SINAMICS G120

Power Module PM240

Hardware Installation Manual · 03/2013

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SINAMICS G120
Power Module PM240

Hardware Installation Manual

Edition 03/2013

03/2013
A5E00807525B AC

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

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Disclaimer of Liability

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

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Order number: A5E00807525B AC
℗ 03/2013 Technical data subject to change

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Introduction

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The SINAMICS G120 range

The SINAMICS G120 inverter has been designed for the accurate and efficient control of the speed and torque for three-phase motors. The SINAMICS G120 system comprises two basic modules, the Control Unit (CU) and the Power Module (PM).

Power Modules PM240

PM240 Power Modules are Power Modules with braking capacity (resistor braking). They are available in a rated-power range from 0.55 kW … 250 kW.

	IP20		Push through	
	Unfiltered	Filltered (class A)	Unfiltered	Filltered (class A)
FSA	0.55 kW … 3 kW	0.55 kW … 2.2 kW	3 kW	2.2 kW
FSB	2.2 kW … 4 kW	2.2 kW … 4 kW	---	---
FSC	7.5 kW … 15 kW	7.5 kW … 15 kW	---	---
FSD	18.5 KW… 30 kW	18.5 KW… 30 kW	---	---
FSE	37 kW … 45 kW	37 kW … 45 kW	---	---
FSF	55 kW … 132 kW	55 kW … 90 kW	---	---
FSGX	160 kW … 250 kW	---	---	---

Note

Rated power is based on the rated output current I_{rated}. The rated output current I_{rated} is based on the duty cycle for low overload (LO).

Variants of the Power Modules

The following variants of Power Modules are available

- **FSA … FSF:** as IP 20 unit for mounting and cooling inside a cabinet.
- **FSA and FSB:** as Push-Through unit with external air cooling.
- **FSGX** available as IP XXB unit for mounting and cooling inside a cabinet.

Block diagram

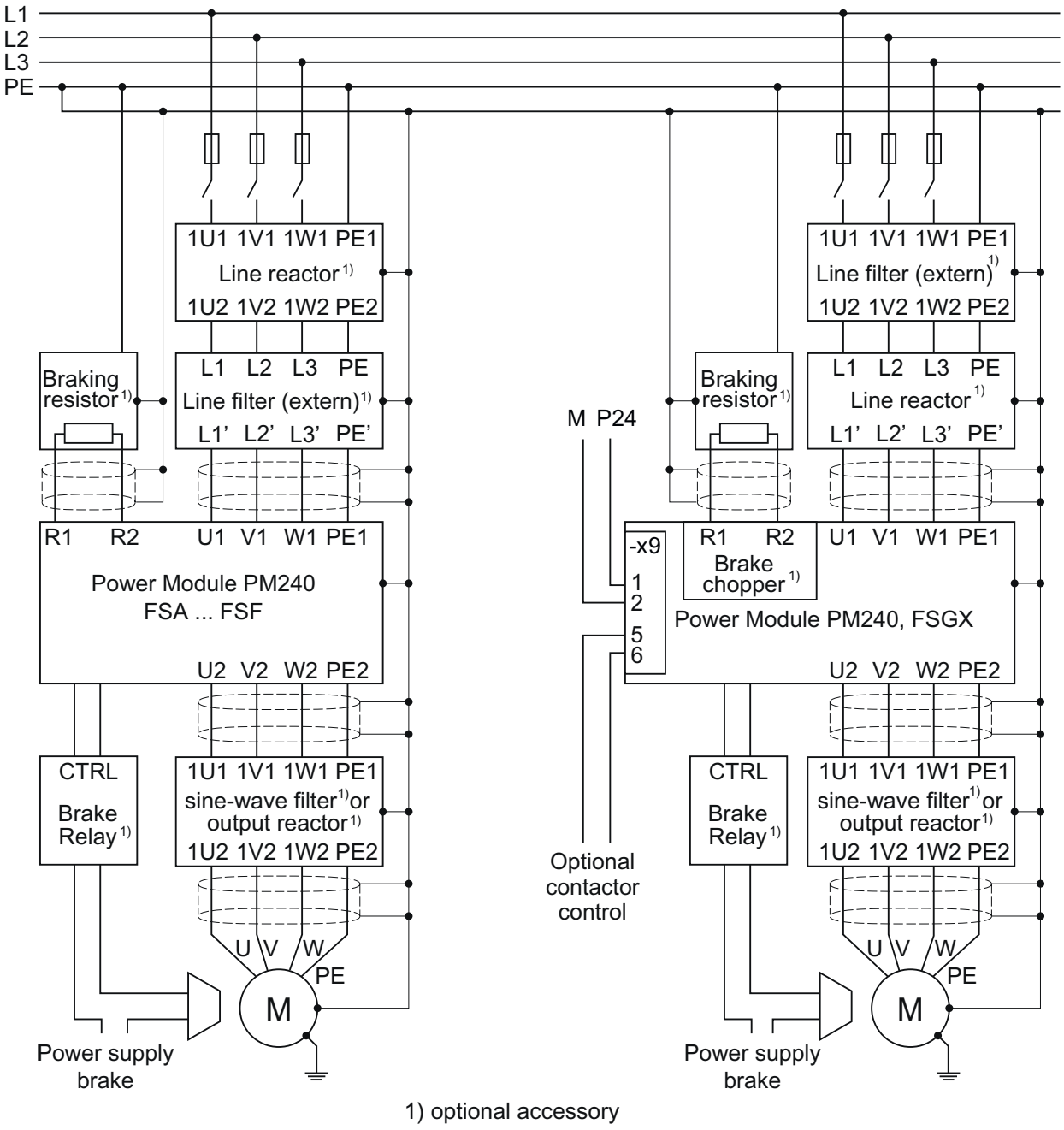


Figure 1-1 Power Modules PM240

Available technical documentation

Comprehensive information and support tools are available from the Service and Support internet site

- http://support.automation.siemens.com

You find there the following types of documentation:

- Getting Started
- Operating Instructions
- Hardware Installation Manual
- Function Manual
- Parameter Manual
- Product Information

Further internet addresses

You can download the respective documents for your inverter under the following links:

- SINAMICS G110
  http://www.siemens.com/sinamics-g110
- SINAMICS G120
  http://www.siemens.com/sinamics-g120
- SINAMICS G120D
  http://www.siemens.com/sinamics-g120d

Application examples

You find various application examples to the inverters under the following link:

- http://support.automation.siemens.com/WW/view/en/20208582/136000

Safety notes

2

Safety Instructions

The following Warnings, Cautions and Notes are provided for your safety and as a means of preventing damage to the product or components in the connected machines. This section lists Warnings, Cautions and Notes, which apply generally when handling the inverter, classified as General, Transport and Storage, Commissioning, Operation, Repair and Dismantling and Disposal.

Specific Warnings, Cautions and Notes that apply to particular activities are listed at the beginning of the relevant sections in this manual and are repeated or supplemented at critical points throughout these sections.

Please read the information carefully, since it is provided for your personal safety and will also help prolong the service life of your inverter and the equipment to which it is connected.

Commissioning

⚠ WARNING

Working on the equipment by unqualified personnel or failure to comply with warnings can result in severe personal injury or serious damage to material. Only suitably qualified personnel trained in the setup, installation, commissioning and operation of the product should carry out work on the equipment.

⚠ CAUTION

Cable connection

The control cables must be laid separately from the power cables. Carry out the connections as shown in the installation section in this manual, to prevent inductive and capacitive interference from affecting the correct function of the system.

Mechanical Installation

⚠WARNING

To ensure the safe operation of the equipment, it must be installed and commissioned by qualified personnel in full compliance with the warnings laid down in this manual.

Take particular note of the general and regional installation and safety regulations regarding work on dangerous voltage installation (e.g. EN 61800-5-1) as well as the relevant regulations regarding the correct use of tools and personal protective equipment (PPE).

Prerequisites

If the inverter is installed properly, mains and motor connections can be established. It is urgently requiered to comply with the following notes:

⚠WARNING

Mains and motor connections

A fixed location, non varying connection is necessary because of a leakage current.

Isolate the mains electrical supply before making or changing connections to the unit.

The terminals of the Inverter can carry dangerous voltages even if the inverter is inoperative. Wait at least 5 minutes to allow the unit to discharge after switching off the mains supply before carrying out any installation work.

When connecting the mains supply to the inverter, make sure that the terminal case of the motor is closed.

When changing from the ON to OFF-state of an operation if an LED or other similar display is not lit or active; this does not indicate that the unit is switched-off or powered-down.

Ensure that the line voltage corresponds to the inverter input voltage – the inverter must not be connected to a higher line voltage.

Grounding and Protective earthing conductor current

The inverter must always be grounded. If it is not grounded correctly, extremely dangerous conditions may arise which could prove potentially fatal.

As the earth leakage for the inverter can be greater than AC 3.5 mA, a fixed earth connection is required and the minimum size of the protective earth conductor shall comply with the local safety regulations for high leakage current equipment.

In the case of doubt, use for grounding the same cable cross section as for the power cable, but at least 2.5 mm^2.

⚠ CAUTION

Operation with ungrounded (IT) supplies

Inverters with built-in filters or external filters can only be used in power systems with grounded starpoint and must not be used with IT or TT supplies.

If the inverter, connected to an IT supply, is required to remain operational if an output phase is connected to ground, the output reactor must be fitted to prevent overcurrent tripping or damage to the drive. The probability of overcurrent tripping without output reactor increases with the size of the IT supply.

⚠ CAUTION

Operation with Residual Current Devices (RCD) or Monitoring (RCM) - only for FSA / FSB

The inverter can cause a DC current in the protective earthing conductor.

If an RCD - residual current-operated protective device (also referred to as an ELCB or a RCCB) or an RCM - residual current-operated monitoring device - is fitted for protection in case of direct or indirect contact, the inverter will operate without nuisance tripping provided that:

- An RCD/RCM type B superresistant is used (e.g. a SIQUENCE circuit breaker by Siemens).
- The trip limit of the RCD/RCM is 300 mA
- The neutral of the supply is grounded
- Only one inverter is supplied from each RCD/RCM
- The output cables are less than 50 m screened

If no RCD/RCM is used, the touch protection can be achieved by double insulation or by separating the inverter from the mains system using a transformer.

Note

Ensure that the appropriate circuit-breakers or fuses with the specified current rating are connected between the power supply and the inverter. The technical data contain information about the circuit breaker and fuses (see Specifications).

⚠ WARNING

Protective earthing conductor current

As the earth leakage for the inverter can be greater than AC 3.5 mA, a fixed earth connection is required and the minimum size of the protective earth conductor shall comply with the local safety regulations for high leakage current equipment.

The inverter can cause a DC current in the protective earthing conductor. Where a residual current-operated protective (RCD) or monitoring (RCM) device is used for protection in case of direct or indirect contact, only an RCD or RCM of Type B superresistant is allowed on the supply side of the inverter.

It has to be ensured by the machine manufacturer, that the line-side overcurrent protection equipment interrupts within 5 s (immovable equipment and modules in immovable equipment) in the case of minimum fault current (current on complete insulation failure to accessible conductive parts that are not live during operation and maximum current loop resistance).

⚠DANGER

Hazardous voltage!

Also after switching off the power supply, hazardous voltages are present for up to 5 minutes.

Do not carry out any installation work before this time has expired.

General

⚠WARNING

This equipment controls potentially dangerous rotating mechanical parts.

Protection in case of direct contact by means of voltages < 60V (PELV = Protective Extra Low Voltage acc. to EN 61800-5-1) is only permissible in areas with equipotential bonding and in dry indoor rooms. If these conditions are not fulfilled, other protective measures against electric shock are to be taken, e.g., protective insulation.

The converter must always be properly grounded. Since the residual current for this product is greater than 3.5mA AC, a fixed ground connection is required, and the minimum size of the protective conductor must comply with local safety regulations for equipment with a high leakage current.

Install the converter on a metal mounting plate in a control cabinet. The mounting plate must not must be painted and must have good electrical conductivity.

It is strictly prohibited for any mains disconnection to be performed on the motor-side of the system, if the converter is in operation and the output current is not equal to zero.

Take particular notice of the general and regional installation and safety regulations regarding work on dangerous voltage installations (e.g. 61800-5-1) as well as the relevant regulations regarding the correct use of tools and personal protective equipment (PPE).

⚠CAUTION

Static discharges on surfaces or interfaces (e.g. terminal or connector pins) can cause malfunctions or defects. ESD protective measures should therefore be observed when working with converters or converter components.

Transport and storage

⚠ CAUTION

Don't drop the converter or converter components during transport and storage. Protect the equipment from water (rainfall) and excessive temperatures.

Installation and Commissioning

⚠ WARNING

Wherever faults occurring in the control equipment can lead to substantial material damage or even grievous bodily injury (that is, potentially dangerous faults), additional external precautions must be taken or facilities provided to ensure or enforce safe operation, even when a fault occurs (e.g. independent limit switches, mechanical interlocks, etc.).

Operation

⚠ DANGER

Operating the converter outside the scope of the specification given in the technical specifications may cause malfunction or damage to the converter components. In exceptional cases there is the potential to cause overheating, danger of fire, damage to property, personal injury or loss of life.

⚠ WARNING

Emergency stop facilities according to EN 60204, IEC 204 (VDE 0113) must remain operative in all operating modes of the control equipment. Any disengagement of the emergency stop facility must not lead to an uncontrolled or an undefined restart of the equipment.

⚠ WARNING

Use of mobile radio devices (e.g. telephones, walkie-talkies) in the immediate vicinity of the devices (< 1.8 m) can interfere with the functioning of the equipment.

⚠ WARNING

Filtered drives can only be used on power systems with grounded neutral point.

⚠ WARNING

During operation and for a short time after switching-off the converter, the surfaces of the converter can reach a high temperature. Avoid coming into direct contact with the converter surface.

Repair

⚠ WARNING

Repairs on equipment may only be carried out by Siemens Service, by repair centers authorized by Siemens or by authorized personnel who are thoroughly acquainted with all the warnings and operating procedures contained in this manual.

Any defective parts or components must be replaced using parts contained in the relevant spare parts list.

Dismantling and disposal

NOTICE

The packaging of the inverter is re-usable. Retain the packaging for future use.

Easy-to-release screw and snap connectors allow you to break the unit down into its component parts. You can recycle these component parts, dispose of them in accordance with local requirements or return them to the manufacturer.

Installing/Mounting

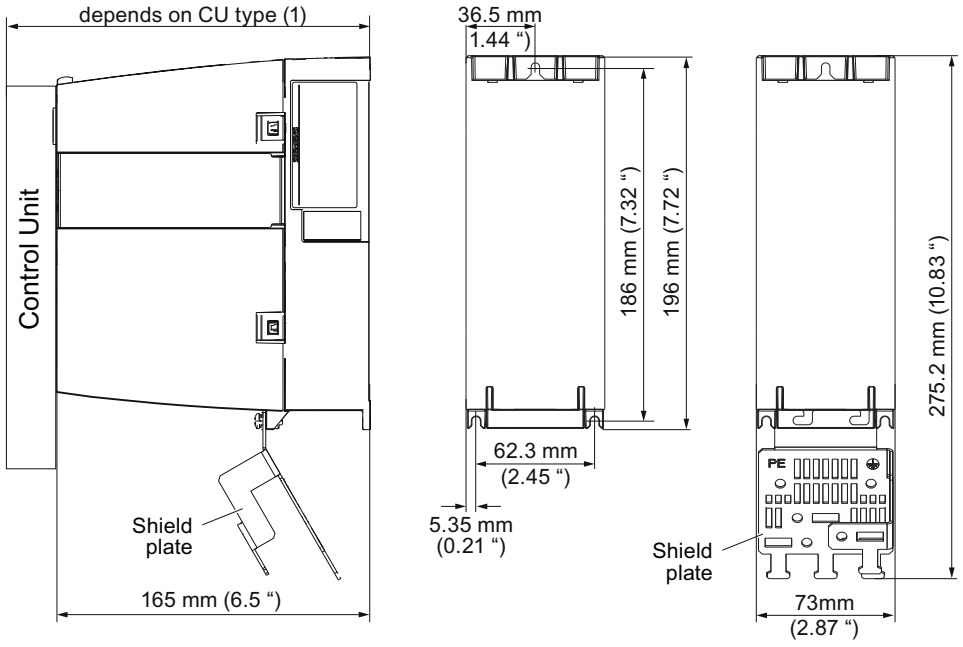
3

3.1 Dimensions and drill pattern

Dimensions, drill patterns and minimum distances

The dimension drawings shown in the following figures are not true to scale.

Power Module PM240, FSA, IP 20



(1): 229 mm: with CU240S or CU230P-2
204 mm: with CU240B or CU240E

For fixing: 3 bolts M4
3 Nuts M4
3 washers M4

Tightening torque 2.5 Nm (22.1 lbf.in)

Figure 3-1 Dimensions and drill pattern for Power Module PM240, FSA, IP 20

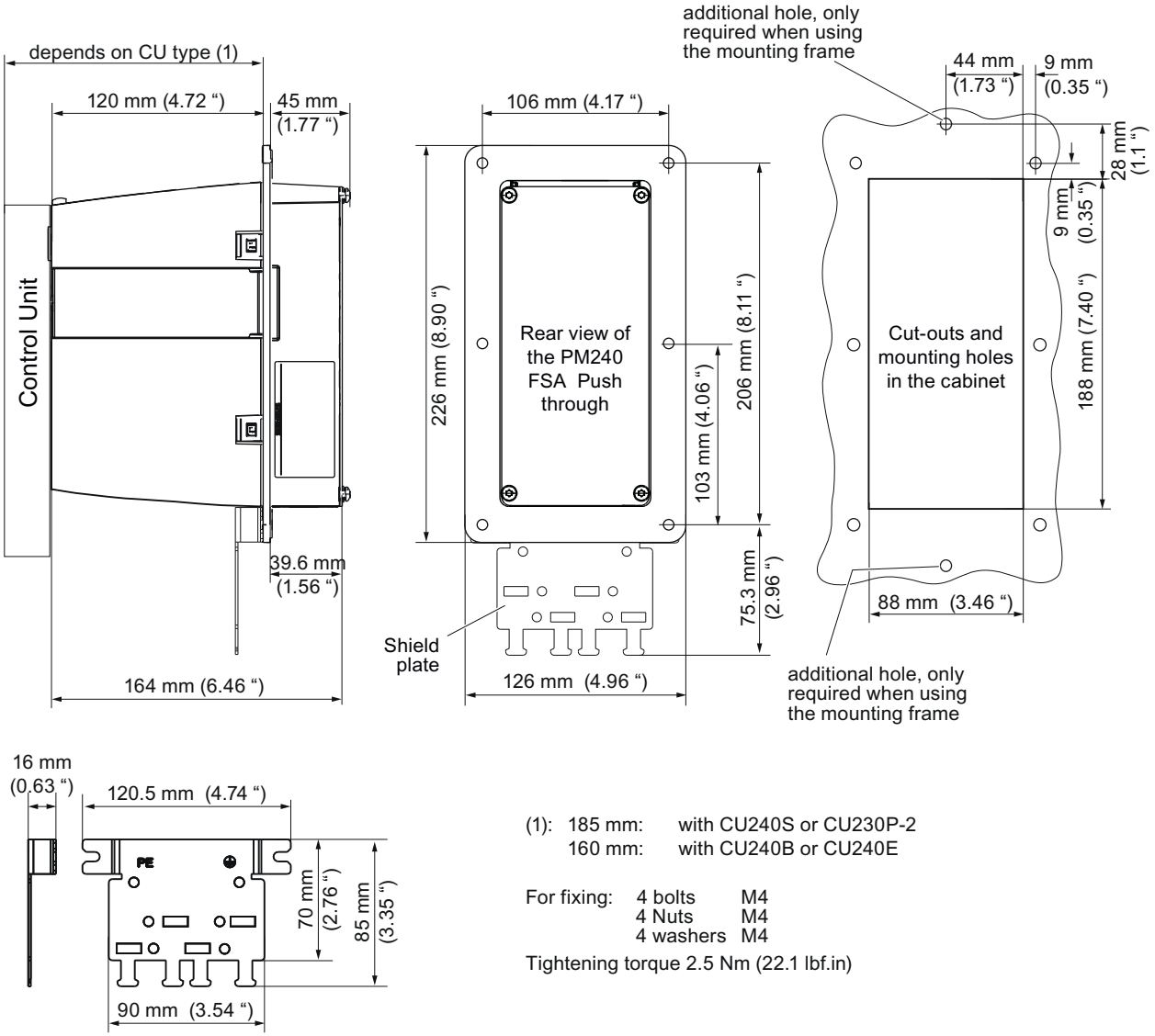
Distances to other euipment:

above and below: 100 mm (3.94 ")

side by side:

- none, if environmental temperature < 40 °C (104° F)
- otherwise 30 mm (1.18 ").

Power Module PM240, FSA, Push Through



(1): 185 mm: with CU240S or CU230P-2
160 mm: with CU240B or CU240E

For fixing: 4 bolts M4
4 Nuts M4
4 washers M4

Tightening torque 2.5 Nm (22.1 lbf.in)

Figure 3-2 Dimensions and drill pattern for Power Module PM240, FSA, Push Through

Distances to other euipment:

above and below: 100 mm (3.94 ")

side by side: None, referred to the heatsink frame

Power Module PM240, FSB, IP20

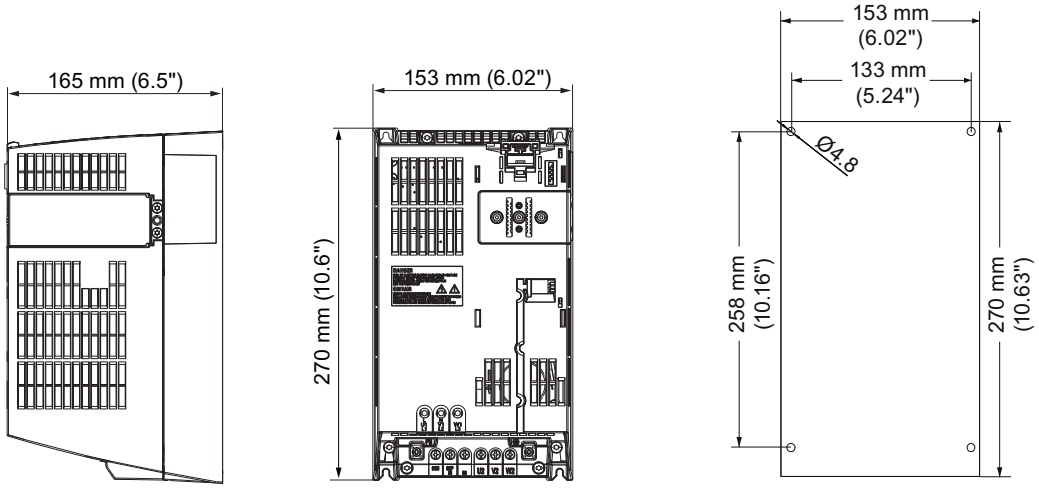


Figure 3-3 Dimensions and drill pattern for Power Module PM240, FSB, IP 20

Distances to other euipment:

above and below: 100 mm (3.94 ")

side by side:
- none, if environmental temperature < 40 °C (104° F)
- otherwise 30 mm (1.18 ").

Power Module PM240, FSC, IP20

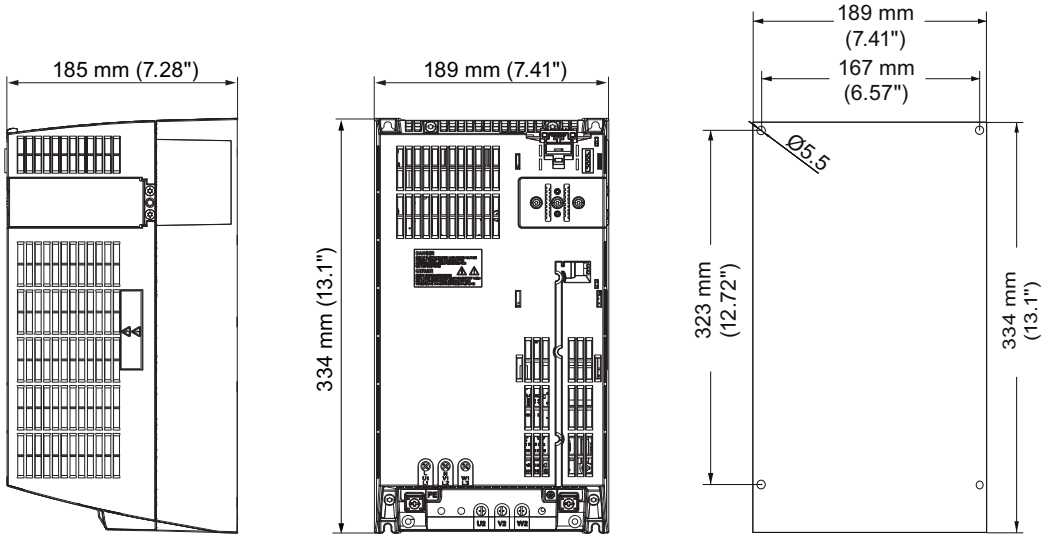


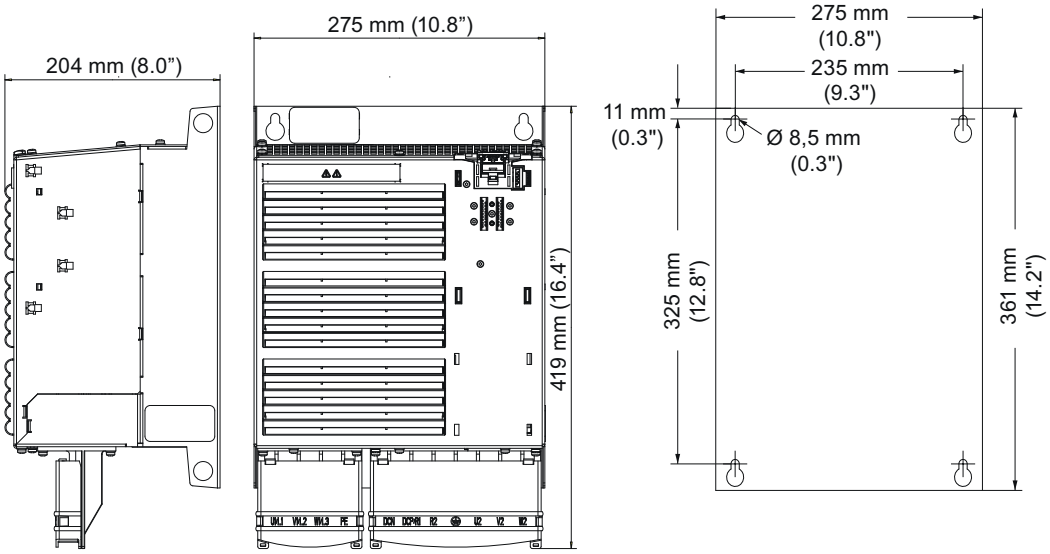
Figure 3-4 Dimensions and drill pattern for Power Module PM240, FSC, IP20

Distances to other euipment:

above and below: 125 mm (4.92 ")

side by side:
- none, if environmental temperature < 40 °C (104° F)
- otherwise 50 mm (1.96 ").

Power Module PM240, FSD, IP20



Height in combination with the screen termination kit (w/o Brake Relay):
540 mm (21.2 inch)

For fixing:
4 x M6 bolts
4 x M6 nuts
4 x M6 washers
Tightening torque: 6 Nm
53 lbf.in

Figure 3-5 Dimensions and drill pattern for Power Module PM240, FSD, IP20, without filter

Distances to other euipment:

above and below: 300 mm (11.81 ")

side by side: none

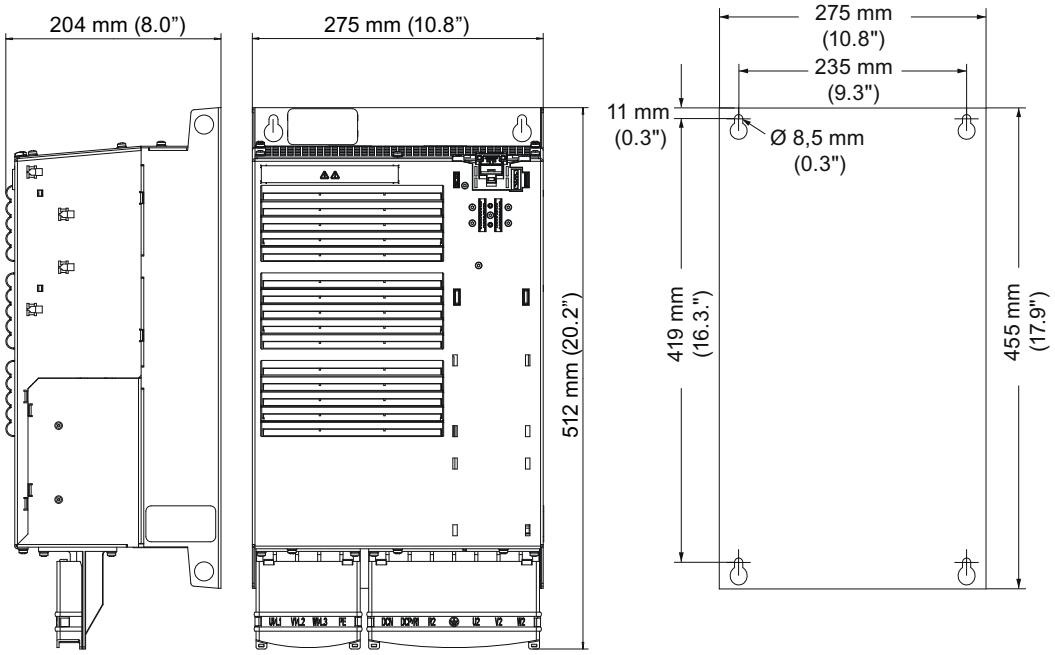


Figure 3-6 Dimensions and drill pattern for Power Module PM240, FSD, IP20, with integrated filter class a

Distances to other euipment:

above and below: 300 mm (11.81 ")

side by side: none

Power Module PM240, FSE, IP20

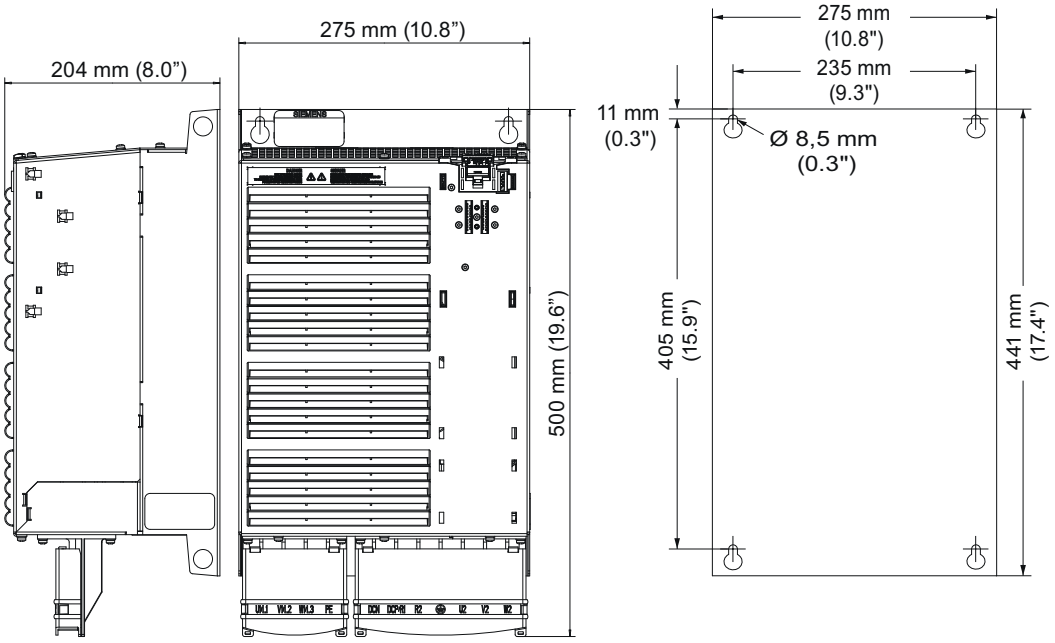
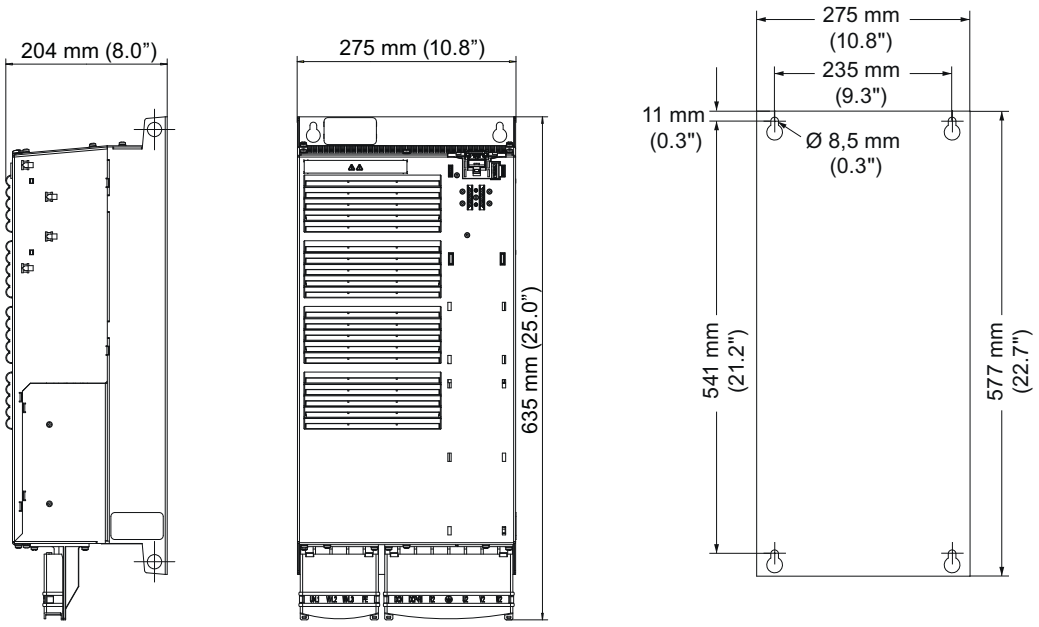


Figure 3-7 Dimensions and drill pattern for Power Module PM240, FSE, IP20, unfiltered

Distances to other euipment:

above and below: 300 mm (11.81 ")

side by side: none



Height in combination with the screen termination kit (w/o Brake Relay):
634 mm (25.0 inch)

For fixing:
4 x M6 bolts
4 x M6 nuts
4 x M6 washers
Tightening torque: 6 Nm
53 lbf.in

Figure 3-8 Dimensions and drill pattern for Power Module PM240, FSE, IP20, with integrated filter class a

Distances to other euipment:

above and below: 300 mm (11.81 ")

side by side: none

Power Module PM240, FSF, IP20

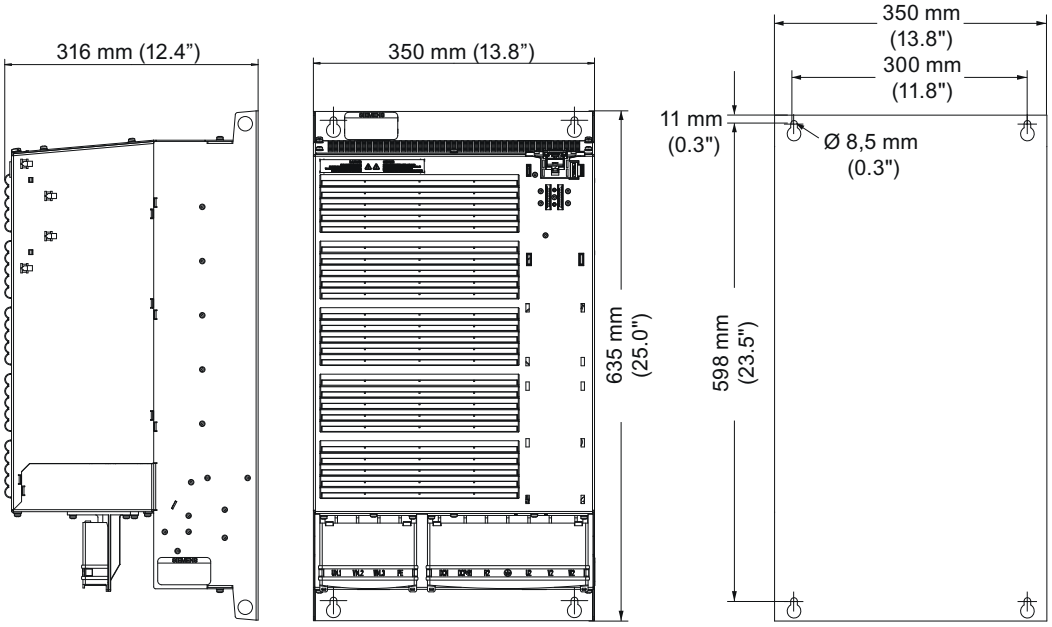


Figure 3-9 Dimensions and drill pattern for Power Module PM240, FSF, IP20, unfiltered

Distances to other euipment:

above and below: 350 mm (13.78 ")

side by side: none

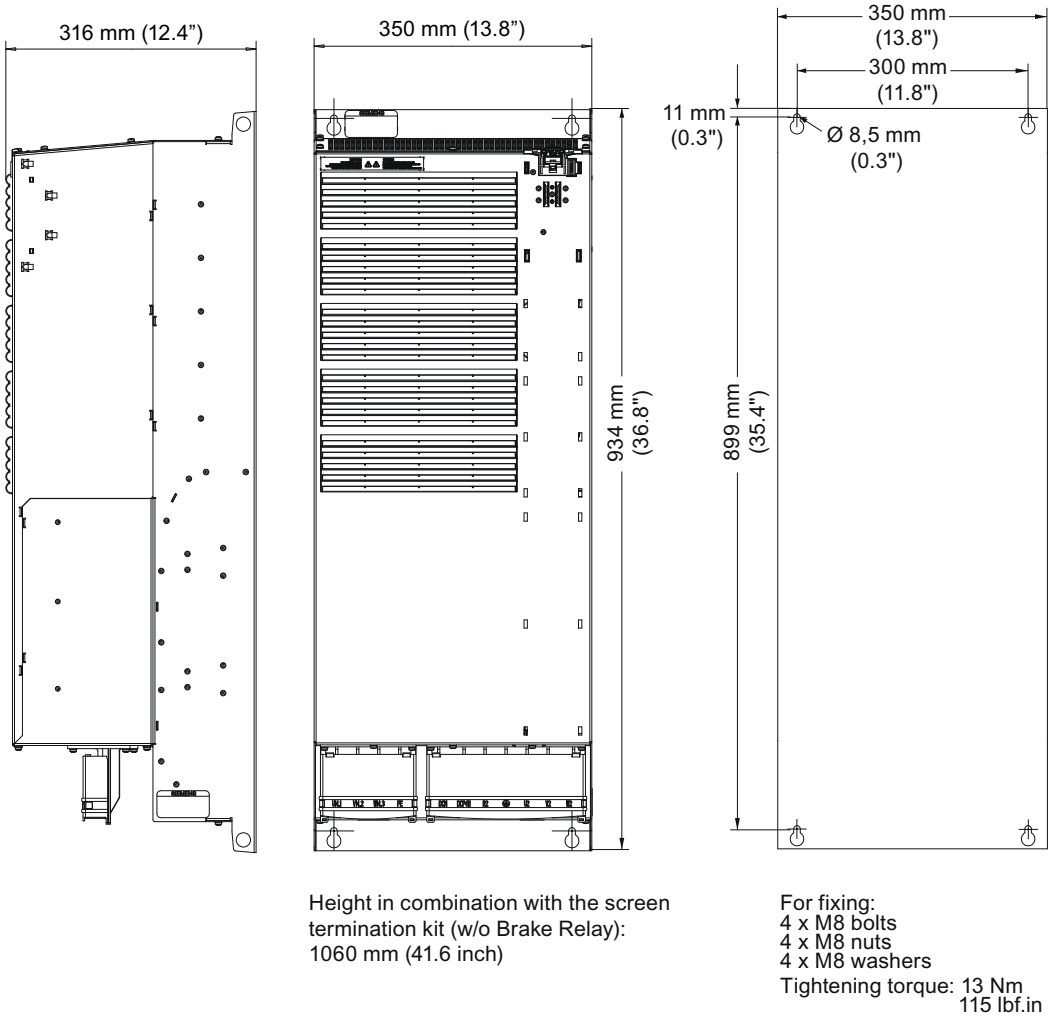


Figure 3-10 Dimensions and drill pattern for Power Module PM240, FSF, IP20, with integrated filter class a

Distances to other euipment:

above and below: 300 mm (11.81 ")

side by side: none

Power Module PM240, FSF, IP20

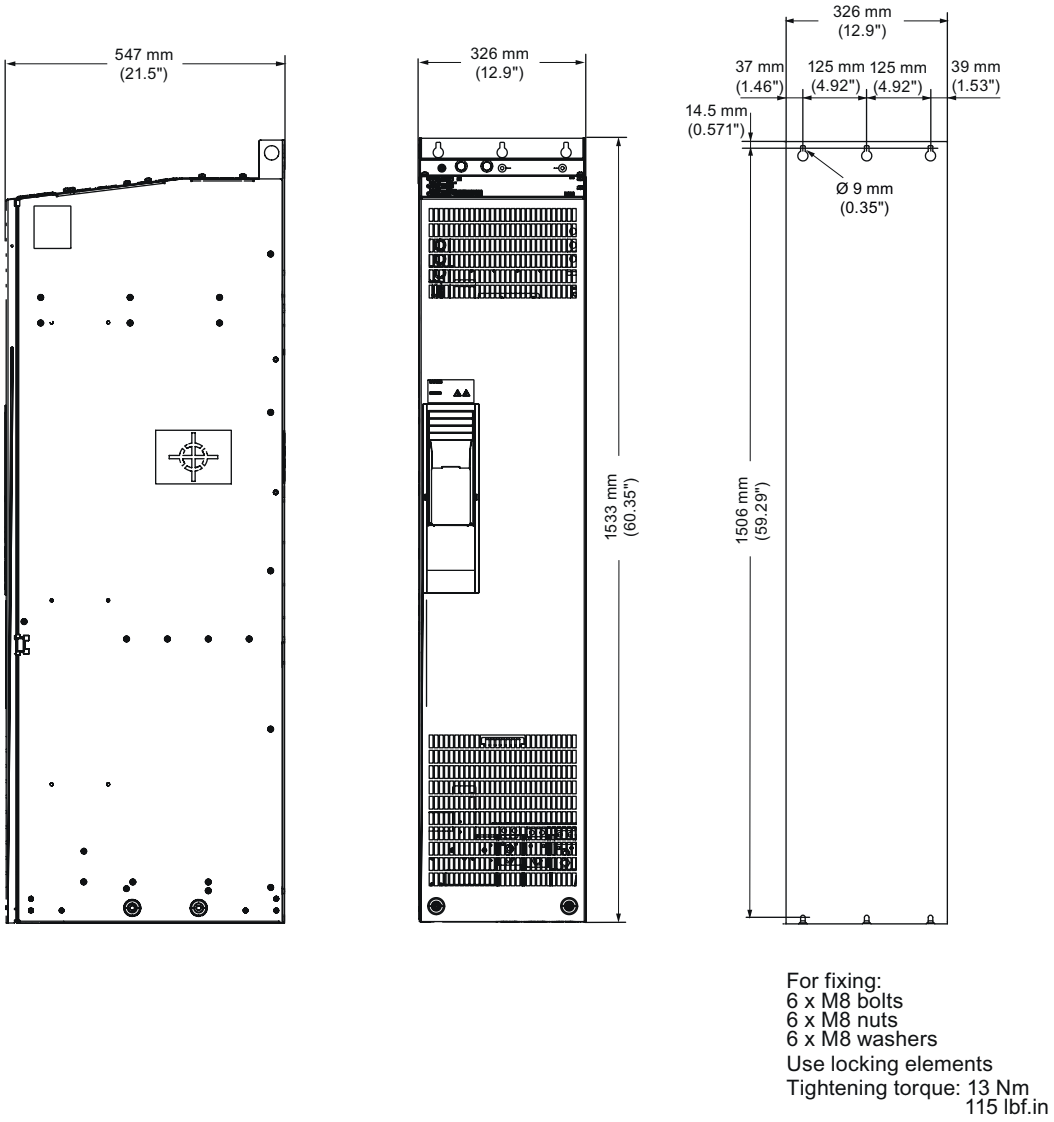


Figure 3-11 Dimensions and drill pattern for Power Module PM240, FSGX, IP20, unfiltered

Distances to other euipment:	above:	300 mm (11.81 ")
	below:	300 mm (11.81 ")
	side by side:	None
	In front:	50 mm (1.97 ")

⚠ WARNING

To ensure the safe operation of the equipment, it must be installed and commissioned by qualified personnel in full compliance with the warnings laid down in this manual.

Take particular note of the general and regional installation and safety regulations regarding work on dangerous voltage installation (e.g. EN 61800-5-1) as well as the relevant regulations regarding the correct use of tools and personal protective equipment (PPE).

General rules for the environmental protection of the Power Modules

To ensure that the power module is installed in the correct environmental conditions, please ensure that you adhere to the following guidelines:

- The Power Modules are designed to be installed in an electrical cabinet
- The Push-Through Power Modules are designed to be mounted into a rectangular hole in an electrical cabinet, with the electrical part as IP 20 inside the cabinet and the heatsink as IP 54 outside the cabinet.
- IP 20 Power Modules are protected from the ingress of solid foreign objects ≥ 12.5 mm (≥ 0.49 inches)
- The Power Modules are not protected against the ingress of water
- Keep the Power Modules free from dust and dirt
- Keep the Power Modules away from water, solvents and chemicals
  Take care to site the Power Modules away from potential water hazards, for example, do not install the Power Modules beneath pipes that are subject to condensation. Avoid installing the Power Modules where excessive humidity and condensation may occur
- Keep the Power Modules within the maximum and minimum operating temperatures
- Ensure that the correct level of ventilation and air flow is provided
- Ensure that earthing and grounding practices for each Power Module and the cabinet follows the guidelines given in section Auto hotspot.

⚠ CAUTION

The SINAMICS G120 Power Modules MUST NOT be mounted horizontally.

See also

ESD guidelines (Page 49)

3.2 Air cooling requirements

Air cooling requirements

Table 3- 1 Air cooling requirements for operation with rated power

Frame size	Rated power	Required cooling air flow	
FSA	0.37 kW … 1.5 kW	4.8 l/s	10 CFM
FSA Push-Through	0.37 kW … 1.5 kW	4.8 l/s	10 CFM
FSB	2.2 kW ... 4 kW	24 l/s	51 CFM
FSC	7.5 kW ... 15 kW	38 l/s	81 CFM
FSD	18.5 kW ... 30 kW	55 l/s	120 CFM
FSE	37 kW	55 l/s	120 CFM
	45 kW	110	230 CFM
FSF	55 kW ... 132 kW	150 l/s	320 CFM
FSGX	160 kW ... 250 kW	360 l/s	760 CFM

Table 3- 2 Power losses of the Power Module and of Power Module components in Watt

	Power losses of … [W]					
For Power Module	Power Module	Control Unit	Line reactor	Line filter	Output reactor	Sine-wave filter
FSA	100 … 110	< 40	6 … 12	0.5 … 1.5	5	32 … 60
FSA Push-Through	100 … 110	< 40	6 … 12	0.5 … 1.5	5	32 … 60
FSB	140 … 180	< 40	9 … 27	2.0 … 4.0	20	65 … 110
FSC	240 … 400	< 40	37	7.5 … 15	60	120 … 200
FSD	440 … 720	< 40	90		200	235 … 190
FSE	1000 … 1300	< 40	170		200 … 270	305
FSF	1500 … 2500	< 40	210 … 280	60	500	350 … 575
FSGX	3900 … 5500	< 40	230 … 310	60	470 … 500	250 … 380

The given power losses of Power Module, output reactor and sine-wave filter are valid for:

- Rated output current
- 50 Hz output frequency
- 4 kHz pulse frequency (2 kHz pulse frequency for rated power > 75 kW)

The given power losses of line reactor and line filter are valid for:

- Rated input current
- 50 Hz line frequency

Further information is given in the technical specifications.

Cooling requirements

Depending on the power losses of the various components a specific cooling air flow is required to protect the components from overheating. The following procedure shows how to calculate the required air flow.

1. Add the power losses of the respective components
2. Calculate the airflow required, using the formula

$$\text{Air flow [l/s]} = \frac{\text{Power loss [W]}}{\Delta T\ [K]} * 0.86$$

ΔT: allowable temperature rise in the cabinet

3. Ensure that no equipment is installed that has a negative influence on the flow of the cooling air.
4. Ensure that the cooling vents in the Power Module are positioned correctly to allow the free movement of air.
5. Avoid short circuits of the cooling air using air barriers, if necessary

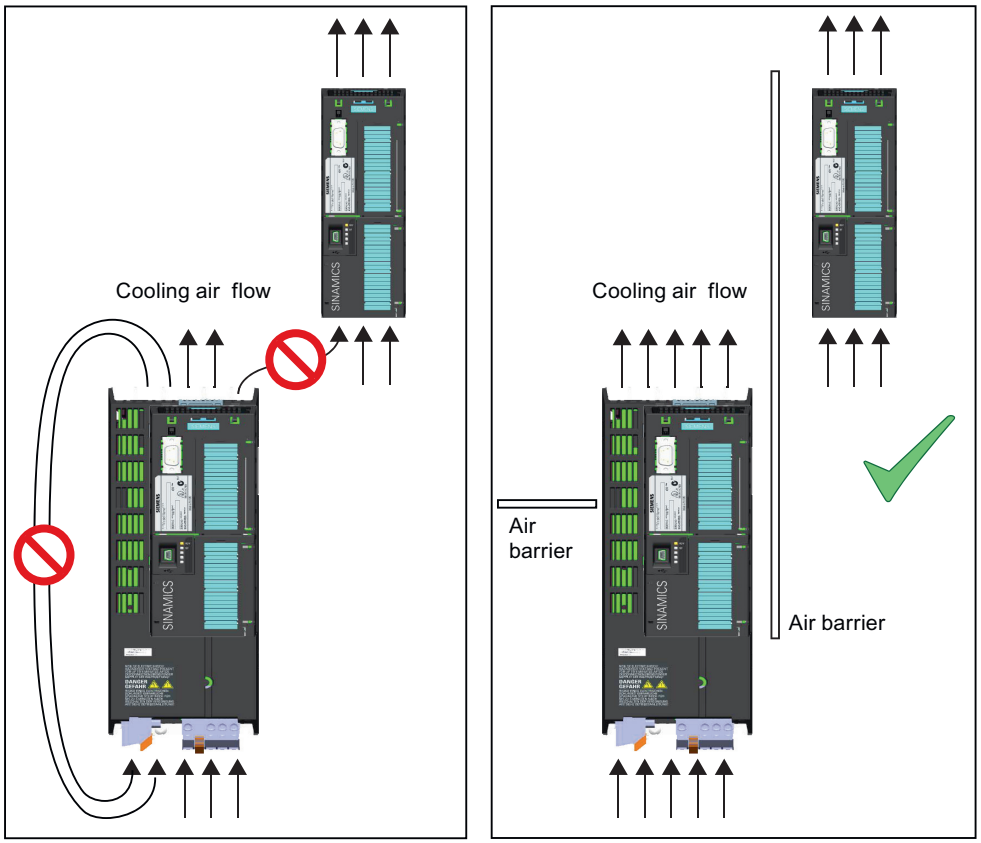


Figure 3-12 Air barriers for avoiding cooling air short circuits

6. Provide an adequate cabinet with sufficient ventilation and suitable air filters.

3.3 Control Unit installation

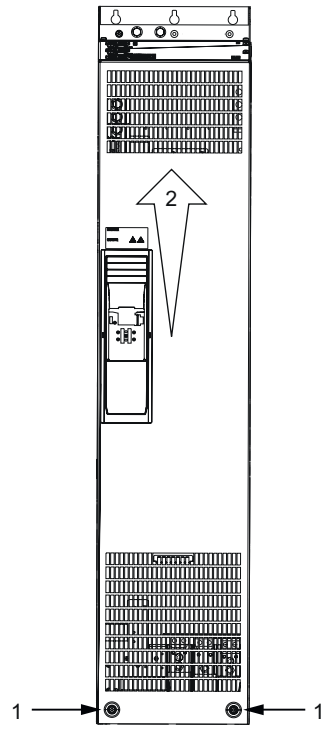
Fitting the CU to the Power Module FSGX

The FSGX is build into a housing. To get access to the Power Module you have to remove the front panel first like described below. The procedure of fitting and removing the Control Unit is unique to the ohter frame sizes.

Unscrew the two fixing screws at the bottom of the front panel.

Push the cover upwards and remove it.

Then performe as described for the other frame sizes (see previous page).

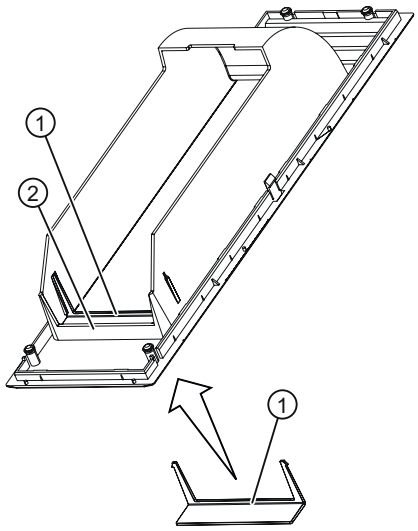
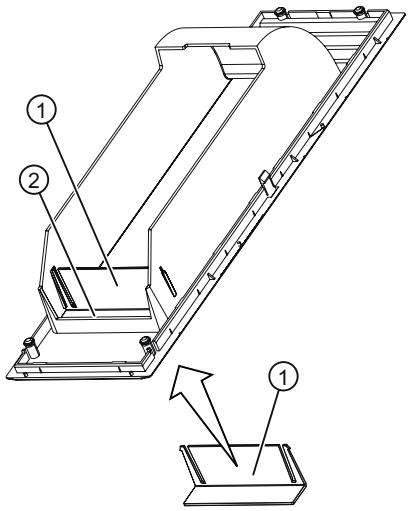


Remove front panel

Adapting the CU frame of the Power Module front cover

A plastic frame in the front cover of the Power Module ensures the IP20 or IPXXB protection class of the inverter. This plastic frame has to be adapted to the Control Unit:

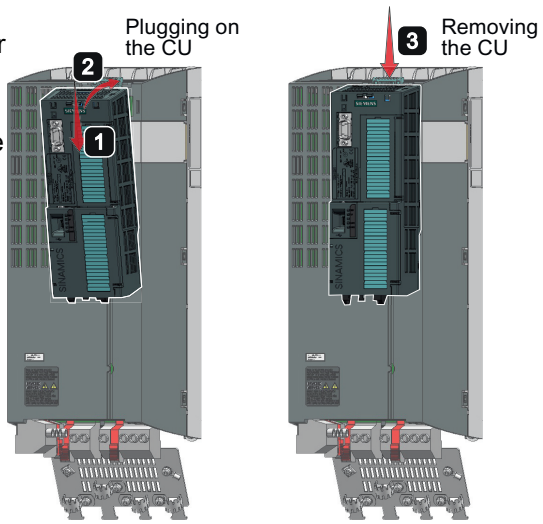
- The frame can be adapted by removing its bottom
- The plastic insert can be reduced or removed

Control Unit **Actions to take**	**Frame adaptation** **(view from behind)**
CU240S CU240S DP CU240S DP-F CU240S PN CU240S PN-F ① Reduce the insert ② Remove the bottom of the frame IP20 protection is ensured with a correctly adapted frame and with the Control Units listed above.	
CU240E ① Use the insert as it is ② Remove the bottom of the frame IPXXB protection is ensured with a correctly adapted frame and with the Control Unit CU240E	

Fitting the CU to the Power Module

The Control Unit is snapped onto the Power Module as shown in the figure. To disconnect the CU push the release button on top of the PM.

The process of fitting the Control Unit to the Power Module is the same technique independent from the type of Control Unit or Power Module.



Fitting the Control Unit to the Power Module

Connecting

4

4.1 Operation with ungrounded (IT) supplies

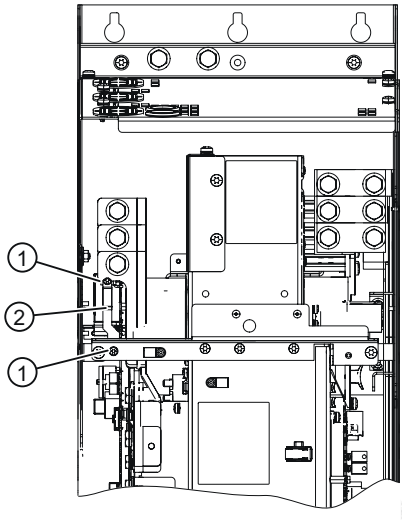
Operation with ungrounded (IT) supplies

IT supplies are fully isolated from the protective earth system, usually by an isolating transformer. It should be noted, however, that a protective earth is still provided.

⚠ WARNING
Power Modules with built-in filters or external filters must not be used with IT supplies.

If the Power Module connected to an IT supply is required to remain operational if an input or output phase is connected to ground, then an output reactor must be fitted to prevent overcurrent tripping. The probability of overcurrent tripping without output reactor increases with the size of the IT supply.

⚠ WARNING
Power Module FSGX from an IT power system If the Power Module FSGX is operated from a non-grounded supply/IT system, the connection bracket for the noise suppression capacitor of the Power Module must be removed as shown in the following figure. Failing to remove the connection bracket for the noise suppression capacitor on a non-grounded system/IT system can cause significant damage to the built-in unit. Operation of the Power Modules without a protective earth is not permitted under any circumstances.



1: Remove the two retaining screws
2: Remove the connection bracket

4.2 Motor cable length and cross section

Permissible Cable Length

The use of unshielded motor cables is possible. However to meet C2 EMI class, shielded cables with appropriate EMI installation are required.

Table 4- 1 The inverters will operate at full specification with cable lengths as follows

Using		FSA	FSB … FSGX
		0.55 kW … 3 kW	7.5 kW … 90 kW
screened cables	filtered Units	50 m (55 yd.)	25 m (27 yd.)
	unfiltered Units	50 m (55 yd.)	50 m (55 yd.)
unscreened cables, filtered or unfiltered Units		100 m (110 yd.)	100 m (110 yd.)

Table 4- 2 Using an output reactor or a sine-wave filter as specified in the catalog, the following cable lengths are possible

Using		FSA	FSB, FSC	FSD … FSF	FSGX
		0.55 kW … 1.5 kW	2.2 kW … 15 kW	18.5 kW … 132 kW	160 kW … 250 kW
an output reactor with	screened cables	150 m (165 yd.)	100 m (110 yd.)	200 m (220 yd.)	200 m (220 yd.)
	unscreened cables	300 m (330 yd.)	150 m (165 yd.)	300 m (330 yd.)	450 m (490 yd)

Using		FSA	FSB, FSC	FSD ... FSF	FSGX
		0.55 kW ... 1.5 kW	2.2 kW ... 15 kW	18.5 kW ... 132 kW	160 kW ... 250 kW
a sine-wave filter with	screened cables	----	200 m (220 yd.)	200 m (220 yd.)	200 m (220 yd.)
	unscreened cables	----	300 m (330 yd.)	300 m (330 yd.)	450 m (490 yd)

NOTICE

Laying control and power cables

The control cables must be laid separately from the power cables. The connection must be carried out as shown in the installation section in this manual, to prevent inductive and capacitive interference from affecting the correct function of the system.

Note

Ensure that the appropriate circuit-breakers or fuses with the specified current rating are connected between the power supply and the inverter. The technical specifications contain information about the circuit breaker and fuses. See Auto hotspot.

Table 4- 3 Cable cross section

Frame size	Cable cross section		Tightening torques	
kW	mm²	AWG	Nm	lbf in
FSA				
0.37:	1.0 … 2.5	18 … 14	1.1	9.7
0.55:	1.0 … 2.5	18 … 14	1.1	9.7
0.75:	1.0 … 2.5	18 … 14	1.1	9.7
1.1:	1.0 … 2.5	18 … 14	1.1	9.7
1.5:	1.0 … 2.5	18 … 14	1.1	9.7
FSB				
2.2:	1.5 … 6.0	16 … 10	1.5	13
3:	1.5 … 6.0	16 … 10	1.5	13
4:	2.5 … 6.0	14 … 10	1.5	13
FSC				
5.5:	4.0 … 10	12 … 8	2.3	20
7.5:	4.0 … 10	12 … 8	2.3	20
11:	6.0 … 10	10 … 8	2.3	20
FSD				
15:	10 … 35	7 … 2	6	53
18.5:	10 … 35	7 … 2	6	53
22:	16 … 35	5 … 2	6	53

Frame size	Cable cross section		Tightening torques	
kW	mm²	AWG	Nm	lbf in
FSE				
30:	25 … 35	3 … 2	6	53
37:	25 … 35	3 … 2	6	53
FSF				
45:	35 … 120	2 … 4/0	13	115
55:	70 … 120	2/0 … 4/0	13	115
75:	95 … 120	3/0 … 4/0	13	115
90:	95 … 120	3/0 … 4/0	13	115
110:	95 … 120	3/0 … 4/0	13	115
FSGX				
132	95 ... 2 x 240	3/0 … 2 x 600	14	120
160	120 ... 2 x 240	4/0 … 2 x 600	14	120
200	185 ... 2 x 240	6/0 … 2 x 600	14	120

⚠ CAUTION

Cable cross section for grounding

For power cables up to 10 mm² (Cu) or 16 mm² (Al) the earth cable must be at least as big as the power cables.

For power cables larger than 10 mm² (Cu) or 16 mm² (Al) the earth cable must be at least 10 mm² (Cu) or 16 mm² (Al), but need not exceed these sizes.

NOTICE

Copper conductors for UL applications

For UL applications, use 60 / 75° C copper conductors only

4.3 Access to power and motor terminals

Accessing the power and motor terminals

The terminals for frame size A to C can be accessed directly, without removing any cover.

The FSA Power Modules are fitted with two-part-connectors. The removable part of the connector can be unplugged from the power module by pressing the yellow locking latch. The connectors cannot be interchanged.

Frame sizes A … C have no terminal covers.

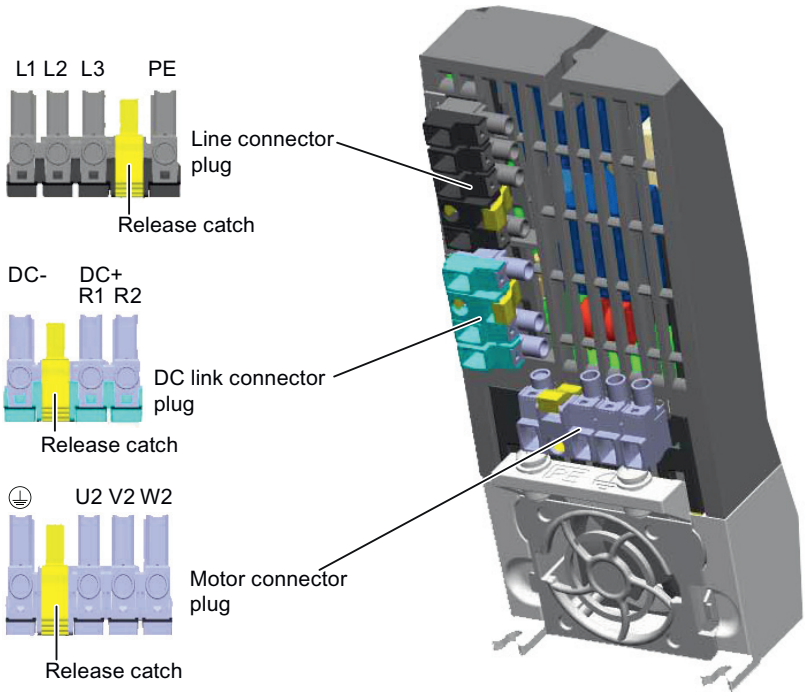


Figure 4-1 FSA connectors for line, dc-link and motor connection

Frame sizes D … F terminal covers are accessed by the following steps, as shown in the figure below:

1. Release the latch on each side of the terminal covers with a suitable flat-bladed screwdriver
2. Push the cover upwards
3. Lock the cover into position

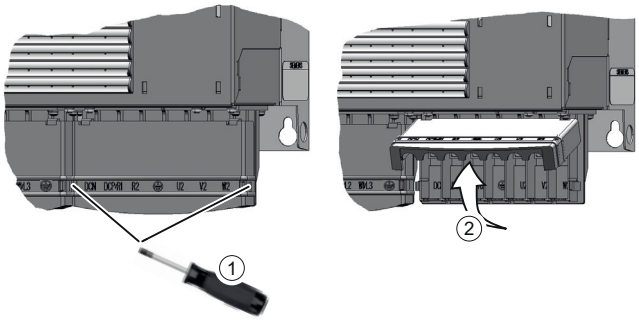
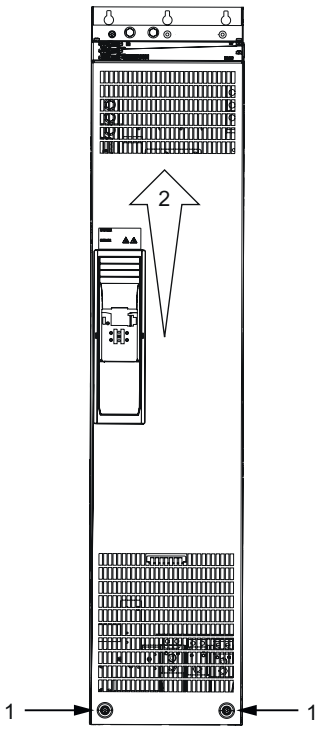


Figure 4-2 Access the power and motor terminals on FSD … FSF

The terminals of FSGX are accessed by removing the front cover:



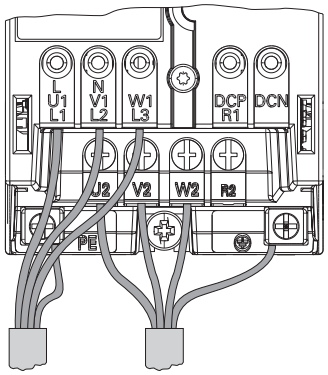
1. Unscrew the two fixing screws at the bottom of the front cover
2. Push the cover upwards and remove it

4.4 Power and motor connections

Power and motor terminal layout

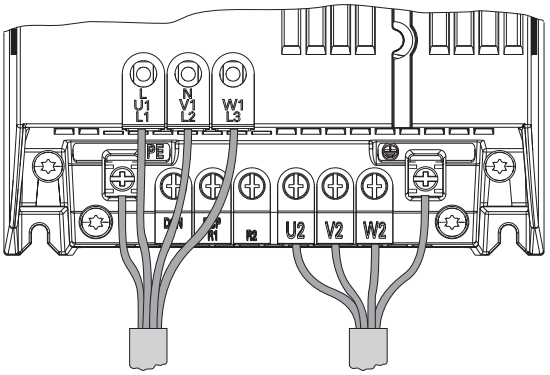
The figures below show the layout of the power and motor terminals of the Power Module. The figure also includes the tightening torques for the terminals.

FSA: 1.1 Nm/9.7 lbf.in



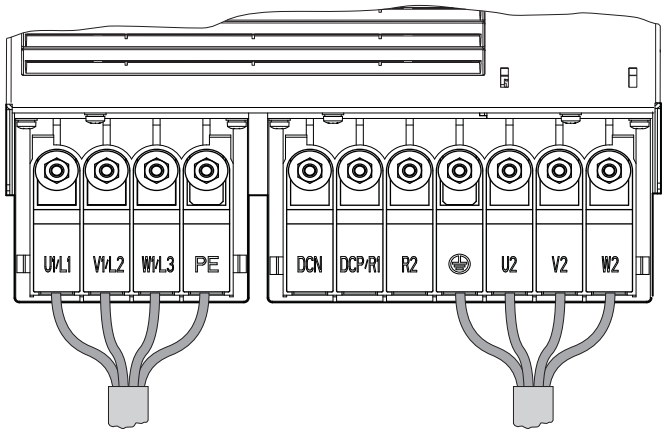
Supply voltage connection Motor connection

FSB: 1.5 Nm/13.27 lbf.in
FSC: 2.25 Nm/19.91 lbf.in



Supply voltage connection Motor connection

FSD/E: M6: 6 Nm/53 lbf.in
FSF: M8: 13 Nm/115 lbf.in



Supply voltage connection Motor connection

Figure 4-3 Power and motor terminal layout for the FSA ... F

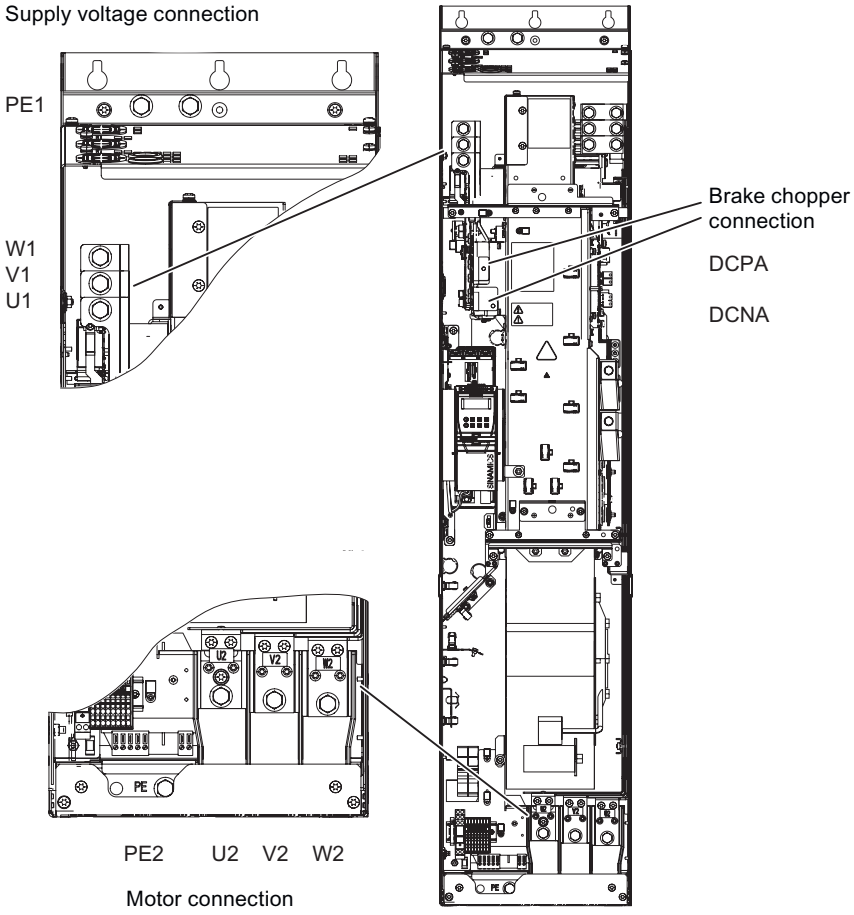


Figure 4-4 Power and motor terminal layout for the FSGX
M10 tightening torque: 25 Nm/18.4 lbf.ft

4.5 DC 24V power supply connection (FSGX)

-X9: Terminal block

The Power Module FSGX requires a separate DC 24V power supply. The power supply is connected to the X9 terminal block of the Power Module.

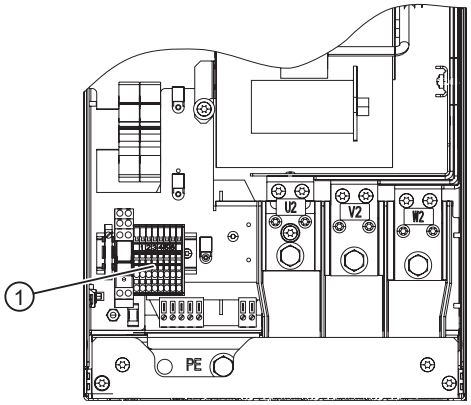
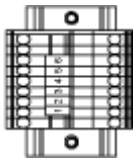


Figure 4-5 -X9 terminal block ① on the Power Module FSGX

Table 4- 4 Terminal block -X9

	Terminal	Function	Technical specifications
	1	P24V	Voltage: 24 V DC (20.4 V - 28.8 V) Current consumption: max. 4 A
	2	M	
	3	Reserved, do not use	
	4	Reserved, do not use	
	5	HS1	Line contactor control
	6	HS2	Line contactor control

Max. connectable cross-section: 1.5 mm²

Connection

Connect the external DC 24 V supply to terminals 1 (P 24 V) and 2 (Mext) of terminal block -X9 on the Power Module.

Note

Not connected 24V power supply lead to a fault message of the inverter as soon as the 400V power supply is disconnected from the Power Module.

4.6 Adjusting the fan voltage (FSGX)

Fine-tuning the supply voltage of the fan

The power supply for the device fan (1 AC 230 V) in the Power Module is generated from the line voltage using a transformer.

The transformer is fitted with primary taps so that it can be fine-tuned to the line voltage. When delivered, the taps are always set to the highest level. With a low line voltage, the appropriate transformer tap must be activated.

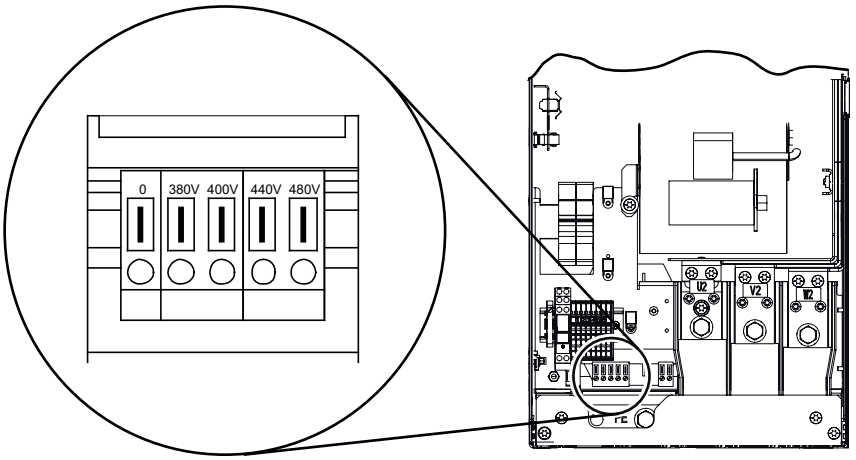


Figure 4-6 Setting terminals for the fan transformer PM240 FSGX

The setting terminals must be connected to "0" and the line voltage.

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

Table 4- 5 line voltage assignments for setting the fan transformer

Line voltage	Fan transformer tap
380 V ± 10%	380 V
400 V ± 10%	400 V
440 V ± 10%	440 V
480 V ± 10%	480 V

Note

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

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

4.7 Line contactor control (FSGX)

-X9: Terminal block

The Power Module FSGX can control its line contactor. The control terminals for the line contactor are on the terminal block -X9.

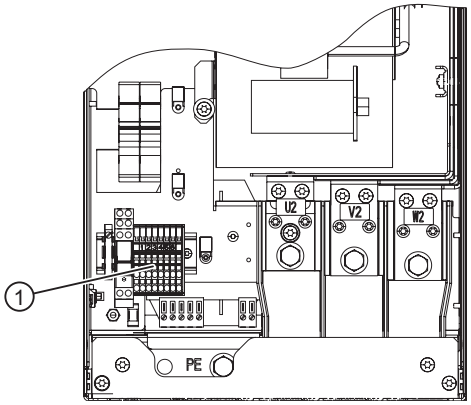
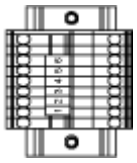


Figure 4-7 -X9 terminal block ① on the Power Module FSGX

Table 4- 6 Terminal block -X9

	Terminal	Function	Technical specifications
	1	P24V	Voltage: 24 V DC (20.4 V - 28.8 V) Current consumption: max. 4 A
	2	M	
	3	Reserved, do not use	
	4		
	5	HS1	Line contactor control 230 V AC ± 15 %, 400 mA
	6	HS2	

Max. connectable cross-section: 1.5 mm²

Connection

Connect the line contactor to terminals 5 and 6 of terminal block –X9 on the Power Module.

Note

The connection of a line contactor to the terminal -X9 is not mandatory. The line contactor can be controlled externally as well.

Control and monitoring of the line contactor

The Power Module closes its line contactor before the motor is switched on. The line contactor is opened after the motor is switched off. The Power Module monitors the line voltage after a tolerance time if the motor is switched on.

Prerequisites

If the inverter is installed properly, mains and motor connections can be established. It is urgently requiered to comply with the following notes:

⚠ WARNING

Mains and motor connections

A fixed location, non varying connection is necessary because of a leakage current.

Isolate the mains electrical supply before making or changing connections to the unit.

The terminals of the Inverter can carry dangerous voltages even if the inverter is inoperative. Wait at least 5 minutes to allow the unit to discharge after switching off the mains supply before carrying out any installation work.

When connecting the mains supply to the inverter, make sure that the terminal case of the motor is closed.

When changing from the ON to OFF-state of an operation if an LED or other similar display is not lit or active; this does not indicate that the unit is switched-off or powered-down.

Ensure that the line voltage corresponds to the inverter input voltage – the inverter must not be connected to a higher line voltage.

Grounding and Protective earthing conductor current

The inverter must always be grounded. If it is not grounded correctly, extremely dangerous conditions may arise which could prove potentially fatal.

As the earth leakage for the inverter can be greater than AC 3.5 mA, a fixed earth connection is required and the minimum size of the protective earth conductor shall comply with the local safety regulations for high leakage current equipment.

In the case of doubt, use for grounding the same cable cross section as for the power cable, but at least 2.5 mm^2.

⚠ CAUTION

Operation with ungrounded (IT) supplies

Inverters with built-in filters or external filters can only be used in power systems with grounded starpoint and must not be used with IT or TT supplies.

If the inverter, connected to an IT supply, is required to remain operational if an output phase is connected to ground, the output reactor must be fitted to prevent overcurrent tripping or damage to the drive. The probability of overcurrent tripping without output reactor increases with the size of the IT supply.

⚠ CAUTION

Operation with Residual Current Devices (RCD) or Monitoring (RCM) - only for FSA / FSB

The inverter can cause a DC current in the protective earthing conductor.

If an RCD - residual current-operated protective device (also referred to as an ELCB or a RCCB) or an RCM - residual current-operated monitoring device - is fitted for protection in case of direct or indirect contact, the inverter will operate without nuisance tripping provided that:

- An RCD/RCM type B superresistant is used (e.g. a SIQUENCE circuit breaker by Siemens).
- The trip limit of the RCD/RCM is 300 mA
- The neutral of the supply is grounded
- Only one inverter is supplied from each RCD/RCM
- The output cables are less than 50 m screened

If no RCD/RCM is used, the touch protection can be achieved by double insulation or by separating the inverter from the mains system using a transformer.

Note

Ensure that the appropriate circuit-breakers or fuses with the specified current rating are connected between the power supply and the inverter. The technical data contain information about the circuit breaker and fuses (see Specifications).

⚠ WARNING

Protective earthing conductor current

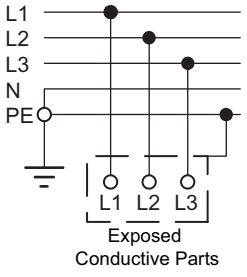
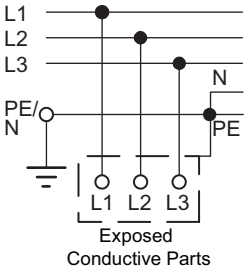
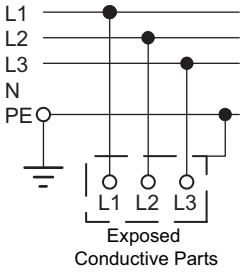
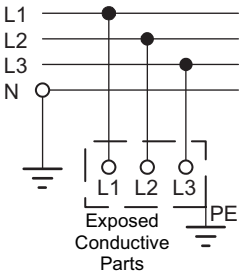
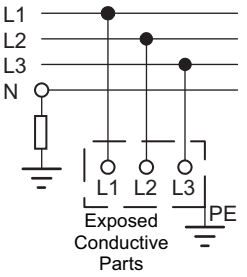
As the earth leakage for the inverter can be greater than AC 3.5 mA, a fixed earth connection is required and the minimum size of the protective earth conductor shall comply with the local safety regulations for high leakage current equipment.

The inverter can cause a DC current in the protective earthing conductor. Where a residual current-operated protective (RCD) or monitoring (RCM) device is used for protection in case of direct or indirect contact, only an RCD or RCM of Type B superresistant is allowed on the supply side of the inverter.

4.8 Power distribution systems

The converter is designed for the following power distribution systems as defined in EN 60950.

Table 4- 7 Power distribution systems for the converter

TN-S Power System	TN-C-S Power System	TN-C Power System	TT Power System	IT Power System
				
A TN-S power system has separate neutral and protective ground conductors throughout the system.	In a TN-C-S power system, the neutral and protective functions are combined in a single part of the system.	In a TN-C power system, the neutral and protective functions are combined in a single conductor throughout the system.	A TT power system has one point directly grounded, the exposed conductive parts of the installation being connected to a ground, which is electrically independent of the ground of the power system.	An IT power system has no direct connection to ground - instead the exposed parts of the electrical installation are grounded.

4.9 Operation with Residual Current Devices (RCD)

If an RCD (also referred to as an ELCB or a RCCB) is fitted, the inverter will operate without nuisance tripping provided that:

- An RCD type B superresistant is used (e.g. a SIQUENCE circuit breaker by Siemens).
- The trip limit of the RCD is 300 mA for filtered units.
- The trip limit of the RCD is 30 mA for unfiltered units.
- The neutral of the supply is grounded.
- Only one inverter is supplied from each RCD.
- The output cables are less than 50 m screened.

If no RCD is used, the touch protection can be achieved by double insulation or by separating the inverter from the mains system using a transformer.

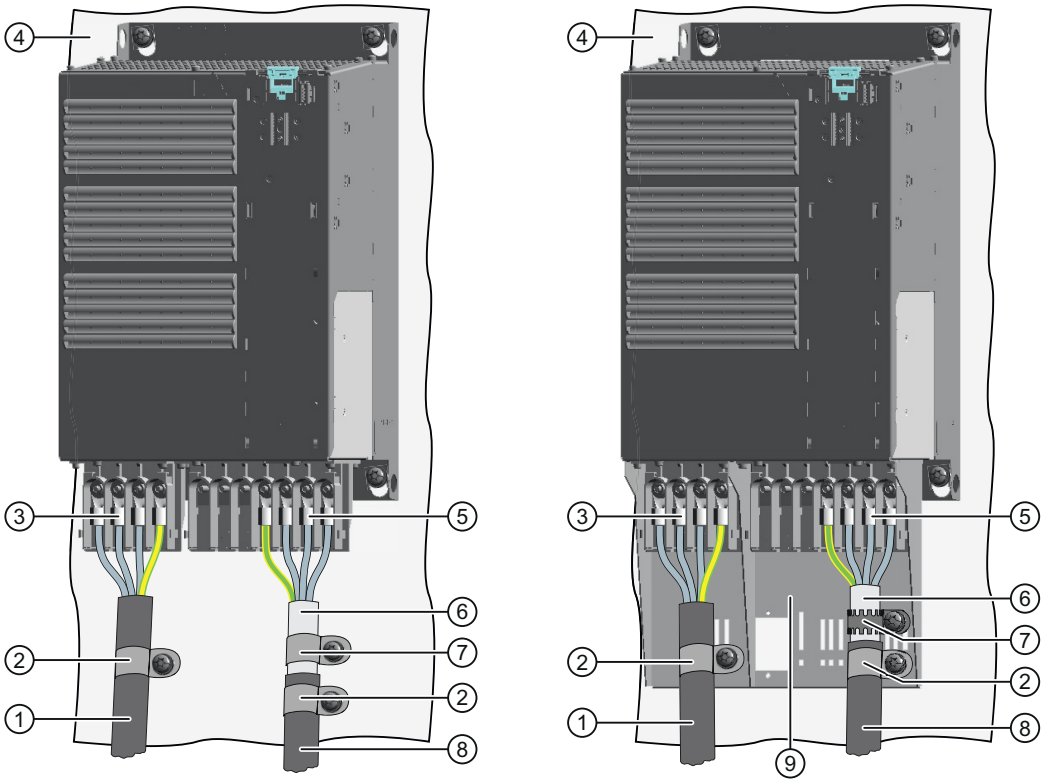
4.10 ESD guidelines

Screening methods

The following illustration shows a connecting example with and without Shielding Plate.

Note

The illustration below is not to scale. The terminal cover cannot be removed. It has been removed in the illustration to show the correct cable connection for the terminals.



① Line connection
② Motor connection
③ Unshielded cable for line connection
④ Shielded cable for motor connection
⑤ Cable screen
⑥ Suitable clip to fix motor cable screen securely to metal back plate
⑦ Steel band
⑧ Cable strap
⑨ Metal back plate
⑩ Shielding plate

Figure 4-8 Example of wiring to minimize the effect of EMI - left side without shielding plate, right side with shielding plate

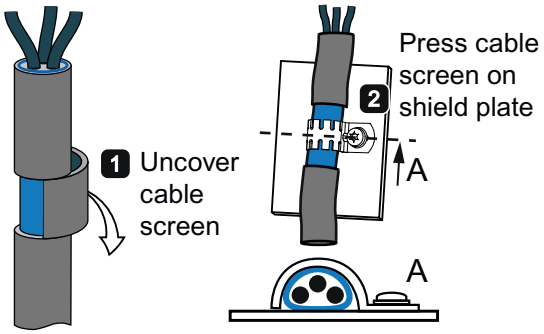


Figure 4-9 Shielding - detail

Note

Use an unshielded cable for the mains connection of Power Modules with integrated filter. Power Modules, which are connected to the line supply via an external filter, require a shielded cable between the line filter and Power Module.

The inverters are designed to operate in an industrial environment where a high level of EMI can be expected. Safe, reliable and disturbance-free operation is only guaranteed if the devices are professionally installed.

Control cabinet design

- Connect the metal parts and components of the control cabinet to the control cabinet frame through a good electrical connection:
  - Side panels
  - Rear panels
  - Roof
  - Base plates

  Using the highest possible surface area or a high number of individual screw connections.
- Connect the PE bar and the EMC shield bar to the control cabinet frame through a good electrical connection established through a large surface area.
- Connect the metal enclosures of the devices in the cabinet, e.g. converter or line filter, to the control cabinet frame through a good electrical connection through the largest possible surface area.

  We recommend to mount these devices on a bare metal mounting plate with good conducting characteristics.

- Choose one of the following methods to establish a conducting contact for screw connections on painted or anodized surfaces:
  - Use special contact (serrated) washers that cut through the
  - Remove the insulating surface at the contact locations
- Equip the following devices with interference suppression elements:
  - Coils of contactors
  - Relays
  - Solenoid valves
  - Motor holding brakes

  Interference suppression elements are RC elements or varistors with AC coils and free-wheeling diodes or varistors for DC coils.

  Connect the interference suppression elements directly at the coil.

Cable routing and shielding

- Rout all inverter power cables (line supply cables, cables between the braking chopper and the associated braking resistance as well as the motor cables) separately from signal and data cables. Keep the minimum clearance to 25 cm. If the cables can not be separated use metal partitions with a good connection to the mounting plate.
- Rout the cables from the line supply to the line filter separately away from the following cables:
  - Cables between the line filter and converter
  - Cables between the braking chopper and the associated braking resistor
  - Motor cables.
- Signal and data cables as well as filtered line supply cables may only cross non-filtered power cables at right angles.
- Keep all cables as short as possible.
- Rout signal and data cables and the associated equipotential bonding always in parallel with the smallest possible clearance between them.
- Use shielded motor cables.
- Route the shielded motor cable separately away from the cables to the motor temperature sensors (PTC/KTY).
- Shield signal and data cables.
- Connect shields at both ends to the grounded enclosures through a good electrical connection and through a large surface area.
- Connect cable shields as close as possible to where the cable enters the cabinet.
- Use EMC shield bars for power cables.

  Use the shield support elements provided in the converter for signal and data cables.

- Do not interrupt the cable shields by intermediate terminals.
- Use appropriate EMC clamps for the cable shields.

  The EMC clamps connect the cable shield to the EMC shield bar or the shield support element through a large conductive area.

Service and maintenance 5

5.1 Maintenance

The purpose of maintenance is to preserve the specified condition of the Power Module. Dirt and contamination must be removed regularly and parts subject to wear replaced. The Power Module comprises mostly electronic components. Apart from the fan(s), the unit, therefore, contains hardly any components that are subject to wear or that require maintenance or servicing.

The following points must generally be observed.

Dust deposits

Dust deposits inside the Power Module must be removed at regular intervals by qualified personnel in line with the relevant safety regulations. The unit must be cleaned using a brush and vacuum cleaner, and dry compressed air (max. 1 bar) for areas that cannot be easily reached.

Ventilation

When installing the devices in a cabinet, make sure that the cabinet ventilation slots are not obstructed. The fan must be checked to make sure that it is functioning correctly.

Cables and screw terminals

Cables and screw terminals must be checked regularly to ensure that they are secure, and if necessary, retightened. Retighten if necessary. The wiring must be checked for damage. Defective parts must be replaced immediately.

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 components

Power Module spare parts

Spare part	available (✓) or not available (-) for Power Module ...						
	FSA 0.37 kW ... 1.5 kW	FSB 2.2 kW ... 4 kW	FSC 5.5 kW ... 11 kW	FSD 15 kW ... 22 kW	FSE 30 kW ... 37 kW	FSF 45 kW ... 110 kW	FSGX 132 kW ... 200 kW
Fan	✓	✓	✓	✓	✓	✓	✓
Fan transformer	-	-	-	-	-	-	✓
Fan fuses	-	-	-	-	-	-	✓
Fan relay	-	-	-	-	-	-	✓
CIM (Control Interface Module)	-	-	-	-	-	-	✓
Power block	-	-	-	-	-	-	✓
Front cover	-	-	-	-	-	-	✓

5.2.1 Replacing the cooling fan fuses and the cooling fan relay (FSGX)

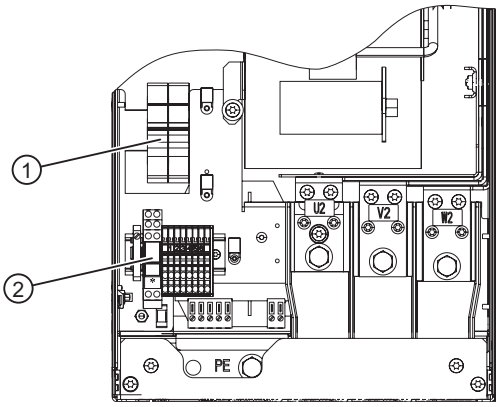


Figure 5-1 Position of the cooling fan fuses ①and the fan relay ②

The cooling fan fuses and the cooling fan relay can be accessed after removing the front cover of the Power Module FSGX.

5.2.2 Replacing the cooling fan

The service life of the cooling fan

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

The fan must be replaced in good time to ensure that the inverter is available.

Replacing the cooling fan FSB … FSC

Preparatory steps

- Power-down the inverter
- Remove the Control Unit from the inverter
- Disconnect all the cables from the Power Module
- Place the Power Module face-down on a clean and safe surface

Removal

1. Using a posi-drive screwdriver, remove the fan retaining screws
2. Release the fan cable connector(s)
3. Slide the cooling fan out from the inverter

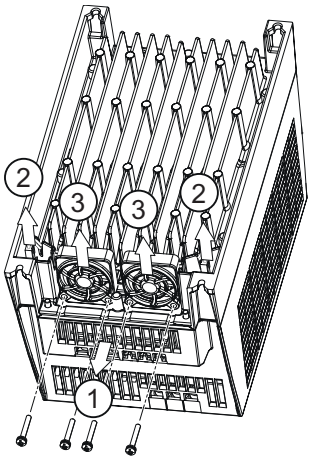


Figure 5-2 Cooling fan removal FSB and FSC

Installation

For re-installation, carry out the above steps in reverse order.

Cooling fan replacement for FSD … FSF

Preparatory steps

- Power-down the inverter
- Remove the Control Unit from the inverter
- Disconnect all the cables from the Power Module
- Place the Power Module face-down on a clean and safe surface

Removal

1. Remove the fan retaining board
2. Release the fan cable connectors
3. Remove the cooling fan out from the inverter

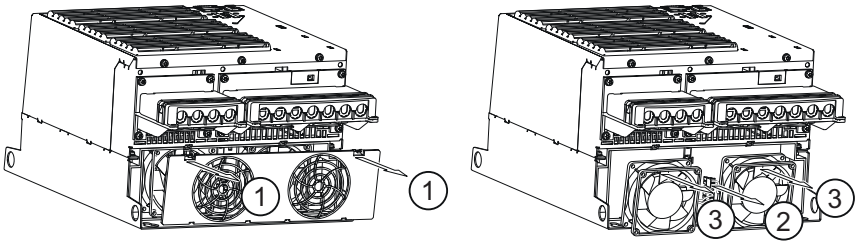


Figure 5-3 Cooling fan removal FSD and FSE (15 kW … 37 kW)

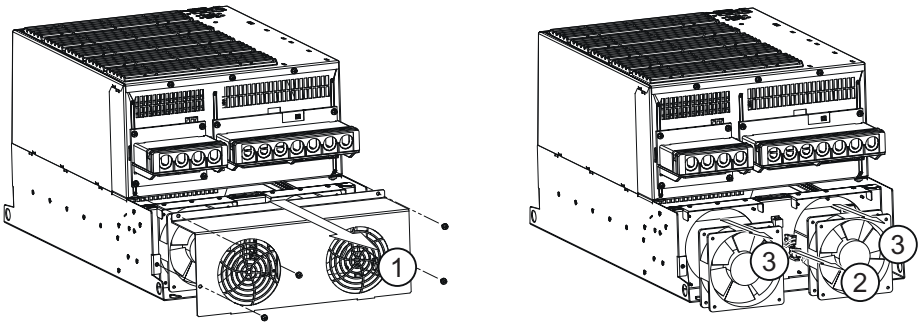


Figure 5-4 Cooling fan removal FSF (45 kW … 110 kW)

Installation

For re-installation, carry out the above steps in reverse order.

Replacing the cooling fan FSGX

Preparatory steps

- Disconnect the chassis unit from the power supply.
- Allow unimpeded access.
- Remove the protective cover.

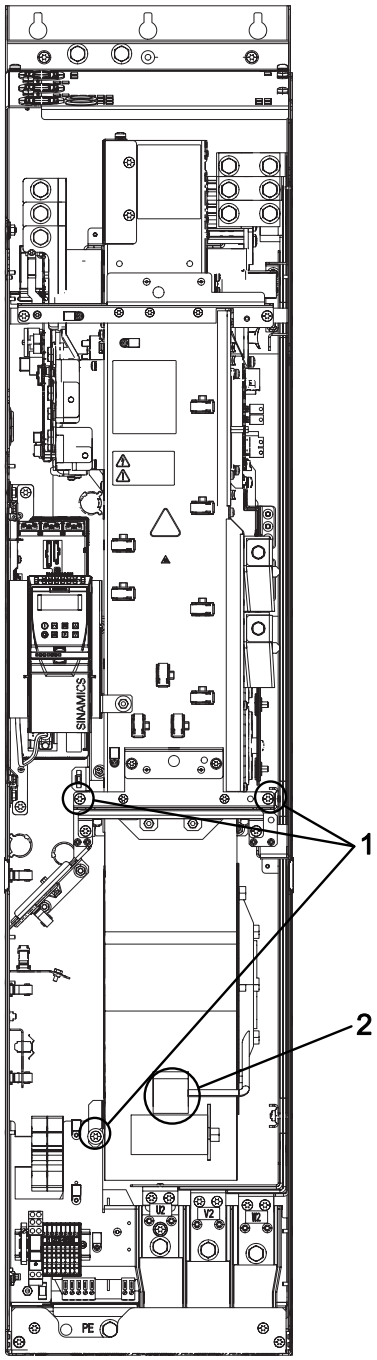


Figure 5-5 Fan replacement, Power Module FSGX

Removal

The steps for the removal procedure are numbered in accordance with the diagram.

1. Remove the retaining screws for the fan (3 screws).
2. Disconnect the supply cables (1 x "L", 1 x "N").

You can now carefully remove the fan.

Note

When removing the fan, ensure that you do not damage any signal cables.

⚠ CAUTION

Fuse holder for the main fan

The fuse holder for the main fan is not intended to interrupt currents and shall not be operated before the incoming main supply is disconnected.

Installation

For re-installation, carry out the above steps in reverse order.

Note

Carefully re-establish the plug connections and ensure that they are secure.

The screwed connections for the protective covers must only be tightened by hand.

5.2.3 Power block replacement (FSGX)

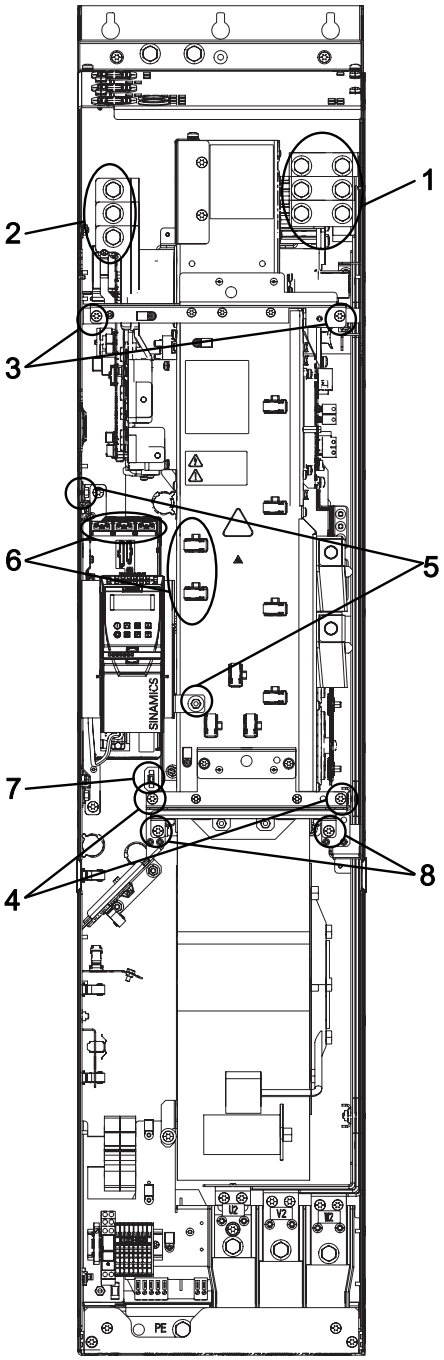


Figure 5-6 Power block replacement, PM240 FSGX

Preparatory steps

- Disconnect the built-in unit from the power supply.
- Allow unimpeded access to the power block.
- Remove the protective cover.

Removal

The steps for the removal procedure are numbered in accordance with the diagram.

1. Unscrew the connection to the outgoing motor section (3 screws on the right side). Loose the 3 screws on the left side and turn the connection straps up.
2. Unscrew the connection to the line supply (3 screws).
3. Remove the retaining screws at the top (2 screws).
4. Remove the retaining screws at the bottom (2 screws).
5. Remove the Control Unit. If necessary, remove the communication plugs and terminal wiring.
6. Disconnect the connectors for the fiber optic cables (3 plugs) and release the cable connection for the signal cables (2 connectors).
   Remove the IPD module by loosening two curled screws. The IPD module remains connected to the current sensor cables.
7. Disconnect the plug for the thermocouple.
8. Unscrew the two retaining screws for the fan and attach the tool for de-installing the power block at this position.

You can now remove the power block.

Note

When removing the power block, ensure that you do not damage any signal cables.

Installation steps

For installation, carry out the above steps in reverse order.

Note

The connectors of the fiber-optic cables have to be mounted on their original plug-in position. The fiber-optic cables and the plug sockets are labelled accordingly (U11, U21, U31).

Carefully establish the plug connections and ensure that they are secure.

The screwed union connections for the protective covers must only be tightened by hand.

Crane lifting lugs for secure transportation of the power block

The power blocks are fitted with crane lifting lugs for transportation on a lifting harness in the context of replacement.

The positions of the crane lifting lugs are illustrated by arrows in the figures below.

⚠ WARNING

A lifting harness with vertical ropes or chains must be used to prevent any risk of damage to the housing.

NOTICE

The power block busbars must not be used to support or secure lifting harnesses for the purpose of transportation.

The positions of the crane lifting lugs are illustrated by arrows in the figures below.

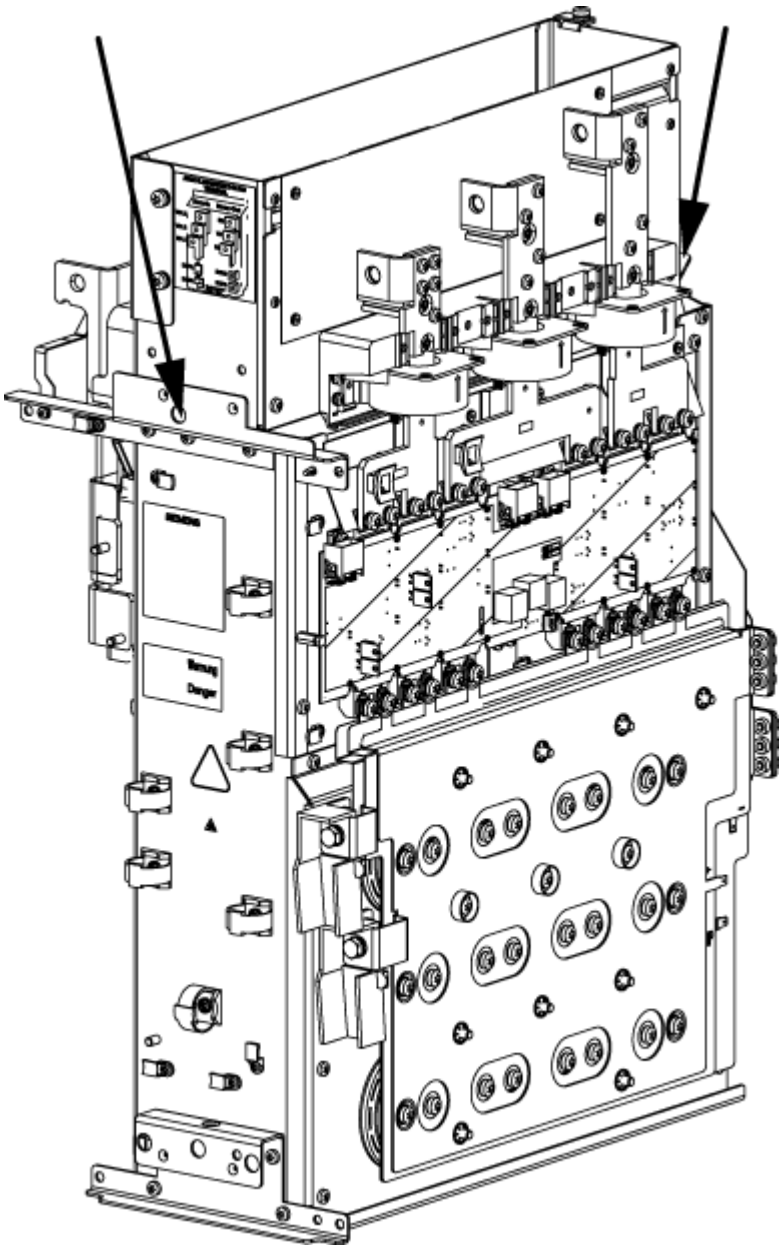


Figure 5-7 Crane lifting lugs of the Power Block FSGX

5.2.4 Control Interface Module replacement (FSGX)

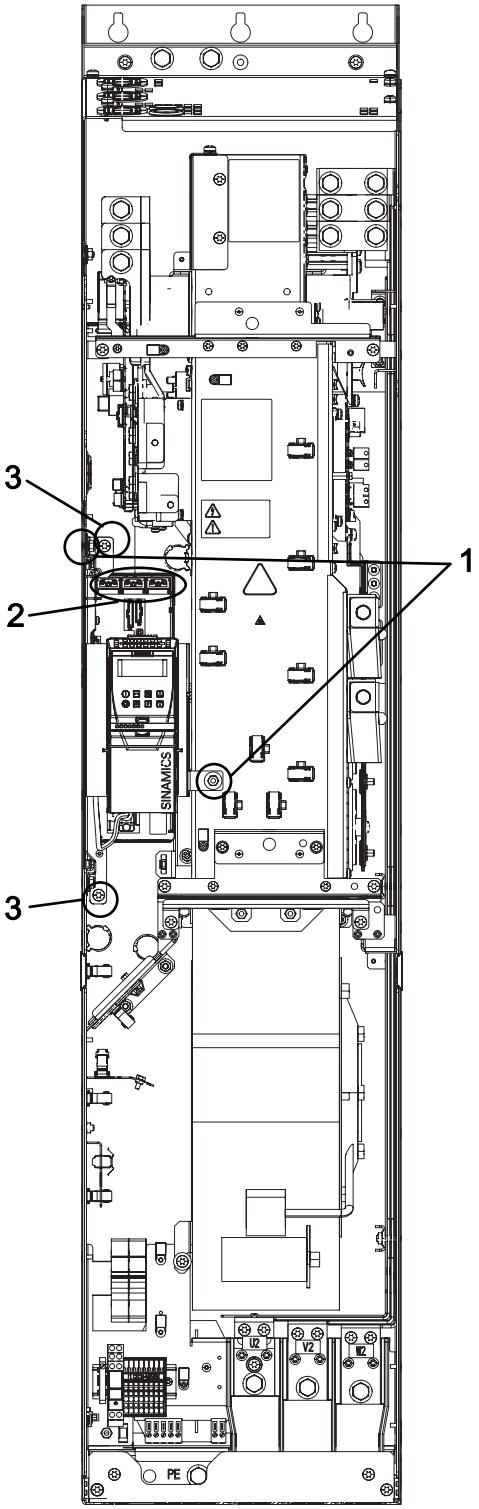


Figure 5-8 Control Interface Module replacement, Power Module PM240 FSGX

Preparatory steps

- Disconnect the Power Module from the power supply.
- Allow unimpeded access.
- Remove the front cover.
- Remove the Control Unit. If necessary, remove the communication plugs and terminal wiring.

Removal

The steps for the removal procedure are numbered in accordance with the diagram.

1. Remove the two retaining screws for the Control Unit bracket.
2. Disconnect the cable from the Control Unit bracket to the CIM.
   Remove the cables to the Brake Relay or Safe Brake Relay, if it is installed.
   Remove carefully the Control Unit bracket.
   Disconnect the connectors for the fiber optic cables (3 plugs) and release the cable connection for the signal cables (2 connectors).
   Remove the IPD module by loosening two curled screws. The IPD module remains connected to the current sensor cables.
3. Remove the two retaining screws for the slide-in electronics unit.
   When removing the slide-in electronics unit, you have to disconnect 5 further plugs one after the other (2 at the top, 3 at the bottom).

NOTICE
When removing the electronics unit, ensure that you do not damage any signal cables.

The Control Interface Board can then be removed from the slide-in electronics unit.

NOTICE
When removing the connector of the ribbon cable, make sure that you actuate the locking lever on the connector very carefully (e.g. with a screwdriver) otherwise the lock could be damaged.

Installation

For re-installation, carry out the above steps in reverse order.

NOTICE
The connectors of the fiber-optic cables have to be mounted on their original plug-in position. The fiber-optic cables and the plug sockets are labelled accordingly (U11, U21, U31). Carefully re-establish the plug connections and ensure that they are secure. When dealing with connectors with a lock, make sure that the locking lever is securely engaged once connected. The screwed connections for the protective covers must only be tightened by hand.

Technical specifications

6

Common performance ratings of the Power Module

Feature	Specification	
Line voltage	3 AC 380 V … 480 V ± 10%	
Output voltage	3 AC 0 V … input voltage * 0.95 (max.)	
Input frequency	50 Hz … 60 Hz, ± 3 Hz	
Output frequency	0 Hz … 650 Hz, depending on the control mode	
Power factor λ	0.7 without line reactor; 0.85 with line reactor	
Line impedance	Uk ≥ 1 %, for lower values, a line reactor must be used.	
Inrush current	Less than input current	
Pulse frequency (factory setting)	4 kHz for 0.37 kW ... 90 kW 2 kHz for 110 kW ... 250 kW Can be increased up to 16 kHz in 2 kHz steps. Increasing the pulse frequencies leads to an output current reduction.	
Electromagnetic compatibility	The devices are suitable for environmental classes category C2 in accordance with IEC61800-3. For details, see the Hardware Installation Manual, Appendix A2. Optional Class A filters available according to EN 55011	
Braking methods	DC braking, Compound braking, Dynamic braking with integrated chopper	
Protection level	IP20 or IPXXB IPXXB protection is ensured with the Power Module FSGX (160 kW … 250 kW) in conjunction with the Control Units CU240E and CU230P-2.	
Operating temperature (LO operation)	0 °C … +40 °C (32 °F … 104 °F) / UL certified rating up to 60 °C (140 °F)	without derating with derating
Operating temperature (HO operation)	0 °C … +50 °C (14 °F … 122 °F): 0.37 kW ... 110 kW 0 °C … +40 °C (32 °F … 104 °F): 132 kW ... 200 kW up to 60 °C (140 °F)	without derating without derating with derating
Storage temperature	-40 °C … +70 °C (-40 °F … 158 °F)	
Installation altitude above sea level	Up to 1000 m (3300 ft): 0.37 kW ... 132 kW Up to 2000 m (6500 ft): 160 kW ... 240 kW Up to 4000 m (13000 ft)	without derating without derating with derating
Humidity	< 95% RH - non-condensing	
Environmental requirements	Protected according to environmental class 3C2 to EN 60721-3-3 against damaging chemical substances	
Pollution	According pollution degree level 2 Do not install the inverter in an environment which contains atmospheric pollutants such as dust and/or corrosive gases.	
Shock and vibration	Do not drop the inverter or expose to sudden shock. Do not install the inverter in an area where it is likely to be exposed to constant vibration.	

Feature	Specification
Electromagnetic radiation	Do not install the inverter near sources of electromagnetic radiation.
Short Circuit Current Rating (SCCR)	See chapter “6.1 Specifications”

Permissible converter overload

The converters have different power ratings "High Overload" and "Low Overload" depending on the expected load.

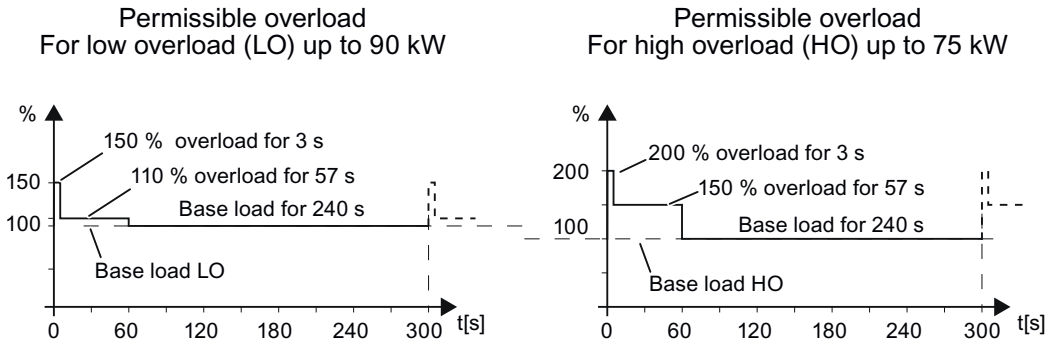


Figure 6-1 Duty cycles, "High Overload" and "Low Overload"

Note

Please note the base load (100 % power or current) for Low Overload is higher the base load for High Overload.

The load characteristics shown in the diagram are only examples. We recommend the use of the "SIZER" engineering software to select the appropriate Power Modules using duty cycles. See Sizer download.

Definitions

- **LO input current** 100 % of the permissible input current with a load cycle according to Low Overload.
- **LO output current** 100 % of the permissible output current with a load cycle according to Low Overload.
- **LO power** Power of the Unit at LO output current.
- **HO input current** 100 % of the permissible input current with a load cycle according to High Overload.
- **HO output current** 100 % of the permissible output current with a load cycle according to High Overload.
- **HO power** Power of the Unit at HO output current.

In case of no further specification or in the case of rated values, the values always refer to low overload.

6.1 Specifications

Note

For UL applications use UL certified fuses

The integral solid state short circuit protection does not provide branch circuit protection. Branch circuit protection must be provided in accordance with the National Electric Code and any additional local codes.

UL certified fuses must be used. In order that the system is in compliance with UL, UL certified fuses, circuit breaker or self protected combination motor controllers must be used.

Semiconductor Fuses (3NE...) must be integrated in the same overall assembly as the drive.

Table 6- 1 PM240, IP20, Frame Sizes A, 3 AC 380 V … 480 V

Order No. - Unfiltered	6SL3224-…	…0BE13-7UA0	…0BE15-5UA0	…0BE17-5UA0
Rated / LO power		0.37 kW	0.55 kW	0.75 kW
Rated / LO input current		1.6 A	2.0 A	2.5 A
Rated / LO Output current		1.3 A	1.7 A	2.2 A
HO power		0.37 kW	0.55 kW	0.75 kW
HO input current		1.6 A	2.0 A	2.5 A
HO output current		1.3 A	1.7 A	2.2 A
Fuse according to UL (by SIEMENS)		3NE1813-0, 16 A	3NE1813-0, 16 A	3NE1813-0, 16 A
Fuse according to UL (class J, K-1 or K-5)		10 A	10 A	10 A
Power losses		0.097 kW	0.099 kW	0.102 kW
Required cooling air flow		4.8 l/s	4.8 l/s	4.8 l/s
Cross section of line and motor cable		1 … 2.5 mm^2 18 … 14 AWG	1 … 2.5 mm^2 18 … 14 AWG	1 … 2.5 mm^2 18 … 14 AWG
Tightening torque for line and motor cable		0.5 Nm / 4 lbf in	0.5 Nm / 4 lbf in	0.5 Nm / 4 lbf in
Weight		1.2 kg	1.2 kg	1.2 kg

Suitable for use on a circuit capable of delivering not more than 65 kA rms symmetrical Amperes, 480 Vac maximum when protected by Class J fuses, on a circuit capable of delivering not more than 10 kA rms symmetrical Amperes, 480 Vac maximum when protected by Class K-1 or K-5 fuses or on a circuit capable of delivering not more than 5 kA rms symmetrical Amperes, 480 Vac maximum when protected by R/C (JFHR2) Semiconductor Fuses (E167357)

Table 6- 2 PM240, IP20, Frame Sizes A, 3 AC 380 V … 480 V

Order No. - Unfiltered	**6SL3224-…**	**…0BE21-1UA0**	**…0BE21-5UA0**
Rated / LO power		1.1 kW	1.5 kW
Rated / LO input current		3.9 A	4.9 A
Rated / LO Output current		3.1 A	4.1 A
HO power		1,1 kW	1,5kW
HO input current		3.8 A	4.8 A
HO output current		3.1 A	4.1 A
Fuse according to UL (by SIEMENS)		3NE1813-0, 16 A	3NE1813-0, 16 A
Fuse according to UL (class J, K-1 or K-5)		10 A	10 A
Power losses		0.108 kW	0.114 kW
Required cooling air flow		4.8 l/s	4.8 l/s
Cross section of line and motor cable		1 … 2.5 mm²	1 … 2.5 mm²
		18 … 14 AWG	18 … 14 AWG
Tightening torque for line and motor cable		0.5 Nm / 4 lbf in	0.5 Nm / 4 lbf in
Weight		1.1 kg	1.1 kg

Suitable for use on a circuit capable of delivering not more than 65 kA rms symmetrical Amperes, 480 Vac maximum when protected by Class J fuses, or on a circuit capable of delivering not more than 10 kA rms symmetrical Amperes, 480 Vac maximum when protected by Class K-1 or K-5 fuses or on a circuit capable of delivering not more than 5 kA rms symmetrical Amperes, 480 Vac maximum when protected by R/C (JFHR2) Semiconductor Fuses (E167357)

Table 6- 3 PM240, IP20, Frame Sizes B, 3 AC 380 V … 480 V

Order No. - Unfiltered	**6SL3224-…**	**…0BE22-2UA0**	**…0BE23-0UA0**	**…0BE24-0UA0**
Order No. - Filtered	**6SL3224-…**	**…0BE22-2AA0**	**…0BE23-0AA0**	**…0BE24-0AA0**
Rated / LO power		2.2 kW	3 kW	4 kW
Rated / LO input current		7.6 A	10.2 A	13.4 A
Rated / LO Output current		5.9 A	7.7 A	10.2 A
HO power		2.2 kW	3 KW	4 kW
HO input current		7.6 A	10.2 A	13.4 A
HO output current		5.9 A	7.7 A	10.2 A
Fuse according to UL (by SIEMENS)		3NE1813-0, 16 A	3NE1813-0, 16 A	3NE1814-0, 20 A
Fuse according to UL (class J, K-1 or K-5)		16 A	16 A	20 A
Power losses		0.139 kW	0.158 kW	0.183 kW
Required cooling air flow		24 l/s	24 l/s	24 l/s
Cross section of line and motor cable		1.5 … 6 mm²	1.5 … 6 mm²	1.5 … 6 mm²
		16 … 10 AWG	16 … 10 AWG	16 … 10 AWG
Tightening torque for line and motor cable		1.5 Nm / 13 lbf in	1.5 Nm / 13 lbf in	1.5 Nm / 13 lbf in
Weight		4.3 kg	4.3 kg	4.3 kg

Suitable for use on a circuit capable of delivering not more than 65 kA rms symmetrical Amperes, 480 Vac maximum when protected by Class J fuses, or on a circuit capable of delivering not more than 10 kA rms symmetrical Amperes, 480 Vac maximum when protected by Class K-1 or K-5 fuses or on a circuit capable of delivering not more than 5 kA rms symmetrical Amperes, 480 Vac maximum when protected by R/C (JFHR2) Semiconductor Fuses (E167357)

Table 6- 4 PM240, IP20, Frame Sizes C, 3 AC 380 V … 480 V

Order No. - Unfiltered	**6SL3224-…**	**…0BE25-5UA0**	**…0BE27-5UA0**	**…0BE31-1UA0**
Order No. - Filtered	**6SL3224-…**	**…0BE25-5AA0**	**…0BE27-5AA0**	**…0BE31-1AA0**
Rated / LO power		7.5 kW	11 kW	15 kW
Rated / LO input current		21.9 A	31.5 A	39.4 A
Rated / LO Output current		18 A	25 A	32 A
HO power		5.5 kW	7.5 kW	11 kW
HO input current		16.7 A	23.7 A	32.7 A
HO output current		13.2 A	19 A	26 A
Fuse according to UL (by SIEMENS)		3NE1814-0, 20 A	3NE1814-0, 20 A	3NE1803-0, 35 A
Fuse according to UL (class J, K-1 or K-5)		20 A	20 A	35 A
Power losses		0.240 kW	0.297 kW	0.396 kW
Required cooling air flow		55 l/s	55 l/s	55 l/s
Cross section of line and motor cable		4 … 10 mm^2 12 … 8 AWG	4 … 10 mm^2 12 … 8 AWG	4 … 10 mm^2 12 … 8 AWG
Tightening torque for line and motor cable		2.3 Nm / 20 lbf in	2.3 Nm / 20 lbf in	2.3 Nm / 20 lbf in
Weight, unfiltered		6.5 kg	6.5 kg	6.5 kg
Weight, filtered		7 kg	7 kg	7 kg

Suitable for use on a circuit capable of delivering not more than 65 kA rms symmetrical Amperes, 480 Vac maximum when protected by Class J fuses, or on a circuit capable of delivering not more than 65 kA rms symmetrical Amperes, 480 Vac maximum when protected by Class K-1 or K-5 fuses or on a circuit capable of delivering not more than 5 kA rms symmetrical Amperes, 480 Vac maximum when protected by R/C (JFHR2) Semiconductor Fuses (E167357)

Table 6- 5 PM240, IP20, Frame Sizes D, 3 AC 380 V … 480 V

Order No. - Unfiltered	**6SL3224-…**	**…0BE31-5UA0**	**…0BE31-8UA0**	**…0BE32-2UA0**
Order No. - Filtered	**6SL3224-…**	**…0BE31-5AA0**	**…0BE31-8AA0**	**…0BE32-2AA0**
Rated / LO power		18.5 kW	22 kW	30 kW
Rated / LO input current		46 A	53 A	72 A
Rated / LO Output current		38 A	45 A	60 A
HO power		15 kW	18.5 kW	22 kW
HO input current		40 A	46 A	56 A
HO output current		32 A	38 A	45 A
Fuse according to UL (by SIEMENS)		3NE1817-0	3NE1818-0	3NE1820-0
Fuse according to UL (class J)		50 A, 600 V	---	---
Power losses		0.44 kW 0.42 kW	0.55 kW 0.52 kW	0.72 kW 0.69 kW
Required cooling air flow		22 l/s	22 l/s	39 l/s
Cross section of line and motor cable		10 … 35 mm^2 7 … 2 AWG	10 … 35 mm^2 7 … 2 AWG	16 … 35 mm^2 5 … 2 AWG
Tightening torque for line and motor cable		6 Nm / 53 lbf in	6 Nm / 53 lbf in	6 Nm / 53 lbf in
Weight, unfiltered		13 kg	13 kg	13 kg
Weight, filtered		16 kg	16 kg	16 kg

Suitable for use on a circuit capable of delivering not more than 65 kA rms symmetrical Amperes, 480 Vac maximum when protected by Class J or R/C (JFHR2) Semiconductor Fuses only

Table 6- 6 PM240, IP20, Frame Sizes E, 3 AC 380 V … 480 V

Order No. - Unfiltered	**6SL3224-…**	**…0BE33-0UA0**	**…0BE33-7UA0**
Order No. - Filtered	**6SL3224-…**	**…0BE33-0AA0**	**…0BE33-7AA0**
Rated / LO power		37 kW	45 kW
Rated / LO input current		88 A	105 A
Rated / LO Output current		75 A	90 A
HO power		30 kW	37 kW
HO input current		73 A	90 A
HO output current		60 A	75 A
Fuse according to UL (by SIEMENS)		3NE1021-0	3NE1022-0
Fuse according to UL		---	---
Power losses, unfiltered		0.99 kW	1.2 kW
Power losses, filtered		1.04 kW	1.2 kW
Required cooling air flow		22 l/s	39 l/s
Cross section of line and motor cable		25 … 35 mm^2 3 … 2 AWG	25 … 35 mm^2 3 … 2 AWG
Tightening torque for line and motor cable		6 Nm / 53 lbf in	6 Nm / 53 lbf in
Weight, unfiltered		16 kg	16 kg
Weight, filtered		23 kg	23 kg

Suitable for use on a circuit capable of delivering not more than 65 kA rms symmetrical Amperes, 480 Vac maximum when protected by R/C (JFHR2) Semiconductor Fuses only

Table 6- 7 PM240, IP20, Frame Sizes F, 3 AC 380 V … 480 V

Order No. - Unfiltered	**6SL3224-…**	**…0BE34-5UA0**	**…0BE35-5UA0**	**…0BE37-5UA0**
Order No. - Filtered	**6SL3224-…**	**…0BE34-5AA0**	**…0BE35-5AA0**	**…0BE37-5AA0**
Rated / LO power		55 kW	75 kW	90 kW
Rated / LO input current		129 A	168 A	204 A
Rated / LO Output current		110 A A	145 A	178 A
HO power		45 kW	55 kW	75 kW
HO input current		108 A	132 A	169 A
HO output current		90 A	110 A	145 A
Fuse according to UL (by SIEMENS)		3NE1224-0	3NE1225-0	3NE1227-0
Fuse according to UL (class J)		150 A, 600 V	200 A, 600 V	250 A, 600 V
Power losses, unfiltered		1.4 kW	1.9 kW	2.3 kW
Power losses, filtered		1.5 kW	2.0 kW	2.4 kW
Required cooling air flow		94 l/s	94 l/s	117 l/s
Cross section of line and motor cable		35 … 120 mm^2 2 … 4/0 AWG	70 … 120 mm^2 2/0 … 4/0 AWG	95 … 120 mm^2 3/0 … 4/0 AWG
Tightening torque for line and motor cable		13 Nm / 115 lbf in	13 Nm / 115 lbf in	13 Nm / 115 lbf in
Weight, unfiltered		36 kg	36 kg	36 kg
Weight, filtered		52 kg	52 kg	52 kg

Suitable for use on a circuit capable of delivering not more than 65 kA rms symmetrical Amperes, 480 Vac maximum when protected by Class J or R/C (JFHR2) Semiconductor Fuses only

Table 6- 8 PM240, IP20, Frame Sizes F, 3 AC 380 V … 480 V

Order No. - Unfiltered	6SL3224-…	…0BE38-8UA0	…0BE41-1UA0
Rated / LO power		110 kW	132 kW
Rated / LO input current		234 A	284 A
Rated / LO Output current		205 A	250 A
HO power		90 kW	110 kW
HO input current		205 A	235 A
HO output current		178 A	205 A
Fuse according to UL (by SIEMENS)		3NE1227-0	3NE1230-0
Fuse according to UL		300 A, 600 V, Class J	400 A, 600 V, Class J
Power losses		2.4 kW	2.5 kW
Required cooling air flow		117 l/s	117 l/s
Cross section of line and motor cable		95 … 120 mm^2 3/0 … 4/0 AWG	95 … 120 mm^2 3/0 … 4/0 AWG
Tightening torque for line and motor cable		13 Nm / 115 lbf in	13 Nm / 115 lbf in
Weight,		39 kg	39 kg

Suitable for use on a circuit capable of delivering not more than 65 kA rms symmetrical Amperes, 480 Vac maximum when protected by Class J or R/C (JFHR2) Semiconductor Fuses only

Table 6- 9 PM240 Frame Sizes GX, 3 AC 380 V … 480 V

Order No. - Unfiltered	6SL3224-…	…0XE41-3UA0	…0XE41-6UA0	…0XE42-0UA0
Rated / Low Overlaod values				
Rated / LO power		160 kW	200 kW	240 kW
Rated / LO input current		297 A	354 A	442 A
Rated / LO Output current		302 A	370 A	477 A
High Overload values				
HO power		132 kW	160 kW	200 kW
HO input current		245 A	297 A	354 A
HO output current		250 A	302 A	370 A
Fuse according to IEC		3NA3254	3NA3260	3NA3372
Fuse according to UL (by SIEMENS)		3NE1333-2	3NE1333-2	3NE1436-2
Power losses,		3.9 kW	4.4 kW	5.5 kW
Required cooling air flow		360 l/s	360 l/s	360 l/s
Cross section of line and motor cable		95 ... 2 x 240 mm^2 3/0 … 2 x 600 AWG	120 ... 2 x 240 mm^2 4/0 … 2 x 600 AWG	185 ... 2 x 240 mm^2 6/0 … 2 x 600 AWG
Tightening torque for line and motor cable		14 Nm / 120 lbf in	14 Nm / 120 lbf in	14 Nm / 120 lbf in
Weight,		176 kg	176 kg	176 kg

Suitable for use on a circuit capable of delivering not more than 65 kA rms symmetrical Amperes, 480 Vac maximum when protected by R/C (JFHR2) Semiconductor Fuses only

6.2 Derating data

Operating temperature derating

The operating temperature range is shown diagramatically in the figures below:

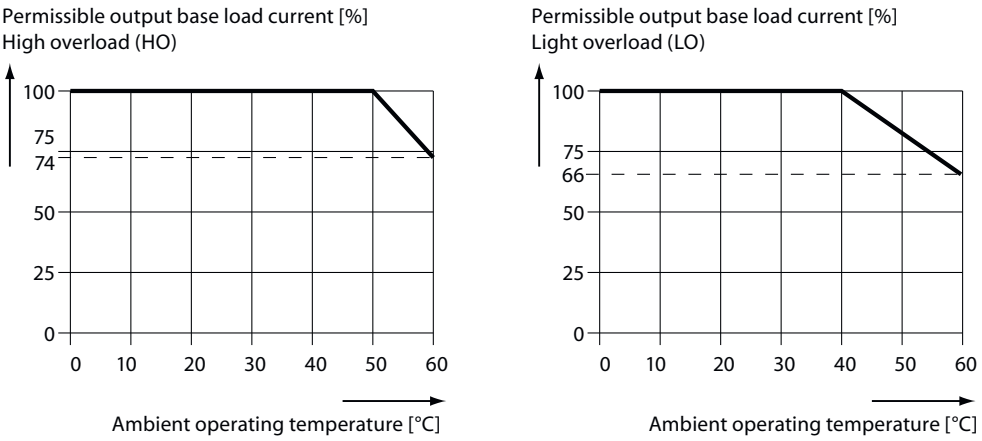


Figure 6-2 Current derating for temperature, FSA … FSF

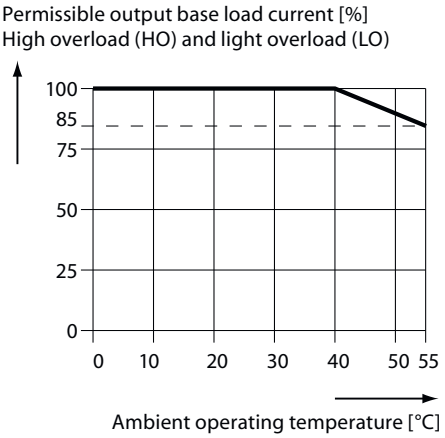
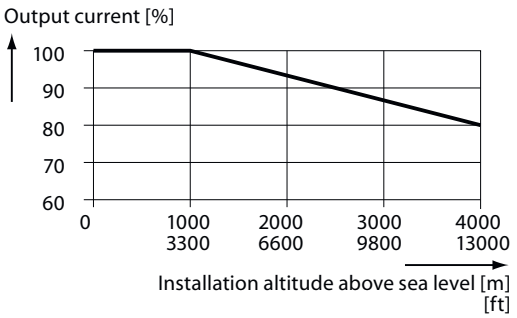


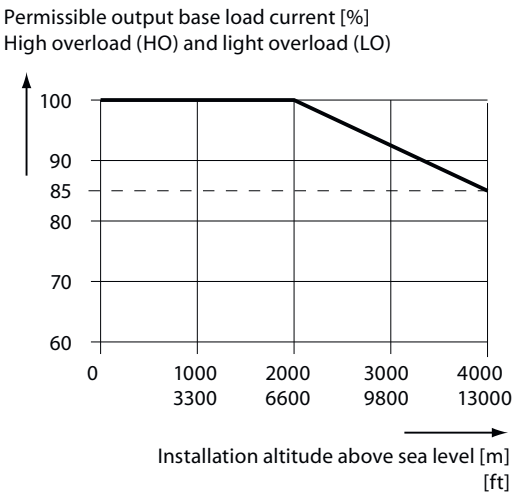
Figure 6-3 Current derating for temperature, FSGX

Operational altitude derating

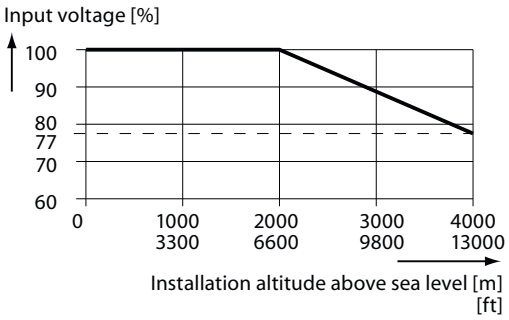
The figures below show the derating required according to altitude.



Current derating for altitude, FSA … FSF



Current derating for altitude, FSGX



Voltage derating for altitude, FSA … FSGX

Relationship between pulse frequency and output base-load current reduction

Table 6- 10 Current reduction depending on pulse frequency

LO base load	Output base-load current at pulse frequency of							
	2 kHz	4 kHz	6 kHz	8 kHz	10 kHz	12 kHz	14 kHz	16 kHz
kW	A	A	A	A	A	A	A	A
0.37	---	1.30	1.11	0.91	0.78	0.65	0.59	0.52
0.55	---	1.70	1.45	1.19	1.02	0.85	0.77	0.68
0.75	---	2.20	1.87	1.54	1.32	1.10	0.99	0.88
1.1	---	3.10	2.64	2.17	1.86	1.55	1.40	1.24
1.5	---	4.10	3.49	2.87	2.46	2.05	1.85	1.64

2.2	--	5.90	5.02	4.13	3.54	2.95	2.66	2.36
3.0	--	7.70	6.55	5.39	4.62	3.85	3.47	3.08
4.0	--	10.20	8.67	7.14	6.12	5.10	4.59	4.08
7.5	--	18.00	16.20	13.30	11.40	9.50	8.60	7.60
11.0	--	25.00	22.10	18.20	15.60	13.00	11.70	10.40
15.0	--	32.00	27.20	22.40	19.20	16.00	14.40	12.80
18.5	--	38.00	32.30	26.60	22.80	19.00	17.10	15.20
22	--	45.00	38.25	31.50	27.00	22.50	20.25	18.00
30	--	60.00	52.70	43.40	37.20	31.00	27.90	24.80
37	--	75.00	63.75	52.50	45.00	37.50	33.75	30.00
45	--	90.00	76.50	63.00	54.00	45.00	40.50	36.00
55	--	110.0	93.50	77.00	--	--	--	--
75	--	145.0	123.3	101.5	--	--	--	--
90	--	178.0	151.3	124.6	--	--	--	--
110	205.0	178.0	--	--	--	--	--	--
132	250.0	205.0	--	--	--	--	--	--
160	302.0	250.0	--	--	--	--	--	--
200	370.0	302.0	--	--	--	--	--	--
250	477.0	370.0	--	--	--	--	--	--

6.3 Permissible shock and vibration values

- Long-term storage in the transport packaging according to Class 1M2 to EN 60721-3-1: 1997
- Transport in the transport packaging according to Class 2M3 to EN 60721-3-2: 1997
- Vibration during operation according to Class 3M2 to EN 60721-3-3: 1995

Accessories

7

Which accessory is available for which Power Module?

Accessory	available (✓) or not available (-) for Power Module …						
	FSA 0.37 kW ... 1.5 kW	FSB 2.2 kW ... 4 kW	FSC 5.5 kW ... 11 kW	FSD 15 kW ... 22 kW	FSE 30 kW ... 37 kW	FSF 45 kW ... 110 kW	FSGX 132 kW ... 200 kW
Line reactor	✓	✓	✓	✓	✓	✓	✓
Line filter	✓	✓	✓	✓	✓	✓	✓
Output reactor	✓	✓	✓	✓	✓	✓	✓
Sine-wave filter	✓	✓	✓	✓	✓	✓	✓
Brake chopper	Integrated in the Power Module						✓
Braking resistor	✓	✓	✓	✓	✓	✓	✓
Brake Relay and Safe Brake Relay	✓	✓	✓	✓	✓	✓	✓
DIN rail mounting kit	✓	✓	-	-	-	-	-
Screen termination kit	✓	✓	✓	✓	✓	✓	-

7.1 DIN rail mounting kit

Function

The DIN rail mounting kit (DRMK) is designed to allow the SINAMICS G120 FSA and FSB inverters to be mounted on a pair of parallel DIN rails.

The DRMK provides an integrated screening plate to allow for the termination of the screened motor cables and other screened cable used with the inverter.

The DRMK for FSA allows for the mounting of either the inverter as a stand-alone or with the inverter and the footprint filter. The FSB inverters, due to their physical size and weight can only be mounted as stand-alone inverters.

The required DIN rail pitch for frame size FSA and FSB is 115 (± 1) mm.

Mounting the DRMK

The mounting description of the DRMK is available in the internet:
http://support.automation.siemens.com/WW/view/en/23622394

7.2 Screen termination kit

Function of the screen termination kit

The screen termination kit has been designed to allow the termination of control, mains and power cables to ensure the correct electrical grounding to the inverter.

For FSA the screen termination kit provides for the termination of 3 screened cables.

For FSB and larger the screen termination kits provides for the termination of at least 4 screened cables.

Mounting the screen termination kit

The mounting description of the screen termination kit is available in the internet:
http://support.automation.siemens.com/WW/view/en/23621093

7.3 Reactor and filter

Line reactor

The purpose of a line reactor is to reduce line-side harmonic currents and harmonic effects. This applies particularly in the case of weak power supplies (network short-circuit power uK > 1 %).

Line filter

The Power Module complies with a higher radio interference class when an additional line filter is used.

Output reactor

Output reactors reduce the voltage loading on the motor windings. At the same time, the capacitive charge/discharge currents, which place an additional load on the power section when long motor cables are used, are reduced.

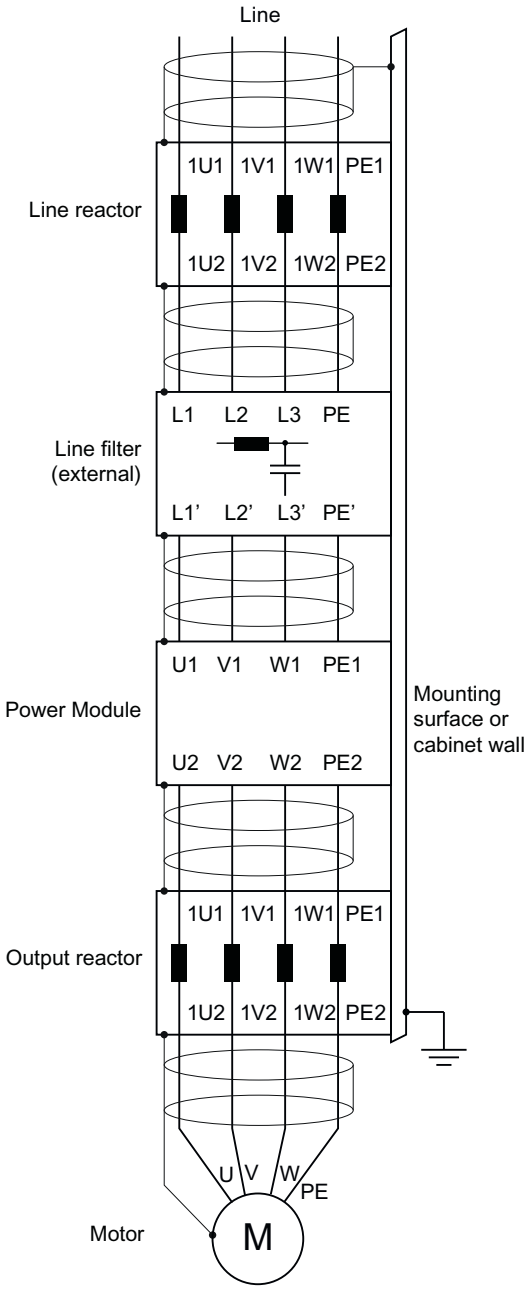
Sine-wave filter

The sine-wave filter is designed to limit the rate of rise of voltage and the capacitive charge or discharge currents which usually occur with inverter operation.

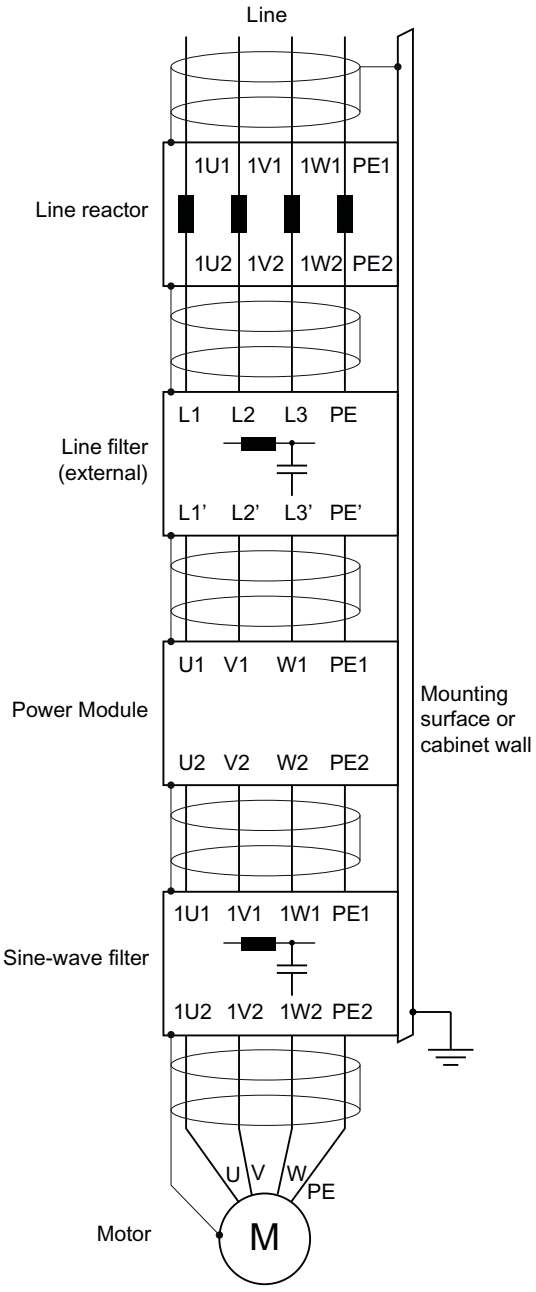
Connecting reactor and filter to the Power Module

The following drawings show the connecting order of the power components. Shielded cables are necessary if a line filter (external or integrated) is used.

Line fuses and contactor have to be installed between line reactor input and mains system.



Connecting power components with output reactor



Connecting power components with sine-wave filter

Mounting base components

Many system components for the Power Modules are designed as base components, that is, the component is mounted on the cabinet wall and the Power Module above it in a space-saving construction. Up to two base components can be mounted above one another. Every further system component has to be mounted laterally.

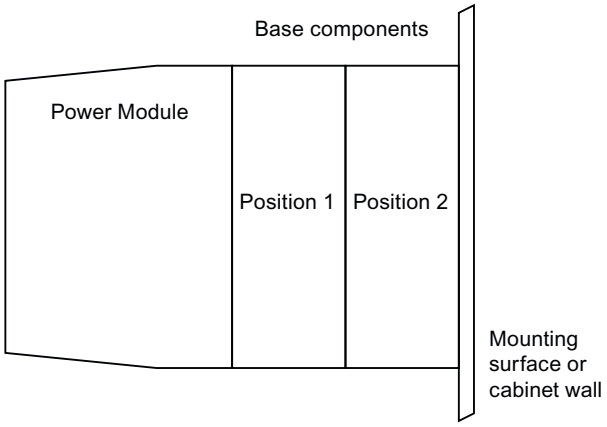


Figure 7-1 Mounting base components

Table 7- 1 Possible combinations of two base components

Power Module frame size	Base component on …	
	… position 1	… position 2
FSA and FSB 0.37 kW … 4 kW	Line reactor	Output reactor
		Sine-wave filter
		Braking resistor
	Line filter	Line reactor
		Output reactor
		Sine-wave filter
		Braking resistor
FSC 5.5 kW … 11 kW	Line reactor	Output reactor
		Sine-wave filter
	Line filter	Line reactor
		Output reactor
		Sine-wave filter

7.3.1 Line reactor

Installing the line reactor as base component

The line reactors for PM240 Power Modules of frame sizes FSA to FSE (0.37 kW … 37 kW) are designed as base components. The line reactor is attached to the mounting surface and the Power Module is mounted directly on the line reactor. The cables to the Power Module are already connected to the line reactor. The line reactor is connected to the line supply through terminals.

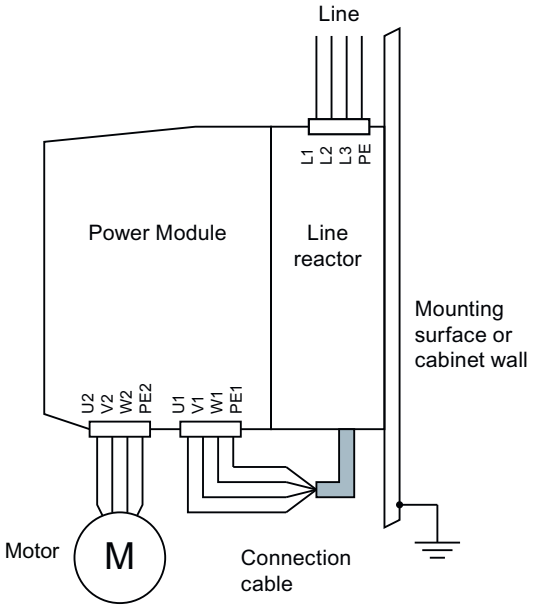


Figure 7-2 Connecting the line reactor as base component

The overall and mounting dimensions of the line reactor are written in the technical specifications. For more information see http://support.automation.siemens.com/WW/view/en/23623183

Installing the line reactor as lateral mounting component

The line reactors for PM240 Power Modules of frame sizes FSF and FSGX (45 kW … 200 kW) have to be mounted laterally.

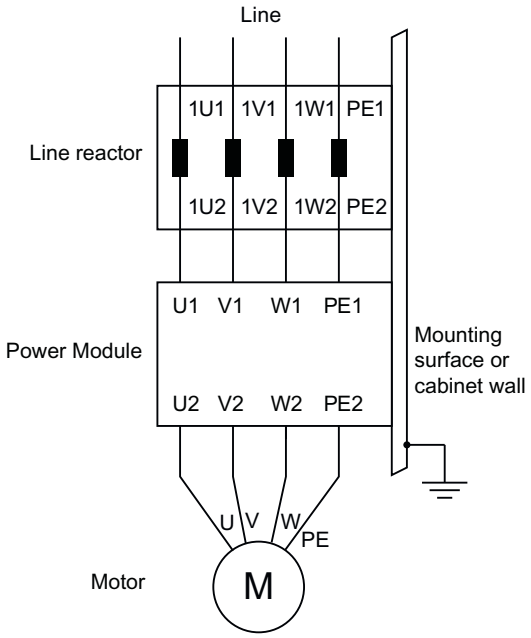


Figure 7-3 Connecting the line reactor as lateral mounting component

Technical specifications of the line reactors

The major electrical specification of the line reactors is the same as for the suitable Power Module. This applies to:

- line voltage
- line frequency
- rated current

The admissible ambient conditions of the line reactors are the same as for the suitable Power Module. This applies to:

- storage and transport temperature
- operating temperature
- relative humidity
- shock and vibration load

Table 7- 2 Technical specifications of the line reactors (table 1 of 6)

Feature	Suitable for Power Module with rated power (HO) of		
	0.37 kW ... 0.55 kW	0.75 kW ... 1.1 kW	1.5 kW
	FSA		
MLFB of the line reactor	6SE6400-3CC00-2AD3	6SE6400-3CC00-4AD3	6SE6400-3CC00-6AD3
MLFB of the suitable Power Module	6SL3224-0BE13-7UA0 6SL3224-0BE15-5UA0	6SL3224-0BE17-5UA0 6SL3224-0BE21-1UA0	6SL3224-0BE21-5UA0
Inductance	11.5 mH	6.3 mH	3.2 mH
Power loss at 50/60 Hz	6/7 W	12.5/15 W	7.5/9 W
Line connection	Screw terminals 1 … 2.5 mm²		
Connection to Power Module	Cable, 380 mm length		
Degree of protection	IP 20		
Overall dimensions Width Height Depth	75.5 mm 200 mm 50 mm		
Fixing dimensions Width Height	187 mm 56 mm		
Fixing screw	4 × M4		
Weight	0.6 kg	0.8 kg	0.6 kg
Possible as base component	yes		

Table 7- 3 Technical specifications of the line reactors (table 2 of 6)

Feature	Suitable for Power Module with rated power (HO) of		
	2.2 kW ... 3 kW	4 kW	5.5 kW ... 7.5 kW
	FSB		FSC
MLFB of the line reactor	6SL3203-0CD21-0AA0	6SL3203-0CD21-4AA0	6SL3203-0CD22-2AA0
MLFB of the suitable Power Module	6SL3224-0BE22-2 . A0 6SL3224-0BE23-0 . A0	6SL3224-0BE24-0 . A0	6SL3224-0BE25-5 . A0 6SL3224-0BE27-5 . A0
Inductance	2.2 mH	1.3 mH	0.56 mH
Power loss at 50/60 Hz	9/11 W	27/32 W	98/118 W
Line connection	Screw terminals 1.5 … 6 mm²		Screw terminals 2.5 … 10 mm²
Connection to Power Module	Cable, 460 mm length		Cable, 490 mm length
Degree of protection	IP20		
Overall dimensions Width Height Depth	153 mm 290 mm 70 mm		189 mm 371 mm 50 mm

Feature	Suitable for Power Module with rated power (HO) of		
	2.2 kW ... 3 kW	4 kW	5.5 kW ... 7.5 kW
	FSB		FSC
Fixing dimensions Width Height	120 mm 200 mm		156 mm 232 mm
Fixing screw	4 × M4		4 × M5
Weight	3.4 kg	3.4 kg	5.2 kg
Possible as base component	yes		

Table 7- 4 Technical specifications of the line rectors (table 3 of 6)

Feature	Suitable for Power Module with rated power (HO) of		
	11 kW	15 kW ... 18.5 kW	22 kW
	FSC	FSD	
MLFB of the line reactor	6SL3203-0CD23-5AA0	6SL3203-0CJ24-5AA0	6SL3203-0CD25-3AA0
MLFB of the suitable Power Module	6SL3224-0BE31-1 . A0	6SL3224-0BE31-5 . A0 6SL3224-0BE31-8 . A0	6SL3224-0BE32-2 . A0
Inductance	0.28 mH	0.41 mH	0.29 mH
Power loss at 50/60 Hz	37/44 W	90/115 W	
Line connection	Screw terminals 16 mm²		
Connection to Power Module	Cable, 490 mm length	Cable, 700 mm length	
Degree of protection	IP20		
Overall dimensions Width Height Depth	 189 mm 371 mm 50 mm	 275 mm 455 mm 84 mm	
Fixing dimensions Width Height	 156 mm 232 mm	 235 mm 421 mm	
Fixing screw	4 × M5	4 × M8	
Weight	5.9 kg	13 kg	
Possible as base component	yes		

Table 7- 5 Technical specifications of the line rectors (table 4 of 6)

Feature	Suitable for Power Module with rated power (HO) of		
	30 kW ... 37 kW		
	FSE		
MLFB of the line reactor	6SL3203-0CJ28-6AA0		
MLFB of the suitable Power Module	6SL3224-0BE33-0 . A0 6SL3224-0BE33-7 . A0		
Inductance	0.22 mH		
Power loss at 50/60 Hz	170/215 W		
Line connection	Screw terminals 50 mm²		
Connection to Power Module	Cable, 700 mm length		
Degree of protection	IP20		
Overall dimensions Width Height Depth	 275 mm 577 mm 94 mm		
Fixing dimensions Width Height	 235 mm 544 mm		
Fixing screw	4 × M8		
Weight	13 kg		
Possible as base component	yes		

Table 7- 6 Technical specifications of the line rectors (table 5 of 6)

Feature	Suitable for Power Module with rated power (HO) of		
	45 kW ... 55 kW	75 kW	90 kW
	FSF		
MLFB of the line reactor	6SE6400-3CC11-2FD0	6SE6400-3CC11-7FD0	6SL3000-0CE32-3AA0
MLFB of the suitable Power Module	6SL3224-0BE34-5 . A0 6SL3224-0BE35-5 . A0	6SL3224-0BE37-5 . A0	6SL3224-0BE38-8UA0
Inductance	0.15 mH	90 µH	76 µH
Power loss at 50/60 Hz	280/360 W	280/360 W	240/270 W
Line connection	Flat connector for M8 cable lug		Flat connector for M10 cable lug
Connection to Power Module	Flat connector for M8 cable lug		Flat connector for M10 cable lug
Degree of protection	IP00		
Overall dimensions Width Height Depth	 240 mm 228 mm 141 mm		 270 mm 200 mm 248 mm

Feature	Suitable for Power Module with rated power (HO) of		
	45 kW ... 55 kW	75 kW	90 kW
	FSF		
Fixing dimensions Width Depth	95 mm 185 mm		101 mm 200 mm
Fixing screw	4 × M8		
Weight	25 kg		24 kg
Possible as base component	no		

Table 7- 7 Technical specifications of the line rectors (table 6 of 6)

Feature	Suitable for Power Module with rated power (HO) of		
	110 kW	132 kW	160 kW and 200 kW
	FSF	FSGX	
MLFB of the line reactor	6SL3000-0CE32-8AA0	6SL3000-0CE33-3AA0	6SL3000-0CE35-1AA0
MLFB of the suitable Power Module	6SL3224-0BE41-1UA0	6SL3224-0XE41-3UA0	6SL3224-0XE41-6UA0 6SL3224-0XE42-0UA0
Inductance	62 µH	52 µH	42 µH
Power loss at 50/60 Hz	210/250 W	270 W	365 W
Line connection	Flat connector for M10 cable lug		Flat connector for M12 cable lug
Connection to Power Module	Flat connector for M10 cable lug		Flat connector for M12 cable lug
Degree of protection	IP00		
Overall dimensions Width Height Depth	270 mm 200 mm 248 mm	270 mm 248 mm 200 mm	300 mm 269 mm 212,5 mm
Fixing dimensions Width Depth	101 mm 200 mm	200 mm 101 mm	224 mm 118 mm
Fixing screw	4 × M8		
Weight	24 kg	28 kg	38 kg
Possible as base component	no		

7.3.2 Line filter

Installing the line filter as base component

The line filters for Power Modules FSB and FSC are designed as base components. The line filter is attached to the mounting surface and the Power Module is mounted directly on the line filter.

The cables to the Power Module are already connected to the line filter. The line filter is connected to the line supply through terminals.

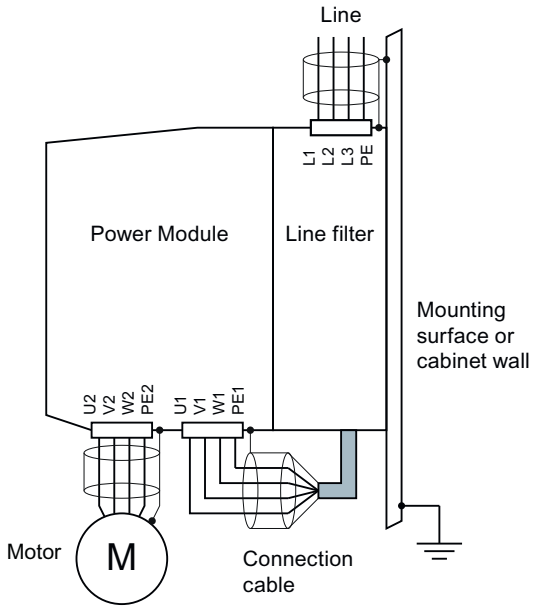


Figure 7-4 Connecting the line filter as base component

The overall and mounting dimensions of the line filter are written in the technical specifications.

Installing the line filter as lateral mounting component

The line filters for for the other frame sizes and line filters from third party suppliers have to be mounted laterally.

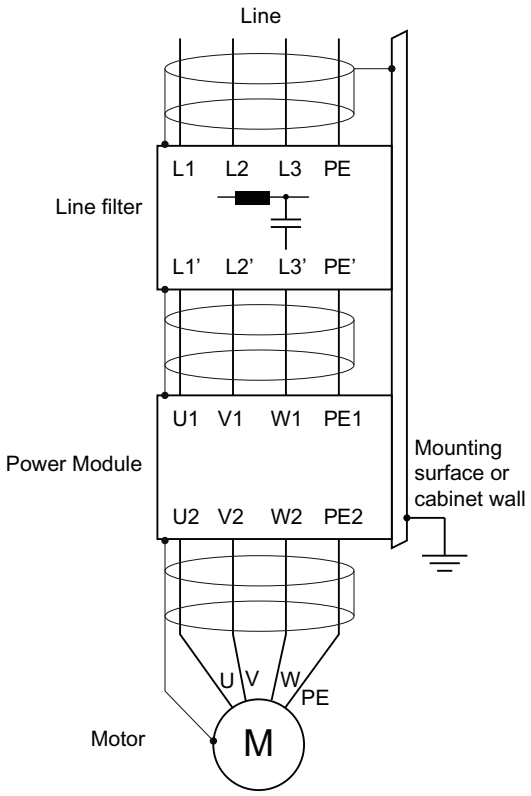


Figure 7-5 Connecting the line filter as lateral component

Shielded cables must be used from the line filter to the motor. The filter has to be installed as close as possible to the line entry of the cubicle.

Technical specifications of the line filters

The major electrical specification of the line filters is the same as for the suitable Power Module. This applies to:

- line voltage
- line frequency
- rated current

The admissible ambient conditions of the line filters are the same as for the suitable Power Module. This applies to:

- storage and transport temperature
- operating temperature
- relative humidity
- shock and vibration load

Table 7- 8 Technical specifications of the line filters class A

Feature	Suitable for Power Module with rated power (HO) of	
	90 kW ... 110 kW	132 kW ... 200 kW
	FSF	FSGX
MLFB of the line filter	6SL3203-0BE32-5AA0	6SL3000-0BE36-0AA0
MLFB of the suitable Power Module	6SL3224-0BE38-8UA0 6SL3224-0BE41-1UA0	6SL3224-0XE41-3UA0 6SL3224-0XE41-6UA0 6SL3224-0XE42-0UA0
Power loss at 50 Hz	60 W	55 W
Line connection	On housing via M8 screw stud	M10 connecting lugs
Connection to Power Module	On housing via M8 screw stud	M10 connecting lugs
Degree of protection	IP00	
Overall dimensions Width Height Depth	 240 mm 360 mm 116 mm	 400 mm 265 mm 140 mm
Fixing dimensions Width Height	 210 mm 220 mm	 240 mm 250 mm
Fixing screw	4 × M8	4 × M10
Weight	12.4 kg	19 kg
Possible as base component	no	

Table 7- 9 Technical specifications of the line filters class B

Feature	Suitable for Power Module with rated power (HO) of	
	2.2 kW ... 4 kW	5.5 kW ... 11 kW
	FSB	FSC
MLFB of the line filter	6SL3203-0BE21-6SA0	6SL3203-0BD23-8SA0
MLFB of the suitable Power Module	6SL3224-0BE22-2AA0 6SL3224-0BE23-0AA0 6SL3224-0BE24-0AA0	6SL3224-0BE25-5AA0 6SL3224-0BE27-5AA0 6SL3224-0BE31-1AA0
Power loss at 50 Hz	2.0 W ... 4.0 W	7.5 W ... 15 W
Line connection	Screw terminals 2.5 mm²	Screw terminals 4 mm²
Connection to Power Module	Cable, 400 mm length	Cable, 400 mm length
Degree of protection	IP20	
Overall dimensions Width Height Depth	 153 mm 296 mm 50 mm	 190 mm 362 mm 55 mm

Feature	Suitable for Power Module with rated power (HO) of	
	2.2 kW ... 4 kW	5.5 kW ... 11 kW
	FSB	FSC
Fixing dimensions Width Height	 120 mm 200 mm	 156 mm 232 mm
Fixing screw	4 × M4	4 × M5
Weight	1.5 kg	2.3 kg
Possible as base component	yes	

7.3.3 Output reactor

Installing the output reactor as base component

The output reactors for the Power Modules FSC with a rated power up to 15 kW are designed as base components. The output reactor is attached to the mounting surface and the Power Module is mounted directly on the output reactor.

The cables to the Power Module are already connected to the output reactor. The output reactor is connected to the motor through terminals.

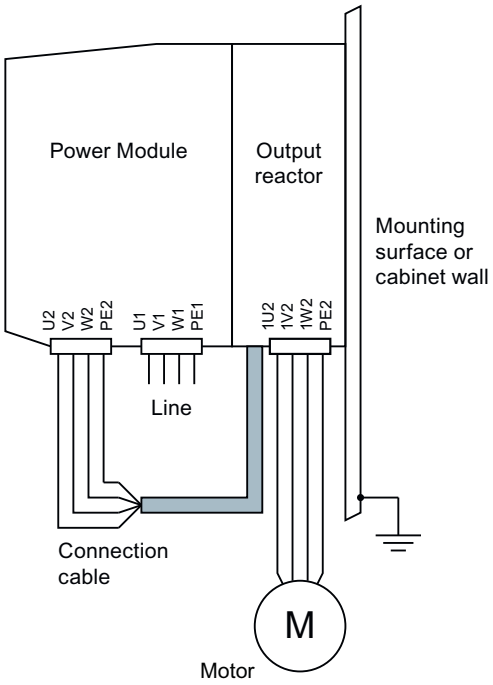


Figure 7-6 Connecting the output reactor as base component

The overall and mounting dimensions of the output reactor are written in the technical specifications.

Installing the output reactor as lateral mounting component

The output reactors for Power Modules with a rated power of more than 15 kW have to be mounted laterally.

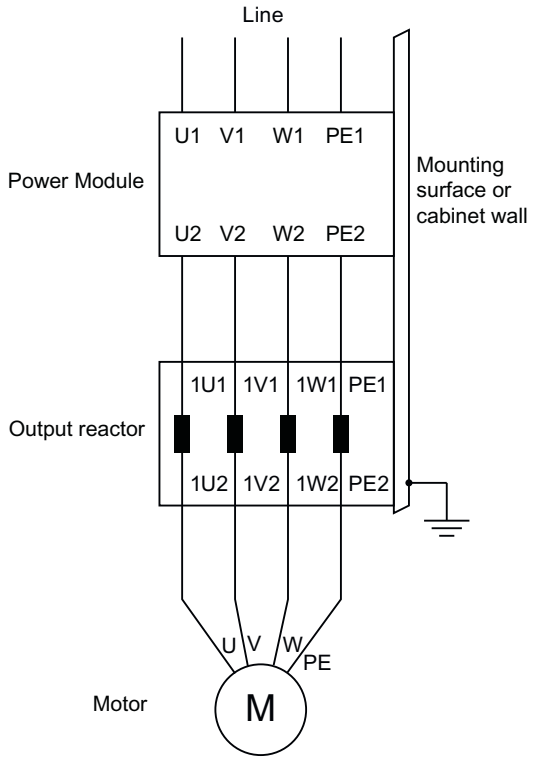


Figure 7-7 Connecting the output reactor as lateral component

For more information see http://support.automation.siemens.com/WW/view/en/22103628

Technical specifications of the output reactors

The major electrical specification of the output reactors is the same as for the suitable Power Module. This applies to:

- voltage
- rated current

The maximum permissible output frequency of the Power Module is 150 Hz when an output reactor is used – the pulse frequency must not exceed 4 kHz.

The admissible ambient conditions of the output reactors are the same as for the suitable Power Module. This applies to:

- storage and transport temperature
- operating temperature
- relative humidity
- shock and vibration load

Table 7- 10 Technical specifications of the output reactors (table 1 of 6)

Feature	Suitable for Power Module with rated power (HO) of	
	2.2 kW ... 4 kW	5.5 kW ... 11 kW
	FSB	FSC
MLFB of the line reactor	6SL3202-0AE21-0CA0	6SL3202-0AJ23-2CA0
MLFB of the suitable Power Module	6SL3224-0BE22-2 . A0 6SL3224-0BE23-0 . A0 6SL3224-0BE24-0 . A0	6SL3224-0BE25-5 . A0 6SL3224-0BE27-5 . A0 6SL3224-0BE31-1 . A0
Power loss at 50/60 Hz	20 W	60 W
Motor connection	Screw terminals 6 mm²	
Connection to Power Module	Cable, 400 mm length	Cable, 350 mm length
Degree of protection	IP00	
Overall dimensions Width Height Depth	 154 mm 270 mm 70 mm	 189 mm 334 mm 80 mm
Fixing dimensions Width Height	 120 mm 200 mm	 156 mm 232 mm
Fixing screw	4 × M4	4 × M5
Weight	4.5 kg	9 kg
Possible as base component	yes	

Table 7- 11 Technical specifications of the output reactors (table 2 of 6)

Feature	Suitable for Power Module with rated power (HO) of		
	15 kW	18.5 kW	22 kW
	FSD		
MLFB of the line reactor	6SE6400-3TC05-4DD0	6SE6400-3TC03-8DD0	6SE6400-3TC05-4DD0
MLFB of the suitable Power Module	6SL3224-0BE31-5 . A0	6SL3224-0BE31-8 . A0	6SL3224-0BE32-2 . A0
Power loss at 50/60 Hz	200 W	200 W	200 W
Motor connection	Flat connector for M6 cable lug		
Connection to Power Module	Flat connector for M6 cable lug		
Degree of protection	IP00		
Overall dimensions Width Height Depth	 225 mm 210 mm 150 mm		
Fixing dimensions Width Height	 70 mm 176 mm	 94 mm 176 mm	 70 mm 176 mm

Feature	Suitable for Power Module with rated power (HO) of		
	15 kW	18.5 kW	22 kW
	FSD		
Fixing screw	4 × M6		
Weight	10.5 kg	16 kg	10.5 kg
Possible as base component	no		

Table 7- 12 Technical specifications of the output reactors (table 3 of 6)

Feature	Suitable for Power Module with rated power (HO) of		
	30 kW	37 kW	45 kW
	FSE		FSF
MLFB of the line reactor	6SE6400-3TC08-0ED0	6SE6400-3TC07-5ED0	6SE6400-3TC14-5FD0
MLFB of the suitable Power Module	6SL3224-0BE33-0 . A0	6SL3224-0BE33-7 . A0	6SL3224-0BE34-5 . A0
Power loss at 50/60 Hz	170 W	270 W	470 W
Motor connection	Flat connector for M6 cable lug		Flat connector for M8 cable lug
Connection to Power Module	Flat connector for M6 cable lug		Flat connector for M8 cable lug
Degree of protection	IP00		
Overall dimensions Width Height Depth	 225 mm 210 mm 150 mm	 270 mm 248 mm 209 mm	 350 mm 321 mm 288 mm
Fixing dimensions Width Height	 70 mm 176 mm	 101 mm 200 mm	 138 mm 264 mm
Fixing screw	4 × M6	4 × M8	
Weight	10.5 kg	25 kg	52 kg
Possible as base component	no		

Table 7- 13 Technical specifications of the output reactors (table 4 of 6)

Feature	Suitable for Power Module with rated power (HO) of		
	55 kW	75 kW	90 kW
	FSF		
MLFB of the line reactor	6SE6400-3TC15-4FD0	6SE6400-3TC14-5FD0	6SL3000-2BE32-1AA0
MLFB of the suitable Power Module	6SL3224-0BE35-5 . A0	6SL3224-0BE37-5 . A0	6SL3224-0BE38-8UA0
Power loss at 50/60 Hz	250 W	470 W	490 W

Feature	Suitable for Power Module with rated power (HO) of		
	55 kW	75 kW	90 kW
	FSF		
Motor connection	Flat connector for M8 cable lug		Flat connector for M10 cable lug
Connection to Power Module	Flat connector for M8 cable lug		Flat connector for M10 cable lug
Degree of protection	IP00		
Overall dimensions Width Height Depth	 270 mm 248 mm 209 mm	 350 mm 321 mm 288 mm	 300 mm 285 mm 257 mm
Fixing dimensions Width Height	 101 mm 200 mm	 138 mm 264 mm	 163 mm 224 mm
Fixing screw	4 × M8		
Weight	52 kg		
Possible as base component	no		

Table 7- 14 Technical specifications of the output reactors (table 5 of 6)

Feature	Suitable for Power Module with rated power (HO) of		
	110 kW	132 kW	160 kW
	FSF	FSGX	
MLFB of the line reactor	6SL3000-2BE32-6AA0	6SL3000-2BE33-2AA0	6SL3000-2BE33-8AA0
MLFB of the suitable Power Module	6SL3224-0BE41-1UA0	6SL3224-0XE41-6UA0	6SL3224-0XE42-0UA0
Power loss at 50/60 Hz	500 W	470 W	500 W
Motor connection	Flat connector for M10 screw	Flat connector for M10 screw	Flat connector for M10 screw
Connection to Power Module	Flat connector for M10 screw	Flat connector for M10 screw	Flat connector for M10 screw
Degree of protection	IP00		
Overall dimensions Width Height Depth	 300 mm 315 mm 277 mm	 300 mm 285 mm 257 mm	 300 mm 285 mm 277 mm
Fixing dimensions Width Height	 183 mm 224 mm	 163 mm 224 mm	 183 mm 224 mm
Fixing screw		4 × M8	
Weight	52 kg	66 kg	73 kg
Possible as base component	no		

Table 7- 15 Technical specifications of the output reactors (table 6 of 6)

Feature	Suitable for Power Module with rated power (HO) of		
	200 kW		
	FSGX		
MLFB of the line reactor	6SL3000-2BE35-0AA0		
MLFB of the suitable Power Module	6SL3224-0XE41-3UA0		
Power loss at 50 Hz	500 W		
Motor connection	Flat connector for M12 screw		
Connection to Power Module	Flat connector for M12 screw		
Degree of protection	IP00		
Overall dimensions Width Height Depth	 300 mm 365 mm 277 mm		
Fixing dimensions Width Height	 183 mm 224 mm		
Fixing screw	M10		
Weight	100 kg		
Possible as base component	no		

7.3.4 Sine-wave filter

Installing the sine-wave filter as base component

The sine-wave filters for Power Modules FSB and FSC are designed as base components. The sine-wave filter is attached to the mounting surface and the Power Module is mounted directly on the sine-wave filter. The cables to the Power Module are already connected to the sine-wave filter. The sine-wave filter is connected to the motor through terminals.

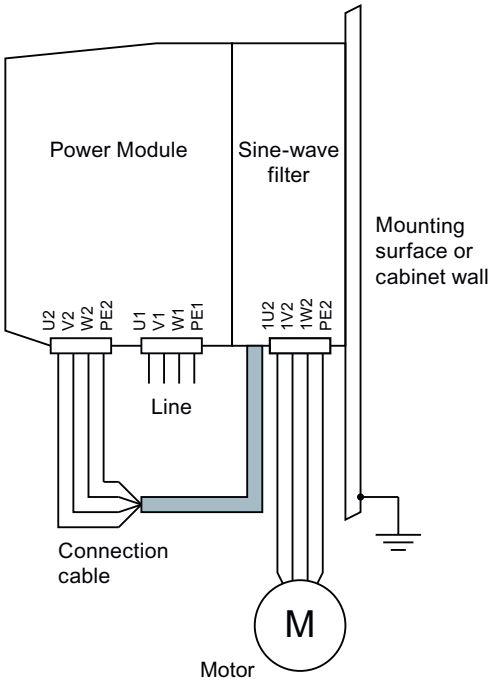


Figure 7-8 Connecting the sine-wave filter as base component

The overall and mounting dimensions of the sine-wave filter are written in the technical specifications.

Installing the sine-wave filter as lateral mounting component

The sine-wave filter for for the other frame sizes have to be mounted laterally.

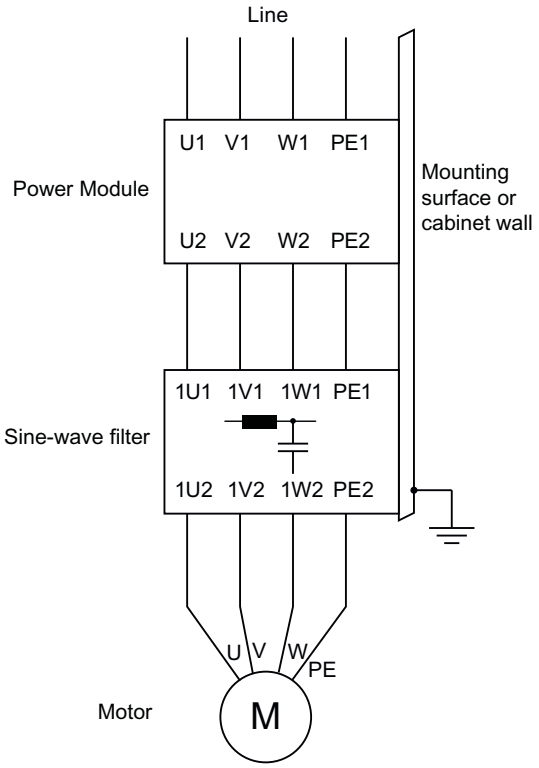


Figure 7-9 Connecting the sine-wave filter as lateral component

For more information see http://support.automation.siemens.com/WW/view/en/29522775

Technical specifications of the sine-wave filter

The major electrical specification of the sine-wave filter is the same as for the suitable Power Module. This applies to:

- voltage
- current

The maximum permissible output frequency of the Power Module is 150 Hz when a sine-wave filter is used – the pulse frequency must not exceed 8 kHz.

The admissible ambient conditions of the sine-wave filter are the same as for the suitable Power Module. This applies to:

- storage and transport temperature
- operating temperature
- relative humidity
- shock and vibration load

Table 7- 16 Technical specifications of the sine-wave filters (table 1 of 5)

Feature	Suitable for Power Module with rated power (HO) of	
	2.2 kW …3 kW	4 kW
	FSB	
MLFB of the sine-wave filter	6SL3202-0AE21-1SA0	6SL3202-0AE21-4SA0
MLFB of the suitable Power Module	6SL3224-0BE22-2 . A0 6SL3224-0BE23-0 . A0	6SL3224-0BE24-0 . A0
Power loss at 50 Hz	22 W	36 W
dv/dt limiting	≤ 500 V/µs	
Motor connection	Screw terminals 6 mm²	
Connection to Power Module	Cable, 500 mm length	
Degree of protection	IP20	
Overall dimensions Width Height Depth	 75.5 mm 200 mm 110 mm	 153 mm 270 mm 100 mm
Installation clearance Top Bottom Side	 100 mm 100 mm 100 mm	
Fixing dimensions Width Height	 56 mm 187 mm	 133 mm 258 mm
Fixing screw	4 × M4	
Weight	2.6 kg	10.0 kg
Possible as base component	yes	

Table 7- 17 Technical specifications of the sine-wave filters (table 2 of 5)

Feature	Suitable for Power Module with rated power (HO) of	
	5.5 kW	7.5 kW … 11 kW
	FSC	
MLFB of the sine-wave filter	6SL3202-0AE22-0SA0	6SL3202-0AE23-3SA0
MLFB of the suitable Power Module	6SL3224-0BE25-5 . A0	6SL3224-0BE27-5 . A0 6SL3224-0BE31-1 . A0
dv/dt limiting	≤ 500 V/µs	
Power loss at 50 Hz	40 W	65 W
Motor connection	Screw terminals 10 mm²	
Connection to Power Module	Cable, 500 mm length	
Degree of protection	IP20	

Feature	Suitable for Power Module with rated power (HO) of	
	5.5 kW	7.5 kW … 11 kW
	FSC	
Overall dimensions Width Height Depth	189 mm 336 mm 140 mm	
Installation clearance Top Bottom Side	100 mm 100 mm 100 mm	
Fixing dimensions Width Height	167 mm 323 mm	
Fixing screw	4 × M5	
Weight	12.0 kg	23.0 kg
Possible as base component	yes	

Table 7- 18 Technical specifications of the sine-wave filters (table 3 of 5)

Feature	Suitable for Power Module with rated power (HO) of		
	15 kW … 18.5 kW	22 kW	30 kW … 37 kW
	FSD		FSE
MLFB of the sine-wave filter	6SL3202-0AE24-6SA0	6SL3202-0AE26-2SA0	6SL3202-0AE28-8SA0
MLFB of the suitable Power Module	6SL3224-0BE31-5 . A0 6SL3224-0BE31-8 . A0	6SL3224-0BE32-2 . A0	6SL3224-0BE33-0 . A0 6SL3224-0BE33-7 . A0
dv/dt limiting	≤ 500 V/µs		
Power loss at 50 Hz	80 W	65 W	100 W
Motor connection	Screw terminals 25 … 50 mm²		Screw terminals 25 … 95 mm²
Connection to Power Module	Screw terminals 25 … 50 mm²		Screw terminals 25 … 95 mm²
Degree of protection	IP00 without terminal cover, IP20 with terminal cover		
Overall dimensions Width Height Depth	250 mm 305 mm 262 mm	250 mm 315 mm 262 mm	275 mm 368 mm 275 mm
Installation clearance Top Bottom Side	100 mm - 100 mm		
Fixing dimensions Width Depth	230 mm 127 mm		250 mm 132 mm
Fixing screw	4 × M6		4 × M8

Feature	Suitable for Power Module with rated power (HO) of		
	15 kW … 18.5 kW	22 kW	30 kW … 37 kW
	FSD		FSE
Weight	24 kg	34 kg	45 kg
Possible as base component	no		

Table 7- 19 Technical specifications of the sine-wave filters (table 4 of 5)

Feature	Suitable for Power Module with rated power (HO) of		
	45 kW … 55 kW	75 kW	90 kW … 110 kW
	FSF		
MLFB of the sine-wave filter	6SL3202-0AE31-5SA0	6SL3202-0AE31-8SA0	6SL3000-2CE32-3AA0
MLFB of the suitable Power Module	6SL3224-0BE34-5 . A0	6SL3224-0BE35-5 . A0	6SL3224-0BE38-8UA0 6SL3224-0BE41-1UA0
dv/dt limiting	≤ 500 V/µs		
Power loss at 50 Hz	180 W	190 W	200 W
Motor connection	Screw terminals 50 … 150 mm²		Flat connector for M10 cable lug
Connection to Power Module	Screw terminals 50 … 150 mm²		Flat connector for M10 cable lug
Degree of protection	IP00 without terminal cover, IP20 with terminal cover		IP00
Overall dimensions Width Height Depth	 350 mm 440 mm 305 mm	 350 mm 468 mm 305 mm	 620 mm 320 mm 300 mm
Installation clearance Top Bottom Side	 100 mm - 100 mm		
Fixing dimensions Width Depth	 320 mm 255 mm	 320 mm 155 mm	 225 mm and 150 mm 280 mm
Fixing screw	4 × M8		6 × M10
Weight	63 kg	80 kg	124 kg
Possible as base component	no		

Table 7- 20 Technical specifications of the sine-wave filters (table 5 of 5)

Feature	Suitable for Power Module with rated power (HO) of		
	132 kW	160 kW	200 kW
	FSGX		
MLFB of the sine-wave filter	6SL3000-2CE32-8AA0	6SL3000-2CE33-3AA0	6SL3000-2CE34-1AA0
MLFB of the suitable Power Module	6SL3224-0XE41-6UA0	6SL3224-0XE42-0UA0	6SL3224-0XE41-3UA0
dv/dt limiting	≤ 500 V/µs		
Power loss at 50 Hz	230 W	180 W	230 W
Motor connection	Flat connector for M10 cable lug		
Connection to Power Module	Flat connector for M10 cable lug		
Degree of protection	IP00		
Overall dimensions Width Height Depth	 620 mm 320 mm 300 mm	 620 mm 370 mm 360 mm	 620 mm 370 mm 360 mm
Installation clearance Top Bottom Side	100 mm -- 100 mm		
Fixing dimensions Width Depth	225 mm and 150 mm 280 mm	225 mm and 150 mm 320 mm	
Fixing screw	6 × M10		
Weight	127 kg	136 kg	198 kg
Possible as base component	no		

7.4 Brake chopper (FSGX)

The function of the brake chopper

The brake chopper controls the external braking resistor.

- The brake chopper is integrated in the Power Module FSA … FSF
- The Power Module FSGX does **not** contain a brake chopper. The brake chopper is available as an accessory only for the Power Module FSGX

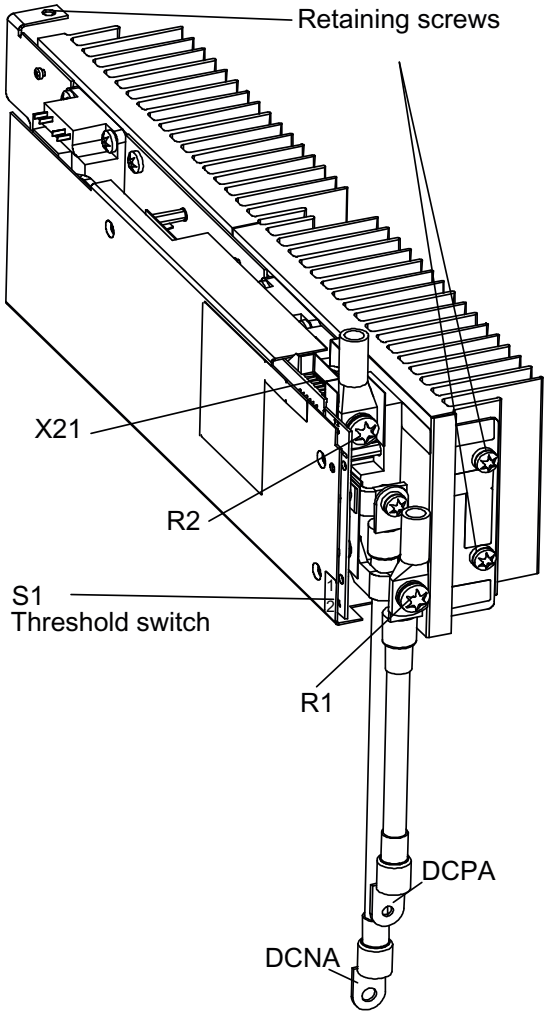


Figure 7-10 Brake chopper for Power Module FSGX

7.4.1 Installing the Brake chopper (FSGX)

The brake chopper is installed in a slot within the Power Module FSGX and force-cooled by its fan. The brake chopper is connected to the DC link by means of flexible cables, which are supplied as standard.

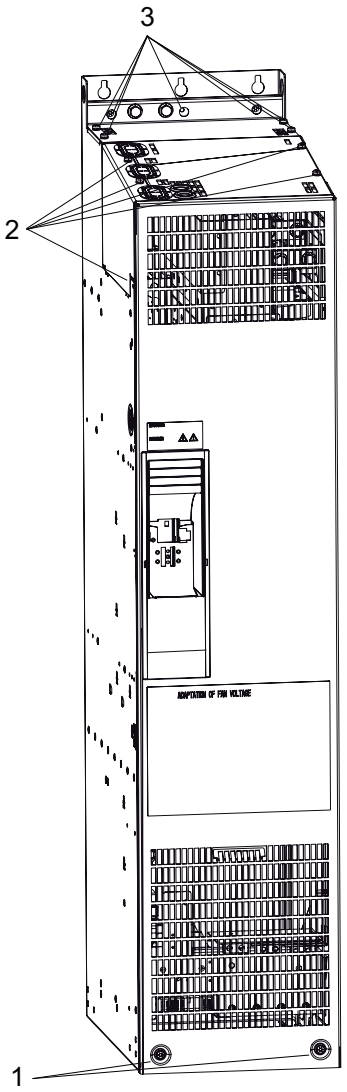


Figure 7-11 Installing the brake chopper in a Power Module FSGX - steps 1 - 3

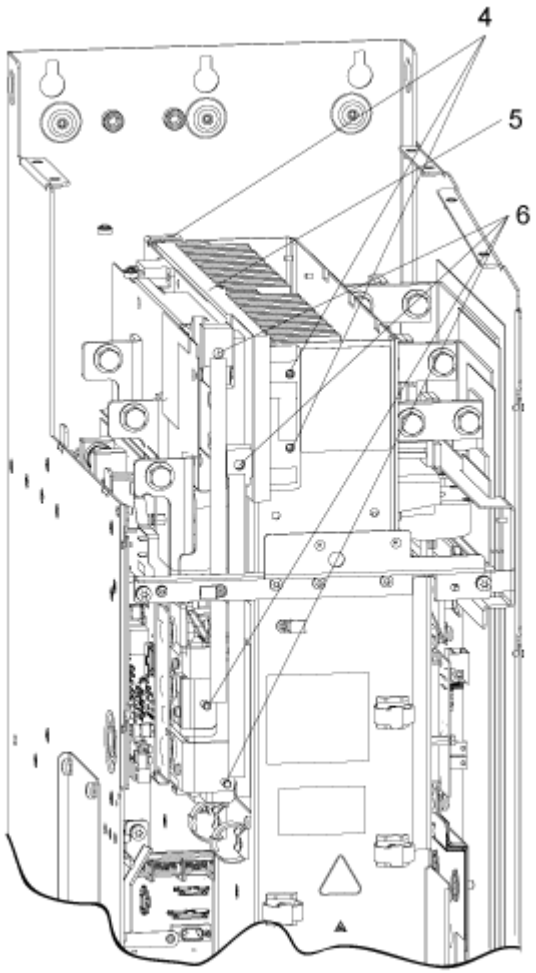


Figure 7-12 Installing the brake chopper in a Power Module FSGX – steps 4 - 6

Installing the brake chopper

The steps for the installation procedure are numbered in accordance with the figures in the diagrams.

1. Unscrew the 2 M6 screws from the front cover and lift off the cover.
2. Unscrew the 4 screws from the upper cover plate.
   Unscrew the 1 x M6 nut on the left-hand side and remove the front cover.
3. Unscrew the 4 screws from the upper cover plate.
   Unscrew the 3 screws from the rear cut-out sections and remove the rear cover.
4. Unscrew the 3 screws for the blanking plate and remove the plate.
5. Insert the brake chopper where the cover used to be and secure it using the 3 screws (from step 4).
6. Secure the connecting cable to the DC link with 2 screws (brake chopper connection) and 2 nuts (DC link connection).

Carry out the subsequent steps in reverse order from steps 1 – 3.

An opening above the connections for the braking resistor (R1, R2) is provided in the cover for connecting the cable to the braking resistor.

NOTICE
You must observe the tightening torques. Information on this can be found in the table in the "Mechanical installation" section

7.4.2 Connecting the brake chopper to the PM

Interface overview

The brake chopper has the following interfaces:

- DC link connection via flexible cables or a fixed busbar
- Braking resistor connection via flexible cables or a fixed busbar
- 1 digital input (inhibit brake chopper with high signal/acknowledge error with negative edge high -> low)
- 1 digital output (brake chopper defective)
- PE/protective conductor connection

Connection overview

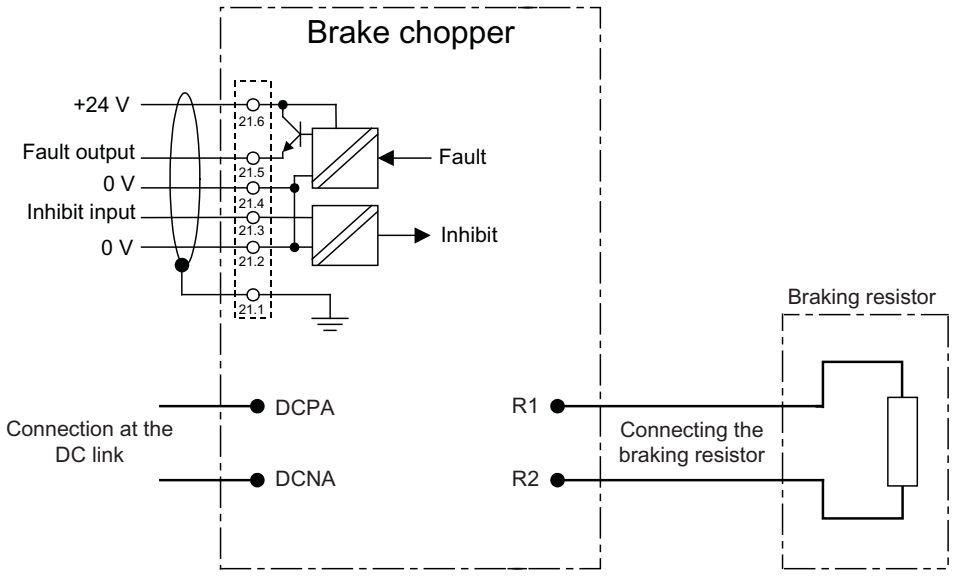
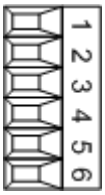


Figure 7-13 Connection overview of the brake chopper

Digital input and output

The connection of the digital input and output is not required for the function of the brake chopper.

Table 7- 21 Terminal block X21

	Terminal	Designation	Technical specifications
	1	Shield	Shield connection for terminals 2 ... 6
	2	0 V	High signal level: +15 V to 30 V Current consumption: 2 mA to 15 mA Low signal level: -3 V to 5 V
	3	Inhibit (digital input)	
	4	0 V	High signal: No fault Low signal: Fault present Voltage: 24 V DC Load current: 0.5 mA to 0.6 mA
	5	Fault (digital output)	
	6	+24 V	Voltage: +18 V to +30 V Typical current consumption (induced current consumption): 10 mA at 24 V DC
Max. connectable cross-section 1.5 mm^2			

Note

Applying a high signal to terminal X21.3 inhibits the brake chopper. With a falling edge, pending fault codes are acknowledged.

Threshold switch

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

⚠ WARNING

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

Table 7- 22 Response thresholds of the brake chopper

Rated voltage	Response threshold	Switch position	Comments
3 AC 380 V … 480 V	673 V	1 ("top")	774 V is the default factory setting. With line voltages of between 380 V and 400 V, the response threshold can be set to 673 V to reduce the voltage stress on the motor and converter. This does, however, reduce the possible braking power with the square of the voltage (673/774)² = 0.75. The maximum possible braking power is, therefore, 75%.
	774 V	2 (bottom")	

7.5 Braking Resistor

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

7.5.1 Mounting the braking resistors

The following points must be taken into account generally:

- Sufficient space must be available for dissipating the energy converted by the braking resistor.
- A sufficient distance from flammable objects must be maintained.
- The braking resistor should not be installed underneath fire detection systems, since these could be triggered by the resulting heat.
- For outdoor installation, a hood should be provided to protect the braking resistor against precipitation (in accordance with degree of protection IP20).

Braking resistor for Power Modules FSA and FSB (0.37 kW … 4 kW)

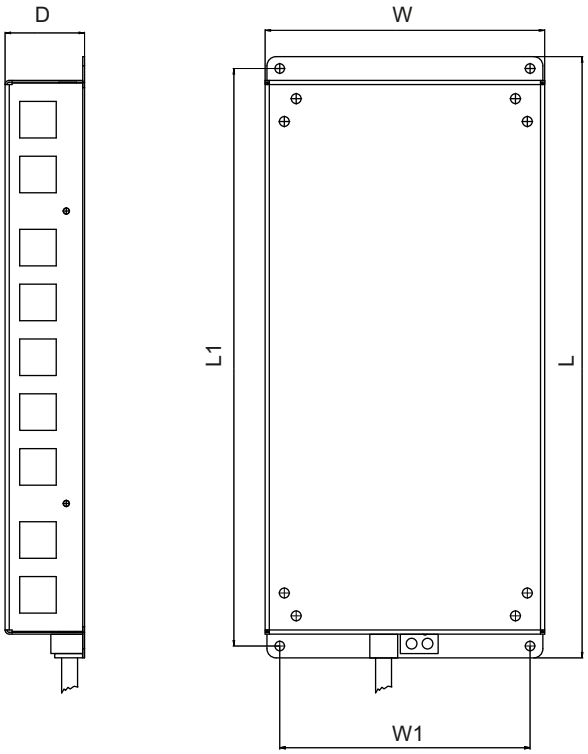


Figure 7-14 Dimensions of the braking resistor, FSA and FSB

Table 7- 23 Dimension data: Braking resistor, all data in mm and (inches)

Order No. of the braking resistor	6SE6400-4BD11-0AA0	6SL3201-0BE12-0AA0
Suitable for Power Module (HO)	FSA	FSB
	0.37 kW ... 1.5 kW	2.2 kW ... 4 kW
Order-No. of the suitable Power Module	6SL3224-0BE13-7UA0 6SL3224-0BE15-5UA0 6SL3224-0BE17-5UA0 6SL3224-0BE21-1UA0 6SL3224-0BE21-5UA0	6SL3224-0BE22-2 . A0 6SL3224-0BE23-0 . A0 6SL3224-0BE24-0 . A0
L	230 (9.05)	239 (9.40)
L1	217 (8.54)	226 (8.89)
D	43.5 (1.71)	43.5 (1.71)
W	72 (2.83)	149 (5.86)
W1	56 (2.20)	138 (5.43)

The braking resistors can be installed horizontally or vertically. The connections on vertically installed resistors must be at the bottom.

The braking resistors for the FSA and FSB frame sizes are designed as sub-chassis components. If the PM240 Power Modules of the FSA or FSB frame size are operated without line reactor, the braking resistors can also be installed under the Power Modules.

The braking resistor can be positioned outside the cabinet or switchgear room. This enables the resulting heat loss around the Power Modules to be dissipated. This reduces the level of air conditioning required.

Braking resistor for Power Modules FSC … FSF (5.5 kW … 110 kW)

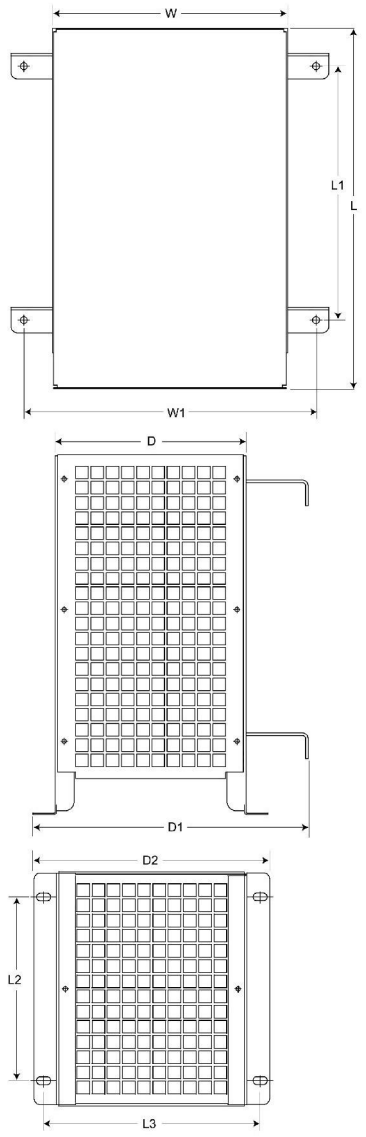


Figure 7-15 Dimensions of the braking resistors, FSC ... FSF

Table 7- 24 Dimension data: Braking resistor, all data in mm and (inches), Part 1

Order No. of the braking resistor	**6SE6400-4BD16-5CA0**	**6SE6400-4BD21-2DA0**	**6SE6400-4BD22-2EA0**
Suitable for Power Module (HO)	**FSC**	**FSD**	**FSE**
	5.5 kW ... 11 kW	**15 kW ... 22 kW**	**30 kW ... 37 kW**
Order-No. of the suitable Power Module	6SL3224-0BE25-5 . A0 6SL3224-0BE27-5 . A0 6SL3224-0BE31-1 . A0	6SL3224-0BE31-5 . A0 6SL3224-0BE31-8 . A0 6SL3224-0BE32-2 . A0	6SL3224-0BE33-0 . A0 6SL3224-0BE33-7 . A0
L	285 (11.22)	515 (20.27)	645 (25.39)
L1	200 (7.87)	350 (13.77)	480 (18.89)
L2	145 (5.70)	205 (8.07)	205 (8.07)
L3	170 (6.69)	195 (7.67)	195 (7.67)
D	150 (5.90)	175 (6.88)	175 (6.88)
D1	217 (8.54)	242 (9.52)	242 (9.52)
D2	185 (7.28)	210 (8.26)	210 (8.26)
W	185 (7.28)	270 (10.62)	270 (10.62)
W1	230 (9.05)	315 (12.40)	315 (12.40)

Table 7- 25 Dimension data: Braking resistor, all data in mm and (inches), Part 2

Order No. of the braking resistor	**6SE6400-4BD24-0FA0**	**6SE6400-4BD26-0FA0**
Suitable for Power Module (HO)	**FSF**	
	45 kW ... 75 kW	**90 kW ... 110 kW**
Order-No. of the suitable Power Module	6SL3224-0BE34-5 . A0 6SL3224-0BE35-5 . A0 6SL3224-0BE37-5 . A0	6SL3224-0BE38-8UA0 6SL3224-0BE41-1UA0
L	650 (25.59)	526 (20.71)
L1	510 (20.07)	-
L2	270 (10.62)	380 (14.96)
L3	335 (13.18)	500 (19.69)
D	315 (12.40)	301 (11.85)
D1	382 (15.03)	-
D2	382 (15.03)	-
W	400 (15.74)	483 (19.09)
W1	435 (17.12)	-

The braking resistors can be installed horizontally or vertically. The connections on vertically installed resistors must be at the bottom.

The braking resistor can be positioned outside the cabinet or switchgear room. This enables the resulting heat loss around the Power Modules to be dissipated. This reduces the level of air conditioning required.

Braking resistor for Power Module FSGX (132 kW … 200 kW)

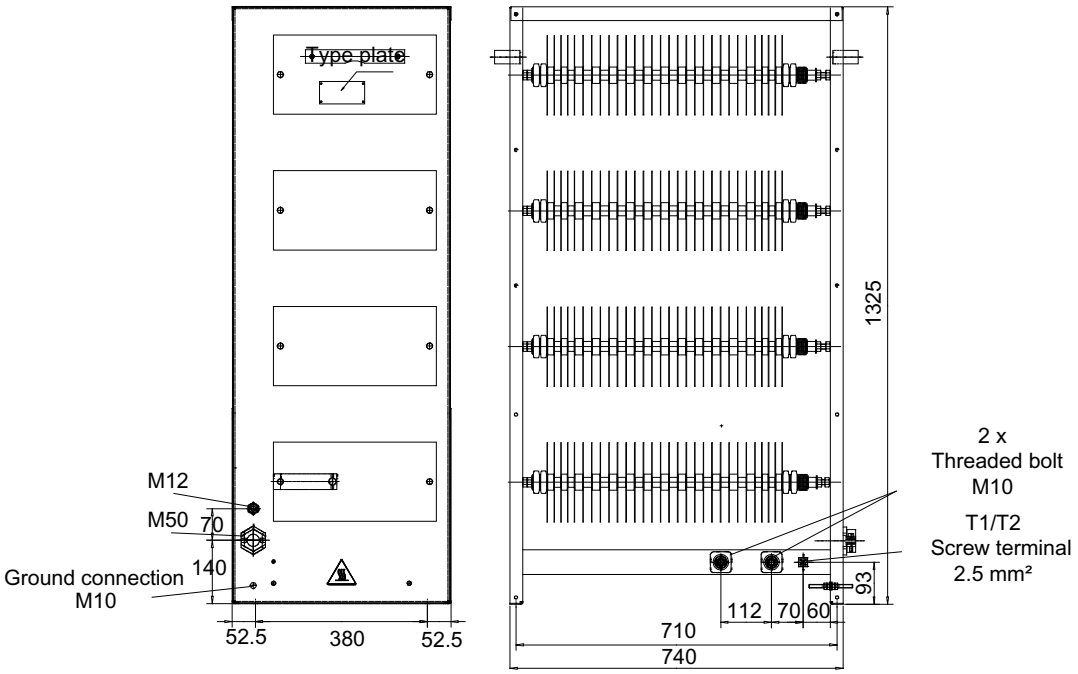


Figure 7-16 Dimensions of the braking resistor FSGX, order-no. 6SL3000-1BE32-5AA0

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

The braking resistor FSGX is suitable for thePower Modules with the following order-no.:
6SL3224-0XE41-3UA0
6SL3224-0XE41-6UA0
6SL3224-0XE42-0UA0

The braking resistor should not be installed in the vicinity of the converter. The following points must be taken into account:

- The braking resistors are only suitable for floor mounting.
- The maximum cable length between the Power Module and braking resistor is 50 m.
- The braking resistor must be installed as a free-standing unit.
- Objects must not be placed on or anywhere above the braking resistor.

7.5.2 Connecting the braking resistor

The braking resistor is connected at terminals DCP/R1 and R2.

FSB ... FSF: The braking resistor can be connected directly to the Power Module.

FSGX: The connecting of a braking resistor requires the installation of a brake chopper.

On FSA to access the R1/R2- terminals the cutout cover must be removed using a small pair of cutters, ensuring that no plastics from the cutout fall into the inverter housing. On FSB and FSC the R1/R2- terminals are located on the underside at the bottom of the unit (see Figure). The terminal connection consists of up to three spades.

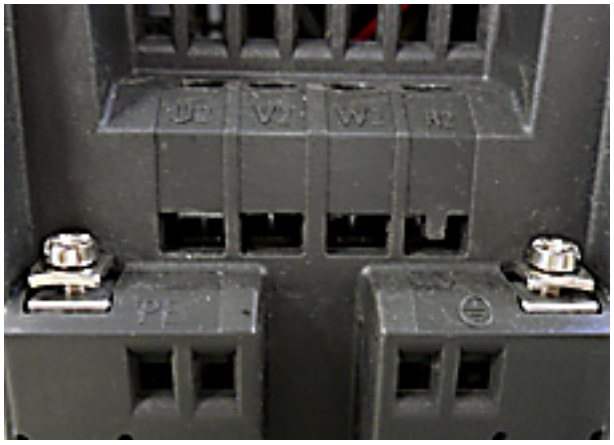


Figure 7-17 PM240 FSA spades

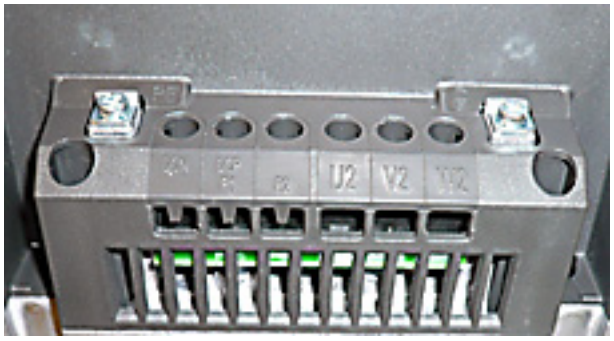


Figure 7-18 PM240 FSB spades

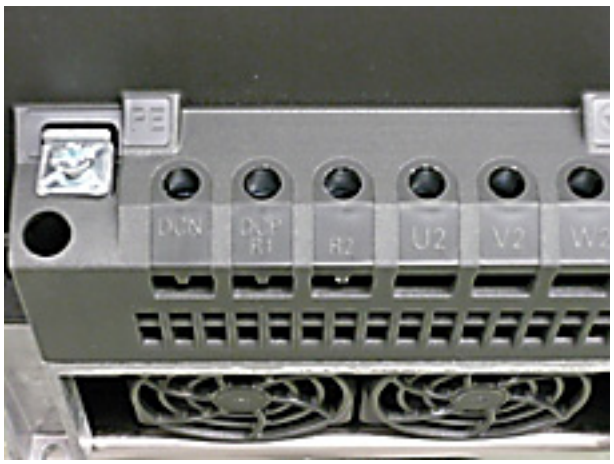


Figure 7-19 PM240 FSC spades

Note

With the cutout cover removed and no connections fitted to the spades, the inverter has only IP00 protection.

7.5.3 Technical specifications of the braking resistor

Table 7- 26 Technical specifications, braking resistors, Part 1

Resistor for Power Module ...	FSB	FSC	FSD
Nominal power (HO) of the Power Module	2.2 kW ... 4 kW	5.5 kW ... 11 kW	15 kW ... 22 kW
Order number	6SE6400-4BD12-0BA0	6SE6400-4BD16-5CA0	6SE6400-4BD21-2DA0
Resistance	160 Ω	56 Ω	27 Ω
Rated power P_{DB}	0.2 kW	0.65 kW	1.2 kW
Peak power P_{max}	4.0 kW	13 kW	24 kW
Degree of protection	IP20 or IPXXB	IP20 or IPXXB	IP20 or IPXXB
Power Connections	Cable 3 x 2.5 mm^2 shielded, length 0.5 m	Cable 3 x 2.5 mm^2 shielded, length 0.9 m	M6 studs
Thermoswitch (NC contact) maximum contact load connecting cable	250 V_{AC} / 2.5 A	250 V_{AC} / 2.5 A	250 V_{AC} / 2.5 A
Weight	1.6 kg	3.8 kg	7.4 kg

Table 7- 27 Technical specifications, braking resistors, Part 2

Resistor for Power Module ...	**FSE**	**FSF**		**FSGX**
Nominal power (HO) of the Power Module	**30 kW ... 37 kW**	**45 kW ... 75 kW**	**90 kW ... 110 kW**	**132 kW ... 200 kW**
Order number	**6SE6400-4BD22-2EA0**	**6SE6400-4BD24-0FA0**	**6SE6400-4BD26-0FA0**	**6SL3000-1BE32-5AA0**
Resistance	15 Ω	8.2 Ω	5.5 Ω	2.2 Ω
Rated power P_{DB}	2.2 kW	4.0 kW	6.0 kW	50 kW
Peak power P_{max}	44 kW	80 kW	120 kW	300 kW
Degree of protection	IP20 or IPXXB	IP20 or IPXXB	IP20 or IPXXB	IP20
Power Connections	M6 studs	M6 studs	M6 studs	M10 bolt-type screw terminal
Thermoswitch (NC contact) maximum contact load connecting cable	250 V_{AC} / 2.5 A	250 V_{AC} / 0.2 A	250 V_{AC} / 0.2 A	250 V_{AC} / 10 A
Weight	10.6 kg	16.7 kg	21 kg	120 kg

7.5.4 Protecting the braking resistor

The braking resistor must be protected against overheating. A thermostatic switch handles the protective function (this is supplied with each break resistor). One of the following two alternatives can be chosen to use this thermostatic switch for protecting the braking resistor:

1. Connect the thermostatic switch to a free digital input of the SINAMICS G120 so that the converter is disconnected from the power supply if the braking resistor overheats. Subsequently the digital input must be used as release for a switch-off with OFF2.

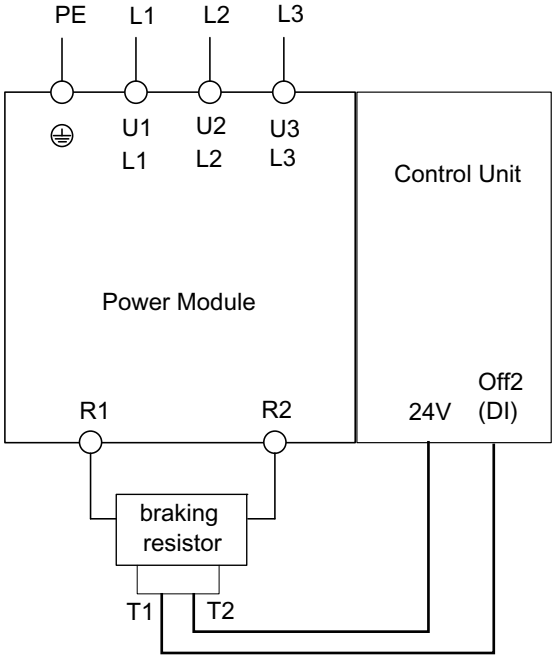


Figure 7-20 Protecting the braking resistor by a OFF2 command

2. Establish the power supply to the Power Module through a contactor which then shuts down the power supply when the resistor overheats. The thermostatic switch is connected in series with the coil feeder cable for the main contactor. The contacts of the thermostatic switch close again as soon as the resistor temperature has fallen below the selected value.

Note

The contactor is not part of the braking resistor option.

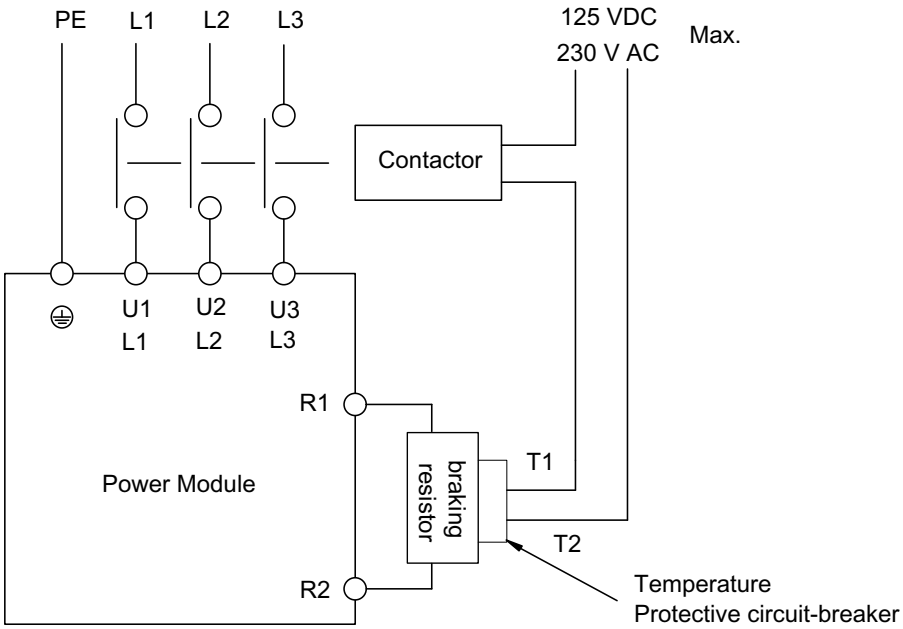


Figure 7-21 Protecting the braking resistor by a circuit breaker

7.6 Brake Relay

7.6.1 Mounting the Brake Relay

Mounting the Brake Relay on Power Module FSA … FSF

The Brake Relay can be panel mounted, wall mounted or mounted on the screen termination kit.

For more information see http://support.automation.siemens.com/WW/view/en/23623179

Mounting the Brake Relay on Power Module FSGX

The Brake Relay has to be mounted on the bracket above the Control Unit.

1. Mount the Brake Relay to the Control Unit bracket.
2. Connect the Brake Relay and the Power Module via the flying lead.
3. Connect the Brake Relay to the brake coil of the motor brake.

Note

The Safe Brake Relay requires an external 24V power supply.

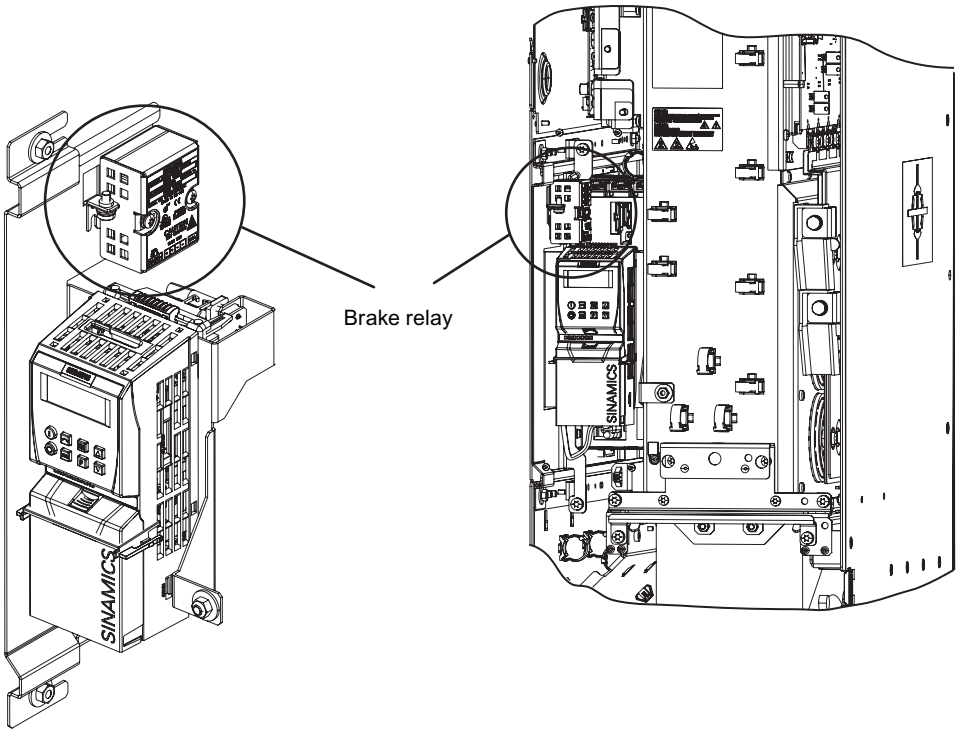
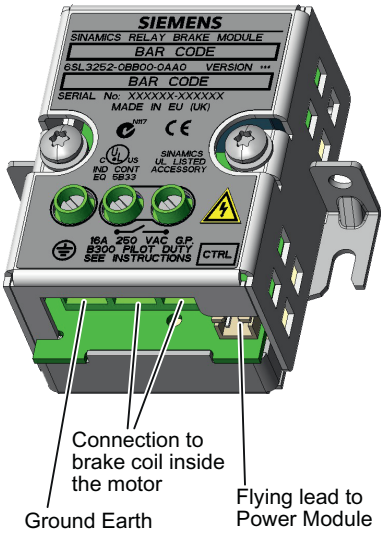
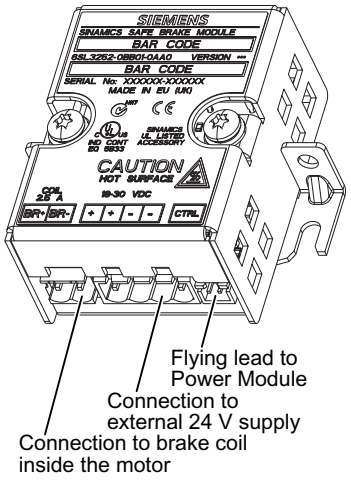


Figure 7-22 Mounting the Brake Relay on Power Module FSGX

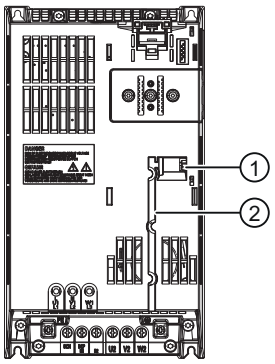
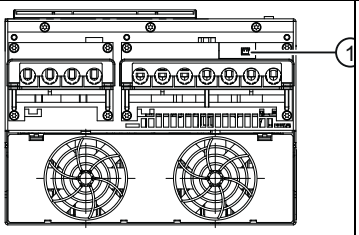
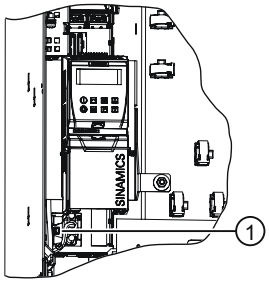
7.6.2 Connecting the Brake Relay

Connecting the Brake Relay to the Power Module

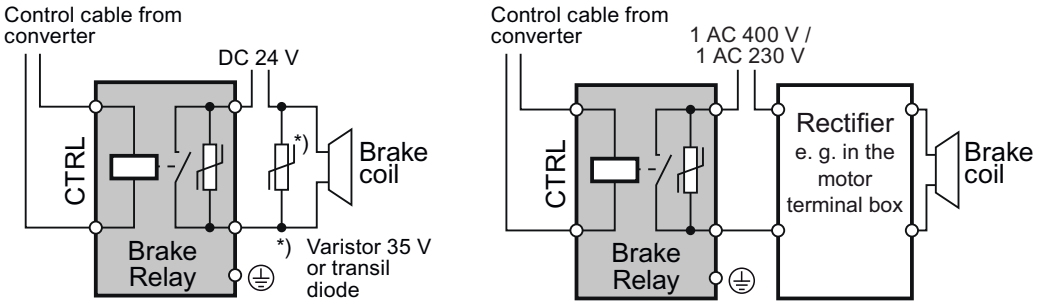
Connect one end of the cable form to the Brake Relay.
Two cable form with different lengths are provided with the Brake Relay. Choice the adequate length of the cable depending on the frame size of the Power Module and on the mounting location of the Brake Relay.

<table>
<tr><th>Brake Relay</th><th>Safe Brake Relay</th></tr>
<tr><td>Brake Relay
 
</td><td> 
</td></tr>
<tr><td colspan="2">The Brake Relay control connector is marked as "CTRL"</td></tr>
</table>

Connect the other end of the cable form to the Power Module

FSA 0.37 kW … 1.5 kW	FSB … FSC 2.2 kW … 15 kW	FSD … FSF 18.5 kW … 110 kW	FSGX 132 kW … 200 kW
No data available			
	The Brake Relay control connector ① is on the front of the Power Module. The Power Module provides a cable duct ② for the control cable	The Brake Relay control connector ① is on the bottom of the Power Module	The Brake Relay control connector ① is below the Control Unit and marked as -X47

Connecting the Brake Relay to the motor brake



24 V brake connection

440V brake connection

Figure 7-23 Brake Relay connection

The Brake Relay has to be connected to protective earth, if the motor brake is supplied by a PELV circuit.

Connecting the Safe Brake Relay to the motor brake

The Safe Brake Relay can only control motor brakes with 24V power supply.

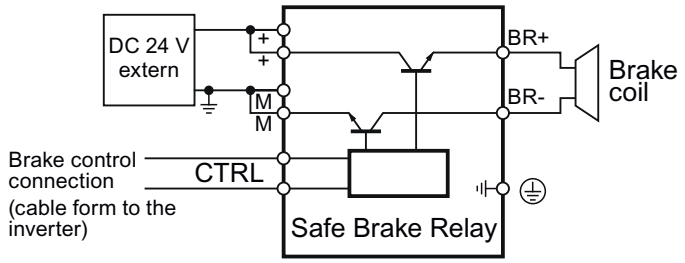


Figure 7-24 Safe Brake Relay connection

The Brake Relay is designed to provide the interface between the Power Module and the brake solenoid of a motor. There are two types of Brake Relays:

- Brake Relay – this provides the basic braking control function.
- Safe Brake Relay – this provides for the braking control function within a safety integrated system. To adhere to the requirements of a safety integrated system, the Safe Brake Relay has been designed to allow a variable voltage to be given to the Safe Brake Relay to allow the system to determine if the Safe Brake Relay is functioning correctly without actually activating the braking function.

7.6.3 Technical specifications of the Brake Relay

	Brake Relay	Safe Brake Relay
Input voltage	connected to the internal power supply of the Power Module	DC 20.4 ... 28.8 V 1)
Input current		Max. 2.5 A
Max. conductor cross-section	2.5 mm²	2.5 mm²
Degree of protection	IP20	IP20
Switching capacity of the NO contact	1 AC 440 V, 3.5 A 1 DC 30 V DC, 12 A	-
Output voltage	-	24 V
Output current	-	max. 2 A
1) External controlled power supply is necessary. Recommended voltage: DC 26 V		

Appendix A

Table A- 1 Compliance Table

Model	Remarks
Category C1 - First Environment	
--	The inverters are not intended for use within the Category C1 Environment.
Category C2 - First Environment - Professional Use	
Filtered Variants	6SL3224-0BE**-*A*0 (integrated class A filter)
	Class A: 25 m screened cable type CY
	All units with integrated filter.
	When used in the First (Domestic) Environment this product may cause radio interference in which case mitigation measures may be required. Units installed within the Cateogry C2 (Domestic) Environment require supply authority acceptance for connection to the puplic low-voltage power supply network. Please contact your local supply network provider.
Category C3 - Second Environment	
Unfiltered Variants	6SL3224-0BE**-*U*0
	The use of unfiltered drives within an industrial installation is only possible if it forms part of a system which includes additional power-line filtering at the "system level" or, alternatively, the use of filtered variants.

Note

All drives should be installed and commissioned in accordance with the manufacturer's guidelines and in accordance with good EMC practices.

For further information refer to SIEMENS application note "EMC Design Guidelines".

A.1 Standards

European Low Voltage Directive

CE

The SINAMICS G120 product range complies with the requirements of the Low Voltage Directive 2006/95/EC as amended by Directive 98/68/EEC. The units are certified for compliance with the following standards:

- EN 61800-5-1 — Semiconductor inverters – General requirements and line commutated inverters
- EN 60204-1 — Safety of machinery – Electrical equipment of machines

European Machinery Directive

The inverters are suitable for installation in machines. Compliance with the Machinery Directive 98/37/EC requires a separate certificate of conformity. This must be provided by the plant construction company or the organization marketing the machine.

European EMC Directive

When installed according to the recommendations described in this manual, the SINAMICS G120 fulfils all requirements of the EMC Directive as defined by the EMC Product Standard for Power Drive Systems EN 61800-3.

ISO 9001

Siemens plc operates a quality management system, which complies with the requirements of ISO 9001.

Underwriters Laboratories

UL and CUL LISTED POWER CONVERSION EQUIPMENT for use in a pollution degree 2 environment.

The Power Module FSGX did not fulfill the UL standard at print date.

The latest information regarding the Power Module is published under http://support.automation.siemens.com/WW/view/de/30563173/133400 (http://support.automation.siemens.com/WW/view/en/30563173/133400)

SEMI F47

Specification for Semiconductor Process Equipment Voltage Sag Immunity

SINAMICS G120 Power Modules PM240 fulfill the requirements of the SEMI F47-0706 standard.

Download certificates

Certificates can be downloaded from the internet under the following link: Certificates (http://support.automation.siemens.com/WW/view/en/22339653/134200)

A.2 Electromagnetic Compatibility

The SINAMICS G120 drives have been tested in accordance with the EMC Product Standard EN 61800-3:2004.

Details see declaration of conformity

A.3 Definition of the EMC Environment and Categories

Classification of EMC performance

The EMC environment and categories are defined within the EMC Product Standard EN 61800-3:2004., as follows:

Environments

First Environment

An environment that includes domestic premises and establishments that are connected directly to a public low-voltage power supply network without the use of an intermediate transformer.

- For example: houses, apartments, commercial premises or offices in a residential building.

Second Environment

An environment that includes industrial premises and establishments that are not connected directly to a public low-voltage power supply network.

- For example: industrial and technical areas of buildings fed from a dedicated transformer.

Categories

Category C1

Power Drive System (PDS) of rated voltage less than 1000 V intended for use in the First (Domestic) Environment.

Category C2

Power Drive System (PDS) of rated voltage less than 1000 V, which is neither a plug in device nor a movable device, and when used in the First (Domestic) Environment, is only intended to be installed and commissioned by a professional.

Note

A professional is a person or an organization having necessary skills in installing and/or commissioning a Power Drive System (PDS), including their EMC aspects.

Category C3

Power Drive System (PDS) of rated voltage less than 1000 V intended for use in the Second (Industrial) Environment and not intended for use within the First (Domestic) Environment.

A.4 EMC Overall Performance

EMC Emissions

The SINAMICS G120 drives have been tested in accordance with the emission requirements of the category C2 (domestic) environment.

Table A- 2 Conducted & Radiated Emissions

EMC Phenomenon	Standard	Level
Conducted Emissions	EN 55011	Class A
Radiated Emissions	EN 55011	Class A

Note

To achieve this performance the default switching frequency should not be exceeded.

Achieving radiated emissions to EN 55011 Class B is largely dependent on the drive being correctly installed inside a metallic enclosure. The limits will not be met if the drive is not enclosed or installed in accordance with good EMC practices.

Harmonic Currents

The harmonic current emissions from the SINAMICS G120 drives is as follows:

Table A- 3 Harmonic Currents

Typical Harmonic Current (% of rated input current) at U_K 1 %							
5th	7th	11th	13th	17th	19th	23rd	25th
73	52	15	6	6	4	3	2

Note

Units installed within the category C2 (domestic) environment require connection to the public low-voltage power supply network. Please contact your local supply network provider.

Units installed within the category C3 (industrial) environment do not require connection approval.

EMC Immunity

The SINAMICS G120 drives have been tested in accordance with the immunity requirements of category C3 (industrial) environment:

Table A- 4 EMC Immunity

EMC Phenomenon	Standard	Level	Performance Criterion
Electrostatic Discharge (ESD)	EN 61000-4-2	4 kV Contact discharge	A
		8 kV Air discharge	
Radio-frequency Electromagnetic Field	EN 61000-4-3	80 MHz … 1000 MHz 10 V/m	A
Amplitude modulated		80% AM at 1 kHz	
Fast Transient Bursts	EN 61000-4-4	2 kV @ 5 kHz	A
Surge Voltage	EN 61000-4-5	1 kV differential (L-L)	A
1.2/50 µs		2 kV common (L-E)	
Conducted	EN 61000-4-6	0.15 MHz … 80 MHz 10 V/rms	A
Radio-frequency Common Mode		80% AM at 1 kHz	
Mains Interruptions & Voltage Dips	EN 61000-4-11	100% dip for 3 ms	A
		30% dip for 10 ms	B
		60% dip for 100 ms	C
		95% dip for 5000 ms	D
Voltage Distortion	EN 61000-2-4 Class 3	10% THD	A
Voltage Unbalance	EN 61000-2-4 Class 3	3% Negative Phase Sequence	A
Frequency Variation	EN 61000-2-4 Class 3	Nominal 50 Hz or 60 Hz (± 4%)	A
Commutation Notches	EN 60146-1-1 Class B	Depth = 40%	A
		Area = 250% x degrees	

Note

The immunity requirements apply equally to both filtered and unfiltered units.

A.5 Abbreviations

Abbreviation	State
AC	Alternating Current
CE	Communauté Européenne
CU	Control Unit
DC	Direct current
DI	Digital input
DIP	DIP switch
DO	Digital output
ECD	Equivalent circuit diagram
EEC	European Economic Community
ELCB	Earth leakage circuit breaker
EMC	Electromagnetic compatibility
EMI	Electromagnetic interference
FS…	Frame size …
GSG	Getting Started Guide
HO	High Overload
I/O	In-/output
IGBT	Insulated gate bipolar transistor
LED	Light emitting diode
LO	Light Overload
NC	Normally closed
NEMA	National Electrical Manufacturers Association
NO	Normally open
OPI	Operating Instructions
PELV	Protection by extra low voltage
PM	Power Module
PPE	Personal protective equipment
RCCB	Residual current circuit breaker
RCD	Residual current device
RFI	Radio frequency interference
SELV	Safety extra low voltage
VT	Variable torque

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