	Diagnose fault (via output terminals) and acknowledge it (via input terminal)
DC LINK	-	Off	Only braking resistors approved by Siemens for this component are identified automatically. Component not active.	–
	Green	Flashing light	Component active (DC link discharge via braking resistor in progress).	–

8.1.6 Dimension drawing

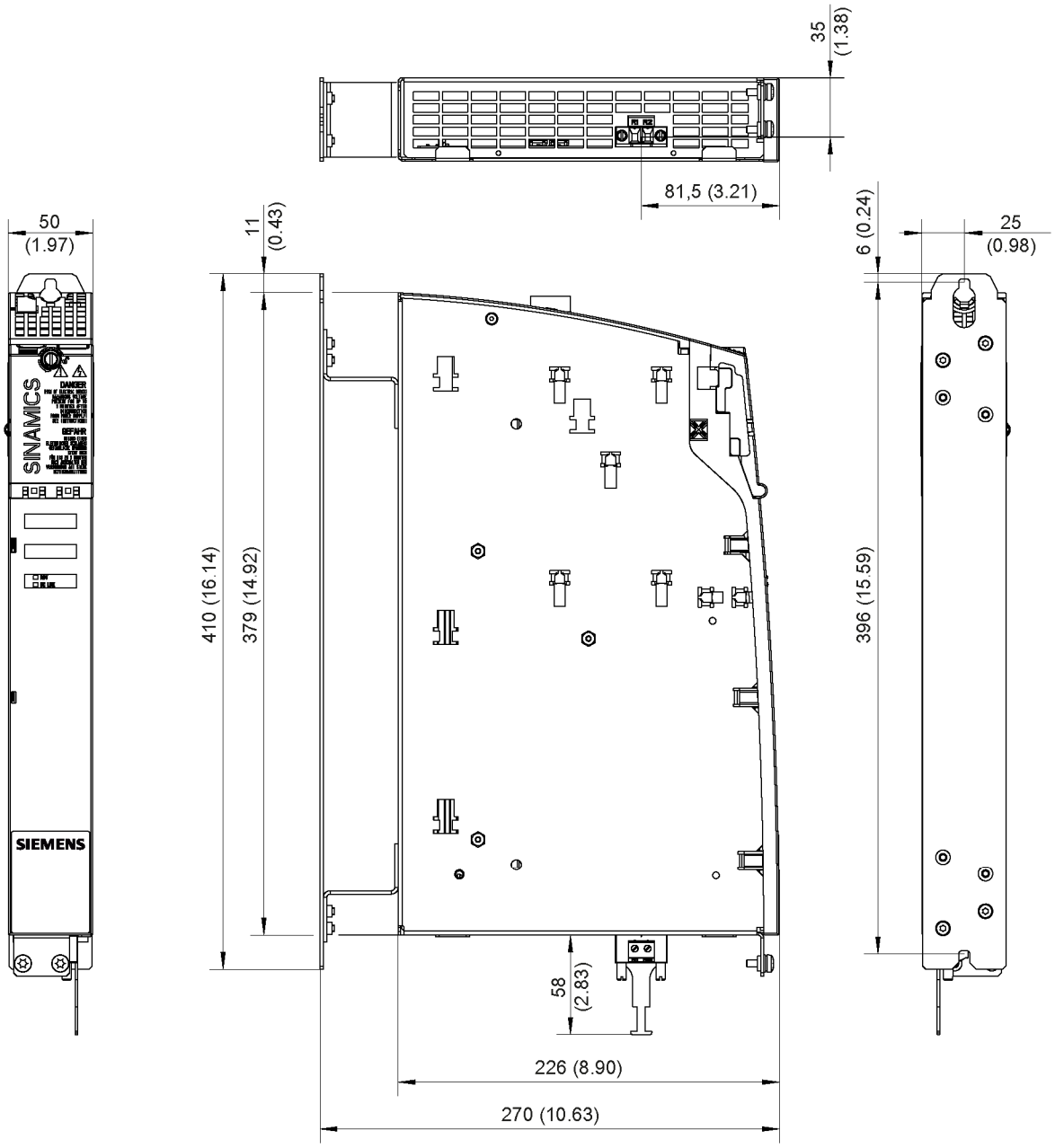
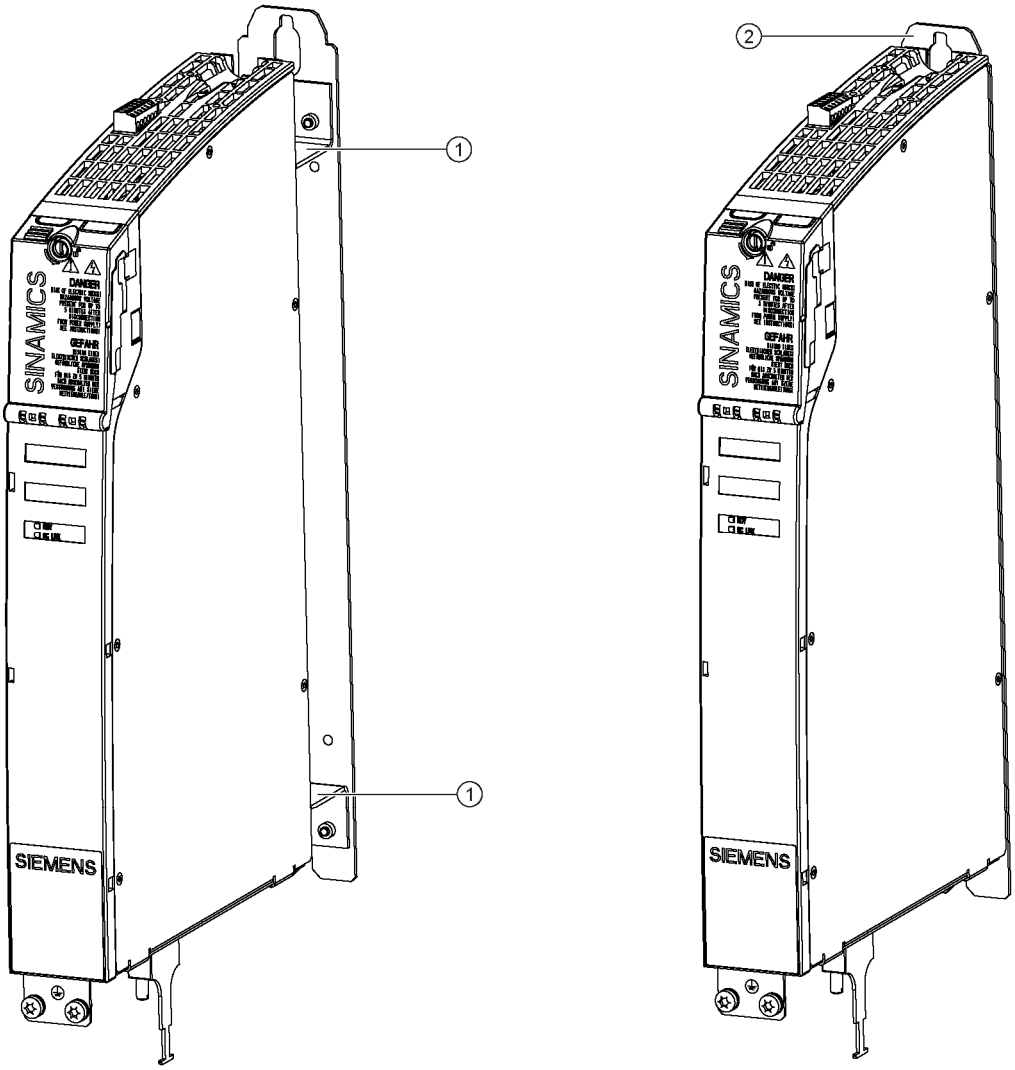


Figure 8-3 Dimension drawing of Braking Module, all dimensions in mm and (inches)

8.1.7 Installation



① Delivery condition with spacer - mounting depth for drive line-up in booksize format with internal air cooling
② Spacer removed - mounting depth for drive line-up in booksize format with external air cooling

Figure 8-4 Methods of installing Braking Modules with/without spacer elements

8.1.8 Technical data

Table 8- 5 Technical data

6SL3100-1AE31-0AB0		
DC link voltage	V_{DC}	510 - 720
ON threshold	V	770
Electronics power supply	V_{DC}	24 (20.4 – 28.8)
Electronics current consumption (at 24 V DC)	A_{DC}	0.5
Current carrying capacity DC link busbar 24 V busbar	 A_{DC} A_{DC}	 100 20
Rated power max. Continuous braking power	 kW kW	 100 1.5
Power loss [1)]	W	20
Cooling method		Natural convection
Weight	kg	4.1

1) For an overview, see the power loss tables in chapter Control cabinet installation

8.1.8.1 Characteristic curves

Duty cycle for braking resistors without a thermostatic switch

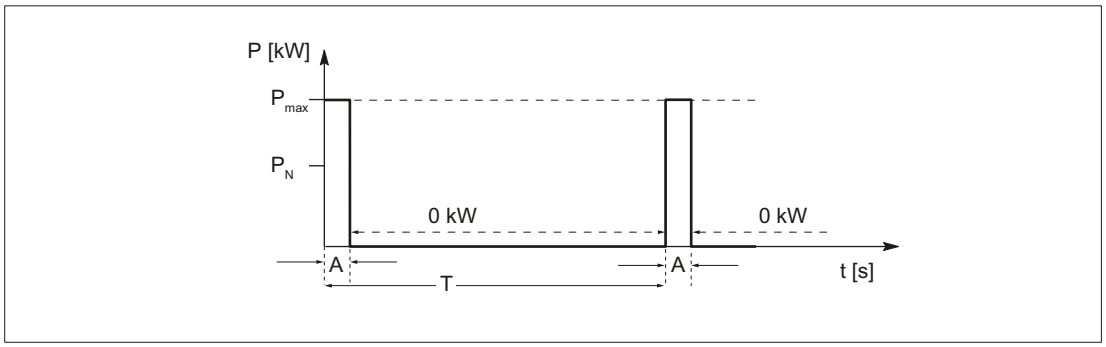


Figure 8-5 Duty cycle for braking resistors without a thermostatic switch

T [s] time period of braking duty cycle

A [s] load duration

P_N [W] rated power (continuous power) of braking resistor

P_{max} [W] peak power of braking resistor (6 x P_N)

Table 8- 6 Duty cycles

	6SN1113–1AA00–0DA0		6SL3100–1BE31–0AAx	
	Short duty cycle	Long duty cycle	Short duty cycle	Long duty cycle
A [s]	0.1	0.4	1	2
T [s]	11.5	210	68	460

The following applies when connecting Braking Modules in parallel:

$P_{N\ total}$ = 0.9 x total P_N of single devices

$P_{max\ total}$ = total P_{max} of single devices

8.1.8.2 Configuration instructions

DC link capacitance

To operate the Braking Modules, a minimum capacitance is required in the DC link. The DC link voltage of braking resistors is 440 µF each.

The capacitance of the Braking Module of 110 µF is included in the total capacitance value.

When booksize format Braking Modules are connected in parallel, the DC link capacitance specified above must be available for each Braking Module.

Note

Only the components that are connected to each other via the DC link busbar can be included in the total capacitance.

DC link cable

In a two-row or distributed drive line-up, the DC links are connected to each other via a DC link cable. When using a Braking Module in the drive line-up, this cable must not be longer than 10 m. In all cases, the DC link cable must have low impedance and a cross-section of at least 10 mm^2.

8.2 Braking Module Booksize Compact

8.2.1 Description

The Braking Module Booksize Compact is always used together with a braking resistor. It has the following tasks:

- Targeted stop of the drives in the event of a line failure
  (e.g. emergency retraction or EMERGENCY OFF category 1).
- Limit the DC link voltage for brief periods of generator operation (e.g. if the regenerative feedback capability of the Line Module is deactivated or is not adequately dimensioned).

The Braking Module includes the necessary power electronics and control. When the module is in operation, the power which is fed back into the DC link is dissipated via an external braking resistor.

The Braking Module can be operated on 200 V or 400 V supply systems; the 4-pin DIP switch on the top of the module is used to select which one applies in each case. The factory setting is 400 V.

When spacers (6SL3426-1CC00-0AA0) are used, the Braking Module Booksize Compact can be integrated into a drive line-up in booksize format with internal air cooling.

External braking resistors

Braking resistors with or without a thermostatic switch can be used on the Braking Module Booksize Compact (for a list of braking resistors, see the chapter titled "X1 braking resistor connection"). The DIP switch sets the type of braking resistor being used in each case. The factory setting is "braking resistor with a thermostatic switch".

The cable length between the Braking Module and the braking resistor is limited to 10 m.

Rapid discharge

Furthermore, the Braking Module Booksize Compact can be used with a braking resistor to quickly discharge the DC link. The DC link is discharged in a controlled manner via the braking resistor once the infeed unit has been switched off and the line-up has been disconnected from the line supply (e.g. via the main switch or line contactor). The function can be activated via a digital input on the Braking Module. A quick discharge makes sense, for example, when maintenance tasks are to be performed at the Motor Module and/or motor installation (reduction of the discharge time).

CAUTION
The drive system must be completely disconnected from the line supply in order for rapid discharge to take place. The motors must be at a standstill. On completion of quick discharge, a voltage of 30 V is still present at the DC link. If quick discharge is aborted before is has been completed, this voltage can still be >60 V. The DC link voltage must be be checked prior to commencing work in all cases!

Cooling methods

The Braking Module Booksize Compact can be operated with the following cooling methods:

- Internal air cooling
- Cold plate cooling

The required cooling method is set using the DIP switch The factory setting is "internal air cooling".

Internal fan

When the Braking Module is being used with internal air cooling, the internal fan starts up immediately and is subsequently controlled by the temperature.

If the DIP switch is set to cold plate cooling by mistake, the fan will still start up when a certain temperature threshold is reached, in order to prevent the Braking Module shutting down due to overtemperature. If this threshold is exceeded, an alarm is issued via the digital output "Prewarning". This ensures that an emergency stop can be performed if necessary.

Monitoring functions

- Automatic detection of braking resistors without thermostatic switch and corresponding braking power monitoring (only if the "Braking resistor without thermostatic switch" setting is used)
- I^2t monitoring of the Braking Module
- Temperature monitoring of the Braking Module
- Temperature monitoring of the connected braking resistor with thermostatic switch (only for setting "Braking resistor with thermostatic switch")
- Short-circuit and overload detection (for all braking resistors)
- Ground fault detection (for all braking resistors)

Parallel operation

Several Braking Modules Booksize Compact can be connected in parallel to increase the braking power. In this case, the braking energy is divided between the modules. Formulae for calculating the parallel connection are given in the section ""Notes on planning/configuration"

A parallel connection of the Braking Module Booksize Compact to SINAMICS S120 Basic Line Modules 20 kW and 40 kW is also possible.

8.2.2 Safety information

⚠ DANGER

Risk of electric shock

A hazardous voltage is present for up to 5 minutes after the power supply has been disconnected.
The protective cover may only be opened after this time has expired.

The components must only be operated when the protective cover of the DC link is closed. Damaged components must not be operated further, otherwise this could result in secondary damage or accidents.

⚠ DANGER

DC-link discharge time

A hazard warning for the DC link discharge time must be attached in the local language to all of the components.
A set of labels in 16 languages is supplied with the component.

With a connected braking resistor, the Braking Module is ground-fault proof.

⚠ DANGER

It is only permissible to establish connections to the DC link using the adapters that SIEMENS has recommended (DC link adapter and DC link rectifier adapter).

⚠ CAUTION

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

CAUTION

The connection to the braking resistors must be made using a shielded cable.

The correct tightening torque of the DC link busbar screws (1.8 Nm, tolerance +30%) must be checked before commissioning. After transportation, the screws must be tightened.

CAUTION

DC link side covers are supplied with the components as standard and must be attached to the first and last components in the drive line-up. They can also be ordered separately, if required (order number: 6SL3162-5AA00-0AA0).

Note

If braking resistors that are not listed in this Manual are used, they can be destroyed.

8.2.3 Interface description

8.2.3.1 Overview

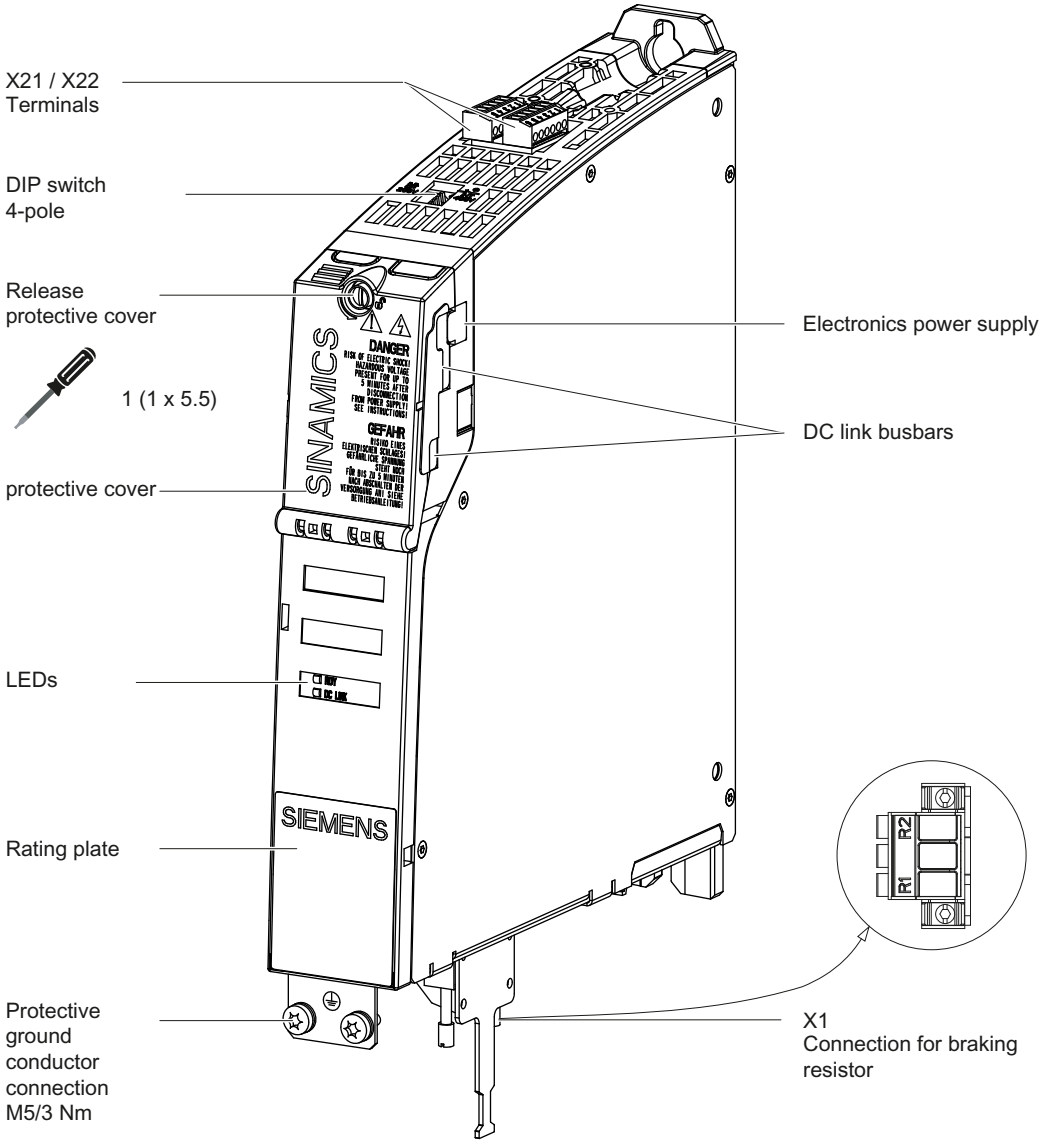
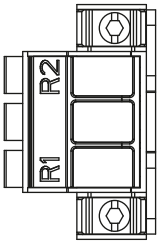


Figure 8-6 Interface overview, Braking Module Booksize Compact

8.2.3.2 X1 braking resistor connection

Table 8- 7 X1 braking resistor connection

	Terminal	Designation	Technical specifications
	1	Braking resistor connection R1	Continued-short-circuit-proof
	2	Not assigned	
	3	Braking resistor connection R2	
Max. connectable cross-section: 6 mm^2 Type: Screw terminal 5 (see Chapter "Control cabinet installation/Connection system")			

Braking resistors without a thermostatic switch

The Braking Module Booksize Compact is only designed for operation with the braking resistors listed below.

Table 8- 8 Braking resistors without a thermostatic switch

Braking resistor	R in Ω	P_N in kW	P_{max} in kW
6SN1113-1AA00-0DA0	17	0.3	25
6SL3100-1BE31-0AA0	5.7	1.5	100

Braking resistors with a thermostatic switch

The Braking Module Booksize Compact is only designed for operation with the braking resistors listed below.

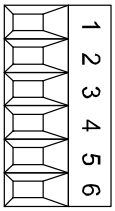
Table 8- 9 Braking resistors with a thermostatic switch

Braking resistor	R in Ω	P_N in kW	P_{20} in kW	P_{max} in kW
6SE7018-0ES87-2DC0	80	1.25	5	7.5
6SE7021-6ES87-2DC0	40	2.5	10	15
6SE7023-2ES87-2DC0	20	5	20	30

For detailed technical information on the braking resistors, see the chapter titled "Braking resistors".

8.2.3.3 X21 digital inputs/outputs

Table 8- 10 X21 digital inputs/outputs

	Terminal	Designation [1]	Technical specifications
	1	DI low: enable Braking Module DI high: inhibit/acknowledge Edge change high -> low: fault acknowledgement	Voltage: -3 V to +30 V Typical current consumption: 10 mA at 24 VDC Level (incl. ripple) High level: 15 V to 30 V Low level: -3 V to +5 V
	2	DI low: braking resistor not activated manually DI high: Braking resistor controlled manually (quick discharge) [2]	
		If X21.1 and X21.2 are activated simultaneously, the Braking Module inhibit has priority.	
	3	DO high: no prewarning DO low: Prewarning:	Max. load current per output: 100 mA Continued-short-circuit-proof Voltage: 24 V DC
	4	DO high: ready for operation, no fault DO low: Fault	
	5	Ground	
	6		
Max. connectable cross-section 1.5 mm^2 Type: Screw terminal 1 (see Chapter, "Control cabinet installation and EMC/connection system")			

1) DI: digital input; DO: digital output; M: Electronics ground

2) The "fast discharge function" is used for discharging the capacitors in the DC link after interruption of the mains supply.

Terminal X21.1 - inhibit/acknowledge

Applying a high signal to terminal X21.1 inhibits the Braking Module. Fault messages that are available are acknowledged with a falling edge.

Terminal X21.3 - prewarning

When a prewarning is sent, disconnection of the braking module is imminent. This may be due to the following causes:

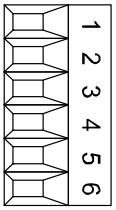
- The temperature switch braking resistor has triggered (only if the "Braking resistor with thermostatic switch" setting is used)
- The temperature of the Braking Module is 80% of the maximum value.
- The I^2t counter of the Braking Module has reached 80% of the maximum value.
- The braking resistor has reached 80% of the maximum permissible braking energy (only for setting "Braking resistor without thermostatic switch")
- An incorrect braking resistor is connected (only if the "braking resistor without a thermostatic switch" setting is used)

Terminal X21.4 - fault

In the event of an overtemperature fault, I^2t monitoring, or braking power monitoring, the fault will be acknowledged automatically after a cooling phase. Manual acknowledgment is not necessary!

8.2.3.4 X22 digital output/temperature switch

Table 8- 11 X22 digital output/temperature switch, braking resistor

	Terminal	Designation [1)]	Technical specifications
	1	+ Temp	Temperature switch of the braking resistor
	2	- Temp	
	3	Reserved	Please do not assign
	4	Reserved	
	5	DO high: 200 V supply system is selected DO low: 400 V supply system is selected	
	6	Reserved	Please do not assign
Max. connectable cross-section 1.5 mm² Type: Screw terminal 1 (see Chapter, "Control cabinet installation/Connection system")			

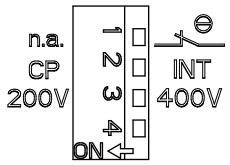
1) DO: digital output

8.2.3.5 DIP switch

The 4-pin DIP switch is located at the top of the Braking Module and sets the braking resistor being used, the cooling method, and the line voltage.

Make the required settings before the Braking Module is installed in the control cabinet; once the module is installed, the DIP switch can no longer be accessed from the front.

Table 8- 12 DIP switch for Braking Module Booksize Compact

	Switch	Switch position	Function	Factory setting
	1	ON	Braking resistor without a thermostatic switch	OFF
		OFF	Braking resistor with a thermostatic switch	
	2	ON	Cold plate cooling	OFF
		OFF	Internal air cooling	
	3	ON	200 V line voltage	OFF
		OFF	400 V line voltage	
	4	ON	Reserved	OFF
		OFF		

NOTICE
For "braking resistor without a thermostatic switch" mode (switch 1 = ON) , terminals X22.1 and X22.2 must not be assigned for the Braking Module to work.

8.2.4 Connection examples

Connection of a braking resistor without thermostatic switch to a Braking Module Booksize Compact

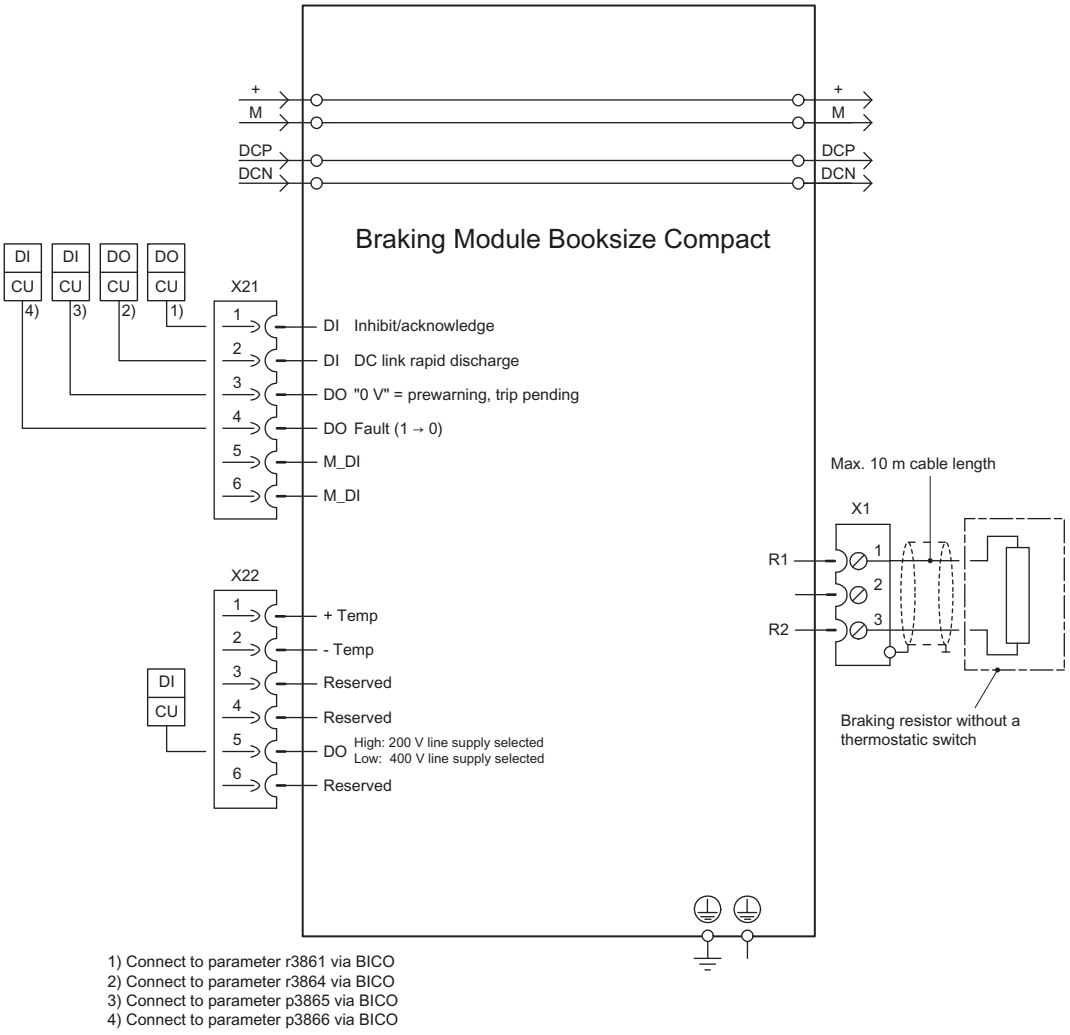


Figure 8-7 Connection example for Braking Module Booksize Compact and braking resistor without a thermostatic switch

Note

The digital inputs DI are isolated and refer to M_DI (X21.5 and X21.6).
The reference point of the digital outputs DO is the ground GND of the 24 V supply.

The connections for the temperature switches (X22.1 and X22.2) must not be assigned for "braking resistor without a thermostatic switch" mode for the Braking Module to work.

Connection of a braking resistor with thermostatic switch to a Braking Module Booksize Compact

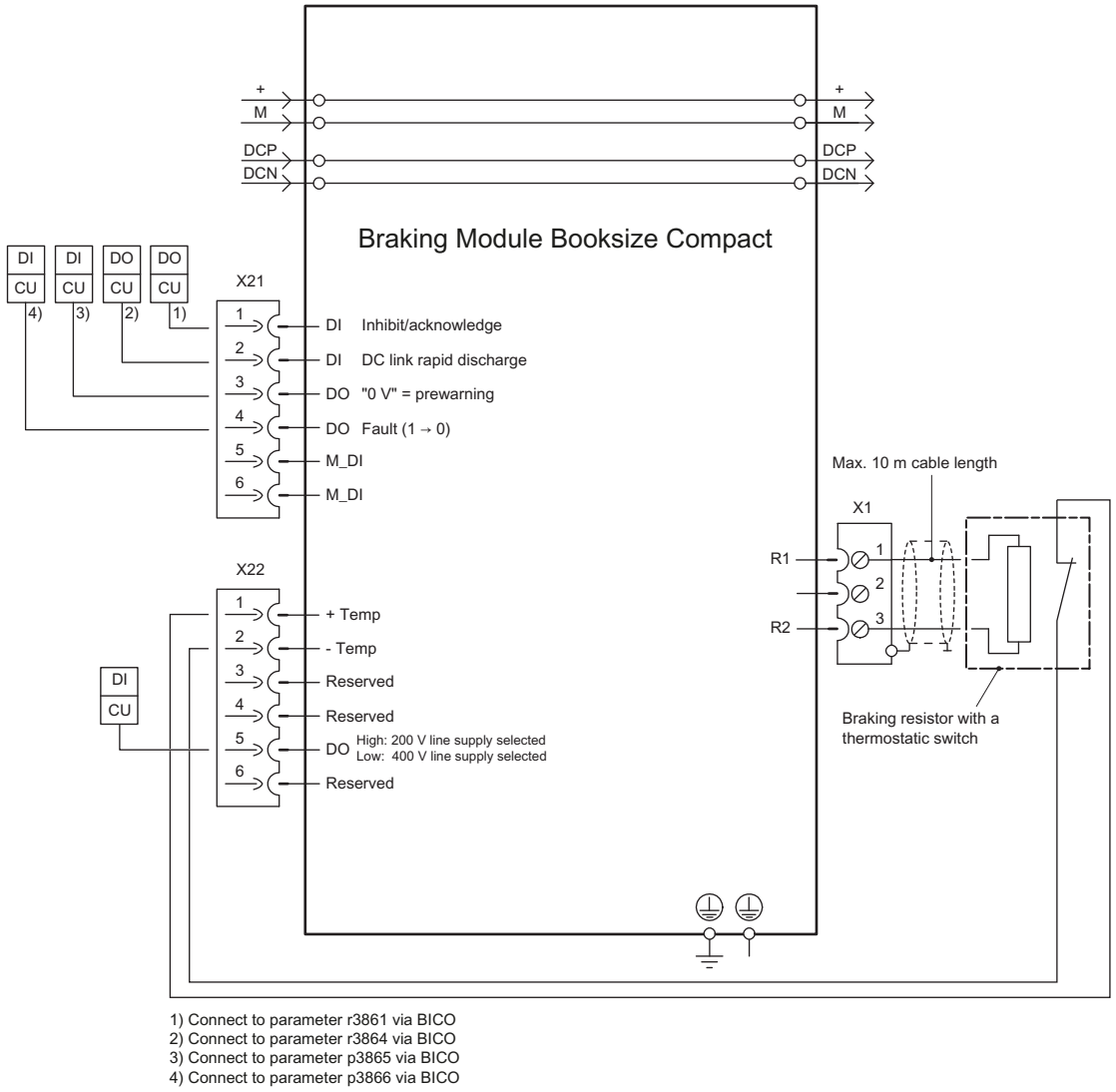


Figure 8-8 Connection example for Braking Module Booksize Compact and braking resistor with a thermostatic switch

Note

The digital inputs DI are isolated and refer to M_DI (X21.5 and X21.6).
The reference point of the digital outputs DO is the ground GND of the 24 V supply.

8.2.5 Meaning of LEDs

Table 8- 13 Meaning of LEDs on the Braking Module Booksize Compact

LED	Color	Status	Description	Remedy
READY	-	Off	Electronics power supply is missing or outside permissible tolerance range.	Check electronics power supply
	Green	Continuous light	The component is ready for operation.	-
	Red	Continuous light	Enable missing (input terminal) Overtemperature of IGBT/braking resistor Overcurrent trip I^2t monitoring activated Braking power monitoring triggered Ground fault/short circuit Note: In the event of overtemperature, I^2t monitoring, or braking power monitoring, the fault will be acknowledged automatically after a cooling phase. Manual acknowledgment is not possible.	Diagnose the fault (using the output terminals) and acknowledge (using the input terminal)
DC LINK	-	Off	Only braking resistors approved by Siemens for this component are identified automatically. The component is not active.	
	Orange	Continuous light	The DC link voltage is present.	-
	Orange	Flashing light	Component active (DC link discharge via braking resistor in progress)	-

8.2.6 Dimension drawing

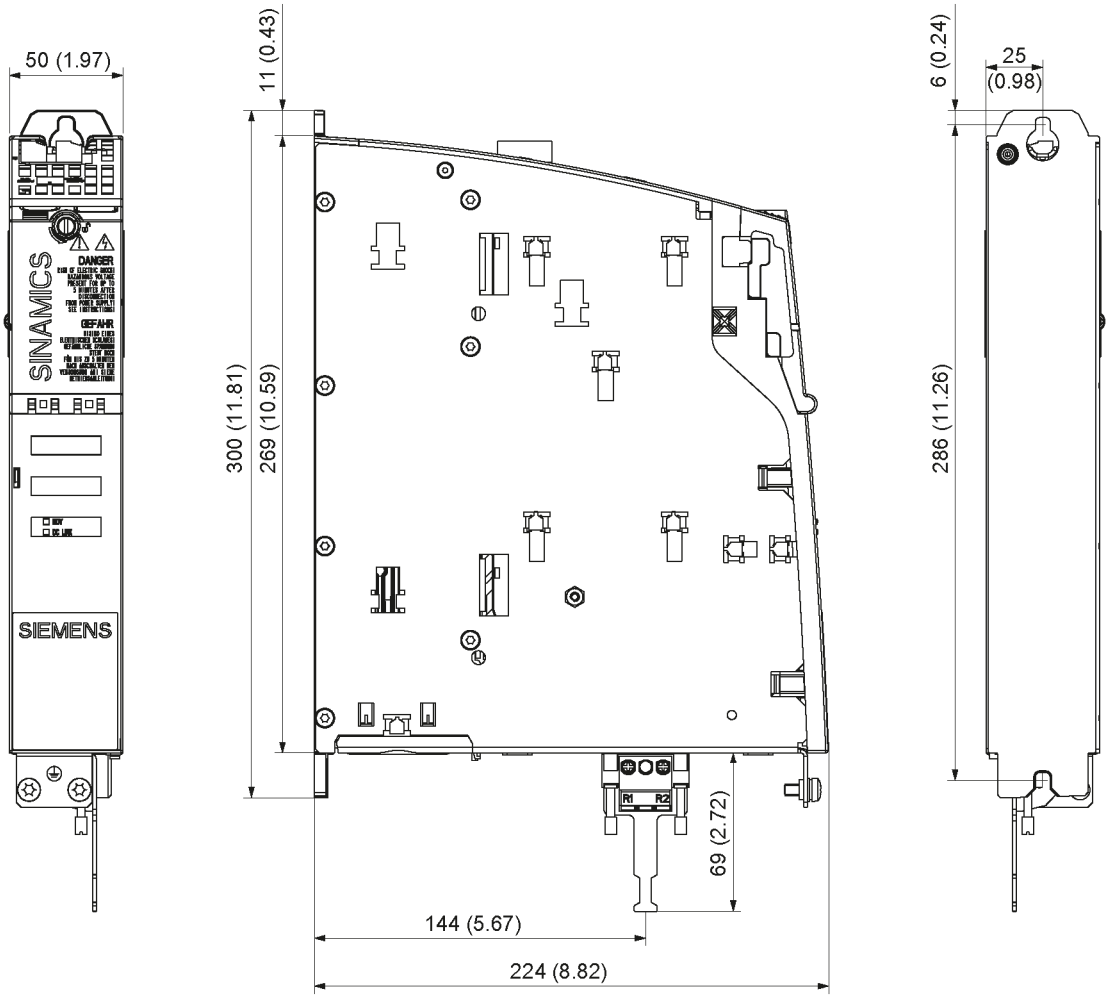
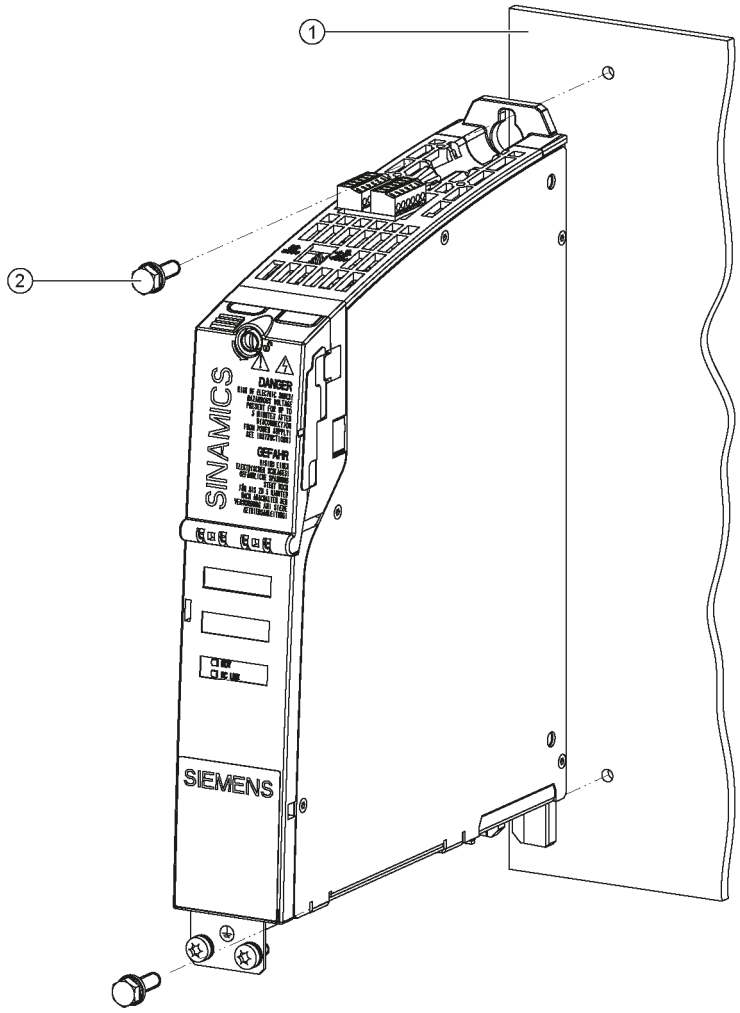


Figure 8-9 Dimension drawing of Braking Module Booksize Compact, all dimensions in mm and (inches)

8.2.7 Installation

Installing a Braking Module Booksize Compact with internal air cooling



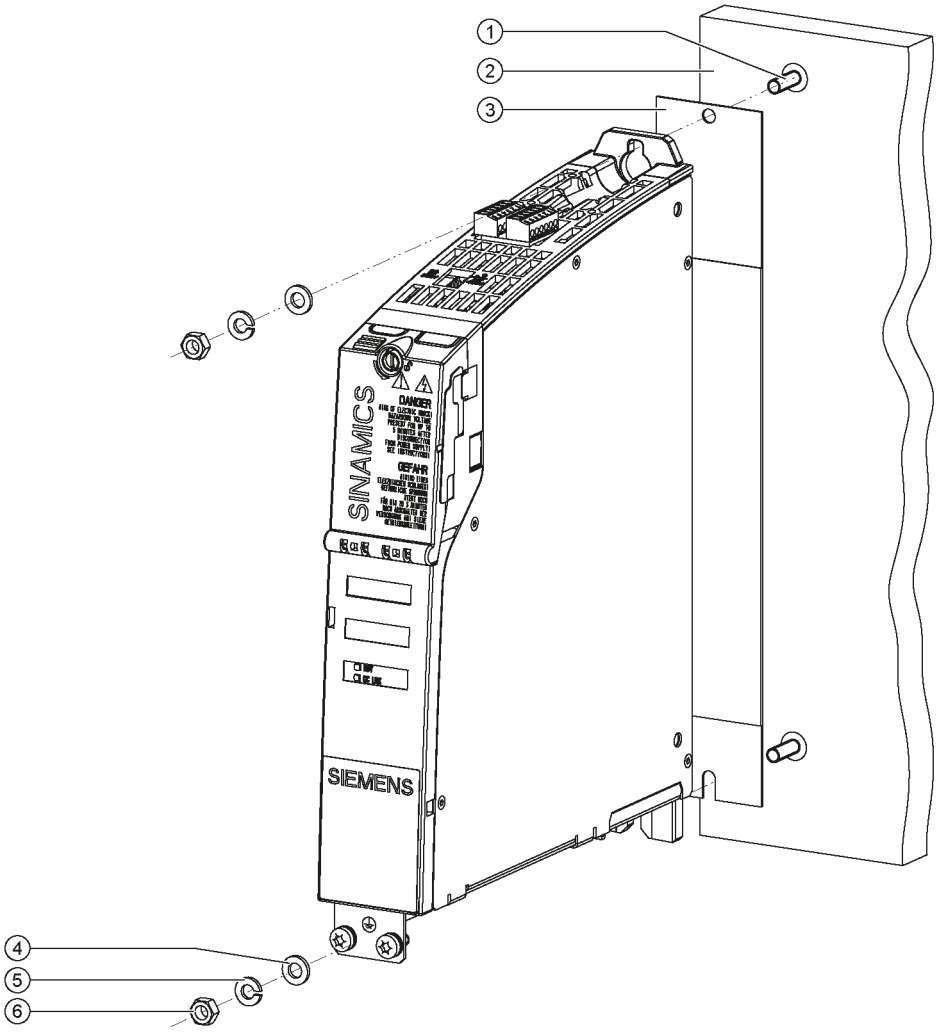
① Mounting wall
② M6 x 16 screw
Hex combination screw or hex screw with spring washer and plain washer

Figure 8-10 Installing a Braking Module Booksize Compact with internal air cooling

Tightening torques:

- Initially, tighten by hand (0.5 Nm)
- Then tighten with 6 Nm.

Installing a Braking Module Booksize Compact with cold plate



① M6 studs
② Cold plate (air or liquid cooling)
③ Heat-conducting foil
④ Washer
⑤ Spring washer
⑥ M6 nut

Figure 8-11 Installing a Braking Module Booksize Compact with cold plate

Tightening torques:

- Initially, tighten the nuts by hand (0.5 Nm)
- Then tighten with 10 Nm.

Special points to note in relation to installation on a cold plate

To improve heat transfer, a heat-conducting medium must be used. Special spherical-indented heat-conducting foil must be used for this purpose. Every Braking Module Booksize Compact is supplied with heat-conducting foil cut to the right size. Note the mounting position of the heat-conducting foil.

Note

When a component is replaced, the heat-conducting foil must also be replaced. Only heat-conducting foil approved or supplied by Siemens may be used.

	Order number
Heat-conducting foil, 50 mm	6SL3162-6FB01-0AA0

8.2.8 Technical data

Table 8- 14 Technical data

6SL3400-1AE31-0AAx			
Line supply		200 V	400 V
DC link voltage	V_{DC}	250 - 360	510 - 720
ON threshold	V_{DC}	400	760
Braking power maximum [1] continuous braking power	 kW kW	 50 2.5	 100 5
Electronics power supply	V_{DC}	24 (20.4 – 28.8)	
Electronics current consumption (at DC 24 V) Standby mode	A_{DC}	 0.2 0.4	
Current carrying capacity: 24 V busbars current carrying capacity	 A_{DC} A_{DC}	 100 20	
Power loss [2] Standby mode	 W W	 5 25	
Switching frequency	Hz	2000	
Cooling methods		Internal air cooling Cold plate cooling	
Max. ambient temperature	°C	55	
Weight	kg	2.7	

1) At upper switch-on threshold

2) For an overview, see the power loss tables in Chapter, Control cabinet installation

8.2.8.1 Characteristic curves

Duty cycle for braking resistors without a thermostatic switch

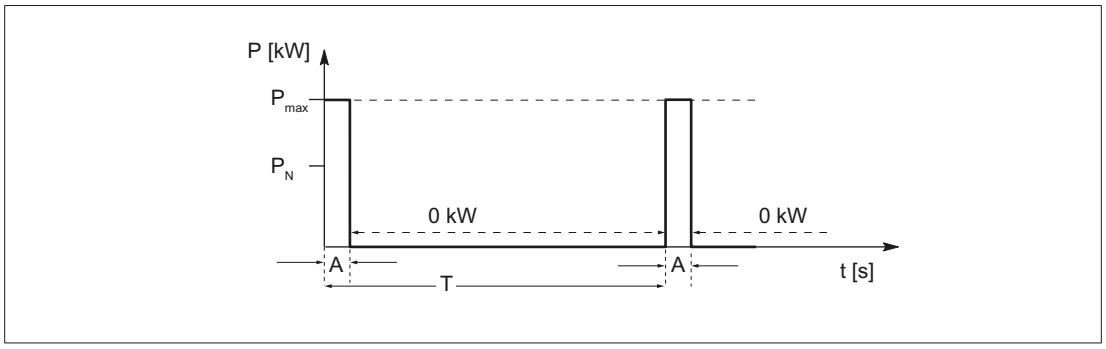


Figure 8-12 Duty cycle for braking resistors without a thermostatic switch

T [s] time period of braking duty cycle

A [s] load duration

P_N [W] rated power (continuous power) of braking resistor

P_{max} [W] peak power of braking resistor (6 x P_N)

Table 8- 15 Duty cycles

	6SN1113–1AA00–0DA0		6SL3100–1BE31–0AAx	
	Short duty cycle	Long duty cycle	Short duty cycle	Long duty cycle
A [s]	0.1	0.4	1	2
T [s]	11.5	46	68	136

Duty cycles for braking resistors with a thermostatic switch

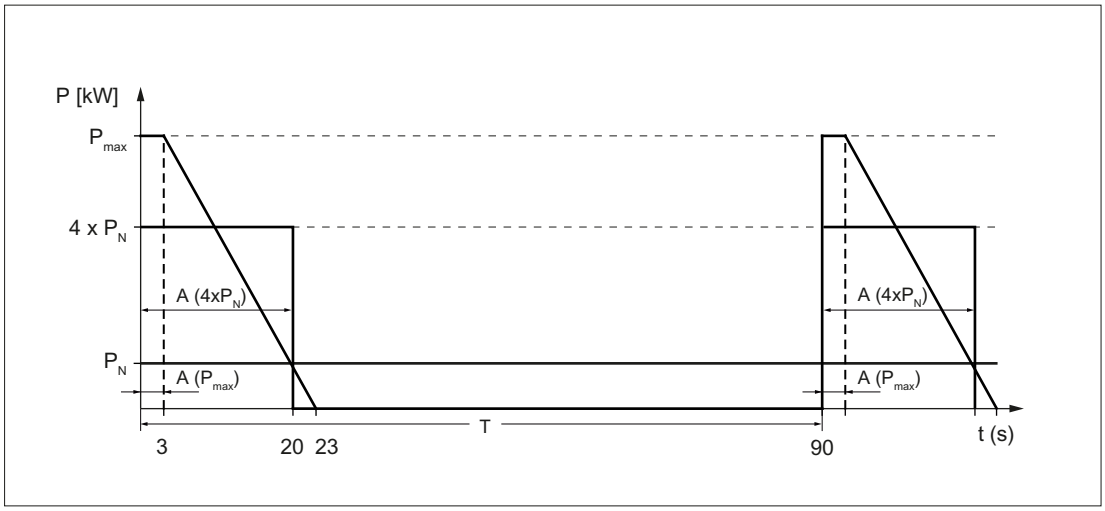


Figure 8-13 Duty cycles for braking resistors with a thermostatic switch

T [s] time period of braking duty cycle

A [s] load duration

P_N [W] rated power (continuous power) of braking resistor

P_{max} [W] peak power of braking resistor (6 x P_N)

4 x P_N [W] = power permitted every 90 s for 20 s

Table 8- 16 Duty cycles

	6SE7018-0ES87-2DC0		6SE7021-6ES87-2DC0		6SE7023-2ES87-2DC0	
	Duty cycle P_{max}	Duty cycle 4 x P_N	Duty cycle P_{max}	Duty cycle 4 x P_N	Duty cycle P_{max}	Duty cycle 4 x P_N
A [s]	3	20	3	20	3	20
T [s]	90	90	90	90	90	90

8.2.9 Configuration instructions

DC link capacitance

When configuring the drive line-up, please note that only one Braking Module Booksize Compact may be used per complete 500 µF DC link capacitance.

Table 8- 17 Configuration examples

DC link capacitance in µF	Max. number of Braking Modules
900	1
2400	4
9800	19

DC link cable

In a two-row or distributed drive line-up, the DC links are connected to each other via a DC link cable. When using a Braking Module Booksize Compact in the drive line-up, this cable must not be longer than 10 m. In all cases, the DC link cable must have low impedance and a cross-section of at least 10 mm^2.

Parallel operation

During configuration of parallel operation for Braking Modules Booksize Compact, dimensioning can only take 90% of the specified braking power into account. Only the peak powers may be added without derating.

The following applies when connecting Braking Modules in parallel:

$P_{N\ total}$ = 0.9 x total P_N of single devices

4 x $P_{N\ total}$ = 0.9 x sum (4 x P_N) of single devices

$P_{max\ total}$ = total P_{max} of single devices

8.3 Braking units for 100 kW Basic Line Modules

8.3.1 Description

Since Basic Line Modules 100 kW cannot feed power back into the supply system, an external braking unit is required, together with a braking resistor, in order to

- enable a controlled shut down of the drives if a power failure occurs (e.g. emergency retraction or EMERGENCY OFF Category 1)
- Limit the DC link voltage during temporary generator operation.

The MASTERDRIVES braking unit includes the necessary power electronics and control. When the braking unit is in operation, the power which is fed back into the DC link is dissipated via an external braking resistor.

For the operation of a Basic Line Module 100 kW, only MASTERDRIVES braking units with the following rated braking powers are permitted:

- 4 x P_N = 100 kW (order number 6SE7031-6EB87-2DA1)
- 4 x P_N = 170 kW (order number 6SE7032-7EB87-2DA1)

For detailed information about the MASTERDRIVES braking unit, please see the operating instructions titled "MASTERDRIVES braking unit", order number 6SE7087-6CX87-2DA0.

8.3.2 Safety information

⚠ DANGER

Risk of electric shock

A hazardous voltage is still present for up to 5 minutes after the power supply has been switched off.
It is only permissible to open the braking unit after this time has expired.

⚠ DANGER

DC link discharge time

A hazard warning in the local language for the DC link discharge time must be attached to the component.
A set of labels in 16 languages is supplied with the component.

With a connected braking resistor, the braking unit is ground-fault proof.

⚠ DANGER

It is only permissible to connect the MASTERDRIVES braking unit to the DC link using the adapters that SIEMENS has recommended (DC link adapter and DC link infeed adapter).

⚠ CAUTION

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

CAUTION

The connection to the braking resistors must be made using a shielded cable.

The correct tightening torque of the DC link busbar screws (1.8 Nm, tolerance +30%) must be checked before commissioning. After transportation, the screws must be tightened.

NOTICE

The electronics of the braking unit is supplied from the DC link. As long as no DC link voltage is present (< 360 V ± 2 %), the electronics are not active and an external control or the Control Unit receives the signal "fault" from the fault output. So more than the 2 seconds are required that the electronics requires to start up as soon as the DC link voltage is present.

Note

If braking resistors other than those listed in the operating instructions, order number 6SE7087-6CX87-2DA1, are used, they may be damaged.

8.3.3 Interface description

8.3.3.1 X3 DC link connection

Table 8- 18 X3 DC link connection

Connection/Meaning	Remarks	Tightening torque [Nm]
C/L+ input (plus DC link)	Busbar C/L+	16
D/L- input (minus DC link)	Busbar D/L	16
 Protective conductor	Busbar PE 	16
Shield connection	M6 bolts at top of housing	8
NOTE		
Connection via	Crimping cable lug to DIN 46234 With shrink-on sleeve pulled over it Cables connected with supplied M8 x 25 screws	
AWG	max 2/ 0	

Note

After the the DC link voltage has been applied, fault output -X38/5 is "low" for approx. 2 seconds (self test), i.e. in the "fault" state.
The Control Unit must suppress this state when switching the system on.

8.3.3.2 X6 braking resistor connection

Table 8- 19 X6 braking resistor connection

Connection/Meaning	Remarks	Tightening torque [Nm]
G/R+ external braking resistor	Busbar G/R+	16
H/R external braking resistor	Busbar H/R	16
 Protective conductor	Busbar PE 	16
Shield connection	M6 bolts at bottom of housing	8
NOTE		
Connection via	Crimping cable lug to DIN 46234 With shrink-on sleeve pulled over it Cables connected with supplied M8 x 25 screws	
AWG	max 2/ 0	

The cable length between the braking unit and the braking resistor is limited to 15 m.

The following braking resistors are suitable for connecting to the MASTERDRIVES braking unit:

Table 8- 20 Braking resistors for MASTERDRIVES braking unit

Braking resistor	P_N in kW	P_{20} in kW	P_{max} in kW	R in Ω
6SE7031-6ES87-2DC0	25	100	150	4
6SE7032-7ES87-2DC0	42.5	170	255	2.35

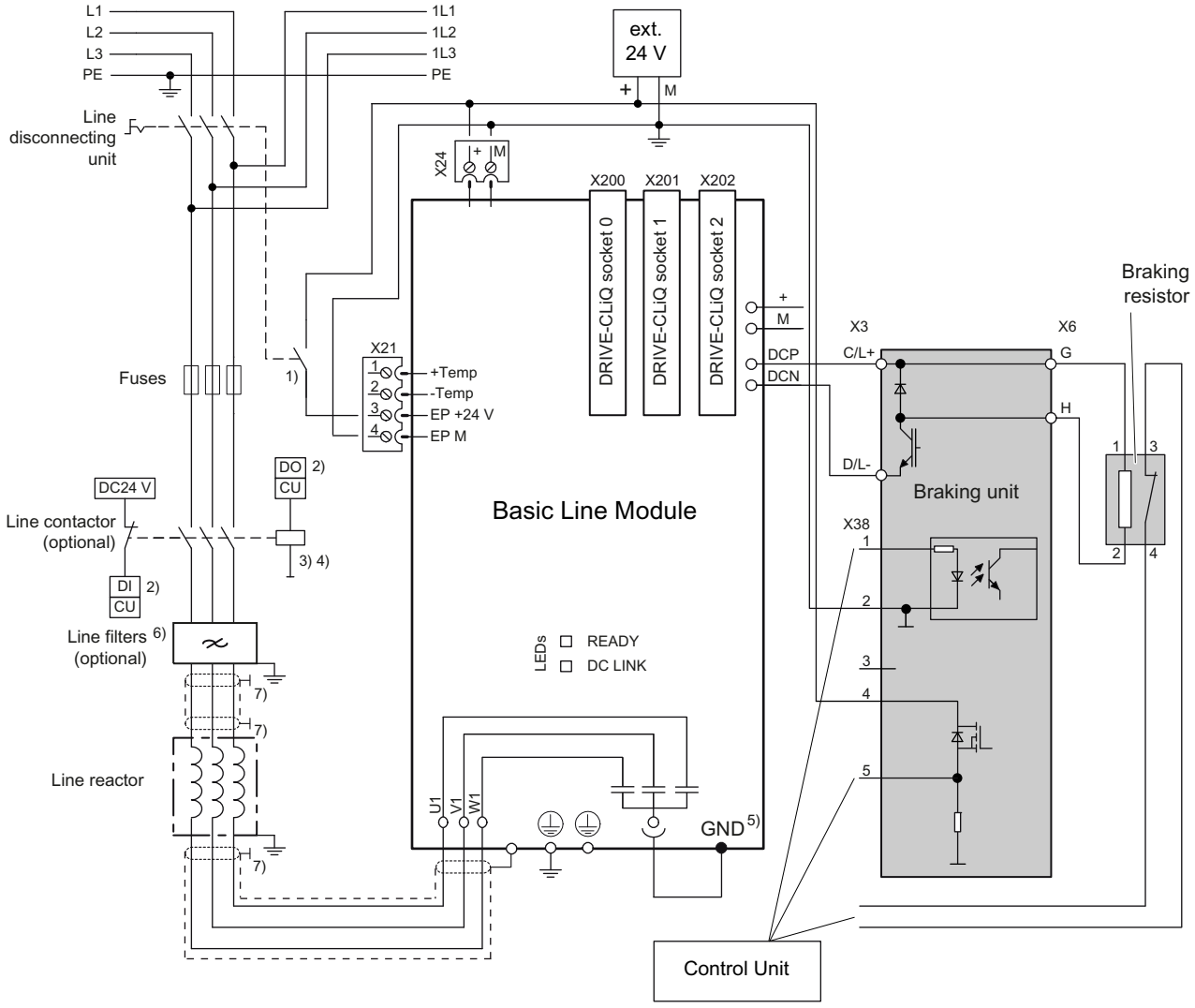
8.3.3.3 Switch S1

Switch S1 on the MASTERDRIVES braking unit is used to set the switch-on threshold. It is located behind the front panel.

Switch S1 should be set to "high" (factory setting) in order to operate the braking unit on a SINAMICS S120 drive line-up in booksize format. This equates to a switch-on threshold of 757 V_{DC}.

For more information, please see the operating instructions for the MASTERDRIVES braking unit.

8.3.4 Connection example



1) 24 V DC and ground must be connected for operation.
2) DI/DO controlled by the Control Unit
3) No additional load permitted downstream of line contactor!
4) The current carrying capacity of the DO must be observed; an output interface must be used if required.
5) When operating the component on an IT system, the connecting bar must be removed.
6) Line filter is required in order to maintain radio interference voltage, category C2.
7) Contact via rear mounting panel or shielding buses in accordance with EMC installation guideline.

Figure 8-14 Connection example for MASTERDRIVES braking unit

8.3.5 Dimension Drawing

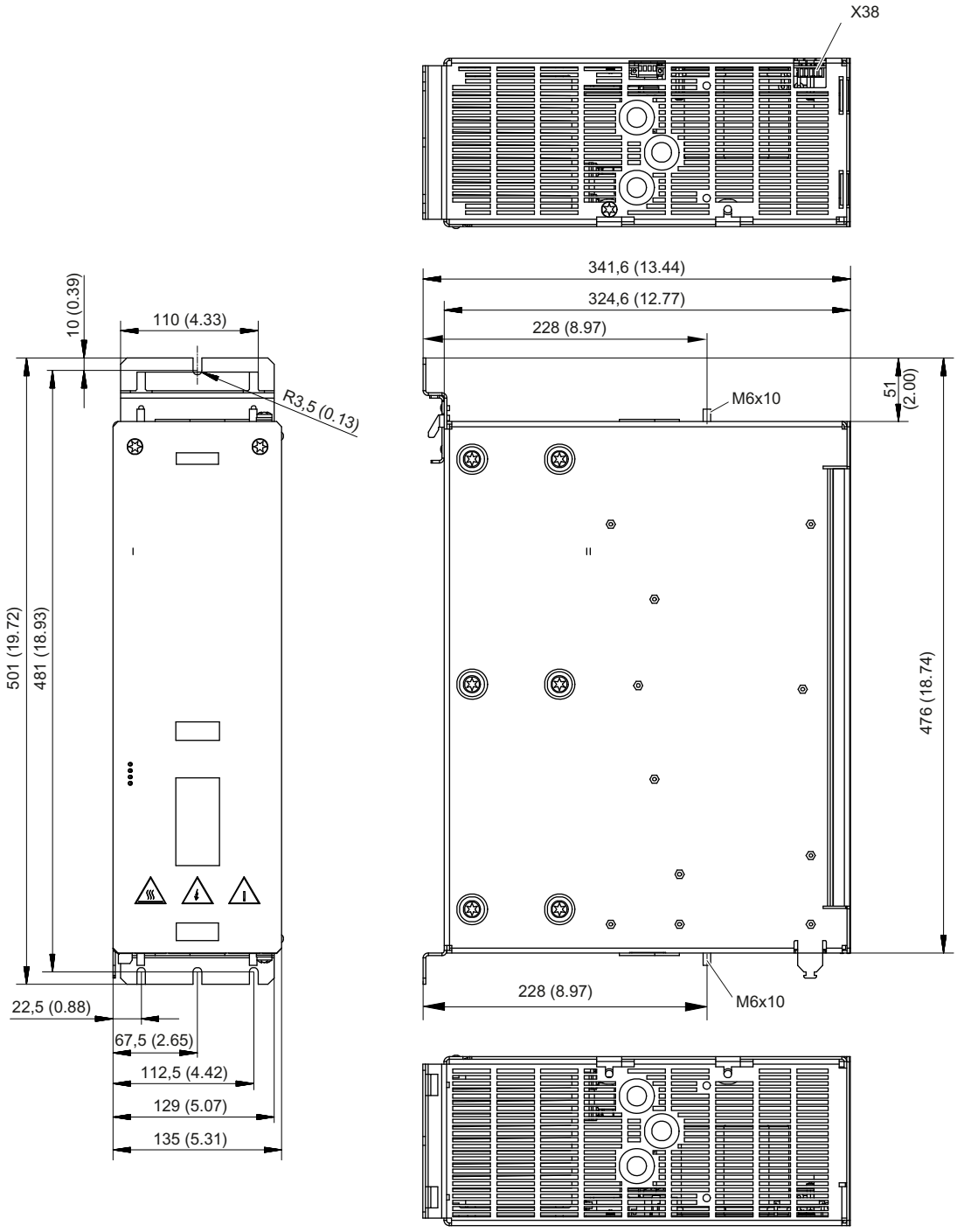


Figure 8-15 Dimension drawing of 100 kW and 170 kW MASTERDRIVES braking unit, all dimensions in mm and (inches)

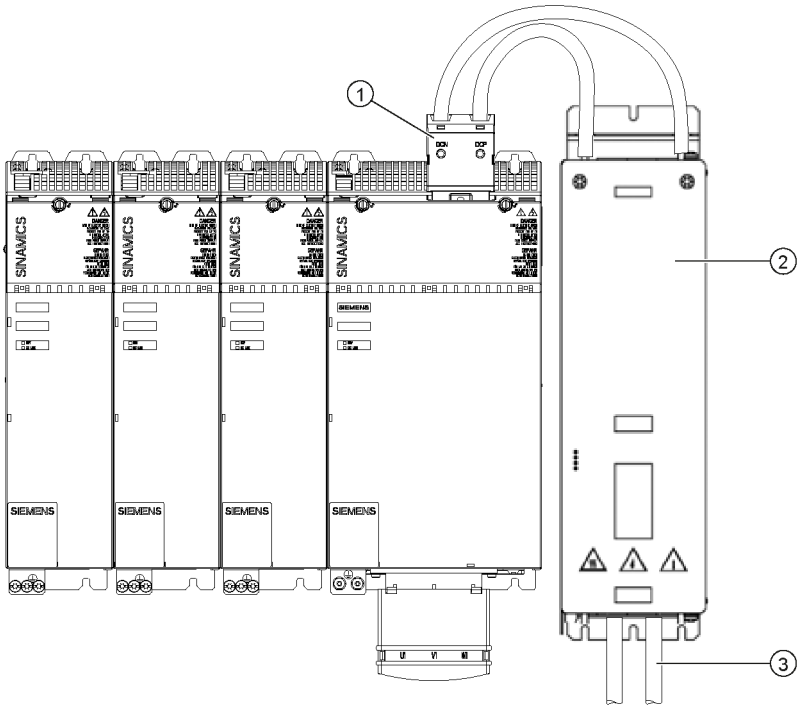
8.3.6 Connection to the Basic Line Module 100 kW

Connecting the braking unit to the DC link

The following adapters can be used to connect the MASTERDRIVES braking unit to a SINAMICS S120 line-up in booksize format:

- DC link rectifier adapter, order number 6SL3162-2BM00-0AA0
- DC link adapter, order number 6SL3162-2BM01-0AA0

The connecting cables used to connect the braking unit to the DC link rectifier adapter or DC link adapter must be kept as short as possible.
Please observe the instructions contained in the chapters titled "Accessories/DC link rectifier adapter" and "Accessories/DC link adapter".



① DC link rectifier adapter
② MASTERDRIVES braking unit
③ Cable routing to the braking resistor

Figure 8-16 Connecting a MASTERDRIVES braking unit via a DC link rectifier adapter

Connecting the braking unit to the DC link adapter or DC link rectifier adapter

1. Connect the C/L+ connection on the braking unit to the DCP terminal on the DC link rectifier adapter or DC link adapter.
2. Connect the D/L- connection on the braking unit to the DCN terminal on the DC link rectifier adapter or DC link adapter.
3. Connect the protective conductor between the S120 drive line-up and the braking unit. The cross-section of the protective conductor connection must be at least 50 mm^2.

The connecting cable between the braking unit and the DC link rectifier adapter or DC link adapter must be dimensioned with a cross-section of 95 mm^2 in accordance with EN 60439-1 (short-circuit-proof cable installation). The electric strength of the cable must be rated to the line voltage. The maximum permissible length of the connecting cables to the DC link is 3 m.

⚠ WARNING

The drive equipment or braking unit may be damaged if the DC link terminals are reversed or short-circuited.

⚠ CAUTION

The exhaust air from the braking units can reach temperatures of > 80 °C. The temperature of the housing can reach > 65 °C.

8.4 Capacitor Module

8.4.1 Description

Capacitor modules are used to increase the DC link capacitance to bridge momentary power losses.

Capacitor modules are connected to the DC link voltage via the integrated DC link busbars. Capacitor modules function autonomously.

Several capacitor modules can be operated in parallel.

8.4.2 Safety Information

⚠ DANGER

Risk of electric shock

A hazardous voltage is present for up to 5 minutes after the power supply has been disconnected.
The protective cover may only be opened after this time has expired.

When opening the protective cover for the DC link, you must press the release catch. You must a suitable tool to do this.

The components must only be operated when the protective cover of the DC link is closed. Damaged components must not be operated further, otherwise this could result in secondary damage or accidents.

⚠ DANGER

DC-link discharge time

A hazard warning for the DC link discharge time must be attached in the local language to all of the components.
A set of labels in 16 languages is supplied with the component.

⚠ DANGER

It is only permissible to establish connections to the DC link using the adapters that SIEMENS has recommended (DC link adapter and DC link rectifier adapter).

⚠ CAUTION

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

CAUTION
DC link side covers are supplied with the components as standard and must be attached to the first and last components in the drive line-up. They can also be ordered separately, if required (order number: 6SL3162-5AA00-0AA0).

NOTICE
The Capacitor Module is precharged by the Line Module. The applicable maximum permissible DC link capacitances of the Line Modules must be taken into account.

8.4.3 Interface description

8.4.3.1 Overview

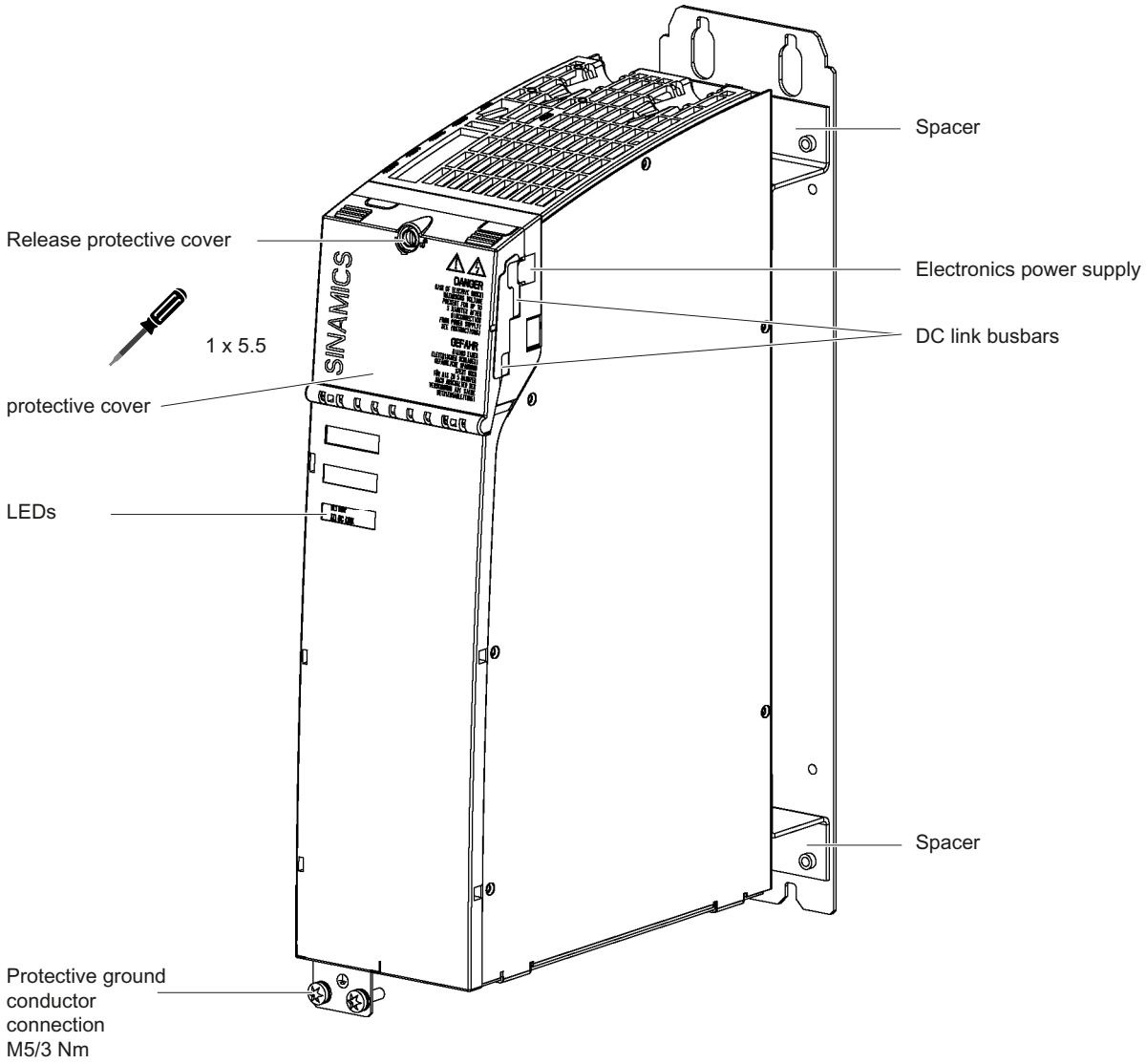


Figure 8-17 Interface overview, Capacitor Module

8.4.4 Dimension Drawing

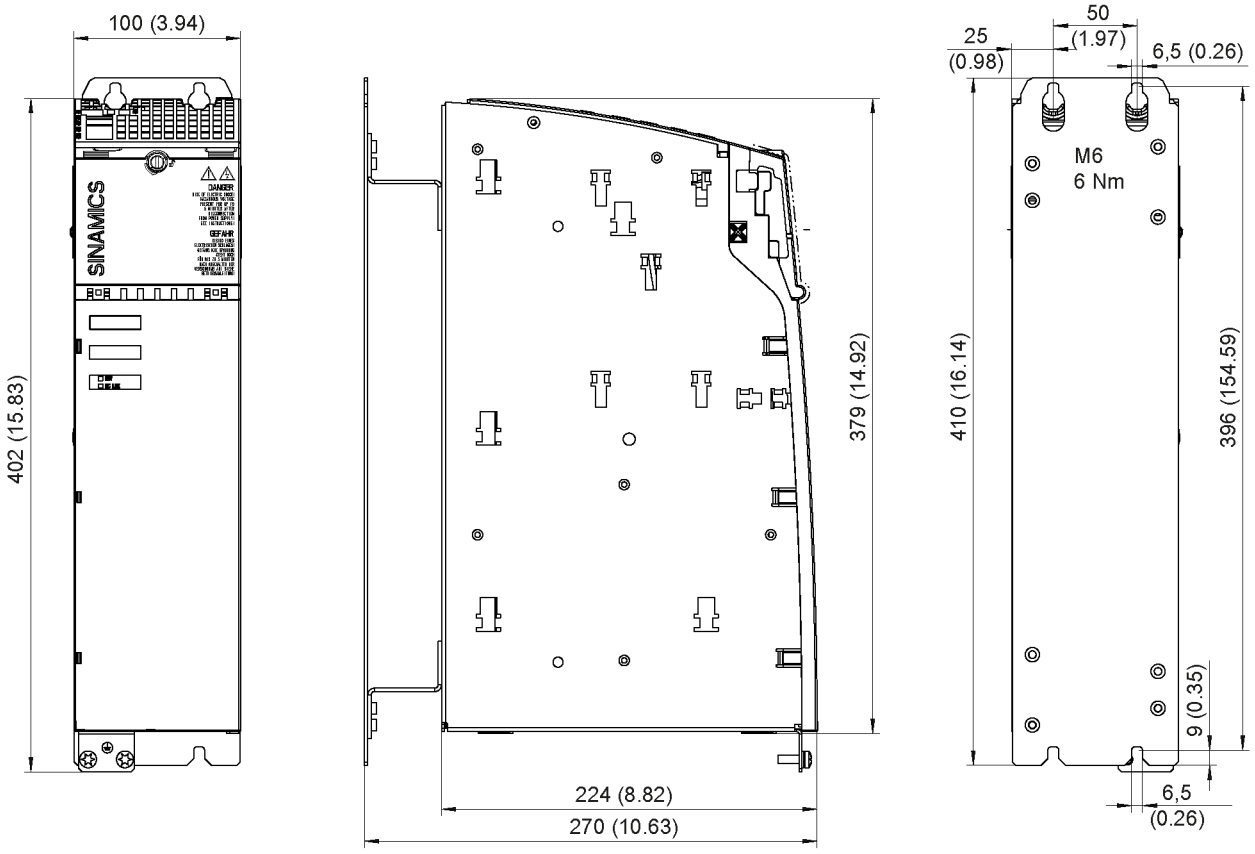
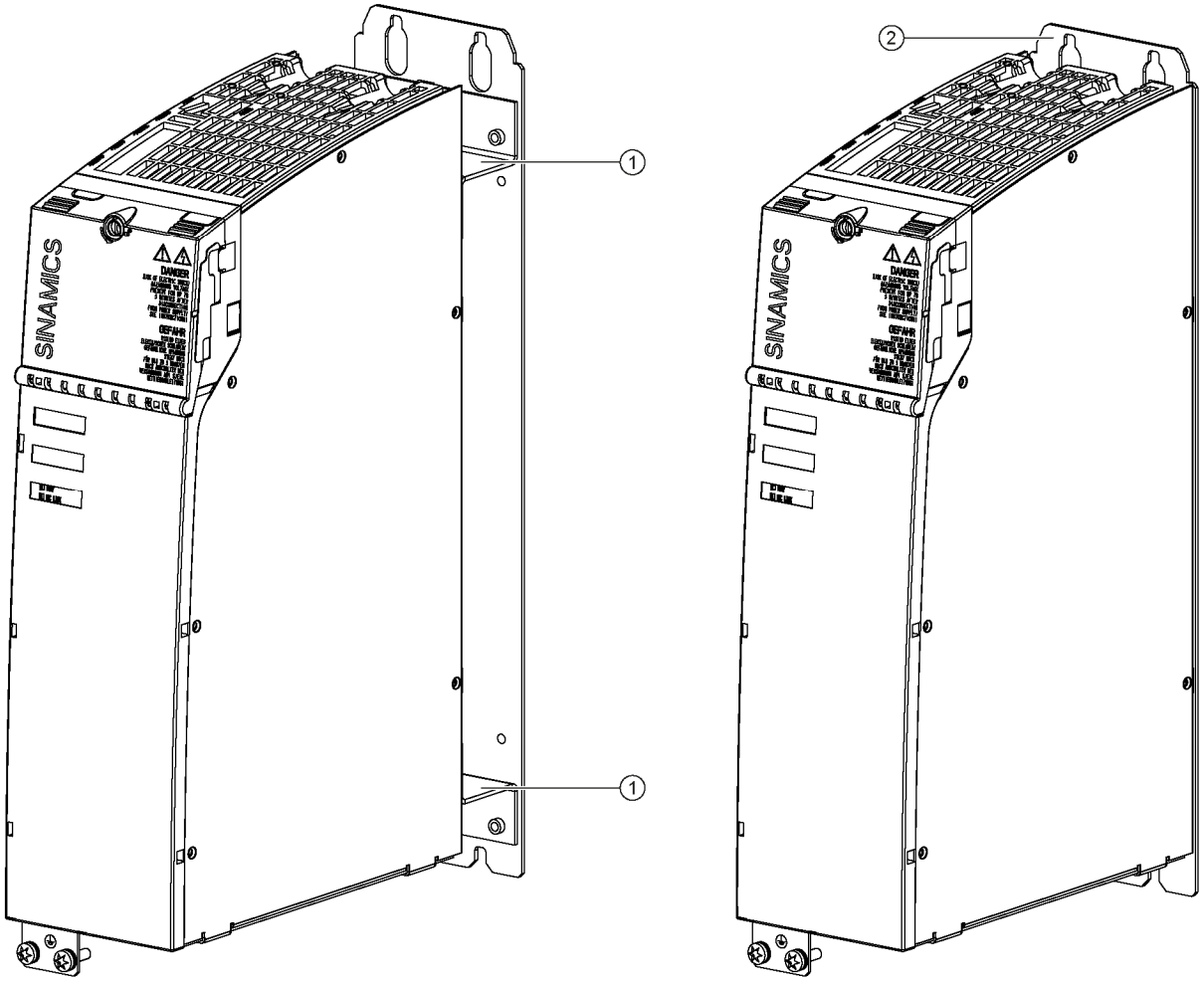


Figure 8-18 Dimension drawing of Capacitor Module, all dimensions in mm and (inches)

8.4.5 Installation



① Delivery condition with spacer - mounting depth for drive line-up in booksize format with internal air cooling
② Spacer removed - mounting depth for drive line-up in booksize format with external air cooling

Figure 8-19 Installation methods for Capacitor Module with/without spacer elements

The Capacitor Module can be attached to the cabinet panel with or without spacer elements.

8.4.6 Technical Specifications

Table 8- 21 Technical data

6SL3100-1CE14-0AA0		
DC link voltage	V_{DC}	510 - 720
Electronics power supply	V_{DC}	24 (20.4 – 28.8)
Capacitance	µF	4000
Current carrying capacity DC link busbar 24 V busbar	 A A	 100 20
Power loss [1)]	W	25
Weight	kg	7.2

1) For an overview, see the power loss tables in chapter Control cabinet installation

8.5 Control Supply Module CSM

8.5.1 Description

The Control Supply Module provides an output voltage of 24 V - 28.8 V DC. The output voltage can be adjusted using an integrated potentiometer.

In normal operation, the Control Supply Module is supplied from the line voltage. In the event of a power failure, the module automatically changes over to supply from the DC link. This makes it possible, for example, to make retraction movements in the event of the failure of the line supply.

The Control Supply Module has safe electrical separation between the line potential and the DC link potential. This therefore ensures that the DC link is not unintentionally charged. The Control Supply Module can therefore remain connected to the supply if the Line Module is galvanically isolated from the supply, for example via a line contactor.

The 24 V ground of the Control Supply Module is internally grounded.
The Control Supply Module is cooled using an internal fan.

Temperature and voltages are internally monitored.

Temperature monitoring:
In the event of an overtemperature in the Control Supply Module, a temperature advance warning is issued via a signaling contact. If the temperature falls below the limit value within the advance warning time, then the module remains operational and the signaling contact is de-energized. If the overtemperature condition persists, the module is switched off and restarted.

Voltage monitoring:
When the monitoring threshold (32 V) of the output voltage is exceeded for > 20 ms, the control supply module switches off and attempts a restart after 10 s. This is supplemented by a hardware-based overvoltage limiting. This prevents that more than 35 V can be output in the case of a fault.

The Control Supply Module can either be operated individually or in a parallel connection with a maximum of 10 devices. The switchover between single and parallel operation is realized in a no-current state using a DIP switch on the upper side of the module.

Note

Compatibility

The new Control Supply Module 6SL3100-1DE22-0AA1 with extended functions described here replaces Control Supply Module 6SL3100-1DE22-0AA0. The modules are spare-part-compatible.

8.5.2 Safety information

⚠ DANGER

Risk of electric shock

This component is equipped with two supply circuits! A hazardous voltage is still present for up to 5 minutes after the power supply has been switched off. The protective cover must not be opened until this time has elapsed. You must use a suitable tool (slot-head screwdriver) to open the protective cover on the DC link.

The components must only be operated when the protective cover of the DC link is closed. Damaged components (e.g. with a defective lock on the protective cover) must not be operated further, otherwise this could result in secondary damage or accidents.

⚠ DANGER

DC-link discharge time

A hazard warning for the DC link discharge time must be attached in the local language to all of the components.
A set of labels in 16 languages is supplied with the component.

⚠ DANGER

It is only permissible to establish connections to the DC link using the adapters that SIEMENS has recommended (DC link adapter and DC link rectifier adapter).

⚠ CAUTION

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

CAUTION

The correct tightening torque of the DC link busbar screws (1.8 Nm, tolerance +30%) must be checked before commissioning. After transportation, the screws must be tightened.

CAUTION

DC link side covers are supplied with the components as standard and must be attached to the first and last components in the drive line-up. They can also be ordered separately, if required (order number: 6SL3162-5AA00-0AA0).

CAUTION

Use of the 24 V terminal adapter

When using the 24 V terminal adapter, it must be screwed onto the Control Supply Module using the EJOT PT K30 x 16 screw supplied (tightening torque: 0.5 Nm).

8.5.3 Interface description

8.5.3.1 Overview

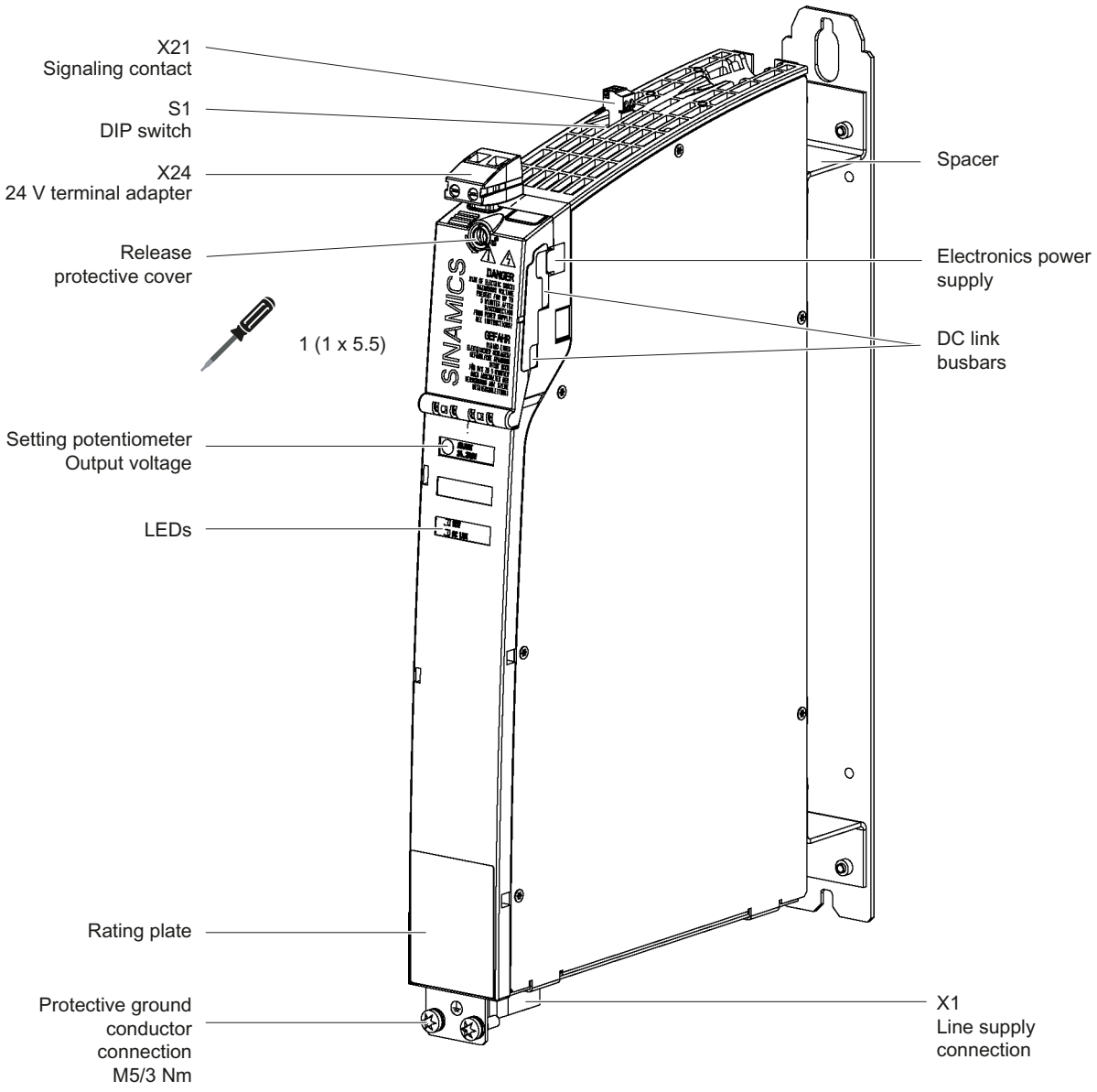
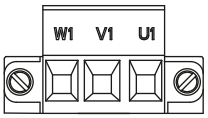
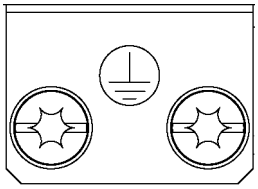


Figure 8-20 Interface overview, Control Supply Module

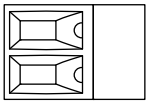
8.5.3.2 X1 line connection

Table 8- 22 X1 line connection

	Terminal	Technical specifications
	U1	Supply voltage:
	V1	380 V - 480 V 3 AC, 50 / 60 Hz
	W1	Max. connectable cross-section: 4 mm^2
		Type: Screw terminal 4 (see Chapter "Control cabinet installation and EMC / connection system") Tightening torque: 0.5 - 0.6 Nm
	PE connection	M5 screw / 3 Nm at the housing

8.5.3.3 X21 signaling contact

Table 8- 23 X21 signaling contact

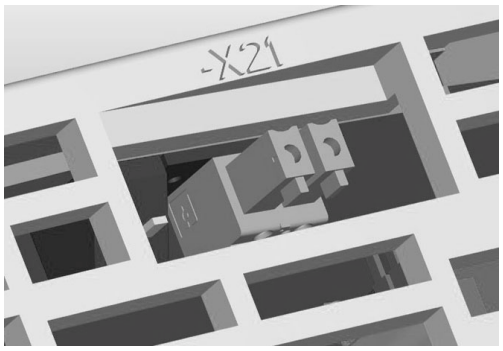
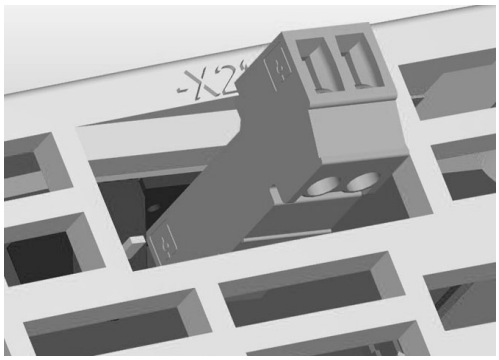
	Terminal	Technical specifications
	1	Voltage 24 V DC
	2	max. load current 0.5 A (ohmic load)
Max. connectable cross-section 1.5 mm^2 Type: Screw terminal 1_1 (see the chapter titled "Control cabinet installation and EMC/Connection system")		

The 2-pole terminal connector for the signaling contact is included in the Completion Kit provided.

The signaling contact can be connected with a digital input (DI) on the Control Unit or other digital interface (PLC, SCADA). In parallel or redundant operation the failure of a Control Supply Module is indicated in order to initiate a service call, for example.

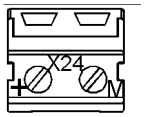
The signaling contact operates as an isolated NO contact. When the switch is closed, the Control Supply Module is "OK" and provides the output voltage. The switch opens in the event of a fault "Not OK" – when the overtemperature condition is still present, after a pre-warning, wire breakage, short-circuit etc. The Control Supply Module is correspondingly switched off.

Table 8- 24 Installing the signaling contact

	
Signaling contact without terminal connector in the delivery condition	Signaling contact, complete with terminal connector

8.5.3.4 X24 24 V terminal adapter

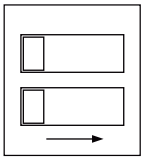
Table 8- 25 X24 24 V terminal adapter

	Terminal	Designation	Technical specifications
	+	24 V power supply	Supply voltage 24 - 28.8 V DC
	M	Ground	Electronics ground
Max. connectable cross-section: 6 mm^2 Type: Screw terminal 5 (see Chapter "Control cabinet installation and EMC / connection system")			

The 24 V terminal adapter is included in the scope of supply.

8.5.3.5 S1 DIP switch

Table 8- 26 DIP switch S1

	Terminal	Designation	Technical specifications
	1	Changeover switch, single operation / parallel operation	Left: Single operation Right: Parallel operation
	2	Dummy contact (not used)	Changing over the output characteristic

The changeover is only made in the no-voltage state.

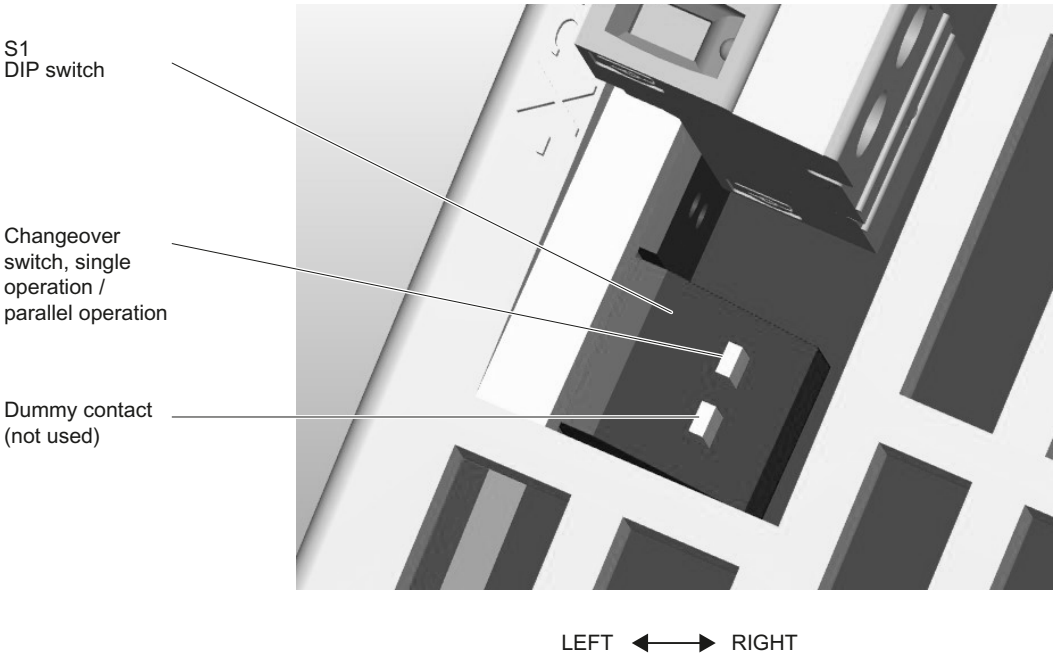


Figure 8-21 DIP switch on the upper side of the component

When delivered, "single operation" is set. Both switches are set to the left.

8.5.4 Connection examples

The Control Supply Module is connected to the line supply (3-ph. 380 V AC –10 % to 480 V AC +10 %) via interface X1 (screw terminals 0.2 to 4 mm ^{2}) This connection should preferably be made without using an isolating device (e.g. contactor).

The CSM has an internal line filter (Class A for TN line supplies), and the pre-charging circuit for the DC link inside the unit is electrically isolated from the 24 V supply.

The CSM also features a current limitation function. When using cables with a cross-section of 2.5 mm^2, no additional protection is required on the 24 V side if a type XLPE or EPR cable is used, or a cable with a similar quality and with a thermal stability of up to 90 °C.

Note

If a selectively tripping, AC/DC-sensitive RCCB is used for the drive line-up, the Control Supply Module must always be connected to the line supply downstream of this circuit breaker.

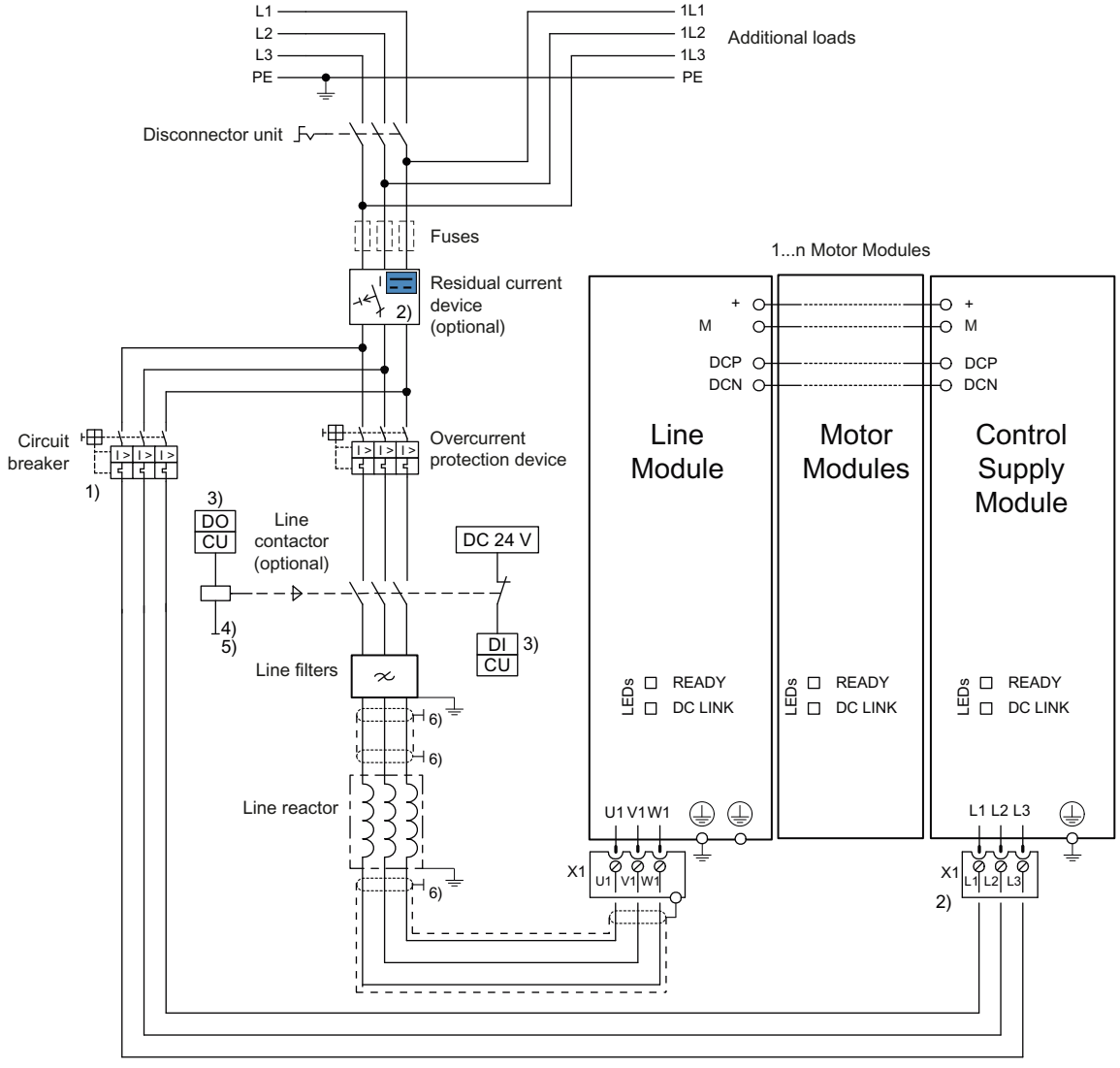
Note

Connecting to the line supply

When configuring the line supply for the Control Supply Module, it should be noted that the CSM must be connected to the line supply before the Line Module has been connected to the line supply. When charging, this prevents the DC link from being immediately loaded by the CSM.

8.5.4.1 Single operation

When used alone, the Control Supply Module must be connected to the drive line-up via the DC link busbars as well as the 24 V busbars. The red 24 V connector from the accessories pack provided must be inserted under all circumstances. The DIP switch on the Control supply Module must be set to "single mode" The connection can be established as shown below.



1) Permissible types:
a) Circuit breaker type SIRIUS, 3RV 1021 1DA10, set to 3A
b) Branch circuit fuse type KTS-R-6 (class RK1)

2) The mains connection must always be available

3) DI/DO, controlled by the Control Unit.

4) No additional load permitted downstream of line contactor!

5) The current carrying capacity of the DO must be observed; an output coupling device must be used if required.

6) Contacting via rear mounting panel or shielding buses in accordance with EMC Directive

Figure 8-22 Connection example for Control Supply Module in single operation

8.5.4.2 Parallel operation

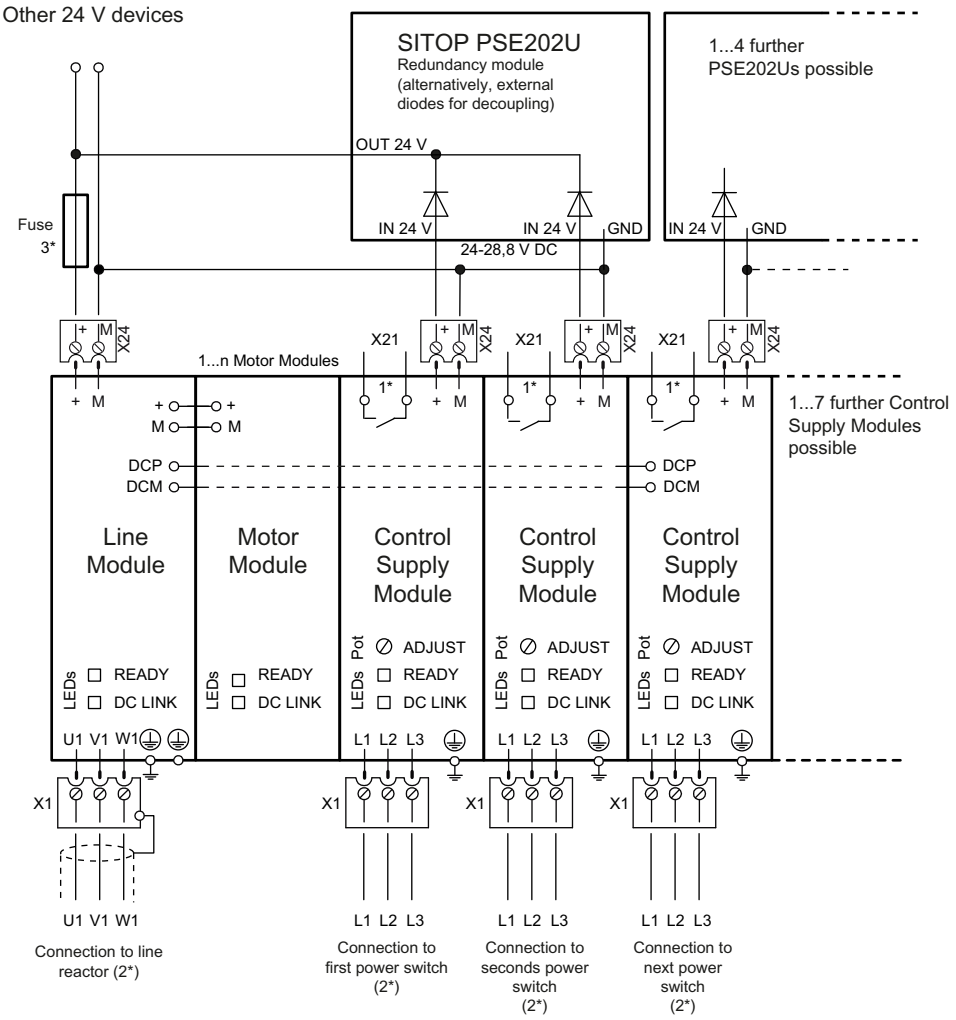
A maximum of 10 Control Supply Modules can be connected in parallel.

The DIP switch of the Control supply Module must be set to "parallel mode". The same output voltage must be set for all modules at the adjusting potentiometer.

In parallel mode, each Control Supply Module should supply the 24 V DC voltage via the 24 V terminal adapter. For this reason, the red 24 V connector must **not** be used (see connection examples).

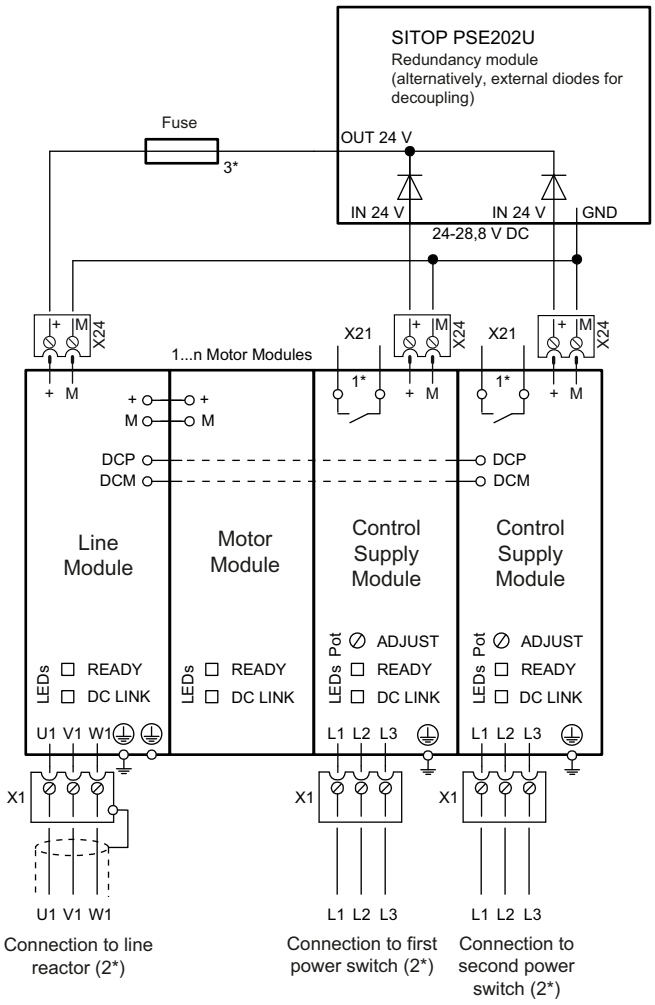
Use of a SITOP redundancy module (6EP1961-3BA20) is recommended for parallel connection. One SITOP redundancy module must be used for two Control Supply Modules in this case. Alternatively, a connection with external diodes to decouple the individual Control Supply Modules is possible. If a Control Supply Module fails, an alarm is generated and provided via the X21 signaling contact. The 24 V supply is maintained via the second module.

CAUTION
Only Control Supply Modules with order number 6SL3100-1DE22-0AA1 may be used for parallel connection.



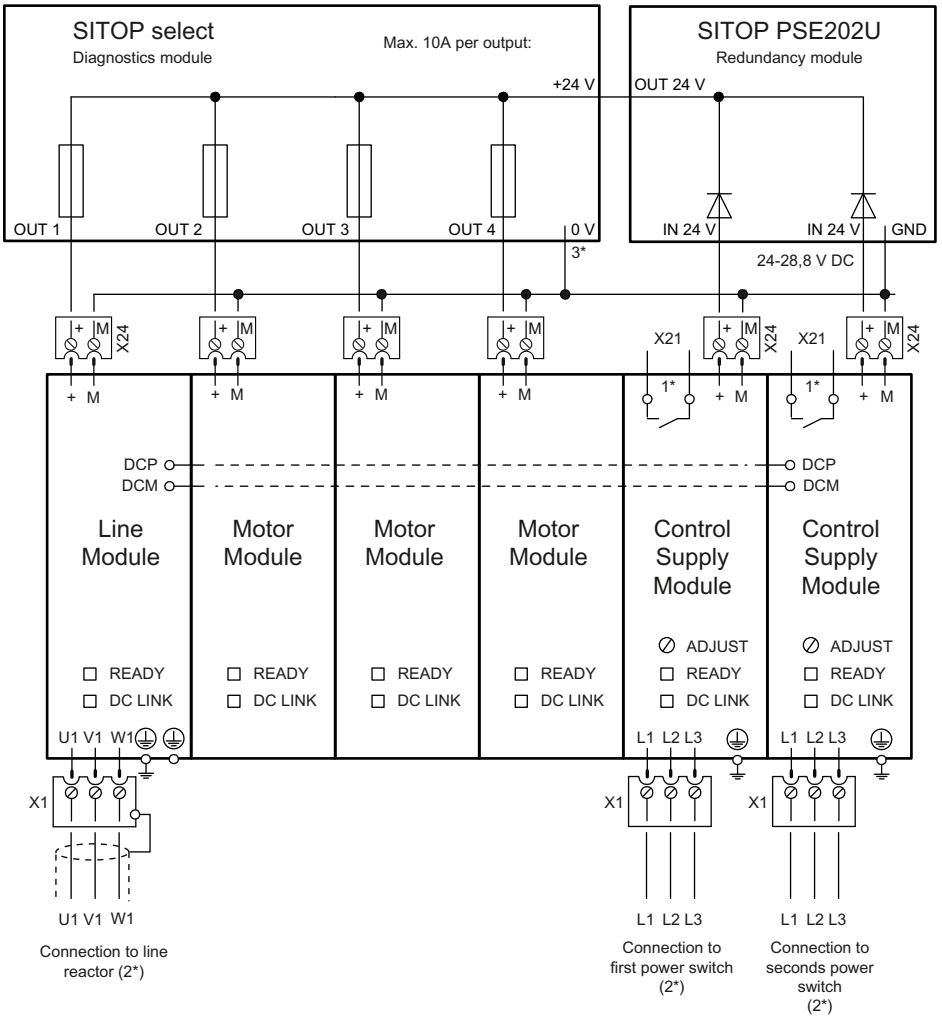
1* Connection to digital interface (SCADA or PLC); closed means: 24 V OK
2* continue as for "connection example Control Supply Module in single mode"
3* max. permissible 20A continuous current (see fuse characteristcs)

Figure 8-23 Connection example for parallel connection of 2 to 10 Control Supply Modules via SITOP PSE202U redundancy module



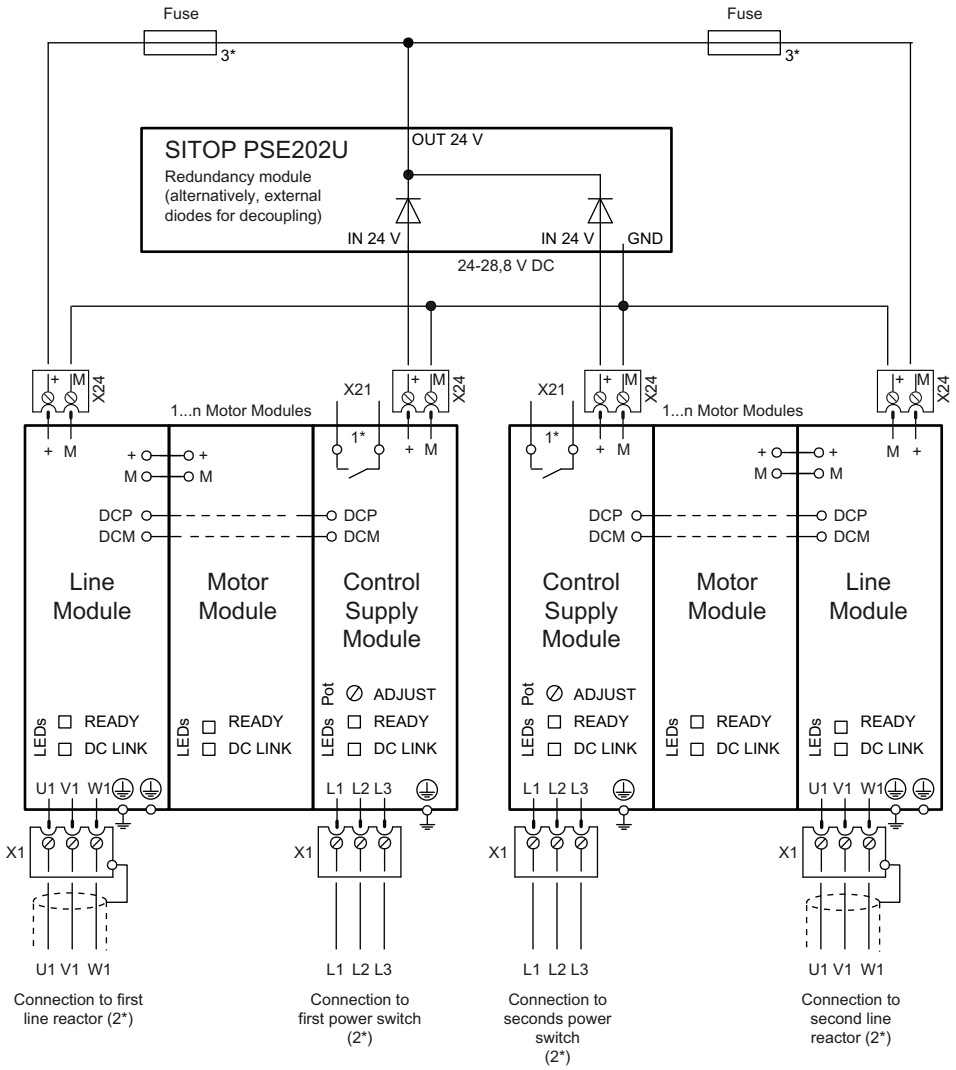
1* Connection to digital interface (SCADA or PLC); closed means: 24 V OK
2* continue as for "connection example Control Supply Module in single mode"
3* max. permissible 20A continuous current (see fuse characteristcs)

Figure 8-24 Connection example for a redundancy circuit with two Control Supply Modules via SITOP PSE202U redundancy module



1* Connection to digital interface (SCADA or PLC); closed means: 24 V OK
2* continue as for "connection example Control Supply Module in single mode"
3* Functional reference point (not load with high current)

Figure 8-25 Connection example for parallel connection of Control Supply Modules via SITOP PSE202U redundancy module and a SITOP select diagnostic module (6EP1961-2BA00)



1* Connection to digital interface (SCADA or PLC); closed means: 24 V OK
2* continue as for "connection example Control Supply Module in single mode"
3* max. permissible 20A continuous current (see fuse characteristcs)

Figure 8-26 Connection example for operation of 2 units with Control Supply Modules via a SITOP PSE202U redundancy module

8.5.5 Meaning of LEDs

Table 8- 27 Meaning of the LEDs on the Control Supply Module

LED	Color	Status	Description
READY	-	Off	Electronics power supply outside the permissible tolerance range or temperature advance warning active
	Green	Continuous light	Ready for operation. Output voltage in the tolerance range and temperature advance warning inactive
DC LINK	-	Off	DC input voltage $V_{E\ DC}$ < 280...300 V Buffer operation not possible
	Yellow	Continuous light	DC input voltage in the range 360...380 < $V_{E\ DC}$ < 820 V ± 3 % Buffer operation possible
	Red	Continuous light	DC input voltage outside the tolerance range: $V_{E\ DC}$ < 360...380 V or $V_{E\ DC}$ > 820 V ± 3 %

8.5.6 Dimension drawing

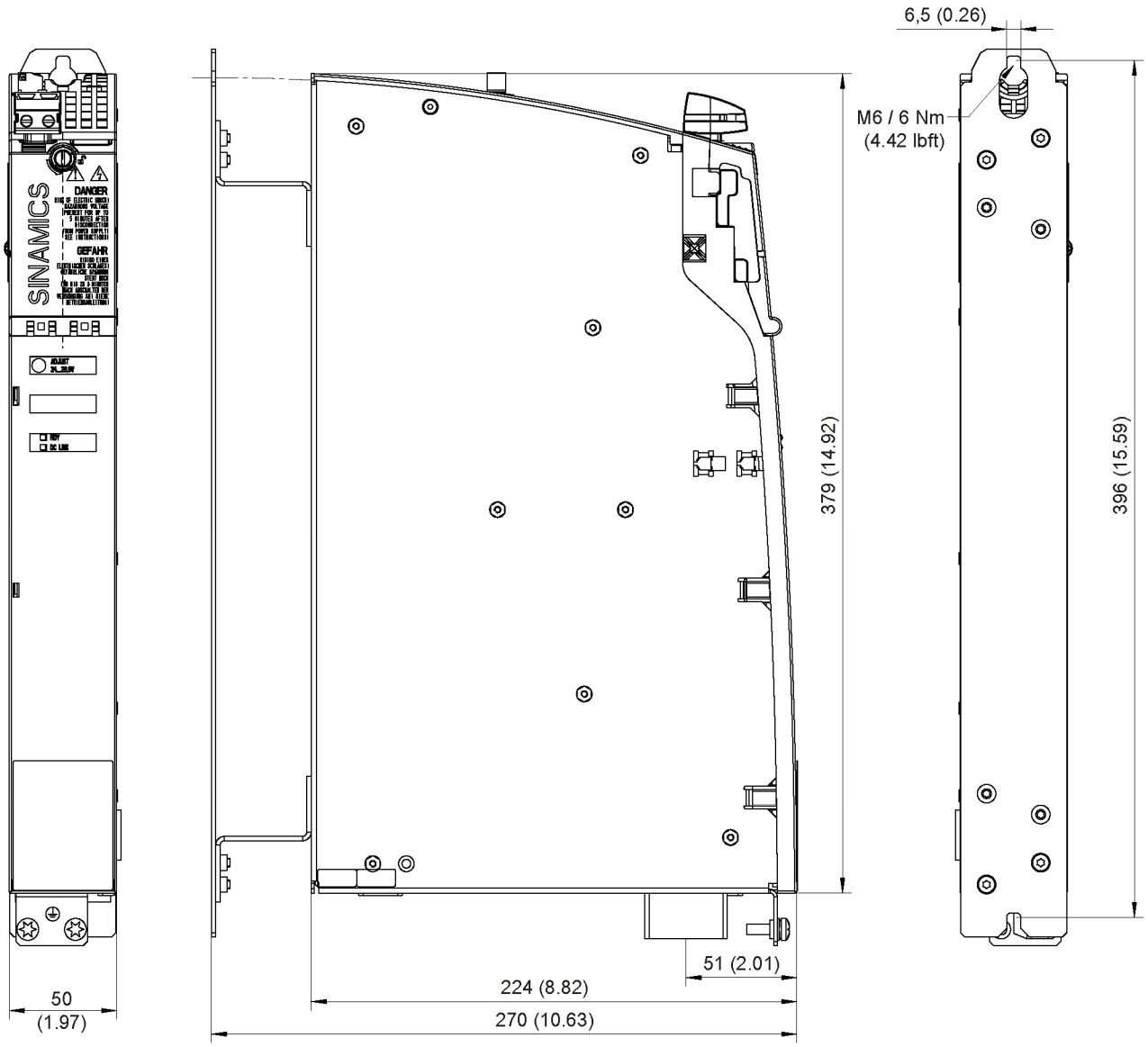
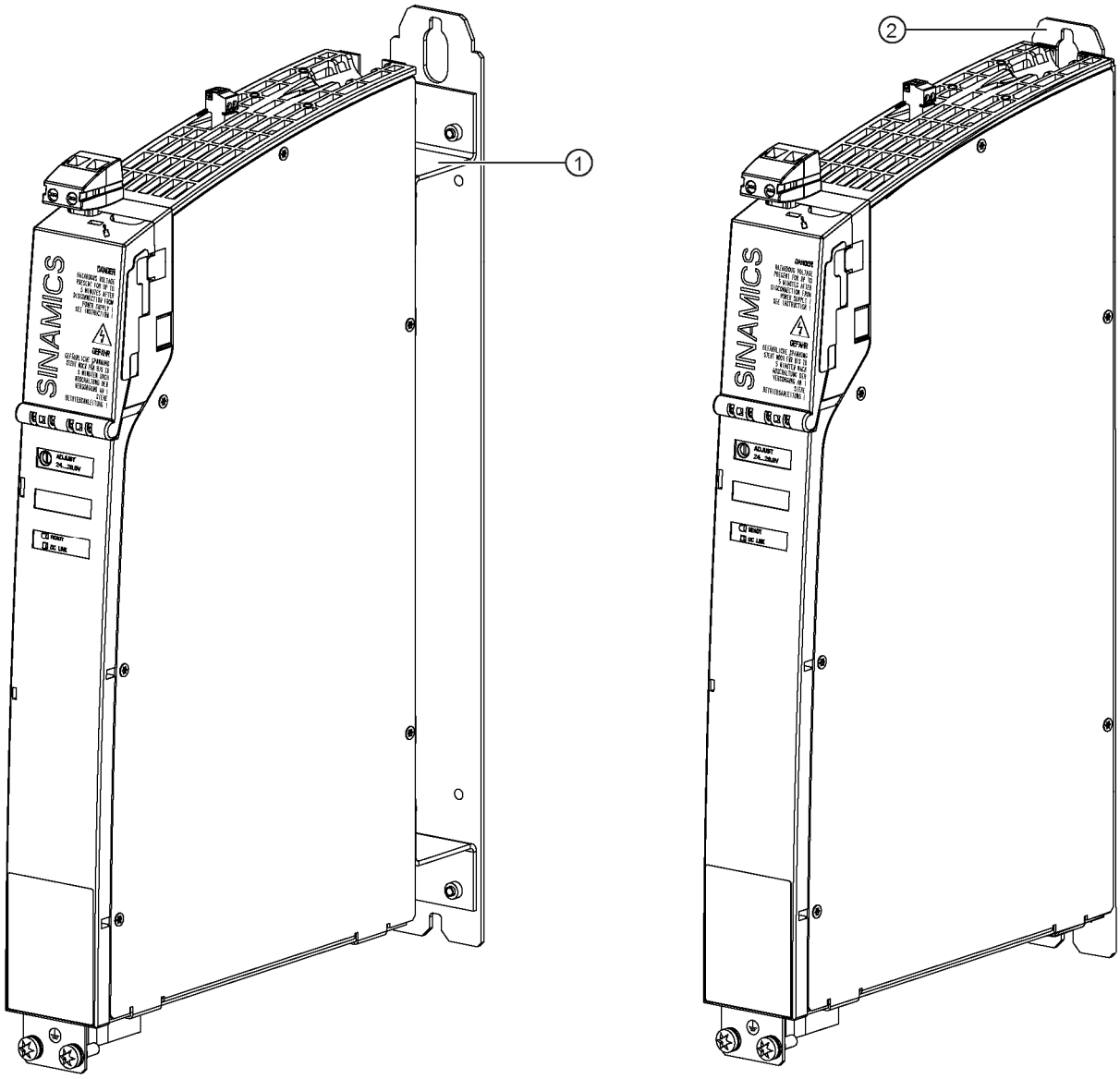


Figure 8-27 Dimension Control Supply Module, all dimensions in mm and (inches)

8.5.7 Installation



① Delivery condition with spacer - mounting depth for drive line-up in booksize format with internal air cooling
② Spacer removed - mounting depth for drive line-up in booksize format with external air cooling

Figure 8-28 Methods of installing the Control Supply Module with and without spacer

The Control Supply Module can be attached to the control cabinet panel with or without spacers.

8.5.8 Technical data

Table 8- 28 Technical data

6SL3100-1DE22-0AA1		
Input data, AC input		
Line voltage Line frequency	V_{AC} Hz	3-ph. 380 - 480 V_{AC} ± 15 % 45 to 66
Rated input current Rated value (at $V_{E\ rated}$)	A_{AC}	≤ 2
Starting current inrush	A_{AC}	≤ 28 at > 5 ms
Input data, DC input		
Rated input voltage	V_{DC}	600
Input voltage range	V_{DC}	300 - 882
DC link voltage (continuous input voltage)	V_{DC}	430 to 800 300 - 430 < 1 min 800 - 853 < 1 min 853 - 882 < 10 s
Supply current (at 600 V)	A_{DC}	1.1
Overvoltage trip Undervoltage trip	V_{DC} V_{DC}	> 882 280 ± 3 %
Output data		
Rated output voltage $V_{A\ rated}$:	V_{DC}	24 - 28.8 V
Rated output current $I_{A\ rated}$[1)]	A_{DC}	20
Rated output power $P_{A\ rated}$	W	520
Overcurrent limitation for short-circuit	A_{DC}	approx. 23
Surge suppression	V	< 35
Current carrying capacity of the 24 V busbar	A_{DC}	20
Residual ripple (clock frequency approx. 50 kHz)	mV_{pp}	< 100
Cycle peaks (bandwidth 20 MHz)	mV_{pp}	< 200
Power loss ride-through (at 400 V_{AC})	ms	5
Power loss [2)] Line DC link	W	 70 65
Efficiency	%	>83
Cooling method		Internal air cooling
Max. ambient temperature Without derating With derating as of 26 V output voltage	 °C °C	 ≤40 >40 to 55
Weight	kg	4.8

1) Upwards 40°C, a linear derating of the output current for 26 V output voltage and higher must be observed

2) For an overview, see the power loss tables in the chapter titled Control cabinet installation

8.5.8.1 Characteristics

Derating characteristic

For ambient temperatures > 40°C, a linear derating for the output current must be observed as of 26 output voltage.

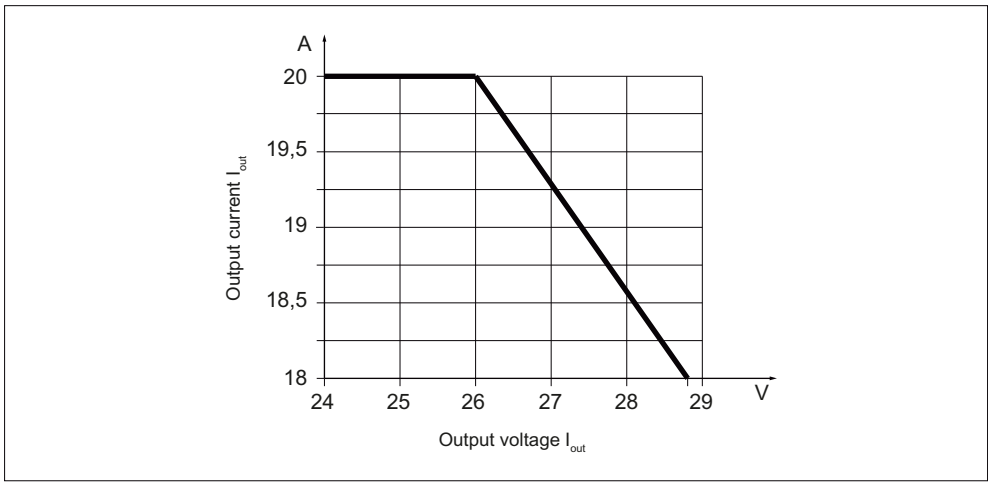


Figure 8-29 Current derating for ambient temperatures >40°C as a function of the output voltage

8.6 Voltage Clamping Module VCM

8.6.1 Description

Under certain unfavorable conditions, voltage rises can occur in extended drive line-ups due to the stimulation of the system resonance frequency. This can be particularly damaging for the insulation systems of the connected motors since partial discharges can occur.

The Voltage Clamping Module ensures that the motor voltages are limited to permissible values even when resonance occurs. In conjunction with an Active Line Module with an HF line reactor the Voltage Clamping Module must always be used if the total lengths of all the motor and DC link cables exceed the following value:

- 350 m for shielded cables.
- 560 m for unshielded cables.

In conjunction with the Voltage Clamping Module, the following total cable lengths are permitted:

- 630 m for shielded cables
- 850 m for unshielded cables

Limitations/secondary conditions

The following secondary conditions must be observed:

- Power derating for Line Modules to 80% for cable lengths > 350m.
- Max. step-up factor 1.4 to 1.6 (rectification factor V_{dc}/V_{line}) with regulated infeed.
- No built-in motors must be connected (torque motors, linear motors).
- Can only be connected to TN line supply systems with grounded neutral point.
- The EMC limit values (radio interference voltage) are no longer observed, which means that special measures have to be taken to ensure CE conformity (on-site measurement (subject to charge) and adjusted filter). Contact: EPCOS, e-mail: emv.labor@epcos.com

Compatibility

The Voltage Clamping Module can be integrated in the drive line-up with:

- Internal air cooling with mounting brackets (included in the scope of delivery)
- External air cooling
- Cold plate cooling
- Liquid cooling

8.6.2 Safety information

⚠ DANGER

Risk of electric shock

A hazardous voltage is present for up to 5 minutes after the power supply has been disconnected.
The protective cover may only be opened after this time has expired.

When opening the protective cover for the DC link, you must press the release catch. You must a suitable tool to do this.

The components must only be operated when the protective cover of the DC link is closed. Damaged components must not be operated further, otherwise this could result in secondary damage or accidents.

⚠ DANGER

DC-link discharge time

A hazard warning for the DC link discharge time must be attached in the local language to all of the components.
A set of labels in 16 languages is supplied with the component.

⚠ DANGER

The drive components generate high leakage currents in the protective conductor. The components must only be operated in cabinets or in closed electrical operating areas and must be connected with the protective conductor. To protect against electric shock, the protective conductor connection at the control cabinet or machine must be implemented in accordance with one of the following measures:

- Fixed connection and protective conductor connection by means of ≥ 10 mm^2 Cu or ≥ 16 mm^2 Al
- Fixed connection and automatic disconnection of the supply system if the protective conductor is interrupted

⚠ DANGER

It is only permissible to establish connections to the DC link using the adapters that SIEMENS has recommended (DC link adapter and DC link rectifier adapter).

⚠ CAUTION

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

CAUTION

After transportation, the screws must be tightened. The correct tightening torque of the DC link busbar screws (1.8 Nm, tolerance +30%) must be checked before commissioning.

CAUTION

DC link side covers are supplied with the components as standard and must be attached to the first and last components in the drive line-up. They can also be ordered separately, if required (order number: 6SL3162-5AA00-0AA0).

NOTICE

It is not permissible to use a green/yellow cable for the functional ground of the Voltage Clamping Module.

The Voltage Clamping Module includes capacitors that are connected with respect to the functional ground. This is the reason that when carrying-out a high-voltage test in the system, the components must be disconnected from the functional ground.

8.6.3 Interface description

8.6.3.1 Overview

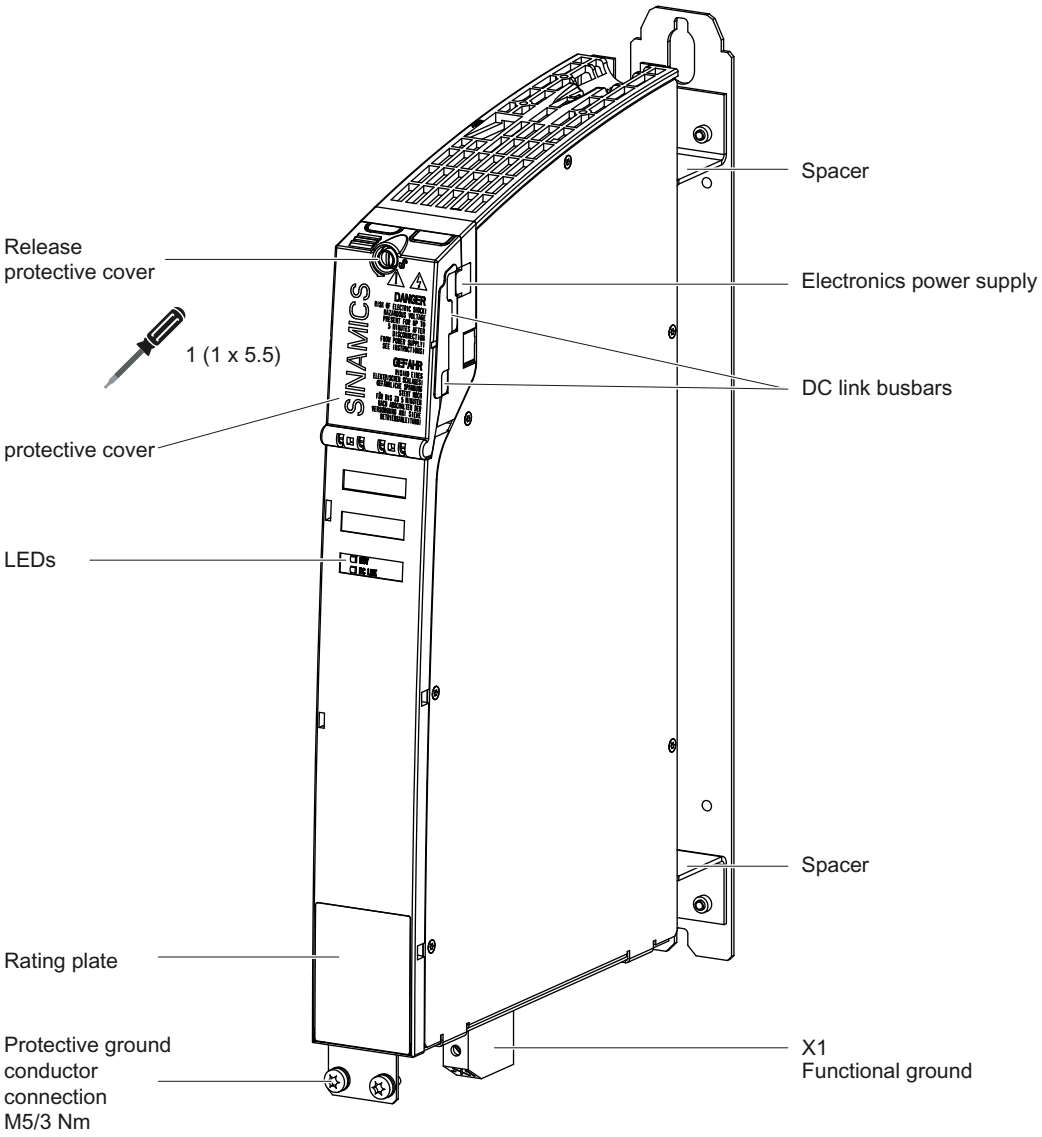


Figure 8-30 Interface overview, Voltage Clamping Module

8.6.3.2 X1 functional ground

X1 functional ground

To ensure that the Voltage Clamping Module functions properly, a functional ground must be connected to X1. Please note:

- The cables must be routed via the shortest possible path
- Cross-section: 4 mm² to 16 mm²
- When a line filter is used, the functional ground should be located on the metallic installation panel in the immediate vicinity of the line filter.
- In systems without a line filter, it should be connected on the PE busbar.

8.6.4 Connection example

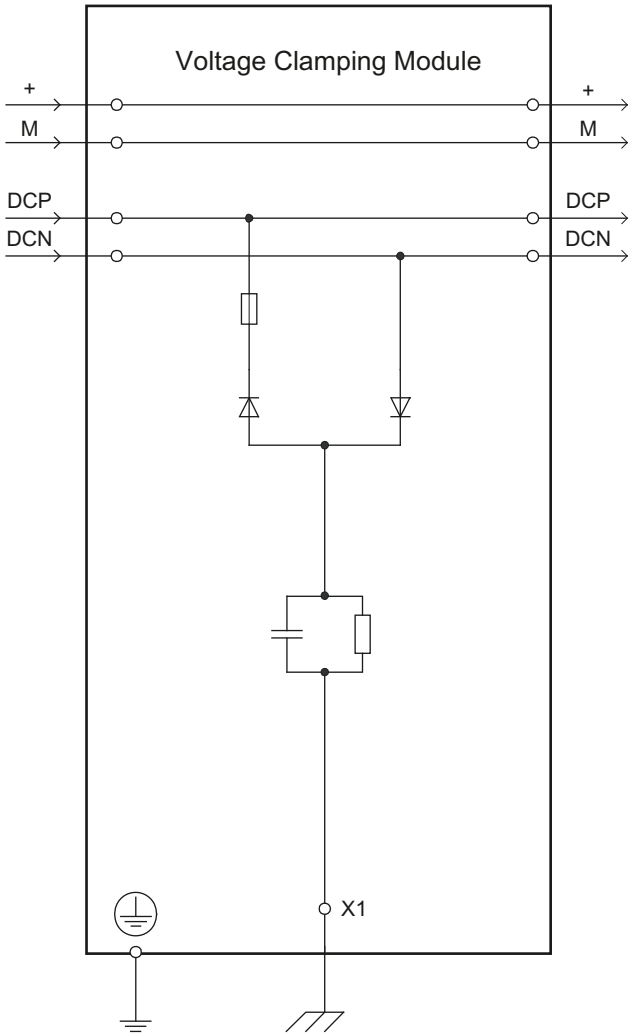


Figure 8-31 Connection example for the Voltage Clamping Module

8.6.5 Dimension drawing

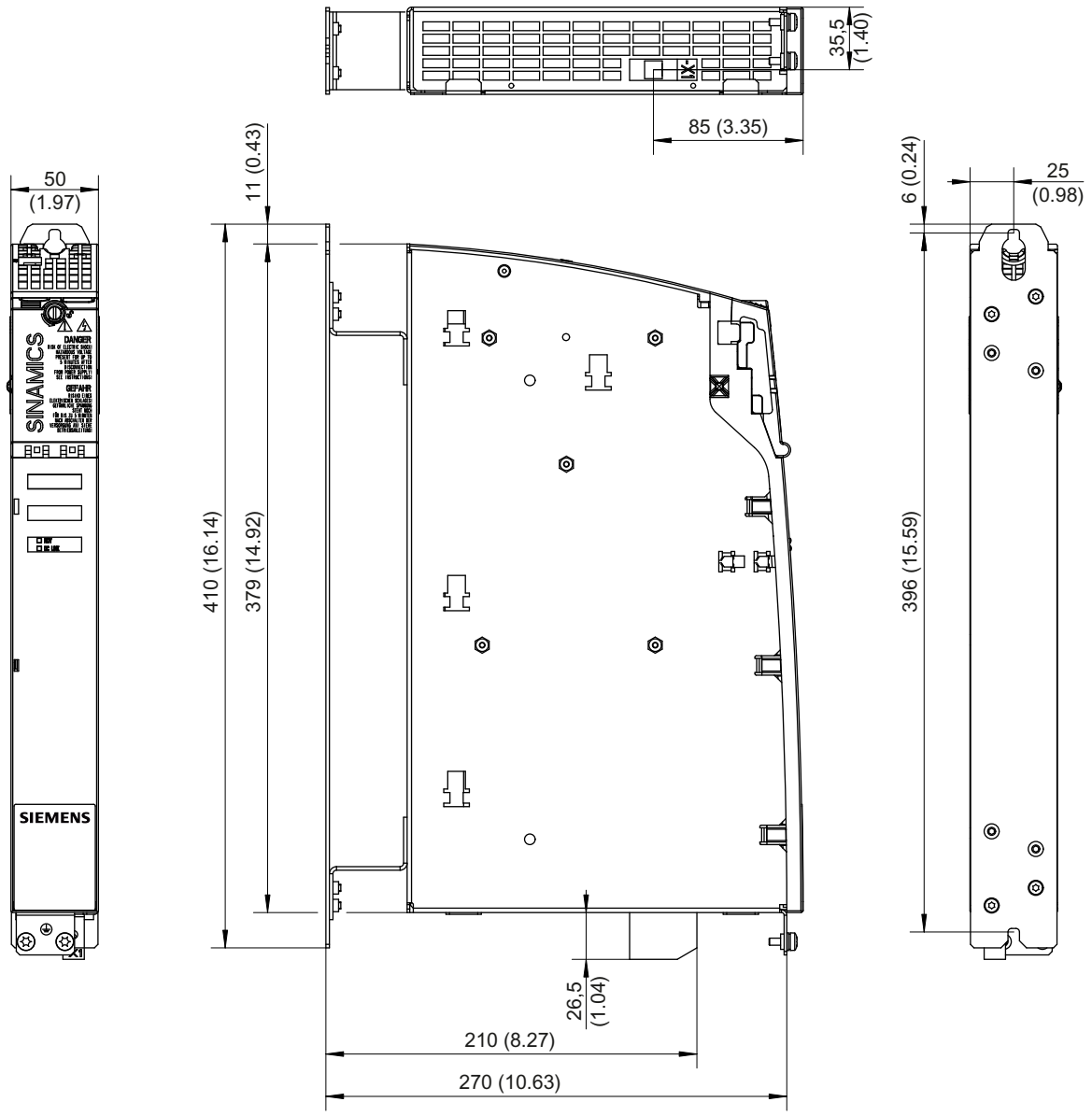


Figure 8-32 Dimension drawing of Voltage Clamping Module, all dimensions in mm and (inches)

8.6.6 Installation

See the instructions for installing other DC link components (e.g. Braking Module, Capacitor Module).

Arrangement of the Voltage Clamping Module:

The Voltage Clamping Module should ideally be placed directly next to the Line Module.

- The current-carrying capacity of the DC link must be taken into account (100 A for the Voltage Clamping Module)
- The Voltage Clamping Module should ideally be placed to the left next to the Line Module.
- If the Voltage Clamping Module is to be installed in an existing drive line-up, it can also be placed at the end.

8.6.7 Technical specifications

Table 8- 29 Technical data

6SL3100-1VE00-0AAx		
DC link voltage	V_{DC}	510 - 720
Electronics power supply	V_{DC}	24 (20.4 – 28.8)
Current carrying capacity DC link busbar 24 V busbar	 A A	 100 20
Power loss [1)]	W	50
Weight	kg	3.1

1) For an overview, see the power loss tables in chapter Control cabinet installation

Derating characteristic

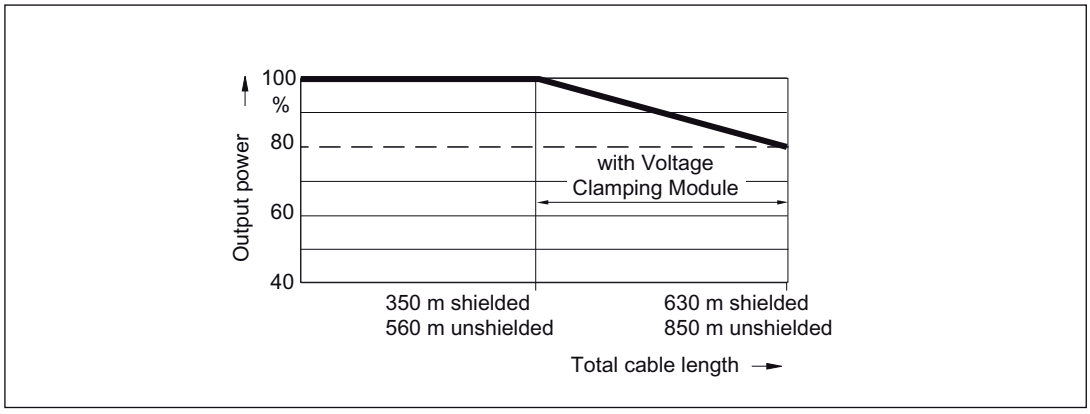


Figure 8-33 Output power as a function of the total cable length

Braking resistors

9

9.1 Description

A braking resistor is used to dissipate the excess DC link energy in generator operation. The braking resistors can be connected to a Braking Module or directly to a 20 kW or 40 kW Basic Line Module.

Resistors with and without a thermostatic switch are available with various rated powers. The thermostatic switch monitors the braking resistors for overtemperature and issues a signal on a floating contact if the limit value is exceeded.

Table 9- 1 Assignment of braking resistors

Braking resistor	Braking Module Booksize	Braking Module Booksize Compact	Basic Line Module 20 kW	Basic Line Module 40 kW
Braking resistors without a thermostatic switch				
6SN1113-1AA00-0DA0 Resistance: 17 Ω P_N: 0.3 kW	X	X		
6SL3100-1BE31-0AA0 Resistance: 5.7 Ω P_N: 1.5 kW	X	X		
Braking resistors with a thermostatic switch				
6SE7018-0ES87-2DC0 Resistance: 80 Ω P_N: 1.25 kW		X	X	X
6SE7021-6ES87-2DC0 Resistance: 40 Ω P_N: 2.5 kW		X	X	X
6SE7023-2ES87-2DC0 Resistance: 20 Ω P_N: 5 kW		X	X	X
6SE7028-0ES87-2DC0 Resistance: 8 Ω P_N: 12.5 kW				X

Installation

The braking resistors can be installed standing on the floor of the control cabinet or suspended. You must ensure that the braking resistors do not obstruct the flow of cooling air to the drive line-up.

Positioning the braking resistor outside the control cabinet or switchgear room enables the resulting thermal losses to be routed away. This reduces the level of air conditioning required.

Connection cables

A shielded connection cable (3 m, 3 x 1.5 mm^2) is supplied with braking resistor 6SN1113-1AA00-0DA0.

All other braking resistors are supplied without a connection cable. The maximum conductor cross-sections are listed in the technical data.

The maximum cable length for all braking resistors is 10 m.

9.2 Safety information

⚠ DANGER

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

⚠ CAUTION

The braking resistor can become very hot. Consequently, it must be installed so that it cannot be touched or, if this is not possible, an appropriate warning notice must be attached to it.

CAUTION

The cooling clearances of 100 mm above and below the components must be observed.

9.3 Dimension drawings

Braking resistors without a thermostatic switch

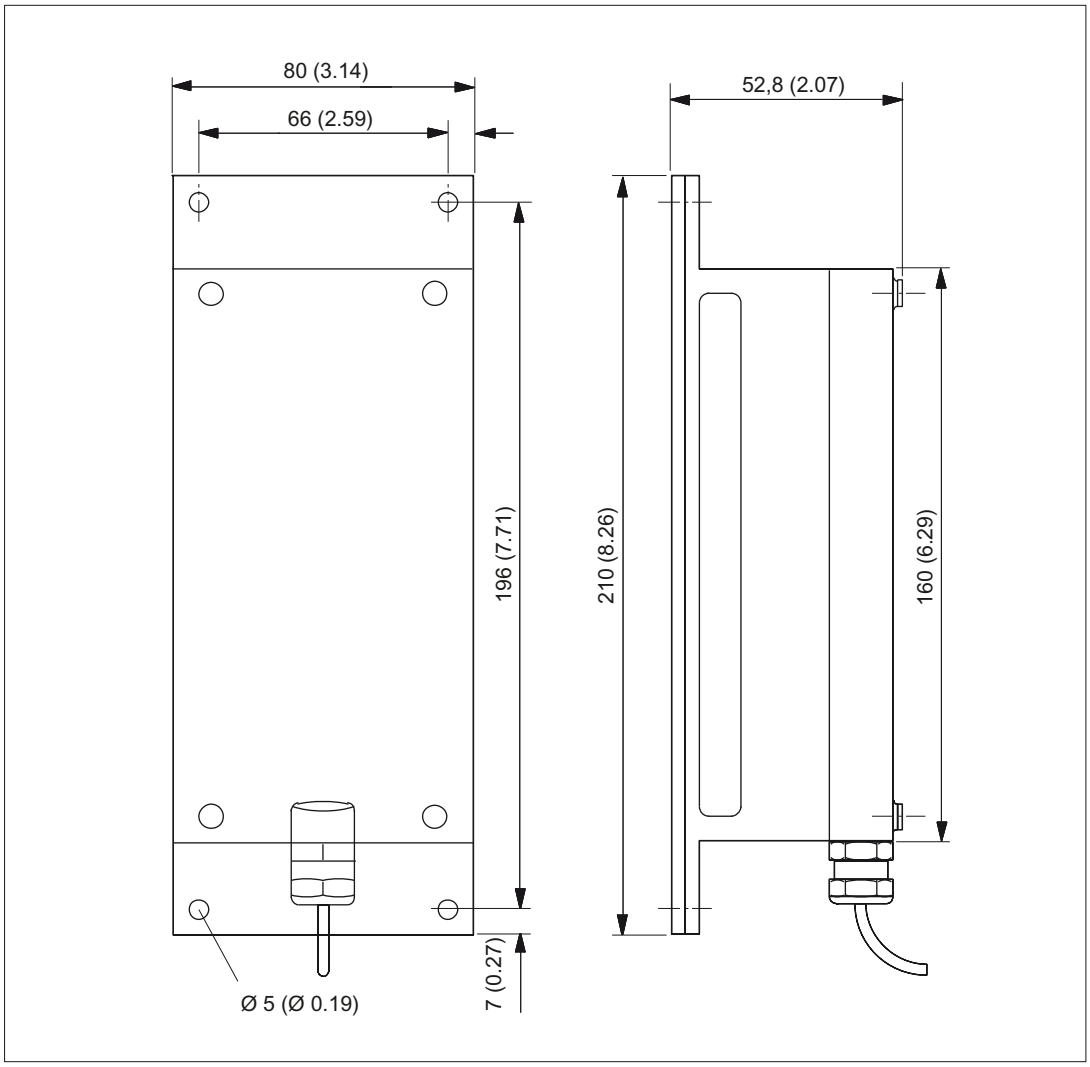


Figure 9-1 Dimension drawing of braking resistor 6SN1113-1AA00-0DA0 where P_n/P_{max} = 0.3 kW/25 kW, all dimensions in mm and (inches)

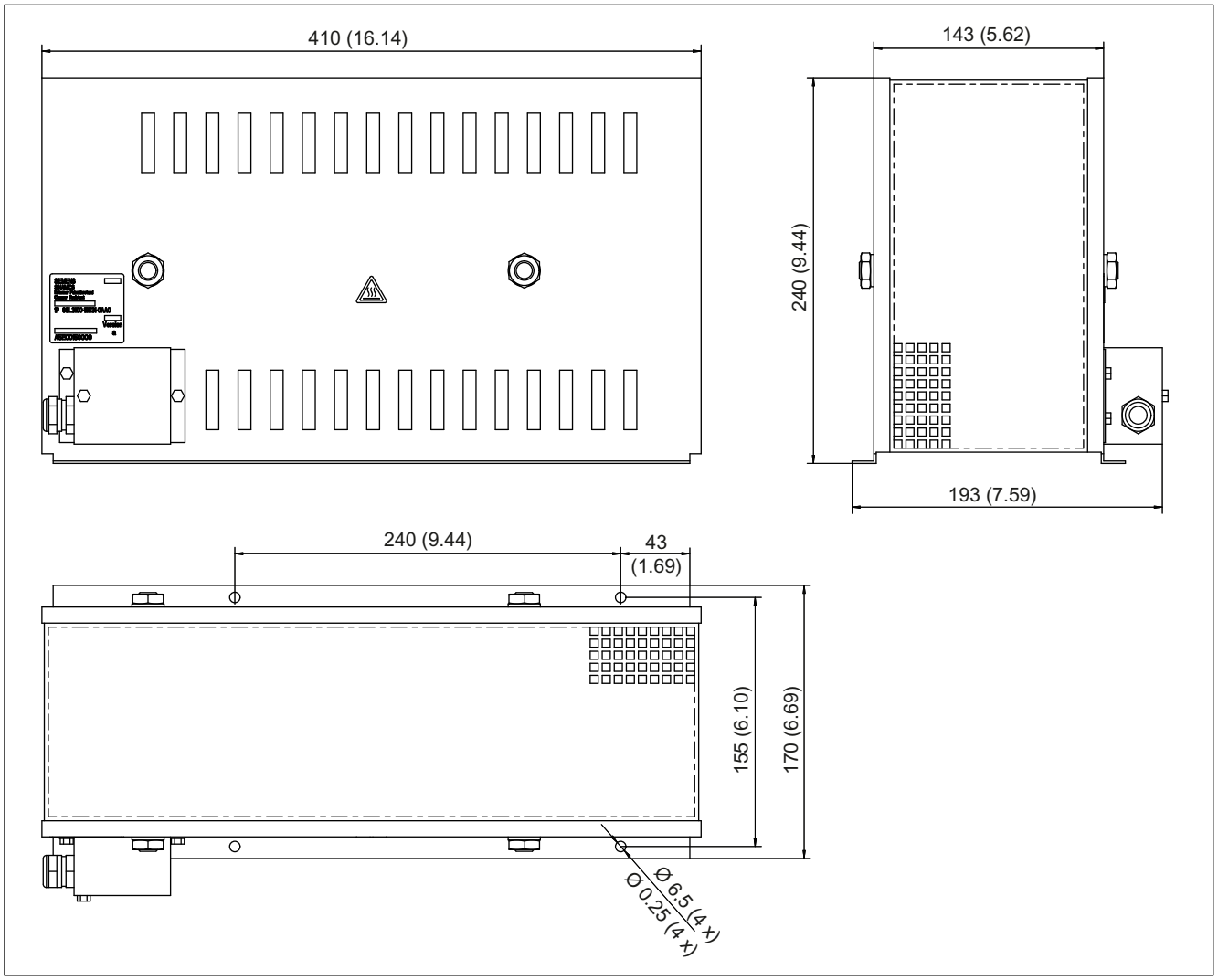


Figure 9-2 Dimension drawing of braking resistor 6SL3100-1BE31-0AA0 where P_n/P_{max} = 1.5 kW/100 kW, all dimensions in mm and (inches)

Braking resistors with a thermostatic switch

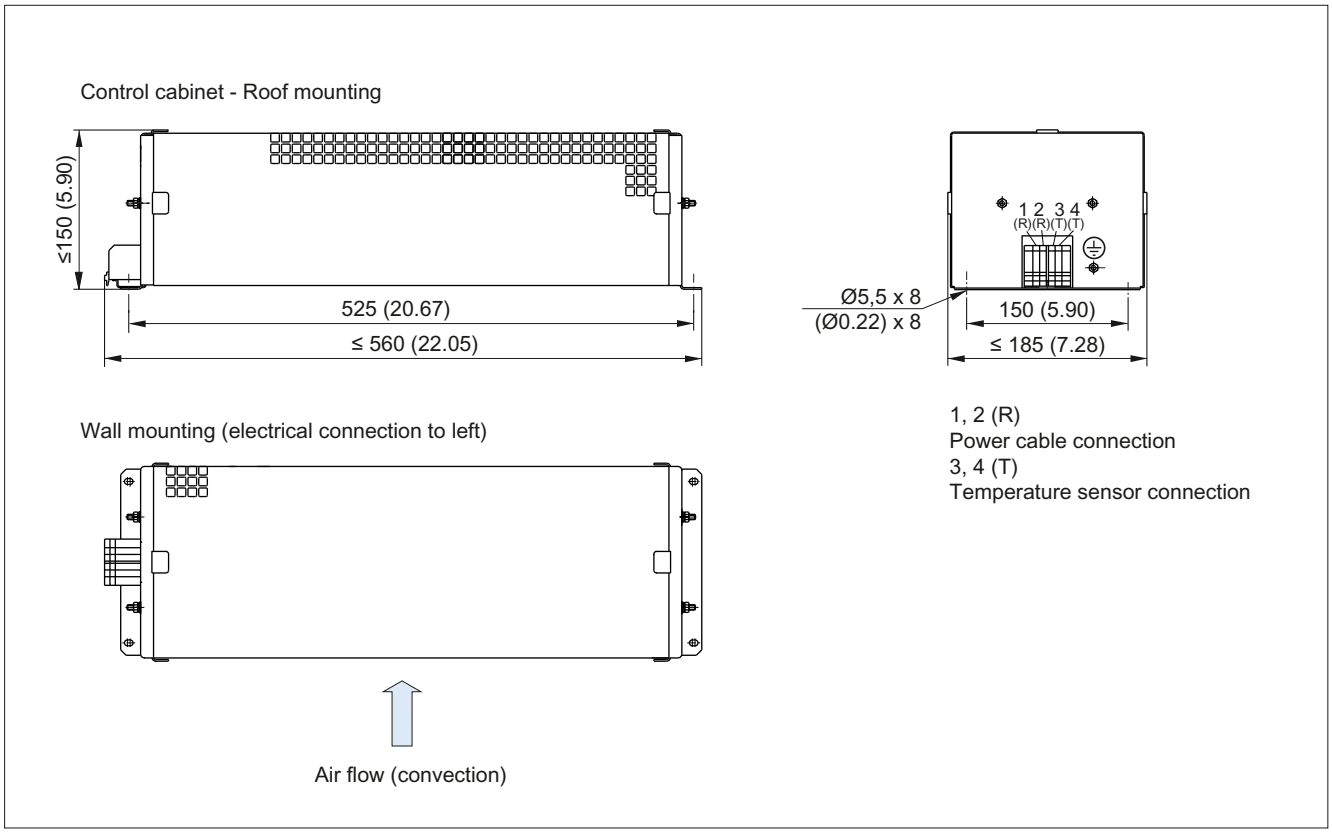


Figure 9-3 Dimension and installation drawing (roof and wall mounting) of braking resistor 6SE7018-0ES87-2DC0 where P_n/P_{max} = 1.25 kW/7.5 kW, all dimensions in mm and (inches)

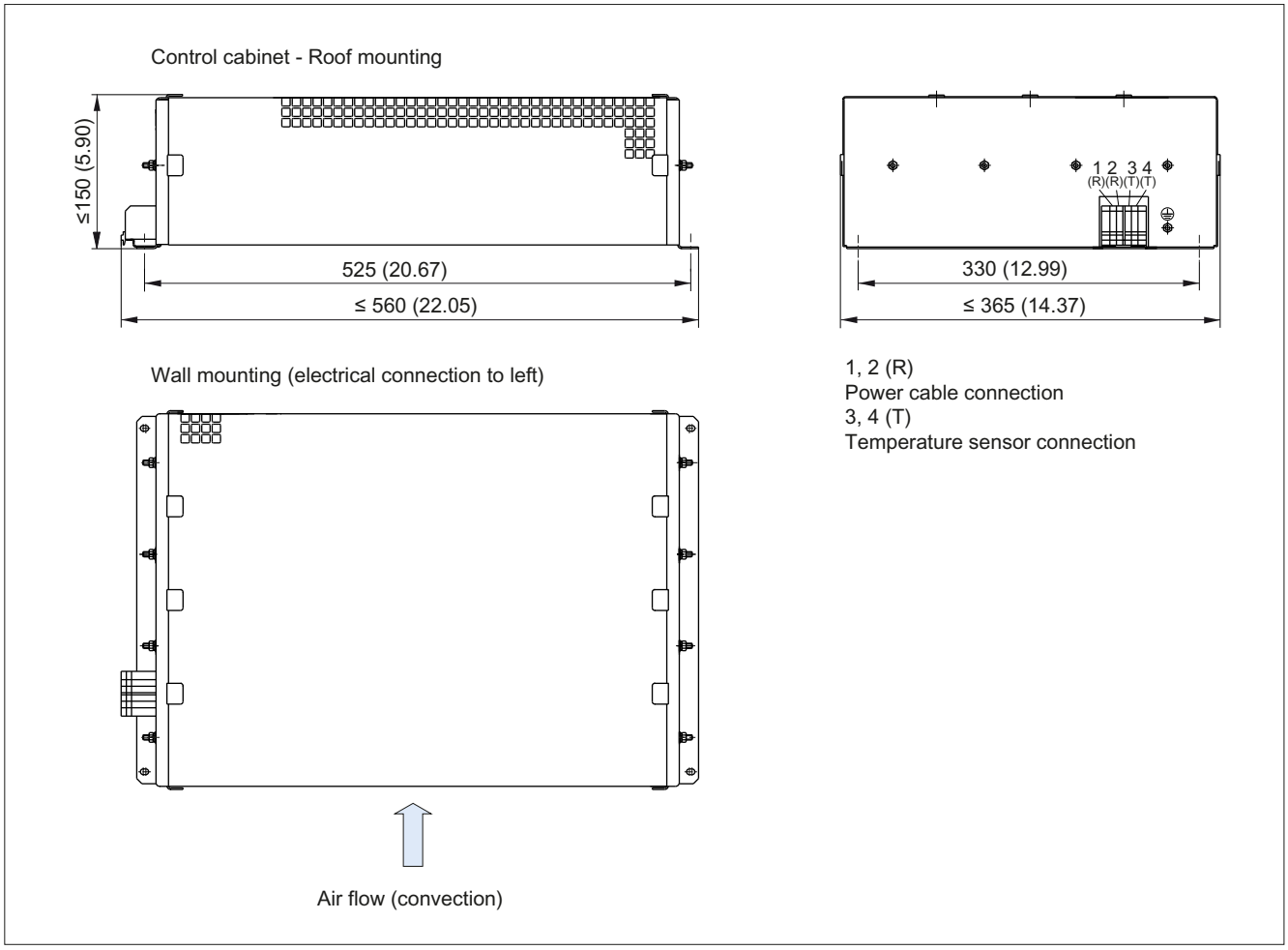
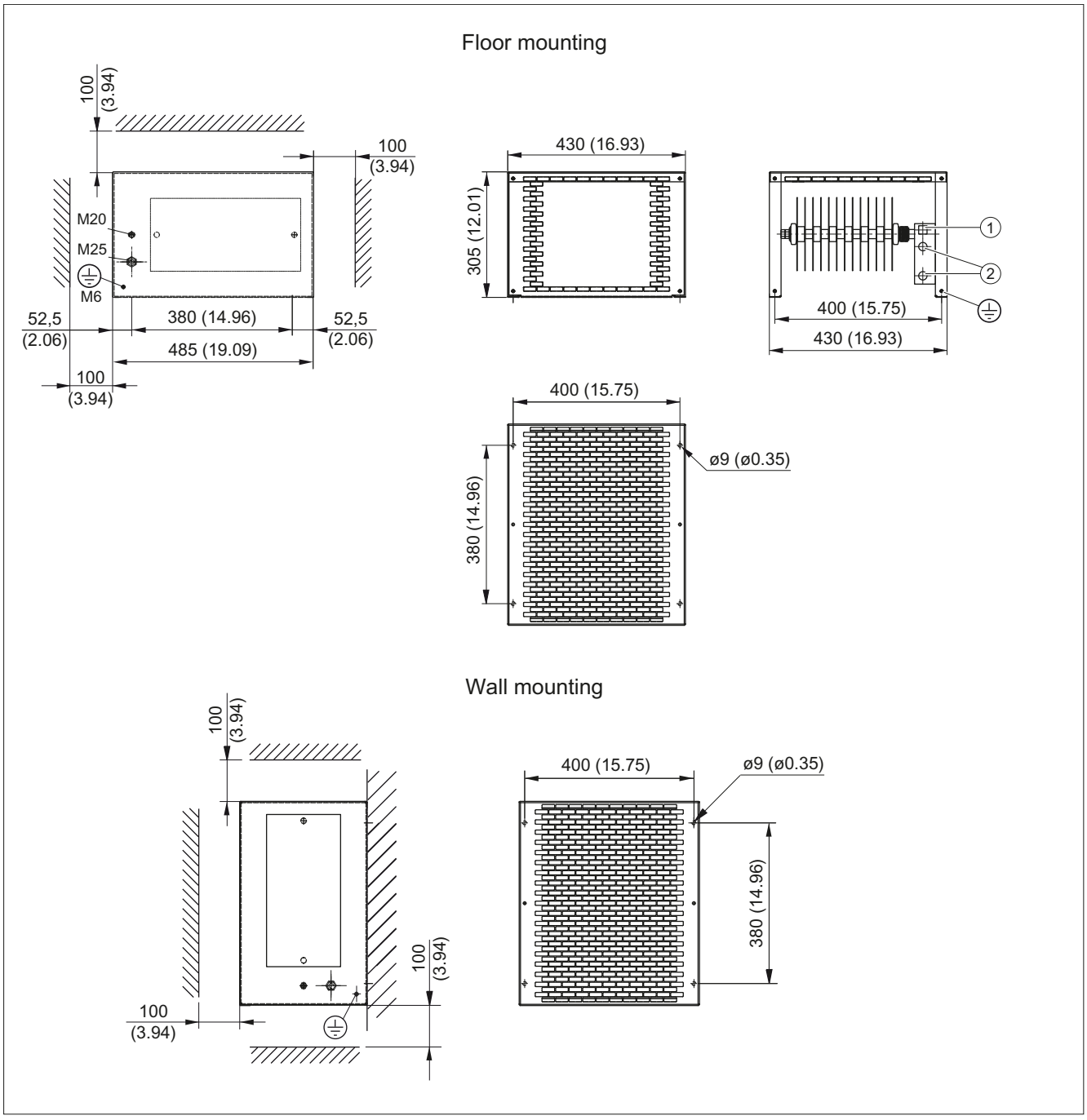


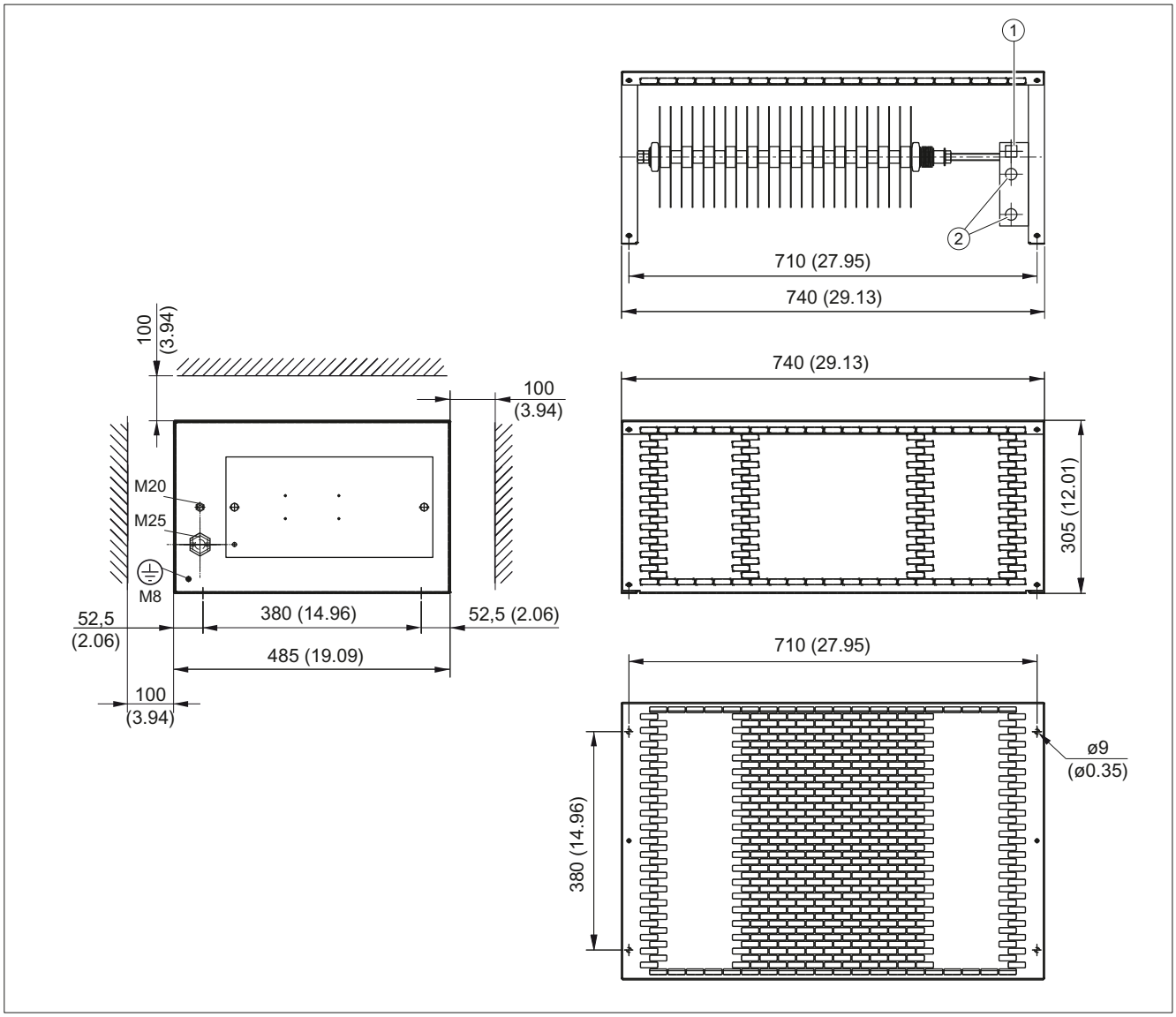
Figure 9-4 Dimension and installation drawing (roof and wall mounting) of braking resistor 6SE7021-6ES87-2DC0 where P_n/P_{max} = 2.5 kW/15 kW, all dimensions in mm and (inches)



1 Connection for thermostatic switch T1/T2 with conductor cross-section 2.5 mm²

2 Connection for power cable, 2 x M6 bolts

Figure 9-5 Dimension and installation drawing (floor and wall mounting) of braking resistor 6SE7023-2ES87-2DC0 where P_n/P_{max} = 5 kW/30 kW, all dimensions in mm and (inches)



1 Connection for thermostatic switch T1/T2 with conductor cross-section 2.5 mm²

2 Connection for power cable, 2 x M6 bolts

Figure 9-6 Dimension and installation drawing (floor mounting) of braking resistor 6SE7028-0ES87-2DC0 where P_n/P_{max} = 12.5 kW/75 kW, all dimensions in mm and (inches)

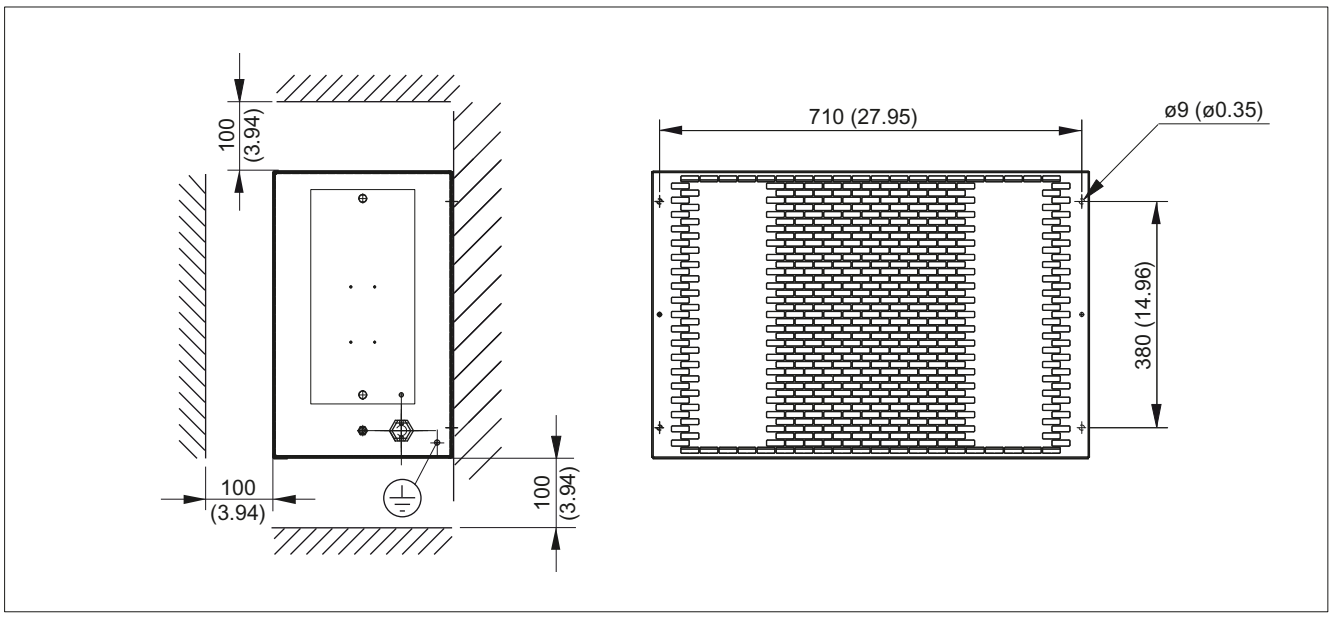


Figure 9-7 Installation drawing (wall mounting) of braking resistor 6SE7028-0ES87-2DC0 where P_n/P_{max} = 12.5 kW/75 kW, all dimensions in mm and (inches)

9.4 Technical data

Table 9- 2 Technical data for braking resistors without a thermostatic switch

	Unit	6SN1113–1AA00–0DA0	6SL3100–1BE31–0AAx
Resistance R	Ω	17	5.7
Rated power P_N	kW	0.3	1.5
Peak power P_{max}	kW	25	100
Max. energy consumption E_{max}	kWs	7.5	200
Power cable connection		Included in delivery; length 3 m, 3 x 1.5 mm^2	Screw terminal, 4 mm^2
Weight	kg	3.4	5.6
Dimensions (W x H x D)	mm	80 x 210 x 53	193 x 410 x 240
Degree of protection to EN 60529		IP54B	IP20

Table 9- 3 Technical data for braking resistors with a thermostatic switch

	Unit	6SE7018-0ES87-2DC0	6SE7021-6ES87-2DC0	6SE7023-2ES87-2DC0	6SE7028-0ES87-2DC0
Resistance R	Ω	80	40	20	8
Rated power P_N	kW	1.25	2.5	5	12.5
Braking power 4 x P_N	kW	5	10	20	50
Peak power P_{max} 1)	kW	7.5	15	30	75
Max. energy consumption E_{max} at P_{max} at $4xP_n$	kWs kWs	22.5 100	45 200	90 400	225 1000
Thermostatic switch connection		Screw terminal 2), 4 mm^2	Screw terminal 2), 4 mm^2	Screw terminal, 2.5 mm^2	Screw terminal, 2.5 mm^2
Power cable connection		Screw terminal 3), 4 mm^2	Screw terminal 3), 4 mm^2	M6 screw bolt for ring cable lug	M8 screw bolt for ring cable lug
PE connection		M5 bolt	M5 bolt	M6 bolt	M8 bolt
Weight	kg	6	12	17	27
Dimensions (W x H x D)	mm	145 x 180 x 540	145 x 360 x 540	450 x 305 x 485	745 x 305 x 485
Degree of protection to EN 60529		IP20	IP20	IP20	IP20

1) Applies to a DC link voltage of 760 V

2) Recommended conductor cross-section: 0.75 to 1.5 mm^2

3) Recommended conductor cross-section: 2.5 mm^2

9.4.1 Characteristic curves

Duty cycle for braking resistors without a thermostatic switch

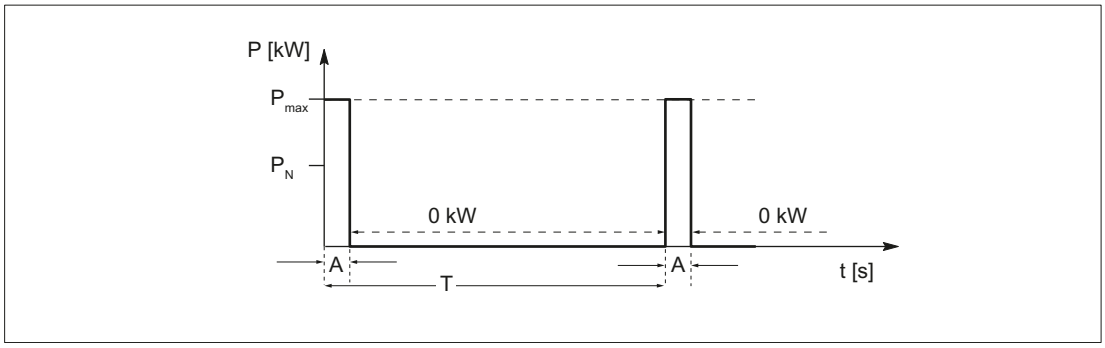


Figure 9-8 Duty cycle for braking resistors without a thermostatic switch

T [s] time period of braking duty cycle

A [s] load duration

P_N [W] rated power (continuous power) of braking resistor

P_{max} [W] peak power of braking resistor (6 x P_N)

Table 9- 4 Duty cycles for Braking Module Booksize

	6SN1113–1AA00–0DA0		6SL3100–1BE31–0AAx	
	Short duty cycle	Long duty cycle	Short duty cycle	Long duty cycle
A [s]	0.1	0.4	1	2
T [s]	11.5	210	68	460

Table 9- 5 Duty cycles for Braking Module Booksize Compact

	6SN1113–1AA00–0DA0		6SL3100–1BE31–0AAx	
	Short duty cycle	Long duty cycle	Short duty cycle	Long duty cycle
A [s]	0.1	0.4	1	2
T [s]	11.5	210	68	460

The following applies when connecting Braking Modules in parallel:

$P_{N\ total}$ = 0.9 x total P_N of single devices

$P_{max\ total}$ = total P_{max} of single devices

Duty cycles for braking resistors with a thermostatic switch

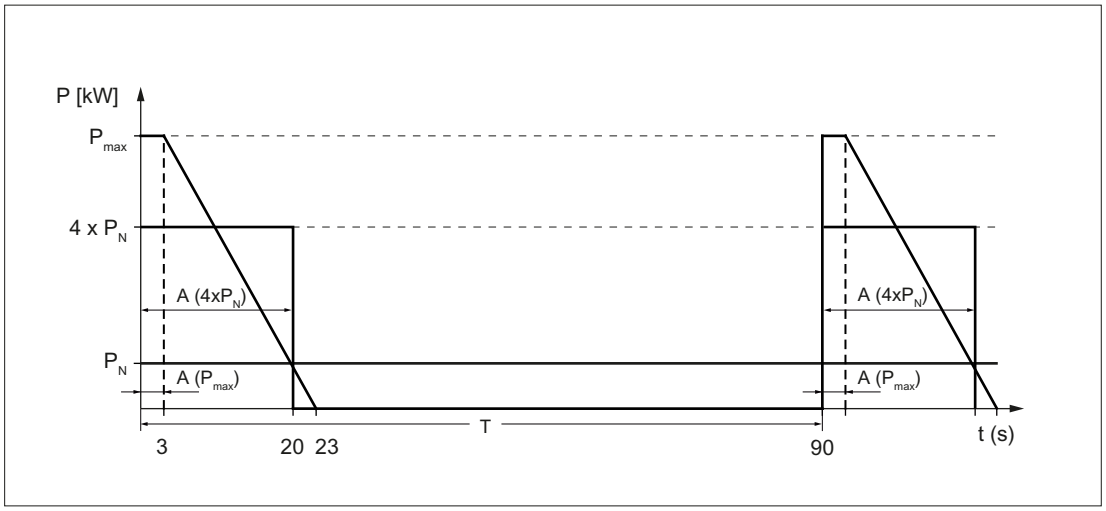


Figure 9-9 Duty cycles for braking resistors with a thermostatic switch

T [s] time period of braking duty cycle

A [s] load duration

P_N [W] rated power (continuous power) of braking resistor

P_{max} [W] peak power of braking resistor (6 x P_N)

4 x P_N [W] = power permitted every 90 s for 20 s

Table 9- 6 Duty cycles

	6SE7018-0ES87-2DC0		6SE7021-6ES87-2DC0		6SE7023-2ES87-2DC0		6SE7028-0ES87-2DC0	
	Duty cycle P_{max}	Duty cycle 4 x P_N	Duty cycle P_{max}	Duty cycle 4 x P_N	Duty cycle P_{max}	Duty cycle 4 x P_{N0}	Duty cycle P_{max}	Duty cycle 4 x P_N
A [s]	3	20	3	20	3	20	3	20
T [s]	90	90	90	90	90	90	90	90

The following applies when connecting Braking Modules in parallel:

$P_{N\ total}$ = 0.9 x total P_N of single devices

4 x $P_{N\ total}$ = 0.9 x sum (4 x P_N) of single devices

$P_{max\ total}$ = total P_{max} of single devices

Motor-side power components

10

10.1 Motor reactors

10.1.1 Description

Motor reactors reduce the voltage stress on the motor windings by reducing the voltage gradients at the motor terminals that occur when motors are fed from drive converters. At the same time, the capacitive charge/discharge currents that also occur on the output of the Motor Module when long motor cables are used are reduced.

Motor reactors can be operated in the VECTOR and SERVO control modes.

Prerequisites

- Ambient temperature 40 °C.
- Pulse frequency f_{max}=4 kHz.
- Output frequency f_{max}=120 kHz.
- Supported in STARTER from Version 2.4 up to 1 motor reactor.
- Supported in STARTER from Version 2.5 up to 3 motor reactors.

Note

In SERVO control mode, the maximum output frequency of the converter must not be higher than the maximum motor reactor frequency.

10.1.2 Safety information

⚠ WARNING

The cooling clearances of 100 mm above and below the components must be observed.

Note

The connection cables to the Motor Module must be kept as short as possible (max. 5 m).

CAUTION

When using motor reactors that SIEMENS has not approved for SINAMICS, then these can thermally damage the reactor.

⚠ CAUTION

The surface temperature of the motor reactors can exceed 80 °C.

CAUTION

The maximum permissible output frequency when motor reactors are used is 120 Hz.

10.1.3 Dimension drawings

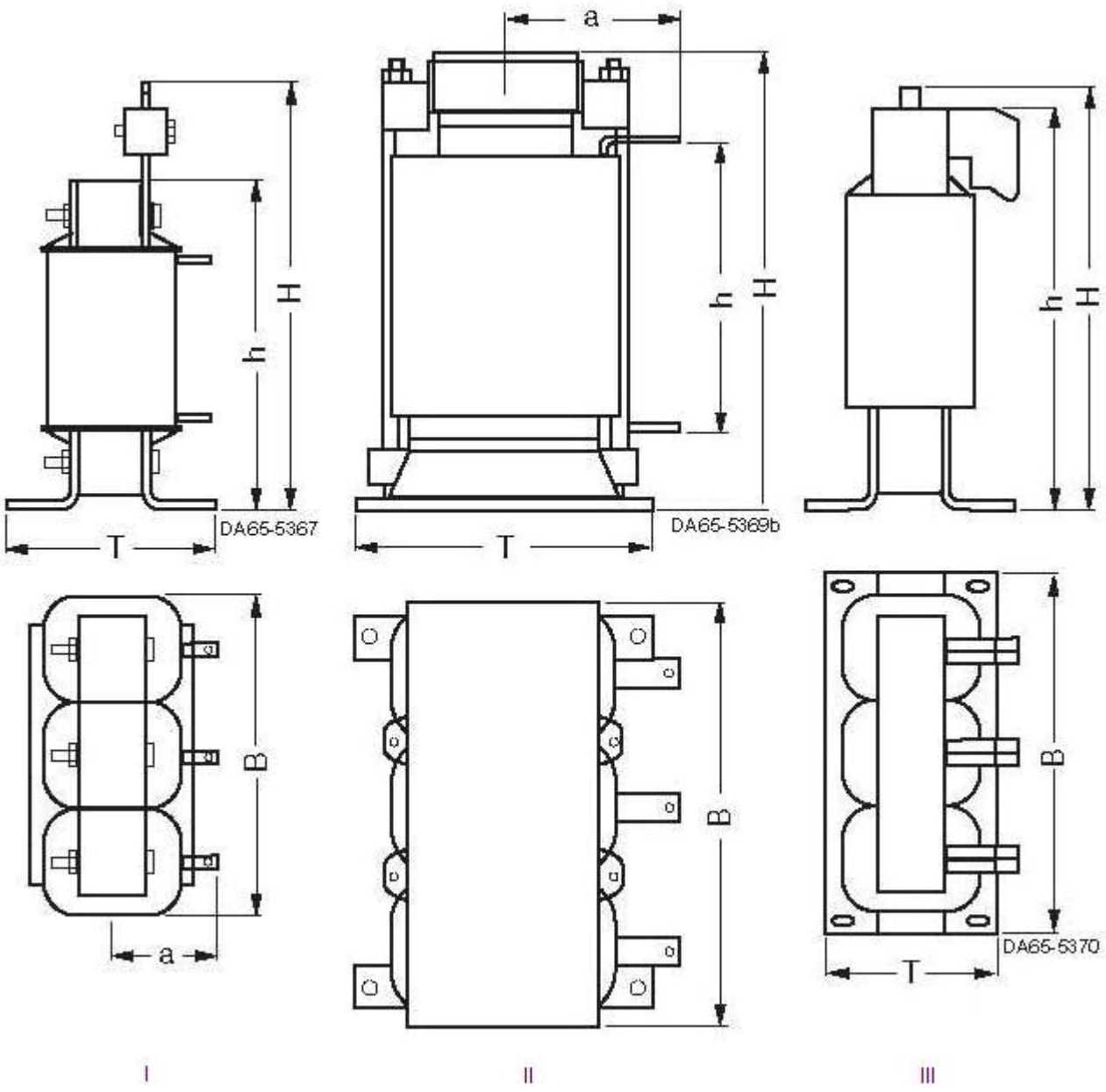


Figure 10-1 Dimension drawings of motor reactors

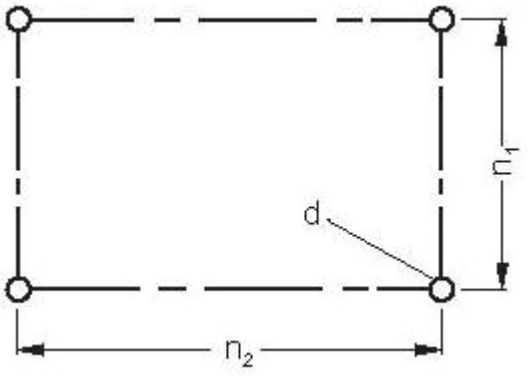


Figure 10-2 Mounting hole

Table 10- 1 Dimensions of motor reactors, all dimensions in mm and (inches)

	6SE7021-0ES87-1FE0	6SE7022-6ES87-1FE0	6SE7024-7ES87-1FE0	6SE7027-2ES87-1FE0
	Fig. III	Fig. III	Fig. II	Fig. I
B	178 (7.00)	219 (8.62)	197 (7.75)	267 (10.51)
H	153 (6.02)	180 (7.08)	220 (8.66)	221 (8.70)
T	88 (3.46)	119 (4.68)	104 (4.09)	107 (4.21)
a	-	-	69 (2.71)	77 (3.03)
h	146 (5.74)	181 (7.12)	103 (4.05)	206 (8.11)
n_1	68 (2.67)	89 (3.50)	70 (2.75)	77 (3.03)
n_2	166 (6.53)	201 (7.91)	176 (6.92)	249 (9.80)
d	M5	M6	M6	M6
Lengths n1 and n2 correspond to the distance between holes				

Table 10- 2 Dimensions of motor reactors, all dimensions in mm and (inches)

	6SE7031-5ES87-1FE0	6SE7031-8ES87-1FE0	6SE7032-6ES87-1FE0
	Fig. II	Fig. II	Fig. II
B	197 (7.75)	281 (11.06)	281 (11.06)
H	220 (8.66)	250 (9.84)	250 (9.84)
T	128 (5.03)	146 (5.74)	146 (5.74)
a	81 (3.18)	98 (3.85)	111 (4.37)
h	100 (3.93)	119 (4.68)	121 (4.76)
n_1	94 (3.70)	101 (3.97)	101 (3.97)
n_2	176 (6.92)	200 (7.87)	200 (7.87)
d	M6	M8	M8
Lengths n1 and n2 correspond to the distance between holes			

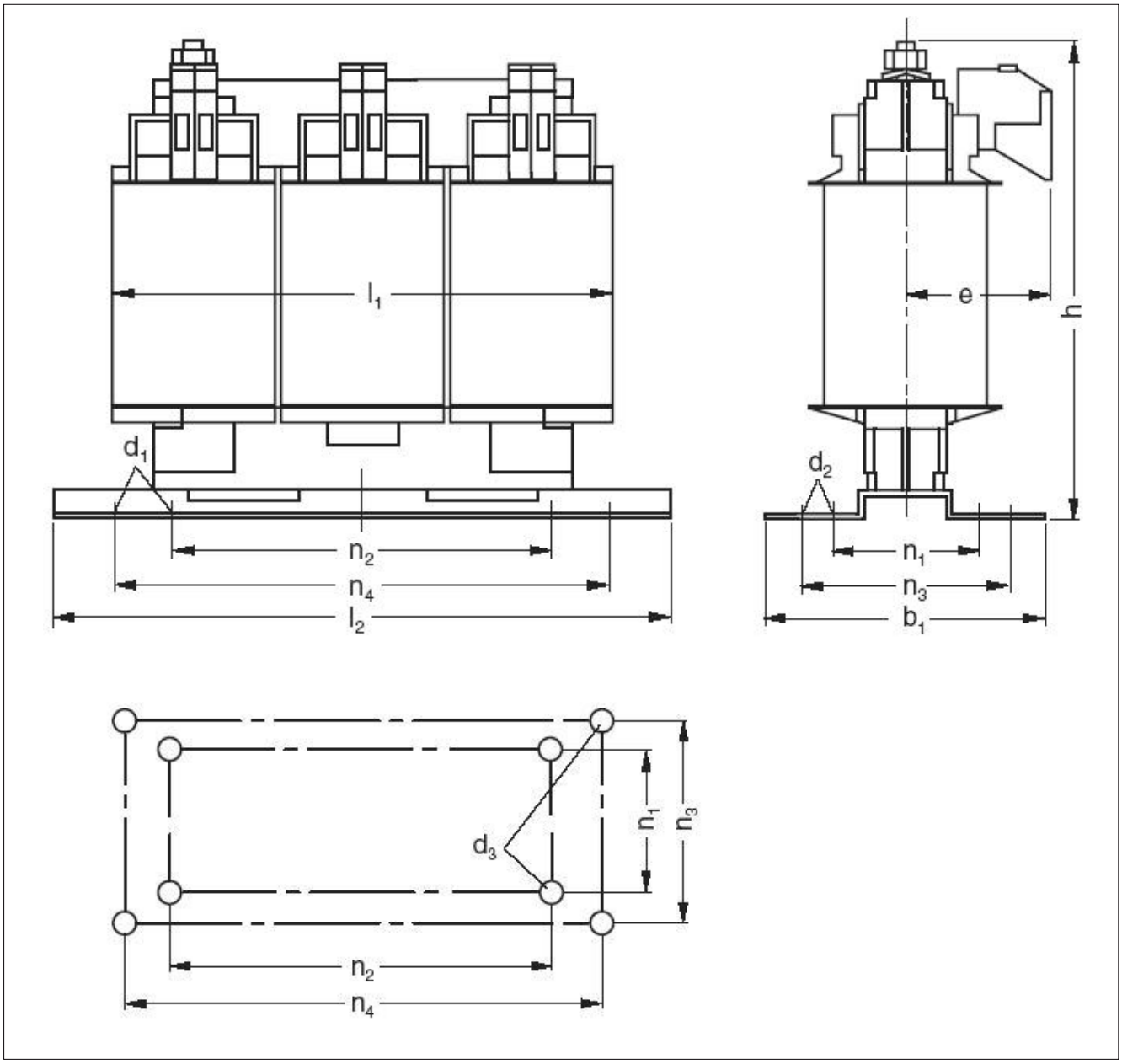


Figure 10-3 Dimension drawing and mounting hole of motor reactor 9 A (6SL3000-2BE21-0AA0)

Table 10- 3 Dimensions of motor reactor 9 A, all dimensions in mm and (inches)

6SL3000-2BE21-0AA0	
l_1	150 (5.90)
l_2	178 (7.00)
b_1	88 (3.46)
b_{max}	111 (4.37)
e	67 (2.63)
h	159 (6.25)
n_1	64 (2.51)
n_2	113 (4.44)
n_3	68 (2.67)
n_4	166 (6.53)
d_1	5.8 (0.22)
d_2	11 (0.43)
d_3	M5
PE	M6
Lengths n_1, n_2, n_3 and n_4 corresponds to the distance between holes	

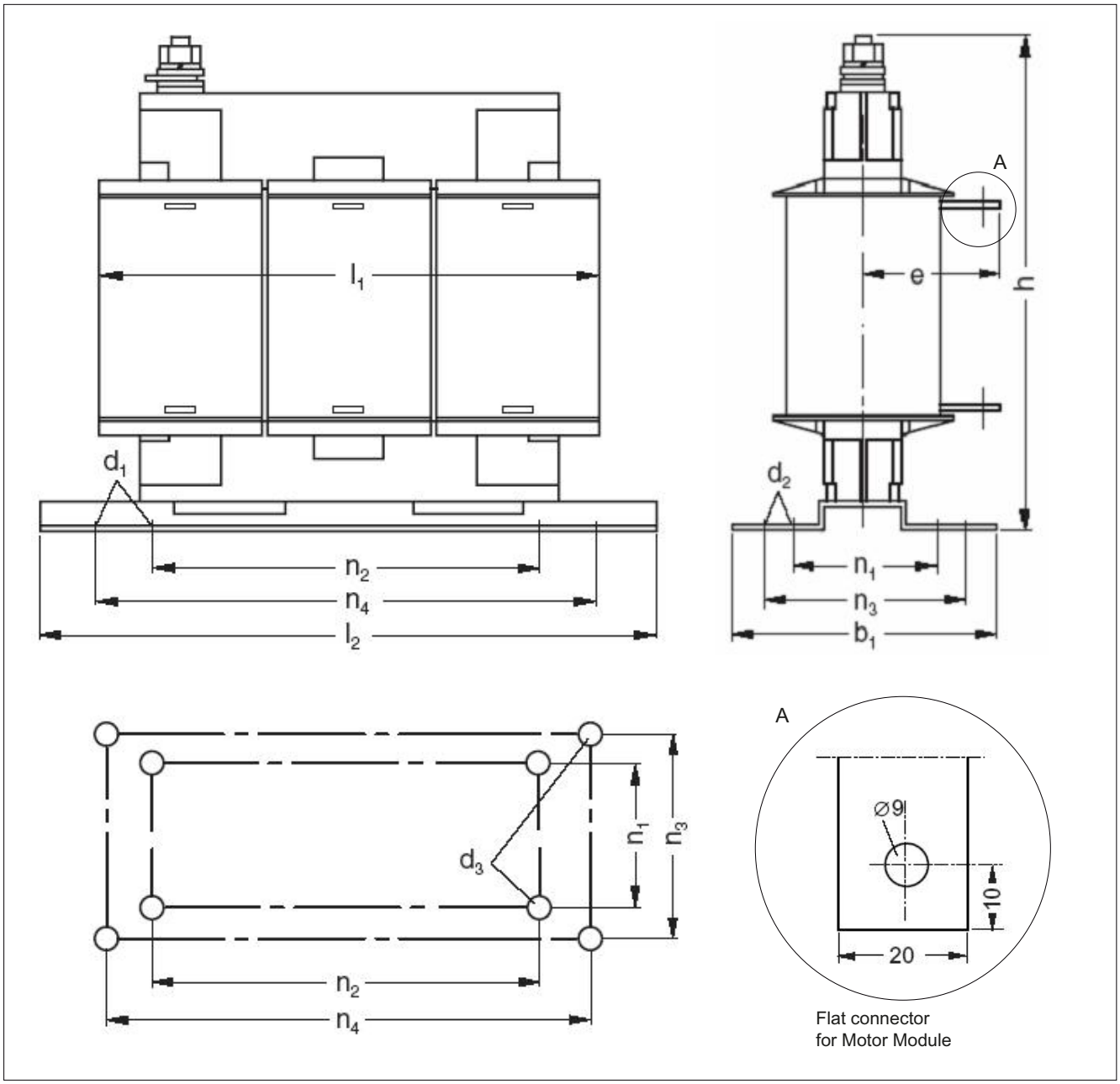


Figure 10-4 Dimension drawing and mounting hole of motor reactor 60 A (6SL3000-2BE26-0AA0)

Table 10- 4 Dimensions of motor reactor 60 A, all dimensions in mm and (inches)

6SL3000-2BE26-0AA0	
l_1	max. 228 (8.97)
l_2	267 (10.51)
b_1	107 (4.21)
b_{max}	125.5 (4.94)
e	72 (2.83)
h	220 (8.66)
h_1	56 (2.20)
h_2	100 (3.93)
n_1	70 (2.75)
n_2	176 (6.92)
n_3	77 (3.03)
n_4	249 (9.80)
d_1	36 (1.41)
d_2	3.5 (0.13)
d_3	M6
PE	M6
Lengths n_1, n_2, n_3 and n_4 corresponds to the distance between holes	

10.1.4 Technical data

Table 10- 5 Technical data, motor reactors, part 1

Order No.		6SE7021-0ES87-1FE0	6SL3000-2BE21-0AA0	6SE7022-6ES87-1FE0	6SE7024-7ES87-1FE0	6SE7027-2ES87-1FE0
Matching the Motor Module		6SL312x-1TE13-0AAx 6SL312x-2TE13-0AAx 6SL312x-1TE15-0AAx 6SL312x-2TE15-0AAx	6SL312x-1TE21-0AAx 6SL312x-2TE21-0AAx	6SL312x-1TE21-8AAx 6SL312x-2TE21-8AAx	6SL312x-1TE23-0AAx	6SL312x-1TE24-5AAx
Rated current	A	5	9	18	30	45
Inductance	µH	1243	1000	332	180	59
Power loss	W	80	90	110	190	130
Connections - to the Motor Module - to the load - PE		 4 mm² 4 mm² M6	 10 mm² 10 mm² M6	 10 mm² 10 mm² M6	 M8 M8 M6	 M8 M8 M6
Degree of protection		IP00	IP00	IP00	IP00	IP00
Weight	kg	5.5	4.83	9.2	20	11

Table 10- 6 Technical data, motor reactors, part 2

Order No.		6SL3000-2BE26-0AA0	6SE7031-5ES87-1FE0	6SE7031-8ES87-1FE0	6SE7032-6ES87-1FE0
Matching the Motor Module		6SL312x-1TE26-0AAx	6SL312x-1TE28-5AAx	6SL312x-1TE31-3AAx	6SL312x-1TE32-0AAx
Rated current	A	60	85	132	200
Inductance	µH	59	29	23	16
Power loss	W	105	220	300	300
Connections - to the Motor Module - to the load - PE		 M8 M8 M6	 M8 M8 M6	 M10 M10 M6	 M10 M10 M6
Degree of protection		IP00	IP00	IP00	IP00
Weight	kg	10.5	25	30	30

Table 10- 7 Cable lengths, Part 1

Order No.	6SE7021-0ES87-1FE0	6SL3000-2BE21-0AA0	6SE7022-6ES87-1FE0	6SE7024-7ES87-1FE0	6SE7027-2ES87-1FE0
Rated current [A]	5	9	18	30	45
Shielded cables					
Maximum motor cable length, 1 reactor	100	135	160	190	200
Maximum motor cable length, 2 reactors	-	-	320	375	400
Maximum motor cable length, 3 reactors	-	-	-	-	600
Unshielded cables					
Maximum motor cable length, 1 reactor	150	200	240	280	300
Maximum motor cable length, 2 reactors	-	-	480	560	600
Maximum motor cable length, 3 reactors	-	-	-	-	900

Table 10- 8 Cable lengths, Part 2

Order No.	6SL3000-2BE26-0AA0	6SE7031-5ES87-1FE0	6SE7031-8ES87-1FE0	6SE7032-6ES87-1FE0
Rated current [A]	60	85	132	200
Shielded cables				
Maximum motor cable length, 1 reactor	200	200	200	200
Maximum motor cable length, 2 reactors	400	400	400	400
Maximum motor cable length, 3 reactors	600	600	600	600
Unshielded cables				
Maximum motor cable length, 1 reactor	300	300	300	300
Maximum motor cable length, 2 reactors	600	600	600	600
Maximum motor cable length, 3 reactors	900	900	900	900

10.2 Voltage Protection Module VPM

10.2.1 Description

The Voltage Protection Module (VPM) is a component for limiting voltage. It is used for both 1FE1 and 2SP1 motors and those with an electromagnetic force (EMF) of between 800 V and 2000 V to limit DC-link voltage if a fault occurs.

The Voltage Protection Module is installed within the motor cable between the Motor Module and motor. If the line voltage fails at the maximum motor speed or the pulses at the Motor Module are canceled as a result of the power failure, the motor regenerates at high voltage into the DC link. The Voltage Protection Module recognizes that the motor voltage is too high (> 800 V) and uses an electronic switch to short-circuit the three phases of the motor at its supply lines. The power remaining in the motor is converted to heat via the short circuit between the Voltage Protection Module and motor cables.

The Voltage Protection Module is available in 3 versions.

Table 10- 9 Overview of the Voltage Protection Modules available

Designation	Rated current
VPM120	120 A
VPM200	200 A
VPM200 Dynamic	200 A

The VPM200 Dynamic should be used in the following applications:

- When operating third-party synchronous motors (they generally have higher inductances than 1FE motors)
- When a third-party motor is combined with a motor reactor
- When a 1FE motor is combined with a motor reactor

This is because of the higher operating inductances and resulting higher voltage rates-of-rise, which can affect the Voltage Protection Module.

Table 10- 10 Interface overview for Voltage Protection Modules

Type	Number VPM120/VPM200	Number VPM200 Dynamic
Signaling interface	1	1
PE connection	2	4
Load connecting bolt, input	3	5
Load connecting bolt, output	3	5

10.2.2 Safety information

⚠ DANGER

Risk of electric shock

Dangerous voltages are still present for up to 30 minutes after the power supply has been switched off.

⚠ DANGER

The motor may only be operated below the field weakening speed while the Voltage Protection Module is ramping up (see the technical data).

⚠ DANGER

Only short-circuit proof motors may be used in conjunction with a Voltage Protection Module.

⚠ DANGER

Only qualified personnel should work on or around the equipment. The personnel must be thoroughly familiar with all the warnings and maintenance procedures described in the relevant description of this manual.

⚠ WARNING

Motors whose EMF can reach a DC-link voltage > 2 kV (EMF = 1.4 kV_{rms}) at maximum speed must not be connected to a Motor Module. The insulation voltage could be exceeded, resulting in personal injury due to electric shocks.

Under fault conditions, voltages up to 2 kV can occur at cables that are cut or damaged.

Depending on the speed of the motors, the motor terminal voltage of the 1FE1 motors can attain values as high as 2 kV.

⚠ WARNING

Measures must be adopted to prevent the drive from starting automatically.

⚠ CAUTION

The cooling clearances of 200 mm above and below the components must be observed.

NOTICE
The unit is a safety-relevant piece of equipment and may only be used as specified. Other applications, e.g. armature short-circuit in operation, are not permissible. The warning information on the unit must be carefully observed! The Voltage Protection Module can only be operated effectively in combination with SINAMICS Booksize and 1FE1/2SP1 motors. Shielded MOTION-CONNECT 800PLUS motor cables (type 6FX8) must be used with the VPM.

10.2.3 Interface description

10.2.3.1 Overview

The drawings below show the basic positions of interfaces and the housing openings of the Voltage Protection Modules VPM120, VPM200 and VPM200 Dynamic.

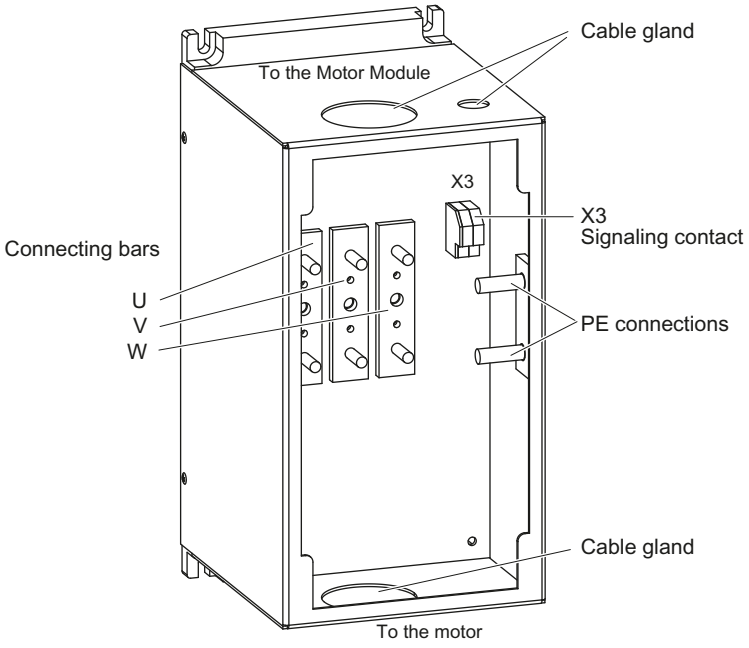


Figure 10-5 Interface overview, Voltage Protection Modules VPM120 (without cover)

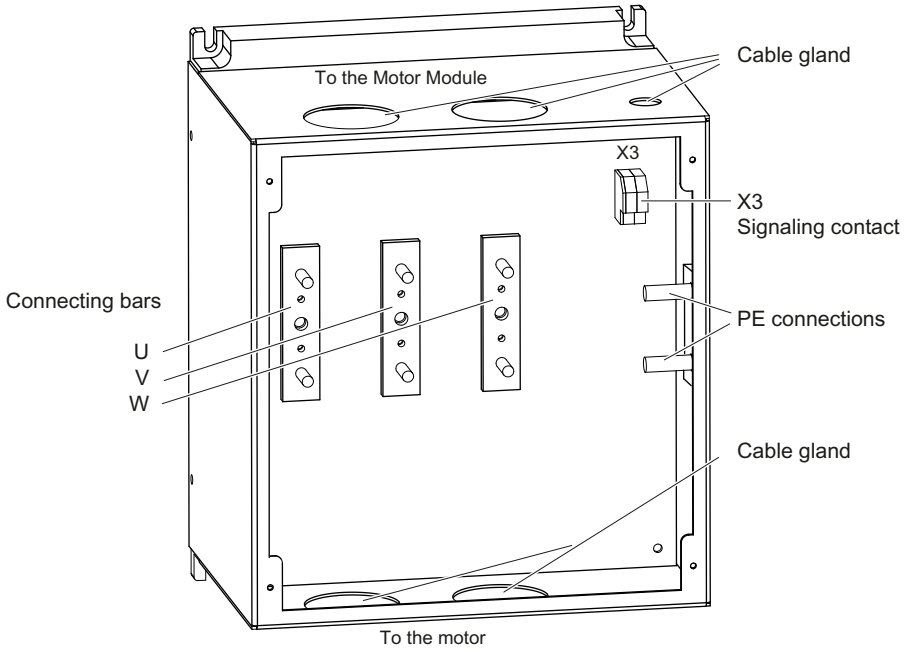


Figure 10-6 Interface overview, Voltage Protection Modules VPM200 (without cover)

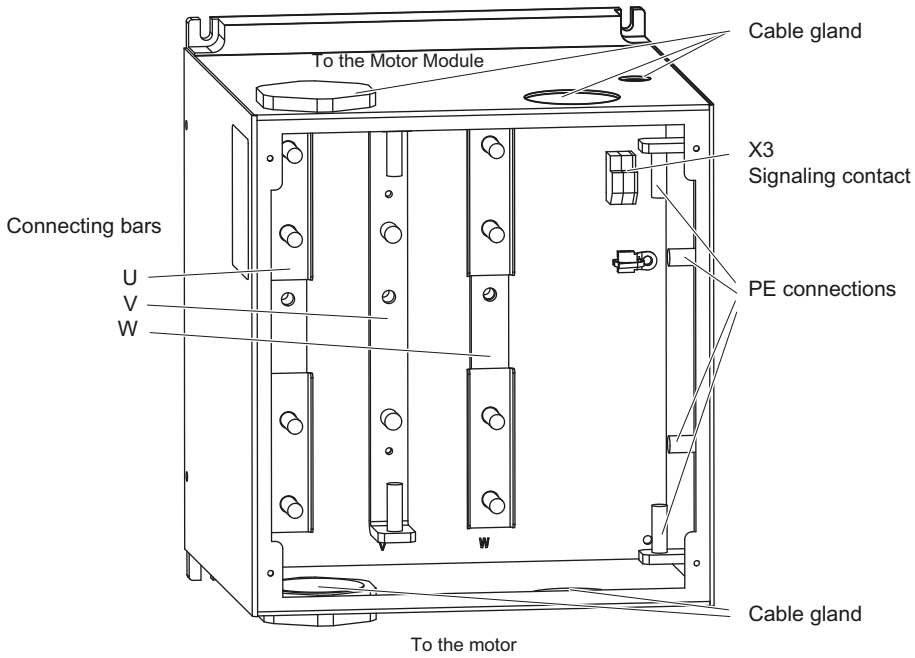


Figure 10-7 Interface overview, Voltage Protection Modules VPM200 Dynamic (without cover)

The housing is closed during operation to ensure the electrical terminals are covered.

10.2.3.2 Signaling interface X3

The signaling interface has the following assignments:

Table 10- 11 Signaling interface X3

Terminal	Designation	Technical specifications
1	Operating message for Control Unit	• The cable shield is connected to the VPM housing via the cable entry. • Floating contact, load rating: 30 VDC at 0.1 A
2	Operating voltage +24 V (from external source)	
Terminal type: WAGO spring-loaded terminal, type 226-111; max. conductor cross-section: 1.5 mm^2, shielded lead		
Cable gland: Max. 9 mm ∅ Types VPM120, VPM200 and VPM200 Dynamic • Screwed joint: 1 x M16, e.g. from Pflitsch, order designation: UNI DICHT EMV 2165211S05 • Locknut M16: GM216PA.		

Operating message via signaling contact X3

After a Voltage Protection Module response or in the event of a temperature error, signaling contact X3 opens and interrupts the inverter system's pulse enable.

When the temperature error no longer applies, signaling contact X3 closes after time t > 2 min.

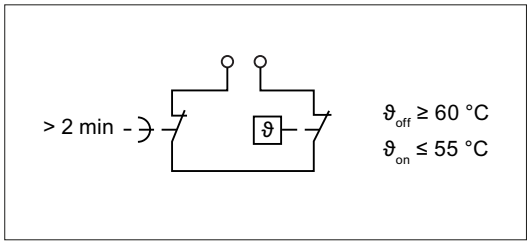


Figure 10-8 Signaling contact X3 of the Voltage Protection Module

⚠ DANGER

Measures must be taken to prevent the drive starting automatically, since signaling contact X3 restores the pulse enable after t > 2 min.

10.2.3.3 Connection bars U, V, W, PE

The cables to the Motor Module and motor are routed through the cable entry of the Voltage Protection Module and attached to the connection bars inside the unit.

Table 10- 12 Connections U, V, W, and PE

	VPM120	VPM200	VPM200 Dynamic
Connection bolt	8 x M6 1)	8 x M8 1)	14 x M8 2)
Cable lug	Crimp-type cable lug M6	Crimp-type cable lug M8	Tubular cable lug M8, 90° angle
Conductor cross section	≤ 50 mm²	≤ 50 mm²	≤ 50 mm²
Tightening torque	10 Nm	25 Nm	25 Nm
Cable gland	For cables with max. 40 mm ∅		
Gland 3)	2 x M50 e.g. from Pflitsch, order designation: UNI DICHT EMV 250584117 Locknut M50: GM250PA	4 x M50 e.g. from Pflitsch, order designation: UNI DICHT EMV 250584117 Locknut M50: GM250PA	4 x M50 e.g. from Pflitsch, order designation: UNI DICHT EMV 250584117 Locknut M50: GM250PA

1) There are 2 connection points for each phase and for PE.

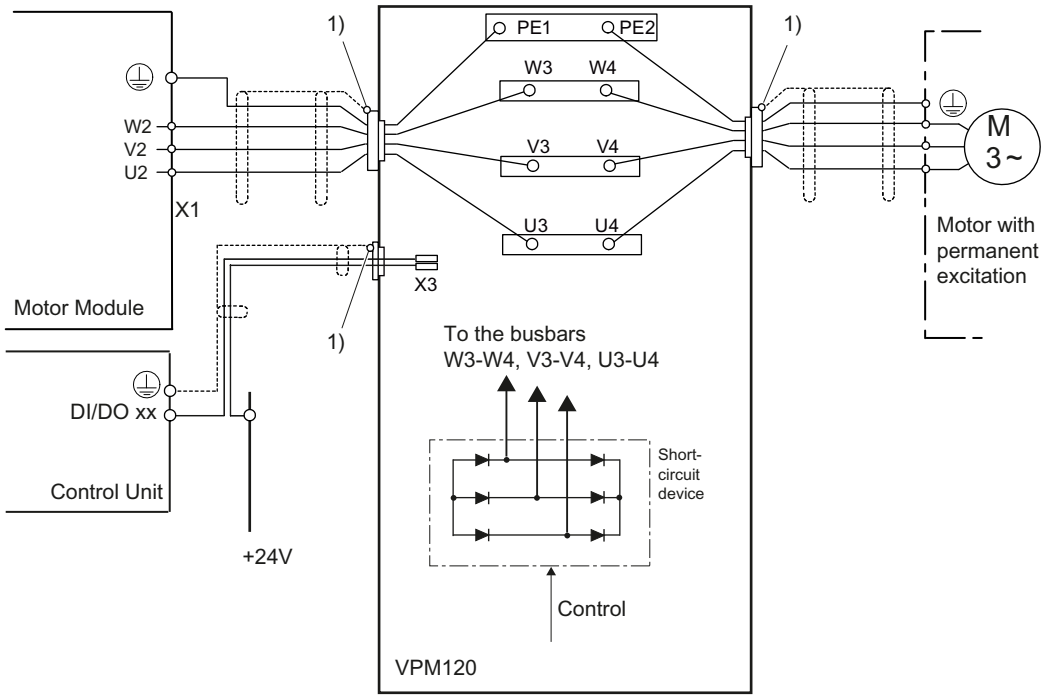
2) There are 4 connection points for each of the phases U, W, and PE, and 2 terminals for phase V.

3) The glands must be separately ordered.

Note

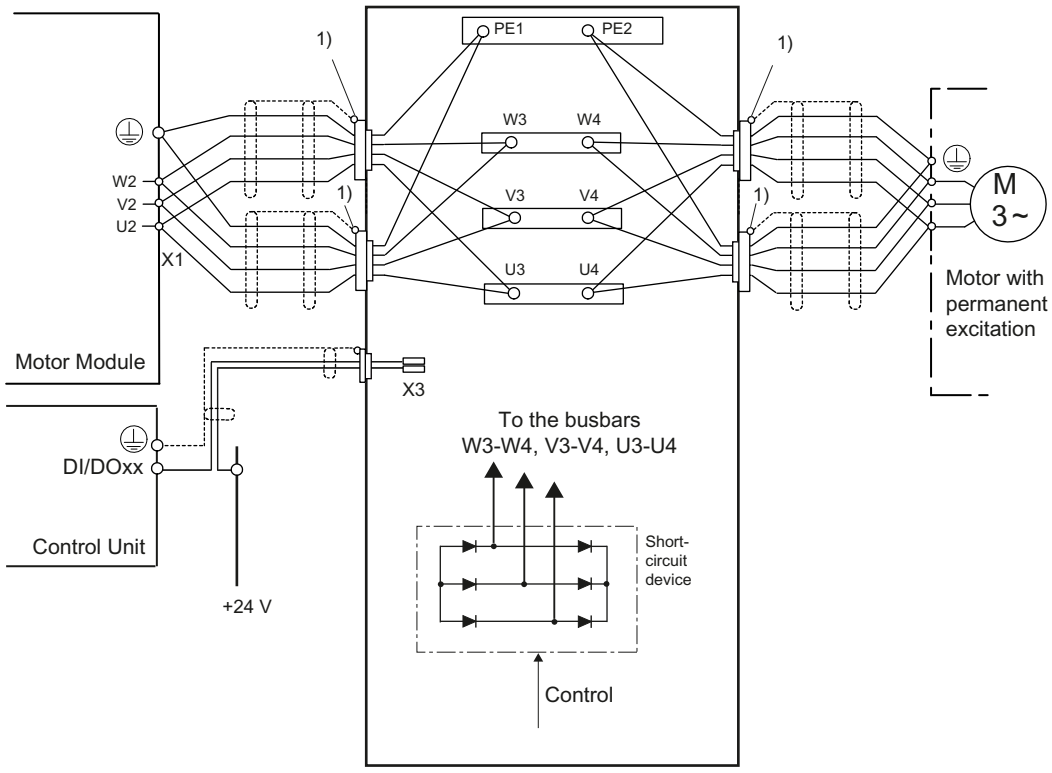
Cable lengths with cross-sections of > 50 mm² between the Motor Module and the Voltage Protection Module or between the Voltage Protection Module and the motor are implemented using two cables connected in parallel.

10.2.4 Connection examples



1) Cable shield is conductively connected to the cable gland

Figure 10-9 Connection example for Voltage Protection Module VPM120



1) Cable shield is conductively connected to the cable gland

Figure 10-10 Connection example for Voltage Protection Module VPM200

Cable lengths

The maximum length of the power cable between the Motor Module and the Voltage Protection Module is 1.5 m and must not include any switching elements.
The power cable between the Voltage Protection Module and the motor must not exceed a length of 50 m.

The length of the signal cable must not exceed 10 m.

Signaling contact

Signaling interface X3 on the Voltage Protection Module is wired to a digital input (DI) on the Control Unit, which controls this spindle. If more than one Voltage Protection Module is used, each X3 terminal is wired to the respective Control Unit. If an armature short-circuit occurs, the pulses of the axis involved must remain inhibited. To ensure this happens, the connected digital input is interconnected to control bit OFF2 (pulse inhibit) via p0845 = r0722.xx. The signaling interface is operated with +24 V.

10.2.5 Dimension drawings

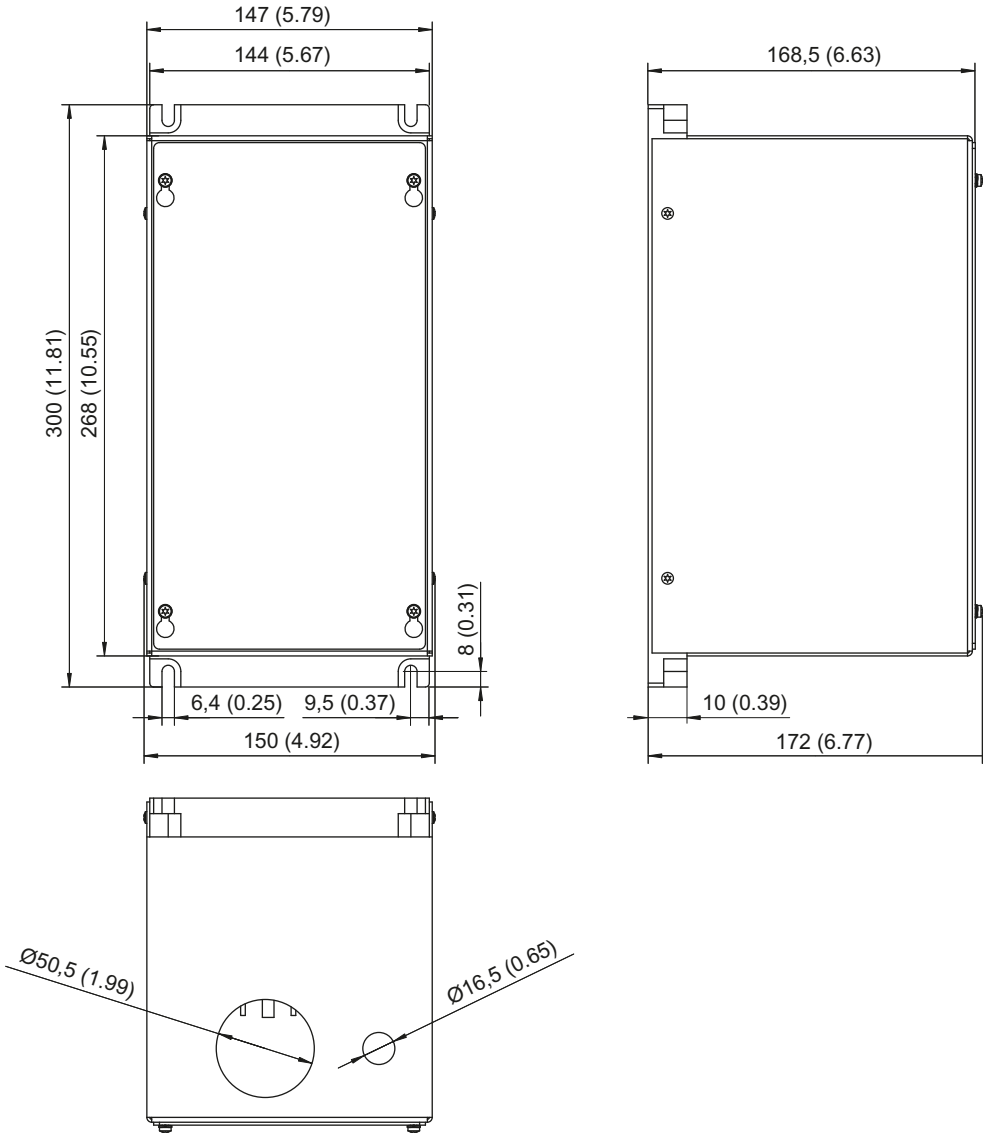


Figure 10-11 Dimension drawing of the Voltage Protection Module VPM120, all data in mm and (inches)

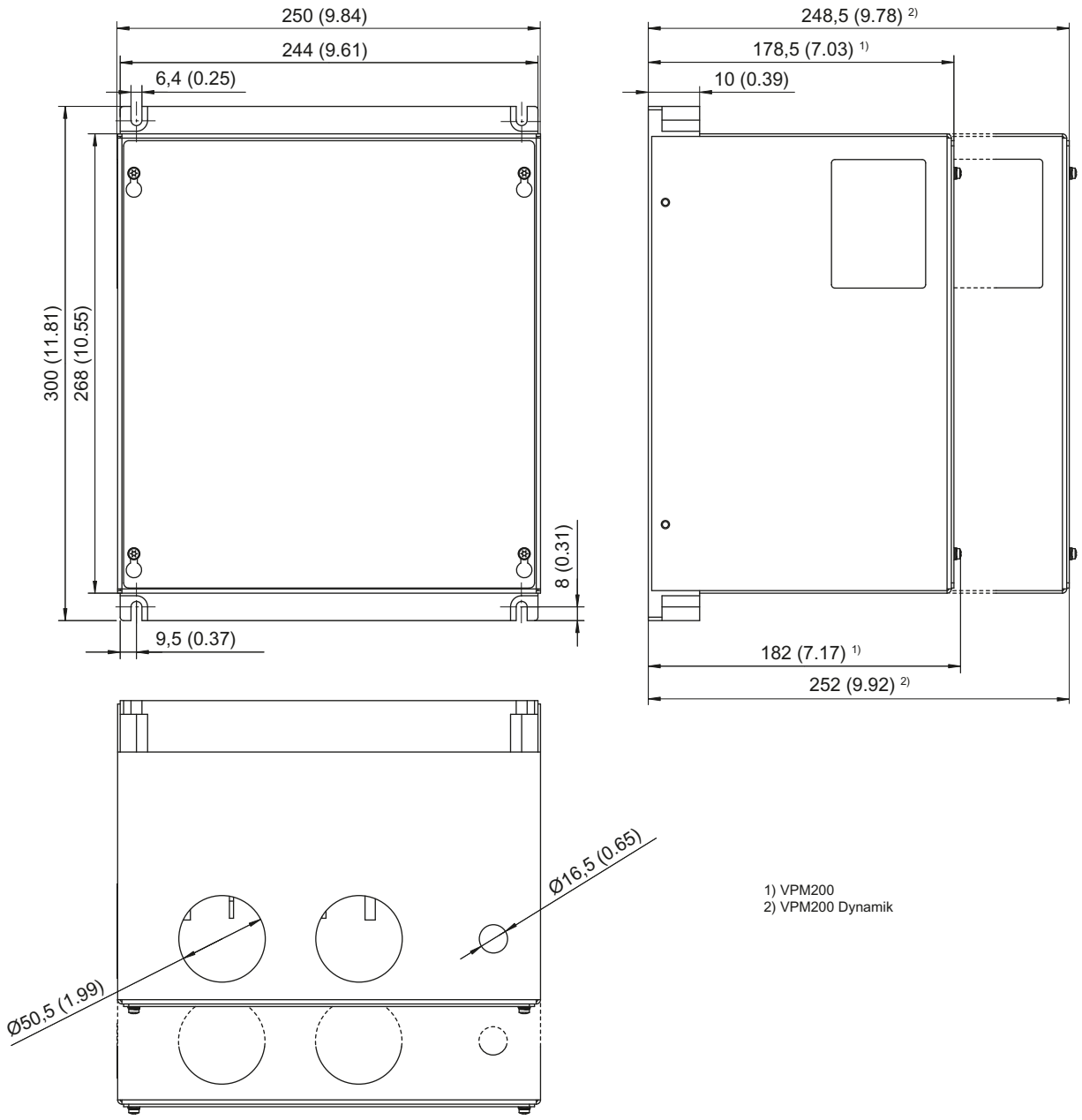


Figure 10-12 Dimension drawing of the Voltage Protection Module VPM200 and VPM200 Dynamic, all data in mm and (inches)

10.2.6 Installation

The Voltage Protection Module is installed in the control cabinet close to the drive.

⚠ DANGER
Motor reactors may only be connected between the Voltage Protection Module and motor.

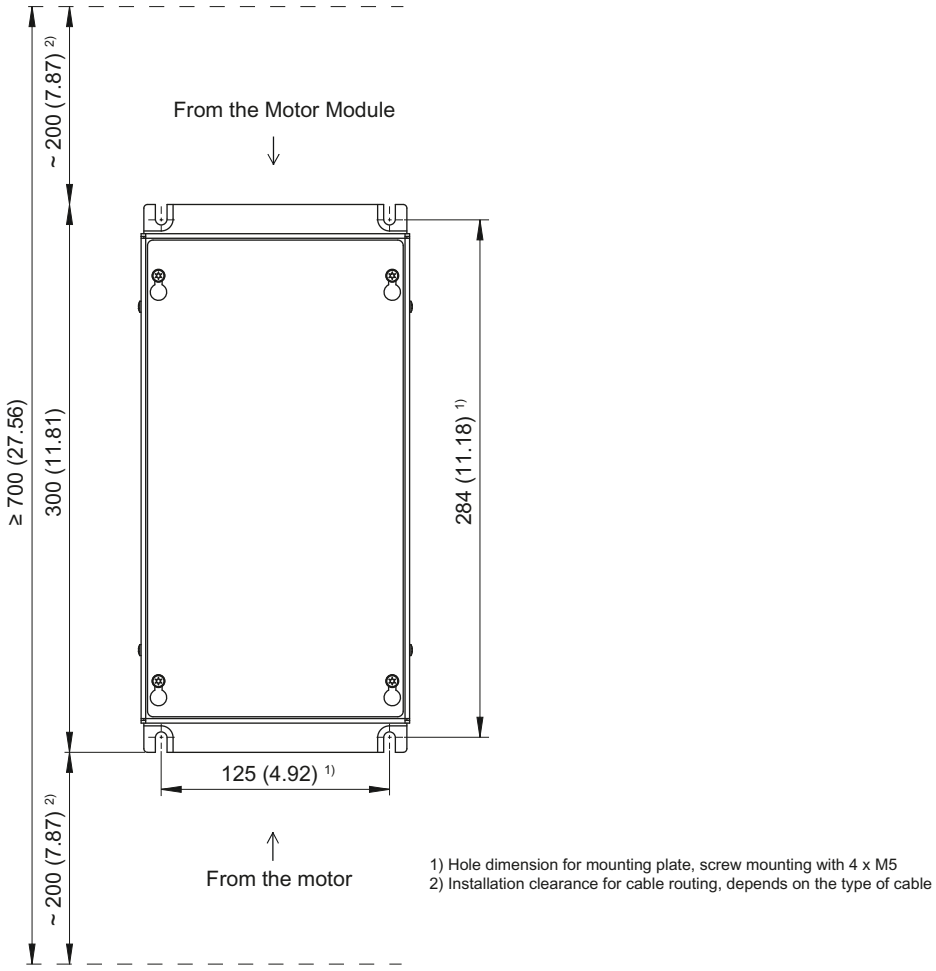


Figure 10-13 Mounting dimension for a Voltage Protection Module VPM120

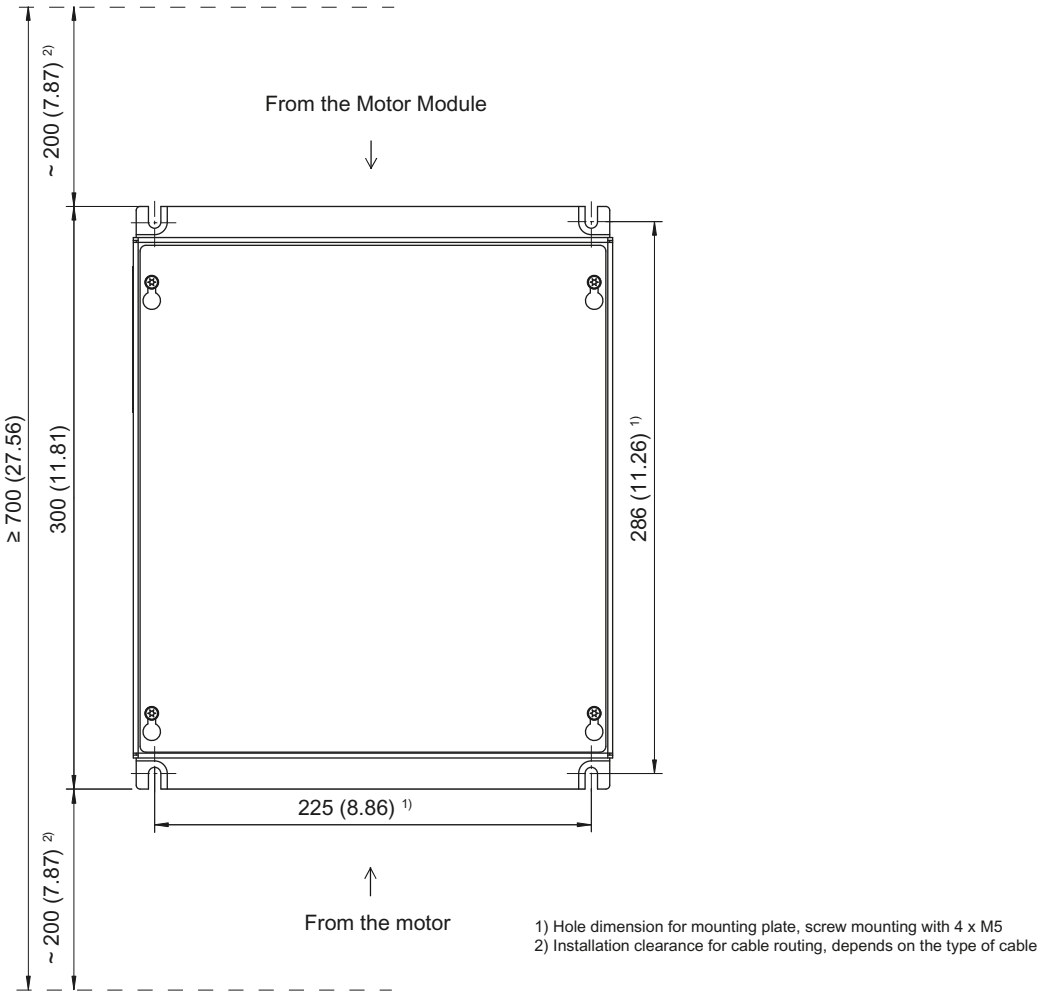


Figure 10-14 Mounting dimensions for a Voltage Protection Module VPM200

10.2.7 Electrical connection

Note

Only the enclosure cover may be opened for electrical connection of the Voltage Protection Module.

Introduction

Various types of cabling work must be carried out in order to integrate a Voltage Protection Module into a motor's feeding branch. All connections must be set up inside the VPM housing. Cable cross-sections are determined by the rated motor power and may be as much as 2 x 50 mm^2 for each conductor. An installation sequence for individual conductors is outlined below. It is particularly relevant for larger cross-sections.

⚠ DANGER

Before installation or maintenance work can begin, the system's main switch must be switched off and measures taken to prevent it being switched on again.

Preparation

The following preparations must be made before setting up connections:

- Loosen 4 screws on the enclosure cover so it can be moved into the cutouts.
- Move the enclosure cover to the point where the cutout widens out so it can be lifted over the screw heads.
- Fix the screwed joints for the signaling cable and power cables (x 2 for the VPM120, x 4 for the VPM200) at the entries in the Voltage Protection Module's housing.
- Strip back 300 mm of sheath from the power cables and expose their shield supports. Make sure they fit the screwed joints of the housing.
- Strip the ends of the individual wires and push the cable lugs on.
- Connect the signaling cable to X3 and use cable ties to secure it inside the Voltage Protection Module.

10.2.7.1 Connecting signaling contact X3

The signaling contact X3 must be wired before connecting the power cables.



Figure 10-15 Connection of the signaling contact using the VPM200 as an example

The X3 signaling contact is routed via a bistable relay. The relay may shift to the other switching state if subjected to excessive movement during transportation and installation. This may prevent the system from starting.

⚠ CAUTION

When a Voltage Protection Module is tripped, the short-circuit thyristor must be safely cleared before the connected inverter can be switched on again. This is only possible if the motor has first come to a standstill. The fact that signaling contact X3 has closed again **does not prove this conclusively!** It is particularly important to bear this in mind when performing servicing and commissioning tasks.

Cause and rectification of faults

The "Installation" sections in the documents referred to below contain additional information on the causes of faults and how they can be rectified:

Operating Instructions for Voltage Protection Module VPM120, Order No.: A5E00302281B

Operating Instructions for Voltage Protection Module VPM200, Order No.: A5E00777655A

Operating Instructions for Voltage Protection Module VPM200 Dynamic, Order No.: A5E00302261B

10.2.7.2 Connecting power cables (using the VPM 200 Dynamik as an example)

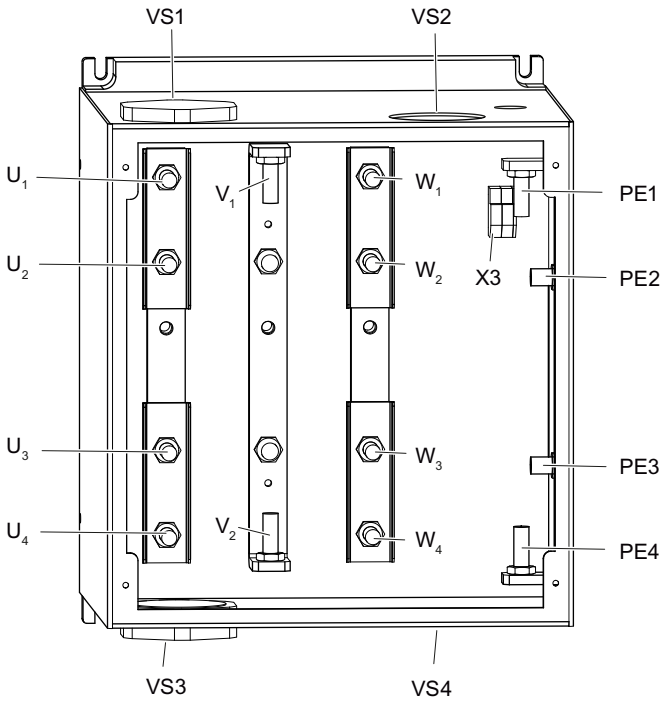


Figure 10-16 Connection points of the Voltage Protection Module VPM200 Dynamic

Table 10- 13 Short designations

Short designation	Explanation
VS1, VS2	Cable screwed joint 1 or 2 in the housing entry of the VPM, towards Motor Module
VS3, VS4	Cable screwed joint 3 or 4 in the housing entry of the VPM, towards motor
K1, K2	Cable 1 or 2 to the Motor Module
K3, K4	Cable 3 or 4 to the motor
U_1, U_2	Connection bolts on busbar U
U_3, U_4	Connection bolts on busbar U
V_1, V_2	Connection bolts on busbar V
W_1, W_2	Connection bolts on busbar W
W_3, W_4	Connection bolts on busbar W
PE_1, PE_2, PE_3, PE_4	Connection bolts on busbar PE
U	Busbar U in the VPM
V	Busbar V in the VPM
W	Busbar W in the VPM

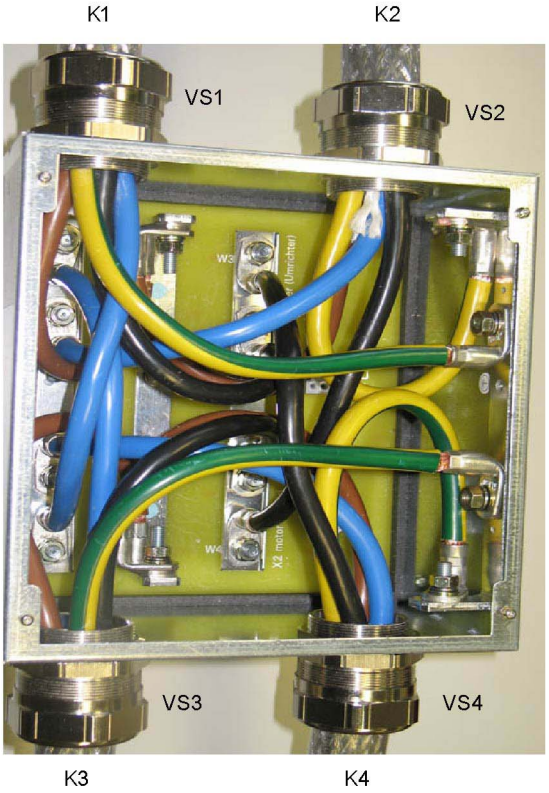


Figure 10-17 Wired Voltage Protection Module VPM200 Dynamic with short designations

Table 10- 14 Installation steps

Screwed cable joint	Cable	Conductor/Phase	Installation step
VS1	K1	L_1, L_2, L_3, PE	Introduce the cable with all the conductors and shield, tighten the screwed joint, lay conductors L_1 (black) and PE (green/yellow) on top of the other conductors.
VS2	K2	L_1, L_2, L_3, PE	Introduce the cable with all the conductors and shield, tighten the screwed joint, lay conductors L_1 (black) and PE (green/yellow) on top of the other conductors.
	K1	L_2 (blue)	Attach to V1 and screw in place.
	K2	L_2 (blue)	Attach to V1 and screw in place.
	K2	PE (green/yellow)	Attach to PE1 and screw in place.
	K1	L_3 (brown)	Attach to W2 and screw in place.
	K2	L_1 (black)	Attach to U2 and screw in place.
	3 separate cable ends for cables K1 and K2 are connected later.		
VS3	K3	L_1, L_2, L_3, PE	Introduce the cable with all the conductors and shield, tighten the screwed joint, laying conductors L_1 (black) and PE (green/yellow) on top of the other conductors.
VS4	K4	L_1, L_2, L_3, PE	Introduce the cable with all the conductors and shield, tighten the screwed joint, laying conductors L_1 (black) and PE (green/yellow) on top of the other conductors.
	K3	L_2 (blue)	Attach to V2 and screw in place.
	K4	L_2 (blue)	Attach to V2 and screw in place.
	K3	L_3 (brown)	Attach to W3 and screw in place.
	K4	PE (green/yellow)	Attach to PE4 and screw in place.
	K4	L_1 (black)	Attach to U3 and screw in place.
	K1	L_1 (black)	Attach to U4 and screw in place.
	K3	L_1 (black)	Attach to U1 and screw in place.
	K2	L_3 (brown)	Attach to W4 and screw in place.
	K4	L_3 (brown)	Attach to W1 and screw in place.
	K3	PE (green/yellow)	Attach to PE3 and screw in place.
	K1	PE (green/yellow)	Attach to PE2 and screw in place.

10.2.8 Technical data

Table 10- 15 Technical data

	VPM 120	VPM 200	VPM 200 Dynamic
Order number	6SN1113–1AA00–1JAx	6SN1113–1AA00–1KAx	6SN1113–1AA00–1KCx
Type of voltage	3-phase pulsed AC voltage, EMF motor		
Ramp-up time for VPM	1 s (from pulse enable)		
Normal range of the DC link voltage: - lower limit - upper limit	 490 V DC 795 V DC		
Operating range for VPM	from 830 V to 2000 V (peak value)		
Clock frequency	3.2...8 kHz		
Rated current	120 A_{rms}	200 A_{rms}	
Time range	Maximum permissible short-circuit current		
0...10 ms 10...500 ms 500 ms...2 min > 2 min	1,500 A 255 A 90 A 0 A	2000 A 600 A 200 A 0 A	
Max. perm. short-circuit time	120 s		
Protection class in accordance with EN 61140	I		
Safe electrical separation	Between the signaling contact and motor cables U, V, W in accordance with EN 61800-5-1, UL 508 C		
Degree of protection to EN 60529	IP20		
Permitted humidity Humidity classification according to EN 60721-3-3	< 90 % Cl. 3K5, condensation and icing excluded Low air temperature 0 °C		
Permissible ambient temperature, min./max.	0 °C/55 °C		
Cooling method	Air-cooled, free convection		
Weight	Approx. 6 kg	Approx. 11 kg	Approx. 13 kg
Dimensions (H x W x D) [mm]	300 x 150 x 180	300 x 250 x 190	300 x 250 x 260

Accessories

11

11.1 Shield connecting plates for power supply and motor cables

11.1.1 Description

Shield connection plates are available to connect the shields of line and motor power cables as well as brake cables for all Line Modules, Motor Modules, and Active Interface Modules.

A shield connection terminal and/or clamp is used to connect the cable shield to the shield connection plate. Shield supports must be properly arranged to ensure EMC compliance.

11.1.2 Shield connecting plates

Table 11- 1 Shield connection for components with internal air cooling

Component	Power	Total width of component	Shield connection plate	Recommended shield connection
Line Module	5 kW/10 kW	50 mm	Included in the scope of delivery	
	16 kW	100 mm	Included in the scope of delivery	KLBÜ CO4 1)
	36 kW	150 mm	6SL3162-1AF00-0AA1	KLBÜ CO4 1)
	55 kW	200 mm	6SL3162-1AH01-0AA0	Clamps
	80 kW / 120 kW	300 mm	6SL3162-1AH00-0AA0	Clamps
Motor Module	3 A to 18 A 2 x 3 A to 2 x 9 A	50 mm	Integrated in the motor connector	
	18 A (Compact) 2 x 1.7 A to 2 x 5 A	75 mm	Integrated in the motor connector	
	30 A and 2 x 18 A	100 mm	Included in the scope of delivery	KLBÜ CO4 1)
	45 A and 60 A	150 mm	6SL3162-1AF00-0AA1	KLBÜ CO1 1) for the brake cable KLBÜ CO4 1) for the motor cable
	85 A	200 mm	6SL3162-1AH01-0AA0	KLBÜ CO1 1) for brake cable clamps for motor cable
	132 A and 200 A	300 mm	6SL3162-1AH00-0AA0	KLBÜ CO1 1) for brake cable clamps for motor cable
Active Interface Module	16 kW	100 mm	Integrated in the connector	
	36 kW	150 mm	6SL3163-1AF00-0AA0	KLBÜ CO4 1)
	55 kW	200 mm	6SL3163-1AH00-0AA0	Clamps
	80 kW / 120 kW	300 mm	6SL3163-1AM00-0AA0	Clamps

1) Shield connection terminal, Weidmüller Company

Table 11- 2 Shield connection for components with external air cooling

Component	Power	Total width of component	Shield connection plate	Recommended shield connection
Line Module	5 kW/10 kW	50 mm	Included in the scope of delivery	
	16 kW	100 mm		KLBÜ CO4 1)
	36 kW	150 mm	6SL3162-1AF00-0BA1	KLBÜ CO4 1)
	55 kW	200 mm	6SL3162-1AH01-0BA0	Clamps
	80 kW / 120 kW	300 mm	6SL3162-1AH00-0AA0	Clamps
Motor Module	3 A to 18 A 2 x 3 A to 2 x 9 A	50 mm	Integrated in the motor connector	
	30 A and 2 x 18 A	100 mm	Included in the scope of delivery	KLBÜ CO4 1)
	45 A and 60 A	150 mm	6SL3162-1AF00-0BA1	KLBÜ CO1 1) for the brake cable KLBÜ CO4 1) for the motor cable
	85 A	200 mm	6SL3162-1AH01-0BA0	KLBÜ CO1 1) for brake cable clamps for motor cable
	132 A and 200 A	300 mm	6SL3162-1AH00-0AA0	KLBÜ CO1 1) for brake cable clamps for motor cable

1) Shield connection terminal, Weidmüller Company

Table 11- 3 Shield connection for components with cold plate

Component	Power	Total width of component	Shield connection plate	Recommended shield connection
Line Module	5 kW/10 kW	50 mm	Included in the scope of delivery	
	16 kW	100 mm		KLBÜ CO4 1)
	36 kW	150 mm	6SL3162-1AF00-0BA1	KLBÜ CO1 1) and KLBÜ CO4 1)
	55 kW	200 mm	6SL3162-1AH01-0BA0	Clamps
	80 kW / 120 kW	300 mm	6SL3162-1AH00-0AA0	Clamps
Motor Module	3 A to 18 A 2 x 3 A to 2 x 9 A	50 mm	Integrated in the motor connector	
	18 A (Compact) 2 x 1.7 A to 2 x 5 A	75 mm		
	30 A and 2 x 18 A	100 mm	Included in the scope of delivery	KLBÜ CO4 1)
	45 A and 60 A	150 mm	6SL3162-1AF00-0BA1	KLBÜ CO1 1) for the brake cable KLBÜ CO4 1) for the motor cable
	85 A	200 mm	6SL3162-1AH01-0BA0	KLBÜ CO1 1) for brake cable clamps for motor cable
	132 A and 200 A	300 mm	6SL3162-1AH00-0AA0	KLBÜ CO1 1) for brake cable clamps for motor cable

1) Shield connection terminal, Weidmüller Company

Table 11- 4 Shield connection for liquid-cooled components

Component	Power	Total width of component	Shield connection plate	Recommended shield connection
Line Module	120 kW	300 mm	6SL3162-1AH00-0AA0	Clamps
Motor Module	200 A	300 mm	6SL3162-1AH00-0AA0	KLBÜ CO1[1)] for brake cable clamps for motor cable

1) Shield connection terminal, Weidmüller Company

11.1.3 Overview examples

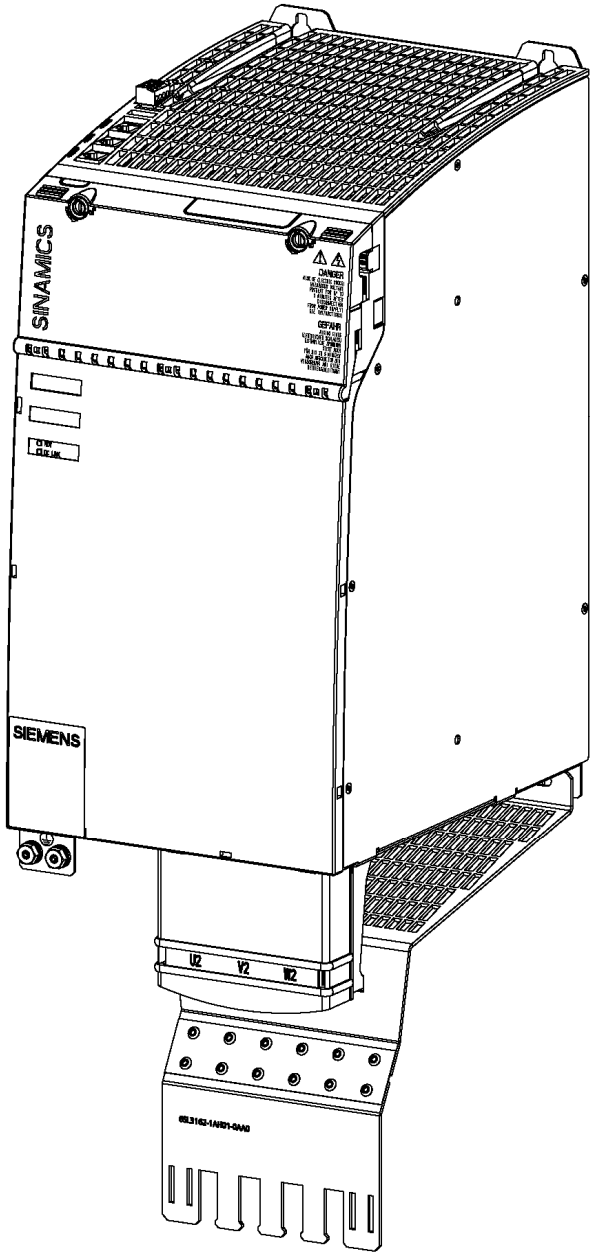


Figure 11-1 Shield connecting plate for a 200 mm module with internal air cooling

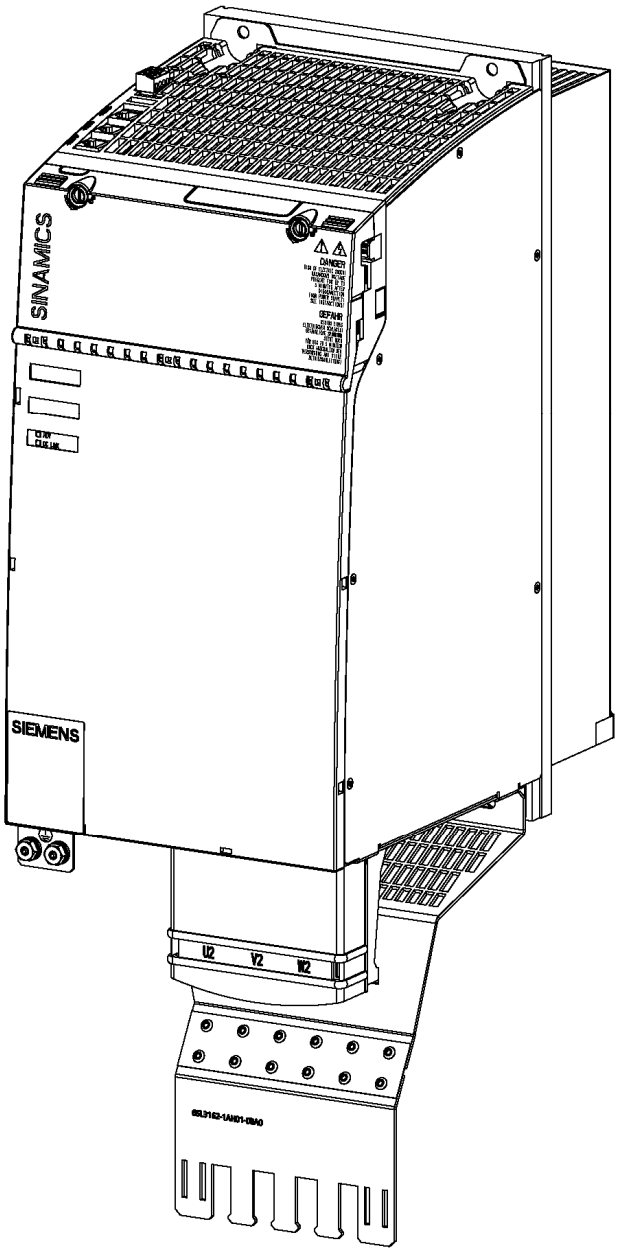


Figure 11-2 Shield connecting plate for a 200 mm module with external air cooling

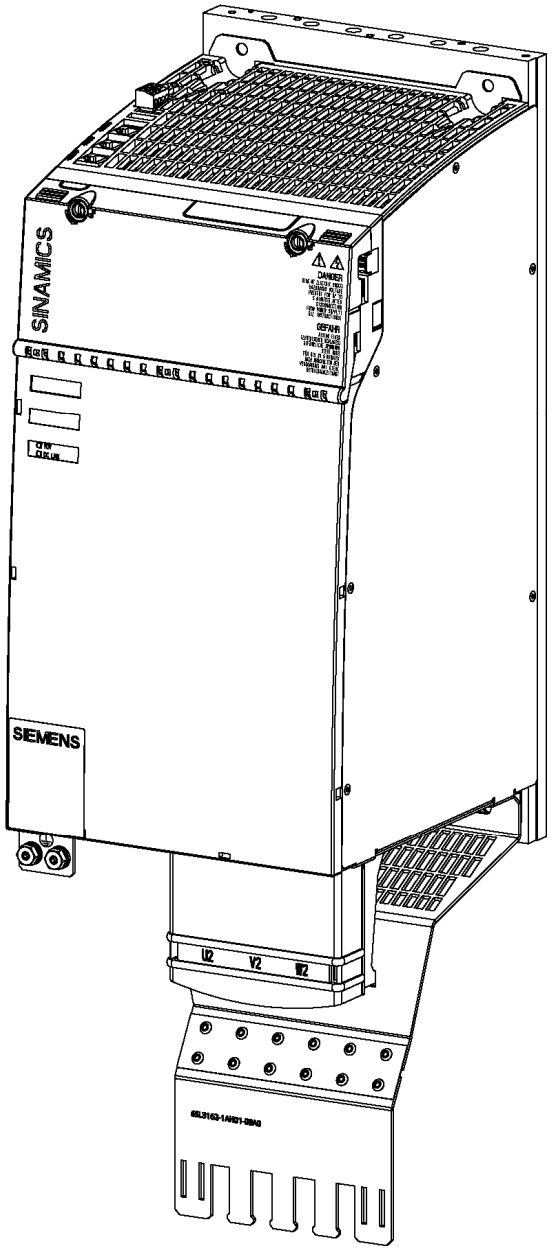


Figure 11-3 Shield connecting plate for a 200 mm module with a cold plate

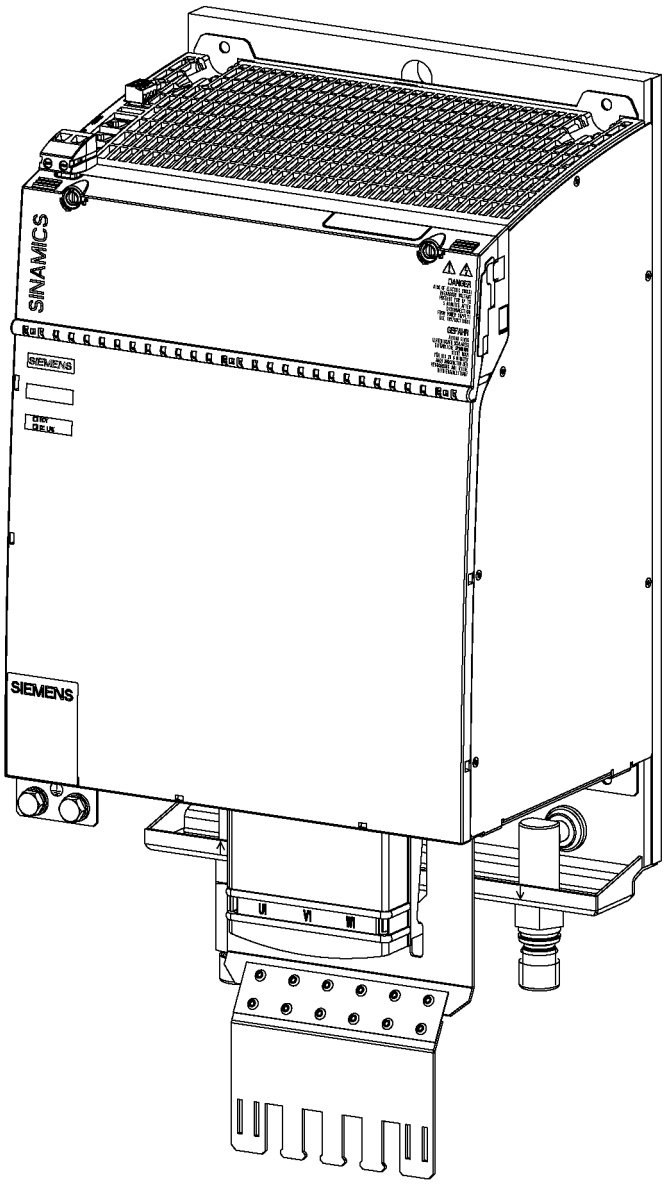


Figure 11-4 Shield connecting plate on a 300 mm module Liquid Cooled

11.1.4 Dimension drawings

11.1.4.1 Line Modules and Motor Modules with internal air cooling

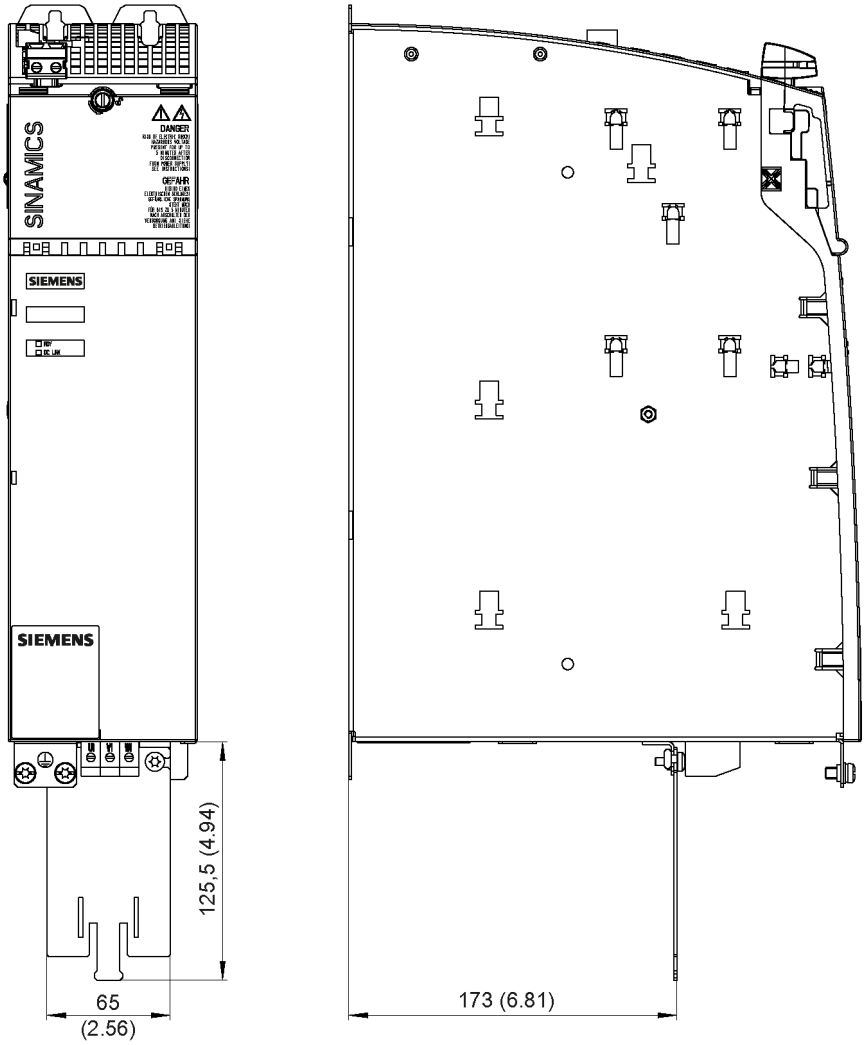


Figure 11-5 Dimension drawing of shield connecting plate on a 100 mm component with internal air cooling, all dimensions in mm and (inches)

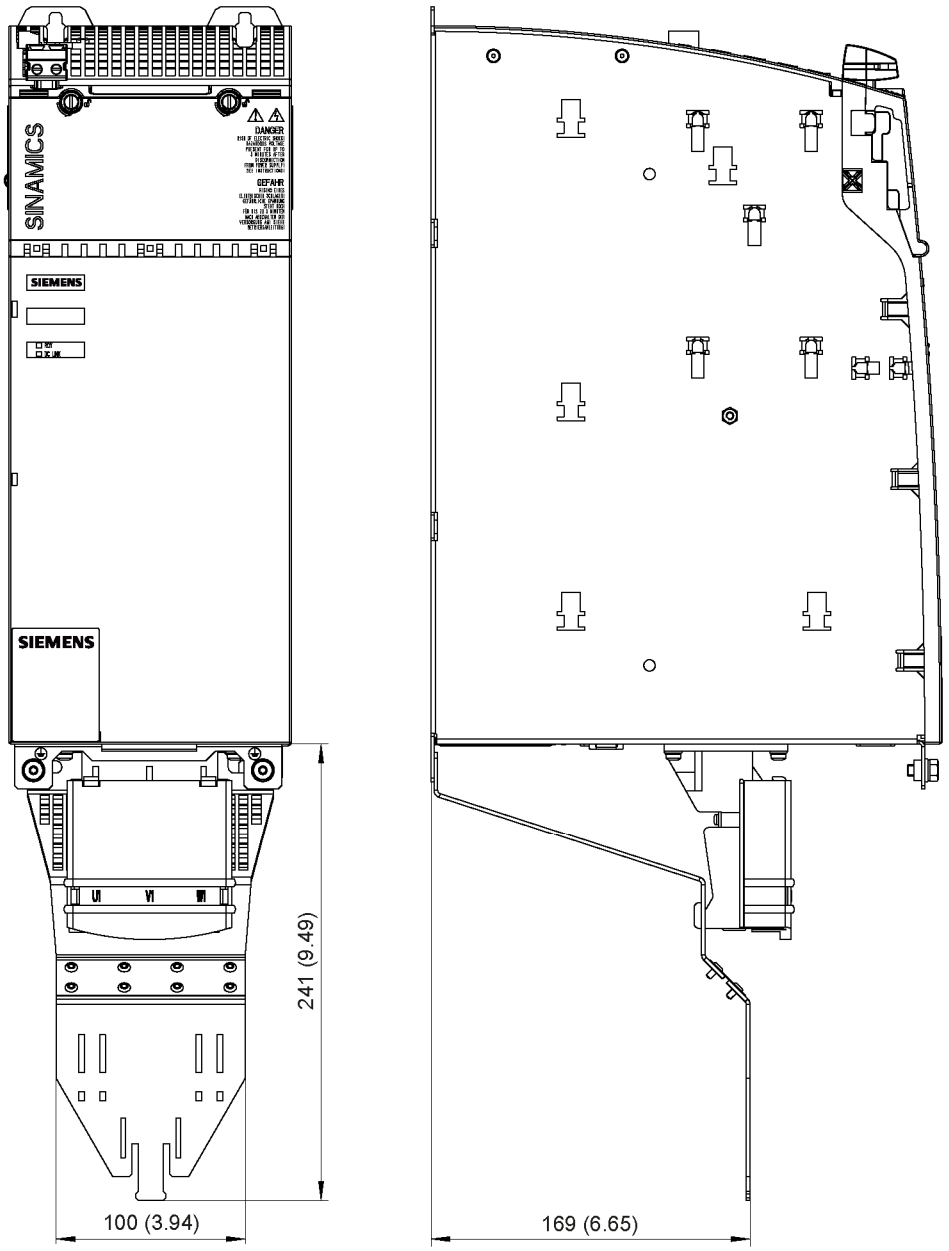


Figure 11-6 Dimension drawing of shield connecting plate on a 150 mm component with internal air cooling, all dimensions in mm and (inches)

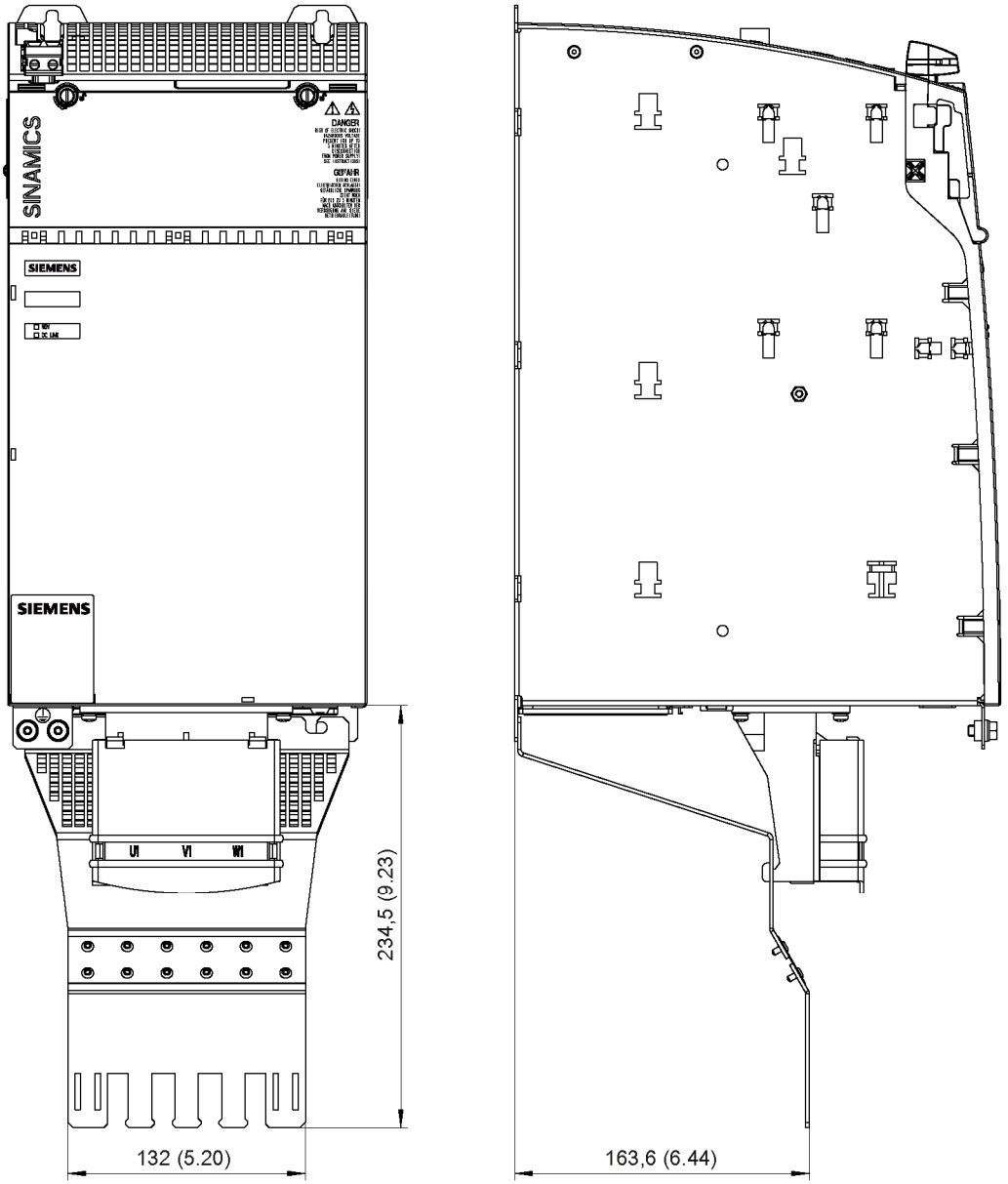


Figure 11-7 Dimension drawing of shield connecting plate on a 200 mm component with internal air cooling, all dimensions in mm and (inches)

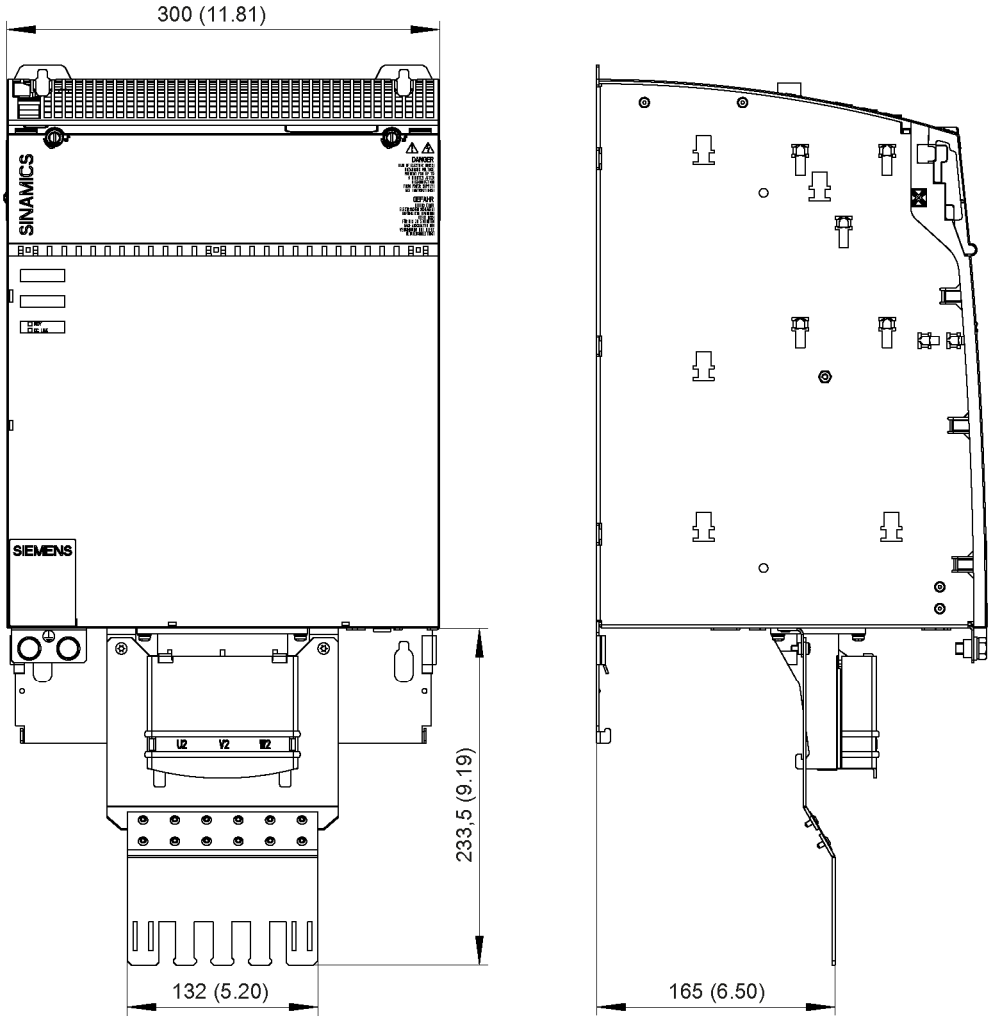


Figure 11-8 Dimension drawing of shield connecting plate on a 300 mm component with internal air cooling, all dimensions in mm and (inches)

11.1.4.2 Line Modules and Motor Modules with external air cooling

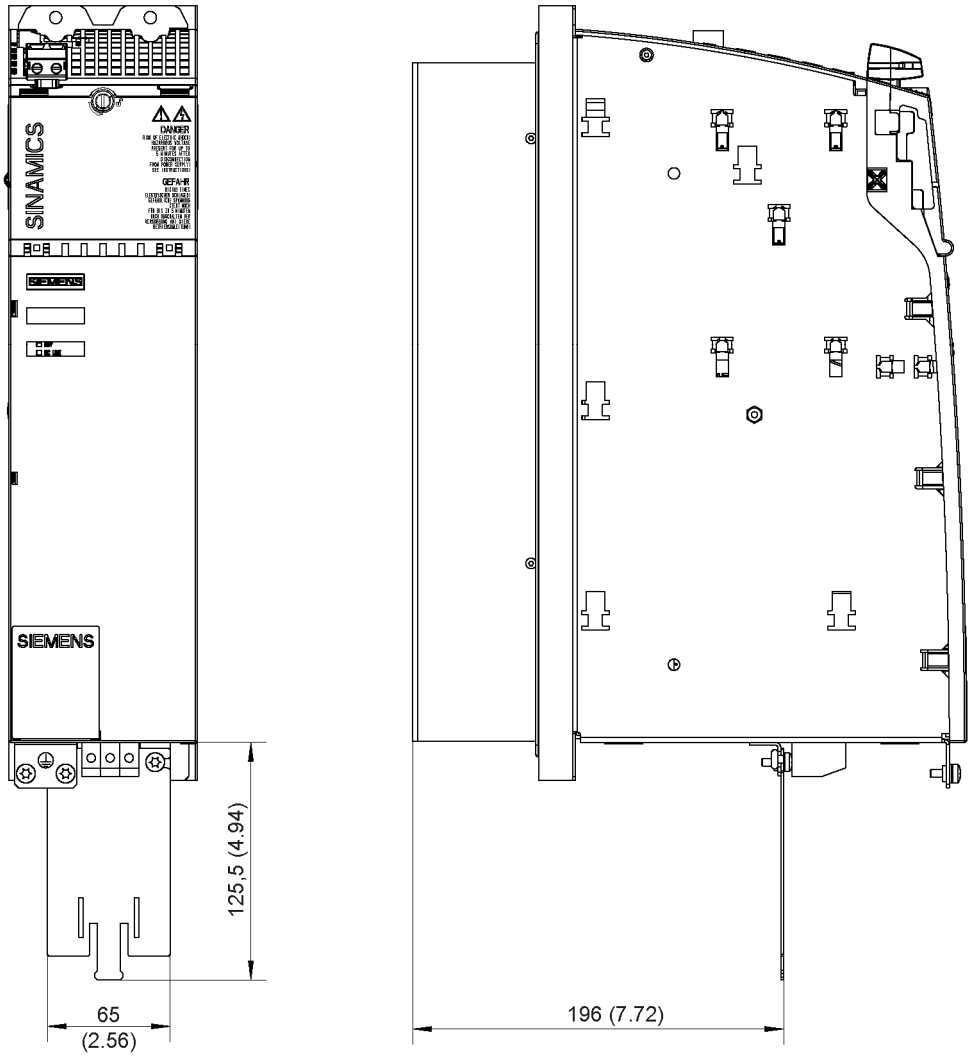


Figure 11-9 Dimension drawing of shield connecting plate on a 100 mm component with external air cooling, all dimensions in mm and (inches)

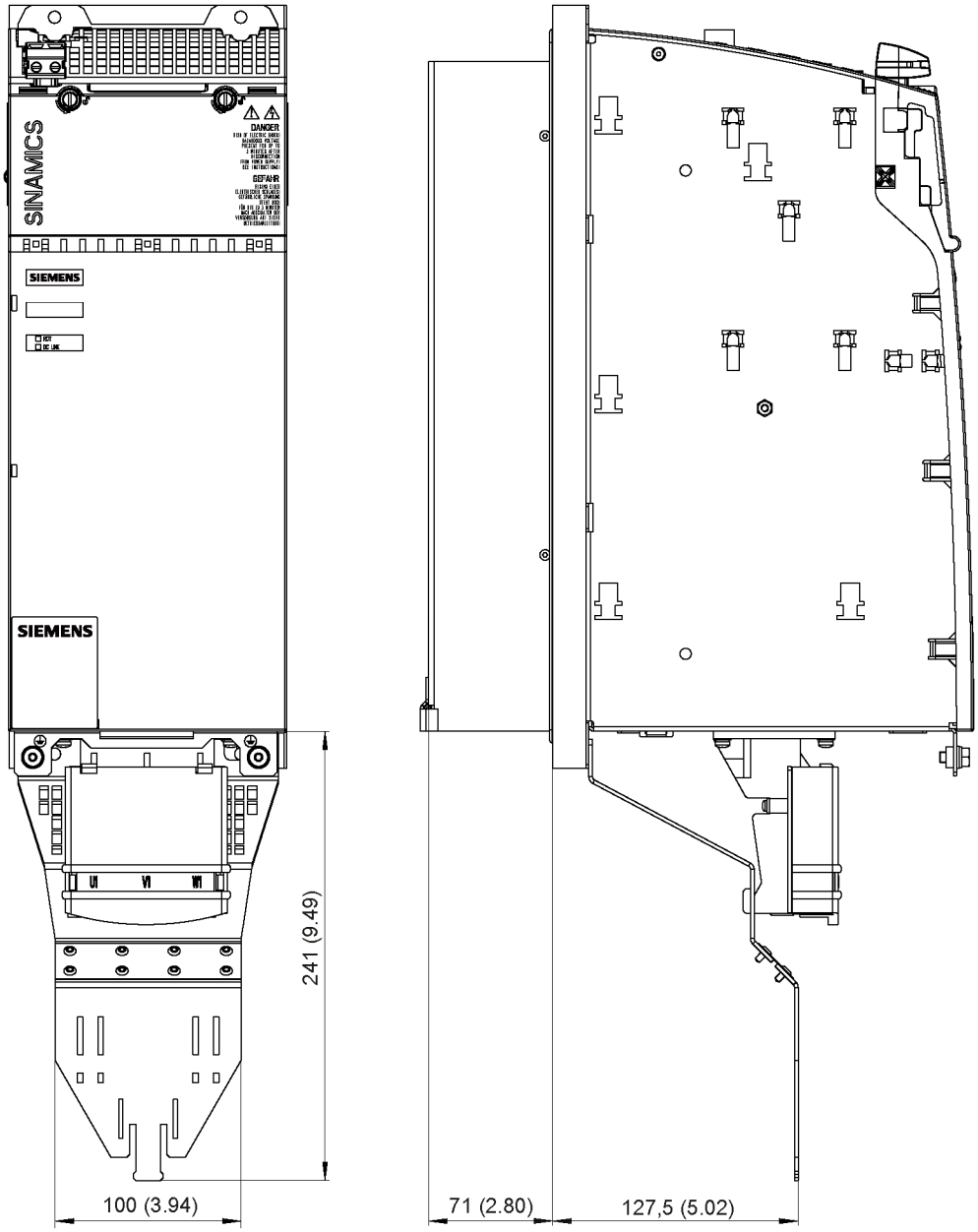


Figure 11-10 Dimension drawing of shield connecting plate on a 150 mm component with external air cooling, all dimensions in mm and (inches)

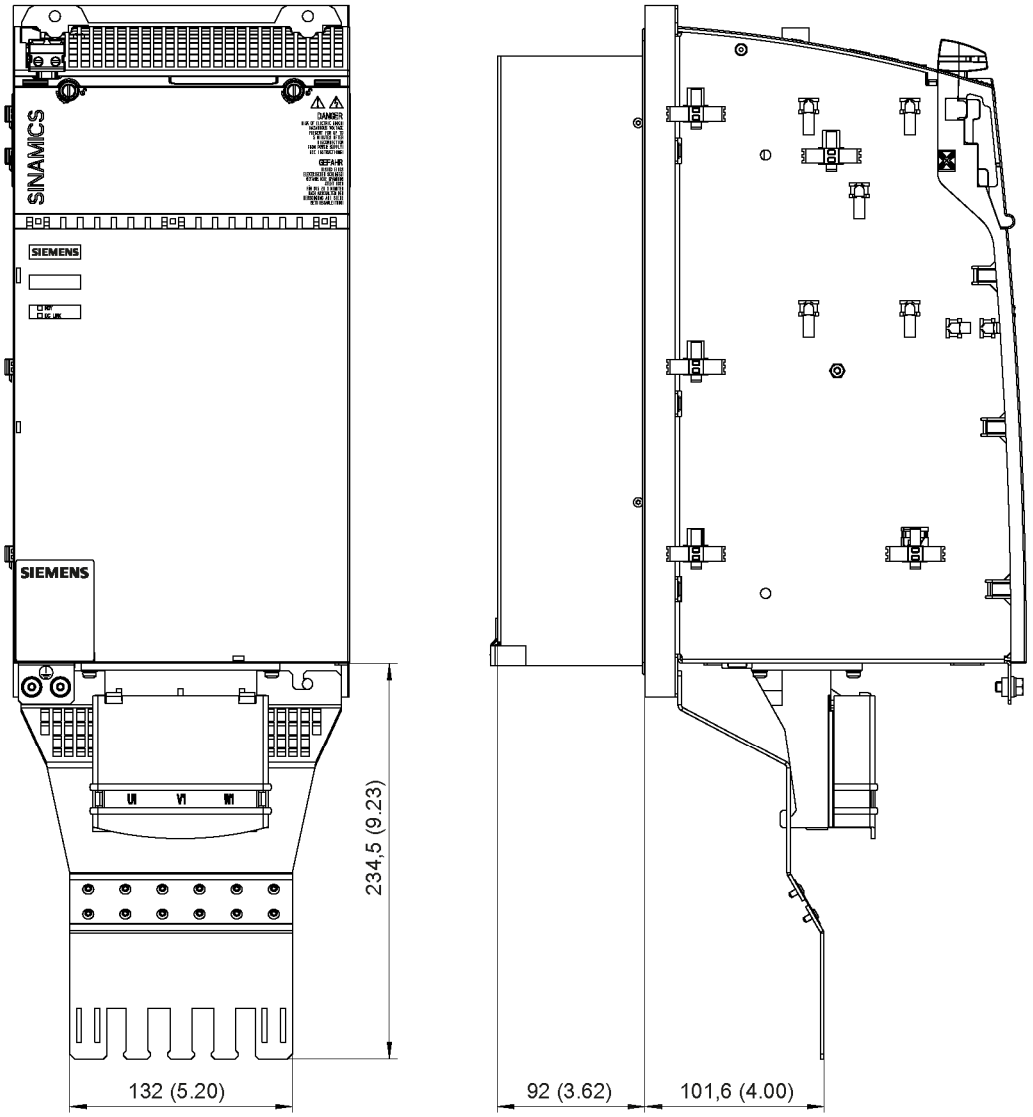


Figure 11-11 Dimension drawing of shield connecting plate on a 200 mm component with external air cooling, all dimensions in mm and (inches)

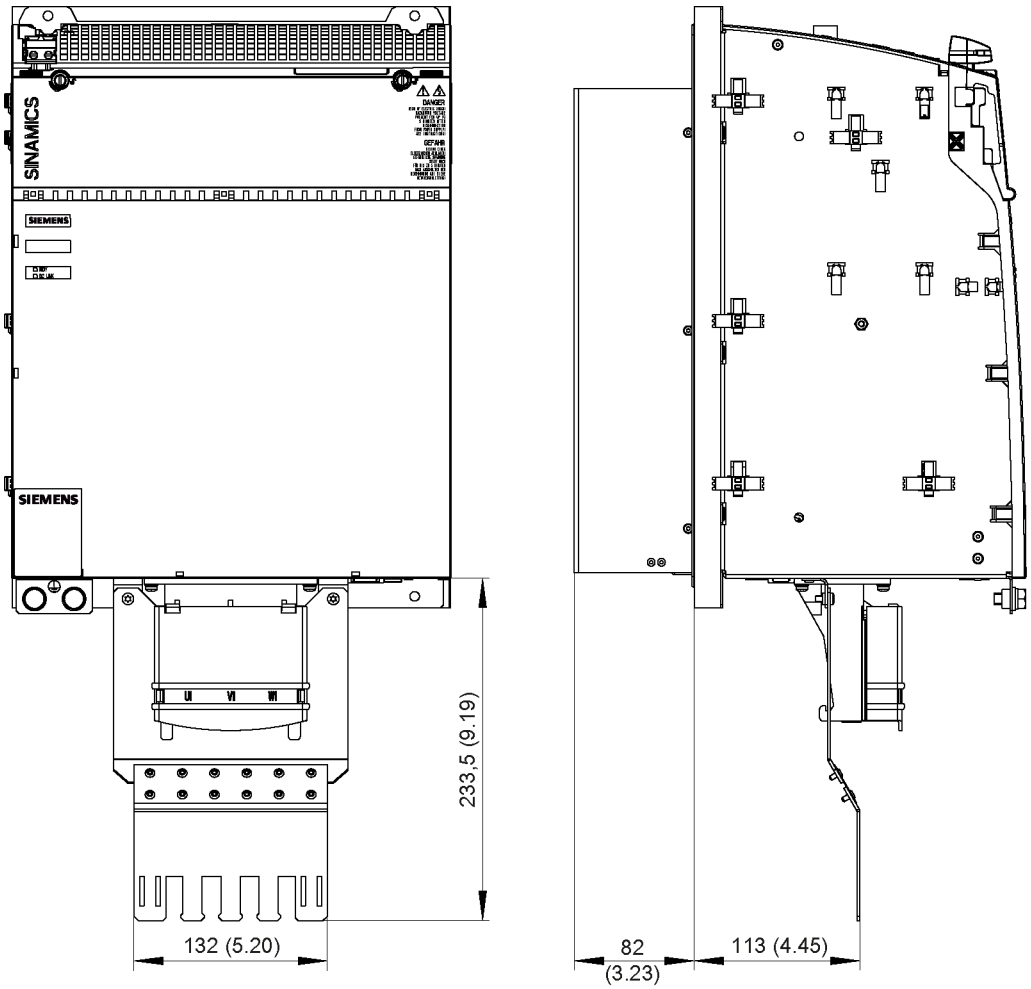


Figure 11-12 Dimension drawing of shield connecting plate on a 300 mm component with external air cooling, all dimensions in mm and (inches)

11.1.4.3 Line Modules and Motor Modules with cold plate

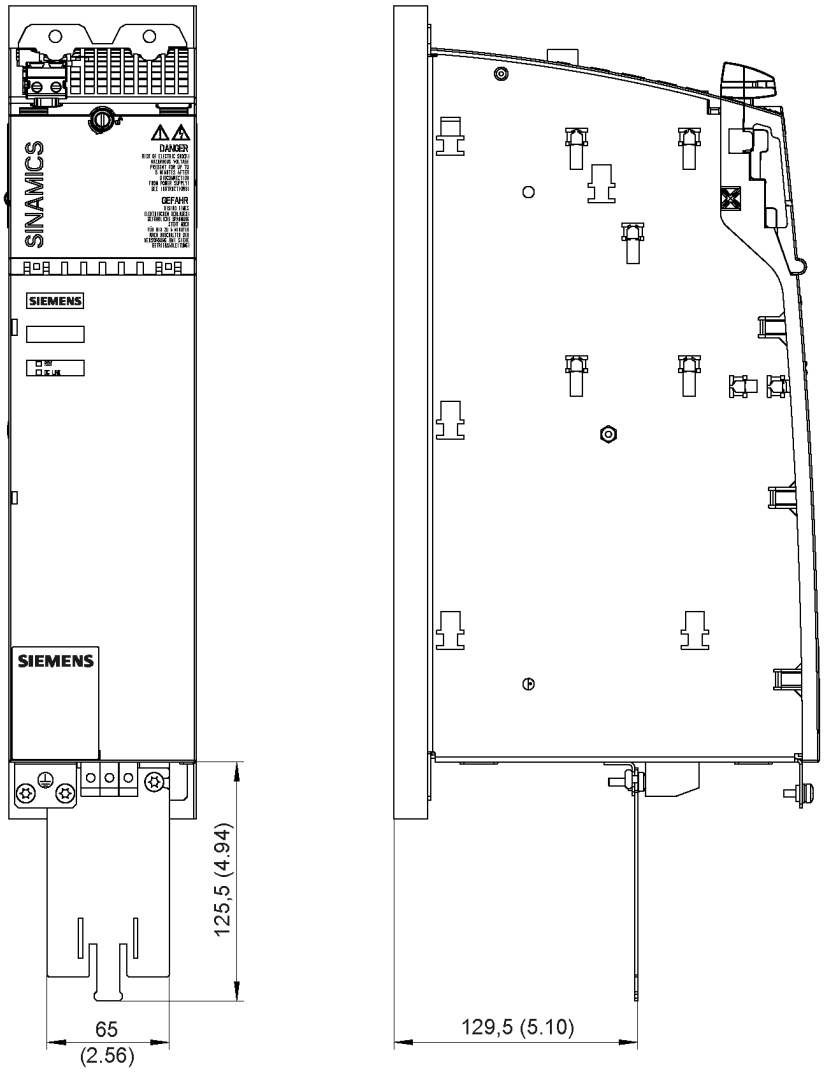


Figure 11-13 Dimension drawing of shield connecting plate on a 100 mm component with cold plate, all dimensions in mm and (inches)

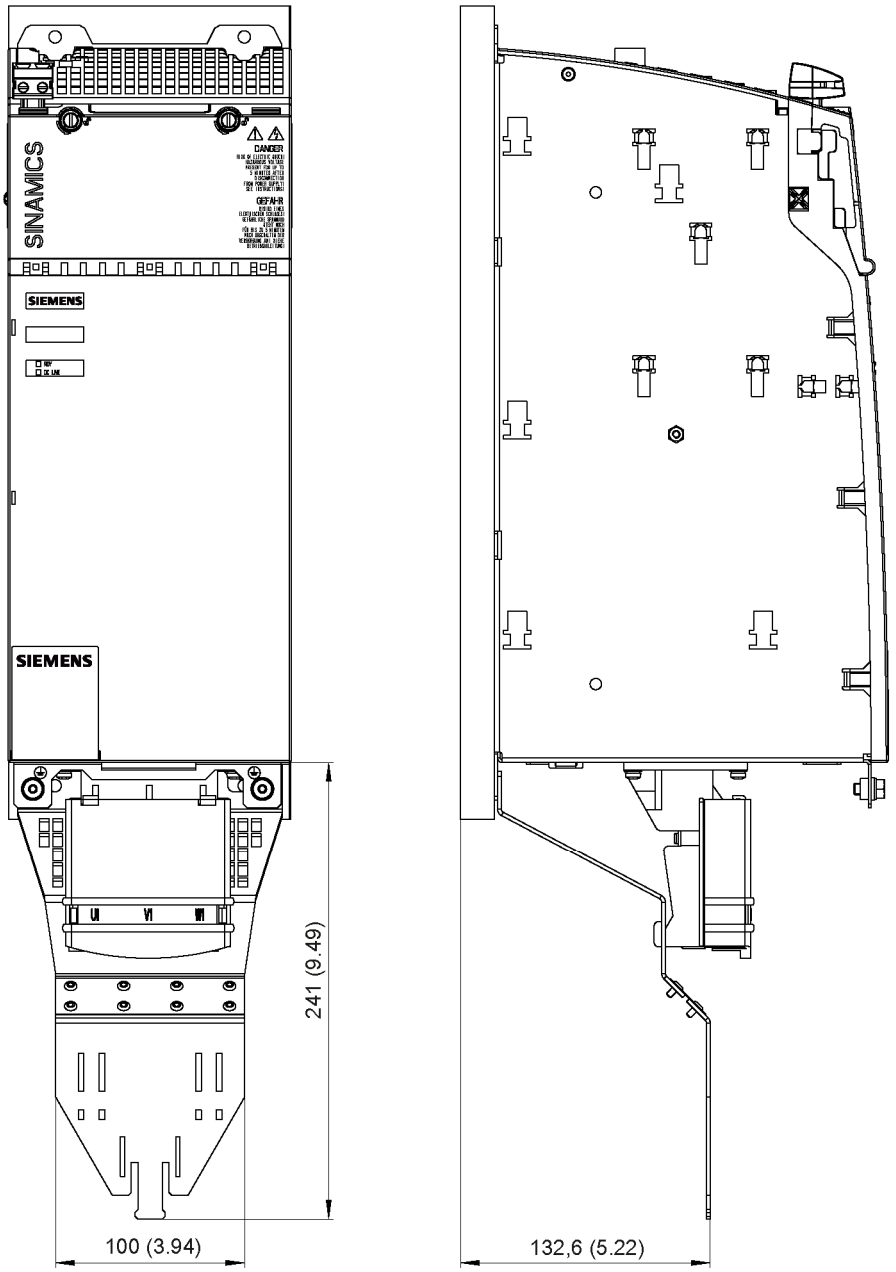


Figure 11-14 Dimension drawing of shield connecting plate on a 150 mm component with cold plate, all dimensions in mm and (inches)

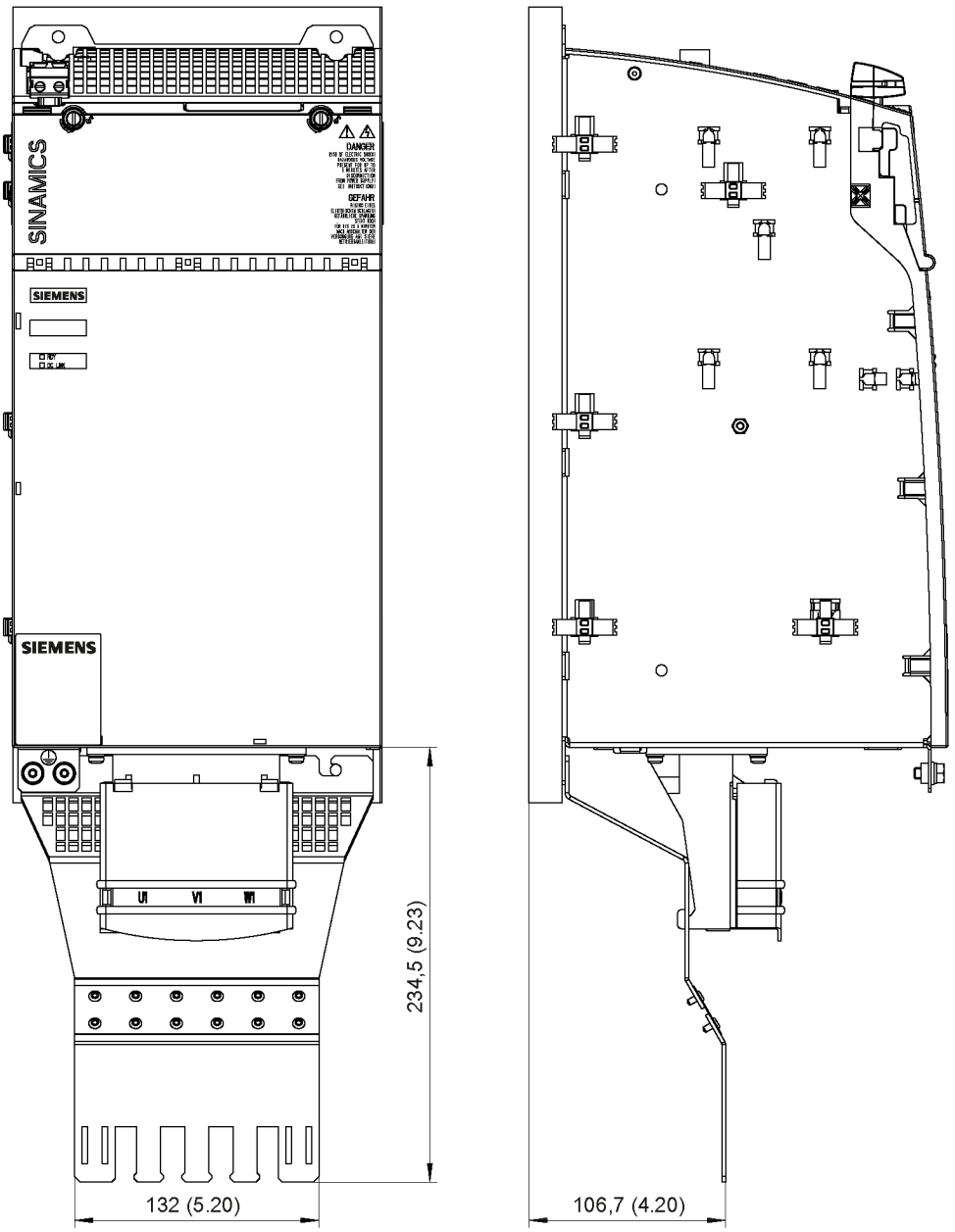
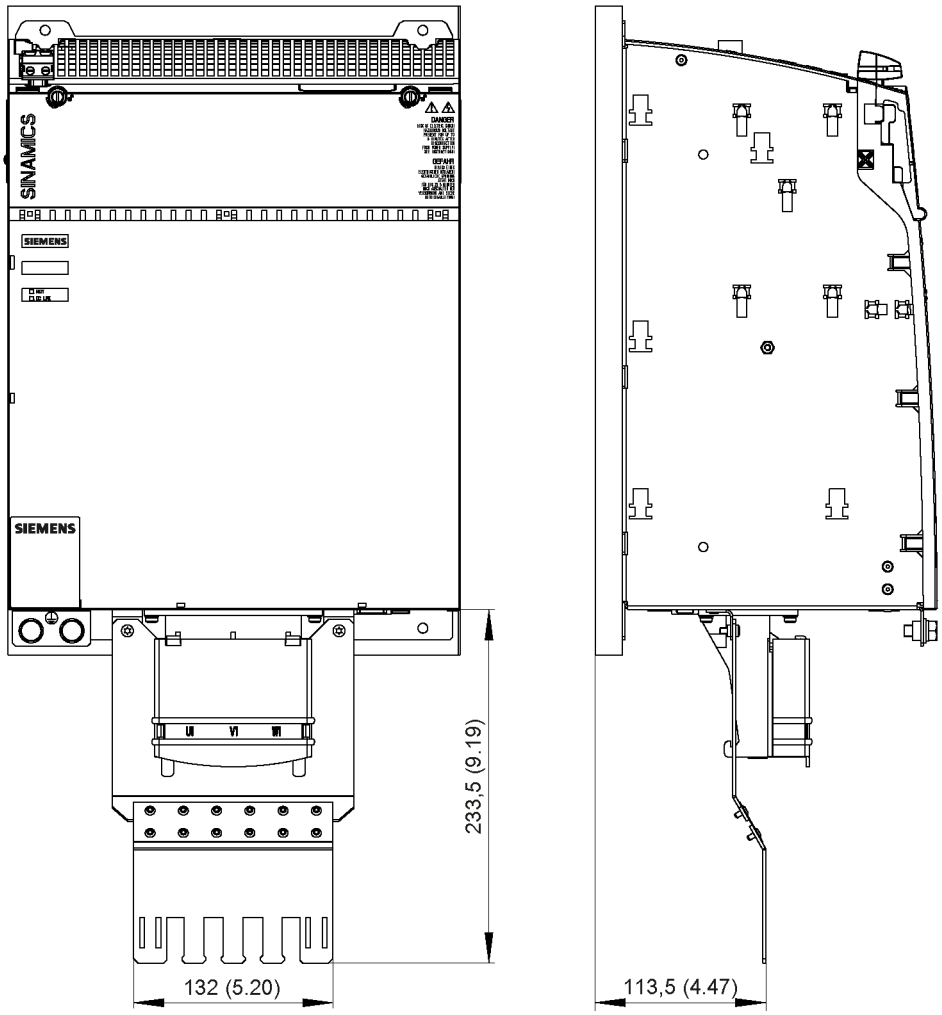


Figure 11-15 Dimension drawing of shield connecting plate on a 200 mm component with cold plate, all dimensions in mm and (inches)



Dimension drawing of shield connecting plate on a 300 mm component with cold plate, all dimensions in mm and (inches)

11.1.4.4 Line Modules and Motor Modules, Liquid Cooled

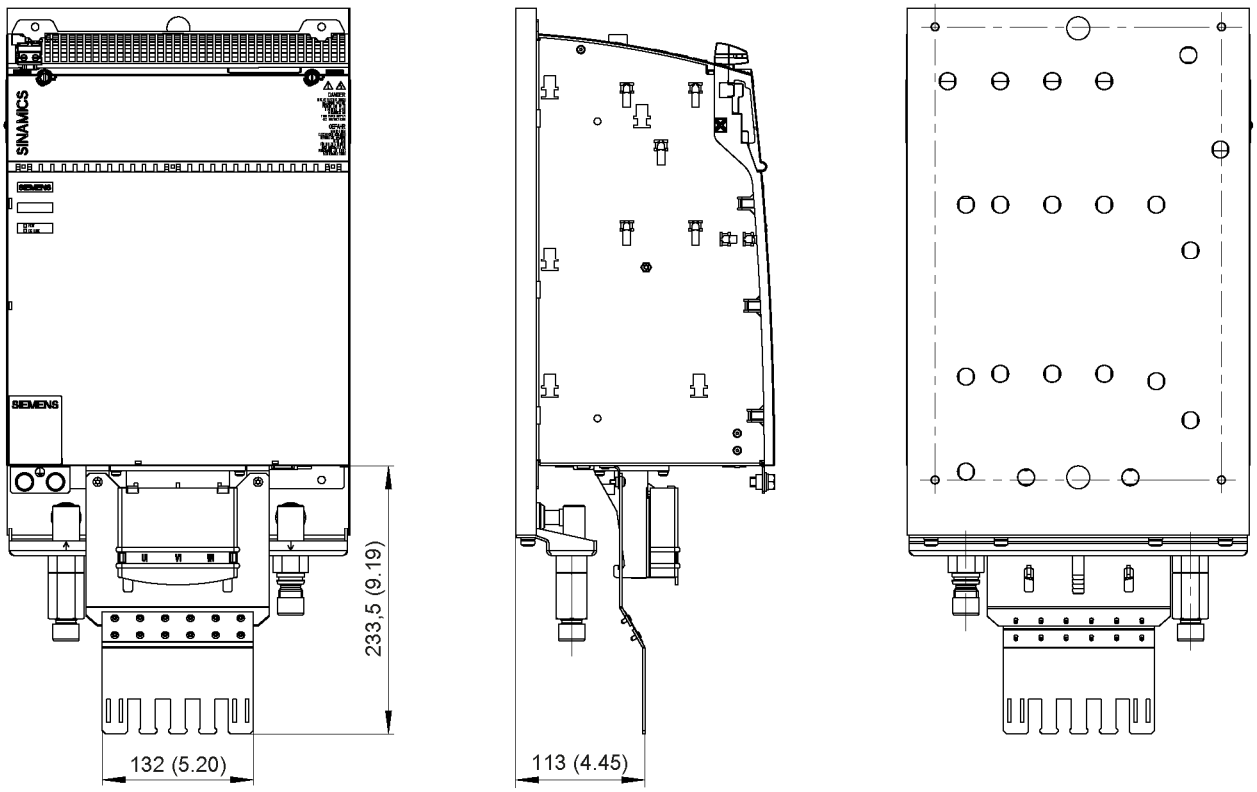


Figure 11-16 Dimension drawing of shield connecting plate on a 300 mm Liquid Cooled component, all dimensions in mm and (inches)

11.1.4.5 Active Interface Modules

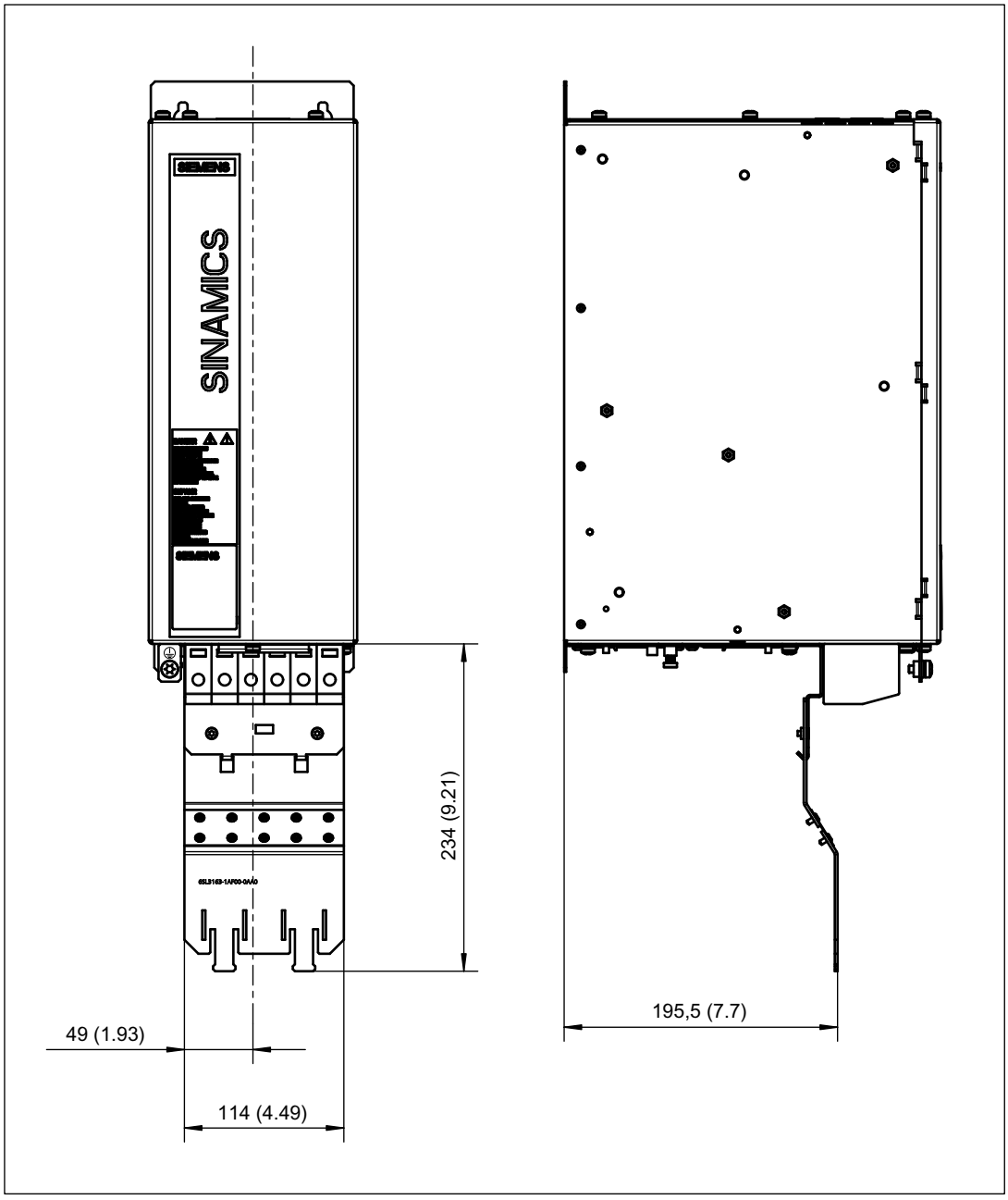


Figure 11-17 Dimension drawing of shield connecting plate on the 36 kW Active Interface Module, all dimensions in mm and (inches)

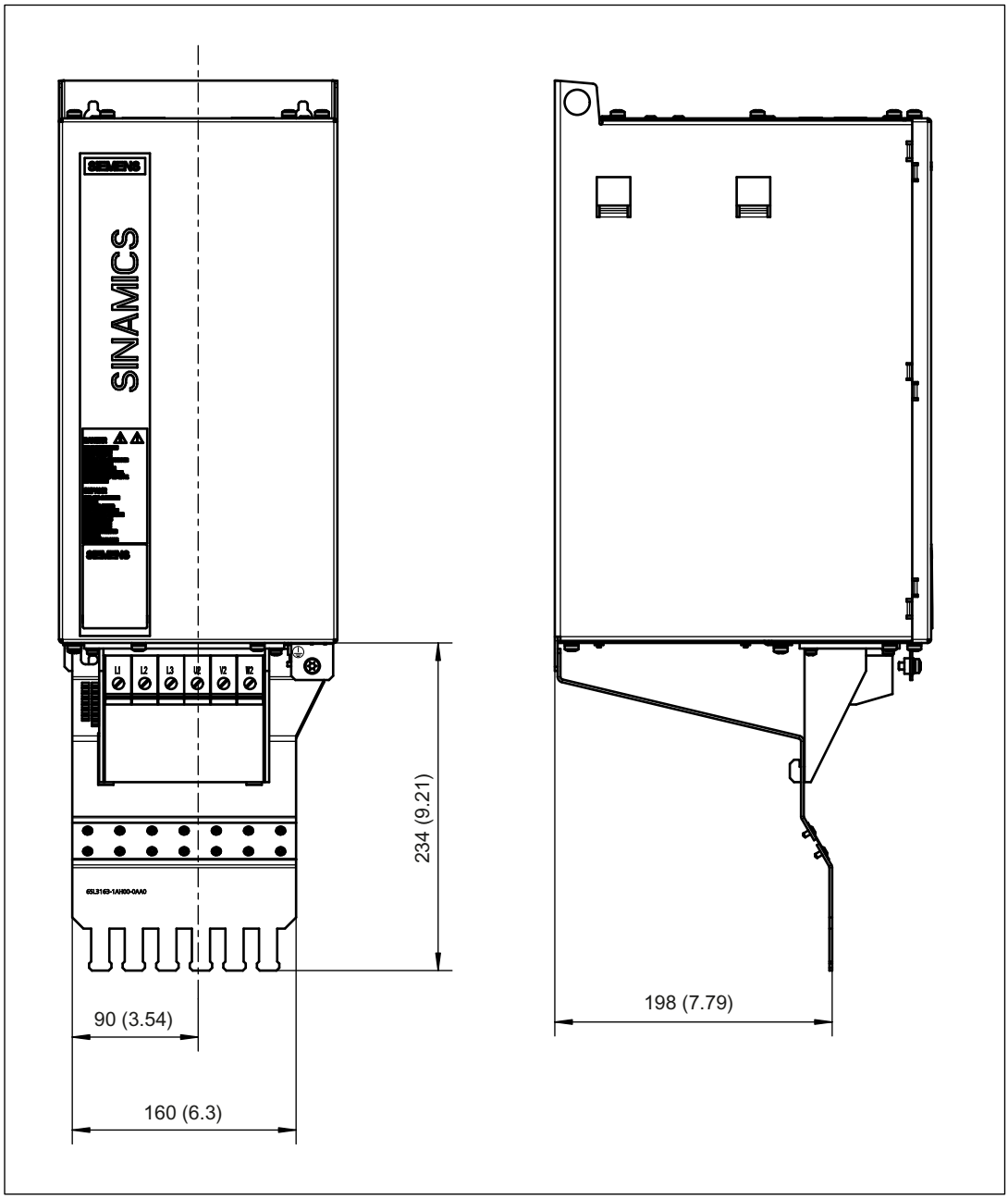


Figure 11-18 Dimension drawing of shield connecting plate on the 55 kW Active Interface Module, all dimensions in mm and (inches)

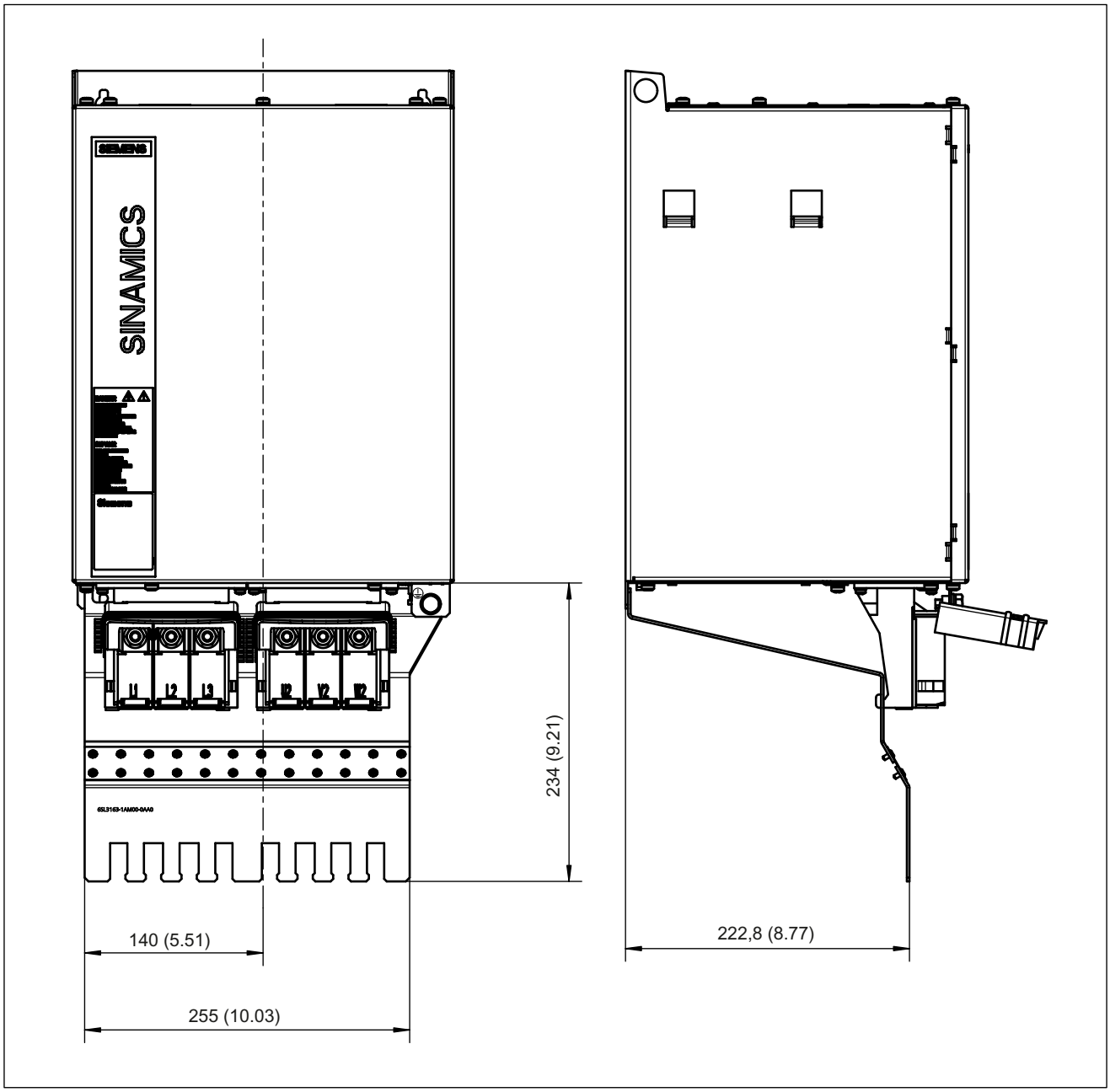


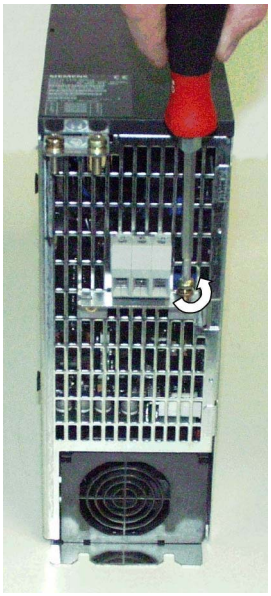
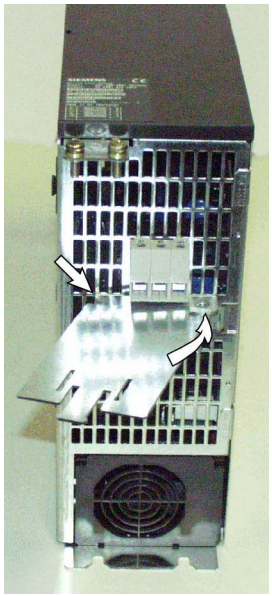
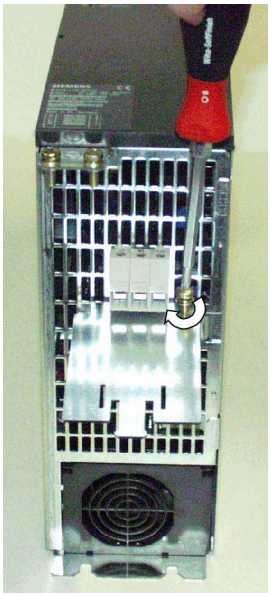
Figure 11-19 Dimension drawing of shield connecting plate on the 80 and 120 kW Active Interface Module, all dimensions in mm and (inches)

11.1.5 Installation

Tools required:

- Torx screwdriver T25 for shield connecting plate

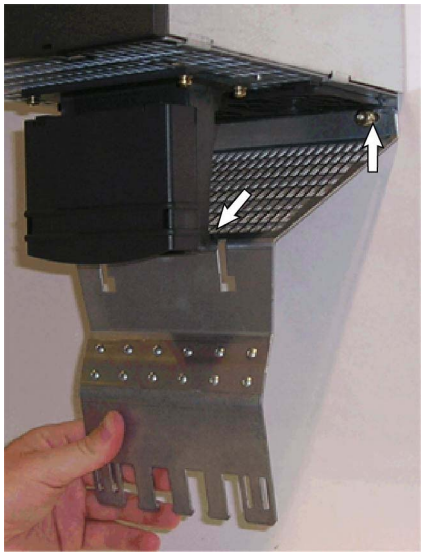
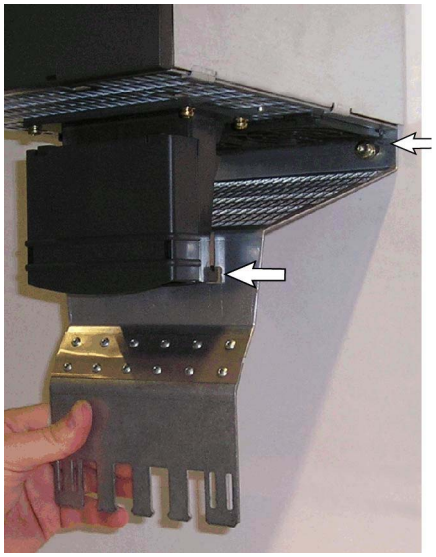
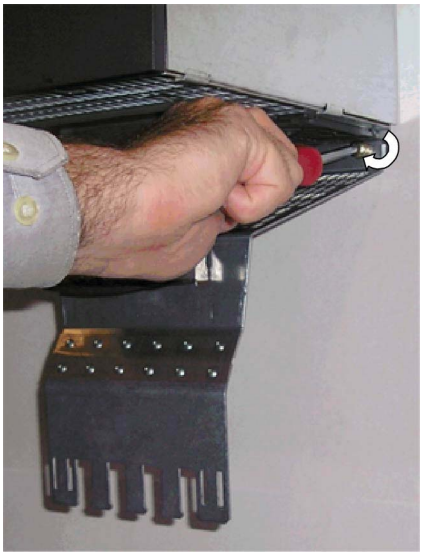
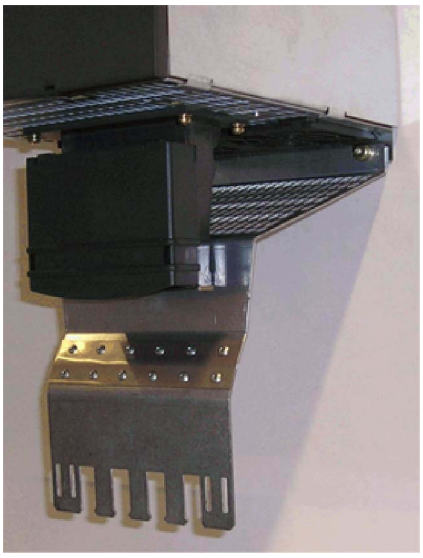
Table 11- 5 Installing the shield connecting plate to a 100 mm component using as an example, internal air cooling

			
Remove the screw	Hook the shield connecting plate into place	Tighten the shield connecting plate Tightening torque: 3 Nm	Installed shield connecting plate

Tools required:

- Screwdriver for fixing screws used

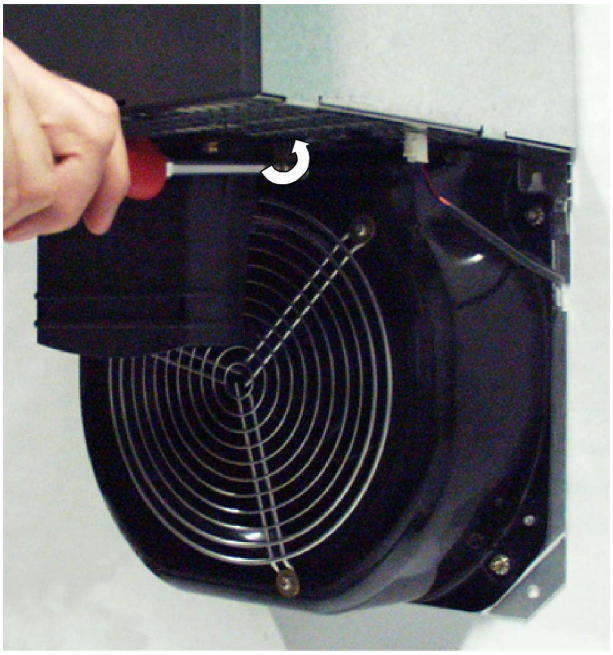
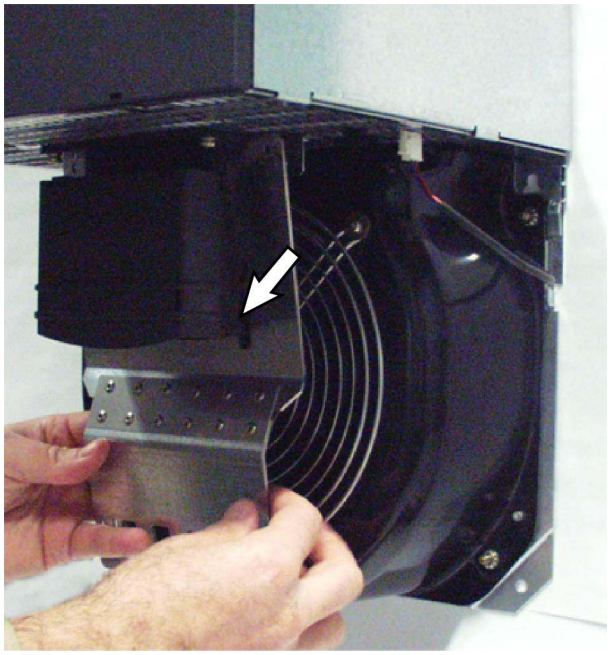
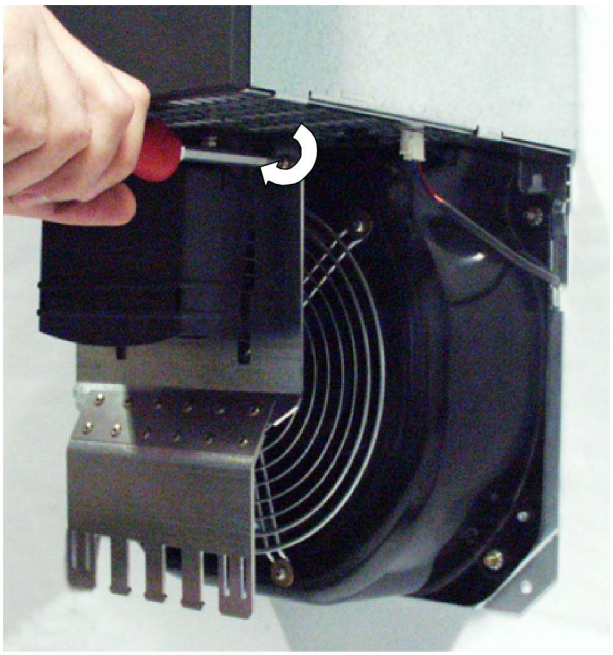
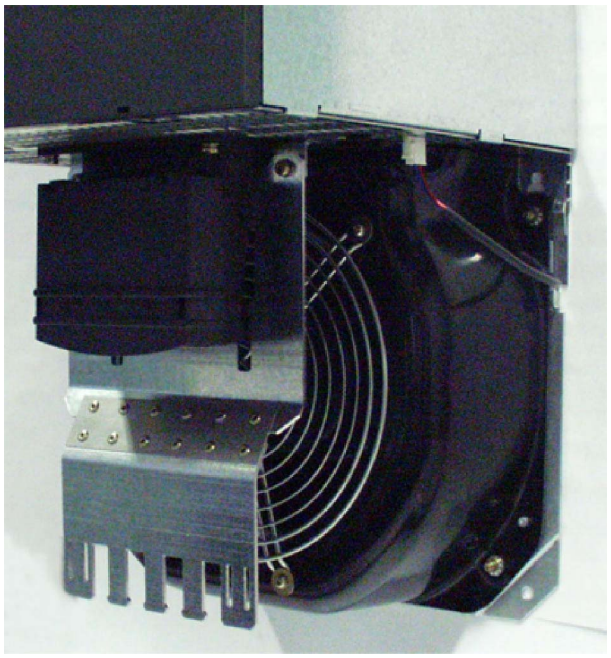
Table 11- 6 Installing the shield connecting plate to a 200 mm component using as an example, internal air cooling

		
Loosen the lower fixing screws	Hook the shield connecting plate into the screws and on the line/motor connection	Secure the shield connecting plate by shifting it to the left
		
Tighten the shield connecting plate Tightening torque: 6 Nm	Installed shield connecting plate	

Tools required:

- Torx screwdriver T25 for shield connecting plate

Table 11- 7 Installing the shield connecting plate to a 300 mm component using as an example, internal air cooling

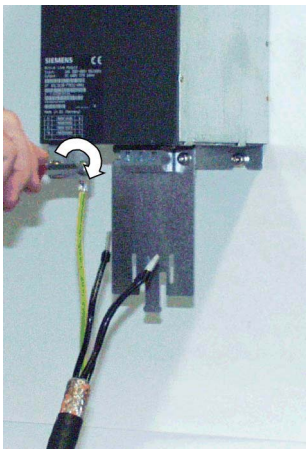
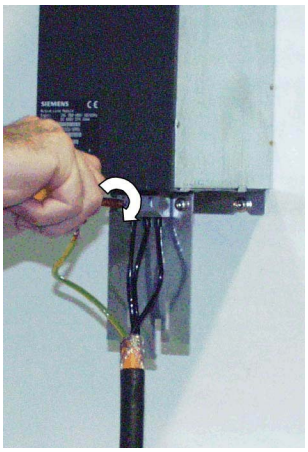
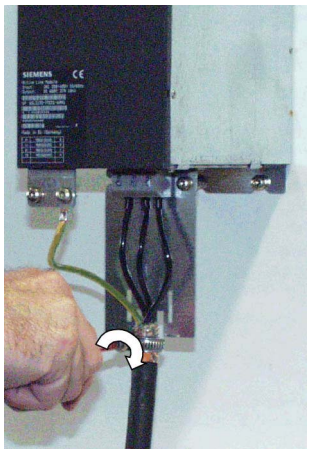
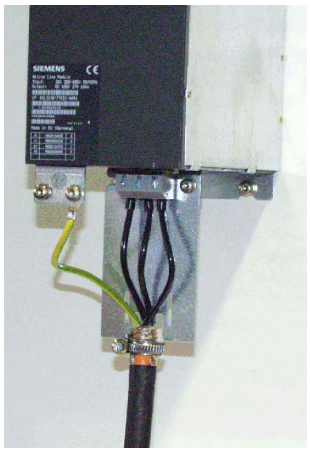
	
Remove the screw	Hook the shield connecting plate into the line/motor connection
	
Tighten the shield connecting plate Tightening torque: 3 Nm	Installed shield connecting plate

11.1.6 Connecting the power cables

Required tools:

- Torx screwdriver T25 for protective conductor connection (Torx slot)
- Flat-bladed screwdriver size 4 for power cables
- Flat-bladed screwdriver for hose clip

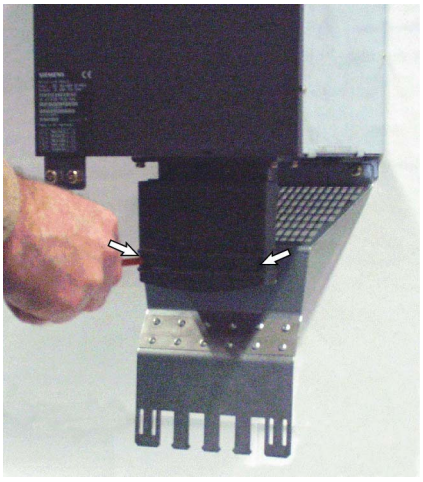
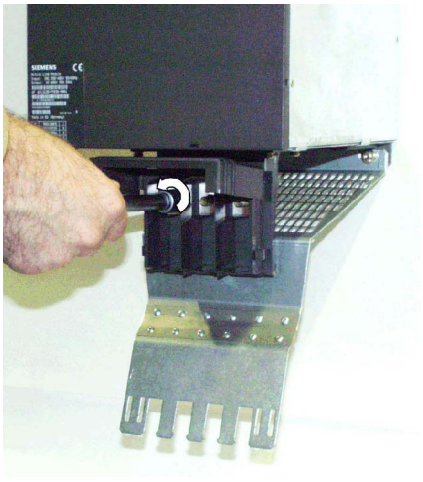
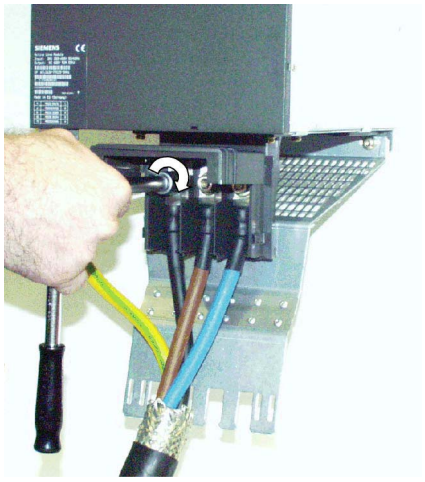
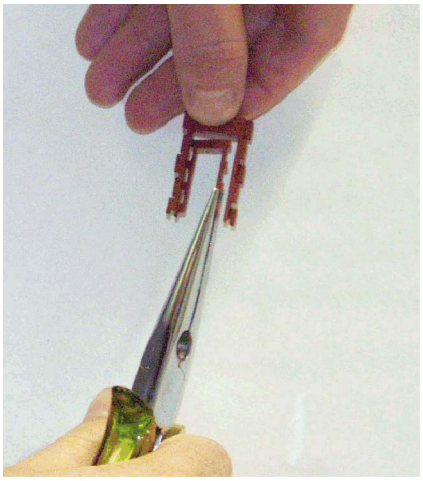
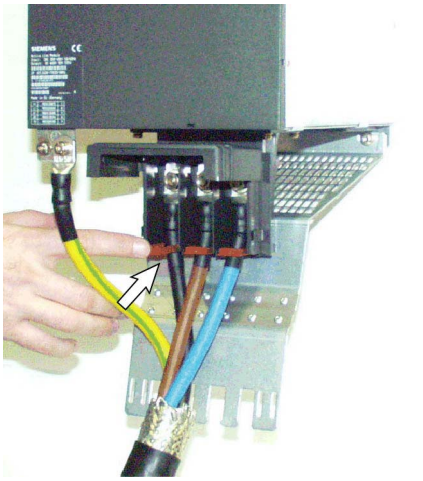
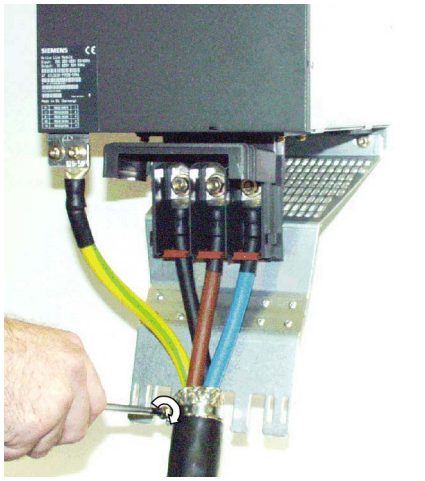
Table 11- 8 Connecting power cables for a 100 mm component using internal air cooling as an example

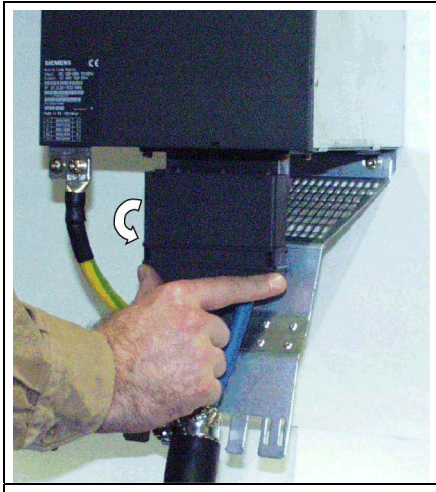
			
Fasten the protective conductor (PE) Tightening torque: 3 Nm	Fasten the power cable Tightening torque: 1.8 Nm	Tighten the hose clip at the shield connecting plate	The power cable is connected.

Required tools:

- Torx screwdriver T25 for protective conductor connection (Torx slot)
- (Torque) wrench M8 for power cables
- Flat-bladed screwdriver for hose clip

Table 11- 9 Connecting power cables for a 200 mm component using internal air cooling as an example

		
Unlock and remove the cover of the terminal strip.	Remove nuts M8	Fasten the protective conductor and the power cable Tightening torque: 13 Nm
		
Adapt a restrictor collar for the purpose of touch protection (by means of a suitable tool)	Attach the restrictor collars	Tighten the hose clip at the shield connecting plate


Close the cover of the terminal strip.

11.2 Releasing the DC link protective cover

The protective covers for the DC link on the SINAMICS S120 components feature an interlock mechanism, which is operated using a slot-head screwdriver (1 x 5.5).

Table 11- 10 Opening the protective cover for the DC link using a screwdriver

		
Protective cover with interlock mechanism	To open the protective cover, use the screwdriver to turn the interlock screw a little, in the direction of the arrow (counter-clockwise)	Opened protective cover

To lock, press the protective cover back on until you hear the interlock engage.

11.3 DC link rectifier adapter for Booksize format

11.3.1 Description

The DC link rectifier adapter supplies the DC link voltage directly. It is best used for supplying an individual component. With a direct supply, each component is connected to the DC link separately. The internal DC link busbar is not used here.

If the DC link rectifier adapter is to be used for supplying more than one component, it is important to remember it can only be installed on the component on the far right. The choice of connection cable diameter should be based on the required summation current for all the connected components.

The connection cables must be fused accordingly.

Mounting on components with reinforced DC link busbars is **not** possible.

Note

When a DC link rectifier adapter and DC busbars are used, the limit values for radio interference suppression under Category C2 according to EN 61800-3 can no longer be observed.

Table 11- 11 Available DC link rectifier adapters

Order number	Screw terminals	Used for Line/Motor Modules with these sizes
6SL3162-2BD00-0AA0	0.5 to 10 mm²	50 mm; 100 mm
6SL3162-2BM00-0AA0	35 to 95 mm²	150 mm; 200 mm; 300 mm

11.3.2 Safety Information

⚠DANGER

Risk of electric shock

A hazardous voltage is present for up to 5 minutes after the power supply has been disconnected.
This time must elapse before any work may be carried-out on the adapter (e.g. mounting/installation).

When opening the protective cover for the DC link, you must press the release catch. A suitable tool (e.g. screwdriver or the release tool supplied) must be used for this purpose.

The components must only be operated when the protective cover of the DC link is closed. Damaged components must not be operated further, otherwise this could result in secondary damage or accidents.

⚠DANGER

DC link discharge time

The DC link discharge voltage hazard warning in the local language must be attached to all of the components on which the adapter is mounted.
A set of labels in 16 languages is supplied with the component.

⚠DANGER

It is only permissible to establish connections to the DC link using the adapters that SIEMENS has recommended (DC link adapter and DC link rectifier adapter).

⚠DANGER

If a 50 mm wide Motor Module or a 50 mm wide DC link component (e.g. Braking Module, Control Supply Module, Voltage Clamping Module) is located at the left-hand end of the drive line-up, then the DC link bridges, including all of the screws, must be removed from this component. It is not permissible to insert the screws without a DC link bridge.

For all other components that are 75 mm wide or wider, it is neither permissible to move the DC link bridge to the left nor to remove it.

If this is not carefully observed, this can result in damage and accidents.

CAUTION

The screw tightening torque (1.8 Nm, tolerance +30 %) for securing components to the module-side DC link busbar must be checked before commissioning to ensure that it is correct. After transportation, the screws must be tightened.

CAUTION

To ensure safe electrical separation, the 24 V supply cables and those for the DC link connection cables must be physically separated (> 100 mm), or the 24 V cables must be doubly insulated (e.g. sheathed cable).

CAUTION

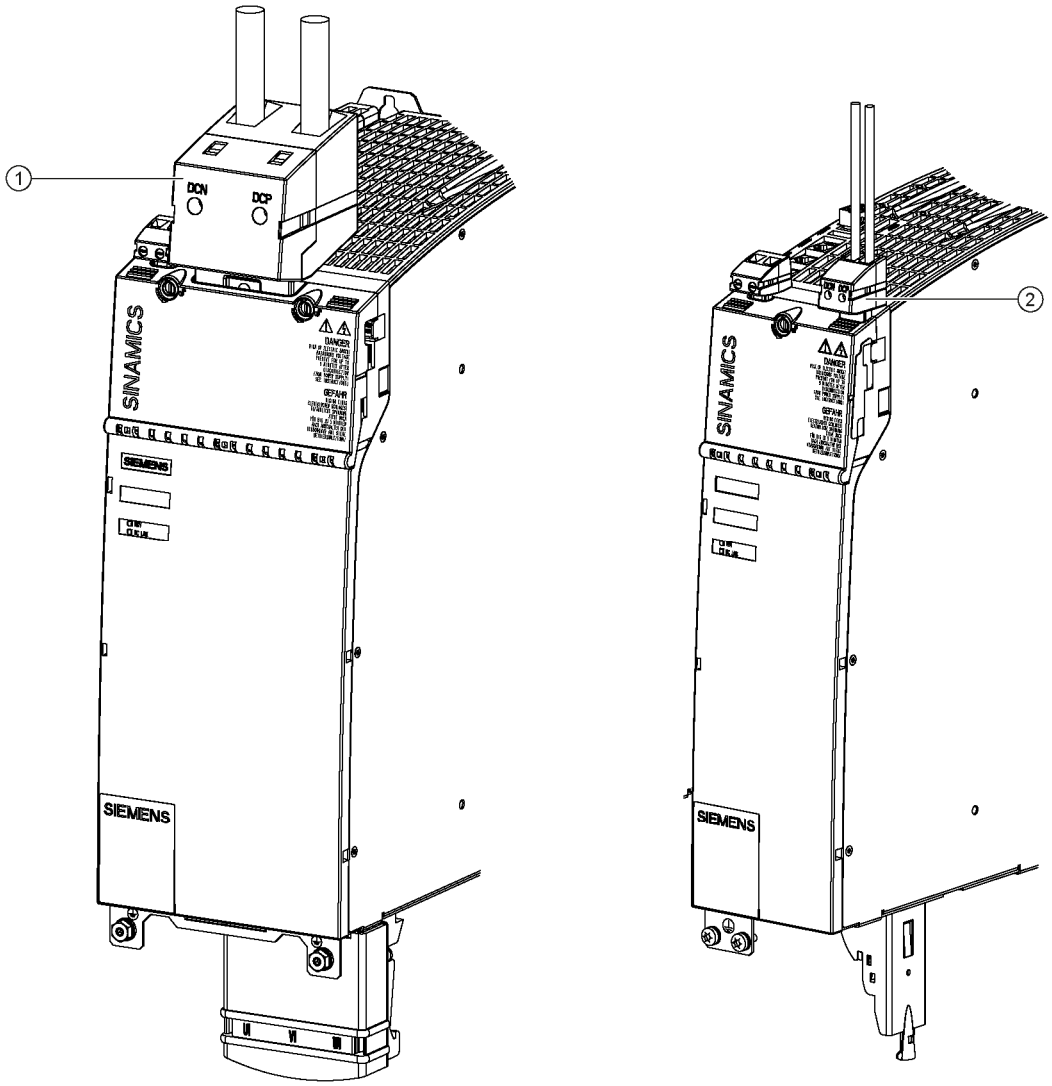
The total length of the DC link (including the connection cables) must not exceed 10 m.

⚠WARNING

The DC link connection cables must be routed in such a way as to ensure that they are ground-fault and short-circuit proof in accordance with DIN/VDE 0100 or suitable fuse protection must be provided.

11.3.3 Interface description

11.3.3.1 Overview



① DC link rectifier adapter (35 mm² to 95 mm²) on a 150 mm component
② DC link rectifier adapter (0.5 mm² to 10 mm²) on a 100 mm component

Figure 11-20 Installed DC link rectifier adapter, using the example of components with a width of 100 mm and 150 mm

11.3.3.2 DC link connection

Table 11- 12 DC link rectifier adapter – description of the terminals

Terminal	Function	Technical specifications
DCP	DC link positive	**Supply voltage:** 720 V-VDE/600 V-UL **Direct supply 0.5 – 10 mm²** Current carrying capacity: 43 A connection cross-section: 0.5 – 10 mm² Stripped length: 11 mm **Direct supply 35 – 95 mm²** Current carrying capacity: 200 A connection cross-section: 35 – 95 mm² Stripped length: 27 mm
DCN	DC link negative	

11.3.4 Dimension drawings

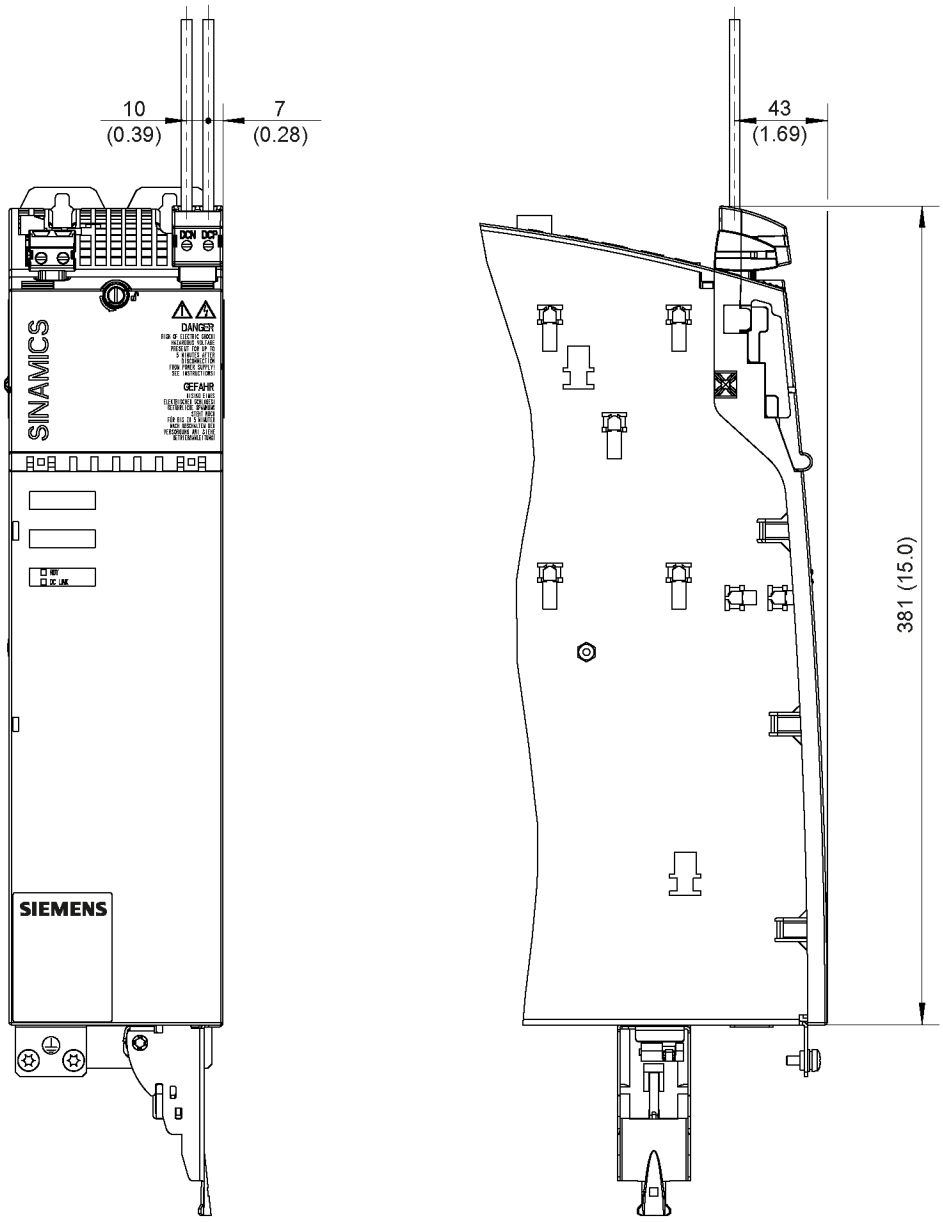


Figure 11-21 Dimension drawing of 100 mm component with DC link rectifier adapter for 0.5 mm² to 10 mm², all dimensions in mm and (inch)

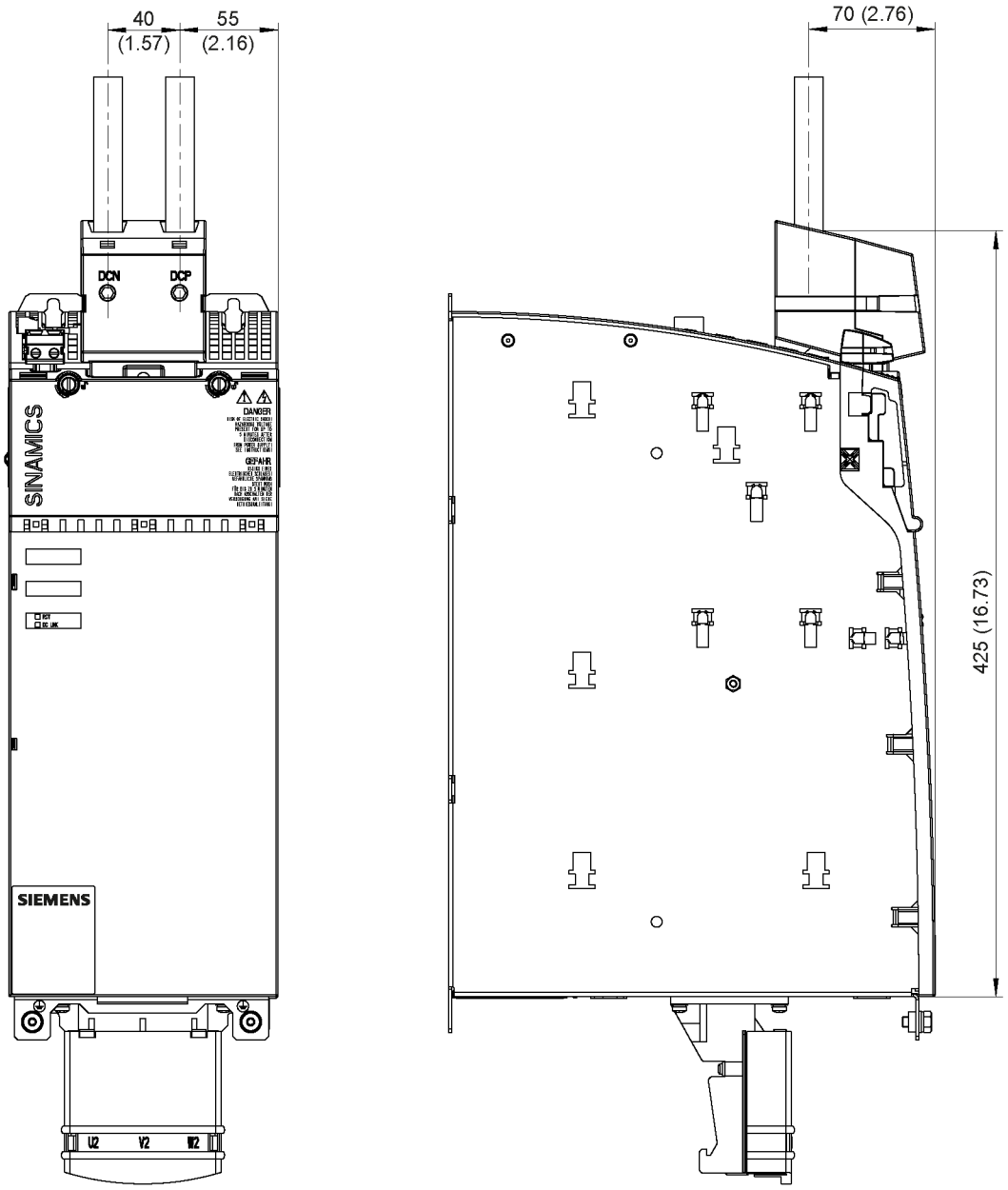


Figure 11-22 Dimension drawing of 150 mm component with DC link rectifier adapter for 35 mm² to 95 mm², all dimensions in mm and (inch)

11.3.5 Installation

11.3.5.1 Safety information

⚠DANGER

If a 50 mm wide Motor Module or a 50 mm wide DC link component (e.g. Braking Module, Control Supply Module, Voltage Clamping Module) is located at the left-hand end of the drive line-up, then the DC link bridges, including all of the screws, must be removed from this component. It is not permissible to insert the screws without a DC link bridge.

For all other components that are 75 mm wide or wider, it is neither permissible to move the DC link bridge to the left nor to remove it.

If this is not carefully observed, this can result in damage and accidents.

NOTICE

If the 24 V terminal adapter and/or the DC link rectifier adapter is removed, the protective cover whose cutouts have been broken out must be replaced by a new one for safety reasons. Operation with broken out cutouts in the protective cover is not permitted!

11.3.5.2 Installation on components that are 50 mm and 100 mm wide

Required tools:

- Slot-head screwdriver (1 x 5.5) for releasing the protective cover
- Torx T10 screwdriver to fasten the 24 V terminal adapter
- Torx screwdriver T20 for DC link screws (Torx slot)
- Pliers for breaking out the cutouts

Table 11- 13 Removing the DC link busbars

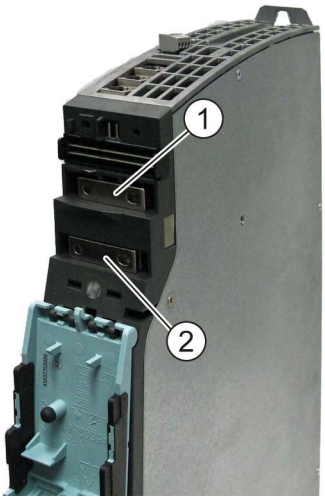
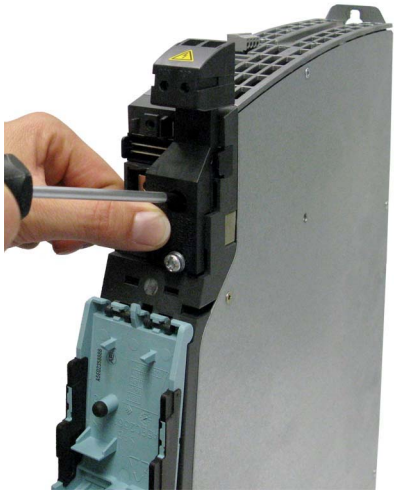
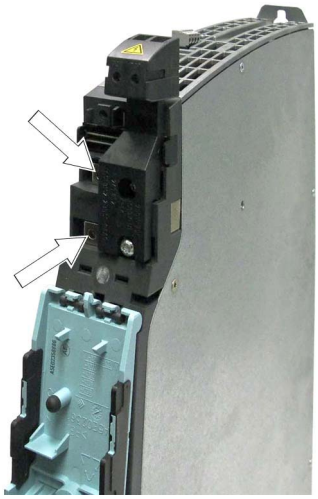
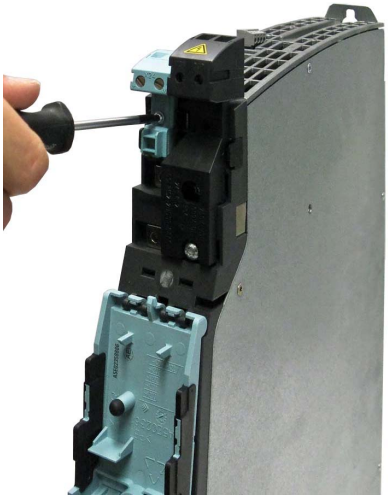
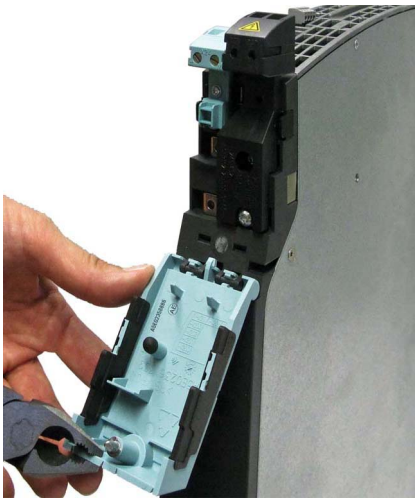
		
Release and open the protective cover	Remove the top left screw and the DC link bridge	Remove the bottom left screw and the DC link bridge
		To install the DC link rectifier adapter, it is essential to leave the DC link busbars ① and ② in the components (hold firmly to prevent them falling out).
Remove the top and bottom right screws on the DC link		

Table 11- 14 Installing the DC link rectifier adapter and 24 V terminal adapter

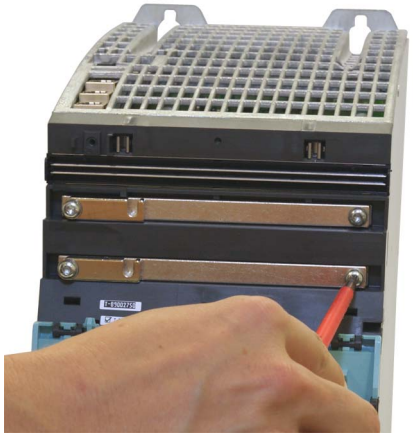
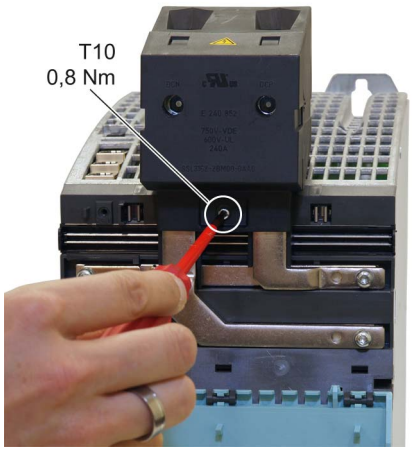
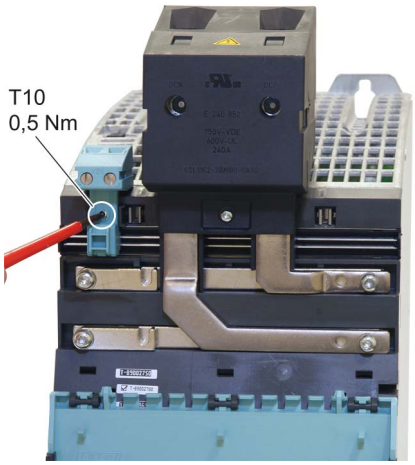
		
Fixing and fastening (top and bottom) the DC line rectifier adapter with the **long** DC link screws.	It is **NOT** permissible to insert the screws at the top markings on the DC link busbar!	Attach and screw on the 24 V terminal adapter, using the corresponding screw provided in the accessories pack
		
Knock out the cutouts on the protective cover	Close the protective cover until you hear it snap into place	Component with installed DC link rectifier adapter and 24 V terminal adapter

11.3.5.3 Installation on components that are 150 mm, 200 mm and 300 mm wide

Required tools:

- Slot-head screwdriver (1 x 5.5) for releasing the protective cover
- Torx T10 screwdriver to attach the adapter
- Torx screwdriver T20 for DC link screws (Torx slot)
- Pliers for knocking out the cutouts

Table 11- 15 Installation of the DC link rectifier adapter for 150 mm, 200 mm, and 300 mm components

		
Release and open the protective cover	Unscrew the DC link screws	Engage the adapter in the grid
		
Attach the adapter bars using the previously removed DC link screws	Attached the adapter with the associated screw (accessories pack)	Attach and screw on the 24 V terminal adapter, using the associated screw provided in the accessories pack

		
Knock out the cutouts on the protective cover	Close the protective cover until you hear it snap into place	

11.3.6 Electrical connection

Table 11- 16 Connecting the DC link rectifier adapter for 50 mm and 100 mm components



Install the cables at the DC link rectifier adapter (Torx T10)



Connected DC link rectifier adapter

Table 11- 17 Connecting the DC link rectifier adapter for 150 mm, 200 mm, and 300 mm components



Install the cables at the DC link rectifier adapter (hexagon socket-head screw)



Connected DC link rectifier adapter

11.3.7 Technical specifications

Table 11- 18 Technical specifications DC link rectifier adapter

DC link rectifier adapter	Unit	6SL3162-2BD00-0AA0 0.5 – 10 mm²	6SL3162-2BM00-0AA0 35 – 95 mm²
Current carrying capacity	A	36	240
Conductor cross-section	mm²	0.5 – 10	35 – 95
Stripped length	mm	11	27
Tightening torque - Terminals - DC link busbars	 Nm Nm	 1.8 1.8	 13 1.8

11.4 DC link adapter

11.4.1 Description

The DC link adapter is required when the drive line-up needs to be divided up (e.g. into two rows). The sub-line-ups are connected using cables (35 $mm^2$to 95 mm^2). Shielded individual cores are recommended.

The DC link adapter can be used for all Line Modules and Motor Modules in the booksize format. Mounting on components with reinforced DC link busbars is **not** possible.

11.4.2 Safety Information

⚠DANGER

Risk of electric shock

A hazardous voltage is present for up to 5 minutes after the power supply has been disconnected.
This time must elapse before any work may be carried-out on the adapter (e.g. mounting/installation).

The components must only be operated when the protective cover of the DC link is closed. Damaged components must not be operated further, otherwise this could result in secondary damage or accidents.

⚠DANGER

DC link discharge time

The DC link discharge voltage hazard warning in the local language must be attached to all of the components on which the adapter is mounted.
A set of labels in 16 languages is supplied with the component.

⚠DANGER

It is only permissible to establish connections to the DC link using the adapters that SIEMENS has recommended (DC link adapter and DC link rectifier adapter).

CAUTION

The screw tightening torque (1.8 Nm, tolerance +30 %) for securing components to the module-side DC link busbar must be checked before commissioning to ensure that it is correct. After transportation, the screws must be tightened.

⚠ DANGER

If a 50 mm wide Motor Module or a 50 mm wide DC link component (e.g. Braking Module, Control Supply Module, Voltage Clamping Module) is located at the left-hand end of the drive line-up, then the DC link bridges, including all of the screws, must be removed from this component. It is not permissible to insert the screws without a DC link bridge.

For all other components that are 75 mm wide or wider, it is neither permissible to move the DC link bridge to the left nor to remove it.

If this is not carefully observed, this can result in damage and accidents.

⚠ DANGER

The DC link connection cables must be routed in such a way that they are ground-fault and short-circuit proof in accordance with EN 60204-1.

CAUTION

The total length of the DC link (including the connection cables) must not exceed 10 m.

11.4.3 Interface description

11.4.3.1 Overview

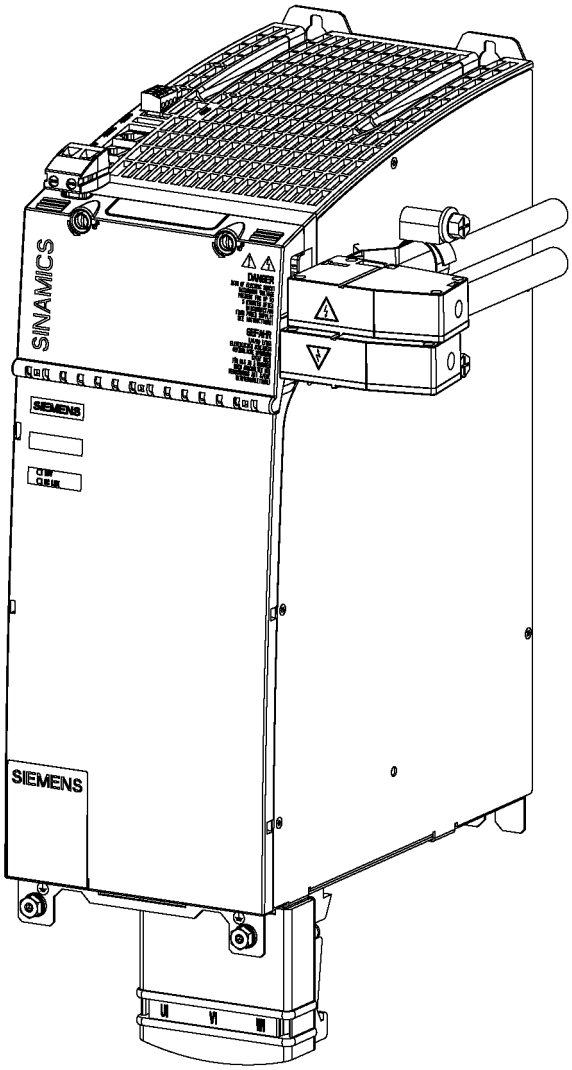


Figure 11-23 150 mm components with DC link adapter for two-row configuration 35 mm² to 95 mm²

11.4.3.2 DC link connection

Table 11- 19 DC link adapter – description of the terminals

Terminal	Function	Technical specifications
DCP	DC link positive	**Two-row configuration of adapter 35 – 95 mm²** Current carrying capacity: 200 A Voltage: 720 V-VDE/600 V AC Connection cross-section: 35 – 95 mm² Stripped length: 27 mm
DCN	DC link negative	

11.4.4 Dimension drawing

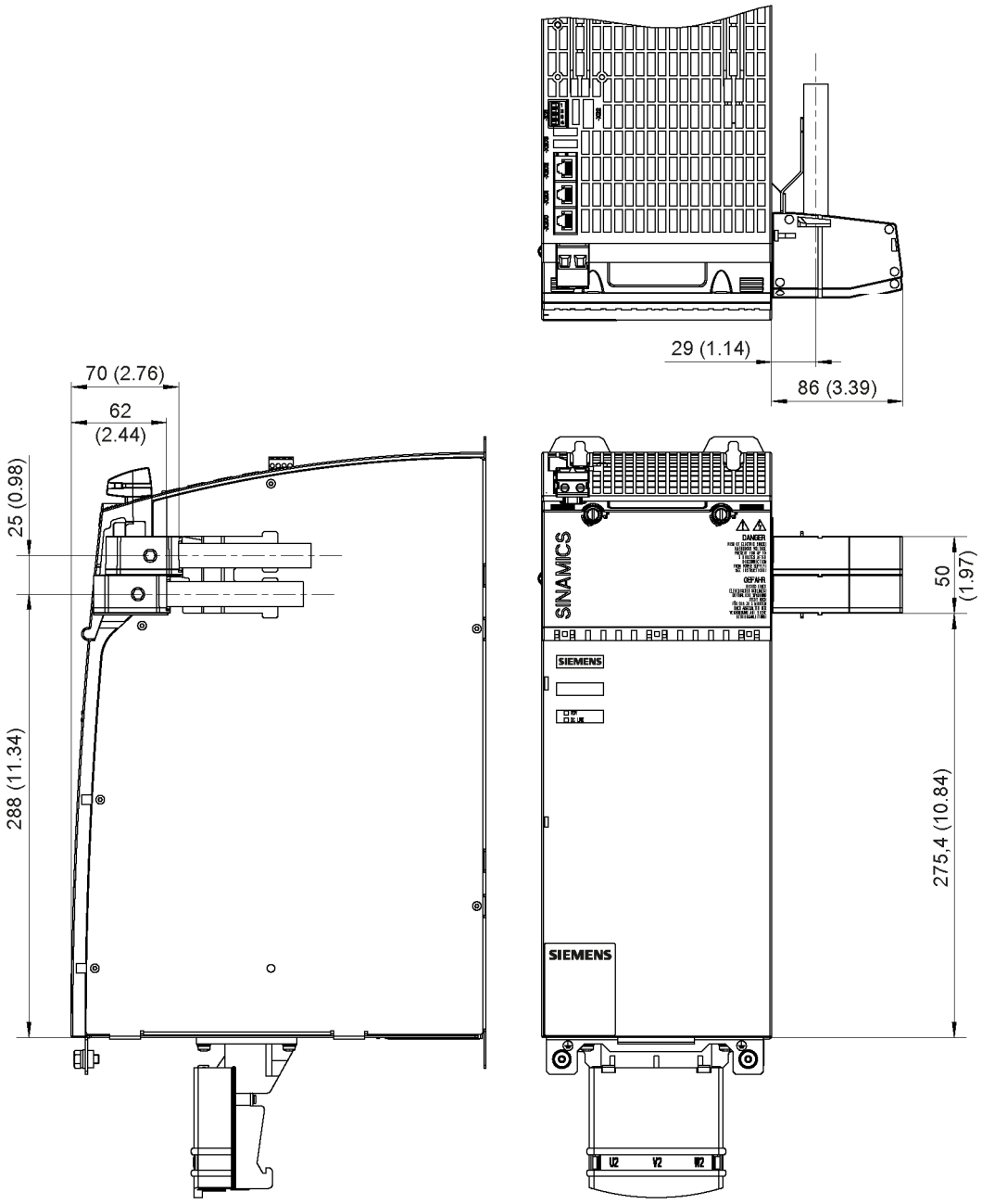


Figure 11-24 Dimension drawing of 150 mm component with DC link rectifier adapter for 35 mm² to 95 mm² for installation on two rows, all dimensions in mm and (inches)

11.4.5 Installation

⚠ DANGER

If a 50 mm wide Motor Module or a 50 mm wide DC link component (e.g. Braking Module, Control Supply Module, Voltage Clamping Module) is located at the left-hand end of the drive line-up, then the DC link bridges, including all of the screws, must be removed from this component. It is not permissible to insert the screws without a DC link bridge.

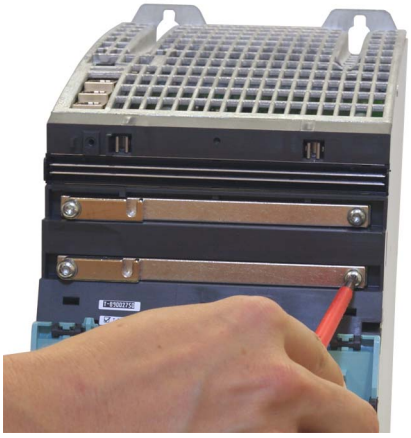
For all other components that are 75 mm wide or wider, it is neither permissible to move the DC link bridge to the left nor to remove it.

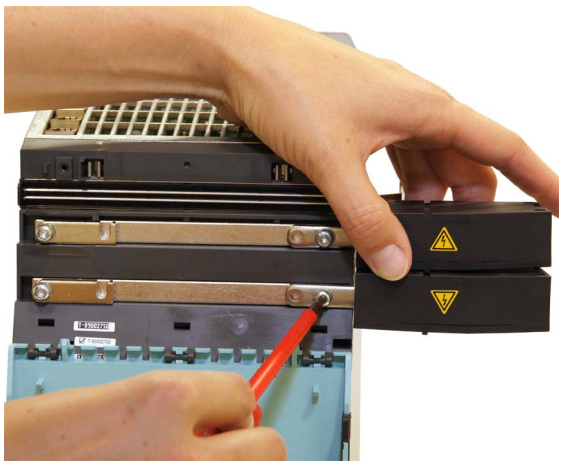
If this is not carefully observed, this can result in damage and accidents.

Required tools:

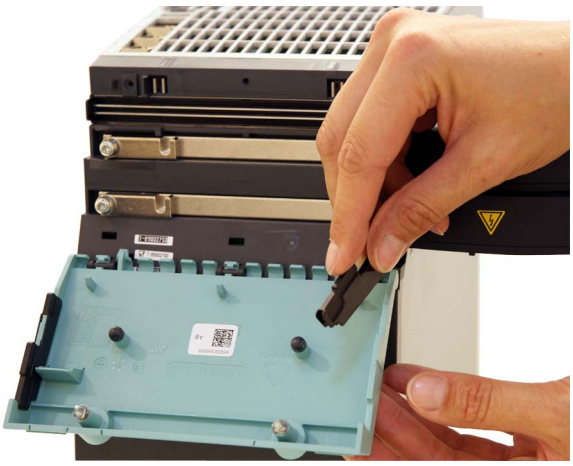
- Slot-head screwdriver (1 x 5.5) for releasing the protective cover
- Torx screwdriver T20 for DC link screws (Torx slot)

Table 11- 20 Installation of the DC link adapter on a 150 mm component

	
Release and open the protective cover	Remove the DC link screws



Tighten the DC link adapter screws (1.8 Nm)



Remove the DC link side cover



Installed DC link adapter and
24 V terminal adapter

Note

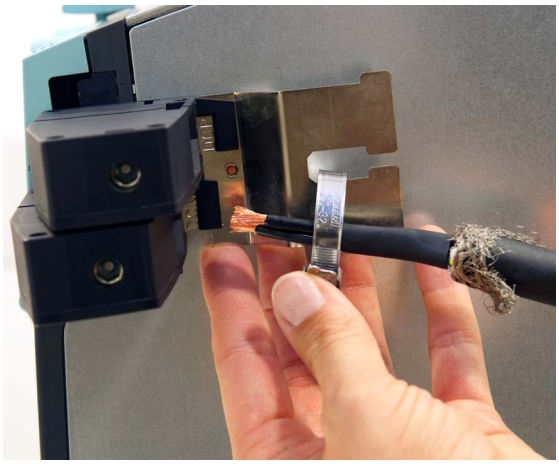
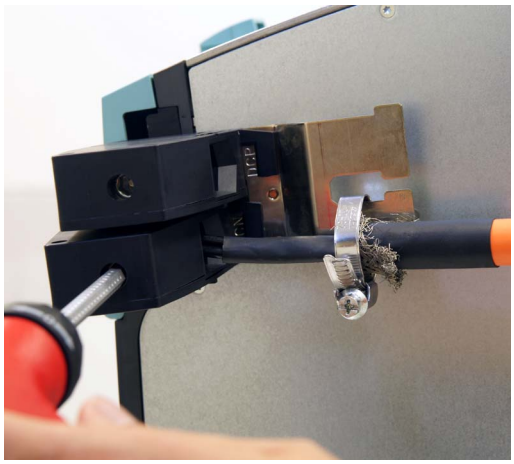
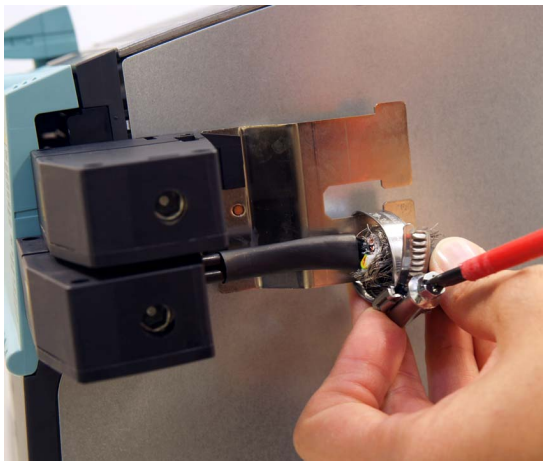
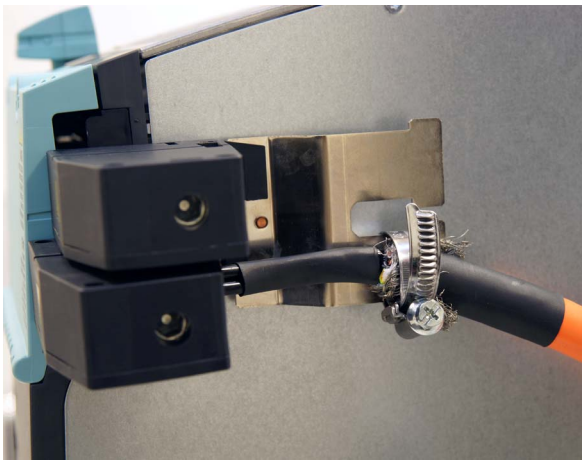
By moving the adapter housing, the DC link adapter can be fitted on either the left-hand or right-hand side of the component. This configuration is possible for all Active Line Modules.

11.4.6 Electrical connection

Required tools:

- Size 6 Allen key to attach the cables
- Suitable tool for tube clips (e.g. flat-bladed screwdriver)

Table 11- 21 Electrical connection of the DC link adapter on a 150 mm component

	
Route the connecting cable through the clamp into the DC link adapter	Securely attach the cable using the hexagon socket-head screw
	
Tighten the clamp using a screwdriver	Connected DCN connecting cable

The procedure described above is applicable for both connecting cables of the DC link, and must be repeated for the DCP connecting cable.

Always use shielded connection cables only.

The DC link adapter can be located at the right or left as required.

11.4.7 Technical specifications

Table 11- 22 Technical specifications DC link adapter

6SL3162-2BM01-0AA0	Unit	Value
Current carrying capacity	A	240
Conductor cross-section	mm²	35 – 95
Stripped length	mm	27
Tightening torque - Terminals - DC link busbars	 Nm Nm	 13 1.8

11.5 Reinforced DC-link busbars

11.5.1 Description

If necessary, reinforced DC link busbars are used to increase the current carrying capacity of the components from 100 A to 150 A. They are available for 50 mm and 100 mm wide components of the Booksize and Booksize Compact series.

Table 11- 23 Reinforced DC link busbars

Reinforced DC link busbars	Order number
Suitable for 50 mm components	6SL3162-2DB00-0AAx
Suitable for 100 mm components	6SL3162-2DD00-0AAx

Notes on configuration and arrangement of the components in the drive line-up can be found in the Chapter, "Control cabinet installation and EMC/arrangement of components and devices".

Note

When using reinforced DC link busbars it is not possible to use a DC link adapter as well as a DC link rectifier adapter for 50 mm and 100 mm wide components.

11.5.2 Safety information

⚠DANGER

Risk of electric shock

A hazardous voltage is present for up to 5 minutes after the power supply has been switched off.
It is only permissible to open the protective cover of the DC link after this time has expired.

When opening the protective cover for the DC link, you must press the release catch. A suitable tool (e.g. screwdriver or the release tool supplied) must be used for this purpose.

The components must only be operated when the protective cover of the DC link is closed. Damaged components must not be operated further, otherwise this could result in secondary damage or accidents.

The protective cover for the DC link must be closed for all components before the voltage supply is switched on. The interlocks must audibly engage.

⚠ DANGER

If a 50 mm wide Motor Module or a 50 mm wide DC link component (e.g. Braking Module, Control Supply Module, Voltage Clamping Module) is located at the left-hand end of the drive line-up, then the DC link bridges, including all of the screws, must be removed from this component. It is not permissible to insert the screws without a DC link bridge.

For all other components that are 75 mm wide or wider, it is neither permissible to move the DC link bridge to the left nor to remove it.

If this is not carefully observed, this can result in damage and accidents.

⚠ CAUTION

The left and right ends of the DC link busbar of a drive line-up must be closed using lateral covers (Order No.: 6SL3162-5AA00-0AA0).

⚠ CAUTION

The correct tightening torque of the DC link busbar screws (1.8 Nm +30%) must be checked after transportation and before commissioning when the system is disconnected from the power supply and the DC link is discharged.

NOTICE

The current carrying capacity of the DC link adapter (Order No.: 6SL3162-2BM00-0AAx) cannot be fully utilized.

11.5.3 Dimension drawings

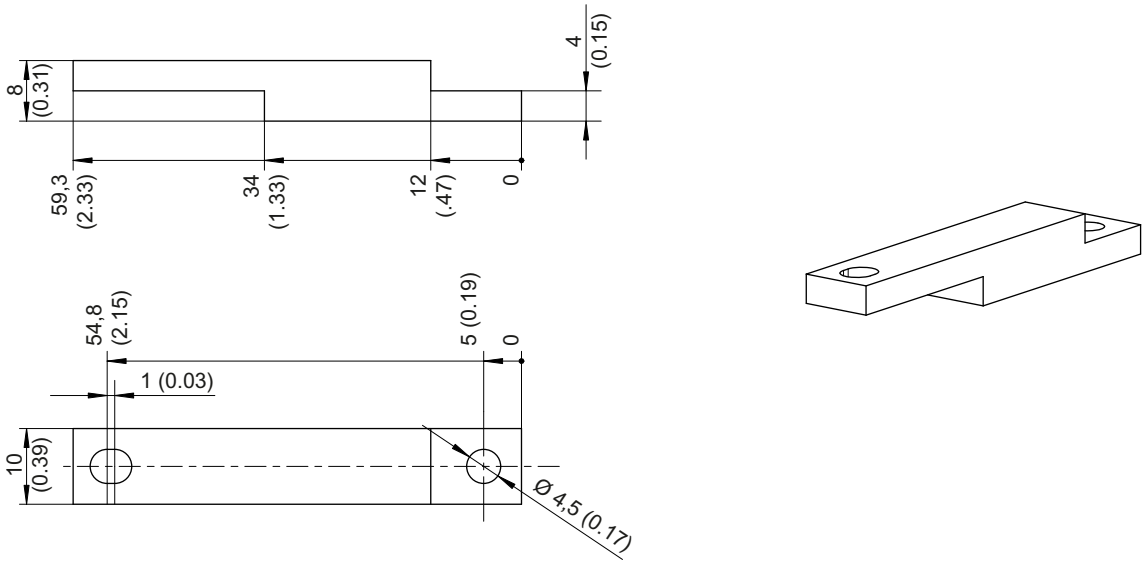


Figure 11-25 Dimension drawing of reinforced DC-link busbar 50 mm, all dimensions in mm and (inches)

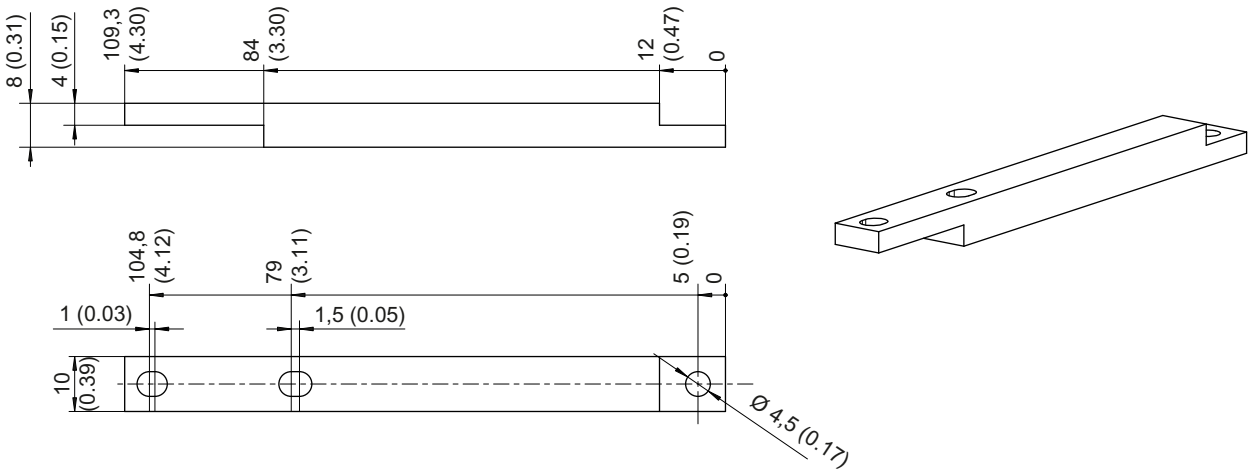


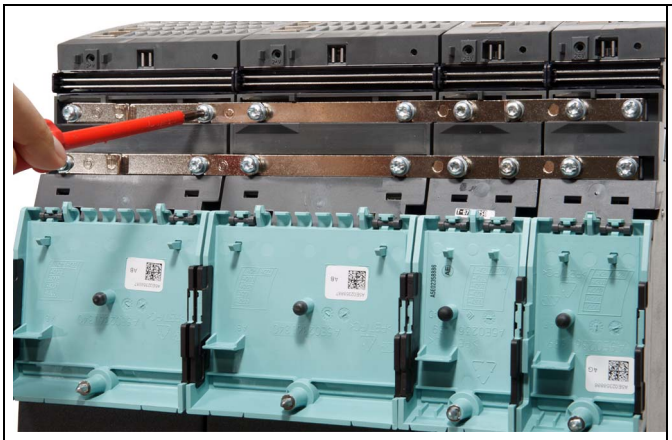
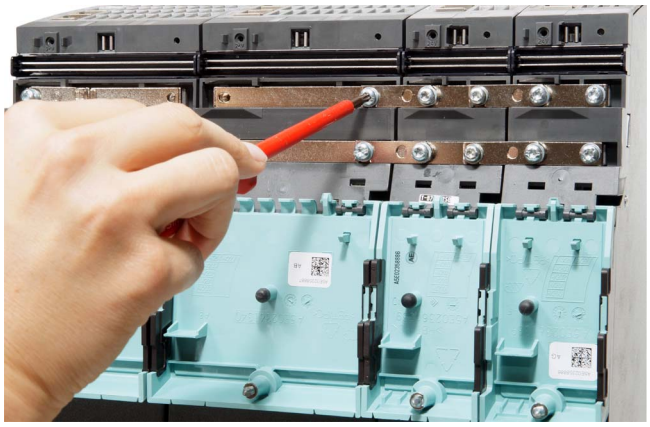
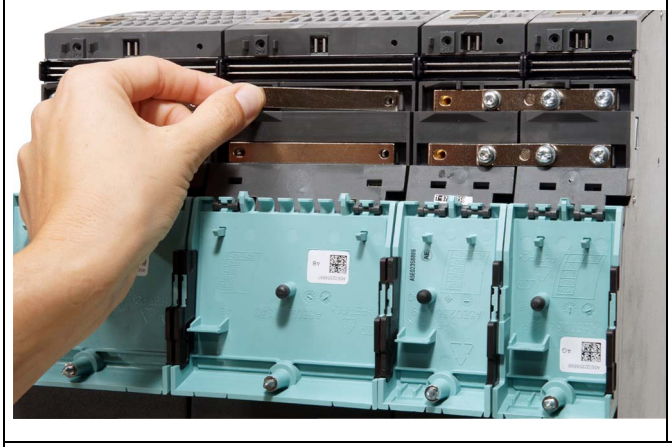
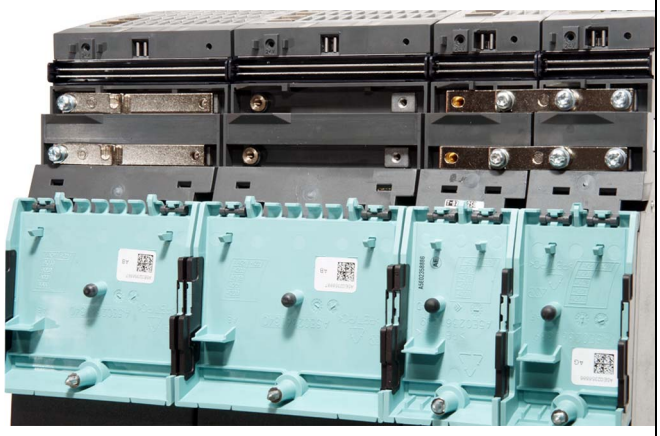
Figure 11-26 Dimension drawing of reinforced DC-link busbar 100 mm, all dimensions in mm and (inches)

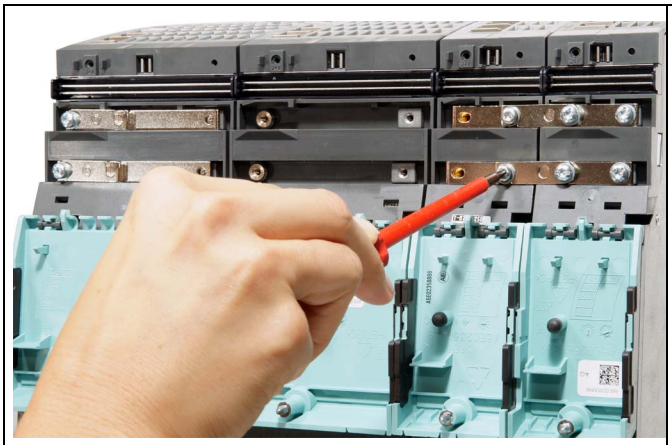
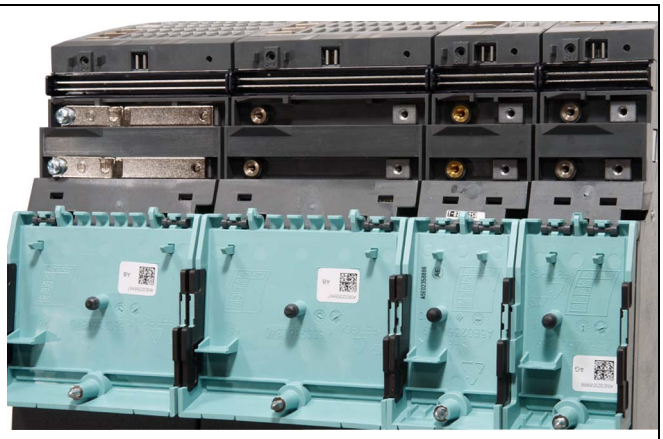
11.5.4 Removing the DC link busbars

Required tools:

- Torx screwdriver T20 for DC link screws (Torx slot)

Table 11- 24 Removing the DC link busbars

	
Unscrew the screws and remove the attached DC link bridge, starting at the second component	Unscrew the screws and remove the attached DC link bridge of the adjacent components
	
Remove the DC link busbars on the second component.	

	
Unscrew the screws and remove the DC link bridges and busbars on the other components	Removed DC link busbars

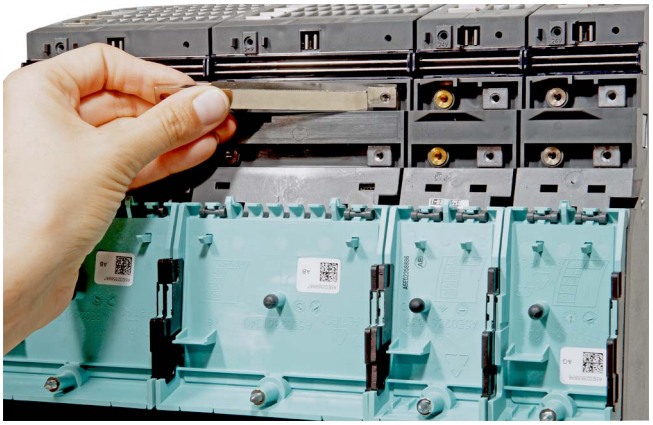
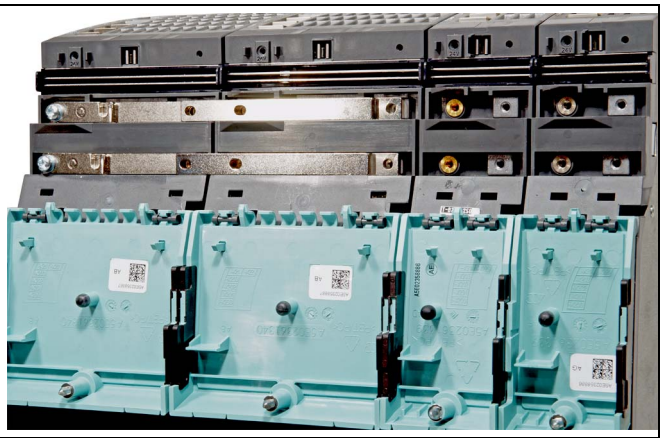
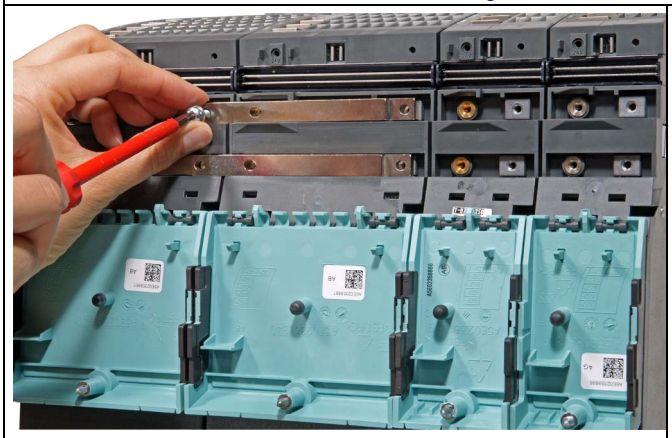
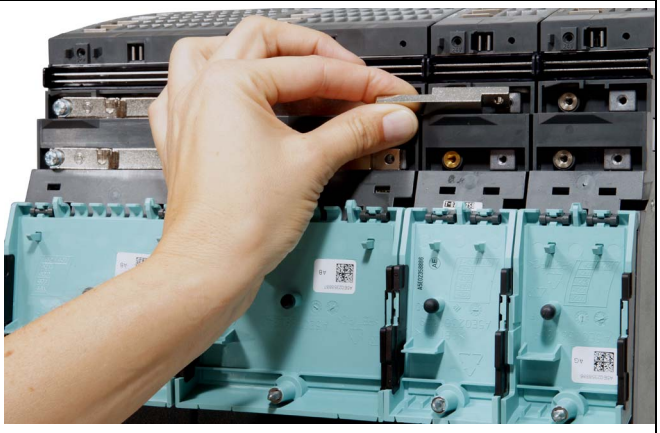
NOTICE
The DC link bridges and the DC link busbars of the outside left components must not be removed.

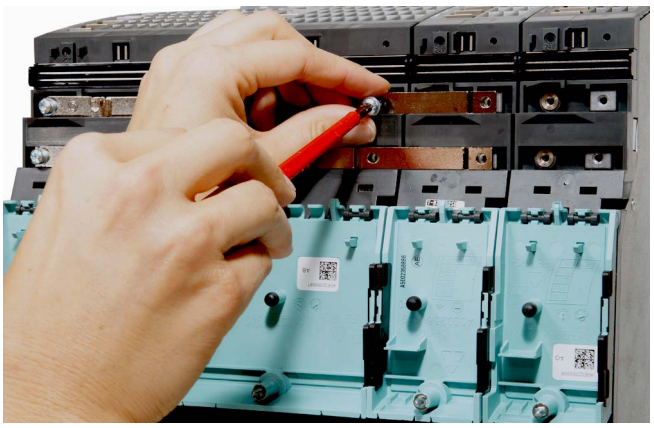
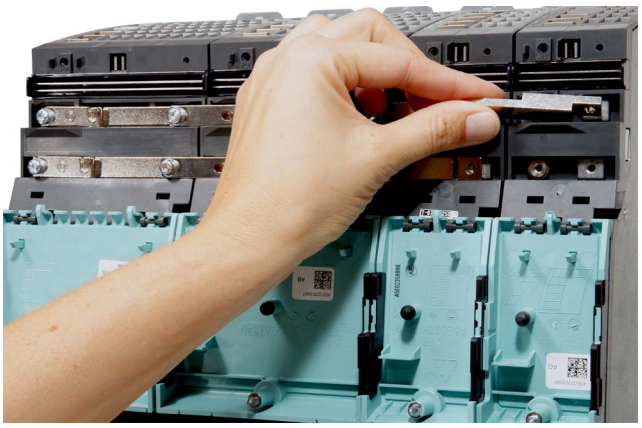
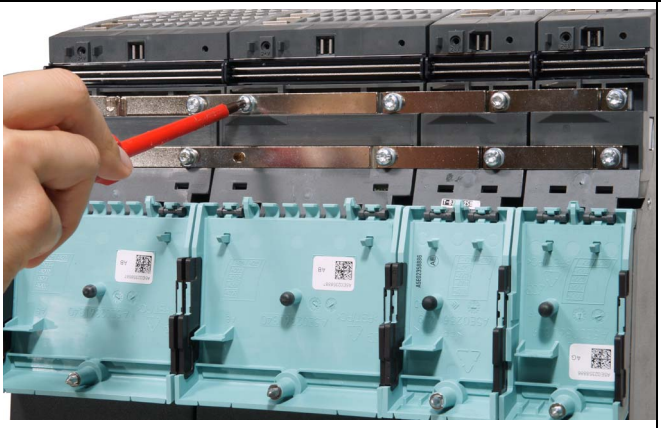
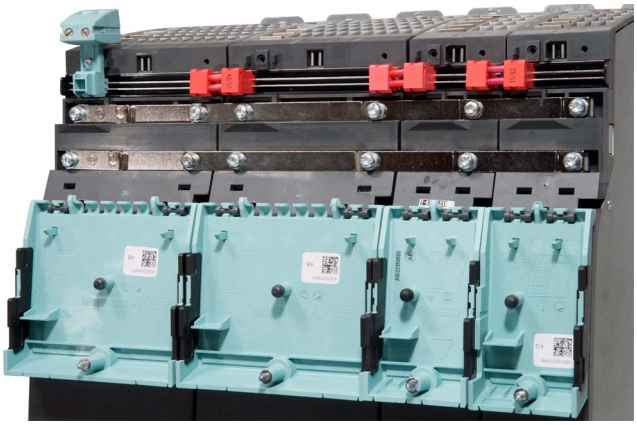
11.5.5 Mounting the reinforced DC link busbars

Required tools:

- Torx screwdriver T20 for DC link screws (Torx slot)

Table 11- 25 Installing the reinforced DC link busbars

	
Install the reinforced DC link busbars, starting on the left	
	
Insert the **long** DC link screws on the right of the first component; do not fully tighten the screws	Install the reinforced DC link busbars on the adjacent components.

	
Insert the **long** DC link screws on the right of the second component; do not fully tighten the screws	Insert the reinforced DC link busbars on the last components and fasten the **long** DC link screws
	
Fasten the **short** DC link screws on the left of the second component Tightly secure all the screws to 1.8 Nm +30%	View of the mounted reinforced DC link busbars with 24 V connectors and 24 V terminal adapter

Note

To connect the 24 V busbars of the individual components, please use the red 24 V connector in the accessories pack.

11.6 DRIVE-CLiQ cabinet bushing

11.6.1 Description

The DRIVE-CLiQ cabinet bushing is used in a control cabinet panel, and serves to connect the DRIVE-CLiQ cables between the inside and the outside of the control cabinet. The data lines and the voltage supply contacts of the DRIVE-CLiQ are also routed through the bushing.

The DRIVE-CLiQ cabinet bushing has degree of protection IP54 according to EN 60529 from the outside towards the inside. Inside the control cabinet, a connection is established according to degree of protection IP20 or IPXXB acc. to EN 60529. So that the complete outside of the cabinet bushing, including the DRIVE-CLiQ interface, has degree of protection IP54, a DRIVE-CLiQ cable must be used, which as a minimum must also have degree of protection IP54.

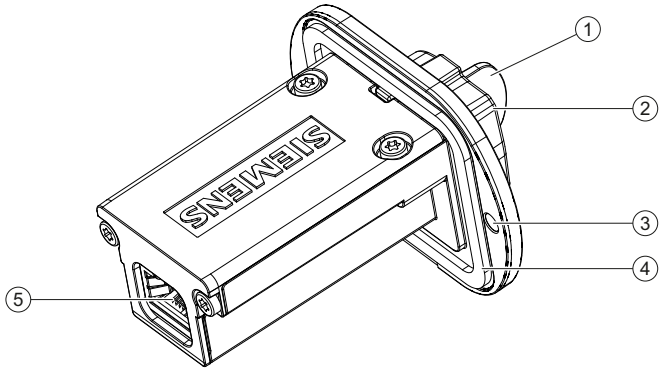
11.6.2 Safety Information

Note

Only cables from Siemens may be used for DRIVE-CLiQ connections.

11.6.3 Interface description

11.6.3.1 Overview



① Protective cap, Yamaichi, order number: Y-ConAS-24-S
② DRIVE-CLiQ interface on the outside (to connect DRIVE-CLiQ signal cables MOTION-CONNECT with IP67 degree of protection)
③ Mounting holes
④ Flange-type seal to ensure degree of protection IP54 on the outside of the control cabinet
⑤ DRIVE-CLiQ interface on the inside (to connect DRIVE-CLiQ signal cables MOTION-CONNECT with IP20 degree of protection)

Figure 11-27 Interface overview, DRIVE-CLiQ cabinet bushing

11.6.4 Dimension drawing

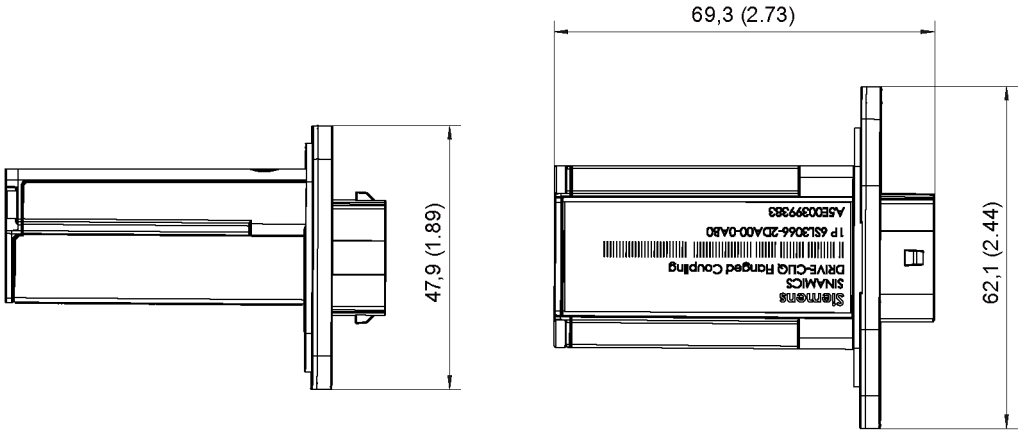


Figure 11-28 Dimension drawing of the DRIVE-CLiQ cabinet gland, all dimensions in mm and (inches)

11.6.5 Installation

In order to install the DRIVE-CLiQ cabinet gland, you must make a cutout in the control cabinet panel as shown in the diagram below.

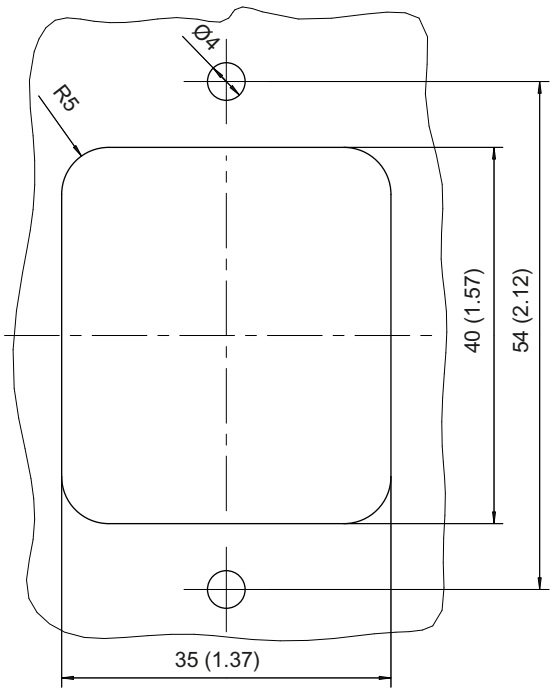
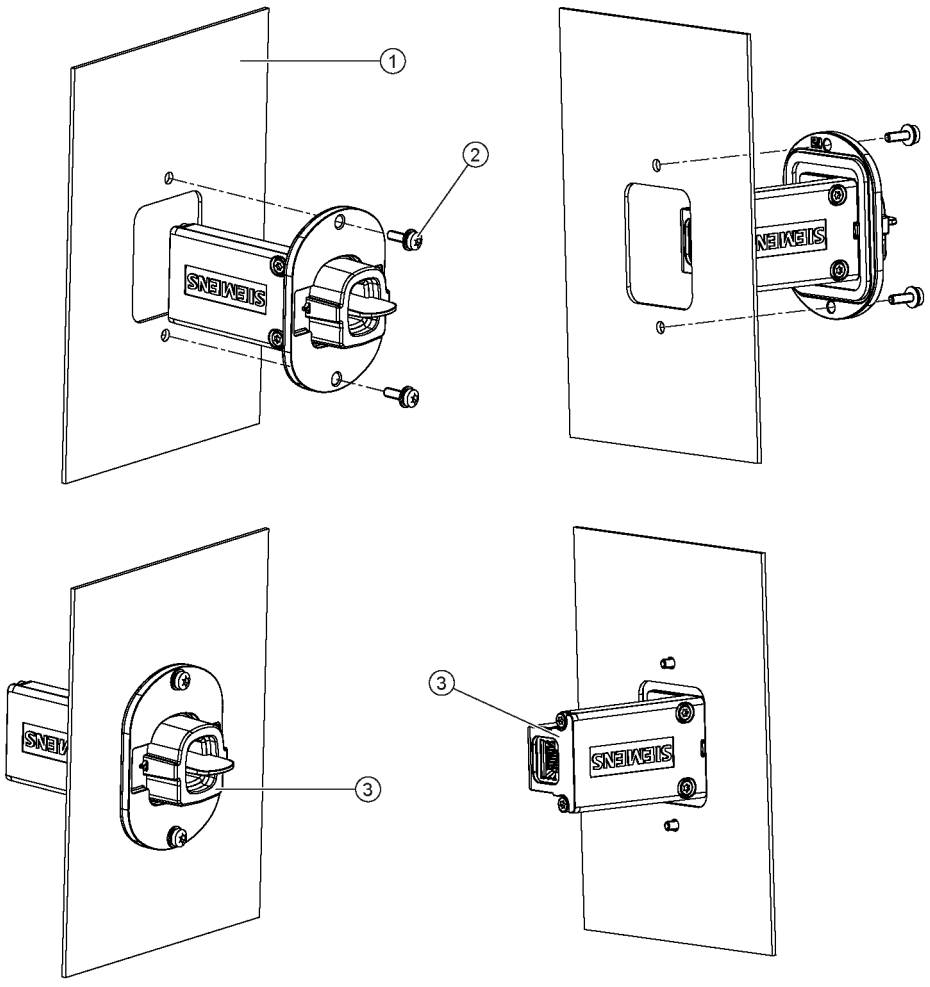


Figure 11-29 Cut-out for the cabinet

Installation

1. Insert the component from the outside of the control cabinet through the opening in the control cabinet.
2. Fix the DRIVE-CLiQ cabinet gland to the outer control cabinet panel using two M3 screws and two nuts. In order to ensure good electromagnetic compatibility, a good electrical connection must be established between the DRIVE-CLiQ cabinet gland and the cabinet panel over a large surface area.



① Control cabinet panel
② M3 screw, tightening torque 0.8 Nm
③ DRIVE-CLiQ cabinet gland

Figure 11-30 Installing the DRIVE-CLiQ cabinet gland

11.6.6 Technical data

Table 11- 26 Technical data

DRIVE-CLiQ cabinet bushing 6SL3066-2DA00-0AA0	Unit	
Weight	kg	0,165
Degree of protection	IP20 or IPXXB acc. to EN 60529 in the electrical cabinet IP54 to EN 60529 outside the electrical cabinet	

11.7 DRIVE-CLiQ coupling

11.7.1 Description

The DRIVE-CLiQ coupling is used to connect two DRIVE-CLiQ cables in accordance with degree of protection IP67 acc. to EN 60529.

In addition to the data lines, the power supply contacts of DRIVE-CLiQ are also routed via the coupling.

You can find information on the permissible cable length in the chapter "DRIVE-CLiQ signal cables".

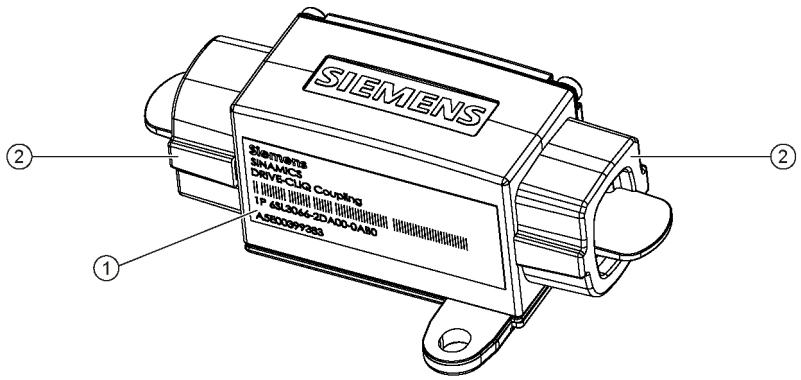
11.7.2 Safety information

Note

Only cables from Siemens may be used for DRIVE-CLiQ connections.

11.7.3 Interface description

11.7.3.1 Overview



① Rating plate
② Protective cap, Yamaichi, order number: Y-ConAS-24-S

Figure 11-31 Interface overview, DRIVE-CLiQ coupling

11.7.4 Dimension drawing

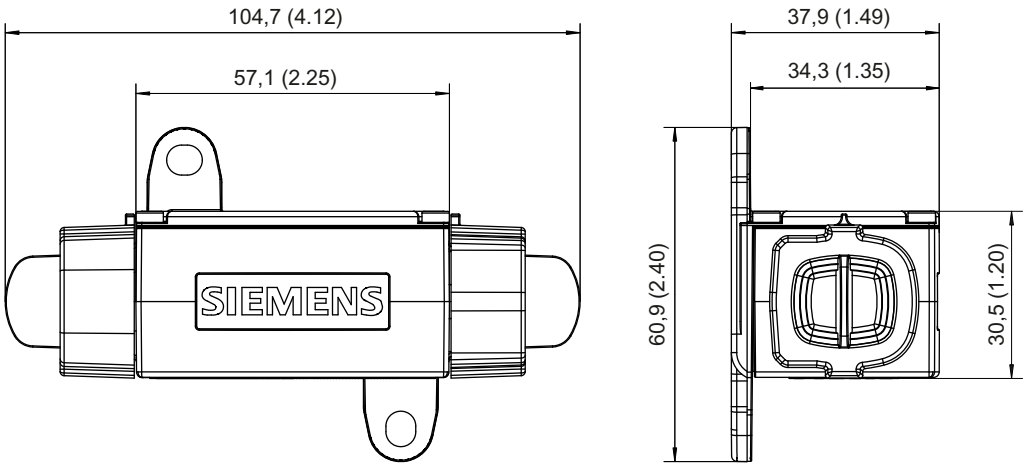
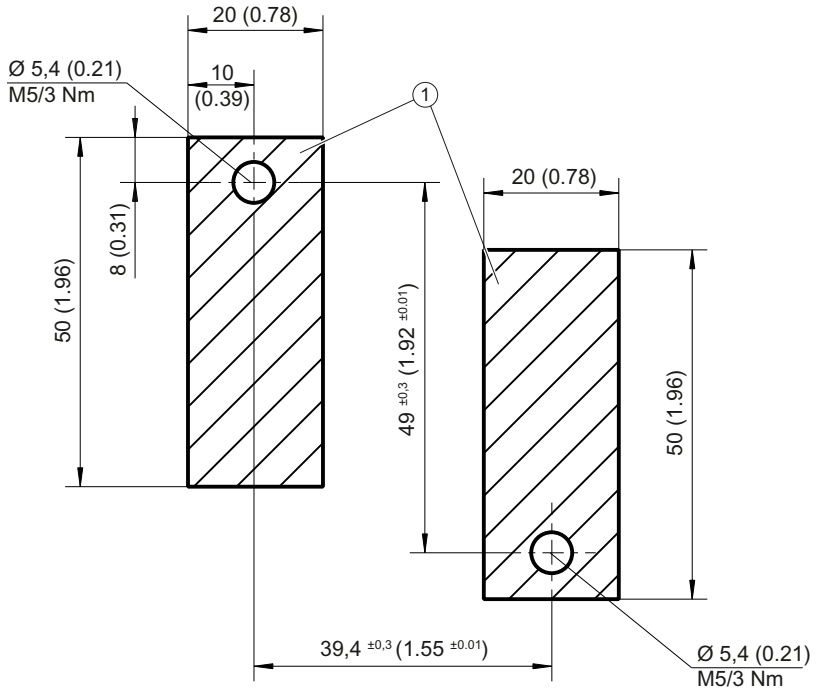


Figure 11-32 Dimension drawing of the DRIVE-CLiQ coupling, all dimensions in mm and (inches)

11.7.5 Installation



① Contact surface

Figure 11-33 Hole drilling pattern for installation

Installation

1. Attach the DRIVE-CLiQ coupling to the mounting surface as shown in the drilling pattern.
2. Remove the protective caps of the DRIVE-CLiQ coupling.
3. Latch the DRIVE-CLiQ connectors at both sides of the DRIVE-CLiQ coupling.

11.7.6 Technical data

Table 11- 27 Technical data

DRIVE-CLiQ coupling 6SL3066-2DA00-0AB0	Unit	
Weight	kg	0.272
Degree of protection	IP67 acc. to EN 60529	

11.8 Spacing bolt for booksize compact components

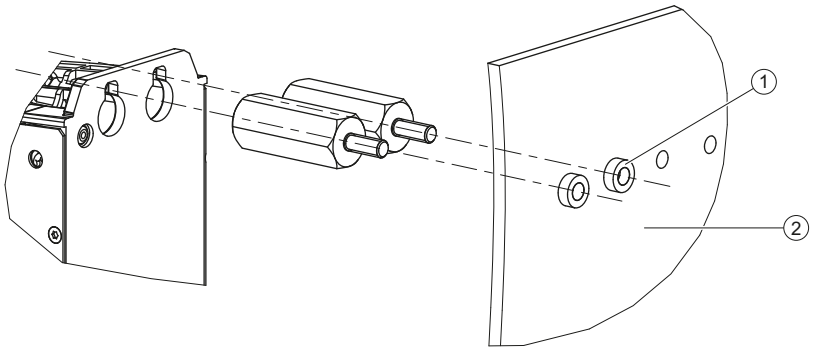
To increase the installation depth of modules in Booksize Compact format, use spacing bolts (order number: 6SL3462-1CC00-0AAx). In this way, it is possible to combine modules in Booksize Compact format directly with booksize modules with internal air cooling.

Table 11- 28 Number of spacing bolts and holes for various module widths

Module width in [mm]	Number of spacing bolts	Number of holes/press-in nuts
50	2	2
75	4	4
100	4	4

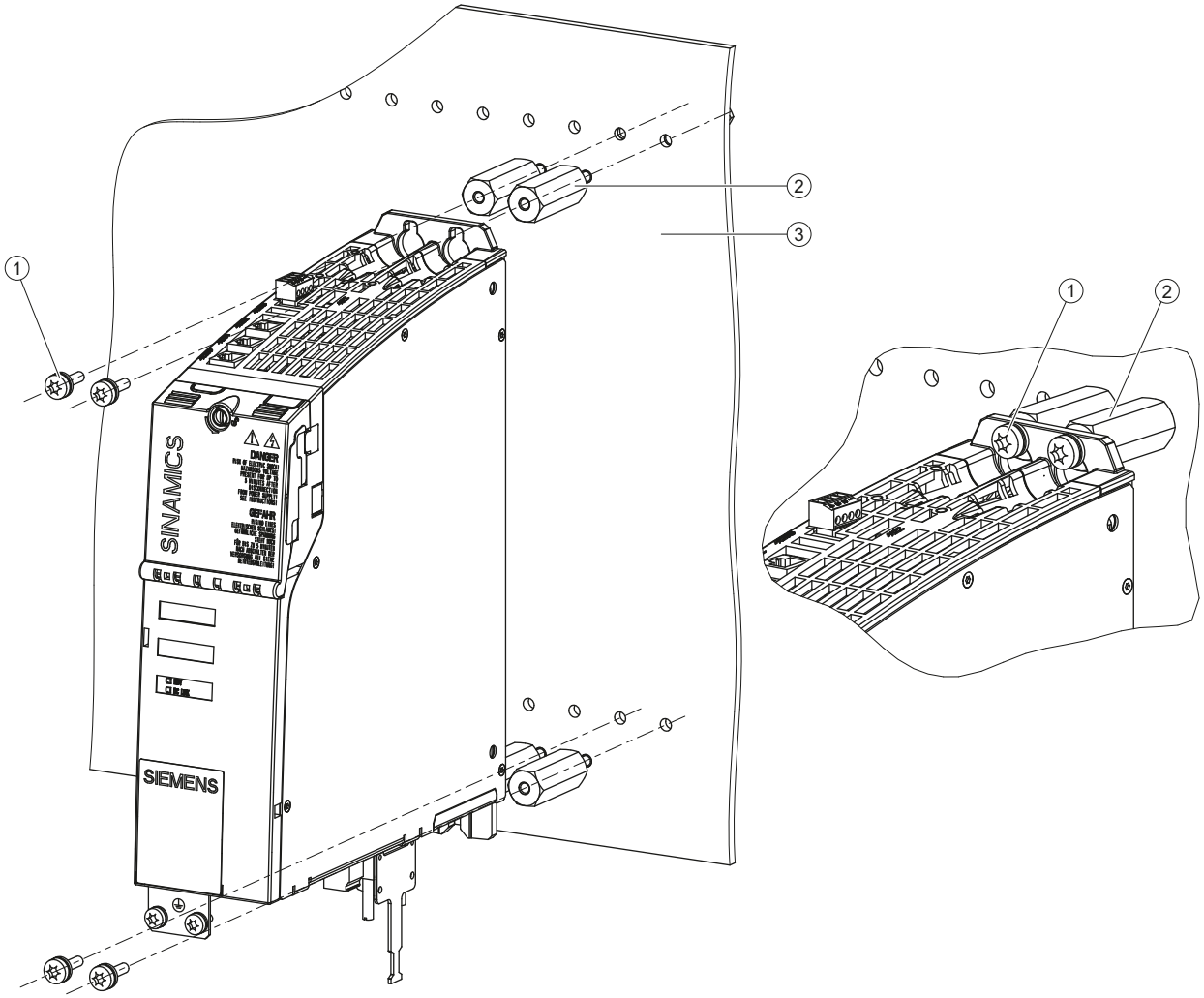
Preparing the mounting panel

- Inserting M6 press-in nuts into the mounting panel
- Distance 25 mm ± 0.15 mm for module width 75 mm
- Distance 50 mm ± 0.15 mm for module width 100 mm



1 M6 press-in nuts
2 Mounting wall

Figure 11-34 Installing the M6 press-in nuts on the rear of the mounting panel



1 M6 x 20 screw, Torx T27
2 Spacing bolts, SW 17 (6SL3462-1CC00-0AAx)
3 Mounting wall

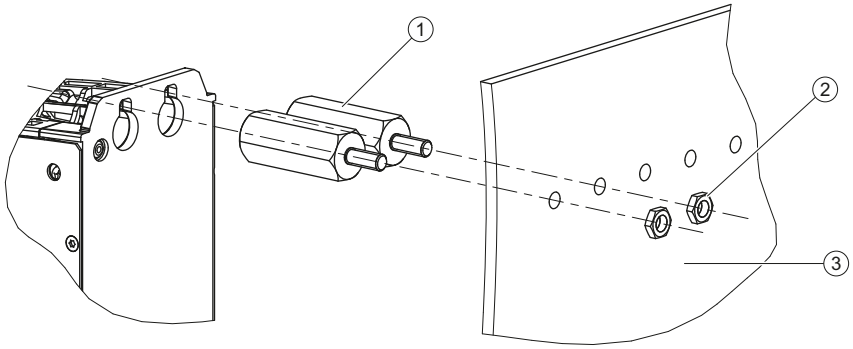
Figure 11-35 Installing a component in booksize compact format with spacing bolts (example: Motor Module booksize compact, 18 A)

Tightening torque: 6 Nm

As an alternative to press-in nuts, you can secure spacing bolts with M6 nuts to the rear of the mounting panel.

Preparing the mounting panel

- Drill Ø 6.5 mm holes for spacing bolts
- Distance 25 mm ± 0.15 mm for module width 75 mm
- Distance 50 mm ± 0.15 mm for module width 100 mm



1 Spacing bolt
2 M6 nuts
3 Mounting wall

Figure 11-36 Installing the spacing bolts with M6 nuts on the rear of the mounting panel

Tightening torque: 6 Nm

Cabinet design and EMC Booksize 12

12.1 General information

The SINAMICS S components are designed in accordance with degree of protection IP20 or IPXXB acc. to EN 60529 and as open-type devices to UL 50. This ensures protection against electric shocks.

To ensure protection against mechanical stress and climatic conditions too, the components should only be operated in housing, cabinets or enclosed electrical operating areas that fulfill at least degree of protection IP54 and, as enclosure type 12, are designed to UL 50.

Prefabricated MOTION-CONNECT cables are recommended.

Note

Functional safety of SINAMICS components

The components must be protected against conductive pollution (e.g. by installing them in a cabinet with degree of protection IP54B acc. to EN 60529. Provided that conductive pollution can be prevented at the installation site, the degree of protection for the cabinet can be decreased accordingly.

Installation in a cabinet with degree of protection IP54B according to EN 60529 is advisable to ensure the safety functions of Safety Integrated are not compromised.

Low-voltage switchgear and controlgear assemblies

If the SINAMICS S drive line-up is used for the electrical equipment of machines, the applicable requirements of EN 60204-1 must also be adhered to.

Safety of machinery

Electrical equipment of machines

All information for device selection in this section applies to

- Connected to TN and TT line supply systems with grounded neutral point and grounded protective conductor as well as to IT line supply systems.
- Operating voltage range from 360 V 3 AC to 440 V 3 AC

12.2 Safety information

CAUTION

The voltage drop between the start of the consumer's installation and the consuming equipment being supplied should generally not exceed 4% in operation with rated values.

The relevant tables in Supplement 5 of the standard DIN VDE 0100 should be consulted. The following note must be included in the technical user documentation: "The machine builder must ensure that the voltage drop between the start of the consumer's installation and the PDS does not exceed 4% when operating with rated values."

(VDE 0100-520)

Checking the documented development stipulations regarding the above requirement, implementation in the production documentation and execution in the device.

⚠DANGER

When installing the cabinet, you must cover the ventilation slots to prevent drill swarf, wire end ferrules, and so on from falling into the housing, which could result in short-circuits or damage the insulation.

Safety regulations governing shock protection must be observed. See also EN 60204-1.

⚠DANGER

Only motors with a safe electrically isolated holding brake may be connected. The brake conductors must also be safely electrically isolated.

If the motor power cable is connected to intermediate terminals, the power cables and brake cables must be routed apart (≥ 300 mm).

⚠WARNING

Cable shields and unused conductors of power cables (e.g. brake conductors) must be connected to PE potential.

If this is not carefully observed, lethal shock voltages could result.

⚠WARNING

If static discharge occurs on surfaces or interfaces that cannot be easily accessed, this can cause malfunctions and/or defects.

CAUTION

The correct tightening torque of the DC-link busbar screws (1.8 Nm) must be checked before commissioning.

To ensure that the encoder system works properly, you are advised to use the original Siemens accessories from catalog PM21 or NC61.

⚠ DANGER

To protect against electric shock the components should only be operated in closed electrical operating areas or in cabinets. Furthermore, an internal protective conductor connection of the components is absolutely essential.

The components generate high leakage currents in the protective conductor. In order to ensure protection against electric shocks if the external protective conductor is interrupted, one of the following measures must be implemented for the external connection:

- Fixed connection and protective conductor connection by means of ≥ 10 mm^2 Cu or ≥ 16 mm^2 Al
- Fixed connection and automatic disconnection of the supply system if the protective conductor is interrupted

12.3 Directives

The product satisfies the protection targets of the following EU Directives applicable within the European Economic Area (EEA):

Table 12- 1 Directives

Directive	Description
2006/95/EC	Directive of the European Parliament and Council of December 12, 2006, on the approximation of the laws of the member states relating to electrical equipment designed for use within certain voltage limits (Low-Voltage Directive).
2004/108/EC	Directive of the European Parliament and Council of December 15, 2004, which repeals directive 89/336/EEC, on the approximation of laws of the member states relating to electromagnetic compatibility (EMC Directive).

12.4 Notes on electromagnetic compatibility (EMC)

Requirements to implement the EMC are listed in EN 61000-6-2, EN 61000-6-4, EN 61800-3, EN 60204-1 and in the Configuration Manual, EMC installation guideline (order number 6FC5297-0AD30-0□P□). Conformance with the EMC Directive of the EC can be ensured by following the measures described in the Configuration Manual, EMC installation guideline. When mounting components in cabinets, in order to fulfill the EMC Directive, the following conditions must be additionally observed:

- Connected to TN and TT supply systems with grounded neutral point and grounded line conductor as well as to IT supply systems.
- Observance of information about cable shielding and equipotential bonding.
- Only the recommended power and signal cables from Siemens are used
- Only cables from Siemens may be used for DRIVE-CLiQ connections.

CAUTION

If couplings or cabinet glands are needed for the DRIVE-CLiQ connections, only the DRIVE-CLiQ coupling and DRIVE-CLiQ cabinet gland, described in the Chapter Accessories, may be used.

⚠ WARNING

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

12.5 Cable Shielding and Routing

In order to comply with the EMC requirements, certain cables must be routed apart from other cables and from certain components. To full EMC requirements, the following cables must be used with shields:

- Line supply conductors from line filter via line reactor to Line Module
- All motor cables (if necessary, including cables for motor holding brake)
- Cables for "fast inputs" of the Control Unit
- Cables for analog direct voltage/current signals
- Signal cables for sensors
- Cables for temperature sensors

Alternative measures (e.g. routing behind mounting plates, suitable clearances) can also be used provided they have similar results. This excludes measures that relate to the design, installation, and routing of motor power cables and signal cables.

If unshielded cables are used between the line supply connection point and line filter, make sure that no interfering cables are routed in parallel.

Power and signal cables must always be routed separately. For this purpose, it is practical to arrange the various cables according to cable groups. Cables belonging to a group can be combined in a bundle. The various cable groups must be routed with the necessary clearance between them. A minimum clearance of 20 cm has proven itself in practice. As an alternative, shielding plates with the appropriate contacts at several locations can be used between the cable bundles.

All cables inside the cabinet must be routed as closely as possible to parts connected with cabinet ground, such as a mounting plate or cabinet wall. Ducts made of sheet steel or cables routed between steel sheets (e.g. between the mounting plate and back wall) should provide adequate shielding.

All cables must be kept as short as possible, to minimize the antenna effect.

Signal and power cables may cross each other (if absolutely necessary), but must never be routed closely to one and other in parallel over longer distances.

Signal cables must be routed with a minimum clearance of 20 cm from strong magnetic fields (motors, transformers). Alternatively, shield plates with the appropriate contacts at several locations along their length can be used to provide be appropriate clearance.

Note: Cables for the 24 V supply should be treated just like signal cables.

Avoid, where possible, routing unshielded cables, connected to the drive line-up, in the immediate vicinity of noise sources, e.g. transformers. Signal cables (shielded and unshielded) connected to the drive line-up must be laid at a great distance from strong external magnetic sources (e.g. transformers, line reactors). In both cases, a distance of ≥ 300 mm is usually sufficient.

⚠ DANGER

A suitable PE conductor must be connected to all devices in protection class I. The protective conductor connection of the individual components must be at least 4 mm².

Shield connection

The cable shields must be connected as close to the conductor terminal connections as possible to ensure a low-impedance connection with cabinet ground. For power cables from Siemens in which the shield is connected to the connector shell (see relevant catalog), this is a sufficiently good shield support.

With components that do not have any special shield connection or where the shield connection is not sufficient, the cable shields can be connected to the metal mounting plate using hose clamps and toothed rails. The cable length between the shield contact point and the terminals for cable conductors must be kept as short as possible.

Shield contact plates with pre-prepared clip contacts are available for contacting the shields for power cables of Line Modules and Motor Modules. Up to a module width of 100 mm (inclusive), these plates are part of the scope of delivery of the components, or they are integrated in the connector.

Routing 24 V cables

When routing 24 V cables, the following must also be observed:

- A maximum of 1 conductor pair may be bundled together.
- 24 V conductors must be routed separately from other cables and conductors that could carry the operating current.
- 24 V cables must never be routed parallel to power cables.
- 24 V cables as well as power cables should be routed to the components so that they never cover ventilation slots

Conditions of use for 24 V cables

- Ambient temperature 55 °C
- Limit conductor temperature, ≤ 70 °C for operation with the rated load current
- Cable length max.:
  - 10 m for the 24 V supply cables
  - 30 m for signal cables without a supplementary RC circuit

12.6 24 V DC supply voltage

12.6.1 General

The 24 VDC voltage is required for the power supply of:

1. the electronics of the SINAMICS components using the integrated 24 V busbar
2. The electronics of the Control Units, Option Boards, Sensor Modules, and Terminal Modules, as well as the process voltage of their digital inputs
3. The load voltage of the digital outputs
4. The motor holding brakes

Other loads can be connected to these power supply units if they are separately protected from overcurrent.

Note

The electronics power supply has to be supplied by the user as described in the System Data chapter of this documentation.

When connecting a DC power supply as specified in EN 60204-1:1997, sect. 4.3.3, malfunctions may occur due to the voltage interruptions permitted for them.

⚠ DANGER

Only motors with a safe electrically isolated holding brake may be connected. The brake conductors must also be safely electrically isolated.

If the motor power cable is connected to intermediate terminals, the power cables and brake cables must be routed apart (≥ 300 mm).

⚠ DANGER

Only protective extra-low voltages (DVC A) that comply with EN 61800-5-1 must be connected to the connections and terminals between 0 V and 48 VDC.

The voltage tolerances of the motor holding brakes (24 V ± 10%) must be taken into account.

NOTICE

If other consumers are connected to the power supply, connected inductance devices (contactors, relays) must be fitted with suitable overvoltage protection circuits.

Note

A regulated DC power supply is required to operate motors with a built-in holding brake. The voltage is supplied via the internal 24 V busbars. The voltage tolerances of the motor holding brakes (24 V ± 10%) and the voltage drops of the connection cables must be taken into account.

The DC power supply should be set to 26 V. The Control Supply Module supplies 26 V. This ensures that the supply voltage for the brake remains within the permissible range when the following conditions are fulfilled:

- Use of Siemens three-phase motors
- Use of Siemens MOTION-CONNECT power cables
- Motor cable lengths: max. 100 m

12.6.2 24 V power supply and 24 V connection of components

The Line Modules, Motor Modules, and DC-link components are connected to the 24 V DC power supply via the integrated 24 V DC busbars. The current carrying capacity of these busbars is 20 A.The 24 V infeed can be realized in two ways:

1. Using a Control Supply Module

When a Current Supply Module is used, the 24 V DC supply can be directly established through the busbars. The electronic current limiting function integrated in the Control Supply Module protects the busbar system when a fault occurs. Additional loads can be connected via the 24 V terminal adapter.

Note

When using cables with a cross-section of 2.5 mm², no additional protection is required on the 24 V side if a type XLPE or EPR cable is used, or a cable with a similar quality and with a thermal stability of up to 90 °C.

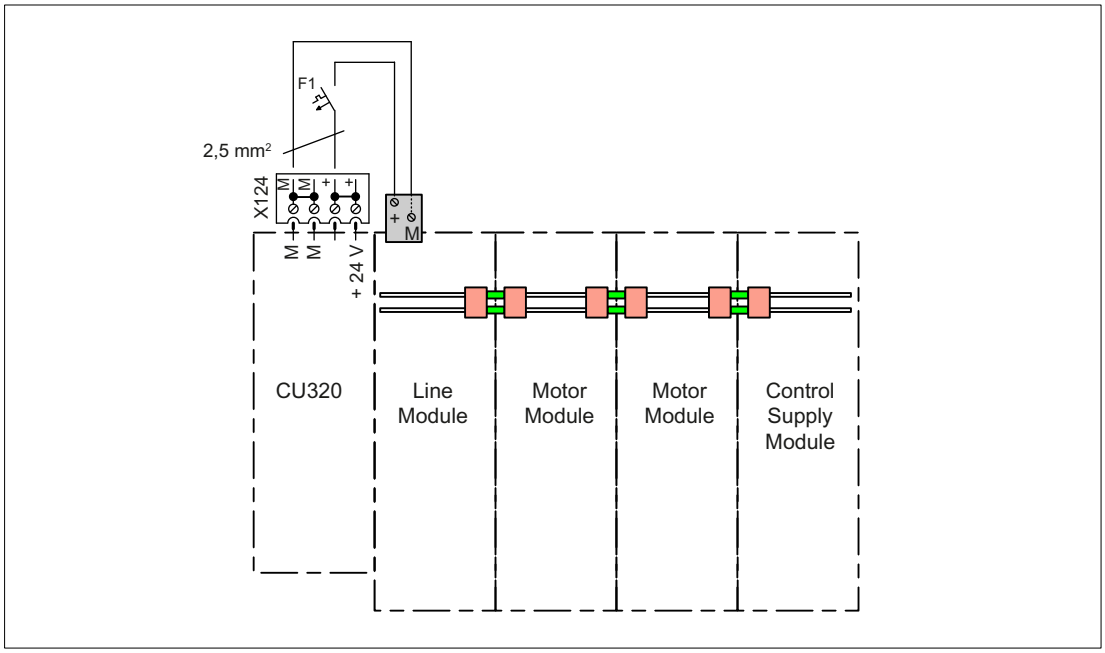


Figure 12-1 Example of a 24 V supply with Control Supply Module

2. Using an external 24 V power supply

When using an external 24 V power supply, e.g. SITOP, the 24 V terminal adapter must be used. The external power supply should be located very close to the load (max. cable length 10 m). We recommend using miniature circuit breakers with tripping characteristic D as overcurrent protection devices for the cables and busbars. The ground potential M must be connected to the protective conductor system (DVC A).

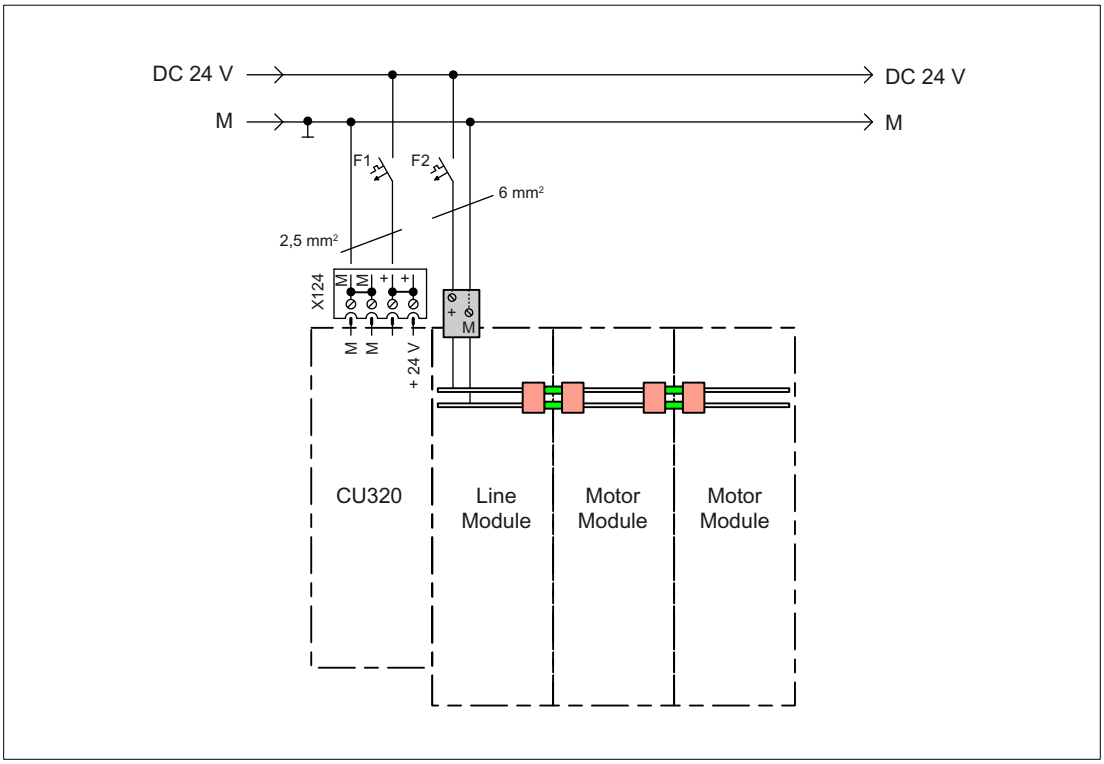


Figure 12-2 Example of an external 24 V power supply

Using the red 24 V connectors

- A 24 V connector must be plugged onto the 24 V busbar between each of the Line Module, Motor Module and DC-link component.
- Attachment and removal are only permissible in a de-energized state
- A maximum of 5 attachment and removal cycles are permissible.

Note

The red 24 V connectors must be attached before the drive line-up is put into operation.

12.6.3 Overcurrent protection

The cables on the primary and secondary sides of the 24 V supply unit must be protected against overcurrent.

Primary side protection must be implemented according to the manufacturer's instructions.

Secondary side protection depends on the prevailing situation. Please note the following:

- Loading due to loads, including simultaneity factor depending on machine operation
- Current carrying capacity of the conductors used and cables in normal and short-circuit conditions
- Ambient temperature
- Cable bundling (laying cables in a common duct)
- Cable routing method according to EN 60204-1

The overcurrent protection devices can be determined according to EN 60204-1, Section 14.

Circuit breakers from the Siemens NSK catalog are recommended as overcurrent protection devices on the primary side.
Miniature circuit breakers or SITOP select (order number 6EP1961-2BA00) are recommended as overcurrent protection devices on the secondary side. The MCBs can be selected according to Siemens catalog "BETA Modular Installation Devices - ET B1".

When selecting the miniature circuit breaker, the following standards must be carefully observed:

- EN 61800-5-1
- EN 60204-1
- IEC 60364-5-52
- IEC 60287-1 to -3
- EN 60228
- UL 508C

Table 12- 2 MCBs by conductor cross-section and temperature

Conductor cross-section	Max. value up to 40 °C	Max. value up to 55°C
1.5 mm^2	10 A	6 A
2.5 mm^2	16 A	10 A
4 mm^2	25 A	16 A
6 mm^2	32 A	20 A
24 V busbar	20 A	20 A

The trip characteristic of the MCBs must be selected to match the loads to be protected and the max. current provided by the power supply unit in the event of a short-circuit.

12.6.4 Overvoltage protection

Overvoltage protection devices are needed if long cables are used.

- Supply cables > 10 m
- Signal cables > 30 m

The following Weidmüller overvoltage protectors are recommended for protecting the components' 24 V power supply and the 24 V signal cables from overvoltage:

Table 12- 3 Recommendations for overvoltage protection

DC power supply	24 V signal cables
Weidmüller Item no.: PU III R 24V Order number: 8860360000	Weidmüller Item no.: MCZ OVP TAZ Order number: 844915 0000

The overvoltage protection components must always be placed next to the area to be protected, e.g. at the entry point to the control cabinet. All 24 V cables which exit the protected area must be routed through an overvoltage protection element.
The diagram below uses a CU320-2 DP as an example to show how the overvoltage protection components are connected.

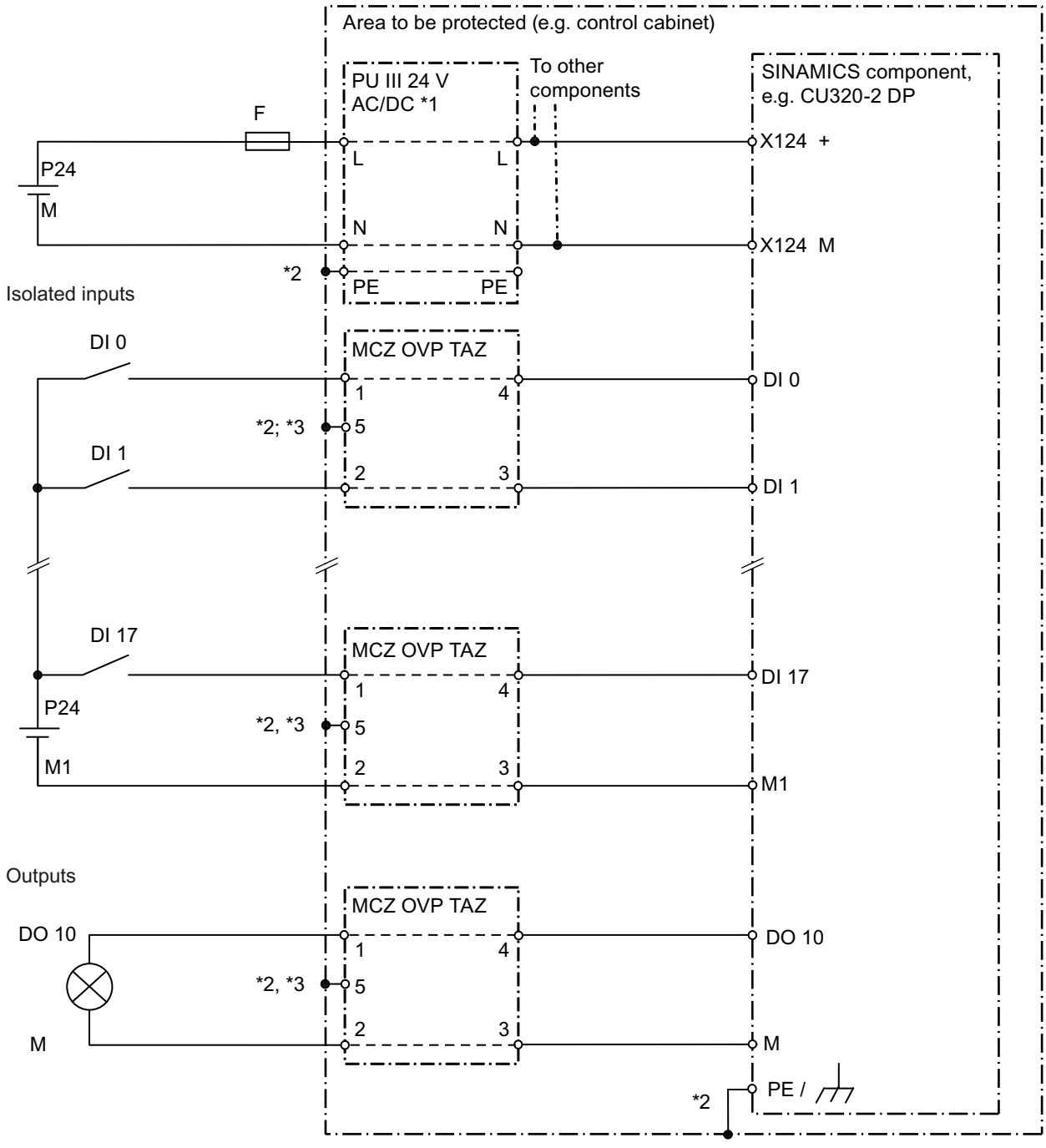


Figure 12-3 Connection example: Overvoltage protection components from Weidmüller to SINAMICS components

*1 Terminals 11, 12, 14 of the "PU III 24 VAC/DC" are isolated monitoring contacts (11 C, 12 NC, 14 NO). In the case of a thermal overload of the varistor installed, contacts 11-12 are opened and contacts 11-14 are closed.

*2 The metallic enclosure of the SINAMICS components and the PE connection of the overvoltage protector must be interconnected in a manner that ensures good conductivity (equipotential bonding). This can be achieved by installing the SINAMICS components on a metallic mounting plate and connecting the PE connections of the overvoltage protectors as directly as possible to the mounting plate.

*3 Snap the overvoltage protector (MCZ OVP TAZ) onto the metallic DIN rail to make the PE connection (terminal 5) to the rail. It is then sufficient to make a good conductive interconnection between the DIN rail and the metallic enclosure of the SINAMICS component (equipotential bonding). This is the case when both the DIN rail and the SINAMICS component are mounted on a common metallic mounting plate.

12.6.5 Typical 24 V current consumption of the components

A separate 24 V power supply must be used for the SINAMICS S120 drive line-up.

The following table can be used to calculate the 24 VDC power supply. The values for typical current consumption are used as a basis for configuration.

Table 12- 4 Overview of 24 V DC current consumption

Component	Typical current consumption [A_{DC}]
Control Units	
CU320 without load	0.8
Per digital output PROFIBUS teleservice	0.1 Max. 0.15
CU320-2 DP without load	1.0
Per digital output	0.1
Sensor Modules Cabinet	
SMC10 without/with encoder system	0.20 / 0.35
SMC20 without/with encoder system	0.20 / 0.355
SMC30 without/with encoder system	0.20 / 0.55
Sensor Modules External	
SME20 without/with encoder system	0.15 / 0.25
SME25 without/with encoder system	0.15 / 0.25
SME120 without/with encoder system	0.20 / 0.30
SME125 without/with encoder system	0.20 / 0.30
Terminal Modules	
TM15 (without digital outputs, without DRIVE-CLiQ)	0.2
Per digital output/DRIVE-CLiQ	0.5
TM17 (without digital outputs, without DRIVE-CLiQ)	0.2
Per digital output/DRIVE-CLiQ	0.5
TM31 (without digital outputs, without DRIVE-CLiQ)	0.2
Σ of all digital outputs	0.1/1 (with switchover to current limitation)
Per DRIVE-CLiQ	0.5
TM41 (without digital outputs, without DRIVE-CLiQ)	0.2
Per digital output/DRIVE-CLiQ	0.5
TM54F (without digital outputs, without DRIVE-CLiQ)	0.2
Per digital output/DRIVE-CLiQ	0.5

Component	Typical current consumption [A_{DC}]
Additional system components	
TB30 (without digital outputs) Per digital output	< 0.05 0.1
DMC20 (without DRIVE-CLiQ) Per DRIVE-CLiQ	0.15 0.5
DME20 (without DRIVE-CLiQ) Per DRIVE-CLiQ	0.15 0.5
VSM10 (without DRIVE-CLiQ) DRIVE-CLiQ	0.2 0.5
CBC10	0.1
CBE20	
Active Interface Modules	
16 kW	0.25
36 kW	0.49
55 kW	1.2
80 kW	1.2
120 kW	1.2
Active Line Modules (internal/external air cooling)	
16 kW	1.1
36 kW	1.5
55 kW	1.9
80 kW	1.7
120 kW	2.1
Active Line Modules (cold plate cooling)	
16 kW	0.9
36 kW	1.0
55 kW	1.4
80 kW	1.7
120 kW	2.1
Smart Line Modules (internal/external air cooling)	
5 kW	1.0
10 kW	1.3
16 kW	1.1
36 kW	1.5
Smart Line Modules (cold plate cooling)	
5 kW	0.7
10 kW	0.8
Smart Line Modules Booksize Compact	
16 kW (internal air cooling)	1.1
16 kW (cold plate cooling)	0.9

Component	Typical current consumption [A_{DC}]
Basic Line Modules (internal/external air cooling)	
20 kW	1
40 kW	1.4
100 kW	2
Basic Line Modules (cold plate cooling)	
20 kW	0.9
40 kW	1.1
100 kW	1.6
DRIVE-CLiQ and brake	
DRIVE-CLiQ (e.g. motors with DRIVE-CLiQ interface)	0.19
Brake (e.g. motor holding brake)	Typ. 0.4 to 1.1; max. 2
Single Motor Modules (internal/external air cooling)	
3 A (+1 x DRIVE–CLiQ; +1 x brake)	0.85
5 A (+1 x DRIVE–CLiQ; +1 x brake)	0.85
9 A (+1 x DRIVE–CLiQ; +1 x brake)	0.85
18 A (+1 x DRIVE–CLiQ; +1 x brake)	0.85
30 A (+1 x DRIVE–CLiQ; +1 x brake)	0.9
45 A (+1 x DRIVE–CLiQ; +1 x brake)	1.2
60 A (+1 x DRIVE-CLiQ; +1 x brake)	1.2
85 A (+1 x DRIVE–CLiQ; +1 x brake)	1.5
132 A (+1 x DRIVE–CLiQ; +1 x brake)	1.2
200 A (+1 x DRIVE–CLiQ + 1 x brake)	1.2
Single Motor Modules (cold plate cooling)	
3 A (+1 x DRIVE–CLiQ; +1 x brake)	0.7
5 A (+1 x DRIVE–CLiQ; +1 x brake)	0.7
9 A (+1 x DRIVE–CLiQ; +1 x brake)	0.7
18 A (+1 x DRIVE–CLiQ; +1 x brake)	0.7
30 A (+1 x DRIVE–CLiQ; +1 x brake)	0.7
45 A (+1 x DRIVE–CLiQ; +1 x brake)	0.8
60 A (+1 x DRIVE–CLiQ; +1 x brake)	0.8
85 A (+1 x DRIVE–CLiQ; +1 x brake)	1.0
132 A (+1 x DRIVE–CLiQ; +1 x brake)	1.2
200 A (+1 x DRIVE–CLiQ; +1 x brake)	1.2
Single Motor Modules Booksize Compact (internal air cooling)	
3 A (+1 x DRIVE–CLiQ; +1 x brake)	0.75
5 A (+1 x DRIVE–CLiQ; +1 x brake)	0.75
9 A (+1 x DRIVE–CLiQ; +1 x brake)	0.75
18 A (+1 x DRIVE–CLiQ; +1 x brake)	0.75

Component	Typical current consumption [A_{DC}]
Single Motor Modules Booksize Compact (cold plate)	
3 A (+1 x DRIVE–CLiQ; +1 x brake)	0.65
5 A (+1 x DRIVE–CLiQ; +1 x brake)	0.65
9 A (+1 x DRIVE–CLiQ; +1 x brake)	0.65
18 A (+1 x DRIVE–CLiQ; +1 x brake)	0.65
Double Motor Modules (internal and external air cooling)	
2 x 3 A (+2 x DRIVE–CLiQ; +2 x brake)	1.15
2 x 5 A (+2 x DRIVE–CLiQ; +2 x brake)	1.15
2 x 9 A (+2 x DRIVE–CLiQ; +2 x brake)	1.15
2 x 18 A (+2 x DRIVE–CLiQ; +2 x brake)	1.3
Double Motor Modules (cold plate)	
2 x 3 A (+2 x DRIVE–CLiQ; +2 x brake)	1.0
2 x 5 A (+2 x DRIVE–CLiQ; +2 x brake)	1.0
2 x 9 A (+2 x DRIVE–CLiQ; +2 x brake)	1.0
2 x 18 A (+2 x DRIVE–CLiQ; +2 x brake)	1.15
Double Motor Modules Booksize Compact	
2 x 1.7 A (+2 x DRIVE–CLiQ; +2 x brake)	1
2 x 3 A (+2 x DRIVE–CLiQ; +2 x brake)	1
2 x 5 A (+2 x DRIVE–CLiQ; +2 x brake)	1
Braking Module	0.5

If no other specifications are made to the contrary, the Line Modules and Motor Modules listed here are components in booksize format.

Example: calculating 24 V current requirements

Table 12- 5 Example of 24 V DC current requirements

Component	Quantity	Current consumption [A]	Total current consumption [A]
CU320	1	0.8	0.8
8 digital outputs	8	0.1	0.8
Active Line Module 36 kW	1	1.5	1.5
Motor Module 18 A	2	0.85	1.7
Motor Module 30 A	3	0.9	2.7
Encoders	5	0.25	1.25
Brake	5	1.1	5.5
Total:			14.25

12.6.6 Selecting power supply units

You are advised to use the devices in the following table. These devices meet the applicable requirements of EN 60204-1.

Table 12- 6 Recommended SITOP Power

Rated output current [A]	Phases	Rated input voltage [V] Working voltage range [V]	Short-circuit current [A]	Order number
5	1 / 2	120 - 230/230 - 500 85 - 264/176 - 550 AC	Approx. 5.5 (power up), typ. 15 for 25 ms (operation)	6EP1333-3BA00-8AC0
10	1 / 2	120 - 230/230 - 500 85 - 264/176 - 550 AC	Approx. 12 (power up), typ. 30 for 25 ms (operation)	6EP1334-3BA00-8AB0
20	1 / 2	120/230 85 - 132/176 - 264 AC	Approx. 23 (power up), typ. 60 for 25 ms (operation)	6EP1336-3BA00-8AA0
	3	230/400 to 288/500 320 - 550 3 AC		6EP1436-3BA00-8AA0
40	1 / 2	120/230 85 - 132/176 - 264 AC	Approx. 46 (power up), typ. 120 for 25 ms (operation)	6EP1337-3BA00-8AA0
	3	230/400 to 288/500 320 - 550 3 AC		6EP1437-3BA00-8AA0

Table 12- 7 Recommendation for Control Supply Module

Rated output current [A]		Input voltage range [V]	Short-circuit current [A]	Order number
20	3	380 V 3 AC -10% (-15% < 1 min) to 480 V 3 AC+10% DC 300 – 800	< 24	6SL3100-1DE22-0AAx

Refer also to Catalog PM21 or NC61.

⚠ WARNING

When using external power supplies, e.g. SITOP, the following points must be observed:

- The ground potential M must be connected to the protective conductor terminal (DVC A).
- The power supply must be installed close to the drive line-up.

Ideally, they should be installed on a common mounting plate. If different mounting plates are used, their electrical interconnection must comply with the EMC installation guideline.

This installation guideline covers protection against electric shock, protection against fire, and best possible electromagnetic compatibility.

12.7 Connection systems

12.7.1 DRIVE-CLiQ signal cables

12.7.1.1 Cable lengths and types

DRIVE-CLiQ signal cables without 24 V DC cores

DRIVE-CLiQ signal cables without 24 V DC cores are used to connect components with DRIVE-CLiQ connection, which have a separate or external 24 V DC power supply.

Table 12- 8 Cable lengths for Line Modules and Motor Modules

DRIVE-CLiQ bridge	Cable length L 1)
50 mm	110 mm
100 mm	160 mm
150 mm	210 mm
200 mm	260 mm
250 mm	310 mm
300 mm	360 mm
350 mm	410 mm

1) Cable length without connector

Cable lengths from 600 mm and higher are used to connect to other applications (e.g. establish a 2nd line in the drive line-up, establish wiring in a star configuration etc.)

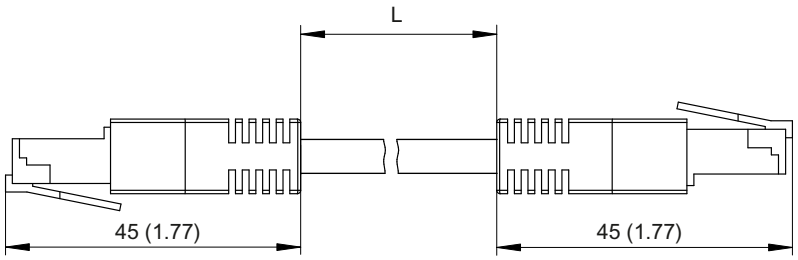


Figure 12-4 DRIVE-CLiQ signal cables without 24 V DC cores

MOTION-CONNECT DRIVE-CLiQ signal cables

MOTION-CONNECT DRIVE-CLiQ signal cables have 24 V DC cores. They are used if higher requirements apply to components with DRIVE-CLiQ connection, such as mechanical stress and oil resistance. For example, they are used for the connection between Motor Modules and motors with DRIVE-CLiQ interface.

The maximum length of the DRIVE-CLiQ MOTION-CONNECT signal cables is:

- 100 m for MOTION-CONNECT 500 cables
- 75 m for MOTION-CONNECT 800PLUS cables

Comparison of DRIVE-CLiQ signal cables

Table 12- 9 Properties of the various DRIVE-CLiQ signal cables

DRIVE-CLiQ signal cable	DRIVE-CLiQ	DRIVE-CLiQ MOTION-CONNECT 500	DRIVE-CLiQ MOTION-CONNECT 800PLUS
Approvals			
VDE cURus or UR/CSA UR-CSA File No. 1) in conformance with RoHS	Yes UL STYLE 2502/CSA-N.210.2-M90 Yes Yes	Yes UL STYLE 2502/CSA-N.210.2-M90 Yes Yes	Yes UL STYLE 2502/CSA-N.210.2-M90 Yes Yes
Rated voltage V_0/V in accordance with EN 50395	30 V	30 V	30 V
Test voltage, rms	500 V	500 V	500 V
Operating temperature at the surface			
Permanently installed Moveable	-20 to +80 °C -	-20 to +80°C 0 to 60°C	-20 to +80°C -20 to +60°C
Tensile load, max.			
Permanently installed Moveable	45 N/mm² –	80 N/mm² 30 N/mm²	50 N/mm² 20 N/mm²
Smallest bending radius			
Permanently installed Moveable	50 mm -	35 mm 125 mm	35 mm 75 mm
Torsional stress	-	30°/m absolute	30°/m absolute
Bending operations	-	100000	10 million
Max. traversing speed	-	30 m/min	300 m/min
Max. acceleration	-	2 m/s²	50 m/s² (3 m traversing distance) 2)
insulation material	CFC/silicone-free	CFC/silicone-free	CFC/halogen/silicone-free IEC 60754-1 / DIN VDE 0472-815
Oil resistance	EN 60811-2-1	EN 60811-2-1 (mineral oil only)	EN 60811-2-1
Protective jacket	PVC Gray RAL 7032	PVC DESINA color green RAL 6018	PUR, HD22.10 S2 (VDE 0282, Part 10) DESINA color green, RAL 6018
Flame retardant	EN 60332-1-1 to 1-3	EN 60332-1-1 to 1-3	EN 60332-1-1 to 1-3

1) The File Number is printed on the cable jacket.

2) Characteristic curves for accelerating can be found in Catalog D31 in Chapter "MOTION-CONNECT connection system".

12.7.1.2 Combined use of MOTION-CONNECT 500 and MOTION-CONNECT 800PLUS

Use of DRIVE-CLiQ couplings

DRIVE-CLiQ couplings are used to combine MOTION-CONNECT 500 cables and MOTION-CONNECT 800PLUS cables. The maximum permissible cable length is calculated as follows:

$\Sigma MC500 + 4/3 * \Sigma MC800PLUS + n_c * 5\ m \leq 100\ m$

ΣMC500: Total length of all MC500 cable segments (fixed routing)

ΣMC800PLUS: Total length of all MC800PLUS cable segments (tow chain)

n_c: Number of DRIVE-CLiQ couplings (max. 0..3)

With this combination, DRIVE-CLiQ cables with a maximum length of over 75 m can also implemented for applications involving a tow chain.

Table 12- 10 Examples of maximum cable lengths when using a DRIVE-CLiQ coupling

ΣMC500 (fixed routing)	87 m	80 m	66 m	54 m	40 m	30 m	20 m	10 m	5 m
ΣMC800PLUS (tow chain)	5 m	10 m	20 m	30 m	40 m	48 m	55 m	63 m	66 m
ΣMC500+ ΣMC800PLUS	92 m	90 m	86 m	84 m	80 m	78 m	75 m	73 m	71 m

Using a DRIVE CLiQ Hub Module

The maximum permissible cable length can be doubled by using DRIVE-CLiQ Hub Modules (DMC20 or DME20). After the hub, the same length conditions apply as before the hub.

$\Sigma MC500 + 4/3 * \Sigma MC800PLUS + n_c * 5\ m \leq 100\ m$ before the hub

$\Sigma MC500 + 4/3 * \Sigma MC800PLUS + n_c * 5\ m \leq 100\ m$ after the hub

It is possible to connect two DRIVE-CliQ Hub Modules in series (cascade connection).

12.7.2 Power cables for motors

12.7.2.1 Configuring the cable length

Where a long motor cable is required, a higher rating of Motor Module must be selected or the permissible continuous output current $I_{continuous}$ must be reduced in relation to the rated output current I_{rated}. The configuring data for booksize format Motor Modules are given in the following table:

Table 12- 11 Permissible cable lengths for shielded motor cables

Motor Module	Length of motor cable (shielded)			
Rated output current I_N	> 50 … 100 m	> 100 … 150 m	> 150 … 200 m	> 200 m
3 A/5 A	Use 18 A Motor Module	Use 18 A Motor Module	Not permissible	Not permissible
9 A	Use 18 A Motor Module	Use 18 A Motor Module	Not permissible	Not permissible
18 A	Use 30 A Motor Module or $I_{max} \le 1.5 \times I_{rated}$ $I_{continuous} \le 0.95 \times I_{rated}$	Use 30 A Motor Module	Not permissible	Not permissible
30 A	Always permitted	$I_{max} \le 1.35 \times I_{rated}$ $I_{continuous} \le 0.9 \times I_{rated}$	$I_{max} \le 1.1 \times I_{rated}$ $I_{continuous} \le 0.85 \times I_{rated}$	Not permissible
45 A/60 A	Always permitted	$I_{max} \le 1.75 \times I_{rated}$ $I_{continuous} \le 0.9 \times I_{rated}$	$I_{max} \le 1.5 \times I_{rated}$ $I_{continuous} \le 0.85 \times I_{rated}$	Not permissible
85 A/132 A	Always permitted	$I_{max} \le 1.35 \times I_{rated}$ $I_{continuous} \le 0.95 \times I_{rated}$	$I_{max} \le 1.1 \times I_{rated}$ $I_{continuous} \le 0.9 \times I_{rated}$	Not permissible
200 A	Always permitted	$I_{max} \le 1.25 \times I_{rated}$ $I_{continuous} \le 0.95 \times I_{rated}$	$I_{max} \le 1.1 \times I_{rated}$ $I_{continuous} \le 0.9 \times I_{rated}$	Not permissible

When using a motor holding brake, the maximum motor cable length is 100 m.

The permissible cable length for an unshielded motor cable is 150 % of the length for a shielded motor cable.

Motor reactors can also be used on motors operating in vector and V/f control modes to allow the use of longer motor cables.

12.7.2.2 Comparison of MOTION-CONNECT power cables

MOTION-CONNECT 500 power cables are mainly suitable for permanent routing. MOTION-CONNECT 800PLUS power cables fulfill all of the high mechanical requirements for use in tow chains. They are resistant to cutting oils.

Table 12- 12 Comparison of the MOTION-CONNECT 500 and MOTION-CONNECT 800PLUS power cables

Power cable	MOTION-CONNECT 500	MOTION-CONNECT 800PLUS
Approvals		
VDE [1] cURus or UR/CSA UR-CSA File No. [2] in conformance with RoHS	Yes UL758-CSA-C22.2-N.210.2-M90 Yes Yes	Yes UL758-CSA-C22.2-N.210.2-M90 Yes Yes
Rated voltage V_0/V in accordance with EN 50395		
Supply cores Signal cores	600 V / 1000 V 24 V (EN) 1000 V (UL/CSA)	600 V / 1000 V 24 V (EN) 1000 V (UL/CSA)
Test voltage, rms		
Supply cores Signal cores	4 kV 2 kV	4 kV 2 kV
Operating temperature at the surface		
Permanently installed Moveable	-20 to +80°C 0 to 60°C	-50 to +80°C -20 to +60°C
Tensile load, max.		
Permanently installed Moveable	50 N/mm² 20 N/mm²	50 N/mm² 20 N/mm²
Smallest bending radius		
Permanently installed Moveable	5 x D_{max} approx. 18 x D_{max}	4 x D_{max} approx. 8 x D_{max}
Torsional stress	30°/m absolute	30°/m absolute
Bending operations	100000	10 million
Max. traversing speed	30 m/min	Up to 300 m/min
Max. acceleration	2 m/s²	50 m/s² (3 m) [3]
insulation material	CFC/silicone-free	CFC/halogen/silicone-free IEC 60754-1 / DIN VDE 0472-815
Oil resistance	EN 60811-2-1 (mineral oil only)	EN 60811-2-1
Protective jacket	PVC DESINA color, orange RAL 2003	PUR, HD22.10 S2 (VDE 0282, Part 10) DESINA color, orange, RAL 2003
Flame retardant	EN 60332-1-1 to 1-3	EN 60332-1-1 to 1-3

1) The registration number is printed on the cable jacket.

2) The File Number is printed on the cable jacket.

3) Characteristic curves for accelerating can be found in Catalog D31 or in PM21 in Chapter "MOTION-CONNECT connection system".

12.7.3 Current-carrying capacity and derating factors for power cables and signal cables

The current-carrying capacity of PVC/PUR-insulated copper cables is specified for routing types B1, B2 and C under continuous operating conditions in the table with reference to an ambient air temperature of 40 °C. For other ambient temperatures, the values must be corrected by the factors listed in the "Derating factors for deviating ambient temperatures" table.

Table 12- 13 Current carrying capacity according to EN 60204-1 for 40 °C ambient temperature

Cross-section	Current carrying capacity, effective; AC 50/60 Hz or DC For routing type		
mm²	B1 A	B2 A	C A
Electronics			
0.20	–	4.3	4.4
0.50	–	7.5	7.5
0.75	–	9	9.5
Power			
0.75	8.6	8.5	9.8
1.00	10.3	10.1	11.7
1.50	13.5	13.1	15.2
2.50	18.3	17.4	21
4	24	23	28
6	31	30	36
10	44	40	50
16	59	54	66
25	77	70	84
35	96	86	104
50	117	103	125
70	149	130	160
95	180	165	194
120	208	179	225

Table 12- 14 Current carrying capacity according to IEC 60364-5-52 for 40 °C ambient temperature

Cross-section	Current carrying capacity, effective; AC 50/60 Hz or DC For routing type		
Power			
150	–	–	344
185	–	–	392
> 185	Values must be taken from the standard		

Routing types

B1 Cables in conduits or installation ducts

B2 Multi-core cables in conduits or installation ducts

C Cables along walls/panels, without conduits or installation ducts

Table 12- 15 Derating factors for deviating ambient temperatures

Ambient air temperature [°C]	Derating factor according to EN 60204-1, Table D1
30	1.15
35	1.08
40	1.00
45	0.91
50	0.82
55	0.71
60	0.58

12.7.4 Maximum cable lengths

The table below provides an overview of the maximum permissible cable lengths for signal and supply cables, power cables, and DC-link cables.

Table 12- 16 Maximum cable lengths

Type	Maximum length [m]
24 VDC supply cables [1]	10
24 V signal cables [1]	30
DRIVE-CLiQ signal cables MC500	100
DRIVE-CLiQ signal cables MC800PLUS	75
DC link, including extensions	10
Total cable length for Active Line Modules 16 kW and 36 kW with Active Interface Module [4]	630 (shielded) [3]
Total cable length for Active Line Modules 55 kW up to 120 kW with Active Interface Module [4]	1000 (shielded) [3]
Total cable length for Active Line Modules with line reactor [4]	350 (shielded) [3]
Total cable length for Basic Line Modules [4]	630 (shielded) [3]
Total cable length for Smart Line Modules [4]	350 (shielded) [3]
Power cable between line filter and line reactor	10 (shielded/unshielded) [2]
Power cable between line reactor and Line Module	10 (shielded/unshielded) [2]
Power cable between motor and Motor Module up to I_n = 9 A	50 (shielded) 75 (unshielded)
Power cable between motor and Motor Module I_n = 18 A	70 (shielded) 100 (unshielded)
Power cable between motor and Motor Module $I_n \geq 30$ A	100 (shielded) 150 (unshielded)
Cable between the Braking Module and braking resistor	10

1) For longer lengths, the user must connect a suitable protective circuit up in order to provide overvoltage protection (refer to the Chapter, “Overvoltage protection” under "24 VDC supply")

2) To comply with EMC limit values, shielded cables (preferably MOTION CONNECT cables) must be used.

3) Restrictions regarding the total cable length and the secondary conditions in order to comply with the corresponding radio interference suppression category are listed in Chapter 2.10 (overview in Fig. "Possible line reactor and line filter combinations").

4) The total lengths specified for power cables in the drive line-up include motor cables, DC-link cable(s), and the line supply conductor from the line filter output on.

12.7.5 Connectable conductor cross-sections and tightening torques for motor and power cables

Table 12- 17 Connectable conductor cross-sections Part 1: Line cable / motor cable

		Connection cross-section [mm²]					
Component	**Terminal type / tightening torque**	**1.5**	**2.5**	**4**	**6**	**10**	**16**
Motor Module Booksize 3 A to 30 A 2 x 3 A to 2 x 18 A	Motor connector 30 A 3+2 pole /	X	X	X	X	X	
Motor Module Booksize Compact 1.7 A - 18 A	Screw terminal 1.2 - 1.5 Nm	X	X	X	X		
Motor Module 45 A to 60 A	Threaded bolts M6 6 Nm 1)				X	X	X
Motor Module 85 A	Threaded bolts M8/13 Nm 2)						X
Smart Line Module Booksize 5 kW to 10 kW	Screw terminal 1.2 - 1.5 Nm	X	X	X	X		
Smart Line Module Booksize Compact 16 kW	Screw terminal 1.5 - 1.8 Nm				X	X	X
Active Line Module 16 kW Smart Line Module 16 kW	Screw terminal 1.5 - 1.8 Nm				X	X	
Active Line Module 36 kW Smart Line Module 36 kW	Threaded bolts M6 6 Nm 1)						X
Active Interface Module 16 kW	Screw terminal 1.7 Nm				X	X	X
Active Interface Module 36 kW	Screw terminal 6 Nm						X

1) For ring cable lugs in accordance with DIN 46234
clamping area ensured for flexible cable with end sleeve, ring cable lug M6 or M8
IP2xB according to EN 60529; Note: The restrictor collar installed as standard for the purpose of touch protection must be used or adapted as required.

2) Alternatively, two cable lugs in accordance with DIN 46234 can be connected to each threaded bolt to facilitate the parallel connection of two cables with a maximum cross-section of 50 mm². Both cable lugs should be installed "back to back".

Table 12- 18 Connectable conductor cross-sections Part 2: Line cable / motor cable,

		Connection cross-section [mm²]					
Component	**Terminal type / tightening torque**	**25**	**35**	**50**	**70**	**95**	**120**
Motor Module 45 A to 60 A	Threaded bolts M6 6 Nm 1)	X	X	X			
Motor Module 85 A	Threaded bolts M8 13 Nm 2)	X	X	X	X	X	X
Motor Module 132 A to 200 A	Threaded bolts M8 13 Nm 2)	X	X	X	X	X	X
Active Line Module 36 kW Smart Line Module 36 kW	Threaded bolts M6 6 Nm	X	X	X			
Active Line Module 55 kW Smart Line Module 55 kW	Threaded bolts M8 13 Nm 2)		X	X	X	X	X
Active Line Module 80 kW to 120 kW	Threaded bolts M8 13 Nm 2)				X	X	X
Active Interface Module 36 kW	Screw terminal 6 Nm	X	X	X			
Active Interface Module 55 kW	Screw terminal 6 Nm		X	X			
Active Interface Module 80 kW to 120 kW	Threaded bolts M8 13 Nm 2)				X	X	X

1) For ring cable lugs in accordance with DIN 46234
clamping area ensured for flexible cable with end sleeve, ring cable lug M6 or M8
IP2xB according to EN 60529; Note: The restrictor collar installed as standard for the purpose of touch protection must be used or adapted as required.

2) Alternatively, two cable lugs in accordance with DIN 46234 can be connected to each threaded bolt to facilitate the parallel connection of two cables with a maximum cross-section of 50 mm². Both cable lugs should be installed "back to back".

Table 12- 19 Connectable conductor cross-sections Part 3: Line cable / connection for braking resistor

		Connection cross-section [mm²]					
Component	**Terminal type / tightening torque**	**1.5**	**2.5**	**4**	**6**	**10**	**16**
Basic Line Module 20 kW line cable connection	Screw terminal 1.5 - 1.7 Nm				x	x	x
Basic Line Module 20 kW Braking resistor connection	Screw terminal 0.5 - 0.6 Nm	x	x	x			
Basic Line Module 40 kW Braking resistor connection	Screw terminal 1.5 - 1.8 Nm			x	x	x	

Table 12- 20 Connectable conductor cross-sections Part 4: Line supply cable

		Connection cross-section [mm²]					
Component	**Terminal type / tightening torque**	**25**	**35**	**50**	**70**	**95**	**120**
Basic Line Module 40 kW Line cable connection	Screw terminal 6 Nm	x	x	x			
Basic Line Module 100 kW Line cable connection 1)	Threaded bolts M8 13 Nm				x	x	x

1) Alternatively, two cable lugs in accordance with DIN 46234 can be connected to each threaded bolt to facilitate the parallel connection of two cables with a maximum cross-section of 50 mm². Both cable lugs should be installed "back to back".

Note

The 40 kW Basic Line Module provides the IP20 degree of protection only with insulated ferrule and a cross-section > 25 mm².

Note

The cross-section of the PE conductor must be selected in accordance with DIN EN 60204-1, DIN EN 61800-5-1, and VDE 0100-540 (IEC 60364-5-54). When doing so, note that certain components conduct a high leakage current, which means that the relevant guidelines must be observed (EN 61800-5-1).

When selecting the line supply conductor, note the loop resistance so that the relevant protective components (line fuse, RCCB, etc.) function properly and that no hazardous shock currents or voltages occur in the event of a fault.

⚠WARNING

The internal overload monitoring function of Motor Module only protects the cable if this has been selected and dimensioned in accordance with the currents of the Motor Module. If smaller cross-sections are selected, then the user must ensure the appropriate level of cable protection - e.g. by suitably setting the control parameters.

12.7.6 Motor connection plug

Motor Modules 3 A to 30 A are supplied without a motor connector. Prefabricated MOTION-CONNECT power cables with pre-assembled motor connectors or unassembled power cables can be used to connect motors. In this case the motor connector must be ordered separately.

The motor connector is equipped with an interlock mechanism. Mounting on the Motor Module is described in the following.

12.7.6.1 Mounting on the Motor Module

Motor connection plugs with locking mechanism are available in two versions:

- Crimp plug for pre-assembled motor cables
- Screw connector for motor cables that need to be assembled

The way in which the motor connection plug is installed depends on the type of Motor Module used.

Note

With Double Motor Modules, the rear motor connection plug must be installed first and then locked.

Installation on Motor Modules without pre-assembled interlock bolt

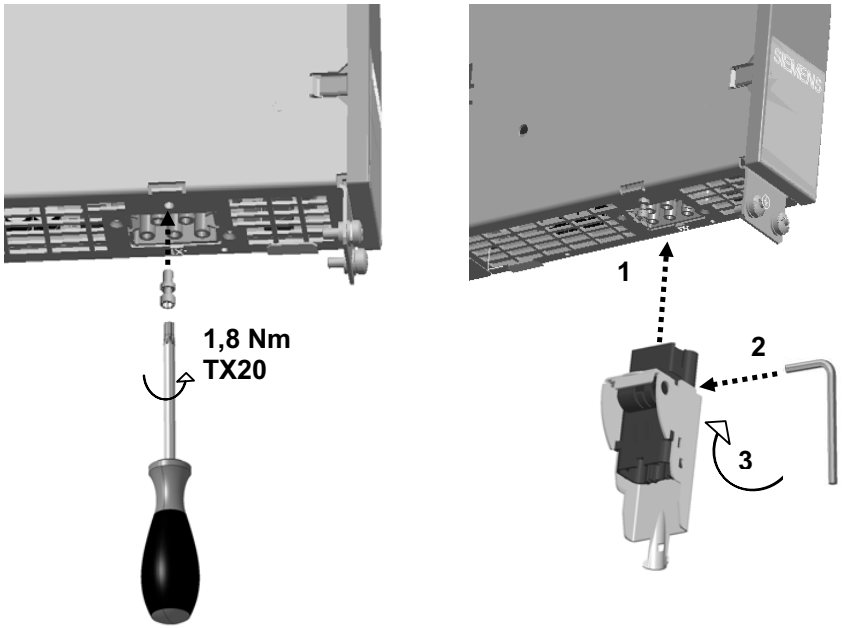


Figure 12-5 Installation example: Crimp plug

1. Screw the interlock bolt into the threaded socket provided in the enclosure.
2. Insert the plug, including the motor cable, and lock it in place by turning a screwdriver or size 4 hexagon socket-head screw clockwise by a ¼ turn (90°).

Installation on Motor Modules with pre-assembled interlock bolt

If Motor Modules with a pre-assembled interlock bolt are used, step 1 described above can be omitted.

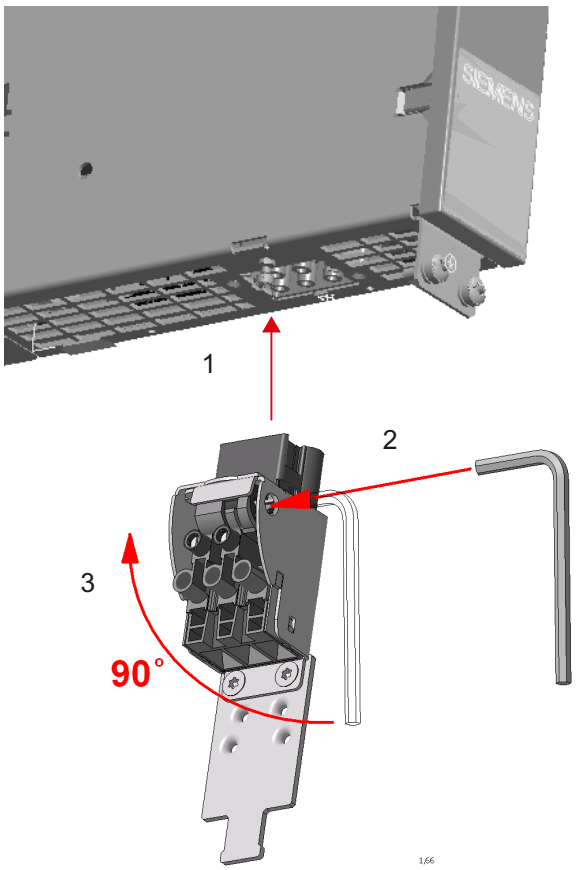


Figure 12-6 Installation example: Screw connector

Simply insert the connector, including the motor cable, and lock it in place by turning a screwdriver or size 4 hexagon socket-head screw clockwise by a ¼ turn (90°).

12.7.6.2 Connecting the motor connector to self-fabricated cables

Preparing the power cable

Non-assembled power cables must be appropriately prepared before the motor connector is connected.

1. Cut the cable jacket to 200 ± 5 mm
2. Fix the braided shield (e.g. with heat-shrink tubing)
3. Cut the single cores U, V, W and connecting cables for the motor holding brake according to the drawing shown below and remove the insulation
4. Strip the insulation from the single PE core, and crimp on a ring cable lug according to DIN 46234

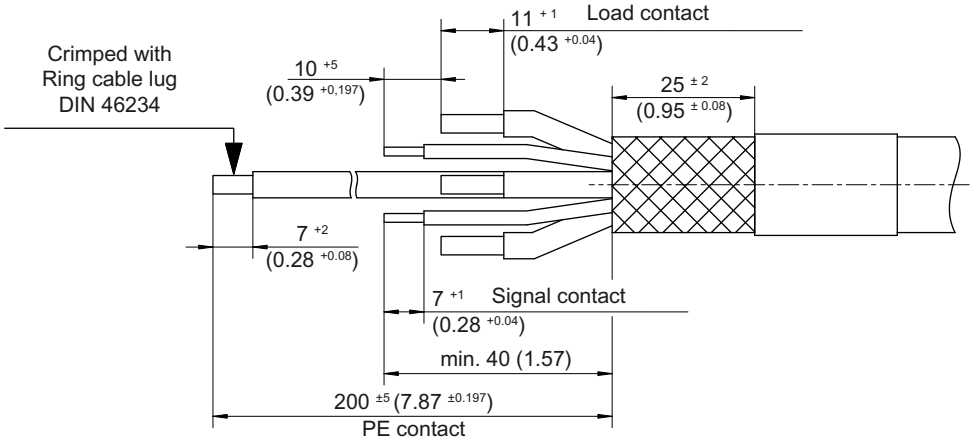
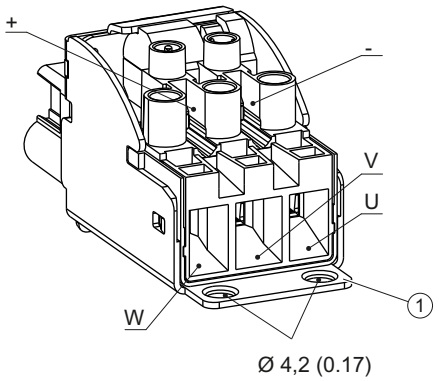


Figure 12-7 Stripped lengths for self-fabricated motor power cables, all data in mm and (inches)

Connecting the motor connector

The connections for the single cores at the motor connector can be taken from the following diagram.

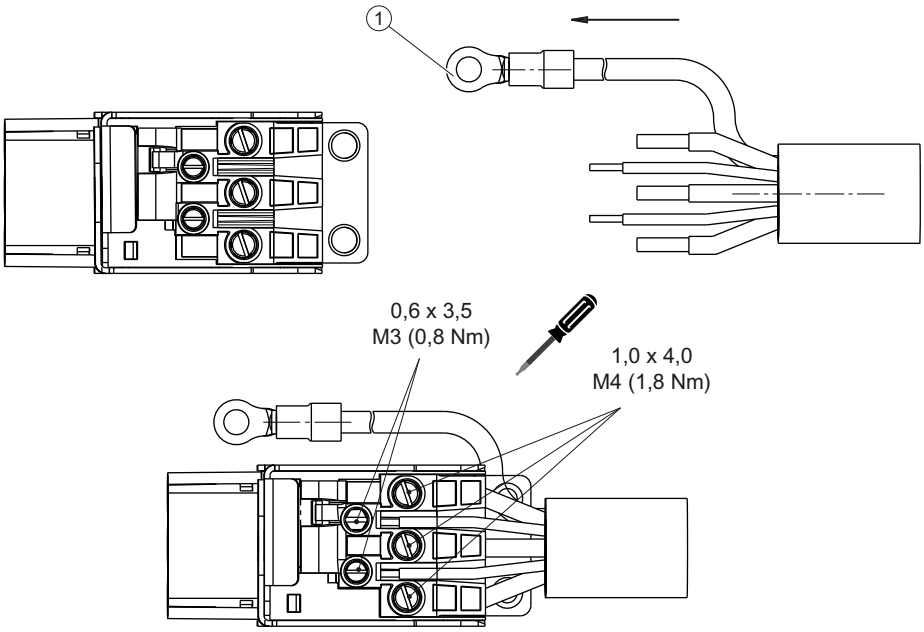


1 Connection for shield plate supplied with the equipment

Figure 12-8 Connections at the motor connector, screw version

The motor connector is connected as shown below.

1. Secure the individual cores U, V, W in the associated terminals of the motor connector
2. Secure the individual cores for the motor holding brake in the associated terminals of the motor connector

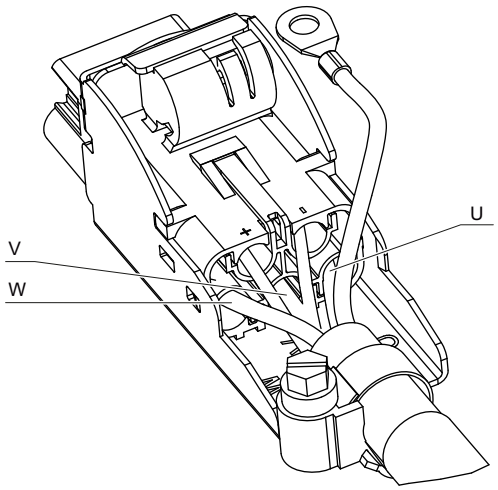


1 Ring cable lug insulated to DIN 46234

Figure 12-9 Connecting the motor connector, screw version

12.7.6.3 Removing the motor connector plug from prefabricated power cables

The motor connection plug of a pre-assembled motor cable might have to be removed if the cable needs to be routed through narrow cable glands, for example.



Motor connector, crimped version

Removing the motor connection plug

1. First loosen the clamp.
2. Raise the interlock mechanism in the connector using a screwdriver, for example.
3. Remove the Insert and withdraw the motor cable out of the connector.

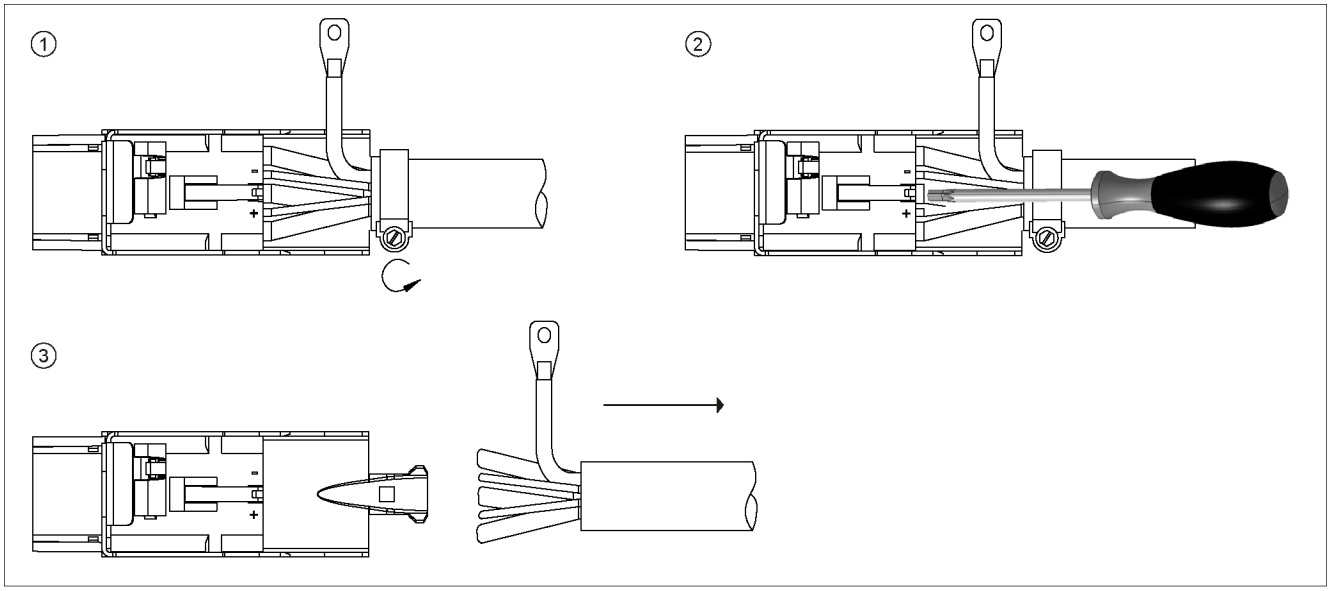
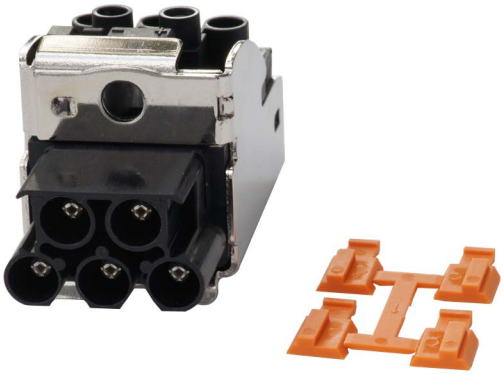


Figure 12-10 Removing the motor connector, crimped version

12.7.6.4 Coding

The motor connection plug is coded using coding plugs. The coding plugs are included in the scope of supply of the motor connection plug. Coding can be used to prevent motor cables being incorrectly connected, particularly in the case of Double Motor Modules.

The coding of a motor connection plug is illustrated below, using the example of a plug with screwed joint.



Motor connection plug with associated coding plugs from the accessories pack



Motor connection plug with mounted coding plugs

12.7.6.5 Shield connection

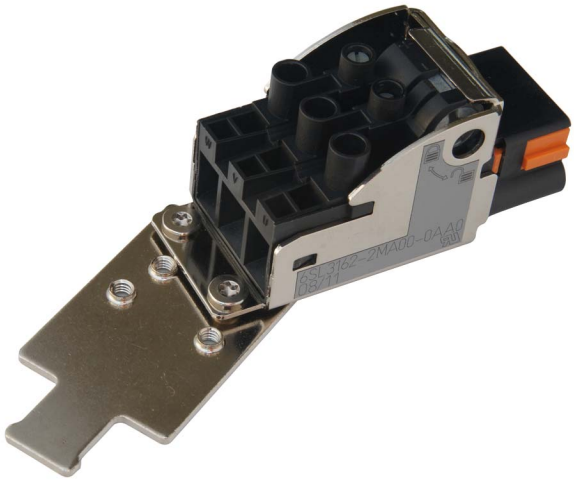
The following options are available for cable shield support:

1. Shield support with shield plate supplied
2. Shield support on a toothed rail
3. Fixing your own shield support at the shield connection of the motor connection plug

Shield support with shield plate supplied

A shield plate is always provided with the screw version of the motor connection plug. The shield of a prefabricated motor power cable should be preferably connected at this shield plate that is provided.

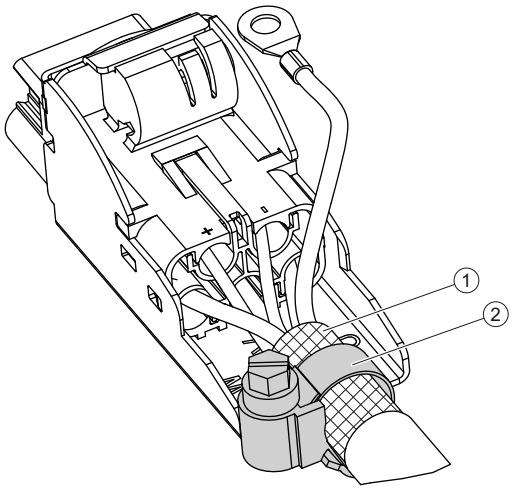
Table 12- 21 Possible installations of the shield plate

	
Shield plate supplied for the motor connection plug	Frontal alignment of the shield plate
	
Lateral alignment of the shield plate	Lateral alignment of the shield plate

The shield plate can be mounted at various angles at the motor connection plug using two screws (M4) that are provided (tightening torque 1.8 Nm).

NOTICE
The motor power cable should be fixed to the shield plate using a steel clamp, in order to ensure that the cable shield is connected through the largest possible surface area.

The shield is connected as shown below



1 Protective braided shield

2 Steel clamp

Figure 12-11 Shield connection using a motor connection plug, crimped version, as example

Shield support on a toothed rail

The toothed rail should be mounted at a distance of ≤ 150 mm below the drive line-up to ensure a good contact. Wherever possible, the brake cores must be kept physically separate from U/V/W connections.

Note

Measures must be taken on site to relieve strain on the cables.
The maximum permissible tensile load in the plug-in direction is 100 N.

With these versions, the shield for the brake connection wires must be laid together with the cable shield.

12.7.7 Spring-loaded terminals

The type of spring-loaded terminal can be taken from the interface description of the particular component.

Table 12- 22 Connectable conductor cross-sections for spring-loaded terminals

Spring-loaded terminal type			
1	Connectable conductor cross-sections	Rigid Flexible Flexible with end sleeve without plastic sleeve AWG/kcmil	0.14 mm^2 to 0.5 mm^2 0.14 mm^2 to 0.5 mm^2 0.25 mm^2 to 0.5 mm^2 26 to 20
	Stripping length	8 mm	
2	Connectable conductor cross-sections	Flexible	0.08 mm^2 to 2.5 mm^2
	Stripping length	8 to 9 mm	
3	Connectable conductor cross-sections	Rigid Flexible Flexible with end sleeve without plastic sleeve Flexible with end sleeve with plastic sleeve AWG/kcmil	0.2 mm^2 to 1 mm^2 0.2 mm^2 to 1.5 mm^2 0.25 mm^2 to 1.5 mm^2 0.25 mm^2 to 0.75 mm^2 24 to 16
	Stripping length	8 mm	
3_1	Connectable conductor cross-sections	Rigid Flexible Flexible with end sleeve without plastic sleeve Flexible with end sleeve with plastic sleeve AWG/kcmil	0.2 mm^2 to 1.5 mm^2 0.2 mm^2 to 1.5 mm^2 0.25 mm^2 to 1.5 mm^2 0.25 mm^2 to 0.75 mm^2 24 to 16
	Stripping length	10 mm	
4	Connectable conductor cross-sections	25 mm^2 to 95 mm^2 AWG 4 to 4/0	
	Stripping length	35 mm	
5	Connectable conductor cross-sections	Rigid Flexible Flexible with end sleeve without plastic sleeve Flexible with end sleeve with plastic sleeve AWG/kcmil	0.2 mm^2 to 10 mm^2 0.2 mm^2 to 6 mm^2 0.25 mm^2 to 6 mm^2 0.25 mm^2 to 4 mm^2 24 to 8
	Stripping length	15 mm	

12.7.8 Screw terminals

The type of screw terminal can be taken from the interface description of the particular component.

Table 12- 23 Connectable conductor cross-sections and tightening torques for screw terminals

Screw terminal type			
1	Connectable conductor cross-sections	Rigid, flexible With wire end ferrule, without plastic sleeve With wire end ferrule, with plastic sleeve	0.08 mm^2 to 1.5 mm^2 0.25 mm^2 to 1.5 mm^2 0.25 mm^2 to 0.5 mm^2
	Stripping length	7 mm	
	Tool	Screwdriver 0.4 x 2.0 mm	
	Tightening torque	0.22 to 0.25 Nm	
1_1	Connectable conductor cross-sections	Rigid, flexible With wire end ferrule, without plastic sleeve With wire end ferrule, with plastic sleeve	0.14 mm^2 to 1.5 mm^2 0.25 mm^2 to 1.5 mm^2 0.25 mm^2 to 0.5 mm^2
	Stripping length	7 mm	
	Tool	Screwdriver 0.4 x 2.5 mm	
	Tightening torque	0.22 to 0.25 Nm	
2	Connectable conductor cross-sections	Rigid, flexible With wire end ferrule, without plastic sleeve With wire end ferrule, with plastic sleeve	0.08 mm^2 to 2.5 mm^2 0.5 mm^2 to 2.5 mm^2 0.5 mm^2 to 1.5 mm^2
	Stripping length	7 mm	
	Tool	Screwdriver 0.6 x 3.5 mm	
	Tightening torque	0.5 to 0.6 Nm	
3	Connectable conductor cross-sections	Flexible With wire end ferrule, without plastic sleeve With wire end ferrule, with plastic sleeve	0.2 mm^2 to 2.5 mm^2 0.25 mm^2 to 1 mm^2 0.25 mm^2 to 1 mm^2
	Stripping length	9 mm	
	Tool	Screwdriver 0.6 x 3.5 mm	
	Tightening torque	0.5 to 0.6 Nm	
4	Connectable conductor cross-sections	Flexible With wire end ferrule, without plastic sleeve With wire end ferrule, with plastic sleeve	0.2 mm^2 to 4 mm^2 0.25 mm^2 to 4 mm^2 0.25 mm^2 to 4 mm^2
	Stripping length	7 mm	
	Tool	Screwdriver 0.6 x 3.5 mm	
	Tightening torque	0.5 to 0.6 Nm	
5	Connectable conductor cross-sections	Flexible With wire end ferrule, without plastic sleeve With wire end ferrule, with plastic sleeve	0.5 mm^2 to 6 mm^2 0.5 mm^2 to 6 mm^2 0.5 mm^2 to 6 mm^2
	Stripping length	12 mm	
	Tool	Screwdriver 1.0 x 4.0 mm	
	Tightening torque	1.2 to 1.5 Nm	

Screw terminal type			
6	Connectable conductor cross-sections	Flexible With wire end ferrule, without plastic sleeve With wire end ferrule, with plastic sleeve	0.5 mm^2 to 10 mm^2 0.5 mm^2 to 10 mm^2 0.5 mm^2 to 10 mm^2
	Stripping length	11 mm	
	Tool	Screwdriver 1.0 x 4.0 mm	
	Tightening torque	1.5 to 1.8 Nm	
7	Connectable conductor cross-sections	0.5 mm^2 to 16 mm^2	
	Stripping length	14 mm	
	Tool	Screwdriver 1.0 x 4.0 mm	
	Tightening torque	1.5 to 1.7 Nm	

12.7.9 Handling restrictor collars for touch protection

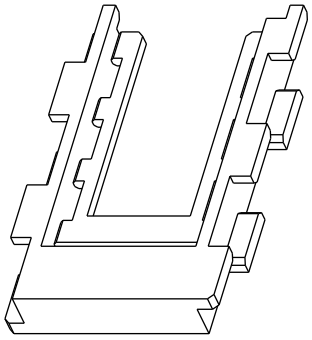
Handling restrictor collars for touch protection and when connecting cables

Restrictor collars are used to provide touch protection in accordance with EN 60529. They must be removed and adapted if necessary before the line supply conductor and/or motor cable is connected, after which they must be reattached. For information on adapting touch protection, refer also to "Electrical connection" in the chapter titled "Shield connecting plates".

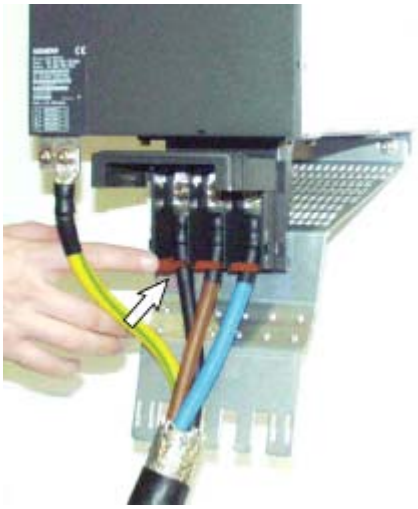
Exception: The cross-section of the connected cables is large enough to ensure that the threaded bolts and the ends of the cables cannot be touched when the cover is closed.

The following components are supplied with restrictor collars as standard:

- Active Line Modules 36 kW and higher
- Smart Line Modules 36 kW and higher
- Basic Line Modules 100 kW and higher
- Motor Modules 45 A and higher
- Active Interface Modules 80 kW and higher



Restrictor collar



Power unit with cables and restrictor collars attached

12.8 Protective connection and equipotential bonding

Protective connections

The SINAMICS S Booksize drive system is designed for use in cabinets with a PE conductor connection.

The protective conductor connection of the SINAMICS components must be connected to the protective conductor connection of the control cabinet as follows:

Table 12- 24 Conductor cross-section for copper protective connections

Line supply cable in mm^2	Copper protective connection in mm^2
Up to 16 mm^2	The same as the line supply cable
From 16 mm^2 to 35 mm^2	16 mm^2
From 35 mm^2	0.5 x line supply cable

For materials other than copper, the cross-section should be increased so that as a minimum, the same conductivity is attained.

All system components and machine parts must be incorporated in the protection concept.

The protective connection (PE connection) for the motors used must be established through the motor cable. For EMC reasons, the shield of the motor cable should be connected through a large surface area both at the Motor Module as well as at the motor.

The drive line-up must be arranged on a common bright mounting plate in order to comply with the EMC limit values. The mounting plate must be connected to the protective conductor connection of the control cabinet through a low impedance.

Copper cables with appropriate cross-sections (>2.5 mm^2) must be used for the ground connection of PROFIBUS nodes.

For more information about grounding PROFIBUS, see:
http://www.profibus.com/fileadmin/media/wbt/WBT_Assembly_V10_Dec06/start.html

Equipotential bonding

A mounting plate serves simultaneously as an equipotential bonding surface. This means that no additional equipotential bonding is required within the drive line-up.

If a common bright mounting plate is not available, then equally good equipotential bonding must be established using cable cross-sections as listed in the table above or, as a minimum, with the same conductivity.

When installing components on standard mounting rails, the data listed in the table also apply to the equipotential bonding. If only smaller conductor cross-sections are permissible on components, the largest cross-section must be used (e.g. 6 mm² for TM31 and SMC). These requirements also apply to distributed components located outside the control cabinet.

⚠ CAUTION

An equipotential 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 an equipotential 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.

No equipotential bonding conductors are required for PROFIBUS inside a control cabinet. For PROFIBUS connections between different buildings or parts of buildings, an equipotential bonding must be laid parallel to the PROFIBUS cable. The following cross-sections must be observed in accordance with IEC 60364-5-54:

- Copper 6 mm²
- Aluminium 16 mm²
- Steel 50 mm²

For more informationen on equipotential bonding with PROFIBUS, refer to:
http://www.profibus.com/fileadmin/media/wbt/WBT_Assembly_V10_Dec06/start.html

NOTICE

If the above information about equipotential bonding is not taken into account, this can cause the field bus interfaces to malfunction or devices to malfunction.

Note

PROFINET

For installation guidelines and information of protective grounding and equipotential bonding for all PROFINET types and topologies, refer to DOWNLOADS at:
http://www.profibus.com

12.9 Arrangement of components and equipment

12.9.1 General information

The arrangement of the components and equipment takes account of

- Space requirements
- Cable routing
- Bending radii of the connecting cables
  MOTION-CONNECT cables, refer to catalog PM21 or NC61
- Heat dissipation
- EMC

The components of the drive line-up should preferably be installed on a conductive mounting surface to ensure low impedance between the component and the mounting surface. Mounting plates with a galvanized surface are suitable.

Components are usually located centrally in a cabinet. The necessary mounting and installation clearances above an below the components can, under certain circumstances, exceed the minimum clearances specified in the product documentation.

The components can be arranged in one or more tiers. In a multiple-tier arrangement, vertical installation or, in a cabinet row, side-by-side installation in different cabinet sections is possible.

To determine the cross-section, use the DC-link busbar current carrying capacity given in the relevant technical data.

A ventilation clearance of 100 mm must be maintained around the line reactor (not including the mounting surface).

⚠DANGER

If a 50 mm wide Motor Module or a 50 mm wide DC link component (e.g. Braking Module, Control Supply Module, Voltage Clamping Module) is located at the left-hand end of the drive line-up, then the DC link bridges, including all of the screws, must be removed from this component. It is not permissible to insert the screws without a DC link bridge.

For all other components that are 75 mm wide or wider, it is neither permissible to move the DC link bridge to the left nor to remove it.

If this is not carefully observed, this can result in damage and accidents.

12.9.2 Current Carrying Capacity of the DC Link Busbar

The current carrying capacity of the DC link busbar must be observed for the configuration and arrangement of the drive line-up. The maximum current carrying capacity of the DC-link busbar differs for the various module widths.

Table 12- 25 Current Carrying Capacity of the DC Link Busbar

Current Carrying Capacity of the DC Link Busbar	Components
100 A	• Motor Modules from 50 mm to 100 mm wide • DC link components
150 A	• Motor Modules from 50 mm to 100 mm wide with reinforced DC link busbars
200 A	• Motor Modules from 150 mm to 300 mm wide

To calculate the load of the DC link busbar, add the DC link currents I_d of the connected Motor Modules. If the current carrying capacity of the DC link busbar is exceeded for the planned configuration, two solutions are possible:

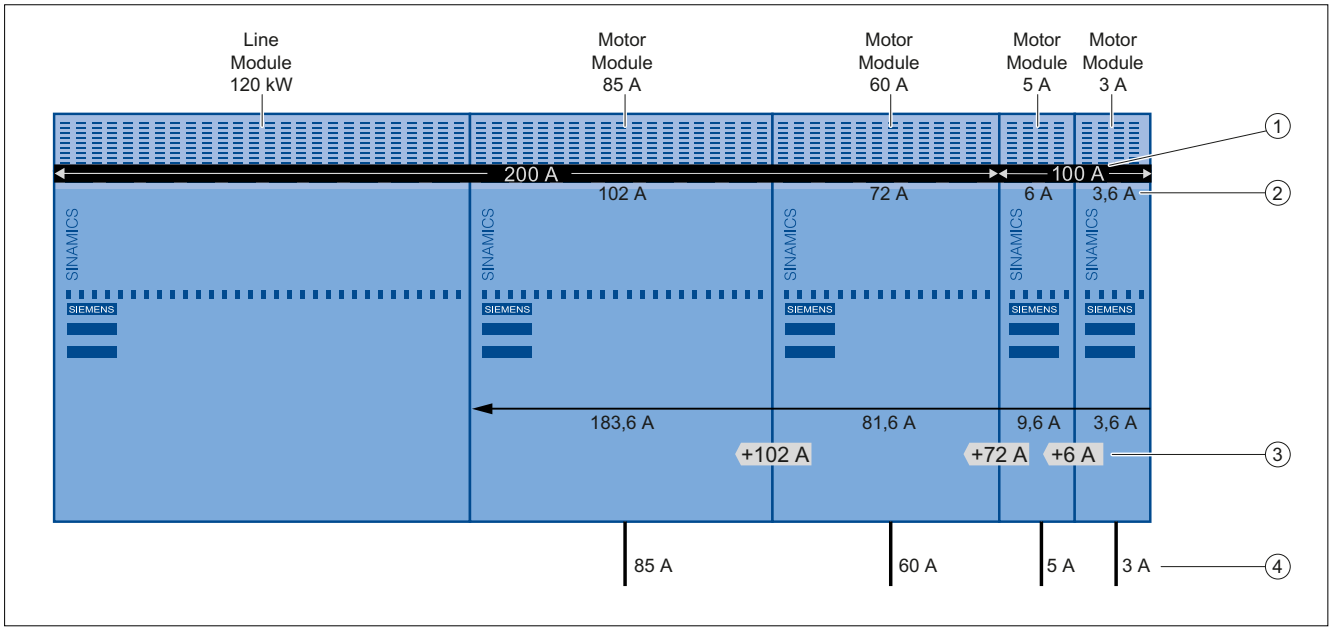
- Center infeed: arrangement of the drive line-up with infeed from left and right (see below)
- Use of another Line Module

Note

The following examples are based on the simultaneous use and loading of the Motor Modules with the rated current I_n. The values of the DC link current were taken from the technical data of the Motor Modules in the Manual Power Units Booksize.

Example 1:

Connection of several Motor Modules with different current carrying capacity of the DC link busbar to a Line Module.



1 DC link busbar current carrying capacity

2 DC link busbar load: DC link current I_d at the rated current I_n of the Motor Module

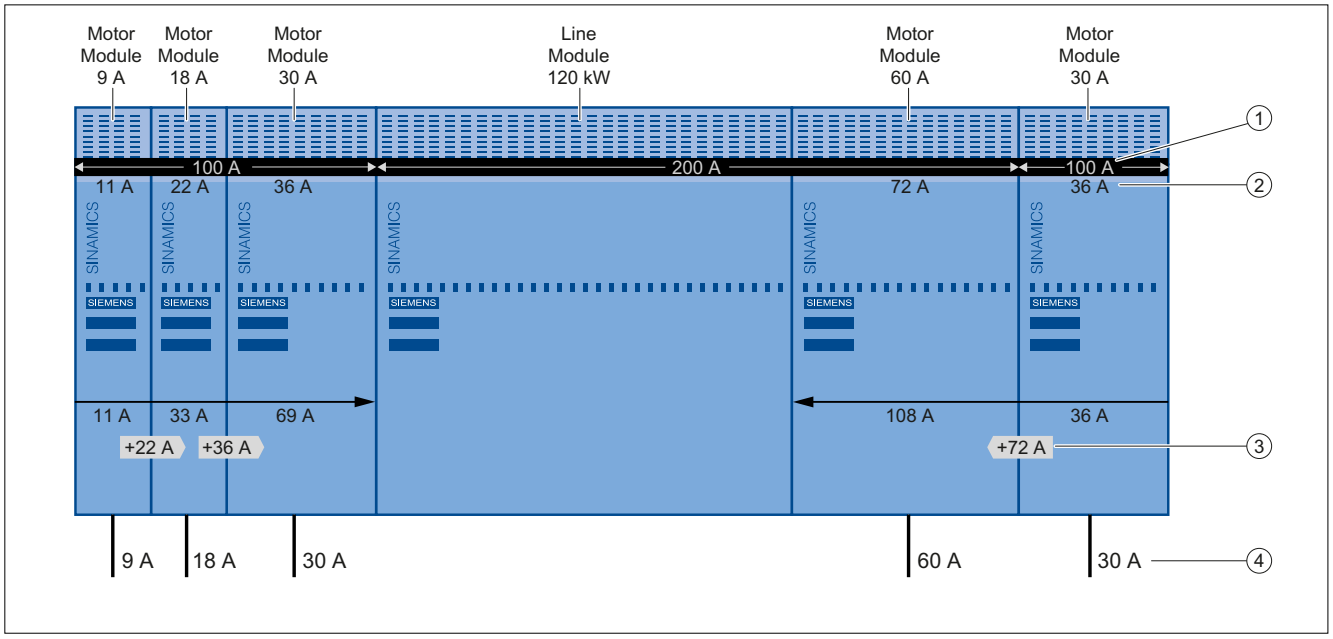
3 Increased load of the DC link busbar

4 Motor current = rated output current I_n of the Motor Module

Figure 12-12 Regular arrangement with infeed to the right of the DC link, DC link busbar not overloaded

Example 2:

Connection of several Motor Modules with different current carrying capacity of the DC link busbar to a Line Module with center infeed



1 DC link busbar current carrying capacity

2 DC link busbar load: DC link current I_d at the rated current I_n of the Motor Module

3 Increased load of the DC link busbar

4 Motor current = rated output current I_n of the Motor Module

Figure 12-13 Center infeed - infeed from left and right to the DC link

A center infeed with Motor Modules to the right and left of the Line Module can be configured for all Line Modules in compliance with current carrying capacity.
Exception: Smart Line Modules 5 kW and 10 kW

Note

For Smart Line Modules 5 kW and 10 kW, the arrangement of the drive line-up must be made to the right!

12.9.3 Single-tier drive line-up

Due to the current carrying capacity of the DC-link busbars and their function in particular, the components should be arranged according to the following rule. From left to right:

- Line Module
- Motor Modules in order of power from the highest power to the lowest power
- DC-link components (e.g. Braking Module, Control Supply Module, Capacitor Module)

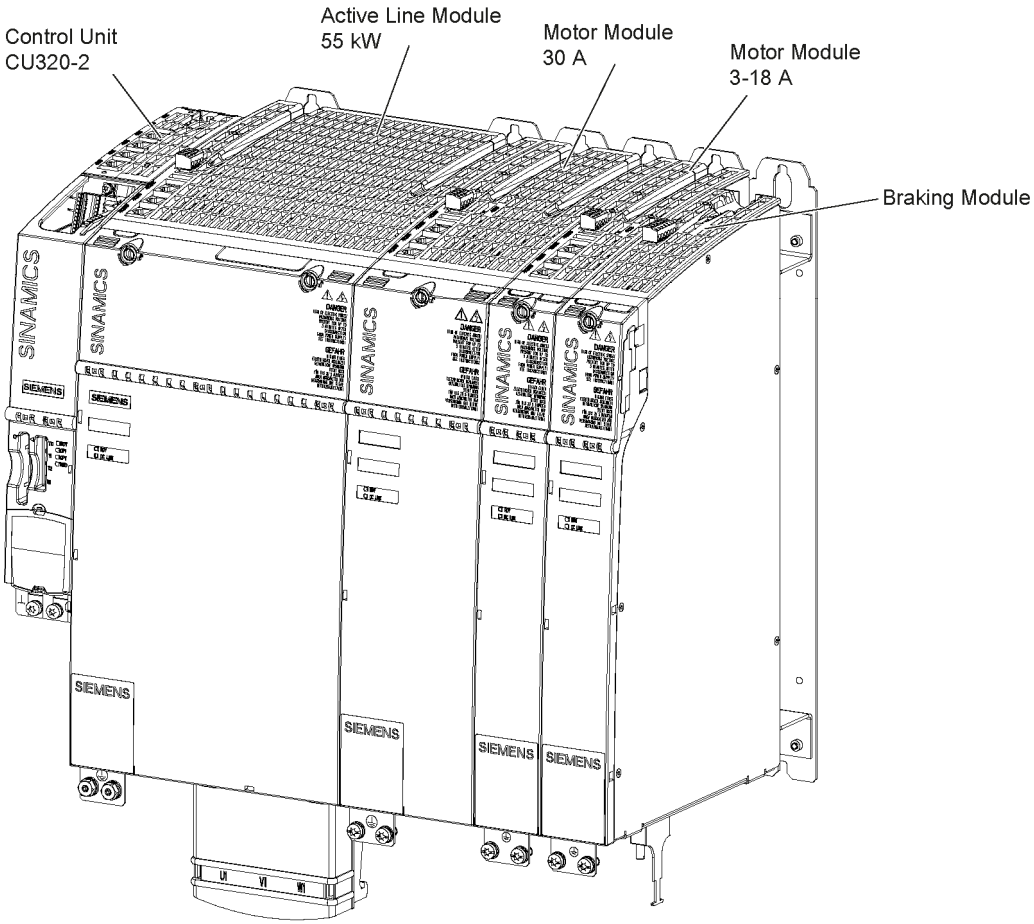


Figure 12-14 Example of a single drive line-up with internal air cooling

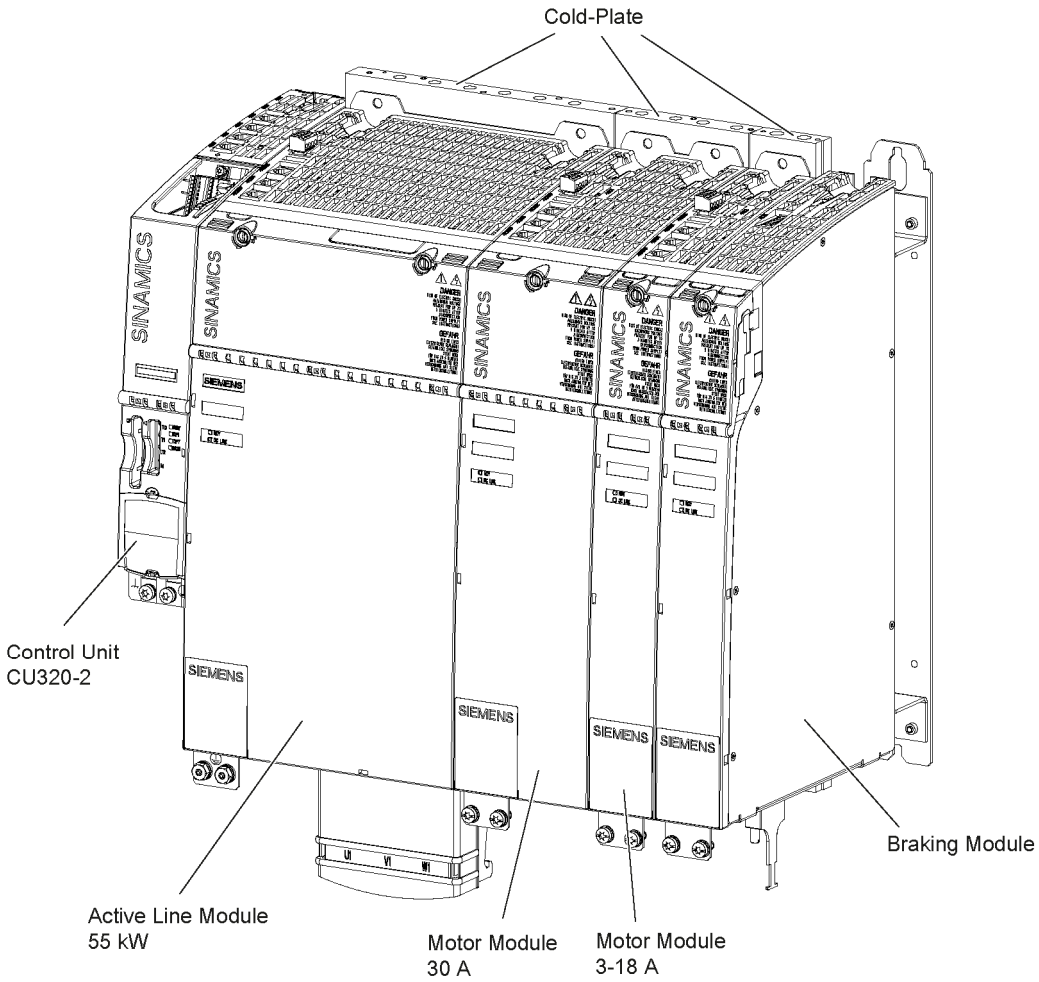


Figure 12-15 Example of a single drive line-up with cold plate

12.9.4 Multi-tier drive line-up

12.9.4.1 Arrangement rules

Design of a multi-tier drive line-up

The following points must be observed for the arrangement of a multi-tier drive line-up:

- The individual wires must be shielded, and the shield must be attached at both ends.
- Continuation of the DC link is achieved outside of the components with the DC-link adapter (for information on installation, refer to the chapter titled "Accessories") using single-core, finely-stranded, shielded cables that are laid so as to ensure they are inherently short-circuit and ground-fault proof.
- The distance between the rows of modules primarily depends on the wiring, the cable cross-section, and the bending radius of the power cables to be connected.
- The inlet temperature of the air sucked in for cooling the module must not exceed 40 °C (with derating, it must not exceed 55 °C). This must be ensured by means of suitable air guidance, the distance between the module rows, or by air baffle plates.

CAUTION
Signal cables must not be routed parallel to power cables.

Note

If the infeed is on the right-hand side of the drive line-up (e.g. in a multi-tier configuration), the rules described in the chapter titled "Single-tier drive line-up" apply in reverse.

This means that: The Motor Modules are arranged in order of power from the highest power to the lowest power, followed by the DC-link components, such as the Braking Module, at the end.

Wiring rules for DRIVE-CLiQ

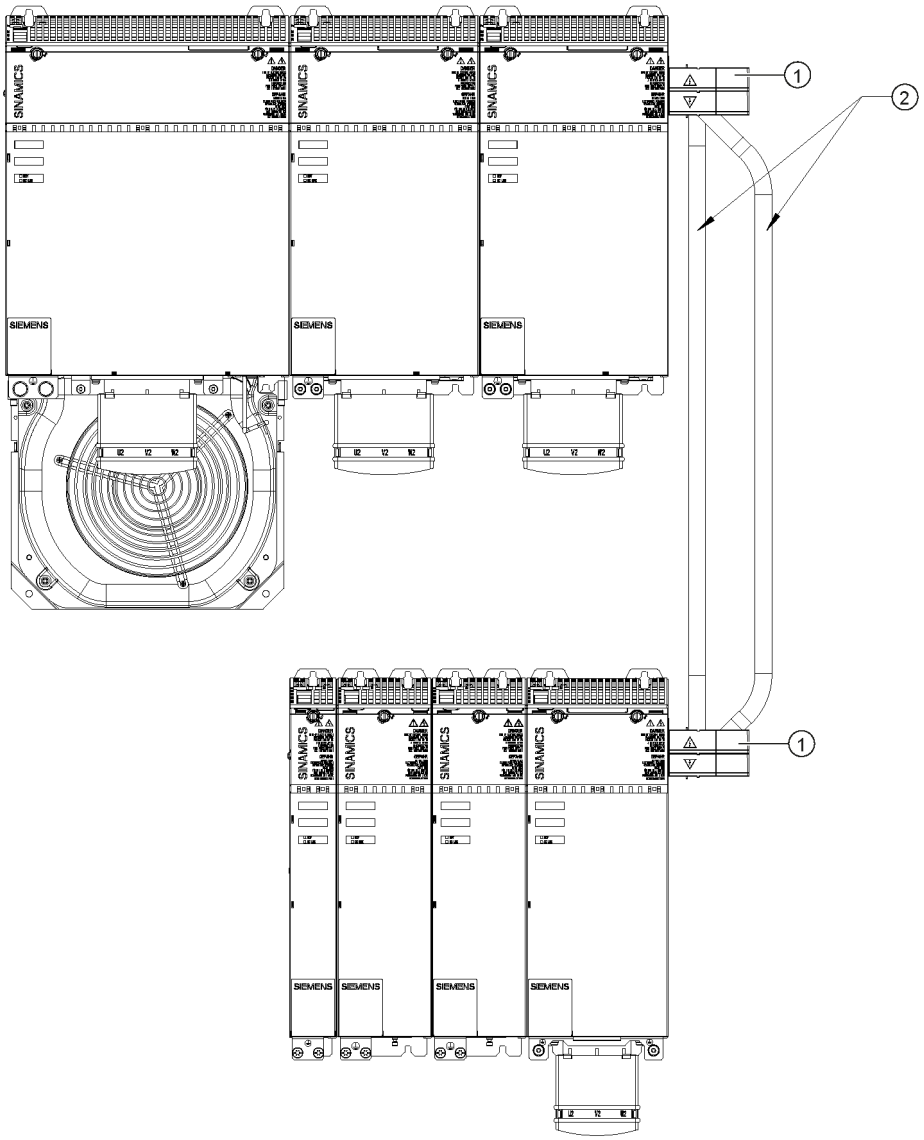
Refer to the Commissioning Manual.

Selecting the DC-link adapter and DC-link rectifier adapter

Table 12- 26 Overview of the DC-link rectifier adapter and DC-link adapter

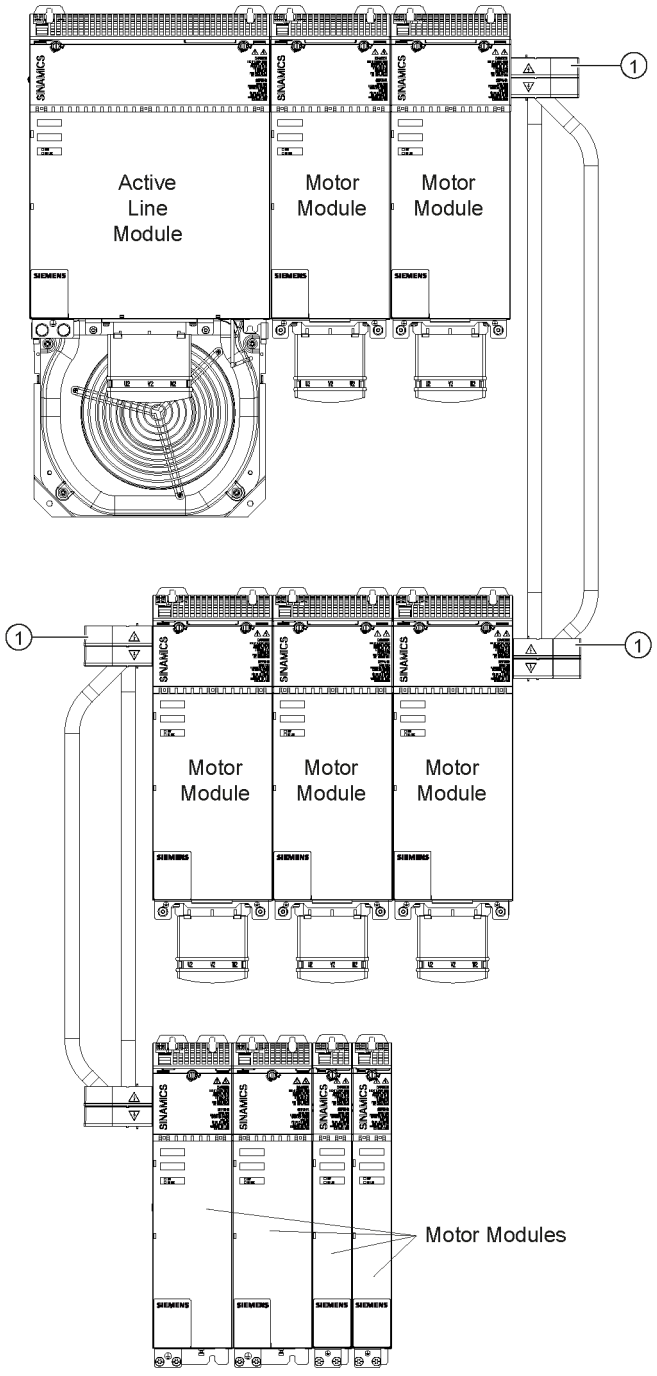
	Suitable for module width	Max. connectable cross-section	Max. current carrying capacity
DC-link rectifier adapter (cable outlet on top)			
6SL3162-2BD00-0AAx	50 mm, 100 mm	10 mm^2	43 A
6SL3162-2BM00-0AAx	150 mm, 200 mm, 300 mm	95 mm^2	240 A
DC-link adapter (cable outlet on side)			
6SL3162-2BM01-0AAx	All	95 mm^2	240 A

12.9.4.2 Examples of a multi-tier configuration



① DC link adapter
② Power cable shielded

Figure 12-16 Example of a two-tier configuration for a drive line-up with internal air cooling



① DC link adapter

Figure 12-17 Example of a three-tier configuration for a drive line-up with internal air cooling

12.9.4.3 Connection example

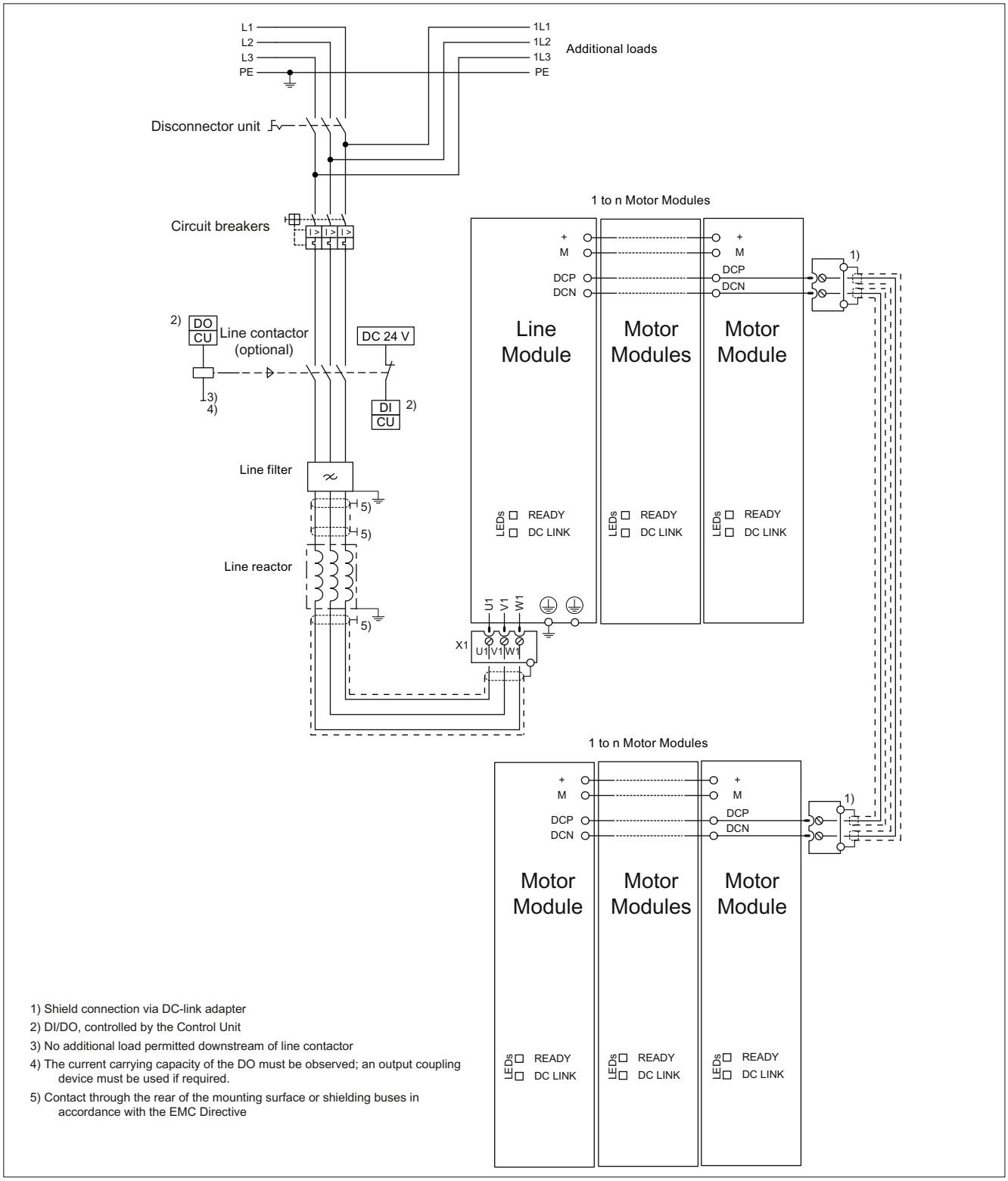


Figure 12-18 Connection example for a two-tier drive line-up

12.10 Information on cold plate cooling

12.10.1 General information

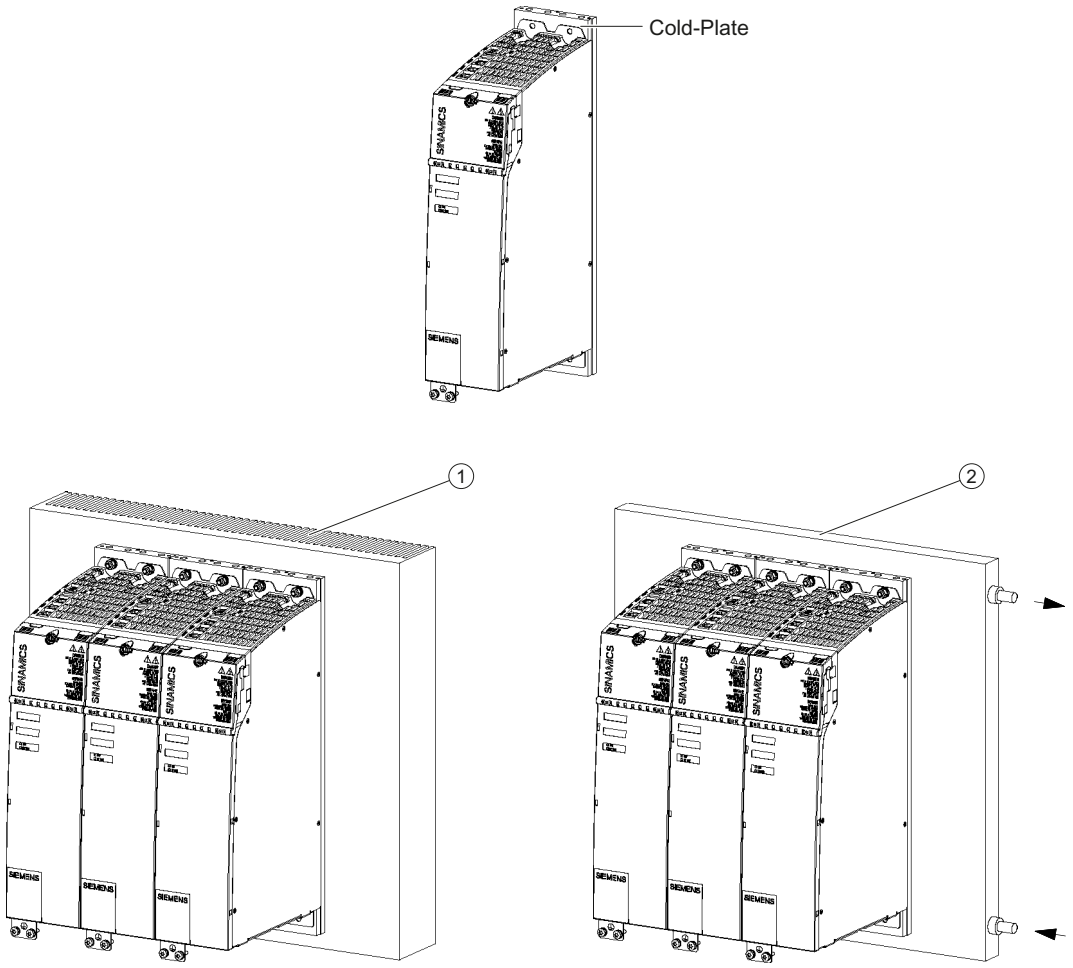
Cold plate cooling is a cooling method that can be used for SINAMICS S120 power units in booksize format. The flat aluminum cold plate (cold plate), which is located on the rear of the device, acts as a thermal interface in cold plate cooling.

The cold plate cooling is especially suitable for the following machine concepts:

- Plants and systems with high degree of pollution in the vicinity of the machine (e.g. in the textiles or timber industry).
  - Reducing cabinet-internal thermal losses facilitates cooling within a sealed cabinet (IP54).
- Plants and systems where liquid cooling is already being used in the process.
  - The existing cooling circuit can be used to externally cool the power components with cold plate.

There are two ways of configuring this type of cooling:

1. Cold plate cooling with an external air heat sink
   The components of the drive line-up are typically all screwed on to the cooling fins of an air heat sink located outside the control cabinet.
2. Cold plate cooling with an external liquid heat sink
   The components of the drive line-up are typically all screwed on to a liquid heat sink located outside the control cabinet.



1 Cold plate components on an external air heat sink

2 Cold plate components on an external liquid heat sink

Figure 12-19 Overview of cooling types for drive line-ups with cold plate

12.10.2 Cold plate with external air heat sink

12.10.2.1 Configuration and conditions

The conditions described below must be taken into account when cooling a cold-plate drive line-up by means of an external air heat sink.

General conditions to be observed:

1. The maximum temperature within the cabinet is 40°C
   (inlet air temperature of the power sections). The maximum temperature inside the cabinet for derating is 55 °C. For the relevant specifications, refer to the "Technical data".
2. The maximum permissible heat-sink temperature is module-dependent. Refer to the "Technical data" for more information. A temperature sensor in the power unit measures the temperature and can be read via parameter r0037.
3. The customer must take measures to protect the devices against condensation (see also chapter "Anti-condensation measures" under "Cooling circuit and coolant properties").

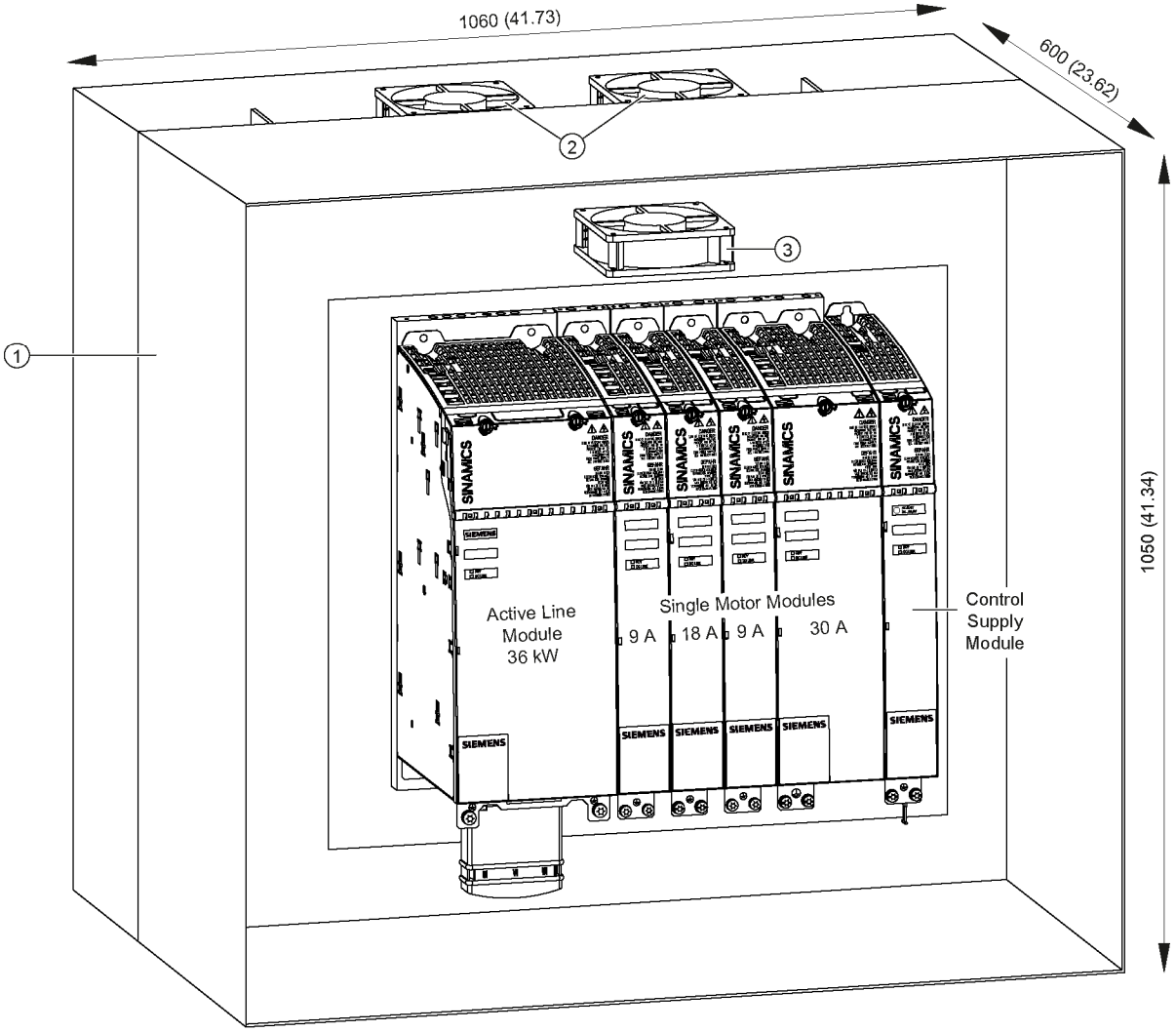
Note

If the components are installed in a sealed cabinet, an internal fan must be installed to prevent hot spots. It is best to install the fan above the modules to optimize the air flow (suction).

If the conditions in the plant do not allow the temperature in the cabinet to be limited to a maximum of 40°C, further measures must be taken. Please contact the hotline for more information (see the Foreword).

The power units must be arranged in such a way that the power (loss) is distributed equally. The permissible current carrying capacities of the DC link busbars in the different modules must be taken into account (see "Technical data" for the various modules).

12.10.2.2 Setup example, drive line-up, cold plate with external air heat sink



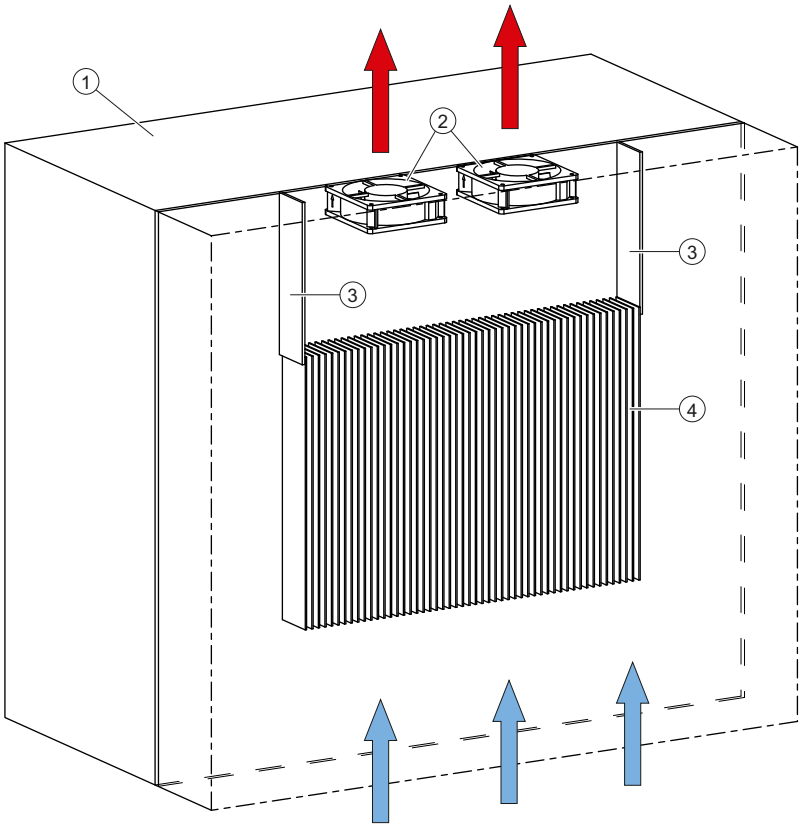
① Control cabinet
② External fan
③ Internal fan

Figure 12-20 Front view of a control cabinet with drive line-up, cold plate and external air heat sink

Setup:

- Infeed: Active Line Module 36 kW
- 4 Single Motor Modules
- Control Supply Module for 24 V supply
- Internal fan at the top of the control cabinet
- One shared external air heat sink

To optimize usage of the external air heat sink, it is best to arrange the components in such a way that the heat is dissipated equally over the surface of the external heat sink. This means that, if possible, a large power section should be situated next to a smaller one. The current carrying capacity of the DC-link busbars must be taken into account here.



① Control cabinet
② External fan
③ Air baffle plates
④ External air heat sink

Figure 12-21 Rear view of a control cabinet with drive line-up, cold plate and external air heat sink

In this example, two axial fans with a diameter of 150 mm ensure forced convection. The ribbed heat sink, which is attached to the rear, is located in an air duct (approx. 150 mm deep). Additional air guides at the sides improve air guidance and significantly optimize the power unit cooling.

Note

The external heat sink must be sealed with respect to the control cabinet in accordance with IP65.

Example: external air heat sink

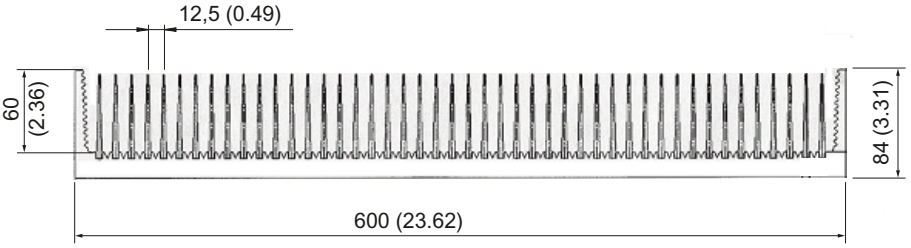


Figure 12-22 External air heat sink, all data in mm and (inches); height: 500 mm (19.69 inch)

Aluminum air heat sinks are recommended.
The heat sinks and fans must be dimensioned for the power loss to be dissipated. For the component-specific power loss in rated operation, refer to "Technical data". (Mean power loss in periodic duty is lower.)
The heat sinks and fans are not part of the scope of supply.
Recommended suppliers for heat sinks include:

Alcan company, Singen:

Sykatec company, Erlangen:

Note

The mounting surface for the heat sink (roughness, evenness) must fulfill the requirements for the corresponding cold plate component described in the chapter titled "Installation".

12.10.3 Cold plate with an external liquid heat sink

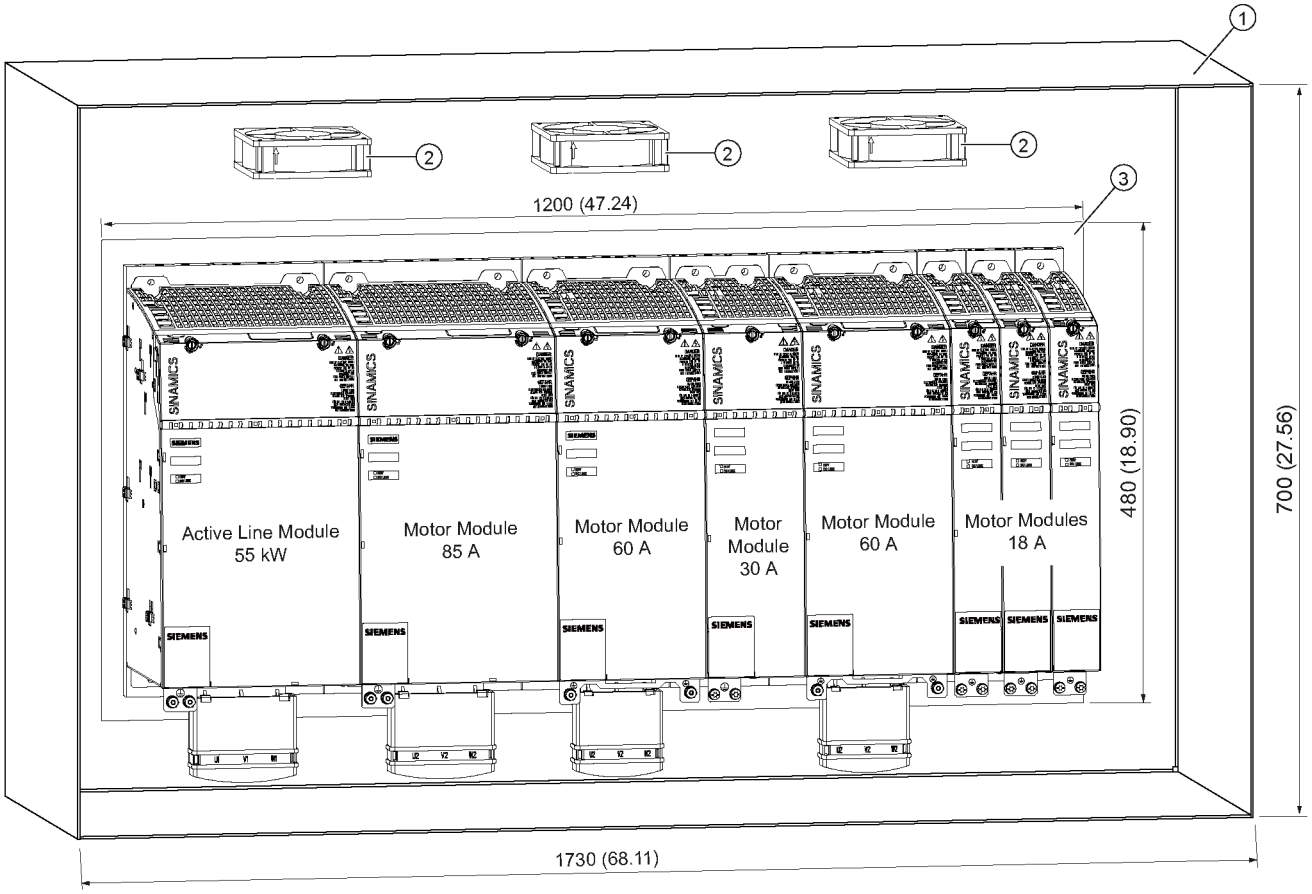
12.10.3.1 Configuration and conditions

When an external liquid heat sink is used, the power sections are all installed on a plate through which cooling water flows to cool the power units. The size of the liquid heat sink can be adjusted in line with the size of the drive line-up.

General conditions to be observed

1. The maximum temperature within the cabinet is 40°C
   (inlet air temperature of the power sections). The maximum temperature inside the cabinet for derating is 55 °C. For the relevant specifications, refer to the "Technical data".
2. The maximum permissible heat-sink temperature is module-dependent. Refer to the "Technical data" for more information. A temperature sensor in the power unit measures the temperature and can be read via parameter r0037.
3. The customer must take measures to protect the devices against condensation (see also chapter "Anti-condensation measures" under "Cooling circuit and coolant properties").

12.10.3.2 Setup example, drive-line-up, cold plate with external liquid heat sink



① Control cabinet
② Fan inside the control cabinet
③ External liquid heat sink

Figure 12-23 Example: cold plate drive line-up with external liquid cooling

Setup:

- Infeed: Active Line Module 55 kW
- 7 Single Motor Modules
- 3 internal fans at the top of the cabinet
- A joint external liquid heat sink (1200 mm x 480 mm)

The heat sinks and fans are not included in the scope of delivery.
Recommended supplier for the liquid heat sink:
DAU Ges.m.b.H & CO.KG., Ligist (Austria)
Rittal GmbH & Co. KG, Herborn

12.11 Notes on electrical cabinet cooling

12.11.1 Control cabinet cooling options

The following options are available for cooling the control cabinet:

- Filter fans
- Heat exchangers
- Cooling units
- Liquid cooling
- external air cooling
- external liquid cooling

The decision in favor of one of these methods will depend on the prevailing ambient conditions and the cooling power required.

The air routing within the control cabinet and the cooling clearances specified must be observed. No components may be installed and no cables routed in the cooling clearance spaces.

CAUTION
If you do not observe the guidelines for installing SINAMICS components in the cabinet, this can reduce the service life of the equipment and result in premature component failure.

You must take into account the following specifications when installing a SINAMICS drive line-up:

- Ventilation clearance
- Wiring and cabling
- Air guidance, air-conditioner

12.11.2 General information on ventilation

SINAMICS components are force-ventilated using integrated fans, and in some cases through natural convection. The fans are not equipped with temperature-dependent speed control; only the states "on" or "off" exist.

Fan operation up to firmware version 2.5

The fans are switched on and switched off as a function of the heat sink temperature.

The fans start at the heat sink temperature specified in the power stack data (normally 56 °C) and are switched off – with a slight hysteresis – as soon as the heat sink temperature decreases again. The run-on time of the fan depends on various factors such as ambient temperature, output current, duty cycle and, therefore, cannot be determined directly.

Fan operation from firmware version 2.6

The fans start when the pulse enable is set, and switch off with a small hysteresis as soon as the heat sink temperature, saved in the power stack data (typically 56 °C), is fallen below. The run-on time of the fan depends on various factors such as ambient temperature, output current, duty cycle and, therefore, cannot be determined directly.

Note

For the 5 kW and 10 kW Smart Line Modules, the fan runs permanently.

The cooling air must flow through the components vertically from bottom (cooler region) to top (region heated by operation).

If filtered fans, heat exchangers, or air conditioners are used, you must ensure that the air is flowing in the right direction. You must also ensure that the warm air can escape at the top. A ventilation clearance of at least 80 mm above and below must be observed.

NOTICE

The connected signal and power cables must be routed to the components in such a way that they do not cover the ventilation slots.

Cold air must not be allowed to blow directly onto electronic equipment.

Note

The distance between the blow-out aperture of the air conditioner and the electronic equipment must be at least 200 mm.

Note

If the components are installed in a sealed cabinet, an internal air cooling system must be installed to circulate the air and prevent hot spots. It is best to install the fan above the components to optimize the air flow (suction).

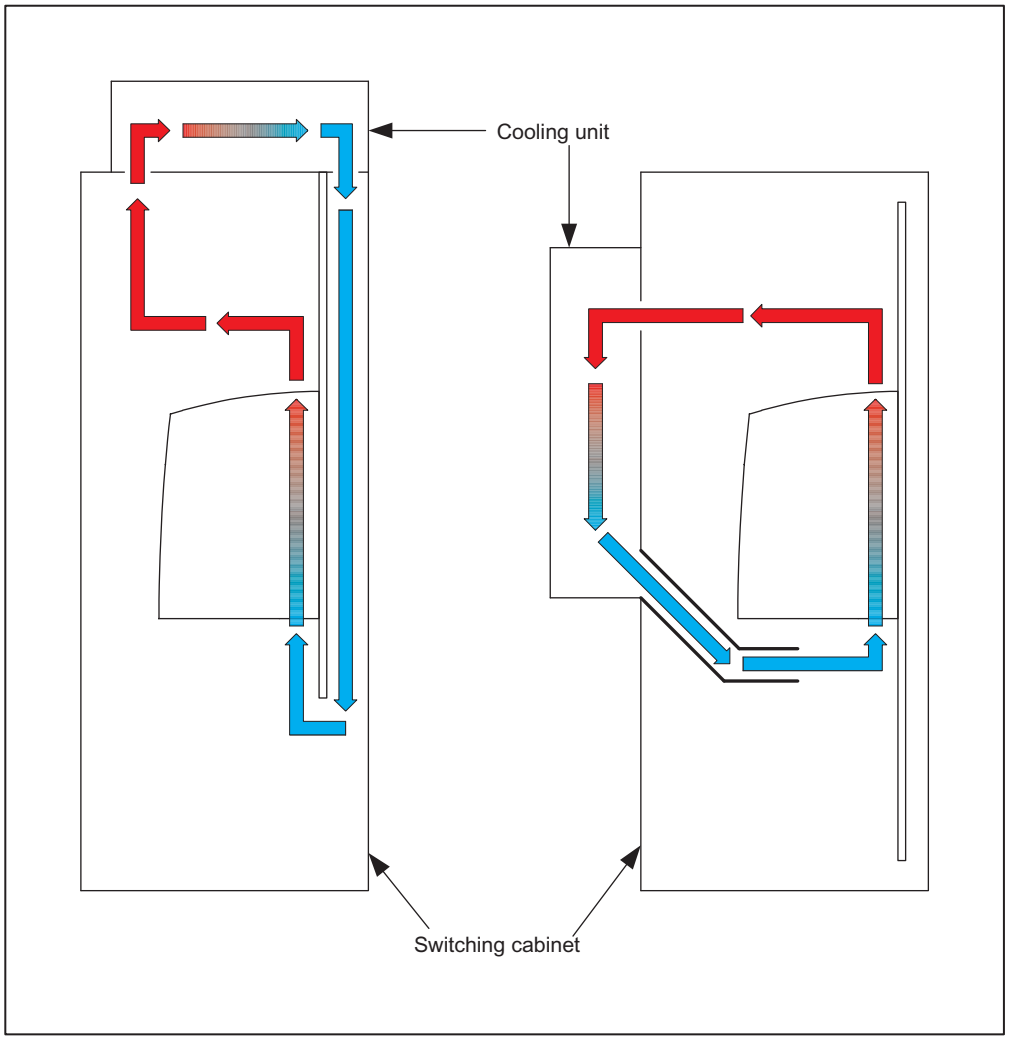


Figure 12-24 Examples of cabinet ventilation

CAUTION
The air guidance and arrangement of the cooling equipment must be chosen in such a way that no condensation can form on the components. If necessary, cabinet enclosure heating may have to be installed.

If air conditioners are used, the relative air humidity of the expelled air increases as the air in the air conditioner cools and may exceed the dew point. If the relative humidity of the air entering the SINAMICS components is over 80% for an extended period of time, it can be assumed that the insulation of the components will fail as a result of electrochemical reactions (refer to Chapter: System Overview). Using air baffle plates, for example, you must ensure that the cold air expelled from the air conditioner mixes with warm air in the cabinet before it enters the components. This reduces the relative air humidity to uncritical values.

12.11.3 Cooling clearances

Table 12- 27 Cooling clearances required above and below SINAMICS components

Component	Clearance [mm]
CU320-2	80
Sensor Modules Cabinet-Mounted SMCxx	50
Terminal Modules TMx	50
Line filter for Line Modules	100
Active Interface Modules	80
Line reactors for Line Modules	100
Active Line Modules 16 kW – 55 kW 80 kW – 120 kW	 80 80 (additional 50 in front of fan)
Smart Line Modules Booksize	80
Smart Line Modules Booksize Compact	80
Basic Line Modules	80
Motor Modules Booksize < 132 A 132 A and 200 A	 80 80 (additional 50 in front of fan)
Motor Modules Booksize Compact	80
Braking Module Booksize	80
Braking Module Booksize Compact	80
Control Supply Module	80
Capacitor Module	80

Drive line-up with internal air cooling

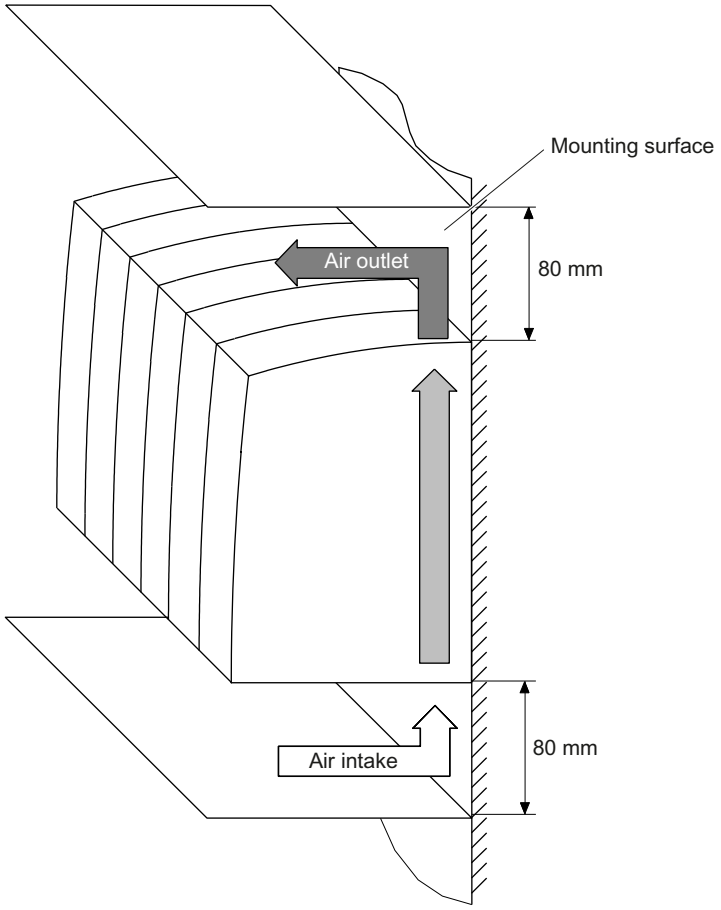


Figure 12-25 Cooling clearances for a drive line-up with internal air cooling (components up to 200 mm width)

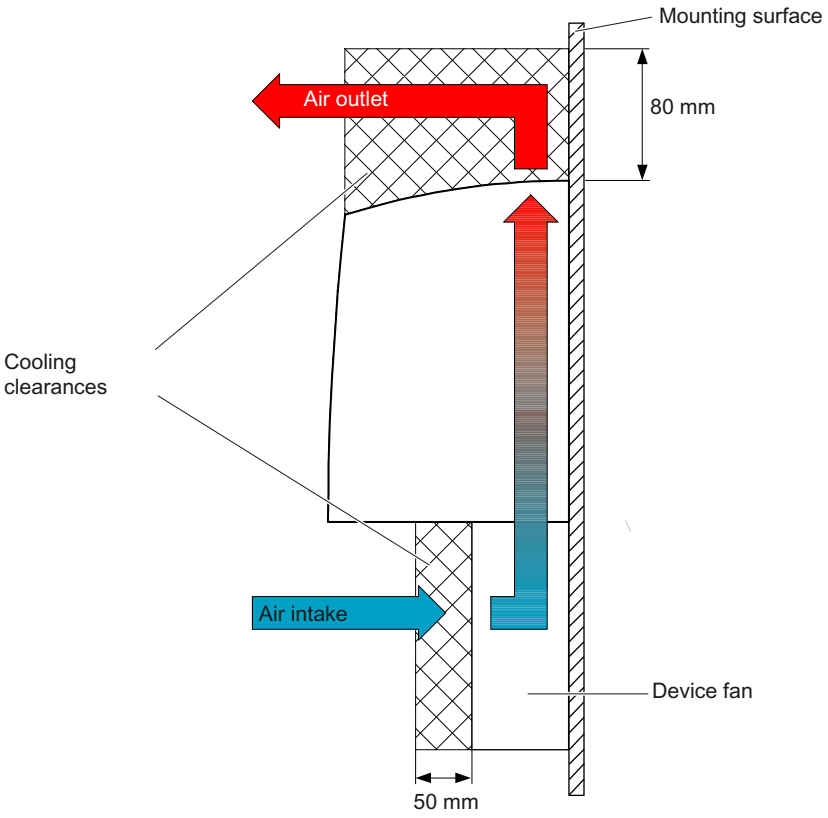


Figure 12-26 Cooling clearances for 300 mm wide components with internal air cooling with mounted unit fan

Drive line-up with external air cooling

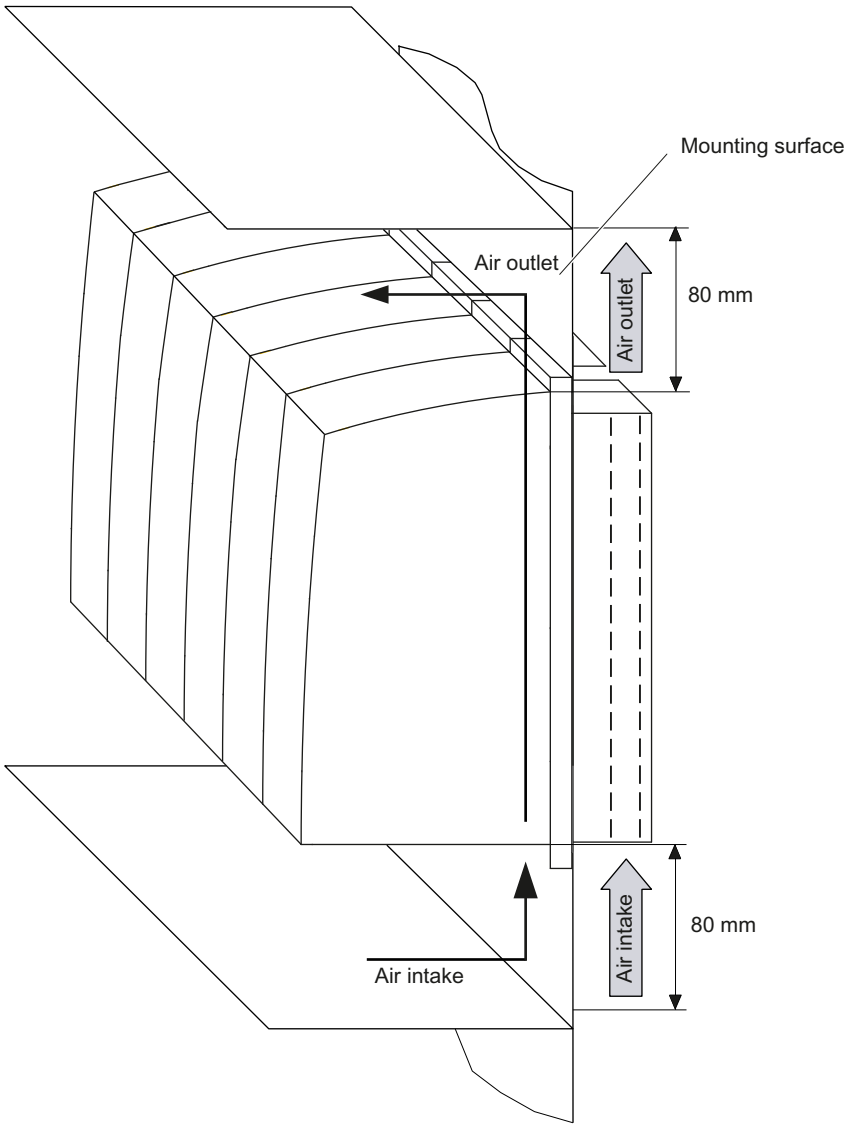


Figure 12-27 Cooling clearances for a drive line-up with external air cooling (components up to 200 mm width)

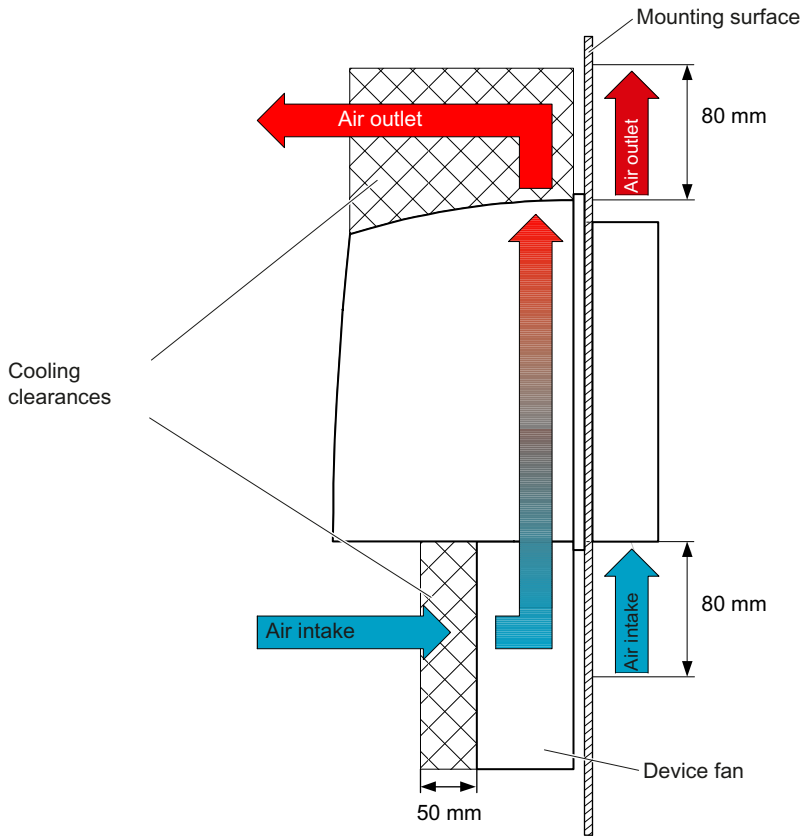


Figure 12-28 Cooling clearances for 300 mm wide components with external air cooling with mounted unit fan

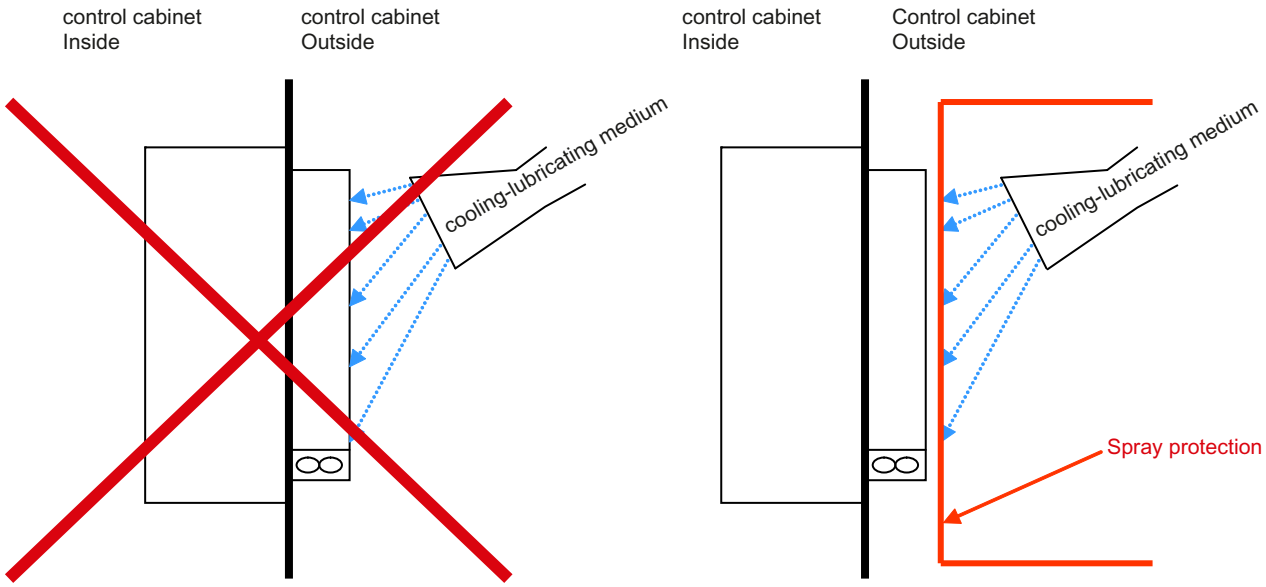


Figure 12-29 Spray protection for a drive line-up with external air cooling

Rail-mounted components

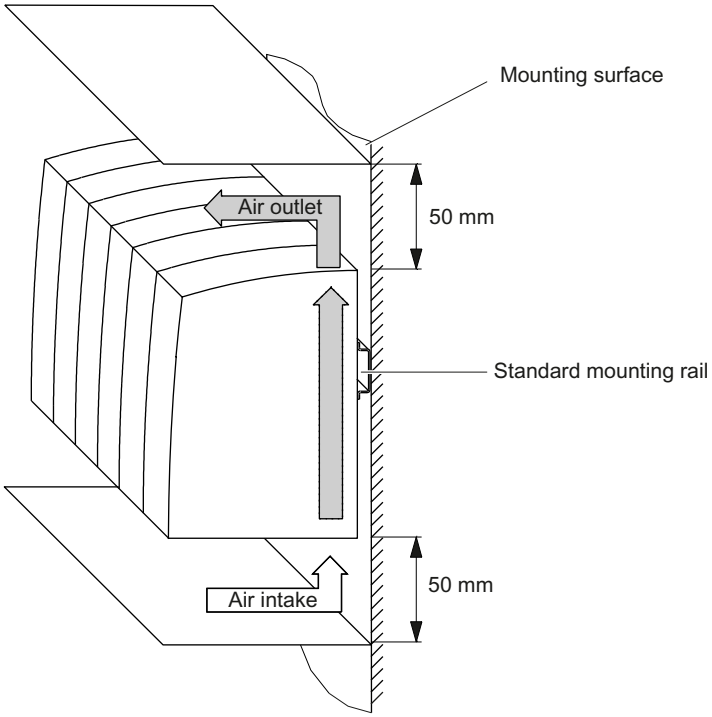


Figure 12-30 Cooling clearances for rail-mounted components (e.g. VSM, SMC, TM, DMC)

12.11.4 Notes on ventilation with cold plate

Notes on ventilation with cold plate

With cold-plate cooling, the SINAMICS devices must always be ventilated separately by means of a fan in the cabinet or by some other means.

When an external air heat sink is used, ventilation must also be provided outside the cabinet or by some other means.

Temperature measurement

The temperature of the power units can be read via parameter r0037.

Temperature limits

1. For the maximum heat sink temperature, see the "Technical data" for the power units.
2. For the maximum internal cabinet temperature, see the "Technical data" for the power units.

Measures for remaining within temperature limits

1. Install one or more fans.
2. If necessary, the drive line-up can be operated with derating.

12.11.5 Dimensioning Climate Control Equipment

Cabinet manufacturers provide calculation programs for selecting climate control equipment. It is always necessary to know the power loss of the components and equipment installed in the cabinet.

The physical relationship is shown in the following example.

$q = Q - k \times A \times \Delta T$

Formula to calculate the power loss

q = thermal power that has to be dissipated through a cooling unit [W]

Q = power loss [W]

ΔT = temperature difference between the room and cabinet interior [K]

k = thermal resistance value, e.g. sheet-steel, painted 5.5 [W / (m^2 * K)]

A = free-standing cabinet surface area [m^2]

Table 12- 28 Example, calculating the power loss of a drive configuration

Component	Number	Total power loss [W] (including electronic losses)	Total power loss [W]
CU320	1	20	20
Line filters	1	90	90
Line reactor	1	250	250
Active Line Module 36 kW	1	666	666
Motor Module 18 A	2	185,4	370,8
Motor Module 30 A	3	311,6	934,8
SMC	5	10	50
SITOP 20	1	53	53
Line contactor	1	12	12
Total:			2446,6

Assumption:

Free-standing cabinet surface area A = 5 m^2

Temperature difference between the room and cabinet interior ΔT = 10 K

q = 2446.6 W - 5.5 W / (m^2 K) * 5 m^2 * 10 K = 2171.6 W

12.12 Power loss of components during rated operation

12.12.1 General information

The tables below provide an overview of the power loss of all components during rated operation. The characteristic values apply for the following conditions:

- Line voltage for Line Modules 400 V
- Pulse frequency of the Motor Modules 4 kHz
- Rated pulse frequency of the Active Line Modules 8 kHz
- Operating components at their rated power

The total losses of the relevant power unit (Line Module, Motor Module) are calculated from the power loss and the corresponding electronics loss of the power unit.

12.12.2 Power loss for Control Units, Sensor Modules, and other system components

Table 12- 29 Overview of power loss during rated operation for Control Units, Sensor Modules, and other system components

	Unit	Power loss
Control Units and Option Boards		
CU320-2	W	24
TB30	W	< 3
CBC10	W	< 3
CBE20	W	2.8
Sensor Modules		
SMC10	W	< 10
SMC20	W	< 10
SMC30	W	< 10
SME20/25	W	≤ 4
SME120/125	W	≤ 4.5
Terminal Modules		
TM15	W	< 3
TM31	W	< 10
TM41	W	12
TM54F	W	4.5
Additional system components		
VSM10	W	< 10
DC link components		
Braking Module Booksize	W	20
Braking Module Booksize Compact	W	< 40
Capacitor Module	W	25
Control Supply Module Line DC link	W	 70 65
Voltage Clamping Module	W	50

12.12.3 Power loss for line filters and line reactors

Table 12- 30 Overview of power loss during rated operation for line filters and line reactors

	Unit	Power loss
Basic Line Filters for Active Line Modules		
16 kW	W	16
36 kW	W	26
55 kW	W	43
80 kW	W	56
120 kW	W	73
Basic Line Filter for Active Line Modules with Active Interface Module		
16 kW	W	16
36 kW	W	26
55 kW	W	43
80 kW	W	56
120 kW	W	73
Wideband Line Filter for Active Line Modules		
16 kW	W	70
36 kW	W	90
55 kW	W	110
80 kW	W	150
120 kW	W	200
Basic Line Filter for Smart Line Modules		
5 kW	W	5
10 kW	W	9
16 kW	W	16
36 kW	W	26
55 kW	W	43
Basic Line Filter for Basic Line Modules		
20 kW	W	16
40 kW	W	26
100 kW	W	73
Active Interface Modules		
16 kW	W	270 1)
36 kW	W	340 1)
55 kW	W	380 1)
80 kW	W	490 1)
120 kW	W	585 1)

	Unit	Power loss
Line reactors for Active Line Modules		
16 kW	W	170
36 kW	W	250
55 kW	W	350
80 kW	W	450
120 kW	W	590
Line reactors for Smart Line Modules		
5 kW	W	62
10 kW	W	116
16 kW	W	110
36 kW	W	170
55 kW	W	200
Line reactors for Basic Line Modules		
20 kW	W	130
40 kW	W	270
100 kW	W	480

1) Referred to $V_{DC\ link}$ 600 V

12.12.4 Power loss for power units with internal air cooling

Table 12- 31 Overview of power loss at rated operation for power units with internal air cooling (including electronics losses)

	Unit	Power loss
Active Line Modules		
16 kW	W	282.8
36 kW	W	666
55 kW	W	945.6
80 kW	W	1383.6
120 kW	W	2243.2
Smart Line Modules Booksize		
5 kW	W	79.2
10 kW	W	141.6
16 kW	W	187.8
36 kW	W	406
55 kW	W	665.6
Smart Line Modules Booksize Compact		
16 kW	W	187.8
Basic Line Modules		
20 kW	W	144
40 kW	W	283.6
100 kW	W	628

	Unit	Power loss
Single Motor Modules Booksize		
3 A	W	50.4
5 A	W	73.4
9 A	W	100.4
18 A	W	185.4
30 A	W	309.2
45 A	W	455.2
60 A	W	615.2
85 A	W	786
132 A	W	1270.4
200 A	W	2070.4
Single Motor Modules Booksize Compact		
3 A	W	68 1)
5 A	W	98 1)
9 A	W	100.4
18 A	W	185.4
Double Motor Modules Booksize		
3 A	W	97.6
5 A	W	132.6
9 A	W	187.6
18 A	W	351.2
Double Motor Modules Booksize Compact		
1.7 A	W	114 1)
3 A	W	134 1)
5 A	W	194 1)

1) Power loss at 8 kHz

12.12.5 Power loss for power units with external air cooling

Table 12- 32 Overview of power loss at rated operation for power units with external air cooling (including electronics losses)

	Unit	Internal Power loss [1)]	External power loss	Total power loss
Active Line Modules				
16 kW	W	82.8 (60 + 22,8)	200	282.8
36 kW	W	171 (135 + 36,0)	495	666
55 kW	W	245.6 (200 + 45,6)	700	945.6
80 kW	W	338.6 (305 + 33,6)	1045	1383.6
120 kW	W	533.2 (490 + 43,2)	1710	2243.2
Smart Line Modules				
5 kW	W	41.2 (22 + 19,2)	38	79.2
10 kW	W	66.6 (45 + 21,6)	75	141.6
16 kW	W	64.8 (42 + 22,8)	123	187.8
36 kW	W	116 (80 + 36)	290	406
55 kW	W	185.6 (140 + 45,6)	480	665.6
Single Motor Modules				
3 A	W	35.4 (15 + 20,4)	15	50.4
5 A	W	43.4 (23 + 20,4)	30	73.4
9 A	W	55.4 (35 + 20,4)	45	100.4
18 A	W	95.4 (75 + 20,4)	90	185.4
30 A	W	99.2 (80 + 19,2)	210	309.2
45 A	W	135.2 (110 + 25,2)	320	455.2
60 A	W	160.2 (135 + 25,2)	455	615.2
85 A	W	196 (160 + 36,0)	590	786
132 A	W	270.4 (250 + 20,4)	1000	1270.4
200 A	W	455.4 (435 + 20,4)	1615	2070.4
Double Motor Modules				
3 A	W	62.6 (35 + 27,6)	35	97.6
5 A	W	72.6 (45 + 27,6)	60	132.6
9 A	W	92.6 (65 + 27,6)	95	187.6
18 A	W	111.2 (80 + 31,2)	240	351.2

1) Power loss of the power electronics + power loss of the 24 V electronics

12.12.6 Power loss for power units with cold plate

With cold-plate cooling, only part of the power loss remains in the cabinet.
The table below shows the internal and external power loss of the components.

Table 12- 33 Overview of power loss at rated operation for power units with cold plate (including electronics losses)

	Unit	Internal power loss [1)]	External power loss	Total power loss
Active Line Modules				
16 kW	W	70.4 (50 + 20,4)	210	280.4
36 kW	W	135.2 (110 + 25,2)	520	655.2
55 kW	W	187.6 (160 + 27,6)	740	927.6
80 kW	W	283.6 (250 + 33,6)	1100	1383.6
120 kW	W	443.2 (400 + 43,2)	1800	2243.2
Smart Line Modules Booksize				
5 kW	W	34.4 (20 + 14,4)	40	74.4
10 kW	W	56.8 (40 + 16,8)	80	136.8
Smart Line Modules Booksize Compact				
16 kW	W	56.6 (36,2 + 20,4)	130	186.6
Basic Line Modules				
20 kW	W	46.6 (25 + 21,6)	95	141.6
40 kW	W	71.4 (45 + 26,4)	205	276.4
100 kW	W	168.4 (130 + 38,4)	450	618.4
Single Motor Modules Booksize				
3 A	W	27.6 (12 + 15,6)	18	45.6
5 A	W	35.6 (20 + 15,6)	35	70.6
9 A	W	45.6 (30 + 15,6)	50	95.6
18 A	W	80.6 (65 + 15,6)	100	180.6
30 A	W	85.6 (70 + 15,6)	220	305.6
45 A	W	108 (90 + 18,0)	340	448
60 A	W	128 (110 + 18,0)	480	608
85 A	W	149.2 (130 + 19,2)	620	769.2
132 A	W	220.4 (200 + 20,4)	1050	1270.4
200 A	W	370.4 (350 + 20,4)	1700	2070.4
Single Motor Modules Booksize Compact				
3 A	W	25.6 (10 + 15,6)	40	65.6
5 A	W	30.6 (15 + 15,6)	65	95.6
9 A	W	45.6 (30 + 15,6)	50	95.6
18 A	W	80.6 (65 + 15,6)	100	180.6
Double Motor Modules Booksize				
2x3 A	W	55.6 (34 + 21,6)	36	91.6
2x5 A	W	61.6 (40 + 21,6)	65	126.6
2x9 A	W	81.6 (60 + 21,6)	100	181.6
2x18 A	W	95.2 (70 + 25,2)	250	345.2

	Unit	Internal power loss 1)	External power loss	Total power loss
Double Motor Modules Booksize Compact				
2x1.7 A	W	42 (20,4 + 21,6)	72	114
2x3 A	W	44 (22,4 + 21,6)	90	134
2x5 A	W	59 (37,4 + 21,6)	135	194

1) Power loss of the power electronics + power loss of the 24 V electronics

Note

Lower average power losses are obtained for intermittent duty.

12.12.7 Power loss for liquid-cooled power units

Table 12- 34 Overview of power loss during rated operation for liquid-cooled power units (including electronics losses)

	Unit	Internal power loss 1)	External power loss	Total power loss
Active Line Modules				
120 kW	W	443.2 (400 + 43,2)	1800	2243.2
Single Motor Modules				
200 A	W	370.4 (350 + 20,4)	1700	2070.4

1) Power loss of the power electronics + power loss of the 24 V electronics

12.12.8 Electronics losses of power units

Table 12- 35 Electronics losses for power units with internal/external air cooling

Component		Internal/external air cooling Power loss [W]
Single Motor Modules	3 A	20.4
	5 A	20.4
	9 A	20.4
	18 A	20.4
	30 A	19.2
	45 A	25.2
	60 A	25.2
	85 A	36.0
	132 A	20.4
	200 A	20.4
Single Motor Modules Booksize Compact	3 A	20.4
	5 A	20.4
	9 A	20.4
	18 A	20.4
Double Motor Modules	3 A	27.6
	5 A	27.6
	9 A	27.6
	18 A	31.2
Double Motor Modules Booksize Compact	1.7 A	27.6
	3 A	27.6
	5 A	27.6
Active Line Modules	16 kW	22.8
	36 kW	36.0
	55 kW	45.6
	80 kW	33.6
	120 kW	43.2
Basic Line Modules	20 kW	24
	40 kW	33.6
	100 kW	48
Smart Line Module	5 kW	19.2
	10 kW	21.6
	16 kW	22.8
	36 kW	36.0
	55 kW	45.6
Smart Line Module Booksize Compact	16 kW	22.8

Table 12- 36 Electronics losses for power units with cold plate

Component		Cold plate Power loss [W]
Motor Modules Booksize	3 A	15.6
	5 A	15.6
	9 A	15.6
	18 A	15.6
	30 A	15.6
	45 A	18.0
	60 A	18.0
	85 A	19.2
	132 A	20.4
	200 A	20.4
	2x3 A	21.6
	2x5 A	21.6
	2x9 A	21.6
	2x18 A	25.2
Motor Modules Booksize Compact	3 A	15.6
	5 A	15.6
	9 A	15.6
	18 A	15.6
	2x1.7 A	21.6
	2x3 A	21.6
	2x5 A	21.6
Active Line Modules	16 kW	20.4
	36 kW	25.2
	55 kW	27.6
	80 kW	33.6
	120 kW	43.2
Smart Line Module Booksize	5 kW	14.4
	10 kW	16.8
Smart Line Module Booksize Compact	16 kW	20.4
Basic Line Modules	20 kW	21.6
	40 kW	26.4
	100 kW	38.4

Table 12- 37 Electronics losses for liquid-cooled power units

Component		Liquid cooled Power loss [W]
Motor Module	200 A	20.4
Active Line Module	120 kW	43.2

12.12.9 Losses for power units in the partial load range

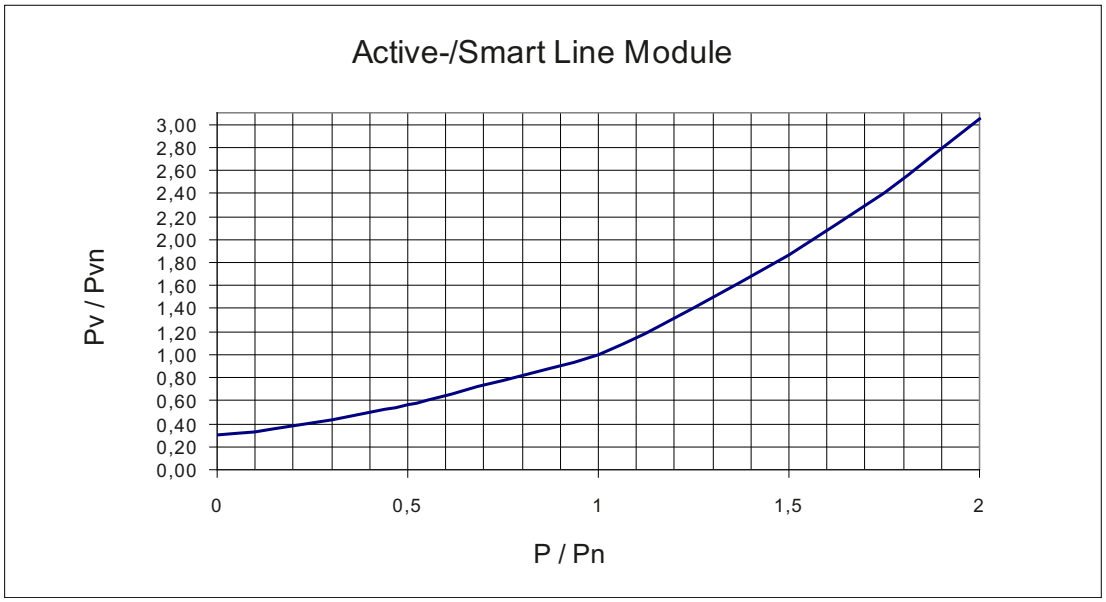


Figure 12-31 Losses in the partial load range for Active Line Modules and Smart Line Modules

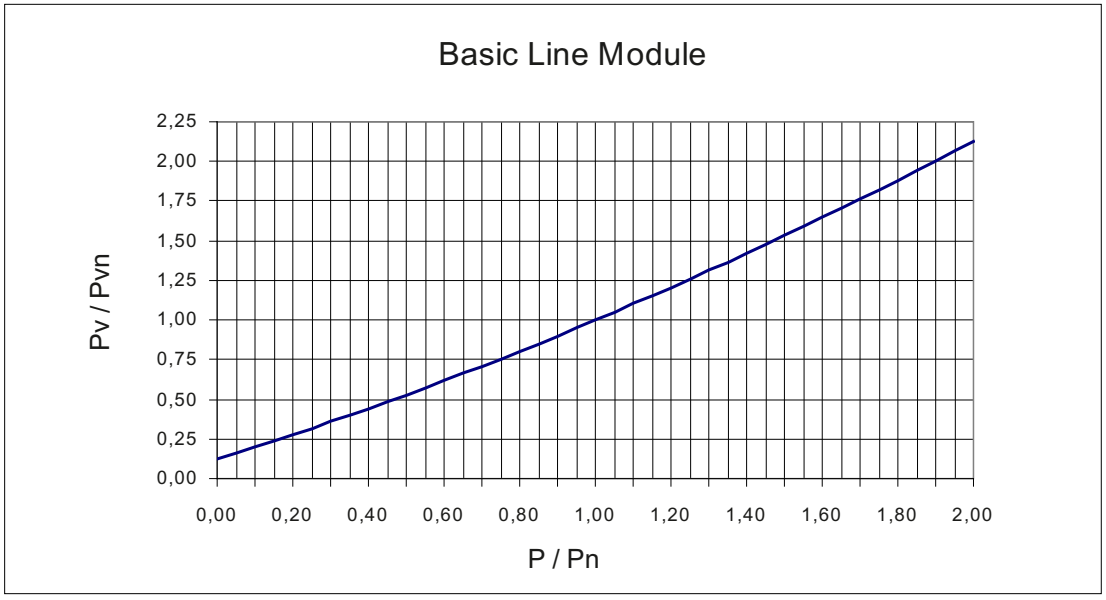


Figure 12-32 Losses in the partial load range for Basic Line Modules

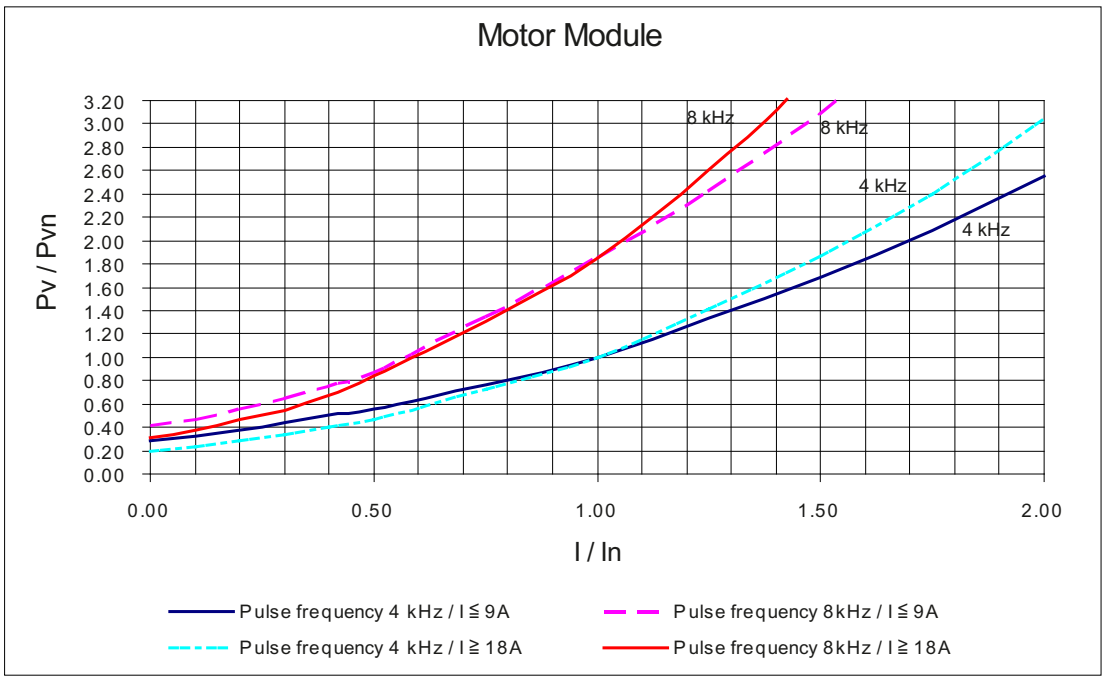


Figure 12-33 Losses in the partial load range for Motor Modules

12.12.10 Typical power losses for Motor Modules

The information on the power losses in the previous chapters are maximum values, which occur in the most unfavorable case. For typical applications, the losses are lower.

The following applies as typical application:

- Maximum motor cable length, 30 m
- 4 kHz pulse frequency
- DC link voltage 540 V - 600 V

The power loss for typical applications can be calculated using the following formula:

$P_V [W] = a + S_1 \cdot (I_1 + I_2) + S_2 \cdot (I_1^2 + I_2^2)$

a	Electronics losses of the Motor Module
S_1, S_2	Coefficients to calculate power loss
I_1	Current (arithmetic mean value) of the 1st axis
I_2	Current (arithmetic mean value) of the 2nd axis

Overview of required coefficients

Table 12- 38 Coefficients to calculate the power loss in the control cabinet for internally cooled Motor Modules for typical applications

Motor Module	a [W]	S_1 [W/A]	S_2 [W/A^2]
3 A Single Motor Module	14	3.29	0.205
5 A Single Motor Module	14	3.29	0.205
9 A Single Motor Module	14	3.29	0.205
18 A Single Motor Module	14	3.29	0.205
30 A Single Motor Module	20	4.71	0.113
45 A Single Motor Module	25	5.50	0.054
60 A Single Motor Module	25	5.50	0.054
85 A Single Motor Module	36	6.11	0.030
132 A Single Motor Module	150	6.01	0.018
200 A Single Motor Module	150	6.01	0.017
3 A Double Motor Module	19	5.20	0.200
5 A Double Motor Module	19	5.20	0.200
9 A Double Motor Module	19	5.18	0.247
18 A Double Motor Module	22	5.57	0.091

Table 12- 39 Coefficients to calculate the power loss in the control cabinet for externally cooled Motor Modules for typical applications

Motor Module	a [W]	S_1 [W/A]	S_2 [W/A^2]
3 A Single Motor Module	10	2.30	0.100
5 A Single Motor Module	10	2.30	0.100
9 A Single Motor Module	10	2.30	0.100
18 A Single Motor Module	10	2.34	0.101
30 A Single Motor Module	16	1.29	0.057
45 A Single Motor Module	21	1.31	0.015
60 A Single Motor Module	27	1.37	0.006
85 A Single Motor Module	32	1.37	0.006
132 A Single Motor Module	50	1.06	0.004
200 A Single Motor Module	50	1.06	0.004
3 A Double Motor Module	15	1.37	0.240
5 A Double Motor Module	15	1.37	0.240
9 A Double Motor Module	15	1.37	0.240
18 A Double Motor Module	18	1.56	0.056

12.13 Insulation test

Insulation test

In accordance with EN 60204-1, an insulation test must be performed on the machine/system.

This can be performed either by

- insulation resistance testing or
- voltage testing

.

⚠ WARNING
Disconnect the machine/system from the power supply prior to testing.

Insulation resistance testing

Insulation resistance testing should be preferred. The insulation resistance for the test must not be lower than 1 MΩ Testing is carried out with 500 V DC between the main-circuit conductors [1)] and the protective conductor system. Testing may be carried out on individual sections of the system.

Exception: A lower resistance value is permissible for certain components of the electrical equipment; however, the value must not be lower than 50 kΩ.

SINAMICS components are covered by this exception. They must therefore be disconnected during testing and tested separately.

Voltage testing

⚠ WARNING
Test equipment to EN61180-2 should be used for voltage testing.

The rated frequency for the test voltage must be 50 Hz or 60 Hz.

The maximum test voltage must be either twice the rated voltage value for the equipment power supply or 1000 V. The larger of the two values should be used. The maximum test voltage must be applied between the conductors of the main circuits [1)] and the protective conductor system for approx. 1 s.

Components and devices that are not rated to withstand this test voltage must be disconnected prior to testing.

Components and devices that are voltage tested according to their product standard may be disconnected during testing.

The SINAMICS components are voltage-tested to EN 61800-5-1 and must be be disconnected during this test.
If they cannot be disconnected, the input and output terminals must be shorted and a bypass installed. In this case, a DC voltage that is 1.5 times the AC test voltage should be used for testing.

1) Main circuits are circuits that are electrically connected to the line voltage.

Cooling circuit and coolant properties 13

13.1 Cooling circuit requirements

13.1.1 Technical cooling circuits

Technical cooling circuits can be divided into three systems:

1. **Closed cooling circuits (recommended)**
   In closed systems, the circuit coolant is separated from the surrounding atmosphere, which prevents the ingress of oxygen. The coolant is only routed through the SINAMICS devices, the components required for cooling and, if necessary, a motor. The heat is dissipated to the atmosphere indirectly by means of heat exchangers. The system should ideally function without losing any coolant and, once filled, should not need any water to be added. The composition of the coolant can be adjusted as required (e.g. by using desalinated water and adding anti-corrosion agents). It either does not change at all during operation, or changes only in a defined manner.
   The closed cooling circuit is recommended as a standard solution.
2. **Open cooling circuit**
   The coolant is routed not only through the SINAMICS devices and components required for cooling, but also through external devices.
   The heat transferred to the circuit coolant evaporates via a cooling tower. This evaporation causes the coolant to become more concentrated (densification) because water molecules escape, while dissolved substances remain in the coolant. During operation, therefore, the composition of the coolant changes significantly, which means that it must be monitored and topped up continuously.
3. **Semi-open cooling circuit**
   Oxygen can only enter the coolant via the pressure compensator. Otherwise, see 1.
   Semi-open cooling circuits are permitted.

13.1.2 Cooling system requirements

Open cooling systems must never be used for liquid-cooled power units. A closed cooling circuit with a membrane expansion tank, safety valve, and heat exchanger is recommended, which connects the cooling circuit to an external cooler (refer also to the chapter titled "Using heat exchangers").

Requirements

- A particle filter (particle size < 100 µm) must be installed in the cooling circuit to prevent foreign particles from being washed in.
- Mixed installations should be avoided wherever possible.
- The permissible pressures in the cooling system must be observed.
- Cavitation must be prevented in the cooling system.
- Equipotential bonding must be provided between the components in the cooling system.
- The customer must take measures to protect the devices against condensation
- An anti-corrosion agent and, if necessary, a biocide should be mixed into the coolant.
- If there is a risk of frost, preventive measures must be taken during operation, storage, and transportation (e.g. emptying and blowing out with air, additional heating).
- The requirements of the coolant in terms of its properties (temperature, chemical characteristics, etc.) must be observed.

Recommendations

- To ensure mechanical decoupling, the devices should be connected by means of hoses.
- To prevent blockages and corrosion, you are advised to install a flushback filter in the circuit (so that residues can be rinsed out when the system is running).
- The power units should be connected to the cooling circuit by means of shut-off fittings so that they can be disconnected from the cooling circuit for servicing or repair without having to empty the entire cooling system. A cooling water hose (EPDM) can be used to connect the shut-off fitting to the power unit. The coolant connections must never be closed if cooling liquid is still present in the device. Reason: If the cooling fluid expands due to heat, the pressure can build up beyond permissible levels and cause the heat sink to burst.

13.1.3 Cooling circuit configuration

The liquid-cooled power units are designed to be connected in parallel to the cooling circuit. The pressure drop in the joint supply and return lines is to be kept at negligible levels by choosing a sufficiently large pipe diameter. The supply line has a differential pressure p compared to the return line; this pressure is usually generated by a pump.

A pump's pressure depends on the volumetric flow, so the pressure created will depend on the number of components which are connected. At the minimum differential pressure p1 (measured between the supply and return lines of the individual component), the volume of coolant required to enable the component to achieve its rated power or rated current is to flow through each component. At the maximum differential pressure p2 (measured between the supply and return lines of the individual component), the volumetric flow must not result in damage to the component, for example by means of cavitation. If necessary, pressure reducing valves such as baffle plates will have to be installed in the piping; these must be easy to access, clean, and/or replace.

When the pump is switched off, static pressure occurs in the system. The static pressure can be influenced by the primary pressure of the membrane expansion tank and should be at least 30 kPa on the pump's suction side. If the static pressure is too low, the pump may be damaged due to cavitation during operation. If necessary, note any differing minimum pressure values from the pump manufacturer. When components are installed at different heights, the geodesic pressure caused by the height difference must be taken into account (1 m height difference corresponds to 10 kPa).

When the pump is switched on, a (location-dependent) flow pressure is present in the cooling circuit, which must be determined from the pump characteristic curve and the volume-flow-dependent pressure drop. The pressure drop in the filter and, if applicable, an additional pressure drop in the connection pipes must be added to the pressure drop of the liquid-cooled power units (70 kPa for H2O). Up to 50 kPa must be added for the pressure drop in a (contaminated) filter and in connection pipes. The intersection of the pump characteristic curve and the pressure drop of the whole cooling system yields the volumetric flow Vn of the coolant at this operating point.

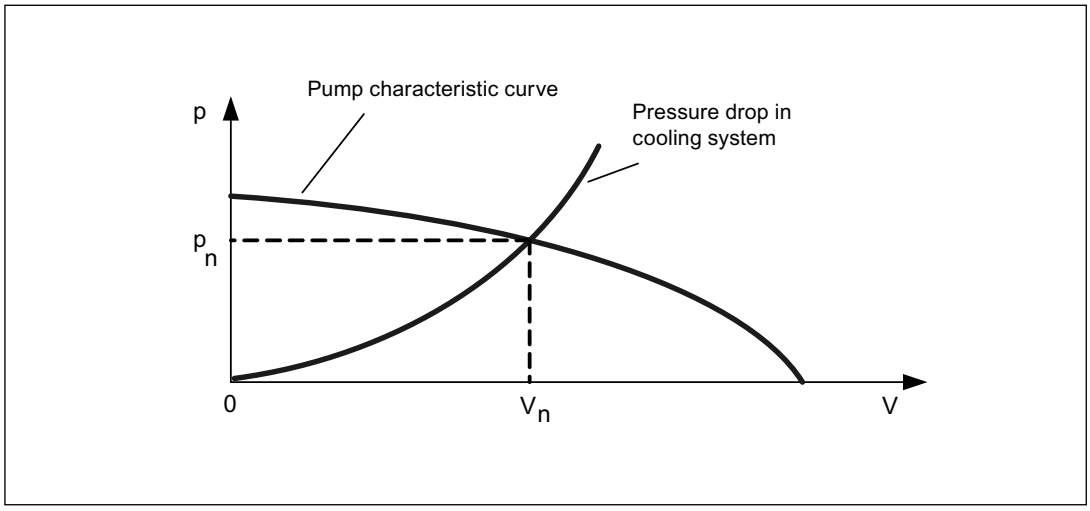


Figure 13-1 Pump characteristic curve

Permissible system pressure

The maximum permissible system pressure is 600 kPa.
If a pump that is capable of exceeding this maximum permissible system pressure is used, the customer must take steps (e.g. safety valve p ≤ 600 kPa, pressure control, or similar) to ensure that the maximum pressure limit is not exceeded.

Permissible pressure difference

The maximum permissible pressure difference for a heat sink is 200 kPa. Higher pressure differences significantly increase the risk of cavitation and abrasion. The lowest possible differential pressure between the coolant in the supply and return lines should be selected to allow pumps with a flat characteristic to be used.

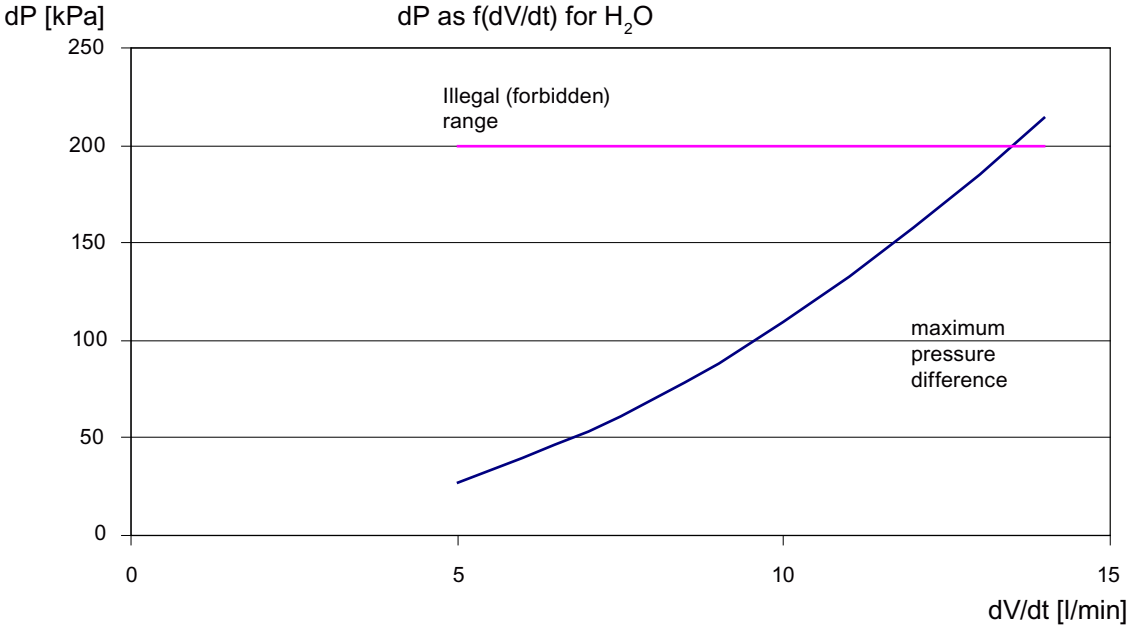


Figure 13-2 Pressure difference as a function of volumetric flow

Pressure difference and pressure drop when using coolant mixtures

If a mixture of Antifrogen N and H_2O is used as a coolant, the rated pressure must be calculated according to the mixing ratio. The following table specifies the pressure drop across components at different coolant temperatures for a coolant with mixing ratio 45 % Antifrogen N.

Table 13- 1 Pressure drop at different coolant temperatures for Antifrogen N/H_2O: 45 %

dV/dt H_2O [l/min]	dP H_2O [kPa]	dP Antifrogen N 0 °C [kPa]	dP Antifrogen N 20 °C [kPa]	dP Antifrogen N 45 °C [kPa]	dP Antifrogen N 50 °C [kPa]
8	70	121	97	81	78

The characteristic curves for the pressure drop across the heatsinks as a function of volumetric flow vary depending on the temperature and the Antifrogen N / water coolant mix.

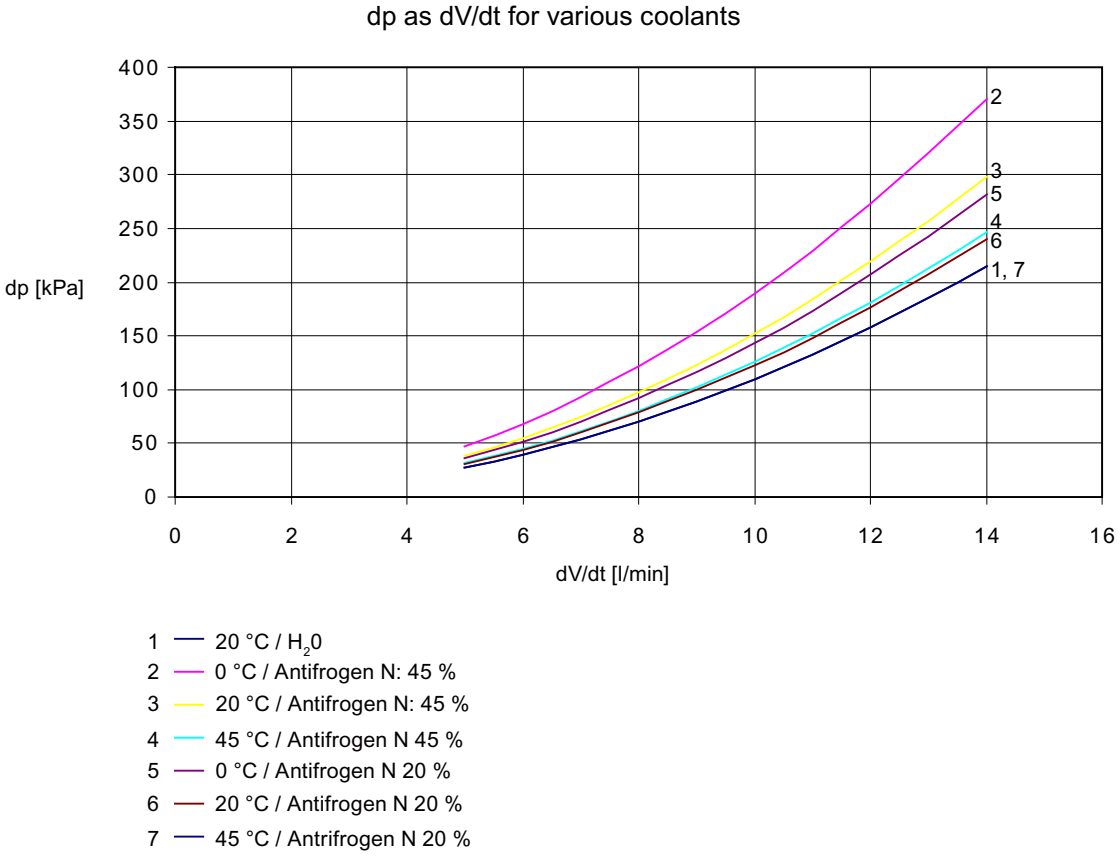


Figure 13-3 Pressure difference as a function of volumetric flow

Operating pressure

The **operating pressure** must be set according to the flow conditions in the supply and return lines of the cooling circuit. The required coolant flow rate per time unit must be set according to the technical data of the components. The components are normalized to a rated pressure of 70 kPa (for coolant type H_2O) via a baffle plate.

Layout of the components

The components should be laid out in the system in such a way that the overall length of the supply and drain lines is the same for every SINAMICS component.

Water cooling systems with series-connected SINAMICS devices are not permitted.

Dimensioning the cooling circuit

Recommendation for dimensioning the cooling circuit:

The differential pressure between the supply and return lines should be selected so that:

$\Sigma dPi < dP_{Syst} < \Sigma dPi + 30$ kPa

The individual pressure drops Pi represent the pressure drops of components (heat exchanger, piping, 70 kPa for the SINAMICS devices connected in parallel, valves, dirt traps, pipe bends, etc.).

Coolant pipes must be routed with extreme care. The pipes must never come into contact with electrically live components. An insulation clearance of > 13 mm must always be maintained between pipes and live parts. The pipes must be securely mounted and checked for leaks.

13.1.4 Installation

A closed stainless-steel cooling circuit, preferably combined with monitoring of the coolant quality, is strongly recommended to ensure the longest possible service life for the heat sink.

CAUTION
Coolant pipes must be routed with extreme care. The pipes must be securely mounted and checked for leaks. The cables must never come into contact with live components.

Materials and connections

Stainless-steel pipes are used to route the coolant through the cooling plates on the liquid-cooled power units. When it comes to power units with internal liquid cooling, the coolant is routed by means of integrated channels in the aluminum cold plate.

To minimize the electrochemical processes taking place in the cooling system, the materials must be coordinated with one another accordingly. For this reason, mixed installations (i.e. a combination of different materials, such as copper, brass, iron, zinc, or halogenated plastic (PVC hoses and seals)) should not be used or should be limited to an absolute minimum.

The valves and connections required in the cooling system must be made of stainless steel (V2A or V4A steel; NIROSTA austenite).

The following materials can be used for the cooling system piping:

- Pipes and corrugated piping made of stainless steel (V2A or V4A steel; NIROSTA austenite)
- Hoses made of EPDM / EPDM with an electrical resistance $<10^9$ ohms (e.g. Semperflex FKD; the Semperit company ,Wimpassing - Austria))
- DEMITEL® hoses made of PE / EPDM (the Telle company, Nuremberg)
- Secure with clips that comply with DIN2871, available from Telle, for example.

All control cabinets must be designed with a PE busbar and a good electrical connection must be established between them.

NOTICE
The sealing materials must be free of chlorides, graphite, and carbon (Viton® or EPDM).

Note

When non-conductive hoses are used, particular attention must be paid to the equipotential bonding of all components. (see chapter "Equipotential bonding")

Note

Teflon-based seals are not permitted.

Note

Once installed, the cooling system must be checked to ensure that it is properly sealed.

13.1.5 Preventing cavitation

The following applies to all cooling circuits:

- The cooling circuit must always be designed in such a way that the pressure compensator is located on the suction side of the pump (if possible, directly on the pump).
- The minimum pressure on the suction side of the pump must be approximately 30 kPa, or the geodesic height from the reservoir to the pump suction side must be > 3 m.
- The pressure drop across a SINAMICS device must not exceed 200 kPa in continuous operation, otherwise the high volumetric flow can increase the risk of cavitation and/or abrasion damage.
- The guidelines provided in the chapter titled "Configuring cooling circuits in accordance with the pressure" regarding series connection and maximum pressure must also be followed.

13.1.6 Commissioning

When commissioning the cooling water circuit, the following sequence must be observed:

- Ventilate the heat sink the first time the devices are filled.
- Remove the fixing glands located in front of the vent valve.
- Perform ventilation.
- Close the vent valve.
- Screw the fixing glands tight again.
- Check the seals.
- Set the operating pressure according to the flow conditions of the cooling water system in the supply and return lines.
- Set the required cooling water flow rate per time unit.

CAUTION
Ventilation must only be performed when the system is at zero voltage.

13.2 Coolant requirements

13.2.1 Coolant properties

Properties of the cooling medium

Water or a water/anti-freeze mixture that meets the relevant requirements can be used as a cooling medium. The cooling medium must be chemically neutral, clean, and not contain any solids.

The cooling water must fulfill the following requirements over the long term:

Table 13- 2 Cooling water specifications

		Liquid Cooled
Properties		Chemically neutral, clean, free of solids
Max. inlet temperature (during operation)	°C	45 (55 with derating)
Max. coolant temperature	°C	55
Operating pressure	kPa	100 to 600
System pressure (with respect to the atmosphere)	kPa	600
Test pressure (with respect to the atmosphere)	kPa	1200
Minimum differential pressure p1	kPa	70
Nominal differential pressure p_n	kPa	100
Maximum differential pressure p2	kPa	200
Flow rate	l/min	5 to 8
Max. particle size of any residue	mm	0.1
pH value		6.5 to 9
Chloride	ppm	< 200
Sulfate	ppm	< 240
Nitrate	ppm	< 50
Dissolved solids	ppm	< 340
Total hardness	ppm	< 170
Electrical conductivity	µS/cm	< 2000

NOTICE
Condensation must not be allowed to form on the SINAMICS S120 equipment as a result of supercooling. The temperature of the cooling water may have to be regulated.

NOTICE
The heat sink is made of non-seawater-proof material, which means that it must not be cooled directly with seawater.

Note

As a general rule, tap water is not suitable for use in the cooling circuit,
although it can be mixed with de-ionized water. Losses must always be replenished with de-ionized water.

Note

The flow created when the heat sinks are filled results in automatic ventilation, so there is no need for the devices to be ventilated separately.

The coolant should be checked 3 months after the cooling circuit is filled for the first time and, subsequently, once a year. If the cooling water becomes cloudy, is colored, or becomes contaminated by mould spores, the cooling circuit must be cleaned and refilled.

An inspection glass should be provided in the cooling circuit to make it easier to check the cooling water.

13.2.2 Corrosion Inhibitor Additive (Inhibiting)

Nalco 00GE056 (Nalco company) is recommended as anti-corrosion agent. The concentration of anti-corrosion agent in the cooling water must be at least 2500 ppm (250 ml/100 liters KW).
The water quality must meet the specifications contained in the chapter titled "Coolant properties" or the water used must be de-ionized.

NOTICE
Corrosion inhibitor does not need to be added if the anti-freeze Antifrogen N is used in the right concentration (refer to the chapter titled "Addition of antifreeze").

13.2.3 Anti-Freeze Additive

Antifrogen N (the Clariant company) is recommended as antifreeze. The proportion of antifreeze must be between 20% and 30%. This ensures frost protection in temperatures down to -10 °C.

NOTICE
If the proportion of antifreeze added is greater than 30%, this can inhibit the transfer of heat and prevent the devices from functioning correctly.

Note

You must always bear in mind that the kinematic viscosity of the cooling water changes when anti-freeze is added, which means that the pump power must be adjusted accordingly.

NOTICE
Cooling water mixtures with Antifrogen N are highly conductive. In the event of leakage, the insulating systems must be cleaned.

NOTICE
When EPDM hoses are used, oily corrosion inhibitor additives must not be used because additives can corrode and destroy EPDM.

13.2.4 Biocide additives (only if required)

Closed cooling circuits with soft water (°DH > 4) are susceptible to microbes. The risk of corrosion caused by microbes is virtually non-existent in chlorinated drinking water systems.

If Antifrogen N antifreeze is used with a concentration of 20% or higher, it can be assumed that there is an adequate biocide effect.

The following types of bacteria are encountered in practice:

- Slime-forming bacteria
- Corrosive bacteria
- Iron-depositing bacteria

The type of bacteria determines the suitability of a biocide. At least one water analysis per year (to determine the number of bacterial colonies) is recommended. Suitable biocides are available, for example, from Nalco.

Recommendation

It is recommended that Nalco N 77352 should be dosed twice a month. The dosing quantity is 5 - 15 mg/100 liters of cooling water. This product has no adverse effect on Nalco 00GE056 corrosion inhibitor.

Note

The type of bacteria determines the biocide.

The manufacturer's recommendations must be followed regarding dosage and compatibility with any inhibitor used.

It is not permissible that biocides and Antifrogen N are mixed.

Antifrogen N has a biocidal effect even at the minimum required concentration of > 20%.

13.3 Anti-condensation measures

The customer must take measures to protect the devices against condensation

Condensation occurs when the inlet temperature of the cooling medium is significantly lower than room temperature (ambient temperature). The permissible temperature difference between coolant and air varies as a function of the relative humidity φ of the ambient air. The air temperature at which the aqueous phase precipitates is referred to as the "dew point".

The table below shows the dew points (in °C) for an atmospheric pressure of 100 kPa (≈ installation altitude: 0...500 m). If the temperature of the coolant is below the specified value, condensation may occur (i.e. the coolant temperature must always be ≥ the dew point temperature).

Table 13- 3 Dew point temperature as a function of the relative air humidity (Φ) and the room temperature at an installation altitude of between 0 m and 500 m

T_{room} °C	Dew point temperature in °C at a relative humidity Φ in %										
	20%	30%	40%	50%	60%	70%	80%	85%	90%	95%	100%
10	<0	<0	<0	0.2	2.7	4.8	6.7	7.6	8.4	9.2	10
20	<0	2	6	9.3	12	14.3	16.4	17.4	18.3	19.1	20
25	0.6	6.3	10.5	13.8	16.7	19.1	21.2	22.2	23.2	24.1	25
30	4.7	10.5	14.9	18.4	21.3	23.8	26.1	27.1	28.1	29.1	30
35	8.7	14.8	19.3	22.9	26.1	28.6	30.9	32.1	33.1	34.1	35
38	11.1	17.4	22	25.7	28.8	31.5	33.8	34.9	36.1	36.9	38
40	12.8	19.1	23.7	27.5	30.6	33.4	35.8	36.9	37.9	38.9	40
45	16.8	23.3	28.2	32.1	35.3	38.1	40.6	41.8	42.9	43.9	45
50	20.8	27.5	32.6	36.6	40.1	42.9	45.5	46.6	47.8	48.9	50
55	24.9	31.9	37.1	41.2	44.7	47.7	50.4	51.7	52.8	53.9	55

The dew point also depends on the absolute pressure (i.e. the installation altitude).

The dew points for lower atmospheric pressures are located under the dew points for a height=0 m, therefore selecting the coolant inlet temperature for the height 0 m always sufficient.

Various measures can be taken to prevent condensation:

1. Temperature-controlled valves in the supply line.
   In the cooling circuit, a temperature-controlled valve must be provided in the supply line.
2. Water temperature control.
   The water temperature is adjusted in line with the room temperature. This is the preferred method with high room temperatures, low water temperatures, and high air humidity.
3. Physical dehumidification.
   This is only effective in closed spaces. This method involves condensing the air humidity in an air-to-water heat exchanger, which is continuously operated using the cold cooling water.
4. Installing a heater with a sufficient capacity in the cabinet.

To prevent condensation, a humidity detector can be used to monitor the air humidity. The humidity detector is not included in the scope of delivery.

13.4 Equipotential bonding in the cooling system

Equipotential bonding between the components in the cooling system is required (SINAMICS S120, heat exchanger, piping, pump, etc.). This must be effected using a copper bar or stranded copper with the appropriate conductor cross-sections to prevent the electrochemical processes.

All cabinets must be bolted together in such a way as to ensure good conductivity (e.g. cabinet beams directly connected to ensure conductivity) to prevent potential differences and, in turn, avoid the risk of electrochemical corrosion. For this reason, a PE bar must also be installed in all the cabinets, including the re-cooling system.

13.5 Using heat exchangers

13.5.1 Water-to-water heat exchanger

If a cooling circuit that does not exceed 35 °C but does not fulfill the cooling water requirements is already installed in the system, the two cooling circuits can be linked via a water-to-water heat exchanger.

The coolers for the Line Modules are attached via a distributor in such a way as to ensure the required flow rate without exceeding the maximum permissible pressure. Conditions, such as height differences and distances, must be taken into account here.

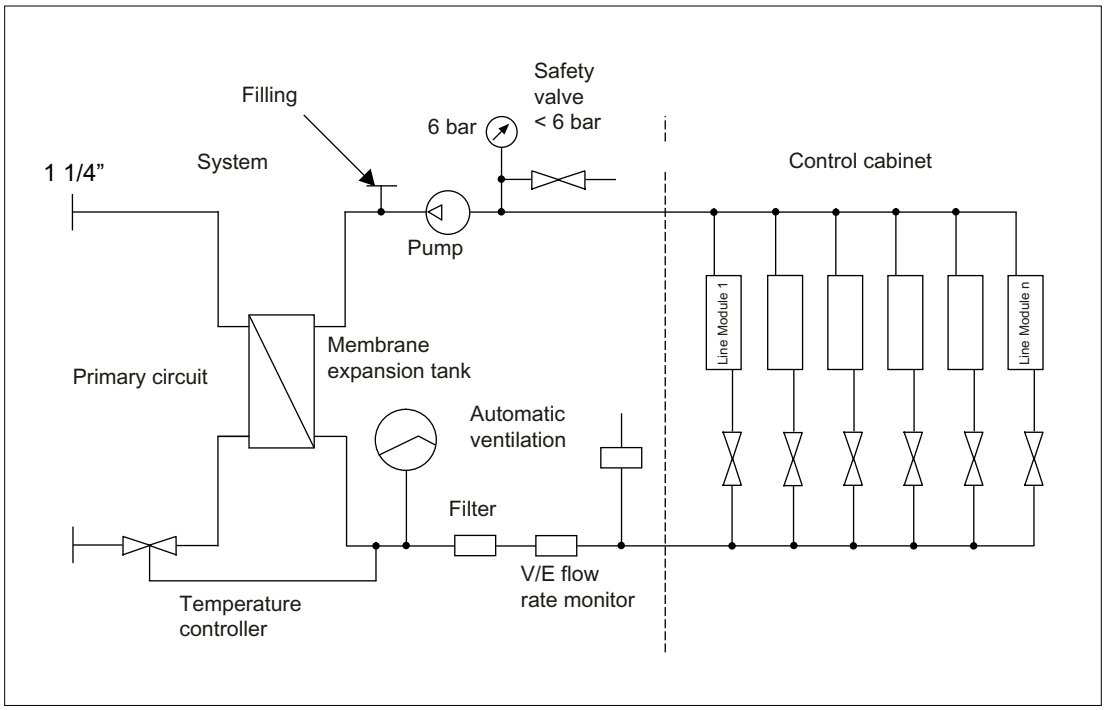


Figure 13-4 Water-to-water heat exchanger

13.5.2 Air-to-water heat exchanger

If no process-water network has been installed but it is nonetheless best to use water-cooled Line Modules, an air-to-water cooling system can be used. The temperature of the ambient air must not be excessively high (e.g. > 35°C) (in accordance with the technical data for the air-to-water heat exchanger).

During setup, you must ensure that a primary air cooling circuit and not a process water circuit is installed.

Measures to prevent supercooling must only be taken on the secondary side by means of temperature closed-loop control, a thermostat, or a solenoid valve.

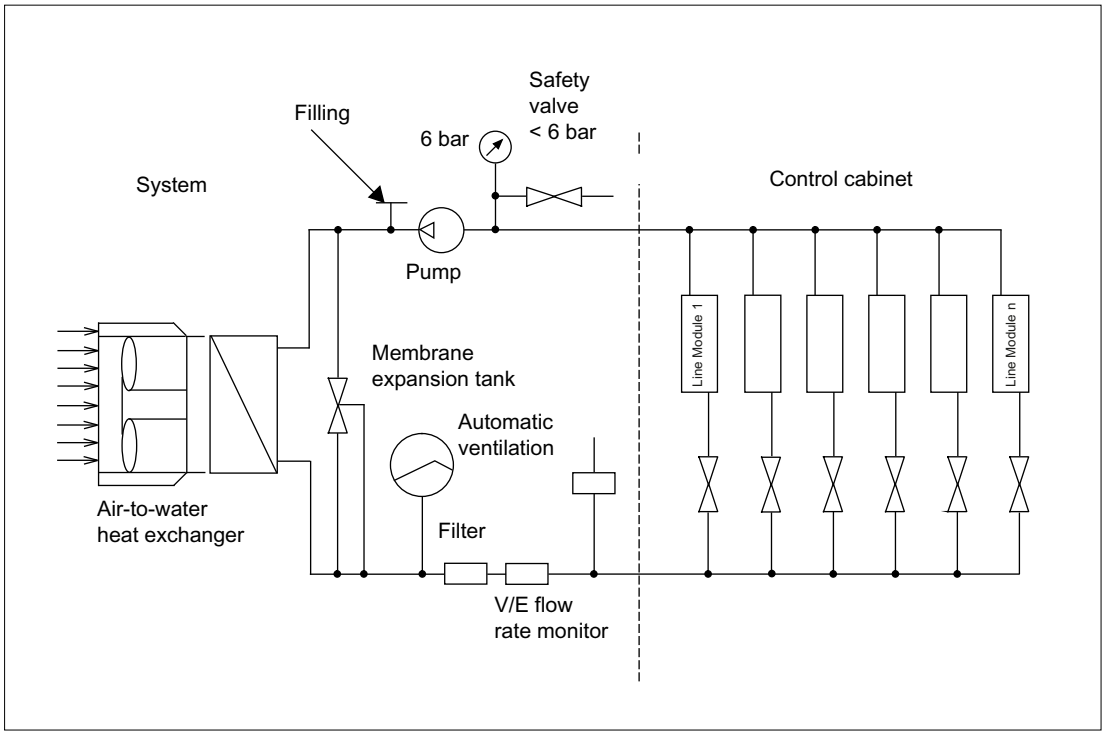


Figure 13-5 Air-to-water heat exchanger

13.5.3 Active cooling unit

If no process-water network has been installed and the ambient air is > 35 °C (35 °C < τ < 40 °C), an active cooling unit can be used. This unit works in the same way as a refrigerator.

The following diagram shows the configuration of the cooling circuit in respect of Line Modules.

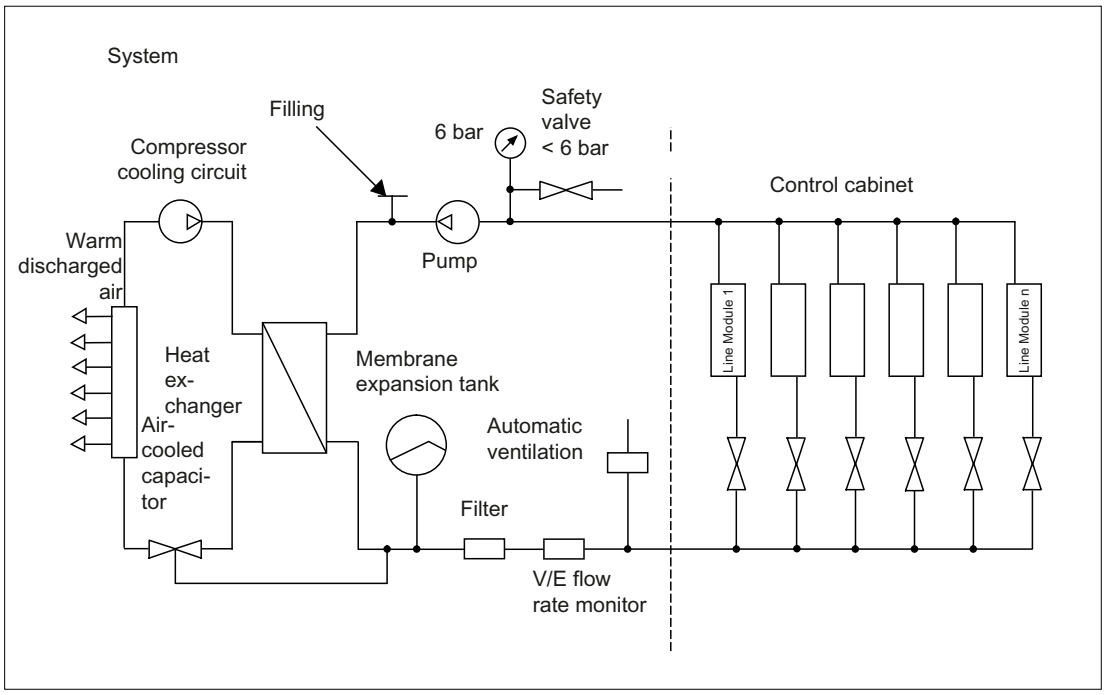


Figure 13-6 Active cooling unit

Service and Support Booksize

14

14.1 Spare parts

Spare parts are available on the Internet at:

http://support.automation.siemens.com/WW/view/de/16612315

14.2 Replacing the fan

14.2.1 Safety instructions when replacing a fan

⚠DANGER

Risk of electric shock

Before replacing the fan, you must switch off the power supplies (400 V AC and 24 V DC). A hazardous voltage is still present for up to 5 minutes after the power supply has been switched off. This time must first elapse before it is permissible to remove the cover of the unit or the fan cover.

Before removing the component, check that the system is in a voltage-free state.

NOTICE

When replacing the fan, you must observe the ESD regulations.

Only qualified personnel are permitted to install spare parts.

14.2.2 Replacing the fan for components with internal and external air cooling

Replacing the fan for components, sizes 50 mm to 200 mm

Table 14- 1 Removing the fan

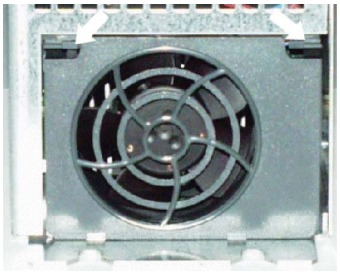
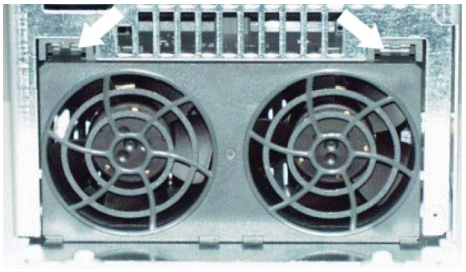
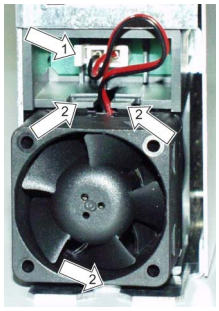
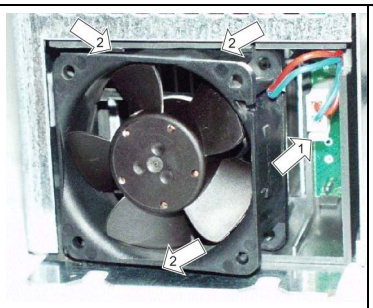
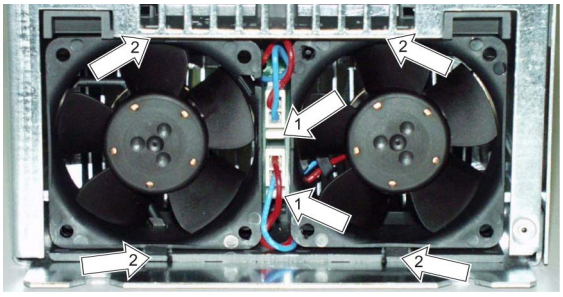
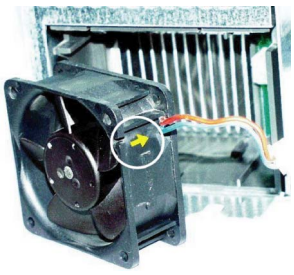
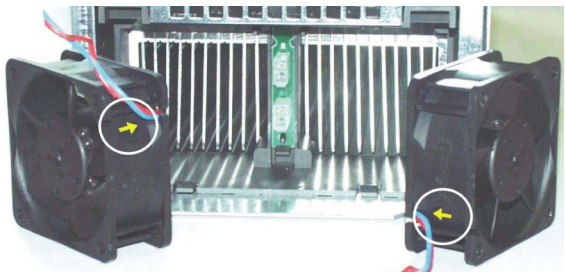
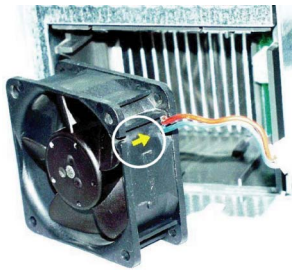
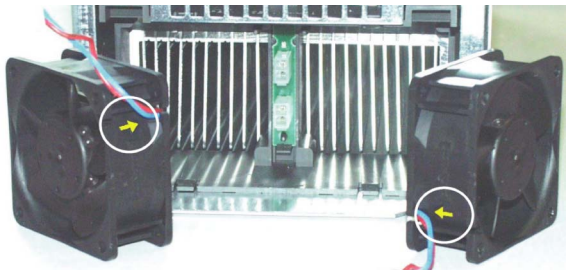
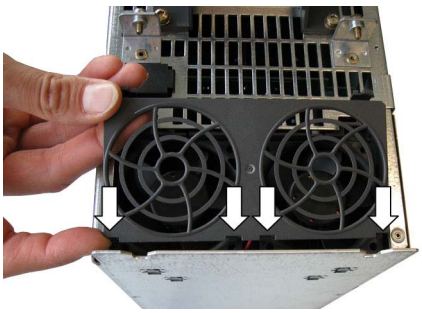
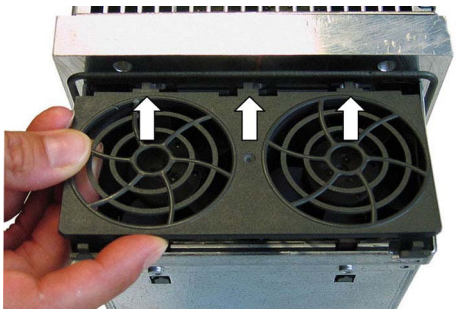
<table>
<tr><th>Size 50 mm</th><th>Size 100 mm</th><th>Sizes 150 mm and 200 mm</th></tr>
<tr><td colspan="3">• Remove the module from the drive line-up.
• Release the snap hooks to open the fan cover.</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td colspan="3">• Release and pull out the connection plugs (1).
• Release the snap hooks (2) and remove the fan.</td></tr>
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</table>

Table 14- 2 Installing a fan

Size 50 mm	Size 100 mm	Sizes 150 mm and 200 mm
• Before installing the fan, check the air flow direction (the arrow on the fan must point towards the cooling ribs).		
		
• Keep moving the fan into position until it is fully engaged **Notice**! Do not crush the connection cables! • Insert the connection plug until it is fully engaged. • Insert the fan cover.		

NOTICE
The spare parts pack for components, sizes 150 mm and 200 mm contains two different fan covers: One is for components with internal air cooling, the other for components with external air cooling. Make sure you use the right fan cover!

Table 14- 3 Attaching the fan cover on components, sizes 150 mm and 200 mm

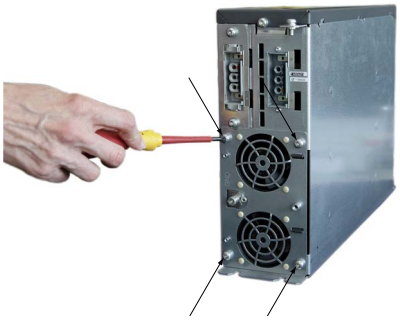
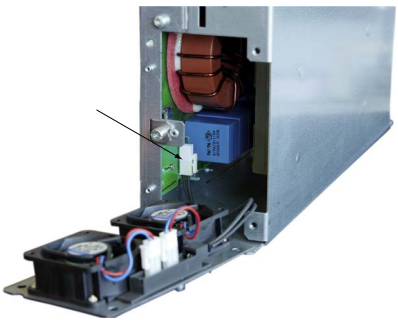
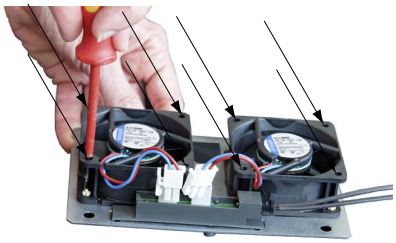
Internal air cooling	External air cooling
 Fan cover for components with internal air cooling	 Fan cover with three installation lugs for components with external air cooling
 Insert the fan cover.	 Insert the fan cover (installation lugs first).
 Push the fan cover in until the snap hooks engage.	 Push the fan cover in until the snap hooks engage.

Replacing the fan for components, size 300 mm

Installing the fan module on 300 mm wide components is described in the Chapter "Installation" of the respective component. The fan module is removed in the inverse sequence to installing.

14.2.3 Replacing the fan on an Active Interface Module

Table 14- 4 Replacing the fan in an Active Interface Module, 16 kW

	
Open the fan cover. Unscrew the combination screws M5 / 3 Nm	Open the fan cover and remove the connector
	
Break through the 8 expansion rivets	Take out the fans
	
Secure the fans with 8 new expansion rivets	

To install, carry out the above steps in reverse order. The torques must be carefully observed.

Table 14- 5 Replacing the fan in an Active Interface Module, 36 kW

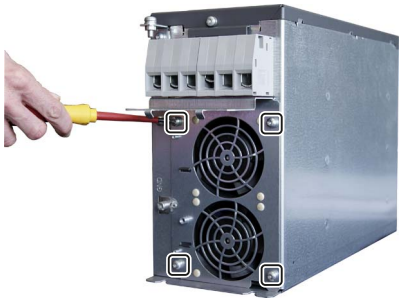
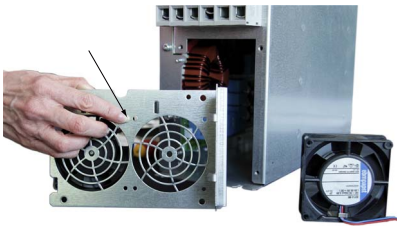
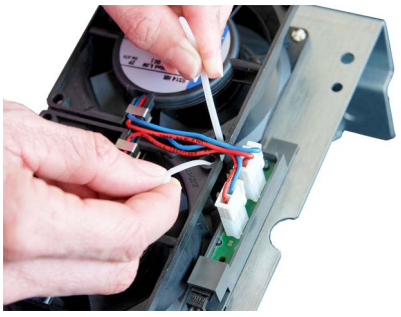
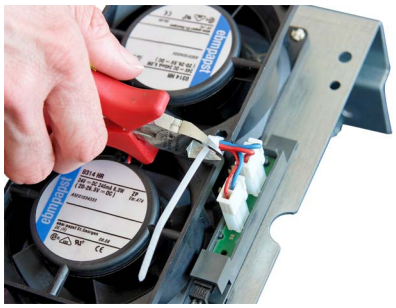
	
Open the fan cover. Unscrew the combination screws M5 / 3 Nm	Open the fan cover and remove the connector
	
Remove the connection cable	Remove the 7 expansion rivets
	
Take out the fans	Secure the fans with 7 new expansion rivets
	
Attach a cable tie around the connection cables	Cut off the protruding end of the cable tie

Table 14- 6 Replacing the fan in an Active Interface Module, 55 kW

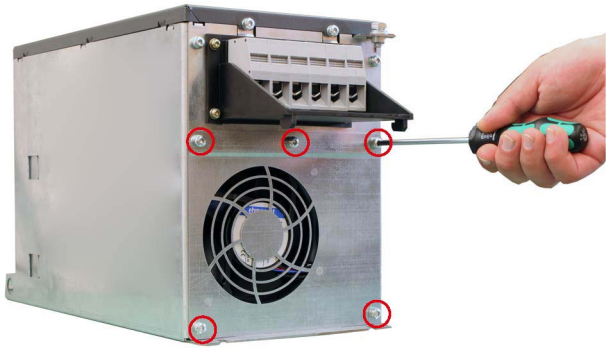
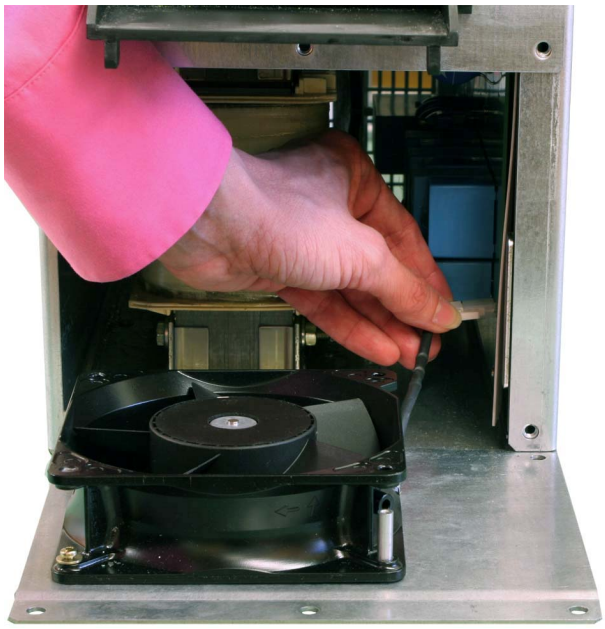
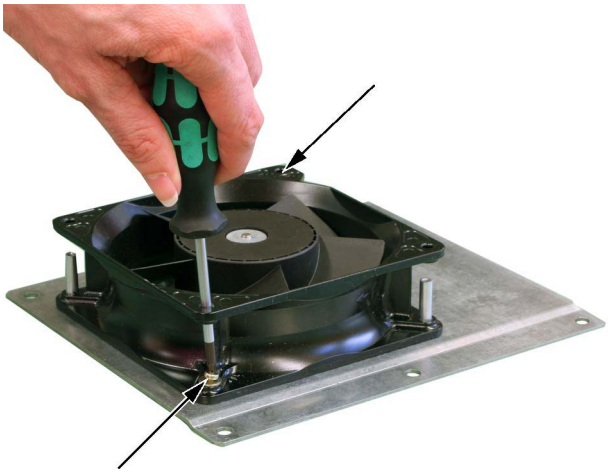
	
Open the fan cover. Unscrew the combination screws M5 / 3 Nm	Open the fan cover and remove the connector
	
Unscrew the screws M3 / 1.8 Nm	Take out the fan

Table 14- 7 Replacing the fan in an Active Interface Module, 80 kW, 120 kW

		
Open the fan cover. Unscrew the combination screws M5 / 3 Nm	Open the fan cover.	Remove the connector.
		
Unscrew the screws M3 / 1.8 Nm	Release the connection cables	Take out the fan

14.2.4 Replacing the fan on the Control Supply Module

Replacement fan (Order. No. 6SL3160-0AB00-0AA0)

⚠ WARNING
This component has more than one supply circuit!

Table 14- 8 Removing the fan

<table>
<tr><td colspan="3">

- Remove the component from the drive line-up.
- Release the 6 screws (Torx T10) of the enclosure cover and open the component



</td></tr>
<tr><td>

- Unlatch and pull out the plug connector

</td><td>

- Release the 2 screws on the fan (Torx T20)

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- Take out the fan

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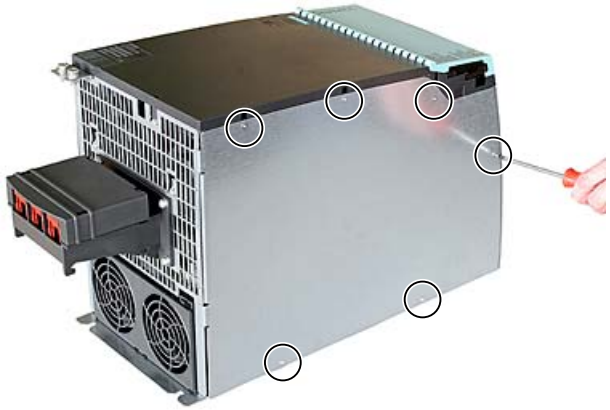
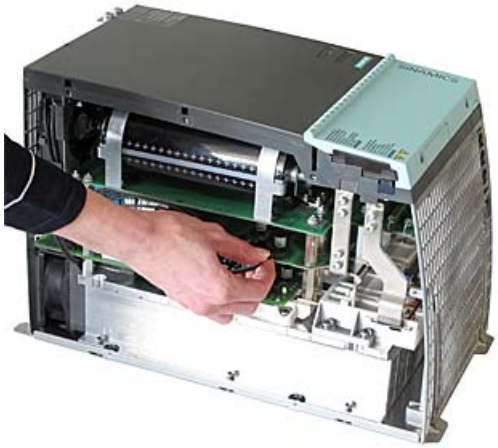
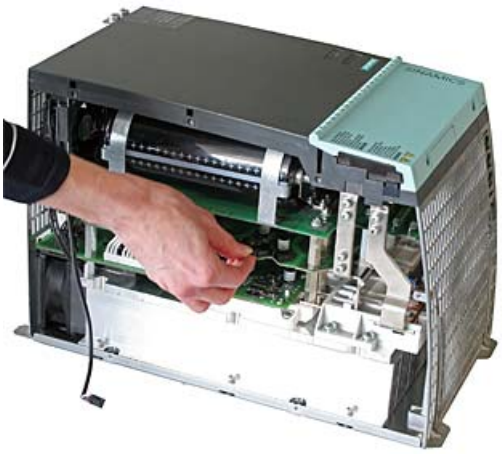
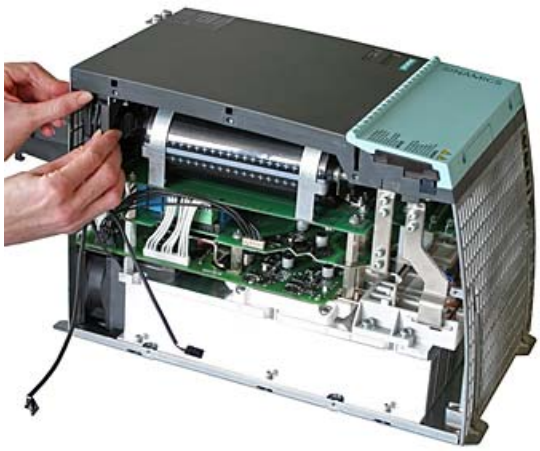
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Installing a fan

1. Before installing the fan, check the air flow direction (the arrow on the fan must point towards the cooling ribs).
2. Insert the connector until it fully engages.
3. Screw in the 2 screws at the fan (Torx T20); tightening torque 1.2 Nm
4. Close the enclosure cover and tighten the 6 screws (Torx T10);
   Tightening torque, 0.8 Nm

14.2.5 Replacing the fan on the 100 kW Basic Line Module for capacitor cooling

Table 14- 9 Removing the fan

	
Open the right device cover by loosening the six marked screws	Pull the first fan cable by lightly pressing the connector together
	
Pull the second fan cable	Release the fan module

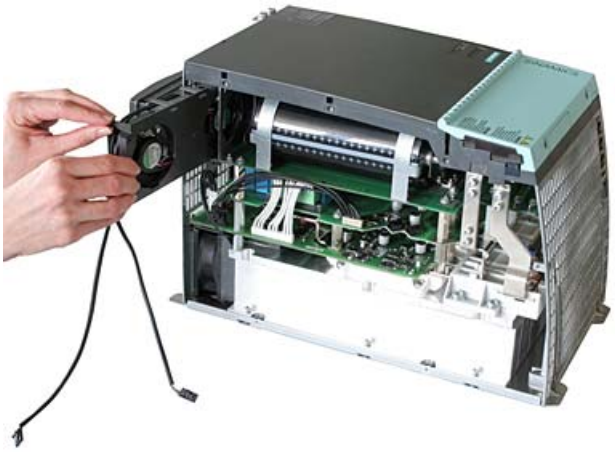
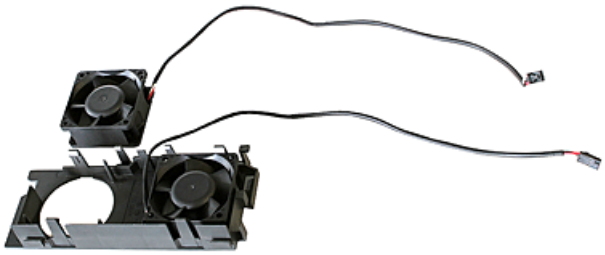
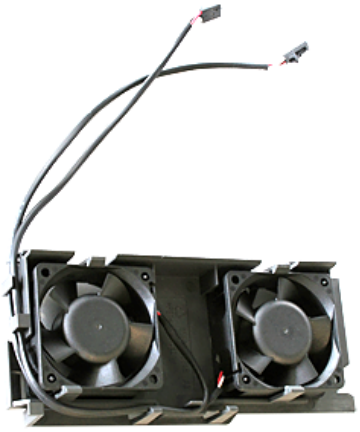
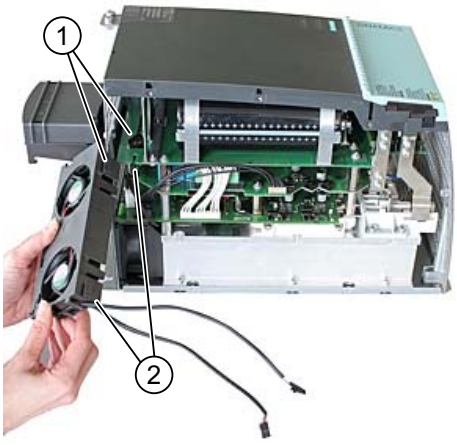
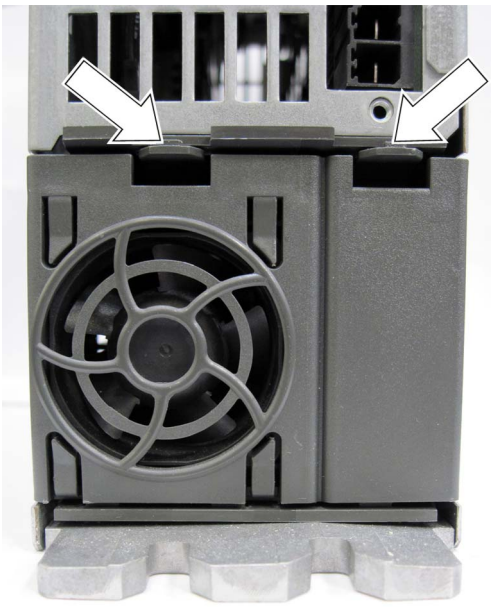
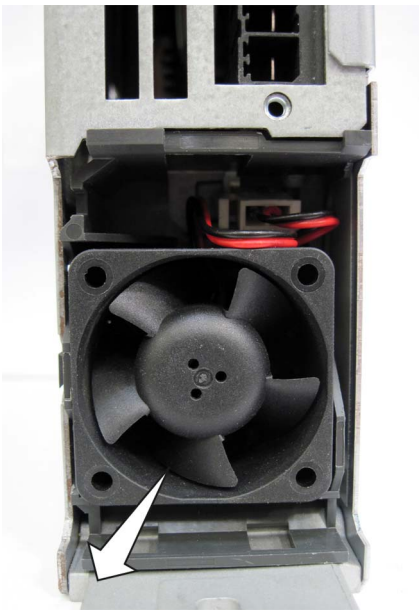
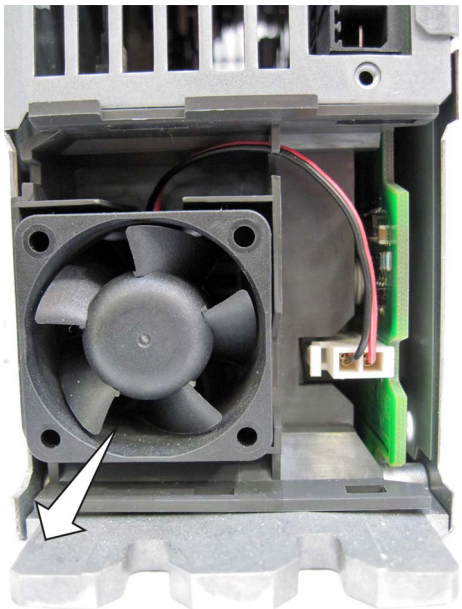
	
Completely pull out the fan module	Slightly push the fan holder apart and pull out the fan

Table 14- 10 Installing a fan

	
Observe the air flow direction markings when inserting the new fan	Observe the cable guide
	Connect the two fan cables. Close the enclosure cover and tighten the six screws, tightening torque: 0.8 Nm
Insert the fan holder into the guide rails ① and ②.	

14.2.6 Replacing the fan for Booksize Compact components

Table 14- 11 Removing the fan

Size 50 mm	**Size 75 mm**
• Remove the component from the drive line-up	
	
• Remove the fan cover at the lower side of the component by releasing the snap hook	
	
• Carefully remove the fan	

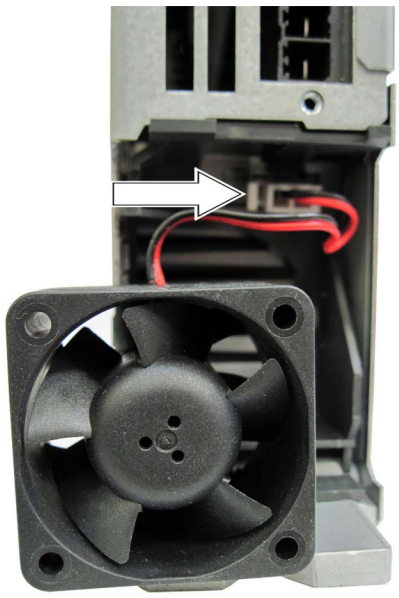
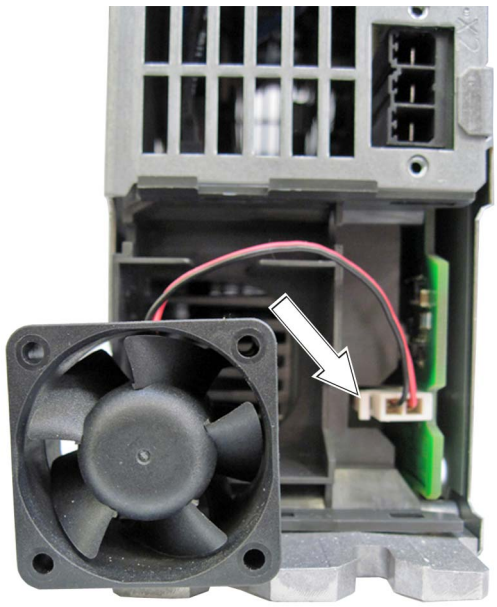
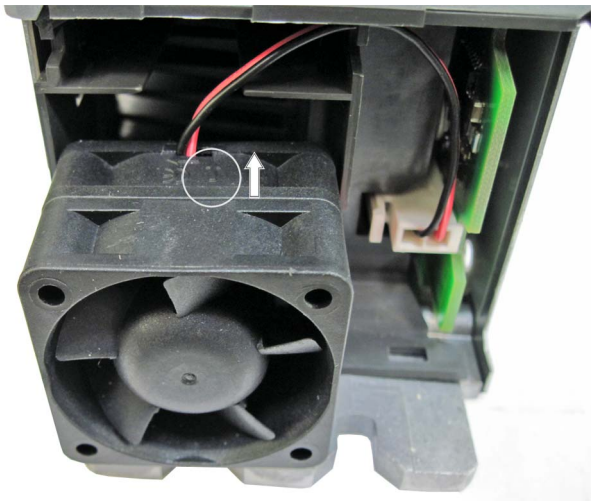
	
• Release the connector and withdraw the connecting cable	

Table 14- 12 Installing a fan

Size 50 mm	**Size 75 mm**
	
• Before installing the fan, check the air flow direction (the arrow on the fan must point towards the cooling ribs). • Insert the connector until it clicks into place • Installing the fan - **Notice**! Do not crush the connection cables! • Insert the fan cover.	

14.3 Forming the DC link capacitors

Description

If the Line Modules and Motor Modules are kept in storage for more than two years, the DC link capacitors have to be reformed. If this is not performed, the units could be damaged when they are switched on.

If the cabinet is commissioned within two years of its date of manufacture, the DC link capacitors do not need to be reformed. The date of manufacture can be taken from the serial number on the rating plate.

Note

It is important that the storage period is calculated from the date of manufacture and not from the date that the equipment was shipped.

Rating plate

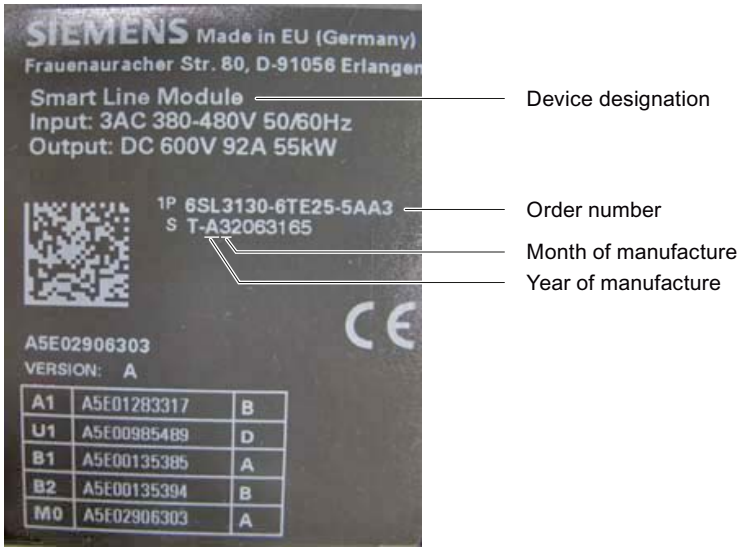


Figure 14-1 Rating plate using an Smart Line Module as example

Date of manufacture

The date of manufacture can be determined as follows:

Table 14- 13 Production year and month

Character	Year of manufacture	Character	Month of manufacture
S	2004	1 to 9	January to September
T	2005	O	October
U	2006	N	November
V	2007	D	December
W	2008		
X	2009		
A	2010		
B	2011		
C	2012		
D	2013		
E	2014		

The serial number is found on the rating plate.

Forming circuit

When DC link capacitors are formed, a defined voltage is connected to them and a defined current flows so that the appropriate capacitor characteristics are re-established for them to be re-used as DC link capacitors.

The forming circuit can be established using incandescent lamps or alternatively, PTC resistors.

Components required (recommendation)

- 1 fuse switch 3-phase 400 V / 10 A
- Cable 1.5 mm^2
- 3 PTC resistors 350 R / 35 W
  (recommendation: PTC-35W PTC800620-350 Ohm, Michael Koch GmbH)
- 3 incandescent lamps 230 V / 100 W
- Various Small components, such as lamp socket, etc.

⚠DANGER

Dangerously high voltage levels are still present in the cabinet up to 5 minutes after it has been disconnected due to the DC link capacitors. It is only permissible to work on the equipment or at the DC link terminals after this time has expired.

Note

Line Modules must be enabled from the connected Motor Module.

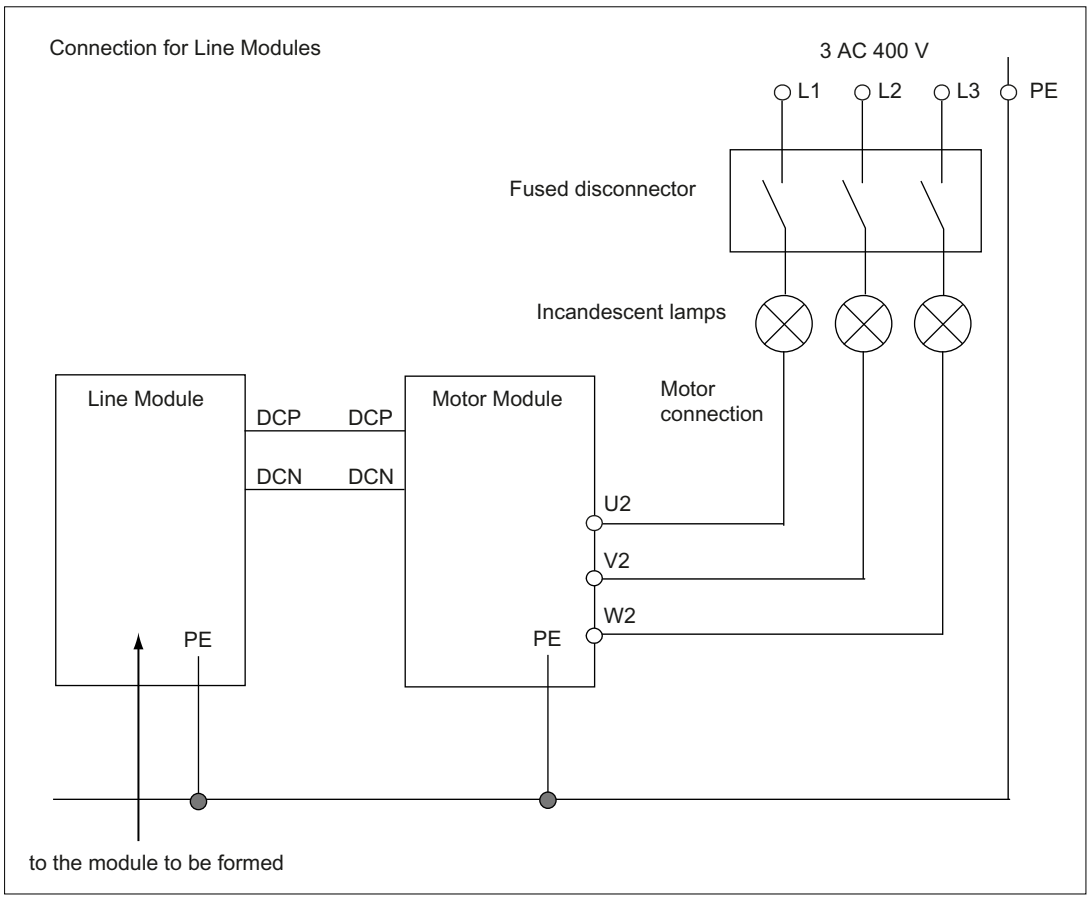


Figure 14-2 Forming circuit for Line Modules with incandescent lamps

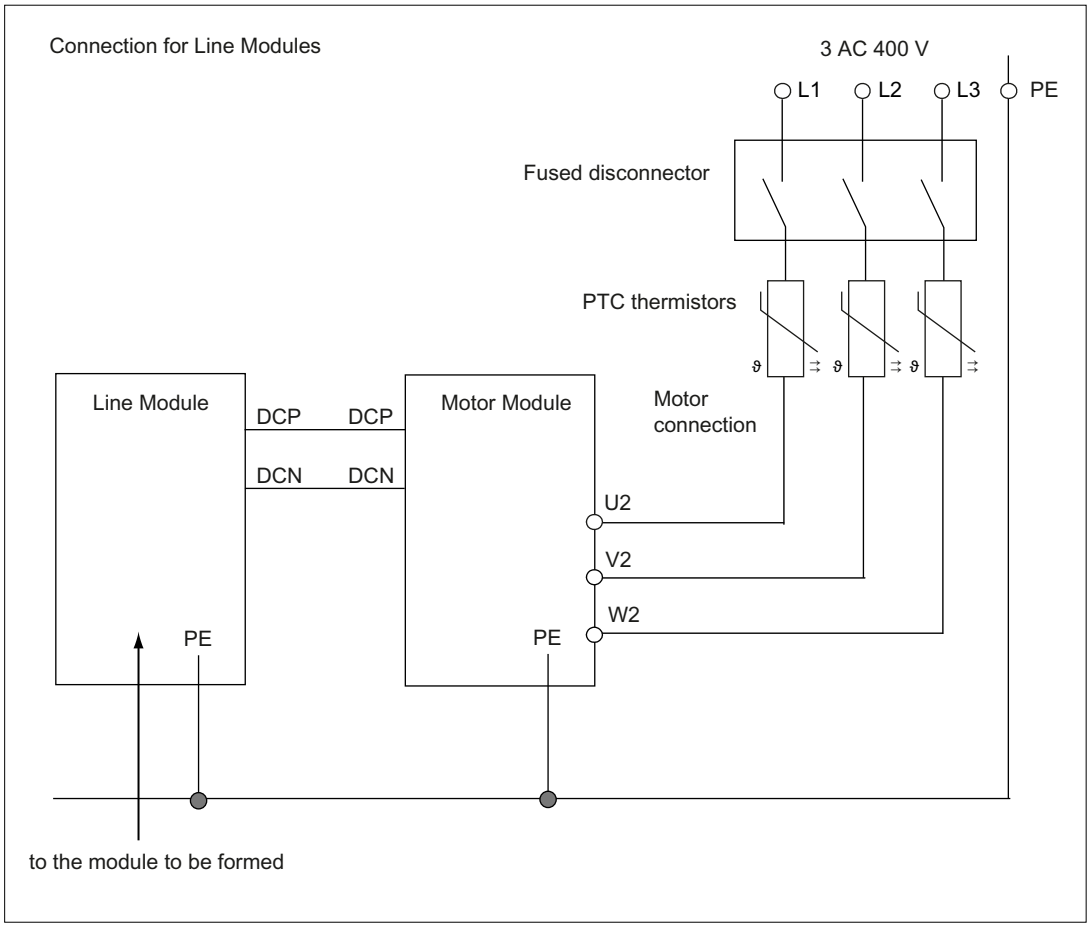


Figure 14-3 Forming circuit for Line Modules with PTC resistors

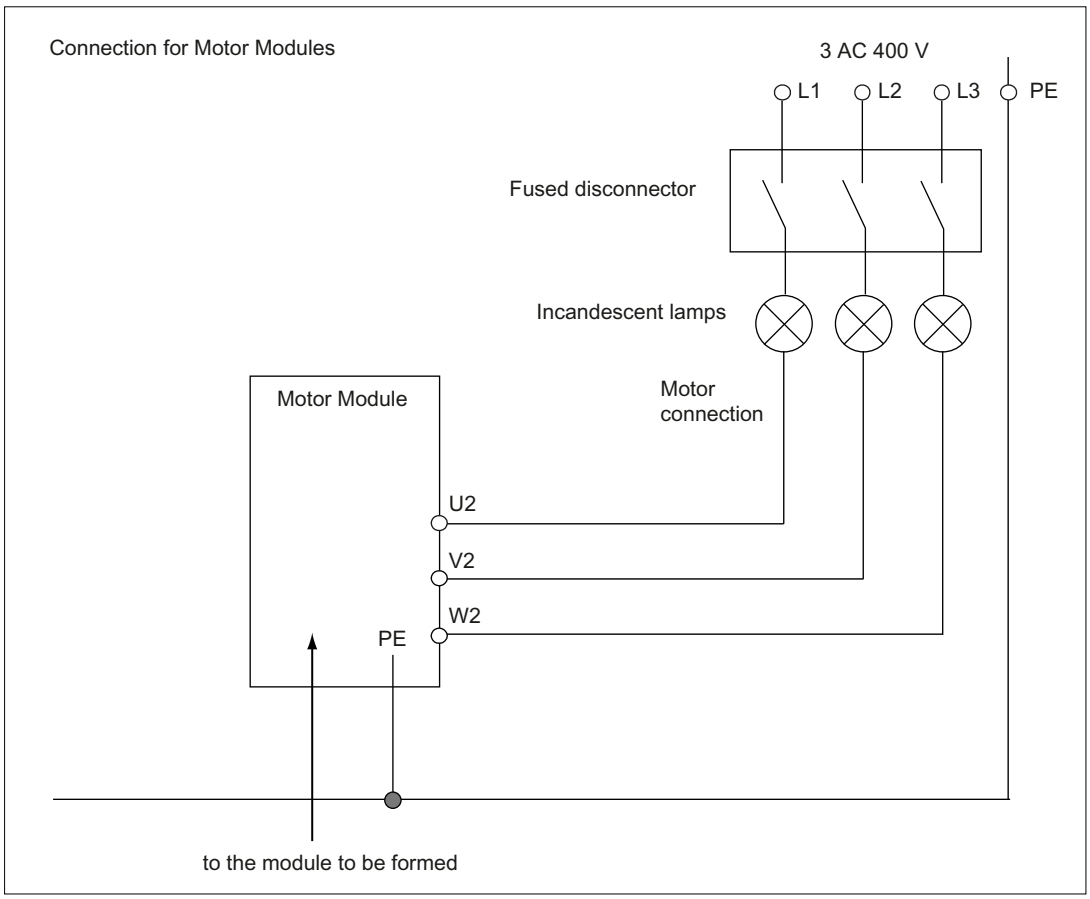


Figure 14-4 Forming circuit for Motor Modules with incandescent lamps

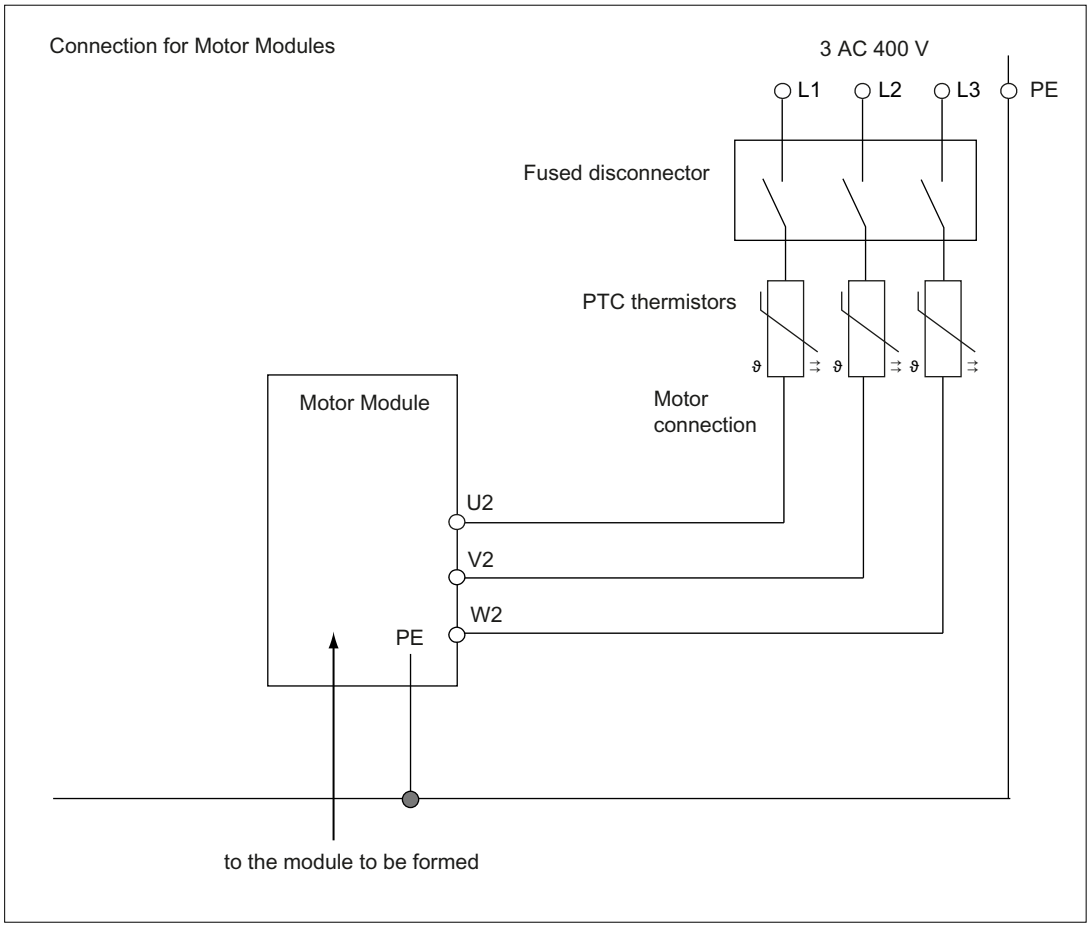


Figure 14-5 Forming circuit for Motor Modules with PTC resistors

Procedure

- Be sure to remove the DC link bridge before forming the DC link capacitors.
- Make sure that the device **does not** receive a power-on command (e.g. from the keyboard, BOP20 or terminal block).
- Connect the forming circuit.
- While forming, the incandescent lamps must become less bright or go completely dark. If the incandescent lamps continue to be brightly lit, a fault has occurred in the drive unit or in the wiring.
- To form using PTC resistors, the modules must remain in the circuit for approx. 1h. The resistors will become very hot if there is a fault in the unit (surface temperature > 80°C).

14.4 Recycling and disposal

The applicable national guidelines must be observed when disposing of the product.

The products described in this Equipment Manual are extensively recyclable on account of the low-toxic composition of the materials used. For environmentally-compliant recycling and disposal of your electronic waste, please contact a company for the disposal of electronic waste.

Appendix A

A

A.1 List of abbreviations

Note:

The following list of abbreviations includes all abbreviations and their meanings used in the entire SINAMICS user documentation.

Abbreviation	Source of abbreviation	Meaning
A		
A...	Alarm	Alarm
AC	Alternating Current	Alternating current
ADC	Analog Digital Converter	Analog digital converter
AI	Analog Input	Analog input
AIM	Active Interface Module	Active Interface Module
ALM	Active Line Module	Active Line Module
AO	Analog Output	Analog output
AOP	Advanced Operator Panel	Advanced Operator Panel
APC	Advanced Positioning Control	Advanced Positioning Control
AR	Automatic Restart	Automatic restart
ASC	Armature Short Circuit	Armature short circuit
ASCII	American Standard Code for Information Interchange	American standard code for information interchange
ASM	Asynchronmotor	Induction motor
B		
BERO	-	Contactless proximity switch
BI	Binector Input	Binector input
BIA	Berufsgenossenschaftliches Institut für Arbeitssicherheit	Germany's Institute for Occupational Safety and Health
BICO	Binector Connector Technology	Binector connector technology
BLM	Basic Line Module	Basic Line Module
BO	Binector Output	Binector output
BOP	Basic Operator Panel	Basic Operator Panel

Abbreviation	Source of abbreviation	Meaning
C		
C	Capacitance	Capacitance
C...	-	Safety message
CAN	Controller Area Network	Serial bus system
CBC	Communication Board CAN	Communication board CAN
CD	Compact Disc	Compact Disc
CDC	Crosswise data comparison	Crosswise data comparison
CDS	Command Data Set	Command data set
CF Card	CompactFlash Card	CompactFlash Card
CI	Connector Input	Connector input
CLC	Clearance Control	Clearance control
CNC	Computer Numerical Control	Computer numerical control
CO	Connector Output	Connector output
CO/BO	Connector Output/Binector Output	Connector/binector output
COB ID	CAN Object Identification	CAN Object identification
COM	Common contact of a changeover relay	Center contact of a changeover contact
COMM	Commissioning	Commissioning
CP	Communication Processor	Communication processor
CPU	Central Processing Unit	Central processing unit
CRC	Cyclic Redundancy Check	Cyclic redundancy check
CSM	Control Supply Module	Control Supply Module
CU	Control Unit	Control Unit
CUA	Control Unit Adapter	Control Unit Adapter
CUD	Control Unit DC MASTER	Control Unit DC MASTER
D		
DAC	Digital Analog Converter	Digital analog converter
DC	Direct Current	DC current
DC link	DC link	DC link
DCB	Drive Control Block	Drive Control Block
DCC	Drive Control Chart	Drive Control Chart
DCC	Data Cross Check	Crosswise data comparison
DCN	Direct Current Negative	DC current negative
DCP	Direct Current Positive	DC current positive
DDS	Drive Data Set	Drive data set
DI	Digital Input	Digital input
DI/DO	Digital Input/Digital Output	Digital input/output bidirectional
DMC	DRIVE-CLiQ Hub Module Cabinet	DRIVE-CLiQ Hub Module Cabinet
DME	DRIVE-CLiQ Hub Module External	DRIVE-CLiQ Hub Module External
DO	Digital Output	Digital output
DO	Drive Object	Drive object

Abbreviation	Source of abbreviation	Meaning
DP	Decentralized Peripherals	Distributed IOs
DPRAM	Dual Ported Random Access Memory	Memory with dual access ports
DRAM	Dynamic Random Access Memory	Dynamic memory
DRIVE-CLiQ	Drive Component Link with IQ	Drive Component Link with IQ
DSC	Dynamic Servo Control	Dynamic Servo Control
E		
EASC	External Armature Short Circuit	External armature short circuit
EDS	Encoder Data Set	Encoder data set
ESD	Electrostatic Sensitive Devices	Electrostatic sensitive devices
ELCB	Earth Leakage Circuit Breaker	Earth leakage circuit breaker
ELP	Earth Leakage Protection	Earth leakage protection
EMC	Electromagnetic Compatibility	Electromagnetic compatibility
EMF	Electromagnetic Force	Electromagnetic force
EMC	Electromagnetic compatibility	Electromagnetic compatibility
EN	European standard	European standard
EnDat	Encoder Data Interface	Encoder interface
EP	Enable Pulses	Pulse enable
EPOS	Einfachpositionierer	Basic positioner
ES	Engineering System	Engineering System
ESB	Equivalent circuit diagram	Equivalent circuit diagram
ESD	Electrostatic Sensitive Devices	Electrostatic sensitive devices
ESR	Extended Stop and Retract	Extended stop and retract
F		
F...	Fault	Fault
FAQs	Frequently Asked Questions	Frequently asked questions
FBL	Free Blocks	Free function blocks
FCC	Function Control Chart	Function Control Chart
FCC	Flux Current Control	Flux current control
FD	Function Diagram	Function diagram
F-DI	Failsafe Digital Input	Fail-safe digital input
F-DO	Failsafe Digital Output	Fail-safe digital output
FEM	Fremderregter Synchronmotor	Separately excited synchronous motor
FEPROM	Flash EPROM	Non volatile read and write memory
FG	Function Generator	Function generator
FI	-	Fault current
FOC	Fiber-Optic Cable	Fiber-optic cable
FP	Function diagram	Function diagram
FPGA	Field Programmable Gate Array	Field Programmable Gate Array

Abbreviation	Source of abbreviation	Meaning
FW	Firmware	Firmware
G		
GB	Gigabyte	Gigabyte
GC	Global Control	Global Control Telegram (Broadcast Telegramm)
GND	Ground	Reference potential for all signal and operating voltages, usually defined as 0 V (also referred to as G)
GSD	Generic Station Description	Generic station description: Describes the characteristics of a PROFIBUS slave
GSV	Gate Supply Voltage	Gate Supply Voltage
GUID	Globally Unique Identifier	Globally unique identifier
H		
HF	High Frequency	High frequency
HFD	Hochfrequenzdrossel	High-frequency reactor
HMI	Human Machine Interface	Human machine interface
HTL	High-Threshold Logic	Logic with a high fault threshold
HW	Hardware	Hardware
I		
I/O	Input/Output	Input/output
I2C	Inter-Integrated Circuit	Internal serial data bus
IASC	Internal Armature Short Circuit	Internal armature short circuit
IBN	Inbetriebnahme	Commissioning
ID	Identifier	Identification
IE	Industrial Ethernet	Industrial Ethernet
IEC	International Electrotechnical Commission	International Electrotechnical Commission
IF	Interface	Interface
IGBT	Insulated Gate Bipolar Transistor	Insulated gate bipolar transistor
IGCT	Integrated Gate-Controlled Thyristor	Semiconductor power switch with integrated control electrode
IL	Impulslöschung	Pulse cancelation
IP	Internet Protocol	Internet Protocol
IPO	Interpolator	Interpolator
IT	Isolé Terré	Non-grounded three-phase power supply
IVP	Internal Voltage Protection	Internal voltage protection
J		
JOG	Jogging	Jogging

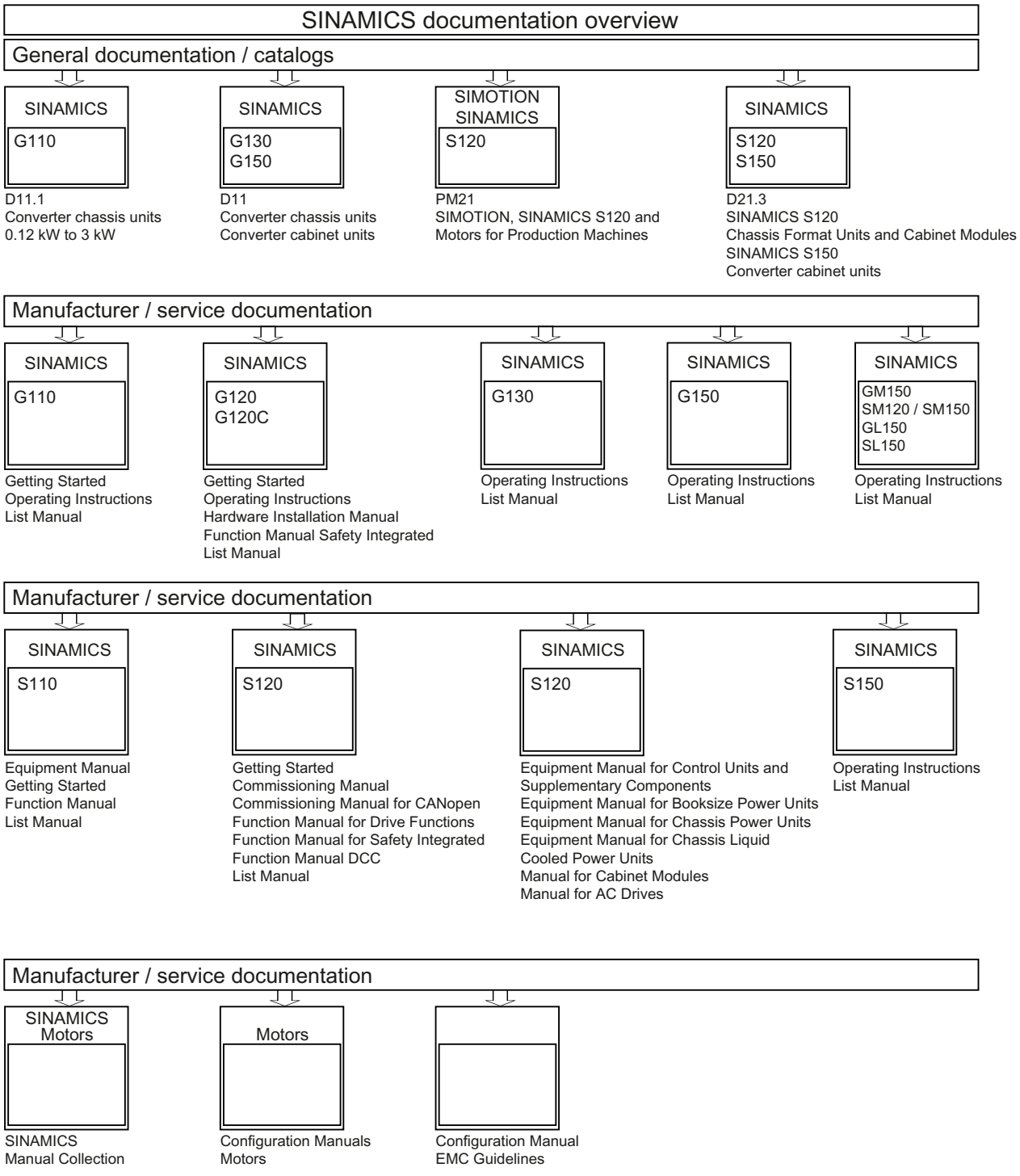
Abbreviation	Source of abbreviation	Meaning
K		
KIP	Kinetische Pufferung	Kinetic buffering
Kp	-	Proportional gain
KTY	-	Special temperature sensor
L		
L	-	Formula symbol for inductance
LED	Light Emitting Diode	Light Emitting Diode
LIN	Linear motor	Linear motor
LSB	Least Significant Bit	Least significant bit
LSC	Line-Side Converter	Line-side converter
LSS	Line Side Switch	Line side switch
LU	Length Unit	Length unit
M		
M	-	Formula symbol for torque
M	Masse	Reference potential for all signal and operating voltages, usually defined as 0 V (also referred to as GND)
MB	Megabyte	Megabyte
MCC	Motion Control Chart	Motion Control Chart
MDS	Motor Data Set	Motor data set
MLFB	Maschinenlesbare Fabrikatebezeichnung	Machine-Readable Product Code
MMC	Man-Machine Communication	Man-machine communication
MMC	Micro Memory Card	Micro memory card
MSB	Most Significant Bit	Most significant bit
MSC	Motor-Side Converter	Motor-side converter
MSCY_C1	Master Slave Cycle Class 1	Cyclic communication between master (Class 1) and slave
MSR	Motorstromrichter	Motor-side converter
MT	Machine Tool	Machine tool
N		
N. C.	Not Connected	Not connected
N...	No Report	No message or internal message
NAMUR	Normenarbeitsgemeinschaft für Mess- und Regeltechnik in der chemischen Industrie	Standardization association for measurement and control in the chemical industry
NC	Normally Closed (contact)	NC contact
NC	Numerical Control	Numerical control
NEMA	National Electrical Manufacturers Association	Standardization body in the US
NM	Nullmarke	Zero mark
NO	Normally Open (contact)	NO contact

Abbreviation	Source of abbreviation	Meaning
NSR	Netzstromrichter	Line-side converter
NVRAM	Non-Volatile Random Access Memory	Non-volatile read/write memory
O		
OA	Open Architecture	Open Architecture
OC	Operating Condition	Operating condition
OEM	Original Equipment Manufacturer	Original Equipment Manufacturer
OLP	Optical Link Plug	Fiber-optic bus connector
OMI	Option Module Interface	Option module interface
P		
p...	-	Adjustable parameters
PB	PROFIBUS	PROFIBUS
PC	Position Controller	Position Controller
PcCtrl	PC Control	Control for master
PD	PROFIdrive	PROFIdrive
PDS	Power unit Data Set	Power unit data set
PE	Protective Earth	Protective earth
PELV	Protective Extra Low Voltage	Protective extra low voltage
PEM	Permanenterregter Synchronmotor	Permanent-magnet synchronous motor
PG	Programmiergerät	Programming device
PI	Proportional Integral	Proportional integral
PID	Proportional Integral Differential	Proportional integral differential
PLC	Programmable Logic Controller	Programmable logic controller
PLL	Phase-Locked Loop	Phase-locked loop
PN	PROFINET	PROFINET
PNO	PROFIBUS Nutzerorganisation	PROFIBUS user organization
PPI	Point-to-Point Interface	Point-to-point interface
PRBS	Pseudo Random Binary Signal	White noise
PROFIBUS	Process Field Bus	Serial data bus
PS	Power Supply	Power supply
PSA	Power Stack Adapter	Power Stack Adapter
PTC	Positive Temperature Coefficient	Positive temperature coefficient
PTP	Point-To-Point	Point-to-Point
PWM	Pulse Width Modulation	Pulse width modulation
PZD	Prozessdaten	Process data
R		
r...	-	Display parameters (read-only)
RAM	Random Access Memory	Read/write memory
RCCB	Residual Current Circuit Breaker	Residual current operated circuit breaker
RCD	Residual Current Device	Residual current operated circuit breaker
RCM	Residual Current Monitor	Residual current monitor

Abbreviation	Source of abbreviation	Meaning
RFG	Ramp-Function Generator	Ramp-function generator
RJ45	Registered Jack 45	Term for an 8-pin socket system for data transmission with shielded or non-shielded multi-wire copper cables
RKA	Rückkühlanlage	Cooling unit
RO	Read Only	Read only
RPDO	Receive Process Data Object	Receive process data object
RS232	Recommended Standard 232	Interface standard for cable-connected serial data transmission between a sender and receiver (also known under EIA232)
RS485	Recommended Standard 485	Interface standard for a cable-connected differential, parallel, and/or serial bus system (data transmission between a number of senders and receivers, also known under EIA485)
RTC	Real Time Clock	Real time clock
RZA	Raumzeigerapproximation	Space vector approximation
S		
S1	-	Uninterrupted duty
S3	-	Intermittent duty
SBC	Safe Brake Control	Safe brake control
SBH	Sicherer Betriebshalt	Safe operating stop
SBR	-	Safe acceleration monitoring
SCA	Safe Cam	Safe cam
SD Card	SecureDigital Card	Secure digital memory card
SE	Sicherer Software-Endschalter	Safe software limit switch
SG	Sicher reduzierte Geschwindigkeit	Safely reduced speed
SGA	Sicherheitsgerichteter Ausgang	Safety-related output
SGE	Sicherheitsgerichteter Eingang	Safety-related input
SH	Sicherer Halt	Safe standstill
SI	Safety Integrated	Safety Integrated
SIL	Safety Integrity Level	Safety Integrity Level
SLM	Smart Line Module	Smart Line Module
SLP	Safely-Limited Position	Safely-limited position
SLS	Safely Limited Speed	Safely limited speed
SLVC	Sensorless Vector Control	Vector control without encoder
SM	Sensor Module	Sensor Module
SMC	Sensor Module Cabinet	Sensor Module Cabinet
SME	Sensor Module External	Sensor Module External
SN	Sicherer Software-Nocken	Safe software cam
SOS	Safe Operating Stop	Safe operating stop

Abbreviation	Source of abbreviation	Meaning
SP	Service Pack	Service pack
SPC	Setpoint Channel	Setpoint channel
SPI	Serial Peripheral Interface	Serial interface for connecting peripherals
SS1	Safe Stop 1	Safe stop 1 (monitored for time and ramping up)
SS2	Safe Stop 2	Safe stop 2
SSI	Synchronous Serial Interface	Synchronous serial interface
SSM	Safe Speed Monitor	Safe feedback for speed monitoring (n < nx)
SSP	SINAMICS Support Package	SINAMICS support package
STO	Safe Torque Off	Safe torque off
STW	Steuerwort	Control word
T		
TB	Terminal Board	Terminal Board
TIA	Totally Integrated Automation	Totally Integrated Automation
TM	Terminal Module	Terminal module
TN	Terre Neutre	Grounded three-phase supply network
Tn	-	Integral time
TPDO	Transmit Process Data Object	Transmit process data object
TT	Terre Terre	Grounded three-phase supply network
TTL	Transistor-Transistor Logic	Transistor-transistor logic
Tv	-	Rate time
U		
u.d.	under development	Under development: This feature is not currently available
UL	Underwriters Laboratories Inc.	Underwriters Laboratories Inc.
UPS	Uninterruptible Power Supply	Uninterruptible power supply
UTC	Universal Time Coordinated	Universal time coordinated
V		
VC	Vector Control	Vector control
Vdc	-	DC link voltage
VdcN	-	Partial DC link voltage negative
VdcP	-	Partial DC link voltage positive
VDE	Verband Deutscher Elektrotechniker	Association of German electrical engineers
VDI	Verein Deutscher Ingenieure	Association of German Engineers
VPM	Voltage Protection Module	Voltage Protection Module
Vpp	Volt peak-to-peak	Volt peak-to-peak
VSM	Voltage Sensing Module	Voltage Sensing Module

Abbreviation	Source of abbreviation	Meaning
X		
XML	Extensible Markup Language	Standard language for Web publishing and document management
Z		
ZM	Zero Mark	Zero mark
ZSW	Zustandswort	Status word


SINAMICS documentation overview
General documentation / catalogs
SINAMICS
G110
D11.1
Converter chassis units
0.12 kW to 3 kW
SINAMICS
G130
G150
D11
Converter chassis units
Converter cabinet units
SIMOTION
SINAMICS
S120
PM21
SIMOTION, SINAMICS S120 and
Motors for Production Machines
SINAMICS
S120
S150
D21.3
SINAMICS S120
Chassis Format Units and Cabinet Modules
SINAMICS S150
Converter cabinet units
Manufacturer / service documentation
SINAMICS
G110
Getting Started
Operating Instructions
List Manual
SINAMICS
G120
G120C
Getting Started
Operating Instructions
Hardware Installation Manual
Function Manual Safety Integrated
List Manual
SINAMICS
G130
Operating Instructions
List Manual
SINAMICS
G150
Operating Instructions
List Manual
SINAMICS
GM150
SM120 / SM150
GL150
SL150
Operating Instructions
List Manual
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SINAMICS
S110
Equipment Manual
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Function Manual
List Manual
SINAMICS
S120
Getting Started
Commissioning Manual
Commissioning Manual for CANopen
Function Manual for Drive Functions
Function Manual for Safety Integrated
Function Manual DCC
List Manual
SINAMICS
S120
Equipment Manual for Control Units and
Supplementary Components
Equipment Manual for Booksize Power Units
Equipment Manual for Chassis Power Units
Equipment Manual for Chassis Liquid
Cooled Power Units
Manual for Cabinet Modules
Manual for AC Drives
SINAMICS
S150
Operating Instructions
List Manual
Manufacturer / service documentation
SINAMICS
Motors
SINAMICS
Manual Collection
Motors
Configuration Manuals
Motors
Configuration Manual
EMC Guidelines

Index

2

24 V connector, 694

A

Active Interface Module, 112
Active Line Module, 145, 168, 194
Active Line Module Liquid Cooled, 213
Addition of biocide, 782
Anti-condensation measures, 783
Anti-corrosion agent, 780
Antifreeze, 781
Autotransformer, 141

B

Basic Line Filter for Basic Line Modules, 73
Basic Line Filter for Smart Line Modules, 78
Basic Line Filters for Active Line Modules, 59
Basic Line Module, 228, 250
Braking duty cycle
  Basic Line Modules, 248, 272
Braking Module, 501
Braking Module Booksize Compact, 514

C

Cable Installation, 689
Cable Shields, 690
Capacitor Module, 539
Cavitation, 778
Center infeed, 732
Cold plate
  Drive line-up with external air heat sink, 741
  Drive line-up with external liquid heat sink, 744
Cold plate cooling in the drive line-up, 739
Components
  Active Interface Module, 112
  Active Line Module, 145, 168, 194
  Active Line Module Liquid Cooled, 213
  Basic Line Filter for Basic Line Modules, 73
  Basic Line Filter for Smart Line Modules, 78
  Basic Line Filters for Active Line Modules, 59
  Basic Line Module, 228, 250
  Braking Module, 501
  Braking Module Booksize Compact, 514
  Capacitor Module, 539
  Control Supply Module CSM, 545
  DC link adapter, 657
  DC link rectifier adapter, 644
  DRIVE-CLiQ cabinet bushing, 673
  DRIVE-CLiQ coupling, 678
  Line reactors for Active Line Modules, 86
  Line reactors for Basic Line Modules, 100
  Line reactors for Smart Line Modules, 106
  MASTERDRIVES braking unit, 531
  Motor Module, 371, 397, 428
  Motor Module Booksize Compact, 471
  Motor Module Liquid Cooled, 454
  Motor reactors, 587
  Smart Line Module booksize compact, 353
  Smart Line Module with cold plate, 334
  Smart Line Module with external air cooling, 301
  Smart Line Module with internal air cooling, 274
  Voltage Clamping Module VCM, 564
  Voltage Protection Module VPM, 597
  Wideband Line Filter for Active Line Modules, 65
Control Supply Module CSM, 545
Coolant
  Features, 779
Coolant mix, 775
Coolant temperatures, 775
Cooling circuit
  Addition of biocide, 782
  Anti-condensation measures, 783
  Anti-corrosion agent, 780
  Antifreeze, 781
  Configuring, 774
  Dimensioning, 776
  General requirements, 772
  Materials and connections, 777
  Pressure, 774
  Pressure drop, 775
Cooling circuits, 771
Current consumption (24 VDC), 699

D

Damping resistor
  HFD line reactor, 98
DC link adapter, 657

DC link busbars, 666
DC link rectifier adapter, 644
DC-link busbar
Overload, 732
Derating
Active Line Modules, 167, 193, 212
Active Line Modules Liquid Cooled, 226
Basic Line Modules, 248, 273
Motor Modules Booksize, 395, 426, 452
Motor Modules Booksize Compact, 492
Motor Modules Booksize Liquid Cooled, 467
Smart Line Modules, 300, 333, 351
Smart Line Modules booksize compact, 369
Diagnostics via LEDs
Active Line Modules, 154, 177, 202, 221
Basic Line Modules, 239, 261
Braking Module Booksize, 508
Braking Module Booksize Compact, 523
Control Supply Module, 559
Motor Module booksize compact, 481
Motor Module Liquid Cooled, 462
Motor Modules, 382, 408, 439
Smart Line Module Booksize Compact, 361
Smart Line Modules 16 kW and higher, 291, 319
Smart Line Modules 5 kW and 10 kW, 290, 318, 344
Dimension drawings
Active Interface Module (internal cooling), 121
Active Line Module Liquid Cooled, 222
Active Line Module with external air cooling, 178
Active Line Modules with cold plate, 203
Active Line Modules with internal air cooling, 155
Basic Line Filter for Basic Line Modules, 75
Basic Line Filter for Smart Line Modules, 80
Basic Line Filters for Active Line Modules, 61
Basic Line Module with cold plate, 262
Basic Line Module with internal air cooling, 240
Braking Module, 509
Braking Module Booksize Compact, 524
Braking resistors for Braking Modules and Basic Line Modules, 577
Control Supply Module, 560
Damping resistor, 96
DC link rectifier adapter, 648
DRIVE-CLiQ cabinet gland, 674
DRIVE-CLiQ coupling, 679
Line reactors for Active Line Modules, 89
Line reactors for Basic Line Modules, 103
Line reactors for Smart Line Modules, 108
Masterdrives braking unit for Basic Line Module, 536
Motor Module Booksize with cold plate, 440
Motor Module Booksize with external air cooling, 409
Motor Module Booksize with internal air cooling, 383
Motor Module Liquid Cooled, 463
Motor Modules Booksize Compact, 482
Shield connecting plates on Active Interface Modules, 635
Shield connecting plates, components, cold plate, 630
Shield connecting plates, components, external air cooling, 626
Shield connecting plates, components, internal air cooling, 622
Shield connecting plates, components, Liquid Cooled, 634
Smart Line Module with external air cooling, 320
Smart Line Module with internal air cooling, 292
Smart Line Modules, 345
Voltage Protection Module VPM, 605
Wideband Line Filter for Active Line Modules, 68
Dimension Drawings
Capacitor Module, 542
DC link adapter, 661
Voltage Clamping Module, 570
Disconnector unit, 46
Drive Line-Up
Single tier, 733
DRIVE-CLiQ cabinet bushing, 673
DRIVE-CLiQ coupling, 678
DRIVE-CLiQ signal cable, 704

E

Electrical connections
DC link adapter, 664
DC link rectifier adapter, 655
DC-link busbars and 24 V busbars, 495
Electronics power supply, 39
EMC Directive, 688
Equipotential bonding, 727
ESD information, 7

F

Field of application, 27
Fuses, 49

H

Heat dissipation, 746

I

Installation
- 24 V terminal adapter, 496
- Active Interface Module (internal cooling), 125
- Active Line Module Liquid Cooled, 223
- Active Line Module with external air cooling, 181
- Active Line Modules with internal air cooling, 159, 388
- Basic Line Module with cold plate, 265
- Basic Line Module with internal air cooling, 243
- Braking Module, 510
- Braking Module Booksize Compact, 525
- Capacitor Module, 543
- Control Supply Module, 561
- DC link adapter, 662
- DC link rectifier adapter on components that are between 50 and 100 mm wide, 651
- DC link rectifier adapter on components that are more than 150 mm wide, 653
- Motor Module Booksize Compact, 485
- Motor Module Booksize with cold plate, 205, 444
- Motor Module Liquid Cooled, 464
- Motor Module with External Air Cooling, 414
- Motor Module with internal air cooling, 389
- Reinforced DC link busbars, 671
- Smart Line Module Booksize Compact, 363
- Smart Line Module with cold plate, 346
- Smart Line Module with external air cooling, 324
- Voltage Clamping Module, 571
- Voltage Protection Module VPM, 607

Insulation test, 769
Interface descriptions
- Active Interface Module (internal cooling), 115
- Active Line Module Liquid Cooled, 216
- Active Line Module with cold plate, 197
- Active Line Module with external air cooling, 171
- Active Line Modules with internal air cooling, 148
- Basic Line Filters for Active Line Modules, 60
- Basic Line Module with cold plate, 253
- Basic Line Module with internal air cooling, 231
- Braking Module Booksize, 504
- Braking Module Booksize Compact, 517
- Control Supply Module, 547
- DC link adapter, 659
- DRIVE-CLiQ cabinet bushing, 674
- DRIVE-CLiQ coupling, 678
- Line reactors for Active Line Modules, 86
- Line reactors for Basic Line Modules, 100
- Line reactors for Smart Line Modules, 106
- Motor Module Booksize with cold plate, 431
- Motor Module Booksize with external air cooling, 400
- Motor Module Booksize with internal air cooling, 374
- Motor Module Liquid Cooled, 457
- Motor Modules Booksize Compact, 474
- Smart Line Module Booksize Compact, 356
- Smart Line Module with cold plate (5 kW and 10 kW), 338
- Smart Line Module with external air cooling, 306
- Smart Line Module with internal air cooling, 278

Introduction, 30
Isolating transformer, 143
IT system, 128

L

LEDs
- Active Line Modules, 154, 177, 202, 221
- Basic Line Modules, 239, 261
- Braking Module Booksize, 508
- Braking Module Booksize Compact, 523
- Control Supply Module, 559
- Motor Module booksize compact, 481
- Motor Module Liquid Cooled, 462
- Motor Modules, 382, 408, 439
- Smart Line Module Booksize Compact, 361
- Smart Line Modules 16 kW and higher, 291, 319
- Smart Line Modules 5 kW and 10 kW, 290, 318, 344

Line connection, 45
Line connection voltage, 39
Line Connections, 133
Line contactor, 54
Line frequency, 39
Line reactors, 84
Line reactors for Active Line Modules, 86
Line reactors for Basic Line Modules, 100
Line reactors for Smart Line Modules, 106

M

MASTERDRIVES braking unit, 531
Motor connection plug
- Coding, 720
- Removal, 719

Motor Module, 371, 397, 428
Motor Module Booksize Compact, 471
Motor Module Liquid Cooled, 454
Motor plug
- With locking mechanism, 715

Motor reactors, 587
Motors

Line connection, 134
Mounting
DRIVE-CLiQ cabinet gland, 676
DRIVE-CLiQ coupling, 680

O

Overcurrent, 695
Overcurrent protection
Line fuses and circuit breakers, 47

P

Platform Concept, 28
Power loss, 756
Power loss calculation, 756
Power Supply Units, 703

R

Rated duty cycles
Active Line Modules, 165, 191, 210
Active Line Modules Liquid Cooled, 226
Active Line Modules with Active Interface Modules, 166, 192, 211
Basic Line Modules, 247, 271
Motor Modules Booksize, 393, 424, 450
Motor Modules Booksize Compact, 490
Motor Modules Booksize Liquid Cooled, 466
Smart Line Modules, 299, 332, 350
Smart Line Modules booksize compact, 368
Rated pulse frequency, 39
RCD
Residual-current operated circuit breakers (line-side), 50
RCM
Residual-current monitors (line-side), 52
Reinforced DC link busbars, 666
Replacing the fan
On the Control Supply Module CSM, 795
Residual risks, 10
Residual risks of power drive systems, 10
Residual-current monitors, 52
Residual-current operated circuit breakers, 50

S

Safety information
Active Interface Module internal air cooling, 113
Active Line Module, 145, 168, 194
Active Line Module Liquid Cooled, 213
Basic Line Module, 229, 251
Braking Module, 503
Braking Module Booksize Compact, 516
Control Supply Module, 546
DRIVE-CLiQ cabinet bushing, 673
DRIVE-CLiQ coupling, 678
Line filters, 57
Line reactors, 85
Motor Module, 471
Voltage Protection Module VPM, 599
Shield connection
For X21/X22 on Motor Modules, 499
Short-circuit current rating, 39
Smart Line Module booksize compact, 353
Smart Line Module with cold plate, 334
Smart Line Module with external air cooling, 301
Smart Line Module with internal air cooling, 274
Spacing bolts for Motor Module in compact booksize format, 681
Spare parts, 787
Standards, 42
Storage, 40

T

Technical data
Active Interface Module internal air cooling, 131
Active Line Module Liquid Cooled, 224
Active Line Modules, cold plate, 208
Active Line Modules, external air cooling, 187
Active Line Modules, internal air cooling, 161
Basic Line Filter for Basic Line Modules, 77
Basic Line Filter for Smart Line Modules, 83
Basic Line Filters for Active Line Modules, 64
Basic Line Modules, 245
Basic Line Modules with cold plate, 270
Braking Module Booksize, 511
Braking Module Booksize Compact, 527
Capacitor Module, 544
Control Supply Module, 562
DRIVE-CLiQ cabinet bushing, 677
DRIVE-CLiQ coupling, 680
Line reactors for Active Line Modules, 94
Line reactors for Basic Line Modules, 106
Line reactors for Smart Line Modules, 111
Motor Modules Booksize Compact, 488
Motor Modules Liquid Cooled, 465
Motor Modules with cold plate, 447
Motor Modules with external air cooling, 421
Motor Modules with internal air cooling, 390
Motor reactors, 596

Smart Line Modules, 348, 366
Smart Line Modules with external air cooling, 330
Smart Line Modules with internal air cooling, 297
Voltage Clamping Module, 571
Voltage Protection Module VPM, 614
Wideband Line Filter for Active Line Modules, 72
Technical Data
Motor reactors, 595
Technical specifications
DC link adapter, 665
DC link rectifier adapter, 656
Temperature limits, 755
Temperature measurement, 755
Totally Integrated Automation, 28
Transport, 40

V

Ventilation, 747, 755
Voltage Clamping Module VCM, 564
Voltage Protection Module VPM, 597

W

Wideband Line Filter for Active Line Modules, 65

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