SIEMENS

Edition 09/2023

INSTALLATION MANUAL

SINAMICS

SINAMICS G120 converters

PM240P-2 Power Modules, IP20

www.siemens.com

SIEMENS

SINAMICS

SINAMICS G120
Power Module PM240P-2

Hardware Installation Manual

09/2023
A5E37800827C AG

Legal information

Warning notice system

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

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

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

⚠**CAUTION**
indicates that minor personal injury can result if proper precautions are not taken.

NOTICE
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:

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

Trademarks

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

Disclaimer of Liability

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

Siemens AG
Digital Industries
Postfach 48 48
90026 NÜRNBERG
GERMANY

A5E37800827C AG
Ⓟ 09/2023 Subject to change

Table of contents

Fundamental safety instructions

1

1.1 General safety instructions

⚠WARNING

Electric shock and danger to life due to other energy sources

Touching live components can result in death or severe injury.

- Only work on electrical devices when you are qualified for this job.
- Always observe the country-specific safety rules.

Generally, the following steps apply when establishing safety:

1. Prepare for disconnection. Notify all those who will be affected by the procedure.
2. Isolate the drive system from the power supply and take measures to prevent it being switched back on again.
3. Wait until the discharge time specified on the warning labels has elapsed.
4. Check that there is no voltage between any of the power connections, and between any of the power connections and the protective conductor connection.
5. Check whether the existing auxiliary supply circuits are de-energized.
6. Ensure that the motors cannot move.
7. Identify all other dangerous energy sources, e.g. compressed air, hydraulic systems, or water. Switch the energy sources to a safe state.
8. Check that the correct drive system is completely locked.

After you have completed the work, restore the operational readiness in the inverse sequence.

⚠WARNING

Risk of electric shock and fire from supply networks with an excessively high impedance

Excessively low short-circuit currents can lead to the protective devices not tripping or tripping too late, and thus causing electric shock or a fire.

- In the case of a conductor-conductor or conductor-ground short-circuit, ensure that the short-circuit current at the point where the converter is connected to the line supply at least meets the minimum requirements for the response of the protective device used.
- You must use an additional residual-current device (RCD) if a conductor-ground short circuit does not reach the short-circuit current required for the protective device to respond. The required short-circuit current can be too low, especially for TT supply systems.

⚠WARNING

Risk of electric shock and fire from supply networks with an excessively low impedance

Excessively high short-circuit currents can lead to the protective devices not being able to interrupt these short-circuit currents and being destroyed, and thus causing electric shock or a fire.

- Ensure that the prospective short-circuit current at the line terminal of the converter does not exceed the breaking capacity (SCCR or Icc) of the protective device used.

⚠WARNING

Electric shock if there is no ground connection

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

Electric shock due to connection to an unsuitable power supply

When equipment is connected to an unsuitable power supply, exposed components may carry a hazardous voltage. Contact with hazardous voltage can result in severe injury or death.

- 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.

⚠WARNING

Electric shock due to equipment damage

Improper handling may cause damage to equipment. 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

Electric shock due to unconnected cable shield

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

Arcing when a plug connection is opened during operation

Opening a plug connection when a system is in operation can result in arcing that may cause serious injury or death.

- Only open plug connections when the equipment is in a voltage-free state, unless it has been explicitly stated that they can be opened in operation.

⚠WARNING

Electric shock due to residual charges in power components

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

Damage to equipment due to unsuitable tightening tools.

Unsuitable tightening tools or fastening methods can damage the screws of the equipment.

- Only use screw inserts that exactly match the screw head.
- Tighten the screws with the torque specified in the technical documentation.
- Use a torque wrench or a mechanical precision nut runner with a dynamic torque sensor and speed limitation system.
- Adjust the tools used regularly.

NOTICE

Property damage due to loose power connections

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

- Tighten all power connections to the prescribed torque.
- Check all power connections at regular intervals, particularly after equipment has been transported.

⚠ WARNING

Electromagnetic interference due to inadequate shield support

A lack of adequate shield support for the power cables can cause malfunctions and impermissibly high levels of interference.

- Use the shield connection plates supplied or recommended.
- Use the shield connection clips recommended.

⚠ WARNING

Spread of fire from built-in devices

Built-in devices can cause a fire and a pressure wave in the event of a fault. Fire and smoke can escape from the control cabinet and cause serious personal injury and property damage.

- Install built-in appliances in a robust metal control cabinet that is suitable for protecting people from fire and smoke.
- Only operate built-in devices with the control cabinet doors closed.
- Ensure that smoke can only escape via controlled and monitored paths.

⚠ WARNING

Active implant malfunctions due to electromagnetic fields

Converters generate electromagnetic fields (EMF) in operation. Electromagnetic fields may interfere with active implants, e.g. pacemakers. People with active implants in the immediate vicinity of an converter are at risk.

- As the operator of an EMF-emitting installation, assess the individual risks of persons with active implants.
- Observe the data on EMF emission provided in the product documentation.

⚠CAUTION

Symptomatic respiratory and skin reaction to chemicals

A newly purchased product might contain traces of substances that are identified as sensitizers.

Sensitizers are substances which can cause sensitization in the lungs and skin after exposure to them.

Once sensitized, individuals can have severe reactions to further exposure, even in small amounts. In the most extreme cases, individuals might develop asthma or dermatitis respectively.

- If the product has a strong smell, keep it in a well-ventilated area for 14 days.

⚠WARNING

Unexpected machine movement caused by radio devices or mobile phones

Using radio devices, cellphones, or mobile WLAN devices in the immediate vicinity of the components can result in equipment malfunction. Malfunctions may impair the functional safety of machines and can therefore put people in danger or lead to property damage.

- Therefore, if you move closer than 20 cm to the components, be sure to switch off radio devices, cellphones or WLAN devices.
- Use the "SIEMENS Industry Online Support App" or a QR code scanner only on equipment that has already been switched off.

NOTICE

Damage to motor insulation due to excessive voltages

When operated on systems with grounded line conductors or in the event of a ground fault in the IT system, the motor insulation can be damaged by the higher voltage against ground. If you use motors that have insulation that is not designed for operation with grounded line conductors, you must perform the following measures:

- IT system: Use a ground fault monitor and eliminate the fault as quickly as possible.
- TN or TT systems with grounded line conductor: Use an isolating transformer on the line side.

⚠WARNING

Fire due to inadequate 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.

NOTICE

Overheating due to inadmissible mounting position

The device may overheat and therefore be damaged if mounted in an inadmissible position.

- Only operate the device in admissible mounting positions.

⚠ WARNING

Unrecognized dangers due to missing or illegible warning labels

Dangers might not be recognized if warning labels are missing or illegible. Unrecognized dangers may cause accidents resulting in serious injury or death.

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

Unexpected movement of machines caused by inactive safety functions

Inactive or non-adapted safety functions can trigger unexpected machine movements that may result in 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 instructions for Safety Integrated

If you want to use Safety Integrated functions, you must observe the Safety instructions in the Safety Integrated documentation.

1.2 Equipment damage due to electric fields or electrostatic discharge

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

NOTICE

Equipment damage due to 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 of 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).

1.3 Warranty and liability for application examples

Application examples are not binding and do not claim to be complete regarding configuration, equipment or any eventuality which may arise. Application examples do not represent specific customer solutions, but are only intended to provide support for typical tasks.

As the user you yourself are responsible for ensuring that the products described are operated correctly. Application examples do not relieve you of your responsibility for safe handling when using, installing, operating and maintaining the equipment.

1.4 Cybersecurity information

Siemens provides products and solutions with industrial cybersecurity 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 cybersecurity concept. Siemens' products and solutions constitute one element of such a concept.

Customers are responsible for preventing unauthorized access to their plants, systems, machines and networks. Such systems, machines and components should only be connected to an enterprise network or the internet if and to the extent such a connection is necessary and only when appropriate security measures (e.g. firewalls and/or network segmentation) are in place.

For additional information on industrial cybersecurity measures that may be implemented, please visit
https://www.siemens.com/global/en/products/automation/topic-areas/industrial-cybersecurity.html.

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

To stay informed about product updates, subscribe to the Siemens Industrial Cybersecurity RSS Feed under
https://new.siemens.com/global/en/products/services/cert.html.

Further information is provided on the Internet:

Industrial Security Configuration Manual
(https://support.industry.siemens.com/cs/ww/en/view/108862708)

⚠WARNING

Unsafe operating states resulting from software manipulation

Software manipulations, e.g. viruses, Trojans, 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 state-of-the-art, integrated industrial cybersecurity concept for the installation or machine.
- Make sure that you include all installed products in the integrated industrial cybersecurity concept.
- Protect files stored on exchangeable storage media from malicious software by with suitable protection measures, e.g. virus scanners.
- Carefully check all cybersecurity-related settings once commissioning has been completed.

1.5 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 integrator 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 faults and/or software errors in the sensors, control system, actuators, 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 inside and outside the components, including open flames, as well as emissions of light, noise, particles, gases, etc. due to fault conditions, e.g.:
   - Component failure
   - Software errors
   - Operation and/or environmental conditions outside the specification
   - External influences/damage
   - Short circuits or ground faults in the intermediate DC circuit of the converter
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 and wireless communications systems, e.g. ripple-control transmitters or data communication via the network or mobile radio, WLAN or Bluetooth.
7. Motors for use in potentially explosive areas:

   When moving components such as bearings become worn, this can cause enclosure components to exhibit unexpectedly high temperatures during operation, creating a hazard in areas with a potentially explosive atmosphere.

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

Introduction

2

Overview

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

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

- 3 AC 400 V 22 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

Article numbers overview

400 V converters

400 V	Rated output power (kW)	Rated output current (A)	Variant	Article number	
Frame size	Based on Low Overload (LO)			Without filter	With filter
FSD	22	45	IP20	6SL3210-1RE24-5UL0	6SL3210-1RE24-5AL0
	30	60	IP20	6SL3210-1RE26-0UL0	6SL3210-1RE26-0AL0
	37	75	IP20	6SL3210-1RE27-5UL0	6SL3210-1RE27-5AL0
FSE	45	90	IP20	6SL3210-1RE28-8UL0	6SL3210-1RE28-8AL0
	55	110	IP20	6SL3210-1RE31-1UL0	6SL3210-1RE31-1AL0
FSF	75	145	IP20	6SL3210-1RE31-5UL0	6SL3210-1RE31-5AL0
	90	178	IP20	6SL3210-1RE31-8UL0	6SL3210-1RE31-8AL0
	110	205	IP20	6SL3210-1RE32-1UL0	6SL3210-1RE32-1AL0
	132	250	IP20	6SL3210-1RE32-5UL0	6SL3210-1RE32-5AL0

690 V converters

690 V	Rated output power (kW)	Rated output current (A)	Variant	Article number	
Frame size	Based on Low Overload (LO)			Without filter	With filter
FSD	11	14	IP20	6SL3210-1RH21-4UL0	6SL3210-1RH21-4AL0
	15	19	IP20	6SL3210-1RH22-0UL0	6SL3210-1RH22-0AL0
	18.5	23	IP20	6SL3210-1RH22-3UL0	6SL3210-1RH22-3AL0
	22	27	IP20	6SL3210-1RH22-7UL0	6SL3210-1RH22-7AL0
	30	35	IP20	6SL3210-1RH23-5UL0	6SL3210-1RH23-5AL0
	37	42	IP20	6SL3210-1RH24-2UL0	6SL3210-1RH24-2AL0
FSE	45	52	IP20	6SL3210-1RH25-2UL0	6SL3210-1RH25-2AL0
	55	62	IP20	6SL3210-1RH26-2UL0	6SL3210-1RH26-2AL0
FSF	75	80	IP20	6SL3210-1RH28-0UL0	6SL3210-1RH28-0AL0
	90	100	IP20	6SL3210-1RH31-0UL0	6SL3210-1RH31-0AL0
	110	115	IP20	6SL3210-1RH31-2UL0	6SL3210-1RH31-2AL0
	132	142	IP20	6SL3210-1RH31-4UL0	6SL3210-1RH31-4AL0

Control Units for the Power Modules

You can operate the Power Modules with a Control Unit from one of the following listed families from firmware version V4.7 SP6 HF1 and higher:

- CU230P-2
- CU230P-2 BT
- CU230P-2 HVAC
- CU240B-2
- CU240E-2
- CU250S-2

Further information about the available firmware versions is provided on the Internet:

FAQ (https://support.industry.siemens.com/cs/ww/en/view/67364620)

Note

Commissioning the converter

You must first commission the converter before you can use it. Commissioning is described in the operating instructions of the relevant Control Unit.

Manuals for your converter (Page 111)

STO independent of the Control Unit

The Power Modules are suitable for implementing the "Safe Torque Off" (STO) safety function corresponding to PL e according to EN 13849-1 and SIL 3 to IEC61508.

STO via Power Module terminals (Page 51)

Note that when using the STO function, the mission time of the converter is restricted. For more information, see the "Safety Integrated" Function Manual.

Manuals for your converter (Page 111)

Component specification according to UL

The components of the SINAMICS G120 product family are UL-certified. The certification is indicated on the products using the UL Listing Mark.

If the converter is protected using semiconductor fuses, then the fuses must be installed in the same electrical cabinet as the converter itself.

You can find proof of the certification on the Internet UL certificates (http://www.ul.com) under "Tools / Online Certifications Directory" by entering the file number or the "Name".

The UL file number for the Power Modules of the SINAMICS G120 product family is:

- E355661, Vol. 6 Sec. 4 for FSD, FSE and FSF

Permissible motors

Note

Motors for converter operation

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

Further information is provided on the Internet:

FAQ (https://support.industry.siemens.com/cs/ww/en/view/100426622)

Motors for 400 V Power Modules

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

Continuous development within the scope of product maintenance

Converter 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).

Intended use

The products described in this manual, together with software, accessories, and options, form an electrical power drive system intended to feed low-voltage AC motors.

The products are professional equipment for stationary indoor use in industrial, light-industrial, and commercial applications and are intended for supply from public and non-public (industrial) low-voltage distribution networks. The products are not intended for use in residential areas.

The products must be transported and stored properly and must be installed, commissioned, and maintained by professionals with sufficient knowledge to implement the safety and EMC measures according to the specifications described in this manual and the recognized state of the art.

You may only use the products in compliance with the following requirements:

- All regulations and directives that are applicable at the site of the end use, especially with regard to electrical safety, functional safety and electromagnetic compatibility.
- All instructions, notes, technical data and safety information contained in this document and other supporting documentation.

The products are used as a component of a machine or plant. You must ensure the safety of persons and property and the electromagnetic compatibility by appropriate system design measures.

You must perform a risk assessment of the entire application including third-party products and implement sufficient safety measures before using the product.

Open type products (IP00 / IP20) are intended for incorporation within control panels or cabinets which will provide necessary protection.

Any application not explicitly permitted is excluded from the warranty and can result in unanticipated hazards.

⚠WARNING

Death or severe personal injury due to unintended use

Applications outside the intended use can lead to dangerous conditions.

- Observe the above notes on intended use.

Note

The compliance with the EMC emission limits cannot be guaranteed if the products are connected to an isolated, or high-impedance earthed, or corner grounded distribution network.

- Create an EMC plan to meet the EMC requirements of the intended application.

Installing

3

3.1 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 at delivery status with the maximum cross section for the connected cables.
- You can find the permissible conductor cross-sections for the terminals in:

  Converter terminals (Page 49)
- 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 25)
- For a system configuration in conformance with IEC, use the fuse types approved for IEC, specified in the Technical data, or the circuit breakers under the following Internet address.
  - Fuse types: Technical data (Page 59)
  - Circuit breaker (https://support.industry.siemens.com/cs/ww/en/view/109750825)

Converters 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 59)
  -  Circuit breaker (https://support.industry.siemens.com/cs/ww/en/view/109750825)
- 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 converters provide internal motor protection corresponding to UL61800-5-1. The protection threshold is 115 % of the converter full load current. When commissioning, you can adapt the motor overload protection using parameter p0640.
- Use suitable UL-listed (ZMVV) ring lugs to connect the power terminals of frame size FSF.
- 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.

3.2 EMC-compliant installation of a machine or system

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

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

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

EMC zones

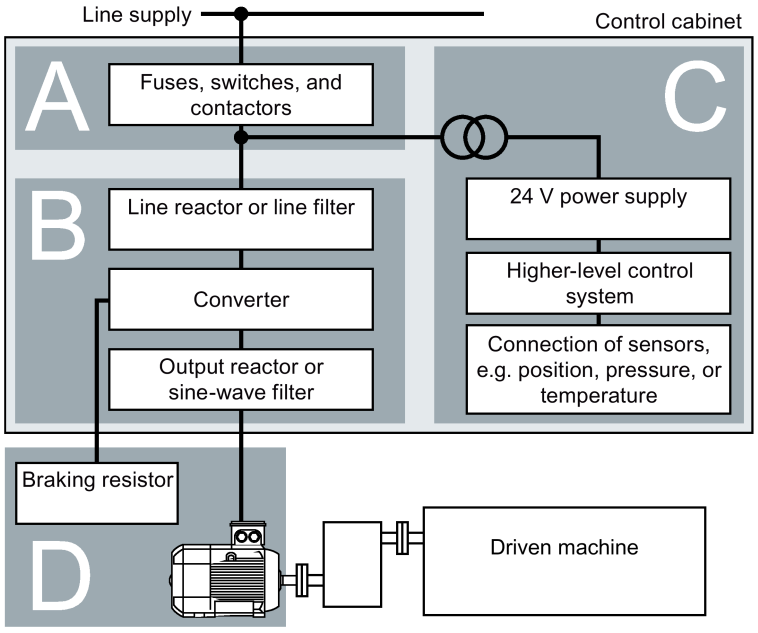


Figure 3-1 Example of the EMC zones of a plant or machine

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

3.2.1 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 ≥ 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 cm² for each contact location
  - Several screw connections
  - Short, finely stranded, braided copper wires with cross-sections ≥ 95 mm² / 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.

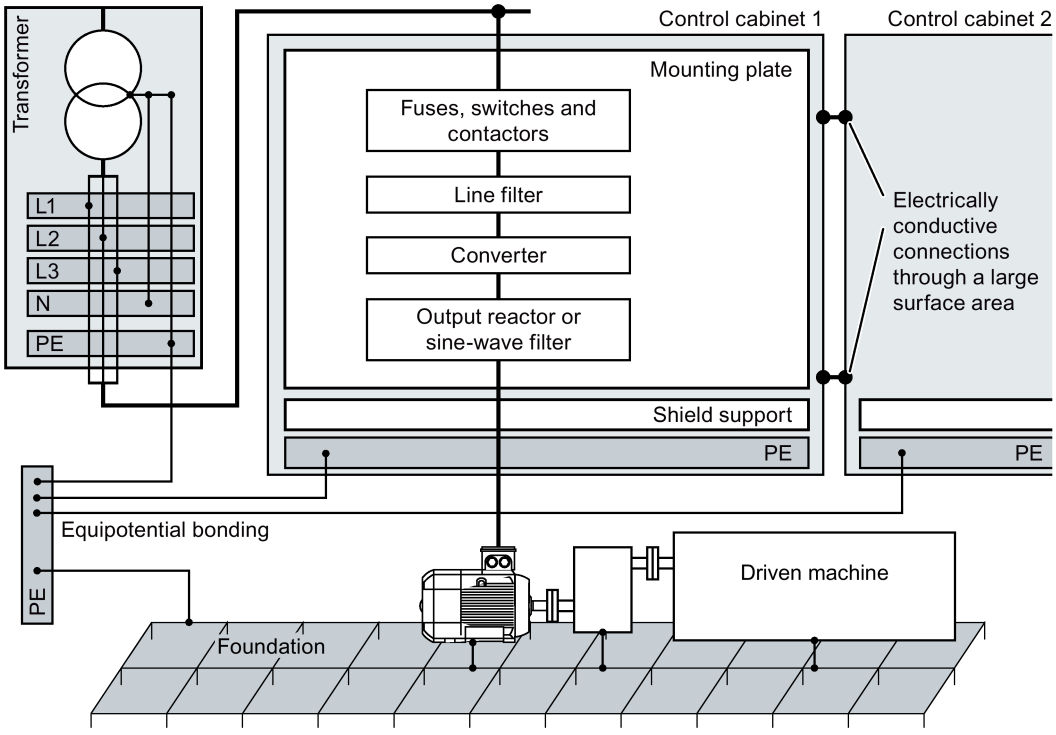


Figure 3-2 Grounding and high-frequency equipotential bonding measures in the control cabinet and in the plant/system

Further information

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

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

3.2.2 Cables

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

- Cables with a high level of interference:
  - Cable between the line filter and converter
  - Motor cable
  - Cable at the converter DC link connection
  - Cable between the converter 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.
- Use shielded cables for the following connections:
  - Cable between the converter and line filter
  - Cable between the converter and output reactor or sine-wave filter

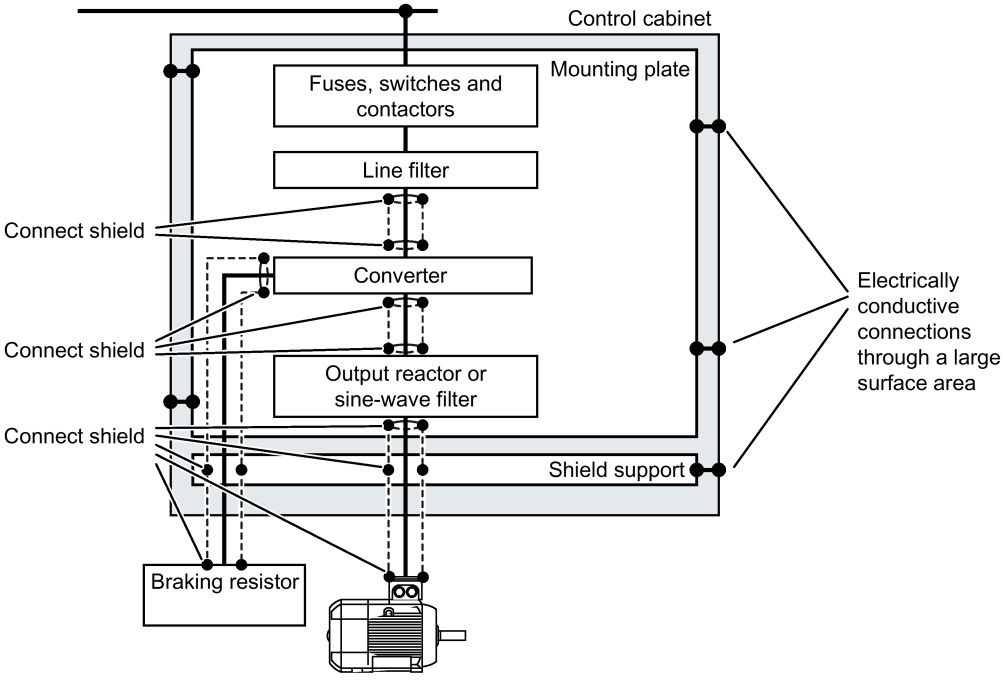


Figure 3-3 Routing converter cables inside and outside a control cabinet

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.
- Use shielded cables for the following connections:
  - Converter motor cable
  - Cable between the converter 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.

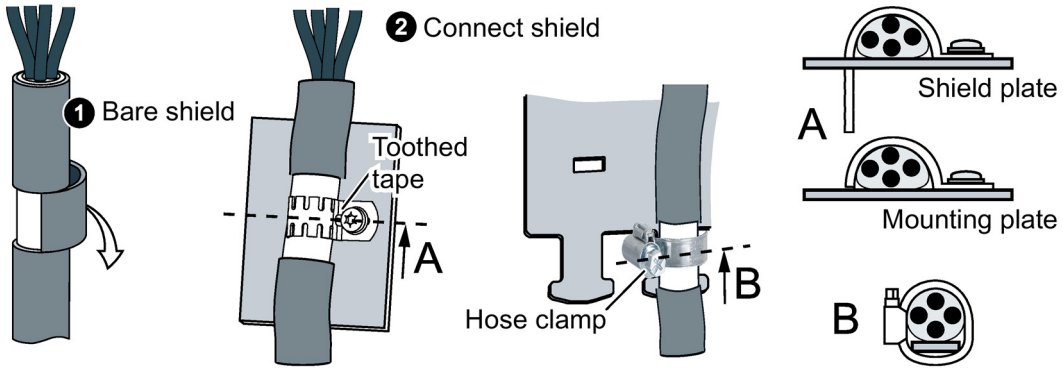


Figure 3-4 Examples for EMC-compliant shield support

- 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.

3.2.3 Electromechanical components

Surge voltage protection circuit

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

3.3 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.

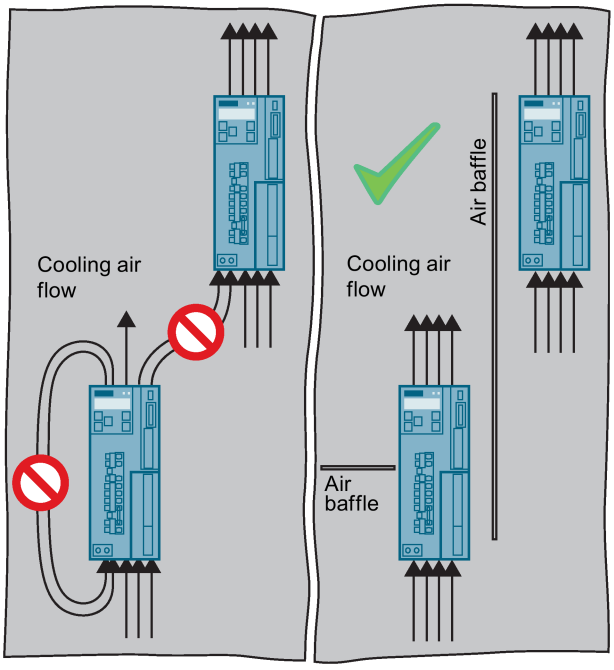
Formula for calculating the cooling airflow:

airflow [l/s] = power loss [W] * 0.86 / ΔT [K]

- Power loss: Total of the power losses of the individual components.
- Δ 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 59)".
  - 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

3.4 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

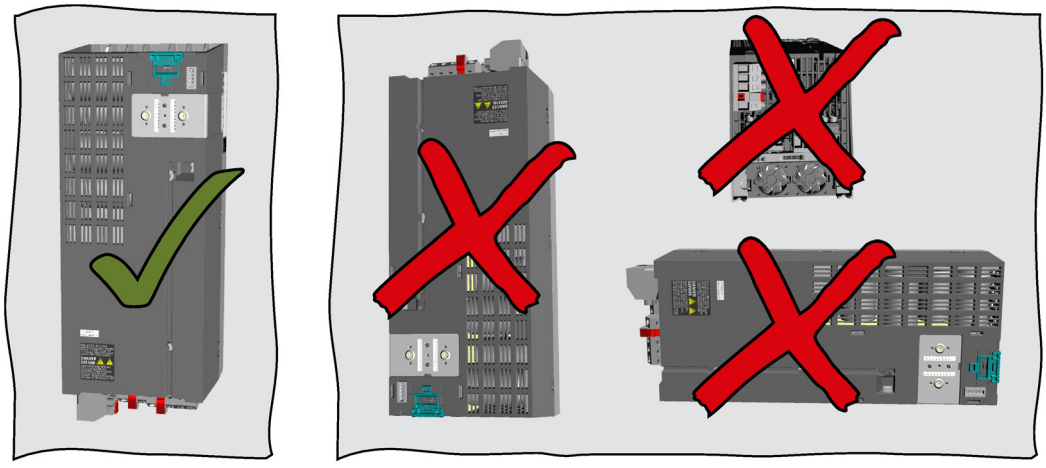
Protect the device, e.g. by installing it in a control cabinet with degree of protection IP54 according to IEC 60529 or NEMA 12. Further measures may be necessary for particularly critical operating conditions.

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

Installing

Rules for admissible mounting:

- Only mount the Power Module in a vertical position with the motor connectors at the bottom.



- Maintain the minimum clearances to other components.
- Use the specified installation parts and components.
- Comply with the specified torques.

3.4.1 Sequence for installing the Power Module

During installation, comply with the sequence listed below.

1. Prepare the cabinet.
2. If you are using a Brake Relay or Safe Brake Relay:
   Install the Brake Relay on the rear side of the shield plate.
3. Mount the shield plates.
4. Install the Power Module.

3.4.2 Dimension drawings and drilling dimensions

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

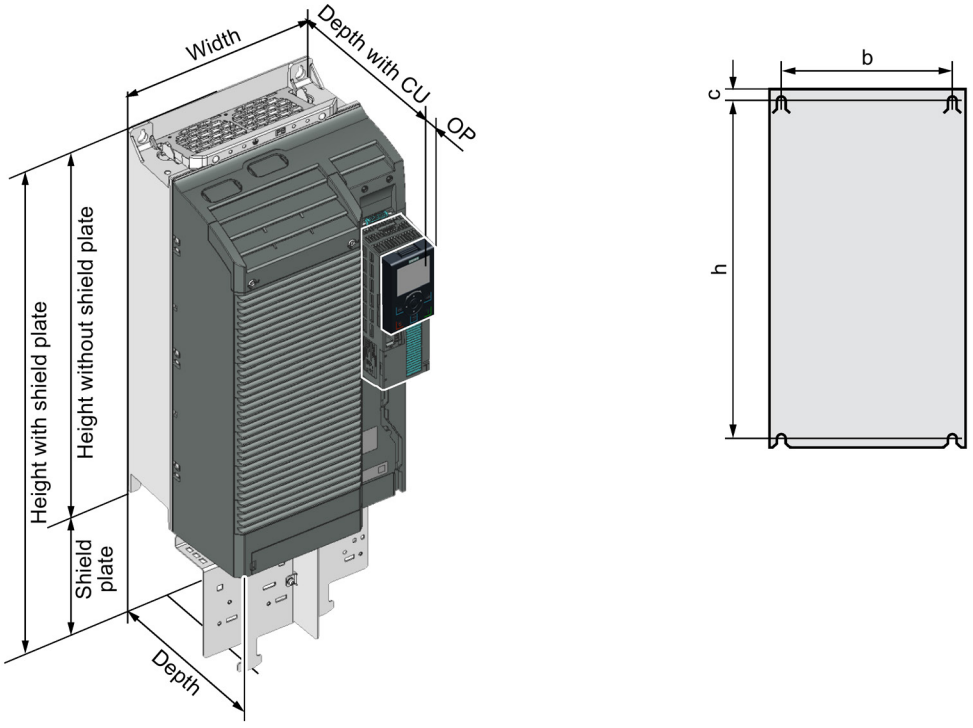


Table 3- 1 Dimensions depend on the Control Unit (CU) and HMI device [mm]

Frame size	Width [mm]	Height [mm]		Depth [mm]		
		without shield plate	with shield plate	without CU	with CU230P-2 [1]	with CU240B-2 [1] / CU240E-2 [1]
FSD	200	472	624	237	253	237
FSE	275	551	728	237	253	237
FSF	305	709	966	357	373	357

[1] With SINAMICS G120 Smart Access plus 9 mm; with blanking cover or with Operator Panel plus 11 mm

Table 3- 2 Drilling dimensions, cooling air clearances and fixing

Frame size	Drilling dimensions [mm]			Cooling air clearances [mm] [1]			Fixing / torque [Nm]
	h	b	c	Top	Bottom	Front	
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

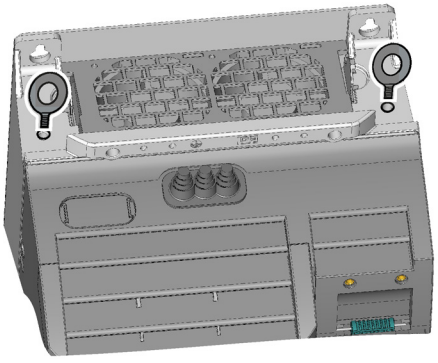
[1] The Power Module is designed for mounting without any lateral cooling air clearance. For tolerance reasons, however, we recommend a lateral clearance of approx. 1 mm

3.4.3 Hoisting gear

Use crane lifting lugs and the appropriate hoisting gear when mounting built-in devices.

Power Module weights:

Technical data (Page 59)



3.4.4 Mounting the shield plate and EMC connecting bracket

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

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

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 converter.

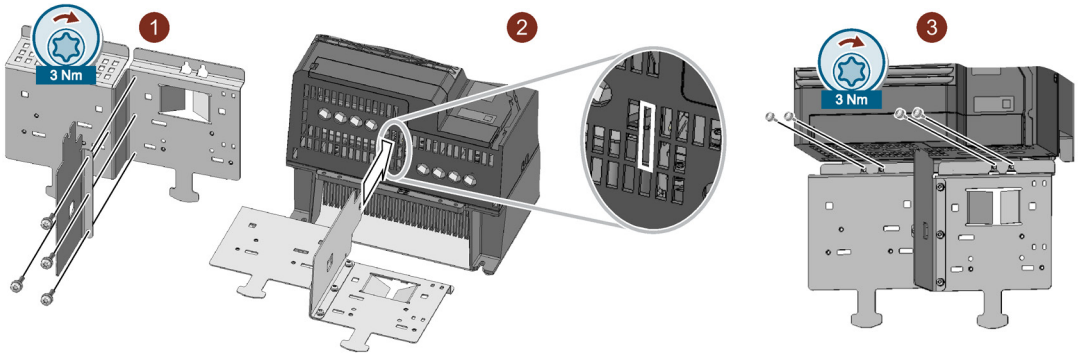
Motor holding brake (Page 88)

FSD and FSE

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

Procedure

1. Attach the EMC connecting bracket to the shield plate ①.
2. Then slide the shield module into the converter, so that it is held in the converter ② by the clamping spring. The shield module is located correctly if it can be easily withdrawn out of the converter without any resistance.
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.

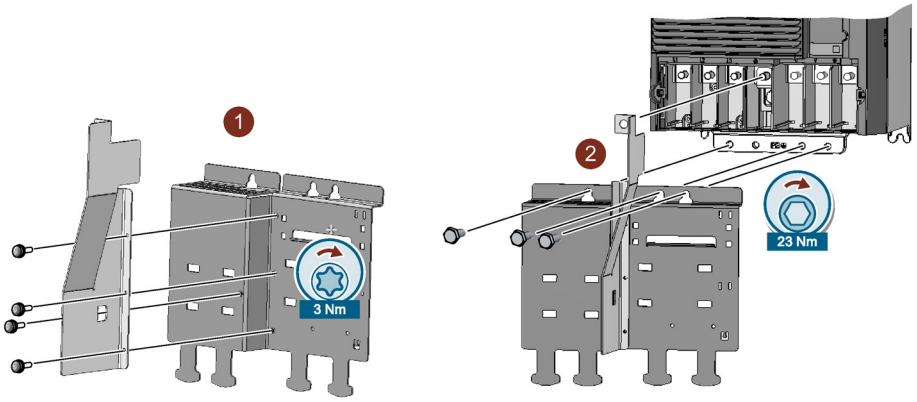
❒

FSF

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

Procedure

1. Attach the EMC connecting bracket to the shield plate ①.
2. Screw the shield module to the converter ② using three screws, as shown in the diagram.



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

❒

3.5 Supplementary 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 47)

 Optional accessories (Page 88)

Connecting

4

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

Note

Safety devices

Install suitable protective equipment between the line supply and converter.

Technical data (Page 59)

Note

Operating displays for converter 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.

Observe the following product note about protection against indirect contact:

To protect against indirectly touching part of the motor circuit of a converter 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

Electrical shock due to inadequate touch protection

Due to faulty contact protection, the power connections of the converter may be openly accessible. Touching live power connections can result in death or severe injury.

- Make the openings for the converter power connections 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 for unused terminals.

WARNING

Fire or electric shock due to unsuitable residual-current protective devices

The converter may create a current through the protective conductor. The current through the protective conductor can cause the residual current device (RCD) or residual current monitor (RCM) to incorrectly trip (nuisance trip). In the case of a ground fault, the fault current can contain a DC component, which prevents the RCD or RCM from tripping, with the risk of subsequent fire or electric shock.

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

⚠CAUTION

Burns due to touching hot surfaces

Certain components (e.g. the heat sink or line reactor) can become very hot during operation. The components can remain hot for some time after operation. Touching hot surfaces can cause burns to the skin.

- Do not touch hot components during operation or immediately following operation.

Protection and monitoring equipment

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

If the earth fault loop impedance of the line supply at the infeed point is too high to ensure that the overcurrent protective device disconnects within the stipulated time in the case of insulation failure (ground fault, fault to frame), then you must use additional residual current protective devices RCD, 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 converters with rated input currents ≤ 80 A referred to LO, use a Siemens SIQUENCE RCCB (series 5SV364.-4), type B, short-time delayed [K] with a rated residual current of 300 mA. Connect the RCCB in series with the overcurrent protective devices.
- For converters with rated input currents ≤ 160 A referred to LO, use a Siemens residual current device RCD520B (3VA9113-0RL21) mounted onto a Siemens molded case circuit breaker (series 3VA1).

  Recommended settings:

  - Response characteristic B
  - Residual current trip level 300 mA
  - Response delay ≥ 0.06 s

- For converters with rated input currents > 160 A referred to LO, use a Siemens modular RCCB device (MRCD type B 5SV8111-4KK) with a current transformer (5SV870.-2K), a circuit breaker (series 3VA1) and a trip element (3VA9988-0BL30).

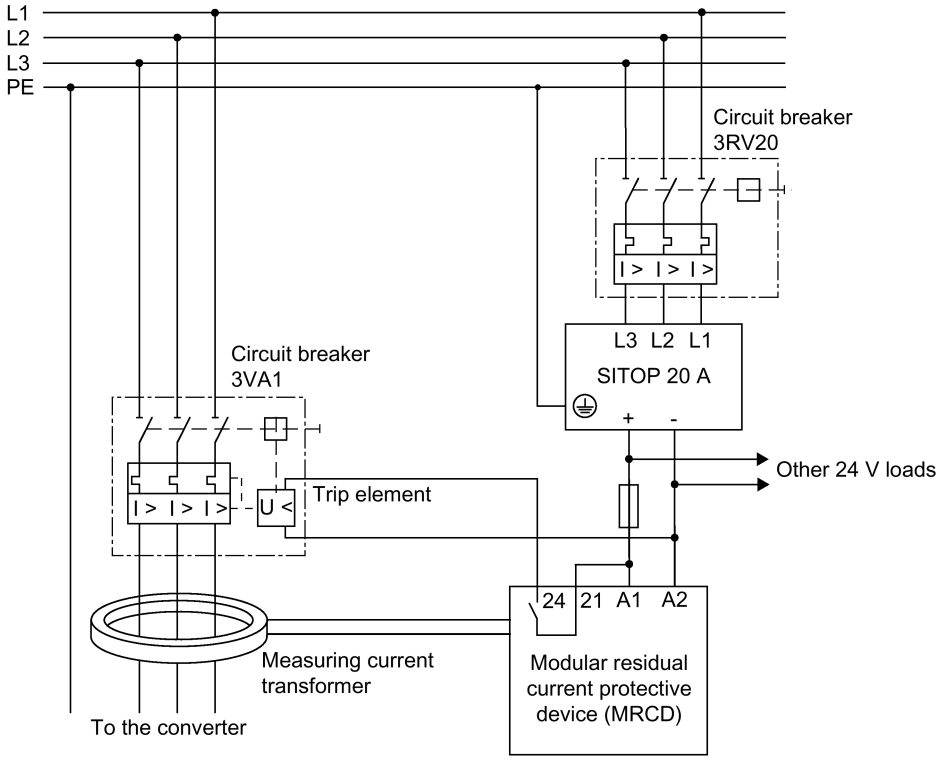


Figure 4-1 MRCD

- A dedicated RCD is used for every converter.
- 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 48)

4.1 Permissible line supplies

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

- TN system
- TT system
- IT system

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 76)

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 converter when operated with its rated values is less than 4% of the transformer rated current

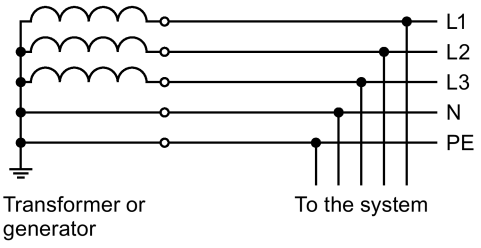
4.1.1 TN line system

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

Generally, in a TN 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 system can transfer the neutral conductor N and the PE protective conductor either separately or combined.

Example: Separate transfer of N and PE, grounded neutral point



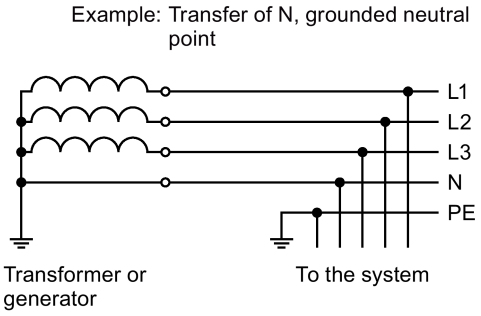
Converter connected to a TN system

- Converters with integrated line filter:
  - Operation on TN line systems with grounded neutral point permissible.
  - Operation on TN line systems with grounded line conductor not permissible.
- Converters with external line filter:
  - Operation on TN line systems with grounded neutral point permissible.
  - Operation on TN line systems with grounded line conductor not permissible.
- Converter without line filter:
  - Operation on all TN line systems ≤ 600 V permissible.
  - Operation on TN line systems (> 600 V and ≤ 690 V) and grounded neutral point permissible; applicable only to 690 V converters.
  - Operation on TN line systems > 600 V and grounded line conductor not permissible.

4.1.2 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.



Note

Operation in IEC or UL systems

For installations in compliance with IEC, operation on TT line systems is permissible. For installations in compliance with UL, operation on TT line systems is not permissible.

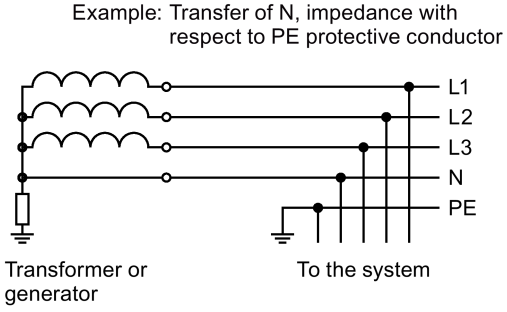
Operating converter on a TT line system

- Converter 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.
- Converter without line filter:
  - Operation on all TT line systems ≤ 600 V permissible.
  - Operation on TT line systems (> 600 V and ≤ 690 V) and grounded neutral point permissible; applicable only to 690 V converters.
  - Operation on TT line systems > 600 V and grounded line conductor not permissible.

4.1.3 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.



Note

Behavior of the converter when a ground fault occurs

If the converter is to remain operable even when a ground fault occurs at the converter output, you must install an output reactor. This prevents an overcurrent trip or damage to the drive.

Converter connected to an IT system

- Converters with integrated line filter:
  - Operation on IT line systems not permissible.
- Converter without line filter:
  - Operation on all IT line systems permissible.

Note

690 V converters: Output reactors for frame sizes FSD and FSE

An output reactor is required for 690 V converters in frame sizes FSD and FSE.

4.1.4 Requirements for the protective conductor

Overview

A high leakage current flows through the protective conductor in converter operation. The protective conductor of the converter must not be interrupted for safe touch protection in converter operation.

This primarily results in requirements for the minimum conductor cross-section of the protective conductor.

No restriction applies to the length of the protective conductor for touch protection.
However, short protective conductors are advantageous for EMC-compliant installation.

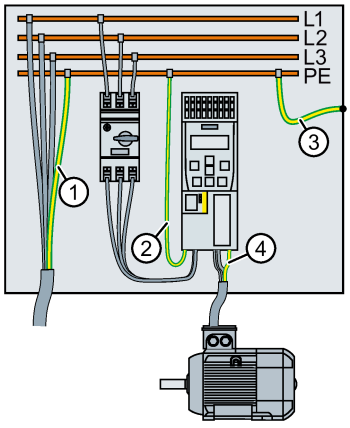
Description

WARNING

Electric shock due to 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.

- Comply with the requirements for the protective conductor.



① Protective conductor for line feeder cables
② Protective conductor for converter line feeder cables
③ Protective conductor between PE and the control 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 ≤ 16 mm^2

  ⇒ Minimum cross-section of the protective conductor = cross-section of the line or motor feeder cable

- 16 mm^2 < line or motor feeder cable ≤ 35 mm^2

  ⇒ Minimum cross-section of the protective conductor = 16 mm^2

- Line or motor feeder cable > 35 mm^2

  ⇒ Minimum cross-section of the protective conductor = ½ cross-section of the line or motor feeder cable

Additional requirements placed on the protective conductor ① according to IEC 60204-1:

- 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 switch 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 ≥ 2.5 mm² Cu.
  - For an individual conductor, the protective conductor has a cross-section ≥ 10 mm² Cu.
  - The protective conductor consists of 2 individual 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 ≥ 2.5 mm² Cu.
- Observe the local regulations for protective conductors subject to a high leakage current at the installation site.

4.1.5 Fault protection for the motor circuit

Description

The converter provides short-circuit protection at the motor output terminals.

The manufacturer's declaration describes the conditions regarding protection against electric shock in the event of an insulation failure in the motor circuit.

More information

You can find more information on the Internet: Manufacturer's declaration (https://support.industry.siemens.com/cs/cn/en/view/109476638)

4.2 Connecting the line and motor cable at the converter

4.2.1 Connection overview

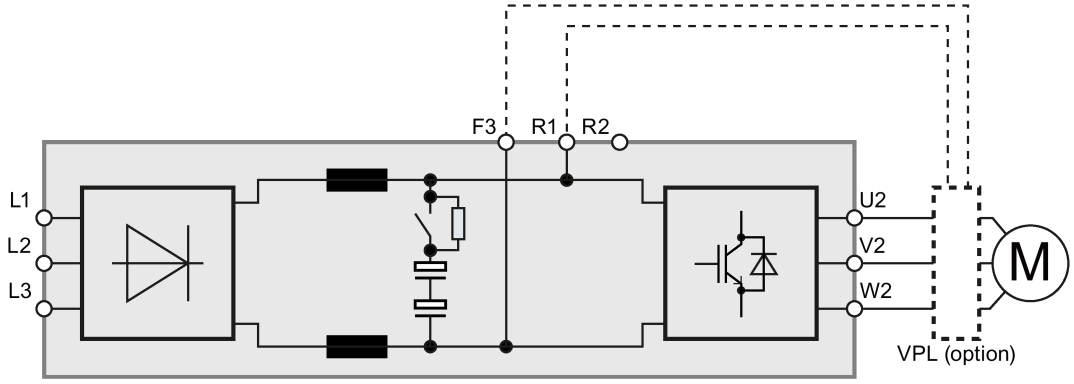


Figure 4-2 Block diagram PM240P-2

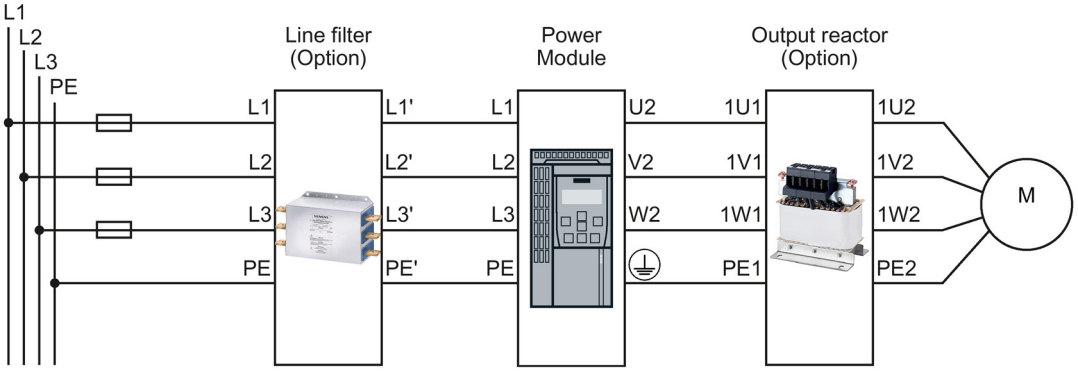


Figure 4-3 Connection overview

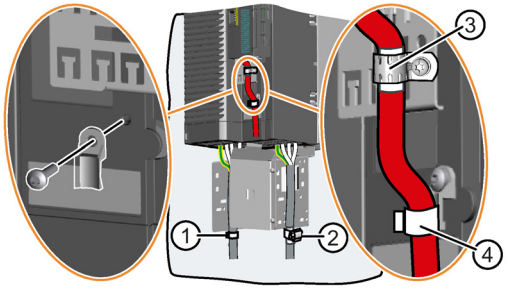
Connect cables at the converter so that they are EMC compliant

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).



4.2.2 Length of the motor cable

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

The permissible length of the motor cable also depends on the quality of the motor cable and the converter 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.

Technical data (Page 59)

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 converter complies with the EMC category listed in the following table.

EMC-compliant installation of a machine or system (Page 25)

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

Electromagnetic compatibility of variable-speed drives (Page 80)

Table 4- 1 Permissible length of motor connecting cables

Converter	**Converter with filter, category C2**		**Converter without filter**			
	EMC category		**No EMC category**			
	Second environment, C2	**Second environment, C3**	**without output reactor**		**with two output reactors in series**	
	Shielded	**Shielded**	**Shielded**	**Unshielded**	**Shielded**	**Unshielded**
Frame sizes FSD/FSE						
400 V	150 m	150 m	200 m	300 m	350 m	525 m
690 V	100 m	100 m	200 m	300 m	350 m	525 m
Frame size FSF						
400 V	150 m	150 m	300 m	450 m	525 m	800 m
690 V	---	150 m	300 m	450 m	525 m	800 m

4.2.3 Converter terminals

Table 4- 2 Connection, cross-section and tightening torque for PM240P-2 Power Modules

Converter	Connection		Cross-section, tightening torque		Stripped insulation length
			Metric	Imperial	
FSD	Line supply, motor	Screw-type terminal	10 ... 35 mm², 2.5 ... 4.5 Nm	8 ... 2 AWG, 22 ... 40 lbf in	18 mm
FSE			25 ... 95 mm², 8 ... 10 Nm	4 ... 3/0 AWG, 71 ... 88.5 lbf in	25 mm
FSF	Line supply, motor	 Cable lug according to SN71322	35 ... 2 × 120 mm², 22 ... 25 Nm	2 ... 2 × 4/0 AWG, 195 ... 221 lbf in	--

Procedure

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.

You have established the connections.

❒

Connections, frame sizes FSD ... FSF

You must remove the covers from the connections in order to connect the line supply and motor cables to the converter.

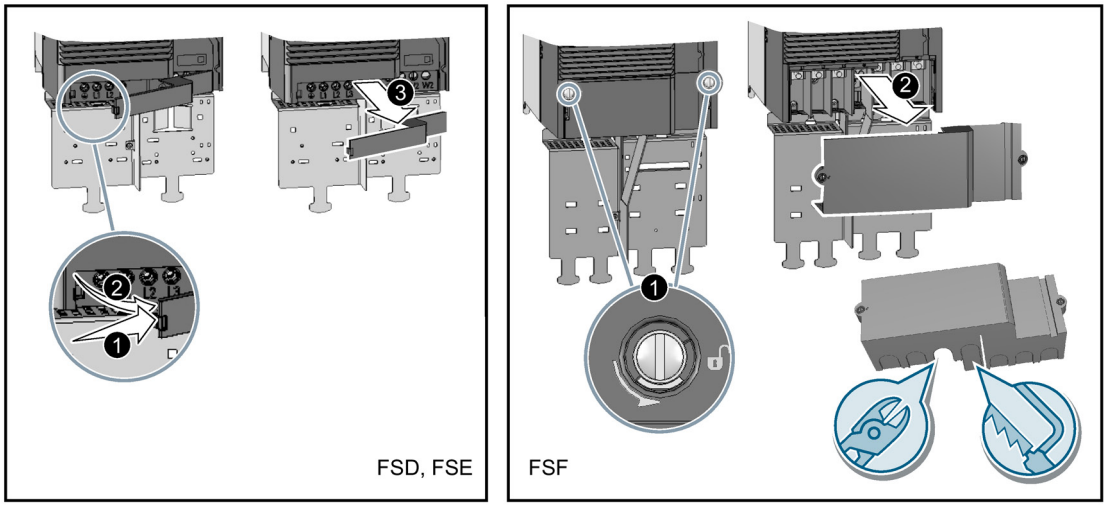


Figure 4-4 Remove the connection covers

In addition, for frame sizes FSD and FSE, release the two terminal screws on the connections for the motor 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.

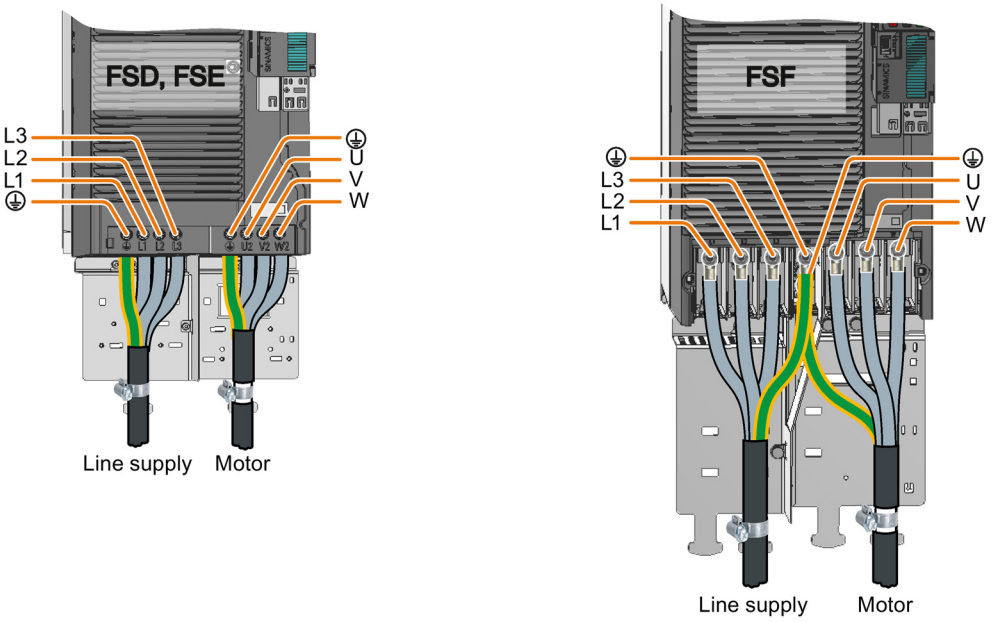


Figure 4-5 Line and motor connections

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

4.3 STO via Power Module terminals

Description

The "Safe Torque Off" (STO) safety function can be implemented via terminals on the power modules of frame sizes FSD ... FSF.

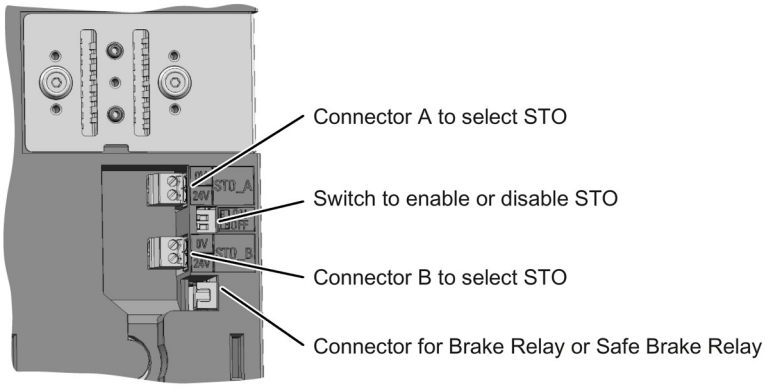


Figure 4-6 Terminals and switches for the "STO via power module terminals" function

The two switches have the following function:

- Both switches = ON: STO is enabled
- Both switches = OFF: STO is locked
- Two switches different: not permissible

Terminals STO_A and STO_B are low active.

Connect line to select STO

Use a SELV or PELV power supply with 24 V DC (20.4 V ... 28.8 V, maximum 60 V briefly) for the STO_A and STO_B connections.

Use a shielded cable with the following properties:

- Length ≤30 m
- Cross section 0.5 mm^2 ... + 1.5 mm^2 (20 ... 16 AWG)
- Insulated for 600 V

Use conductor end sleeves, stripped length 7 mm.

Procedure

1. Connect the cable to select STO at terminals STO_A and STO_B on the front of the power module.
2. Tighten the screws of the terminals with a torque of 0.2 Nm (2 lbf in).
3. Attach the shield to the shield plate of the Control Unit through the largest possible surface area.

You have connected the STO terminals.
❒

Note

Configuring a safety function

In order to use the "STO via power module terminals" safety function, the function has to be configured with a commissioning tool.

Further information and wiring examples are to be found in the "Safety Integrated" Function Manual.

Manuals for your converter (Page 111)

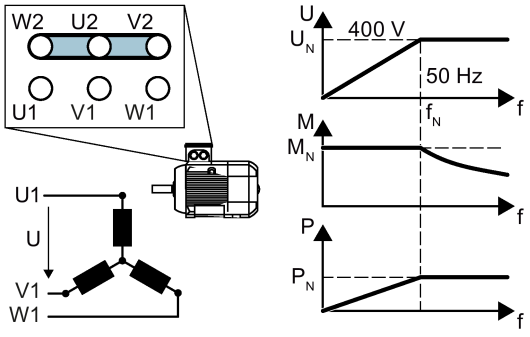
4.4 Connecting the motor to the converter in a star or delta connection

Overview

Standard induction motors up to a rated power of approximately 3 kW are usually connected in star/delta connection (Y/Δ) at 400 V/230 V. For a 400-V line supply, you can connect the motor to the converter either in a star or in a delta connection.

Function description

Operating the motor in a star connection

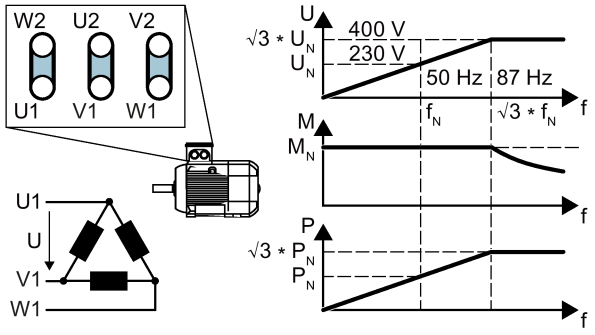


In a star connection, the motor can provide its rated torque M_N in the range 0 ... rated frequency f_N.

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 proportionally 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 √3 ≈ 1.73.

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

The maximum voltage U = 400 V is available at a frequency of f = √3 × 50 Hz ≈ 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 converter must supply approximately 1.73x current. Select a converter based on its rated current - and not its rated power.
- The motor temperature increases more significantly than when operated with f ≤ 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 ≤ 50 Hz.

Further information

You can find more information on the Internet:

- Operating motors at higher frequencies (https://support.industry.siemens.com/cs/ww/en/view/25338130)
- Parameterizing the 87 Hz characteristic (https://support.industry.siemens.com/cs/ww/en/view/88963613)

Service and maintenance

5

⚠WARNING

Fire or electric shock due to defective components

If an overcurrent protection device is triggered, the converter may be defective. A defective converter can cause a fire or electric shock.

- Have the converter and the overcurrent protection device checked by a specialist.

Repair

⚠WARNING

Fire or electric shock due to improper repair

Improper repair of the converter may cause malfunctions or result in consequential damage such as fire or electric shock.

- Only commission the following persons to repair the converter:
  - Siemens customer service
  - A repair center that has been authorized by Siemens
  - Specialist personnel who are thoroughly acquainted with all the warnings and operating procedures contained in this manual.
- Only use original spare parts when carrying out repairs.

Recycling and disposal

For environmentally-friendly recycling and disposal of your old device, please contact a company certified for the disposal of waste electrical and electronic equipment, and dispose of the old device as prescribed in the respective country of use.

5.1 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 57)

Cleaning

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

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.

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.

5.2 Replacing a fan

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 converter is ready for operation.

Applies to all frame sizes

Proceed as follows to remove the fan unit:

Switch off the converter power supply before replacing the fan.

⚠WARNING

Electric shock as a result of a residual charge in power components

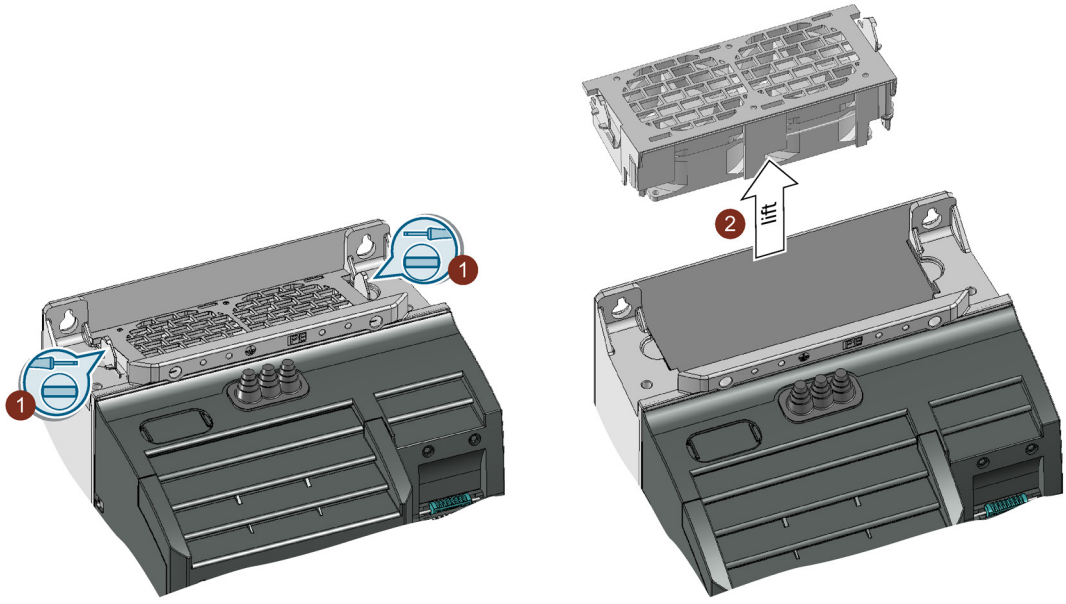
After the power supply has been switched off, it takes up to 5 minutes until the capacitors in the converter have discharged so that the residual charge is at a non-hazardous level.

- Check the voltage at the converter connections before you carry out any installation work.

The fan module is installed at the top.

Procedure

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



2. Install the new fan module in inverse sequence.
   By inserting the fan module, you establish the electrical connection between the converter and fan module.

You have replaced the fan module.

❒

Technical data

6

Note

Power loss of the 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.

Protective devices 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/109750825)

6.1 Electromagnetic compatibility - overview

Electromagnetic compatibility according to EN61800-3

Property	Version	
Interference immunity	The converters are suitable for use in the first and second industrial environments	
Interference emission - second environment	Category C2	for converters with integrated radio interference suppression filter
	Category C2	for converters 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 690-V converters with integrated radio interference suppression filter, frame size FSF
	Category C4	for converters without integrated radio interference suppression filter for operation on IT line supplies

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

Electromagnetic compatibility of variable-speed drives (Page 80).

6.2 Ambient conditions

Property	Version
Ambient conditions for transport in the transport packaging	
Climatic ambient conditions	- 40 °C ... + 70 °C, according to Class 2K4 to EN 60721-3-2:1997 maximum humidity 95% at 40 °C
Mechanical ambient conditions	Shocks and vibrations permissible according to 2M3 to IEC 60721-3-2:1997
Protection against chemical substances	Protected according to Class 2C2 to IEC 60721-3-2:1997
Biological environmental conditions	Suitable according to Class 2B1 to IEC 60721-3-2:1997
Ambient conditions for long-term storage in the transport packaging	
Climatic ambient conditions	- 25 °C ... + 55 °C, according to Class 1K4 to IEC 60721-3-1:1997
Protection against chemical substances	Protected according to Class 1C2 to IEC 60721-3-1:1997
Biological environmental conditions	Suitable according to Class 1B1 to IEC 60721-3-1:1997
Ambient conditions in operation	
Installation altitude	Up to 1000 m above sea level without derating, > 1000 m  Restrictions for special ambient conditions (Page 76)
Climatic ambient conditions [1]	• Frame sizes FSD ... FSF temperature range [2] – in operation acc. to LO: -20 °C ... +40 °C – in operation acc. to HO: -20 °C ... +50 °C – for higher temperatures  Restrictions for special ambient conditions (Page 76) • Relative humidity: 5 ... 95%, condensation not permitted • Oil mist, ice formation, condensation, dripping water, spraying water, splashing water and water jets are not permitted
Mechanical ambient conditions	• Vibration levels permissible according to Class 3M1 to EN 60721-3-3:2002 • Shocks permissible according to Class 3M1 to EN 60721-3-3:2002
Protection against chemical substances	Protected according to 3C2 to IEC 60721-3-3:2002
Biological environmental conditions	Suitable according to 3B1 to IEC 60721-3-3: 2002
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 IEC 60721-3-3: 2002

[2] Observe the permissible ambient temperatures for the Control Unit and possibly the operator panel (IOP-2 or BOP-2).

6.3 Overload capability of the converter

Overload capability is the property of the converter 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 using the "SIZER" engineering software to select the converter.

You can 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 furnaces
- Extruders

"High Overload" load cycle

The "High Overload" load cycle permits dynamic accelerating phases at a reduced base load. 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 converter load cycles

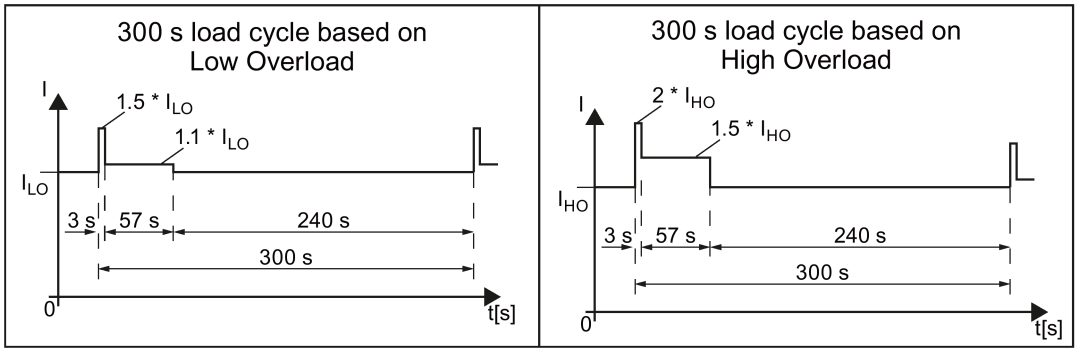


Figure 6-1 "Low Overload" and "High Overload" load cycles

6.4 Data regarding the power loss in partial load operation

You can find data regarding power loss in partial load operation on the Internet:

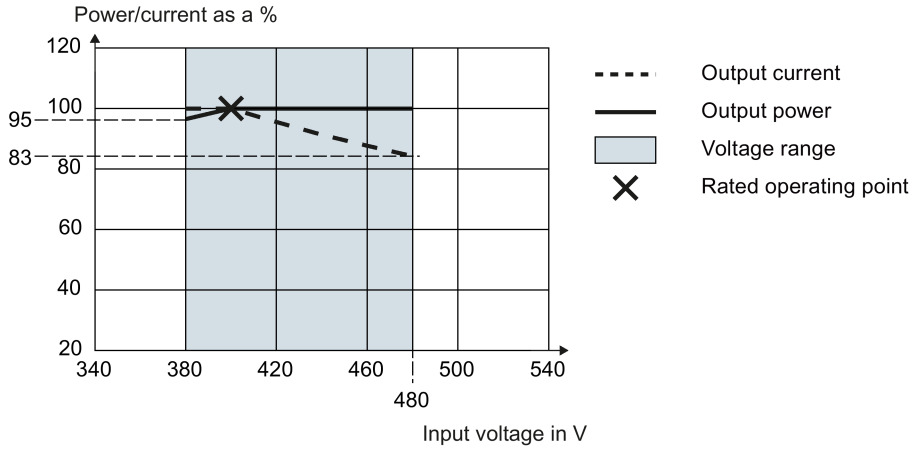
Partial load operation (https://support.industry.siemens.com/cs/ww/en/view/94059311)

6.5 400 V converters

6.5.1 General data, 400 V converters

Property	Version
Line voltage	3 AC 380 V ... 480 V ± 10% (in operation -20% < 1 min)
Line system configurations	Grounded TN/TT line systems or non-grounded IT line systems
Line impedance	Uk < 4%, line reactor is not required
Power factor λ	> 0.9
Output voltage	3 AC 0 V ... 0.95 x input voltage (max.)
Input frequency	50 Hz ... 60 Hz, ± 3 Hz
Output frequency	0 Hz ... 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 • 4 kHz for devices with an LO base load power < 75 kW • 2 kHz for devices with an LO base load power ≥ 75 kW Can be adjusted in 2 kHz steps as follows: • 2 kHz ... 16 kHz for devices with an LO base load power < 55 kW • 2 kHz ... 8 kHz for devices with an LO base load power ≥ 55 kW • 2 kHz ... 4 kHz for devices with an LO base load power 55 kW ... 132 kW If you increase the pulse frequency, the converter reduces the maximum output current.
Short-circuit current rating (SCCR) and branch protection	≤ 100 kA rms Branch protection and short-circuit strength according to UL and IEC (https://support.industry.siemens.com/cs/ww/en/view/109750825)
Braking methods	DC braking, compound braking
Degree of protection according to EN 60529	IP20 Must be installed in a control cabinet
Protection class according to EN 61800-5-1	The converters 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

Current and power limiting depending on the line voltage



6.5.2 Specific data, 400 V converters

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

You can find additional suitable fuses on the Internet:

Branch protection and short-circuit strength according to UL and IEC (https://support.industry.siemens.com/cs/ww/en/view/109479152)

Table 6- 1 PM240P-2, IP20, Frame Size D, 3-ph. AC 380 V ... 480 V

Article number without filter **Article number with filter**	**6SL3210-1RE24-5UL0** **6SL3210-1RE24-5AL0**	**6SL3210-1RE26-0UL0** **6SL3210-1RE26-0AL0**	**6SL3210-1RE27-5UL0** **6SL3210-1RE27-5AL0**
LO base load power	22 kW	30 kW	37 kW
LO base load input current	42 A	57 A	70 A
LO base load output current	45 A	60 A	75 A
HO base load power	18.5 kW	22 kW	30 kW
HO base load input current	38 A	47 A	62 A
HO base load output current	38 A	45 A	60 A
Siemens fuse according to IEC/UL Fuse according to IEC/UL, Class J	3NE1820-0 / 80 A 70 A	3NE1021-0 / 100 A 90 A	3NE1021-0 / 100 A 100 A
Power loss without filter	0.68 kW	0.76 kW	1.01 kW
Power loss with filter	0.68 kW	0.77 kW	1.02 kW
Required cooling air flow	55 l/s	55 l/s	55 l/s
Weight without filter	16.6 kg	18.3 kg	18.3 kg
Weight with filter	18.3 kg	19 kg	19 kg

Table 6- 2 PM240P-2, IP20, Frame Size E, 3-ph. AC 380 V ... 480 V

Article number without filter **Article number with filter**	**6SL3210-1RE28-8UL0** **6SL3210-1RE28-8AL0**	**6SL3210-1RE31-1UL0** **6SL3210-1RE31-1AL0**
LO base load power	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 power	37 kW	45 kW
HO base load input current	78 A	94 A
HO base load output current	75 A	90 A
Siemens fuse according to IEC/UL Fuse according to IEC/UL, Class J	3NE1022-0 / 125 A 125 A	3NE1224-0 / 160 A 150 A
Power loss without filter	1.19 kW	1.54 kW
Power loss with filter	1.2 kW	1.55 kW
Required cooling air flow	83 l/s	83 l/s
Weight without filter	26.4 kg	26.4 kg
Weight with filter	28.4 kg	28.4 kg

Table 6- 3 PM240P-2, IP20, Frame Size F, 3-ph. AC 380 V ... 480 V

Article number without filter **Article number with filter**	**6SL3210-1RE31-5UL0** **6SL3210-1RE31-5AL0**	**6SL3210-1RE31-8UL0** **6SL3210-1RE31-8AL0**	**6SL3210-1RE32-1UL0** **6SL3210-1RE32-1AL0**
LO base load power	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 power	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
Siemens fuse according to IEC/UL Fuse according to IEC/UL, Class J	3NE1225-0 / 200 A 200 A	3NE1227-0 / 250 A 250 A	3NE1230-0 / 315 A 300 A
Power loss without filter	1.95 kW	2.54 kW	2.36 kW
Power loss with filter	1.97 kW	2.56 kW	2.38 kW
Required cooling air flow	153 l/s	153 l/s	153 l/s
Weight without filter	58 kg	58 kg	62 kg
Weight with filter	64 kg	64 kg	66 kg

Table 6- 4 PM240P-2, IP20, Frame Size F, 3-ph. AC 380 V ... 480 V

Article number without filter **Article number with filter**	**6SL3210-1RE32-5UL0** **6SL3210-1RE32-5AL0**
LO base load power	132 kW
LO base load input current	242 A
LO base load output current	250 A
HO base load power	110 kW
HO base load input current	218 A
HO base load output current	205 A
Siemens fuse according to IEC/UL Fuse according to IEC/UL, Class J	3NE1331-0 / 350 A 350 A
Power loss without filter	3.09 kW
Power loss with filter	3.12 kW
Required cooling air flow	153 l/s
Weight without filter	62 kg
Weight with filter	66 kg

6.5.3 Current derating depending on the pulse frequency, 400 V converters

LO base load

Article number	LO power [kW]	LO base load output current [A]							
Pulse frequency [kHz]		**2**	**4** *)	**6**	**8**	**10**	**12**	**14**	**16**
6SL3210-1RE24-5 . L0	22	45	**45**	38.3	31.5	27	22.5	20.3	18
6SL3210-1RE26-0 . L0	30	60	**60**	51	42	36	30	27	24
6SL3210-1RE27-5 . L0	37	75	**75**	63.8	52.5	45	37.5	33.8	30
6SL3210-1RE28-8 . L0	45	90	**90**	76.5	63	54	45	40.5	36
6SL3210-1RE31-1 . L0	55	110	**110**	93.5	77	---	---	---	---
Pulse frequency [kHz]		**2** *)	**4**	**6**	**8**	**10**	**12**	**14**	**16**
6SL3210-1RE31-5 . L0	75	**145**	145	123.3	101.5	---	---	---	---
6SL3210-1RE31-8 . L0	90	**178**	178	151.3	124.6	---	---	---	---
6SL3210-1RE32-1 . L0	110	**205**	143.5	---	---	---	---	---	---
6SL3210-1RE32-5 . L0	132	**250**	175	---	---	---	---	---	---

*) Factory setting

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

HO base load

Article number	HO power [kW]	HO base load output current [A]							
Pulse frequency [kHz]		**2**	**4** *)	**6**	**8**	**10**	**12**	**14**	**16**
6SL3210-1RE24-5 . L0	18.5	38	**38**	32.3	26.6	22.8	19	17.1	15.2
6SL3210-1RE26-0 . L0	22	45	**45**	38.3	31.5	27	22.5	20.3	18
6SL3210-1RE27-5 . L0	30	60	**60**	51	42	36	30	27	24
6SL3210-1RE28-8 . L0	37	75	**75**	63.8	52.5	45	37.5	33.8	30
6SL3210-1RE31-1 . L0	45	90	**90**	76.5	63	54	45	40.5	36
Pulse frequency [kHz]		**2** *)	**4**	**6**	**8**	**10**	**12**	**14**	**16**
6SL3210-1RE31-5 . L0	55	110	**110**	93.5	77	---	---	---	---
6SL3210-1RE31-8 . L0	75	**145**	145	123.3	101.5	---	---	---	---
6SL3210-1RE32-1 . L0	90	**178**	178	151.3	124.6	---	---	---	---
6SL3210-1RE32-5 . L0	110	**205**	143.5	102.5	82	---	---	---	---

*) Factory setting

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

6.6 690 V converters

6.6.1 General data, 690 V converters

Property	Version
Line voltage	3 AC 500 V ... 690 V ± 10% (in operation -20% < 1 min) with Class J fuses, maximum 600 V
Line system configurations	Grounded TN/TT line systems or non-grounded IT line systems
Line impedance	Uk < 4%, line reactor is not required
Power factor λ	> 0.9
Output voltage	3 AC 0 V ... 0.95 × input voltage (max.)
Input frequency	50 Hz ... 60 Hz, ± 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 converter reduces the maximum output current.
Short-circuit current rating (SCCR) and branch protection	≤ 100 kA rms Branch protection and short-circuit strength according to UL and IEC (https://support.industry.siemens.com/cs/ww/en/view/109479152)
Braking methods	DC braking, compound braking
Degree of protection according to EN 60529	IP20; must be installed in a control cabinet
Protection class according to EN 61800-5-1	The converters 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

6.6.2 Specific data, 690 V converters

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

You can find additional suitable fuses on the Internet:

Branch protection and short-circuit strength according to UL and IEC (https://support.industry.siemens.com/cs/ww/en/view/109479152)

Table 6- 5 PM240P-2, IP20, frame size D, 3 AC 500 V ... 690 V

Article number without filter **Article number with filter**	**6SL3210-1RH21-4UL0** **6SL3210-1RH21-4AL0**	**6SL3210-1RH22-0UL0** **6SL3210-1RH22-0AL0**	**6SL3210-1RH22-3UL0** **6SL3210-1RH22-3AL0**
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
Siemens fuse according to IEC/UL Fuse according to IEC/UL, Class J	3NE1815-0 / 25 A 20 A	3NE1815-0 / 25 A 25 A	3NE1803-0 / 35 A 30 A
Power loss	0.32 kW	0.41 kW	0.48 kW
Required cooling air flow	55 l/s	55 l/s	55 l/s
Weight without filter	17.4 kg	17.4 kg	17.4 kg
Weight with filter	18.9 kg	18.9 kg	18.9 kg

Table 6- 6 PM240P-2, IP20, frame size D, 3 AC 500 V ... 690 V

Article number without filter **Article number with filter**	**6SL3210-1RH22-7UL0** **6SL3210-1RH22-7AL0**	**6SL3210-1RH23-5UL0** **6SL3210-1RH23-5AL0**	**6SL3210-1RH24-2UL0** **6SL3210-1RH24-2AL0**
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 Fuse according to IEC/UL, Class J	3NE1803-0 / 35 A 35 A	3NE1817-0 / 50 A 50 A	3NE1818-0 / 63 A 60 A
Power loss without filter	0.56 kW	0.72 kW	0.88 kW
Power loss with filter	0.56 kW	0.73 kW	0.88 kW
Required cooling air flow	55 l/s	55 l/s	55 l/s
Weight without filter	17.4 kg	17.4 kg	17.4 kg
Weight with filter	18.9 kg	18.9 kg	18.9 kg

Table 6- 7 PM240P-2, IP20, frame sizes E, 3 AC 500 V ... 690 V

Article number without filter **Article number with filter**	**6SL3210-1RH25-2UL0** **6SL3210-1RH25-2AL0**	**6SL3210-1RH26-2UL0** **6SL3210-1RH26-2AL0**
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 Fuse according to IEC/UL, Class J	3NA1820-0 / 80 A 80 A	3NE1820-0 / 80 A 80 A
Power loss without filter	1.00 kW	1.21 kW
Power loss with filter	1.00 kW	1.22 kW
Required cooling air flow	83 l/s	83 l/s
Weight without filter	27.1 kg	27.1 kg
Weight with filter	28.5 kg	28.5 kg

Table 6- 8 PM240P-2, IP20, frame size F, 3 AC 500 V ... 690 V

Article number without filter **Article number with filter**	**6SL3210-1RH28-0UL0** **6SL3210-1RH28-0AL0**	**6SL3210-1RH31-0UL0** **6SL3210-1RH31-0AL0**	**6SL3210-1RH31-2UL0** **6SL3210-1RH31-2AL0**
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 Fuse according to IEC/UL, Class J	3NE1021-0 / 100 A 110 A	3NE1022-0 / 125 A 150 A	3NE1224-0 / 160 A 150 A
Power loss without filter	1.34 kW	1.71 kW	2 kW
Power loss with filter	1.35 kW	1.72 kW	2.02 kW
Required cooling air flow	153 l/s	153 l/s	153 l/s
Weight without filter	61 kg	61 kg	61 kg
Weight with filter	65 kg	65 kg	65 kg

Table 6- 9 PM240P-2, IP20, frame size F, 3 AC 500 V ... 690 V

Article number without filter **Article number with filter**	**6SL3210-1RH31-4UL0** **6SL3210-1RH31-4AL0**
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 Fuse according to IEC/UL, Class J	3NE1225-0 / 200 A 200 A
Power loss without filter	2.56 kW
Power loss with filter	2.59 kW
Required cooling air flow	153 l/s
Weight without filter	61 kg
Weight with filter	65 kg

6.6.3 Current derating depending on the pulse frequency, 690 V converters

LO base load

Article number	LO power [kW]	LO base load output current [A]	
Pulse frequency [kHz]		**2** *)	**4**
6SL3210-1RH21-4 . L0	11	**14**	8.4
6SL3210-1RH22-0 . L0	15	**19**	11.4
6SL3210-1RH22-3 . L0	18.5	**23**	13.8
6SL3210-1RH22-7 . L0	22	**27**	16.2
6SL3210-1RH23-5 . L0	30	**35**	21
6SL3210-1RH24-2 . L0	37	**42**	25.2
6SL3210-1RH25-2 . L0	45	**52**	31.2
6SL3210-1RH26-2 . L0	55	**62**	37.2
6SL3210-1RH28-0 . L0	75	**80**	48
6SL3210-1RH31-0 . L0	90	**100**	60
6SL3210-1RH31-2 . L0	110	**115**	69
6SL3210-1RH31-4 . L0	132	**142**	85.2

*) Factory setting

The permissible motor cable length depends on the cable type and the selected pulse frequency.

HO base load

Article number	HO power [kW]	HO base load output current [A]	
Pulse frequency [kHz]		**2** *)	**4**
6SL3210-1RH21-4 . L0	7.5	**11**	6.6
6SL3210-1RH22-0 . L0	11	**14**	8.4
6SL3210-1RH22-3 . L0	15	**19**	11.4
6SL3210-1RH22-7 . L0	18.5	**23**	13.8
6SL3210-1RH23-5 . L0	22	**27**	16.2
6SL3210-1RH24-2 . L0	30	**35**	21
6SL3210-1RH25-2 . L0	37	**42**	25.2
6SL3210-1RH26-2 . L0	45	**52**	31.2
6SL3210-1RH28-0 . L0	55	**62**	37.2
6SL3210-1RH31-0 . L0	75	**80**	48
6SL3210-1RH31-2 . L0	90	**100**	60
6SL3210-1RH31-4 . L0	110	**115**	69

*) Factory setting

The permissible motor cable length depends on the cable type and the selected pulse frequency.

6.7 Safety Integrated

Property	Explanation
Standards	STO fulfils the requirements of the following standards: • SIL 3 according to IEC61508, part 1 to 3 (2010) • PL e according to IEC61800-5-2 (2016) • Category 3 according to ISO13849 part 1 (2015) The function STO corresponds to stop category 0 according to IEC60204 (2005)
Response time	20 ms The response time of the Safe Torque Off function is the time between selecting the function and the function becoming active.
Probability of failures	• Probability of failures per hour: PFH, $PFH_D = 50 \times 10^{-9}$ 1/h PFH according to IEC 61800-5-2, PFH_D according to IEC 62061 • Mean probability of failure for a low demand rate of the safety function according to IEC 61508: $PFD = 50 \times 10^{-5}$
Mission time	20 years You may not operate converters with integrated safety functions for longer than the mission time. The mission time starts when the device is delivered. The mission time cannot be extended. This is the case even if a service department checks the converter – or in the meantime, the converter was decommissioned.

6.8 Restrictions for special ambient conditions

Maximum current at low speeds

NOTICE
Overheating the converter due to unsuitable load Loading the converter with a high output current at the same time as a low output frequency can cause the current-conducting components in the converter to overheat. Excessively high temperatures can damage the converter or have a negative impact on the converter service life. • Never operate the converter continuously with an output frequency = 0 Hz. • Only operate the converter in the permissible operating range.

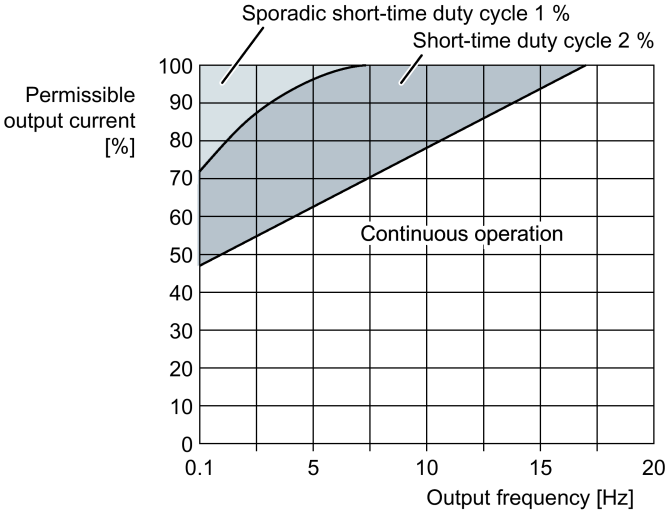


Figure 6-2 Permissible operating range of the converter

- Continuous operation:

  Operating state that is permissible for the complete operating time.
- Short-time duty cycle:

  Operating state that is permissible for less than 2 % of the operating time.
- Sporadic short-time duty cycle:

  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 the permissible converter output current is reduced.

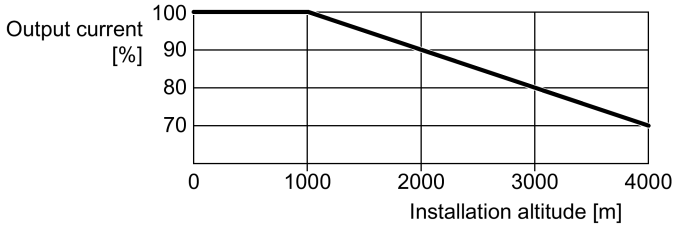


Figure 6-3 Current reduction as a function of the installation altitude

At installation altitudes above 1000 m, you can compensate the permissible converter output current to a certain extent using the ambient temperature. The following tables contain the details.

PM240P-2, FSD-FSF, 400 V converters

Table 6- 10 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 6- 11 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

PM240P-2, FSD-FSF, 690 V converters

Table 6- 12 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	60	35
1500	100				95	88	81	57	33
2000	100			97	90	83	77	54	32
2500	100		98	91	85	79	72	51	30
3000	100	98	92	86	80	74	68	48	28
3500	98	92	86	81	75	69	64	45	26
4000	91	86	81	75	70	65	60	42	25

Table 6- 13 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							75	50
1500	100						95	71	48
2000	100				99	95	90	68	45
2500	100			98	94	89	85	64	43
3000	100		96	92	88	84	80	60	40
3500	98	94	90	86	83	79	75	56	38
4000	91	88	84	81	77	74	70	53	35

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 ≤ 2000 m above sea level, it is permissible to connect the converter 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 ≥ 600 V for installation altitudes 2000 m ... 4000 m

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

6.9 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. EMC applies 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 converter as well as the associated electric motors and encoders including the connecting cables.

The driven machine is not part of the drive system.

Note

PDS as component of machines or systems

When you install 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.

Environments and categories

Environments

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

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

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 PDS for rated voltages < 1000 V for operation in the "second environment".

  Appropriately qualified personnel are required to install the PDS. An appropriately trained and qualified person has the necessary experience for installing and commissioning a PDS, including the associated EMC aspects.

  Additional measures are required for operation in the "first environment".

- **Category C3:**
  PDS for rated voltages < 1000 V - only for operation in the "second environment".
- **Category C4:**
  PDS for IT line supplies for operation in complex systems in the "second environment".

  An EMC plan is required.

6.9.1 Converter applications

Converters 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 devices described there are intended for operation in the first and second environments. Conditions for operation in the respective environment are subsequently listed.

6.9.1.1 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 system.
- The permissible motor cable length is complied with.
  Length of the motor cable (Page 48).
- A converter with an integrated line filter is being used.

  Converters with integrated line filters comply with the requirements of the second environment, Category C2 with reference to interference emission.
- If you use converters without integrated filters, then you are responsible for verifying that the interference emission is limited.

  You can use a dedicated radio interference suppression filter for each converter, or a common filter for multiple converters.

Further information on unfiltered devices can be found on the Internet:

Compliance with EMC limits with unfiltered devices
(https://support.industry.siemens.com/cs/ww/en/view/109750634)

Interference emission - operation in the second environment, Category C4

When connected to IT line supplies, only unfiltered converters 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).

6.9.1.2 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.

- **Converters with an LO base load input current > 16 A and ≤ 75 A**

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

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

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

    $SSC \geq 120 \cdot \sqrt{3} \cdot Uin \cdot$ LO base load input current

    Example: FSD converter, 400 V, input current, 70 A:

    $S_{SC} \geq 120 \cdot \sqrt{3} \cdot 400\ V \cdot 70\ A$
    This corresponds to a low-voltage transformer with an apparent power rating of approximately 300 kVA ... 400 kVA

    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.

  Harmonic currents (Page 84)

- **Converters with an LO base load current > 75A**

  There are no standard-related requirements for installing devices such as these. However, it is recommended to inform the grid operator when connecting such a device.

Operation in residential environment (category C1)

Caution

In a residential environment, this product may cause radio interference, in which case supplementary mitigation measures may be required.

6.9.2 Harmonic currents

Table 6- 14 Typical harmonic currents (%) of the converter

Converter	Harmonic number							
	5th	7th	11th	13th	17th	19th	23rd	25th
FSD ... FSF, 400 V [1)]	37	21	7	5	4	3	3	2
FSD ... FSF, 690 V [1)]	34	18	8	5	4	3	3	2

[1)] Values referred to the LO input current

6.9.3 Harmonics at the power supply connection point according to IEC 61000-2-2

Description

IEC 61000-2-2 defines the compatibility level for voltage harmonics for the point of common coupling (PCC) with the public supply system.

For systems in which converters or other non-linear loads are widely used, a circuit feedback calculation that takes the individual system configuration into consideration should always be performed.

The converter with upstream Line Harmonics Filters (LHF) allows adherence to the compatibility level for voltage harmonics, regardless of what percentage of the overall load is made up of the converter load.

Note

The voltage distortions behavior in the frequency range of 2 kHz to 9 kHz (IEC 61000-2-2 AMD 1) and from 9 kHz to 150 kHz (IEC 61000-2-2 AMD 2) must be evaluated specifically for each system as a function of the impedance at the power supply connection point.

6.9.4 EMC limit values in South Korea

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

All other converters 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.

You can find additional information about EMC-compliant configuration of the plant or system on the Internet:

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.

6.10 Protecting persons from electromagnetic fields

Overview

Protection of workers from electromagnetic fields is specified in the European EMF Directive 2013/35/EU. This directive is implemented in national law in the European Economic Area (EEA). Employers are obligated to design workplaces in such a way that workers are protected from impermissibly strong electromagnetic fields.

To this end, assessments and/or measurements must be performed for workplaces.

General conditions

The following general conditions apply for the evaluations and measurements:

1. The laws for protection from electromagnetic fields in force in individual EU member states can go beyond the minimum requirements of the EMF Directive 2013/35/EU and always take precedence.
2. The ICNIRP 2010 limits for the workplace are the basis for the assessment.

3. The 26th BImSchV (German Federal Emission Protection Regulation) defines 100 µT (RMS) for the assessment of active implants.
   According to Directive 2013/35/EU, 500 µT (RMS) at 50 Hz is applicable here.
4. The routing of power cables has a significant impact on the electromagnetic fields that occur.

   Install and operate the components inside metallic cabinets in compliance with the documentation and use shielded motor cables.

   EMC-compliant installation of a machine or system (Page 25)

Evaluation of the converter

The converters are normally used in machines. The assessment and testing is based on DIN EN 12198.

Compliance with the limit values was assessed for the following frequencies:

- Line frequency 47 ... 63 Hz
- Pulse frequency, for example 4/8/16 kHz and multiples thereof, assessed up to a maximum of 100 kHz

The indicated minimum distances apply to the head and complete torso of the human body. Shorter distances are possible for extremities.

Table 6- 15 Minimum distances to the converter

Individuals without active implants		**Individuals with active implants**	
Control cabinet closed	**Control cabinet open**	**Control cabinet closed**	**Control cabinet open**
0 cm	Forearm length (approx. 35 cm)	Must be separately assessed depending on the active implant.	

6.11 Service life

The PM240P-2 is designed to have a service life of 10 years under the following conditions:

- Nominal load at 40 °C: 4000 h/y
- Idle time or standby at 20 °C: 4000 h/y
- Power off: 760 h/y

Spare parts and accessories

7

7.1 Spare parts

	Article No.		
	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 *)	6SL3262-1AD01-0DA0	6SL3262-1AE01-0DA0	6SL3262-1AF01-0DA0

*) Included in the scope of delivery of the converter

Spare parts through Spares on Web

Spares on Web (https://www.automation.siemens.com/sow)

When you enter the article number and serial number of your device, you obtain a spare parts list current at the time of your inquiry.

7.2 Optional accessories

Which components are available?

- Shield plate at the top
- Line harmonics filter
- Motor holding brake controlled using a Brake Relay or Safe Brake Relay
- Sine-wave filter
- Output reactor

Connection components

Connection overview for the electrical components Connection overview (Page 47).

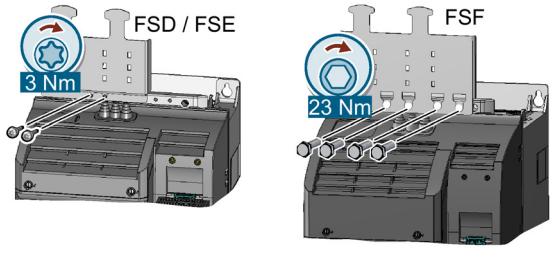
7.2.1 Shield plate at the top

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

Spare parts (Page 87)

Fasten the shield plate as shown in the graphic:

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



7.2.2 Motor holding brake

The converter 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

There are no differences between the Brake Relay and the Safe Brake Relay in terms of installation and connection to the converter.

Connection to the converter

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

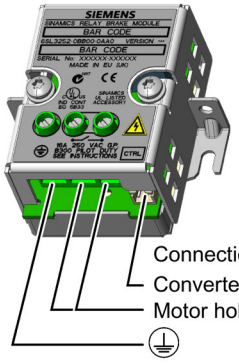
7.2.2.1 Technical data of the Brake Relay

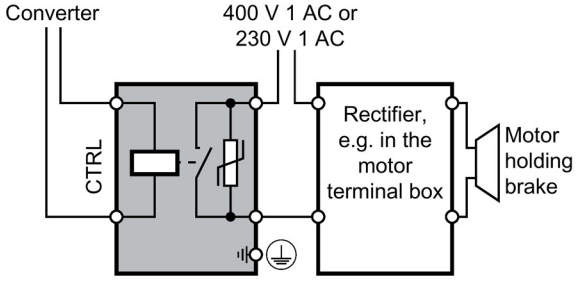
	Brake Relay 6SL3252-0BB00-0AA0	Safe Brake Relay 6SL3252-0BB01-0AA0
Input voltage	via the Power Module	20.4 ... 28.8 VDC [1]
Input current	via the Power Module	Max. 2.5 A
Max. connection cross-section:	2.5 mm²	2.5 mm²
Degree of protection	IP20	IP20
Switching capability of the NO contact	1-phase 250 VAC, 16 A 1-phase 30 VDC, 12 A	-
Output voltage	-	24 V
Output current	-	max. 2.5 A

[1] External, controlled power supply required. Recommended voltage: 26 VDC

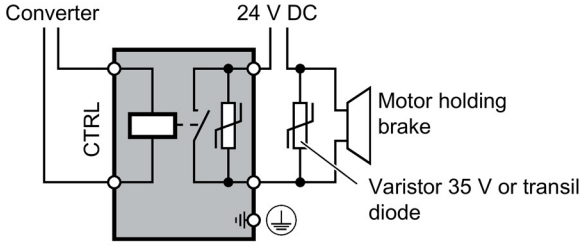
7.2.2.2 Connections and circuit diagrams

Brake Relay



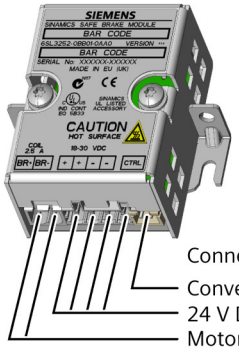


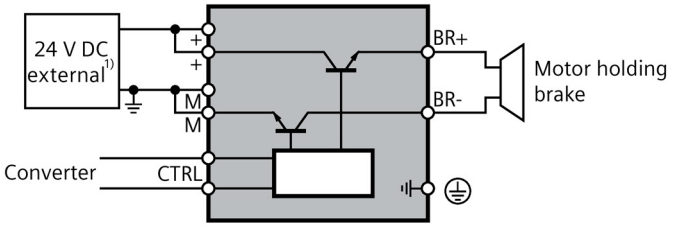
Connection 230 V ... 400 V 1 AC



Connection 24 V DC

Safe Brake Relay



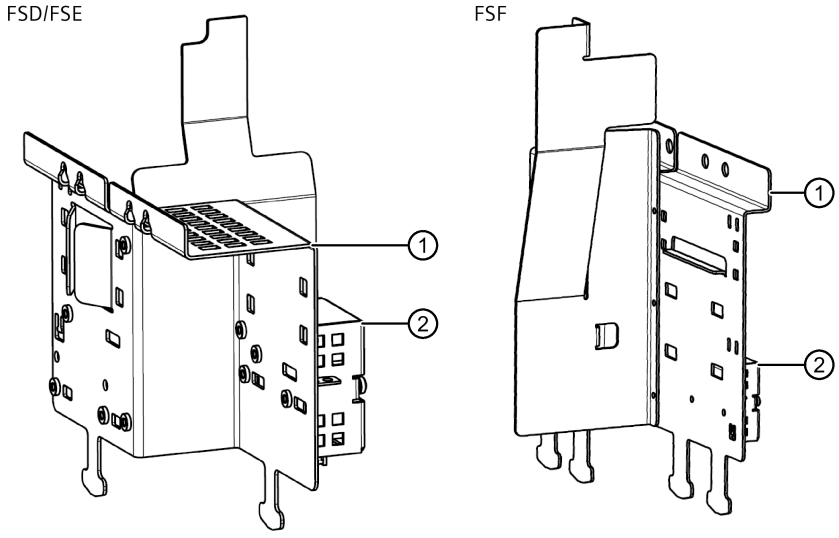


1) The cable connected to the external 24 V DC power supply must be as short as possible. The maximum cable length is 30 m.

7.2.2.3 Mounting and connecting the Brake Relay

Mounting the Brake Relay

Mount the Brake Relay at the rear of the shield plate. Mount it before you mount the shield plate.

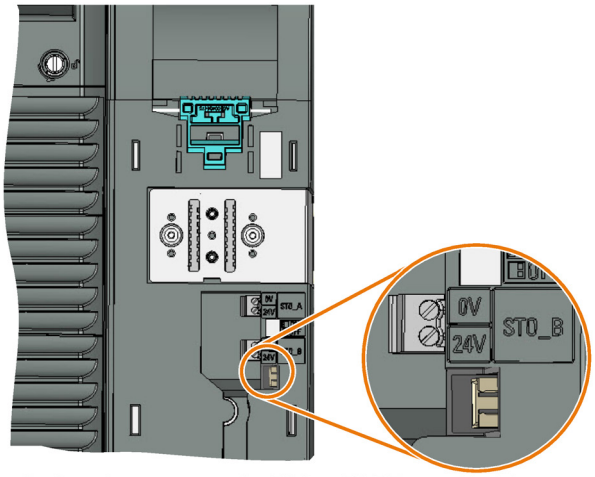


① Shield plates
② Brake Relay or Safe Brake Relay

Mounting the shield plate and EMC connecting bracket (Page 36)

Connecting the Brake Relay to the converter

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 FSD ... FSF Power Modules with STO terminals

7.2.3 Line harmonics filter

For applications out of the USA and Canada

The line harmonics filters reshape the distorted current back to the desired sinusoidal waveform.

With the line harmonics filters the converter fulfills the IEEE 519 standards.

For technical details refer to the following link:

Line harmonics filters
(https://www.schaffner.com/products/download/product/datasheet/fn-3440-ecosine-50hz-passive-harmonic-filters/)

Note

When using a line harmonics filter, a line reactor is not required and the permissible line voltage is 380 V ... 415 V 3 AC ±10 % instead of 380 V ... 480 V 3 AC ± 10 % without a line harmonics filter.

For applications in the USA and Canada

For applications in the USA and Canada, use the line harmonics filters recommended by Siemens Product Partner for Drive Options.

For more information, see the link below:

Siemens Product Partner for Drive Options
(https://new.siemens.com/global/en/company/topic-areas/partners/product-partners-industry.html)

Assignment tables

Power Module, 400 V			Line harmonics filter
Frame size	**Article number**	**Power [kW]**	**Article number** **Manufacturer: Schaffner EMV GmbH**
FSD	6SL3210-1RE24-5 . L0 6SL3210-1RE26-0 . L0 6SL3210-1RE27-5 . L0	22 30 37	UAC:FN344022115E2FAJRX UAC:FN344030115E2FAJRX UAC:FN344037115E2FAJRX
FSE	6SL3210-1RE28-8 . L0 6SL3210-1RE31-1 . L0	45 55	UAC:FN344045115E2FAJRX UAC:FN344055115E2FAJRX
FSF	6SL3210-1RE31-5 . L0 6SL3210-1RE31-8 . L0 6SL3210-1RE32-1 . L0 6SL3210-1RE32-5 . L0	75 90 110 132	UAC:FN344075116E2FAJRX UAC:FN344090116E2FAJRX UAC:FN3440110118E2FAJRX UAC:FN3440132118E2FAJXX

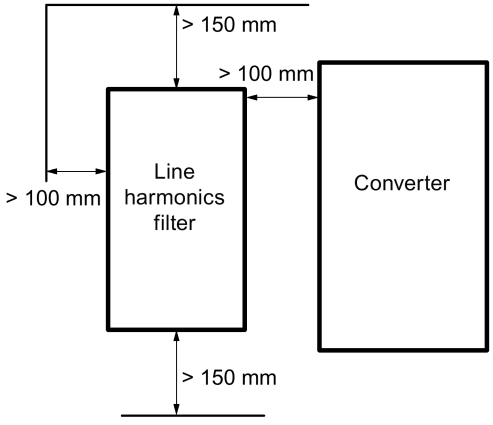
NOTICE
Line harmonic filters for Power Modules with 132 kW The following combination must not be used with v/f control: • Power Module 132 kW with LHF: UAC:FN3440132118E2FAJXX When you use the above combination, only the following settings of p1300 are allowed: • P1300 = 20 • P1300 = 21 • P1300 = 22 • P1300 = 23

Clearances to other devices

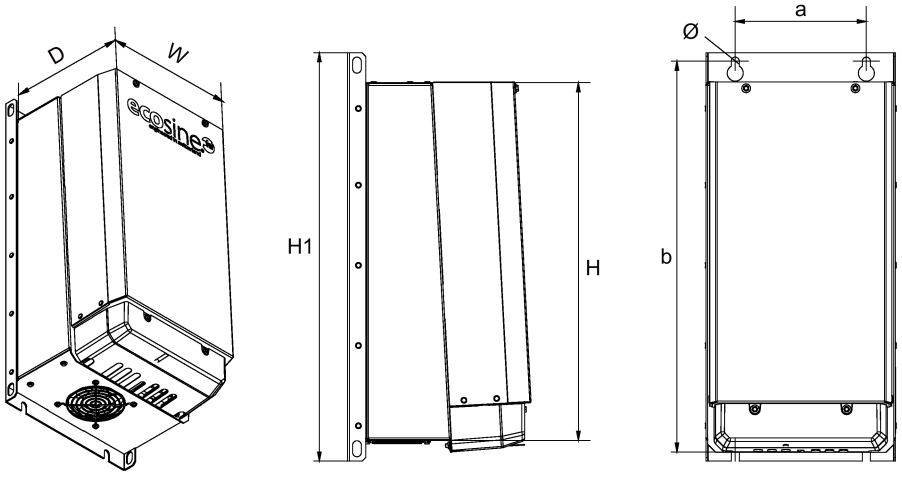
Line harmonics filters are best installed as close as possible to the non-linear load. Ideally they are mounted next to the converter inside the electrical cabinet.

In order to ensure sufficient air flow, keep a clearance of minimum 150 mm above and below the filter to walls or other components.

It must be ensured that the environmental temperature is kept below 45 °C with appropriate thermal management (e.g. cabinet cooling). Filter operation in environments with higher temperatures require a temperature derating.



Dimensions, drilling patterns, and technical data



Article number	Weight [kg]	Dimensions [mm]				Drilling patterns [mm]			Power connections		
		D	W	H	H1	a	b	∅	[mm² / Nm]	[AWG / lbf.in]	PE / torque [Nm]
UAC:FN344022115E2FAJRX UAC:FN344030115E2FAJRX UAC:FN344037115E2FAJRX UAC:FN344045115E2FAJRX UAC:FN344055115E2FAJRX	53 55 66 73 75	319	290	635	705	220	680	11	10 ... 50 / 8	1/0 ... 8 / 70.8	M8 / 14
UAC:FN344075116E2FAJRX UAC:FN344090116E2FAJRX	126 147	386	353	863	960	280	920	11	10 ... 95 / 8	3/0 ... 8 / 70.8	M10 / 25
UAC:FN3440110118E2FAJRX UAC:FN3440132118E2FAJXX	175 194	456	462	1053	1150	390	1115	11	95 ... 240 / 10	3/0 ... 500 kcmil / 88.5	M10 / 25

7.2.4 Output reactor

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

When using an output reactor, observe the following restrictions:

- The output frequency must not exceed 150 Hz.
- The pulse frequency must not exceed 4 kHz.

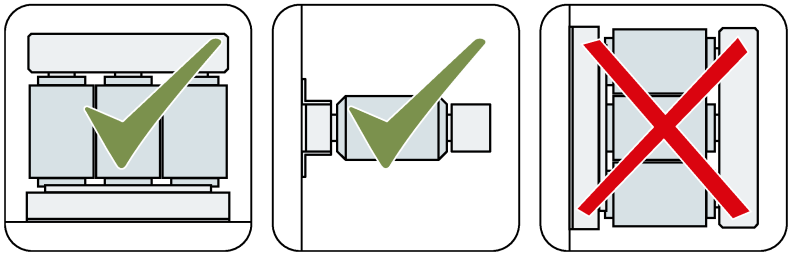
NOTICE
Damage to the output reactor by exceeding the maximum pulse frequency The maximum permissible pulse frequency when using the output reactor is 4 kHz. The output reactor can be damaged if the pulse frequency is exceeded. • When using an output reactor, the pulse frequency of the Power Module must not be higher than 4 kHz.

NOTICE
Damage to the output reactor if it is not activated during commissioning The output reactor may be damaged if it is not activated during commissioning. • Activate the output reactor during commissioning via parameter p0230. • Activate the output reactor during commissioning according to the electric specifications.

For applications in the USA and Canada, you can also use the output reactors recommended by Siemens Product Partner for Drive Options. For more information, see the link below:

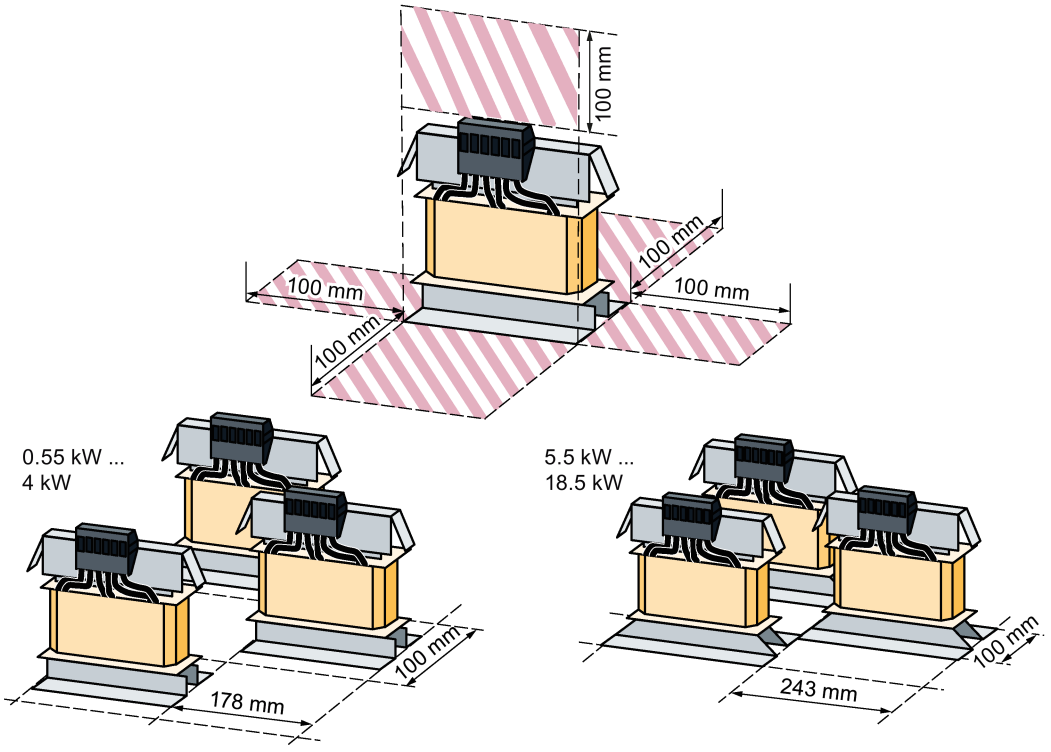
Siemens Product Partner for Drive Options
(https://new.siemens.com/global/en/company/topic-areas/partners/product-partners-industry.html)

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 FSD ... FSF converters

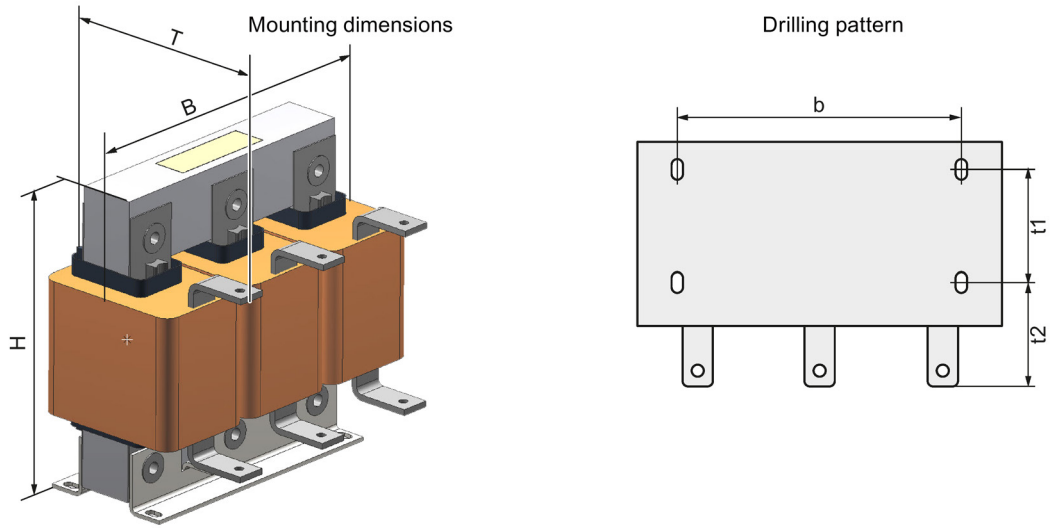


Figure 7-1 Dimensions and drilling patterns

Table 7- 1 Dimensions and weights

Article number	Inductance [mH]	Overall dimensions [mm]			Drilling dimensions [mm]			Fixing/ torque [Nm]	Weight [kg]
		W	H	D	b	t1	t2		
JTA:TEU2532-0FP00-4EA0	1.5	264	255	131	249	101	/	4 x M6 / 10	18
JTA:TEU 9932-0FP00-4EA0	1.2	264	270	159	249	129	/	4 x M6 / 10	26
JTA:TEU 9932-0FS00-0EA0	0.9	310	370	182	289	142	/	4 x M8 / 25	42
JTA:TEU 9932-1FC00-1BA0	0.53	400	320	193	379	150	/	4 x M8 / 25	66
JTA:TEU 9932-0FV00-1BA0	0.37	400	355	193	379	150	/	4 x M8 / 25	90

The output reactors have a protection rating of IP00.

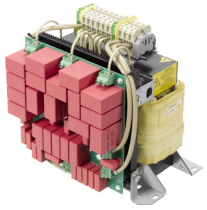
Table 7- 2 Connections to the Power Module and to the motor

Article number	**Connection**	
	Motor Module and motor	**PE**
JTA:TEU 2532-0FP00-4EA0	Screw terminals 16 mm^2	Screw terminals 16 mm^2
JTA:TEU 9932-0FP00-4EA0	Screw terminals 35 mm^2	Screw terminals 35 mm^2
JTA:TEU 9932-0FS00-0EA0	Screw terminals 70 mm^2	Screw terminals 70 mm^2
JTA:TEU 9932-1FC00-1BA0	Cable lug M8 / 13 Nm	Screw M6 / 10 Nm
JTA:TEU 9932-0FV00-1BA0	Cable lug M10 / 25 Nm	Screw M6 / 10 Nm

Table 7- 3 Assignment table for 690 V Power Modules

Power Module			**Output reactor**
Frame size	**Article number**	**Power [kW]**	**Article number** **Manufacturer: mdexx Magnetronic Devices s.r.o**
FSD	6SL3210-1RH21-4 . L0 6SL3210-1RH22-0 . L0 6SL3210-1RH22-3 . L0	11 15 18.5	JTA:TEU 2532-0FP00-4EA0
	6SL3210-1RH22-7 . L0 6SL3210-1RH23-5 . L0 6SL3210-1RH24-2 . L0	22 30 37	JTA:TEU 9932-0FP00-4EA0
FSE	6SL3210-1RH25-2 . L0 6SL3210-1RH26-2 . L0	45 55	JTA:TEU 9932-0FS00-0EA0
FSF	6SL3210-1RH28-0 . L0 6SL3210-1RH31-0 . L0	75 90	JTA:TEU 9932-1FC00-1BA0
	6SL3210-1RH31-2 . L0 6SL3210-1RH31-4 . L0	110 132	JTA:TEU 9932-0FV00-1BA0

7.2.5 dv/dt filter plus VPL



A combination of dv/dt filter and a voltage peak limiter (VPL) – dv/dt filter plus VPL – is available to suppress voltage peaks.

When using a dv/dt filter plus VPL, observe the following restrictions:

- The output frequency must not exceed 150 Hz.
- The pulse frequency must not exceed 4 kHz.

NOTICE
Damage to the dv/dt filter plus VPL if it is not activated during commissioning The dv/dt filter plus VPL may be damaged if it is not activated during commissioning. • Activate the dv/dt filter plus VPL during commissioning via parameter p0230. • Activate the dv/dt filter plus VPL during commissioning according to the electric specifications.

NOTICE
Damage to the dv/dt filter plus VPL if the connection to the capacitor is not removed The dv/dt filter plus VPL may be damaged if the connection to the capacitor of the common mode filter is not removed when the dv/dt filter plus VPL operates in the IT line system.

For applications in the USA and Canada, you can also use the dv/dt filters plus VPL recommended by Siemens Product Partner for Drive Options. For more information, see the link below:

Siemens Product Partner for Drive Options (https://new.siemens.com/global/en/company/topic-areas/partners/product-partners-industry.html)

dv/dt filters plus VPL for PM240P-2 Power Modules, 3 AC 400 V

Power Module		Power	dv/dt filter plus VPL Manufacturer: mdexx Magnetronic Devices s.r.o
FSD	6SL3210-1RE24-5 .L0 6SL3210-1RE26-0 .L0	22 kW 30 kW	JTA:TEF1203-0JB
FSD FSE	6SL3210-1RE27-5 .L0 6SL3210-1RE28-8 .L0	37 kW 45 kW	JTA:TEF1203-0KB
FSE FSF	6SL3210-1PE31-1 .L0 6SL3210-1RE31-5 .L0	55 kW 75 kW	JTA:TEF1203-0LB
FSF	6SL3210-1RE31-8 .L0 6SL3210-1RE32-1 .L0 6SL3210-1RE32-5 .L0	90 kW 110 kW 132 kW	JTA:TEF1203-0MB

dv/dt filters plus VPL for PM240P-2 Power Modules, 3 AC 690 V

Power Module		Power	dv/dt filter plus VPL Manufacturer: mdexx Magnetronic Devices s.r.o
FSD	6SL3210-1RH21-4 .L0 6SL3210-1RH22-0 .L0 6SL3210-1RH22-3 .L0	11 kW 15 kW 18.5 kW	JTA:TEF1203-0GB
	6SL3210-1RH22-7 .L0 6SL3210-1RH23-5 .L0 6SL3210-1RH24-2 .L0	22 kW 30 kW 37 kW	JTA:TEF1203-0HB
FSE	6SL3210-1RH25-2 .L0 6SL3210-1RH26-2 .L0	45 kW 55 kW	JTA:TEF1203-0JB
FSF	6SL3210-1RH28-0 .L0 6SL3210-1RH31-0 .L0	75 kW 90 kW	JTA:TEF1203-0KB
	6SL3210-1RH31-2 .L0 6SL3210-1RH31-4 .L0	110 kW 132 kW	JTA:TEF1203-0LB

Dimensions

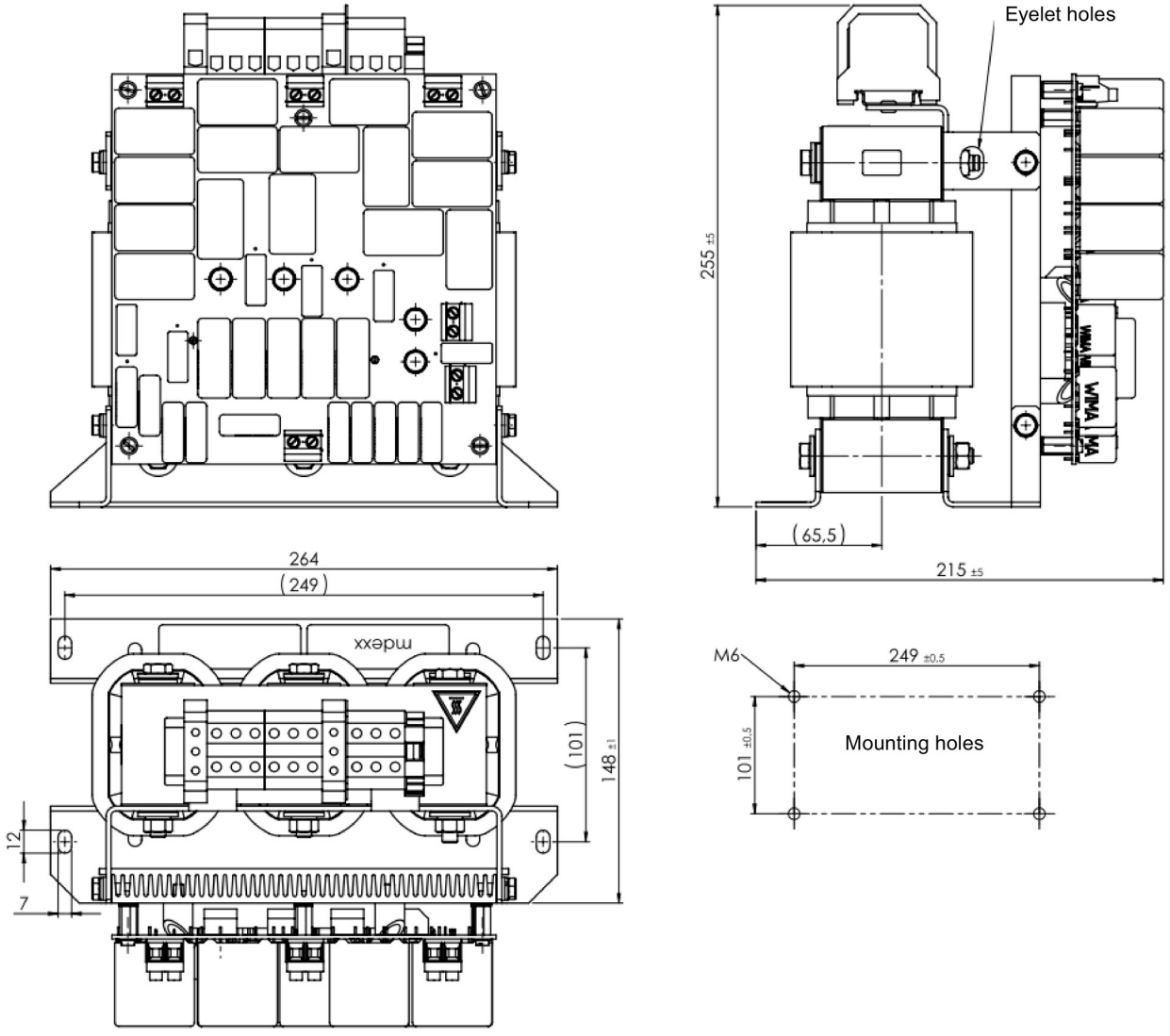


Figure 7-2 Dimensions for JTA:TEF1203-0GB

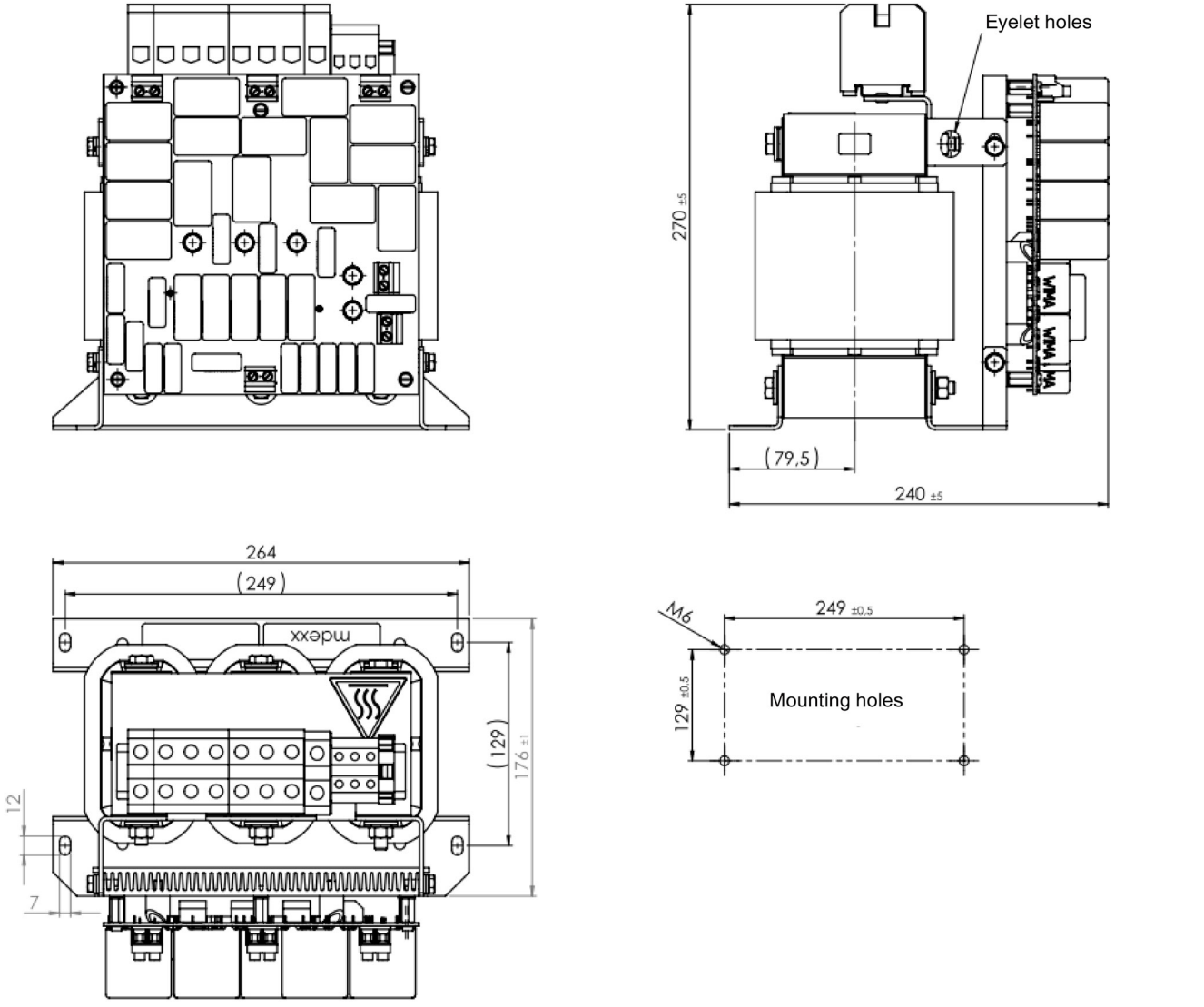


Figure 7-3 Dimensions for JTA:TEF1203-0HB

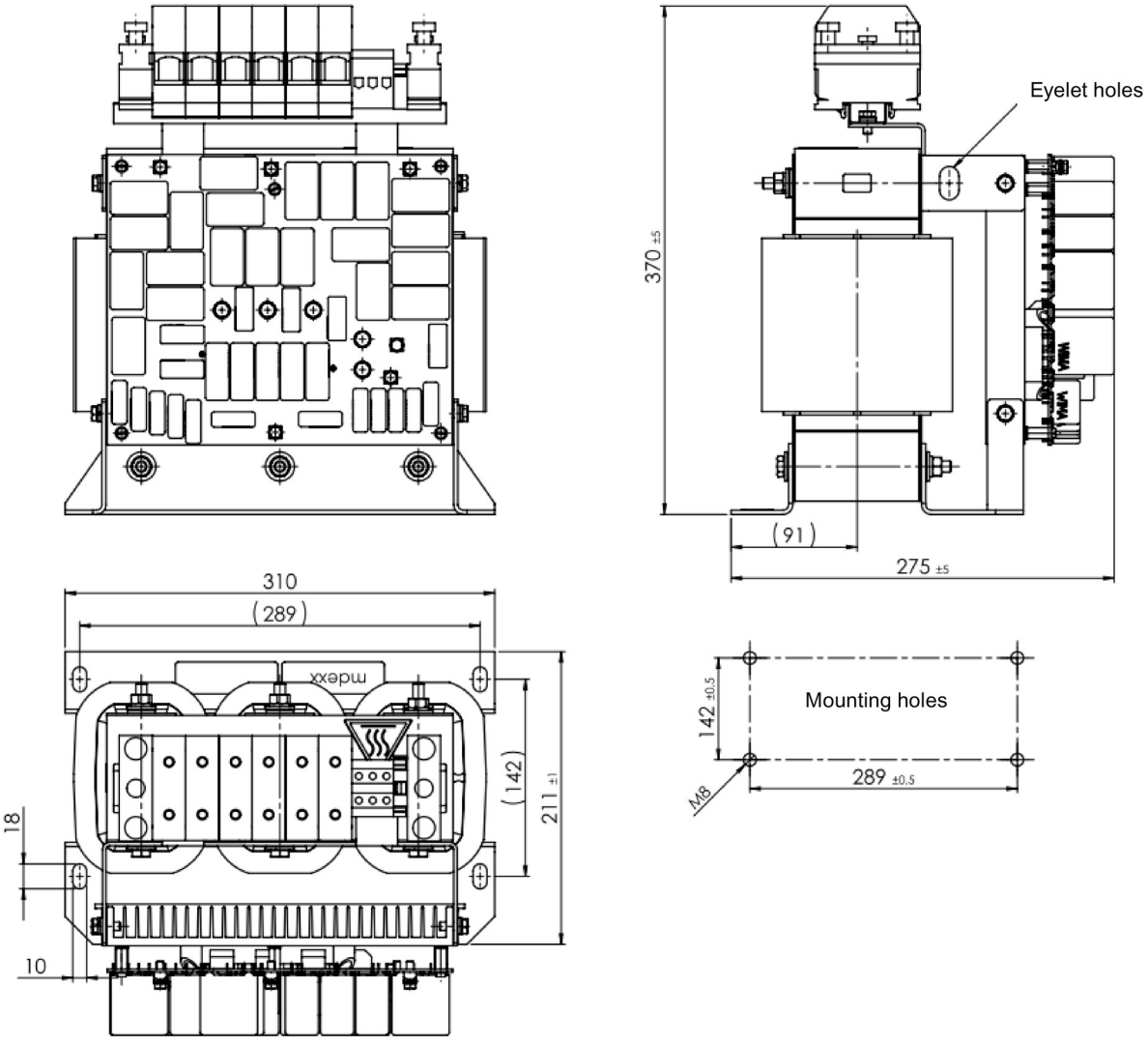


Figure 7-4 Dimensions for JTA:TEF1203-0JB

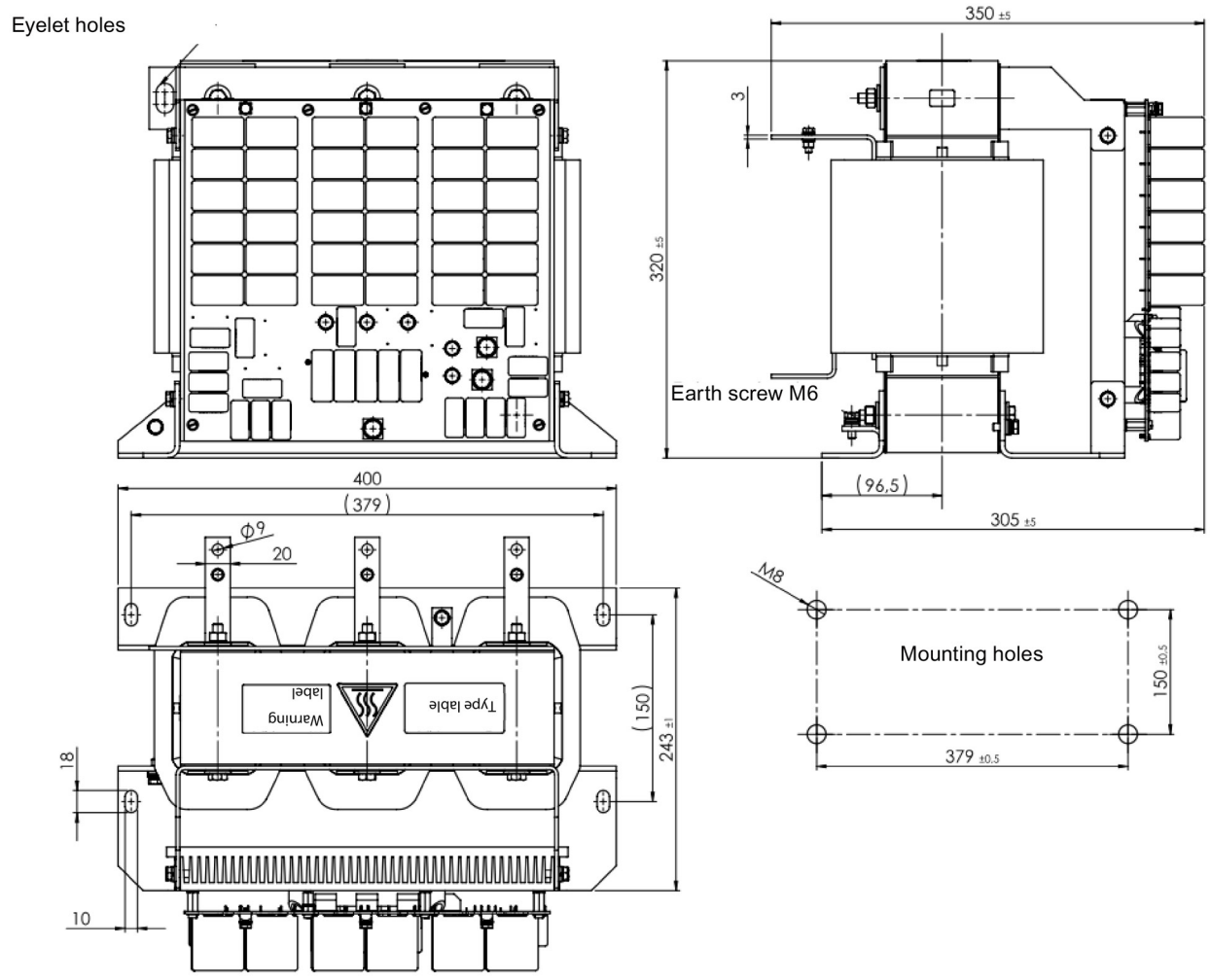


Figure 7-5 Dimensions for JTA:TEF1203-0KB

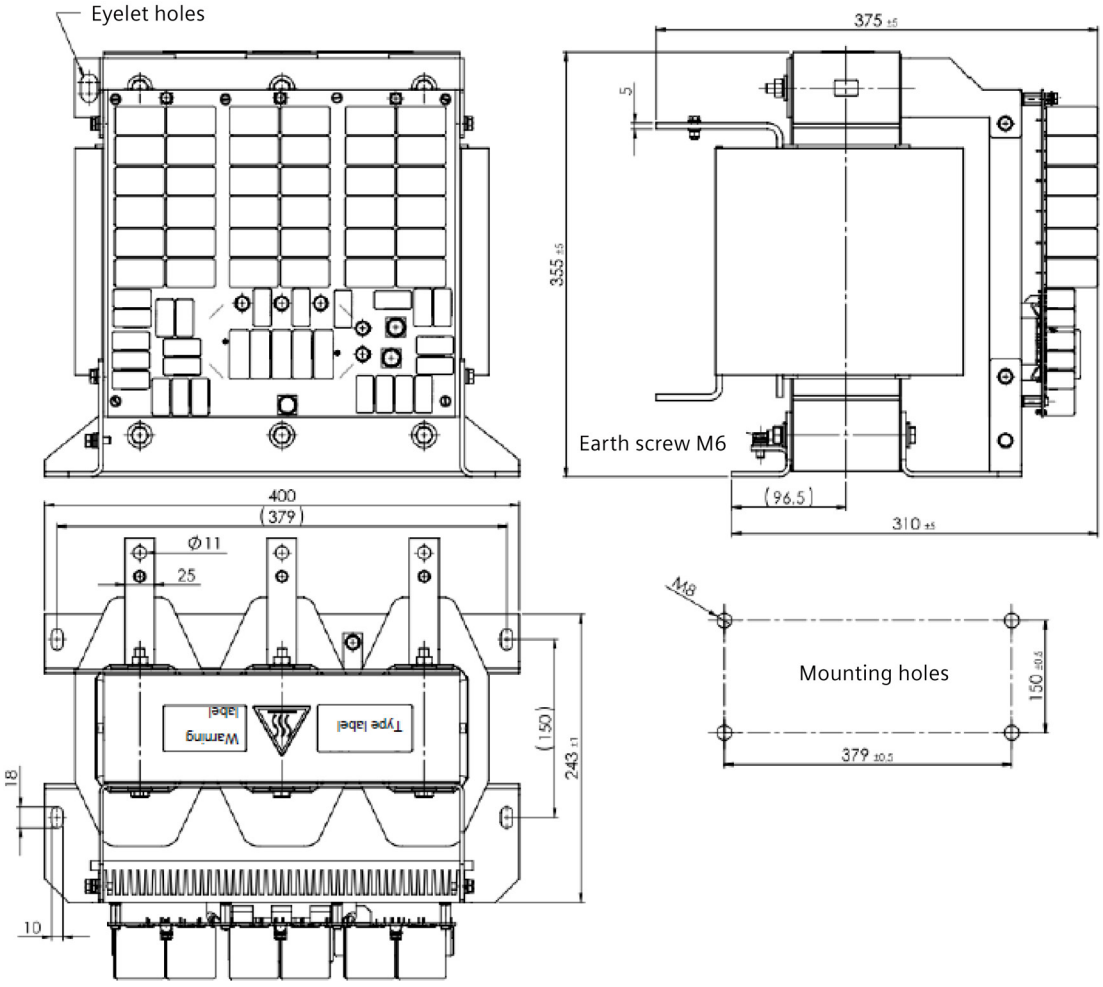


Figure 7-6 Dimensions for JTA:TEF1203-0LB

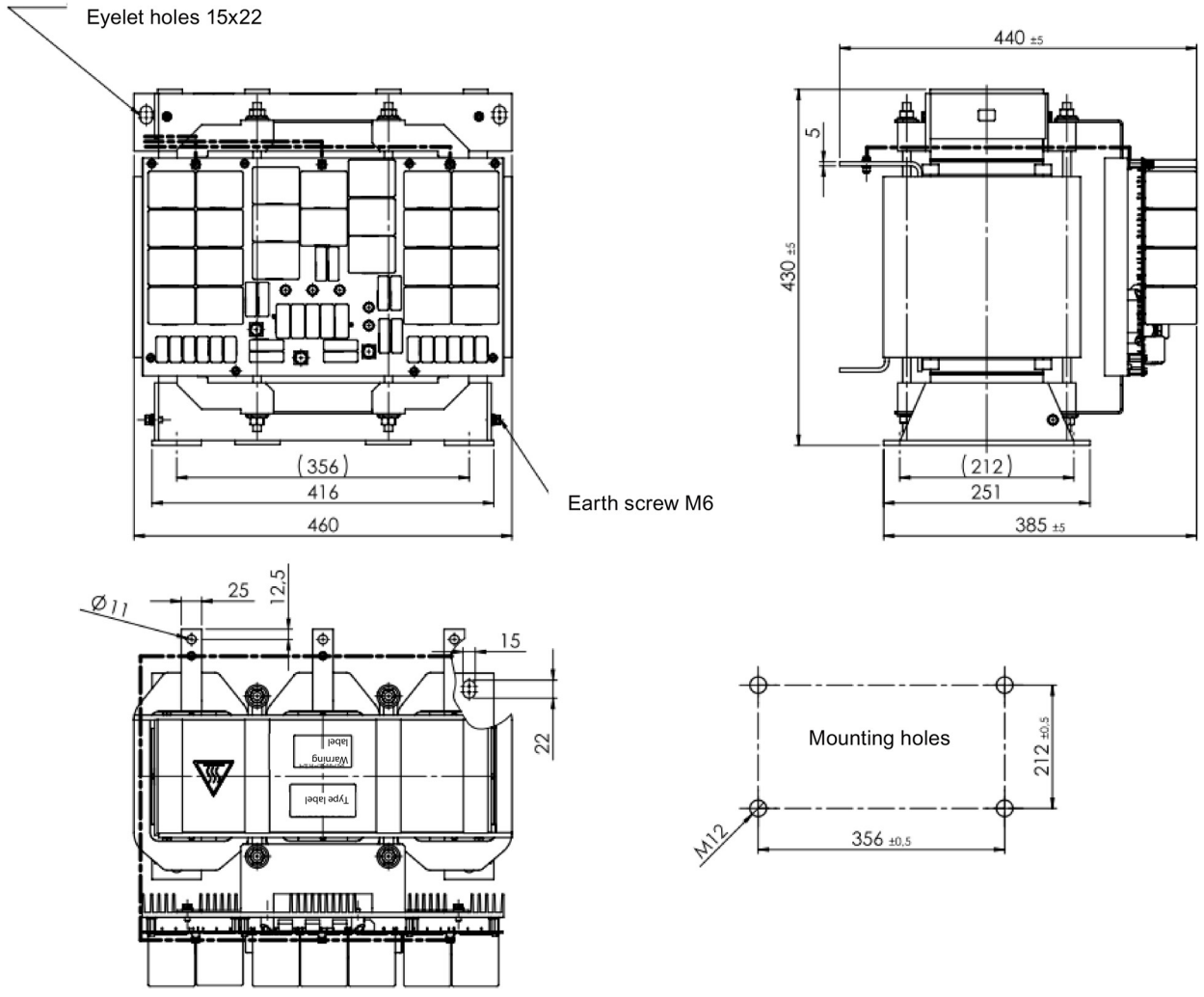


Figure 7-7 Dimensions for JTA:TEF1203-0MB

Technical data

Article number JTA: TEF1203		**-0GB**	**-0HB**	**-0JB**
Rated power		18.5 kW	37 kW	55 kW
Rated voltage (phase to phase)		690 V (+10%)	690 V (+10%)	690 V (+10%)
Rated output current (rms)		24 A	44 A	64 A
Maximum output current (rms)		38 A	70 A	104 A
Inductance (Tolerance ± 5%)		1.5 mH	1.2 mH	0.9 mH
Winding resistance		3 x 20.9 mΩ	3 x 14.6 mΩ	3 x 10.24 mΩ
Nominal pulse frequency		2 kHz	2 kHz	2 kHz
Maximum pulse frequency		4 kHz	4 kHz	4 kHz
Output current maximum pulse frequency		14.4 A	26.4 A	38.4 A
Maximum output frequency		150 Hz	150 Hz	150 Hz
Voltage drop		17.15 V	17.13 V	17.97 V
Rated DC link voltage		935 V	935 V	935 V
Maximum voltage rise at motor terminals [1]		< 500 V/µs	< 500 V/µs	< 500 V/µs
Maximum peak voltage at motor terminals (phase to phase) [2]	@ 400 V	800 V	800 V	800 V
	@ 690 V	1350 V	1350 V	1350 V
Maximum peak voltage at motor terminals (phase to earth) [2]	@ 400 V	650 V	650 V	650 V
	@ 690 V	1100 V	1100 V	1100 V
Maximum cable length filter - motor (screened / unscreened)		350 m / 525 m	350 m / 525 m	350 m / 525 m
Terminal type		Screw terminals	Screw terminals	Screw terminals
Rated terminal cross section (load circuit)		16 mm²	35 mm²	50 mm²
Rated terminal cross section (DC link feedback) [3]		16 mm²	16 mm²	16 mm²
Degree of protection [4]		IP00	IP00	IP00
Ambient temperature [5]		-20°C to 40°C	-20°C to 40°C	-20°C to 40°C
Weight		20 kg	29 kg	46 kg

Article number JTA: TEF1203	**-0GB**	**-0HB**	**-0JB**
Connection	Metrical (mm² / Nm) Imperial (AWG / lbf.in) Stripping length (mm)		
Line / motor cable	16 / 1.2 6 / 11.0 13	35 / 2.5 2 / 22 17	70 / 6.0 2/0 / 53 24
DC link	16 / 1.2 6 / 11.0 13	16 / 1.2 6 / 11 13	16 / 1.2 6 / 11 13
Ground	16 / 1.2 6 / 11.0 13	35 / 2.5 2 / 22 17	70 / 10.0 2/0 / 86 24

1) Voltage rise according IEC/TS 60034-17

2) Under nominal DC link voltage

3) Short-circuit-proof wiring is required

4) Installing the filter in an enclosure is required

5) Higher ambient temperatures up to 60°C allowed with current derating at 40°C, in the range 40...50°C with 1.5% per 1K and in the range 50...60°C with 1.9% per 1K

Article number JTA: TEF1203		**-0KB**	**-0LB**	**-0MB**
Rated power		90 kW	132 kW	250 kW
Rated voltage (phase to phase)		690 V (+10%)	690 V (+10%)	690 V (+10%)
Rated output current (rms)		103 A	230 A	416 A
Maximum output current (rms)		160 A	70 A	104 A
Inductance (Tolerance ± 5%)		0.53 mH	0.37 mH	0.22 mH
Winding resistance		3 x 4.9 mΩ	3 x 3.25 mΩ	3 x 1.4 mΩ
Nominal pulse frequency		2 kHz	2 kHz	2 kHz
Maximum pulse frequency		4 kHz	4 kHz	4 kHz
Output current maximum pulse frequency		61.8 A	87.6 A	156 A
Maximum output frequency		150 Hz	150 Hz	150 Hz
Voltage drop		17.2 V	17.1 V	18.0 V
Rated DC link voltage		935 V	935 V	935 V
Maximum voltage rise at motor terminals [1]		< 500 V/µs	< 500 V/µs	< 500 V/µs
Maximum peak voltage at motor terminals (phase to phase) [2] [3]	@ 400 V	800 V	800 V	800 V
	@ 690 V	1350 V ... 1500 V	1350 V ... 1500 V	1350 V ... 1500 V
Maximum peak voltage at motor terminals (phase to earth) [2]	@ 400 V	650 V	650 V	650 V
	@ 690 V	1100 V	1100 V	1100 V
Maximum cable length filter - motor (screened / unscreened) [3]		450 m / 650 m 525 m / 800 m	450 m / 650 m 525 m / 800 m	450 m / 650 m 525 m / 800 m
Terminal type		Busbar M8	Busbar M10	Busbar M10
Rated terminal cross section (load circuit)		95 mm²	120 mm²	2x120 mm² 1x185 mm²
Rated terminal cross section (DC link feedback) [4]		25 mm²	25 mm²	50 mm²
Degree of protection [5]		IP00	IP00	IP00
Ambient temperature [6]		-20°C to 40°C	-20°C to 40°C	-20°C to 40°C
Weight		77 kg	97 kg	172 kg

Article number JTA: TEF1203	**-0KB**	**-0LB**	**-0MB**
Connection	Metrical (mm² / Nm) Imperial (AWG / lbf.in)		
Line / motor cable	95 / 13.0 3/0 / 115	120 / 13.0 4/0 / 115	2 x 120 / 13.0 2 x 4/0 / 115 185 / 13.0 6/0 / 13.0
DC link	25 / 9.0 4 / 80	25 / 9.0 4 / 80	50 / 9.0 1 / 80
Ground	50 / 6.0 1 / 53	70 / 6.0 2/0 / 53	95 / 6.0 3/0 / 53

1) Voltage rise according IEC/TS 60034-17

2) Under nominal DC link voltage

3) Maximum peak voltage at motor terminals < 1350V at cable length up to 450m screened or 650m unscreened Maximum peak voltage at motor terminals < 1500V at cable length up to 525m screened or 800m unscreened

4) Short-circuit-proof wiring is required

5) Installing the filter in an enclosure is required

6) Higher ambient temperatures up to 60°C allowed with current derating at 40°C, in the range 40...50°C with 1.5% per 1K and in the range 50...60°C with 1.9% per 1K

Appendix

A

A.1 Manuals and technical support

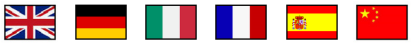
A.1.1 Manuals for your converter

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/109744767)
  Commissioning the converter

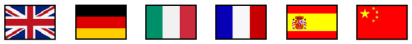
- CU240B/E-2 Compact Operating Instructions
  (https://support.industry.siemens.com/cs/ww/en/view/109744768)
  Commissioning the converter

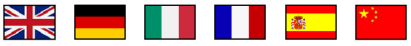
- CU250S-2 Compact Operating Instructions
  (https://support.industry.siemens.com/cs/us/en/view/109782994)
  Commissioning the converter.

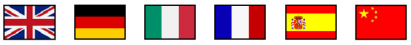
- CU230P-2 operating instructions
  (https://support.industry.siemens.com/cs/ww/en/view/109782866)
  Installing, commissioning and maintaining the converter. Advanced commissioning

- CU240B/E-2 operating instructions
  (https://support.industry.siemens.com/cs/ww/en/view/109782865)
  Installing, commissioning and maintaining the converter. Advanced commissioning

- CU250S-2 operating instructions
  (https://support.industry.siemens.com/cs/ww/en/view/109482988)
  Installing, commissioning and maintaining the converter. Advanced commissioning

- "Safety Integrated" function manual
  (https://support.industry.siemens.com/cs/ww/en/view/109782490)
  Configuring PROFIsafe. Installing, commissioning and operating fail-safe functions of the converter.

- CU230P-2 List Manual
  (https://support.industry.siemens.com/cs/us/en/view/109782303)
  Parameter list, alarms and faults. Graphic function diagrams

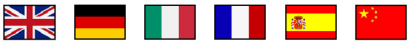
- CU240B/E-2 List Manual
  (https://support.industry.siemens.com/cs/us/en/view/109782301)
  Parameter list, alarms and faults. Graphic function diagrams

- CU250S-2 List Manual
  (https://support.industry.siemens.com/cs/ww/en/view/109782287)
  Parameter list, alarms and faults. Graphic function diagrams

- EMC installation guideline
  (https://support.industry.siemens.com/cs/ww/en/view/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 converter 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 the converters SINAMICS G.

Catalogs for download or online catalog (Industry Mall):

All about SINAMICS G120 (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 (https://support.industry.siemens.com/cs/ww/en/ps/13434)

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
(https://support.industry.siemens.com/cs/ww/en/view/60612658)

A.1.3 Product Support

Overview

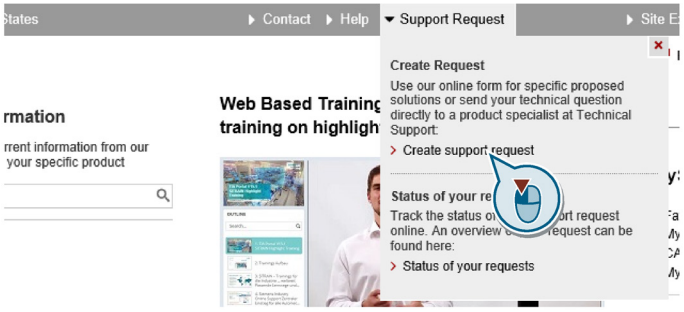
You can find additional information about the product on the Internet:

Product support (https://support.industry.siemens.com/cs/ww/en/)

This URL provides the following:

- Up-to-date product information (product announcements)
- FAQs
- 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".

If you have any technical questions, use the online form in the "Support Request" menu:



A.2 Abbreviations

Abbreviation	Explanation
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

A.3 Directives and standards

The following directives and standards are relevant for the converters:

European Low Voltage Directive

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

Directive 2011/65/EU

The converter fulfills the requirements of Directive 2011/65/EU relating to the restriction of the use of certain hazardous substances in electrical and electronic devices (RoHS).

European Directive on Waste Electrical and Electronic Equipment (WEEE)

The SINAMICS converter series complies with the 2012/19/EU directive on taking back and recycling waste electrical and electronic equipment.

European EMC Directive

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

UK Declaration of Conformity

The converter complies with the requirements for the market in Great Britain (England, Wales and Scotland).

Underwriters Laboratories (North American market)

Converters 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 converters with the KC marking on the rating plate satisfy the EMC requirements for South Korea.

Eurasian conformity

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

Australia and New Zealand (RCM formerly C-Tick)

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

Specification for semiconductor process equipment voltage drop immunity

The converters comply with the requirements of standard SEMI F47-0706.

Quality systems

Siemens AG employs a quality management system that meets the requirements of ISO 9001 and ISO 14001.

Certificates for download

- EC Declaration of Conformity: (https://support.industry.siemens.com/cs/ww/en/view/58275445)
- Certificates for the relevant directives, prototype test certificates, manufacturers declarations and test certificates for functions relating to functional safety ("Safety Integrated"): (http://support.automation.siemens.com/WW/view/en/22339653/134200)
- Certificates of products that were certified by UL: (http://database.ul.com/cgi-bin/XYV/template/LISEXT/1FRAME/index.html)
- Certificates of products that were certified by TÜV SÜD: (https://www.tuev-sued.de/industrie_konsumprodukte/zertifikatsdatenbank)

Standards that are not relevant

China Compulsory Certification

The converters do not fall in the area of validity of the China Compulsory Certification (CCC).

Index

P

Q

S

T

Further information

SINAMICS converters:
www.siemens.com/sinamics

Industry Online Support (Service and Support):
www.siemens.com/online-support

Industry Mall:
www.siemens.com/industrymall

Siemens AG
Digital Industries
Motion Control
P.O. Box 3180
91050 Erlangen
Germany

Scan the QR code for additional information about SINAMICS G120.