

**SIEMENS**



# SINAMICS

## SINAMICS G120 Inverters

PM240-2, IP20 Power Modules / Push Through Technology (PT)

Hardware Installation Manual

Edition

01/2017



# SIEMENS

## SINAMICS

### SINAMICS G120 Power Module PM240-2

#### Hardware Installation Manual

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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.

 <b>DANGER</b>
indicates that death or severe personal injury <b>will</b> result if proper precautions are not taken.
 <b>WARNING</b>
indicates that death or severe personal injury <b>may</b> result if proper precautions are not taken.
 <b>CAUTION</b>
indicates that minor personal injury can result if proper precautions are not taken.
<b>NOTICE</b>
indicates that property damage can result if proper precautions are not taken.


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:

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

### Trademarks

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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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## Changes in this manual

### With respect to the PM240-2 Power Modules Manual, Edition 12/2015

The "EMC-compliant installation" section has been revised and moved to the "Installation/mounting" chapter. It now has the title "EMC-compliant installation of a machine or system".

The "Installing Power Modules" section has been revised.

The "Connecting" chapter has been restructured. "Connecting the motor to the inverter in a star or delta connection" section has been revised.


The "Technical data" chapter has been revised and restructured.




## Fundamental safety instructions

### 2.1 General safety instructions



 <b>DANGER</b>
<p><b>Danger to life due to live parts and other energy sources</b></p> <p>Death or serious injury can result when live parts are touched.</p> <ul style="list-style-type: none"> <li>• Only work on electrical devices when you are qualified for this job.</li> <li>• Always observe the country-specific safety rules.</li> </ul> <p>Generally, six steps apply when establishing safety:</p> <ol style="list-style-type: none"> <li>1. Prepare for shutdown and notify all those who will be affected by the procedure.</li> <li>2. Disconnect the machine from the supply.             <ul style="list-style-type: none"> <li>– Switch off the machine.</li> <li>– Wait until the discharge time specified on the warning labels has elapsed.</li> <li>– Check that it really is in a no-voltage condition, from phase conductor to phase conductor and phase conductor to protective conductor.</li> <li>– Check whether the existing auxiliary supply circuits are de-energized.</li> <li>– Ensure that the motors cannot move.</li> </ul> </li> <li>3. Identify all other dangerous energy sources, e.g. compressed air, hydraulic systems, or water.</li> <li>4. Isolate or neutralize all hazardous energy sources by closing switches, grounding or short-circuiting or closing valves, for example.</li> <li>5. Secure the energy sources against switching on again.</li> <li>6. Ensure that the correct machine is completely interlocked.</li> </ol> <p>After you have completed the work, restore the operational readiness in the inverse sequence.</p>



 <b>WARNING</b>
<p><b>Danger to life through a hazardous voltage when connecting an unsuitable power supply</b></p> <p>Touching live components can result in death or severe injury.</p> <ul style="list-style-type: none"> <li>• Only use power supplies that provide SELV (Safety Extra Low Voltage) or PELV- (Protective Extra Low Voltage) output voltages for all connections and terminals of the electronics modules.</li> </ul>



**! WARNING**

**Danger to life when live parts are touched on damaged devices**

Improper handling of devices can cause damage.

For damaged devices, hazardous voltages can be present at the enclosure or at exposed components; if touched, this can result in death or severe injury.

- Ensure compliance with the limit values specified in the technical data during transport, storage and operation.
- Do not use any damaged devices.



**! WARNING**

**Danger to life through electric shock due to unconnected cable shields**

Hazardous touch voltages can occur through capacitive cross-coupling due to unconnected cable shields.

- As a minimum, connect cable shields and the conductors of power cables that are not used (e.g. brake cores) at one end at the grounded housing potential.



**! WARNING**

**Danger to life due to electric shock when not grounded**

For missing or incorrectly implemented protective conductor connection for devices with protection class I, high voltages can be present at open, exposed parts, which when touched, can result in death or severe injury.

- Ground the device in compliance with the applicable regulations.



**! WARNING**

**Danger to life due to electric shock when opening plug connections in operation**

When opening plug connections in operation, arcs can result in severe injury or death.

- Only open plug connections when the equipment is in a no-voltage state, unless it has been explicitly stated that they can be opened in operation.



**! WARNING**

**Danger to life through electric shock due to the residual charge of the power component capacitors**

Because of the capacitors, a hazardous voltage is present for up to 5 minutes after the power supply has been switched off. Contact with live parts can result in death or serious injury.

- Wait for 5 minutes before you check that the unit really is in a no-voltage condition and start work.

**NOTICE****Material damage due to loose power connections**

Insufficient tightening torques or vibrations can result in loose electrical connections. This can result in damage due to fire, device defects or malfunctions.

- Tighten all power connections with the specified tightening torques, e.g. line supply connection, motor connection, DC link connections.
- Check all power connections at regular intervals. This applies in particular after transport.

 **WARNING****Danger to life due to fire spreading if housing is inadequate**

Fire and smoke development can cause severe personal injury or material damage.

- Install devices without a protective housing in a metal control cabinet (or protect the device by another equivalent measure) in such a way that contact with fire is prevented.
- Ensure that smoke can only escape via controlled and monitored paths.

 **WARNING****Danger to life from electromagnetic fields**

Electromagnetic fields (EMF) are generated by the operation of electrical power equipment, such as transformers, converters, or motors.

People with pacemakers or implants are at particular risk in the immediate vicinity of this equipment.

- If you have a heart pacemaker or implant, maintain a minimum distance of 2 m from electrical power equipment.

 **WARNING****Danger to life through unexpected movement of machines when using mobile wireless devices or mobile phones**

Using mobile wireless devices or mobile phones with a transmit power > 1 W closer than approx. 2 m to the components may cause the devices to malfunction, influence the functional safety of machines therefore putting people at risk or causing material damage.

- Switch the wireless devices or mobile phones off in the immediate vicinity of the components.

 **WARNING**

**Danger to life due to the motor catching fire in the event of insulation overload**

There is higher stress on the motor insulation through a ground fault in an IT system. If the insulation fails, it is possible that death or severe injury can occur as a result of smoke and fire.

- Use a monitoring device that signals an insulation fault.
- Correct the fault as quickly as possible so the motor insulation is not overloaded.

 **WARNING**

**Danger to life due to fire if overheating occurs because of insufficient ventilation clearances**

Inadequate ventilation clearances can cause overheating of components with subsequent fire and smoke. This can cause severe injury or even death. This can also result in increased downtime and reduced service lives for devices/systems.

- Ensure compliance with the specified minimum clearance as ventilation clearance for the respective component.

 **WARNING**

**Danger of an accident occurring due to missing or illegible warning labels**

Missing or illegible warning labels can result in accidents involving death or serious injury.

- Check that the warning labels are complete based on the documentation.
- Attach any missing warning labels to the components, in the national language if necessary.
- Replace illegible warning labels.

**NOTICE**

**Device damage caused by incorrect voltage/insulation tests**

Incorrect voltage/insulation tests can damage the device.

- Before carrying out a voltage/insulation check of the system/machine, disconnect the devices as all converters and motors have been subject to a high voltage test by the manufacturer, and therefore it is not necessary to perform an additional test within the system/machine.

 **WARNING**

**Danger to life when safety functions are inactive**

Safety functions that are inactive or that have not been adjusted accordingly can cause operational faults on machines that could lead to serious injury or death.

- Observe the information in the appropriate product documentation before commissioning.
- Carry out a safety inspection for functions relevant to safety on the entire system, including all safety-related components.
- Ensure that the safety functions used in your drives and automation tasks are adjusted and activated through appropriate parameterizing.
- Perform a function test.
- Only put your plant into live operation once you have guaranteed that the functions relevant to safety are running correctly.

**Note**

**Important safety notices for Safety Integrated functions**

If you want to use Safety Integrated functions, you must observe the safety notices in the Safety Integrated manuals.

## 2.2 Handling electrostatic sensitive devices (ESD)

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



### NOTICE

#### Damage through electric fields or electrostatic discharge

Electric fields or electrostatic discharge can cause malfunctions through damaged individual components, integrated circuits, modules or devices.

- Only pack, store, transport and send electronic components, modules or devices in their original packaging or in other suitable materials, e.g. conductive foam rubber or aluminum foil.
- Only touch components, modules and devices when you are grounded by one of the following methods:
  - Wearing an ESD wrist strap
  - Wearing ESD shoes or ESD grounding straps in ESD areas with conductive flooring
- Only place electronic components, modules or devices on conductive surfaces (table with ESD surface, conductive ESD foam, ESD packaging, ESD transport container).



## 2.3 Industrial security

### Note

#### Industrial security

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

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

The customer is responsible for preventing unauthorized access to its plants, systems, machines and networks. Systems, machines and components should only be connected to the enterprise network or the internet if and to the extent necessary and with appropriate security measures (e.g. use of firewalls and network segmentation) in place.

Additionally, Siemens' guidance on appropriate security measures should be taken into account. For more information about industrial security, please visit:

Industrial security (<http://www.siemens.com/industrialsecurity>).

Siemens' products and solutions undergo continuous development to make them more secure. Siemens strongly recommends to apply product updates as soon as available and to always use the latest product versions. Use of product versions that are no longer supported, and failure to apply latest updates may increase customer's exposure to cyber threats.

To stay informed about product updates, subscribe to the Siemens Industrial Security RSS Feed at:

Industrial security (<http://www.siemens.com/industrialsecurity>).

### WARNING

#### **Danger to life as a result of unsafe operating states resulting from software manipulation**

Software manipulations (e.g. viruses, trojans, malware or worms) can cause unsafe operating states in your system that may lead to death, serious injury, and property damage.

- Keep the software up to date.
- Incorporate the automation and drive components into a holistic, state-of-the-art industrial security concept for the installation or machine.
- Make sure that you include all installed products into the holistic industrial security concept.
- Protect files stored on exchangeable storage media from malicious software by with suitable protection measures, e.g. virus scanners.

## 2.4 Residual risks of power drive systems

When assessing the machine- or system-related risk in accordance with the respective local regulations (e.g., EC Machinery Directive), the machine manufacturer or system installer must take into account the following residual risks emanating from the control and drive components of a drive system:

1. Unintentional movements of driven machine or system components during commissioning, operation, maintenance, and repairs caused by, for example,
  - Hardware and/or software errors in the sensors, control system, actuators, and cables and connections
  - Response times of the control system and of the drive
  - Operation and/or environmental conditions outside the specification
  - Condensation/conductive contamination
  - Parameterization, programming, cabling, and installation errors
  - Use of wireless devices/mobile phones in the immediate vicinity of electronic components
  - External influences/damage
  - X-ray, ionizing radiation and cosmic radiation
2. Unusually high temperatures, including open flames, as well as emissions of light, noise, particles, gases, etc., can occur inside and outside the components under fault conditions caused by, for example:
  - Component failure
  - Software errors
  - Operation and/or environmental conditions outside the specification
  - External influences/damage
3. Hazardous shock voltages caused by, for example:
  - Component failure
  - Influence during electrostatic charging
  - Induction of voltages in moving motors
  - Operation and/or environmental conditions outside 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
6. Influence of network-connected communication systems, e.g. ripple-control transmitters or data communication via the network

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

# Introduction

## Overview

The Power Modules belong to the modular family of SINAMICS G120 inverters. A modular inverter comprises Control Unit and Power Module.

Depending on the power rating in frame sizes FSA ... FSF, the following Power Module versions are supplied:

- 1 AC 200 V 0.55 kW ... 4 kW for line voltages from 1 AC 200 V ... 240 V
- 3 AC 200 V 0.55 kW ... 55 kW for line voltages from 3 AC 200 V ... 240 V
- 3 AC 400 V 0.55 kW ... 132 kW for line voltages from 3 AC 380 V ... 480 V
- 3 AC 690 V 11 kW ... 132 kW for line voltages from 3 AC 500 V ... 690 V

## Control Units for the Power Modules

You can operate the Power Modules with a Control Unit from one of the following listed families.

- CU230P-2
- CU240B-2
- CU240E-2
- CU250S-2

For Power Modules FSA ... FSC, you require a Control Unit with firmware version V4.4 or higher.

For Power Modules FSD ... FSF, you require a Control Unit with firmware version V4.7 HF8 or higher.

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### Note

#### Commissioning the inverter

You must first commission the inverter before you can use it. Commissioning is described in the Operating Instructions of the relevant Control Unit.



Manuals for your inverter (Page 133)

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## STO independent of the Control Unit

Using the PM240-2 Power Modules, frame sizes FSD, FSE and FSF, you can implement the "Safe Torque Off" safety function (STO), corresponding to PL e according to EN 13849-1 and SIL 3 according to IEC61508.



STO via Power Module terminals (Page 57).

3.1 Component specification according to UL

### 3.1 Component specification according to UL

The inverters have UL approval according to UL508C and CSA C22.2 No. 274-13.

Further information and a link for downloading the appropriate certificates can be found in the following Section:



Directives and standards (Page 137)

### 3.2 Permissible motors

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**Note**

**Motors for inverter operation**

Only use motors that are suitable for operation with inverters with a DC link.

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**Motors for 200 V Power Modules**

For the 200 V Power Modules, induction motors are permissible in the range from 25% ... 150% of the inverter power without any restrictions.

**Motors for 400 V Power Modules**

For the 400 V Power Modules, induction motors are permissible in the range from 25 % ... 150 % of the inverter power without any restrictions.

**Motors for 690 V Power Modules**

For the 690 V Power Modules, induction motors are permissible in the range from 50 % ... 150 % of the inverter power without any restrictions.

# Installing/mounting

## 4.1 Installation conditions

### General installation conditions

When installing the Power Modules carefully observe the conditions listed below in order to guarantee reliable, continuous and disturbance-free operation.

- The Power Modules are designed for installation in a control cabinet.
- The Power Modules are certified for use in environments with degree of pollution 2 without condensation; i.e. in environments where no conductive pollution/dirt occurs.
- The built-in units fulfill IP20 degree of protection.
- Devices with push-through technology (PT devices) have IP20 degree of protection, at the rear of the control cabinet, IP55.
- You can find the permissible conductor cross-sections for the terminals in:





Connection terminals at the inverter (Page 53)

- The following section describes how you can install the Power Modules in compliance with EMC regulations:



EMC-compliant installation of a machine or system (Page 23)

### Inverters for systems in the United States / Canada (UL/cUL)

- For a system configuration in conformance with UL/cUL, use the fuse types approved for UL/cUL, specified in the Technical data, or the circuit breakers under the following Internet address.
  -  Fuse types: Technical data (Page 65)
  -  Circuit breaker  
 (<https://support.industry.siemens.com/cs/ww/en/view/109486009>)
- The integrated semiconductor short-circuit protection does not provide cable protection.
- On the system side, provide **cable protection** in conformance with NEC or CEC, Part 1 and the local regulations.
- The inverters provide internal motor protection corresponding to UL61800-5-1. The protection threshold is 115 % of the inverter full load current. When commissioning, you can adapt the motor overload protection using parameter p0640.
- For frame size FSF, to connect the line supply and motor only use UL approved ring-type cable lugs (ZMVV), which are certified for the particular voltage, with a permissible current of at least 125 % of the input and output current. Use the higher value as basis.

4.1 Installation conditions

- Carefully note that for plants and systems in conformance with UL/cUL, the line and output voltage may not be higher than 600 V.
- Only use copper cables rated for 60 °C or 75 °C.
- For frame size FSE inverters, use only cables certified for temperatures of 75° C to connect the braking resistor.
- The DC-link terminals, DCP and DCN, were not investigated regarding conformance with UL/cUL.

**Additional requirements for CSA compliance, frame sizes FSA ... FSC**

Install the inverter with an external suppression device with the following properties:

- Surge protection device with the appropriate certification (category checking numbers VZCA and VZCA7)
- Rated supply voltage
  - 240 V (phase with respect to ground), 240 V (phase to phase) for 200 V inverters
  - 480 V (phase with respect to ground), 480 V (phase to phase) for 400 V inverters
- Terminal voltage,  $V_{PR} = 2000 \text{ V}$
- Suitable for SPD applications, type 1 or type 2

Alternatively, use a surge protection device, article number 5SD7 424-1 from Siemens AG.

**Additional requirements relating to CSA conformance, frame sizes FSD ... FSF**

Overvoltage category OVC III must be ensured for all connections of the power circuit. This can mean that a surge suppressor must be connected upstream on the line side. The rated voltage of the surge suppressor must not exceed the line voltage, and must guarantee the limit values (VPR) specified here.

Line voltage		Phase to ground		Phase to phase	
		Rated voltage	VPR	Rated voltage	VPR
3 AC 200 V ... 240 V	Grounded neutral conductor	139 V	2.5 kV	240 V	4 kV
	Grounded line conductor	240 V	4 kV	240 V	4 kV
3 AC 380 V ... 480 V	Grounded neutral conductor	277 V	4 kV	480 V	4 kV
	Grounded line conductor	480 V	6 kV	480 V	4 kV
3 AC 500 V ... 600 V	Grounded neutral conductor	347 V	6 kV	600 V	4 kV
	Grounded line conductor	600 V	6 kV	600 V	4 kV

## 4.2 EMC-compliant installation of a machine or system

The inverter is designed for operation in industrial environments where strong electromagnetic fields are to be expected.

Reliable and disturbance-free operation is only guaranteed for EMC-compliant installation.

To achieve this, subdivide the control cabinet and the machine or system into EMC zones:

### EMC zones

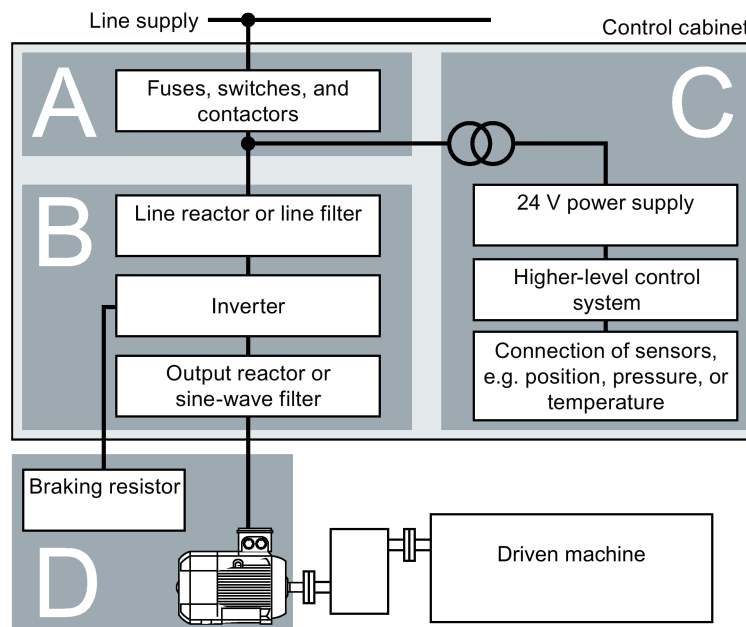


Figure 4-1 Example of the EMC zones of a plant or machine

#### Inside the control cabinet

- Zone A: Line supply connection
- Zone B: Power electronics  
Devices in Zone B generate energy-rich electromagnetic fields.
- Zone C: Control and sensors  
Devices in Zone C do not generate any energy-rich electromagnetic fields themselves, but their functions can be impaired by electromagnetic fields.

#### Outside the control cabinet

- Zone D: Motors, braking resistors  
Devices in Zone D generate electromagnetic fields with a significant amount of energy

### 4.2.1 Control cabinet

- Assign the various devices to zones in the control cabinet.
- Electromagnetically uncouple the zones from each other by means of one of the following actions:
  - Side clearance  $\geq 25$  cm
  - Separate metal enclosure
  - Large-area partition plates
- Route cables of various zones in separate cable harnesses or cable ducts.
- Install filters or isolation amplifiers at the interfaces of the zones.

#### Control cabinet assembly

- Connect the door, side panels, top and base plate of the control cabinet with the control cabinet frame using one of the following methods:
  - Electrical contact surface of several  $\text{cm}^2$  for each contact location
  - Several screw connections
  - Short, finely stranded, braided copper wires with cross-sections  $\geq 95 \text{ mm}^2 / 000 (3/0) (-2)$  AWG
- Install a shield support for shielded cables that are routed out of the control cabinet.
- Connect the PE bar and the shield support to the control cabinet frame through a large surface area to establish a good electrical connection.
- Mount the control cabinet components on a bare metal mounting plate.
- Connect the mounting plate to the control cabinet frame and PE bar and shield support through a large surface area to establish a good electrical connection.
- For screw connections onto painted or anodized surfaces, establish a good conductive contact using one of the following methods:
  - Use special (serrated) contact washers that cut through the painted or anodized surface.
  - Remove the insulating coating at the contact locations.

#### Measures required for several control cabinets

- Install equipotential bonding for all control cabinets.
- Screw the frames of the control cabinets together at several locations through a large surface area using serrated washers to establish a good electrical connection.
- In plants and systems where the control cabinets are lined up next to one another, and which are installed in two groups back to back, connect the PE bars of the two cabinet groups at as many locations as possible.



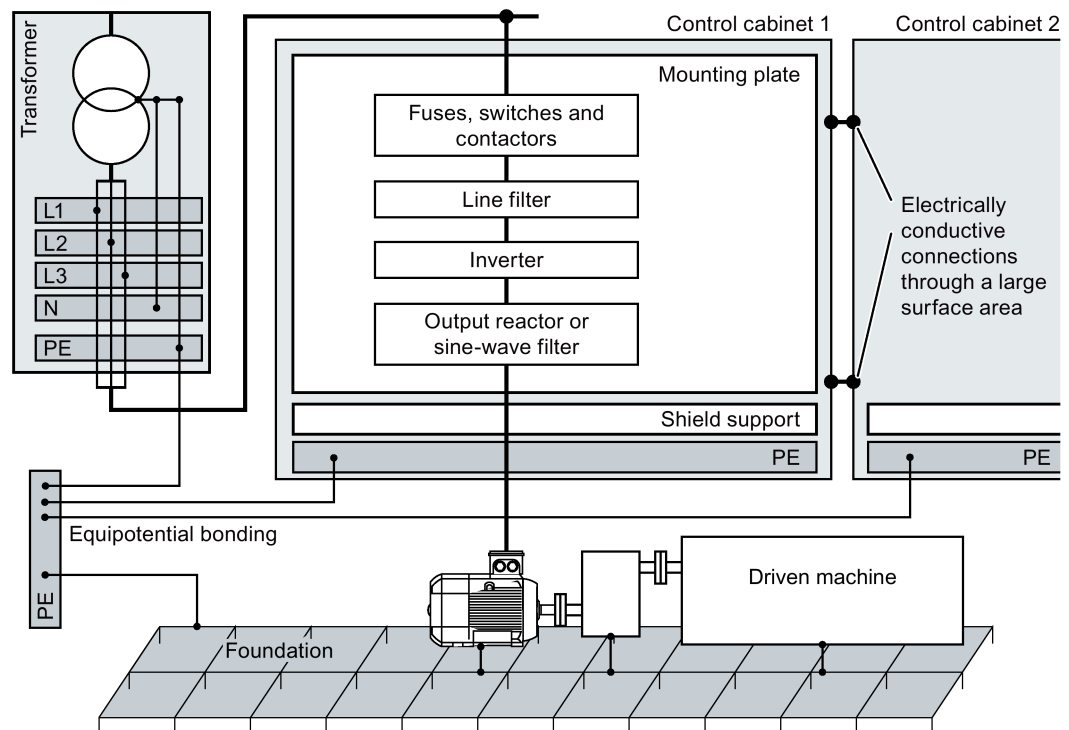


Figure 4-2 Grounding and high-frequency equipotential bonding measures in the control cabinet and in the plant/system

## Further information



Additional information about EMC-compliant installation is available in the Internet:

EMC installation guideline

<https://support.industry.siemens.com/cs/ww/de/view/60612658/en>

### 4.2.2 Cables

Cables with a high level of interference and cables with a low level of interference are connected to the inverter:

- Cables with a high level of interference:
  - Cable between the line filter and inverter
  - Motor cable
  - Cable at the inverter DC link connection
  - Cable between the inverter and braking resistor
- Cables with a low level of interference:
  - Cable between the line and line filter
  - Signal and data cables

**Cable routing inside the cabinet**

- Route the power cables with a high level of interference so that there is a minimum clearance of 25 cm to cables with a low level of interference.

If the minimum clearance of 25 cm is not possible, insert separating metal sheets between the cables with a high level of interference and cables with a low level of interference. Connect these separating metal sheets to the mounting plate to establish a good electrical connection.

- Cables with a high level of interference and cables with a low level of interference may only cross over at right angles:
- Keep all of the cables as short as possible.
- Route all of the cables close to the mounting plates or cabinet frames.
- Route signal and data cables - as well as the associated equipotential bonding cables - parallel and close to one another.
- Twist incoming and outgoing unshielded individual conductors.

Alternatively, you can route incoming and outgoing conductors in parallel, but close to one another.

- Ground any unused conductors of signal and data cables at both ends.
- Signal and data cables must only enter the cabinet from one side, e.g. from below.
- Using shielded cables for the following connections:
  - Cable between the inverter and line filter
  - Cable between the inverter and output reactor or sine-wave filter

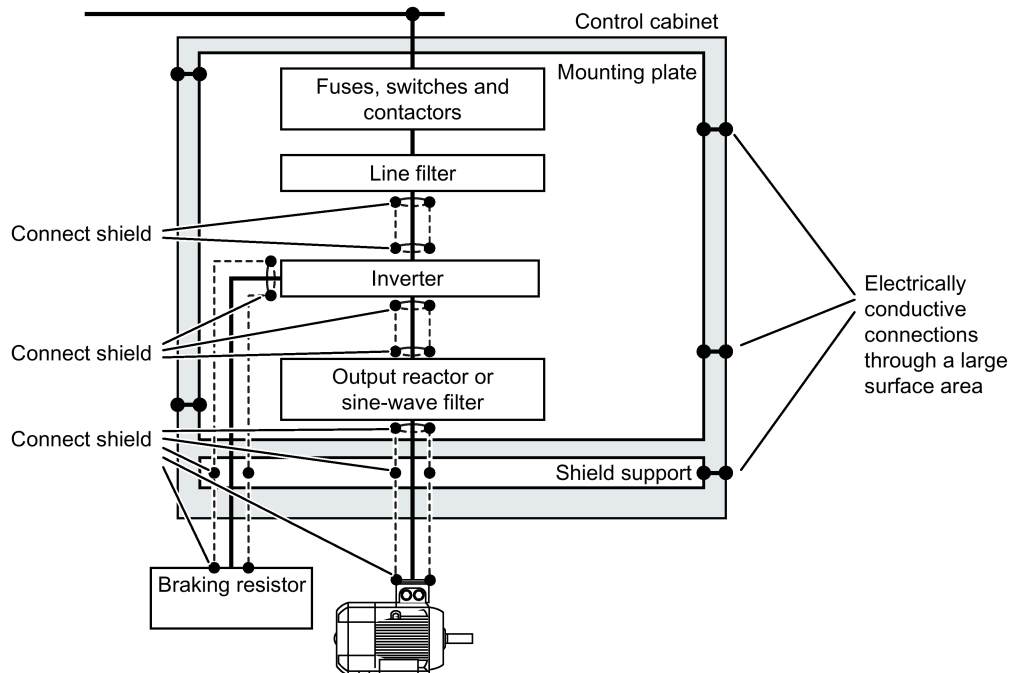


Figure 4-3 Routing inverter cables inside and outside a control cabinet

### Routing cables outside the control cabinet

- Maintain a minimum clearance of 25 cm between cables with a high level of interference and cables with a low level of interference.
- Using shielded cables for the following connections:
  - Inverter motor cable
  - Cable between the inverter and braking resistor
  - Signal and data cables
- Connect the motor cable shield to the motor enclosure using a PG gland that establishes a good electrical connection.

### Requirements relating to shielded cables

- Use cables with finely-stranded, braided shields.
- Connect the shield to at least one end of the cable.

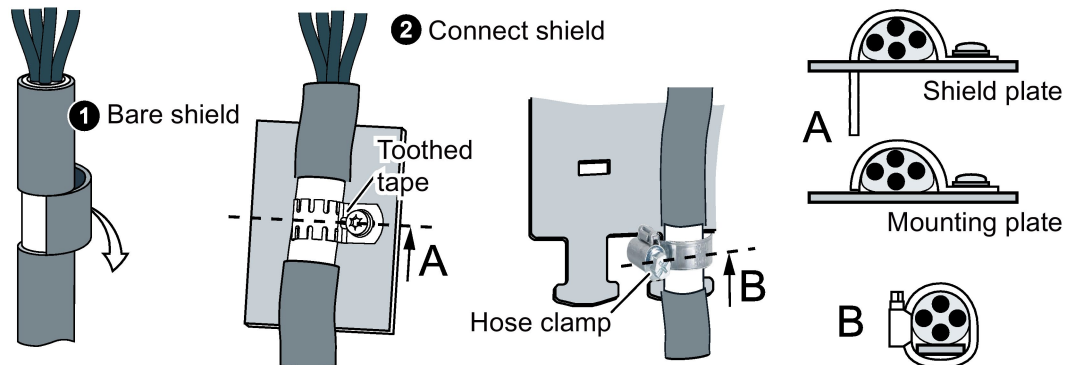


Figure 4-4 Examples for EMC-compliant shield support

- Attach the shield to the shield support directly after the cable enters the cabinet.
- Do not interrupt the shield.
- Only use metallic or metallized plug connectors for shielded data cables.

### **4.2.3 Electromechanical components**

#### **Radio interference suppression**

- Connect interference suppression elements to the following components:
  - Coils of contactors
  - Relays
  - Solenoid valves
  - Motor holding brakes
- Connect the interference suppression element directly at the coil.
- Use RC elements or varistors for AC-operated coils and freewheeling diodes or varistors for DC-operated coils.

## 4.3 Power losses and air cooling requirements

### Cooling requirements


To protect the components from overheating, the control cabinet requires a cooling air flow, which depends on the power loss of the individual components.

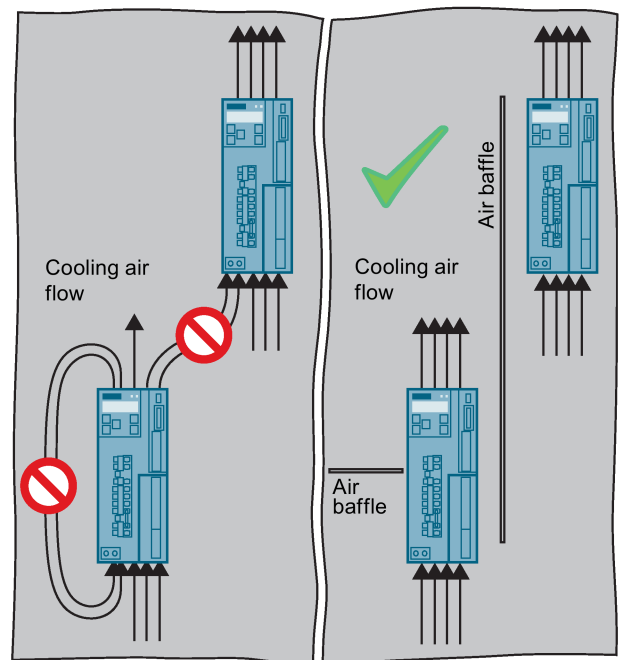
Formula for calculating the cooling airflow:

$$\text{airflow [l/s]} = \text{power loss [W]} * 0.86 / \Delta T [\text{K}]$$

- Power loss: Total of the power losses of the individual components.
- $\Delta T$ : Permissible temperature rise in the control cabinet

### Measures in order to ensure that the components are adequately cooled

- Add the power losses of the individual components.
  - Power Module data:  "Technical data (Page 65)".
  - The Control Unit power loss is less than 0.04 kW.
  - Use the manufacturers data for components, for example reactors or filters
- Calculate the air flow required, using the formula above.
- Ensure that the control cabinet is appropriately ventilated and equipped with suitable air filters.
- Ensure that the components maintain the specified clearances with respect to one another.



- Ensure that the components are provided with adequate cooling air through the cooling openings.
- Use the appropriate air barriers to prevent cooling air short circuits

### **Power loss for Power Modules with push-through technology - PT devices**

When you use PT Power Modules, the majority of the power loss is dissipated through the heatsink located outside the control cabinet.

The following losses occur in the cabinet when the device is operated with its rated data:

- FSA: 0.02 kW
- FSB: 0.045 kW
- FSC: 0.075 kW

## 4.4 Mounting the Power Modules

### Protection against the spread of fire

The device may be operated only in closed housings or in control cabinets with protective covers that are closed, and when all of the protective devices are used. The installation of the device in a metal control cabinet or the protection with another equivalent measure must prevent the spread of fire and emissions outside the control cabinet.

### Protection against condensation or electrically conductive contamination

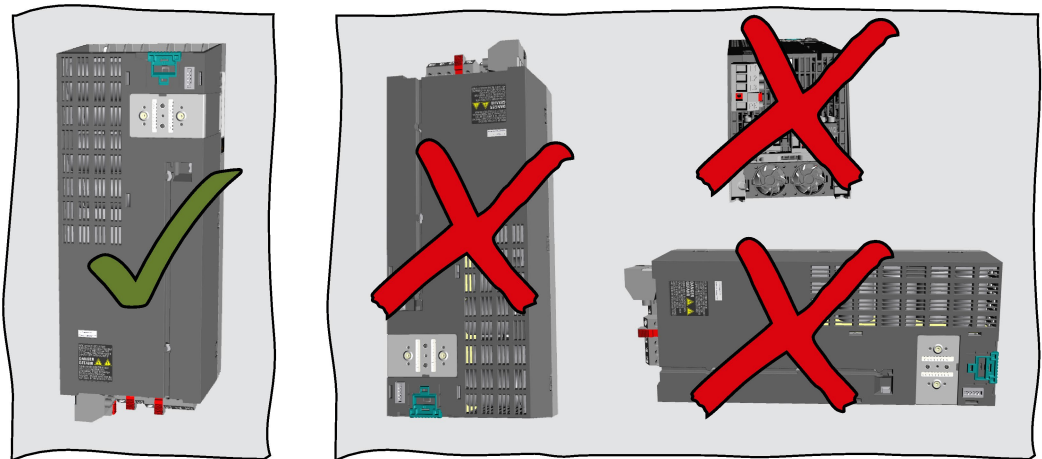
Protect the device, e.g. by installing it in a control cabinet with degree of protection IP54 according to IEC 60529 or NEMA 12. Further measures may be necessary for particularly critical operating conditions.

If condensation or conductive pollution can be excluded at the installation site, a lower degree of control cabinet protection may be permitted.

### Installing Power Modules

The following is required to correctly install a Power Module:

- Install the Power Module vertically with the motor connections facing downwards.



- Comply with the installation regulations specified in the following sections:
  - Minimum clearances to other components
  - Fixing elements
  - Tightening torques for fixing elements

### **Additional for Power Modules with push-through technology - PT devices**

Use the optional mounting frames to mount a Power Module in push-through technology in a control cabinet. The mounting frames include the necessary seals and frames to ensure compliance with degree of protection IP55.

If you do not use the optional mounting frames, then you must ensure that the required degree of protection is complied with using other appropriate measures.

Mounting instructions are provided in the following section:



Mounting frames for PT power modules (Page 107)

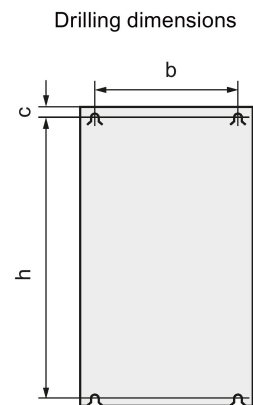
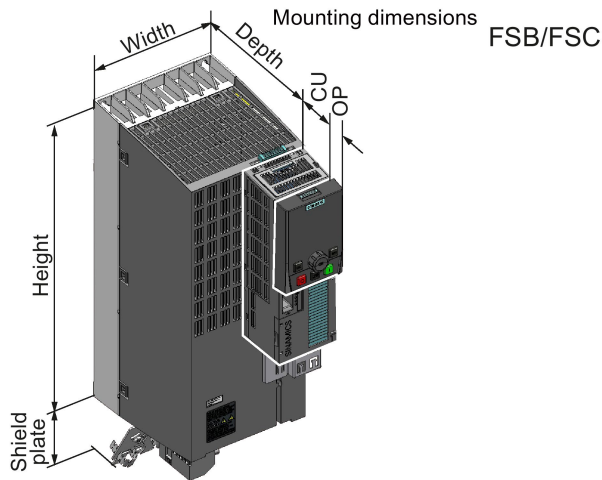
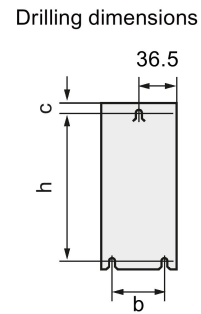
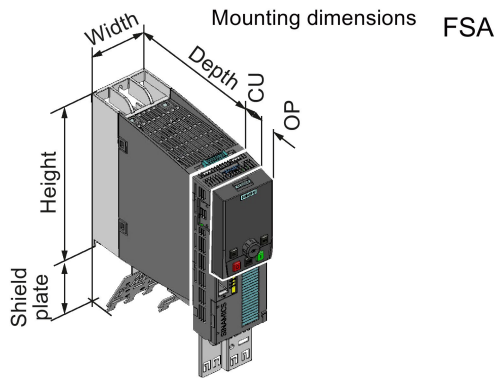


### 4.4.1 Dimension drawings and drilling dimensions for built-in units - IP20 devices

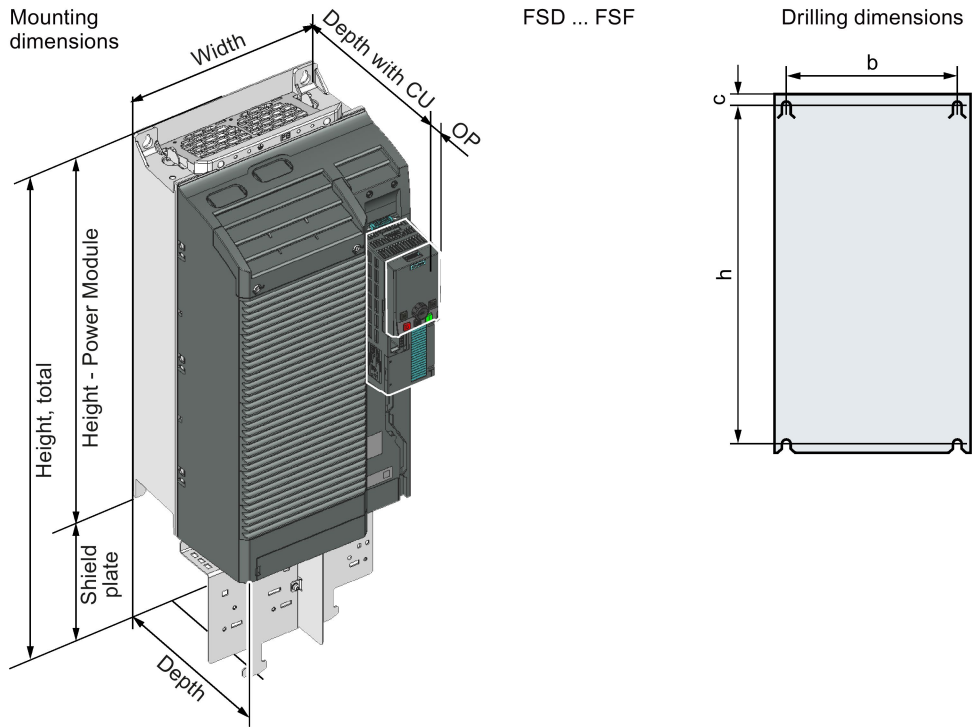
Table 4- 1 Mounting dimensions without Control Unit [mm]

Frame size	Width	Height		Depth
		Power Module	Shield plate	
FSA	73	196	80	165
FSB	100	292	78	165
FSC	140	355	77	165
FSD	200	472	152	237
FSE	275	551	177	237
FSF	305	708	257	357

The following dimension drawings and drilling patterns are not to scale.



4.4 Mounting the Power Modules



Depth with Control Unit and Operator Panel (mm)	CU230P-2	CU240B/E-2	CU250S-2
<b>FSA ... FSC</b>			
• With Control Unit:	+ 59	+ 41	+ 62
• With Control Unit and blanking cover / BOP-2:	+ 70	+ 52	+ 73
• With Control Unit and IOP:	+ 81	+ 63	+ 84
<b>FSD ... FSF</b>			
• With Control Unit:	+ 15.5	+ 0	+ 18.5
• With Control Unit and blanking cover / BOP-2:	+ 26.5	+ 8.5	+ 29.5
• With Control Unit and IOP:	+ 37.5	+ 19.5	+ 40.5

Table 4- 2 Drilling dimensions, cooling air clearances [mm] and fixing [Nm]


Frame size	Drilling dimensions			Cooling air clearances 1)			Fixing/torque
	h	b	c	Top	Bottom	Front	
FSA	186	62.3	6	80	100	100	3 x M4 / 2.5
FSB	281	80	6	80	100	100	4 x M4 / 2.5
FSC	343	120	6	80	100	100	4 x M5 / 3.5
FSD	430	170	7	300	350	100	4 x M5 / 6.0
FSE	509	230	8.5	300	350	100	4 x M6 / 10
FSF	680	270	13	300	350	100	4 x M8 / 25

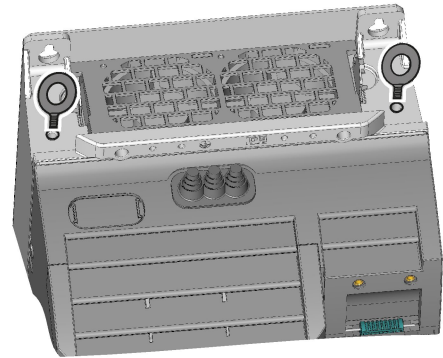
1) The Power Modules are designed for mounting without any lateral cooling air clearance. For tolerance reasons, we recommend a lateral clearance of approx. 1 mm.

#### 4.4.2 Hoisting gear FSD ... FSF

Use crane lifting lugs and the appropriate hoisting gear when mounting Power Modules.

Power Module weights:

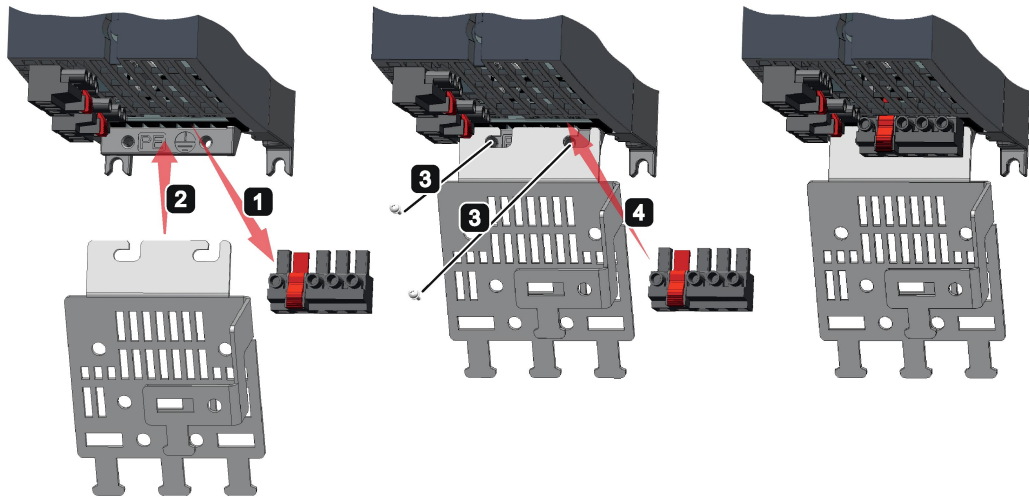
 Technical data (Page 65).



#### 4.4.3 Mounting the shield plate for built-in units

The shield plates and fixings screws are included in the inverter accessory kit.

##### Shield plate FSA ... FSC



### Mounting the shield plate and EMC connecting bracket, FSD ... FSF

Use the shield plate provided for strain relief of the line and motor cable – as well as the shield support for the motor cable.

If you are using the inverter without filter, then you do not require the EMC connecting bracket. In this case, attach the shield plate to the inverter without the EMC connecting bracket


If you are using an inverter with integrated line filter, then mount the shield plate and EMC connecting bracket as described below.

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#### Note

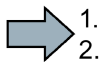
##### Brake relay

If you are using a brake relay to control a motor brake, then mount the brake relay at the rear of the lower shield plate before you attach the shield module to the inverter.

 Mounting and connecting the brake relay (Page 124)

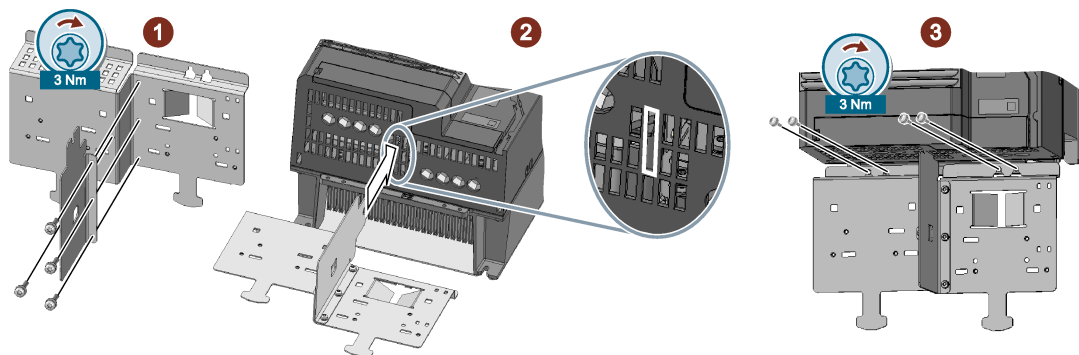
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#### Procedure - FSD and FSE



1. Proceed as follows to mount the EMC connecting bracket and the shield plate:

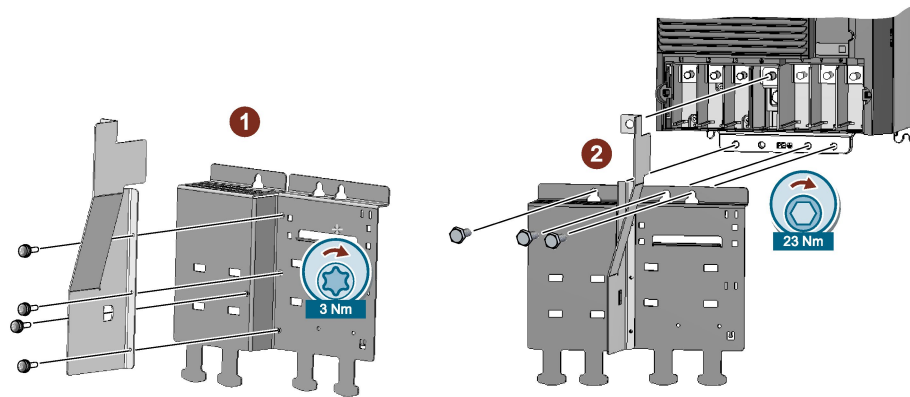
2. 1. Attach the EMC connecting bracket to the shield plate ①.
2. 2. Then slide the shield module into the inverter, so that it is held in the inverter ② by the clamping spring. The shield module is located correctly if it can be easily withdrawn out of the inverter without any resistance.
3. 3. After you have ensured that it is correctly located, fix the shield module using the four screws ③.



 You have correctly mounted the EMC connecting bracket and the shield plate.

**Procedure - FSF:**

- ➔ 1. Proceed as follows to mount the EMC connecting bracket and the shield plate:
1. Attach the EMC connecting bracket to the shield plate ①.
  2. Screw the shield module to the inverter ② using three screws, as shown in the diagram.



- You have correctly mounted the EMC connecting bracket and the shield plate.

### 4.4.4 Dimension drawings and drilling dimensions for PT Power Modules

Table 4- 3 Mounting dimensions without Control Unit (CU) [mm]

Frame size	Width	Height		Depth <sup>1)</sup>		
		without shield plate	with shield plate	T1 +T2	T1	T2
FSA	126	238	322	171	118	53
FSB	154	345	430	171	118	53
FSC	200	411	500	171	118	53

1) Panel thickness of the control cabinet ≤ 3.5 mm

The following dimension drawings and drilling patterns are not to scale.

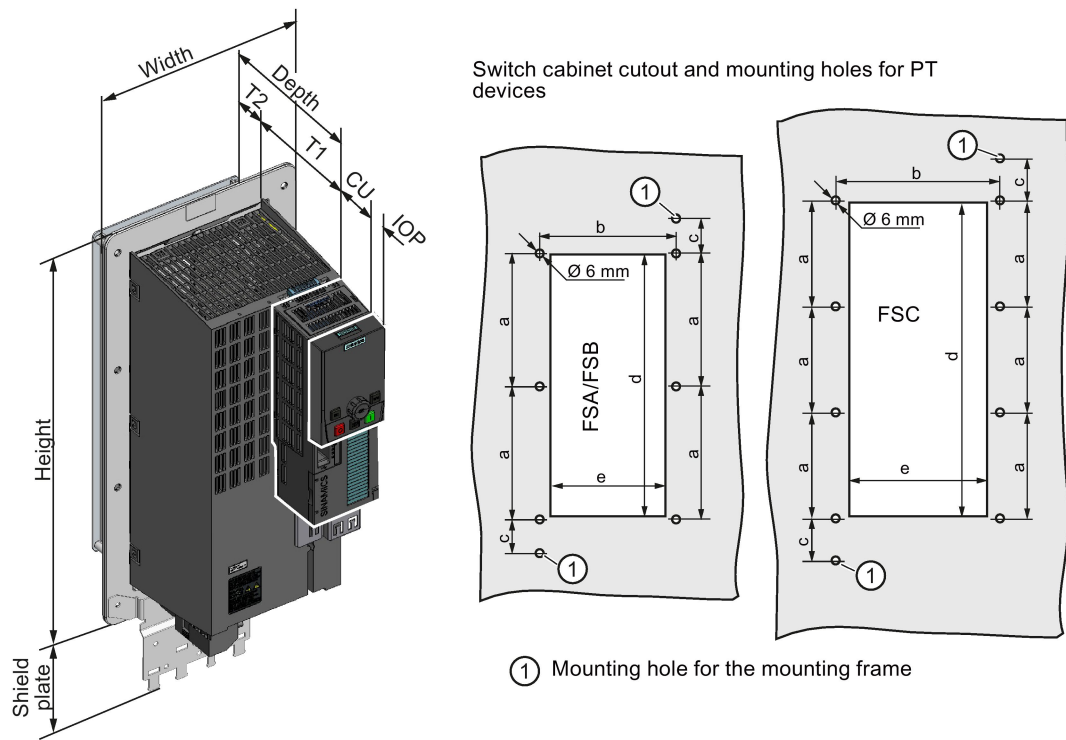


Table 4- 4 Depth with Control Unit and operator panel

Control Unit	Power Module + Control Unit (mm)		Power Module + Control Unit + IOP (mm)		Power Module + Control Unit + BOP (mm)	
	Total	in the cabinet	Total	in the cabinet	Total	in the cabinet
CU230P-2	231	177.7	253	199.7	244	190.7
CU240B-2 / CU240E-2	212	158.7	234	180.7	225	171.7
CU250S-2	234	180.7	256	202.7	247	193.7

Table 4- 5 Drilling dimensions, cooling clearances and fixing

Frame size	Control cabinet cutout [mm]					Cooling air clearances [mm] <sup>1)</sup>			Fixing/torque
	a	b	c	d	e	Top	Bottom	Front	
FSA	103	106	27	198	88	80	100	100	8 x M5 / 3.5 Nm
FSB	148	134	34.5	304	116	80	100	100	8 x M5 / 3.5 Nm
FSC	123	174	30.5	365	156	80	100	100	10 x M5 / 3.5 Nm

<sup>1)</sup> The Power Modules are designed for mounting without any lateral cooling air clearance. For tolerance reasons, we recommend a lateral clearance of 1 mm.

### 4.4.5 Mounting the shield plate for PT Power Modules

The shield plates and fixings screws are included in the inverter accessory kit.

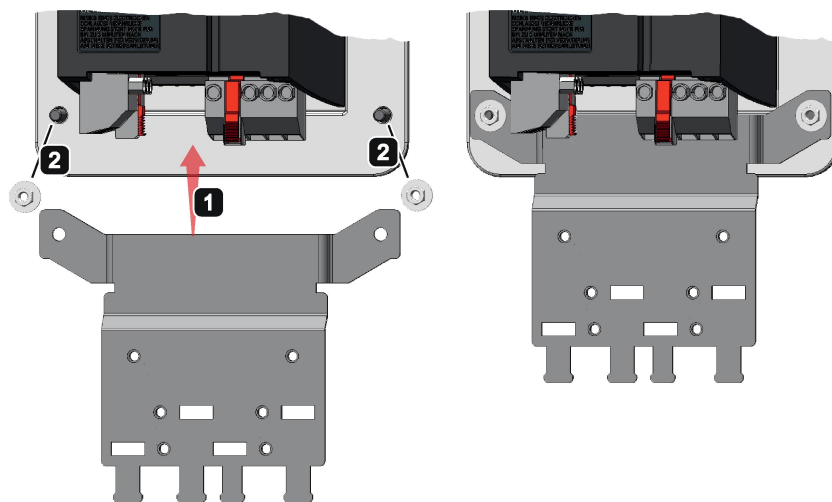




Figure 4-5 Mounting the shield plate

## 4.5 Additional components

Depending on the particular application, additional components may be required for your system. Information about additional components is provided in the following Sections:

-  Connection overview (Page 49)
-  Accessories (Page 105).





Install the inverters so that you are compliant with local regulations for erecting and installing low voltage systems.



**! DANGER**

**Danger to life through electric shock due to the residual charge of the DC link capacitors**

Because of the DC link capacitors, a hazardous voltage is present for up to 5 minutes after the power supply has been switched off.

Contact with live parts can result in death or serious injury.

- Do not open the protective covers or the terminal covers of the device until 5 minutes have elapsed.
- Before starting any work, check that the system is in a voltage-free state by measuring all terminals, also to ground.
- Ensure that the associated warning plate in the appropriate language is attached.

**Note**

**Operating displays for inverter operation**

If, when switching over a function from ON to OFF, an LED or other similar display is not lit or not active; this does not indicate that the device is switched-off or in a no-current condition.

**Note**

**Safety devices**

Install suitable protective equipment between the line supply and inverter.



Technical data (Page 65)



To protect against indirectly touching part of the motor circuit of an inverter and to automatically shut down in the case of a fault according to DIN EN 60364-4-41 (VDE 0100-410). (<http://support.automation.siemens.com/WW/view/en/103474630>)

 **WARNING**

**Danger to life due to electric shock if there is poor touch protection**

Death or injury can occur if accessible parts or connections, which are live, are touched.

- At all of the power connections carefully ensure that neither cables nor terminals can be touched. Make the openings just large enough for the cables to be routed through.
- Cover power connections that are not used so that they cannot be touched.
- Use the dummy plugs provided in the accessory pack to occupy unused terminals.

 **WARNING**

**Danger to life due to fire or electric shock when using unsuitable residual current protection devices**

The inverter can cause a current to flow in the protective conductor. This current can cause the residual current device (RCD) or residual current monitoring (RCM) to incorrectly trip (nuisance trip). In the case of a fault (ground fault), the fault current can contain a DC component, which prevents the RCD/RCM from tripping, with the risk of subsequent fault or electric shock.

- Use the protection and monitoring devices recommended in the documentation.



 **CAUTION**

**Risk of injury due to hot surfaces**

During operation and for a short time after the inverter shuts down, the surface of the device can reach a high temperature.

- During this time, avoid any direct contact with the surface of the inverter.

 **WARNING**

**Danger to life through electric shock as well as fire hazard due to protective devices that either do not trip or trip too late**

Overcurrent protective equipment that trips too late or not at all can cause electric shock or fire.

- In the case of a conductor-conductor or conductor-ground short-circuit, ensure that the short-circuit current at the point where the inverter is connected to the line supply corresponds as a minimum to the requirements of the protective equipment used.
- You must additionally use a residual-current protective device (RCD) if, for a conductor-ground short circuit, the required short-circuit current is not reached. Especially for TT line systems, the required short-circuit can be too low.
- It is not permissible that the short-circuit current exceeds the SCCR or the  $I_{cc}$  of the inverter and the disconnecting capacity of the protective equipment.

## Protection and monitoring equipment

To provide protection against short-circuit, use the overcurrent devices listed in Technical data (fuses, circuit breakers etc.).

If the apparent impedance of the line supply at the infeed point is not suitable, so that fuses do not rupture in the specified time in the case of insulation failure (ground fault, fault to frame), then you must use additional fault current protective devices RCD (RCCB or MRCD), type B.

In order that an RCD does not unnecessarily trip as a result of operational leakage currents, the following preconditions must be fulfilled:

- The neutral point of the line supply is grounded.
- For inverters with rated input currents  $\leq 125$  A referred to LO, use an RCCB type B with a response limit current of 300 mA. Connect the RCCB in series with the overcurrent protective devices.
- For inverters with rated input currents  $> 125$  A referred to LO, use a type B MRCD (for example, from the Bender company).

An MRCD comprises an RCM (differential current monitoring device), a measuring current transducer and a circuit breaker with additional undervoltage release, listed in the Technical data. An example of an MRCD design is provided in the following diagram.

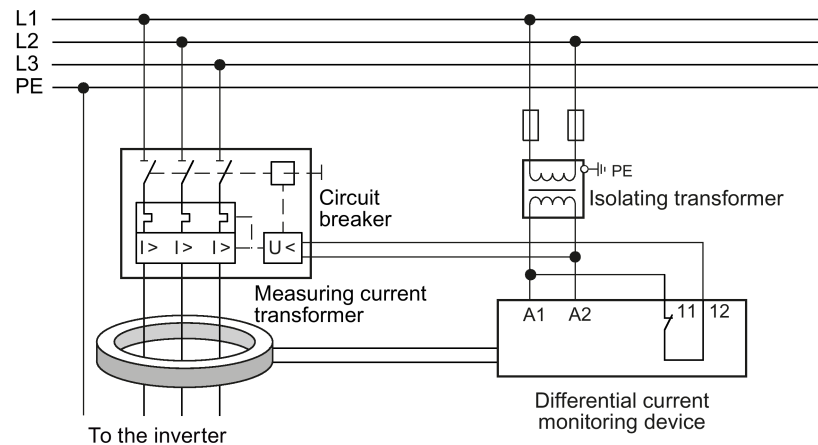



Figure 5-1 MRCD

- A dedicated RCD is used for every inverter.
- The motor cables are shorter than 50 m (164 ft) shielded, or 100 m (328 ft) unshielded.

Additional information about motor cables

 Length of the motor cable (Page 52)



Further protection and monitoring equipment

(<https://support.industry.siemens.com/cs/ww/en/view/109486009>)

## 5.1 Permissible line supplies

The converter is designed for the following line supplies according to IEC 60364-1 (2005).

- N system
- TT system
- IT system

### General requirements on line supply

The plant builder or machine manufacturer must ensure for operation with rated current  $I_{rated}$  that the voltage drop between the transformer input terminals and the inverter when operated with its rated values is less than 4% of the transformer rated current

### Restrictions for installation altitudes above 2000 m

Above an installation altitude of 2000 m, the permissible line supplies are restricted.



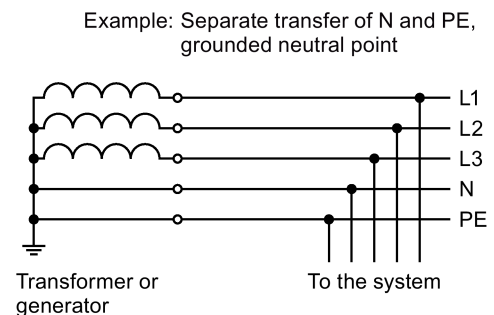
Restrictions for special ambient conditions (Page 93)

### 5.1.1 TN line system

A TN line system transfers the PE protective conductor to the installed plant or system using a cable.

Generally, in a TN line system the neutral point is grounded. There are versions of a TN system with a grounded line conductor, e.g. with grounded L1.

A TN line system can transfer the neutral conductor N and the PE protective conductor either separately or combined.



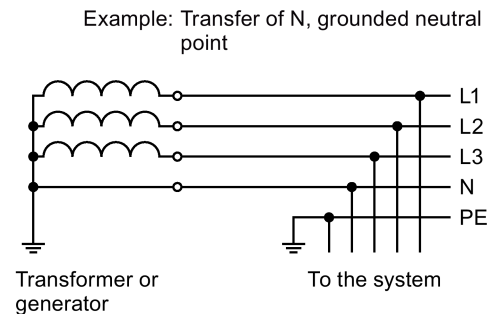
### Inverter operated on a TN line system

- Inverter with integrated or external line filter:
  - Operation on TN line systems with grounded neutral point permissible.
  - Operation on TN line systems with grounded line conductor not permissible.
- Inverter without line filter:
  - Operation on all TN line systems  $\leq 600$  V permissible
  - Operation on TN line systems  $> 600$  V and grounded neutral point permissible.
  - Operation on TN line systems  $> 600$  V and grounded line conductor not permissible.

## 5.1.2 TT line system

In a TT line system, the transformer grounding and the installation grounding are independent of one another.

There are TT line supplies where the neutral conductor N is either transferred – or not.



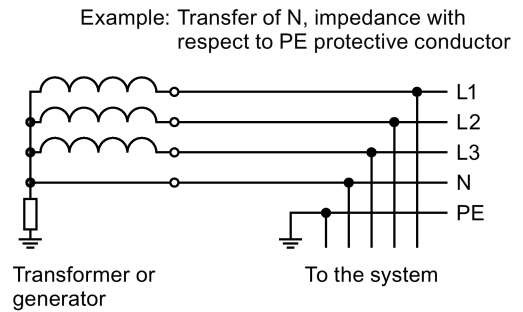
### Inverter operated on a TT line system

- Inverter with integrated or external line filter:
  - Operation on TT line systems with grounded neutral point permissible.
  - Operation on TT line systems without grounded neutral point not permissible.
- Inverter without line filter:
  - Operation on all TT line systems permissible.
- For installations in compliance with IEC, operation on a TT line system is permissible. For installations in compliance with UL, operation on a TT line system is not permissible.

### 5.1.3 IT system

In an IT line system, all of the conductors are insulated with respect to the PE protective conductor – or connected to the PE protective conductor through an impedance.

There are IT systems with and without transfer of the neutral conductor N.



#### Inverter operated on an IT line system

- Inverters with integrated line filter:
  - Operation on IT line systems not permissible.
- Inverter without line filter:
  - Operation on all IT line systems permissible.

#### Behavior of the inverter when a ground fault occurs

In some instances, even for a ground fault, the inverter should still remain functional. In cases such as these, you must install an output reactor. This prevents an overcurrent trip or damage to the drive.

## 5.1.4 Protective conductor



### WARNING

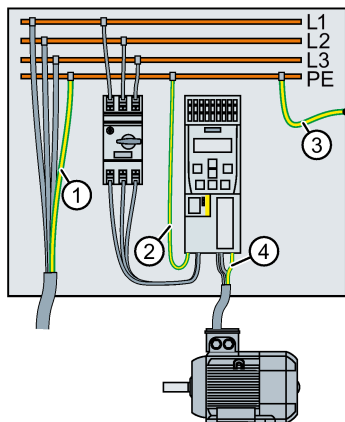
#### Danger to life caused by high leakage currents for an interrupted protective conductor

The drive components conduct a high leakage current via the protective conductor. Touching conductive parts when the protective conductor is interrupted can result in death or serious injury.

- Dimension the protective conductor as stipulated in the appropriate regulations.

### Dimensioning the protective conductor

Observe the local regulations for protective conductors subject to an increased leakage current at the site of operation.



- ① Protective conductor for line feeder cables
- ② Protective conductor for inverter line feeder cables
- ③ Protective conductor between PE and the electrical cabinet
- ④ Protective conductor for motor feeder cables

The minimum cross-section of the protective conductor ① ... ④ depends on the cross-section of the line or motor feeder cable:

- Line or motor feeder cable  $\leq 16 \text{ mm}^2$   
⇒ Minimum cross-section of the protective conductor = cross-section of the line or motor feeder cable
- $16 \text{ mm}^2 < \text{line or motor feeder cable} \leq 35 \text{ mm}^2$   
⇒ Minimum cross-section of the protective conductor =  $16 \text{ mm}^2$
- Line or motor feeder cable  $> 35 \text{ mm}^2$   
⇒ Minimum cross-section of the protective conductor =  $\frac{1}{2}$  cross-section of the line or motor feeder cable

Additional requirements placed on the protective conductor ①:

- For permanent connection, the protective conductor must fulfill at least one of the following conditions:
  - The protective conductor is routed so that it is protected against damage along its complete length.  
Cables routed inside electrical cabinets or enclosed machine housings are considered to be adequately protected against mechanical damage.
  - As a conductor of a multi-conductor cable, the protective conductor has a cross-section  $\geq 2.5 \text{ mm}^2 \text{ Cu}$ .
  - For an individual conductor, the protective conductor has a cross-section  $\geq 10 \text{ mm}^2 \text{ Cu}$ .
  - The protective conductor consists of two conductors with the same cross-section.
- When connecting a multi-core cable using an industrial plug connector according to EN 60309, the protective conductor must have a cross-section of  $\geq 2.5 \text{ mm}^2 \text{ Cu}$ .



## 5.2 Connecting the line and motor cable at the inverter


### 5.2.1 Connection overview

#### Note

##### Line reactor

A line reactor is not required for the Power Modules FSD ... FSF.

##### Line filter

The inverters are available with or without integrated line filter (Class A). For frame sizes FSA ... FSC, 3 AC 400 V, there are external filters (Class B) for increased EMC requirements.  Line filter (Page 113)

##### Output reactor

An output reactor is not required for the Power Modules FSD ... FSF.

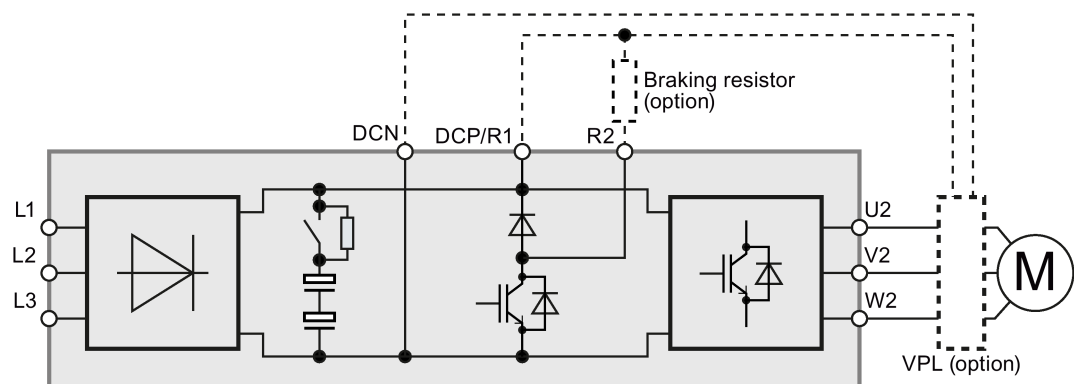


Figure 5-2 Block diagram of the inverter, FSA ... FSC

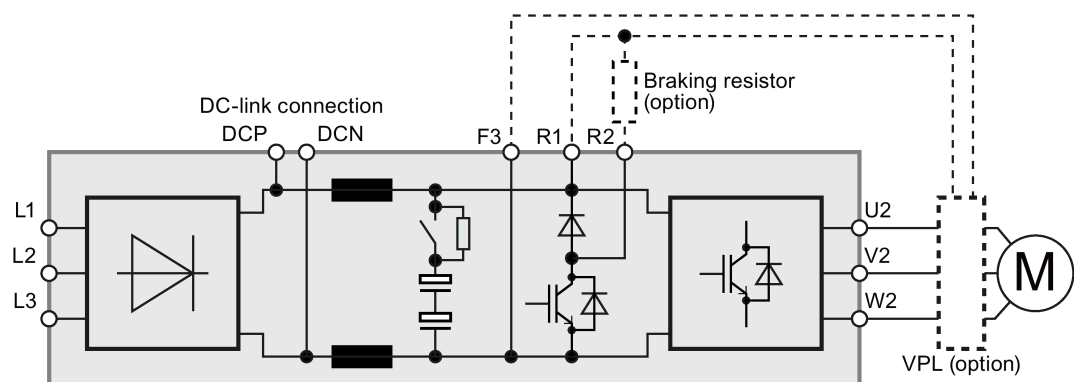


Figure 5-3 Block diagram for the inverter, FSD ... FSF

5.2 Connecting the line and motor cable at the inverter

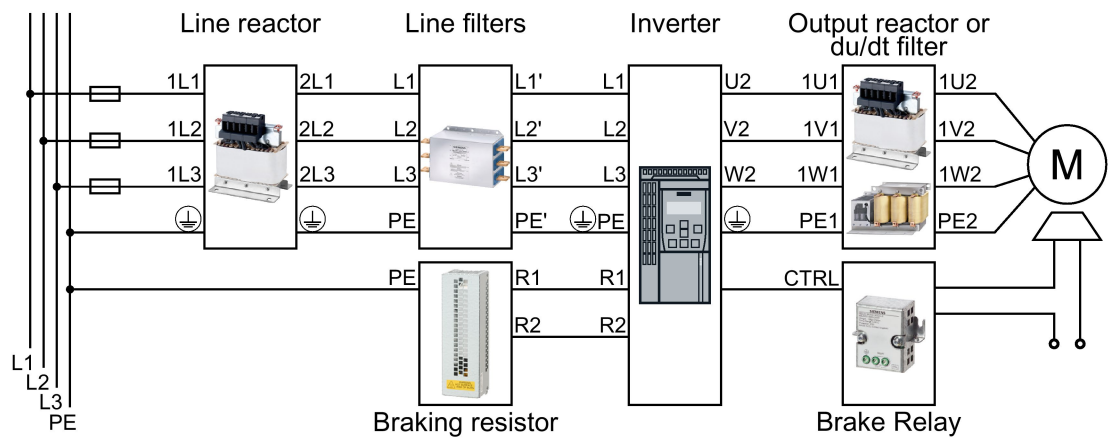


Figure 5-4 Connection to 3 AC 200 V / 400 V / 690 V

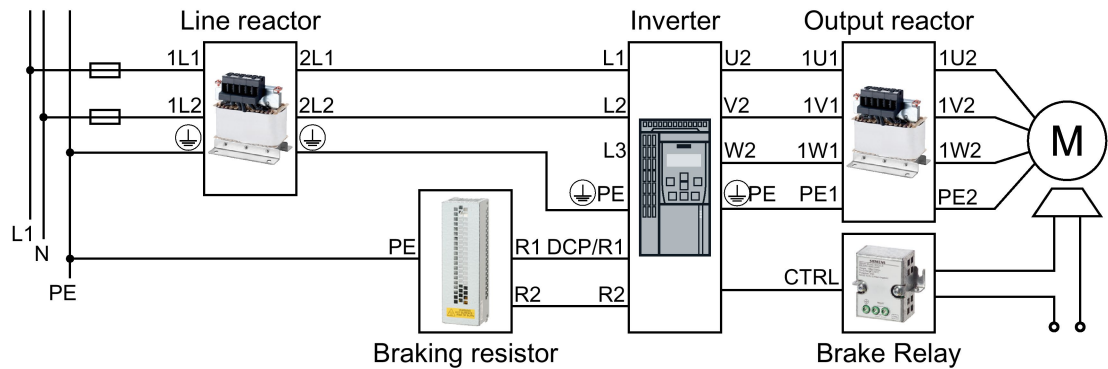


Figure 5-5 Connection to 1 AC 200 V - only FSA ... FSC

**Note**

**Connecting PM240-2 Power Modules, 200 V to 1 AC - only FSA ... FSC**

For the 200 V versions and single-phase line systems, connect the phase conductor and neutral conductor to any two of the terminals L1, L2, L3.

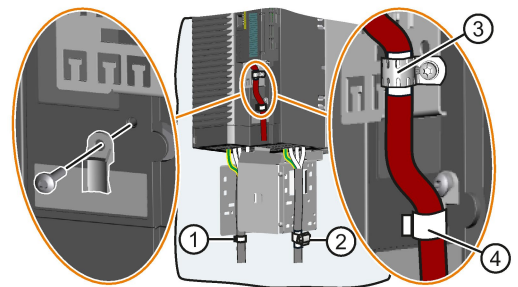
## Connect cables at the inverter so that they are EMC compliant

Attach the cable tie holders to the Power Module as shown to the left in the diagram before you establish the connections.

Fix the line connecting cable using a cable tie as shown in ①.

Fix the shield of the motor connecting cable using a hose clamp (②).


Connect the shield of the control cable with the shield plate of the Control Unit (③) using a steel band. Also attach the control cable to the Power Module using a cable tie (④).



### 5.2.2 Length of the motor cable


Always dimension the motor cable so that the ohmic losses are less than 5 % of the inverter power rating.

The permissible length of the motor cable also depends on the quality of the motor cable and the inverter pulse frequency. The values specified below are applicable for high quality cables, such as CY100 or similar, and for the pulse frequencies set in the factory.

 Pulse frequencies (Page 65).

If you set other pulse frequencies, then you must ensure that the EMC category is complied with on the plant or system side.

EMC-compliant wiring is required in order that the inverter complies with the EMC category listed in the following table.

 EMC-compliant installation of a machine or system (Page 23)

Carefully observe the following section for operation in the first environment:


 Electromagnetic compatibility of variable-speed drives (Page 96)

Table 5- 1 Permissible lengths of motor connecting cables, inverter FSA ... FSC

EMC category	Second Environment, C2			No EMC category		
	with internal C2 filter	with external C2 filter	with external C1 filter, with output reactor	without filter, without output reactor	without filter, with output reactor	
Cable	Shielded	Shielded	Shielded	Shielded/unshielded	Shielded	Unshielded
200 V	50 m	50 m	---	150 m	150 m	225 m
400 V	50 m <sup>1)</sup>	50 m <sup>2)</sup>	150 m <sup>3)</sup>	150 m	150 m	225 m

1) For a low-capacitance motor cable: FSB 100 m, FSC 150 m

2) For a low-capacitance motor cable: FSA 150 m, FSB 100 m, FSC 100 m

3) 150 m for voltages in the range 380 V ... 415 V,  
100 m for voltages in the range 440 V ... 480 V

Table 5- 2 Permissible cable lengths for the motor connection, FSD ... FSE

EMC category	Second Environment, C2	No EMC category			
		with or without filter, with or without output reactor		without filter, with two output reactors in series	
Cable	Shielded	Shielded	Unshielded	Shielded	Unshielded
200 V	---	200 m	300 m	350 m	525 m
400 V	150 m	200 m	300 m	350 m	525 m
690 V	100 m	200 m	300 m	---	---



Table 5- 3 Permissible cable lengths for the motor connection, FSF

Inverter	with internal C2 filter	with or without filter, with or without output reactor		without filter, with two output reactors in series	
EMC category	Second Environment, C2	No EMC category			
Cable	Shielded	Shielded	Unshielded	Shielded	Unshielded
200 V	---	300 m	450 m	525 m	800 m
400 V	150 m	300 m	450 m	525 m	800 m
690 V	150 m <sup>1)</sup>	300 m	450 m	525 m	800 m

<sup>1)</sup> only C3

### 5.2.3 Connection terminals at the inverter

Table 5- 4 Connection, cross-section and tightening torque for PM240-2 Power Modules

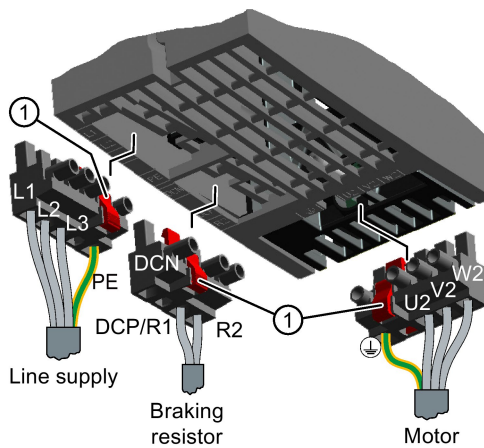
Inverters	Connection		Cross-section, tightening torque		Stripped insulation length
			Metric	Imperial	
<b>FSA</b>	Line supply, motor, DC link and braking resistor	 Plug connector with screw terminals	1.5 ... 2.5 mm <sup>2</sup> , 0.5 Nm	16 ... 14 AWG, 4.5 lbf in	8 mm
<b>FSB</b>			1.5 ... 6 mm <sup>2</sup> , 0.6 Nm	16 ... 10 AWG, 5.5 lbf in	8 mm
<b>FSC</b>			6 ... 16 mm <sup>2</sup> , 1.3 Nm	10 ... 6 AWG, 12 lbf in	10 mm
<b>FSD</b>	Line supply, motor and DC link	Screw-type terminal	10 ... 35 mm <sup>2</sup> , 2.5 ... 4.5 Nm	20 ... 10 AWG, 22 lbf in 8 ... 2 AWG, 40 lbf in	18 mm
	Braking resistor		2.5 ... 16 mm <sup>2</sup> , 1.2 ... 1.5 Nm	20 ... 6 AWG, 15 lbf in	10 mm
<b>FSE</b>	Line supply, motor and DC link	Screw-type terminal	25 ... 70 mm <sup>2</sup> , 8 ... 10 Nm	6 ... 3/0 AWG, 88.5 lbf in	25 mm
	Braking resistor		10 ... 35 mm <sup>2</sup> , 2.5 ... 4.5 Nm	20 ... 10 AWG, 22 lbf in 8 ... 2 AWG, 40 lbf in	18 mm
<b>FSF</b>	Line supply, motor and DC link	 Cable lug according to SN71322	35 ... 2 × 120 mm <sup>2</sup> , 22 ... 25 Nm	1 ... 2 × 4/0 AWG, 210 lbf.in	--
	Braking resistor	Screw-type terminal	25 ... 70 mm <sup>2</sup> , 8 ... 10 Nm	6 ... 3/0 AWG, 88.5 lbf in	25 mm

### 5.2.4 Establishing connections

**Procedure**

- ➔ 1. Proceed as follows to establish the connections:
- ➔ 2.
  - 1. Ensure that the device is in a no-voltage condition and the DC link is discharged.
  - 2. Establish the connections as described in the following sections.
- This means that you have established the connections.

#### Connections for frame sizes FSA ... FSC



The Power Modules are equipped with withdrawable plug connectors that cannot be inadvertently interchanged.

To remove a plug connector, you must release it by pressing on the red lever.

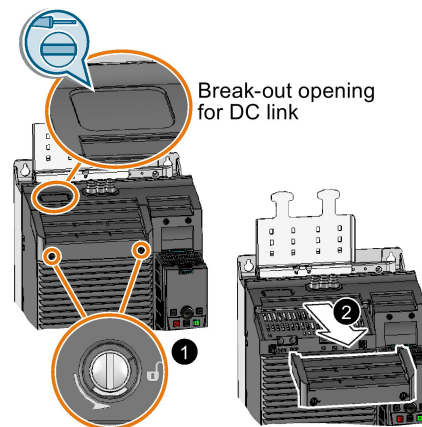
- ① Release lever

#### Connections for frame sizes FSD ... FSF

You must remove the covers from the connections in order to connect the line supply, braking resistor and motor to the inverter.

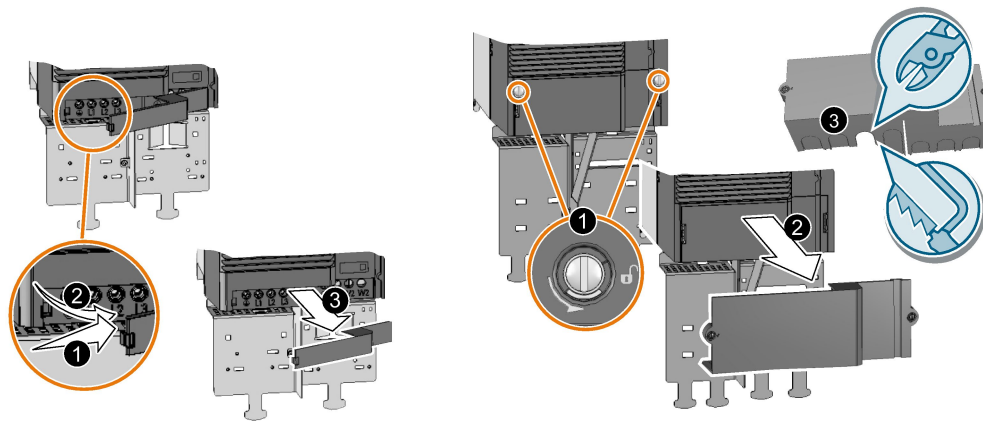
In addition, for frame sizes FSD and FSE, release the two terminal screws on the connections for the motor and braking resistor, and remove the dummy plug.

For frame size FSF you must breakout the openings from the connection cover for the power connections. Use side cutters or a fine saw blade.



FSD ... FSF: remove the top covers

5.2 Connecting the line and motor cable at the inverter



FSD, FSE: remove the lower covers    FSF: remove the lower covers

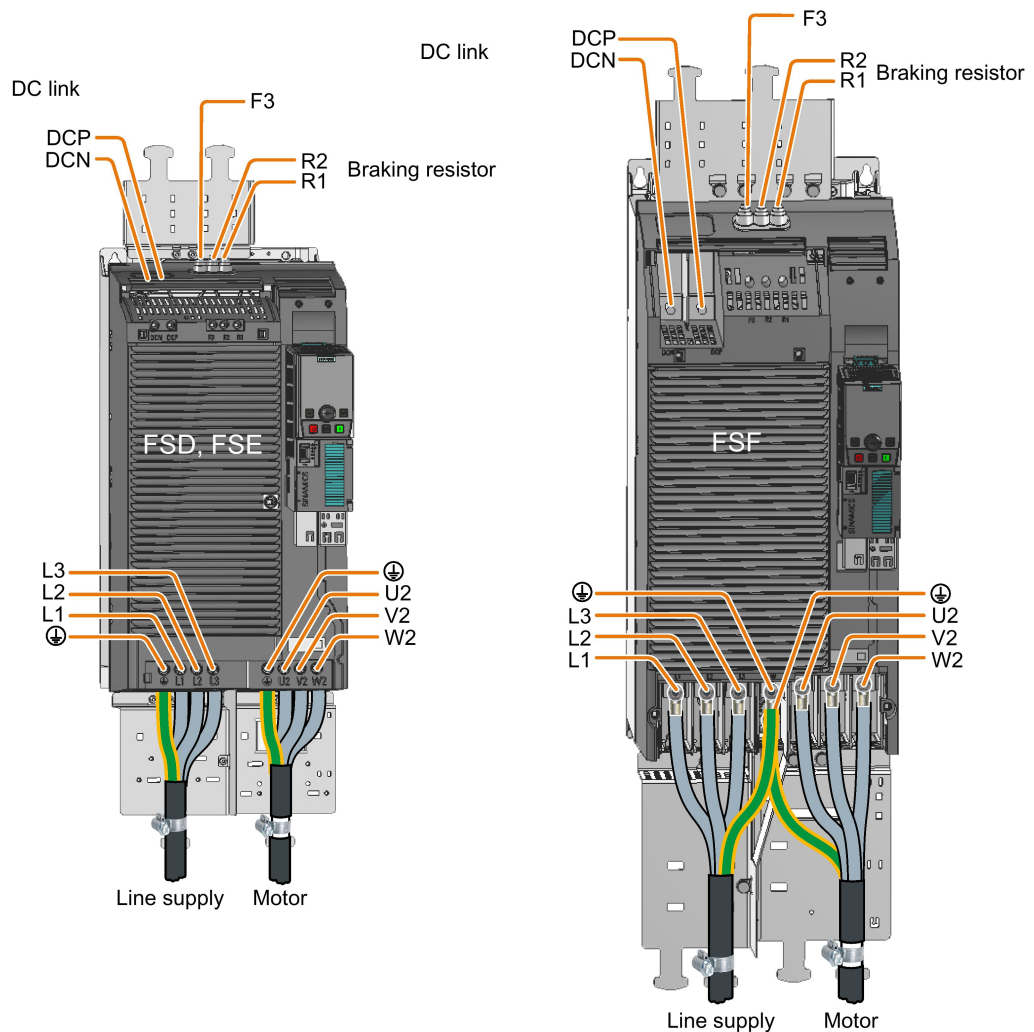


Figure 5-6    Connections for the line supply, motor and braking resistor

You must re-attach the connection covers in order to re-establish the touch protection of the inverter after it has been connected up.

### Connecting DC link or braking resistor

Use the rubber cable gland as shown in the right-hand figure for connecting the braking resistor.

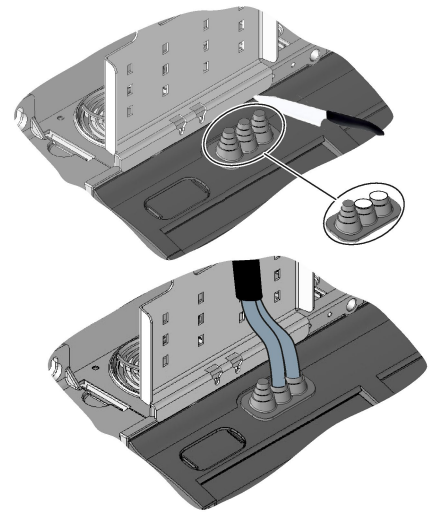
Using a sharp knife, cut the cap of the cable gland corresponding to the diameter of the connection cable of the braking resistor and establish the connections.

An optional shield plate is available as strain relief for the connection cable of the braking resistor.



Top shield plate - FSD ... FSF (Page 106)

The connections for the DC link have not been released in the current version.



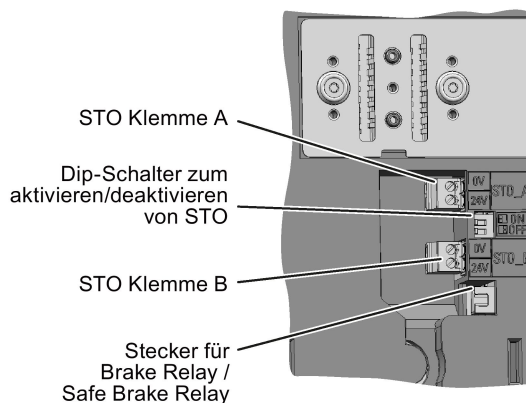


## 5.3 STO via Power Module terminals

With Power Modules, frame sizes FSD ... FSF, you can implement the "Safe Torque Off" (STO) safety function, corresponding to PL e according to EN 13849-1 and SIL 3 to IEC61508.

You have two terminal blocks - STO(A) and STO(B) - and two DIP switches at the front of the Power Module.

To be able to use the safety functions, you must enable the terminals; you do this by setting the two DIP switches to ON. You can only use the safety function if both DIP switches are set to ON.



Set both DIP switches to OFF if you do not wish to use STO. If one switch is set to OFF and the other to ON, the inverter signals that the pulses are inhibited, and the motor does not start.

The terminals are low active.

Further information and wiring examples:  Manuals for your inverter (Page 133)

### STO connection

Use shielded cables with a maximum length of 30 m, a cross-section of 0.5 mm<sup>2</sup> ... 1.5 mm<sup>2</sup> (20 ... 16 AWG), insulated for 600 V. Connect the shield to the shield plate of the Control Unit through the largest possible surface area.

Use conductor end sleeves, stripped length 7 mm.

### Note

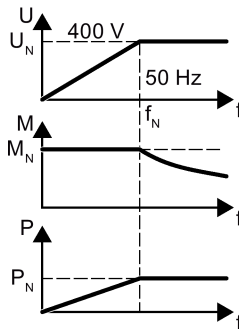
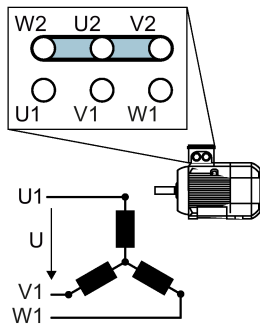
#### Safety functions via the Control Unit

You can implement the safety functions via the Control Unit independent of the safety function "STO via the Power Module terminals".

## 5.4 Connecting the motor to the inverter in a star or delta connection

Standard induction motors with a rated power of approximately  $\leq 3$  kW are normally connected in a star/delta connection (Y/ $\Delta$ ) at 400 V/230 V. For a 400-V line supply, you can connect the motor to the inverter either in a star or in a delta connection.

### Operating the motor in a star connection

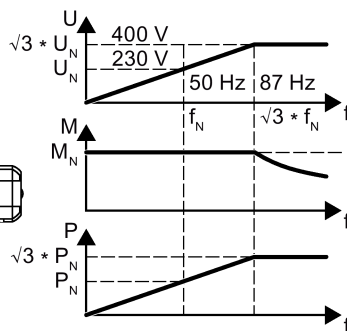
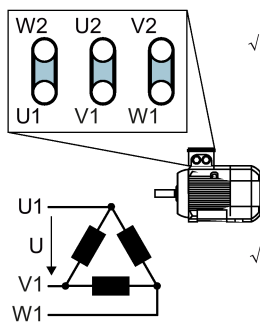


In a star connection, the motor can provide its rated torque  $M_N$  in the range 0 ... rated frequency  $f_N$ .

Rated voltage  $U_N = 400$  V is available at a rated frequency  $f_N = 50$  Hz.

The motor goes into field weakening above the rated frequency. In field weakening, the available motor torque decreases linearly with  $1/f$ . In field weakening, the available power remains constant.

### Operating the motor in a delta connection with 87 Hz characteristic



In a delta connection, the motor is operated with a voltage and frequency above its rated values. As a consequence, the motor power is increased by a factor  $\sqrt{3} \approx 1.73$ .


In the range  $f = 0 \dots 87$  Hz, the motor can output its rated torque  $M_N$ .

The maximum voltage  $U = 400$  V is available at a frequency of  $f = \sqrt{3} \times 50$  Hz  $\approx 87$  Hz.


The motor only goes into field weakening above 87 Hz.

The higher motor power when operated with an 87 Hz characteristic has the following disadvantages:

- The inverter must supply approximately 1.73x current. Select an inverter based on its rated current - and not its rated power.
- The motor temperature increases more significantly than when operated with  $f \leq 50$  Hz.
- The motor must have windings that are approved for a voltage  $>$  rated voltage  $U_N$ .
- As the fan impeller rotates faster, the motor has a higher noise level than operation with  $f \leq 50$  Hz.


 <b>WARNING</b>
<b>Risk of fire or electric shock as a result of defective components</b> If an overcurrent protection device responds, this can indicate that a fault current was interrupted. Check the circuit components and all of the components of the inverter and replace defective parts and components to reduce the risk of a fire or an electric shock. You must replace the complete overload relay if the current carrying element of the relay has burnt through.

## Repair

 <b>WARNING</b>
<b>Danger due to incorrect repair</b> Repairs may only be carried out by Siemens Service, by repair centers authorized by Siemens or by authorized personnel who are thoroughly acquainted with all the warnings and operating procedures contained in this manual. <ul style="list-style-type: none"><li>• Only use original spare parts when carrying out repairs.</li></ul>

## 6.1 Maintenance

The purpose of maintenance is to maintain the specified condition of the Power Module.

Regularly remove dirt and pollution, and replace the fan in plenty of time.  Replacing a fan (Page 62)

### Cleaning

#### Inverters with IP20 degree of protection - built-in units

Clean the inverter with an anti-static brush, a vacuum cleaner and areas that are difficult to access, using dry compressed air (max. 1 bar).

#### Inverters with push-through technology – PT devices

Clean the heatsink at regular intervals. If necessary, remove the air deflection plate at the rear. Use a torque of 2 Nm when reconnecting. The fans must be installed if you clean the heatsink using water.

### Ventilation

The devices must be installed in a cabinet. Ensure that the cabinet's ventilation slots are not blocked. Check that the fan is functioning correctly.

### Cables and screw terminals

Regularly check the cables for damage, and immediately replace any defective parts.

Regularly check that the screw terminals have been correctly tightened. Retighten the screws if necessary.

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#### Note

The actual maintenance intervals depend on the installation and operating conditions.

Siemens offers its customers support in the form of service contracts. For further information, contact your Siemens regional office or sales office.

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## 6.2 Commissioning after a long storage time

If the inverter was not operational for a longer period of time, it is possible that you must form the DC-link capacitors before switching on.

Form the DC-link capacitors in the following cases:

- If the inverter was not operational for longer than one year.
- If the date of manufacture of the inverter was more than one year ago when commissioning the drive system for the first time. The date of manufacture is coded in the serial number (see the next paragraph).

You form the DC-link capacitors by connecting power to the inverters as shown below.

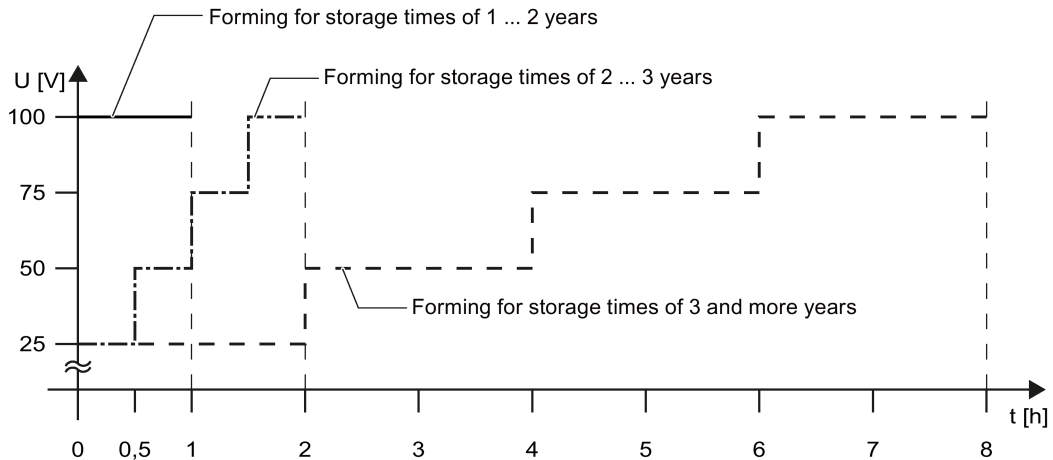


Figure 6-1 Forming the DC-link capacitors

### Data of manufacture of the inverter

The date of manufacture of the inverter is coded in positions 3 - 6 of the serial number.

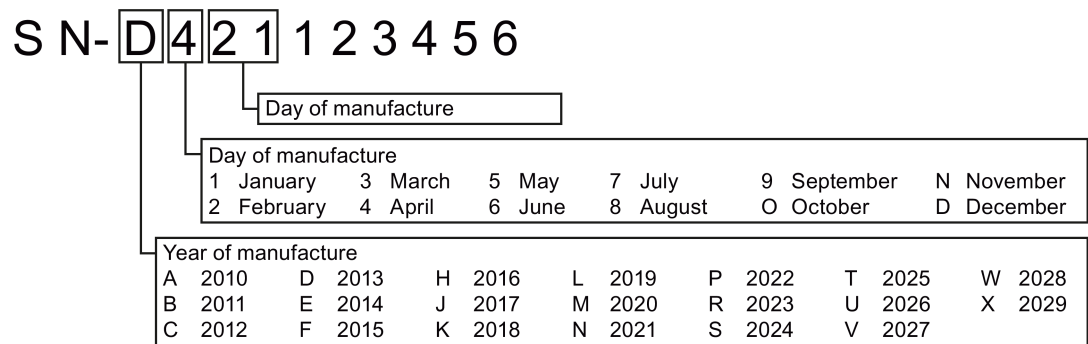


Figure 6-2 Data of manufacture in the serial number (example, April 21, 2013)

## 6.3 Replacing a fan

For frame sizes FSA ... FSC the fan module is installed at the bottom. For frame sizes FSD ... FSF it is located at the top.

For frame sizes FSA and FSB the fan module has one fan, for frame sizes FSC ... FSF, two fans.

### Service life of the fan

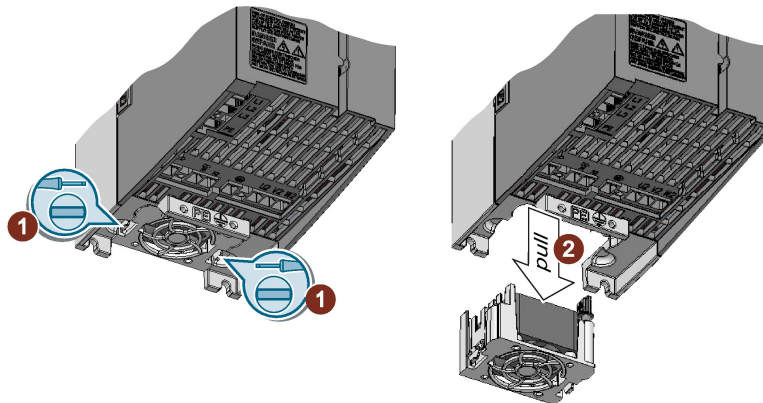
The average service life of the fan is 40,000 hours. In practice, however, the service life may deviate from this value. Especially a dusty environment can block up the fan.

The fan must be replaced in good time to ensure that the inverter is ready for operation.

### 6.3.1 Fan replacement FSA ... FSC

#### Replacing the fan modules for inverters, frame sizes FSA ... FSC

- ➔
1. Proceed as follows to replace a fan module:
  2.
    1. Switch-off the inverter, and wait 5 minutes until the DC link capacitors have been discharged.
    2. Withdraw the line and motor cable plug connectors and, if available, remove the braking resistor from the Power Module.
    3. Remove the shield plate from the Power Module.
    4. Remove the fan module from the Power Module in steps ① and ② as shown in the diagram. Use a screwdriver if necessary.

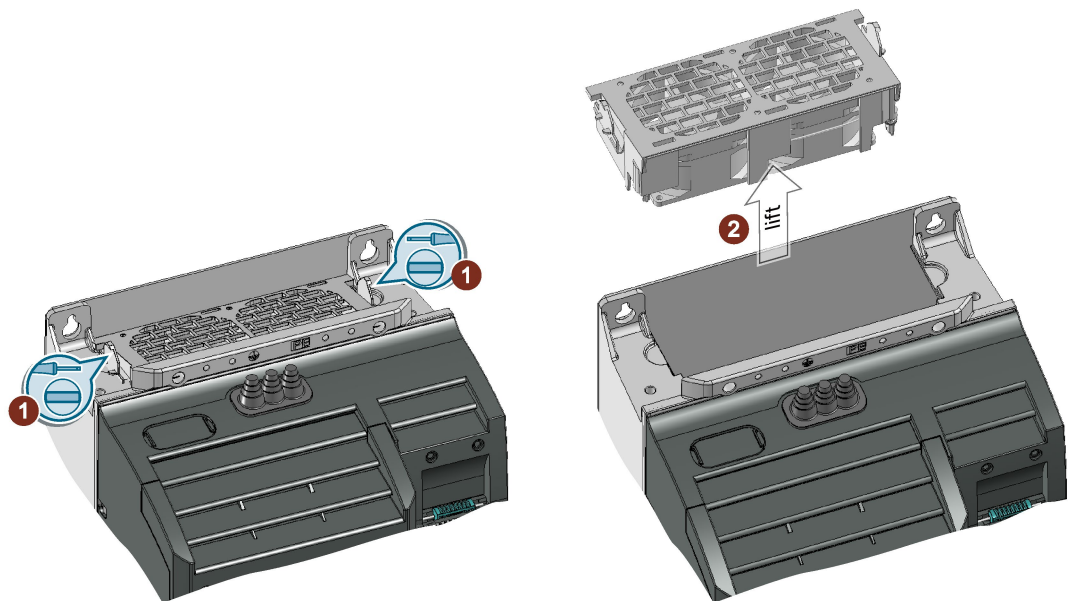


5. Install the new fan module in the inverse sequence.

■ You have replaced the fan module.

## 6.3.2 Fan replacement FSD ... FSF

### Removing the fan unit, FSD ... FSF



#### Procedure

- ➔ 1. Proceed as follows to remove the fan unit:
2. 1. Switch off the inverter power supply.



#### **!** DANGER

##### **Danger to life as a result of live parts and components**

Death or serious injury can result when live parts are touched.

- Wait until the discharge time elapses, which is stamped on the inverter warning plates and labels.

2. 2. Remove the fan unit from the Power Module in steps ① and ② as shown in the diagram. Use a screwdriver if necessary.

- You have withdrawn the fan unit.

### Installing the fan unit, FSD ... FSF

Install the fan unit in the reverse order to what is described above.

When inserting the fan unit, you establish the electrical connection between the inverter and fan unit.





## Technical data

### Power loss of the Power Modules

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#### Note

##### Power loss for the FSA ... FSC Power Modules

The values specified for the power loss are typical values at 100% of the rated speed and 100% of the load corresponding to Low Overload.

##### Power loss for the FSD ... FSF Power Modules

The values specified for the power loss are typical values at 90% of the rated speed and 100% of the load corresponding to Low Overload.

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### Protective organs for the Power Module



The fuses listed in the following tables are examples of suitable fuses.

Additional components for branch protection are available in the Internet:

Branch protection and short-circuit strength according to UL and IEC  
<https://support.industry.siemens.com/cs/ww/en/view/109486009>

## 7.1 Electromagnetic compatibility - Overview

### Electromagnetic compatibility according to EN61800-3




Property	Version
Interference immunity	The inverters are suitable for use in the first and second industrial environments
Interference emission - second environment	Category C2 for inverters with integrated radio interference suppression filter
	Category C2 for inverters without filter with optional external radio interference suppression filter for grounded line supplies (recommended for operation in conjunction with a residual current protective device RCD)
	Category C3 for 690V inverters with integrated radio interference suppression filter, frame size FSF
	Category C4 for inverters without integrated radio interference suppression filter for operation on IT line supplies

Additional information as well as conditions for using the inverter in the first environment are provided in the following Section:



Electromagnetic compatibility of variable-speed drives (Page 96).

## 7.2 Ambient conditions

Property	Version
<b>Ambient conditions for transport in the transport packaging</b>	
Climatic ambient conditions	- 40° C ... + 70° C, according to Class 2K4 to EN 60721-3-2 maximum humidity 95% at 40° C
Mechanical ambient conditions	<ul style="list-style-type: none"> <li>• FSA ... FSC: Shock and vibration permissible according to 1M2 to EN 60721-3-2</li> <li>• FSD ... FSF: Shock and vibration permissible according to 2M3 to EN 60721-3-2</li> </ul>
Protection against chemical substances	Protected according to Class 2C2 to EN 60721-3-2
Biological ambient conditions	Suitable according to Class 2B1 to EN 60721-3-2
<b>Ambient conditions for long-term storage in the product packaging</b>	
Climatic ambient conditions	- 25° C ... + 55° C, according to Class 1K3 to EN 60721-3-1
Protection against chemical substances	Protected according to Class 1C2 to EN 60721-3-1
Biological ambient conditions	Suitable according to class 1B1 to EN 60721-3-1
<b>Ambient conditions in operation</b>	
Installation altitude	Up to 1000 m above sea level without limitations  Restrictions for special ambient conditions (Page 93)
Climatic ambient conditions <sup>1)</sup>	<ul style="list-style-type: none"> <li>• FSA ... FSC ambient operating temperature <sup>2)</sup> <ul style="list-style-type: none"> <li>– For operation according to Low Overload: -10° C ... +40° C</li> <li>– For operation according to High Overload: -10° C ... +50° C</li> <li>–  Restrictions for special ambient conditions (Page 93)</li> </ul> </li> <li>• FSD ... FSF ambient operating temperature <sup>2)</sup> <ul style="list-style-type: none"> <li>– For operation according to Low Overload: -20° C ... +40° C</li> <li>– For operation according to High Overload: -20° C ... +50° C</li> <li>–  Restrictions for special ambient conditions (Page 93)</li> </ul> </li> <li>• Relative humidity: 5 ... 95%, condensation not permitted</li> <li>• Oil mist, salt mist, ice formation, condensation, dripping water, spraying water, splashing water and water jets are not permitted</li> </ul>
Mechanical ambient conditions	<p>Shock and vibration permissible, according to Class 3M1 to EN 60721-3-3</p> <p>Vibration test during operation according to IEC 60068-2-6 Test Fc (sinusoidal)</p> <ul style="list-style-type: none"> <li>• 0 ... 57 Hz: 0.075 mm deflection amplitude</li> <li>• 57 ... 150 Hz: 1 g acceleration amplitude</li> <li>• 10 frequency cycles per axis</li> </ul> <p>Shock test according to IEC 60068-2-27 Test Ea (half-sine)</p> <ul style="list-style-type: none"> <li>• 5 g peak acceleration</li> <li>• 30 ms duration</li> <li>• 3 shocks in all three axes in both directions</li> </ul>

Property	Version
Protection against chemical substances	<ul style="list-style-type: none"> <li>• FSA ... FSC: Protected according to 3C2 to EN 60721-3-3</li> <li>• FSD ... FSF: 3C3 protection according to EN 60721-3-3</li> </ul>
Biological ambient conditions	Suitable according to 3B1 to EN 60721-3-3
Pollution	Suitable for environments with degree of pollution 2 according to EN 61800-5-1
Cooling	Forced air cooling AF, according to EN 60146
Cooling air	Clean and dry air

- 1) Increased ruggedness regarding temperature range and relative humidity; therefore better than 3K3 according to EN 60721-3-3
- 2) Observe the permissible ambient operating temperatures for the Control Unit and the Operator Panel (IOP or BOP-2).

## 7.3 Overload capability of the inverter

Overload capability is the property of the inverter to temporarily supply a current that is higher than the rated current to accelerate a load. Two typical load cycles are defined to clearly demonstrate the overload capability: "Low Overload" and "High Overload"

### Definitions

#### Base load

Constant load between the accelerating phases of the drive

#### Low Overload

- **LO base load input current**  
Permissible input current for a "Low Overload" load cycle
- **LO base load output current**  
Permissible output current for a "Low Overload" load cycle
- **LO base load power**  
Rated power based on the LO base load output current

#### High Overload

- **HO base load input current**  
Permissible input current for a "High Overload" load cycle
- **HO base load output current**  
Permissible output current for a "High Overload" load cycle
- **HO base load power**  
Rated power based on the HO base load output current

If not specified otherwise, the power and current data in the technical data always refer to a load cycle according to Low Overload.

We recommend the "SIZER" engineering software to select the inverter.



You will find additional information about SIZER on the Internet: Download SIZER (<http://support.automation.siemens.com/WW/view/en/10804987/130000>).

**Load cycles and typical applications:**

**"Low Overload" load cycle**

The "Low Overload" load cycle assumes a uniform base load with low requirements placed on brief accelerating phases. Typical applications when designing according to "Low Overload" include:

- Pumps, fans and compressors
- Wet or dry blasting technology
- Mills, mixers, kneaders, crushers, agitators
- Basic spindles
- Rotary kilns
- Extruders

**"High Overload" load cycle**

The "High Overload" load cycle permits, for reduced base load, dynamic accelerating phases. Typical applications when designing according to "High Overload" include:

- Horizontal and vertical conveyor technology (conveyor belts, roller conveyors, chain conveyors)
- Centrifuges
- Escalators/moving stairways
- Lifters/Lowerers
- Elevators
- Gantry cranes
- Cable railways
- Storage and retrieval machines

**Typical inverter load cycles**

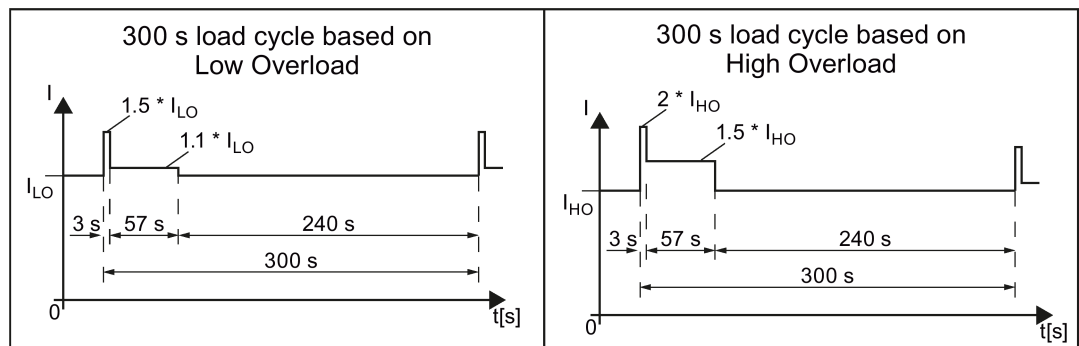











Figure 7-1 "Low Overload" and "High Overload" load cycles

## 7.4 Cable cross-sections and tightening torques

Table 7- 1 Connection type, cable cross sections and tightening torques

Inverters	Connection		Cross-section and tightening torque		Strip lengths
			Metric	Imperial	
<b>FSA</b>	Line, motor cable, DC link and braking resistor		1.5 ... 2.5 mm <sup>2</sup> 0.5 Nm	16 ... 14 AWG: 4.5 lbf in	8 mm
<b>FSB</b>	Line, motor cable, DC link and braking resistor		1.5 ... 6 mm <sup>2</sup> 0.6 Nm	16 ... 10 AWG: 5.5 lbf in	8 mm
<b>FSC</b>	Line, motor cable, DC link and braking resistor		6 ... 16 mm: 1.3 Nm	10 ... 6 AWG: 12 lbf in	10 mm
<b>FSD</b>	Line, motor cable and DC link		10 ... 35 mm <sup>2</sup> : 2.5 ... 4.5 Nm	20 ... 10 AWG: 22 lbf in 8 ... 2 AWG: 40 lbf in	18 mm
	Braking resistor		2.5 ... 16 mm <sup>2</sup> : 1.2 ... 1.5 Nm	20 ... 6 AWG: 15 lbf in	10 mm
<b>FSE</b>	Line, motor cable and DC link		25 ... 70 mm <sup>2</sup> : 8 ... 10 Nm	6 ... 3/0 AWG: 88.5 lbf in	25 mm
	Braking resistor		10 ... 35 mm <sup>2</sup> : 2.5 ... 4.5 Nm	20 ... 10 AWG: 22 lbf in 8 ... 2 AWG: 40 lbf in	18 mm
<b>FSF</b>	Line, motor cable and DC link with cable lugs according to SN71322		35 ... 2*120 mm <sup>2</sup> : 22 ... 25 Nm	1 ... 2*4/0 AWG: 210 lbf.in	--
	Braking resistor		25 ... 70 mm <sup>2</sup> : 8 ... 10 Nm	6 ... 3/0 AWG: 88.5 lbf in	25 mm

## 7.5 Technical data, 200 V inverters

### Motors for 200 V Power Modules



For the 200 V Power Modules, induction motors are permissible in the range from 25 % ... 150 % of the inverter power without any restrictions.

#### Note

#### Motors for inverter operation

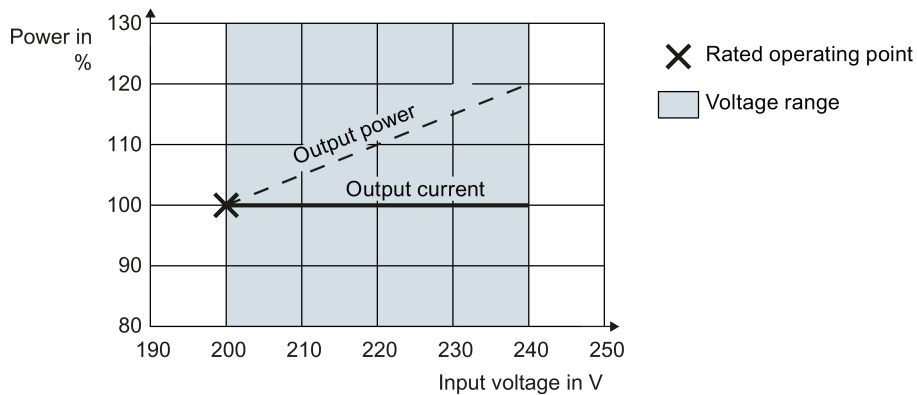
Only use motors that are suitable for operation with inverters with a DC link.

### 7.5.1 General data, 200 V inverters

Property	Version
Line voltage	FSA ... FSC 200 V ... 240 V 1-ph. AC $\pm$ 10% 0.55 kW ... 4 kW - LO 0.37 kW ... 3 kW - HO
	200 V ... 240 V 3-ph. AC $\pm$ 10% 0.55 kW ... 7.5 kW - LO 0.37 kW ... 5.5 kW - HO
	FSD ... FSF 200 V ... 240 V 3-ph. AC $\pm$ 10% (in operation -20% < 1 min)
Line supply configurations	Grounded TN/TT line supplies or non-grounded IT line supplies  Permissible line supplies (Page 44)
Line impedance	FSA ... FSC 2% $\leq$ Uk < 4%. For Uk < 2%, we recommend a line reactor, or a Power Module with the next higher power rating.
	FSD ... FSF No restrictions
Power factor $\lambda$	FSA ... FSC 0.7 without line reactor for Uk $\geq$ 2% 0.85 with line reactor for Uk < 2%
	FSD ... FSF 0.95
Output voltage	0 V ... 0.95 3-ph. AC $\times$ input voltage
Input frequency	50 Hz ... 60 Hz, $\pm$ 3 Hz
Output frequency	0 ... 550 Hz, depending on the control mode
Inrush current	< LO base load input current
Overvoltage category according to EN 61800-5-1	III for line supplies
Pulse frequency	4 kHz (factory setting), Adjustable as follows in 2 kHz steps: • 2 kHz ... 16 kHz for devices with an LO base load output from 0.55 kW ... 30 kW. • 2 kHz ... 8 kHz for devices with an LO base load output 37 kW and higher If you increase the pulse frequency, the inverter reduces the maximum output current.
Short-circuit current rating (SCCR) and branch protection	$\leq$ 100 kA rms  Branch protection and short-circuit strength according to UL and IEC ( <a href="https://support.industry.siemens.com/cs/ww/en/view/109479152">https://support.industry.siemens.com/cs/ww/en/view/109479152</a> )

Property	Version
Braking methods	DC braking, compound braking, dynamic braking with integrated braking chopper
Degree of protection according to EN 60529	IP20 IP55 PT devices outside the control cabinet
Protection class according to EN 61800-5-1	The inverters are devices with protection class I
Touch protection according to EN 50274	DGUV regulation 3 when used for the intended purpose
Cooling in compliance with EN 60146	Forced air cooling AF

**Dependent on the input voltage and output power**





## 7.5.2 Specific technical data, 200 V inverters

Table 7- 2 PM240-2, IP20, frame size A, 1 AC / 3 AC 200 V ... 240 V

Article number without filter	6SL3210-1PB13-0UL0	6SL3210-1PB13-8UL0
Article number with filter	6SL3210-1PB13-0AL0	6SL3210-1PB13-8AL0
LO base load power	0.55 kW	0.75 kW
1 AC LO base load input current	7.5 A	9.6 A
3 AC LO base load input current	4.2 A	5.5 A
LO base load output current	3.2 A	4.2 A
HO base load power	0.37 kW	0.55 kW
1 AC HO base load input current	6.6 A	8.4 A
3 AC HO base load input current	3.0 A	4.2 A
HO base load output current	2.3 A	3.2 A
Fuse according to IEC	3NA3805 (16 A)	3NA3805 (16 A)
Fuse according to UL, class J	15 A	15 A
Power loss	0.04 kW	0.04 kW
Required cooling air flow	5 l/s	5 l/s
Weight without filter	1.4 kg	1.4 kg
Weight with filter	1.6 kg	1.6 kg

Table 7- 3 PM240-2, PT, frame size A, 1 AC / 3 AC 200 V ... 240 V

Article number without filter	6SL3211-1PB13-8UL0
Article number with filter	6SL3211-1PB13-8AL0
LO base load power	0.75 kW
1 AC LO base load input current	9.6 A
3 AC LO base load input current	5.5 A
LO base load output current	4.2 A
HO base load power	0.55 kW
1 AC HO base load input current	8.4 A
3 AC HO base load input current	4.2 A
HO base load output current	3.2 A
Fuse according to IEC	3NA3 805 (16 A)
Fuse according to UL, class J	15 A
Power loss	0.04 kW
Required cooling air flow	5 l/s
Weight without filter	1.8 kg
Weight with filter	2.0 kg

Technical data

7.5 Technical data, 200 V inverters

Table 7- 4 PM240-2, IP20, frame size B, 1 AC / 3 AC 200 V ... 240 V

Article number without filter	6SL3210-1PB15-5UL0	6SL3210-1PB17-4UL0	6SL3210-1PB21-0UL0
Article number with filter	6SL3210-1PB15-5AL0	6SL3210-1PB17-4AL0	6SL3210-1PB21-0AL0
LO base load power	1.1 kW	1.5 kW	2.2 kW
1 AC LO base load input current	13.5 A	18.1 A	24.0 A
3 AC LO base load input current	7.8 A	9.7 A	13.6 A
LO base load output current	6 A	7.4 A	10.4 A
HO base load power	0.75 kW	1.1 kW	1.5 kW
1 AC HO base load input current	11.8 A	15.8 A	20.9 A
3 AC HO base load input current	5.5 A	7.8 A	9.7 A
HO base load output current	4.2 A	6 A	7.4 A
Fuse according to IEC	3NA3812 (32 A)	3NA3812 (32 A)	3NA3812 (32 A)
Fuse according to UL, class J	35 A	35 A	35 A
Power loss	0.05 kW	0.07 kW	0.12 kW
Required cooling air flow	9.2 l/s	9.2 l/s	9.2 l/s
Weight without filter	2.8 kg	2.8 kg	2.8 kg
Weight with filter	3.1 kg	3.1 kg	3.1 kg

Table 7- 5 PM240-2, PT, frame size B, 1 AC / 3 AC 200 V ... 240 V

Article number without filter	6SL3211-1PB21-0UL0
Article number with filter	6SL3211-1PB21-0AL0
LO base load power	2.2 kW
1 AC LO base load input current	24.0 A
3 AC LO base load input current	13.6 A
LO base load output current	10.4 A
HO base load power	1.5 kW
1 AC HO base load input current	20.9 A
3 AC HO base load input current	9.7 A
HO base load output current	7.4 A
Fuse according to IEC	3NA3812 (32 A)
Fuse according to UL, class J	35 A
Power loss	0.12 kW <sup>1)</sup>
Required cooling air flow	9.2 l/s
Weight without filter	3.4 kg
Weight with filter	3.7 kg

1) approx. 0.08 through the heatsink

Table 7- 6 PM240-2, IP 20, frame size C, 1 AC / 3 AC 200 V ... 240 V

Article number without filter	6SL3210-1PB21-4UL0	6SL3210-1PB21-8UL0
Article number with filter	6SL3210-1PB21-4AL0	6SL3210-1PB21-8AL0
LO base load power	3 kW	4 kW
1 AC LO base load input current	35.9 A	43.0 A
3 AC LO base load input current	17.7 A	22.8 A
LO base load output current	13.6 A	17.5 A
HO base load power	2.2 kW	3 kW
1 AC HO base load input current	31.3 A	37.5 A
3 AC HO base load input current	13.6 A	17.7 A
HO base load output current	10.4 A	13.6 A
Fuse according to IEC	3NA3820 (50 A)	3NA3820 (50 A)
Fuse according to UL, class J	50 A	50 A
Power loss	0.14 kW	0.18 kW
Required cooling air flow	18.5 l/s	18.5 l/s
Weight without filter	5.0 kg	5.0 kg
Weight with filter	5.2 kg	5.2 kg

Table 7- 7 PM240-2, PT, frame size C, 1 AC / 3 AC 200 V ... 240 V

Article number without filter	6SL3211-1PB21-8UL0
Article number with filter	6SL3211-1PB21-8AL0
LO base load power	4 kW
1 AC LO base load input current	43.0 A
3 AC LO base load input current	22.8 A
LO base load output current	17.5 A
HO base load power	3 kW
1 AC HO base load input current	37.5 A
3 AC HO base load input current	17.7 A
HO base load output current	13.6 A
Fuse according to IEC	3NA3820 (50 A)
Fuse according to UL, class J	50 A
Power loss	0.18 kW <sup>1)</sup>
Required cooling air flow	18.5 l/s
Weight without filter	5.9 kg
Weight with filter	6.2 kg

1) approx. 0.09 through the heatsink

7.5 Technical data, 200 V inverters

Table 7- 8 PM240-2, IP 20, frame size C, 3 AC 200 V ... 240 V

Article number without filter	6SL3210-1PC22-2UL0	6SL3210-1PC22-8UL0
Article number with filter	6SL3210-1PC22-2AL0	6SL3210-1PC22-8AL0
LO base load power	5.5 kW	7.5 kW
LO base load input current	28.6 A	36.4 A
LO base load output current	22.0 A	28.0 A
HO base load power	4 kW	5.5 kW
HO base load input current	22.8 A	28.6 A
HO base load output current	17.5 A	22.0 A
Fuse according to IEC	3NA3820 (50 A)	3NA3820 (50 A)
Fuse according to UL, class J	50 A	50 A
Power loss	0.2 kW	0.26 kW
Required cooling air flow	18.5 l/s	18.5 l/s
Weight without filter	5.0 kg	5.0 kg
Weight with filter	5.2 kg	5.2 kg

Table 7- 9 PM240-2, PT, frame size C, 3 AC 200 V ... 240 V

Article number without filter	6SL3211-1PC22-2UL0	6SL3211-1PC22-8UL0
Article number with filter	6SL3211-1PC22-2AL0	6SL3211-1PC22-8AL0
LO base load power	5.5 kW	7.5 kW
LO base load input current	28.6 A	36.4 A
LO base load output current	22.0 A	28.0 A
HO base load power	4 kW	5.5 kW
HO base load input current	22.8 A	28.6 A
HO base load output current	17.5 A	22.0 A
Fuse according to IEC	3NA3820 (50 A)	3NA3820 (50 A)
Fuse according to UL, class J	50 A	50 A
Power loss	0.2 kW <sup>1)</sup>	0.26 kW <sup>2)</sup>
Required cooling air flow	18.5 l/s	18.5 l/s
Weight without filter	5.0 kg	5.0 kg
Weight with filter	5.2 kg	5.2 kg

<sup>1)</sup> approx. 0.2 kW through the heatsink

<sup>2)</sup> approx. 0.15 kW through the heatsink

Table 7- 10 PM240-2, IP20, frame size D, 3 AC 200 V ... 240 V

Article number without filter	6SL3210-1PC24-2UL0	6SL3210-1PC25-4UL0	6SL3210-1PC26-8UL0
LO base load power	11 kW	15 kW	18.5 kW
LO base load input current	40 A	51 A	64 A
LO base load output current	42 A	54 A	68 A
HO base load power	7.5 kW	11 kW	15 kW
HO base load input current	36 A	43 A	56 A
HO base load output current	35 A	42 A	54 A
Fuse according to IEC/UL	3NA3822 (63 A)	3NA3824 (80 A)	3NA3830 (100 A)
Fuse according to IEC/UL, Class J	60 A	70 A	90 A
Power loss	0.45 kW	0.61 kW	0.82 kW
Required cooling air flow	55 l/s	55 l/s	55 l/s
Weight	17 kg	17 kg	17 kg

Table 7- 11 PM240-2, IP20, frame size E, 3 AC 200 V ... 240 V

Article number without filter	6SL3210-1PC28-0UL0	6SL3210-1PC31-1UL0
LO base load power	22 kW	30 kW
LO base load input current	76 A	98 A
LO base load output current	80 A	104 A
HO base load power	18.5 kW	22 kW
HO base load input current	71 A	83 A
HO base load output current	68 A	80 A
Fuse according to IEC/UL	3NA3830 (100 A)	3NA3836 (160 A)
Fuse according to IEC/UL, Class J	100 A	150 A
Power loss	0.92 kW	1.28 kW
Required cooling air flow	83 l/s	83 l/s
Weight	26 kg	26 kg

7.5 Technical data, 200 V inverters

Table 7- 12 PM240-2, IP20, frame size F, 3 AC 200 V ... 240 V

Article number without filter	6SL3210-1PC31-3UL0	6SL3210-1PC31-6UL0	6SL3210-1PC31-8UL0
LO base load power	37 kW	45 kW	55 kW
LO base load input current	126 A	149 A	172 A
LO base load output current	130 A	154 A	178 A
HO base load power	30 kW	37 kW	45 kW
HO base load input current	110 A	138 A	164 A
HO base load output current	104 A	130 A	154 A
Fuse according to IEC/UL	3NA3140 (200 A)	3NA3140 (200 A)	3NA3142 (224 A)
Fuse according to IEC/UL, Class J	175 A	200 A	225 A
Power loss	1.38 kW	1.72 kW	2.09 kW
Required cooling air flow	153 l/s	153 l/s	153 l/s
Weight	57 kg	57 kg	57 kg

7.5.3 Current derating depending on the pulse frequency, 200 V inverters

Article number	LO power [kW]	LO base load output current [A]							
		2	4 *)	6	8	10	12	14	16
6SL3210-1PB13-0 . LO	0.55	3.2	<b>3.2</b>	2.7	2.2	1.9	1.6	1.4	1.3
6SL321 . -1PB13-8 . LO	0.75	4.2	<b>4.2</b>	3.6	2.9	2.5	2.1	1.9	1.7
6SL3211-1PB15-5 . LO	1.1	6	<b>6</b>	5.1	4.2	3.6	3	2.7	2.4
6SL3210-1PB17-4 . LO	1.5	7.4	<b>7.4</b>	6.3	5.2	4.4	3.7	3.3	3
6SL321 . -1PB21-0 . LO	2.2	10.4	<b>10.4</b>	8.8	7.3	6.2	5.2	4.7	4.2
6SL3210-1PB21-4 . LO	3	13.6	<b>13.6</b>	11.6	9.5	8.2	6.8	6.1	5.4
6SL321 . -1PB21-8 . LO	4	17.5	<b>17.5</b>	14.9	12.3	10.5	8.8	7.9	7
6SL3210-1PC22-2 . LO	5.5	22	<b>22</b>	18.7	15.4	13.2	11	9.9	8.8
6SL3210-1PC22-8 . LO	7.5	28	<b>28</b>	23.8	19.6	16.8	14	12.6	11.2
6SL3210-1PC24-2 . LO	11	42	<b>42</b>	35.7	29.4	25.2	21	18.9	16.8
6SL3210-1PC25-4 . LO	15	54	<b>54</b>	45.9	37.8	32.4	27	24.3	21.6
6SL3210-1PC26-8 . LO	18.5	68	<b>68</b>	57.8	47.6	40.8	34	30.6	27.2
6SL3210-1PC28-0 . LO	22	80	<b>80</b>	68	56	48	40	36	32
6SL3210-1PC31-1 . LO	30	104	<b>104</b>	88.4	72.8	62.4	52	46.8	41.6
6SL3210-1PC31-3 . LO	37	130	<b>130</b>	110.5	91	---	---	---	---
6SL3210-1PC31-6 . LO	45	154	<b>154</b>	130.9	107.8	---	---	---	---
6SL3210-1PC31-8 . LO	55	178	<b>178</b>	151.3	124.6	---	---	---	---

\*) Factory setting

The permissible motor cable length depends on the particular cable type and the pulse frequency that has been selected

## 7.6 Technical data, 400 V inverters

### Motors for 400 V Power Modules


For the 400 V Power Modules, induction motors are permissible in the range from 25 % ... 150 % of the inverter power without any restrictions.

#### Note


#### Motors for inverter operation

Only use motors that are suitable for operation with inverters with a DC link.

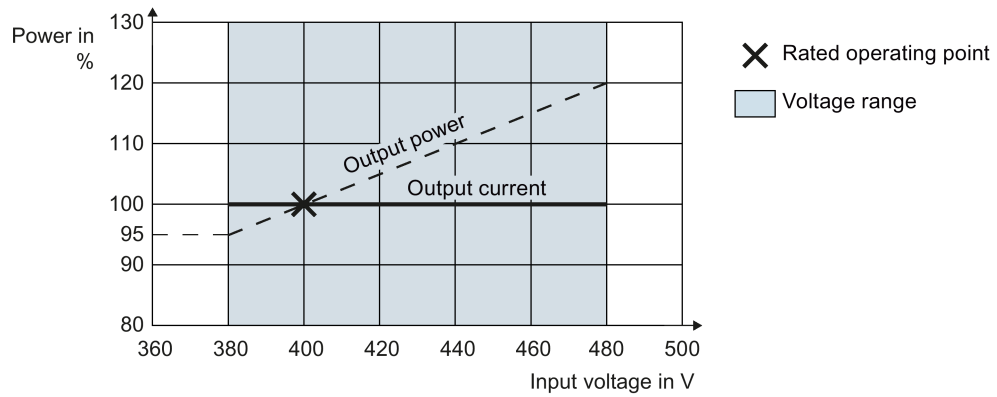
### 7.6.1 General data, 400 V inverters

Property	Version
Line voltage	FSA ... FSC 380 V ... 480 V 3-ph. AC $\pm 10\%$
	FSD ... FSF 3-ph. AC 380 V ... 480 V $\pm 10\%$ (in operation $-20\% < 1$ min)
Line supply configurations	Grounded TN/TT line supplies or non-grounded IT line supplies  Permissible line supplies (Page 44)
Line impedance	FSA ... FSC $1\% \leq U_k < 4\%$ , for values smaller than 1%, we recommend a line reactor, or a Power Module with the next higher power rating.
	FSD ... FSF No restrictions
Power factor $\lambda$	FSA ... FSC 0.7 without line reactor for $U_k \geq 1\%$ 0.85 with line reactor for $U_k < 1\%$
	FSD ... FSF $> 0.9$
Output voltage	3-ph. AC 0 V ... 0.95 x input voltage (max.)
Input frequency	50 Hz ... 60 Hz, $\pm 3$ Hz
Output frequency	0 ... 550 Hz, depending on the control mode
Inrush current	$< LO$ base load input current
Overvoltage category according to EN 61800-5-1	III for line supplies
Pulse frequency	Factory setting
	<ul style="list-style-type: none"> <li>• 4 kHz for devices with an LO base load power <math>&lt; 75</math> kW</li> <li>• 2 kHz for devices with an LO base load power <math>\geq 75</math> kW</li> </ul> Can be adjusted in 2 kHz steps as follows: <ul style="list-style-type: none"> <li>• 2 kHz ... 16 kHz for devices with an LO base load power <math>&lt; 55</math> kW</li> <li>• 2 kHz ... 8 kHz for devices with an LO base load output of 55 kW ... 90 kW</li> <li>• 2 kHz ... 4 kHz for devices with an LO base load output <math>\geq 110</math> kW</li> </ul> If you increase the pulse frequency, the inverter reduces the maximum output current.

7.6 Technical data, 400 V inverters

Property	Version
Short-circuit current rating (SCCR) and branch protection	$\leq 100$ kA rms  Branch protection and short-circuit strength according to UL and IEC <a href="https://support.industry.siemens.com/cs/ww/en/view/109479152">https://support.industry.siemens.com/cs/ww/en/view/109479152</a>
Braking methods	DC braking, compound braking, dynamic braking with integrated braking chopper
Degree of protection according to EN 60529	IP20 IP55 PT devices outside the control cabinet
Protection class according to EN 61800-5-1	The inverters are devices with protection class I
Touch protection according to EN 50274	DGUV regulation 3 when used for the intended purpose
Cooling in compliance with EN 60146	Forced air cooling AF

Dependent on the input voltage and output power





## 7.6.2 Specific technical data, 400 V inverters

Table 7- 13 PM240-2, IP20, Frame Size A, 3-ph. AC 380 V ... 480 V

Article no. without filter	6SL3210-1PE11-8UL1	6SL3210-1PE12-3UL1	6SL3210-1PE13-2UL1
Article no. with filter	6SL3210-1PE11-8AL1	6SL3210-1PE12-3AL1	6SL3210-1PE13-2AL1
LO base load output	0.55 kW	0.75 kW	1.1 kW
LO base load input current	2.3 A	2.9 A	4.1 A
LO base load output current	1.7 A	2.2 A	3.1 A
HO base load output	0.37 kW	0.55 kW	0.75 kW
HO base load input current	2.0 A	2.6 A	3.3 A
HO base load output current	1.3 A	1.7 A	2.2 A
Fuse according to IEC	3NA3805 (16 A)	3NA3805 (16 A)	3NA3805 (16 A)
Fuse according to UL, class J	10 A	10 A	15 A
Power loss	0.04 kW	0.04 kW	0.04 kW
Required cooling air flow	5 l/s	5 l/s	5 l/s
Weight without filter	1.3 kg	1.3 kg	1.3 kg
Weight with filter	1.5 kg	1.5 kg	1.5 kg

Table 7- 14 PM240-2, IP20, Frame Size A, 3-ph. AC 380 V ... 480 V

Article no. without filter	6SL3210-1PE14-3UL1	6SL3210-1PE16-1UL1	6SL3210-1PE18-0UL1
Article no. with filter	6SL3210-1PE14-3AL1	6SL3210-1PE16-1AL1	6SL3210-1PE18-0AL1
LO base load output	1.5 kW	2.2 kW	3.0 kW
LO base load input current	5.5 A	7.7 A	10.1 A
LO base load output current	4.1 A	5.9 A	7.7 A
HO base load output	1.1 kW	1.5 kW	2.2 kW
HO base load input current	4.7 A	6.1 A	8.8 A
HO base load output current	3.1 A	4.1 A	5.9 A
Fuse according to IEC	3NA3805 (16 A)	3NA3805 (16 A)	3NA3805 (16 A)
Fuse according to UL, class J	20 A	30 A	30 A
Power loss	0.07 kW	0.1 kW	0.12 kW
Required cooling air flow	5 l/s	5 l/s	5 l/s
Weight without filter	1.4 kg	1.4 kg	1.4 kg
Weight with filter	1.6 kg	1.6 kg	1.6 kg

Technical data

7.6 Technical data, 400 V inverters

Table 7- 15 PM240-2, PT, Frame Size A, 3-ph. AC 380 V ... 480 V

<b>Article no. without filter</b>	<b>6SL3211-1PE18-0UL1</b>
<b>Article no. with filter</b>	<b>6SL3211-1PE18-0AL1</b>
LO base load output	3.0 kW
LO base load input current	10.1 A
LO base load output current	7.7 A
HO base load output	2.2 kW
HO base load input current	8.8 A
HO base load output current	5.9 A
Fuse according to IEC	3NA3805 (16 A)
Fuse according to UL, class J	30 A
Power loss without filter	0.12 kW <sup>1)</sup>
Required cooling air flow	7 l/s
Weight without filter	1.8 kg
Weight with filter	2.0 kg

1) approx. 0.1 kW through the heatsink

Table 7- 16 PM240-2, IP20, Frame Size B, 3-ph. AC 380 V ... 480 V

<b>Article no. without filter</b>	<b>6SL3210-1PE21-1UL0</b>	<b>6SL3210-1PE21-4UL0</b>	<b>6SL3210-1PE21-8UL0</b>
<b>Article no. with filter</b>	<b>6SL3210-1PE21-1AL0</b>	<b>6SL3210-1PE21-4AL0</b>	<b>6SL3210-1PE21-8AL0</b>
LO base load output	4.0 kW	5.5 kW	7.5 kW
LO base load input current	13.3 A	17.2 A	22.2 A
LO base load output current	10.2 A	13.2 A	18.0 A
HO base load output	3.0 kW	4.0 kW	5.5 kW
HO base load input current	11.6 A	15.3 A	19.8 A
HO base load output current	7.7 A	10.2 A	13.2 A
Fuse according to IEC	3NA3812 (32 A)	3NA3812 (32 A)	3NA3812 (32 A)
Fuse according to UL, class J	35 A	35 A	35 A
Power loss	0.11 kW	0.15 kW	0.2 kW
Required cooling air flow	9.2 l/s	9.2 l/s	9.2 l/s
Weight without filter	2.9 kg	2.9 kg	3.0 kg
Weight with filter	3.1 kg	3.1 kg	3.2 kg

Table 7- 17 PM240-2, PT, Frame Size B, 3-ph. AC 380 V ... 480 V

Article no. without filter	6SL3211-1PE21-8UL0
Article no. with filter	6SL3211-1PE21-8AL0
LO base load output	7.5 kW
LO base load input current	22.2 A
LO base load output current	18.0 A
HO base load output	5.5 kW
HO base load input current	19.8 A
HO base load output current	13.7 A
Fuse according to IEC	3NA3812 (32 A)
Fuse according to UL, class J	35 A
Power loss	0.2 kW <sup>1)</sup>
Required cooling air flow	9.2 l/s
Weight without filter	3.6 kg
Weight with filter	3.9 kg

1) approx. 0.16 kW through the heatsink

Table 7- 18 PM240-2, IP20, Frame Size C, 3-ph. AC 380 V ... 480 V

Article no. without filter	6SL3210-1PE22-7UL0	6SL3210-1PE23-3UL0
Article no. with filter	6SL3210-1PE22-7AL0	6SL3210-1PE23-3AL0
LO base load output	11.0 kW	15.0 kW
LO base load input current	32.6 A	39.9 A
LO base load output current	26.0 A	32.0 A
HO base load output	7.5 kW	11.0 kW
HO base load input current	27.0 A	36.0 A
HO base load output current	18.0 A	26.0 A
Fuse according to IEC	3NA3820 (50 A)	3NA3820 (50 A)
Fuse according to UL, class J	50 A	50 A
Power loss	0.3 kW	0.37 kW
Required cooling air flow	18.5 l/s	18.5 l/s
Weight without filter	4.7 kg	4.8 kg
Weight with filter	5.3 kg	5.4 kg

Technical data

7.6 Technical data, 400 V inverters

Table 7- 19 PM240-2, PT, Frame Size C, 3-ph. AC 380 V ... 480 V

<b>Article no. without filter</b>	<b>6SL3211-1PE23-3UL0</b>
<b>Article no. with filter</b>	<b>6SL3211-1PE23-3AL0</b>
LO base load output	15.0 kW
LO base load input current	39.9 A
LO base load output current	32.0 A
HO base load output	11.0 kW
HO base load input current	36.0 A
HO base load output current	26.0 A
Fuse according to IEC	3NA3820 (50 A)
Fuse according to UL, class J	50 A
Power loss	0.37 kW <sup>1)</sup>
Required cooling air flow	18.5 l/s
Weight without filter	5.8 kg
Weight with filter	6.3 kg

1) approx. 0.3 kW through the heatsink

Table 7- 20 PM240-2, IP20, Frame Size D, 3-ph. AC 380 V ... 480 V

<b>Article no. without filter</b>	<b>6SL3210-1PE23-8UL0</b>	<b>6SL3210-1PE24-5UL0</b>	<b>6SL3210-1PE26-0UL0</b>
<b>Article no. with filter</b>	<b>6SL3210-1PE23-8AL0</b>	<b>6SL3210-1PE24-5AL0</b>	<b>6SL3210-1PE26-0AL0</b>
LO base load output	18.5 kW	22 kW	30 kW
LO base load input current	36 A	42 A	57 A
LO base load output current	38 A	45 A	60 A
HO base load output	15 kW	18.5 kW	22 kW
HO base load input current	33 A	38 A	47 A
HO base load output current	32 A	38 A	45 A
Fuse according to IEC/UL	3NA3822 (63 A)	3NA3824 (80 A)	3NA3830 (100 A)
Fuse according to IEC/UL, Class J	60 A	70 A	90 A
Power loss without filter	0.57 kW	0.70 kW	0.82 kW
Power loss with filter	0.58 kW	0.71 kW	0.83 kW
Required cooling air flow	55 l/s	55 l/s	55 l/s
Weight without filter	16 kg	16 kg	17 kg
Weight with filter	17.5 kg	17.5 kg	18.5 kg

Table 7- 21 PM240-2, IP20, Frame Size D, 3-ph. AC 380 V ... 480 V

Article no. without filter	6SL3210-1PE27-5UL0
Article no. with filter	6SL3210-1PE27-5AL0
LO base load output	37 kW
LO base load input current	70 A
LO base load output current	75 A
HO base load output	30 kW
HO base load input current	62 A
HO base load output current	60 A
Fuse according to IEC/UL	3NA3830 (100 A)
Fuse according to IEC/UL, Class J	100 A
Power loss without filter	1.09 kW
Power loss with filter	1.10 kW
Required cooling air flow	55 l/s
Weight without filter	17 kg
Weight with filter	18.5 kg

Table 7- 22 PM240-2, IP20, Frame Size E, 3-ph. AC 380 V ... 480 V

Article no. without filter	6SL3210-1PE28-8UL0	6SL3210-1PE31-1UL0
Article no. with filter	6SL3210-1PE28-8AL0	6SL3210-1PE31-1AL0
LO base load output	45 kW	55 kW
LO base load input current	86 A	104 A
LO base load output current	90 A	110 A
HO base load output	37 kW	45 kW
HO base load input current	78 A	94 A
HO base load output current	75 A	90 A
Fuse according to IEC/UL	3NA3832 (125 A)	3NA3836 (160 A)
Fuse according to IEC/UL, Class J	125 A	150 A
Power loss without filter	1.29 kW	1.65 kW
Power loss with filter	1.30 kW	1.67 kW
Required cooling air flow	83 l/s	83 l/s
Weight without filter	26 kg	26 kg
Weight with filter	28 kg	28 kg

Technical data

7.6 Technical data, 400 V inverters

Table 7- 23 PM240-2, IP20, Frame Size F, 3-ph. AC 380 V ... 480 V

Article no. without filter	6SL3210-1PE31-5UL0	6SL3210-1PE31-8UL0	6SL3210-1PE32-1UL0
Article no. with filter	6SL3210-1PE31-5AL0	6SL3210-1PE31-8AL0	6SL3210-1PE32-1AL0
LO base load output	75 kW	90 kW	110 kW
LO base load input current	140 A	172 A	198 A
LO base load output current	145 A	178 A	205 A
HO base load output	55 kW	75 kW	90 kW
HO base load input current	117 A	154 A	189 A
HO base load output current	110 A	145 A	178 A
Fuse according to IEC/UL	3NA3140 (200 A)	3NA3142 (224 A)	3NA3250 (300 A)
Fuse according to IEC/UL, Class J	200 A	250 A	300 A
Power loss without filter	1.91 kW	2.46 kW	2.28 kW
Power loss with filter	1.93 kW	2.48 kW	2.30 kW
Required cooling air flow	153 l/s	153 l/s	153 l/s
Weight without filter	57 kg	57 kg	61 kg
Weight with filter	63 kg	63 kg	65 kg

Table 7- 24 PM240-2, IP20, Frame Size F, 3-ph. AC 380 V ... 480 V

Article no. without filter	6SL3210-1PE32-5UL0
Article no. with filter	6SL3210-1PE32-5AL0
LO base load output	132 kW
LO base load input current	242 A
LO base load output current	250 A
HO base load output	110 kW
HO base load input current	218 A
HO base load output current	205 A
Fuse according to IEC/UL	3NA3252 (315 A)
Fuse according to IEC/UL, Class J	350 A
Power loss without filter	2.98 kW
Power loss with filter	3.02 kW
Required cooling air flow	153 l/s
Weight without filter	61 kg
Weight with filter	65 kg

### 7.6.3 Current derating depending on the pulse frequency, 400 V inverters

Article number	LO power [kW]	LO base load output current [A]							
		2	4 *)	6	8	10	12	14	16
<b>Pulse frequency [kHz]</b>									
6SL3210-1PE11-8 . L1	0.55	1.7	<b>1.7</b>	1.4	1.2	1	0.9	0.8	0.7
6SL3210-1PE12-3 . L1	0.75	2.2	<b>2.2</b>	1,9	1.5	1.3	1.1	1	0.9
6SL3211-1PE13-2 . L1	1.1	3.1	<b>3.1</b>	2.6	2.2	1,9	1.6	1.4	1.2
6SL3210-1PE14-3 . L1	1.5	4.1	<b>4.1</b>	3.5	2.9	2.5	2.1	1.8	1.6
6SL3210-1PE16-1 . L1	2.2	5.9	<b>5.9</b>	5	4.1	3.5	3	2.7	2.4
6SL321 . -1PE18-0 . L1	3	7.7	<b>7.7</b>	6.5	5.4	4.6	3.9	3.5	3.1
6SL3210-1PE21-1 . L0	4	10.2	<b>10.2</b>	8.7	7.1	6.1	5.1	4.6	4.1
6SL3210-1PE21-4 . L0	5.5	13.2	<b>13.2</b>	11.2	9.2	7.9	6.6	5.9	5.3
6SL321 . -1PE21-8 . L0	7.5	18	<b>18</b>	15.3	12.6	10.8	9	8.1	7.2
6SL3210-1PE22-7 . L0	11	26	<b>26</b>	22.1	18.2	15.6	13	11.7	10.4
6SL321 . -1PE23-3 . L0	15	32	<b>32</b>	27.2	22.4	19.2	16	14.4	12.8
6SL3210-1PE23-8 . L0	18.5	38	<b>38</b>	32.3	26.6	22.8	19	17.1	15.2
6SL3210-1PE24-5 . L0	22	45	<b>45</b>	38.3	31.5	27	22.5	20.3	18
6SL3210-1PE26-0 . L0	30	60	<b>60</b>	51	42	36	30	27	24
6SL3210-1PE27-5 . L0	37	75	<b>75</b>	63.8	52.5	45	37.5	33.8	30
6SL3210-1PE28-8 . L0	45	90	<b>90</b>	76.5	63	54	45	40.5	36
6SL3210-1PE31-1 . L0	55	110	<b>110</b>	93.5	77	---	---	---	---
<b>Pulse frequency [kHz]</b>		<b>2 *)</b>	<b>4</b>	<b>6</b>	<b>8</b>	<b>10</b>	<b>12</b>	<b>14</b>	<b>16</b>
6SL3210-1PE31-5 . L0	75	<b>145</b>	145	123.3	101.5	---	---	---	---
6SL3210-1PE31-8 . L0	90	<b>178</b>	178	151.3	124.6	---	---	---	---
6SL3210-1PE32-1 . L0	110	<b>205</b>	143.5	---	---	---	---	---	---
6SL3210-1PE32-5 . L0	132	<b>250</b>	175	---	---	---	---	---	---

\*) Factory setting

The permissible motor cable length depends on the particular cable type and the pulse frequency that has been selected

## 7.7 Technical data, 690 V inverters

### Motors for 690 V Power Modules



For the 690 V Power Modules, induction motors are permissible in the range from 50 % ... 150 % of the inverter power without any restrictions.

#### Note

#### Motors for inverter operation

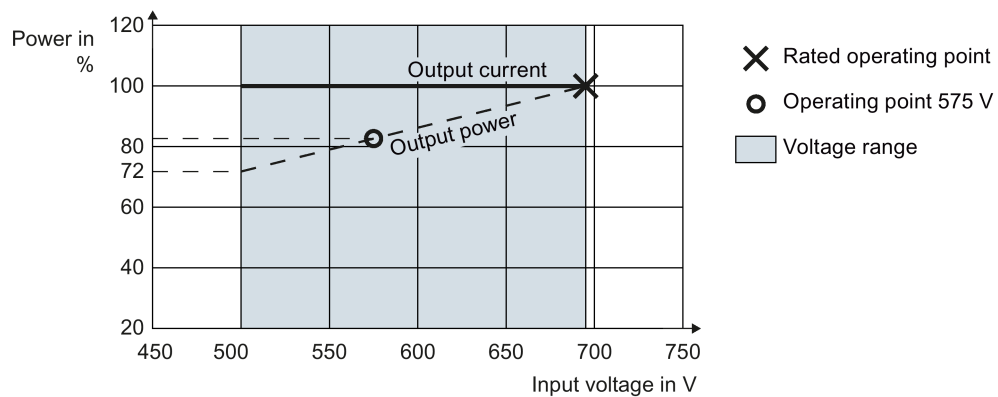
Only use motors that are suitable for operation with inverters with a DC link.

### 7.7.1 General data, 690 V inverters

Property	Version
Line voltage	<ul style="list-style-type: none"> <li>for systems according to IEC: 3-ph. AC 500 V ... 690 V <math>\pm</math> 10% (in operation -20% &lt; 1 min)</li> <li>for systems according to UL 3-ph. AC 500 V ... 600 V <math>\pm</math> 10% (in operation -20% &lt; 1 min) filtered devices only with Slash Rating (600Y/347V AC)</li> </ul>
Line supply configurations	Grounded TN/TT line supplies or non-grounded IT line supplies  Permissible line supplies (Page 44)
Line impedance	No restrictions
Power factor $\lambda$	> 0.9
Output voltage	3-ph. AC 0 V ... 0.95 x input voltage (max.)
Input frequency	50 Hz ... 60 Hz, $\pm$ 3 Hz
Output frequency	0 ... 550 Hz, depending on the control mode
Inrush current	< LO base load input current
Overvoltage category according to EN 61800-5-1	III for line supplies
Pulse frequency	2 kHz (factory setting), can be adjusted to 4 kHz If you increase the pulse frequency, the inverter reduces the maximum output current.
Short-circuit current rating (SCCR) and branch protection	$\leq$ 100 kA rms  Branch protection and short-circuit strength according to UL and IEC <a href="https://support.industry.siemens.com/cs/ww/en/view/109479152">https://support.industry.siemens.com/cs/ww/en/view/109479152</a>
Braking methods	DC braking, compound braking, dynamic braking with integrated braking chopper
Degree of protection according to EN 60529	IP20; must be installed in a control cabinet
Protection class according to EN 61800-5-1	The inverters are devices with protection class I
Touch protection according to EN 50274	DGUV regulation 3 when used for the intended purpose
Cooling in compliance with EN 60146	Forced air cooling AF



Dependent on the input voltage and output power



### 7.7.2 Specific technical data, 690 V inverters

Table 7- 25 PM240-2, IP20, frame size D, 3 AC 500 V ... 690 V

Article number - without filter	6SL3210-1PH21-4UL0	6SL3210-1PH22-0UL0	6SL3210-1PH22-3UL0
Article number - with filter	6SL3210-1PH21-4AL0	6SL3210-1PH22 -0AL0	6SL3210-1PH22 -3AL0
LO base load power	11 kW	15 kW	18.5 kW
LO base load input current	14 A	18 A	22 A
LO base load output current	14 A	19 A	23 A
HO base load power	7.5 kW	11 kW	15 kW
HO base load input current	11 A	14 A	20 A
HO base load output current	11 A	14 A	19 A
Fuse according to IEC/UL	3NA3807-6 (20 A)	3NA3810-6 (25 A)	3NA3812-6 (32 A)
Fuse according to IEC/UL, Class J	20 A	25 A	30 A
Power loss without filter	0.35 kW	0.44 kW	0.52 kW
Power loss with filter	0.35 kW	0.45 kW	0.52 kW
Required cooling air flow	55 l/s	55 l/s	55 l/s
Weight without filter	17 kg	17 kg	17 kg
Weight with filter	18.5 kg	18.5 kg	18.5 kg

Table 7- 26 PM240-2, IP20, frame size D, 3 AC 500 V ... 690 V

Article number - without filter	6SL3210-1PH22-7UL0	6SL3210-1PH23-5UL0	6SL3210-1PH24-2UL0
Article number - with filter	6SL3210-1PH22-7AL0	6SL3210-1PH23 -5AL0	6SL3210-1PH24-2AL0
LO base load power	22 kW	30 kW	37 kW
LO base load input current	25 A	33 A	40 A
LO base load output current	27 A	35 A	42 A
HO base load power	18.5 kW	22 kW	30 kW
HO base load input current	24 A	28 A	36 A
HO base load output current	23 A	27 A	35 A
Siemens fuse according to IEC/UL	3NA3817-6KJ (40 A)	3NA3820-6KJ (50 A)	33NA3822-6 (63 A)
Fuse according to IEC/UL, Class J	35 A	45 A	60 A
Power loss without filter	0.60 kW	0.77 kW	0.93 kW
Power loss with filter	0.60 kW	0.78 kW	0.94 kW
Required cooling air flow	55 l/s	55 l/s	55 l/s
Weight without filter	17 kg	17 kg	17 kg
Weight with filter	18.5 kg	18.5 kg	18.5 kg

Table 7- 27 PM240-2, IP20, frame size E, 3 AC 500 V ... 690 V

Article number - without filter	6SL3210-1PH25-2UL0	6SL3210-1PH26-2UL0
Article number - with filter	6SL3210-1PH25-2AL0	6SL3210-1PH26-2AL0
LO base load power	45 kW	55 kW
LO base load input current	50 A	59 A
LO base load output current	52 A	62 A
HO base load power	37 kW	45 kW
HO base load input current	44 A	54 A
HO base load output current	42 A	52 A
Siemens fuse according to IEC/UL	3NA3824-6 (80A)	3NA3824-6 (80A)
Fuse according to IEC/UL, Class J	80 A	80 A
Power loss without filter	1.07 kW	1.30 kW
Power loss with filter	1.08 kW	1.31 kW
Required cooling air flow	83 l/s	83 l/s
Weight without filter	26 kg	26 kg
Weight with filter	28 kg	28 kg

Table 7- 28 PM240-2, IP20, frame size F, 3 AC 500 V ... 690 V

Article number - without filter	6SL3210-1PH28-0UL0	6SL3210-1PH31-0UL0	6SL3210-1PH31-2UL0
Article number - with filter	6SL3210-1PH28-0AL0	6SL3210-1PH31-0AL0	6SL3210-1PH31-2AL0
LO base load power	75 kW	90 kW	110 kW
LO base load input current	78 A	97 A	111 A
LO base load output current	80 A	100 A	115 A
HO base load power	55 kW	75 kW	90 kW
HO base load input current	66 A	85 A	106 A
HO base load output current	62 A	80 A	100 A
Siemens fuse according to IEC/UL	3NA3830-6 (100 A)	3NA3132-6 (125 A)	3NA3136-6 (160 A)
Fuse according to IEC/UL, Class J	100 A	125 A	150 A
Power loss without filter	1.37 kW	1.74 kW	1.95 kW
Power loss with filter	1.38 kW	1.76 kW	1.97 kW
Required cooling air flow	153 l/s	153 l/s	153 l/s
Weight without filter	60 kg	60 kg	60 kg
Weight with filter	64 kg	64 kg	64 kg

Table 7- 29 PM240-2, IP20, frame size F, 3 AC 500 V ... 690 V

<b>Article number - without filter</b>	<b>6SL3210-1PH31-4UL0</b>
<b>Article number - with filter</b>	<b>6SL3210-1PH31-4AL0</b>
LO base load power	132 kW
LO base load input current	137 A
LO base load output current	142 A
HO base load power	110 kW
HO base load input current	122 A
HO base load output current	115 A
Siemens fuse according to IEC/UL	3NA3140-6 (200 A)
Fuse according to IEC/UL, Class J	200 A
Power loss without filter	2.48 kW
Power loss with filter	2.51 kW
Required cooling air flow	153 l/s
Weight without filter	60 kg
Weight with filter	64 kg

### 7.7.3 Current derating depending on the pulse frequency, 690 V inverters

Article number	LO power [kW]	LO base load output current [A]	
		2 *)	4
6SL3210-1PH21-4 . LO	11	14	8.4
6SL3210-1PH22-0 . LO	15	19	11.4
6SL3210-1PH22-3 . LO	18.5	23	13.8
6SL3210-1PH22-7 . LO	22	27	16.2
6SL3210-1PH23-5 . LO	30	35	21
6SL3210-1PH24-2 . LO	37	42	25.2
6SL3210-1PH25-2 . LO	45	52	31.2
6SL3210-1PH26-2 . LO	55	62	37.2
6SL3210-1PH28-0 . LO	75	80	48
6SL3210-1PH31-0 . LO	90	100	60
6SL3210-1PH31-2 . LO	110	115	69
6SL3210-1PH31-4 . LO	132	142	85.2

\*) Factory setting

The permissible motor cable length depends on the particular cable type and the pulse frequency that has been selected

## 7.8 Restrictions for special ambient conditions

### Maximum current at low speeds

#### NOTICE

#### Negative impact on the inverter service life as a result of overheating.

Loading the inverter with a high output current and at the same time with a low output frequency can cause the current-conducting components in the inverter to overheat. Excessively high temperatures can damage the inverter or have a negative impact on the inverter service life.

- Never operate the inverter continuously with an output frequency = 0 Hz.
- Only operate the inverter in the permissible operating range.

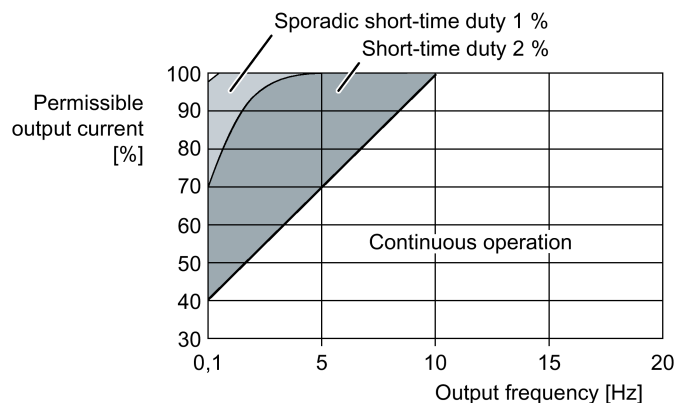


Figure 7-2 Permissible operating range of the inverter

- Continuous operation:  
Operating state that is permissible for the complete operating time.
- Short-time duty:  
Operating state that is permissible for less than 2 % of the operating time.
- Sporadic short-time duty:  
Operating state that is permissible for less than 1 % of the operating time.

Current reduction as a function of the installation altitude and ambient temperature

At installation altitudes above 1000 m and temperatures higher than 40° C (low overload) or 50° C (high overload), the inverter output current is reduced. The following tables contain the details.

Table 7- 30 Maximum permitted output current for loading according to LO

Installation altitude [m] up to	Ambient temperature [°C]									
	20	25	30	35	40	45	50	55	60	
	Output current in [%] when loading to LO									
1000	100					93	85	76	66	
1500	100				95	88	81	72	63	
2000	100			97	90	83	77	68	59	
2500	100		98	91	85	79	72	64	56	
3000	100	98	92	86	80	74	68	60	53	
3500	98	92	86	81	75	69	64	57	50	
4000	91	86	81	75	70	65	60	53	46	

Table 7- 31 Maximum permitted output current when loading according to HO

Installation altitude [m] up to	Ambient temperature [°C]									
	20	25	30	35	40	45	50	55	60	
	Output current in [%] when loading to HO									
1000	100							87	74	
1500	100						95	83	70	
2000	100				99	95	90	78	67	
2500	100			98	94	89	85	74	63	
3000	100		96	92	88	84	80	70	59	
3500	98	94	90	86	83	79	75	65	56	
4000	91	88	84	81	77	74	70	61	52	

Also observe the maximum permissible ambient operating temperatures for the Control Unit and possibly the Operator Panel.

### Permissible line supplies dependent on the installation altitude

- For installation altitudes  $\leq 2000$  m above sea level, it is permissible to connect the inverter to any of the line supplies that are specified for it.
- For installation altitudes 2000 m ... 4000 m above sea level, the following applies:
  - Connection to a TN line system with grounded neutral point is permissible.
  - TN systems with grounded line conductor are not permitted.
  - The TN line system with grounded neutral point can also be supplied using an isolation transformer.
  - The phase-to-phase voltage does not have to be reduced.

---

#### Note

**Using Power Modules connected to TN line supplies with voltages  $\geq 600$  V for installation altitudes 2000 m ... 4000 m**

For voltages  $\geq 600$  V, the TN line supply must have a grounded neutral point established using an isolating transformer.

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## 7.9 Electromagnetic compatibility of variable-speed drives

EMC (electromagnetic compatibility) means that the devices function satisfactorily without interfering with other devices and without being disrupted by other devices. This is true when the emitted interference (emission level) and the interference immunity are matched with each other.

The product standard IEC/EN 61800-3 describes the EMC requirements placed on "Variable-speed drive systems".

A variable-speed drive system (or Power Drive System PDS) consists of the inverter as well as the associated electric motors and encoders including the connecting cables.

The inverter comprises the Control Unit and Power Module.

The driven machine is not part of the drive system.

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### Note

#### PDS as component of machines or systems

When you integrate PDS into machines or systems, additional measures may be required so that the product standards of these machines or systems is complied with. The machine or system builder is responsible for taking these measures.

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## Environments and categories

### Environments

IEC/EN 61800-3 makes a distinction between the first and second environments - and defines different requirements for these environments.

- **First environment:**  
Residential buildings or locations at which the drive system is directly connected to a public low-voltage supply without intermediate transformer.
- **Second environment:**  
All locations that are connected to the public grid through their own, dedicated transformer. These are essentially industrial plants and systems.

### Categories

IEC/EN 61800-3 makes a distinction between four drive system categories:

- **Category C1:**  
Drive systems for rated voltages < 1000 V for unrestricted use in the first environment
- **Category C2:**  
Stationary drive systems for rated voltages < 1000 V for operation in the second environment.

The drive system must be installed by appropriately qualified and trained personnel.

Additional measures are required for operation in the first environment.



- **Category C3:**  
Drive systems for rated voltages < 1000 V - only for operation in the second environment.
- **Category C4:**  
Drive systems for IT line supplies for operation in complex systems in the second environment.  
  
An EMC plan must be created.

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**Note****Appropriately trained and qualified personnel**

An appropriately trained and qualified person has the necessary experience for installing and/or commissioning drive systems (Power Drive Systems - PDS), including the associated EMC aspects.

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## 7.9.1 Inverter applications

Inverters involve equipment used on a professional basis, deployed in certain areas of business and industry - and are not operated in the general public domain.



For an EMC-compliant installation, observe the information provided in the Configuration manual: EMC installation guideline (<http://support.automation.siemens.com/WW/view/en/60612658>).

The Power Modules described here are intended for operation in the first and second environments. Conditions for operation in the respective environment are subsequently listed.

### 7.9.1.1 Operation in the Second Environment


#### Interference immunity


You do not have to take any additional measures regarding interference immunity.

#### Interference emission - operation in the second environment, Category C2

The drive system must comply with the following conditions in order to comply with the limit values of the second environment, Category C2:

- The drive system is installed by appropriately qualified personnel in compliance with EMC regulations - and the installation notes provided in the manual.
- You use a shielded motor cable with low capacitance.
- The pulse frequency is not higher than the value set in the factory.

- The drive system is connected to a TN or TT line supply.
- You comply with the permissible motor cable length.  
 Length of the motor cable (Page 52).
- The inverters are equipped with a Category C2 line filter (internal or external).
  - **200 V inverter, frame size FSA ... FSC**  
Inverters with integrated filter are suitable for operation in the Second Environment, Category C2.
  - **200 V inverter, frame size FSD ... FSF**  
The inverters require an external filter, Category C2
  - **400 V inverter**  
Inverters with integrated filter are suitable for operation in the Second Environment, Category C2.
  - **690 V inverter**  
Inverters of frame sizes FSD and FSE with integrated filter are suitable for operation in the Second Environment, Category C2.  
Inverters of frame size FSF with integrated filter are suitable for operation in the Second Environment, Category C3.

With the external filters, from Section  Line filter (Page 113), the inverters without integrated filter comply with the requirements of the Second Environment, Category C2 with reference to interference emission.

If you use inverters without integrated filter or a filter other than those mentioned above, then you are responsible for verifying that the interference emission is limited.

You can use a dedicated radio interference suppression filter for each inverter - or a common filter for several inverters.

#### Interference emission - operation in the second environment, Category C4

When connected to IT line supplies, only filtered inverters are permissible. Use external filters without capacitors with respect to ground to limit symmetrical interference emission.

When necessary, contact one of our Solution Partners

(<https://www.automation.siemens.com/solutionpartner/partnerfinder/Home/Index?country=DE&program=1&technology=19&lang=en>).

## 7.9.1.2 Operation in the First Environment

### Interference immunity

You do not have to take any additional measures regarding interference immunity.

### Interference emission - operation in the first environment, Category C2

In order that you may operate the drive system in the first environment, Category C2, then in addition to the requirements for use in the second environment, you must also observe the limit values related to harmonic currents.

---

#### Note

##### Maintaining the limit values for harmonic currents

With respect to the compliance with limits for harmonic currents, the EMC product standard EN61800-3 for PDS refers to compliance with standards EN 61000-3-2 and EN 61000-3-12.

---

#### Inverter with an LO base load power $\leq 1$ kW:

It cannot be guaranteed that the limit values are complied with corresponding to IEC 61000-3-2. The installation person/company or company operating the professionally used device must obtain authorization from the grid operator to connect the device regarding the harmonic currents.



Typical harmonic currents (Page 100)

#### Inverters with an LO base load input current $\leq 16$ A:

These devices are not subject to any limit values, and as a consequence can be connected to the public low-voltage grid without any prior consultation.

#### Inverters with an LO base load input current $> 16$ A and $\leq 75$ A

The drive system is in compliance with IEC/EN 61000-3-12 under the following preconditions:

- FSC Power Module, input voltage 3 AC 200 ... 240 V: You use a 3% or 4% line reactor.
- FSD Power Module, input voltage 3 AC 200 ... 240 V: A line reactor is not required
- FSB/FSC Power Module, input voltage 3 AC 380 ... 480 V: You use a 3% or 4% line reactor.

- Power Module FSD, input voltage 380 ... 480 V 3 AC: A line reactor is not required

**Note**

**Line reactor**

Contact our Solution Partners

(<https://www.automation.siemens.com/solutionpartner/partnerfinder/Home/Index?country=DE&program=1&technology=19&lang=en>) for a line reactor.

- Short-circuit power  $S_{SC}$  at the connection point of the customer's system to the public grid, is greater than or equal to the value according to the following formula:

$$S_{SC} \geq 120 \times \sqrt{3} \times V_{in} \times LO \text{ base load input current}$$


**Example:** FSD inverter, 400 V, input current, 70 A:

$$S_{SC} \geq 120 \times \sqrt{3} \times 400 \text{ V} \times 70 \text{ A}$$

This corresponds to a low-voltage transformer with an apparent power rating of 300 kVA ... 400 kVA with  $V_K = 4\% \dots 6\%$

The installation company or company operating the equipment is responsible for ensuring that this equipment is only connected at a connection point with an appropriate short-circuit power (fault level).

If these preconditions do not apply, then the installation company or company operating the device must obtain authorization from the grid operator to connect the device regarding the harmonic currents.

 Typical harmonic currents (Page 100)

**Inverters with an LO base load current > 75A**

There are no standard-related requirements for installing devices such as these. However, we recommend that the grid operator is informed when such a device is connected. 400 V inverters conform to EN 61000-3-12.

## 7.9.2 Typical harmonic currents

Table 7- 32 Typical harmonic currents (%) of the inverter

Inverter	Harmonic number							
	5th	7th	11th	13th	17th	19th	23rd	25th
FSA ... FSC, 200 V, 400 V <sup>1)</sup>	54	39	11	5.5	5	3	2	2
FSD ... FSF, 200 V <sup>2)</sup>	28	14	8	6	5	4	3	3
FSD ... FSF, 400 V <sup>2)</sup>	37	21	7	5	4	3	3	2
FSD ... FSF, 690 V <sup>2)</sup>	34	18	8	5	4	3	3	2

1) Values relative to the LO input current for  $V_K 1\%$

2) Values relative to the LO input current

### 7.9.3 EMC limit values in South Korea

The following statements apply for filtered 400 V inverters, frame sizes FSD ... FSF.

All other inverters do not comply with the limit values.

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

The EMC limit values to be observed for Korea correspond to the limit values of the EMC product standard for variable-speed electric drives EN 61800-3 of category C2 or the limit value class A, Group 1 to KN11.

By implementing appropriate additional measures, the limit values according to category C2 or limit value class A, Group 1, are observed.

Additional measures, such as the use of an additional RFI suppression filter (EMC filter), may be necessary.



In addition, measures for EMC-compliant configuration of the plant or system are described in detail in this manual and in the Configuration manual EMC installation guideline (<http://support.automation.siemens.com/WW/view/en/60612658>).

The final statement on compliance with the applicable standard is given by the respective label attached to the individual device.



## Spare parts

### Continuous development within the scope of product maintenance

Inverter components are being continuously developed within the scope of product maintenance. Product maintenance includes, for example, measures to increase the ruggedness or hardware changes which become necessary as components are discontinued.

These further developments are "spare parts-compatible" and do not change the article number.

In the scope of such spare parts-compatible ongoing development, plug connector or connection positions are sometimes slightly modified. This does not cause any problems when the components are properly used. Please take this fact into consideration in special installation situations (e.g. allow sufficient reserve regarding the cable length).

### Spare parts for frame sizes FSA ... FSC

	Article number		
	FSA	FSB	FSC
Accessory kit IP20*)	A5E33860501A	A5E33879111A	A5E33879131A
Accessory kit PT*)	A5E03396337	A5E03395273	A5E03343234

\*) Included in the scope of delivery of the inverter

### Spare parts for frame sizes FSD ... FSF

	Article number		
	FSD	FSE	FSF
Set of small components	6SL3200-0SK08-0AA0	6SL3200-0SK08-0AA0	6SL3200-0SK08-0AA0
Mechanical kit	6SL3200-0SM13-0AA0	6SL3200-0SM14-0AA0	6SL3200-0SM15-0AA0
Fan kit	6SL3200-0SF15-0AA0	6SL3200-0SF16-0AA0	6SL3200-0SF17-0AA0
Accessory kit / shield connection kit	6SL3262-1AD01-0DA0	6SL3262-1AE01-0DA0	6SL3262-1AF01-0DA0






## Accessories

### Which components are available?

- Accessory kit / shield connection kit (includes the upper shield plate)
- Mounting frames for PT Power Modules - frame sizes FSA ... FSC
- Line reactors for frame sizes FSA ... FSC.  
Line reactors are not required for frame sizes FSD ... FSF.
- External line filters, Class B for frame sizes FSA ... FSC.  
No Class B filters are available for frame sizes FSD ... FSF.
- Braking resistors
- Brake Relay or Safe Brake Relay for controlling a motor holding brake
- Output reactors
- Voltage limiter and du/dt filter


### Connection components

Connection overview for the electrical components  Connection overview (Page 49).

## 9.1 Top shield plate - FSD ... FSF

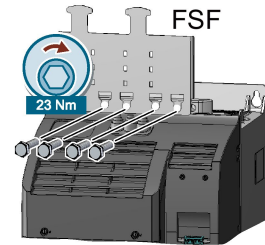
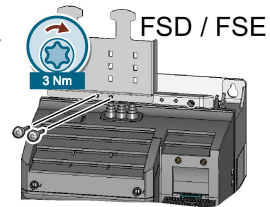
### Top shield plate - only FSD ... FSF

The shield plate is included in the accessory kit / shield connection kit. Order numbers:

 Spare parts (Page 103)

Attach the shield plate as shown in the diagram

- FSD and FSE: 2 x M5 / 3 Nm
- FSF 4 x M8 / 23 Nm



## 9.2 Mounting frames for PT power modules



### Order numbers for mounting frames

- FSA: 6SL3260-6AA00-0DA0
- FSB: 6SL3260-6AB00-0DA0
- FSC: 6SL3260-6AC00-0DA0

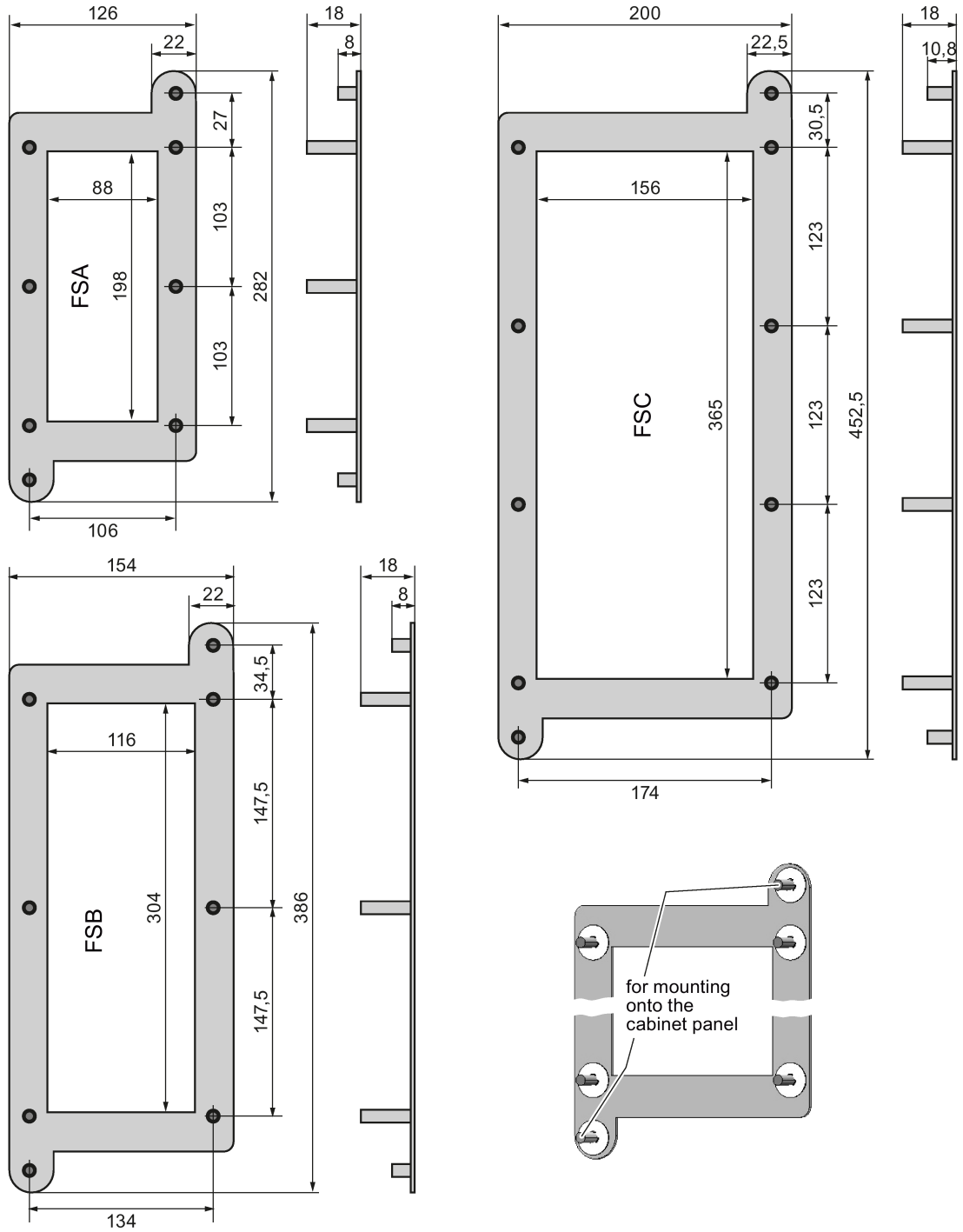
All of the necessary nuts and seals are included in the scope of delivery.

### Mounting instructions for the mounting frames

#### Procedure

- 
1. Proceed as follows to correctly mount the Power Module:
  2.
    1. Prepare a cutout and holes in the control cabinet panel for the mounting frame corresponding to the dimension drawing.
    2. Insert the mounting frame from the rear of the control cabinet through the corresponding holes and fix it in place at the fixing screws for the control cabinet panel; tighten the two nuts by hand.
    3. Attach the seal to the inner side of the control cabinet.
    4. Insert the Power Module and tighten the screws by hand.
    5. Finally, tighten the eight or ten screws with a torque of 3.5 Nm.
-  You have correctly installed the Power Module.

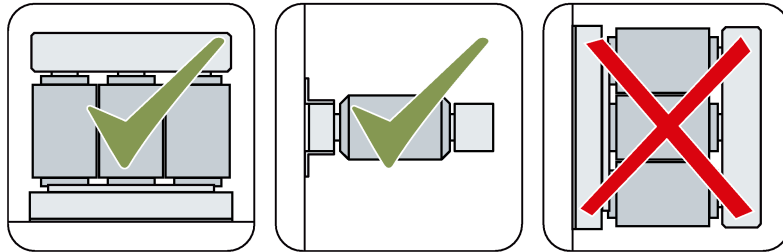
Dimension drawings for mounting frames



## 9.3 Line reactor

A line reactor protects the inverter when connected to dirty line supplies (line supply environment). A line reactor supports the overvoltage protection, smooths the harmonics in the line supply and buffers commutation dips.

### Mounting position



### Clearances to other devices

For a line reactor, a minimum clearance to other devices must be maintained on all sides.

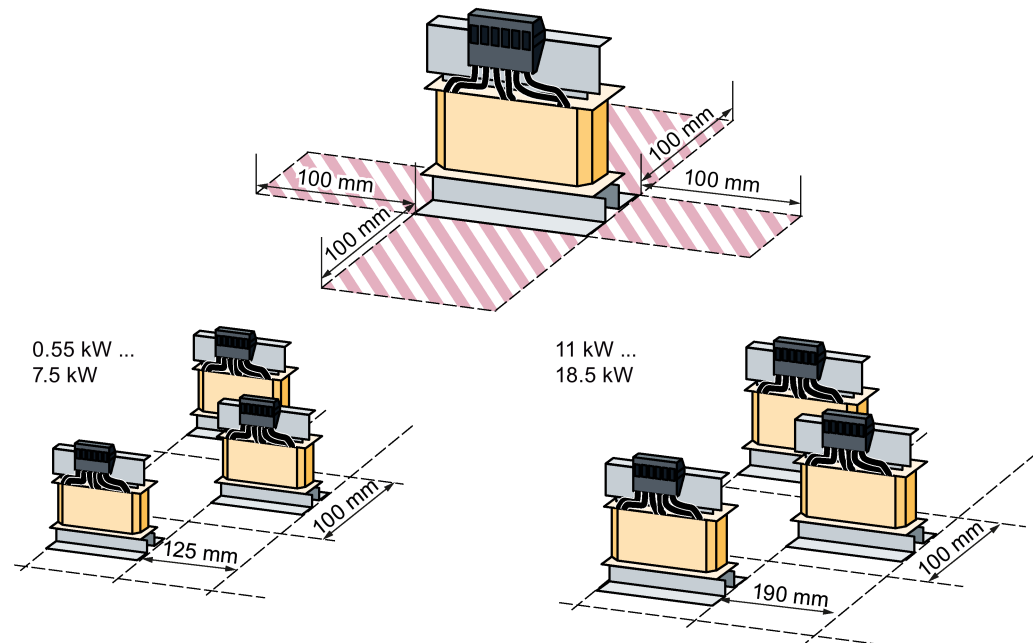
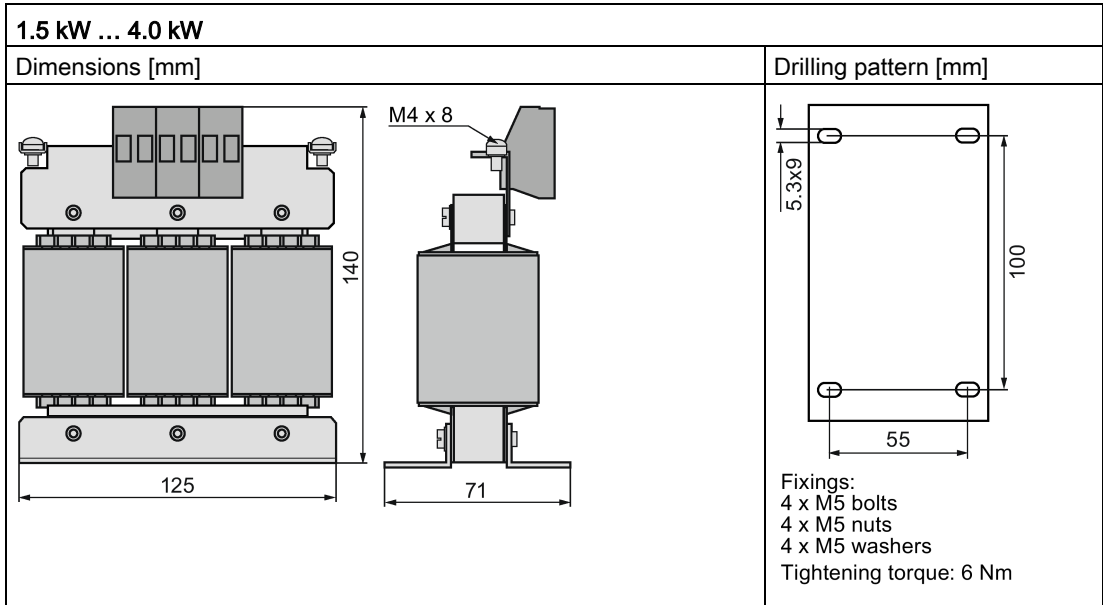
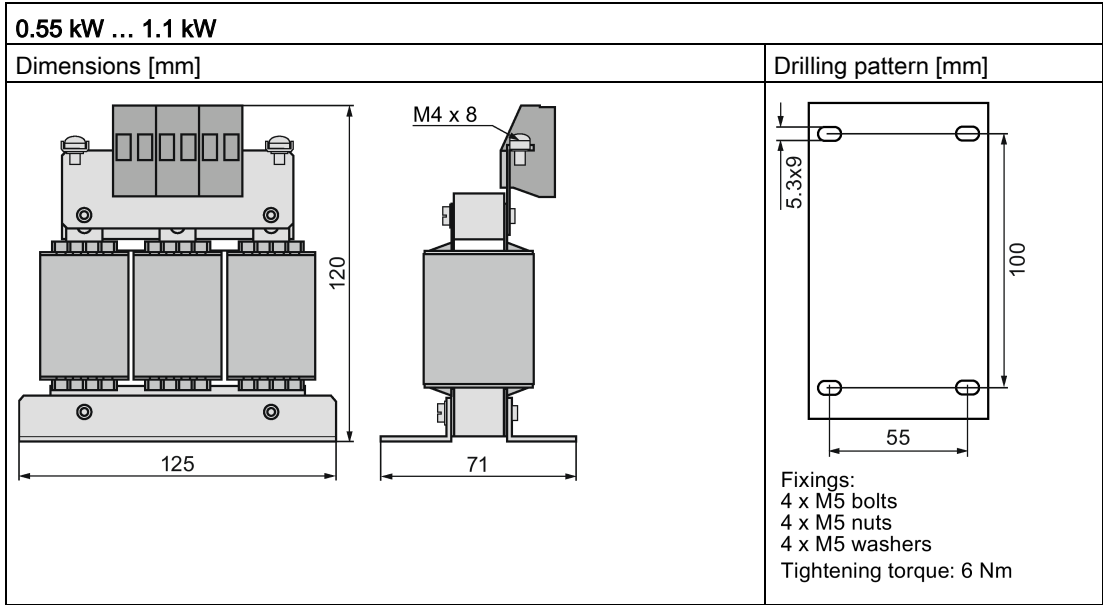


Figure 9-1 Clearances between the line reactors and other devices, examples for space-saving installation

Dimensions and drilling patterns



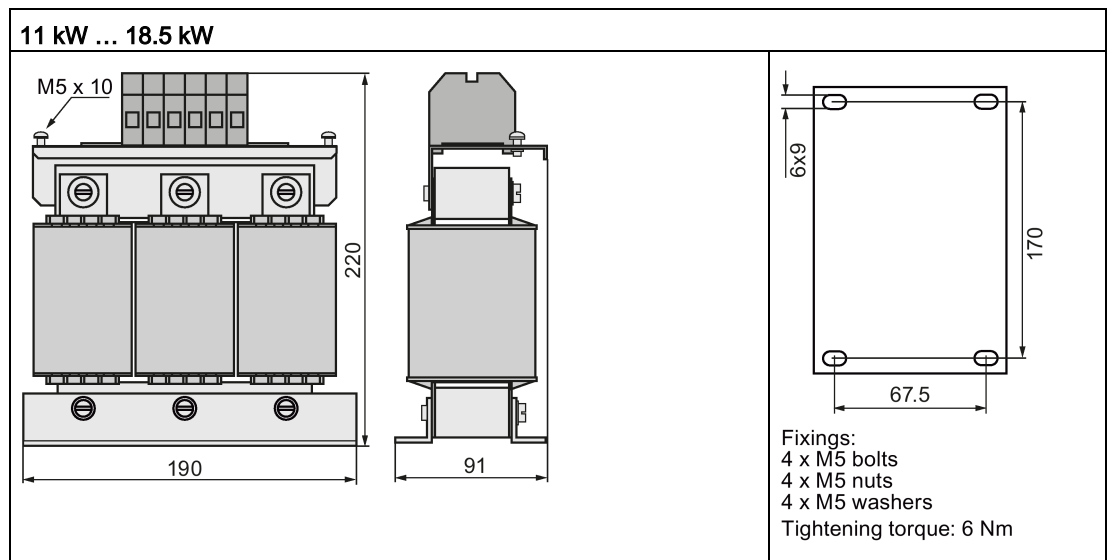
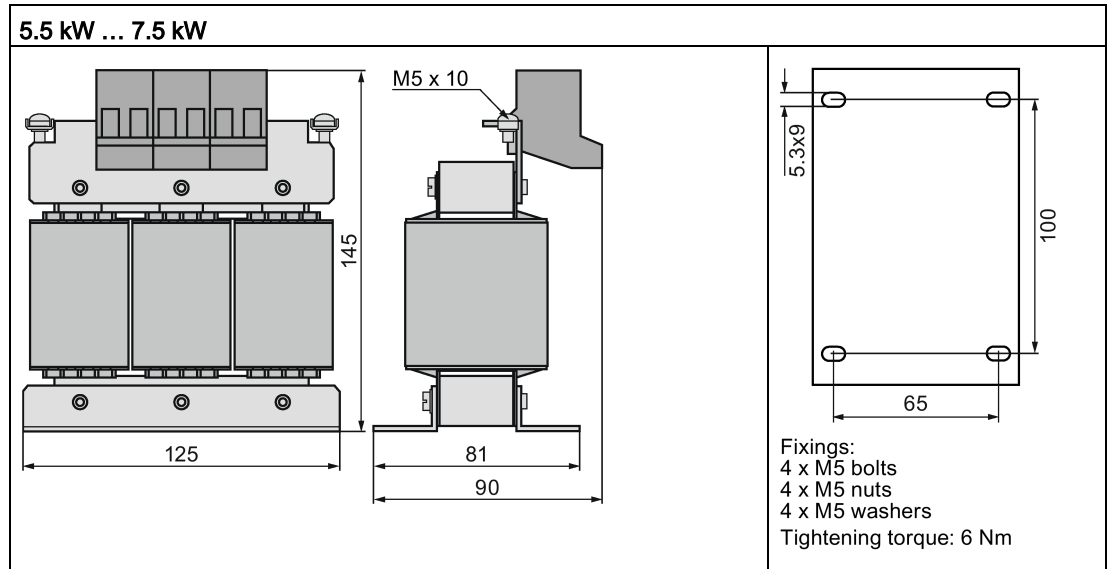


Table 9- 1 Technical data of the line reactors

Article number	Inductance [mH]	Line/load connection		PE connection [mm <sup>2</sup> / lbf in]	Weight [kg]
		[mm <sup>2</sup> / nM]	[AWG / lbf in]		
6SL3203-0CE13-2AA0	2.5	2.5 / 0.8	14 / 7	M4 [3 / 26.5]	1.1
6SL3203-0CE21-0AA0	1	6 / 1.8	10 / 15.9	M4 [3 / 26.5]	2.1
6SL3203-0CE21-8AA0	0.5	6 / 1.8	10 / 15.9	M5 [5 / 44.3]	2.95
6SL3203-0CE23-8AA0	0.3	16 / 4	6 / 34.5	M5 [5 / 44.3]	7.80

The line reactors are designed to IP20 degree of protection.

Table 9- 2 Assignment table

Line reactors	Power Module, 400 V		Power Module, 200 V	
6SL3203-0CE13-2AA0	6SL3210-1PE11-8 . L1, 6SL3210-1PE12-3 . L1 6SL3210-1PE13-2 . L1	FSA	6SL3210-1PB13-0 . L0, 6SL321 . -1PB13-8 . L0	FSA
6SL3203-0CE21-0AA0	6SL3210-1PE14-3 . L1, 6SL321 . -1PE16-1 . L1 6SL321 . -1PE18-0 . L1	FSA	6SL3210-1PB15-5 . L0, 6SL3210-1PB17-4 . L0 6SL321 . -1PB21-0 . L0	FSB
6SL3203-0CE21-8AA0	6SL3210-1PE21-1 . L0, 6SL3210-1PE21-4 . L0 6SL321 . -1PE21-8 . L0	FSB	6SL3210-1PB21-4 . L0 6SL321 . -1PB21-8 . L0	FSC
6SL3203-0CE23-8AA0	6SL3210-1PE22-7 . L0, 6SL321 . -1PE23-3 . L0	FSC	6SL321 . -1PC22-2 . L0 6SL3210-1PC22-8 . L0	FSC

### Line reactors for 1 AC 200 V

For inverters with 1 AC 200 V connection, rather than the line reactors listed above, you can also deploy the following or similar products:

- FSA:  
NKE 10 / 2.93 (Block company)
- FSB  
NKE 25 / 1.17 (Block company)
- FSC  
NKE 35 / 1.46 (Block company)

The technical properties and statements made by the manufacturer apply.



## 9.4 Line filter

### Dimensions for mounting the line filter

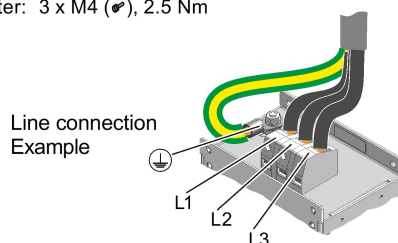
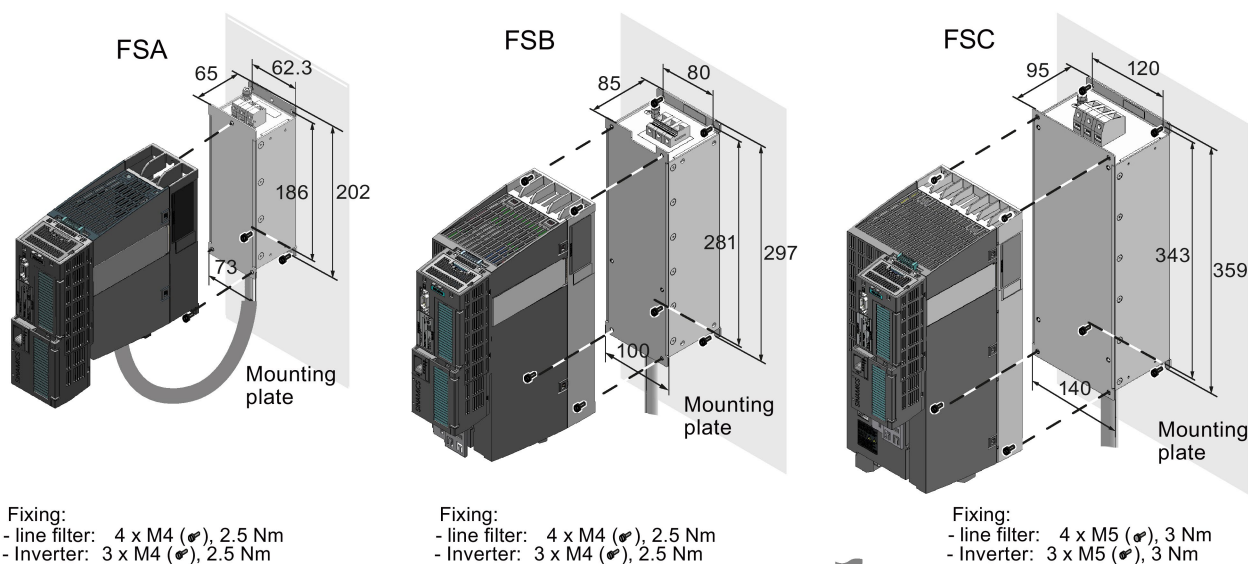


Table 9- 3 Technical data of the line filter (Class B)

Article number	Power loss [W]	Connection		Weight [kg]
		Line supply and Power Module	PE	
6SL3203-0BE17-7BA0	13	2.5 mm <sup>2</sup> / 0.8 Nm 14 AWG / 7 lbf in	2.5 mm <sup>2</sup> / 2 Nm 14 AWG / 17.7 lbf in	1.75
6SL3203-0BE21-8BA0	22	6 mm <sup>2</sup> / 1.8 Nm 10 AWG / 15.9 lbf in	2.5 mm <sup>2</sup> / 2 Nm 14 AWG / 17.7 lbf in	4.0
6SL3203-0BE23-8BA0	50	16 mm <sup>2</sup> / 4 Nm 6 AWG / 35.4 lbf in	16 mm <sup>2</sup> / 32 Nm 6 AWG / 26.5 lbf in	7.3

Line filters are designed to IP20 degree of protection.

Table 9- 4 Assignment table

Power Module, 400 V			Line filter (Class B)
Frame size	Article number	Power	Article number
FSA	6SL3210-1PE11-8UL1	0.55	6SL3203-0BE17-7BA0
	6SL3210-1PE12-3UL1	0.75	
	6SL3210-1PE13-2UL1	1.1	
	6SL3210-1PE14-3UL1	1.5	
	6SL3210-1PE16-1UL1	2.2	
	6SL321 . -1PE18-0UL1	3.0	
FSB	6SL3210-1PE21-1UL0	4.0	6SL3203-0BE21-8BA0
	6SL3210-1PE21-4UL0	5.5	
	6SL321 . -1PE21-8UL0	7.5	
FSC	6SL3210-1PE22-7UL0	11	6SL3203-0BE23-8BA0
	6SL321 . -1PE23-3UL0	15	

## 9.5 Braking resistor

The braking resistor enables loads with a large moment of inertia to be braked quickly. During braking of the motor and the load, excess energy is fed back to the converter. This causes the voltage to rise in the DC link. The converter transfers the excess energy to the externally mounted braking resistor.



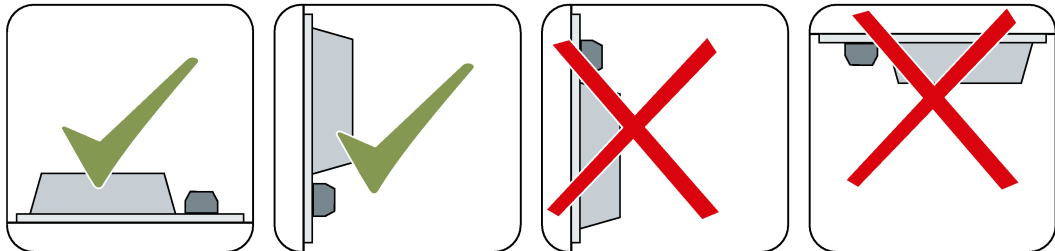
### WARNING

**Danger to life due to fire spreading because of an unsuitable or improperly installed braking resistor**

Using an unsuitable or improperly installed braking resistor can cause fires and smoke to develop. Fire and smoke development can cause severe personal injury or material damage.

- Only use braking resistors that are approved for the inverter.
- Install the braking resistor in accordance with regulations.
- Monitor the temperature of the braking resistor.

### Mounting position



### Mounting instructions

Mount the resistor on a heat resistant surface with a high thermal conductivity.

Do not cover the ventilation openings of the braking resistor.

You can mount the braking resistor either outside or inside the switchgear room. When mounted outside, the cooling air requirement for the switchgear room is lower.

### Clearances to other devices

The following data are applicable for devices, frame sizes FSA ... FSC.

The clearances for braking resistors for devices, frame sizes FSD ... FSF are specified in the documentation, which is supplied with the braking resistor.

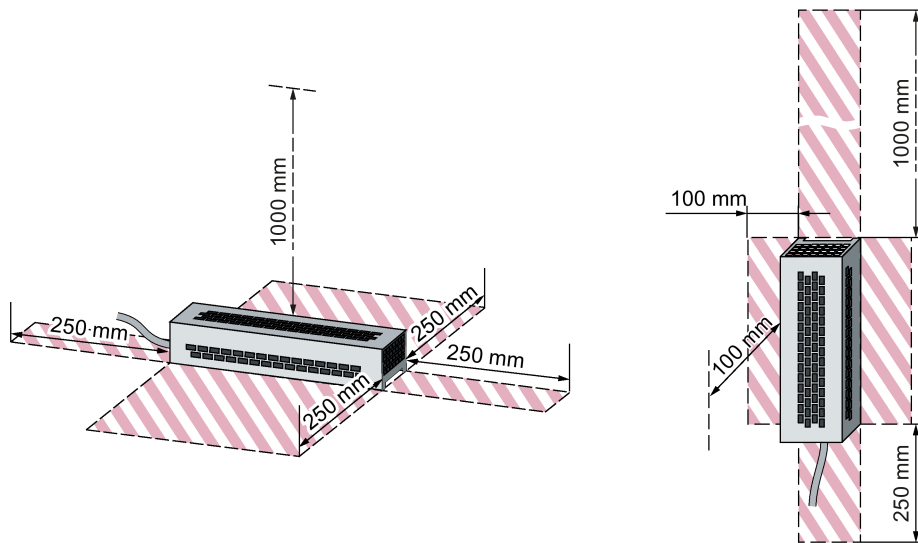


Figure 9-2 Minimum clearances for the braking resistor when mounting on a flat surface and for wall/panel mounting

Keep shaded areas free of any devices and components.

### Dimensions and drilling patterns

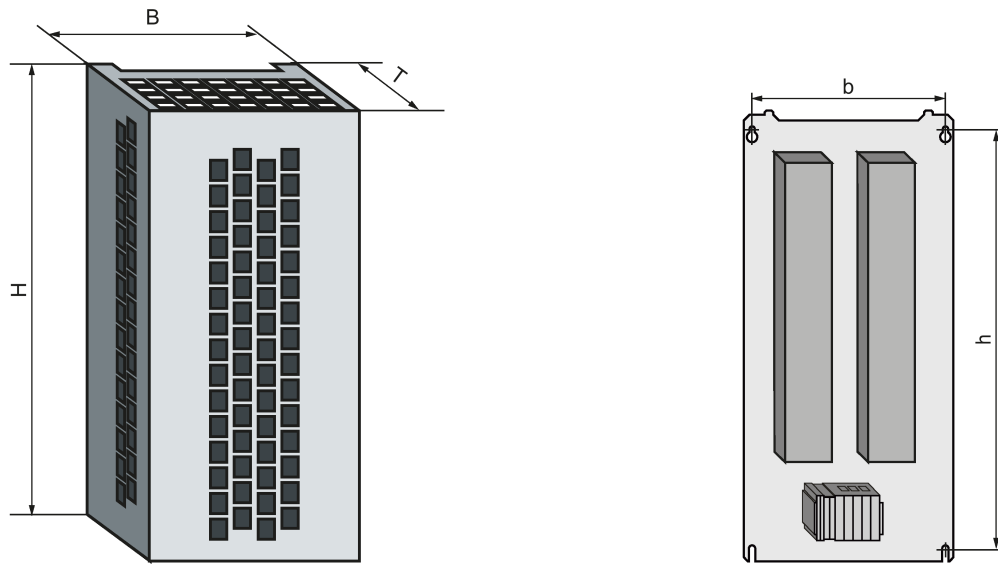


Figure 9-3 Braking resistor

Table 9- 5 Dimensions and weights

Article number	Overall dimensions [mm]			Drilling dimensions [mm]		Fixing/torque	Weight [kg]	Inverter frame size
	W	H	D	b	h			
<b>for 200 V inverters</b>								
JJY:023146720008	105	295	100	72	266	M4 / 3 Nm	1.5	FSA
JJY:023151720007	105	345	100	72	316	M4 / 3 Nm	1.8	FSB
JJY:02 3163720018	175	345	100	142	316	M4 / 3 Nm	2.7	FSC
JJY:023433720001	250	490	140	217	460	M5 / 6 Nm	6.2	FSC
JJY:023422620002	220	470	180	187	430	M5 / 6 Nm	7	FSD
JJY:023423320001	220	560	180	187	500	M5 / 6 Nm	8.5	FSE
JJY:023434020003	350	630	180	317	570	M5 / 6 Nm	13.5	FSF
<b>for 400 V inverters</b>								
6SL3201-0BE14-3AA0	105	295	100	72	266	M4 / 3 Nm	1.5	FSA
6SL3201-0BE21-0AA0	105	345	100	72	316	M4 / 3 Nm	1.8	FSA
6SL3201-0BE21-8AA0	175	345	100	142	316	M4 / 3 Nm	2.7	FSB
6SL3201-0BE23-8AA0	250	490	140	217	460	M5 / 6 Nm	6.2	FSC
JJY:023422620001	220	470	180	187	430	M5 / 6 Nm	7	FSD
JJY:023424020001	220	610	180	187	570	M5 / 6 Nm	9.5	FSD
JJY:023434020001	350	630	180	317	570	M5 / 6 Nm	13.5	FSE
JJY:023454020001*)								FSF
• JJY:023422620001	220	470	180	187	430	M5 / 6 Nm	7	(FSD)
• JJY:023434020001	350	630	180	317	570	M5 / 6 Nm	13.5	(FSE)
JJY:023464020001*)								FSF
• JJY:023434020001	350	630	180	317	570	M5 / 6 Nm	13.5	(FSE)
• JJY:023434020001	350	630	180	317	570	M5 / 6 Nm	13.5	(FSE)
<b>for 690 V inverters</b>								
JJY:023424020002	220	610	180	187	570	M5 / 6 Nm	9.5	FSD
JJY:023434020002	350	630	180	317	570	M5 / 6 Nm	13.5	FSE
JJY:023464020002*)								FSF
• JJY:023434020002	350	630	180	317	570	M5 / 6 Nm	13.5	(FSE)
• JJY:023434020002	350	630	180	317	570	M5 / 6 Nm	13.5	(FSE)

Use the screws, nuts and washers when fixing the braking resistors

\*) This braking resistor comprises two components, which must be connected in parallel on the plant/system side

### 9.5.1 Connecting a braking resistor

The following figure shows a connection overview of the braking resistor on the inverter.

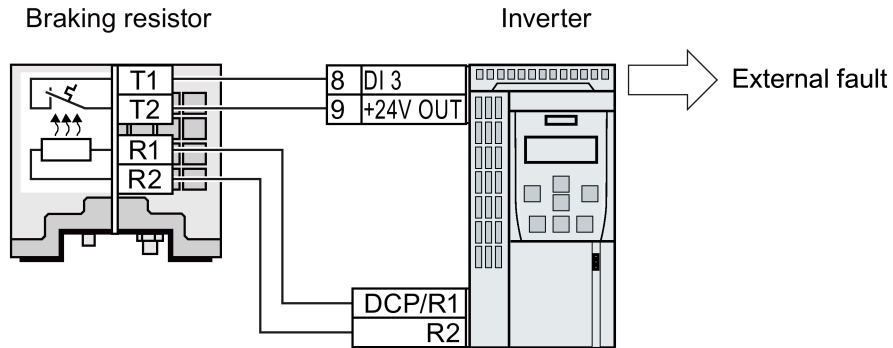


Figure 9-4 Connecting a braking resistor with temperature monitoring via digital input DI 3

Some braking resistors have an integrated connection cable for the power connections (R1/R2) on the inverter. Thus, the length and cross-section of the connection cable are given.

For braking resistors without integrated connection cable, the maximum cable length is 10 m. The required conductor cross-sections are contained in the following tables.

The conductor cross-sections for the temperature monitoring are contained in the Operating Instructions of the Control Unit of your inverter.

### Monitoring the temperature of the braking resistor

#### Procedure

1. Proceed as follows to monitor the braking resistor temperature:
2.
  1. Connect the temperature monitoring system of the braking resistor (terminals T1 and T2 on the braking resistor) to a free digital input at the Control Unit of the inverter.
  2. When commissioning the drive, define the function of the digital input used as external fault, using p2106.

As an example with temperature monitoring via digital input DI 3: p2106 = 722.3.

- You have ensured that the temperature is monitored.

## 9.5.2 Technical data of the braking resistor

For the inverters, use the following or comparable braking resistors. The technical properties and statements made by the manufacturer apply.

### Note

#### Braking resistors FSD ... FSF

Only use braking resistors that are UL approved, and have successfully passed the "Abnormal Operation Test" according to UL 508.

### Braking resistors for PM240-2, 200 V

Table 9- 6 Technical data

Article number	Re- sistance	Maximum power, $P_{max}$	Connection R1 / R2	Degree of protection	Power Module	
		Rated power $P_{db}$		Weight	Article numbers	Frame size
JJY:023146720008	200 $\Omega$	0.75 kW	Connecting cable integrated in the braking resistor	IP20	6SL3210-1PB13-0 . L0 6SL321 . -1PB13-8 . L0	FSA
		37.5 W		1.5 kg		
JJY:023151720007	68 $\Omega$	2.2 kW		IP20	6SL3210-1PB15-5 . L0 6SL3210-1PB17-4 . L0 6SL321 . -1PB21-0 . L0	FSB
		110 W		1.8 kg		
JJY:02 3163720018	37 $\Omega$	4 kW		IP20	6SL3210-1PB21-4 . L0 6SL321 . -1PB21-8 . L0	FSC
		200 W		2.7 kg		
JJY:023433720001	20 $\Omega$	7.5 kW		IP20	6SL3210-1PC22-2 . L0 6SL3210-1PC22-8 . L0	FSC
		375 W		6.2		
JJY:023422620002	7.5 $\Omega$	18.5 kW	10 mm <sup>2</sup> / 0.5 Nm 8 AWG / 4.5 lbf in	IP21	6SL3210-1PC24-2 . L0 6SL3210-1PC25-4 . L0 6SL3210-1PC26-8 . L0	FSD
		930 W		7.0 kg		
JJY:023423320001	4.5 $\Omega$	30 kW	16 mm <sup>2</sup> / 1.2 Nm 6 AWG / 10.6 lbf in	IP21	6SL3210-1PC28-0 . L0 6SL3210-1PC31-1 . L0	FSE
		1500 W		8.5 kg		
JJY:023434020003	2.5 $\Omega$	55 kW	16 mm <sup>2</sup> / 1.2 Nm 6 AWG / 10.6 lbf in	IP21	6SL3210-1PC31-3 . L0 6SL3210-1PC31-6 . L0 6SL3210-1PC31-8 . L0	FSF
		2750 W		13.5 kg		

## Braking resistors for PM240-2, 400 V

Table 9- 7 Technical data

Article number	Re- sistance	Maximum power, P <sub>max</sub>	Connection R1 / R2	Degree of protection	Power Module	
		Rated power P <sub>db</sub>		Weight	Article numbers	Frame size
6SL3201-0BE14-3AA0	370 Ω	1.5 kW	2.5 mm <sup>2</sup> / 0.5 Nm 14 AWG / 4.5 lbf in	IP20	6SL3210-1PE11-8 . L1 6SL3210-1PE12-3 . L1 6SL3210-1PE13-2 . L1 6SL3210-1PE14-3 . L1	FSA
		75 W		1.5 kg		
6SL3201-0BE21-0AA0	140 Ω	4 kW	2.5 mm <sup>2</sup> / 0.5 Nm 14 AWG / 4.5 lbf in	IP20	6SL321 . -1PE16-1 . L1 6SL321 . -1PE18-0 . L1	FSA
		200 W		1.8 kg		
6SL3201-0BE21-8AA0	75 Ω	7.5 kW	4 mm <sup>2</sup> / 0.7 Nm 10 AWG / 6.2 lbf in	IP20	6SL3210-1PE21-1 . L0 6SL3210-1PE21-4 . L0 6SL321 . -1PE21-8 . L0	FSB
		375 W		2.7 kg		
6SL3201-0BE23-8AA0	30 Ω	18.5 kW	4 mm <sup>2</sup> / 0.7 Nm 10 AWG / 6.2 lbf in	IP20	6SL3210-1PE22-7 . L0 6SL321 . -1PE23-3 . L0	FSC
		925 W		6.2 kg		
JJY:023422620001	25 Ω	22 kW	10 mm <sup>2</sup> / 0.8 Nm 8 AWG / 7.1 lbf in	IP21	6SL3210-1PE23-8 . L0 6SL3210-1PE24-5 . L0	FSD
		1100 W		7.0 kg		
JJY:023424020001	15 Ω	37 kW	10 mm <sup>2</sup> / 0.8 Nm 8 AWG / 7.1 lbf in	IP21	6SL3210-1PE26-0 . L0 6SL3210-1PE27-5 . L0	FSD
		1850 W		9.5 kg		
JJY:023434020001	10 Ω	55 kW	16 mm <sup>2</sup> / 1.2 Nm 6 AWG / 4.5 lbf in	IP21	6SL3210-1PE28-8 . L0 6SL3210-1PE31-1 . L0	FSE
		2750 W		13.5 kg		
JJY:023454020001 (JJY:023422620001    JJY:023434020001)	7.1 Ω	77 kW	10 mm <sup>2</sup> / 0.8 Nm 8 AWG / 7.1 lbf in 16 mm <sup>2</sup> / 1.2 Nm 6 AWG / 4.5 lbf in	IP21	6SL3210-1PE31-5 . L0 6SL3210-1PE31-8 . L0	FSF
		3850 W		20.5 kg		
JJY:023464020001 (JJY:023434020001    JJY:023434020001)	5 Ω	110 kW	16 mm <sup>2</sup> / 1.2 Nm 6 AWG / 4.5 lbf in 16 mm <sup>2</sup> / 1.2 Nm 6 AWG / 4.5 lbf in	IP21	6SL3210-1PE32-1 . L0 6SL3210-1PE32-5 . L0	FSF
		5500 W		27 kg		



Braking resistors for PM240-2, 690 V

Table 9- 8 Technical data

Article number	Re-sistance	Maximum power, $P_{max}$	Connection R1 / R2	Degree of protection	Power Module	
		Rated power $P_{db}$		Weight	Article Nos.	Frame size
JJY:023424020002	31 $\Omega$	37 kW	10 mm <sup>2</sup> / 0.8 Nm 8 AWG / 7.1 lbf in	IP21	6SL3210-1PH21-4 . L0 6SL3210-1PH22-0 . L0 6SL3210-1PH22-3 . L0 6SL3210-1PH22-7 . L0 6SL3210-1PH23-5 . L0 6SL3210-1PH24-2 . L0	FSD
		1850 W		9.5 kg		
JJY:023434020002	21 $\Omega$	55 kW	16 mm <sup>2</sup> / 1.2 Nm 6 AWG / 4.5 lbf in	IP21	6SL3210-1PH25-2 . L0 6SL3210-1PH26-2 . L0	FSE
		2750 W		13.5 kg		
JJY:023464020002 (JJY:023434020002    JJY:023434020002)	10.5 $\Omega$	110 kW	16 mm <sup>2</sup> / 1.2 Nm 6 AWG / 10.6 lbf in	IP21	6SL3210-1PH28-0 . L0 6SL3210-1PH31-0 . L0	FSF
		5500 W				
			16 mm <sup>2</sup> / 1.2 Nm 6 AWG / 10.6 lbf in		6SL3210-1PH31-2 . L0 6SL3210-1PH31-4 . L0	

Load cycles for the braking resistors

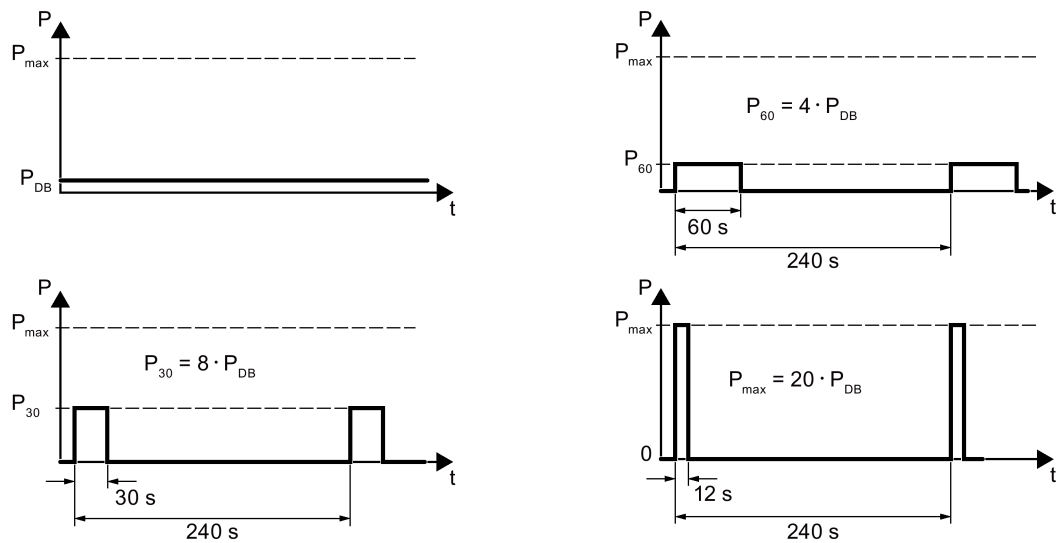


Figure 9-5 Pulse power, rated power and examples of the switch-on duration of the braking resistor

## 9.6 Connecting a motor holding brake

The inverter uses the Brake Relay to control the motor holding brake. Two types of Brake Relay exist:

- The Brake Relay controls the motor holding brake
- The Safe Brake Relay controls a 24 V motor holding brake and monitors the brake control for short-circuit or cable breakage.

---

### Note

#### Brake Relay and Safe Brake Relay

The Brake Relay and the Safe Brake Relay do not differ from each other in the installation and the connection to the inverter.

#### Connection to the inverter

To ensure that you have the correct cable for connecting the Brake Relay irrespective of the inverter size, you are supplied with two preassembled cables with different lengths. Connect the appropriate cable to the Brake Module and to the inverter as shown below.

If you are using your own cable, ensure that the cable is insulated and rated for 600 V.

#### Connecting the motor holding brake via a PELV circuit

The Brake Relay must be connected to the protective conductor if the motor brake is supplied from a PELV circuit.

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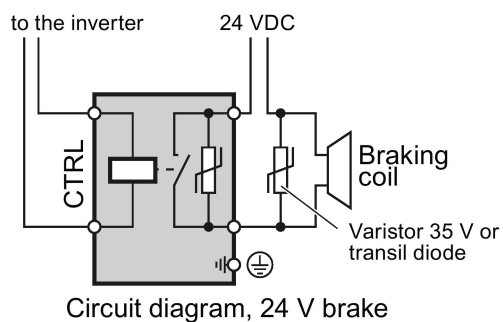
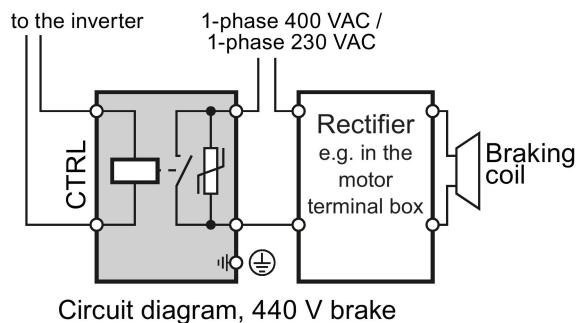
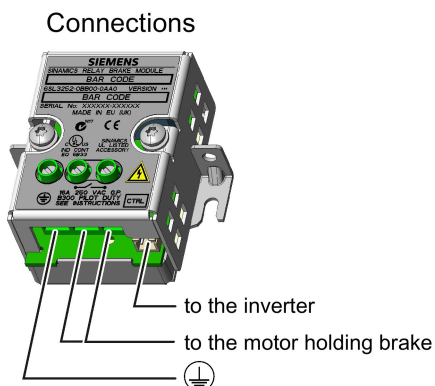
### 9.6.1 Technical data of the brake relay?

	<b>Brake Relay</b> <b>6SL3252-0BB00-0AA0</b>	<b>Safe Brake Relay</b> <b>6SL3252-0BB01-0AA0</b>
Input voltage	via the Power Module	20.4 ... 28.8 VDC <sup>1)</sup>
Input current	via the Power Module	Max. 2.5 A
Max. connection cross-section:	2.5 mm <sup>2</sup>	2.5 mm <sup>2</sup>
Degree of protection	IP20	IP20
Switching capability of the NO contact	1-phase 440 VAC, 3.5 A 1-phase 30 VDC, 12 A	-
Output voltage	-	24 V
Output current	-	max. 2 A

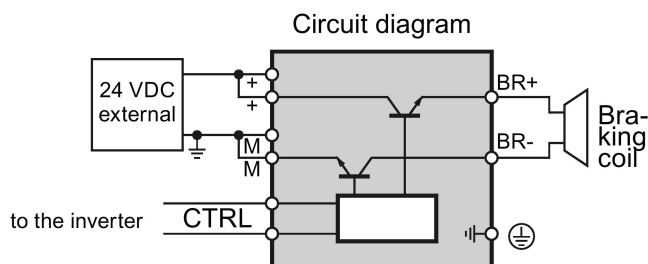
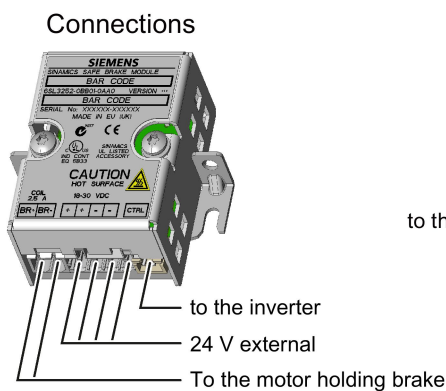
<sup>1)</sup> External, controlled power supply required. Recommended voltage: 26 VDC

## 9.6.2 Connections and circuit diagrams

### Brake Relay



### Safe Brake Relay



### 9.6.3 Mounting and connecting the brake relay

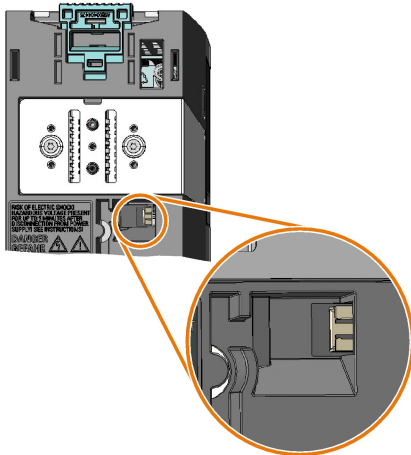
#### Installing the Brake Relay

- **FSA ... FSC:** Install the Brake Relay next to the Power Module.
- **FSD ... FSF:** Install the Brake Relay at the rear of the lower shield plate. Attach the Brake Relay before you install the shield plate.

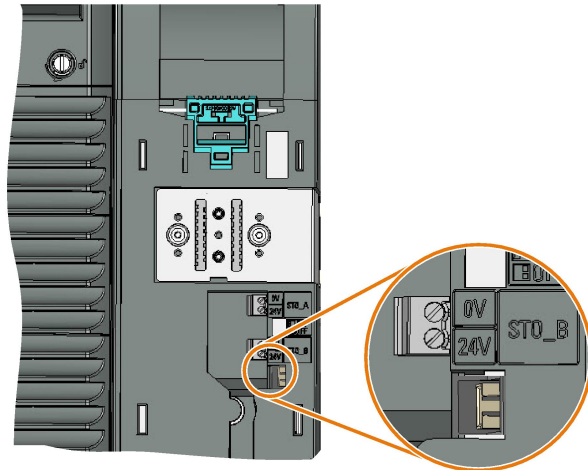
 Mounting the shield plate for built-in units (Page 35)

#### Connecting the Brake Relay to the inverter

The connector for the Brake Relay is located at the front of the Power Module. Lay the cable harness for the Brake Relay in the cable routing.



Brake relay connector for FSA ... FSC Power Modules without STO terminals



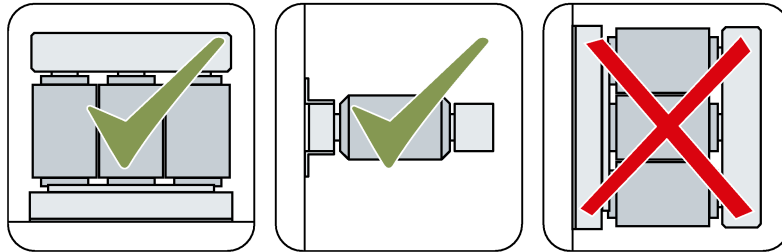
Brake relay connector for FSD ... FSF Power Modules with STO terminals

## 9.7 Output reactor

Output reactors reduce the voltage stress on the motor windings and the load placed on the inverter as a result of capacitive recharging currents in the cables.

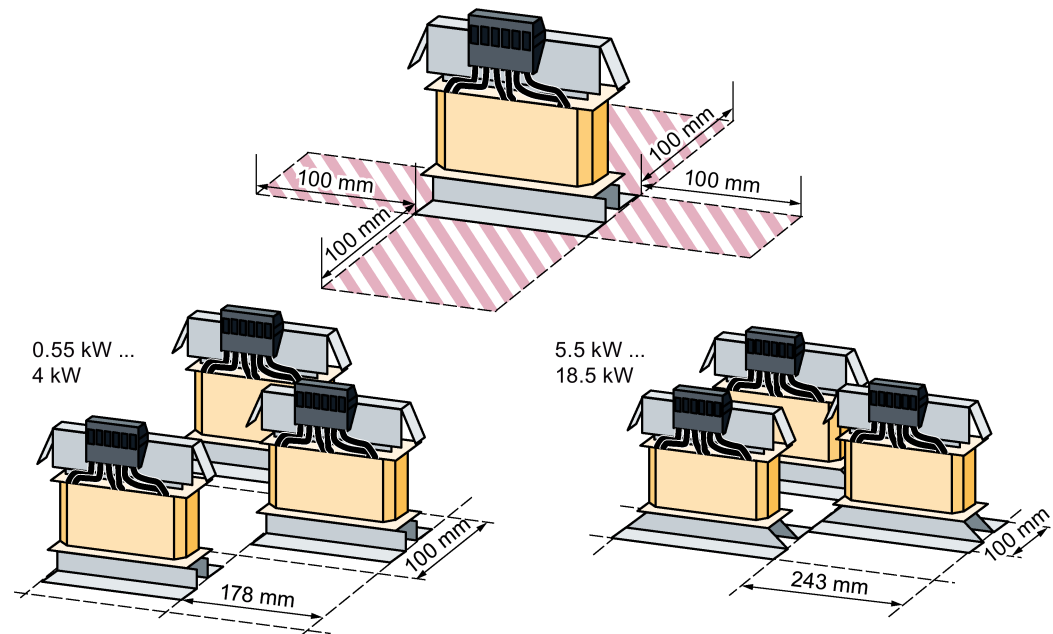
When using the output reactor it is not permissible that the output frequency exceeds 150 Hz. It is not permissible that the pulse frequency exceeds 4 kHz

### Mounting position



### Clearances to other devices

Keep shaded areas free of any devices and components.



Minimum clearances of the output reactor to other devices, space-saving mounting examples

Dimensions, drilling patterns and weights for FSA ... FSC inverters

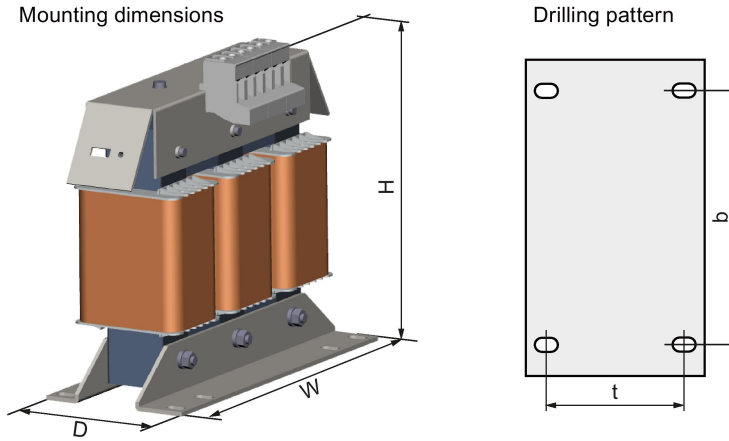


Table 9- 9 Dimensions and weights

Article number	Inductance [mH]	Overall dimensions [mm]			Drilling dimensions [mm]		Fixing/torque [Nm]	Weight [kg]
		W	H	D	b	t		
6SL3202-0AE16-1CA0	2.5	207	166	73	166	57	4 x M4 / 3	3.4
6SL3202-0AE18-8CA0	1.3	207	166	73	166	57	4 x M4 / 3	3.9
6SL3202-0AE21-8CA0	0.54	247	211	100	225	81	4 x M5 / 6	10.1
6SL3202-0AE23-8CA0	0.26	257	228	115	225	85	4 x M5 / 6	11.2

Output reactors are designed to IP20 degree of protection.

Table 9- 10 Connections to the Power Module and to the motor

Article number	Connection	
	Motor Module and motor	PE
6SL3202-0AE16-1CA0 6SL3202-0AE18-8CA0	Screw terminals 4 mm <sup>2</sup> ; 0.6 ... 0.8 Nm	Threaded bolt M4 / 3 Nm
6SL3202-0AE21-8CA0	Screw terminals 10 mm <sup>2</sup> ; 1.5 ... 1.8 Nm	Threaded bolt M5 / 5 Nm
6SL3202-0AE23-8CA0	Screw terminals 16 mm <sup>2</sup> ; 2 ... 4 Nm	Threaded bolt M5 / 5 Nm

Dimensions, drilling patterns and weights for FSD ... FSF inverters

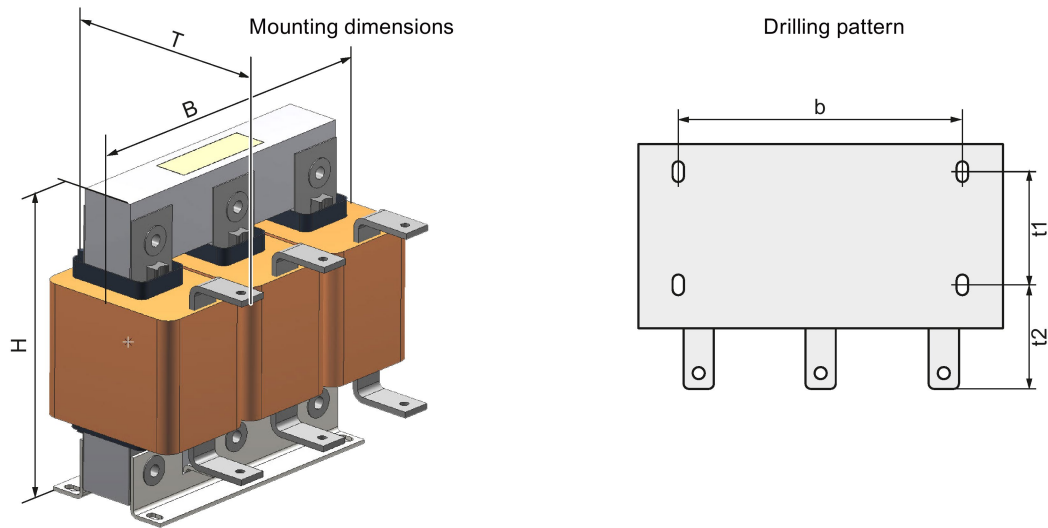


Figure 9-6 Dimensions and drilling patterns

Table 9- 11 Dimensions and weights

Article number	Overall dimensions [mm]			Drilling dimensions [mm]			Fixing/torque [Nm]	Weight [kg]
	W	H	D	b	t1	t2		
6SE6400-3TC07-5ED0	270	248	209	200	102	91.5	4 x M8 / 13	26.5
6SE6400-3TC14-5FD0	350	321	288	264	140	134	4 x M8 / 13	57
6SL3000-2BE32-1AA0	300	285	257	224	165	78	4 x M8 / 13	60
6SL3000-2BE32-6AA0	300	315	277	224	185	78	4 x M8 / 13	66
6SL3000-2AH31-0AA0	270	248	200	200	103	82	4 x M8 / 13	25
6SL3000-2AH31-5AA0	270	248	200	200	103	82	4 x M8 / 13	26

Output reactors are designed to IP20 degree of protection.

Table 9- 12 Connections to the Power Module and to the motor

Article number	Connection	
	Motor Module and motor	PE
6SE6400-3TC07-5ED0	Cable lug M6 / 6 Nm	Screw M6 / 10 Nm
6SE6400-3TC14-5FD0	Cable lug M8 / 13 Nm	Screw M8 / 25 Nm
6SL3000-2BE32-1AA0 6SL3000-2BE32-6AA0	Cable lug M10 / 50 Nm	Screw M8 / 25 Nm
6SL3000-2AH31-0AA0 6SL3000-2AH31-5AA0	Cable lug M10 / 50 Nm	Screw M6 / 10 Nm

Table 9- 13 Assignment table for 200 V Power Modules

Power Module			Output reactor
Frame size	Article number	Power [kW]	Article number
FSA	6SL3210-1PB13-0 . L0	0.55	6SL3202-0AE16-1CA0
FSA	6SL321 . -1PB13-8 . L0	0.75	
FSB	6SL3210-1PB15-5 . L0	1.1	
FSB	6SL3210-1PB17-4 . L0	1.5	6SL3202-0AE18-8CA0
FSB	6SL321 . -1PB21-0 . L0	2.2	6SL3202-0AE21-8CA0
FSC	6SL3210-1PB21-4 . L0	3	
FSC	6SL321 . -1PB21-8 . L0	4	
FSC	6SL321 . -1PC22-2 . L0	5.5	6SL3202-0AE23-8CA0
FSC	6SL3210-1PC22-8 . L0	7.5	
FSD	6SL3210-1PC24-2UL0	11	6SE6400-3TC07-5ED0
FSD	6SL3210-1PC25-4UL0	15	
FSD	6SL3210-1PC26-8UL0	18.5	
FSE	6SL3210-1PC28-0UL0	22	6SE6400-3TC14-5FD0
FSE	6SL3210-1PC31-1UL0	30	
FSF	6SL3210-1PC31-3UL0	37	
FSF	6SL3210-1PC31-6UL0	45	
FSF	6SL3210-1PC31-8UL0	55	

Output reactors are not required for inverters of frame sizes FSD ... FSF

Table 9- 14 Assignment table for 400 V Power Modules

Power Module			Output reactor
Frame size	Article number	Power [kW]	Article number
FSA	6SL3210-1PE11-8 . L1	0.55	6SL3202-0AE16-1CA0
FSA	6SL3210-1PE12-3 . L1	0.75	
FSA	6SL3210-1PE13-2 . L1	1.1	
FSA	6SL3210-1PE14-3 . L1	1.5	
FSA	6SL3210-1PE16-1 . L1	2.2	
FSA	6SL321 . -1PE18-0 . L1	3	
FSB	6SL3210-1PE21-1 . L0	4	6SL3202-0AE21-8CA0
FSB	6SL3210-1PE21-4 . L0	5.5	
FSB	6SL321 . -1PE21-8 . L0	7.5	
FSC	6SL3210-1PE22-7 . L0	11	6SL3202-0AE23-8CA0
FSC	6SL321 . -1PE23-3 . L0	15	
FSD	6SL3210-1PE23-8 . L0	18.5	6SE6400-3TC07-5ED0
FSD	6SL3210-1PE24-5 . L0	22	
FSD	6SL3210-1PE26-0 . L0	30	
FSD	6SL3210-1PE27-5 . L0	37	
FSE	6SL3210-1PE28-8 . L0	45	6SE6400-3TC14-5FD0
FSE	6SL3210-1PE31-1 . L0	55	
FSF	6SL3210-1PE31-5 . L0	75	
FSF	6SL3210-1PE31-8 . L0	90	
FSF	6SL3210-1PE32-1 . L0	110	
FSF	6SL3210-1PE32-5 . L0	132	

Output reactors are not required for inverters of frame sizes FSD ... FSF



Table 9- 15 Assignment table for 690 V Power Modules

Power Module			Output reactor
Frame size	Article number	Power [kW]	Article number
FSF	6SL3210-1PH28-0 . L0	75	6SL3000-2AH31-0AA0
	6SL3210-1PH31-0 . L0	90	
FSF	6SL3210-1PH31-2 . L0	110	6SL3000-2AH31-5AA0
	6SL3210-1PH31-4 . L0	132	

Output reactors are not required for 690 V inverters

## 9.8 Voltage limiter and du/dt filter

A combination of du/dt filter and a voltage peak limiter (VPL) are available to suppress voltage peaks.



Further details for the functional principle and the application cases are available at: Voltage limiter and du/dt filter

(<https://support.industry.siemens.com/cs/ww/de/view/109742112>)

The assignment of the du/dt filter / VPL combination to the Power Modules is contained in the following tables.

### Assignment tables

Table 9- 16 Assignment table for 200 V Power Modules

Power Module			VPL-du/dt
Frame size	Article number	Power [kW]	Article number
FSD	6SL3210-1PC24-2UL0	11	6SL3000-2DE32-6AA0
FSD	6SL3210-1PC25-4UL0	15	
FSD	6SL3210-1PC26-8UL0	18.5	
FSE	6SL3210-1PC28-0UL0	22	
FSE	6SL3210-1PC31-1UL0	30	
FSF	6SL3210-1PC31-3UL0	37	
FSF	6SL3210-1PC31-6UL0	45	
FSF	6SL3210-1PC31-8UL0	55	

Table 9- 17 Assignment table for 400 V Power Modules

Power Module			VPL-du/dt
Frame size	Article number	Power [kW]	Article number
FSF	6SL3210-1PE31-5 . L0	75	6SL3000-2DE32-6AA0
FSF	6SL3210-1PE31-8 . L0	90	
FSF	6SL3210-1PE32-1 . L0	110	
FSF	6SL3210-1PE32-5 . L0	132	

Table 9- 18 Assignment table for 690 V Power Modules

Power Module			VPL-du/dt
Frame size	Article number	Power [kW]	Article number
FSD	6SL3210-1PH21-4 . L0	11	6SL3000-2DH31-0AA0
FSD	6SL3210-1PH22-0 . L0	15	
FSD	6SL3210-1PH22-3 . L0	18.5	
FSD	6SL3210-1PH22-7 . L0	22	
FSD	6SL3210-1PH23-5 . L0	30	
FSD	6SL3210-1PH24-2 . L0	37	
FSE	6SL3210-1PH25-2 . L0	45	
FSE	6SL3210-1PH26-2 . L0	55	
FSF	6SL3210-1PH28-0 . L0	75	
FSF	6SL3210-1PH31-0 . L0	90	
FSF	6SL3210-1PH31-2 . L0	110	6SL3000-2DH31-5AA0
FSF	6SL3210-1PH31-4 . L0	132	



## Appendix

### A.1 Manuals and technical support

#### A.1.1 Manuals for your inverter



##### Manuals with additional information that can be downloaded:

- Power Module Installation Manual  
<https://support.industry.siemens.com/cs/ww/en/ps/13224/man>  
 Installing Power Modules, reactors and filters. Technical specifications, maintenance (this manual)  

- CU230P-2 Compact Operating Instructions  
<https://support.industry.siemens.com/cs/ww/en/view/109477360>  
 Commissioning the inverter  






- CU240B/E-2 Compact Operating Instructions  
<https://support.industry.siemens.com/cs/ww/en/view/109477361>  
 Commissioning the inverter  

- CU250S-2 Compact Operating Instructions  
<https://support.industry.siemens.com/cs/ww/en/view/99730303>  
 Commissioning the inverter.  

- CU230P-2 operating instructions  
<https://support.industry.siemens.com/cs/ww/en/view/109478827>  
 Installing, commissioning and maintaining the inverter. Advanced commissioning  

- CU240B/E-2 operating instructions  
<https://support.industry.siemens.com/cs/ww/en/view/109478828>  
 Installing, commissioning and maintaining the inverter. Advanced commissioning  

- CU250S-2 operating instructions  
<https://support.industry.siemens.com/cs/ww/en/view/109478829>  
 Installing, commissioning and maintaining the inverter. Advanced commissioning  


- CU230P-2 List Manual (<https://support.industry.siemens.com/cs/ww/en/view/109477248>)  
Parameter list, alarms and faults. Graphic function diagrams  

- CU240B/E-2 List Manual (<https://support.industry.siemens.com/cs/ww/en/view/109477251>)  
Parameter list, alarms and faults. Graphic function diagrams  

- CU250S-2 List Manual (<https://support.industry.siemens.com/cs/ww/en/view/109477253>)  
Parameter list, alarms and faults. Graphic function diagrams  

- EMC installation guideline (<http://support.automation.siemens.com/WW/view/en/60612658>)  
EMC-compliant control cabinet design, equipotential bonding and cable routing  

- Accessories manual (<https://support.industry.siemens.com/cs/ww/en/ps/13225/man>)  
Installation descriptions for inverter components, e.g. line reactors and line filters. The printed installation descriptions are supplied together with the components.  


## A.1.2 Configuring support

### Catalog

Ordering data and technical information for SINAMICS G inverters.



Catalogs for download or online catalog (Industry Mall):



All about SINAMICS G120 ([www.siemens.com/sinamics-g120](http://www.siemens.com/sinamics-g120))

### SIZER

The configuration tool for SINAMICS, MICROMASTER and DYNAVERT T drives, motor starters, as well as SINUMERIK, SIMOTION controllers and SIMATIC technology



SIZER on DVD:

Article number: 6SL3070-0AA00-0AG0



Download SIZER (<http://support.automation.siemens.com/WW/view/en/10804987/130000>)

## EMC (electromagnetic compatibility) technical overview

Standards and guidelines, EMC-compliant control cabinet design



EMC overview (<https://support.industry.siemens.com/cs/ww/en/view/103704610>)

## EMC Guidelines configuration manual

EMC-compliant control cabinet design, potential equalization and cable routing



EMC installation guideline (<http://support.automation.siemens.com/WW/view/en/60612658>)

## Safety Integrated for novices technical overview

Application examples for SINAMICS G drives with Safety Integrated



Safety Integrated for novices  
(<https://support.industry.siemens.com/cs/ww/en/view/80561520>)

## A.1.3 Product Support



You can find additional information on the product and more in the Internet under  
(<http://www.siemens.com/automation/service&support>)

This address provides the following:

- Actual product information (product memorandums), FAQs (frequently asked questions), downloads.
- The Newsletter contains the latest information on the products you use.
- The Knowledge Manager (Intelligent Search) helps you find the documents you need.
- Users and specialists from around the world share their experience and knowledge in the Forum.
- You can find your local representative for Automation & Drives via our contact database under "Contact & Partner".
- Information about local service, repair, spare parts and much more can be found under "Services".

## A.2 Disposal

Protecting the environment and preserving its resources are corporate goals of the highest priority for Siemens. Our worldwide environmental management system according to ISO 14001 ensures compliance with legislation and sets high standards in this regard. Environmentally friendly design, technical safety and health protection are always firm goals, even at the product development stage.

Recommendations for the environmentally friendly disposal of the machine and its components are given in the following chapter.

- Be sure to comply with local disposal regulations.
- Separate the housing parts according to their material.
- Dispose of the parts in accordance with the applicable legal regulations.
- Dispose of the packaging material in accordance with the applicable legal regulations.

### Components

- Sort the components for recycling according to whether they are:
  - Electronic waste
  - Scrap iron, e.g. shield plates
  - Aluminum
  - Insulating materials and plastics



## A.3 Directives and standards

### Relevant directives and standards

The following directives and standards are relevant for the inverters:



#### European Low Voltage Directive

The inverters fulfil the requirements stipulated in Low Voltage Directive 2014/35/EU insofar as they are covered by the scope of application of this Directive.

#### European Machinery Directive

The inverters fulfil the requirements stipulated in Machinery Directive 2006/42/EU insofar as they are covered by the scope of application of this Directive.

Use of the inverters in a typical machine application has been fully assessed for compliance with the main regulations in this Directive concerning health and safety.

#### European EMC Directive

By completely complying with IEC/EN 61800-3, it has been proven that the inverter is in compliance with Directive 2004/108/EC or 2014/30/EU.



#### Underwriters Laboratories (North American market)

Inverters bearing one of the certification marks shown on the left meet the requirements for the North American market as a component of drive applications and are listed correspondingly.



#### EMC requirements for South Korea

The inverters with the KC marking on the rating plate satisfy the EMC requirements for South Korea.



#### Eurasian conformity

The inverters comply with the requirements of the Russia/Belarus/Kazakhstan customs union (EAC).



#### Australia and New Zealand (RCM formerly C-Tick)

The inverters bearing the certification mark shown here meet the EMC requirements for Australia and New Zealand.



## A.4 Abbreviations

<b>Abbreviation</b>	<b>Explanation</b>
AC	Alternating current
CE	Communauté Européenne
CU	Control Unit
DC	Direct current
DI	Digital input
DIP switch	DIP switches are small switches, found mostly on PBCs, for making basic device settings
DO	Digital output
ECD	Equivalent circuit diagram
EEC	European Economic Community
ELCB	Earth leakage circuit breaker
EMC	Electromagnetic compatibility (EMC)
EMI	Electromagnetic interference
FS...	Frame size ...
HO	High overload
I/O	Input/Output
IGBT	Insulated gate bipolar transistor
LED	Light emitting diode
LO	Low overload
NC	NC contact
NEMA	National Electrical Manufacturers Association
NO	NO contact
OPI	Operating instructions
PELV	Protective extra low voltage
PM	Power Module
PPE	Personnel protective equipment
PT	Push-through technology
RCCB	Residual-current operated circuit breaker
RCD	Residual current device
RFI	Radio frequency interference
SELV	Safety extra-low voltage
VPL	Voltage Peak Limiter; component for limiting voltage peaks



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## Further information

SINAMICS inverter:  
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